6. WATER QUALITY

A number of parameters are monitored to assess water quality under the waste licence at the facility. There are no limit values set in the waste licence with regard to these monitored parameters. Therefore, where results are above method detection limits, they have been compared to the EPA Interim Guidance Values (IGVs) taken from the interim report "Towards Setting Guidance Values for the Protection of Groundwater in Ireland". These limits are generally taken from the lower limits of the Drinking Water Standards and the EQSs (Environmental Quality Standards for Surface Waters). Where significant variations in these limits exist, these are discussed in the text.

6.1. Surface Water Quality

Environmental monitoring points upstream and downstream of the landfill for the Tramore and Trabeg were assessed between 2001 and 2008 for several water quality indicator parameters, one of which (ammonium) is illustrated in Figures 6.1 and 6.2 as a semi-log plot. As shown, surface water quality was found to differ considerably between the Tramore and Trabeg rivers.

Figure 6.1: Surface Water Ammonium Results 2001-2008, Tramore River

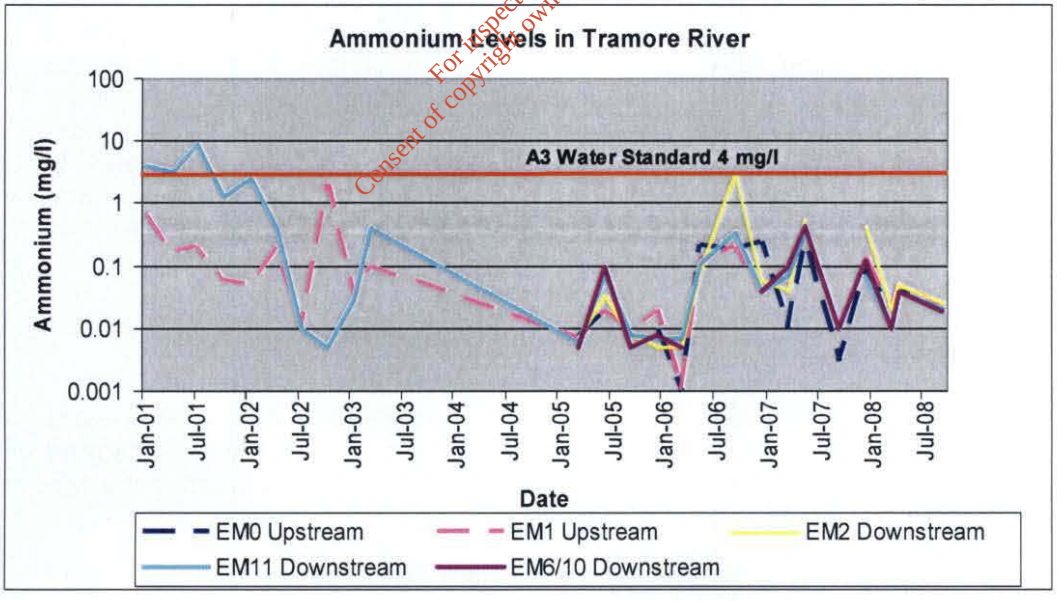
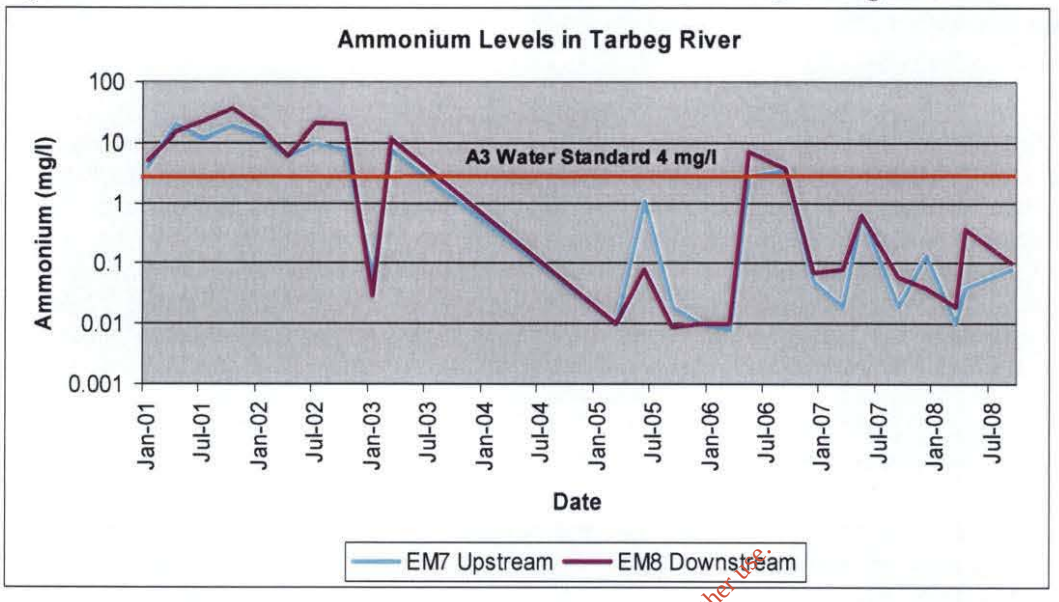


Figure 6.2: Surface Water Ammonium Results 2001-2008, Tarbeg River



Ammonium levels for 2001 to 2003 show a marked increase downstream of the landfill in the Tramore River indicating that it receives influxes of ammonium from the landfill site. A comparison with the recent data from 2007 and 2008 shows that the levels of ammonium detected in surface waters have reduced appreciably since 2003. The recent results also show that there is now no major difference between results taken upstream and downstream of the landfill site or between the Tramore or Trabeg rivers. Levels of ammonium recorded during 2007 and 2008 are below the surface water regulation A3 water standard of 4 mg/l (Quality of Surface Water Intended for Abstraction of Drinking Water, 1989), which indicates that this surface water can be used for drinking water purposes following intensive physical and chemical treatment. A detailed assessment of surface water quality is outside the scope of this report, however where relevant, results have been included below to assist with the assessment of the groundwater quality.

6.2. Bedrock Groundwater Quality

As discussed previously, two distinct hydrogeological environments exist at the Kinsale Road Landfill: an overburden groundwater table in the peat horizon, and an underlying bedrock aquifer in the limestone. The variable layer of silty clay separates the two hydrogeological environments from one another.

Bedrock groundwater quality is monitored by wells prefixed with BR or KC. With respect to groundwater flow direction, KC7/8 and BR1 are considered to be upgradient of the site, BR2 and BR7 are cross-gradient, and BR3 is downgradient of the landfill.

The waste licence conditions require analysis of a list of parameters which allow an assessment of groundwater quality to be assessed.

Parameters such as visual and odour, ammonium, conductivity, chloride and List I and List II parameters under the Groundwater Directive (80/68/EEC) are examined in this report from the test results obtained between 2006 and 2008, where available.

6.2.1. Visual inspection/Odour in Bedrock Water Samples

Each laboratory sample is assessed for visual or olfactory evidence of contamination. The results of the assessment are summarised below:

Table 6.1: Visual/Odour Assessment of Bedrock Groundwater

	KC7/8 (up gradient)	MWBR1 (up gradient)	MWBR2 (cross gradient)	MWBR7 (cross gradient)	MWBR3 (down gradient)
Mar-05	Good	Good		Poor	
Jun-05	Good	Good	Good		
Sep-05	Good	Good		Fair	
Dec-05		Good		Fair	
Mar-06	Good	Good		Good	
Sep-06	Good	Good			
Dec-06	Good	Good	Good		Poor
Mar-07	Good	Good	Fair		Poor
May-07	Good	Good	Fair		Poor
Sep-07	Good	Good	Fair	Fair	Poor
Dec-07	Good	Good	Fair	Poor	Poor
Mar-08	Good	Good	Good	Poor	Poor
Apr-08	Good	Good	Fair		Poor
Sep-08	Good	Good	Fair	Poor	Poor

The visual/olfactory evidence would suggest that the landfill is having some effect on the groundwater quality, particularly in a down-gradient direction, at MWBR3.

6.2.2. Ammonium, Chloride and Conductivity in Bedrock Water Samples

Figures 6.3 to 6.5 show groundwater quality parameters within the bedrock wells in terms of ammonium, chloride and electrical conductivity.

The results show consistently that poor quality water exists down-gradient of the landfill within WBR3 which suggests that direct leachate contamination at this location may be occurring. No results were obtained from WBR3 during 2005 and 2006 due to the well being recorded as dry during these years. For this reason, it is possible that this well may be malfunctioning due to improper sealing of the well or subsequent deterioration which may have resulted in direct migration of leachate into the well annulus. Further investigation would be required to confirm whether this is the case.

