



**ANNUAL ENVIRONMENTAL REPORT**

**FOR**

**MARLINSTOWN LANDFILL**

**2008**

**WASTE LICENCE NO. W0071-02**

**Prepared By: -**

Environment Section,  
Westmeath County Council,  
County Buildings,  
Mullingar,  
Co. Westmeath.

**26 January 2009**

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**30th January 2009**

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# TABLE OF CONTENTS

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## PAGE

<b>1. INTRODUCTION</b> .....	<b>1</b>
<b>2. SITE DESCRIPTION</b> .....	<b>2</b>
2.1 WASTE MANAGEMENT ACTIVITIES .....	2
2.2 TOTAL QUANTITY OF WASTES ACCEPTED.....	2
2.3 CALCULATED REMAINING CAPACITY OF THE SITE .....	2
2.3.1 <i>Waste Deposition</i> .....	2
2.4 LOCAL ENVIRONMENTAL CONDITIONS.....	3
2.4.1 <i>Meteorological Report</i> .....	3
<b>3. Emission Monitoring &amp; Control</b> .....	<b>4</b>
3.1 GROUNDWATER.....	4
3.1.1 <i>Site Geology &amp; Hydrogeology</i> .....	4
3.1.2 <i>Monitoring Locations</i> .....	4
3.1.3 <i>Monitoring Programme</i> .....	5
3.1.3.1 <i>Groundwater Levels</i> .....	5
3.1.3.2 <i>Groundwater Quality</i> .....	5
3.1.4 <i>Estimated Annual and Cumulative Quantity of Emissions to Groundwater</i> .....	6
3.1.5 <i>Control Measures</i> .....	7
3.2 SURFACE WATER QUALITY MONITORING .....	7
3.2.1 <i>Monitoring Locations</i> .....	7
3.2.2 <i>Monitoring Programme</i> .....	7
3.2.3 <i>Control Measures</i> .....	8
3.3 LEACHATE .....	9
3.3.1 <i>Monitoring Locations</i> .....	9
3.3.2 <i>Monitoring Programme</i> .....	9
3.3.2.1 <i>Leachate Levels</i> .....	9
3.3.2.2 <i>Leachate Quality</i> .....	9
3.3.3 <i>Leachate Volumes</i> .....	10
3.3.4 <i>Control Measures</i> .....	11
3.4 LANDFILL GAS.....	12
3.4.1 <i>Monitoring Locations</i> .....	12
3.4.2 <i>Monitoring Programme</i> .....	13
3.4.3 <i>Landfill Gas Volumes</i> .....	13
3.5 NOISE SURVEY .....	16
3.6 DUST MONITORING.....	16
<b>4. SITE DEVELOPMENT WORKS</b> .....	<b>17</b>
4.1 ENGINEERING WORKS UNDERTAKEN DURING THE REPORTING PERIOD.....	17
4.2 SITE RESTORATION.....	17
4.3 SITE SURVEY .....	17
4.4 FUTURE DEVELOPMENTS .....	18
4.5 RESOURCE CONSUMPTION .....	18
4.6 SEPTIC TANK MAINTENANCE .....	18
<b>5. Environmental incidents and complaints</b> .....	<b>19</b>
5.1 INCIDENTS .....	19
5.2 REGISTER OF COMPLAINTS .....	19
<b>6. Environmental Management Programme Report</b> .....	<b>20</b>
6.1.1 <i>Project 1 – Environmental Management System (EMS)</i> .....	20
6.1.2 <i>Project 2 – Leachate Collection</i> .....	21
6.1.3 <i>Project 3 – Surface Water Management</i> .....	21
6.1.4 <i>Project 4 – Restoration of Landfill Areas</i> .....	21
<b>7. OTHER REPORTS</b> .....	<b>23</b>
7.1 RESTORATION AND AFTERCARE PROGRAMME.....	23
7.2 SURFACE WATER MANAGEMENT PLAN.....	24

7.3	LEACHATE MANAGEMENT PLAN .....	24
7.4	GAS RISK ASSESSMENT .....	25
7.5	LANDFILL GAS FLARING.....	25
7.6	ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) DOCUMENTATION .....	25
7.7	FINANCIAL PROVISION.....	26

<b>APPENDIX 1</b>	-	Meteorological Report
<b>APPENDIX 2</b>	-	Groundwater
<b>APPENDIX 3</b>	-	Surface Water
<b>APPENDIX 4</b>	-	Leachate
<b>APPENDIX 5</b>	-	Landfill Gas
<b>APPENDIX 6</b>	-	Dust
<b>APPENDIX 7</b>	-	Topographical Site Survey

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## 1. INTRODUCTION

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This is the eighth Annual Environmental Report (AER) for Marlinstown Landfill, Mullingar, County Westmeath, which is operated by Westmeath County Council (Council). The AER is prepared in response to Schedule E of Waste Licence W0071-02 issued to the Council by the Environmental Protection Agency (Agency) on 9<sup>th</sup> January 2004.

The AER describes the site activities for the period from 1<sup>st</sup> January 2008 to 31<sup>st</sup> December 2008 and complies with the Agency's direction that the reports should be submitted within one month of the end of the reported year. The content of the AER is based on Schedule G of the Waste Licence W0071-02.

It should be noted that disposal of all waste at Marlinstown Landfill ceased on the 31<sup>st</sup> December 2002 in accordance with Waste Licence (W0071-01). Recycling at Marlinstown and the acceptance of Household Waste from private vehicles for transport off-site for disposal at Ballydonagh Landfill, Athlone, Co. Westmeath, ceased on the 13<sup>th</sup> January 2007.

The facility address is: -

Marlinstown Landfill,  
Marlinstown Bog,  
Mullingar,  
County Westmeath.

The Council's Address is: -

Westmeath County Council,  
County Buildings,  
Mullingar,  
County Westmeath.

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## **2. SITE DESCRIPTION**

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### **2.1 Waste Management Activities**

Westmeath County Council ceased accepting waste for disposal off-site and recycling at the Civic Waste Facility on January 13<sup>th</sup> 2007.

### **2.2 Total Quantity of Wastes Accepted**

There was no waste accepted at Marlinstown Landfill in 2008. No Inert Cover Material was accepted at the site as a stockpile from previous years is available on-site for future restoration works.

### **2.3 Calculated Remaining Capacity of the Site**

The landfill had been in operation between 1963 and the 31<sup>st</sup> December 2002. The facility occupies an area of some 9 ha (22 acres). It is estimated that the total volume of waste disposed at the site was approximately 461,500 tonnes. The remaining capacity for the landfill is zero.

#### *2.3.1 Waste Deposition*

Waste deposition is not taking place at the facility as the final capping has been placed on the landfill. Waste was placed in a manner to facilitate the achievement of the proposed restoration profile of the site. In the areas where filling was required to achieve the required grade the waste was placed and a bulldozer was used to level and compact the soil/subsoil in layers.

## **2.4 Local Environmental Conditions**

### *2.4.1 Meteorological Report*

A meteorological report for the period January to December 2008 for the meteorological station at Mullingar is included in Appendix 1. The report includes daily rainfall, air temperature, wind (speed and direction), relative humidity, barometric pressure, monthly evaporation and potential evapotranspiration totals.

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### **3. EMISSION MONITORING & CONTROL**

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The Council carries out an environmental monitoring programme at the facility to assess the significance of emissions from site activities. The monitoring programme includes groundwater, surface water, landfill gas, leachate and dust. With the agreement of the EPA the requirement to monitor noise is no longer necessary. The results of all monitoring carried out in the reporting period have been submitted to the Agency. An overview of the monitoring results for the reporting period, and comparisons with previous monitoring results, are presented in this section. The results are discussed in the context of the impact of the emissions on the environment and compared with available data on background and or ambient conditions.

#### **3.1 Groundwater**

##### *3.1.1 Site Geology & Hydrogeology*

The subsurface at the site is composed of peat, which ranges in thickness from 1 metre (m) in the North West of the site to 8.5 m in the north east of the site. The peat is underlain by glacial tills ranging in thickness from 4.3 m to 19.7 m. In the north of the site there is 10m thickness of coarse gravels. The overburden overlies the bedrock, which comprises Waulsortian limestones, basinal limestones and mudstones of the Tobercolleen formation.

The basinal limestones underlying the western half of the site and the Waulsortian limestones underlying the south-eastern corner of the site are classed as a 'locally important aquifer-generally moderately productive'. The mudstones underlying the eastern part of the site are classified as a 'poor aquifer-generally unproductive except for local zones'.

The groundwater flow in both formations is generally from the southwest to the northeast. There is local mounding of the shallow groundwater beneath the landfill.

##### *3.1.2 Monitoring Locations*

The Council monitors groundwater quality in ten (10) monitoring wells in the general vicinity of the site. The wells are located in the overburden and the bedrock aquifers up and down gradient of the site. The well locations are shown on Figure 1 in Appendix 2.

Wells BH31 (D) and BH32 (S) are up gradient of the site on the opposite side of the Mullingar bypass. BH2 (S) and BH1 (D) although located up gradient are considered to



be within the zone of influence of the landfill due to proximity and the effect of localised mounding of the shallow groundwater beneath the landfill.

The perimeter wells BH9 (D) and BH10 (S) were damaged during the construction works and were replaced by BH3 (D) and BH4 (S) for monitoring purposes. BH3 (D) and BH4 (S) just like BH9 (D) and BH (10) and are considered as down gradient due to the localised mounding of the shallow groundwater beneath the site. These wells BH3 (D) and BH4 (S) are along the site boundary.

Wells BH 13 (D), BH14 (S), BH15 (D) and BH16 (S) are all down gradient and located at some distance from the site.

### *3.1.3 Monitoring Programme*

Groundwater levels are monitored at monthly intervals. Water quality is monitored at quarterly and annual intervals for a range of different parameters. The range of analysis is as specified in Schedule D (table D.5.1) of the Waste Licence and includes pH, electrical conductivity, organic, inorganic and metals/ non-metals parameters. The sampling and analysis is carried out in accordance with recognised quality assurance and control procedures.

The full details of all the monitoring events including the sampling techniques, analytical methods and results are included in the monitoring reports submitted to the Agency. Summary tables of all of the data, graphs of indicator parameters and National Grid co-ordinates for each location are included in Appendix 2.

#### *3.1.3.1 Groundwater Levels*

The groundwater level data confirm the direction of groundwater flow in both the overburden and the bedrock is locally generally northwards, and that there is localised mounding in the overburden in the area of the site.

#### *3.1.3.2 Groundwater Quality*

The monitoring data for the up gradient wells BH31 (D) and BH32 (S) indicate good quality water with little variation throughout the year. One high result for Ammonia (0.33mg/l N) occurred in Quarter 3 (exceeding the Drinking Water Quality Standard <0.23mg/l N, Table C of the Drinking Water Regs, 2000). All the other results were less than 0.07mg/l N. Chloride was detected in the range of 6 to 17 mg/l which is close to the typical value in Irish groundwater of 20mg/l Cl and well below the concentrations extracted from the E.C. (Drinking Water) Regulations, 2000 SI No. 439 of 2000, of 250 mg/l Cl).

The water quality was also good in up gradient wells BH1 (D) and BH2 (S). The ammonia levels in both wells were less than 0.025mg/l N and the Chloride levels were in the range 15 to 95mg/l Cl. The Chloride results are better than those

recorded in 2007 and may indicate the landfill is not impacting on this location as appeared to be the case previously.

The data for the perimeter wells BH3 (D) and BH4 (S) indicate an improvement on previous years. There were 2 high readings in shallow well BH4 for the ammonia, 0.427mg/L N in Quarter 2 and 6.74mg/l N in Quarter 4. All the other figures were less than 0.02mg/l N. The chloride figures were low, in the range of 10 to 30mg/l CL. There is some impact on the overburden from the site leachate at this location.

In the down gradient locations the poorest quality water is in the deep well BH13 with ammonia levels on 3 of the 4 monitoring occasions in the range of 0.312 to 6.58mg/l N. The chloride levels are in the range of 19 to 33mg/l Cl, close to the typical level of 20mg/l for Irish ground waters. The shallow well BH14 has lower levels of ammonia, in the range of 0.02 to 3.2mg/l N, than the nearby deep well BH13. The chloride values at BH14 (S) are all less than 20mg/l Cl.

At the other down gradient locations of BH15 (D) and BH16 (S) there are some relatively poor readings in relation to ammonia, 2.35 and 0.737mg/l N respectively in Quarter 4. All the other readings were less than 0.23mg/l N. The chloride readings followed a similar pattern for BH16 (S) with a high level of 185mg/l Cl in Quarter 4. Overall the water quality in the down gradient locations shows a slight improvement on the 2007 figures.

#### *3.1.4 Estimated Annual and Cumulative Quantity of Emissions to Groundwater*

The site is not provided with an engineered lining system but a leachate collection lagoon and collection sumps have been constructed and are operating. Leachate is being collected and tankered off-site for treatment. However, there is the potential for the direct discharge of leachate to groundwater. The groundwater quality-monitoring programme has confirmed that leachate is impacting on groundwater quality.

There are two distinct water-bearing formations beneath the site. The uppermost formation is the peat and glacial tills. The bedrock underlying the tills forms the lower formation. It is considered likely that leachate discharges directly to the upper water bearing formation. However, the thickness and low permeability of the tills retards and attenuates the discharge to the bedrock formation.

Leachate also discharges to the site surface water drainage system. Surface water is a potential source of groundwater recharge and as such provides a possible pathway for indirect discharge to groundwater. It is not possible, based on the available information to estimate the recharge contribution of the surface water drainage system to the groundwater beneath the site.

Estimates of the volumes of leachate generated at the site are discussed in Section 3.3.3. It is not possible based on the available information to quantify the volumes of leachate discharged directly or indirectly to groundwater.

### *3.1.5 Control Measures*

The Council has prepared surface water management, leachate management and restoration and aftercare plans for the site that are designed to mitigate the impact on groundwater quality. Details of the plans are included in Section 6. The works on the restoration programme Phase I Final Capping are completed and construction of the leachate lagoon and leachate collection system have taken place, details of which have been submitted to the Agency. Phase 2 Capping contract works due to cover the old recycling centre area have been stalled due to access difficulties at the site.

## **3.2 Surface Water Quality Monitoring**

Surface water from the site drains to the Marlinstown stream. The stream is fed by numerous bog drains. The main stream draining the site runs from east to west along the southern boundary before turning north through the western part of the site. It turns west and flows along the northern boundary for a short distance before turning northwards again. The stream swings eastwards and flows for approximately 2.6 km to join the Riverstown River. The Riverstown River is a tributary of the River Deel which itself is a tributary of the Boyne.

### *3.2.1 Monitoring Locations*

The Council monitors surface water quality in 4 locations (SW1, SW2, SW3 and SW5) as shown on Figure 1 in Appendix 3. SW1 and SW2 are located on drains upstream of the site SW5 is on the Marlinstown Stream immediately downstream of the site. SW3 is also located on the Marlinstown stream approximately 0.7 km downstream of the site.

### *3.2.2 Monitoring Programme*

The monitoring is conducted at weekly, quarterly and annual intervals in accordance with Licence conditions and includes weekly visual inspections and monthly in situ and laboratory testing. The range of analysis is as specified in Schedule D.5.1 of the Waste Licence and includes dissolved oxygen, pH, electrical conductivity, and organic and inorganic parameters.

The sampling and analysis is carried out in accordance with recognised quality assurance and control procedures. The detailed monitoring results are presented in the quarterly monitoring reports submitted to the Agency in the reporting period. Summary tables of all of the data, graphs of indicator parameters for each monitoring location are included in Appendix 3.

The sampling point SW1 is upstream on a small drain flowing towards the Landfill from the south. The flow is generally low and in summer it can be stagnant. The water at this point is of poorer quality than at any of the other sites. This may be accounted for by the low flow, the sometimes stagnant nature of the drain, and the unavoidable disturbance of solids when taking the sample. The high readings in Quarter 2 (June) of ammonia (83.1mg/l N), suspended solids (242mg/l) and chloride (215mg/l) were taken when the drain was stagnant. The sampling point SW2, located on the stream west of the site, is a more representative example of upstream water. It has a steady flow throughout the year. The water quality is satisfactory and complies with A2 values as set out in the EC (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1988[S.I. No. 294 of 1989]. The quality would reach A1 standards were it not for the ammonia levels which ranged from 0.2 to 0.67mg/l.

The water quality at SW5 immediately downstream of the Landfill is of a lesser quality than upstream at SW2, and reflects the impact of the Landfill leachate. Ammonia levels were in the range of 1.45 to 6.17mg/ and chloride levels were in the range of 32 to 48mg/l Cl. The suspended solids (SS) was particularly high in Quarter 2 at 54mg/l compared to levels of less than 7mg/l on the other 3 sampling occasions. The further downstream surface water location SW3 is broadly similar in quality to SW5. The parameters ammonia (ranging from 0.7 to 5.37mg/l N) and chloride (23 to 75mg/l Cl) are the most indicative of the quality of the water. The improvement noted on previous years in the downstream sample locations did not continue in 2008.

The annual monitoring event included a comprehensive range of organic and inorganic compounds, including those parameters specified in the Water Quality (Dangerous Substances) Regulations 2001. Heavy metals concentration for all the points are below the respective limits of detection with the exception of chromium at SW1, SW2 and SW5 with concentration levels of 0.02, 0.11 and 0.007mg/l respectively. All the organic compounds analysed were found to be below their limit of detection.

### 3.2.3 *Control Measures*

The Council recognises the impact of the site on surface water quality and has prepared surface water management plans, which in conjunction with the works set out in the leachate management and site restoration and aftercare plans, will effectively mitigate the impact of the site on surface water quality. The Council has completed Phase I Final Capping of the restoration plans and this has included the leachate lagoon and combined leachate /gas extraction system. The final capping has been placed on the landfill and this will reduce the ingress of water into the waste and effectively reduce the amount of leachate produced. Leachate is being pumped from the landfill and tankered off-site for treatment. Phase II capping contract works due to cover the old recycling centre area have been stalled due to access difficulties at the site.

### **3.3 Leachate**

Leachate is a contaminated liquid generated when waste comes into contact with water. The sources of the water typically include rainfall, surface water runoff and groundwater. At Marlinstown the primary source of leachate generation is rainfall. There may be limited surface water infiltration around the margins of the waste.

#### *3.3.1 Monitoring Locations*

A total of six leachate collection wells were installed in the landfill mass during initial site investigations in 1998 and 1999. These six monitoring boreholes were identified as (BH21 to BH26 inclusive). Due to landfill works up to and during 2004 BH23, BH24 and BH25 became inaccessible. Because of this five new boreholes were drilled and identified as BH27-BH31 inclusive. These were monitored during 2004 and part of 2005. After all the Phase 1 Capping works were completed BH21 and BH22 were the only remaining boreholes of the original network. Gas Extraction Wells GEW31, GEW28, GEW25, GEW23, GEW18 and GEW20 have been identified for sampling and taking weekly levels of Leachate. Due to damage to the well pipes both GEW18 and GEW31 cannot be monitored.

#### *3.3.2 Monitoring Programme*

Leachate levels are monitored weekly. Leachate quality is monitored at quarterly and annual intervals for a range of different parameters. The range of analysis is as specified in Schedule D.5.1 of the Waste Licence and includes pH, electrical conductivity, and organic, inorganic and microbiological parameters. The sampling and analysis is carried out in accordance with recognised quality assurance and control procedures.

The full details of all the monitoring events including the sampling techniques, analytical methods and results are included in the monitoring reports submitted to the Agency. Summary tables of all of the data for each location are included in Appendix 4.

##### *3.3.2.1 Leachate Levels*

The level monitoring did not identify any significant fluctuations in leachate levels during the year. Levels in GEW18 and GEW31 could not be determined due to pipe damage of the wells.

##### *3.3.2.2 Leachate Quality*

Leachate samples were collected from the accessible boreholes during the monitoring events in 2008 (only three sampling locations specified in the Licence; BH21, GEW20 and the Leachate Lagoon). The samples were analysed for the range of organic and inorganic parameters defined in the Waste Licence. The results are consistent with leachate generated at a municipal waste landfill in

various stages of the waste degradation lifecycle. The COD ranged from a low of 427mg/l at GEW23 to a high of 1120mg/l at GEW28. The Ammonia levels were in the range of 36.6 to 1730mg/l N while the Chloride ranged from a low of 23mg/l Cl to a high of 2200mg/l Cl. The leachate at the Lagoon, which is taken to Mullingar WWTP, fell into the lower end of the ranges for the various parameters; COD – 526mg/l, Ammonia – 150mg/l N and Chloride – 400mg/l. In regard to the metal analysis Mercury concentrations were below the level of detection while Cadmium was detected in one location; GEW20, at a level of 0.011mg/l. Chromium and Lead were detected in all samples. The highest concentration of Chromium was found at GEW23 (0.15mg/l) and the highest level of Lead was at GEW20 (0.4mg/l). Analyses for List I/II organic compounds were determined for samples at BH21 and Lagoon. All parameters were below the limit of detection.

### 3.3.3 Leachate Volumes

Water balance calculations have been prepared for the period January to December 2008. The calculations include a cumulative total for the twelve-month period. These calculations will form the basis for the estimation of cumulative totals over the lifetime of the landfill, which will be reported in future AERs.

The water balance calculates the volume of leachate generated at the site on a monthly basis based solely on rainfall data. It was considered that the potential for surface water infiltration was insignificant. The water balance methodology is described below and the calculations shown on Table 3.2 and 3.3

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

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

Lo	= leachate produced (m <sup>3</sup> )
ER	= effective rainfall (m) (Use actual rainfall (R) for active cells)
A	= area of cell (m <sup>2</sup> )
LW	= liquid waste (also includes excess water from sludges) (m <sup>3</sup> )
IRCA	= infiltration through restored and capped areas (m)
l	= surface area of lagoon (m <sup>2</sup> )
a	= absorptive capacity of waste (m <sup>3</sup> /t)
W	= weight of waste deposited (t/a)

The meteorological data used was from the meteorological station at Mullingar. Given the history of filling at the site the entire site was included in the calculations. Meteorological data is presented in Appendix 1.

Where the evapotranspiration rate was higher than the total rainfall a conservative zero effective rainfall was assumed. In the restored area (70,000 m<sup>2</sup>) the infiltration rate of the rainfall was assumed at zero due to the permanent capping being completed on this area of the landfill in March 2005, which is in accordance with the EPA Landfill Site Design Manual. In the unrestored area (20,000 m<sup>2</sup> approx) a conservative estimate of 25% of the annual rainfall figure was used to calculate the infiltration in the temporary capped area. The Civic amenity area does not form part of the temporary capped area

for calculation purposes as it is paved. The 20,000 m<sup>2</sup> covers the area from the civic amenity area to the entrance gate.

The estimated volume of leachate generated for the reporting period is 2621 m<sup>3</sup> (Table 3.2). Cumulative annual figures are given in Table 3.3. The quantity of leachate removed off site for treatment in the reporting period is shown in Table 3.1 below.

**2008 Leachate Volumes Removed from Site. Table 3.1**

<b>Month</b>	<b>Volume of Leachate Removed (m<sup>3</sup>)</b>
January	91
February	520
March	273
April	182
May	182
June	0
July	273
August	273
September	455
October	273
November	52
December	208
<b>Total</b>	<b>2782</b>

#### 3.3.4 Control Measures

The Council has prepared and implemented a leachate management plan for the site, which in conjunction with the surface water management and restoration and aftercare plans, is designed to minimise the future generation of leachate and to mitigate the impact on surface and ground water quality. Work on Phase I Final Capping contract was completed in 2005. Phase 2 Capping contract works to cover the old recycling centre area have been stalled due to access problems at the site.

