SOUTH TIPPERARY COUNTY COUNCIL

DONOHILL LANDFILL SITE

ANNUAL ENVIRONMENTAL REPORT

JANUARY 2010 – DECEMBER 2010

Waste Licence No. W0074-03
Register

Prepared by:

South Tipperary County Council
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April 2011

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NON TECHNICAL SUMMARY

This Annual Environmental Report (AER) is required for submission to the Environmental Protection Agency (EPA) in accordance with Condition 11.4 of Waste Licence W0074-03 for Donohill Landfill site. This report presents all the environmental data and other relevant information regarding the operation of the Donohill Landfill Site for the period January 2010 to December 2010.

The site is licensed to accept 40,000 tonnes of waste per annum. In 2010 15,950.97 tonnes of waste was accepted onsite for landfill, however of this 10,740.47tonnes was waste and 5,210.5tonnes was cover material. A further 175.78 tonnes of recyclable material was accepted at the Civic Amenity Centre, which was taken offsite for recycling.

Extensive environmental monitoring takes place onsite in accordance with the Waste Licence requirements and the monitoring results comprise the main bulk of this report.

Landfill gas (LFG) is produced by the waste as it breaks down. LFG generally consists of 60% methane and 40% carbon dioxide; and it can be explosive when mixed with air in a certain ratio. The LFG produced onsite is collected and flared off at the enclosed 500m^3/hr capacity flare. LFG monitoring includes monitoring of the flare emissions, continuous gas monitoring in the site offices, onsite gas well monitoring and perimeter gas well monitoring. A gas balance calculation shows that approximately fourteen percent of the gas produced onsite in 2010 was flared, with the rest being emitted directly to atmosphere. This figure is based on a generic gas simulation model that has not been calibrated for Donohill. It is believed that less gas was emitted that the model estimates as there are no gas odours from the site. However, in order to improve the gas collection onsite seven additional gas wells were drilled in late 2010.

The stream which runs adjacent to the site is monitored at 4 locations, two upstream of the site and two downstream of the site. The stream is monitored on a weekly basis for some key parameters; and more in depth analysis of the stream takes place on a quarterly and annual basis. Biological monitoring also takes place in the stream twice a year, where the flora and fauna in the stream are examined. Based on this monitoring data it can be concluded Donohill landfill is not contributing in any material way to the impairment of the surface water quality. A number of groundwater wells are located around the boundary of the site and these are monitored on a quarterly and annual basis.

Rain which comes in contact with the waste becomes contaminated (leachate) and must be collected onsite so that it can be removed for appropriate treatment. There is continuous monitoring of the levels of leachate onsite and the composition of the leachate is monitored on a quarterly and annual basis. An onsite weather station records the rainfall and this data can be used to calculate how much leachate should be produced, which can then be compared with the amount taken offsite.

Other monitoring onsite includes dust deposition monitoring which takes place three times a year and noise emission monitoring and slope stability assessment which takes place annually. The lagoons onsite are also integrity tested every three years.

There were seventeen incidents raised and reported to the EPA during 2010.

- Eight were due to high leachate level
- Five were due to CO2 gas migration trigger level exceedance.
- One where the flare was not running well
- Two where there was a power cut turning off flare and pumps.
- One where the settlement sensors under cell 4 were broken.

No complaints were received from members of the public in 2010.

1. INTRODUCTION

This Annual Environmental Report (AER) is required for submission to the Environmental Protection Agency in accordance with Condition 11.4 of Waste Licence W0074–03 for Donohill Landfill Site. This report presents all the environmental data and other relevant information regarding the operation of the Donohill Landfill Site for the period January 2010 to December 2010.

1.1. Scope and Purpose of the Report

South Tipperary County Council holds a waste licence (Register No W0074-03) for the operation of Donohill Landfill Site. The aim of this Annual Environmental Report (AER) is to provide a review of activities at Donohill Landfill Site during 2010.

This is the eight AER to be submitted under Condition 11.4 of the licence. The Content of this AER is as defined in Schedule G of the waste licence.

1.2. Site Location

Donohill Landfill is located in a rural area, approximately 7km north of Tipperary town and 0.5km south of Donohill. The landfill is comprised of the following areas:

- 21,100m^2 (2.110ha.) capped Area 1 & 2
- 14,800m^2 (1.480ha.) uncapped Area 1
- 6,850m^2 (0.685ha.) uncapped Area 3
- 4,600m^2 (0.464ha.) Area 4
- 7,010m^2 (0.701ha) Roads and office space
- Total area: 54,400m^2 (5.44ha.)

The location of the site is shown on Appendix 1 – Site drawings. The National Grid Reference for the site is 1895E, 1425N.

1.2.1.Site Contacts

1.	Site Manager:	Ms. Louise Ryan
	Telephone No:	(062) 76277
	Fax No:	(062) 76277
2.	Deputy Site Manager:	Mr. Pat Walsh
	Telephone No:	(062) 64150
	Fax No:	(062) 64157
3.	Weighbridge Operator:	Mr. Pat Quinn
	Telephone No:	(062) 76277
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1.3. Environmental Policy

South Tipperary County Council is committed to conducting all activities such that they have a minimal effect on the environment.

South Tipperary County Councils main objectives are:

1. To comply with the Waste Licence (Licence Reg. W0074-03) and all relevant environmental legislation

2. To ensure that all site infrastructure, as required in Condition 3 of the Waste Licence, is established

3. To ensure that all site personnel are familiar with:

    a. the Conditions of the Waste Licence
    b. the content of the Environmental Management System
    c. all operational procedures

4. To reduce the potential for negative environmental impacts by a programme of continuous development on-site and appropriate mitigation measures.

5. To carry out all environmental monitoring, as required by Condition 8 of the Waste Licence.

6. To provide adequate training and awareness to all employees with regard to minimising environmental risks.

2. WASTE ACTIVITIES

The licensed waste disposal activities of the facility, in accordance with the Third Schedule of the Waste Management Act 1996 are:

Class 1. Deposit on, in or under land (including landfill)

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

Class 5. Specially engineered landfill, including placement into lined discrete cells which are capped and isolated from one another and the environment

Class 7 Physico-chemical treatment not referred to elsewhere in this Schedule (including evaporation, drying and calcinations) which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraph 1 to 10 of this Schedule

The licensed waste disposal activities of the facility, in accordance with the Third Schedule of the Waste Management Act 1996 are:

Class 3. Recycling or reclamation of metals and metal compounds

Class 4. Recycling or reclamation of other inorganic materials

Class 9 Use of any waste principally as a fuel or other means to generate energy

Class 13. Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.

The main activity at the site was the landfilling of non-hazardous domestic, commercial and industrial waste. Schedule A of the waste licence outlines the types and volumes of waste that can be disposed of at the landfill. They are shown in Table 2.1 below.

Table 2.1 Licensed Categories and Quantities of Waste for Disposal

Waste Category	Maximum Quantity (Tonnes per annum)
Household	30,000
Commercial	4,000
Treated Sewage Sludge	500
Construction & Demolition	1,000
Industrial non-hazardous solids	3,500
Treated industrial non-hazardous sludges	1,000
Total	**40,000**

2.1 Waste Quantity and Composition

The quantity of waste landfilled at Donohill is outlined in Table 2.2 below.

Table 2.2 Quantities of waste received at Donohill Landfill

Year	Quantity of Waste (Tonnes)
1989	3,700
1990	3,700
1991	4,200
1992	4,400
1993	7,000
1994	8,000
1995	12,100
1996	13,300
1997	15,700
1998	13,600
1999	40,000
2000	40,000
2001	41,620
2002	36,762
2003	27,512
2004	23,275
2005	20,416
2006	23,724
2007	16,632
2008	17,047
2009	16,933
2010	15,951
Total	**405,572**

The quantity of waste recycled during 2010 at Donohill landfill is outlined in Table 2.3 below.

Table 2.3 Quantities of waste recycled at Donohill Landfill

Waste Type	EWC Code	Quantity of Waste 2007 (Tonnes)	Quantity of Waste 2008 (Tonnes)	Quantity of Waste 2009 (Tonnes)	Quantity of Waste 2010 (Tonnes)
Aluminium Cans	15 01 04	00.20	00.16	00.20	0.16
Batteries	16 06 01*	02.28	02.14	00.06	-
Fluorescent Tubes	20 01 21*	00.42	0.44	00.06	0.06
Fridges	20 01 23*	13.68	-	-	-
Glass	20 01 02	06.74	09.84	08.96	8.2
Metal	20 01 40	48.34	64.02	41.98	42.58
Newsprint	20 01 01	27.50	37.52	32.40	34.48
Oil	13 02 04*	00.00	00.00	01.12	-
Steel Food Cans	15 01 04	01.16	01.14	01.44	1.6
WEEE	20 01 35*/ 20 01 36	76.60	75.54	67.86	60.6
Textiles	20 01 10 / 20 01 11	01.72	02.56	01.96	1.54
Dry Recyclables	15 01 06	04.90	16.64	32.42	25.98
Calor Gas Cylinders	15 01 04	01.58	-	00.64	-
Household Hazardous Waste	20 01 27*	-	-	1.44	0.58
	Total	**185.12**	**210**	**190.54**	**175.78**

2.2 Methods of Waste Placement

Waste is deposited within the active area of the site. Any large articles or containers likely to cause a void are crushed prior to deposition. Waste is compacted using a sheep's foot steel wheeled landfill compactor. The compactor passes over the waste a minimum of three times in order to achieve satisfactory compaction.

3. MONITORING AND EMISSIONS

The monitoring carried out during 2010 is detailed below.

3.1. Landfill Gas

All gas monitoring locations are illustrated in Appendix 1 – Site Drawings.

The landfill gas produced onsite is collected and flared off at the enclosed 500m3/hr capacity flare. Annual monitoring of the emissions from the flare was carried out as per Schedule C4 of the Waste Licence. All parameters were within licence Emission Limit Values. The monitoring report on flare emissions can be seen in Appendix 2.

Condition 8 and Schedule D.2 of the licence requires that the licensee conducts the following landfill gas monitoring:

- Monthly monitoring in the gas borehole/vents/wells in order to detect offsite gas migration.
- Weekly monitoring in the site offices to detect accumulation of landfill gas.

Gas monitoring consisted of:

- Monthly monitoring of 15 No. gas migration wells around the perimeter of the landfill
- Monthly monitoring of four gas monitoring wells within the landfill
- Continuous monitoring at the site offices - canteen, manager's office and weighbridge office

3.1.1.Gas Monitoring Results

Gas Monitoring – Site Offices

The system for gas monitoring within the site offices was installed in 2003. This system was operating throughout 2010. No gas has been detected at any of the monitoring locations. The gas readings are downloaded from the system and stored in digital format.

The results for the office gas monitoring are presented in Appendix 3.

Gas Monitoring – Perimeter Gas Wells

There are 15 perimeter gas wells around the landfill. Table 3.1 gives the maximum values of CH_4, CO_2 and O_2 recorded during the year at these wells. Trigger levels for CO_2 were breached at GM14 and GM15 periodically during the year. This is believed to be due to natural ground conditions.

Table 3.1 Perimeter Gas Well Monitoring Results Maximum Values

Well	Max CH_4 (%)	Max CO_2 (%)	Max O_2 (%)
GM 1	0	0.1	21.3
GM 2	0	0.7	21.3
GM 3	0	0.7	21.2
GM 4	0	0.2	21.5
GM 5	0	0.2	21.3
GM 6	0	0.3	21.6
GM 7	0	0.3	21.4
GM 8	0	0.3	21.5
GM 9	0	0.9	21.3
GM 10	0	0.7	21.3
GM 11	0.1	0.4	21.2
GM 12	0.7	1.1	21.2
GM 13	0.2	0.4	21.5
GM 14	0.1	3.4	21.3
GM15	0	3.3	21.1

* The gas is monitored using GA2000 and GFM automatic infrared analysers, which detect levels of carbon dioxide, methane and oxygen. The margin of error of the instruments is plus or minus 0.5%. Therefore readings below 0.5% are insignificant.

Gas Monitoring – Gas Wells within the Landfill

There are four gas monitoring wells within the landfill. Table 3.2 gives the maximum value of CH_4, CO_2 and O_2 measured at these wells.

To manage gas production on site, STCC installed a permanent gas flare in May 2005. The flare is a high temperature enclosed ground flare and its maximum capacity is 500m^3/hour. The monitoring report on the emissions from the enclosed flare during the reporting period is included in Appendix 2.

Table 3.2 Landfill Gas Well Monitoring Results Maximum Values

Well	Max CH_4 (%)	Max CO_2 (%)	Max O_2 (%)
G1	58.1	39.1	17.8
G2	63.3	36.5	21.8
G3	54.2	36.2	11.8
G4	43.5	31.6	20.4

3.2. Surface Water

Condition 8 and Schedule D.5 of the licence require the licensee to conduct weekly, quarterly and annual monitoring on surface water at four monitoring points off site, two upstream and two downstream of the landfill. At the Agency's request an additional monitoring point SW5 (surface water lagoon) is also monitored along with surface water run off points SW7 and SW8 where possible. Trigger levels have been set for each of the parameters specified in the waste licence. Summary data obtained from the a) weekly b) quarterly and c) annual monitoring rounds are presented in Tables 3.3, 3.4 and 3.5 below.

The surface water stream adjacent to the landfill is a small slow flowing stream with extensive siltation \ sedimentation present on the bed throughout much of its length upstream of the landfill site. Downstream of the landfill stream morphology changes and the stream velocity picks up and sedimentation and siltation is not as pronounced. The stream is not used as a drinking water abstraction source. Based on the surface water data gathered for the years 2004 to 2010 it is readily apparent that this stream is suffering moderate pollution upstream of the landfill, which carries through downstream of the landfill facility. The Council has carried out investigations into the causes of poor quality upstream. Based on these investigations it is the Councils belief that the quality upstream is primarily being impaired by agricultural activities both diffuse and point source and this together with the stream morphology is responsible for its current 'Poor ecological Status'. The Councils Environment Section has taken enforcement action against two local landowners. During Council investigations 'Cattle Access' and low summer flows have also been identified as a significant issues as well as runoff from adjacent bog areas. Based on the 2010 monitoring data South Tipperary County Council are satisfied that the Donohill Landfill is not contributing in any material way to the impairment of surface water quality. However it is acknowledged that further work is required to improve the quality of this water body. Due to the investment in improvement works at the site the contamination of surface water run-off with leachate has been eliminated. This water continued to be collected in the 'Surface Water Lagoon' during 2010 and was either discharged to the stream as per licence conditions or tankered off site for treatment at Tipperary or Cashel Waste Water Treatment Plant when the licence conditions could not be met (for example when the assimilative capacity of the stream was too low).

The analytical results are presented below with the raw data attached as Appendix 4.

Table 3.3 Surface Water Weekly Monitoring of Conductivity (µS/cm)

Location	Median	Min	Max
SW1	697	492	739
SW2a	692	487	748
SW3a	695	487	742
SW4	686	428	836
SW5	318	198	755
SW7	317	192	411
SW8	276	201	460

3.2.1.Quarterly Monitoring

Appendix 1 – Site Drawings shows the four surface water monitoring points at Donohill Landfill, as well as the surface water lagoon onsite. The sampling points are located, from upstream to downstream, in the following order: SW4 (next to Ballydonagh Marsh), SW1, SW2, and SW3. The surface water lagoon (SW5) was also monitored in 2010.

Table 3.4 Surface Water Quarterly Median Values

Chemical/Parameter	Units	Trigger Level	SW1 Median	SW2 Median	SW3 Median	SW4 Median	SW5 Median
Dissolved Oxygen	mg/l O2	**70**	90	80.5	87.5	79	74.5
Chloride	mg/l Cl	**30**	14	14	14	19	9
Conductivity	µS/Cm	**900**	680.5	685	678.5	679.5	321.5
pH	Units	**8.5**	8.05	7.8	8.1	7.7	7.55
Ammonia	mg/l N	**0.75**	0.08	0.145	0.08	0.305	0.46
Biochemical Oxygen Demand	mg/l O2	**5**	1.25	1.05	0.9	1.4	2.35
Chemical Oxygen Demand	mg/l O2	**60**	21.5	26	25.5	28	22
Suspended Solids	mg/	**20**	10.88	8.85	9.5	**33**	**24.3**

3.2.2.Annual Monitoring

The waste licence requires in Schedule D, that annual monitoring be carried out for those parameters listed in Table 3.5. The data in this table confirms that the Landfill is not impacting on the adjacent surface water body. The parameters covered in the annual programme were below the trigger levels set in each case.

Table 3.5 Annual Surface Water Monitoring Results

PARAMETER	Units	SW1	SW2a	SW3a	SW4	SW5
Temperature	°C	7.3	6.5	6.1	6.7	*Not sampled:*
Dissolved Oxygen	%	100	88	93	83	
Ammonia	mg/l N	0.13	0.15	0.12	0.5	*Lagoon*
BOD	mg/l O2	1.0	1.1	0.9	3.8	*empty*
COD	mg/l O2	<20	<20	<20	39	*on day of*
Suspended Solids	mg/l	<6.5	<9.5	<9.4	59	*sampling*
Chloride	mg/l Cl	13	13	13	15	
Conductivity	µS/cm	630	643	645	573	
Nitrite	mg/l N					
o-Phosphate	mg/l P	0.06	0.05	0.05	0.12	
Total Oxidised Nitrogen	mg/l N	1.1	1.2	1.7	1	
pH	pH	8.2	7.8	8.0	7.8	
Total Alkalinity (as	mg/l	330	335	309	288	
Aluminium	µg/l	<125	<125	<125	600	
Antimony	µg/l	<5	<5	<5	<5	
Arsenic	µg/l	<5	<5	<5	<5	
Barium	µg/l	<30	<30	<30	<30	
Beryllium	µg/l	<5	<5	<5	<5	
Boron	µg/l	<50	<50	230	<50	
Cadmium	µg/l	<5	<5	<5	<5	
Calcium	mg/l	58	65	64	50	
Cobalt	µg/l	<5	<5	<5	<5	
Chromium	µg/l	<5	<5	<5	<5	
Iron	µg/l	280	320	350	660	
Lead	µg/l	<5	<5	<5	<5	
Magnesium	mg/l	<5	<5	<5	<5	
Manganese	µg/l	<250	<250	<250	<250	
Mercury	µg/l	<0.5	<0.5	<0.5	<0.5	
Molybdenum	µg/l<5	<5	<5	<5	<5	
Nickel	µg/l	<5	<5	<5	<5	
Potassium	mg/l	<5	<5	<5	<5	
Selenium	µg/l	<5	<5	<5	<5	
Sodium	mg/l	<5	<5	<5	<5	
Thallium	µg/l	<5	<5	<5	<5	
Tin	µg/l	<10	<10	<10	<10	
Uranium	µg/l	<5	<5	<5	<5	
Vanadium		<5	<5	<5	<5	
Zinc	µg/l	<30	<30	<30	40	

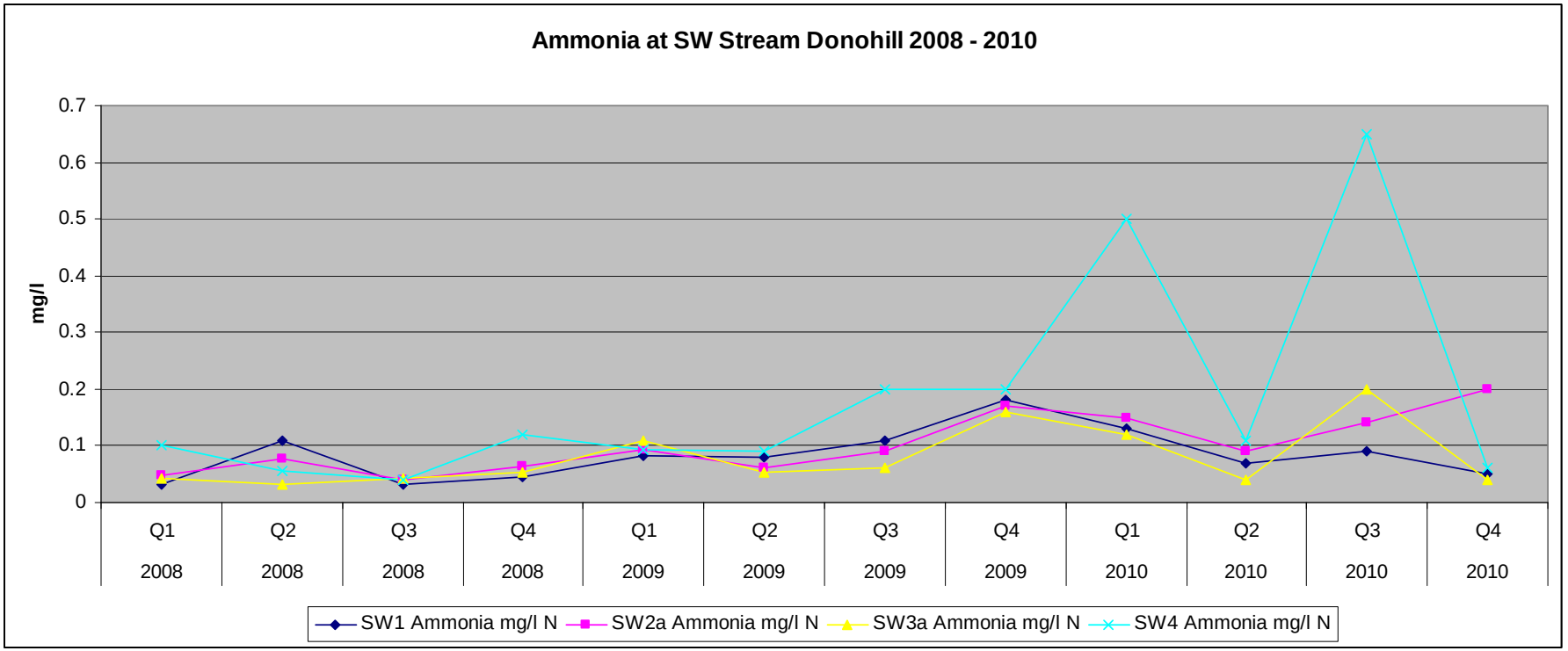


Figure 3.1 Three Year Ammonia Trend (2008 – 2010) at Four Surface Water Locations

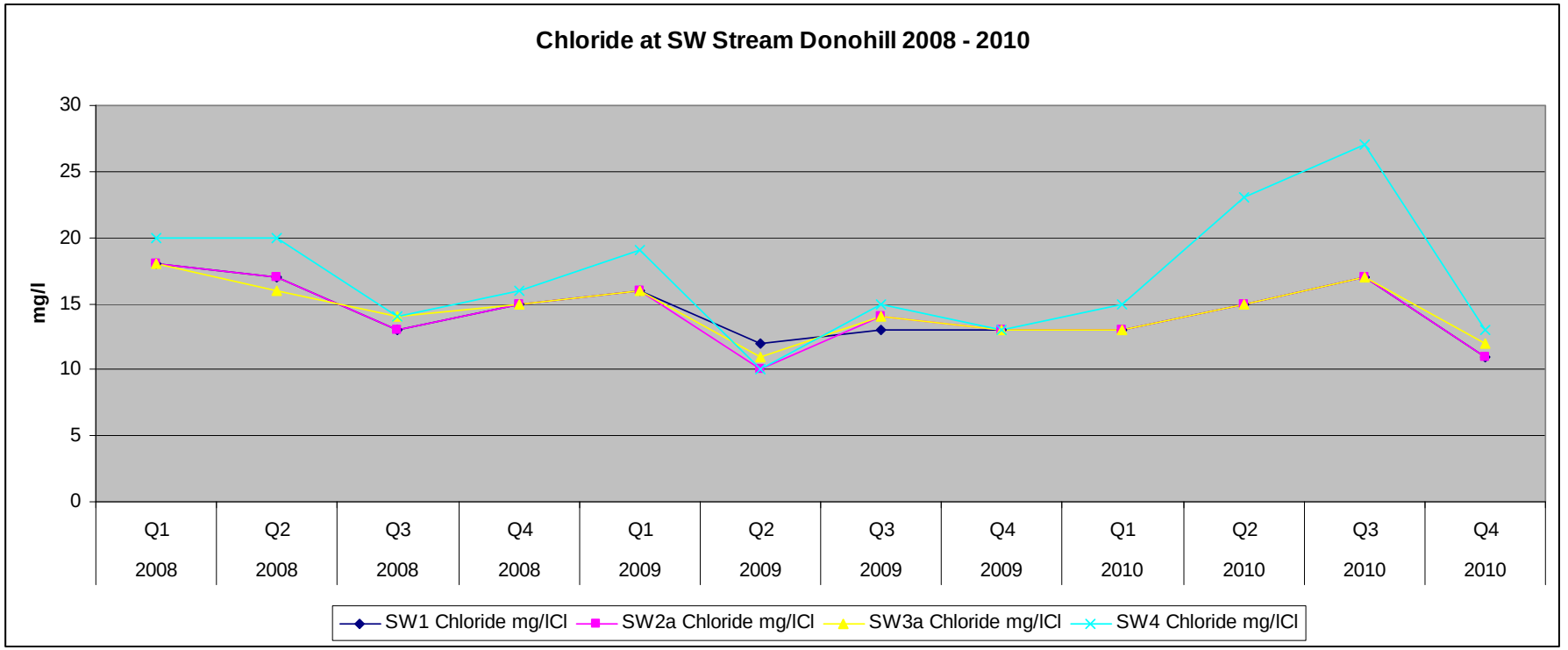


Figure 3.2 Three Year Chloride Trend (2008 – 2010) at Four Surface Water Locations

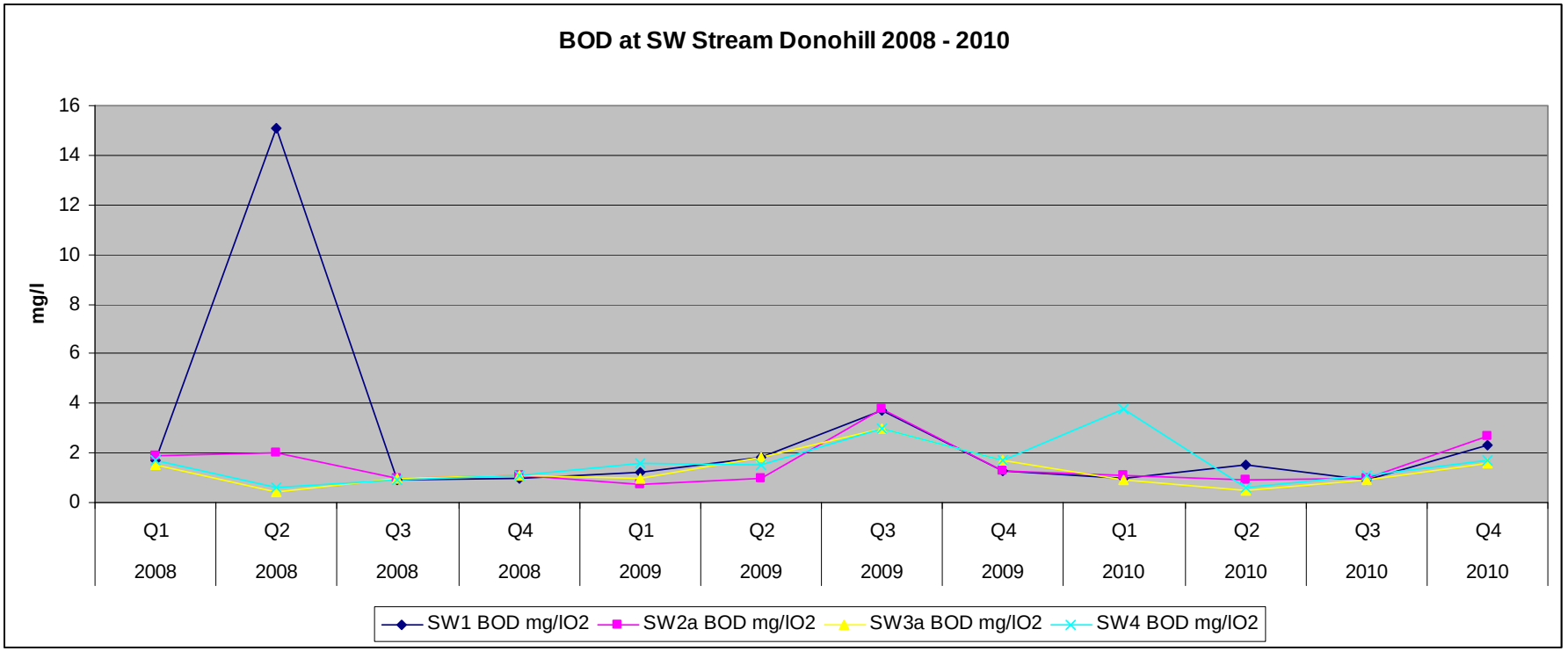


Figure 3.3 Three Year BOD Trend (2008 – 2010) at Four Surface Water Locations

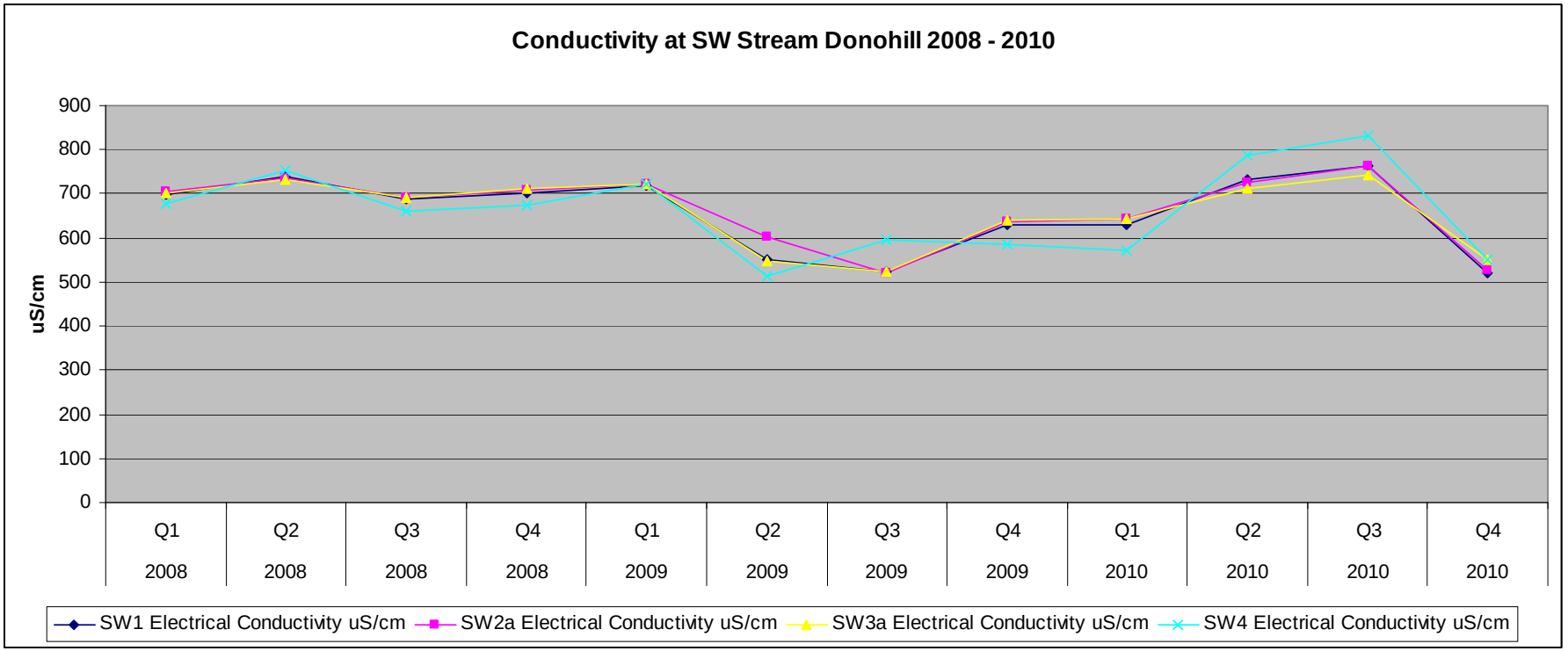


Figure 3.4 Three Year Conductivity Trend (2008 – 2010) at Four Surface Water Locations

3.2.3. Biological Assessment

A biological assessment was carried on two separate dates during 2010 (May and September). The result of this assessment is summarised below in Table 3.6.

Conservation Services carried out the biological assessment on behalf of South Tipperary County Council. There were four sampling points, two of which were upstream of the landfill (SW4 and SW1) and the other two (SW2a and SW3a) downstream. The assessment included flora/fauna populations as well as the physical characteristics of the stream. The biological Q values for each site for the years 2008, 2009 and 2010 are presented in table 3.6 below. The assessment indicates that the surface water body is poor at location SW4 and moderately polluted to poor at SW1. SW2a is also moderately polluted. At site SW3a which is downstream of the site, the stream has marginally improved to a moderately polluted condition. The assessment is consistent with the chemical data in that it clearly indicates unsatisfactory conditions upstream of the site. The 'Poor Status' is as indicated in Section 3.2 due to a combination of stream morphology and diffuse & point source agricultural pollution upstream of the site.

The results of the biological assessment contain no evidence that the landfill is causing any deterioration in the biological water quality of the stream. This conclusion is based on the assumption that contamination of stream from the landfill cannot take place either upstream of Site SW1 or downstream of Site SW2A.

Table 3.6 SUMMARY OF MONITORING RESULTS: Q-RATINGS 2008 – 2010

	Upstream of Landfill		**Downstream of landfill**	
	SW4	**SW1**	**SW2A**	**SW3A**
May 2008	2-3	2-3	2-3	3-4
Oct. 2008	2	1-2	2	3
May 2009	3	2-3	2-3	3
Sept. 2009	1-2	2-3	2-3	3
May 2010	3	3	3	3-4
Sept. 2010	2	2-3	2-3	3

Biotic Index	**Q5**	**Q4-5**	**Q4**	**Q3-4**	**Q3**	**Q2-3**	**Q2**	**Q1-2**	**Q1**
EPA Water Quality	Good	Fair - Good	Fair	Doubtful - Fair	Doubtful	Poor - Doubtful	Poor	Bad - Poor	Bad

3.3. Groundwater

Condition 8 and Schedule D of the licence require the licensee to conduct groundwater monitoring at seven groundwater sampling wells, GW11d, GW11s, GW12d, GW12s, GW13, GW14, and GW15. The Well at GW11s is a shallow groundwater well, which runs dry before a sample can be obtained for monitoring. An extra well GW16 (see Appendix 1 – Site Drawings) is a private well off site on a farm near the landfill and has also been monitored. This is a shallow dug well, subject to infiltration with surface water during wet weather and localised contamination from the adjacent farmyard. GW16 is not required to be monitored by the licence and the results are not representative of any potential impact of the landfill on the environment. Condition 8 and Schedule D stipulates that monthly, quarterly and annual monitoring be carried out for groundwater. Summary data obtained from the a) quarterly and b) annual programmes are presented in Tables 3.7 and 3.8 below.

The analytical results are presented below with the raw data attached as Appendix 5.

Groundwater monitoring results have been compared where possible to the Maximum Admissible Concentrations (MAC values) as set out in the Drinking Water Regulations [European Community (Drinking Water) Regulations, 2000 (S.I. No. 439 of 2000)]. None of these wells are used as drinking water abstraction points.

3.3.1 Quarterly Monitoring

Median quarterly monitoring results are shown in Table 3.7. The data for chloride, ammonia and conductivity in the wells supports the Councils belief that Donohill landfill is not giving rise to any detectable Groundwater contamination.

Table 3.7: Quarterly Groundwater Median Values 2010

Parameter	Units	Trigger Level	GW11d	GW12d	GW12s	GW13	GW14	GW15
Depth of Borehole	m	-	40	32.5	14.5	31.4	34.25	33
Temperature	°C	-	11.65	11.1	10.9	11.35	11.3	11.65
pH	pH	**8.5**	7.55	7.3	7.2	7.55	7.65	7.45
Conductivity	µS/cm	**1000**	686	800	768	569.5	557.5	609
Ammonia	mg/l N	**0.3**	0.035	0.02	0.005	0.085	0.035	0.06
Chloride	mg/l Cl	**30**	17	25	19	15	16	19
Total coliforms	No/100 ml	**5000**	5	230	5	12.5	5	5
E Coli	Per 100ml	**100**	5	5	5	5	5	5

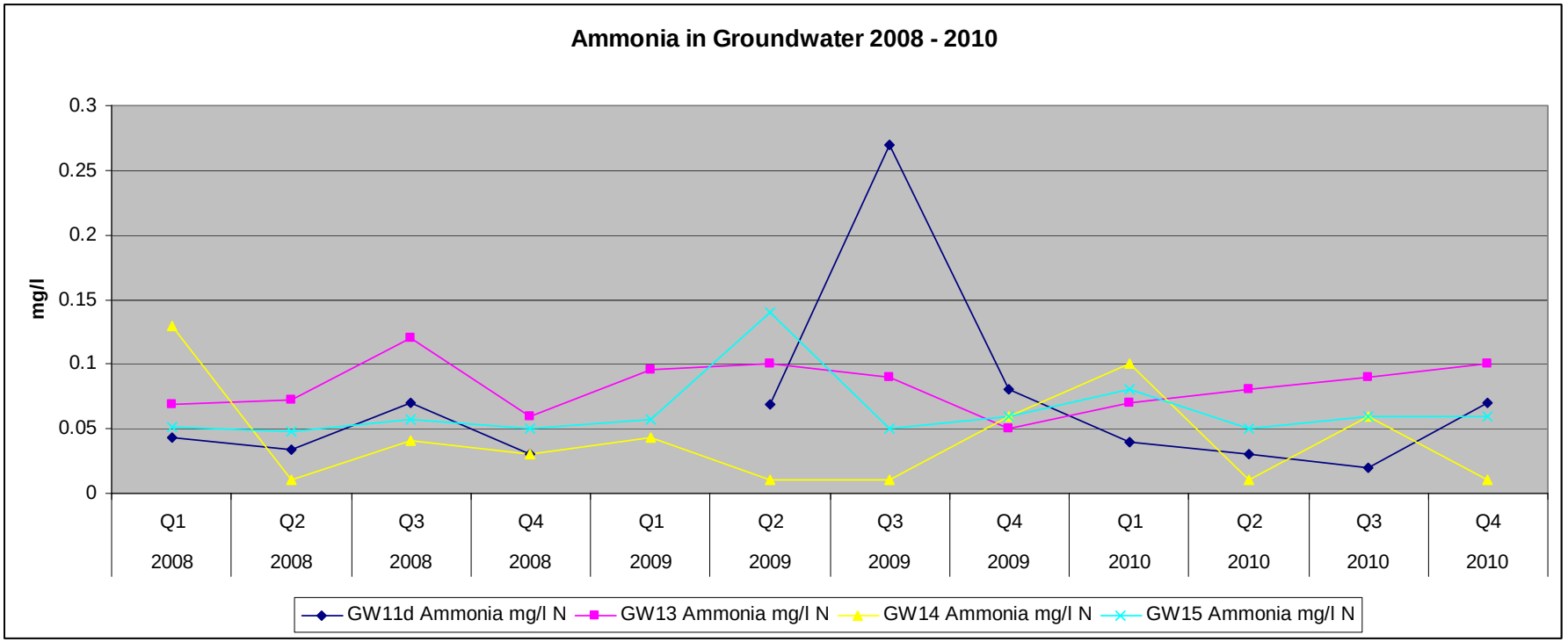


Figure 3.5 Ammonia Trend (2008 – 2010) at Four Ground Water Wells

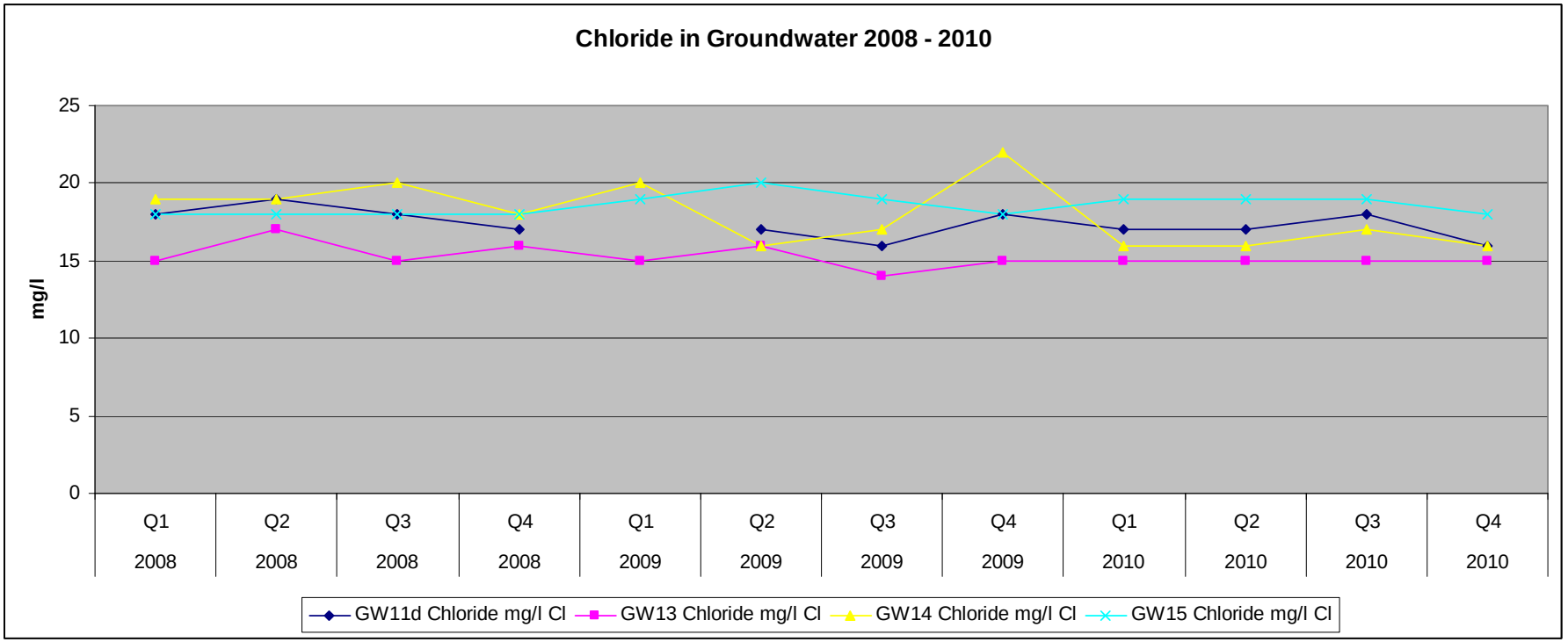


Figure 3.6 Chloride Trend (2008 – 2010) at Four Ground Water Wells

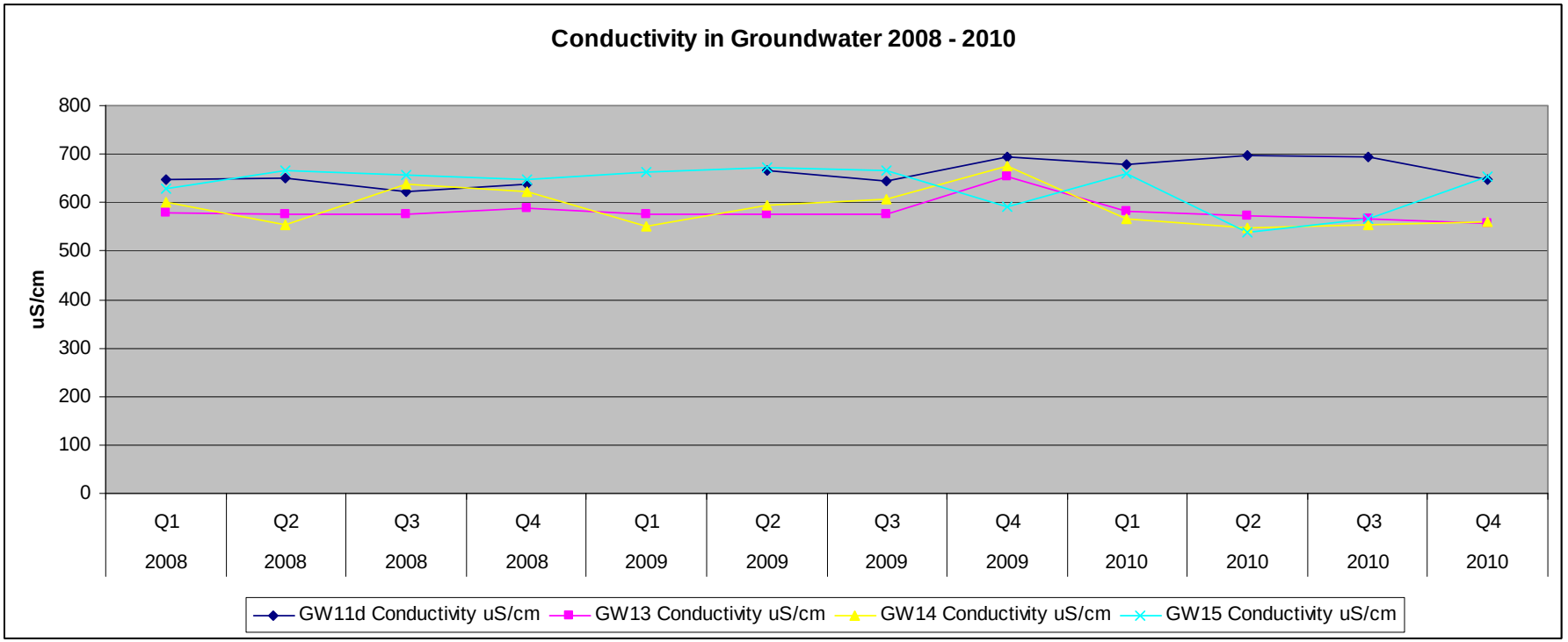


Figure 3.7 Conductivity Trend (2008 – 2010) at Four Ground Water Wells

3.3.1. Annual Monitoring

An annual sampling event was required for those parameters listed in Table 3.8. Table 3.8 outlines those parameters listed in Schedule D and List I/II Organic Substances. The results for parameters covered annually (Presented in table 3.8) were satisfactory for all locations and well below trigger levels set, further supporting the view that no groundwater contamination is taking place.

Table 3.8: Annual Groundwater Monitoring Results 04/02/2010

Parameter	Units	Trigger Level	GW11d	GW12d	GW12s	GW13	GW14	GW15
Sulphate	mg/l SO4		14	26	16	13	18	27
Calcium	mg/l Ca		48	82	87	24	29	60
Magnesium	mg/l	**100**	<5	<5	<5	<5	<5	<5
Sodium	mg/l	**50**	<5	<5	<5	<5	<5	<5
Potassium	mg/l	**25**	<5	<5	<5	<5	<5	<5
Aluminium	µg/l		190	220	<125	990	260	270
Antimony	µg/l		<5	<5	<5	<5	<5	<5
Arsenic	µg/l		<5	<5	<5	<5	<5	<5
Barium	µg/l		91	80	190	48	<30	<30
Boron	µg/l		<50	<50	<50	<50	<50	<50
Cadmium	µg/l		<5	<5	<5	<5	<5	<5
Cobalt	µg/l		<5	<5	<5	<5	<5	<5
Chromium	µg/l		<5	<5	<5	<5	<5	<5
Iron	µg/l		810	260	<250	650	<250	<250
Lead	µg/l	**15**	<5	<5	<5	<5	<5	<5
Manganese	µg/l		<250	<250	<250	<250	<250	390
Mercury	µg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Molybdenum	µg/l		<5	<5	<5	<5	<5	<5
Nickel	µg/l		<5	<5	<5	<5	<5	<5
Selenium	µg/l		<5	<5	<5	<5	<5	<5
Thallium	µg/l		<5	<5	<5	<5	<5	<5
Tin			<10	<10	<10	<10	<10	<10
Uranium	µg/l		<5	<5	<5	<5	<5	<5
Vanadium	µg/l		<5	<5	<5	<5	<5	<5
Zinc	µ	**1000**	<5	52	160	<30	700	<30

Table 3.8 (Continued): Annual Groundwater Monitoring Results

04/02/2010

Parameter	Units	Trigger Level	GW11d	GW12s	GW12d	GW13	GW14	GW15
1,1,1,2-Tetrachlorethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,1-Trichloroethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	µg/l	>1	<1	<1	<1	<1	<1	<1
1,1,2-Trichloroethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloropropene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichlorobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichloropropane	µg/l	>1	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
1,2,4-Trichlorobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dibromo-3-Chloropropane	µg/l	>1	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
1,2-Dibromoethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloroethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,2-Dichloropropane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Chlorotoluene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Chlorotoluene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromochloromethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromoform	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Bromomethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table 3.8 (Continued): Annual Groundwater Monitoring Results

04/02/2010

Parameter	Units	Trigger Level	GW11d	GW12s	GW12d	GW13	GW14	GW15
c-1,2-Dichloroethene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
c-1,3-Dichloropropene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon Tetrachloride	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloroform	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dibromomethane		>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichloromethane			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobutadiene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Isopropylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m,p-Xylene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Butylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Propylbenzene		>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
o-Xylene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-1,2-Dichloroethene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-1,3-Dichloropropene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene			1.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichlorofluoromethane	µg/l	>1	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Vinyl Chloride	µg/l	>1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

3.4. Leachate

Condition 8 and Schedule D of the licence require the licensee to conduct leachate monitoring at monitoring points LC2, LC1, LE8 and LC4. Quarterly and Annual leachate composition monitoring is required for parameters specified in Schedule D. The analytical results are presented below are for the quarterly and annual monitoring of leachate composition. The leachate monitoring locations are shown in Appendix 1 – Site Drawings.

3.4.1.Quarterly Monitoring

The results for parameters covered in the quarterly monitoring are detailed in Table 3.9, 3.10, 3.11 and 3.12 below. The leachate composition at Donohill is typical for a municipal landfill site not receiving hazardous waste.

Table 3.9: Quarterly LC2 Leachate Monitoring Results 2010

Leachate Parameters	Units	LC2 Q1
Sampler		J McGarry
Temperature	°C	19.2
pH	pH	7.3
Conductivity	µS/cm	6710
Ammonia	mg/IN	350
Chloride	mg/l CI	533
Total Oxidised Nitrogen (as N)	mg/IN	0.6
Biochemical Oxygen Demand	mg/l 02	35.4
Chemical Oxygen Demand	mg/l 02	524

Table 3.10: Quarterly LE8 Leachate Monitoring Results 2010

Leachate Parameters		LE8 Q1
Sampler		J McGarry
Temperature	°C	12.4
pH	pH	7.1
Conductivity	µS/cm	4380
Ammonia	mg/IN	150
Chloride	mg/l CI	359
Total Oxidised Nitrogen (as N)	mg/IN	0.97
Biochemical Oxygen Demand	mg/l 02	16.9
Chemical Oxygen Demand	mg/l 02	252

Table 3.11: Quarterly LC4 Leachate Monitoring Results 2010

Leachate Parameters	**Units**	**LC-4 Q1 (Leachate Lagoon)**	**LC-4 Q2 (Leachate Lagoon)**	**LC-4 Q3 (Leachate Lagoon)**	**LC-4 Q4 (Leachate Lagoon)**
Sampler		J McGarry	J McGarry	J McGarry	J McGarry
Temperature	°C	11.9	21.2	21.0	12.6
pH	pH	7.5	8.5	8.0	7.5
Conductivity	µS/cm	5440	5870	5820	3060
Ammonia	mg/IN	270	280	200	110
Chloride	mg/l CI	420	611	505	198
Total Oxidised Nitrogen (as N)	mg/l N	1.7	<0.5	<0.50	6.18
BOD	mg/l 02	16.9	104	45.0	19.5
COD	mg/l 02	432	840	541	259

Table 3.12: Quarterly LC1 Leachate Monitoring Results 2010

Leachate Parameters	Units	LC1 Q2	LC1 Q3	LC1 Q4
Sampler		J McGarry	J McGarry	J McGarry
Temperature	°C	16.7	21.0	21.3
pH	pH	7.4	7.3	7.2
Conductivity	µS/cm	6910	6220	5170
Ammonia	mg/IN	380	220	270
Chloride	mg/l CI	562	447	362
Total Oxidised Nitrogen (as N)	mg/IN	1.5	<0.50	<0.50
Biochemical Oxygen Demand	mg/l 02	21	36.0	26.0
Chemical Oxygen Demand	mg/l 02	495	402	368

3.4.2.Annual Monitoring

The results of annual monitoring are detailed in Table 3.13 below. The leachate composition confirms that the waste received at Donohill is typical of a municipal landfill and that hazardous waste is not being received in any detectable or significant quantity.

Table 3.13 Annual Leachate Monitoring Results 2010

PARAMETER	Units	LC2	LC4	LE8
Sulphate	mg/l SO_4	48	96	300
Total coliforms	/100ml	>2400	>2400	140
Calcium	mg/l	91	98	150
Magnesium	mg/l	35	31	19
Sodium	mg/l	610	440	370
Potassium	mg/l	230	200	170
Aluminium	µg/l	150	140	<125
Antimony	µg/l	<5	<5	<5
Arsenic	µg/l	12	66	24
Barium	µg/l	560	350	340
Beryllium	µg/l	<5	<5	<5
Boron	µg/l	8400	5200	5800
Cadmium	µg/l	<5	<5	<5
Cobalt	µg/l	<5	<5	<5
Chromium	µg/l	49	33	16
Iron	µg/l	1900	2600	2900
Lead	µg/l	<5	<5	<5
Manganese	µg/l	2000	1400	1300
Mercury	µg/l	<0.5	<0.5	<0.5
Molybdenum	µg/l	<5	<5	<5
Nickel	µg/l	32	25	19
Selenium	µg/l	<5	<5	<5
Thallium	µg/l	<5	<5	<5
Tin		<10	<10	<10
Uranium	µg/l	<5	<5	<5
Vanadium	µg/l	<5	<5	<5
Zinc	µg/l	<30	<30	<30

3.4.3.Water Balance

Rainfall data figures for the reporting period were obtained from the weather station located on the Donohill site.

The monthly rainfall data is detailed in Table 3.14 below.

Table 3.14 Donohill Rainfall Data

Month	Precipitation(mm)
Jan-10	64.6
Feb-10	41.4
Mar-10	70.8
Apr-10	32
May-10	41.2
Jun-10	32.2
Jul-10	89.2
Aug-10	29.6
Sep-10	105.2
Oct-10	106.6
Nov-10	72
Dec-10	20.2
Total	**705**

The fraction of effective rainfall estimated to infiltrate into the ground is represented by the infiltration coefficient. For the purposes of this water balance, a number of infiltration values were used. 5% on the engineered cap, 100% on the uncapped and partially capped areas and 65% in temporarily capped areas. It should be noted that these are estimates only, and actual values will vary locally. Table 3.15 represents a summary of the monthly water balance for the site in 2010 Water balance calculations are provided in full in Appendix 6.

Table 3.15 Water Balance Summary

Month	Rainfall (mm)	Total Predicated Leachate (m^3)	Actual leachate tankered off site (m^3)
Jan-10	64.6	1703.11	2571.94
Feb-10	41.4	1241.31	2006.28
Mar-10	70.8	1400.08	1288.62
Apr-10	32	906.81	1933.18
May-10	41.2	1023.77	595.72
Jun-10	32.2	909.36	752.28
Jul-10	89.2	1634.00	1186.27
Aug-10	29.6	876.30	564.54
Sep-10	105.2	1837.40	1811.29
Oct-10	106.6	1855.20	725.42
Nov-10	72	1415.33	3702.79
Dec-10	20.2	695.72	1011.44
Total	**705**	**15,498.39**	**18149.77**

3.5. Leachate Volumes

The estimated volumes of leachate produced at Donohill Landfill, for the reporting period, are outlined in Table 3.15. The estimated prediction for the volume of leachate to be produced was 15498.39m^3. The volume of leachate actually tankered off-site during the reporting period was 18,149.77m^3. The difference in actual and predicted leachate removed from the site may be attributed to leachate that was attenuated in the cells and stored in the lagoon and groundwater extraction.

3.6. Dust Monitoring

Under Schedule D of the licence Donohill landfill is required to carry out dust monitoring at three stations on site: ST1, ST2, & ST3 as per Appendix 1 – Site Drawings. Dust monitoring was carried out during the following periods

21st June – 26th July 2010.
27th July – 28th August 2010.
28th August – 30th September 2010.

Dust levels on site were below limit value of 350 mg/m^2/day at each of the monitoring stations during each monitoring period. Results are shown in Table 3.16.

Table 3.16 Dust Monitoring Results 2010

Dust Monitoring Point	Emission Limit	21/06/2010 to 26/07/2010	27/07/2010 to 28/08/2010	28/08/2010 to 30/09/2010	Median
D1 (mg/m2/day)	350	5	1	32.7	83
D2 (mg/m2/day)	350	93	2	36.6	25
D3 (mg/m2/day)	350	<1	1	35.2	19

3.7. Noise Monitoring

Under Schedule D Donohill landfill is required to carry out noise monitoring at four stations on-site (N1 – N4) and two sensitive locations off-site (S1 & S2). Noise monitoring was carried out on site on 16th June 2010 between the hours of 12:22 and 15:43, the results are summarised in Table 3.17. The findings of this monitoring event are presented below with the full report attached as Appendix 7.

Table 3.17 Noise Monitoring Results 2010

Station No.	LA_{EQ}	Daytime Limit	Comment
S1	**66.8**	55	Main source of noise was produced by vehicles driving into and out of the landfill site (3 cars). Interference noise included a power grass cutter, traffic movements on the R497 road (21 cars) and birds singing.
S2	**59.4**	55	Main source of noise was produced by plant operating on the landfill site. Interference noise included a power grass cutter, traffic movements on the R497 road (5 cars and 2 HGVs) and birds singing.
N1	49.6	55	Main source of noise was produced by a compactor truck operating at the active cell and people talking at the active cell. Interference noise included birds singing.
N2	53.2	55	Main source of noise was produced by vehicles passing by and idling at the monitoring location. Interference noise included birds singing.
N3	44.5	55	Main source of noise was produced by a compactor truck in operating at the active cell. Interference noise included birds singing, overhead aircraft and the horn of a train sounding.
N4	47.3	55	Main source of noise was produced by vehicles driving into and out of the site and idling at the weighbridge (2 cars and 1 HGV). Interference noise included birds singing.

Noise levels exceeded the licensed levels at two locations, S1 and S2. The exceedances at S1 and S2 can be attributed outside interferences, as none of the onsite noise monitoring locations exceeded the daytime limit of 55dB(A). The noise sensitive monitoring locations are both located on the side of a road and the main source of noise would be passing traffic.

3.8. Sludge Analysis

Condition 5.7 of the waste licence states that, twice yearly, analysis is required for all sludges landfilled at Donohill Landfill. Merck, Sharpe & Dohme, Ballydine, Ireland Ltd. is the only company currently landfilling sludges at the facility. Chemical testing of this sludge was carried out on four occasions during 2010. One of the samples was taken in the presence of Denis Maguire; Executive Chemist for STCC, all analysis was carried out by independent agencies. Table 3.18 details the monitoring results for the sludge. Total tonnage sent to Donohill Landfill during 2010 was 535.48 tonnes.

Table 3.18 Wastewater Treatment & Potable Water Sludge analysis results 2010 from Merck, Sharpe & Dohme (IPPC REG. NO. P0011-03)

PARAMETER	MONITORING FREQUENCY	1st Qtr 02-Mar-10	2nd Qtr 14-May-10	3rd Qtr 13-Jul-10	4th Qtr 14-Nov-10
Sludge Analysis Data					
% Solids	Quarterly	92%	98%	94%	94%
% Water	Quarterly	8%	2%	6%	6%
% Organic Matter (dry basis)	Quarterly	22%	31%	33%	36%
% Ash (dry basis)	Quarterly	78%	69%	67%	64%
Heavy Metals	Quarterly	% (w/w)	% (w/w)	% (w/w)	% (w/w)
Arsenic		0.00010	0.00007	0.00009	0.00012
Tin		<0.00005	<0.00005	0.00005	0.00006
Mercury		<0.00003	<0.00003	<0.00003	<0.00001
Chromium		0.00098	0.00095	0.00120	0.0012
Phosphorus		0.004	0.003	0.017	0.012
Zinc		0.0061	0.0059	0.0084	0.0062
Cadmium		<0.00005	<0.00005	<0.00005	0.00002
Lead		0.00780	0.00018	0.00015	0.00022
Cobalt		0.00008	0.00006	0.00008	0.00010
Nickel		0.0011	0.0013	0.0016	0.0013
Iron		1.7	1.1	1.3	2.4
Boron		0.0039	0.0088	0.0139	0.0069
Manganese		0.0087	0.0058	0.0077	0.0136
Magnesium		0.35	0.55	0.45	0.31
Calcium		19.4	14.5	15.4	13.7
Copper		0.00052	0.00045	0.00066	0.00059
Aluminium		0.0420	0.0479	0.0567	0.0660
Berylium		<0.00005	<0.00005	<0.00005	<0.00005
Strontium		0.01933	0.00461	0.01287	0.01344
Barium		0.0085	0.0101	0.0069	0.0094
Sodium		0.16	0.10	0.22	0.20
Potassium		0.04	0.05	0.07	0.04
Molybdenum		0.00005	0.00001	0.00010	0.00006
Selenium		0.00039	0.00110	0.00067	0.00006
Antimony		<0.00005	<0.00005	<0.00005	0.00002
Titanium		0.00069	0.00027	0.00024	0.00261

Note: 1) Heavy Metals testing conducted by Bord na Mona Lab., Newbridge.

IPPC REG. NO. P0011-03

Wastewater Treatment & Potable Water Sludge analysis results 2010.

IPPC Register Schedule C.4

PARAMETER	MONITORING FREQUENCY	1st Qtr 02-Mar-10	2nd Qtr 14-May-10	3rd Qtr 13-Jul-10	4th Qtr 14-Nov-10
Sludge Analysis Data					
% Solids	Quarterly	92%	98%	94%	94%
% Water	Quarterly	8%	2%	6%	6%
% Organic Matter (dry basis)	Quarterly	22%	31%	33%	36%
% Ash (dry basis)	Quarterly	88%	69%	67%	64%
Nutrients & additional parameters	Information	% (w/w)	% (w/w)	% (w/w)	% (w/w)
Ammonia - N		0.0547	0.0626	0.0657	0.0141
Nitrate (as N)		0.00008	0.00026	<0.00001	<0.00005
Nitrite (as N)		<0.00003	0.00009	0.00041	0.00010
Kjeldahl Nitrogen (as N)		1.8058	2.7159	3.0127	2.7867
Chloride (as Cl)		0.05589	0.05473	0.08151	0.01877
Fluoride (as F)		0.00014	<0.0001	<0.0001	<0.0001
Sulphate (as SO_4)		0.02863	0.10866	0.04582	0.01437
Total Extractable Organic Halides (as Cl)	Information	0.0004	0.0003	0.0002	0.0001

Notes:

1) Nutrients testing conducted by Bord na Mona Lab., Newbridge.
2) Total Extractable Organic Halide testing conducted by Chemex laboratory, Cambridge (UK).

IPPC REG. NO. P0011-03

Wastewater Treatment & Potable Water Sludge Leachate analysis results 2010.

PARAMETER	MONITORING FREQUENCY	1st Qtr 02-Mar-10	2nd Qtr 14-May-10	3rd Qtr 13-Jul-10	4th Qtr 14-Nov-10
Leachate Analysis					
Heavy Metals	Quarterly	% (w/v)	% (w/v)	% (w/v)	% (w/v)
Arsenic		0.000001	0.000001	0.000001	<0.000002
Tin		<0.000001	<0.000001	<0.000001	<0.000002
Mercury		0.0000001	<0.000001	<0.000001	<0.000001
Chromium		0.000004	0.000005	0.000008	0.000006
Phosphorus		0.00338	0.00327	0.00969	0.00172
Zinc		0.00002	0.00018	0.00004	0.00011
Cadmium		<0.000001	<0.000001	<0.000001	<0.000002
Lead		<0.000001	<0.000001	0.000001	<0.000002
Cobalt		0.000002	0.000002	0.000002	0.000002
Nickel		0.00003	0.00002	0.00002	0.00004
Iron		0.0040	0.0023	0.0068	0.0013
Boron		0.00005	0.00015	0.00016	0.00013
Manganese		0.00003	0.00002	0.00004	0.00002
Magnesium		0.0078	0.0125	0.0082	0.0068
Calcium		0.0227	0.0159	0.0305	0.0124
Copper		0.000007	0.000006	0.000005	0.000010
Aluminium		0.000109	0.000051	0.000199	0.000019
Berylium		<0.000001	<0.000001	<0.000001	<0.000002
Strontium		0.000020	0.000002	0.000029	0.000141
Barium		0.00001	0.00037	0.00002	0.00009
Sodium		0.0127	0.0089	0.0128	0.0156
Potassium		0.0023	0.0024	0.0036	0.0026
Molybdenum		0.000002	0.000005	0.000005	0.000003
Selenium		0.000002	0.000003	0.000008	<0.000002
Antimony		<0.000001	<0.000001	<0.000001	<0.000002
Titanium		0.000012	0.000006	0.000014	0.000006
Nutrients & additional parameters	Information				
Ammonia - N		0.0367	0.0161	0.0329	0.0135
Nitrate (as N)		<0.000005	0.00005	0.00001	<0.00002
Nitrite (as N)		0.00013	0.00008	<0.00001	0.000005
Kjeldahl Nitrogen (as N)		0.063	0.080	0.028	0.093
Chloride (as Cl)		0.00741	0.00439	0.00718	0.014
Fluoride (as F)		<0.00001	<0.00001	<0.00001	<0.00001
Sulphate (as SO_4)		0.00891	0.01040	0.00491	0.01771
Non-Purgeable Organic Carbon (as C) – *g/lt*		2.276	2.775	3.000	3.740
Chemical Oxygen Demand – *g/lt*		7.100	9.035	10.160	11.860
Total Dissolved Solids – *g/lt*		4.604	7.210	6.820	4.429

Note: 1) Heavy Metals & nutrients testing conducted by Bord na Mona Lab., Newbridge.

IPPC REG. NO. P0011-03

Wastewater Treatment & Potable Water Sludge Leachate analysis results 2010.

PARAMETER	MONITORING FREQUENCY	1st Qtr 02-Mar-10	2nd Qtr 14-May-10	3rd Qtr 13-Jul-10	4th Qtr 14-Nov-10
Leachate Analysis					
Toxicity Testing	Quarterly				
48 hour EC_{50} to Daphnia Magna		4.0 TU	<5.6 TU	<5.6 TU	<3.1 TU
5 mins. EC_{50} to Vibrio fisheri		8.0 TU	11.5 TU	11.9 TU	14.1 TU
15 mins. EC_{50} to Vi fisheri		9.8 TU	28.6 TU	50 TU	90.9 TU
Organic Compounds	Bi-Annually	% (w/v)		% (w/v)	
Acetic Acid		0.0473		0.0467	
Acetonitrile		<0.00005		<0.00005	
Dimethylformamide		<0.0001		<0.0010	
Ethylene Glycol		<0.0001		<0.0001	
Isopropyl Acetate		<0.00001		<0.00001	
Ethyl Acetate		<0.00006		<0.00006	
Tetrahydrafuran		<0.00006		<0.00006	
Acetone		0.00006		<0.00005	
Ethanol		0.00396		0.00350	
Methanol		0.00011		0.00009	
Propan-2-ol		0.00018		<0.00005	
1,2,3-Trichlorobenzene		<0.000001		<0.000001	
1,3,5-Trimethylbenzene		<0.000001		<0.000001	
Benzene		<0.000001		<0.000001	
Carbon Tetrachloride		<0.000001		<0.000001	
Chloroform		0.0000063		<0.000001	
Chlorobenzene		<0.000001		<0.000001	
Dichloromethane		<0.000001		<0.000001	
Ethylbenzene		<0.000001		<0.000001	
o-Xylene		<0.000001		<0.000001	
m,p-Xylene		<0.000001		<0.000001	
n-Propyl Benzene		<0.000001		<0.000001	
Naphthalene		<0.000001		<0.000001	
Styrene		<0.000001		<0.000001	
Toluene		<0.000001		<0.000001	
Trichloroethene		<0.000001		<0.000001	

Notes:

1) Toxicity testing conducted by Enterprise Ireland Laboratory, Shannon.
2) Toxicity testing per water extraction method DIN - 38414 - S4.
3) Organic Compounds testing conducted by Bord na Mona Lab., Newbridge.
4) Testing conducted using US EPA 524.2 GC/MS method, GC/FID and HPLC.

3.9. Estimated Landfill Gas Emissions

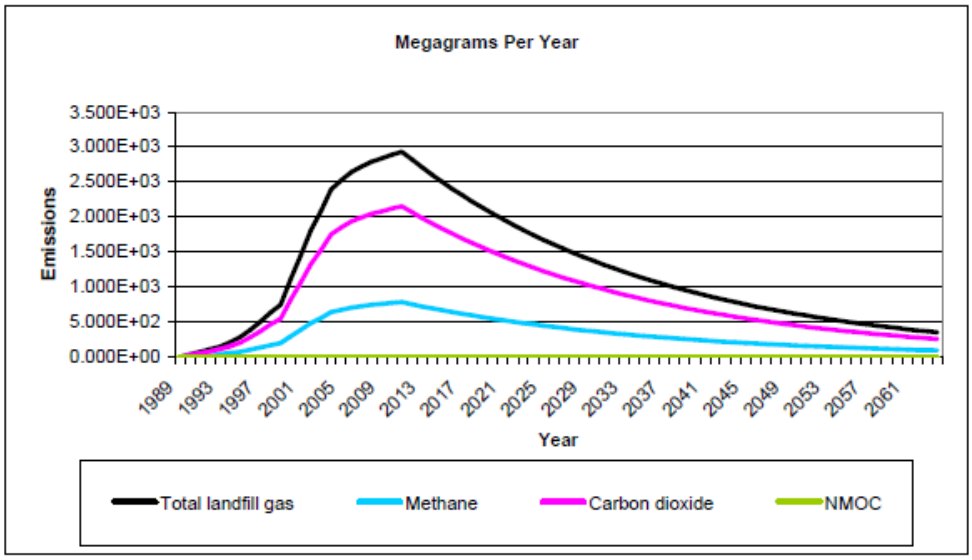
Landfill gas quantities generated at the site have been predicted with the aid of the Landfill Gas Emissions Model (LandGEM-Version 3.02). LandGEM provides an automated tool for quantifying emission rates for methane, carbon dioxide, non methane organic compounds, and individual air pollutants from municipal solid waste (MSW) landfills. The model was developed by the Control Technology Centre (CTC) of the U.S. Environmental Protection Agency and can be obtained by downloading from the TTNWeb (http:\www.epa.gov/ttn/catc/).

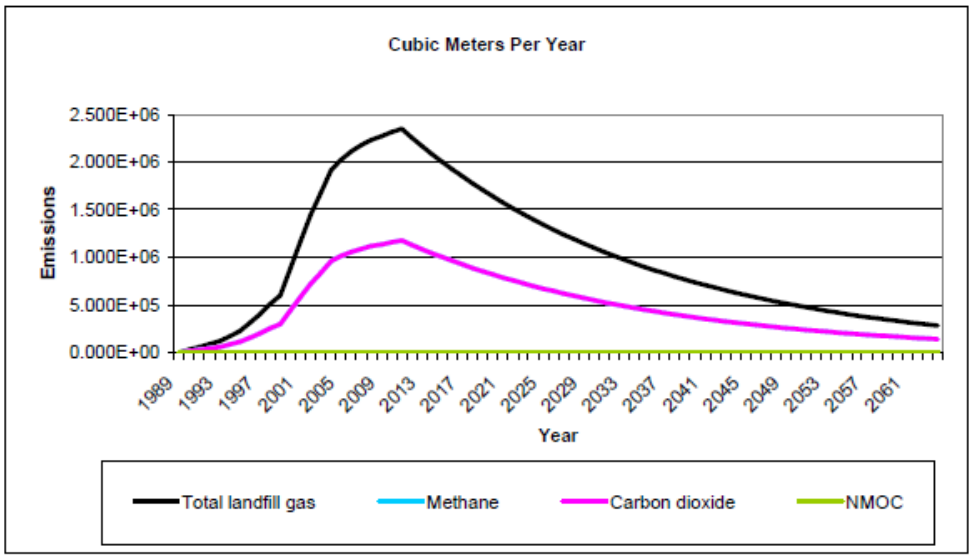
The model is based on a first order decay equation and can be run using site specific data for the parameters needed to estimate emissions or, if no site specific data is available, using default values.

The AP-42 set of default values was used in the prediction. This set of values is based on emissions factors in the USEPA Compilation on Air Pollutant Emission Factors, AP-42. This set of default values produces more representative emission values and can be used to produce typical emission estimates in the absence of site-specific test data.

The landfill gas calculations are attached in Appendix 8. In summary 2,314,937m^3 of landfill gas was generated in 2010. 319,541m^3 of landfill gas was flared in 2010. Therefore 1,995,395m^3 of landfill gas was emitted to atmosphere in 2010.

Figure 3.8 graphs estimated methane and landfill gas production, assuming a 50% v/v ration for methane gas and carbon dioxide.





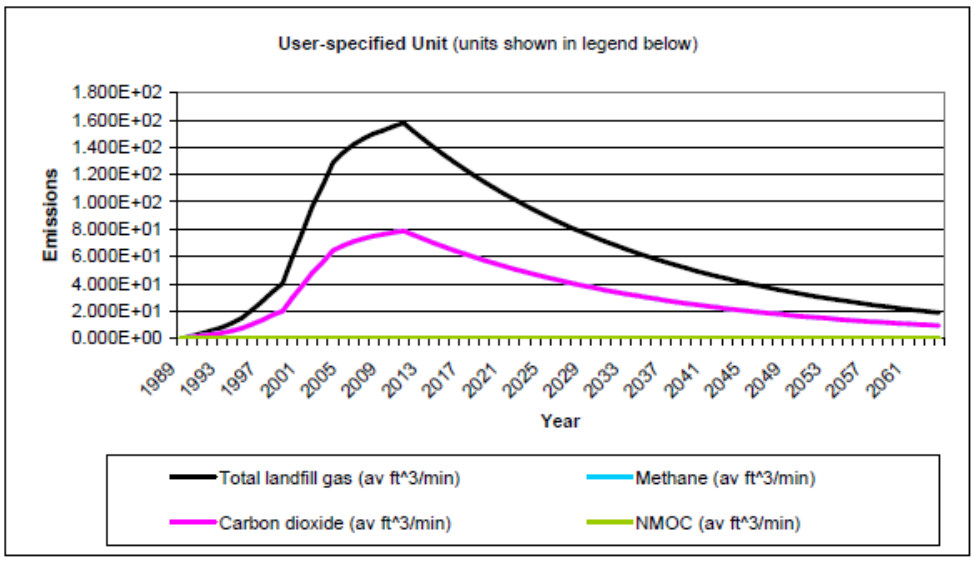


Figure 3.8 Estimate of Landfill Gas Production

3.10. Estimated Indirect Emissions to Groundwater

An estimate of emissions to groundwater can be made by using the hydrogeological properties of the underlying strata, assuming a leachate head and calculating a vertical throughput.

Using the parameters for the underlying strata given in the original waste licence application, the vertical leachate leakage is estimated for Area 1 (unlined) and Area 2 (lined) of the landfill using the following calculation:

Using the parameters for the underlying strata given in the original waste licence application, the vertical leakage is estimated for each Area using the following calculation:

$$Leakage = Area \times \left[\frac{K_{aug} \times h_{aug}}{b_{aug}} \right]$$

where: K_{aug} = hydraulic conductivity, m/s
b_{aug} = thickness of underlying strata, m
h_{aug} = head of leachate, m
Area = Area of cell, m²
Leakage = vertical leakage, m³/sec

	Area 1	Area 2	Area 3	Area 4	
K_{aug}	3.20E-07	1.00E-09	1.00E-09	1.00E-09	m/s
b_{aug}	28	1	1	1	m
h_{aug}	1.28	0.50	0.51	0.32	m
Area	25,190	6,100	7,200	4,800	m²
Leakage	3.70E-04	3.05E-06	3.70E-06	1.53E-06	m³/sec

Estimated leakage rate for 2010: 0.000378 m³/sec
Estimated leakage for 2010: 11,925 m³/annum

It should be noted that the effect of the underlying materials are not taken into account in Areas 2 to 4, i.e. the only attenuation considered is that afforded by the engineered lining systems. This is a conservative assumption, in reality the effect of the underlying material will further reduce leakage to groundwater.

The following points should be noted in relation to the calculations above.

The leakage calculation does not take into account the effect of the underlying strata below the lined cells. This will result in an overestimate of emissions to groundwater.

The upward head (counteracting the downward leachate movement) from the underlying bedrock aquifer is not taken into account. This will result in overestimate of emissions to groundwater. FTC's experience at the site suggests that an artesian groundwater head exists at the site, and the likelihood of actual emissions to groundwater is low.

That attenuation of contaminants in the leachate will occur as it passes through the 28m of underlying strata.

The values shown above are estimates only, and should be examined in conjunction with groundwater monitoring results to determine the extent (if any) of groundwater contamination at the site.

The potential leachate generation calculated in the water balance for 2010 is approximately 15,500 m³, and the volume recorded as being tankered off site is over 18,000 m³. Taking these figures into account it is likely that no actual emissions to groundwater are generated at the site. The figures above should be read as a maximum potential leakage rate based on a number of conservative assumptions, rather than as an indication of actual leakage.

