ANNUAL ENVIRONMENTAL REPORT 2015

DUNGARVAN WASTE DISPOSAL SITE

BALLYNAMUCK MIDDLE

DUNGARVAN CO. WATERFORD

Waste Licence Register No. W0032-3

Report Compiled by;

Mr David Regan, Facility Manager, Dungarvan Landfill

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Introduction

Waterford County Council was granted a Waste Licence (Ref 32-1) by the Environmental Protection Agency on the 29th November 2002 for the continued acceptance of municipal waste within the existing footprint of the Dungarvan Landfill Facility at Ballynamuck Middle, Dungarvan Co. Waterford. The landfill ceased to accept waste on the 30th June 2003. This licence was updated by Waste Licence (Ref 32-2) which included permission for a Transfer Station and Composting facilities. A further licence (W032 – 03) was granted by the Agency in October, 2014. This is the twelvth Annual Environmental Report for the Facility and includes the monitoring period 1st January 2013 – 31st December 2015. The report has been prepared in accordance with Condition 11.7 and Schedule E of the Waste Licence.

1. Reporting Period

This is the eleventh Annual Environmental Report for the Dungarvan Waste Disposal Site, which covers the period 1st January 2014 to 31st December 2015.

2. Waste Activities carried out at the Facility

Part 1 of the Waste Licence details the activities authorised by the licence:

Waste Management Act 1996: Third Schedule

Class 4. **Surface impoundment, including placement of liquid or sludge discards in to pits, ponds or lagoons:**

This activity is limited to the storage of leachate generated within the facility in lined Integrated Constructed Wetland Ponds and the storage of surface water runoff in surface water retention (s) ponds

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

This activity is limited to the storage of rejected waste in the waste Inspection and Quarantine area and the Construction and Demolition Recovery Area prior to the removal of such waste off site for the disposal at an appropriate facility

Waste Management Act, 1996, Fourth Schedule

Class 2. **Recycling or reclamation of organic substances, which are not used as solvents (including composting and other biological transformation processes):**

This activity is limited to recycling of organic waste including cardboard and paper at the civic waste facility only and the acceptance and storage of waste oils in appropriate containers at the civic waste facility prior to removal offsite.

Class 3. **Recycling or reclamation of metals and metal compounds:**

This activity is limited to the acceptance of white goods within a designated Metal Recovery Area, the acceptance and storage of beverage cans in the appropriate containers at the civic waste facility prior to removal offsite.

Class 4. **Recycling or reclamation of other inorganic materials:**

This activity is limited to the acceptance and storage in appropriate containers of glass bottles, batteries and fluorescent tubes and the recovery of inert waste at the facility for use in site development and restoration works.

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

Class 11. **Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule:**

This activity is limited to the use of suitable inert waste in site development and restoration works.

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

This activity is limited to the storage of wastes within designated areas and receptacles prior to recovery offsite and the storage of inert waste prior to restoration of the facility.

3. Quantity and Composition of Waste received, disposed of and removed during the reporting period and each year previous

The quantity and composition of waste received, disposed of and removed for the reporting period 1st January 2014 – 31st December 2015 is attached in Appendix A.

4. Methods of deposition of inert waste for restoration

All capping and restoration works have now been completed.

5.0 Environmental Monitoring

Introduction

Dungarvan landfill is located in County Waterford approximately 2km north west of Dungarvan off the N25 road on the southern edge of the Colligan River. The total area of the landfill site is approximately 6.5 hectares, and has been in operation since 1968. The landfill closed on 30th June 2003, but a transfer station, which accepts residual household waste remains operational on site.

Monitoring of surface waters, groundwater's and leachate and landfill gas was carried out in accordance with the waste licence W032-03. EPA and Waterford City and County Council staff carried out sampling and field measurements. Sampling of leachate, groundwater and surface waters was carried out during Q1 to Q4 2015. Analysis was carried out at EPA Laboratories.

Sampling sites are as set out in Table 1 and attached Drawing, DUN-EIS-003.

Surface water stations	Groundwater station	Leachate station	Gas monitoring station	Noise	Dust
SW1*, SW2*, EPA station 280, EPA station 300 Also - Annual biological survey	GW1*, GW2a, RC3a, RC4*, RC6a, RC7*, RC8*	L1, L2a, L3*, L4* L5a, L6*, Leachate tank	L1*, L2a, L3*, L4*, L5a, L6, RC1*, RC3, RC4*, RC6, RC7, RC8, GW1*, GW2a	Entrance	D1, D2, D2a

Table 1: Monitoring locations, Dungarvan Landfill

*Baseline results available for these sites

Baseline Monitoring

One of the purposes of compliance monitoring is to determine if there has been a release of contaminants to the environmental media, and to demonstrate compliance with landfill licence

conditions. ***Baseline monitoring*** is monitoring which serves as a reference point to which later monitoring results are compared. While there is no data available preceding the landfill, for the purpose of this report, water quality results obtained during 2001 will be used as baseline monitoring data. Two new groundwater monitoring boreholes (RC7 and RC8) were installed since 2001, and results of tests carried out in 2002 at these sites are used as baseline. Noise measurements taken during the 1998 survey will also be used as comparison with this 2014 study.

5.1 SURFACE WATER.

5.1.1 Introduction

Sampling was carried out by EPA and Waterford City and County Council personnel at sites SW1, SW2, EPA site 300, EPA Site 280 and the landfill lagoon, as per attached map. Analysis was carried out at EPA Laboratories in Kilkenny and Dublin.

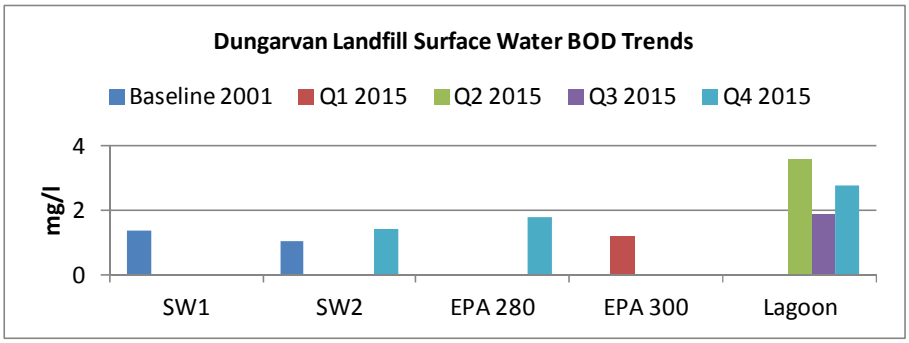
Sampling site EPA 300, at Ballyneety Bridge downstream of the landfill site, is subject to saline intrusion from Dungarvan Estuary. There are difficulties involved in monitoring surface water pollution from landfills adjacent to estuaries, as the salinity of the samples can interfere with many of the tests, (*ammonia, COD, arsenic, copper*). Additionally, many of the ions, which are considered indicators of leachate contamination, are also major components of sea/brackish water, *(chloride*, *sulphate, sodium, magnesium, calcium, boron).*

5.1.2 Results – see table 5.1.1 to 5.1.4 below.

River and lagoon water quality was satisfactory.

Key Parameter – BOD

The BOD test is a measure of the amount of oxygen consumed by microorganisms in breaking down organic matter in water. Respiration by phytoplankton or their decay, can also lead to oxygen depletion during the BOD test resulting in a high BOD value. Surface waters supporting fish life should have a BOD value < 4 mg/l BOD.



Discussion

BOD levels were low in the lagoon and at river sites throughout the year. . Other water quality tests were satisfactory.

Table 5.1.1 Dungarvan landfill surface water monitoring Q1 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan		
StationName	Lagoon	SW1	SW2	SW280	SW300	COMMENTS	ENVIRONMENTAL SIGNIFICANCE
SampleDate	23/02/2015	23/02/2015	23/02/2015	23/02/2015	23/02/2015		
Ammonium(NH4)	NT	NT	NT	NT	NT	NT	NA
BOD	BLD	BLD	BLD	BLD	BLD	LOW	NONE
Chemical Oxygen Demand	48	BLD	BLD	BLD	85	LOW	NONE
Conductivity @ 25°C	699	273	231	142	1583	SALINE INFLUENCES	NONE IN THIS NATURALLY BRACKISH ESTUARINE ENVIRONMENT
Dissolved Oxygen % Saturation	75	105	105	105	98	LOW IN LAGOON, SATISFACTORY IN RIVER	NONE
pH	7.1	7	7.1	6.7	7.2	NORMAL RANGE	NONE
Suspended Solids	BLD	BLD	BLD	15	11	LOW	NONE
Temperature	5.5	6.1	6.2	5.9	5.3	NORMAL RANGE	NONE
Total Oxidised Nitrogen	NT	NT	NT	NT	NT	NT	NA

Table 5.1.2 Surface water quality Dungarvan landfill Q2 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan		
StationName	Lagoon	SW1	SW2	SW280	SW300	COMMENTS	ENVIRONMENTAL SIGNIFICANCE
SampleDate	23/02/2015	23/02/2015	23/02/2015	23/02/2015	23/02/2015		
Ammonium(NH4)	NT	NT	NT	NT	NT	NT	NA
BOD	NT	BLD	BLD	BLD	BLD	LOW	NONE
Chemical Oxygen Demand	NT	BLD	BLD	BLD	71	LOW	NONE
Conductivity @ 25°C	NT	NT	NT	161	NT	SALINE INFLUENCES	NONE IN THIS NATURALLY BRACKISH ESTUARINE ENVIRONMENT
Dissolved Oxygen % Saturation	NT	118	118.1	112	83	LOW IN LAGOON, SATISFACTORY IN RIVER	NONE
pH	NT	7.5	7	7.4	7.4	NORMAL RANGE	NONE
Suspended Solids	NT	NT	NT	NT	NT	LOW	NONE
Temperature	NT	14.8	14.8	14.9	13	NORMAL RANGE	NONE
Total Oxidised Nitrogen	NT	NT	NT	NT	NT	NT	NA

Table 5.1.3 Surface water quality Dungarvan landfill Q3 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan		
StationName	Lagoon	SW1	SW2	SW280	SW300	COMMENTS	ENVIRONMENTAL SIGNIFICANCE
SampleDate	10/08/2015	10/08/2015	10/08/2015	10/08/2015	10/08/2015		
Ammonium(NH4)	NT	NT	NT	NT	NT	NT	NA
BOD	1.9	BLD	NT	BLD	NT	LOW	NONE
Chemical Oxygen Demand	32	BLD	106	BLD	NT	LOW	NONE
Conductivity @ 25°C	519	144	142	132	NT	SALINE INFLUENCES	NONE IN THIS NATURALLY BRACKISH ESTUARINE ENVIRONMENT
Dissolved Oxygen % Saturation	68	107	106	107	NT	LOW IN LAGOON, SATISFACTORY IN RIVER	NONE
pH	7.1	7.2	7	7.2	NT	NORMAL RANGE	NONE
Suspended Solids	BLD	BLD	BLD	BLD	NT	LOW	NONE
Temperature	16.4	14.9	15	15.2	NT	NORMAL RANGE	NONE
Total Oxidised Nitrogen	NT	NT	NT	NT	NT	NT	NA

Table 5.1.4 Surface water quality Dungarvan landfill Q4 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan		
StationName	Lagoon	SW1	SW2	SW280	SW300	COMMENTS	ENVIRONMENTAL SIGNIFICANCE
SampleDate	09/11/2015	09/11/2015	09/11/2015	09/11/2015	09/11/2015		
Ammonium(NH4)	NT	NT	NT	NT	NT	NT	NA
BOD	2.8	1.8	1.4	1.8	NT	LOW	NONE
Chemical Oxygen Demand	30	30	33	28	NT	LOW	NONE
Conductivity @ 25°C	678	134	134	128	NT	SALINE INFLUENCES	NONE IN THIS NATURALLY BRACKISH ESTUARINE ENVIRONMENT
Dissolved Oxygen % Saturation	51	93	93	97	NT	LOW IN LAGOON, SATISFACTORY IN RIVER	NONE
pH	6.9	7	6.9	7.1	NT	NORMAL RANGE	NONE
Suspended Solids	4	4	BLD	BLD	NT	LOW	NONE
Temperature	11.9	11.2	11.2	11.2	NT	NORMAL RANGE	NONE
Total Oxidised Nitrogen	NT	NT	NT	NT	NT	NT	NA

5.2 Groundwater

5.2.1 INTRODUCTION

Sites GW1, GW2a, RC3a, RC4, RC6a, RC7 and RC8 were sampled during 2015. RC1 is no longer in place.

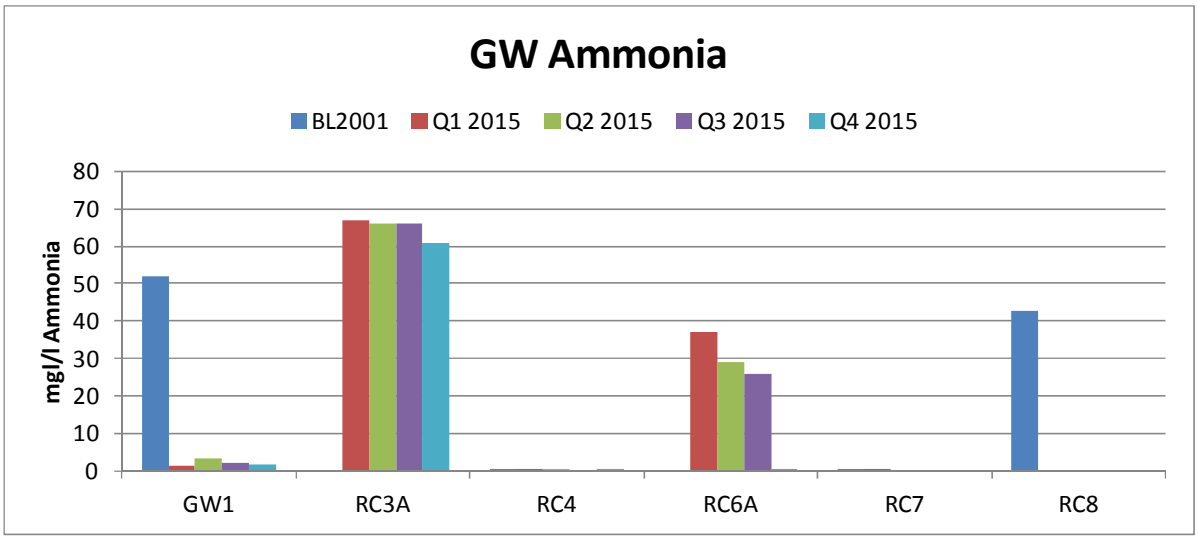
RC4 (south west of site) and RC7 (east of site) are outside the waste deposit area.

All the other ground water stations are within the site boundary, either within or immediately adjacent to waste deposit areas. Ground-water flow through the site has previously been described as south to north.

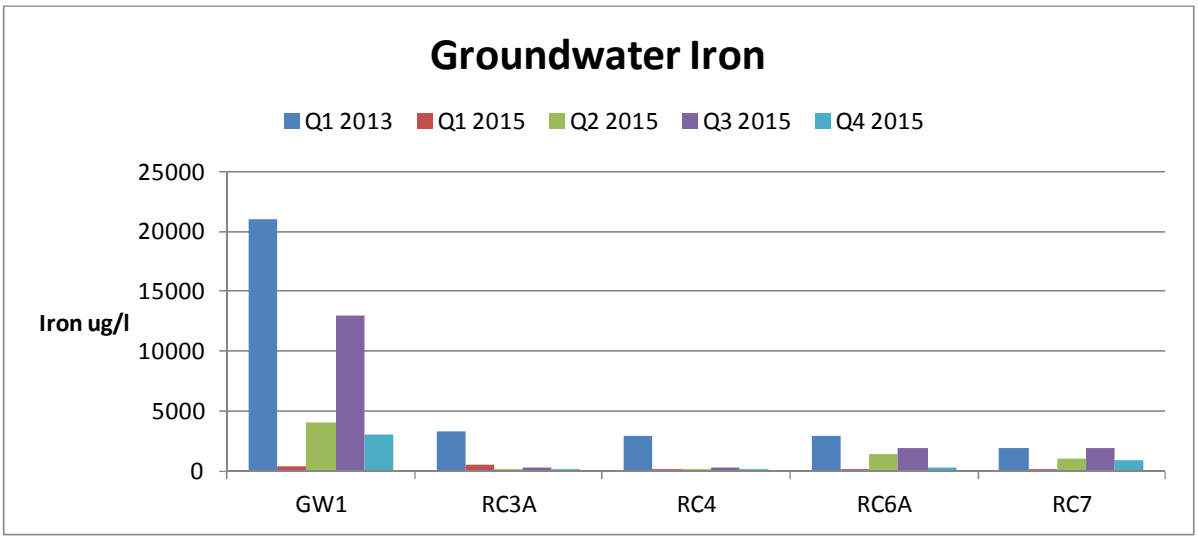
5.2.2 RESULTS

Results for 2015 are presented on tables 5.2.1 to 5.2.4 below, and appendices. High ammonia levels were detected at borewells RC3a, and RC6a, within the landfill site. Metals levels were generally low, although high iron levels were detected at GW1. Trace organics were not detected in groundwaters. High conductivity levels detected at site RC7, outside the landfill boundary, when tested in Q4, which indicates likely saline intrusion from the estuary.

