



GREENSTAR LTD. - KNOCKHARLEY LANDFILL, CO. MEATH

ANNUAL ENVIRONMENTAL REPORT:

Report Period: January 2011 – December 2011

WASTE LICENCE REF. NO. W0146-02

Original

April 2012





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Abstract: This report details the Annual Environmental Report for the Knockharley Landfill, Co. Meath for the reporting period from 1st January 2011 to 31st December 2011. This report was prepared in order to fully comply with the requirements of the EPA Waste Licence Reg. No. W0146-02.

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Section 1

Introduction



1. INTRODUCTION

The Environmental Protection Agency (EPA) issued Greenstar with Waste Licence Reg. No. W0146-01 for a landfill at Knockharley, Navan, Co. Meath on 19th of March, 2003. A revision of the licence, W0146-02 was issued by the EPA on 23rd of March 2010.

The facility has been in operation since 2004 and is being developed on a phased basis. Final capping of the perimeter of Cells 1 to 4 was completed in 2009. The uncapped areas of Cells 1 to 4 are now at final height and final capping works in this area is scheduled to be completed in 2012. Progressive intermediate capping is ongoing in the remaining cells. Cell 11 and Cell 12 were constructed during 2009, but waste placement did not commence during the reporting period. 25 additional landfill gas extraction wells were drilled and installed during 2011; 11 in February and 14 in October.

Greenstar retained Fehily Timoney & Company (FTC) to prepare the Annual Environmental Report (AER) for the facility for the reporting period January 2011 to December 2011. This report has been prepared in accordance with Condition 11.7 and Schedule E & F of the waste licence.

The site is located in a rural area, approximately 1.5 km north of Kentstown Village and 7 km south of Slane, just off the N2 (Dublin to Derry Road). 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.

This report addresses Condition 11.7 of the waste licence for the facility.

Condition 11.7 states that:

11.7 Annual Environmental Report

11.7.1 The licensee shall submit to the Agency for its agreement by 31st March of each year an Annual Environmental Report (AER) covering the previous calendar year.

11.7.2 The AER shall include as a minimum the information specified in Schedule F: Content of Annual Environmental Report of this licence and shall be prepared in accordance with any relevant written guidance issued by the Agency.

This report addresses the items listed in *Schedule F: Content of Annual Environmental Report* of the waste licence for the facility.

1.1. Statement of compliance of facility with any updates of the relevant waste Management Plan

Compliance is considered during the planning and licensing processes and on that basis the facility is compliant.

1.2. Statement on the achievement of the waste acceptance and treatment obligations

In compliance with licence Condition 5.3 and in line with the facility's Environmental Management System (EMS) all waste accepted at this facility is in accordance with comprehensive waste acceptance procedures. Following a review of the facility licence in 2010, revised and updated Waste Acceptance Procedures (KNKP 24, KNKP 24B, KNKP 25) were submitted to the Agency on 1st October 2010.

In compliance with Condition 1.6 only waste that has been subject to treatment is accepted for disposal at the facility. Furthermore, this facility submits quarterly summary reports to the Agency on the quantity of MSW and BMW accepted at the landfill during the preceding quarter and on a cumulative basis for the calendar year.

1.3. Reporting Period

The reporting period for the AER is 1st January to 31st December 2011.

Section 2

Waste Activities & Records



2. WASTE ACTIVITIES & RECORDS

2.1. Waste Activities Carried out at the Facility

Knockharley Landfill is a fully engineered and contained landfill site. It is licensed to accept 175,000 tonnes per annum of waste for disposal, as follows:

Table 2.1: Waste Acceptance Categories and Quantities

Waste Type	Maximum (Tonnes per Annum)
Household	100,000
Commercial	45,000
Industrial	30,000
Subtotal Total Waste for Disposal	175,000
Construction & Demolition for recovery at the facility	25,000
TOTAL	200,000

Waste activities at the facility are restricted to those outlined in *Part 1 - Activities Licensed* of the Waste Licence.

Licensed waste disposal activities, in accordance with the Third Schedule of the Waste Management Acts 1996 to 2010

- Class 1 Deposit on, in or under land (including landfill)**
This activity is limited to the disposal of non-hazardous wastes specified in Condition 1.4 in lined cells that are on, in and under land.
- Class 4 Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons.**
This activity is limited to the storage of leachate in a lagoon prior to disposal off-site at a suitable waste water treatment plant and the use of a surface water pond to control the quality and quantity of the surface water run-off from the site.
- Class 5 Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment.**
This activity is limited to the deposition of non-hazardous waste into lined cell(s).
- Class 6 Biological treatment not referred to elsewhere in this Schedule which results in final compounds of mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 10 of this Schedule.**
This activity is limited to possible future biological pre-treatment of leachate subject to the agreement of the Agency.
- Class 13 Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned was produced.**
This activity is limited to the temporary storage of unacceptable wastes in the waste quarantine area prior to transport to another site .

Licensed waste recovery activities, in accordance with the Fourth Schedule of the Waste Management Acts 1996 to 2010

- Class 4 Recycling or reclamation of other inorganic materials:**
This activity is limited to the use of recycled construction and demolition waste as cover and/or construction material at the site.

- Class 9** **Use of any waste principally as a fuel or other means to generate energy:**
This activity is limited to the utilisation of landfill gas
- Class 11** **Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule.**
This activity is limited to the use of construction and demolition waste on site.
- Class 13** **Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced:**
This activity is limited to the storage of construction and demolition waste on site prior to reuse. .

2.2. Waste Quantities and Composition 2005 - 2011

The quantities and types of wastes accepted for disposal and recovery at Knockharley Landfill are presented in Table 2.2 for the years 2004, 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

Table 2.2: Waste Quantities Accepted at Knockharley Landfill from 2004 – 2011

Waste Type – European Waste Code Categories	Description	Total Accepted 2004 (tonnes)	Total Accepted 2005 (tonnes)	Total Accepted 2006 (tonnes)	Total Accepted 2007 (tonnes)	Total Accepted 2008 (tonnes)	Total Accepted 2009 (tonnes)	Total Accepted 2010 (tonnes)	Total Accepted 2011 (tonnes)
<i>Waste for disposal</i>									
EWC 02 02 03	Wastes from the preparation and processing of meat, fish and other foods of animal origin - materials unsuitable for consumption or processing		7						
EWC 02 06 01	Confectionary waste							17.08	
EWC 06 05 03	Effluent Sludge (Non Hazardous)						52.42		
EWC 06 13 99	Spent activated carbon								27.70
EWC 08 03 15	Ink sludges other than those mentioned in 08 03 14						147.38	113.9	96.92
EWC 10 03 05	Waste Alumina						10.48		
EWC 11 01 10	Industrial Filter Cake (Non Hazardous)						537.38	331.78	271.26
EWC 12 01 17	Waste Blasting Material						110.78	104.92	12.46
EWC 16 03 04	Stabilised Inorganic Filter Cake						735.98		
EWC 17 06 04	Insulation Materials						1.7		
EWC 17 09 04	Mixed Construction and Demolition Waste							154.62	0.86
EWC 18 02 03	Wastes from human or animal health care and/or related research		0.22						
EWC 19 02 03	Physio/Chemical Treated Waste						315.84	589.32	21.20
EWC 19 03 05	Stabilised Inorganic Filter Cake						48.28	7.6	
EWC 19 05 99	Stabilised Waste - Residual Fraction								902.86
EWC 19 08 99	Bio Plant Residual Solids							2.7	
EWC 19 09 02	Filter cake from water treatment						17.24		
EWC 19 09 05	Filter cake from water treatment						39.88		27.16
EWC 19 12 09	Minerals-Fines/Stones and Concrete								8.36
EWC 19 12 12	Residual municipal and commercial waste		98,125.18		92,009.82	101,380.76	92,304.54	75,116.59	38,887.24
EWC 19 13 02	Solid wastes from soil remediation					9,107.30			
EWC 20 01 01	Paper and Cardboard							38.02	2.36
EWC 20 01 11	Textiles								34.18
EWC 20 01 39	Plastics							16.38	31.20
EWC 20 01 99	Other MSW not specified				27.5				
EWC 20 03 01	Mixed Municipal Waste	909.54	37,988.84	133,119.48	44,144.59	23,126.38	12,576.38	26,635.48	34,214.96
EWC 20 03 03	Street cleaning waste						69.46	99.84	2,603.22
EWC 20 03 07	Municipal Bulky Waste					144.44	27,105.50	32,700.70	12,435.36
Total waste for disposal		909.54	136,121.24	133,119.48	136,181.91	133,758.88	134,073.24	135,928.93	89577.30
<i>Waste for recovery</i>									
EWC 11 01 10	Sludges and filter cakes				103.96	230.30			
EWC 16 03 04	Inorganic wastes					388.28			
EWC 17 01 01	Concrete					106.84			
EWC 17 05 04	Soil and Stone			26,622.46	22,314.04	17,800.62		2,930.56	7544.66
EWC 17 09 04	Mixed Construction and Demolition wastes		768.88		2,743.12	1,814.24	514.76		
EWC 19 05 03	Off specification compost		120.22	2,754.10	2,990.30	6,785.90	39,155.02	25,336.42	
EWC 19 09 02	Sludges from water clarification					8.12			
EWC 19 12 02	Ferrous metal				176.06				
EWC 19 12 07	Woodchip	112.94	7,358.34	7,397.28	9,534.76	6,183.50	5,382.86	5,149.60	3,173.96
EWC 19 12 09	Minerals	371.24	25,434.80	22,924.03	24,926.73	16,821.46	23,292.02	28,749.24	25,831.03
EWC 19 12 12	Other waste from the mechanical treatment of waste					9,953.64			
EWC 20 01 38	Woodchip						38.70		
Total Waste for Recovery		484.18	33,682.24	59,697.87	62,788.97	60,092.90	68,383.36	62,165.82	36549.65

Table 2.3: Waste Quantities Consigned from Knockharley Landfill, 2011

European Waste Code Categories	Description	Tonnes	Destination
EWC 19 07 03	Leachate	10,559.80	Navan WWTP
EWC 19 07 03	Leachate	11,975.72	Rilta Dublin
<i>Total waste consigned</i>		22,535.52	

2.3. Calculated Remaining Capacity of the Facility

The total capacity of the facility is estimated to be 3,282,500m³. It is estimated that approximately 1,238,330m³ of void space has been used to January 2012. The remaining capacity is approximately 2,044,170m³. The most recent topographical survey, carried out on the 17th January 2012, is attached in Appendix II.

2.4. Methods of Deposition of Waste

The waste accepted for disposal is residual waste predominantly from the Northeast region, from household, commercial and industrial sources.

Waste is delivered to Knockharley Landfill facility in heavy goods vehicles (HGVs) with the appropriate covers in place to prevent any loss of load. Each HGV passes over the incoming weighbridge prior to proceeding to the active waste disposal area and the weight of the vehicle plus load is recorded. The weighbridge operator and/or facility manager may, at their discretion, request that the load be tipped in the Waste Inspection Area. Waste vehicles then proceed to the active waste disposal area where waste is deposited under the direction of a banks man. The vehicles weigh out at the outgoing weighbridge and receive an individual weighbridge docket before exiting the site.

Waste is deposited close to the advancing tipping face. In accordance with Condition 5.6.1 of the Waste Licence, the active working face is confined to a height of 2.5 metres after compaction, a width of 25 metres, a length of 25m 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 compactor operates on the gradient of the more shallow face, pushing thin layers of wastes and applying compaction pressure to them. Waste is covered daily with recovered inert materials which have been approved by the Agency. Fabric cover systems are also utilised as appropriate.

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.

Section 3

Report on Environmental Emissions



3. REPORT ON ENVIRONMENTAL EMISSIONS

This section of the AER has been compiled in accordance with emission limit values (ELVs) for the following media as detailed in Condition 6 and Schedule C of the waste licence for the facility.

3.1. Noise Emissions

Noise limits are stipulated in Schedule C.1 of the waste licence, as presented in Table 3.2.

Table 3.1: Noise Limits

Day dB L_{Aeq} (30 minutes)	Night dB L_{Aeq} (15 minutes)
55	45

Noise monitoring was conducted at four locations on a quarterly basis during the 2011 reporting period undertaken at the four locations outlined in Drawing Number LW11-172-03-100-001, Appendix I. The results were issued to the Agency as part of the quarterly reports.

The measured noise levels, as represented by the L_{Aeq} over a 30-minute period, were breached on two occasions during the reporting period. During monitoring for Quarter 2, in May the L_{Aeq} was 58 dB at N2 and in Quarter 4, November the L_{Aeq} was 59 dB at N2. Traffic movements on the close-by main road, the N2, and vehicle movements on the local road, adjacent to the noise monitoring locations, both off-site noise sources, contributed to the dominant noise at the monitoring location. The L_{A90} on both occasions was significantly under the emission limit of 55dB(A) indicating the influence of noise occurring in the upper 10% of the monitoring period on the overall results thereby indicating that background noise in the area is generally low. Therefore the activities of the landfill are generally not having an adverse impact on noise regime in the surrounding area.

Following monitoring, all measurements were subject to a one-third octave band analysis to identify potential tonal components in accordance with Annex D of ISO 1996-2: 2007 *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of environmental noise levels*. On occasions where tones are identified in the 1/3 octave analysis, a 5 dB penalty is applied to the L_{Aeq} as per the 'Guidance Note for Noise In Relation To Scheduled Activities, 2nd Edition', (2006).

On assessment, tonal elements were not identified during the monitoring period.

3.2. Landfill Gas

Landfill gas trigger levels are stipulated in Condition 6.3.1 and landfill gas monitoring is referenced in Schedule D, Table D.1.1, Table D.2.1 of the waste licence, as presented in Table 3.2.

Table 3.2: Landfill Gas Trigger levels

Methane	Carbon Dioxide
1.0 % v/v	1.5% v/v

3.2.1. Landfill gas monitoring wells

Monthly monitoring of landfill gas (LFG) levels is carried out in the perimeter gas boreholes and in the in-waste gas boreholes, in accordance with Schedule D.2 of the waste licence. The wells are at 50m intervals around the landfill footprint and two per cell. Monitoring of landfill gas parameters was carried out at the locations indicated on Drawing Number LW11-172-03-100-001, Appendix I.

Measured methane concentrations were recorded above the emission limit value on 4 occasions at 2 no. well during the monitoring period. Namely in:

- in LG-03 and LG-12 in Quarter 1
- in LG-12 in Quarter 3, in both August and September

Concentrations of 0% were recorded for these wells in all other months.

Levels were not above the emission limit in any other well during the reporting period.

Elevated carbon dioxide concentrations were recorded during the reporting period. The levels of carbon dioxide exceeded the emission limit:

- on 34 occasions in 14 no. wells during Quarter 1 (LG-01, LG-02, LG-03, LG-04, LG-05, LG-12, LG-15, LG-16, LG-20, LG-50, LG-51, LG-52, LG-53 and LG-54)
- on 30 occasions in 14 no. wells during Quarter 2 (LG-02, LG-03, LG-04, LG-13, LG-15, LG-16, LG-20, LG-22, LG-24, LG-50, LG-51, LG-52, LG-53 and LG-54)
- on 37 occasions in 15 no. wells during Quarter 3 (LG-02, LG-03, LG-04, LG-12, LG-15, LG-16, LG-22, LG-23, LG-24, LG-25, LG-50, LG-51, LG-52, LG-53 and LG-54)
- on 7 occasions in 7 wells during Quarter 4 (LG-04, LG-12, LG-15, LG-16, LG-51, LG-52 and LG-53)

Carbon dioxide is generally detected at some level in all perimeter monitoring wells during monthly monitoring at Knockharley Landfill. The occurrence of carbon dioxide at levels exceeding the 1.5% v/v trigger level is common and has been a regular occurrence since monitoring began in 2004.

This regular incidence of high concentrations of naturally occurring carbon dioxide is caused by the in-situ subsoils located throughout the site. Studies have shown high concentrations of carbon dioxide can occur naturally at shallow depths of up to 2m 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 which underlie the site. Monitoring of perimeter wells in November 2004, prior to waste deposition, confirmed elevated naturally occurring concentrations of carbon dioxide in the subsoils.

3.3. Dust Deposition Limits

Dust deposition emission limit values (ELV) are stipulated in Schedule C.3 of the waste licence, as presented in Table 3.3.

Table 3.3: Dust Deposition Emission Limit Value

Level (mg/m ² /day)
350

Dust monitoring was conducted at eight locations on a monthly basis during the 2011 reporting period. Monitoring of dust was carried out at the locations shown on Drawing Number LW11-172-03-100-001, in Appendix I. Oldcastle Laboratories Ltd. carried out the analysis of the dust deposition results from the facility for 11 months, with Southern Scientific Services Ltd. carrying out the analysis of dust results during October. The certificates of analysis were included in the quarterly reports issued to the Agency.

Dust monitoring showed dust deposition at the facility was recorded below the ELV on all monitoring occasions during the reporting period.

In January the dust sampling container used at D8 was cracked due to freezing conditions prevalent during the sampling period.

3.4. Surface Water Discharge Limits (measured at SW9)

Surface water monitoring was carried out at 8 no. monitoring locations in accordance with Schedule D of the licence and these are shown on the Drawing Number LW11-172-03-100-001 in Appendix I.

Surface water discharge emission limit values at monitoring location SW9 are stipulated in Schedule C.4 of the waste licence, as follows:

Table 3.4: Surface water discharge Emission Limit Values

Level (Suspended Solids mg/l)
35

Suspended solids concentrations were under the limit of 35 mg/l specified for SW9 in the waste licence during the reporting period.

Section 4

Summary of Environmental Results



4. SUMMARY ENVIRONMENTAL RESULTS

Environmental monitoring was carried out at the facility throughout the reporting period in accordance with Schedule D of the waste licence. All monitoring results were presented to the Agency in the quarterly reports and a summary of the monitoring results is presented below. The locations of all monitoring points are illustrated in Drawing Number LW11-172-03-100-001, Appendix I.

4.1. Biological Assessment

4.1.1. Macroinvertebrate Survey

Biological monitoring of surface water quality was undertaken in accordance with Schedule D of the waste licence on the 28th August 2011 at four locations, 1 – 4. These monitoring locations are shown on Figure 4.1.

4.1.2. Methodology

Samples were taken according to standard EPA methodology for kick-sampling (EPA, 2002¹; EPA, 2005)². Four kick samples were taken from two watercourses – the Knockharley Stream and the River Nanny. The kick samples were taken in the most suitable gravel-stone substrate present and in a riffle area where it was available. Samples were taken using a kick-sample net with a 1 mm mesh for a duration of 2 minutes.

The samples were preserved in the field with 70% alcohol and transferred to the laboratory where they were identified and analysed by an FTC ecologist. The appropriate values were assigned using the EPA scheme of Biotic Indices or Quality (Q) Values and their relationship to water quality (EPA, 2005), as set out in Tables 4.1 and 4.2.

Table 4.1: The Biological River Quality Classification System (Q Values)

Q VALUE	COMMUNITY DIVERSITY	WATER QUALITY	CONDITION
Q1	Very low	Bad	Unsatisfactory
Q2	Low	Poor	Unsatisfactory
Q3	Much reduced	Doubtful	Unsatisfactory
Q4	Reduced	Fair	Satisfactory
Q5	High	Good	Satisfactory

Table 4.2: Relationship between Q Values & Water Quality

BIOTIC INDEX	QUALITY CLASS
Q5, Q4-5, Q4	Class A
Q3-4	Class B
Q3, Q2-3	Class C
Q2, Q1-2, Q1	Class D

¹ EPA. (2002). *Water Quality in Ireland 1998-2000*. Appendix 1. PO Box 3000, Johnston Castle Estate, Co. Wexford.

