



**Clare County Council**

**Waste Licence W0031-01**

**Annual Environmental Report for 2008**

**Location of facility: Doora Landfill, Bunnow, Ballaghboy,**

**Gaurus, Doora, Co. Clare**



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## 1.0 Introduction

### 1.1 Licence Reference

Condition	Details
<b>Condition 2</b> <b>Management of the activity</b>  <b>Schedule C</b>	2.8 AER: The licensee shall submit to the agency for its agreement, within thirteen months from the date of grant of this licence, or within one month of the end of each year thereafter.  AER Content.

### 1.2 Waste Licence Register Number

The waste license number is W0031-01.

### 1.3 Name of Operator, Name and Address of Facility

Clare County Council  
Doora Landfill Site  
Bunnow/Ballaghboy/Gaurus/Doora  
County Clare

### 1.4 Reporting Period

The reporting period for this AER is the calendar year 2008.

### 1.5 Site Description

#### 1.5.1 Site Location

Doora landfill is located in a semi-rural area approximately 1.6km east of Ennis Town.

#### 1.5.2 Area Occupied

The area occupied by the landfill and its ancillaries amounts to 29.8 hectares, of which 18.7 hectares was used for landfilling. No waste has been deposited at the site since June 30<sup>th</sup> 2001.

## 2.0 Waste Activities carried out at the facility.

In accordance with Condition 5.1.2 of the licence, no waste has been accepted for deposition on the site since June 30th 2001.

In accordance with Condition 4.18.1, no waste has been accepted for transfer at the facility since 30th June 2002.

Site restoration works commenced at Doora Landfill in mid-August 2008. During the restoration works, the power supply to the gas flare and leachate abstraction pumps was interrupted from mid-October 2008. Power was restored in early December. The flare was operational again from the 5<sup>th</sup> December 2008. Leachate abstraction recommenced shortly after that. Leachate is currently being pumped to a road tanker. Abstraction volumes are low at present. This may be due to a problem with the pumps, which will be serviced shortly. The reduced volumes may also be partially attributable to reduced rainfall infiltration in zone 3 (see section 6).

A permanent leachate storage tank has been installed in Zone 3. Handover of this unit is expected to take place on completion of the restoration project in August 2009.

A number of groundwater, leachate and gas monitoring wells were damaged as a result of the site works. These wells will be replaced on completion of the project.

### **3.0 Quantity and Composition of Waste Received in 2008.**

No waste was received at the facility since June 2002.

### **4.0 Environmental Monitoring Results and Interpretation.**

Section 4 presents the results of environmental monitoring undertaken from January to December 2008 in accordance with Condition 9 of Waste Licence No.0031-01, as indicated in Table 4.1 below.

During this reporting period, consultants TMS Environment Ltd conducted monthly, quarterly and annual monitoring programmes for surface water, groundwater and leachate. TMS Environment also carried out monitoring for dust, noise and flare emissions. Conservation Services carried out biological monitoring on surface water drains and on the Fergus river. Weekly surface water visual inspections<sup>1</sup>, gas monitoring and leachate level monitoring surveys were carried out by Clare County Council staff. Monitoring locations are shown on Drawing Number 1 in Appendix I.

**Table 4.1 :Doora Landfill (W0031-01) Monitoring Schedule**

<b>Schedule</b>	<b>Monitoring Requirement</b>
E.1	Landfill Gas
E.2	Dust
E.3	Noise
E.4	Surface Water, Groundwater and Leachate
E.5	Enclosed Landfill Gas Flare

*Note <sup>1</sup>: The monitoring frequency for surface water visual inspections was reduced to monthly from August 2008, as agreed with the EPA.*

Monitoring was carried out in accordance with Schedule E of the Waste Licence as indicated in Table 4.1 unless otherwise noted in this report. Results for key parameters are summarised in Sections 4.1 to 4.6 of this report. A more detailed discussion of results can be found in the quarterly reports submitted to the Agency during the year.

#### **4.1. Landfill Gas**

Clare County Council staff conducted landfill gas monitoring at weekly and monthly intervals during the reporting period, in accordance with Schedule E.1 of the waste licence. Gas monitoring locations are shown in Drawing No. 1 "Environmental Monitoring Points" in Appendix I. Monitoring was undertaken at forty-two locations across the three zones of Doora landfill. Thirty-five of these locations were tested on a monthly basis primarily to enable field balancing to be carried out to optimise gas collection and flare efficiency. The remaining seven locations are the original gas monitoring wells (LG1 to LG7) that are not connected to the gas network. A number of these wells were damaged during the last quarter due to earthworks carried out during the landfill remediation project. Replacement monitoring wells will be installed on completion of the project. Undamaged wells were monitored on a weekly basis during the reporting period. Gas monitoring results from January to December 2008 are shown in figures 1a to 1g. As can be seen from these graphs, higher concentrations of landfill gas were detected in LG2, LG5 and to a lesser extent in LG7. Methane levels were higher than CO<sub>2</sub> levels in these wells. Methane and CO<sub>2</sub> levels were similar in LG1, LG3, LG4 and LG6, where lower landfill gas levels have been measured. The ratio of CH<sub>4</sub> to CO<sub>2</sub> is related to the age and stage of decomposition of the waste.

The enclosed landfill gas flare was operational for approximately 55% of the time in 2008. A total of 1,228,503m<sup>3</sup> of landfill gas was burned during the year. The periods of flare downtime were due to several reasons including poor quality gas in the first part of the year, re-laying of the gas collection network in October/November and periodic interruptions to the flare power supply due to the landfill restoration project in the last quarter. There was also one period of power outage due to ESB works in November 2008.

Weekly gas monitoring surveys were carried out during the year at offsite gas monitoring wells, OSW1 and OSW2. No methane was detected in either of the wells. Carbon dioxide levels occasionally exceeded the 1.5%v/v trigger level in OSW2 during the year, due most likely to the presence of peat in the area around the wells. These exceedences were notified to the EPA in incident reports during the year.

### Landfill Gas Levels at LG1 to LG7, 2008

Figure 1a

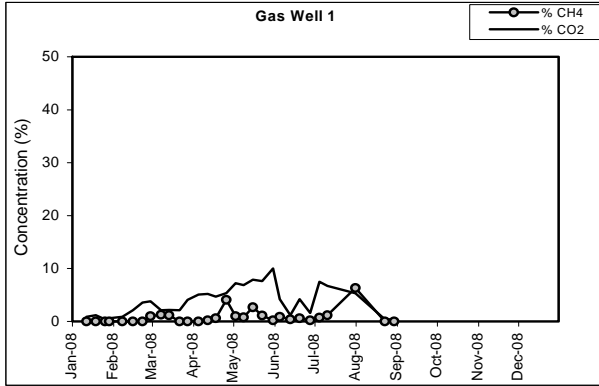


Figure 1b

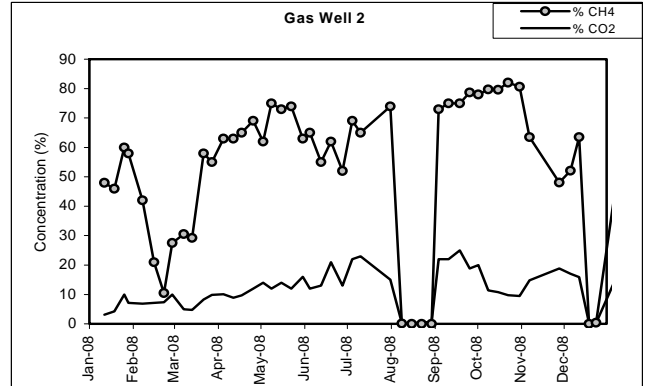


Figure 1c

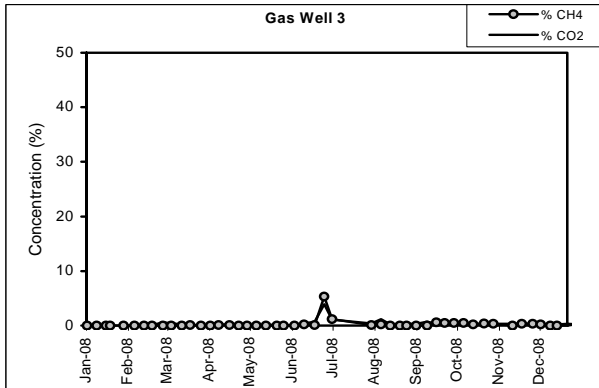


Figure 1d

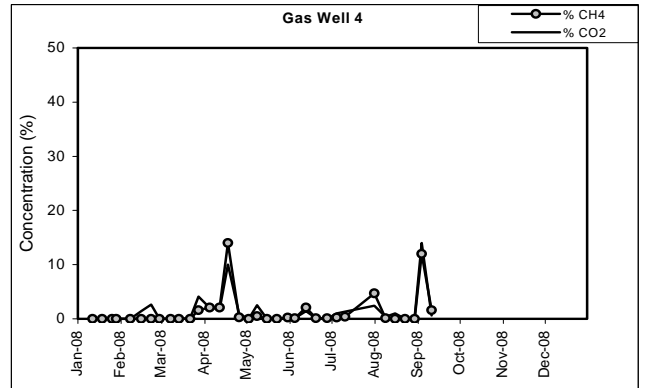


Figure 1e

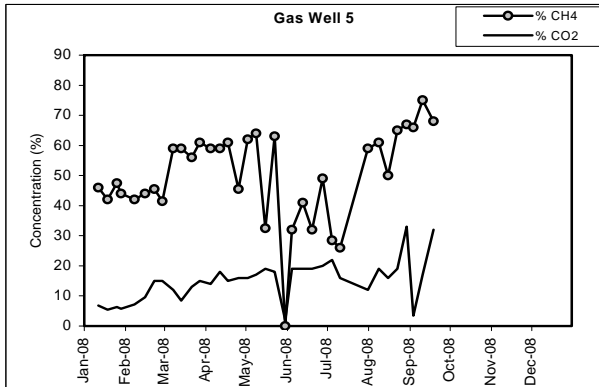


Figure 1f

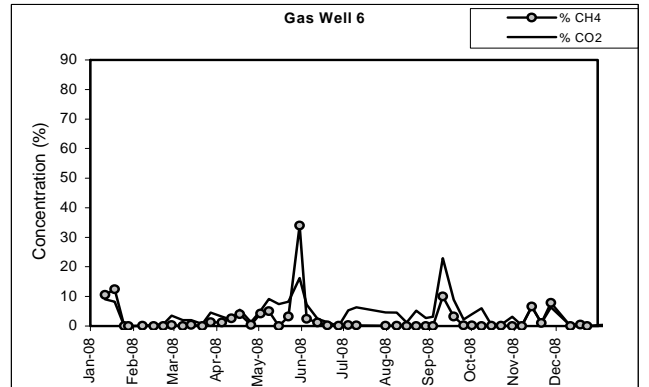
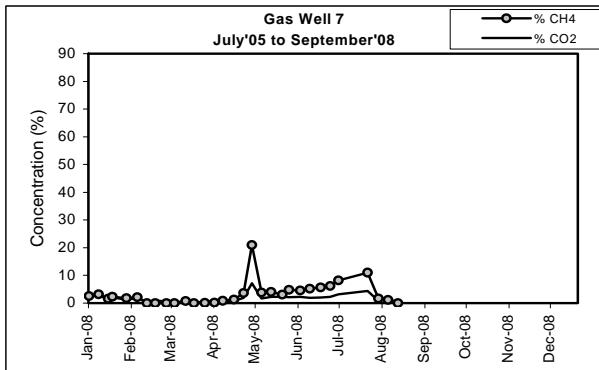


Figure 1g





#### 4.2. Dust

Three ambient dust monitoring surveys were completed during this reporting period. Monitoring locations are shown in Drawing 1 in Appendix I. Results are summarised in Table 4.2 below. These results have previously been submitted to the Agency in quarterly reports for the facility.

**Table 4.2: Total Dust Monitoring Results.**

Sample location	Monitoring Period			Dust Deposition Limit (mg/m <sup>2</sup> /day)
	24 <sup>th</sup> June to 28 <sup>th</sup> July 2008 (mg/m <sup>2</sup> /day)	28 <sup>th</sup> July to 5 <sup>th</sup> September 2008 (mg/m <sup>2</sup> /day)	5 <sup>th</sup> Sept to 15 <sup>th</sup> October 2008 (mg/m <sup>2</sup> /day)	
ST1	48	196	184	350
ST2	150	118	148	350
ST3	121	<b>2123</b>		350
ST4	No result	<b>1025</b>	262	350
ST5	<b>1503</b> (organic contamination-algal growth).	236	2500 (organic contamination, algal growth in sample)	350

As can be seen from the table, the dust deposition limit of 350mg/m<sup>2</sup>/day was exceeded at ST5 in the June/July sample and at ST3 and ST4 in the July/September sample. The exceedences were reported in incident report numbers 08-07 and 08-08. These elevated dust levels were not considered to be due to site restoration works, which did not commence until mid-August 2008 (major capping works did not take place until mid September). The test laboratory reported the presence of organic contamination (algal growth) in all three of the elevated samples.

