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environmental management for business

Office of Environmental Enforcement (Waste),
Environmental Protection Agency,
McCumiskey House,
Richview,
Clonskeagh,
Dublin 14

20th April 2010

RE: 2009 Annual Environmental Report - Greenstar Ltd. - Knockharley Landfill (Reg. No. W0146-01)

Dear Sir/Madam,

Please find enclosed an original and 2 no. copies of the 2009 Annual Environmental Report (AER) for the above referenced facility. The AER file has been uploaded to the EPA website and is a true copy of the original Annual Environmental Report. The AER/PRTR emissions data reporting workbook has also been uploaded to the EPA website.

If you have any queries, please call me.

Yours sincerely,

Michael Watson

0904816/MW/MG
Encl
CC: Ms. Heather Miller, Greenstar Ltd

email. info@ocallaghanmoran.com Website: www.ocallaghanmoran.com

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ANNUAL ENVIRONMENTAL REPORT

FOR

GREENSTAR LTD

KNOCKHARLEY LANDFILL

LICENCE NO. W0146-01

JANUARY – DECEMBER 2009

Prepared For: -

Greenstar Ltd,
Knockharley Landfill,
Knockharley,
Co. Meath.

Prepared By: -

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

20th April 2010

Project	Annual Environmental Report 2009			
Client	Greenstar Ltd W0146-01			
Report No	Date	Status	Prepared By	Reviewed By
0481605	26/03/2010	Draft 1	Barry Sexton MSc	Michael Watson MA.
0481605 Rev A	19/04/2010	Draft 2	Barry Sexton MSc	Michael Watson MA.
0481605 Rev A	19/04/2010	Final	Barry Sexton MSc	Michael Watson MA.

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1. INTRODUCTION

This is the 2009 Annual Environmental Report (AER) for Greenstar Ltd's (Greenstar) non-hazardous residual landfill at Knockharley, Navan, County Meath. It covers the twelve month period from 1st January 2009 to 31st December 2009. The facility received its Waste Licence (W0146-01) in March 2003 and began accepting residual waste in December 2004.

The content of the AER is based on *Schedule F* of the Waste Licence and the report format follows guidelines set in the "Guidance Note for Annual Environmental Report" issued by the Environmental Protection Agency (Agency).

2. SITE DESCRIPTION

2.1 Site Location and Layout

The site is located in a rural area, approximately 1.5 km north of Kentstown Village and 7 km south of Slane. The licensed area encompasses 135.2 ha. The landfill footprint, where waste is deposited in engineered landfill cells, is located in the centre of the site and will eventually occupy an area of approximately 25 ha. A buffer of 100 m is maintained between the active landfill footprint and the site boundary. The fill areas are more than 250 m from all occupied dwellings.

The facility will be developed in seven phases. The initial phase, which was completed in December 2004, involved the completion of four engineered landfill cells (Cells 1-4), the construction of an access road from the N2, the provision of the supporting infrastructure (waste reception area, leachate holding lagoons and site offices), groundwater and surface water control measures, and initial landscape works. An additional two cells (Cells 5 & 6) were completed in July 2006 and Cells 7 to 10 were constructed in 2007. Cells 11 and 12 were constructed in 2009.

Subsequent phases will involve the construction of additional engineered cells, the expansion of the active gas management and flaring system, progressive landscape works and the capping and restoration of completed landfill cells. Final capping of the perimeter of cells 1 to 4 was completed in 2009.

2.2 Waste Types & Volumes

Only non-hazardous, solid, residual waste is accepted for disposal. Hazardous and liquid wastes are not accepted. All wastes delivered to the facility are subject to Waste Acceptance Procedures that have been approved by the Agency, as specified in Condition 5.3 of the Waste Licence.

The facility is licensed to accept 200,000 tonnes of waste per annum. The following waste types and volumes, as specified in Schedule A of the Waste Licence, can be accepted: -

Household (100,000 tonnes),

Commercial (45,000 tonnes),

Industrial (30,000 tonnes),

Construction & Demolition (25,000 tonnes).

2.3 Waste Activities

The facility is a full containment landfill, which is designed to accept treated waste for final disposal. The waste activities carried out during the reporting period were: -

Disposal (landfilling) of wastes,

Recovery of wastes for removal off-site and recycling, and

Recovery of certain inert wastes on-site for engineering purposes and use as daily cover.

2.4 Waste Received & Consigned

A breakdown of the different types and quantities of wastes received and consigned from the facility in 2009 and previous years are shown in Tables 2.1, 2.2 and 2.3.

Table 2.1 Waste Received 2009

European Waste Code Categories	Description	Tonnes
Waste for disposal		
EWC 19 12 12	Residual municipal and commercial waste	92,304.54
EWC 20 03 01	Mixed Municipal Waste	12,576.38
EWC 20 03 03	Street cleaning waste	69.46
EWC 20 03 07	Mixed construction and demolition waste	27,105.50
EWC 17 06 04	Insulation Materials	1.7
EWC 19 02 03	Physico/chemical Treated Waste	315.84
EWC 10 03 05	Waste Alumina	10.48
EWC 08 03 15	Ink Sludge (Non Hazardous)	147.38
EWC 06 05 03	Effluent Sludge (Non Hazardous)	52.42
EWC 11 01 10	Industrial Filter Cake (Non Hazardous)	537.38
EWC 16 03 04	Stabilised Inorganic Filter Cake	735.98
EWC 12 01 17	Paint Stripping Waste (Non Hazardous)	110.78
EWC 19 03 05	Stabilised Inorganic filter cake	48.28
EWC 19 09 02	Filter cake from water treatment	17.24
EWC 19 09 05	Filter cake from water treatment	39.88
Total waste for disposal		134,073.24

European Waste Code Categories	Description	Tonnes
Waste for recovery		
EWC 17 09 04	Mixed Construction and Demolition Waste	514.76
EWC 19 05 03	Off specification compost	39,155.02
EWC 19 12 07	Woodchip	5,382.86
EWC 20 01 38	Woodchip	38.70
EWC 19 12 09	Minerals-Fines	20,656.94
EWC 90 01 01	Soil and stones	2,635.08
Total waste for recovery		68,383.36

*As per agreement with the Agency M146-1/GEN06dh.doc

Table 2.2 Waste Consigned 2009

European Waste Code Categories	Description	Tonnes	Destination
EWC 16 01 06	Batteries	0.36	Returnbatt
EWC 19 07 03	Leachate	16,528.96	Navan WWTP
Total waste consigned			16,529.32

Table 2.3 Waste Received 2004 to 2008

European Waste Code Categories	2004	2005	2006	2007	2008
Waste for disposal					
EWC 02 02 03	-	7.00	-		
EWC 18 02 03	-	0.22	-		
EWC 19 12 12	-	98,125.18	-	92,009.82	101,380.76
ECW 19 13 12	-	-	-	-	9,107.30
EWC 20 01 99				27.50	
EWC 20 03 01	909.54	37,988.84	133,119.48	44,144.59	23,126.38
EWC 20 03 07	-	-	-	-	144.44
Total waste for disposal	*909.54*	*136,121.24*	*133,119.48*	*136,181.91*	*133,758.88*
Waste for recovery					
EWC 11 01 10	-	-	-	103.96	230.30
EWC 16 03 04	-	-	-	-	388.28
EWC 17 01 01	-	-	-	-	106.84
EWC 17 05 04	-	-	26,622.46	22,314.04	17,800.62
EWC 17 09 04	-	768.88	-	2,743.12	1,814.24
EWC 19 05 01	-	-	-	-	6,780.52
EWC 19 05 03	-	120.22	2,754.10	2,990.30	5.38
EWC 19 09 02	-	-	-	-	8.12
EWC 19 12 02	-	-	-	176.06	-
EWC 19 12 07	112.94	7,358.34	7,397.28	9,534.76	6,183.50
EWC 19 12 09	371.24	25,434.80	22,924.03	24,926.73	16,821.46
EWC 19 12 12	-	-	-	-	9,953.64
Total waste for recovery	*484.18*	*33,682.24**	*59,697.87*	*62,788.97*	*60,092.90*

2.5 Landfill Capacity

The most recent topographic survey for the landfill cell footprint is included in Appendix 1. The total capacity of the facility is estimated to be 3,282,500m^3. It is estimated that approximately 1,019,500 m^3 of void space has been used. The remaining capacity is approximately 2,263,000m^3.

2.6 Method of Deposition of Wastes

2.6.1 Waste Acceptance

The waste accepted for disposal is residual waste predominantly from the Northeast region, from household, commercial and industrial sources. At present the majority of waste is delivered to the facility by two waste contractors based in County Meath. Both

contractors have systems in place whereby the recyclable fraction is either collected separately, or else separation is carried out manually at their facilities. Both contractors have the infrastructure in place to compost biodegradable wastes, including food waste.

All waste is delivered to the site in Heavy Goods Vehicles (HGV) 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 banksman. 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.

2.6.2 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's waste input is deposited to form a 'block', which is compacted and covered. The following day a new 'block' of waste is deposited adjacent to this block. 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.

3. ENVIRONMENTAL MONITORING

Greenstar implements a comprehensive environmental monitoring programme to assess the significance of emissions from site activities. The programme includes groundwater, surface water, leachate, landfill gas, noise, dust and particulate monitoring and a biological assessment of the Kentstown Stream and Nanny River. The monitoring locations are shown on Figure 3.1.

The monitoring results, including the full laboratory reports, were submitted to the Agency at quarterly intervals in the reporting period. This section presents a summary of the monitoring with summary graphs showing trends included in Appendix 2.

3.1 Groundwater Monitoring

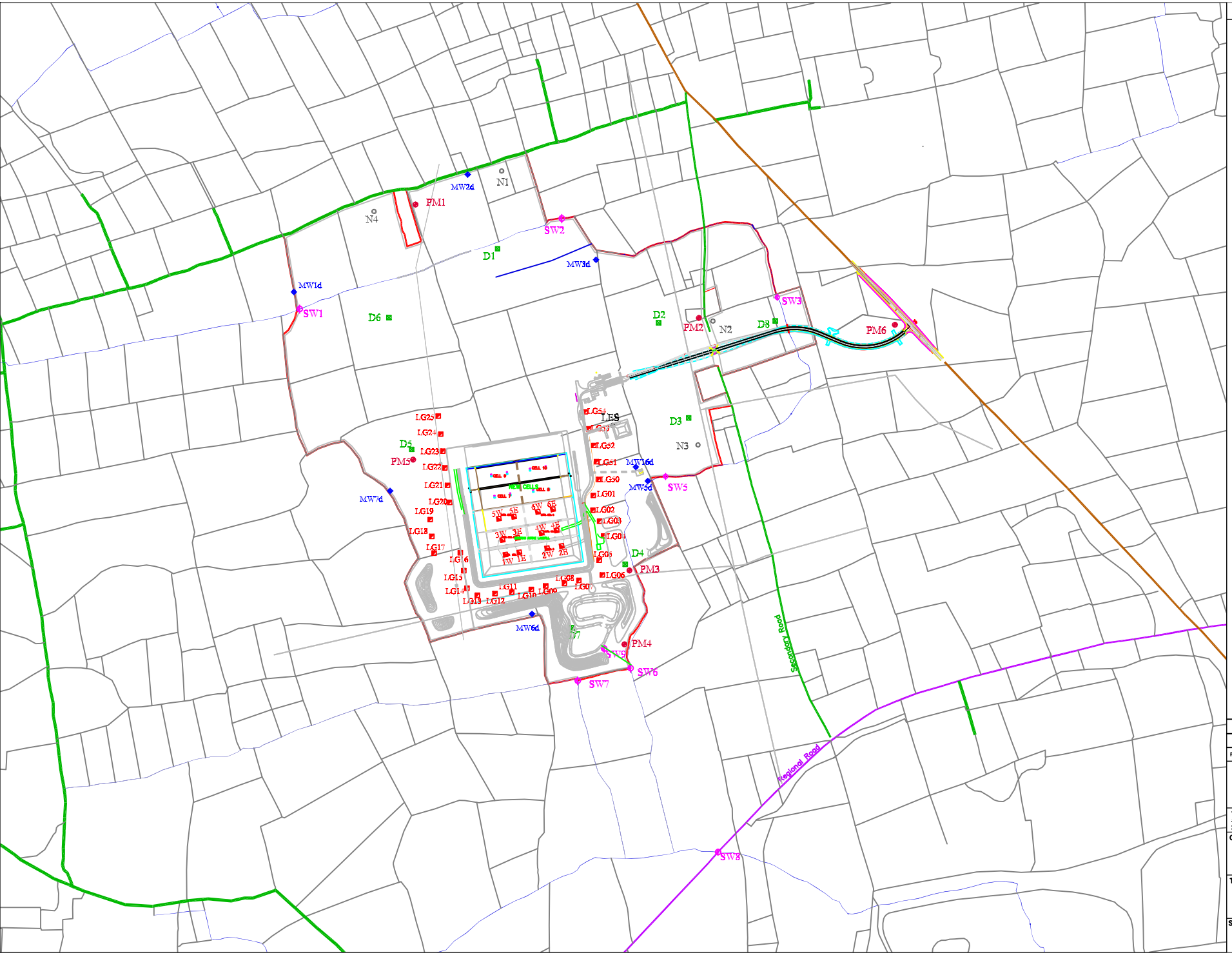
3.1.1 Groundwater Levels

Groundwater levels were measured in each of the seven monitoring wells specified in the Waste Licence (MW1d – MW6d and MW16d) on four occasions during the reporting period. The wells are all screened exclusively in the bedrock. The monitoring confirmed that the direction of groundwater flow in the bedrock aquifer is from the north west to the south east. The monitoring also identified artesian conditions in MW-5d and MW-1d.

3.1.2 Groundwater Quality

Groundwater quality was monitored in the on-site monitoring wells and reported to the Agency at quarterly intervals. The sampling was carried out in accordance with internationally accepted techniques and control procedures and the analyses were completed by a laboratory using standard and internationally accepted procedures.

The 2009 results were generally consistent with those obtained during the monitoring completed before the start of site development works. The monitoring programme confirms that the site activities are not impacting on groundwater quality.



NOTES

No	Id	Eastings	Northings
	DUST		
1	D1	29'278	26'774
2	D2	29'744	26'640
3	D3	29'831	26'298
4	D4	29'654	26'867
5	D5	29'030	26'719
6	D6	29696	26'575
7	D7	29'587	26667'8
8	D8	29808	26'565
	GROUNDWATER		
9	MW1D	296689	26'6'9
10	MW2D	29'191	26'588
11	MW3D	29'562	26'7'2
12	MW5D	29'712	26'102
13	MW6D	29'377	266'18
14	MW7D	296967	26'0'4
15	MW16D	29'678	26'143
	NOISE		
16	N1	29'280	26'999
17	N2	29'901	26'466
18	N3	29'858	26'20'
19	N4	296921	26'882
	SURFACE WATER		
20	SW1	296'06	26'600
21	SW2	29'46+	26'882
22	SW3	29808'	26'63+
23	SW4	29'6+	26'116
24	SW6	29'663	266562
25	SW7	29'510	266575
26	SW8	29'916	266029
27	SW9	29'587	266621
	PM10		
28	PM1	29'030	26'909
29	PM2	29'833	26'291
30	PM3	29'656	26689+
31	PM4	29'606	266630
32	PM5	29'035	26'170
33	PM6	298+9+	26'576
	LANDFILL GAS		
34	LG01	29'555	26'061
35	LG02	29'53+	26'018
36	LG03	29'559	2669'5
37	LG04	29'563	266928
38	LG05	29'572	2668'4
39	LG06	29'581	266831
40	LG07	29'513	266815
41	LG08	29'4+2	266806
42	LG09	29'418	26679'9
43	LG010	29'376	266'89
44	LG011	29'319	266'81
45	LG012	29'271	266'77
46	LG013	29'230	266'72
47	LG014	29'190	266'93
48	LG015	29'181	2668'3
49	LG016	29'170	26689+
50	LG017	29'095	26689'
51	LG018	29'068	2669'2
52	LG019	29'08+	26699'
53	LG020	29'1-0	26'0'1
54	LG021	29'13+	26'090
55	LG022	29'126	26'1-0
56	LG023	29'150	26'188
57	LG024	29'114	26'238
58	LG025	29'107	26'299
59	LG50	29'5'0	26'107
60	LG51	29'56+	26'158
61	LG52	29'536	26'206
62	LG53	29'5+1	26'2'3
63	LG54	29'532	26'302

MONITORING LOCATIONS LEGEND:
- Denotes landfill gas monitoring location
- Denotes groundwater monitoring location
- Denotes surfacewater monitoring location
- Denotes noise monitoring location
- Denotes dust monitoring location
- Denotes PM10 monitoring location
- Denotes leachate monitoring location

REV	DATE	DESCRIPTION	DRN	CHKD	APP
B	28/05/08	LFG	MW	JOC	JOC
A	29/11/04	ISSUE	MW	JOC	JOC

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CLIENT
GREENSTAR LTD

TITLE
MONITORING LOCATIONS
KNOCKHARLEY
LANDFILL

SCALE
1:5,000
A3

FIGURE 3.1

REV.
B

3.2 Surface Water Monitoring

The site lies within the Nanny River catchment, close to the catchment divide with the River Boyne. The Nanny catchment is characterised by sudden high flows coinciding with high rainfall periods and particularly low flows in the drier summer months.

3.2.1 Visual Assessment

Greenstar carries out weekly inspections of the surface water drainage system. The inspections completed in the reporting period did not identify the presence of any impact on the drainage system associated with site activities.

3.2.2 Chemical Assessment

The surface water monitoring was conducted quarterly at the eight monitoring locations specified in the Licence and reported to the Agency on a quarterly basis. The sampling was carried out in accordance with internationally accepted techniques and control procedures, the analyses were completed by a laboratory using standard and internationally accepted procedures.

Monitoring prior to site development established that the water quality is seasonally affected by the surrounding land use, including agriculture and septic tanks. These impacts are reflected in the elevated and variable Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and ammonia levels. Continuous monitoring at the outfall of the surface water lagoon has not shown any impact by the site activities. The 2009 results confirm that this remains the case and that site activities are not impacting on surface water quality.

3.3 Leachate

The monitoring programme involves the collection and testing of leachate samples from the collection sumps and the storage lagoon. The 2009 results indicate an increase in leachate strength throughout the monitoring period, which is expected given the age of the facility. Leachate is removed off site to a Waste Water Treatment Plant (WWPT) as agreed with the Agency.

3.4 Landfill Gas (LFG)

The gas monitoring programme includes measurements of methane, carbon dioxide, oxygen and atmospheric pressure in wells located both outside and inside the waste body on a monthly basis. The wells are at 50 m intervals around the landfill footprint and two per

hectare within the cells. The locations of the 30 external wells (LG-01 – LG-25 and LG-50 to LG-54) were agreed in advance with the Agency and are shown on Figure 3.1.

3.4.1 Outside the Waste Body

Low levels of methane were detected in the well LG-50 at levels ranging from 3% in August 2009 to 0.1% in October 2009. Methane has not been detected in LG-50 since October 2009. The presence of the methane does not indicate that landfill gas is migrating to the well. It is likely that the results were anomalous.

Since monitoring began in 2004, high concentrations of naturally occurring carbon dioxide have been detected in the in-situ subsoils, and these were confirmed in 2009. High concentrations of carbon dioxide can occur naturally at shallow depths of up to 2 metres due to microbiological activity associated with the roots of many types of vegetation, providing concentrations of up to 7% by volume in certain soils such as the silty clays that underlie the site.

3.4.2 Inside the Waste Body

Methane levels varied from 3.8 to 69.0 %v/v, carbon dioxide levels varied from 0.1 to 63.3 %v/v, while oxygen levels varied from 0.0 to 21.0 %v/v. The levels were as expected considering the age of the landfill.

3.5 Noise Surveys

Noise surveys were conducted on four occasions at the locations specified in Table D.1.1 of the Waste Licence (Ref. Figure 3.1). The surveys were carried out in accordance with International Standards Organisation 1996: Acoustics-description and Measurement of Environmental Noise (Parts 1, 2 and 3).

The results at the noise sensitive locations indicate that noise from the site complied with the licence limits. In Q-4 due to the continuous dominance of road traffic noise to the north, it was necessary to estimate the contribution from the Greenstar facility. The estimated contribution was in all cases lower than the 55 dB daytime limit specified in the Licence.

3.6 Dust Monitoring

Dust deposition is monitored monthly at eight monitoring locations (D1 to D8) as specified in Table D.1.1 of the Waste Licence (Ref. Figure 3.1). All of the 2009 monitoring results were less than the deposition limit set in the Licence (350 mg/m^2/day).

3.7 PM_{10}

PM_{10} levels were monitored on four occasions at the locations specified in Table D.1.1 (Figure 3.1) in February, May, July and October 2009. All measurements were below the trigger level of 50 μ/m^3.

3.8 Meteorological Monitoring

Average rainfall, temperature, humidity and wind speed and direction for the monitoring period were obtained from the Meteorological Station at Dublin Airport located approximately 30 km from the facility is presented in Table 3.1.

Table 3.1 Meteorological Data: Dublin Airport – 2009

Rainfall	
Total Annual	917.8 mm
Maximum month (November)	171.3 mm
Minimum month (September)	24.2 mm
Temperature	
Mean Daily	9.5°C
Mean Daily Maximum (August)	15.3°C
Mean Daily Minimum (December)	3.6°C
Wind (Knots)	
Frequency of calms	3.3%
Prevailing direction	South West
Prevailing sector	South West

The total annual rainfall is 917.8 mm. The winds are predominantly from the south west sector.

3.9 Biological Monitoring

The annual biological assessment of the Kentstown Stream and Nanny River was carried out in accordance with Condition 8.11 of the licence on the 25th May 2009 and a full copy of the report is included in Appendix 2. Two control sites and two receptor sites were surveyed on each water course using the EPA Q-rating system for the assessment of rivers and streams. Benthic macro-invertebrates were sampled qualitatively at the four sites using kick-sampling and based on the results, the water quality of each site was determined using the EPA Q-rating scheme. Similarly, the SSRS (small stream risk score) of each site was calculated.

The findings indicate that biological water quality at the control site and the receptor site downstream of the landfill on the Knockharley Stream has improved. The biological water quality has also improved in the receptor site on the River Nanny but has reduced at the control site.

Biological water quality at the receptor site on the Knockharley Stream (Site 1) improved from 'Moderately Polluted (Q2-3) from 2004-2007, to 'Moderately Polluted (Q3)' in 2008 and 2009. Improvement in biological water quality at the reference site on the Knockharley has coincided with an improvement at the receptor site between 2008 and 2009, following unparalleled changes (deterioration) at the reference between 2005 (Q3) and 2006 (Q2-3).

Biological water quality at the receptor site on the River Nanny (Site 3) has also improved recently. Since 2007 / 2008 there was a marked improvement in water quality with status rising from 'Poor' in 2008 to 'Moderate' in 2009. Biological water quality at the reference site on the River Nanny has declined from 'Moderate Status' in 2008 to 'Poor Status' in 2009.

There is no evidence that the landfill operations are having any effect on the water quality of the receptor streams. It is likely that diffuse sources of pollution, such as agricultural inputs, are the main causes of pollution in these watercourses. Variations in such inputs, environmental factors, and (to a lesser degree) timing and micro-location of sampling have probably all contributed to the variation in results obtained over the past five years.

4. SITE DEVELOPMENT WORKS

4.1 Summary of Resource & Energy Consumption

Table 4.1 presents an estimate of the resources used on-site in 2009. OCM completed an Energy Efficiency Audit of the facility in compliance with Condition 2.5.1 of the Licence in Q1 2007. The audit was carried out in accordance with the Agency's "Guidance Note on Energy Efficiency Auditing" (2003).

The Audit report recommended the development of a documented energy policy statement as this is considered 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. An energy management policy document was developed in 2008, a copy of which is included in Appendix 3.

A landfill is a significant source of greenhouse gas emissions, not through the use of fossil fuels, but as a result of the production and flaring of landfill gas. However, to address this a landfill gas utilisation plant was installed at the facility in 2009, which will mean that the facility will have a negative carbon footprint in 2010.

Table 4.1 Resources Used On-Site

Resources	Quantities
Diesel (green)	127,195 litres
Electricity	258,650 units
Hydraulic Oil	180litres
Mains Water	89,580m^3
Odour Neutralisers	2,500 litres

4.2 Site Developments

The construction of cells 11 and 12 was completed during 2009. The partial final capping of cells 1 to 4 was completed in 2009.

Leachate circulation infrastructure was installed in 2009 as part of the partial final capping of cells 1 to 4.

A gas engine and a 2,500m^3/hour enclosed flare in a new compound with associated welfare facilities and office was installed in 2009. A second gas engine with a 650m^3/hour capacity will be installed in 2010.

In 2010, Greenstar will provide temporary impermeable cover on the flanks of the landfill footprint and the terraced area facing into the new Cells 11 and 12.

5. EMISSIONS

5.1 Leachate

Water balance calculations were prepared using guidance in the Agency's Landfill Manual-Landfill Site Design and are based on total rainfall data from the onsite met station and the volumes of waste deposited at the site during the reporting period. The calculations are presented in Table 5.1.

It was assumed that all of the incident rainfall on the active cells had the potential to generate leachate. An absorptive capacity of 0.07 m^3/tonne was used based on a waste density of 0.8 tonnes/m^3.

The calculations indicate that approximately 17,655 m^3 of leachate was generated in 2009. 16,529 m^3 of leachate was removed during the reporting period. The balance is stored in the base of the landfill cells and the storage lagoon.

5.2 Landfill Gas

It is estimated that approximately 1,354 m^3 / hour of landfill gas (methane and carbon dioxide) was generated at the facility over the reporting period. This overall estimate is derived from predictive gas generation model GasSim Version 1.54 the results of which are included in Appendix 4. The actual volume of methane and carbon dioxide burned was 1,263 m^3 / hour as measured by the flares and based on a mixture of 40.3% methane and 31.2% carbon dioxide. Input data for the model are the site specific values, i.e. size of the site, operational period, quantity and type of waste.

5.3 Surface Water

Rainfall on the undeveloped parts of the site discharges directly to the surface water drainage system. Rainfall on active fill areas is collected in the leachate collection system. The surface drainage from all roads is directed to the surface water retention pond via an oil interceptor. Drainage from the waste inspection and quarantine bays is directed to the leachate lagoon. The retention pond design and capacity meets the requirements of the Waste Licence. The inlet to the pond is fitted with a Class 1 Full Oil interceptor.