**Table 3.2: 2008 Annual Leachate Volume Calculations**

Month	Restored Area (m <sup>2</sup> )	Unrestored Area (m <sup>2</sup> )	Actual Rainfall (m)	Effective Rainfall (m) ER	(1)Infiltration Through Restored Area (m <sup>3</sup> ) IRCA	(2)Infiltration Through Unrestored Area (m <sup>3</sup> ) IRCA	Weight of Waste Deposited (Tonnes) W	Leachate Produced (m <sup>3</sup> ) Lo
January	70,000	20,000	0.1343	0.1148	0.00	574.00	0.0	574.00
February	70,000	20,000	0.0543	0.0325	0.00	162.50	0.0	162.50
March	70,000	20,000	0.0923	0.0615	0.00	307.50	0.0	307.50
April	70,000	20,000	0.0591	0.0078	0.00	39.00	0.0	39.00
May	70,000	20,000	0.0234	0.0000	0.00	0.00	0.0	0.00
June	70,000	20,000	0.0847	0.0115	0.00	57.50	0.0	57.50
July	70,000	20,000	0.1089	0.0381	0.00	190.50	0.0	190.50
August	70,000	20,000	0.1544	0.0982	0.00	491.00	0.0	491.00
September	70,000	20,000	0.1047	0.0648	0.00	324.00	0.0	324.00
October	70,000	20,000	0.1242	0.1021	0.00	510.50	0.0	510.50
November	70,000	20,000	0.0756	0.0655	0.00	327.50	0.0	327.50
December	70,000	20,000	0.0613	0.0544	0.00	272.00	0.0	272.00
<b>Total</b>				<b>0.6512</b>	<b>0</b>	<b>3,256</b>		<b>3256.00</b>

**Notes:**

(1) The 70,000 m<sup>2</sup> Restored Area was permanently capped by the end of March 2005 so the infiltration rate since from the rainfall is 0.

(2) Effective rainfall figures, at a 25% infiltration rate, were used to calculate the infiltration through the unrestored fill area.

**Table 3.3 - 2008 Cumulative Leachate Volume Calculations**

Year	Active Area (m <sup>2</sup> )	Active area infiltration (m <sup>3</sup> )	Waste inputs tonnes	Restored area (m <sup>2</sup> )	Rest. area infiltration (m <sup>3</sup> )	Unrestored area (m <sup>2</sup> )	Unrest. area infiltration (m <sup>3</sup> )	Total Water (m <sup>3</sup> )	Cumulative water (m <sup>3</sup> )	Absorptive Capacity input (m <sup>3</sup> )	Cumulative Absorptive Capacity (m <sup>3</sup> )	Total Volume Sludge	Cumulative Volume Sludge (tonnes)	Annual Leachate (m <sup>3</sup> )	Cumulative Leachate (m <sup>3</sup> )
2001	2000	1330	30058.2	8000	639	80000	25576	29948	29948	1803	1803	2402	2402	28144	28144
2002	2000	2425	32383.7	8000	1614	80000	64551	68606	98554	1943	3747	15	2417	66663	94807
2003	0	0	0	70000	5493	0	0	5493	104047	0	3747	0	0	5493	100300
2004	0	0	0	70000	7317	0	0	7316.75	111364	0	3747	0	0	7316.75	107617
2005	0	0	0	70000	3210	20,000	2583	5793	117157	0	3747	0	0	5793	113410
2006	0	0	0	70000	0	20,000	3037	3037	120194	0	3747	0	0	3037	116447
2007	0	0	0	70000	0	20,000	2621	2621	122815	0	3747	0	0	2621	119068
2008	0	0	0	70000	0	20,000	3256	3256	126071	0	3747	0	0	3256	122324

(1) The 70,000 m<sup>2</sup> Restored Area was permanently capped by the end of March 2005 so the infiltration rate then from the rainfall is 0 for all of 2006

(2)Effective rainfall figures were used to calculate the infiltration through unrestored fill area (past the civic waste area and to the west of the site out to entrance gate) a 25% infiltration rate was used for the unrestored area. Temporary Capping with 600mm soil



### 3.4 Landfill Gas

Landfill gas is produced during the breakdown of waste within the landfill. It is a by-product of the digestion, by anaerobic bacteria, of the organic component of the waste. Landfill gas comprises a mixture of different gases. Methane and carbon dioxide (in the ratio of 3:2) are the main components, with small concentrations of a wide variety of compounds. The number and ratio of gases at any one time depends on the breakdown process which occurs in stages and which is subject to controlling factors. These factors include: -

- Physical dimension of the site,
- Type and input rate of waste deposited,
- Waste age,
- Moisture content, pH, temperature and density of wastes,
- Application of cover, compaction and capping.

#### 3.4.1 *Monitoring Locations*

The Council monitors landfill gas at 32 permanent monitoring wells (G1 to G32) at locations in and around the landfill and since the 4<sup>th</sup> July 2001 in Hamills shop. Since May 2006 the Council have been monitoring the level of Gas at G26 which is south of the Landfill and to the west of the Service Station daily because of gas migration issues. In mid June 2006 the Council installed 5 temporary Piezometers (G33 to G37 inc.) around the perimeter of G26 to fully investigate the gas migration issue and along with their consultants Fehily Timoney & Company have submitted a proposal to The Agency for approval to address this issue and carry out the works in conjunction with the Phase II Final Capping works. Works have been stalled due to site access difficulties. In October 2007 the Council installed 20 gas monitoring/vent wells 11 of which are on the south side, 5 on the North East, 3 on the North West and one on the main entrance road between the leachate lagoon and boundary fence of the landfill. It was noted that whilst the boreholes were being drilled that the Methane levels adjacent to the filling station significantly reduced and stayed low whilst the wells were open prior to fitting of the gas valves. Monitoring locations G11 to G15 are located in the fill area and have become inaccessible due to the engineering works and have been replaced for monitoring purposes with GEW1, GEW4, GEW28 and GEW24 (GEW Denotes Gas Extraction Well). Monitoring locations G1 to G10 and G16, G17 and G18 are located outside the fill area to monitor for the migration of landfill gas from the fill. The location of the additional 20 gas monitoring wells are shown in Appendix 8, Dry. No.07-794-EHLoc-001. Summary tables of the data are included in Appendix 5.

### 3.4.2 *Monitoring Programme*

Monitoring is carried out at the monitoring locations on daily, weekly and monthly intervals in accordance with the licence conditions. Since 4<sup>th</sup> July 2001 the Council has also conducted daily monitoring at Hamills' shop, at points G16, G17, G18, and three times weekly at G7, G8 and G9 to monitor migration and assess the efficacy of the landfill gas migration barrier installed along the southern edge of the fill area.

The monitoring programme includes methane, carbon dioxide, oxygen, temperature and atmospheric pressure. The monitoring results and National Grid co-ordinates for each location are presented in the summary tables in Appendix 5.

The data for the wells in the main body of the Landfill confirmed that the waste in this area of the site is actively gassing. The Methane levels in wells G10 and G11 are much lower (less than 10%, except for January reading – 23.9%) than those in the rest of the Landfill. The waste in this area of the landfill is older, and is consistent with an aged waste with generally lower levels of methane. In the remaining wells in the main body of the Landfill the Methane ranges from 0.3 to 63.3% with an average of 26%.

On the south side of the Landfill the perimeter wells G1, G2 and G3 have Methane levels which are consistently high (0.9% to 69.9%). This indicates that gas is migrating towards the south in this area. The other wells on the south side (G4 and G5) have occasional high levels, which indicate that the migration in this area is of an intermittent nature. No Methane reading was detected in well G6 on the north-east corner of the site on 11 of the 12 sampling occasions, the exception was a level of 30.5% in April.

A limit of 1% methane applies to any measurements on or adjacent to the facility and/or at any point located outside the body of the waste. The data from the points located outside the fill (G7, G8, G9 and G32) indicate that gas is migrating to the north margins of the fill with Methane levels consistently greater than 10%. At G7 there was a high of 59.2% recorded in February. Elevated levels of methane gas were observed at G26 outside the facility on the southern side, with levels generally in the range of 10 to 30%. At G17 adjacent to the Esso Service Station methane readings did not exceed 1% and were generally less than 0.3%. The presence of elevated levels of gases was not detected at the Esso shop.

Gas balancing is carried out weekly at the Landfill in order to optimise the flaring process and to reduce migration from the site.

### 3.4.3 *Landfill Gas Volumes*

The Council has prepared and submitted to the Agency a report on the feasibility of flaring landfill gas at the site. The report included a detailed assessment of the landfill gas generation potential of the site, which is summarised below.

Estimates of gas volumes generated at the site were made for a thirty-five year period. This period extends more than 30 years beyond the operational lifetime of the landfill to reflect the continued generation of gas post-closure and the Council's recognition of the need to provide for post-closure landfill gas management.

For predictive purposes Year 1 was taken as 1999. The estimates were based on the following assumptions of waste inputs and landfill gas characteristics: -

Biodegradable waste placed	251,000 tonnes
Annual Biodegradable waste inputs	15,000 tonnes/annum
Lifetime	4 years
Time to reach steady stage production	1 year
Potential future gas production per annum	8.5 m <sup>3</sup> /tonne of waste; years 1-10 2.0 m <sup>3</sup> /tonne of waste; years 10-40

It was assumed that in Year 1 251,000 tonnes of the waste placed were generating gases, of which 122,500 was generating 8.5 m<sup>3</sup>/tonne and 128,500 at 2 m<sup>3</sup>/tonne. It was assumed the waste placed in 1999 would not begin producing significant volumes of gas until 2000.

It was assumed that the annual waste inputs reached steady state gas generating conditions within twelve months and that gas generation would not be impacted by reductions in moisture content following the placement of the final capping. Gas volumes will gradually reduce over the following 40 years as the biodegradable content is depleted and although gas may continue to be produced to year 50, the levels will be negligible. The projected gas yields are presented in Table 3.4.

#### 3.4.4 Landfill Gas Control

The initial site design did not include for any landfill gas control measures at the site, which was consistent with the typical design and operation of small scale landfills throughout the country. Based on the monitoring data the Council was concerned about the off-site migration of landfill gas from the southern boundary of the fill. The Council commissioned a risk assessment of landfill gas migration, which confirmed that off-site movement presented a risk to properties to the south of the facility. A copy of the risk assessment report was submitted to the Agency and its findings are discussed in more detail in Section 6.

The Council constructed a landfill gas cut off and venting trench along the southern edge of the landfill. The trench was excavated in the natural ground to a level below the base of the waste. The southern side of the trench was lined with synthetic liner and the trench was backfilled with granular material. The barrier was installed in September



2001. The gas-venting trench was covered with a plastic sheet and 300mm of soil in May 2002 to prevent ingress of rainwater and gas venting pipes were installed to allow gas to vent to atmosphere. A further 10 no. Gas venting wells were constructed under Phase I of the Contract works at Marlinstown Landfill in August 2003.

In addition to the barrier along the southern site boundary, the Council installed an active landfill gas collection system as part of the closure and restoration plan for the site. In 2005 Phase I Final Capping along with a combined gas/leachate extraction system was installed. The capping consisted of a topsoil layer, a subsoil layer, a drainage layer, an impermeable layer and a gas collection layer. The combined gas/leachate extraction system comprised of installation of 38 gas wells with five gas well manifolds and five pumped condensate knockout pots. A new enclosed 750m<sup>3</sup>/hr flare was installed with a programmable logic computer (PLC) and data logging system to monitor operation of the gas/leachate system. The gas field was balanced during 2007 to optimise the flaring system and reduce gas migration from the site. All previously installed gas venting wells around the landfill and in the gas barrier were covered with phase I capping works. In September 2007 the Council also installed a further 20 no. gas monitoring wells around the perimeter of the Landfill. This work was carried out as part of the site investigation work to determine the gas migration pathway. The information gained from the site investigation will be used in the design of the gas mitigation measures. For Phase II Final Capping works at Marlinstown the Council have submitted proposals to The Agency for approval. Part of these work include 10 no. additional gas extraction wells to help alleviate the gas migration issue from the landfill site. Approval for the SEW has been received from The Agency for the proposed works.

A report on the Findings on Marlinstown Gas Pathway Investigation was submitted to the Agency along with a position paper to review the specified engineering works for Phase 2 final capping. The position paper recommends changing the design philosophy to allow passive venting.

### **3.5 Noise Survey**

At the start of 2008 the Council applied to the EPA for permission to cease noise monitoring at Marlinstown Landfill, as the Landfill was closed and therefore, there were no activities giving rise to noise. The EPA acceded to this request so there was no noise monitoring carried out in 2008.

In 2007 the noise levels recorded during the survey exceeded the recommended daytime noise limit value of 55dB(A) as set out in Waste Licence W0071-2. The exceedence was due to traffic on the nearby dual carriageway.

### **3.6 Dust Monitoring**

Dust is monitored at three locations around the site (D1, D2, and D3) as shown on Figure 1 in Appendix 7. During the reporting period three dust monitoring events were completed in January to February, May to June and July to August. A summary table of the results of the monitoring locations is included in Appendix 7.

In Quarters 3 and 4 there was compliance with the licence limit of 350 mg/m<sup>2</sup>/day, while in Quarter 2 elevated levels at the 3 monitoring sites, exceeding the licence limit, were found. The high levels were caused by algae and bird faeces. It can therefore be concluded that the quality of the ambient air in the vicinity of Marlinstown Landfill site is good, as it should be, given that there is no activity at the site.

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## **4. SITE DEVELOPMENT WORKS**

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### **4.1 Engineering Works Undertaken During the Reporting Period**

There were no engineering works carried out in 2008. The planned Phase 2 capping contract was deferred to 2009 due to access problems.

### **4.2 Site Restoration**

The Council prepared and submitted to the Agency a Restoration and Aftercare Programme in August 2001 (Ref. Section 6). The Agency accepted the programme subject to a number of specified amendments. The programme involved re-grading existing filled areas and placing additional fill to achieve a proposed final waste profile. Following this the waste was capped with a low permeability capping system and seeded. Phase II of the final capping of the Civic Amenity area planned for 2008 was unable to go ahead due to access difficulties.

### **4.3 Site Survey**

A site survey is being submitted with this report in Appendix 8.

#### **4.4 Future Developments**

Phase 2 capping works are scheduled to go ahead in June 2009 once CPO/purchase of the right of way to the Landfill has been completed. Phase II capping works will include measures to deal with the gas migration from the Landfill.

A site investigation contract undertaken in October 2007 with the installation of 20 gas monitoring wells will provide the necessary information on the geology and hydrogeology along the Landfill perimeter in the areas of the migration. This information will be used in the design of the gas mitigation measures. The location of the additional wells are shown in Appendix 8.

#### **4.5 Resource Consumption**

The following resources were used on-site during the reporting period: -

- Electricity (530 kWhr),

#### **4.6 Septic Tank Maintenance**

Toilet facilities have been disconnected since the closure of the Waste Transfer Station and Civic Amenity Area in January 2007.



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## **5. ENVIRONMENTAL INCIDENTS AND COMPLAINTS**

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### **5.1 Incidents**

During the reporting period there were 15 incidents recorded at the site. Twelve of these were in relation to elevated levels of Methane and Carbon Dioxide at some of the wells during the monthly and daily monitoring at gas wells G7 to G32 inclusive. The three others were in relation to operation problems with the flare. All Incidents were notified to the Agency.

### **5.2 Register of Complaints**

The Council maintains a register of complaints in relation to the operation of the facility in accordance with Condition 10.4 of the Waste Licence. No complaints were received during the reporting period of 2008.

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## 6. ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

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### **Report on progress during 2008 towards achieving the Objectives and Targets.**

The Environmental Management Programme (EMP) prepared for 2008 contained a schedule of objectives and targets and the means for their implementation.

#### **6.1.1 Project 1 – Environmental Management System (EMS)**

Task 1: Task 1 was assumed to be in order regarding the EMS documentation.

Obtain confirmation from the Agency of the suitability of the proposed EMS documentation.

Task 2: This task was completed.

Complete an assessment of personnel training needs by 31/08/2008.

Task 3: This task was completed.

Establish additional training programme(s) required by 30/09/2008.

Task 4: This task was completed.

Deliver the training programme by 31/12/2008.

Task 5: This task was completed.

Ensure that all procedures prepared as part of the works to meet the other Objective and Targets specified in this Schedule comply with all EMS requirements including designation of responsibility, performance assessment, corrective action and document control.

Task 6 This task was not completed and will be incorporated into the objectives and targets for 2009.

Develop and implement an internal audit procedure to monitor EMS performance by 30/06/2008.

### **6.1.2 Project 2 – Leachate Collection**

Task 1: This task was not completed and will be incorporated into the objectives and targets for 2009.

The interceptor drain will intercept leachate migrating from the Civic Amenity Recycling Area of the site. The leachate will be pumped from collection chambers located on the drain to the leachate holding lagoon. The leachate interceptor drain will be constructed by 31/10/2008.

Task 2: This task is ongoing.

Carry out pumping and draw down trials in the existing leachate extraction wells to establish the effectiveness of reducing leachate levels within the body of the waste of Phase 1 area.

### **6.1.3 Project 3 – Surface Water Management**

Task 1: This task was not completed and will be incorporated into the objectives and targets for 2009.

The design and construct the swale taking into consideration the existing ground conditions. The swale is constructed outside the leachate interceptor drain located around the Civic Amenity Recycling Area of site. The surface water interceptor swale will be lined with LLDPE and constructed by 31/10/2008.

### **6.1.4 Project 4 – Restoration of Landfill Areas**

Task 1: This task was not completed and will be incorporated into the objectives and targets for 2009.

Complete installation of low permeability capping system around the Civic Amenity Recycling Area of the site incorporating a topsoil layer, a subsoil layer, an infiltration drainage layer, low permeability layer and a landfill gas collection layer. The infiltration drainage layer will tie into the perimeter surface water swale. The topsoil element of the cap will be seeded. The capping system for the Civic Amenity Recycling Area of the site will be completed by 31/10/2008.

Task 2 This task was not completed and will be incorporated into the objectives and targets for 2009.

Instillation of two sets of gas wells within the Civic Amenity Recycling Area of the site.

Task 3 This task was not completed and will be incorporated into the objectives and targets for 2009.

To carry out mitigation measures for the gas migration from the site in accordance with the SEW approved by the agency.

Task 4 This task was not necessary as works did not take place.

Flare was kept fully operational at all times.  
Existing 750m<sup>3</sup>/hr flare and existing gas extraction wells in Phase 1 of the site to be kept fully operational during the construction work.

Task 5 This task was not completed and will be incorporated into the objectives and targets for 2009.

Every precaution to be taken to ensure that any migration of gas be kept to a minimum during the construction work. In particular method statements will be required from the contractor to show how capping work will be carried out around the existing gas extraction system.

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## 7. OTHER REPORTS

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A report on the Findings on Marlinstown Gas Pathway Investigation June 2008 was submitted to the Agency along with a position paper to review the specified engineering works for Phase 2 final capping. The position paper recommends changing the design philosophy to allow passive venting.

### 7.1 Restoration and Aftercare Programme

The following programmes and plans will continue to be implemented until all closure works have been completed on the entire site. The majority of these reports have already been discussed in previous sections of the AER and have been submitted to The Agency. They are summarised below.

The Council has prepared a restoration and aftercare plan for the site, which has been submitted, to the Agency. The restoration plan included capping of the Landfill with: -

- Topsoil (150-300 mm),
- Subsoils (700-850 mm),
- Drainage layer (500 mm thick,  $k 1 \times 10^{-4}$  m/s),
- Compacted mineral layer (600 mm thick,  $k < 1 \times 10^{-9}$  m/s) or geosynthetic layer,
- Gas collection layer (300 mm of natural material or geosynthetic).

Phase 1 of the capping works has been completed. SEW approval has been given by the Agency for phase II capping works.

Following the placement of the cap the topsoil will be seeded with long-term leys suitable as poor pasture. A test area will be planted with a standard meadow grass mixture prior to selection of the grass mixture to be used in the overall seeding. In order to lessen the impact of the final profile the site will also be planted with patches of brambles or hedges to break up the overall landmass.

## **7.2 Surface Water Management Plan**

The Council proposes to install a surface water cut-off drain/swale surrounding the entire site to intercept and divert surface water from the body of the waste. The swale will be lined with a geosynthetic clay liner to limit infiltration into the body of the waste.

The Council's proposals for the final shaping and capping of the waste includes for surface water control measures. The final waste profile encourages the shedding of rainwater to a series of new perimeter drains. The capping system includes for a drainage layer, which intercepts infiltrating rainfall, and direct it to the perimeter drains.

## **7.3 Leachate Management Plan**

There are no engineered natural or synthetic basal seals in the landfill area. The Council has prepared a leachate management programme that has been approved by the Agency. The programme includes the installation of the perimeter collection drain, extraction boreholes in the body of the waste and the provision of a low permeability capping system.

The perimeter drains were installed at original ground level, or formation level at which the waste was placed and were graded to a fall of 1:200. Leachate is pumped from the drains at 4 collection chambers located on the drains to an on-site leachate holding lagoon. The leachate monitoring boreholes will be converted to extraction wells following the completion of the site restoration works.

The holding lagoon has been provided with a composite lining system comprising a 2 mm synthetic sheet, such as High Density Polyethylene (HDPE), overlying a 1m layer of compacted soil with a permeability of less than  $1 \times 10^{-9}$  m/s. The lagoon is fitted with floating aerators to provide on-site pre-treatment of the leachate. The leachate is removed by a road tanker for treatment at a municipal wastewater treatment facility.

The Council has placed a low permeability capping system over the landfill area as described in Section 7.2. Before placement of the capping system the area to be capped was shaped to enhance surface water run-off. The capping system will minimise the infiltration of incident rainfall to the waste, which is the primary source of leachate generation at the site. The above works have been completed for Phase I capping works. SEW approval has been given by The Agency for Phase II capping works.

## **7.4 Gas Risk Assessment**

The report identified that landfill gas migration from the site presented a range of moderate to high risks to properties around the site, to the on-site buildings, to vegetation and local air quality. The areas of greatest concern were the site buildings, the service station to the south of the site, and the properties to the west and south of the site. The report recommended that automatic gas alarms be installed in the site buildings, that further monitoring locations be installed and the monitoring frequency increased to allow preventative actions to be taken if considered necessary.

The Council has acted on the findings of the report. Automatic gas alarms have been fitted in the site buildings and the monitoring frequency increased. The Council installed a gas interceptor and venting trench along the southern site boundary and has incorporated an active abstraction and flaring system in the works programme for the restoration and aftercare of the site. The Council has installed 15 additional gas monitoring wells around the fill area in 2002 and 10 new gas venting wells in August 2003, and 10 new gas extraction wells and open flare for the pumping trial in March 2004. Throughout 2005 the council has installed 38 no. gas extraction wells and 5 no. combined leachate extraction wells. During June 2006 the Council installed 5 no. piezometers to assess the extent of the gas migration on the southern side of the landfill and a report was submitted to The Agency. In October 2007 the Council installed 20 gas monitoring wells, 11 of which are on the south side, 5 on the North East, 3 on the North West and one on the main entrance road between the leachate lagoon and boundary fence of the landfill.

## **7.5 Landfill Gas Flaring**

The Council completed a feasibility study on the active collection and flaring of landfill gas at the site. The study report estimated that the maximum gas generation rate is 154 cubic metres/hour which will occur in 2003. However, there will be a progressive decrease in the generation rate following the closure of the site and by 2008 the estimated generation rate is 87 cubic metres/hour.

In the short term (5 years) these generation rates could potentially support a gas flaring unit. However, by 2013 the estimated gas generation rate 14 cubic metres/ hour is below the rates that would sustain a flare.

The report recommended that gas pumping and flaring trials and monitoring be carried out to confirm the feasibility of an efficient gas flaring system at the facility. The pumping trial results recommended a 750m<sup>3</sup>/hr with 38 landfill gas extraction wells but the council have installed extra capacity to allow for further capping of the landfill under phase II Final Capping contract works. The Council have submitted a proposal for approval to install 10 no. additional gas extraction wells to help remediate the gas migration from the landfill.

## **7.6 Environmental Management System (EMS) Documentation**

During 2008 the council did not submit any new Standard Operating Procedure to The Agency.

## **7.7 Financial Provision**

The Agency has not set a date for the establishment of a fund or written guarantee required to ensure the implementation of the Restoration and Aftercare Plan as set out in Condition 12.2.1 of the Waste Licence.