#### 4.3 Noise

An annual noise monitoring survey was conducted on the 14<sup>th</sup> August 2008 at noise sensitive locations N1 to N4 and S1 to S4. As for previous surveys, the daytime noise limit of 55dB(A)<sub>L<sub>Aeq, 30 mins</sub></sub> was exceeded at two monitoring locations to the east of the site, S2 and S3 (57 and 64.6 dB(A)<sub>L<sub>Aeq, 30 mins</sub></sub> respectively). Passing traffic was the predominant noise source at both locations. Activities at the site did not contribute to the elevated noise levels. A detailed report on the noise survey was submitted in the quarterly environmental monitoring report for June to September 2008.

#### 4.4 Groundwater, Surface Water and Leachate.

##### 4.4.1 Groundwater

Groundwater monitoring was carried out in accordance with schedule E.4 of Waste Licence W0031-01 for the parameters and at the monitoring frequency specified in Table E.4.1 at locations: OB1, BR1, OB2, BR2, OB3, BR3, OB4, OB5, OB6, OB8, BR6, BR7, BR8 and BR9 (refer to Drawing No. 1 in Appendix I. for locations).

Three new groundwater-monitoring wells were installed at the site in May 2008. Two of the wells were replacement wells for OB1 and OB5. The third well (BR10) was installed close to zone 3 of the landfill to monitor groundwater levels immediately downgradient of this area. Monitoring of these wells commenced in June 2008. Unfortunately, all three wells were lost towards the end of 2008, due to earthworks carried out as part of the landfill restoration project. Results for key parameters chloride and ammonia are summarised below.

##### Chloride:

Groundwater chloride levels are graphed in figures 2 and 3 below. As can be seen from the graphs, higher chloride levels were observed in wells located close to the River Fergus (OB1, BR1, OB2, BR2, and OB5). These elevated chloride levels may be in part attributed to the influence of the Fergus river. Groundwater contamination from landfilling activities at the site may also be a factor (see section on ammonia below).

Figure 2

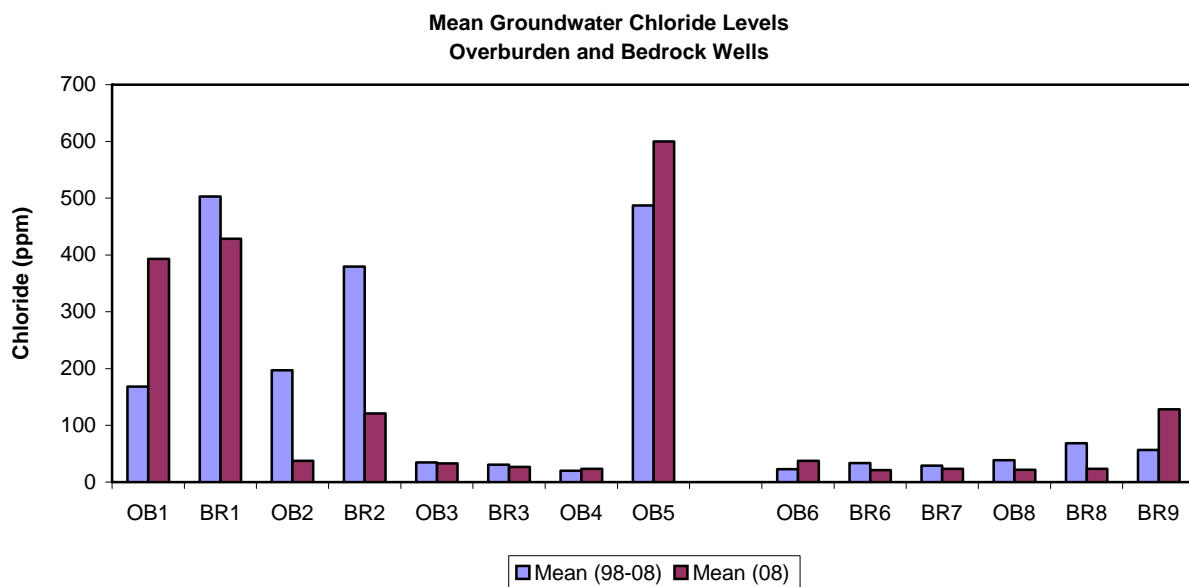
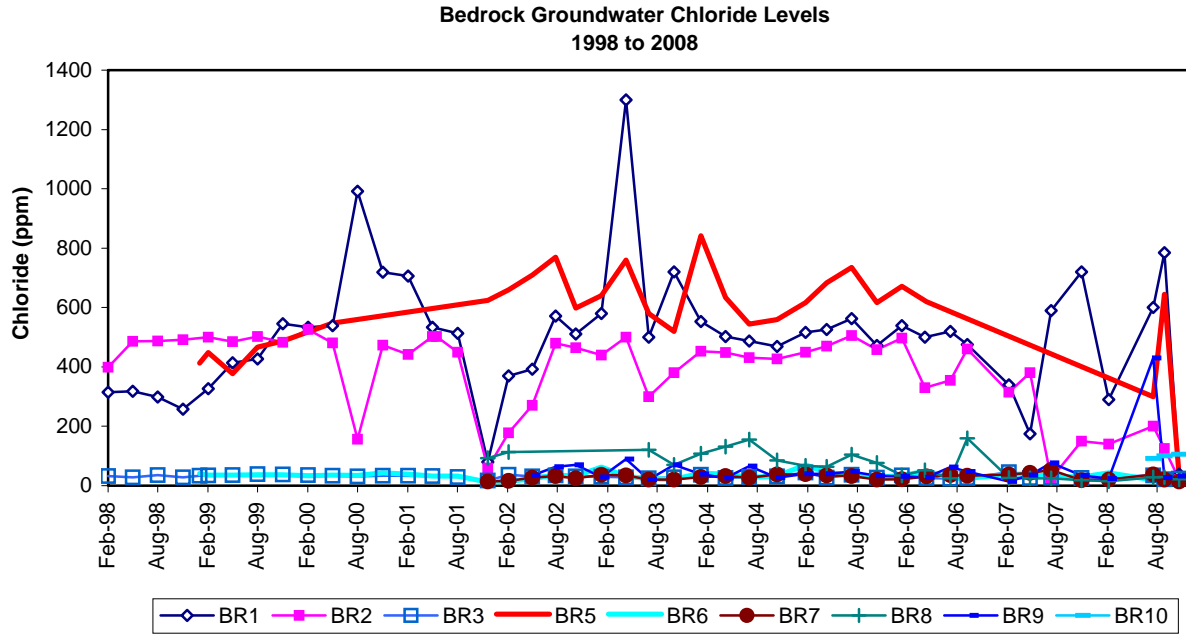


Figure 3



**Ammonia:**

Groundwater ammonia levels for the five-year period from January 2004 to December 2008 are graphed below in figures 4 to 12. Mean ammonia levels for the period are graphed in figure 13. As can be seen from the graphs, groundwater ammonia results have been elevated for onsite monitoring wells (OB1/BR1 and OB2/BR2) since monitoring commenced at the site. Highest results for 2008 were obtained at these four wells, particularly at BR2, which is located close to the southwestern boundary of the site. Ammonia levels at BR2 have increased gradually in the past two years. BR2 is downgradient of zones 2 and 3 of the landfill. To determine whether the elevated ammonia levels at BR2 are due to a local problem around the well or to migration of leachate from zone 3 of the landfill, a new bedrock well (BR10) was installed upgradient of BR2 and downgradient of zone 3 in May 2008. Monitoring of this well commenced in June 2008 but ceased in November 2008 when the landfill remediation contractors accidentally destroyed the well when carrying out earthworks in the vicinity.

Results obtained between June and November 2008 are presented below in figure 12. As can be seen from the graph, BR10 ammonia results were unusually elevated. This indicates that the elevated ammonia levels observed at BR2 (and at BR10) are likely to be due to migration of leachate from Zone 3. Monitoring results for the Fergus river to date do not indicate that this leachate plume is causing problems in the Fergus river. However, further investigation is needed to confirm whether the Fergus river is fed by groundwater flowing from the landfill direction. To this end, it is proposed to install two offsite bedrock monitoring wells on lands to

the west of the Fergus river. Tentative locations for these wells are presented in the map below. The exact locations will be determined based on accessibility and site ownership and will be notified to the EPA in advance of installation.



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Leachate is currently being abstracted from four purpose built wells in zones 2 and 3. A dedicated leachate storage tank was installed as part of the landfill remediation project. This tank is due to be commissioned shortly. It is hoped that installation of the final capping layer, combined with ongoing leachate abstraction, will effect a reduction in groundwater ammonia levels over time.

As expected, lowest ammonia levels were found in upgradient wells OB3, BR3 and BR7 and in the cross-gradient nested pair of wells OB6 and BR6. Mean ammonia levels at these locations were below 0.5ppm for this twelve-month monitoring period (see figures 9 to 11 and 13)