The value shown above is an estimate only. The groundwater monitoring results outlined in Section 3.4 show no indication of groundwater contamination by leachate. The full calculation can be seen in Appendix 12.

3.11. Meteorological Data

Under Condition 8 and Schedule D.6 meteorological data is to be collected from the Kilkenny meteorological station, however due to the installation of a weather station at Donohill, meteorological data is now collected directly onsite. The following details are to be recorded on a daily basis:

- Precipitation Volume
- Temperature (min/max.)
- Wind Force and Direction
- Evaporation
- Evapotranspiration
- Humidity
- Atmospheric Pressure

See appendix 9 for a full record of meteorological data for 2010.

3.12. Slope Stability

The landfill side slopes are considered stable in the long term provided that leachate levels are maintained close to the base of the waste body at levels which were typically recorded during 2010 monitoring.

The full report can be seen in Appendix 10.

4. SITE DEVELOPMENT WORKS

Site development works initiated or completed during the report period are described hereunder.

4.1 Site Development

In 2010:

- Contract to permanently cap a portion of Area 1 / 3 commenced. This work includes a permanent cap that will divert rainwater away from the leachate collection system and prevent fugitive gas emissions, aswell as new gas and leachate extraction wells.
- Work commenced to improve the drainage system at the Recycling Centre. Any potentially contaminated water will now be diverted to the leachate collection system instead of the surface water collection system.
- Work commenced to install new fencing along the road from the weighbridge to the corner of area 3. This will improve the security and appearance of the site.
- Certification to OHSAS 18000 Health and Safety Management System was obtained.
- Installed a horizontal gas extraction system in Area 4.
- New signage was installed at the Recycling Centre.
- Lifting davitt for heavy electrical leachate pumps installed in area 4.
- Manual handling refresher training was carried out with all staff onsite.
- Emergency Response Procedure refresher training with a focus on dealing with fires was carried out with all staff and full time contractors onsite.
- Safe Pass refresher training was carried out for all staff onsite.

Planned for 2011

- Review and Improve site signage.
- Carry out further landscaping works at the site entrance.
- Complete the capping works on Area 1 / 3.
- Cap the finished side slopes of Area 4.
- Put a skirt of LLDPE around LE9 and LE10 to prevent them from venting gas.
- Carry out a full review of all existing landfill gas wells and KOPs and carry out and necessary repairs.
- Install a leachate pump in LE11 and replace the leachate pump in LE9.
- Extract gas from LE9 and LE10.
- Review covering and securing the WEEE area.

4.2 Restoration of Completed Cells / Phases

Capping of the majority of area 1 and all of area 2 commenced in October 2005 and was completed in March 2006. The cap covers an area of 20,230 m^2 and includes surface water drainage infrastructure as well as permanent gas collection infrastructure and additional gas collection wells.

Phase 2 capping of part of Area 1 and Area 3 commenced in late 2010.

A revised Aftercare and Restoration Plan was submitted to the Agency in 2010.

4.3 Remaining Capacity of the Landfill

In accordance with Condition 8.7 of the licence, Focus Surveys Ltd conducted a topographical survey of the site including the void space analysis, on the 15th of March 2010. A copy of the report is included as Appendix 11. The analysis estimates the remaining potential capacity of the landfill as 24,700 m^3.

4.4 Tank, Pipeline and Bund Testing

The surface water and leachate lagoons were both integrity tested in 2008. Both lagoons passed. This testing is carried out every three years and was not due to be done in 2010.

5 ENVIRONMENTAL INCIDENTS AND COMPLAINTS

5.1 Incidents Summary

Condition 11.2 of the waste licence requires that the licensee shall make written records of environmental incidents. Table 5.1 details recorded incidents during the reporting period. Corrective actions taken in response to incidents and complaints are in accordance with the requirements of the licence and with the site Corrective Action Procedure. Copies of all written records of environmental incidents for the reporting period are contained in Appendix 13.

Seventeen incidents were recorded during this reporting period

Table 5.1 Incidents Summary

	Date	07-10-09
	Nature of Incident	High level of leachate at LGE8 & LE7
	Cause	Heavy rainfall. This incident was opened in 2009 and closed in 2010.
	Corrective Action	Tanker leachate offsite.
	Open / Closed	Closed
1	**Date**	30-03-10
	Nature of Incident	High level of leachate at LGE8 & LE7
	Cause	Heavy rainfall.
	Corrective Action	Tanker leachate offsite.
	Open / Closed	Closed
2	**Date**	23-04-10
	Nature of Incident	CO2 trigger level breached at perimeter gas wells GM14 & GM15
	Cause	Natural ground conditions
	Corrective Action	N/A
	Open / Closed	Closed
3	**Date**	25-05-10
	Nature of Incident	CO2 trigger level breached at perimeter gas well GM15
	Cause	Natural ground conditions
	Corrective Action	N/A
	Open / Closed	Closed
4	**Date**	20-07-10
	Nature of Incident	High level of leachate at LE7
	Cause	Heavy rainfall.
	Corrective Action	Tanker leachate offsite.
	Open / Closed	Closed
5	**Date**	21-07-10
	Nature of Incident	High level of leachate at LE6
	Cause	Pump malfunction
	Corrective Action	Pump repaired
	Open / Closed	Closed

6	**Date**	28-07-10
	Nature of Incident	CO2 trigger level breached at perimeter gas wells GM14 & GM15
	Cause	Natural ground conditions
	Corrective Action	N/A
	Open / Closed	Closed
7	**Date**	16-08-10
	Nature of Incident	Flare and leachate pumps not working
	Cause	Power cut
	Corrective Action	Flare and leachate pumps resumed operation once power restored
	Open / Closed	Closed
8	**Date**	30-08-10
	Nature of Incident	CO2 trigger level breached at perimeter gas well GM15
	Cause	Natural ground conditions
	Corrective Action	N/A
	Open / Closed	Closed
9	**Date**	07-09-10
	Nature of Incident	High level of leachate at LGE7 & LE7
	Cause	Heavy rainfall.
	Corrective Action	Tanker leachate offsite.
	Open / Closed	Closed
10	**Date**	01-10-10
	Nature of Incident	CO2 trigger level breached at perimeter gas wells GM14 & GM15
	Cause	Natural ground conditions
	Corrective Action	N/A
	Open / Closed	Closed
11	**Date**	01-11-10
	Nature of Incident	High level of leachate at LGE8, LGE7 & LE7
	Cause	Heavy rainfall.
	Corrective Action	Tanker leachate offsite.
	Open / Closed	Closed
12	**Date**	19-11-10
	Nature of Incident	High level of leachate at LGE7 & LE7. Flare not working
	Cause	Power cut.
	Corrective Action	Restore power
	Open / Closed	Closed
13	**Date**	23-11-10
	Nature of Incident	High level of leachate at LGE7 & LE7
	Cause	Pump stopped working at LGE7. Recent heavy rainfall filled lagoon.
	Corrective Action	Tanker leachate offsite, service pump.
	Open / Closed	Closed
14	**Date**	22-11-10
	Nature of Incident	High level of leachate at LGE7
	Cause	Pump stopped working at LGE7. Working intermittently.
	Corrective Action	Service pump.
	Open / Closed	Open

15	**Date**	16-12-10
	Nature of Incident	Flare performing poorly
	Cause	Air ingress / condensate in pipes.
	Corrective Action	Detailed site investigation & commissioning of seven new wells.
	Open / Closed	Open
16	**Date**	13-12-10
	Nature of Incident	Settlement sensors under cell 4 not working.
	Cause	Sensors damaged.
	Corrective Action	Not possible to repair.
	Open / Closed	Closed.
17	**Date**	27-12-10
	Nature of Incident	High level of leachate at LE7
	Cause	Heavy rainfall.
	Corrective Action	Tanker leachate offsite.
	Open / Closed	Closed

5.2. Complaints Summary

No complaints were received during the reporting period.

5.3 Review of Nuisance Controls.

All nuisance control systems are monitored weekly to ensure that they are working effectively. The findings of these inspections are recorded on Nuisance Check Sheets, which are held on record in the facility. Environmental nuisances include:

1. Litter
2. Bird
3. Vermin & Insects
4. Odour
5. Dust

5.3.1 Litter Control

There are a number of systems in place to control litter.

1. Deposited waste is compacted, this ensures that the maximum use is made of void space within the landfill but also reduces the amount of waste available to generate litter
2. There is litter netting positioned around the active area of the site to capture any loose litter blown off the active area
3. Any litter that gets past the netting will be identified in the site inspection and litter picking is carried out as required

4. All waste deposited on site is covered at the end of each working day to stop scavenging and ensure that deposited waste does not blow away as litter
5. Waste will not be deposited on-site when there are adverse wind conditions

5.3.2 Bird Control

Bird control on-site is contracted out to Bird Control Ireland but is done in conjunction with STCC personnel. They use several systems to control birds on site:

1. Fly Falcons and Hawks
2. Use species specific distress calls
3. Use fixed distress calling unit with speakers.
4. Fly various types of kite
5. Fly holographic streamers
6. Use bird scaring cartridges
7. Use of a shotgun

5.3.3 Vermin & Insects Control

The initial vermin control system on site is prompt waste disposal and compaction, reducing access to material. Additional vermin control work is contracted to Pest Patrol (Pest control and Environmental Services). They use the following systems to control vermin and insects on site:

1. Spraying is used to control insects
2. Bait boxes are used to capture vermin.

Pest Patrol carries out eight to ten site inspections annually to ensure that the site is free of insects and vermin. Pest Patrol has installed forty-two bait boxes around the perimeter of the site, which are inspected and freshly baited during each visit. STCC has also contracted Pest Patrol to install bait boxes in twenty locations adjacent to the landfill site at local dwellings. These traps are also inspected during site visits. Donohill landfill is not considered to have an insect or vermin problem.

5.3.4 Odour Control

STCC use the following systems on site to control odour:

1. All waste is compacted post placement
2. Daily cover
3. Excavating the waste body is avoided where possible

5.3.5 Dust Control

Dust control on-site is controlled using the following systems:

1. Reduced vehicle speed on site to control dust rising
2. Roads sprayed with water to keep dust down, done in dry weather

No complaints were received at the landfill as regards dust raised by operational activities.

6 SUMMARY OF PROCEDURES ASSOCIATED WITH THE FACILITY

Documented procedures governing the operation of the facility are outlined below. Complete copies of all procedures are included in the facility's EMS.

Procedure Title	**Compactor Skip Procedure**
Summary	To ensure the compactor skip is operated in a safe manner
Revision Date & No.	April 2010; Rev 1

Procedure Title	**Competence, Awareness and Training Procedure**
Summary	To ensure that training needs are identified and appropriate training is provided for facility personnel.
Revision Date & No.	April 2010; Rev 0

Procedure Title	**Complaints Procedure**
Summary	To ensure that all complaints that landfill activities are creating a nuisance are recorded and dealt with, in compliance with Condition 10.4 of the waste licence
Revision Date & No.	April 2010, Rev. 7

Procedure Title	**Corrective Action Procedure**
Summary	To ensure that the appropriate corrective action is taken in the event of an incident on-site, where an incident can be defined as: • an emergency • any emission which does not comply with the requirements of this licence (W0074-02) • any trigger level specified in this licence which is attained or exceeded • any indication that environmental pollution has, or may have, taken place
Revision Date & No.	April 2010; Rev. 5

Procedure Title	**Emergency Response Procedure**
Summary	The purpose of this procedure is to propose appropriate actions to ensure the safety & health of all site personnel and visitors, minimise damage to property and risk to the environment This procedure describes the action to be used in the event of an emergency where an emergency can be described as but is not limited to any of the following incidences:
Revision Date & No.	April 2010; Rev. 8

Procedure Title	**Environmental Monitoring Procedure**
Summary	To formalise the system of environmental monitoring on-site for: • Landfill Gas • Surface Water, Groundwater and Leachate • Meteorological data • Dust • Noise
Revision Date & No.	April 2010; Rev. 6

Procedure Title	**External Communication Procedure**
Summary	To ensure that all communications regarding the landfill facility are correctly directed to be addressed by the correct personnel.
Revision Date & No.	April 2010; Rev. 5

Procedure Title	**Hessian Procedure**
Summary	To define how the waste is covered with Hessian
Revision Date & No.	April 2010 Rev. 1

Procedure Title	**High Winds Procedure**
Summary	To ensure that the correct action is taken on site during conditions of high wind
Revision Date & No.	April 2010; Rev. 3

Procedure Title	**Landfill Gas Management Procedure**
Summary	To effectively manage the onsite landfill gas system.
Revision Date & No.	April 2010; Rev 4

Procedure Title	**Leachate Handling Procedure**
Summary	To formalise the system of leachate handling on-site, during removal from the leachate lagoon and its subsequent removal to Tipperary Town Waste Water Treatment Plant.
Revision Date & No.	April 2010; Rev. 4

Procedure Title	**Leachate Management Procedure**
Summary	To effective manage the leachate produced onsite.
Revision Date & No.	April 2010; Rev 5

Procedure Title	**Litter Netting Procedure**
Summary	To define how litter netting is erected and taken down
Revision Date & No.	April 2010 Rev. 1

Procedure Title	**Litter Picking Procedure**
Summary	To ensure litter picking is carried out in a safe manner
Revision Date & No.	April 2010; Rev 1

Procedure Title	**Machines Working at the Tip Face Procedure**
Summary	To describe the operation procedure for machines working at tip face.
Revision Date & No.	April 2010; Rev. 1

Procedure Title	**Monitoring and Measurement Procedure**
Summary	To outline the monitoring and measurement to be carried out as part of the OH&S management system.
Revision Date & No.	April 2010; Rev. 0

Procedure Title	**Nuisance Inspection Procedure**
Summary	To ensure that the site is inspected on a weekly basis to ensure that there is no nuisance being caused by vermin, birds, flies, mud, dust, litter and odours.
Revision Date & No.	April 2010; Rev. 3

Procedure Title	**Odour Impact Assessment Procedure**
Summary	To carry out odour assessments.
Revision Date & No.	April 2010; Rev 2

Procedure Title	**On-Site Communication Procedure**
Summary	To ensure that members of the public can access, at the facility, information on the sites environmental performance, in compliance with Condition 2.4.1 of the waste licence
Revision Date & No.	April 2010; Rev. 4

Procedure Title	**Record Control Procedure**
Summary	To define how to control records – their storage, back-up, revisions and retention period.
Revision Date & No.	April 2010; Rev 0

Procedure Title	**Resources, Roles & Responsibilities Procedure**
Summary	To identify the responsible people at Donohill Landfill.
Revision Date & No.	April 2010; Rev 0

Procedure Title	**Site Inspection Procedure**
Summary	To ensure that the site is inspected on a weekly basis to ensure that there is nothing of note occurring on site that is being missed.
Revision Date & No.	April 2010; Rev. 5

Procedure Title	**Site Supervision Procedure**
Summary	To ensure there is adequate supervision on the site at all times
Revision Date & No.	August 2010, Rev. 1

Procedure Title	**Surface Water Lagoon Management Procedure**
Summary	To ensure the surface water is properly managed
Revision Date & No.	April 2010, Rev. 1

Procedure Title	**Vehicle Movement Procedure**
Summary	Ensure that all disposal vehicles using the site enter, travel and discharge waste safely
Revision Date & No.	April 2010; Rev. 8

Procedure Title	**Waste Acceptance & Rejection Procedure**
Summary	To formalise the system of receiving and recording the delivery and acceptance of waste.
Revision Date & No.	April 2010; Rev 2

Procedure Title	**Waste Characterisation and Testing Procedure**
Summary	To provide a system of checking to ensure that waste to be disposed of at Donohill Landfill complies with Schedule A of the Waste Licence.
Revision Date & No.	April 2010; Rev. 4

Procedure Title	**Waste Handling Procedure**
Summary	To ensure waste is handled in a safe manner
Revision Date & No.	April 2010; Rev 1

Procedure Title	**Working at the Lagoon Enclosure Procedure**
Summary	To define how to work safely at the lagoon area.
Revision Date & No.	April 2010; Rev 1

7 FACILITY RESOURCES

7.1 Management and Staff Structure

There are six operational staff at the landfill site: a Facility Manager, responsible for the day-to-day site activities, a deputy manager, environmental chemist, a weighbridge operator and two general operatives.

A staffing structure for site operations is presented in Figure 7.1. Their qualifications and responsibilities are outlined below:

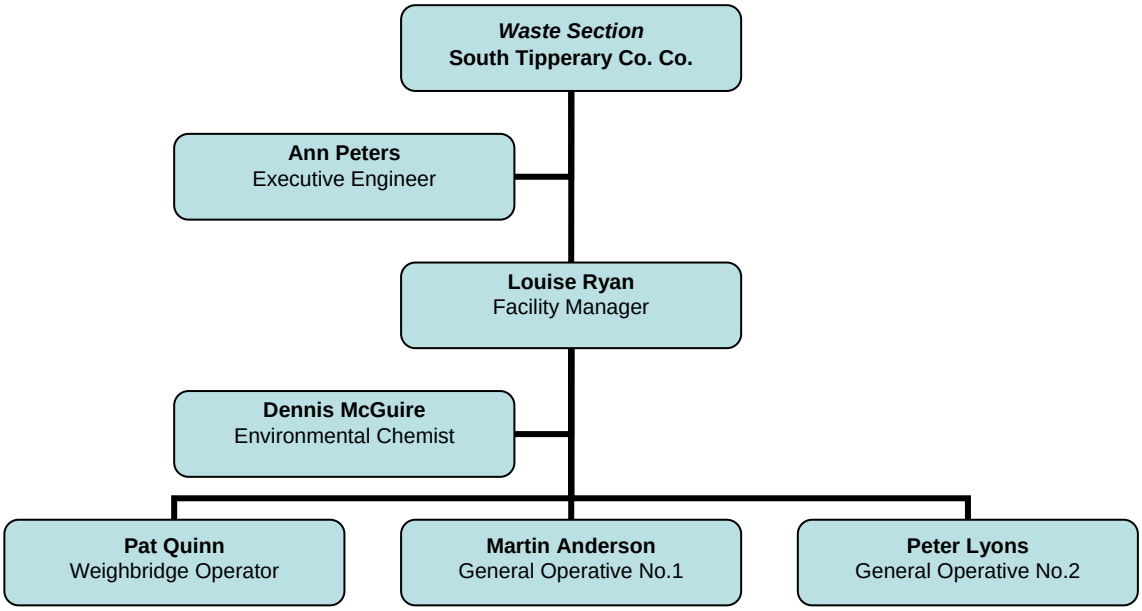


Figure 7.1 Management Structure

Facility Manager:	*Louise Ryan*
Qualifications:	B.Sc. (Environmental Science) FAS SafePass Course
Responsibilities:	Day-to-Day Operations Waste Acceptance Environmental Protection

Executive Engineer:	*Anne Peters*
Qualifications:	B.E. (Chem.) FAS Waste Management Training Course FAS SafePass Course
Responsibilities:	Oversee infrastructure development and management on site

Chemist:	*Dennis McGuire*
Qualifications:	B.Sc.
Responsibilities:	Responsible for analytical analysis of monitoring on site

Deputy Manager:	*Pat Walsh*
Qualifications:	FAS Waste Management Training Course FAS SafePass Course
Responsibilities:	Deputy for the Facility Manager, has the same responsibilities • Day-to-day operations • Waste acceptance • Environmental protection

Weighbridge Operator	*Pat Quinn*
Qualifications:	In –house Training • Weighbridge operation • Instruction on the implication of the waste licence on site staff
Responsibilities:	• Weighing • Waste Acceptance • Records • Cash Duty

Staff will be present on site during operational hours to supervise the waste disposal, deal with any emergency that arises and to prevent unauthorised entry into the site. The Facility Manager, or appointed deputy, must be on site during opening hours.

The primary goal of all training is to ensure that there is awareness at all levels of:

- the importance of compliance with conditions of the licence
- the potential environmental effects of work activities
- individual roles and responsibilities in achieving compliance with the waste licence
- the environmental benefits of improved performance
- the Health, Safety & Welfare at Work Act.

7.1.1 Training of Personnel

It will be the responsibility of the Landfill Manager to ensure that all landfill staff receives training in relevant areas/tasks, including:

- instruction and operation of the landfill machinery
- operation of the weighbridge and computer system
- training for specific functions, e.g. bird control devices, gas monitoring, vermin/fly control and leachate monitoring.

The Landfill Manager shall also ensure that all staff receives general training, including:

- instruction in manual handling
- the use of fire extinguishers
- FAS SafePass Course
- First Aid training

It is also the responsibility of the Landfill Manager to ensure that site staff are aware of the terms of the waste licence at the facility and the responsibility of each staff member to maintain specific terms of the waste licence. It is the responsibility of the facility manager to ensure that each staff member is aware of his or her specific function.

The Health and Safety Officer makes regular visits to the site, to promote awareness of safety issues and to audit the site. Any suggested improvements are implemented as soon as possible.

7.1.2 Records for the Training and Awareness Programme

- A training records file is kept at the site office
- All relevant operational procedures and documentation relevant to the licence shall be kept at the facility office and updated regularly
- All staff shall be made aware of the existence of such documents.

7.2 Financial Provisions

STCC charged €100 per tonne for disposal of waste at Donohill landfill during 2010. This charge does not include the landfill levy and VAT, which is applied in addition to the gate fee.

This gate fee is adequate to provide for the current operation and development of the site, waste licence compliance and to ensure that the facility will be restored to the satisfaction of the Agency.

7.2.1 Local Community Involvement

Donohill landfill is currently liaising with the Donohill Liaison Committee community group.

STCC holds meetings with this group, for discussions on the facility's impact on the local community and proposals for improving the local area.

In total over €541,561 has been invested into the local community by the facility (€80,235 in 2002, €129,994 in 2003, €71,332 in 2004, €60,000 in 2005, €60,000 in 2006, €60,000 in 2007, €40,000 in 2008, €20,000 in 2009 and €20,000 in 2010). The money contributed in 2010 was put towards development of a community sports facility.

APPENDIX 1 SITE DRAWINGS

I. N. G.
NORTH

GAS MIGRATION

GM1	190476	142588
GM2	190496	142532
GM3	190531	142503
GM4	190567	142470
GM5	190603	142484
GM6	190637	142517
GM7	190687	142532
GM8	190729	142563
GM9	190773	142617
GM10	190768	142666
GM11	190754	142697
GM12 †	190678	142754
GM13 †	190705	142846
GM14 †	190407	142966
GM15 †	190268	142736

GAS MONITORING

G2	190678	142590
G3 ✳	190569	142641
G4	190523	142562

FLARE

F1	190502	142581

LEACHATE COMPOSITION

LC1	190496	142615
LC2	190496	142615
LC3 ✳✳✳	190495	142584
LC4	190495	142600

LEACHATE LEVEL

L2 ✳	190690	142575
L3 ✳	190738	142615
L4	190500	142576
L5	190656	142706

LEACHATE EXTRACTION

LE1	190484	142595
LE2 ✳	190503	142585
LE3	190625	142536
LE4 ✳	190500	142612
LE5	190647	142546
LE6	190690	142575
LE7	190738	142615
LE8	190715	142571
LE9	190698	142635
LE10 ✳✳	190707	142615
LE11 ✳✳	190718	142593
LE12	190521	142612

LEACHATE GAS EXTRACTION

LGE1✳✳✳	190691	142576
LGE3✳✳✳	190498	142650
LGE4✳✳✳	190521	142612
LGE5✳✳✳	190647	142546
LGE6	190620	142609
LGE7	190569	142641
LGE8	190660	142701

HORZ. GAS EXTRACTION

HGEV1/2	190517	142650
HGEV3/4	190514	142581
HGEV5/6/7	190505	142554
HGEV8/9/10	190680	142555

KNOCK-OUT POTS

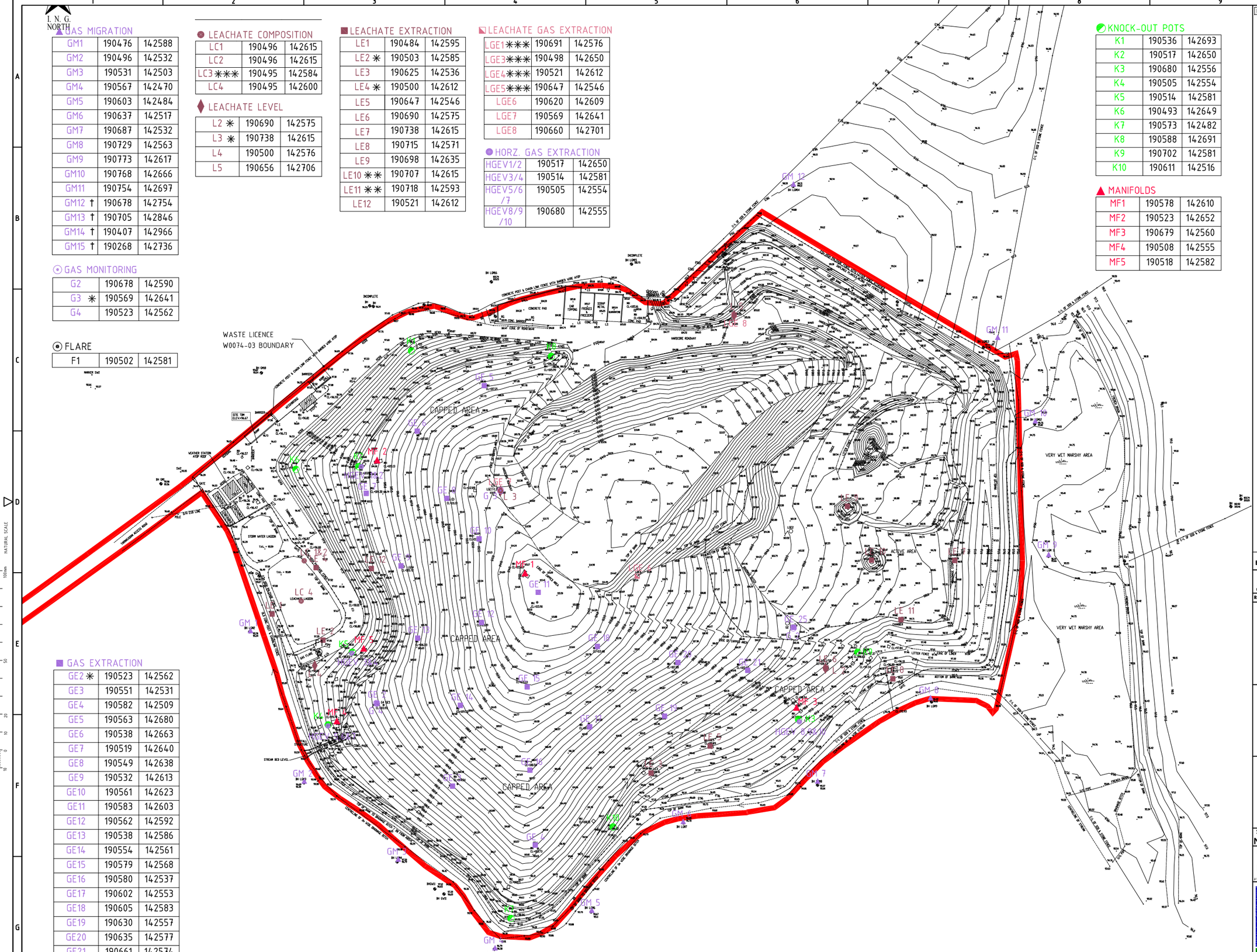
K1	190536	142693
K2	190517	142650
K3	190680	142556
K4	190505	142554
K5	190514	142581
K6	190493	142649
K7	190573	142482
K8	190588	142691
K9	190702	142581
K10	190611	142516

MANIFOLDS

MF1	190578	142610
MF2	190523	142652
MF3	190679	142560
MF4	190508	142555
MF5	190518	142582

GAS EXTRACTION

GE2 ✳	190523	142562
GE3	190551	142531
GE4	190582	142509
GE5	190563	142680
GE6	190538	142663
GE7	190519	142640
GE8	190549	142638
GE9	190532	142613
GE10	190561	142623
GE11	190583	142603
GE12	190562	142592
GE13	190538	142586
GE14	190554	142561
GE15	190579	142568
GE16	190580	142537
GE17	190602	142553
GE18	190605	142583
GE19	190630	142557
GE20	190635	142577
GE21	190661	142574
GE25	190678	142590



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LEGEND :

Gas, Monitoring & Extraction Locations

- Gas Migration
- Gas Monitoring
- Gas Extraction
- Leachate Gas Extraction
- Horizontal Gas Extraction
- Knock-Out Pots
- Manifolds
- Flare

Leachate Monitoring & Extraction Locations

- Leachate Composition
- Leachate Level
- Leachate Extraction

NOTE :

† Denotes not shown on plan. Refer to DE07-024-04-Fig.001.

✳ Location moved since a previous revision.

✳✳ No pumps installed yet.

✳✳✳ Well not in use.

Background Survey Date 09.10.09

Rev.	Drawn	Chkd	Appd		
E	CBC	TR	BG	Cork 22.3.2010	ISSUE FOR AER 2009
				Rev Origin / Date	Description

Revision History: A B C D E

Name of Client

SOUTH TIPPERARY COUNTY COUNCIL

Name of Job

DONOHILL LANDFILL
LICENCE COMPLIANCE 2007

Title of Drawing

GAS AND LEACHATE MONITORING AND EXTRACTION LOCATIONS

Scales Used: NTS

Dwg. No.: DE07-024-04-001

Rev.: E

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE 10 0 10 20 50 100mm

Sheet FTC-A1-2006 rev. C (template filed in O:Acad\Templates\Autocad) (May 2007) - template externally referenced (Claire Curran)

GAS MIGRATION

GM1	190476	142588
GM2	190496	142532
GM3	190531	142503
GM4	190567	142470
GM5	190603	142484
GM6	190637	142517
GM7	190687	142532
GM8	190729	142563
GM9	190773	142617
GM10	190768	142666
GM11	190754	142697
GM12 †	190678	142754
GM13 †	190705	142846
GM14 †	190407	142966
GM15 †	190268	142736

LEACHATE COMPOSITION

LC1	190496	142615
LC2	190496	142615
LC3 ✱✱✱	190495	142584
LC4	190495	142600

GROUNDWATER

GW11S	190545	142493
GW11D	190548	142491
GW12S	190841	142635
GW12D	190845	142638
GW13 †	190700	142846
GW14 †	190412	142965
GW15 †	190286	142741
GW16 †	190070	144050

SURFACE WATER

SW1	190754	142564
SW2	190461	142631
SW3 †	190695	142966
SW4 †	191390	140939
SW5	190481	142623
SW7	190508	142544
SW8	190626	142515

NOISE

N1	190717	142711
N2	190594	142706
N3	190675	142563
N4	190482	142639
S1 †	190293	142606
S2 †	190979	142702

DUST

ST1	190562	142704
ST2B	190737	142700
ST3	190490	142620

FLARE

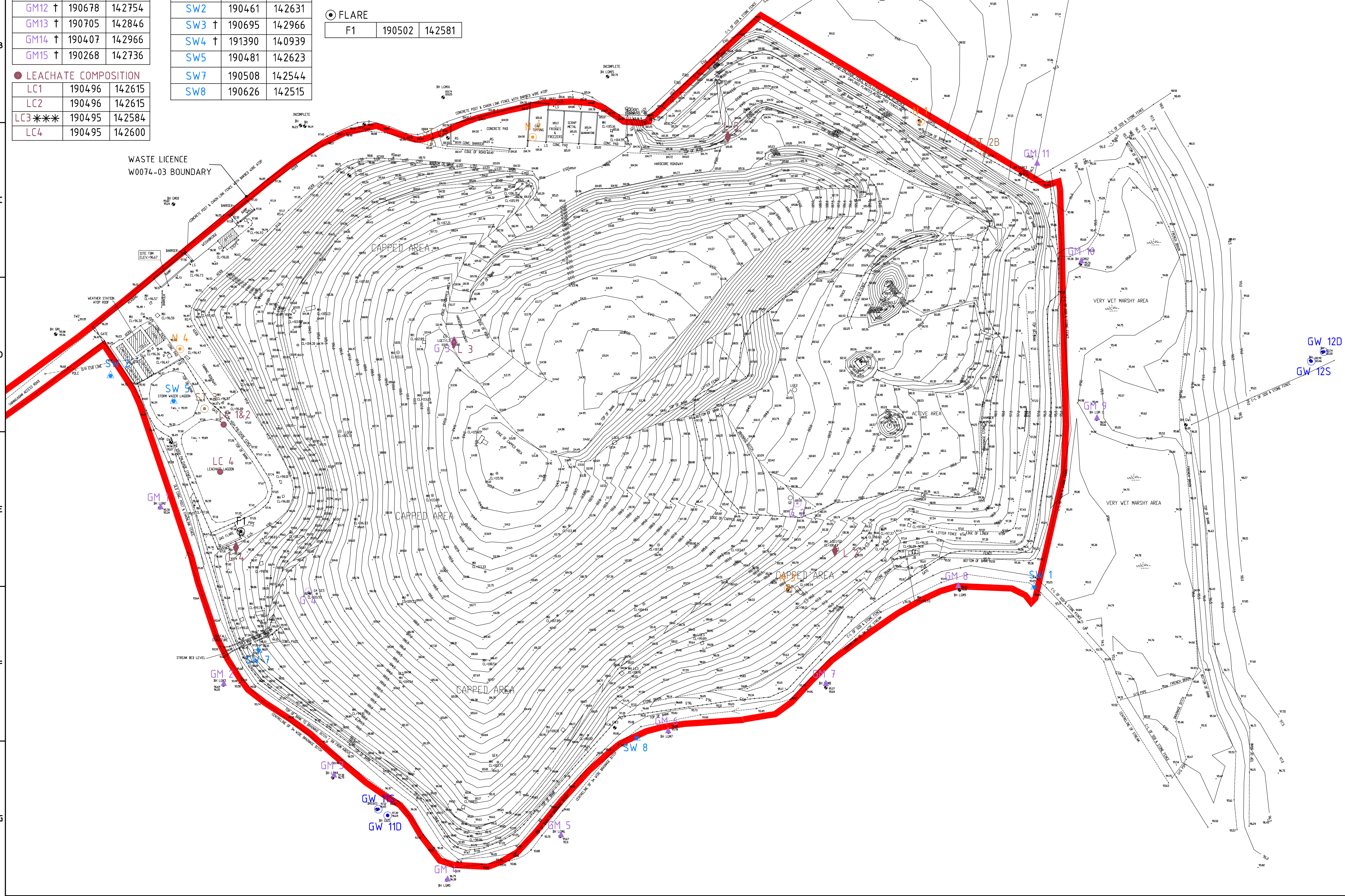
F1	190502	142581

LEACHATE LEVEL

L2 ✱	190690	142575
L3 ✱	190738	142615
L4	190500	142576
L5	190656	142706

GAS MONITORING

G2	190678	142590
G3 ✱	190569	142641
G4	190523	142562



LEGEND :

Environmental Monitoring Locations

- Groundwater
- Surface Water
- Proposed Surface Water
- Noise
- Dust
- Gas Migration
- Leachate Level
- Gas Monitoring
- Flare
- Leachate Composition

NOTE :

† Denotes not shown on plan. Refer to DE07-024-04-Fig.001.

✱ Location moved since a previous revision.

✱✱ No pumps installed yet.

✱✱✱ Well not in use.

Background Survey Date 09.10.09

Rev.	Drawn	Chk'd	App'd	Rev Origin / Date	Description
F	CBC	TR	BG	Cork 22.3.2010	ISSUE FOR AER 2009

Revision History A B C D E F

Name of Client

SOUTH TIPPERARY COUNTY COUNCIL

Name of Job

DONOHILL LANDFILL
LICENCE COMPLIANCE 2007

Title of Drawing

ENVIRONMENTAL MONITORING LOCATIONS

Scales Used: NTS

Dwg. No.: DE07-024-04-002 — Rev.: F

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE

Sheet FTC-A1-2006 rev. C (template filed in O:Acad\Templates\Autocad) (May 2007) - template externally referenced (Claire Curran)

ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE 10 0 10 20 50 100mm

NOT FOR CONSTRUCTION UNLESS SPECIFICALLY STATED OTHERWISE

LEGEND :

Noise & Dust
Monitoring Locations

- Noise
- Dust

NOISE

N1	190717	142711
N2	190594	142706
N3	190675	142563
N4	190482	142639
S1 †	190293	142606
S2 †	190979	142702

DUST

ST1	190562	142704
ST2B	190737	142700
ST3	190490	142620

NOTE :

† Denotes not shown on plan. Refer to DE07-024-04-Fig.001.

Background Survey Date 09.10.09

Rev.	Drawn	Chk'd	App'd	Rev Origin / Date	Description
C	CBC	TR	BG	Cork 22.3.2010	ISSUE FOR AER 2009

Revision History A B C

Name of Client

SOUTH TIPPERARY
COUNTY COUNCIL

Name of Job

DONOHOLL LANDFILL
LICENCE COMPLIANCE 2007

Title of Drawing

NOISE AND DUST MONITORING LOCATIONS

Scales Used: NTS

Dwg. No.: DE07-024-04-003 Rev.: C

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N. G. FORTH

GROUNDWATER

GW11S	190545	142493
GW11D	190548	142491
GW12S	190841	142635
GW12D	190845	142638
GW13 †	190700	142846
GW14 †	190412	142965
GW15 †	190286	142741
GW16 †	190070	144050

SURFACE WATER

SW1	190754	142564
SW2	190461	142631
SW3 †	190695	142966
SW4 †	191390	140939
SW5	190481	142623
SW7	190508	142544
SW8	190626	142515

LEGEND :

Groundwater & Surface Water Monitoring Locations

- Groundwater
- Surface Water

NOTE :

† Denotes not shown on plan. Refer to DE07-024-04-Fig.001.

Background Survey Date 09.10.09

Rev.	Drawn	Chk'd	Appd	Date	Description
D	CBC	TR	BG	Cork 22.3.2010	ISSUE FOR AER 2009

Revision History: A B C D

Name of Client

SOUTH TIPPERARY COUNTY COUNCIL

Name of Job

DONOHILL LANDFILL
LICENCE COMPLIANCE 2007

Title of Drawing

GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS

Scales Used: NTS

Dwg. No. DE07-024-04-004 — Rev. D

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE 10 0 10 20 50 100mm

N. G. ORTH

▲ GAS MIGRATION

GM1	190476	142588
GM2	190496	142532
GM3	190531	142503
GM4	190567	142470
GM5	190603	142484
GM6	190637	142517
GM7	190687	142532
GM8	190729	142563
GM9	190773	142617
GM10	190768	142666
GM11	190754	142697
GM12 †	190678	142754
GM13 †	190705	142846
GM14 †	190407	142966
GM15 †	190268	142736

⊙ GAS MONITORING

G2	190678	142590
G3 ✳	190569	142641
G4	190523	142562

■ GAS EXTRACTION

GE2 ✳	190523	142562
GE3	190551	142531
GE4	190582	142509
GE5	190563	142680
GE6	190538	142663
GE7	190519	142640
GE8	190549	142638
GE9	190532	142613
GE10	190561	142623
GE11	190583	142603
GE12	190562	142592
GE13	190538	142586
GE14	190554	142561
GE15	190579	142568
GE16	190580	142537
GE17	190602	142553
GE18	190605	142583
GE19	190630	142557
GE20	190635	142577
GE21	190661	142574
GE25	190678	142590

◪ LEACHATE GAS EXTRACTION

LGE1✳✳	190691	142576
LGE3✳✳	190498	142650
LGE4✳✳	190521	142612
LGE5✳✳	190647	142546
LGE6	190620	142609
LGE7	190569	142641
LGE8	190660	142701

● HORZ. GAS EXTRACTION

HGEV1/2	190517	142650
HGEV3/4	190514	142581
HGEV5/6/7	190505	142554
HGEV8/9/10	190680	142555

◔ KNOCK-OUT POTS

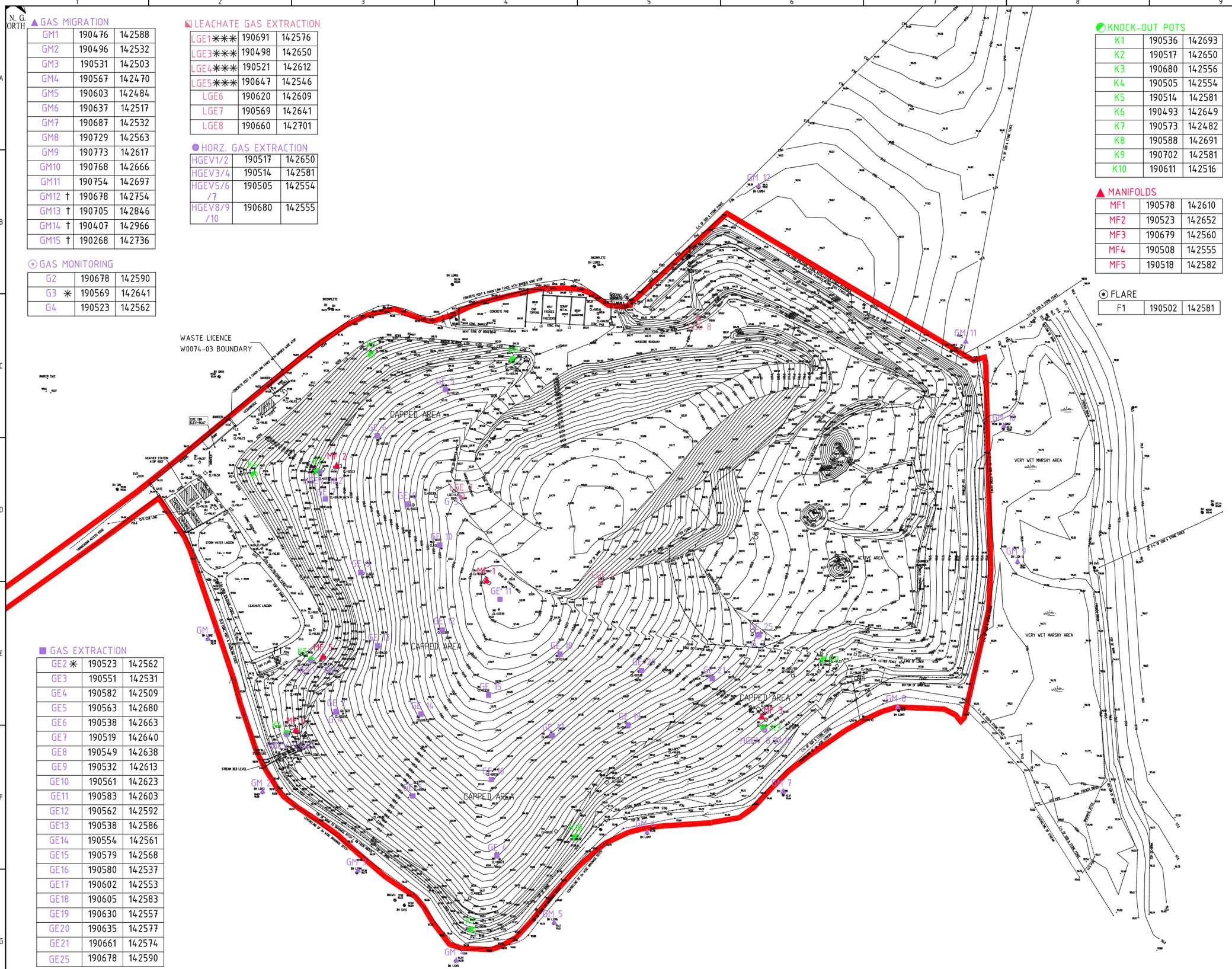
K1	190536	142693
K2	190517	142650
K3	190680	142556
K4	190505	142554
K5	190514	142581
K6	190493	142649
K7	190573	142482
K8	190588	142691
K9	190702	142581
K10	190611	142516

▲ MANIFOLDS

MF1	190578	142610
MF2	190523	142652
MF3	190679	142560
MF4	190508	142555
MF5	190518	142582

⊙ FLARE

F1	190502	142581



NOT FOR CONSTRUCTION UNLESS SPECIFICALLY STATED OTHERWISE

LEGEND :

Gas, Monitoring & Extraction Locations

- ▲ Gas Migration
- ⊙ Gas Monitoring
- ■ Gas Extraction
- ◪ Leachate Gas Extraction
- ● Horizontal Gas Extraction
- ◔ Knock-Out Pots
- ▲ Manifolds

NOTE :

† Denotes not shown on plan. Refer to DE07-024-04-Fig.001.

✳ Location moved since a previous revision.

✳✳ No pumps installed yet.

Background Survey Date 09.10.09

Rev.	Drawn	Chk'd	App'd	Date	Description
B	CBC	TR	BG	Cork 22.3.2010	ISSUE FOR AER 2009

Revision History: A | B

Name of Client

SOUTH TIPPERARY COUNTY COUNCIL

Name of Job

DONOHILL LANDFILL
LICENCE COMPLIANCE 2007

Title of Drawing

GAS MONITORING AND EXTRACTION LOCATIONS

Scales Used
NTS

Dwg. No. DE07-024-04-005 — **Rev.** B

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE 10 0 10 20 50 100mm

N. G.
ORTH

LEACHATE COMPOSITION

LC1	190496	142615
LC2	190496	142615
LC3 ***	190495	142584
LC4	190495	142600

LEACHATE LEVEL

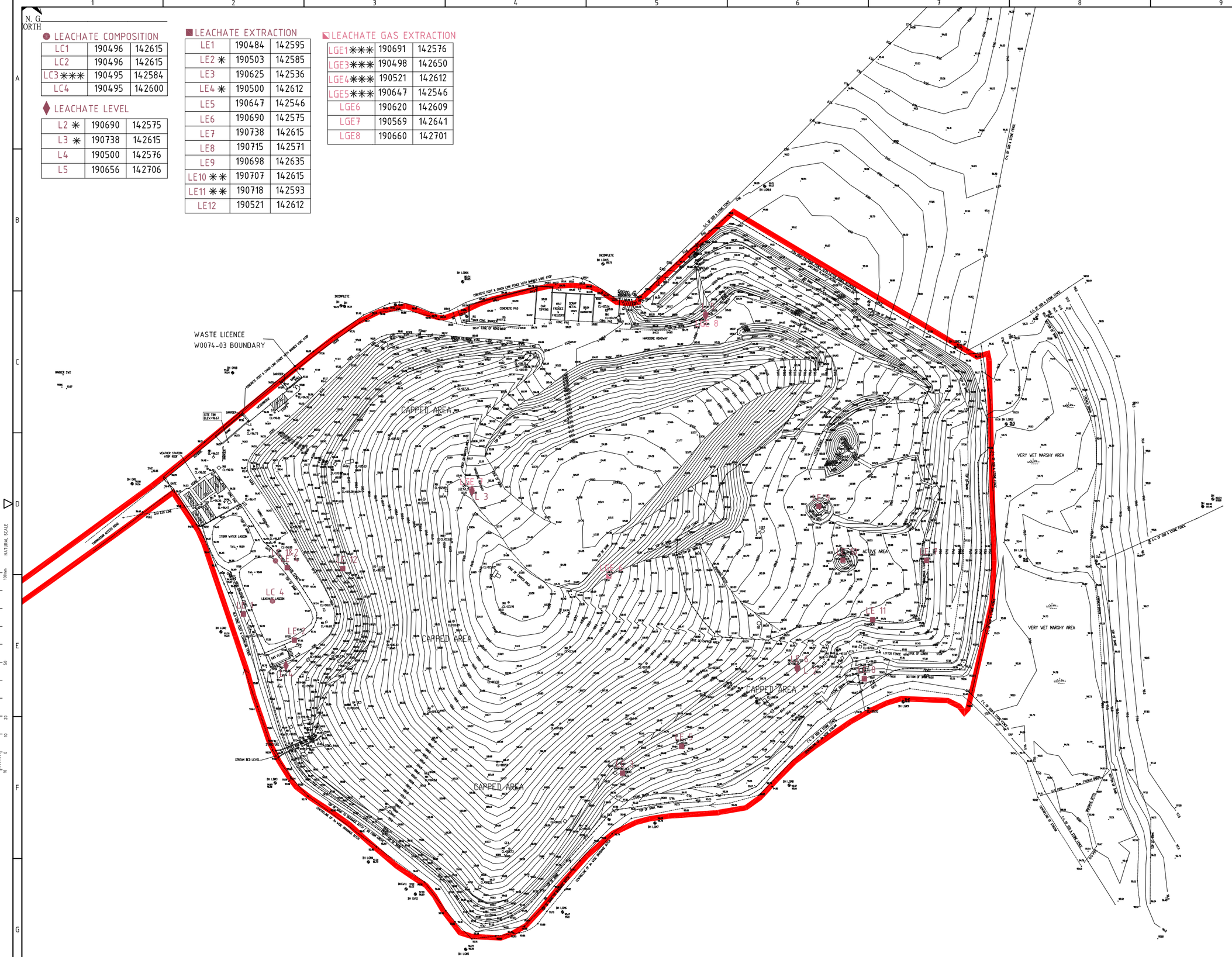
L2 *	190690	142575
L3 *	190738	142615
L4	190500	142576
L5	190656	142706

LEACHATE EXTRACTION

LE1	190484	142595
LE2 *	190503	142585
LE3	190625	142536
LE4 *	190500	142612
LE5	190647	142546
LE6	190690	142575
LE7	190738	142615
LE8	190715	142571
LE9	190698	142635
LE10 **	190707	142615
LE11 **	190718	142593
LE12	190521	142612

LEACHATE GAS EXTRACTION

LGE1***	190691	142576
LGE3***	190498	142650
LGE4***	190521	142612
LGE5***	190647	142546
LGE6	190620	142609
LGE7	190569	142641
LGE8	190660	142701



LEGEND :

Leachate Monitoring & Extraction Locations

- Leachate Composition
- Leachate Level
- Leachate Extraction
- Leachate Gas Extraction

* Location moved since a previous revision.

** No pumps installed yet.

*** Well not in use.

Background Survey Date 09.10.09

Rev.	Drawn	Chk'd	Appd	Date	Description
B	CBC	TR	BG	Cork 22.3.2010	ISSUE FOR AER 2009
Revision History	A	B			

Name of Client

SOUTH TIPPERARY
COUNTY COUNCIL

Name of Job

DONOHILL LANDFILL
LICENCE COMPLIANCE 2007

Title of Drawing

LEACHATE MONITORING AND
EXTRACTION LOCATIONS

Scales Used
NTS

Dwg. No.
DE07-024-04-006

Rev.
B

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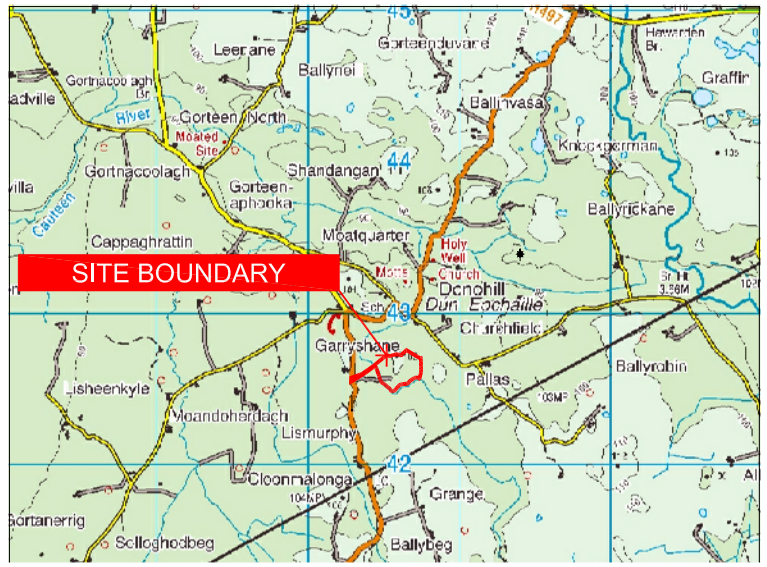
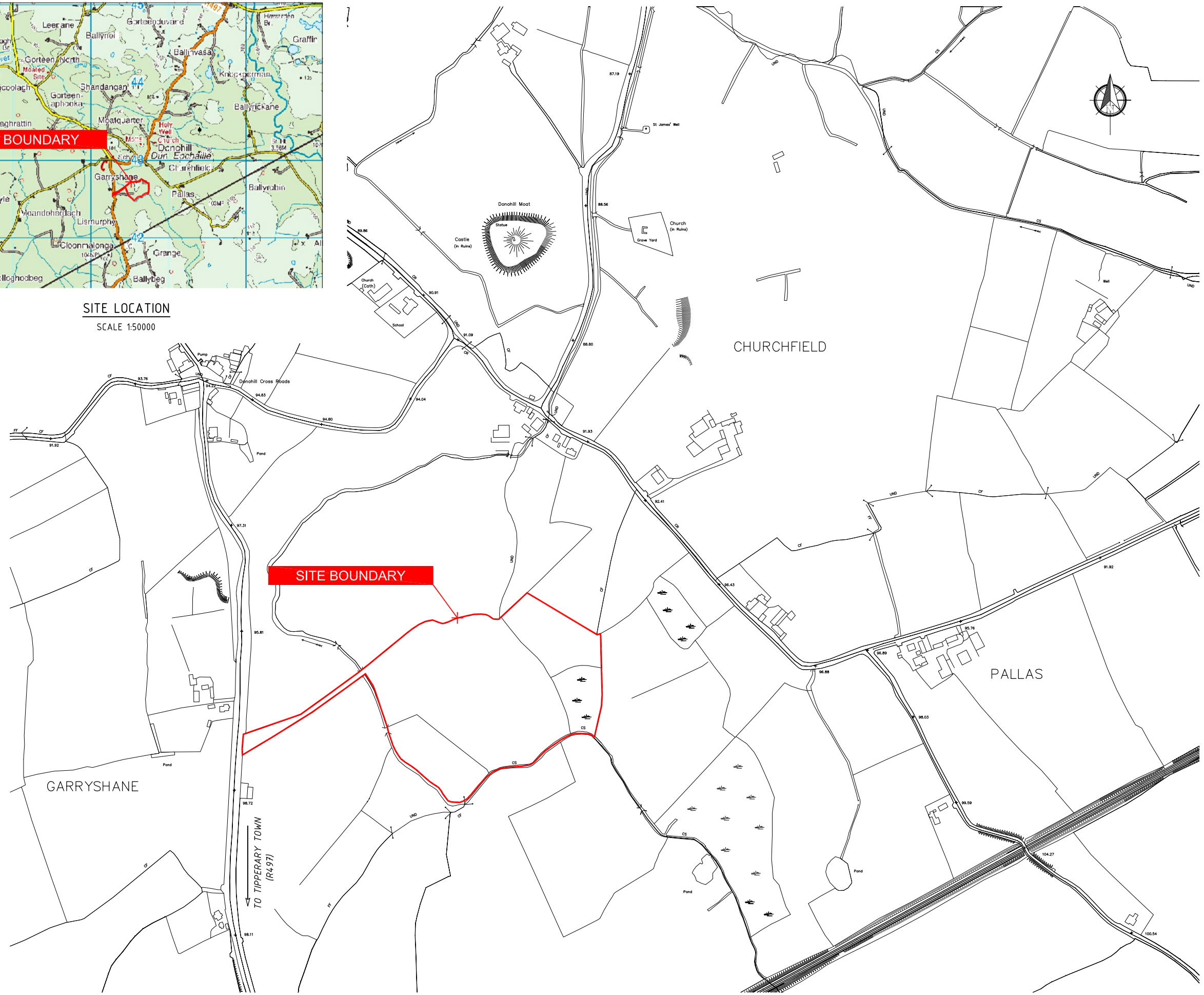
ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE 10 0 10 20 50 100mm



SITE LOCATION

SCALE 1:50000



LEGEND:

Site and Waste Licence Boundary

Rev.	Drawn	Chk'd	App'd	
C	AR	CJC	BG	Cork 08.03.10 ISSUE FOR TENDER
				Rev Origin Date Description

Revision History: A | B | C

Name of Client

SOUTH TIPPERARY COUNTY COUNCIL

Name of Job

DONOHILL CAPPING WORKS
PHASE 2

Title of Drawing

SITE LOCATION MAP

Scales Used: 1:5000

This Drawing was printed to A3

Dwg. No.: DE08-024-05-101-001

Rev.: C

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE

▲ GAS MIGRATION

GM1	190476	142588
GM2	190496	142532
GM3	190531	142503
GM4	190567	142470
GM5	190603	142484
GM6	190637	142517
GM7	190687	142532
GM8	190729	142563
GM9	190773	142617
GM10	190768	142666
GM11	190754	142697
GM12 †	190678	142754
GM13 †	190705	142846
GM14 †	190407	142966
GM15 †	190268	142736

⊙ GAS MONITORING

G2	190678	142590
G3 ✳	190569	142641
G4	190523	142562

● LEACHATE COMPOSITION

LC1	190496	142615
LC2	190496	142615
LC3✳✳✳	190495	142584
LC4	190495	142600

◆ LEACHATE LEVEL

L2 ✳	190690	142575
L3 ✳	190738	142615
L4	190500	142576
L5	190656	142706

■ GAS EXTRACTION

GE2 ✳	190523	142562
GE3	190551	142531
GE4	190582	142509
GE5	190563	142680
GE6	190538	142663
GE7	190519	142640
GE8	190549	142638
GE9	190532	142613
GE10	190561	142623
GE11	190583	142603
GE12	190562	142592
GE13	190538	142586
GE14	190554	142561
GE15	190579	142568
GE16	190580	142537
GE17	190602	142553
GE18	190605	142583
GE19	190630	142557
GE20	190635	142577
GE21	190661	142574
GE25	190678	142590

■ LEACHATE EXTRACTION

LE1	190484	142595
LE2 ✳	190503	142585
LE3	190625	142536
LE4 ✳	190500	142612
LE5	190647	142546
LE6	190690	142575
LE7	190738	142615
LE8	190715	142571
LE9	190698	142635
LE10 ✳✳	190707	142615
LE11 ✳✳	190718	142593
LE12	190521	142612

◪ LEACHATE GAS EXTRACTION

LGE1✳✳✳	190691	142576
LGE3✳✳✳	190498	142650
LGE4✳✳✳	190521	142612
LGE5✳✳✳	190647	142546
LGE6	190620	142609
LGE7	190569	142641
LGE8	190660	142701

● HORZ. GAS EXTRACTION

HGEV1/2	190517	142650
HGEV3/4	190514	142581
HGEV5/6/7	190505	142554
HGEV8/9/10	190680	142555

◐ KNOCK-OUT POTS

K1	190536	142693
K2	190517	142650
K3	190680	142556
K4	190505	142554
K5	190514	142581
K6	190493	142649
K7	190573	142482
K8	190588	142691
K9	190702	142581
K10	190611	142516

▲ MANIFOLDS

MF1	190578	142610
MF2	190523	142652
MF3	190679	142560
MF4	190508	142555
MF5	190518	142582

⊙ FLARE

F1	190502	142581

⊙ GROUNDWATER

GW11S	190545	142493
GW11D	190548	142491
GW12S	190841	142635
GW12D	190845	142638
GW13 †	190700	142846
GW14 †	190412	142965
GW15 †	190286	142741
GW16 †	190070	144050

◬ SURFACE WATER

SW1	190754	142564
SW2	190461	142631
SW3 †	190695	142966
SW4 †	191390	140939
SW5	190481	142623
SW7	190508	142544
SW8	190626	142515

NOTE :

† Denotes not shown on plan. Refer to DE07-024-04-Fig.001.

✳ Location moved since a previous revision.

✳✳ No pumps installed yet.

✳✳✳ Well not in use.

Rev.	Drawn	Chk'd	App'd	Date	Description
A	CJC	TPC	CJC	11.03.10	ISSUE FOR APPROVAL

Revision History: A

Name of Client
SOUTH TIPPERARY COUNTY COUNCIL

Name of Job
DONOHILL LANDFILL LICENCE COMPLIANCE 2010

Title of Drawing
MONITORING TABLES FOR COMPOSITE MAP OF LANDFILL FOR EPA

Scales Used: N/A

This Drawing was printed to A3

Dwg. No.: LW10-024-01-003

Rev.: A

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AREA B
TEMPORARY CAP OF STEEP SLOPES

AREA D
TEMPORARY CAP, POZIDRAIN AND 1M CLAY

AREA A
PROPOSED EXTENT OF AREA 1/3 CAP

AREA 1 (UNLINED SECTION)

AREA 3 (FULLY LINED CELL)

EXISTING SURFACE WATER SWALE

FRENCH DRAIN

WASTE LICENCE
W0074-03 BOUNDARY

LEACHATE RISING MAIN

PHASE 1 CAPPING

50mm COMPRESSED AIR PIPE

OIL INTERCEPTOR

EXISTING OUTFALL STRUCTURE

AREA 2 (FULLY LINED CELL)

AREA C
TEMPORARY CAP

AREA 4
(CELL BOUNDARY)

160mm SLOTTED HDPE

160mm SOLID HDPE

STONE DRAIN

SECONDARY SURFACE WATER SWALE

50mm LEACHATE PIPE

ORIGINAL LEACHATE INTERCEPTOR TRENCH (2003)

EXISTING SURFACE WATER SWALE

SITE PLAN
Scale 1:1000

NOT FOR CONSTRUCTION UNLESS SPECIFICALLY STATED OTHERWISE

NOTE: This drawing is for indicative purposes only.

- Waste Licence W0074-03 Boundary
- Area 1 (Unlined Section) Boundary
- Area 2 (Fully Lined Cell) Boundary
- Area 3 (Fully Lined Cell) Boundary
- Area 4 (Fully Lined Cell) Boundary
- Phase 1 Cap Fully Lined Cap
- Area A Proposed Extent of 1/3 Cap
- Area B Temporary Cap of Steep Slopes
- Area C Temporary Cap
- Area D Temporary Cap, Pozidrain&1m Clay
- Existing Surface Water Swale
- Secondary Surface Water Swale
- French Drain
- Oil Interceptor
- RG Denotes Road Gully
- Overliner Gas Extraction Pipe 90mm HDPE PE100 SDR 17.6
- Overliner Gas Extraction Pipe 250mm HDPE PE100 SDR 17.6
- 50mm Compressed Air Pipe
- 50mm Leachate Pipe
- Leachate Rising Main
- Original Leachate Interceptor Trench (2003)

Refer to Drawing LW10-024-01-003 for details of monitoring points.

Rev.	Drawn	Chk'd	App'd	Date	Description
C				Cork 24.3.2010	ISSUE FOR INFORMATION

Revision History: A B C

Name of Client
SOUTH TIPPERARY
COUNTY COUNCIL

Name of Job
DONOHILL LANDFILL LICENCE
COMPLIANCE 2010

Title of Drawing
COMPOSITE MAP OF LANDFILL
FOR EPA

Scales Used	This Drawing was printed to
1:1000	A3

Dwg. No.	Rev.
LW10-024-01-004	C

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

APPENDIX 2 FLARE EMISSIONS MONITORING REPORT

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AIR EMISSION TESTING OF A LANDFILL FLARE LOCATED IN DONOHILL LANDFILL, GARRYSHANE, DONOHILL, CO. TIPPERARY

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF TIPPERARY COUNTY COUNCIL

PREPARED BY:	Dr. John Casey
ATTENTION:	Ms. Louise Ryan
REFERENCE:	Waste licence W0074-03
DATE:	06th Dec. 2010
REPORT NUMBER:	2010A346(1)
REVIEWERS:	

TABLE OF CONTENTS

Document Amendment Record

Client: ***South Tipperary County Council***

Title: Air emission testing of a Landfill flare located in Donohill Landfill, Garryshane, Donohill, Co. Tipperary.

Project Number: 2010A346(1)			**Document Reference:** Air emission testing of a Landfill flare located in Donohill Landfill, Garryshane, Donohill, Co. Tipperary.		
2010A346(1)	Document for review	JWC	BAS	JWC	06/12/2010
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**

1. Introduction

This report has been prepared by Odour Monitoring Ireland and contains the results of emission testing carried out on 1 No. Enclosed ground flare at Donohill Landfill, Garryshane, Donohill, Co. Tipperary. The emission testing was carried out in compliance with the requirements of *Waste licence W0074-03*.

Odour Monitoring Ireland was requested by Ms. Louise Ryan, Landfill Manager, Donohill Landfill to perform emission testing of the 1 flare stack located within Donohill Landfill, Garryshane, Donohill, Co. Tipperary. The parameters listed in *Table 1.1* were monitored using the appropriate instrumentation as illustrated in *Table 1.1*.

Table 1.1. Monitored parameters and techniques for Donohill Landfill 1 No. Enclosed flare

Sample location	Parameter	Analytical method
1 Landfill Flare outlet	Volumetric airflow rate & Temperature (^{0}C)	Pitot in accordance with EN13284-1 and K type thermocouple and PT100 Theoretical calculated for Landfill flare
1 Landfill Flare outlet	Oxides of nitrogen (NO_X), Carbon monoxide (CO), Carbon dioxide (CO_2), Sulphur dioxide (SO_2), and Oxygen (O_2)	Flue gas analyser, Testo 350/454 MXL
1 Landfill Flare outlet	Total non methane VOC's (TOC)	Total non methane hydrocarbon cutter in conjunction with Portable Signal 3030 PM Heated FID

This report presents details of this monitoring programme. This environmental monitoring was carried out by Dr. John Casey, Odour Monitoring Ireland on the 19th November 2010. Methodology, Results, Discussion and Conclusions are presented herein.

2. Materials and Methods

This section provides brief details of the methodology employed to perform emission testing of the landfill flare stack located in Donohill Landfill, Garryshane, Donohill, Co. Tipperary.

2.1 Volumetric flow rate and temperature measurement

The volumetric flow rate of the landfill flare was determined from theoretically calculated total volumetric flow rates using the assumptions presented in *Appendix II*. The inlet landfill gas velocity measurements were calculated from the CEMS monitoring system within the landfill flare control building. Temperature traverse measurements were performed across the stack in one plane only. Only one plane was possible due to access port issues. A magnesium oxide K type and PT100 thermocouple was used for measuring temperature in the landfill flare.

2.2 In stack analysis for flue gases

Flue gas analysis was performed using a pre-calibrated Testo 350 MXL/454 flue gas analyser. Concentrations of Oxygen, Sulphur dioxide, Carbon dioxide, Temperature, Carbon monoxide and Oxides of nitrogen were measured using electrochemical cells within the analyser box and all data was logged electronically in 1 minute intervals during the sampling exercise. Data was downloaded from the control handheld using the Com soft software and average concentrations calculated are presented within. All results presented are at 273.15 K, 101.3 kPa on a dry gas basis.

2.3 Heated Flame Ionisation Detector-Total hydrocarbon concentration (THC) determination

A heated portable FID (Signal), heated line, controller and data logger was used to analyse the duct air stream for total hydrocarbon concentration. Once stabilised and calibrated using span gas (Propane-800 ppm; European standard), a sintered probe connected to a 181 ^{0}C heated line was placed in the air stream. After stabilisation, the data logger was activated and commences reading. The FID remained analysing continuously for approximately 45 minutes in the duct air stream. Results were presented as mg [THC] m^{-3} as propane. All measurement was performed in accordance with the methodologies contained within EN13526:2002 and EN12619:1999.

An FID operates on the principle where influent contaminated gas is mixed with hydrogen and the mixture is burned at the tip of a jet with air or oxygen. Ions and free electrons are formed in the flame and enter a gap between two electrodes, the flame jet and a collector, mounted 0.5-1.0 centimetres above the flame tip. A potential (400 volts) is applied across the two electrodes and with the help of produced ions, a very small current flows between the two electrodes. When an organic substance is introduced this is burned in the flame; a complex process takes place in which positively charged carbon species and electrons are formed. The current is greatly increased and therefore the sample is detected. The FID is a mass flow detector, its response depending directly on the flow rate of the carrier gas. Its response also varies with applied voltage and the temperature of the flame.

2.4 Total non-methane volatile organic compounds (TOC)

In order to measure total non-methane VOC, a total non-methane hydrocarbon cutter was placed in line with the FID whereby concentrations of total volatile organic carbon and total non-methane organic were displayed digitally upon the display. This allowed for the calculation of total non-methane VOC's. All results are presented in mgC/Nm^3 as propane which is in accordance with the EN13526:2002 and EN12619:1999.

3. Results-Emission testing.

3.1 Sampling time

Table 3.1 summarises the sampling time that was carried out on the individual stack. *Table 3.2* illustrates the inlet landfill gas parameters as characterised from the CEMS analyser system operating within the landfill flare control building. Additionally, manual monitoring was performed using a GA2000 landfill gas analyser.

All outlet gas samples were taken approximately 1.20 metres below the top of the stack for the landfill flare No.1. All sampling was performed through the existing 25mm sampling ports on the landfill flare. A one-plane oxygen and temperature traverse was performed to assess any difference in oxygen concentrations and temperature across the sampling plane. Temperature and Oxygen differences were less than the 15% deviation level as recommended by the UK Environmental Agency (Guidance for monitoring enclosed Landfill flares, 2002).

3.2 Volumetric flow rate results

Table 3.3 summarises the theoretical airflow rate calculations for the Landfill gas flare No. 1. *Table 3.3* includes the exhaust volumetric airflow rate expressed in m^3 hr^{-1} at both actual and standard reference conditions of 273.15 K, 101.3 kPa (i.e. standard temperature and pressure).

3.3 Flue gas concentration results

Flue gas concentrations were monitored using a pre-calibrated Testo 350/454 MXL flue gas analyser. The results of SO_2, NO_x as NO_2 + NO, CO, and O_2 are presented in *Table 3.4*. The results of ppm have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, on a dry gas basis with correction for oxygen content. In accordance with EPA flare monitoring requirements, Oxygen correction to 3% should be performed for landfill gas flares. The average temperature of the gas analyser on the day of sampling was 280.15 K.

3.4 Total hydrocarbon concentration (THC) results

THC concentrations were monitored using a pre-calibrated Signal 3030PM analyser. The results of THC are presented in *Table 3.4*. The results of ppm have been converted to mg Nm^{-3} at 273.15 K, 101.3 kPa, with correction for oxygen content. Conversion from ppm to mg m^{-3} was performed using a 1.60 multiplication factor for propane. The average temperature of the FID on the day of sampling was 454 K.

3.5 Total non-methane volatile organic compound (TNMVOC) (TOC)

Total non-methane volatile organic compound (TNMVOC) concentrations were monitored using a total non methane hydrocarbon cutter. The results of TNMVOC's are presented in *Table 3.4*. The results are presented as mg/Nm^3 at 273.15 K, 101.3 kPa, with correction for oxygen content. In accordance with EPA flare monitoring requirements, Oxygen correction to 3% should be performed for landfill gas flares. The average temperature of the FID on the day of sampling was 454 K.

Table 3.1. Sampling time runs on the 19thNovember 2010.

Parameter	**Approx. Sampling period for 1 No. landfill flare**
Volumetric air flow rate	Theoretically calculated
SO_2	60 minutes
NO_x	60 minutes
CO	60 minutes
O_2	60 minutes
CO_2	60 minutes
Stack gas temp	60 minutes
THC	60 minutes
TNMVOC (TOC)	60 minutes

Table 3.2. Characteristics of raw inlet landfill gas to the 1 No. Enclosed Landfill flare gas burner.

Inlet compound identity	**Enclosed flare Unit**	**Unit values**
CH_4	28.4	%
CO_2	21.36	%
O_2	4.1	%
Total Landfill gas Volumetric airflow rate	332	m^3/hr

Table 3.3. Theoretically calculated landfill gas exhaust volume and physical characteristics from 1 No. Landfill flare.

Parameter	Enclosed flare Unit
Total Volumetric methane loading (m^3/hr)	94.2
Total Volumetric Oxygen loading (m^3/hr)	13.6
Ratio to complete combustion of methane assuming no excess Oxygen	9.57
Oxygen concentration level in flue gas (%)	7.76
Flue gas temperature (Kelvin)[1]	1,258
Theoretical Volumetric exhaust airflow rate (m^3/h)	1,942
Normalised average exhaust airflow rate (Nm^3/h)[2]	421

Notes: [1] denoted converted from degrees Celsius to Kelvin (^{0}C + 273.15);
[2] denotes normalised to 273.15 Kelvin and 101.3 kPa.

Table 3.4. Emission value results from the measurement of emissions from the landfill gas flare burner.

Flare – Compound identity	Value	Units	Adjusted units (mg/Nm^3)	Emission conc (mg/Nm^3)	Oxygen corrected emission conc to 3% (mg/Nm^3)	Mass emission rate (kg/hr)	Emission limits
CO	1.5	ppm	1.88	1.88	2.55	0.001	<50 mg/m^3
Temperature	985	degrees	1258K	-	-	-	>1273 K
O_2	7.76	%	-	-	-	-	-
Total NOx [as NO_2]	33	ppm	67.77	67.77	92.32	0.03	<150 mg/m^3
SO_2	0	ppm	0	0	0	0	-
CO_2	9.51	%	-	-	-	-	-
TOC/TNMVOC	2	ppm	3.2	3.2	4.36	0.002	<10 mg/m^3
Inlet CH_4	-	ppm	-	-	-	67.53	-
Volumetric airflow rate	332	Nm^3/hr	-	-	-	-	-
Total methane destruction efficiency	99.9	%	-	-	-	-	-

Notes: [1] denotes refer to *Appendix II* for Oxygen correction calculations.
[2] denotes units normalised to 3% O_2 for flare.

4. Discussion of results

Tables 3.1 to *3.4* present the results of the emission monitoring carried out on the landfill flare stack burner located in Donohill Landfill, Garryshane, Donohill, Co. Tipperary

There was very little variation at one traverse in oxygen and flue gas temperature profiles across the stack during the monitoring exercise (i.e. less than 15% as recommended by the Environment Agency, UK (Environment Agency, 2002)).

A high temperature Inconel 625 and ceramic probe (Testo, Germany) was used to prevent variations in CO emissions data. Normal stainless steel probes when subjected to temperatures above 600^0C can release CO from within the structure of the material and cause the recording of erroneous results (Environment Agency, 2002).

Correction of data to 3% oxygen was performed. Due to possible inaccuracies in airflow rate measurement, it was not possible to determine the oxygen intake of the flare through the louver system using measurement. Since the volume of intake air required for complete combustion was known and the oxygen concentration in the exhaust flue gas was known, the volume of intake excess fuel air could be manually and theoretically calculated through numerous iterations using the Solver program (i.e. Microsoft Excel). This allows for the calculation of the volume of intake excess air through the louver landfill flare intake system. These calculations were validated through use of the published Environment Agency equation (see *Eqn 8.3.1*) (Environment Agency, 2002).

Landfill methane destruction efficiency was calculated using the inlet methane loading concentration and the exhaust total methane hydrocarbon concentration as presented in *Table 3.4*. As can be observed, the landfill flares is achieving a methane destruction efficiency of greater than 99%. Typical reported concentrations of methane from landfill flare burner systems are in the order of 0.040% to 0.52%. The complete combustion of methane results in the formation of CO_2 and H_2O. The incomplete combustion of methane results in the formation of CO. CO concentration levels was low in the flue gas of the landfill flare.

5. Conclusion

The following conclusions can be drawn from this study:

1. A theoretically exhaust flue gas volume was calculated for landfill gas flare.
2. NO_x, SO_2, CO, O_2, and TOC monitoring and analysis was carried out in accordance with specified requirements;
3. All data was standardised to 273.15 Kelvin, 101.3 kPa;
4. All data is presented as Oxygen corrected to 3% (v/v) using the appropriate equations as presented in *Section 8.3*;
5. NO_x as NO_2, CO, and TOC were in compliance for the landfill gas flare exhaust stack and within the emission limit values contained within Waste licence W0074-03 – Schedule C4.

6. References

1. Environment Agency. (2002). Guidance for Monitoring Enclosed Landfill Gas Flares. www.environment-agency.co.uk
2. McVay, M., (2003). Personal communication. Environment Agency, Wales, UK.

7. *Appendix I* - Sampling, analysis and calculation details

7.1.1 Location of Sampling

Donohill Landfill, Garryshane, Donohill, Co. Tipperary

7.1.2 Date & Time of Sampling

19th Nov. 2010

7.1.3 Personnel Present During Sampling

Dr. John Casey, Odour Monitoring Ireland, Trim, Co. Meath.

7.1.4 Instrumentation

Testo 350 MXL/454 in stack analyser;
L type pitot and thermocouples;
Testo 400 handheld and appropriate probes.
Ceramic and Inconel 625 sampling probes.
Portable Signal 3030PM FID calibrated with Propane
Model 320A non-methane total hydrocarbon cutter.

