Comhairle Contae Fhine Gall
Fingal County Council

DUNSINK LANDFILL
ANNUAL ENVIRONMENTAL REPORT 2013

REPORTING PERIOD: JANUARY TO DECEMBER 2013

WASTE LICENCE REGISTER NO. W0127-01

FINGAL COUNTY COUNCIL
COUNTY HALL
MAIN STREET
SWORDS
COUNTY DUBLIN

Document Control

Document:	Dunsink Landfill Annual Environmental Report - 2013
Project:	Dunsink Landfill Annual Environmental Report
Client:	Fingal County Council
Job Number:	J102 - 01
File Origin:	C:\Users\Donal Marron\Desktop\Marron Environmental\Active Folder\J102-1 Dunsink Active\DOC\08 Reports\2013\2013 AER

Document Checking:

Primary Authors: D. Marron (Marron Environmental) A. Kerveillant (Fingal County Council)	:

Review By: A. Kerveillant	:

Date: 31st March 2014

TABLE of CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

The Environmental Protection Agency (EPA) granted a waste licence (register no. 127-1) to Fingal Council in respect of the above facility on 9th January 2004. From July 2006 the register number was changed to W0127-01. This licence is for the closure and restoration of areas previously landfilled. Under its terms, the Council was required to restore and remediate the facility, to install infrastructure to monitor and manage landfill gas and leachate emissions, to cap previously filled areas using inert materials and these works have been completed. In accordance with the requirements of condition 11.6 of the Waste Licence, an Annual Environmental Report (AER) for the facility must be submitted to the Environmental Protection Agency on an annual basis.

1.1 REPORTING PERIOD

The reporting period for the AER is 1st January to 31st December 2013. This is the tenth AER for the facility as required by the waste licence.

1.2 FACILITY LOCATION

Fingal County Council has responsibility for the management and operation of the facility. The facility is located at:

Dunsink Landfill,
Dunsink Lane,
Finglas,
County Dublin.

Access to the landfill is now from the Elm Green end of Dunsink Lane only, Irish National Grid 238886 (Northings) 311766 (Eastings). Figure 1 presents a map of the facility and the surrounding locations.

1.3 ENVIRONMENTAL POLICY FOR DUNSINK LANDFILL

Comply with the terms of waste licence W0127-01 and all other relevant legislation and codes of practice.

Strive for continuous improvement in the running of the facility; in order to minimise the effects of the landfill on the environment.

Create better awareness and training for all staff involved in the running of the landfill.

Develop a good relationship with local residents around Dunsink for the betterment of the surrounding area.

FIGURE 1: DUNSINK LANDFILL SITE LOCATION AND SITE ACCESS

2.0 SITE DESCRIPTION

Dunsink Landfill is situated southwest of Finglas, County Dublin (National Grid Reference 239500E, 310500N). It is bounded by Dunsink Lane to the south, Rathoath Road to the east, the M50 motorway to the Northwest and Cappagh Hospital to the North. It is approximately 61ha. in extent. The most elevated point of the site (as measured in 2010) lies at 100m on the western side of the site. The base of the landfill varies topographically but is estimated to average from 65-70m.

The landfill opened in 1976. Approximately 4,400,000 tonnes of waste is estimated to have been deposited at the facility to June 1996. The landfill subsequently phased to closure, culminating in the closure of the civic amenity in 2003. A landfill gas utilisation plant was installed on site in 1996.

The original application for a waste licence was submitted to the Environmental Protection Agency in September 1999. An amendment to the original application was sought in February 2003. A Proposed Decision was issued in August 2003. Waste Licence 127-1 was issued in January 2004.

2.1 LICENCED WASTE ACTIVITIES AT THE FACILITY

On January 9th 2004 Fingal County Council was licensed to carry out the following waste activities at Dunsink Landfill, Finglas, County Dublin subject to twelve conditions.

Licensed Waste Disposal Activities, in accordance with the *Third Schedule* of the Waste Management Act 1996.

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

This activity is limited to:

The provision and use of a leachate lagoon to temporarily store leachate generated in the landfill, prior to discharge to the public foul sewer; and

The provision and use of a surface water attenuation pond to control the quality and quantity of the surface water run-off from the site.

Licensed Waste Recovery Activities, in accordance with the *Fourth Schedule* of the Waste Management Act 1996.

Class 2 Recycling or reclamation of organic substances, which are not used as solvents (including composting and other biological transformation processes):
This activity is limited to the composting of green waste, the recycling / reclamation of cardboard, paper and waste oil at the facility.

Class 3 Recycling or reclamation of metals and metal compounds:
This activity is limited to the recycling of ferrous / non-ferrous metals and white goods.

Class 4 Recycling or reclamation of other inorganic materials:
This activity is limited to the recycling or reclamation of subsoil and topsoil (for the restoration of the site) and dry recyclables at the bring centre.

Class 9 Use of any waste principally as a fuel or other means to generate energy:
This activity is limited to the utilisation of landfill gas for the generation of electricity.

Class 11 The use of waste obtained from any activity referred to in a preceding paragraph of this Schedule:
This activity is limited to the use of suitable subsoil and topsoil and composted material for the restoration programme.

Class 13 Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced:
This activity is limited to the storage of recyclable waste prior to recovery off site and the storage of soil on site for the restoration programme.

3.0 EMISSIONS AND INTERPRETATION OF MONITORING RESULTS

3.1 GROUNDWATER

There are eight groundwater stations (BH3, BH4, BH16, BH18, BH28, BH-29, BH31 and BH32) listed in Schedule D.1 of the waste licence. BH28 listed in Table D.1.1 of the licence was not installed however; BH27 was added to the monitoring infrastructure under agreement with the *Environmental Protection Agency.* Borehole monitoring recorded leachate characteristics from BH29 suggesting that it was a potential migration pathway to groundwater for leachate. It was therefore decommissioned on 14th March 2005, upon agreement with *The Agency*. Two additional groundwater stations (BH33 and BH34) were added to the sampling programme upon agreement with *The Agency*, these were installed on Dunsink Observatory land between the 14th and 16th March 2005. BH18 was destroyed during slope stability work in August 2006 and was replaced as BH18_R on 7th September 2006. BH18_R was decommissioned during Q1 of 2011 and replaced with BH35 during the same quarter. BH34 became damaged in 2011 and was replaced in 2012 by a new borehole, BH34N installed adjacent. The grid references for these are shown in Table 1. The sample locations are illustrated in Figure 2.

Table 1: Groundwater Monitoring Locations

Groundwater Borehole Monitoring Location	Eastings	Northings	Classification
BH3	310665	239505	Deep Groundwater
BH4	310650	239490	Shallow Groundwater
BH16	311340	239085	Deep Groundwater
BH18_R	Decommissioned		
BH27	310030	238720	Deep Groundwater
BH28	Not Installed		
BH29	Decommissioned		
BH31	311765	238820	Shallow Groundwater
BH32	311770	238800	Deep Groundwater
BH33	310735	238724	Deep Groundwater
BH34	310719	238725	Shallow Groundwater
BH34N	310717	238724	Shallow Groundwater
BH35	311158	239456	Deep Groundwater

Detailed analysis reports are contained in Appendix I. The results obtained have been compared to the Interim Guideline Values of EPA document "Towards Setting Guideline Values for the Protection of Groundwater Ireland", 2003 and the trigger levels set as per Condition 6.4.1 of the Licence. The Threshold Values of European Communities (Groundwater) Regulations S.I. 9 of 2010 have also been cited for reference since 2011. The following sampling programme was completed in 2013 (Table 2).

Table 2: Groundwater Sampling Programme 2013

Groundwater Borehole Monitoring Location	Q1 Jan-March	Q2 April-June	Q3 July-September	Q4 October - December
BH3	Sampled	Sampled	Sampled	Sampled
BH4	Sampled	Sampled	Sampled	Sampled
BH16	Sampled	Sampled	Sampled	Sampled
BH18_R	Decommissioned			
BH27	Sampled	Sampled	Sampled	Sampled
BH28	Not Installed			
BH29	Decommissioned 14th March 2005			
BH31	Sampled	Sampled	Sampled	Sampled
BH32	Sampled	Sampled	Sampled	Sampled
BH33	Sampled	Sampled	Sampled	Sampled
BH34	Replaced by BH34N	Replaced by BH34N	Replaced by BH34N	Replaced by BH34N
BH34N	Sampled	Sampled	Sampled	Sampled
BH35	Sampled	Sampled	Sampled	Sampled

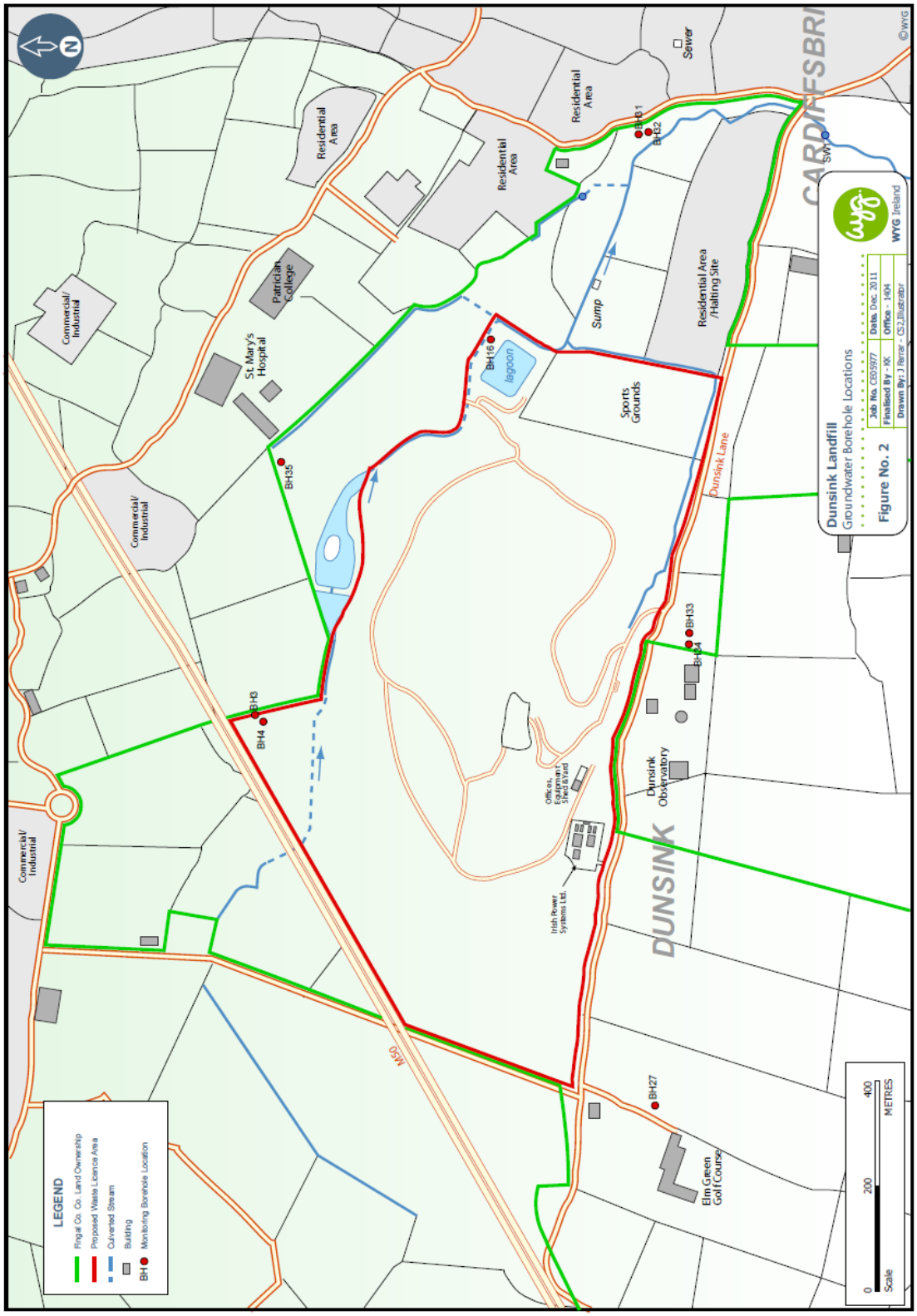

Figure 2 Groundwater Monitoring Locations

3.1.1 Groundwater Monitoring Quality - Findings (See Appendix I)

Q1 January to March 2013 – Sampling dated 13th February 2013

Results from groundwater sampling during the 1st Quarter of 2013 indicated good groundwater quality at the site monitoring boreholes. Results for all parameters were below the threshold values and the control and trigger values where defined.

It is noted that there were slightly elevated levels of conductivity (above normal background levels) recorded at BH27 (0.990 mS/cm), BH3 (0.957 mS/cm) and BH4 (0.915 mS/cm), however, none of these exceeded the threshold, control or trigger values.

Q2 April to June 2013- Sampling dated 16th May 2013

Results from groundwater sampling during the 2nd Quarter of 2013 indicated good groundwater quality at the site monitoring boreholes. Results for all parameters were below the threshold values and the control and trigger values where defined.

It is noted that there were slightly elevated levels of conductivity (above normal background levels) recorded at BH3 (1.039 mS/cm), BH4 (1.092 mS/cm) and BH27 (0.954 mS/cm), however, none of these exceeded the threshold, control or trigger values.

Q3 July to September 2013- Sampling dated 21st August 2013

Results from annual groundwater sampling carried out during the 3rd Quarter of 2013 indicated generally moderate quality water at boreholes BH16, BH27, BH31, BH32, BH33, BH34N and BH35 and slightly contaminated groundwater at BH3 and BH4.

There were elevated levels of conductivity, sodium, chloride, manganese, and sulphate at both BH3 and BH4 and elevated alkalinity at BH3. The levels of ammonia, total oxidised nitrogen and TOC were very low indicating a non-organic source of contamination and the levels of sodium, chloride and conductivity may indicate an elevated salinity in the water. The source of contamination is unclear though the location of the boreholes close to the M50 motorway which was regularly salted last Winter/Spring may have resulted in run-off/seepage of saline water into the groundwater local to the M50.

There were slightly elevated levels of manganese at most boreholes (all except BH4) where levels were either higher than the control, trigger or SI 9 of 2010 threshold values or a combination of these. Slightly elevated levels of iron were also recorded at BH16, BH27, BH31 and BH32. Elevated levels of manganese and iron at the levels reported are not

unusual in groundwaters from this type of geological environment and can be subject to some variation in levels at the same sampling station over time.

There were slightly elevated levels of alkalinity (834 mg/l) and ammonia (0.33 mg/l) at BH31, fluoride at BH33 (1 mg/l) and BH35 (1.5 mg/l) and ammoniacal nitrogen at BH34N (1.11 mg/l). These were isolated occurrences in individual parameters and apart from slightly elevated levels of iron and/or manganese there were no other elevated parameters at these boreholes.

BH3, BH4, BH31, BH32, BH33 and BH34N were analysed for VOCs, Semi-VOCs and pesticides and all results were recorded at less than the laboratory detection limits.

In overview, the results indicated a deterioration in quality at BH3 and BH4 compared to the 2012 annual monitoring round and a slight deterioration in levels of iron and manganese generally at most boreholes since 2012.

Q4 October to December 2013- Sampling dated 13th November 2013

Results from groundwater sampling during the 4th Quarter of 2013 indicated good groundwater quality at most of the site monitoring boreholes. There was a high TOC level and a slightly elevated ammoniacal nitrogen level at BH31 and a slightly elevated ammoniacal nitrogen value at BH34N. Results for all other parameters at all other boreholes were below the threshold values and the control and trigger values where defined.

3.1.2 Groundwater Levels

Groundwater levels were recorded from each borehole during each quarter and the results are displayed in Table 3.

Table 3: Groundwater borehole water levels in metres below ground level (mbgl)

Groundwater Borehole Monitoring Location	Q1 2013 (mbgl)	Q2 2013 (mbgl)	Q3 2013 (mbgl)	Q4 2013 (mbgl)
BH3	2.63	3.17	4.09	3.25
BH4 Shallow	2.48	2.83	3.14	2.54
BH16*	0.0	0.0	0.17	0.12
BH27	1.71	3.16	3.23	3.33
BH31 Shallow	3.40	3.95	3.75	3.73
BH32	0.26	0.91	0.73	0.68
BH33	1.58	2.74	3.47	3.21

BH34N Shallow	0.2	1.0	1.87	1.32
BH35	1.98	2.83	3.40	3.3

*BH16 is artesian

A hydrogeological Assessment of the facility was forwarded to the Agency in November 2004 (FCC-127-1-2004-065). It determined a regional up gradient / down gradient trending of groundwater from West-North-West to East-South-East beneath the landfill and surrounds. This pattern is generally consistent with the regional drainage pattern.

Bedrock Groundwater Quality

Results during 2013 indicated generally moderate or good groundwater quality in bedrock monitoring wells over the course of the year. There were slightly elevated levels of conductivity at BH3 and BH27 though no threshold values were exceeded.

During Q2, slightly elevated conductivity was again recorded at BH3 and BH27 though the threshold values were not exceeded.

During Q3, there were slight elevations in manganese at all deep boreholes, iron at BH16, BH27 and BH32, fluoride at BH33 and BH35 and conductivity, chloride and sodium at BH3 where either the threshold, control or trigger values were exceeded. Elevated levels of iron and manganese are not unusual in this geological environment and apart from BH3 the other deep groundwater monitoring wells exhibited generally moderate or good quality water.

During Q4, the results indicated good quality groundwater at all deep groundwater monitoring boreholes.

Overburden Groundwater Quality

Shallow groundwater at the site was of moderate to good quality during Quarter 1 and Quarter 2 2013.

During Q3 there were elevated levels of conductivity, chloride and sodium at BH4, slightly elevated levels of ammonia, alkalinity, iron and manganese at BH31 and ammonia and manganese at BH34N. Apart from BH4 the boreholes were of general moderate or good quality.

During Q4 there was a high level of TOC and a slightly elevated level of ammonia at BH31, and a slightly elevated level of ammonia at BH34N.

Conclusion & Annual Assessment

In overview, groundwater quality was generally moderate or good at most of the boreholes across the four quarters. The results from Q3 indicated slight contamination at BH3, BH4 and

BH31 and there were slightly elevated levels of ammonia at the shallow BH31 and BH34N in both Q3 and Q4.

As per Technical Amendment to the Licence issued in January 2013, a risk screening exercise for the site is going to be prepared in accordance with the Guidance on the Authorisation of Discharges to Groundwater. This exercise is planned to commence on the second quarter of 2014.

3.2 SURFACE WATER

Schedule D.1 of the waste licence requires the monitoring of surface water at six locations (SW1, SW2, SW4, SW7, SW9 & SW10). Biological sampling is required at three locations (KS1, KS2, KS3) and biological samples were collected at an additional three locations in 2012 (KS3a, KS4 and KS6) (See Table 4 and Figure 3). The Biological Sampling Assessment for 2013 was undertaken on 30th September 2013. However, stream flows were very low at the time and samples were only retrievable from KS3, KS3a and KS4.

SW11 was incorporated as an additional sampling location under instruction from *The Agency* following Q1 Monitoring Report 2004.

Surface water sampling points were established at the discharge from the wheelwash to the open channel WWSW1 and from the open channel to the Scribblestown Stream WWSW2.

SW1 is located downstream of the facility and sampling at this point monitors the effect of the facility on water quality. SW1 is located some distance downstream of the facility and a breakers yard lies adjacent to the stream and illegal waste tipping occurs between the facility and SW1. A case was put to *The Agency* to move SW1 further upstream to avoid these potential sources of surface water contamination and provide a truer picture of the effect of the facility on surface water quality. During the annual audit of the licence *The Agency* agreed and from 15th August 2005 a new downstream monitoring point, SW17, was used instead of SW1.

SW4 was replaced on 27/2/2006 by SW18 as the upstream sampling point as agreed with *The Agency* (127-1/AK11EM).

In 2010 two additional sampling points were added for the biological monitoring sampling, KS3a and KS6 and in 2011 an additional sampling point, KS4, was included, all of which are presented in Tables 4 & 5 and Figure 3.

In October 2012 it was agreed by the Agency to include SW21 located on the Scribblestown stream upstream of the landfill (on the opposite side of the M50) in the monitoring programme.

Table 4: Surface Water Monitoring Locations

Surface Water Monitoring Location	Eastings	Northings
SW1	311800	238460
SW2	311380	238980
SW4	310480	239365
SW7	311120	239220
SW9	310885	238795
SW10	311350	239100
SW11*	311360	238915
SW12**	310424	239410
SW13**	310829	239356
SW14**	311173	239277
SW15**	311417	239069
SW16**	311410	238926
SW17***	311687	238826
SW18****	310464	239394
SW21*	310334	239455
KS1*****	310781	239373
KS2*****	311145	239242
KS3*****	311739	238812
KS3a*****	311600	238840
KS4*****	311415	239052
KS6*****	311590	238994
WWSW1******	311616	238921
WWSW2******	311644	238835

* Additional sampling location for monitoring programme.