Figure 4

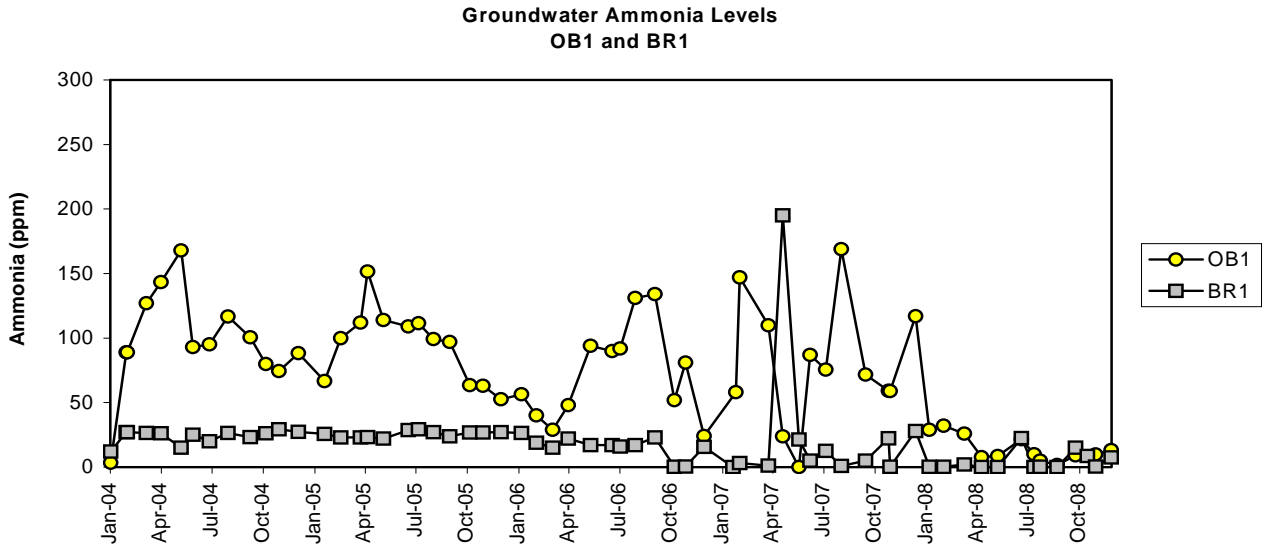


Figure 5

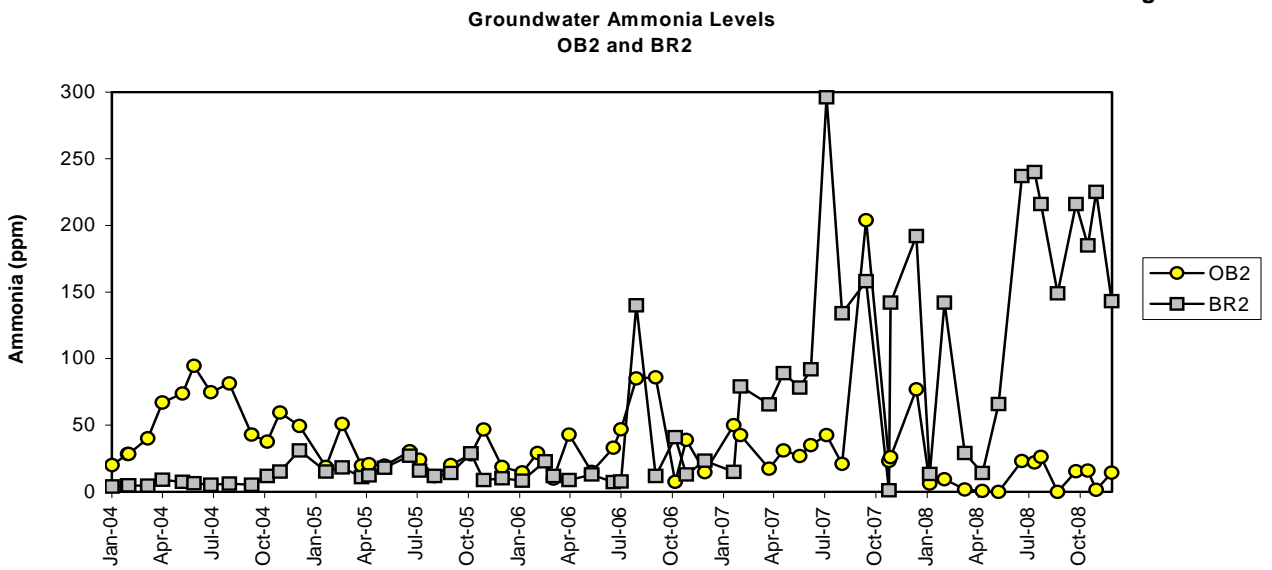


Figure 6

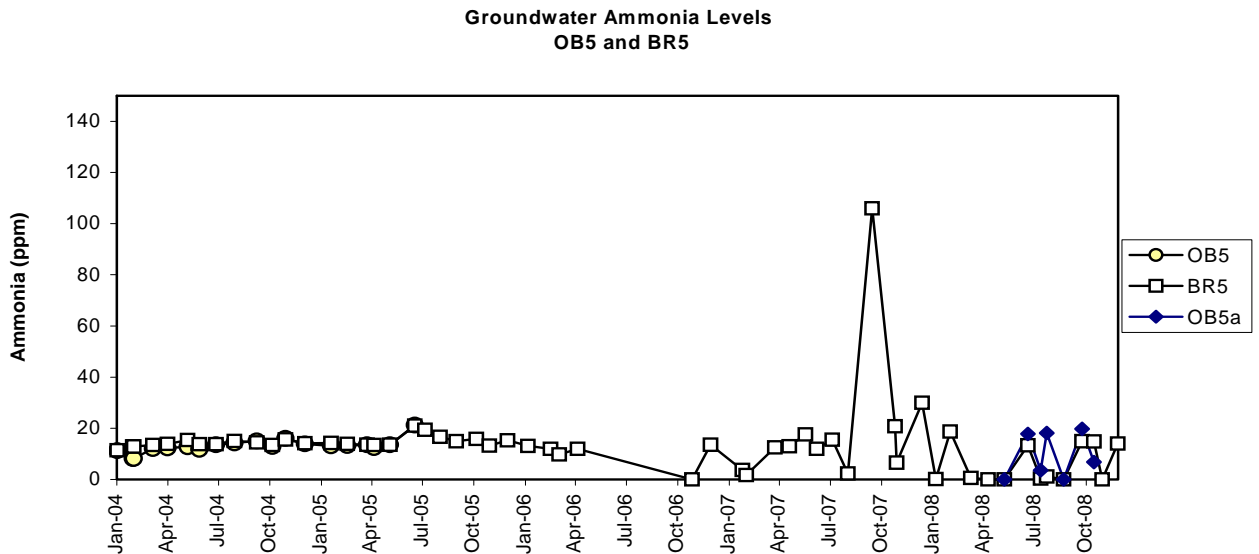


Figure 7

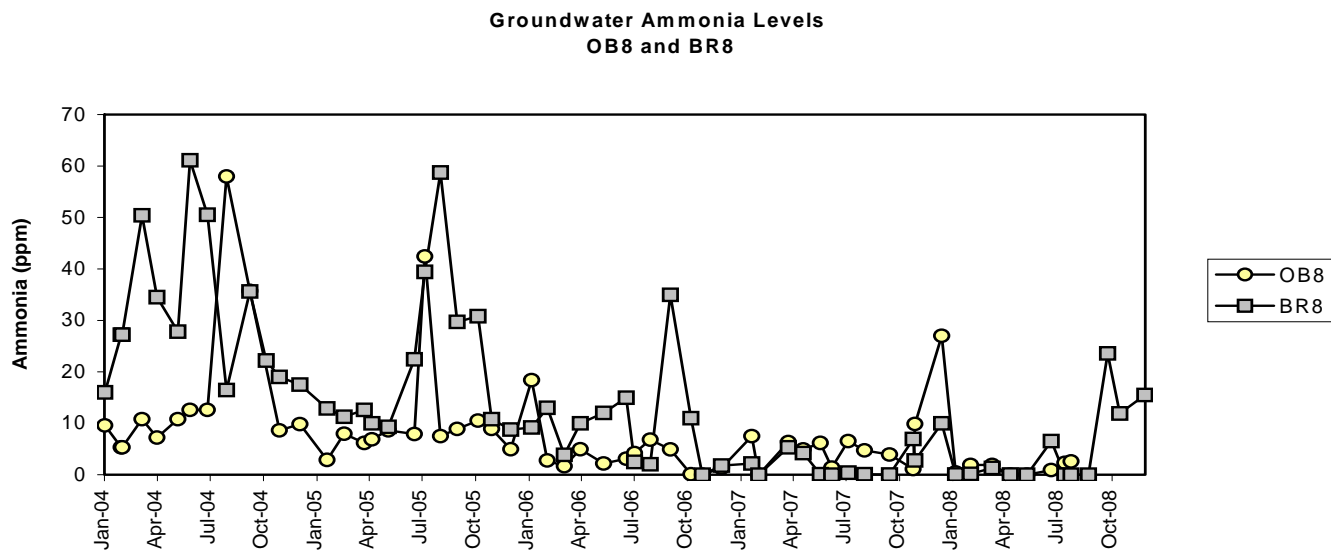


Figure 8

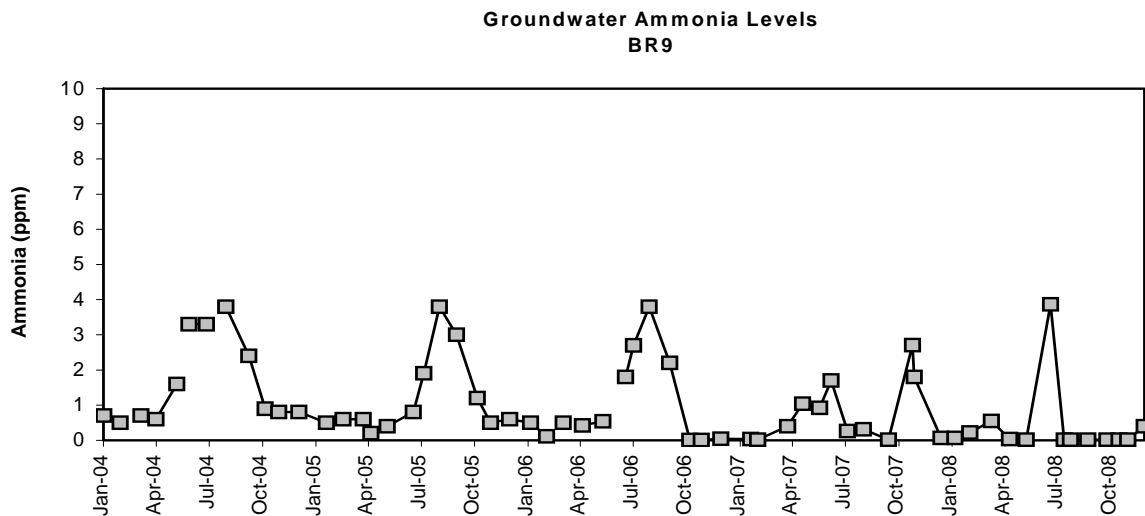


Figure 9

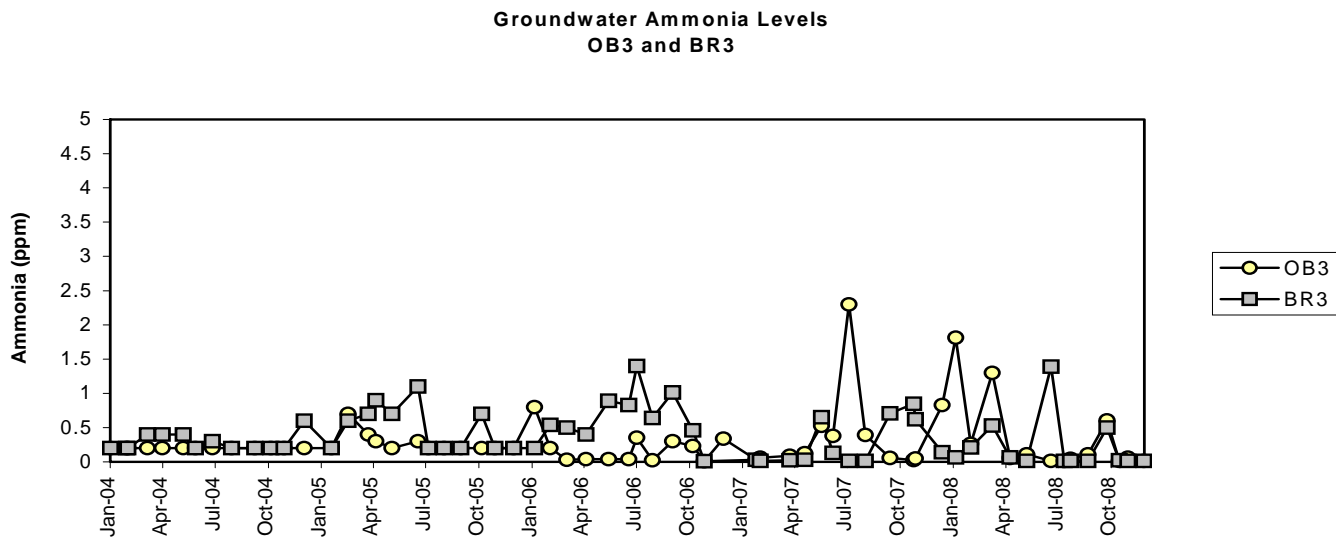


Figure 10

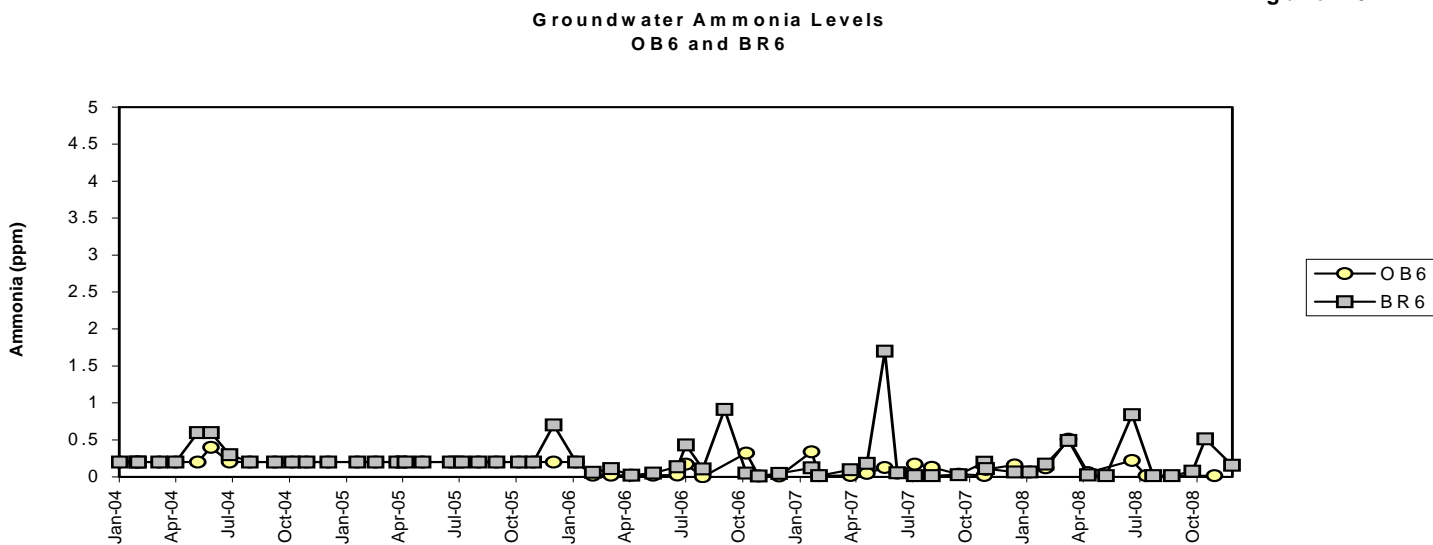


Figure 11

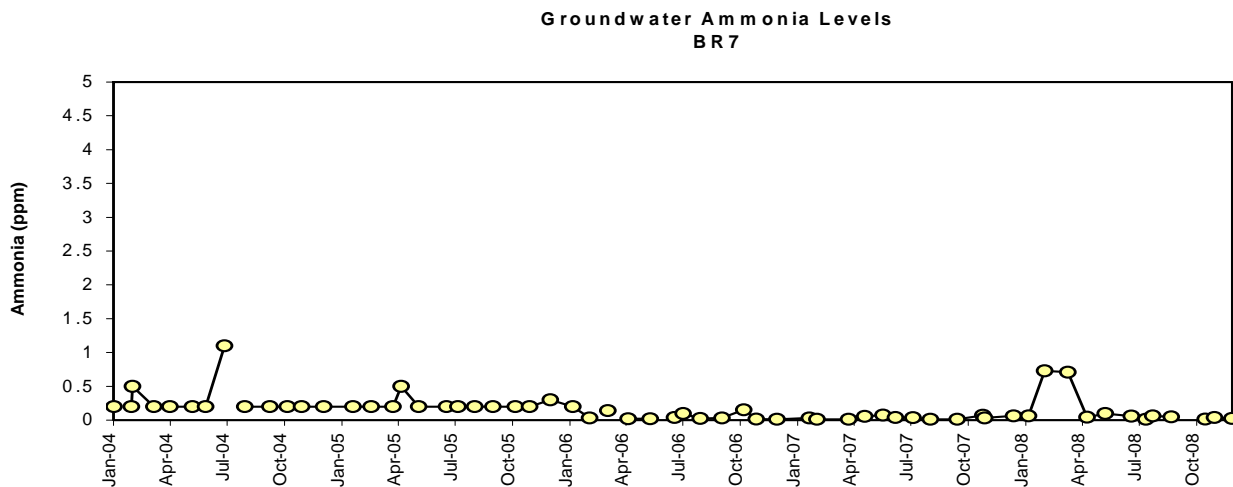


Figure 12

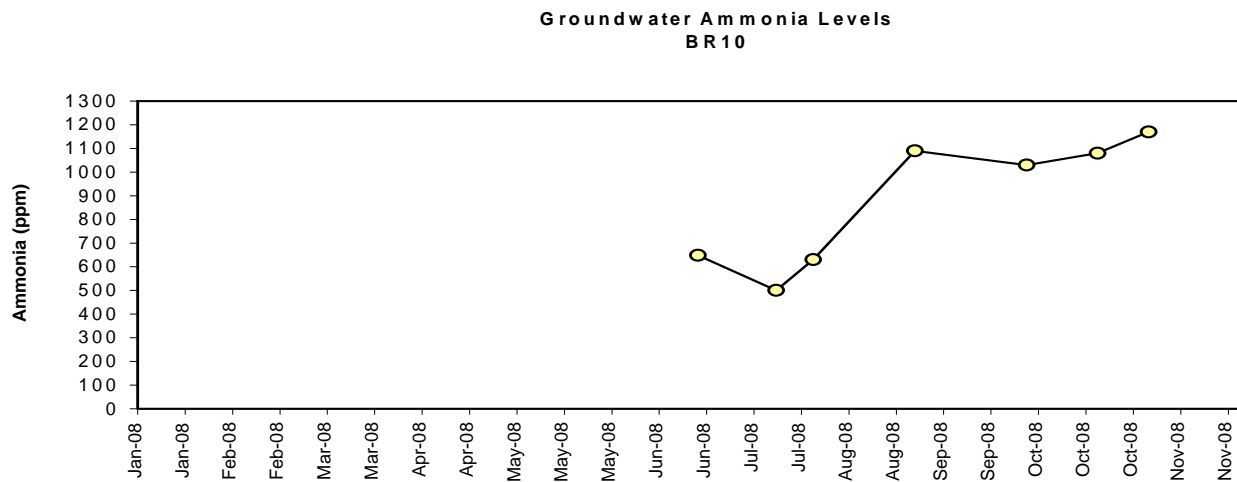
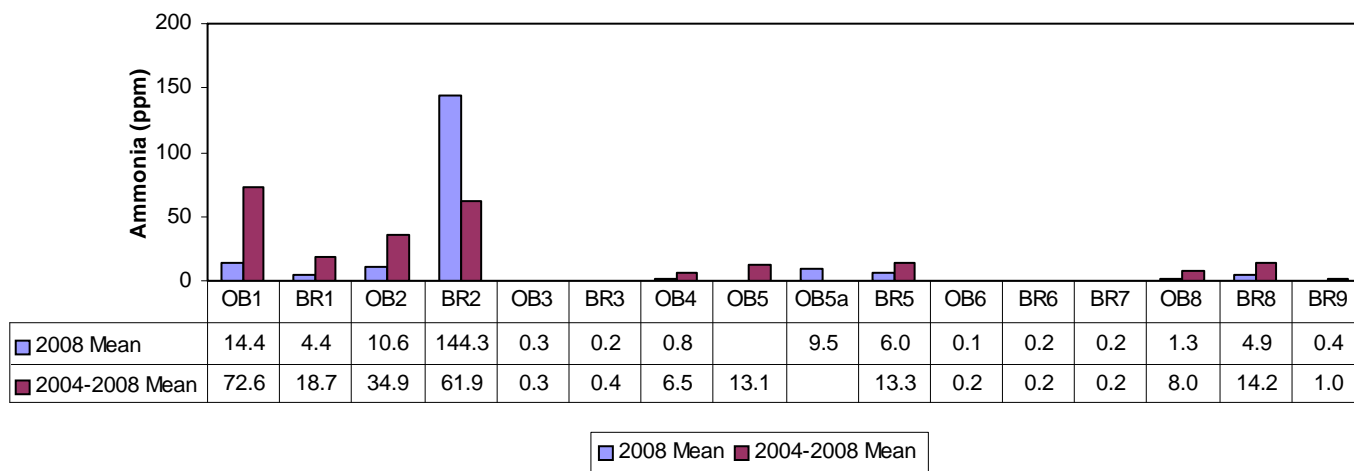


Figure 13

Mean Groundwater Ammonia Levels



#### 4.4.2 Surface Water

Surface water monitoring was carried out during the year at the following locations: SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW11, SW12, SW13, SW14 and SW15. Monitoring locations are shown in Drawing no. 1 in Appendix I. Surface water samples were collected for analysis as specified in Table E.4.1 of Waste Licence W0031-01. In addition, monthly monitoring was carried out at SW2, SW3 and SW7 for pH, conductivity and ammonia levels. Results for key parameters ammonia and BOD are summarised in this report.

#### BOD:

BOD results for the Fergus and Gaurus rivers for the five-year period from 2004 to 2008 are graphed in figures 14 and 15 respectively. The Fergus river is classified as a Salmonid water<sup>1</sup> to which a 5ppm BOD limit applies. This