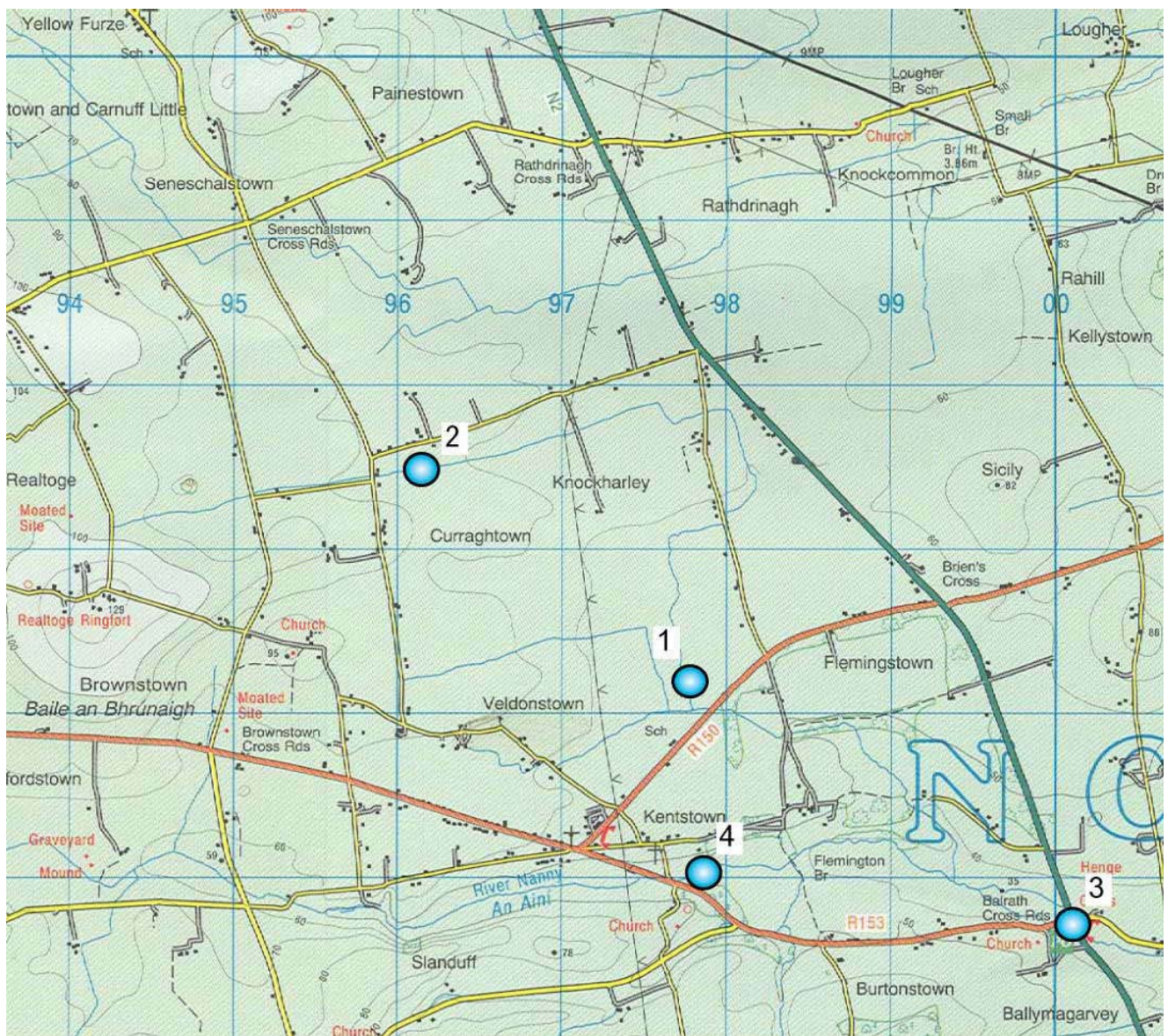
² EPA. (2005). *Water Quality in Ireland 2001-2003*. Appendix 1. PO Box 3000, Johnston Castle Estate, Co. Wexford.

4.1.3. Monitoring Location Descriptions

Biological monitoring of surface water quality by an assessment of the macroinvertebrate community present was undertaken in accordance with Schedule D of the waste licence on the 28th August 2011 at four locations, Site 1 – 4. The monitoring locations are represented in Figure 4.1 and Table 4.3.

Table 4.3: Summary of Macroinvertebrate Survey Locations

Sample	Location
Site 1	Less than 1 km downstream receptor site on the Knockharley stream
Site 2	Upstream control site on the Knockharley stream
Site 3	Downstream receptor site (corresponds with the EPA site 08/N/01/ 200) on the River Nanny
Site 4	Upstream control site (Corresponds with EPA site 08/N/01/0110) on the River Nanny

**Figure 4.1: Biological monitoring locations at Knockharley - 2011**

Site 1 - Knockharley Stream

This site is located less than 1 km downstream of Knockharley Landfill on the Knockharley stream. The monitoring location is approximately 1 – 1.5 m wide at the sample location and approximately 0.2 m deep. A low flow was recorded at the time of monitoring. The substrate was observed to be stony, with silt present. The location is very overshadowed, with trees and shrubbery. The water was clear with a very slight stagnant or stale water odour.

Site 2 – Knockharley Stream

This site is located upstream of Knockharley Landfill on the Knockharley stream. The monitoring location was approximately 0.5 m in width and approximately 0.1 m in depth. A low flow with slight riffles was recorded at the time of monitoring. The substrate was observed to be gravelly and covered in mud and silt. The banks were covered with vegetation and trees overhanging the stream. The water was clear with no detectable odour.

Site 3 – River Nanny

This site is located downstream of Knockharley Landfill on the River Nanny. The monitoring location was approximately 2.5 – 3.0 m in width and up to 0.5 m in depth. The kick sample was taken at a location that was only 0.25 m in depth. The substrate was observed to be stony and gravelly with some silt. Trees and vegetation was observed to be on the banks. The water was clear with no detectable odour.

Site 4 – River Nanny

This site is located upstream of Knockharley landfill on the River Nanny. The monitoring location is approximately 1 – 1.5 m in width and approximately 0.4 m in depth. Low flow was observed at the time of sampling. The substrate was observed to be rocky and muddy. Vegetation on banks, including trees were shading the monitoring location. There was a slight stagnant or stale water odour detected from the sample, which was more notable when the sample was opened for assessment.

4.1.4. Results

A summary of the results from the survey is presented in the table below.

Table 4.4: Summary of Macroinvertebrate Survey Results 2011

Sample	Water Quality	Quality Status	Q Index
1	Doubtful	Moderately polluted	Q3
2	Doubtful	Moderately polluted	Q3
3	Poor	Seriously polluted	Q2
4	Poor-Doubtful	Moderately polluted	Q2-3

Table 4.5: Abundance of each faunal group present in each sample.

Sample	A – sensitive	B – less sensitive	C – tolerant	D – very tolerant	E – most tolerant	Total	Q Index
1	0	16	67	233	7	323	Q3
2	0	7	79	31	11	128	Q3
3	0	2	30	37	1000+	1069+	Q2
4	0	1	76	2	30	109	Q2-3

Table 4.6: Percentage of each faunal group present in each sample

Sample	A – sensitive	B – less sensitive	C – tolerant	D – very tolerant	E – most tolerant	Q Index
1	0	5	21	72	2	Q3
2	0	5	62	24	9	Q3
3	0	0	3	3	94	Q2
4	0	1	70	2	28	Q2-3

Table 4.7: Taxa present in each sample

Macro-invertebrate taxa	Group	Tolerance	Sample			
			1	2	3	4
Ecdyonuriidae/Heptageniidae	A	Sensitive				
Perlidae	A	Sensitive				
Baetidae (excl. B. rhodani)	B	Less sensitive			2	1
Ephemerae	B	Less sensitive		5		
Leuctridae	B	Less sensitive				
Nemouridae	B	Less sensitive				
Cased Trichoptera	B	Less sensitive	16	2		
Beatis rhodani	C	Tolerant				
Gammarus	C	Tolerant	62	68	23	74
Coleoptera	C	Tolerant		9	1	
Uncased Trichoptera	C	Tolerant				
Uncased Trichoptera - Psychomyiidae	C	Tolerant				
Uncased Trichoptera - Rhyacophilidae	C	Tolerant				
Cased Trichoptera - Limnephilidae	C	Tolerant	3			
Ancylidae	C	Tolerant				
Simuliidae	C	Tolerant		1	6	1
Tipulidae	C	Tolerant	2	1		1
Hemiptera - Aphelocheiridae	C	Tolerant				
Hydroptilidae	C	Tolerant				
Asellus	D	Very tolerant	59		4	
Mollusca	D	Very tolerant	26	2	1	
Hirudinea	D	Very tolerant				
Chironomidae	D	Very tolerant	144	27	29	2
Hirudinea - Rhynchobdellae	D	Very tolerant	4		3	
Tubificidae	E	Most tolerant		2		
Chironomus	E	Most tolerant				
Oligochaeta	N/A	N/A	7	11	1000+	30
Total individuals			323	128	1069+	109
Q Index						

4.1.5. Interpretation of Results

Benthic macro-invertebrates are widely considered a good indicator of ecosystem change for many reasons. The duration of their life cycles allow long-term exposure to substances in their environment. Furthermore, they exist in close contact with the substrate, which increases their contact with many substances. Consequently, any changes in the macro-invertebrate community will reflect changes in the pollution status of the ecosystem, particularly because many of these organisms are relatively sessile.

Whereas chemical data can provide an illustration of ambient conditions at any given moment, biotic data can supply a cumulative indicator of conditions in the ecosystem over time, depending on the lifetime of the organisms being studied. It is widely accepted that assessment of the health of a river's or stream's ecosystem can be achieved through analysis of the benthic macro-invertebrate community structure and this is the basis of the EPA Q rating system. The results of the biological assessment of the four watercourses presented in Table 4.4 and are discussed below.

Table 4.8: Comparison of Q values obtained from 2007-2011

Sampling Period	Site 1	Site 2	Site 3	Site 4
2007	Q2 – Q3	Q2 – Q3	Q3 – Q4	Q3
2008	Q3	Q2	Q3	Q3 – Q4
2009	Q3	Q3	Q3 – Q4	Q3
2010	Q2	Q3	Q3	Q3
2011	Q3	Q3	Q2	Q2 – 3

Table 4.8 presents the results of biological assessments undertaken at these locations since 2007. These results show that biological water quality appears to have improved slightly at Site 1 (downstream), deteriorated slightly at Site 3 (downstream) and Site 4 (upstream), and has improved slightly at Site 2 (upstream).

4.1.6. EPA Results

The most recent EPA monitoring took place in 2009. The EPA report noted that the River Nanny was in an "unsatisfactory" state (moderately polluted, with a Q rating of 3-4). The nearest EPA station on the River Nanny upstream of the site is at Kentstown (EPA site code 08N010110) where water quality has been recorded as Q3 in 2010 (Q2-5 in 2008, 2005, 2001 and 1998).

The Nanny Bridge, the nearest EPA monitoring station downstream of the site (EPA site code 08N010280) recorded satisfactory results (good status, Q4) in 2008 and 2005, and Q3-4 in 2010.

4.1.7. Conclusion

EPA monitoring results from the upper reaches of the River Nanny indicate that there is a history of "unsatisfactory" biological water quality. Current and previous biological assessments do not indicate that operations at the facility are having an adverse impact on the biological quality of receiving water courses in the area.

Based on all available information including EPA results it is likely that diffuse sources of pollution such as agricultural sources (run-off from grassland or sediment from tilled land) in the area, are influencing biological water quality in the area upstream and downstream of the site. EPA monitoring results downstream of the site indicate satisfactory results (good status, Q4) in 2008 and 2005, with a slight deterioration in 2010 (Q3-4).

4.2. Surface Water

Surface water monitoring was carried out quarterly at 8 no. monitoring locations in accordance with Schedule D of the licence.

4.2.1. Monitoring Locations

Surface water monitoring was carried out at 8 no. monitoring locations. The locations are shown on the Drawing Number LW11-172-03-100-001 in Appendix I. Table 4.9 shows the location of the monitoring points in relation to the site.

Table 4.9: Surface Water Monitoring Locations

Monitoring Location	Easting	Northing	Description
SW1	296706	267600	Upstream
SW2	297464	267862	Upstream
SW3	298087	267634	Upstream
SW5	297764	267116	Upstream
SW6	297663	266562	Downstream
SW7	297510	266525	Downstream
SW8	297916	266029	Downstream
SW9	297587	266621	Discharge from the surface water wetland

4.2.2. Surface Water Monitoring Results – 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. Detailed visual assessment results were reported to the Agency in the quarterly reports.

4.2.3. Surface water Monitoring Results - Chemical Assessment

Two surface water bodies are sampled on a quarterly basis, namely the Knockharley Stream and the Nanny River. Surface water samples were analysed for a range of parameters as specified in Schedule D of the waste licence.

The figures below present the summary results of the main surface water monitoring parameters undertaken during the four quarters of the reporting period. The baseline monitoring results are presented in Table 4.10. Annual surface water monitoring parameters are discussed below.

Table 4.10: Baseline Surface Water Quality

Parameter	Units	SW1	SW2	SW3	SW5	SW6	SW7	SW8
pH	pH Units	7.94-8.20	7.7-8.44	7.75-7.98	7.61-8.07	7.76-8.06	7.42-8.37	7.63-8.02
Electrical Conductivity	mS/cm	0.613-0.730	0.653-0.682	0.593-0.688	0.549-0.726	0.625-0.698	0.590-0.694	0.662-0.720
Ammoniacal Nitrogen	mg/l	<0.2-0.6	<0.2	<0.2-1.1	<0.2-0.5	<0.2-0.5	<0.2-1.7	<0.2-0.4
Dissolved Oxygen	mg/l	5.3-9.4	4.7-8.9	5.1-8.6	4.4-8.4	5.0-8.9	5.0-8.7	4.6-8.5
Chloride	mg/l	21-31	23-56	29-36	29-35	28-33	24-36	30-54
Total Suspended	mg/l	<10-48	<10-46	<10-34	<10	<10-11	<10-10	<10-15

Parameter	Units	SW1	SW2	SW3	SW5	SW6	SW7	SW8
Solids								
BOD	mg/l	<2-2	<2-12	<2-5	<2-4	<2-3	<2-3	<2-3
COD	mg/l	<15-41	<15-25	<15-46	<15-43	<15-41	<15-29	<15-31
Potassium	mg/l	9	2.6	10.8	11.6	11.8	17.6	2.4
Sodium	mg/l	13.5	8.1	13	14	15	9.8	15
Total Oxidised Nitrogen	mg/l	4.1	7.9	5.4	5.1	5.3	3.7	4.3
Calcium	mg/l	95.44	99.93	77.87	74.7	72.58	99.99	93.66
Cadmium	µg/l	3.5	3.5	3.5	3.5	<0.4	<0.4	<0.4
Chromium	µg/l	4	4	3	4	<1	<1	<1
Copper	µg/l	10	8	8	9	6	6	<5
Iron	µg/l	75	47	112	132	123	38	55
Lead	µg/l	<5	<5	<5	<5	<5	<5	<5
Magnesium	mg/l	6.48	4.44	5.38	5.3	5.23	8.89	6.73
Manganese	µg/l	11	10	10	9	5	6	4
Mercury	µg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphate	mg/l	25	24	29	29	30	30	29
Zinc	µg/l	<5	<5	<5	<5	<5	<5	<5
Total Alkalinity as CaCo3	mg/l	300	220	200	90	250	270	250
Total Phosphorous	mg/l	0.44	0.09	0.34	0.56	0.54	0.54	0.32

The pH results, presented in Figure 4.2, display a downwards trend through the monitoring period, slightly halted at a number of locations during quarter 4. The results are consistent across all monitoring locations.

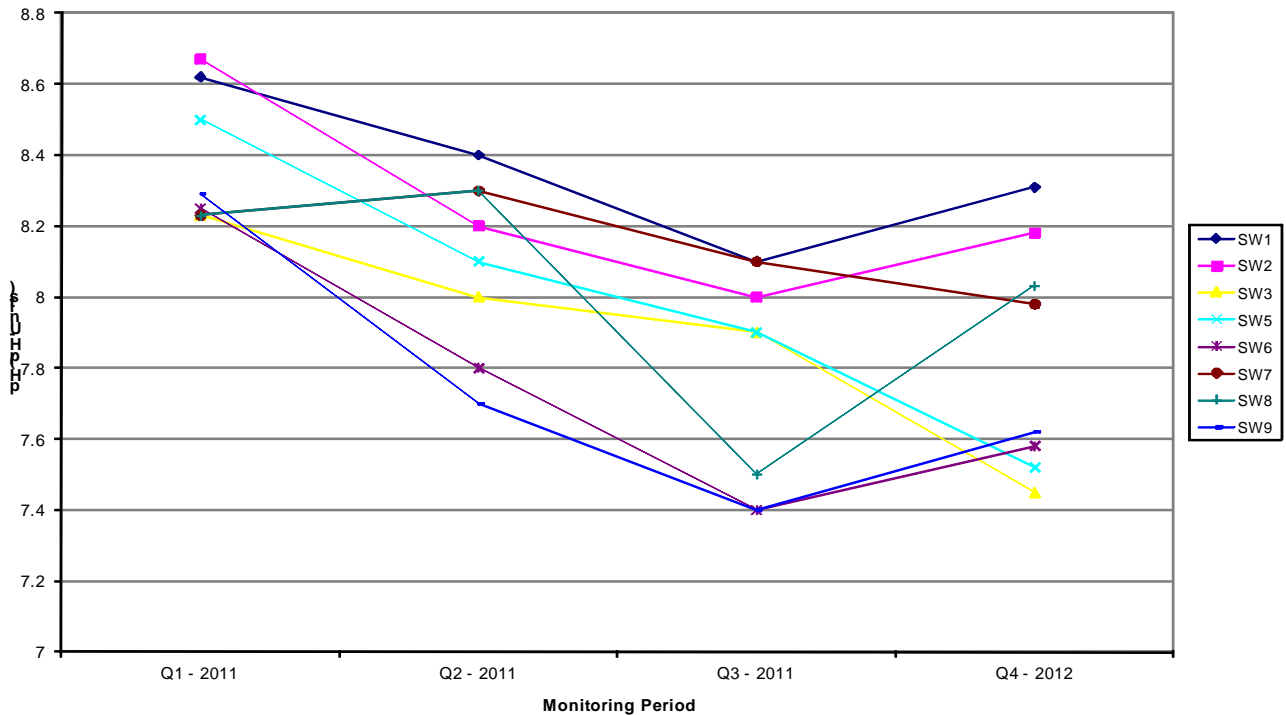


Figure 4.2: pH Results for Surface Water

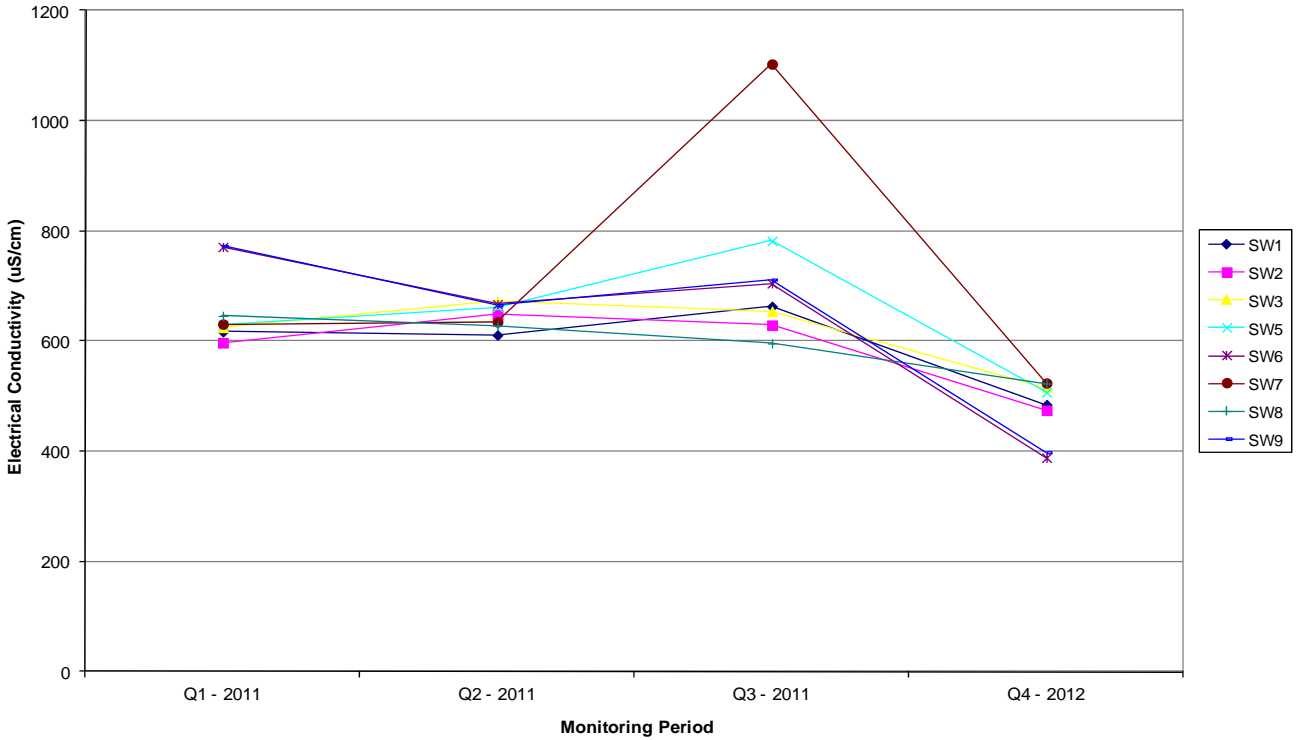


Figure 4.3: Electrical Conductivity Results for Surface Water

The electrical conductivity (EC) results, presented in Figure 4.3, were also relatively consistent throughout the reporting period. An exception to the general trend observed was a reading of 1103 $\mu\text{S}/\text{cm}$ during quarter 3 at SW7. Results generally display a slight falling trend through the period. EC levels are within the range of 389 – 1103 $\mu\text{S}/\text{cm}$. With the exception of EC at SW7, all pH and EC readings were within normal ranges for surface water.