APPENDIX 3 LANDFILL GAS MONITORING RESULTS

Sample Pt	Sam Date	CH4	CO2	O2	Pressure
GM 01	29/01/2010	0	0	20.2	994
GM 01	26/02/2010	0	0.1	20	
GM 01	31/03/2010	0	0.1	20.4	994
GM 01	21/04/2010	0	0.1	21.1	1011
GM 01	25/05/2010	0	0.1	21.3	1005
GM 01	29/06/2010	0	0	21.3	1009
GM 01	27/07/2010	0	0.1	20.7	1008
GM 01	26/08/2010	0	0.1	21.2	1014
GM 01	27/09/2010				
GM 01	29/10/2010	0	0	21	973
GM 01	30/11/2010				
GM 01	22/12/2010	0	0.1	20.7	
GM 02	29/01/2010	0	0.1	20.1	994
GM 02	26/02/2010	0	0.3	19.9	
GM 02	31/03/2010	0	0.2	20.1	994
GM 02	21/04/2010	0	0.6	20.6	1011
GM 02	25/05/2010	0	0.7	21	1005
GM 02	29/06/2010	0	0.3	21.1	1009
GM 02	27/07/2010	0	0.3	20.8	1008
GM 02	26/08/2010	0	0	21.3	1014
GM 02	27/09/2010				
GM 02	29/10/2010	0	0.1	21.1	973
GM 02	30/11/2010				
GM 02	22/12/2010	0	0.1	20.9	
GM 03	29/01/2010	0	0	20.3	994
GM 03	26/02/2010	0	0.1	20.1	
GM 03	31/03/2010	0	0.1	20.3	994
GM 03	21/04/2010	0	0.3	21	1012
GM 03	25/05/2010	0	1	20.7	1005
GM 03	29/06/2010	0	0.7	20.4	1009
GM 03	27/07/2010	0	0.2	20.8	1008
GM 03	26/08/2010	0	0	20.4	1014
GM 03	27/09/2010				
GM 03	29/10/2010	0	0	21.2	973
GM 03	30/11/2010				
GM 03	22/12/2010	0	0.2	20.9	
GM 04	29/01/2010	0	0.2	20	994
GM 04	26/02/2010	0	0.2	20.3	
GM 04	31/03/2010	0	0.1	20.2	994
GM 04	21/04/2010	0	0	21.3	1011
GM 04	25/05/2010	0	0.1	21.5	1005
GM 04	29/06/2010	0	0.2	21.2	1009
GM 04	27/07/2010	0	0	20.9	1008
GM 04	26/08/2010	0	0	20.6	1014
GM 04	27/09/2010				
GM 04	29/10/2010	0	0	21.1	973
GM 04	30/11/2010				
GM 04	22/12/2010	0	0.1	20.8	
GM 05	29/01/2010	0	0.1	20.1	994
GM 05	26/02/2010	0	0.2	20.4	
GM 05	31/03/2010	0	0.2	20.3	994

GM 05	21/04/2010	0	0	21.3	1011
GM 05	25/05/2010				
GM 05	29/06/2010				
GM 05	27/07/2010				
GM 05	26/08/2010	0	0	20.5	1015
GM 05	27/09/2010				
GM 05	29/10/2010	0	0	21.1	974
GM 05	30/11/2010				
GM 05	22/12/2010	0	0.1	20.7	
GM 06	29/01/2010	0	0.3	20	994
GM 06	26/02/2010	0	0.1	20.3	
GM 06	31/03/2010	0	0.1	20.3	994
GM 06	21/04/2010	0	0	21.3	1011
GM 06	25/05/2010	0	0.1	21.6	1005
GM 06	29/06/2010	0	0.2	21	1009
GM 06	27/07/2010	0	0.1	21.2	1008
GM 06	26/08/2010	0	0.1	21.2	1015
GM 06	27/09/2010				
GM 06	29/10/2010	0	0	21.2	974
GM 06	30/11/2010				
GM 06	22/12/2010	0	0	20.6	
GM 07	29/01/2010	0	0.1	20.1	994
GM 07	26/02/2010	0	0.1	20.4	
GM 07	31/03/2010	0	0.3	20	994
GM 07	21/04/2010	0	0	21.3	1011
GM 07	25/05/2010				
GM 07	29/06/2010				
GM 07	27/07/2010				
GM 07	26/08/2010	0	0.1	20.7	1015
GM 07	27/09/2010				
GM 07	29/10/2010	0	0	21.4	974
GM 07	30/11/2010				
GM 07	22/12/2010	0	0	20.7	
GM 08	29/01/2010	0	0	20.4	994
GM 08	26/02/2010	0	0.3	20.4	
GM 08	31/03/2010	0	0.1	20.4	994
GM 08	21/04/2010	0	0	21.3	1011
GM 08	25/05/2010	0	0.1	21.5	1005
GM 08	29/06/2010	0	0.1	21.3	1009
GM 08	27/07/2010	0	0	21.2	1008
GM 08	26/08/2010	0	0.2	20.8	1015
GM 08	27/09/2010				
GM 08	29/10/2010	0	0.1	20.7	974
GM 08	30/11/2010				
GM 08	22/12/2010	0	0.1	20.8	
GM 09	29/01/2010	0	0.2	20.2	994
GM 09	26/02/2010	0	0.1	20.3	
GM 09	31/03/2010	0	0	20.4	994
GM 09	21/04/2010	0	0.2	21.1	1004
GM 09	25/05/2010	0	0.1	21.2	1002
GM 09	29/06/2010	0	0.1	21.2	1002
GM 09	27/07/2010	0	0.1	21.3	1009

GM 09	26/08/2010	0	0.9	20.6	1015
GM 09	27/09/2010	0	0.1	20.6	997
GM 09	29/10/2010	0	0.4	20.8	974
GM 09	30/11/2010	0	0.1	20.8	1005
GM 09	22/12/2010	0	0.2	21	
GM 10	29/01/2010	0	0.1	20.2	994
GM 10	26/02/2010	0	0.2	20.4	
GM 10	31/03/2010	0	0.2	20.1	994
GM 10	21/04/2010	0	0	21.2	1005
GM 10	25/05/2010	0	0.1	21.3	1002
GM 10	29/06/2010	0	0.2	21.1	1002
GM 10	27/07/2010	0	0.1	21.1	1009
GM 10	26/08/2010	0	0.7	20.4	1015
GM 10	27/09/2010	0	0.1	20.5	997
GM 10	29/10/2010	0	0.3	20.9	974
GM 10	30/11/2010	0	0	20.9	1005
GM 10	22/12/2010	0	0.2	20.6	
GM 11	29/01/2010	0	0.2	20.1	994
GM 11	26/02/2010	0	0.1	20.5	
GM 11	31/03/2010	0	0.2	20.1	994
GM 11	21/04/2010	0	0.1	21.1	1004
GM 11	25/05/2010	0	0.1	21.2	1002
GM 11	29/06/2010	0	0.2	21.1	1002
GM 11	27/07/2010	0	0	20.9	1009
GM 11	26/08/2010	0	0.6	21	1015
GM 11	27/09/2010	0	0.2	20.6	996
GM 11	29/10/2010	0.1	0.4	21	974
GM 11	30/11/2010	0	0.1	20.9	1005
GM 11	22/12/2010	0	0.3	20.4	
GM 12	29/01/2010	0.7	0.9	19.4	994
GM 12	26/02/2010	0.4	0.6	19.1	
GM 12	31/03/2010	0.6	1.1	17.2	994
GM 12	21/04/2010	0	0.2	21	1005
GM 12	25/05/2010	0	0.3	21.2	1002
GM 12	29/06/2010	0	0.1	21.1	1003
GM 12	27/07/2010	0	0.3	21	1009
GM 12	26/08/2010	0	0.1	21.2	1016
GM 12	27/09/2010	0	0.4	20.4	996
GM 12	29/10/2010	0.5	0.8	19.7	974
GM 12	30/11/2010	0.4	0.6	20.2	1006
GM 12	22/12/2010	0.2	0.7	19.1	
GM 13	29/01/2010	0	0.2	20.2	994
GM 13	26/02/2010	0	0.1	20.3	
GM 13	31/03/2010	0	0.4	20	994
GM 13	21/04/2010	0	0	21.5	1005
GM 13	25/05/2010	0	0.1	21.3	1002
GM 13	29/06/2010	0	0.3	20.8	1003
GM 13	27/07/2010	0	0.1	21.1	1009
GM 13	26/08/2010	0	0.2	21.2	1017
GM 13	27/09/2010	0	0	20.8	996
GM 13	29/10/2010	0	0.1	20.4	974
GM 13	30/11/2010	0	0.1	20.5	1006

GM 13	22/12/2010	0.02	0.3	20.1	
GM 14	29/01/2010	0	1.1	17.6	994
GM 14	26/02/2010	0	0.4	20	
GM 14	31/03/2010	0	1	19	994
GM 14	21/04/2010	0	2.2	16.2	1012
GM 14	25/05/2010	0	0.7	19.7	1002
GM 14	29/06/2010	0	0.1	21.2	1003
GM 14	27/07/2010	0	2.5	18.2	1009
GM 14	26/08/2010	0	0	21.3	998
GM 14	27/09/2010	0	3.4	15.9	1004
GM 14	29/10/2010	0.1	0	20.4	974
GM 14	30/11/2010	0.1	0.3	20.5	1006
GM 14	22/12/2010	0.1	0.1	20.7	
GM 15	29/01/2010	0	0.3	20.1	994
GM 15	26/02/2010	0	0.7	19.8	
GM 15	31/03/2010	0	0.7	19.2	994
GM 15	21/04/2010	0	1.9	18.4	1013
GM 15	25/05/2010	0	2.3	18.4	1002
GM 15	29/06/2010	0	0.2	21.1	1003
GM 15	27/07/2010	0	2.6	19.1	1008
GM 15	26/08/2010	0	3.1	18	997
GM 15	27/09/2010	0	3.3	18.3	1004
GM 15	29/10/2010	0	0.9	20.2	974
GM 15	30/11/2010	0	0.7	20.1	1006
GM 15	22/12/2010	0	0.1	20.7	

2010

Time/Date	Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8	Cha 9	Ch 10	Ch 11	Ch 12	Ch 13	Ch 14	Ch 15
01/01/2010 06:40	6.7	3.2	2.4	0	0	0.1	0.1	0.3	2.9	4.7	22.1	21.6	21.8	25	22
01/01/2010 18:40	6.7	2.3	3.5	0	0	0.1	0.1	0.3	2.6	4	22.1	21.5	21.8	25	22
02/01/2010 06:40	6.7	2.6	4.1	0	0.1	0.1	0.1	0.4	2.6	4.6	22.1	21.6	21.7	25	21.9
02/01/2010 18:40	6.6	1.5	2.7	0	0	0.1	0.1	0.4	2.3	4.7	22.1	21.5	21.8	25	22
03/01/2010 06:40	6.7	5	3.5	0	0	0.1	0.1	0.4	2.3	4.1	22.1	21.6	21.8	25	21.9
03/01/2010 18:40	6.4	1.4	3.4	0	0	0.1	0.1	0.3	2.4	5.5	22.1	21.5	21.8	25	22
04/01/2010 06:41	7	2.4	4.3	0	0.1	0.1	0.1	0.4	2	6.6	22.1	21.6	21.8	25.1	22
04/01/2010 18:41	4.4	1.1	2.1	0	0	0.1	0.1	0.3	2.1	6.1	22.2	21.5	21.7	25	22
05/01/2010 06:41	5.2	4.4	1.1	0	0	0	0.1	0.3	2.6	4.4	22.1	21.6	21.6	25	22
05/01/2010 18:41	4.3	1.8	3.2	0	0	0.1	0.1	0.3	2.3	4.1	22.1	21.5	21.8	25	22
06/01/2010 06:41	4.3	3.2	3.4	0	0	0.1	0.1	0.3	3.5	4.7	22.1	21.6	21.8	25	22
06/01/2010 18:41	3.8	1.4	3.7	0	0	0.1	0.1	0.3	1.5	4	22.1	21.5	21.8	25	22
07/01/2010 06:41	2.7	4.4	4.3	0	0.1	0.1	0.1	0.3	2.3	5.8	22.1	21.6	21.8	25.1	22
07/01/2010 18:41	4	1.7	3.4	0	0	0.1	0.1	0.4	2.1	4.1	22.1	21.5	21.8	25	22
08/01/2010 06:41	3.8	2.7	4.1	0	0.1	0.1	0.1	0.4	2.1	4.1	22.1	21.6	21.8	25.1	22
08/01/2010 18:41	3.8	1.1	3.5	0	0	0.1	0.1	0.4	2.6	5.9	22.1	21.5	21.8	25.1	22
09/01/2010 06:41	4	5.2	4.3	0	0.2	0.2	0.1	0.5	2.1	3.8	22.1	21.6	21.7	25	21.9
09/01/2010 18:41	2.9	1.8	4.1	0	0	0.1	0.1	0.5	0.8	4.1	22.1	21.6	21.8	25	21.9
10/01/2010 06:41	3	2.9	5.6	0	0.1	0.1	0.1	0.5	2.9	4.1	22.1	21.6	21.7	25	21.9
11/01/2010 04:01	4.6	2.9	4.3	0	0	0.1	0.1	0.3	3.4	4.6	22.1	21.6	21.6	25	22
11/01/2010 16:01	4	1.5	2.4	0	0	0.1	0.1	0.3	2	5.3	22	21.3	21.5	25	22.1
12/01/2010 04:01	6.3	2.7	4.4	0	0	0.1	0.1	0.4	2.1	5.5	22	21.5	21.6	25	21.8
12/01/2010 16:01	5.8	3.2	4.3	0	0	0.1	0.1	0.3	2.4	5	22.1	21.2	21.5	24.9	22
13/01/2010 04:02	7.8	3.7	3.5	0	0	0.1	0.1	0.3	2.7	4.6	22	21.5	21.5	24.9	22
13/01/2010 16:02	5.3	2.3	2.4	0	0	0.1	0	0.3	2.4	4.7	22	21.2	21.4	24.9	22
14/01/2010 04:02	7	2.9	4.4	0	0	0.1	0.1	0.2	2.7	4.9	22	21.5	21.5	24.9	22
14/01/2010 16:02	4.1	2.3	1.4	0	0	0.1	0	0.3	2.6	4.9	22	21.2	21.4	25	22
15/01/2010 04:02	4.4	3.2	4.6	0	0	0.1	0.1	0.3	2.6	6.1	22	21.5	21.5	24.9	21.9
15/01/2010 16:02	5.5	2.3	4	0	0	0	0.1	0.2	2.3	5	22	21.2	21.4	24.8	22.1
16/01/2010 04:02	6.9	2.9	4.3	0	0	0	0.1	0.2	2.7	5.3	22	21.4	21.4	24.8	22
16/01/2010 16:02	5.5	2.1	3	0	0	0	0.1	0.2	2.3	5	22	21.2	21.4	24.7	22
17/01/2010 04:02	7.2	2.9	4.3	0	0	0.1	0	0.2	1.5	5	22	21.5	21.4	25	22.1

17/01/2010 16:02	5.3	1.5	2.6	0	0	0	0.1	0.3	2.7	4.6	22.1	21.2	21.4	24.9	22.1
18/01/2010 04:02	6.3	3.2	3.4	0	0	0.1	0	0.3	1.7	5.8	22.1	21.5	21.4	24.9	22.1
18/01/2010 16:02	3.8	3.2	0.9	0	0	0.1	0.1	0.2	2.6	5	22	21.2	21.2	24.8	22.1
19/01/2010 04:02	7	4.3	4	0	0	0.1	0	0.2	2.9	4.7	22.1	21.5	21.3	24.9	22.1
19/01/2010 16:02	4.7	2	2.1	0	0	0.1	0	0.2	3.4	4.4	22.1	21.2	21.3	24.9	22
20/01/2010 04:02	6.7	2.9	1.5	0	0	0	0	0.3	2.6	5.2	22	21.5	21.2	24.9	21.9
20/01/2010 16:02	5.3	0.9	1.8	0	0	0.1	0	0.2	2.6	4.9	22.1	21	21.1	24.8	22
21/01/2010 04:02	6.9	3	4	0	0	0.1	0.1	0.2	2.7	5.2	22	21.5	21.3	25	22
21/01/2010 16:02	5.8	3.7	4.1	0	0	0.1	0	0.1	1.8	6.3	22	21.1	21.2	24.8	22
22/01/2010 04:02	6.9	4.4	4.1	0	0	0.1	0	0.2	2.9	6.1	22.1	21.5	21.2	24.9	22
22/01/2010 16:02	4.3	1.5	1.7	0	0	0.1	0.1	0.2	2.6	5.8	22.1	21.1	21.1	24.9	21.7
23/01/2010 04:02	7.5	4.6	3.8	0	0	0.1	0.1	0.2	2.1	5.2	22	21.5	21.2	25	22
23/01/2010 16:02	6.3	3.2	2.6	0	0	0.1	0.1	0.2	2.3	4.7	22.1	21.3	21.3	25	22.1
24/01/2010 04:02	6.6	2.9	4.1	0	0	0.1	0	0.3	3.4	4.7	22	21.5	21.2	25	22.3
24/01/2010 16:02	5.5	1.4	2.1	0	0	0	0	0.3	1.7	4.7	22.1	21.3	21.2	25	22
25/01/2010 04:02	6.7	2.3	3.4	0	0	0.1	0.1	0.2	2.4	5	22.1	21.5	21.2	25	22.3
25/01/2010 16:02	3.5	1.1	1.5	0	0	0.1	0.1	0.2	2.1	4.7	22.1	21.2	21.1	25	21.7
26/01/2010 04:02	4.1	2.1	1.5	0	0	0.1	0.1	0.3	3.8	4.9	22.2	21.6	21.2	25.1	22
26/01/2010 16:03	3.2	0.5	1.2	0	0	0.1	0	0.2	2.1	4.6	22.1	21.2	21	25	22.2
27/01/2010 04:03	4.9	1.5	3.4	0	0	0.1	0.1	0.2	2.4	4.9	22.1	21.5	21.2	25	21.9
27/01/2010 16:03	3.4	1.8	1.8	0	0	0.1	0.1	0.2	2.4	4.9	22	21.2	20.9	24.8	22
28/01/2010 04:03	6.1	2.6	3.5	0	0	0.1	0	0.1	2	4.9	22.1	21.5	21.1	24.9	22.3
28/01/2010 16:03	5	1.4	3	0	0	0.1	0.1	0.1	2.4	5	22.1	21.2	21	24.8	22.3
29/01/2010 04:03	7.3	3	3.2	0	0	0	0	0.1	3.4	5.2	22	21.4	20.9	24.8	22
29/01/2010 16:03	5.3	2.9	2.1	0	0	0.1	0	0.1	3.7	5.3	22.1	21.1	20.9	24.8	22.1
30/01/2010 04:03	7.6	3.5	4.1	0	0	0.1	0	0.1	3.5	5.2	22	21.5	21	24.9	22.1
30/01/2010 16:03	5.6	1.7	1.8	0	0	0	0.1	0.1	2.3	5.9	22.1	21.2	20.9	24.9	21.4
31/01/2010 04:03	8.1	3.5	4.7	0	0	0.1	0	0.2	2.9	5	22	21.5	20.9	25	21.3
31/01/2010 16:03	6.6	1.8	2.1	0	0	0	0.1	0.2	2.4	5	22.1	21.3	21	24.9	22.1
01/02/2010 04:03	7.8	3	4.6	0	0	0.1	0.1	0.3	0.9	5	22	21.6	21	25	22.1
01/02/2010 16:03	4.3	1.8	1.8	0	0	0.1	0.1	0.2	2.9	4.7	22.1	21.3	20.9	24.9	22.1
02/02/2010 04:03	6.1	2.4	3.5	0	0	0.1	0	0.3	2.4	4.9	22.1	21.5	20.9	24.9	21.8
02/02/2010 16:03	5.3	2.4	3.4	0	0	0.1	0.1	0.1	2.3	5.2	22.1	21.2	20.8	24.8	22.1
03/02/2010 04:03	7	4	4	0	0	0.1	0	0.1	2.7	5.5	22.1	21.4	20.8	24.9	22.1
03/02/2010 16:03	5.6	2.4	3.2	0	0	0.1	0.1	0.1	2.7	5.2	22	21.1	20.7	24.8	22
04/02/2010 04:03	8.1	3.7	4.6	0	0	0.1	0.1	0.2	2.3	5.3	22	21.5	20.8	24.9	22.1

04/02/2010 16:03	6.6	2.9	4.3	0	0	0.1	0	0.2	2.7	5.8	22	21	20.7	24.8	22.2
05/02/2010 04:03	7.8	4	4.4	0	0	0.1	0	0.2	1.8	5.8	22	21.4	20.7	24.9	22.1
05/02/2010 23:13	3.4	0.9	3.7	0	0	0	0	0.1	0.9	0.5	22	21.4	23.8	23.6	22
06/02/2010 11:13	2.1	-0.2	1.1	0	0	0.1	0.1	0.2	0.8	0.6	22.1	21.4	23.6	23.6	21.5
06/02/2010 23:13	2.4	0.3	3.4	0	0	0.1	0.1	0.2	0.6	1.1	22.1	21.5	23.9	23.6	22.2
07/02/2010 11:13	1.8	-0.5	1.4	0	0	0	0	0.2	1.2	0.5	22.1	21.4	23.8	23.6	22.2
07/02/2010 23:13	3	-0.5	3.2	0	0	0.1	0	0.2	1.1	0.6	22	21.5	23.8	23.6	22
08/02/2010 11:13	1.4	-0.2	0.8	0	0	0.1	0	0.2	2.1	2	22.1	21.5	23.6	23.6	22
08/02/2010 23:13	0.3	-0.3	3.4	0	0	0.1	0	0.2	0.9	0.9	22.1	21.5	23.8	23.7	22
09/02/2010 11:13	0.2	0.8	0.9	0	0	0.1	0	0.2	0.6	0.6	22.1	21.4	23.6	23.6	22.1
09/02/2010 23:13	1.7	0	3.7	0	0	0.1	0	0.2	1.2	0.8	22.1	21.5	23.8	23.6	22.1
10/02/2010 11:13	0.2	-0.3	0.2	0	0	0.1	0.1	0.3	0.6	1.1	22	21.5	23.5	23.7	22.1
10/02/2010 23:13	0.3	-1.2	3.2	0	0	0.1	0.1	0.2	0.5	0.6	22.1	21.6	23.9	23.7	21.9
11/02/2010 11:13	-1.1	-1.1	0.8	0	0	0.1	0	0.3	1.1	0.3	22.1	21.4	23.6	23.7	22.1
11/02/2010 23:13	2	0	2.9	0	0	0.1	0.1	0.2	0.8	1.2	22	21.6	23.8	23.6	22.1
12/02/2010 11:13	-0.3	-0.5	-0.2	0	0	0.1	0	0.2	0	0.9	22.1	21.5	23.6	23.7	22.2
12/02/2010 23:14	2.1	-0.6	4	0	0	0.1	0	0.1	1.1	0.3	22.1	21.5	23.8	23.6	22
13/02/2010 11:14	1.4	-0.3	1.2	0	0	0.1	0.1	0.1	1.4	0.9	22	21.5	23.6	23.6	22.1
13/02/2010 23:14	0	0.3	2.9	0	0	0.1	0	0.1	0.9	0.5	22	21.5	23.8	23.6	22
14/02/2010 11:14	1.7	-0.8	1.1	0	0	0.1	0.1	0.2	0.5	0.3	22.1	21.5	23.7	23.7	22.1
14/02/2010 23:14	1.8	-0.8	3	0	0	0.1	0	0.1	1.4	0.5	22.1	21.4	23.8	23.6	21.8
15/02/2010 11:14	1.1	0	3	0	0	0.1	0	0.1	0.6	0.8	22	21.4	23.6	23.5	22
15/02/2010 23:14	2.6	0.2	4	0	0	0.1	0	0.1	0.9	0.9	22	21.4	23.7	23.5	22.1
16/02/2010 11:14	1.7	0.3	3.2	0	0	0.1	0	0.1	1.1	0.3	22	21.3	23.5	23.5	22
16/02/2010 23:14	3.4	1.1	4.1	0	0	0.1	0	0.1	1.4	0.5	22	21.5	23.8	23.6	21.8
17/02/2010 11:14	2.4	0.3	1.4	0	0	0.1	0	0.1	1.4	0.9	22	21.3	23.6	23.6	22
17/02/2010 23:14	3.4	0.3	3.7	0	0	0.1	0	0.1	0.8	2	22	21.5	23.8	23.6	21.9
18/02/2010 11:14	1.1	0.6	1.5	0	0	0.1	0.1	0.2	2	2.3	22.1	21.4	23.6	23.7	22.2
18/02/2010 23:14	3.4	0.5	4	0	0	0.1	0	0.2	0.8	0.8	22	21.5	23.8	23.6	21.9
19/02/2010 11:14	0.8	0	0.6	0	0	0.1	0	0.2	1.2	0.6	22	21.3	23.3	23.6	22.1
19/02/2010 23:14	2.9	0.3	4.3	0	0	0.1	0	0.2	1.2	0.9	22	21.5	23.7	23.6	22
20/02/2010 11:14	1.7	0.6	1.7	0	0	0	0	0.1	1.2	0.8	22	21.4	23.6	23.6	22
20/02/2010 23:14	2.6	0.9	3.5	0	0	0.1	0	0.1	1.5	2	22	21.5	23.8	23.6	22
21/02/2010 11:14	2.1	0.6	2.7	0	0	0	0	0.1	0.6	0.9	22	21.4	23.8	23.6	21.9
21/02/2010 23:14	3.4	0.6	4.3	0	0	0.1	0	0.1	1.1	1.1	22	21.5	23.8	23.6	22
22/02/2010 11:14	1.1	0	3.4	0	0	0.1	0.1	0.2	1.1	2.4	22	21.4	23.6	23.7	22

22/02/2010 23:14	2.1	0.6	5.5	0	0	0.1	0	0.1	1.8	0.6	22.1	21.5	23.8	23.7	22
23/02/2010 11:14	2.1	0.6	4.4	0	0	0.1	0.1	0.2	1.4	1.1	22	21.4	23.6	23.6	22
23/02/2010 23:14	2	0.9	4.6	0	0	0.1	0	0.2	2.1	2.4	22.1	21.5	23.8	23.6	22
24/02/2010 11:14	-0.3	0.8	2.3	0	0	0.1	0	0.2	0.5	1.4	22	21.3	23.6	23.6	22
24/02/2010 23:14	2.4	1.5	4.4	0	0	0.1	0	0.1	0.9	1.4	22	21.4	23.8	23.6	21.9
25/02/2010 11:14	2	0.8	1.8	0	0	0.1	0	0.2	0.9	1.2	22	21.3	23.6	23.6	21.9
25/02/2010 23:14	3	0.5	4.3	0	0	0.1	0	0.1	1.4	1.2	22.1	21.4	23.7	23.6	22
26/02/2010 11:14	1.2	0.5	2	0	0	0.1	0	0.1	-0.2	0.9	22	21.3	23.5	23.6	22
26/02/2010 23:15	2.4	0.5	2.1	0	0	0.1	0	0.1	2	0.5	22	21.4	23.8	23.6	21.9
27/02/2010 11:15	1.7	0.3	2	0	0	0.1	0	0.1	0.2	0.8	22	21.3	23.5	23.6	22
28/02/2010 05:49	2.7	1.1	3.5	0	0	0.1	0	0.2	2.4	1.1	22	21.5	23.8	23.6	22
28/02/2010 17:49	1.2	-0.8	2.1	0	0	0	0	0.1	1.2	1.2	22.1	21.2	23.7	23.6	21.9
01/03/2010 05:49	2.4	0.5	3.4	0	0.1	0.1	0.1	0.2	0.5	2.7	22	21.5	23.8	23.7	22
01/03/2010 17:49	0.2	-0.3	2.1	0	0	0	0	0.1	0.6	1.8	22.1	21.2	23.7	23.6	21.9
02/03/2010 05:49	2.1	0.6	3.4	0	0	0.1	0	0.2	1.4	1.1	22	21.5	23.8	23.7	22
02/03/2010 17:49	0.2	-1.1	2.9	0	0	0.1	0	0.2	0.5	1.2	22.1	21.4	23.8	23.7	22
03/03/2010 05:49	2.3	0	2.4	0	0	0.1	0	0.1	1.8	0.6	22.1	21.5	23.8	23.6	22
03/03/2010 17:49	1.1	-0.6	3	0	0	0.1	0	0.1	1.2	1.7	22.1	21.4	23.7	23.6	22
04/03/2010 05:49	2.4	2.4	2.9	0	0	0.1	0	0.2	1.1	0.9	22	21.6	23.8	23.7	22
04/03/2010 17:49	-0.5	-1.8	1.2	0	0	0.1	0	0.1	0.6	0.9	22.1	21.2	23.7	23.6	21.9
05/03/2010 05:49	2.6	0.9	4.4	0	0.1	0.1	0.1	0.2	1.1	1.1	22	21.5	23.9	23.7	22
05/03/2010 17:49	-0.3	-1.7	0.9	0	0	0.1	0	0.1	1.4	1.5	22.1	21.3	23.7	23.6	21.9
06/03/2010 05:49	2.7	0	3.7	0	0.1	0.1	0.1	0.1	0.2	0.5	22	21.6	23.9	23.7	22
06/03/2010 17:49	0.9	-1.8	2.6	0	0	0	0	0.1	0.8	0.8	22.1	21.2	23.7	23.6	21.9
07/03/2010 05:49	2	-1.2	2.4	0	0	0.1	0	0.1	2	0.9	22.1	21.4	23.8	23.7	22
07/03/2010 17:49	1.1	-2.4	2.3	0	0	0	0	0.1	1.4	0.8	22.1	21	23.8	23.6	21.8
08/03/2010 05:49	4	-1.2	3.2	0	0	0.1	0.1	0.1	1.1	0.6	22	21.5	23.9	23.7	22
08/03/2010 17:49	-0.6	-2.3	1.7	0	0	0.1	0	0.1	0.8	0.8	22.1	21.2	23.8	23.7	22
09/03/2010 05:49	0.9	-0.3	3.2	0	0.1	0.1	0.1	0.2	1.1	0.8	22.1	21.6	23.9	23.7	22
09/03/2010 17:49	-0.8	-2.6	1.7	0	0	0	0	0.1	0.9	0.9	22.1	21.2	23.8	23.6	22.1
10/03/2010 05:49	2.7	0.2	3.4	0	0.1	0.1	0	0.1	1.1	1.1	22	21.5	23.9	23.7	22.2
10/03/2010 17:49	-0.6	-1.7	2.1	0	0	0	0	0.1	0.6	1.4	22.1	21.3	23.8	23.6	22.1
11/03/2010 05:50	1.1	0	3	0	0.1	0.1	0.1	0.1	0.9	0.6	22.1	21.5	23.9	23.6	22.1
11/03/2010 17:50	-0.5	-0.2	3.2	0	0	0	0	0.1	0.8	1.7	22.1	21.2	23.8	23.6	22.1
12/03/2010 05:50	1.7	0	2.6	0	0	0.1	0	0.1	1.4	1.1	22	21.5	23.8	23.6	22
12/03/2010 17:50	0.5	-1.4	1.7	0	0	0	0	0.1	1.1	1.2	22.1	21.2	23.7	23.5	22.1

13/03/2010 05:50	-0.8	-0.6	1.8	0	0	0.1	0	0.1	1.8	1.2	22.1	21.5	23.8	23.6	22.1
13/03/2010 17:50	0.3	-1.4	2.4	0	0	0	0	0.1	1.4	1.1	22.1	21.2	23.7	23.6	22
14/03/2010 05:50	1.8	-0.5	2	0	0	0.1	0	0.1	1.1	0.8	22.1	21.5	23.8	23.7	22
14/03/2010 17:50	0.3	-2	1.4	0	0	0	0	0.1	2.1	1.1	22.1	21.2	23.7	23.5	22
15/03/2010 05:50	2.3	0	2.7	0	0	0.1	0.1	0.1	1.5	1.4	22	21.5	23.8	23.7	22
15/03/2010 17:50	-0.8	-2	1.7	0	0	0	0	0.1	1.2	0.9	22.1	21.2	23.7	23.6	21.8
16/03/2010 05:50	1.8	-0.2	2.3	0	0	0.1	0	0.1	1.5	0.8	22	21.5	23.8	23.6	21.9
16/03/2010 17:50	1.4	-1.1	4.3	0	0	0	0	0.2	0.9	2.3	22.1	21.3	23.8	23.6	21.7
17/03/2010 05:50	2	0.5	2.7	0	0	0	0	0.2	1.2	2.1	22.1	21.4	23.7	23.6	21.8
17/03/2010 17:50	1.2	-0.6	2.1	0	0	0	0	0.1	1.4	2.1	22.1	21.2	23.7	23.5	21.9
18/03/2010 05:50	2.1	2.3	4.1	0	0	0	0	0.2	1.5	1.4	22	21.3	23.7	23.5	21.7
18/03/2010 17:50	1.5	-0.2	2.3	0	0	0	0.1	0.3	1.8	1.8	22	21.2	23.7	23.4	21.6
19/03/2010 05:50	2.3	0.5	1.8	0	0	0.1	0	0.1	1.4	1.5	22.1	21.5	23.7	23.6	21.9
19/03/2010 17:50	2.4	0.2	3	0	0	0	0.1	0.1	1.1	1.4	22.1	21.3	23.7	23.5	22.1
20/03/2010 05:50	3.2	1.1	3.4	0	0	0	0	0.1	1.8	1.7	22	21.4	23.8	23.6	21.4
20/03/2010 17:50	1.1	-0.8	1.8	0	0	0.1	0	0	1.5	1.7	22.1	21.2	23.7	23.4	21.9
21/03/2010 05:50	2.9	2.4	4.7	0	0	0.1	0	0.1	1.4	2.6	22	21.5	23.8	23.6	21.8
21/03/2010 17:50	-0.5	-0.6	2.6	0	0	0	0	0.1	0.3	1.2	22.1	21.2	23.8	23.4	21.9
22/03/2010 05:50	2.4	0.9	4.3	0	0	0.1	0	0.2	2.1	2.7	22.1	21.4	23.8	23.5	21.8
22/03/2010 17:50	0.2	-1.1	1.7	0	0	0	0	0	1.5	1.8	22	21.3	23.8	23.5	21.9
23/03/2010 05:50	2.6	0.8	4.7	0	0	0.1	0	0.1	1.4	1.7	22	21.5	23.8	23.6	22.1
23/03/2010 17:50	2.6	0	2.9	0	0	0	0	0.1	1.2	1.4	22.1	21.3	23.8	23.5	22
24/03/2010 05:50	2.9	1.4	4.9	0	0	0	0	0.1	0.6	1.2	22	21.4	23.8	23.5	21.7
24/03/2010 17:50	0.6	-0.2	2.4	0	0	0	0.1	0	1.7	2.1	22	21.2	23.7	23.4	21.8
25/03/2010 05:51	3.5	2.6	2.4	0	0	0	0	0.1	0.5	1.4	22	21.4	23.7	23.5	21.9
25/03/2010 17:51	2.1	0.6	3.8	0	0	0	0	0	1.7	1.8	22	21.2	23.7	23.5	22
26/03/2010 05:51	2.6	0.8	4.3	0	0	0.1	0	0.1	1.5	1.5	22	21.4	23.7	23.6	22
26/03/2010 17:51	1.7	0	2.3	0	0	0	0	0	1.7	2	22	21.2	23.7	23.4	22
27/03/2010 05:51	2.4	0.6	3	0	0	0	0	0.1	0.6	1.8	22.1	21.4	23.7	23.5	22.1
27/03/2010 17:51	0.5	-0.8	1.7	0	0	0	0	0	1.5	1.7	22	21.2	23.7	23.4	20.9
28/03/2010 05:51	1.1	0.6	3.7	0	0	0.1	0	0.1	1.7	1.4	22.1	21.5	23.8	23.6	21.8
28/03/2010 17:51	0.2	-0.9	1.7	0	0	0.1	0	0	1.2	1.7	22	21.1	23.6	23.4	21.7
29/03/2010 05:51	3.5	0.9	3.7	0	0	0.1	0	0.1	1.7	1.4	22	21.4	23.7	23.6	22
29/03/2010 17:51	0.3	0.6	3.7	0	0	0.1	0	0.1	1.7	3	22	21.2	23.7	23.5	21.8
30/03/2010 05:51	1.2	1.5	5.3	0	0	0.1	0	0.1	2.7	2.4	22	21.5	23.8	23.6	22
30/03/2010 17:51	3.5	0.8	5.2	0	0	0.1	0	0.1	1.8	1.5	22	21.3	23.8	23.6	22.1

31/03/2010 05:51	3.7	1.2	4	0	0	0.1	0	0.2	2.3	2.4	22	21.5	23.8	23.6	21.9
31/03/2010 17:51	2	-0.3	2.9	0	0	0.1	0	0.1	1.5	1.7	22.1	21.2	23.8	23.5	22.1
01/04/2010 05:51	3.2	1.4	3.5	0	0	0.1	0	0.3	1.1	1.5	22	21.5	23.9	23.7	22.1
01/04/2010 17:51	1.4	-1.1	2.3	0	0	0	0	0.1	1.7	1.7	22.1	21.2	23.7	23.5	21.8
02/04/2010 05:51	3.5	1.4	4	0	0	0.1	0	0.2	2	1.8	22	21.4	23.8	23.6	21.5
02/04/2010 17:51	1.7	1.1	2.7	0	0	0	0	0.1	1.4	1.8	22.1	21.2	23.7	23.4	22
03/04/2010 05:51	4.1	1.2	4	0	0	0.1	0	0.2	1.8	2.1	22	21.5	23.8	23.7	21.9
03/04/2010 17:51	1.4	-0.3	2.6	0	0	0	0	0.1	2.3	2.6	22.1	21.2	23.7	23.5	22
04/04/2010 05:51	3.4	0.8	4	0	0	0.1	0	0.1	1.1	1.5	22	21.5	23.9	23.6	22
04/04/2010 17:51	1.5	-0.6	3	0	0	0	0	0	1.2	1.5	22.1	21.3	23.7	23.6	21.8
05/04/2010 05:51	2.4	0.9	4.1	0	0	0	0	0.1	2	2	22.1	21.4	23.8	23.5	22.1
05/04/2010 17:51	2.7	0.3	3.5	0	0	0	0	0.1	2.6	1.8	22.1	21.3	23.7	23.5	21.9
06/04/2010 05:51	3.4	2	3.4	0	0	0	0	0.1	2.9	2.1	22	21.4	23.7	23.5	22
06/04/2010 17:51	0.9	-0.5	3.2	0	0	0	0	0	2.6	1.8	22	21.1	23.7	23.4	21.8
07/04/2010 05:51	2	0.3	3.4	0	0	0.1	0	0.1	2.3	2	22.1	21.4	23.9	23.6	21.8
07/04/2010 17:52	-0.5	-1.7	2.1	0	0	0	0	0	1.8	1.8	22	21.1	23.8	23.4	21.8
08/04/2010 05:52	2	0	4	0	0	0.1	0	0.1	2.4	1.8	22.1	21.4	23.9	23.6	22
08/04/2010 17:52	-0.8	-1.8	1.5	0	0	0	0.1	0	1.8	2.1	22.1	21.1	23.7	23.4	22
09/04/2010 05:52	1.8	0.3	3.5	0	0	0.1	0.1	0.1	1.2	1.5	22.1	21.5	23.9	23.6	22.1
09/04/2010 17:52	-0.3	-1.4	1.8	0	0	0	0	0	1.7	1.8	22.1	21.2	23.7	23.4	21.7
10/04/2010 05:52	2.6	-0.2	3	0	0	0.1	0	0.1	1.7	1.4	22.1	21.5	23.9	23.6	21.9
10/04/2010 17:52	0.5	-1.1	1.4	0	0	0	0	0	1.8	2.3	22.1	21.1	23.7	23.4	21.8
11/04/2010 05:52	4	1.7	3.4	0	0	0.1	0.1	0.1	1.5	2.9	22	21.5	23.8	23.6	21.9
11/04/2010 17:52	-0.8	-1.5	0.3	0	0	0.1	0.1	0	2	2.4	22	21	23.5	23.3	21.8
12/04/2010 05:52	2.7	0.3	3	0	0	0.1	0.1	0	1.7	1.8	22.1	21.5	23.8	23.6	21.9
12/04/2010 17:52	-0.2	-2	0.8	0	0	0.1	0	0	1.8	1.8	22.1	21.1	23.7	23.4	21.8
13/04/2010 05:52	1.8	0.9	3	0	0	0.1	0.1	0.1	1.4	1.5	22	21.5	23.8	23.6	21.9
13/04/2010 17:52	-0.3	-1.5	1.1	0	0	0.1	0.1	0	1.5	1.4	22.1	21.1	23.6	23.4	21.6
14/04/2010 05:52	3	0.3	3.4	0	0	0.1	0	0.1	1.4	1.5	22	21.5	23.8	23.6	21.1
14/04/2010 17:52	0	-0.8	1.8	0	0	0	0	0	0.9	2.6	22.1	21.2	23.7	23.4	21.8
15/04/2010 05:52	2.6	0.5	4.4	0	0	0.1	0.1	0.1	2	1.1	22.1	21.5	23.8	23.7	21.7
15/04/2010 17:52	1.1	-1.2	1.5	0	0	0	0	0	1.8	2.4	22.1	21.2	23.7	23.4	21.9
16/04/2010 05:52	3.5	0	3.4	0	0	0.1	0.1	0.1	1.8	1.7	22	21.5	23.9	23.6	22.1
16/04/2010 17:52	-0.3	-1.7	1.1	0	0	0	0.1	0	1.8	1.4	22.1	21	23.7	23.4	21.9
17/04/2010 05:52	3.8	0.6	4.7	0	0.1	0.2	0.1	0.1	2	1.4	22	21.4	23.8	23.6	21.8
17/04/2010 17:52	-0.8	-0.9	0.8	0	0	0.1	0	0	2.4	1.8	22	21	23.6	23.3	21.8

18/04/2010 05:52	3	0.8	4.1	0	0	0.1	0	0.1	1.2	1.7	22.1	21.4	23.8	23.6	21.9
18/04/2010 17:52	0	0.2	2.1	0	0	0	0.1	0	1.4	1.8	22.1	21.2	23.7	23.4	21.6
19/04/2010 05:52	3.2	0.6	4.3	0	0	0.1	0	0.1	0.6	2.1	22	21.4	23.9	23.6	21.8
19/04/2010 17:52	-0.2	-1.7	1.7	0	0	0	0.1	0	1.5	2.1	22	21.1	23.7	23.4	22
20/04/2010 05:52	3.7	0.6	4.1	0	0	0.1	0.1	0.1	1.7	1.5	22	21.5	23.9	23.6	22.1
20/04/2010 17:52	0.5	-1.2	2	0	0	0	0	0	1.7	2.3	22.1	21.2	23.7	23.5	20.9
21/04/2010 05:52	3.4	0.5	4.9	0	0	0.1	0.1	0.1	1.8	1.2	22	21.5	23.8	23.6	22.1
21/04/2010 17:53	0.2	-1.4	0.3	0	0	0	0.1	0	0.8	1.8	22.1	21.2	23.7	23.4	21.9
22/04/2010 05:53	2.1	0.3	4.9	0	0	0.1	0	0.1	1.5	1.7	22	21.5	23.8	23.6	21.1
22/04/2010 17:53	0.2	0.3	2	0	0	0	0	0	1.5	1.7	22.1	21.2	23.7	23.4	21.9
23/04/2010 05:53	2.9	0.8	3.4	0	0	0.1	0	0.1	2.3	2.6	22.1	21.4	23.8	23.6	21.8
23/04/2010 17:53	-0.5	-1.5	2	0	0	0	0.1	0	2	1.7	22	21.1	23.7	23.4	22
24/04/2010 05:53	1.8	0.5	3.4	0	0	0	0	0.1	2.1	2.1	22.1	21.4	23.8	23.6	22
24/04/2010 17:53	0.8	-0.2	3.2	0	0	0	0	0	1.7	2	22.1	21.2	23.7	23.5	21.8
25/04/2010 16:12	0.3	0.5	2	0	0	0	0.1	0	2	2.4	22	21.1	23.6	23.3	22
26/04/2010 04:12	1.8	0.5	3.2	0	0	0.1	0.1	0.1	1.4	3.7	22.1	21.4	23.7	23.5	22
26/04/2010 16:12	0.3	-0.2	2.4	0	0	0	0.1	0	1.5	3.4	22	21.2	23.7	23.3	21.7
27/04/2010 04:12	2.7	0	3.5	0	-0.1	0.1	0	0	2	2.1	22.1	21.3	23.8	23.5	22
27/04/2010 16:12	1.5	-0.2	3.2	0	0	0	0.1	0	1.8	2.7	22	21.2	23.7	23.4	21.9
28/04/2010 04:12	0.3	2.4	3.8	0	0	0	0	0	3	2.3	22	21.3	23.7	23.5	22.1
28/04/2010 16:12	1.2	0.3	3.5	0	0	0	0.1	0	2.3	2.9	22	21.2	23.7	23.4	21.8
29/04/2010 04:12	3	1.4	3.4	0	0	0.1	0	0	2.6	2	22.1	21.4	23.8	23.5	21.8
29/04/2010 16:13	1.4	-0.2	2.3	0	0	0	0	0	1.5	2.4	22	21.2	23.7	23.4	21
30/04/2010 04:13	3.5	1.2	3.8	0	0	0.1	0.1	0.1	1.8	3	22	21.4	23.8	23.6	21.1
30/04/2010 16:13	1.4	0.3	2.7	0	0	0.1	0.1	0	2	2.6	22	21.1	23.6	23.3	21.8
01/05/2010 04:13	2.4	1.1	3.8	0	0	0.1	0.1	0.1	2.4	2.3	22	21.4	23.8	23.5	21.8
01/05/2010 16:13	2	0.3	2.4	0	0	0	0	0	1.8	3.7	22.1	21.2	23.6	23.4	21.9
02/05/2010 04:13	3.8	1.8	4.1	0	0	0.1	0.1	0.1	2	2.4	22	21.4	23.8	23.6	22
02/05/2010 16:13	2	-0.2	2.4	0	0	0	0.1	0	2.4	2.7	22.1	21.2	23.7	23.5	22.1
03/05/2010 04:13	4	0.3	3.8	0	0	0.1	0.1	0.1	1.8	2.3	22	21.5	23.9	23.6	21.9
03/05/2010 16:13	0.9	-0.6	1.8	0	0	0	0.1	0.1	0.5	2.4	22.1	21.2	23.7	23.5	22
04/05/2010 04:13	3	-0.2	4.3	0	0	0.1	0.1	0.1	2.9	2.4	22.1	21.5	23.8	23.6	21.8
04/05/2010 16:13	0.5	0.6	2.1	0	0	0	0.1	0.1	2	2.3	22.1	21.2	23.7	23.4	21.8
05/05/2010 04:13	1.7	1.5	3.2	0	0	0	0.1	0.1	1.8	2.3	22.1	21.4	23.8	23.5	22.1
05/05/2010 16:13	0.5	0.3	2.9	0	0	0	0.1	0.1	2.1	2.4	22	21.2	23.7	23.4	21.8
06/05/2010 04:13	2.6	0.5	3.4	0	0	0	0.1	0	2.6	2.7	22.1	21.3	23.8	23.4	22.1

06/05/2010 16:13	1.7	0.3	2.9	0	0	0	0	0	1.8	2.9	22	21.2	23.7	23.4	21.6
07/05/2010 04:13	2.4	0.8	3.5	0	0	0.1	0.1	0.1	2.4	2.4	22.1	21.4	23.8	23.5	21.9
07/05/2010 16:13	0.6	0	2.7	0	0	0	0.1	0	2.1	2.4	22.1	21.2	23.7	23.5	22
08/05/2010 04:13	3.4	1.8	3.8	0	0	0.1	0	0.1	2.4	2.4	22	21.4	23.8	23.6	22
08/05/2010 16:13	1.7	-0.8	1.4	0	0	0	0	0	1.5	2.6	22.1	21.2	23.7	23.4	21.8
09/05/2010 04:13	4	0.6	4.3	0	0	0.1	0.1	0.1	1.8	2.3	22	21.5	23.9	23.6	21.6
09/05/2010 16:13	1.7	1.1	1.7	0	0	0.1	0	0.1	1.5	2.9	22.1	21.2	23.7	23.4	21.8
10/05/2010 04:13	2.1	0.5	3.5	0	0	0.1	0	0.1	1.7	3.4	22.1	21.4	23.8	23.6	21.9
10/05/2010 16:13	0.6	-0.5	3.2	0	0	0.1	0	0.1	1.5	2.7	22.1	21.3	23.8	23.5	22
11/05/2010 04:13	2.9	0.6	3.5	0	0	0.1	0	0.1	0.6	3.2	22.1	21.5	23.9	23.6	22
11/05/2010 16:13	0.3	-0.6	1.8	0	0	0.1	0	0	2.3	2.1	22.1	21.3	23.7	23.5	22.1
12/05/2010 04:13	2.9	2.1	3.4	0	0	0.1	0	0.1	2.6	3.4	22.1	21.4	23.8	23.6	21.8
12/05/2010 16:13	-1.4	-0.5	2	0	0	0.1	0	0	1.5	3.7	22	21.2	23.7	23.5	21.7
13/05/2010 04:14	0.5	0.8	3.8	0	0	0.1	0	0.1	1.8	2.3	22	21.5	23.8	23.6	21.8
13/05/2010 16:14	1.2	0.3	3.7	0	0	0.1	0	0.1	2	2.4	22	21.3	23.7	23.4	21.8
14/05/2010 04:14	4	1.1	3.7	0	0	0.1	0	0.1	1.8	2.6	22	21.4	23.8	23.5	21.8
14/05/2010 16:14	-0.2	0.9	1.8	0	0	0	0.1	0	2.1	2.9	22	21.1	23.7	23.3	21.7
15/05/2010 04:14	3.5	0.3	3.8	0	0	0.1	0.1	0.1	2	2.6	22	21.5	23.9	23.6	21.9
15/05/2010 16:14	0.2	-0.9	1.4	0	0	0	0	0	2.3	2.3	22	21.1	23.6	23.4	21.7
16/05/2010 04:14	3.4	0.9	3	0	0	0.1	0	0	1.7	2.4	22.1	21.4	23.8	23.5	21.9
16/05/2010 16:14	-0.6	-1.1	1.7	0	0	0.1	0.1	0	2.1	2.6	22	21	23.6	23.3	20.9
17/05/2010 04:14	3.8	0.8	3.5	0	0	0.1	0	0.1	2	2.1	22	21.4	23.8	23.6	21
17/05/2010 16:14	-0.2	-0.8	2.4	0	0	0	0.1	0	2	2.6	22	21.2	23.7	23.4	22
18/05/2010 04:14	2.4	0.3	3.7	0	0	0.1	0	0	0.8	2.6	22.1	21.4	23.8	23.5	21.8
18/05/2010 16:14	1.4	0.6	2.9	0	0	0.1	0	0	2.6	2.9	22.1	21.3	23.7	23.4	22
19/05/2010 04:14	2.4	0.8	3	0	0	0.1	0	0	2.1	3	22.1	21.3	23.7	23.5	21.8
19/05/2010 16:14	0.8	-0.2	1.8	0	0	0.1	0.1	0	2.1	2.7	21.9	21	23.6	23.2	21.7
20/05/2010 04:14	1.2	0.5	3.2	0	0	0.1	0	0	1.4	3.8	22.1	21.3	23.8	23.4	21.9
20/05/2010 16:14	-1.5	0	1.5	0	0	0.1	0.1	0	1.8	2.9	21.8	20.8	23.4	23	21.7
21/05/2010 04:14	2.1	0.3	2.4	0	0	0.1	0.1	0	2.4	2.6	22	21.3	23.8	23.4	21.6
21/05/2010 16:14	0	-0.2	1.2	0	0	0.1	0.1	0	2.9	2.9	21.9	21	23.6	23.1	21.6
22/05/2010 04:14	2.7	0.2	3.7	0	0	0.1	0.1	0	2.1	3	22.1	21.4	23.8	23.4	21.7
22/05/2010 16:14	-1.4	-1.2	0.8	0	0	0.1	0.1	0	2.3	2.6	21.8	20.9	23.4	23	21.5
23/05/2010 04:14	2.7	0.5	3.7	0	0	0.1	0.1	0.1	2.4	3.4	22	21.3	23.8	23.4	21.7
23/05/2010 16:14	-2.1	-0.8	-0.5	0	0	0.1	0.1	0	2.1	2.9	21.6	20.8	23.3	23	21.5
24/05/2010 04:14	2.3	0.6	3.7	0	0	0.1	0.1	0	0.6	2.6	22	21.3	23.8	23.4	21.8

24/05/2010 16:14	1.1	0.2	2.7	0	0	0.1	0.1	0	1.4	2.7	21.8	21	23.5	23.1	21.8
25/05/2010 04:14	2.4	2.7	3.4	0	0	0.1	0.1	0	2.7	3.2	22	21.4	23.8	23.4	21.6
25/05/2010 16:14	0.6	-0.2	1.2	0	0	0.1	0.1	0	2.1	2.9	21.9	21.1	23.6	23.2	20.9
26/05/2010 04:14	3.4	1.1	2.7	0	0	0.1	0	0	2	2.7	22	21.4	23.8	23.5	21.9
26/05/2010 16:15	0.2	0.5	0.3	0	0	0	0.1	0.1	1.5	2.7	22	21.2	23.7	23.3	21.6
27/05/2010 04:15	3.5	1.2	4	0	0	0.1	0.1	0.1	1.1	2.6	22	21.3	23.8	23.5	21.9
27/05/2010 16:15	1.4	0.9	2.6	0	0	0.1	0.1	0	2.3	2.7	22	21.1	23.7	23.3	21.6
28/05/2010 04:15	2.9	1.8	3.8	0	0	0.1	0.1	0.1	2.6	3	22	21.4	23.8	23.5	21.5
28/05/2010 16:15	0.6	0.6	2	0	0	0	0	0	2.1	3	22	21.2	23.7	23.3	21.1
29/05/2010 04:15	3.8	1.7	4	0	0	0.1	0	0	2.3	3	22	21.3	23.7	23.4	21.7
29/05/2010 16:15	2.1	1.7	2.7	0	0	0.1	0.1	0	1.7	3.2	22	21.3	23.7	23.3	21.7
30/05/2010 04:15	3.4	1.5	3.2	0	0	0.1	0.1	0	2.1	3.2	22	21.4	23.8	23.5	21.9
30/05/2010 16:15	-0.2	0.3	1.2	0	0	0.1	0.1	0	1.7	3.4	21.9	21	23.6	23.2	21.6
31/05/2010 04:15	2.9	2	2.7	0	0	0.1	0.1	0	2.4	2.4	22	21.4	23.7	23.4	21
31/05/2010 16:15	1.5	0.5	2.4	0	0	0	0.1	0	2.3	4.3	22	21.2	23.6	23.2	21.7
01/06/2010 04:15	2.9	1.4	3	0	0	0	0.1	0	2.4	3.2	22	22.1	23.8	23.4	21.6
01/06/2010 20:14	0.9	0.3	1.5	0	0	0.1	0.1	0	2	3.4	22	21.2	23.6	23.3	21.8
02/06/2010 08:14	2.4	0.9	2	0	0	0.1	0.1	0	3.2	3.5	22	21.3	23.6	23.4	21.9
02/06/2010 20:14	0.8	0.2	1.4	0	0	0.1	0.1	0	2.1	2.9	22	21.1	23.6	23.1	21.7
03/06/2010 08:14	2.3	0.8	2	0	0	0.1	0.1	0	2.3	3.4	22	21.3	23.7	23.3	21.5
03/06/2010 20:14	1.5	0.8	2.1	0	0	0.1	0.1	0	2.4	3.5	22	21.2	23.7	23.3	21.9
04/06/2010 08:14	2.9	2	3.2	0	0	0.1	0.1	0	2	4	22	21.2	23.7	23.4	21.4
04/06/2010 20:14	0.5	0.3	1.4	0	0	0.1	0.1	0	3.2	3.4	21.9	21	23.6	23.3	21.6
05/06/2010 08:14	1.5	0.8	2.7	0	0	0.1	0.1	0	1.8	2.9	21.9	21.3	23.6	23.4	21.9
05/06/2010 20:14	0.3	0.8	0.9	0	0	0.1	0.1	0	2.3	3.4	21.8	21.3	23.6	23.3	21
06/06/2010 08:14	2.7	2.6	3	0	0	0.1	0.1	0	2.4	3.4	22	21.2	23.7	23.4	21.8
06/06/2010 20:14	0.5	0.5	1.5	0	0	0.1	0.1	0	2.3	3	21.9	21.2	23.6	23.4	21.5
07/06/2010 08:14	2.7	1.4	3.4	0	0	0.1	0.1	0	2.6	3.4	22	21.2	23.7	23.5	21.6
07/06/2010 20:14	4	1.8	3.5	0	0	0.1	0.1	0	2.7	3.2	22	21.3	23.7	23.5	21.6
08/06/2010 08:14	3.8	1.8	4	0	0	0.1	0.1	0	2.6	3.8	22	21.3	23.7	23.5	21.8
08/06/2010 20:14	2.7	1.8	2.9	0	0	0.1	0.1	0	3	3.4	22	21.1	23.7	23.4	21.8
09/06/2010 08:15	4	2.4	4.1	0	0	0.1	0.1	0	2.3	4.1	22	21.3	23.7	23.5	21.8
09/06/2010 20:15	3.4	1.5	3	0	0	0.1	0.1	0	2.6	3.5	22	21.2	23.7	23.4	21.7
10/06/2010 08:15	3.7	1.7	3	0	0	0.1	0.1	0	2.7	2.7	22	21.3	23.7	23.6	22
10/06/2010 20:15	2.3	1.5	2.3	0	0	0.1	0.1	0	2.4	3.7	22	21.2	23.7	23.5	21.7
11/06/2010 17:00	1.4	0.8	1.8	0	0	0.1	0.1	0	2.7	4.4	21.9	21	23.6	23.2	21.8

12/06/2010 05:00	2.9	1.2	2.7	0	0	0.1	0.1	0	2.6	3.7	22	21.3	23.8	23.6	21.7
12/06/2010 17:00	-1.1	0.2	0.3	0	0	0.1	0.1	0	2.3	3.4	21.8	21.5	23.5	23.3	21.6
13/06/2010 05:00	3	1.8	4.3	0	0	0.1	0.1	0	3	3.7	22	21.2	23.7	23.6	21.8
13/06/2010 17:00	0.5	0.5	2.1	0	0	0	0.1	0.1	2.6	3.4	22	21	23.7	23.4	21.7
14/06/2010 05:00	3.2	1.4	3.7	0	0	0.1	0.1	0	2.6	3.2	22.1	21.3	23.8	23.6	21.8
17/06/2010 22:33	0.2	1.1	2	0	0	0.1	0.1	0	0.6	1.4	21.9	22.5	23.6	23.4	21.4
18/06/2010 10:33	1.5	0.9	3	0	0	0.1	0.1	0	1.2	1.7	21.9	22.4	23.6	23.4	20.8
18/06/2010 22:33	1.7	1.1	2.4	0	0	0.1	0.1	0	1.4	0.9	22	22.6	23.7	23.4	21.6
19/06/2010 10:33	0.3	0.8	2.9	0	0	0.1	0	0	0	1.2	22	22.6	23.7	23.4	21.9
19/06/2010 22:33	0.2	0.5	2.1	0	0	0.1	0.1	0	0	0.8	22	22.7	23.7	23.5	21.6
20/06/2010 10:33	0.5	0.5	0.8	0	0	0.1	0.1	0	1.8	2	21.9	22.6	23.4	23.4	21.9
20/06/2010 22:33	0.8	0.5	1.4	0	0	0.1	0.1	0	0.8	1.8	21.9	22.6	23.6	23.4	20.6
21/06/2010 10:33	0.2	0.6	1.5	0	0	0.1	0.1	0	1.1	1.1	21.9	22.6	23.5	23.3	21.5
21/06/2010 22:33	1.2	0.6	2	0	0	0.1	0.1	0	0.5	0.9	21.9	22.6	23.7	23.3	21.4
22/06/2010 10:33	1.2	1.2	2	0	0	0.1	0.1	0	1.5	0.9	21.9	22.7	23.7	23.4	21.1
22/06/2010 22:33	1.1	2.3	2.3	0	0	0.1	0.1	0	0.2	1.2	22	22.7	23.7	23.4	21.5
23/06/2010 17:28	0.5	0.9	2	0	0	0.1	0.1	0	1.5	1.4	21.8	22.6	23.6	23.3	21.7
24/06/2010 05:28	3	1.7	3	0	0	0.1	0.1	0	1.5	1.5	22	22.8	23.7	23.5	21.6
24/06/2010 17:28	-0.6	0.3	1.7	0	0	0.1	0	0	1.2	1.4	21.7	22.5	23.5	23.2	21.5
25/06/2010 05:28	2.9	1.4	3.2	0	0	0.1	0.1	0	1.5	2.1	22	22.8	23.7	23.4	21.2
25/06/2010 17:28	1.5	0.9	2.7	0	0	0.1	0.1	0	1.7	2.3	21.9	22.6	23.6	23.3	21.6
26/06/2010 05:29	3	3.2	3	0	0	0.1	0	0	2.1	2.1	22	22.7	23.7	23.4	21.6
26/06/2010 17:29	0.3	0.3	1.5	0	0	0.1	0	0	1.4	2.1	21.8	22.6	23.6	23.3	21.5
27/06/2010 05:29	3	1.5	3.5	0	0	0.1	0	0	0.6	1.5	22	22.7	23.7	23.4	21.8
27/06/2010 17:29	0.2	1.8	0.9	0	0	0.1	0.1	0	1.4	1.4	21.8	22.6	23.6	23.3	21.7
28/06/2010 05:29	3	2.9	3	0	0	0.1	0	0	0.9	1.8	22	22.8	23.7	23.4	21.9
28/06/2010 17:29	2.9	1.8	3.5	0	0	0.1	0	0	2.4	2.3	21.8	22.6	23.6	23.2	21.6
29/06/2010 05:29	3.2	1.5	3.2	0	0	0.1	0	0	2.7	1.8	22	22.7	23.7	23.4	21.6
29/06/2010 18:02	-0.2	0.8	1.7	0	0	0.1	0	0	1.1	1.7	21.8	22.5	23.5	23.2	20.8
30/06/2010 06:02	2.9	1.5	2.9	0	0	0.1	0.1	0	1.2	1.8	21.9	22.7	23.7	23.4	21.5
30/06/2010 18:02	2.9	1.5	3.2	0	0	0.1	0	0	1.4	2.1	21.9	22.7	23.6	23.3	21.7
01/07/2010 06:02	4	2.6	4.3	0	0	0.1	0	0	0.9	1.8	21.9	22.6	23.7	23.4	21.3
01/07/2010 18:02	2	1.7	2.3	0	0	0.1	0.1	0	1.4	1.8	21.9	22.6	23.6	23.3	21.5
02/07/2010 06:02	4.1	2.6	3.8	0	0	0	0.1	0	1.7	1.8	22	22.7	23.7	23.4	21.6
02/07/2010 18:02	1.8	1.1	2.1	0	0	0.1	0	0	1.8	1.5	21.9	22.7	23.6	23.4	21.8
03/07/2010 06:02	2.9	1.5	3.5	0	0	0.1	0.1	0	2.1	1.5	22	22.8	23.7	23.5	21.7

03/07/2010 18:02	0	0.9	2.6	0	0	0.1	0	0	1.5	1.8	21.8	22.7	23.6	23.4	21.7
04/07/2010 07:40	3.4	2.4	3.8	0	0	0	0	0	-0.3	2.6	21.9	22.7	23.7	23.4	21.8
04/07/2010 19:40	0.8	0.9	2.3	0	0	0.1	0	0	1.4	1.7	21.9	22.7	23.6	23.4	21.8
05/07/2010 07:40	1.8	1.7	4.6	0	0	0.1	0	0	2.1	1.7	21.9	22.8	23.8	23.5	21.7
05/07/2010 19:40	0.3	0.5	2.1	0	0	0.1	0	0	1.8	1.8	21.9	22.7	23.7	23.4	21.7
06/07/2010 07:40	3.4	1.7	3.7	0	0	0.1	0	0	2.3	1.7	22	22.8	23.8	23.5	21.9
06/07/2010 20:53	2.1	1.5	2.9	0	0	0	0	0	1.5	1.7	21.9	22.6	23.6	23.4	21.6
07/07/2010 18:08	1.1	0.3	1.7	0	0.1	0.1	0	0	1.5	1.7	21.9	22.6	23.6	23.3	21.8
08/07/2010 07:00	3.5	3.5	4.1	0	0	0.1	0	0	1.4	3.2	22	22.8	23.7	23.5	21.6
08/07/2010 19:00	3.2	3.2	3.7	0	0	0	0	0	1.4	2	22	22.7	23.7	23.4	21.6
09/07/2010 07:00	2.6	2	4	0.1	0	0.1	0	0	1.1	2.3	22	22.7	23.7	23.4	21.6
10/07/2010 01:41	4.1	2.4	3.8	0	0	0	0	0	1.7	2.4	22	22.6	23.7	23.4	21.8
10/07/2010 13:41	4.1	2.4	4	0	0	0.1	0	0	1.5	2.1	21.9	22.6	23.6	23.4	21.6
11/07/2010 01:41	4.6	2.3	4	0	0	0.1	0	0	1.4	2	22	22.7	23.7	23.4	21.8
11/07/2010 13:41	1.5	1.2	2.6	0	0	0	0	0	1.5	2.4	21.8	22.7	23.6	23.4	21.7
12/07/2010 01:41	4	2.7	3.8	0	0	0.1	0.1	0	1.7	2	22	22.8	23.8	23.5	21.7
12/07/2010 13:41	1.5	1.4	2.3	0	0	0.1	0.1	0	1.7	2.6	21.9	22.6	23.6	23.4	21.7
13/07/2010 01:41	3.8	1.5	3.5	0	0	0.1	0.1	0	2.1	2.3	22	22.7	23.7	23.4	21.6
13/07/2010 13:41	5	2.3	3.7	0	0	0.1	0	0	1.4	3.2	21.9	22.6	23.6	23.4	21.7
14/07/2010 01:41	5.2	2.4	2.9	0	0	0.1	0	0	1.8	2.1	22	22.7	23.7	23.4	21.8
14/07/2010 13:41	4.7	2.6	3.7	0	0	0	0.1	0	2.9	2	21.9	22.6	23.6	23.2	21.6
15/07/2010 01:41	4.4	2.9	4.6	0	0.1	0.1	0.1	0	1.7	2.6	22	22.7	23.7	23.4	21.7
15/07/2010 13:41	3.7	3.5	2.9	0	0	0.1	0	0	0.6	2	21.9	22.7	23.6	23.3	21.8
16/07/2010 01:41	5.2	2.7	4.1	0	0	0.1	0.1	0	2.1	2.3	22	22.7	23.7	23.4	21.6
16/07/2010 13:41	2.7	1.4	2.6	0	0	0.1	0	0	1.4	2.3	21.9	22.6	23.6	23.4	21.7
17/07/2010 01:41	4.3	1.8	3.2	0	0	0.1	0	0	1.2	2	22	22.8	23.8	23.5	21.8
17/07/2010 13:41	1.4	0.8	1.8	0	0	0.1	0	0	1.7	2	21.9	22.7	23.6	23.4	21.7
18/07/2010 01:41	3.7	3.4	3	0	0	0	0	0	2.3	2	22	22.7	23.7	23.5	21.6
18/07/2010 13:41	3.2	2.1	3.2	0	0	0.1	0	0	1.8	2.4	21.9	22.6	23.7	23.4	21.6
19/07/2010 01:41	3.4	2.3	3.8	0	0	0.1	0	0	1.4	2.3	22	22.7	23.7	23.4	21.7
19/07/2010 13:41	2.4	2.7	2.9	0	0	0.1	0.1	0	1.2	2.4	21.9	22.6	23.6	23.3	21.6
20/07/2010 01:41	3.5	1.7	3.4	0	0	0	0.1	0	2	2.4	21.9	22.6	23.7	23.4	21.6
20/07/2010 13:42	1.4	0.9	2.6	0	0	0.1	0.1	0	2.7	2.3	21.9	22.6	23.6	23.2	21.8
21/07/2010 01:42	4.6	2.1	3.5	0	0	0.1	0	0	1.5	2.1	22	22.7	23.7	23.4	21.6
21/07/2010 13:42	2.6	1.8	3.4	0	0	0.1	0	0	1.5	2	21.9	22.6	23.6	23.4	20.7
22/07/2010 01:42	4.1	2	4.1	0	0	0	0.1	0	1.8	1.8	22	22.7	23.7	23.4	21.4

22/07/2010 13:42	3	1.7	4.3	0	0	0.1	0.1	0	2	2.6	22	22.7	23.7	23.5	21.7
23/07/2010 01:42	3.8	1.7	3.2	0	0	0.1	0.1	0	1.7	2.7	22	22.8	23.8	23.5	21.8
23/07/2010 13:42	1.2	1.4	1.8	0	0	0.1	0.1	0	1.7	1.7	21.9	22.7	23.6	23.3	21.6
24/07/2010 01:42	2.9	1.4	3.4	0	0	0.1	0	0	1.4	1.8	22	22.7	23.7	23.5	21.6
24/07/2010 13:42	2	2	2.1	0	0	0.1	0.1	0	1.8	3	21.8	22.5	23.5	23.3	21.8
25/07/2010 01:42	3.4	1.7	3.2	0	0	0.1	0	0	2.7	2	22	22.7	23.7	23.4	21.8
25/07/2010 13:42	1.8	1.4	2.1	0	0	0.1	0.1	0	1.4	2.1	21.8	22.6	23.6	23.4	21.6
26/07/2010 01:42	3	3.2	3	0	0	0	0	0	1.8	2.1	21.9	22.6	23.7	23.4	21.8
26/07/2010 13:42	3.4	1.5	2.1	0	0	0	0.1	0	1.8	2.3	21.8	22.6	23.5	23.4	21.6
27/07/2010 01:42	3.2	1.8	3	0	0	0.1	0	0	1.8	3	21.9	22.6	23.7	23.4	21.5
27/07/2010 13:42	2.6	1.1	2.7	0	0	0.1	0.1	0	1.7	2.1	21.9	22.6	23.6	23.4	21.6
28/07/2010 01:42	3.4	1.5	3.2	0	0	0	0	0	1.1	2.3	22	22.7	23.7	23.4	21.7
28/07/2010 13:42	2.9	1.4	2.1	0	0	0.1	0.1	0	2	2	22	22.6	23.6	23.4	21.9
29/07/2010 01:42	2.9	3.2	2.9	0	0	0.1	0	0	2	2.4	22	22.7	23.8	23.5	21.9
29/07/2010 13:42	2	1.5	3	0	0	0.1	0	0	1.7	1.7	21.9	22.7	23.6	23.4	21.6
30/07/2010 01:42	3.2	1.8	2.7	0	0	0.1	0.1	0	2.1	2.6	21.9	22.6	23.6	23.4	21.6
30/07/2010 13:42	3.2	2.6	3.2	0	0	0.1	0.1	0	0.9	2.4	21.8	22.6	23.5	23.4	21.8
31/07/2010 01:42	4.1	4	3.7	0	0	0.1	0	0	2	3	22	22.7	23.7	23.5	21.6
31/07/2010 13:42	3.5	2.1	3.4	0	0	0	0.1	0	2	2.9	21.9	22.7	23.6	23.4	21.5
01/08/2010 01:42	4.3	3	4.7	0	0	0.1	0	0	2.6	2.4	22	22.7	23.7	23.5	21.7
01/08/2010 13:42	2.1	1.5	1.8	0	0	0.1	0	0	1.7	3	21.8	22.6	23.5	23.4	21.9
02/08/2010 01:42	3.4	1.7	4.3	0	0	0.1	0	0	1.8	2.6	22	22.7	23.7	23.4	21.6
02/08/2010 13:43	2.1	1.7	3	0	0	0	0	0	1.7	3.2	21.9	22.7	23.6	23.4	21.6
03/08/2010 01:43	3.4	2.1	3.5	0	0	0.1	0	0	2.3	2.9	22	22.7	23.7	23.4	21.6
03/08/2010 13:43	3	1.4	3.4	0	0	0	0	0	2.3	3.5	21.9	22.7	23.7	23.4	21.8
04/08/2010 01:43	4.1	2.3	3.8	0	0	0.1	0	0	2	2.7	22	22.7	23.7	23.4	21.6
04/08/2010 13:43	2.4	1.8	2.9	0	0	0	0	0	1.8	2.3	22	22.7	23.7	23.3	21.7
05/08/2010 01:43	3.4	1.7	4.6	0	0	0.1	0	0	0.6	2.6	22	22.7	23.7	23.4	21.7
05/08/2010 13:43	2.3	1.2	2.6	0	0	0.1	0	0	2	2.3	21.9	22.7	23.6	23.4	21.5
06/08/2010 01:43	4.6	2.4	3.8	0	0	0.1	0.1	0	1.8	2.4	22	22.7	23.7	23.5	20.8
06/08/2010 13:43	4.1	1.8	3	0	0	0.1	0	0	1.4	2.6	21.9	22.6	23.6	23.4	21.5
07/08/2010 01:43	4.3	2	3.8	0	0	0.1	0	0	2.1	2.7	22	22.7	23.7	23.5	21.9
07/08/2010 13:43	3	1.5	3.2	0	0	0.1	0.1	0	2.3	2.9	21.9	22.6	23.6	23.3	21.7
08/08/2010 01:43	4.1	1.8	3.4	0	0	0.1	0	0	2.6	2.6	22	22.7	23.7	23.5	21.6
08/08/2010 13:43	0.8	0.9	1.7	0	0	0.1	0	0	1.8	2.4	21.8	22.6	23.5	23.4	21.5
09/08/2010 01:43	3.7	1.7	3.7	0	0	0.1	0	0	2.1	3	22	22.7	23.7	23.5	21.5

09/08/2010 13:43	2.4	1.2	2.1	0	0	0.1	0.1	0	1.8	2.6	21.9	22.6	23.5	23.2	21.6
10/08/2010 01:43	4.3	2.1	4.4	0	0	0.1	0	0	1.8	2.6	22	22.7	23.7	23.5	21.3
10/08/2010 13:43	2.7	0.9	3.5	0	0	0.1	0	0	2	2.9	21.9	22.6	23.6	23.3	21.8
11/08/2010 01:43	4.1	1.5	4.7	0	0	0.1	0	0	1.7	3.4	22	22.8	23.7	23.5	21.4
11/08/2010 13:43	2.4	1.1	2.4	0	0	0.1	0.1	0	2.9	2.7	21.9	22.6	23.6	23.4	21
12/08/2010 01:43	4	2	3.7	0	0	0	0	0	1.8	3	22	22.7	23.7	23.5	21.8
12/08/2010 13:43	2.7	0.9	2.7	0	0	0.1	0	0	0.8	2.4	22	22.7	23.6	23.4	21.4
13/08/2010 01:43	3.8	1.2	3.5	0	0	0	0	0	1.8	3.8	22	22.8	23.7	23.5	21.8
13/08/2010 13:43	3.2	2.7	2.4	0	0	0.1	0	0	3	2.3	22	22.7	23.6	23.5	21.6
14/08/2010 01:43	3.8	3	3.4	0	0	0.1	0	0	2	2.7	22	22.8	23.7	23.5	21.6
14/08/2010 13:43	2.9	1.7	3.7	0	0	0.1	0	0	2.1	2.9	22	22.7	23.7	23.5	21.9
15/08/2010 01:43	4.6	1.7	3.8	0	0	0.1	0.1	0	2.3	2.7	22	22.8	23.8	23.5	21.6
15/08/2010 13:44	1.2	0.3	0.3	0	0	0.1	0	0	1.1	2.6	21.8	22.5	23.3	23.3	21.6
16/08/2010 01:44	4	1.2	3.4	0	0	0.1	0	0	2.1	2.3	22	22.7	23.7	23.5	21.9
16/08/2010 22:05	4.3	4	3.8	0	0	0.1	0	0	2.1	2.9	22	22.7	23.7	23.5	21
17/08/2010 10:05	3.4	1.5	2.1	0	0	0.1	0	0	2.4	2.6	21.9	22.6	23.6	23.4	21.8
17/08/2010 22:05	4.1	1.8	2.6	0	0	0.1	0	0	0.8	2.6	22	22.7	23.7	23.5	21.6
18/08/2010 10:05	3.7	1.8	2.9	0	0	0.1	0	0	1.8	2.6	21.9	22.7	23.5	23.4	21.9
18/08/2010 22:05	4.3	2	4.1	0	0	0.1	0	0	2	2.6	22	22.7	23.7	23.5	21.6
19/08/2010 10:05	4.3	1.8	3.7	0	0	0.1	0	0	1.8	3.2	22	22.7	23.6	23.5	21.7
19/08/2010 22:05	4.4	4	5	0	0	0	0	0	2	3.4	21.9	22.6	23.6	23.4	21.7
20/08/2010 10:05	4.6	2.1	4	0	0	0.1	0.1	0	2.9	3.2	21.9	22.6	23.5	23.4	21.8
20/08/2010 22:05	4	0.8	3.4	0	0	0.1	0	0	1.5	3.5	22	22.6	23.7	23.5	21.6
21/08/2010 10:05	4	2	3.7	0	0	0.1	0	0	2.7	3.7	21.9	22.7	23.6	23.4	21.7
21/08/2010 22:05	4	1.2	3.5	0	0	0.1	0	0	1.8	3.2	22	22.7	23.7	23.4	21.6
22/08/2010 10:05	3.4	2	2.6	0	0	0.1	0	0	2	3	21.9	22.7	23.6	23.4	21.8
22/08/2010 22:05	4.3	2.1	3.7	0	0	0.1	0	0	2	2.6	21.9	22.7	23.7	23.4	20.7
23/08/2010 10:05	4.7	2	3.8	0	0	0.1	0	0	2.3	2.9	21.9	22.7	23.6	23.4	21.7
23/08/2010 22:05	4.6	3.5	4	0	0	0.1	0	0	1.8	3	22	22.8	23.7	23.5	21.6
24/08/2010 10:05	4.7	1.7	3.7	0	0	0.1	0	0	1.4	2.9	22	22.8	23.7	23.5	21.7
24/08/2010 22:05	4.3	2	3.7	0	0	0.1	0	0	2	2.4	22	22.7	23.7	23.5	21.6
25/08/2010 10:05	3.5	2.1	3.4	0	0	0.1	0.1	0	1.8	2.7	22	22.7	23.7	23.5	21.8
25/08/2010 22:05	4.9	2	4	0	0	0.1	0	0	2	2.6	22	22.7	23.7	23.5	21.9
26/08/2010 10:05	4.7	2	3.2	0	0	0.1	0.1	0	2.3	2.7	22	22.7	23.6	23.5	21.9
26/08/2010 22:05	4.4	1.8	3.7	0	0	0.1	0	0	2.1	2.3	22	22.7	23.7	23.5	21.6
27/08/2010 10:05	3.5	1.8	2.6	0	0	0.1	0	0	1.8	3	22	22.7	23.5	23.5	21.6