** Enhanced monitoring programme undertaken 30th July 2004.

*** New downstream sampling point agreed during EPA audit August 2005.

**** New upstream sampling point agreed with *The Agency*.

***** Biological Sampling Programme.

****** Sampling points at discharge from wheelwash to open channel and from open channel to Scribblestown Stream. Only sampled when clay is imported onto the Landfill.

See Table 5 for sampling programme completed in 2013.

3.2.1 Surface Water Monitoring Quality - Findings of quarterly monitoring (See Appendix II)

Surface water quality was monitored in the drainage network within the landfill and its immediate environs throughout 2013. All the surface water sampling locations stipulated in the waste licence were sampled throughout 2013 (Table 5). The results of the biological sampling programme are discussed later in the report (note that biological samples were not retrieved from KS1, KS2 and KS6 due to low flow conditions).

The water quality results have been compared to SI 293 of 1988 European Communities (Quality of Salmonid Waters) Regulations 1988 and SI 272 of 2009 (Surface Water Regulations) (Appendix II).

Table 5: Surface Water Monitoring Programme 2013

Surface Water Monitoring Location	Q1	Q2	Q3	Q4	Monthly Visual	Annual
SW2	Y	Y	Y	Y	Y	Y
SW4	N	N	N	N	N	N
SW7	Y	Y	Y	Y	Y	Y
SW9	Y	Y	Y	Y	Y	Y
SW10	Y	Y	Y	Y	Y	Y
SW11	Y	Y	Y	Y	Y	Y
SW12	N	N	N	N	N	N
SW13	N	N	N	N	N	N
SW14	N	N	N	N	N	N
SW15	N	N	N	N	N	N
SW16	N	N	N	N	N	N
SW17	Y	Y	Y	Y	Y	Y
SW18	Y	Y	Y	Y	Y	Y
SW19	N	N	N	N	Y	N
SW21	Y	Y	Y	Y	Y	Y
WWSW1	N	N	N	N	Y	N
WWSW2	Y	Y	Y	Y	Y	Y
KS1	N	N	N*	N	N	N
KS2	N	N	N*	N	N	N
KS3	N	N	Y	N	N	Y
KS3a	N	N	Y	N	N	Y
KS4	N	N	Y	N	N	Y
KS6	N	N	N*	N	N	N
*= No sample possible						

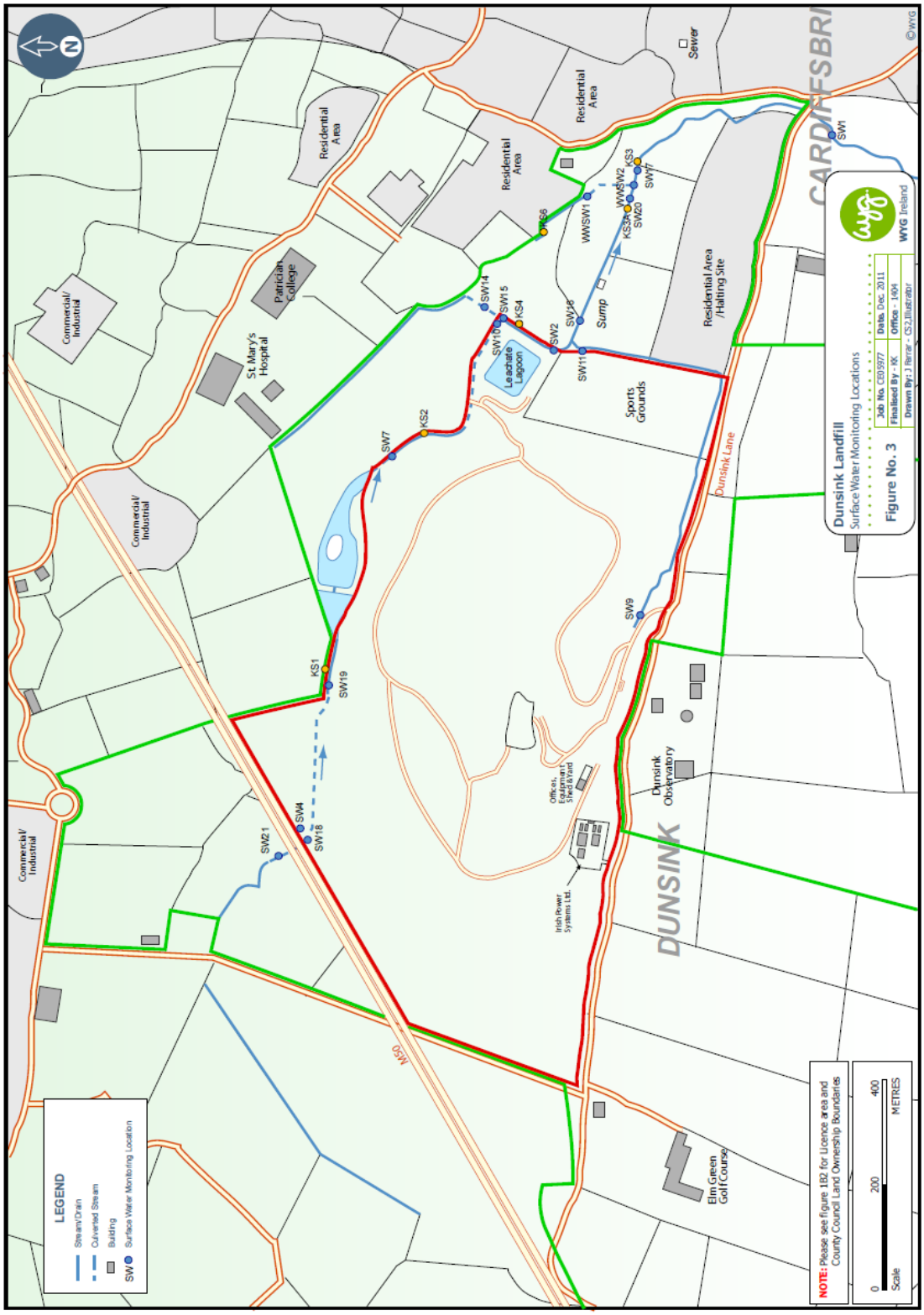

Figure 3 Surface Water Monitoring Locations

The Environmental Protection Agency's document "Parameters of Water Quality – Interpretation and Standards" details concentrations of total ammonia in fresh water which contain an unionised ammonia concentration of 0.02mg/l at their given pH and temperature.

Unionised ammonia is the component of total ammonia which at "the value of 0.02 mg/l has a long term toxic effect level for fish both salmonid and cyprinid. Lethal levels are about ten times greater".

Using this data, concentrations of ammoniacal nitrogen determined during sampling in 2013 indicated that the concentrations of unionized ammonia at the following stations were above the 0.02 mg/l level (note: SW17, SW18 and SW21 were monitored for ammonia on a monthly basis, all other surface water monitoring stations were monitored quarterly).

- 16/01/2013 – SW18 and SW21
- 13/02/2013 – SW11
- 13/03/2013 – SW21

All other monitoring stations were below the 0.02 mg/l level for all other monitoring events.

Q1 January to March 2013 – Sampling dated 13th February 2013

During Quarter 4 2012, elevated levels of conductivity in excess of the 1,000 µS/cm threshold were recorded at most surface water sampling locations in December 2012. During Q1 2013 conductivity levels were still elevated in January, reduced back to normal levels in February and increased again in March.

A review of historical data indicates that there has been a rise in conductivity levels at the site during the Winter months in previous years and reducing again during the Q2 and Q3 periods. This may relate to gritting of the M50 during the Winter months or there may be other seasonal factors causing this trend.

Elevated levels of ammoniacal nitrogen have occurred at SW21 and SW18 periodically throughout 2012. Monthly samples were collected from SW21, SW18 and SW17 during the first quarter of 2013. The results indicated elevated levels of ammoniacal nitrogen at SW21 ranging from 1.16 mg/l to 3.68 mg/l and at SW18 ranging from 0.76 mg/l to 3.77 mg/l. There were some slightly elevated levels at SW17 ranging from 0.09 mg/l to 0.42 mg/l. These results indicated a slight improvement in quality compared to results from 2012.

Fingal County Council carried out remedial works on local drains and sewers in the vicinity of SW21 between February and March 2013. This resulted in a marked improvement in visual quality at SW21 and SW18, the disappearance of the grey deposit on the substrate, clearer water and a significant reduction in the organic odour. This likely contributed also to the general improvement in levels of ammoniacal nitrogen.

While there were elevated levels of ammoniacal nitrogen at SW21 and SW18 during the first quarter levels were significantly lower at SW17 downstream of the site.

The quarterly results also indicated moderately low levels of dissolved oxygen at all sampling stations, slightly elevated levels of BOD at SW21 and SW18 and slightly elevated levels of suspended solids at SW21, SW9 and SW2.

Q2 April to June 2013 - Sampling dated 16th May 2013

The results from the Q2 2013 indicated elevated levels of conductivity above 1,000 µS/cm recorded at SW21, SW18, SW19, SW7, SW10, SW2, SW11 and SW17 on 17/04/13 and at SW18 on 16/05/13.

The ammoniacal nitrogen results from the second quarter of 2013 were significantly lower than previous though still marginally elevated above the threshold level of 0.14 mg/l (SI 272 of 2009) at SW21 ranging from 0.15 to 0.23 mg/l, SW18 ranging from 0.12 to 0.17 mg/l and on one occasion (12/06/13) at SW17 (0.16 mg/l).

Q3 July to September 2013- Sampling dated 21st August 2013

During Q1 2013 conductivity levels were still elevated in January, reduced back to normal levels in February and increased again in March. Elevated levels of conductivity above 1,000 µS/cm were recorded at SW21, SW18, SW19, SW7, SW10, SW2, SW11 and SW17 on 17/04/13 and at SW18 on 16/05/13. Conductivity levels were low again in June though in July the conductivity threshold of 1,000 µS/cm was breached at SW18, SW10 and SW2. Levels reduced again in August and were at their lowest for the year in September.

The ammoniacal nitrogen results from the second quarter of 2013 were significantly lower than previous though still marginally elevated above the threshold level of 0.14 mg/l (SI 272 of 2009) at SW21 ranging from 0.15 to 0.23 mg/l, SW18 ranging from 0.12 to 0.17 mg/l and on one occasion (12/06/13) at SW17 (0.16 mg/l). The ammonia results from the third quarter showed further improvement in quality with no exceedances in July, a marginal exceedance at SW18 in August and marginal exceedances at SW21, SW18 and SW17 in September.

Surface water results during the Q3 2013 annual sampling round indicated generally moderate to good quality water at most sampling stations apart from SW11 (conductivity, BOD, total suspended solids and alkalinity) and slight exceedances of ammoniacal nitrogen at SW18 and SW19 and total suspended solids at SW21. The overall results showed an improvement from the annual sampling round in Q3 2012 – likely due to the upstream source of pollution being identified and remediated. There were slightly elevated levels of chloride at SW18, SW19 and SW11, sodium at SW18 and SW19 and sulphate at all sampling stations apart from SW7 (ranging from 66.12 mg/l to 97.07 mg/l). There are no threshold levels set

for these parameters in the SI 272 of 2009 or the Salmonid Regulations, however, the levels reported were in line with levels observed in previous monitoring years.

The results from SW17 located at the downstream end of the site indicated good quality water with only the sulphate level of 89.44 mg/l elevated.

Q4 October to December 2013- Sampling dated 13th November 2013

Conductivity levels were at their lowest for the year in October. They rose again in November and breached the 1,000 µS/cm threshold at SW21, SW18 and SW19 and remained elevated in December with threshold breaches at SW18 and SW19.

The results for ammoniacal nitrogen showed an improving trend since Q1 of 2013. The improved trend continued into the fourth quarter with only marginal exceedances of the threshold value at SW21 in October and December and at SW17 in October only.

Relatively low dissolved oxygen results were recorded at all sampling stations in November ranging from 31.1% to 69.8%.

In overview, there was a general slight improvement in ammoniacal nitrogen results at all stations over the year and as with previous years the conductivity levels were higher in the Winter months than at other times of the year.

Compared to previous years the water quality upstream at SW21 and SW18 has improved significantly. The results at SW17 downstream of the landfill indicated slightly better quality water than at SW21 during the quarter indicating further attenuation of the stream quality as it passes along the landfill.

Monthly sampling for Ammonia

Due to the regularly elevated levels of ammoniacal nitrogen recorded at SW21 and SW18, monthly samples were taken at SW21, SW18 and SW17 and sent for analysis during 2013.

Results indicated elevated or high levels at SW21 and SW18 during the first quarter of the year. The results from those stations were much lower thereafter though still marginally exceeded the threshold values on some occasions. The results from SW17 indicated normal levels of ammoniacal nitrogen with only four of the twelve results marginally exceeding the threshold value. The improvement in quality from the first quarter on is likely due to the remedial works carried out by Fingal County Council water pollution unit in March 2013 in the area of SW21.

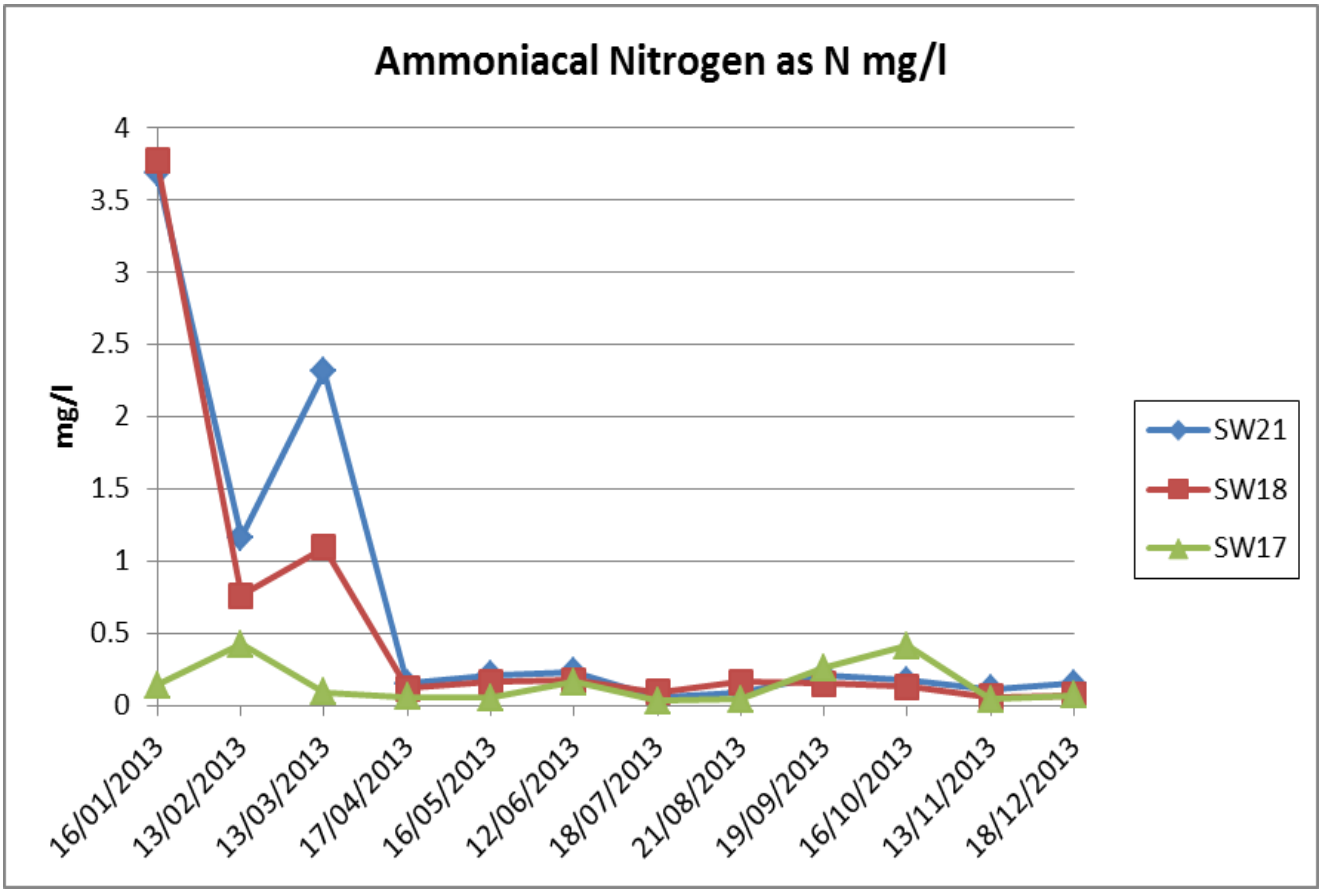

Figure 4: Ammoniacal Nitrogen Levels at SW21, SW18 & SW17 (2013)

Results from Monthly Monitoring

Monthly Electrical Conductivity measurements at SW21, SW18 and SW17 for 2013 are shown on Figure 5 below. The results indicated elevated conductivity levels (> 1,000 µS/cm) at the three monitoring stations in January, March and April, generally lower than the threshold value during the Summer and Autumn months and increasing somewhat again in November and December. There has been a trend over recent years for elevated conductivity levels at these monitoring stations during the Winter months. This may be related to the salting of the M50 during these months or there may be other localised seasonal factors.

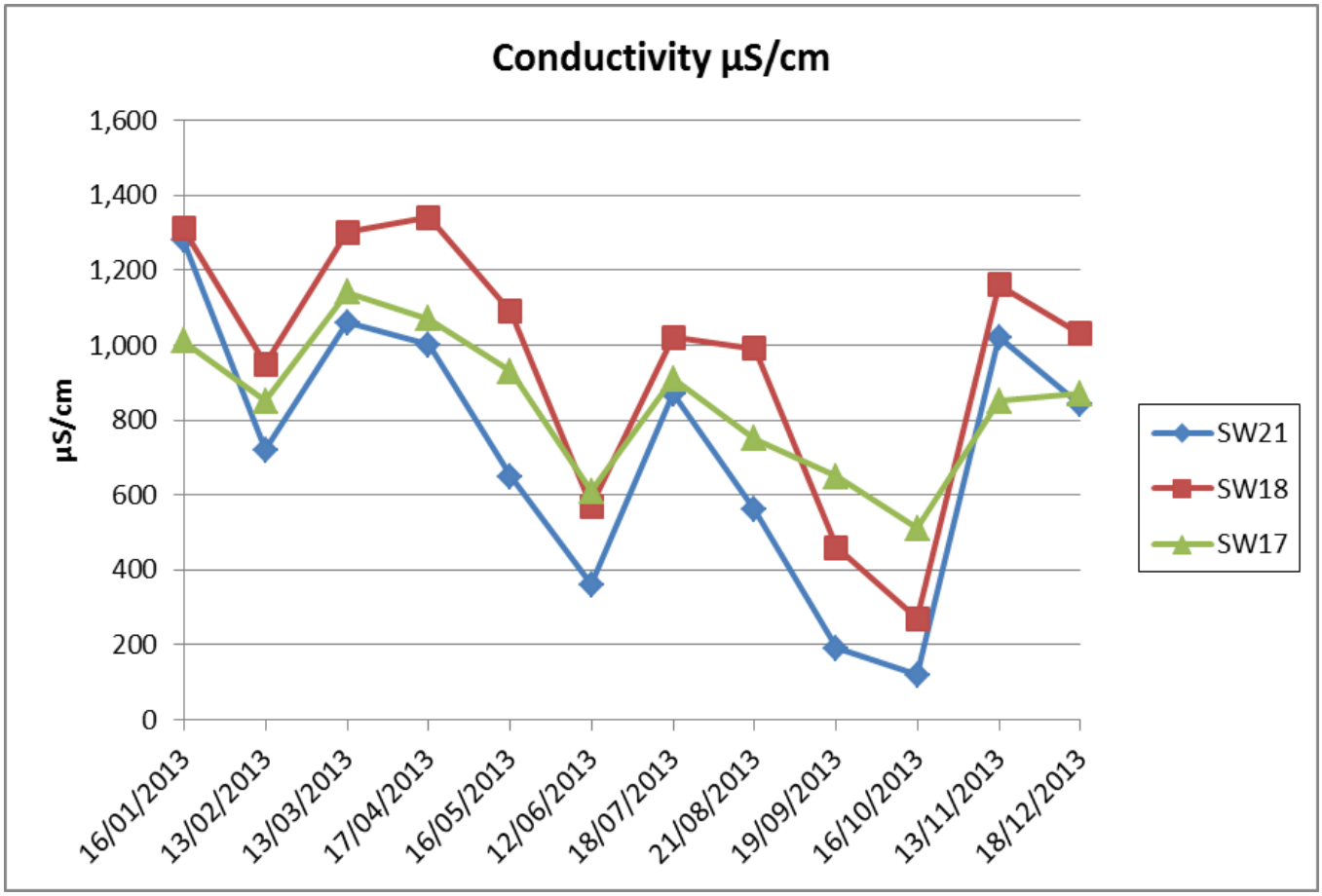

Figure 5: Conductivity measurements at SW21, SW18 & SW17 (2013)

Monthly Visual Inspections

Monthly visual inspections were carried out at all Surface Water Monitoring stations during 2013. The visual inspections included sampling of pH, temperature and conductivity as well as logging a description of the waters, colour, odour, cloudiness, the substrate, weed growth and algae. Conductivity results are discussed above. All temperature readings and the vast

majority of the pH measurements were within normal ranges for the water type and time of year.