Figure 6.3: Ammonium, Chloride, Concentrations in Bedrock Wells

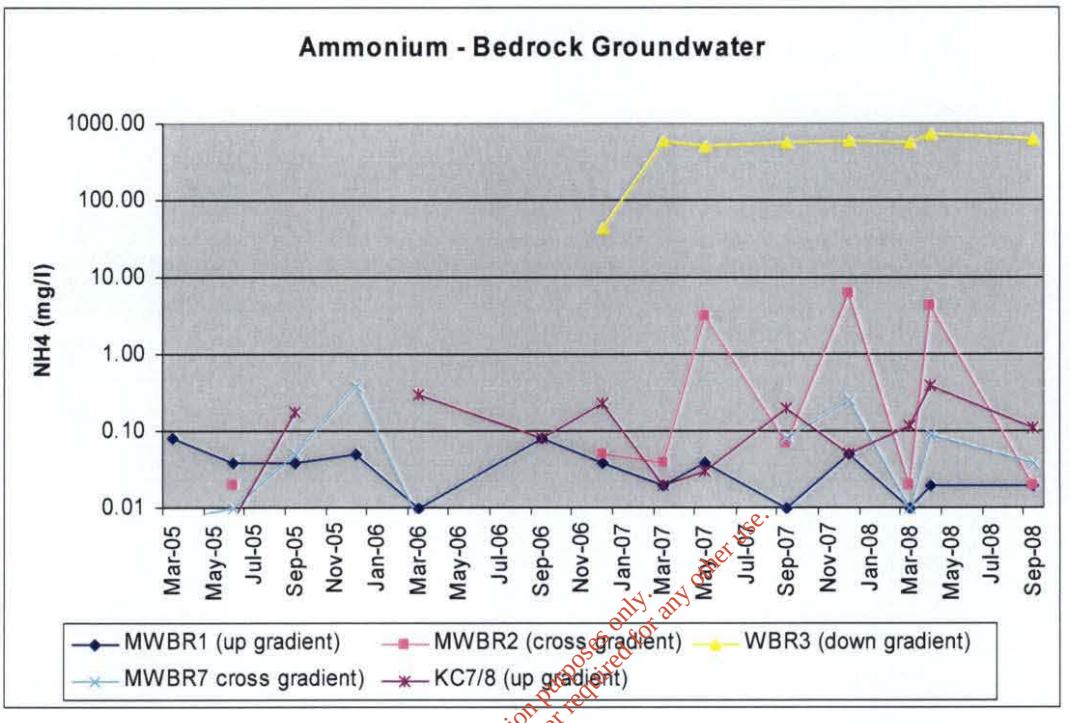


Figure 6.4: Chloride Concentrations in Bedrock Wells

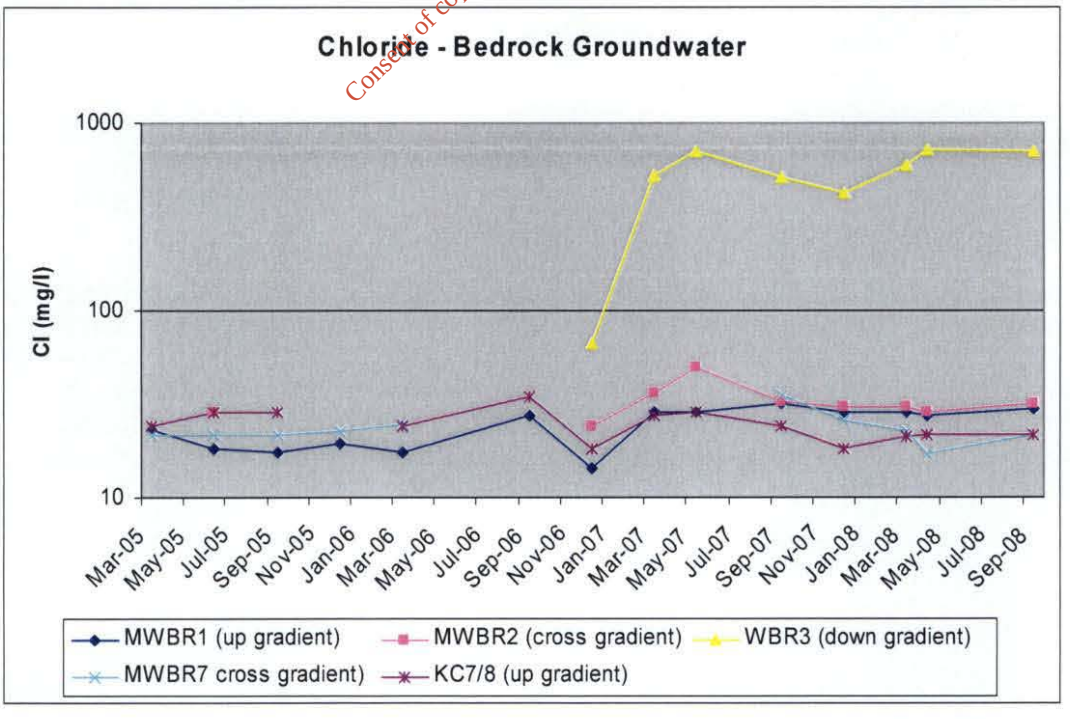
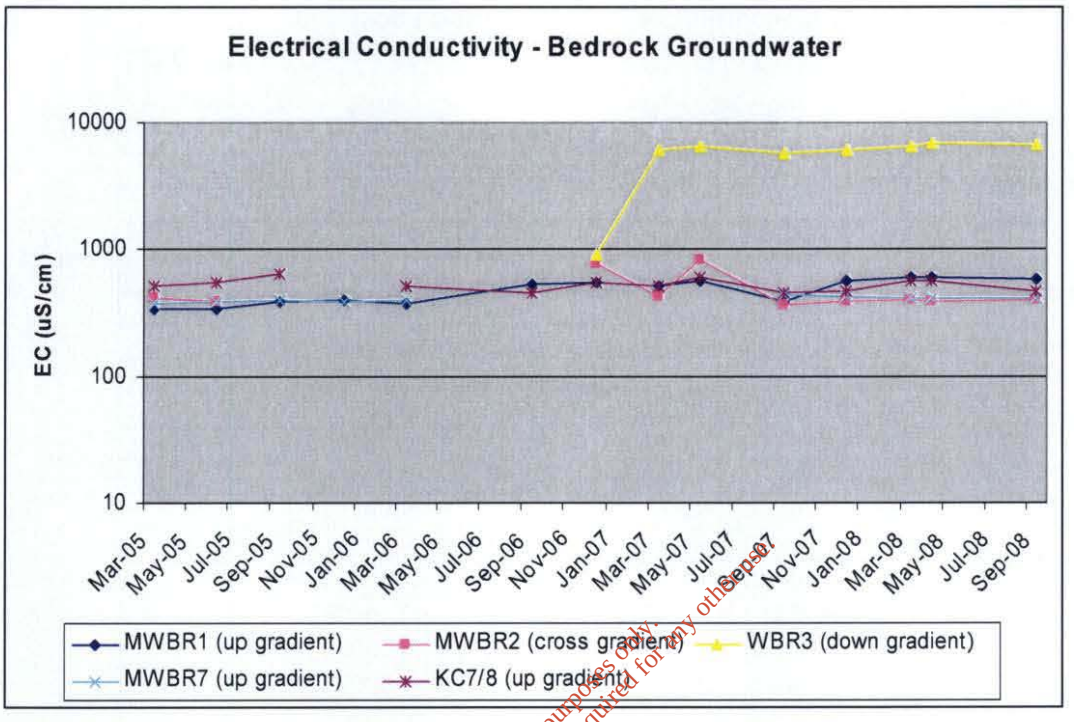


Figure 6.5: Conductivity Concentrations in Bedrock Wells



6.3. List I & List II Substances (EU Groundwater Directive 80/68/EEC)

In accordance with the terms of the Licence, certain substances listed within the Groundwater Directive are regularly monitored at selected well locations. The following sections give a brief discussion of the results of these analyses between 2005 and 2008.

6.3.1. Mercury

Mercury analysis was undertaken at a number of different locations between 2005 and 2008. Test results are given in the following table:

Table 6.2: Mercury Concentrations at Monitoring Locations

Area	Well Name	2005 mg/l	2006 mg/l	2007 mg/l	02/04/2008 mg/l	18/04/2008 mg/l
Bedrock Wells	BR1	<0.001	<0.0005	0.00105	<0.00005	
	BR2	<0.001		0.00021	<0.00005	
	BR3			0.00009	<0.00005	
	BR7	<0.001	<0.0005		<0.00005	
	KC7/8			0.00073	<0.00005	
Overburden Wells	OB1	<0.001	<0.0005	0.00057	<0.00005	
	OB2			0.00028	<0.00005	
	OB3			0.00009	<0.00005	
	OB7	<0.001	<0.0005	<0.00002	<0.00005	
Leachate Wells	PS1	<0.001	<0.0005	0.00043	<0.00005	
	PS2	<0.001	<0.0005	0.00011	<0.00005	
	PS3	<0.001	<0.0005	0.00034	0.00005	
	PS4	<0.001	<0.0005	0.00033	0.00005	
	PS5	<0.001	<0.0005	0.00029	<0.00005	
	PS6	<0.001	<0.0005	0.00031	<0.00005	
	PS7	<0.001	<0.0005	0.00016	<0.00005	
	PS8	<0.001	<0.0005	0.00033	<0.00005	
	PS9	<0.001	<0.0005	0.0007	<0.00005	
Perimeter Wells	NW1	<0.001	<0.0005	0.00008	<0.00005	
	NW2			0.00007	<0.00005	
	NW8	<0.001	<0.0005	<0.00002	0.00008	
	NW9	<0.001	<0.0005	0.00019	0.00007	
	NW3	<0.001	<0.0005	<0.00002	0.0002	
	NW4	<0.001	<0.0005	0.00002	0.0002	
	NW5			<0.00002	0.0001	
	NW6	<0.001	<0.0005	0.00008	0.0001	
	NW7	<0.001	<0.0005	0.00007	<0.00005	
Surface Water	EM0	<0.0001	<0.0005	0.00053	0.0006	<0.00005
	EM1	<0.0001	<0.0005	0.00088	0.0002	<0.00005
	EM2	<0.0001	<0.0005	0.00093	0.002	<0.00005
	EM11	<0.0001	<0.0005	0.00505	0.0002	<0.00005
	EM6	<0.0001		0.00871	0.012	<0.00005
	EM7	<0.0001	<0.0005	0.00126	0.0004	<0.00005
	EM8	<0.0001	<0.0005	0.00143	0.0003	<0.00005

Although mercury has not been routinely monitored within all site wells, some annual results are available, particularly for 2007 and 2008 with results above the EPA IGV for mercury of 0.001 mg/l as highlighted. The results show a marked decrease in mercury levels in both bedrock, overburden and leachate wells between 2007 and 2008. Much higher concentrations were noted within surface water samples, particularly within EM6 and EM11 (both located downstream on the Tramore River) during 2007, although all concentrations have decreased significantly in 2008. Analysis was repeated on the surface water samples in April 2008 and mercury concentrations had decreased below the limit of detection. The fact that low levels of mercury were also detected within the leachate wells would also suggest that the risks posed by mercury to the groundwater are minimal.