27/08/2010 22:05	3.8	1.4	2	0	0	0.1	0	0	2.3	2.6	22	22.8	23.7	23.5	20.8
28/08/2010 10:06	4	1.7	2.9	0	0	0.1	0.1	0.1	2.6	2.3	22	22.7	23.6	23.5	20.9
28/08/2010 22:06	3.4	1.4	3.2	0	0	0.1	0	0	2.3	2.7	22	22.8	23.7	23.5	21.5
29/08/2010 10:06	4	3.7	2.4	0	0	0	0.1	0	2.3	3	22	22.7	23.7	23.5	21.7
29/08/2010 22:06	3.8	2.1	3.4	0	0	0.1	0	0	2	3.4	22	22.8	23.8	23.6	21.7
30/08/2010 10:06	3.4	1.2	2.9	0	0	0.1	0.1	0.1	1.8	3.5	22	22.7	23.7	23.5	21.8
30/08/2010 22:06	3.8	1.1	2.9	0	0	0.1	0	0	3.2	2.7	22.1	22.8	23.8	23.6	21.7
31/08/2010 10:06	4.1	2.3	2.9	0	0	0.1	0	0	2.3	2.9	22	22.7	23.7	23.5	21.6
31/08/2010 22:06	3.7	1.5	2.7	0	0	0.1	0	0	2.7	2.9	22	22.8	23.7	23.6	21.8
01/09/2010 10:06	5.2	1.8	3.2	0	0	0.1	0.1	0	0.9	2.7	22	22.7	23.6	23.5	21.8
DATA DELETED BY CSL DURING SERVICE VISIT															
01/11/2010 15:25	5.5	1.8	3.7	0	0	0.1	-1000	0.1	2.9	4.3	21.9	22.6	23.6	23.5	21.9
02/11/2010 03:25	6.7	2.4	4.1	0	0	0.1	-1000	0.1	2.9	4.1	22	22.7	23.8	23.6	22.1
02/11/2010 15:25	5.6	2.7	4.4	0	0	0.1	-1000	0.1	3.8	4.6	22	22.6	23.7	23.5	21.8
03/11/2010 03:25	6.4	1.7	4.3	0	0	0.1	-1000	0.1	2.6	5.2	22	22.7	23.7	23.6	21.9
03/11/2010 15:25	5.5	1.7	3.2	0	0	0.1	-1000	0	2.9	4.7	21.9	22.4	23.6	23.5	21.8
04/11/2010 03:25	6.1	4.4	3.7	0	0	0	-1000	0.1	3.7	4.9	22	22.6	23.7	23.5	21.8
04/11/2010 15:25	6.3	1.5	4.1	0	0	0.1	-1000	0	2.3	4.6	21.9	22.5	23.6	23.4	21.8
05/11/2010 03:26	6.3	1.7	4.1	0	0	0.1	-1000	0	2.6	5.2	22	22.7	23.7	23.5	21.8
05/11/2010 15:26	5.3	2.4	4	0	0	0.1	-1000	0.1	2.3	4.6	21.9	22.6	23.7	23.5	21.7
06/11/2010 03:26	6.6	1.5	5.2	0	0	0.1	-1000	0	0.8	4.9	22	22.7	23.7	23.6	21.8
06/11/2010 15:26	6.3	2.4	3.8	0	0	0.1	-1000	0	2.7	4.4	22	22.6	23.7	23.5	21.1
07/11/2010 03:26	7.2	1.8	4.3	0	0	0.1	-1000	0.1	2.9	4	22	22.8	23.8	23.6	21.8
07/11/2010 15:26	6.7	2.4	4.6	0	0	0.1	-1000	0.1	2.3	4.1	22	22.7	23.8	23.6	21.8
08/11/2010 03:26	8.7	3.2	5.6	0	0	0.1	-1000	0.1	3	4.9	21.9	22.7	23.7	23.5	21.7
08/11/2010 15:26	7.6	2.7	4.9	0	0	0.1	-1000	0.1	2.6	4.6	21.9	22.4	23.6	23.4	22
09/11/2010 03:26	8.5	3.4	7.2	0	0	0.1	-1000	0.1	2.1	4.6	21.9	22.7	23.7	23.5	22
09/11/2010 15:26	6.9	1.8	4.6	0	0	0.1	-1000	0.1	1.5	5.2	22	22.6	23.7	23.5	21.9
10/11/2010 03:26	8.2	2.3	5.2	0	0	0.1	-1000	0.1	2.3	4.6	22	22.8	23.8	23.5	22
10/11/2010 15:26	4.6	0.9	4.4	0.1	0	0.1	-1000	0.1	1.8	4.4	21.8	22.6	23.7	23.5	22.1
11/11/2010 03:26	7.3	3.4	5.3	0	0	0.1	-1000	0.1	2.7	4.6	22	22.7	23.7	23.3	21.8
11/11/2010 15:26	7.2	2.4	4.7	0	0	0.1	-1000	0.1	2.6	5.6	22	22.6	23.7	23.2	21.9
12/11/2010 03:26	7.6	3.4	3.8	0	0	0.1	-1000	0.1	3.4	4.9	22	22.7	23.7	23.3	22
12/11/2010 15:26	6.9	1.8	4.9	0	0	0.1	-1000	0.1	2.1	4.1	22	22.6	23.6	23.2	21.8
13/11/2010 03:26	8.1	2.9	6.1	0	0	0.1	-1000	0.1	2.9	5.2	22	22.7	23.7	23.1	22
13/11/2010 15:26	7.9	1.7	5	0	0	0.1	-1000	0.1	2.4	5.3	22	22.6	23.7	23.3	21.5

14/11/2010 03:26	9	2.7	5.8	0	0	0.1	-1000	0.1	3.4	4.7	22	22.8	23.8	23.5	21.9
14/11/2010 15:26	7	0.6	3.8	0	0	0	-1000	0.1	2.3	5.2	22	22.6	23.7	23.4	21.8
15/11/2010 03:26	8.5	2	5.9	0	0	0.1	-1000	0.1	2.4	4.4	22	22.8	23.8	23.5	21.9
15/11/2010 15:26	5.3	0.6	3.8	0	0	0.1	-1000	0.1	2.4	5	22.1	22.7	23.7	23.4	21.8
16/11/2010 03:26	6.4	1.8	5.2	0	0	0.1	-1000	0.1	2.3	3.8	22	22.8	23.8	23.5	21.8
16/11/2010 15:26	6.6	1.4	3.8	0	0	0.1	-1000	0.1	2.6	4.6	22	22.6	23.7	23.4	21.8
17/11/2010 03:26	7.3	2.6	5.5	0	0	0.1	-1000	0	2.7	5.6	22	22.7	23.7	23.3	21.9
17/11/2010 15:26	6.7	2.1	4.4	0	0	0.1	-1000	0.1	2.6	5.2	22	22.6	23.7	23.2	21.9
18/11/2010 03:26	7.5	2.4	3.2	0	0	0	-1000	0.1	2.6	4.6	22	22.7	23.6	23.5	22
19/11/2010 04:08	7.8	2.4	3.7	0	0	0.1	-1000	0	3.2	4.6	22	22.8	23.7	23.5	21.6
19/11/2010 16:08	5.9	1.8	4.4	0	0	0.1	0.1	0	3.5	4.3	22	22.8	23.7	23.5	21.1
20/11/2010 04:08	7	2.3	4.7	0	0	0.1	0.1	0	2.4	4.1	22	22.8	23.8	23.5	21.9
20/11/2010 16:08	6.6	1.7	4.6	0	0	0.1	0.1	0	2.6	4.3	22.1	22.7	23.8	23.4	21.7
21/11/2010 04:08	7.2	3.7	4.7	0	0	0.1	0.1	0	2.7	4.6	22	22.8	23.9	23.5	21.7
21/11/2010 16:08	7.2	2	5	0	0	0.1	0.1	0	2.6	4.3	22	22.8	23.9	23.5	21.7
22/11/2010 04:08	8.4	1.8	5.3	0	0	0.1	0.1	0.1	3.5	4.9	22	22.8	23.9	23.6	22
22/11/2010 16:08	5.6	2.6	3.2	0	0	0.1	0.1	0.1	2.3	4.6	22	22.8	23.7	23.5	22
23/11/2010 04:08	8.8	2.1	3.2	0	0	0.1	0.1	0.1	3	4.4	22	22.8	23.8	23.6	22
23/11/2010 16:08	5.3	1.5	2.9	0	0	0.1	0.1	0.1	2.4	4.6	22.1	22.8	23.7	23.4	21.6
24/11/2010 04:08	7	1.8	5	0	0	0.1	0.1	0.1	2.7	4.9	22.1	22.8	23.8	23.5	21.8
24/11/2010 16:08	5	1.4	3.8	0	0	0.1	0.1	0.1	2.9	5.2	22	22.8	23.7	23.4	22
25/11/2010 04:08	6.1	2	5.3	0	0	0.1	0.1	0.1	2.9	4	22.1	22.8	23.9	23.6	22
25/11/2010 16:08	5.3	1.2	3.8	0	0	0.1	0.1	0.1	2.3	4.1	22.1	22.8	23.7	23.5	21.9
26/11/2010 04:08	7	2.1	6.3	0	0	0.1	0.1	0.1	2.1	5.5	22	22.8	23.8	23.6	21.3
26/11/2010 16:08	7	1.7	4.4	0	0	0.1	0.1	0.1	2.6	4.4	22	22.8	23.8	23.5	22.1
27/11/2010 04:08	7.6	2.4	2.9	0	0	0	0.1	0.1	1.8	5	22	22.8	23.7	23.6	21.9
27/11/2010 16:09	8.4	1.8	2.9	0	0	0	0.1	0.1	2.4	5.5	22	22.8	23.7	23.5	22.1
28/11/2010 04:09	8.1	2.4	3.4	0	0	0.1	0.1	0.2	2.3	4.9	22	22.8	23.7	23.6	21.8
28/11/2010 16:09	8.2	1.5	1.8	0	0	0	0.1	0.2	2.7	4.4	22	22.8	23.6	23.6	21.9
29/11/2010 04:09	9.5	2.3	3.7	0	0.1	0.1	0.1	0.2	3.4	4.7	22	22.8	23.7	23.6	21.8
29/11/2010 16:09	5	1.8	3.4	0	0	0.1	0.2	0.2	2.6	4.9	22.1	22.9	23.6	23.6	21.8
30/11/2010 04:09	5.5	1.7	5.8	0	0	0.1	0.1	0.2	3	5.5	22.1	22.9	23.9	23.6	22
30/11/2010 16:09	5	1.7	3	0	0	0.1	0.1	0.2	2	4.4	22.1	22.8	23.7	23.6	21.6
01/12/2010 04:09	7.3	2	4.4	0	0	0.1	0.1	0.2	2.1	4.6	22	22.8	23.8	23.6	21.9
01/12/2010 16:09	4.6	2.9	4	0	0	0.1	0.1	0.2	2.4	4.1	22.1	22.8	23.7	23.6	22.1
02/12/2010 04:09	5.9	2.1	3.7	0	0	0.1	0.1	0.2	2.1	4.4	22.1	22.8	23.8	23.6	21.9

02/12/2010 16:09	5.2	1.1	2.9	0	0	0.1	0.1	0.2	2.4	4.4	22.1	22.8	23.7	23.5	21.2
03/12/2010 04:09	7.5	2.3	3.7	0	0.1	0.1	0.1	0.2	2.3	4.7	22	22.8	23.8	23.6	21.2
03/12/2010 16:09	6.7	2.1	4.4	0	0	0.1	0.1	0.2	2.6	4.7	22	22.8	23.7	23.5	22.1
04/12/2010 04:09	5.5	2	5.5	0	0	0.1	0.1	0.2	2.7	4.7	22	22.8	23.8	23.5	21.3
04/12/2010 16:09	7	2	4.9	0	0	0.1	0.1	0.2	1.8	5.8	22	22.8	23.8	23.3	22.1
05/12/2010 04:09	8.7	2.3	5.9	0	0	0.1	0.1	0.2	2	4.7	22	22.8	23.8	23.4	21.8
05/12/2010 16:09	8.5	3.4	4.9	0	0	0.1	0.1	0.2	1.1	4	22	22.8	23.8	23.2	22
06/12/2010 04:09	8.8	4.6	5.8	0	0	0.1	0.1	0.2	2.9	4.4	22	22.8	23.8	23.3	21.8
06/12/2010 16:09	6.4	2.3	1.8	0	0	0.1	0.1	0.2	2.7	4.9	22.1	22.8	23.7	23.2	21.5
07/12/2010 04:09	5.3	4.3	3.2	0	0	0.1	0.1	0.2	2.7	5.2	22	22.8	23.7	23.2	21.8
07/12/2010 16:09	5.2	2.3	3.2	0	0	0.1	0.1	0.2	2.4	4.9	22	22.8	23.7	23.3	21.2
08/12/2010 04:09	7.2	2.3	3.5	0	0	0.1	0.1	0.2	2.3	5.9	22	22.8	23.8	23.4	21.9
08/12/2010 16:09	5	1.5	2.4	0	0	0.1	0.1	0.2	2	4.6	22.1	22.8	23.7	23.3	22.1
09/12/2010 04:09	5.6	2.4	4.7	0	0	0.1	0.1	0.2	2.6	4.3	22.1	22.9	23.8	23.4	21.9
09/12/2010 16:09	4.9	0.8	2.7	0	0	0.1	0.1	0.2	1.8	4.6	22.1	22.8	23.7	23.5	22

APPENDIX 4 SURFACE WATER MONITORING RESULTS

Location	Date Sampled	Temp	Conductivity	pH
SW1	04/01/2010	5	712	7.19
SW1	12/01/2010	4.8	687	7.62
SW1	20/01/2010	7.9	577	7.51
SW1	28/01/2010	8.1	647	7.65
SW1	05/02/2010	8.1	492	7.51
SW1	12/02/2010	7.9	507	7.49
SW1	16/02/2010	6.7	646	7.31
SW1	26/02/2010	6.2	691	8.14
SW1	04/03/2010	6.1	702	8.09
SW1	09/03/2010	8	726	6.98
SW1	19/03/2010	9.6	702	7.84
SW1	23/03/2010	9.4	704	7.11
SW1	01/04/2010	10.2	570	7.08
SW1	06/04/2010	10.9	542	7.07
SW1	16/04/2010	14.6	621	6.97
SW1	21/04/2010	10.4	684	7.48
SW1	30/04/2010	13.4	685	7.37
SW1	07/05/2010	13.4	685	7.37
SW1	14/05/2010	11.4	694	7.32
SW1	21/05/2010	13.1	706	7.21
SW1	28/05/2010	8.1	716	7.17
SW1	03/06/2010	10.2	712	7.29
SW1	11/06/2010	14.1	708	7.41
SW1	18/06/2010	14.4	712	7.38
SW1	25/06/2010	16.9	722	7.12
SW1	01/07/2010	15.2	724	7.08
SW1	09/07/2010	15.8	721	7.11
SW1	16/07/2010	15.9	687	7.04
SW1	23/07/2010	16.7	722	
SW1	26/07/2010	20.2	722	7.16
SW1	06/08/2010	16.1	730	7.21
SW1	12/08/2010	16	717	7.1
SW1	20/08/2010	17.8	724	7.32
SW1	25/08/2010	13.9	696	7.12
SW1	02/09/2010	16.7	716	7.6
SW1	08/09/2010	16.1	622	7.1
SW1	15/09/2010	15.2	510	7.27
SW1	24/09/2010	12.9	525	7.39
SW1	01/10/2010	14.4	691	7.32
SW1	08/10/2010	7.29	642	15
SW1	15/10/2010	14.1	716	7.4
SW1	20/10/2010	15.1	739	7.1
SW1	29/10/2010	12.4	702	7.11
SW1	05/11/2010	12.1	697	7.31
SW1	11/11/2010	9	624	7.14
SW1	19/11/2010	8.7	612	7.2
SW1	26/11/2010	7	646	7.13
SW1	02/12/2010	4.5	732	7.4
SW1	09/12/2010	4.4	728	7.21
SW1	17/12/2010	5.2	712	7.4
SW1	22/12/2010	0	0	0

SW1	31/12/2010	9.6	696	7.31
SW2A	04/01/2010	4.3	717	7.03
SW2A	12/01/2010	4.3	692	7.44
SW2A	20/01/2010	7.8	571	7.64
SW2A	28/01/2010	7.2	646	7.47
SW2A	05/02/2010	7.7	487	7.46
SW2A	12/02/2010	7.4	495	7.46
SW2A	16/02/2010	6.3	641	7.26
SW2A	26/02/2010	5.9	682	8.11
SW2A	04/03/2010	5.4	689	7.92
SW2A	09/03/2010	7.5	720	6.95
SW2A	19/03/2010	9.6	693	7.79
SW2A	23/03/2010	9	703	7
SW2A	01/04/2010	10.1	565	7.17
SW2A	06/04/2010	9.8	591	7.12
SW2A	16/04/2010	14.4	624	6.95
SW2A	21/04/2010	10.1	681	7.5
SW2A	30/04/2010	13.8	691	7.43
SW2A	07/05/2010	13.8	691	7.43
SW2A	14/05/2010	11.3	682	7.3
SW2A	21/05/2010	13.3	692	7.11
SW2A	28/05/2010	8	708	7.14
SW2A	03/06/2010	11.1	718	7.36
SW2A	11/06/2010	13.6	714	7.54
SW2A	18/06/2010	13.9	711	7.42
SW2A	25/06/2010	16.7	724	7.18
SW2A	01/07/2010	15	730	7.11
SW2A	09/07/2010	15.6	709	7.06
SW2A	16/07/2010	15.8	692	7.1
SW2A	23/07/2010	16.5	713	
SW2A	26/07/2010	19.6	710	7.29
SW2A	06/08/2010	15.5	722	7.24
SW2A	12/08/2010	15.3	718	6.63
SW2A	20/08/2010	17.4	727	7.1
SW2A	25/08/2010	13.8	689	7.05
SW2A	02/09/2010	15.1	748	7.33
SW2A	08/09/2010	15.7	627	7.04
SW2A	15/09/2010	15.4	508	7.22
SW2A	24/09/2010	13.1	518	7.27
SW2A	01/10/2010	14	688	7.29
SW2A	08/10/2010	7.32	637	14.9
SW2A	15/10/2010	14.2	712	7.42
SW2A	20/10/2010	13.3	729	7.32
SW2A	29/10/2010	12.5	700	7.12
SW2A	05/11/2010	12.9	689	7.28
SW2A	11/11/2010	8.9	619	7.11
SW2A	19/11/2010	8.4	611	7.14
SW2A	26/11/2010	6.8	645	7.11
SW2A	02/12/2010	4.4	729	7.42
SW2A	09/12/2010	4.3	724	7.3
SW2A	17/12/2010	4.9	707	7.38
SW2A	22/12/2010	0	0	0

SW2A	31/12/2010	10.1	692	7.34
SW3A	04/01/2010	4.7	731	7.42
SW3A	12/01/2010	4.4	710	7.7
SW3A	20/01/2010	7.9	568	7.68
SW3A	28/01/2010	9.4	641	7.94
SW3A	05/02/2010	8.7	487	8.68
SW3A	12/02/2010	7.7	492	7.87
SW3A	16/02/2010	6.5	632	7.42
SW3A	26/02/2010	8.6	679	7.92
SW3A	04/03/2010	7.3	682	7.67
SW3A	09/03/2010	8.3	713	6.9
SW3A	19/03/2010	9.4	689	7.42
SW3A	23/03/2010	9.5	694	6.99
SW3A	01/04/2010	12	584	7.19
SW3A	06/04/2010	10.1	526	7.14
SW3A	16/04/2010	14.9	629	6.99
SW3A	21/04/2010	11.5	672	7.59
SW3A	30/04/2010	14.7	695	7.45
SW3A	07/05/2010	14.7	695	7.45
SW3A	14/05/2010	11.8	661	7.44
SW3A	21/05/2010	14.2	687	7.28
SW3A	28/05/2010	8.7	700	7.22
SW3A	03/06/2010	11.8	704	7.23
SW3A	11/06/2010	14.2	712	7.68
SW3A	18/06/2010	14	710	7.49
SW3A	25/06/2010	17	718	7.22
SW3A	01/07/2010	15.6	729	7.14
SW3A	09/07/2010	16	725	7.47
SW3A	16/07/2010	16.3	700	7.16
SW3A	23/07/2010	17.2	708	
SW3A	26/07/2010	21.1	699	7.38
SW3A	06/08/2010	16.3	710	7.56
SW3A	12/08/2010	16.5	722	7.59
SW3A	20/08/2010	18.1	728	7.6
SW3A	25/08/2010	14.1	701	7.47
SW3A	02/09/2010	14.2	734	7.52
SW3A	08/09/2010	16.3	667	7.25
SW3A	15/09/2010	16	516	7.31
SW3A	24/09/2010	14.2	520	7.32
SW3A	01/10/2010	16.5	671	7.43
SW3A	08/10/2010	7.3	632	15.8
SW3A	15/10/2010	14.7	734	7.39
SW3A	20/10/2010	14.1	742	7.75
SW3A	29/10/2010	13.4	712	7.24
SW3A	05/11/2010	13	688	7.27
SW3A	11/11/2010	9.4	614	7.1
SW3A	19/11/2010	9	607	7.16
SW3A	26/11/2010	7.7	623	7.19
SW3A	02/12/2010	4.7	727	7.39
SW3A	09/12/2010	4.8	725	7.22
SW3A	17/12/2010	5.4	708	7.38
SW3A	22/12/2010	0	0	0

SW3A	31/12/2010	10.3	689	7.33
SW4	04/01/2010			
SW4	12/01/2010			
SW4	20/01/2010	8	532	7.5
SW4	28/01/2010	9.6	626	8.14
SW4	05/02/2010	9.4	428	7.8
SW4	12/02/2010	8.2	468	7.61
SW4	16/02/2010	7	621	7.5
SW4	26/02/2010	9.4	683	7.19
SW4	04/03/2010	7.6	687	7.83
SW4	09/03/2010	9.8	652	6.85
SW4	19/03/2010	10.2	631	7.67
SW4	23/03/2010	9.7	672	6.92
SW4	01/04/2010	12.9	534	6.64
SW4	06/04/2010	10.4	542	7.09
SW4	16/04/2010	15.1	607	7.02
SW4	21/04/2010	11.6	687	7.21
SW4	30/04/2010	13.9	651	7.34
SW4	07/05/2010	13.9	651	7.34
SW4	14/05/2010	12.1	670	7.27
SW4	21/05/2010	14.7	695	7.32
SW4	28/05/2010	9	732	7.26
SW4	03/06/2010	12.1	729	7.21
SW4	11/06/2010	14.7	726	7.67
SW4	18/06/2010	14.5	719	7.6
SW4	25/06/2010	17.4	710	7.31
SW4	01/07/2010	16	721	7.22
SW4	09/07/2010	15.8	787	6.91
SW4	16/07/2010	16.6	664	7.07
SW4	23/07/2010	17.7	764	
SW4	26/07/2010	20.9	747	6.86
SW4	06/08/2010	16.6	756	7.26
SW4	12/08/2010	16.8	787	7.55
SW4	20/08/2010	18.4	836	7.02
SW4	25/08/2010	15	826	6.86
SW4	02/09/2010	16.4	814	7.27
SW4	08/09/2010	17.5	570	7.08
SW4	15/09/2010	17.2	499	7.28
SW4	24/09/2010	14.6	501	7.37
SW4	01/10/2010	16.5	686	7.36
SW4	08/10/2010	7.14	669	16.1
SW4	15/10/2010	15.4	695	7.18
SW4	20/10/2010	13.2	748	7.4
SW4	29/10/2010	13.9	716	7.31
SW4	05/11/2010	11.8	701	7.18
SW4	11/11/2010	9.7	627	7.01
SW4	19/11/2010	9.3	632	7.11
SW4	26/11/2010	7.8	673	7.38
SW4	02/12/2010	4.8	739	7.32
SW4	09/12/2010			
SW4	17/12/2010			
SW4	22/12/2010	0	0	0

SW4	31/12/2010	10.5	704	7.26
SW5	04/01/2010			
SW5	12/01/2010			
SW5	20/01/2010	7.5	198	7.69
SW5	28/01/2010	7.1	238	7.91
SW5	05/02/2010	7.8	228	7.48
SW5	12/02/2010	7.2	259	7.24
SW5	16/02/2010	7.7	271	7.21
SW5	26/02/2010	7.1	306	8.77
SW5	04/03/2010			
SW5	09/03/2010			
SW5	19/03/2010			
SW5	23/03/2010			
SW5	01/04/2010	13.1	262	7.67
SW5	06/04/2010	10.7	211	7.02
SW5	16/04/2010	17.7	235	6.77
SW5	21/04/2010			
SW5	30/04/2010	15.2	227	7.07
SW5	07/05/2010	15.2	227	7.07
SW5	14/05/2010			
SW5	21/05/2010			
SW5	28/05/2010			
SW5	03/06/2010	15.2	212	6.82
SW5	11/06/2010			
SW5	18/06/2010			
SW5	25/06/2010	21.5	392	8.41
SW5	01/07/2010	19.2	381	8.37
SW5	09/07/2010	19.1	343	8.18
SW5	16/07/2010	17.4	321	7.02
SW5	23/07/2010	23.6	258	
SW5	26/07/2010	22.9	271	7.88
SW5	06/08/2010	18.2	318	7.45
SW5	12/08/2010	19.7	340	7.56
SW5	20/08/2010	19.3	351	7.64
SW5	25/08/2010	17	367	7.55
SW5	02/09/2010	17.1	755	7.82
SW5	08/09/2010	16.9	248	6.92
SW5	15/09/2010	16.8	310	7.1
SW5	24/09/2010	14.9	322	7.22
SW5	01/10/2010	16.8	531	7.43
SW5	08/10/2010	7.52	601	16.4
SW5	15/10/2010	15.1	521	7.3
SW5	20/10/2010	14.2	402	7.63
SW5	29/10/2010	14.7	307	7.22
SW5	05/11/2010	13.9	472	7.38
SW5	11/11/2010	9.6	454	7.03
SW5	19/11/2010	9.9	391	7.09
SW5	26/11/2010		357	7.01
SW5	02/12/2010			
SW5	09/12/2010			
SW5	17/12/2010	2.2	303	7.11
SW5	22/12/2010	0	0	0

SW5	31/12/2010	10.9	342	7.67
SW7	04/01/2010			
SW7	12/01/2010			
SW7	20/01/2010	7.3	368	7.55
SW7	28/01/2010			
SW7	05/02/2010	8.4	342	7.56
SW7	12/02/2010			
SW7	16/02/2010			0
SW7	26/02/2010	7	322	8.69
SW7	04/03/2010			
SW7	09/03/2010			0
SW7	19/03/2010			
SW7	23/03/2010			
SW7	01/04/2010	13.3	210	7.91
SW7	06/04/2010	11.2	192	7.62
SW7	16/04/2010			
SW7	21/04/2010			
SW7	30/04/2010			
SW7	07/05/2010			
SW7	14/05/2010			
SW7	21/05/2010			
SW7	28/05/2010			
SW7	03/06/2010			
SW7	11/06/2010			
SW7	18/06/2010			
SW7	25/06/2010			
SW7	01/07/2010			
SW7	09/07/2010			
SW7	16/07/2010	17	266	7.82
SW7	23/07/2010			
SW7	26/07/2010			
SW7	06/08/2010			
SW7	12/08/2010			
SW7	20/08/2010			
SW7	25/08/2010			
SW7	02/09/2010			
SW7	08/09/2010	17	212	7.28
SW7	15/09/2010	16.9	209	7.14
SW7	24/09/2010			
SW7	01/10/2010			
SW7	08/10/2010			
SW7	15/10/2010			
SW7	20/10/2010			
SW7	29/10/2010	13.3	411	7.44
SW7	05/11/2010	12.4	311	7.51
SW7	11/11/2010	9.1	386	7.21
SW7	19/11/2010	9.4	371	7.16
SW7	26/11/2010			
SW7	02/12/2010			
SW7	09/12/2010			
SW7	17/12/2010			
SW7	22/12/2010	0	0	0

SW7	31/12/2010			
SW8	04/01/2010			
SW8	12/01/2010			
SW8	20/01/2010	9	212	7.51
SW8	28/01/2010	9.7	219	7.62
SW8	05/02/2010	8.5	201	7.52
SW8	12/02/2010	7.4	221	7.49
SW8	16/02/2010	7.2	227	7.47
SW8	26/02/2010	7.2	385	8.69
SW8	04/03/2010	6.9	276	8.72
SW8	09/03/2010	8.4	294	7.02
SW8	19/03/2010	9.5	298	7.11
SW8	23/03/2010	10.1	283	8.31
SW8	01/04/2010	12.7	286	7.94
SW8	06/04/2010	11.7	238	7.6
SW8	16/04/2010			
SW8	21/04/2010			
SW8	30/04/2010			
SW8	07/05/2010			
SW8	14/05/2010			
SW8	21/05/2010			
SW8	28/05/2010			
SW8	03/06/2010			
SW8	11/06/2010			
SW8	18/06/2010			
SW8	25/06/2010			
SW8	01/07/2010			
SW8	09/07/2010	18.2	277	7.97
SW8	16/07/2010	17.1	240	7.71
SW8	23/07/2010			
SW8	26/07/2010			
SW8	06/08/2010	17.4	242	8.62
SW8	12/08/2010	18.3	267	7.53
SW8	20/08/2010		272	7.55
SW8	25/08/2010	16.9	233	8.11
SW8	02/09/2010	18.7	313	7.63
SW8	08/09/2010	17.2	276	7.48
SW8	15/09/2010	16.9	242	7.29
SW8	24/09/2010	13.4	263	7.34
SW8	01/10/2010	16.9	257	7.47
SW8	08/10/2010	7.49	312	15.3
SW8	15/10/2010	7.51	314	14.5
SW8	20/10/2010			
SW8	29/10/2010	13.7	460	7.49
SW8	05/11/2010	12.8	348	7.63
SW8	11/11/2010	9.2	351	7.24
SW8	19/11/2010	9.3	363	7.18
SW8	26/11/2010	6.4	311	7.12
SW8	02/12/2010			
SW8	09/12/2010			
SW8	17/12/2010			
SW8	22/12/2010	0	0	0

SW8	31/12/2010	10.1	376	7.7

2010 Quarterly Surface Water Monitoring

		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
Dis Oxygen q1	%Sat	100	88	93	83	70
Dis Oxygen q2	%Sat	109	112	107	80	nm
Dis. Oxygen q3	%Sat	80	72	82	75	nm
Dis. Oxygen q4	%Sat	71	73	73	78	79
median		90	80.5	87.5	79	74.5

		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
pH q1	pH	8.2	7.8	8	7.8	7.7
pH q2	pH	8.3	8.3	8.2	7.7	nm
pH q3	pH	7.9	7.8	8.2	7.7	nm
pH q4	pH	7.3	7.5	7.5	7.3	7.4
median		8.05	7.8	8.1	7.7	7.55

		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
Cond @25°C q1	uS/cm	630	643	645	573	231
Cond @25°C q2	uS/cm	731	727	712	786	nm
Cond. @25°C q3	µS/cm	764	763	744	831	nm
Cond. @25°C q4	µS/cm	520	527	552	550	412
median		680.5	685	678.5	679.5	321.5

		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
Ammonia q1	mg/lN	0.13	0.15	0.12	0.5	0.44
Ammonia q2	mg/lN	0.07	0.09	0.04	0.11	nm
Ammonia q3	mg/lN	0.09	0.14	0.2	0.65	nm
Ammonia q4	mg/lN	0.05	0.2	0.04	0.06	0.48
median		0.08	0.145	0.08	0.305	0.46

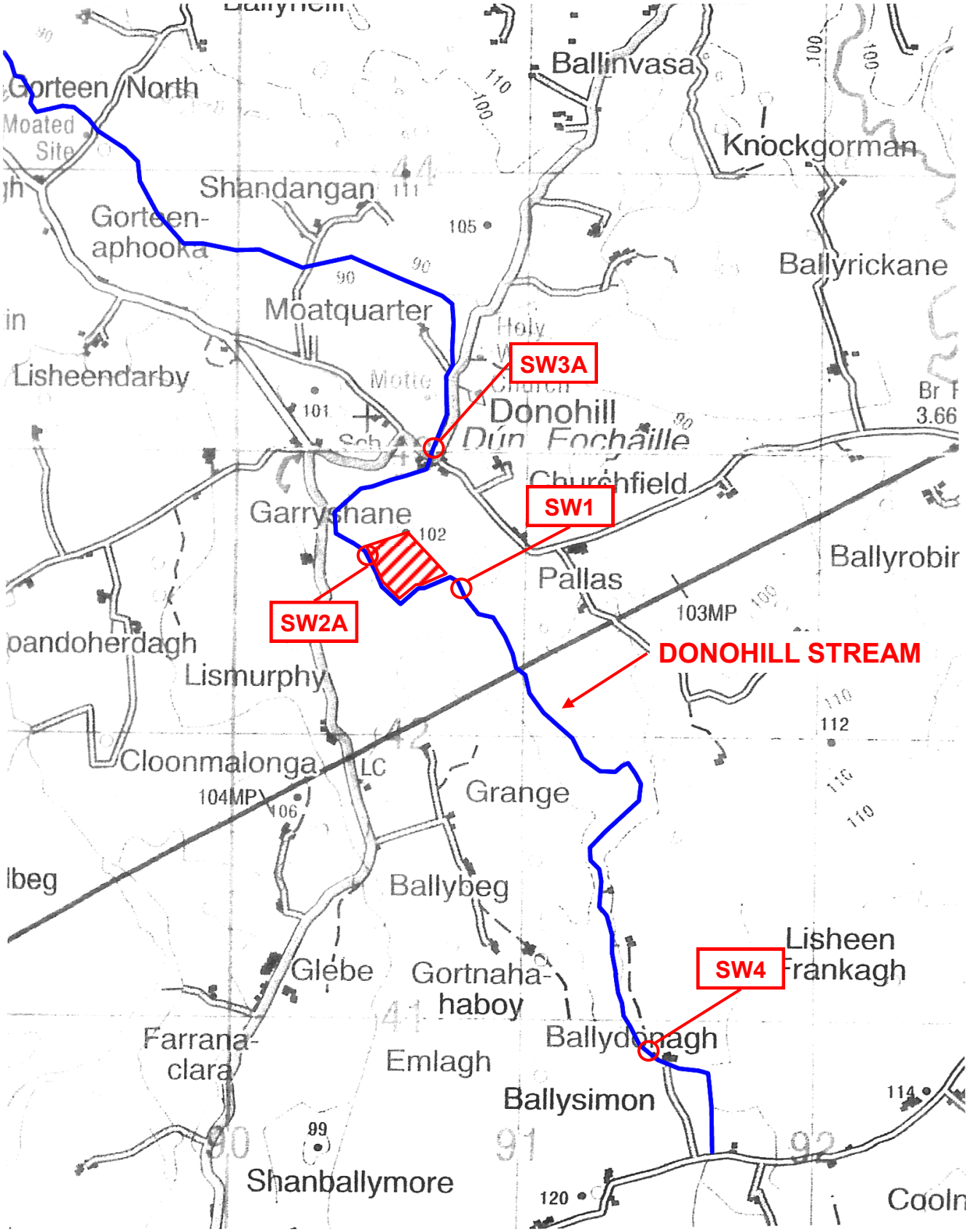
		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
Chloride q1	mg/l Cl	13	13	13	15	12
Chloride q2	mg/l Cl	15	15	15	23	nm
Chlorideq3	mg/l Cl	17	17	17	27	nm
Chloride q4	mg/l Cl	11	11	12	13	6
median		14	14	14	19	9

		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
BOD q1	mg/l 02	1	1.1	0.9	3.8	1.6
BOD q2	mg/l 02	1.5	0.9	0.5	0.6	nm
BOD q3	mg/l 02	0.9	1	0.9	1.1	nm
BOD q4	mg/l 02	2.3	2.7	1.6	1.7	3.1
median		1.25	1.05	0.9	1.4	2.35

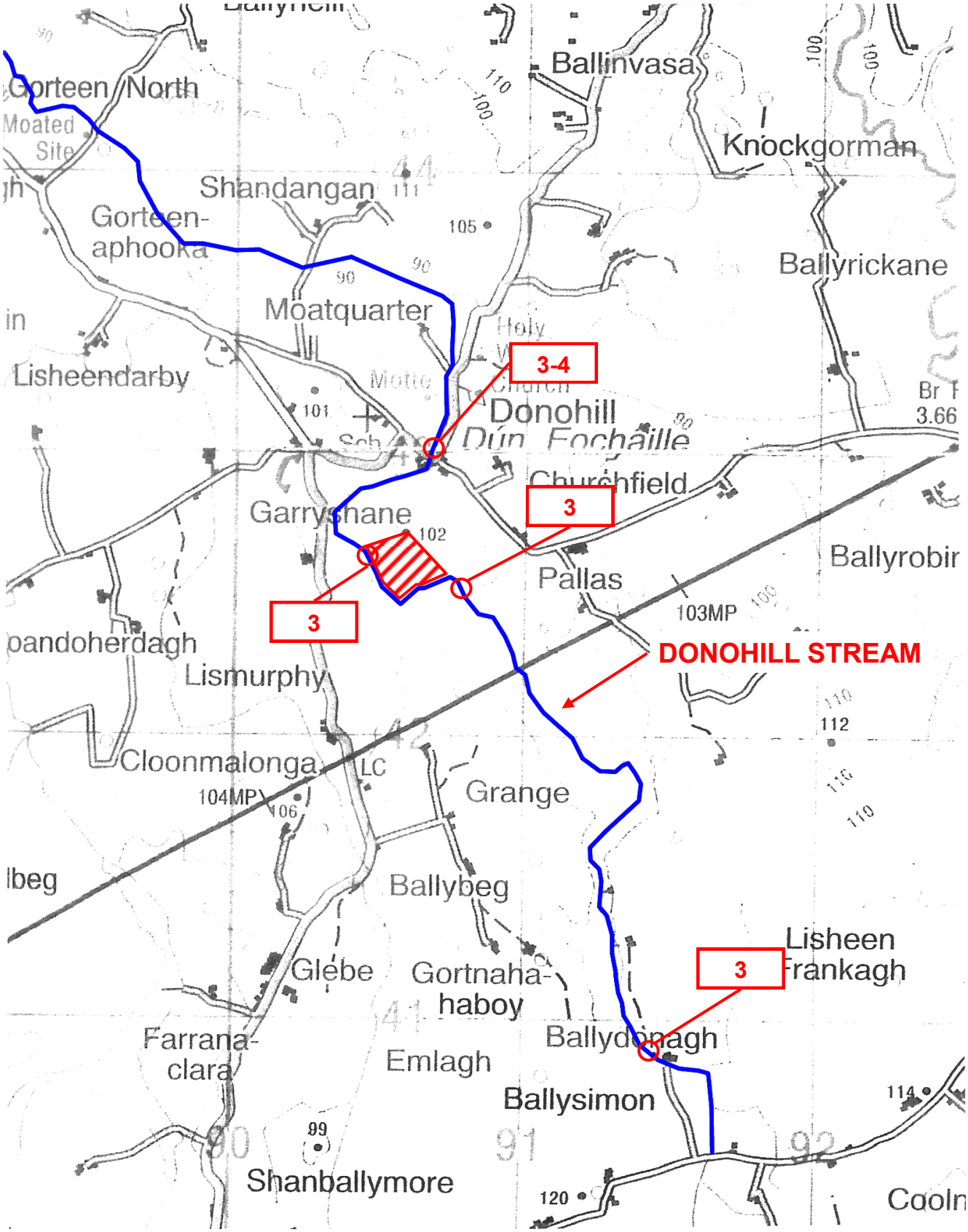
		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
COD q1	mg/l 02	10	10	10	39	20
COD q2	mg/l 02	23	25	25	22	nm
COD q3	mg/l 02	20	27	26	26	nm
COD q4	mg/l 02	40	38	33	30	24
median		21.5	26	25.5	28	22

		SW1	SW2a	SW3a	SW4	SW5
		WST-W0074-02-SW1	WST-W0074-02-SW2a	WST-W0074-02-SW3a	WST-W0074-02-SW4	WST-W0074-02-SW5
Susp. Solids q1	mg/l	4.75	4.7	3.25	59	2.5
Susp. Solids q2	mg/l	23	14	27	69	nm
Susp. Solids q3	mg/l	17	13	13	6	nm
Susp. Solids q4	mg/l	2.5	2.5	6	7	46
median		10.875	8.85	9.5	33	24.25

MAP 1 LOCATION OF BIOLOGICAL ASSESSMENT SITES



MAP 2 Q-RATINGS AT BIOLOGICAL ASSESSMENT SITES



BIOLOGICAL MONITORING OF WATER QUALITY IN THE VICINITY OF DONOHILL LANDFILL, COUNTY TIPPERARY

September 2010

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Tel/Fax 064 6630130 e-mail cs@conservation-services.ie

CONTENTS

1. INTRODUCTION

As part of the monitoring of water quality in the vicinity of Donohill Landfill Site, Conservation Services, Ecological & Environmental Consultants have been commissioned by Tipperary S.R. County Council to carry out biological water quality assessment in accordance with EPA Q-rating methodology at four locations adjacent to the landfill site. Biological monitoring was most recently carried out by Conservation Services in May 2010 (Conservation Services May 2010).

Sampling was carried out on 20th September 2010.

2. METHODOLOGY

2.1. SITE LOCATIONS

Biological sampling and water quality assessment was carried out at the following sites specified by Tipperary S.R. County Council. Grid references were recorded at all sites using a GPS.

SITE	GRID REFERENCE (GPS)
Site SW4	R 9143 4088
Site SW1	R 9076 4255
Site SW2A	R 9046 4263
Site SW 3A	R 9070 4298

The location of the sites is shown on Map 1.

2.2. HABITAT ASSESSMENT

Habitat assessment was carried out at each of the four sites selected for invertebrate/water quality assessment. These sites were assessed in terms of:

- Stream width and depth
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area

- Instream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site

- Dominant bankside vegetation, listing the main species overhanging the stream

- Estimated summer cover by bankside vegetation, giving percentage shade of the sampling site

- Rating of the site as habitat for trout adult, nursery and spawning on a scale of Poor/Fair/Good/Very Good/Excellent. This rating assesses the physical suitability of the habitat; the presence/absence/density of salmonids at the site will also depend on present and historical water quality and accessibility of the site to fish.

2.3. INVERTEBRATE SAMPLING AND WATER QUALITY ASSESSMENT

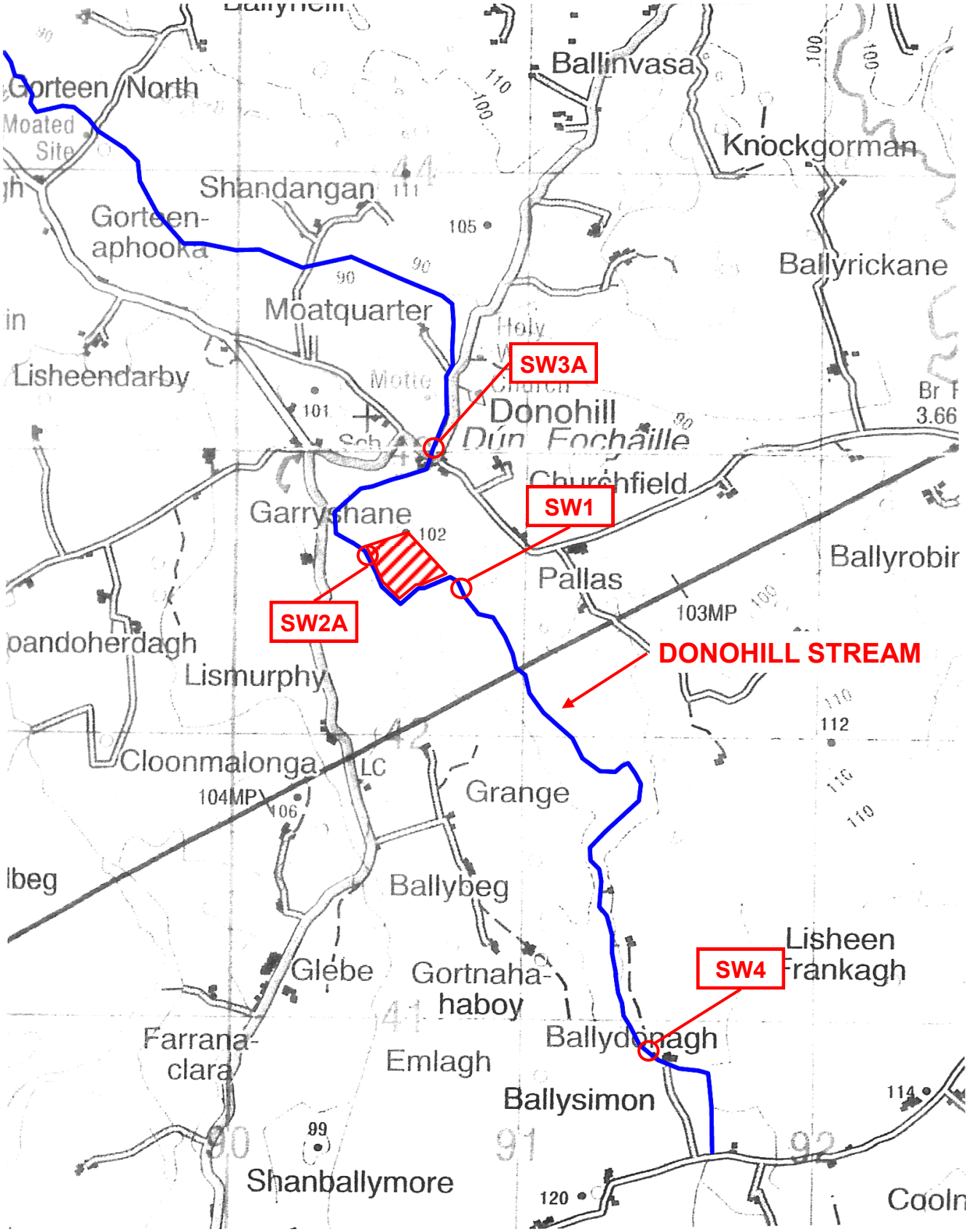
A five-minute kick and stone wash sample was taken at each of the four sites (ISO 7828:1985). Each sample was retained in a large plastic bag at the sampling site. Sample processing and preservation was carried out under laboratory conditions within 24 hours of sampling. Mud was removed from each sample by sieving under running water through a 500µ sieve. Sieved samples were then live sorted for 30 minutes in a white plastic sorting tray under a bench lamp (ISO 5667-3:1994) and if necessary using a magnifying lens.

Macroinvertebrates were stored in 70% alcohol. Preserved invertebrates were identified to the level required for the EPA Q-rating method (McGarrigle *et al*, 2002) using high-power and low-power binocular microscopes when necessary. The preserved samples were archived for future examination or verification. Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined for each site in accordance with the biological assessment procedure used by the Environmental Protection Agency (McGarrigle *et al*,

2002) and more detailed unpublished methodology (McGarrigle, Clabby and Lucey pers. comm.)

Biotic Index	**Water Framework Directive Ecological Status**	**Quality Status**
Q5	High	Unpolluted Waters
Q4-5	High	
Q4	Good	
Q3-4	Moderate	Slightly Polluted Waters
Q3	Poor	Moderately Polluted Waters
Q2-3	Poor	
Q2	Bad	Seriously Polluted Waters
Q1-2	Bad	
Q1	Bad	

MAP 1 LOCATION OF BIOLOGICAL ASSESSMENT SITES



3. RESULTS

Detailed habitat assessment for each sampling site, including aquatic plant assessment and site photograph, is contained in Appendix 1.

3.1. SITE SW4

The invertebrates recorded at this site merit a Q-rating of Q2 indicating seriously polluted conditions, marking a deterioration from the Q3 recorded in May 2010.

INDICATOR GROUP	TAXON	Sep 2010
Group A - Very Pollution Sensitive	Taeniopterygidae	1
Group B - Moderately Pollution Sensitive	None Recorded	
Group C - Moderately Pollution Tolerant	Chironomidae (ex. *Chironomus*)	17
Group D - Very Pollution Tolerant	*Lymnaea peregra*	6
	Asellus aquaticus	47
Group E - Most Pollution Tolerant	Tubificidae	7
	Chironomus sp.	43
Taxa not assigned to an indicator group	Lumbricidae	1
	Lumbriculidae	2
	Ceratopogonidae	1

3.2. SITE SW1

The invertebrates recorded at this site merit a Q-rating of Q2-3 indicating moderately polluted conditions; a disimprovement compared with Q3 in May 2010.

INDICATOR GROUP	TAXON	Sep 2010
Group A - Very Pollution Sensitive	None Recorded	
Group B - Moderately Pollution Sensitive	Coenagriidae	1
	Sericostomatidae	1
Group C - Moderately Pollution Tolerant	*Bithynia tentaculata*	14
	Hydracarina	3
	Dytiscidae	2
	Hydrophilidae	1
	Chironomidae (ex. *Chironomus*)	76
Group D - Very Pollution Tolerant	Erpobdellidae	1
	Glossiphonia sp.	3
	Lymnaea palustris	2
	Physa fontinalis	1
	Asellus aquaticus	12
Group E - Most Pollution Tolerant	Tubificidae	30
	Chironomus sp.	10

3.3. SITE SW2A

The invertebrates recorded at this site merit a Q-rating of Q2-3 indicating moderately polluted conditions; a disimprovement compared with Q3 in September 2009.

INDICATOR GROUP	TAXON	Sep 2010
Group A - Very Pollution Sensitive	None Recorded	
Group B - Moderately Pollution Sensitive	Coenagriidae	1
	Sericostomatidae	2
Group C - Moderately Pollution Tolerant	Planorbiidae	1
	Gammarus duebeni	1
	Hydracarina	4
	Chironomidae (ex. *Chironomus*)	9
Group D - Very Pollution Tolerant	Erpobdellidae	4
	Glossiphonia sp.	1
	Asellus aquaticus	69
Group E - Most Pollution Tolerant	Tubificidae	4
	Chironomus sp.	1
Taxa not assigned to an indicator group	Ceratopogonidae	2

3.4. SITE SW3A

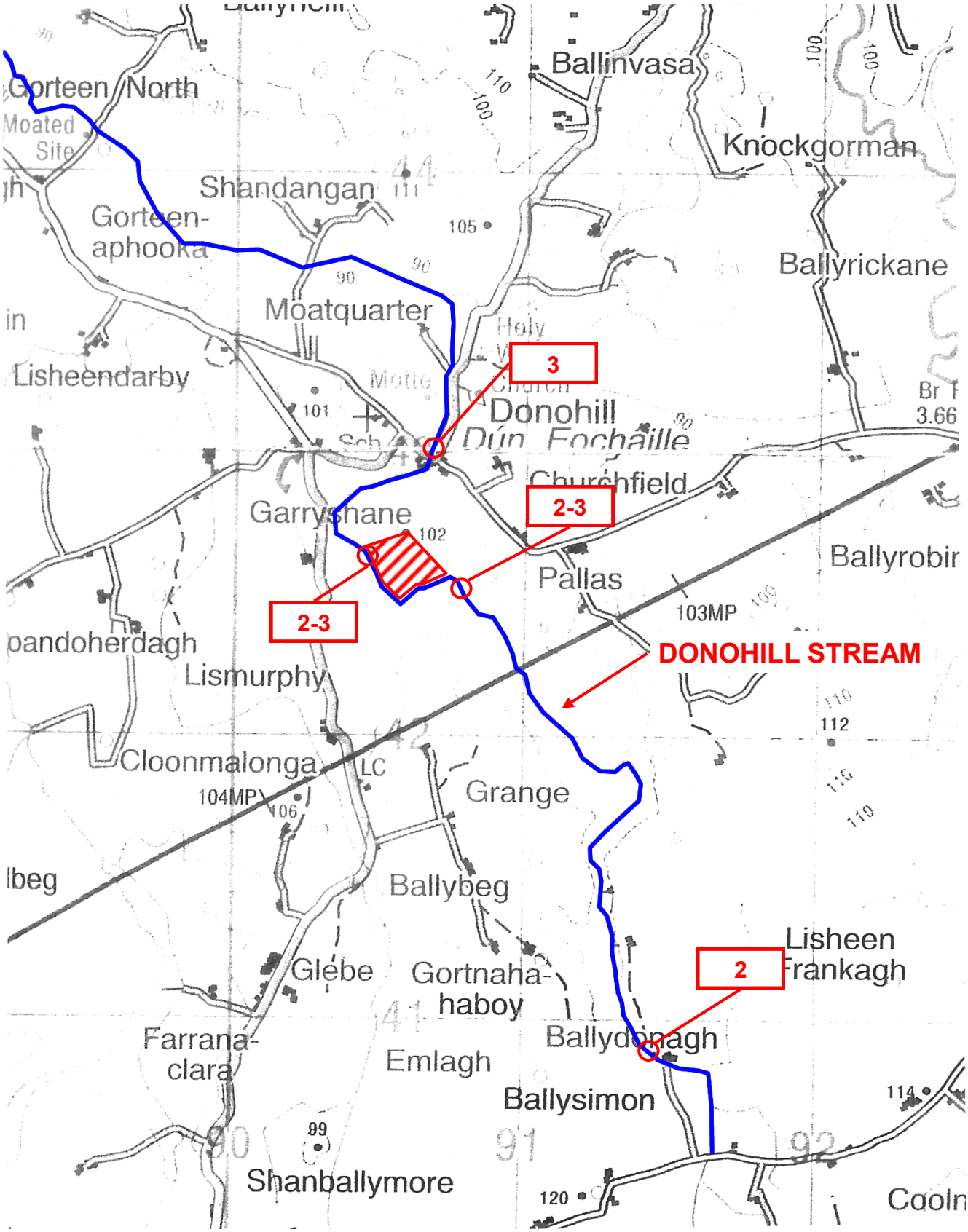
The invertebrates recorded at this site merit a Q-rating of Q3 indicating moderately polluted conditions; a disimprovement compared with Q3-4 in May 2010.

INDICATOR GROUP	TAXON	Sep 2010
Group A - Very Pollution Sensitive	None Recorded	
Group B - Moderately Pollution Sensitive	*Baetis muticus*	7
	Sericostomatidae	20
Group C - Moderately Pollution Tolerant	*Gammarus duebeni*	c.300
	Baetis rhodani	2
	Hydropsychidae	4
	Elmidae	17
	Gyrinidae	2
	Helodidae	1
	Chironomidae	2
Group D - Very Pollution Tolerant	*Glossiphonia sp.*	1
	Helobdella stagnalis	1
	Asellus aquaticus	15
Group E - Most Pollution Tolerant	Tubificidae	11
Taxa not assigned to an indicator group	Lumbricidae	6

4. SUMMARY OF MONITORING RESULTS: Q-RATINGS 2003 - 2010

	Upstream of Landfill		Downstream of landfill	
	SW4	**SW1**	**SW2A**	**SW3A**
March 2003	-	-	-	2-3
June 2004	1-2	2-3	2	2-3
April 2005	1-2	2-3	2-3	2-3
July 2005	2-3/0	2-3/0	2-3	2-3
March 2006	2/0	2-3	2-3	2-3
Nov. 2006	2	2	2	2-3
July 2007	2	2-3/0	2-3	2-3
Sept. 2007	2	2-3	2-3	3
May 2008	2-3	2-3	2-3	3-4
Oct. 2008	2	1-2	2	3
May 2009	3	2-3	2-3	3
Sept. 2009	1-2	2-3	2-3	3
May 2010	3	3	3	3-4
Sept. 2010	2	2-3	2-3	3

MAP 2 Q-RATINGS AT BIOLOGICAL ASSESSMENT SITES



5. CONCLUSIONS

Results of biological assessment in September 2010 indicate a deterioration in the water quality of the Donohill Stream, both upstream and downstream of the landfill, since May 2010.

As biological water quality is the same immediately upstream and immediately downstream of the landfill, the results of the biological assessment contain no evidence that the landfill is causing any deterioration in the biological water quality of the stream.

Signed on behalf of Conservation Services

_____

Helena Twomey BA(Mod.) PhD

Date

6. REFERENCES

Conservation Services (May 2010) Biological monitoring of water quality in the vicinity of Donohill Landfill, County Tipperary – May 2010. Report to Tipperary South Riding County Council.

McGarrigle *et al* (2002) Water Quality in Ireland 1998-2000. Environmental Protection Agency.

APPENDIX 1

HABITAT ASSESSMENT AT SAMPLING SITES

Site Code	SW4
Site Photograph	
Site Location	End of lane, Ballydonagh, c. 2km upstream of landfill
Grid Reference	R9143 4088
Width	1.5m
Depth	5cm
Substrate	Mud, Sand, Gravel
Flow Type	Glide 100%
Instream Vegetation	Algae 30%, Slime growth 60%
Dominant Bankside Vegetation	Ash, Bramble, Hawthorn
Summer Cover of Stream by Bankside Vegetation	50%
Salmonid Adult Habitat	None
Salmonid Nursery Habitat	None
Salmonid Spawning Habitat	None

Site Code	SW 1
Site Photograph	
Site Location	Just upstream of landfill
Grid Reference	R9076 4255
Width	3m
Depth	25cm
Substrate	Mud
Flow Type	Slow Glide 100%
Instream Vegetation	*Lemna minor* 60% *Phalaris arundinacea* 15% *Callitriche sp.* 20% *Sparganium erectum* 10%
Dominant Bankside Vegetation	Hawthorn
Summer Cover of Stream by Bankside Vegetation	20%
Salmonid Adult Habitat	None
Salmonid Nursery Habitat	None
Salmonid Spawning Habitat	None

Site Code	SW 2A
Site Photograph	
Site Location	Just upstream of landfill entrance.
Grid Reference	R 9046 4263
Width	2-4m
Depth	25cm
Substrate	Mud
Flow Type	Glide 100%
Instream Vegetation	*Apium nodiflorum* 65% *Phalaris arundinacea* 30% *Sparganium erectum* 10% *Rorippa nasturtium-aquaticum* agg. <1% *Berula erecta* <1%
Dominant Bankside Vegetation	Grass, Phalaris
Summer Cover of Stream by Bankside Vegetation	5%
Salmonid Adult Habitat	None
Salmonid Nursery Habitat	None
Salmonid Spawning Habitat	None

Site Code	SW 3A
Site Photograph	
Site Location	Donohill Village d/s bridge
Grid Reference	R 9070 4298
Width	1 - 1.5m
Depth	10 - 15cm
Substrate	Sand, Gravel, Cobble, Mud
Flow Type	Riffle 40% Glide 50%
Instream Vegetation	*Apium nodiflorum* 70% *Phalaris arundinacea* 20% *Berula erecta* <1%
Dominant Bankside Vegetation	Grasses, Nettle, Bramble
Summer Cover of Stream by Bankside Vegetation	20%
Salmonid Adult Habitat	None
Salmonid Nursery Habitat	Poor-Fair
Salmonid Spawning Habitat	None-Poor

APPENDIX 5 GROUNDWATER MONITORING RESULTS

Location	Date Sampled	Water Temp	Depth to GW
GW 11D	29/01/2010	8.9	2.92
GW 11D	26/02/2010	2.97	7.1
GW 11D	31/03/2010	9.2	2.9
GW 11D	21/04/2010	19.7	3.22
GW 11D	25/05/2010	18.9	3.43
GW 11D	29/06/2010	24.1	3.59
GW 11D	28/07/2010	19.8	3.67
GW 11D	30/08/2010	23.9	3.66
GW 11D	27/09/2010		
GW 11D	29/10/2010	11.2	3.04
GW 11D	30/11/2010		
GW 11D	22/12/2010	7.9	2.98
GW 11S	29/01/2010	8.6	2.7
GW 11S	26/02/2010	2.82	7.4
GW 11S	31/03/2010	8.9	2.67
GW 11S	21/04/2010	19.8	3.21
GW 11S	25/05/2010	21.5	3.38
GW 11S	29/06/2010	23.2	3.45
GW 11S	28/07/2010	19.4	3.52
GW 11S	30/08/2010	23.7	3.81
GW 11S	27/09/2010		
GW 11S	29/10/2010	11.1	3.12
GW 11S	30/11/2010		
GW 11S	22/12/2010	7.6	3.01
GW 12D	29/01/2010	9.4	8.87
GW 12D	26/02/2010	8.91	8
GW 12D	31/03/2010	9	8.84
GW 12D	21/04/2010		
GW 12D	25/05/2010	22.7	8.19
GW 12D	29/06/2010	18.6	8.28
GW 12D	28/07/2010	18.7	8.34
GW 12D	30/08/2010	24	8.47
GW 12D	27/09/2010	16.4	8.3
GW 12D	29/10/2010	10.8	7.95
GW 12D	30/11/2010	8.4	8.04
GW 12D	22/12/2010	8.1	7.94
GW 12S	29/01/2010	9	8.64
GW 12S	26/02/2010	8.73	7.6
GW 12S	31/03/2010	8.4	8.61
GW 12S	21/04/2010	14.4	9.51
GW 12S	25/05/2010	22.6	8.03
GW 12S	29/06/2010	18.4	8.14
GW 12S	28/07/2010	18.9	8.26
GW 12S	30/08/2010	23.2	8.32
GW 12S	27/09/2010	16.1	8.45
GW 12S	29/10/2010	10.9	8.07
GW 12S	30/11/2010	8.8	8.15
GW 12S	22/12/2010	8.3	8.01

GW 13	29/01/2010	9.2	2.12
GW 13	26/02/2010	9.41	7
GW 13	31/03/2010	8.7	2.09
GW 13	21/04/2010	15.2	2.74
GW 13	25/05/2010	23	3
GW 13	29/06/2010	17.3	3.11
GW 13	28/07/2010	19.1	3.2
GW 13	30/08/2010	24.1	3.43
GW 13	27/09/2010	16	3.45
GW 13	29/10/2010	9.9	3.24
GW 13	30/11/2010	9.1	3.26
GW 13	22/12/2010	8.4	3.11
GW 14	29/01/2010	10.3	6.94
GW 14	26/02/2010	10.39	6.8
GW 14	31/03/2010	9.1	6.9
GW 14	21/04/2010	15.5	7.19
GW 14	25/05/2010	22.8	7.39
GW 14	29/06/2010	17.5	7.52
GW 14	28/07/2010	21.8	7.59
GW 14	30/08/2010	22.6	7.7
GW 14	27/09/2010	16.3	7.71
GW 14	29/10/2010	10.2	7.29
GW 14	30/11/2010	9.2	7.32
GW 14	22/12/2010	7.9	7.19
GW 15	29/01/2010	14.4	5.65
GW 15	26/02/2010	14.62	6.7
GW 15	31/03/2010	9.4	5.61
GW 15	21/04/2010	18.8	5.94
GW 15	25/05/2010	23	6.24
GW 15	29/06/2010	18.5	6.41
GW 15	28/07/2010	22.2	6.5
GW 15	30/08/2010	22.2	6.59
GW 15	27/09/2010	16.5	6.73
GW 15	29/10/2010	10.3	6.53
GW 15	30/11/2010	9.4	6.59
GW 15	22/12/2010	8	6.44

2010 Groundwater Monitoring

GW11d		Q1	Q2	Q3	Q4	
LOCATION_	**unit**					
CODE		11d	11d	11d	11d	**Median**
Temperature	°C	10.7	11.8	11.8	11.5	11.65
pH	pH	7.6	7.7	7.5	7.3	7.55
Conductivity @25°C	uS/cm	679	696	693	648	686
Ammonia	mg/l N	0.04	0.03	0.02	0.07	0.035
Chloride	mg/l Cl	17	17	18	16	17
Total coliforms	No/100 ml	360	5	5	5	5
EColi	per 100ml	5	5	5	5	5

GW12s		Q1	Q2	Q3	Q4	
LOCATION_	**unit**					
CODE		**12s**	**12s**	**12s**	12s	**Median**
Temperature	°C	10.3	10.9	11.2		10.9
pH	pH	7.3	7.2	7.2		7.2
Conductivity @25°C	uS/cm	776	762	768		768
Ammonia	mg/l N	0.005	0.11	0.005		0.005
Chloride	mg/l Cl	19	19	19		19
Total coliforms	No/100 ml	10	5	5		5
EColi	per 100ml	10	5	5		5

GW12d		Q1	Q2	Q3	Q4	
LOCATION_CODE	**unit**	**12d**	**12d**	12d	12d	**Median**
Temperature	°C	10.2	11.1	11.5		11.1
pH	pH	7.3	7.4	7.3		7.3
Conductivity @25°C	uS/cm	800	800	804		800
Ammonia	mg/l N	0.02	0.03	0.02		0.02
Chloride	mg/l Cl	19	25	27		25
Total conforms	No/100 ml	2000	20	230		230
EColi	per 100ml	10	5	5		5

GW13

		Q1	Q2	Q3	Q4	
LOCATION_CODE	**unit**	**13**	**13**	**13**	**13**	**Median**
Temperature	°C	10.6	11.4	11.3	11.4	11.35
pH	pH	7.5	7.8	7.6	7.5	7.55
Conductivity @25°C	uS/cm	582	574	565	557	569.5
Ammonia	mg/l N	0.07	0.08	0.09	0.1	0.085
Chloride	mg/l Cl	15	15	15	15	15
Total conforms	No/100 ml	31	5	5	20	12.5
EColi	per 100ml	5	5	5	5	5

GW14

		Q1	Q2	Q3	Q4	
LOCATION_CODE	**unit**	**14**	**14**	**14**	**14**	**Median**
Temperature	°C	10.7	11.6	11.7	11	11.3
pH	pH	7.7	8	7.6	7.4	7.65
Conductivity @25°C	uS/cm	567	547	554	561	557.5
Ammonia	mg/l N	0.1	0.01	0.06	0.01	0.035
Chloride	mg/l Cl	16	16	17	16	16
Total conforms	No/100 ml	5	5	5	5	5
EColi	per 100ml	5	5	5	5	5

GW15

		Q1	Q2	Q3	Q4	
LOCATION_CODE	**unit**	**15**	**15**	**15**	**15**	**Median**
Temperature	°C	10.6	11.8	11.9	11.5	11.65
pH	pH	7.5	7.8	7.4	7.3	7.45
Conductivity @25°C	uS/cm	660	539	565	653	609
Ammonia	mg/l N	0.08	0.05	0.06	0.06	0.06
Chloride	mg/l Cl	19	19	19	18	19
Total conforms	No/100 ml	20	5	5	5	5
EColi	per 100ml	5	5	5	5	5

APPENDIX 6 WATER BALANCE CALCULATIONS

South Tipperary Co. Co.

Water Balance Calculation

Prepared for:
South Tipperary County Council
Donohill Landfill

Revision: 1 ***Date: 16/03/11***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: AR **CHECKED:** CJC
DATE: 16/03/11 **REVISION:** 1
JOB NUMBER: **LW11-024-01**
CALC NUMBER: **C-01**
FILE Q:\2011\LW11\024\01\Calculations\Calc Set 03 Water Balance\LW1102401_Calc set 03 Water Balance.xls
SHEET Calc cover

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Water Balance Calculation**

Rev	Date	Purpose and Description	Prepared	Checked
1	16/3/11	Preparation of annual water balance calculation	AR	CJC

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DATE:	16.3.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 03 Water Balance\LW1102401_Calc set 03 Water Balance.xls		
SHEET	Calc Sheet		

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Water Balance Calculation**

Ref.

Output

i references

1 2009 AER for Donohill Landfill
..\..\Incoming\LW1102401_2009 AER.pdf
2 Incoming weather data from STCC
ARC RE recent quotation request - rain and leachate data.msg
3 2009 Water Balance Calculation
LW1002401_One Year Water Balance Rev A.xls
4 Waste Data for 2010
LW1002401_Waste Summary 10.xls
LW1002401_Tonnages Refuse Collection and landfilled 05, 06, 07, 08,09, 10,11.xls
5 Email in re waste inputs
..\Calc Set 02 LFG\ ARC_RE_recent quotation request - waste 2010.msg
6 Sketch of catchment areas
LW1002401_catchment areas donohill 2010.pdf
7 Revised waste input data from STCC
..\..\Incoming\LW1002401_waste summary 2010 rerun.xls

ii List of FTC Drawings

iii List of Appendices
Appendix A - Water Balance

1.0 Introduction
2.0 Calculation
2.1 Review of 2010 leachate removal & weather records
2.2 Water Balance Equation
2.3 Definition of catchment areas
2.4 Waste inputs 2010
2.5 Comparison

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JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 03 Water Balance\LW1102401_Calc set 03 Water Balance.xls		
SHEET	Calc Sheet		

PROJECT: South Tipperary Co. Co.
DESCRIPTION: Water Balance Calculation

Ref. | Output

1.0 Introduction

The purpose of this calculation is to prepare the annual water balance calculation for Donohill Landfill for inclusion in the 2010 AER.

FTC will:
- Review background information, including historical water balance calculations, siteworks and 2010 leachate records
- Prepare the water balance calculation and report

2.0 Calculation

2.1 Review of 2010 leachate removal & weather records

Using information provided by STCC, the following are the monthly leachate removal volumes for Donohill for 2010. (2)

Month	Leachate Tankered from site	Rainfall (mm)	Evaporation (mm)	Eff. Rainfall (mm)
Jan	2,571.94	64.6	6.46	58.14
Feb	2,006.28	41.4	4.14	37.26
Mar	1,288.62	70.8	7.08	63.72
Apr	1,933.18	32	3.2	28.8
May	595.72	41.2	4.12	37.08
Jun	752.28	32.2	3.22	28.98
Jul	1,186.27	89.2	8.92	80.28
Aug	564.54	29.6	2.96	26.64
Sep	1,811.29	105.2	10.52	94.68
Oct	725.42	106.6	10.66	95.94
Nov	3,702.79	72	7.2	64.8
Dec	1,011.44	20.2	2.02	18.18
Total	**18,149.77**	**705**	**70.5**	**634.5**

It is assumed that 1 tonne of leachate is equivalent to 1 m^3 (i.e. the density of leachate is 1 t/m^3).

The evaporation measurements taken at site are not reliable. For the purposes of this calculation, a 10% evaporation factor has been assumed (as in previous years).

The total figures compare to those from the 2009 AER as follows:

	2009	**2010**
Total Leachate:	24,800	18,150
Total Rainfall	1,074	705
Total Evaporation:	107	71
Total Eff. Rainfall:	966	635

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DESIGNED:	AR	**CHECKED:**	CJC
DATE:	16.3.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 03 Water Balance\LW1102401_Calc set 03 Water Balance.xls		
SHEET	Calc Sheet		

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Water Balance Calculation**

Ref. | Output

2.2 Water Balance Equation

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

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

where:
- Lo = leachate produced(m³)
- effective rainfall, [(ER) is defined as Total Rainfall (R) minus
- ER = Actual Evapotranspiration (AE) i.e. ER=R-AE]
- A = area of cell (m³)
- 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)

2.3 Definition of catchment areas

The areas contributing to the surface water calculation are defined as in previous years as follows:

Zone	Area (m²)	Infiltration (%)	Description
1	23,120	5	Phase 1 Capping (Areas 1 and 2)
2a	5,600	65	Phase 2 Capping (temp cap up to Dec 2010)
2b	5,600	5	Phase 2 Capping (perm cap installed by Dec 2010)
3a	2,430	65	Area 3 Cell, 750 mm temp cap installed
3b	2,640	100	Area 3 Cell, haul road with terram and road makeup; runoff flows into active cells
4a	3,130	100	Area 4 temp cap, discharge is to leachate collection system
5	7,180	100	Active Area
Lagoon	570		Lagoon Area

2.4 Waste inputs 2010

7 The total waste input for 2010 is 15951 t

Monthly waste inputs provided by STCC are as follows:

	Month	Input (t)
4	Jan	1,402
	Feb	1,399
	Mar	1,924
	Apr	1,164
	May	1,077
	Jun	1,319
	Jul	1,883
4	Aug	553

Month	Input (t)
Sept	1,002
Oct	1,148
Nov	1,378
Dec	1,701
Total	**15,951**

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DATE:	16.3.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 03 Water Balance\LW1102401_Calc set 03 Water Balance.xls		
SHEET	Calc Sheet		

PROJECT: South Tipperary Co. Co.
DESCRIPTION: Water Balance Calculation

Ref. | Output

2.5 Comparison

The leachate generation estimated from the water balance is shown below compared to the leachate removed from site as per STCC's records.

Month	Leachate Tankered from site	Estimated Leachate Generation
Jan	2,571.94	1,703.11
Feb	2,006.28	1,241.31
Mar	1,288.62	1,400.08
Apr	1,933.18	906.81
May	595.72	1,023.77
Jun	752.28	909.36
Jul	1,186.27	1,634.00
Aug	564.54	876.30
Sep	1,811.29	1,837.40
Oct	725.42	1,855.20
Nov	3,702.79	1,415.33
Dec	1,011.44	695.72
Total	**18,149.77**	**15,498.39**

1 The calculated leachate generation for 2009 was 27,117 m³ which compared to a recorded volume removed from site of 24,800 m³.

The discrepancy between water balance calculations and records is less than 15% suggesting the model is representative of prevailing site conditions.

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Appendix A - Water Balance

Appendix A

Water Balance Calculation for Donohill Landfill Facility

Month	Rainfall	Evaporation	Effective Rainfall	Waste Input (from STCC)	Active Area* (Z5)	Intermediate Area (with discharge to leachate system) (Z3b&4a)	Intermediate Area (temporarily capped) (2a & 3a)	Fully Capped Area (Z1&2b)	Active Infiltration	Intermediate Infiltration *	Capped Infiltration	Liquid Waste	Lagoon Contribution	Absorptive Capacity	Active Leachate	Contaminated water from Cell 4 settlement	Total Leachate Production	Cumulative 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)	(m^3)	(m^3)	(m^3)
Jan-10	64.6	6.46	58.14	1,402	7,180	5,770	8,030	23,120	463.8	638.9	67.2	0	33.1	0.0	463.8	500	1,703.1	1,703.1
Feb-10	41.4	4.14	37.26	1,399	7,180	5,770	8,030	23,120	267.5	409.5	43.1	0	21.2	0.0	267.5	500	1,241.3	2,944.4
Mar-10	70.8	7.08	63.72	1,924	7,180	5,770	8,030	23,120	457.5	332.6	73.7	0	36.3	0.0	457.5	500	1,400.1	4,344.5
Apr-10	32	3.2	28.8	1,164	7,180	5,770	8,030	23,120	206.8	150.3	33.3	0	16.4	0.0	206.8	500	906.8	5,251.3
May-10	41.2	4.12	37.08	1,077	7,180	5,770	8,030	23,120	266.2	193.5	42.9	0	21.1	0.0	266.2	500	1,023.8	6,275.1
Jun-10	32.2	3.22	28.98	1,319	7,180	5,770	8,030	23,120	208.1	151.3	33.5	0	16.5	0.0	208.1	500	909.4	7,184.4
Jul-10	89.2	8.92	80.28	1,883	7,180	5,770	8,030	23,120	576.4	419.0	92.8	0	45.8	0.0	576.4	500	1,634.0	8,818.4
Aug-10	29.6	2.96	26.64	553	7,180	5,770	8,030	23,120	191.3	139.0	30.8	0	15.2	0.0	191.3	500	876.3	9,694.7
Sep-10	105.2	10.52	94.68	1,002	7,180	5,770	8,030	23,120	679.8	494.2	109.5	0	54.0	0.0	679.8	500	1,837.4	11,532.1
Oct-10	106.6	10.66	95.94	1,148	7,180	5,770	8,030	23,120	688.8	500.8	110.9	0	54.7	0.0	688.8	500	1,855.2	13,387.3
Nov-10	72	7.2	64.8	1,378	7,180	5,770	8,030	23,120	465.3	338.2	74.9	0	36.9	0.0	465.3	500	1,415.3	14,802.7
Dec-10	20.2	2.02	18.18	1,701	7,180	5,770	2,430	28,720	130.5	28.7	26.1	0	10.4	0.0	130.5	500	695.7	15,498.4
Total	**705**	**71**	**635**	**15,951**					**4,602**	**3,796**	**739**	**0**	**362**	**0**	**4,602**	**6,000**	**15,498**	

Notes:

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

Lo = [ER(A) + LW + IRCA + ER(I)] - 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)
	I =	surface area of lagoons (m2)
	a =	absorptive capacity of waste (m3/t)
	W =	weight of waste deposited (t/a)

* Infiltration Rates (%) Look to Design Criteria for exact figures (Ranges from 5% to 100%)

APPENDIX 7 NOISE MONITORING REPORT

South Tipperary County Council

Donohill Landfill Site

Garryshane, Donohill, Co. Tipperary

Annual Environmental Noise Survey

Report Date:

25th June 2010

EURO environmental services

Unit 35A, Boyne Business Park, Drogheda, Co Louth

Report No. 4190/M08

1.0 Introduction

EURO environmental services was commissioned by Louise Ryan of South Tipperary County Council to conduct an environmental noise survey at the Donohill Landfill Site, Garryshane, Donohill, Co. Tipperary. The noise survey was carried out on six pre-determined perimeter-monitoring points on the 16th June 2010 by Victor Olmos of EURO environmental services as per requirement of Schedule D.4 of Waste Licence No. 74-2.