Key Parameter – Ammonia



Key parameter - Iron



5.2.3 DISCUSSION

Ammonia was elevated at sites RC3a and RC6a. RC4 and RC7, outside the landfill area, had relatively low *ammonia*. RC7 had a high ionic content at times, possibly indicating brackish water intrusion.

Heavy metals and organics were not detected or else present in low concentrations.

The results of groundwater monitoring are in line with results from previous rounds of testing. The sites within and closely adjacent to the working area appear to be impacted by landfill leachate in terms of ammonia and iron concentration. Site RC4 at the south-western boundary had relatively good water quality. Site RC7, 200 metres east of the facility, and outside the landfill area, had generally satisfactory water quality though saline intrusion was evident.

Table 5.2.1 Dungarvan landfill groundwater monitoring Q1 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Groundwater quality standards S.I. No. 9 of 2010	Comment	Environmental significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	23/02/2015	23/02/2015	23/02/2015	23/02/2015	23/02/2015			
Ammonia(N)	1.4	67	0.65	37	0.026	0.175	Elevated levels at GW1, RC3a and RC6a, likely due to landfill leachate.	None, given dilution available
Chloride	32	140	32	136	1840	24	Elevated at RC3a, RC6a and RC7. Likely due to landfill material at RC3a and RC6a and brackish water ingress at RC7.	None, given available dilution and estuarine nature of receiving environment.
Conductivity @ 25°C	1049	1360	649	1443	NT	800	As for chloride	As for chloride
Dissolved Oxygen % Saturation	20.2	14.6	50.5	25	29.6		Relatively low as to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
Iron	400	500	23	170	29	200	Elevated at GW1 and RC3A	None, given dilution available
pH	6.6	6.9	6.7	6.8	6.7			
Temperature	10.8	11.8	10.7	11.5	10.6			
Total Oxidised Nitrogen	BLD	1.3	11	8.1	3.6	8.48	Slightly elevated at RC4	None, given dilution available

Table 5.2.2. Groundwater quality Dungarvan landfill Q2 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Groundwater quality standards S.I. No. 9 of 2010	Comment	Environmental significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	18/06/2015	18/06/2015	18/06/2015	18/06/2015	18/06/2015			
Ammonia(N)	3.3	66	0.27	29	BLD	0.175	Elevated levels at GW1, RC3a and RC6a, likely due to landfill leachate.	None, given dilution available
Chloride	21	119	29	112	2200	24	Elevated at RC3a, RC6a and RC7. Likely due to landfill material at RC3a and RC6a and brackish water ingress at RC7.	None, given available dilution and estuarine nature of receiving environment.
Conductivity @ 25°C	1145	1713	644	1294	NT	800	As for chloride	As for chloride
Dissolved Oxygen % Saturation	33.8	13.9	50	14	46.1		Relatively low as to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
Iron	17000	4100	200	1400	990	200	Elevated at GW1,RC3A,RC6a and RC7	None, given dilution available
pH	6.6	6.9	7.1	7	7.3			
Temperature	13.3	12.8	12	12	11.8			
Total Oxidised Nitrogen	BLD	BLD	11	8.3	2.1	8.48	Slightly elevated at RC4	None, given dilution available

Table 5.2.3. Groundwater quality Dungarvan landfill Q3 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Groundwater quality standards S.I. No. 9 of 2010	Comment	Environmental significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	10/08/2015	10/08/2015	10/08/2015	10/08/2015	10/08/2015			
Ammonia(N)	2.2	66	BLD	26	BLD	0.175	Elevated levels at GW1, RC3a and RC6a, likely due to landfill leachate.	None, given dilution available
Chloride	16	113	30	105	4700	24	Elevated at RC3a, RC6a and RC7. Likely due to landfill material at RC3a and RC6a and brackish water ingress at RC7.	None, given available dilution and estuarine nature of receiving environment.
Conductivity @ 25°C	1108	1618	615	1291	NT	800	As for chloride	As for chloride
Dissolved Oxygen % Saturation	22	17	45	22	30		Relatively low as to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
Iron	13000	4700	240	1900	1900	200	Elevated at GW1,RC3A,RC6a and RC7	None, given dilution available
pH	6.5	6.9	6.9	7	7			
Temperature	14.2	13.1	12.5	12.4	12.5			
Total Oxidised Nitrogen	BLD	BLD	11	7.1	0.87	8.48	Slightly elevated at RC4	None, given dilution available

Table 5.2.4 Dungarvan landfill groundwater monitoring Q4 2015

EntityName	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Dungarvan	Groundwater quality standards S.I. No. 9 of 2010	Comment	Environmental significance
StationName	GW1	RC3a	RC4	RC6a	RC7			
SampleDate	09/11/2015	09/11/2015	09/11/2015	09/11/2015	09/11/2015			
Ammonia(N)	1.6	61	0.031	0.054	34	0.175	Elevated levels at GW1, RC3a and RC6a, likely due to landfill leachate.	None, given dilution available
Chloride	20	110	29	121	121	24	Elevated at RC3a, RC6a and RC7. Likely due to landfill material at RC3a and RC6a and brackish water ingress at RC7.	None, given available dilution and estuarine nature of receiving environment.
Conductivity @ 25°C	1049	1597	643	1390	1390	800	As for chloride	As for chloride
Dissolved Oxygen % Saturation	50	20	50	30	15		Relatively low as to be expected	None
Faecal Coliforms	NT	NT	NT	NT	NT			
Iron	3100	3600	93	270	900	200	Elevated at GW1,RC3A, RC6a and RC7	None, given dilution available
pH	6.7	6.8	6.8	6.8	6.8			
Temperature	12.8	12.4	12	12.4	11.9			
Total Oxidised Nitrogen	BLD	0.21	11	1.4	5	8.48	Slightly elevated at RC4	None, given dilution available

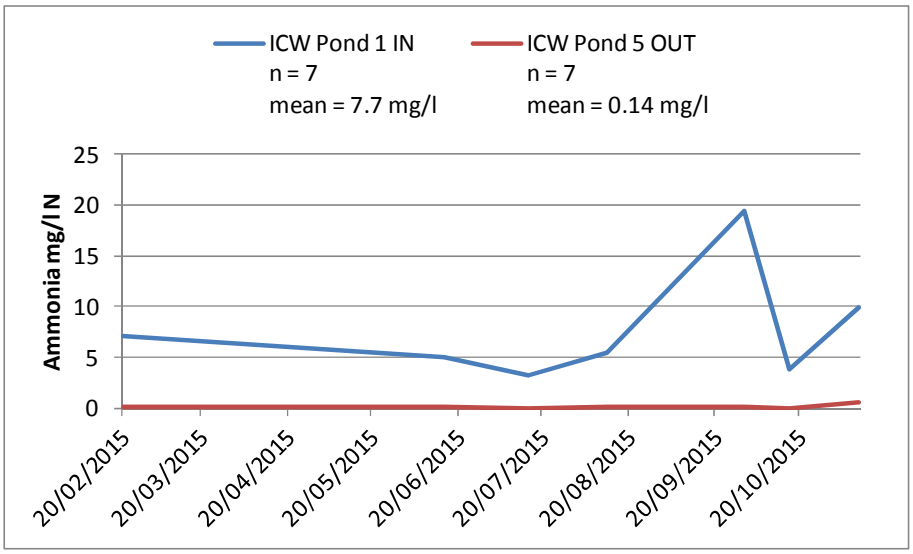
5.3 LEACHATE

5.3.1 INTRODUCTION

In order to treat the leachate collected from the landfill an ICW consisting of five cells of varying size was constructed on top of the capped landfill. Each ICW cell was constructed by creating 1m x 3-4m wide perimeter bunds. Each cell was lined with HDPE to contain the leachate and each cell has a 500mm depth of subsoil to support the establishment of the wetland helophytic (emergent) vegetation. The wetlands have a total surface area of 18,000 m2. The ICW can be generally categorized as a surface flow wetland and strives to mimic natural wetlands of similar structure and vegetation. The dominant vegetation in the wetland consists of a range of helophytic genera (emergent plants) including amongst others Typha, Glyceria, Carex and Iris species. The sizing of the overall functional area of the ICW is based on an area loading of 0.2 litres of leachate per meter squared per day (0.2 l/m2/d). The leachate, after dilution, is pumped to the first ICW cell and thereafter flows by gravity sequentially from cell to cell where it is comprehensively treated prior to intermittent discharge to the on-site surface water lagoon.
Currently leachate from the interceptor tank and leachate boreholes 2 and 6 are mixed with groundwater from RC8 and pumped to the ICW for treatment. Flow and contaminant loadings to the wetland are presented in table 5.3.1. Inlet and outlet concentrations for ammonia, phosphate and chemical oxygen demand are graphed in figure 5.3.1.

Table 5.3.1 Dungarvan landfill integrated constructed wetland estimated loadings – present and (future expected).

Number of ponds	6
Total working wetland area m2	5158
Total working wetland volume m3	1032
HYDRAULIC FLOWS	
Influent Volume m3 per Day	26.9 (50)
Hydraulic loading l/m2/day	5.2 (12)
Ammoniacal Nitrogen loading (g/m2/day)	0.5
Total Phosphorous loading (g/m2/day)	0.003
COD loading (g/m2/day)	0.6
Metals mg/m2/day	<0.1



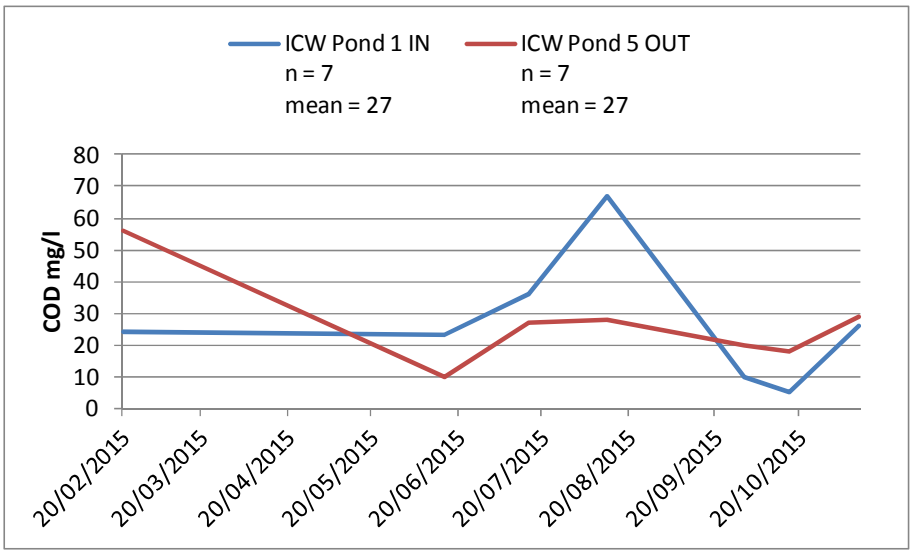


Figure 5.3.1: ICW inlet / outlet concentrations a) ammonium, b) chemical oxygen demand.

Key Parameter – leachate COD

The COD test measures the organic matter in a sample that is amenable to chemical oxidation. The COD test is usually applied to polluted waters and waste-waters.

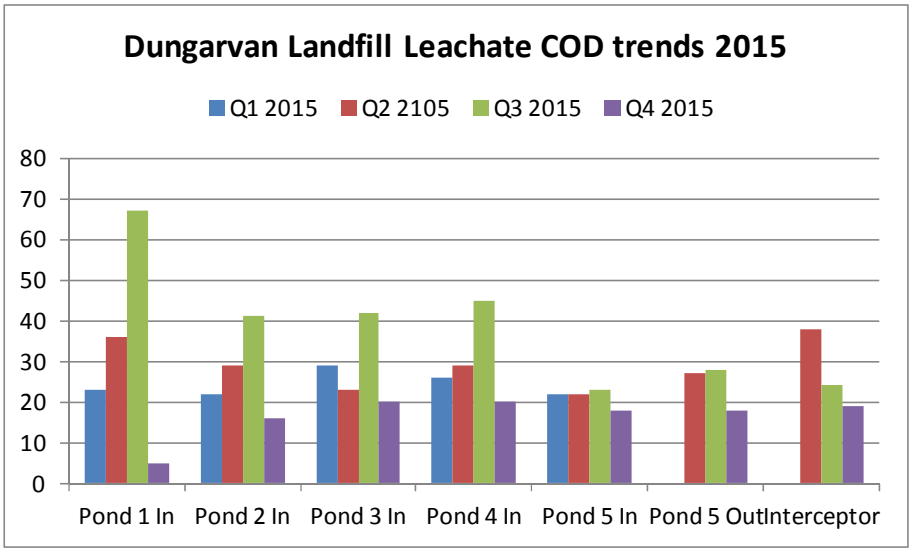


Figure 5.3.2 Leachate COD trends 2015

DISCUSSION

The strengths of leachate present in the holding/interceptor tank and at the ICW inlet were quite low, with an average COD value of 32 and 27 mg/l respectively. The interceptor tank receives leachate from a drain around the landfill and also from a waste transfer station. The contents of the interceptor tank and leachate boreholes 2 and 6 are treated in the on-site constructed wetland. Ammonium values at the ICW outlet ranged from 0.01 to 0.58 mg/l, with an average of 0.14 mg/l, and were below the proposed discharge licence limit of 5 mg/l. Similarly COD (mean 27 mg/l) values were low for the ICW outlet.

Table 5.3.3 Leachate quality Dungarvan landfill, Q1 2015

EntityName	Dungarvan
StationName	Interceptor
SamplePurpose	LANDFILL LEACHATE QUARTERLY
SampleDate	23/02/2015
Ammonium(NH4)	BLD
BOD	1.2
Chemical Oxygen Demand	BLD
Chloride	NT
Conductivity @ 25°C	693
pH	7
Total Oxidised Nitrogen	NT

EntityName	Dungarvan
StationName	ICW Pond 5 outlet
SamplePurpose	Landfill leachate ICW
SampleDate	23/02/2015
Ammonia(N)	BLD
BOD	NT
Chloride	NT
Dissolved Oxygen % Saturation	75
Iron	NT
Ortho-phosphate	BLD
pH	6.8
Total Oxidised Nitrogen	BLD

Table 5.3.4 Leachate Quality Dungarvan landfill, Q2 2015

EntityName	Dungarvan
StationName	Interceptor
SamplePurpose	LANDFILL LEACHATE QUARTERLY
SampleDate	23/02/2015
Ammonium(NH4)	BLD
BOD	BLD
Chemical Oxygen Demand	27
Chloride	NT
Conductivity @ 25°C	630
pH	7.2
Total Oxidised Nitrogen	NT

EntityName	Dungarvan
StationName	ICW Pond 5 outlet
SamplePurpose	Landfill leachate ICW
SampleDate	15/07/2015
Ammonia(N)	NT
BOD	4
Chloride	NT
Dissolved Oxygen % Saturation	NT
Iron	NT
Ortho-phosphate	BLD
pH	7.73
Total Oxidised Nitrogen	NT

Table 5.3.5 Leachate Quality Dungarvan landfill, Q3 2015

EntityName	Dungarvan
StationName	Interceptor
SamplePurpose	LANDFILL LEACHATE QUARTERLY
SampleDate	23/02/2015
Ammonium(NH4)	NT
BOD	BLD
Chemical Oxygen Demand	32
Chloride	NT
Conductivity @ 25°C	519
pH	7.2
Total Oxidised Nitrogen	NT

EntityName	Dungarvan
StationName	ICW Pond 5 outlet
SamplePurpose	Landfill leachate ICW
SampleDate	15/07/2015
Ammonia(N)	NT
BOD	1.9
Chloride	NT
Dissolved Oxygen % Saturation	68
Iron	NT
Ortho-phosphate	BLD
pH	7.1
Total Oxidised Nitrogen	NT

Table 5.3.6 Leachate Quality Dungarvan landfill, Q4 2015

EntityName	Dungarvan
StationName	Interceptor
SamplePurpose	LANDFILL LEACHATE QUARTERLY
SampleDate	23/02/2015
Ammonium(NH4)	0.53
BOD	2
Chemical Oxygen Demand	30
Chloride	NT
Conductivity @ 25°C	649
pH	7.65
Total Oxidised Nitrogen	NT

EntityName	Dungarvan
StationName	ICW Pond 5 outlet
SamplePurpose	Landfill leachate ICW
SampleDate	15/07/2015
Ammonia(N)	NT
BOD	3
Chloride	NT
Dissolved Oxygen % Saturation	NT
Iron	NT
Ortho-phosphate	BLD
pH	7.75
Total Oxidised Nitrogen	NT

5.4. Groundwater and Leachate Levels

5.4.1 Introduction

Groundwater and leachate levels are determined monthly, by dip meter, at boreholes GW1, RC3a, RC4, RC6a, RC7, RC8, L4, and L5a.