Notwithstanding this, the Council has made provision for the closure and aftercare of the facility as follows: -

- During 2004, €239,000 was set aside as a restoration fund.
- During 2005, €239,000 was set aside as a restoration fund.
- During 2006, €239,000 was set aside as a restoration fund.
- During 2007, €239,000 was set aside as a restoration fund.
- During 2008 €117,000 was set aside as a restoration fund

Westmeath County Council has invested over 2.95 Million Euro in Restoration and Capping Works to date.



## **APPENDIX 1**

Meteorological Report

**Effective Rainfall Calculation 2008 (Actual Rainfall minus Potential Evaporation)**

<b>Month</b>	<b>Rainfall (mm)</b>	<b>Potential Evapotranspiration</b>	<b>Effective Rainfall</b>
<b>Jan</b>	<b>134.3</b>	<b>19.5</b>	<b>114.8</b>
<b>Feb</b>	<b>54.3</b>	<b>21.8</b>	<b>32.5</b>
<b>Mar</b>	<b>92.3</b>	<b>30.8</b>	<b>61.5</b>
<b>Apr</b>	<b>59.1</b>	<b>51.3</b>	<b>7.8</b>
<b>May</b>	<b>23.4</b>	<b>80.0</b>	<b>-56.6</b>
<b>Jun</b>	<b>84.7</b>	<b>73.2</b>	<b>11.5</b>
<b>Jul</b>	<b>108.9</b>	<b>70.8</b>	<b>38.1</b>
<b>Aug</b>	<b>154.4</b>	<b>56.2</b>	<b>98.2</b>
<b>Sep</b>	<b>104.7</b>	<b>39.9</b>	<b>64.8</b>
<b>Oct</b>	<b>124.2</b>	<b>22.1</b>	<b>102.1</b>
<b>Nov</b>	<b>75.6</b>	<b>10.1</b>	<b>65.5</b>
<b>Dec</b>	<b>61.3</b>	<b>6.9</b>	<b>54.4</b>
<b>Total</b>	<b>1077.2</b>	<b>482.6</b>	<b>594.6</b>

Note: The effective rainfall value for May is negative value, assumed to be 0



## Feb-08

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	2	1	3.4	6.5	260	94	1004.4	3.2	-0.6	0.45	0.61
2008	2	2	0.4	8.4	180	93	1005.3	7.7	-2.6	1.05	1.30
2008	2	3	5.6	12.4	165	90	985.0	8.1	0.5	1.06	1.38
2008	2	4	4.7	8.5	195	89	989.0	8.8	-0.3	0.94	1.16
2008	2	5	15.5	6.7	245	95	989.3	6.7	3.4	0.45	0.62
2008	2	6	1.7	6.5	175	85	1021.0	8.9	-0.6	0.79	1.00
2008	2	7	0.2	10.4	175	88	1021.6	13.6	8.7	0.83	1.04
2008	2	8	0.8	10.1	170	91	1020.6	10.8	9.3	0.49	0.69
2008	2	9	0.0	9.2	170	87	1023.9	13.3	4.9	1.03	1.26
2008	2	10	0.0	4.5	135	93	1031.7	7.4	0.5	0.41	0.55
2008	2	11	0.0	6.3	135	91	1030.1	11.0	4.4	0.74	0.97
2008	2	12	0.2	3.7	130	85	1034.0	11.8	1.3	0.69	1.01
2008	2	13	0.0	3.2	65	88	1037.3	12.4	-0.9	0.50	0.77
2008	2	14	0.0	6.8	70	89	1038.1	5.7	3.4	0.48	0.68
2008	2	15	0.0	4.1	85	84	1039.1	5.9	2.7	0.48	0.64
2008	2	16	0.0	2.4	75	83	1041.5	7.2	-3.1	0.40	0.68
2008	2	17	0.0	2.6	30	94	1039.9	5.6	-5.4	0.39	0.62
2008	2	18	0.0	3.8	70	93	1032.9	7.6	-1.0	0.68	0.99
2008	2	19	0.0	3.9	170	91	1023.2	5.6	-5.6	0.44	0.64
2008	2	20	0.7	4.3	215	91	1017.1	7.3	0.7	0.39	0.55
2008	2	21	0.9	12.2	230	90	1015.0	10.9	5.6	1.02	1.34
2008	2	22	1.8	11.2	235	85	1017.7	11.4	6.0	0.95	1.31
2008	2	23	0.2	10.4	205	88	1016.1	11.7	6.2	1.01	1.31
2008	2	24	1.9	6.8	240	82	1014.5	10.0	1.9	0.99	1.33
2008	2	25	7.5	10.6	175	88	1006.4	9.9	1.0	1.27	1.60
2008	2	26	1.6	10.2	235	80	1003.4	8.7	4.3	0.97	1.40
2008	2	27	0.1	4.3	225	87	1016.7	9.7	0.5	0.85	1.05
2008	2	28	0.0	4.1	215	92	1019.4	9.4	1.9	0.87	1.20
2008	2	29	7.1	12.8	195	92	1005.1	11.1	4.0	1.22	1.58
<b>Total</b>			<b>54.3</b>							<b>21.8</b>	

## Mar-08

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	3	1	1.8	11.2	255	83	1008.1	11.1	5.2	0.76	1.10
2008	3	2	1.1	8.0	250	78	1010.3	9.3	0.8	0.92	1.33
2008	3	3	3.1	7.2	225	93	1011.1	4.3	-0.7	0.56	0.85
2008	3	4	0.3	5.8	285	82	1032.1	9.0	1.4	0.94	1.36
2008	3	5	0.1	6.8	235	87	1032.9	9.3	4.0	0.73	1.03
2008	3	6	3.3	10.4	230	85	1018.3	9.5	4.3	0.73	1.12
2008	3	7	2.3	8.4	225	87	1006.7	9.0	1.6	0.83	1.31
2008	3	8	4.8	11.2	215	86	994.2	10.3	3.6	0.95	1.46
2008	3	9	2.1	8.5	225	84	989.3	7.4	1.3	0.97	1.50
2008	3	10	12.9	10.3	290	89	964.6	7.8	1.2	0.88	1.33
2008	3	11	5.0	11.0	235	83	980.6	9.9	2.9	1.19	1.71
2008	3	12	8.1	12.5	250	83	998.6	8.6	2.9	1.21	1.89
2008	3	13	1.7	6.3	205	87	1007.6	10.1	2.3	0.85	1.21
2008	3	14	0.0	4.7	135	88	1009.4	8.1	-0.1	0.59	0.85
2008	3	15	7.7	5.0	65	96	1002.2	9.2	6.7	0.50	0.71
2008	3	16	2.1		50	81	1011.9	8.3	4.2	0.95	1.31
2008	3	17	0.4	5.1	60	80	1021.6	8.3	0.0	1.00	1.46
2008	3	18	0.0	2.7	350	77	1025.9	8.2	-1.3	1.09	1.57
2008	3	19	0.3	3.6	295	84	1029.1	8.9	-1.5	1.07	1.54
2008	3	20	5.0	9.5	265	91	1015.9	9.9	4.2	0.58	0.89
2008	3	21	2.1	10.9	295	75	1002.8	8.9	2.8	1.42	2.17
2008	3	22	0.0	7.2	335	71	1013.9	7.3	1.5	1.42	2.05
2008	3	23	1.1	6.8	320	79	1007.1	8.3	2.3	1.15	1.66
2008	3	24	1.7	4.0	310	83	1006.5	8.2	1.2	1.14	1.63
2008	3	25	1.8	4.2	225	91	1008.0	10.1	0.0	1.02	1.45
2008	3	26	0.9	5.1	260	83	1000.1	9.6	2.5	1.47	2.19
2008	3	27	1.9	6.0	190	78	999.9	9.9	-1.6	1.44	2.14
2008	3	28	9.4	10.1	240	90	990.7	9.1	2.7	0.84	1.44
2008	3	29	10.1	8.0	185	90	992.7	10.3	2.2	1.03	1.50
2008	3	30	0.0	6.1	220	79	995.8	11.2	2.1	1.54	2.20
2008	3	31	1.2	7.4	190	85	1009.7	10.4	-0.1	1.04	1.73
<b>Total</b>			<b>92.3</b>							<b>30.8</b>	

## Apr-08

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	4	1	1.3	11.8	250	74	1014.8	12.1	7.7	2.06	3.13
2008	4	2	0.9	5.6	245	90	1026.4	14.0	6.7	1.16	1.66
2008	4	3	0.0	4.2	265	80	1031.9	15.5	7.1	1.80	2.45
2008	4	4	0.3	5.2	235	86	1027.9	13.9	3.3	1.48	2.09
2008	4	5	0.2	6.7	335	74	1023.5	8.9	1.5	1.81	2.70
2008	4	6	0.4	7.8	325	76	1014.7	7.5	-1.0	1.68	2.55
2008	4	7	0.3	6.0	325	84	1007.0	7.8	0.1	1.53	2.32
2008	4	8	0.2	2.4	275	81	1003.5	9.4	0.6	1.37	1.90
2008	4	9	0.0	4.1	270	81	999.7	9.9	1.7	1.69	2.43
2008	4	10	4.0	4.7	215	87	994.3	8.3	2.2	1.45	2.11
2008	4	11	5.0	4.7	275	86	993.2	9.5	2.1	1.55	2.22
2008	4	12	5.7	3.4	245	91	1001.1	9.2	-0.3	1.02	1.42
2008	4	13	1.2	4.2	295	81	1011.8	11.7	1.1	1.92	2.75
2008	4	14	0.0	3.7	290	74	1022.5	12.0	0.8	2.09	2.95
2008	4	15	0.0	2.3	245	74	1023.0	11.8	-1.7	1.83	2.56
2008	4	16	0.0	8.0	90	76	1017.4	11.1	2.2	1.92	2.88
2008	4	17	0.8	10.3	75	79	1009.7	7.7	3.7	1.59	2.40
2008	4	18	2.0	10.3	70	79	1002.9	8.8	2.6	1.28	1.91
2008	4	19	0.0	11.0	60	72	1003.1	8.6	5.8	1.51	2.07
2008	4	20	1.6	7.9	60	85	1007.0	8.4	5.7	1.08	1.45
2008	4	21	0.0	5.9	65	79	1010.4	11.9	6.1	1.55	2.12
2008	4	22	6.2	7.8	125	82	1008.4	15.6	6.0	2.21	3.19
2008	4	23	0.1	6.9	175	80	1011.9	15.7	3.2	2.44	3.60
2008	4	24	4.2	7.7	210	81	1014.1	13.2	5.6	1.98	2.95
2008	4	25	1.2	8.1	180	88	1018.8	15.1	6.4	1.34	1.91
2008	4	26	0.5	7.0	260	77	1016.3	14.2	5.4	1.82	2.71
2008	4	27	13.7	2.8	190	81	1011.0	15.7	0.3	2.34	3.23
2008	4	28	7.6	4.3	255	88	1000.8	12.5	4.5	1.81	2.56
2008	4	29	0.5	4.4	55	79	995.9	12.9	1.9	2.09	2.98
2008	4	30	1.2	7.0	330	81	994.5	11.9	5.9	1.96	2.78
<b>Total</b>			<b>59.1</b>							<b>51.3</b>	

**May-08**

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	5	1	3.4	5.1	235	80	1002.7	12.9	3.6	2.25	3.21
2008	5	2	0.3	6.6	160	82	1014.5	14.6	2.5	2.31	3.37
2008	5	3	2.6	11.7	135	80	1014.0	18.9	9.9	3.12	4.62
2008	5	4	4.1	7.1	205	75	1015.6	18.4	8.3	2.69	3.86
2008	5	5	0.0	4.6	135	76	1024.7	19.5	4.8	3.29	4.61
2008	5	6	0.0	6.3	85	70	1021.8	21.2	7.4	3.45	4.77
2008	5	7	0.0	5.2	80	70	1017.9	21.6	8.9	3.44	4.66
2008	5	8	0.3	7.1	70	72	1011.5	22.5	11.0	3.43	4.53
2008	5	9	1.0	3.2	300	90	1012.8	14.9	11.8	1.27	1.65
2008	5	10	0.2	2.5	340	89	1019.4	16.7	11.0	1.39	1.80
2008	5	11	0.0	2.6	70	80	1021.2	20.1	9.6	2.41	3.18
2008	5	12	0.0	6.4	70	75	1020.1	20.6	12.4	3.45	4.76
2008	5	13	0.0	7.5	65	76	1021.2	17.3	10.2	3.31	4.73
2008	5	14	0.0	6.5	65	74	1018.5	16.2	9.1	3.09	4.35
2008	5	15	0.0	5.3	55	74	1013.7	15.5	7.1	2.75	3.92
2008	5	16	0.0	4.5	75	77	1010.3	17.1	2.6	2.67	3.76
2008	5	17	0.0	4.7	60	80	1010.9	15.4	4.4	1.78	2.47
2008	5	18	0.0	6.5	75	74	1016.7	13.5	6.9	2.32	3.31
2008	5	19	0.0	5.5	145	71	1017.9	15.8	2.5	2.41	3.41
2008	5	20	0.0	6.4	130	69	1017.2	12.9	3.6	1.94	2.68
2008	5	21	1.1	8.9	115	69	1012.9	14.9	8.5	2.71	3.83
2008	5	22	5.0	6.7	95	93	1010.4	13.4	9.6	1.14	1.57
2008	5	23	0.4	6.5	80	81	1012.4	17.2	8.4	2.31	3.25
2008	5	24	0.0	8.6	55	75	1017.3	15.8	9.5	2.91	4.25
2008	5	25	0.0	9.9	50	67	1019.5	17.4	6.4	3.42	5.04
2008	5	26	0.0	11.6	50	64	1019.5	16.3	9.4	3.72	5.46
2008	5	27	0.4	7.7	45	82	1015.3	12.1	8.9	1.58	2.13
2008	5	28	0.0	2.3	35	88	1007.3	14.5	9.5	1.29	1.66
2008	5	29	0.5	2.4	180	80	1012.2	17.9	8.4	2.44	3.22
2008	5	30	0.1	1.8	55	74	1015.4	21.1	10.4	2.67	3.49
2008	5	31	4.0	2.0	35	80	1017.8	22.4	11.1	3.03	3.94
<b>Total</b>			<b>23.4</b>							<b>80.0</b>	

**Jun-08**

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	6	1	0.1	3.4	70	79	1017.1	21.2	7.6	2.96	3.94
2008	6	2	6.6	3.2	110	83	1012.8	20.9	4.8	3.03	4.06
2008	6	3	0.0	4.5	220	72	1014.5	17.1	7.9	3.72	5.16
2008	6	4	6.5	5.8	155	87	1012.9	14.0	6.3	1.39	2.00
2008	6	5	2.8	1.7	35	81	1016.4	15.7	2.1	2.49	3.32
2008	6	6	3.1	3.1	260	83	1019.9	16.5	6.7	2.54	3.44
2008	6	7	0.0	2.5	245	74	1021.8	19.8	6.2	3.72	4.97
2008	6	8	0.0	1.8	220	83	1025.6	19.4	10.6	1.98	2.54
2008	6	9	0.0	5.7	225	83	1027.0	19.5	13.4	2.99	4.10
2008	6	10	0.0	5.2	285	75	1028.1	18.0	11.5	3.39	4.62
2008	6	11	3.8	3.5	285	88	1025.8	14.7	9.9	1.66	2.23
2008	6	12	0.0	4.0	320	77	1023.8	13.9	7.2	2.17	2.97
2008	6	13	0.0	4.5	295	74	1020.7	15.5	8.2	2.59	3.51
2008	6	14	3.1	2.8	285	81	1017.2	14.6	3.7	2.36	3.19
2008	6	15	1.8	2.6	325	76	1014.3	14.1	6.5	2.41	3.25
2008	6	16	0.0	3.6	295	73	1013.6	14.6	6.2	2.48	3.39
2008	6	17	2.3	7.8	200	82	1006.4	15.7	9.1	2.42	3.44
2008	6	18	9.2	5.2	195	88	1001.5	16.1	9.3	2.05	2.78
2008	6	19	3.1	5.4	255	80	1007.4	16.3	7.4	2.77	3.97
2008	6	20	0.0	3.0	250	68	1016.4	17.2	5.6	3.68	5.00
2008	6	21	16.6	6.0	65	92	1009.1	15.5	8.9	1.19	1.61
2008	6	22	7.7	10.0	260	86	1002.8	14.2	9.3	1.78	2.89
2008	6	23	0.5	2.8	225	84	1018.7	15.5	5.5	2.25	3.02
2008	6	24	2.2	8.5	140	88	1013.1	14.5	10.9	1.63	2.39
2008	6	25	3.1	10.3	235	79	1008.1	16.4	11.7	3.05	4.55
2008	6	26	6.3	7.0	200	88	1012.1	14.9	9.3	1.72	2.49
2008	6	27	3.1	6.2	225	93	1012.5	17.5	7.6	1.37	1.95
2008	6	28	1.1	7.2	215	85	1013.8	17.0	12.4	2.21	3.12
2008	6	29	1.5	7.0	225	82	1014.1	16.4	10.5	2.93	4.17
2008	6	30	0.2	8.7	175	81	1014.6	18.1	11.9	2.31	3.20
<b>Total</b>			<b>84.7</b>							<b>73.2</b>	



**Jul-08**

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	7	1	8.0	11.5	155	84	1003.5	18.3	12.0	2.10	3.09
2008	7	2	4.5	5.7	150	90	1002.3	15.1	11.0	1.63	2.29
2008	7	3	18.6	1.3	255	95	1007.9	14.3	9.0	1.04	1.27
2008	7	4	0.2	5.2	95	80	1011.3	18.3	3.7	3.06	4.35
2008	7	5	23.6	7.8	65	87	1001.6	18.3	11.7	2.32	3.27
2008	7	6	18.2	4.0	320	93	997.4	16.0	11.2	1.58	2.11
2008	7	7	0.6	5.7	295	84	999.8	16.1	10.7	2.46	3.42
2008	7	8	0.0	5.0	250	74	1006.8	17.7	9.3	3.06	4.17
2008	7	9	4.0	5.1	75	92	1003.8	15.1	10.7	1.36	1.83
2008	7	10	2.4	5.8	235	94	1000.6	14.8	11.8	1.27	1.73
2008	7	11	0.3	5.4	310	82	1007.7	14.9	9.8	1.96	2.71
2008	7	12	0.4	4.7	285	80	1011.8	16.0	8.6	2.33	3.22
2008	7	13	0.0	3.6	210	82	1014.3	19.1	4.6	2.63	3.60
2008	7	14	0.0	4.8	235	90	1020.2	20.7	14.3	2.14	2.83
2008	7	15	0.9	7.2	250	79	1024.5	18.9	11.9	2.88	4.10
2008	7	16	0.2	5.5	250	84	1023.2	15.9	11.7	1.81	2.46
2008	7	17	0.6	5.6	245	87	1014.0	16.4	12.8	1.69	2.28
2008	7	18	1.7	5.4	240	93	1008.2	16.3	13.5	1.27	1.74
2008	7	19	0.8	7.0	305	77	1011.6	17.4	9.3	3.02	4.34
2008	7	20	0.0	5.8	285	76	1022.8	18.3	7.8	3.31	4.69
2008	7	21	0.0	3.9	265	86	1026.9	17.8	5.3	2.30	3.17
2008	7	22	0.1	4.5	225	90	1025.5	19.5	12.1	1.67	2.24
2008	7	23	0.2	4.5	135	86	1022.0	22.3	11.1	2.96	3.97
2008	7	24	0.6	6.4	85	84	1014.6	21.9	13.6	2.65	3.62
2008	7	25	1.4	3.8	90	85	1008.8	19.9	14.3	1.81	2.36
2008	7	26	0.0	2.2	225	76	1015.6	22.5	10.6	3.33	4.36
2008	7	27	0.0	2.9	185	74	1017.4	23.3	9.5	3.72	4.91
2008	7	28	0.0	4.6	65	85	1014.0	22.9	11.1	2.60	3.46
2008	7	29	3.1	7.8	155	84	1006.2	20.7	13.3	2.92	4.11
2008	7	30	5.6	7.0	135	82	1007.9	20.1	13.5	2.45	3.40
2008	7	31	12.9	4.6	115	93	1005.4	18.7	12.1	1.44	1.90
<b>Total</b>			<b>108.9</b>							<b>70.8</b>	

**Aug-08**

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	8	1	6.2	4.6	245	86	1004.1	18.3	12.3	2.05	2.74
2008	8	2	3.3	5.3	210	83	1008.2	19.2	12.3	2.58	3.51
2008	8	3	0.6	5.5	215	81	1007.1	18.1	12.3	2.69	3.67
2008	8	4	0.0	2.7	260	83	1009.6	18.3	11.9	2.07	2.71
2008	8	5	6.0	4.9	70	93	1007.4	17.1	12.5	1.07	1.44
2008	8	6	9.8	3.1	155	93	1005.1	18.1	14.4	1.27	1.63
2008	8	7	0.2	4.0	325	86	1007.0	17.1	13.2	1.50	1.96
2008	8	8	0.0	3.3	280	75	1014.2	17.8	9.1	2.66	3.59
2008	8	9	23.0	7.0	225	90	1001.5	20.1	12.9	1.76	2.35
2008	8	10	6.1	7.5	235	85	996.9	17.3	11.9	2.06	2.94
2008	8	11	25.4	6.5	200	88	994.6	18.4	11.7	2.01	2.71
2008	8	12	1.1	4.0	270	85	987.1	16.7	10.3	2.18	2.92
2008	8	13	0.8	4.8	270	88	997.4	17.7	9.4	1.99	2.72
2008	8	14	0.0	4.8	220	79	1009.4	17.9	9.6	2.64	3.62
2008	8	15	4.4	6.5	200	85	1010.3	17.5	11.6	1.95	2.71
2008	8	16	48.7	8.0	130	91	997.2	16.4	11.6	1.40	1.95
2008	8	17	0.6	6.3	155	88	997.7	17.8	8.5	1.70	2.35
2008	8	18	3.2	5.4	120	88	992.0	18.6	12.9	1.79	2.39
2008	8	19	0.6	5.0	285	88	1001.8	17.7	13.4	1.66	2.19
2008	8	20	0.5	3.7	210	86	1007.2	17.2	12.7	1.68	2.22
2008	8	21	0.0	3.6	290	81	1013.7	17.7	9.8	2.36	3.22
2008	8	22	0.0	3.8	280	80	1018.3	16.8	9.6	2.04	2.73
2008	8	23	7.2	6.0	160	93	1009.4	14.8	8.0	0.75	1.10
2008	8	24	0.3	7.0	210	83	1004.4	17.8	11.6	2.20	3.07
2008	8	25	2.9	8.3	210	89	1006.7	15.9	13.2	1.13	1.55
2008	8	26	1.3	7.5	215	90	1015.1	17.1	13.5	1.07	1.44
2008	8	27	0.6	5.7	245	91	1019.3	17.1	14.6	1.07	1.40
2008	8	28	0.1	5.2	230	89	1020.4	20.7	14.4	1.72	2.28
2008	8	29	0.2	3.4	175	90	1018.1	19.0	13.8	1.71	2.18
2008	8	30	0.0	6.2	160	87	1013.0	18.1	14.8	1.39	1.84
2008	8	31	1.3	3.4	250	80	1010.6	17.1	11.3	2.05	2.75
<b>Total</b>			<b>154.4</b>							<b>56.2</b>	