2.0 Duration and Measurements of Surveying

The survey was carried out between 12:22 and 15:43 on Wednesday the 16th of June 2010. The following measurements were carried out at each monitoring point:

- Daytime Broadband measurements $L(A)_{eq}$, $L(A)_{10}$, $L(A)_{90}$, $L(A)_{50}$, $L(A)_{1}$ and $L(A)_{99}$ over a 30 minute period.
- Daytime 1/3 Octave Band measurements over a 30 minute period in the range 25Hz to 16kHz.

3.0 Weather Conditions

Weather conditions were raining sunny and warm.

4.0 Location of Monitoring Points

N1 was located on hard ground along the northern site boundary. The meter was placed approximately 1m from the boundary fence.

N2 was located on hard ground at the quarantine area of the site. The meter was placed approximately 45-50m away from the waste tipping area on the active waste cell.

N3 is located on hard ground on the capped area of the landfill site, near the southern site boundary.

N4 was located on hard ground, approximately 35-40m away from the weighbridge office area. The monitoring location was also located approximately 50-60m from the landfill gas flare.

S1 was a noise sensitive location, located at a house on the R497 Road, across from the site entrance. The meter was placed on hard ground approximately 2.5m away from the road and 30 metres away from landfill access gate.

S2 was a noise sensitive location at a dwelling house located approximately 120-150m to the north of the landfill site. The meter was placed on hard ground, approximately 2m from the edge of a roadway where the dwelling was located.

5.0 Activities on Site

Activities on site continued as normal during the daytime survey. Vehicles entered and left the site and waste disposal operations within the site continued.

6.0 Methodology

The noise survey was carried out in accordance with ISO 1996/1/2/3 – Acoustics – Description and Measurement of Environmental Noise and The Environmental Noise Survey Guidance Document issued by the EPA.

Reference was also made to the guidance note issued by the Environmental Protection Agency for the assessment of noise from licensed facilities.

7.0 Equipment

The equipment used was a Bruel & Kjaer 2250 serial No. 2463166 integrating sound pressure meter, with selective 1:1 or 1:3 octave band measurements.

The meter was fixed to a tripod 1.3 meters above ground level and the microphone was protected using a windshield. The microphone cartridge type was BK4189, serial number 2457949 with open circuit sensitivity level of 53.2 mV per Pa.

8.0 Calibration

Calibration was carried out on site using an acoustic calibrator at 94dBA. The meter was calibrated before and after the monitoring round.

9.0 Day Time Measurements

Monitoring Point	Date/ Time	Sampling Interval minutes	L(A)eq	$L(A)_{10}$	$L(A)_{90}$	Comments
N1	16/06/2010 12:54	30	49.6	50.4	28.0	Main source of noise was produced by a compactor truck operating at the active cell and people talking at the active cell. Interference noise included birds singing.
N2	16/06/2010 13:26	30	53.2	46.6	29.4	Main source of noise was generated by vehicles passing by and idling at the monitoring location. Interference noise included birds singing.
N3	16/06/2010 12:22	30	44.5	45.3	28.4	Main source of noise was produced by a compactor truck in operation at the active cell. Interference noise included birds singing, overhead aircraft and the horn of train sounding.
N4	16/06/2010 14:01	30	47.3	48.6	36.0	Main sources of noise were generated by vehicles driving to and from site and idling at weigh bridge (2 cars and 1 HGV). Interference noise included birds singing.
S1	16/06/2010 15:13	30	66.8	61.9	34.5	Main source of noise was produced by vehicles driving into and out of landfill site (3 cars). Interference noise included traffic movements on the R497 road (21 cars) and birds singing.
S2	16/06/2010 14:34	30	59.4	47.5	36.9	Main source of noise was produced by plant operating on the landfill site. Interference noise included a power grass cutter, traffic movements on the R497 road (5 cars and 2 HGV) and birds singing.

10.0 Third Octave Noise Measurements

Third octave noise monitoring results are attached in the appendix and are used to identify prominent tonal components in noise. No tonal noise was detected during this monitoring interval.

11.0 Interference

Traffic had an influence on the monitoring locations N1, N3, N4, S1 and S2 as these monitoring locations were located close to roads. Trains and train horns were also audible at locations N1, N2, N3 and N4.

12.0 Summary and Conclusions

Noise levels were determined at six monitoring points around the Donohill Landfill site. The EPA recommend a day time noise limit of 55 dB(A).

Two out of the six monitoring points exceeded the recommended day time noise limit of 55 dB(A) although main sources of noise recorded at them were not produced by landfill activities but interferences such as traffic movements in the vicinity of these monitoring locations.

Patrick O'Brien
Environmental Technician

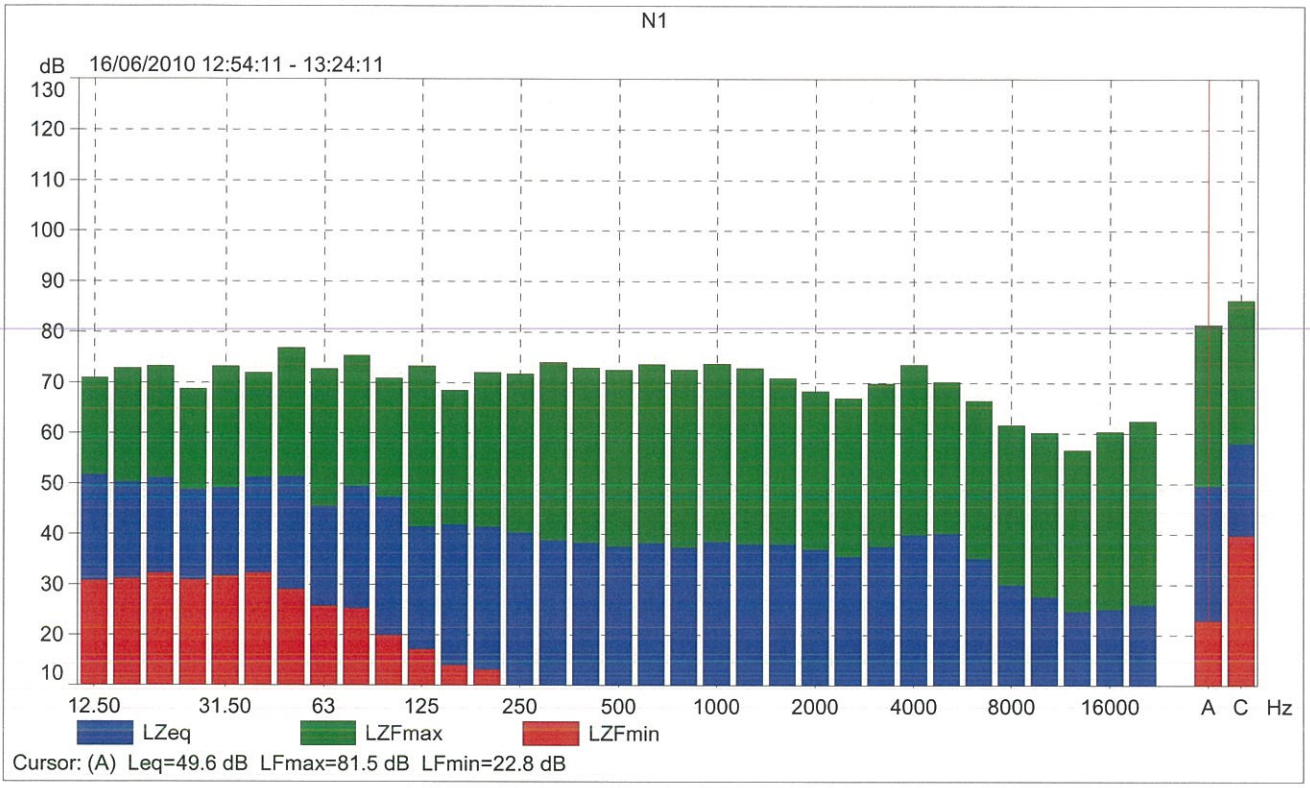
Aadil Khan
Environmental Technical Manager

25th June 2010

Appendix 1: Broadband and 1/3 Octave Monitoring Data

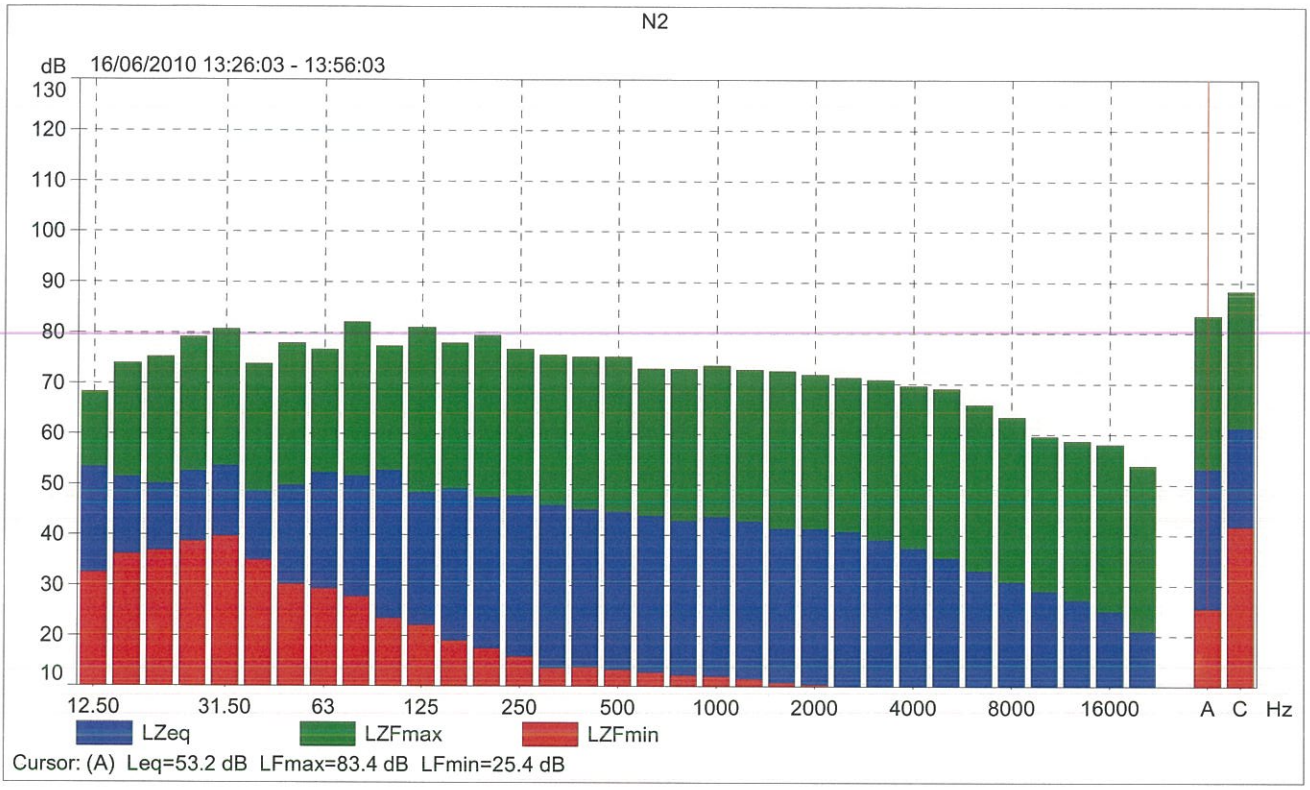
N1

	Start time	End time	Overload [%]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	LAF10 [dB]	LAF90 [dB]	LCpeak [dB]
Value			0.00	81.5	22.8	49.6	50.4	28.0	109.7
Time	12:54:11	13:24:11							12:55:24
Date	16/06/2010	16/06/2010							16/06/2010



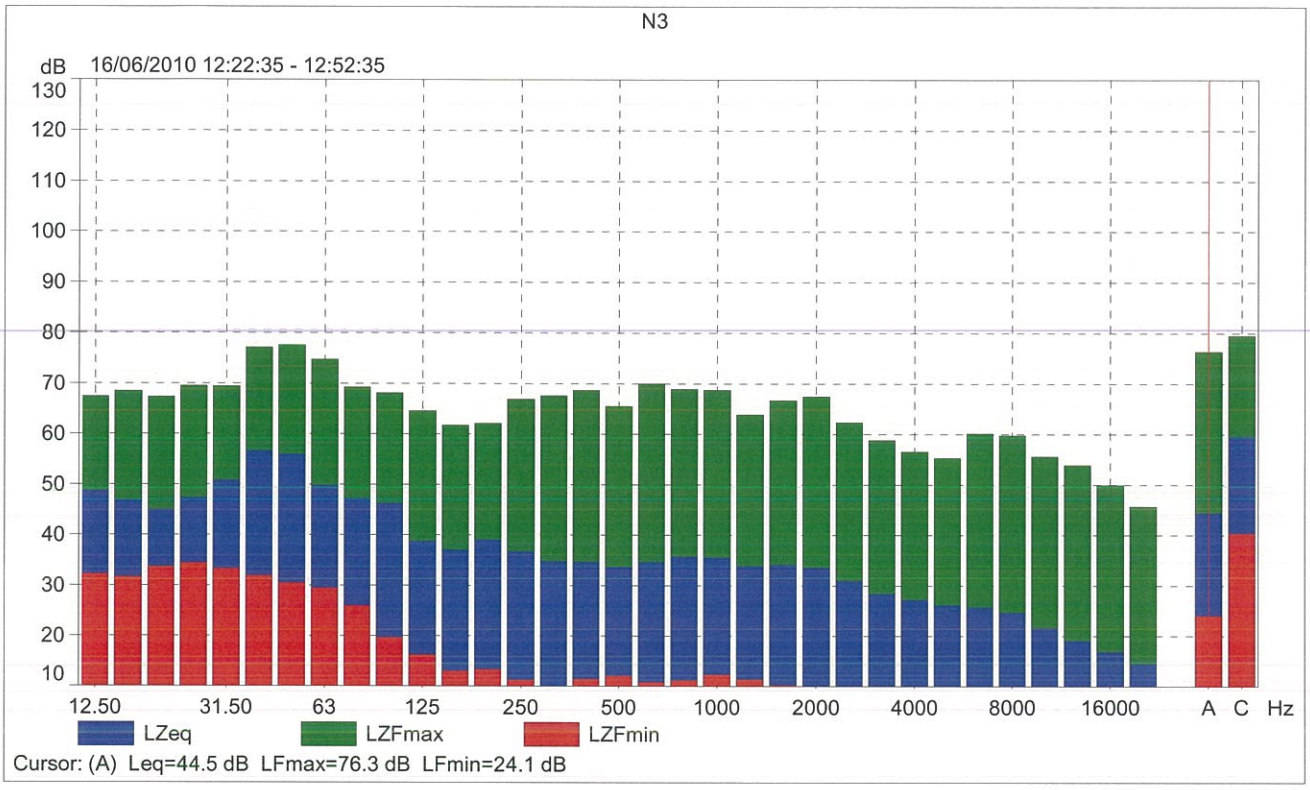
N2

	Start time	End time	Overload [%]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	LAF10 [dB]	LAF90 [dB]	LCpeak [dB]
Value			0.00	83.4	25.4	53.2	46.6	29.4	99.3
Time	13:26:03	13:56:03							13:28:04
Date	16/06/2010	16/06/2010							16/06/2010



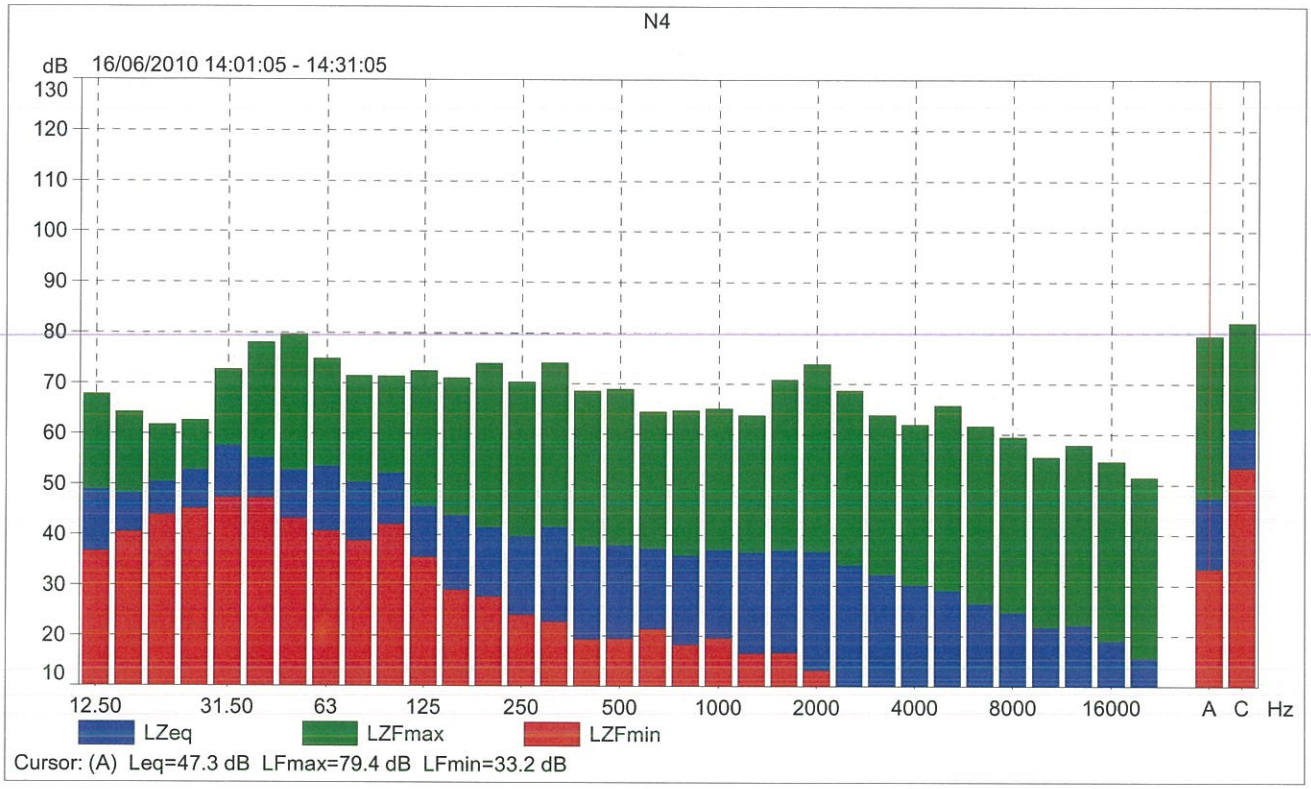
N3

	Start time	End time	Overload [%]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	LAF10 [dB]	LAF90 [dB]	LCpeak [dB]
Value			0.00	76.3	24.1	44.5	45.3	28.4	96.5
Time	12:22:35	12:52:35							12:52:25
Date	16/06/2010	16/06/2010							16/06/2010



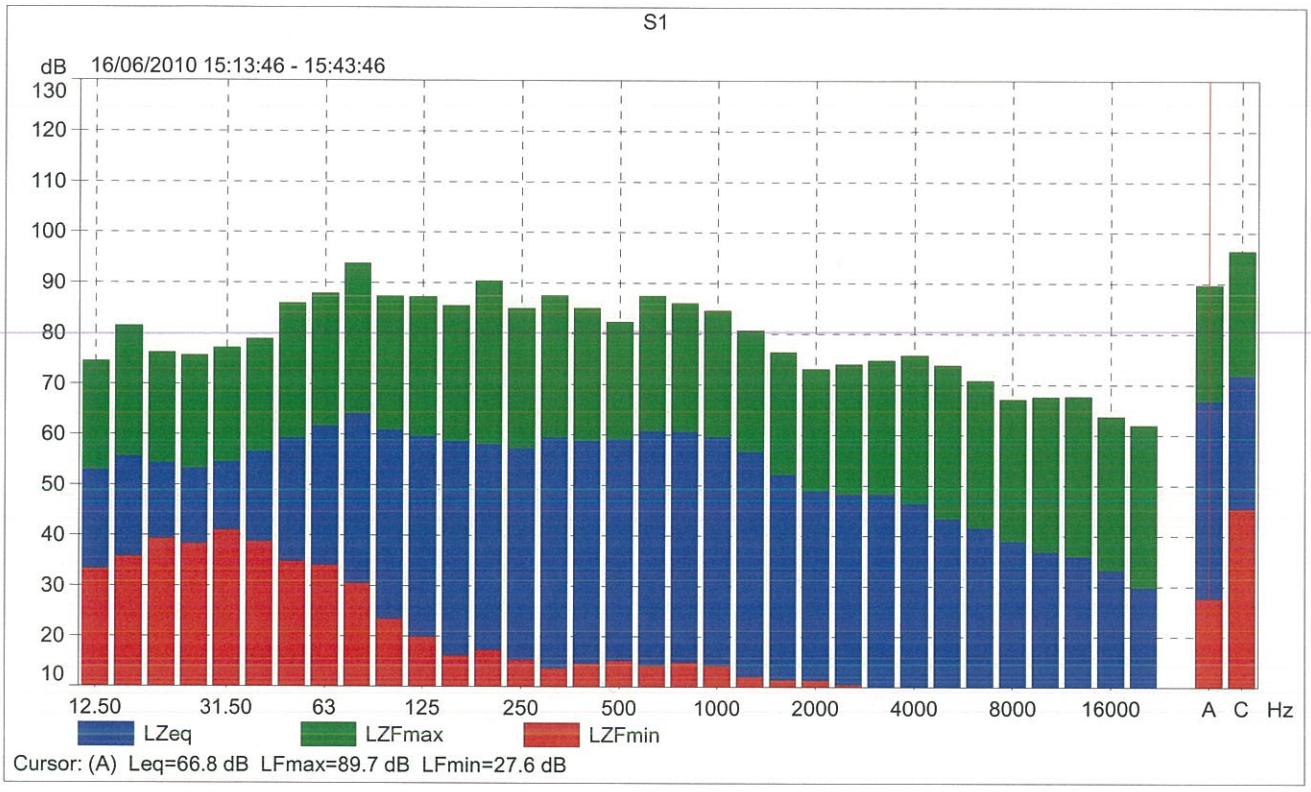
N4

	Start time	End time	Overload [%]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	LAF10 [dB]	LAF90 [dB]	LCpeak [dB]
Value			0.00	79.4	33.2	47.3	48.6	36.0	97.3
Time	14:01:05	14:31:05							14:21:44
Date	16/06/2010	16/06/2010							16/06/2010



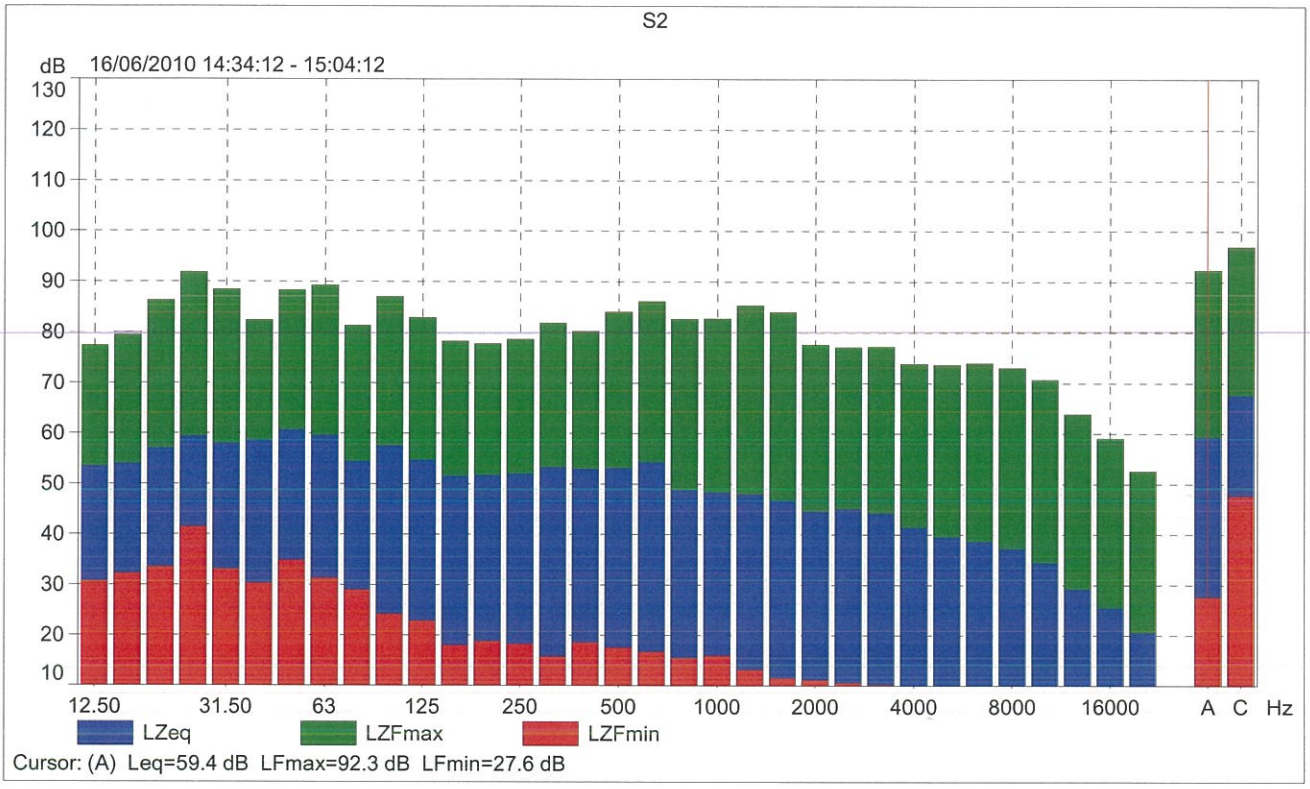
S1

	Start time	End time	Overload [%]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	LAF10 [dB]	LAF90 [dB]	LCpeak [dB]
Value			0.00	89.7	27.6	66.8	61.9	34.5	105.7
Time	15:13:46	15:43:46							15:37:34
Date	16/06/2010	16/06/2010							16/06/2010



S2

	Start time	End time	Overload [%]	LAFmax [dB]	LAFmin [dB]	LAeq [dB]	LAF10 [dB]	LAF90 [dB]	LCpeak [dB]
Value			0.00	92.3	27.6	59.4	47.5	36.9	115.8
Time	14:34:12	15:04:12							14:34:13
Date	16/06/2010	16/06/2010							16/06/2010



APPENDIX 8 LANDFILL GAS CALCULATIONS

South Tipperary Co. Co.

Landfill Gas Model

Prepared for:
South Tipperary County Council
Donohill Landfill

Revision: 1 ***Date: 05/04/11***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: AR **CHECKED:** CJC
DATE: 05/04/11 **REVISION:** 1
JOB NUMBER: **LW11-024-01**
CALC NUMBER: **C-01**
FILE Q:\2011\LW11\024\01\Calculations\Calc Set 02 LFG\LW1102401_Calc set 02 LFG calculation.xls
SHEET Calc cover

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Landfill Gas Model**

Rev	Date	Purpose and Description	Prepared	Checked
1	5/4/11	Calculation of annual and cumulative landfill gas emissions	AR	CJC

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DESIGNED:	AR	**CHECKED:**	CJC
DATE:	5.4.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 02 LFG\LW1102401_Calc set 02 LFG calculation.xls		
SHEET	Calc Sheet		

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Landfill Gas Model**

Ref.

Output

i references

1 2009 AER for Donohill Landfill
..\..\Incoming\LW1102401_2009 AER.pdf
2 Incoming flare data from STCC
LW1102401_Active Flare ByDate 2010 FTC edits.xls
3 LandGem Model
LW1102401_LandGEM 2010.xls
4 2009 LandGem Model
LW1002401_landgem 2009 Donohill Rev 0.xls
7 Waste input data for 2010
_ARC_RE_recent quotation request - waste 2010.msg

ii List of FTC Drawings

iii List of Appendices

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DATE:	5.4.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 02 LFG\LW1102401_Calc set 02 LFG calculation.xls		
SHEET	Calc Sheet		

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Landfill Gas Model**

Ref.		Output

1.0 Introduction

The purpose of this calculation is to estimate the annual and cumulative quantities of landfill gas emitted from the facility.

FTC will:
- Review the flaring records for 2010
- Prepare a landfill model using LandGem
- Compare the quantity of gas flared and the quantity of gas generated to calculate the quantity emitted

2.0 Calculation

2.1 Review of 2010 flare data

2 Using information provided by STCC, the following are the details of the flare runtimes at Donohill.

Subtotal of hours runtime:	1,516	hours
Subtotal of minutes runtime:	9,349	minutes
Convert minutes to hours:	156	hours
Total runtime in Hours:	1,672	hours
Maximum potential (@500m³/hr)	835,908	m³/annum
Average Blower Speed:	38	%
At ave. efficiency	319,541	m³/annum

The figures above suggest that 319,541 m³ of LFG was flared in 2010.

The flare records show that the average methane concentration at Donohill in 2010 was 28%.

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JOB NUMBER: LW11-024-01
CALC NUMBER: C-01
FILE Q:\2011\LW11\024\01\Calculations\Calc Set 02 LFG\LW1102401_Calc set 02 LFG calculation.xls
SHEET Calc Sheet

PROJECT: South Tipperary Co. Co.
DESCRIPTION: Landfill Gas Model

Ref. | Output

2.2 LandGEM model

3 A LandGEM model is prepared using the 2009 model as a reference point.
The waste inputs for each year to date are noted below:

Year	tpa
1989	3,700
1990	3,700
1991	4,200
1992	4,400
1993	7,000
1994	8,000
1995	12,100
1996	13,300
1997	15,700
1998	13,600
1999	40,000

Year	tpa
2000	40,000
2001	41,620
2002	35,800
2003	39,247
2004	23,257
2005	21,507
2006	18,603
2007	18,089
2008	15,812
2009	16,933
2010	15,951

4,5 Data for years from 1989 to 2010 are taken from the 2009 model. Waste input for 2010 is input using information from STCC.

As this model is used for reporting purposes only, and is not concerned with future estimates, no details for future waste inputs are required.

The LandGEM model results will be appended to the summary report and are summarised below:

	Total LFG (m³)	Total methane (m³)	Total Carbon
2010	2,314,937	1,157,468	1,157,468
1989-2010	22,748,674	11,374,337	11,374,337

2.3 Emissions from site

Using the estimate of flaring at the site in 2.1 above, and the results of the LandGEM model, the estimated emissions from site can be calculated:

Estimated LFG produced:	2,314,937	m³
Estimated LFG flared:	319,541	m³
Estimated emissions 2010:	1,995,395	m³

In order to estimate the cumulative emissions from the site, the data presented in the 2009 AER will be used, together with the figures calculated above.

1 The 2009 AER estimated that the total cumulative emissions from the site was:
16,997,271 m³
This gives a total estimated emissions to end 2010 of: 18,992,666 m³

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JOB NUMBER:	LW11-024-01
CALC NUMBER:	C-01
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 02 LFG\LW1102401_Calc set 02 LFG calculation.xls
SHEET	Calc Sheet

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Landfill Gas Model**

Ref.		Output

2.4 Discussion

The results of the model indicate that large volumes of LFG are emitted from the site. However, experience on site suggests that the model results are misleading, as neither gas migration, or odour nuisance have been the subject of complaints at the site. It is possible that the model significantly over-estimates the volumes of landfill gas produced at the site.

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ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

DONOHILL LANDFILL

LANDFILL GAS REPORT 2010

WASTE LICENCE REGISTER W0074-03

April 2011

FEHILY TIMONEY & COMPANY

DONOHILL LANDFILL

LANDFILL GAS REPORT 2010

WASTE LICENCE REGISTER W0074-03

User is Responsible for Checking The Revision Status of This Document

Rev. Nr.	Description of Changes:	Prepared by:	Checked by:	Approved by:	Date:
0	Issue to Client	AR/MG			05-04-11

Client South Tipperary County Council

Keywords landfill gas model, estimated emissions, Donohill, landfill, landfill gas, active extraction system, methane, carbon dioxide, AER

Abstract FTC was retained by South Tipperary County Council to prepare this section of the annual environmental report – the estimation of annual and cumulative quantities of landfill gas emitted from Donohill landfill facility.

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APPENDICES

1 INTRODUCTION

1.1 Purpose

This calculation is a requirement of the Annual Environmental Report (AER). Calculations have been carried out to estimate the quantity of landfill gas emitted from the facility in 2010 and the cumulative quantity emitted since landfilling operations commenced in 1989.

Donohill Landfill is owned and operated by South Tipperary County Council (STCC). The landfill has an active landfill gas (LFG) extraction system and a 500 m^3/hour enclosed flare. The site is licensed by the Environmental Protection Agency (EPA), waste licence register number W0074-03. The production of an AER is a requirement of the waste licence (Schedule G).

1.2 Background Information

The landfill has been operational since 1989. There was an open flare on site from January to April 2005. It was replaced in May 2005 with a 500 m^3 enclosed flare. The first phase of engineered capping was completed in May 2006. At present, capping works are ongoing on the second phase of capping. Filling is taking place in Area 4.

Landfill gas generation can only be estimated. There are 2 no. estimator tools; LandGem and Gassim. LandGem was produced by the US EPA and has been approved by the Irish EPA. Gassim was developed more recently by the UK EA. FTC has used both models and finds them both to have inaccuracies. LandGem is more user friendly and has been used in these calculations.

2 QUANTITIES OF LANDFILL GAS EMITTED

Two sources were used to calculate landfill gas emissions:

1. Landfill Gas Flare data
2. LandGem landfill gas prediction model

2.1 Landfill Gas Flare Data

In 2010 the flare ran for 1,516 hours. The flare ran at approximately 38.2% of capacity based on data from STCC. Based on this information, it is estimated that 319,541 m^3 of landfill gas was flared in 2010.

2.2 LandGem Gas Prediction Model

The model produces a report which has been included as Appendix 1. LandGem is an estimator tool for landfill gas generation from a landfill. It does not estimate emissions as it does not take flaring or utilisation into account.

A summary table of results has been shown as Table 2.1.

Table 2.1: Summary of LandGem Results

	Landfill Gas	Methane*	Carbon Dioxide*
2009 (annual quantity)			
Volume (m^3)	2,314,937	1,157,468	1,157,468
1989-2009(cumulative quantity)			
Volume (m^3)	22,748,674	11,374,337	11,374,337

* The model assumes that methane (CH_4) and carbon dioxide (CO_2) are present in equal volumes, 50%:50% of the landfill gas.

2.3 Estimate of Landfill Gas Emissions

2.3.1 Annual Emissions (2010)

There is an enclosed flare on site to combust landfill gas to reduce emissions. As shown in Section 2.1, it is estimated that 319,541 m^3 of landfill gas was flared in 2010.

Volume of landfill gas generated in 2010 (LandGem): 2,314,937 m^3
Volume of landfill gas flared in 2010 (site records): 319,541 m^3
Therefore, Volume of landfill gas emitted to atmosphere: 1,995,396 m^3

2.3.2 Cumulative Emissions (1989-2010)

As seen in Table 2.1, 22,748,674 m^3 of landfill gas is estimated to have been generated by the facility since it commenced landfilling operations in 1989. It is difficult to estimate the quantity of that gas that was emitted to atmosphere as the flaring records are poor.

The enclosed flare was commissioned in May 2005. Using data from the 2006 to 2009 AERs and this year's data, the quantity of gas flared can be subtracted from the cumulative generation.

From the 2009 AER, it is estimated that the total cumulative generation to the end of 2009 is 16,997,271 m^3. Combining this with the 2010 estimated emission figure, gives a total estimate of the cumulative emissions to atmosphere from 1989 to 2010 of 18,992,666 m^3.

Assumptions made in the calculations:

- Landfill gas generation at Donohill is as per the LandGem model (Methane Generation Rate, k $year^{-1}$ = Inventory Conventional 0.04; Potential Methane Generation Capacity, L_o m^3/Mg = Inventory Conventional 100)
- Methane and carbon dioxide are generated in equal volume as 50%:50% of landfill gas (this is not true at Donohill, where the average methane concentration for 2010 is recorded as 28%. However, LandGEM's first order decomposition equation is only accurate for a methane concentration range of between 40 to 60%.)
- Flare and waste records as provided by STCC are correct

3 CONCLUSION

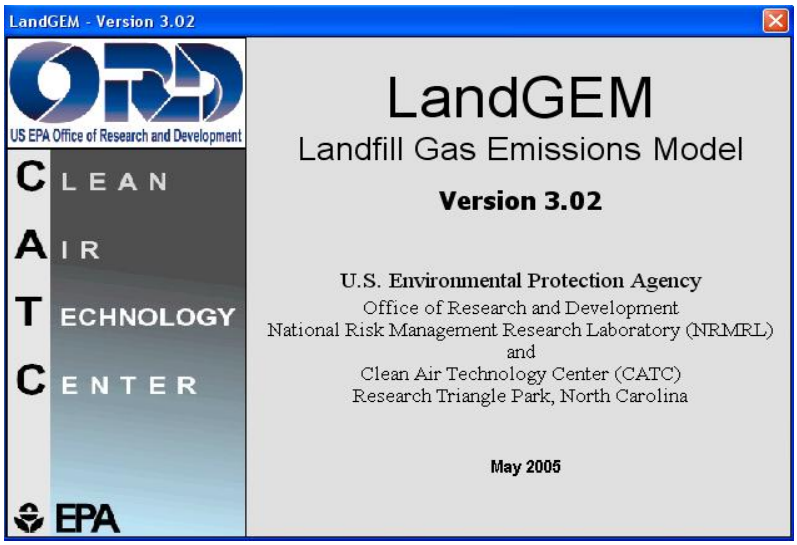
1,995,396 m^3 of landfill gas is estimated to have been emitted to atmosphere in 2010.

18,992,666 m^3 of landfill gas is estimated to have been emitted to atmosphere since landfilling operations commenced in 1989.

The results of the model indicate that large volumes of LFG are emitted from the site. However, experience on site suggests that the model results are misleading, as neither gas migration, or odour nuisance have been the subject of complaints at the site. It is possible that the model significantly over-estimates the volumes of landfill gas produced at the site.

Appendix 1

LandGem Model Report



Summary Report

Landfill Name or Identifier:

Date: 05 April 2011

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1989**	
Landfill Closure Year (with 80-year limit)	**2010**	
Actual Closure Year (without limit)	***2010***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	**0.040**	$year^{-1}$
Potential Methane Generation Capacity, L_o	**100**	m^3/Mg
NMOC Concentration	**600**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1989	3,700	4,070	0	0
1990	3,700	4,070	3,700	4,070
1991	4,200	4,620	7,400	8,140
1992	4,400	4,840	11,600	12,760
1993	7,000	7,700	16,000	17,600
1994	8,000	8,800	23,000	25,300
1995	12,100	13,310	31,000	34,100
1996	13,300	14,630	43,100	47,410
1997	15,700	17,270	56,400	62,040
1998	13,600	14,960	72,100	79,310
1999	40,000	44,000	85,700	94,270
2000	40,000	44,000	125,700	138,270
2001	41,620	45,782	165,700	182,270
2002	35,800	39,380	207,320	228,052
2003	39,247	43,172	243,120	267,432
2004	23,257	25,583	282,367	310,604
2005	21,507	23,658	305,624	336,186
2006	18,603	20,463	327,131	359,844
2007	18,089	19,898	345,734	380,307
2008	15,812	17,393	363,823	400,205
2009	16,933	18,626	379,635	417,599
2010	15,951	17,546	396,568	436,225
2011	0	0	412,519	453,771
2012	0	0	412,519	453,771
2013	0	0	412,519	453,771
2014	0	0	412,519	453,771
2015	0	0	412,519	453,771
2016	0	0	412,519	453,771
2017	0	0	412,519	453,771
2018	0	0	412,519	453,771
2019	0	0	412,519	453,771
2020	0	0	412,519	453,771
2021	0	0	412,519	453,771
2022	0	0	412,519	453,771
2023	0	0	412,519	453,771
2024	0	0	412,519	453,771
2025	0	0	412,519	453,771
2026	0	0	412,519	453,771
2027	0	0	412,519	453,771
2028	0	0	412,519	453,771

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2029	0	0	412,519	453,771
2030	0	0	412,519	453,771
2031	0	0	412,519	453,771
2032	0	0	412,519	453,771
2033	0	0	412,519	453,771
2034	0	0	412,519	453,771
2035	0	0	412,519	453,771
2036	0	0	412,519	453,771
2037	0	0	412,519	453,771
2038	0	0	412,519	453,771
2039	0	0	412,519	453,771
2040	0	0	412,519	453,771
2041	0	0	412,519	453,771
2042	0	0	412,519	453,771
2043	0	0	412,519	453,771
2044	0	0	412,519	453,771
2045	0	0	412,519	453,771
2046	0	0	412,519	453,771
2047	0	0	412,519	453,771
2048	0	0	412,519	453,771
2049	0	0	412,519	453,771
2050	0	0	412,519	453,771
2051	0	0	412,519	453,771
2052	0	0	412,519	453,771
2053	0	0	412,519	453,771
2054	0	0	412,519	453,771
2055	0	0	412,519	453,771
2056	0	0	412,519	453,771
2057	0	0	412,519	453,771
2058	0	0	412,519	453,771
2059	0	0	412,519	453,771
2060	0	0	412,519	453,771
2061	0	0	412,519	453,771
2062	0	0	412,519	453,771
2063	0	0	412,519	453,771
2064	0	0	412,519	453,771
2065	0	0	412,519	453,771
2066	0	0	412,519	453,771
2067	0	0	412,519	453,771
2068	0	0	412,519	453,771

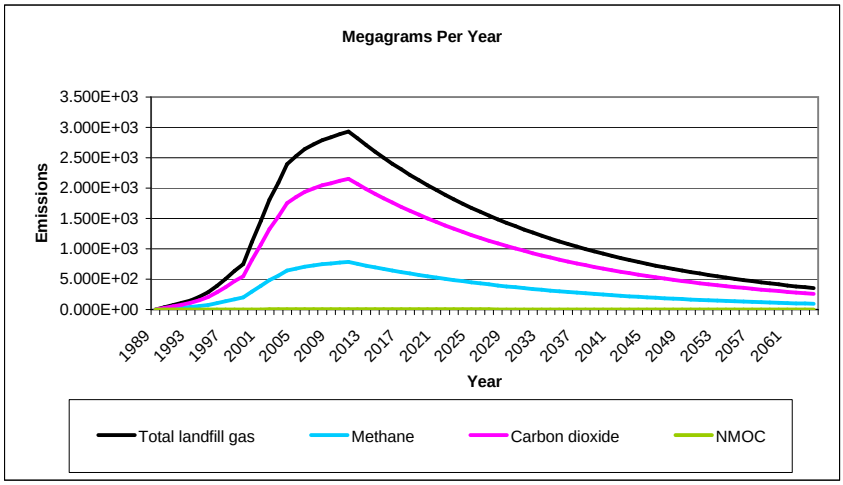
Pollutant Parameters

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs


Megagrams Per Year
Emissions
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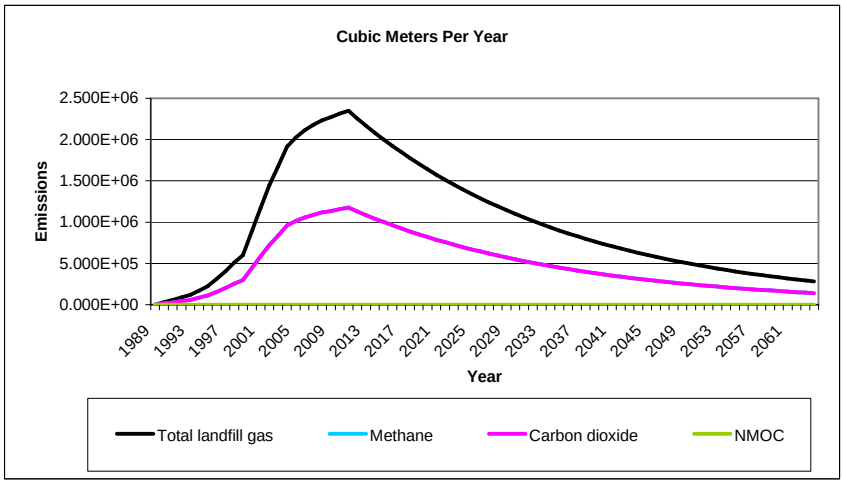
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045 2049 2053 2057 2061
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
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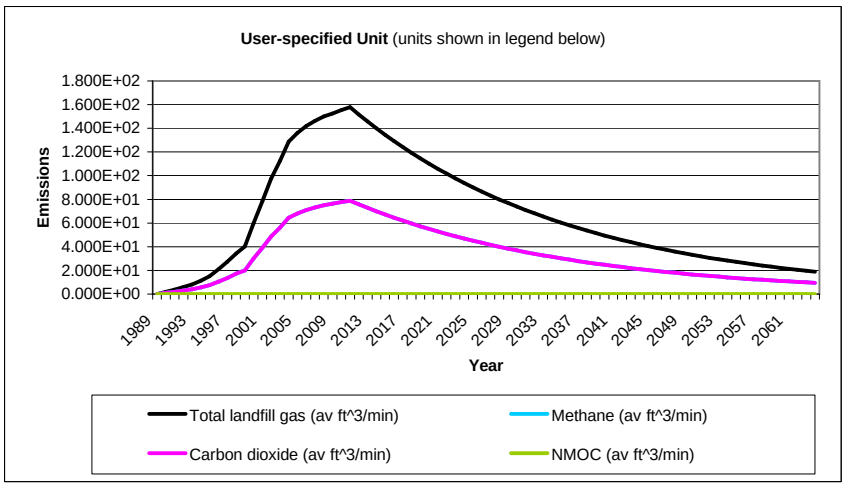
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045 2049 2053 2057 2061
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
1.800E+02
1.600E+02
1.400E+02
1.200E+02
1.000E+02
8.000E+01
6.000E+01
4.000E+01
2.000E+01
0.000E+00
1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045 2049 2053 2057 2061
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1989	0	0	0	0	0	0
1990	3.631E+01	2.907E+04	1.953E+00	9.698E+00	1.454E+04	9.767E-01
1991	7.119E+01	5.701E+04	3.830E+00	1.902E+01	2.850E+04	1.915E+00
1992	1.096E+02	8.778E+04	5.898E+00	2.928E+01	4.389E+04	2.949E+00
1993	1.485E+02	1.189E+05	7.989E+00	3.966E+01	5.945E+04	3.995E+00
1994	2.114E+02	1.693E+05	1.137E+01	5.646E+01	8.463E+04	5.686E+00
1995	2.816E+02	2.255E+05	1.515E+01	7.521E+01	1.127E+05	7.575E+00
1996	3.893E+02	3.117E+05	2.094E+01	1.040E+02	1.559E+05	1.047E+01
1997	5.045E+02	4.040E+05	2.714E+01	1.348E+02	2.020E+05	1.357E+01
1998	6.388E+02	5.115E+05	3.437E+01	1.706E+02	2.558E+05	1.718E+01
1999	7.472E+02	5.983E+05	4.020E+01	1.996E+02	2.992E+05	2.010E+01
2000	1.110E+03	8.892E+05	5.974E+01	2.966E+02	4.446E+05	2.987E+01
2001	1.459E+03	1.169E+06	7.852E+01	3.898E+02	5.843E+05	3.926E+01
2002	1.811E+03	1.450E+06	9.742E+01	4.836E+02	7.249E+05	4.871E+01
2003	2.091E+03	1.674E+06	1.125E+02	5.585E+02	8.372E+05	5.625E+01
2004	2.394E+03	1.917E+06	1.288E+02	6.395E+02	9.585E+05	6.440E+01
2005	2.528E+03	2.025E+06	1.360E+02	6.754E+02	1.012E+06	6.802E+01
2006	2.640E+03	2.114E+06	1.421E+02	7.053E+02	1.057E+06	7.103E+01
2007	2.719E+03	2.178E+06	1.463E+02	7.264E+02	1.089E+06	7.315E+01
2008	2.790E+03	2.234E+06	1.501E+02	7.453E+02	1.117E+06	7.506E+01
2009	2.836E+03	2.271E+06	1.526E+02	7.575E+02	1.135E+06	7.629E+01
2010	2.891E+03	2.315E+06	1.555E+02	7.722E+02	1.157E+06	7.777E+01
2011	2.934E+03	2.350E+06	1.579E+02	7.837E+02	1.175E+06	7.893E+01
2012	2.819E+03	2.257E+06	1.517E+02	7.530E+02	1.129E+06	7.584E+01
2013	2.709E+03	2.169E+06	1.457E+02	7.235E+02	1.084E+06	7.286E+01
2014	2.602E+03	2.084E+06	1.400E+02	6.951E+02	1.042E+06	7.001E+01
2015	2.500E+03	2.002E+06	1.345E+02	6.679E+02	1.001E+06	6.726E+01
2016	2.402E+03	1.924E+06	1.292E+02	6.417E+02	9.618E+05	6.462E+01
2017	2.308E+03	1.848E+06	1.242E+02	6.165E+02	9.241E+05	6.209E+01
2018	2.218E+03	1.776E+06	1.193E+02	5.923E+02	8.879E+05	5.966E+01
2019	2.131E+03	1.706E+06	1.146E+02	5.691E+02	8.530E+05	5.732E+01
2020	2.047E+03	1.639E+06	1.101E+02	5.468E+02	8.196E+05	5.507E+01
2021	1.967E+03	1.575E+06	1.058E+02	5.254E+02	7.875E+05	5.291E+01
2022	1.890E+03	1.513E+06	1.017E+02	5.048E+02	7.566E+05	5.083E+01
2023	1.816E+03	1.454E+06	9.768E+01	4.850E+02	7.269E+05	4.884E+01
2024	1.744E+03	1.397E+06	9.385E+01	4.659E+02	6.984E+05	4.693E+01
2025	1.676E+03	1.342E+06	9.017E+01	4.477E+02	6.710E+05	4.509E+01
2026	1.610E+03	1.289E+06	8.664E+01	4.301E+02	6.447E+05	4.332E+01
2027	1.547E+03	1.239E+06	8.324E+01	4.133E+02	6.194E+05	4.162E+01
2028	1.486E+03	1.190E+06	7.998E+01	3.971E+02	5.951E+05	3.999E+01
2029	1.428E+03	1.144E+06	7.684E+01	3.815E+02	5.718E+05	3.842E+01
2030	1.372E+03	1.099E+06	7.383E+01	3.665E+02	5.494E+05	3.691E+01
2031	1.318E+03	1.056E+06	7.093E+01	3.522E+02	5.279E+05	3.547E+01
2032	1.267E+03	1.014E+06	6.815E+01	3.383E+02	5.072E+05	3.408E+01
2033	1.217E+03	9.745E+05	6.548E+01	3.251E+02	4.873E+05	3.274E+01
2034	1.169E+03	9.363E+05	6.291E+01	3.123E+02	4.682E+05	3.146E+01
2035	1.123E+03	8.996E+05	6.044E+01	3.001E+02	4.498E+05	3.022E+01
2036	1.079E+03	8.643E+05	5.807E+01	2.883E+02	4.322E+05	2.904E+01
2037	1.037E+03	8.304E+05	5.580E+01	2.770E+02	4.152E+05	2.790E+01
2038	9.964E+02	7.979E+05	5.361E+01	2.662E+02	3.989E+05	2.680E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2039	9.573E+02	7.666E+05	5.151E+01	2.557E+02	3.833E+05	2.575E+01
2040	9.198E+02	7.365E+05	4.949E+01	2.457E+02	3.683E+05	2.474E+01
2041	8.837E+02	7.077E+05	4.755E+01	2.361E+02	3.538E+05	2.377E+01
2042	8.491E+02	6.799E+05	4.568E+01	2.268E+02	3.400E+05	2.284E+01
2043	8.158E+02	6.533E+05	4.389E+01	2.179E+02	3.266E+05	2.195E+01
2044	7.838E+02	6.276E+05	4.217E+01	2.094E+02	3.138E+05	2.109E+01
2045	7.531E+02	6.030E+05	4.052E+01	2.012E+02	3.015E+05	2.026E+01
2046	7.235E+02	5.794E+05	3.893E+01	1.933E+02	2.897E+05	1.946E+01
2047	6.952E+02	5.567E+05	3.740E+01	1.857E+02	2.783E+05	1.870E+01
2048	6.679E+02	5.348E+05	3.594E+01	1.784E+02	2.674E+05	1.797E+01
2049	6.417E+02	5.139E+05	3.453E+01	1.714E+02	2.569E+05	1.726E+01
2050	6.166E+02	4.937E+05	3.317E+01	1.647E+02	2.469E+05	1.659E+01
2051	5.924E+02	4.744E+05	3.187E+01	1.582E+02	2.372E+05	1.594E+01
2052	5.692E+02	4.558E+05	3.062E+01	1.520E+02	2.279E+05	1.531E+01
2053	5.468E+02	4.379E+05	2.942E+01	1.461E+02	2.189E+05	1.471E+01
2054	5.254E+02	4.207E+05	2.827E+01	1.403E+02	2.104E+05	1.413E+01
2055	5.048E+02	4.042E+05	2.716E+01	1.348E+02	2.021E+05	1.358E+01
2056	4.850E+02	3.884E+05	2.609E+01	1.296E+02	1.942E+05	1.305E+01
2057	4.660E+02	3.731E+05	2.507E+01	1.245E+02	1.866E+05	1.254E+01
2058	4.477E+02	3.585E+05	2.409E+01	1.196E+02	1.793E+05	1.204E+01
2059	4.302E+02	3.445E+05	2.314E+01	1.149E+02	1.722E+05	1.157E+01
2060	4.133E+02	3.309E+05	2.224E+01	1.104E+02	1.655E+05	1.112E+01
2061	3.971E+02	3.180E+05	2.136E+01	1.061E+02	1.590E+05	1.068E+01
2062	3.815E+02	3.055E+05	2.053E+01	1.019E+02	1.528E+05	1.026E+01
2063	3.666E+02	2.935E+05	1.972E+01	9.791E+01	1.468E+05	9.861E+00
2064	3.522E+02	2.820E+05	1.895E+01	9.407E+01	1.410E+05	9.474E+00
2065	3.384E+02	2.710E+05	1.821E+01	9.038E+01	1.355E+05	9.103E+00
2066	3.251E+02	2.603E+05	1.749E+01	8.684E+01	1.302E+05	8.746E+00
2067	3.124E+02	2.501E+05	1.681E+01	8.344E+01	1.251E+05	8.403E+00
2068	3.001E+02	2.403E+05	1.615E+01	8.016E+01	1.202E+05	8.073E+00
2069	2.883E+02	2.309E+05	1.551E+01	7.702E+01	1.154E+05	7.757E+00
2070	2.770E+02	2.218E+05	1.491E+01	7.400E+01	1.109E+05	7.453E+00
2071	2.662E+02	2.131E+05	1.432E+01	7.110E+01	1.066E+05	7.161E+00
2072	2.557E+02	2.048E+05	1.376E+01	6.831E+01	1.024E+05	6.880E+00
2073	2.457E+02	1.968E+05	1.322E+01	6.563E+01	9.838E+04	6.610E+00
2074	2.361E+02	1.890E+05	1.270E+01	6.306E+01	9.452E+04	6.351E+00
2075	2.268E+02	1.816E+05	1.220E+01	6.059E+01	9.081E+04	6.102E+00
2076	2.179E+02	1.745E+05	1.173E+01	5.821E+01	8.725E+04	5.863E+00
2077	2.094E+02	1.677E+05	1.127E+01	5.593E+01	8.383E+04	5.633E+00
2078	2.012E+02	1.611E+05	1.082E+01	5.374E+01	8.054E+04	5.412E+00
2079	1.933E+02	1.548E+05	1.040E+01	5.163E+01	7.739E+04	5.200E+00
2080	1.857E+02	1.487E+05	9.991E+00	4.960E+01	7.435E+04	4.996E+00
2081	1.784E+02	1.429E+05	9.600E+00	4.766E+01	7.144E+04	4.800E+00
2082	1.714E+02	1.373E+05	9.223E+00	4.579E+01	6.864E+04	4.612E+00
2083	1.647E+02	1.319E+05	8.862E+00	4.399E+01	6.594E+04	4.431E+00
2084	1.582E+02	1.267E+05	8.514E+00	4.227E+01	6.336E+04	4.257E+00
2085	1.520E+02	1.217E+05	8.180E+00	4.061E+01	6.087E+04	4.090E+00
2086	1.461E+02	1.170E+05	7.860E+00	3.902E+01	5.849E+04	3.930E+00
2087	1.404E+02	1.124E+05	7.551E+00	3.749E+01	5.619E+04	3.776E+00
2088	1.348E+02	1.080E+05	7.255E+00	3.602E+01	5.399E+04	3.628E+00
2089	1.296E+02	1.037E+05	6.971E+00	3.461E+01	5.187E+04	3.485E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2090	1.245E+02	9.968E+04	6.697E+00	3.325E+01	4.984E+04	3.349E+00
2091	1.196E+02	9.577E+04	6.435E+00	3.195E+01	4.789E+04	3.217E+00
2092	1.149E+02	9.202E+04	6.183E+00	3.069E+01	4.601E+04	3.091E+00
2093	1.104E+02	8.841E+04	5.940E+00	2.949E+01	4.420E+04	2.970E+00
2094	1.061E+02	8.494E+04	5.707E+00	2.833E+01	4.247E+04	2.854E+00
2095	1.019E+02	8.161E+04	5.483E+00	2.722E+01	4.081E+04	2.742E+00
2096	9.792E+01	7.841E+04	5.268E+00	2.616E+01	3.921E+04	2.634E+00
2097	9.408E+01	7.534E+04	5.062E+00	2.513E+01	3.767E+04	2.531E+00
2098	9.039E+01	7.238E+04	4.863E+00	2.414E+01	3.619E+04	2.432E+00
2099	8.685E+01	6.954E+04	4.673E+00	2.320E+01	3.477E+04	2.336E+00
2100	8.344E+01	6.682E+04	4.489E+00	2.229E+01	3.341E+04	2.245E+00
2101	8.017E+01	6.420E+04	4.313E+00	2.141E+01	3.210E+04	2.157E+00
2102	7.703E+01	6.168E+04	4.144E+00	2.057E+01	3.084E+04	2.072E+00
2103	7.401E+01	5.926E+04	3.982E+00	1.977E+01	2.963E+04	1.991E+00
2104	7.111E+01	5.694E+04	3.826E+00	1.899E+01	2.847E+04	1.913E+00
2105	6.832E+01	5.471E+04	3.676E+00	1.825E+01	2.735E+04	1.838E+00
2106	6.564E+01	5.256E+04	3.532E+00	1.753E+01	2.628E+04	1.766E+00
2107	6.306E+01	5.050E+04	3.393E+00	1.685E+01	2.525E+04	1.697E+00
2108	6.059E+01	4.852E+04	3.260E+00	1.618E+01	2.426E+04	1.630E+00
2109	5.822E+01	4.662E+04	3.132E+00	1.555E+01	2.331E+04	1.566E+00
2110	5.593E+01	4.479E+04	3.009E+00	1.494E+01	2.239E+04	1.505E+00
2111	5.374E+01	4.303E+04	2.891E+00	1.435E+01	2.152E+04	1.446E+00
2112	5.163E+01	4.135E+04	2.778E+00	1.379E+01	2.067E+04	1.389E+00
2113	4.961E+01	3.972E+04	2.669E+00	1.325E+01	1.986E+04	1.335E+00
2114	4.766E+01	3.817E+04	2.564E+00	1.273E+01	1.908E+04	1.282E+00
2115	4.579E+01	3.667E+04	2.464E+00	1.223E+01	1.834E+04	1.232E+00
2116	4.400E+01	3.523E+04	2.367E+00	1.175E+01	1.762E+04	1.184E+00
2117	4.227E+01	3.385E+04	2.274E+00	1.129E+01	1.693E+04	1.137E+00
2118	4.062E+01	3.252E+04	2.185E+00	1.085E+01	1.626E+04	1.093E+00
2119	3.902E+01	3.125E+04	2.100E+00	1.042E+01	1.562E+04	1.050E+00
2120	3.749E+01	3.002E+04	2.017E+00	1.001E+01	1.501E+04	1.009E+00
2121	3.602E+01	2.885E+04	1.938E+00	9.622E+00	1.442E+04	9.691E-01
2122	3.461E+01	2.771E+04	1.862E+00	9.245E+00	1.386E+04	9.311E-01
2123	3.325E+01	2.663E+04	1.789E+00	8.882E+00	1.331E+04	8.946E-01
2124	3.195E+01	2.558E+04	1.719E+00	8.534E+00	1.279E+04	8.595E-01
2125	3.070E+01	2.458E+04	1.652E+00	8.199E+00	1.229E+04	8.258E-01
2126	2.949E+01	2.362E+04	1.587E+00	7.878E+00	1.181E+04	7.934E-01
2127	2.834E+01	2.269E+04	1.525E+00	7.569E+00	1.135E+04	7.623E-01
2128	2.723E+01	2.180E+04	1.465E+00	7.272E+00	1.090E+04	7.324E-01
2129	2.616E+01	2.095E+04	1.407E+00	6.987E+00	1.047E+04	7.037E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1989	0	0	0	0	0	0
1990	2.661E+01	1.454E+04	9.767E-01	6.253E-02	1.744E+01	1.172E-03
1991	5.218E+01	2.850E+04	1.915E+00	1.226E-01	3.420E+01	2.298E-03
1992	8.034E+01	4.389E+04	2.949E+00	1.888E-01	5.267E+01	3.539E-03
1993	1.088E+02	5.945E+04	3.995E+00	2.557E-01	7.134E+01	4.794E-03
1994	1.549E+02	8.463E+04	5.686E+00	3.640E-01	1.016E+02	6.823E-03
1995	2.064E+02	1.127E+05	7.575E+00	4.849E-01	1.353E+02	9.090E-03
1996	2.853E+02	1.559E+05	1.047E+01	6.704E-01	1.870E+02	1.257E-02
1997	3.698E+02	2.020E+05	1.357E+01	8.689E-01	2.424E+02	1.629E-02
1998	4.682E+02	2.558E+05	1.718E+01	1.100E+00	3.069E+02	2.062E-02
1999	5.476E+02	2.992E+05	2.010E+01	1.287E+00	3.590E+02	2.412E-02
2000	8.138E+02	4.446E+05	2.987E+01	1.912E+00	5.335E+02	3.585E-02
2001	1.070E+03	5.843E+05	3.926E+01	2.513E+00	7.012E+02	4.711E-02
2002	1.327E+03	7.249E+05	4.871E+01	3.118E+00	8.699E+02	5.845E-02
2003	1.532E+03	8.372E+05	5.625E+01	3.601E+00	1.005E+03	6.750E-02
2004	1.755E+03	9.585E+05	6.440E+01	4.123E+00	1.150E+03	7.728E-02
2005	1.853E+03	1.012E+06	6.802E+01	4.354E+00	1.215E+03	8.162E-02
2006	1.935E+03	1.057E+06	7.103E+01	4.547E+00	1.269E+03	8.523E-02
2007	1.993E+03	1.089E+06	7.315E+01	4.683E+00	1.307E+03	8.778E-02
2008	2.045E+03	1.117E+06	7.506E+01	4.805E+00	1.341E+03	9.007E-02
2009	2.078E+03	1.135E+06	7.629E+01	4.884E+00	1.363E+03	9.155E-02
2010	2.119E+03	1.157E+06	7.777E+01	4.979E+00	1.389E+03	9.332E-02
2011	2.150E+03	1.175E+06	7.893E+01	5.053E+00	1.410E+03	9.472E-02
2012	2.066E+03	1.129E+06	7.584E+01	4.855E+00	1.354E+03	9.100E-02
2013	1.985E+03	1.084E+06	7.286E+01	4.665E+00	1.301E+03	8.744E-02
2014	1.907E+03	1.042E+06	7.001E+01	4.482E+00	1.250E+03	8.401E-02
2015	1.832E+03	1.001E+06	6.726E+01	4.306E+00	1.201E+03	8.071E-02
2016	1.761E+03	9.618E+05	6.462E+01	4.137E+00	1.154E+03	7.755E-02
2017	1.692E+03	9.241E+05	6.209E+01	3.975E+00	1.109E+03	7.451E-02
2018	1.625E+03	8.879E+05	5.966E+01	3.819E+00	1.065E+03	7.159E-02
2019	1.561E+03	8.530E+05	5.732E+01	3.669E+00	1.024E+03	6.878E-02
2020	1.500E+03	8.196E+05	5.507E+01	3.525E+00	9.835E+02	6.608E-02
2021	1.441E+03	7.875E+05	5.291E+01	3.387E+00	9.450E+02	6.349E-02
2022	1.385E+03	7.566E+05	5.083E+01	3.254E+00	9.079E+02	6.100E-02
2023	1.331E+03	7.269E+05	4.884E+01	3.127E+00	8.723E+02	5.861E-02
2024	1.278E+03	6.984E+05	4.693E+01	3.004E+00	8.381E+02	5.631E-02
2025	1.228E+03	6.710E+05	4.509E+01	2.886E+00	8.052E+02	5.410E-02
2026	1.180E+03	6.447E+05	4.332E+01	2.773E+00	7.737E+02	5.198E-02
2027	1.134E+03	6.194E+05	4.162E+01	2.664E+00	7.433E+02	4.994E-02
2028	1.089E+03	5.951E+05	3.999E+01	2.560E+00	7.142E+02	4.799E-02
2029	1.047E+03	5.718E+05	3.842E+01	2.460E+00	6.862E+02	4.610E-02
2030	1.006E+03	5.494E+05	3.691E+01	2.363E+00	6.593E+02	4.430E-02
2031	9.662E+02	5.279E+05	3.547E+01	2.270E+00	6.334E+02	4.256E-02
2032	9.283E+02	5.072E+05	3.408E+01	2.181E+00	6.086E+02	4.089E-02
2033	8.919E+02	4.873E+05	3.274E+01	2.096E+00	5.847E+02	3.929E-02
2034	8.570E+02	4.682E+05	3.146E+01	2.014E+00	5.618E+02	3.775E-02
2035	8.234E+02	4.498E+05	3.022E+01	1.935E+00	5.398E+02	3.627E-02
2036	7.911E+02	4.322E+05	2.904E+01	1.859E+00	5.186E+02	3.484E-02
2037	7.601E+02	4.152E+05	2.790E+01	1.786E+00	4.983E+02	3.348E-02
2038	7.303E+02	3.989E+05	2.680E+01	1.716E+00	4.787E+02	3.217E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2039	7.016E+02	3.833E+05	2.575E+01	1.649E+00	4.600E+02	3.090E-02
2040	6.741E+02	3.683E+05	2.474E+01	1.584E+00	4.419E+02	2.969E-02
2041	6.477E+02	3.538E+05	2.377E+01	1.522E+00	4.246E+02	2.853E-02
2042	6.223E+02	3.400E+05	2.284E+01	1.462E+00	4.079E+02	2.741E-02
2043	5.979E+02	3.266E+05	2.195E+01	1.405E+00	3.920E+02	2.634E-02
2044	5.744E+02	3.138E+05	2.109E+01	1.350E+00	3.766E+02	2.530E-02
2045	5.519E+02	3.015E+05	2.026E+01	1.297E+00	3.618E+02	2.431E-02
2046	5.303E+02	2.897E+05	1.946E+01	1.246E+00	3.476E+02	2.336E-02
2047	5.095E+02	2.783E+05	1.870E+01	1.197E+00	3.340E+02	2.244E-02
2048	4.895E+02	2.674E+05	1.797E+01	1.150E+00	3.209E+02	2.156E-02
2049	4.703E+02	2.569E+05	1.726E+01	1.105E+00	3.083E+02	2.072E-02
2050	4.519E+02	2.469E+05	1.659E+01	1.062E+00	2.962E+02	1.990E-02
2051	4.342E+02	2.372E+05	1.594E+01	1.020E+00	2.846E+02	1.912E-02
2052	4.171E+02	2.279E+05	1.531E+01	9.802E-01	2.735E+02	1.837E-02
2053	4.008E+02	2.189E+05	1.471E+01	9.418E-01	2.627E+02	1.765E-02
2054	3.851E+02	2.104E+05	1.413E+01	9.048E-01	2.524E+02	1.696E-02
2055	3.700E+02	2.021E+05	1.358E+01	8.693E-01	2.425E+02	1.630E-02
2056	3.555E+02	1.942E+05	1.305E+01	8.353E-01	2.330E+02	1.566E-02
2057	3.415E+02	1.866E+05	1.254E+01	8.025E-01	2.239E+02	1.504E-02
2058	3.281E+02	1.793E+05	1.204E+01	7.710E-01	2.151E+02	1.445E-02
2059	3.153E+02	1.722E+05	1.157E+01	7.408E-01	2.067E+02	1.389E-02
2060	3.029E+02	1.655E+05	1.112E+01	7.118E-01	1.986E+02	1.334E-02
2061	2.910E+02	1.590E+05	1.068E+01	6.839E-01	1.908E+02	1.282E-02
2062	2.796E+02	1.528E+05	1.026E+01	6.570E-01	1.833E+02	1.232E-02
2063	2.686E+02	1.468E+05	9.861E+00	6.313E-01	1.761E+02	1.183E-02
2064	2.581E+02	1.410E+05	9.474E+00	6.065E-01	1.692E+02	1.137E-02
2065	2.480E+02	1.355E+05	9.103E+00	5.827E-01	1.626E+02	1.092E-02
2066	2.383E+02	1.302E+05	8.746E+00	5.599E-01	1.562E+02	1.050E-02
2067	2.289E+02	1.251E+05	8.403E+00	5.379E-01	1.501E+02	1.008E-02
2068	2.200E+02	1.202E+05	8.073E+00	5.168E-01	1.442E+02	9.688E-03
2069	2.113E+02	1.154E+05	7.757E+00	4.966E-01	1.385E+02	9.308E-03
2070	2.030E+02	1.109E+05	7.453E+00	4.771E-01	1.331E+02	8.943E-03
2071	1.951E+02	1.066E+05	7.161E+00	4.584E-01	1.279E+02	8.593E-03
2072	1.874E+02	1.024E+05	6.880E+00	4.404E-01	1.229E+02	8.256E-03
2073	1.801E+02	9.838E+04	6.610E+00	4.232E-01	1.181E+02	7.932E-03
2074	1.730E+02	9.452E+04	6.351E+00	4.066E-01	1.134E+02	7.621E-03
2075	1.662E+02	9.081E+04	6.102E+00	3.906E-01	1.090E+02	7.322E-03
2076	1.597E+02	8.725E+04	5.863E+00	3.753E-01	1.047E+02	7.035E-03
2077	1.535E+02	8.383E+04	5.633E+00	3.606E-01	1.006E+02	6.759E-03
2078	1.474E+02	8.054E+04	5.412E+00	3.465E-01	9.665E+01	6.494E-03
2079	1.417E+02	7.739E+04	5.200E+00	3.329E-01	9.286E+01	6.240E-03
2080	1.361E+02	7.435E+04	4.996E+00	3.198E-01	8.922E+01	5.995E-03
2081	1.308E+02	7.144E+04	4.800E+00	3.073E-01	8.572E+01	5.760E-03
2082	1.256E+02	6.864E+04	4.612E+00	2.952E-01	8.236E+01	5.534E-03
2083	1.207E+02	6.594E+04	4.431E+00	2.837E-01	7.913E+01	5.317E-03
2084	1.160E+02	6.336E+04	4.257E+00	2.725E-01	7.603E+01	5.108E-03
2085	1.114E+02	6.087E+04	4.090E+00	2.618E-01	7.305E+01	4.908E-03
2086	1.071E+02	5.849E+04	3.930E+00	2.516E-01	7.019E+01	4.716E-03
2087	1.029E+02	5.619E+04	3.776E+00	2.417E-01	6.743E+01	4.531E-03
2088	9.883E+01	5.399E+04	3.628E+00	2.322E-01	6.479E+01	4.353E-03
2089	9.495E+01	5.187E+04	3.485E+00	2.231E-01	6.225E+01	4.182E-03

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2090	9.123E+01	4.984E+04	3.349E+00	2.144E-01	5.981E+01	4.018E-03
2091	8.765E+01	4.789E+04	3.217E+00	2.060E-01	5.746E+01	3.861E-03
2092	8.422E+01	4.601E+04	3.091E+00	1.979E-01	5.521E+01	3.710E-03
2093	8.092E+01	4.420E+04	2.970E+00	1.901E-01	5.304E+01	3.564E-03
2094	7.774E+01	4.247E+04	2.854E+00	1.827E-01	5.096E+01	3.424E-03
2095	7.469E+01	4.081E+04	2.742E+00	1.755E-01	4.897E+01	3.290E-03
2096	7.177E+01	3.921E+04	2.634E+00	1.686E-01	4.705E+01	3.161E-03
2097	6.895E+01	3.767E+04	2.531E+00	1.620E-01	4.520E+01	3.037E-03
2098	6.625E+01	3.619E+04	2.432E+00	1.557E-01	4.343E+01	2.918E-03
2099	6.365E+01	3.477E+04	2.336E+00	1.496E-01	4.173E+01	2.804E-03
2100	6.115E+01	3.341E+04	2.245E+00	1.437E-01	4.009E+01	2.694E-03
2101	5.876E+01	3.210E+04	2.157E+00	1.381E-01	3.852E+01	2.588E-03
2102	5.645E+01	3.084E+04	2.072E+00	1.327E-01	3.701E+01	2.487E-03
2103	5.424E+01	2.963E+04	1.991E+00	1.275E-01	3.556E+01	2.389E-03
2104	5.211E+01	2.847E+04	1.913E+00	1.225E-01	3.416E+01	2.295E-03
2105	5.007E+01	2.735E+04	1.838E+00	1.177E-01	3.282E+01	2.205E-03
2106	4.811E+01	2.628E+04	1.766E+00	1.130E-01	3.154E+01	2.119E-03
2107	4.622E+01	2.525E+04	1.697E+00	1.086E-01	3.030E+01	2.036E-03
2108	4.441E+01	2.426E+04	1.630E+00	1.043E-01	2.911E+01	1.956E-03
2109	4.267E+01	2.331E+04	1.566E+00	1.003E-01	2.797E+01	1.879E-03
2110	4.099E+01	2.239E+04	1.505E+00	9.633E-02	2.687E+01	1.806E-03
2111	3.939E+01	2.152E+04	1.446E+00	9.255E-02	2.582E+01	1.735E-03
2112	3.784E+01	2.067E+04	1.389E+00	8.892E-02	2.481E+01	1.667E-03
2113	3.636E+01	1.986E+04	1.335E+00	8.543E-02	2.383E+01	1.601E-03
2114	3.493E+01	1.908E+04	1.282E+00	8.208E-02	2.290E+01	1.539E-03
2115	3.356E+01	1.834E+04	1.232E+00	7.887E-02	2.200E+01	1.478E-03
2116	3.225E+01	1.762E+04	1.184E+00	7.577E-02	2.114E+01	1.420E-03
2117	3.098E+01	1.693E+04	1.137E+00	7.280E-02	2.031E+01	1.365E-03
2118	2.977E+01	1.626E+04	1.093E+00	6.995E-02	1.951E+01	1.311E-03
2119	2.860E+01	1.562E+04	1.050E+00	6.720E-02	1.875E+01	1.260E-03
2120	2.748E+01	1.501E+04	1.009E+00	6.457E-02	1.801E+01	1.210E-03
2121	2.640E+01	1.442E+04	9.691E-01	6.204E-02	1.731E+01	1.163E-03
2122	2.537E+01	1.386E+04	9.311E-01	5.961E-02	1.663E+01	1.117E-03
2123	2.437E+01	1.331E+04	8.946E-01	5.727E-02	1.598E+01	1.073E-03
2124	2.342E+01	1.279E+04	8.595E-01	5.502E-02	1.535E+01	1.031E-03
2125	2.250E+01	1.229E+04	8.258E-01	5.287E-02	1.475E+01	9.909E-04
2126	2.162E+01	1.181E+04	7.934E-01	5.079E-02	1.417E+01	9.521E-04
2127	2.077E+01	1.135E+04	7.623E-01	4.880E-02	1.361E+01	9.148E-04
2128	1.995E+01	1.090E+04	7.324E-01	4.689E-02	1.308E+01	8.789E-04
2129	1.917E+01	1.047E+04	7.037E-01	4.505E-02	1.257E+01	8.444E-04