Grey water, a grey deposit on the substrate and strong organic odours were noted at SW21 during the first quarter. Grey water and organic odours were recorded at SW18 and occasionally grey tinted water was noted at SW19 for the same period. However, following remedial works in the area of SW21 during the first quarter a significant improvement in the visual quality of SW21, SW18 and SW19 was recorded for all subsequent months.

Heavy weed growth was recorded in the streams at SW2 and WWSW1 throughout the year.

On each occasion when an incident was recorded, an incident report was issued to the EPA and ERFB.

Monthly Wheelwash Sampling

Monthly sampling ceased in November 2007 as it was agreed with *the Agency* that future sampling of WWSW1 and WWSW2 will occur on a needs be basis.

Conclusion & Annual Assessment

The 2013 annual assessment suggests an improvement in water quality at Dunsink Landfill compared to 2012 and this was particularly evident after the remedial works carried out at SW21 in February/March of 2013. The ammonia results from SW17, downstream of the site indicated normal levels of ammonia indicating that the ammonia was attenuated as it passed by the site.

There were also elevated levels of conductivity at many of the sampling stations on some occasions particularly during the Winter months both early in the year and during November and December.

In general the surface water sampling indicated moderate to good water quality over the 4 quarters of the year. The leachate pumping infrastructure (pumps, sump and leachate valve configuration) commissioned in June 2005 and the leachate interceptor drains established to the West and South of the Lagoon along with the remedial works at SW21 earlier in the year have significantly aided in the general improvement in water quality at the facility.

3.3 LEACHATE

Schedule D of the waste licence requires the monitoring of leachate at the station "north-east lagoon", Table 6. A monitoring station which facilitates the obtaining of representative grab and / or continuous samples in accordance with Condition 8.4 is provided at the sump.

Table 6: Leachate Monitoring Locations 2013

Leachate Monitoring Location	Eastings	Northings
Northeast Lagoon	311323	239031
Sump	311417	238895

Table D.5.1 of Schedule D of the waste licence sets down the parameters and frequency for leachate monitoring. Table 9 below outlines the sampling programme for leachate undertaken in 2013.

Table 7: Leachate Monitoring Programme 2013

Leachate Monitoring Location	Q1	Q2	Q3	Q4	Annual
North East Lagoon	Sampled	Sampled	Sampled	Sampled	Sampled (Q3)
Sump	Sampled	Sampled	Sampled	Sampled	Sampled (Q3)

3.3.1 Leachate - Methodology

The monitoring of leachate was undertaken during 2013 using 2 methods – through a grab sample taken at 2 locations (sump and lagoon) at each quarter on one hand, and through continuous monitoring in the sump via a dissolved methane probe.

Refer to Schedule D.5 of waste licence 127-1 for the parameters and frequency of monitoring.

3.3.2 Leachate Monitoring – Results of Quarterly Sampling (See Appendix II)

Q1 January to March 2013 – Sampling dated 13th February 2013

Results from leachate sampling at the lagoon on 13th February 2013 recorded pH of 8.47, conductivity of 1.130 mS/cm and temperature of 7.6°C. A dissolved methane concentration of <0.001 mg/l and ammonia of 0.34 mg/l were recorded.

Results from leachate sampling at the leachate sump recorded pH of 7.15, conductivity of 2.660 mS/cm and temperature of 12.0 °C. Dissolved methane was recorded at 1.574 mg/l and ammonia of 85.26 mg/l. Table C.6 of the waste licence states that Emission Limits for Dissolved Methane in Leachate Being Discharged to Sewer as 0.14mg/l. The results indicated that emission limit values for dissolved methane were exceeded for leachate in the leachate sump.

Q2 April to June 2013- Sampling dated 16th May 2013

Results from leachate sampling at the lagoon on 16th May 2013 recorded pH of 9.29, conductivity of 1,480 µS/cm and temperature of 12.1°C. A dissolved methane concentration of <0.001 mg/l and ammonia of 6.12 mg/l were recorded.

Results from leachate sampling at the leachate sump recorded pH of 7.29, conductivity of 4,360 µS/cm and temperature of 13.9 °C. Dissolved methane was recorded at 1.013 mg/l and ammonia of 162.78 mg/l. The results indicated that the emission limit value for dissolved methane (0.14 mg/l) was exceeded for leachate in the leachate sump.

Q3 July to September 2013 - Sampling dated 21st August 2013

Results from leachate sampling at the lagoon on 21st August 2013 recorded pH of 7.92, conductivity of 3,518 µS/cm and temperature of 19.7°C. A dissolved methane concentration of 0.052 mg/l and ammoniacal nitrogen of 118.32 mg/l were recorded.

Results from leachate sampling at the leachate sump recorded pH of 7.23, conductivity of 4,949 µS/cm and temperature of 17.7 °C. Dissolved methane was recorded at 1.431 mg/l and ammoniacal nitrogen of 234.1 mg/l. The results indicated that the emission limit value for dissolved methane (0.14 mg/l) was exceeded for leachate in the leachate sump.

Q4 October to December 2013- Sampling dated 13th November 2013

Results from leachate sampling at the lagoon on 13th November 2013 recorded pH of 9.0, conductivity of 2,160 µS/cm and temperature of 7.1°C. A dissolved methane concentration of <0.001 mg/l and ammoniacal nitrogen of 4.16mg/l were recorded

Results from leachate sampling at the leachate sump recorded pH of 7.31, conductivity of 3,170 µS/cm and temperature of 11.2 °C. Dissolved methane was recorded at 3.333 mg/l and ammonia of 122.22 mg/l. The results indicated that the emission limit value for dissolved methane (0.14 mg/l) was exceeded for leachate in the leachate sump.

Leachate – Discussion.

The results from monthly visual inspections and quarterly and annual chemical monitoring of the leachate lagoon and leachate sump indicated concentrations typical of leachate quality at both stations. The lagoon water is of higher quality than the leachate sump for most parameters (apart from BOD, COD, TON and sulphate) and this may be due to the diluting effect of rainwater in the lagoon.

Weekly monitoring of Methane, Carbon dioxide and Oxygen is being carried out at the headspace of the sump and the point of discharge to public sewer in Finglas (See Figure 1). The results are being sent to The Agency through weekly notifications and are also being compiled for Dublin City Council. Dublin City Council may require further mitigation measures following a review of the results of these monitoring rounds.

3.3.3 Continuous monitoring of Dissolved Methane in Leachate

Continuous monitoring of dissolved methane at the sump commenced during Q1 2006. Table C.6 of the waste licence states that Emission Limits for Dissolved Methane in Leachate Being Discharged to Sewer as 0.14mg/l. Continuous monitoring of dissolved Methane has been carried out from 3rd October 2006 to present. Reporting of incidents under this system is being undertaken through the quarterly environmental reports as the data has emerged and is analysed.

3.3.4 Results from Continuous monitoring of Dissolved Methane in Leachate

Resulting from the annual audit of October 2010 (Audit W0127-01AR10EM), a new methane probe was purchased and installed on Wednesday 5th January 2011. The new probe had a range of 0.016 to 1mg/L of dissolved methane. During 2011 most values recorded by the new probe were at the maximum range of the probe – which would indicate the value measured is in excess of the range the probe can read. These results indicate that the ELV is exceeded almost continuously at high levels. The accuracy of the probe readings was questioned, partly due to the discrepancy between probe readings and the results of the quarterly spot sampling.

Expert advice was sought from ENVIROS, and an onsite test was carried out using a technique developed by ENVIROS that allows determination of on the spot levels of dissolved methane in the leachate. The on the spot levels recorded on the 14/11/2011 were at an average of 3.357mg/L. As a result of these elevated readings a new probe was purchased and installed in January 2012. The new probe measures dissolved methane concentrations ranging from 0.016mg/L to 5mg/L.

Detailed results have been provided in the Quarterly Reports issued during 2013; these show a continuous exceedance of the ELV. Compliance investigation CI000399 has been open to monitor progress towards achieving compliance with the ELV.

3.3.5 Discussion of Results from Continuous Sampling of Dissolved Methane

The results indicate that the ELV is exceeded almost continuously at high levels.

Fingal County Council undertook various exercises in 2012 to try and decrease the dissolved methane levels in the leachate pumped to sewer. These are continuing in 2013. Progress reports on the matter are issued to the Agency as developments occur and are monitored through Compliance Investigation CI000399.

Weekly monitoring of Methane, Carbon dioxide and Oxygen is being carried out at the headspace of the sump and the point of discharge to public sewer in Finglas. The results are being sent to The Agency through weekly notifications and are also being compiled for Dublin City Council.

3.4 NOISE

No noise survey was undertaken at Dunsink Landfill in 2013. This was addressed in Licence Audit Report for 2008 from the Agency W1027-01/08/AR08EM, observation No.5, on Environmental Monitoring.

3.5 DUST

No dust monitoring surveys were carried out at Dunsink Landfill in 2013. This was addressed in Licence Audit Report for 2008 from the Agency W1027-01/08/AR08EM, observation No.5, on Environmental Monitoring.

3.6 PM_{10} MONITORING

The Agency in correspondence referenced 127-1/GEN01EM stated that "The Agency, in accordance with Condition 8.2, does not require monitoring of PM_{10} as listed in Table D.3.1 of the waste licence unless otherwise instructed by the Agency."

3.7 BIOLOGICAL ASSESSMENT OF THE SCRIBBLESTOWN STREAM

In accordance with the requirements of Dunsink Landfill Waste Licence W0127-01, Condition 8.8.1, WYG Environment and Planning (WYG) were appointed by Marron Environmental on behalf of their client Fingal County Council to carry out a detailed freshwater biological assessment of the Scribblestown Stream at Dunsink landfill, Dunsink, Co. Dublin. The site's waste licence requires a biological assessment of the Scribblestown Stream on an annual basis.

3.7.1 Methodology

In order to retain consistency with previous surveys, six monitoring locations were visited, assessed, and resampled where conditions permitted. Survey locations are presented on Figure 3 and described in Table 8 below. Due to the dry weather conditions that pertained throughout the Summer/Autumn months the stream flows at Dunsink were very low and it was not possible to retrieve samples at some of the monitoring stations.

Table 8: Sampling Location Descriptions

Location Code	Waste License Sample Point?	Location Description	Sample Point Description at time of Survey
KS1	Yes	KS1 is located approximately 10m downstream of where the stream opens up.	At KS1, the stream was observed to be virtually devoid of flowing water. At some locations upstream and downstream from KS1 some ponded water was observed. A weedsweep in these areas

			returned no aquatic macroinvertebrates, therefore **no assessment of aquatic macroinvertebrates was possible**.
KS2	Yes	Located approximately 20m downstream of the attenuation system. The 2012 location as with the 2011 survey point was 10m upstream from this location as marked on Figure 1. No sample was possible in 2013.	At KS2, the stream was observed to be dry. **Therefore no assessment of aquatic macroinvertebrates was possible.**
KS3	Yes	Sampling location KS3 is located towards the eastern boundary of the site close to where the Scribblestown exits the landfill site. It was positioned downstream of the confluence of Unnamed stream 2 with Scribblestown Stream	At KS3, water levels within the stream were observed to be very low, and velocity was also very low. The stream bed was also noted to be comprised largely of silt which limits the potential for sensitive macroinvertebrate taxa which require oxygenated water. At the time of the assessment, earthworks were being completed on land adjacent to the stream. **A kick sample was retrievable from the stream and an assessment was carried out.**
KS3a	No	A small weir/dam on the stream. Downstream of the confluence of unnamed stream 2 with Scribblestown Stream	At KS3a, water levels within the stream were observed to be very low, and velocity was also very low. The stream bed was also noted to be comprised largely of fine gravel, which limits the potential for sensitive macroinvertebrate taxa which require oxygenated water. At the time of the assessment, earthworks were being completed on land adjacent to the stream. **A kick sample was retrievable from the stream and an assessment was carried out.**
KS4	No	Located on Scribblestown Stream	At KS4, water levels within the stream were observed to be low, and velocity was also very slow. The stream bed was also noted to be comprised largely of fine gravel, which limits the potential for sensitive macroinvertebrate taxa which require oxygenated water. **A kick sample was retrievable from the stream and an assessment was carried out.**
KS6	No	Located on Unnamed Stream 2	At KS6, the stream was observed to be dry. The stream channel was observed to be densely vegetated. **Therefore no assessment of aquatic macroinvertebrates was possible.**

EPA Q-Value

The EPA Q-value system is a biometric index. The water quality of a river or stream is determined primarily on the relative abundance of indicator groups of benthic (bottom dwelling) macroinvertebrates. The indicator groups have different sensitivities to organic

pollutants (McGarrigle *et al.*, 2002). Other parameters taken into account in determining the Q-value score include the channel substrate, macrophytes and the presence or absence of sewage fungus and filamentous algae. Physico-chemical parameters (pH, temperature, conductivity and dissolved oxygen) are also measured.

The relative abundance of the indicator groups, in conjunction with the other recorded parameters, are used to determine the Q-value of a water course. The Q-value categories are presented in Table 9.

Table 9: The EPA Q-Value Categories

Biotic Index	Quality Status	Quality Class
Q5, Q4-5, Q4	Unpolluted	Class A
Q3-4	Slightly polluted	Class B
Q3, Q2-3	Moderately Polluted	Class C
Q2, Q1-2, Q1	Seriously Polluted	Class D

The EPA does not monitor the Scribblestown Stream as part of its River Water Quality Monitoring programme.

Small Stream Risk Score (SSRS)

The SSRS is a biological risk assessment system for detecting potential sources of pollution in 1st and 2nd order streams. It was developed by the Environmental Protection Agency (EPA) in association with Western River Basin District (WRBD, 2005) as part of the Water Framework Directive (WFD) catchment management plans. It is intended to determine if a section of a stream is at risk of pollution and not meeting 'good status' water quality i.e. Q4 or Q5 under the Q-Value System.

The SSRS methodology only considers certain indicator species to calculate a risk score. These are mayfly nymphs, stonefly nymphs, caddis fly larvae, Gastropods (snails and limpets), Oligochaetes (various worms), Diptera larvae (true fly larvae) and *Asellus* sp. (water hog louse). The number and relative abundance of each of the groups of taxa are recorded and used to determine the Risk Score for the sample. The score is compared to the risk grading as outlined below.

Risk Score:

- > 7.25 Probably not at Risk
- 6.5 – 7.25 Intermediate - May be at risk

- <6.5 Stream at Risk of failing to meet 'Good Status'

The Scribblestown Stream and associated tributaries are 1st and 2nd order streams and therefore SSRS is suitable for use in this particular investigation.

Species Diversity

Diversity indices are mathematical expressions that use three components of community structure including species richness (number of taxa present), evenness (uniformity in the distribution of individuals amongst taxa) and abundance (total number of organisms present), to describe the response of the community to the environmental quality of the associated habitat. The Shannon-Weiner diversity index (H') is the most widely used index to assess biodiversity and this index was used to calculate species diversity at each of the sampling points.

$$H' = -\sum p_i \ln$$

p_i where p_i is the proportion of individuals found in the *i*th species and ln is the natural logarithm.

Hence Pi = S/N

Where

S = species richness (number of species in the community)

N = Abundance (total number of individuals in the sample).

Aquatic Macrophytes

Dominant vegetation within water-bodies and along banks was recorded. Plant nomenclature followed Stace (2010) for vascular plants

3.7.2 RESULTS

The field biological assessment was conducted on 30 September 2013. Weather conditions were overcast with periods of sun, dry, and mild. The macroinvertebrate survey was conducted within the optimum period for Q-value assessment which is generally considered to be between June to September. It was conducted outside the recommended SSRS sampling period of November to February however SSRS allows for a comparison to be made for annual samples conducted at comparable times of the year even if outside of the optimal period.

Sample Point KS1

At KS1 the channel is variable ranging between 50cm and 120cm in width with an average depth of 0.20cm, a significant increase from the 0.40m measured during the 2012

assessment. This sampling point was observed to be heavily vegetated and devoid of flowing water. The stream bed substrate could not be confirmed due to the dense vegetation, however, it is assumed that the bed is comprised largely of fine material such as silt, sand, and fine gravel. As a result of the low flow, dense vegetation, kick sampling was not possible. A weed sweep was attempted, but returned no aquatic macroinvertebrates. The channel was generally overgrown with Fool's water cress *Apium nodiflorium*. The banks were dominated by grasses and occasional stands of other species such as, horsetail *Equisitum* spp., dock *Rumex obtusifolius* and rosebay willowherb *Chamerion angustifolium*.

Sample Point KS2

This section of the Scribblestown Stream is downstream of the surface water attenuation pond system. Under wetter conditions, the stream flows along the northern boundary of the landfill and a liner, associated with the attenuation pond system, is exposed in places at the bottom of the channel. Under normal flow conditions, the stream habitat consists of riffles and glides with a bed (substrate) of gravels and cobbles. During the site visit, the stream at KS2 was observed to be completely dry, therefore no aquatic macroinvertebrate assessment was possible. Alternative sampling locations upstream and downstream were considered, however, no suitable sampling locations were identified. The bank side vegetation was grazed by horses and mainly consisted of common grasses and white clover *Trifolium repens*. The channel bed vegetation was also dominated by terrestrial species providing almost continuous cover.

Sample Point KS3

This section of the Scribblestown Stream consists of a run habitat type, with a mud, gravel and sand substrate. The channel varies from 1m to 3m wide and is approximately 5cm deep. This depth represents a significant decrease from 30cm observed during 2012. On approach, this sampling point appeared dry and the stream channel was heavily vegetated. However, upon closer inspection, the water was, at its deepest, 30cm deep. The channel was completely overgrown with fool's water cress with localised areas of brooklime *Veronica beccabunga.* Almost no open water was visible. The stream bed substrate was found to consist of largely silt. As the stream was overgrown with vegetation, the flow was very slow with no riffle habitats present. As a result of the low flow conditions, dense vegetation, and heavily silted stream bed, a light kick sampling technique was employed, and was further supplemented with a weed sweep. During the weed sweep, some terrestrial species were encountered. On the banks, grasses, soft rush *Juncus effusus*, horsetail and creeping buttercup *Ranunculus repens* were present though due to the use of the landfill as grazing pasture for horses, the banks of the stream were considerably poached in this area with patches of exposed mud noted in areas.

The sample had only 2 taxa and a total of 9 individuals representing a decrease in diversity and quantity of aquatic macroinvertebrates. Group C dominated the sample (77.78%).

A **Q3** classification was assigned indicating **moderately polluted** water. The Shannon-Weiner (H') diversity index value was 0.853 indicating low species richness and diversity. The SSRS score is 1.6 as no scoring taxa for the assessment were encountered during the SSRS assessment and *Asellus* was also absent, indicating that the section of the stream is 'at risk'. The reduced individual count has resulted in a further reduced SSRS score when compared with the scores calculated during assessments completed in 2011 and 2012.

Sample Point KS3a

This sample was taken upstream of the weir and upstream of the confluence culvert pipe from Unnamed Stream 2. This section of the Scribblestown Stream consists of a run habitat type, with substrate predominantly composed of silt. The channel varies from 1m to 3m wide and is approximately 5cm deep, which is significantly shallower than the 40cm recorded during the 2012 assessment. Filamentous algae were present within the sample area. On the banks, grasses, dock, soft rush, horsetail, buttercup, ragwort, thistle and dandelion were noted.

The sample had 8 taxa and a total of 96 individuals. No Group A or B taxa was present. Group C taxa (89.25%) dominated the sample comprising predominantly *Gammarus* sp.

A **Q3** classification was assigned indicating **moderately polluted** water. The Shannon-Weiner (H') diversity index value was 0.75 indicating low species richness and diversity, however an increase on the value calculated during the 2012 assessment. The SSRS score is 4.8 which indicates that this stretch of the channel is '**at risk'** despite being greater than the score of 1.6 calculated during the 2012 assessment This represents an improvement in biological quality from the 2012 assessment due to the increased macroinvertebrate diversity.

Sample Point KS4

This sample was taken upstream from the confluence of Unnamed Stream 1 and Scribblestown Stream. On approach, this sampling point appeared dry and the stream channel was heavily vegetated. However, upon closer inspection, there was some water in the channel. The channel was completely overgrown with fool's water cress. As a result of the low flow conditions, dense vegetation, and heavily silted stream bed, a light kick sampling technique was employed which was further supplemented with a weed sweep. The channel varies from 1m to 3m wide and is approximately 35cm deep which is consistent with the average depth recorded during the 2012 assessment. On the banks grasses, dock, and soft rush were noted.

The sample had 7 taxa and a total of 22 individuals. The sample comprised of groups B, C, D, and E taxa.

A **Q3** classification was assigned indicating **moderately polluted** water. The Shannon-Weiner (H') diversity index value was 1.55 indicating low species richness and diversity, but an improvement on the score calculated during the 2012 assessment. The SSRS score is 3.2 which indicates that this stretch of the channel is **'at risk'**. The SSRS score remains unchanged from the 2011 and 2012 assessment.