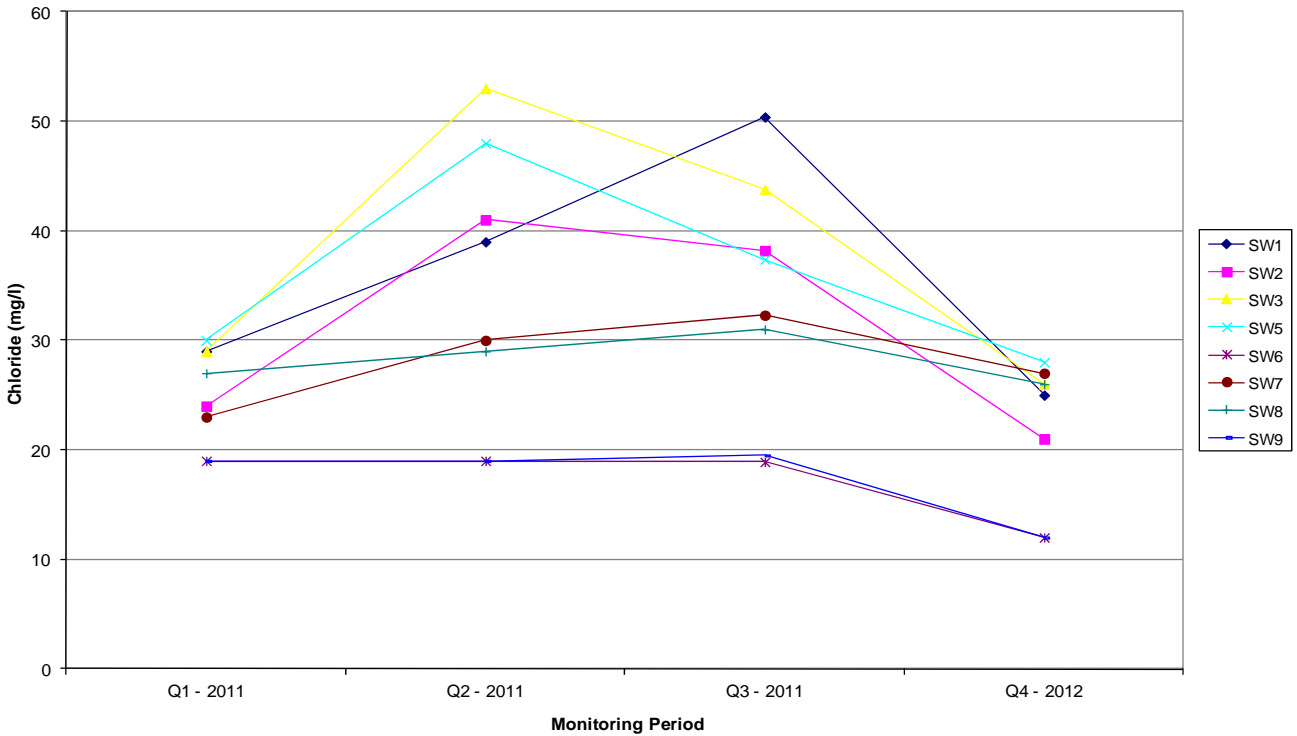


Figure 4.4: Chloride Results for Surface Water

The results for chloride (Cl) at surface water locations as presented in Figure 4.4, are consistent across all locations showing a similar trend during the reporting period. During quarter 2 and quarter 3, Cl results at SW1, SW3 and SW5 are over baseline levels. It is noted that the incidence of Cl over baseline was recorded at three upstream locations and is therefore not considered as a result of site activities.

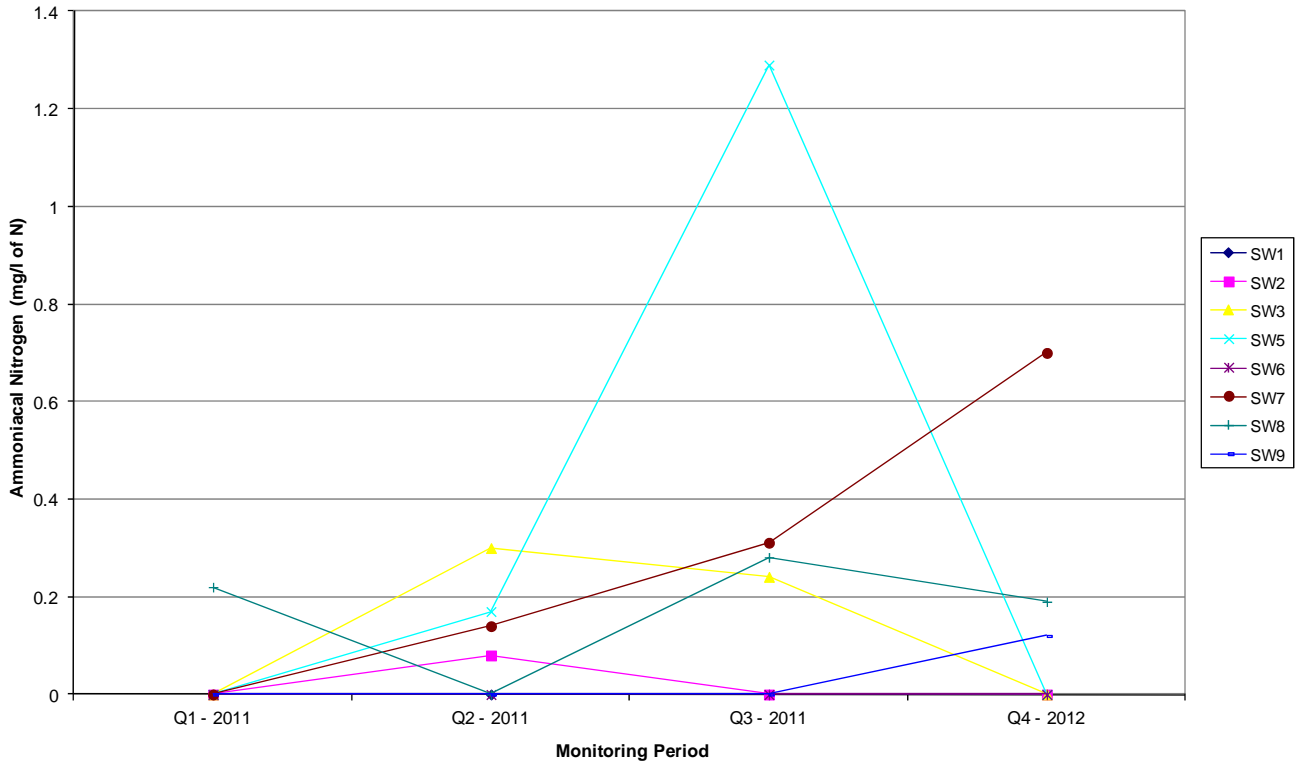


Figure 4.5: Ammoniacal Nitrogen Results for Surface Water

There is some variation in the ammoniacal nitrogen results (as shown in Figure 4.5) during the reporting period. Elevated results were recorded in SW5 upstream during quarter 3 and at SW7 during quarter 4. All other results were recorded below 0.4 mg/l as N. A number of results across monitoring locations were so low during the reporting period that they were under the laboratory limit of detection.

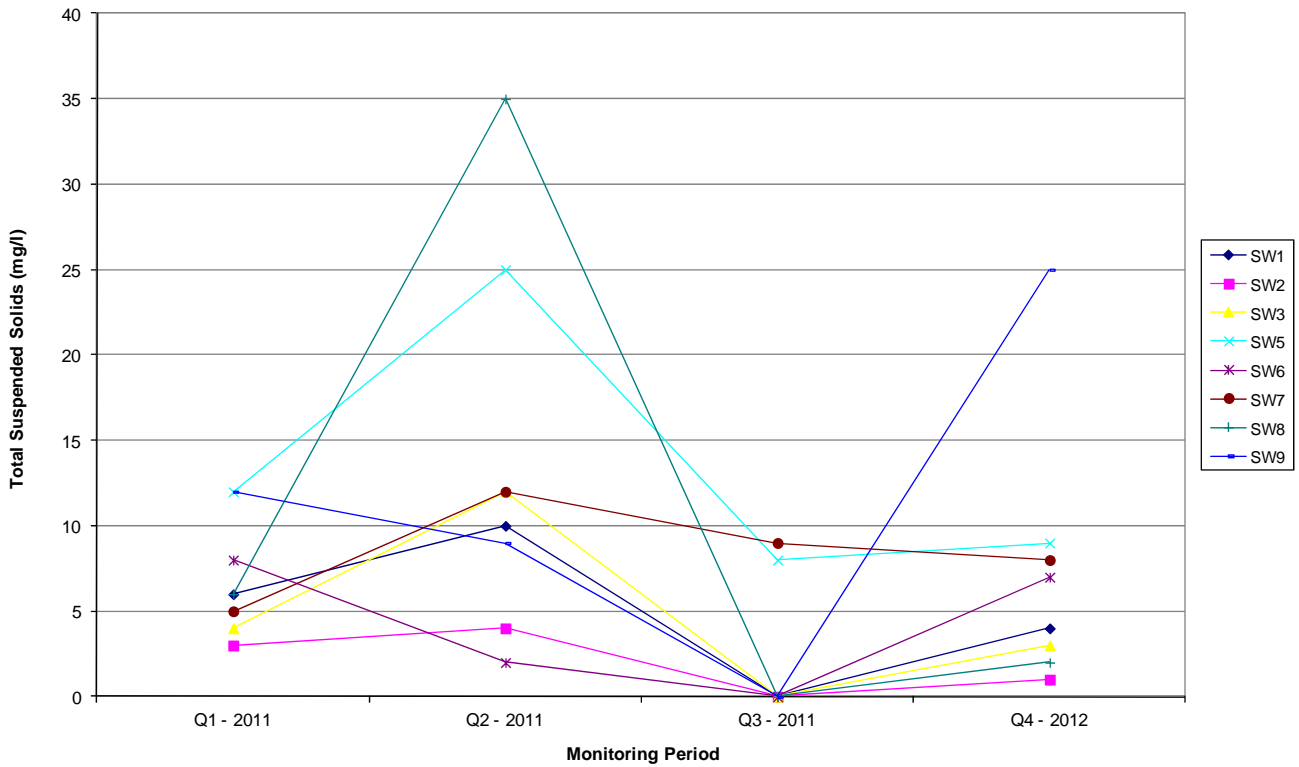


Figure 4.6: Total Suspended Solids Results for Surface Water

Levels of total suspended solids (TSS), Figure 4.6, were all within the normal range for surface waters with the exception the results for SW5 and SW8 during quarter 2, which were recorded marginally above the baseline range. A fluctuation in the COD, Figure 4.7, levels through the quarters was recorded, although in general all monitoring locations follow a similar trend. During quarter 2 the results are over the baseline levels at SW3 and SW5, both upstream locations and at SW7 and SW8 are marginally over the baseline range. All other results were recorded within the baseline range.

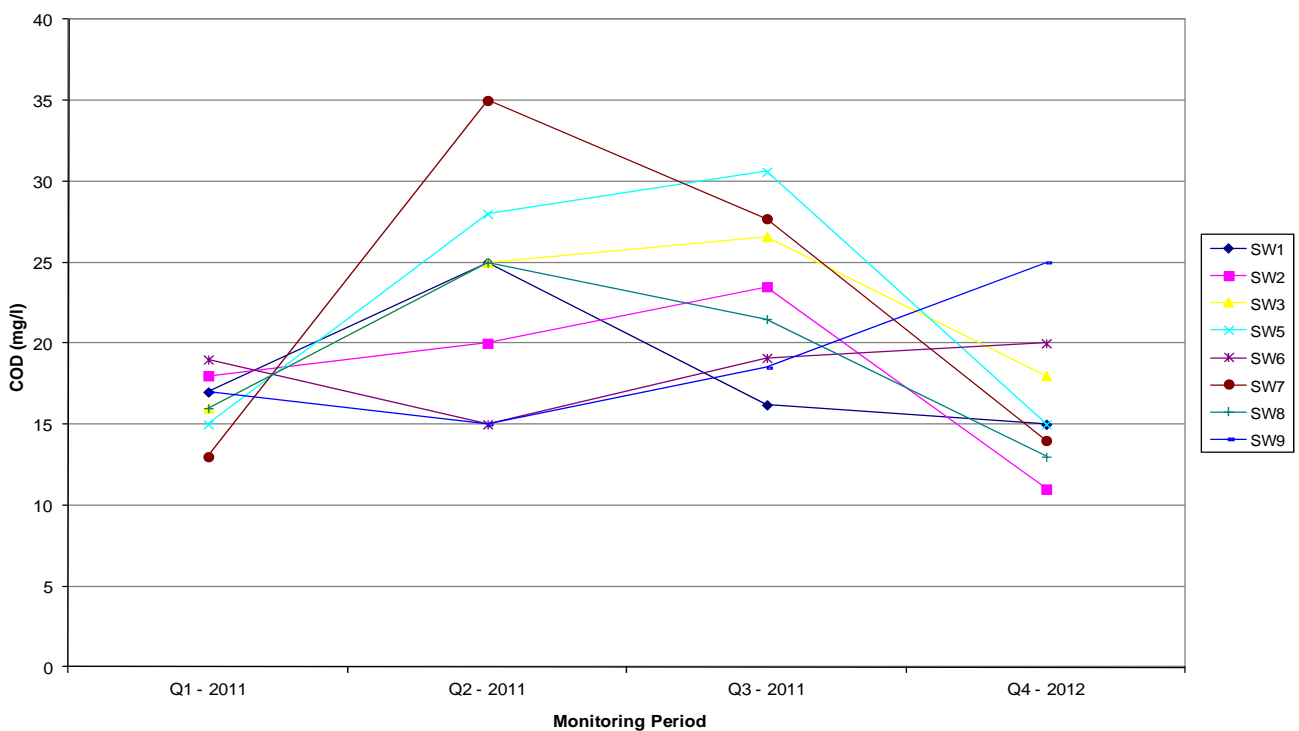


Figure 4.7: Chemical Oxygen Demand Results for Surface Water

Regarding the annual surface water monitoring parameters, the results for total oxidised nitrogen, calcium, cadmium, chromium, copper, iron lead, magnesium, manganese and zinc are all recorded under the baseline range of results for all monitoring locations. Mercury levels are all lower than the laboratory limit of detection at all monitoring locations.

Potassium results are under the baseline results at SW3, SW5 and SW6, while the recorded results at SW1, SW2, SW7 and SW8 are over the baseline results. Sodium levels range from 13.70 mg/l to 27.20 mg/l over baseline monitoring results at all monitoring locations, except SW6 which is recorded under the baseline levels.

Sulphate levels range from 10.7 mg/l to 288 mg/l. The results are over the baseline results at SW1, SW5, SW6, SW7 and SW8, while the results for SW2 and SW3 are under the baseline levels. Baseline and annual monitoring data has been assessed to determine any trends in sulphate concentrations and the results show sulphate concentrations to be highly variable, both up and down stream, in the eight year period since monitoring began.

The total alkalinity levels are over the baseline at SW5 and SW7. The results at all other locations are within the baseline range of results.

Total phosphorous results were under the baseline at SW6 and were over the baseline at all other monitoring locations.

4.2.4. Conclusion

In general, surface water quality in the surface water bodies surrounding the site is good and operations at the site have not resulted in any adverse impacts on the water quality during the reporting period.

4.3. Groundwater

Groundwater monitoring was undertaken at 7 no. groundwater wells on the site during the reporting period and the results were reported to the Agency as part of the quarterly reports for the facility. The wells were monitored in accordance with Schedule D.5.1 of the waste licence and shown on Drawing Number LW11-172-03-100-001, Appendix I. The direction of groundwater flow on the site is from northwest to southeast. Groundwater wells MW1d, MW2d, MW3d and MW7d are located up-gradient of the landfill and MW5d, MW6d and MW16d are located downgradient of the landfill.

The groundwater trigger levels (GWTL) were revised and forwarded to the EPA for approval on 17th August 2010. Approval was granted on 23rd December 2011. The revised GWTL will be used in the assessment of groundwater quality from quarter 1 2012 onwards. For the present reporting period, groundwater quality is assessed against baseline groundwater results, presented in Table 4.11.

Table 4.11: Baseline Groundwater Quality

Parameter	Units	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
pH	pH units	7.39-7.60	7.24-7.96	7.20-8.00	7.27-8.32	7.47-7.87	7.38-7.88	7.28-7.61
Conductivity	mS/cm	0.586-0.654	0.685-0.705	0.796-0.858	0.626-0.861	0.604-0.660	0.621-0.685	0.627-0.689
Ammoniacal Nitrogen	mg/l	<0.2-0.3	<0.2	0.4-1.4	<0.2-0.5	<0.2-0.6	0.3-1.3	0.4-0.7
Dissolved Oxygen	mg/l	4.9-8.5	4.5-8.3	4.7-8.1	4.7-8.1	3.7-8.2	3.8-8.1	4.4-7.8
Chloride	mg/l	22-27	18-19	24-26	13-26	15-17	16-18	17-18
Total Organic Carbon	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Potassium	mg/l	1.8-7.2	2.0-3.0	3.0-4.2	2.0-5.0	2.0-3.6	2.4-4.2	2.2-3.6

Parameter	Units	MW1d	MW2d	MW3d	MW5d	MW6d	MW7d	MW16d
Sodium	mg/l	16-62	29-62	39-142.5	25-84.5	21-55	31.5-79	25.5-41.5
Total Oxidised Nitrogen (as N)	mg/l	<0.3-3.4	<0.3-0.4	<0.3-0.5	<0.3-5.0	<0.3-0.8	0.4-0.9	<0.3
Phenols	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Coliforms	no./100ml	2-140	0-24	0-56	0-780	0-18	0-28	0-4
Faecal Coliforms	no./100ml	0-2	0-3	0-37	0-9	0-17	0-2	0-2

4.3.1. Groundwater Monitoring Results - Levels

The groundwater levels were recorded on a monthly basis and the results are presented in Figure 4.8. The levels remained relatively stable throughout the reporting period.