Table 5.1 Annual Leachate Volume

Yr.	Active Cell No.	Active Area Uncapped (m^2)	Waste Input (t)	Active Infiltration (m^3)	Intermediate Restoration Cell No.	Intermediate Restored Area (m^2)	Intermediate Infiltration (m^3)	Final Restoration Cell No.	Restored Area (m^2)	Restored Infiltration (m^3)	Liquid Waste (m^3)	Total Leachate (m^3)	Cummulative Leachate (m^3)	Absorptive Capacity (m^3)	Cummulative Absorptive Capacity (m^3)	Cummulative Leachate Generation (m^3)	Annual Leachate Generation (m^3)
2009	1,2,3,4,5,6, 7,8,9,10	42,420	134,588	**19,089**	Perimeter 5-10	26,167	**7,065**	1,2,3,4 perimeter	20,485	**922**	0	27,076	107,237	9,421	46,875	60,362	**17,655**
Cell area ($m^{2)}$						8,907		Estimated maximum waste input (t/year)						200,000			
Total rainfall (m/year)						0.917		Liquid waste input (t/year)						0			
Effective Rainfall post vegetation (m/year)						0.338		Final Infiltration						0.1	10% of Effective Rainfall per annum		
Density of *in-situ* waste ($t/m^{3)}$						0.8		Intermediate Infiltration						0.6	60% of Effective Rainfall per annum		
Absorptive capacity (m^3/t)						0.07		Calculations are based on a 11 year landfill operation.									
Effective Rainfall before vegetation assumed to be (m)						0.45											

6. NUISANCE CONTROL

Greenstar is committed to operating in the best possible manner, using the best available techniques to minimise impacts to the environment and local residential neighbours. The potential sources of nuisance at a landfill facility are odour, vermin, birds, flies, mud, dust, litter and odours.

6.1 Odour

In addition to the landfill gas abstraction system, good operational practices on-site are the main controls to avoid odour nuisances. The handling, depositing and covering of waste at the facility is carried out in accordance with the Agency's Landfill Manual "Landfill Operational Practices". In addition Greenstar have developed a site specific Odour Management Plan (KNKP 033) a copy of which is included in Appendix 5. The plan specifies the operational requirements for the waste placement, the landfill gas management infrastructure and addresses all aspects of odour control.

Any loads with a particular potential for generation of odours are rejected in accordance with the waste acceptance procedures, which are in operation at the facility as submitted to and agreed by the Agency in December 2004.

The waste delivery trucks are unloaded at the working face and the waste is compacted within 3 to 4 minutes. The level areas of the working face are covered on a continuous basis during the day. The slope of the working face is covered completely with artificial cover sheets at the end of each working day, which can easily be removed again the following day prior to commencement of operations.

An odour neutralizing misting spray is installed along several sections of the litter fencing to mitigate potential waste odours. A mobile misting unit and contact neutralizer are also available on site and are used as necessary.

6.2 Vermin / Flies / Insects

The methods used for vermin control are as detailed in Nuisance Inspection Procedure (KNKP 32) in Appendix 5. A specialist contractor is employed by Greenstar to carry out a vermin control programme. Measures used include 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.

The fly monitoring, which was undertaken throughout the summer months using a Scudder grid and fly counting technique revealed low fly numbers.

6.3 Birds

Greenstar employs one of the leading bird control specialists, Falcon Bird Control Services, who operate a seven day dawn to dusk programme. An aviary is provided at the site, which houses the birds of prey used by the contractor. The main aim of the Programme is to create an association of danger, so that birds choose not to fly around the area where bird control is active. This association is achieved using a variety of methods such as visual and audible deterrents in compliance with the licence. To date these measures have proven to be successful.

6.4 Dust

Dust and mud control measures were implemented at the start of the construction phase of the site and continued into the operational phase. These 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. To date these measures have proven to be successful.

6.5 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. As part of operational controls all litter is collected at the end of the working day and litter has not been an issue at the facility.

7. ENVIRONMENTAL INCIDENTS AND COMPLAINTS

7.1 Incidents

There was one incident on-site during the reporting period, which was a small fire on the compactor.

7.2 Register of Complaints

Greenstar maintains a register of complaints in compliance with Condition 10.14. Details of all complaints received during the reporting period and the action taken by Greenstar are available at the facility. A graph showing the composition of the 275 complaints is included in Appendix 6.

8. ENVIRONMENTAL MANAGEMENT SYSTEM

8.1 Management Structure

The Management Structure as required by Condition 2.2.1 of the waste licence was submitted to the Agency on 14th December 2004, before the start of waste activities and updated in each AER.

8.1.1 Site Management Structure

The day to day management of the facility and supervision of waste activities are the responsibility of the General Manager, nominated Deputy Manager(s) and the site operatives. The positions and names of the persons who provide management and supervision are set out below: -

General Manager, John Jones *
Assistant Landfill Manager, Heather Miller *
Site Scientist, Neil Menzies *
Site Foreman, Robert Hughes *
Chargehand, Sean Smith *
Weighbridge Operator, Michael Noone
General Operatives, Donal Blaney, Ainars Elbergs and Martin Maguire
***** Nominated Deputy

The following Plant Operators, including suitably experienced and qualified replacement staff will be supplied by the Plant Hire Contractor, Renton Plant: -

Plant Operators, Patrick Maguire.

8.1.2 Responsibilities

Greenstar, as the licensee, is responsible for ensuring that the requisite resources are provided to operate the facility in accordance with the objective of the EMP and the Waste Licence conditions.

The General Manager or nominated Deputy is responsible for ensuring that the day to day operation of the facility is carried out in accordance with the EMP, the Waste Licence conditions and the Operating Procedures.

The General Manager or nominated Deputy is responsible for ensuring that the environmental monitoring programme is carried out and reports submitted to the Agency in accordance with the schedule in the EMP and the Waste Licence conditions.

The General Manager or nominated Deputy is responsible for arranging that the specified engineering works, the leachate and landfill gas management programmes and the restoration programmes are properly implemented.

The General Manager or nominated Deputy is responsible for ensuring that the Corrective Action Procedures, Emergency Response Procedures and Contingency Arrangements specified in the EMP and the Waste Licence are implemented.

The General Manager or nominated Deputy is responsible for arranging appropriate training programmes for all facility personnel and for maintaining training records.

The General Manager, nominated Deputy and designated staff are responsible for implementing the waste acceptance procedures, including the assessment of suitability of the waste for disposal and recording the data specified in the Waste Licence. They are responsible for receiving and recording complaints from members of the public at the facility and informing the General Manager or nominated Deputy of the complaints.

The General Manager, nominated Deputy, Site Foreman and designated staff are responsible for ensuring compliance with conditions relating to waste inspection, placement and nuisance control (e.g. daily cover, litter, dust, vermin, birds).

8.1.3 Staff Training

All training was carried out as scheduled in the training plan for 2009:

FETAC Level 6 Landfill Waste Management – Assistant Manager and Site Scientist

Safe Pass – All staff with the exception of Site Scientist and Weighbridge Operator

Complaints Procedure – Site Foreman, Chargehand and Weighbridge Operator

Landfill Operations and Logistics Safety Procedures DVD – All staff with the exception of Donal Blaney

Any facility staff who performs duties which involve interpretation of monitoring results or site inspections, will receive the appropriate training by the General Manager or nominated deputy, prior to carrying out such duties.

All facility staff will receive further training in their individual areas of activity. This training will comprise theoretical sessions as well as practical training. All such training will be recorded and documented in individual training files.

8.2 EMP

Condition 2.3 requires Greenstar to submit a proposal for a documented Environmental Management System (EMS) to the Agency for its approval three months prior to the start of waste activities at the site. The EMS proposal completed as part of the Environmental Management Plan was sent to the Agency on the 23rd July 2004 and was approved on the 23rd December 2004.

8.2.1 Schedule of Objectives 2009

Table 8.1 describes the implementation of the objectives and targets in the reporting period.

8.2.2 Schedule of Objectives 2010

Greenstar has set a schedule of targets and objectives for 2010. These are presented in Table 8.2.

8.3 Communications Programme

The Communications Programme required by Condition 2.4.1 of the waste licence, was established three months before the start of waste activities and has been submitted to the Agency.

Table 8.1 Progress Report on Schedule of Objectives and Targets for 2009

Ref.	Objective	Aspect	Target	Responsibility	Progress
1	Gas Management	1. Generation of LFG 7. Release of LFG	Hold Gas Management meetings every 6 months to review existing infrastructure and discuss maintenance and upgrading as required.	AM/GM	2 meetings were held in 2009
2	Leachate Management	2. Generation of leachate	Continue to monitor and control leachate through quarterly leachate quality monitoring and weekly leachate level checks.	GM	On-going.
			Submit proposals for recirculation of leachate to the EPA for their approval.	GM	SEW submitted and approved for leachate recirculalation infrastructure.
			Implement recirculation of leachate at the landfill and continually assess and upgrade infrastructure as necessary.	GM	Leachate recirculation infrastructure installed in partial permanent capping in Cells 1 - 4.
			Assess the potential for alternatives outlets for leachate, e.g. Anaerobic Digestion	GM	On-going
3	Landscaping	4. Generation of GHG's 14. Emissions to air 17. Visual Impact	Maintain and continue to improve all on site landscaping and the wetland area.	GM	On-going
			Employ a landscape contractor to assess plantations, replace failed trees/plants and improve the overall general appearance of the landfill site.	GM	On-going

4	Public Relations	5/9/12. Generation of dust 6. Birds/vermin/flies 7. Release of LFG 8/13. Litter 16/18.Noise 17. Visual Impact	Review relationships with neighbours and interested parties on a continual basis and produce annual public relations report.	AM/GM	On-going
			Review the number and composition of complaints to determine any trends.	GM	Carried out quarterly
			Establish a newsletter for distribution to local people at regular intervals.	GM	Newsletter Issue 2 and 3 circulated during 2009
			Continue to hold regular meetings with local residents.	AM/GM	Scheduled meetings are held quarterly.
5	Education and Environmental Awareness	5/9/12. Generation of dust 6. Birds/vermin/flies 7. Release of LFG 8/13. Litter 16/18.Noise 17. Visual Impact	Actively encourage site visits from interested parties i.e. local community groups, schools, clubs, etc.	AM	One local school site visit and two Open Days were held in 2009.
			Continue to provide sponsorship of interested local parties, clubs, etc.	GM	On-going
			Keep Public Information Room updated and current.	AM	On-going
6	Reduce energy usage on site	3/10/15. Use of energy 4. Generation of GHG's	Carry out an annual review of energy usage	AM/GM	Energy usage reviewed quarterly and annually.
			Employ an energy consultant to carry out a follow up energy audit and report every 3 years	GM	Scheduled for 2010
			Prepare an Energy Policy Statement for the site.	AM/ GM	Prepared Dec 2008
			Implement an Energy Awareness Programme incorporating the recommendations from the 2007 energy audit.	AM/ GM	Awareness programme is on-going

Table 8.2 Schedule of Objectives and Targets for 2010

Ref.	Objective	Aspect	Target	Deadline	Responsibility
1	Gas Management	1. Generation of LFG 7. Release of LFG	Hold Gas Management meetings every 6 months to review existing infrastructure and discuss maintenance and upgrading as required.	On-going	AM/GM
2	Leachate Management	2. Generation of leachate	Continue to monitor and control leachate through quarterly leachate quality monitoring and weekly leachate level checks.	Weekly, Quarterly On-going	GM
			Implement recirculation of leachate at the landfill.	When final capping sufficient	GM
			Continually assess and upgrade infrastructure as necessary.	Continually	GM
			Assess the potential for alternatives outlets for leachate, e.g. Anaerobic Digestion	2011/2012	Donal Monaghan
3	Landscaping	4. Generation of GHG's 14. Emissions to air 17. Visual Impact	Maintain and continue to improve all on site landscaping and the wetland area.	On-going	GM
			Employ a landscape contractor to assess plantations, replace failed trees/plants and improve the overall general appearance of the landfill site.	On-going (seasonal)	GM
4	Public Relations	5/9/12. Generation of dust 6. Birds/vermin/flies 7. Release of LFG 8/13. Litter 16/18.Noise 17. Visual Impact	Review relationships with neighbours and interested parties on a continual basis and review communications programme annually.	Annually and on-going	AM
			Review the number and composition of complaints to determine any trends.	Monthly	AM/GM
			Establish a newsletter for distribution to local people at regular intervals.	On-going bi-annual publication	AM
			Continue to hold regular meetings with local residents.	Quarterly On-going	AM/ GM

5	Education and Environmental Awareness	5/9/12. Generation of dust 6. Birds/vermin/flies 7. Release of LFG 8/13. Litter 16/18.Noise 17. Visual Impact	Actively encourage site visits from interested parties i.e. local community groups, schools, clubs, etc.	On-going	AM
			Continue to provide sponsorship of interested local parties, clubs, etc.	On-going	AM/GM
			Keep Public Information Room updated and current.	On-going	AM
			Organise Open Day for 2010	Quarter 2/3	AM/GM
6	Reduce energy usage on site	3/10/15. Use of energy 4. Generation of GHG's	Carry out an annual review of energy usage	Annually On-going	AM/GM
			Employ an energy consultant to carry out a follow up energy audit and report every 3 years	June 2010	GM
			Implement an Energy Awareness Programme incorporating the recommendations from the 2007 energy audit.	Ongoing	AM/ GM
			Implement a review of energy consumed versus energy generated on site.	September 2010	AM

9. OTHER REPORTS

9.1 Financial Provision

Greenstar has accrued sufficient funds, to provide for any potential environmental liabilities at this facility. Greenstar also has adequate insurance cover for environmental liabilities to €10,000,000 for any one occurrence, which will apply to "sudden identifiable and unintended incidents".

A financial guarantee, as required by condition 12.2.2 of the Waste Licence was in place during 2008. The guarantee was renewed in December 2008 and is now valid until December 2009.

Condition 12.3 of the waste licence states that *"In accordance with the provisions of Section 53A of the Waste Management Acts 1996 to 2010 the licensee shall ensure the costs involved in the setting up and operation of the facility, as well as the costs of closure and after-care (including cost of provision of financial security) for a period of at least 30 years (post closure) shall be covered by the price to be charged for the disposal of waste at the facility. The statement required under Section 53A(5) of said Acts is to be included as part of the AER"*. In relation to this matter Greenstar can confirm that the gate fee for the disposal of waste at the Knockharley Residual Landfill is appropriate in the current market and includes financial provision for the closure, restoration and aftercare of the site.

9.2 Landscape Programme

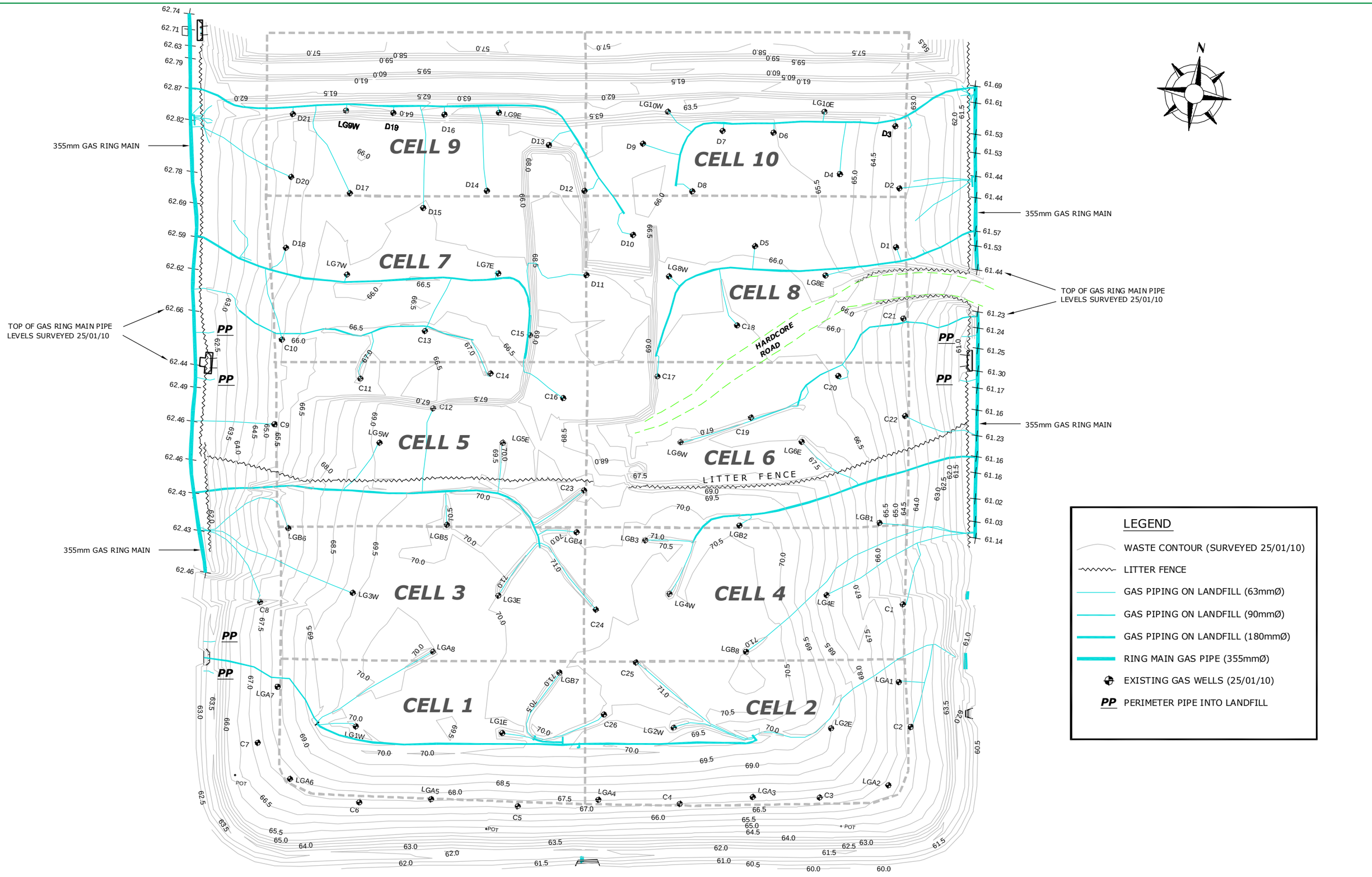
The planting programme was initiated in 2004 and completed in 2005. Approximately 180,000 trees have been planted over 112 acres. Greenstar submitted a landscape proposal to the Planning Authority in December 2002 and to the Agency in March 2005. It is estimated that up to 97% of all trees planted have established. There is approximately a 3% die-back rate at the facility.

9.3 European Pollutant Release and Transfer Register

Under the European Pollutant Release and Transfer Register Regulation (EC) No. 166/2006 Greenstar are required to submit information annually to the Agency. A copy of the information submitted to the Agency via the web-based data reporting system is included in Appendix 7.

APPENDIX 1

Topographic Survey



Golder Associates
TOWN CENTRE HOUSE, DUBLIN ROAD, NAAS, CO. KILDARE
TEL.: 045 874411 - FAX:045 874549 - www.golder.com

Client: greenstar	Title: WASTE CONDITIONS & EXISTING GAS WELLS AS SURVEYED 25/01/2010			Project number 09.50719.0114	Drawing W-S 14/1
Location: KNOCKHARLEY LANDFILL CO. MEATH				File Location GREENSTAR/KNOCKHARLEY/GOLDER DWGS/ WASTE SURVEYS/WS-14-01	
Project: ANNUAL WASTE VOID VOLUME SURVEY	Scale 1:750 A1 1:1,500 A3	Created by POB	Engineer CC	Reviewed by CC	ORDNANCE SURVEY IRELAND LICENCE NUMBER **AR0056010**

Issue to	Date	Version
TO CLIENT	Jan. '10	A

APPENDIX 2

Monitoring Results 2009

Biological Assessment of Kentstown Stream and Nanny River

Knockharley Landfill (146-1)

Annual Report 2009

Prepared on behalf of

O'Callaghan Moran & Associates
Granary House
Rutland Street
Cork

29th May 2009

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INTRODUCTION

This report details a biological assessment undertaken on watercourses in the vicinity of Knockharley Landfill (EPA Waste License Registration Number 146-1), Co Meath. This assessment was undertaken as per Condition 8.11 of the license. The scope, content and details of the contractor carrying out the assessment were previously submitted to the Agency for its approval. Samples were taken on 25th May 2009. The assessment was undertaken on behalf of O' Callaghan Moran & Associates by Ecofact Environmental Consultants Ltd.

METHODS

Benthic, or bottom dwelling, macro-invertebrates were sampled qualitatively at the four sites using kick-sampling (Abel, 1996) on the 25th May 2009. This procedure involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the river bed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute in order to dislodge invertebrates, which were subsequently caught in the net. This procedure was undertaken at three points located at equal distances across the watercourse, where depth allowed. Stone washings and vegetation sweeps were also undertaken to ensure a representative sample of the fauna present at each site was collected. All samples of invertebrates were combined for each site and live sorted on the river bank for 20 minutes with the assistance of a headband magnifier. Specimens were fixed in a 10% formalin solution. Identification was undertaken in the laboratory using high-power and low-power binocular microscopes.

Specimens were identified using the keys produced by the Freshwater Biological Association. These keys included Elliott & Humpesch (1988) for mayflies, Edington & Hildrew (1995) and Wallace *et al* (2003) for caddis fly larvae, Gledhill *et al* (1993) for crustaceans, Macan (1994) for snails, Savage (1989, 1999) for bugs and Elliott & Mann (1979) for leeches. The relative abundance of invertebrates in samples was described as follows:

- Present (1 or 2 individuals);
- Scarce/Few (<1%);
- Small Numbers (<5%);
- Fair Numbers (5-10%);
- Common (10-20%);
- Numerous (25-50%);
- Dominant (50-75%);
- Excessive (>75%)

The Quality Rating (Q) System (Toner *et al*, 2005) was used to obtain a water quality rating for each site. The use of this particular biotic index allows the comparison with data published by the EPA. This method categorizes invertebrates into one of five groups, depending on their sensitivity to pollution. The higher the biological diversity and the greater the abundance of invertebrate species sensitive to organic pollution, the higher the water quality is assumed to be, and the higher the 'Q value' assigned to that sampling station. Further details on the Q-rating system are provided in Appendix 1.

The Small Stream Risk Score (SSRS) also used in the current assessment. This system was devised by the EPA as a biological monitoring tool for first and second order streams as part of the Water Framework Monitoring Programme. This system does not define the status of a stream but is a risk assessment (Walsh, 2005). The SSRS was developed based on presence of indicator mayfly species, stonefly species, caddis fly larvae and the overall abundance of Gastropods, Oligochaetes and Dipteran larvae and *Asellus*. It is believed to be an efficient indicator of pollution risk from either point or diffuse sources in small streams. The index categorises streams into three risk groups: at risk, probably at risk and not at risk according to the score it attains where > 8 = probably not at risk, 6.5-8 = probably at risk, and < 6.5 = at risk.

Site Locations

In Table 1 and Figure 1 the location of the four sites investigated is given. Two sites were located on the Knockharley stream, which flows at the boundary of the landfill facility and two sites were located on the River Nanny which is the largest local watercourse. The two sites on the Knockharley Stream were located upstream and downstream of the landfill facility, while the two sites on the River Nanny were located upstream and downstream of the confluence of the Knockharley stream. Site photographs are provided in Plates 1-4.

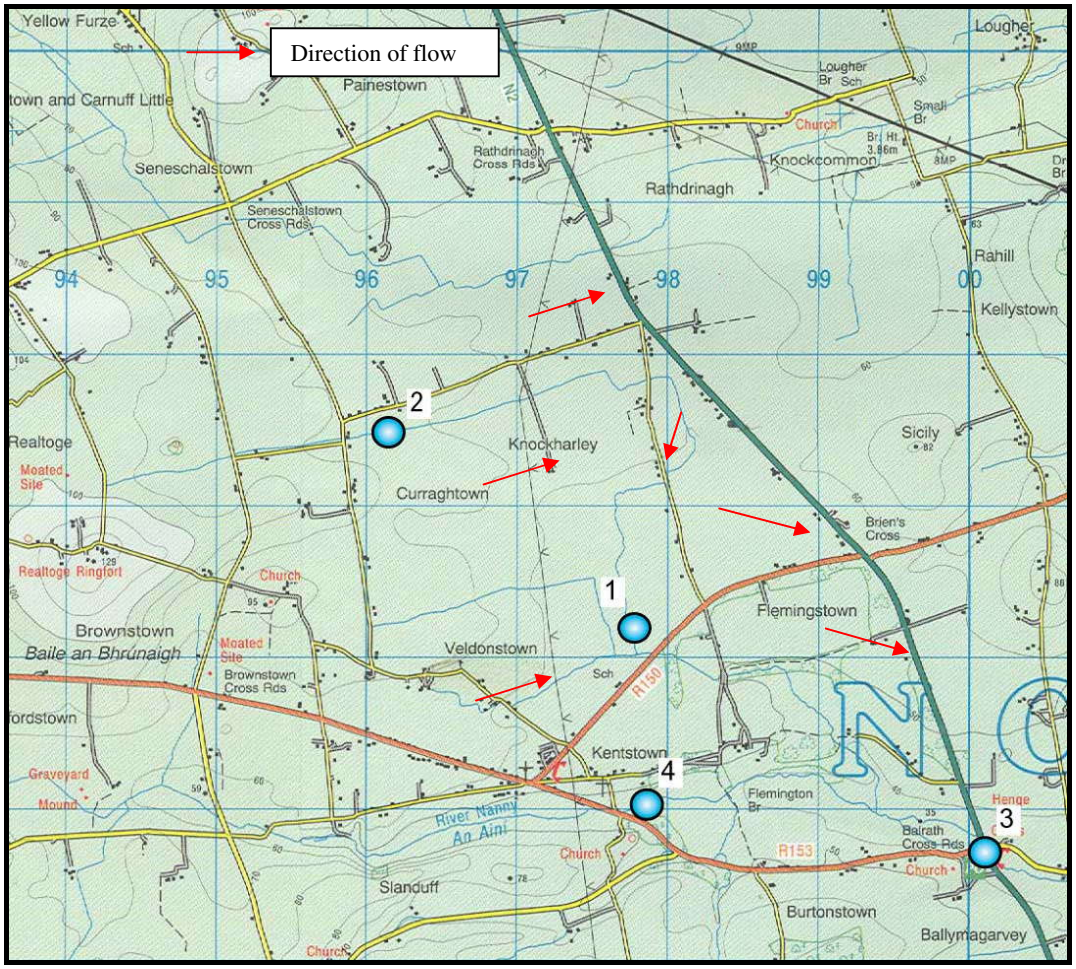

Figure 1 Location of the four biological assessment sites (O.S License Agreement Number AR0038702, Ordnance Survey Ireland, Government of Ireland).

RESULTS

The physical characteristics of the survey sites are given in Table 2. The results of the biological assessments are given in Table 3. Common names of invertebrate species or groups are given where they are available. Table 4 provides the derived water quality ratings for the four sites investigated for the current survey and the surveys undertaken by Ecofact in previous years. The results from the individual sites are discussed below.

As part of its rollover assessment of water quality in Irish rivers, the EPA (and their predecessors) has assessed water quality in the River Nanny since 1971 (Toner *et al*, 2005). The Knockharley stream is not assessed by the EPA, due presumably to its small size. The results of the EPA Biological Water Quality Assessments of the River Nanny during the period 1971-2005 are given in Appendix 2. An EPA assessment of the River Nanny is also provided in this Appendix.

Site 1 Knockharley Stream (receptor)

Site 1 was located on the Knockharley Stream, less than 1 km downstream of the landfill facility (Plate 2). This part of the stream was approximately 1.1 m wide and banks of approximately 50 cm in height. The stream was modified, having been deepened and channelized. The substrate was dominated by finer substrates (gravel and silt) and was mostly riffles (60%). Like the previous survey undertaken by Ecofact (Ecofact, 2008) the site appeared fairly clean, with no apparent filamentous algal growths. There was some silt recorded at the verges of the stream however.