APPENDIX 9 METEOROLOGICAL DATA

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24	status	Avg	status	Max	status	Min
01/01/2010	23:59:07	VALID	0.614366	VALID	0	VALID	-2.63121	VALID	0.231525	VALID	-5.82685
02/01/2010	23:59:07	VALID	0.062297	VALID	0	VALID	-3.37944	VALID	0.273515	VALID	-6.42386
03/01/2010	23:59:08	VALID	-0.023357	VALID	0	VALID	-0.089719	VALID	2.2311	VALID	-1.93514
04/01/2010	23:59:08	VALID	0.273336	VALID	0	VALID	-2.34413	VALID	0.832233	VALID	-6.25619
05/01/2010	23:59:08	VALID	0.169535	VALID	0.2	VALID	-0.072606	VALID	1.8952	VALID	-1.72202
06/01/2010	23:59:08	VALID	0.316349	VALID	0	VALID	-0.711853	VALID	1.16505	VALID	-4.00425
07/01/2010	23:59:08	VALID	0.710513	VALID	0	VALID	-3.70456	VALID	1.84334	VALID	-7.49789
08/01/2010	23:59:07	VALID	0.044655	VALID	0	VALID	-4.76052	VALID	-0.21089	VALID	-8.71606
09/01/2010	23:59:07	VALID	-0.01629	VALID	0	VALID	-7.76044	VALID	-2.6387	VALID	-11.9257
10/01/2010	23:59:07	VALID	-0.018159	VALID	0.2	VALID	-2.18954	VALID	0.48672	VALID	-7.7457
11/01/2010	23:59:07	VALID	0.076005	VALID	0.8	VALID	0.253702	VALID	1.33616	VALID	-1.06338
12/01/2010	23:59:07	VALID	-0.030911	VALID	26.6	VALID	1.9838	VALID	4.65489	VALID	-0.256104
13/01/2010	23:59:07	VALID	0.543747	VALID	0.8	VALID	1.21202	VALID	2.52846	VALID	-0.972914
14/01/2010	23:59:07	VALID	-0.068562	VALID	0.2	VALID	-0.181884	VALID	6.72484	VALID	-3.55202
15/01/2010	23:59:08	VALID	0.189621	VALID	9.8	VALID	8.64598	VALID	10.1682	VALID	5.29528
16/01/2010	23:59:08	VALID	0.715554	VALID	2	VALID	6.33186	VALID	10.1774	VALID	2.23776
17/01/2010	23:59:08	VALID	0.57187	VALID	0	VALID	5.1616	VALID	8.59742	VALID	0.363974
18/01/2010	23:59:08	VALID	0.530674	VALID	0	VALID	5.30427	VALID	9.11799	VALID	0.561006
19/01/2010	23:59:08	VALID	0.212321	VALID	7.8	VALID	6.08616	VALID	6.98682	VALID	4.39328
20/01/2010	23:59:07	VALID	0.170027	VALID	2	VALID	4.22854	VALID	9.05638	VALID	1.03257
21/01/2010	23:59:07	VALID	0.11385	VALID	9	VALID	7.77239	VALID	10.6311	VALID	1.04228
22/01/2010	23:59:07	VALID	-0.057982	VALID	0.2	VALID	3.26068	VALID	8.5616	VALID	-1.50259
23/01/2010	23:59:07	VALID	-0.002621	VALID	0.2	VALID	-1.8315	VALID	0.008699	VALID	-4.45847
24/01/2010	23:59:07	VALID	-0.035819	VALID	1	VALID	-0.106271	VALID	4.92302	VALID	-4.83608
25/01/2010	23:59:07	VALID	-0.027112	VALID	0.2	VALID	-0.061175	VALID	2.7804	VALID	-5.48043
26/01/2010	23:59:07	INVALID	-0.027112	VALID	0	VALID	-1.51902	VALID	5.1943	VALID	-5.4555
27/01/2010	23:59:08	VALID	-0.072726	VALID	1.6	VALID	4.27032	VALID	7.93153	VALID	-0.159236
28/01/2010	23:59:08	VALID	-0.110408	VALID	0.6	VALID	5.15214	VALID	7.04497	VALID	3.61444
29/01/2010	23:59:08	VALID	-0.145642	VALID	1	VALID	5.00859	VALID	6.81832	VALID	1.41698
30/01/2010	23:59:08	VALID	0.388248	VALID	0.2	VALID	0.456217	VALID	4.04052	VALID	-3.38088
31/01/2010	23:59:08	VALID	0.091967	VALID	0.2	VALID	-0.966851	VALID	3.60105	VALID	-4.27789
TOTAL			**5.158234**		**64.6**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24	status	Avg	status	Max	status	Min
01/02/2010	23:59:07	VALID	0.080213	VALID	0	VALID	0.855057	VALID	5.79357	VALID	-4.20714
02/02/2010	23:59:07	VALID	0.024316	VALID	6.4	VALID	6.03979	VALID	7.46173	VALID	4.44813
03/02/2010	23:59:07	VALID	-0.175261	VALID	6	VALID	5.25077	VALID	8.84922	VALID	1.00676
04/02/2010	23:59:07	VALID	-0.031044	VALID	13.4	VALID	5.68898	VALID	9.09024	VALID	0.867872
05/02/2010	23:59:07	VALID	-0.12996	VALID	4	VALID	5.82983	VALID	8.05087	VALID	3.29454
06/02/2010	23:59:07	VALID	-0.074934	VALID	0.2	VALID	2.03153	VALID	6.13638	VALID	-1.48634
07/02/2010	23:59:08	VALID	-0.097012	VALID	0	VALID	4.19093	VALID	6.37189	VALID	2.17625
08/02/2010	23:59:08	VALID	-0.15481	VALID	0	VALID	2.51566	VALID	3.68214	VALID	1.30389
09/02/2010	23:59:08	VALID	0.181993	VALID	0	VALID	2.02575	VALID	4.72285	VALID	-1.54447
10/02/2010	23:59:08	VALID	0.548226	VALID	0	VALID	-1.04885	VALID	5.04297	VALID	-6.44925
11/02/2010	23:59:08	VALID	0.307605	VALID	0	VALID	-1.63221	VALID	4.94882	VALID	-6.83011
12/02/2010	23:59:07	VALID	0.187801	VALID	0	VALID	0.913824	VALID	5.48884	VALID	-3.87475
13/02/2010	23:59:07	VALID	0.090983	VALID	0	VALID	1.93437	VALID	5.4406	VALID	-2.14167
14/02/2010	23:59:07	VALID	0.17839	VALID	0	VALID	1.73599	VALID	7.07329	VALID	-3.70399
15/02/2010	23:59:07	VALID	0.281343	VALID	2.4	VALID	4.22766	VALID	7.61371	VALID	2.29913
16/02/2010	23:59:07	VALID	0.061827	VALID	0.2	VALID	1.89881	VALID	6.59833	VALID	-0.972913
17/02/2010	23:59:07	VALID	0.201448	VALID	0	VALID	1.27915	VALID	5.31785	VALID	-2.0996
18/02/2010	23:59:07	VALID	0.31134	VALID	0	VALID	-0.032971	VALID	4.63532	VALID	-5.36876
19/02/2010	23:59:08	VALID	0.266174	VALID	0	VALID	0.334467	VALID	5.09445	VALID	-3.98781
20/02/2010	23:59:08	VALID	0.24497	VALID	0.6	VALID	0.716472	VALID	5.44673	VALID	-1.26027
21/02/2010	23:59:08	VALID	0.166438	VALID	0.4	VALID	0.405137	VALID	4.62221	VALID	-1.53463
22/02/2010	23:59:08	VALID	0.115933	VALID	0	VALID	-2.68273	VALID	-0.084956	VALID	-5.4684
23/02/2010	23:59:08	VALID	-0.067934	VALID	2.4	VALID	-0.036984	VALID	2.118	VALID	-1.71883
24/02/2010	23:59:07	VALID	0.055898	VALID	2.2	VALID	1.9084	VALID	3.98244	VALID	0.680463
25/02/2010	23:59:07	VALID	-0.044187	VALID	1.6	VALID	1.41557	VALID	3.74684	VALID	-0.517682
26/02/2010	23:59:07	VALID	0.103173	VALID	1.2	VALID	3.19751	VALID	6.54367	VALID	1.03584
27/02/2010	23:59:07	VALID	0.245289	VALID	0	VALID	2.69787	VALID	8.94877	VALID	-2.47743
28/02/2010	23:59:07	VALID	0.358532	VALID	0.4	VALID	0.888055	VALID	8.41888	VALID	-3.49721
TOTAL			**3.236751**		**41.4**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min
01/03/2010	23:59:07	VALID	0.359746	VALID	0	VALID	0.885121	VALID	9.40898	VALID	-5.46833
02/03/2010	23:59:07	VALID	0.239758	VALID	0	VALID	1.63289	VALID	7.26149	VALID	-4.233
03/03/2010	23:59:08	VALID	0.474658	VALID	2	VALID	4.14128	VALID	5.33718	VALID	2.20199
04/03/2010	23:59:08	VALID	-0.0314083	VALID	0	VALID	1.09306	VALID	7.82345	VALID	-4.51331
05/03/2010	23:59:08	VALID	0.371545	VALID	0.2	VALID	0.498353	VALID	9.85487	VALID	-6.93554
06/03/2010	23:59:08	VALID	-0.00668892	VALID	0	VALID	1.04634	VALID	6.93418	VALID	-5.44891
07/03/2010	23:59:08	VALID	0.0553244	VALID	0	VALID	2.11791	VALID	5.60455	VALID	-2.06735
08/03/2010	23:59:07	VALID	0.484555	VALID	0	VALID	0.360852	VALID	6.3419	VALID	-5.29761
09/03/2010	23:59:07	VALID	1.0237	VALID	0	VALID	1.2158	VALID	8.23661	VALID	-5.87155
10/03/2010	23:59:07	VALID	0.469739	VALID	0	VALID	0.792739	VALID	8.47994	VALID	-7.37059
11/03/2010	23:59:07	VALID	0.27035	VALID	0	VALID	2.28329	VALID	8.027	VALID	-4.64567
12/03/2010	23:59:07	VALID	0.361462	VALID	0	VALID	5.1964	VALID	8.92378	VALID	-0.239952
13/03/2010	23:59:07	VALID	0.281705	VALID	0	VALID	5.72841	VALID	8.11498	VALID	3.40061
14/03/2010	23:59:07	VALID	0.17101	VALID	0	VALID	3.72228	VALID	10.5805	VALID	-2.78052
15/03/2010	23:59:08	VALID	0.404955	VALID	0	VALID	3.21683	VALID	9.91625	VALID	-3.92959
16/03/2010	23:59:08	VALID	0.482201	VALID	0	VALID	5.65373	VALID	8.70758	VALID	-0.53701
17/03/2010	23:59:08	VALID	0.317773	VALID	0	VALID	9.64742	VALID	12.0403	VALID	7.72952
18/03/2010	23:59:08	VALID	0.163769	VALID	2	VALID	9.94053	VALID	13.4078	VALID	7.67872
19/03/2010	23:59:08	VALID	0.191618	VALID	5	VALID	6.69904	VALID	9.26284	VALID	2.91287
20/03/2010	23:59:07	VALID	0.0574275	VALID	2.6	VALID	6.51587	VALID	10.8877	VALID	2.01463
21/03/2010	23:59:07	VALID	0.446569	VALID	0.2	VALID	7.93668	VALID	13.4038	VALID	0.0506824
22/03/2010	23:59:07	VALID	0.61657	VALID	4.6	VALID	7.23534	VALID	10.1944	VALID	1.8789
23/03/2010	23:59:07	VALID	0.744983	VALID	2.8	VALID	6.54509	VALID	8.19558	VALID	2.43452
24/03/2010	23:59:07	VALID	0.0799504	VALID	7	VALID	8.27512	VALID	12.5805	VALID	5.75123
25/03/2010	23:59:07	VALID	0.594473	VALID	5	VALID	7.69808	VALID	11.0599	VALID	5.5957
26/03/2010	23:59:07	VALID	0.209953	VALID	0	VALID	7.91932	VALID	11.4214	VALID	4.04401
27/03/2010	23:59:08	VALID	0.181518	VALID	0	VALID	7.33638	VALID	11.0977	VALID	3.35911
28/03/2010	23:59:08	VALID	0.43955	VALID	0.2	VALID	7.07133	VALID	11.0903	VALID	4.01199
29/03/2010	23:59:08	VALID	0.353148	VALID	27.4	VALID	4.87723	VALID	7.48799	VALID	1.08104
30/03/2010	23:59:08	VALID	-0.15499	VALID	10.8	VALID	2.26153	VALID	5.70918	VALID	-0.530605
31/03/2010	23:59:08	VALID	0.143489	VALID	1	VALID	2.35764	VALID	6.03549	VALID	-1.00203
TOTAL			**9.80**		**70.8**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h	
date	time	status	evap	status	PR_Sum24	status	Avg	status	Max	status	Min	status
01/04/2010	23:59:07	VALID	0.586215	VALID	1.6	VALID	3.78659	VALID	8.97869	VALID	-0.947181	VALID
02/04/2010	23:59:07	VALID	0.308071	VALID	4.6	VALID	5.50101	VALID	9.54122	VALID	0.867871	VALID
03/04/2010	23:59:07	VALID	0.329823	VALID	0.6	VALID	2.46096	VALID	8.41564	VALID	-3.10992	INVALID
04/04/2010	23:59:07	VALID	0.186978	VALID	1.2	VALID	4.15663	VALID	9.02066	VALID	-2.62247	VALID
05/04/2010	23:59:07	VALID	0.565448	VALID	1.4	VALID	9.22762	VALID	11.6307	VALID	7.67519	INVALID
06/04/2010	23:59:07	VALID	-0.329584	VALID	12.2	VALID	7.84548	VALID	12.1278	VALID	4.83602	INVALID
07/04/2010	23:59:07	VALID	0.285711	VALID	0.2	VALID	6.52118	VALID	11.3901	VALID	1.78859	INVALID
08/04/2010	23:59:08	VALID	0.260386	VALID	0	VALID	8.18834	VALID	13.0341	VALID	3.07758	VALID
09/04/2010	23:59:08	VALID	0.165835	VALID	0	VALID	7.93611	VALID	13.5913	VALID	1.26834	VALID
10/04/2010	23:59:08	VALID	0.438871	VALID	0	VALID	9.33869	VALID	14.3608	VALID	4.74207	VALID
11/04/2010	23:59:08	VALID	0.265341	VALID	0	VALID	10.5059	VALID	18.5203	VALID	0.790283	VALID
12/04/2010	23:59:08	VALID	0.074057	VALID	0	VALID	9.78218	VALID	15.9296	VALID	3.46875	VALID
13/04/2010	23:59:07	VALID	0.642861	VALID	0	VALID	8.60437	VALID	15.5411	VALID	1.0196	VALID
14/04/2010	23:59:07	VALID	0.66971	VALID	0	VALID	6.53549	VALID	11.3308	VALID	3.20375	VALID
15/04/2010	23:59:07	VALID	0.512496	VALID	0	VALID	7.08397	VALID	13.6034	VALID	-1.25701	VALID
16/04/2010	23:59:07	VALID	0.531187	VALID	0	VALID	7.56104	VALID	13.4896	VALID	1.97899	VALID
17/04/2010	23:59:07	VALID	0.681471	VALID	0	VALID	7.708	VALID	16.1134	VALID	-1.6283	VALID
18/04/2010	23:59:07	VALID	0.499709	VALID	0	VALID	7.85319	VALID	13.7659	VALID	2.56378	VALID
19/04/2010	23:59:07	VALID	0.507184	VALID	0	VALID	7.22253	VALID	13.2142	VALID	1.36195	VALID
20/04/2010	23:59:08	VALID	0.403785	VALID	0	VALID	6.19408	VALID	12.4156	VALID	-1.61857	VALID
21/04/2010	23:59:08	VALID	0.619758	VALID	0	VALID	6.09818	VALID	11.6335	VALID	1.49765	VALID
22/04/2010	23:59:08	VALID	1.18732	VALID	0	VALID	6.24258	VALID	12.2101	VALID	-0.795271	VALID
23/04/2010	23:59:08	VALID	0.880554	VALID	0	VALID	8.10943	VALID	15.4301	VALID	0.874144	VALID
24/04/2010	23:59:08	VALID	1.03147	VALID	1	VALID	9.02898	VALID	12.3835	VALID	5.59816	VALID
25/04/2010	23:59:07	VALID	0.433607	VALID	1.8	VALID	11.3195	VALID	15.4637	VALID	8.59019	VALID
26/04/2010	23:59:07	VALID	0.328733	VALID	0	VALID	11.6906	VALID	16.2863	VALID	8.24391	VALID
27/04/2010	23:59:07	VALID	0.214161	VALID	0	VALID	10.9748	VALID	14.8144	VALID	7.42918	VALID
28/04/2010	23:59:07	VALID	0.072917	VALID	0.4	VALID	12.0459	VALID	15.2699	VALID	9.55142	VALID
29/04/2010	23:59:07	VALID	0.07777	VALID	1.6	VALID	9.04799	VALID	12.8423	VALID	3.90804	VALID
30/04/2010	23:59:07	VALID	0.312923	VALID	5.4	VALID	8.88	VALID	13.7274	VALID	5.48884	VALID
Total			**12.74477**		**32**							

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min
01/05/2010	23:59:07	VALID	0.159373	VALID	5	VALID	7.50539	VALID	12.633	VALID	4.26983
02/05/2010	23:59:08	VALID	0.229749	VALID	0.2	VALID	7.32627	VALID	11.387	VALID	3.7949
03/05/2010	23:59:08	VALID	0.770198	VALID	0	VALID	7.39004	VALID	12.0559	VALID	2.38614
04/05/2010	23:59:08	VALID	1.0192	VALID	0	VALID	7.63801	VALID	11.5895	VALID	1.60097
05/05/2010	23:59:08	VALID	0.70783	VALID	0.2	VALID	10.1796	VALID	14.2299	VALID	6.42639
06/05/2010	23:59:07	VALID	0.275785	VALID	0.2	VALID	10.7565	VALID	13.7274	VALID	8.95615
07/05/2010	23:59:07	VALID	0.0676177	VALID	0	VALID	8.41635	VALID	11.409	VALID	5.22367
08/05/2010	23:59:07	VALID	0.855734	VALID	0	VALID	8.68616	VALID	13.2541	VALID	5.16579
09/05/2010	23:59:07	VALID	1.64415	VALID	0	VALID	7.64973	VALID	14.0061	VALID	-1.59916
10/05/2010	23:59:07	VALID	0.914777	VALID	0	VALID	7.24984	VALID	10.4571	VALID	4.11169
11/05/2010	23:59:07	VALID	1.50304	VALID	0	VALID	6.44444	VALID	11.9356	VALID	1.21328
12/05/2010	23:59:07	VALID	1.59729	VALID	0.6	VALID	6.72056	VALID	11.5309	VALID	2.69596
13/05/2010	23:59:07	VALID	1.60819	VALID	1.6	VALID	7.40311	VALID	11.4049	VALID	2.88992
14/05/2010	23:59:08	VALID	0.903563	VALID	0.2	VALID	8.59429	VALID	13.6714	VALID	4.0437
15/05/2010	23:59:08	VALID	1.10788	VALID	0	VALID	8.48547	VALID	13.7285	VALID	1.64934
16/05/2010	23:59:08	VALID	1.03908	VALID	4.8	VALID	9.19644	VALID	13.6378	VALID	4.38314
17/05/2010	23:59:08	VALID	1.16837	VALID	0.4	VALID	8.76928	VALID	14.4543	VALID	1.26176
18/05/2010	23:59:07	VALID	0.902911	VALID	2.4	VALID	10.4212	VALID	12.4155	VALID	6.72408
19/05/2010	23:59:07	VALID	0.329005	VALID	0.4	VALID	14.46	VALID	19.5611	VALID	10.0856
20/05/2010	23:59:07	VALID	0.28003	VALID	0	VALID	16.6186	VALID	23.8541	VALID	11.1665
21/05/2010	23:59:07	VALID	-0.00699091	VALID	0	VALID	14.3917	VALID	19.9623	VALID	8.5424
22/05/2010	23:59:07	VALID	-0.1315	VALID	0	VALID	16.0623	VALID	22.7854	VALID	8.74631
23/05/2010	23:59:07	VALID	0.063053	VALID	0	VALID	15.7775	VALID	24.4526	VALID	5.38529
24/05/2010	23:59:07	VALID	0.340087	VALID	0	VALID	13.2717	VALID	19.3327	VALID	7.11274
25/05/2010	23:59:08	VALID	0.490205	VALID	0	VALID	11.989	VALID	17.9804	VALID	6.47557
26/05/2010	23:59:08	VALID	1.55485	VALID	0	VALID	9.77216	VALID	15.8552	VALID	4.03416
27/05/2010	23:59:08	VALID	2.04072	VALID	3.2	VALID	7.49941	VALID	13.4497	VALID	1.11972
28/05/2010	23:59:08	VALID	0.671228	VALID	0.8	VALID	9.61746	VALID	14.368	VALID	4.16018
29/05/2010	23:59:08	VALID	0.911402	VALID	12.8	VALID	10.936	VALID	15.4122	VALID	8.42254
30/05/2010	23:59:07	VALID	0.149018	VALID	0.4	VALID	10.6823	VALID	16.0319	VALID	5.94161
31/05/2010	23:59:07	VALID	0.422386	VALID	8	VALID	11.9609	VALID	16.5801	VALID	9.5447
TOTAL			**23.59**		**41.2**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min
01/06/2010	23:59:07	VALID	0.71154	VALID	1.6	VALID	12.8338	VALID	17.0858	VALID	8.28035
02/06/2010	23:59:07	VALID	0.566203	VALID	0	VALID	13.45	VALID	20.2867	VALID	7.14779
03/06/2010	23:59:07	VALID	0.49415	VALID	0	VALID	13.1144	VALID	17.014	VALID	9.19338
04/06/2010	23:59:07	VALID	0.624425	VALID	0	VALID	15.4981	VALID	20.7236	VALID	11.5038
05/06/2010	23:59:07	VALID	0.667512	VALID	0	VALID	14.7607	VALID	19.7676	VALID	9.11083
06/06/2010	23:59:08	VALID	0.414185	VALID	8.6	VALID	13.6201	VALID	18.7674	VALID	10.1636
07/06/2010	23:59:08	VALID	0.576183	VALID	10.6	VALID	11.7623	VALID	13.8305	VALID	10.2256
08/06/2010	23:59:08	VALID	0.0430507	VALID	1.4	VALID	13.6153	VALID	18.0719	VALID	11.2994
09/06/2010	23:59:08	VALID	0.0912612	VALID	0.6	VALID	12.6313	VALID	15.3977	VALID	10.7567
10/06/2010	23:59:08	VALID	-0.239702	VALID	0	VALID	12.4367	VALID	16.4018	VALID	9.58776
11/06/2010	23:59:07	VALID	-0.039028	VALID	0	VALID	12.2498	VALID	18.0916	VALID	6.23958
12/06/2010	23:59:07	VALID	0.221191	VALID	0	VALID	12.6943	VALID	17.5594	VALID	9.83756
13/06/2010	23:59:07	VALID	0.547606	VALID	1.8	VALID	11.4969	VALID	14.9028	VALID	8.6423
14/06/2010	23:59:07	VALID	0.577118	VALID	0	VALID	12.5386	VALID	17.1044	VALID	7.46905
15/06/2010	23:59:07	VALID	0.53189	VALID	0	VALID	14.3	VALID	20.9259	VALID	7.72745
16/06/2010	23:59:07	VALID	0.363842	VALID	0	VALID	14.4897	VALID	21.1819	VALID	7.94428
17/06/2010	23:59:07	VALID	0.224607	VALID	0	VALID	15.6094	VALID	22.0124	VALID	9.4339
18/06/2010	23:59:08	VALID	0.109441	VALID	0	VALID	14.4162	VALID	17.8678	VALID	9.7921
19/06/2010	23:59:08	VALID	0.320684	VALID	0	VALID	13.4879	VALID	18.976	VALID	7.74393
20/06/2010	23:59:08	VALID	1.49255	VALID	0	VALID	14.4682	VALID	22.8553	VALID	4.53532
21/06/2010	23:59:08	VALID	0.557236	VALID	0	VALID	15.2943	VALID	21.6976	VALID	6.09047
22/06/2010	23:59:08	VALID	0.512108	VALID	0	VALID	14.8125	VALID	19.3676	VALID	9.74677
23/06/2010	23:59:07	VALID	0.677079	VALID	0.4	VALID	15.4292	VALID	20.0053	VALID	11.7529
24/06/2010	23:59:07	VALID	0.581119	VALID	0	VALID	14.9086	VALID	20.9086	VALID	9.17996
25/06/2010	23:59:07	VALID	0.52114	VALID	0	VALID	14.7617	VALID	19.0998	VALID	8.19682
26/06/2010	23:59:07	VALID	0.191016	VALID	0.2	VALID	16.1892	VALID	20.2118	VALID	13.1395
27/06/2010	23:59:07	VALID	0.800524	VALID	0	VALID	16.2141	VALID	21.4043	VALID	12.9091
28/06/2010	23:59:07	VALID	1.11456	VALID	5	VALID	15.0822	VALID	18.9237	VALID	11.3165
29/06/2010	23:59:07	VALID	-0.225951	VALID	0	VALID	16.0334	VALID	20.9874	VALID	11.2971
30/06/2010	23:59:08	VALID	0.27557	VALID	2	VALID	15.5195	VALID	19.87	VALID	12.7402
TOTAL			**13.30**		**32.2**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min
01/07/2010	23:59:08	VALID	-0.303828	VALID	5	VALID	16.092	VALID	19.6073	VALID	11.9027
02/07/2010	23:59:08	VALID	-0.312219	VALID	0.2	VALID	14.2657	VALID	18.4506	VALID	10.0111
03/07/2010	23:59:08	VALID	-0.274355	VALID	0	VALID	13.7956	VALID	18.284	VALID	10.271
04/07/2010	23:59:08	VALID	0.202008	VALID	0.6	VALID	15.1496	VALID	18.6124	VALID	11.3847
05/07/2010	23:59:07	VALID	0.324539	VALID	0.2	VALID	12.8552	VALID	17.6889	VALID	7.91121
06/07/2010	23:59:07	VALID	0.492405	VALID	1.4	VALID	12.4502	VALID	18.8576	VALID	5.08495
07/07/2010	23:59:07	VALID	0.163766	VALID	0	VALID	14.928	VALID	19.3522	VALID	11.2031
08/07/2010	23:59:07	VALID	0.586835	VALID	5.6	VALID	12.6383	VALID	15.5116	VALID	10.1154
09/07/2010	23:59:07	VALID	-0.100554	VALID	11.6	VALID	14.2046	VALID	15.813	VALID	13.0332
10/07/2010	23:59:07	INVALID	-0.100554	VALID	13.2	VALID	15.0021	VALID	16.6479	VALID	10.5399
11/07/2010	23:59:08	INVALID	-0.100554	VALID	0.6	VALID	12.292	VALID	16.0502	VALID	8.89287
12/07/2010	23:59:08	INVALID	-0.100554	VALID	0	VALID	13.7482	VALID	18.8796	VALID	9.50106
13/07/2010	23:59:08	INVALID	-0.100554	VALID	5	VALID	12.7007	VALID	15.4229	VALID	10.0574
14/07/2010	23:59:08	INVALID	-0.100554	VALID	7.6	VALID	14.1601	VALID	18.0863	VALID	11.5982
15/07/2010	23:59:08	INVALID	-0.100554	VALID	8.8	VALID	12.9513	VALID	15.0743	VALID	10.5239
16/07/2010	23:59:08	INVALID	-0.100554	VALID	3.4	VALID	12.0877	VALID	16.2488	VALID	9.36113
17/07/2010	23:59:07	INVALID	-0.100554	VALID	3.4	VALID	12.3929	VALID	17.4576	VALID	8.38789
18/07/2010	23:59:07	INVALID	-0.100554	VALID	5.8	VALID	15.6036	VALID	17.8605	VALID	13.8724
19/07/2010	23:59:07	INVALID	-0.100554	VALID	5.2	VALID	16.1052	VALID	19.1469	VALID	13.9043
20/07/2010	23:59:07	INVALID	-0.100554	VALID	1.2	VALID	13.787	VALID	18.4406	VALID	9.98575
21/07/2010	23:59:07	INVALID	-0.100554	VALID	2.2	VALID	12.5267	VALID	17.2528	VALID	10.4331
22/07/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	12.4834	VALID	17.1546	VALID	10.4747
23/07/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	13.0622	VALID	18.6534	VALID	6.6924
24/07/2010	23:59:08	INVALID	-0.100554	VALID	1	VALID	14.6575	VALID	18.3419	VALID	11.9027
25/07/2010	23:59:08	INVALID	-0.100554	VALID	0	VALID	15.0471	VALID	19.1839	VALID	12.645
26/07/2010	23:59:08	INVALID	-0.100554	VALID	1	VALID	15.949	VALID	19.9743	VALID	13.431
27/07/2010	23:59:08	INVALID	-0.100554	VALID	0.8	VALID	14.2987	VALID	16.8445	VALID	12.4008
28/07/2010	23:59:08	INVALID	-0.100554	VALID	0	VALID	13.6292	VALID	16.4752	VALID	11.1941
29/07/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	14.2082	VALID	18.8759	VALID	11.5496
30/07/2010	23:59:07	INVALID	-0.100554	VALID	2	VALID	14.8733	VALID	16.8605	VALID	12.0426
31/07/2010	23:59:07	INVALID	-0.100554	VALID	3.4	VALID	12.7622	VALID	15.9612	VALID	10.9424
Total			**-1.433591**		**89.2**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24	status	Avg	status	Max	status	Min
01/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	13.8691	VALID	17.4565	VALID	10.8092
02/08/2010	23:59:07	INVALID	-0.100554	VALID	0.4	VALID	13.6497	VALID	16.3064	VALID	11.0806
03/08/2010	23:59:07	INVALID	-0.100554	VALID	2.8	VALID	12.934	VALID	15.0407	VALID	10.9767
04/08/2010	23:59:07	INVALID	-0.100554	VALID	0.8	VALID	13.2015	VALID	16.0419	VALID	10.5557
05/08/2010	23:59:08	INVALID	-0.100554	VALID	1.2	VALID	13.3215	VALID	17.0125	VALID	10.8351
06/08/2010	23:59:08	INVALID	-0.100554	VALID	1.6	VALID	13.8392	VALID	16.1596	VALID	12.0715
07/08/2010	23:59:08	INVALID	-0.100554	VALID	0.2	VALID	13.7688	VALID	17.6232	VALID	9.62373
08/08/2010	23:59:08	INVALID	-0.100554	VALID	0	VALID	13.4661	VALID	19.7211	VALID	9.31987
09/08/2010	23:59:07	INVALID	-0.100554	VALID	2.8	VALID	13.6814	VALID	17.2004	VALID	9.25153
10/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	12.7059	VALID	18.2703	VALID	7.22941
11/08/2010	23:59:07	INVALID	-0.100554	VALID	1.2	VALID	12.4235	VALID	17.6187	VALID	6.7663
12/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	12.83	VALID	16.4369	VALID	10.4625
13/08/2010	23:59:07	INVALID	-0.100554	VALID	0.6	VALID	12.6961	VALID	15.5131	VALID	10.1701
14/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	12.288	VALID	15.6655	VALID	8.86318
15/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	13.8881	VALID	22.6876	VALID	5.0365
16/08/2010	23:59:07	INVALID	-0.100554	VALID	0.2	VALID	12.6805	VALID	16.9035	VALID	7.20739
17/08/2010	23:59:08	INVALID	-0.100554	VALID	0.4	VALID	13.2314	VALID	15.9728	VALID	9.72972
18/08/2010	23:59:08	INVALID	-0.100554	VALID	1	VALID	12.8063	VALID	16.8622	VALID	10.1681
19/08/2010	23:59:08	INVALID	-0.100554	VALID	2	VALID	12.7417	VALID	16.958	VALID	9.00005
20/08/2010	23:59:08	INVALID	-0.100554	VALID	1.6	VALID	16.2677	VALID	19.2774	VALID	9.95463
21/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	13.8649	VALID	18.3794	VALID	9.19997
22/08/2010	23:59:07	INVALID	-0.100554	VALID	4	VALID	13.5767	VALID	19.2515	VALID	9.81862
23/08/2010	23:59:07	INVALID	-0.100554	VALID	5.8	VALID	11.8756	VALID	15.2677	VALID	9.46521
24/08/2010	23:59:07	INVALID	-0.100554	VALID	3	VALID	11.8344	VALID	16.1489	VALID	6.91547
25/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	10.6897	VALID	16.4308	VALID	4.52937
26/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	11.3129	VALID	18.2316	VALID	4.18032
27/08/2010	23:59:07	INVALID	-0.100554	VALID	0	VALID	11.5785	VALID	16.9963	VALID	5.61539
28/08/2010	23:59:08	VALID	-0.089704	VALID	0	VALID	10.7011	VALID	16.9477	VALID	2.40898
29/08/2010	23:59:08	INVALID	-0.089704	VALID	0	VALID	12.4632	VALID	17.3646	VALID	5.64407
30/08/2010	23:59:08	VALID	-0.1587	VALID	0	VALID	9.24831	VALID	17.3289	VALID	0.476987
31/08/2010	23:59:08	VALID	0.118627	VALID	0	VALID	11.0154	VALID	17.4842	VALID	3.12626
TOTAL					**29.6**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min
01/09/2010	23:59:08	VALID	-0.0116859	VALID	0	VALID	13.1121	VALID	18.4969	VALID	9.03105
02/09/2010	23:59:07	VALID	-0.218466	VALID	0	VALID	13.2177	VALID	18.4742	VALID	8.67834
03/09/2010	23:59:07	VALID	-0.260024	VALID	0	VALID	14.1247	VALID	18.8569	VALID	10.2518
04/09/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	16.1663	VALID	21.1364	VALID	13.4789
05/09/2010	23:59:07	INVALID	-0.260024	VALID	7.4	VALID	14.0536	VALID	17.6855	VALID	10.0376
06/09/2010	23:59:07	INVALID	-0.260024	VALID	35.2	VALID	13.5587	VALID	16.0907	VALID	11.2672
07/09/2010	23:59:07	INVALID	-0.260024	VALID	13	VALID	11.4495	VALID	16.1087	VALID	10.0637
08/09/2010	23:59:07	INVALID	-0.260024	VALID	1	VALID	13.08	VALID	17.0235	VALID	9.77591
09/09/2010	23:59:08	INVALID	-0.260024	VALID	4.4	VALID	13.2936	VALID	18.2949	VALID	9.64004
10/09/2010	23:59:08	INVALID	-0.260024	VALID	2.2	VALID	15.8256	VALID	18.157	VALID	13.1827
11/09/2010	23:59:08	INVALID	-0.260024	VALID	3	VALID	12.379	VALID	16.2079	VALID	7.91211
12/09/2010	23:59:08	INVALID	-0.260024	VALID	1	VALID	10.8428	VALID	14.7171	VALID	7.1104
13/09/2010	23:59:08	INVALID	-0.260024	VALID	3.6	VALID	14.613	VALID	17.7747	VALID	11.5181
14/09/2010	23:59:07	INVALID	-0.260024	VALID	9	VALID	12.894	VALID	15.2898	VALID	7.53424
15/09/2010	23:59:07	INVALID	-0.260024	VALID	0.6	VALID	10.4632	VALID	14.7907	VALID	6.01022
16/09/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	10.6666	VALID	15.0584	VALID	6.79943
17/09/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	8.85501	VALID	13.7965	VALID	3.43337
18/09/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	9.14094	VALID	13.878	VALID	1.92108
19/09/2010	23:59:07	INVALID	-0.260024	VALID	4.8	VALID	13.3399	VALID	16.0548	VALID	11.7765
20/09/2010	23:59:07	INVALID	-0.260024	VALID	2.6	VALID	13.7541	VALID	17.9641	VALID	11.0326
21/09/2010	23:59:08	INVALID	-0.260024	VALID	0.4	VALID	14.3753	VALID	16.2139	VALID	12.1491
22/09/2010	23:59:08	INVALID	-0.260024	VALID	9.6	VALID	14.5963	VALID	17.785	VALID	11.4456
23/09/2010	23:59:08	INVALID	-0.260024	VALID	0.6	VALID	11.4749	VALID	13.5763	VALID	10.5203
24/09/2010	23:59:08	INVALID	-0.260024	VALID	0	VALID	9.60598	VALID	12.5233	VALID	3.76947
25/09/2010	23:59:08	INVALID	-0.260024	VALID	0	VALID	6.54318	VALID	12.2678	VALID	0.896911
26/09/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	7.62468	VALID	11.9243	VALID	2.04697
27/09/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	9.80256	VALID	13.6112	VALID	7.89867
28/09/2010	23:59:07	INVALID	-0.260024	VALID	5.4	VALID	10.4377	VALID	13.2239	VALID	6.60862
29/09/2010	23:59:07	INVALID	-0.260024	VALID	0.6	VALID	8.65703	VALID	15.9821	VALID	3.51396
30/09/2010	23:59:07	INVALID	-0.260024	VALID	0.8	VALID	9.51202	VALID	13.6474	VALID	3.34294
Total					**105.2**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min
01/10/2010	23:59:07	INVALID	-0.260024	VALID	1.4	VALID	11.3362	VALID	13.6629	VALID	6.56922
02/10/2010	23:59:07	INVALID	-0.260024	VALID	5.4	VALID	10.4779	VALID	13.1524	VALID	8.70824
03/10/2010	23:59:08	INVALID	-0.260024	VALID	0.2	VALID	9.52658	VALID	14.5216	VALID	3.19425
04/10/2010	23:59:08	INVALID	-0.260024	VALID	0.2	VALID	8.69056	VALID	14.2929	VALID	1.42674
05/10/2010	23:59:08	INVALID	-0.260024	VALID	0	VALID	10.4318	VALID	14.3405	VALID	8.05462
06/10/2010	23:59:08	INVALID	-0.260024	VALID	0.6	VALID	9.67478	VALID	14.9852	VALID	4.41932
07/10/2010	23:59:08	INVALID	-0.260024	VALID	1	VALID	12.4153	VALID	14.8008	VALID	10.2805
08/10/2010	23:59:07	INVALID	-0.260024	VALID	2.8	VALID	14.8129	VALID	16.4347	VALID	12.4138
09/10/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	14.1778	VALID	15.4008	VALID	12.799
10/10/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	11.8171	VALID	13.1881	VALID	7.13207
11/10/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	10.1485	VALID	16.5658	VALID	5.69265
12/10/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	7.34424	VALID	16.2543	VALID	0.435049
13/10/2010	23:59:07	INVALID	-0.260024	VALID	0	VALID	4.58771	VALID	8.08981	VALID	0.254141
14/10/2010	23:59:07	INVALID	-0.260024	VALID	32.6	INVALID	0	INVALID	0	INVALID	0
15/10/2010	23:59:08	VALID	2.62495	VALID	3.2	INVALID	0	INVALID	0	INVALID	0
16/10/2010	23:59:08	INVALID	2.62495	VALID	0	INVALID	0	INVALID	0	INVALID	0
17/10/2010	23:59:08	INVALID	2.62495	VALID	0.8	INVALID	0	INVALID	0	INVALID	0
18/10/2010	23:59:08	INVALID	2.62495	VALID	0.6	INVALID	0	INVALID	0	INVALID	0
19/10/2010	23:59:08	INVALID	2.62495	VALID	0.8	INVALID	0	INVALID	0	INVALID	0
20/10/2010	23:59:07	INVALID	2.62495	VALID	0	INVALID	0	INVALID	0	INVALID	0
21/10/2010	23:59:07	INVALID	2.62495	VALID	0.4	INVALID	0	INVALID	0	INVALID	0
22/10/2010	23:59:07	INVALID	2.62495	VALID	3.8	INVALID	0	INVALID	0	INVALID	0
23/10/2010	23:59:07	INVALID	2.62495	VALID	4.2	INVALID	0	INVALID	0	INVALID	0
24/10/2010	23:59:07	INVALID	2.62495	VALID	0	INVALID	0	INVALID	0	INVALID	0
25/10/2010	23:59:07	INVALID	2.62495	VALID	0.2	INVALID	0	INVALID	0	INVALID	0
26/10/2010	23:59:08	INVALID	2.62495	VALID	6	INVALID	0	INVALID	0	INVALID	0
27/10/2010	23:59:08	INVALID	2.62495	VALID	3.2	INVALID	0	INVALID	0	INVALID	0
28/10/2010	23:59:08	INVALID	2.62495	VALID	2.2	INVALID	0	INVALID	0	INVALID	0
29/10/2010	23:59:08	INVALID	2.62495	VALID	20.8	INVALID	0	INVALID	0	INVALID	0
30/10/2010	23:59:08	INVALID	2.62495	VALID	0.2	INVALID	0	INVALID	0	INVALID	0
31/10/2010	23:59:07	INVALID	2.62495	VALID	16	INVALID	0	INVALID	0	INVALID	0
Total					**106.6**						

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h	
date	time	status	evap	status	PR_Sum24h	status	Avg	status	Max	status	Min	
01/11/2010	23:59:07	INVALID	2.62495	VALID	3.8	INVALID	0	INVALID	0	INVALID	0	
02/11/2010	23:59:07	INVALID	2.62495	VALID	5.4	INVALID	0	INVALID	0	INVALID	0	
03/11/2010	23:59:07	INVALID	2.62495	VALID	2	INVALID	0	INVALID	0	INVALID	0	
04/11/2010	23:59:07	INVALID	2.62495	VALID	6	INVALID	0	INVALID	0	INVALID	0	
05/11/2010	23:59:07	INVALID	2.62495	VALID	0.4	INVALID	0	INVALID	0	INVALID	0	
06/11/2010	23:59:07	INVALID	2.62495	VALID	4	INVALID	0	INVALID	0	INVALID	0	
07/11/2010	23:59:08	INVALID	2.62495	VALID	6	INVALID	0	INVALID	0	INVALID	0	
08/11/2010	23:59:08	INVALID	2.62495	VALID	8	INVALID	0	INVALID	0	INVALID	0	
09/11/2010	23:59:08	INVALID	2.62495	VALID	0	INVALID	0	INVALID	0	INVALID	0	
10/11/2010	23:59:08	INVALID	2.62495	VALID	0.6	INVALID	0	INVALID	0	INVALID	0	
11/11/2010	23:59:08	INVALID	2.62495	VALID	7.4	INVALID	0	INVALID	0	INVALID	0	
12/11/2010	23:59:07	INVALID	2.62495	VALID	0.8	INVALID	0	INVALID	0	INVALID	0	
13/11/2010	23:59:07	INVALID	2.62495	VALID	1	INVALID	0	INVALID	0	INVALID	0	
14/11/2010	23:59:07	INVALID	2.62495	VALID	0.2	INVALID	0	INVALID	0	INVALID	0	
15/11/2010	23:59:07	INVALID	2.62495	VALID	1.2	INVALID	0	INVALID	0	INVALID	0	
16/11/2010	23:59:07	INVALID	2.62495	VALID	18	INVALID	0	INVALID	0	INVALID	0	
17/11/2010	23:59:07	INVALID	2.62495	VALID	4.4	INVALID	0	INVALID	0	INVALID	0	
18/11/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
19/11/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
20/11/2010	23:59:07	INVALID	0	VALID	0.4	INVALID	0	INVALID	0	INVALID	0	
21/11/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
22/11/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
23/11/2010	23:59:08	INVALID	0	VALID	0.2	INVALID	0	INVALID	0	INVALID	0	
24/11/2010	23:59:08	INVALID	0	VALID	0.8	INVALID	0	INVALID	0	INVALID	0	
25/11/2010	23:59:07	INVALID	0	VALID	0.6	INVALID	0	INVALID	0	INVALID	0	
26/11/2010	23:59:07	INVALID	0	VALID	0.4	INVALID	0	INVALID	0	INVALID	0	
27/11/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
28/11/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
29/11/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
30/11/2010	23:59:07	INVALID	0	VALID	0.4	INVALID	0	INVALID	0	INVALID	0	

TOTAL **72**

			EvapCalcDaily		PR_Sum24h		TA_24h		TA_24h		TA_24h	
date	time	status	evap	status	PR_Sum24	status	Avg	status	Max	status	Min	
01/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
02/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
03/12/2010	23:59:08	INVALID	0	VALID	1.4	INVALID	0	INVALID	0	INVALID	0	
04/12/2010	23:59:08	INVALID	0	VALID	0.4	INVALID	0	INVALID	0	INVALID	0	
05/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
06/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
07/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
08/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
09/12/2010	23:59:07	INVALID	0	VALID	0.6	INVALID	0	INVALID	0	INVALID	0	
10/12/2010	23:59:07	INVALID	0	VALID	0.6	INVALID	0	INVALID	0	INVALID	0	
11/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
12/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
13/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
14/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
15/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
16/12/2010	23:59:08	INVALID	0	VALID	2.2	INVALID	0	INVALID	0	INVALID	0	
17/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
18/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
19/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
20/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
21/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
22/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
23/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
24/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
25/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
26/12/2010	23:59:08	INVALID	0	VALID	2	INVALID	0	INVALID	0	INVALID	0	
27/12/2010	23:59:08	INVALID	0	VALID	13	INVALID	0	INVALID	0	INVALID	0	
28/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
29/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
30/12/2010	23:59:08	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
31/12/2010	23:59:07	INVALID	0	VALID	0	INVALID	0	INVALID	0	INVALID	0	
Total					**20.2**							

APPENDIX 10 SLOPE STABILITY

ENVIRONMENTAL BALANCE IN DESIGN AND CONSTRUCTION

DONOHILL AREA 4 SETTLEMENT ASSESSMENT

SOUTH TIPPERARY COUNTY COUNCIL

MARCH 2011

FEHILY TIMONEY & COMPANY

DONOHILL AREA 4 SETTLEMENT ASSESSMENT

SOUTH TIPPERARY COUNTY COUNCIL

User is Responsible for Checking the Revision Status of This Document

Rev. Nr.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	Issue to Client	PEC/MT	AG/CJC	DOS	1/09/2010
1	Updated Issue to Client	PEC/MT	CJC		19/10/2010
2	Issue to Agency	PEC/MT	CJC		01/11/2010
3	Issue to Agency	PEC/MT	CJC	CJC	05/11/2010
4	Re-Issue to Agency	CJC/PEC/MG	DO'S	CJC	16/11/2010
5	Re-Issue to Client	CJC/MT	DO'S	CJC	08/03/2011
6	Re-Issue to Client	CJC/MT	DO'S	CJC	16/03/2011
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Client: South Tipperary County Council

Keywords: Area 4, Settlement, Geotechnical, Porewater Pressure

Abstract: The purpose of this report is to assess the settlement and porewater pressure measurements recorded in the Area 4 cell development

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1. EXECUTIVE SUMMARY

The purpose of this report is to review the effects of porewater and settlement data on the stability of the new cell in Area 4 and to make recommendations in relation future operations.

The Area 4 cell was designed to stabilise a 2004 rotational failure.

The new cell at Area 4 was constructed on an existing area of peat overlying very soft Clay/Silt. To mitigate the risk of liner failure, the foundation was designed to prevent shear failure of the basal formation and to accommodate differential settlement. Sensors were placed beneath the formation immediately above the original peat bog formation at two locations to monitor both settlement and porewater pressure in the underlying formation.

Construction of the cell commenced in late spring 2006. Waste was placed in the cell in May 2008.

Area 4 also had a sheet pile wall to contain lateral displacement of peat following surcharging with waste and topographic monitoring of the sheet pile wall and pump sumps has also been carried out to assess movement of the cell.

Settlement Data

Design criteria required primary consolidation to be complete prior to waste placement and settlement sensors were installed to determine this. Settlement sensors were also used following waste placement to assess cell settlement.

Settlement data shows that post initial consolidation and since the introduction of waste to the cell within Area 4 in May 2008, the settlement sensors have steadily risen as shown in Figure 2.1.

The most notable change in settlement readings occurred at sensor SS2 during the period July 2009 to September 2009 when the sensor dropped in elevation by approximately 2 m. A surface depression of 1 to 2 m was also visible on the surface of the landfill within 20 m of the sensor location corroborating the sensor SS2 reading.

The sensor at SS2 was observed to rise significantly from September 2009 and surpassed its original level of 94.6 m following installation in June 2006. In 2009 the sensor SS1 located to the south of SS2 however, did not display a similar drop or rise in level. In October 2010 SS1 also began to show a significant rise.

Concern was raised at the continued rise of both settlement sensors as there was no visible evidence of a rise in the surface of the waste. South Tipperary Co Council (STCC) commissioned MGS the installers of the sensors to review the installation. Following a site visit in December 2010, MGS advised that the settlement sensors were not working correctly and that all settlement data from the end of 2009 should be regarded as being suspect. At present there is no evidence on site to suggest that the cells are settling or rising outside what is considered as being normal for the prevailing ground conditions.

Porewater Pressure Data

Settlement sensors behaved as predicted and showed that primary consolidation was complete in March 2007.

Since May 2008:

- The pore water pressure measurements in sensor PWPS1 have maintained a relatively consistent level following introduction of waste to the cell. The pressure measurements have also gradually decreased during periods when no waste or additional loading was placed within the cell.
- The pore water pressure measurements in PWPS2 increased steadily since the placement of waste within the cell at Area 4 commenced.
- Rapid increases and falls in pore water pressure correlate to periods when the leachate levels within extraction well LE7 have increased due to heavy rainfall events. The sudden drop in pore water pressure measurements also corresponds with the pumping and management of these increased levels of leachate within the cell.

An increase in pore water pressure within the soils underlying the cell in Area 4 results in a decrease in shear strength and it is possible to reduce the shear strength such that a bearing failure and subsequent rotational failure of the landfill slope could occur.

Slope stability analysis indicates that a pore water pressure reading of 35 kN/m^2 will provide an equivalent factor of safety against failure of 1.3, see Figure 2.12. A porewater pressure of 50 kN/m^2 will reduce this factor of safety to 1.25.

Miscellaneous Observations

In addition to the sensor readings below the cell:

- Topographic surveys were used to monitor the sheet pile wall and pump sump movements located within the Area 4 cell; and
- Site walks along prescribed routes have been used to monitor for tension cracks on the Area 1 slope which would show the presence of a rotational failure.
- Bollard levels have been recorded recently albeit not included in this report as there are insufficient readings thus far to comment on

These miscellaneous observations have shown no cause for concern thus far.

Conclusions

Data readings from the settlement sensors post 2009 caused concern as the readings suggested a serious failure in the formation even though there was no other evidence to support that such a failure had taken place. Following receipt of the MGS assessment in December 2010 which showed that the sensors were faulty these concerns were allayed. MGS concluded that settlement sensor SS2 may have been damaged late 2009 and results thereafter should be ignored. Settlement sensor SS1 appeared to be working until September 2010 after which it is believed that frost damage caused a leak in the sensor tubing.

Analysis making allowance for the MGS findings shows that:

Settlement

In July 2009 there was evidence of localised settlement (1 to 2 m depth) within Area 4 both visually on the surface which was corroborated by the adjacent Settlement Sensor SS2.

Whether as a result of surcharge loading from gabion baskets being removed or for other reasons the depression on the surface was observed to stabilise in September 2009 and Sensor SS2 showed the formation changed from what was a fall to a rise. However we cannot be sure that the rise actually occurred or whether it was as a consequence of leakage from the settlement tubing.

The liner was designed to accommodate settlement and differential settlement and there is no evidence to suggest that the liner integrity has been compromised.

Overall the sensor records show that the cell formation has risen and settled at respective locations.

Whilst settlement in the formation was predicted and is easier to understand following surcharge loadings, rises in the formation are more difficult to assess because it is not possible on a live cell to provide an accurate correlation between surface elevations and cell formation.

Observed rises in formation at sensor locations maybe as a consequence of:

- Sensor faults
- Differential settlement resulting in sagging or hogging of the formation; or
- The original 2004 rotational failure not having stabilised.

In conclusion the settlement observations are in line with original design predictions and there is no evidence to suggest that the liner integrity has been compromised.

Porewater pressure

The ability of the waste to resist a deep seated rotational failure is linked to the shear strength of the underlying materials. Shear strength is directly related to porewater pressure. Design requires that porewater pressure should not exceed 35 kN/m^2 for a factor of safety of 1.3. Observations on site showed porewater pressure reached 50 kN/m^2 which has a calculated factor of safety of 1.25.

Porewater pressure sensors were installed immediately above the formation in order to monitor the impacts of surcharge loading from waste on the underlying foundation materials subject to deep seated rotational failures.

Records have shown that:

- Increased loading be it from leachate or waste increases porewater pressure
- Porewater pressure dissipates if leachate is removed
- Porewater pressure dissipates if waste loading ceases

Use of the porewater pressures sensors is used to inform operations staff on site to cease waste placement when porewater pressure levels exceed design limits.

Recommended Actions

This detailed analysis has shown that the Area 4 cell installation appears to be working as per the original design.

Even if the worst case scenario highlighted above in the settlement sensor possible consequences is occurring, namely that the 2004 failure has yet to stabilise, then it is still recommended that filling continues in line with original design and operational criteria until such time as the landfill reaches it final licence contours and provides a counterweight to stabilise the rotational failure.

Only when the waste in place will it be possible to determine whether or not the surcharge has been able to stabilise the Area 1 rotational failure as per original design.

Analysis suggests that the landfill will be stable when the final formation is reached as long as waste licence leachate levels are not breached and as long as filling is in accordance with operational guidelines.

However in the event of an unforeseen event which causes a rotational failure it is recommended that an action plan be prepared to plan for such events.

This report advises that in the event of such a failure:

- There is a very low risk to operators health and safety
- There is a very low risk of ground water contamination
- There is a very low risk of surface water contamination
- Infrastructure on the Phase 1 side slopes may be compromised and may require low level maintenance to reconnect pipes that may have pulled apart at well head chambers or similar
- It is possible that ground elevations outside the licence boundary may be impacted albeit that it may be difficult to discern to an untrained eye that a failure has taken place as was the case in the original 2004 failure

The primary objective of the action plan should be to procure and or otherwise gain access to the adjoining peat bog to allow the area to be surcharged so that additional surcharge material can be placed to mitigate further the risks that a rotational failure may have on what are currently third party lands.

2. INTRODUCTION

The purpose of this report is to review the effects of porewater and settlement data on the stability of the new cell in Area 4 and to make recommendations in relation future operations.

The Area 4 cell was designed to stabilise a 2004 rotational failure. Construction of the cell commenced in late spring 2006. Waste was first placed in the cell in May 2008.

The new cell at Area 4 was constructed on an existing area of peat overlying very soft Clay/Silt. To mitigate the risk of liner failure, the foundation was designed to prevent shear failure of the basal formation and to accommodate differential settlement. The cell is bounded to the north and west by landfill areas 1 and 3. The cell abuts the site boundary to the east and south. A sheet-pile wall was constructed between the east/south boundaries and the Area 4 cell. Donohill landfill is operated under Waste Licence Reg. No. 74-3.

South Tipperary County Council has installed sensors beneath the concrete element of the Area 4 basal cell formation and liner. At each location there are settlement sensors and duplicate pore water pressure sensors installed to monitor the impacts of working practices during waste placement. The locations of the sensors are shown in the photograph below. 'PWP' represents a pore water sensor, SS represents a settlement sensor.

Figure 2.1: Position of Pore Water Pressure & Settlement Sensors

Following a report on Area 4 settlement observations prepared by FTC in February 2010, a geotechnical review of the settlement and pore water pressure measurements has been undertaken to assess the possible impacts of variations in measurements and readings observed since installation of the sensors. This report will outline the observations made from the review of the sensor data and other available monitoring data and provide an interpretation of the data and recommendations for works within Area 4 at the landfill facility.

In addition this report will summarise settlement observations on LE7, LE9, LE10 and LE11 (existing pump sumps) within Area 4 that were installed on the basal formation and displacement observations on the sheet pile wall at three locations.

3. SETTLEMENT AND PORE WATER PRESSURE DATA LOGGER OBSERVATIONS

An assessment of the overall settlement data provided to date indicates that since the introduction of waste to the cell within Area 4 in May 2008, the settlement sensors have steadily risen as shown in Figure 3.1.

The most notable change in settlement reading occurred at sensor SS2 during the period July 2009 to September 2009. During this period the sensor dropped in elevation by approximately 2 m.

The sensor at SS2 has since been observed to rise significantly since September 2009 and has surpassed its original level of 94.6 m following installation in June 2006. The sensor SS1 located to the south of SS2 however, did not display a similar drop in level and has continued to rise at a steady rate.

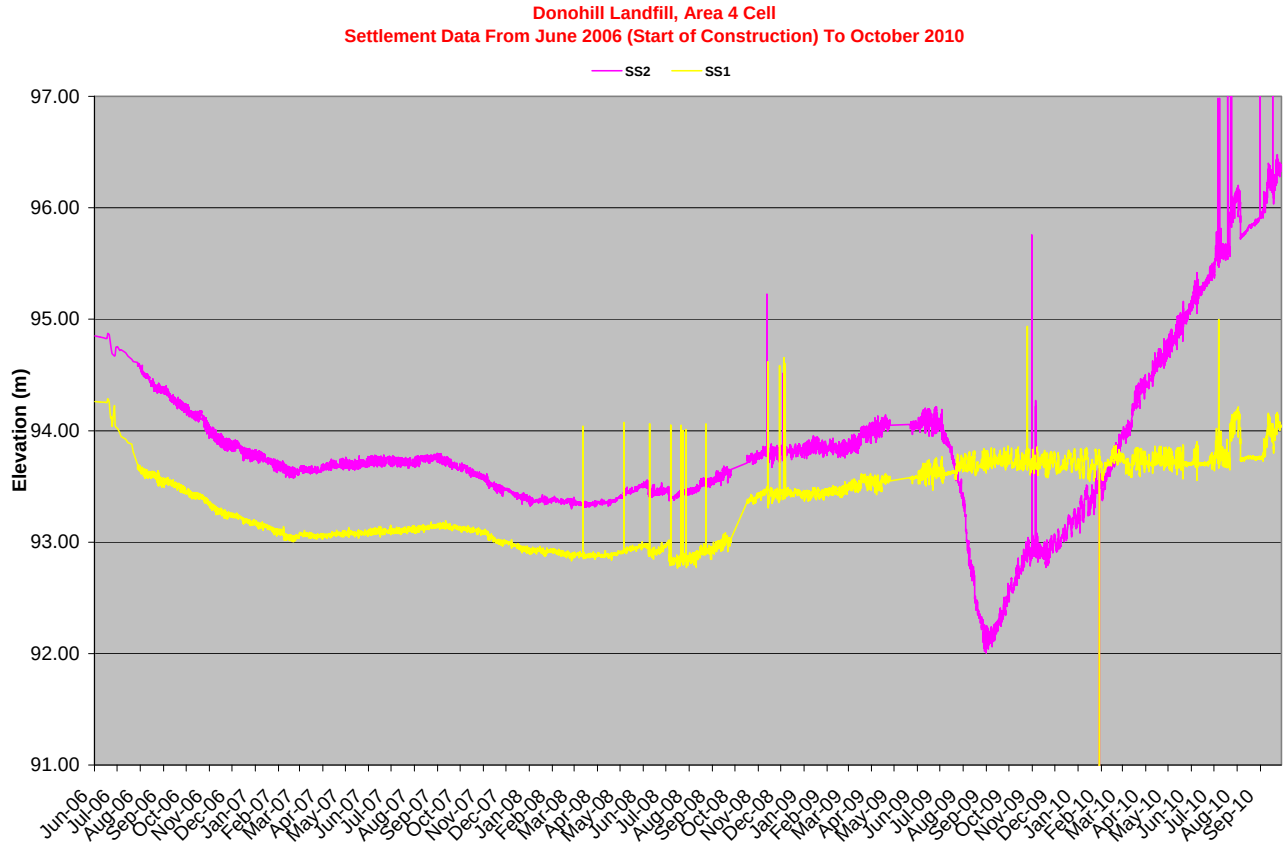


Figure 3.1: Settlement Data June 2006 to October 2010

A review of the pore water pressure data provided indicates that the pore water pressure rose sharply during the period of construction of the cell in Area 4 (Aug to Oct 2006) and dissipated at a steady rate from the end of construction until the introduction of waste to the cell in May 2008.

The pore water pressure measurements associated with sensor PWPS2 have steadily risen since this time.

The pore water pressure measurements associated with PWPS1 remained constant or fell moderately during this same time period, with occasional rapid rises and fall in pressure.

The occasional rapid rise and fall in pressure is noted on both pore water pressure sensors PWPS1 and PWPS2 and can be seen in Figure 3.2 below.

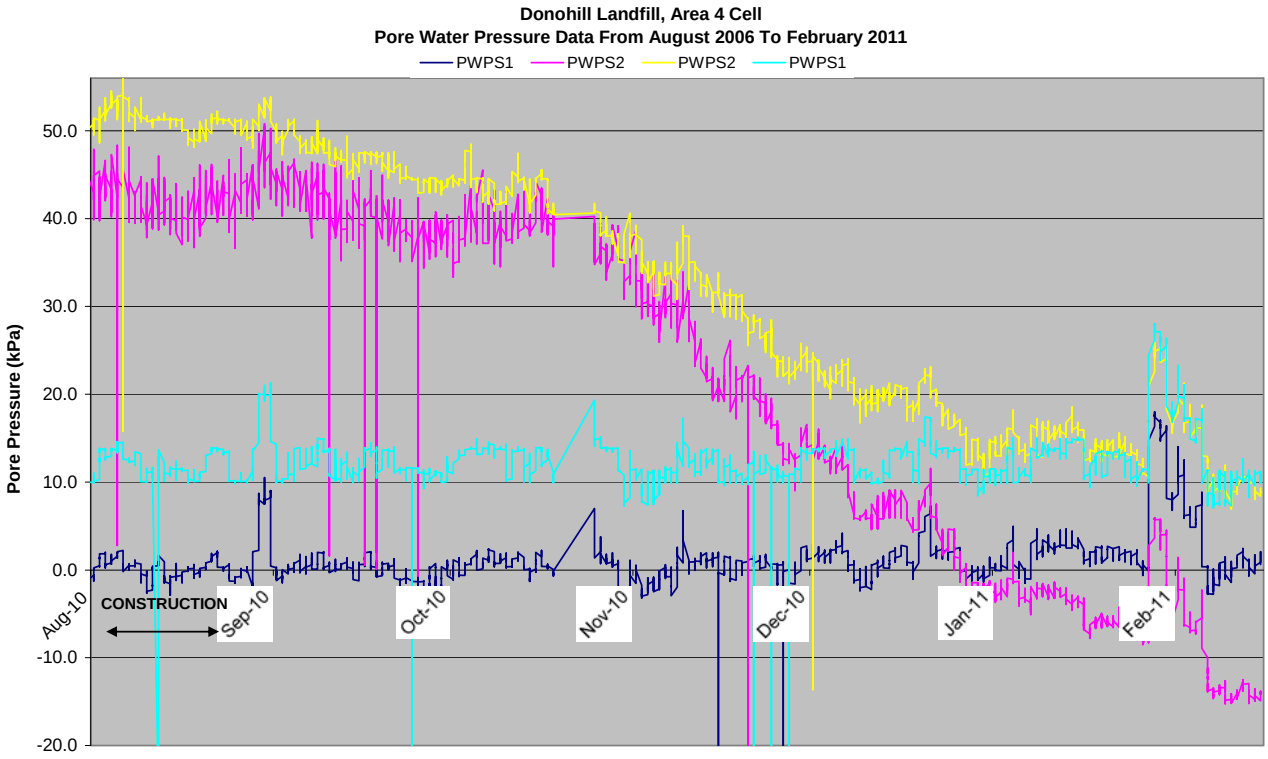


Figure 3.2: Pore Water Pressure Data June 2006 to August 2010

A closer inspection of the settlement readings at sensor SS2 during the period July 2009 to October 2009 is provided in Figure 3.3 below and indicates that the rapid drop in the levels recorded by settlement sensor SS2 occurred from mid July to mid September 2009.

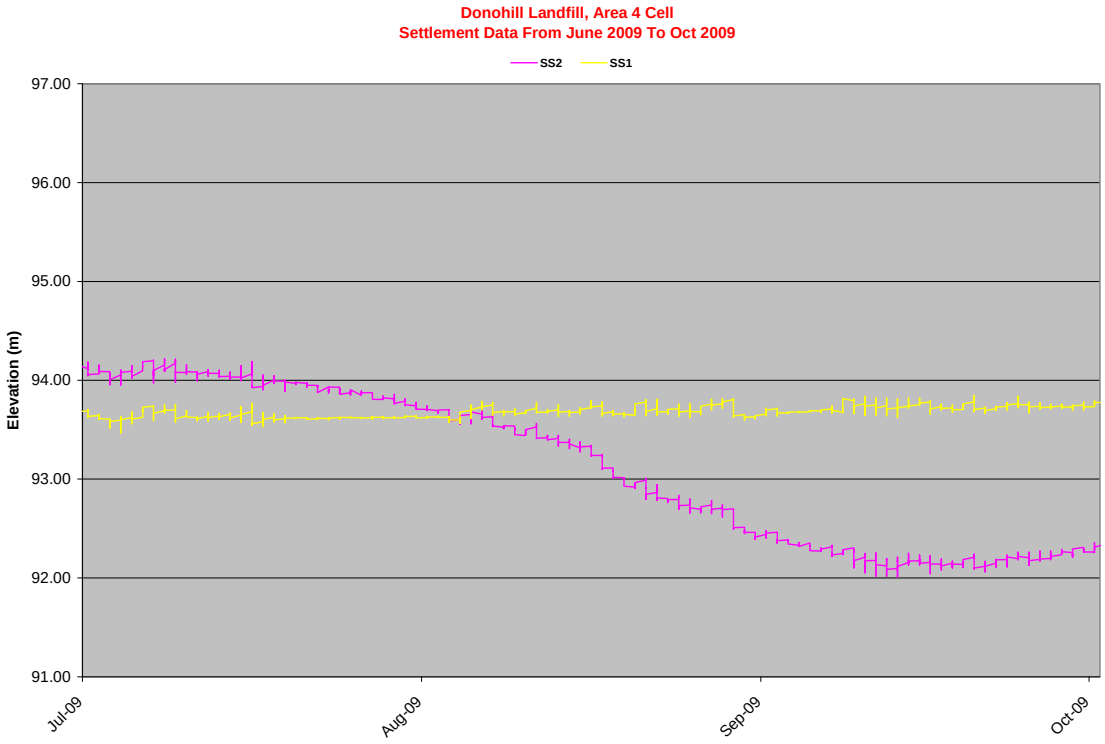


Figure 3.3: Settlement Data July 2009 to October 2009

The pore water pressure data for the same period of July to October 2009 is shown on Figure 3.4 and does not indicate any sustained increase in pore water pressure at either sensor that would match the drop in level recorded at settlement sensor SS2.

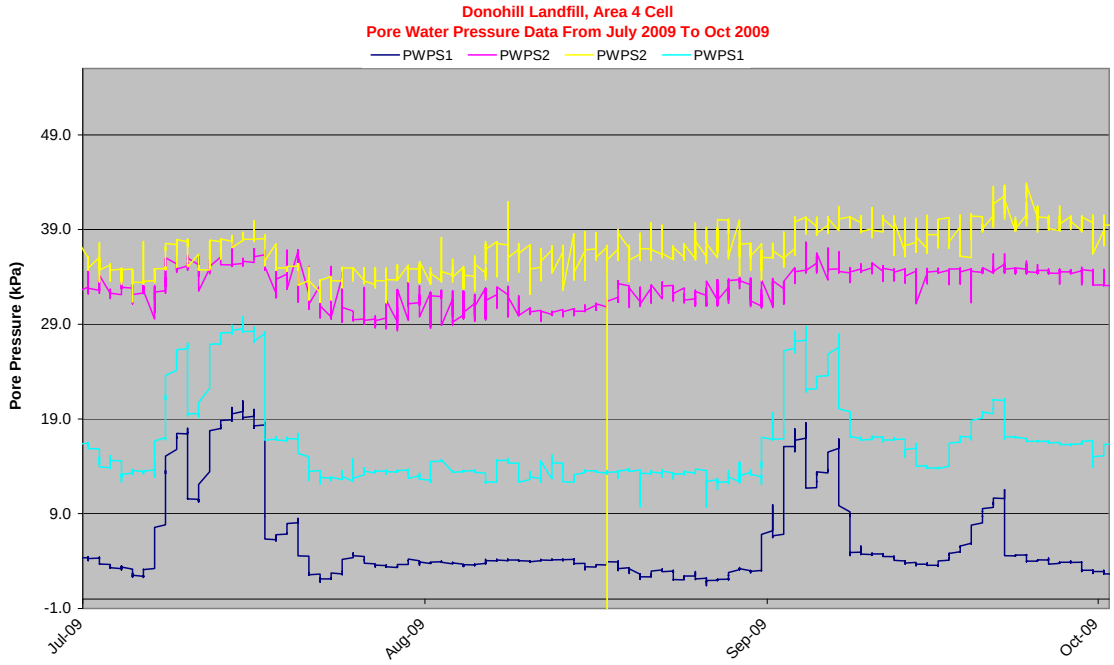


Figure 3.4: Pore water Pressure Data July 2009 to October 2009

A rapid rise and fall in pore water pressure is noted in the data readings for pressure sensors PWPS1 during the periods early to late July, early September and at the end of September 2009. This sudden increase in pressure readings is also recorded but not as readily apparent in the readings from pressure sensors PWPS2.

A review of the leachate levels recorded in leachate extraction well LE7 during the same period are shown on Figure 3.5 below and indicates that the leachate levels recorded within the cell experienced a similar sudden rise and fall during the same time periods as the increases in pressure recorded by PWPS1.

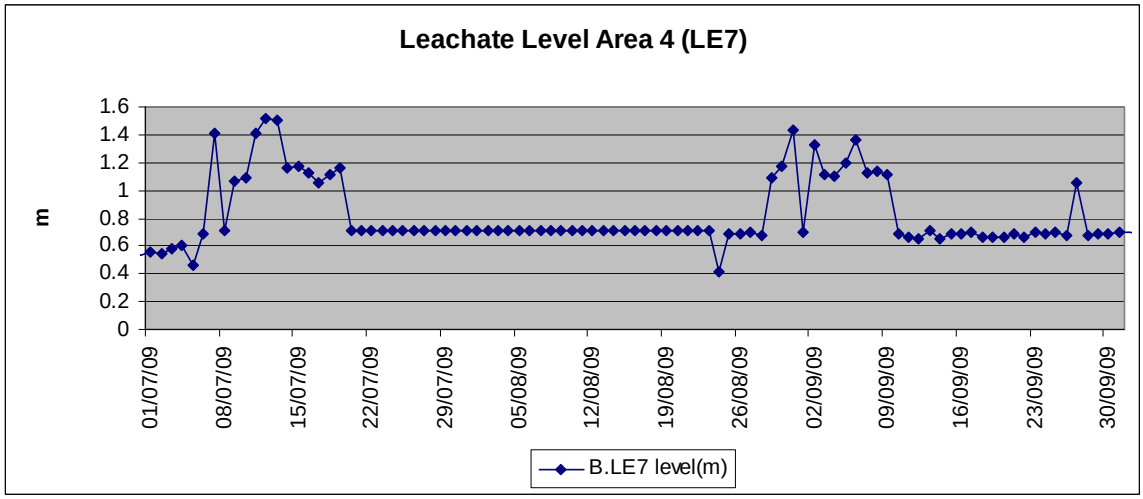


Figure 3.5: Leachate Levels in Area 4 Cell LE7 July 2009 to September 2009

The sudden rise in leachate levels are associated with heavy rainfall events that occurred during the months of July and August 2009 as shown on Figure 3.6 below, and the fall in levels are the result of the pumping of leachate from extraction well LE7.

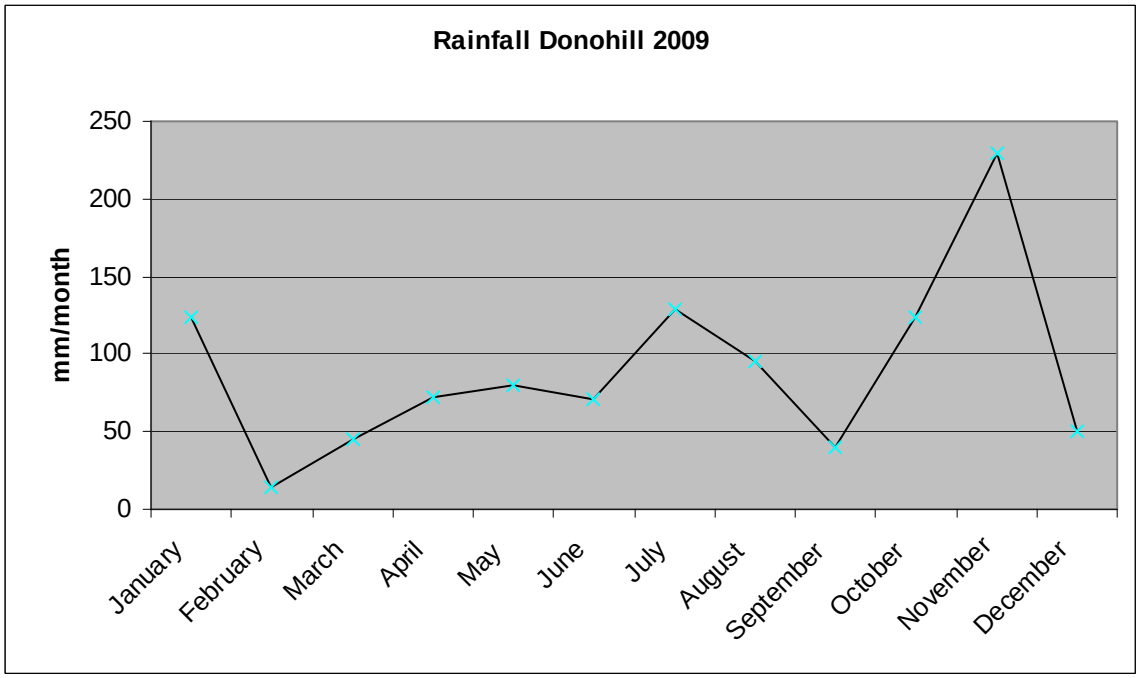


Figure 3.6: Rainfall Donohill 2009

3.1 Sensor Observations during Cell Activity

In an effort to establish a more comprehensive understanding of the data recorded by the sensors, a review of the settlement and pore water pressure sensors was carried out when no waste was placed in Area 4. It was noted that following initial construction of the cell in 2006, the settlement sensors recorded a rise of approximately 200 mm prior to any waste being placed in the cell.

The first period reviewed was January 2009 to July 2009. The purpose of isolating this data was to establish the trend in readings during a period of inactivity in the cell i.e. there was no waste placement during this period. The data indicates that both settlement sensors SS1 and SS2 rose by approximately 250 mm during this period as shown in Figure 3.7 below.

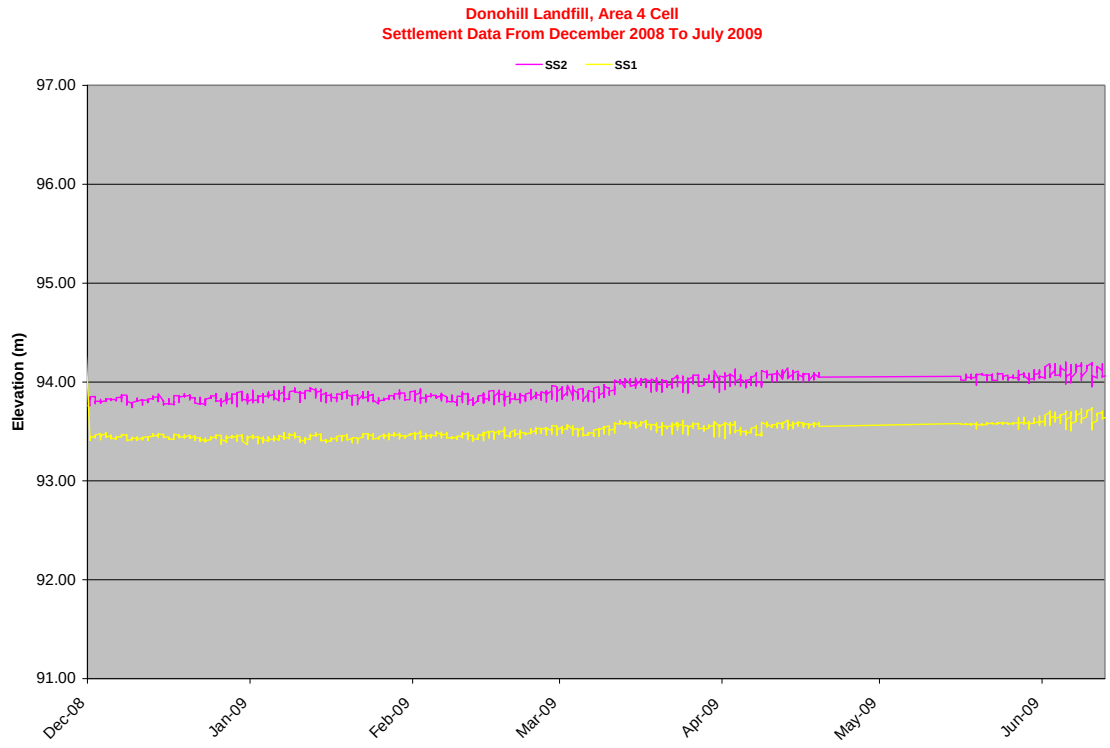


Figure 3.7: Settlement December 2008 to July 2009

A review of the pore water pressure measurements during this same period January 2009 to July 2009 indicates that the pore water pressure recorded in sensor PWPS2 increased steadily whereas the pressure recorded in sensor PWPS1 fell during this period as shown in Figure 3.8 below.