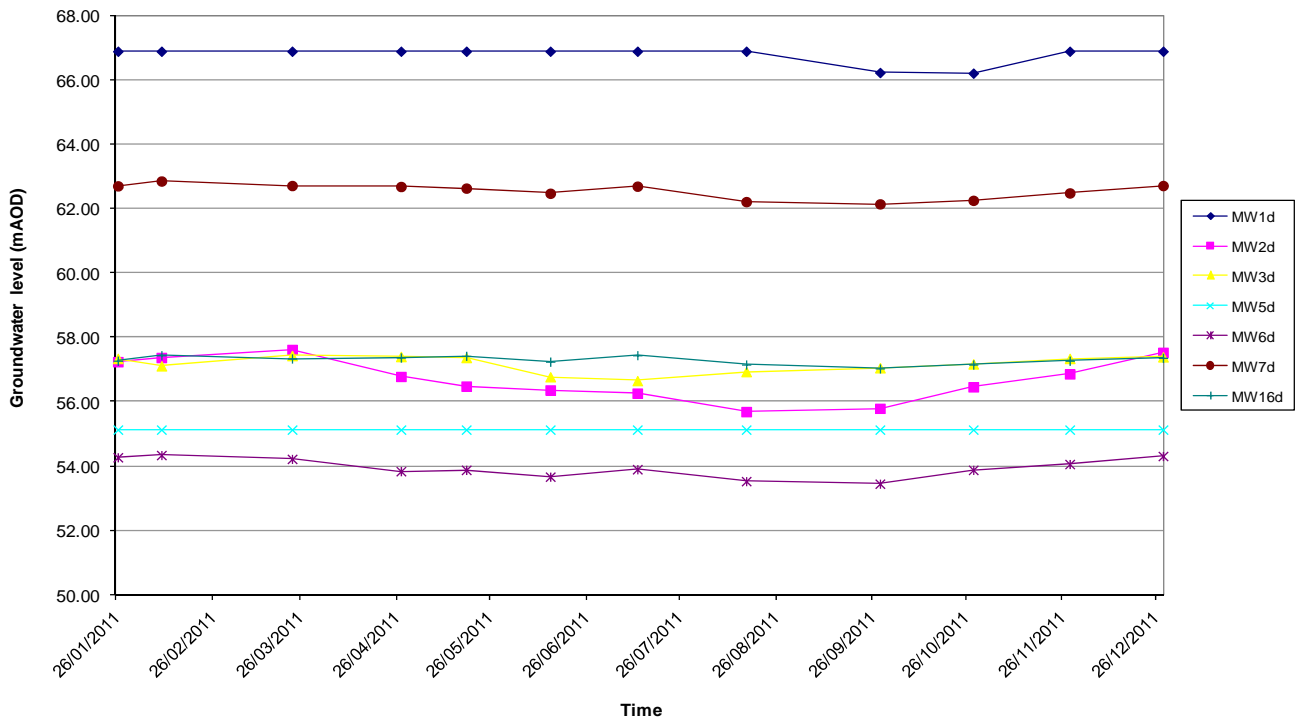


Figure 4.8: Groundwater Levels

4.3.2. Groundwater Monitoring Results – Chemical Assessment

The pH and electrical conductivity levels recorded in the groundwater were within the normal ranges. The pH levels, presented in Figure 4.9, fell from quarter 1 to quarter 2 and into quarter 3, before increasing slightly in quarter 4. During quarter 2 and quarter 4 the results at MW1d, an upgradient well, are elevated above the baseline pH range. The pH levels are all consistent with unpolluted groundwater.

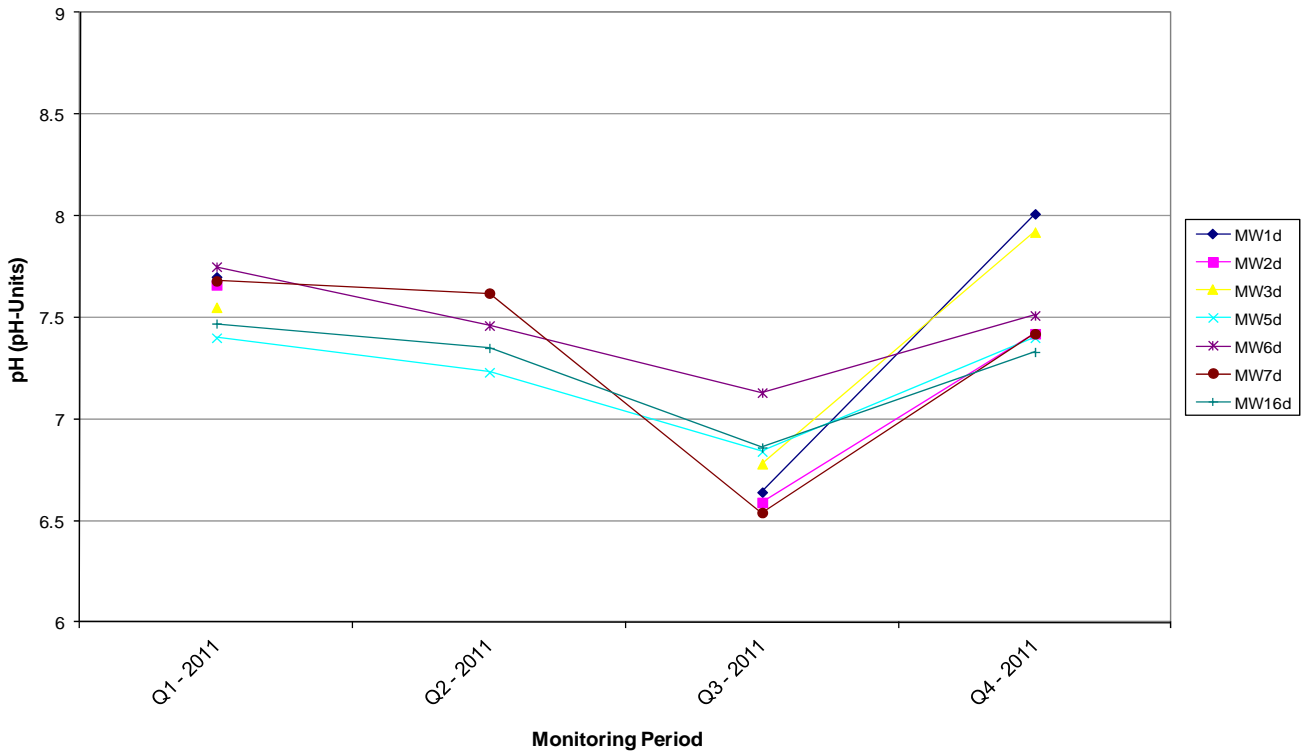


Figure 4.9: pH Results for Groundwater

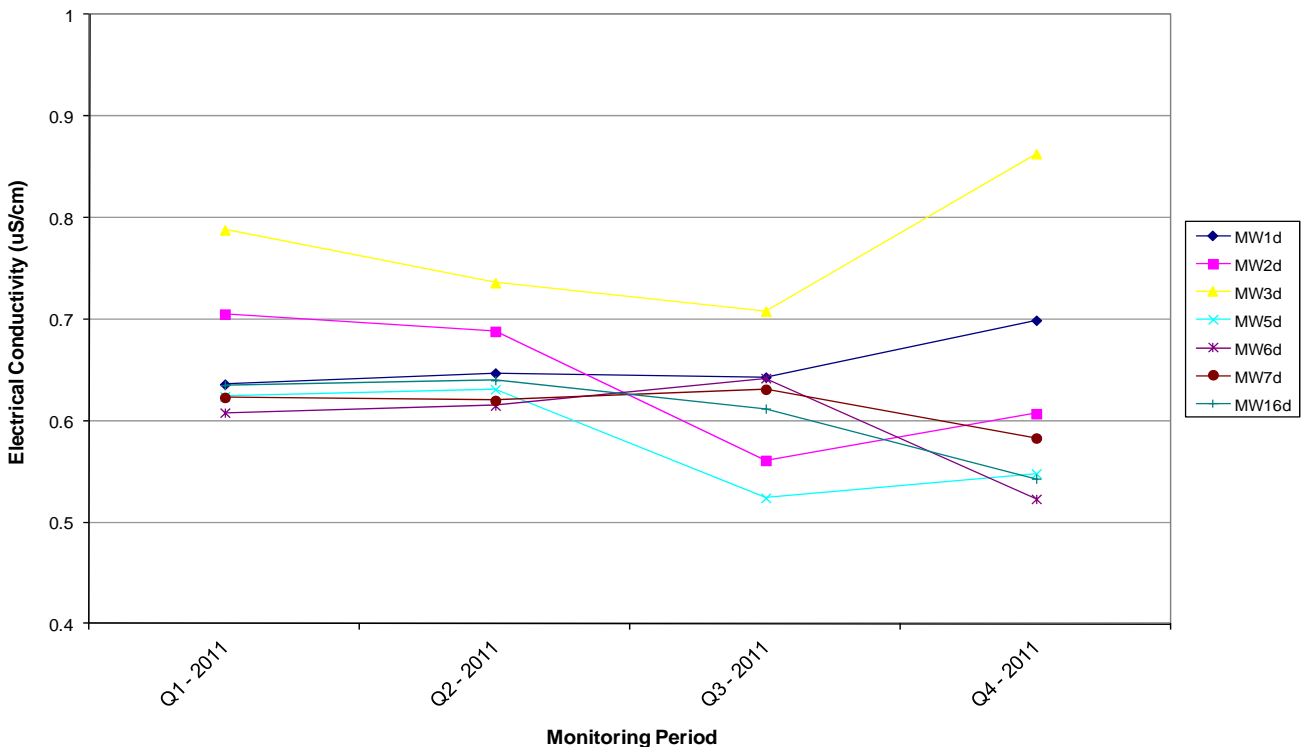


Figure 4.10: Electrical Conductivity Results for Groundwater

Electrical conductivity levels, presented in Figure 4.10, show that with the exception of a spike in levels in quarter 4 at MW3d all readings remain consistent through the reporting period. The MW3d result from quarter 4 is above the baseline levels and it is also noted that the results for MW3d, located up-gradient of the landfill, remained consistently higher than all other locations. The electrical conductivity levels are all consistent with unpolluted groundwater. The levels of ammoniacal nitrogen are presented below in Figure 4.11. The ammoniacal nitrogen results are relatively consistent over the reporting period.

The quarter 3 ammoniacal nitrogen levels range from 0.313 mg/l to 0.557 mg/l and are over the baseline levels at MW1d and MW2d. It is noted that these are up-gradient borehole locations and that all other locations are within the baseline range.

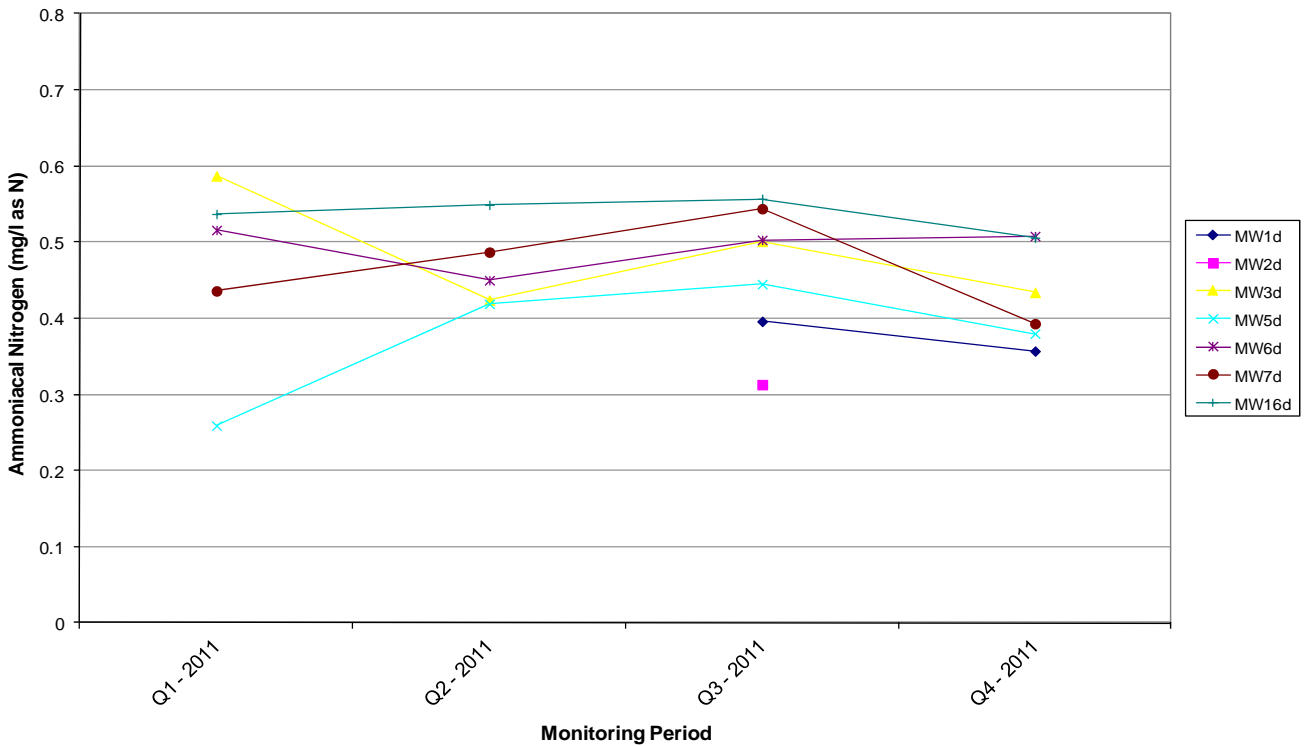


Figure 4.11: Ammoniacal Nitrogen Results for Groundwater

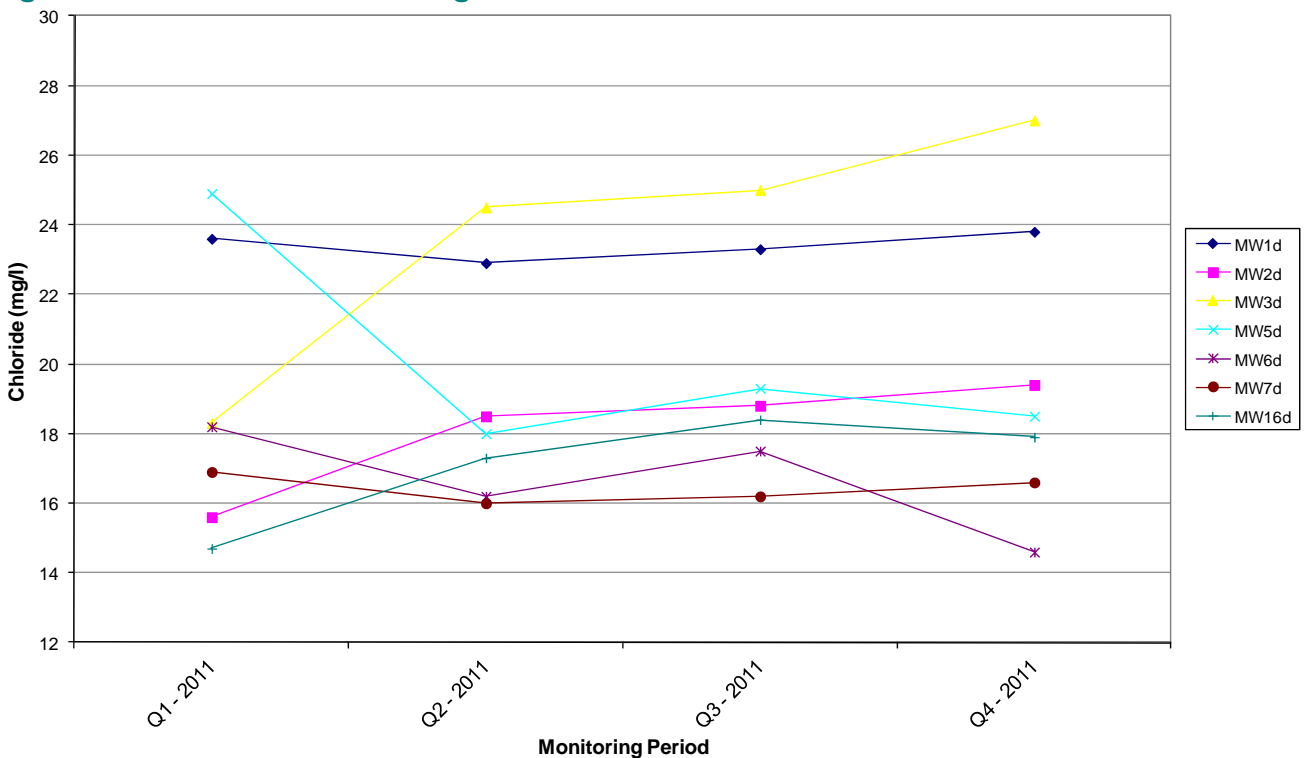


Figure 4.12: Chloride Results for Groundwater

Chloride (Cl) levels, presented in Figure 4.12, show some variability in levels. The results for quarter 4 range from 14.6 mg/l Cl to 27.0 mg/l Cl; results were over the baseline range at MW2d and MW5d.

All CL levels recorded during the reporting period are within the Interim Guideline Values, (IGV) set out in the Environmental Protection Agency, (EPA) Groundwater "Towards Setting the Guideline Values for the Protection of Groundwater in Ireland". The total organic carbon (TOC), presented in Figure 4.13, levels during the monitoring period were frequently so low the levels were under the laboratories limit of detection and not represented by any value on the graph. TOC levels above baseline have been recorded at upgradient locations MW1d, MW2d and MW3d in addition to down gradient locations MW6d and MW16d.