A total of 14 different macroinvertebrate families were recorded. Cased trichopteran/caddisfly larvae, (Group B less sensitive indicators) were the most diverse group with fair numbers of larvae of the little black caddisfly *Agapetus fuscipes* and Goeridae (undergoing metamorphosis). Small numbers of larvae of the black caperer *Sericostoma personatum* while larvae of the northern caddisflies *Drusus annulatus* (scarce) and *Potamophylax latipennis* (present) were also recorded. Group C pollution tolerant caseless larvae of the trumpet-net caddisfly *Plectronemia conspersa* were present. The only mayfly recorded at this site was the large dark olive *Baetis rhodani* at larval stage, which was numerous. Small numbers of blackfly larvae (Group C) and pollution tolerant (Group D) hog louse *Asellus aquaticus*, flatworms and leech *Glossiphonia complanata* were recorded. The freshwater shrimp *Gammarus deubeni* was common. Oligochaeta (aquatic earthworms) were scarce at this site while the parasitic fish leech *Piscicola geometra* was present.

The dissolved oxygen (D.O.) concentration at this site was found to be 83.7% at the time of the survey. The community was largely composed of pollution tolerant organisms. Applying EPA biological monitoring criteria (Toner *et al*., 2005), this stretch of the Knockharley Stream was deemed to be 'Moderately Polluted (Q3)'. This corresponds to 'Poor Status' in the Draft European Communities Environmental Objectives (Surface Waters) Regulations 2008 (DOEHLG, 2008). This is due to the absence of Group A indicators and the relative abundances of the other pollution indicator groups. Using the Small Streams Risk Score (SRSS) (Walsh, 2005), this stretch of site had a score of 4 and therefore considered to be 'at risk'.

Table 1 Location and selected water quality characteristics of the four aquatic survey sites.

Site	**1**	**2**	**3**	**4**
Location	Downstream receptor site on the Knockharley Stream	Upstream control site on the Knockharley Stream	Downstream receptor site (Corresponds with EPA site 08/N/01/0200) on the River Nanny	Upstream control site (Corresponds with EPA site 08/N/01/0110) on the River Nanny
Temp (^{0}C)	13.7	12.7	13	12.8

Table 3 Results of the May 2009 biological assessment of the Knockharley Stream and River Nanny.

Organism	Pollution sensitivity group	Functional group	Site			
			1	2	3	4
MAYFLIES (Uniramia, Ephemeroptera)						
Family Heptagenidae						
Ecdyonurus sp.	A	SG collector			****	
Baetidae						
Large dark olive *Baetis rhodani*	C	SG Collector	******	******	******	******
White midges (Caenidae)						
Caenis robusta	C	Gathering collector			*	
CASED CADDIS FLIES (Tricoptera)						

Site 2 Knockharley Stream (control)

Site 2 was the control site on the Knockharley Stream. This site was located approximately 1 km upstream of the landfill facility. The Knockharley stream at this site was approximately 1 m wide and had a mean depth of 10 cm. This section of stream had been deepened and channelized in the past but it has recovered well. The banks had approximately 85% vegetation cover and the substrate consisted of rock (5%), cobbles (15%), gravel (65%) and fine (15%). The stretch of stream surveyed comprised mainly of riffled habitat.

Macroinvertebrates in 10 different families were recorded at this site. Larvae of the Group C pollution tolerant mayfly *Baetis rhodani* was numerous while Group B cased northern caddisfly larvae of *Potamophylax latipennnis* and *Drusus annulatus* were both present. Pollution tolerant (Group C) true fly larvae were the best represented group with four taxa recorded; small numbers of green chironomid and *Dicranota sp.*, blackfly scarce and cranefly larvae of Tipulidae (indeterminate species) present. The freshwater shrimp and hog louse were numerous and scare, respectively. Very tolerant Group D leeches were generally recorded in small numbers with *Erpobdella octoculata, Glossiphonia complanata* and *Helobdella stagnalis* occurring.

The dissolved oxygen (D.O.) at this site was recorded as 87.9 % and there was no silt observed in the stream. Using the EPA freshwater biological monitoring system this site was rated as 'Moderately Polluted (Q3)', 'Poor Status'. With an SSR score of 3.2, this part of the stream is considered to be 'at risk'.

Site 3 River Nanny (receptor)

This site was located approximately 0.6 km downstream of the Knockharley stream confluence (Plate 3). This section of the Nanny has been deepened in the past with banks of approximately 1 meter high. The section surveyed had a mean wetted width of 3.5 m and had maximum depth of 70cm. Water levels were normal at the time of the survey. The substrate consisted of rock, cobble, gravel and fine in the order 15%, 30%, 35% and 20%, respectively. Indeed, this stretch of river was noticeably silted in the depositing reaches with a layer of silt on submerged aquatic vegetation and rocks.

European eel *Anguilla anguilla* and three-spined stickleback *Gasterosteus aculeatus* were recorded while sweep sampling at this site. This site had a diverse macro-invertebrate community with 16 different families recorded. Freshwater shrimp *Gammaurs deubeni* were dominant. Three mayfly taxa were recorded; Group A *Ecdyonurus sp.* in fair numbers, Group C *Baetis rhodani* in fair numbers and Group C *Caenis robusta* was present. Trichopterans were the best represented group with a total of four families occurring at larval stage. Cased Group B (less sensitive) Limnephilidae and *Agapetus fuscipes* were found in fair numbers with *Sericostoma personatum* scarce. Caseless Group C caddisfly larvae of the grey flag *Hydropsyche angustipennis* were common. Blackfly and Tipulid larvae were common and scarce, respectively. Fair numbers of each of river limpet *Ancylus fluviatilis* (Group C), hog louse (Group D) and aquatic earthworm (Group D) was recorded. Small numbers of adult riffle beetle *Elmis sp.* were recorded with larvae of the riffle beetle *Limnius sp.* present. A diving beetle in sub family Colymbetinae was present. The leeches *Erpobdella octoculata* and *Glossiphonia complanata* were scarce and present, in that order.

With the relative abundances of the different sensitivity groups recorded at this site, this stretch of the river was rated as 'Moderately polluted (Q3)', 'Poor Status'. A Small Stream Risk Score (SSRS) of 6.4 was calculated for this site. This implies that this stretch of stream is 'at risk'.

Site 4 River Nanny (control)

This site was located on the River Nanny approximately 1.5 km upstream of the Knockharley stream confluence. The section surveyed had a mean wetted width of approximately 2 m and a mean depth of

25 cm. There were considerable silt deposits in the pools along this section. This section of the stream is becoming increasingly shaded with bankside trees growing in size.

In addition to European eel, macroinvertebrates in 15 different families were recorded at this site. Pollution tolerant larvae of mayfly *Baetis rhodani* were numerous. Larvae of the Group B northern caddisflies *Drusus annulatus* and *Potamophylax latipennnis* were scarce while larval *Agapetus fuscipes* were common. Small numbers of larvae of the pollution tolerant trumpet-net caddisfly *Plectronemia conspersa* were recorded while the sandfly *Rhyacophila dorsalis* was scarce. Pollution tolerant true fly larvae (green chironomid, blackfly and *Dicranota sp.*) were generally scarce. Group C freshwater shrimp were numerous with another crustacean, the Group D hog louse being common. Fair numbers of the river limpet, a pollution tolerant snail were recorded. Small numbers of water crickets (Vellidae) and *Elmis sp.* riffles beetles were recorded while very pollution tolerant aquatic earthworms and leech *Erpobdella octoculata* were recorded.

Using EPA freshwater biological monitoring criteria, this stretch of river was deemed to be 'Slightly Polluted (Q3-4)', 'Moderate Status'. Siltation is suspected to be a significant factor in lowering biological water quality at this site. This site was rated 'Moderate Status' due to siltation but is considered to be close to the 'Good-Moderate Status' boundary due to the relative abundance of pollution sensitive Heptagenid mayfly larvae. The SSRS for this site was calculated to be 4 meaning that this part of the river is in the 'at risk' category.

Table 4 Water quality ratings of the four sites investigated during the current survey. Results of the previous biological assessments of the Knockharley Stream and the River Nanny are also provided.

	Site 1	**Site 2**	**Site 3**	**Site 4**
Q-value 2009	3	3	3-4	3
Q-value 2008	3	2	3	3-4

larvae were recorded in the current survey but not in 2008. Conversely, Group D snails were not recorded in the current survey but were recorded in 2008. The change in composition of the macroinvertebrate community probably coincides with a decrease in instream siltation (significant in 2008 but not recorded in 2009). The SSRS has risen from 0 in the previous 2008 assessment to 3.2 (2009). This corresponds to Q-values of Q2 (Bad Status) and Q3 (Poor Status) in 2008 and 2009, respectively.

The Q-ratings of the reference and receptor site on the Knockharley Stream between 2004 and 2006 were comparable, with the receptor site generally slightly more polluted than the reference site, as evident from Q values comparisons. Since 2007, there has been inconsistency in biological water quality between the reference and receptor sites. It appears as though biological water quality at both sites has improved over the July 2008 – May 2009 with the receptor site improving significantly since 2007.

River Nanny

Both sites on the River Nanny changed significantly since the survey carried out in July 2008, with deterioration in biological water quality at the reference site (Site 3) and an improvement at the receptor site (Site 4). The reference site on the River Nanny was rated 'Slightly Polluted (Q3-4)', Moderate Status in 2008 and had an SSRS of 6.4 (at risk). Biological water quality in the current assessment was rated 'Moderately Polluted (Q3)', 'Poor Status' and scored 4 on the SSRS scale. This decline in water quality was due to the emergence of very tolerant Group D hog louse *Asellus aquaticus* and the 'disappearance' of grey flag *Hydropsyche angustipennis*. This change in water quality could be attributed in part to siltation, to which the latter invertebrate is sensitive. Furthermore, larvae of the blue-winged olive mayfly *Ephemerella ignita* and the Group B cased caddisfly *Sericostoma personatum* were recorded in 2008 and but not in 2009.

The receptor site (Site 3) on the River Nanny was considered less silted than in the previous survey and once more had the richest macro-invertebrate assemblage of the four sites investigated. This is also the largest stream site in the survey so this would be an expected result. Pollution sensitive Group A Heptagenid mayfly larvae of *Ecdyonurus sp.* and larvae of the grey flag caseless caddisfly were recorded in the current survey and also in 2007 but not in 2008. This site was rated 'Slightly Polluted (Q3-4)', 'Moderate Status' in the current survey, an improvement since the previous year when it was rated 'Moderately Polluted (Q3)'. The SSRS also increased from 4.8 in 2008 to 6.4 in 2009. The more recent score of 6.4 is near the 'at risk / probably at risk' threshold of 6.5.

EPA results

The most recent EPA monitoring for which results are available took place in 2005. EPA report noted that the River Nanny was in a most unsatisfactory state (Moderately Polluted) when surveyed in May 2005 (www.epa.ie). The nearest EPA station on the River Nanny upstream of the study area is at the east bridge in Kentstown (EPA site code 08/N/01/0110) when water quality was Q2-3 in 2005. It was noted that '*the substratum there at Kentstown (0110) was very heavily silted with deep banks of mud at the sides*'.

The Bridge downstream of Nanny Bridge (EPA site code 08/N/01/0280) is the nearest EPA biological monitoring station downstream of the study area and was rated Q4 in 2005. This site is approximately 3 km downstream of the River Nanny receptor site (Site 3) and may have changed since 2005.

CONCLUSIONS

There is a history of 'Unsatisfactory' biological water quality in the River Nanny with siltation quoted by the EPA as a likely factor influencing water quality the Kentstown region in 2005. The upper reaches of the river are particularly impacted with the four EPA monitoring stations from Kentstown upstream not achieving more than 'Poor' status since monitoring began in 1988.

Based on the assessments carried out by Ecofact (2004-2008), biological water quality at the receptor site on the Knockharley Stream (Site 1) improved from 'Moderately Polluted (Q2-3) from 2004-2007, to 'Moderately Polluted (Q3)' in 2008 and 2009. Improvement in biological water quality at the reference site on the Knockharley has coincided with an improvement at the receptor site between 2008 and 2009, following unparalleled changes (deterioration) at the reference between 2005 (Q3) and 2006 (Q2-3).

Biological water quality at the receptor site on the River Nanny (Site 3) has also improved recently. Since 2007 / 2008 there was a marked improvement in water quality with status rising from 'Poor' in 2008 to 'Moderate' in 2009. Biological water quality at the reference site on the River Nanny has declined from 'Moderate Status' in 2008 to 'Poor Status' in 2009. Pollution episodes, or more likely, long term diffuse pollutants (runoff from agricultural land and sediments from tilled land) are likely to be influencing biological water quality in this upper reach of the River Nanny. The River Nanny reference site is approximately 2.3 km upstream of the receptor site. Probably due to natural recovery process that takes place in rivers, the receptor site appears to be less affected by pollutants entering the river upstream of the reference site. A second order stream joins the River Nanny at Flemingstown, between the reference site and the receptor site. Perhaps dilution from this stream also influences water quality at the receptor site on the River Nanny.

From the current and previous assessments, any impacts from the Knockharley landfill site on watercourses draining the Knockharley landfill area are not currently detectible in the macroinvertebrate communities. In fact, biological water quality has improved downstream of the Knockharley landfill on both the Knockharley Stream and the River Nanny over the study period to date.

Plates (2009 survey)

Plate 1 Knockharley Stream downstream receptor site (Site 1).

Plate 2 Knockharley Stream upstream control site (Site 2).

Plate 3 River Nanny downstream receptor site (Site 3).

Plate 4 River Nanny upstream control site (Site 4).

Plate 5 Larvae of the pollution sensitive Heptagenid mayfly *Ecdyonurus sp.* was recorded at the River Nanny receptor site.

Plate 6 Larvae of the Group B northern caddisfly *Halesus digitatus* with its case

Plate 7 Pollution tolerant freshwater shrimp *Gammarus deubeni*

Plate 8 Very tolerant (Group D) Hog louse *Asellus aquaticus*

Plate 9 European eel *Anguilla anguilla* was present at both sites on the River Nanny.

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Appendix 1 EPA River Quality Classification Scheme

The Q values are a measure of the EPA's Biological River Quality classification system. The EPA conducts a rolling programme of biological surveys of selected rivers. The higher the biological diversity and the greater the abundance of invertebrate species sensitive to organic pollution, the higher the water quality is assumed to be, and the higher the 'Q value' assigned to that sampling station. The EPA's water quality classification systems are summarized below:

Table 1.1 Biological River Quality Classification and River Water Quality Class System (McGarrigle *et al* 2002).

'Q' value	Community Diversity	Water Quality	Condition*	Status	Quality
Q5	High	Good	Satisfactory	Unpolluted	Class A
Q4	Reduced	Fair	Satisfactory	Unpolluted	Class A
Q3	Much Reduced	Doubtful	Unsatisfactory	Slightly Polluted	Class B
Q2	Low	Poor	Unsatisfactory	Moderately Polluted	Class C
Q1	Very Low	Bad	Unsatisfactory	Seriously Polluted	Class D

* 'Condition' refers to the likelihood of interference with beneficial or potential beneficial use.

Class A waters are those in which problems relating to existing or potential uses are unlikely to arise. They are therefore regarded as being in a 'satisfactory' condition. Classes B, C and D are to a lesser or greater extent 'unsatisfactory' in this regard. For example, the main characteristics of Class B and C waters is eutrophication, which may interfere with the amenity, abstraction or fisheries uses of such waters. The general characteristics of waters of the various Biological Quality Classes are provided in Table A1.2.

Table A1.2 The general characteristics of waters of the various Biological Quality Classes.

Quality Classes	Class A		Class B	Class C	Class D	
Quality Ratings	Q5	Q4	Q3-4	Q3	Q2	Q1

Appendix 2 EPA Water Quality Data for the River Nanny

Overall water quality results from the Nanny catchment - EPA hydrometric area 08. The surveyed channel length is shown in km with the four corresponding biological quality classes - A - Unpolluted, B - Slightly polluted / eutrophic, C - Moderately polluted and D - Seriously polluted. Data is taken from EPA biological surveys during the year 2005 (adapted from Clabby *et al* 2008).

Catchment	Class A	Class B	Class C	Class D	Total (km)
Nanny (km)	6.5	12	9.5	0	28
Nanny (%)	23	43	34	0	100

Biological Quality Ratings (Q values) from the River Nanny (EPA code 08/N/01). Taken from Toner *et al*, 2005, with 2005 results and assessment downloaded from the EPA website www.epa.ie.

Station No.	1971	1974	1978	1980	1982	1986	1988	1991	1996	1998	2001	2005
0040	-	-	-	-	-	-	-	-	2-3	2-3	2	2-3
0090	-	-	-	-	-	-	2-3	2-3	-	-	-	-
0100	-	-	-	-	-	-	-	-	-	-	-	-
0110	-	-	-	-	-	-	3	3	3	2-3	2-3	2-3
0200	-	-	-	3-4	2-3	3	3-4	3-4	-	-	-	-
0280	-	-	-	-	-	-	3	3	3	3-4	3-4	4
0300	5	4-5	3-4	3	1-2	2	-	3	-	-	-	-
0400	4-5	3-4	4	3-4	4	3-4	2-3	3	-	-	-	-
0500	3	1-2	3	3	3-4	3-4	3	3-4	3	3-4	3-4	3-4
0600	-	-	-	3-4	3	3-4	3	-	-	-	-	-
0650	-	-	-	-	-	3-4	3-4	3-4	4	4	3	-
0700	4	3-4	3	3	3-4	3-4	3-4	3	3-4	3-4	3	3-4

Station No.	Location	Station No.	Location
0040	Folistown Br	0300	Bridge near Deenes
0090	East Bridge, S. of Brownstown	0400	Upstream Bridge, Duleek
0100	West Br Kentstown	0500	Bridge N.E. of Bellewstown Ho
0110	East Bridge, Kentstown	0600	Beaumont Bridge
0200	Br just S. of Balrath X-Roads	0650	Dardistown Bridge
0280	Bridge d/s Nanny Bridge	0700	Bridge at Julianstown

EPA Assessment of the River Nanny: *Despite slight improvements at three locations (0040, 0280 and 0700) the Nanny was in a mostly unsatisfactory quality condition when surveyed in May 2005. Just one location (0280) could be regarded as satisfactory as regards macroinvertebrate composition but the high Dissolved Oxygen reading recorded there (134%) indicated some enrichment also. The upper river was no longer seriously polluted at Folistown Bridge (0040) but the substratum there and also downstream at Kentstown (0110) was very heavily silted with deep banks of mud at the sides. As indicated by luxuriant algal crops and considerable bottom siltation at Bellewstown (0500) and Julianstown (0700) the lower river continued to be impacted by eutrophication and possibly land disturbance.*

	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Emission Limit ($mg/m^2/day$)
	34 Days	30 Days	28 Days	30 Days	31 Days	30 Days	28 Days	31 Days	29 Days	32 Days	29 Days	32 Days	
D1	74	**	68	*	*	*	55	14	97	31.7	124	9	350
D2	86	67	46	206	*	81	36	23	83	34.2	78	25.5	350
D3	16	<10	156	99	116	99	17	21	143	37.2	79	19.9	350
D4	19	<10	49	114	82	68	12	9	74	35.7	96	9.5	350
D5	54	<10	133	121	100	*	*	15	93	60.3	98	13.7	350
D6	88	*	104	219	*	101	*	143	47	*	28	20.8	350
D7	13	**	57	90	*	*	38	*	90	37.2	47	39.2	350
D8	47	28	135	163	96	110	106	108	91	67.8	87	75.2	350

* Contaminated with bird excrement
** Containers broken in transit

Perimeter Landfill Gas Results

Sample Station Number	CH_4 (% v/v) 08/01/2009	CH_4 (% v/v) 10/02/2009	CH_4 (% v/v) 11/03/2009	CH_4 (% v/v) 22/04/2009	CH_4 (% v/v) 25/05/2009	CH_4 (% v/v) 30/06/2009	CH_4 (% v/v) 29/07/2009	CH_4 (% v/v) 28/08/2009	CH_4 (% v/v) 30/09/2009	CH_4 (% v/v) 30/10/2009	CH_4 (% v/v) 31/11/2009	CH_4 (% v/v) 15/12/2009
LG-01	0	0	0	0	0	0	0	0	0	0	0	0
LG-02	0	0	0	0	0	0	0	0	0	0	0	0
LG-03	0	0	0	0	0	0	0	0	0	0	0	0
LG-04	0	0	0	0	0	0	0	0	0	0	1	0.2
LG-05	0	0	0	0	0	0	0	0	0	0	0.2	0
LG-06	0	0	0	0	0	0	0	0	0	0	0.1	0
LG-07	0	0	0	0	0	0	0	0	0	0	0	0
LG-08	0	0	0	0	0	0	0	0	0	0	0	0
LG-09	0	0	0	0	0	0	0	0	0	0	0	0
LG-10	0	0	0	0	0	0	0	0	0	0	0	0
LG-11	0	0	0	0	0	0	0	0	0	0	*	*
LG-12	0	0	0	0	0	0	0	0	0	0	*	*
LG-13	0	0	0	0	0	0	0	0	0	0	*	*
LG-14	0	0	0	0	0	0	0	0	0	0	0	0
LG-15	0	0	0	0	0	0	0	0	0	0	0	0
LG-16	0	0	0	0	0	0	0	0	0	0	0	0
LG-17	0	0	0	0	0	0	0	0	0	0	0	0
LG-18	0	0	0	0	0	0	0	0	0	0	0	0
LG-19	0	0	0	0	0	0	0	0	0	0	0	0
LG-20	0	0	0	0	0	0	0	0	0	0	0	0
LG-21	0	0	0	0	0	0	0	0	0	0	0	0
LG-22	0	0	0	0	0	0	0	0	0	0	0	0
LG-23	0	0	0	0	0	0	0	0	0	0	0	0
LG-24	0	0	0	0	0	0	0	0	0	0	0	0
LG-25	0	0	0	0	0	0	0	0	0	0	0	0
LG-50	1.3	0	1.4	0	0.2	0	2.6	3	2	0.1	0	0
LG-51	0	0	0	0	0	0	0	0	0	0	0	0.1
LG-52	0	0	0	0	0	0	0	0	0	0	0	0
LG-53	0	0	0	0	0	0	0	0	0	0	0	0
LG-54	0	0	0	0	0	0	0	0	0	0	0	0.1

*Denoted sample point not available due to engineering works

Perimeter Landfill Gas Results

Sample Station Number	CO_2 (% v/v) 08/01/2009	CO_2 (% v/v) 10/02/2009	CO_2 (% v/v) 11/03/2009	CO_2 (% v/v) 22/04/2009	CO_2 (% v/v) 25/05/2009	CO_2 (% v/v) 30/06/2009	CO_2 (% v/v) 29/07/2009	CO_2 (% v/v) 28/08/2009	CO_2 (% v/v) 30/09/2009	CO_2 (% v/v) 30/10/2009	CO_2 (% v/v) 31/11/2009	CO2 (% v/v) 15/12/2009
LG-01	0	5.7	5.2	4.9	5.5	7	6.8	7.5	6	9.4	8.9	4.7
LG-02	5.8	4	4.3	4.8	5.8	6.5	6.1	7.5	5	6.4	6.9	7.3
LG-03	1.7	0	0	0	3.5	0.2	0	0.2	0.1	0	0.1	5.7
LG-04	0	4.6	4.9	3.9	5.8	4.9	2.8	3.6	3.1	4.1	3.9	1.5
LG-05	0.8	0.3	0.7	0.7	0.3	1.4	0.3	0.2	0.2	0.5	1.3	1.7
LG-06	0.9	0.2	0.9	0.3	0.6	0.3	0.2	0.3	0.3	1	1.5	1.8
LG-07	0.3	2.3	2.4	1.4	1.2	1.1	1.1	0.9	0.9	1	2.4	2.9
LG-08	2.4	2.2	1.7	0.2	0.1	0.1	0	0.1	0.1	0.4	1.6	2.4
LG-09	0	1.1	0.6	0.1	0.3	0.1	0.1	0.1	0.1	0.3	0.9	1.1
LG-10	0.2	0	0.1	0	0	0	0	0	0	0.2	0.3	0.2
LG-11	0	0	0	0	0	0	0	0	0	0	*	*
LG-12	0.6	0	0.4	0.1	0	0	0	0	0	0	*	*
LG-13	0.4	0	0.2	0	0	0	0	0	0.2	0.4	*	*
LG-14	0.2	0	0.1	2.5	0.1	0.1	0	0.1	0.1	0.2	0.2	0.1
LG-15	0	0	2.3	0.4	2.4	6.1	5.6	5.1	2.9	2	2	2.7
LG-16	0	0.7	1.7	0	0.9	1.4	1.7	1	1.6	1.1	2.1	2.1
LG-17	0	0	1.1	0	0.6	0.1	0.2	0.3	1.1	1.1	1.3	1.8
LG-18	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1
LG-19	0.3	0	0.1	2.4	0	0	0	0	0	0	0.2	0.1
LG-20	2.2	0.5	2.4	0.1	2.3	2.6	3.1	4.8	4.5	3	3	3.1
LG-21	0.9	0.3	0.8	0	0	0	0.1	0.1	0.1	0.5	1.6	1.6
LG-22	0.5	0.8	0	1.1	0	0	0	0	0	1.7	0.4	0.4
LG-23	1.3	0.2	1	0.4	0.8	1.2	0.6	1.8	1.4	2.5	1.4	0.3
LG-24	1.5	0.9	1.2	0.2	0.4	0.2	0.3	0.7	0.1	1.8	1.4	1.6
LG-25	1.1	0.7	0.5	2.9	0.1	0	0	0.1	0.2	0.1	2.3	2.1
LG-50	3.3	1.6	1.3	4.4	1.7	6.1	2.1	2.9	2.9	1.8	3.6	2.2
LG-51	3.8	2.5	1.9	3.2	4.7	3.5	4.8	5.1	4	3.4	4.8	1.6
LG-52	2.9	2.8	3	3.7	3.1	4.7	4.4	4.7	4.6	4.7	4	4.6
LG-53	0.9	2.6	3.2	3.7	2.7	4.8	4.6	4.8	4.8	5.1	1.8	4.5
LG-54	3.1	2.3	2.5	4	1.5	3.3	2.5	3.4	4	3.6	0.9	2.3

