



March 2011

## ANNUAL ENVIRONMENTAL REPORT 2010

# Ballynagran Residual Landfill W0165-02

**Submitted to:**

John Jones and Robert Kirwan  
Greenstar Ltd.  
Coolbeg and Killcandra  
Ballynagran  
Co. Wicklow

REPORT



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## 1.0 INTRODUCTION

This Annual Environmental Report (AER) has been prepared in accordance with Condition 11.5 of Waste Licence Register No. W0165-02 and contains the required elements and information listed in Schedule G of the Licence.

## 2.0 SITE HISTORY

Ballynagran Residual Landfill, a wholly owned subsidiary company of Greenstar Recycling Ltd. is currently developing and operating the Landfill at Ballynagran under Waste Licence Register Number W0165-02. Ballynagran Residual Landfill was granted a Waste Licence (W0165-01) by the Environmental Protection Agency (EPA) on 5 September 2003. This licence was reviewed and re-issued (W0165-02) on the 23 March 2010.

## 3.0 REPORTING PERIOD

The reporting period for the Annual Environmental Report (AER) is from 1 January 2010 to 31 December 2010. During this reporting period Waste Licence Register No. W0165-02 was in effect.

## 4.0 WASTE ACTIVITIES CARRIED OUT AT THE FACILITY

Ballynagran Residual Landfill is a fully engineered facility with a composite lining system on the base and side walls of a large excavation. The licensed waste activities are as follows:

**Table 1: Licensed Waste Disposal Activities, in accordance with the Third Schedule of the Waste Management Act 1996**

<b>Class 1</b>	<b>Deposit on, in or under land (including landfill).</b>
Class 4	Surface impoundment, including placement of liquids or sludge discards into pits, ponds or lagoons: This activity is limited to the storage and management of leachate and surface water at the facility.
Class 5	Specially engineered landfill, including placement into lines discrete cells which are capped and isolated from one another and the environment: This is the principal activity. This activity is limited to the construction of the landfill in distinct phases consisting of specially engineered lined cells, the deposit of non-hazardous waste into these lined cells and the collection of leachate and landfill gas.
Class 6	Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 10 of this Schedule: This activity is limited to the treatment of leachate at the facility.
Class 13	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced. This activity is limited to the storage of unacceptable waste prior to its transport off-site to another facility.



**Table 2: Licensed Waste Recovery Activities, in accordance with the Fourth Schedule of the Waste Management Act 1996**

<b>Class 4</b>	<b>Recycling or reclamation of other inorganic materials.</b> <b>This activity is limited to the use of recycled construction and demolition waste as cover and/or construction material at the facility.</b>
Class 9	Use of any waste principally as a fuel or other means to generate energy: This activity is limited to the utilisation of landfill gas at the facility.
Class 11	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule: This activity is limited to the use of recycled construction and demolition waste at the facility.
Class 13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced: This activity is limited to the storage of recycled construction and demolition waste prior to reuse.





## 5.0 QUANTITY AND COMPOSITION OF WASTE RECEIVED, DISPOSED OF AND RECOVERED DURING THE REPORTING PERIOD.

### 5.1 Waste Input Summary 2010

The quantity of wastes received and recovered on site for disposal and recovery during 2010 is shown in Table 3 and Table 4.

**Table 3: Ballynagran Residual Landfill Waste Inputs 2010 (Wastes Received)**

Waste Description	European Waste Code (EWC)	Tonnage
Waste after mechanical treatment (MSW/C&I)	19 12 12	84,621.98
Agricultural Waste (Bedding Material)	02 01 06	4.10
Mixed municipal waste	20 03 01	37,379.62
Street cleaning residues	20 03 03	16.70
Premixed waste compounds only of non-hazardous waste	19 02 03	6,767.16
Confectionary Waste	02 06 01	19.10
Healthcare – Non-infectious	18 01 04	35.78
Ion Exchange resins	19 09 05	67.36
Screenings from waste water treatment plant	19 08 01	1,133.22
Waste from de-sanding	19 08 02	249.58
C+I Dry Mixed Residual waste from mechanical treatment of domestic and commercial sources	20 03 07	132.50
Filter Cake (non-hazardous)	07 05 14	105.74
C+I Dry Mixed	20 01 32	0.96
Stone, C&D and C&I Fines used for engineering	19 12 09	29,212.27
Shredded wood used on site for engineering material (C&I Dry Mixed)	19 12 07	8,262.75
Soil & Stones	17 05 04	1,466.08
<b>Total Tonnage</b>		<b>169,474.90</b>

**Table 4: Wastes Recovered**

Waste Description	European Waste Code (EWC)	Tonnage
Shredded wood used on site for engineering	19 12 07	8262.75
Stones and fines used for engineering	19 12 09	29,212.27
C&D Soil & Stones	17 05 04	1,466.08
<b>Total Recovered 2010</b>		<b>38,941.10</b>



## **6.0 CALCULATED REMAINING CAPACITY OF THE FACILITY**

The remaining capacity of the Ballynagran facility is a function of time and available space at the site. The facility pre development planning permission states that the designed post settlement void space available at the facility is approximately 2,770,000 m<sup>3</sup>.

It is estimated that the void space consumed since the site opened up until 5 January 2011 is approximately 763,500 m<sup>3</sup>.

## **7.0 WASTE DEPOSITION METHODS AND TREATMENT OF WASTE**

### **7.1 Waste Acceptance**

The waste accepted for disposal is residual waste from the County Wicklow and adjoining counties, from household, commercial and industrial sources. At present the majority of waste is delivered to the facility by waste contractors based in County Wicklow. Waste contractors have systems in place whereby the recyclable fraction is either collected separately, or else separation is carried out mechanically at their facilities.

All waste is delivered to the site in Heavy Goods Vehicles (HGV) and small refuse trucks provided with the appropriate covers to prevent loss of load. Each vehicle first proceeds to the incoming weighbridge where it is weighed. The weighbridge operator and/or the facility manager may at their own discretion request the load to be tipped in the Waste Inspection Area.

The vehicles then proceed to the active waste disposal area where waste is deposited under the direction of a banks man. The vehicles weigh out at the outgoing weighbridge and receive an individual weighbridge docket before exiting the site. Each landfill cell is divided into a number of grids, which are used to identify the areas where waste is deposited. Each load is assigned the relevant grid number.

### **7.2 Working Face**

Waste is deposited close to and above the advancing tipping face. In accordance with Condition 5.6.1 the active face is confined to a height of 2.5 metres after compaction, a width of 25 metres and a slope no greater than 1 in 3. Deposited waste is spread in shallow layers on the inclined surface and compacted. The steel-wheeled compactors operate on the gradient of the more shallow face, pushing thin layers of waste and applying compaction pressure to them. The site operatives inspect the deposited waste for items that are not acceptable under the Waste Licence, such as tyres, gas bottles, batteries etc. These are removed and stored in appropriate areas for later removal from the site. Each day waste is deposited to form a block, which is compacted and covered as described above. The following day a new block of waste is deposited adjacent to the existing block. The waste is covered at the end of each day with a covering of fines and woodchips

This ordered method of waste deposition enables areas, which have been filled and are to be left for a period to be progressively restored over the site life, minimising the areas of active waste deposition.

### **7.3 Report on Development and Restoration at the Site**

No waste was placed in cells 9 or 10 during 2010

During 2010 waste placement focused on achieving final waste levels in Cells 1-3, in order to progress final capping works of these cells. Final capping and restoration of Cells 1-3 is now scheduled to take place during early summer 2011.

### **7.4 Progress and Implementation of Landscaping Programme**

There was no additional tree planting at the facility during 2010. Maintenance involving re-stacking and re-tying of existing trees was carried out during November 2010.



## 7.5 Report on Meeting the Requirements of the Landfill Directive

The site is fully compliant with the requirements of the Landfill Directive.

## 7.6 Programme for Public Information

During 2010 the site accommodated all requests for site visits and tours.

## 8.0 RESOURCE AND ENERGY CONSUMPTION SUMMARY

The principal energy resources consumed at the site are electricity, water for potable supply oil, vehicle wheel cleaning and dust suppression, diesel fuel and hydraulic oils. All site vehicles are fuelled by diesel. Details of resource usage are presented below in Table 5

**Table 5: Resource usage and Energy Consumption**

Consumable	Units	Total Consumption in 2010
Electricity	kWh	373,916
Diesel Oil	Litres	174,512
Water, potable supply	Litres	50,000
Water, dust suppression	Litres	1280,000
Water, wheelwash	Litres	100,000
Hydraulic Oils	Litres	1,000

An audit of energy consumption was conducted in February 2011. The audit was carried out to improve efficiency and minimise unnecessary waste at the facility. The audit report is attached in Appendix D.

## 9.0 VOLUME OF LEACHATE GENERATED/TRANSPORTED OFF-SITE DURING 2010

At Ballynagran, leachate generated on-site is collected in the main leachate storage lagoon prior to removal off-site for treatment. The total volume of leachate tankered off-site during the reporting period January 2010 – December 2010 was 30,165 m<sup>3</sup>. Detailed figures are presented overleaf in Table 6.



Table 6: Volume of Leachate generated/transported off-site during 2010 at Ballynagran

Month	Volume (m <sup>3</sup> )
January	3,929
February	3,894
March	3,363
April	2,993
May	2,131
June	1,726
July	2,316
August	1,604
September	1,909
October	1,524
November	2,560
December	2,210
<b>Total</b>	<b>30,165</b>

### 10.0 ESTIMATED AND ANNUAL CUMULATIVE QUANTITIES OF LANDFILL GAS EMITTED FROM THE FACILITY

The enclosed 2500 m<sup>3</sup>/hour landfill gas flare was installed in February 2008 and is connected to 82 No. vertically drilled and passive gas wells, 70 No. gas wells (sacrificial) and 30 No. horizontal gas wells. During the 2010 a further 18 No. drilled vertical wells and 30 No. pin wells were installed. The most recent gas well information is presented in Drawing 05 Rev G in Appendix B.

Landfill gas infrastructure such as the different variety of wells is installed progressively as the waste is placed and the different gas types are chosen to meet the specific needs of that particular landfill area.

A Landfill Utilisation Compound was constructed in late 2010 and one Landfill Gas Engine commissioned. The facility is currently exporting 0.75 MWhr to the national grid. The Main Enclosed flare which is connected to the landfill gas engine is extracting on average 2200m<sup>3</sup>/hour of landfill gas presently. The facility installed a further Enclosed Flare in Cell 7 in May 2010 to replace two open flares situated there since December 2008. Currently this Enclosed Flare is extracting 1200 m<sup>3</sup>/hour poorer quality landfill gas from Cells 6 and 7.

### 11.0 ESTIMATED ANNUAL AND CUMULATIVE QUANTITY OF INDIRECT EMISSIONS TO GROUNDWATER

The potential sources of indirect emissions to groundwater from the facility are as follows:

- **Landfill Base** – The landfill has a composite base lining system comprising a HDPE geomembrane and a half metre thick layer of Bentonite Enhanced Soil. A leak detection survey of the HDPE geomembrane after placement of the drainage stone layer was completed and defects to the HDPE liner were repaired in accordance with industry standards;
- **Surface Water Collection and Treatment System** – Surface water from the paved access roads and landfill cell swale drain is collected and discharged into the surface water lagoon along with



groundwater collected at the interceptor sump located below the landfill cells. Water from the lagoon discharges to the reed bed which further filters the water before it is finally discharged to the Longford Stream; and

- **Treated Sewage Effluent** – There is a biocycle wastewater treatment plant located adjacent to the weighbridge which treats the canteen and office waste water prior to being pumped to the leachate holding tank via the foul-water sump. Leachate (containing foul water) is tankered off-site to a waste water treatment plant via a vacuum tanker.

In summary, as the landfill is fully contained, there are no indirect emissions to groundwater

## 12.0 METEOROLOGICAL DATA & POTENTIAL LEACHATE GENERATION

### 12.1 Meteorological Report

Climate data for 2010 was collected from the synoptic stations at Casement Aerodrome and Ashford Climatological Station which is located 16 km to the north of the facility. The rainfall data was taken from the Ashford station as it is closer to the landfill site than Casement. Table 7 below details summary monthly data for 2010.

**Table 7: Climatological Data for 2010**

Ashford Climatological Station					Casement Aerodrome Synoptic Station				
Month	Rainfall	Max Temp	Min Temp	Average Monthly Temp.	Average Wind Speed	Average Wind Direction (Degrees from North)	Average MSL Pressure (hPa)	Average Relative Humidity (%)	Average Potential Evapotran
	(mm)	°C	°C	°C	(Knots)				Spiration mm (Penman)
January	123.6	6.9	0.4	3.64	8.4	209.8	1015.6	91.7	0.2
February	57.8	7.8	0.4	4.06	6.5	176.4	1003.9	90.6	0.4
March	82.5	10.2	1.3	5.75	8	194.8	1015.4	79.6	1.2
April	33.6	13.3	3.6	8.45	7.6	172.2	1018.6	75.6	1.9
May	67.3	15.5	6.3	10.9	6.2	164	1019	77	2.5
June	41	18.8	9.1	13.97	6.4	182.3	1018.1	77.6	3
July	89.6	20.5	12	16.25	10	220.2	1012.4	82.9	2.5
August	37.1	19.5	10.3	14.92	8.5	223.2	1014.7	82.6	2.2
September	111.9	18	10	13.98	8.9	207.5	1013.1	85.4	1.5
October	81.1	14.9	6.7	10.78	10	189.2	1010.9	87	0.9
November	164.4	9.9	2.7	6.34	9.6	195.2	1005	91.4	0.4
December	88.2	5.7	-0.6	2.56	6.2	208.4	1016.5	94.8	0.1



### 12.2 Estimation of potential leachate generation within waste mass

Climate data from Casement Synoptic Weather Station and Ashford Climatological Station was used in the estimation of potential leachate generation at the site during the period January 2010 – December 2010. Total annual precipitation at Ashford was calculated as 978.10 mm (P). Evapotranspiration in mm as potential evaporation (EP) was taken from data collected from Casement Weather Station and stands at 512.53 mm. Therefore effective precipitation (EP) is estimated as being 465.57 mm. The potential leachate generation calculations are shown below in Table 8. Note that no waste was placed in the new cells 9 and 10 constructed in 2010 therefore no leachate was generated from these cells.

Table 8: Annual Water Balance Ballynagran Residual Landfill during 2010

Landfill Cell	Area (m <sup>2</sup> )	Effective Rainfall (Rainfall less ET)	Potential Leachate Generation
Cell 1	11200	0.465	5208.0
Cell 2	7500	0.465	3487.5
Cell 3	6700	0.465	3115.5
Cell 4	6300	0.465	2929.5
Cell 5	10100	0.465	4696.5
Cell 6	8200	0.465	3813
Cell 7	6700	0.465	3115.5
Potential Volume (m <sup>3</sup> )			<b>26365.50</b>
Absorptive Capacity Estimate aW m <sup>3</sup> 0.025 Aw/t			<b>4,377 aW m<sup>3</sup></b>
Estimated Leachate Generation			<b>21,988.5 m<sup>3</sup></b>

### 13.0 SUMMARY REPORT ON EMISSIONS

This summary report has been compiled in accordance with emission limit values (ELVs) for the following media as detailed in Condition 6 and Schedule C of Waste Licence (W0165-02).

- Surface Water Discharge;
- Groundwater;
- Leachate;
- Landfill Gas;
- Dust;
- Noise; and
- Biological Assessment.

#### 13.1 Surface Water Discharge at Lagoon Outlet

Surface water discharge emission limit values measured at the outlet from the surface water lagoon as stipulated in Waste License Register Number W0165-02.



Surface Water Discharge Limits Level (Suspended Solids mg/l)

35 mg/l

Over the course of the year 2010, levels of Total Suspended Solids recorded from samples retrieved at SW8, SW9 and SW10 were below the emission limit value on all occasions except during the 1st Quarter of 2010 and a slightly elevated reading in quarter 4 at SW9.

SW9 and SW10 are located within the facility's surface water management system. SW9 is at the inlet of the attenuation pond and SW10 was measured in the pond. SW5, immediately down gradient of the outlet from the pond, is complaint throughout the year and demonstrates that the surface water attenuation pond is working effectively. SW8 is upstream of the facility's discharge and the fact that SW5 was compliant suggests that the elevated reading was not related to activities on site.

In total surface water samples are taken quarterly from the following locations. The recorded Total Suspended Solids results are also included.

Table 9: Surface Water Monitoring Locations showing TSS Results for 2010

Surface	Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SW1	On-Site	7	2	12	2
SW2	On-Site	4.5	2	10	2
SW3	Off Site	2.5	2.5	10	3.5
SW4	Off Site	2	2	12	4
SW5	On-Site	6	2	9	3
SW6	Off Site	8	2	9	2
SW7	Off Site	13	2.5	11	2
SW8	On-Site	79	2	9	2
SW9	On-Site	602	9.5	12	38
SW10	On-Site	1220	9	12	19

Table 10: EPA EQS's for Surface Water

Parameter	EPA EQS Limit Value
pH	≥6.5 and 9.5 ≤
Electrical Conductivity µS/cm	1,000 µS/cm
Chloride mg/l	250 mg/l
Dissolved Oxygen mg/l	No Abnormal Change
COD mg/l	-
BOD mg/l	-
Total Suspended Solids mg/l	1,000 mg/l
Ammoniacal Nitrogen mg/l	-





## **13.2 Surface Water Monitoring Methodology**

3 no. watercourses flow within the site boundary, namely, the Kilcandra Stream, Ballynagran Stream and the Longford Stream. These watercourses are all tributaries of the Three Mile River, which flows down-gradient of the landfill footprint, in a west-east direction under the N11 and east towards the townland of Newtown.

10 no. surface water monitoring points are sampled quarterly as defined in Schedule D of Waste Licence W0165-02. Surface water sampling involves the retrieval of water from within water-body at the monitoring location. The sample container is fully submerged and completely filled ensuring no headspace during the sampling exercise and every effort is made to remove air bubbles that are created in the sampling media. This is easily done by tapping on the side of the container allowing bubbles to travel to the surface of the container.

SW1 is upstream of the landfill footprint. SW4 is downstream of SW1, but upstream of phase 1 of the development; both are located within the site boundary on the Ballynagran Stream. SW3 is located south of the landfill footprint on the Kilcandra Stream. SW2 is located upstream of the landfill footprint and SW5 is downstream on the Longford Stream. SW6 and SW7 are both off-site monitoring locations downstream of the facility on the Three Mile River. SW8 is situated at a road culvert on the Longford Stream upstream of the reed bed outfall. SW9 is located at the inlet to the surface water attenuation pond and SW10 is at the outlet of the attenuation pond prior to discharging into the reed bed. The locations of these monitoring points are shown in Drawing 5 Rev C in Appendix A.

Details and analyses of all surface water sampling were forwarded to the Agency in Quarterly reports 1 to 4 of 2010. A summary of concentrations from a number of indicator parameters up-gradient and down-gradient of the facility recorded during the reporting period are presented in Figures 1-3. These basic indicator parameters are pH, Electrical Conductivity and Chloride.

## **13.3 Discussion of Surface Water Monitoring Results**

Surface water was sampled at the site on 4 separate occasions during 2010. The graphical data shown above in Figures 1-3 detail those parameters for which result data was above the limit of detection.

Ammoniacal nitrogen was not detected at any monitoring location during the 2<sup>nd</sup> and 4<sup>th</sup> Quarters of 2010. Elevated ammoniacal nitrogen levels were observed in the 1<sup>st</sup> Quarter 2010 and this coincides with works being carried out at the surface water lagoon in late 2009 and also high rainfall during that period. Slightly elevated readings were observed in the 3<sup>rd</sup> Quarter but were insignificant. These levels are below the limit values for surface water when compared to the limits specified in S.I. 294/1989.

pH and conductivity were below the limit values for surface water when compared to the limits specified in S.I. 294/1989.

BOD and COD were detected in low levels at all locations during the reporting period but are considered insignificant as the numbers are just above detectable limits.

It can be seen from the reported data during 2010 that the landfill operations at Ballynagran are not having a detrimental effect on the surface water system in the area.

## **13.4 Depositional Dust Monitoring**

### **13.4.1 Locations and Methods**

In compliance with Table D.3 of Waste Licence W0165-02, atmospheric depositional dust monitoring is conducted on a monthly basis at Ballynagran Landfill. Dust gauges are installed on a rolling basis and are collected and changed each month in conjunction with the groundwater level monitoring. A description and co-ordinates of the dust monitoring stations at the site are presented overleaf in Table 11. Sampling locations are illustrated on Drawing 5 Rev C Environmental Monitoring Locations which is attached in Appendix A.





**Table 11: Atmospheric Depositional Dust Monitoring Locations**

Dust Monitoring Location	Eastings	Northings
AD6	327107	190974
AD7	326347	191276
AD8	327007	190967
AD9	327540	190819
AD10	327748	191038
AD11	327325	191517
AD12	327897	190950

### 13.4.2 Dust Monitoring Methods

Total dust deposition was measured at the site using Bergerhoff gauges as specified in the Standard Method VDI 2119 (German Engineering Institute).

The dust gauges were set up such that the glass containers were approximately 2m above the ground surface. In order to inhibit the growth of algae in the dust jars 20ml of 5% 2-methoxyethanol was added to each jar. The glass jars containing the dust were submitted to GeoTesting Ltd. for analysis.

### 13.4.3 Dust Monitoring Results

The atmospheric dust monitoring results for 2010 are presented below in Table 12.

**Table 12: Depositional Dust Levels Recorded at Ballynagran Residual Landfill during 2010**

ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Licence Limit	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>	350m g/m <sup>3</sup>
AD6	40.2	-	176.8	57.4	192.9	-	-	45.9	70.3	5.5	42.9	-
AD7	70.3	11.1	69.7	160.8	58.9	171.1	133.1	143.5	-	205.1	-	-
AD8	145.7	33.3	96.5	160.8	155.4	103.7	122.0	40.2	60.3	49.9	-	38.8
AD9	100.5	22.2	107.2	34.5	117.9	20.7	349.3	51.7	75.4	33.3	-	27.7
AD10	155.7	11.1	21.4	17.2	58.9	31.1	155.2	17.2	105.5	11.1	10.7	11.1
AD11	60.3	77.6	69.7	114.8	101.8	-	-	-	-	11.1	53.6	11.1
AD12	212.6	110.9	10.7	51.7	58.9	15.6	133.1	63.2	20.1	22.2	32.2	66.5

Note 1: - indicates no measurement

The facility was compliant all year with regard to ambient dust and the licence limit of 350 mg/m<sup>3</sup>.