6.3.2. Cadmium

Table 6.3 below displays the cadmium analysis undertaken during 2005 to 2008.

Table 6.3: Cadmium Concentration at Monitoring Locations

Location	Well Name	2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.001	<0.001	<0.001	<0.001
	BR2	0.001		<0.001	0.001
	BR3			<0.001	0.001
	BR7	<0.001	<0.001		0.001
	KC 7/8	0.001	<0.001	<0.001	<0.001
Overburden Wells	OB1	0.001	<0.001	<0.001	0.001
	OB2			<0.001	<0.001
	OB3			<0.001	0.002
	OB7	0.001	<0.001	<0.001	0.001
Perimeter Wells	NW1	<0.001	<0.001	<0.001	<0.001
	NW2			<0.001	<0.001
	NW8	<0.001	<0.001	<0.001	<0.001
	NW9	<0.001	<0.001	<0.001	<0.001
	NW3		<0.001	<0.001	<0.001
	NW4	<0.001	<0.001	<0.001	<0.001
	NW5	<0.001		<0.001	<0.001
	NW6	<0.001	<0.001	<0.001	<0.001
	NW7	<0.001	<0.001	<0.001	<0.001
Leachate Wells	PS1	0.001	<0.001	<0.001	0.001
	PS2	<0.001	<0.001	<0.001	0.001
	PS3	0.001	<0.001	<0.001	0.001
	PS4	0.001	<0.001	<0.001	0.001
	PS5	<0.001	<0.001	<0.001	0.001
	PS6	0.001	<0.001	<0.001	<0.001
	PS7	0.001	<0.001	<0.001	0.001
	PS8	0.001	<0.001	<0.001	<0 .001
	PS9	<0.001	<0.001	<0.001	0.001
Surface Water	EM0	0.001	<0.001	<0.001	<0.001
	EM1	0.001	<0.001	<0.001	<0.001
	EM2	<0.001	<0.001	<0.001	<0.001
	EM11	0.001	<0.001	<0.001	<0.001
	EM6/10	<0.001		<0.001	<0.001
	EM7	0.001	<0.001	<0.001	<0.001
	EM8	<0.001	<0.001	<0.001	<0.001

Cadmium concentrations are low and are predominantly at or below the detection limit of the laboratory with the exception of one sample taken from well OB3 during 2008 which was marginally above the detection limit.

While this may indicate contamination of groundwater, a maximum concentration of 0.001 mg/l was recorded within the leachate samples and all recorded levels are well below the EPA IGV concentration of 0.005 mg/l and are therefore not considered to present a risk to groundwater. Surface water results are also below detection limits for cadmium.

6.3.3. Cyanide

Table 6.4: Cyanide Concentrations at Monitoring Locations

Location	Well Name	2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	<0.0002	<0.0005	<0.005	<0.005
	BR2	<0.0002		<0.005	<0.005
	BR3			<0.005	<0.005
	BR7	<0.0002	<0.0005		<0.005
	KC 7/8	<0.0002	<0.005	<0.005	<0.005
Overburden Wells	OB1	<0.0002	<0.005	<0.005	<0.005
	OB2	-	-	<0.005	<0.005
	OB3	-	-	<0.005	<0.005
	OB7	<0.0002	<0.005	<0.005	<0.005
Perimeter Wells	NW1	<0.005	<0.005	<0.005	<0.005
	NW2	-	-	<0.005	<0.005
	NW8	<0.005	<0.005	<0.005	<0.005
	NW9	<0.005	<0.005	<0.005	<0.005
	NW3	<0.005	<0.005	<0.005	<0.005
	NW4	<0.005	<0.005	<0.005	<0.005
	NW5	-	-	<0.005	<0.005
	NW6	<0.005	<0.005	<0.005	<0.005
	NW7	<0.005	<0.005	<0.005	<0.005
Leachate Wells	PS1	<0.0002	0.01	<0.005	<0.005
	PS2	0.0007	<0.005	0.01	<0.005
	PS3	<0.0002	<0.005	0.005	<0.005
	PS4	<0.0002	<0.005	0.006	<0.005
	PS5	<0.0002	0.01	<0.005	<0.005
	PS6	<0.0002	<0.005	<0.005	<0.005
	PS7	<0.0002	<0.005	<0.005	<0.005
	PS8	<0.0002	<0.005	<0.005	<0.005
	PS9	<0.0002	<0.005	<0.005	<0.005

This parameter is not monitored in surface water under the facility's waste licence.

Monitoring results show some elevated results above the detection limit of <0.005 in the leachate wells at the facility during 2006 and 2007. None of the results however exceeded the EPA IGV for cyanide of 0.01 mg/l although this figure was reached but not exceeded at three of the leachate wells. Recorded levels in leachate decreased in 2008 to below the detection limit. All groundwater cyanide levels were below the detection limit. Therefore, the groundwater and surface water is not considered to be at risk by cadmium from leachate.

6.3.4. Metals

Table 6.5: Lead Concentrations at Monitoring Locations

Location	Well Name	Lead			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.001	<0.001	<0.001	<0.001
	BR2	0.001	-	0.001	<0.001
	BR3	-	-	0.002	0.001
	BR7	0.001	<0.001	-	<0.001
	KC 7/8	-	-	<0.001	<0.001
Overburden Wells	OB1	0.001	<0.001	<0.001	<.001
	OB2	-	-	<0.001	<.001
	OB3	-	-	<0.001	0.001
	OB7	0.001	0.002	0.001	0.001
Perimeter Wells	NW1	0.001	<0.001	<0.001	<0.001
	NW2	-	-	0.001	<0.001
	NW8	0.001	<0.001	0.001	<0.001
	NW9	0.001	<0.001	<0.001	<0.001
	NW3	0.001	<0.001	0.001	<0.001
	NW4	0.002	0.001	0.001	<0.001
	NW5	-	-	<0.001	<0.001
	NW6	0.001	<0.001	<0.001	<0.001
	NW7	0.001	<0.001	<0.001	<0.001
Leachate Wells	PS1	0.001	0.003	0.001	<0.001
	PS2	0.001	<0.001	0.002	<0.001
	PS3	0.001	<0.001	0.001	<0.001
	PS4	0.001	0.001	0.001	<0.001
	PS5	0.001	<0.001	<0.001	<0.001
	PS6	0.003	<0.001	<0.001	<0.001
	PS7	0.001	<0.001	<0.001	<0.001
	PS8	0.001	<0.001	<0.001	<0.001
	PS9	0.002	<0.001	<0.001	<0.001
Surface Water	EM0	0.001	<0.001	<0.001	<0.001
	EM1	0.001	<0.001	<0.001	<0.001
	EM2	0.001	<0.001	<0.001	<0.001
	EM11	0.001	<0.001	<0.001	<0.001
	EM6/10	0.001		<0.001	<0.001
	EM7	0.001	<0.001	<0.001	<0.001
	EM8	0.001	<0.001	<0.001	<0.001

Recorded lead concentrations are predominantly at or below detection limit with a maximum recorded value of 0.003 mg/l which is well below the IGV of 0.01 mg/l.
The concentrations of lead in leachate are therefore not considered to present a risk to groundwater or surface water.

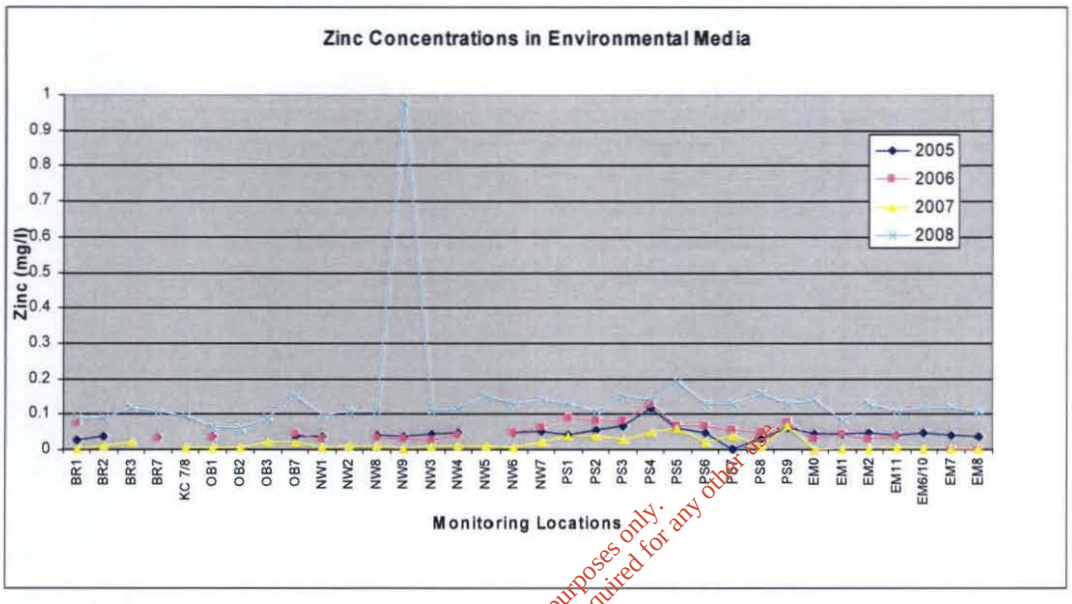
Table 6.6: Zinc Concentrations at Monitoring Locations