*Denoted sample point not available due to engineering works

Perimeter Landfill Gas Results

Sample Station Number	O_2 (% v/v) 08/01/2009	O_2 (% v/v) 10/02/2009	O_2 (% v/v) 11/03/2009	O_2 (% v/v) 22/04/2009	O_2 (% v/v) 25/05/2009	O_2 (% v/v) 30/06/2009	O_2 (% v/v) 29/07/2009	O_2 (% v/v) 28/08/2009	O_2 (% v/v) 30/09/2009	O_2 (% v/v) 30/10/2009	O_2 (% v/v) 31/11/2009	O_2 (% v/v) 15/12/2009
LG-01	21.2	7	12.3	16.5	14.3	13	10.6	10	12.6	13.4	5.2	19.3
LG-02	3.8	8.1	6.8	6.5	4.1	6.2	8.6	9	14.1	19	10.6	9.7
LG-03	15.6	21.2	21.3	20.2	4.8	19.4	20.2	19.7	20	19.9	21.3	2.2
LG-04	21.1	14.9	14.8	14.7	14.5	14.6	15.9	17.1	18	14.4	10.6	20.1
LG-05	19.5	17.5	19.8	19.8	20.7	17.7	19.7	20.2	20	20.1	19.7	18.7
LG-06	19.4	18.6	19.7	19.7	20.7	19.7	20.1	20.2	20.4	19.8	19.3	18.2
LG-07	20.7	18.6	18.5	18.8	20	19.2	19.4	19.9	20	20.1	20.3	19.5
LG-08	14.5	13.7	17.9	19.9	21	19.8	20.3	20.4	20.6	19.9	19.8	18.6
LG-09	21	16.8	20.4	19.8	21	19.8	20.3	20.4	20.4	20.1	20.6	19.5
LG-10	21.1	21.1	21.1	19.9	21.2	19.8	20.4	20.6	20.1	20.4	21.3	20.9
LG-11	21.1	21	21.2	19.9	21.2	19.9	20.3	20.6	20.7	20.8	*	*
LG-12	20.5	21	20.9	19.8	21.1	19.8	20.1	20.6	20.6	20.7	*	*
LG-13	20.9	21.5	21	19.8	21.1	19.8	20.1	20.6	19.8	19.6	*	*
LG-14	21.1	21	21.1	19.8	21.1	20	20.1	20.7	20.4	19	21.2	20.9
LG-15	21.1	19	17.4	16.3	16.3	15.5	12.5	15.6	17.4	18.1	19.7	16.3
LG-16	21.1	21	17.9	19.2	20	19.3	18.4	19.3	19.1	19.2	19.5	19.4
LG-17	21	21	18.9	20	20.2	18.3	20.3	20.5	19.3	19.8	18.1	16
LG-18	21	21	21	20	20.9	18.4	20.6	20.9	20.3	20.1	21.2	21.1
LG-19	21	21	21	20	20.9	18.7	20.6	20.9	20.3	20.4	21.1	21
LG-20	18.3	19.5	17.6	17.3	17.1	17.1	16.1	15.2	15.8	17.2	16.6	15.9
LG-21	20.1	20	19.9	19.9	20.9	19.5	20.6	20.5	20.4	19.8	19.5	19.5
LG-22	20.8	21	21	20	21	19.6	20.8	20.5	20.6	18.7	20.7	21
LG-23	18.9	20	18.6	16.5	18.8	18.1	20.2	18.1	19.1	16.1	9.2	20.7
LG-24	19.5	21.3	19.8	19.9	20.8	19.4	20.5	20.2	20.2	18.9	19.9	19.5
LG-25	18	21	20.2	20.2	21	19.7	20.7	20.5	20.1	19.9	19.9	19.8
LG-50	9.7	12.8	12.2	9.5	15.4	6.9	12.7	10.9	11.1	11.2	8.9	13.9
LG-51	16.4	18	17.2	15.9	16.5	16.9	14.1	8.4	9.6	18.9	13.1	14.3
LG-52	19	19.5	19	18.1	18.9	16.4	16.9	17.3	17.9	16.5	19	18
LG-53	19.7	15.9	14.6	14	15.8	13	8.2	8.4	9.1	10.5	6.8	12.5
LG-54	16.4	18.3	17.3	14.8	20	16.5	17.9	17	16.8	9.7	16.9	16

*Denoted sample point not available due to engineering works

Footprint Landfill Gas Results

Sample Station Number	CH_4 (% v/v) 08/01/2009	CH_4 (% v/v) 10/02/2009	CH_4 (% v/v) 11/03/2009	CH_4 (% v/v) 22/04/2009	CH_4 (% v/v) 25/05/2009	CH_4 (% v/v) 30/06/2009	CH_4 (% v/v) 29/07/2009	CH_4 (% v/v) 28/08/2009	CH_4 (% v/v) 30/09/2009	CH_4 (% v/v) 30/10/2009	CH_4 (% v/v) 31/11/2009	CH_4 (% v/v) 15/12/2009
1E	53	39	53	55	51.8	53	42	12	60	58	30.6	12
1W	59	53	52	48	58.2	53	57	57	57	50	52.2	45.3
2E	45	40.5	65	54	60.4	48	49	48	56	52	37	41
2W	60	46	46.5	46	50.4	51	58	45	56	49	37	36
3E	68	47	53	45	60.8	51	45	40	57	51	42	36
3W	57	56	67	49	53.5	41	46	40	58	51	3.8	0
4E	54	14	16.5	23	24.8	20	21	25	54	52	6.4	62.2
4W	41.5	55	46	48	39.5	54	36	48	15	17	47.6	60.3
5E	67	39	53	58	44.6	57	45	44	44	46	48.9	47
5W	65	51	13.5	21	34.8	39	36	33	15	35	48.6	56.2
6E	69	-	58	49	48.2	48	40	46	54	54	44.6	57.8
6W	67	29	64	43	39.8	57	38	41	50	46	53.9	61.8
7E	-	-	-	38	45.1	54	33	52	43	41	42.6	51
7W	-	-	-	27	30.6	37	36	42	42	46	17.2	44
8E	-	-	-	51	53.1	48	49	56	54	54	35.8	38.6
8W	-	-	-	47	43.1	48	40	46	44	47	41.2	34.4
9E	-	-	-	-	-	-	-	0	40	43	30.3	30.5
9W	-	-	-	-	-	-	-	0	57	55	41.3	32.5
10E	-	-	-	-	-	-	-	44	36	55	39.2	34.7
10W	-	-	-	-	-	-	-	39	35	36	34.8	35.1

Footprint Landfill Gas Results

Sample Station Number	CO_2 (% v/v) 08/01/2009	CO_2 (% v/v) 10/02/2009	CO_2 (% v/v) 11/03/2009	CO_2 (% v/v) 22/04/2009	CO_2 (% v/v) 25/05/2009	CO_2 (% v/v) 30/06/2009	CO_2 (% v/v) 29/07/2009	CO_2 (% v/v) 28/08/2009	CO_2 (% v/v) 30/09/2009	CO_2 (% v/v) 30/10/2009	CO_2 (% v/v) 31/11/2009	CO_2 (% v/v) 15/12/2009
1E	29	19	29	39	38.6	36	30	10	40	40	22.2	10.7
1W	32	27	30	37	40.5	38	40	40	38	38	38.8	37.6
2E	26	20	35	38	40.8	33	34	36	39	39	30	34
2W	34	25	28	35	36.6	35	40	34	39	32	28	28.5
3E	32	19	27	32	41.9	35	32	36	40	42	35	33
3W	28	27	32	34	37.2	29	33	30	40	41	2.7	0.1
4E	27	7.5	9.5	18	18.5	14	15	18	38	32	5.5	42.9
4W	23	26	24	39	29.6	38	28	36	11	10	38.2	44.1
5E	33	22	29	40	32.2	39	36	34	31	30	37.2	35.8
5W	31	24	7.8	15	25	26	26	23	11	21	36.2	40.5
6E	31	-	29	36	37.2	35	29	35	39	38	33.1	40.9
6W	32	17	32	33	31.6	41	31	32	37	40	39.9	44.5
7E	-	-	-	35	42	43	35	43	36	35	43.3	46
7W	-	-	-	27	29.1	31	33	36	38	39	14.4	45
8E	-	-	-	40	43.7	37	37	41	38	39	28	29.8
8W	-	-	-	37	37.4	42	34	38	33	32	39	31.8
9E	-	-	-	-	-	-	-	0	59	54	38.9	38.3
9W	-	-	-	-	-	-	-		45	51	39.3	32
10E	-	-	-	-	-	-	-	60	40	51	49.4	43.5
10W	-	-	-	-	-	-	-	48	42	40	63.3	57

Footprint Landfill Gas Results

Sample Station Number	O_2 (% v/v) 08/01/2009	O_2 (% v/v) 10/02/2009	O_2 (% v/v) 11/03/2009	O_2 (% v/v) 22/04/2009	O_2 (% v/v) 25/05/2009	O_2 (% v/v) 30/06/2009	O_2 (% v/v) 29/07/2009	O_2 (% v/v) 28/08/2009	O_2 (% v/v) 30/09/2009	O_2 (% v/v) 30/10/2009	O_2 (% v/v) 31/11/2009	O_2 (% v/v) 15/12/2009
1E	4.2	7.2	3	1	0.8	1	4	14	0.1	0	9.8	14.6
1W	0.6	0.6	0.7	1	0.7	0.6	0	0.3	0.8	0.9	1.7	0.8
2E	7	7.9	0.2	1	0.2	4	3	3	0.8	1	5	3.1
2W	1.4	2.7	3.1	2	2.7	2	0.1	4.5	1.3	2	7	6.6
3E	0.2	6	4.1	4.9	0.5	2	3	1	0.1	0.2	1.5	2.3
3W	3.9	3.5	0.4	4	2.7	5	4	6	0.5	1	20.1	21
4E	3.7	16.2	14.8	10	10.9	12	12	11	1.2	1.2	18.6	0.4
4W	5.8	1.2	4	2	6.9	1	6	0.3	14	11	1.5	0.4
5E	0.1	3.1	3.1	0.9	5.6	1	3	4	4	3	3.4	4.3
5W	1.3	2.6	16.9	12	8.5	6	7	8	14	6	3.6	1.9
6E	0.1	-	19	3	3.4	3	6	4	1.2	2	5.2	1.7
6W	0.3	9	0.6	5	6.6	6	6	6	2.2	1.9	1.8	0.6
7E	-	-	-	4.8	1.2	0.1	3	0.1	2	2.2	3.2	1
7W	-	-	-	8	7.2	4	4	2	2.5	2	13.8	2.5
8E	-	-	-	1	1.1	3	2	0.5	0.7	1	7.9	7.2
8W	-	-	-	2.2	4.3	2	3	2	4	4	3.8	6.2
9E	-	-	-	-	-	-	-	0	1.3	1.9	2.8	1.9
9W	-	-	-	-	-	-	-	0	0	0	3.8	7
10E	-	-	-	-	-	-	-	0.5	4	6	1.2	1.2
10W	-	-	-	-	-	-	-	4	3	4	0.4	0.6

Parameter		MW1d	MW1d	MW1d	MW1d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.16	8.6	8.15	8.3
Conductivity	mS/cm	0.715	0.657	0.67	0.683
Temperature	°C	11.3	11.4	12.1	11.1
Ammoniacal Nitrogen	mg/l	0.82	0.33	0.3	0.39
Dissolved Oxygen	mg/l	7	9.4	6	5
Chloride	mg/l	24.3	24	25.8	25.9
Potassium	mg/l	3.04	3.22	2.92	3.2
Sodium	mg/l	36.82	38.16	35.06	37.35
Iron	µg/l	<20	<20	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	3
Total Oxidised Nitrogen	mg/l	<0.2	<0.05	0.12	0.56
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	36.4	>1000	>1,000	1,610
Faecal Coliforms	cfu/100ml	26	>1000	>1,000	8
Mercury	µg/l			<1	
Total Solids	mg/l			507	
Total Chromium	mg/l			0.0033	
Total Phosphorous	mg/l			0.095	
Boron	µg/l			24	
Cadmium	µg/l			<0.5	
Calcium	mg/l			51	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			22.51	
Manganese	µg/l			121	
Zinc	µg/l			5	
Fluoride	mg/l			<0.3	
Sulphate	mg/l			32.88	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			276	

Parameter		MW2d	MW2d	MW2d	MW2d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.25	8.45	**8.33**	8.25
Conductivity	mS/cm	0.709	0.693	0.708	0.663
Temperature	°C	10.7	11.6	11.6	11.1
Ammoniacal Nitrogen	mg/l	0.44	0.27	0.2	<0.2
Dissolved Oxygen	mg/l	7	9.7	10	9
Chloride	mg/l	19.1	19.1	20.3	28.1
Potassium	mg/l	2.2	2.33	2.07	0.99
Sodium	mg/l	34.99	35.64	33.05	11.78
Iron	mg/l	<20	21	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	8
Total Oxidised Nitrogen	mg/l	<0.2	<0.05	0.12	0.35
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	1	900	>1,000	22,470
Faecal Coliforms	cfu/100ml	0	350	>1,000	60
Mercury	µg/l			<1	
Total Solids	mg/l			437	
Total Chromium	mg/l			<0.0015	
Total Phosphorous	mg/l			0.008	
Boron	µg/l			42	
Cadmium	µg/l			<0.5	
Calcium	mg/l			70.99	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			17.29	
Manganese	µg/l			71	
Zinc	µg/l			10	
Fluoride	mg/l			<0.3	
Sulphate	mg/l			61.52	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			260	

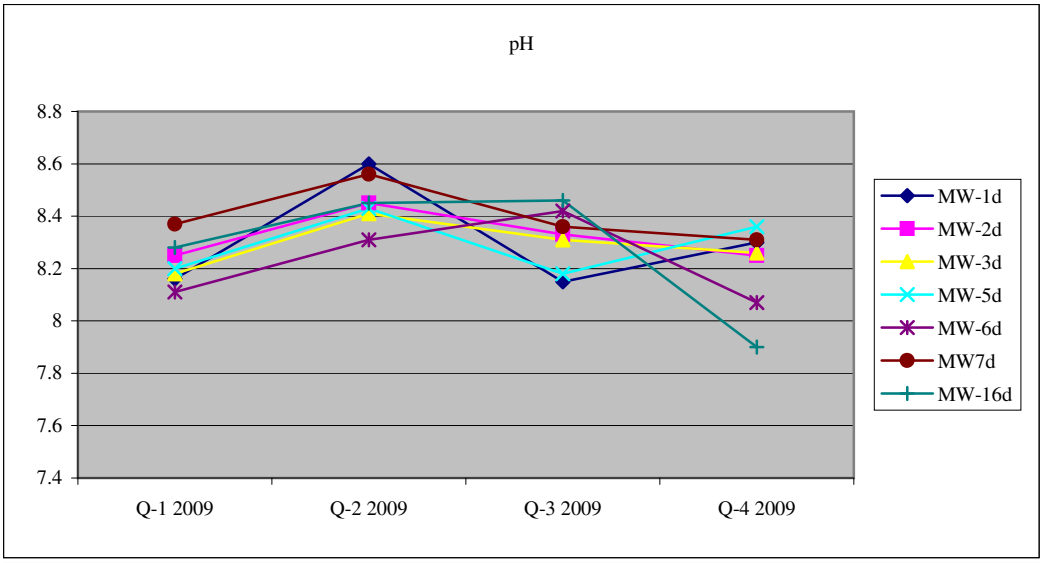
Parameter	Units	MW3d	MW3d	MW3d	MW3d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.18	8.41	8.31	8.26
Conductivity	mS/cm	0.827	0.787	0.832	0.808
Temperature	°C	10.6	11.6	11.8	11.2
Ammoniacal Nitrogen	mg/l	0.67	0.53	0.5	0.6
Dissolved Oxygen	mg/l	7	9.5	6	7
Chloride	mg/l	26.3	26.1	27.4	27.4
Potassium	mg/l	2.86	3.17	2.74	2.93
Sodium	mg/l	43.72	46.35	42.44	46.41
Iron	mg/l	<20	<20	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	5
Total Oxidised Nitrogen	mg/l	<0.2	<0.05	0.37	0.31
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	5.2	180	>1,000	2,590
Faecal Coliforms	cfu/100ml	5	0	>1,000	2
Mercury	µg/l			<1	
Total Solids	mg/l			608	
Total Chromium	mg/l			0.0021	
Total Phosphorous	mg/l			0.077	
Boron	µg/l			30	
Cadmium	µg/l			<0.5	
Calcium	mg/l			74.93	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			18.92	
Manganese	µg/l			59	
Zinc	µg/l			7	
Fluoride	mg/l			<0.3	
Sulphate	mg/l			184.83	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			184	

Parameter	Units	MW5d	MW5d	MW5d	MW5d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.2	8.43	8.18	8.36
Conductivity	mS/cm	0.646	0.644	0.68	0.643
Temperature	°C	10.4	10.1	12.1	11
Ammoniacal Nitrogen	mg/l	0.54	0.48	0.5	0.56
Dissolved Oxygen	mg/l	8	9.6	4	6
Chloride	mg/l	19.6	19.3	20.2	20.7
Potassium	mg/l	2.18	2.1	2.04	2.13
Sodium	mg/l	24.06	22.29	22.38	24.5
Iron	mg/l	<20	32	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	<2
Total Oxidised Nitrogen	mg/l	<0.2	<0.05	0.13	0.61
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	1	280	>1,000	<1
Faecal Coliforms	cfu/100ml	0	0	0	0
Mercury	µg/l			<1	
Total Solids	mg/l			397	
Total Chromium	mg/l			<0.0015	
Total Phosphorous	mg/l			0.012	
Boron	µg/l			30	
Cadmium	µg/l			<0.5	
Calcium	mg/l			73.16	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			14.44	
Manganese	µg/l			243	
Zinc	µg/l			18	
Fluoride	mg/l			0.4	
Sulphate	mg/l			16.08	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			276	

Parameter	Units	MW6d	MW6d	MW6d	MW6d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.11	8.31	8.42	8.07
Conductivity	mS/cm	0.693	0.642	0.663	0.631
Temperature	°C	10.1	11.1	12.1	10.5
Ammoniacal Nitrogen	mg/l	0.55	0.45	0.6	0.73
Dissolved Oxygen	mg/l	8	9.6	7	6
Chloride	mg/l	16.5	17	18.3	18.8
Potassium	mg/l	2.35	3.01	2.25	2.5
Sodium	mg/l	20.84	24.27	21.14	24.36
Iron	mg/l	<20	<20	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	3
Total Oxidised Nitrogen	mg/l	0.59	<0.05	0.16	0.41
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	4.1	190	>1,000	261.3
Faecal Coliforms	cfu/100ml	1	0	0	5
Mercury	µg/l			<1	
Total Solids	mg/l			1378	
Total Chromium	mg/l			0.0173	
Total Phosphorous	mg/l			0.42	
Boron	µg/l			31	
Cadmium	µg/l			<0.5	
Calcium	mg/l			67.11	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			18.24	
Manganese	µg/l			134	
Zinc	µg/l			12	
Fluoride	mg/l			<0.3	
Sulphate	mg/l			36.47	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			256	

Parameter	Units	MW7d	MW7d	MW7d	MW7d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.37	8.56	8.36	8.31
Conductivity	mS/cm	0.648	0.619	0.693	0.662
Temperature	°C	11	10.8	11.9	10.5
Ammoniacal Nitrogen	mg/l	0.64	0.38	0.4	0.42
Dissolved Oxygen	mg/l	8	9.6	4	5
Chloride	mg/l	17	16.9	16.6	16.6
Potassium	mg/l	2.76	2.94	2.13	2.27
Sodium	mg/l	60.49	57.96	41.99	47.4
Iron	mg/l	<20	<20	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	<2
Total Oxidised Nitrogen	mg/l	<0.2	<0.05	0.12	0.49
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	8.5	>1000	70	204.6
Faecal Coliforms	cfu/100ml	0	900	60	17
Mercury	µg/l			<1	
Total Solids	mg/l			435	
Total Chromium	mg/l			<0.0015	
Total Phosphorous	mg/l			0.014	
Boron	µg/l			26	
Cadmium	µg/l			<0.5	
Calcium	mg/l			62.13	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			13.36	
Manganese	µg/l			516	
Zinc	µg/l			20	
Fluoride	mg/l			<0.3	
Sulphate	mg/l			39.73	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			268	

Parameter	Units	MW16d	MW16d	MW16d	MW16d
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.28	8.45	8.46	7.9
Conductivity	mS/cm	0.652	0.643	0.687	0.76
Temperature	°C	10.6	10.8	12.5	10.9
Ammoniacal Nitrogen	mg/l	1.29	0.57	0.6	<0.2
Dissolved Oxygen	mg/l	8	9.2	4	5
Chloride	mg/l	19.1	18.6	20	14.6
Potassium	mg/l	2.42	2.51	2.28	3
Sodium	mg/l	24.21	23.74	22.76	20.12
Iron	mg/l	<20	62	<20	<0.02
Total Organic Carbon	mg/l	<3	<5	<2	2
Total Oxidised Nitrogen	mg/l	<0.2	<0.05	0.08	1.53
Total Phenols	mg/l	<0.01	<0.01	<0.01	<0.1
Total Coliforms	cfu/100ml	9.8	95	20	2,590
Faecal Coliforms	cfu/100ml	7	0	0	3
Mercury	µg/l			<1	
Total Solids	mg/l			402	
Total Chromium	mg/l			<0.0015	
Total Phosphorous	mg/l			0.005	
Boron	µg/l			37	
Cadmium	µg/l			<0.5	
Calcium	mg/l			74.03	
Copper	µg/l			<7	
Lead	µg/l			<5	
Magnesium	mg/l			15.23	
Manganese	µg/l			228	
Zinc	µg/l			18	
Fluoride	mg/l			<0.3	
Sulphate	mg/l			23.3	
VOC	µg/l			<10	
SVOC	µg/l			<5	
Pesticides	µg/l			<0.01	
Total Cyanide	mg/l			<0.04	
Total Alkalinity	mg/l			280	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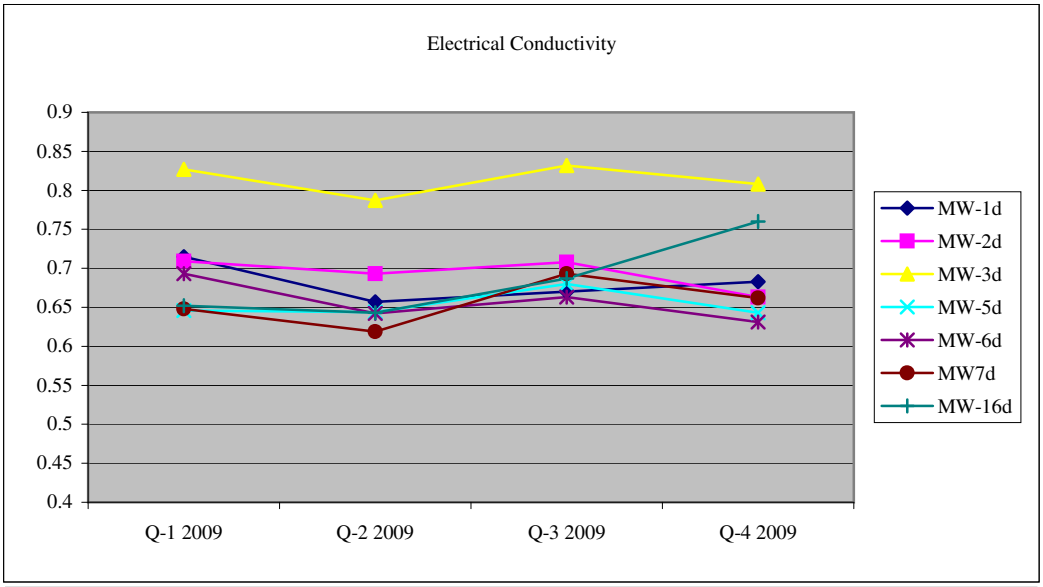
8.6
8.4
8.2
8
7.8
7.6
7.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d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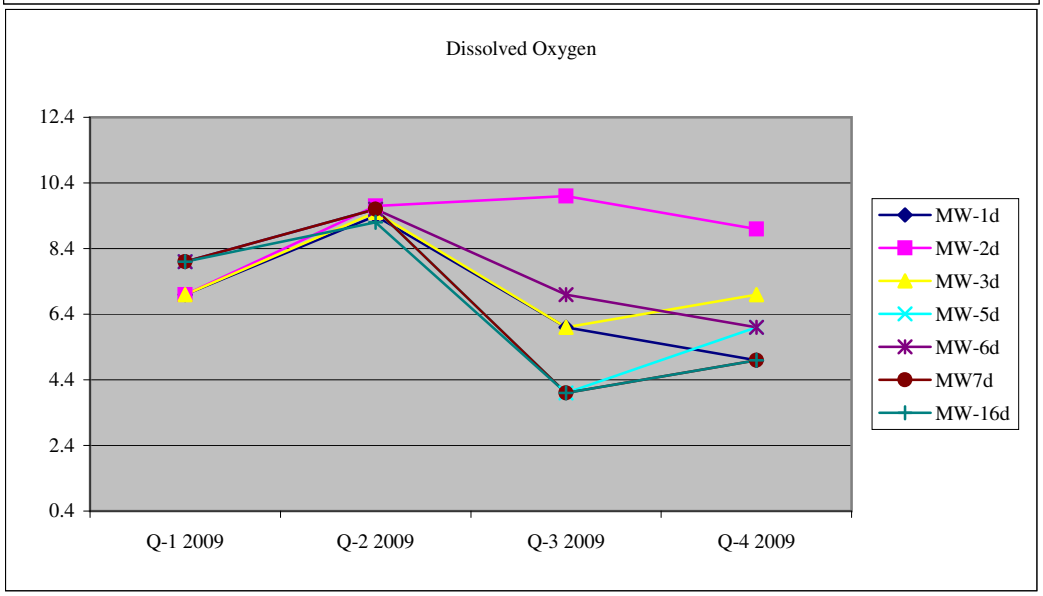
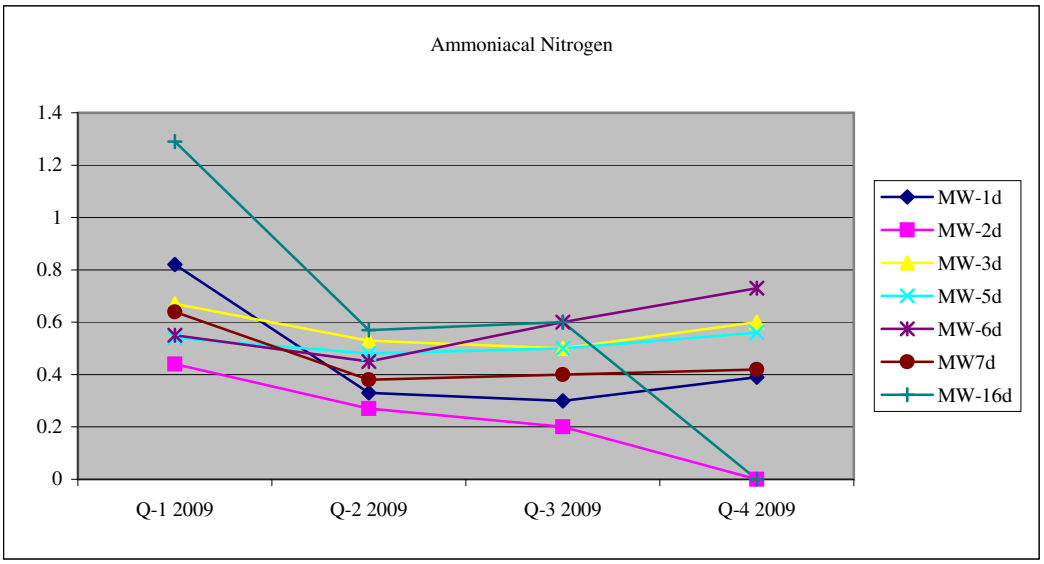
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


Dissolved Oxygen
12.4
10.4
8.4
6.4
4.4
2.4
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