5.4.2 Results

Results of monitoring are presented in table 4.1.

Table 5.4.1 Dungarvan landfill leachate levels 2015

Date	Operator	RC7	RC6A	GW2A	L5A	L4	RC3A	RC4	L1A	L2B	RC 8	GW1
05/01/2015	DR	10.3	8.5	1.9		0.9	12.6	15.4			12.2	2.7
02/02/2015	DR	10.3	8.5	1.9		0.9	12.6	15.3			12.0	2.7
03/03/2015	DR	10.2	8.4	1.9		0.9	12.6	15.3			12.0	2.7
06/04/2015	DR	10.2	8.4	1.9		0.9	12.6	15.3			12.0	2.7
12/05/2015	DR	10.2	8.3	1.9		1.0	12.6	15.3			12.1	2.7
04/06/2015	DR	10.2	8.3	1.9		1.0	12.6	15.2			12.1	2.7
07/07/2015	DR	10.2	8.2	1.9		0.9	12.6	15.2			12.1	2.7
04/08/2015	DR	10.3	8.2	1.9		0.9	12.6	15.2			12.1	2.7
01/09/2015	DR	10.3	8.3	1.9		0.9	12.6	15.3			12.1	2.7
01/10/2015	DR	10.3	8.3	1.9		0.9	12.6	15.2			12.0	2.7
10/11/2015	DR	10.3	8.3	1.9		0.9	12.6	15.4			12.0	2.7
08/12/2015	DR	10.4	8.4	1.9		0.9	12.6	15.2			12.1	2.7

D=Damaged

Note new wells drilled at L1A, L2B and L5B in August 2011

5.4.3 Discussion

There was some fluctuation in levels in all boreholes. Some pumping of leachate to the on-site constructed wetlands was ongoing during this period and may have had an effect on leachate levels. Note new wells were drilled at L1A, L2B and L5B in August 2011.

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5.5 LANDFILL GASES

5.5.1 Introduction

Gases (mainly methane –65% and carbon dioxide – 35%) are given off by the biodegradation of organic matter within the landfill waste. The rate of gas generation is dependent on waste type, moisture content and age of waste. Gas is monitored weekly at the site building, and monthly at the groundwater and leachate boreholes. Results of gas monitoring are presented in figures 5.5.1 and 5.5.2 and tables 5.1 to 5.4 below.

5.5.2 Results

KEY PARAMETER –METHANE

Methane is a colourless, odourless gas generated by the biodegradation of organic matter. Landfill gas contains about 65% methane.

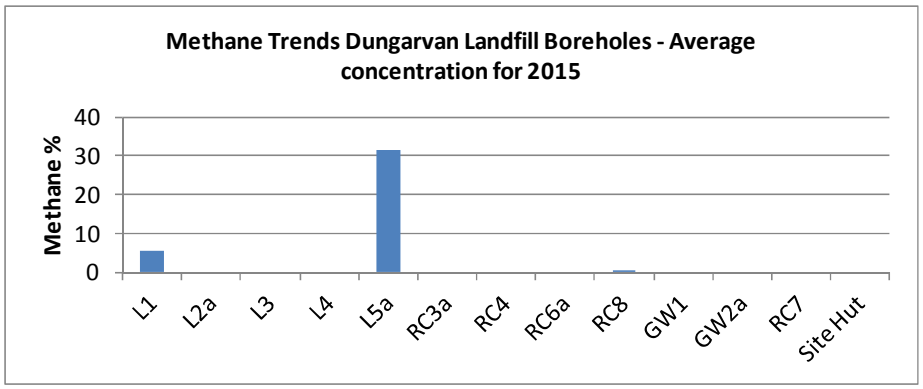


Figure 5.5.1 Methane spatial trends 2015

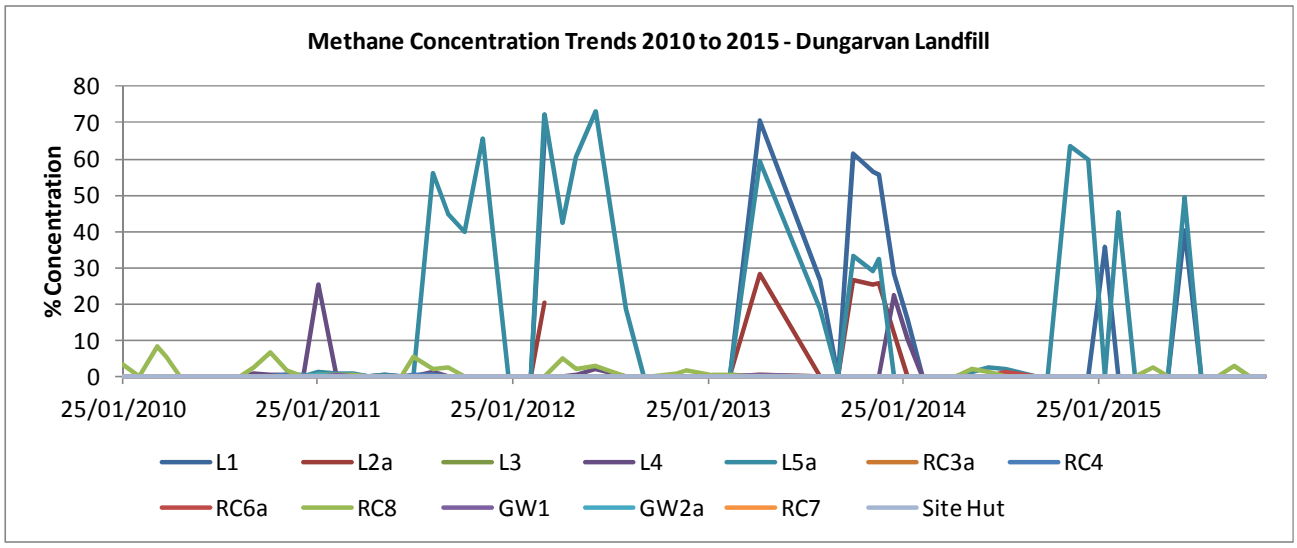


Figure 5.5.2 Methane temporal trends 2010 to 2015

Relatively high levels (63.7%) of methane were detected at L5a within the waste deposit area in Q1 and 2. No methane was detected in the site buildings or at monitoring points outside the landfill area.

Table 5.5.1: Dungarvan Landfill Gas monitoring Q1 2015

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	RC 3A	RC 4	RC 6A	LT 1	LT 2A	LT 3	LT 4	LT 5A	RC 7	RC 8
1	05/01/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	59.8 24.2 8.1 1014	0 0 20.9 1014	0 0 20.9 1014
2	12/01/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 997												
3	19/01/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1007												
4	28/01/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 999												
5	02/02/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1001	0 0 20.9 1001	0 0 20.9 1001	0 0 20.9 1001	0 0 20.9 1001	0 0 20.9 1001	64.4 31.1 1.1 1001	0 0 20.9 1001	0 0 20.9 1001	0 0 20.9 1001	47.6 26.4 15.7 1001	0 0 20.9 1001	0 0 20.9 1001
6	10/02/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1022												
7	18/02/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1021												
8	25/02/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1005												
9	03/03/2015	DR	CH_4, CO_2, O_2	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	0 0 20.9 1009	38.8 20.4 22.7 1009	0 0 20.9 1009	0 0 20.9 1009
10	11/03/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1014												
11	18/03/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1025												
12	25/03/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 999												
13	30/03/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 997												
Week No	**Date**	**Operator**	**Gas**	**Site Hut**	**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**LT 1**	**LT 2A**	**LT 3**	**LT 4**	**LT 5A**	**RC 7**	**RC 8**

Table 5.5.2: Dungarvan Landfill Gas monitoring Q2 2015

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	RC 3A	RC 4	RC 6A	LT 1	LT 2A	LT 3	LT 4	LT 5A	RC 7	RC 8
14	06/04/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	0 0 20.9 1026	41.1 25.3 17.8 1026	0 0 20.9 1026	0 0 20.9 1026
15	14/04/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1014												
16	22/04/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1021												
17	29/04/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1003												
18	06/05/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 994												
19	12/05/2019	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	45.2 21.2 17.2 1010	0 0 20.9 1010	0 0 20.9 1010
20	20/05/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1012												
21	25/05/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1015												
22	29/05/2015	DR	CH_4, CO_2, O_2	0 0 20.9 1001												
23	04/06/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	0 0 20.9 1012	31.5 15.3 10.2 1012	0 0 20.9 1012	0 0 20.9 1012
24	17/06/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1015												
25	24/06/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1011												
26	30/06/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1007												
Week No	**Date**	**Operator**	**Gas**	**Site Hut**	**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**LT 1**	**LT 2A**	**LT 3**	**LT 4**	**LT 5A**	**RC 7**	**RC 8**

Table 5.5.3: Dungarvan Landfill Gas monitoring Q3 2015

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	RC 3A	RC 4	RC 6A	LT 1	LT 2A	LT 3	LT 4	LT 5A	RC 7	RC 8
27	07/07/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	32.4 16.8 8.8 998	0 0 20.9 998	3.2 2.1 18.2 998
28	12/07/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1006												
29	22/07/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1007												
30	29/07/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1008												
31	04/08/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	0 0 20.9 998	26.5 15.4 12.1 998	0 0 20.9 998	3.4 1.6 17.6 998
32	12/08/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1016												
33	18/08/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1008												
34	25/08/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 994												
35	01/09/2015	DR	CH_4, CO_2, O_2	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	0 0 20.9 1014	18.2 13.2 16.8 1014	0 0 20.9 1014	0 0 20.9 1014
36	09/09/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1016												
37	16/09/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 985												
38	22/09/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1000												
39	30/09/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1026												
Week No	**Date**	**Operator**	**Gas**	**Site Hut**	**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**LT 1**	**LT 2A**	**LT 3**	**LT 4**	**LT 5A**	**RC 7**	**RC 8**

Table 5.5.4: Dungarvan Landfill Gas monitoring Q4 2015

Week No	Date	Operator	Gas	Site Hut	GW 1	GW 2A	RC 3A	RC 4	RC 6A	LT 1	LT 2A	LT 3	LT 4	LT 5A	RC 7	RC 8
40	01/10/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	0 0 20.9 1024	18.8 16.4 15.8 1024	0 0 20.9 1024	0 0 20.9 1024
41	14/10/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1018												
42	21/10/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1009												
43	27/10/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 997												
44	04/11/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1003												
45	11/11/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	0 0 20.9 1008	11.2 10.4 14.6 1008	0 0 20.9 1008	0 0 20.9 1008
46	17/11/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 993												
47	24/11/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1008												
48	30/11/2015	DR	CH_4, CO_2, O_2	0 0 20.9 1005												
49	08/12/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	0 0 20.9 1010	8.6 7.3 16.1 1010	0 0 20.9 1010	0 0 20.9 1010
50	15/12/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 998												
51	22/12/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 996												
52	30/12/2015	DR	CH_4, CO_2, O_2 Air Pressure	0 0 20.9 987												
Week No	**Date**	**Operator**	**Gas**	**Site Hut**	**GW 1**	**GW 2A**	**RC 3A**	**RC 4**	**RC 6A**	**LT 1**	**LT 2A**	**LT 3**	**LT 4**	**LT 5A**	**RC 7**	**RC 8**

5.6 NOISE

5.6.1 Introduction

Noise levels were not recorded during the reporting period as due to cessation of our kerbside collection noise levels on site have lessened considerably. 2014 results are included here.

Daytime noise levels were recorded on 11/6/14 at the site entrance. There are limits of 55 dB Leq(30) daytime, and 45 dB Leq(30) night-time imposed as a condition of the licence. Night-time measurements were not considered necessary as the landfill does not operate at night.
A Cirrus 800A Sound Level Meter was used. The meter was calibrated and checked with a 94 dB calibrator before and after each measurement. Broadband and Frequency Band analysis measurements were conducted at each location. A summary of results is presented in the table below. Octave band analysis is presented in figures 5.6 below.

5.6.2 Noise levels

Table 5.6.1 - 2012 Noise levels

1998 "Baseline" noise levels

Site	*Date of Monitoring*	*L(A)eq[30mins] dB*
Site entrance	11/6/14 *Baseline 1998*	**55.7** 54

5.6.3 Discussion

Noise level recorded in June 2014 was 55.7, which was slightly in excess of the noise emission requirement of 55 dB(A) LAeq (30 mins) and was higher than the baseline level of 54 dB recorded in 1998. No unusual vehicle or other noise sources were reported by the operator. The octave analysis followed the usual pattern for this site, with no tonal extremes at either end of the frequency spectrum.

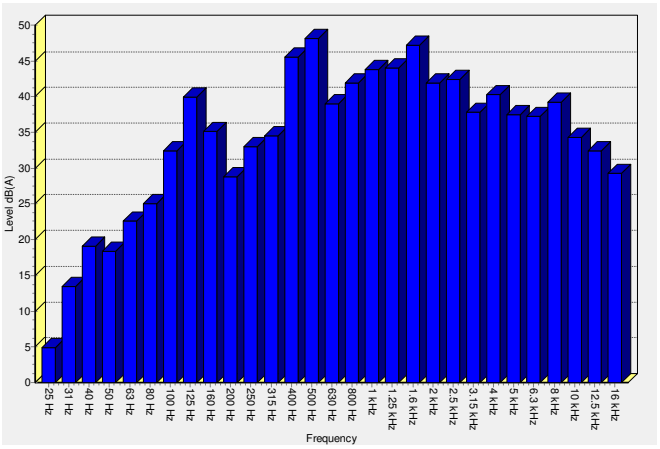


Fig 5.6 Dungarvan landfill noise monitoring 11/6/14, site entrance, octave band analysis, A weighting

5.7 DUST

5.7.1 Introduction / Methodology

Dust levels were not recorded during the reporting period as due to the cessation of our kerbside collection dust levels on site have lessened considerably. 2014 results are included here.

Dust deposition rates were measured over 28 days in 2014 at three locations (D1, D2 and D2A) at Dungarvan Landfill. The measurement method was the Bergerhoff deposition method. Two of the sample sites at D2 and D3 were damaged and could not be reported.

5.7.2 Results

Date started	1/10/14
Date finished	29/10/14
Dust deposition mg/m2/day	160

Table 5.7.1 - Dust Deposition at Dungarvan Landfill 2014

5.7.3 Discussion

Dust deposition rates was below the limit expected to give rise to nuisance (350 mg/m2/day).

5.8 MACROINVERTEBRATE SURVEY

INTRODUCTION

Sampling of macroinvertebrates was carried out at River Colligan sites SW1 and SW2 adjacent to Dungarvan Landfill on 12/12/12. Sampling was conducted on this date to take advantage of suitable river levels which could change on rainfall and prevent sampling on other dates. Sample procedure each time was two minute kick sampling in the riffle zones, plus 2 minute stone washing, with capture in biota net. The catch was returned to Adamstown Laboratory and kept aerated overnight in river water. Identification and counting of biota, using various freshwater macroinvertebrate identification keys, was carried out. The EPA Q-rating scheme was applied to the results in order to get a Q value for each site. However, it should be noted that both stations are subject to tidal influences and may at times be brackish, depending on flow of freshwater and extent of tide.

RESULTS –

Table 5.8.1. Macroinvertebrate counts 12/12/12

	Sample location	SW1 River Colligan	SW2 River Colligan
	Date sampled	12/12/2012	12/12/2012
GROUP	**Species**	**Count**	**Count**
	Mayflies EPHEMEROPTERA		
B	Baetis	2	
A1	Ephemera	2	
A1	Ecdyonurus	3	3
	Stoneflies PLECOPTERA		
A1	Perla	1	
	Caddis TRICOPTERA		
B	Hydropsyche	1	
B	Rhyacophila	1	
B	Polycentropus	1	2
A2	Anabolia		1
A2	Stenophylax	1	
A2	Sericostoma	1	2
	Other		
B	Limnius		1
	Other Snails		1
B	Gammarus	125	200
	Water mites		1
	TAXON RICHNESS	**10**	**8**

Table 5.8.2 Nominal Q-Ratings 12/12/12.