Location	Well Name	Zinc			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.03	0.075	0.005	0.091
	BR2	0.04	-	0.01	0.09
	BR3	-	-	0.02	0.12
	BR7	0.035	0.032	-	0.11
	KC 7/8	-	-	0.007	0.094
Overburden Wells	OB1	0.04	0.035	0.007	0.064
	OB2	-	-	0.006	0.062
	OB3	-	-	0.02	0.091
	OB7	0.04	0.046	0.02	0.15
Perimeter Wells	NW1	0.04	0.033	0.007	0.098
	NW2	-	-	0.01	0.11
	NW8	0.043	0.035	0.01	0.11
	NW9	0.04	0.032	0.004	0.98
	NW3	0.046	0.03	0.01	0.11
	NW4	0.052	0.045	0.01	0.12
	NW5	-	-	0.01	0.15
	NW6	0.051	0.051	0.007	0.13
	NW7	0.053	0.065	0.02	0.14
Leachate Wells	PS1	0.044	0.089	0.04	0.13
	PS2	0.059	0.084	0.04	0.11
	PS3	0.068	0.083	0.03	0.15
	PS4	0.12	0.13	0.05	0.14
	PS5	0.062	0.07	0.06	0.19
	PS6	0.05	0.067	0.02	0.13
	PS7	0.002	0.057	0.04	0.13
	PS8	0.034	0.05	0.01	0.16
	PS9	0.066	0.08	0.07	0.13
Surface Water	EM0	0.047	0.032	0.001	0.14
	EM1	0.047	0.047	0.002	0.082
	EM2	0.049	0.032	0.004	0.13
	EM11	0.044	0.041	0.006	0.11
	EM6/10	0.05		0.004	0.12
	EM7	0.045	<0.032	0.002	0.12
	EM8	0.04	<0.029	0.005	0.11

Zinc levels in all environmental media are increased in 2008 when compared to other years. There was a significant peak in concentration in NW9 during 2008 as shown above. It should be noted that this monitoring point is up gradient of the landfill. Trends in concentration upstream and downstream the landfill is not evident from this data which suggests that the recorded values may be in line with typical background values. The values highlighted orange in the previous table are the parameters which exceed the IGV of 0.1 mg/l (derived from the EQSs for Surface Waters). Most locations during the 2008 monitoring was marginally over the IGV limit value however NW9 is elevated and is inconsistent with the other results.

This location is up gradient of the landfill and is an inactive part of the landfill, this recorded level may be due to an upstream contamination event.

Figure 6.6: Zinc Concentrations



It appears that some contamination event may have occurred which has resulted in higher than normal concentrations of zinc. It is notable that the high concentrations occur within most surface water samples (including those upstream) and also within leachate and perimeter wells. Only one overburden well and two bedrock wells show limits which are above the IGV for zinc. While there is a potential risk to groundwater and surface water identified, it is noted that the risk to human health from these levels of zinc is minimal and the levels are well below the Drinking Water Standards guideline value of 5.0 mg/l.

Table 6.7: Nickel Concentrations at Monitoring Locations

Location	Well Name	Nickel			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.017	0.061	0.008	0.014
	BR2	0.035		0.02	0.018
	BR3			0.05	0.066
	BR7	0.015	0.06		0.013
	KC 7/8			0.01	0.017
Overburden Wells	OB1	0.015	0.065	0.01	0.02
	OB2			0.02	0.02
	OB3			0.05	0.065
	OB7	0.02	0.071	0.01	0.02
Perimeter Wells	NW1	0.02	0.014	0.01	0.021
	NW2			0.02	0.035
	NW8	0.04	0.023	0.01	0.028
	NW9	0.03	0.032	0.01	0.036
	NW3	0.02	0.007	0.01	0.046
	NW4	0.03	0.026	0.02	0.027
	NW5			0.04	0.042
	NW6	0.02	0.04	0.02	0.036
	NW7	0.03	0.032	0.02	0.03
Leachate Wells	PS1	0.047	0.11	0.02	0.31
	PS2	0.06	0.12	0.03	0.018
	PS3	0.09	0.14	0.04	0.027
	PS4	0.079	0.13	0.04	0.049
	PS5	0.071	0.16	0.04	0.045
	PS6	0.08	0.14	0.03	0.031
	PS7	0.074	0.12	0.03	0.026
	PS8	0.061	0.13	0.02	0.023
	PS9	0.069	0.14	0.02	0.027
Surface Water	EM0	0.007	0.031	0.003	0.03
	EM1	0.009	0.035	0.005	0.03
	EM2	0.02	0.034	0.004	0.03
	EM11	0.023	0.043	0.007	0.04
	EM6/10	0.03		0.005	0.04
	EM7	0.042	0.037	0.008	0.05
	EM8	0.054	0.43	0.01	0.05

Results highlighted exceed the IGV for Nickel of 0.02 mg/l (derived from the Drinking Water Standards). It is noted that a higher limit of 0.05 mg/l exists for the EQSs for Surface Water Standards.

Leachate levels (PS1-9) are elevated to that recorded in groundwater and surface water records. Nickel concentrations in the leachate have reduced since 2006. In 2007 and 2008 elevated levels were recorded in BR3 and OB3. Levels in surface water in 2008 are elevated over the previous years with a slight increase downstream of the landfill on the Tramore River (EM11, EM6/10). The Trabeg River has elevated

concentration both upstream (EM7) and down stream (EM8) which suggest that nickel concentrations are variable and may reflect background levels in the area.

Figure 6.7: Nickel Concentrations

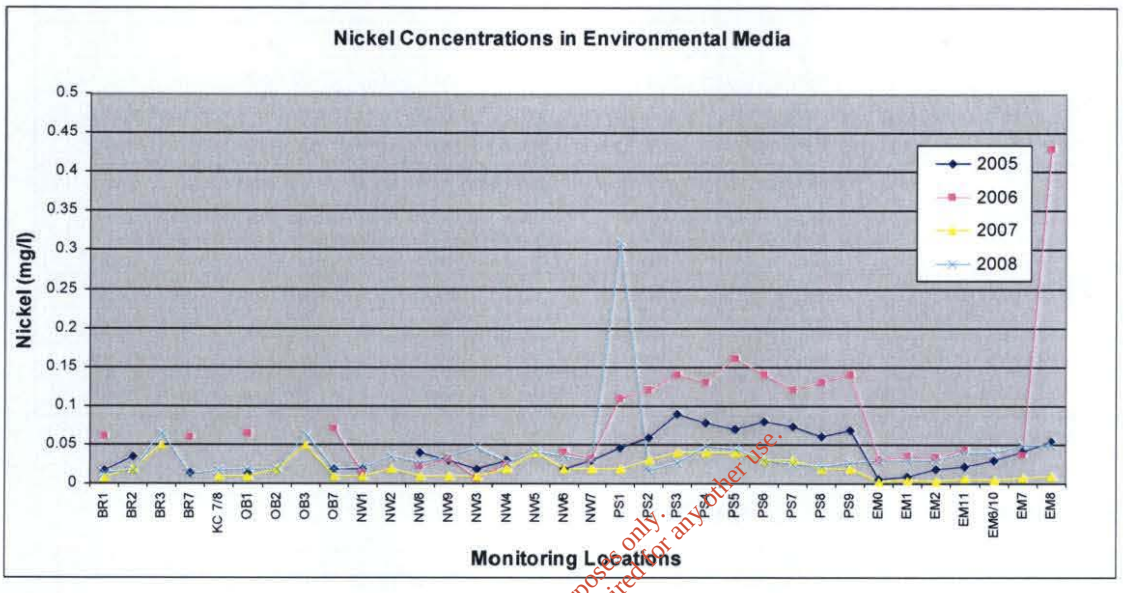
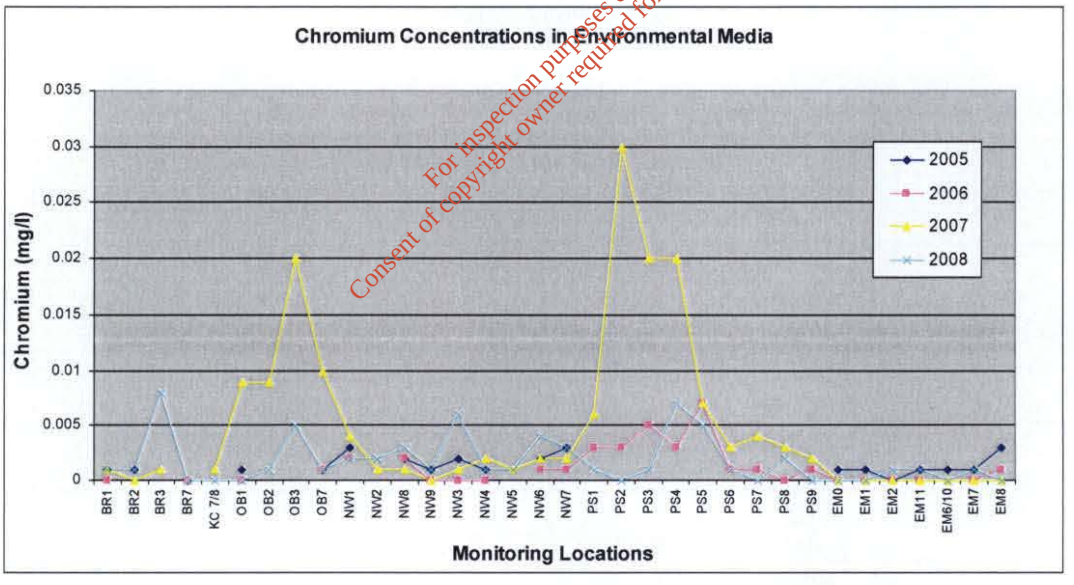


Table 6.8: Chromium Concentrations at Monitoring Locations

Location	Well Name	Chromium			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.001	<0.001	0.001	0.001
	BR2	0.001		<0.001	0.001
	BR3			0.001	0.008
	BR7	<0.001	<0.001		<.001
	KC 7/8			0.001	<.001
Overburden Wells	OB1	0.001	<0.001	0.009	<.001
	OB2			0.009	0.001
	OB3			0.02	0.005
	OB7	0.001	0.001	0.01	0.001
Perimeter Wells	NW1	0.003	0.002	0.004	0.002
	NW2			0.001	0.002
	NW8	0.002	0.002	0.001	0.003
	NW9	0.001	<0.001	<0.001	0.001
	NW3	0.002	<0.001	0.001	0.006
	NW4	0.001	<0.001	0.002	0.001
	NW5			0.001	0.001
	NW6	0.002	0.001	0.002	0.004
	NW7	0.003	0.001	0.002	0.003
Leachate Wells	PS1	0.01	0.003	0.006	0.001
	PS2	0.012	0.003	0.03	<.001
	PS3	0.001	0.005	0.02	0.001