limit is shown in figure 14. As can be seen from the graph, Fergus river BOD results exceeded the salmonid limit on three occasions in 2008. Results at SW4 (upstream in Ennis Town) were unusually elevated in February at 17ppm. However, the COD level of this sample was only 5ppm, indicating that the BOD result may have been due to laboratory error.

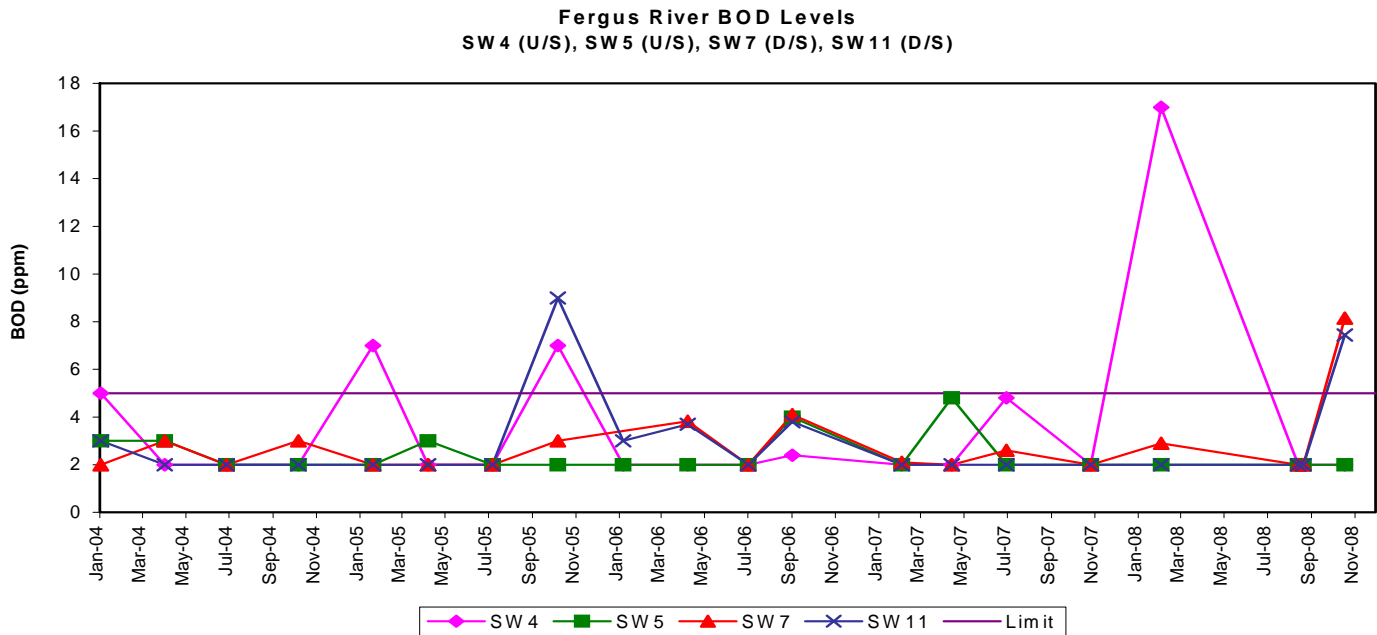
BOD results downstream at SW7 and SW11 were slightly above the 5ppm salmonid limit in October 2008 (see figure 14). These results are not believed to be due to landfill discharges because BOD levels were not particularly elevated in site drains/streams discharging to the Gaurus and Fergus rivers at that time.

1: From European Communities (Quality of Salmonid Waters) Regulations, 1988 (SI No. 293 of 1988). Note that the freshwater fish directive 2006/44/EC does not include a mandatory BOD limit but does include a guide BOD level of  $\leq 3$ ppm for salmonid waters.



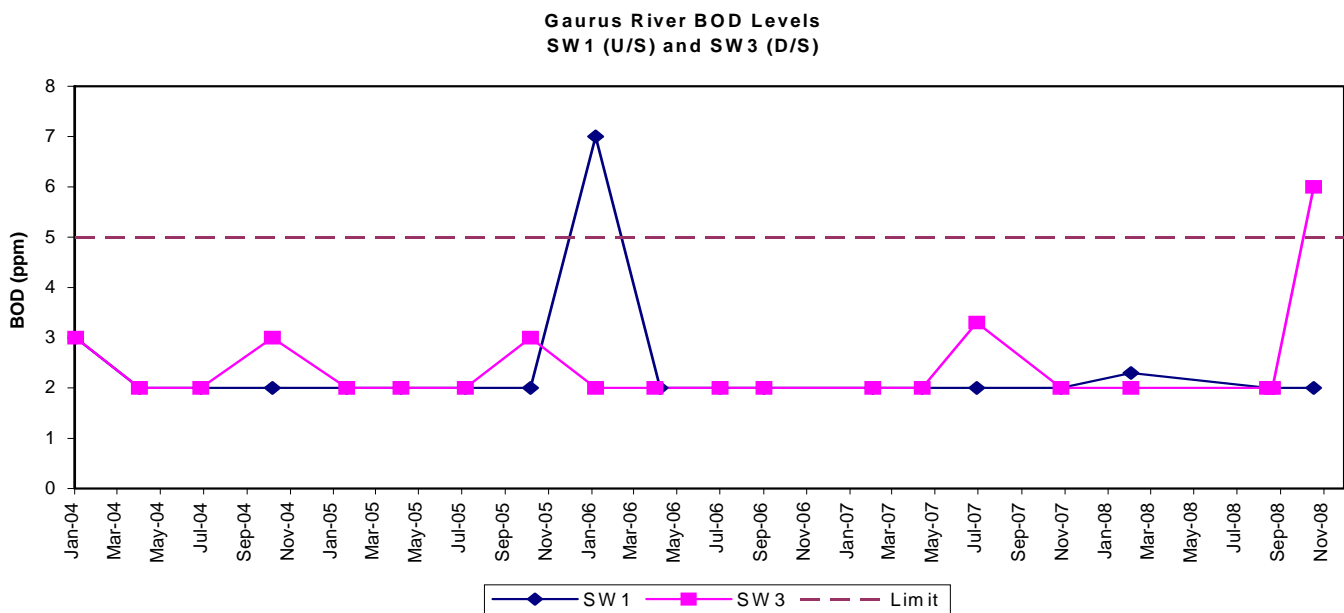
There are three significant combined storm overflows (CSO's) discharging to the Fergus river upstream of SW7 and SW11. With the heavy rainfall that occurred during 2008, particularly in August and October, it is very likely that the discharge from these CSO's is responsible for the intermittent elevated BOD levels observed at SW7 and at SW11.