Sample Point KS6

At KS6 the channel is variable ranging between 150cm and 200cm in width. The stream channel contained no running or standing water. The stream bed substrate could not be confirmed due to the dense vegetation, however, it is assumed that the bed is comprised largely of fine material such as silt, sand, and fine gravel. As a result of the low flow, dense vegetation, kick sampling was not possible, therefore no aquatic macroinvertebrate sampling was possible. The channel was overgrown with an absence of aquatic plants. Large stands of rosebay willowherb were present, with frequent thistles *Cirsium spp.*. Most notably ash Fraxinus excelsior was noted in the channel base. The steep banks were dominated by rank grasses with dense stands of butterfly bush *Buddleja davidii*, brambe *Rubus fruticosus* agg. present.

Historic Q-value

The Q-value results from the current and previous sampling rounds are presented in Table 10 below.

Table 10: Trend of Q-Value Rating for Sampling Locations From 2005-2013

Site/ Year	2005	2006	2007	Dec 2008	Aug 2009	Dec 2009	Sept 2010	Sept 2011	Aug 2012	Sept 2013
KS1	Q3	Q3	Q2-3	Q2-3	Q2-3	-	Q3	Q3*	Q3	-
KS2	Q3	-	-	Q3	Q2-3	Q3	Q3	Q3*	Q3	-
KS3	Q3	Q3	Q3	Q3	Q2	Q2-3	Q2-3	Q3*	Q3	Q3
KS3a							Q3	Q3*	Q3	Q3
KS4	-	-	-	-	-	Q3	-	Q3*	Q3	Q3
KS5	-	-	-	-	-	Q3	-	-	-	-
KS6	-	-	-	-	-	Q2	Q1-2	Q3*	Q2	-

- indicates not sampled

* very low flow conditions
No kick sample, just weed sweep

3.7.3 Discussion

During the 2013 biological assessment of surface waters at Dunsink Landfill Site, water levels were observed to be significantly lower than what would be expected, given the average depths monitored during previous aquatic assessments at the site. As a result of the reduced water levels in the streams within the site, aquatic assessments were only permissible on 3 of the kick sampling monitoring locations – KS3, KS3a, and KS4. Due to the downstream location and greater stream order at KS3 and KS3a, groundwater baseflow is expected to sustain some flow in the scribblestown stream during longer periods of low precipitation. This baseflow is expected to be absent in the smaller streams at KS1, KS2, and KS6 which were observed to be dry or almost dry during the 2013 assessment.

The monitoring locations generally do not permit conventional macroinvertebrate sampling techniques, i.e. aggressive kick sampling, due to very soft silty beds and/or dense vegetation. In the absence of highly oxygenated habitats such as riffles, sensitive to pollution, Group A and B taxa are unlikely to be encountered which will continually limit the maximum potential biological score during future monitoring rounds.

When kick sampling cannot be undertaken this presents a limitation to the survey. The limited macroinvertebrate diversity and individual count may be attributed to the generally dry summer when compared to recent years. This should be considered as a limitation to this survey when comparing the results of this assessment to assessments conducted in previous years given a number of locations were unsuitable for aquatic assessment.

Has Q-Value Changed?

Where it was possible to complete an aquatic assessment, with the exception of KS3, the remaining sampling points recorded a reduced total individual count, but an increased number of different taxa. This increased diversity was reflected in the increased Shannnon-Weiner Index value.

Despite the varied total individuals and increased species diversity, the Q value at the locations monitored remained the same when compared with the assessments completed in 2011 and 2012.

Has the SSR Score Improved?

When comparing the results of the 2012 assessment and the 2013 assessment, the risk category of each of the sampling locations remains 'at risk'. The 'at risk' category is to be expected at streams which, have been modified (including upstream reaches), heavily vegetated, and devoid of a pool riffle habitat. This category is unlikely to change at the site due to the historical development at the site as opposed to current site practices or current

chemical loading from the waste mass. Where stream channels are muddy and soft, heavily vegetated, and devoid of riffles, the potential for oxygenation of water is limited. Where dissolved oxygen concentrations are low, the habitat for sensitive taxa which will increase the SSRS score into the 'probably not at risk' category will not exist. Therefore, it is unlikely that an improvement to the SSRS score to this extent will be achieved in the short term.

3.7.4 Conclusions

A number of kick sampling monitoring locations could not be assessed due to the absence of flowing or even standing water. Despite the subdued water levels, the species diversity increased at KS3 and KS4.

Due to the nature of 1st and 2nd order streams, discharge and velocity of the stream is considered to be variable and dependent upon local meteorological conditions. During prolonged periods of reduced precipitation, 1st and 2nd order streams are susceptible to running dry.

Where lower than normal volumes of water are present, it is expected that background chemical concentrations will be elevated due to the reduced potential of dilution. This scenario has been presented, it is not considered to be the primary limitation on biological scores at the site.

The primary limitation on biological scores is considered to be the reduced water levels in the streams which has resulted in dense vegetation and heavily silted beds which do not permit conventional kick sampling techniques. Some aquatic biologists would argue that a heavily silted bed is resultant from elevated suspended solids, and therefore the absence of sensitive taxa would be correct and the stream would be considered polluted.

It is recommended that monitoring continues on an annual basis as per the requirements of the waste license held for the site. However, in light of the reduced water levels recorded during this assessment, it is recommended that the survey is undertaken early in the optimum sampling period for Q-value scoring – June. It is also recommended that the SSRS becomes the primary biological scoring tool for the site due to the 1st and 2nd order nature of the stream, which have been identified as being 1st or 2nd order streams and which are subject to low flows and even flash floods. A Q-value type assessment should still be undertaken in order to be consistent with previous assessments and to capture species not scored as part of an SSRS.

3.8 LANDFILL GAS

3.8.1 Landfill Gas Facility Monitoring

Since the 4th Quarter (Q4) of 2006 measurements of landfill gas were carried out at twenty four locations at the perimeter of the landfill (See Figure 6 and Table 11).

During November 2007 (Q4) in agreement with the *Agency*, weekly gas monitoring decreased to six monitoring locations (G35 to G40) and the leachate sump and sewer, with the monthly monitoring round still consisting of all accessible gas monitoring locations (24 locations). From September 2010 monitoring location G23 was also included in the weekly gas monitoring.

Gas monitoring station G41 was lost during site excavation work in September 2012 and a replacement borehole G41R was drilled adjacent to it on 5/12/2012.

At the end of October 2012 the Agency and Fingal County Council agreed to amend the monitoring programme from weekly to monthly with the following exceptions. The sewer at Finglas continues to be monitored weekly and in the event that monitoring at the landfill indicates any exceedances of methane above the trigger level, or unusually high levels of carbon dioxide relative to historical levels at the site, then monitoring should continue weekly until the gas levels subside or remedial action effected.

Table 11: Landfill Gas monitoring Locations and Programme 2013

Landfill Gas Monitoring Locations.	Monitoring Frequency Pre Nov. 2012	Monitoring Frequency Post Nov. 2012	Eastings	Northings
G3**	Monthly	Quarterly	311270	238670
G6**	Monthly	Quarterly	311180	239425
G7**	Monthly	Quarterly	311230	239375
G8**	Monthly	Quarterly	311300	239320
G9**	Monthly	Quarterly	311360	239260
G10**	Monthly	Quarterly	311410	239170
G12	Monthly	Quarterly	310040	238850
G13	Monthly	Quarterly	310560	238795
G18	Monthly	Quarterly	311150	238630

G21	Monthly	Quarterly	311380	238990
G23	Weekly	Monthly	310325	239265
G35	Weekly	Monthly	311265	238740
G36	Weekly	Monthly	311210	238740
G37	Weekly	Monthly	311290	238875
G38	Weekly	Monthly	311245	238880
G39	Weekly	Monthly	311195	238835
G40	Weekly	Monthly	311520	239090
G41R	Monthly	Monthly	311580	239020
G42**	Monthly	Quarterly	311410	238805
G43**	Monthly	Quarterly	311524	239088
G44**	Monthly	Quarterly	311516	239100
IPS inlet	Weekly	Monthly	310515	238849
Leachate Sump	Weekly	Monthly	311417	238895
Finglas Manhole	Weekly	Weekly	311909	238733

** (Changed to monthly monitoring during November 2007)

Gas levels were monitored using a GA2000 landfill gas analyser. The boreholes were monitored for Methane (CH_4), Carbon dioxide (CO_2), Oxygen (O_2), Hydrogen Sulphide, Carbon Monoxide (CO) and atmospheric pressure.

Gas trigger levels at monitoring boreholes outside the waste body have been set at 1% for methane and 1.5% for Carbon dioxide in accordance with the waste licence.

The results of the gas monitoring are recorded in monthly landfill gas monitoring round sheets – these are available from the quarterly environmental monitoring reports.

Landfill Gas - Proximity of Buildings and Developments to the Site

There are a number of buildings and developments on site, which are identified in the risk analysis of the site from landfill gas, which have potential to expose receptors to risk from landfill gas (See Figure 6). These include the former Irish Power Systems (IPS) compound (now Fingal County Council) at the southern boundary to the site along Dunsink lane. The Equipment yard and shed (which will also house the site offices) is close to the southern boundary of the site, immediately east of the IPS compound.

There are a number of buildings and developments close to the site which have potential to expose receptors to risk from landfill gas. Cappagh Hospital is located to the north of the landfill boundary. Dunsoghly estate lies to the east of Cappagh Hospital and north east of the landfill boundary. A halting site is established along the south-east boundary of the landfill (Figure 6).

South of Dunsink Lane, which marks the southern boundary of the site, there are a number of developments. From west to east these include; Elm Green Golf Course, Dunsink Observatory and a series of unauthorised halting sites (Figures 2 & 6).

FIGURE 6: LANDFILL GAS MONITORING BOREHOLES AT DUNSINK.

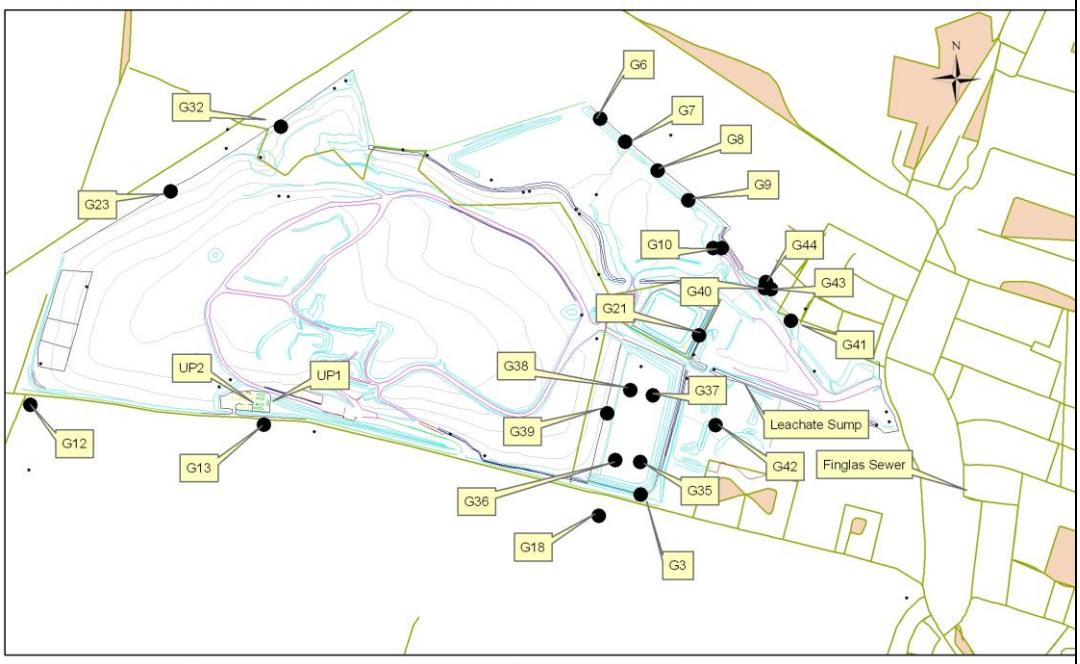

Figure 6: Landfill Gas Borehole Monitoring Locations

Locations of Trigger Level Exceedances

Q1 January to March 2013

The monthly monitoring boreholes (G23, G35, G36, G37, G38, G39, G40, G41R and the leachate sump) were monitored on 6 occasions during Q1 and at all boreholes on one occasion (quarterly monitoring round on 13/02/13). During Quarter 1 2013, elevated levels of carbon dioxide were recorded above the trigger level at a number of boreholes including G36, G37, G38, G39, G40, G41R and the leachate sump on a regular basis. Elevated levels of carbon dioxide were also occasionally recorded at G35 and at G6, G9, G10, G23, G43 and

G44 on the 13/02/13 (the only date they were sampled). The highest level recorded was 11.8% v/v at G41R though most of the elevated levels were <5% v/v with a few measurements between 5% and 10% v/v.

Elevated levels of methane were recorded on 16/01/13 at G41R (2.2%) and the leachate sump (1.0%); 23/01/13 at G37 (1.5%), G41R (7.0%) and the leachate sump (1.1%); 13/03/13 at G37 (3.2%) and G41R (3.9%); 21/03/13 at G37 (2.4%) and the leachate sump (2.1%); and 27/03/13 at G37 (3.6%) and G41R (4.1%).

No other significant concentrations of methane and no positive values for hydrogen sulphide were recorded during the 1st Quarter of 2013.

Q2 April – June 2013

The monthly monitoring stations (G35 to G39, G40, G41R and the leachate sump) were monitored on 4 occasions during Q2 2013 and the quarterly monitoring stations on 16/05/13. Elevated levels of carbon dioxide continued to be recorded at a number of the boreholes including G35, G36, G37, G38, G39, G40, G41R and the leachate sump on a regular basis. Elevated levels of carbon dioxide were also recorded at G3, G6, G9, G10, G21 and G44 during the quarterly monitoring round on 16/05/13. The highest level was recorded at G40 (10.1%) on 12/06/13, most other levels ranged from 1.5% to 5% with a few between 5% and 10%.

Elevated levels of methane were recorded on 3/04/13 at G41R (3.2%); 10/04/13 at G37 (3.1%), G41R (2.8%) and the leachate sump (1.0%); and 16/05/13 at the leachate sump (1.0%). No other significant concentrations of methane and no positive values for hydrogen sulphide were recorded during the 2nd Quarter of 2013.

Q3 July – September 2013

The monthly monitoring stations (G23, G35 to G39, G40, G41R and the leachate sump) were monitored on 3 occasions during Q3 2013 and the quarterly monitoring stations on 21/08/13. Elevated levels of carbon dioxide continued to be recorded at a number of boreholes including G35, G36, G37, G38, G39 and at G40. Elevated levels of carbon dioxide were recorded at G23 and G35 on two of the four monitoring occasions and at G3, G6, G9, G10, G23, G43, G44 and the leachate sump during the quarterly monitoring round on 21/08/13. The highest level was recorded at G38 (13.9%) on 21/08/13, most other levels ranged from 1.5% to 5% with a few between 5% and 10%.

Elevated levels of methane were only recorded on 18/07/13 at G23 (2.3%) and on 21/08/13 at the leachate sump (2.2%). No other significant concentrations of methane and no positive values for hydrogen sulphide were recorded during the 3rd Quarter of 2013.

Q4 October – December 2013

The monthly monitoring stations (G23, G35 to G39, G40, G41R and the leachate sump) were monitored on 8 occasions during Q4 2013 and the quarterly monitoring stations on 13/11/13. Elevated levels of carbon dioxide continued to be recorded at a number of boreholes including G23, G35, G36, G37, G38, G39, G40, G41R and the leachate sump on a regular basis. Elevated levels of carbon dioxide were also recorded at G9, G10, G21, G42, G43 and G44 during the quarterly monitoring round on 21/08/13. The highest level was recorded at the leachate sump (14.9%) on 11/12/13.

Elevated levels of methane were recorded on 16/10/13 at G23 (1.6%) and G37 (2.3%); 23/10/13 at G23 (1.1%); 13/11/13 at G23 (4.3%); 20/11/13 at G23 (4.2%); 27/11/13 at G23 (2.9%); 4/12/13 at G23 (1.5%); and 11/12/13 at the leachate sump (4.0%). No other significant concentrations of methane and no positive values for hydrogen sulphide were recorded during the 4th Quarter of 2013.

Weekly gas monitoring at the sewer in Finglas recorded methane levels ranging from 0.0% v/v to 0.3% v/v, carbon dioxide levels ranging from 0.0% v/v to 4.7% v/v and all hydrogen sulphide levels at 0 ppm.

Landfill Gas infrastructure

A venting trench was proposed and agreed by the Agency for the remediation of landfill gas migration on the "sports-ground". These works went to public tender and the venting trench was commissioned during Q2 2005.

A landfill gas spike monitoring report conducted in September 2004 suggested that the Scribblestown Stream may well be acting as an effective natural barrier/vent to landfill gas migration towards Cappagh Hospital and the Northern Boundary of the site and implies that these areas are not at risk.

The gas extraction and recovery facility continues to operate at the IPS compound. This includes for the pumping of gas from extraction boreholes on the landfill and the generation of electricity from gas turbines. The system also includes for a gas flare which operates when the gas engines are shut down for maintenance.

Landfill Gas Monitoring – Summary

Landfill gas monitoring undertaken at Dunsink landfill in 2013 indicated a slight reduction in the number and level of exceedances in trigger levels compared to previous years. However, there continues to be regular (monthly), though not continuous elevations of carbon dioxide

at the sportsfield monitoring boreholes (G35 to G39), at G40, G41R, the leachate sump and at G6, G9, G21, G42, G43 and G44 during the quarterly monitoring rounds.

Elevated levels of methane were recorded regularly at G37, G41R and the leachate sump over the first three quarters and at G23 during the fourth quarter.

Exceedances in the monthly and quarterly monitoring of gas at the landfill are reported to the EPA in incident reports as they occur.

3.8.2 Landfill Gas Utilisation Plant Monitoring Equipment and Sampling points

Weekly monitoring at the inlet and continuous monitoring at the outlet commenced during Q1 2006. It was agreed by the Agency that reporting of incidents under this system could be done through the quarterly and annual environmental reports.

Inlet to Landfill Gas Utilisation Plant

A gas sampling system to include chilling and filtration for the protection of the portable infrared analyser was installed. This facilitates weekly monitoring of methane, carbon dioxide and oxygen using a portable landfill gas analyser, which is used for borehole monitoring. It also provides a sampling location for annual monitoring of Total Sulphur, Total Chlorine and Total Fluorine. The results from the weekly sampling at the inlet are reported in the weekly landfill gas monitoring round sheets. These sheets are available from the quarterly environmental monitoring reports.

Outlet from Landfill Gas Utilisation Plant

Carbon monoxide and nitrogen oxides are monitored continuously. Continuous monitors on the outlets of the two gas engines were installed. The analysers are proven to be effective on other landfill gas utilisation plants. An appropriate data management system has been installed and this provides for data logging and data storage.

Additionally, a gas sampling system to allow for annual monitoring of total VOCs as carbon, total non-methane VOCs and Particulates, Hydrochloric acid and Hydrogen fluoride, and, quarterly monitoring of nitrogen oxides has been installed.

Emission limit values for Landfill Gas Plant

The emission point reference numbers are proposed to be:

UP1 Utilisation Plant Input 1

UP2 Utilisation Plant Output Engine 1

UP3 Utilisation Plant Output Engine 2

The analysers are able to measure and report at a sufficient resolution to register the emission limit for Carbon monoxide (CO) (1400mg/m3).

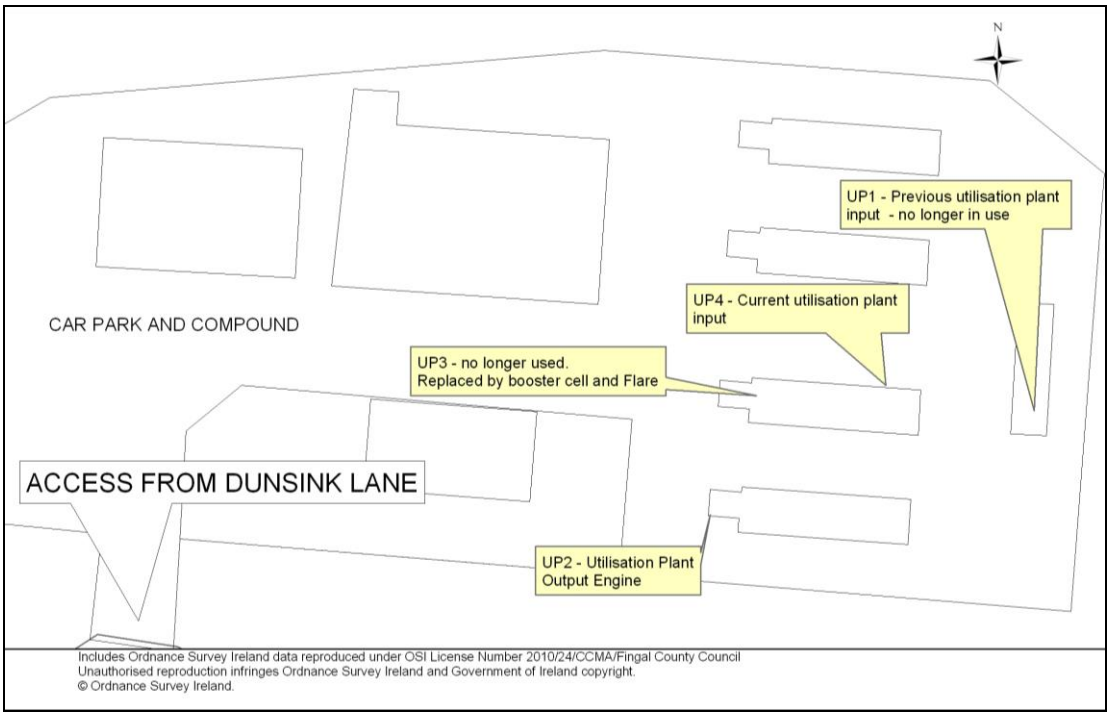

Figure 7: Dunsink Landfill Gas Utilisation Plant

3.8.3 Results from Continuous sampling of parameters at outlets from Landfill Gas Combustion Plant.

Continuous monitoring of outlet parameters at the Landfill Gas Combustion Plant was undertaken throughout 2013. The source of these emissions is the engine identified as UP2, Engine #2 was removed and UP3 is no longer used (see Figure 7 above).