## 14.0 GROUNDWATER MONITORING

### 14.1 Locations and Methods

Groundwater levels are monitored on a monthly basis at Ballynagran Landfill. In total 16 No. wells are dipped each month. During 2010, Locations MW8s and MW8d have been found to dry on all occasions. The description and co-ordinates of all groundwater monitoring locations at the site are presented below in



Table 13 and in Figures 4, 5 and 6. Details of groundwater levels recorded during 2010 were sent to the Agency in each Quarterly Report during 2010. Groundwater flow direction across the site is to the south-east. Sampling locations are illustrated on Drawing 05 Rev G Environmental Monitoring Locations which is attached in Appendix A.

**Table 13: Static Groundwater Levels at Ballynagran Residual Landfill during 2010. All figures are presented in metres below top of casing.**

ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MW1s	2.76	3.33	4.62	3.28	5.12	6.32	7.03	7.04	5.55	6.10	2.65	2.4
MW1d	3.44	4.03	5.36	3.96	5.87	7.14	7.88	7.92	6.34	5.26	3.36	3.15
MW2s	5.77	5.84	6.00	6.02	6.09	6.17	6.18	6.39	6.4	6.36	6.18	5.89
MW2d	12.37	12.31	12.48	12.46	12.41	12.48	12.35	stuck	11.73	12.64	12.4	12.35
MW3s	0.79	0.79	1.90	0.79	0.79	2.54	2.41	Stuck	2.62	2.64	Flooded	Flooded
MW3d	2.49	2.48	2.51	2.46	3.12	2.55	2.38	2.53	2.45	2.43	1.95	3.7
MW4s	5.90	5.74	6.12	6.44	6.55	6.88	7.02	7.25	7.23	7.15	6.55	5.8
MW4d	5.53	5.37	5.76	6.60	6.20	6.95	6.72	6.9	6.88	6.82	6.18	5.65
MW5s	1.50	1.27	1.86	0.93	1.30	1.75	1.98	1.95	1.83	2.02	1.71	1.24
MW5d	3.89	3.73	4.05	4.19	4.30	4.65	4.80	4.8	4.94	4.82	4.25	4.06
MW6s	1.08	1.20	1.36	1.25	1.45	1.53	1.62	1.6	1.56	1.6	1.09	1.03
MW6d	0.67	0.78	0.95	0.83	1.03	1.13	1.24	1.21	1.17	1.23	0.68	0.62
MW7s	0.85	0.91	1.16	0.72	1.89	2.38	3.12	2.48	1.24	1.48	0.56	0.49
MW7d	8.51	8.73	10.36	10.00	10.89	11.98	12.21	DRY	DRY	12.66	9.9	9.5
MW8s	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
MW8d	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

### 14.1.1 Method of Retrieving Static Groundwater Level

Groundwater levels were measured using a standard dip-meter probe, which upon contact with water emits an audible signal. Measurements were made to the nearest centimetre relative to the top of the steel casing that protects each monitoring pipe.

### 14.1.2 Groundwater Quality

Analysis of groundwater quality at the facility was conducted on a quarterly basis in accordance with Schedule D.5 of the current licence (W0165-02).

### 14.1.3 Methods of Measuring Groundwater Quality

Groundwater samples were collected by purging a minimum 3 borehole volumes prior to sample collection. This allowed stagnant water to be removed and representative groundwater to be drawn into the hole. Dedicated sampling equipment was used to prevent cross contamination between sampling locations. Field measurements of temperature, pH and conductivity were recorded. Samples were decanted into accredited laboratory designated containers and stored in cooler boxes to maintain sample temperature at approximately 4°C. All samples were submitted to the laboratory within 24 hours of sampling.

### 14.1.4 Groundwater Quality Results 2010

#### 14.1.4.1 Locations and Methods

According to Schedule D.1 of the waste licence, groundwater quality is to be monitored at sixteen locations. During 2010 in a total of 14 No. groundwater wells were monitored as locations MW8s and MW8d were found to be dry during all monitoring events. The results of all quarterly monitoring have been presented to



The Agency in reports Quarter 1 to Quarter 4 of 2010. A summary of concentrations from a number of indicator parameters up-gradient and down-gradient of the facility recorded during the reporting period are presented in Figures 5 – 13.

### 14.1.5 Private Well Groundwater Monitoring

During 2010, 14 No. private groundwater wells were sampled and analysed for set parameters. These sampling events took place during the 3<sup>rd</sup> and 4<sup>th</sup> Quarters of 2010. The results of the chemical analysis of the samples were included the 3<sup>rd</sup> and 4<sup>th</sup> Quarterly environmental reports. All residents received results of analyses following private well sampling.

Figure 1: Static Groundwater Levels in Monitoring Boreholes at Ballynagran Residual Landfill during 2010

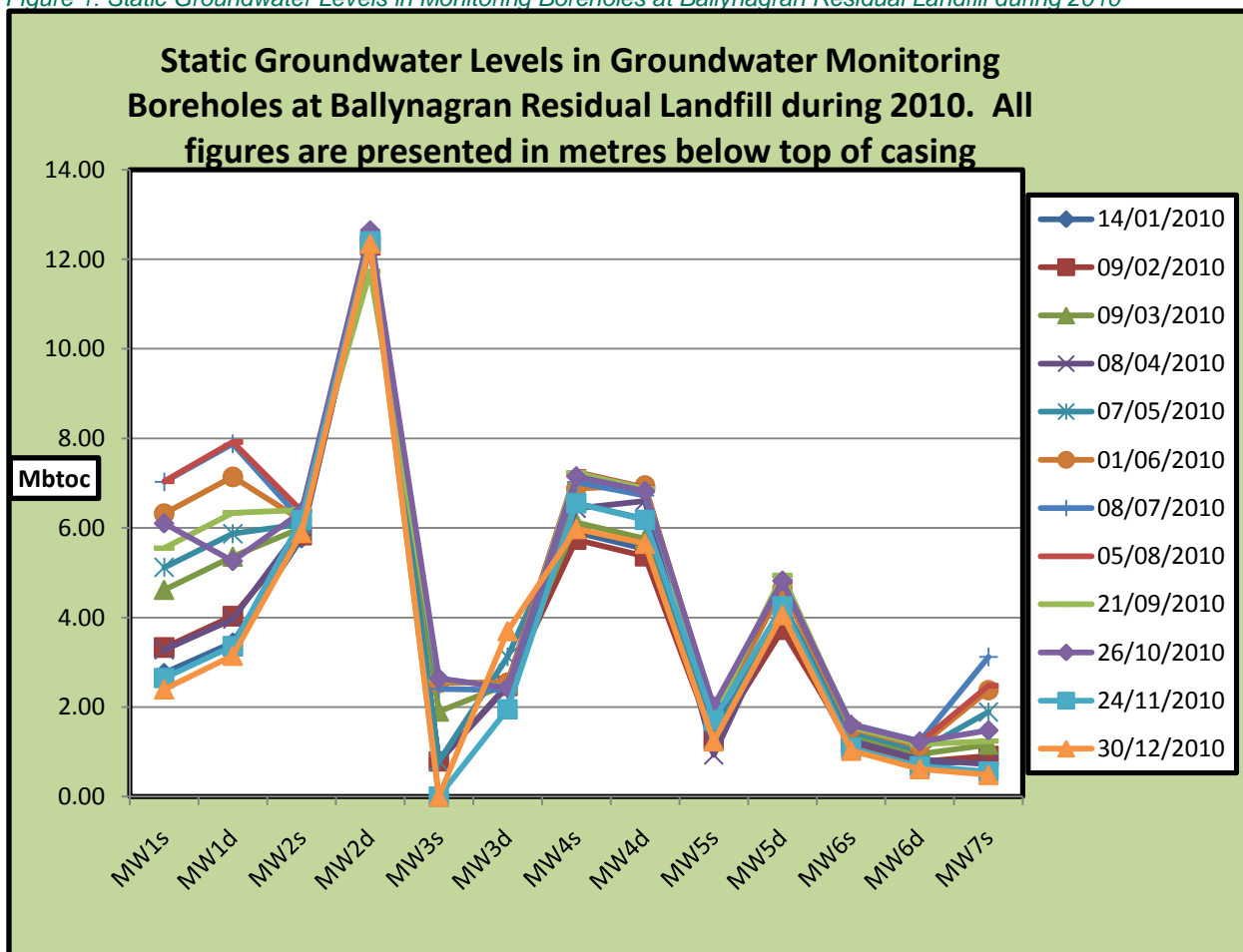




Figure 2: pH Values in Down-Gradient Groundwater Monitoring Wells

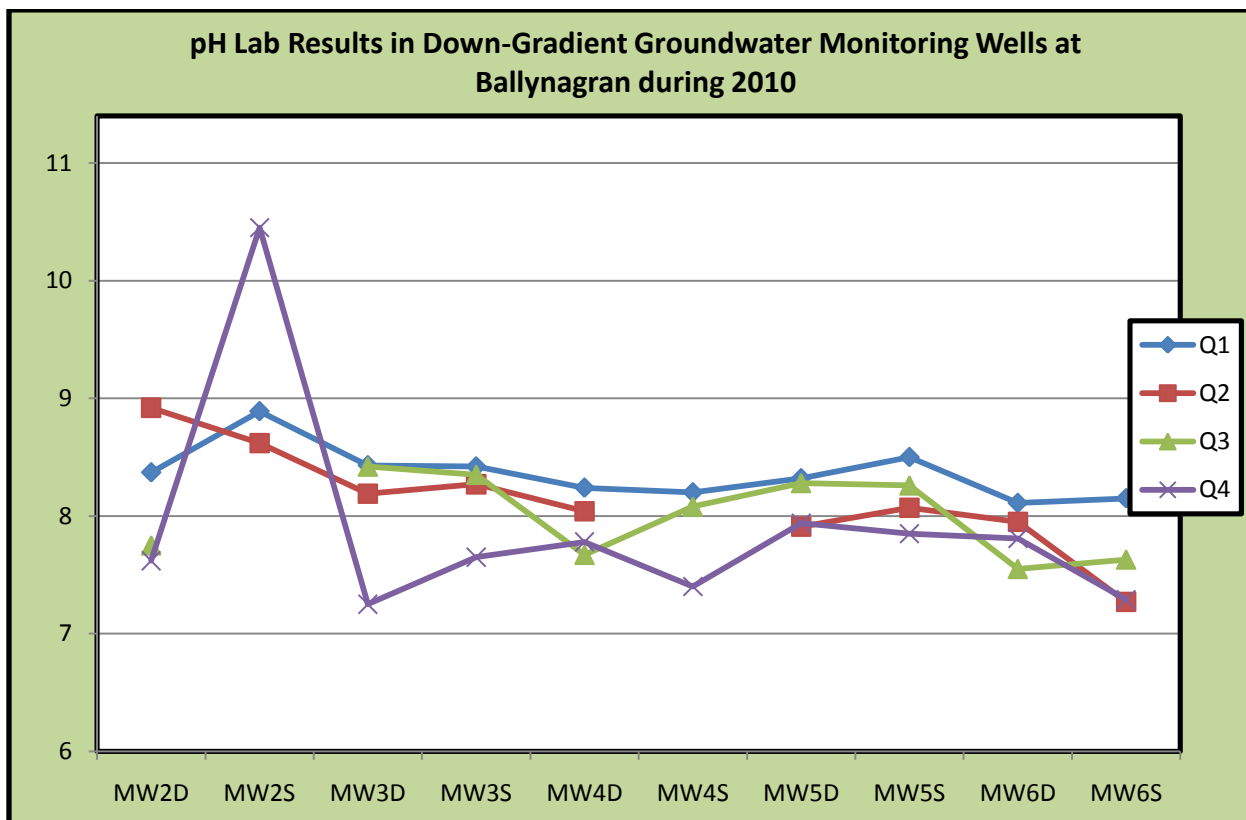
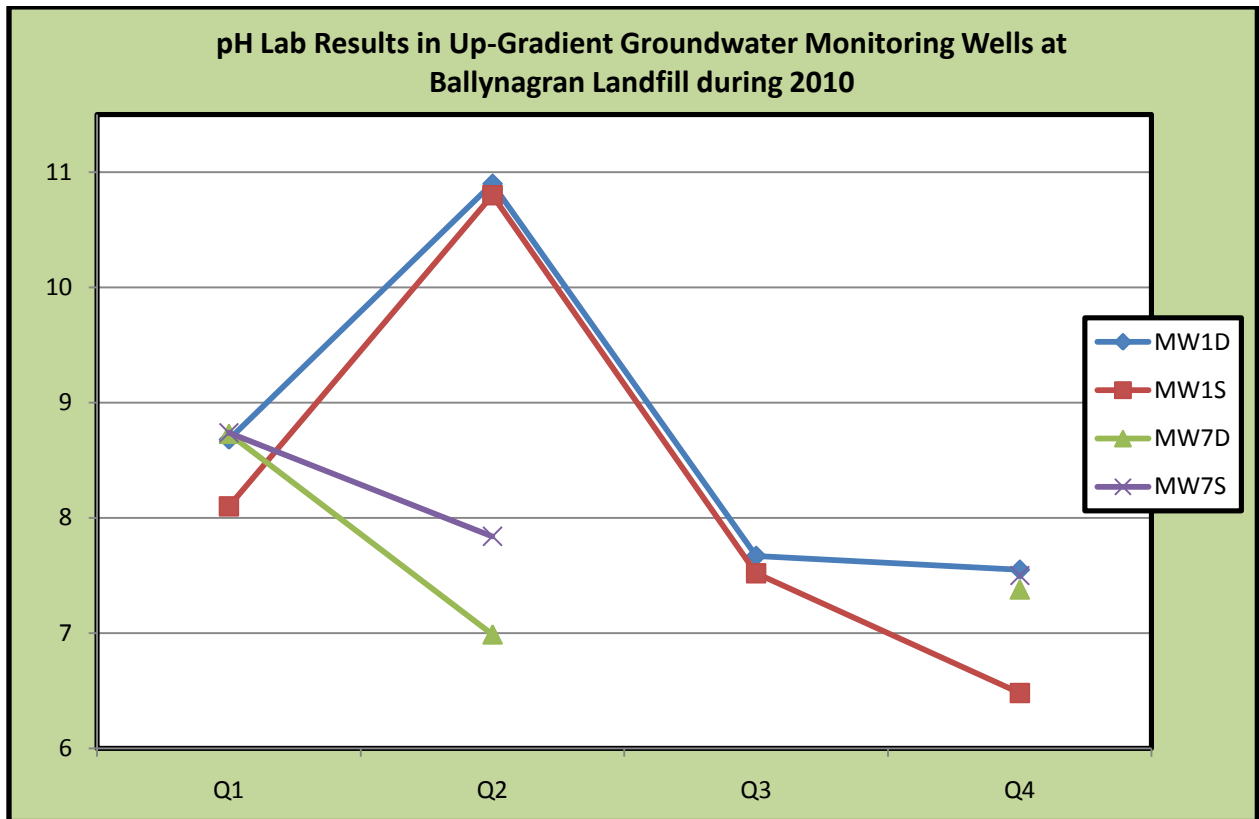




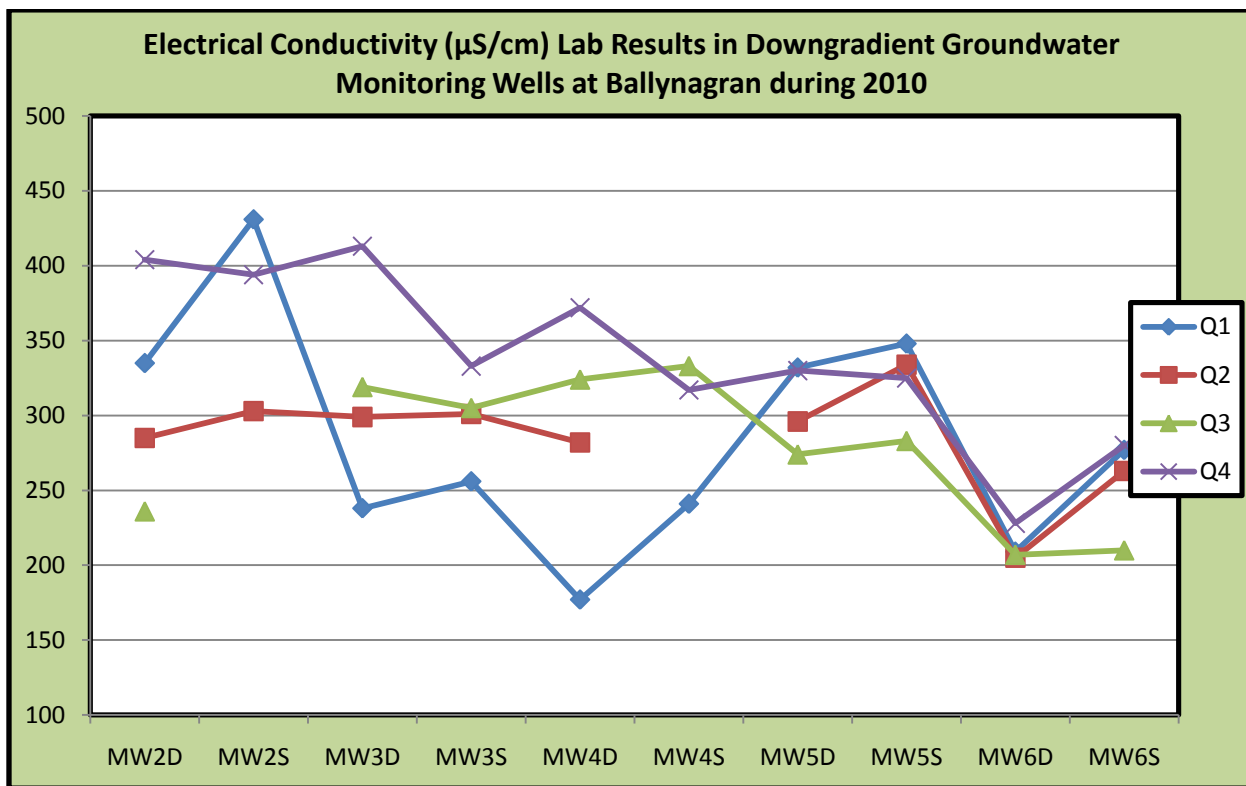
Figure 3: pH Values in Up-Gradient Groundwater Monitoring Wells during 2010



Note 1: Gaps in the graphical illustration of data are due to results being unavailable for that location for that period.



Figure 4: Electrical Conductivity Levels in Down-Gradient Wells at Ballynagran during 2010



Note 1: Gaps in the graphical illustration of data are due to results being unavailable for that location for that period.



Figure 5: Electrical Conductivity Levels in Up-Gradient Wells at Ballynagran during 2010

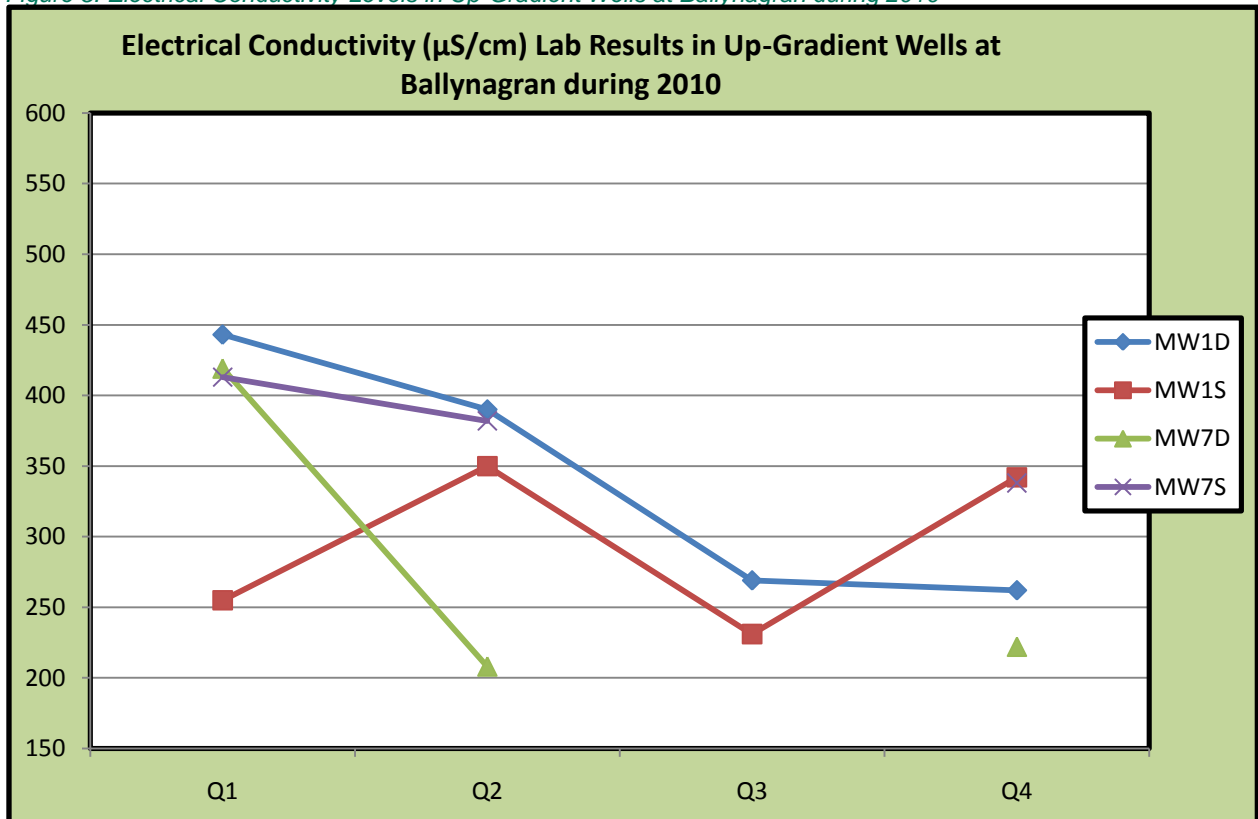


Figure 6: Chloride Levels Detected in Down-Gradient Groundwater Monitoring Wells during 2010