Ammoniacal Nitrogen
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1.2
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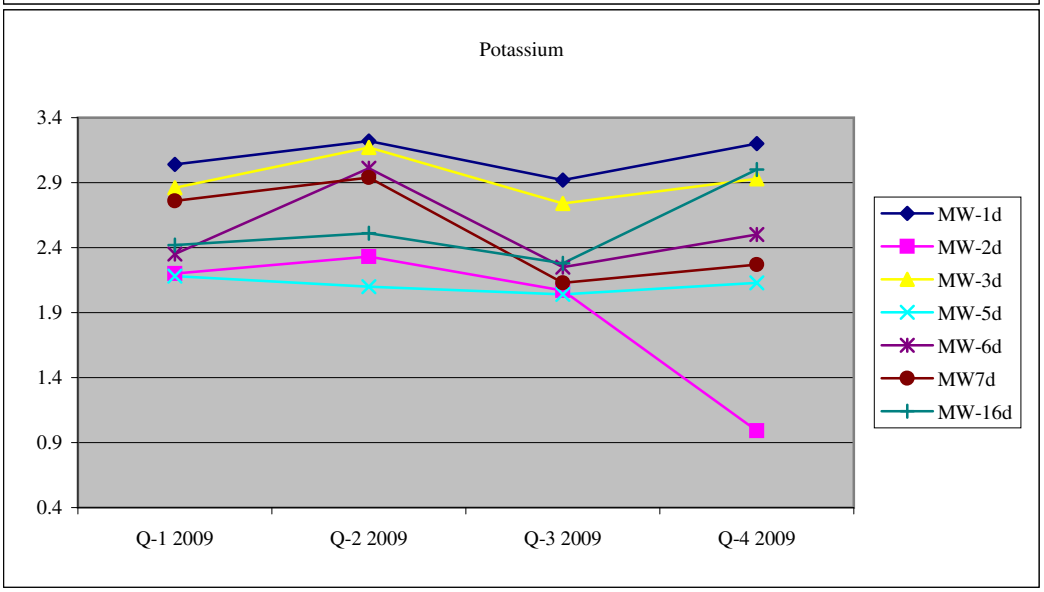
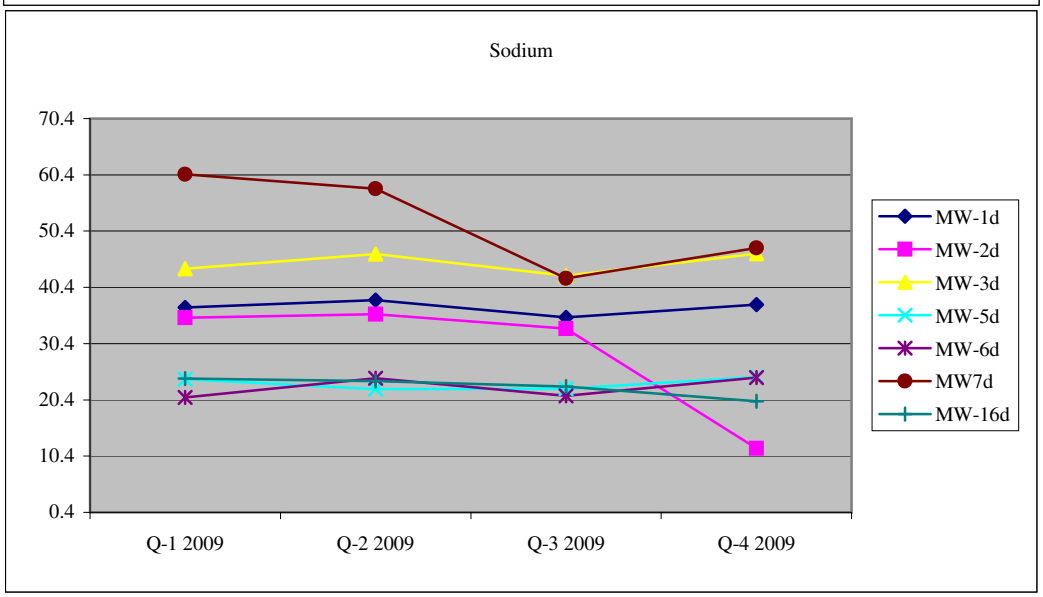
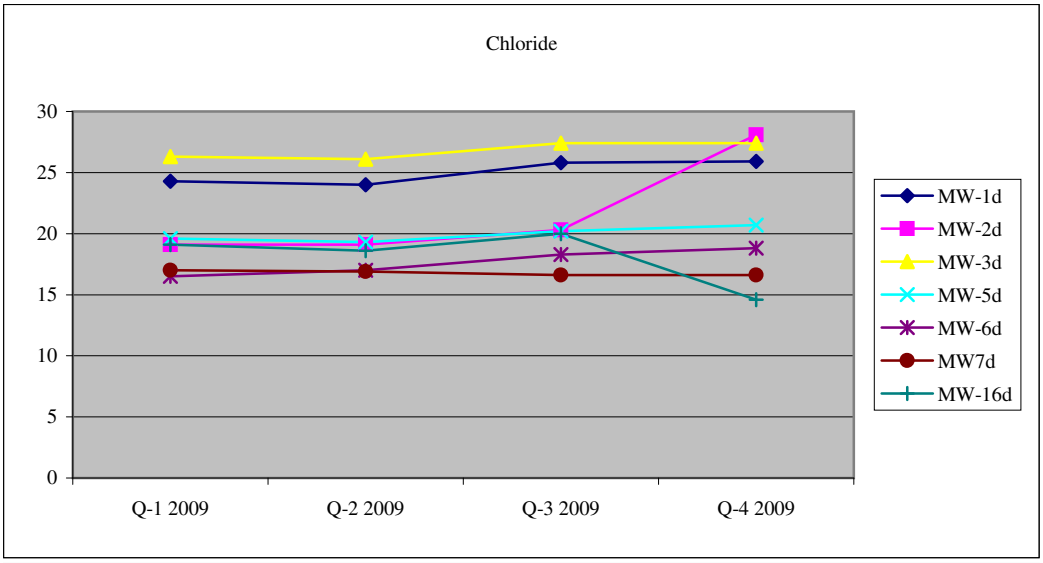
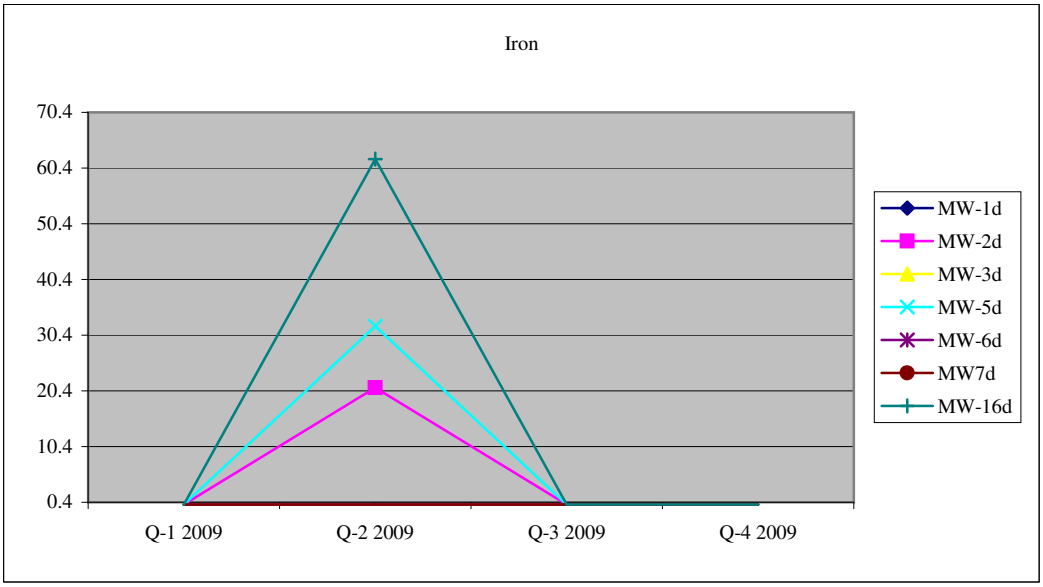
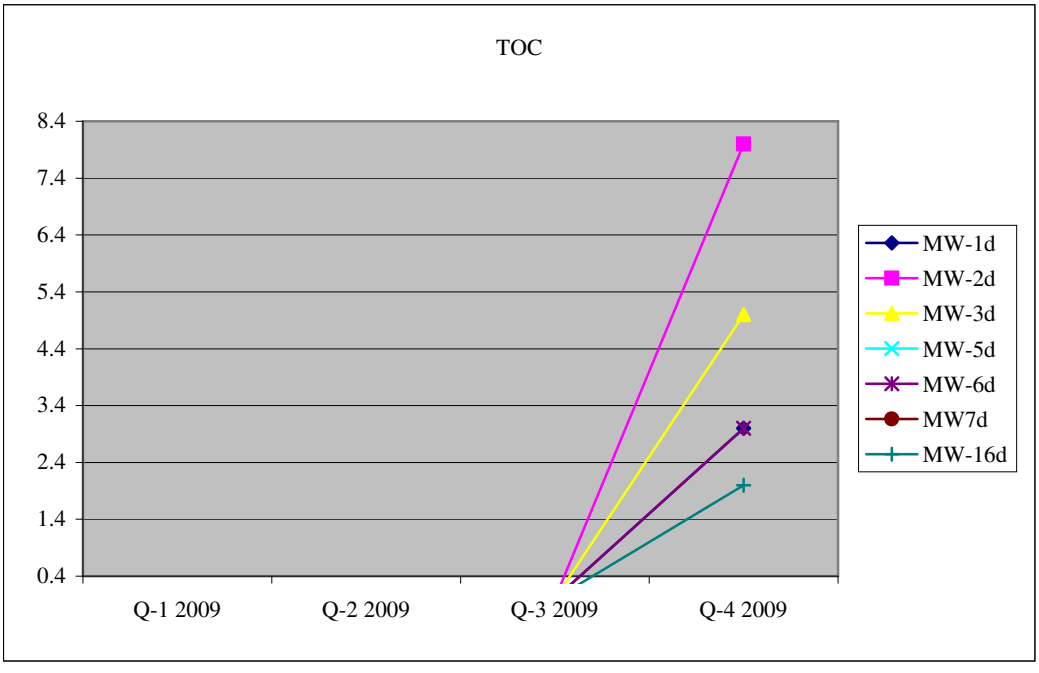
0.8
0.6
0.4
0.2
0
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d

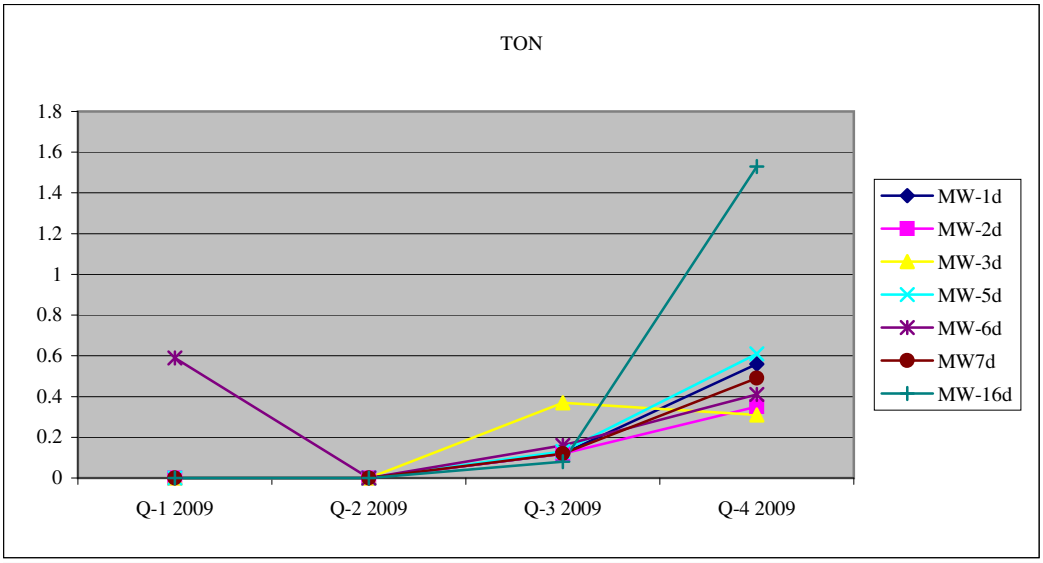

Potassium
3.4
2.9
2.4
1.9
1.4
0.9
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d

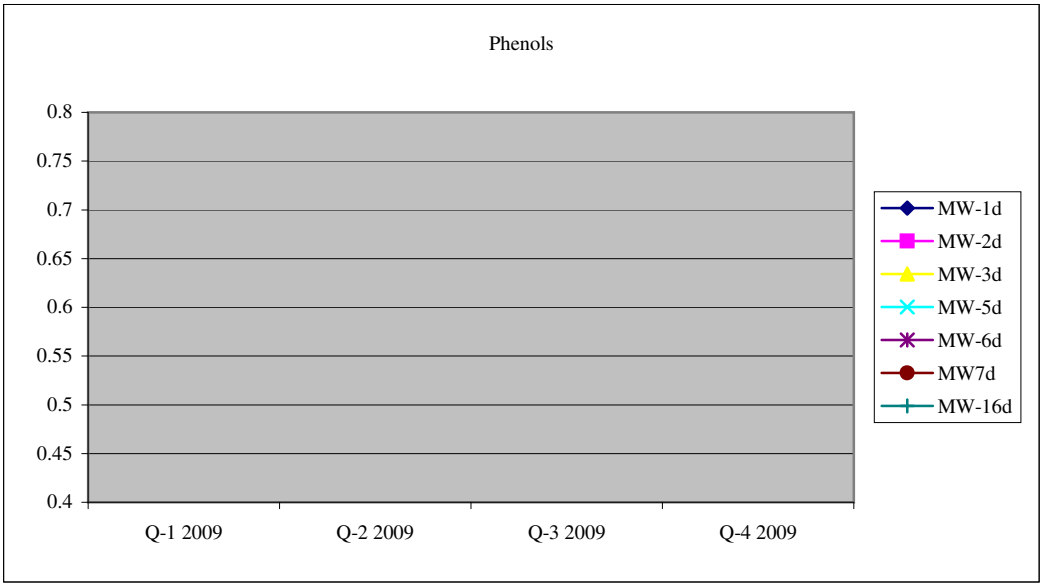

Sodium
70.4
60.4
50.4
40.4
30.4
20.4
10.4
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d

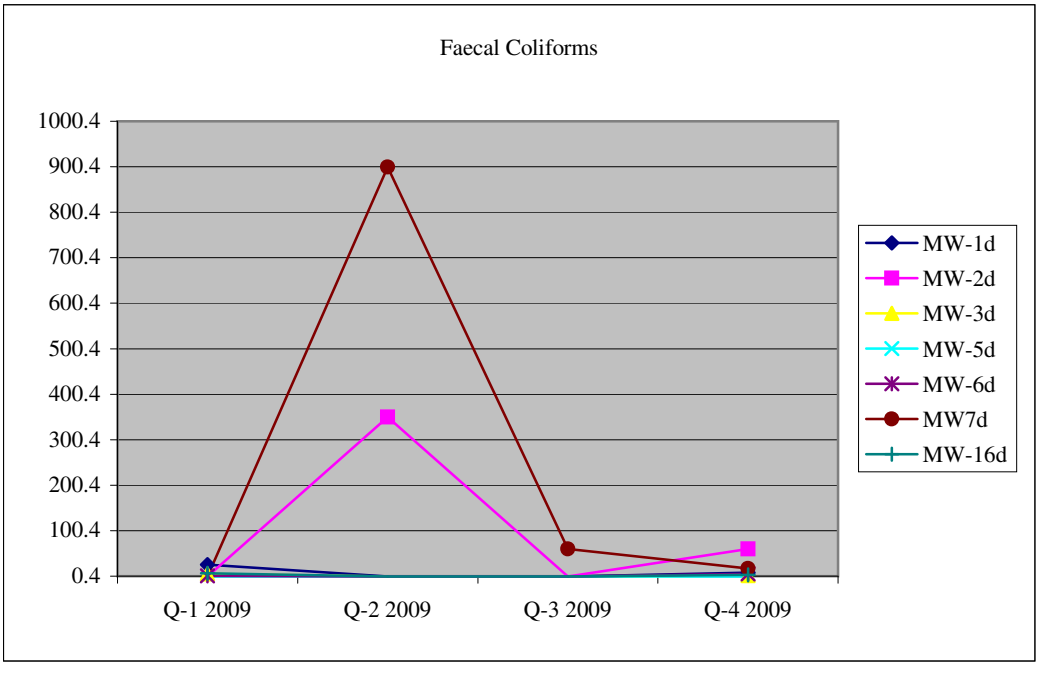

Chloride
30
25
20
15
10
5
0
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d

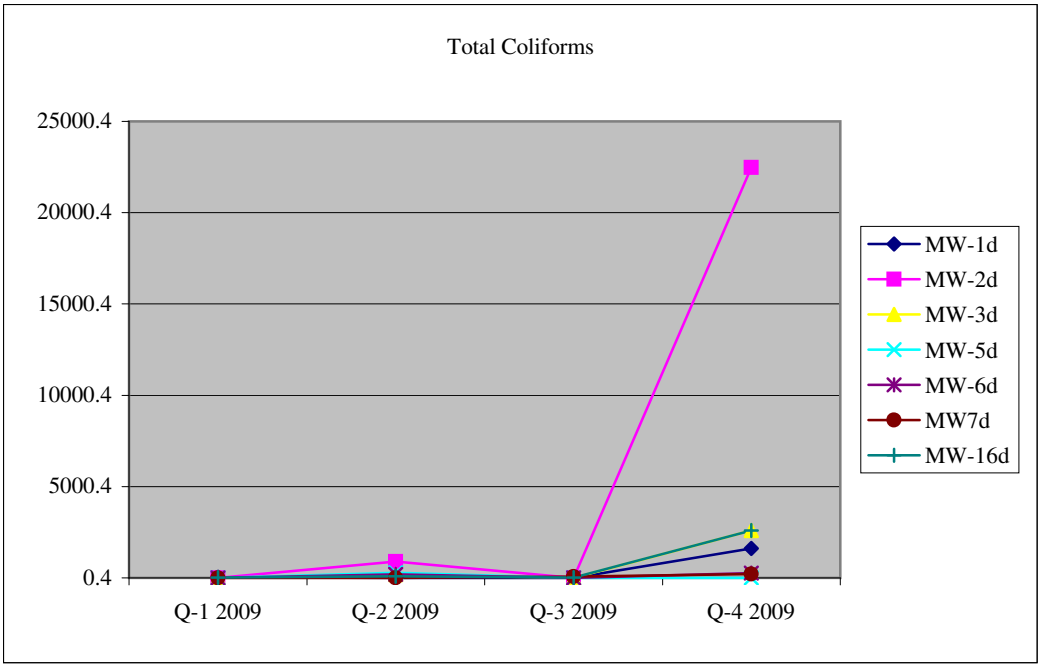

Iron
70.4
60.4
50.4
40.4
30.4
20.4
10.4
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


TOC
8.4
7.4
6.4
5.4
4.4
3.4
2.4
1.4
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


TON
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


Phenols
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


Faecal Coliforms
1000.4
900.4
800.4
700.4
600.4
500.4
400.4
300.4
200.4
100.4
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d


Total Coliforms
25000.4
20000.4
15000.4
10000.4
5000.4
0.4
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
MW-1d
MW-2d
MW-3d
MW-5d
MW-6d
MW7d
MW-16d

Parameter	Units	LE1	LE1	LE1	LE1
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.24	8.57	8.88	8.33
Conductivity	mS/cm	18.58	23.7	27	18840
Ammoniacal Nitrogen	mg/l	1600	2309.9	1952.28	850.2
Chloride	mg/l	2164.3	2333.1	214.3	2042.5
Total Oxidised Nitrogen	mg/l	0.28	11.53	<0.2	<0.05
BOD	mg/l	415	>1000	662	370
COD	mg/l	3500	5200	6000	3110
Mercury	µg/l				<5
Sodium	mg/l				1427
Potassium	mg/l				757.5
Total Phosphorous	mg/l				7246
Boron	mg/l				3233
Cadmium	µg/l				<2.5
Calcium	mg/l				101.8
Chromium	µg/l				282.5
Copper	µg/l				<35
Iron	mg/l				2.651
Lead	µg/l				<25
Magnesium	mg/l				165.5
Manganese	mg/l				0.343
Zinc	µg/l				63
Fluoride	mg/l				0.6
Sulphate	mg/l				2.88
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				8500
Faecal Coliforms	cfu/100ml				2,000
Total Coliforms	cfu/100ml				72,700

Parameter	Units	LE2	LE2	LE2	LE2
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.02	8.48	7.73	8.36
Conductivity	mS/cm	10.63	17.24	97.9	15590
Ammoniacal Nitrogen	mg/l	870	1323.73	257.18	775.6
Chloride	mg/l	844.98	1616.5	547.2	1436.7
Total Oxidised Nitrogen	mg/l	1.11	8.13	<0.2	<0.05
BOD	mg/l	777	>1000	3090	365
COD	mg/l	2000	3000	13530	2710
Mercury	µg/l				<5
Sodium	mg/l				1087
Potassium	mg/l				507.5
Total Phosphorous	mg/l				5729
Boron	mg/l				3272
Cadmium	µg/l				<2.5
Calcium	mg/l				132.7
Chromium	µg/l				237.9
Copper	µg/l				<35
Iron	mg/l				0.582
Lead	µg/l				<25
Magnesium	mg/l				94.28
Manganese	mg/l				0.889
Zinc	µg/l				33
Fluoride	mg/l				0.6
Sulphate	mg/l				102.24
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				6800
Faecal Coliforms	cfu/100ml				300
Total Coliforms	cfu/100ml				1,340

Parameter	Units	LE3	LE3	LE3	LE3
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.27	8.46	9.01	8.2
Conductivity	mS/cm	18.37	16.226	193.1	19350
Ammoniacal Nitrogen	mg/l	1600	1465.16	1364.78	738.1
Chloride	mg/l	2209.9	1620.3	2197	2076.2
Total Oxidised Nitrogen	mg/l	0.32	7.51	<0.2	<0.05
BOD	mg/l	1337	>1000	600	340
COD	mg/l	3400	3000	4210	2780
Mercury	µg/l				<5
Sodium	mg/l				299.2
Potassium	mg/l				162.5
Total Phosphorous	mg/l				6819
Boron	mg/l				3520
Cadmium	µg/l				<2.5
Calcium	mg/l				21.88
Chromium	µg/l				265.4
Copper	µg/l				<35
Iron	mg/l				2.93
Lead	µg/l				<25
Magnesium	mg/l				35.33
Manganese	mg/l				0.371
Zinc	µg/l				83
Fluoride	mg/l				0.6
Sulphate	mg/l				4.53
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				8,400
Faecal Coliforms	cfu/100ml				100
Total Coliforms	cfu/100ml				86,640

Parameter	Units	LE4	LE4	LE4	LE4
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.24	8.27	7.7	8.22
Conductivity	mS/cm	19.33	13.32	10.5	13340
Ammoniacal Nitrogen	mg/l	1700	935.79	289.09	777.5
Chloride	mg/l	2309	1125.2	557.7	1229.9
Total Oxidised Nitrogen	mg/l	0.19	7.2	<0.2	<0.05
BOD	mg/l	534	>1000	3132	922
COD	mg/l	3700	2100	13100	3570
Mercury	µg/l				<5
Sodium	mg/l				918.5
Potassium	mg/l				421.8
Total Phosphorous	mg/l				4926
Boron	mg/l				3202
Cadmium	µg/l				<2.5
Calcium	mg/l				225.9
Chromium	µg/l				169
Copper	µg/l				<35
Iron	mg/l				0.696
Lead	µg/l				<25
Magnesium	mg/l				102.4
Manganese	mg/l				1.16
Zinc	µg/l				26
Fluoride	mg/l				0.5
Sulphate	mg/l				209.97
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				5000
Faecal Coliforms	cfu/100ml				8,000
Total Coliforms	cfu/100ml				14,500

Parameter	Units	LE5	LE5	LE5	LE5
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8	8.46	8.91	8.28
Conductivity	mS/cm	14.69	20.4	24.9	19160
Ammoniacal Nitrogen	mg/l	920	1570.17	1049.98	819.6
Chloride	mg/l	1843	2262.6	2511.4	2105.6
Total Oxidised Nitrogen	mg/l	1.12	8.76	<0.2	<0.05
BOD	mg/l	345	>1000	646	311
COD	mg/l	1800	2700	2810	3170
Mercury	µg/l				<5
Sodium	mg/l				1510
Potassium	mg/l				827.3
Total Phosphorous	mg/l				6525
Boron	mg/l				4092
Cadmium	µg/l				<2.5
Calcium	mg/l				110.4
Chromium	µg/l				277.7
Copper	µg/l				<35
Iron	mg/l				3.438
Lead	µg/l				<25
Magnesium	mg/l				179.9
Manganese	mg/l				0.429
Zinc	µg/l				75
Fluoride	mg/l				0.6
Sulphate	mg/l				3.66
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				8200
Faecal Coliforms	cfu/100ml				1,300
Total Coliforms	cfu/100ml				77,010

Parameter	Units	LE6	LE6	LE6	LE6
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	7.96	8.42	8.96	8.12
Conductivity	mS/cm	13.68	16.63	19.21	17650
Ammoniacal Nitrogen	mg/l	920	108.04	972.49	754.6
Chloride	mg/l	1675.6	1655.4	2514.9	1874.6
Total Oxidised Nitrogen	mg/l	0.98	8.08	<0.2	<0.05
BOD	mg/l	243	>1000	743	924
COD	mg/l	1700	2600	2800	4650
Mercury	µg/l				<5
Sodium	mg/l				1398
Potassium	mg/l				655.3
Total Phosphorous	mg/l				5439
Boron	mg/l				3457
Cadmium	µg/l				<2.5
Calcium	mg/l				260.9
Chromium	µg/l				229
Copper	µg/l				<35
Iron	mg/l				4.424
Lead	µg/l				<25
Magnesium	mg/l				141.4
Manganese	mg/l				3.25
Zinc	µg/l				46
Fluoride	mg/l				23.3
Sulphate	mg/l				17.04
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				7100
Faecal Coliforms	cfu/100ml				300
Total Coliforms	cfu/100ml				15,390