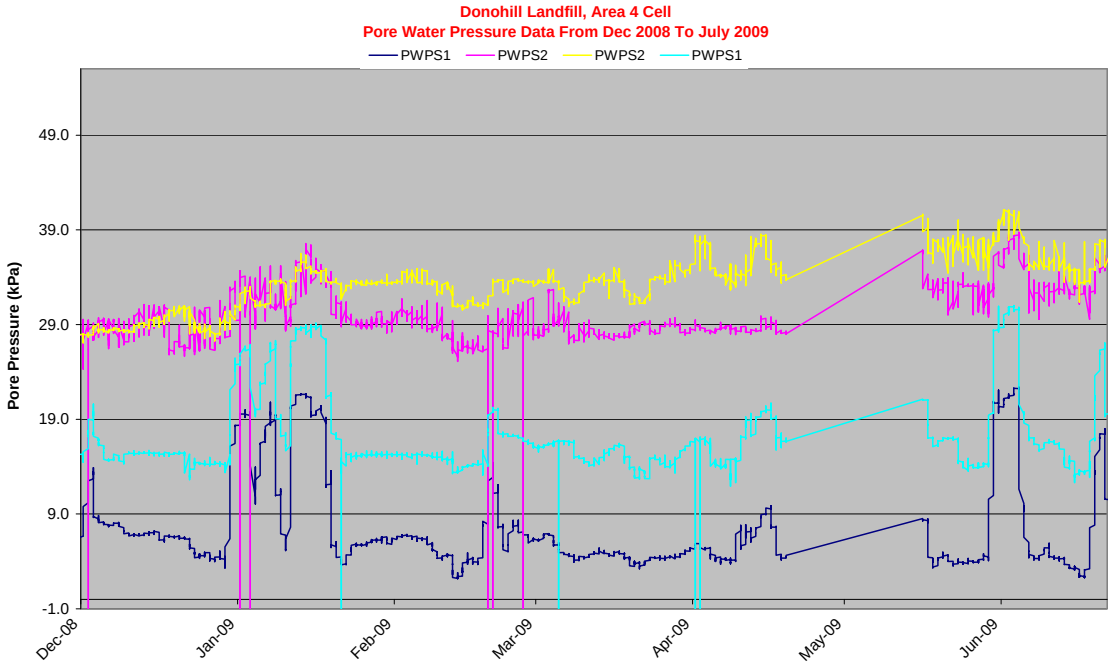


Figure 3.8: Pore water Pressure December 2008 to July 2009

The measured leachate levels for the period also indicate that the sudden increase in leachate levels match the sharp rise in pore water pressures recorded during this period. The increase in leachate levels correlate to high rainfall events in January and June as shown in Figure 3.9.

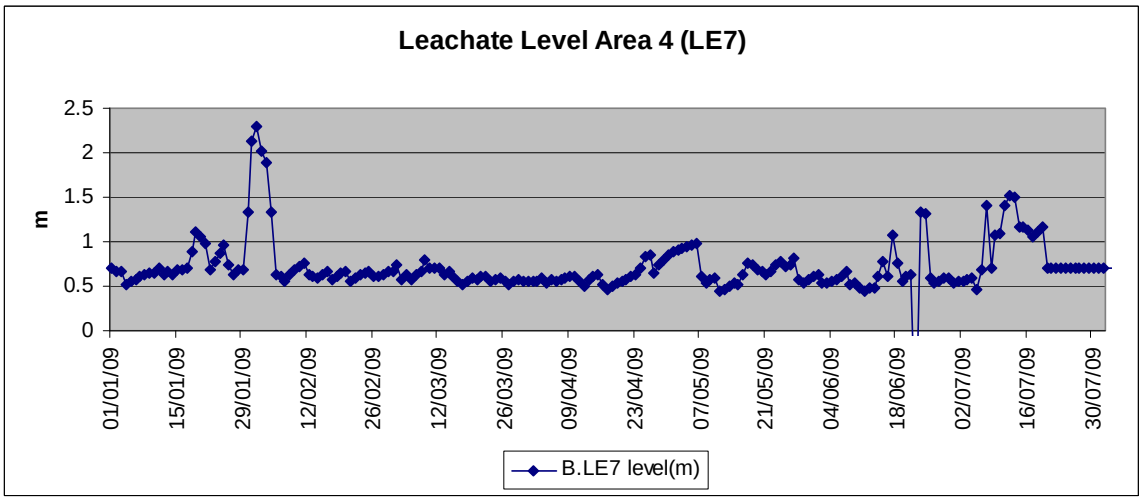


Figure 3.9: Leachate Levels in Area 4 Cell LE7 January 2009 to July 2009

A review of a second time period during which waste was not placed in Area 4 was carried out for the period 30th July 2010 to 11th October 2010. During this period the settlement sensors revealed a rise of approximately 300 mm and 800 mm in sensors SS1 and SS2 respectively as shown in Figure 3.10 below.

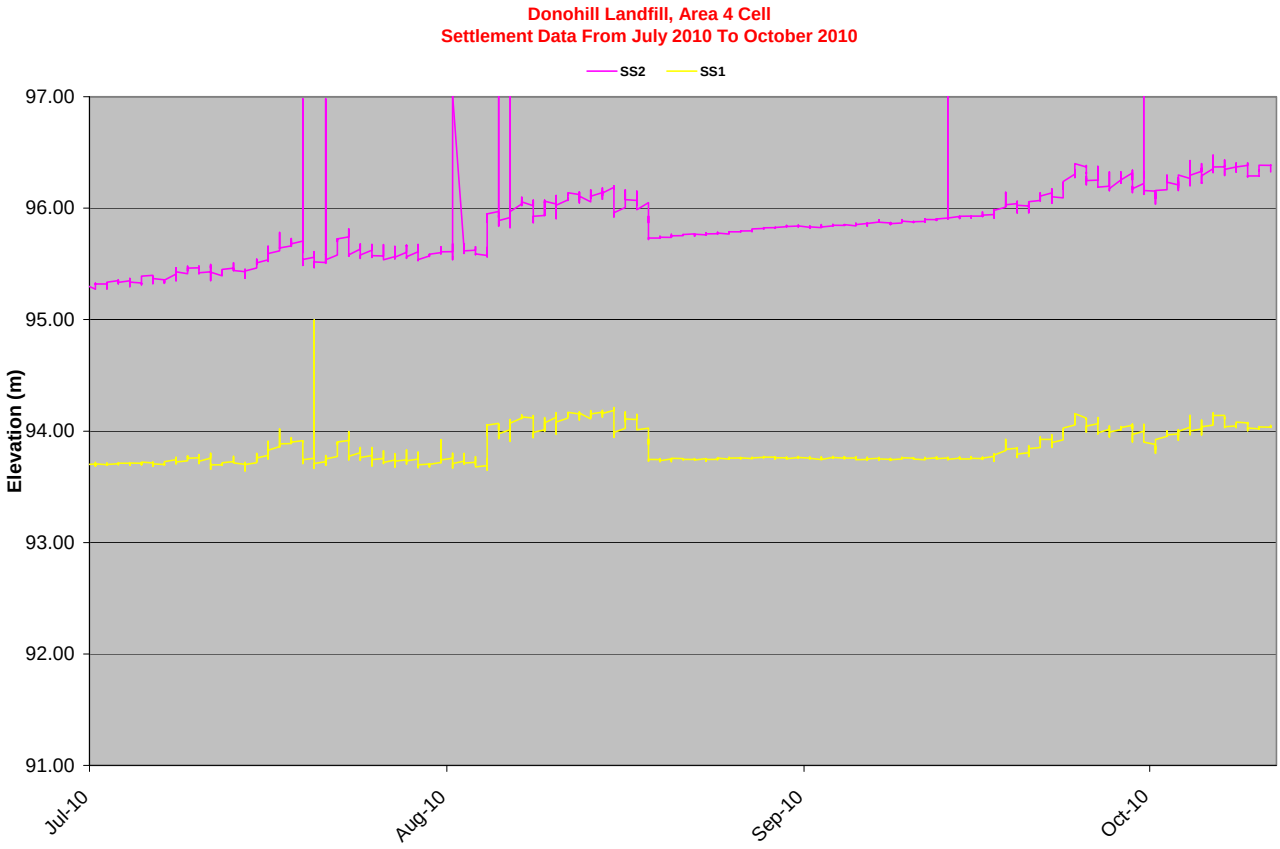


Figure 3.10: Settlement July 2010 to October 2010

The pore water pressure measurements during the period 30th July 2010 to 11th October 2010 are shown on Figure 3.11 below and indicate that the pressure recorded in sensor PWPS2 has fallen slightly whereas the pressure recorded in sensor PWPS1 has remained relatively constant during this period. This trend in pore water pressure measurements is similar to those observed in the earlier Jan to July 2009 pressure readings.

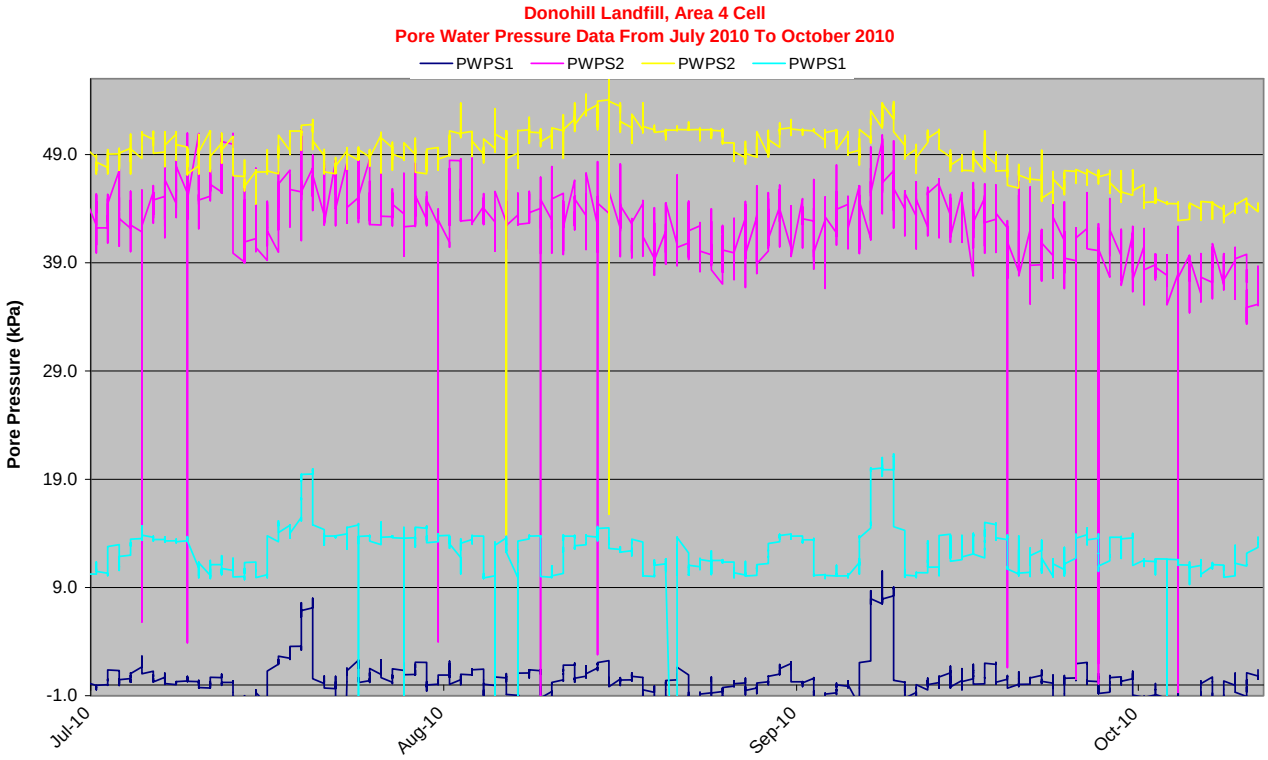


Figure 3.11: Pore water Pressure July 2010 to October 2010

During the placement of waste within the cell at Area 4, the pore water pressures would be expected to rise and subsequently fall during periods of no activity as the excess pressures are allowed to dissipate. This appears to be occurring in the data recorded for the sensors.

Since January 2011 sensor PWPS2 has shown a negative pore water pressure. The causes for this are unknown. It may be caused by a number of reasons which may include but not be limited to: faulty sensor, impacts of gas extraction or localised falling water tables. It is not believed to be a cause for concern.

3.2 Summary of Sensor Observations

A review of the settlement and pore water sensor readings in conjunction with recorded leachate levels in Area 4 and rainfall data for the site shows:

- The settlement sensors rose steadily seemingly independent of the placement of waste within the cell.
- A significant drop of approximately 2 m in the level of settlement sensor SS2 occurred during the period mid July 2009 to mid September 2009. Pore water pressure measurements for the same time period did not record a sustained rise in pressure that would correlate to the settlement recorded in SS2.
- The pore water pressure measurements in sensor PWPS1 have maintained a relatively consistent level following introduction of waste to the cell. The pressure measurements have also gradually decreased during periods when no waste or additional loading was placed within the cell.
- The pore water pressure measurements in PWPS2 are increasing steadily since the placement of waste within the cell at Area 4 commenced.

- Rapid increases and falls in pore water pressure correlate to periods when the leachate levels within extraction well LE7 have increased due to heavy rainfall events. The sudden drop in pore water pressure measurements also corresponds with the pumping and management of these increased levels of leachate within the cell.
- Falls in pore water pressure correlate to periods when waste filling has ceased

Analysis of settlement sensor observations should also make reference to sheet pile wall and pump sump observations recorded in Sections 4.0 and 5.0 of this report.

3.3 Accuracy of Settlement Sensors

Sensor checks were carried out by MGS on 20 December 2010 and tubing on both sensors was shown to be leaking. A leak reduces the head of liquid on the sensor such that the sensor indicates a rise in the formation. MGS suggested that readings from settlement sensor SS2 should be discounted since December 2009. Settlement sensor readings in SS1 should be discounted from October 2010.

3.4 Conclusion of Sensor Observations

The cell in Area 4 is constructed directly over a layer of peat up to 7 m in thickness. This peat layer is underlain by a very soft clay/silt layer up to 3 m thick. The eastern edge of adjoining Area 1 is also constructed directly on this peat and soft silt. The slope along the eastern side of Area 1 experienced a failure in 2004 and the current design for Area 4 was proposed as a solution to mitigate against further failures.

Following a review of the settlement and pore water pressure readings in conjunction with information on activities at the site and within the cell, a number of probable conclusions on the data recorded can be drawn.

3.4.1 Upward Cell Movement

Upward cell movement at the respective cell locations may be a consequence the original rotational failure or of the cells hogging or sagging following differential loading and settlement.

Consider Rotational Failure

The failure of the eastern slope of Area 1 in 2004 was the result of a rotational failure occurring within the peat and/or very soft silt at depth beneath the landfill mass. The residual lower shear strength and friction angle of the underlying soft material following the failure may mean that further movement and rotational failure of the slope may occur over time.

Construction of the cell within Area 4 slightly consolidated the underlying peat and soft clay/silt and provided a counter balance to the toe of the progressive rotational slope failure occurring within Area 1. In light of settlement observations this counterbalance may now serve only as a temporary measure and following the initial consolidation of the underlying soft soils, movement of the Area 1 slope may continue.

Appendix 1 Eurocode stability analysis does however indicate that the finished profile will be stable and that current cell failure plane will become shallower and will move closer to the sheet pile wall as loadings increase following continued waste placement. Shear strength in the peat and silts will also increase once loadings cease. An assessment of the effectiveness of the proposed measures can only be assessed once the waste profile has been brought to the finished design profile.

Consider Hogging and Sagging

Observed rises in formation at sensor locations may also be as a consequence of differential settlement and sagging or hogging of the formation. During placement of the leveling layer above the concrete mat the formation reacted similar to a rolling wave with an amplitude between peaks and troughs of 1.0 m as compaction machinery worked across the cell. It is probable that the cell behaves in a similar fashion during subsequent placement operations albeit that the rate of change of respective elevations and the amplitude are likely to be lower.

3.4.2 Sudden Settlement of SS2

The sudden drop in the level of the settlement sensor SS2 between mid July and mid September 2009 may be the result of a localised settlement of the formation beneath the waste material in Area 4.

A settlement depression approximately 1 to 2 m in depth with a localised footprint estimated to be 5 m to 10 m diameter was observed in the vicinity of SS1 in September 2009, however the exact location was not recorded making it difficult to definitively link the two events. Gabion baskets were also noted as being placed around the leachate wells LE10 and LE9 in December 2008.

The site was visited by Mr. Chris Cronin of FTC on 14 October 2009 and it was recommended that STCC remove the gabion baskets as concern was highlighted that the localised loading may be causing the settlement. The gabion baskets were removed on 15th October 2009.

The settlement sensor SS2 adjacent to the gabion baskets was then observed to rise over the following months, but as the upward trend of the sensor had begun to occur in mid September prior to removal of the gabion baskets, it is difficult to conclude if the presence or removal of the gabions had any influence on the sudden settlement recorded in SS2. Subsequent

The rapid upward movement of SS2 from mid September 2009 to present may be the result of additional waste material being placed in the northern portion of the cell, inducing a differential loading on the underlying slab and soils. This differential loading of the cell in the vicinity of SS2 may result in a localised failure of the peat underlying the cell and may permit the slab and sensor to rotate upward, resulting in an upward reading. The exact cause of this sudden settlement and subsequent upward movement is however still uncertain.

3.4.3 Evidence of Tension Cracks on the Area 1 Side slopes

As of March 2011 There has been no evidence of tension cracks on the Area 1 side slopes.

3.4.4 Evidence of Rotational Failure

Topographic records in Sections 4 and 5 of this report observe very minor changes on the sheet pile wall and pumps sumps neither of which suggests any failure in the formation.

3.4.5 Increase in Pore Water Pressure

An increase in pore water pressure within the soils underlying the cell in Area 4 results in a decrease in shear strength. This lowering of the soil's shear strength results in a reduction of the safety factor against a slope failure. A significant increase in a soil's pore water pressure can reduce the shear strength such that a bearing failure and subsequent rotational failure of the landfill slope could occur.

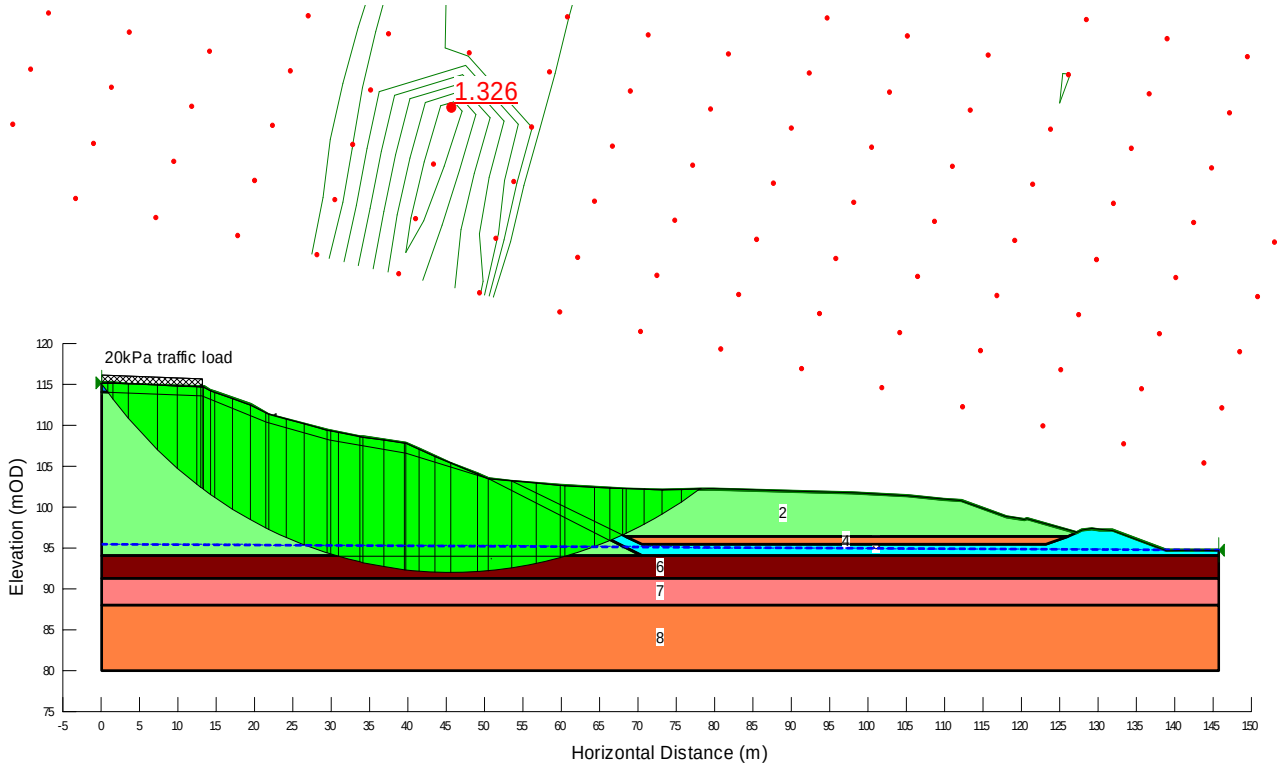
Analysis using Slope/W computer software indicates a pore water pressure reading of 35 kN/m^2 will provide an equivalent factor of safety against failure of 1.3, see Figure 3.12. The pore water pressure reading in mid August 2010 at PWPS2 of 50 kN/m^2, see Figure 3.13, results in a reduced factor of safety of 1.25. Further increases in pore water pressure would reduce this factor of safety thus increasing risk of slope failure. The current PWPS2 sensor readings indicate a drop in pore water pressure to between 35 and 44 kN/m^2, thus increasing the factor of safety margin.

The increase in pore water pressure measurements recorded in both pressure sensors PWPS1 and PWPS2 suggests an increased loading corresponding to an increase level of leachate within the cell. The rapid increase and decrease in pressure recorded by PWPS1 may suggest the material in the vicinity of this sensor is more permeable than that in the vicinity of PWPS2 adjacent to extraction well LE7. The increase in pressure recorded by PWPS2 is approximately half the pressure recorded by PWPS1 during a high rainfall/leachate level event. This may be the result of a decrease in the permeability of the waste and subsequently the rate at which rainfall and leachate can accumulate and be extracted within this waste material. This decrease in permeability may be the result of an increased applied loading in the vicinity of PWPS2 as this area is the main entrance route into the cell for waste delivery and placement

The continued increase in pore water pressure measurements in PWPS2 may therefore be the result of increased loading of the underlying soft soils by higher and increasing levels of leachate within the waste in the northern part of the cell in Area 4.

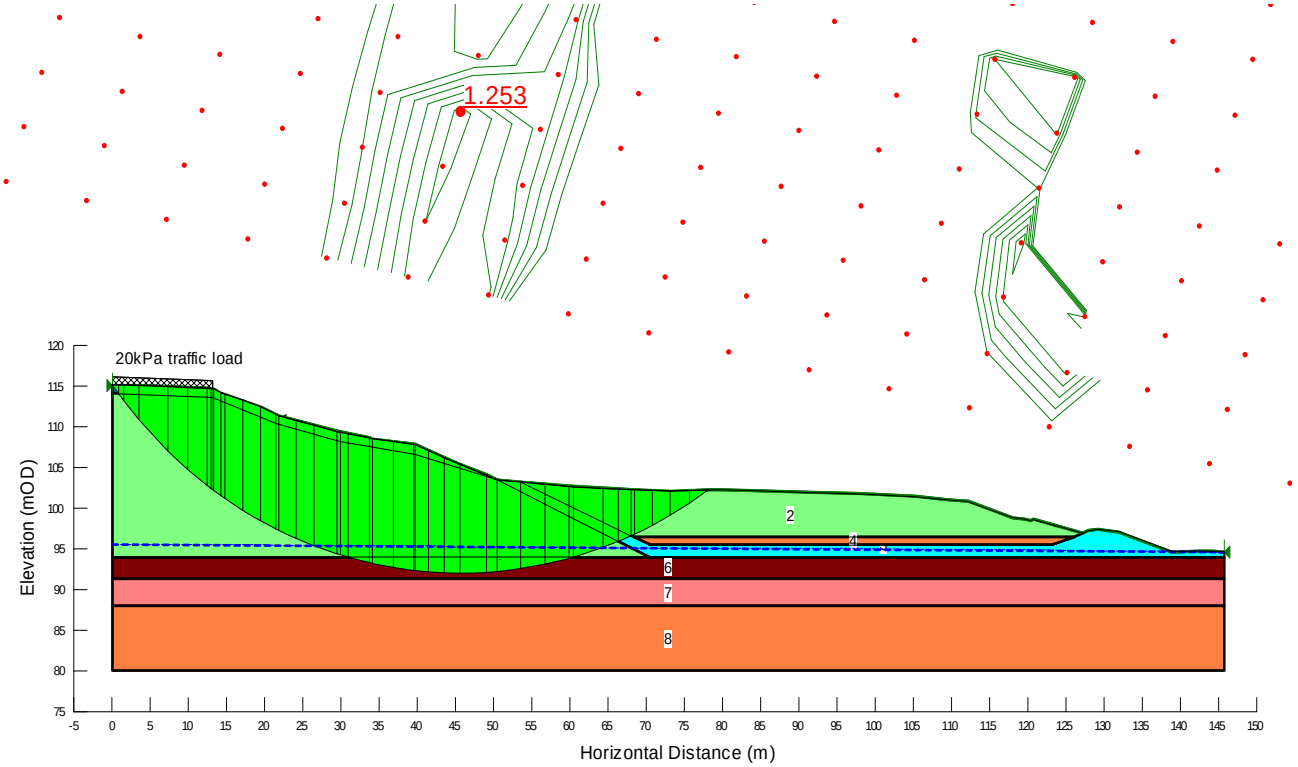
The stability analysis carried out above was calculated in accordance with BS: 6031 and not the Eurocode.

Eurocode analysis of the slope is discussed in more detail in Section 6.0 of this report.



Material #: 1 Description: Temporary Capping Wt: 18 Cohesion: 4 Phi: 30
Material #: 2 Description: New Waste Wt: 9.5 Cohesion: 10 Phi: 15
Material #: 3 Description: Gravel drainage layer Wt: 21 Cohesion: 0 Phi: 35
Material #: 4 Description: Clay Liner Wt: 18 Cohesion: 4 Phi: 29
Material #: 5 Description: Consol. Peat Wt: 11 Cohesion: 9 Phi: 0
Material #: 6 Description: Consol. Silt/Clay Wt: 18 Cohesion: 24 Phi: 0
Material #: 7 Description: Sandy Gravel Wt: 21 Cohesion: 0 Phi: 35

Figure 3.12: Slope Stability Pore Water Pressure 35 kN/m^2 (BS:6031)



Material #: 1 Description: Temporary Capping Wt: 18 Cohesion: 4 Phi: 30
Material #: 2 Description: New Waste Wt: 9.5 Cohesion: 10 Phi: 15
Material #: 3 Description: Gravel drainage layer Wt: 21 Cohesion: 0 Phi: 35
Material #: 4 Description: Clay Liner Wt: 18 Cohesion: 4 Phi: 29
Material #: 5 Description: Consol. Peat Wt: 11 Cohesion: 5 Phi: 0
Material #: 6 Description: Consol. Silt/Clay Wt: 18 Cohesion: 13 Phi: 0
Material #: 7 Description: Sandy Gravel Wt: 21 Cohesion: 0 Phi: 35

Figure 3.13: Slope Stability Porewater Pressure 50 kN/m^2 (BS:6031)

4. SETTLEMENT OBSERVATIONS ON EXISTING PUMP SUMPS

4.1 Description

Figure 4.1 shows the locations of pump sumps LE7, LE9, LE10 and LE11 in Area 4.

These sumps were placed on the basal liner of the area 4 cell and comprise flanged 560 mm diameter HDPE pipework. Accordingly displacement at the top of the cell will reflect that on the base.

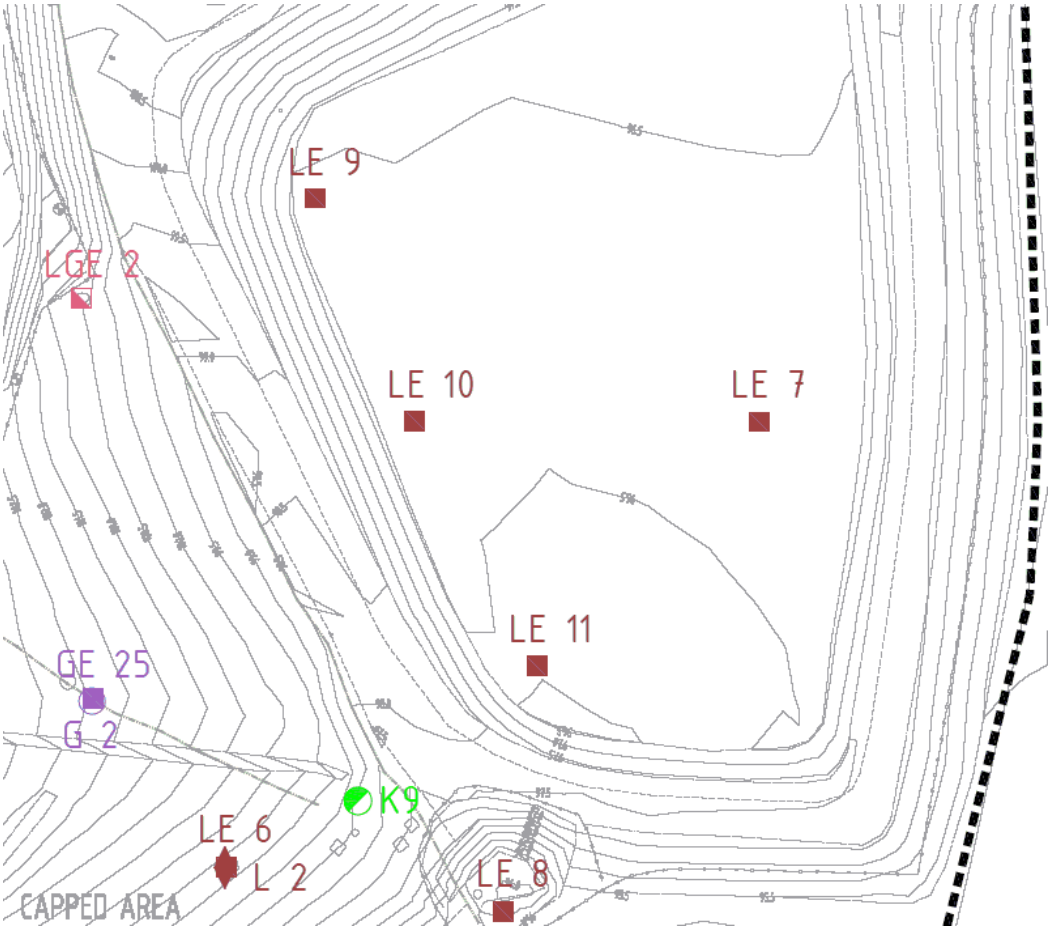


Figure 4.1: Pump Sump Locations in Area 4

4.2 Settlement Observations at Pump Sumps

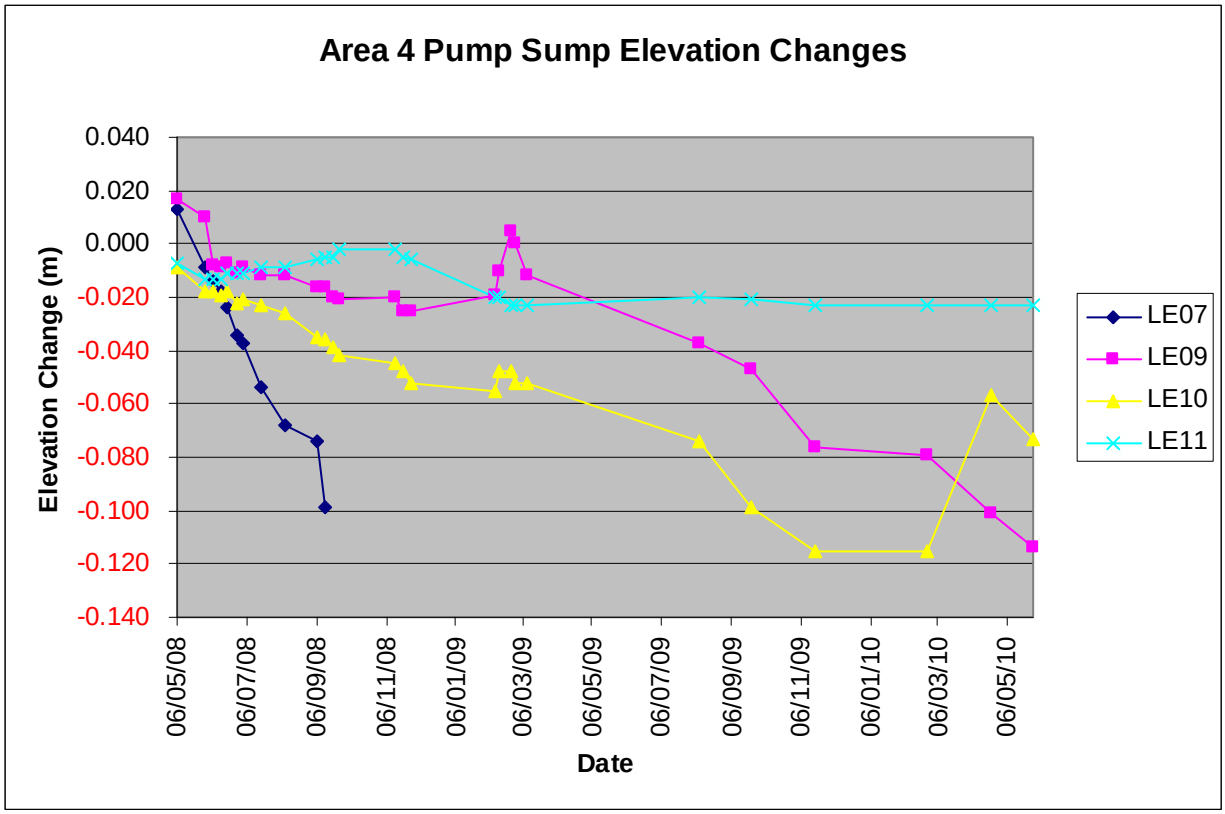


Figure 4.2: Pump Sump Settlement Observations in Area 4

Figure 4.2 shows the Area 4 cell formation at the pump sump locations has steadily fallen between 40 mm and 140 mm since May 2008. Since March 2011 there has been a small rise of 60 mm.

The low point remains as LE07 albeit that observations in Figure 4.2 do not reflect same as LE07 elevations have not been recorded since September 2008. Site leachate observations suggests it is the low point.

Readings suggest that the cell is tilting with the low point adjacent to the sheet pile wall. This may change as filling increases up the slope.

Settlement sensor readings for the same period suggest movement of approximately 600 mm which is significantly different. The reasons for this are unclear. However the locations are removed from each other and may be subject to differing settlement.

5. DISPLACEMENT OBSERVATIONS ON SHEET PILE WALL

5.1 Description

Survey of x,y and z coordinates has been carried out since 13 September 2010 at the locations shown on Figure 5.1.

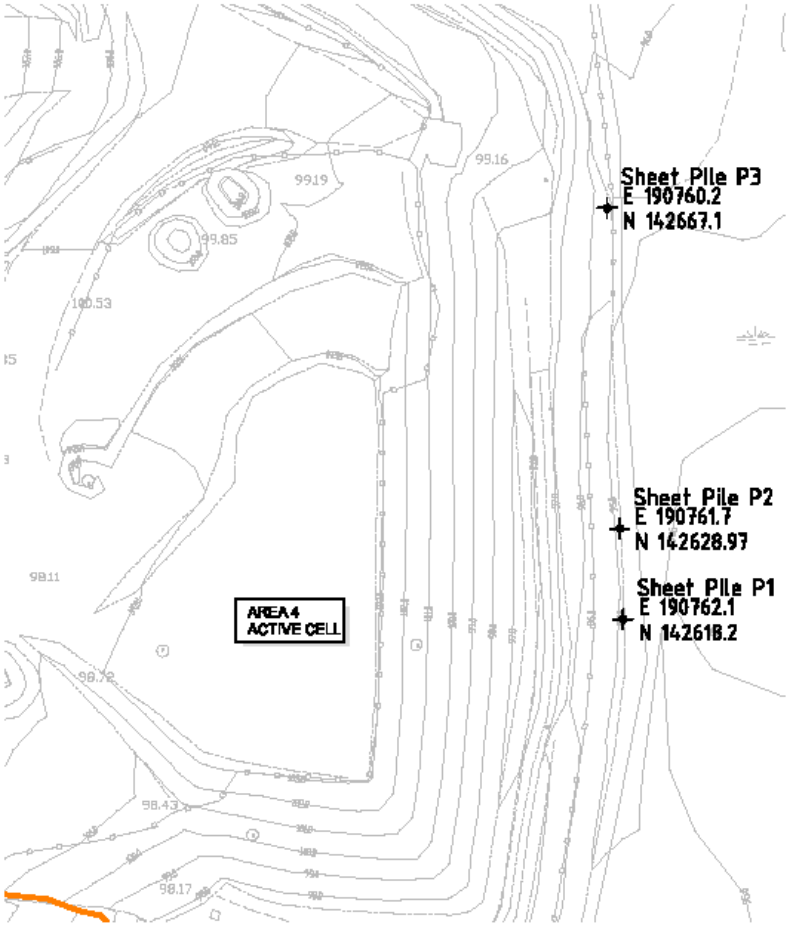


Figure 5.1: Area 4 Sheet Pile Monitoring Locations

5.2 Displacement Observations at Sheet Pile Wall

Figure 5.2 displacement observations thus far commencing 13 October 2010 do not indicate significant movement. Displacements are so small and may be as a consequence of surveying tolerances associated with methodology and/or prevailing site conditions.

Whilst visual checks have not indicated movement there is insufficient survey data to draw any conclusions.

Visual checks and surveying at these locations will need to be continued for several months to gain a more accurate assessment.

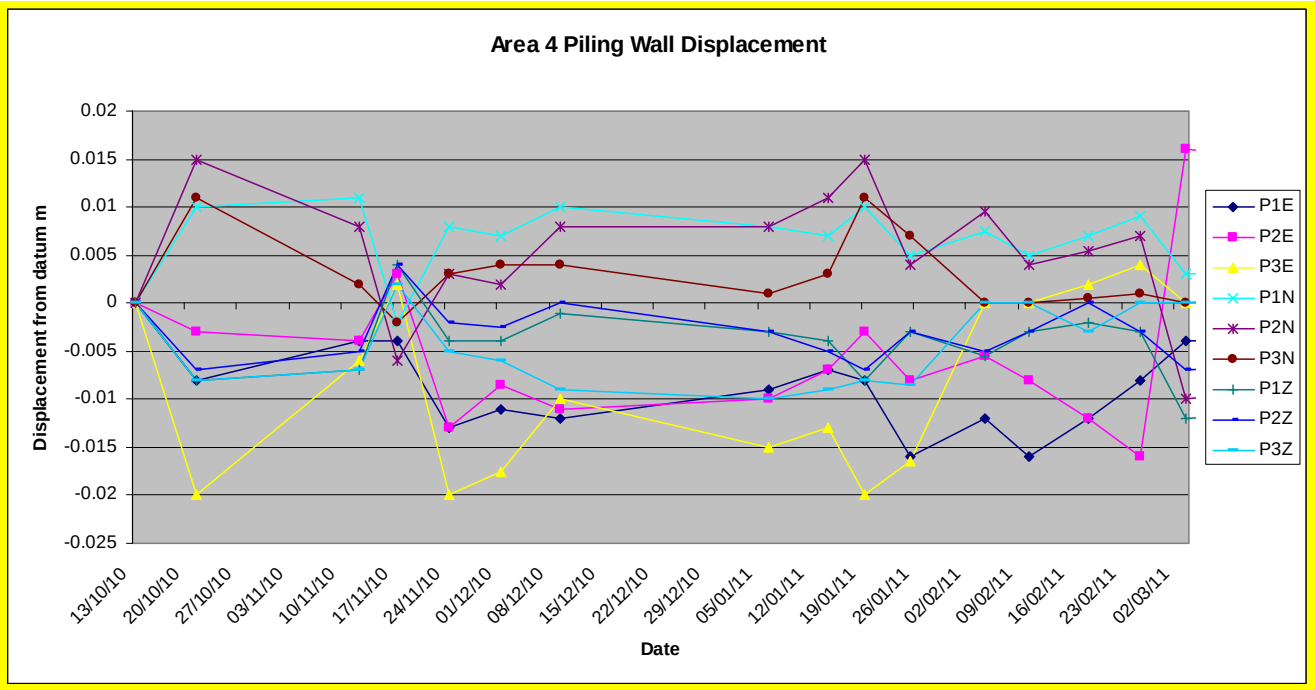


Figure 5.2: Area 4 Sheet Pile Displacement Observations

6. ROTATIONAL STABILITY (EUROCODE 7)

Stability Analysis carried out in Section 4 reviewed the impact of filling at present using the old BS:6031 code. This was carried out to allow facilitate an easier understanding of the issues.

An assessment of slope stability using the Eurocode 7 analysis method (as required by public bodies) during filling and post waste placement is presented in Appendix 1 to illustrate the immediate and long term stability issues.

In accordance with the principals of Eurocode 7, rather than using a global factor of safety as per previous design codes, (BS:6031) the factors of safety (termed partial factors) are applied to the chosen characteristic values to obtain design values. Actions (influences) are multiplied by the safety factor, while resistances are divided by the safety factor.

Eurocode analysis outputs require a **Safety Ratio** > 1.0. BS:6031 has a factor applied to the stability result and the **Factor of Safety** typically requires to be greater than 1.3

Appendix 1 analysis shows that under existing slope conditions the slope is stable (0.998) for a porewater pressure of 35 kN/m^2 in the consolidate peat and silt formations.

Analysis of the final profile shows the critical failure slope to be adjacent to the sheet pile wall. Under these conditions the Safety Ratio requires the porewater pressure to be 29kN/m^2 or less.

This analysis suggests that the slope between Areas 1 and 4 will be stable upon cessation of waste inputs when the landfill has reached is final formation for surcharge loads of 20 kN/m^2.

7. CONCLUSIONS AND RECOMENDATIONS

7.1 Overview

Analysis has shown the following:

- Settlement sensors albeit suspect from December 2009 (SS2) and December 2010 (SS1) have shown a gentle rise in the cell formation at both SS1 and SS2 which may be caused by hogging and sagging of the formation or by continued rotational displacement of the Area 1 slopes.
- Visual observations of Area 1 side slopes show no evidence of tension cracks indicating a rotational failure.
- Sheet pile wall sensors show no indication of any movement indicating a rotational failure.
- Sump pump observations show a steady settlement of the pump sumps with settlement being greatest adjacent to the sheet pile wall.

FTC advises observations thus far should be regarded representative of site conditions and the cell and operational criteria have been designed to accommodate such.

The original design brief was to stabilise the rotational failure observed in 2004. The effectiveness of this solution will only be realised once waste levels have reached the design profile.

7.2 Settlement

7.2.1 Settlement Overview

Information from sensors below the cell, pumps sumps on the cell formation and sheet piles surrounding the cell do not provide a definitive conclusion as to what may have occurred in relation to settlement.

Evidence appears to be conclusive in that there was a localised depression in July 2009 which was corroborated by sensor SS2 (Figure 2.1) and visual observations.

SS2 settlement sensors also indicated a recovery at this depression which developed into a significant rise. The rise was not corroborated by visual observations and subsequent investigations by MGS in December 2010 advised that readings post December 2009 should be disregarded. Accordingly the earlier concerns in relation to excessive rising of the cell have no basis and settlement is behaving within design limits. However the settlement shown by pump sumps (140 mm) is significantly lower than the settlement sensors for the same period (600 mm). Pump sump readings are however not at the same location as sensor readings and pump sump readings have only been carried out since May 2008.

7.2.2 Impacts of Localised Settlement on Liner Integrity

The liner was designed to accommodate significant differential settlement and the lowest part of the cell formation has a positive artesian head acting on the liner.

There is no evidence thus far from surrounding monitoring boreholes of leachate contaminating ground water nor of excessive leachate volumes within the Area 4 cell indicating a leak. Evidence therefore suggests that the liner integrity has not been compromised. The risk of liner integrity being compromised is considered to be very low as is the risk of ground water contamination.

7.3 Pore water Pressure

7.3.1 Pore water Pressure Overview

There appears to be a correlation between loading (from waste or leachate) and high pore water pressure sensor readings below the cell most noticeably at location PWPS2.

Once loading ceases, pore water sensor readings are observed to reduce over time.

There may be two causes of high pore water sensor readings.

1. The sensor reading reflects actual pore water pressure in the underlying soils. If this is the case then there are serious operational constraints as it would result in a reduction in soil shear strength
2. The sensor readings reflect a hydrostatic head of water above the sensor which is unlikely to have the same impact on reduced soil shear strength.

7.3.2 Impacts of Pore water Pressure on Design and Operations

From a stability perspective design has assumed the worst case scenario i.e. that sensor readings are reflecting actual pore water pressure. Stability analysis under the current conditions suggests that the Factor of Safety against a rotational failure is 1.3 (BS:6031) if the pore water pressure in the underlying consolidated silts and peat is 35 kN/m^2 or lower.

If pore water pressure in the silts and peat exceeds 50 kN/m^2, as has happened historically, this will reduce soil shear strength and reduce the factor of safety against rotation to 1.25. This factor of safety is not recommended.

Accordingly it is recommended that:

- Loading should be managed such that pore water pressure does not exceed 35 kN/m^2.
- Compacted lifts do not exceed 1.0 m
- Application of waste is applied over as big a footprint as possible
- Only MSW waste to be placed in the cell to mitigate the impacts of differential loading and differential settlement
- Leachate to be maintained within licence limits.

7.4 Consequences of a Rotational Failure

Settlement observations showed a rise in the cell formation. This may have been caused by hogging and sagging or may indicate of a progressive failure of the eastern slope of Area 1 (originally observed in 2004).

Even though evidence is unable to define what is happening, the worst case would clearly be a continued rotational failure.

The two most common ways of stabilising the failure are to:

1. Reduce the active loading mobilising the failure, and/or
2. Produce a counter weight to the rotational failure ie the Area 4 cell development (Eurocode analysis predicts that when the cell has reached final formation the cell loading will be sufficient to stabilise the rotational failure)

It is not considered appropriate to remove soils from the existing formation because the localised loadings associated with excavation and transport of waste and consequent water ingress might precipitate additional stability problems. Furthermore it is probable that if excavated volumes are to be placed in Area 4 there maybe loading restrictions because of pore water pressure limitations. Accordingly the removal of soil surcharge from the cap is not recommended.

The current capping works will also apply an active load that will increase the risk of instability. The question therefore is should this loading take place. If the landfill is not capped leachate management will need to be reviewed and there will also be additional loadings from deep percolation rainfall inputs.

Design thus far has adopted the philosophy of using waste loadings in Area 4 to arrest the failure as the preferred option as opposed to removing/preventing additional surcharge from the existing waste body.

FTC is still of the opinion that this is the most suitable solution and long term stability analysis using Eurocode 7 (Appendix 1) confirms this approach as being viable for the assumed soil parameters and loading conditions.

7.4.1 Physical Displacement of the Waste Body

There is a peat bog extending some 20 to 40 m outside the sheet pile wall bounding Area 4. The sheet pile wall is not designed as a retaining wall.for a rotational failure. It is designed solely to contain displacement of peat.

In the event of a failure, there is likely to be displacement of the waste body beyond the perimeter fence within the existing peat bog. This scenario is an assumed worst case and there is no evidence thus far indicating any movement in the sheet pile wall suggesting a failure of this nature has occurred.

However if a failure did happen it is probable that it would be a slow failure resulting in an increased ground elevation in the peat bog area.

7.4.2 Environmental Consequences

Movement of the waste body following a rotational failure may have impacts on the following:

Leachate

A rotational failure may displace the cell. The cell lining system is robust and ground water pressure below the cell formation is such that even if a tear occurred in the liner groundwater will enter the cell. There is an extremely low risk that leachate will pollute groundwater.

Infrastructure

A rotational failure may cause sloughing or tension cracks in surface profiles. Gas and leachate collection pipe work may be disturbed at fixed points e.g. well heads, drip legs. This is not considered to be serious as this infrastructure is already designed to accommodate differential settlement. Accordingly it would be relatively easy to correct.

Surface water

A rotational failure may cause displacement of the water course (open drain). The drain could be re-excavated. The risk of surface water contamination is extremely low.

Impact on adjacent lands

The most probable impact of a rotational failure would be vertical displacement of peat in the adjacent field raising ground elevation locally.

Even if such a failure did happen, it is unlikely to damage either human, animals or the environment.

7.5 Recommendations

It is recommended that:

- Waste placement be continued in accordance with the original design philosophy
- Sensors be maintained on a regular basis

- Continued regular monitoring of the porewater sensor pressure readings on an ongoing basis.
- Continued topographic monitoring of settlement on sheet pile walls and pump sumps and reference survey locations to monitor the area external to Area 4 if possible in the event the movement in the sheet pile wall occurs.
- Establishment of slope stability monitoring locations on the Area 1 side slopes and topographic surveying of same on a regular basis.
- Sensor, rainfall and leachate data in conjunction with waste elevation in the cell to be reviewed monthly.
- The controlled placement of additional waste in thin layers (< 1.0 m thick compacted) within the cell should be carried out in a uniform manner to minimize differential loading of the soft soils underlying the cell. Stockpiling of material should not be permitted anywhere within the cell.
- A waste contingency plan to be put in place in the event that a limit on or cessation of waste inputs Area 4 are required.
- Waste inputs into Area 4 to be stopped if signs of slope instability be observed, such as tension cracks, movement of slope monitoring pegs.
- An assessment to be made of the possible impacts in the event that Area 1 slope continues to fail.
- An action plan to be implemented to either mitigate the risk of, or implement possible long term contingency requirements, in the event of failure causing displacement of the waste body.
- STCC to be aware of the possible impact of waste loadings on slope stability as the waste platform gets higher and moves towards the Area 1 slope. Whilst the Eurocode analysis suggests that the critical failure plane will move towards the sheet pile wall, the waste loadings nevertheless may change from being a stabilising moment (resisting failure) to a potentially de-stabilising moment. Slopes will also allow easier egress and access of machinery and movement of stockpiles. Therefore, it is essential that all work practices, loading of waste and associated monitoring are implemented in full until such time as all waste is placed and monitoring results indicate slopes to be stable.
- Establish/maintain trigonometric stations at following locations:
    - Peat bog outside licence boundary in existing bog adjacent to Area 4 (4 no)
    - Side slope (4 no 1.0 m steel pegs with concrete surround)
    - Sheet pile wall (3 additional to supplement existing 3 no)
    - Pump sumps (make sure there is a defined reference point that does not change using “hilti” nails or similar)
    - Bollard monitoring between respective lifts. To support bollard information try to get operator to finish cover on lift areas to smooth level finish and to avoid tracking over lift areas once complete so that depressions or rises can be easily observed
- Maintain a log of all operations and machinery working areas to facilitate interrogation of events should evidence of a failure become apparent.

7.6 Summary of Operational Criteria

Table 7.1 below summarises the key operational criteria

Table 7.1: Summary of Key Operational Criteria

Item	description	Criteria	Actions required if target exceeded
1	Cell lift	1.0 m compacted	Manage operation
2	Allowable porewater pressure	35 kPa or 35 kN/m^2	Cease waste placement
3	Allowable leachate in cell	1.0 m max	Remove leachate
4	Allowable deflection in X of fixed points per week	0.025 m	Review all monitoring and operations immediately
5	Allowable deflection in Y of fixed points per week	0.025 m	Review all monitoring and operations immediately
6	Allowable deflection in Z of fixed points per week	0.050 m	Review all monitoring and operations immediately
7	Tension crack inspection along defined routes	< 0.005 m	Check all topo reference points with particular emphasis on sheet pile wall and elevations on adjacent peat bog outside boundary
8	Allowable deflection in Z of bollard fixed points per week	<0.050	Review all data for signs of failure
9	Allowable surcharge on final cap	10 kN/m^2	Do not allow exceedances

Appendix 1

Slope Stability Assessment at Interface between Areas 1 and 4.

FEHILY TIMONEY & COMPANY GIFFORD

Calculation Check Sheet

PROJECT NAME:	Dunoh. II Landfill II
PROJECT NO.	DE08-024-05
ELEMENT:	Cell 4 Final CAP - Slope Analysis
CALCULATION ID:	1
REVISION:	D
DATE:	15 November 2010
PREPARED BY:	Ph.L Cullen

The level of technical check is appropriate to the element being designed. The form and detail of the check is as follows:

CATEGORY	DESIGN TYPE	LEVEL OF CHECK REQUIRED	tick
Category 0	Simple design elements	General check by another member of the design team	X
Category 1	Straightforward design elements	Detailed check by another member of the design team	
Category 2	Intermediate design elements	3rd party check by an independent FTC Checking Team	
Category 3	Complex design elements	Check to be carried out by a Checking Team from a separate organisation	

I confirm that I have checked the calculations detailed above to the level of check required and identified above in accordance with the FTC Calculation Check Requirements for checking of calculations.

CHECKED BY:

SIGNED:		
NAME:	P.L Cullen	Date: 15 Nov 2010

This form must be signed, scanned and inserted into a PDF file along with the related calculations and saved onto the V drive – see PP02.

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: Phil C CHECKED:
DATE: 25/11/10 REVISION: -
JOB NUMBER: DE08-024-05
CALC NUMBER: C01
FILE J:\2008\DE08\024\05\Area 4 Settlement\Slope W Calculations\Final Design Check\Donohill Eurocode 7
SHEET Calc cover

PROJECT: Donohill Landfill Area 4 Settlement Stability
DESCRIPTION: Slope W Parameters

Rev	Date	Purpose and Description	Prepared	Checked	Reviewed	Approved
0	15-Nov-10	Stability check of final landfill profile accounting for increase in porewater pressure in underlying peat and silt	P Cullen			

Fehily Timoney Co.
Core House
Pouladuff Rd.
Cork

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: Phil C CHECKED:
DATE: 25 11 10 REVISION: -
JOB NUMBER: DE08-024-05
CALC NUMBER: C01
FILE J:\2008\DE08\024\05\Area 4 Settlement\Slope W Calculations\Fin
SHEET Calc Sheet

PROJECT: Donohill Landfill Area 4 Settlement Stability
DESCRIPTION: Slope W Parameters

Ref.		Output

i references

1 Euro Code 7 Part 1 (Irish Annex)
2
3
4
5
6
7
8
9
10

ii List of FTC Drawings

List all drawings associated with this calculation.

Fig 1 Final Design Critical Failure
Fig 2 Final Design large Rotational Failure (not critical)
Fig 3 Existing Slope conditions.

iii List of Appendices

Any appendices should be listed here (ie model outputs, standard spreadsheets, etc)

Contents.

1.0 Slope Stability Analysis
2.0 Soil Shear Strength / Boundary Pressure Assessment

Fehily Timoney Co.,
Core House,
Pouladuff Rd.,
Cork
Tel 021 4064133

1.0 **Slope Stability Analysis** **Donohill Landfill Area 4 Cell Stability**

EN 1997-1 Design Approach 3
Total Stress Analysis
A2 + M2 + R3

C_u Undrained shear strength (kN/m²)
γ Bulk unit weight (kN/m³)
z Depth of sliding layer
β Slope Angle
q Applied Surcharge

Traffic Load 20 kPa

Characteristic Values

	Old Waste	New Waste	Clay Capping	Sand & Gravel	Peat	Consolidated Peat	Silt/Clay	Consolidated Silt/Clay	Temp Capping	Clay Liner	Pozidrain/Smooth LLDPE
c_u					16 kPa	11 kPa	40 kPa	28 kPa			
c'	10 kPa	10 kPa	4 kPa	0 kPa	0 kPa	0 kPa	0 kPa	0 kPa	4 kPa	4 kPa	3 kPa
γ_k	11 kN/m³	9.5 kN/m³	18 kN/m³	21 kN/m³	11 kN/m³	11 kN/m³	18 kN/m³	18 kN/m³	20 kN/m³	18 kN/m³	20 kN/m³
ϕ_k'	22 °	15 °	29 °	35 °	0 °	0 °	22 °	0 °	30 °	29 °	16 °
q_k	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa	20.0 kPa

Partial Factors

	γ_{Cu}	1.4	Undrained Shear Strength
M2	$\gamma_{c'}$	1.25	Effective cohesion
	$\gamma_{\phi'}$	1.25	Effective angle of friction
	γ_γ	1	Soil density
A2	γ_Q	1.3	Traffic Loading (variable unfavourable)
R3	$\gamma_{R,e}$	1	earth resistance

Design Values

	Old Waste	New Waste	Clay Capping	Sand & Gravel	Peat	Consolidated Peat	Silt/Clay	Consolidated Silt/Clay	Temp Capping	Clay Liner	Pozidrain/Smooth LLDPE
c_u	0.0 kPa	0.0 kPa	0.0 kPa		11.4 kPa	7.9 kPa	28.6 kPa	20.0 kPa			
c'd	8.0 kPa	8.0 kPa	3.2 kPa	0.0 kPa	0.0 kPa	0.0 kPa	0.0 kPa	0.0 kPa	3.2 kPa	3.2 kPa	2.4 kPa
γ_d	11 kN/m³	9.5 kN/m³	18 kN/m³	21 kN/m³	11 kN/m³	11 kN/m³	18 kN/m³	18 kN/m³	20 kN/m³	18 kN/m³	20 kN/m³
ϕ_d'd	17.6 °	12 °	23.2 °	28 °	0 °	0 °	17.6 °	0 °	24 °	23.2 °	12.8 °
q_d	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	26.0 kPa	

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
CORK: Tel: 021-4964133 Fax: 021-4964464

DESIGNED: [signature] CHECKED:
DATE: 15 NOV 2010 REVISION:
JOB NO: DF08 - 024 - 05
PROJECT: Doohill Landfill
DESCRIPTION: Area 4 Cell - Final Profile Stability

Ref.

2.0 Soil Shear Strength / Porewater Assessment

Soil Shear Strength reduction due to increased Porewater Pressure

$\tau = C + (\sigma_n - \Delta u) \tan \phi$

σ_n = Total normal Pressure
C = cohesion
Δu = change in Hydrostatic Pressure

$\therefore \frac{\tau_{reduced}}{\tau} = I$ Stability factor

$I = \left(1 - \frac{\Delta u}{\sigma_n}\right)$

Assumed
C_u Peat = 16 kPa (consol. load)
C_u Silt = 40 kPa (consol. load)

σ_n = 63 kPa at Peat 65.5 kPa at Silt
Initial Porewater Pressure = 9 kPa

Shear Strength reduction for Porewater Pressure = 29 kPa

$\Delta u = 29 - 9 = 20$ kPa

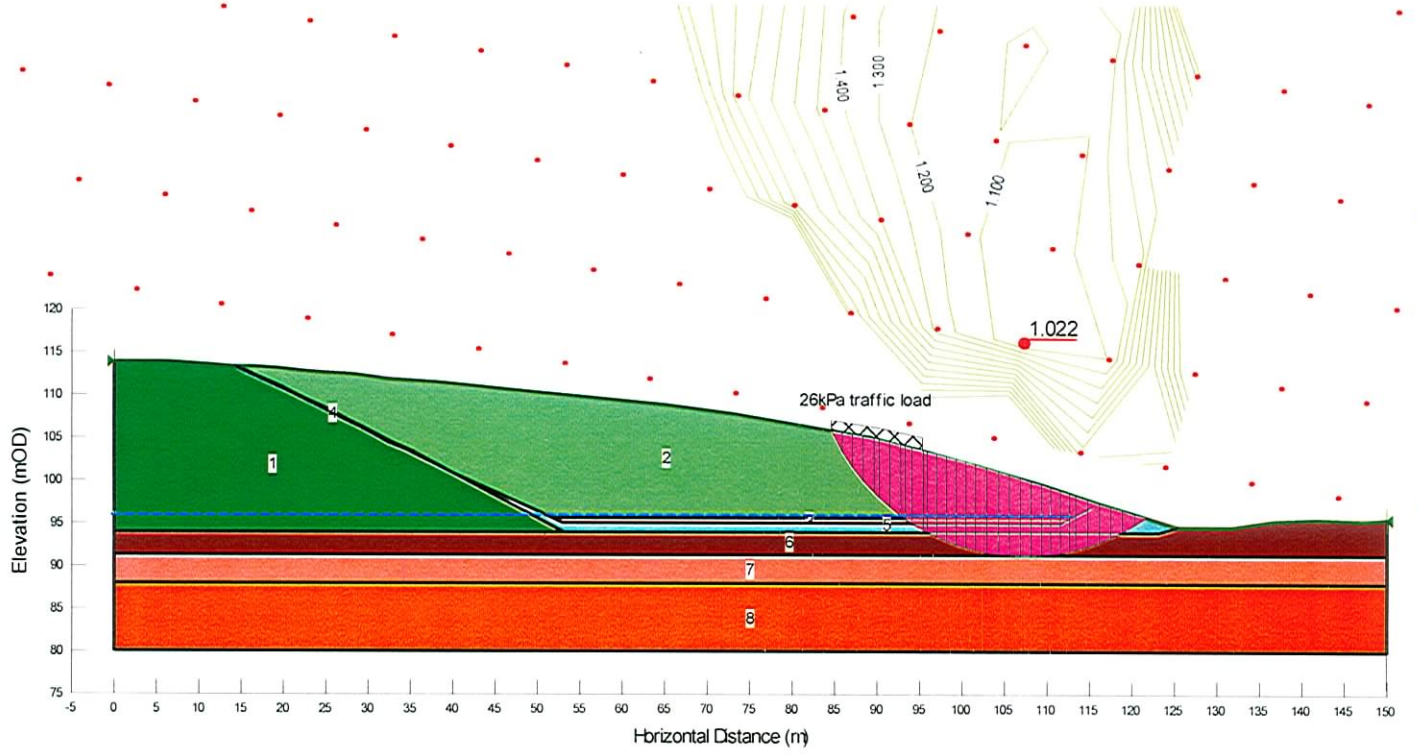
$\tau_{reduced\ Peat} = \left(1 - \frac{20}{63}\right) \times 16 = 11$ kPa (Peat)

$\tau_{reduced\ Silt} = \left(1 - \frac{20}{65.5}\right) \times 40 = 24$ kPa (Silt)

OUTPUT

Fig. 1

DE08-024-05
Donohill Cell 4 – Final Design Profile (critical failure)

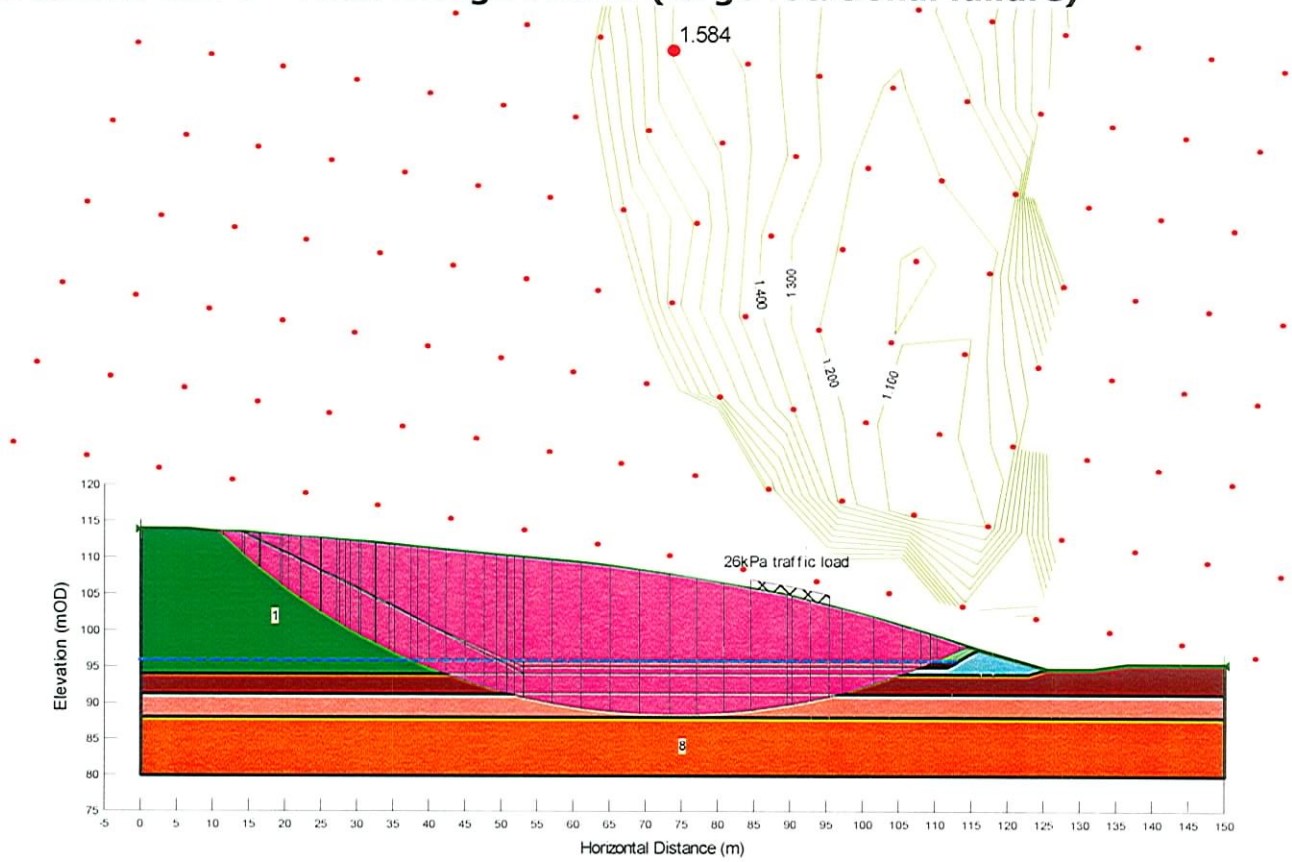


Material #: 1 Description: Old Waste Wt: 11 Cohesion: 8 Phi: 17.6
Material #: 2 Description: New Waste Wt: 9.5 Cohesion: 8 Phi: 12
Material #: 3 Description: Gravel drainage Wt: 21 Cohesion: 0 Phi: 28
Material #: 4 Description: LLDPE smooth/Pozidrain Wt: 20 Cohesion: 0 Phi: 12.8
Material #: 5 Description: Clay Liner Wt: 18 Cohesion: 3.2 Phi: 23.2
Material #: 6 Description: Consolidated Peat Wt: 11 Cohesion: 7.9 Phi: 0
Material #: 7 Description: Consolidated Silt Wt: 18 Cohesion: 20 Phi: 0
Material #: 8 Description: Sandy Gravel Wt: 21 Cohesion: 0 Phi: 28

4/5

Fig 2

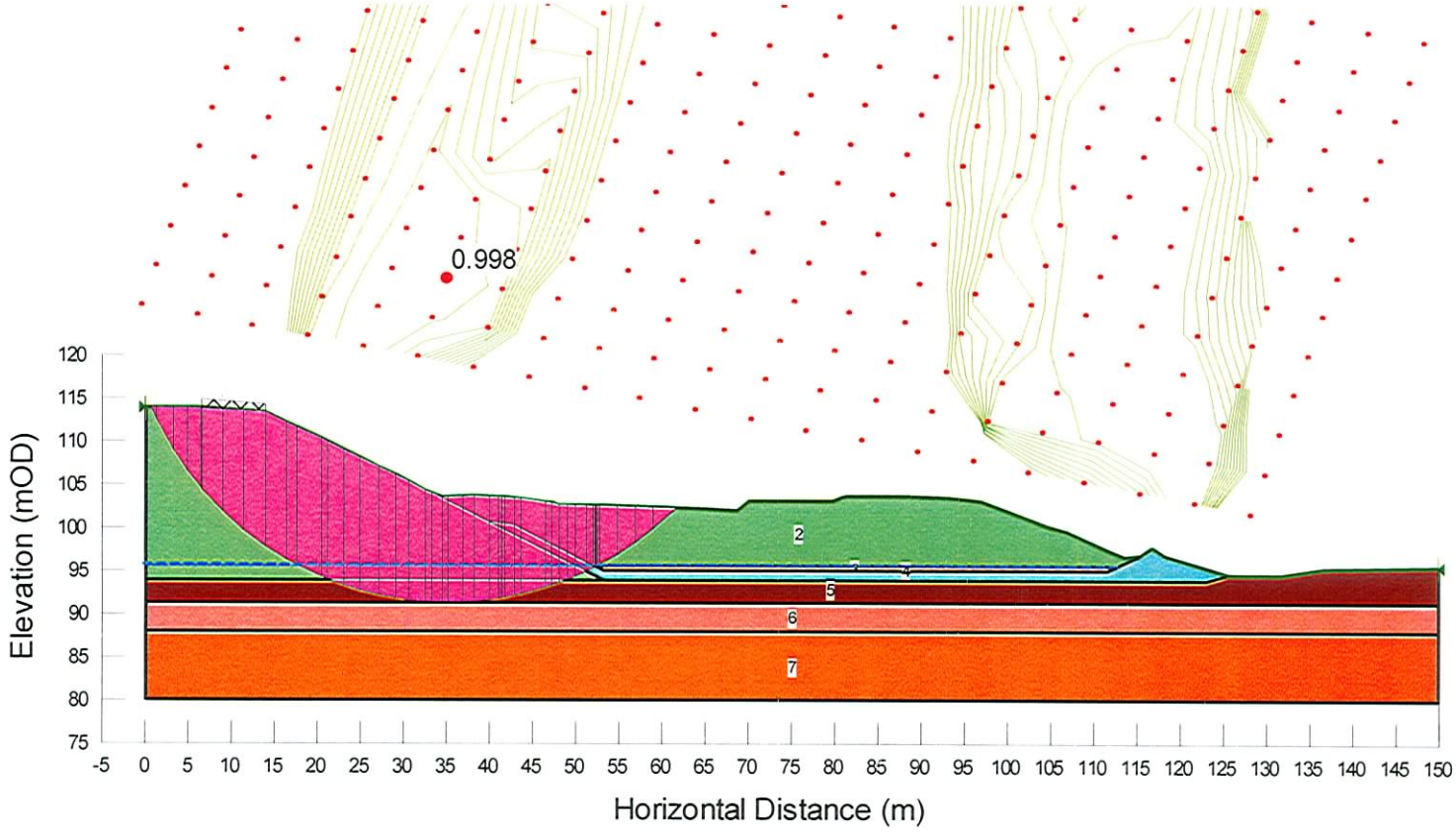
Donohill Cell 4 – Final Design Profile (large rotational failure)



Material #: 1 Description: Old Waste Wt: 11 Cohesion: 8 Phi: 17.6
Material #: 2 Description: New Waste Wt: 9.5 Cohesion: 8 Phi: 12
Material #: 3 Description: Gravel drainage Wt: 21 Cohesion: 0 Phi: 28
Material #: 4 Description: LLDPE smooth/Pozidrain Wt: 20 Cohesion: 0 Phi: 12.8
Material #: 5 Description: Clay Liner Wt: 18 Cohesion: 3.2 Phi: 23.2
Material #: 6 Description: Consolidated Peat Wt: 11 Cohesion: 7.9 Phi: 0
Material #: 7 Description: Consolidated Silt Wt: 18 Cohesion: 20 Phi: 0
Material #: 8 Description: Sandy Gravel Wt: 21 Cohesion: 0 Phi: 28

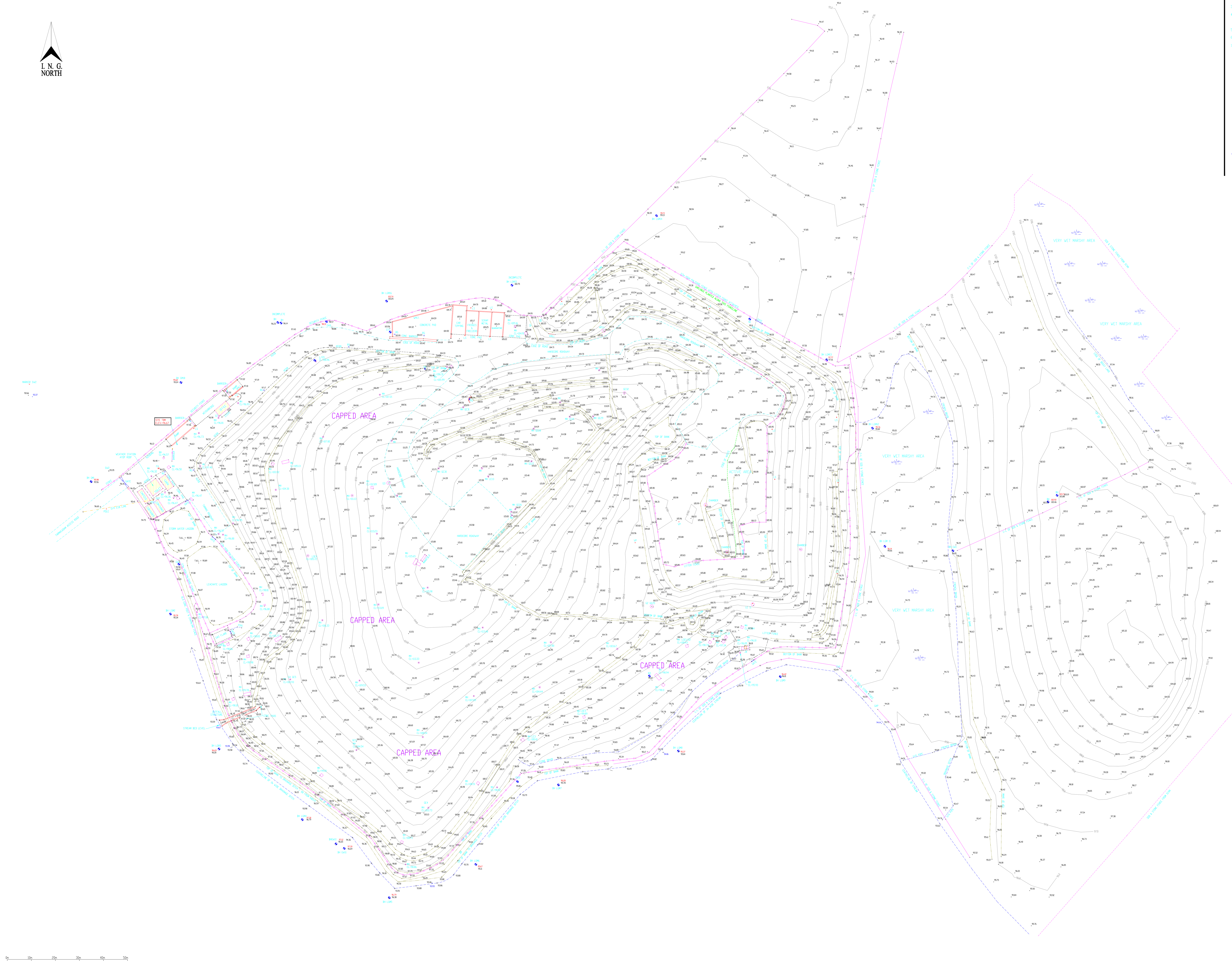
Fig 3

Cell 4 - Existing Slope Conditions



Material #: 1 Description: Old Waste Wt: 11 Cohesion: 8 Phi: 17.6
Material #: 2 Description: New Waste Wt: 9.5 Cohesion: 8 Phi: 12
Material #: 3 Description: Gravel drainage Wt: 21 Cohesion: 0 Phi: 28
Material #: 4 Description: Clay Liner Wt: 18 Cohesion: 3.2 Phi: 23.2
Material #: 5 Description: Consolidated Peat Wt: 11 Cohesion: 3.6 Phi: 0
Material #: 6 Description: Consolidated Silt Wt: 18 Cohesion: 17.1 Phi: 0
Material #: 7 Description: Sandy Gravel Wt: 21 Cohesion: 0 Phi: 28

APPENDIX 11 VOID SPACE ANALYSIS REPORT



NOTES:

1. ALL LEVELS ARE IN METRES, UNLESS OTHERWISE STATED.
2. ANY DISCREPANCIES FOUND SHOULD BE REPORTED TO FOCUS SURVEYS LTD. AND ANY OTHER RELEVANT PARTIES.
3. THE COORDINATE SYSTEM IS BASED ON THE IRISH NATIONAL GRID.
4. ALL LEVELS ARE RELATED TO A SITE TBM WHICH IS A HILTI-NAIL WITH ORANGE TAPE SET OFF THE SOUTH RAMP OF THE WEIGHBRIDGE ITS ELEVATION BEING 96.67m MALIN HEAD DATUM AS SHOWN ON THIS DRAWING.
5. ALL LEVELS IN RED ARE TO THE TOP OF THE BOREHOLE CASING.
6. ALL LEVELS IN BLUE ARE TO THE STREAM WATER LEVEL.
7. PIPELINES NOT VISIBLE DURING THE SURVEY MAY EXIST IN THE LONG GRASS

LEGEND:

MH DENOTES MANHOLE
CL DENOTES MANHOLE COVER LEVEL
RG DENOTES ROAD GULLY
DLT DENOTES DRIPLINE OF TREES
LS DENOTES LAMP STANDARD
FH DENOTES FIRE HYDRANT
O/H DENOTES OVERHEAD
CP DENOTES CONTROL POINT
GT DENOTES GULLY TRAP
VP DENOTES VENT PIPE
● DENOTES BOREHOLE
TOC DENOTES TOP OF CHAMBER

REVISION	REVISION DATE	DESCRIPTION OF REVISION
N	15-03-11	SURVEY UPDATE OF LANDFILL SITE & EXTENSION INTO LANDS EAST
M	16-04-10	SURVEY UPDATE OF ACTIVE AREA & AREA 1 SIDE SLOPES
L	09-10-09	SURVEY UPDATE OF ACTIVE & CAPPED AREAS
K	28-08-08	SURVEY UPDATE OF ACTIVE & NON-CAPPED AREAS
J	09-10-07	SURVEY UPDATE OF ACTIVE AREA & NEW ACCESS ROAD TO CELL
H	30-01-07	SURVEY UPDATE OF ACTIVE AREA & CAPPED AREA
G	27-09-06	SURVEY UPDATE OF ACTIVE AREA & NEW CELL
F	15-02-06	VOLUMETRIC ANALYSIS ONLY
E	11-10-05	ANNUAL SURVEY UPDATE
D	11-11-04	ANNUAL SURVEY UPDATE
C	29-10-03	SURVEY UPDATE AND BOREHOLES IN ADJACENT LANDS
B	21-11-02	SURVEY UPDATE AND EXTENSION TO NORTH AND EAST
A	29-09-01	MAJOR SURVEY UPDATE

FOCUS
Focus Surveys Ltd., O'Connell Avenue, Turner's Cross, Cork.
Tel : 021-4314555 Fax : 021-4975907 e-mail : focussurveys@eircom.net

THE IRISH INSTITUTION OF SURVEYORS

TITLE
TOPOGRAPHICAL SITE SURVEY

SURVEY LOCATION
DONOHILL LANDFILL SITE,
DONOHILL, Co. TIPPERARY.