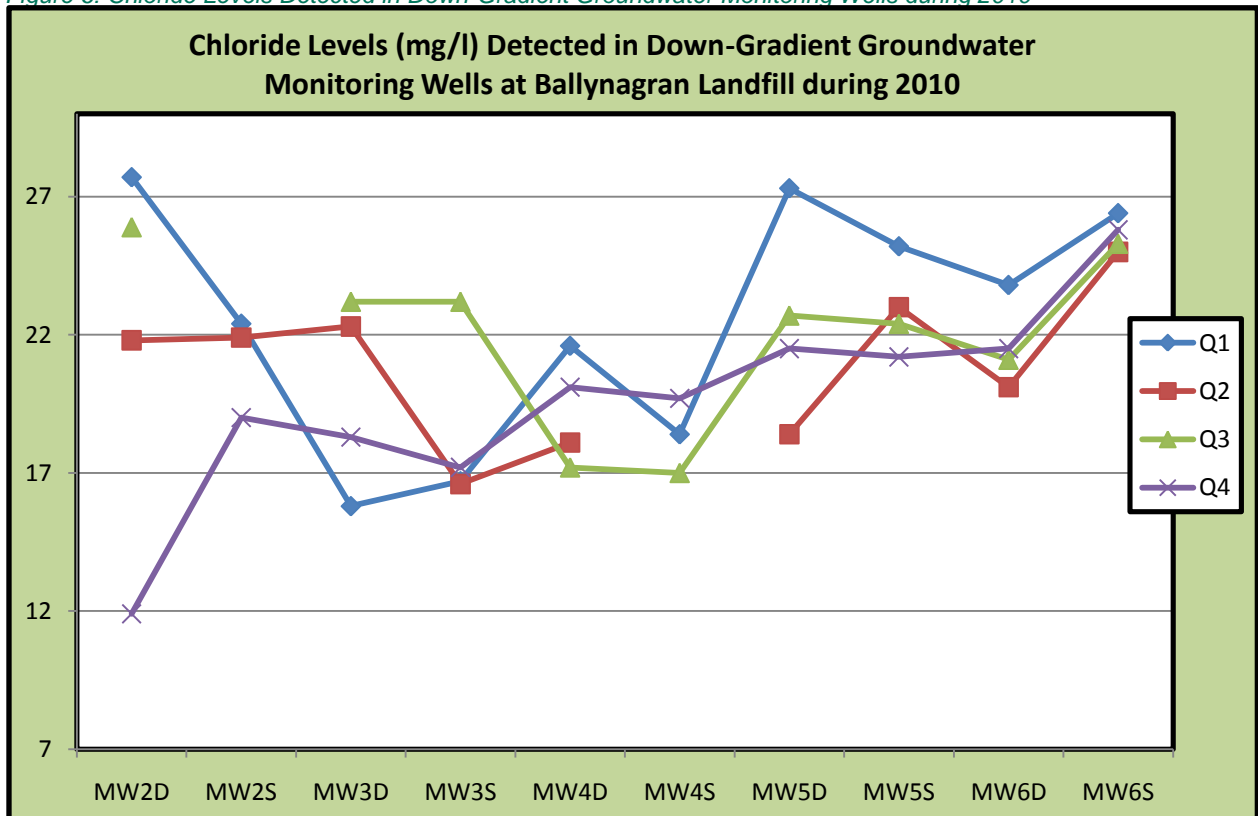
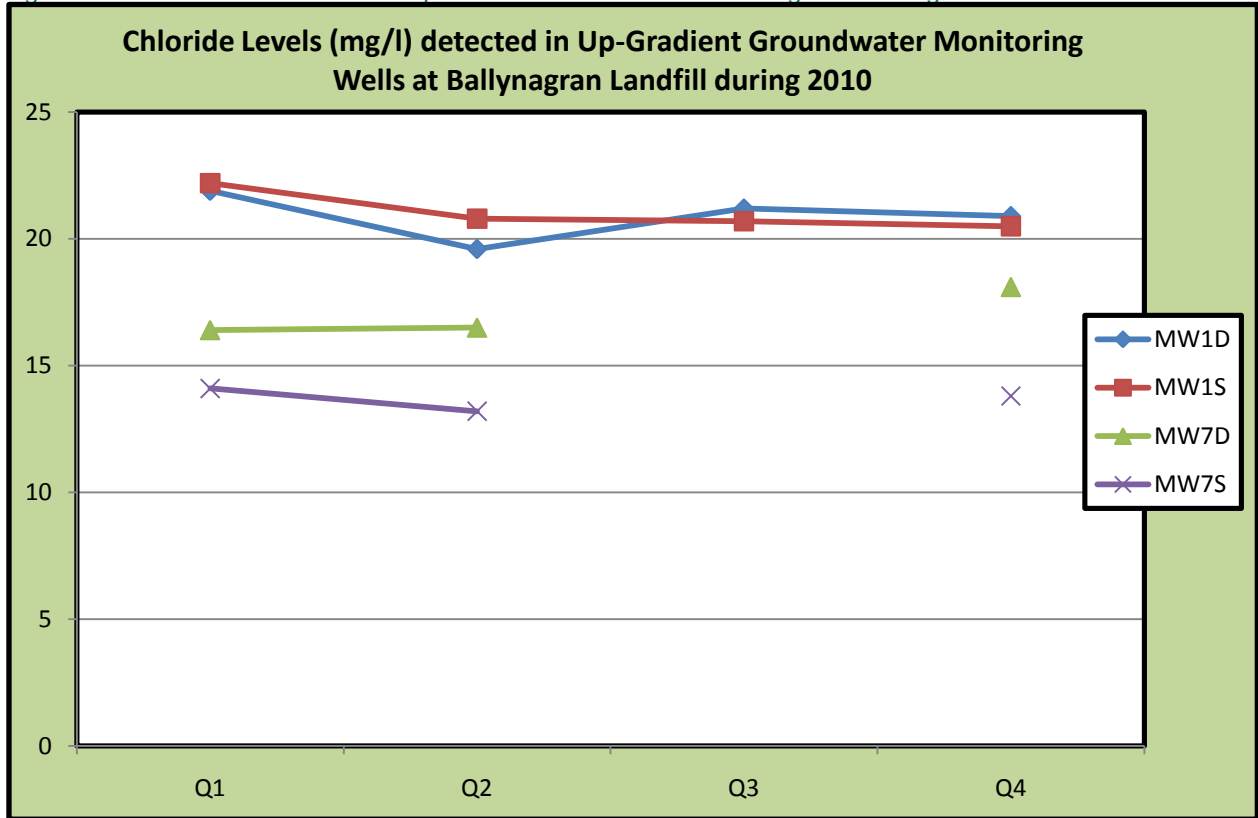




Figure 7: Chloride Levels Detected in Up-Gradient Groundwater Monitoring Wells during 2010



Note 1: Gaps in the graphical illustration of data are due to results being unavailable for that location for that period.





Figure 8: Dissolved Oxygen Levels in Down-Gradient Groundwater Monitoring Wells during 2010

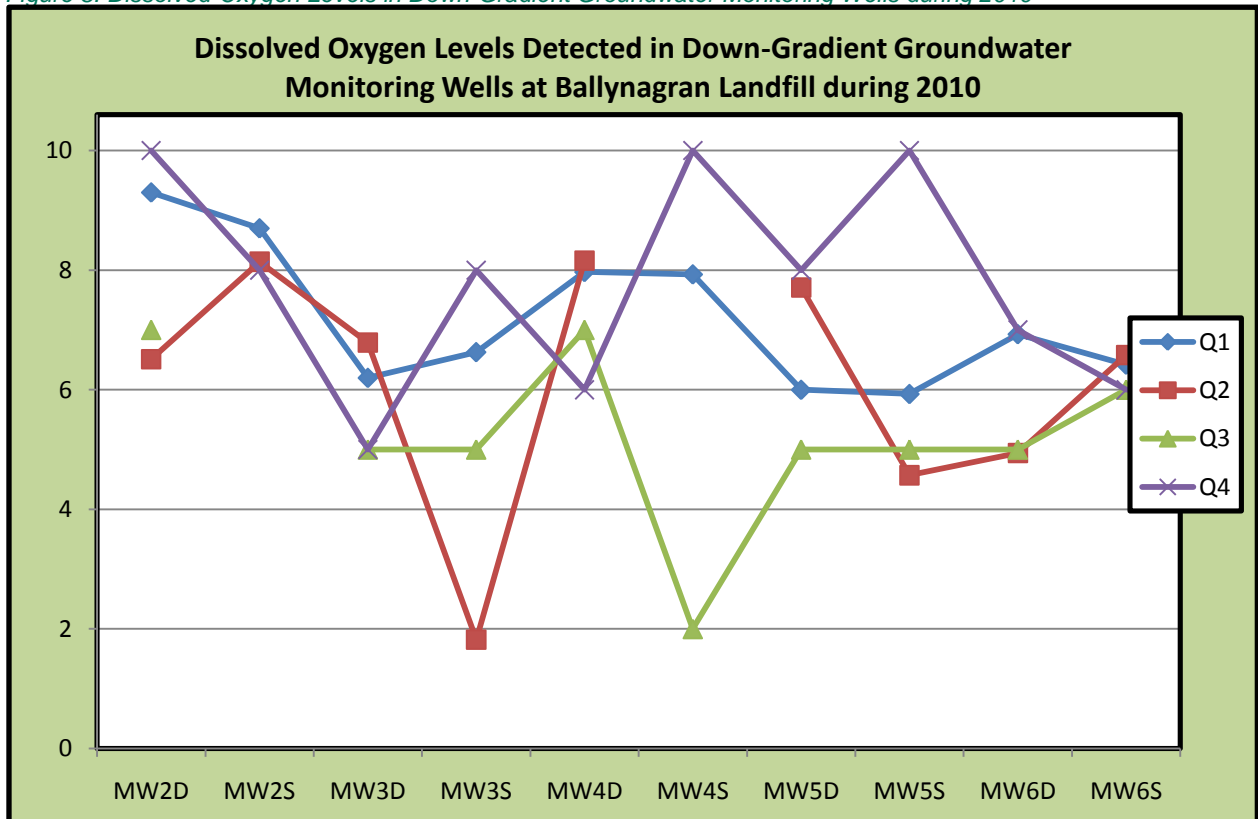


Figure 9: Dissolved Oxygen Levels in Up-Gradient Groundwater Wells during 2010

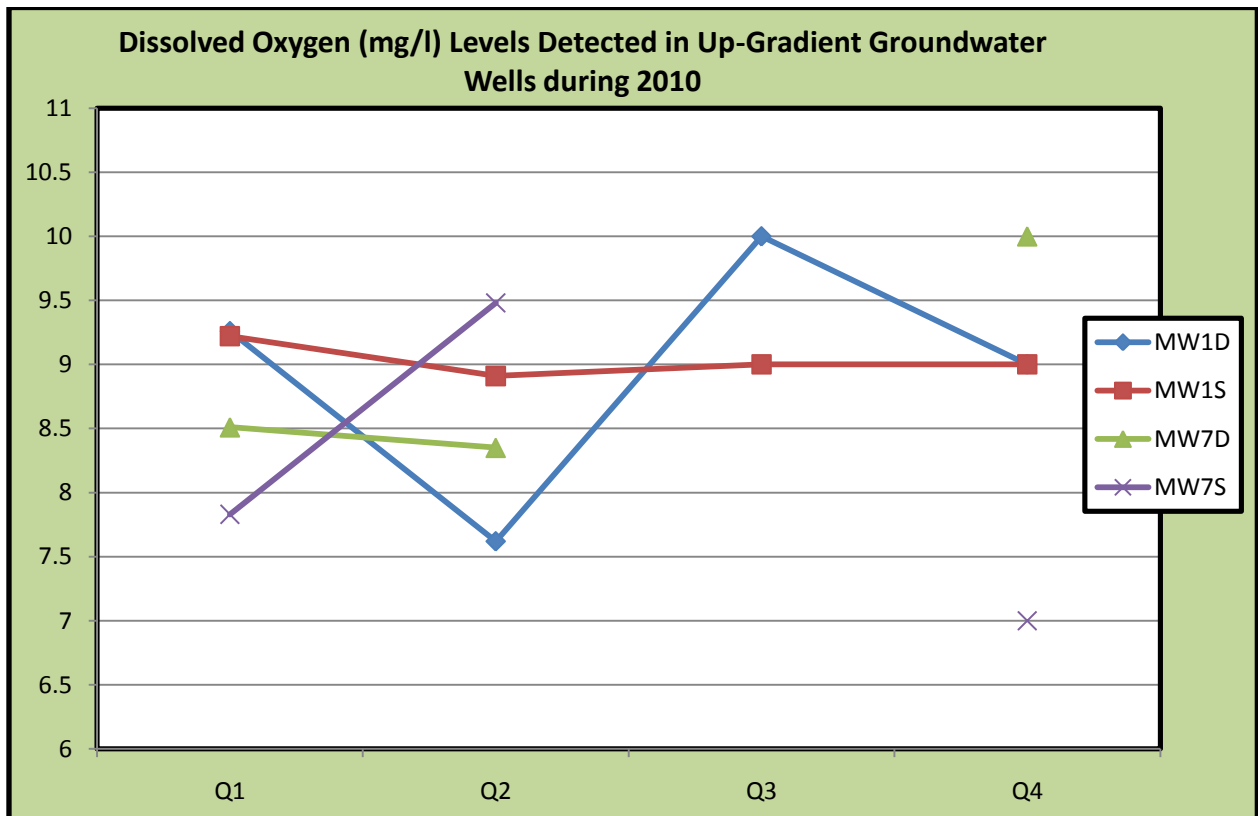
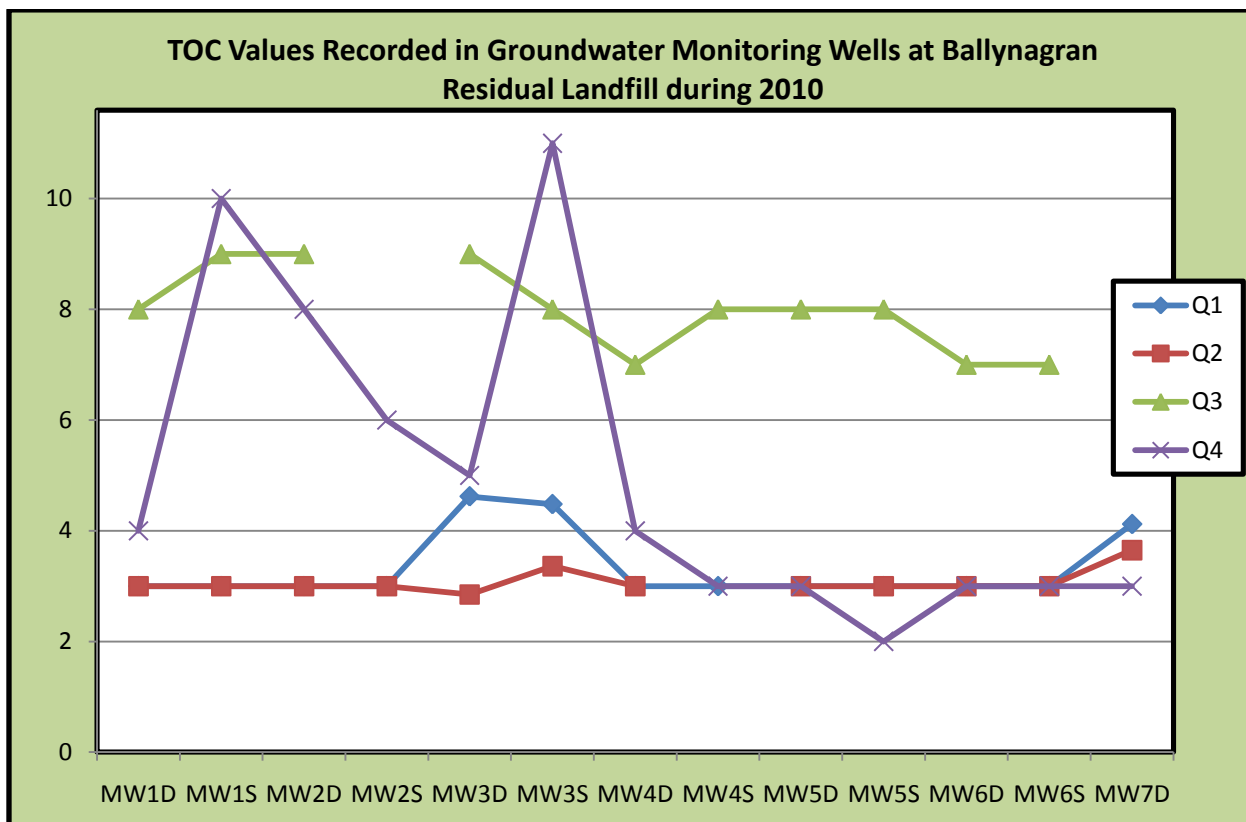




Figure 10: TOC levels in Groundwater Wells during 2010



Note 1: Gaps in the graphical illustration of data are due to results being unavailable for that location for that

## 14.2 Groundwater results discussion – Review of 2010 Chemical Trigger Parameter Concentrations

Table 14: Groundwater Trigger Levels as per Condition 6.4.2 of Waste Licence W0165-02

Parameter	pH	Chloride	Ammoniacal Nitrogen	Total Organic Carbon	Potassium
Units	pH Units	mg/l	mg/l	mg/l	mg/l
All Wells	≤6 pH ≥9	40 mg/l	0.15 mg/l	50 mg/l	12 mg/l

### Ammoniacal Nitrogen levels in groundwater during 2010 at Ballynagran Landfill.

Samples tested during the 1<sup>st</sup> and 2<sup>nd</sup> Quarter of 2010 indicated that the trigger value and the IGV were breached at several locations across the site at locations MW1D, MW3S and MW3D, and MW7S. The most significant breach was recorded at location MW3S where a level of 0.984 mg/l was recorded.



Elevated levels of ammoniacal nitrogen in both down gradient and up-gradient wells were recorded prior to waste being placed in the facility and suggests that the underlying source of these breaches were of an agricultural nature.

The 3<sup>rd</sup> and 4<sup>th</sup> Quarter 2010 sampling round, ammoniacal nitrogen levels were not breached.

### **Chloride Levels in groundwater during 2010 at Ballynagran Landfill.**

Samples taken and analysed for chloride during the 1<sup>st</sup> Quarter of 2010 indicated that neither the Trigger Level of 40 mg/l nor the EPA IGTV of 30 mg/l were breached.

Samples taken and analysed for chloride during the 2<sup>nd</sup> Quarter of 2010 indicated that neither the Trigger Level of 40 mg/l nor the EPA IGTV of 30 mg/l were breached.

Samples taken and analysed for chloride during the 3<sup>rd</sup> Quarter of 2010 indicated that neither the Trigger Level of 40 mg/l nor the EPA IGTV of 30 mg/l were breached.

Samples taken and analysed for chloride during the 4<sup>th</sup> Quarter of 2010 indicated that neither the Trigger Level of 40 mg/l nor the EPA IGTV of 30 mg/l were breached.

### **pH Levels in groundwater during 2010 at Ballynagran Landfill.**

pH values in groundwater samples taken during the 1<sup>st</sup> Quarter of 2010 indicated that several breaches occurred. These were reported to the Agency in the 1<sup>st</sup> Quarter 2010 environmental monitoring reports. These level breaches were recorded at locations MW1D, MW2S and MW4D and MW4S.

These sampling locations are located up-gradient of the facility and these breaches were not related to landfill activity and are thought to be related to agricultural activities in the area.

During the 2<sup>nd</sup> Quarter of 2010 pH level breaches were recorded at locations MW1D, MW1S, MW2D.

Samples taken and analysed for pH during the 3<sup>rd</sup> Quarter of 2010 indicated that neither the Trigger Level of nor the EPA IGTV were breached.

Samples taken and analysed for pH during the 4<sup>th</sup> Quarter of 2010 indicated that neither the Trigger Level of nor the EPA IGTV were breached.

During the 4<sup>th</sup> Quarter of 2010 pH level breaches were recorded at locations MW1D, and MW2S.

### **Total Organic Carbon Levels in groundwater during 2010 at Ballynagran Landfill**

Samples taken and analysed for Total Organic Carbon during the 1<sup>st</sup> Quarter of 2010 indicated that the trigger level 50 mg/l was not breached.

Samples taken and analysed for Total Organic Carbon during the 2<sup>nd</sup> Quarter of 2010 indicated that the trigger level 50 mg/l was not breached.

Samples taken and analysed for Total Organic Carbon during the 3<sup>rd</sup> Quarter of 2010 indicated that the trigger level 50 mg/l was not breached.

Samples taken and analysed for Total Organic Carbon during the 4<sup>th</sup> Quarter of 2010 indicated that the trigger level 50 mg/l was not breached.

### **Potassium Levels in groundwater during 2010 at Ballynagran Landfill**

Samples taken and analysed for potassium during the 3<sup>rd</sup> Quarter of 2010 indicated that neither the Trigger Level of 12 mg/l nor the EPA IGTV of 5 mg/l were breached.

### **Chromium Levels in groundwater during 2010 at Ballynagran Landfill**



Samples taken and analysed for Chromium during the 3<sup>rd</sup> quarter in 2010 were found to have elevated levels of Chromium. The samples obtained were analysed for the annual parameters specified in the licence. During this monitoring round, four wells sampled (i.e. MW4s, MW5d, MW5s and MW6s) were found to have elevated Total Chromium concentrations. As elevated chromium had not been detected in previous monitoring rounds and no obvious explanation could be found, it was decided to monitor this parameter again in 2011. The Quarter 1 2011 results were significantly lower than the concentrations seen in Quarter 3 2010, and are also below the IGV concentration limits.

All the results for the samples taken in Quarter 1 of 2011 show very low concentrations of chromium; and the Total Chromium concentrations are below the IGV of 30 µg/l. The concentrations measured in Quarter 1 2011 and in March 2011 in the four wells of concern, are now consistent with historical chromium measurements (Quarter 3 2009, shown in Table 2). Furthermore, all the March 2011 samples showed Hexavalent Chromium and Trivalent Chromium concentrations below the limit of detection.

These results strongly indicate that no significant chromium concentrations are currently present in the groundwater at Ballynagran Landfill, or were present prior to Quarter 3 2010. In light of this, it is likely that the elevated concentrations detected in the Quarter 3 2010 monitoring round may have been due to laboratory error or a contamination event unrelated to activities at the landfill.

The results for 2010 indicate that the operation of the landfill is not having any negative effect on the underlying groundwater.

In accordance with Condition 8.7 of the waste licence W0165-02, a monitoring programme of private wells was conducted within 500 m of the facility subject to the agreement of the well owners. The results of the monitoring rounds were reported in the 3<sup>rd</sup> and 4<sup>th</sup> Quarter Environmental Monitoring Reports of 2010.