Sep-08

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	9	1	5.4	6.1	205	82	1004.7	15.6	8.8	1.93	2.74
2008	9	2	5.4	5.1	185	87	997.2	15.1	8.0	1.49	2.05
2008	9	3	3.8	6.9	235	85	993.7	14.7	8.0	1.64	2.33
2008	9	4	2.1	2.7	225	78	995.2	17.1	9.3	2.26	3.07
2008	9	5	25.6	7.3	40	93	991.0	12.8	8.7	0.65	0.89
2008	9	6	4.2	6.9	360	78	1001.4	17.0	8.2	1.93	2.65
2008	9	7	0.2	3.5	285	79	1010.3	17.1	6.6	2.13	2.95
2008	9	8	1.3	4.8	160	82	1010.2	16.6	8.7	1.66	2.29
2008	9	9	6.9	9.6	120	90	999.6	16.5	10.0	0.98	1.34
2008	9	10	6.3	9.5	150	91	998.6	16.0	7.7	0.82	1.19
2008	9	11	2.2	8.2	185	87	997.1	16.1	10.1	1.21	1.72
2008	9	12	3.5	2.6	285	89	1014.0	16.4	10.5	1.41	1.88
2008	9	13	0.1	2.5	165	84	1018.9	17.6	5.1	1.53	2.10
2008	9	14	17.2	4.9	130	92	1021.8	14.8	11.8	0.83	1.09
2008	9	15	1.6	4.0	285	90	1022.7	15.1	11.6	1.07	1.43
2008	9	16	0.3	3.5	315	88	1024.2	14.0	9.9	0.89	1.17
2008	9	17	0.0	2.5	300	86	1023.3	15.6	5.8	1.22	1.66
2008	9	18	0.8	3.2	205	87	1022.4	15.9	4.5	1.22	1.67
2008	9	19	0.1	4.4	205	89	1026.5	15.7	11.1	1.07	1.40
2008	9	20	0.0	3.5	200	81	1028.2	19.4	10.4	1.93	2.65
2008	9	21	0.1	2.1	95	86	1027.5	17.4	6.5	1.33	1.83
2008	9	22	0.1	3.5	345	78	1031.7	15.0	7.0	1.52	2.11
2008	9	23	0.0	2.9	55	81	1030.9	15.4	5.8	1.35	1.87
2008	9	24	0.1	2.4	65	85	1030.1	14.8	5.1	0.90	1.21
2008	9	25	0.0	1.3	90	85	1033.7	17.3	7.4	1.26	1.77
2008	9	26	0.0	3.6	170	83	1034.0	17.5	8.1	1.39	1.91
2008	9	27	0.6	3.0	190	88	1030.3	16.3	4.2	1.08	1.49
2008	9	28	0.1	2.5	335	79	1028.4	13.7	8.1	1.23	1.74
2008	9	29	2.0	5.7	245	87	1018.6	14.1	7.8	1.02	1.38
2008	9	30	14.7	7.8	255	90	1004.0	13.8	10.6	0.91	1.26
<b>Total</b>			<b>104.7</b>							<b>39.9</b>	

## Oct-08

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	10	1	4.8	7.5	270	81	1002.1	11.2	5.3	0.98	1.50
2008	10	2	1.6	6.9	270	84	1008.2	10.8	4.0	0.99	1.41
2008	10	3	0.0	4.7	280	78	1019.1	10.2	3.3	1.09	1.55
2008	10	4	15.8	8.2	195	90	1001.7	14.2	6.8	0.67	0.92
2008	10	5	3.2	2.8	5	81	1002.8	11.9	1.4	0.99	1.46
2008	10	6	4.0	6.3	155	92	1002.9	14.5	2.2	0.59	0.82
2008	10	7	7.0	3.9	250	92	999.8	12.7	6.8	0.54	0.74
2008	10	8	0.2	2.9	210	88	1018.5	15.7	4.0	0.97	1.39
2008	10	9	9.0	8.3	170	92	1021.8	14.2	4.4	0.61	0.87
2008	10	10	17.3	8.2	180	93	1017.6	16.2	9.5	0.55	0.79
2008	10	11	0.3	2.9	210	90	1022.1	14.4	5.2	0.74	1.04
2008	10	12	0.1	2.6	180	91	1019.7	14.8	1.5	0.74	1.09
2008	10	13	0.1	4.5	210	85	1015.1	16.1	6.6	0.89	1.25
2008	10	14	9.2	1.6	350	95	1015.2	11.4	4.4	0.50	0.63
2008	10	15	0.9	4.1	220	90	1012.4	12.1	3.2	0.62	0.86
2008	10	16	1.0	4.0	265	85	1017.4	11.9	4.6	0.71	1.03
2008	10	17	0.4	4.0	205	92	1018.9	11.4	2.3	0.59	0.83
2008	10	18	1.7	5.9	205	92	1014.5	12.8	7.4	0.76	1.00
2008	10	19	1.4	10.0	190	89	1005.3	13.9	9.2	0.63	0.87
2008	10	20	3.8	10.6	215	82	996.8	13.2	5.7	0.72	1.02
2008	10	21	1.3	6.0	225	81	1009.1	10.6	3.4	0.89	1.20
2008	10	22	0.2	6.8	215	85	1016.7	12.2	4.0	0.76	1.03
2008	10	23	12.4	12.9	185	86	1005.4	14.7	7.3	0.91	1.18
2008	10	24	0.4	7.8	210	78	1018.1	11.0	4.8	0.93	1.21
2008	10	25	14.3	11.7	185	88	1014.3	13.4	8.2	0.81	1.05
2008	10	26	1.2	6.8	235	81	1012.4	11.5	4.0	0.45	0.68
2008	10	27	0.1	5.0	290	85	1013.6	8.5	2.2	0.54	0.79
2008	10	28	1.1	4.6	270	85	1016.3	5.1	-0.9	0.35	0.54
2008	10	29	9.8	5.0	260	92	1003.3	7.0	0.1	0.42	0.57
2008	10	30	1.6	7.2	15	81	1002.8	6.7	2.6	0.67	0.88
2008	10	31	0.0	4.0	335	80	1015.7	8.3	1.3	0.47	0.70
<b>Total</b>			<b>124.2</b>							<b>22.1</b>	

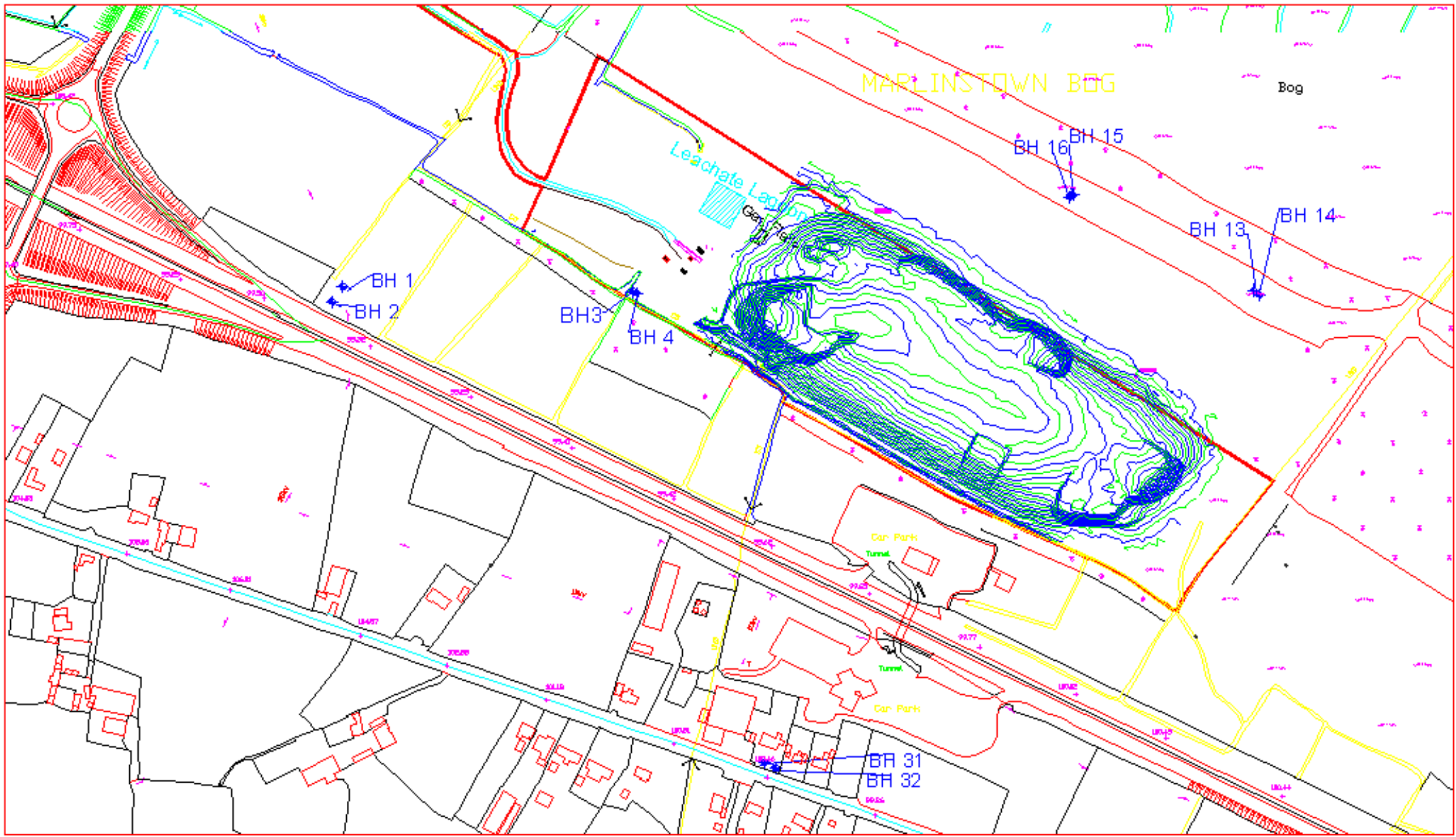
## Nov-08

Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotrans- piration (Penman)	Evaporation (mm)
2008	11	1	0.0	3.5	335	83	1017.4	7.0	0.8	0.38	0.57
2008	11	2	0.0	2.4	315	88	1022.1	9.9	3.4	0.32	0.50
2008	11	3	0.1	2.0	335	92	1021.7	9.0	2.8	0.16	0.33
2008	11	4	0.2	3.0	30	91	1021.5	9.0	1.7	0.36	0.47
2008	11	5	0.5	1.9	70	94	1021.5	10.7	8.0	0.38	0.51
2008	11	6	0.8	5.8	115	91	1009.4	9.9	6.4	0.42	0.56
2008	11	7	8.9	9.0	200	91	995.3	9.1	4.7	0.47	0.64
2008	11	8	5.4	7.5	170	90	994.4	10.8	3.8	0.52	0.69
2008	11	9	12.1	9.5	205	89	996.2	6.2	1.8	0.50	0.67
2008	11	10	6.9	11.4	205	83	993.3	8.4	2.8	0.38	0.52
2008	11	11	3.6	7.3	255	84	1005.1	9.3	4.7	0.58	0.72
2008	11	12	0.2	4.5	265	88	1018.7	10.0	4.0	0.32	0.46
2008	11	13	4.7	7.9	245	94	1018.5	11.8	7.8	0.49	0.64
2008	11	14	1.0	9.2	225	89	1020.6	12.3	10.5	0.55	0.70
2008	11	15	3.4	3.9	240	91	1024.3	11.9	8.5	0.21	0.31
2008	11	16	5.6	1.8	80	90	1031.6	9.6	7.5	0.36	0.51
2008	11	17	4.8	7.4	200	93	1022.6	10.7	7.8	0.43	0.58
2008	11	18	0.3	5.7	285	90	1023.0	10.6	6.4	0.20	0.29
2008	11	19	0.8	6.0	260	92	1025.2	11.4	5.7	0.32	0.44
2008	11	20	1.6	9.5	280	89	1021.3	11.5	9.2	0.27	0.34
2008	11	21	2.3	7.7	290	86	1022.5	9.8	6.5	0.31	0.41
2008	11	22	0.6	4.5	300	90	1022.1	8.3	6.1	0.42	0.54
2008	11	23	8.2	10.0	275	86	1002.1	10.4	3.3	0.35	0.45
2008	11	24	2.8	7.9	320	80	1010.0	7.5	1.3	0.33	0.41
2008	11	25	0.4	3.8	270	89	1028.5	8.2	2.0	0.17	0.25
2008	11	26	0.2	6.0	230	91	1025.5	10.6	7.9	0.27	0.36
2008	11	27	0.1	10.0	200	89	1015.6	8.9	8.9	0.56	0.62
2008	11	28	0.0	2.9	210	92	996.8	4.8	-3.0	0.06	0.14
2008	11	29	0.0	1.5	230	95	997.3	2.9	-5.0	0.00	0.03
2008	11	30	0.1	3.2	290	92	1003.4	3.6	-2.0	0.00	0.04
<b>Total</b>			<b>75.6</b>							<b>10.1</b>	

Dec-08											
Year	Month	Day	Rainfall (mm)	Wind Speed (Knots)	Wind Direction (Degrees from North)	Relative Humidity (%)	MSL Pressure (hPa)	Max. Temp. (Degrees Celsius)	Min. Temp. (Degrees Celsius)	Potential Evapotranspiration (Penman)	Evaporation (mm)
2008	12	1	0.0	3.5	295	90	1011.8	5.2	-0.9	0.03	0.09
2008	12	2	1.3	3.8	250	89	1005.1	3.7	0.7	0.21	0.30
2008	12	3	6.2	4.6	235	92	999.9	4.7	-3.8	0.05	0.08
2008	12	4	7.3	6.9	220	89	977.0	6.4	2.5	0.03	0.05
2008	12	5	0.8	5.1	280	91	992.2	7.2	1.6	0.15	0.20
2008	12	6	0.0	1.1	160	91	1016.7	6.8	-3.6	0.00	0.07
2008	12	7	0.0	3.5	195	90	1024.3	6.0	-5.1	0.05	0.10
2008	12	8	3.9	4.8	265	90	1020.8	6.5	0.7	0.18	0.25
2008	12	9	0.1	4.9	280	89	1026.9	5.7	0.8	0.13	0.18
2008	12	10	0.2	1.5	250	96	1023.1	4.3	-1.3	0.10	0.16
2008	12	11	4.3	3.0	160	96	1011.7	5.9	1.6	0.22	0.29
2008	12	12	19.6	7.6	200	92	998.0	9.5	1.3	0.41	0.55
2008	12	13	0.0	3.5	240	93	987.7	4.8	-0.8	0.00	0.00
2008	12	14	0.8	4.3	295	93	1003.9	3.9	-0.8	0.13	0.19
2008	12	15	0.3	3.5	190	93	1017.4	6.9	-3.0	0.12	0.17
2008	12	16	3.3	7.5	210	90	1008.5	9.7	3.6	0.36	0.48
2008	12	17	1.7	7.8	220	91	1011.5	10.5	0.8	0.31	0.41
2008	12	18	4.2	9.1	230	84	1012.4	10.6	3.2	0.57	0.71
2008	12	19	1.5	10.5	220	88	1016.4	11.5	1.4	0.53	0.71
2008	12	20	3.9	7.3	230	90	1021.3	11.5	7.8	0.46	0.60
2008	12	21	1.6	9.7	230	92	1025.2	11.9	9.4	0.46	0.58
2008	12	22	0.3	5.7	205	91	1031.5	10.7	5.7	0.25	0.34
2008	12	23	0.0	4.0	180	87	1033.3	9.2	4.6	0.17	0.25
2008	12	24	0.0	1.8	160	86	1034.1	8.8	5.8	0.29	0.46
2008	12	25	0.0	2.8	100	83	1035.0	7.7	3.9	0.22	0.31
2008	12	26	0.0	3.0	70	84	1037.8	6.0	0.9	0.33	0.45
2008	12	27	0.0	4.9	60	88	1036.9	5.5	0.7	0.14	0.18
2008	12	28	0.0	6.8	70	86	1029.9	5.7	1.8	0.23	0.26
2008	12	29	0.0	3.9	100	86	1027.1	2.8	0.2	0.18	0.26
2008	12	30	0.0	5.8	100	85	1027.4	3.9	0.0	0.40	0.52
2008	12	31	0.0	5.8	100	88	1027.0	4.7	1.5	0.17	0.22
<b>Total</b>			<b>61.3</b>							<b>6.9</b>	

## **APPENDIX 2**

### Groundwater



REVISION	DESCRIPTION	DATE

WESTMEATH COUNTY COUNCIL

MARLINSTOWN  
LANDFILL

**GROUND\_WATER\_MONITORING\_LOCATIONS  
POST\_CAPPING\_WORKS**

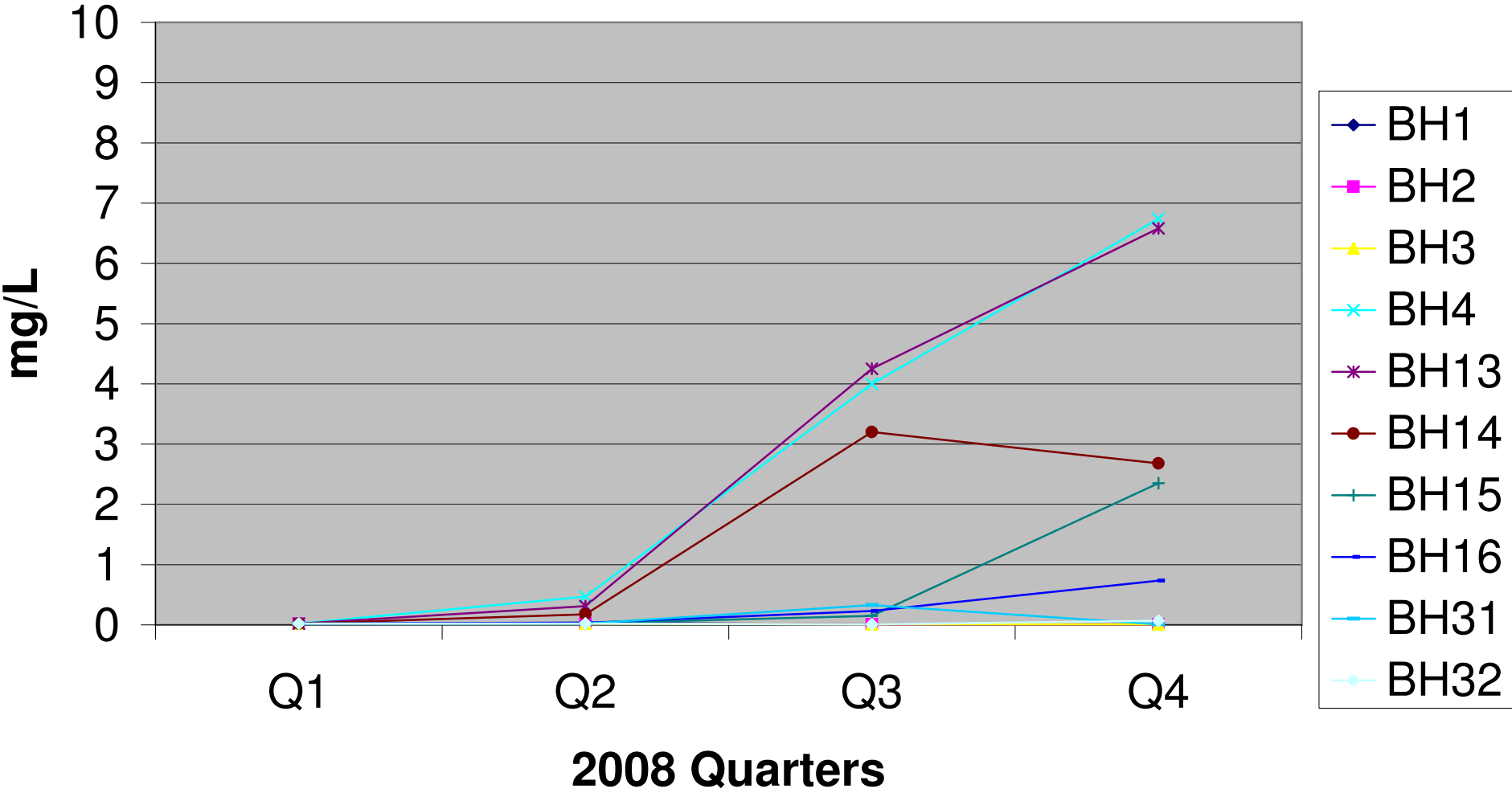


SURVEYED: 2008  
DRAWN: 2008  
CHECKED: 2008  
SCALE: 1:500  
DATE: 2008  
ENVIRONMENT DEPARTMENT  
COURTNEYVIEW

**MRL\_GW\_2**  
FILE NAME & DIRECTORY  
FILE



# Ammonia Groundwater Marlinstown 2008



**Groundwater Lab Monitoring 2008**

<b>Q1</b>	<b>Parameter</b>	<b>Units</b>	<b>Methodology</b>	<b>BH1</b>	<b>BH2</b>	<b>BH3</b>	<b>BH4</b>	<b>BH13</b>	<b>BH14</b>	<b>BH15</b>	<b>BH16</b>	<b>BH31</b>	<b>BH32</b>
16/01/2008	TOC	mg/l C	Spectrophotometry	2.40	8.80	14.60	20.00	38.00	29.00	95.00	70.00	3.40	11.60
	Chloride	mg/l C	Titration	36.00	32.00	12.00	14.00	23.00	10.00	33.00	34.00	16.00	12.00
	pH		Electrometry	7.00	7.00	7.60	6.90	5.50	6.10	7.10	7.00	7.20	7.60
	Ammonia	mg/l N	Spectrophotometry	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02

<b>Q2</b>	<b>Parameter</b>	<b>Units</b>	<b>Methodology</b>	<b>BH1</b>	<b>BH2</b>	<b>BH3</b>	<b>BH4</b>	<b>BH13</b>	<b>BH14</b>	<b>BH15</b>	<b>BH16</b>	<b>BH31</b>	<b>BH32</b>
15/04/2008	TOC	mg/l C	Spectrophotometry	<.3	<.3	0.50	15.90	45.00	43.00	83.50	95.50	1.80	<.03
	Chloride	mg/l C	Titration	56.00	78.00	13.00	13.00	19.00	13.00	32.00	34.00	17.00	14.00
	pH		Electrometry	7.10	7.20	7.50	6.90	5.50	6.10	7.10	7.10	7.00	7.40
	Ammonia	mg/l N	Spectrophotometry	0.037	0.025	<.02	0.427	0.312	0.176	0.027	0.034	0.022	<.02

<b>Q3</b>	<b>Parameter</b>	<b>Units</b>	<b>Methodology</b>	<b>BH1</b>	<b>BH2</b>	<b>BH3</b>	<b>BH4</b>	<b>BH13</b>	<b>BH14</b>	<b>BH15</b>	<b>BH16</b>	<b>BH31</b>	<b>BH32</b>
16/12/2008	TOC	mg/l C	Spectrophotometry	10.00	8.80	18.10	19.10	36.00	25.00	75.00	67.00	1.00	1.80
	Chloride	mg/l C	Titration	15.00	95.00	30.00	13.00	33.00	9.00	26.00	33.00	9.00	12.00
	pH		Electrometry	7.20	7.20	7.50	7.00	6.00	6.10	7.10	7.10	7.30	7.10
	Ammonia	mg/l N	Spectrophotometry	<.01	<.01	<.01	4.000	4.250	3.200	0.150	0.230	0.330	<.01

<b>Q4</b>	<b>Parameter</b>	<b>Units</b>	<b>Methodology</b>	<b>BH1</b>	<b>BH2</b>	<b>BH3</b>	<b>BH4</b>	<b>BH13</b>	<b>BH14</b>	<b>BH15</b>	<b>BH16</b>	<b>BH31</b>	<b>BH32</b>
19/11/2008	TOC	mg/l C	Spectrophotometry	0.40	1.10	1.5	13.30	12.00	3.40	13.60	17.80	2.30	10.10
	Chloride	mg/l C	Titration	40.00	50.00	12	7.00	32.00	12.00	26.00	185.00	6.00	10.00
	pH		Electrometry	7.20	7.20	7.6	10.00	6.10	6.40	7.30	7.20	7.40	7.10
	Ammonia	mg/l N	Spectrophotometry	<.01	<.01	<.01	6.740	6.580	2.680	2.350	0.735	<.01	0.068