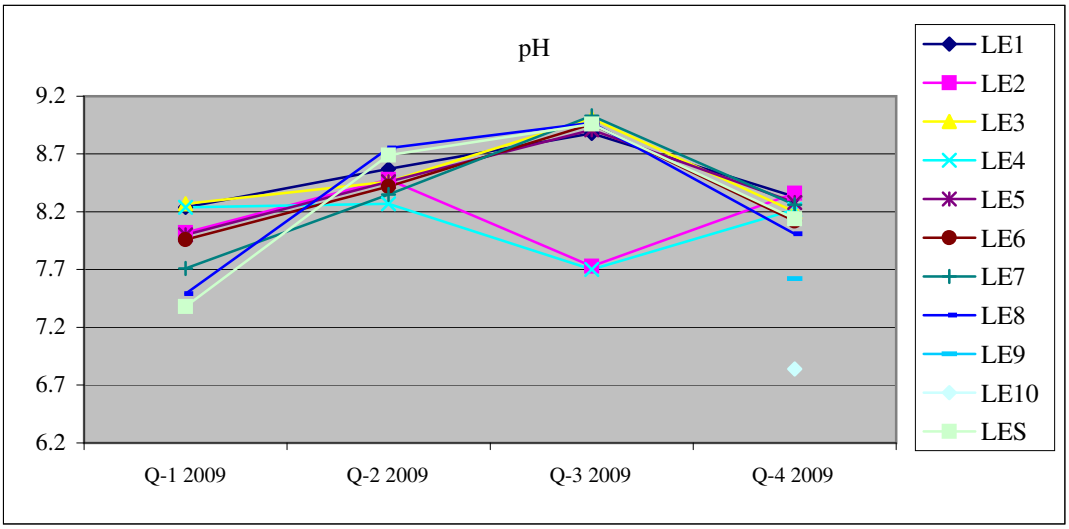
Parameter	Units	LE7	LE7	LE7	LE7
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	7.71	8.35	9.03	8.26
Conductivity	mS/cm	14.61	17.2	19.93	19520
Ammoniacal Nitrogen	mg/l	910	1165.31	919.22	807.1
Chloride	mg/l	1890.5	1982.8	2370.9	2043.4
Total Oxidised Nitrogen	mg/l	1.16	7.69	<0.2	<0.05
BOD	mg/l	283	>1000	754	447
COD	mg/l	1800	2400	3350	3180
Mercury	µg/l				<5
Sodium	mg/l				1526
Potassium	mg/l				820.3
Total Phosphorous	mg/l				6178
Boron	mg/l				3990
Cadmium	µg/l				<2.5
Calcium	mg/l				109.6
Chromium	µg/l				242.3
Copper	µg/l				<35
Iron	mg/l				3.344
Lead	µg/l				<25
Magnesium	mg/l				177.7
Manganese	mg/l				0.422
Zinc	µg/l				100
Fluoride	mg/l				0.6
Sulphate	mg/l				2.43
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				8500
Faecal Coliforms	cfu/100ml				0
Total Coliforms	cfu/100ml				64,800

Parameter	Units	LE8	LE8	LE8	LE8
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	7.49	8.75	8.97	8.01
Conductivity	mS/cm	9.79	14.36	16.85	17780
Ammoniacal Nitrogen	mg/l	690	1556.4	665.46	716.5
Chloride	mg/l	1064.6	11511.1	1886	1912.5
Total Oxidised Nitrogen	mg/l	1.72	3.06	<0.2	<0.05
BOD	mg/l	182	>1000	504	928
COD	mg/l	1400	1900	5290	5160
Mercury	µg/l				<5
Sodium	mg/l				1376
Potassium	mg/l				661.4
Total Phosphorous	mg/l				5104
Boron	mg/l				3911
Cadmium	µg/l				<2.5
Calcium	mg/l				325.6
Chromium	µg/l				226.5
Copper	µg/l				<35
Iron	mg/l				5.464
Lead	µg/l				<25
Magnesium	mg/l				150
Manganese	mg/l				4.898
Zinc	µg/l				48
Fluoride	mg/l				44.7
Sulphate	mg/l				21.74
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				6900
Faecal Coliforms	cfu/100ml				2,100
Total Coliforms	cfu/100ml				27,500

Parameter	**Units**				**LE9**
					Q-4 2009
pH	pH units				7.62
Conductivity	mS/cm				10680
Ammoniacal Nitrogen	mg/l				459.5
Chloride	mg/l				903.9
Total Oxidised Nitrogen	mg/l				2.43
BOD	mg/l				927
COD	mg/l				4770
Mercury	µg/l				<5
Sodium	mg/l				752.6
Potassium	mg/l				372.7
Total Phosphorous	mg/l				2618
Boron	mg/l				2634
Cadmium	µg/l				<2.5
Calcium	mg/l				400.3
Chromium	µg/l				78.6
Copper	µg/l				<35
Iron	mg/l				3.938
Lead	µg/l				27
Magnesium	mg/l				143.3
Manganese	mg/l				1.979
Zinc	µg/l				222
Fluoride	mg/l				78.4
Sulphate	mg/l				4.4
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				4300
Faecal Coliforms	cfu/100ml				7,600
Total Coliforms	cfu/100ml				98,040

Parameter	**Units**				**LE10**
					Q-4 2009
pH	pH units				6.84
Conductivity	mS/cm				13970
Ammoniacal Nitrogen	mg/l				681.4
Chloride	mg/l				1143.1
Total Oxidised Nitrogen	mg/l				2.63
BOD	mg/l				927
COD	mg/l				21480
Mercury	µg/l				<5
Sodium	mg/l				828.9
Potassium	mg/l				405.7
Total Phosphorous	mg/l				1291
Boron	mg/l				2560
Cadmium	µg/l				<2.5
Calcium	mg/l				1318
Chromium	µg/l				124.1
Copper	µg/l				<35
Iron	mg/l				3.182
Lead	µg/l				<25
Magnesium	mg/l				213.2
Manganese	mg/l				3.331
Zinc	µg/l				42
Fluoride	mg/l				422.5
Sulphate	mg/l				75.67
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				7100
Faecal Coliforms	cfu/100ml				5,000
Total Coliforms	cfu/100ml				77,010

Parameter	Units	LES	LES	LES	LES
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	7.38	8.69	8.96	8.14
Conductivity	mS/cm	8.68	11720	12.93	13100
Ammoniacal Nitrogen	mg/l	650	968.81	692.25	564
Chloride	mg/l	888.21	1315.9	1353.5	1276.4
Total Oxidised Nitrogen	mg/l	2.05	<0.05	<0.2	<0.05
BOD	mg/l	132	<1000	582	345
COD	mg/l	1300	1400	2380	2640
Mercury	µg/l				<5
Sodium	mg/l				1047
Potassium	mg/l				490.8
Total Phosphorous	mg/l				6776
Boron	mg/l				3924
Cadmium	µg/l				<2.5
Calcium	mg/l				248
Chromium	µg/l				171.5
Copper	µg/l				<35
Iron	mg/l				42.51
Lead	µg/l				<25
Magnesium	mg/l				119
Manganese	mg/l				41.3
Zinc	µg/l				153
Fluoride	mg/l				0.6
Sulphate	mg/l				42.65
Total Cyanide	mg/l				<40
Total Alkalinity	mg/l				6000
Faecal Coliforms	cfu/100ml				800
Total Coliforms	cfu/100ml				9,590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9.2
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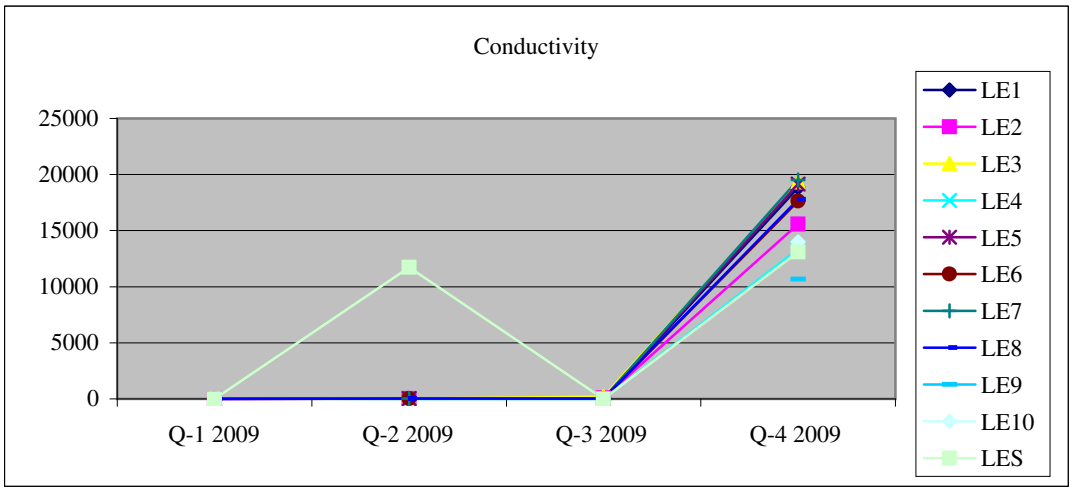
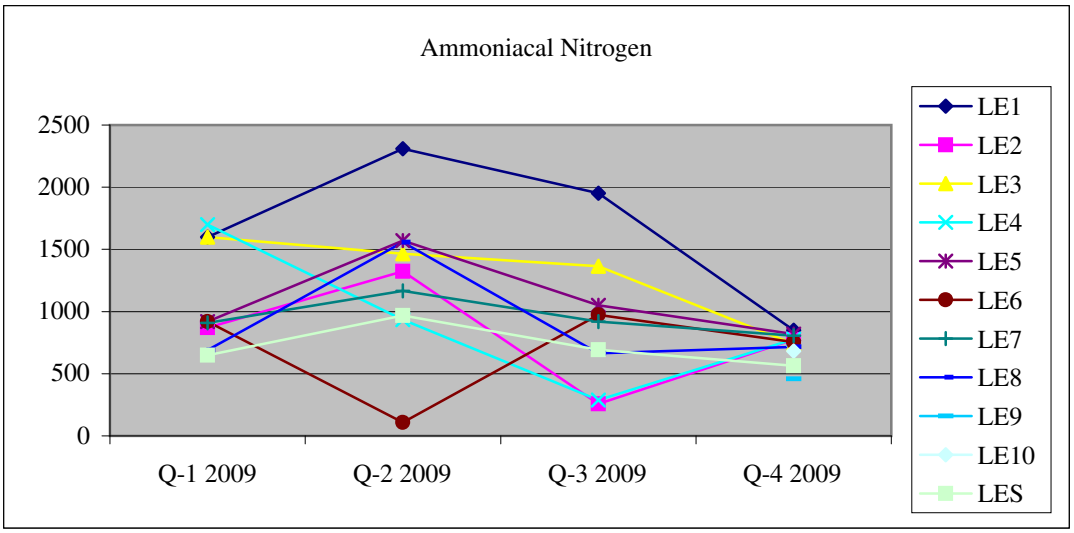
8.2
7.7
7.2
6.7
6.2
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
LE1
LE2
LE3
LE4
LE5
LE6
LE7
LE8
LE9
LE10
LES


Conductivity
25000
20000
15000
10000
5000
0
Q-1 2009
Q-2 2009
Q-3 2009
Q-4 2009
LE1
LE2
LE3
LE4
LE5
LE6
LE7
LE8
LE9
LE10
LES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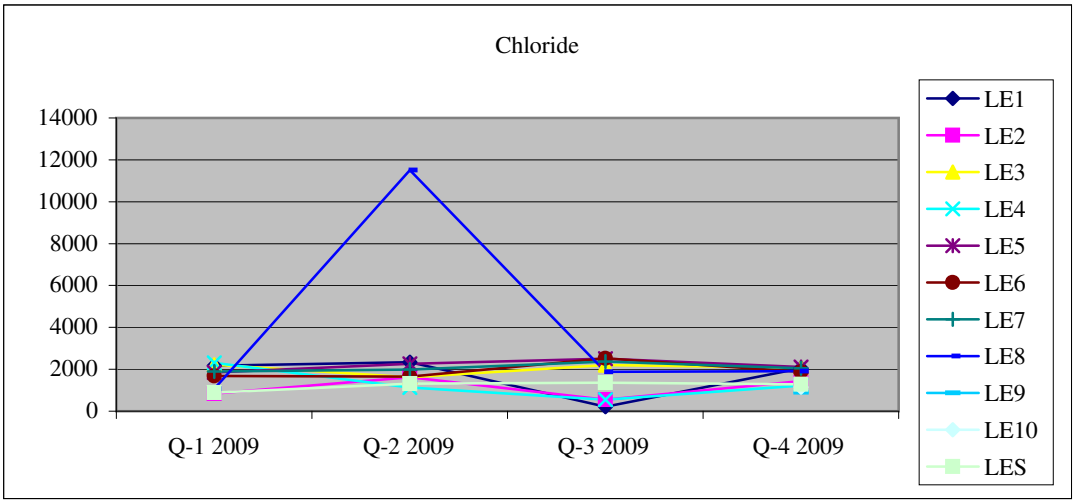
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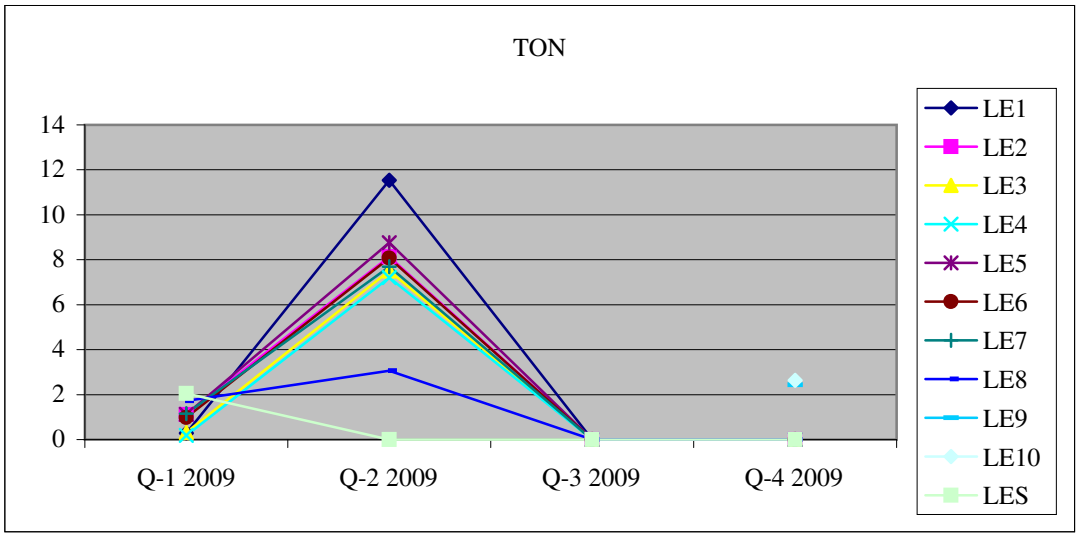
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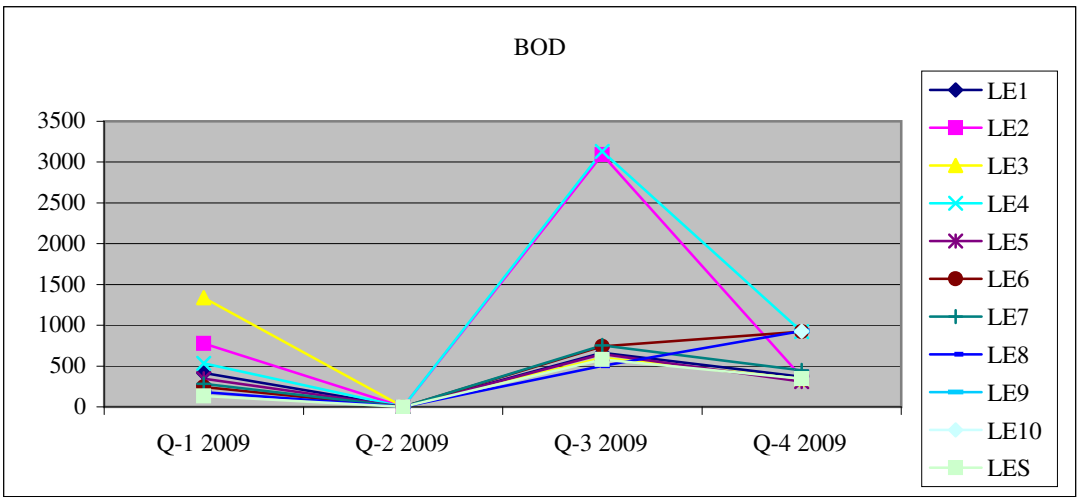
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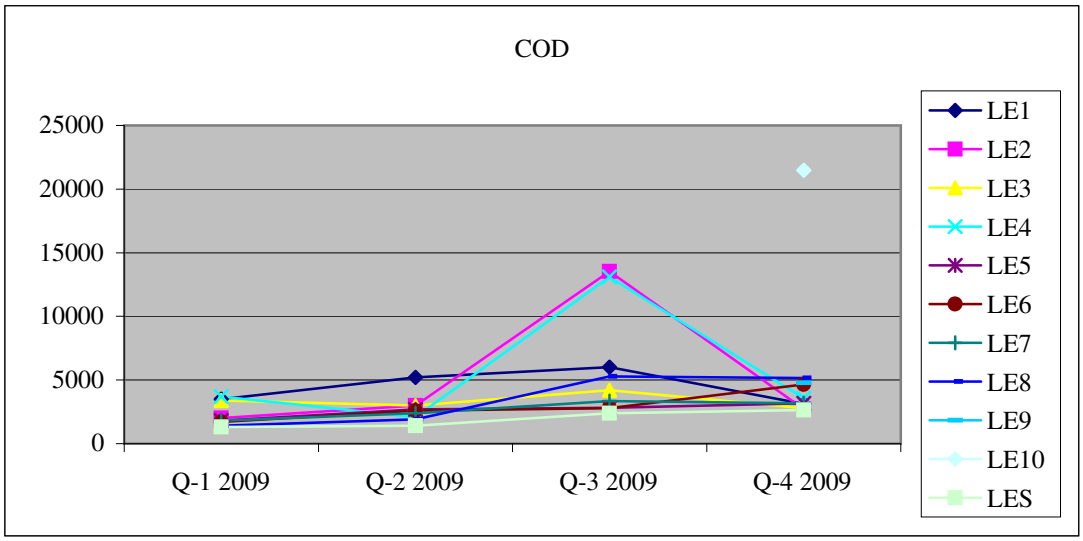
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LE4
LE5
LE6
LE7
LE8
LE9
LE10
LES

Q1 2009

Location	Time	Measured Noise Levels (dB re. 2x10-5 Pa)			Comments
		L_{Aeq}	L_{A10}	L_{A90}	
N1	1503-1533	47	46	39	No facility emissions audible. Traffic to N and NE dominant. Birdsong. Rustling vegetation. Sporadic local traffic.
N2	1427-1457	46	47	39	No facility emissions audible. Traffic to N and NE dominant. Birdsong. Rustling vegetation. Sporadic local traffic.
N3	1344-1414	48	50	44	Onsite plant audible occasionally at low level, including trucks on access road. Distant road traffic to N and NE clearly audible continuously and dominant. Birdsong.
N4	1540-1610	56	53	46	No facility emissions audible. Traffic to N and NE dominant. Birdsong. Rustling vegetation. Sporadic local traffic, more frequent than at N1.

Q2 2009

Location	Time	Measured Noise Levels (dB re. 2x10-5 Pa) L_{Aeq}	L_{A10}	L_{A90}	Comments
N1	08:45 – 09:15	48	51	36	Sporadic ejector trailers and truck movements at Greenstar facility slightly audible. Also, emissions from site slightly audible on breeze almost continuously, variously from road sweeper truck, tanker pump, screen deck. Distant traffic to N, E and S audible in background. Bleating sheep nearby dominant to 0855, and regularly audible thereafter. Birdsong. Sporadic local traffic. Aircraft.
N2	08:08 – 08:38	54	54	39	Occasional truck movements on access road audible and at weighbridge area. Ejector trailers audible at low level sporadically. Sporadic local traffic. Birdsong. Aircraft.
N3	10:24 – 10:54	42	45	37	Emissions regularly audible from varying sources onsite: ejector trailers, road sweeper truck, tanker pump, screen deck, trucks on access road. Emissions audibility varying from slightly audible to clearly audible, depending on time, breeze and location. Emissions subjectively not significant. Birdsong. Distant traffic slightly audible. Sporadic traffic on local road to E. Aircraft.
N4	09:19 – 09:49	47	50	36	Sporadic ejector trailers and truck movements at Greenstar facility slightly audible. Also, continuous emissions from road sweeper truck, tanker pump, and screen deck slightly audible on breeze. Distant traffic to N, E and S audible in background. Birdsong. Sporadic local traffic. Aircraft.

Q-3 2009

Location	Time	Measured Noise (dB re. 2x10-5 Pa)			Comments
		L_{Aeq}	L_{A10}	L_{A90}	
N1	1444-1514	45	44	33	No landfill emissions audible apart from faintly audible white noise reversing alarm. Sporadic local traffic dominant when present. Distant traffic to N continuously slightly audible. Birdsong and rustling vegetation. Aircraft.
N2	1408-1438	45	42	36	Emissions continuously audible at low level from Greenstar screening plant, not significant. Sporadic truck movements on access road audible. Strimmer(s) audible, used by onsite landscaping crew operating near site access road. Offsite, road traffic to N continuously audible and significant. Birdsong. Local car x4. Aircraft.
N3	1606-1636	50	53	47	Greenstar screening plant continuously audible. Strimmers x2 near access road also audible. Offsite, hammering associated with domestic fencing project nearby audible and impulse. Birdsong. Aircraft.
N4	1520-1550	43	41	34	No landfill emissions audible. Sporadic local traffic dominant when present. Distant traffic to N continuously slightly audible. Birdsong and rustling vegetation. Aircraft.

Q-4 2009

Location	Time	Measured Noise Levels (dB re. 2x10-5 Pa)			Comments
		L_{Aeq}	L_{A10}	L_{A90}	
N1	0839-	54	51	44	No facility emissions audible. N2 road traffic to N continuously audible and dominant. Sporadic
N2	0802-0832	60	58	49	No facility emissions audible apart from sporadic truck movements on site access road and occasionally audible reversing alarm onsite, both slightly audible. N2 road traffic to N continuously audible and dominant. Occasional local traffic. Birdsong. Aircraft.
N3	0955-1025	48	50	45	Onsite reversing alarm and continuous excavator emissions audible at low level until 1000, not significant. Sporadic truck movements on access road audible, including road sweeper truck. Continuous N2 emissions to N dominant. Birdsong and aircraft.
N4	0913-0943	51	50	43	No facility emissions audible. N2 road traffic to N continuously audible and dominant. Sporadic local traffic. Birdsong. Aircraft.

Monitoring Location	PM_{10} Concentration ($\mu g/m^3$)	PM_{10} Concentration ($\mu g/m^3$)	PM_{10} Concentration ($\mu g/m^3$)	PM_{10} Concentration ($\mu g/m^3$)
	Q-1 2009	**Q-2 2009**	**Q-3 2009**	**Q-4 2009**
PM1	10	22	26	14
PM2	12	19	21	20
PM3	9	21	19	16
PM4	15	28	16	22
PM5	14	26	28	24
PM6	19	16	19	21

Parameter	Units	SW1	SW1	SW1	SW1
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.63	8.37	8.37	8.42
Conductivity	mS/cm	0.629	0.677	0.739	0.536
Temperature	°C	3.5	12.3	11.5	10.4
Ammoniacal Nitrogen	mg/l	0.19	0.94	<0.2	0.1
Dissolved Oxygen	mg/l	11	9	10	10
Chloride	mg/l	26.4	27.3	32.9	16.9
Total Suspended Solids	mg/l	<10	<10	19	6
BOD	mg/l	<1	9	<1	2
COD	mg/l	17	17	16	27
Potassium	mg/l		4.45		
Sodium	mg/l		15.31		
TON	mg/l		<0.05		
Calcium	mg/l		91.45		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		79		
Lead	µg/l		<5		
Magnesium	mg/l		7.76		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		19.81		
Zinc	µg/l		7		
Phosphorous	mg/l		170		
Total Alkalinity	mg/l		<1		

Parameter	Units	SW2	SW2	SW2	SW 2
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.62	8.35	8.38	7.96
Conductivity	mS/cm	0.599	0.611	0.736	0.496
Temperature	°C	3.7	11.2	11.1	10.1
Ammoniacal Nitrogen	mg/l	0.06	0.83	<0.2	0.1
Dissolved Oxygen	mg/l	11	9	9	9
Chloride	mg/l	23.5	16.5	18.9	14
Total Suspended Solids	mg/l	<10	<10	39	8
BOD	mg/l	<1	5	<1	2
COD	mg/l	23	<7	17	23
Potassium	mg/l		2.12		
Sodium	mg/l		10.49		
TON	mg/l		0.21		
Calcium	mg/l		102.8		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		120		
Lead	µg/l		<5		
Magnesium	mg/l		8.19		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		29.19		
Zinc	µg/l		4		
Phosphorous	mg/l		108		
Total Alkalinity	mg/l		<1		

Parameter	Units	SW3	SW3	SW3	SW 3
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.61	8.54	8.44	8.15
Conductivity	mS/cm	0.597	0.694	0.678	0.455
Temperature	°C	5.4		11.8	10
Ammoniacal Nitrogen	mg/l	0.15	0.68	<0.2	0.2
Dissolved Oxygen	mg/l	11	8	9	9
Chloride	mg/l	27.6	21.6	19.8	16.4
Total Suspended Solids	mg/l	<10	<10	80	8
BOD	mg/l	<1	4	2	2
COD	mg/l	19	11	21	26
Potassium	mg/l		3.3		
Sodium	mg/l		13.33		
TON	mg/l		0.41		
Calcium	mg/l		104.2		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		185		
Lead	µg/l		<5		
Magnesium	mg/l		8.56		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		15.9		
Zinc	µg/l		<3		
Phosphorous	mg/l		205		
Total Alkalinity	mg/l		<1		

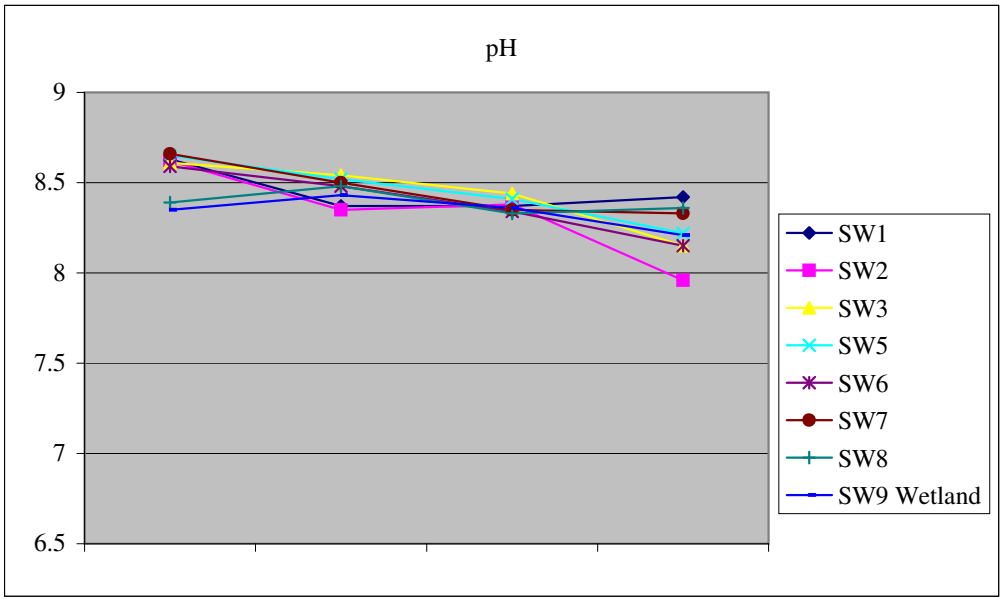
Parameter	Units	SW5	SW5	SW5	SW5
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.65	8.52	8.41	8.22
Conductivity	mS/cm	0.633	0.719	0.662	0.471
Temperature	°C	3.7	11.1	11.8	9.9
Ammoniacal Nitrogen	mg/l	0.39	0.33	<0.2	0.1
Dissolved Oxygen	mg/l	10	9	9	9
Chloride	mg/l	26.4	21.4	20.3	17.4
Total Suspended Solids	mg/l	<10	<10	47	9
BOD	mg/l	<1	5	1	2
COD	mg/l	26	<7	20	24
Potassium	mg/l		3.07		
Sodium	mg/l		12.31		
TON	mg/l		0.51		
Calcium	mg/l		104.7		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		162		
Lead	µg/l		<5		
Magnesium	mg/l		8.35		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		15.59		
Zinc	µg/l		4		
Phosphorous	mg/l		167		
Total Alkalinity	mg/l		<1		