## 15.0 LEACHATE MONITORING

### 15.1 Sampling Methodology

Six (6 no.) leachate monitoring points are defined in accordance with Schedule D of Waste Licence W0165-02. Samples were collected and analysed from LP1, LP3, LP2/5, LP6, LP7 and the Leachate lagoon. The locations of these monitoring points are shown in Drawing 5 Rev. C. in Appendix A.

Leachate sampling was undertaken by using the “grab” sampling method. Samples from the waste cells were taken from automatically controlled pumping and sampling stations. The samples were then transferred to a refrigerated unit until collected from the site by the laboratory couriers. Visual, olfactory and field parameters were recorded on site. Alcontrol Geochem Laboratories, conducted chemical analyses on the leachate samples. A suite of quarterly parameters set out in Table D.5.1 of Schedule D of the Waste Licence W0165-02 were requested for analysis.

### 15.2 Results

Results from leachate monitoring conducted at the facility during the reporting period have been presented to the Agency in each of the quarterly reports. Summary tables for selected parameters are presented below in Table 15 to Table 19.

**Table 15: Major Parameters recorded at Leachate Monitoring Location LP1 during 2010**

Parameter	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
BOD mg/l	260	200	-	246



## BALLYNAGRAN AER 2010

Parameter	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
COD mg/l	3000	4210	-	3980
Chloride mg/l	979	1759	-	1596
NH4-N mg/l	1790	2146	-	2829
Electrical Conductivity $\mu$ S/cm	17.4	21.8	-	20.78
pH	8.59	7.8	-	7.86

**Table 16: Major Parameters Recorded at Leachate Monitoring Location LP3 during 2010**

Parameter	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
BOD mg/l	193	200	-	286
COD mg/l	2530	3255	-	3685
Chloride mg/l	1450	1454	-	1847
NH <sub>4</sub> -N mg/l	1320	1802	-	2360
Electrical Conductivity $\mu$ S/cm	15.4	19.32	-	19.88
pH	8.36	7.8	-	7.91

**Table 17: Major Parameters Recorded at Leachate Monitoring Location LP5 during 2010**

Parameter	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
BOD mg/l	581	240	>474	522
COD mg/l	5600	5365	8060	6720
Chloride mg/l	1370	1886	2249	2323
NH <sub>4</sub> -N mg/l	2460	2384	-	3599
Electrical Conductivity $\mu$ S/cm	22.1	23.7	27.44	27.59
pH	8.6	7.7	8.5	8.07

**Table 18: Major Parameters Recorded at Leachate Monitoring Location LP7 during 2010**

Parameter	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
BOD mg/l	-	140	223	60.2
COD mg/l	-	1674	3220	2466
Chloride mg/l	-	2993	1444.5	1488
NH4-N mg/l	-	1113	-	1713
Electrical Conductivity $\mu$ S/cm	-	14.93	17.47	16.29
pH	-	7.5	8.36	7.57

**Table 19: Major Parameters Recorded at the Leachate Lagoon during 2010**

Parameter	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
BOD mg/l	298	350	>443	300
COD mg/l	3240	3795	5520	2336
Chloride mg/l	2120	1511	1875.6	1560.9
NH4-N mg/l	1490	1610	-	2336
Electrical Conductivity $\mu$ S/cm	16.2	18.38	23.6	18.77
pH	8.68	7.7	8.53	7.92

### 15.3 Discussion

**BOD:** Biological Oxygen Demand showed regular fluctuations during 2010. The highest figure recorded was 581 mg/l at location LP5 during Quarter 1 of 2010. The lowest figure recorded was at LP7 during Quarter 4 of 2010.

**COD:** The highest recorded figure for COD during 2010 was 8060 mg/l which was recorded at leachate location LP2/5 during Quarter 3 of 2010. The lowest COD figure recorded was 1150 mg/l at LP6 during Quarter 1 of 2010.



**Ammoniacal Nitrogen:** The highest level recorded was 3599 mg/l at monitoring location LP5 during Quarter 4 of 2010 and the lowest figure recorded was 1113 mg/l at leachate monitoring location LP7 during Quarter 2 of 2010.

**Electrical Conductivity:** The highest figure recorded during 2010 was at location LP5 during Quarter 4 of 2010 where a figure of 27.597 $\mu$ S/cm was recorded. The lowest figure recorded was at location LP7 during Quarter 2 of 2010 where a figure of 14.93  $\mu$ S/cm was recorded.

**pH:** The highest pH value recorded during 2010 was at the leachate lagoon during Quarter 1 of 2010 where a figure of 8.68 was recorded. A low figure of 7.5 was recorded at LP7 during Quarter 2 of 2010.

## 16.0 LANDFILL GAS MONITORING

### 16.1 Locations and Methods

Landfill gas is monitored at Ballynagran landfill in compliance with Condition 6.3 Landfill Gas as well as Table C.2 of Schedule C: Emission Limits and Table D.2.2 Landfill Gas Monitoring Parameters, Frequency and Technique.

#### 16.1.1 Landfill gas Emission Limit Values

Landfill gas emission limit values as given in Licence W0165-02 are assigned to gas monitoring locations at the perimeter of the landfill. These emission limit values are listed below in Table 20.

**Table 20: Waste Licence Landfill Gas Emission Limit Values**

<b>Methane</b>	<b>Carbon Dioxide</b>
1.0 % v/v	1.5 % v/v

Landfill gas monitoring was conducted by Ballynagran Landfill staff members and Golder Associates consultants.

In accordance with Table D.2.2 of the waste licence, landfill gas must be monitored on a monthly basis. Ballynagran staff members conducted landfill gas monitoring for the remaining part of 2010. In total 23 no. landfill gas monitoring wells were monitored at Ballynagran during 2010.

A description and detailed co-ordinates of all landfill gas monitoring wells at Ballynagran is given in Table 21 overleaf.





**Table 21: Landfill Gas Monitoring Locations at Ballynagran during 2010**

Monitoring Location	Eastings	Northings
MG01	327146	191328
MG02	326926	191073
MG03	326949	191034
MG04	326980	191002
MG05	327017	190975
MG06	327062	191971
MG07	327107	191974
MG08	327151	190977
MG09	327196	190978
MG10	327239	190993
MG11	327264	191031
MG12	327285	191070
MG13	327301	191112
MG14	327305	191157
MG15	327303	191202
MG16	327288	191244
MG17	327269	191285
MG18	327233	191313
MG19	327189	191314
MG20	327146	191328
MG47	326852	191226
MG48	326879	191191
MG49	326901	191151

## 16.2 Landfill Gas Monitoring Methodology

Landfill gas measurements were undertaken using a GA2000 Landfill Gas Analyser. The gas is analysed for its content by % volume of the following constituents:

- • Methane CH<sub>4</sub>;
- • Carbon dioxide CO<sub>2</sub>; and
- • Oxygen O<sub>2</sub>.

The LEL (lower explosive limit of methane), atmospheric pressure (millibars) and temperature (°C) were also recorded by the GA2000 Landfill Gas Analyser.

## 16.3 Landfill Gas Monitoring Results

Monthly gas results are sent to Golder Associates for inclusion in each quarterly environmental monitoring report. These were included as an appendix in each report sent to the Agency during 2010.

During 2010, methane levels were detected in levels above the licence emission limit value (ELV) of 1% at locations MG16 and MG17 and MG18. The methane levels have fluctuated over the course of the year with a high of 71.4% v/v recorded in MG16 in September 2010. A high of 65.2% was detected in MG17 during the October 2010 monitoring round.



At location MG 18, methane elevations were beached only on one occasion in November 2010 monitoring round at 16.1% (v/v)..

Elevated levels of Carbon Dioxide were detected in levels above the licence emission limit value of 1.5% v/v in monitoring wells in MG2, MG5, MG9, MG10, MG11, MG13, MG14, MG15, MG16, MG17, MG18, MG19 and MG47 during 2010. The highest level detected was recorded in monitoring well MG17 in November 2010 at a level of 20.8% v/v.

The high CH<sub>4</sub> and CO<sub>2</sub> levels can be explained by the high baseline concentrations in these wells before the facility began accepting waste.

Historically, high concentrations of methane and carbon dioxide were recorded in MG15, MG16, MG17 and MG18 in October 2006, which was prior to the placement of any waste in the landfill. Background CH<sub>4</sub> and CO<sub>2</sub> concentrations continue to be elevated outside the perimeter of the landfill active waste area. These concentrations are consistent with baseline levels recorded prior to the period of active landfilling on the site. The concentrations may be as a result of the natural degradation of organic material and historical waste having been placed in the vicinity prior to the current operators being active at the site.

Analysis carried out in the vicinity of Ballynagran on two occasions in 2007, and reported by Odour Monitoring Ireland (OMI), showed a VOC profile that is significantly different when comparing perimeter gas wells with active gas wells. In their report, they state that it is highly unlikely that methane and carbon dioxide concentrations in the perimeter gas wells are the results of lateral or horizontal landfill gas migration.

They indicate that the most likely source of the high measurements is from disturbed ground from the construction phase and results represent natural degradation of organic material.

## 17.0 PM10 MONITORING

### 17.1 Locations and Methods

In accordance with Table D.3.1 of Waste Licence W0165-02, PM10 monitoring is conducted quarterly at the site. During 2010, Emerald Environmental conducted PM10 sampling at the site at 4 No. locations labelled PM1 – PM4 inclusive. During the 1<sup>st</sup> Quarter of 2010 the PM10 survey was carried out between 8 and 12 March 2010. During the 2<sup>nd</sup> Quarter of 2010 Emerald Environmental conducted the PM10 survey between 14 June 2010 and 18 June 2010. The 3<sup>rd</sup> Quarter survey was conducted between 6 September 2010 and 10 September 2010 and the final PM10 survey for 2010 was conducted between 30 November 2010 and 10 of December 2010. All reports were forwarded to the Agency as an attachment to each corresponding quarterly report. Sampling locations are illustrated on Drawing 5 Rev C Environmental Monitoring Locations which is attached in Appendix A. A summary table of results is presented in below

Table 22: Summary of PM10 Survey Results at Ballynagran during 2010:

Monitoring Location	Quarter 1 2010	Quarter 2 2010	Quarter 3 2010	Quarter 4 2010
Licence Limit	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>	50 µg/m <sup>3</sup>
PM1	15.3	5.3	10.4	3.5
PM2	9.2	6.5	12.2	4.3
PM3	7.4	6.8	11.9	6.0
PM4	6.9	8.9	14.6	5.5

### 17.2 Interpretation and Discussion

All PM10 results for 2010 are below the licence limit.



## **18.0 ENVIRONMENTAL NOISE**

### **18.1 Monitoring Locations**

During 2010, noise monitoring was conducted quarterly at the site in accordance with Table D.4 of Waste Licence W0165-02. Noise monitoring was conducted at 4 No locations on-site and a further 3 noise sensitive locations off-site during each survey. Each survey was reported to the Agency in a separate report attached as an appendix to each corresponding quarterly report. In summary, it was noted that location NSL3 is influenced to a very dominant level by road traffic on the main N11 motorway. Operations at the landfill do not have any influence on the environmental noise level at locations NSL2 and NSL3. Both of these locations are dominated to a much greater extent by road traffic on the N11 and other surrounding local access roads. Of the on-site noise monitoring locations, operations are inaudible although distant reversing sirens can be heard intermittently. Operations are inaudible at locations N3 and N4. Passing site traffic and operational activities are dominant at location NL2 and the licence emission limit value of 55 dB (A) was breached. Sampling locations are illustrated on Drawing 5 Rev C. Environmental Monitoring Locations. A summary of results is presented below in Tables 17 - 20.



**Table 23: Summary Table of Recorded Noise Survey Results during Quarter 1 2010**

<b>Monitoring Location</b>	<b>Date/Time</b>	<b>LAeq 30 mins</b>	<b>LA10 30 mins</b>	<b>LA90 30 mins</b>
N1	09/03/10 14:00pm	46	44	38
N2	09/03/10 13:00pm	52	49	45
N3	09/03/10 15:00pm	51	50	48
N4	09/03/10 12:15pm	<b>54</b>	51	48
NSL1	09/03/10 11:30am	50	52	45
NSL2	09/03/10 10:50am	<b>66</b>	62	59
NSL3	09/03/10 10:00am	<b>59</b>	52	49

**Table 24: Summary Table of Recorded Noise Survey Results during Quarter 2 2010**

<b>Monitoring Location</b>	<b>Date/Time</b>	<b>LAeq 30 mins</b>	<b>LA10 30 mins</b>	<b>LA90 30 mins</b>
N1	18/05/10 13:51 hrs	48	51	43
N2	18/05/10 12:41 hrs	50	63	47
N3	18/05/10 15:05 hrs	50	54	45
N4	18/05/10 11:58 hrs	47	53	41
NSL1	18/05/10 11:17 hrs	50	59	43
NSL2	18/05/10 10:35 am	72	77	46
NSL3	18/05/10 09:54 hrs	60	63	55

**Table 25: Summary Table of Recorded Noise Survey Results during Quarter 3 2010**

Monitoring Location	Date/Time	LAeq 30 mins	LA10 30 mins	LA90 30 mins
N1	09/09/10 11:30 hrs	51	52	39
N2	09/09/10 10:24 hrs	49	52	43
N3	09/09/10 12:28 hrs	61	63	43
N4	09/09/10 15:28 hrs	53	49	38
NSL1	09/09/10 14:36 hrs	57	56	39
NSL2	09/09/10 09:07 hrs	64	60	42
NSL3	09/09/10 13:30 hrs	58	61	53

**Table 26: Summary Table of Recorded Noise Survey Results during Quarter 4 2010**

Monitoring Location	Date/Time	LAeq 30 mins	LA10 30 mins	LA90 30 mins
N1	10/01/11 14:10 hrs	52	55	48
N2	10/01/11 11:53 hrs	50	-	47
N3	10/01/11 13:03 hrs	50	-	46
N4	10/01/11 10:52 hrs	53	47	43
NSL1	10/01/11 10:02 hrs	49	46	42
NSL2	10/01/11 09:12 hrs	62	64	49
NSL3	10/01/11 08:19 hrs	66	68	63

## 18.2 Results and Interpretation

Noise monitoring was conducted at 7 No. monitoring locations on a quarterly basis at Ballynagran Landfill in compliance with Section D.4 and Table D.4.1 of Waste Licence W0165-02. During 2010, the dominant noise source that produced noise levels above 55 dB(A) LAeq – the licence limit, was road traffic. The two locations that regularly show figures above this licence limit are locations NSL2 and NSL3.

Both of these locations are situated very close to busy local access routes and in the case of NSL3, the main N11 motorway. It is noted that during the 3<sup>rd</sup> Quarter of 2010, a figure of 61 dB(A) LAeq was recorded at location N3. On-site, the dominant noise source comes from reversing sirens on site plant. This is a necessary safety feature of these vehicles and is an intermittent noise source.

## 19.0 BIOLOGICAL ASSESSMENT

### 19.1 Locations and Methods

Biological sampling and a water quality assessment was carried out by Golder Associates Ireland Ltd, on behalf of Greenstar as part of their Environmental Monitoring Programme, for compliance with their Waste Licence, W0165-02. Sampling was carried out on 24 September 2010 in accordance with EPA Q-rating methodology (Clabby *et al.*, 2004) at eight locations on 3 no. watercourses which flow within, and outside of, the Site boundary. Sampling locations are described overleaf in Table 27 and illustrated on Drawing 5 Rev G provided in the Quarter 4 2010 Report for Ballynagran Landfill.



**Table 27: Sampling Locations**

Monitoring Point	Description
SW1	Ballynagran Stream – west of landfill, upstream of landfill
SW2	Longford Stream – east of landfill, upstream of landfill
SW3	Killandra Stream – southeast of landfill, upstream of confluence with Ballynagran Stream
SW4	Ballynagran Stream – west of landfill, downstream of SW1, upstream of Phase 1 Area
SW5	Longford Stream – east of landfill, downstream of landfill
SW6	Three Mile Water River – off-site to south, downstream of landfill
SW7	Three Mile Water River – off-site to south, downstream of landfill
SW8	Longford Stream – east of landfill, downstream of landfill

## 19.2 Interpretation and Discussion

Samples are dominated by tolerant ‘Group C’ taxa such as *Gammarus duebeni*, Simuliidae and *Baetis rhodani*. Group B taxa were relatively common, Group A and E taxa were absent, and Group D taxa were scarce (ref. Section 2.2 for Group descriptions). Similar results in upstream (SW1-4) and downstream (SW5-8) locations indicate that there is no evidence of water quality deterioration as a result of the landfill development (Table 6).

The current results differ from the 2009 results in that SW1 and SW7 have been assigned a Q3 rating on this occasion due to the lack of Group A and Group B species in these samples.

Although only one individual specimen of Group A taxa accounted for the Q3-4 assignments in both 2008 and 2009, the absence of both Group A and Group B taxa in 2010 indicates a possible deterioration in water quality compared to 2009 and 2008, where SW3 and SW6 were assigned a value of Q3-4 in 2008 (Openfield, 2008), and SW1 and SW7 assigned a value of Q3-4 in 2009 (Golder Associates, 2009).

As described in Section 2.4, a prolonged period of rainfall occurred in the days prior to the taking of kick samples, which may have affected the numbers of macroinvertebrate taxa and individuals present. Furthermore, as SW1 is situated upstream of the landfill, it is probable that any possible deterioration in water quality represented by the lower numbers of macroinvertebrate taxa and individuals present in the samples is a result of factors upstream of the landfill, and not as a result of the landfill development.

Given that only one individual specimen accounted for the Q3-4 assignment in previous years, and taking into account the factors discussed above, it is not considered that in practice the biological water quality at these sites in 2010 is significantly different to that in previous years (2008 and 2009).

A summary table of results for the biological assessment is presented below in Table 28.

**Table 28: Biological Assessment 2010 Summary Results Table**

Taxa	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
<b>GROUP A</b>								
none								
<b>GROUP B</b>								
<b>Cased Trichoptera</b>								
Glossosomatidae				1		1		
Limnephilidae						4		
Sercostomatidae						2		4



Taxa	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
<i>Odontoceridae albicorne</i>		2				4		2
<b>GROUP C</b>								
<b>Ephemeroptera</b>								
<i>Baetis rhodani</i>	6	10	13		107			
<i>Ephemerella ignita</i>		4	3		3			
<b>Uncased Trichoptera</b>								
<i>Rhyacophila dorsalis</i>	6	2	1	2				
<b>Coleoptera</b>								
Elminthidae			1		2		8	4
Helodidae	2		10				1	25
Dryopidae		12						
<b>Crustacea</b>								
<i>Gammarus duebeni</i>	13	63	8	3	90		15	>100
<b>Gastropoda</b>								
<i>Potamopyrgus jenkinsi</i>	1	13	3		36	2		34
<i>Ancylus fluviatilis</i>			2	1		1		12
<b>Diptera</b>								
Simuliidae	21	1	1	4	4			
Tipulidae								
Chironomidae						>100	4	4
<b>GROUP D</b>								
<b>Lamellibranchiata</b>								
<i>Pisidium spp.</i>		1				1		1
<b>GROUP E</b>								
None								
<b>OTHER</b>								
<i>Dugesia lugubris</i>	9			3				
<b>Oligochaeta</b>	5	12	9	13	12			1
<b>Q VALUE</b>	<b>Q3</b>	<b>Q3</b>	<b>Q3</b>	<b>Q3</b>	<b>Q3</b>	<b>Q3</b>	<b>Q3</b>	<b>Q3</b>

## 20.0 SCHEDULE OF OBJECTIVES AND TARGETS FOR 2010

Table 29 below details the objectives and targets at Ballynagran Residual Landfill for 2010.