## 2008 Ground Water In-Situ Monitoring

### Q1

Well ID Sample ID	Conductivity ( $\mu\text{S}/\text{cm}@20^{\circ}\text{C}$ )	Temperature ( $^{\circ}\text{C}$ )	Dissolved Oxygen $\text{Mg}/\text{L O}^2$	Water Level mbgl	Odour & Visual
BH1	849	9.0	8.43	1.0	No odour, turbid
BH2	850	9.0	6.6	1.2	No odour, turbid
BH3	468	9.0	7.66	2.0	No odour, clear
BH4	728	9.0	4.76	2.6	No odour, slightly brown, turbid
BH13	154	9.0	5.96	3.6	No odour, yellow-brown
BH14	341	9.0	5.36	3	H <sub>2</sub> S odour, turbid
BH15	678	9.0	5.36	2.3	Slight H <sub>2</sub> S odour, dark red colour
BH16	609	9.0	7.68	2.3	Foul odour, brown colour
BH 31	703	9.0	9.27	1.8	None, turbid
BH32	512	9.0	9.43	1.6	None, turbid

### Q2

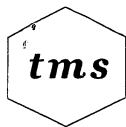
Well ID Sample ID	Conductivity ( $\mu\text{S}/\text{cm}@20^{\circ}\text{C}$ )	Temperature ( $^{\circ}\text{C}$ )	Dissolved Oxygen $\text{Mg}/\text{L O}^2$	Water Level mbgl	Odour & Visual
BH1	805	10	5.81	1.39	No odour, clear
BH2	841	10	6.94	1.4	No odour, clear
BH3	443	11	6.5	2.3	No odour, clear
BH4	681	12	5.51	3.07	Foul, light brown and few solids
BH13	104	11	6.33	3.7	Slightly foul, brown colour
BH14	310	11	5.83	3.34	Foul odour, brown colour, solids
BH15	582	12	5.34	2.5	Foul odour, very dark brown colour
BH16	480	12	6.03	2.65	Foul odour, very dark brown colour
BH 31	678	8	5.07	2.7	None, clear
BH32	495	8	5.27	3.52	None, clear

### Q3

Well ID Sample ID	Conductivity ( $\mu\text{S}/\text{cm}@20^{\circ}\text{C}$ )	Temperature ( $^{\circ}\text{C}$ )	Dissolved Oxygen $\text{Mg}/\text{L O}^2$	Water Level mbgl	Odour & Visual
BH1	1004	13.5	7.82	1.43	
BH2	1036	12.3	7.48	1.37	
BH3	503	12.7	7.96	2.07	
BH4	761	12.8	0.31	2.92	
BH13	305	13.8	0.72	3.59	
BH14	388	13.3	0.39	3.32	
BH15	647	12.1	4.27	3.39	
BH16	616	13	4.47	3.6	
BH 31	481	12.6	6.27	1.24	
BH32	752	12.2	7.06	1.5	

### Q4

Well ID Sample ID	Conductivity ( $\mu\text{S}/\text{cm}@20^{\circ}\text{C}$ )	Temperature ( $^{\circ}\text{C}$ )	Dissolved Oxygen $\text{Mg}/\text{L O}^2$	Water Level mbgl	Odour & Visual
BH1	815	12	8.12	1.17	No odour, clear
BH2	818	11	8.02	1.2	No odour, clear
BH3	449	10	3.35	2.84	No odour, clear
BH4	655	11	8.86	2.92	Slightly foul, dark brown with SS
BH13	286	10	5.87	3.2	Slightly foul, brown colour some SS
BH14	415	11	4.72	3.02	Slightly foul, brown colour some SS
BH15	562	12	7.62	2.5	Foul odour, very dark brown colour
BH16	478	11	7.33	2.13	Foul odour, orange brown colour
BH 31	474	12	8.39	2.76	No odour, opaque with few SS
BH32	625	11	7.69	2.36	Slightly foul, opaque



## Confidential Laboratory Test Report

**Client:** Marlinstown Landfill Site  
Environmental Section  
Westmeath County Council  
Bishopsgate Street  
Mullingar  
Co. Westmeath

**F.T.A.O:** John Waldron  
**Commencement Date:** 16/07/2008  
**Completion Date:** 14/10/2008  
**Report Date:** 14/10/2008

**Client Ref.:**

**TMS Environment Ref:** 13880

**Sample Type:** Ground Water

### TEST RESULTS

Parameter	13880-1 BH31	13880-2 BH32	13880-3 BH14	13880-4 BH13	13880-5 BH15	Units	Methodology	Test Procedure Ref.
*Alkalinity	254	201	150	75	267	mg/L CaCO <sub>3</sub>	Potentiometric Titration	QP-CHEM-2012
*Ortho-phosphate	< 0.1	< 0.1	0.134	0.288	2.27	mg/L P	Spectrophotometry	QP-CHEM-2040
*Chloride	9	12	9	33	26	mg/L	Titration	QP-CHEM-2035
Sulphate	19	24	8.8	13	17	mg/L SO <sub>4</sub> <sup>2-</sup>	Turbidimetry	QP-CHEM-2050
Ammonia	0.33	< 0.01	3.2	4.25	0.15	mg/L N	Spectrophotometry	QP-CHEM-2037
Fluoride	0.162	0.190	0.100	0.068	0.238	mg/L F	Ion Selective Electrode	QP-CHEM-2036
*pH	7.3	7.1	6.1	6.0	7.1	pH Unit	pH Meter	QP-CHEM-2007
DO	6.27	7.06	0.39	0.72	4.27	mg/L O <sub>2</sub>	DO Meter	QP-CHEM-2016
TOC	1.0	1.8	25	36	75	mg/L C	Spectrophotometry	QP-CHEM-2071
Total Cyanide	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	Distillation & Spectrophotometry	QP-CHEM-2072
Total Oxidised Nitrogen	2.2	6.3	< 0.7	1.2	2.4	mg/L TON	Calculation	QP-CHEM-2069
Total Dissolved Solids	305	453	270	275	477	mg/L	Gravimetry	QP-CHEM-2059
Conductivity	481	752	388	305	647	µS/cm	Note 1	Note 1
Temperature	12.6	12.2	13.3	13.8	12.1	°C	Note 1	Note 1

\*Accredited Test

Note 1: Analysis carried out on site.

### TEST RESULTS

Parameter	13880-6 BH16	13880-7 BH3	13880-8 BH4	13880-9 BH1	13880-10 BH2	Units	Methodology	Test Procedure Ref.
*Alkalinity	308	211	374	281	250	mg/L CaCO <sub>3</sub>	Potentiometric Titration	QP-CHEM-2012
*Ortho- phosphate	6.98	0.198	< 0.1	< 0.1	< 0.1	mg/L P	Spectrophotometry	QP-CHEM-2040
*Chloride	33	30	13	15	95	mg/L	Titration	QP-CHEM-2035
Sulphate	17	< 2	3.1	47	54	mg/L SO <sub>4</sub> <sup>2-</sup>	Turbidimetry	QP-CHEM-2050
Ammonia	0.23	< 0.01	4.0	< 0.01	< 0.01	mg/L N	Spectrophotometry	QP-CHEM-2037
Fluoride	0.279	0.389	0.112	0.109	0.360	mg/L F	Ion Selective Electrode	QP-CHEM-2036
*pH	7.1	7.5	7.0	7.2	7.2	pH Unit	pH Meter	QP-CHEM-2007
DO	4.47	7.96	0.31	7.82	7.48	mg/L O <sub>2</sub>	DO Meter	QP-CHEM-2016
TOC	67	18.1	19.1	10.0	8.8	mg/L C	Spectrophotometry	QP-CHEM-2071
Total Cyanide	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	Distillation & Spectrophotometry	QP-CHEM-2072
Total Oxidised Nitrogen	2.0	< 0.7	1.2	4.8	4.2	mg/L TON	Calculation	QP-CHEM-2069
Total Dissolved Solids	499	484	454	590	582	mg/L	Gravimetry	QP-CHEM-2059
Conductivity	616	503	761	1004	1036	µS/cm	Note 1	Note 1
Temperature	13.0	12.7	12.8	13.5	12.3	°C	Note 1	Note 1

\*Accredited Test

Note 1: Analysis carried out on site.

## METALS TEST RESULTS

Units: mg/L

Parameter	13880-1 BH31	13880-2 BH32	13880-3 BH14	13880-4 BH13	13880-5 BH15	Methodology	Test Procedure Ref
<b>*Cadmium</b>	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	ICP-AES	QP-CHEM-2026
<b>*Chromium</b>	< 0.005	< 0.005	0.011	0.0068	< 0.005	ICP-AES	QP-CHEM-2026
<b>*Iron</b>	0.085	2.4	3.4	1.4	0.83	ICP-AES	QP-CHEM-2026
<b>Mercury</b>	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	ICP-AES	QP-CHEM-2026
<b>*Manganese</b>	0.014	0.51	0.35	0.082	0.16	ICP-AES	QP-CHEM-2026
<b>*Nickel</b>	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	ICP-AES	QP-CHEM-2026
<b>Phosphorus</b>	< 0.01	0.12	0.35	0.37	3.1	ICP-AES	QP-CHEM-2026
<b>*Lead</b>	< 0.01	< 0.01	< 0.01	0.012	< 0.01	ICP-AES	QP-CHEM-2026
<b>*Zinc</b>	< 0.01	< 0.01	0.013	< 0.01	< 0.01	ICP-AES	QP-CHEM-2026
<b>*Boron</b>	0.37	0.41	0.44	0.05	0.37	ICP-AES	QP-CHEM-2026
<b>*Calcium</b>	6.7	139	47	32	72	ICP-AES	QP-CHEM-2026
<b>Copper</b>	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	ICP-AES	QP-CHEM-2026
<b>*Potassium</b>	1.2	4.9	2.9	2.0	2.4	ICP-AES	QP-CHEM-2026
<b>*Magnesium</b>	< 1	7.0	3.4	2.7	4.2	ICP-AES	QP-CHEM-2026
<b>*Sodium</b>	3.8	16	12	11	9	ICP-AES	QP-CHEM-2026

\*Accredited Test

## METALS TEST RESULTS

Units : mg/L

Parameter	13880-6 BH16	13880-7 BH3	13880-8 BH4	13880-9 BH1	13880-10 BH2	Methodology	Test Procedure Ref
*Cadmium	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	ICP-AES	QP-CHEM-2026
*Chromium	< 0.005	< 0.005	0.0067	< 0.005	< 0.005	ICP-AES	QP-CHEM-2026
*Iron	5.0	0.23	3.2	3.4	< 0.005	ICP-AES	QP-CHEM-2026
Mercury	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	ICP-AES	QP-CHEM-2026
*Manganese	0.33	0.23	0.35	0.04	< 0.005	ICP-AES	QP-CHEM-2026
*Nickel	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	ICP-AES	QP-CHEM-2026
Phosphorus	7.2	0.23	0.21	< 0.01	0.048	ICP-AES	QP-CHEM-2026
*Lead	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	ICP-AES	QP-CHEM-2026
*Zinc	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	ICP-AES	QP-CHEM-2026
*Boron	0.35	0.05	0.27	0.05	0.36	ICP-AES	QP-CHEM-2026
*Calcium	91	64	134	129	141	ICP-AES	QP-CHEM-2026
Copper	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	ICP-AES	QP-CHEM-2026
*Potassium	14	< 1	2.6	8.7	6.6	ICP-AES	QP-CHEM-2026
*Magnesium	6.4	12	5.5	10	10	ICP-AES	QP-CHEM-2026
*Sodium	28	12	12	43	52	ICP-AES	QP-CHEM-2026

\*Accredited Test



**VOC TEST RESULTS**

Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
<b>MIXTURE 1</b>						
Chlorobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Isopropylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
N-Propylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
o-Xylene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
m/p-Xylene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Sec-Butylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Tert-Butylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichlorobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3-Dichlorobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,4-Dichlorobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
2-Chlorotoluene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
4-Chlorotoluene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 2</b>						
Benzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Toluene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Ethylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
N-Butyl benzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Napthalene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
P-Isopropyltoluene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Styrene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,3-Trichlorobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,4-Trichlorobenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,4 -Trimethylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3,5-Trimethylbenzene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
<b>MIXTURE 3</b>						
Cis 1,3-Dichloropropene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Hexachlorobutadiene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trans 1,3-Dichloropropene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trichloroethylene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1-Dichloropropene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,1,2-Tetrachloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,2-Trichloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,2,2-Tetrachloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dibromo-3-chloropropane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dibromoethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichloropropane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,3-Trichloropropane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3-Dichloropropane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 4</b>						
Bromochloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromoform	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Carbon tetrachloride	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Chloroform	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Dibromomethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Tetrachloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1-Dichloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,1-Trichloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
2,2-Dichloropropane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
<b>MIXTURE 5</b>						
Dichloromethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromodichloromethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Cis-1,2-Dichloroethylene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Dibromochloromethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trans-1,2-Dichloroethylene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1-Dichloroethylene	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 6</b>						
Bromomethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Chloroethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Chloromethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Dichlorodifluoromethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trichlorofluoromethane	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Vinyl Chloride	< 1	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

**SEMIVOLATILE TEST RESULTS**

Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
<b>BASE/NEUTRALS MIX 1</b>						
<b>Bis(2-chloroethyl)ether</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>N-Nitrodimethylamine</b>	< 10	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Bis(2-Chloroisopropyl)ether</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>N-nitroso-di-N-propylamine</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Bis(2-Chloroethoxy)methane</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Dimethylphthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>4-Chlorophenyl-phenylether</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Diethyl Phthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>N-Nitrosodiphenylamine</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>4-Bromophenyl-phenylether</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Di-N-butylphthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Butyl phthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Butyl benzyl phthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Bis (2-ethylhexyl) phthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Di-n-octyl phthalate</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>BASE/NEUTRALS MIX 2</b>						
<b>1,2-dichlorobenzene</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>1,3-dichlorobenzene</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>1,4-dichlorobenzene</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Hexachloroethane</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Nitrobenzene</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Isophorone</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>1,2,4-trichlorobenzene</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Hexachlorobutadiene</b>	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068


Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
Hexachlorocyclopentadiene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Chloronaphthalene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dinitrotoluene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,6-Dinitrotoluene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Azobenzene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Hexachlorobenzene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Carbazole	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>HAZARDOUS SUBSTANCES MIX 1</b>						
2-Methylphenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Methylphenol	< 5	< 5	< 5	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzoic acid	< 250	< 250	< 250	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4,5-Trichlorophenol	< 20	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>HAZARDOUS SUBSTANCES MIX 2</b>						
Benzyl alcohol	< 10	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Aniline	< 10	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chloroaniline	< 10	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Methylnaphthalene	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Nitroaniline	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
3-Nitroaniline	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dibenzofuran	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Nitroaniline	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>BENZIDINE MIX</b>						
Benzidine	< 20	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
3,3-Dichlorobenzidine	< 20	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>PHENOLS MIX</b>						
Pentachlorophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
Phenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Chlorophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Methyl-4,6-dinitrophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Nitrophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dimethylphenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dinitrophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dichlorophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4,6-Trichlorophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chloro-3-methylphenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Nitrophenol	< 2	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
PAH MIX						
Naphthalene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Acenaphthene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Acenaphthylene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Fluorene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Anthracene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Phenanthrene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Fluoranthene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Pyrene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo (a) Anthracene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Chrysene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

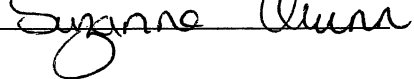
Parameter	13880-3 BH14	13880-6 BH16	13880-9 BH1	Units	Methodology	Test Procedure Ref
Benzo(a)Anthracene	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(b)Fluoranthene*	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(k)fluoranthene*	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(a)Pyrene*	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dibenzo(a,h)Anthracene*	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(ghi)perylene*	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Indenol(1,2,3,-cd)pyrene*	< 0.1	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

\* Relative to naphthalene

Prepared By: Chris Dunlop  
Senior Laboratory Analyst

Signature: 

Approved By: Suzanne Quinn  
Laboratory Manager

Signature: 

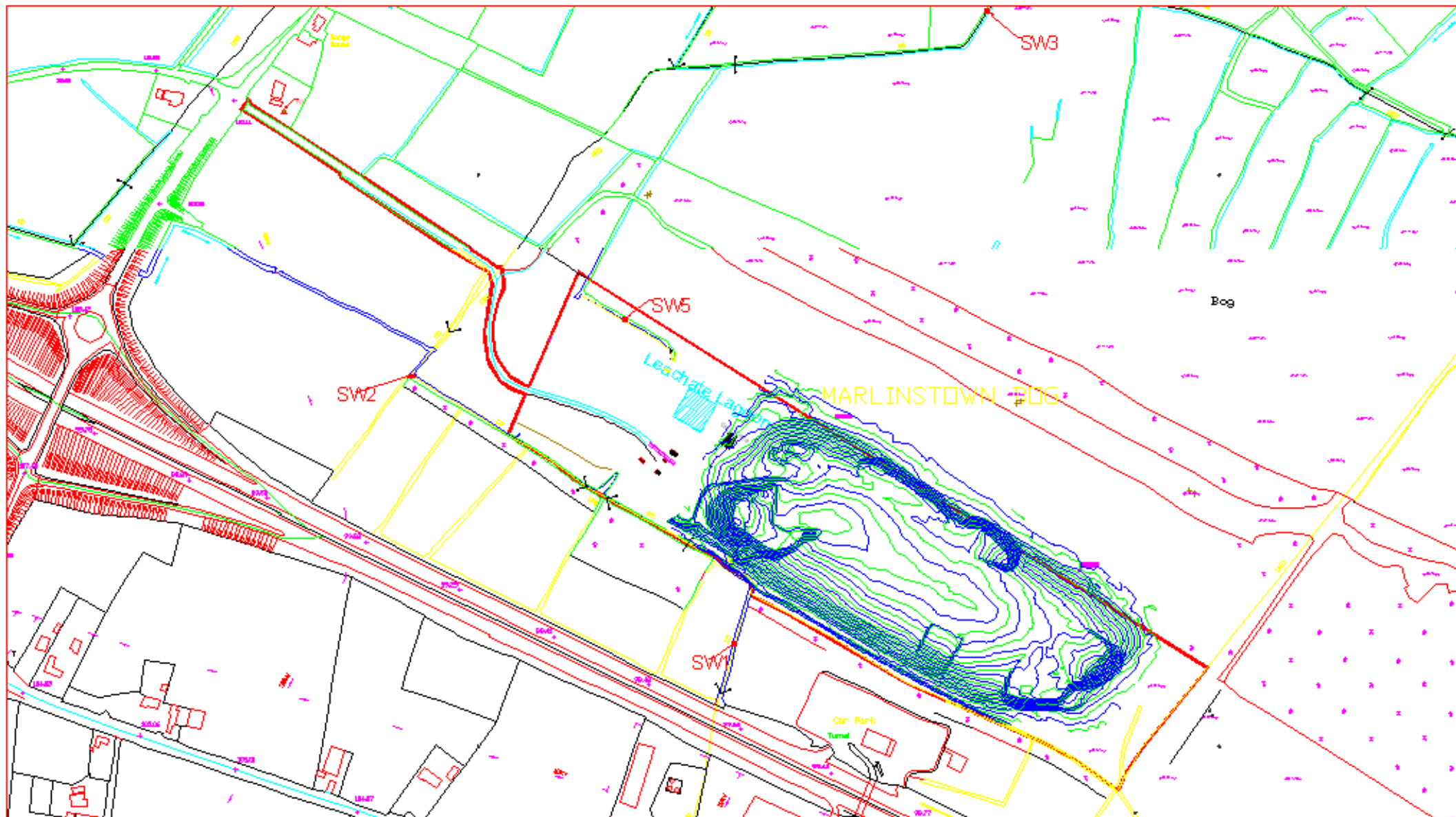
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2. This report relates only to the items tested.
3. Complaints should be addressed in writing to the Laboratory Manager.

## **APPENDIX 3**

Surface Water





REVISION	DESCRIPTION	DATE

WESTMEATH COUNTY COUNCIL

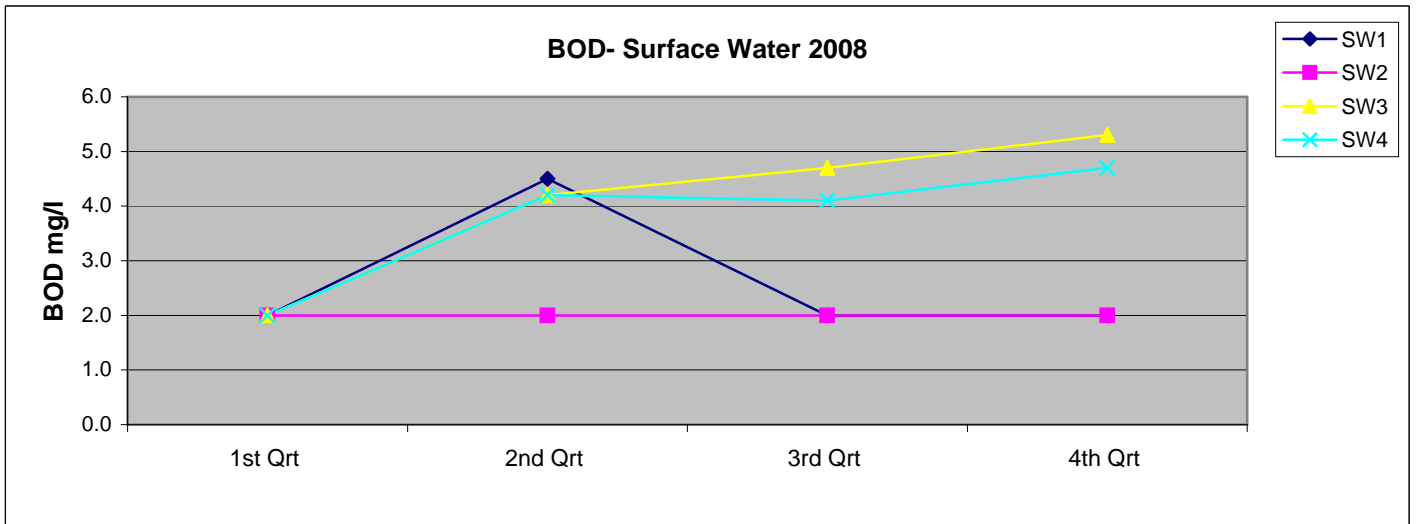
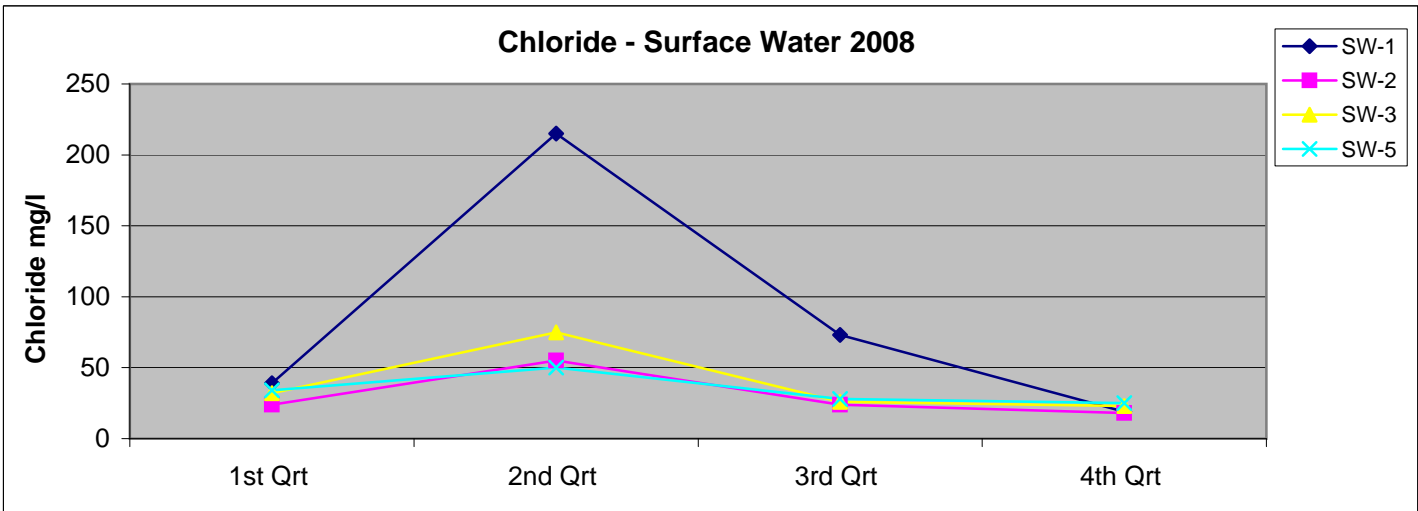
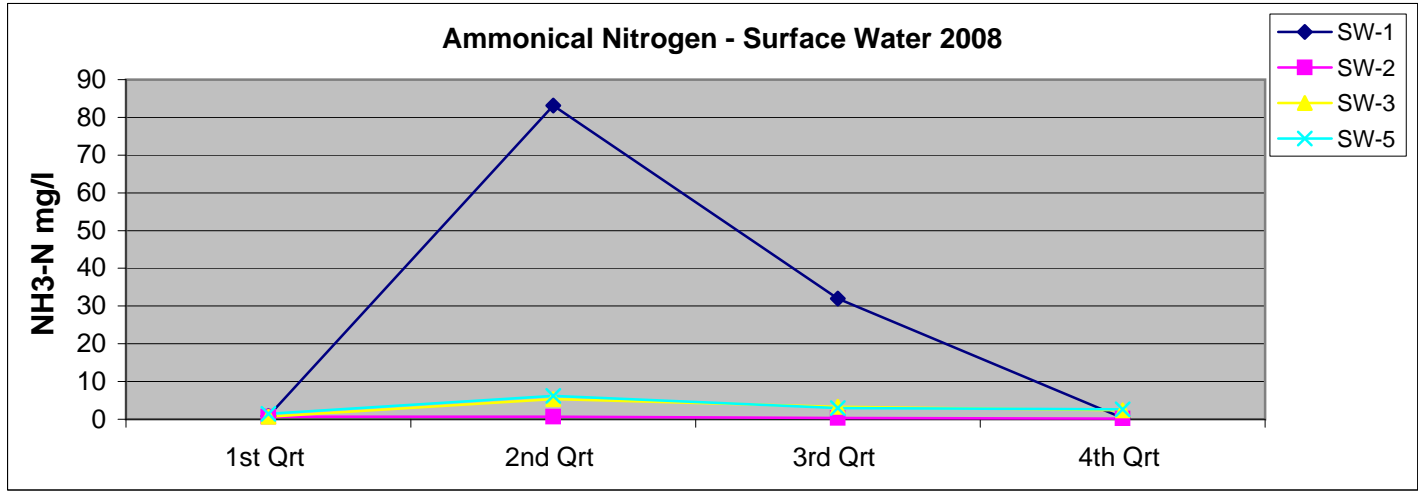
MARLINSTOWN  
LANDFILL