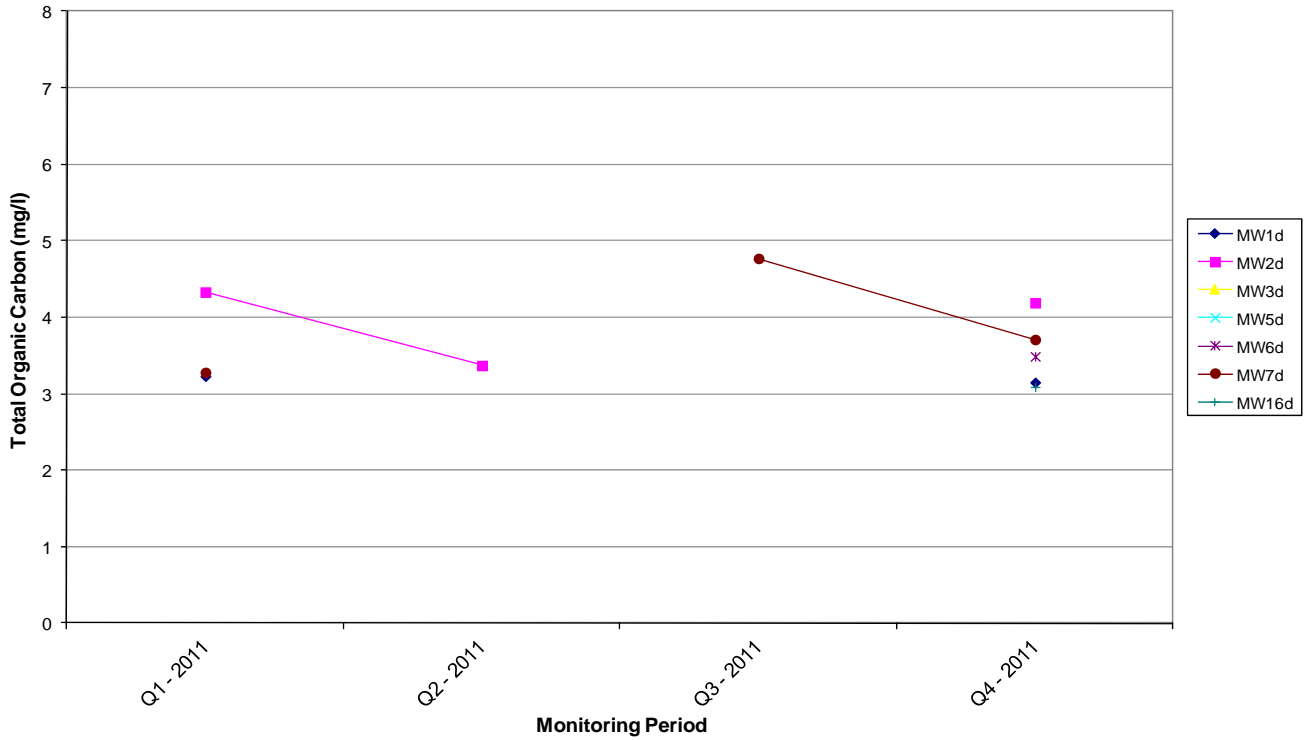


Figure 4.13: TOC Results for Groundwater

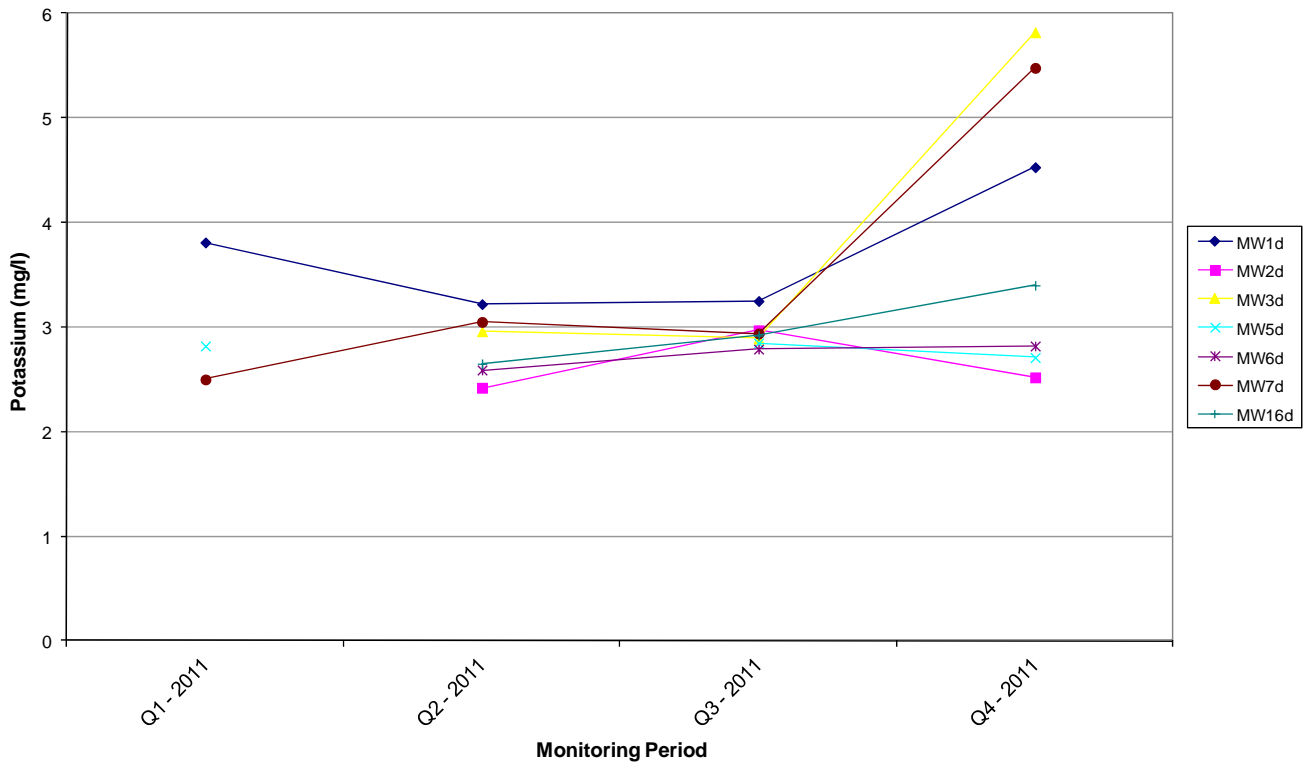


Figure 4.14 Potassium Results for Groundwater

A spike in groundwater potassium levels was observed in quarter 4, presented in Figure 4.14. In quarter 4 levels ranging from 2.52 to 5.82 mg/l are elevated above both the IGV and the baseline results range at MW3d and MW5d.

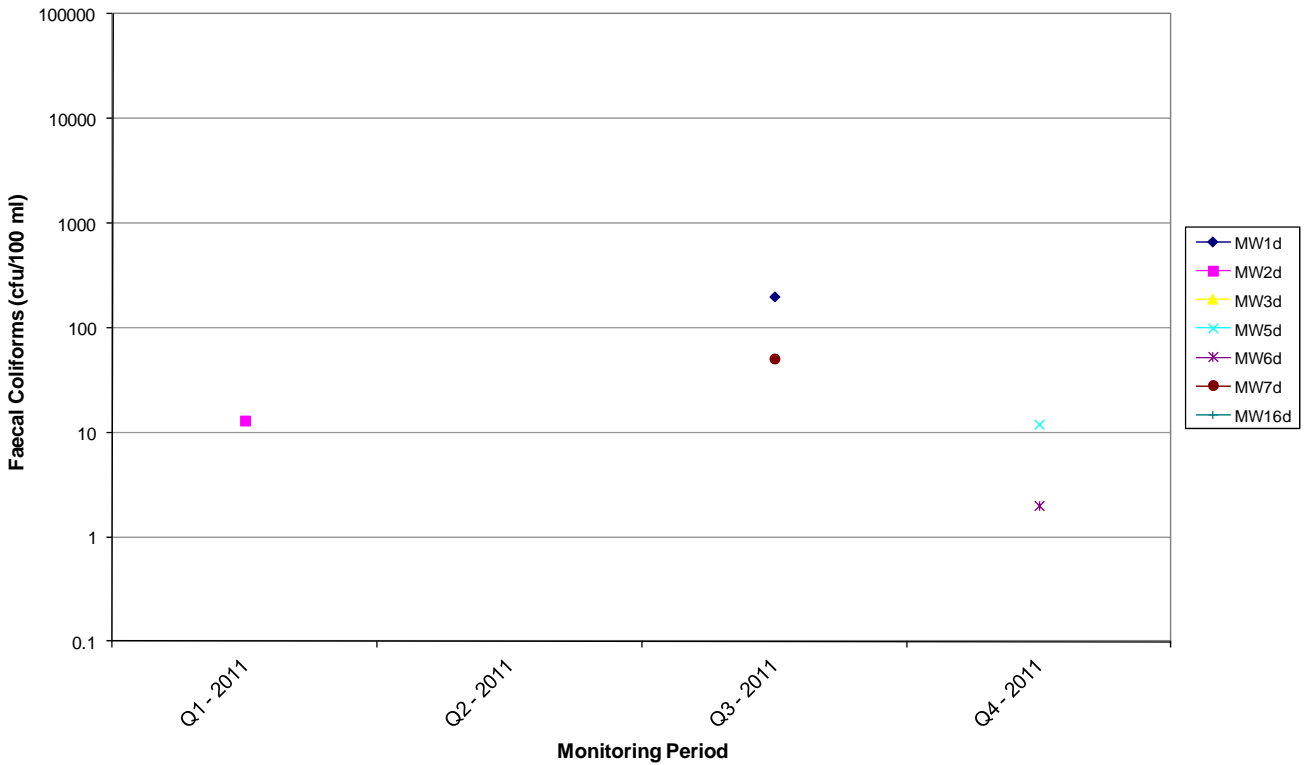


Figure 4.15: Faecal Coliform Results for Groundwater

Variable levels of faecal and total coliforms, presented in Figure 4.15 and Figure 4.16 respectfully, were recorded in a number of wells during the reporting period. Gaps in the graph are present where no faecal or total coliform was detected by the laboratory during analysis. Historically total and faecal coliforms have been detected in all groundwater monitoring boreholes around the site. All the monitored groundwater boreholes are dedicated monitoring wells and not used for any other purpose than groundwater monitoring.

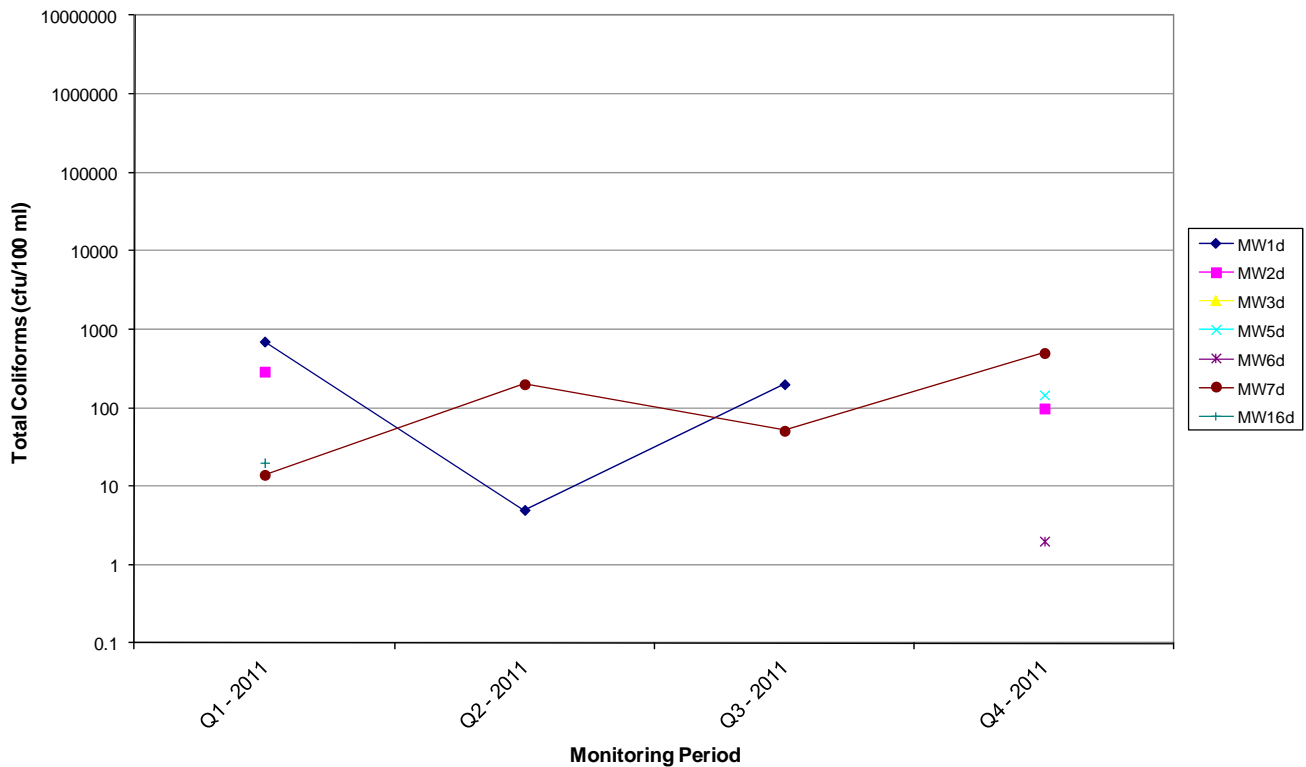


Figure 4.16: Total Coliform Results for Groundwater

4.3.3. Conclusion

In general, groundwater conditions at the site have not altered significantly from the baseline results. Levels of faecal and total coliforms outside the baseline range are observed at a number of groundwater locations upgradient of the landfill. These parameters will continue to be closely observed during coming monitoring events.

The monitoring program confirms that site activities are not impacting on groundwater quality.

4.4. Dust and PM₁₀ Monitoring

As discussed in Section 3.1, no dust levels were recorded above the limit at the facility during the reporting period. The monitoring results were reported to the Agency as part of the quarterly reports.

PM₁₀ levels are monitored on a quarterly basis at six locations around the perimeter of the facility. These locations are presented on Drawing Number LW11-172-03-100-001, Appendix I. The results of this monitoring, including the certificates of analysis, were submitted to the Agency as part of the quarterly reports. On two occasions during the reporting period a battery failure resulted in an incomplete run. The sample deemed not to be representative of conditions were above the limits on both instances.

4.4.1. Conclusion

The PM₁₀ trigger level, as set out in the waste licence condition 6.8.1 of 50 µg/m³ was exceeded at two locations location during the reporting period. The exceedance was related to an incomplete sampling run as a result of a battery failure, yielding an unrepresentative sample. No dust exceedances were recorded during the reporting period.

4.5. Leachate Monitoring

Leachate monitoring was carried out at ten locations (LC1, LC2, LC3, LC4, LC5, LC6, LC7, LC8, LC9, LC10 and LL) during the reporting period. LC1 to LC10 are sumps within Cells 1 to 10 respectively and LL is at the leachate lagoon.

Chemical analysis of leachate samples is undertaken in accordance with Schedule D of the waste licence. . The main indicator parameter results, pH, electrical conductivity, Ammoniacal Nitrogen and Chemical Oxygen Demand are summarised below.

The pH level, presented in Figure 4.17, for leachate samples, though showing variation between quarters, follows a similar trend for all sample locations. The pH level trend indicates that the leachate is generally becoming more acidic from quarter 1 to quarter 4.

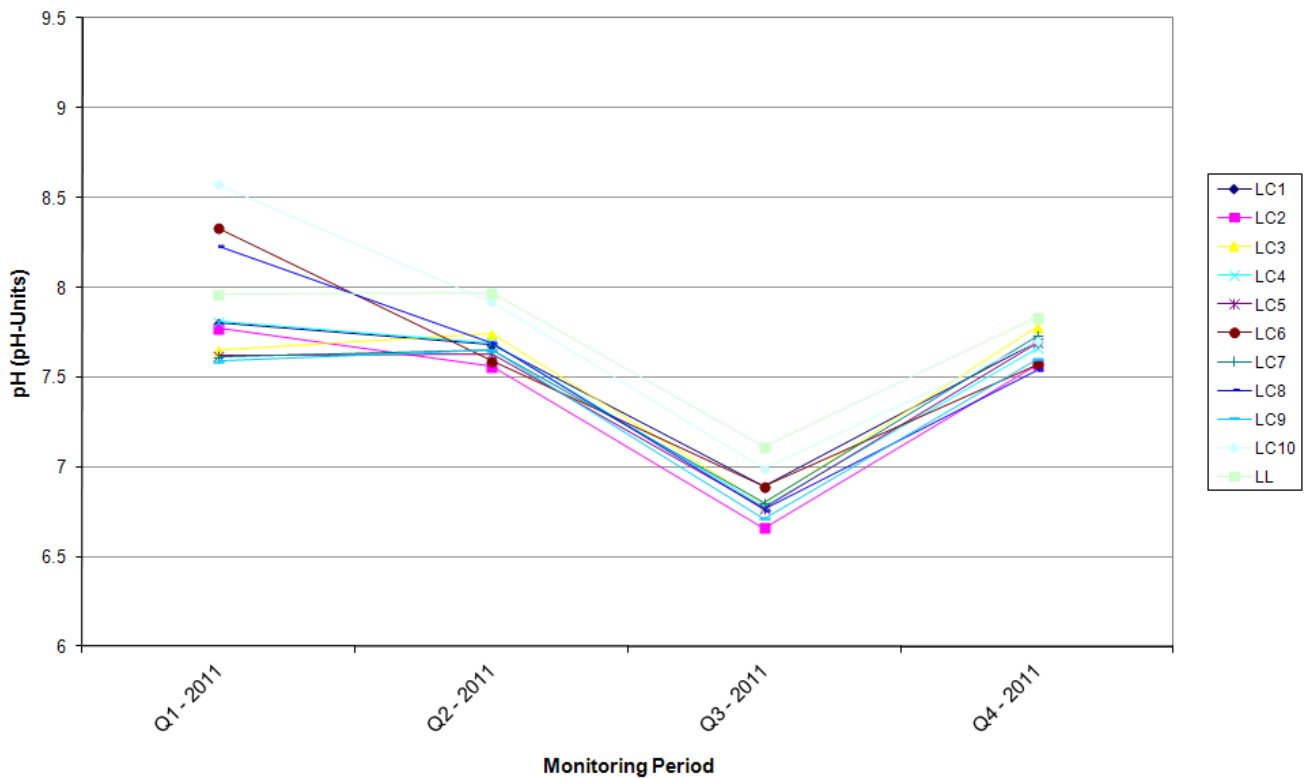


Figure 4.17: pH Results for Leachate

The electrical conductivity (EC), readings presented in Figure 4.18, show greater variation in results between individual cells and between quarters. High EC levels are observed in all cells.