**Table 29: Schedule of Objectives and Targets for 2010**

<b>Originated from</b>	<b>Objective</b>	<b>Target including timescale</b>	<b>Project no.</b>
F01 – impact no. 6 and AER 2007 & 2009 & 2010	Reduce risk of wind blown litter when the site is operating in adverse weather conditions	Ensure site remains compliant with Licence conditions which refer to wind blown litter (for timescale see project sheet)	8
Risk assessment (hazard no. 4) / AER 2009	To reduce the risk of site personnel being hit by a vehicle	To significantly reduce this type of incident on site.	14
F01 - impact no. 7 / AER 2007 & 2008 & 2009 & 2010	Review and assess the effectiveness of nuisance control procedures including bird, rats and mice	Continually review and assess all nuisance control procedures to ensure minimal impact on surrounding area. Update reports on bird control and odour abatement measures. Prepare and implement odour nuisance management plan (for timescale see project sheet)	4
AER 2007 & 2008 & 2009 & 2010	Minimise nuisance from vehicle movements and uploading / tipping	Ensure noise, dust, odour from vehicle movements are minimised by correct implementation of relevant operational protocols (for timescale see project sheet)	5
AER 2007 & 2008 & 2009 & 2010	Continue to improve relationships with neighbouring communities / reduce environmental complaints	Develop communications with site neighbours and respond to queries as quickly as reasonably practicable, ensuring that any complaints are followed up in writing as soon as possible after receipt of complaint (for timescale see project sheet).	10
AER 2007 & 2009 & 2010	Environmental monitoring	Ensure monitoring results comply with Licence limits and investigate any exceedances of emission limit value (for timescale see project sheet).	11





Originated from	Objective	Target including timescale	Project no.
F01 - impact no. 1 / AER 2008 & 2009 & 2010	Develop landfill gas collection infrastructure and gas utilisation plant.	Extend gas collection infrastructure into new cells, respond to increased gas generation by installing additional flares and engines, as required. Expand LFG utilisation plant and set up extra engines. Collect and burn approximately 95% of all landfill gas generated by the facility. In 2011 permanently cap southern boundary to improve gas containment and increase FID surveys from biannually to quarterly. (for timescale see project sheet)	1
F01 – impact no. 3 / AER 2009/2010	Minimise risk of potential water pollution from generation of leachate	Minimise leachate generation. In 2011 permanently cap southern boundary to reduce leachate generation. (for timescale see project sheet)	2
F01 – impact no. 5 / AER 2009/2010	Reduce dust nuisance on environment and surrounding neighbours	All dust emissions in accordance with Licence (for timescale see project sheet)	3
F01 – impact no. 4 / AER 2009/2010	Avoid contamination of groundwater after a spillage or emergency situation	Carry out spillage emergency response training (for timescale see project sheet)	7
Risk assessment (hazard no. 5) and F01 – impact no. 2	Reduce the hazard posed to all personnel and the environment (emissions to air) by fire or explosion from flammable materials on site	Minimise the occurrence of this type of incident	6



## BALLYNAGRAN AER 2010

Originated from	Objective	Target including timescale	Project no.
AER 2007 & 2008 & 2009	Monitor progress of planting programme on a regular basis	Regularly review planted woodland area and ensure the replacement of any failed trees to ensure visual impact of site is minimised (for timescale see project sheet).	12
AER 2008 & 2009	Awareness and training programme	Carry out continued ISO and Health and Safety Training	n/a
H&S Policy / AER 2009/AER 2010	<ul style="list-style-type: none"> <li>■ Promotion of H&amp;S amongst all employees and the generation of an ethos of continual improvement</li> <li>■ Diligent management of operations by employing control mechanisms, procedures and processes that are technologically proven and economically feasible</li> <li>■ Promotion of continual improvement, good health and safety work practices through continual review of O&amp;Ts</li> <li>■ Fostering of openness, dialogue, enhanced communication and discussion with employees, clients, neighbours, suppliers, contractors and all interested parties regarding our H&amp;S and our O&amp;Ts</li> <li>■ Publication and communication of our policy internally and ensuring its availability to the public and interested parties on request so that it is understood implemented and maintained</li> <li>■ Measurement of performance by conducting regular audits and assessment of compliance with the OHSAS 18001:2007 standards, EHS policy, relevant legislation and regulatory requirements</li> </ul>	<ul style="list-style-type: none"> <li>■ Improvement driven Safety Observation Audit Reports are to be undertaken bi-monthly focussing on swiftly resolving problems as they occur</li> <li>■ Develop H&amp;S training giving more focus on empowering employees to become safety representatives, as applicable</li> <li>■ Look to develop staff interaction enabling keen spotting of potential problem or hazards through training and communication</li> <li>■ Encourage feedback on equipment and resources including adequacy of PPE in protective properties, wear ability and durability and look at alternatives, where appropriate</li> <li>■ Develop neighbour relations by encouraging site visits to complainants or mediation through local groups such as the liaison committee or anti-dump group also handling complaints with higher degree of positive feedback</li> </ul>	n/a



Originated from	Objective	Target including timescale	Project no.
AER 2008 & 2009 / Energy Audit March 10/Jan 11	Assess and review resource and energy consumption at the site (AER 2008) 14 points from Energy Audit March 2011. 1. Review energy policy statement annually. 2. Provide appropriate training annually. 3.. Prepare targets and objectives 4. Annual summary on performance in AER 5. Assessment of energy efficiency of future plant and equipment 6. Communicate policy objectives to staff 7. Provide sub meters for gas utilisation plants 8. Bi-monthly data analyses and identification of efficiency opportunities 9. Annual summary report in AER 10. Provide awareness training to staff 11. Provide feedback to staff 12. Provide time sensors for office lighting 13. Consider introducing bio-diesel for mobile plant 14. Benchmark gas utilisation plant against KTK and IPS systems	Carry out energy efficiency and resource use audit Annually next audit report to be carried out in March 2012.  For 14 points of energy audit carried out in February 2011 see project sheet.	17



## 21.0 LANDFILL ENVIRONMENTAL MANAGEMENT PLAN

The facility has an accredited ISO 14001 Environmental Management System (EMS) which is audited by SGS biannually. This EMS provides set out objectives and targets in the form of a project sheet and progress updates are conducted quarterly through the management meetings. THE LEMP is incorporated in our ISO 14001 system and gauges facility development in terms of active cells and cells under development, evolving legislative requirements, BAT updates and rolling EPA directions.

## 22.0 ODOUR MANAGEMENT PLAN

There have been no changes or amendments to the plan since its submission to the agency.

## 23.0 PROGRESS ON AER 2009 OBJECTIVES AND TARGETS

### Develop landfill gas infrastructure and gas utilisation plant

16 Jan 2010 – 12 extra vertical wells were drilled.

18 May 10 – Enclosed AFS 1500 flare installed in Cell 7

8 Sept 10 – Began construction on LFG Utilisation Compound

13 Oct 10 - installed 14 new gas wells and 30 pin wells which were all connected up in Nov 10

27 Nov 10 - installed additional 125 mm gas ring and 180mm gas ring in Cell 6, 7 and Cell4. Approximately 20 horizontal trenches installed during the year

16 Dec 10 – relocated Haase 2500 Enclosed Flare to new LFG Utilisation Compound

### Review and assess effectiveness of nuisance controls

26 February 10 – on going

March 10 – annual review of O&T by GM

26 May 10 – on going

19 Aug 10 – on going



### Review and assess effectiveness of nuisance controls

27 29 Nov 10 – no changes – on going

### Nuisance from vehicles movements

26 February 10 – on going

March 10 – annual review of O&T by GM

26 May 10 – ongoing

19 Aug 10 - continue to tip in Cells 1,2,3, and 4 in preparation for final capping heights

29 Nov 10 – no changes

### Relationship with neighbouring communities / reduce environmental complaints

22 Mar 10 – all complaints are up to date.

March 10 – annual review of O&T by GM

Greenstar Ballynagran Landfill Community Fund was formally established during 2010.

The fund provides support to local community organisations which are located within 3km of the landfill.

Allocation of money from the fund is managed by Local Residents, Greenstar, Wicklow County Council and local Councillors

Community liaison committee meetings held throughout 2010. The liaison committee decides which community facilities and environmental projects the fund is to support in the local area.

The community liaison fund paid out the following amounts during 2010 –

1. Glenealy National School, new boiler and radiators – 25k
2. Ballynagran Energy Plus Community Project – 5k
3. Small Grants Scheme to upgrade local residents houses – 120k

Community Liaison Meetings are held monthly

26 May 10 – An Bord Pleanála have confirmed the Community Liaison Committee levy, while facility sponsorship however has been given to the following in 2010 :-



Red Kite Project

Buffers Alley Hurling Team Golf Classic

Glenealy National School Golf Classic

Glenealy Camogie Team

Rathnew Soccer Club

Barndarrig National School

BNG are continuing to support Wicklow Lifeboats and made a further donation in May 10

Greenstar Ballynagran has decided to support the **Ballynagran Zero Carbon Community Project** which aims to make the local area carbon neutral using the community liaison fund to implement local sustainable projects

### Planting programme

There was no additional tree planting at the facility during 2010.

Maintenance involving re-stacking and re-tying of existing trees was carried out during November 2010.

18 Mar 11 - next planting programme will commence in 2011 budget dependant

### Awareness and Training Programme

The next awareness training is due in June 2011 for all staff members and in September 2012 for Renton Plant contractors. Contractors to site are inducted to site before commencing work, part of the inductions includes information on the environmental systems operating on site and how to handle environmental emergency situations.

### Assess and Review Energy Consumption

During 2010 an energy audit was undertaken and consideration given to recommendations. However, further development of thorough energy management systems are being undertaken in Spring 2011 and onwards.



## 24.0 PROCEDURES DEVELOPED BY THE LICENCEE DURING 2010 WHICH RELATE TO THE OPERATION OF THE FACILITY

Work procedures developed during the reporting period with respect to the operation of the facility are detailed below in Table 30.

**Table 30: Work procedures developed at the facility during 2010**

Item Number	Description	Type	Document Location	Revision	Date
F08	Documentation and control of documents	PROC	Meeting Room	1	11.01.10
F09	Managing landfill gas	PROC	Meeting Room	2	18.03.10
F09a	Waste acceptance and characterisation procedures	PROCESS	Meeting Room	2	23.09.10
F09a 01	Waste acceptance at Ballynagran weighbridge	PROC	Meeting Room	1	21.07.10
F09d	Operating in adverse weather conditions	PROCESS	Meeting Room	3	14.01.10
F09 007	Cleaning the wheelwash procedure	PROC	Meeting Room	1	22.04.10
F09 008	Monitoring perimeter gas wells	PROC	Meeting Room	1	28.03.10



## 25.0 SITE TESTING REPORTS

### 25.1 Slope Stability Reports

A surface water and leachate management system inspection and slope stability assessment report was prepared by Golder Associates and delivered to the Agency separately.

## 26.0 REPORTED INCIDENTS AND COMPLIANTS SUMMARIES

In total, Ballynagran Residual Landfill received 4 No. minor incidents of Non Urgent Category 3 level with regard to trigger levels as specified in Condition 6.4.2 of the licence and 6 No. minor incidents of Non Urgent Category 3 level excess emissions as specified in Schedule C of the licence. These were reported to the Agency as soon as the licensee was notified. The site received a total of 139 No. complaints over the course of the reporting period January 2010– December 2010. A table containing the date, the issue number, the corrective action taken and the date that the compliant was closed off is provided in Appendix C.

A summary of the overall number of complaints and issues raised are presented in Table 31 below.

**Table 31: Reported Incidents and Complaints 2010**

Complaint	Issue
136	Odour
2	Visible Rubbish
1	Alleged chicken killing by facility birds of prey

## 27.0 REVIEW OF NUISANCE CONTROLS

In accordance with Condition 7 of the waste licence, Greenstar is committed to ensure that the facility does not give rise to nuisance at the facility or in the immediate area of the facility. The potential sources of nuisance at a landfill facility are odour, vermin, birds, flies, mud, dust and litter. A procedure, (F09j - Completion of Daily Site Condition Reports) has been drawn up to comply with Condition 7 and is being carried out at the facility. To adhere with procedure F 09j, and form F 09 (j) (i) is completed daily.

### 27.1 Odour

In accordance with Condition 8.12.2 of the waste licence, Greenstar has submitted a programme to the Agency for the monitoring and assessment of odours emissions arising from the facility. An odour control and monitoring procedure (F 09 r) has been drawn up and carried out in 2010.

Good operational practices on site are the main controls to avoid odour nuisances. Procedures on the Operation Start-Up and Shut-Down (F 09 001) and Waste Acceptance (F 09 a (iv) ) deal with the handling, depositing and covering of waste at Ballynagran Residual Landfill. These procedures have been written in accordance with the Landfill Manual .Landfill Operational Practices., published by the Environmental Protection Agency and are incorporated into the odour control and monitoring procedure onsite.

Landfill gas extraction wells and a landfill gas flare are currently in operation. This active gas extraction system allows for the long term control of any potential odours. Independent experts Odour Ireland conducted monitoring on behalf of the Office of Environmental Enforcement in June. The PID/FID survey highlighted areas where there could be potential for VOC escape, by measuring VOC levels around the landfill area. Recommendations from their study of the site have been implemented.

In accordance with daily condition reports F 09 j (i) odour inspections have been carried out on a daily basis by site staff at the facility, agreed locations in the neighbouring areas with the agency and also in response to any odour complaints. In the monitoring period there have been complaints in relation to odours and these are dealt more specifically in Reported Incidents and Complaints





## **27.2 Litter**

Litter is controlled by fencing which was installed around the landfill footprint as specified in the waste licence. Portable litter fencing is also used at the working face, which can be moved to various points around the working face depending on the wind direction. Litter inspections are carried out and recorded as part of the daily inspection, which is outlined in the Completion of Daily Site Condition Reports (F09j (i)) and the Procedure for Litter Prevention & Assembly/Disassembly of Nets (F 09 g). The presence of litter shall be noted on the Inspection Form and removed immediately if practicable. Any litter noted at or outside the boundary fence, which appears to be illegally dumped, shall be inspected for any indications of identity if possible and reported to the Facility Manager.

## **27.3 Vermin & Birds**

Inspections for vermin shall be carried out on a weekly basis for rodents etc. and on a daily basis for birds, in particular crows. Specialist contractors are employed by Greenstar to control vermin and birds on the facility. Vermin control measures used as part of this programme includes internal and external bait boxes, rodenticides and insect control measures. The specialist contractor visits the site at regular intervals throughout the year to inspect the control measures and assess their effectiveness. These control measures have found to be successful. Any observations made during inspections shall be recorded on the Daily Site Condition Report (F09j (i)).

## **27.4 Flies**

Particularly during the warmer months, attention shall be paid to observations of flies. Any observations shall be recorded on the Daily Site Condition Report (F09(j)(i)). The Facility Manager or the Site Supervisor shall be notified immediately in order to take measures to eliminate any fly populations from establishing.

## **27.5 Mud and Dust**

The site roads shall be inspected on a daily basis for mud or dust and any observations recorded on the Daily Site Condition Report ((F09(j)(i)). Special attention shall be paid to dust during the dry months and mud during the wet months and the Site Supervisor or the Facility Manager will be notified immediately in order to take measures to minimise or eliminate any potential nuisances arising from mud or dust accumulating on site roads. Some measures include the use of a wheelwash, road sweeper and the use of a water bowser to dampen access roads and stockpiles during periods of dry weather.

## **28.0 FINANCIAL PROVISION, STAFF TRAINING AND LOCAL ENTERPRISE PROJECTS**

### **28.1 Financial provisions made during 2010**

During 2010, the EPA Bank Guarantee was reviewed and is in place for €1,662,504. A copy of the bond was sent to the Agency in January 2011.

### **28.2 Proportion of waste charges and gate fees spent on appropriate local environmental improvement schemes**

The community liaison fund paid out the following amounts during 2010 –

1. Glenealy National School, new boiler and radiators – 25k
2. Ballynagran Energy Plus Community Project – 5k
3. Small Grants Scheme to upgrade local residents houses – 120k

### **28.3 Management and Staffing Structure**

The management and staffing structure at Ballynagran landfill is presented in Figure 15.



## **28.4 Programme of Public Information**

Ballynagran Landfill pursues an active programme of disseminating information on its operations to all interested parties. This is undertaken through a variety of means including site tours, the company website, presentations and open days. During 2008, a short film was produced detailing how the facility was constructed and is operated. The film is shown to all those visiting the facility.

The overall communications programme contains the following objectives:

- To promote public awareness of Greenstar's activities and environmental policies;
- To maintain an ongoing dialogue with authorities that have direct involvement with waste;.
- To make available Environmental Performance Data to all interested parties;
- To disseminate information relating to the operation and management of the site;
- To encourage liaison between the site and local residents and those who may be affected by the site operations;.
- To provide general information on waste management issues;
- To ensure all users and customers of the site are conversant with the requirements of the site waste licence;
- To ensure that all objectives are, where possible, measurable and quantifiable;

The objectives of the programme are met through the following elements as appropriate:

- Personal contact;
- Residents meetings/Liaison groups;
- Information displays;
- Information packs;
- Site visits;
- Web page;
- Educational links; and
- Published information

## **28.5 Report on Staff Training**

A full training schedule for 2010 at Ballynagran is presented in Table 32 below.



## BALLYNAGRAN AER 2010

**Table 32: Training Schedule and training completed during 2010 at Ballynagran**

Trainee (C denotes a course where a certificate has been received and is on display in the offices)	JONES, John	MACLEOD, Michael	KIRWAN, Robbie	DONOHUE, Joseph	MOORE, Joseph	HEALY, Kevin	KINSELLA, John	BATES, Angela	Powell, Matthew
Course / Trainer									
TBT Occupational H&S system awareness	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Jul-10
TBT Safe use of lifting equipment and working in adverse weather conditions	Jan-10	Jan-10	Jan-10		Jan-10	Jan-10	Jan-10	Jan-10	
TBT Reversing vehicles	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	
TBT Vehicle and pedestrian collisions	Mar-10	Mar-10	Mar-10		Mar-10	Mar-10	Mar-10	Mar-10	
TBT Wheelwash procedure	Apr-10	Apr-10	Apr-10	Apr-10	Apr-10	Apr-10	Apr-10	Apr-10	
TBT Hearing protection	May-10	May-10	May-10	Jul-10	May-10	May-10	May-10	May-10	
TBT Vehicle tipovers	Aug-10	Aug-10	Aug-10	Aug-10	Aug-10		Aug-10	Aug-10	
TBT H&S whats is all about and working at heights	Sep-10	Sep-10	Sep-10	Sep-10	Sep-10	Sep-10	Sep-10	Sep-10	
TBT Covering down procedure		Oct-10	Oct-10	Oct-10	Oct-10	Oct-10		Oct-10	
TBT slips and falls	Jan-11	Jan-11	Jan-11	Jan-11	Jan-11	Jan-11	Jan-11	Jan-11	
Tractor and Bowser J Donohue		May-07			June -07		June -07		
VDU assessments	Jan-	Jan-	Jan-		Jan-10	Jan-		Jan-	

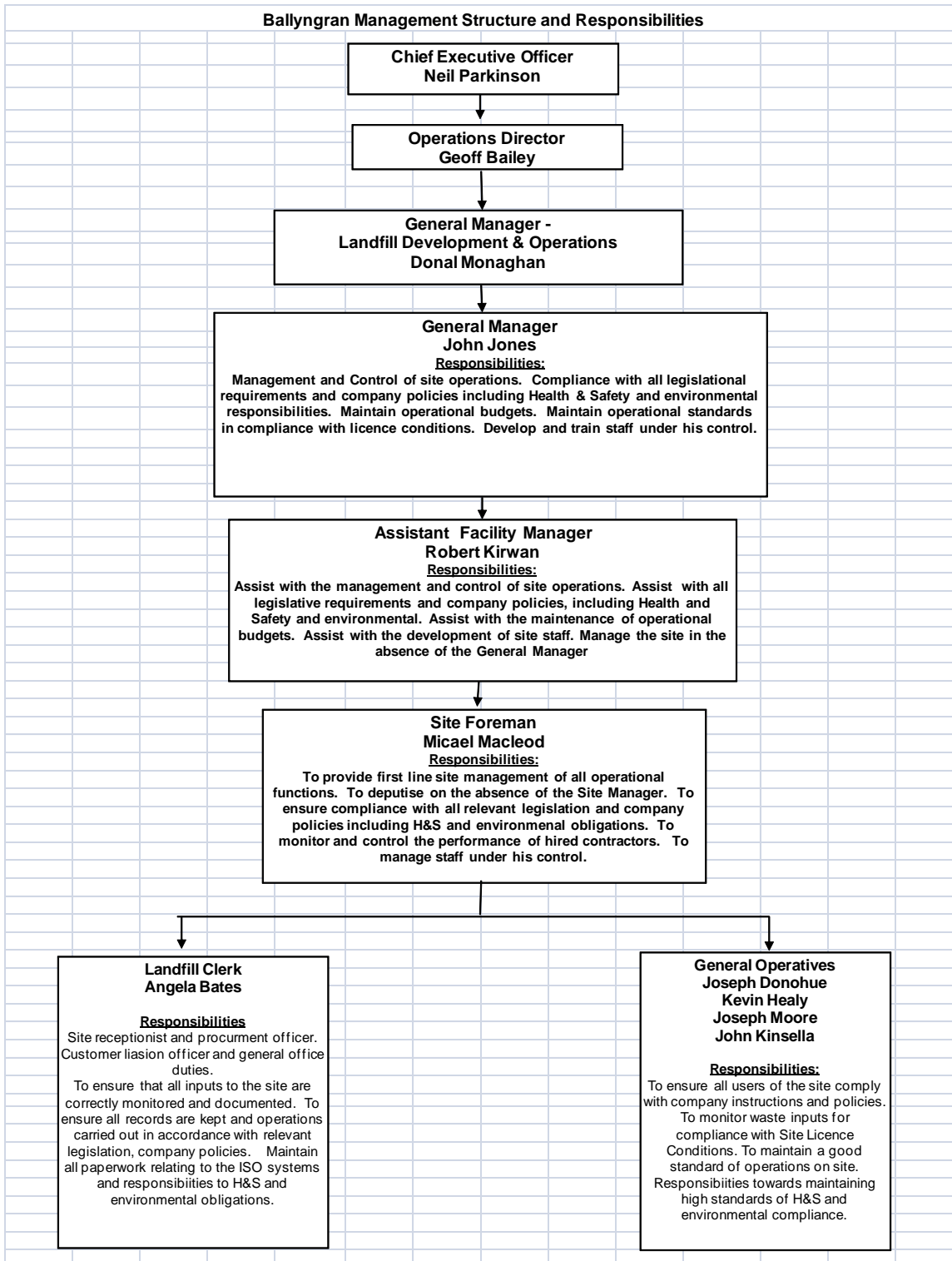


## BALLYNAGRAN AER 2010

	10	10	10			10		10	
Emergency Response Drill GENERAL EMERGENCY	Sep-10		Sep-10	Sep-10	Sep-10	Sep-10	Sep-10	Sep-10	Sep-10
Energy Policy and awareness training / Robert Kirwan	Mar-10	Mar-10	Mar-10	Jul-10	Mar-10	Mar-10	Mar-10	Mar-10	Jul-10
Emergency Response Drill FIRE	Mar-10	Mar-10	Mar-10	Mar-10		Mar-10	Mar-10	Mar-10	Jul-10
TBT Occupational H&S system awareness									Jul-10



Figure 11: Management and Staffing Structure at Ballynagran Landfill during 2010





## **29.0 POLLUTION RELEASE TRANSFER RECORD**

Under EU Regulation 166/2006, all licensed facilities are obliged to prepare a PRTR which details all releases of pollutants and off-site transfer of pollutants and waste. Figures for releases to air, releases to storm-water and wastes transferred off-site are included in Appendix F. The complete PRTR document was also uploaded to the dedicated EPA PRTR website.