Limit values as per Schedule C.5 of the governing waste licence 127-1 are outlined in the table below;

Table 12: Emission Limit Values for continuous monitoring parameters at outlets for utilisation plant

Parameter	Utilisation Plant Emission Limit Value
Nitrogen oxides (No_x)	500mg/m^3
CO	1400mg/m^3

Note 1: Dry gas referenced to 5% oxygen by volume for utilisation plants.

As per condition 1.6 b) of the waste licence 127-1, and Schedule C.5, specifying the Emission Limits Values (ELV) for Landfill Gas Plant (see Table 9 above) the following incidents occurred during 2013 at the IPS compound in Dunsink.

Condition 6.3.2 has been complied with in full as of 27-09-2006; "The concentration limits …..shall be based on gas volumes under standard conditions of:-

In the case of landfill gas combustion plant:
Temperature 273K, pressure 101.3kPa, dry gas; 5% oxygen".

Throughout 2013 reporting of continuous landfill gas monitoring was as per protocols specified in condition 6.3.3.1.

Results for full year 2013 of continuous emissions monitoring

(a) No 24 hour mean value shall exceed the ELV;

0 No. 24 hour means exceeded 500 mg/m3 for Nitrogen Oxides and 0 No. 24 hour means exceeded 1400 mg/m3 for Carbon monoxide.

(b) 97% of all 30 minute mean values taken continuously over an annual period shall not exceed 1.2 times the emission limit value.

16 No. 30 minute mean values or 0.11% of samples taken continuously over this quarter for Carbon monoxide exceeded 1.2 times the 1400mg/m3 ELV at engine number 1. 43 No. 30 minute mean values or 0.29% taken continuously over this quarter for Nitrogen Oxides exceeded 1.2 times the 500mg/m3 ELV at engine number 1.

(c) No 30-minute mean value shall exceed twice the emission limit value.

11 No. or 0.07% of 30 minute mean values taken continuously over this quarter for Carbon monoxide exceeded twice the 1400mg/m3 ELV at engine number 1. 1 No. or 1.7% of 30 minute mean values taken continuously over this quarter for Nitrogen Oxides exceeded twice the 500mg/m3 ELV at engine number 1.

The equipment experienced downtime on multiple occasions in 2013 – from 1st March to 11th April, from 11th June to 14th June and from 25th June to 1st July. These downtimes were reported as incidents to the Agency upon discovery.

The results above show non compliance with the ELV on a number of occasions – most of these happened during the third quarter prior to an engine overhaul. Emissions after the overhaul have improved significantly.

3.8.4 Summary of Continuous Sampling of Emissions at Landfill Gas Combustion Plant

The available results from continuous sampling of parameters from outlets at landfill gas combustion plant throughout 2013 presented a general picture of compliance with emission limit values apart from Q3 where there were a number of 30-minute mean values that exceeded twice the ELV for Carbon Monoxide. These readings were prior to an engine overhaul and have not been repeated since that overhaul took place.

3.9 METEOROLOGICAL MONITORING

Condition 8.6 and Schedule D.6 require daily monitoring of precipitation volume, temperature (min/max), wind force and direction, evapotranspiration, humidity and atmospheric pressure. This data is obtained from Met. Éireann's Dublin Airport Weather Station and is available in full tabular format at the facility offices.

Table 13 below shows the monthly data – indicating a total rainfall of 763.9mm.

Table 13: Dublin Airport Meteorological Data 2013

year	month	Mean Temperature (C)	Mean Maximum Temperature (C)	Mean Minimum Temperature (C)	Rainfall (mm)	Mean MSL Pressure (hpa)
2013	1	4.9	7.8	1.9	94.4	1009.9
2013	2	4.3	7.2	1.4	47.3	1018.3
2013	3	3.2	6.0	0.4	85.5	1009.2
2013	4	7.0	11.1	2.8	40.1	1013.3
2013	5	10.2	14.5	5.8	45.8	1012.1
2013	6	12.9	17.9	7.9	60.8	1017.8
2013	7	16.8	21.9	11.7	68.8	1019.2
2013	8	15.7	19.8	11.6	48.5	1016.0
2013	9	13.2	16.9	9.5	35.1	1015.3
2013	10	11.8	14.7	8.8	127.8	1007.9
2013	11	6.3	9.2	3.4	26.6	1018.3
2013	12	7.0	10.0	4.0	83.2	1007.1
Total					**763.9**	

Total evaporation for the year was 812.8mm and Potential Evapotranspiration was 569.7mm.

4.0 RESOURCE & ENERGY CONSUMPTION

Resources consumed at Dunsink Landfill include diesel fuel, electricity and hydraulic oil. There were three main consumer entities operating on site:

Fingal County Council

Contractors

Bioverda Power Systems (BPS)

Resource	FCC	Contractors	BPS	Total 2013	Total 2012	Total 2011
Electricity MWh	35	Nil	97	132	132*	156*
Diesel Vehicles	3,000*	8,100*	Nil	11,100*	11,100*	11,100*
Hydraulic Oil	Nil	60*	Nil	60*	60*	60*
Lubricating Oil	Nil	200*	3,500	3700*	3,938*	3,000*

Table 14: Summary of Resources used on site for the reporting period

*Estimates

5.0 VOLUME OF LEACHATE PRODUCED AND DISCHARGED OFF-SITE

A flow metre measuring volumes of leachate produced from the facility or volumes of leachate discharged off-site was installed with the new pump house in June 2005. However, during 2004 efforts were made to get estimates for leachate production in Dunsink to determine the appropriate capacity of current and proposed leachate infrastructure. It was considered important in view of the daily discharge limit of 1,400m^3 imposed by the Sanitary Authority (Dublin City Council) to determine responses should this limit be breached.

5.1 METHODS FOR ESTIMATING LEACHATE PRODUCTION

An annual water balance calculation was performed to estimate leachate production in Dunsink. This figure is compared with figures measured as discharged offsite (See Table 14).

5.1.1 Water Balance Calculations

In calculating the water balance for Dunsink the formula used was taken from Environmental Protection Agency (EPA) guidelines (EPA 2000)[1]. Rainfall data from Dublin airport Meteorological station are used in this calculation. Data from 2013 is used in the average and scenario calculations.

Lo = [ER(A) + LW + IRCA + ER(l)] – [aW]
Whereby;
ER = effective rainfall (m).
A = Area of cell (m^2).
LW = Liquid waste (also includes excess water from sludges) M^3.
IRCA = Infiltration through restored and capped areas (m^3).
l = Surface area of lagoons (m^2).
a =absorptive capacity of waste M^3/t.
W = weight of waste deposited.

ER = Total Rainfall (R) minus Actual Evapotranspiration (AE).
For Dunsink landfill, following the guidance given in the EPA guidelines the ER is taken as R.

[1] Environmental Protection Agency (2000). Landfill Manuals; Landfill Site Design. EPA, Ireland. ISBN 1 84095 026 9

Total rainfall (R) for Dunsink in 2013 was 763.9mm or **0.7639m**.

A= The landfill area is 154 acres or 62.3 hectares or **623,000m^2**. No area is active, there has been no dumping of municipal waste for over seven years.

ER(A)=0

LW = Liquid waste is not deposited in Dunsink - 0m^3.

IRCA = In areas that have been temporarily capped / restored an infiltration rate of 25-30% of the annual rainfall should be used. In areas which have been restored an infiltration rate of 2-10% should be applied. Given that the landfill is now restored 10% will be used as the infiltration rate through restored and capped areas.
10% of ER = 0.07639. 623,000m^2 X 0.07639m=47,590.97m^3

IRCA= 47,590.97m^3
l = In Dunsink the area of the lagoon is 6,000m^2, ER=0.7639
ER(l) =4,583.4m^3

aW = The total volume of waste has been calculated roughly, as 3.3 million m^3 on the basis of volume of three phases of landfill. It has also been roughly estimated that approximately 5,000,000 tonnes of waste have been deposited in Dunsink based on figures available from 1994 for annual inputs to the site. On this basis the roughly estimated waste density is 1.5t/m^3. This is very high and may be due to compaction by its overburden of subsoil or fill. The absorptive capacity of waste falls to negligible or none per tonne of waste before leachate is generated at densities greater than 1.2t/m^3,
aW=0 m^3/tonne

Lo = [ER(A) + LW + IRCA + ER(l)] – [aW]

Lo = [0 + 0 + 47,590.97+ 4,583.4] – [0]

Lo = 52,174.37m^3 pa
Lo = 142.94m^3 /d
Lo = 5.95m^3 /hr

5.1.2 Scenario Building

This rough estimate should be viewed in the context of varying annual rainfall over a year period. Water balance calculations should be carried out for a number of scenarios such as average monthly leachate volumes to be generated (See Table 15).

Table 15: Estimates of Leachate Production: Average Monthly rainfall recorded at Dublin Airport 2013 (Source: Met Éireann)

2013	Rain (mm)	Rainfall % Total	Estimated Monthly Leachate Production M^3
January	94.4	12.36%	6447.52
February	47.3	6.19%	3230.59
March	85.5	11.19%	5839.65
April	40.1	5.25%	2738.83
May	45.8	6.00%	3128.14
June	60.8	7.96%	4152.64
July	68.8	9.01%	4699.04
August	48.5	6.35%	3312.55
September	35.1	4.59%	2397.33
October	127.8	16.73%	8728.74
November	26.6	3.48%	1816.78
December	83.2	10.89%	5682.56
Total 2013	**763.9**	**100.00%**	**52174.37**

The EPA guidelines (EPA, 2000) suggest a peak flow factor of 3 to 5 times the predicted average flow rate should be used when sizing plant / pipe work. Therefore using 2013 rain data and allowing for the now completed restoration of Dunsink, an adequate pump station should be able to handle about (5.95 * 3) to (5.95 * 5) or 17.85 m^3/hr to 29.75 m^3/hr during wet weather flow. During 2013, the volume of leachate discharged to public sewer was 139,163 m^3 which equates to 15.88 m^3/hr.

5.1.3 Results

Water balance calculations from EPA guidelines for Dunsink during peak wet conditions suggest that leachate production / discharge could be in the range of 428-714m^3 /day.

5.1.4 Discussion

The results presented above are estimates only. The results from this exercise (EPA model), indicate that Dublin City Council's discharge limit of 1,400m^3/day would not be breached and the leachate lagoon would not ordinarily be needed to deal with any excess leachate generated. The lagoon has a capacity of 26,700m^3. The pump house design facilitates pumping a maximum of 20 litres/s or 72m^3 / hr or 1,728m^3 / day and the modelled leachate production is well below this.

The new pumping arrangements installed during June 2005 provide data for the volume of leachate generated at the facility (Table 16).

Table 16: Estimates of Leachate Production and Volumes Measures as Discharged from site

2013	Rain mm	%	Estimated Monthly Leachate Production M^3	Volume Discharged as Measured By Flow Metre
January	94.4	12.36%	6447.52	24208
February	47.3	6.19%	3230.59	21780
March	85.5	11.19%	5839.65	21323
April	40.1	5.25%	2738.83	15782
May	45.8	6.00%	3128.14	9746
June	60.8	7.96%	4152.64	7354
July	68.8	9.01%	4699.04	6742
August	48.5	6.35%	3312.55	4553
September	35.1	4.59%	2397.33	5026
October	127.8	16.73%	8728.74	6876
November	26.6	3.48%	1816.78	7014
December	83.2	10.89%	5682.56	8759
Total	**763.9**	**100.00%**	**52174.37**	**139163**

The estimated monthly leachate production is significantly and substantially less than the actual volumes measured as discharged from site. There may be a groundwater influence in leachate generation at the site which accounts for this anomaly. The EPA water balance calculation is based on rainfall contribution to leachate generation.

Since 2006 a significant rise in leachate pumped off-site has occurred and it is considered that this is partially explained by the emplacement of two major leachate interception drains

at the north and south of the facility. These leachate interception drains are obviously harnessing significant amounts of leachate and contributing to the leachate load at Dunsink.

5.1.5 Conclusion

Given all the results presented above (the varied estimates for leachate production and the actual volumes discharged offsite), it is suggested that the pump house design, in conjunction with the option to use the lagoon periodically provides sufficient capacity for dealing with the estimated leachate generated in the landfill. The completion of the restoration of the site during 2008 and 2009 has led to a reduced estimate of the amount of leachate generated by the facility through the water balance calculations. However the progress in landfill restoration has ultimately resulted in greater leachate collection and consequent increased volumes of leachate being discharged offsite. Nevertheless, the data provided by the leachate flow metre continues to vindicate the capacity designed into the leachate infrastructure.

5.2 ANNUAL WATER BALANCE CALCULATIONS AND INTERPRETATIONS

5.2.1 Introduction

The actual water balance calculations are outlined in detail in Section 5.1.

5.2.2 Discussion and Interpretation

It must be stated that the results are estimates only and based on many assumptions, which may or may not be correct. Furthermore data from key variables, such as depth of waste, proximity of groundwater table and effect of springs within waste body, are unavailable.

(i) Previous estimates of the wet weather flow and dry weather flows for leachate were prepared by Fingal County Council in 2003 on the basis of direct measurements. These estimates calculated Wet Weather Flow leachate volumes in the range of 1242-1656m^3/day and 414m^3/day during dry weather flow.

(ii) Water balance calculations are presented in Section 5.1.1 from EPA guidelines for Dunsink during peak wet conditions. They suggest that peak leachate production / discharge could be 714m^3/day during wet weather and 143m^3/day during average Flow.

(iii) During 2013, the volume of leachate discharged to public sewer was 139,163m^3 which equates to 15.9m^3/hr. (See Table 15). This suggests that average leachate production/discharge over the year is 381m^3/day.

These figures must be seen in the context of the bedrock geology and aquifer status of the site. The regional view of the vicinity of the Dunsink Landfill is of a low yielding aquifer.

5.2.3 Conclusion

The results from water balance calculations and from the pump house flow-metre are very different in terms of leachate modelled as generated on site and leachate volumes pumped off-site. However both sets of results validate the choice of leachate pump house design, which was based on empirical measurements of leachate flowing through the existing infrastructure. The pump house design facilitates pumping a maximum of 20 litres/s or 72m^3 / hr or 1728m^3 / day. Dublin City Council allows a maximum discharge of 1400 m^3 / day.

The worst case scenario for Dunsink from wet weather flows derived from previous estimates at 1,656m^3/day exceeds this limit. In instances when the pump-house cannot pump away volumes as they are generated from the facility the system is self regulating. During Wet Weather Flow peak flows in excess of the limit are rare and short in duration. When they do occur the automatic valve opens and closes to regulate the level of leachate in the sump and facilitate controlled discharge of leachate to public sewer or the lagoon. The lagoon has additional capacity of 26,700m^3 and if empty would have capacity for 16+ days pumping to lagoon during wet weather flow. This contingency provides for scenarios whereby pumping to the public sewer would not be feasible for any reason.

The results suggest that the pump house design, in conjunction with the option to use the lagoon periodically may provide sufficient capacity for dealing with the estimated leachate generated in the landfill.

5.3 ESTIMATED ANNUAL AND CUMULATIVE QUANTITY OF INDIRECT EMISSIONS TO GROUNDWATER

5.3.1 Emissions to Groundwater - Introduction

At present there are no estimates for annual and cumulative quantities of indirect emissions of leachate to groundwater.

Inferences are made from estimates in Sections 5.1.1 (estimates of leachate going through leachate management infrastructure during Wet Weather Flow) and 5.1.2 (estimates of leachate generated at the facility based on water balance calculations). At the outset, it must be stated that this is an exercise fraught with difficulties in that these estimates are based upon many assumptions, which may or may not be correct. Furthermore; data from key variables such as depth of waste, proximity of groundwater table and effect of springs within the facility; are unavailable.

Nevertheless the volumes of leachate discharged from the facility consistently and substantially exceed those estimated from water balance calculations.

5.3.1.1 Dry weather flow

The leachate infrastructure and discharge consents from Dublin City Council are more than adequate to deal with the volumes of leachate generated in Dunsink during dry weather flow. This suggests that there may be no indirect emissions to groundwater during Dry Weather Flow conditions.

5.3.1.2 Wet weather flow

The leachate infrastructure system seems to be "flashy" i.e. the amount of leachate going through the system rapidly increases following rainfall events. For all but the highest peaks in wet weather flow the leachate infrastructure and discharge consents from Dublin City Council are more than adequate to deal with the volumes of leachate generated in Dunsink and there is little risk of contamination of groundwater.

In instances when the pump-house cannot pump away volumes as they are generated from the facility the system is self regulating. Peak discharges during Wet Weather Flow are rare and short in duration, the automatic valve opens and closes to regulate the level of leachate in the sump and facilitate controlled discharge of leachate to public sewer or the lagoon.

5.3.2 Bedrock Geology of the site and Aquifer Status

The western half of the landfill is underlain by Waulsortian Limestones. The GSI classify the County Meath Waulsortian Limestones as Ll, bedrock which is moderately productive only in local zones and this can be assumed to be the case for Dunsink.

The central part of the landfill is underlain by the Tober Colleen formation. The thinly bedded mudstones of the Tober Colleen formation which underlie the Calp Limestone have been

classified by the GSI as Pu, bedrock which is generally unproductive due to the low permeability of the bedrock.

The eastern part of the site is underlain by basinal limestones consisting of limestone turbidites with bioclastic and calcareous mudstones (Calp Limestone). The Calp Limestone of County Dublin has been classified in the GSI Groundwater Protection Scheme as a Ll aquifer, bedrock which is generally moderately productive.

There is a minor faulting in the vicinity of the site and there is a minor fault running in a north-west south-east direction through the site.

A number of boreholes have been drilled into the bedrock on the site and a visual inspection of the drill chips from the monitoring boreholes indicated the site to be generally underlain by the soft black basinal (Calp) limestones and mudstones. These were recorded at all boreholes that were drilled to bedrock. The hardness and shade of the rock varied between boreholes and between different depths within the same borehole.
The monitoring well drilling programme confirmed the regional view that the area in the vicinity of Dunsink Landfill should be classified as a low to moderate yielding aquifer.

5.3.3 Conclusion

On the basis that:

(1) The underlying geology and overburden have produced a localised classification of the aquifer as generally low to moderate yielding.
(2) Measured volumes of leachate discharged from the facility are consistently and substantially higher than those calculated through water balance calculations.
(3) The groundwater monitoring programme indicates that groundwater around the facility is generally good;

It is considered that indirect discharges to groundwater are not significant in volumes or effect.

As per Technical Amendment to the Licence issued in January 2013, a risk screening exercise for the site is going to be prepared in accordance with the Guidance on the Authorisation of Discharges to Groundwater. This exercise is planned to commence on the second quarter of 2014.

6.0 WORKS PROPOSED AND UNDERTAKEN & TIMESCALE FOR THOSE PROPOSED DURING THE COMING YEAR

6.1 WORKS UNDERTAKEN DURING 2013

The phased handover of the landfill and surrounding areas to the Parks (now Operations) Department was completed by December 2009. The Environment Department continued with all monitoring obligations as set out in the landfill license.

In 2013, Fingal County Council Operations Department kept working closely with the Irish Horse Welfare Trust and local horse owners in Dunsink in an effort to address and regulate the situation with regard to the wandering horses in Dunsink. The Council, the Irish Horse Welfare Trust and the owners have now formed a club, which regulates the numbers of animals on the site, all of the horses are now microchipped and passported, and traceable to their owners.

Work has been ongoing on a site to the East of the landfill to prepare an area for permanent stables and grazing paddocks for the horses.

6.2 WORKS PLANNED FOR 2014

In 2014, maintenance works identified in the slope stability report will be completed, such as clearing vegetation from the drainage stone and re-seeding some areas. A new drain will also be laid to drain the haulage road located above the attenuation pond.

Works to ensure compliance with the ELV for dissolved methane in the leachate pumped to the sewer will also be undertaken.
Maintenance and repair works will be undertaken to bring the gas management infrastructure to a satisfactory level.