	SW1	SW2
A1	Small Numbers	Small Numbers
A2	Small Numbers	Small Numberw
B	Numerous/Dominant	Numerous/Dominant
C	Absent	Absent
D	Absent	Absent
Assigned Q Rating	3/4	¾

Table 5. Species list of macroinvertebrates 2009 survey (Limosa 2009).

Order	Family	Tolerance	SW2	SW1	SW4 Pond
Ephemeroptera (Mayflies)	Heptageniidae	A	1		
	Baetidae	C	4		
Trichoptera (Cased caddis)	Seracostomatidae	B	2	"	
	Goeridae	B	4		
Trichoptera (Uncased caddis)	Linephilidae	B	1		
	Polycentropodidae	C			4
Coleoptera (Beetles)	Elmidae	C	7	3	
Crustacea (Crustaceans)	Gammaridae	C	60	120	
Odonata (Damselflies)	Coenagrioniidae	-			4
Diptera (Flies)	Chironomidae	C	1		
	Ceratopogonidae	C			1
	Chaoboridae	C			2
Gastropoda (Snails)	Lymnaeidae	D	2		59
	Hydrobiidae	C	20	11	
Fish	Pleuronectidae	-	3	4	
	Corixidae	-			11
Freshwater Worms	Oligochaeta	-			9
Cladocera (Water Flea)	Daphniidae	-			>500
Taxon Richness			11	5	8

DISCUSSION

Both stations SW1 and SW2 are subject to tidal influences and may at times be brackish, depending on river flow and tidal range.

Nominal Q-scores are assigned for this survey (table 5.8.2) in order to comply with licence requirements, aid interpretation of the species count and to allow trends to be tracked. However, as the Q index system is designed for freshwaters, standard interpretation of the Q score is not possible for these tidal and possibly brackish stations.

Comparison with previous surveys and between stations is possible. Taxon richness was higher in the December 2012 survey compared to the Oct 2009 survey at SW1 (10_{2012} vs 5_{2009}) and slightly lower for SW2 (8_{2012} vs 11_{2009}). In the December 2012 survey here was a slight increase in taxon richness between the upstream station SW2 (8) and the downstream station SW1 (10).

Taxon richness and species present at both stations indicate good water quality.

A detailed Ecological Report is included in APPENDIX J

5.11 CONCLUSIONS

Water quality, at the River Colligan surface water sites, in the vicinity of the landfill was satisfactory throughout 2015.

The results of groundwater monitoring are in line with results from previous rounds of testing carried out since 1999. As indicated in previous reports, some of the boreholes within the current working area appear to be impacted by leachate from the landfill in terms of ammonia and iron, however groundwater outside the landfill site was generally satisfactory.

Leachate quality was as expected for a landfill accepting mainly domestic and inert waste. Metal and trace organics concentrations were low. Based on leachate management, treatment in the on-site constructed wetlands, attenuation and dilution, no environmental effect from landfill leachate is expected.

Noise was slightly in exceedance of the 55 dB daytime limit but no tonal impulses were noted. No complaints related to noise have been received and it is thought that the noise level on the day was due to natural background noise as activity on this closed site is very low.

Dust deposition level was below nuisance levels.

Taxon richness and species present at both river stations' macroinvertebrate surveys indicated good water quality, in line with previous biological surveys.

Overall, water and ecological quality in the vicinity of the landfill were satisfactory and there was no indication that the landfill was having a detrimental impact on the surrounding environment.

5.12 Meteorological Data.

Monthly meteorological data is attached in Appendix F.

6. Sequence and timescale for development and restoration of the facility

a) Landfill Capping and Restoration

A Restoration and Aftercare Plan has been approved by the EPA. Capping was completed in 2008.

b) Landfill Gas & Leachate Management

Tank and pipeline testing and inspection report

As part of the leachate and gas systems required under the licence, 1549m of leachate pipework (315mm, 225mm, 160mm, 90mm, 63mm), 3334m of gas pipework (250mm, 90mm), and 3 No. gas manifolds, were installed in 2009. All pipework was pressure tested in accordance with the contract and passed.

Two No. 25m3 Glass lined steel leachate storage tanks were erected onsite in 2009, however works onsite were suspended before final testing and commissioning. In May 2010, one of these tanks was brought into use as a leachate storage tank, and was (water) tested prior to usage. The tank on the western side of the site is now fully operational and forms part of the leachate abstraction system.

Report on progress made and proposals being developed to minimise generation of leachate for disposal

As per the information in the waste licence review submission (Dec-08), capping works were completed in mid 2008. The final capping system generally comprises of a gas collection layer, LLDPE liner, drainage layer, subsoil layer and topsoil layer as follows:

- 150-300mm layer of topsoil; underlain by
- Subsoil such that thickness of topsoil and subsoil is at least 1m thick; underlain by

- A surface water geocomposite layer; underlain by
- 1mm LLDPE liner (a low permeability geomembrane material).
- Geocomposite gas collection layer.

The capping layers will provide protection from the ingress of rain into the site and thus minimise leachate generation.

Wetland ponds were constructed in 2008 for the purpose of treating leachate. Leachate extraction wells are located strategically across the site in order to maximise collection efficiency. Furthermore, rainwater will assist in the dilution of leachate within the constructed wetlands.

The leachate and gas collection pipework and ancillary items was completed in 2009.

Work on the completion of the Landfill Gas and Leachate Management system were hindered by financial restrictions encountered by the licensee during the previous reporting period, however a temporary leachate extraction system is now operational, with initial results proving to be successful.

A report on the operation of the leachate extraction system, along with a layout drawing and laboratory analysis results of treated leachate to date are included in Appendix K Financial sections of the report have been omitted in the interests of confidentiality.

Development / Infrastructural works summary (completed in previous year or prepared for current year)

In 2009, as part of the leachate and gas systems required under the licence, 1549m of leachate pipework (315mm, 225mm, 160mm, 90mm, 63mm), 3334m of gas pipework (250mm, 90mm), and 3 No. gas manifolds, were installed. Two No. 25m3 Glass lined steel leachate storage tanks were erected.

A flare trial was carried out in 2009 to confirm the size of permanent flare required. A closed permanent flare of 100 m3/hr capacity was assessed as required, and was installed.

Following the tender and recommendations in the Gas Flare Tender Assessment Report (May 2008), AFS was awarded the tender for the flare and associated works. The gas collection system was completed in June 2009, but the project was then put on hold due to funding issues. The permanent flare was installed and commissioned by AFS in July 2010, and intensive field balancing over a three month period was completed.

The telemetry system associated with the flare is fully operational and monitoring data referred to in Schedule C.1.2 of the licence can be furnished to the Agency as required. The licensee will agree a period for residence time also in accordance with Schedule C.1.2. The 2015 EPA Landfill Gas survey is included in Appendix G

In 2014 a 12kW thirty metre high micro wind turbine was erected at Dungarvan Civic Amenity site, in order to contribute towards attaining the 2020 targets for local authorities of reducing CO2 emissions by 33% and the gross electrical consumption from renewable sources target of 40% as set out in government policy.

The wind turbine generated 13,000KWh in 2015, which equates to an annual saving of €2,600 in electricity supply costs at the facility.

7. Topographical survey

No significant topographical changes have occurred on site since the previous survey was carried out. The previous survey has not been attached as it is cannot be accommodated with an acceptable level of detail in this document.

8. Schedule of Environmental Objectives and Targets for the forthcoming year

Objective 1 – To maintain site infrastructure to the standards outlined in Condition 3 of the Waste Licence

Target 1.1 - Any defect to the existing infrastructure will be repaired / replaced as quickly as possible on an ongoing basis.

Objective 2 – That no specified emissions from the facility, shall exceed the limit values, set out in Condition 6 and Schedule C of the Waste Licence and that all measures referred to in Condition 6 of the licence are adhered to

Objective 3 – To maintain the Monitoring Programme as outlined in Condition 8 and Schedule D of the Waste Licence.

Target 3.1 – To carry out the monitoring programme as outlined in Condition 6 and Schedule C of the Waste Licence.

Target 3.2 – To submit Annual Environmental Report to the Agency within the timescale as outlined in Schedule E of the Waste Licence.

Objective 4 – To establish good record keeping and that all records are held at the facility office to comply with Condition 11 of the Waste Licence.

Objective 5 – That no emergency situation occurs on the site.

Target 5.1 – Ensure the contingency arrangements as outlined in Condition 9 of the Waste Licence are implemented throughout the year. A document entitled 'Emergency Response Procedures' forms the nucleus of the contingency arrangements and is currently with the Agency.

Objective 6 – To restore the landfill on an ongoing basis in such a way that final works have a minimal impact on the surrounding environment.

Objective 7 – To carry out regular maintenance of the Gas Management System including gas field balancing, telemetry maintenance and temperature control.

Objective 8 – To maintain Leachate Management System

Objective 9 – To maintain Landscaping of Landfill Cap

Objective 10 – To maintain SCADA system

9. Full title and a written summary of any procedures continued during the reporting period

The European Council Directive 90/313/EEC on the *Freedom of Access to Information on the Environment* recognises the significance of the public's access to information relating to the environment. At present, copies of all documents and correspondence relating to Waste Licence 32-2 are on display at the Civic Offices, Dungarvan.

A communications programme will be put in place as required under condition 2.4.1 of the Waste Licence to ensure that members of the public can obtain information concerning the environmental performance of Ballynamuck Landfill. This in turn will address any local community concerns and allow the public the opportunity to provide feedback on the facility.

The Facility Manager will be responsible for the implementation of this programme, which shall form part of the routine operation and management of the facility. Further support will be provided from the Environment Section of Waterford County Council if required.

Programme

Information to be provided at the Facility

1. The following information will be available for inspection at the Site Office, and will be maintained by the Facility Manager.

- Map of the Facility showing all environmental monitoring points
- Current Waste Licence for the Facility
- All records relating to the Facility
- Civic Waste Records
- Nuisance Inspection
- Integrity Tests of Bunds
- Complaints Register
- Incidents Register

- Environmental Monitoring Records (Groundwater, Surface water, Leachate, Landfill Gas, Noise and Meteorological Data).

- Emergency Response Procedure
- Programme for the control and Eradication of Vermin and Flies
- The current EMS for the Facility
- Annual Environmental Report
- Visitors Book

2. The Waste Acceptance hours under condition 1.7.1.2 of the Waste Licence are

Monday – Friday	9.00am – 1.00pm and 1.30pm – 5.00pm,
Saturday's	9.00am – 1.00pm.

3. All visitors are required to sign a Visitors Book at the site office outlining their reason for visiting. Unauthorised personnel are not allowed access to the site.

4. Members of the public may arrange a site visit by contacting the Facility Manager prior to their visit. For Health and Safety reasons all visitors must have appropriate clothing (High Vis-jacket, Walking boots/Wellingtons). The Facility Manager or Caretaker shall accompany all visitors on site visits. A number of school visits to the facility took place during the reporting period

5. If information is requested that is not available at the site, the interested party will be directed to the Environment Section of Waterford County Council at the Civic Offices in Dungarvan.

6. Written Requests for Information

All requests concerning the environmental performance of the facility should be made in writing to:

David Regan
Facility Manager
Ballynamuck Waste Disposal Site
Dungarvan, Co. Waterford.

7. The Facility Manager shall copy all requests to:

Senior Executive Officer
Environment Section
Waterford City and County Council
Civic Offices
Dungarvan
Co. Waterford

8. Each request should indicate the name, address and contact telephone number of the concerned party, an outline of the required information and the manner in which they require the information i.e. copy of record, e-mail etc.

9. Waterford City and County Council shall make replies in writing within twenty working days of receiving the written request.

10. The information required shall be issued in paper format unless otherwise requested by the concerned party. Requests that require information in digital format may require more time than the twenty working days as outlined previously.

11. If requested Waterford City and County Council will provide a clear explanation of the information provided.

12. If the concerned party requests the examination of a particular report/document relating to the facility, then it will be made available for viewing at the Landfill site office.

13. ***Media Requests***

The Director of Services within the Environment Section of Waterford City and County Council shall nominate a liaison person to respond to requests made by the media for information relating to the environmental performance of the facility.

14. ***Feedback from the public***

The Facility Manager will record any comments or suggestions made by the public during their visits and the opportunity will also be available to submit a written comment to the landfill site office. Copies of such minutes or submissions will be kept in a register by the Facility Manager and will also be copied to the Environment Section, for the attention of the

Senior Engineer. If requested a reply will be provided by the Council within twenty working days.

Emergency Response Procedures

Scope

The Emergency Response Procedures apply but is not limited to the following incidents occurring:

- Fire / Explosions
- Spillages
- Migration of Landfill Gas
- Environmental Pollution
- Injury or serious accident to persons
- Any other incident, which may pose a significant threat to persons or the environment.

Responsibility

1. The Facility Manager is responsible for the implementation of the Emergency Response Procedure and for the training of all landfill personnel and contractors in effective emergency response procedures.
2. In the event of a major fire or an explosion the Senior Rostered Fire Officer will be notified immediately via the Regional Fire
3. In the event of a serious accident or injury to a person the Ambulance service should be contacted
4. In the event of other incidents e.g. spillages or environmental pollution the Senior Environment Engineer will be notified and will assume responsibility along with the Facility Manager.

Procedure

In the event of an accident occurring the following procedure will be adopted:

- Evacuate the immediate area within the site if necessary
- Inform other site users
- Remain upwind of any hazard area
- Contact site office and advise in detail of the emergency
- Ensure entrance/exit gate is not obstructed

- Contact fire Brigade, Ambulance, Gardaí, and / or Senior Engineer, Waterford County Council as required by dialing 999 or 112
- If incident occurs outside office hours an emergency telephone contact number will be provided on the site notice board
- Personnel shall report to the designated assembly point at the site office
- All areas affected by the incident shall remain closed until given the all-clear by an authorised person

In the event of landfill gas being detected in the site office the following procedure will be followed:

- Raise the alarm
- Evacuate the site office
- Notify relevant senior personnel in Waterford County Council or emergency services if necessary
- Immediately conduct gas survey to identify source
- Remedy cause of problem
- Document incident properly

In the event of a spillage, the Facility Manager shall apply a suitable absorbent material to contain and absorb any spillage at the facility. Once contained the Facility Manager shall have regard to the Corrective Action Procedure.
In the event of a serious threat to the environment, the Facility Manager shall take all necessary short-term action to minimise any further impact and allow the Corrective Action Procedure.

Records

Details of any incident will be recorded in a written register, which will be maintained at the site office

Waste Characterisation & Acceptance Procedures for the Acceptance, Storage and Segregation of Waste

The Civic Waste Facility at Dungarvan Landfill accepts waste from Domestic Householders only.
The following items are accepted:

Waste Electronic and Electrical Equipment – Cages are provided for the collection and storage of small electrical goods. Members of the public are instructed to place all items into these cages by Waterford City and County Council Employees.

Paint – A 20ft container allows for the collection and storage of paint cans. Members of the public are instructed to place all items on the floor of the container where they are later packed in to steel drums by Waterford City and County Council Employees.

White Goods (Cookers, washing machines, driers, fridges, freezers) - A 20 ft container allows for the collection and storage of all White goods. Members of the public are instructed to leave all items near the door of the container where they are later double stacked by Waterford City and County Council Employees.

Glass – Bottle banks are in place to facilitate the disposal of green, brown and clear glass bottles. There is also a small skip in place for the collection of flat glass where it is removed off site for recovery at a later stage**.**

Hazardous Materials (These are collected and stored in a 40ft container)

Cooking Oil – Waterford City and County Council employees place all cooking oil in steel drums.

Car oil – Members of the public are instructed to leave all cans beside the oil collection unit where it is later emptied in to the unit by Waterford City and County Council employees.

Fluorescent tubes – Are collected and stored in a specifically made timber container.

Domestic Batteries – These are collected and stored in plastic barrels.

Car Batteries – These are collected are stored in specifically designed battery receptacles.

Obsolete medicines - These are collected and stored in plastic barrels.

Aerosols – These are collected and stored in plastic barrels (all aerosols are separated in to flammable, non – flammable, toxic prior to packing. The aerosols are stacked in layers and covered with vermiculite which is a fire proofing material)

Pesticides - These are collected and stored in plastic barrels.

Scrap metal – Members of the public are instructed to place all metal items in to an open skip where it is later removed off site for recovery

Bulky Items (Beds, Carpets, Mattresses, etc) - Members of the public dispose of these items in to a 20ft container where they are later disposed of to the tip head.