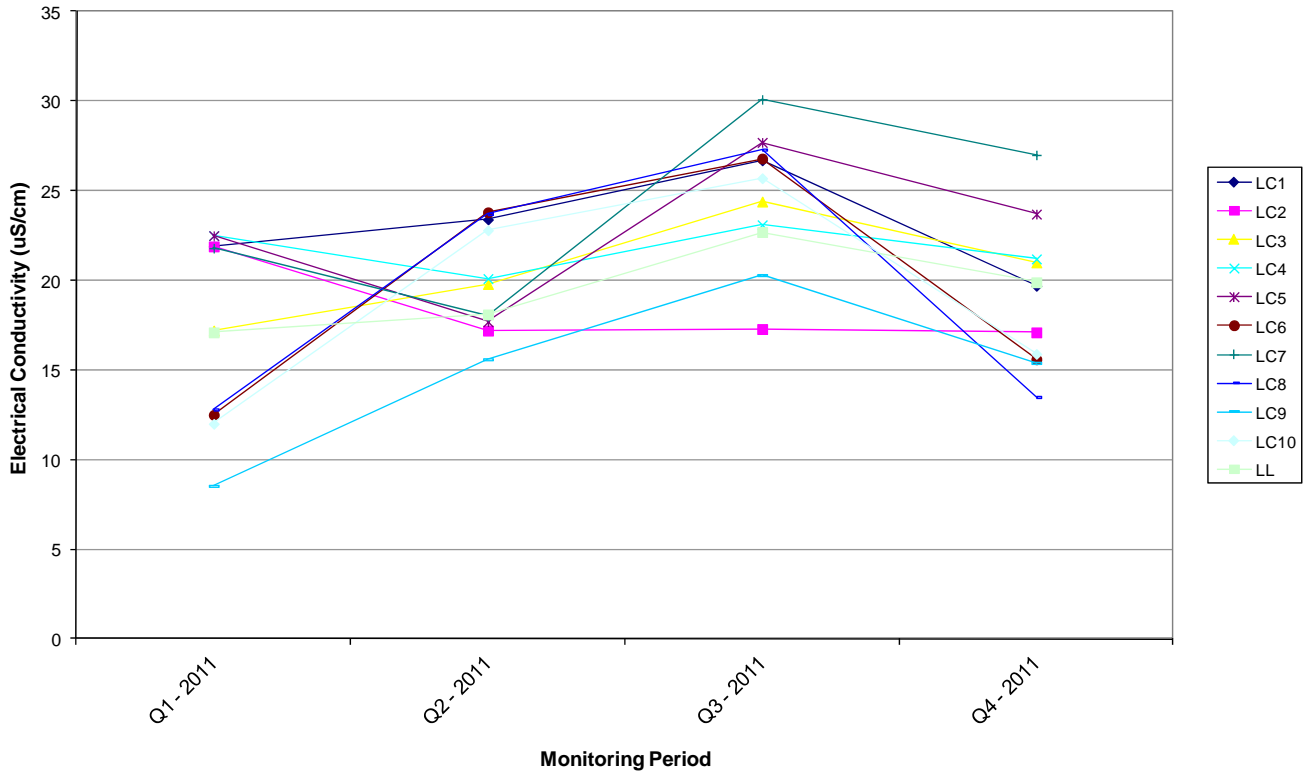


Figure 4.18: Electrical Conductivity Results for Leachate

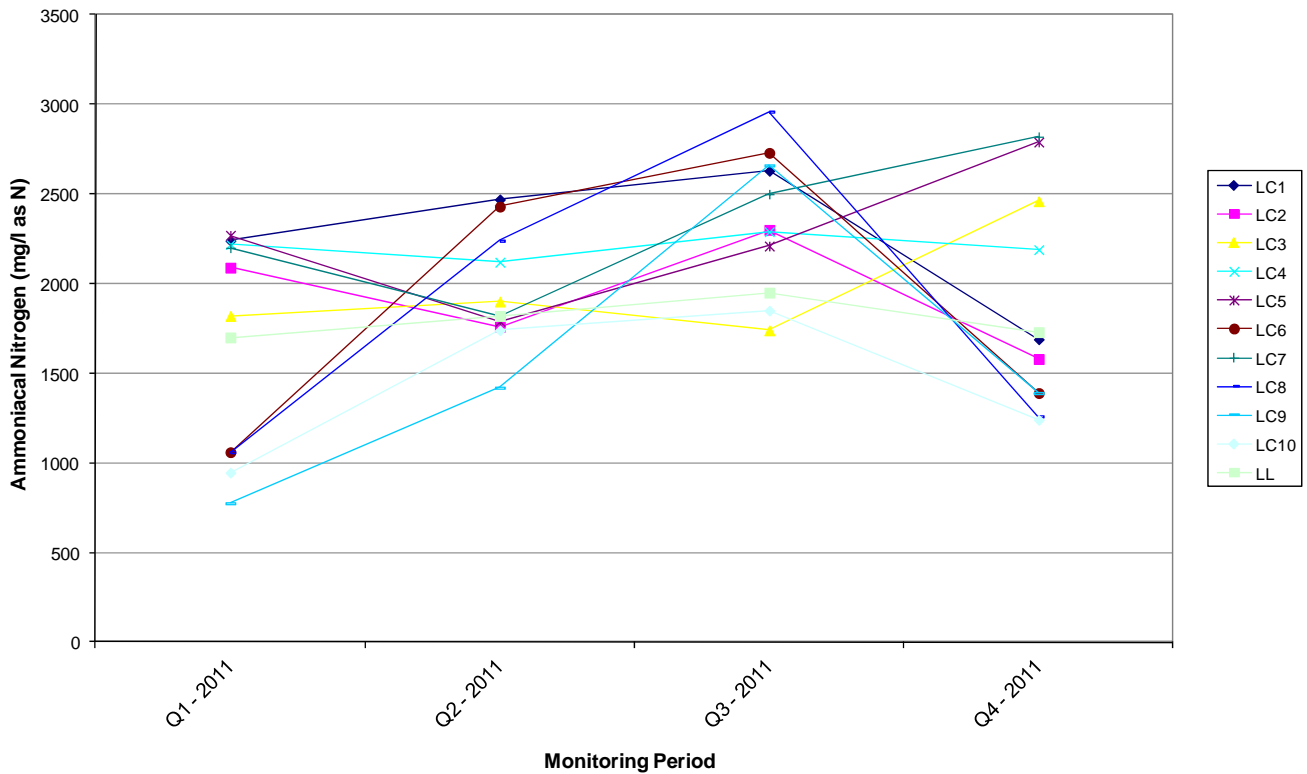


Figure 4.19: Ammoniacal Nitrogen Results for Leachate

There is a general trend indicating increasing ammoniacal nitrogen, presented in Figure 4.19, and chemical oxygen demand, presented in Figure 4.20 in leachate sampled through the reporting period. It is however observed that levels in a number of cells decreased in quarter 4.

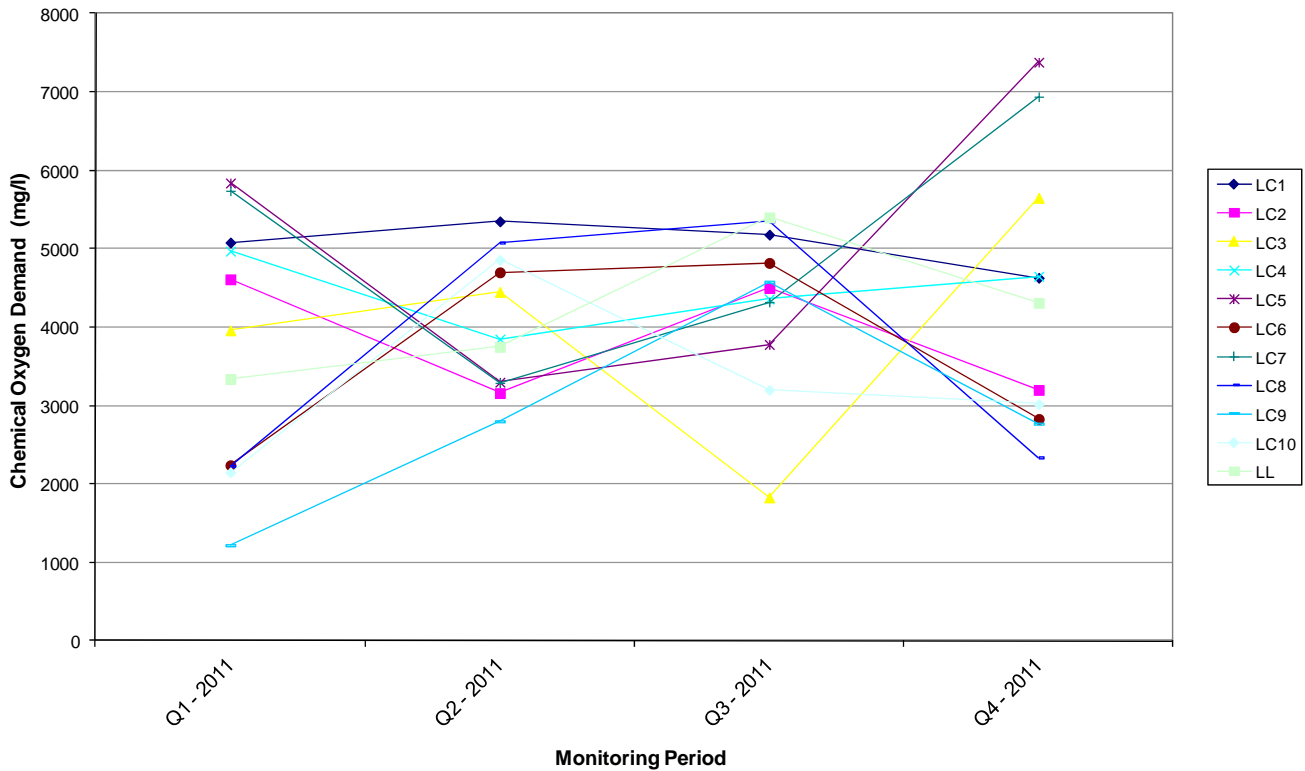


Figure 4.20: Chemical Oxygen Demand Results for Leachate

4.5.1. Conclusion

In general, the reported concentrations for the leachate sample are consistent with the typical composition of leachate sampled from large landfills and in line with the levels presented in the Environmental Protection Agency (EPA) Landfill Manual on Landfill Site Design (2000). The 2011 general results indicate an increase in leachate strength throughout the reporting period, which is expected given the age of the facility.

Leachate is removed off site to a Waste Water Treatment Plant (WWTP) as agreed with the Agency.

4.6. Noise Monitoring

Noise monitoring was discussed in Section 3.1 above. Monitoring of noise emissions from the facility is carried out on a quarterly basis at four locations outlined in Drawing Number LW11-172-03-100-001, Appendix I. The results were reported to the Agency as part of the quarterly reports but are summarised below.

Table 4.12: LAeq Results for Noise Recorded

Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4
N1	48	51	44	45
N2	55	58	50	59
N3	46	49	46	45
N4	46	51	44	44

With the exception of noise recorded in quarter 2 and quarter 4 at N2, all other results were within the 55dB limit for daytime noise at the facility boundary. During monitoring for Quarter 2, in May the LAeq was 58 dB at N2 and in Quarter 4, November the LAeq was 59 dB at N2.

As referred to in Section 3.1 above, traffic movements on the close by main road, the N2 and vehicle movements on the local road, adjacent to the noise monitoring locations, both off-site noise sources, contributed to the dominant noise at the monitoring location.

Section 5

Resource and Energy Consumption



5. RESOURCE AND ENERGY CONSUMPTION

The main resources consumed at the facility during the reporting period were electricity, water for potable supply & vehicle wheel cleaning, diesel fuel and hydraulic oils. The details are listed in Table 5.1 below.

Table 5.1: Energy and Resource Consumption at Knockharley, 2011

Resource	Consumption
Electricity	39,450 kWh
Water, Mains	1574 units
Diesel (green)	119,034 litres
Hydraulic Oils	360 litres
Odour Neutralisers	2000 litres

An Energy Efficiency Audit was completed in September 2010 in compliance with Condition 2.5.1. The audit was carried out in accordance with the Agency's "Guidance Note on Energy Efficiency Auditing" (2003).

Section 6

Development & Restoration Works



6. DEVELOPMENT & RESTORATION WORKS

6.1. Development Works Undertaken in 2011

A number of development works were carried out during 2011. The main development works included:

- 25 additional landfill gas extraction wells were drilled and installed during 2011; 11 in February and 14 in October
- The planning application submitted to An Bord Pleanala in 2010 for a proposed anaerobic digestion plant was withdrawn

6.2. Proposed Development Works to be undertaken in 2012

The following development works are planned to be undertaken in 2012:

- Extension of the existing final cap to complete Cells 1, 2, 3 and 4
- Installation of additional landfill gas engine capacity
- Installation of a new dedicated medium voltage electricity line to allow increased export capacity from landfill gas utilisation

6.3. Restoration of Completed Cells/Phases

The facility will be developed in seven phases. Each phase contains four cells. To date, three phases have been constructed and waste has been placed in ten cells.

Final capping of the perimeter of Cells 1 to 4 was completed in 2009. The uncapped areas of Cells 1 to 4 are now at final height and final capping works in this area is scheduled to be completed in 2012. Progressive intermediate capping is ongoing in the remaining cells.

6.4. Updates of the Restoration and Aftercare Plan

A restoration and aftercare plan was submitted to the Agency for agreement on 6th April 2005.

6.5. Site Survey

In accordance with Condition 8.9.1 of the waste licence a topographical survey of the facility is carried out annually. The survey for the 2011 reporting period is included in Appendix II.

Section 7

Leachate Volumes



7. LEACHATE

The annual leachate management structure Report (Condition 3.14.5) was submitted to the Agency on 13th December 2011.

7.1. Volume of Leachate Transported Off Site

The volume of leachate tankered off-site was 22,535.52 tonnes. 10,559.8 tonnes was consigned to Navan Wastewater Treatment Plant, while a further 11,975.72 tonnes was consigned to Rilta Dublin.

Section 8

Landfill Gas



8. LANDFILL GAS

There were two gas utilisation engines and three enclosed flares in operation on-site during the reporting period.

Two high temperature enclosed landfill gas flares (each a *Haase 1,500m³/hr*) were installed at a dedicated gas management area east of the waste cells in 2007 and February 2009 respectively. A high temperature enclosed landfill gas flare (*Haase 2,500m³/hr*) was installed in the dedicated gas management area east of the waste cells in December 2009. A temporary open flare (*Flaretech 500m³/hr*) has been operated since 2005 on occasion as a standby flare within the active waste cells of the Site.

Two landfill gas utilisation engines were installed within the same gas management compound during 2010.

Table 8.1 and Table 8.2 present data on the flaring and utilisation of methane occurring on-site during the reporting period.

Flare and engine monitoring was undertaken in May 2011, in accordance with Schedule D.

Landfill gas generation at the Site has been determined throughout the filling period and post-closure until 2050. The peak landfill gas generation rate has been modelled by GasSim2 to be 3,130 m³/hr (at the 50%ile) occurring in 2011. After 2011 the gas generation rate is forecast to decline steadily to approximately 200 m³/hr (at the 50%ile) in 2038. The modelled peak of maximum recoverable landfill gas (LFG) is forecasted to be 2,560 m³/hr (50%ile) in 2010. After 2010 the gas recovery rate is forecast to decline being 2,540 m³/hr (50%ile) in 2011.

Based on actual data recorded *in-situ* on-site at the flares and engines and entered into the EPA Gas Combustion spread sheet for annual summation, the flare utilisation figure is 4,295,006 kg/yr and the engine utilisation is 2,958,872 /yr CH₄.

Table 8.1: Summary of Landfill Gas Flared at Knockharley, 2011

Month	Flare 1				Flare 2				Flare 3				Total Methane Collected (m ³ /hr)	Total Methane Collected (kg/yr)
	Total run time	Flaring Total	Quantity of Methane Collected		Total run time	Flaring Total	Quantity of Methane Collected		Total run time	Flaring Total	Quantity of Methane Collected			
	(hrs/mth)	(m ³ /hr)	Total CH ₄ (m ³ /yr)	Total CH ₄ (kg/yr)	(hrs/mth)	(m ³ /hr)	Total CH ₄ (m ³ /yr)	Total CH ₄ (kg/yr)	(hrs/mth)	(m ³ /hr)	Total CH ₄ (m ³ /yr)	Total CH ₄ (kg/yr)		
January	0.00	0.00	0.00	0.00	734.00	588.00	146,983.00	94,073.00	744.00	1710	521,440.00	342,617.00	668,423.00	436,690.00
February	0.00	0.00	0.00	0.00	668.00	660.00	116,974.00	75,265.00	672.00	1816	500,173.00	327,281.00	617,147.00	402,546.00
March	0.00	0.00	0.00	0.00	711.00	570.00	132,402.00	85,282.00	744.00	1657	522,365.00	342,157.00	654,767.00	427,439.00
April	0.00	0.00	0.00	0.00	710.00	720.00	184,216.00	118,405.00	717.00	1214	387,672.00	254,724.00	571,888.00	373,129.00
May	0.00	0.00	0.00	0.00	740.00	682.00	170,875.00	109,597.00	744.00	1165	381,851.00	250,899.00	552,726.00	360,496.00
June	0.00	0.00	0.00	0.00	718.00	732.50	162,340.00	104,123.00	720.00	977	334,275.00	219,638.00	496,615.00	323,761.00
July	0.00	0.00	0.00	0.00	744.00	719.00	168,409.00	108,589.00	744.00	1097	379,763.00	249,527.00	548,172.00	358,116.00
August	0.00	0.00	0.00	0.00	744.00	677.00	161,563.00	106,157.00	744.00	1173	398,297.00	261,705.00	559,860.00	367,862.00
September	141.00	445.00	22,647	14,989	625.00	500.00	97,144.00	64,293.00	720.00	1101	354,726.00	232,351.00	474,517.00	311,633.00
October	0.00	0.00	0.00	0.00	686.00	509.00	122,717.00	80,967.00	744.00	1187	387,313.00	254,488.00	510,030.00	335,455.00
November	0.00	0.00	0.00	0.00	672.00	508.60	127,948.00	84,331.00	720.00	1103	355,371.00	233,984.00	483,319.00	318,315.00
December	94.00	507.00	16,844	11,148	623.00	458.10	93,675.00	61,423.00	744.00	933	314,055.00	206,995.00	424,574.00	279,566.00
Total	235.00		39,491	26,136	8,375.00		1,685,246.00	1,092,503.00	8,757.00		4,837,303.00	3,176,367.00	6,562,038.00	4,295,008.00

Table 8.2: Summary of Landfill Gas Utilised at Knockharley, 2011

Month	Engine 1				Engine 2				Total methane collected (m ³ /hr)	Total Methane Collected (kg/yr)
	Total run time	Utilisation Total	Quantity of Methane Collected		Total run time	Utilisation Total	Quantity of Methane Collected			
	(hrs/month)	(m ³ /hr)	Total CH ₄ (m ³)	Total CH ₄ (kg/yr)	(hrs/month)	(m ³ /hr)	Total CH ₄ (m ³)	Total CH ₄ (kg/yr)		
Total	8,520.00		2,430,569	1,479,436	8,520.00		2,430,569	1,479,436	4,861,138.00	2,958,872.00

Section 9

Summary Annual Water Balance



9. METEOROLOGICAL DATA & ANNUAL WATER BALANCE

9.1. Meteorological Data

Meteorological data for the site was obtained from Dublin Airport and is presented below.

Table 9.1: Total Rainfall (millimetres)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2011	29.2	76.1	19.4	28.4	37.0	64.3	42.6	39.7	65.2	169.5	48.5	51.9	671.8

The total annual rainfall was recorded as 671.8 mm, with the wettest month recorded as October with 169.5 mm of rainfall and the driest month recorded as April with 19.4 mm of rainfall.

Table 9.2: Mean Temperature (degrees Celsius)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2011	3.6	7.0	5.8	10.1	11.4	12.0	13.8	13.5	14.0	11.8	9.7	5.8	9.9

The warmest month was recorded as September with a mean temperature of 14.0 °C, while the coolest month was recorded as January with a mean temperature of 3.6 °C.

9.2. Indirect Emissions to Groundwater

The Knockharley is a fully engineered and contained landfill and there are no indirect emissions to groundwater from the facility.

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

Landfill Base:	The landfill site has a composite base lining system comprising a HDPE geomembrane and a 0.5 m thick layer of compacted Bentonite Enhanced Soil. A leak detection survey of the HDPE geomembrane after placement of the drainage stone layer was completed and defects to the HDPE liner were repaired in accordance with industry standards. A CQA report was then completed and submitted to the Agency.
Surface Water Collection and Treatment System:	Surface water from the paved access roads and landfill cell swale drain is collected and discharged into the surface water lagoon along with groundwater collected at the interceptor sump located below the landfill cells. Water from the lagoon is then piped to a reed bed, which further filters the water before it is finally discharged into the nearby stream
Treated Sewage Effluent:	There is a BioCycle wastewater treatment plant located adjacent to the weighbridge which treats the canteen and office wastewater prior to being pumped to the leachate holding tank via the foul water sump. Leachate (containing foul water) is tankered off-site to a waste water treatment plant via a vacuum tanker.

9.3. Groundwater Trigger Levels

In accordance with Condition 6.6 of the waste licence the groundwater trigger levels (GWTL) were revised and forwarded to the EPA. Approval of the GWTL was given by the EPA for use in the assessment of groundwater samples on the 23 December 2011.

For the present reporting period groundwater quality was assessed against baseline groundwater results, however groundwater samples will be assessed against the approved GWTL in the future.

9.4. Water Balance Calculation

An annual water balance calculation was completed for the site. The calculation is based on a waste input of 89,577.30 tonnes of waste.

The calculation indicated a leachate production of 30,899.8 m³ yr⁻¹ while leachate tankered off site was recorded at 22,535.52 tonne yr⁻¹. A greater volume of leachate was calculated to have been produced, than was tankered off-site during the reporting period. It is noted that last year more leachate was tankered off-site (29,672.16 tonne yr⁻¹) than was calculated to have been produced (27,633.1 m³ yr⁻¹).