Location	Well Name	Chromium			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
	PS4	0.001	0.003	0.02	0.007
	PS5	0.001	0.007	0.007	0.005
	PS6	0.002	0.001	0.003	0.001
	PS7	0.002	0.001	0.004	<.001
	PS8	0.001	<0.001	0.003	0.002
	PS9	0.001	0.001	0.002	<.001
Surface Water	EM0	0.001	<0.001	<0.001	<.001
	EM1	0.001	<0.001	<0.001	<.001
	EM2	<0.001	<0.001	<0.001	0.001
	EM11	0.001	<0.001	<0.001	0.001
	EM6/10	0.001		<0.001	<.001
	EM7	0.001	<0.001	<0.001	0.001
	EM8	0.003	0.001	<0.001	<.001

Figure 6.8: Chromium Concentrations



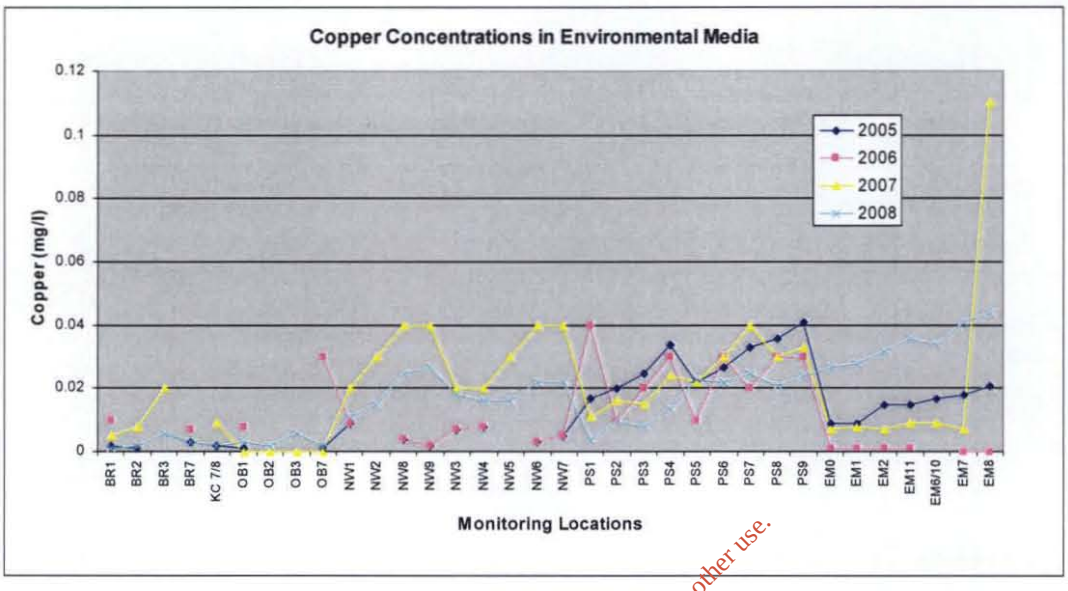
Increased levels of chromium were detected in leachate wells and overburden wells, particularly in 2007. 2008 levels are slightly elevated in BR3 and NW3. Levels in surface water are similar up stream and downstream of the landfill. It is noted that none of the values exceed the IGV for Chromium of 0.03 mg/l and are therefore not considered to present a risk to groundwater or surface water.

Table 6.9: Copper Concentrations at Monitoring Locations

Location	Well Name	Copper			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.002	0.01	0.005	0.001
	BR2	0.001		0.008	0.002
	BR3			0.02	0.006
	BR7	0.003	0.007		0.003
	KC 7/8	0.002		0.009	0.002
Overburden Wells	OB1	0.001	0.008	<0.005	0.003
	OB2			<0.005	0.002
	OB3			<0.005	0.006
	OB7	0.001	0.03	<0.005	0.002
Perimeter Wells	NW1	0.009	0.009	0.02	0.011
	NW2			0.03	0.015
	NW8	0.004	0.004	0.04	0.025
	NW9	0.002	0.002	0.04	0.027
	NW3	0.007	0.007	0.02	0.018
	NW4	0.008	0.008	0.02	0.016
	NW5			0.03	0.016
	NW6	0.003	0.003	0.04	0.022
	NW7	0.005	0.005	0.04	0.022
Leachate Wells	PS1	0.017	0.04	0.011	0.004
	PS2	0.02	0.01	0.016	0.01
	PS3	0.025	0.02	0.015	0.008
	PS4	0.034	0.03	0.024	0.014
	PS5	0.022	0.01	0.022	0.023
	PS6	0.027	0.03	0.03	0.022
	PS7	0.033	0.02	0.04	0.025
	PS8	0.036	0.03	0.03	0.021
	PS9	0.041	0.03	0.033	0.024
Surface Water	EM0	0.009	0.001	0.007	0.027
	EM1	0.009	0.001	0.008	0.028
	EM2	0.015	0.001	0.007	0.032
	EM11	0.015	0.001	0.009	0.036
	EM6/10	0.017		0.009	0.034
	EM7	0.018	<0.001	0.007	0.041
	EM8	0.021	<0.001	0.11	0.044

The samples highlighted have concentrations which exceed the IGV for copper of 0.03 mg/l which is derived from the EQSs for protection of Surface Waters.

Figure 6.9: Copper Concentrations



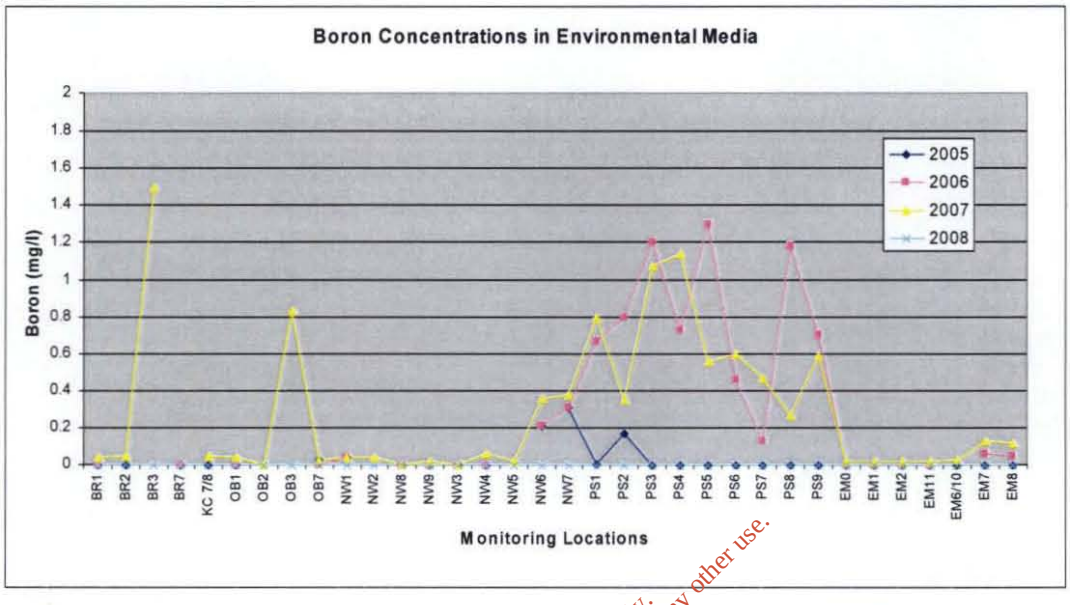
Copper trends mainly show a decrease in concentrations from 2007 to 2008. Copper levels are higher in surface water monitoring in 2008. Elevated copper levels are also detected up stream of the landfill, however they slightly increased downstream of the landfill on the Tramore River. The Trabeg River has similar copper levels both up stream and down stream and the concentrations may therefore not be associated with contamination from the landfill. The levels of copper recorded within the groundwater wells are considered to be typical background concentrations and do not present a risk to human health or the aquatic environment. It is noted that the Drinking Water Standard limit for copper is 2.0 mg/l.

Table 6.10: Boron Concentrations at Monitoring Locations

Location	Well Name	Boron			
		2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	<0.002	<0.01	0.04	<.001
	BR2	<0.002		0.05	<.001
	BR3			1.5	<.001
	BR7	<0.002	<0.01		<.001
	KC 7/8	<0.0002		0.05	<.001
Overburden Wells	OB1	<0.002	<0.014	0.04	<.001
	OB2			<0.02	<.001
	OB3			0.83	<.001
	OB7	0.03	<0.014	0.03	<.001
Perimeter Wells	NW1	0.04	0.04	0.04	<0.001
	NW2			0.04	<0.001
	NW8	<0.01	<0.01	<0.02	<0.001
	NW9	<0.01	<0.01	0.02	<0.001
	NW3	<0.01	<0.01	<0.02	<0.001
	NW4	<0.01	<0.01	0.06	<0.001
	NW5			0.02	<0.001
	NW6	0.21	0.21	0.36	<0.001
	NW7	0.31	0.31	0.38	<0.001
Leachate Wells	PS1	0.004	0.67	0.8	<.001
	PS2	0.17	0.8	0.35	<.001
	PS3	<0.0002	1.2	1.07	<.001
	PS4	<0.0002	0.73	1.14	<.001
	PS5	<0.0002	1.3	0.56	<.001
	PS6	<0.0002	0.46	0.6	<.001
	PS7	<0.0002	0.13	0.47	<.001
	PS8	<0.0002	1.18	0.27	<.001
	PS9	<0.0002	0.7	0.59	<.001
Surface Water	EM0	<0.0002	<0.014	0.02	<.001
	EM1	<0.0002	<0.014	0.02	<.001
	EM2	<0.0002	<0.014	0.02	<.001
	EM11	<0.0002	<0.014	0.02	<.001
	EM6/10	<0.0002		0.03	<.001
	EM7	<0.0002	0.059	0.13	<.001
	EM8	<0.0002	0.05	0.12	<.001

Values highlighted exceed the EPA IGV for Boron of 1.0 mg/l. Although some exceedences have occurred within the leachate wells, only one exceedence was noted within the bedrock wells. It is notable that all test results for 2008 were below method detection limits.