**Figure 14**



Gaurus River BOD results are graphed in figure 15. The 5ppm salmonid limit is also shown on this graph for comparative purposes.

**Figure 15**

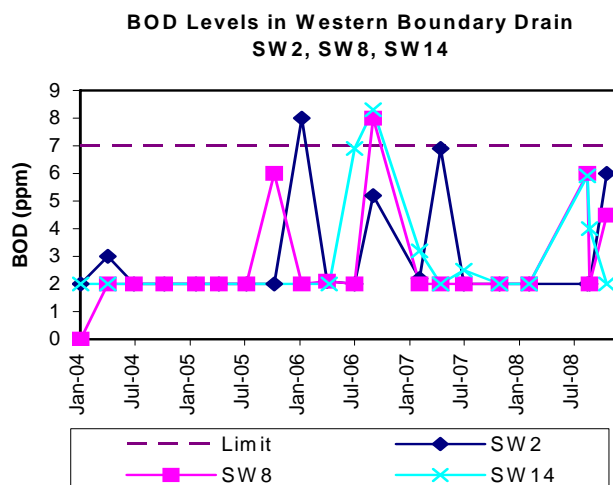
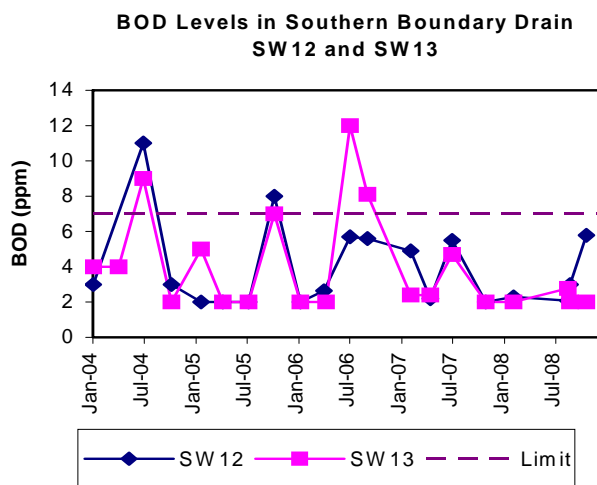


As can be seen from the graph, results for one upstream sample and one downstream sample have exceeded this comparative limit during the past five years.

There are two surface water sampling locations (SW12 and SW13) on the eastern boundary drain. This drain runs in a southerly direction along the eastern boundary and is piped underground close to the southern site boundary, feeding into the Fergus river upstream of Doora Bridge. BOD levels in the eastern boundary drain are graphed in figure 16. There are three sampling locations on the western boundary drain (SW2, SW8 and SW14) which feeds into the Gaurus river downstream of SW2. Results for this drain are graphed in figure 17. Also included on the graphs is the 7ppm BOD for A3 waters from the Surface Water Regulations (1989). This limit is included for comparative purposes only; no limits exist for BOD levels in site drains.

**Figure 16**

**Figure 17**



BOD results for both site drains have been within this comparative BOD limit since September 2006.

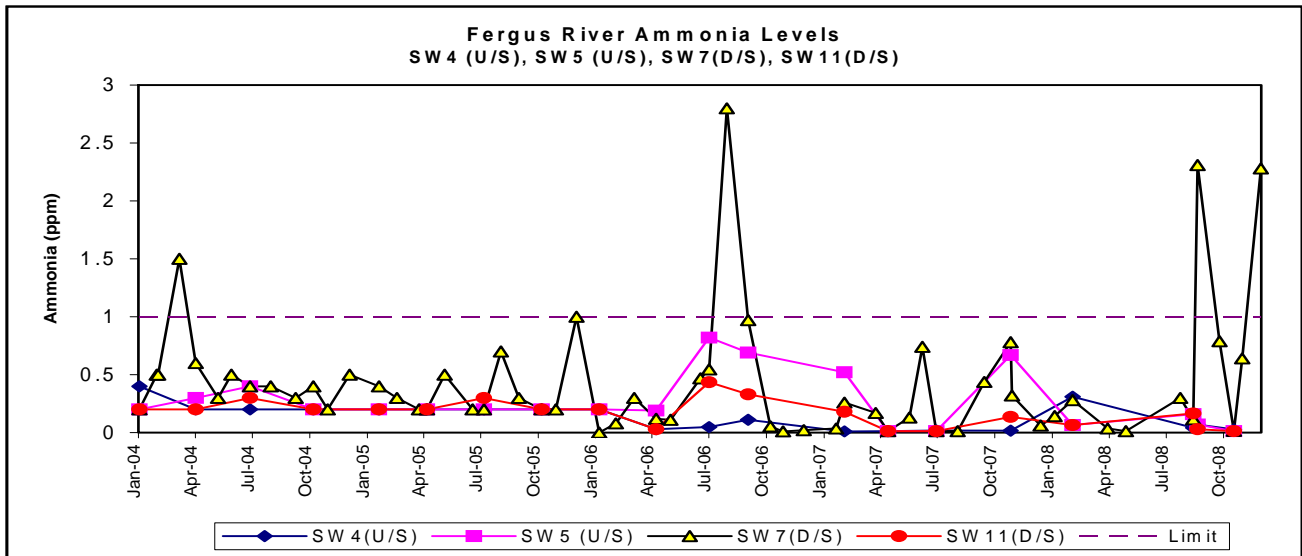
**Ammonia:**

Ammonia results for Gaurus and Fergus river samples for the five-year period from January 2004 to December 2008 are graphed in figures 18 and 19 respectively. Also shown on the graphs is the 1ppm ammonia limit for Salmonid Waters. This limit is included in the Gaurus river graph for comparative purposes only.

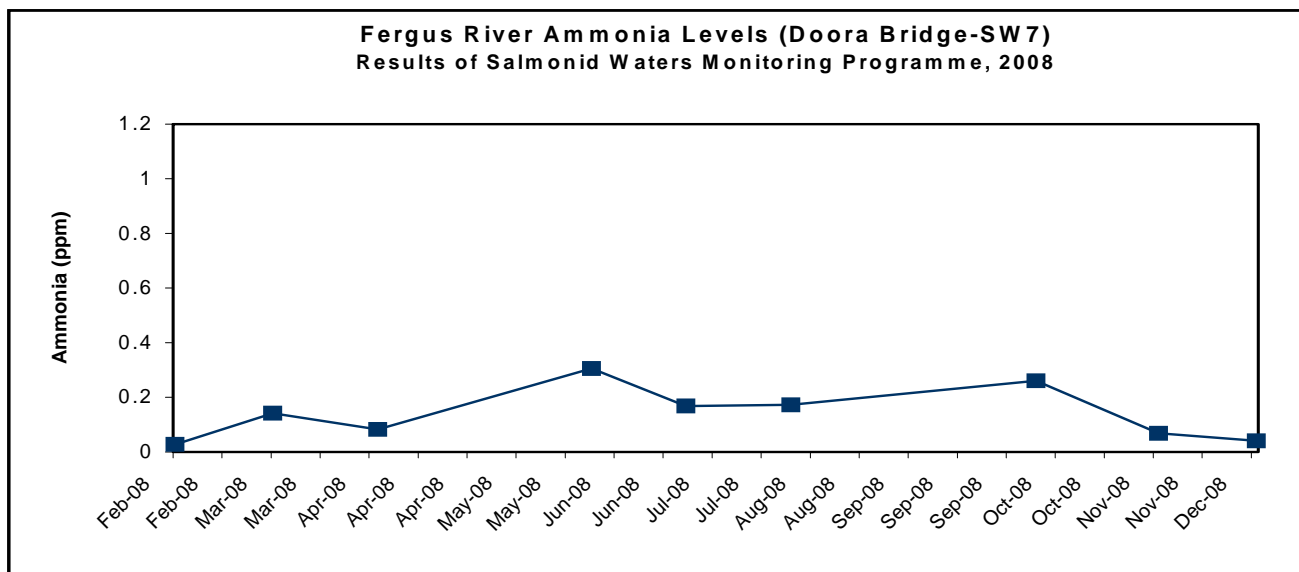
As can be seen from figure 18, ammonia levels at SW7 (Doora bridge) exceeded the 1ppm salmonid limit on two occasions in 2008, on the 25<sup>th</sup> August and on the 4<sup>th</sup> December 2008.

The limit was not previously exceeded at this location since September 2006. The elevated ammonia levels may be associated with discharges to the Fergus from the combined storm overflows mentioned above, taking account of the elevated rainfall during the sampling events. SW7 is also monitored on a monthly basis under a separate monitoring programme for compliance with the salmonid waters regulations. Clare County Council staff and the Roscommon Regional Laboratory carry out this monitoring programme. Ammonia results obtained under this monitoring regime were all within the limits for salmonid waters. These results are shown below in figure 18a.

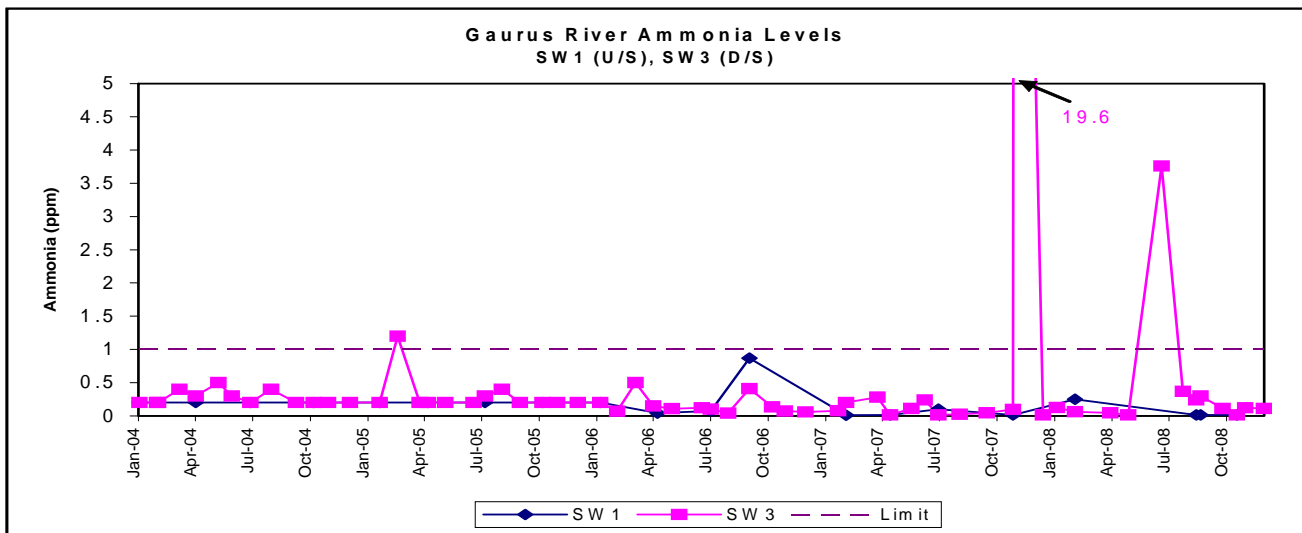
**Figure 18**



**Figure 18a**



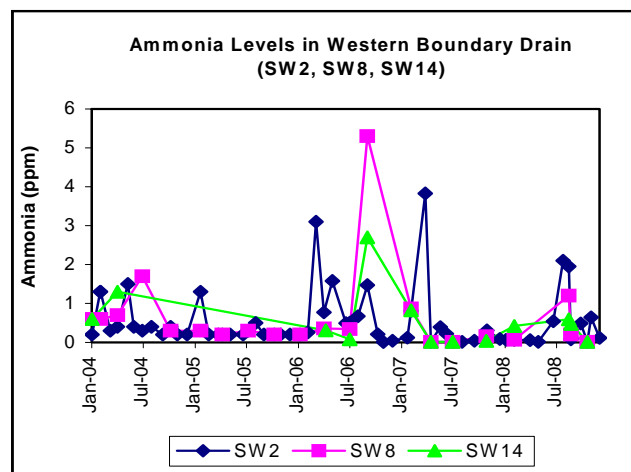
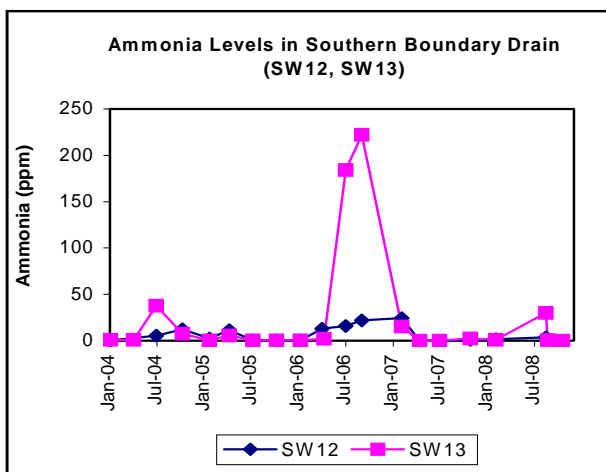
Ammonia results for Gaurus river location SW1 (upstream of the landfill) have been below 1ppm for the five-year period from January 2004. Ammonia results at SW3 (downstream of the landfill) have also been below 1ppm except for two occasions, in November 2007 and in July 2008. The SW3 result for November 2007 was unusually elevated at 19.6ppm (see 2007 AER). Results for a repeat sample taken at the end of November 2007 were satisfactory (0.013ppm). The SW3 ammonia result in June 2008 was also slightly elevated at 3.76ppm. The results for the rest of the year were well below 1ppm. **Figure 19**



Ammonia results for the western and eastern boundary drains from January 2004 to December 2008 are shown in figures 20 and 21.