9.5. Estimated Liquid In-Waste Volume

Year	Rainfall	Evaporation	Effective Rainfall †	Waste Input	Active area	Intermediate restoration area (cell 5-10)	Final restoration (cells 1,2,3,4)	Active Infiltration *	Intermediate Infiltration **	Capped Infiltration* **	Liquid Waste	Absorptive Capacity ††	Active Leachate	Total Leachate Production
	(mm)	(mm)	(mm)	(tonnes)	(m ²)	(m ²)	(m ²)	(m ³)	(m ³)	(m ³)	(m ³)	(m ³)	(m ³)	(m ³)
2011	671.8	67.18	604.62	89577.3	42,420	26167	20485	25,648.0	10,283.7	1,238.6	0	6,270.4	19,377.6	30,899.8

Notes:

The calculation was carried out using MS Excel following the method from the EPA Landfill Manual on Landfill Site Design, as shown:

$$L_o = [ER(A) + LW + IRCA + ER(l)] - a(W);$$

where:	Lo =	leachate produced(m3)
	ER =	effective rainfall, [(ER) is defined as Total Rainfall (R) minus Actual Evapotranspiration (AE) i.e. ER=R-AE]
	A =	area of cell (m2)
	LW =	liquid waste (m3)
	IRCA =	infiltration through restored and capped areas (m3)
	l =	surface area of lagoons (m2)
	a =	absorptive capacity of waste (m3/t)
	W =	weight of waste deposited (t/a)

Cell Area (m2) 8907

† Evapotranspiration calculated at 10% of actual rainfall

†† Absorptive Capacity (m3/tonne) 0.07

* Active infiltration rate 100%

** Intermediate Infiltration 65%

*** Final infiltration 10%

Section 10

Environmental Management System



10. ENVIRONMENTAL MANAGEMENT SYSTEM

10.1. Environmental Management System

In accordance with Condition 2.3 of the waste licence an Environmental Management System is maintained at the facility. 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.

Updates on the EMS are presented in the following sections of the AER.

10.2. Updates on the Landfill Environmental Management Plan (LEMP)

The Landfill Environmental Management Plan was revised and updated in compliance with Condition 2.3.2.2 in December 2011.

Updates included change in permitted annual tonnage from 132,000tpa to 88,000tpa in accordance with PL 17.220331, change in out of hours security arrangement, change of management staff structure, change of site opening hours, updated objectives and targets, updated group Environment, Health and Safety Policy and updated ISO 14001 certificate (valid until 2014).

10.3. Report on Staff Training

All training was carried out as scheduled in the training plan for 2011. Details are as follows –

- ISO 14001 and Environmental Awareness – All staff
- Manual Handling – All staff
- Wedge and Extrusion Welding – Chargehand/Landfill Gas Technician and General Operative
- Working practices and safety procedures on the working face – All staff
- Incident reporting procedure – All staff
- Various site specific procedure training and H&S toolbox talks – All staff

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

10.4. Management and Staffing Structure

The day to day management of the facility and supervision of waste activities are the responsibility of the Landfill Manager, nominated Deputy Manager(s) and the site operatives. The positions and names of the persons who provide management and supervision are set out as follows –

Landfill Manager	Heather Lamont
Assistant Landfill Manager	Neil Menzies*
Assistant Landfill Manager	Thomas Finnegan*
Site Foreman	Robert Hughes*
Chargehand/LFG Technician	Sean Smith*
Weighbridge Operator	Michael Noone
Operatives	Donal Blaney and Martin Maguire

*Nominated Deputy in accordance with WO146-02 Condition 2.1.

10.4.1. 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 LEMP and the Waste Licence conditions.

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

10.5. New Procedures Developed During 2011

New operational procedures developed in for the site are presented below.

KNKP 44 Procedure for Secure Burial of Waste	This operating procedure details the method to be used by landfill staff when disposing of special waste types requiring secure burial, for example, Department of Agriculture, Fisheries and Food (DAFF) designated Category 1 wastes.
KNKP 45 Haase Flare Operation & Switch Room Fault	This operating procedure provides for the correct operation of the Haase flares, including start up and shut down, and operation of MV switchgear in the event of power failure.
KNKP 46 Banksman Operating Procedure	This procedure details the banksman's duties and responsibilities and sets out the method to achieve these without harm to human health or the environment.

10.6. Summary Schedule of Environmental Objectives and Targets

This section of the report presented the program of environmental objectives and targets for 2011. The progress against the 2010 objectives and targets are also discussed.

Table 10.1: Programme of Environmental Objectives and Targets proposed for 2008-2013

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
1	Gas Management	1. Generation of LFG 4. Release of LFG	Hold Gas Management meetings every 6 months to review existing infrastructure and discuss maintenance and upgrading as required.	On-going	AM/FM
			In accordance with condition 6.10.5 of the waste licence W0146-02, the site will aim to reduce the number of fugitive VOC emissions from the landfill at each survey. Records are kept showing results of surveys.	On-going	All
			All waste filled to final levels during 2011 to have permanent capping installed within 24 months	2013	FM/AM
			Flow meters to be installed on gas engines to give better optimisation whilst balancing gas wells	Completed	
			Reduce O2 level in bad gas stream to for optimal operational efficiency of flares once temporary capping in place -5% -4.50% -3.50%	Completed Completed Jun-12	AM/FM
			Maintain engines at O2 level of 2.5% and below for optimal running and output	On-going	AM/FM
			Extend existing measures to further insulate pipes and flares to prevent against potential downtime during cold months. Use of light bulbs to keep pumps warm.	Completed	AM/FM
			Increase use of double lifts and horizontal wells along exposed outer flanks of landfill.	On-going	AM/FM

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
2	Leachate Management	12. Generation of leachate	Continue to monitor and control leachate through quarterly leachate quality monitoring and weekly leachate level checks.	Weekly, Quarterly, On-going	FM
			Implement recirculation of leachate at the landfill.	When final capping sufficient and Agency approval given	
			Continually assess and upgrade infrastructure as necessary.	Continual	FM
			Construct leachate processing plant on site.	Q3/Q4, 2012	AM/FM
			Permanent capping to all finished areas of landfill and extra clay capping on intermediate areas.	Start 2011 - 2013	AM/FM
3	Landscaping	2/26.Generation of GHG's	Maintain and continue to improve all on site landscaping and the wetland area.	On-going	FM
		20. Emissions to air	Employ a landscape contractor to assess plantations, replace failed trees/plants and improve the overall general appearance of the landfill site.	On-going (Seasonal)	FM
		17. Visual Impact	Implement planting of fruit and nut trees as part of landscaping planning application.	Planning application withdrawn	
4	Environmental Control / Nuisance	3/6/8. Generation of dust	Review relationships with neighbours and interested parties on a continual basis and review communications programme annually.	Annually & On-going	AM/FM
		6/14. Birds/vermin/flies	Review the number and composition of complaints to determine any trends.	Monthly	FM
		4. Release of LFG	Extend litter picking to include inner boundary road as illegal dumping appears to have increased here.	On-going from March	AM/FM
		5/9. Litter	Continue to hold regular meetings with local residents	On-going	AM/FM
		13/15/19.Noise	Finish cells 9/10 and go into cells 11/12 where visual aspect can be minimised.	During 2012 (filling speed has been affected by 88 ktpa planning restriction)	FM
		17. Visual Impact	Continue with litter patrols and litter picking	On-going, weekly	AM/FM

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility
5	Education and Environmental Awareness	Aspects 1-28	Actively encourage site visits from interested parties i.e. local community groups, schools, clubs, etc.	On-going	AM
			Review relationships with neighbours and interested parties on a continual basis and review communications programme annually.	Annually & On-going	AM/FM
			Continue distribution of newsletter to local people at regular intervals.	Annually	AM/FM
			Continue to provide sponsorship of interested local parties, clubs, etc.	On-going	FM
			Keep Public Information Room updated and current.	On-going	AM
			Update as part of newsletter, progress on planning permission	Planning application withdrawn	
			Review Communications Programme	August 2011	FM
			Investigate possibility of establishing fruit and nut orchard in perimeter land as a natural habitat and as an educational area for local schools and residents	Plans on hold due to the withdrawal of planning application	AM/FM
6	Reduce energy usage on-site	11/16/23. Use of energy 2/19. Generation of GHG's	Implement an updated Energy Awareness Programme incorporating the recommendations from the 2010 energy audit.	Sept 2010 Onwards	AM/FM
			Look into changing all light bulbs to energy saving versions	Investigation closed out	
			Fix water leak and regain costs lost as a direct result by issuing a leak rectifying report to Meath Co Co	Completed	
			Put energy use and energy saving report into Autumn Newsletter	Not issued	
			Install new energy saving dishwasher	Completed	
7	Minimise fugitive emissions while carrying out capping works	29. Global warming and nuisance	Cap in progressive, small sections to reduce the potential of fugitive emissions. Coordinate with the contractor on this and include nuisance issues in regular construction meetings	Q2 – Q3 2012	AM/FM

Table 10.2: Schedule & progress against Environmental Objectives and Targets for 2011

Ref. No.	Objective	Aspect	Target	Deadline	Responsibility	Progress
1	Gas Management	1. Generation of LFG 4. Release of LFG	Hold Gas Management meetings every 6 months to review existing infrastructure and discuss maintenance and upgrading as required.	On-going	AM/FM	2 meetings were held in 2011
			In accordance with condition 6.10.5 of the waste licence W0146-02, the site will aim to reduce the number of fugitive VOC emissions from the landfill at each survey. Records are kept showing results of surveys.	On-going	All	The number of locations where VOC emissions exceeded the trigger levels decreased from 2010 to 2011
			All waste filled to final levels during 2011 to have permanent capping installed within 24 months	2013	FM/AM	Plans are in place to final cap Cells 1-4 in 2012
			Flow meters to be installed on gas engines to give better optimisation whilst balancing gas wells	March/April 2011	CetCo	Completed July 2011
			Reduce O2 level in bad gas stream to for optimal operational efficiency of flares once temporary capping in place -5% -4.50% -3.50%	April 2011 Dec 2011 June 2012	AM/FM	April and December targets were met
			Maintain engines at O2 level of 2.5% and below for optimal running and output	On-going	AM/FM	O2 level maintained between 2 – 3%
			Extend existing measures to further insulate pipes and flares to prevent against potential downtime during cold months. Use of light bulbs to keep pumps warm.	Sept/Oct 2011	AM/FM	Trace heat wire and insulation installation installed on all vital lines Nov 2011
			Increase use of double lifts and horizontal wells along exposed outer flanks of landfill.	On-going	AM/FM	On-going

2	Leachate Management	12. Generation of leachate	Continue to monitor and control leachate through quarterly leachate quality monitoring and weekly leachate level checks.	Weekly, Quarterly On-going	FM	All levels compliant with the licence
			Implement recirculation of leachate at the landfill.	When final capping sufficient and Agency approval given		Recirculation plans have been drawn up and pipe installation scheduled for Q1, 2012
			Continually assess and upgrade infrastructure as necessary.	Continually	FM	On-going.
			Permanent capping to all finished areas of landfill and extra clay capping on intermediate areas	Start 2011 - 2013	AM/FM	Final capping works scheduled for 2012. Clay capping on-going
3	Landscaping	2/26. Generation of GHG's 20. Emissions to air 17. Visual Impact	Maintain and continue to improve all on site landscaping and the wetland area.	On-going	FM	Grass cutting programme completed in conjunction with local farmers
			Employ a landscape contractor to assess plantations, replace failed trees/plants and improve the overall general appearance of the landfill site.	On-going (seasonal)	FM	Contractor engaged and work on-going
			Implement planting of fruit and nut trees as part of landscaping in planning application	End 2011	AM/FM	Planning application withdrawn in Sept 2011
4	Environmental Control / Nuisance	3/6/8. Generation of dust 6. Birds/vermin/flies 4. Release of LFG 5/9. Litter 13/15/19.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/FM	Communications Programme reviewed in Aug 2011
			Review the number and composition of complaints to determine any trends.	Monthly	FM	Completed for monthly reports

			Extend litter picking to include inner boundary road as illegal dumping appears to have increased here	On-going from March	AM/FM	Completed and on-going
			Continue to hold regular meetings with local residents.	On-going	AM/FM	Completed
			Finish cells 9/10 and go into cells 1/12 where visual impact aspect can be minimised	End 2011	FM	Waste filling has slowed due to planning intake limit. Filling has been concentrated in cells 3-8
			Continue with litter patrols and litter picking	Ongoing weekly	AM/FM	Completed and ongoing
5	Education and Environmental Awareness	Aspect 1-28	Actively encourage site visits from interested parties i.e. local community groups, schools, clubs, etc.	On-going	AM	2 school visits, 1 college visit and site used as movie location
			Review relationships with neighbours and interested parties on a continual basis and review communication programme annually	Annually and on-going	AM/FM	On-going. Scheduled for early 2012
			Continue to provide sponsorship of interested local parties, clubs, etc.	Spring and Autumn 2011	FM	Sponsorships continue but target has been reviewed due to budget constraints
			Keep Public Information Room updated and current.	On-going	AM	Completed and on-going
			Update as part of newsletter, progress on planning permission	Autumn 2011	AM/FM	Not completed – planning application withdrawn in Sept 2011
			Review Communications Program	August 2011	FM	Completed

			Investigate possibility of establishing fruit and nut orchard in perimeter land as a natural habitat area and as an educational area for local schools and residents	End 2011	AM/FM	Was planned as part of AD planning application – planning application withdrawn in Sept 2011
6	Reduce energy usage on site	11/16/23. Use of energy 2. Generation of GHG's	Implement an Energy Awareness Programme incorporating the recommendations from the 2010 energy audit.	Sept 2010 Ongoing	AM/FM	Limited progress. Efforts will be made to progress this in 2012
			Look into changing all light bulbs to energy saving versions	June 2011	AM	Completed
			Implement a review of energy consumed per area of the site	May 2011	AM	Reviewed and determined unfeasible
			Fix water leak and regain cost lost as a direct result by issuing a leak rectifying report to Meath Co Co	June 2011	AM/FM	Completed
			Put energy use and energy savings report into Autumn Newsletter	Autumn 2011	AM	Not completed – newsletter on-hold
			Install new energy saving dishwasher	March 2011	FM	Completed

10.7. Review of Nuisance Controls

Greenstar Ltd is committed to operating the Knockharley facility in the best possible manner using the best available techniques to minimise impacts on the environment and local residential neighbours. Knockharley landfill welcomes communications from local residents and any interested parties and all reasonable and practical measures will be implemented to eliminate or minimise any issues or nuisances.

10.7.1. 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). 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 October 2010..

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.

10.7.2. Vermin Control

The methods used for vermin control are as detailed in Nuisance Inspection Procedure (KNKP 32). 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.

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

10.7.3. 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.

10.7.4. 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.

10.7.5. Litter Control

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.

10.8. Reported Incidents and Complaints Summary

There were two reported incidents on-site during the reporting period. Once was a rejected load of non-conforming waste and the other was for VOC surface emission exceedances in accordance with Condition 6.10.5 of WL W0146-02.

Greenstar maintains a register of complaints in compliance with Condition 10.4. Details of all complaints received during the reporting period and the action taken by Greenstar are available at the facility. Summary data showing the composition of the complaints presented in Table 11.3 and Figure 10.1.

Table 10.3: Summary of Complaints

Month	Odour	Other	Total
January	11		11
February	8		8
March	7		7
April	6		6
May	2		2
June	4		4
July	1	1	2
August	6		6
September	5		5
October	6	1	7
November	0		0
December	1		1

As observed from the data in Table 10.3 odour complaints dominate the register during the reporting period.

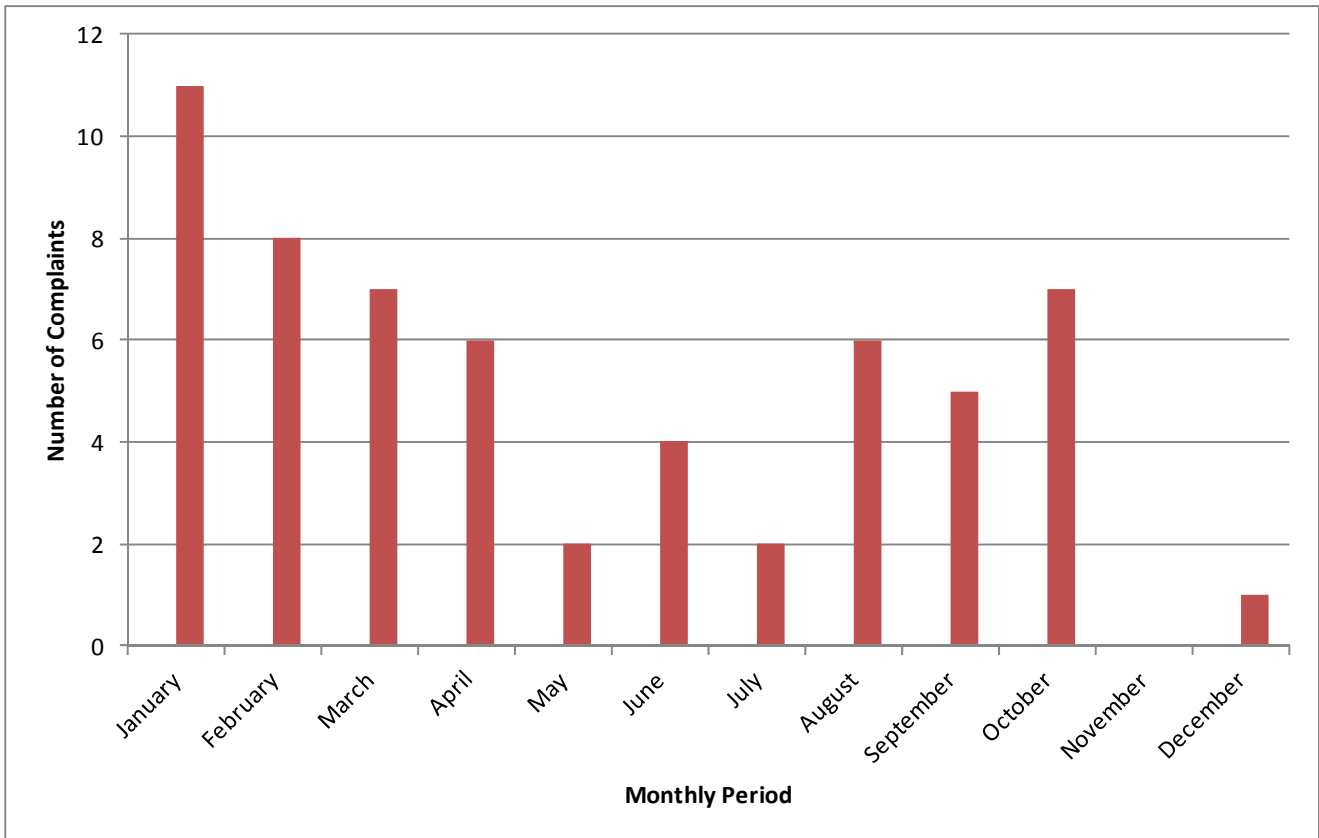


Figure 10.1: Total number of complaints to the site during the reporting period

10.9. Site Testing and Inspection Reports

As per Schedule E and Condition 3.11.6 of the waste licence, the integrity of the bunds and tanks are carried out every three years. This integrity testing was carried out in July 2011 – test certificates are included in Appendix III.

10.10. 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. The information is submitted separately to the Agency via the web-based data reporting system.

10.11. Statement of Measures for prevention of environmental damage and financial provisions/ELRA

In compliance with waste licence Condition 12.2 Greenstar has put in place a Bank Guarantee with Bank of Ireland to the value of €2,717,820. Details of this bank guarantee have been submitted to the EPA.

In compliance with waste licence condition 12.2.2 a comprehensive and fully costed Environmental Liabilities Risk Assessment (ELRA) has been completed.

Condition 12.3 of the waste licence states, *'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'*.

In relation to this matter Greenstar can confirm that the gate fee for the disposal of waste at the Knockharley Landfill is appropriate in the current market and includes financial provision for the closure, restoration and aftercare of the site.

10.12. Public Information Programme

Knockharley Landfill pursues an active programme of disseminating information on its operations to interested parties. This is undertaken through a variety of means including site tours, the company website, presentations and open days.

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. This document is reviewed and updated at regular intervals.