Figure 6.10: Boron Concentrations

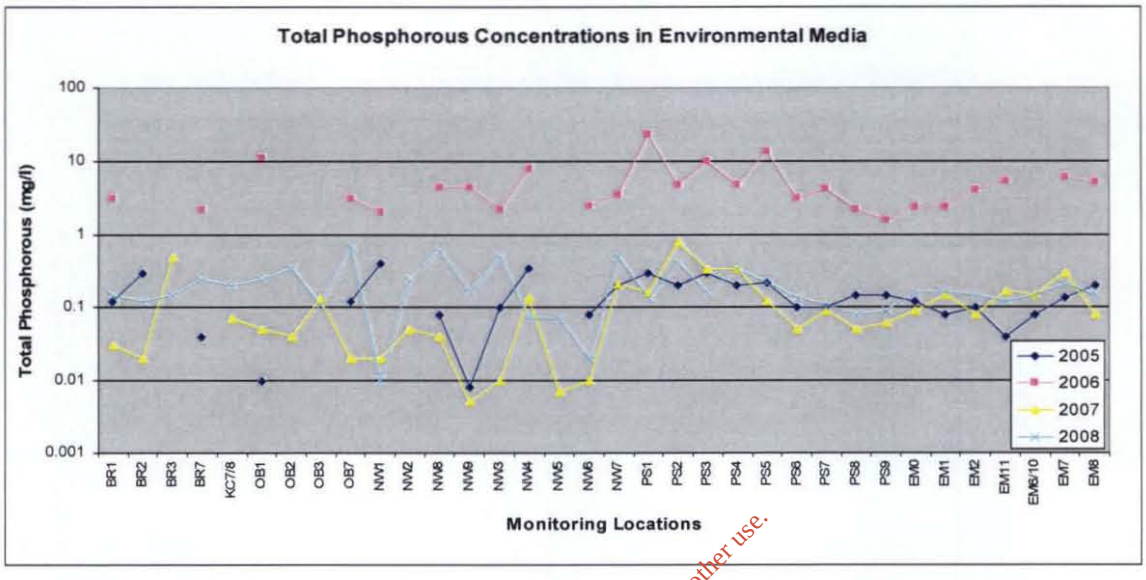


Levels of boron in the leachate were elevated during 2006 and 2007 however levels have decreased in 2008. BR2 and OB3 had elevated levels in 2007 but again had decreased by 2008. The elevated levels appear to have impacted on the 2007 BR3 result (down gradient of the landfill), however levels have recovered to below detection limits in 2008. Levels in surface water are similar both upstream and downstream of the landfill. There appears to be presently no risk of boron contamination to groundwater or surface water.

Table 6.11: Total Phosphorous & Fluoride Concentrations at Monitoring Locations

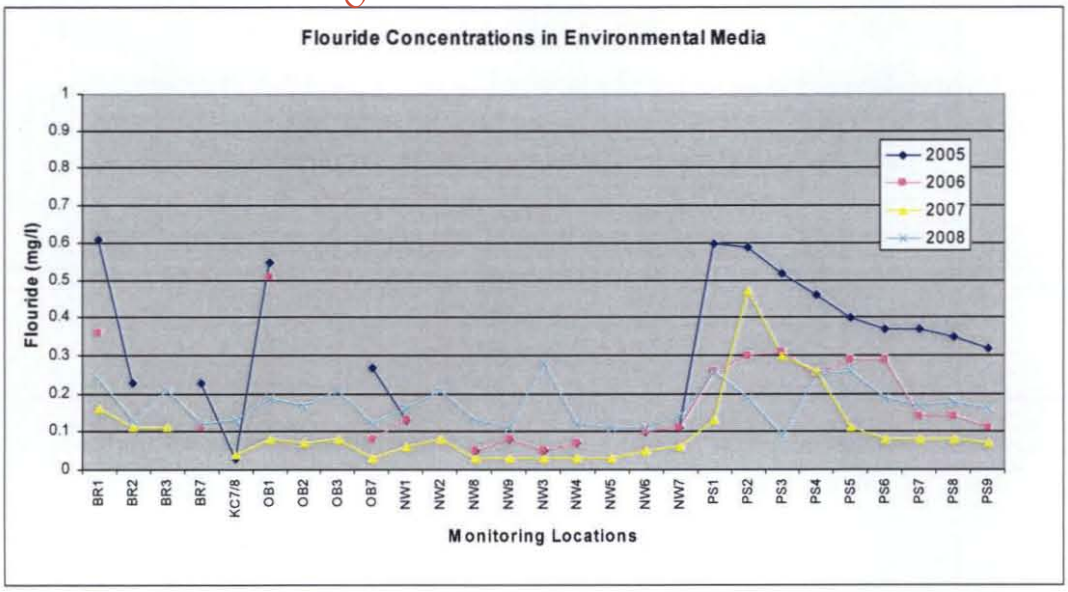
Location	Well Name	Total Phosphorous				Fluoride			
		2005	2006	2007	2008	2005	2006	2007	2008
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Bedrock Wells	BR1	0.12	3.2	0.03	0.15	0.61	0.36	0.16	0.24
	BR2	0.3		0.02	0.12	0.23		0.11	0.13
	BR3			0.5	0.15			0.11	0.21
	BR7	0.04	2.2		0.25	0.23	0.11		0.12
	KC7/8			0.07	0.2	0.03		0.04	0.13
Overburden Wells	OB1	0.01	11.2	0.05	0.25	0.55	0.51	0.08	0.19
	OB2			0.04	0.35			0.07	0.17
	OB3			0.13	0.11			0.08	0.21
	OB7	0.12	3.2	0.02	0.7	0.27	0.08	0.03	0.12
Perimeter Wells	NW1	0.4	2.1	0.02	0.01	0.13	0.13	0.06	0.16
	NW2			0.05	0.25			0.08	0.21
	NW8	0.08	4.5	0.04	0.6	0.05	0.05	0.03	0.13
	NW9	0.008	4.5	0.005	0.17	0.08	0.08	0.03	0.11
	NW3	0.1	2.2	0.01	0.5	0.05	0.05	0.03	0.28
	NW4	0.35	8.1	0.14	0.07	0.07	0.07	0.03	0.12
	NW5			0.007	0.07			0.03	0.11
	NW6	0.08	2.5	0.01	0.02	0.1	0.1	0.05	0.11
	NW7	0.2	3.5	0.21	0.5	0.11	0.11	0.06	0.14
Leachate Wells	PS1	0.3	24.1	0.16	0.14	0.6	0.26	0.13	0.26
	PS2	0.2	4.8	0.8	0.4	0.59	0.3	0.47	0.19
	PS3	0.3	10.1	0.34	0.16	0.52	0.31	0.3	0.09
	PS4	0.2	4.8	0.33	0.34	0.46	0.25	0.26	0.25
	PS5	0.22	13.6	0.12	0.22	0.4	0.29	0.11	0.26
	PS6	0.1	3.2	0.05	0.14	0.37	0.29	0.08	0.19
	PS7	0.1	4.4	0.09	0.11	0.37	0.14	0.08	0.17
	PS8	0.15	2.2	0.05	0.08	0.35	0.14	0.08	0.18
	PS9	0.15	1.6	0.06	0.09	0.32	0.11	0.07	0.16
Surface Water	EM0	0.12	2.4	0.09	0.16	Not Applicable			
	EM1	0.08	2.4	0.15	0.17				
	EM2	0.1	4.2	0.08	0.15				
	EM11	0.04	5.5	0.17	0.12				
	EM6/10	0.08		0.15	0.15				
	EM7	0.14	6.1	0.3	0.21				
	EM8	0.2	5.3	0.08	0.15				

Figure 6.11: Total Phosphorous Concentrations



Levels of total phosphorous were highest during 2006. Total phosphorous concentrations are very variable throughout 2007 and 2008. Levels are elevated in leachate and overburden monitoring locations. In surface waters, levels are elevated both upstream and downstream of the landfill. No IGVs exist at present in Ireland for safe levels of Phosphorous in drinking water or surface water, however the Phosphate Regulations (EPA 2005) cite a limit of 0.03 mg/l to prevent eutrophication of surface waters). Almost all the samples tested on site exceeded this level.

Figure 6.12: Fluoride Concentrations



Monitoring of fluoride on surface water is not required under the facilities waste licence. Fluoride concentrations in leachate are elevated compared to groundwater levels however they have reduced in 2008. 2008 fluoride levels seem to be higher in all

groundwater locations compared to previous years. NW3 has a marked increase in 2008. All recorded values fall well below the IGV for fluoride of 1 mg/l (derived from the Drinking Water Standards compared to a limit of 5.0 mg/l in the EQSs for Surface Waters).

6.3.5. List I & II Organic Substances

In accordance with the licence conditions, an annual analysis is undertaken within groundwater samples for a range of organic substances in line with List I and II of the 1979 Groundwater Directive (80/68/EEC) which include VOCs, THMs, PAHs, Pesticides, Triazines, Acid Herbicides and Tentatively Identified Compounds (TICs).