**Figure 20**

**Figure 21**



On the eastern boundary drain, ammonia levels at SW13 and to a lesser extent at SW12 were elevated on a number of occasions in mid 2006 (see figure 20 above). This was attributed to leachate breakout in the vicinity of SW13 and was reported to the EPA in a separate communication (see quarterly monitoring report for August to November 2006). The breakout area was sealed in early 2007. A full report of the investigation was included in the quarterly monitoring report for August to November '06. Results since February 2007 have been consistently quite low (<4ppm) with the exception of an elevated ammonia result for SW13 on the 18<sup>th</sup> July 2008 (30.1ppm). Monitoring at this sample location was repeated one week later and a result of 0.6ppm ammonia was obtained.

Ammonia results for western boundary drain samples have been consistently quite low throughout the monitoring period (see figure 21).

#### **4.4.3 Leachate**

Leachate monitoring was conducted in accordance with Schedule E.4 of Waste Licence W0031-01 for the parameters and at the monitoring frequency specified in Table E.4.1 at locations L1, L6, L7, L8 and L9 (see Drawing No. 1 in Appendix I for locations). A new leachate abstraction well (L10) was installed in mid 2008 in zone 3 of the landfill. Monitoring of this well commenced in July 2008.

Ammonia, BOD and COD results for leachate wells are graphed in figures 22 to 26.

As would be expected given the locations of L8, L9 and L10 in Zone 3 (the area of most recent waste deposition) BOD, COD and ammonia levels were higher in these wells than in zone 1 (L1) and zone 2 (L6).

Figure 22

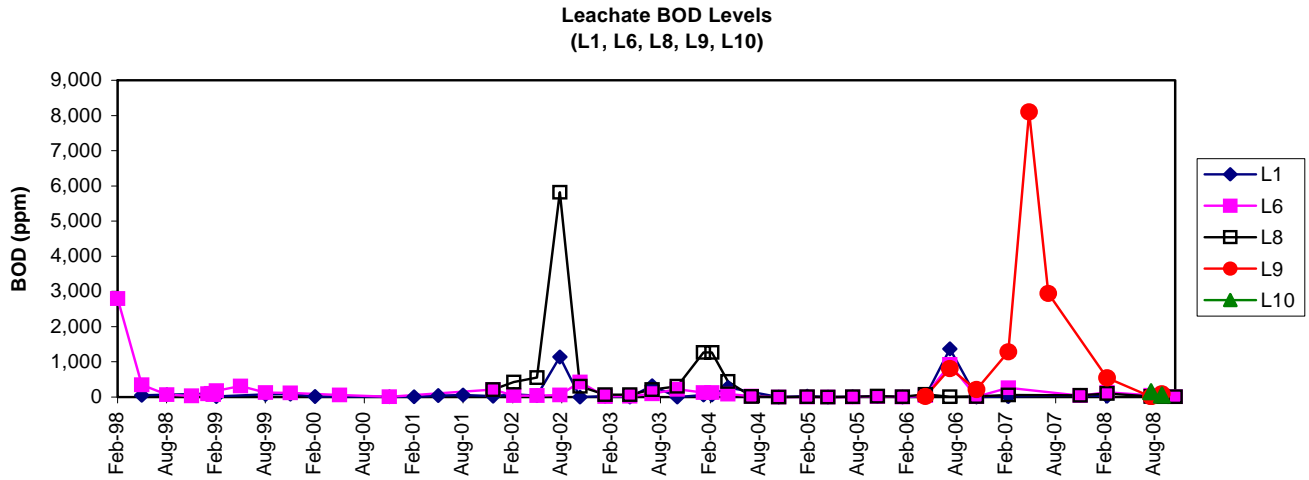


Figure 23

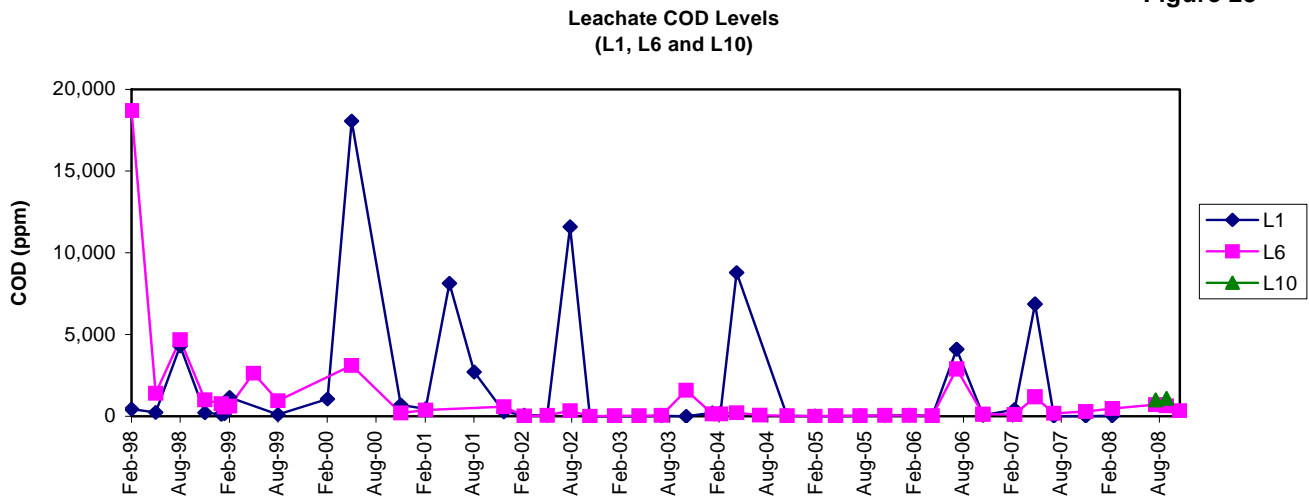


Figure 24

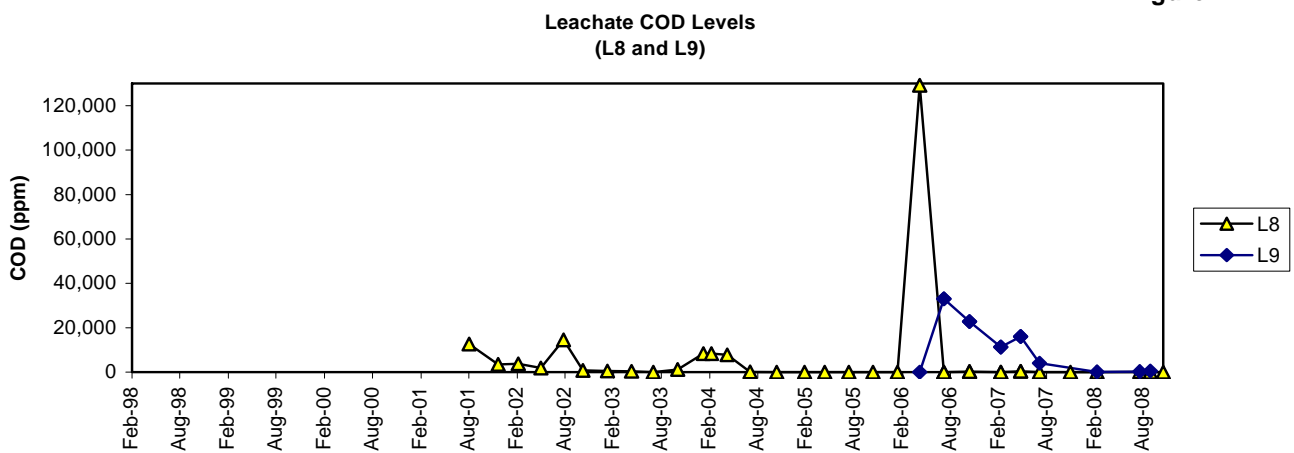


Figure 25

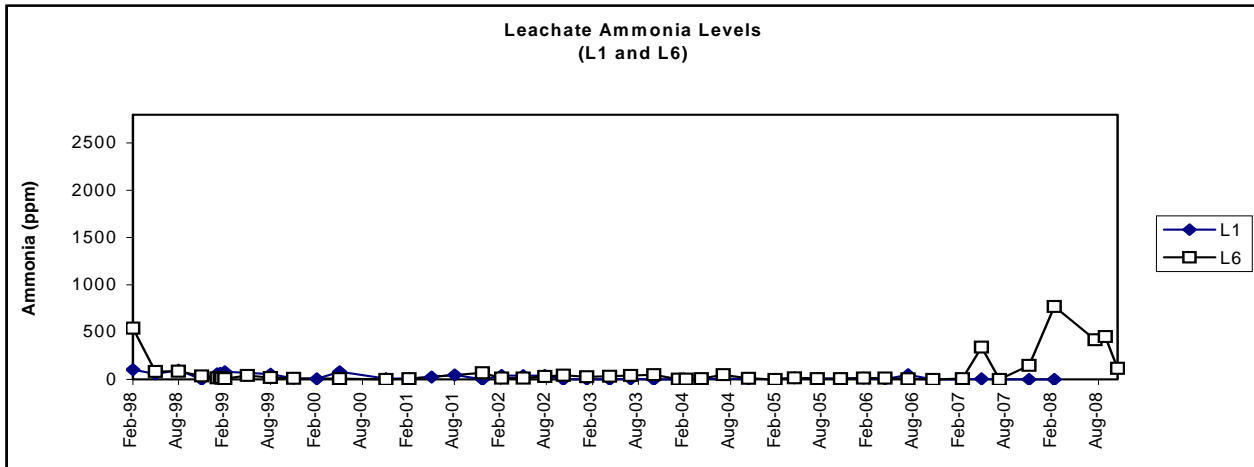
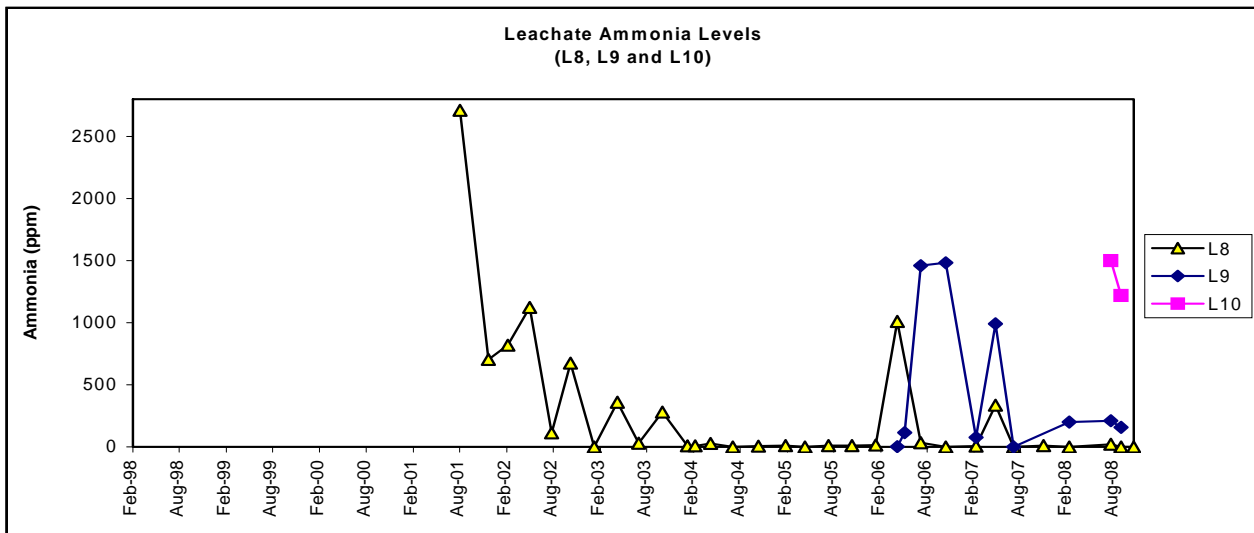


Figure 26



Abstraction of leachate from L6, L8, L9 and L10) was ongoing up to August/September 2008, with approximately 20m<sup>3</sup> of leachate removed each week for treatment at Sixmilebridge WWTP. No leachate was taken off site in October and November 2008 due to the power supply to the leachate pumps being interrupted. Leachate abstraction recommenced in December 2008 although only very small quantities have since been pumped. We are currently experiencing problems with the existing pumps. These will be repaired or replaced as required within the next four weeks.