CLIENT
SOUTH TIPPERARY COUNTY COUNCIL.

SCALE	1:500
SURVEYED BY	E.D.
DATE OF ORIGINAL SURVEY	JUNE 1998
FIRST FOCUS REVISION	27-09-01
DRAWN BY	E.D.
CHECKED BY	D.C.

DRAWING NAME: 01-072_1 REV. N

FOCUS

Focus Surveys Ltd.,
O'Connell Avenue,
Turner's Cross,
Cork.

Tel: 021 4314555
E-mail: info@focussurveys.ie
Web: www.focussurveys.ie

Louise Ryan,
Environment Section,
South Tipperary County Council,
The Old Museum,
Parnell Street,
Clonmel,
Co. Tipperary.

24th March, 2011.
Our Ref: 0-072_28

Land Surveys

Building Surveys

Setting-Out

GPS

Volumetric Surveys

Site Control

Boundary Surveys

Land Registry

Deformation Monitoring

Re : Volumetric Analysis at Donohill Landfill.

Dear Louise,

Enclosed please find the results of our recent survey on the 15th March last at Donohill Landfill Site

- A plot of the updated survey with current contours only.
- A plot of the updated survey with current contours and FINAL PRE-SETTLEMENT WASTE CONTOURS (shown in green).
- A plot of the updated survey showing restoration contours. These show at a glance how much filling (if any) may take place at any area of the landfill site. Red contours indicate that the final contour level has been exceeded.

Volumetric Analysis.

A. Amount of waste/fill material gone into the Active Areas from the survey of 16-04-10 to the latest survey 15-03-11 = **10630 m^3.**

B. Overall potential void space = **24,700 m^3**

This can be broken down into the different areas as previously advised.

Area 1: Potential void space = **16,800 m^3**

Area 3: Potential void space = **4,600 m^3**

Area 4: Potential void space = **3,300 m^3**

THE IRISH INSTITUTION OF SURVEYORS
230

VAT No: IE6337319Q

Company Reg: 317319

- *I have received the new pre-settlement capping contours from FTC and reduced them by 1m (allowing for 1m of capping material) to approximate pre-settlement waste contours.*

I have emailed the results to you and Chris Cronin.

Should you have any queries, please do not hesitate to contact me.

Regards,

Edgar Delaney BE MIEI MIS.

APPENDIX 12 GROUNDWATER LEAK CALCULATION

South Tipperary Co. Co.

Groundwater Discharge Calculation

Prepared for:
South Tipperary County Council
Donohill Landfill

Revision: 1 ***Date: 05/04/11***

Prepared by:
Fehily Timoney & Co.
Core House,
Pouladuff Road,
Cork.

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED: AR **CHECKED:** CJC
DATE: 05/04/11 **REVISION:** 1
JOB NUMBER: **LW11-024-01**
CALC NUMBER: **C-01**
FILE Q:\2011\LW11\024\01\Calculations\Calc Set 01 Groundwater\LW1102401_Calc set 01 GW Calculation.xls

PROJECT: **South Tipperary Co. Co.** **SHEET** Calc cover
DESCRIPTION: **Groundwater Discharge Calculation**

Rev	Date	Purpose and Description	Prepared	Checked
1	5/4/11	Calculation of annual and cumulative discharge to groundwater	AR	CJC

Fehily Timoney Co.
Core House
Pouladuff Rd.
Cork

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED:	AR	**CHECKED:**	CJC
DATE:	5.4.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 01 Groundwater\LW1102401_Calc set 01 GW Calculation.xls		
SHEET	Calc Sheet		

PROJECT: **South Tipperary Co. Co.**
DESCRIPTION: **Groundwater Discharge Calculation**

Ref.

Output

i references

1 2009 AER for Donohill Landfill
..\..\Incoming\LW1102401_2009 AER.pdf
2 Incoming leachate monitoring data from STCC
LW1102401_2010 master file scada.xls
3 Details of previous calculation supplied by STCC
..\..\Incoming\LW1102401_Incoming information groundwater_ARC_LW11-024-01_07032011-090128_Alice_Riordan.msg
4 Email correspondence from STCC
RE ARC RE recent quotation request - gw.msg
5 Topographical survey of site 2010
6 Details of leachate and groundwater wells
..\..\Incoming\LW1102401_Groundwater.doc
..\..\Incoming\LW1102401_Leachate wells.doc

ii List of FTC Drawings

iii List of Appendices

Fehily Timoney Co.
Core House
Pouladuff Rd.
Cork
Ireland

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Cork : Tel 021-4964133 Fax 021-4964464

DESIGNED:	AR	**CHECKED:**	CJC
DATE:	5.4.11	**REVISION:**	1
JOB NUMBER:	LW11-024-01		
CALC NUMBER:	C-01		
FILE	Q:\2011\LW11\024\01\Calculations\Calc Set 01 Groundwater\LW1102401_Calc set 01 GW Calculation.xls		
SHEET	Calc Sheet		

PROJECT: South Tipperary Co. Co.
DESCRIPTION: Groundwater Discharge Calculation

Ref. | Output

1.0 Introduction

The purpose of this calculation is to estimate the annual and cumulative indirect emissions to groundwater. FTC will use the same calculation method as has been used by STCC over previous years.

FTC will:
- Review the leachate level monitoring records for 2010 to determine average leachate head in each area.
- Calculate the vertical leachate leakage for each area, on an annual basis.
- Use previous calculations to estimate the cumulative indirect emissions to groundwater

2.0 Calculation

2.1 Review of 2010 leachate & groundwater level monitoring data

Using information provided by STCC, the following are the average readings at each of the leachate level monitoring locations at Donohill over 2010. Levels are interpolated from the
2 topo. survey and should be calibrated against borehole records.

5,6

	Location	Top of casing (mOD)	Average Leachate Level (m)	Area	Area Description	Base of Well (mOD)	Ave. Leachate Level (mOD)
	LE2	98.06	0.50	2	Fully lined cell	95.46	95.96
	LE4	96.8	1.96	Lagoon Area			
	LE6	98.63	0.13	1	Unlined cell	92.73	92.86
	LE7	99.5	0.81	4	Fully lined cell	89.5	90.31
	LE8	95.93	1.53	1	Unlined cell		
	LE9	105	0.08	4	Fully lined cell	93.83	93.91
	LE10	103.5	0.07	4	Fully lined cell		
	LE11	100.5	0.31	4	Fully lined cell		
	LGE6	112.5	2.20	1	Unlined cell	97.34	99.54
**	LGE7	113.5	2.51	1	Unlined cell	97.51	100.02
	LGE8	106.25	0.51	3	Fully lined cell	94.05	94.56
	LC4		0.55	Lagoon Area			

**LGE 7 is ignored due to erroneous readings.

As in previous years, the site is divided into a number of areas for calculation purposes. The table above identifies the area associated with each monitoring location.

The average head of leachate for each area can be derived from the table above as follows:

Area 1	1.28	m	=	97.47 mOD
Area 2	0.50	m	=	95.96 mOD
Area 3	0.51	m	=	94.56 mOD
Area 4	0.32	m	=	92.11 mOD
Lagoon Area	1.25	m		

Fehily Timoney Co.
Core House
Pouladuff Rd.
Cork
Ireland

Ref. | Output

6 In order to assess groundwater levels at the site, the results of groundwater monitoring at some locations at the site are presented below, with results shown in approximate mOD:

Location	GW level (mOD)	
GW11d	94.15	GW 11d/s are located to the south west of Area 1.
GW11s	93.95	
GW12d	95.36	GW 12d/s are located east of Area 4.
GW12s	95.05	
GW13	89.78	GW 13 is located due north of the site.

These figures suggest that GW levels in the surrounding ground is close to, or in some cases, higher than the average leachate levels. This could mean that groundwater in the surrounding land is under artesian pressure. If artesian head exists at the site, the likelihood is that very little, if any, leachate will discharge to groundwater.

2.2 Vertical Leakage for each Area

1,3 Using the parameters for the underlying strata given in the original waste licence application, the vertical leakage is estimated for each Area using the following calculation:

$$Leakage = Area \times \left[\frac{K_{aug} \times h_{aug}}{b_{aug}}\right]$$

where: K_{aug} = hydraulic conductivity, m/s
b_{aug} = thickness of underlying strata, m
h_{aug} = head of leachate, m
Area = Area of cell, m²
Leakage = vertical leakage, m³/sec

	Area 1	Area 2	Area 3	Area 4	
K_{aug}	3.20E-07	1.00E-09	1.00E-09	1.00E-09	m/s
b_{aug}	28	1	1	1	m
h_{aug}	1.28	0.50	0.51	0.32	m
Area	25,190	6,100	7,200	4,800	m²
Leakage	3.70E-04	3.05E-06	3.70E-06	1.53E-06	m³/sec

Estimated leakage rate for 2010: 0.000378 m³/sec
Estimated leakage for 2010: 11,925 m³/annum

It should be noted that the effect of the underlying materials are not taken into account in Areas 2 to 4, i.e. the only attenuation considered is that afforded by the engineered lining systems. This is a conservative assumption, in reality the effect of the underlying material will further reduce leakage to groundwater.

Ref. | Output

2.3 Cumulative indirect emissions to groundwater

The following leakage rates were calculated in historic AERs submitted to the Agency:

		Leakage (m³/s)	Leakage (m³/annum)
1	2009	0.00062	19,552
4	2008	0.00062	19,552
4	2007	0.00062	19,552
4	2006	0.00062	19,552
4	2005	0.00062	19,552

The cumulative leakage to groundwater is therefore estimated as: 109,687 m³

3.0 Summary

The estimated annual indirect 2010 emission to groundwater at Donohill is:
11,925 m³
The estimated total cumulative indirect emission to groundwater is:
109,687 m³

The following points should be noted in relation to the calculations above.

The leakage calculation does not take into account the effect of the underlying strata below the lined cells. This will result in an overestimate of emissions to groundwater.

The upward head (counteracting the downward leachate movement) from the underlying bedrock aquifer is not taken into account. This will result in overestimate of emissions to groundwater. FTC's experience at the site suggests that an artesian groundwater head exists at the site, and the likelihood of actual emissions to groundwater is low.

That attenuation of contaminants in the leachate will occur as it passes through the 28m of underlying strata.

The values shown above are estimates only, and should be examined in conjunction with groundwater monitoring results to determine the extent (if any) of groundwater contamination at the site.

The potential leachate generation calculated in the water balance for 2010 is approximately 15,500 m³, and the volume recorded as being tankered off site is over 18,000 m³. Taking these figures into account it is likely that no actual emissions to groundwater are generated at the site. The figures above should be read as a maximum potential leakage rate based on a number of conservative assumptions, rather than as an indication of actual leakage.

APPENDIX 13 INCIDENT REPORTS

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	38

Date of occurrence 29/03/2010 **Time**

Place of occurrence Donohill Landfill

Nature of incident (including Licence Condition affected)

At approx 18:00 on 29-03-10 the levels of leachate rose above trigger levels in Area 3 and Area 4. They are currently at the following levels:
LGE8 (Area 3): 1.73m (trigger level 1m)
LE7 (Area 4): 1.93m (trigger level 1m).

Update 13-04-10: leachate levels across the site are now below trigger levels. LGE8 and LE7 current levels are:

LGE8 (Area 3): 0.26m (trigger level 1m)
LE7 (Area 4): 0.68m (trigger level 1m).

Cause of incident 27mm of rain fell on 29-03-10

Emissions arising from incident No emission arising from the incident. The exceedance of a trigger level does not indicate that emissions occurred, but that actions must be taken to reduce levels below the trigger.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident Tankering of leachate offsite to Cashel WWTP. A second truck has been ordered for the rest of the week. The storage tank in Cashel will be used if the WWTP in Cashel comes under pressure with storm flow.

Provisions taken to avoid recurrence of incident Capping works to be carried out later this year should reduce the amount of leachate produced onsite.

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 13/04/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	39

Date of occurrence	21/04/2010 **Time**
Place of occurrence	GM14 and GM15
Nature of incident (including Licence Condition affected)	Monthly gas migration monitoring was carried out on 21-04-10 and 22-04-10. Two gas wells exceeded their trigger levels for CO2 as follows: GM14: 2.2% (Trigger: 1.5%) GM15: 1.9% (Trigger: 1.5%)
Cause of incident	Local ground conditions are the most likely cause for the CO2 levels. There was no methane detected at any of the migration monitoring wells. There was No odour found at any of the migration monitoring wells.
Emissions arising from incident	No emissions arising from this incident.
Person Responsible for Dealing with Incident	Louise Ryan
Actions used to minimise effect of incident	Continue monthly monitoring
Provisions taken to avoid recurrence of incident	The cause is local ground conditions - No provisions to be put in place.
Notifiable to Fisheries Board	☐
Training/retraining required	
Sign off (action carried out)	Louise Ryan
Signed off by	Louise Ryan **Date signed off** 23/04/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan

12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	40

Date of occurrence 25/05/2010 **Time** 16:00

Place of occurrence GM15

Nature of incident (including Licence Condition affected) Monthly gas migration monitoring was carried out on May 24th and 25th. One gas trigger level was exceeded during this monitoring. 2.3% of CO2 was detected at GM15, the trigger level fro CO2 is 1.5%.

Cause of incident Local ground conditions.

No methane was detected at any of the migration wells. There was no odour at any of the migration wells.

Emissions arising from incident There is no emission arising from this incident. The CO2 is due to local ground conditions and not from landfill gas migration.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident N/a

Provisions taken to avoid recurrence of incident N/a

Notifiable to Fisheries Board ☐

Training/retraining required N/a

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 27/05/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	41

Date of occurrence 16/07/2010 **Time** 23:00

Place of occurrence LE7

Nature of incident (including Licence Condition affected) Leachate exceeded 1m above the liner.

Cause of incident Rainfall caused the leachate level to rise.
See details for rainfall and leachate levels for the month of July to date attached.

Emissions arising from incident No emission occurred.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident Two leachate trucks onsite all week.
Leachate level was reduced below 1m on 19-07-10.

Provisions taken to avoid recurrence of incident Continuing to tanker leachate offsite.

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 20/07/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	42

Date of occurrence 20/07/2010 **Time** 15:00

Place of occurrence LE6

Nature of incident (including Licence Condition affected) Leachate level exceeded 1m. The level is 1.7m.

Cause of incident The pump has stopped working.

Emissions arising from incident No emission has occurred

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

The pump has been checked this morning and it has been lifted and shaken in an attempt to start it in case the float was stuck, but this had no effect.
An emergency call out has been placed with CSL to come and repair the pump.

Update: CSL attended site on 22-07-10. They found that the air filter was full of water and the valve was closed so that the water could not drain away. The valve was opened and the pump resumed operation. Leachate in thi swell is now at 0.08m.

Provisions taken to avoid recurrence of incident Pump will be repaired or replaced as appropriate.

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 22/07/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	43

Date of occurrence 27/07/2010 **Time** 15:00

Place of occurrence GM14 & GM15

Nature of incident (including Licence Condition affected)

Trigger level for CO2 of 1.5% was exceeded at these perimeter boreholes.

GM14: 2.5% CO2
GM15: 2.6% CO2

Cause of incident

Natural ground conditions.

No methance was detected at any of the perimeter wells. No odour was detected at any of the perimeter wells. It is believed that the CO2 is from natural sources.

Emissions arising from incident

No emissions.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

Monthly monitoring will continue.

Provisions taken to avoid recurrence of incident

N/a

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 28/07/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	44

Date of occurrence 15/08/2010 **Time** 08:50

Place of occurrence Donohill Landfill

Nature of incident (including Licence Condition affected)

The ESB power supply dropped a phase at approximately 08:50 on 15-08-10. The flare and the leachate pumps were off as a result.

The leachate levels in LE7 and LGE7 rose due to the pumps being off.

LE7: 1.17m (exceeding 1m over cell floor)
LGE7: 5.5m (exceeding temporary trigger level of 3.8m)

There is not a lot of leachate on the site due to the dry weather, the levels are not high across the whole site but rather these are localised levels in the wells themselves. The levels dropped rapidly once the pumps turned back on. The current leachate levels in these wells are:

LE7: 0.63m
LGE7: 0.30m

Cause of incident

The electrician was called and he was on site within half an hour. He found that the ESB power supply had dropped a phase possibly due to a blown fuse. ESB Networks were contacted and they sent someone to look at the problem within an hour. Once the power was restored the pumps and the flare resumed operation.

Emissions arising from incident

No emission from this incident.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

The electrician was contacted and he was onsite within a half hour. He contacted the ESB once he had determined the problem.

Provisions taken to avoid recurrence of incident

Any interruptions to the power supply is outside of our control.

Notifiable to Fisheries Board ☐

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		**ID #**	**44**

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 16/08/2010

Date of occurrence 26/08/2010 **Time**

Place of occurrence GM15

Nature of incident (including Licence Condition affected) Monthly gas migration monitoring was carried out on 26/08/10 and 30/08/10. There was one trigger level exceedance found during this monitorin round at GM15.

CO2: 3.1% (trigger level: 1.5%)

Cause of incident I believe that the CO2 comes from natural ground conditions.

No odour or methane was detected at GM15 or any of the other migration wells.

Emissions arising from incident There is no emission associated with this incident.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident Monthly monitoring will continue.

Provisions taken to avoid recurrence of incident N/a

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 30/08/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	46

Date of occurrence 07/09/2010 **Time**

Place of occurrence LE7 & LGE7

Nature of incident (including Licence Condition affected)

There has been heavy rain since Sunday afternoon. 7.4mm of rain fell on 05/09/10 and 35.2mm fell yesterday (06/09/10). As a result of this the level of leachate onsite has risen and two of the wells have exceeded their trigger levels.

LE7: 1.45m (trigger: 1m)
LGE7: 5.28m (trigger: 3.8m)

The WWTP in Tipperary town is closed due to the rain, so we are tankering leachate to the holding tank in Cashel WWTP.

Update on 15-09-10: Leachate levels have been below the trigger levels for three days now. See details on the sheet attached. Removal of leachate to local WWTPs will continue.

Cause of incident Heavy rainfall.

Emissions arising from incident There is no emission from this incident.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

Leachate will be tankered offsite for the rest of the week.
There are two trucks onsite today.

Provisions taken to avoid recurrence of incident

Tankering of leachate will continue.
Part of the site will be capped this year.

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		**ID #**	**46**
Signed off by	Louise Ryan	**Date signed off**	15/09/2010
Date of occurrence	30/09/2010	**Time**	
Place of occurrence	GM14 & GM15		
Nature of incident (including Licence Condition affected)	The monthly gas migration monitoring was carried out on 27-09-10 and 30-09-10. During this routine monitoring two wells were found to be in exceedance of the trigger level for CO2. These wells have shown similar levels of CO2 in the past and it is believed that the CO2 is naturally occurring in the ground. There is no methane in the wells nor is there any odour from them. The levels are as follows: GM14: 3.4% CO2 (trigger level 1.5%) GM15: 3.3% CO2 (trigger level 1.5%)		
Cause of incident	Natural ground conditions		
Emissions arising from incident	There is no emission associated with this incident.		
Person Responsible for Dealing with Incident	Louise Ryan		
Actions used to minimise effect of incident	Continued monthly monitoring.		
Provisions taken to avoid recurrence of incident	n/a		
Notifiable to Fisheries Board	☐		
Training/retraining required			
Sign off (action carried out)	Louise Ryan		
Signed off by	Louise Ryan	**Date signed off**	01/10/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan

12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	48

Date of occurrence 01/11/2010 **Time**

Place of occurrence LE7, LGE8, LGE7

Nature of incident (including Licence Condition affected)

Leachate trigger level exceedance.

The trigger levels at LGE7 (area 1), LGE8 (area 3) and LE7 (area 4) exceeded their leachate trigger levels over the weekend.
LE7 exceeded on 29-10-10 with a level of 1.24m (trigger: 1m)
LGE8 exceeded on 30-10-10 with a level of 1.10m (trigger: 1m)
LGE7 exceeded on 29-10-10 with a level of 6.92m (provisional trigger 3.8m).

The levels at LGE7 and LGE8 have already dropped below their trigger levels and the level at LE7 has started to drop and should reduce below the trigger level tomorrow.

The attached sheet shows more detail of leachate levels, rainfall and volumes of leachate removed from the site.

Update on 08-11-10 at 14:15: the levels have fluctuated up and down over the last week. LGE7 and LGE8 were below their triggers on 01/11/10 for a while, but the levels rose again once the pumps turned off that night. All three wells fell below their triggers during 02/11/10 but the levels rose again that evening. On the 03/11/10 all three wells dropped below their trigger levels from around mid-day and stayed down for the rest of the day. The pumps turned off in the early hours of 04-11-10 and the levels rose above the triggers again for a while until pumping resumed later in the day.The levels stayed down from the evening of 04-11-10, and right through the 05-11-10, 06-11-10 and 07-11-10. After 5am on the 08-11-10 the pumps turned off again as the lagoon filled and the levels in LGE7 and LE7 rose above their triggers again, the level in LGE8 however stayed down. We are taking the leachate to Clonmel WWTP today. It is hoped to be able to use Tipperary or Cashel WWTP later in the week. Further details of leachate levels can be seen attached.

UPDATE 11-11-10: All of the three leachate wells are now below their trigger levels. The leachate lagoon is also now empty. A detailed record of levels since the last update is attached.

To summarise the extent of the exceedances:

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

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Date: 12 April 2011

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LE7 Exceeded between:
29-10-10 @ 19:30 and 03-11-10 @ 11:30;
04-11-10 @ 02:30 and 04-11-10 @ 12:00;
08-11-10 @ 05:30 and 08-11-10 @ 12:30;
08-11-10 @ 14:30 and 09-11-10 @ 11:00.

LGE8 exceeded between:
30-10-10 @ 09:00 and 01-11-10 @ 15:30;
01-11-10 @ 20:00 and 03-11-10 @ 12:00;
04-11-10 @ 05:30 and 04-11-10 @ 11:30.
08-11-10 @ 07:00 and 08-11-10 @ 13:00

LGE7 exceeded between:
29-10-10 @ 21:00 and 01-11-10 @ 13:00.
01-11-10 @ 21:00 and 02-11-10 @ 11:30;
04-11-10 @ 04:30 and 04-11-10 @ 17:00;
08-11-10 @ 16:00 and 09-11-10 @ 10:00.

Cause of incident

Heavy rainfall. 37mm of rain fell over the period between 29th to 31st of October. There was further heavy rain today.

Update on 08-11-10: There has been a further 27.6mm of rain between 01-11-10 and 07-11-10 inclusive.

Emissions arising from incident

No emission has occurred. Tankering of leachate offsite is taking place to lower the levels.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

Two leachate trucks have been taking leachate to Cashel WWTP all day. The trucks will work late tonight and tomorrow night to get as much leachate offsite as possible.

Update 08-11-10: The two leachate trucks worked late all of last week and for a half day on Saturday. We will use three leachate trucks for the rest of this week and if the WWTPs allow us we will work late whenever possible this week too.

We will review whether further late nights are required tomorrow afternoon.

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

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Provisions taken to avoid recurrence of incident	The capping contract for area 1 / 3 has started. This will significantly reduce the volume of leachate produced per mm of rain. The leachate lagoon will also have it's volume increased as part of the capping works.

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 11/11/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	49

Date of occurrence 16/11/2010 **Time** 17:30

Place of occurrence LE7 & LGE7 & Flare

Nature of incident (including Licence Condition affected)

The leachate level at LE7 exceeded its trigger level and the leachate at LGE7 exceeded its provisional trigger level.

The leachate levels on 16-11-10 were very low, in fact the leachate tanker went home early that day as he had emptied the lagoon. That evening 21.6mm of rain fell over 7 hours causing the lagoon to fill and the pumps to turn off.

The next day CSL and Omni were onsite working on the SCADA and the Deputy Manager was not able to view the levels untill evening. He then arranged for the tankers to stay late that night.

There was a power cut on the 18-11-10 from appox 10:30 to 16:30 so the leachate pumps were off for this time, as was the flare. The site fax was also not working and the OEE Kilkenny were phoned to inform them of the lecahate levels and the power cut. The leachate tankers worked late again on 18-11-10 which allowed the pumps to stay on for most of the night.

The WWTPs have not granted access for late evenings for the rest of this week as the storage tank in Cashel WWTP is now full. The levels are currently below the triggers, it is expected that they will remain low over the weekend as the weather forecast is not predicting much rain.

A detailed overview of the rainfall and leachate over the course of the incident is attached. A summary of the duration of the incident is outlined here:

LGE7 exceeded the provisional trigger level of 3.8m for the following periods:
16-11-10 at 17:30 to 18-11-10 at 10:00
19-11-10 at 08:30 to 19-11-10 at 12:00

LE7 exceeded the trigger level of 1m for the following periods:
16-11-10 at 22:00 to 18-11-10 at 17:30
19-11-10 at 06:00 to 19-11-10 at 09:30

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

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Date: 12 April 2011

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	There was no power to operate the flare or other equipment onsite between 10:00 and 16:30 on 18-11-10.
Cause of incident	High rainfall.
Emissions arising from incident	No emission arose from the incident.
Person Responsible for Dealing with Incident	Louise Ryan / Pat Walsh
Actions used to minimise effect of incident	The capping works are progressing onsite and are due for completion in January 2011.
Provisions taken to avoid recurrence of incident	The capping works that are currently underway will reduce the volume of leachate per mm of rain.
Notifiable to Fisheries Board	☐
Training/retraining required	
Sign off (action carried out)	Louise Ryan
Signed off by	Louise Ryan
Date signed off	19/11/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan

12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	50

Date of occurrence 22/11/2010 **Time**

Place of occurrence LGE7

Nature of incident (including Licence Condition affected)

The float in the pump in LGE7 is sticking. This is causing interruptions in the pumping from this well with resulting high levels of leachate. The provisional trigger level of 3.8m of leachate has been intermittantly exceeded over the last week.

The sticking is caused by grit and / or the cold weather. This pump has been serviced twice in recent weeks and there is nothing wrong with it. It is being adversly effected by the weather and grit in the well. CSL who maintain our pumps are unable to travel to site in the current weather conditions.

The level of leachate in this well is not indicative of the level of leachate in the surrounding waste. It is most likely being fed by perched leachate at a height of approximately 7m above the base of the well. In order to take this into consideration it has been recommended in the past to allow this well 72hrs before considering the trigger level to be breached.

Update on 16-12-10: Water in the air line is still causing the pump to work intermittently. CSL will service the air compressor on 17-12-10 and will recommend how to reduce the water problem followingthe service.

Update on 31-12-10: Water in the line combined with the leachate lagoon filling and turning off the pumps has meant a continued high level at this well. Regular draining of the air compressors has been recommended in order to reduce water getting into the system.

Update on 20-01-11: Regular draining of the air compressors has not improved the performance of this pump. CSL have been requested to return to check the pump again and are onsite today. They found that sand and / or ice was blocking the pump air outlet. This could be residue left from the water problem in the air lines. There does not seem to be anything else wrong with the pump. It is currently working and has dropped leachate levels to 0.3m. It will be monitored and if it continues to give trouble another pump will be put into LGE7.

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

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Cause of incident	The cold weather and grit is causing the pump to stop intermittently.
Emissions arising from incident	No emissions
Person Responsible for Dealing with Incident	Louise Ryan
Actions used to minimise effect of incident	The pump has been serviced twice in the past few weeks. It will be checked again once the weather allows the service company to travel.
Provisions taken to avoid recurrence of incident	The trigger level at this well is currently under a review and a report will be submitted to the Agency in the coming weeks.
Notifiable to Fisheries Board	☐
Training/retraining required	
Sign off (action carried out)	
Signed off by	Louise Ryan
Date signed off	

Signed: _____ Date : _____

Report Generated By: Louise Ryan

12 April 2011

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Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

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Date of occurrence 19/11/2010 **Time**

Place of occurrence LE7 & LGE7

Nature of incident (including Licence Condition affected)

The pump in LGE7 stopped working on the evening of 19-11-10 and the level of leachate in the well rose above the provisional trigger level of 3.8m.

On 22-11-10 the leachate lagoon filled turning off all the pumps. Following the level of leachate in LE7 also rose above its trigger level of 1m.

Tankering of leachate has been taking place on 22-11-10 and 23-11-10 with 368 tonnes of leachate removed between these two days. CSL were called out to repair LGE7 and this pump has now resumed operation. Both of the wells are now back below thie trigger levels.

A detailed report on the leachate levels is attached.

Cause of incident

The pump at LGE7 had a fault. The lagoon filled over the weekend from leachate which was contained in the waste body - there was not much rain over the weekend but the waste is saturated after the recent heavy rainfall.

Emissions arising from incident

No emissions.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

Tanker leachate offsite.

Provisions taken to avoid recurrence of incident

Tanker leachate offsite. The lagoon is currently empty.

Capping of Area 1 / 3 and the increase in the capacity of the leachate lagoon - both of these jobs are currently underway.

Notifiable to Fisheries Board ☐

Training/retraining required

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

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Date: 12 April 2011

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Sign off (action carried out)	Louise Ryan
Signed off by	Louise Ryan
Date signed off	23/11/2010
Date of occurrence	16/12/2010
Time	
Place of occurrence	Flare
Nature of incident (including Licence Condition affected)	The performance of the flare has decreased over the past few weeks. Details are attached. Update: The poor performance has continued. A survey of the gas field has been comissioned by GTS. They will compile a report on the condition of gas wells and knock out pots.
Cause of incident	The cause of this is thought to be that by exposing the edge of the exisiting cap a pathway for air into the landfill has been created. This will be resolved once the new cap is welded in to the existing cap.
Emissions arising from incident	Reduced flaring of gas.
Person Responsible for Dealing with Incident	Louise Ryan
Actions used to minimise effect of incident	The welding of the cap has been delayed by the cold weather. It will be completed as soon as is practical.
Provisions taken to avoid recurrence of incident	
Notifiable to Fisheries Board	☐
Training/retraining required	
Sign off (action carried out)	
Signed off by	Louise Ryan
Date signed off	

Signed: _____ Date : _____

Report Generated By: Louise Ryan

12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

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Date: 12 April 2011

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Date of occurrence 13/12/2010 **Time**

Place of occurrence Settlement Sensors

Nature of incident (including Licence Condition affected)

The resevoir for the settlement sensors is checked once a month to make sure that it is filled with water (which is an indicator that the sensors are working). When it was checked in November it was fine. However when it was checked on 13-12-10 the level of water in the resevoir was found to have dropped below normal levels. The resevoir was manually filled with distilled water. The water levels in the resevoir have maintained themselves at normal levels since.

The recent settlement readings showing an increase in the height of the sensors is now questionable. Since the resevoir has been refilled the readings have dropped again.

Update: Sensors were serviced by MGS, it was found that they were leaking liquid under the cell. This can not be repaired and the use of the sensors will have to be discontinued.

Cause of incident

The cause will be determined at the service visit from MGS on 20th and 21st of December

Emissions arising from incident

Inaccurate sensor readings.

Monitoring of surface movement will now have to be relied upon as well as pore pressure readings.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident

The resevoir was manually filled.

The resevoir will be check daily until the unit is serviced.

Provisions taken to avoid recurrence of incident

The checks on the resevoir will be increased from once a month to once a week.

Notifiable to Fisheries Board ☐

Training/retraining required

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

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Date: 12 April 2011

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Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 20/01/2011

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

Donohill Landfill

Waste Licence Reference Nº: W0074-03

Incident Report Form

Date: 12 April 2011

# of Sheets including This one		ID #	54

Date of occurrence 27/12/2010 **Time**

Place of occurrence LE7

Nature of incident (including Licence Condition affected) The leachate lagoon filled on at 19:00 on 27-12-10 following 13mm of rain that day and warmer temperatures thawing the ice. This caused the leachate pumps to turn off and resulted in an exceedance of 1m of leachate at LE7. There was no tankering of leachate until 30-12-10 due to the WWTP being closed.

Leachate was tankered offsite yesterday and today and the levels are now below 1m.

Cause of incident Rainfall and ice melting coupled with reduced tankering of leachate over the Christmas holiday period.

Emissions arising from incident No emission from the site.

Person Responsible for Dealing with Incident Louise Ryan

Actions used to minimise effect of incident Leachate tankered offsite on 30-12-10 and 31-12-10.

Provisions taken to avoid recurrence of incident The capping works that are on going will reduce the leachate produced onsite and the capacity of the leachate lagoon is to be increased.

Notifiable to Fisheries Board ☐

Training/retraining required

Sign off (action carried out) Louise Ryan

Signed off by Louise Ryan **Date signed off** 31/12/2010

Signed: _____ Date : _____

Report Generated By: Louise Ryan 12 April 2011

APPENDIX 14 LEACHATE LEVELS

2010												
Date & Time	LE8 (m)	LE7 (m)	LE9 (m)	LE10 (m)	LE11 (m)	LE6 (m)	LGE6 (m)	LGE8 (m)	LGE7 (m)	LE4 (m)	LE2 (m)	LC4 (m)
01/01/2010 23:30	2.6	1.7	error	-0.1	0.1	0.3	2.9	1.5	7.5	4.3	0.7	0.9
02/01/2010 23:30	2.7	1.8	error	-0.1	0.1	0.3	2.9	1.5	7.4	4.3	0.7	0.9
03/01/2010 23:30	2.7	1.8	error	-0.1	0.1	0.3	2.8	1.6	7.2	4.3	0.7	0.9
04/01/2010 23:30	2.7	1.4	error	-0.1	0.1	0.3	2.8	1.6	7.1	2.7	0.7	0.9
05/01/2010 23:30	3.0	1.2	error	-0.1	0.1	0.3	1.9	1.7	6.5	2.2	0.7	0.9
06/01/2010 23:30	2.0	1.2	error	-0.1	0.1	error	1.8	0.0	6.1	2.0	0.7	0.9
07/01/2010 23:30	1.4	0.7	error	-0.1	0.1	error	2.2	0.0	6.8	1.8	0.7	0.8
08/01/2010 23:30	1.3	0.7	error	-0.1	0.1	error	2.3	0.0	6.8	1.6	0.7	0.7
09/01/2010 23:30	1.2	0.7	error	-0.1	0.1	error	2.3	0.0	6.8	1.8	0.7	0.8
10/01/2010 23:30	1.1	0.7	error	-0.1	0.1	error	2.4	0.0	6.9	1.6	0.7	0.9
11/01/2010 23:30	1.5	0.7	error	-0.1	0.1	error	1.6	0.0	6.2	1.8	0.7	0.9
12/01/2010 23:30	2.7	1.5	error	-0.1	0.1	error	3.1	0.0	7.6	5.0	0.7	0.9
13/01/2010 23:30	3.5	1.6	error	-0.1	0.1	error	2.8	0.0	7.5	4.5	0.7	0.9
14/01/2010 23:30	3.7	1.3	error	-0.1	0.1	error	2.4	0.0	6.3	2.6	0.7	1.0
15/01/2010 23:30	3.4	1.3	error	-0.1	0.1	error	2.6	0.0	7.1	4.7	0.7	1.0
16/01/2010 23:30	3.6	1.6	error	-0.1	0.1	error	2.9	0.0	7.8	4.6	0.7	1.0
17/01/2010 23:30	3.5	1.7	error	-0.1	0.1	error	2.9	0.0	7.6	4.4	0.7	1.0
18/01/2010 23:30	3.7	1.3	error	-0.1	0.1	error	2.1	0.0	6.6	2.7	0.7	0.9
19/01/2010 23:30	3.0	1.2	error	-0.1	0.1	error	2.8	0.0	7.5	3.6	0.8	0.9
20/01/2010 23:30	2.6	1.2	error	-0.1	0.1	error	2.7	5.0	7.1	3.0	0.8	1.0
21/01/2010 23:30	3.4	1.4	error	-0.1	0.1	error	2.6	5.1	7.2	4.5	0.8	1.0
22/01/2010 23:30	3.5	1.3	error	-0.1	0.1	error	2.8	4.9	7.5	3.4	0.8	1.0
23/01/2010 23:30	3.5	1.4	error	-0.1	0.1	error	2.8	5.0	7.5	4.3	0.8	1.0
24/01/2010 23:30	3.5	1.5	error	-0.1	0.1	error	2.8	5.0	7.4	4.3	0.8	1.0
25/01/2010 23:30	2.4	1.2	error	-0.1	0.1	error	2.7	4.6	7.3	2.5	0.8	1.0
26/01/2010 23:30	1.2	1.1	error	-0.1	0.1	error	1.6	3.9	6.8	2.1	0.8	1.0
27/01/2010 23:30	1.4	0.7	error	-0.1	0.1	error	1.9	2.4	7.0	1.8	0.8	0.8
28/01/2010 23:30	1.5	0.7	error	-0.1	0.1	error	1.9	0.9	6.3	1.7	0.8	0.7
29/01/2010 23:30	1.1	0.7	error	-0.1	0.1	error	2.5	0.0	6.5	1.6	0.8	0.7
30/01/2010 23:30	1.1	1.1	error	-0.1	0.1	error	2.6	0.9	0.7	1.9	0.8	1.0
31/01/2010 23:30	1.5	1.2	error	-0.1	0.1	error	2.6	1.0	6.9	3.4	0.7	1.0
01/02/2010 23:30	1.3	0.7	error	-0.1	0.1	error	1.9	1.0	6.8	1.6	0.8	0.9
02/02/2010 23:30	1.4	0.7	error	-0.1	0.1	error	2.4	0.0	7.2	1.6	0.7	1.0
03/02/2010 23:30	2.0	-1.3	error	-0.1	0.1	error	1.4	1.1	5.8	3.0	0.7	1.0

04/02/2010 23:30	2.9	-1.3	error	-0.1	0.2	error	2.8	1.5	8.0	4.9	0.8	1.0
05/02/2010 23:30	3.8	1.9	error	-0.1	0.3	error	2.1	1.8	7.2	4.6	0.8	1.0
06/02/2010 23:30	3.8	1.9	error	-0.1	0.3	error	2.6	2.0	7.5	4.6	0.8	1.0
07/02/2010 23:30	3.5	2.0	error	-0.1	0.3	error	2.7	2.2	7.6	4.5	0.8	1.0
08/02/2010 23:30	3.2	1.7	error	-0.1	0.3	error	2.5	1.9	6.9	2.6	0.8	1.0
09/02/2010 23:30	2.0	1.4	error	-0.1	0.3	error	2.6	1.6	7.0	2.4	0.8	1.0
10/02/2010 23:30	1.4	1.4	error	-0.1	0.3	error	2.6	1.4	7.2	2.1	0.8	1.0
11/02/2010 23:30	1.4	0.5	error	-0.1	0.3	error	1.6	0.0	5.8	1.8	0.8	0.7
12/02/2010 23:30	1.3	0.5	error	-0.1	0.3	error	2.2	0.0	2.1	1.7	0.8	0.5
13/02/2010 23:30	1.2	0.5	error	-0.1	0.2	error	2.4	0.0	7.0	1.8	0.8	0.7
14/02/2010 23:30	1.0	0.5	error	-0.1	0.2	error	2.5	0.0	7.2	1.7	0.7	0.9
15/02/2010 23:30	1.5	0.5	error	-0.1	0.2	error	2.6	0.6	6.6	1.8	0.7	0.7
16/02/2010 23:30	1.5	0.5	error	-0.1	0.1	error	2.7	0.0	7.3	1.7	0.7	0.5
17/02/2010 23:30	1.4	0.5	error	-0.1	0.1	error	2.7	0.0	7.4	1.8	0.7	0.4
18/02/2010 23:30	1.2	0.5	error	-0.1	0.0	error	2.7	0.6	0.1	1.7	0.4	0.1
19/02/2010 23:30	1.5	1.4	error	0.1	0.0	0.1	1.8	0.6	0.3	error	0.4	0.3
20/02/2010 23:30	1.3	1.4	error	0.1	0.0	0.1	2.3	0.7	0.3	error	0.4	0.5
21/02/2010 23:30	1.4	1.4	error	0.1	0.0	0.1	2.4	0.7	0.3	error	0.4	0.6
22/02/2010 23:30	1.4	1.5	error	0.1	0.0	0.1	2.5	0.7	0.3	error	0.4	0.7
23/02/2010 23:30	1.0	1.5	error	0.1	0.0	0.1	2.6	0.8	0.3	error	0.4	0.5
24/02/2010 23:30	1.2	0.7	error	0.1	0.0	0.1	2.6	0.6	0.3	1.5	0.4	0.6
25/02/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.6	0.6	0.4	1.7	0.4	0.5
26/02/2010 23:30	1.1	0.7	0.0	0.1	0.0	0.1	2.6	0.6	0.3	1.5	0.4	0.6
27/02/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.2	2.6	0.7	3.1	1.6	0.4	0.6
28/02/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.3	2.5	0.8	6.5	1.7	0.4	0.7
01/03/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.3	2.5	0.8	6.6	1.7	0.4	0.5
02/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	1.5	0.7	0.3	1.7	0.4	0.5
03/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.0	0.7	0.3	1.7	0.4	0.2
04/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.1	0.7	0.3	1.7	0.4	0.1
05/03/2010 23:30	1.5	0.7	0.0	0.0	0.0	0.1	2.1	0.6	0.3	1.5	0.4	0.2
06/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.7	0.4	0.4
07/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.6	0.4	0.5
08/03/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.7	0.4	0.5
09/03/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.7	0.4	0.6
10/03/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.7	0.4	0.6
11/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.6	0.4	0.4

12/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.2	0.6	0.3	1.8	0.4	0.5
13/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.2	0.5	0.3	1.8	0.4	0.5
14/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.2	0.5	0.3	1.8	0.4	0.6
15/03/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	2.2	0.4	0.3	1.8	0.4	0.6
16/03/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	2.3	0.1	0.3	1.7	0.4	0.7
17/03/2010 23:30	1.1	0.7	0.0	0.1	0.0	0.1	2.3	0.1	0.3	1.7	0.4	0.8
18/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.3	0.0	0.3	1.7	0.4	0.6
19/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.3	0.2	0.3	1.5	0.4	0.5
20/03/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	2.3	0.3	0.3	1.7	0.4	0.6
21/03/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	2.3	0.1	0.3	1.7	0.4	0.6
22/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.3	0.4	0.3	1.7	0.4	0.4
23/03/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	2.4	0.5	0.3	1.7	0.4	0.2
24/03/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	2.7	0.7	0.3	1.7	0.4	0.6
25/03/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	2.8	0.7	0.3	1.5	0.4	0.5
26/03/2010 23:30	1.0	0.7	0.0	0.1	0.0	0.1	2.8	0.8	0.3	1.6	0.4	0.5
27/03/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	2.7	0.8	0.3	1.7	0.4	0.5
28/03/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.7	0.8	0.3	1.7	0.4	0.6
29/03/2010 23:30	2.0	1.6	0.0	0.1	0.0	0.3	3.2	1.3	4.1	4.5	0.4	1.0
30/03/2010 23:30	3.7	2.0	0.0	0.1	0.0	0.3	3.1	2.1	7.4	4.8	0.4	0.9
31/03/2010 23:30	3.3	1.7	0.0	0.1	0.0	0.3	2.7	1.8	7.0	2.9	0.4	1.0
01/04/2010 23:30	2.6	1.4	0.0	0.1	0.0	0.3	2.6	2.1	6.1	2.7	0.4	1.0
02/04/2010 23:30	1.7	1.4	0.0	0.1	0.0	0.3	2.8	2.3	6.2	2.8	0.4	1.0
03/04/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	2.0	2.3	0.3	1.6	0.4	0.6
04/04/2010 23:30	1.2	0.7	0.0	0.0	0.0	0.1	1.9	2.3	0.3	1.7	0.4	0.8
05/04/2010 23:30	1.2	1.3	0.0	0.1	0.0	0.1	2.0	2.3	0.3	1.7	0.4	1.0
06/04/2010 23:30	1.4	1.8	0.0	0.1	0.0	0.1	2.3	3.0	0.3	1.7	0.4	1.0
07/04/2010 23:30	1.3	2.0	0.0	0.1	0.0	0.2	2.3	2.3	2.1	2.0	0.4	1.0
08/04/2010 23:30	3.6	0.7	0.0	0.1	0.0	0.1	2.1	1.8	0.3	1.7	0.4	0.9
09/04/2010 23:30	3.6	1.7	0.0	0.1	0.0	0.1	1.9	1.3	0.3	1.7	0.4	0.7
10/04/2010 23:30	3.6	1.8	0.0	0.1	0.0	0.1	1.9	1.4	0.3	1.7	0.4	0.7
11/04/2010 23:30	3.6	1.8	0.0	0.1	0.0	0.1	1.9	1.4	0.3	1.8	0.4	0.8
12/04/2010 23:30	1.2	0.7	0.0	0.1	0.0	0.1	1.9	1.0	0.3	1.7	0.4	0.4
13/04/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	1.9	0.8	0.3	1.7	0.4	0.3
14/04/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	1.8	0.7	0.3	1.7	0.4	0.5
15/04/2010 23:30	1.4	0.7	0.0	0.1	0.0	0.1	1.8	0.6	0.3	1.7	0.4	0.2
16/04/2010 23:30	1.5	0.7	0.0	0.1	0.0	0.1	1.9	0.5	0.3	1.7	0.4	0.4

17/04/2010 23:30	1.3	0.7	0.0	0.1	0.0	0.1	1.9	0.5	0.3	1.7	0.4	0.5
18/04/2010 23:30	0.9	0.7	0.0	0.1	0.0	0.1	1.9	0.5	0.3	1.7	0.4	0.6
19/04/2010 23:30	1.4	0.3	0.0	0.1	0.0	0.1	1.9	0.5	0.3	1.8	0.4	0.6
20/04/2010 23:30	1.3	0.1	0.0	0.1	0.0	0.1	1.9	0.4	0.3	1.8	0.4	0.7
21/04/2010 23:30	1.3	0.2	0.0	0.1	0.0	0.1	1.8	0.4	0.3	1.7	0.4	0.5
22/04/2010 23:30	1.5	0.2	0.0	0.1	0.0	0.1	1.9	0.4	0.3	1.7	0.4	0.5
23/04/2010 23:30	1.3	0.3	0.0	0.1	0.0	0.1	1.7	0.4	0.3	1.8	0.4	0.6
24/04/2010 23:30	1.5	0.2	0.0	0.1	0.0	0.1	1.8	0.4	0.3	1.8	0.4	0.6
25/04/2010 23:30	1.1	0.2	0.0	0.1	0.0	0.2	2.0	0.5	6.0	1.7	0.4	0.7
26/04/2010 23:30	1.3	0.2	0.0	0.1	0.0	0.1	1.8	0.5	0.3	1.7	0.4	0.4
27/04/2010 23:30	1.5	0.2	0.0	0.1	0.0	0.1	1.8	0.5	0.3	1.7	0.4	0.4
28/04/2010 23:30	1.3	0.2	0.0	0.1	0.0	0.1	1.9	0.5	0.3	1.8	0.4	0.1
29/04/2010 23:30	1.5	0.1	0.0	0.1	0.0	0.1	0.0	0.5	0.3	1.6	0.4	0.2
30/04/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	0.0	0.4	0.3	1.6	0.4	0.5
01/05/2010 23:30	1.5	0.7	0.0	0.1	error	0.1	0.2	0.4	0.3	1.6	0.4	0.6
02/05/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	0.0	0.4	0.3	1.7	0.4	0.7
03/05/2010 23:30	1.0	0.7	0.0	0.1	error	0.1	0.0	0.4	0.3	1.7	0.4	0.8
04/05/2010 23:30	1.3	0.7	0.0	0.0	error	0.1	0.0	0.5	0.3	1.7	0.4	0.5
05/05/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	1.2	0.4	0.3	1.8	0.4	0.1
06/05/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	1.5	0.5	0.3	1.8	0.4	0.3
07/05/2010 23:30	1.0	0.7	0.0	0.1	error	0.1	1.7	0.5	0.3	1.7	0.4	0.5
08/05/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	1.8	0.4	0.3	1.7	0.4	0.5
09/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	1.9	0.4	0.3	1.8	0.4	0.5
10/05/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	1.9	0.3	0.3	1.7	0.4	0.6
11/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	1.9	0.3	0.3	1.8	0.4	0.2
12/05/2010 23:30	1.3	0.7	0.0	0.0	error	0.1	1.9	0.3	0.3	1.7	0.4	0.4
13/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.0	0.3	0.3	1.7	0.4	0.4
14/05/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	2.0	0.2	0.3	1.7	0.4	0.5
15/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.6	0.4	0.5
16/05/2010 23:30	1.1	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.8	0.4	0.6
17/05/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.6	0.4	0.3
18/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.7	0.4	0.4
19/05/2010 23:30	1.1	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.8	0.4	0.5
20/05/2010 23:30	1.3	0.7	0.0	0.0	error	0.1	1.9	0.2	0.3	1.7	0.4	0.1
21/05/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.8	0.4	0.3
22/05/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.3

23/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.3
24/05/2010 23:30	1.3	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.5
25/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.1	0.1	0.3	1.8	0.4	0.5
26/05/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.1	0.1	0.3	1.7	0.4	0.6
27/05/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.1	0.1	0.3	1.6	0.4	0.6
28/05/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.1	0.1	0.3	1.8	0.4	0.3
29/05/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.2	0.1	0.3	1.5	0.4	0.5
30/05/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.2	0.1	0.3	1.7	0.4	0.6
31/05/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	2.3	0.1	0.3	1.5	0.4	0.7
01/06/2010 23:30	1.5	0.7	0.0	0.1	error	0.2	2.3	0.3	4.2	1.7	0.4	0.4
02/06/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	1.6	0.2	0.3	1.7	0.4	0.5
03/06/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	2.0	0.2	0.3	1.7	0.4	0.1
04/06/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.0	0.2	0.3	1.7	0.4	0.2
05/06/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.1	0.2	0.3	1.8	0.4	0.2
06/06/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	2.2	0.2	0.3	1.8	0.4	0.4
07/06/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	2.5	0.3	0.3	1.7	0.4	0.6
08/06/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.5	0.3	0.3	1.7	0.4	0.5
09/06/2010 23:30	1.1	0.7	0.0	0.1	error	0.1	2.5	0.3	0.3	1.7	0.4	0.1
10/06/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	2.4	0.3	0.3	1.8	0.4	0.2
11/06/2010 23:30	1.5	0.7	0.0	0.1	error	0.1	1.7	0.3	0.3	1.8	0.4	0.2
12/06/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	2.0	0.3	0.3	1.7	0.4	0.4
13/06/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.1	0.3	0.3	1.8	0.4	0.4
14/06/2010 23:30	1.1	0.7	0.0	0.0	error	0.1	2.1	0.3	0.3	1.7	0.4	0.5
15/06/2010 23:30	1.3	0.7	0.0	0.0	error	0.1	2.1	0.3	0.3	1.7	0.4	0.5
16/06/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.1	0.2	0.3	1.8	0.4	0.6
17/06/2010 23:30	1.1	0.7	0.0	0.0	error	0.1	1.3	0.2	0.3	1.7	0.4	0.3
18/06/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	1.8	0.2	0.3	1.7	0.4	0.3
19/06/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	1.9	0.2	0.3	1.8	0.4	0.4
20/06/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.5
21/06/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.5
22/06/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.5
23/06/2010 23:30	1.3	0.7	0.0	0.0	error	0.2	2.0	0.3	4.6	1.7	0.4	0.6
24/06/2010 23:30	1.4	0.7	0.0	0.0	error	0.2	2.0	0.3	5.9	1.8	0.4	0.2
25/06/2010 23:30	1.1	0.7	0.0	0.0	error	0.2	2.1	0.3	6.0	1.8	0.4	0.3
26/06/2010 23:30	1.3	0.7	0.0	0.0	error	0.3	2.1	0.3	6.1	1.7	0.4	0.3
27/06/2010 23:30	1.5	0.7	0.0	0.1	error	0.3	2.0	0.3	6.1	1.7	0.4	0.3

28/06/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	1.3	0.1	0.3	1.7	0.4	0.5
29/06/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	1.7	0.1	0.3	1.5	0.4	0.5
30/06/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	1.9	0.1	0.3	1.7	0.4	0.1
01/07/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	2.0	0.1	0.3	1.7	0.4	0.3
02/07/2010 23:30	1.5	0.7	0.0	0.1	error	0.1	2.0	0.1	0.3	1.7	0.4	0.3
03/07/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	2.0	0.2	0.8	1.8	0.4	0.4
04/07/2010 23:30	1.5	0.7	0.0	0.2	error	0.2	2.0	0.2	5.8	1.8	0.4	0.4
05/07/2010 23:30	1.1	0.7	0.0	0.1	error	0.1	1.2	0.1	0.3	1.7	0.4	0.5
06/07/2010 23:30	1.4	0.7	0.0	0.0	error	0.2	1.7	0.2	4.7	1.7	0.4	0.5
07/07/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	0.8	0.2	1.1	1.7	0.4	0.2
08/07/2010 23:30	1.4	0.7	0.0	0.0	error	0.1	0.0	0.1	0.3	1.6	0.4	0.2
09/07/2010 23:30	1.2	0.7	0.0	0.0	error	0.2	1.5	0.3	3.0	1.5	0.4	0.5
10/07/2010 23:30	1.3	0.7	0.0	0.1	error	0.2	2.2	0.5	6.1	1.5	0.4	0.6
11/07/2010 23:30	1.4	0.7	0.0	0.1	error	0.2	2.3	0.6	6.2	1.4	0.4	0.7
12/07/2010 23:30	1.3	0.7	0.0	0.0	error	0.1	2.0	0.5	0.3	1.7	0.4	0.8
13/07/2010 23:30	1.2	0.7	0.0	0.0	error	0.1	2.3	0.5	0.3	1.6	0.4	0.9
14/07/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.6	0.6	0.3	1.5	0.4	0.8
15/07/2010 23:30	0.9	0.7	0.0	0.1	error	0.1	2.7	0.0	0.3	1.4	0.4	0.8
16/07/2010 23:30	1.6	**1.1**	0.0	0.1	error	0.1	2.3	0.5	3.8	1.9	0.4	1.0
17/07/2010 23:30	1.7	**1.2**	0.0	0.1	error	0.2	2.4	0.6	6.3	3.0	0.4	1.0
18/07/2010 23:30	1.7	**1.3**	0.0	0.1	error	0.2	2.4	0.6	6.5	3.7	0.4	1.0
19/07/2010 23:30	2.2	0.7	0.0	0.1	error	0.1	2.4	0.0	0.3	1.5	0.4	0.8
20/07/2010 23:30	1.3	0.7	0.0	0.1	error	1.8	2.5	0.4	0.3	1.6	0.4	0.7
21/07/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.5	0.0	0.3	1.6	0.4	0.4
22/07/2010 23:30	1.2	0.7	0.0	0.2	error	0.1	2.4	0.3	0.3	1.6	0.4	0.1
23/07/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.4	0.4	0.3	1.7	0.4	0.1
24/07/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.4	0.4	0.3	1.6	0.4	0.3
25/07/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.3	0.4	0.3	1.7	0.4	0.3
26/07/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.3	0.2	0.3	1.6	0.4	0.5
27/07/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.3	0.4	0.3	1.7	0.4	0.5
28/07/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	2.3	0.4	0.3	1.6	0.4	0.5
29/07/2010 23:30	1.5	0.7	0.0	0.1	error	0.1	2.3	0.0	0.3	1.6	0.4	0.2
30/07/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.3	0.0	0.4	1.7	0.4	0.5
31/07/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.3	0.0	0.3	1.7	0.4	0.6
01/08/2010 23:30	1.2	0.7	0.0	0.1	error	0.1	2.2	0.0	0.3	1.5	0.4	0.7
02/08/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.2	0.0	0.3	1.7	0.4	0.7

03/08/2010 23:30	1.5	0.7	0.0	0.1	error	0.1	2.2	0.0	0.3	1.7	0.4	0.7
04/08/2010 23:30	1.3	0.7	0.0	0.1	error	0.1	2.2	0.0	0.3	1.7	0.4	0.8
05/08/2010 23:30	1.4	0.7	0.0	0.1	error	0.1	2.2	0.0	0.3	1.7	0.4	0.6
06/08/2010 23:30	1.1	0.7	0.0	0.1	error	0.1	2.2	0.0	0.3	1.7	0.4	0.7
07/08/2010 23:30	1.4	0.7	0.0	0.2	error	0.1	2.2	0.0	0.3	1.7	0.4	0.7
08/08/2010 23:30	1.5	0.7	0.0	0.0	error	0.1	2.2	0.0	0.3	1.6	0.4	0.7
09/08/2010 23:30	1.20	0.73	-0.02	0.03	error	0.09	2.19	0.02	0.29	1.65	0.43	0.47
10/08/2010 23:30	1.38	0.69	-0.01	0.09	error	0.08	2.19	0.02	0.29	1.60	0.43	0.48
11/08/2010 23:30	1.50	0.66	-0.02	0.10	error	0.08	2.14	0.02	0.28	1.67	0.43	0.48
12/08/2010 23:30	1.27	0.71	-0.02	0.06	error	0.08	2.08	0.02	0.28	1.70	0.43	0.19
13/08/2010 23:30	1.42	0.76	-0.02	0.03	error	0.08	2.07	0.02	0.29	1.73	0.43	0.20
14/08/2010 23:30	1.54	0.74	-0.02	0.01	error	0.08	2.06	0.02	0.29	1.64	0.43	0.21
15/08/2010 23:30	1.24	**1.19**	-0.01	0.02	error	0.18	2.04	0.02	3.70	1.75	0.43	0.36
16/08/2010 23:30	1.41	0.68	-0.01	-0.07	error	0.08	1.38	0.02	0.29	1.85	0.43	0.38
17/08/2010 23:30	1.51	0.71	-0.02	-0.05	error	0.08	1.80	0.02	0.29	1.95	0.43	0.38
18/08/2010 23:30	1.34	0.71	-0.02	-0.02	error	0.08	1.96	0.02	0.29	2.03	0.43	0.46
19/08/2010 23:30	1.25	0.69	-0.01	-0.01	error	0.08	2.06	0.02	0.34	2.14	0.43	0.07
20/08/2010 23:30	1.44	0.71	-0.01	0.11	error	0.08	2.06	0.02	0.29	2.30	0.43	0.18
21/08/2010 23:30	1.29	0.71	-0.01	0.11	error	0.08	2.04	0.02	0.29	2.37	0.43	0.16
22/08/2010 23:30	1.31	0.70	-0.01	0.04	error	0.08	2.09	0.01	0.29	2.62	0.43	0.31
23/08/2010 23:30	1.38	0.70	-0.01	0.07	error	0.08	2.16	0.08	0.29	3.19	0.43	0.41
24/08/2010 23:30	1.17	0.68	error	0.14	error	0.08	2.15	0.09	0.29	1.66	0.51	0.57
25/08/2010 23:30	1.37	0.71	error	0.11	error	0.08	2.14	0.08	0.29	1.62	0.49	0.16
26/08/2010 23:30	1.39	0.74	error	0.13	error	0.08	2.13	0.12	0.29	1.66	0.49	0.22
27/08/2010 23:30	1.05	0.66	error	0.14	error	0.08	2.07	0.01	0.50	1.64	0.49	0.19
28/08/2010 23:30	1.23	0.66	error	0.13	error	0.08	2.02	0.03	0.28	1.67	0.49	0.24
29/08/2010 23:30	1.36	0.75	error	0.15	error	0.08	2.00	0.03	0.28	1.58	0.49	0.28
30/08/2010 23:30	1.46	0.69	error	0.13	error	0.08	1.97	0.02	0.28	1.72	0.49	0.32
31/08/2010 23:30	1.17	0.74	error	0.11	error	0.08	1.98	0.02	0.28	1.60	0.49	0.44
01/09/2010 23:30	1.35	0.65	error	0.11	error	0.08	2.01	0.02	0.28	1.64	0.49	0.46
02/09/2010 23:30	1.06	0.68	error	0.12	error	0.08	2.01	0.02	0.28	1.67	0.50	0.18
03/09/2010 23:30	1.23	0.71	error	0.09	error	0.08	2.01	0.01	0.28	1.67	0.50	0.17
04/09/2010 23:30	1.35	0.63	error	0.10	error	0.08	2.02	0.02	0.28	1.68	0.50	0.16
05/09/2010 23:30	1.11	0.69	error	0.08	error	0.08	2.12	0.00	0.28	1.47	0.50	0.29
06/09/2010 23:30	1.86	1.20	error	0.09	error	0.08	2.87	0.47	0.82	2.40	0.51	0.98
07/09/2010 23:30	2.54	1.26	error	0.11	error	0.15	2.91	0.80	5.04	3.61	0.52	0.99

08/09/2010 23:30	2.44	1.18	error		0.16	error		0.14	2.46	0.71	1.94	1.97	0.52	0.98
09/09/2010 23:30	0.98	1.20	error		0.11	error		0.08	2.30	0.62	1.28	2.01	0.52	0.98
10/09/2010 23:30	0.13	0.70	error		0.09	error		0.29	2.57	0.01	6.42	1.51	0.52	0.75
11/09/2010 23:30	0.12	0.70	error		0.20	error		0.29	2.54	0.44	6.46	1.55	0.52	0.91
12/09/2010 23:30	0.98	1.16	error		0.09	error		0.29	2.50	0.48	6.56	1.94	0.52	0.99
13/09/2010 23:30	1.44	0.70	error		0.03	error		0.08	2.06	0.32	0.27	1.61	0.53	0.59
14/09/2010 23:30	1.27	0.70	error		0.05	error		0.08	2.65	0.02	0.26	1.57	0.53	0.92
15/09/2010 23:30	1.33	0.71	error		0.05	error		0.08	2.62	0.41	0.26	1.64	0.53	0.81
16/09/2010 23:30	1.22	0.71	error		0.07	error		0.08	2.59	0.41	0.26	1.66	0.53	0.63
17/09/2010 23:30	1.49	0.69	error		0.04	error		0.08	2.53	0.41	0.27	1.64	0.53	0.38
18/09/2010 23:30	1.36	0.74	error		-0.03	error		0.08	2.55	0.40	0.27	1.66	0.54	0.49
19/09/2010 23:30	1.32	0.71	error		-0.08	error		0.08	2.60	0.41	0.27	1.63	0.54	0.61
20/09/2010 23:30	1.23	0.70	error		-0.04	error		0.08	2.54	0.43	0.27	1.67	0.54	0.39
21/09/2010 23:30	1.48	0.69	error		-0.05	error		0.08	2.53	0.43	0.28	1.53	0.54	0.14
22/09/2010 23:30	1.15	0.70	error		-0.12	error		0.08	2.76	0.45	0.28	1.49	0.54	0.41
23/09/2010 23:30	1.21	0.70	error		-0.11	error		0.08	2.76	0.10	0.28	1.60	0.54	0.37
24/09/2010 23:30	1.30	0.70	0.24		-0.10	0.59		0.08	2.61	0.42	0.28	1.50	0.54	0.21
25/09/2010 23:30	1.51	0.68	0.23		-0.11	0.59		0.08	2.53	0.41	0.28	1.68	0.54	0.27
26/09/2010 23:30	1.37	0.73	0.23		-0.18	0.59		0.08	2.54	0.39	0.28	1.68	0.54	0.41
27/09/2010 23:30	1.23	0.70	0.23		-0.17	0.59		0.08	2.53	0.38	0.28	1.64	0.54	0.19
28/09/2010 23:30	1.52	0.70	0.23		-0.18	0.60		0.08	2.55	0.40	0.28	1.56	0.54	0.24
29/09/2010 23:30	1.40	0.70	0.23		-0.20	0.60		0.08	2.49	0.39	0.41	1.68	0.54	0.39
30/09/2010 23:30	1.21	0.73	0.22		-0.24	0.60		0.08	2.55	0.39	0.27	1.64	0.54	0.50
01/10/2010 23:30	1.47	0.72	0.22		-0.21	0.59		0.08	2.55	0.39	0.28	1.45	0.54	0.19
02/10/2010 23:30	1.45	0.69	0.22		-0.31	0.59		0.08	2.61	0.43	0.28	1.57	0.55	0.36
03/10/2010 23:30	1.39	0.71	0.25		-0.33	0.59		0.08	2.59	0.44	0.28	1.49	0.55	0.48
04/10/2010 23:30	1.49	0.69	0.24		-0.43	0.59		0.08	2.61	0.44	0.27	1.67	0.55	0.14
05/10/2010 23:30	1.35	0.70	0.24		-0.43	0.59		0.08	2.55	0.44	0.28	1.63	0.55	0.33
06/10/2010 23:30	1.50	0.72	0.22		-0.43	0.59		0.08	2.45	0.42	0.27	1.57	0.55	0.37
07/10/2010 23:30	1.18	0.69	0.22		-0.43	0.59		0.08	2.39	0.41	0.28	1.69	0.55	0.19
08/10/2010 23:30	1.42	0.70	0.22		-0.43	0.60		0.08	2.39	0.42	0.28	1.72	0.55	0.22
09/10/2010 23:30	1.17	0.70	0.22		-0.43	0.60		0.08	2.34	0.40	0.27	1.66	0.55	0.37
10/10/2010 23:30	1.39	0.73	0.24		-0.43	0.60		0.08	2.28	0.39	0.27	1.62	0.55	0.40
11/10/2010 23:30	1.15	0.72	0.23		-0.43	0.60		0.08	2.22	0.37	0.27	1.60	0.55	0.17
12/10/2010 23:30	1.33	0.67	0.22		-0.43	0.59		0.08	2.19	0.35	0.27	1.59	0.55	0.17
13/10/2010 23:30	1.45	0.73	0.22		-0.43	0.60		0.08	2.17	0.33	0.28	1.63	0.55	0.22

14/10/2010 23:30	1.21	0.73	0.22	-0.43	0.59	0.08	2.15	0.31	0.27	1.71	0.55	0.37
15/10/2010 23:30	1.39	0.72	0.22	-0.43	0.60	0.08	2.18	0.29	0.27	1.60	0.55	0.41
16/10/2010 23:30	1.41	0.70	0.23	-0.43	0.60	0.16	2.13	0.43	2.39	1.67	0.55	0.43
17/10/2010 23:30	1.36	0.66	0.21	-0.43	0.60	0.21	2.12	0.47	5.75	1.66	0.55	0.51
18/10/2010 23:30	1.48	0.67	0.21	-0.43	0.60	0.24	2.15	0.48	5.97	1.66	0.55	0.19
19/10/2010 23:30	1.28	0.69	0.23	-0.43	0.60	0.25	2.14	0.42	6.04	1.66	0.55	0.33
20/10/2010 23:30	1.41	0.67	0.21	-0.43	0.60	0.27	2.10	0.42	5.98	1.72	0.55	0.33
21/10/2010 23:30	1.52	0.70	0.20	-0.43	0.60	0.28	2.10	0.43	6.02	1.69	0.55	0.34
22/10/2010 23:30	1.42	0.69	0.21	-0.43	0.61	0.08	1.49	0.32	0.24	1.45	0.55	0.46
23/10/2010 23:30	1.34	0.68	0.25	-0.44	0.60	0.08	1.87	0.34	0.26	1.68	0.56	0.57
24/10/2010 23:30	1.48	0.68	0.22	-0.44	0.60	0.08	1.97	0.33	0.26	1.43	0.56	0.60
25/10/2010 23:30	1.30	0.66	0.21	-0.44	0.60	0.08	2.05	0.30	0.26	1.73	0.56	0.69
26/10/2010 23:30	0.89	0.70	0.24	-0.44	0.60	0.08	2.17	0.35	0.30	1.46	0.56	0.50
27/10/2010 23:30	1.47	0.70	0.23	-0.44	0.61	0.08	2.36	0.38	0.51	1.50	0.56	0.56
28/10/2010 23:30	1.45	0.70	0.20	-0.44	0.60	0.09	2.55	0.42	0.31	1.45	0.56	0.35
29/10/2010 23:30	1.63	1.24	0.24	-0.44	0.80	0.26	3.00	0.90	6.92	3.95	0.57	0.98
30/10/2010 23:30	2.02	1.49	0.24	-0.44	0.62	0.31	2.85	1.10	7.51	4.27	0.57	0.98
31/10/2010 23:30	3.16	1.93	0.25	-0.44	0.89	0.31	3.06	1.98	7.93	4.61	0.58	1.00
01/11/2010 23:30	3.35	1.70	0.25	-0.44	0.80	0.30	2.19	1.75	7.04	2.56	0.58	0.98
02/11/2010 23:30	2.38	1.34	0.25	-0.44	0.87	0.30	2.72	1.66	6.68	3.44	0.58	0.88
03/11/2010 23:30	1.45	0.70	0.25	-0.44	0.81	0.09	2.69	0.02	1.09	1.48	0.58	0.94
04/11/2010 23:30	1.18	0.70	0.24	-0.44	0.88	0.09	2.78	0.02	1.24	1.50	0.58	0.75
05/11/2010 23:30	1.32	0.71	0.25	-0.44	error	0.08	2.85	0.47	1.81	1.45	0.58	0.37
06/11/2010 23:30	1.42	0.70	0.23	-0.44	error	0.09	2.92	0.47	1.45	1.49	0.57	0.41
07/11/2010 23:30	1.12	0.67	0.23	-0.44	error	0.09	3.17	0.02	0.43	1.40	0.57	0.78
08/11/2010 23:30	1.71	**1.38**	0.25	-0.44	error	0.33	3.13	0.84	**7.96**	4.24	0.57	0.98
09/11/2010 23:30	1.25	0.71	0.24	-0.44	error	0.09	2.75	0.09	1.49	1.52	0.57	0.85
10/11/2010 23:30	1.18	0.69	0.24	-0.44	error	0.09	2.88	0.44	1.68	1.44	0.56	0.46
11/11/2010 23:30	1.35	0.70	0.25	-0.44	error	0.09	3.13	0.02	2.90	1.47	0.56	0.41
12/11/2010 23:30	1.49	0.71	0.24	-0.44	error	0.09	3.02	0.45	0.65	1.47	0.56	0.26
13/11/2010 23:30	1.37	0.71	0.24	-0.44	error	0.09	2.99	0.44	0.64	1.50	0.56	0.51
14/11/2010 23:30	1.47	0.72	0.25	-0.44	error	0.09	2.86	0.44	0.40	1.47	0.56	0.62
15/11/2010 23:30	1.18	0.71	0.25	-0.44	error	0.09	2.75	0.44	0.58	1.48	0.56	0.14
16/11/2010 23:30	1.59	**1.54**	0.30	-0.44	error	0.09	error	0.02	**6.78**	1.72	0.56	0.47
17/11/2010 23:30	1.76	**1.27**	0.25	-0.44	0.73	0.15	error	0.74	**7.71**	2.16	0.57	0.98
18/11/2010 23:30	1.16	0.70	0.25	-0.44	0.72	0.15	error	0.01	0.29	1.68	0.54	0.90

19/11/2010 23:30	0.98	0.70	0.22	-0.44	0.74	0.15	error	0.39	**6.47**	1.82	0.55	0.73
20/11/2010 23:30	1.40	0.70	0.25	-0.44	0.81	0.15	error	0.39	**7.21**	2.01	0.55	0.89
21/11/2010 23:30	1.51	0.72	0.19	-0.44	0.71	0.15	error	0.36	**7.19**	2.70	0.55	0.96
22/11/2010 23:30	1.43	0.69	0.22	-0.44	0.72	0.15	error	0.37	**6.06**	3.19	0.55	0.54
23/11/2010 23:30	1.47	0.71	0.22	0.05	0.73	-0.05	error	0.30	**6.37**	1.77	0.55	0.21
24/11/2010 23:30	1.15	0.71	0.23	0.12	0.81	-0.05	error	0.28	**5.78**	1.74	0.55	0.20
25/11/2010 23:30	1.49	0.71	0.23	0.13	0.79	-0.05	error	0.26	0.29	1.83	0.55	0.20
26/11/2010 23:30	1.23	0.70	0.22	0.11	0.76	0.14	error	0.25	**5.91**	1.78	0.55	0.21
27/11/2010 23:30	1.49	0.70	0.26	0.10	0.76	0.14	error	0.24	**6.81**	1.78	0.55	0.20
28/11/2010 23:30	1.49	0.68	0.29	0.09	0.83	0.15	error	0.24	**6.88**	1.72	0.55	0.37
29/11/2010 23:30	1.44	0.70	0.26	0.07	0.87	0.14	error	0.22	**6.76**	1.81	0.55	0.47
30/11/2010 23:30	1.39	0.68	0.26	0.06	0.85	0.14	error	0.21	0.28	1.72	0.55	0.55
01/12/2010 23:30	1.32	0.69	0.23	0.06	0.80	0.14	error	0.20	**6.01**	1.80	0.55	0.22
02/12/2010 15:30	1.48	0.70	0.24	0.05	0.82	0.14	error	0.19	0.29	1.74	0.55	0.24
02/12/2010 23:30	1.20	0.72	0.24	0.05	0.80	0.14	error	0.19	0.29	1.71	0.55	0.38
03/12/2010 23:30	1.50	0.71	0.16	0.05	0.85	0.14	error	0.18	**5.90**	1.57	0.55	0.41
04/12/2010 23:30	1.43	0.70	0.24	0.05	0.85	0.14	error	0.17	**6.63**	1.72	0.55	0.51
05/12/2010 23:30	1.36	0.72	0.20	0.04	0.84	0.14	error	0.16	**6.77**	1.76	0.55	0.59
06/12/2010 23:30	1.28	0.69	0.21	0.04	0.95	0.14	error	0.14	0.24	1.76	0.55	0.32
07/12/2010 23:30	1.28	0.74	0.29	-1.25	0.97	0.14	error	0.12	**4.97**	1.80	0.55	0.45
08/12/2010 23:30	1.17	0.70	0.29	-1.25	0.82	0.14	error	0.09	6.38	1.80	0.55	0.50
09/12/2010 23:30	1.23	0.69	0.27	-1.25	0.88	0.14	error	0.06	5.94	1.71	0.56	0.16
10/12/2010 23:30	1.35	0.70	0.24	-1.25	0.99	0.14	error	0.11	6.83	1.74	0.56	0.36
11/12/2010 23:30	1.41	0.71	0.19	-1.23	0.88	0.14	error	0.12	7.13	1.75	0.56	0.48
12/12/2010 23:30	1.44	0.71	0.22	-1.24	0.83	0.14	error	0.13	7.26	1.74	0.56	0.58
13/12/2010 23:30	1.43	0.71	0.28	-1.23	0.83	0.14	error	0.12	6.62	1.82	0.56	0.32
14/12/2010 23:30	1.39	0.73	0.28	-1.24	0.86	0.14	error	0.10	7.01	1.80	0.56	0.45
15/12/2010 23:30	1.33	0.72	0.21	-1.25	0.78	0.14	error	0.10	7.14	1.76	0.56	0.54
16/12/2010 23:30	1.40	0.69	0.16	-1.24	0.82	0.14	error	0.10	6.90	1.72	0.56	0.63
17/12/2010 23:30	1.42	0.51	0.13	-1.25	-0.58	0.31	error	0.10	0.24	1.52	0.56	0.57
18/12/2010 23:30	1.37	0.51	0.18	-1.25	-0.57	0.31	error	0.09	6.63	1.70	0.56	0.66
19/12/2010 23:30	1.25	0.51	0.25	-1.25	-0.57	0.31	error	0.08	6.97	1.71	0.56	0.75
20/12/2010 23:30	1.52	0.51	0.27	-1.25	-0.57	0.31	error	0.07	6.94	1.71	0.56	0.47
21/12/2010 23:30	1.43	0.52	0.26	-1.25	-0.57	0.31	error	0.05	6.98	1.75	0.56	0.56
22/12/2010 23:30	1.28	0.52	0.28	-1.25	-0.57	0.30	error	0.03	6.86	1.70	0.56	0.36
23/12/2010 23:30	1.50	0.52	0.27	-1.22	-0.58	0.30	error	0.01	6.77	1.69	0.56	0.40

24/12/2010 23:30	1.39	0.51	0.25	-1.25	-0.57	0.30	error	0.03	6.66	1.69	0.56	0.51
25/12/2010 23:30	1.24	0.51	0.21	-1.25	-0.58	0.30	error	0.02	6.67	1.48	0.56	0.55
26/12/2010 23:30	1.52	0.50	0.12	-1.25	-0.57	0.30	error	0.02	6.77	1.73	0.57	0.63
27/12/2010 23:30	1.62	1.41	0.15	-1.25	-0.55	0.30	error	0.33	7.99	4.02	0.57	0.98
28/12/2010 23:30	1.93	1.59	0.19	-1.25	-0.57	0.31	error	0.47	7.83	4.26	0.57	0.98
29/12/2010 23:30	2.09	1.67	0.22	-1.25	-0.57	0.31	1.13	0.54	7.70	4.19	0.57	0.98
30/12/2010 23:30	1.43	0.50	0.23	-1.25	-0.57	0.31	1.29	0.43	7.60	1.72	0.57	0.97
31/12/2010 23:30	1.44	0.50	0.22	-1.25	-0.57	0.31	0.61	0.32	7.08	1.74	0.57	0.80