Household Waste – Members of the Public place domestic waste in to a closed skip where it is later disposed of to the Transfer Station.

Rubble - Members of the Public place rubble waste in to an open skip. It is transported offsite for recovery

Clay & Top soil - Members of the Public place clay & topsoil in to an open skip. It is transported offsite for recovery

Household Dry Recyclables – Members of the public dispose of recycling material in to a closed skip where it is later removed off site for recovery.

Timber - Members of the Public place timber products in to an open skip where it is later removed off site for recovery.

10. Reported Incidents and Complaints

There were no reported incidents or complaints for the reported period.

11. Management and Staffing of the Facility

Management and staffing of the facility is attached in Appendix H.

12. Programme for Public Information

All files are held at the site office and at the Civic Offices Dungarvan Co. Waterford

13. Report on training of staff

Both the Facility Manager and Deputy Manager have attended the Fás Waste Management Training Course. Site personnel have attended the Fás Safe Pass program, Waste Facility Operative Course and site operatives attended a course in the handling, storage and removal of Waste from the Civic Amenity Site. All staff have received manual handling training, Waste Facility Operative Course, Fire Fighting and fire extinguisher training and a refresher First Aid Course.

14. Statement on the costs of Landfill

The project budget as submitted to the Department of the Environment and Local Government has not changed since the last reporting period.

15. Reports on Financial Charges and Provisions

Waterford County Council is responsible for providing annual fees to the Agency for monitoring and inspection of the site. The annual fee for 2015 for monitoring was €46,000.00 and €22704 for licences.

Aftercare Phase (30yrs)

The original estimates for long term liabilities were contained in the CRAMP and detail €80,000, €70,000, and €20,000 for general management, leachate, and gas systems, respectively (as per extracted Table 7.3 below).

Costs of aftercare management proposals

Environmental Liability	Description	Cost Estimate
General Management and maintenance of site during aftercare phase (30 yrs – includes for 20 years of aftercare).	€ 80,000 per annum– monitoring contract with Laboratory, small maintenance works.	€ 2,400,000
Management and maintenance of Leachate Abstraction & Treatment Process and pumping system during aftercare phase (30 yrs – includes for 20 years of aftercare)	€ 70,000 per annum- maintain Leachate Abstraction & treatment Process and SCADA system and replace pumps, lines etc. where required; Power supply; Testing	€ 2,100,000
Management and maintenance of Gas Management System during aftercare phase (30 yrs – includes for 20 years of aftercare)	€ 20,000 per annum – Maintain & operate landfill gas extraction system	€ 600,000
	Total for 30 year period	**€ 5,100,000**
	Contingency set at 15% for increased scope on last three items.	**€ 765,000**
	Total for 30 years with contingency	**€ 5,865,000**

Dungarvan landfill Maintenance costs

Item	Description	Details	Cost
1	Flare maintenance	As per contract	€3,400
2	Flare maintenance	Allow for 4 days callouts at contract rate	€3,000
3	Flare maintenance	Allow for parts replacement	€3,000
4	Leachate system maintenance	Current contract (to Oct-11, new contract needed thereafter)	€3,600
5	Leachate system maintenance	Allow for 4 days callouts at contract rate	€3,000
6	Leachate system maintenance	Allow for parts replacement	€1,500
7	Subtotal		€17,500
8	Contingencies at 15%		€2,625
9	Subtotal		€20,125
10	VAT		€2,717
11	**Total**		**€22,842**

16. Slope Stability Assessment

No significant slope slippage has occurred since the previous assessment was carried out in 2010. As a consequence a revised Slope Stabilty Assessment has not been included in the report.

17. Environmental Liabilities Risk Assessment Review

An Environmental Liabilities Risk Assessment Review is included in Appendix L

APPENDIX A

Quantity & Composition of Waste Received, Disposed of & Recovered during the reporting period.

Total Waste received for Disposal at Dungarvan Civic Amenity Site and Transfer Station between January 1st and December 31st 2015

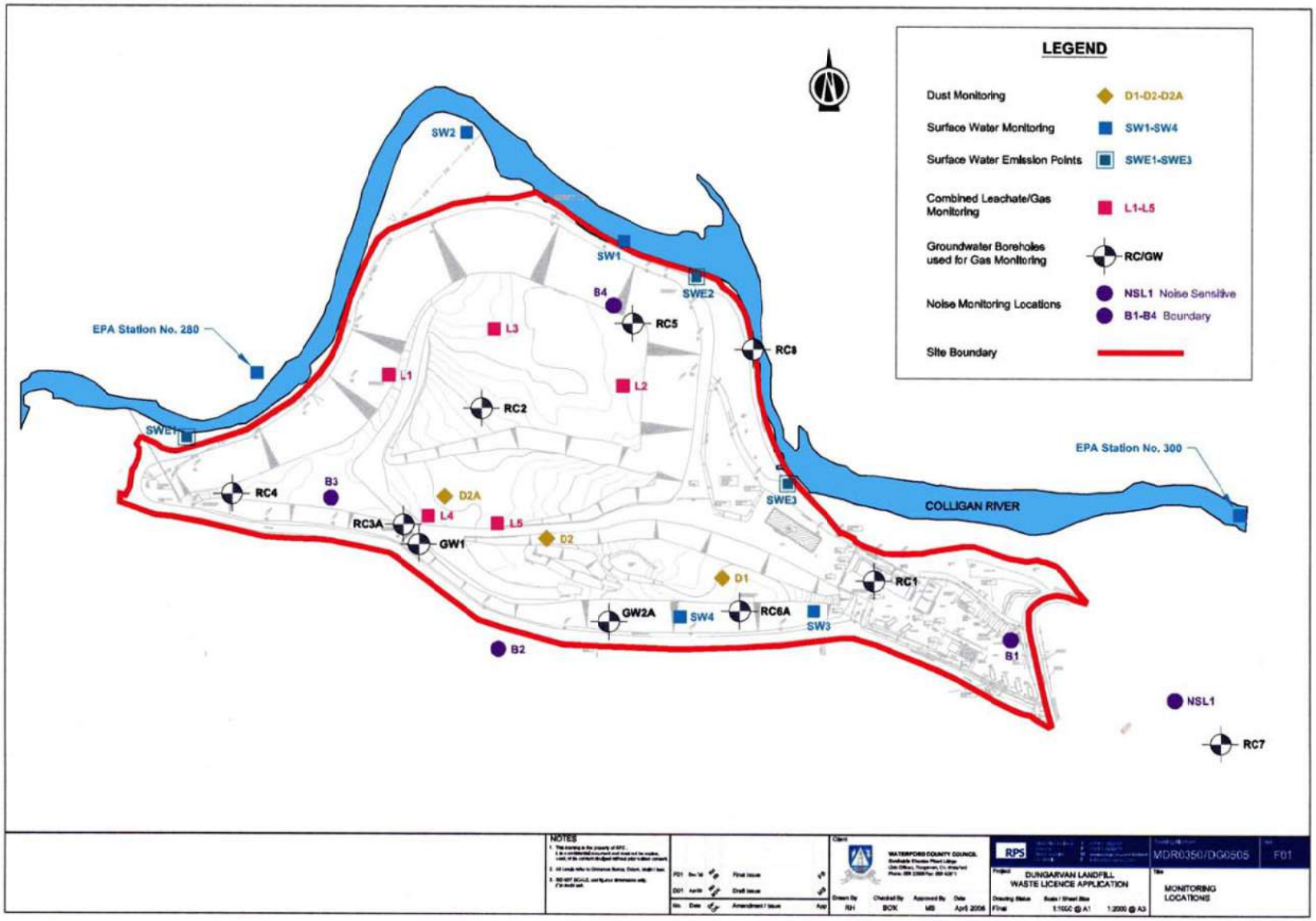
Waste Disposed	Type	EWC Code	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Total
Domestic	Domestic Bulky CoCo	20 03 01	8.34		1.06	5.38	0.64	0.84	1.08	2.38	0.72	3.76	0.88	3.88	28.96
	Bulky CoCo	20 03 01	0.96		10.04	20.52	10.40	3.62	1.40	5.32	4.16	11.80	0.62		68.84
	Civic Skip	20 03 99	11.52	6.62	8.70	11.08	7.98	8.80	8.82	9.10	8.92	10.96	9.04	13.40	114.94
	Clean Up	20 03 99				21.92		0.10			0.20	0.50	0.14		22.86
	Dom CoCo by DTC	20 03 99													0.00
	Domestic Bulky UDC	20 03 01	1.28	11.40	8.36	5.38	7.98	0.50	2.06	14.40	2.52	3.56	46.06	102.46	205.96
	Domestic CoCo	20 03 99	254.78	2.12	31.12	7.02	6.52	5.02	1.54	5.02	3.18	5.34	2.42	2.56	326.64
	Film Farm Plastics	02 01 04							49.36						49.36
	Litterbins	20 03 99	13.02	15.90	17.38	25.36	19.62	21.82	25.30	23.42	19.30	22.90	19.32	15.08	238.42
	LitterbinsUDC	20 03 99	13.38	6.48	9.20	10.34	12.58	12.10	11.54	9.66	10.28	13.66	12.02	13.90	135.14
MRF Plant	MRF Plant	20 03 99			2.14								4.50		6.64
Litter	Roadsweeper	20 03 99	44.34	39.18	52.36	35.50	33.52	38.56	46.40	37.42	46.64	60.86	63.74	32.72	531.24
	RoadsweeperUDC	20 03 99					9.24								9.24
	UDC Domestic	20 03 99	75.92											0.16	76.08
	WCC Housing	20 03 99	0.64	0.16	0.60	3.08	3.64	6.66	14.08	1.02	2.16	2.92	1.32	2.84	39.12
	Irish Water	20 03 99		0.54	0.34	0.42		0.08				0.16	1.70	0.22	3.46
Total Disposed			**424.18**	**82.40**	**141.30**	**146.00**	**112.12**	**98.10**	**161.58**	**107.74**	**98.08**	**136.42**	**119.28**	**187.22**	**1856.90**

Total Waste received for Recovery at Dungarvan Civic Amenity Site and Transfer Station between January 1st and December 31st 2015

Recycling	Dry Material	15 01 01	15.06	9.72	9.66	12.66	10.76	17.22	9.04	11.02	11.72	11.22	14.62	16.74	149.44
	Textiles	04 02 22	0.24	0.12	0.16			0.18	0.46	0.18	0.26	0.04	0.22	0.44	2.30
	Fridges	16 02 11													0.00
	Large Household	16 02 13													0.00
	Small Household (WEEE)	16 02 13	10.30	8.34	8.64	9.90	4.94	17.10	9.36	5.84	9.72	6.82	8.02	11.50	110.48
	TV's Monitors	16 02 13													0.00
Scrapmetal	Scrap metal	17 04 07	1.68	0.16	1.64	1.72	1.62	2.84	1.30	0.66	0.56	1.48	1.86		15.52
Recovery	Clay	17 05 04		8.22									15.04		23.26
	Rubble	17 01 07				8.22	10.14					8.78	11.02		38.16
	Cooking Oil	02 02 99													0.00
Glass	Flat Glass	17 02 02		2.52		1.96		2.36			2.48		2.52	2.98	14.82
Compost	Compost	02 01 07													0.00
	Brown Bin	02 01 07	100.82												100.82
	WCC Brown by DTC	02 01 07													0.00
	Brown Bin UDC	02 01 07													**0.00**
	Brown Bin Commercial	02 01 07													0.00
	Garden CoCo	02 01 07		9.30		10.12	20.90		33.88		26.92		5.86	3.74	110.72
	Garden UDC	02 01 07										15.68			15.68
	Garden Private	02 01 07													0.00
	Public Trailers	02 01 07	48.40	51.46				62.80		82.40	55.60	64.00	33.60		398.26
	Garden waste Tramore	02 01 07													0.00
Timber	Timber	17 02 01	14.34	1.88	39.34	6.44	3.96	2.06	17.66	8.82	8.96	12.80	8.94	9.12	134.32
Hazardous	Aerosols	16 05 04						0.04							0.04
	Batteries (Small)			0.38	0.24		0.34		0.30			0.08	0.20	0.16	1.70
	Batteries (Car)														0.00
	Car Filters														0.00
	Flourescent Lamps	16 02 11													0.00
	Engine Oil	13 02 06							0.86						0.86
	Medicines									0.14					0.00
	Paint	08 01 21		0.82			0.38	0.48			0.74	0.78			3.20
Total Accepted			190.84	92.54	59.44	51.02	52.70	105.08	72.56	108.92	116.96	121.60	101.70	44.52	1119.58

Appendix B

Monitoring Locations


LEGEND
Dust Monitoring
D1-D2-D2A
Surface Water Monitoring
SW1-SW4
Surface Water Emission Points
SWE1-SWE3
Combined Leachate/Gas Monitoring
L1-L5
Groundwater Boreholes used for Gas Monitoring
RC/GW
Noise Monitoring Locations
NSL1 Noise Sensitive
B1-B4 Boundary
Site Boundary
SW2
SW1
SWE2
B4
RC5
RC8
L3
L1
L2
RC2
EPA Station No. 280
SWE1
EPA Station No. 300
RC4
B3
D2A
L4
L5
RC3A
GW1
D2
SWE3
COLLIGAN RIVER
D1
RC1
GW2A
SW4
RC6A
SW3
B2
B1
NSL1
RC7
NOTES
WATERFORD COUNTY COUNCIL
RPS
DUNGARVAN LANDFILL
WASTE LICENCE APPLICATION
MDR0350/DG0505
F01
MONITORING LOCATIONS

Appendix C

Surface Water Results

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 19/03/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 23/02/2015 Date received: 23/02/2015

							Laboratory Ref:
		Type of sample:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
		Location code:	WST-W0032-01-SW lagoon	WST-W0032-01-SW280	WST-W0032-01-SW1	WST-W0032-01-SW2	WST-W0032-01-SW300
		Sampling point:	Clear	Clear	Clear	Clear	Clear
		Sampled by:	DB & AT	DB & AT	DB & AT	DB & AT	DB & AT
		Time Sampled:	12:25	12:05	12:55	12:45	10:10
		Start/End - Dates of Analysis:	23-02-15/02-03-15	23-02-15/02-03-15	23-02-15/02-03-15	23-02-15/02-03-15	23-02-15/02-03-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter		**Units**	**Limits**				
F **	Temperature	℃		5.5	5.9	6.1	6.2	5.3
F **	Dissolved Oxygen (as %Sat)	% Saturation		75.0	106.0	105.0	105.0	98.0
F	pH	pH		7.1	6.7	7.0	7.1	7.2
F	Conductivity @25℃	µS/cm		699	142	273	231	1583
F **	Salinity	‰		-	-	-	-	0.6
L	Chemical Oxygen Demand	mg/l O2		<20	<20	<20	<20	27
L	BOD	mg/l O2		<1.0	<1.0	<1.0	<1.0	1.2
L	Suspended Solids	mg/l		<4	15	<8	<4	11

Comments:

Signed: PP Date: 19/Mar/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road,
Kilkenny

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 1131

Test Report

Report of:	Analysis of landfill site sample(s)
Report to:	Waterford City and County Council
Report date:	31/07/15

Facility:	**Dungarvan Waste Disposal Site** Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No:	W0032-01

Date collected:	18/06/2015	Date received:	18/06/2015

			Laboratory Ref:	1522597	1522598	1522599	1522600	1522601
			Type of sample:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
			Location code:	WST-W0032-01-SW lagoon	WST-W0032-01-SW280	WST-W0032-01-SW1	WST-W0032-01-SW2	WST-W0032-01-SW300
			Sampling point:	Clear	Clear	Clear	Clear	Clear
			Sampled by:	D. Berry/P.Coady	D. Berry/P.Coady	D. Berry/P.Coady	D. Berry/P.Coady	D. Berry/P.Coady
			Time Sampled:	10:20	11:40	11:45	12:00	09:20
			Start/End - Dates of Analysis:	18-06-15/24-06-15	18-06-15/24-06-15	18-06-15/24-06-15	18-06-15/24-06-15	18-06-15/24-06-15
			Status of results:	Final Report	Final Report	Final Report	Final Report	Final Report
Parameter		Units	Limits					
F **	Temperature	°C		15.6	14.9	14.8	14.8	13.0
F **	Dissolved Oxygen (as %Sat)	% Saturation		45.0	112.0	118.0	118.1	83.0
F	pH	pH		7.3	7.4	7.5	7.0	7.4
F	Conductivity @25°C	µS/cm		589	161	NM	NM	NM
F **	Salinity	‰		-	-	0.6	0.5	2.8
L	Chemical Oxygen Demand	mg/l O2		38	<20	25	25	71
L	BOD	mg/l O2		3.6	<1.0	<1.0	<1.0	<1.0
L	Suspended Solids	mg/l		15	<4	<8	<4	<8