#### 4.5 Landfill Gas Flare Unit.

Emissions to atmosphere from the enclosed landfill gas flare were monitored in accordance with the requirements of Schedule E.5. of Waste Licence W0031-01. This monitoring was carried out by TMS Environment monitoring staff, on the 3<sup>rd</sup> September and the xxth December 2008. Monitoring results are presented below in Table 4.3:

**Table 4.3: Flare Monitoring Results:**

Parameter/units	3 <sup>rd</sup> September 2008	2 <sup>nd</sup> December'08	Emission Limit <sup>1</sup>
Nitrogen Oxides (NO <sub>x</sub> ) as NO <sub>2</sub> (mg/Nm <sup>3</sup> )	131.2	122	150 mg/m <sup>3</sup> for Flare Stacks
Carbon Monoxide (CO) (mg/Nm <sup>3</sup> )	27.5	41.7	50 mg/m <sup>3</sup> for Flare Stacks
Sulphur Dioxide (SO <sub>2</sub> ) (mg/Nm <sup>3</sup> )	<5.7	9.5	-
Temperature (°C)	873	898	-
Volumetric Flow Rate (Nm <sup>3</sup> /hr)	425	265	-
Vinyl Chloride (mg/Nm <sup>3</sup> )	<1.40	-	-
Acetonitrile (mg/Nm <sup>3</sup> )	<1.40	-	-
Dichloromethane (mg/Nm <sup>3</sup> )	<1.40	-	-
Tetrachloroethylene (mg/Nm <sup>3</sup> )	<1.40	-	-
TA Luft Class I (mg/Nm <sup>3</sup> )	<1.40	-	20 mg/m <sup>3</sup> (at mass flows >0.1 kg/hr)
TA Luft Class II (mg/Nm <sup>3</sup> )	<1.40	-	100 mg/m <sup>3</sup> (at mass flows >2 kg/hr)
TA Luft Class III (mg/Nm <sup>3</sup> )	<1.40	-	150 mg/m <sup>3</sup> (at mass flows >3 kg/hr)
HCl (mg/Nm <sup>3</sup> )	<3.59	-	50 mg/m <sup>3</sup> (at mass flows >0.3kg/hr)
HF (mg/Nm <sup>3</sup> )	<0.72	-	5 mg/m <sup>3</sup> (at mass flows >0.05 kg/hr)

All results were within emission limit values specified in Schedule F.4. of Waste Licence W0031-01.



## **4.6 Biological Monitoring**

A Biological Monitoring survey was carried out in May and August 2008 in accordance with Condition 9, Schedule E of WL 31-1. Results were provided to the Agency under separate cover. Survey conclusions are summarised below:

### **4.6.1 Gaurus River**

At Gaurus Bridge (Site WQ1) c.750m upstream of the landfill, a slight deterioration in water quality was observed in the August 2008 survey. A Q3 rating was obtained for this site, compared to Q3-4 in previous surveys. This does not appear to be related to the landfill. Ennis Town Council are currently investigating a problem with an overflow from a pumping station located in the area.

A deterioration was also observed at Site WQ3, adjacent to the landfill, from a Q3 to a Q2-3. A possible negative impact from the landfill cannot be ruled out at this site. An additional location will be monitored upstream of WQ3 in May 2009, in order to provide more data on water quality on the Gaurus river, upstream of the facility.

### **4.6.2 Fergus River**

Three sites are monitored on the Fergus river: WQ4, WQ5 and WQ6. Sites WQ4 and WQ6 upstream and downstream of the confluence of the Fergus and Gaurus rivers, were given tentative Q-ratings of Q3 in 2008, indicating moderately polluted conditions. Sites WQ4 and WQ6 upstream and downstream of the confluence of the Fergus River and the Gaurus river were given tentative Q-ratings of Q3, indicating moderately polluted conditions. Site WQ5 downstream of the drain entering the river from the facility a short distance upstream of the bridge, was also given a tentative Q-rating of Q3. The consultant's report states that it cannot be concluded from the invertebrate data that there is an adverse impact on the Fergus from the landfill; however, given the tentative nature of the Q-ratings at these sites a minor impact cannot be ruled out. A summary of monitoring results obtained since April 2002 is given below in Table 4.4.

**Table 4.4: Summary of monitoring results 2002 – 2008.**

	WQ1	WQ2	WQ3	WQ4	WQ5	WQ6
<b>April 2002</b>	4-5	3-4	3	3	3	3
<b>May 2002</b>	4	3-4	3	3	3	3
<b>April 2003</b>	4	3-4	3	3	3	3
<b>June 2003</b>	3-4	3-4	3	3	3	3
<b>Sept. 2003</b>	3-4	3	3	3	3	3
<b>July 2004</b>	3	3	3	3	3	3
<b>Sept 2004</b>	3-4	3	3	3	3	3
<b>May 2005</b>	3-4	3	3	3	3	3
<b>Sept 2005</b>	3-4	3-4	3	3	2-3	3
<b>May 2006</b>	3-4	3	3	2-3	2-3	2-3
<b>Sept 2006</b>	3-4	3	3	3	3	3
<b>May 2007</b>	3-4	3	3	3	3	3
<b>Aug 2007</b>	3	3	3	3	3	3
<b>May 2008</b>	3-4	3	3	3	3	3
<b>Aug 2008</b>	3	3	2-3	3	3	3

#### **4.7 Odours**

No odour problems were encountered during the reporting period.

## 5.0 Monthly Water Balance Calculations and Interpretation

Total effective rainfall for the reporting period was calculated using monthly data from the Shannon Airport Meteorological Station. Rainfall details are summarised in Table 5.1:

**Table 5.1 Rainfall Details For Shannon Airport From January to December 2008**

Month /Year	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Rainfall	223.9	58.0	102.9	49.2	35.9	110.8	100.8	176.6	86.4	156.4	92.2	75.1
P <sup>1</sup>	19.4	20.2	36.2	58.0	90.9	79.5	76.2	57.0	43.7	25.1	11.2	10.7
ER <sup>2</sup>	204.5	37.8	66.7	-8.8	-55	31.3	24.6	119.6	42.7	131.3	81.0	64.4

Note<sup>1</sup>: Evapotranspiration values (Penman).

Note<sup>2</sup>: Effective rainfall

The effective rainfall for the period January to December 2008 was **740.1mm**.

The water balance calculation for the period is set out in Table 5.2 below:

**Table 5.2: Water Balance Calculation at Infiltration Rates from 10-30%.**

Capped area infiltration (%)	Active Area	Active area infiltration	Capped Area (m <sup>2</sup> )	Total rainfall (m)	Net Leachate 2008 (m <sup>3</sup> )
30%	0	0	186,900	0.741	41,548
20%	0	0	186,900	0.741	27,698
10%	0	0	186,900	0.741	13,849

As for previous reports, the rainfall infiltration through capping was assessed at three infiltration rates (10%, 20% and 30%), based on a variation in capping thickness throughout the site. At these infiltration rates, the theoretical total leachate production for the period ranged from 13,849 m<sup>3</sup> to 41,548m<sup>3</sup>. Final capping has been in place throughout the site since early November 2008 so in practice, the actual amount of rainfall infiltration will be at the lower end of the range from that time.

## 6.0 Volume of Leachate Produced and Discharged On Site

The theoretical assessment of leachate generation at the Doora site was based on the monthly water balance calculation provided in Table 5.2. As the landfill was operated on the “dilute and disperse” principle, it is not possible to provide an absolute value for leachate volumes arising during the year. The volume of leachate produced is linked to two external factors (in addition to the moisture content of the waste deposited):

- Possible infiltration from tidal movement as the landfill site is below the high water mark.
- Rainfall infiltration.

Infiltration from tidal movement cannot be quantified. An assessment of tidal infiltration was made from two wells in Zones 2 and 3 in January 2004 and no link was found (8m well depth). This assessment was not carried out in Zone 1 so the possibility of tidal infiltration can't be ruled out here but observations from monitoring data indicate that Zone 1 is virtually dry with very little leachate produced.

The most significant factor limiting rainfall infiltration and resultant leachate production at Doora is the extent of capping in place at the facility. Prior to November 2008, there were varying depths of soil cover through the site. Trial pit investigations revealed that the majority of Zone 3 had a capping thickness of >1.5m. The southern part of Zone 3 had up to 6m of cover and in the northeast, the cover ranged from 3.5 to 5m. Less capping was in place in the older landfilled zones - Zones 1 and 2. Areas in each of these zones had between 0.5 and 2m of capping in place but there were sections with less than 0.5m of cover. Since November 2008, the required thickness of final capping material has been in place throughout the site and rainfall infiltration should now be minimal.

Based on the water balance calculations for the period (given in table 5.2), the theoretical minimum daily volume of leachate generated was 38m<sup>3</sup> and the maximum volume generated was 113m<sup>3</sup>. This assumes that the level of rainfall infiltration ranges from 10% to 30%, depending on the level of capping in place.

## **7.0 Cumulative Annual Emissions to Groundwater**

Leachate is the most significant emission to groundwater from the site. Monitoring results indicate that leachate is more likely to be discharging to ground than to surface waters. Theoretical leachate volumes are addressed in Sections 5 and 6 above. In summary, the theoretical leachate generation for 2008 ranged from 38 to 113m<sup>3</sup> per day. The direction of groundwater flow is northeast to southwest across the site, towards the Fergus river. Additional wells will be installed in 2009 to establish whether the groundwater flows into the Fergus river. Existing information from investigations on Drumcliffe Springs in the same bedrock body, located approx x km to the northeast of the landfill, indicate that there is No hydrological link between surface and groundwater bodies.

Continuous leachate abstraction has been taking place at the site since 2006 although this process was interrupted in the latter end of 2008 due to works associated with the landfill restoration project. We will provide a report on the effect of leachate abstraction and final capping on groundwater quality, by the end of 2009.

## **8.0 Resource and energy consumption**

### **8.1 Fuels usage**

All machinery fuel use on site during 2008 was related to the landfill restoration project, which commenced in August 2008 and was ongoing through December. The estimated fuels usage due to these works can be obtained from the contractor if requested.

### **8.2 Electrical usage:**

The facility is a closed landfill site with no power-consuming equipment in use except for the landfill gas flare and the leachate abstraction pumps. Approximate data on electrical usage for the period is as follows:

Day Units: 18,000

Night Units: 9,000

### **8.3 Water usage**

No full-time staff have been employed at the site since October 2004. Only monitoring personnel access the site at present. Monitoring staff work on site for one to two days per week with occasional use of the toilet facilities, giving an estimated maximum water usage of 60 litres per week (2 x 30litres per day).

Calculated water usage from January to December 2008 3.0m<sup>3</sup>.

## **9.0 Review of nuisance controls**

### **9.1 Site Inspection**

As Doora landfill is a closed facility, site inspections are no longer formally carried out. However Council staff visit the facility once per week at a minimum, to carry out surface water visual inspections and to measure gas and leachate levels. No nuisance was noted during these site visits.

### **9.2 Litter Control**

Doora landfill is a closed facility. The most significant potential issue in relation to fresh litter would be fly tipping outside the site entrance. There was no incidence of fly tipping during this reporting period. Clare County Council personnel carry out informal litter audits as part of the weekly surface water visual inspection surveys. There were no litter problems noted.

### **9.3 Bird Control**

No bird nuisance was observed by Council staff or reported to the Council by any other person during the reporting period. Since closure of the landfill and capping of the waste body birds have not been a problem.

### **9.4 Odour Control**

No odours were observed by Council staff or by our monitoring consultants during this reporting period. The Council received no complaints of odours relating to Doora landfill during the period.

## **10.0 Environmental objectives and targets for 2003–2007**

A copy of the Environmental Objectives and Targets is included in Appendix II.

## **11.0 Summary of procedures developed in 2008.**

No new procedures were developed during this reporting period.