## Report Signature Page

GOLDER ASSOCIATES IRELAND LIMITED

Ruth Treacy  
Environmental Scientist

Thomas Vainio-Mattila  
Senior Environmental Consultant

RT/TVM/aw

Registered in Ireland Registration No. 297875  
Town Centre House, Dublin Road, Naas, Co. Kildare, Ireland  
Directors: M. Gilligan, A. Harris (British)  
VAT No.: 8297875W



# **APPENDIX A**

## **Environmental Monitoring Locations**

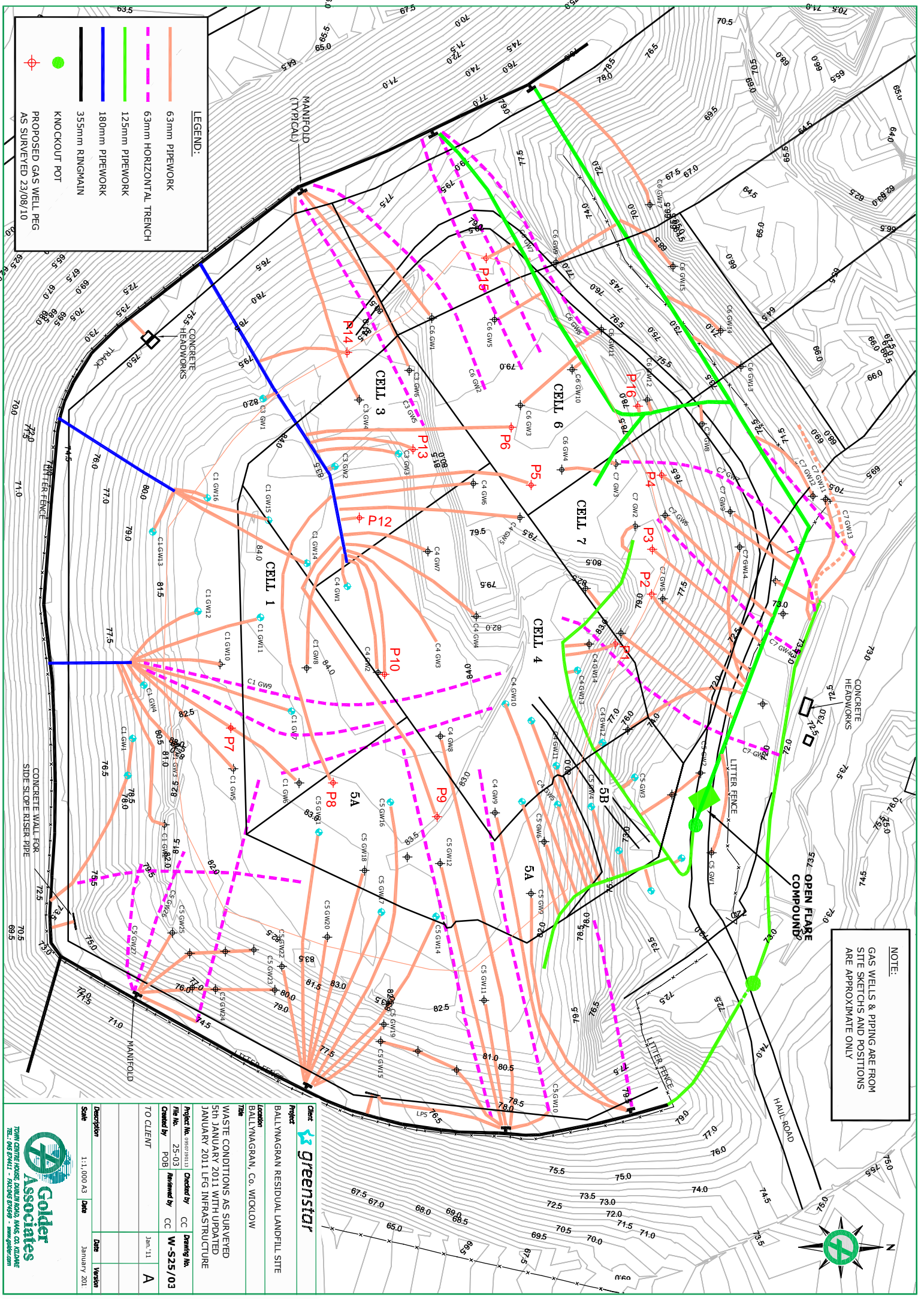






# **APPENDIX B**

## **Gas Well Drilling**



**NOTE:**  
 GAS WELLS & PIPING ARE FROM  
 SITE SKETCHES AND POSITIONS  
 ARE APPROXIMATE ONLY

**LEGEND:**

	63mm PIPEWORK
	63mm HORIZONTAL TRENCH
	125mm PIPEWORK
	180mm PIPEWORK
	355mm RINGMAIN
	KNOCKOUT POT
	PROPOSED GAS WELL PEG AS SURVEYED 23/08/10

**Client:** **greenstar**

**Project:** BALLYNAAGRAN RESIDUAL LANDFILL SITE

**Location:** BALLYNAAGRAN, CO. WICKLOW

**Title:** WASTE CONDITIONS AS SURVEYED 5TH JANUARY 2011 WITH UPDATED JANUARY 2011 LFG INFRASTRUCTURE

**Project No.:** W-525/03

**Rev. No.:** 25-03

**Created by:** CC

**Checked by:** CC

**Reviewed by:** CC

**TO CLIENT:** A

**Date:** Jan. 11

**Version:** A

**Scale:** 1:1,000 A3

**Date:** January 2011

**Goldier Associates**  
 GOLDIER ASSOCIATES  
 TOWN CENTRE PLAZA, DUBLIN ROAD, WARS CO. DUBLINE  
 TEL: 01 454 1111 - FAX: 01 454 1199 - WWW.GOLDIER.COM





# **APPENDIX C**

## **Reports Incidents and Complaints 2010**

## Incidents Register

Incident no.	Type of incident	Date of incident	Date of incident report	Details of incident
I-025	Excess Trigger Level	09-Feb-10	19-Apr-10	Elevated Ammoniacal Nitrogen and pH levels in groundwater wells, MW 1D, MW 3S, MW3D, MW4S, MW4D and MW7S
I-026	Excess Emission	Feb-10	19-Apr-10	Suspended Solids over 35mg/l at SW8, SW9 and SW10
I-027	Excess Emission	09-Mar-10	19-Apr-10	NSL 2 and NSL3 exceeded their emission limits
I-028	Excess Trigger Level	01-Jun-10	21-Jul-10	Elevated Ammoniacal N at MW 3s and MW 7d . Elevated pH at MW1d, MW1s and MW2d
I-029	Excess Emission	18-May-10	21-Jul-10	NSL2 and NSL3 over 55dB limit
I-030	Excess Trigger Level	10-Jun-10	27-Jul-10	Elevated VOC at C1GW7 of greater than or equal 500ppmv methane
I-031	Excess Emission	09-Aug-10	22-Oct-10	NL3, NSL1, NSL2, NSL3 over 55dB limit due to constant noise noise from non-landfill sources
I-032	Excess Emission	Oct-10	17-Jan-11	Suspended Solids over 35mg/l at SW9
I-033	Excess Emission	10-Jan-11	17-Jan-11	NSL2, NSL3 over 55dB limit due to noise from non-landfill sources
I-034	Excess Trigger Level	17-Dec-11	04-Feb-11	Elevated VOCs surface emssions

<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>111</b>	14.01.10	Ms Liz Hayden	1	Odour	F
<b>112</b>	20.01.10	Ms Allison Cooney	1	Odour	F
<b>113</b>	20.01.10	Mr Robert McCoy	1	Odour	F
<b>114</b>	25.01.10 26.01.10	Ms Liz Hayden	2	Odour	F
<b>115</b>	27.01.10	Ms Liz Hayden	1	Odour	F
<b>116</b>	02.02.10, 03.02.10 & 07.02.10	Ms Liz Hayden	3	Odour	F
<b>117</b>	02.02.10	Mrs Dorothy Nolan	1	Odour	F
<b>118</b>	03.02.10	Mr Mulvihill	1	Odour	F
<b>119</b>	03.02.10 & 07.02.10	Ms Rosie Cooney	2	Odour	I/Telephone
<b>120</b>	05.02.10	Mr John Connolly	1	Odour	I/Telephone
<b>121</b>	09.02.10, 10.02.10, 11.02.10 & 26.01.10	Mr Mulvihill	4	Odour	F
<b>122</b>	09.02.10, 10.02.10 & 12.02.10	Ms Liz Hayden	3	Odour	F
<b>123</b>	10.02.10	Mrs Dorothy Nolan	1	Odour	F
<b>124</b>	15.02.10	Mr Paul Verdes	1	Odour	F
<b>125</b>	18.02.10	Ms Katja McCoy	1	Odour	F
<b>126</b>	18.02.10	Mr Mulvihill	1	Odour	F

<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>127</b>	<b>18.02.10 &amp; 21.02.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone /F</b>
<b>128</b>	<b>19.02.10</b>	<b>Ms. Delphine Geoghegan</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>129</b>	<b>23.02.10 &amp; 25.02.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>130</b>	<b>02.03.10</b>	<b>Ms Katja McCoy</b>	<b>1</b>	<b>Odour</b>	<b>F/Email</b>
<b>131</b>	<b>13.02.10</b>	<b>Mr David Ryan</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>132</b>	<b>08.03.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>133</b>	<b>27.02.10, 03.03.10, 05.03.10, 08.03.10 &amp; 09.03.10</b>	<b>Mr Mulvihill</b>	<b>5</b>	<b>Odour</b>	<b>F</b>
<b>134</b>	<b>03.03.10 &amp; 15.03.10</b>	<b>Ms. Dorothy Nolan</b>	<b>2</b>	<b>Odour</b>	<b>F</b>
<b>135</b>	<b>04.03.10</b>	<b>Mr. Bill Ryan</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>136</b>	<b>29.03.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>137</b>	<b>10.04.10, 12.04.10 &amp; 18.04.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>138</b>	<b>15.04.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>139</b>	<b>15.04.10</b>	<b>Thomas Delahunt</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>140</b>	<b>21.04.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>141</b>	<b>28.04.10</b>	<b>Mrs. Fedaline King</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>142</b>	<b>28.04.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>

<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>143</b>	<b>04.05.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>144</b>	<b>06.05.10 &amp; 10.05.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>145</b>	<b>10.05.10</b>	<b>Mrs Joanne Verdes</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>146</b>	<b>25.05.10 &amp; 26.05.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>147</b>	<b>08.06.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>148</b>	<b>14.06.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>149</b>	<b>06.05.10, 11.05.10, 12.05.10, 10.06.10, 14.06.10</b>	<b>Mr Mulvihill</b>	<b>5</b>	<b>Odour</b>	<b>F</b>
<b>150</b>	<b>18.06.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>151</b>	<b>30.06.10</b>	<b>Ms Fidelma King</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>152</b>	<b>12.07.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>153</b>	<b>12.07.10 &amp; 15.07.10</b>	<b>Mr Mulvihill</b>	<b>2</b>	<b>Odour</b>	<b>F</b>
<b>154</b>	<b>23.07.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>155</b>	<b>04.08.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>156</b>	<b>21.07.10, 28.07.10 &amp; 09.08.10</b>	<b>Mr Mulvihill</b>	<b>3</b>	<b>Odour</b>	<b>F</b>
<b>157</b>	<b>13.08.10 &amp; 14.08.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>158</b>	<b>13.08.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>



<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>159</b>	<b>17.08.10</b>	<b>Dean Mulvihill</b>	<b>1</b>	<b>Alleged killing of his chickens by birds of prey used by bird control contractor employed by site</b>	<b>I/ Verbally during site visit by Dean Mulvihill</b>
<b>160</b>	<b>25.08.10 &amp; 27.08.10</b>	<b>Mr Mulvihill</b>	<b>2</b>	<b>Odour</b>	<b>F</b>
<b>161</b>	<b>27.08.10</b>	<b>Mrs. Joanne Verdes</b>	<b>1</b>	<b>Odour</b>	<b>I</b>
<b>162</b>	<b>30.08.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>163</b>	<b>30.08.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F</b>
<b>164</b>	<b>01.09.10 &amp; 03.09.10</b>	<b>Ms Liz Hayden</b>	<b>2</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>165</b>	<b>10.09.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>166</b>	<b>17.09.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>167</b>	<b>16.09.10 &amp; 17.09.10</b>	<b>Mr Mulvihill</b>	<b>2</b>	<b>Odour</b>	<b>F</b>
<b>168</b>	<b>17.09.10</b>	<b>Mrs. Joanne Verdes</b>	<b>1</b>	<b>Odour</b>	<b>I</b>
<b>169</b>	<b>22.09.10</b>	<b>Ms. Fidelma King</b>	<b>1</b>	<b>Rubbish visible on truck</b>	<b>F</b>
<b>170</b>	<b>24.09.10</b>	<b>Ms Liz Hayden</b>	<b>1</b>	<b>Odour</b>	<b>I/Telephone</b>
<b>171</b>	<b>24.09.10 &amp; 27.09.10</b>	<b>Mr Mulvihill</b>	<b>2</b>	<b>Odour</b>	<b>F</b>
<b>172</b>	<b>09.10.10, 10.10.10 &amp; 11.10.10</b>	<b>Ms Liz Hayden</b>	<b>4</b>	<b>Odour</b>	<b>I/Telephone</b>

<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>173</b>	11.10.10	Mr Mulvihill	1	Odour	F
<b>174</b>	13.10.10	Ms Liz Hayden	1	Odour	F
<b>175</b>	12.10.10 & 13.10.10	Mrs Edel Mulvihill	2	Odour	F
<b>176</b>	06.11.10, 08.11.10 & 09.11.10	Mr Mulvihill	3	Odour	F
<b>177</b>	15.11.10	Mr Mulvihill	1	Odour	F
<b>178</b>	19.11.10, 20.11.10, 21.11.10 & 22.11.10	Ms Liz Hayden	4	Odour	I
<b>179</b>	20.11.10, 21.11.10 & 22.11.10	Mr Mulvihill	3	Odour	F
<b>180</b>	29.11.10 & 30.11.10	Ms Liz Hayden	2	Odour	I
<b>181</b>	06.12.10 & 07.12.10	Ms Liz Hayden	2	Odour	I/F
<b>182</b>	06.12.10	Mr John Connolly	1	Odour	I
<b>183</b>	07.12.10	Mrs Fidelma King	1	Odour and Litter Issues	F
<b>184</b>	13.12.10	Ms Liz Hayden	1	Odour	I/F
<b>185</b>	17.12.10 (about a smell on road 13.11.10)	Mr Colin O'Neill	1	Odour	I/F
<b>186</b>	20.12.10, 22.12.10 & 23.12.10	Ms Liz Hayden	3	Odour	F

<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>187</b>	<b>17.12.10 &amp; 18.12.10</b>	<b>Mrs Dorothy Nolan</b>	<b>2</b>	<b>Odour</b>	<b>F</b>
<b>188</b>	<b>07.12.10, 14.12.10, 16.12.10 &amp; 20.11.10</b>	<b>Mr Mulvihill</b>	<b>4</b>	<b>Odour</b>	<b>F</b>
<b>189</b>	<b>23.12.10</b>	<b>Mr Mulvihill</b>	<b>1</b>	<b>Odour</b>	<b>F (phonecall to wbr at 16.10)</b>
<b>190</b>	<b>28.12.10</b>	<b>Val Cosgrave</b>	<b>1</b>	<b>Odour</b>	<b>I (phonecall to JJ)</b>
<b>191</b>	<b>24.12.10, 25.12.10, 29.12.10, 30.12.10, 31.11.10, 03.01.10, 05.01.10 &amp; 06.01.10</b>	<b>Mr Mulvihill</b>	<b>8</b>	<b>Odour</b>	<b>F</b>
<b>192</b>	<b>30.12.10, 31.11.10, 01.01.10, 02.01.10, 03.01.10, 06.01.10 &amp; 07.01.10 (JJ checked and No smell)</b>	<b>Ms Liz Hayden</b>	<b>6</b>	<b>Odour</b>	<b>F</b>
<b>193</b>	<b>30.12.10</b>	<b>Mr John Connolly</b>	<b>1</b>	<b>Odour</b>	<b>I</b>
<b>194</b>	<b>30.12.10</b>	<b>Mr Colin O'Neill</b>	<b>1</b>	<b>Odour</b>	<b>I</b>
<b>195</b>	<b>30.12.10</b>	<b>Mrs Liz Doyle</b>	<b>1</b>	<b>Odour</b>	<b>I</b>
<b>196</b>	<b>30.12.10</b>	<b>Mr. Paul Verdes</b>	<b>1</b>	<b>Odour</b>	<b>I</b>

<b>Complaint Number</b>	<b>Date/s of complaint</b>	<b>Name of Complainant</b>	<b>Number of complaints</b>	<b>Nature of Complaint</b>	<b>Formal/Informal F/I</b>
<b>197</b>	<b>30.12.10</b>	<b>Mr. Stephen Verdes</b>	<b>1</b>	<b>Odour</b>	<b>I</b>
<b>198</b>	<b>29.12.10 &amp; 10.01.11</b>	<b>Mr. Pat King</b>	<b>2</b>	<b>Odour</b>	<b>F</b>



# **APPENDIX D**

## **Energy Conservation Audit Report**



**ENERGY AUDIT**  
**GREENSTAR LTD.**  
**BALLYNAGRAN RESIDUAL LANDFILL**  
**WASTE LICENCE NO. W0165-02**

**Prepared For: -**

Greenstar Ltd.,  
Ballynagran Residual Landfill,  
Ballynagran,  
Co Wicklow

**Prepared By: -**

O' Callaghan Moran & Associates,  
Granary House,  
Rutland Street,  
Cork

**4<sup>th</sup> March 2011**

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## APPENDIX 1 - Energy Consumption Information

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# 1. INTRODUCTION

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O’Callaghan Moran & Associates (OCM) was appointed by Greenstar Ltd. (Greenstar) to undertake an energy efficiency audit of their landfill facility at Ballynagran County Wicklow. The facility is a non-hazardous residual landfill and operates under Waste Licence (W0165-02) issued by the Environmental Protection Agency (Agency). The facility is one of the four operational Greenstar landfills in the country. OCM carried out an energy audit of the facility in 2009 for the calendar year 2009 and this report updates that report and includes energy consumption figures for the calendar year 2010. This report assesses the implementation of the recommendations in the 2009 report and assesses the current energy management practices at the facility.

The facility is a non-hazardous residual landfill and operates under Waste Licence (W0165-02) issued by the Environmental Protection Agency (Agency). The objective of this audit is to:-

- (i) identify all opportunities for energy use reduction and efficiency;
- (ii) be carried out in accordance with the guidance published by the Agency - “Guidance Note on Energy Efficiency Auditing (2003)”.

## 1.1 Audit Process

The audit was carried out in accordance with the Agency’s Guidance Note and included a site visit on 31<sup>st</sup> January 2011. At the time of the site visit the facility was fully operational. The weather was cold, sunny with a gentle south easterly breeze.

The Facility Deputy Manager, Mr. Robert Kirwan, was interviewed and provided information on facility activities, energy usage and resource consumption. A site inspection was carried out, which included the administration buildings, maintenance building, operational areas, landfill gas flare, leachate storage lagoon and surface water storage lagoon.

The Guidance Note recommends at least twelve months of data on the various energy using systems. Electricity meter records and records of diesel use from January to December 2010 formed the basis for the assessment of consumption levels.



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## **2. SITE LAYOUT & ACTIVITIES**

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### **2.1 Site Location**

The site, which encompasses approximately 128 ha, is located on the eastern side of the Wicklow Mountains in the townlands of Ballynagran, Coolbeg and Kilcandra. It is approximately 5 km to the south west of Wicklow Town and 1.5 km to the south east of Glenealy. It is on the southern side of an east-west ridge at an elevation between 52 and 147 m Ordnance Datum (OD).

The setting is predominantly rural, with dispersed residential dwellings. The site is bounded to the south by a country road (L1111 / L1113), to the east by a green waste composting facility, and to the north and west by agricultural lands – a mix of pasture and tillage. There is a former concrete batching plant to the east of the composting facility and further east is the N11 national primary route.

### **2.2 Site Layout and Description**

The facility is a non-hazardous waste residual landfill, which is licensed to accept up to 175,000 tonnes of Household, Commercial and Industrial Non-Hazardous waste per annum for disposal and up to 28,000 tonnes of Construction and Demolition Waste for recovery purposes. The site layout is shown on Drawing No. 3 and the facilities used include: -

Waste Reception Area;

Weighbridges (2 No.);

Wheel Wash;

Waste Quarantine & Inspection Areas;

Landfill Cells;

Leachate Storage lagoon;

Surface Water Pond;

Administration Block (offices, stores, canteen, toilets and showers);

Standby Generator (Diesel);

Oil Storage Tank & Bund;

Security Fencing.

The facility will be developed in five phases. The initial phase involved the provision of five (5) landfill cells (1, 2, 3, 4 and 5A/B), and the entire supporting infrastructure. In 2007 the

Agency approved the development of two additional cells (Cells 6 and 7), which were constructed in 2008 and became active in 2009. In 2010, the Agency approved the development of two additional cells (Cells 8 and 9). These cells were constructed in 2010 but have not yet become active. An active gas abstraction and flaring system was commissioned in April 2007. Subsequent phases will involve the provision of additional landfill cells and the associated expansion of leachate, landfill gas and surface water control measures.

## **2.3 Activities:**

### *2.3.1 Overview*

All waste delivery vehicles are inspected and recorded at the weighbridge. Following acceptance at the weighbridge, waste carrying vehicles drive to the active landfill cell, where they discharge their load. The waste is then spread and compacted using a steel-wheeled diesel fuelled landfill compactor. There are two diesel fuelled excavators which are used mainly to place daily cover material, which is delivered by road vehicles and stockpiled adjacent to the active fill area. The excavators and compactor are the most significant users of diesel at the facility.

Landfill gas is actively abstracted from the fill areas using electrically powered boosters. The gas was initially flared in an open flare between November 2007 and March 2008. The open flare was replaced by an enclosed flare in March 2008. In November 2009 an additional two open flares were installed and commissioned at the facility. In May 2010 an additional enclosed flare was installed and commissioned. The open flares run off a diesel generator. This is discussed in more detail in Section 2.2.4. Leachate is pumped from the cells and sanitary wastewater is pumped from the Administration Block to the leachate storage lagoon using electrically powered pumps. Groundwater intercepted by a drainage layer beneath the cells is directed to a sump, from where it is pumped to surface water swails. Surface water is pumped from the surface water storage lagoon to a wetland. Further details are provided in Section 2.2.5.

### *2.3.2 Weighbridge & Administration Block*

The Weighbridge Office and Administration Block contain offices, meeting room, welfare and canteen facilities and a supervisory control and data acquisition system (SCADA) room, all of which are provided with lighting and electrically powered heating units. A list of the electrically powered items in the buildings is shown on Tables 2.2.-2.3.

**Table 2.2 – Weighbridge**

No.	Item
1	Electric Wall Mounted Heater
1	Microwave
1	Toaster
1	Fridge
1	Air Conditioner
2	PCs & Screens
1	Photocopier & Printer
1	Printer
1	Shredder
1	Electronic Fly Killer
1	Hand Dryer
1	Water Cooler
1	CCTV system
1	60W Light
3	Double Fluorescent Lights

**Table 2.3 – Main Administration Block including Canteen**

No.	Item
9	Electric Wall Mounted Heaters
5	Air Conditioners
5	PCs & Screens
2	Printers
2	Shredders
5	Halogen Lights
17	Double Fluorescent Lights
3	Single Fluorescent Lights
1	Scanner
1	Microwave
1	Dishwasher
1	Fridge
1	Water Cooler
1	Toaster
1	Radio
1	Electric Grill
1	Clothes Washer
2	Electric Showers
3	Hand dryers
1	Kettle
1	SCADA System
1	Photo copier
9	Fluorescent Lights (Coiled)
2	Water Heaters
2	Electronic Fly Killers

### 2.3.3 Maintenance Garage

Maintenance of the fixed and mobile plant is carried out in the on-site garage. The garage is provided with electrical lighting, but there is no heating system. There is a skid steer road sweeper, quad bike and a small diesel generator stored at the garage, which use small amounts of diesel.