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/10/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 10/08/2015 Date received: 10/08/2015

		Laboratory Ref:	1523338	1523339	1523340	1523341	1523342	
		Type of sample:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	
		Location code:	WST-W0032-01-SW lagoon	WST-W0032-01-SW280	WST-W0032-01-SW1	WST-W0032-01-SW2	WST-W0032-01-SW300	
		Sampling point:	Clear	Clear	Clear	Clear	Tide out - no sample	
		Sampled by:	DB/J.MCG	DB/J.MCG	DB/J.MCG	DB/J.MCG	DB/J.MCG	
		Time Sampled:	11:25	12:45	12:50	12:55	10:45	
		Start/End - Dates of	10-08-15/17-08-15	10-08-15/17-08-15	10-08-15/17-08-15	10-08-15/17-08-15	10-08-15/10-08-15	
		Analysis: Status of results:		**Final Report**	**Final Report**	**Final Report**	**Final Report**	**Fin**
Parameter		**Units**	**Limits**					
F **	Temperature	℃		16.4	15.2	14.9	15.0	-
F **	Dissolved Oxygen (as %Sat)	% Saturation		68.0	107.0	107.0	106.0	-
F	pH	pH		7.1	7.2	7.2	7.2	-
F	Conductivity @25℃	µS/cm		519	132	144	142	-
L	Chemical Oxygen Demand	mg/l O2		34	<20	<20	<20	-
L	BOD	mg/l O2		1.9	<1.0	<1.0	<1.0	-
L	Suspended Solids	mg/l		<4	<4	<4	<4	-

Comments:

Signed: PP Date: 16/Oct/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/12/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 09/11/2015 Date received: 09/11/2015

							Laboratory Ref:
		Type of sample:	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
		Location code:	WST-W0032-01-SW lagoon	WST-W0032-01-SW280	WST-W0032-01-SW1	WST-W0032-01-SW2	WST-W0032-01-SW300
		Sampling point:	clear	brownish	clear	clear	no sample - tide out
		Sampled by:	DB/AT	DB/AT	DB/AT	DB/AT	DB/AT
		Time Sampled:	10:50	12:15	12:25	12:35	10:00
		Start/End - Dates of Analysis:	09-11-15/16-11-15	09-11-15/16-11-15	09-11-15/16-11-15	09-11-15/16-11-15	09-11-15/09-11-15
		Status of results:		**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	**Units**	**Limits**					
F **	Temperature	℃		11.9	11.2	11.2	11.2	-
F **	Dissolved Oxygen (as %Sat)	% Saturation		51.0	97.0	93.0	93.0	-
F	pH	pH		6.9	7.1	7.0	6.9	-
F	Conductivity @25℃	µS/cm		678	128	134	134	-
L	Chemical Oxygen Demand	mg/l O2		30	28	30	33	-
L	BOD	mg/l O2		2.8	1.8	1	1.4	-
L	Suspended Solids	mg/l		4	<4	4	<4	-

Comments:

Signed: PP Date: 16/Dec/2015

Caroline Bowden, Regional Chemist

Appendix D

Ground Water Results

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 19/03/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 23/02/2015 Date received: 23/02/2015

		Laboratory Ref:	1520882	1520883	1520884	1520885
		Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
		Location code:	WST-W0032-01-GW2a	WST-W0032-01-GW1	WST-W0032-01-RC6a	WST-W0032-01-RC7
		Sampling point:	No sample, BH pumped dry	Muddy	Grey	Clear
		Sampled by:	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner
		Time Sampled:	11:20	11:40	11;00	10:30
		Start/End - Dates of Analysis:	23-02-15/23-02-15	23-02-15/04-03-15	23-02-15/04-03-15	23-02-15/04-03-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter	**Units**	**Limits**				
F **	Depth of Borehole	m	-	10.3	12	12
F **	Water Level	m	-	3.3	9.2	10.9
F **	Temperature	℃	-	10.8	11.5	10.6
F **	Dissolved Oxygen (as %Sat)	% Saturation	-	45.0	12.0	77.0
F	pH	pH	-	6.6	6.8	6.7
F	Conductivity @25℃	µS/cm	-	1049	1443	NM
F **	Salinity	‰	-	-	-	3.1
L	Ammonia	mg/l N	-	1.4	37	0.026
L	Chloride	mg/l Cl	-	32	136	1840
L	Total Oxidised Nitrogen	mg/l N	-	<0.20	8.1	1.5
L	Aluminium	ug/l	-	13	11	22
L	Arsenic	ug/l	-	<1.0	<1.0	<1.0
L	Barium	ug/l	-	10	3.9	1.5
L	Beryllium	ug/l	-	<1.0	<1.0	<1.0
L	Boron	ug/l	-	<10.0	25	43
L	Cadmium	ug/l	-	<0.020	<0.020	<0.020
L	Calcium	mg/l	-	21	12	9.7
L	Cobalt	ug/l	-	<1.0	<1.0	<1.0
L	Iron	ug/l	-	400	170	29
L	Lead	ug/l	-	<1.0	2.5	<1.0
L	Magnesium	mg/l	-	<0.25	1	11
L	Manganese	ug/l	-	350	14	<5.0
L	Nickel	ug/l	-	<1.0	<1.0	<1.0

Laboratory Ref:	1520882	1520883	1520884	1520885
Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
Location code:	WST-W0032-01-GW2a	WST-W0032-01-GW1	WST-W0032-01-RC6a	WST-W0032-01-RC7
Sampling point:	No sample, BH pumped dry	Muddy	Grey	Clear
Sampled by:	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner
Time Sampled:	11:20	11:40	11;00	10:30
Start/End - Dates of Analysis:	23-02-15/23-02-15	23-02-15/04-03-15	23-02-15/04-03-15	23-02-15/04-03-15
Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

Parameter	**Units**	**Limits**				
L Potassium	mg/l		-	0.3	2.7	3.4
L Selenium	ug/l		-	<1.0	<1.0	<1.0
L Sodium	mg/l		-	1.3	9	95
L Strontium	ug/l		-	44	36	86
L Thallium	ug/l		-	<1.0	<1.0	<1.0
L Uranium	ug/l		-	<1.0	<1.0	<1.0
L Vanadium	ug/l		-	<1.0	<1.0	<1.0

Comments:

Signed: PP Date: 19/Mar/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 19/03/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 23/02/2015 Date received: 23/02/2015

		Laboratory Ref:	1520886	1520887	1520888	1520889
		Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
		Location code:	WST-W0032-01-RC4	WST-W0032-01-RC3a	WST-W0032-01-RC8	WST-W0032-01-GW pond outlet
		Sampling point:	Clear	Clear	No tubing, no sample	Clear. Taken from sanpling pt.
		Sampled by:	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner
		Time Sampled:	11:55	11:35	12:00	12:15
		Start/End - Dates of Analysis:	23-02-15/04-03-15	23-02-15/04-03-15	23-02-15/23-02-15	23-02-15/04-03-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter		**Units**	**Limits**			
F **	Depth of Borehole	m		22.6	22.4	-	NM
F **	Water Level	m		15.3	11.9	-	NM
F **	Temperature	℃		10.7	11.8	-	5.8
F **	Dissolved Oxygen (as %Sat)	% Saturation		50.0	18.0	-	35.0
F	pH	pH		6.7	6.9	-	6.7
F	Conductivity @25℃	µS/cm		649	1974	-	673
L	Ammonia	mg/l N		0.65	67	-	9.5
L	Chloride	mg/l Cl		32	140	-	80
L	Total Oxidised Nitrogen	mg/l N		11	1.3	-	<0.20
L	Aluminium	ug/l		<10.0	<10.0	-	<10.0
L	Arsenic	ug/l		<1.0	1.6	-	<1.0
L	Barium	ug/l		1.3	18	-	1.5
L	Beryllium	ug/l		<1.0	<1.0	-	<1.0
L	Boron	ug/l		<10.0	49	-	11
L	Cadmium	ug/l		<0.020	<0.020	-	<0.020
L	Calcium	mg/l		11	11	-	8.3
L	Cobalt	ug/l		<1.0	<1.0	-	<1.0
L	Iron	ug/l		23	500	-	28
L	Lead	ug/l		<1.0	<1.0	-	<1.0
L	Magnesium	mg/l		<0.25	0.94	-	<0.25
L	Manganese	ug/l		<5.0	210	-	28
L	Nickel	ug/l		<1.0	3.8	-	<1.0

L	Potassium	mg/l	<0.25	3.9	-	1.2

Report number:KK1500319/1

		Laboratory Ref:	1520886	1520887	1520888	1520889
		Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
		Location code:	WST-W0032-01-RC4	WST-W0032-01-RC3a	WST-W0032-01-RC8	WST-W0032-01-GW pond outlet
		Sampling point:	Clear	Clear	No tubing, no sample	Clear. Taken from sanpling pt.
		Sampled by:	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner
		Time Sampled:	11:55	11:35	12:00	12:15
		Start/End - Dates of Analysis:	23-02-15/04-03-15	23-02-15/04-03-15	23-02-15/23-02-15	23-02-15/04-03-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter		**Units**	**Limits**			
L	Selenium	ug/l		<1.0	<1.0	-	<1.0
L	Sodium	mg/l		1.4	15	-	4.3
L	Strontium	ug/l		35	54	-	25
L	Thallium	ug/l		<1.0	<1.0	-	<1.0
L	Uranium	ug/l		<1.0	<1.0	-	<1.0
L	Vanadium	ug/l		<1.0	<1.0	-	<1.0

Comments:

Signed: PP Date: 19/Mar/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road,
Kilkenny

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 117T

Test Report

Report of:	Analysis of landfill site sample(s)
Report to:	Waterford City and County Council
Report date:	31/07/15

Facility:	**Dungarvan Waste Disposal Site** Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No:	W0032-01

Date collected:	18/06/2015	Date received:	18/06/2015

			Laboratory Ref:	1522606	1522607	1522608	1522609	
			Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater	
			Location code:	WST-W0032-01-RC4	WST-W0032-01-RC3a	WST-W0032-01-RC8	WST-W0032-01-GW	
			Sampling point:	Clear	Clear	No tubing - no sample	Clear (Pond 5 Outlet)	
			Sampled by:	DB/P.Coady	DB/P.Coady	DB/P.Coady	DB/P.Coady	
			Time Sampled:	11:10	11:05	11:20	11:30	
			Start/End - Dates of Analysis:	01-01-00/19-06-15	01-01-00/19-06-15	18-06-15/18-06-15	01-01-00/19-06-15	
			Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**	
Parameter		**Units**	**Limits**					
F**	Depth of Borehole	m		22.6	22.4	-	NM	
F**	Water Level	m		15.3	12.7	-	NM	
F**	Temperature	°C		12.0	12.8	-	17.6	
F**	Dissolved Oxygen (as %Sat)	% Saturation		50.0	13.9	-	30.0	
F	pH	pH		7.1	6.9	-	7.0	
F	Conductivity @25°C	µS/cm		644	1713	-	720	
L	Ammonia	mg/l N		0.27	66	-	0.03	
L	Chloride	mg/l Cl		29	119	-	64	
L	Total Oxidised Nitrogen	mg/l N		11	<0.20	-	<0.20	
L	Iron	ug/l		200	4100	-	990	
L	Potassium	mg/l		1.5	30	-	0.73	
L	Sodium	mg/l		12	120	-	47	

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/10/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 10/08/2015 Date received: 10/08/2015

Laboratory Ref:	1523343	1523344	1523345	1523346
Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
Location code:	WST-W0032-01-GW2a	WST-W0032-01-GW1	WST-W0032-01-RC6a	WST-W0032-01-RC7
Sampling point:	Dry-no sample	Dark	Clear	Slightly brown
Sampled by:	DB/J.McG	DB/J.McG	DB/J.McG	DB/J.McG
Time Sampled:	11:05	11:35	11:15	10:55
Start/End - Dates of Analysis:	10-08-15/10-08-15	10-08-15/07-10-15	10-08-15/07-10-15	10-08-15/07-10-15
Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	Units	Limits				
F **	Depth of Borehole	m		-	10.3	12	12
F **	Water Level	m		-	2.2	8.3	10.3
F **	Temperature	℃		-	14.2	12.4	12.5
F **	Dissolved Oxygen (as %Sat)	% Saturation		-	22.0	22.0	30.0
F	pH	pH		-	6.5	7.0	7.0
F	Conductivity @25℃	µS/cm		-	1108	1291	nm
F **	Salinity	‰		-	-	-	8.4
L	Ammonia	mg/l N		-	2.2	26	<0.020
L	Chloride	mg/l Cl		-	16	105	4700
L	Total Oxidised Nitrogen	mg/l N		-	<0.20	7.1	0.87
L	Iron	ug/l		-	13000	1900	1900
L	Potassium	mg/l		-	3.8	21	95
L	Sodium	mg/l		-	13	72	2600

Comments:

Signed: PP Date: 16/Oct/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/10/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 10/08/2015 Date received: 10/08/2015

		Laboratory Ref:	1523347	1523348	1523349	1523350
		Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
		Location code:	WST-W0032-01-RC4	WST-W0032-01-RC3a	WST-W0032-01-RC8	WST-W0032-01-GW
pond						outlet
		Sampling point:	Clear	Clear	No tubing - no sample	Clear
		Sampled by:	DB/J.McG	DB/J.McG	DB/J.McG	DB/J.McG
		Time Sampled:	11:55	11:45	12:00	12:15
		Start/End - Dates of Analysis:	10-08-15/07-10-15	10-08-15/07-10-15	10-08-15/10-08-15	10-08-15/07-10-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter	**Units**	**Limits**				
F ** Depth of Borehole	m		22.6	22.4	-	NM
F ** Water Level	m		15.2	12.4	-	NM
F ** Temperature	℃		12.5	13.1	-	19.8
F ** Dissolved Oxygen (as %Sat)	% Saturation		45.0	17.0	-	51.0
F pH	pH		6.9	6.9	-	7.0
F Conductivity @25℃	µS/cm		615	1618	-	623
L Ammonia	mg/l N		0.025	66	-	0.069
L Chloride	mg/l Cl		30	113	-	57
L Total Oxidised Nitrogen	mg/l N		11	<0.20	-	<0.20
L Iron	ug/l		240	4700	-	1200
L Potassium	mg/l		1.4	27	-	3.5
L Sodium	mg/l		13	110	-	39

Comments:

Signed: PP Date: 16/Oct/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/12/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 09/11/2015 Date received: 09/11/2015

		Laboratory Ref:	1524691	1524692	1524693	1524694
		Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
		Location code:	WST-W0032-01-GW2a	WST-W0032-01-GW1	WST-W0032-01-RC7	WST-W0032-01-GW
		Sampling point:	dry, no sample	muddy brown	Black	Grey
		Sampled by:	DB/AT	DB/AT	DB/AT	DB/AT
		Time Sampled:	12:40	11:15	10:30	10:10
		Start/End - Dates of Analysis:	09-11-15/09-11-15	09-11-15/25-11-15	09-11-15/25-11-15	09-11-15/25-11-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter	**Units**	**Limits**				
F ** Depth of Borehole	m		-	10.3	12	12
F ** Water Level	m		-	6	8.4	10.6
F ** Temperature	℃		-	12.8	11.9	12.4
F ** Dissolved Oxygen (as %Sat)	% Saturation		-	50.0	15.0	30.0
F pH	pH		-	6.7	6.8	6.8
F Conductivity @25℃	µS/cm		-	1049	1390	nm
F ** Salinity	‰		-	-	-	6.7
L Ammonia	mg/l N		-	1.6	34	0.054
L Chloride	mg/l Cl		-	20	121	3700
L Total Oxidised Nitrogen	mg/l N		-	<0.20	5	1.4
L Aluminium	ug/l		-	290	<10.0	190
L Arsenic	ug/l		-	2.4	3.5	<1.0
L Barium	ug/l		-	86	33	32
L Beryllium	ug/l		-	<1.0	<1.0	<1.0
L Boron	ug/l		-	36	230	870
L Cadmium	ug/l		-	0.05	0.43	0.09
L Calcium	mg/l		-	200	120	170
L Cobalt	ug/l		-	5.8	1.2	<1.0
L Iron	ug/l		-	3100	900	270
L Lead	ug/l		-	<1.0	<1.0	<1.0
L Magnesium	mg/l		-	14	28	240
L Manganese	ug/l		-	4800	220	29