Works on permanent stables and grazing paddocks for the horses in the area to the East of the landfill will be progressed further.
It is intended to commence the resurfacing of the existing pathway/road system throughout the former landfill area in line with the Council's long term plan to provide a public park. It is also intended to continue to improve the boundaries from a safety and aesthetic point of view.

7.0 SITE SURVEY INDICATING EXISTING LEVELS OF THE FACILITY

Fingal County Council sought approval from the Environmental Protection Agency on the 13/08/2009, (letter Ref FCC-127-1-2009-010) not to undertake a topographic survey in 2009. This was due to the fact that there was no importation of soil into the restored landfill and no subsidence was anticipated. Approval was given by the EPA on the 20/08/2009 by telephone from Mr Eamonn Merriman. A telephone conversation with Mr Merriman on 28/01/2013 confirmed that an updated topographic survey was not required. Figure 8 below shows the topographic status of the landfill as established by the most recent topographic survey completed in 2007.

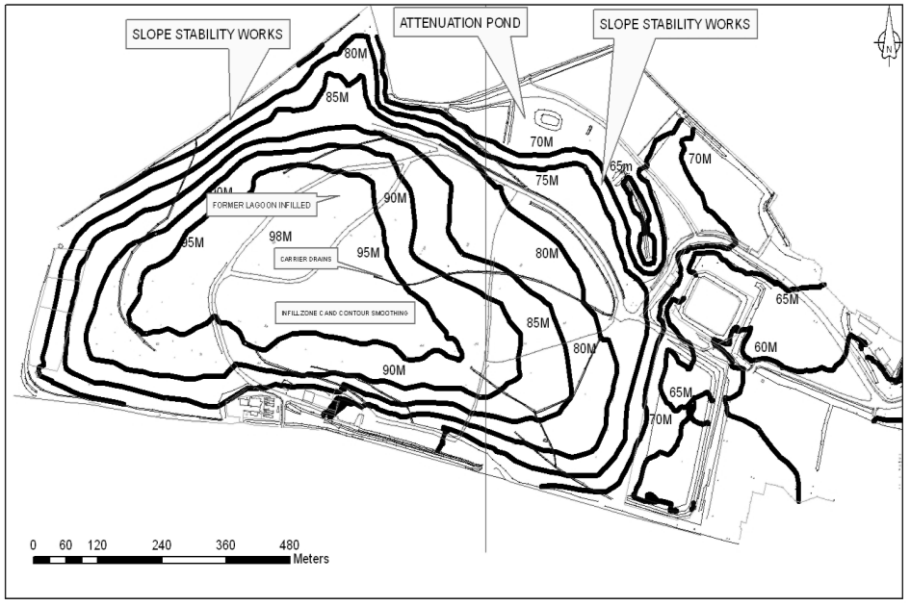

Figure 8: Simplified Topographical Map of Dunsink 2007

8.0 ESTIMATED ANNUAL & CUMULATIVE QUANTITY OF LANDFILL GAS EMITTED

In early 1996 a gas collection network was first configured throughout the whole landfilled portion of Dunsink. In 1999 the collection network was replaced by a larger more extensive arrangement.

It is comprised of a high-density polyethylene (HDPE) ring main around the site with a number of branch lines, which contains manifolds that connect to individual gas extraction wells.

There are approximately eighty-five gas extraction wells connected to manifolds throughout the site. Some of the wellheads are buried so it is not physically possible to confirm their condition or truly assess their performance. An additional thirteen gas wells were installed in Zone A and six additional gas wells were installed in Zone C during 2006.

There are ten branch lines off the main collection ring. These branches are 250mm in diameter and have multi-outlet manifolds configured to collect the gas from the wells in their vicinity. Each branch can be isolated where it connects to the main line. The manifold arrangement allows the line from the individual wells to be sampled and controlled. This has the effect of balancing the "good gas" with the bad to maintain the optimum quality to the utilisation plant.

The mainline ring is a 355mm HDPE pipe that completely encircles the landfill and finishes back at the utilisation plant compound. It has two dewatering chambers, one next to the old main landfill entrance and the other adjacent to the IPS compound, where the collected condensate is returned to the waste body via a disused extraction well. This ring main can be isolated in a number of locations to permit maintenance operations and still maintain operation of the utilisation plant.

The extraction pump which feeds the remaining generator (one was removed from site during 2006) is capable of collecting three thousand cubic metres of gas per hour at a maximum suction pressure of –150mbar. It is currently delivering approximately four hundred and fifty cubic metres per hour at a quality of 46%CH_4. In the unlikely event the engine is out of service for an extended duration, the integral flare can be run to maintain negative pressure on the landfill.

8.1 LANDFILL GAS CONSUMED BY UTILISATION PLANT 2013

Figures for landfill gas emitted from the facility are derived from data submitted by Bioverda Power Systems for the utilisation plant in Dunsink. The migration issues of previous years are largely resolved and the utilisation plant controls the vast majority of the landfill gas emitted. The figures for 2013 are presented in Table 16.

8.2 LANDFILL GAS CONSUMED BY UTILISATION PLANT AND GENERATED BY FACILITY 1996-PRESENT

The amount of landfill gas utilised by the plant has continued to trend downwards as would be expected but utilisation is dropping less sharply in recent years than the period 2003-2005.

In 2009, 2010, 2011 and 2012 the gas engine occasionally 'ran out of gas' at viable concentrations indicating that the gas field production is decreasing at an increasing rate. That trend continued in 2013 with the engine regularly 'running out of gas' and having to be restarted after giving the field an opportunity to recover, typically 48-60 hours.

In August 2012, the engine was swapped for a smaller engine, more efficient to run with the amount and quality of landfill gas present in Dunsink. The new engine has been running since early August 2012.

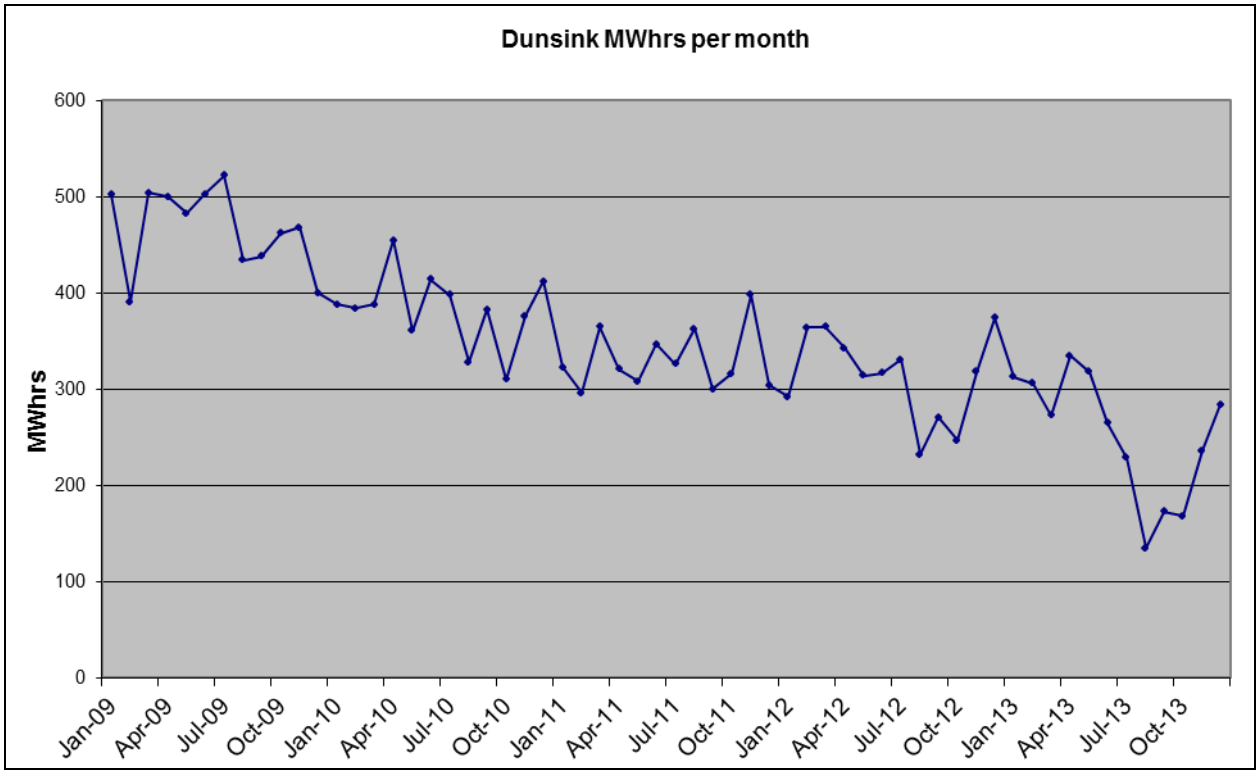

Figure 9 - MWhr exported per month at Dunsink.

Bioverda are reporting that supply of gas has dropped sharply. It is considered that landfill gas migration is not an overwhelming issue at Dunsink and it is suggested that these figures reflect a downward pattern over time of landfill gas emitted from the facility.

Bioverda POWER SYSTEMS LTD

Table 17: landfill gas consumed by utilisation plant 2013

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Diesel	Litres	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Consumed	kWhrs	9852	7285	8945	6377	4250	28725	7511	4762	7889	5517	3884	2413	97410
Oil (Lubrication)	Litres	450	0	450	450	0	450	800	0	0	450	450	0	3500
Landfill Gas	m^3	120,915	118,170	105,766	129,577	123,104	102,546	88,478	52,229	66,971	65,009	91,346	110,036	1,174,147
Average Monthly CH_4	% by Volume	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%	46%
Electrical units exported (power output)	MWhrs	313	306	273	335	318	265	229	135	173	168	236	284	3036

Data compiled and verified by: Donal Monahan, Director of Resource and Recovery

9.0 REPORT ON PROGRESS TOWARDS ACHIEVEMENT OF ENVIRONMENTAL OBJECTIVES AND TARGETS CONTAINED IN PREVIOUS YEAR'S REPORT.

This is the ninth AER under this Licence. In 2011 the majority of objectives for the facility nearing completion were fully completed and the Enclosed Flare was commissioned and handed over to Fingal County Council.
The Phased Handover of the landfill and surrounding areas to the Parks Department which began in 2008 was completed as of December 2009
Capping works, final landscaping and slope stability maintenance were completed in 2009.
Environmental Infrastructure Inspection, Maintenance and Monitoring were on-going in 2013.

10.0 SCHEDULE OF ENVIRONMENTAL OBJECTIVES AND TARGETS 2014

The schedule of environmental objectives and targets for 2014 will be as follows:
Resolve the issue of the continuous breach of Emission Limit Value for Dissolved Methane in the leachate released to sewer (Compliance Investigation CI000399);
Resolve the issues highlighted in Compliance Investigation CI000397 with the Gas Management Infrastructure;
Continue the environmental monitoring to identity any potential sources of pollution coming from the landfill and resolve them as they happen.

11.0 PROCEDURES DEVELOPED RELATING TO THE FACILITY OPERATION

No new Standard operating procedures (SOP`s) were introduced in 2013.

12.0 TANK, PIPELINE AND BUND TESTING AND INSPECTION REPORT

Conditions 3.10.5 and 5.10.2 of the licence require that integrity tests be carried out on the leachate lagoon and oil bunds every three years by an independent and appropriately qualified chartered engineer.

12.1 LAGOON

An integrity test was carried out on the leachate lagoon in late January 2012 and it passed the test. The results of the integrity test were submitted to the Agency in February 2012 (FCC-127-1-2012-03).

12.2 OIL BUND IPS COMPOUND- DUNSINK

An integrity test was conducted during October 2007 on the oil bund in the IPS compound. The bund integrity was found to be good, it was watertight and found fit for its intended use. Oil is no longer stored in the compound – it is therefore proposed not to carry out further integrity test on the disused bund.

13.0 REPORTED INCIDENTS AND COMPLAINTS SUMMARIES

13.1 REPORTED ENVIRONMENTAL INCIDENTS

There were 23 reported incidents in 2013 reported under condition 1.6 c) "Any trigger level specified in this licence which is attained or exceeded"; and d) "Any indication that environmental pollution has, or may have, taken place." 12 of these were notified to the Inland Fisheries Ireland (IFI) during 2013.

In October 2012 the Agency agreed that any incidents relating to gas should only be notified to the Agency where methane levels exceeded 1% or where there were unusually high levels of carbon dioxide. Levels of carbon dioxide have regularly exceeded the 1.5% threshold and in each case were notified to the Agency. It was agreed that only unusually high levels for the site should be notified to the Agency from 1/11/12 onwards – which led to a considerable decrease of incidents notified compared to 2012.

Table 18: Summary of reported incidents during 2013

	Surface Water	Landfill Gas	Other
Month	**2013**	**2013**	**2013**
January	0	1	
February	1	0	
March	3	1	1
April	2	1	
May	1	0	
June	0	0	
July	2	1	2
August	0	0	
September	0	0	
October	1	2	1
November	1	1	1
December	1	0	
Total	**12**	**7**	**4**

Incidents from monthly inspections of surface waters and gas monitoring were notified to Fingal County Council, the EPA and the IFI where relevant by 10am the day following monitoring/inspections. Exceedances of groundwater and Dissolved methane were reported in the quarterly reports.

Surface water incidents in the main were caused by elevated levels of ammonia and/or conductivity during Winter months particularly at the upstream monitoring stations (SW21 and SW18) and these reflected off site sources of contamination.

The EPA was notified of all incidents. IFI were notified on all incidents pertaining to surface water and Dublin City Council continues to be informed in relation to Dissolved Methane.

13.2 REPORTED ENVIRONMENTAL COMPLAINTS

Condition 10.4 of Licence 127-1 requires that the licensee shall maintain a written record of all complaints relating to the operation of the facility. No complaints were received by FCC during 2013.

It is considered that with the closure and completed restoration and improvements to landfill infrastructure since the end of 2009, the landfill is now less of an issue for its surroundings. This is a continuation of the trend in recent years. There were no complaints in 2009 while in 2008 there were just two complaints, compared with five for 2004, one for 2005 and two for 2006.

14.0 REVIEW OF NUISANCE CONTROLS

Condition 7 of Waste Licence 127-1 requires that vermin, birds, flies, mud, dust, litter, noise and odours do not give rise to nuisance at the facility or in the immediate area of the facility.

Staff for the Operations Department access the landfill on a regular basis and tackle any nuisance as they arise. The site is also monitored every week by the landfill manager and any outstanding issues observed are reported to be addressed.

15.0 FINANCIAL PROVISION, MANAGEMENT, STAFFING STRUCTURE & PROGRAMME FOR PUBLIC INFORMATION

15.1 FINANCIAL PROVISION

Fingal County Council has made a financial provision of €2.63 million on its accounts (as of 31 December 2013) for the aftercare of Dunsink Landfil.
Aftercare costs continued to be paid for from the revenue account and in 2013 no recourse was made to the capital reserve.

15.2 MANAGEMENT AND STAFFING STRUCTURE

The following comprised the current management structure for Dunsink Landfill in 2013.

Licence Compliance

Senior Engineer:	John Daly.
Waste Infrastructure and Enforcement:	John Daly. B.E. (Civil Engineering), M.Sc (Environmental Engineering), MIEI
Assistant Scientist:,	Mr. A. Kerveillant. Management of waste licence conditions & License Compliance. M.S.c Environment

Landfill Management

Senior Executive Officer :	Mr. John O'Brien. Manager of Castleknock / Mulhuddart Operational Area,
Senior Executive Parks Superintendant:	Ruairi O'Dulaing. Responsibility For Operations Development and transition
Inspector:	Eamonn Brady, Inspector. Responsibility for overseeing Landfill management operations
Assistant Foreman:	Paul Rattigan, Management of Landfill,

15.3 PROGRAMME FOR PUBLIC INFORMATION

Public information can be viewed at the **Council's Headquarters** between 9.30 a.m. and 12.45 p.m. and 2.00 p.m. and 4.00 p.m. Monday to Friday (excluding public holidays), unless otherwise arranged by prior appointment.
Facilities for viewing information from a computer or files are provided at Dunsink Facility office by prior arrangement with the Landfill Manager.

The website (www.fingal.ie) informs that the remediation and restoration phase is now complete.

Site visits to **Dunsink Landfill** can be arranged by applying in writing to the Landfill Manager requesting a date and time for the proposed visit and indicating the number of visitors and the purpose of such a visit and whether any presentation is required. The use of cameras and video equipment during the visit must be agreed in advance with Fingal County Council. Such requests will be accommodated where possible. Operational and security matters will take precedence and visits may be cancelled at short notice.

16.0 STAFF TRAINING REPORT

As activities at the landfill have gradually decreased since the closure and restoration phases during 2008 and 2009, training requirements have also decreased. Manual Handling training of the site operatives took place in 2009. No training took place in 2013.

GLOSSARY

Aftercare	Any measures that are necessary to be taken in relation to the facility for the purposes of preventing environmental pollution following the cessation of the activity in question at a facility.
Annually	At approximately twelve monthly intervals.
Aquifer	A formation (e.g. body of rock, gravel or sand stratum) that is capable of storing significant quantities of water and through which groundwater moves.
Baseline monitoring	Monitoring in and around the location of a proposed facility so as to establish background environmental conditions prior to any development of the proposed facility.
Borehole	A shaft installed outside a waste area for the monitoring of and/or extraction of landfill gas/groundwater. Established by placing a casing and well screen into the boring. If installed within the waste area, it is called a well.
Bunding / Berm	A dike or mound usually of clay or other inert material used to define limits of cells or phases or roadways; or to screen the operation of a landfill from adjacent properties; reducing noise, visibility, dust and litter impacts.
Capping	The covering of a landfill, usually with low permeability material (landfill cap).
Condensate	The liquid which forms within the gas pipe work due to the condensation of water vapour from landfill gas.
Detection limit.	The concentration of the determinant for which there is a 95% probability of detection when a single analytical result is obtained, detection being defined as obtaining a result which is significantly greater (p=0.05) than zero. Also referred to as Limit of Detection.
Direct discharge	The introduction into groundwater of List I or II substances without percolation through the ground or subsoil.
Downgradient	The direction towards which groundwater or surface water flows.
Emission	Meaning assigned by the EPA Act of 1992.
Flare unit	A device used for the combustion of landfill gas thereby converting its methane content to carbon dioxide.

Gas wells	Wells installed during filling or retrofitted later within the waste area for the monitoring of and/or removal of landfill gas either actively through an extraction system or passively by venting.
Groundwater	Groundwater is that part of the subsurface water which is in the saturated zone.
Hydrogeology	The study of the interrelationships of the geology of soils and rocks with groundwater.
Indirect discharge	The introduction into groundwater of List I or II substances after percolation through the ground or subsoil.
Inert landfill	A landfill that accepts only inert waste that fulfils the criteria set out in the Agency's draft manual "Waste Acceptance".
Lagoon	A land area used to contain liquid, e.g.leachate collected from landfill.
Landfill	Waste disposal facility used for the deposit of waste on to or in to land.
Landfill gas (LFG)	All gases generated from the landfilled waste.
Leachate	Any liquid percolating through the deposited waste and emitted from or contained within a landfill as defined in Section 5(1) of the Waste Management Act.
Leachate Well	Well installed within the waste area for the monitoring and/or extraction of leachate as opposed to borehole, which is the term, used when located outside the waste deposition area.
List I/II substances	Substances referred to in the EU Directives on Dangerous Substances (76/464/EEC) and Groundwater (80/68/EC).
Lower explosive limit (LEL)	The lowest percentage concentration by volume of a mixture of flammable gas with air which will propagate a flame at 25^{o}C and atmospheric pressure.
Macroinvertebrate	Larger invertebrate animals visible to the eye. Usually defined as those that are retained by a net or sieve of mesh size 0.6mm.
Minimum reporting value	This is the lowest concentration of a substance that can be determined with a known degree of confidence. It is a matrix dependent and not necessarily equivalent to the Limit of Detection of the analytical system but is generally a multiple of that value which reflects the robustness and reproducibility of the test method as applied to the specific

	matrix. Also referred to as the limit of quantitation or practical reporting limit.
Noise Sensitive Location	(NSL) Any dwelling-house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.
Quarterly	At approximately three monthly intervals.
Receiving water	A body of water, flowing or otherwise, such as a stream, river, lake, estuary or sea, into which water or wastewater is discharged.
Restoration	Works carried out on a landfill site to allow planned afteruse.
Substrata	River bed or bottom on or in which invertebrates live.
Taxa	Named taxonomic groups. Usually family or species level in biotic indices.
Trigger level	A parameter value specified in the licence, the achievement or exceedance of which requires certain actions to be taken by the licensee.
Upper explosive limit (UEL)	The highest percentage concentration by volume of a mixture of flammable gas with air which will propagate a flame at 25^{o}C and atmospheric pressure.
Void space	Space available to deposit waste.

Water balance A calculation to estimate a volume of liquid generated. In the case of landfills, water balance normally refers to leachate generation volumes.