Parameter	Units	SW6	SW6	SW6	SW6
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.59	8.48	8.34	8.15
Conductivity	mS/cm	0.613	0.717	0.722	0.722
Temperature	°C	2.8	11.8	13.8	9.5
Ammoniacal Nitrogen	mg/l	0.2	0.24	<0.2	0.1
Dissolved Oxygen	mg/l	11	10	10	11
Chloride	mg/l	26.6	21.1	9.3	9.1
Total Suspended Solids	mg/l	<10	<10	<10	13
BOD	mg/l	<1	3	<1	<1
COD	mg/l	17	<7	13	10
Potassium	mg/l		2.99		
Sodium	mg/l		11.99		
TON	mg/l		0.75		
Calcium	mg/l		109.5		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		168		
Lead	µg/l		<5		
Magnesium	mg/l		8.32		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		16.81		
Zinc	µg/l		<3		
Phosphorous	mg/l		161		
Total Alkalinity	mg/l		<1		

Parameter	Units	SW7	SW7	SW7	SW7
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.66	8.5	8.35	8.33
Conductivity	mS/cm	0.657	0.726	0.739	0.59
Temperature	°C	4.5	11.4	12.1	10.3
Ammoniacal Nitrogen	mg/l	1.21	0.17	0.3	0.3
Dissolved Oxygen	mg/l	10	9	10	10
Chloride	mg/l	27.8	25	26.7	20.9
Total Suspended Solids	mg/l	<10	<10	41	15
BOD	mg/l	5	3	1	2
COD	mg/l	34	<7	15	20
Potassium	mg/l		4.35		
Sodium	mg/l		9.23		
TON	mg/l		1.87		
Calcium	mg/l		108.6		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		100		
Lead	µg/l		<5		
Magnesium	mg/l		10.19		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		22.79		
Zinc	µg/l		6		
Phosphorous	mg/l		180		
Total Alkalinity	mg/l		<1		

Parameter	Units	SW8	SW8	SW8	SW8
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.39	8.48	8.33	8.36
Conductivity	mS/cm	0.64	0.717	0.724	0.542
Temperature	°C	5.4		12.4	10.1
Ammoniacal Nitrogen	mg/l	0.43	0.19	0.2	0.2
Dissolved Oxygen	mg/l	11	10	10	9
Chloride	mg/l	26.9	22.6	22.5	18.5
Total Suspended Solids	mg/l	<10	11	15	9
BOD	mg/l	6	3	<1	2
COD	mg/l	44	<7	16	22
Potassium	mg/l		3.24		
Sodium	mg/l		11.45		
TON	mg/l		0.76		
Calcium	mg/l		99.09		
Cadmium	µg/l		<0.5		
Chromium	mg/l		<0.0015		
Copper	µg/l		<7		
Iron	µg/l		147		
Lead	µg/l		<5		
Magnesium	mg/l		9.74		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		36.61		
Zinc	µg/l		7		
Phosphorous	mg/l		129		
Total Alkalinity	mg/l		<1		

Parameter	Units	SW9 Wetland	SW9 Wetland	SW9 Wetland	SW9 Wetland
		Q-1 2009	Q-2 2009	Q-3 2009	Q-4 2009
pH	pH units	8.35	8.43	8.36	8.21
Conductivity	mS/cm	0.69	0.698	0.706	0.687
Temperature	°C	3.2	13.4	11.8	9.6
Ammoniacal Nitrogen	mg/l	0.06	0.16	<0.2	0.1
Dissolved Oxygen	mg/l	11	10	9	11
Chloride	mg/l	13.5	12.8	9.7	9.1
Total Suspended Solids	mg/l	<10	<10	<10	15
BOD	mg/l	47	4	<1	<1
COD	mg/l	290	<7	14	11
Potassium	mg/l		2.15		
Sodium	mg/l		10.4		
TON	mg/l		<0.05		
Calcium	mg/l		98.89		
Cadmium	µg/l		<0.5		
Chromium	mg/l		0.0023		
Copper	µg/l		<7		
Iron	µg/l		93		
Lead	µg/l		<5		
Magnesium	mg/l		16.07		
Manganese	µg/l		<2		
Mercury	µg/l		<0.6		
Sulphate	mg/l		234.51		
Zinc	µg/l		20		
Phosphorous	mg/l		16		
Total Alkalinity	mg/l		<1		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7
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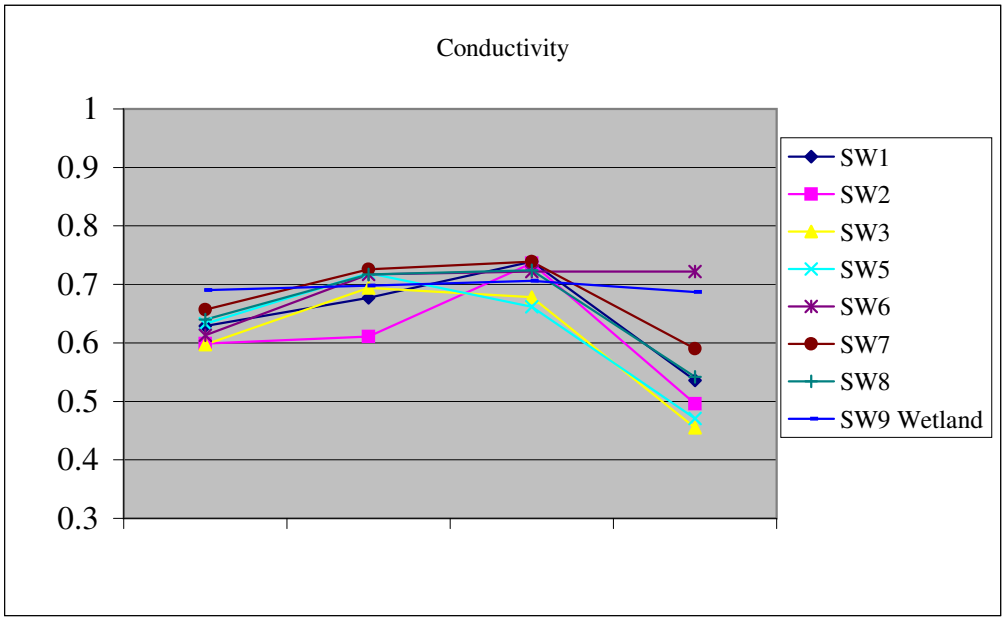
SW8
SW9 Wetland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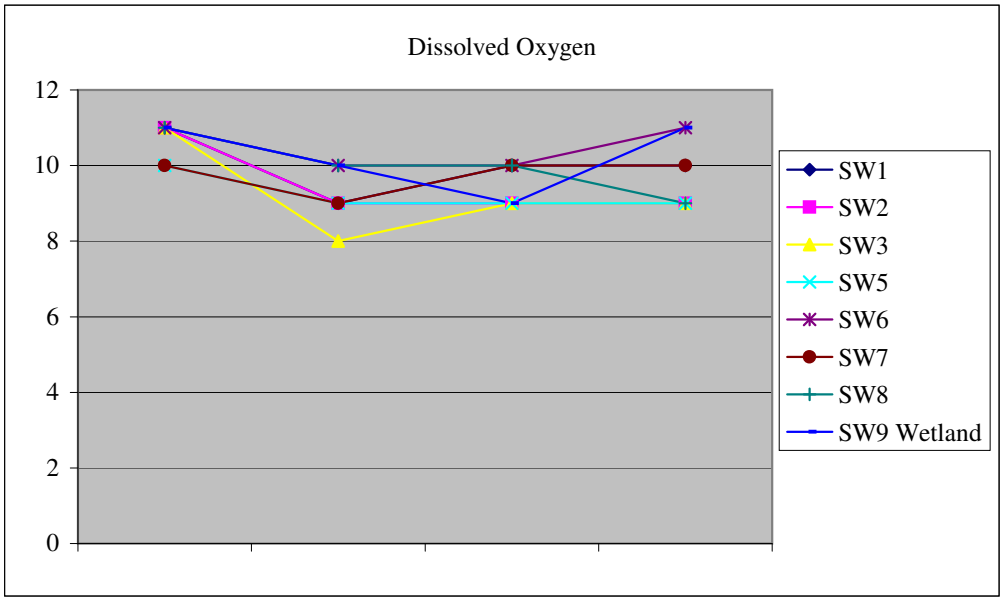
SW9 Wetland


Dissolved Oxygen
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SW1
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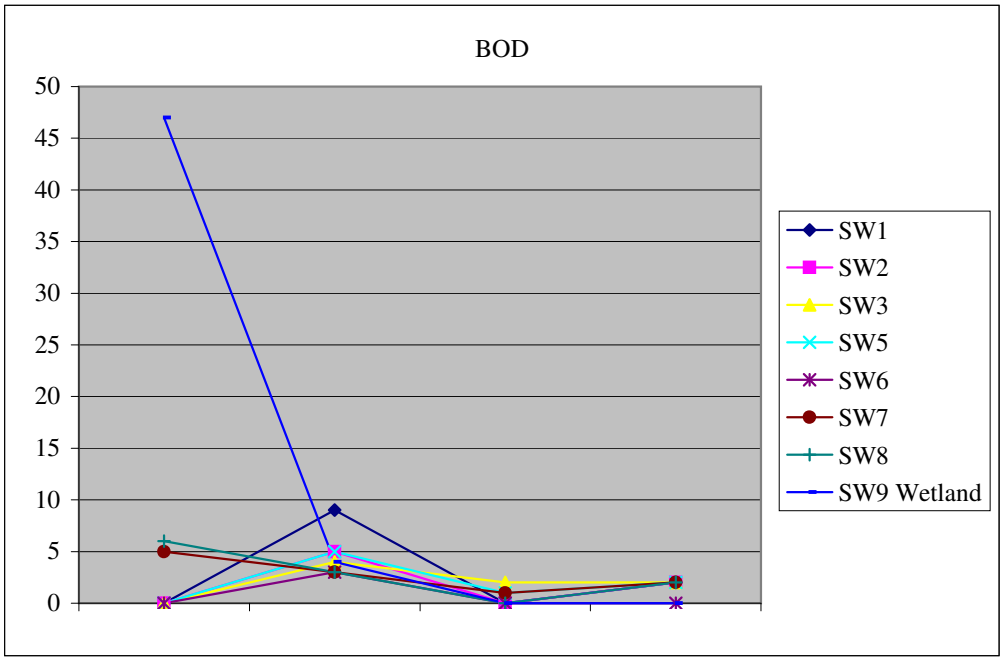
SW8
SW9 Wetland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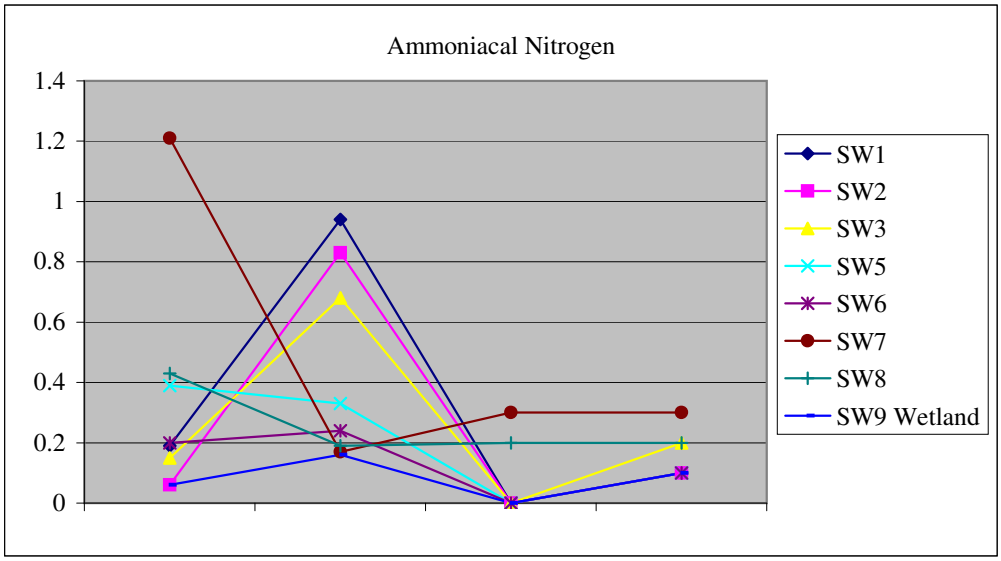
SW5
SW6
SW7
SW8
SW9 Wetland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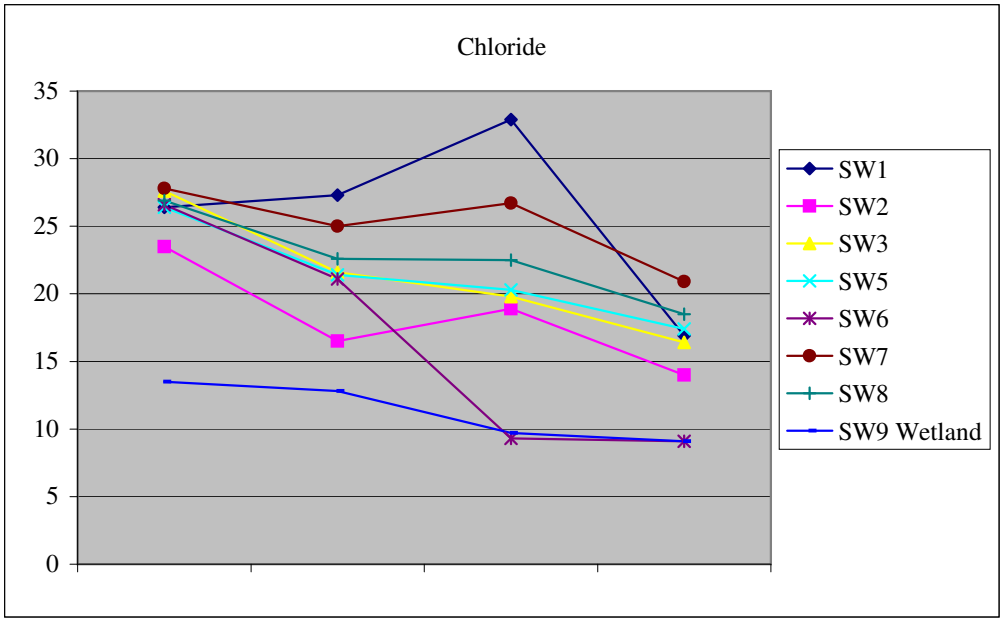
SW8
SW9 Wetland


Chloride
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SW1
SW2
SW3
SW5
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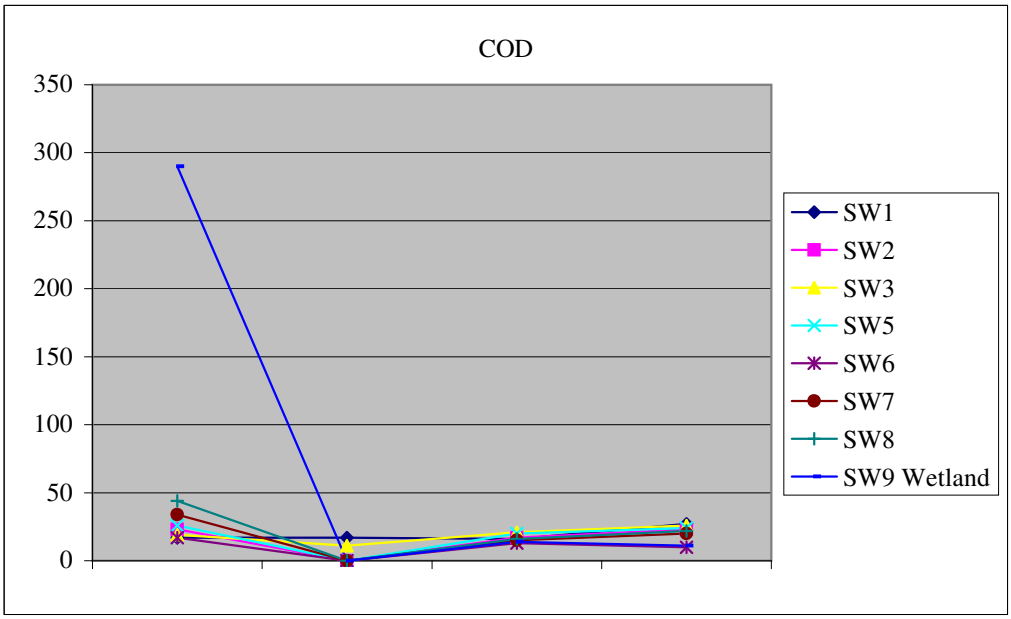
SW7
SW8
SW9 Wetland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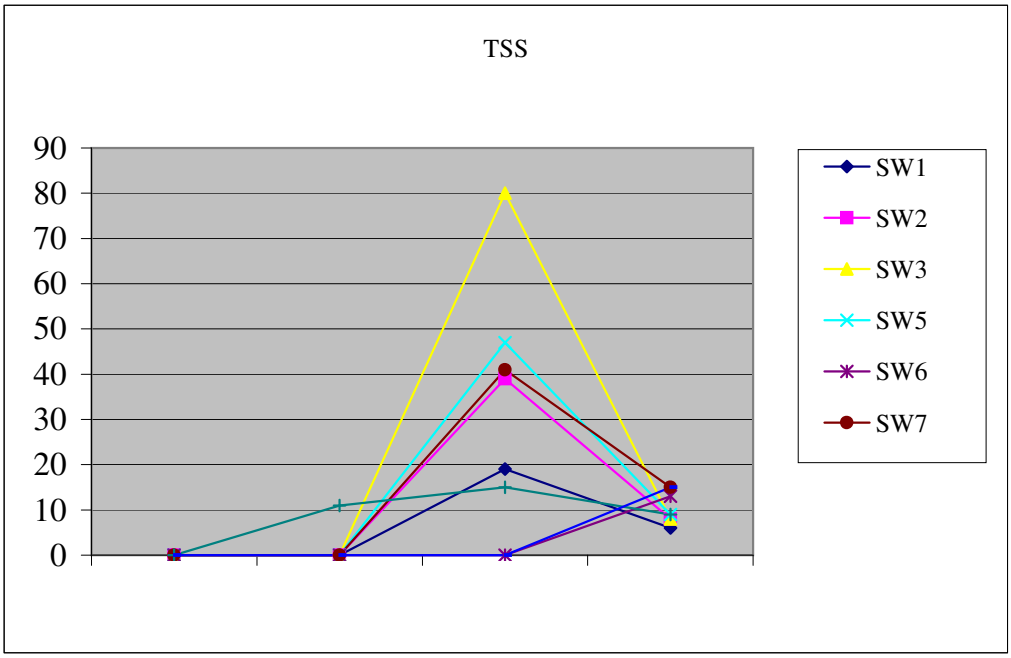
SW1
SW2
SW3
SW5
SW6
SW7
SW8
SW9 Wetland


TSS
90
80
70
60
50
40
30
20
10
0
SW1
SW2
SW3
SW5
SW6
SW7

APPENDIX 3

Energy Management Policy Statement

Knockharley Landfill
Energy Management Policy Statement

Greenstar regards environmental protection as an integral and essential part of good business practice. We are committed to achieving and maintaining a high standard of environmental quality in all of our operations.

In conjunction with Knockharley Landfill's Environmental Management System, this policy has been developed as a commitment to reduce the environmental impact of our activities and the energy consumption associated with these activities.

This Energy Management Policy declares intent to:

- Improve energy efficiency
- Reduce energy consumption where possible
- Reduce emissions of CO_2 and other harmful greenhouse gases
- Reduce consumption of finite fossil fuels
- Improve energy awareness

To achieve these, we shall establish:

- long-term goals
- medium-term objectives
- short-term targets
- an action plan for achieving all goals, objectives and targets
- an energy management plan to ensure continual review and improvement

Author: Heather Miller
Date: 17/12/08
Revision: 0

APPENDIX 4

Gas Sim Report

GasSim Version 1.54
Project Name : Knockharley
Client Name :

Gas	CAS	Reporting Threshold	Value to report	Amount Produced 25%	75%
Inorganics					
Ammonia	7664-41-7	1.00 t	n/a		
Asbestos	1332-21-4	1.00 kg	n/a		
Carbon Dioxide - 'chemical'	124-38-9	10,000.00 t	10,300.00 t	10,100.00 t	10,400.00 t
Carbon Dioxide - 'thermal'	124-38-9	10,000.00 t	0.00 g	0.00 g	0.00 g
Carbon disulphide	75-15-0	1.00 t	95.00 kg	26.10 kg	485.00 kg
Carbon monoxide	630-08-0	100.00 t	65.40 kg	11.00 kg	431.00 kg
Hydrogen chloride	7647-01-0	10.00 t	0.00 g	0.00 g	0.00 g
Hydrogen cyanide	74-90-8	100.00 kg	n/a		
Nitrous oxide	10024-97-2	10.00 t	n/a		
Phosgene	75-44-5	10.00 kg	n/a		
Sulphur hexafluoride	2551-62-4	10.00 kg	n/a		
Organics					
Acetaldehyde [Ethanal]	75-07-0	100.00 kg	2.86 kg	1.42 kg	7.59 kg
Acrolein	107-02-8	10.00 kg	n/a		
Acrylamide [2-Propenamide]	79-06-1	10.00 kg	n/a		
Acrylonitrile [2-Propenenitrile]	107-13-1	1.00 t	n/a		
Aldrin	309-00-2	1.00 kg	n/a		
Allyl alcohol [2-Propen-1-ol]	107-18-6	10.00 kg	n/a		
Amitrole [3-Amino-1,2,4-triazole]	61-82-5	1.00 kg	n/a		
Aniline [Benzeneamine]	62-53-3	10.00 kg	n/a		
Anthracene	120-12-7	10.00 kg	n/a		
Benzene	71-43-2	1.00 t	136.00 kg	76.80 kg	203.00 kg
Benzo(a)pyrene	50-32-8	1.00 kg	0.00 g	0.00 g	0.00 g
Benzo(b)fluoranthene	205-99-2	1.00 kg	n/a		
Benzo(g,h,i)perylene	191-24-2	1.00 kg	n/a		
Benzo(k)fluoranthene	207-08-9	1.00 kg	n/a		
Benzo butyl phthalate (BBP)	85-68-7	10.00 kg	n/a		
Benzyl chloride	100-44-7	10.00 kg	n/a		
Bromoethene	593-60-2	10.00 kg	n/a		
Butadiene [1,3-Butadiene]	106-99-0	100.00 kg	0.00 g	0.00 g	0.00 g
Butene - all isomers	-	1.00 t	679.00 g	258.00 g	1.69 kg
Carbon tetrachloride [Tetrachloromethane]	56-23-5	10.00 kg	0.00 g	0.00 g	0.00 g
Chlordane	57-74-9	1.00 kg	n/a		
Chlordecone	143-50-0	1.00 kg	n/a		
Chlororethane	75-00-3	10.00 kg	n/a		
Chloroform [Trichloromethane]	67-66-3	100.00 kg	1.84 kg	226.00 g	5.61 kg
Chloroprene	126-99-8	10.00 kg	n/a		
Chrysene	218-01-9	10.00 kg	n/a		
Crotonaldehyde	4170-30-3	10.00 kg	n/a		
Cumene hydroperoxide	80-15-9	10.00 kg	n/a		
Dibutyl phthalate	84-74-2	10.00 kg	n/a		
p-Dichlorobenzene [1,4-Dichlorobenzene]	106-46-7	1.00 kg	872.00 g	325.00 g	2.56 kg
Dichlorodiphenyltrichloroethane (DDT)	50-29-3	1.00 kg	n/a		
Dichloromethane (DCM) [Methylene chloride]	75-09-2	1.00 t	945.00 g	187.00 g	7.28 kg
Dieldrin	60-57-1	1.00 kg	n/a		
Diethyl aniline [N,N-Diethyl benzeneamine]	91-66-7	10.00 kg	n/a		
Di(2-ethylhexyl)phthalate (DEHP)	117-81-7	10.00 kg	n/a		
Diethyl ether	60-29-7	10.00 kg	n/a		
Diisopropyl ether	108-20-3	10.00 kg	n/a		
Dimethylaniline [N,N-Dimethyl benzeneamine]	121-69-7	10.00 kg	n/a		
Dimethyl sulphate	77-78-1	1.00 kg	n/a		
Dimethylformamide	68-12-2	1.00 t	n/a		
Dimethyl-o-toluidine	609-72-3	10.00 kg	n/a		
Dimethyl-p-toluidine	99-97-8	10.00 kg	n/a		
Dioxane	123-91-1	10.00 kg	n/a		
Diphenylamine	122-39-4	10.00 kg	n/a		
Endrin	72-20-8	1.00 kg	n/a		
2-Ethoxyethanol [Ethyleneglycol ethylether]	110-80-5	10.00 kg	n/a		
2-Ethoxyethyl acetate [Ethyleneglycol ethylether acetate]	111-15-9	1.00 kg	n/a		
Ethyl acrylate	140-88-5	10.00 kg	n/a		
Ethyl benzene	100-41-4	100.00 kg	n/a		
Ethyl bromide [Bromoethane]	74-96-4	10.00 kg	n/a		
1-Ethyl-3,5-dimethylbenzene	934-74-7	10.00 kg	n/a		
Ethylene [Ethene]	74-85-1	1.00 t	23.70 kg	11.50 kg	32.70 kg
Ethylene dichloride [1,2-Dichloroethane]	107-06-2	1.00 t	3.69 kg	511.00 g	40.20 kg
Ethylene oxide [1,2-Epoxyethane]	75-21-8	1.00 t	n/a		
Ethyl toluene - all isomers	25550-14-5	10.00 kg	326.00 g	86.10 g	953.00 g
Fluoranthene	206-44-0	1.00 kg	n/a		
Formaldehyde [Methanol]	50-00-0	10.00 kg	534.00 g	416.00 g	704.00 g
Heptachlor	76-44-8	1.00 kg	n/a		
Hexabromobiphenyl	36355-1-8	100.00 g	n/a		
Hexabromocyclododecane	25637-99-4	10.00 kg	n/a		
Hexachlorobenzene	118-74-1	1.00 kg	n/a		