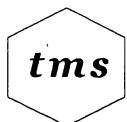
**SURFACE WATER MONITORING POINTS  
POST\_CAPPING\_WORKS**



DRAWN: JGG  
 CHECKED: JGG  
 DATE: 22/03/22  
 COUNTY COUNCIL  
 MULLINGAR, TEL: (045) 32000

MRL\_SW\_2  
 FILE NO.  
 DR





## Confidential Laboratory Test Report

**Client:** Marlinstown Landfill Site  
Environmental Section  
Westmeath County Council  
Bishopsgate Street  
Mullingar  
Co. Westmeath

**F.T.A.O:** Elizabeth Whelan  
**Commencement Date:** 17/07/2008  
**Completion Date:** 24/09/2008  
**Report Date:** 13/10/2008

**Client Ref.:**

**TMS Environment Ref:** 13890

**Sample Type:** Surface Water

### TEST RESULTS

Parameter	13890-1 SW 1	13890-2 SW 2	13890-3 SW 3	13890-4 SW 5	Units	Methodology	Test Procedure Ref.
<b>Total Cyanide</b>	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	Distillation & Spectrophotometry	QP-CHEM-2072
<b>*Chloride</b>	73	24	26	28	mg/L Cl	Titration	QP-CHEM-2035
<b>TON</b>	4.9	2.0	2.6	2.4	mg/L N	Calculation	QP-CHEM-2069
<b>Sulphate</b>	< 2	69	52	67	mg/L SO <sub>4</sub> <sup>-2</sup>	Turbimetry	QP-CHEM-2050
<b>BOD</b>	< 2	< 2	4.7	4.1	mg/L O <sub>2</sub>	5 Day Incubation & DO Meter	QP-CHEM-2016
<b>Dissolved Oxygen</b>	5.17	8.47	8.47	8.63	mg/L O <sub>2</sub>	DO Meter	QP-CHEM-2016
<b>Ammonia</b>	32	0.33	3.3	3.0	mg/L N	Spectrophotometry	QP-CHEM-2037
<b>*Orthophosphate</b>	< 0.01	< 0.01	< 0.01	< 0.01	mg/L P	Spectrophotometry	QP-CHEM-2040
<b>*COD</b>	40	26	33	32	mg/L O <sub>2</sub>	Spectrophotometry	QP-CHEM-2065
<b>*Suspended Solids</b>	242	5.7	9.8	6.2	mg/L	Gravimetry	QP-CHEM-2002
<b>Conductivity</b>	965	747	751	743	µS/cm	Note 1	Note 1
<b>Temperature</b>	17	16	16	16	°C	Note 1	Note 1
<b>pH</b>	7.5	7.4	7.5	7.4	-	Note 1	Note 1

\* Accredited Test

Note 1: Analysis carried out on site

### METALS TEST RESULTS

Parameter	13890-1 SW 1	13890-2 SW 2	13890-3 SW 3	13890-4 SW 5	Units	Methodology	Test Procedure Ref
*Cadmium	< 0.005	< 0.005	< 0.005	< 0.005	mg/L	ICP-AES	QP-CHEM-2026
*Chromium	0.020	0.011	< 0.005	0.0066	mg/L	ICP-AES	QP-CHEM-2026
*Iron	4.1	0.90	1.1	0.92	mg/L	ICP-AES	QP-CHEM-2026
Mercury	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	ICP-AES	QP-CHEM-2026
*Manganese	0.13	0.14	0.20	0.19	mg/L	ICP-AES	QP-CHEM-2026
*Nickel	< 0.02	< 0.02	< 0.02	< 0.02	mg/L	ICP-AES	QP-CHEM-2026
Phosphorus	0.62	0.088	0.087	0.090	mg/L	ICP-AES	QP-CHEM-2026
*Lead	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	ICP-AES	QP-CHEM-2026
*Zinc	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	ICP-AES	QP-CHEM-2026
*Boron	< 0.05	< 0.05	< 0.05	< 0.05	mg/L	ICP-AES	QP-CHEM-2026
*Calcium	137	142	147	148	mg/L	ICP-AES	QP-CHEM-2026
Copper	< 0.05	< 0.05	< 0.05	< 0.05	mg/L	ICP-AES	QP-CHEM-2026
*Potassium	15	2.5	4.2	4.4	mg/L	ICP-AES	QP-CHEM-2026
*Magnesium	9.5	6.3	6.8	7.2	mg/L	ICP-AES	QP-CHEM-2026
*Sodium	42	11	15	16	mg/L	ICP-AES	QP-CHEM-2026

\*Accredited Test

**SEMIVOLATILE TEST RESULTS**

<b>Parameter</b>	<b>13890-2 SW 2</b>	<b>13890-3 SW 3</b>	<b>Units</b>	<b>Methodology</b>	<b>Test Procedure Ref</b>
<b>BASE/NEUTRALS MIX 1</b>					
<b>Bis(2-chloroethyl)ether</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>N-Nitrodimethylamine</b>	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Bis(2-Chloroisopropyl)ether</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>N-nitroso-di-N-propylamine</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Bis(2-Chloroethoxy)methane</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Dimethylphthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>4-Chlorophenyl-phenylether</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Diethyl Phthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>N-Nitrosodiphenylamine</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>4-Bromophenyl-phenylether</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Di-N-butylphthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Butyl phthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Butyl benzyl phthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Bis (2-ethylhexyl) phthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Di-n-octyl phthalate</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>BASE/NEUTRALS MIX 2</b>					
<b>1,2-dichlorobenzene</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>1,3-dichlorobenzene</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>1,4-dichlorobenzene</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Hexachloroethane</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Nitrobenzene</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Isophorone</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>1,2,4-trichlorobenzene</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>Hexachlorobutadiene</b>	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

Parameter	13890-2 SW 2	13890-3 SW 3	Units	Methodology	Test Procedure Ref
Hexachlorocyclopentadiene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Chloronaphthalene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dinitrotoluene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,6-Dinitrotoluene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Azobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Hexachlorobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Carbazole	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>HAZARDOUS SUBSTANCES MIX 1</b>					
2-Methylphenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Methylphenol	< 5	< 5	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzoic acid	< 250	< 250	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4,5-Trichlorophenol	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>HAZARDOUS SUBSTANCES MIX 2</b>					
Benzyl alcohol	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Aniline	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chloroaniline	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Methylnaphthalene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Nitroaniline	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
3-Nitroaniline	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dibenzofuran	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Nitroaniline	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>BENZIDINE MIX</b>					
Benzidine	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
3,3-Dichlorobenzidine	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>PHENOLS MIX</b>					
Pentachlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Phenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

Parameter	13890-2 SW 2	13890-3 SW 3	Units	Methodology	Test Procedure Ref
2-Chlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Methyl-4,6-dinitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Nitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dimethylphenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dinitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dichlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4,6-Trichlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chloro-3-methylphenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Nitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>PAH MIX</b>					
Naphthalene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Acenaphthene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Acenaphthylene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Fluorene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Anthracene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Phenanthrene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Fluoranthene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Pyrene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo (a) Anthracene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Chrysene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(a)Anthracene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(b)Fluoranthene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(k)fluoranthene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(a)Pyrene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dibenzo(a,h)Anthracene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(ghi)perylene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Indenol(1,2,3,-cd)pyrene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

\* Relative to naphthalene

**VOC TEST RESULTS**

Parameter	13890-2 SW 2	13890-3 SW 3	Units	Methodology	Test Procedure Ref
<b>MIXTURE 1</b>					
Chlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Isopropylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
N-Propylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
o-Xylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
m/p-Xylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Sec-Butylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Tert-Butylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3-Dichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,4-Dichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
2-Chlorotoluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
4-Chlorotoluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 2</b>					
Benzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Toluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Ethylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
N-Butyl benzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Napthalene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
P-Isopropyltoluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Styrene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,3-Trichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,4-Trichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,4 -Trimethylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3,5-Trimethylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022



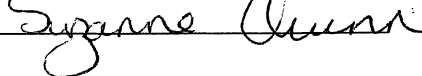
Parameter	13890-2 SW 2	13890-3 SW 3	Units	Methodology	Test Procedure Ref
<b>MIXTURE 3</b>					
Cis 1,3-Dichloropropene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Hexachlorobutadiene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trans 1,3-Dichloropropene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trichloroethylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1-Dichloropropene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,1,2-Tetrachloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,2-Trichloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,2,2-Tetrachloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dibromo-3-chloropropane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dibromoethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichloropropane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,3-Trichloropropane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3-Dichloropropane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 4</b>					
Bromochloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromoform	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Carbon tetrachloride	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Chloroform	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Dibromomethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Tetrachloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1-Dichloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1,1-Trichloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
2,2-Dichloropropane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

Parameter	13890-2 SW 2	13890-3 SW 3	Units	Methodology	Test Procedure Ref
<b>MIXTURE 5</b>					
Dichloromethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromodichloromethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Cis-1,2-Dichloroethylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Dibromochloromethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trans-1,2-Dichloroethylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,1-Dichloroethylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 6</b>					
Bromomethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Chloroethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Chloromethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Dichlorodifluoromethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Trichlorofluoromethane	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Vinyl Chloride	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

Prepared By: Chris Dunlop  
Senior Laboratory Analyst

Signature: 

Approved By: Suzanne Quinn  
Laboratory Manager

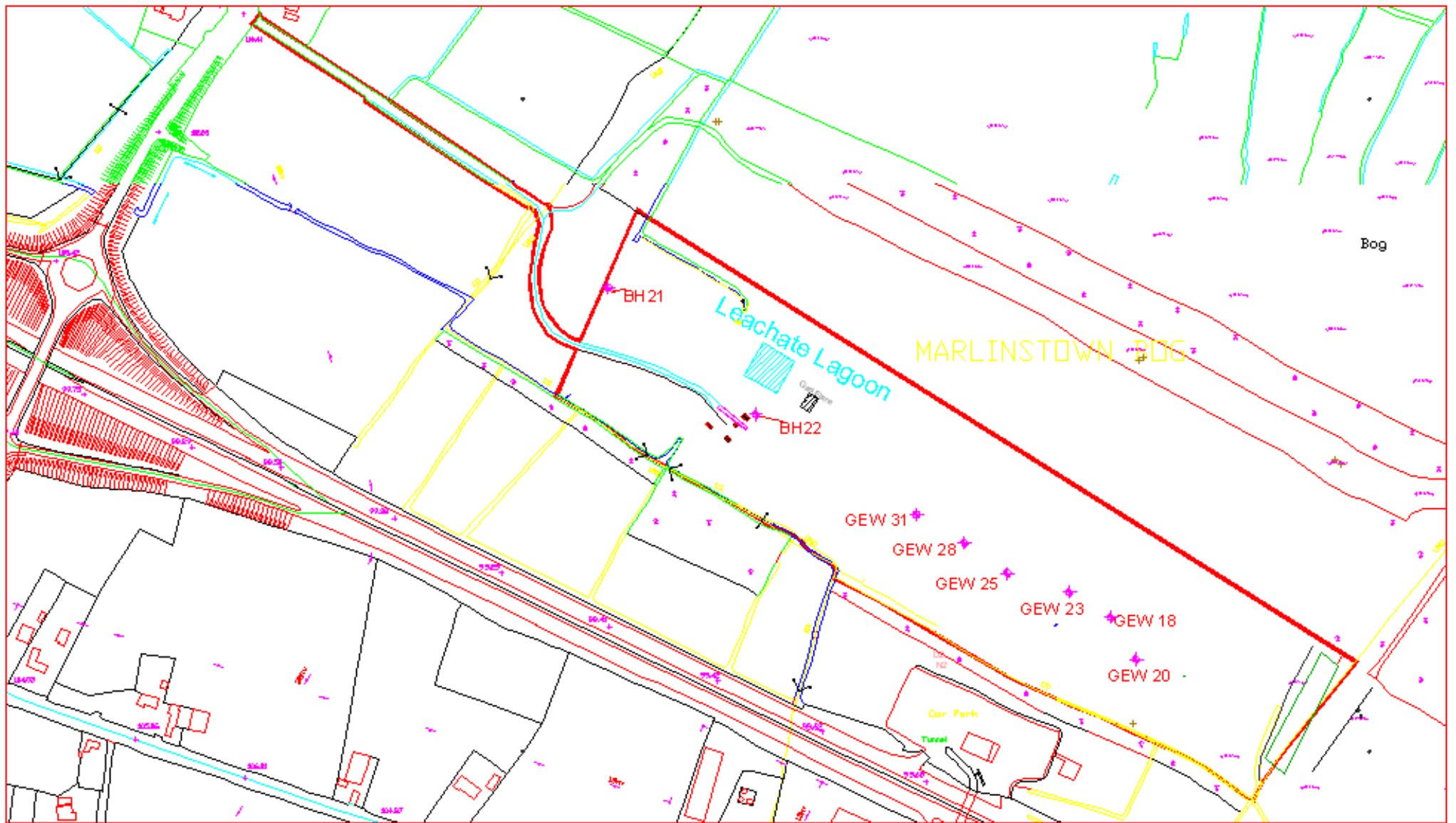
Signature: 

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## **APPENDIX 4**

Leachate



REVISION	DESCRIPTION	DATE

**WESTMEATH COUNTY COUNCIL**

**MARLINSTOWN LANDFILL**

**LEACHATE\_MONITORING\_POINTS  
POST\_CAPPING\_WORKS**



PROJECT: [REDACTED]  
 SURVEY/ISSUE: [REDACTED] SCALE: [REDACTED]  
 [REDACTED] [REDACTED]  
 MALLINGAL TEL: (046) 32000 DR

**MRL\_LHS\_2**

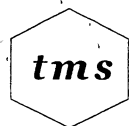
### Leachate Lab Monitoring 2008

Quarter 1	Sample I D	Depth of Leachate (m)	Temp C	Odour/Visual Appearance
16/01/2008	GEW31			Pipe damaged
	GEW28	3.8	15	Oily, light yellow
	GEW25	3.1	15	No odour, dark grey
	GEW23	1.6	15	Oily, dark grey
	GEW18			Pipe damaged
	GEW20	1.5	10	Oily, dark grey
	BH21	1.4	9	Oily, dark yellow
	BH22			No sample volume

Quarter 1	Sample I D	Depth of Leachate (m)	Temp C	Odour/Visual Appearance
17/04/2008	GEW31			Pipe damaged
	GEW28	2.0	16	Mild odour, green-black with SS
	GEW25	2.1	15	Medium odour, green-black with SS
	GEW23	0.8	14	Medium odour, black with SS
	GEW18			Pipe damaged
	GEW20	0.7	12	Mild odour, black with SS
	BH21	0.9	9	Mild odour, yellow brown with SS
	BH22	1.1	8	Mild odour, orange brown with SS

Quarter 1	Sample I D	Depth of Leachate (m)	Temp C	Odour/Visual Appearance
30/07/2008	GEW31			Pipe damaged
	GEW28	7.3	15	
	GEW25	2.2	15	
	GEW23	1.0	15	
	GEW18			Pipe damaged
	GEW20	0.8	10	
	BH21	1.6	9	
	BH22	0.2	17.4	

Quarter 1	Sample I D	Depth of Leachate (m)	Temp C	Odour/Visual Appearance
17/12/2008	GEW31			Pipe damaged
	GEW28	2.3	16	Foul odour, yellow colour with SS
	GEW25	2.0	10	Foul odour, yellow colour with SS
	GEW23	1.0	14	Foul odour, black colour with SS
	GEW18			Pipe damaged
	GEW20	1.0	11	Foul odour, black colour with SS
	BH21	1.0	9	Foul odour, yellow colour with SS
	BH22	3.0		



## Confidential Laboratory Test Report

**Client:** Marlinstown Landfill Site  
Environmental Section  
Westmeath County Council  
Bishopsgate Street  
Mullingar  
Co. Westmeath

**F.T.A.O:** John Waldron  
**Commencement Date:** 30/07/2008  
**Completion Date:** 15/10/2008  
**Report Date:** 16/10/2008  
**Revision Issued:** 20/11/2008

**Client Ref.:**

**TMS Environment Ref:** 13889 Rev 1.0

**Sample Type:** Leachate

### TEST RESULTS

Parameter	13889-1 GEW25	13889-2 GEW23	13889-3 GEW20	13889-4 GEW 28	Units	Methodology	Test Procedure Ref.
*Nitrite	< 0.005	< 0.005	2.36	0.060	mg/L N	Spectrophotometry	QP-CHEM-2045
Nitrate	61.5	23.1	34.8	33.3	mg/L O <sub>3</sub>	Ion Selective Electrode	QP-CHEM-2043
*Ortho-phosphate	5.4	0.90	0.81	< 0.1	mg/L P	Spectrophotometry	QP-CHEM-2040
*COD	1113	427	552	1120	mg/L O <sub>2</sub>	Microdigestion + Spectrophotometry	QP-CHEM-2065
BOD	95	Note 1	208	44	mg/L O <sub>2</sub>	5 Day Incubation + DO Probe	QP-CHEM-2016
Ammonia	1730	490	779	1174	mg/L N	Spectrophotometry	QP-CHEM-2037
Fluoride	5.41	2.51	0.82	1.46	mg/L F	Ion Selective Electrode	QP-CHEM-2036
*Chloride	2200	290	605	140	mg/L	Titration	QP-CHEM-2035
Sulphate	266	71.2	< 2	46.12	mg/L SO <sub>4</sub>	Turbidimetry	QP-CHEM-2050
DO	0.31	0.77	0.41	5.89	mg/L O <sub>2</sub>	DO Meter	QP-CHEM-2016
Total Cyanide	< 0.01	< 0.01	< 0.01	< 0.01	mg/L	Distillation & Spectrophotometry	QP-CHEM-2072
Total Oxidised Nitrogen	14	5.3	10.3	21.3	mg/L TON	Calculation	QP-CHEM-2069
pH	7.39	6.33	7.26	7.39	pH Unit	Note 2	Note 2
Conductivity	15.91	3.60	8.01	12.11	mS	Note 2	Note 2
Temperature	18	19	18	21.8	°C	Note 2	Note 2

\*Accredited Test

Note 1: Results not available as outside dilution range performed in the Laboratory

Note 2: Analysis carried out on site

### TEST RESULTS

Parameter	13889-5 BH22	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref.
*Nitrite	< 0.005	< 0.005	< 0.005	mg/L N	Spectrophotometry	QP-CHEM-2045
Nitrate	7.10	3.61	11.7	mg/L O <sub>3</sub>	Ion Selective Electrode	QP-CHEM-2043
*Ortho- phosphate	0.143	< 0.1	< 0.1	mg/L P	Spectrophotometry	QP-CHEM-2040
*COD	984	460	526	mg/L O <sub>2</sub>	Spectrophotometry	QP-CHEM-2065
BOD	115	34	18	mg/L O <sub>2</sub>	5 Day Incubation + DO Probe	QP-CHEM-2016
Ammonia	36.6	274	150	mg/L N	Spectrophotometry	QP-CHEM-2037
Fluoride	1.22	0.20	0.47	mg/L F	Ion Selective Electrode	QP-CHEM-2036
*Chloride	23	240	400	mg/L	Titration	QP-CHEM-2035
Sulphate	197.1	42.40	26.53	mg/L SO <sub>4</sub>	Turbidimetry	QP-CHEM-2050
DO	5.41	6.81	7.21	mg/L O <sub>2</sub>	DO Meter	QP-CHEM-2016
Total Cyanide	< 0.01	< 0.01	< 0.01	mg/L	Distillation & Spectrophotometry	QP-CHEM-2072
Total Oxidised Nitrogen	1.6	2.2	2.7	mg/L TON	Calculation	QP-CHEM-2069
pH	6.81	6.96	8.28	pH Unit	Note 2	Note 2
Conductivity	1.31	4.27	2.78	mS	Note 2	Note 2
Temperature	17.4	15.0	22.7	°C	Note 2	Note 2

\*Accredited Test

Note 2: Analysis carried out on site

## METALS TEST RESULTS

Units: mg/L

Methodology: ICP-AES

Test Procedure Ref: QP-CHEM-2026

Parameter	13889-1 GEW25	13889-2 GEW23	13889-3 GEW20	13889-4 GEW 28	13889-5 BH22	13889-6 BH21	13889-7 Lagoon
*Cadmium	< 0.005	0.015	0.011	< 0.005	< 0.005	< 0.005	< 0.005
*Chromium	0.049	0.15	0.096	0.037	0.015	0.046	0.015
*Iron	7.1	110	78	21	49	27	1.3
Mercury	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
*Manganese	0.28	3.6	3.1	0.53	0.56	0.82	0.18
*Nickel	0.14	0.44	0.33	0.13	0.06	0.56	0.03
Phosphorus	6.1	7.3	6.2	8.6	9.3	1.1	0.35
*Lead	0.049	0.28	0.40	0.088	0.041	0.23	0.018
*Zinc	3.2	1.5	1.9	1.1	0.7	2.4	0.1
Barium	1.2	2.9	1.6	1.1	1.1	1.4	< 0.05
*Boron	3.2	1.6	1.7	1.7	0.38	1.7	0.63
*Calcium	114	689	546	153	218	214	66
Copper	0.10	0.43	0.63	0.07	0.080	0.70	< 0.05
*Potassium	558	126	307	510	17	195	162
*Magnesium	177	66	257	118	18	162	44
*Sodium	330	162	418	538	50	175	288