### 2.3.4 Gas Flares

In 2010 the active gas extraction and flaring system comprised eighty two (82 No.) vertical gas wells, seventy (70) spike wells, thirty seven (37) horizontal wells and three (3) knock-out pots in the body of the waste, one (1) condensate knock-out pot and four (4) flares. A 2,500m<sup>3</sup>/hour enclosed flare was commissioned in March 2008 and runs continuously. There is also an open 2,500m<sup>3</sup>/hour flare which provides back-up for the main enclosed flare and runs less than 1% of the year. Two open 500m<sup>3</sup>/hour flares were installed in November 2009 and these were replaced by a 1,500m<sup>3</sup> enclosed flare in May 2010. This flare is running constantly in Cell 7.

A gas utilisation plant was installed in Autumn 2010 but only began running in January 2011. The utilisation plant will be discussed further in the Energy Audit for 2011. The utilisation plant will be benchmarked against the systems used at Greenstar's KTK and Knockharley landfills.

### 2.3.5 Leachate Management

The facility is designed to minimise leachate generation. Surface water runoff and groundwater flow is directed away from the fill area by means of interceptor drains installed outside the landfill cells.

The leachate collection system in the individual landfill cells drains by gravity to leachate collection sumps. Leachate accumulating in the cells is pumped from the collection sumps located inside the cells via side risers to the leachate main, from where it flows to a leachate storage lagoon.

In the reporting period there were six (6 No.) electrically powered (1.5 kW) submersible leachate pumps in operation within the cells. These pumps are ATEX rated to operate in explosive atmospheres. There is also a pump (1.5kW) used to collect composite samples of leachate for environmental monitoring purposes, which is used once per month for approximately ten minutes.

Sanitary wastewater from the Administration Block is pumped using one (1 No.) electrically powered 1.5kW pump to the leachate storage tank.

### *2.3.6 Surface Water Pumping*

There is one pump (2.2 kW) used to discharge surface water from the surface water storage lagoon to a wetland.

### *2.3.7 Ground Water Pumping*

Groundwater intercepted by a drainage layer beneath the cells is directed to a sump, from where it is pumped using five 1.5kW pumps to surface water swails.

### *2.3.8 External Lighting*

Area lighting comprising fourteen (14 No.) halogen lights fitted to standards are provided from the site entrance to the maintenance shed. They are all fitted with photocell daylight sensors and time clocks. There are also twelve (12) area lights around the weighbridge which are fitted with photocell daylight sensors and time clocks. These are turned off when not required. There are three (3) small safety lights around the lagoons, which are fitted with photocell daylight sensors and motion detectors. There are six (6) halogen lights fitted in the gas utilisation compound which are fitted with photocell daylight sensors.

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### **3. CURRENT ENERGY USE**

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#### **3.1 Electricity Consumption January 2010 – December 2010**

The following electricity consuming energy systems were operational in the reporting period:-

- Landfill gas abstraction and flaring;
- Leachate/Waste water pumping;
- Surface water pumping;
- Groundwater Pumping,
- Office lighting;
- Office heating;
- Area lighting;
- Office IT.

There is only one electricity meter on-site, which provides data for the entire facility and therefore a breakdown of the usage by the individual energy systems is not available. A copy of the electricity bills for the period January to December 2010 are included in Appendix 1. Electricity consumption was estimated for the various electricity users where possible using the kW/hr rating and operational hours. The estimates are presented in Table 3.1.

The total consumption of electricity at the facility in 2010 was 374,129 kWh, which cost €39,344.83 (excluding VAT, capacity and standing charges). The average cost is 11c per unit, which comprises a daytime kWh cost of approximately 13c and 6c for night time.

There was a slight increase in the consumption from 2009 (340,585 kWh) which was due to increased flare usage over the year.

**Table 3.1 – Electricity Consumption 2010**

Energy System	kWh/year	% of total	Cost (€)	Comments
Enclosed Flare (30kW)	262,800	70.28	27,652.79	In operation 8,760 hours at 30kW
Open Flare (14.9kW)	1,490	0.40	156.78	In operation 100 hours at 14.9kW
Leachate Pumps	39,420	10.54	4,147.92	Six 1.5kW pumps. Assumed to operate 6 months per annum. (4,380 hours)
Outdoor Lights	28,908	7.73	3,041.81	20 outdoor halogen lights used and provided with daylight sensors. 12 area lights, 3 motion sensor lights
Offices Lights	2,233	0.60	234.96	No time/daylight controls
Offices Electrical Heating / Air Conditioning	7,000	1.87	736.59	Wall mounted storage heaters. Manually controlled, individual thermostat. Manually controlled air conditioning units.
Groundwater Pumps	16,425	4.39	1,728.30	Five 1.5 kW pumps assumed to operate 3 months per annum. (2,190 hours)
Surface Water Pump	1,606	0.43	168.99	1 pump (2.2 kW) lagoon to wetland Assumed to operate two months per annum (1,460 hours)
Sanitary Pump	2,190	0.59	230.44	1 pump (1.5 kW) assumed to operate 2 months per annum (1,460 hours)
Borrow Pump	10,950	2.93	1,152.20	1 pump (7.5 kW). Assumed to operate 2 months per annum. (1,460 hours)
Other	894	0.24	94.07	PCs, printer, photocopier, SCADA, CCTV Maintenance Shed. Misc.
<b>Total</b>	<b>373,916</b>	<b>100</b>	<b>€39,344.83</b>	

### 3.2 Diesel

A breakdown on diesel usage in 2010 is presented in Table 3.2 and Appendix 1. The volume was calculated from fuel delivery logs. Some of the diesel fuelled equipment used in day to day operations are owned and operated by a separate contracting company - Rentons. Table 3.2 includes all of diesel used on site by both Greenstar and the contractor. The costs are only known for the diesel used by Greenstar. The average cost of diesel was 57 c per litre. Using this average cost, the table also includes an estimate of the diesel costs for the contractor. The increase in diesel usage from 2009 (132,438 litres) is due to the installation of the 1,500 m<sup>3</sup> enclosed flare which runs on a diesel generator.

**Table 3.2 – Onsite Day to Day Diesel Usage Totals 2010**

User	Volume (litre)	Cost € 0.57c/l	Comments
Greenstar	73,337	42,114.33	Greenstar – Vehicles, Generators for flares
Contractor	101,175	57,669	Rentons - Compactor & Excavator

### **3.3 Carbon Footprint**

The total carbon footprint for the facility is estimated at 468.12 tonnes of Carbon Dioxide (CO<sub>2</sub>) per annum, which is negligible in the context of national CO<sub>2</sub> emissions per annum. The carbon emissions are from diesel energy consumption (plant, equipment and vehicles) at the facility in 2010.

The electricity supplier is Airtricity, who generate power from renewable sources. This means there is zero carbon emissions from this source, which has resulted in a reduction of an estimated 217 tonnes of CO<sub>2</sub> released to the air in the reporting period. The Airtricity summary of consumption sheet is included in Appendix 1.



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## **4. EXISTING ENERGY MANAGEMENT SYSTEM**

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The Agency's Guidance Note is targeted at industrial sites, which typically have multiple and complex energy systems and high consumption rates of different energy sources (e.g. electricity, natural gas, fuels). A landfill, while it can occupy a large physical footprint, has more simple energy systems and relatively low consumption rates.

A landfill is a significant source of greenhouse gas emissions, not through the use of fossil fuels, but as a result of the production, capture and flaring of landfill gas. A landfill gas utilisation plant was installed at the facility in 2010 and became operational in January 2011. This will generate electricity which will be directed to the national electricity grid and thereby achieve a negative carbon footprint.

### **4.1 Energy Management System**

The objective of an Energy Management System is to make the best possible use of the energy consumed at a particular facility. The facility carried out its first Energy Audit in 2007 and an energy management system is now in place. It includes the following elements: Energy Policy, procedures, action plans, responsibility chains, training, awareness and motivation, data collection and monitoring systems.

The Agency's Guidance Document presents an energy management matrix to assist in the assessment of the status of the different key elements that comprise the system. The facility's existing management system is assessed below using the categories set out in the Matrix.

### **4.2 Energy Policy**

The facility operates an Environmental Management System and has achieved ISO 14001 accreditation. This EMS includes the adoption of an environmental policy. When the original energy audit was carried out in 2007 there was no facility specific documented energy policy prepared. An energy policy has since been put in place, a copy of which is included in Appendix 1.

The purpose of the policy is to provide the supporting framework for the implementation of measures to ensure that energy is actively managed in day to day activities and that the assessment of energy efficiency is an integral part of the procurement process for plant items during the lifetime of the facility.

### **4.3 Organising**

Facility management is already aware of the need for energy efficiency in the operation of the facility. The areas of responsibility have been clearly defined and are documented in job descriptions. It is the overall responsibility of the General Manager to improve performance through implementation of the Energy Policy and the responsibility of the Assistant Manager to implement the day to day energy management issues.

### **4.4 Motivation**

In 2009 the need for efficient energy management was not communicated to the facility staff. In 2010, a basic energy management system was put in place and all staff attended an energy management training session which highlighted the need to reduce general energy consumption. Future training will be carried out when necessary.

### **4.5 Information Systems**

There is one electricity meter on-site, which provides data for the entire facility. There are no sub meters so a breakdown of the actual usage by individual energy systems (flares, lighting, pumps storage heaters) is not available and is not considered necessary.

The data provided by Airtricity allows an assessment of total consumption, broken down into daily and night time on a bi-monthly basis which allows seasonal changes in usage patterns to be determined. Less electricity was used in the summer months as would be expected with reduced demand for lighting and heating.

### **4.6 Marketing**

Although termed marketing this element actually relates to the communication and 'selling' the concept of energy management within an organisation. At the time of the audit in 2009 there was no formal site specific training/awareness programmes on energy management for site staff. An Energy Awareness programme has been put in place at the facility. In 2010 an energy awareness training course was implemented with all site staff. The course was carried out onsite and highlighted the various energy users onsite and the need to reduce consumption where possible.

## **4.7 Investment**

While at present only low cost measures have been applied (e.g. storage heaters using night time electricity units, signs in place in the administration office to turn off electrical items when not in use, awareness training course, photo cells on the external lights) the Facility Management is aware of the need for future investment to contribute to energy efficiencies. It is intended to operate the landfill gas utilisation plant from 2011. This measure will achieve a negative carbon footprint for the facility.

## **4.8 Overall Assessment**

An overall assessment of the current level of performance of the facility's energy management system is included in Table 4.1. The Table, which is based on the Matrix in the Agency Guidance, includes levels (0 to 4) that represent the possible range of performance. Level 4 represents Best Practice; however the Agency Guidance recognises that this level of development may not be appropriate for all sites.

In 2009, the facility was at the lowest level in the Energy Matrix. In 2010, following the implementation of training and signage, the facility has moved up to Level 3 for Energy Policy and Level 3 for Marketing. The framework to allow for the effective communication and promotion of an energy management system is in place. It should also be borne in mind that the energy systems at the facility are simple and that, at this stage in the development of the facility, the energy costs comprise a small percentage of the overall operational costs.

**Table 4.1 Energy Management Matrix**

Level	Energy Policy	Organising	Motivation	Information systems	Marketing	Investment
4	Energy policy, Action Plan and regular review have commitment of top management as part of an environmental strategy	Energy management fully integrated into management structure. Clear delegation of responsibility for energy consumption.	Formal and informal channels of communication regularly exploited by energy manager and energy staff at all levels.	Comprehensive system sets targets, monitors consumption, identifies faults, quantifies savings and provides budget tracking.	Marketing the value of energy efficiency and the performance of energy management both within the organisation and outside it.	Positive discrimination in favour of 'green' schemes with detailed investment appraisal of all new-build and refurbishment opportunities.
3	Formal energy policy, but no active commitment from top management for energy.	Energy manager accountable to energy committee representing all users, chaired by a member of the managing board.	Energy committee used as main channel together with direct contact with most users.	M&T reports for individual premises based on sub-metering, but savings not reported effectively to users.	Programme of staff awareness and regular publicity campaigns.	Same pay back Criteria employed as for all other investment.
2	Un-adopted energy policy set by energy manager or senior departmental manager.	Energy manager in post, reporting to ad-hoc committee, but line management and authority are unclear.	Contact with most users through ad-hoc committee chaired by senior departmental manager.	Monitoring and targeting reports based on supply meter data. g.	Some ad-hoc staff awareness training.	Investment using short-term payback criteria only.
1	An unwritten set of guidelines	Energy management is the part-time responsibility of an office staff.	Informal contacts with a few users.	Cost reporting based on invoice data. Engineer compiles reports for internal use within technical department.	Informal contacts used to promote energy efficiency.	Only low cost measures taken.
0	No explicit policy	No energy management or any formal delegation of responsibility for energy consumption	No contact with users.	No information system. No accounting for energy consumption.	No promotion of energy efficiency.	No investment in increasing energy efficiency in premises.

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## **5. CONCLUSIONS & RECOMMENDATIONS**

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The current energy management practices are described in Sections 3 and 4 and an assessment of the main elements presented in Table 4.1. The facility carried out an initial Energy Audit in 2007 with subsequent ones in 2008 and 2009 and this one for 2010. Although there is no need, based on the nature of the facility, to achieve Level 4 for all categories the facility has introduced measures in the past two years which have improved its performance.

As the facility is in the early stages of its life, all of the energy management systems, with the exception of the heating and lighting in the Administration Block and the mobile plant, are not fully developed. There will be a progressive expansion of three energy systems - leachate pumping, groundwater pumping and landfill gas utilisation over the operational lifetime of the facility. Therefore, it is not yet possible to provide benchmarks against which targets can be set and improvements measured. However, it is the objective of the energy management system to avoid unnecessary costs by ensuring that the expansion of the energy systems is done in the most efficient manner.

There was a slight increase in the consumption from 2009 (340,585 kWh) which was due to increased flare usage over the year.

### **5.1 Energy Policy**

A documented energy policy statement has been prepared for the facility. The policy statement is fundamental to the successful implementation of any management system as it provides the framework for the introduction and maintenance of energy efficiency and conservation measures in the day to day operation of the facility.

### **5.2 Organising**

Effective energy management requires the assignment of responsibility to a senior member of the Facility Management Team for the implementation of the Energy Policy and monitoring performance. The General Manager has been assigned overall responsibility for energy management at the facility. Responsibility for the day to day implementation of energy management issues can be delegated to the Assistant Manager.

### **5.3 Motivation**

The Assistant Manager is responsible for the communication of energy management issues to all facility staff. This is done through awareness training carried out when necessary at the facility and the placement of signs at light switches, sockets and in the canteen.

### **5.4 Information Systems**

At present there is only one electricity meter on-site. This provides data on total consumption, but does not allow an accurate assessment of usage by the different energy systems. Airtricity provides a spreadsheet of the bi-monthly electricity consumption figure and comparisons can be made on a bi-monthly basis.

Electricity consumption should be monitored on a bi-monthly basis. The data should be analysed in context of the site operations, and information recorded by the SCADA system, to identify possible opportunities for efficiencies. These may include the following: -

- Identification of unnecessary loads e.g. excessive leachate pumping from the landfill cells; use of storage heaters in the summer;

- Load shifting to lower tariff periods, and

- Reducing peak demand.

In the absence of accurate data on electricity usage it is not possible to predicate precise energy savings, but it could be in the range of 10 - 20% with a pay back period of 3 years.

### **5.5 Marketing**

At present energy awareness training is provided to staff members. Such awareness is crucial in the implementation of an effective energy management system and the achievement of targets and objectives.

The Assistant Manager is responsible for the implementation of the awareness programme and has received appropriate training by staff at other Greenstar landfills and there is no need for external trainers.

The results of the programme should be communicated regularly to the staff in order to maintain the requisite level of awareness and avoid the development of indifference.

## **5.6 Investment**

The external lighting system is provided with daylight and motion sensors, which represent best practice.

The office lighting is not fitted with time or daylight sensors. It is recommended that consideration be given to the installation of daylight/time controls. These could achieve up to 30% savings with a pay back time of 2 - 3 years.

The mobile plant uses diesel. There is the potential to change to biodiesel, which would reduce the facilities carbon footprint.

It is intended to provide the landfill gas utilisation plant from 2011. This will be a significant user of electricity. It is recommended that the system be benchmarked against the systems in operation at the KTK landfill and operated by Irish Power Systems Ltd to ensure that the most energy efficient system is procured.

## **5.7 Summary Recommendations**

A summary of the recommendations is presented in Table 5.1. The table, which follows the format set out in the Agency's Guidance Document, includes projected cost savings and reductions in CO<sub>2</sub> emissions.

**Table 5.1**

	<b>Action</b>	<b>Investment Cost Category</b>	<b>Payback (years)</b>	<b>Annual Energy Savings (kWh)</b>	<b>Annual Energy Savings (€)</b>	<b>Annual CO<sub>2</sub> Emissions Savings (Tonnes)</b>
<b>Energy Policy</b>	1. Review annually	No Cost	NA	NA	NA	NA
<b>Organising</b>	2. Provide appropriate training annually	No Cost	NA			
	3. Prepare targets and objectives	Low Cost	NA			
	4. Annual summary on performance in AER	Low Cost	NA			
	5. Assessment of energy efficiency of future plant and equipment	Low Cost	Immediate	*		
<b>Motivation</b>	6. Communicate policy objectives to staff	Low Cost	Immediate	**		
<b>Information Systems</b>	7. Provide sub meters for gas utilisation plants	Moderate Cost	3 years	*		
	8. Bi-Monthly data analyses and identification of efficiency opportunities.	Low Costs	NA	*		
	9. Annual summary report in AER	Low Cost	NA	NA		
<b>Marketing</b>	10. Provide awareness training to staff	Low Cost	Immediate	**		
	11. Provide feed back to staff.	Low Cost	Immediate	**		
<b>Investment</b>	12. Provide time sensors for office lighting	Low Cost	2-3 years	2128	274.51	1.65
	13. Consider introducing bio-diesel for mobile plant.	No Cost	NA			
	14. Benchmark gas utilisation plant against KTK and IPS systems	No Cost	NA			

NA: Not Applicable

\* : Not possible to quantify as benchmark not established.

\*\* : Costs incorporated into savings associated with Recommendations 13 and 14.



# **APPENDIX 1**

## Energy Consumption Information

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# **APPENDIX E**

## **PRTR**

## Reminder – Environmental Protection Agency -2010 AER /PRTR Returns - Deadline 31<sup>st</sup> March 2011

**Please note there has been a change to the AER/PRTR reporting requirements - Task 2: Submission of a Paper AER is No Longer a Requirement.**

If you have any questions please contact the AER/PRTR Returns helpdesk at [aerreturns@epa.ie](mailto:aerreturns@epa.ie)

### PRTR Workbook 2010 Updates

- **Links to Guidance Documents** – There is a link to [Guidance Documents](#) on the “Facility Details Sheet”. These documents provide guidance on: AER/PRTR reporting requirements, how to fill in the PRTR workbook, uploading the workbook to the AER/PRTR website etc.
- **Method Codes** – The method code cells are protected and instead of free-text the operator must choose from a list of method codes. The method code list includes – approved standards, a detailed explanation of each method code and examples of where the description field should be filled in or left blank.
- **+/- 50% Prompt** – When an operator enters an emission on the “Releases to Air”, “Releases to Water” or “Releases to Wastewater” Sheets a pop-up box will appear if the emission is +/- 50% of the previous year’s emission. It is hoped this will eliminate clerical errors.
- **Description field on Waste Transfer Sheet** – The description field is auto-populated with a description. However, if this description does not describe the waste exactly it can be edited accordingly.
- **Recovery & Disposal Codes on Waste Transfer Sheet** – The description of each of the recovery and disposal codes has been updated and includes examples of when the codes would be used.
- **Previous Years PRTR Data** – On each of the sheets there is a link to your facility’s previous year’s data.

### Releases to Land

This sheet only applies to certain disposal operations such as land treatment of oily sludges (Waste Disposal Activity D2) and deep injection of saline solutions underground (Waste Disposal Activity D3). These activities are generally **NOT** employed in Ireland. Therefore, although a page has been made available in the PRTR Workbook for the reporting of releases to land to cater for future developments, it is currently not expected that any operation in Ireland will report under this category.

### **Facility Contact Details**

The contact details for your facility are visible on the “Facility Details” sheet of the PRTR workbook. These are the details we have on our system for contacting your facility. Please check these details and update if required.