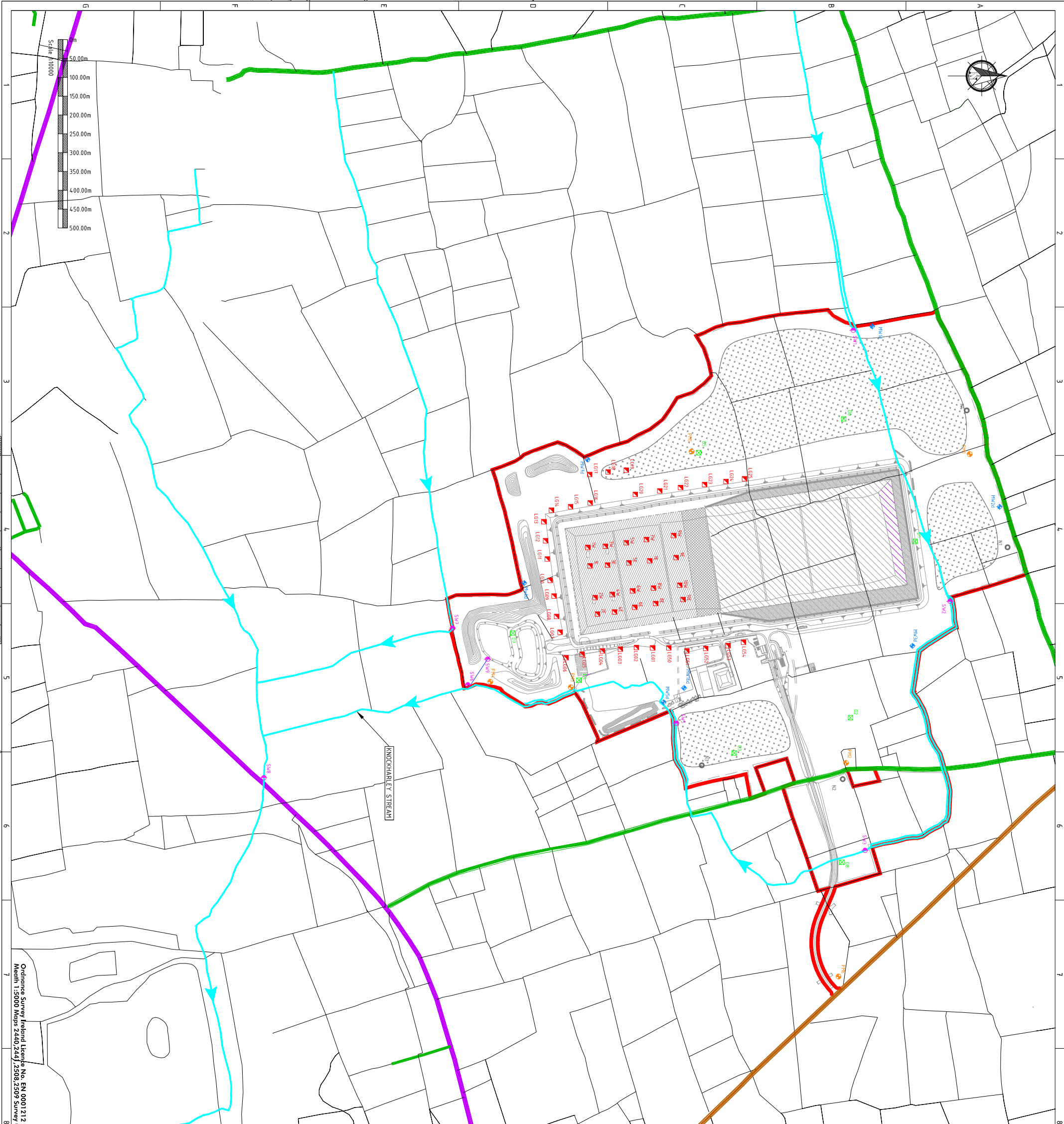
A dedicated public information room is maintained at the facility and an open door policy is encouraged.

Appendix I

Maps



ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION



ID	Eastings	Northings
D1	297272	267256
D2	297174	267560
D3	297831	267285
D4	297632	266886
D5	297030	267194
D6	296964	267575
D7	297516	266690
D8	298124	267563
GROUNDWATER		
HW1D	296706	267640
HW2D	297176	267992
HW3D	297558	267161
HW4D	297101	267094
HW5D	297302	266922
HW6D	297096	266890
HW7D	297096	267143
NOISE		
N1	297290	267999
N2	297901	267565
N3	297858	267202
N4	296921	267882
SURFACE WATER		
SW1	296706	267600
SW2	297464	267862
SW3	298087	267634
SW4	297164	267116
SW5	297663	266562
SW6	297510	266525
SW7	297510	266029
SW8	297916	266029
SW9	297585	266623
PH10		
PH1	297030	267909
PH2	297833	267491
PH3	297656	266826
PH4	297036	266970
PH5	298454	267576
LANDFILL GAS		
L01	297560	267060
L02	297559	267060
L03	297560	266982
L04	297571	266936
L05	297574	266875
L06	297584	266837
L07	297513	266814
L08	297482	266815
L09	297426	266804
L10	297372	266795
L11	297326	266784
L12	297275	266786
L13	297226	266775
L14	297194	266759
L15	297182	266846
L16	297111	266804
L17	297111	266804
L18	297093	266827
L19	297093	266893
L20	297148	267015
L21	297138	267080
L22	297130	267135
L23	297121	267200
L24	297114	267255
L25	297107	267305
L26	297055	267104
L27	297053	267152
L28	297052	267202
L29	297054	267261
L30	297054	267302
L31	297289	266889
L32	297337	266895
L33	297422	266908
L34	297465	266915
L35	297465	266933
L36	297435	266951
L37	297435	266967
L38	297440	266980
L39	297330	266999
L40	297330	267008
L41	297404	267013
L42	297468	267045
L43	297268	267053
L44	297324	267053
L45	297396	267063
L46	297438	267069
L47	297257	267117
L48	297315	267123
L49	297388	267132
L50	297427	267174

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- Legend:**
- Denotes Groundwater Monitoring Location
 - Denotes Surfacewater Monitoring Location
 - Denotes Noise Monitoring Location
 - Denotes PH10 Monitoring Location
 - National Primary Route
 - National Regional Route
 - National County Route
 - Existing Water Course (Arrow showing flow direction)
 - Site Boundary
 - Existing Forestry stands (immature)

ISSUE FOR INFORMATION

Rev.	Drawn By	Check By	Issue Date	Description
A	GM	GM	03.04.12	

Name of Client
greenstar

Name of Job
 KNOCKHARLEY LANDFILL
 ENVIRONMENTAL MONITORING & REPORTING

Title of Drawing
 ENVIRONMENTAL MONITORING LOCATIONS

FEHILY TIMONEY & COMPANY
 CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

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Scale Used
 1:10000

Dwg. No.
 LW11-172-03-100-001

Rev.
 A

Original Drawing Size A1 - (841 x 594)

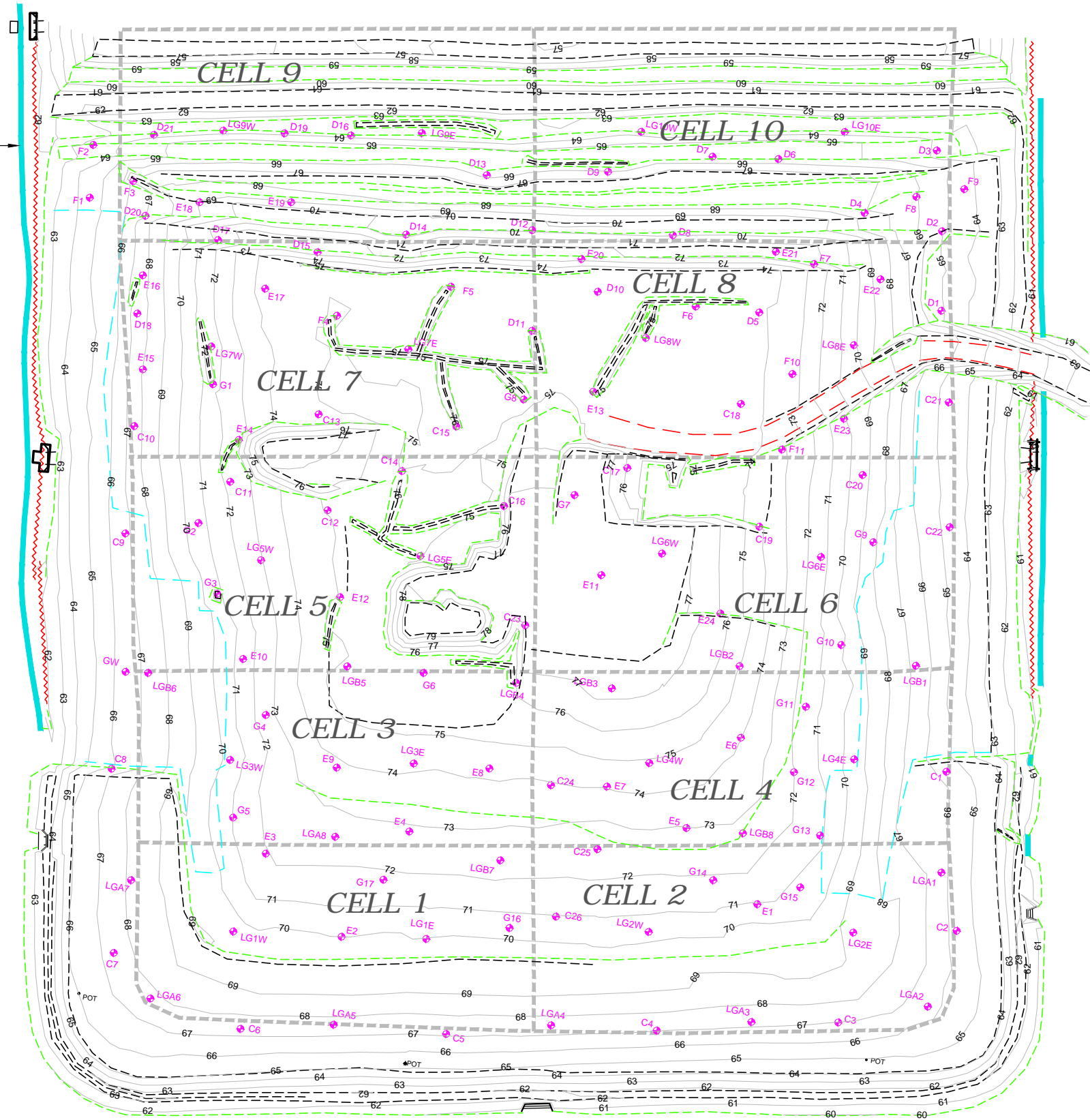
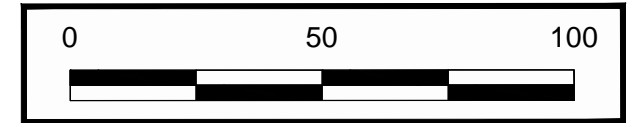
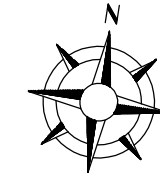
Appendix II

Topographical Survey



ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

355mm GAS RING MAIN



LEGEND	
	WASTE CONTOUR (SURVEYED 17/01/12)
	F-B; 'A5-B'; 5G'D-D9'fl)) a a « L
	EXISTING GAS WELL



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

Client:	greenstar
Location:	KNOCKHARLEY LANDFILL CO. MEATH
Project:	WASTE VOID VOLUME SURVEY

Title:	WASTE CONDITIONS AS SURVEYED 17th JANUARY 2012		
Scale:	1:750 A1	1:1,500 A3	
Surveyed by:	POB	Engineer:	PC
Reviewed by:	CW		

Project number	09.50719.0114
File Location	GREENSTAR/KNOCKHARLEY/GOLDER DWGS/ WASTE SURVEYS/WS-22-01
ORDNANCE SURVEY IRELAND LICENCE NUMBER	AR0056012

Issue to	Date	Version	Drawing
CLIENT	Jan. '12	A	


W-S 22/1


Appendix III


Bund Test Certificates




ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

Knockharley Landfill Knockharley, Kentstown, Co. Meath ☎ 041 9821650 7 041 9821750	Issued by	H. Miller	
	Approved by	J. Jones	
	Date	19.05.11	
	Revision	0	
Bund Test Record (GS050)			

Bund Testing Form					
Bund name and ref No.:		Date of day 1 of test:		Test no.:	
DIESEL BUND B1		07/07/11		01	
Pre-filling checks :					(Initial if complete)
No visible cracks or other features likely to affect integrity					✓ TH
Bund clean and free of debris					✓ TH
Bund and sump empty					✓ TH
Isolate all electrical components in the sump					✓ TH
Carry out all health and safety checks					✓ TH
If all of the 4 checks above are complete then proceed with the test. If it is not possible to carry out all the above checks contact the manager.					
Day	Time	Bund Level (mm)	Control Level (mm)	Personnel involved	Comments
0-1 hrs	10.30	400	150	DONAL B	Stabilisation period
2 hrs	12.30	400	150	"	
8 hrs	16.45	400	150	"	
24 hrs	10.54	420	160	"	Rainfall overnight
Final level		420	160		
Drop in level (mm)= Day 1- Final level		A 0mm	B 0mm	Note: If the control level drops by more than the bund level the test is deemed void and must be rescheduled	
Test Result					
Calculation: $A-B=X$ (Where X is positive the bund level has risen. Where X is negative the bund level has dropped)					X= 0mm
Is X between -10 mm and 10 mm? If 'yes' the bund is deemed passed (Y/N)					YES
Final Result (Pass/ Fail): PASS					
Test completed by : _____ Date : <u>08/07/11</u> 					
Follow up in event of failed bund test					
Carry out visual inspection of the bund. Specifically try to identify cracks, holes or other defects likely to affect bund integrity.					
Date of Visual Inspection					
Description and Results of Visual Inspection :					
Does bund require further repairs or maintenance? If 'yes' pass request to manager and await completion of remedial works before scheduling re-test. If 'no' follow instruction below (Y/N)					
Schedule re-test within 3 months of end of original test (initial if complete)					
Completed by : _____ Date : _____					

Knockharley Landfill Knockharley, Kentstown, Co. Meath ☎ 041 9821650 7 041 9821750	Issued by	H. Miller	
	Approved by	J. Jones	
	Date	19.05.11	
	Revision	0	
Bund Test Record (GS050)			

Bund Testing Form					
Bund name and ref No.:		Date of day 1 of test:		Test no.:	
PLASTIC BUND 132		07/07/11		01	
Pre-filling checks :					(Initial if complete)
No visible cracks or other features likely to affect integrity					✓ JM
Bund clean and free of debris					✓ JM
Bund and sump empty					✓ JM
Isolate all electrical components in the sump					✓ JM
Carry out all health and safety checks					✓ JM
If all of the 4 checks above are complete then proceed with the test. If it is not possible to carry out all the above checks contact the manager.					
Day	Time	Bund Level (mm)	Control Level (mm)	Personnel involved	Comments
0-1 hrs	10.30	900	150	DONALIS	Stabilisation period
2 hrs	12.30	900	150	"	
8 hrs	16.45	895	150	"	
24 hrs	10.53	895	150	"	
Final level		895	150		
Drop in level (mm)= Day 1- Final level		A 5mm	B 0mm	Note: If the control level drops by more than the bund level the test is deemed void and must be rescheduled	
Test Result					
Calculation: A-B= X (Where X is positive the bund level has risen. Where X is negative the bund level has dropped)					X= 5mm
Is X between -10 mm and 10 mm? If 'yes' the bund is deemed passed (Y/N)					YES
Final Result (Pass/ Fail): PASS					
Test completed by :		Date :			
		08/07/11			
Follow up in event of failed bund test					
Carry out visual inspection of the bund. Specifically try to identify cracks, holes or other defects likely to affect bund integrity.					
Date of Visual Inspection					
Description and Results of Visual Inspection :					
Does bund require further repairs or maintenance? If 'yes' pass request to manager and await completion of remedial works before scheduling re-test. If 'no' follow instruction below (Y/N)					
Schedule re-test within 3 months of end of original test (initial if complete)					
Completed by : _____ Date : _____					

Knockharley Landfill
Knockharley, Kentstown, Co. Meath

☎ 041 9821650 7 041 9821750

Issued by	H. Miller
Approved by	J. Jones
Date	19.05.11
Revision	0



Bund Test Record (GS050)

Bund Testing Form					
Bund name and ref No.:		Date of day 1 of test:		Test no.:	
PLASTIC BUND B3		07/07/11		01	
Pre-filling checks :					(Initial if complete)
No visible cracks or other features likely to affect integrity					✓ TM
Bund clean and free of debris					✓ TM
Bund and sump empty					✓ TM
Isolate all electrical components in the sump					✓ TM
Carry out all health and safety checks					✓ TM
If all of the 4 checks above are complete then proceed with the test. If it is not possible to carry out all the above checks contact the manager.					
Day	Time	Bund Level (mm)	Control Level (mm)	Personnel involved	Comments
0-1 hrs	10.30	360	150	DCNALIS	Stabilisation period
2 hrs	12.30	360	150	"	
8 hrs	16.45	360	150	"	
24 hrs	10.54	360	150	"	
Final level		360	150	"	
Drop in level (mm)= Day 1- Final level		A 0	B 0	Note: If the control level drops by more than the bund level the test is deemed void and must be rescheduled	
Test Result					
Calculation: $A-B=X$ (Where X is positive the bund level has risen. Where X is negative the bund level has dropped)					X= 0mm
Is X between -10 mm and 10 mm? If 'yes' the bund is deemed passed (Y/N)					YES
Final Result (Pass/ Fail): PASS					
Test completed by : _____ Date : 08/07/11					
Follow up in event of failed bund test					
Carry out visual inspection of the bund. Specifically try to identify cracks, holes or other defects likely to affect bund integrity.					
Date of Visual Inspection					
Description and Results of Visual Inspection :					
Does bund require further repairs or maintenance? If 'yes' pass request to manager and await completion of remedial works before scheduling re-test. If 'no' follow instruction below (Y/N)					
Schedule re-test within 3 months of end of original test (initial if complete)					
Completed by : _____ Date : _____					


Knockharley Landfill
Knockharley, Kentstown, Co. Meath

Issued by	H. Miller
Approved by	J. Jones
Date	19.05.11
Revision	0



☎ 041 9821650 7 041 9821750

Bund Test Record (GS050)

Bund Testing Form					
Bund name and ref No.:		Date of day 1 of test:		Test no.:	
PLASTIC BUND 134		07/07/11		01	
Pre-filling checks :					(Initial if complete)
No visible cracks or other features likely to affect integrity					✓ TH
Bund clean and free of debris					✓ TH
Bund and sump empty					✓ TH
Isolate all electrical components in the sump					✓ TH
Carry out all health and safety checks					✓ TH
If all of the 4 checks above are complete then proceed with the test. If it is not possible to carry out all the above checks contact the manager.					
Day	Time	Bund Level (mm)	Control Level (mm)	Personnel involved	Comments
0-1 hrs	10.30	220	150	DNALIS	Stabilisation period
2 hrs	12.30	220	150	"	
8 hrs	16.45	220	150	"	
24 hrs	10.54	220	150	"	
Final level		220	150	"	
Drop in level (mm)= Day 1-Final level		A 0	B 0	Note: If the control level drops by more than the bund level the test is deemed void and must be rescheduled	
Test Result					
Calculation: A-B= X (Where X is positive the bund level has risen. Where X is negative the bund level has dropped)					X= 0mm
Is X between -10 mm and 10 mm? If 'yes' the bund is deemed passed (Y/N)					YES
Final Result (Pass/ Fail): PASS					
Test completed by : _____ Date : 08/07/11 					
Follow up in event of failed bund test					
Carry out visual inspection of the bund. Specifically try to identify cracks, holes or other defects likely to affect bund integrity.					
Date of Visual Inspection					
Description and Results of Visual Inspection :					
Does bund require further repairs or maintenance? If 'yes' pass request to manager and await completion of remedial works before scheduling re-test. If 'no' follow instruction below (Y/N)					
Schedule re-test within 3 months of end of original test (initial if complete)					
Completed by : _____ Date : _____					