\*Accredited Test



**VOC TEST RESULTS**

Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
<b>MIXTURE 1</b>					
Chlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Isopropylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
N-Propylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
o-Xylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
m/p-Xylene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Sec-Butylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Tert-Butylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2-Dichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3-Dichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,4-Dichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
2-Chlorotoluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
4-Chlorotoluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 2</b>					
Benzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Toluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Bromobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Ethylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
N-Butyl benzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Napthalene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
P-Isopropyltoluene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
Styrene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,3-Trichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,4-Trichlorobenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,2,4 -Trimethylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
1,3,5-Trimethylbenzene	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
<b>MIXTURE 3</b>					
<b>Cis 1,3-Dichloropropene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Hexachlorobutadiene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Trans 1,3-Dichloropropene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Trichloroethylene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1-Dichloropropene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1,1,2-Tetrachloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1,2-Trichloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1,2,2-Tetrachloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,2-Dibromo-3-chloropropane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,2-Dibromoethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,2-Dichloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,2-Dichloropropane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,2,3-Trichloropropane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,3-Dichloropropane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 4</b>					
<b>Bromochloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Bromoform</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Carbon tetrachloride</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Chloroform</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Dibromomethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Tetrachloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1-Dichloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1,1-Trichloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>2,2-Dichloropropane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
<b>MIXTURE 5</b>					
<b>Dichloromethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Bromodichloromethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Cis-1,2-Dichloroethylene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Dibromochloromethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Trans-1,2-Dichloroethylene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>1,1-Dichloroethylene</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>MIXTURE 6</b>					
<b>Bromomethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Chloroethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Chloromethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Dichlorodifluoromethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Trichlorofluoromethane</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022
<b>Vinyl Chloride</b>	< 1	< 1	ppb	Purge and Trap, GCMS	QP-CHEM-2022

**SEMIVOLATILE TEST RESULTS**

Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
<b>BASE/NEUTRALS MIX 1</b>					
Bis(2-chloroethyl)ether	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
N-Nitrodimethylamine	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Bis(2-Chloroisopropyl)ether	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
N-nitroso-di-N-propylamine	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Bis(2-Chloroethoxy)methane	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dimethylphthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chlorophenyl-phenylether	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Diethyl Phthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
N-Nitrosodiphenylamine	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Bromophenyl-phenylether	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Di-N-butylphthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Butyl phthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Butyl benzyl phthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Bis (2-ethylhexyl) phthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Di-n-octyl phthalate	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>BASE/NEUTRALS MIX 2</b>					
1,2-dichlorobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
1,3-dichlorobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
1,4-dichlorobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Hexachloroethane	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Nitrobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Isophorone	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
1,2,4-trichlorobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Hexachlorobutadiene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
Hexachlorocyclopentadiene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Chloronaphthalene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dinitrotoluene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,6-Dinitrotoluene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Azobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Hexachlorobenzene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Carbazole	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>HAZARDOUS SUBSTANCES MIX 1</b>					
2-Methylphenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Methylphenol	< 5	< 5	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzoic acid	< 250	< 250	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4,5-Trichlorophenol	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>HAZARDOUS SUBSTANCES MIX 2</b>					
Benzyl alcohol	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Aniline	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chloroaniline	< 10	< 10	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Methylnaphthalene	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Nitroaniline	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
3-Nitroaniline	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dibenzofuran	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Nitroaniline	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>BENZIDINE MIX</b>					
Benzidine	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
3,3-Dichlorobenzidine	< 20	< 20	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
<b>PHENOLS MIX</b>					
Pentachlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
Phenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Chlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Methyl-4,6-dinitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2-Nitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dimethylphenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dinitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4-Dichlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
2,4,6-Trichlorophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Chloro-3-methylphenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
4-Nitrophenol	< 2	< 2	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
PAH MIX					
Naphthalene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Acenaphthene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Acenaphthylene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Fluorene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Anthracene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Phenanthrene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Fluoranthene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Pyrene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo (a) Anthracene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Chrysene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

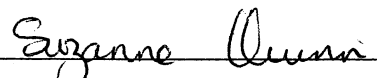
Parameter	13889-6 BH21	13889-7 Lagoon	Units	Methodology	Test Procedure Ref
Benzo(a)Anthracene	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(b)Fluoranthene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(k)fluoranthene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(a)Pyrene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Dibenzo(a,h)Anthracene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Benzo(ghi)perylene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068
Indenol(1,2,3,-cd)pyrene*	< 0.1	< 0.1	ppb	Solvent Extraction, GCMS	QP-CHEM-2068

\* Relative to naphthalene

Prepared By: Chris Dunlop  
Senior Laboratory Analyst

Signature: 

Approved By: Suzanne Quinn  
Laboratory Manager

Signature: 

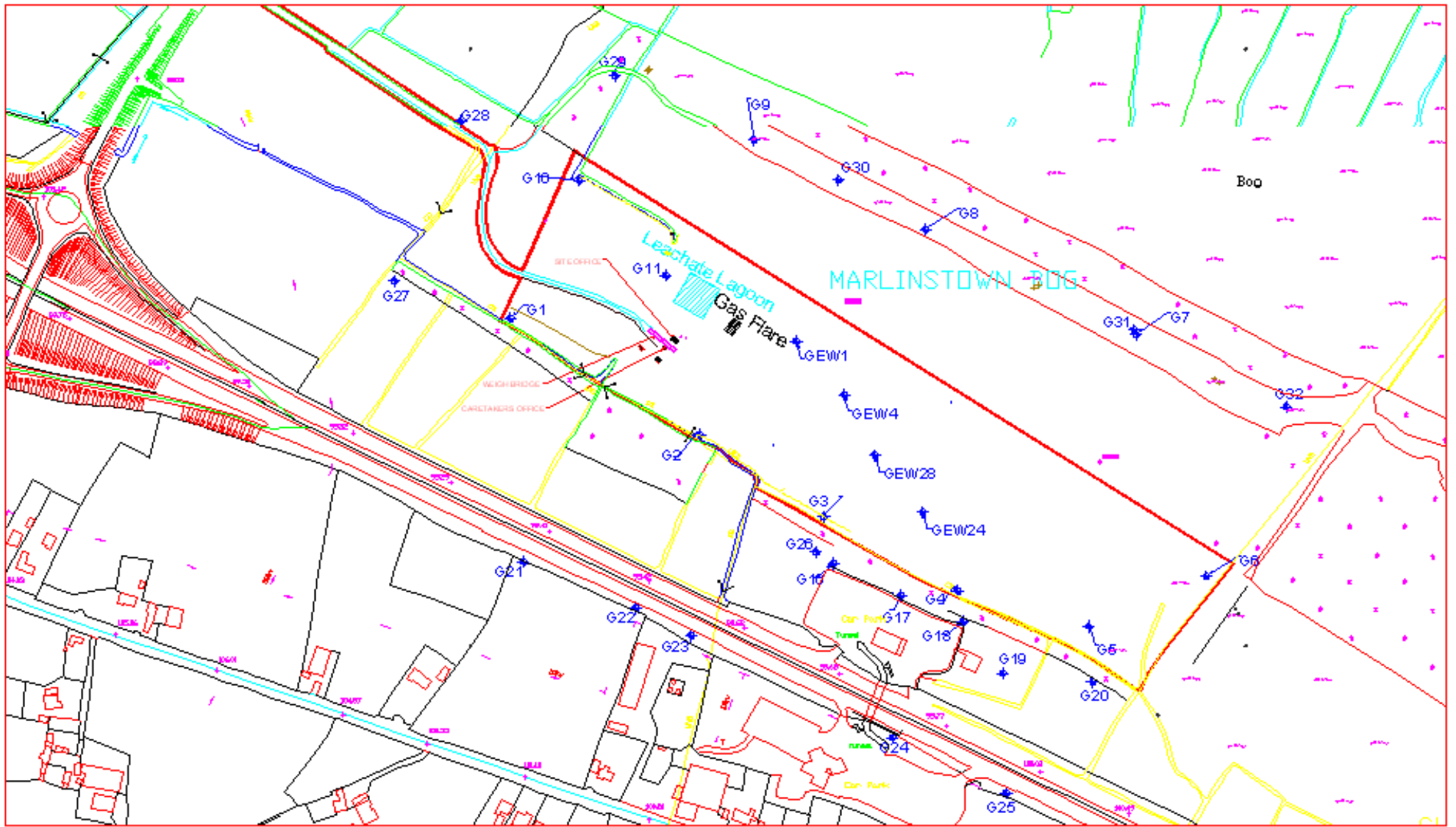
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2. This report relates only to the items tested.
3. Complaints should be addressed in writing to the Laboratory Manager.

## **APPENDIX 5**

Landfill Gas





NO.	DESCRIPTION	DATE

**GAS\_MONITORING\_LOCATIONS  
POST\_CAPPING\_WORKS**

**WESTMEATH COUNTY COUNCIL**

**MARLINSTOWN  
LANDFILL**

MRL\_GS\_2

<b>LANDFILL GAS MONITORING RECORD SHEET</b>
---

**SITE** Marlinstown Landfill Site, Mullingar, Co Westmeath

**LICENCE REGISTER NO** W0071-02

**DATE & TIME** 16/01/2008

**JOB NO.** 12971

**GAS MONITORING INSTRUMENTATION**

GA2000

**SERIAL NO** GA05588

**EXTERNAL CALIBRATION**

**DATE** 22/03/2007

**CERTIFICATE NO** CSL Cert. No 1173

**INTERNAL CALIBRATION DETAILS**

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

**WIND SPEED AND DIRECTION**

**COMMENTS**

MONITORING LOCATION	METHANE	CARBON DIOXIDE	OXYGEN	ATMOSPHERIC	ATMOSPHERIC	HYDROGEN SULPHIDE	CARBON MONOXIDE	COMMENTS
	CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>	TEMPERATURE	PRESSURE	H <sub>2</sub> S	CO	
	% v/v	% v/v	% v/v	°C	mbar	ppm	ppm	
<i>Monitoring Wells</i>								
G1	10.9	12.9	5.2	5.6	981	0	0	
G2	19.7	4.3	0.5	5.3	981	0	0	
G3	29.5	2.6	< 0.1	5.4	981	0	0	
G4	0.1	0.7	19.4	6.3	981	0	0	
G5	0.1	0.6	19.3	5.3	981	0	0	
G6	< 0.1	< 0.1	20.6	4.8	981	0	0	
G7	47.9	3.6	2.6	6.6	981	0	10	
G8	25.3	8.1	9.2	6.5	981	0	0	
G9	13.1	9.6	9.8	5.3	981	0	11	
G10	6.4	7.7	< 0.1	8.2	981	0	0	
G11	23.9	1.2	2.1	5.7	981	0	0	
GEW 1	37.0	27.5	< 0.1	6.1	981	25	0	
GEW 4	31.0	18.4	8.7	4.8	981	16	0	
GEW 28	39.9	30.0	0.4	5.0	981	33	0	
GEW 24	19.7	17.4	9.6	5.1	981	16	0	
G16	< 0.1	< 0.1	20.1	6.5	981	0	0	
G17	< 0.1	4.3	18.7	6.4	981	0	0	
G18	0.7	0.1	19.6	6.4	981	0	0	
<i>Buildings</i>								
Hamill's Shop	< 0.1	< 0.1	20.1	6.5	981	0	0	
Site Hut	-	-	-	-	-	-	-	
Site Office	-	-	-	-	-	-	-	

**NOTES:**

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

<b>LANDFILL GAS MONITORING RECORD SHEET</b>
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**SITE** Marlinstown Landfill Site, Mullingar, Co Westmeath

**LICENCE REGISTER NO** W0071-02

**DATE & TIME** 15/02/2008

**JOB NO.** 13120

**GAS MONITORING INSTRUMENTATION**

GA2000

**SERIAL NO** GA05588

**EXTERNAL CALIBRATION**

**DATE** 22/03/2007

**CERTIFICATE NO** CSL Cert. No 1173

**INTERNAL CALIBRATION DETAILS**

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

**WIND SPEED AND DIRECTION**

**COMMENTS**

MONITORING LOCATION	METHANE	CARBON DIOXIDE	OXYGEN	ATMOSPHERIC	ATMOSPHERIC	HYDROGEN SULPHIDE	CARBON MONOXIDE	COMMENTS
	CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>	TEMPERATURE	PRESSURE	H <sub>2</sub> S	CO	
	% v/v	% v/v	% v/v	°C	mbar	ppm	ppm	
<i>Monitoring Wells</i>								
G1	3.1	10.2	6.9	5.0	1027	0	0	
G2	11.4	2.6	0.0	5.3	1027	0	0	
G3	29.6	2.3	0.0	5.5	1027	0	0	
G4	0.7	1.7	9.8	5.5	1027	0	0	
G5	0.7	0.4	18.7	5.0	1027	0	0	
G6	0.0	0.0	19.9	5.3	1027	0	0	
G7	59.2	3.8	4.8	4.9	1026	0	19	Pipe full of water
G8	12.4	10.4	9.6	4.4	1026	0	2	
G9	10.7	15.1	0.2	4.4	1026	0	16	
G10						0	2	Pipe full of water
G11	1.9	0.3	17.8	7.6	1025	0	0	
GEW 1	16.2	21.6	0.0	4.8	1025	0	0	
GEW 4	24.7	16.0	9.4	5.3	1025	2	0	
GEW 28	30.5	25.4	0.0	5.7	1027	22	0	
GEW 24	15.0	16.4	7.7	5.3	1025	0	0	
G16	0.0	0.1	19.9	5.5	1025	0	0	
G17	0.0	0.2	19.8	5.5	1025	0	0	
G18	0.0	0.1	19.8	5.8	1025	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.0	20.0	5.4	1025	0	0	

**NOTES:**

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE

Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO

WL 71-2

DATE &amp; TIME

7/03/08-12/03/2007

JOB NO.

13221

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO

GA05588

EXTERNAL CALIBRATION

DATE

7/03/08-12/03/08

CERTIFICATE NO

CSL Cert. No 2123

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	32.0	20.8	0.0	8.7	997	0	0	
G2	16.9	5.0	1.8	8.2	997	0	0	
G3	23.8	2.9	0.0	7.9	997	0	0	
G4	32.6	3.1	0.9	9.1	997	0	0	
G5	2.9	0.6	15.9	9.3	997	0	0	
G6	< 0.1	< 0.1	19.8	8.3	997	0	0	
G7	17.0	4.3	4.6	7.0	997	0	0	
G8	13.5	9.5	8.2	8.3	997	0	0	
G9	9.2	15.3	1.0	7.6	997	0	0	
G10	0.1	18.8	0.9	8.5	997	0	0	
G11	0.3	0.4	18.0	10.2	997	0	0	
GEW 1	35.4	24.9	0	7.3	997	14	0	
GEW 4	25.1	18.4	6.6	8.7	997	12	0	
GEW 28	37.9	27.4	0.0	10.5	997	27	0	
GEW 24	40.2	24.8	2.7	10.8	997	0	0	
G16	< 0.1	< 0.1	20.4	6.7	989	0	0	
G17	< 0.1	< 0.1	20.4	7.5	989	0	0	
G18	< 0.1	< 0.1	20.2	7.2	989	0	0	
<i>Buildings</i>								
Hamill's Shop	< 0.1	< 0.1	20.0	13.0	997	0	0	
Site Hut								
Site Office								

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE 7/03/08-12/03/2007

TIME 11.00

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 13/02/2006

CERTIFICATE NO CSL Cert. No 2123

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [1]

WIND SPEED AND DIRECTION

COMMENTS

Each quarter an extended network of gas points G19 - G32 are monitored in addition to G1 - G18 and the buildings.

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G19	<0.1	3.3	17.5	7.0	989	0	0	
G20	<0.1	<0.1	19.9	8.6	989	0	0	
G21	<0.1	0.5	19.9	7.7	989	0	0	
G22	<0.1	0.1	20.3	6.1	989	0	0	
G23	<0.1	0.4	19.3	6.4	988	0	0	
G24	<0.1	2.1	18.9	10.3	989	0	0	
G25	<0.1	0.6	19.6	6.3	989	0	0	
G26	0.2	<0.1	20.0	8.1	989.0	0	0	
G27								pipe full of water
G28	3.2	8.3	0.0	9.2	997	0	22	
G29	<0.1	14.2	6.0	8.0	997	0	0	
G30	<0.1	0.1	19.0	8.4	997	0	10	
G31	<0.1	3.6	15.0	8.3	997	0	0	
G32	18.9	1.1	6.8	10.5	997	0	325	

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

SITE **Marlinstown Landfill Site, Mullingar, Co Westmeath**LICENCE REGISTER NO **W0071-02**DATE & TIME **02/05/2008**JOB NO. **13488**

GAS MONITORING INSTRUMENTATION

**GA2000**

SERIAL NO

**GA05588**

EXTERNAL CALIBRATION

DATE **04/04/08**

CERTIFICATE NO

**CSL Cert. No 7669**

INTERNAL CALIBRATION DETAILS

**CH4 5.5%, CO2 4.9%, O2 5.1% [2]**

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE	CARBON DIOXIDE	OXYGEN	ATMOSPHERIC	ATMOSPHERIC	HYDROGEN SULPHIDE	CARBON MONOXIDE	COMMENTS
	CH <sub>4</sub>	CO <sub>2</sub>	O <sub>2</sub>	TEMPERATURE	PRESSURE	H <sub>2</sub> S	CO	
	% v/v	% v/v	% v/v	°C	mbar	ppm	ppm	
<i>Monitoring Wells</i>								
G1	46.4	20.8	0.3	14.2	1001	0	0	
G2	19.0	6.7	0.0	14.3	1001	0	5	
G3	23.4	4.7	0.0	13.0	1001	0	6	
G4	7.8	3.2	1.9	14.0	1001	0	3	
G5	0.6	0.6	18.3	13.1	1001	0	7	
G6	0.0	0.0	20.4	14.2	1001	0	0	
G7	10.0	2.1	12.7	14.1	1001	0	0	
G8	17.5	11.0	7.4	15.6	1001	0	4	
G9	1.9	18.6	0.1	18.8	1001	0	9	
G10								Pipe full of water
G11	0.0	0.5	17.8	17.0	1001	0	4	
GEW 1	17.1	21.2	0.1	16	1001	0	6	
GEW 4	32.0	19.2	7.5	16.9	1001	0	5	
GEW 28	25.1	23.6	0.4	13.9	1001	1	6	
GEW 24	10.6	16.1	6.0	13.6	1001	15	2	
G16	0.0	0.1	20.6	18.3	1001	0	1	
G17	0.0	0.0	20.8	14.8	1001	0	0	
G18	0.0	0.0	20.8	14.8	1001	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.0	20.8	14.9	1001	0	0	

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE &amp; TIME 6/06/08-27/06/2008

JOB NO. 13647

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	27.0	21.4	0.0	15.0	1,007	0	12	
G2	1.5	11.2	0.3	13.3	1,007	1	17	
G3	0.9	13.4	0.0	15.3	997	0	0	
G4	12.3	5.6	0.5	14.7	1,007	1	16	
G5	1.4	0.4	13.6	14.1	1,007	0	20	
G6	0.1	0.0	20.9	16.3	1,007	1	5	
G7	10.3	2.0	0.0	12.9	1,007	0	32	
G8	6.9	12.2	1.2	13.8	1,007	0	4	
G9	9.8	18.3	0.0	13.9	1,007	0	14	
G10	0.1	9.4	5.3	15.4	1,007	0	16	
G11	0.1	5.9	6.1	16.7	1,007	0	20	
GEW 1	16.7	21.4	0	15.5	1,007	6	29	
GEW 4	6.0	28.7	0.0	17.1	1,007	25	16	
GEW 28	31.2	23.9	0.2	18.6	1,007	25	16	
GEW 24	13.6	12.6	9.4	20.0	1,007	1	15	
G16	0.0	0.2	20.6	18.4	997	0	0	
G17	8.2	18.6	0.9	16.3	997	0	5	
G18	0.0	0.0	20.1	16.3	997	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.0	20.5	16.4	997	0	0	
Site Hut								
Site Office								

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

SITE

Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO

WL 71-2

DATE

6/06/08-27/06/2008

TIME

11.00

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO

GA05588

EXTERNAL CALIBRATION

DATE

04/04/08

CERTIFICATE NO

CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [1]

WIND SPEED AND DIRECTION

COMMENTS

Each quarter an extended network of gas points G19 - G32 are monitored in addition to G1 - G18 and the buildings.

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G19	0.0	5.4	14.0	17.0	997	0	0	
G20								Note 2
G21	0.0	1.5	20.0	13.4	1,006	1	11	
G22	0.0	1.2	19.4	12.2	1,006	1	13	
G23	0.0	2.2	17.9	12.6	1,006	1	13	
G24	0.0	0.8	20.2	15.3	1,006	2	16	
G25	0.0	0.6	20.5	14.9	1,006	2	16	
G26	83.0	20.6	0.0	17.5	997.0	0	0	
G27	1.1	2.5	0.0	14.8	997	0	55	
G28	2.1	0.0	6.5	16.4	997	0	25	
G29	0.0	5.2	15.0	18.4	1,007	0	6	
G30	0.1	0.3	20.2	12.8	1,007	0	0	
G31	0.0	7.7	10.5	14.1	1,007	0	5	
G32	15.3	0.6	0.1	13.6	1,007	8	>500	

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste
2. No results available due to no access to the monitoring location



## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE &amp; TIME 16/07/2008

JOB NO. 13879

GAS MONITORING INSTRUMENTATION GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	12.6	15.6	3.1	15.9	1,010	0	2	
G2	53.0	6.7	0.0	13.6	1,010	0	0	
G3	5.6	8.3	0.0	14.9	1,010	0	0	
G4								Note 2
G5	0.2	0.9	18.7	16.5	1,010	0	0	
G6	0.0	0.0	20.7	17.1	1,010	0	0	
G7	35.5	2.7	0.3	14.4	1,011	0	4	
G8	4.9	9.3	4.8	15.3	1,011	0	0	
G9	9.5	16.6	1.0	16.4	1,011	0	2	
G10	0.1	10.1	0.3	16.2	1,010	0	13	
G11	0.1	10.1	0.3	16.2	1,010	0	1	
GEW 1	34.2	24.3	0	17.8	1,010	16	7	
GEW 4	62.0	31.0	0.0	17.6	1,010	72	4	
GEW 28	27.9	24.0	0.5	16.7	1,010	28	4	
GEW 24	0.3	0.2	20.5	18.8	1,010	0	0	
G16	0.0	0.6	19.8	16.2	1,009	0	0	
G17	0.0	0.0	20.9	15.6	1,009	0	0	pipe blocked
G18	0.1	0.0	21.1	17.1	1,009	0	0	
<i>Buildings</i>								
Hamil's Shop	0.0	0.0	21.1	18.3	1,009	0	0	
Site Hut								
Site Office								

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste
2. Well not found due to high vegetation

## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE &amp; TIME 20/08/2008

JOB NO. 14060

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	19.4	15.6	4.0	16.7	994	0	6	
G2	12.9	4.4	0.0	17.8	994	0	0	
G3								Note 2
G4								Note 2
G5	8.4	3.8	3.0	18.4	994	0	0	
G6	0.0	0.0	20.4	17.3	994	0	0	
G7	42.2	2.4	1.7	19.1	994	0	7	
G8	15.8	9.7	4.8	19.0	994	0	0	
G9	18.6	17.0	0.2	16.9	994	0	0	
G10	2.0	8.1	0.0	17.2	994	0	13	
G11								Note 2
GEW 1	30.6	24.5	0.0	17.6	994	22	9	
GEW 4	63.3	34.4	0.0	19.5	994	80	3	
GEW 28	23.8	23.2	0.2	17.6	994	20	7	
GEW 24	26.7	12.9	6.4	17.9	994	0	3	
G16	0.0	0.2	20.6	18.3	993	0	0	
G17	0.1	0.2	20.7	17.1	993	0	0	
G18	0.0	0.0	21.0	16.8	993	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.1	20.7	17.9	993	0	0	
Site Hut								
Site Office								

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste
2. Well not found due to high vegetation

## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE &amp; TIME 15/09/2008

JOB NO. 14174

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	10.9	17.1	3.1	15.1	1,009	0	1	
G2	9.2	3.1	0.4	15.4	1,009	0	0	
G3	25.9	4.9	0.0	14.4	1,009	0	0	
G4	28.5	6.5	6.5	14.2	1,009	0	1	
G5								water in the pipe .
G6	0.0	0.0	20.7	14.3	1,008	0	0	
G7	50.0	3.0	5.4	14.9	1,009	0	4	water in the pipe
G8	11.4	8.6	5.7	15.2	1,009	0	0	
G9	14.4	18.5	0.0	1009.0	17	0	4	
G10	3.9	8.1	0.0	14.1	1,009	0	25	
G11	0.1	0.6	18.5	15.3	1,008	0	0	
GEW 1	32.5	25.3	0	14.5	1,008	6	5	
GEW 4	31.0	22.1	5.8	14.9	1,008	41	0	
GEW 28	25.0	24.1	0.0	14.1	1,008	8	1	
GEW 24	29.7	24.7	1.2	14.8	1,008	55	0	
G16								water in the pipe
G17								pipe blocked
G18	0.1	0.0	20.2	14.3	1,008	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.0	20.8	18.0	1,008	0	0	
Site Hut								
Site Office								

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE 15/09/2008

TIME 11.00

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [1]

WIND SPEED AND DIRECTION

COMMENTS

Each quarter an extended network of gas points G19 - G32 are monitored in addition to G1 - G18 and the buildings.