[Guidance to completing the PRTR workbook](#)

# AER Returns Workbook

Version 1.1.11

<b>REFERENCE YEAR</b>	2010
-----------------------	------

## 1. FACILITY IDENTIFICATION

Parent Company Name	Greenstar Holdings Limited
Facility Name	Ballynagran Residual Landfill
PRTR Identification Number	W0165
Licence Number	W0165-02

Waste or IPPC Classes of Activity

No.	class_name
3.5	Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.
3.1	Deposit on, in or under land (including landfill).
3.13	Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.
3.4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.
3.6	Biological treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1. to 10. of this Schedule.
4.11	Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.
4.13	Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced.
4.4	Recycling or reclamation of other inorganic materials.
4.9	Use of any waste principally as a fuel or other means to generate energy.
Address 1	Ballynagran
Address 2	Coolbeg and Kilcandra
Address 3	Co Wicklow
Address 4	
Country	Ireland
Coordinates of Location	-8.41098 51.914
River Basin District	IESW
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
<b>AER Returns Contact Name</b>	John Jones (W0165)
<b>AER Returns Contact Email Address</b>	robert.kirwan@greenstar.ie
<b>AER Returns Contact Position</b>	Landfill Manager
<b>AER Returns Contact Telephone Number</b>	0404-25440
<b>AER Returns Contact Mobile Phone Number</b>	
<b>AER Returns Contact Fax Number</b>	
<b>Production Volume</b>	0.0
<b>Production Volume Units</b>	
<b>Number of Installations</b>	0
<b>Number of Operating Hours in Year</b>	0
<b>Number of Employees</b>	0
<b>User Feedback/Comments</b>	
<b>Web Address</b>	

## 2. PRTR CLASS ACTIVITIES

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

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

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

4.1 RELEASES TO AIR

[Link to previous years emissions data](#)

| PRTR#: W0165 | Facility Name: Ballynagran Residual Landfill | Filename: W0165\_2010(2).xls | Return Year: 2010 |

07/07/2011 09:30

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASERS TO AIR		METHOD			Please enter all quantities in this section in KGs			QUANTITY		
POLLUTANT		Method Used			OnSite Flares	Surface Emissions	Site Emissions			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	Emission Point 3	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
03	Carbon dioxide (CO2)	C	OTH	GasSim2 Calculation	0.0	0.0	27900000.0	27900000.0	0.0	0.0
01	Methane (CH4)	C	OTH	GasSim2 Calculation	50683.0	0.0	0.0	1274580.0	0.0	1223897.0
08	Nitrogen oxides (NOx/NO2)	M	EN 14792:2005	OMI report	1985.01	0.0	0.0	1985.01	0.0	0.0
11	Sulphur oxides (SOx/SO2)	M	PER	OMI report	38219.56	0.0	0.0	38219.56	0.0	0.0

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

SECTION B : REMAINING PRTR POLLUTANTS

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

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

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

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

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

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill:		Method Used			Facility Total Capacity m3 per hour
Please enter summary data on the quantities of methane flared and / or utilised		M/C/E	Method Code	Designation or Description	
Total estimated methane generation (as per site model)					
	6444857.0	C		GasSim2 calculation	N/A
Methane flared	5944980.0	M		Facility on-site monitoring	3200.0 (Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0 (Total Utilising Capacity)
Net methane emission (as reported in Section A above)	499877.0	C			N/A



4.2 RELEASES TO WATERS

[Link to previous years emissions data](#)

| PRTR# : W0165 | Facility Name : Ballynagran Residual Landfill | Filename : W0165\_2010(2).xls | Return Year : 2010 |

07/07/2011 09:30

**SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS**

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

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

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

**SECTION B : REMAINING PRTR POLLUTANTS**

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

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

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

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

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

4.3 RELEASES TO WASTEWATER OR SEWER

[Link to previous years emissions data](#)

| PRTR#: W0165 | Facility Name : Ballynagran Residual Landfill | Filename : W0165\_2010(2).xls | Retu

07/07/2011 09:30

**SECTION A : PRTR POLLUTANTS**

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

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

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

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

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

4.4 RELEASES TO LAND

[Link to previous years emissions data](#)

| PRTR# : W0165 | Facility Name : Ballynagran Residual Landfill | Filename : W0165\_2010(2).xls | Return Year : 2010 |

07/07/2011 09:30

SECTION A : PRTR POLLUTANTS

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

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

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

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

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

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

| PRTR#: W0165 | Facility Name : Ballynagran Residual Landfill | Filename : W0165\_2010(2).xls | Return Year : 2010 |

07/07/2011 09:30

Please enter all quantities on this sheet in Tonnes

9

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility	Haz Waste : Address of Next Destination Facility	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used		Haz Waste: Name and Licence/Permit No of Recover/Disposer	Non Haz Waste: Address of Recover/Disposer		
Within the Country	19 07 03	No	10542.29	landfill leachate other than those mentioned in 19 07 02	R3	M	Weighed	Offsite in Ireland	Enniskerry WWTP,D0088-01	.....,Ireland		
Within the Country	19 07 03	No	19404.2	landfill leachate other than those mentioned in 19 07 02	R3	M	Weighed	Offsite in Ireland	Greystones WWTP,D0010-01	.....,Ireland		
Within the Country	19 07 03	No	166.64	landfill leachate other than those mentioned in 19 07 02	R3	M	Weighed	Offsite in Ireland	Kilcoole WWTP,D0087-01	.....,Ireland		
Within the Country	19 07 03	No	27.62	landfill leachate other than those mentioned in 19 07 02	R3	M	Weighed	Offsite in Ireland	Leixlip WWTP,D0004-01	.....,Ireland		
<b>Within the Country</b>	<b>19 07 03</b>	<b>No</b>	24.58	landfill leachate other than those mentioned in 19 07 02	R3	M	Weighed	Offsite in Ireland	Ringsend WWTP,D0034-01	.....,Ireland		
Within the Country	16 05 04	Yes		gases in pressure containers (including halons) containing dangerous substances	R7	C	Volume Calculation	Offsite in Ireland	Harbour Trading Company, .....	Bray,Co Wicklow,Ireland		

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

[Link to previous years waste data](#)

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



# **APPENDIX F**

## **Slope Stability Report**



February 2011

## BALLYNAGRAN RESIDUAL LANDFILL

# Annual Leachate Management Structure, Surface Water Lagoon and Slope Stability Assessment

**Submitted to:**

John Jones  
Ballynagran Residual Waste Landfill  
Ballynagran  
Coolbeg and Kilcandra  
Co. Wicklow



REPORT

**Report Number.** 11507190008.R01.B0

**Distribution:**

Greenstar - 2 copies (1 pdf)  
Golder Associates (Ireland) Ltd - 1 copy



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## Record of Issue

Company	Client Contact	Version	Date Issued	Method of Delivery
Greenstar Ltd	John Jones	B.0	14 February 2011	Email



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### APPENDICES

#### APPENDIX A Plates





## **1.0 INTRODUCTION**

Greenstar operates a Residual Waste Landfill known as Ballynagran Landfill Site in Coolbeg Cross near Wicklow, in Co. Wicklow. This facility was developed in 2006 and opened in late 2006 accepting residual waste. Filling has progressed from the initial development of cells 1 and 2, with the most recent development involving the construction of cells 9 and 10, although filling has yet to commence in these recently constructed cells.

The Landfill is designed and managed to operate within the requirements of the Waste Licence Register No. W0165-02.

## **2.0 BACKGROUND**

As stated above, a Waste Licence exists for the Landfill at Ballynagran and this covers a range of requirements. Of particular relevance to this report is Condition 5.11.3 which states:

*“All leachate management structures, leachate lagoon and surface water lagoon on the facility shall be inspected and certified fit for purpose on an annual basis by an independent and appropriately qualified chartered engineer.”*

and Condition 8.11.1

*“The licensee shall carry out an annual stability assessment of the side slopes of the facility.”*

In order to comply with the requirements of the above conditions Greenstar employed Golder Associates (Ireland) Limited (Golder) to undertake the assessment in December 2007 (reference 1), December 2008 (reference 2) and December 2009 (reference 3); the latter of these inspections taking place on 22 December 2009. This report indicated no areas of concern, but stated that:

*“All slopes, including higher berms, should be inspected daily and any changes reported immediately to the Facility Manager”.*

In January 2011, Greenstar approached Golder to undertake the next assessment. Golder did not propose to undertake numerical analysis of the slopes, but to carry out a visual inspection of the landfill giving particular attention to the slopes, the leachate management structures and the leachate and surface water lagoons as stated in the above licence conditions. The report of the December 2009 inspection and assessment was used as a base reference for this assessment.

## **3.0 SITE INSPECTION METHODOLOGY**

### **3.1 Leachate Management Infrastructure**

Golder proposed to visually inspect all of the visible leachate infrastructure. In general terms this included the following:

- Leachate Holding Lagoon;
- Cell Leachate Riser Headworks; and
- Sections of visible leachate pipework.

### **3.2 Surface Water Lagoon**

Golder proposed to visually inspect all of the visible surface water infrastructure. In general terms this included the following:



- Surface Water Lagoon;
- Swales; and
- Other areas of visible surface water infrastructure.

### **3.3 Slope Stability**

Golder proposed to Greenstar that a full Stability Risk Assessment involving significant numerical evaluation and modelling was not required as Golder understands that the stability of the slopes had already been demonstrated to the EPA's satisfaction. Instead, Golder proposed a visual inspection of the slopes and environs looking for the following:

- Signs of distress – e.g. cracking;
- Signs of movement – e.g. bulging in the slope and/or depressions at the top of the slopes;
- Disturbance of, or discontinuities in, vegetation; and
- Evidence of movement or distress to surrounding structures, notably retaining walls facilitating leachate riser headworks.

It is worth noting that to date none of the site is capped.

## **4.0 SITE INSPECTION**

*Please also refer to the Photographic Plates accompanying this report.*

### **4.1 General**

Golder visited the site on the morning of Tuesday 08 February 2011. Following site inductions and discussions with the Site Manager John Jones, Golder accessed the site and commenced the inspection.

The weather was dry and sunny, with very good visibility, although there had been heavy rain and strong winds for the previous few days. No intrusive investigations were undertaken.

Active landfilling was ongoing on the top of cells 1, 2, 3, 4, 5, 6 and 7. Cells 9 and 10 were constructed in 2009 / 2010 but remain empty of waste. Rainfall captured in these two new cells is pumped out and disposed of to the surface water system.

Landfill gas extraction is currently active and feeds a 2,500 m<sup>3</sup>/hr flare and one recently installed 1MW engine. These are located to the north east of Cell 5, beyond the site access road. Furthermore a 1,500 m<sup>3</sup>/hr flare is installed to the north of Cell 7 within the extents of the lined area to manage the fresh, or bad, gas.

No leachate levels were provided to Golder's Engineer and it is assumed that the leachate levels are controlled within limits considered in the analysis carried out at site design, and in compliance with the Licence. Leachate levels observed on the headworks installations during the inspection were all below 1 m.

### **4.2 Leachate Management Infrastructure**

Various items of leachate management infrastructure are present on the site and these were observed from the surface without gaining entry into any chambers.

The inspection undertaken by Golder involved visiting the following specific locations:

- Leachate holding lagoon; and
- Leachate headworks, including pipework visible above waste / ground level.



#### **4.2.1 Leachate Holding Lagoon**

The lagoon is located near the southern extent of the site and to the west of the surface water lagoon. It is rectangular in shape, measuring approximately 60 m in length and 30 m in width. It is understood that the lagoon is lined with 2 mm HDPE Geomembrane, although Golder could not confirm this during the site inspection; no as built records were provided. The lagoon is covered with a floating HDPE Geomembrane welded to the basal liner. The presence of the cover limited the extent of Golder's inspection as the majority of the lagoon liner is hidden from sight. Golder was able to inspect the anchor trench to the perimeter and this indicated no visible signs of stress.

As well as receiving leachate from the active landfill area it also drains the hardstanding area immediately adjacent to the east of the lagoon so that any spillages during tanker loading are returned to the lagoon.

The visual inspection undertaken by Golder did not indicate any defects or any areas of concern which would warrant further investigation. During Golder's visit, a tanker was present at the lagoon and was observed loading leachate – this procedure occurred in the designated zone and no areas of concern were evident to Golder.

#### **4.2.2 Leachate Headworks**

Each cell of the landfill has a leachate upslope (or sideslope) riser. This is a large diameter HDPE pipe, into which is installed a leachate pump, with associate rising main and automated level measuring transducer. The top of the riser is enclosed in a reinforced concrete wall with associated electrical control panels surface mounted to the wall. The base of the wall ties in to a reinforced concrete base slab. No drawings of these structures were provided to Golder during this visit.

Cells 3 and 4 have a combined headworks as do cells 2 and 5. The remaining cells, 1, 6, 7, 9 and 10, all have individual headworks. The inspection of all seven of these structures indicates that they are all in a good state of repair with no evidence of deterioration. Pipework leading from the headworks was also inspected prior to it entering the ground and no evidence of leaks or deterioration was evident.

### **4.3 Surface Water Management Infrastructure**

Surface water management on the site is extremely important. There is a variety of surface water infrastructure present on the site and these were observed from the surface without gaining entry into any chambers.

The inspection undertaken by Golder involved visiting the following specific locations:

- Surface water lagoon;
- Reed bed;
- Surface water lagoon inlet *V notch weir*, and
- Swales.

#### **4.3.1 Surface Water Lagoon**

The lagoon is located towards the south east of the facility, just to the south of the weighbridges which are immediately to the south of the site offices. Like the leachate lagoon it is rectangular in shape, measuring approximately 100 m in length and 40 m in width. It is understood that the lagoon is lined with 2 mm HDPE Geomembrane, and this was backed up by observation during the site inspection; no as built records were provided. The lagoon was observed from outside of the perimeter fence, with particular attention given to pipe penetrations, patches and other areas of extrusion welding, and to the main inlet at the western end. These observations indicate that the lagoon is in a good condition. Golder was also able to inspect the anchor trench to the perimeter and this indicated no visible signs of stress.



### 4.3.2 V notch weir

The main inlet to the lagoon is from the main open channel drain which runs to the south of the facility, with swales from the site entering this channel at various locations along its route. The water in the main channel passes over a V notch weir which has a calibrated ultrasonic device to measure inlet flow. At the time of the inspection both the weir and the ultrasonic device appeared to be in good condition, although Golder is not in a position to comment on the calibration of these installations.

### 4.3.3 Reed Bed

The outflow from the lagoon is to a reed bed. The channels conveying flow to the reed bed were inspected and found to be in satisfactory condition. No further inspection was undertaken due to the difficulties with access and the presence of the reeds impairing visual observation.

### 4.3.4 Swales

Swales are cut at various locations around the site, notably just beyond the toes of the landfill structure slopes. These convey surface run off quickly away to minimise saturation of the toe of the slope. All of the swales are in reasonable condition, although at a few locations, notably to the east of the site parallel to the ESB overhead lines, areas of erosion are evident. This is not a particular problem at this stage, but should be monitored to ensure that the swales continue to be *fit for purpose*. In addition, several silt traps have been incorporated in the swales using gravel as a dam; these have proved effective but now require *desilting* whenever the main water flow is reduced. These locations are on the eastern and southern swales. Further, some of the road crossings to the south have become heavily silted and these should also be monitored and *desilted* as appropriate.

## 4.4 Slope Stability

### 4.4.1 Visual Inspection

During the inspection of the facility, Golder's Engineer walked the perimeter of the actual landfill and observed the side slopes which form the landfill. This involved a walk around the toe of the slopes followed by a walk around the crest. As observations from the toe or crest merited further investigation, the slope was accessed. This visual inspection was looking for indicators of movement as outlined in section 3.3 above. The inspection did not identify any areas of concern.

### 4.4.2 Structures

As stated above, a number of structures are present around the perimeter of the waste mass. These are mainly the leachate riser headworks – see section 4.2.2 above. None of these headworks support the waste mass behind. All of the headworks appear to be constructed over the anchor trench, with the side riser pipe passing through. None of these structures shows any signs of distress, eg cracking.

A further structure is located just below the crest on the north of the slope at the north eastern edge of cell 7 slope extension. This is a groundwater pumping installation headwall. This headwall supports the short length of slope above it and at the time of inspection neither the slope or the structure exhibited any visible signs of distress or deterioration.

## 5.0 SUMMARY AND CONCLUSIONS

The survey undertaken by Golder on Tuesday 08 February 2011, indicates that:

- The perimeter slopes are not showing signs of movement or distress;
- Measures to limit saturation of slopes appear effective;
- All leachate side risers headwall structures to the perimeter of the waste mass appear to be in good condition;



- The surface water lagoon that was visible appears to be in good condition;
- Drainage channels / swales, around the site all appear to be functioning adequately, although in some locations silt traps are filling up; and
- The cover to the leachate lagoon and the lining that is visible appear to be intact and in good condition.

### 6.0 RECOMMENDATIONS

Based on the information made available to Golder and the site inspection undertaken on Tuesday 08 February 2011, Golder makes the following recommendations:

- Continue with the good practice evident on site with regard to slope profiles and minimisation of surface water ingress;
- All slopes, including higher berms, should be inspected daily and any changes reported immediately to the Facility Manager;
- Continue with good leachate management practices; and
- During a period of dry weather, consider the removal of silt from silt traps in swales.

### 7.0 REFERENCES

- Golder Associates (Ireland) Limited, Report 07507190300.R01, December 2007
- Golder Associates (Ireland) Limited, Report 07507190300.R02, December 2008
- Golder Associates (Ireland) Limited, Report 10507190033/R01/A.0, April 2010
- Golder Associates (Ireland) Limited Drawing No. 08507190234/510A Rev B, dated September 2009
- Golder Associates (Ireland) Limited Drawing No. 08507190234/511 Rev B, dated September 2009
- Golder Associates (Ireland) Limited Drawing No. W-S25/03 Rev B dated February 2011



## Report Signature Page

**GOLDER ASSOCIATES IRELAND LIMITED**

Handwritten signature of John Dundee in blue ink.

John Dundee BEng (Hons) CEng MICE  
Senior Engineer

Handwritten signature of Thomas Vainio-Mattila in blue ink.

Thomas Vainio-Mattila MSc PGeo EurGeol  
Senior Consultant

Author; John Dundee/TVM/aw

Date: 11 February 2011

Registered in Ireland Registration No. 297875  
Town Centre House, Dublin Road, Naas, Co. Kildare, Ireland  
Directors: M. Gilligan, A. Harris (British)  
VAT No.: 8297875W






# **APPENDIX A**

## **Plates**





### Leachate Lagoon

<p><b>Plate Nr: 1</b></p>	
<p><b>Caption:</b> General view looking west.</p>	
<p><b>Plate Nr: 2</b></p>	
<p><b>Caption:</b> Extraction headworks.</p>	
<p><b>Plate Nr: 3</b></p>	
<p><b>Caption:</b> Tanker loading area.</p>	





**Plate Nr: 4**

**Caption:** Extrusion weld patch on cover at north west corner.






**Plate Nr: 5**

**Caption:** Leachate tanker transfer area with tanker present.





Leachate Riser Headworks

<p><b>Plate Nr: 6</b></p>	
<p><b>Caption: Cell 9.</b></p>	
<p><b>Plate Nr: 7</b></p>	
<p><b>Caption: Cell 6.</b></p>	
<p><b>Plate Nr: 8</b></p>	
<p><b>Caption: Cells 3 and 4.</b></p>	





**Plate Nr: 9**  
**Caption: Cell 1.**



**Plate Nr: 10**  
**Caption: Cells 2 and 5.**



**Plate Nr: 11**  
**Caption: Cell 7.**








**Plate Nr:** 12

**Caption:** Cell 10.





### Surface Water Lagoon and Inlet Weir

<p><b>Plate Nr:</b> 13</p>	
<p><b>Caption:</b> General view looking west.</p>	
<p><b>Plate Nr:</b> 14</p>	
<p><b>Caption:</b> Inlet pipe in northern side slope.</p>	
<p><b>Plate Nr:</b> 15</p>	
<p><b>Caption:</b> Main inlet at western slope with V notch weir and ultrasonic device in foreground.</p>	








**Plate Nr: 16**

**Caption:** Looking west from lagoon to V notch weir and open channel beyond.








Surface Water Channel and Swales

<p><b>Plate Nr: 17</b></p>	
<p><b>Caption:</b> General view of channel looking west alongside leachate lagoon.</p>	
<p><b>Plate Nr: 18</b></p>	
<p><b>Caption:</b> Same section of channel as above, but looking east towards surface water lagoon.</p>	
<p><b>Plate Nr: 19</b></p>	
<p><b>Caption:</b> Channel to south east of landfill area.</p>	








<p><b>Plate Nr: 20</b></p> <p><b>Caption:</b> Road crossing at south of landfill area – note silt deposits in base.</p>	 A photograph showing a road crossing over a stone wall. The area is overgrown with grass and weeds. There are significant silt deposits and some debris (plastic bags, tires) in the base of the wall. A wooden fence runs along the top of the wall. In the background, a green tractor is visible on the road.
<p><b>Plate Nr: 21</b></p> <p><b>Caption:</b> Swale to south of landfill area running west to road crossing.</p>	 A photograph of a swale, a shallow ditch, running through a grassy field. The swale is filled with water and has a gravel dam at the bottom. The surrounding area is overgrown with grass and weeds. In the background, a road and some trees are visible.
<p><b>Plate Nr: 22</b></p> <p><b>Caption:</b> Swale to south west of Cell 3 – note silt retained behind gravel dam.</p>	 A photograph of a swale with a gravel dam. The water is murky and brown, indicating silt. The dam is made of gravel and is retaining a large amount of silt. The surrounding area is overgrown with grass and weeds. In the background, a road and some trees are visible.








<p><b>Plate Nr: 23</b></p> <p><b>Caption:</b> Ground water discharge pipe from Cell 6 downslope to swale.</p>	
<p><b>Plate Nr: 24</b></p> <p><b>Caption:</b> Looking down slope from Cell 7 groundwater drainage structure to swale running along northern extent of the landfill area.</p>	
<p><b>Plate Nr: 25</b></p> <p><b>Caption:</b> Looking north west from crest of Cell 7 along Cell 10 outer slope with swale to perimeter fence. This continues to swale shown above.</p>	








<p><b>Plate Nr: 26</b></p> <p><b>Caption:</b> Eastern slope of landfill area with swale at toe of slope running south.</p>	
<p><b>Plate Nr: 27</b></p> <p><b>Caption:</b> Looking north along eastern extent of landfill area along line of swale.</p>	
<p><b>Plate Nr: 28</b></p> <p><b>Caption:</b> Silt trap on eastern swale functioning effectively, but needs desilting.</p>	






Side slopes




<p><b>Plate Nr:</b> 29</p>	
<p><b>Caption:</b> Slope to south east of Cell 2.</p>	
<p><b>Plate Nr:</b> 30</p>	
<p><b>Caption:</b> Looking west along Cell 1 southern slope.</p>	
<p><b>Plate Nr:</b> 31</p>	
<p><b>Caption:</b> View up Cell 3 slope – typical of most of the site slopes.</p>	





<p><b>Plate Nr: 32</b></p> <p><b>Caption:</b> View from southern extent of landfill slopes, looking northwest along Cells 3, 6 and 9 slopes.</p>	
<p><b>Plate Nr: 33</b></p> <p><b>Caption:</b> Looking north east at Cell 6 and part of cell 9 slopes – note leachate headworks.</p>	
<p><b>Plate Nr: 34</b></p> <p><b>Caption:</b> Slope to north west of Cell 10.</p>	



<p><b>Plate Nr: 35</b></p> <p><b>Caption:</b> Looking south east along perimeter of Cell 10 slope and onto Cell 7 slope.</p>	
<p><b>Plate Nr: 36</b></p> <p><b>Caption:</b> Looking west along Cell 7 slope with Cell 10 slope in background. Note leachate headworks for Cell 10.</p>	
<p><b>Plate Nr: 37</b></p> <p><b>Caption:</b> Looking south along eastern slope of landfill area.</p>	





<p><b>Plate Nr: 38</b></p> <p><b>Caption:</b> Typical vegetation on eastern slope.</p>	
<p><b>Plate Nr: 39</b></p> <p><b>Caption:</b> looking north along eastern slope from south east extent of landfill area.</p>	

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

[solutions@golder.com](mailto:solutions@golder.com)  
[www.golder.com](http://www.golder.com)

**Golder Associates Ireland Limited**  
**Town Centre House**  
**Dublin Road**  
**Naas**  
**Co. Kildare**  
**Ireland**  
**T: +353 45 87 4411**