APPENDIX 1:

Groundwater Monitoring Results

Dunsink Landfill - Groundwater Quality Results Q1 2013

Parameter	Unit	Threshold Value	BH3	BH3 Control Values	BH3 Trigger Values	BH4	BH4 Control Values	BH4 Trigger Values	BH16	BH16 Control Values	BH16 Trigger Values	BH27	BH27 Control Values	BH27 Trigger Values
pH	pH Units	**6.5 - 9.5** [1]	7.28	8	8.38	7.23	8.2	8.59	7.39	8.24	8.64	7.03	8.18	8.57
Conductivity	mS/cm	**1.875**	0.957	1.231	1.289	0.915	1.352	1.414	0.723	0.8379	0.8778	0.990	1.282	1.343
Temperature	°C	**-**	10.2	-	-	10	-	-	10.5	-	-	11.1	-	-
Ammoniacal Nitrogen	mg/l	**0.175**	0.02	0.42	0.44	0.02	0.31	0.33	0.07	0.21	0.22	0.03	1.89	1.98
Total Organic Carbon	mg/l	**N-A-C**[1]	3	6.3	6.6	<2	6.3	6.6	<2	6.3	6.3	4	5.25	5.5

Parameter	Unit	Threshold Value	BH31	BH31 Control Values	BH31 Trigger Values	BH32	BH32 Control Values	BH32 Trigger Values	BH33	BH33 Control Values	BH33 Trigger Values	BH34N	BH34 Control Values	BH34 Trigger Values	BH35	BH35 Control Values	BH35 Trigger Values
pH	pH Units	**6.5 - 9.5**[1]	7.19	8.39	8.79	7.31	8.18	8.6	7.24	8.58	8.99	7.2	8.61	9.02	7.3	Control & Trigger values not yet determined	
Conductivity	mS/cm	**1.875**	0.560	0.791	0.828	0.668	1.227	1.286	0.674	0.852	0.892	0.795	0.998	1.045	0.751		
Temperature	°C	**-**	10.8	-	-	10.7	-	-	9.1	-	-	8.8	-	-	11.1		
Ammoniacal Nitrogen	mg/l	**0.175**	0.09	1.575	1.65	0.15	0.735	0.77	0.02	0.21	0.22	0.12	0.21	0.22	0.16		
Total Organic Carbon	mg/l	**N-A-C**[1]	3	8.4	8.8	<2	5.25	6	<2	5.25	5.5	4	6.3	6.6	<2		

Threshold value = Groundwater regulations SI 9 of 2010

[1] = Where no threshold value exists results are compared to EPA I.G.V. from Table 3.1 of EPA document "Towards Setting Guideline Values for the protection of Groundwater in Ireland"

Shading & Bold = Value has exceeded threshold value

Shading = Value has exceeded the Control Value

Shading = Value has exceeded Trigger Value

Sampled on 13th February 2013

Analysis conducted by Jones Environmental Laboratory

Dunsink Landfill - Groundwater Quality Results Q2 2013

Parameter	Unit	Threshold Value	BH3	BH3 Control Values	BH3 Trigger Values	BH4	BH4 Control Values	BH4 Trigger Values	BH16	BH16 Control Values	BH16 Trigger Values	BH27	BH27 Control Values	BH27 Trigger Values
pH	pH Units	**6.5 - 9.5** [1]	7.23	8	8.38	7.2	8.2	8.59	7.42	8.24	8.64	7.27	8.18	8.57
Conductivity	mS/cm	**1.875**	1.039	1.231	1.289	1.092	1.352	1.414	0.662	0.8379	0.8778	0.954	1.282	1.343
Temperature	°C	**-**	11.0	-	-	11.0	-	-	9.6	-	-	10.7	-	-
Ammoniacal Nitrogen	mg/l	**0.175**	<0.03	0.42	0.44	<0.03	0.31	0.33	0.05	0.21	0.22	0.03	1.89	1.98
Total Organic Carbon	mg/l	**N-A-C**[1]	<2	6.3	6.6	<2	6.3	6.6	<2	6.3	6.3	<2	5.25	5.5

Parameter	Unit	Threshold Value	BH31	BH31 Control Values	BH31 Trigger Values	BH32	BH32 Control Values	BH32 Trigger Values	BH33	BH33 Control Values	BH33 Trigger Values	BH34N	BH34 Control Values	BH34 Trigger Values	BH35	BH35 Control Values	BH35 Trigger Values
pH	pH Units	**6.5 - 9.5**[1]	7.32	8.39	8.79	7.32	8.18	8.6	7.51	8.58	8.99	7.36	8.61	9.02	7.46	Control & Trigger values not yet determined	
Conductivity	mS/cm	**1.875**	0.660	0.791	0.828	0.684	1.227	1.286	0.632	0.852	0.892	0.789	0.998	1.045	0.783		
Temperature	°C	**-**	11.0	-	-	11.2	-	-	11.0	-	-	10.6	-	-	10.8		
Ammoniacal Nitrogen	mg/l	**0.175**	0.12	1.575	1.65	0.09	0.735	0.77	<0.03	0.21	0.22	0.07	0.21	0.22	0.07		
Total Organic Carbon	mg/l	**N-A-C**[1]	<2	8.4	8.8	<2	5.25	6	<2	5.25	5.5	<2	6.3	6.6	<2		

Threshold value = Groundwater regulations SI 9 of 2010

[1] = Where no threshold value exists results are compared to EPA I.G.V. from Table 3.1 of EPA document "Towards Setting Guideline Values for the protection of Groundwater in Ireland"

Shading & Bold = Value has exceeded threshold value

Shading = Value has exceeded the Control Value

Shading = Value has exceeded Trigger Value

Sampled on 16th May 2013

Analysis conducted by Jones Environmental Laboratory

Dunsink Q3 2013 GW annual

Groundwater Results

PARAMETER	UNIT	Threshold Value	BH3	BH3 Control Values	BH3 Trigger Values	BH4	BH4 Control Values	BH4 Trigger Values	BH16	BH16 Control Values	BH16 Trigger Values	BH27	BH27 Control Value	BH27 Trigger Values	BH31	BH31 Control Values	BH31 Trigger Values	BH32	BH32 Control Values	BH32 Trigger Values	BH33	BH33 Control Values	BH33 Trigger Values	BH34	BH34 Control Values	BH34 Trigger Values	BH34N	BH35
pH Value	**units**	**6.5 - 9.5**	7.11	8	8.38	7.07	8.2	8.59	7.36	8.24	8.64	7.29	8.18	8.57	7.16	8.39	8.79	7.22	8.18	8.6	7.3	8.58	8.99	Not	8.61	9.02	7.6	7.23
Conductivity	**mS/cm**	**1.875**	1.329	1.231	1.289	1.463	1.352	1.414	0.680	0.838	0.878	0.982	1.282	1.343	0.735	0.791	0.828	0.699	1.227	1.286	0.638	0.852	0.892	Sampled	0.998	1.045	0.808	0.768
Ammonical Nitrogen as N	**N mg/l**	**0.175**	<0.03	0.42	0.44	<0.03	0.315	0.33	0.08	0.21	0.22	0.05	1.89	1.98	0.33	1.575	1.65	0.14	0.735	0.77	<0.03	0.21	0.22		0.21	0.22	1.11	0.1
Dissolved Oxygen (O2)	**O2 mg/l**	**N-A-C**	7.0	-	-	7.0	-	-	6.0	-	-	6.0	-	-	6.0	-	-	6.0	-	-	7.0	-	-		-	-	4.0	6.0
Chloride (Cl)	**Cl mg/l**	**187.5**	143.7	76.65	80.3	176.5	91.35	95.7	22.9	40.95	42.9	47.1	75.6	79.2	26.6	32.55	34.1	26.4	26.25	27.5	16.3	28.35	29.7		32.55	34.1	23.5	26.9
Potassium (K)	**K mg/l**	**5** [1]	4.5	5.25	5.5	4.3	7.77	8.14	2.3	3.78	3.96	2.1	3.36	3.52	2.2	4.41	4.62	3.3	6.72	7.04	1.8	5.25	5.5		3.99	4.2	3.7	1.6
Sodium (Na)	**Na mg/l**	**150**	66.7	51.24	53.68	97.8	37.8	39.6	17.1	21	22	27.9	47.25	49.5	16.9	25.2	26.4	17.4	21.31	22.33	16.3	82.95	86.9		64.58	67.7	23.2	25.6
Fluoride (F)	**F mg/l**	**1** [1]	<0.3	0.315	0.33	<0.3	0.315	0.33	0.6	0.74	0.77	0.7	0.74	0.77	<0.3	0.945	0.99	<0.3	0.315	0.33	1.0	0.945	0.99		0.32	0.3	0.4	1.5
Total Organic Carbon	**C mg/l**	**N-A-C**	<2	6.3	6.6	<2	6.3	6.6	<2	6.3	6.6	<2	5.25	5.5	<2	8.4	8.8	<2	5.25	6	<2	5.25	5.5		6.3	6.6	<2	<2
Total Oxidised Nitrogen (water)	**N mg/l**	**N-A-C**	0.4	-	-	1.2	-	-	<0.2	-	-	<0.2	-	-	<0.2	-	-	<0.2	-	-	<0.2	-	-		-	-	0.5	<0.2
Calcium (Ca)	**Ca mg/l**	**200** [1]	180	-	-	188.3	-	-	84.3	-	-	116.5	-	-	111.6	-	-	97.7	-	-	82.4	-	-		-	-	124.6	89.3
Cadmium (Cd)	**Cd mg/l**	**0.003**	<0.0005	-	-	<0.0005	-	-	<0.0005	-	-	<0.0005	-	-	<0.0005	-	-	<0.0005	-	-	<0.0005	-	-		-	-	<0.0005	<0.0005
Chromium (Cr)	**Cr mg/l**	**0.037**	<0.0015	-	-	<0.0015	-	-	<0.0015	-	-	<0.0015	-	-	<0.0015	-	-	<0.0015	-	-	<0.0015	-	-		-	-	<0.0015	<0.0015
Copper (Cu)	**Cu mg/l**	**1.5**	<0.007	-	-	<0.007	-	-	<0.007	-	-	<0.007	-	-	<0.007	-	-	<0.007	-	-	<0.007	-	-		-	-	<0.007	<0.007
Total Cyanide (Cn)*	**Cn mg/l**	**0.037**	<0.01	-	-	<0.01	-	-	<0.01	-	-	<0.01	-	-	<0.01	-	-	<0.01	-	-	<0.01	-	-		-	-	<0.01	<0.01
Iron (Fe)	**Fe mg/l**	**0.2** [1]	<0.02	0.018	0.019	<0.02	0.019	0.02	0.309	0.03	0.028	0.082	0.03	0.032	0.177	0.0441	0.0462	0.098	0.01365	0.0143	<0.02	0.0147	0.0154		0.0304	0.0319	0.122	0.109
Lead (Pb)	**Pb mg/l**	**0.018**	<0.005	-	-	<0.005	-	-	<0.005	-	-	<0.005	-	-	<0.005	-	-	<0.005	-	-	<0.005	-	-		-	-	<0.005	<0.005
Magnesium (Mg)	**Mg mg/l**	**50** [1]	15.6	22.73	23.82	13.0	19.08	19.99	27.0	29.23	30.62	37.6	51.07	53.5	14.6	18.76	19.66	19.7	25.074	26.268	23.8	21.95	23.001		23.247	24.354	17.2	29.0
Manganese (Mn)	**Mn mg/l**	**0.05** [1]	0.283	0.151	0.158	0.003	0.0294	0.0308	0.123	0.169	0.177	0.06	0.077	0.08	0.736	0.9135	0.957	0.094	0.0672	0.0704	0.046	0.0483	0.0506		0.391	0.4103	0.376	0.11
Nickel (Ni)	**Ni mg/l**	**0.015**	0.009	0.0116	0.0121	<0.002	0.042	0.044	<0.002	0.0021	0.0022	<0.002	0.063	0.066	<0.002	0.0105	0.011	<0.002	0.0105	0.011	<0.002	0.021	0.022		0.00525	0.0055	<0.002	<0.002
Mercury (Hg)	**Hg mg/l**	**0.00075**	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-		-	-	0.004	<0.001
Residue on Evaporation	**mg/l**	**-**	931	-	-	839	-	-	328	-	-	545	-	-	432	-	-	362	-	-	340	-	-		-	-	573	443
Sulphate (soluble) (SO4)	**SO4 mg/l**	**187.5**	133.17	-	-	130.31	-	-	40.04	-	-	69.18	-	-	44.98	-	-	47.05	-	-	21.95	-	-		-	-	42.98	62.63
Zinc (Zn)	**Zn mg/l**	**0.1** [1]	0.009	-	-	0.014	-	-	0.007	-	-	<0.003	-	-	<0.003	-	-	0.004	-	-	0.008	-	-		-	-	0.005	0.004
Boron (B)	**B mg/l**	**0.75**	0.031	-	-	0.032	-	-	0.068	-	-	0.084	-	-	0.039	-	-	0.041	-	-	0.031	-	-		-	-	0.035	0.075
Alkalinity (as CaCO3)	**CaCO3 mg/l**	**N-A-C**	974	-	-	376	-	-	304	-	-	410	-	-	834	-	-	304	-	-	308	-	-		-	-	412	330
Ortho Phosphate	**P04 mg/l**	**-**	<0.06	-	-	<0.06	-	-	<0.06	-	-	<0.06	-	-	<0.06	-	-	<0.06	-	-	<0.06	-	-		-	-	<0.06	<0.06

Threshold value = Groundwater regulations SI 9 of 2010

[1] = Where no threshold value exists results are compared to EPA I.G.V. from Table 3.1 of EPA document "Towards Setting Guideline Values for the protection of Groundwater in Ireland"

Shading = Value has exceeded threshold value

Shading = Value has exceeded the trigger/control value

* Laboratory level of Detection is above threshold value

Laboratory level of Detection is in excess of trigger/control value

Sampling was undertaken on the 21st August 2013.

N-A-C= No abnormal change

Analysis conducted by Jones Laboratories, UK

Marron Environmental

J102

Dunsink Landfill Annual Groundwater Quality Results, 21/08/2013
Volatile Organic Compounds

Compound	Unit	LOD	BH3	BH4	BH31	BH32	BH33	BH34N
Dichlorodifluoromethane	µg/l	<2	<2	<2	<2	<2	<2	<2
Chloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3
Vinyl chloride	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bromomethane	µg/l	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3
Trichlorofluoromethane	µg/l	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3
Dichloromethane	µg/l	<3	<3	<3	<3	<3	<3	<3
Methyl tertiary butyl ether (MTBE)	µg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
trans-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,1-Dichloroethane	µg/l	<3	<3	<3	<3	<3	<3	<3
cis-1,2-Dichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3
2,2-Dichloropropane	µg/l	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2
Chloroform	µg/l	<2	<2	<2	<2	<2	<2	<2
1,1,1-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2
1,1-Dichloropropene	µg/l	<3	<3	<3	<3	<3	<3	<3
Carbontetrachloride	µg/l	<2	<2	<2	<2	<2	<2	<2
1,2-Dichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2
Benzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,2-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2
Dibromomethane	µg/l	<3	<3	<3	<3	<3	<3	<3
Bromodichloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2
cis-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2
Toluene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
trans-1,3-Dichloropropene	µg/l	<2	<2	<2	<2	<2	<2	<2
1,1,2-Trichloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2
1,3-Dichloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2
Tetrachloroethene	µg/l	<3	<3	<3	<3	<3	<3	<3
Dibromochloromethane	µg/l	<2	<2	<2	<2	<2	<2	<2
1,2-Dibromoethane	µg/l	<2	<2	<2	<2	<2	<2	<2
Chlorobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2
1,1,1,2-Tetrachloroethane	µg/l	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m,p-Xylene	µg/l	<1	<1	<1	<1	<1	<1	<1
o-Xylene	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	µg/l	<2	<2	<2	<2	<2	<2	<2
Bromoform	µg/l	<2	<2	<2	<2	<2	<2	<2
Isopropylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,1,2,2-Tetrachloroethane	µg/l	<4	<4	<4	<4	<4	<4	<4
1,2,3-Trichloropropane	µg/l	<3	<3	<3	<3	<3	<3	<3
Bromobenzene	µg/l	<2	<2	<2	<2	<2	<2	<2
Propylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
2-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,3,5-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	µg/l	<3	<3	<3	<3	<3	<3	<3
tert-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,2,4-Trimethylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
sec-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
4-iso-Propyltoluene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,3-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,4-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
n-Butylbenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,2-Dichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,2-Dibromo-3-chloropropane	µg/l	<2	<2	<2	<2	<2	<2	<2
1,2,4-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3
Hexachlorobutadiene	µg/l	<3	<3	<3	<3	<3	<3	<3
1,2,3-Trichlorobenzene	µg/l	<3	<3	<3	<3	<3	<3	<3

Dunsink Landfill Annual Groundwater Quality Results, 21/08/2013

Semi-Volatile Organic Compounds

Compound	Unit	LOD	BH3	BH4	BH31	BH32	BH33	BH34N
1,2,4-Trichlorobenzene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
1,2-Dichlorobenzene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
1,3-Dichlorobenzene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
1,4-Dichlorobenzene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
2,4,5-Trichlorophenol (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-Trichlorophenol (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
2,4-Dichlorophenol (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-Dimethylphenol (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,6-Dinitrotoluene (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
2-Chloronaphthalene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
2-Chlorophenol (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
2-Methylnaphthalene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
2-Methylphenol (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Nitroaniline (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
2-Nitrophenol (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3-Nitroaniline (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
4-Bromophenylphenylether (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
4-Chloro-3-methylphenol (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chloroaniline (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
4-Chlorophenylphenylether (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
4-Methylphenol (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
4-Nitrophenol (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
4-Nitroaniline (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Azobenzene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthylene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Acenaphthene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Anthracene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bis(2-Chloroethyl)ether (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
bis(2-Chloroethoxy)methane (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
bis(2-Ethylhexyl) phthalate (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Benzo(a)anthracene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Butylbenzyl phthalate (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Benzo(bk)fluoranthene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Benzo(a)pyrene (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Benzo(g,h,i)perylene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbazole (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chrysene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibenzofuran (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Dibutyl phthalate (aq)	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Diethyl phthalate (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dimethyl phthalate (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
n-Dioctyl phthalate (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Fluoranthene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fluorene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Pentachlorophenol (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Phenol (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
n-Nitroso-n-dipropylamine (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachloroethane (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Nitrobenzene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Naphthalene (aq)	µg/l	<1	<1	<1	<1	<1	<1	<1
Isophorone (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorocyclopentadiene (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Phenanthrene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1,2,3-cd)pyrene (aq)	µg/l	<10	<10	<10	<10	<10	<10	<10
Pyrene (aq)	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Dunsink Landfill, Annual Groundwater Quality Results 21/08/2013 - Pesticides

Parameter (µg/l)	BH3	BH4	BH31	BH32	BH33	BH34N
Organochlorine Pesticides						
Aldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Alpha-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulphan I	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulphan II	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulphan Sulphate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Gamma-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor Epoxide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p'-DDT	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p,p'-TDE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Organophosphorous Pesticides	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Azinphos methyl	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Diazinon	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Disulfoton	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethyl Parathion	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl Parathion	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mervinphos	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Marron Environmental

J102-01

Dunsink Landfill - Groundwater Quality Results Q4 2013

Parameter	Unit	Threshold Value	BH3	BH3 Control Values	BH3 Trigger Values	BH4	BH4 Control Values	BH4 Trigger Values	BH16	BH16 Control Values	BH16 Trigger Values	BH27	BH27 Control Values	BH27 Trigger Values
pH	pH Units	**6.5 - 9.5** [1]	7.37	8	8.38	7.29	8.2	8.59	7.9	8.24	8.64	7.07	8.18	8.57
Conductivity	mS/cm	**1.875**	1.135	1.231	1.289	0.973	1.352	1.414	0.700	0.8379	0.8778	0.871	1.282	1.343
Temperature	°C	**-**	10.5	-	-	11.3	-	-	12.3	-	-	10.6	-	-
Ammoniacal Nitrogen	mg/l	**0.175**	<0.01	0.42	0.44	0.02	0.31	0.33	0.05	0.21	0.22	0.06	1.89	1.98
Total Organic Carbon	mg/l	**N-A-C**[1]	4	6.3	6.6	<2	6.3	6.6	4	6.3	6.3	<2	5.25	5.5

Parameter	Unit	Threshold Value	BH31	BH31 Control Values	BH31 Trigger Values	BH32	BH32 Control Values	BH32 Trigger Values	BH33	BH33 Control Values	BH33 Trigger Values	BH34N	BH34 Control Values	BH34 Trigger Values	BH35	BH35 Control Values	BH35 Trigger Values
pH	pH Units	**6.5 - 9.5**[1]	7.42	8.39	8.79	7.4	8.18	8.6	7.53	8.58	8.99	7.49	8.61	9.02	7.59	Control & Trigger values not yet determined	
Conductivity	mS/cm	**1.875**	0.681	0.791	0.828	0.639	1.227	1.286	0.591	0.852	0.892	0.749	0.998	1.045	0.695		
Temperature	°C	**-**	10.8	-	-	10.9	-	-	10.7	-	-	11.3	-	-	10.5		
Ammoniacal Nitrogen	mg/l	**0.175**	**0.29**	1.575	1.65	0.09	0.735	0.77	0.04	0.21	0.22	**0.47**	0.21	0.22	0.14		
Total Organic Carbon	mg/l	**N-A-C**[1]	**136**	8.4	8.8	<2	5.25	6	5	5.25	5.5	<2	6.3	6.6	<2		