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G19	0.1	8.1	12.3	15.1	1,009	0	0	
G20	6.4	1.3	0.0	17.2	1,009	0	0	
G21	0.0	1.7	18.9	14.0	1,009	0	0	
G22	0.0	0.4	20.6	13.7	1,009	0	0	
G23	0.0	2.9	15.1	13.4	1,009	0	0	
G24	0.0	0.6	20.2	14.4	1,009	0	0	
G25	0.0	0.9	20.2	13.9	1,009	0	0	
G26	32.0	17.7	0.6	14.1	1,008	0	0	
G27	6.7	0.0	0.0	15.0	1,009	0	0	
G28	1.4	0.0	4.3	13.4	1,009	0	70	
G29	0.0	11.2	8.9	13.4	1,009	0	0	
G30	0.2	0.2	20.5	15.2	1,009	0	0	
G31	0.1	0.8	19.3	15.3	1,009	0	13	
G32	18.4	0.0	0.0	14.9	1,009	0	826	

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE &amp; TIME 17/10/2008

JOB NO. 14344

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	24.7	21.4	2.7	10.4	1,006	0	0	
G2	2.3	4.5	11.8	12.1	1,006	0	0	
G3	27.3	4.6	0.3	9.2	1,006	0	0	
G4	3.3	4.5	2.7	9.7	1,006	0	0	
G5	23.0	0.8	0.2	10.6	1,006	0	0	
G6	0.0	0.0	20.1	11.3	1,006	0	0	
G7	39.3	2.3	6.7	11.6	1,006	0	0	
G8	13.4	7.4	8.8	11.4	1,006	0	0	
G9	5.3	13.0	5.0	12.0	1,006	0	11	
G10	5.9	8.7	0.0	18.3	1,006	0	8	
G11	0.1	0.6	19.3	10.3	1,006	0	0	
GEW 1	48.1	27.2	0.0	9.9	1,006	2	1	
GEW 4	40.1	24.0	4.3	10.6	1,006	55	0	
GEW 28	40.4	25.9	0.0	10.9	1,006	4	2	
GEW 24	37.5	24.7	3.1	13.1	1,006	0	22	
G16	-	-	-	-	-	-	-	water in the pipe
G17	-	-	-	-	-	-	-	water in the pipe
G18	0.0	0.0	21.2	8.8	1,006	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.0	21.2	9.9	1,006	0	0	
Site Hut								
Site Office								

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste
2. Well not found due to high vegetation

## LANDFILL GAS MONITORING RECORD SHEET

SITE

Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO

WL 71-2

DATE &amp; TIME

20/11/08-2/12/08

JOB NO.

14480

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO

GA05588

EXTERNAL CALIBRATION

DATE

04/04/08

CERTIFICATE NO

CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	69.9	25.3	0.0	9.2	1,012	0	3	
G2	3.7	4.0	3.0	10.1	1,012	0	0	
G3	30.3	3.2	0.6	3.9	993	0	0	
G4	0.1	2.6	6.2	3.8	993	0	0	
G5								water in the pipe
G6	0.0	0.0	19.9	4.2	993	0	0	pipe outside casing
G7								water in the pipe
G8	16.3	7.6	9.9	2.7	993	0	0	
G9	16.1	18.2	0.5	1.6	993	0	37	
G10	7.8	8.5	0.4	8.5	1,012	0	25	
G11								ice
GEW 1	31.8	24.2	0.1	3.3	993	8	2	
GEW 4	36.0	21.7	5.5	3.6	993	74	0	
GEW 28	29.8	24.8	0.0	2.4	993	16	0	
GEW 24	23.0	21.5	4.5	3.0	993	37	0	
G16	0.0	0.2	19.6	3.9	993.0	0	0	
G17	0.0	7.4	8.0	-	-	-	-	
G18	0.0	0.0	20.1	3.8	993	0	0	lid missing
<i>Buildings</i>								
Hamill's Shop	0.0	0.1	20.1	7.7	993	0	0	
Site Hut								
Site Office								

## NOTES:

- A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste
- Well not found due to high vegetation

## LANDFILL GAS MONITORING RECORD SHEET

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE 20/11/08-2/12/08

TIME 11.00

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO

GA05588

EXTERNAL CALIBRATION

DATE 04/04/08

CERTIFICATE NO

CSL Cert. No 7669

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [1]

WIND SPEED AND DIRECTION

COMMENTS

Each quarter an extended network of gas points G19 - G32 are monitored in addition to G1 - G18 and the buildings.

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G19	0.0	4.7	15.1	3.0	993	0	0	
G20	7.3	0.8	10.3	4.6	993	0	0	
G21	0.0	1.0	19.6	8.4	1,012	0	0	
G22	0.0	0.1	20.4	8.4	1,012	0	0	
G23	0.0	2.1	17.5	8.1	1,012	0	0	
G24	0.0	4.2	15.8	8.2	1,012	0	0	
G25	0.0	0.8	20.1	8.3	1,012	0	0	
G26	7.5	5.4	16.0	3.8	1012.0	0	0	
G27	15.4	0.0	0.0	5.4	993	0	11	pipe full of water
G28	2.6	0.0	6.0	4.8	993	0	30	
G29								no valve, pipe blocked
G30	0.1	0.2	19.5	2.6	993	0	4	
G31	0.0	3.8	17.5	3.0	993	0	0	
G32	30.3	1.8	0.0	3.7	993	0	28	

## NOTES:

1. A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste

## LANDFILL GAS MONITORING RECORD SHEET

Issue 1

SITE Marlinstown Landfill Site, Mullingar, Co Westmeath

LICENCE REGISTER NO WL 71-2

DATE &amp; TIME 17/12/2008

JOB NO. 14625

GAS MONITORING INSTRUMENTATION

GA2000

SERIAL NO GA05588

EXTERNAL CALIBRATION

DATE 26/11/08

CERTIFICATE NO CSL Cert. No 8178

INTERNAL CALIBRATION DETAILS

CH4 5.5%, CO2 4.9%, O2 5.1% [2]

WIND SPEED AND DIRECTION

COMMENTS

MONITORING LOCATION	METHANE CH <sub>4</sub> % v/v	CARBON DIOXIDE CO <sub>2</sub> % v/v	OXYGEN O <sub>2</sub> % v/v	ATMOSPHERIC TEMPERATURE °C	ATMOSPHERIC PRESSURE mbar	HYDROGEN SULPHIDE H <sub>2</sub> S ppm	CARBON MONOXIDE CO ppm	COMMENTS
<i>Monitoring Wells</i>								
G1	9.1	14.8	3.5	6.8	1,001	0	6	
G2	0.0	0.4	20.2	6.9	1,001	0	0	
G3	28.3	3.9	1.0	5.1	1,001	0	0	
G4	0.8	2.4	6.5	5.4	1,001	0	0	
G5	-	-	-	-	-	-	-	water in the pipe
G6	0.0	0.1	20.7	4.7	1,001	0	0	pipe outside casing
G7	11.7	0.5	16.0	5.5	1,001	0	0	
G8	4.9	5.7	14.1	4.5	1,001	0	0	
G9	0.0	0.0	20.5	1.3	1,001	0	0	
G10	8.8	8.8	0.0	4.9	1,001	0	0	
G11	-	-	-	-	-	-	-	water in the pipe
GEW 1	0	0.1	19.7	4.9	1,001	0	0	
GEW 4	22.4	19.4	6.3	4.9	1,001	46	0	
GEW 28	23.8	23.7	0.4	4.0	994	20	7	
GEW 24	10.1	14.7	7.4	4.0	999	15	0	
G16	0.0	0.1	20.2	6.6	1,000	0	0	
G17	0.0	15.2	2.6	6.1	1,000	0	0	
G18	0.0	0.0	20.2	7.0	1,000	0	0	
<i>Buildings</i>								
Hamill's Shop	0.0	0.0	20.4	10.8	1,000	0	0	
Site Hut								
Site Office								

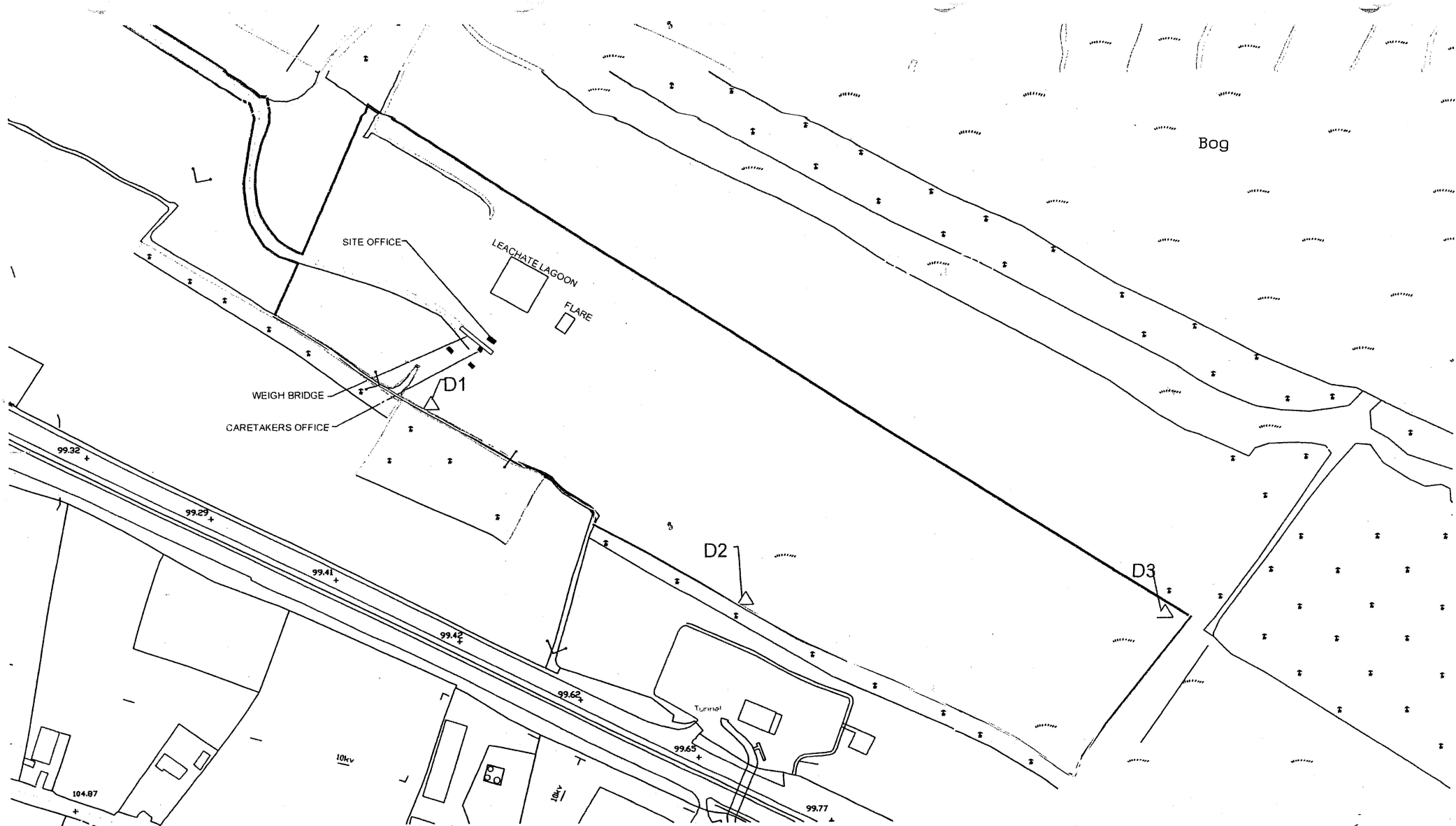
## NOTES:

- A Limit of 1%v/v Methane OR 1.5% v/v Carbon Dioxide applies to any measurement in a building on or adjacent to the facility and/or at any point located outside the body of the waste
- Well not found due to high vegetation



## **APPENDIX 6**

Dust



REVISION	DESCRIPTION	DATE

DRAWING TITLE

**DUST\_MONITORING\_LOCATIONS**

**WESTMEATH COUNTY COUNCIL**

**MARLINSTOWN  
LANDFILL**

	SURVEYED: DOD	SCALE: NTS	DRAWING NO. <b>MRL_DUST_2</b>
	DRAWN: DOD	DATE: 21.12.08	
	CHECKED: P.CAREY	DATUM: DATUM	
	APPROVED: P.CAREY		
ENVIRONMENT DEPARTMENT CHURCH VIEW	FILE NAME & DIRECTORY FILE		

### Marlinstown Landfill Dust Results 2008

Q2

SAMPLING POINT	DUST DEPOSITION RATE mg/m <sup>2</sup> -day
D-1	365
D-2	784
D-3	794

elevated levels due to Algae growth and bird faeces

Q3

SAMPLING POINT	DUST DEPOSITION RATE mg/m <sup>2</sup> -day
D-1	334
D-2	156
D-3	

Dust jar damaged

Q4

SAMPLING POINT	DUST DEPOSITION RATE mg/m <sup>2</sup> -day
D-1	87
D-2	111
D-3	147

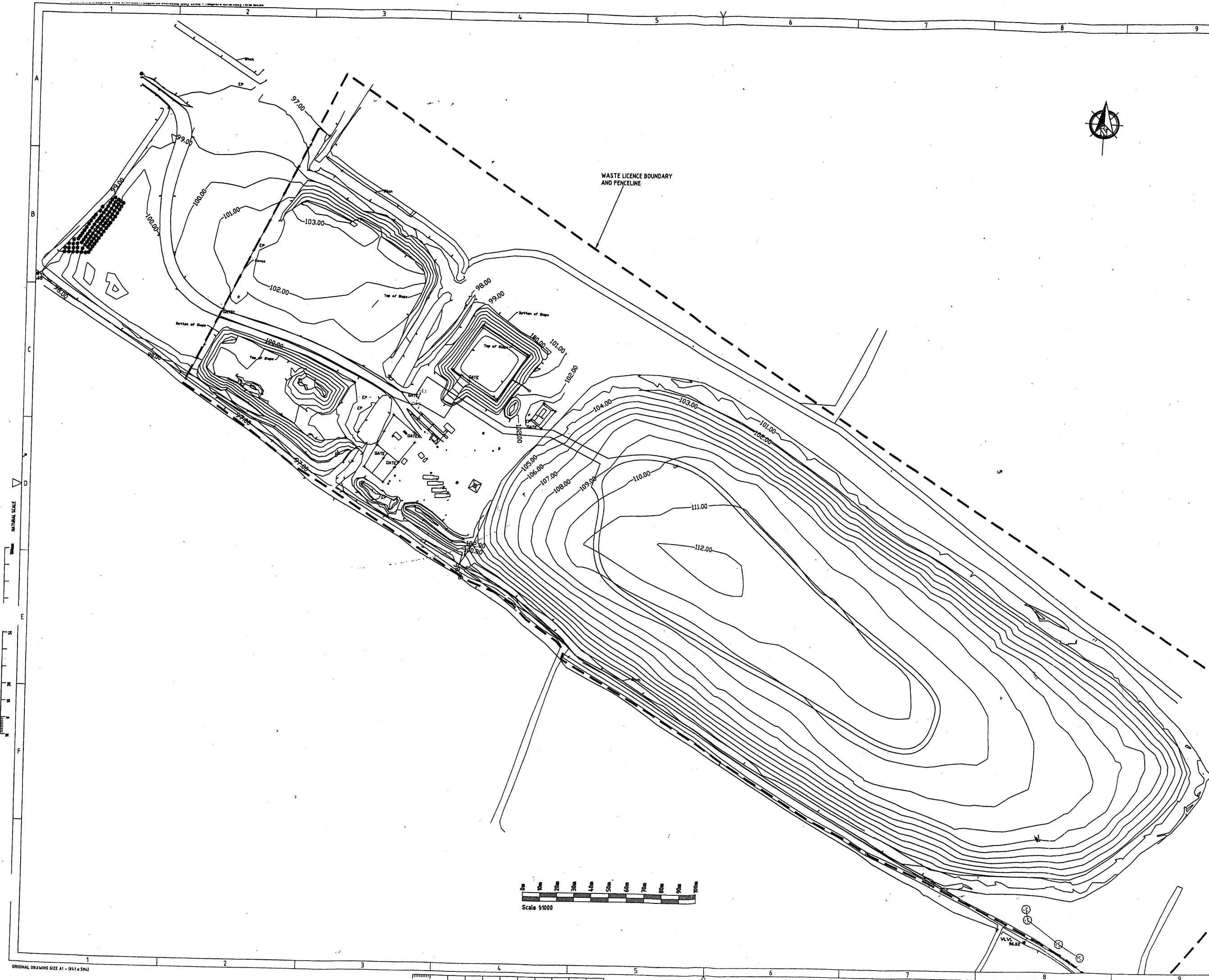
## **APPENDIX 7**

Topographical Site Survey

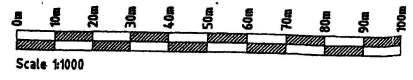
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Do not scale. Use figured dimensions only. If in doubt - Ask!



WASTE LICENCE BOUNDARY AND FENCELINE



NATURAL SCALE



A	TM	PK	Dublin	03.01.07	ISSUE FOR INFORMATION
Rev.	Drawn	Checked	App'd	Rev Origin	Description
				Date	

Name of Client  
**WESTMEATH COUNTY COUNCIL**

Name of Job  
**MARLINSTOWN LANDFILL PHASE 2 CAPPING**

Title of Drawing  
**UPDATED TOPO SURVEY FOR AER**

Scales Used  
**A1-1:1000, A3-1:2000**

Dwg. No.  
**2006-044-01-008**

Rev.  
**A**

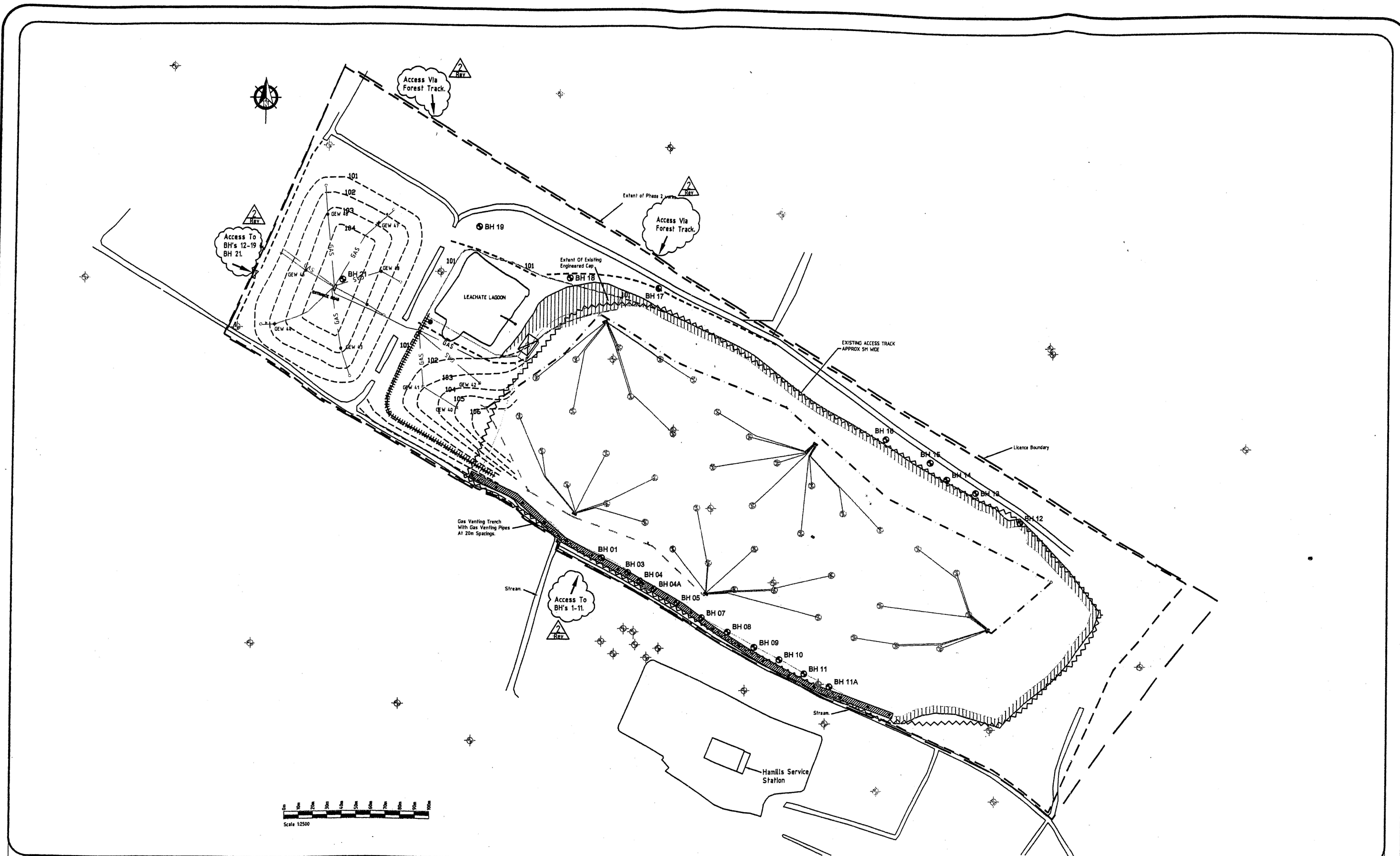
**FEHILY TIMONEY & COMPANY**

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<b>PROJECT:</b> Marlinstown Landfill		<b>TITLE:</b> Gas Monitoring Borehole Location Plan											
<b>CLIENT:</b>  WestMeath County Council	<b>SCALE:</b> 1:2500 @ A3	<b>SERIES:</b> 01 of 01	<b>KEY:</b>  Gas Monitoring Borehole										
<b>ENGINEER:</b>  Fehily Timoney & Co Consultants in Engineering & Environmental Sciences	<b>DRWN:</b> A.W.	<b>DATE:</b> 23/11/07											
	<b>CHCK:</b> D.C.												
		<b>DWG NO:</b> 07-794-EHLoc-001	<table border="1"> <tr> <td>REV:</td> <td>DATE:</td> <td>DETAILS:</td> <td>DRW:</td> <td>CHK:</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	REV:	DATE:	DETAILS:	DRW:	CHK:					
REV:	DATE:	DETAILS:	DRW:	CHK:									