Analysis results were obtained for years 2006, 2007 and 2008. The results showed that for the majority of substances, results were below the method limits for the analyses with the exception of the sample taken from BR1 and tested during May 2006 which detected traces of Trichloromethane / Chloroform (0.78 µg/l). A summary of the general compounds are presented below:

Table 6.12: Organic Concentrations at Bedrock Monitoring Locations

Parameter	Units	2006		2007			2008		
		BR1	NW4	BR1	BR3	NW4	BR1	BR3	NW4
Benzo(a) Pyrene	ug/l	<0.015	<0.015	<0.015	<0.015	<0.015			
PAH	ug/l	<0.05	<0.05	<0.05	<0.05	<0.05			
THM	ug/l	<3.84	<3.84	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00
Benzene	ug/l	<0.09	<0.09	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1,2-diCl ethane	ug/l	<0.06	<0.06	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Pesticide	ug/l	<0.05	<0.05	<0.05	<0.05	<0.05			
Tetra+ TriCl Ethene	ug/l	<0.18	<0.18	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Once-off testing of organic substances was also undertaken (during 2001) on surface water samples EM1, located up-stream of the site on the Tramore River, EM6 (downstream Tramore), EM7 (Upstream Trabeg) and EM11 (downstream Tramore but close to site). The samples gave the following parameters above detection limits:

Table 6.13: Organic Substances Concentration in Surface Water

Sample Point	Group	Parameter	Detection Limit	Result	Units
EM1	THMs	Chloroform	<0.5	2.5	µg/l
	Triazine pesticides	Atrazine Simazine	<0.01 <0.01	0.02 0.02	µg/l
EM6	THMs	Chloroform	<0.5	1.9	µg/l
	Triazine pesticides	Atrazine Simazine	<0.01 <0.01	0.02 0.02	µg/l
EM7	THMs	Chloroform	<0.5	3.2	µg/l
	Triazine pesticides	Atrazine Simazine	<0.01 <0.01	0.02 0.05	µg/l
EM11	THMs	Chloroform	<0.5	2.5	µg/l
	Triazine pesticides	Atrazine Simazine	<0.01 <0.01	0.02 0.03	µg/l

7. SUMMARY & CONCLUSIONS

The Kinsale Road Landfill site is an unlined landfill which was developed on boggy ground in the Tramore River valley from the 1960's to date. Approximately 3 million tonnes of waste has been deposited at this landfill over this time frame.

The underlying geology consists of peat and silty clays overlying discontinuous gravels, and limestone or shale bedrock. Bedrock groundwater flow is generally to the east. Surface water and baseflow is to the Tramore and Trabeg Rivers to the south and east of the site respectively. Recent increases in the profile of the landfill have resulted in increased leachate heads, particularly in the southern part of the site. The potential vertical downward migration of leachate to the bedrock aquifer is estimated at up to 26,492 m^3 per year for the entire site (approximately 0.3 litres per day per m^2).

The conditions of the licence include for the routine testing of a number of parameters, which include substances listed in List I and II of the Groundwater Directive.

The results show that some impact on groundwater quality from leachate contamination may be occurring, particularly at monitoring well BR3 to the east of the landfill which shows evidence of contamination. It is recommended that further investigation should be carried out to examine the well integrity, which may have resulted in direct migration of leachate into the annulus of the well.

The test results show that some improvements in water quality have been observed recently, possibly as a result of the collection of leachate in the cut-off trench, a general reduction in waste deposit and the ongoing capping of the landfill.

A risk screening has been undertaken for the range of List I and II substances which are routinely analysed on site. The results show that the risks associated with the release of List I and II substances into the groundwater and surface water appears to be minimal for the majority of substances, namely mercury, cadmium, cyanide, lead, chromium, copper, boron and fluoride and a range of organic substances which include VOCs, THMs, PAHs, Pesticides, Triazines, Acid Herbicides and Tentatively Identified Compounds (TICs).

Elevated levels of zinc, nickel and phosphorous were detected in leachate, groundwater and surface waters (compared with EPA published Interim Guidance Values (IGVs)). However the levels recorded were inconsistent between years and between locations. The sources of contamination are inconclusive as elevated levels of these analytes were also recorded in surface waters both upstream and downstream of the site which suggests that the landfill may not be the sole source of contamination for these substances.

Appendices

Appendix A

Drawing No. 2007-011-03-003 Rev 1:
Present Capped and Future Capping Areas Onsite

Legend:

Waste Licence Boundary

Factory
Pitch & Putt Course
Electricity Station
Greenhills Estate
Steel Works
Tramore Bridge

PROPOSED SERVICES DEPOT AREA

CONTRACT 08 PROPOSED PLAYING PITCH AND ACCESS ROAD -CONTRACT 8-

CONTRACT 09 PROPOSED AMENITY AREA

CONTRACT 10

CONTRACT 11

CONTRACT 07 PHASE 3 CAPPING

PHASE 1 CAPPING

PHASE 2 CAPPING

CENTRAL AREA FOR FUTURE WORKS

Waste Licence Boundary

Site Administration Building.

Main Entrance Gates.

WEEE Slab.

Gas Flare Compound.

Park & Ride Site

Civic Amenity Area.

Composting Slab.

Surface Water Conditioning

Leachate Pump Sumps.

Gas Interceptor Drainage Trench.

Lagoon 1 Contaminated Stormwater Pond

Lagoon 2 Covered Leachate Lagoon

Lagoon 3 Contaminated Stormwater Pond

Leachate Conditioning Plant.

Reed Bed 1

Reed Bed 2

Stormwater Storage Pond

Pump Sump 1
Pump Sump 2
Pump Sump 3
Pump Sump 4
Pump Sump 5
Pump Sump 5A
Pump Sump 6
Pump Sump 7
Pump Sump 8
Pump Sump 9

LW 1
LW 2
LW 3
LW 4
LW 5

Swale

KINSALE ROAD
SOUTH CITY LINK ROAD
GREEN LANE
SOUTH RING ROAD
N25 SOUTH RING ROAD
TRAMORE RIVER

Scale 1:2000

Rev.	Drawn	Chkd	Appd	Date	Description
1	SK			Cork 29.2.2008	ISSUE FOR EPA MEETING

Revision History: A B 0 1

Name of Client
CORK CITY COUNCIL

Name of Job
KINSALE ROAD SANITARY LANDFILL
WASTE FILLING HISTORY

Title of Drawing
COMPLETED AND FUTURE MAJOR CONTRACTS ON SITE

Scales Used
A1-1:2000, A3-1:4000

Dwg. No. 2007-011-03-003
Rev. 1

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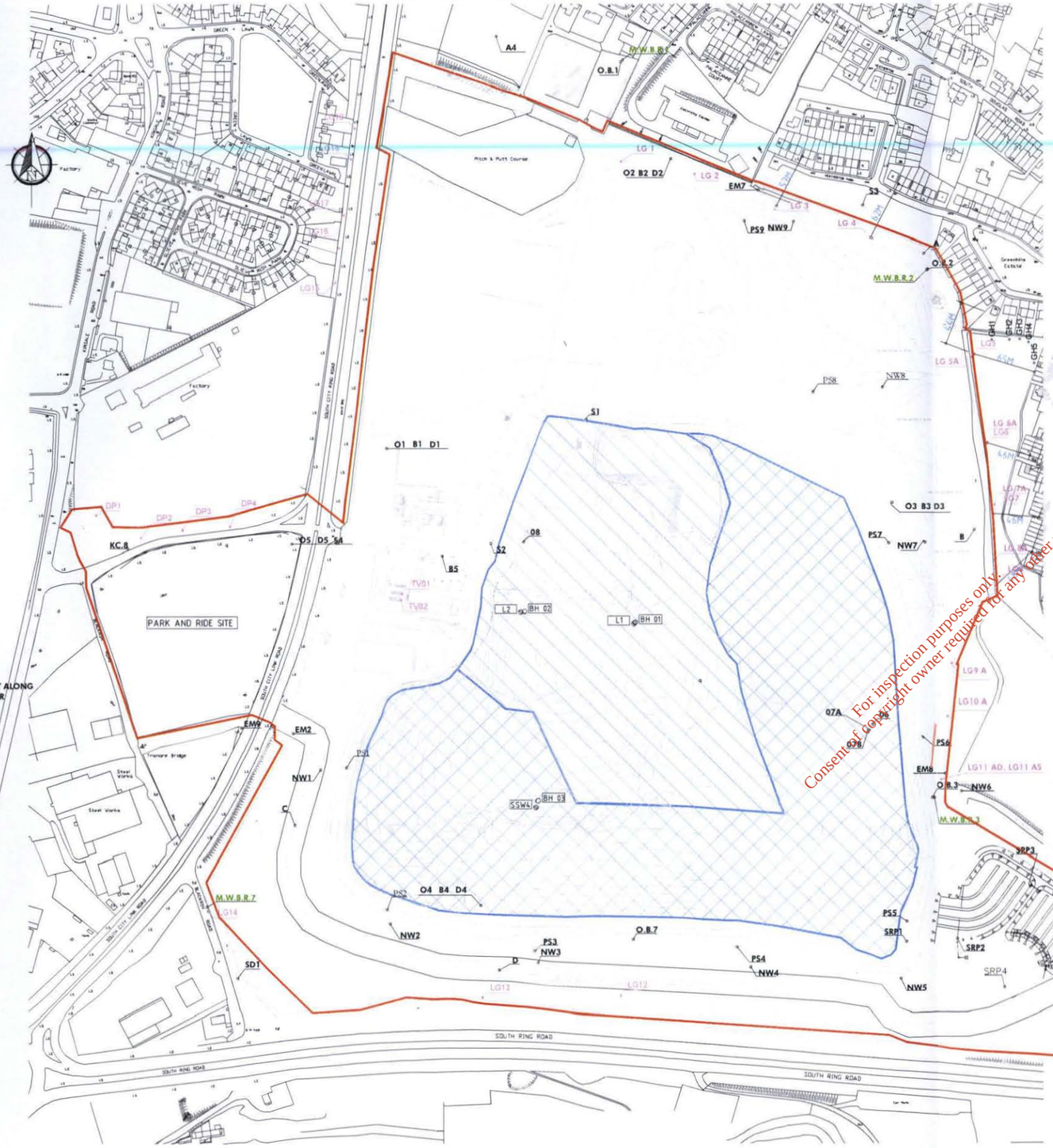
ORIGINAL DRAWING SIZE A1 - 841 x 594