Threshold value = Groundwater regulations SI 9 of 2010

[1] = Where no threshold value exists results are compared to EPA I.G.V. from Table 3.1 of EPA document "Towards Setting Guideline Values for the protection of Groundwater in Ireland"

Shading & Bold = Value has exceeded threshold value

Shading = Value has exceeded the Control Value

Shading = Value has exceeded Trigger Value

Sampled on 13th November 2013

Analysis conducted by Jones Environmental Laboratory

APPENDIX 2:

Surface Water and Leachate Monitoring Results

Dunsink Landfill - Surface Water Quality Results, Q1 2013

Parameter	Unit	SI 272 of 2009	Salmonid Regs	SW21	SW18	SW7	SW10	SW9	SW11	SW2	WWSW2	SW17
pH	pH Units	6-9 (note 1)	≥6≤9	7.72	7.6	7.91	7.81	8.21	7.86	7.82	7.62	7.76
Conductivity	mS/cm	1 (note 2)	-	0.720	0.950	0.950	0.980	0.400	0.910	0.78	0.87	0.85
Temperature	°C	-	<10°C*	10	9.6	6.3	7.0	7.4	7.9	7.6	8.5	7.2
Dissolved Oxygen	%	80-120% saturation	50%>9mg/l	**63.1**	**65.4**	**71.6**	**70.5**	**74.1**	**74.0**	**76.7**	**72.0**	**71.8**
Ammoniacal Nitrogen#	mg/l	0.14	<1	**1.16**	**0.76**	**0.34**	**0.26**	**0.17**	**1.89**	**0.2**	**0.15**	**0.42**
BOD	mg/l	<=1.5 mean (note 3)	5	**6**	**4**	2	2	1	1	1	1	2
Total Suspended Solids	mg/l	-	25	30	<10	<10	<10	125	13	55	<10	<10

SI 272 of 2009 = European Communities Environmental Objectives (Surface Water) Regulations 2009
Bold = Value has exceeded Surface Water Regulations
Salmonid Regs= European Communities (Quality of Salmonid Waters) Regulation , SI 293 of 1988.
Shading = Value has exceeded Salmonid Regulations
# Standard for Ionised Ammonia = <1, Ionised Ammonia= total ammonium x 1.28-Results stated should be converted before being compared to the standard.
*=Second Schedule of Salmonid Regulations states " temperature must not exceed 10 degrees celsius during the period from 1 November to 30 April where species which need cold water for reproduction are present
Note 1 : Hard water - >100mg/l CACO3
Note 2 : In the absence of a standard for conductivity under SI 272 of 2009 or the Salmonid Regulations SI 293 of 1988, a threshold value from SI 294 of 1989 (Quality of SW Intended for Abstraction of Drinking Water) has been used (1 mS/cm)
Note 3 : For waters achieving good status

Sampled on 13th February 2013

Analysis conducted by Jones Environmental Laboratory

Dunsink Landfill - Surface Water Quality Results, Q2 2013

Parameter	Unit	SI 272 of 2009	Salmonid Regs	SW21	SW18	SW7	SW10	SW9	SW11	SW2	WWSW2	SW17
pH	pH Units	6-9 (note 1)	≥6≤9	7.9	7.7	8.56	7.7	7.96	8.03	7.78	7.91	8.02
Conductivity	µS/cm	1,000 (note 2)	-	650	1090	790	950	900	940	940	810	930
Temperature	°C	-	<10°C*	11.3	10.0	11.2	11.5	14.4	9.0	11.2	10.0	10.0
Dissolved Oxygen	%	80-120% saturation	50%>9mg/l	**54.7**	**54.4**	**65.4**	**59.3**	**77.8**	**63.7**	**62.8**	**66.4**	**69.7**
Ammoniacal Nitrogen#	mg/l	0.14	<1	**0.21**	**0.16**	0.09	0.14	<0.03	0.03	0.05	<0.03	0.05
BOD	mg/l	<=1.5 mean (note 3)	5	**2**	**2**	**3**	1	**3**	<1	<1	<1	<1
Total Suspended Solids	mg/l	-	25	<10	<10	<10	<10	119	<10	<10	<10	<10

SI 272 of 2009 = European Communities Environmental Objectives (Surface Water) Regulations 2009
Bold = Value has exceeded Surface Water Regulations
Salmonid Regs= European Communities (Quality of Salmonid Waters) Regulation , SI 293 of 1988.
Shading = Value has exceeded Salmonid Regulations
# Standard for Ionised Ammonia = <1, Ionised Ammonia= total ammonium x 1.28-Results stated should be converted before being compared to the standard.
*=Second Schedule of Salmonid Regulations states " temperature must not exceed 10 degrees celsius during the period from 1 November to 30 April where species which need cold water for reproduction are present
Note 1 : Hard water - >100mg/l CACO3
Note 2 : In the absence of a standard for conductivity under SI 272 of 2009 or the Salmonid Regulations SI 293 of 1988, a threshold value from SI 294 of 1989 (Quality of SW Intended for Abstraction of Drinking Water) has been used (1 mS/cm)
Note 3 : For waters achieving good status

Sampled on 16th May 2013

Analysis conducted by Jones Environmental Laboratory

Dunsink Landfill Annual Surface Water Quality Results, 21st August 2013

Surface Water Results													
PARAMETER	UNIT	SI 272 of 2009	Salmonid	SW21	SW18	SW19	SW7	SW10	SW2	SW17	SW11	WWSW2	SW9 Dry
pH Value	units	6-9 (note 1)	6-9	7.26	7.5	7.5	7.21	7.58	7.85	8.01	7.35	7.7	Dry
Conductivity	mS/cm	1	-	0.564	0.763	0.753	0.350	0.700	0.738	0.768	**1.020**	0.758	
Ammonical Nitrogen as N	N mg/l	0.14	1	0.09	**0.16**	**0.23**	0.07	0.05	<0.03	0.04	0.06	0.04	
Dissolved Oxygen (O2)*	O2 mg/l	80-120% saturation	50% >9mg/l	8	8	9	9	9	9	9	9	9	
Chloride (Cl)	Cl mg/l	-	-	27.0	55.1	55.5	30.7	35.1	34.6	36.8	49.8	37	
Potassium (K)	K mg/l	-	-	3.0	3.0	2.9	1.9	3.1	2.4	2.2	2.0	1.8	
Sodium (Na)	Na mg/l	-	-	19.0	43.1	43.3	25.4	28.0	27.7	27.4	30.7	25.8	
COD	02 mg/l	-	-	16	16	18	23	17	21	23	30	16	
BOD	02 mg/l	<=1.5 mean (note 2)	5	<1	<1	<1	1	<1	<1	<1	**2**	<1	
Total Oxidised Nitrogen (water)	N mg/l	-	-	1.6	1.2	2.4	<0.2	1.0	0.7	1.0	<0.2	2.2	
Total Suspended Solids	mg/l	-	25	106	<10	<10	<10	<10	<10	<10	33	<10	
Calcium (Ca)	Ca mg/l	-	-	86.9	101	96.4	33.8	101.1	105.6	112.8	154.6	114.9	
Cadmium (Cd)	Cd mg/l	0.15	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Chromium (Cr)	Cr mg/l	0.0047	-	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	
Copper (Cu)	Cu mg/l	0.03 (Note 3)	-	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	
Iron (Fe)	Fe mg/l	-	-	<0.02	0.03	<0.02	0.037	<0.02	<0.02	<0.02	0.122	<0.02	
Lead (Pb)	Pb mg/l	0.0072	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Magnesium (Mg)	Mg mg/l	-	-	6.0	8.3	8.1	3.6	8.1	8.4	8.7	15.2	7.6	
Manganese (Mn)	Mn mg/l	-	-	0.064	0.107	0.23	0.027	0.043	0.014	0.074	0.269	0.017	
Nickel (Ni)	Ni mg/l	0.02	-	0.002	0.002	<0.002	<0.002	0.002	<0.002	<0.002	0.004	<0.002	
Mercury (Hg)	Hg mg/l	0.00005	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Sulphate (soluble) (SO4)	SO4 mg/l	-	-	66.12	85.7	83.46	33.35	78.91	82.4	89.44	95.88	97.07	
Zinc (Zn)	Zn mg/l	0.1	-	0.023	0.026	0.019	0.007	0.007	<0.003	0.004	0.007	0.005	
Alkalinity (as CaCO3)	CaCO3 mg/l	N-A-C	-	188	230	222	92	246	256	266	**1002**	246	
Boron (B)	B mg/l	-	-	0.028	0.035	0.34	0.022	0.049	0.047	0.045	0.072	0.044	
ortho - phosphate	PO4 mg/l	-	-	<0.06	<0.06	<0.06	<0.06	0.18	<0.06	<0.06	<0.06	<0.06	

Legend:
SI 272 of 2009 = European Communities Environmental Objectives (Surface Water) Regulations 2009
Bold = Value has exceeded Surface water Regulations
Salmonid Regs= European Communities (Quality of Salmonid Waters) Regulation, 1988
Shading = Value has exceeded Salmonid Water Quality Standard
Sampling was undertaken on 21st August 2013
Note 1 : Hard water - >100mg/l CACO3
Note 2 : For waters achieving good status
Note 3 : The standard of 0.005mg/l applies where hardness <100mg/l CACO3; 0.03mg/l applies where hardness >100mg/l CACO3
N-A-C= No abnormal change
* DO values are laboratory results

Marron Environmental
J102-01

Analysis conducted by Jones Laboratories, UK

Dunsink Landfill - Surface Water Quality Results, Q4 2013

Parameter	Unit	SI 272 of 2009	Salmonid Regs	SW21	SW18	SW7	SW10	SW9	SW11	SW2	WWSW2	SW17
pH	pH Units	6-9 (note 1)	≥6≤9	7.81	8.03	8.31	7.83	Dry	8.18	8.24	8.02	8.12
Conductivity	µS/cm	1,000 (note 2)	-	1020	1160	740	880	Dry	1000	860	870	850
Temperature	°C	-	<10°C*	12.5	11.7	7.0	9.7	Dry	7.5	8.8	10.2	9.7
Dissolved Oxygen	%	80-120% saturation	50%>9mg/l	**31.1**	**46.6**	**69.8**	**54.1**	Dry	**57.5**	**60.5**	**62.1**	**63.1**
Ammoniacal Nitrogen#	mg/l	0.14	<1	0.11	0.06	0.05	0.06	Dry	0.05	0.04	0.02	0.04
BOD	mg/l	<=1.5 mean (note 3)	5	<1	<1	<1	1	Dry	<1	**3**	<1	<1
Total Suspended Solids	mg/l	-	25	30	52	25	10	Dry	<10	<10	104	<10

SI 272 of 2009 = European Communities Environmental Objectives (Surface Water) Regulations 2009
Bold = Value has exceeded Surface Water Regulations
Salmonid Regs= European Communities (Quality of Salmonid Waters) Regulation , SI 293 of 1988.
Shading = Value has exceeded Salmonid Regulations
# Standard for Ionised Ammonia = <1, Ionised Ammonia= total ammonium x 1.28-Results stated should be converted before being compared to the standard.
*=Second Schedule of Salmonid Regulations states " temperature must not exceed 10 degrees celsius during the period from 1 November to 30 April where species which need cold water for reproduction are present
Note 1 : Hard water - >100mg/l CACO3
Note 2 : In the absence of a standard for conductivity under SI 272 of 2009 or the Salmonid Regulations SI 293 of 1988, a threshold value from SI 294 of 1989 (Quality of SW Intended for Abstraction of Drinking Water) has been used (1 mS/cm)
Note 3 : For waters achieving good status

Sampled on 13th November 2013

Analysis conducted by Jones Environmental Laboratory

Table 1: Water Quality Results -January 2013 to December 2013

Parameter	Unit	SI 272 of 2009	Salmonid Regs	SW21	SW21	SW21
				16/01/2013	13/02/2013	13/03/2013
pH	pH Units	6-9 (note 1)	≥6≤9	7.84	7.72	7.99
Conductivity	µS/cm	1 ,000 (note 2)	-	1,280	720	1,060
Temperature	°C	-	<10°C*	10.4	10.0	8.9
Ammoniacal Nitrogen	mg/l	0.14	<1	**3.68**	**1.16**	**2.31**

Parameter	Unit	SI 272 of 2009	Salmonid Regs	SW18	SW18	SW18
				16/01/2013	13/02/2013	13/03/2013
pH	pH Units	6-9 (note 1)	≥6≤9	7.63	7.6	7.2
Conductivity	µS/cm	1,000 (note 2)	-	1,310	950	1,300
Temperature	°C	-	<10°C*	9.6	9.6	9.9
Ammoniacal Nitrogen	mg/l	0.14	<1	**3.77**	0.76	**1.09**

Parameter	Unit	SI 272 of 2009	Salmonid Regs	SW17	SW17	SW17
				16/01/2013	13/02/2013	13/03/2013
pH	pH Units	6-9 (note 1)	≥6≤9	8.13	7.76	8.37
Conductivity	µS/cm	1 ,000 (note 2)	-	1,010	850	1,140
Temperature	°C	-	<10°C*	5.3	7.2	4.9
Ammoniacal Nitrogen	mg/l	0.14	<1	0.14	0.42	0.09

Salmonid Regs= European Communities (Quality of Salmonid Waters) Regulation , SI 293 of 1988.

Bold = Value has exceeded Salmonid Regulations

SI 272 of 2009 = European Communities Environmental Objectives (Surface Water) Regulations 2009

Shading = Value has exceeded S.I 272 of 2009

Italics = Field reading

*=Second Schedule of Salmonid Regulations states " temperature must not exceed 10 degrees celsius during the period from 1 November to 30 April where species which need cold water for reproduction are present

Note 1 : Hard water - >100mg/l CACO3

Note 2: Trigger Level for Surface Waters

Note 3 : For waters achieving good status

Analysis conducted by Jones Environmental Forensics Lasboratory Ltd.

Dunsink Landfill - Leachate Quality Results, Q1 2013

Parameter	Units	Leachate Sump	Lagoon
		13/02/2013	13/02/2013
pH	pH units	7.15	8.47
Conductivity	mS/cm	2.660	1.130
Temperature	°C	12.0	7.6
Ammoniacal Nitrogen#	mg/l	85.26	0.34
Dissolved Methane	mg/l	1.574	<0.001

Sampled on 13th February 2013

Analysis conducted by Jones Environmental Laboratory

Dunsink Landfill - Leachate Quality Results, Q2 2013

Parameter	Units	Leachate Sump	Lagoon
		16/05/2013	16/05/2013
pH	pH units	7.29	9.29
Conductivity	µS/cm	4,360	1480
Temperature	°C	13.9	12.1
Ammoniacal Nitrogen#	mg/l	162.78	6.12
Dissolved Methane	mg/l	1.013	<0.001

Sampled on 16th May 2013

Analysis conducted by Jones Environmental Laboratory

Dunsink Landfill Annual Leachate Results, 21st August 2013

Leachate Monitoring			
PARAMETER	**UNIT**	**Lagoon**	**Leachate Sump**
pH Value	units	7.92	7.23
Conductivity	mS/cm	3.518	4.949
Ammonical Nitrogen as N	N mg/l	118.32	234.1
Dissolved Methane	CH4 mg/l	0.052	1.431
Chloride (Cl)	Cl mg/l	483.4	584.1
Potassium (K)	K mg/l	152.2	176.4
Sodium (Na)	Na mg/l	362.6	406.7
COD	02 mg/l	284	196
BOD	02 mg/l	62	9
Total Oxidised Nitrogen (water)	N mg/l	1.5	0.2
Calcium (Ca)	Ca mg/l	81.5	169.4
Cadmium (Cd)	Cd mg/l	<0.0005	<0.0005
Chromium (Cr)	Cr mg/l	0.0017	0.0018
Copper (Cu)	Cu mg/l	<0.007	<0.007
Fluoride (F)	F mg/l	<0.3	0.4
Iron (Fe)	Fe mg/l	0.234	4.837
Lead (Pb)	Pb mg/l	<0.005	<0.005
Magnesium (Mg)	Mg mg/l	49.5	62.8
Manganese (Mn)	Mn mg/l	0.377	0.829
Nickel (Ni)	Ni mg/l	0.03	0.029
Mercury (Hg)	Hg mg/l	<0.001	<0.001
Sulphate (soluble) (SO4)	SO4 mg/l	44.87	38.85
Zinc (Zn)	Zn mg/l	0.004	0.011
Boron (B)	B mg/l	1.334	1.41
ortho-phosphate	PO4 mg/l	<0.06	<0.06

Analysis conducted by Jones Laboratories, UK

Marron Environmental

J102-01

Dunsink Landfill - Leachate Quality Results, Q4 2013

Parameter	Units	Leachate Sump	Lagoon
		13/11/2013	13/11/2013
pH	pH units	7.31	9.0
Conductivity	µS/cm	3,170	2,160
Temperature	°C	11.2	7.1
Ammoniacal Nitrogen#	mg/l	122.22	4.16
Dissolved Methane	mg/l	3.333	<0.001

Sampled on 13th November 2013

Analysis conducted by Jones Environmental Laboratory

APPENDIX 3:

Pollution Release and Transfer Register

Environmental Protection Agency

Guidance to completing the PRTR workbook

AER Returns Workbook

Version 1.1.18

REFERENCE YEAR	2013

1. FACILITY IDENTIFICATION

Parent Company Name	Fingal County Council
Facility Name	Dunsink Landfill aka Dunsink Civic Amenity
PRTR Identification Number	W0127
Licence Number	W0127-01

Waste or IPPC Classes of Activity

No.	class_name
4.4	Recycling or reclamation of other inorganic materials.
3.4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
4.11	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.
4.13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.
4.2	Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological transformation processes).
4.3	Recycling or reclamation of metals and metal compounds.
4.9	Use of any waste principally as a fuel or other means to generate energy.
Address 1	Dunsink Lane
Address 2	Finglas
Address 3	County Dublin
Address 4	
	Dublin
Country	Ireland
Coordinates of Location	-6.33899 53.3903
River Basin District	IEEA
NACE Code	3832
Main Economic Activity	Recovery of sorted materials
AER Returns Contact Name	Alain Kerveillant
AER Returns Contact Email Address	alain.kerveillant@fingal.ie
AER Returns Contact Position	Assistant Scientist / Landfill Manager
AER Returns Contact Telephone Number	01-8708461
AER Returns Contact Mobile Phone Number	087-9915832
AER Returns Contact Fax Number	none
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
50.1	General
50.1	General

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

Is it applicable?	No
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

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

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

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

4.1 RELEASES TO AIR Link to previous years emissions data | PRTR# : W0127 | Facility Name : Dunsink Landfill aka Dunsink Civic Amenity | Filename : W0127_2013.xls | Return Year : 2013 | 31/03/2014 11:36

SECTION A : SECTOR SPECIFIC 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 B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs				
POLLUTANT		METHOD					QUANTITY		
			Method Used		Flare	Engine			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
01	Methane (CH4)	C	OTH	total methane estimated generated minus utilised/flared	102.0	15396.78	941095.5	0.0	925596.72
03	**Carbon dioxide (CO2)**	C	OTH	GAS SIM data from RPS	5431.75	1446889.85	7163907.8	0.0	5711586.2

* 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					
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

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: Dunsink Landfill aka Dunsink Civic Amenity

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)	1700548.45	C	other	GAS SIM data from RPS	N/A	
Methane flared	5011.0	E	other	Data provided by Bioverda -	2500.0	(Total Flaring Capacity)
Methane utilised in engine/s	754442.0	E	other	Data provided by Bioverda -	0.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	941095.0	C	c	Total generated - flared - util	N/A	

4.2 RELEASES TO WATERS

Link to previous years emissions data

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

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

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

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

SECTION B : REMAINING PRTR POLLUTANTS

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

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

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

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

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

ity

4.3 RELEASES TO WASTEWATER OR SEWER

Link to previous years emissions data

| PRTR# : W0127 | Facility Name : Dunsink Landfill aka Dunsink Civic Amenity | Filename : W0127_: 31/03/2014 11:36

SECTION A : PRTR POLLUTANTS

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

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

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

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

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

4.4 RELEASES TO LAND

Link to previous years emissions data

SECTION A : PRTR POLLUTANTS

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

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

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

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

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

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE | PRTR# : W0127 | Facility Name : Dunsink Landfill aka Dunsink Civic Amenity | Filename : W0127_2013.xls | Return Year : 2013 | 31/03/2014 11:36

Please enter all quantities on this sheet in Tonnes 3

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	19 07 03	No	139163.0	landfill leachate other than those mentioned in 19 07 02	D9	M	Volume Calculation	Offsite in Ireland	Dublin City Council Waste Water Treatment Facility,D0034-01	.,Ringsend,Dublin 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