L	Nickel	ug/l	-	<1.0	<1.0	<1.0

Report number:KK1501786/1

Laboratory Ref:	1524691	1524692	1524693	1524694
Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
Location code:	WST-W0032-01-GW2a	WST-W0032-01-GW1	WST-W0032-01-RC7	WST-W0032-01-GW
Sampling point:	dry, no sample	muddy brown	Black	Grey
Sampled by:	DB/AT	DB/AT	DB/AT	DB/AT
Time Sampled:	12:40	11:15	10:30	10:10
Start/End - Dates of Analysis:	09-11-15/09-11-15	09-11-15/25-11-15	09-11-15/25-11-15	09-11-15/25-11-15
Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	**Units**	**Limits**				
L	Potassium	mg/l		-	3.6	27	77
L	Selenium	ug/l		-	<1.0	<1.0	14
L	Sodium	mg/l		-	16	93	2200
L	Strontium	ug/l		-	390	320	1500
L	Thallium	ug/l		-	<1.0	<1.0	<1.0
L	Uranium	ug/l		-	2.6	<1.0	<1.0
L	Vanadium	ug/l		-	1	<1.0	<1.0

Comments:

Signed: PP Date: 16/Dec/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/12/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 09/11/2015 Date received: 09/11/2015

		Laboratory Ref:	1524695	1524696	1524697	1524698
		Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
		Location code:	WST-W0032-01-RC4	WST-W0032-01-RC3a	WST-W0032-01-RC8	WST-W0032-01-GW
pond						outlet
		Sampling point:	clear	clear	no sample - no tubing	clear
		Sampled by:	DB/AT	DB/AT	DB/AT	DB/AT
		Time Sampled:	11:30	11:00	12:00	11:50
		Start/End - Dates of Analysis:	09-11-15/25-11-15	09-11-15/25-11-15	09-11-15/09-11-15	09-11-15/25-11-15
		Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**
Parameter	**Units**	**Limits**				
F ** Depth of Borehole	m		22.6	22.4	-	NM
F ** Water Level	m		15.6	12.8	-	NM
F ** Temperature	℃		12.0	12.4	-	12.3
F ** Dissolved Oxygen (as %Sat)	% Saturation		50.0	20.0	-	63.0
F pH	pH		6.8	6.8	-	7.0
F Conductivity @25℃	µS/cm		643	1597	-	680
L Ammonia	mg/l N		0.031	61	-	0.58
L Chloride	mg/l Cl		29	110	-	77
L Total Oxidised Nitrogen	mg/l N		11	0.21	-	<0.20
L Aluminium	ug/l		<10.0	10	-	14
L Arsenic	ug/l		<1.0	10	-	<1.0
L Barium	ug/l		9.9	130	-	9.4
L Beryllium	ug/l		<1.0	<1.0	-	<1.0
L Boron	ug/l		31	260	-	95
L Cadmium	ug/l		<0.020	0.13	-	<0.020
L Calcium	mg/l		110	110	-	72
L Cobalt	ug/l		<1.0	6.7	-	<1.0
L Iron	ug/l		93	3600	-	860
L Lead	ug/l		<1.0	<1.0	-	<1.0
L Magnesium	mg/l		13	22	-	14
L Manganese	ug/l		13	2500	-	160
L Nickel	ug/l		<1.0	28	-	<1.0

L	Potassium	mg/l	1.5	27	-	19	

Report number:KK1501787/1

Laboratory Ref:	1524695	1524696	1524697	1524698
Type of sample:	Groundwater	Groundwater	Groundwater	Groundwater
Location code:	WST-W0032-01-RC4	WST-W0032-01-RC3a	WST-W0032-01-RC8	WST-W0032-01-GW
pond				outlet
Sampling point:	clear	clear	no sample - no tubing	clear
Sampled by:	DB/AT	DB/AT	DB/AT	DB/AT
Time Sampled:	11:30	11:00	12:00	11:50
Start/End - Dates of Analysis:	09-11-15/25-11-15	09-11-15/25-11-15	09-11-15/09-11-15	09-11-15/25-11-15
Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	**Units**	**Limits**				
L	Selenium	ug/l		1.8	<1.0	-	<1.0
L	Sodium	mg/l		16	120	-	57
L	Strontium	ug/l		320	440	-	220
L	Thallium	ug/l		<1.0	<1.0	-	<1.0
L	Uranium	ug/l		<1.0	1.4	-	<1.0
L	Vanadium	ug/l		1.5	<1.0	-	<1.0

Comments:

Signed: PP Date: 16/Dec/2015

Caroline Bowden, Regional Chemist

Appendix E

Leachate Results

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 19/03/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 23/02/2015 Date received: 23/02/2015

Laboratory Ref:	1520890	1520891	1520892	1520893
Type of sample:	Leachate	Leachate	Leachate	Leachate
Location code:	WST-W0032-01-L Interceptor	WST-W0032-01-L2a	WST-W0032-01-L4	WST-W0032-01-L1
Sampling point:	Clear	No sample	No sample	No sample, not enough in BH
Sampled by:	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner	D.Berry/A.Turner
Time Sampled:	12:20	12:08	11:30	12:05
Start/End - Dates of Analysis:	23-02-15/02-03-15	23-02-15/23-02-15	23-02-15/23-02-15	23-02-15/23-02-15
Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	**Units**	**Limits**				
F **	Depth of Borehole	m		NM	-	-	-
F **	Leachate Level	m		NM	-	-	-
F **	Temperature	℃		6.2	-	-	-
F	pH	pH		7.0	-	-	-
F	Conductivity @25℃	µS/cm		693	-	-	-
L	Chemical Oxygen Demand	mg/l O2		<20	-	-	-
L	BOD	mg/l O2		1.2	-	-	-

Comments:

Signed: PP Date: 19/Mar/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road,
Kilkenny

ISO 17025 IVNAB ACCREDITED TESTING DETAILED IN SCOPE REG NO. 117T

Test Report

Report of:	Analysis of landfill site sample(s)
Report to:	Waterford City and County Council
Report date:	31/07/15

Facility:	**Dungarvan Waste Disposal Site** Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No:	W0032-01

Date collected:	18/06/2015	Date received:	18/06/2015

			Laboratory Ref:	1522610	1522611	1522612	1522613	
			Type of sample:	Leachate	Leachate	Leachate	Leachate	
			Location code:	WST-W0032-01-L Interceptor	WST-W0032-01-L2a	WST-W0032-01-L4	WST-W0032-01-L1	
			Sampling point:	Clear	Dry - no sample	Dry - no sample	Not enough in BH. - no sample	
			Sampled by:	DB/PCoady	DB/PCoady	DB/PCoady	DB/PCoady	
			Time Sampled:	10:30	10:40	10:35	10:45	
			Start/End - Dates of Analysis:	18-06-15/24-06-15	18-06-15/18-06-15	18-06-15/18-06-15	18-06-15/18-06-15	
			Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**	
Parameter		**Units**	**Limits**					
F**	Depth of Borehole	m		NM	-	-	-	
F**	Leachate Level	m		NM	-	-	-	
F**	Temperature	°C		15.0	-	-	-	
F	pH	pH		7.3	-	-	-	
F	Conductivity @25°C	µS/cm		721	-	-	-	
L	Chemical Oxygen Demand	mg/l O2		38	-	-	-	
L	BOD	mg/l O2		1.6	-	-	-	

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/10/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 10/08/2015 Date received: 10/08/2015

Laboratory Ref:	1523351	1523352	1523353	1523354
Type of sample:	Leachate	Leachate	Leachate	Leachate
Location code:	WST-W0032-01-L Interceptor	WST-W0032-01-L2a	WST-W0032-01-L4	WST-W0032-01-L1
Sampling point:	Clear	Dry -no tubing	Dry - no sample	Not enough in BH- no sample
Sampled by:	DB/J.McG	DB/J.McG	DB/J.McG	DB/J.McG
Time Sampled:	11:20	12:10	11:50	12:05
Start/End - Dates of Analysis:	10-08-15/17-08-15	10-08-15/10-08-15	10-08-15/10-08-15	10-08-15/10-08-15
Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	**Units**	**Limits**			
F **	Depth of Borehole	m		NM	-	-	-
F **	Leachate Level	m		NM	-	-	-
F **	Temperature	℃		16.9	-	-	-
F	pH	pH		7.2	-	-	-
F	Conductivity @25℃	µS/cm		630	-	-	-
L	Chemical Oxygen Demand	mg/l O2		32	-	-	-
L	BOD	mg/l O2		<4	-	-	-

Comments:

Signed: PP Date: 16/Oct/2015

Caroline Bowden, Regional Chemist

Environmental Protection Agency
Regional Inspectorate
Seville Lodge, Callan Road, Kilkenny

Test Report

Report of: Analysis of landfill site sample(s)
Report to: Waterford City and County Council
Report date: 16/12/15

Facility: **Dungarvan Waste Disposal Site**
Ballynamuck Middle, Dungarvan, Co. Waterford
Reference No: W0032-01

Date collected: 09/11/2015 Date received: 09/11/2015

	Laboratory Ref:	1524699	1524700	1524701	1524702
	Type of sample:	Leachate	Leachate	Leachate	Leachate
	Location code:	WST-W0032-01-L Interceptor	WST-W0032-01-L2a	WST-W0032-01-L4	WST-W0032-01-L1
	Sampling point:	clear	dry, no sample	dry, no sample	dry, no sample
	Sampled by:	DB/AT	DB/AT	DB/AT	DB/AT
	Time Sampled:	10:45	12:45	12:55	13:10
	Start/End - Dates of Analysis:	09-11-15/16-11-15	09-11-15/09-11-15	09-11-15/09-11-15	09-11-15/09-11-15
	Status of results:	**Final Report**	**Final Report**	**Final Report**	**Final Report**

	Parameter	**Units**	**Limits**			
F **	Depth of Borehole	m		NM	-	-	-
F **	Leachate Level	m		NM	-	-	-
F **	Temperature	℃		11.7	-	-	-
F	pH	pH		7.1	-	-	-

F	Conductivity @25℃	µS/cm	692	-	-	-
L	Chemical Oxygen Demand	mg/l O2	32	-	-	-
L	BOD	mg/l O2	2.5	-	-	-

Report number:KK1501788/1

Comments:

Signed: PP Date: 16/Dec/2015

Caroline Bowden, Regional Chemist

Appendix F

Meteorological Data

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
01-Jan-15	0	12	0	9.1	0	11.4	1010.4	17	0	23	0	210	0	39	9.462
02-Jan-15	0	9.2	0	4.1	0	0.3	1019.2	9.1	0	17	0	270	0	27	5.974
03-Jan-15	0	7.2	0	4.2	0	11.9	1015.1	6.2	0	10	0	20	0	16	6.201
04-Jan-15	0	8.9	0	4.8	0	0	1023.5	4.9	0	11	0	200	0	17	6.291
05-Jan-15	0	9.9	0	8	0	4.3	1014.3	10.9	0	16	0	170	0	26	8.262
06-Jan-15	0	9.8	0	3.2	0	5	1010	9.7	0	17	0	300	0	26	6.371
07-Jan-15	0	10.9	0	8.1	0	7.2	1007.5	17.5	0	23	0	210	0	39	7.644
08-Jan-15	0	9.8	0	5.4	0	2.4	1011.2	11.7	0	22	0	210	0	36	6.756
09-Jan-15	0	11.9	0	7.1	0	0.5	1007	16.6	0	26	0	220	0	42	8.396
10-Jan-15	0	11.5	0	2	0	2.3	1005.5	16	0	25	0	220	0	39	7.148
11-Jan-15	0	8.6	0	2	0	0.3	1009.9	15.2	0	26	0	220	0	41	4.465
12-Jan-15	0	10	0	4.7	0	4.7	997.6	13.2	0	29	0	220	0	46	6.75
13-Jan-15	0	5.9	0	-0.1	0	1.5	991.9	8.6	0	18	0	240	0	30	3.632
14-Jan-15	0	10.2	0	-0.4	0	7.7	981.1	16.5	0	29	0	190	0	53	3.329
15-Jan-15	0	7.2	0	2.9	0	1.6	979.3	17.1	0	25	0	230	0	40	4.035
16-Jan-15	0	4.4	0	0.6	0	0	996.5	9.1	0	15	0	280	0	22	2.692
17-Jan-15	0	4.9	0	-0.7	0	0.1	1003.2	7.3	0	11	0	260	0	16	2.142
18-Jan-15	0	5.6	0	-1.2	0	0.1	1008.8	9.9	0	15	0	330	0	27	2.003
19-Jan-15	0	3.7	0	-1.8	0	0	1007	4.8	0	11	0	320	0	16	0.988
20-Jan-15	0	5.7	0	2	0	7.3	996.2	8.8	0	16	0	120	0	26	3.438
21-Jan-15	0	5	0	1.2	0	0	1000.3	8.8	0	14	0	320	0	22	2.888
22-Jan-15	0	7.7	0	0.3	0	0.3	1011.6	4.8	0	8	0	320	0	12	2.52
23-Jan-15	0	9.5	0	3.2	0	2.2	1011.8	11.1	0	18	0	300	0	27	4.782
24-Jan-15	0	7.8	0	-0.5	0	0.1	1020.1	6.3	0	12	0	260	0	15	3.439
25-Jan-15	0	9.4	0	4	0	0.9	1019.3	12	0	17	0	220	0	25	5.842
26-Jan-15	0	9.3	0	3.4	0	0.6	1019.5	7	0	16	0	280	0	23	6
27-Jan-15	0	8.7	0	4.3	0	0.6	1015.3	8.3	0	16	0	220	0	24	5.743
28-Jan-15	0	9.2	0	1.6	0	1.2	999	14.9	0	25	0	270	0	40	5.577
29-Jan-15	0	4.5	0	1.5	0	3.1	982.7	14.6	0	26	0	290	0	38	2.852
30-Jan-15	0	6.6	0	1.4	0	0.1	976.4	14.5	0	23	0	280	0	35	3.293
31-Jan-15	0	5.2	0	0.8	0	0	988.8	16.5	0	24	0	320	0	39	2.328

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	4.7	0	-0.4	0	0	1000.6	10.2	0	18	0	290	0	27	1.733
########	0	4.7	0	-0.8	0	0	1001.6	6.2	0	9	0	320	0	14	1.488
########	0	5.3	0	-1.4	0	0.2	1006.6	7.8	0	11	0	330	0	18	1.328
########	0	5.3	0	-1	0	0	1017.8	8.6	0	11	0	320	0	20	1.571
########	0	7.5	0	1.1	0	0	1023.1	8	0	12	0	330	0	19	2.866
########	0	5.8	0	2.9	0	0	1026.6	7	0	13	0	30	0	19	3.642
########	0	7	0	3.4	0	0	1031.6	8.2	0	14	0	10	0	22	4.209
########	0	8.2	0	-0.3	0	0	1033.7	4.4	0	10	0	330	0	15	4.23
########	0	4.1	0	-0.5	0	0.1	1029.9	4.3	0	10	0	320	0	14	3.441
########	0	5.5	0	1.4	0	0	1022.8	3.9	0	9	0	130	0	11	4.338
########	0	6.1	0	4.6	0	0	1015.5	2.7	0	10	0	180	0	14	4.722
########	0	7.1	0	4.6	0	1.8	1004.8	6.3	0	17	0	170	0	27	4.939
########	0	9	0	4.1	0	6.1	989.8	10.9	0	23	0	140	0	32	6.065
########	0	8.6	0	4.3	0	0	996.5	6.7	0	13	0	330	0	19	6.093
########	0	9	0	3.2	0	12.8	1003.8	7.9	0	14	0	170	0	21	5.492
########	0	8.1	0	1.9	0	1.5	1012.2	10	0	16	0	290	0	24	5.717
########	0	8.8	0	0.7	0	0	1026.6	9.9	0	17	0	220	0	25	4.272
########	0	9.7	0	7.8	0	1.5	1021.5	14.5	0	19	0	200	0	32	7.241
########	0	9	0	2.3	0	2.8	1008.7	10.3	0	18	0	210	0	32	7.106
########	0	7.5	0	0	0	1.1	999.7	7.4	0	15	0	280	0	22	4.076
########	0	7.2	0	0.9	0	0	998.7	11.4	0	21	0	290	0	28	3.349
########	0	9.9	0	2.2	0	10.4	991.2	12.3	0	24	0	260	0	37	4.964
########	0	6.4	0	1.2	0	3.9	980.8	15.9	0	27	0	240	0	39	3.835
########	0	8.9	0	2.6	0	0.3	994.5	13.4	0	23	0	270	0	36	4.563
########	0	12.5	0	6.6	0	1	1005.2	9.5	0	18	0	230	0	27	7.64
########	0	9.9	0	0.5	0	1.5	1005.2	13.1	0	20	0	290	0	30	7.23
########	0	8.3	0	0.4	0	1.5	1006.9	10.9	0	17	0	190	0	28	4.379
########	0	10.2	0	6.6	0	0.7	992.6	11.9	0	23	0	250	0	36	7.35