Appendix B

Drawing No. CE08-011-001 Rev A:
Existing Environmental Monitoring Locations



SITE PLAN

Scale 1:5000

STATION	EASTING	NORTHING
Groundwater Monitoring Location		
KC8	167813	069643
MWBR1	168323	070148
MWBR2	168636	069932
MWBR3	168644	069387
MWBR7	167894	069275
OB1	168321	070146
OB2	168637	069933
OB3	168642	069387
OB7	168334	069241
NW1	168012	069416
NW2	168085	069258
NW3	168237	069218
NW4	168455	069213
NW5	168609	069201
NW6	168672	069394
NW7	168634	069650
NW8	168590	069603
NW9	168498	069981
Ecological Monitoring Location		
A	168633	069948
B	168685	069662
C	167986	069359
D	168197	069210
E	167642	069400
F	168945	069204
Bedrock Monitoring Locations		
BH1	168337	69568
BH2	168223	69580
BH3	168237	69384
Leachate Monitoring Locations		
L1	168335	69567
L2	168219	69579
SSW4	168234	69377

STATION	EASTING	NORTHING
Leachate Monitoring Station		
PS1	168039	069418
PS2	168082	069272
PS3	168233	069230
PS4	168411	069233
PS5	168615	069259
PS6	168632	069449
PS7	168596	069649
PS8	168518	069805
PS9	168448	069982
Noise Monitoring Location		
B1	168081	069747
B2	168373	070046
B3	168600	069691
B4	168178	069276
A1	168831	069519
A2	169070	069416
A3	168824	068990
A4	168193	070173
Air Quality Monitoring Station		
O1 &D1	168081	069747
O2 & D2	168373	070046
O3 & D3	168600	069691
O4 & D4	168178	069276
O5 & D5	167982	069648
S1	168286	069778
S2	168188	069649
S3	168312	069303
S4	168085	069595
06	168580	069463
08	168222	069651
07A	168576	069457
07B	168575	069455
Gas Monitoring Station		
TV01	168097	069597
TV02	168096	069591
DP1	167781	069678
DP2	167827	069655
DP3	167869	069663
DP4	167918	069666
LG1	168322	070044
LG2	168398	070031
LG3	168480	069994
LG4	168580	069964
LG5	168585	069844
LG5A	168682	069841
LG6	168698	069752
LG6A	168696	069757
LG7	168704	069679
LG7A	168706	069689
LG8	168708	069607
LG8A	168706	069632
LG9A	168718	069525
LG10A	168708	069471
LG11AD	168651	069411
LG11AS	168656	069412
LG12	168322	069183
LG13	168179	069181
LG14	167896	069270
LG15	168027	069918
LG16	168031	069954
LG17	168036	069988
LG18	168044	070046
LG19	168048	070078
Surfacewater Monitoring Location		
EM0	166967	069478
EM1	167642	069400
EM2	167984	069454
EM6	169281	069193
EM7	168462	070014
EM8	168655	069412
EM9	167930	069459
EM10	168964	069197
EM11	168825	069191
Stormwater/Reed Beds Monitoring		
SRP1	168654	069305
SRP2	168668	069242
SRP3	168644	069241
SRP4	168739	069227
SRP5	168758	069210
Sewer Monitoring Location		
SD1	167926	069201

NOTE
THE INFORMATION ON THIS DRAWING IS A COPY OF DRAWING No. 98-011-27-006

LEACHATE MONITORING STATION-(PS1)
NOISE MONITORING LOCATION-(B1/A1)
AIR QUALITY MONITORING STATION-(D1/S1/O1)
ODOUR MONITORING LOCATION (06/07A/07B)
GAS MONITORING STATION-(LG1/DP1/TVO1)
SURFACEWATER MONITORING LOCATION-(EM1)
GROUNDWATER MONITORING LOCATION-(BR1/OB1/KC8/NW1)
STROMWATER/REED BEDS MONITORING-(SRP1)
SEWER MONITORING LOCATION-(SD1)
ECOLOGICAL MONITORING LOCATION-(A)

LEGEND

FACILITY BOUNDARY

CAPPED AREA

UNCAPPED AREA

Rev.	Drawn	Chk'd	Appr'd	Date	Description
A	KL			Cork 31.01.2008	A.E.R 2007
Revision History	A				

Name of Client

CORK CITY COUNCIL

Name of Job

KINSALE ROAD LANDFILL
2007 ANNUAL
ENVIRONMENTAL REPORT

Title of Drawing

EXISTING ENVIRONMENTAL MONITORING LOCATIONS

Scales Used: 1:5000

Dwg. No.: CE08-011-01-001

Rev.: A

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ORIGINAL DRAWING SIZE: A1 - (841 x 594)

Appendix C

Drawing CE08-011-01-003 Rev 0:
Hydrological Areas for Water Balance Assessment

SITE PLAN

Scale 1:5000

LEGEND

- CAPPED AREA
- UNCAPPED AREA
- FACILITY BOUNDARY
- Surface Water Swale
- Boundaries of hydrometric areas
- Boundaries of temporary conditioning plant catchment
- Bedrock Monitoring Boreholes (BH1, BH2, BH3)
- Leachate Monitoring Boreholes (L1, L2, SSW4)
- Surface Water Flow measurement location

Area	Description	Area (ha)	Waste-bearing?
1	Semi-Active Area	8.32	✓
1a	Active area	0.97	✓
2	Phase 1 Capped Area	5.31	✓
3	Soil Storage Area	4.74	✓
4	Pitch & Putt Course	2.37	✓
5	Adjacent to C & D Facility	0.99	✓
6	C & D Facility	4.39	✓
7	Office/CA Area	2.36	✓
8	Phase 2 Capped Area	5.49	✓
9	Tramore River Bank	7.20	
10	Lined Lagoon areas	1.43	✓
11	Eastern Access Road	2.35	✓
12	Marsh/Trabeg River Area	8.36	
13	Blackash Road Area	3.96	✓
14	Phase 3 Capped Area	3.31	
Total		61.55	

Rev.	Drawn	Chk'd	App'd		
A	KL			Cork 31.01.2008	A.E.R 2007
				Rev Origin Date	Description

Revision History: A

Name of Client

CORK CITY COUNCIL

Name of Job

KINSALE ROAD LANDFILL
2007 ANNUAL
ENVIRONMENTAL REPORT

Title of Drawing

HYDROMETRIC AREAS:
ANNUAL ENVIRONMENTAL REPORT 2007

Scales Used: 1:5000

Dwg. No.: CE08-011-01-003

Rev.: A

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ORIGINAL DRAWING SIZE A1 - (841 x 594)

Appendix D

Extract of Licence W0012-02 Table D.5.1
Water and Leachate Testing Parameters/Frequency

D.5 Surface Water, Groundwater and Leachate

Table D.5.1 Water and Leachate - Parameters / Frequency

Parameter [Note 1]	SURFACE WATER [Note 2] Monitoring Frequency	GROUNDWATER Monitoring Frequency	LEACHATE [Note 3] Monitoring Frequency
Visual Inspection/Odour [Note 4]	Weekly	Quarterly	Quarterly
Groundwater Level	Not Applicable	Monthly	Not Applicable
Leachate Level	Not Applicable	Not Applicable	Continuous
Ammoniacal Nitrogen	Quarterly	Quarterly [Note 5]	Annually [Note 5]
BOD	Quarterly	Not Applicable	Annually
COD	Quarterly	Not Applicable	Annually
Chloride	Quarterly	Quarterly	Annually
Dissolved Oxygen	Quarterly	Quarterly	Not Applicable
Electrical Conductivity	Quarterly	Quarterly [Note 5]	Annually [Note 5]
pH	Quarterly	Quarterly [Note 5]	Annually [Note 5]
Total Suspended Solids	Quarterly	Not Applicable	Not Applicable
Temperature	Quarterly	Quarterly	Quarterly
Cadmium & other metals/elements [Note 6]	Annually	Annually	Annually
Cyanide (Total)	Not Applicable	Annually	Annually
Fluoride	Not Applicable	Annually	Annually
List I/II organic substances [Note 7]	Once off [Note 8]	Annually [Note 8]	Once off [Note 8]
Mercury	Annually	Annually	Annually
Sulphate	Annually	Annually	Annually
Total Alkalinity	Annually	Annually	Not applicable
Total P/orthophosphate	Annually	Annually	Annually
Total Oxidised Nitrogen	Annually	Quarterly	Annually
Total Organic Carbon	Not Applicable	Quarterly [Note 5]	Not Applicable
Residue on evaporation	Not Applicable	Annually	Not Applicable
Biological Assessment	Annually [Note 9]	Not Applicable	Not Applicable

Note 1: All the analysis shall be carried out by a competent laboratory using standard and internationally accepted procedures.
Note 2: See Table D.5.2 for monitoring requirements of stormwater retention ponds and reed beds.
Note 3: See Table D.5.3. for monitoring requirements at SD1, discharge point to sewer.
Note 4: Where there is evident gross contamination of leachate, additional samples should be analysed.
Note 5: For groundwater monitoring locations NW1-NW9 downgradient of the leachate collection drain, monitoring for these parameters shall be on a monthly basis. For the leachate pump sumps monitoring shall be for these parameters on a quarterly basis.
Note 6: Metals and elements to be analysed by AA/ICP should include as a minimum: boron, calcium, chromium (total), copper, iron, lead, magnesium, manganese, nickel, potassium, sodium and zinc.
Note 7: Samples screened for the presence of organic compounds using Gas Chromatography / Mass Spectrometry (GC/MS) or other appropriate techniques and using the list I/II Substances from EU Directive 76/464/EEC and 80/68/EEC as a guideline. Recommended analytical techniques include: volatiles (US Environmental Protection Agency method 524 or equivalent), semi-volatiles (USEPA method 525 or equivalent, and pesticides (USEPA method 608 or equivalent).
Note 8: Annually for groundwater (MWBR1, MWBR3, NW4). Once off for surface water (EM1 and EM11); leachate (PS3 and PS4).
Note 9: Appropriate biological methods (such as EPA Q-Rating System) to be used for the assessment of rivers and streams.