Gas	CAS	Reporting Threshold	Value to report	Amount Produced 25%	75%
Hexachlorocyclohexane - all isomers	608-73-1	1.00 kg	0.00 g	0.00 g	0.00 g
Hexane	110-54-3	10.00 kg	n/a		
1-Hexene	592-41-6	10.00 kg	n/a		
Indeno(1,2,3-cd)pyrene	193-39-5	1.00 kg	n/a		
Iodomethane	74-88-4	10.00 kg	n/a		
Isophorone	78-59-1	10.00 kg	n/a		
Isophorone diisocyanate	4098-71-9	1.00 kg	n/a		
Isoprene	78-79-5	10.00 kg	n/a		
Lindane	58-89-9	1.00 kg	n/a		
Maleic anhydride	108-31-6	10.00 kg	n/a		
Methane	74-82-8	10.00 t	4,440.00 t	4,370.00 t	4,470.00 t
Methanol	67-56-1	100.00 kg	n/a		
2-(Methoxyethoxy)ethanol	111-77-3	10.00 kg	n/a		
2-Methoxyethanol	109-86-4	10.00 kg	n/a		
2-Methoxyethyl acetate	110-49-6	10.00 kg	n/a		
Methyl bromide [Bromomethane]	74-83-9	100.00 kg	n/a		
2-Methyl-2-butene	513-35-9	10.00 kg	n/a		
3-Methyl-1-butene	563-45-1	100.00 kg	n/a		
Methyl chloride [Chloromethane]	74-87-3	1.00 t	2.41 kg	861.00 g	7.28 kg
Methyl chloroform [1,1,1-Trichloroethane]	71-55-6	10.00 kg	49.20 kg	2.11 kg	479.00 kg
4,4'-Methylene-bis(2-chloroaniline)	101-14-4	1.00 kg	n/a		
4,4'-Methylene dianiline	101-77-9	10.00 kg	n/a		
4,4'-Methylenediphenyl diisocyanate	101-68-8	1.00 kg	n/a		
Methyl isocyanate	624-83-9	1.00 kg	n/a		
Mirex	2385-85-5	1.00 kg	n/a		
Naphthalene	91-20-3	100.00 kg	n/a		
Nitrobenzene	98-95-3	10.00 kg	n/a		
2-Nitropropane	79-46-9	1.00 kg	n/a		
Pentachlorobenzene	608-93-5	1.00 kg	n/a		
Pentachlorophenol	87-86-5	1.00 kg	n/a		
Pentane	109-66-0	100.00 kg	5.03 kg	1.55 kg	35.10 kg
Pentene - all isomers	25377-72-4	1.00 t	19.70 kg	9.15 kg	36.30 kg
Phenol	108-95-2	10.00 kg	0.00 g	0.00 g	0.00 g
Propylbenzene	103-65-1	10.00 kg	n/a		
Propylene	115-07-1	10.00 t	n/a		
Propylene oxide	75-56-9	100.00 kg	n/a		
Styrene	100-42-5	100.00 kg	n/a		
Tetrachloroethane [1,1,2,2-Tetrachloroethane]	79-34-5	10.00 kg	4.67 kg	278.00 g	47.20 kg
Tetrachloroethylene	127-18-4	100.00 kg	2.14 kg	156.00 g	39.50 kg
Tetrafluoroethylene	116-14-3	10.00 kg	n/a		
Toluene	108-88-3	100.00 kg	10.00 kg	1.16 kg	49.90 kg
Toluene diisocyanate - all isomers	-	10.00 kg	n/a		
Toxaphene	8001-35-2	1.00 kg	n/a		
Trichlorobenzene - all isomers	12002-48-1	1.00 kg	187.00 g	121.00 g	298.00 g
Trichloroethylene	79-01-6	1.00 t	26.10 kg	11.10 kg	85.20 kg
Trichlorotoluene	98-07-7	10.00 kg	n/a		
Trimellitic anhydride	552-30-7	1.00 kg	n/a		
Trimethylbenzene - all isomers	25551-13-7	10.00 kg	964.00 g	158.00 g	10.10 kg
Vinyl acetate	108-05-4	10.00 kg	n/a		
Vinyl chloride	75-01-4	1.00 t	185.00 kg	68.90 kg	573.00 kg
Xylene - all isomers	1330-20-7	1.00 t	4.11 kg	80.50 g	120.00 kg
Metals and compounds					
Antimony	7440-36-0	1.00 kg	n/a		
Arsenic	7440-38-2	1.00 kg	n/a		
Beryllium	7440-41-7	1.00 kg	n/a		
Boron	7440-42-8	1.00 t	n/a		
Cadmium	7440-43-9	1.00 kg	n/a		
Chromium	7440-47-3	10.00 kg	n/a		
Copper	7440-50-8	10.00 kg	n/a		
Lead	7439-92-1	100.00 kg	n/a		
Manganese	7439-96-5	10.00 kg	n/a		
Mercury	7439-97-6	1.00 kg	n/a		
Nickel	7440-02-0	10.00 kg	n/a		
Selenium	7782-49-2	100.00 kg	n/a		
Vanadium	7440-62-2	10.00 kg	n/a		
Zinc	7440-66-6	100.00 kg	n/a		
Other substances					
Brominated diphenylethers - penta, octa and deca	-	10.00 kg	n/a		
Chlorine and total inorganic compounds - as HCl	7782-50-5	10.00 t	n/a		
Chlorofluorocarbons (CFCs)	EDF-079	1.00 kg	266.00 kg	22.60 kg	649.00 kg
Dioxins and furans (PCDDs/PCDFs) - I-TEQ	-	0.01 g	0.00 g	0.00 g	0.00 g
Dioxins and furans (PCDDs/PCDFs) - WHO-TEQ	-	0.01 g	n/a		
Fluorine and total inorganic compounds - as HF	7782-41-4	1.00 t	n/a		
Halons	-	1.00 kg	0.00 g	0.00 g	0.00 g
Hydrobromofluorocarbons (HBFCs)	-	10.00 kg	n/a		
Hydrochlorofluorocarbons (HCFCs)	-	1.00 kg	103.00 kg	14.40 kg	378.00 kg
Hydrofluorocarbons (HFCs)	-	100.00 kg	0.00 g	0.00 g	0.00 g
Nitrogen oxides - NO and NO2 as NO2	-	100.00 t	0.00 g	0.00 g	0.00 g
Non-methane volatile organic compounds (NMVOCs)	-	10.00 t	0.00 g	0.00 g	0.00 g

Gas	CAS	Reporting Threshold	Value to report	Amount Produced 25%	75%
Particulate matter - PM2.5	-	1.00 t	n/a		
Particulate Matter - PM10	-	1.00 t	0.00 g	0.00 g	0.00 g
Particulate Matter - total	-	10.00 t	n/a		
Perfluorocarbons (PFCs)	-	10.00 kg	0.00 g	0.00 g	0.00 g
Polychlorinated biphenyls (PCBs)	1336-36-3	100.00 g	n/a		
Polychlorinated Biphenyls (PCBs) - as WHO TEQ	1336-36-3	0.01 g	n/a		
Sulphur oxides - SO2 and SO3 as SO2	-	100.00 t	0.00 g	0.00 g	0.00 g

APPENDIX 5

Odour Management Plan
Nuisance Procedure

Title	Odour Management Plan				
Ref	KNKP 33	**Rev**	1	**Date**	14/04/07
Issued.	RW	**App**.	RW	**Pg**	1/3

01. Scope

This procedure addresses all aspects of odour control and landfill gas management.

02. Responsibility

The FM will implement this procedure and will, together with the site supervisor, ensure that the procedure is correctly followed. All site staff will notify the FM or the SS about any relevant observations and ensure that all required corrective action is implemented.

03. References

GS 001 Daily Site Condition Report

GS 003 Weekly Inspection Sheet

GS 005 Odour Inspection Record

GS 037 Flare Downtime Log

KNKP 23 Completion of Daily Site Condition Reports

KNKP 30 Weekly Inspection Procedure

KNKP 31 Odour Control and Monitoring

KNKP 32 Nuisance Inspection Procedure

KNKP 34 Operation of Landfill Gas Flare

Waste Licence 146-1

04. PROCEDURE

4.1. *Odour Inspections*

Odour inspections shall be carried out in accordance with Nuisance Inspection Procedure KNKP 32, as follows:

Odour Inspections shall be carried out in accordance with guidance notes on the Odour Inspection Record (GS 005) on a daily basis on and/or off site as required and any findings recorded on the Daily Site Condition Report (GS 001) and the Weekly Inspection Form (GS 003) as well as the Odour Inspection Record (GS 005).

Any odour inspections carried out following receipt of a complaint, shall have particular regard to the location to which the complaint relates and shall also have regard to any other observations or other activities in the area that could have contributed to complaints, e.g. spreading of slurry by farmers etc.

4.2. *Odour Monitoring*

All odour monitoring will be carried out in accordance with the Odour Control and Monitoring Procedure KNKP 31.

4.3. *Operational Requirements*

All operational activities shall consider the requirements as descried in the Odour Control and Monitoring Procedure KNKP 31, with particular regard to the acceptance and/or rejection of odorous loads as well as the application of daily cover material and temporary capping.

It shall be ensured that the joint between vertical bunds and horizontal layers of daily cover material and temporary capping is not less than the required 150 mm and 300 mm respectively, as it is a potentially weak point which could provide a migration path for landfill gas as well as waste odours.

Appendix 1 describes the planned phasing of waste deposition such as to minimise the potential for odour emissions.

4.4. *Landfill Gas Management*

4.4.1. Monitoring of fugitive emissions

The monitoring of fugitive emissions of landfill gas shall be carried out on a quarterly basis or as appropriate by means of PID surveys as described in the Odour Control and Monitoring Procedure KNKP 31.

The employment of thermography as a further tool of establishing potential emissions of fugitive landfill gas shall be considered on an annual basis.

4.5. *Landfill Gas Extraction*

Extraction of landfill gas shall be carried out through vertical wells, progressively constructed and retrofitted as required, as well as horizontal extraction wells.

4.5.1. Vertical Wells

Vertical landfill gas extraction wells shall be constructed, progressively with the development of the landfill, at 50 meter lateral and longitudinal centres. Additionally, vertical wells shall be drilled into the waste as required and determined by surveys of fugitive emissions, in order to minimise or eliminate landfill gas migration. The additional drilled wells shall be installed between the constructed main gas extraction wells, so as to reduce the distances between the individual wells and to increase the capture rate of landfill gas. It shall be ensured that the vertical gas wells are sealed at surface with bentonite as required in order to minimise the ingress of oxygen and the potential for migration of landfill gas.

4.5.2. Horizontal wells

In order to further enhance gas extraction and commencing in phase 2 of the landfill (i.e. cells 5 and 6 and higher), horizontal gas wells, consisting of slotted gas extraction pipes embedded in stone filled trenches of no less than 1 m^2 sections (i.e. 1 meter depth and 1 meter width), shall be installed in the surface of lifts at least 5 meters above the cell bases and, in areas with a total landfill depth of more than 18 meters, at least 5 meters below the finished waste level as appropriate. It shall be ensured

that horizontal trenches are installed as close as possible before filling the next lift of waste above in order to minimise the potential for migration of landfill gas from the trenches. Should this not be possible, a seal of bentonite shall be applied to the top of the trenches.

4.5.3. Landfill gas collection network

All vertical and horizontal landfill gas extraction wells shall be connected to the gas collection pipe network which shall consist of a 355 mm ring main around the landfill footprint and 180 mm branches laid across the landfill surface. Each individual well as well as each individual branch shall, prior the point of connection into the next higher collection level (i.e. well-branch connections and branch-ring main connections) be equipped with shut-off valves, in order to enable flow restriction or isolation of individual wells or branches.

4.5.4. Condensate removal

In order to continuously remove condensate from the landfill gas extraction network and therefore avoid uncontrolled flow restriction and pulsating, the ring main shall be connected to the gas flaring and utilisation plant via condensate knockout pots. The condensate accumulating in these pots shall be removed by pneumatic pumps and piped back into the leachate riser pipes, from where it can drain to the cell base and be removed with the leachate.

4.6. *Landfill gas utilisation and flaring plant*

The landfill gas collected in the landfill gas extraction and collection network shall, after passing through the condensate knockout pots, be flared off in an enclosed flare or utilised in gas combustion engines with electricity generation, as appropriate. The sizing of the gas utilisation and flaring equipment shall be planned ahead, in conjunction with expert consultants and subject to the appropriate planning permissions, so that no excess landfill is generated at any stage. Contingency arrangements shall be made to avoid gas venting in the case of plant failures.

The procedure KNKP 34 for the operation of landfill gas flares shall be extended to incorporate the modified enclosed gas flare currently in operation at the facility as soon as the modified operation and maintenance manual for the flare is obtained from the contractor. It shall address the operational requirements to optimise the combustion rates.

Procedure KNKP 35 (in progress – not yet finalised) describes the monitoring and balancing of landfill gas extraction wells and collection network in order to maximise the extraction of landfill gas.

Any significant downtime of landfill gas flares or other utilisation equipment shall be logged on Form GS 037, detailing as a minimum the date(s), time(s) and reason(s) for the downtime of the flare.

Title	Nuisance Inspection Procedure				
Ref	KNKP 32	**Rev**	0	**Date**	13/02/07
Issued.	RW	**App**.	RW	**Pg**	1 /3

1.0 Scope

This procedure documents the approach to be taken when carrying out nuisance inspections at the facility.

2.0 Responsibility

The FM will implement this procedure and site supervisor will ensure the procedure is correctly followed. All site staff will notify the FM or the SS about any observations and will take any other measures necessary to avoid any nuisances from arising outside the facility boundary. The Bird Control and Vermin Control Contractor and their staff will carry out all duties required under the conditions of their contracts and will notify the Facility Management of any other observations which might have the potential to give rise to nuisances outside the facility boundary.

3.0 References

Daily Site Condition Report GS 001

Weekly Inspection Sheet GS 003

Odour Inspection Record GS 005

Weekly Inspection Procedure KNKP 30

Daily Site Condition Report KNKP 23

Licence Condition 7.1: The licensee shall ensure that vermin, birds, flies, mud, dust, litter and odours do not give rise to nuisance at the facility or in the immediate area of the facility. Any method used by the licensee to control any such nuisance shall not cause environmental pollution

Licence Condition 8.14 Nuisance Monitoring: The licensee shall, at a minimum of one week intervals, inspect the facility and its immediate surrounds for nuisances caused by litter, vermin, birds, flies, mud, dust and odours.

4.0 Procedure

4.1 Litter

Litter Inspections shall be carried out and recorded as part of the weekly inspection, which is outlined in the Weekly Inspection Procedure KNKP 30 and the Procedure for completion of the Site Condition Report KNKP 23. It is of importance that the 5 individual areas, sections A to E as outlined in the Weekly Inspection Procedure and the Weekly Inspection Form GS 003, are inspected at a frequency of one per day if practicable. 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.

4.2 Vermin and 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. The bird control operator, who carries out regular bird control duties on site, shall assist the Site Supervisor by notifying him of any unusual observations. He shall also record any observations in the daily bird control report. Any observations made during inspections shall be recorded on the Daily Site Condition Report GS 001 and the Weekly Inspection Form GS 003.

4.3 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 GS 001 and the Weekly Inspection Form GS 003. The Facility Manager or the Site Supervisor shall be notified immediately in order to take measures to eliminate any fly populations from establishing. The areas around the Surface Water Lagoon and the Wetland as well as the immediate vicinity of the working face shall be inspected with particular intensity, as these are the most likely locations for fly populations to develop.

4.4 Mud and Dust

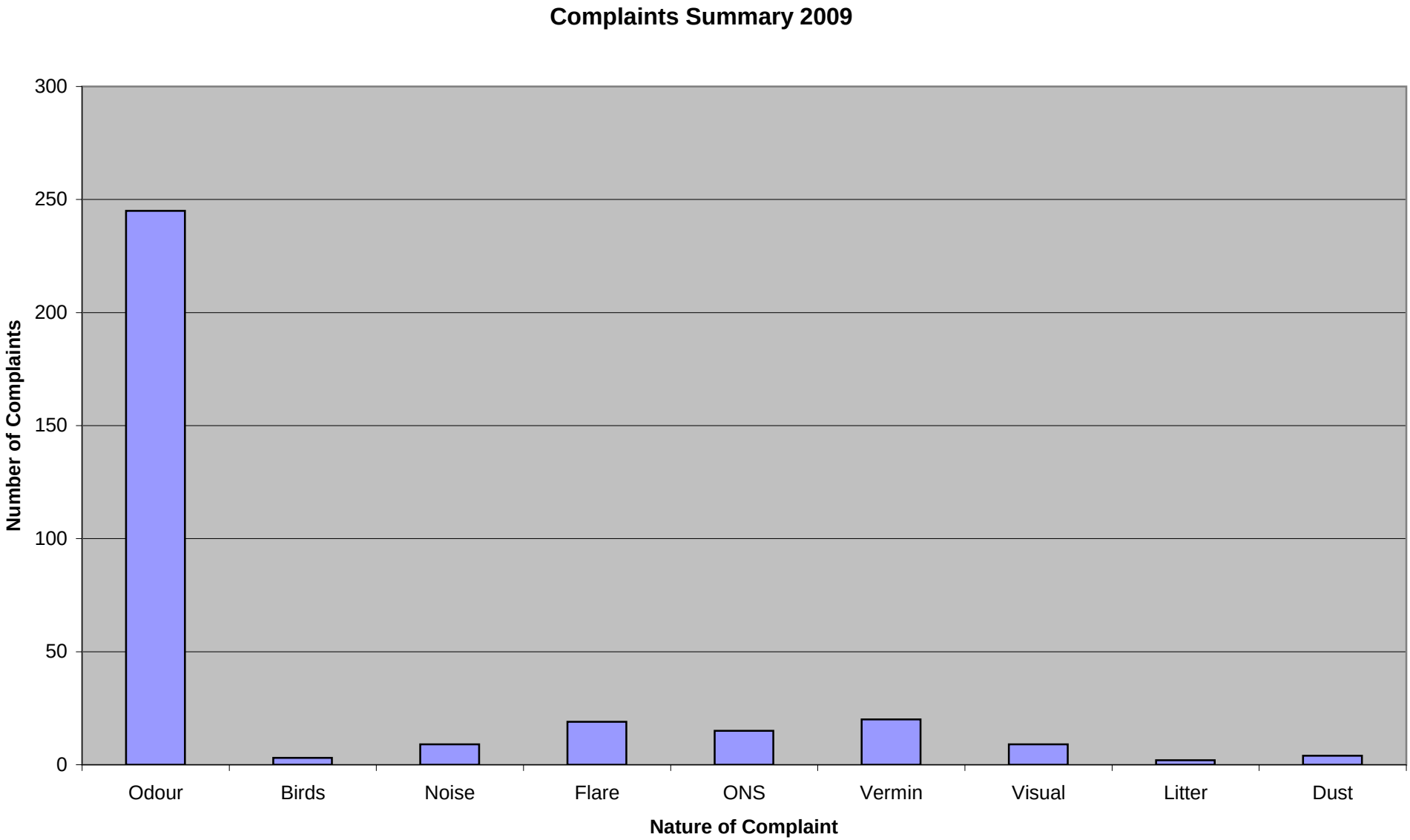
The site roads shall be inspected on a daily basis for mud or dust and any observations recorded on the Daily Site Condition Report GS 001 and the Weekly Inspection Form GS 003. Special attention shall be paid to dust during the dry months and mud during the wet months and the Site Supervisor or the Facility Manager notified immediately in order to take measures to minimise or eliminate any potential nuisances arising from mud or dust accumulating on site roads.

4.5 Odour

Odour Inspections shall be carried out in accordance with guidance notes on the Odour Inspection Record GS 005 on a daily basis on and/or off site as required and any findings recorded on the Daily Site Condition Report GS 001 and the Weekly Inspection Form GS 003 as well as the Odour Inspection Record GS 005. Any odour inspections carried out following receipt of a complaint, shall have particular regard to the location to which the complaint relates and shall also have regard to any other observations or other activities in the area that could have contributed to complaints, e.g. spreading of slurry by farmers etc.

APPENDIX 6

Complaints 2009


Complaints Summary 2009
300
250
200
150
100
50
0
Number of Complaints
Odour
Birds
Noise
Flare
ONS
Vermin
Visual
Litter
Dust
Nature of Complaint

APPENDIX 7

E-PRTR Returns

| PRTR# : W0146 | Facility Name : Knockharley Landfill | Filename : Appendix 7.xls | Return Year : 2009 |

AER Returns Worksheet

Version 1.1.10

REFERENCE YEAR	2009

1. FACILITY IDENTIFICATION

Parent Company Name	Greenstar Holdings Limited
Facility Name	Knockharley Landfill
PRTR Identification Number	W0146
Licence Number	W0146-01

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	Knockharley
Address 2	Navan
Address 3	(Includes Townlands of Tuiterath & Flemingstown)
Address 4	Co. Meath
Country	Ireland
Coordinates of Location	-6.52819 53.6439
River Basin District	IEEA
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	John Jones (W0146)
AER Returns Contact Email Address	john.jones@greenstar.ie
AER Returns Contact Position	Landfill Manager
AER Returns Contact Telephone Number	041-9821650 / 086-8189533
AER Returns Contact Mobile Phone Number	
AER Returns Contact Fax Number	
Production Volume	0.0
Production Volume Units	
Number of Installations	0

Number of Operating Hours in Year	0
Number of Employees	0
User Feedback/Comments	
Web Address	

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

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR									
POLLUTANT		METHOD					QUANTITY		
			Method Used		Flare 1	Flare 2			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
08	Nitrogen oxides (NOx/NO2)	C	PER	Calculated based on emissons from flare and total LFG flared in year	826.64266	1033.303	1859.94566	0.0	0.0
11	Sulphur oxides (SOx/SO2)	C	PER	Calculated based on emissons from flare and total LFG flared in year	23114.311	7757.336	30871.647	0.0	0.0
03	Carbon dioxide (CO2)	E	Estimate	Fugitive emission based on GasSim Model	127.74077	131.3411	752489.68187	0.0	752230.6
01	Methane (CH4)	E	Estimate	Fugitive emission based on GasSim Model	11.521152	25.34653	278345.767682	0.0	278308.9

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR									
POLLUTANT		METHOD					QUANTITY		
			Method Used		Flare 1	Flare 2			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
84	Fluorine and inorganic compounds (as HF)	C	PER	Calculated based on emissons from flare and total LFG flared in year	0.0	8.064806	8.064806	0.0	0.0
80	Chlorine and inorganic compounds (as HCl)	C	PER	Calculated based on emissons from flare and total LFG flared in year	56.741674	67.83078	124.572454	0.0	0.0
					0.0	0.0	0.0	0.0	0.0

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

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

RELEASES TO AIR									
POLLUTANT		METHOD					QUANTITY		
			Method Used		Flare 1	Flare 2			
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	Emission Point 2	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
351	Total Organic Carbon (as C)	C	PER	Calculated based on emissons from flare and total LFG flared in year	50.693069	43.78038	94.473449	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: Knockharley Landfill

Please enter summary data on the quantities of methane flared and / or utilised	T (Total) kg/Year	M/C/E	Method Used: Method Code	Method Used: Designation or Description	Facility Total Capacity m3 per hour	
Total estimated methane generation (as per site model)	4440000.0	E	Estimate	Estimate based on Gas Sim Model	N/A	
Methane flared	4161691.0	C	PER	Calculated based on percen	1767.0	(Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	278345.767682	E	Estimate	Estimate based on Gas Sim	N/A	

4.2 RELEASES TO WATERS

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 on

RELEASES TO WATERS								
POLLUTANT					QUANTITY			
			Method Used		SW-9			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
79	Chlorides (as Cl)	C	EN ISO 17025	Calculated on the flow from the wetland	1303.751	1303.751	0.0	0.0
24	Zinc and compounds (as Zn)	C	EN ISO 17025	Calculated on the flow from the wetland	2.31264	2.31264	0.0	0.0
19	Chromium and compounds (as Cr)	C	EN ISO 17025	Calculated on the flow from the wetland	0.266	0.266	0.0	0.0
13	Total phosphorus	C	EN ISO 17025	Calculated on the flow from the wetland	1.850112	1.850112	0.0	0.0

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

SECTION B : REMAINING PRTR POLLUTANTS

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

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

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

RELEASES TO WATERS								
POLLUTANT					QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
238	Ammonia (as N)	C	EN ISO 17025	Calculated on the flow from the wetland	12.334	12.334	0.0	0.0
240	Suspended Solids	C	EN ISO 17025	Calculated on the flow from the wetland	1734.48	1734.48	0.0	0.0
303	BOD	C	EN ISO 17025	Calculated on the flow from the wetland	2948.616	2948.616	0.0	0.0
306	COD	C	EN ISO 17025	Calculated on the flow from the wetland	12141.36	12141.36	0.0	0.0
338	Potassium	C	EN ISO 17025	Calculated on the flow from the wetland	248.609	248.609	0.0	0.0
341	Sodium	C	EN ISO 17025	Calculated on the flow from the wetland	1202.573	1202.573	0.0	0.0
305	Calcium	C	EN ISO 17025	Calculated on the flow from the wetland	11434.848	11434.848	0.0	0.0
357	Iron	C	EN ISO 17025	Calculated on the flow from the wetland	10.753776	10.753776	0.0	0.0
320	Magnesium	C	EN ISO 17025	Calculated on the flow from the wetland	1858.206	1858.206	0.0	0.0
343	Sulphate	C	EN ISO 17025	Calculated on the flow from the wetland	27116.86	27116.86	0.0	0.0
					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

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER

POLLUTANT		METHOD			QUANTITY			
			Method Used		LES			
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
79	Chlorides (as Cl)	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	23535.5862	23535.5862	0.0	0.0
13	Total phosphorus	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	131.9626	131.9626	0.0	0.0
19	Chromium and compounds (as Cr)	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	3.3399625	3.3399625	0.0	0.0
83	Fluorides (as total F)	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	11.685	11.685	0.0	0.0
24	Zinc and compounds (as Zn)	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	2.979675	2.979675	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

POLLUTANT		METHOD			QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
238	Ammonia (as N)	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	13997.9484	13997.9484	0.0	0.0
303	BOD	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	6874.675	6874.675	0.0	0.0
306	COD	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	37586.75	37586.75	0.0	0.0
341	Sodium	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	20390.325	20390.325	0.0	0.0
338	Potassium	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	9558.33	9558.33	0.0	0.0
374	Boron	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	76419.9	76419.9	0.0	0.0
305	Calcium	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	4829.8	4829.8	0.0	0.0
357	Iron	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	827.88225	827.88225	0.0	0.0
320	Magnesium	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	2317.525	2317.525	0.0	0.0
321	Manganese (as Mn)	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	804.3175	804.3175	0.0	0.0
343	Sulphate	C	EN ISO 17025	Calculated on the amount of leachate removed during the year	830.60875	830.60875	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

SECTION A : PRTR POLLUTANTS

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

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

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

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

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

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

| PRTR# : W0146 | Facility Name : Knockharley Landfill | Filename : Appendix 7.xls | Return Year : 2009 |

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Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	**16 01 06**	**No**	0.36	Batteries	R4	M	Weighed	Offsite in Ireland	Returnbatt Ltd.,97/2002	Returnbatt Ltd.,Old Mill Industrial Estate.,Kill.,Co. Kildare.,Ireland		
Within the Country	19 07 03	No	16528.96	Leachate	R3	C	Weighed	Offsite in Ireland	Navan Wate Water,Treatment	Navan Waste Water Treatment.,Navan.,Navan.,Co. Meath.,Ireland		

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