## **12.0 Incidents**

Ten incident reports were submitted to the Agency during this reporting period. Details are provided in Table 12.1 below:

**Table 12.1: Summary of Incident Reports for the period.**

<b><i>Incident Report No.</i></b>	<b><i>Details of Incident</i></b>	<b><i>Follow-up action taken</i></b>
<i>Doora 08/01</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>Weekly monitoring to continue. No other action deemed necessary as this is considered to be a naturally occurring phenomenon-these off-site wells were installed in peat. No methane has been detected in either perimeter well since installation in August 2005.</i>
<i>Doora 08/02</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>
<i>Doora 08/03</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>
<i>Doora 08/04</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>
<i>Doora 08/05</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>
<i>Doora 08/06</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>
<i>Doora 08/07</i>	<i>Dust monitoring results at D5 were above the dust deposition limit in August 2008r</i>	<i>None considered necessary. Exceedance is not considered to be due to site activities-algal growth in sample</i>
<i>Doora 08/08</i>	<i>Dust monitoring results at D4 and D5 were above the dust deposition limit in August 2008r</i>	<i>None considered necessary. Exceedance is not considered to be due to site activities-algal growth in sample</i>
<i>Doora 08/09</i>	<i>No incident. This number was inadvertently omitted.</i>	<i>N/A</i>
<i>Doora 08/10</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>
<i>Doora 08/11</i>	<i>Carbon dioxide levels exceeded the CO<sub>2</sub> trigger of 1.5% at OSW2</i>	<i>See 08/01 above</i>

## **12.2 Complaints**

No complaints were received during the reporting period.

### 13.0 Development works undertaken and

### 14.0 Proposed development of the facility with timescale

Restoration of the landfill commenced in Summer 2008. As part of the facility restoration, the site will be developed for recreational purposes. The completed development will include two sports pitches (to be located in Zone 1). A new entrance will be constructed to the east of the existing entrance, giving access to a public car park. From the car park there will be pedestrian-only access to the sports pitches and to zones 2 and 3, which will have a network of landscaped scenic walks. The project is expected to be completed by Summer 2009.

### 15.0 Annual and cumulative quantities of landfill gas

The following information in relation to annual and cumulative quantities of landfill gas was obtained using the US EPA E-Plus landfill gas modelling program which utilises two methods for estimation of landfill gas and methane production:

- i) The First Order Decay method uses the waste in place as well as factors accounting for the emissions of methane from this waste over time.
- ii) The WIP-30 method uses the amount of waste in place over the past thirty years to estimate methane emissions.

Data generated from both methods is provided in Table 15.1:

**Table 15.1 Landfill gas and methane production**

End of year	Model	Methane m <sup>3</sup> /yr (x10 <sup>6</sup> )	Landfill Gas m <sup>3</sup> /yr (x10 <sup>6</sup> )
2008	1 <sup>st</sup> Order Decay	0.88	2.74
2008	WIP-30	1.88	5.89

This information was provided by RPS McHugh in September 2003 and was based on weighbridge data for waste tonnage information from 1998 to 2001 and on estimated tonnages for the period prior to 1998. As part of the restoration and aftercare plan for Doora landfill, the Landgem gas generation model was run for the facility in August 2006, with each of the three zones addressed separately. Results from this model for 2008 are shown below in table 15.2:



**Table 15.2: Results from Landgem Gas Model for 2008**

<b>Zone</b>	<b>Methane m<sup>3</sup>/yr</b>	<b>Landfill Gas m<sup>3</sup> /yr</b>
<b>1</b>	0.003262	0.01314
<b>2</b>	22.98	45.96
<b>3</b>	1,384,000 (rounded)	2,768,000 (rounded)
<b>Total:</b>	<b>1,384,000 (rounded)</b>	<b>2,767,692</b>

The final landfill gas production figures derived using the Landgem model were similar to the figures obtained using the 1st Order Decay method. The Landgem model is based on the original first order decay model. The additional information provided from running each zone separately under the Landgem model indicates, as would be expected, that practically all of the theoretical tonnage of landfill gas generated is coming from Zone 3.

## **16. Financial provisions, staffing and public information.**

### **16.1 Budgetary allocations for the facility.**

The maintenance budget for the facility for 2008 is €96,000. The cost of permanent restoration and landscaping is €1.3m.

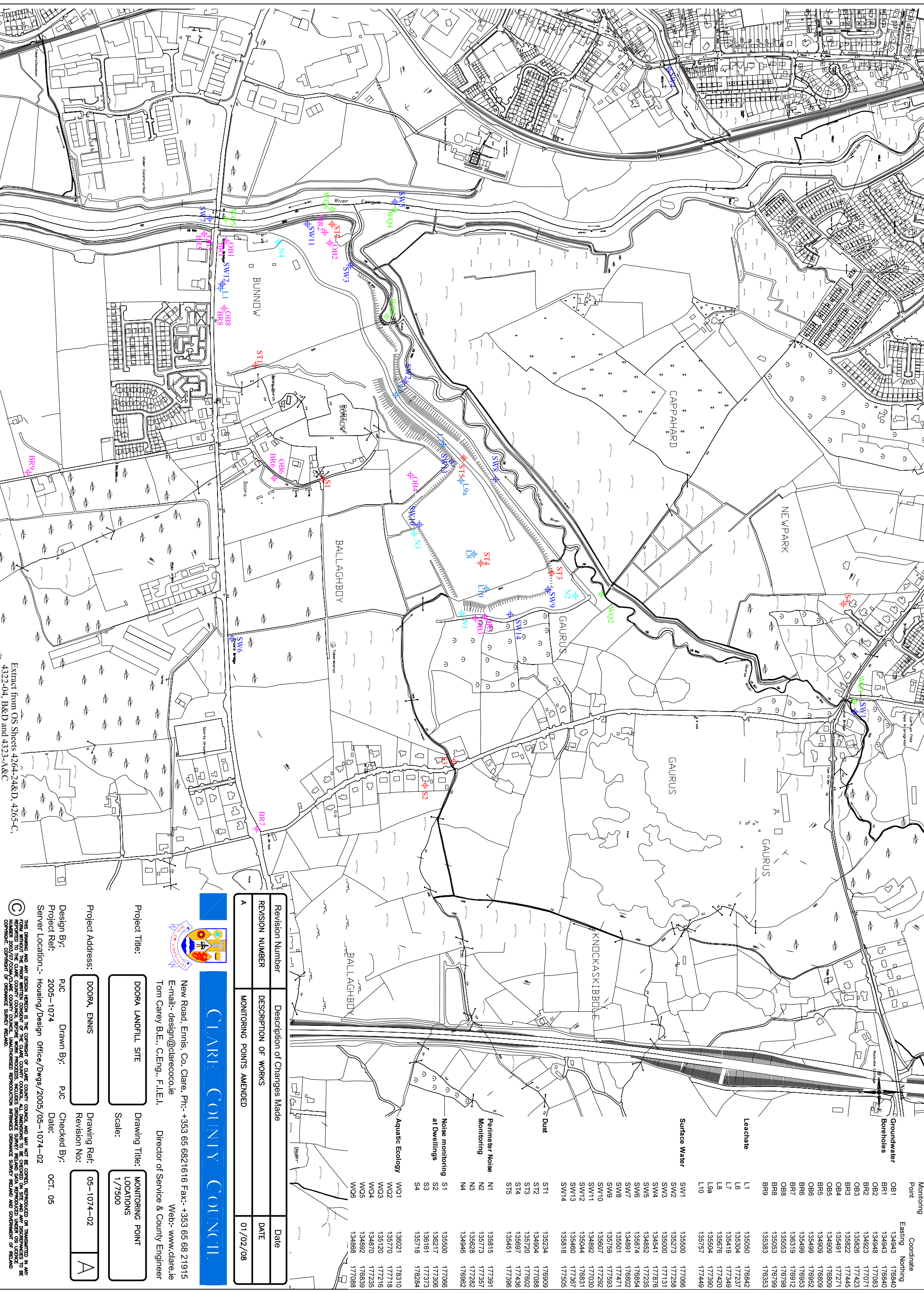
### **16.2 Public Information.**

Information relating to monitoring of the facility and correspondence to/from the EPA is available for inspection at the Environment Section of Clare County Council, Áras Contae An Chláir, New Road, Ennis, County Clare.

APPENDIX II

**Schedule of Objectives and Targets.**





Monitoring Point	Coordinate
Easting	Northing
OB1	176840
BR1	134943
OB2	134943
BR2	177083
OB3	134923
BR3	177071
OB4	134822
BR4	177423
OB5	13481
BR5	177271
OB6	134909
BR6	176809
OB7	134909
BR7	176809
OB8	13499
BR8	176952
OB9	13499
BR9	176952
OB10	13499
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OB100	13499
BR100	176952

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Project Title: DOORA LANDFILL SITE MONITORING POINT LOCATIONS  
 Scale: 1/7500

Project Address: DOORA, ENNIS  
 Drawing Ref: 05-1074-02  
 Revision No: A

Design By: PJC Drawn By: PJC Checked By: OCT. 05  
 Project Ref: 2005-1074  
 Server Location: Housing/Design Office/Dwgs/2005/05-1074-02

Revision Number | Description of Changes Made | Date

REVISION NUMBER	DESCRIPTION OF WORKS	DATE
A	MONITORING POINTS AMENDED	01/02/08

Revision Number | Description of Changes Made | Date

Revision Number	Description of Changes Made	Date
1	MONITORING POINTS AMENDED	01/02/08

Groundwater Boreholes: OB1, BR1, OB2, BR2, OB3, BR3, OB4, BR4, OB5, BR5, OB6, BR6, OB7, BR7, OB8, BR8, OB9, BR9

Surface Water: SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, SW11, SW12, SW13, SW14

Leachate: L1, L6, L7, L8, L9a, L10

Dust: ST1, ST2, ST3, ST4, ST5

Perimeter Noise Monitoring: N1, N2, N3, N4

Noise monitoring at Dwellings: S1, S2, S3, S4

Aquatic Ecology: WO1, WO2, WO3, WO4, WO5, WO6

Extract from OS Sheets 4264-24&D, 4265-C, 4322-04, B&D and 4323-A&C

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APPENDIX II

**Schedule of Objectives and Targets.**

***DOORA LANDFILL***

***WASTE LICENCE***

***Ref W0031-01***

**ENVIRONMENTAL OBJECTIVES AND TARGETS**

**FOR PERIOD 2008-2009**

## **Environmental Objectives and Targets**

### **Objective 1**

Comply with all aspects of the licence.

Target 1.1 - Every effort will be made to comply with all conditions of the waste licence by the prescribed dates.

The Senior Engineer, Executive Engineer, Executive Environmental Scientist and various contractors under the supervision of Clare County Council staff have responsibility for implementing this objective.

Performance against Target: - Waste licence requirements have been complied with in a timely manner on all occasions except on occasion in relation to quarterly reports where delay in receipt of reports from consultants resulted in a delay in submission of reports to the Agency.

### **Objective 2**

Ensure that sufficient funds are available to comply with Condition 11 of the licence.

Responsibility for ensuring compliance with this objective lies with the Finance Officer of Clare County Council.

Performance against Target: Satisfactory.

### **Objective 3**

Rehabilitate the closed landfill.

Target 3.1 – Ensure that the site is restored in accordance with a plan submitted to the EPA and ensure good aftercare.

The Senior Engineer, Environmental Services has responsibility for implementing this objective with the assistance of the Executive Engineer in charge and the Environmental Awareness Officer in the Environment Dept.

Performance against Target: On time. Restoration of the facility commenced in summer 2008 and is on target to be completed in August 2009.

### **Objective 4**

Develop the closed Landfill site as an amenity for the public.

Target 4.1 – Restore the site to a green field site and develop playing pitches and facilities for the general public. These facilities to be developed by the year 2008.

The Executive Engineer in charge has responsibility for implementing this objective.

**Performance against Target:** Upon completion of remediation works two playing pitches and a series of public walkways will be assessable from a carpark facility on the site.

### **Objective 5**

Improve correspondence with the E.P.A.

Target 5.1 - Council will make every effort to reply to letters of correspondence received from the Agency by the requested dates.

The Executive Engineer in charge and Senior Staff Officer have responsibility for implementing this objective.

Performance against Target: The Council has responded to EPA communications by prescribed dates

### **Objective 6**

Continue monitoring of site for leachate and landfill gas

Performance against Target: The Council is in compliance with this objective on an ongoing basis. Upon completion of the remediation works improved gas and leachate infrastructure will have been installed on site.

### **Time scale**

The time scale for achieving these objectives is generally outlined in the target description. The others are generally ongoing and the aim is to achieve progress before the next review of the E.M.P.

### **Designation of Responsibilities**

The Senior Engineer, Environmental Services Section of Clare County Council has overall responsibility for the implementation of these objectives. The specific responsibilities for each objective are outlined in the description.

Responsibility for ensuring compliance with objective number 2 lies with the Finance Officer of Clare County Council.