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	8.9	0	1.5	0	3.6	989.5	11.7	0	27	0	290	0	40	5.106
########	0	6.6	0	0.5	0	0.3	998.5	11.2	0	21	0	250	0	30	3.621
########	0	7.1	0	0.7	0	0.6	1009.4	11.8	0	23	0	280	0	34	3.496
########	0	9.4	0	1	0	0	1023.4	9.7	0	18	0	270	0	26	4.039
########	0	9.5	0	5.6	0	0	1028.4	10.7	0	16	0	200	0	26	6.381
########	0	9.8	0	7.7	0	0	1018.9	15	0	20	0	210	0	32	7.434
########	0	9.8	0	8.5	0	0.3	1009.8	17.7	0	23	0	210	0	36	8.135
########	0	10.1	0	2.5	0	4.5	1012.6	9.3	0	20	0	200	0	34	8.537
########	0	10.9	0	3.3	0	10.3	1011.2	13.5	0	25	0	190	0	38	6.851
########	0	9.9	0	1.3	0	0	1021	5.8	0	10	0	250	0	13	6.248
########	0	13.2	0	4	0	7	1013.8	12.3	0	23	0	150	0	35	7.47
########	0	9.6	0	2.9	0	13.8	1011.1	12.1	0	21	0	160	0	33	7.877
########	0	9	0	1.2	0	0.1	1019.8	6.9	0	12	0	40	0	18	5.916
########	0	6.6	0	2.8	0	0	1025.4	5.8	0	9	0	40	0	16	5.339
########	0	7.2	0	3.5	0	0	1022.5	6.9	0	11	0	50	0	18	5.62
########	0	6.8	0	4.6	0	0	1016.5	5.8	0	9	0	80	0	15	6.045
########	0	8.5	0	3.1	0	0.3	1018.7	3.4	0	8	0	100	0	11	6.301
########	0	9	0	1.2	0	0.1	1025.9	5.8	0	10	0	50	0	15	6.297
########	0	9.9	0	2.4	0	0.1	1027.1	4.2	0	6	0	330	0	10	7.178
########	0	13.2	0	3.7	0	0	1022.6	5.8	0	12	0	320	0	17	7.663
########	0	9.3	0	3	0	0	1021.2	7.3	0	15	0	50	0	20	8.29
########	0	9.3	0	1.9	0	0.1	1016.8	6.5	0	11	0	220	0	19	7.155
########	0	11.5	0	2.3	0	0.3	1009.4	7.5	0	15	0	320	0	22	8.259
########	0	9.4	0	1.1	0	0	1006.3	9.2	0	18	0	310	0	26	6.256
########	0	8.8	0	1	0	12	999	9.5	0	19	0	170	0	32	6.207
########	0	11.5	0	4.3	0	0.1	1000.4	12.7	0	21	0	290	0	32	7.779
########	0	9.9	0	1.3	0	1.4	1008.8	5.6	0	11	0	170	0	17	7.029
########	0	13.7	0	8.2	0	2	1001	16	0	23	0	230	0	35	9.843
########	0	13.4	0	4.8	0	3	992.4	15.7	0	27	0	250	0	43	8.802
########	0	11.7	0	3.6	0	1.6	996.9	13.8	0	30	0	260	0	46	7.195
########	0	10.4	0	3.1	0	0.3	1004.7	18.6	0	28	0	250	0	45	7.649

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
01-Apr-15	0	10.7	0	2.8	0	0.6	1016	10.9	0	16	0	240	0	28	6.735
02-Apr-15	0	10.7	0	6.6	0	2.8	1011.5	8.7	0	17	0	260	0	25	9.193
03-Apr-15	0	11.8	0	5.4	0	0.9	1011.8	12.8	0	21	0	310	0	32	9.565
04-Apr-15	0	11.8	0	5.6	0	0	1018.3	6.1	0	12	0	60	0	18	9.37
05-Apr-15	0	11.5	0	5.6	0	0	1021	4.7	0	8	0	50	0	11	10.618
06-Apr-15	0	12.5	0	2.3	0	0.2	1026.1	3.8	0	6	0	0	0	9	11.457
07-Apr-15	0	15.4	0	5.9	0	0	1028.5	4.2	0	8	0	320	0	10	12.012
08-Apr-15	0	13.9	0	5.8	0	0.1	1023.9	5	0	12	0	150	0	15	11.565
09-Apr-15	0	13.8	0	4.3	0	0	1017	3.8	0	9	0	150	0	12	11.43
10-Apr-15	0	10.8	0	2.9	0	0.2	1006.3	9.2	0	16	0	210	0	25	9.61
11-Apr-15	0	10.2	0	2.4	0	1.8	1007.5	12.4	0	19	0	290	0	33	9.47
12-Apr-15	0	10.9	0	3.8	0	1.3	1014.3	10.4	0	23	0	200	0	40	9.03
13-Apr-15	0	12.2	0	5.1	0	0.2	1019.5	8.3	0	16	0	220	0	24	9.47
14-Apr-15	0	11.2	0	8.3	0	0	1014.8	12.6	0	20	0	220	0	29	10.92
15-Apr-15	0	14.5	0	5.7	0	0	1010.8	7.1	0	15	0	230	0	23	11.21
16-Apr-15	0	10.9	0	5	0	0.1	1008.6	10.4	0	17	0	40	0	25	10.69
17-Apr-15	0	11.6	0	5.9	0	1.2	1013	7.7	0	13	0	50	0	19	10.102
18-Apr-15	0	10.5	0	6.9	0	0	1019.7	11.4	0	20	0	40	0	29	10.645
19-Apr-15	0	9.7	0	5.3	0	0	1018.8	10.1	0	22	0	40	0	32	10.488
20-Apr-15	0	12.8	0	5.2	0	0	1022.5	4.8	0	7	0	80	0	12	11.617
21-Apr-15	0	13.2	0	5	0	0	1027.6	9.8	0	16	0	40	0	24	11.693
22-Apr-15	0	14.1	0	7.6	0	0	1021.8	8.4	0	13	0	40	0	20	12.45
23-Apr-15	0	14.9	0	6.3	0	0	1012	4.9	0	9	0	140	0	14	13.35
24-Apr-15	0	11.9	0	7.6	0	1.2	1001.6	8.8	0	14	0	220	0	22	11.825
25-Apr-15	0	13.7	0	5.1	0	2.6	998.8	9.3	0	16	0	40	0	24	11.51
26-Apr-15	0	9.5	0	1.5	0	0	1004.3	7	0	14	0	30	0	20	10.533
27-Apr-15	0	9.6	0	2.2	0	1.8	1005.2	8.6	0	18	0	280	0	30	9.418
28-Apr-15	0	9.9	0	1.2	0	3.2	1006	12.9	0	20	0	230	0	36	9.116
29-Apr-15	0	10.2	0	2.3	0	3.7	1003	10.3	0	20	0	220	0	35	9.25
30-Apr-15	0	11.9	0	3	0	0	1004.5	7.4	0	13	0	300	0	19	10.046

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	10	0	7	0	2.5	1001.8	9.4	0	13	0	60	0	21	10.202
########	0	9.8	0	6.7	0	33.4	994.3	13.5	0	19	0	130	0	29	9.59
########	0	13.3	0	7.6	0	4.9	986.6	10.3	0	17	0	200	0	25	11.497
########	0	12.2	0	5.6	0	6.6	988	8.1	0	15	0	160	0	22	11.33
########	0	12.1	0	6.8	0	17.2	981.6	10.8	0	20	0	250	0	35	10.833
########	0	14.4	0	6.3	0	1.3	994.1	13.7	0	23	0	250	0	37	10.208
########	0	12.3	0	5.9	0	5.3	1006.3	5.3	0	11	0	180	0	15	11.062
########	0	11	0	6.7	0	27	1001	7.3	0	13	0	80	0	22	9.748
########	0	13.1	0	5.9	0	0.1	1006.4	7.8	0	12	0	210	0	18	11.545
########	0	13.1	0	10.4	0	7.3	1007.8	14.7	0	20	0	180	0	31	12
########	0	13.8	0	9.8	0	3	1005.4	14.3	0	21	0	210	0	32	12.767
########	0	15.1	0	7.5	0	0.2	1010	10.5	0	18	0	210	0	28	12.15
########	0	12.1	0	6.2	0	0	1008.8	6.8	0	11	0	60	0	17	12.717
########	0	12	0	6.7	0	7	1003.9	7.5	0	15	0	100	0	22	11.95
########	0	12.6	0	5.5	0	0	1012.7	8.2	0	16	0	220	0	24	10.985
########	0	14.2	0	6.6	0	0	1017.7	9.6	0	16	0	260	0	25	11.997
########	0	12.7	0	5.7	0	3.1	1012.8	10.3	0	16	0	220	0	27	11.578
########	0	12.2	0	5.9	0	8.3	999.3	12.4	0	21	0	250	0	31	11.115
########	0	12.8	0	5	0	0.2	1001.6	11.9	0	23	0	290	0	40	10.43
########	0	15.3	0	4.6	0	0	1012.4	8.5	0	13	0	280	0	20	11.45
########	0	14.2	0	6.1	0	0	1018.5	8.1	0	15	0	220	0	21	13.035
########	0	18.9	0	11.3	0	0	1018.7	5.7	0	13	0	320	0	17	15.507
########	0	15.3	0	8.8	0	0	1017.2	6.6	0	14	0	220	0	19	16.66
########	0	17.4	0	10.4	0	0	1013.6	7.9	0	16	0	290	0	21	17.493
########	0	17.8	0	9.4	0	0	1015.5	6	0	16	0	290	0	20	16.017
########	0	18.1	0	7.8	0	0	1019.1	5.3	0	10	0	130	0	16	16.632
########	0	12.5	0	6.8	0	1.6	1014.2	9.8	0	18	0	220	0	29	13.42
########	0	14.7	0	5.9	0	0.1	1006.6	8.9	0	15	0	250	0	24	12.76
########	0	14.1	0	6.2	0	5.1	1001.7	10.1	0	16	0	300	0	24	13.087
########	0	12.2	0	4.6	0	7.2	1000.3	9.3	0	16	0	160	0	23	12.125
########	0	13.2	0	5.8	0	3.6	999.1	11.4	0	18	0	280	0	29	12.49

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

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hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
01-Jun-15	0	11.7	0	5.3	0	18.3	995.5	12	0	25	0	190	0	40	9.825
02-Jun-15	0	14.3	0	8.9	0	1	995.9	13	0	22	0	220	0	36	12.538
03-Jun-15	0	14.6	0	6.8	0	0	1010.8	8.6	0	15	0	230	0	21	13.68
04-Jun-15	0	14.7	0	8.3	0	0	1012	6.9	0	12	0	160	0	19	14.953
05-Jun-15	0	13.9	0	9.1	0	2.8	1007	12.1	0	21	0	210	0	32	14.762
06-Jun-15	0	14.3	0	8	0	0	1016.1	11.5	0	19	0	220	0	28	13.812
07-Jun-15	0	13.9	0	5.3	0	0	1025.9	4.6	0	9	0	270	0	13	13.842
08-Jun-15	0	12.4	0	6.7	0	0	1029.3	8.6	0	14	0	50	0	21	14.202
09-Jun-15	0	14.4	0	6.8	0	0	1027.9	8.3	0	12	0	50	0	18	15.667
10-Jun-15	0	15.6	0	8	0	0	1022	8.8	0	15	0	50	0	23	16.455
11-Jun-15	0	15.5	0	9	0	0.5	1011.9	9.5	0	15	0	50	0	23	14.825
12-Jun-15	0	17.9	0	13	0	0.6	1004.1	7.7	0	11	0	20	0	19	15.52
13-Jun-15	0	16.8	0	11.1	0	0	1004.2	6.3	0	10	0	330	0	15	16.218
14-Jun-15	0	14.6	0	7.7	0	0	1009.8	5.9	0	12	0	330	0	19	17.545
15-Jun-15	0	16.8	0	7.4	0	0	1014.7	6.3	0	9	0	220	0	15	17.9
16-Jun-15	0	16.3	0	11.9	0	0	1017.2	10.3	0	17	0	220	0	24	18.443
17-Jun-15	0	21.2	0	11.4	0	0	1015.7	10	0	15	0	240	0	24	19.237
18-Jun-15	0	19.3	0	8.1	0	0	1016.9	7	0	12	0	300	0	18	18.913
19-Jun-15	0	19.9	0	8.8	0	0	1016.8	7	0	15	0	300	0	21	18.958
20-Jun-15	0	19.9	0	10.6	0	0	1013.6	8.4	0	14	0	220	0	21	20.605
21-Jun-15	0	17.4	0	10.3	0	0.8	1009.5	9.9	0	17	0	260	0	26	17.755
22-Jun-15	0	17.7	0	9	0	0.4	1007.4	7.7	0	13	0	290	0	19	17.692
23-Jun-15	0	17.9	0	9.8	0	0	1010.7	7	0	11	0	210	0	16	18.84
24-Jun-15	0	17	0	11	0	1.2	1011.6	7.3	0	13	0	210	0	20	17.413
25-Jun-15	0	16.8	0	13.7	0	0.1	1009.6	9.5	0	14	0	180	0	21	17.177
26-Jun-15	0	18.7	0	12.2	0	1.2	1007	11.1	0	17	0	230	0	25	18.667
27-Jun-15	0	17.1	0	11.5	0	3.4	1009.7	10.8	0	16	0	220	0	27	17.81
28-Jun-15	0	17.9	0	12.9	0	2.5	1008.2	11.7	0	18	0	230	0	29	17.968
29-Jun-15	0	17.9	0	12.2	0	1.9	1011.7	8.6	0	15	0	170	0	21	17.88
30-Jun-15	0	22.1	0	14.8	0	0.3	1006.9	8.5	0	15	0	150	0	20	19.658

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

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cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
01-Jul-15	0	20	0	14	0	0	1002.5	5.9	0	15	0	220	0	23	19.698
02-Jul-15	0	17.9	0	12.2	0	0	1009.9	7.5	0	12	0	170	0	18	19.2
03-Jul-15	0	19.2	0	12.1	0	0.1	1009.8	7.9	0	14	0	150	0	20	19.535
04-Jul-15	0	18.1	0	12.8	0	0.8	1006	11.1	0	19	0	210	0	29	20.038
05-Jul-15	0	16.6	0	11.8	0	5.3	1007.1	8.6	0	16	0	170	0	28	18.182
06-Jul-15	0	15.9	0	11.5	0	35.8	1003.7	11.8	0	18	0	180	0	30	15.227
07-Jul-15	0	16.8	0	12.9	0	0.3	998.5	12.3	0	19	0	210	0	30	16.1
08-Jul-15	0	18.1	0	11.2	0	0.2	1007.2	11.8	0	24	0	300	0	35	16.785
09-Jul-15	0	16.3	0	8.7	0	0	1015.4	6.9	0	13	0	300	0	18	17.08
10-Jul-15	0	18.5	0	13.5	0	0.7	1009.5	8.2	0	15	0	180	0	22	17.983
11-Jul-15	0	15.7	0	10.4	0	4.8	1007.2	10.9	0	18	0	220	0	29	15.855
12-Jul-15	0	18.3	0	13.4	0	0	1006.7	8.3	0	14	0	230	0	25	17.425
13-Jul-15	0	19.5	0	14	0	3.9	1005.3	9	0	16	0	220	0	27	17.612
14-Jul-15	0	15.4	0	12.8	0	1.3	1010.3	6.5	0	11	0	60	0	16	16.942
15-Jul-15	0	15.8	0	9.1	0	0	1013.3	5.3	0	8	0	40	0	14	18.195
16-Jul-15	0	15.8	0	8.8	0	23.6	1004.7	10.2	0	17	0	150	0	25	15.575
17-Jul-15	0	16.6	0	10	0	0.3	1001.7	12.3	0	19	0	210	0	33	16.233
18-Jul-15	0	17	0	10.3	0	2.5	1004.2	10.5	0	18	0	210	0	28	16.118
19-Jul-15	0	17.1	0	8.9	0	11.1	1001.7	7.8	0	15	0	200	0	23	16.618
20-Jul-15	0	17.6	0	12	0	5	999	11.3	0	19	0	220	0	32	16.528
21-Jul-15	0	17.4	0	12.8	0	0.4	1002.1	9.5	0	15	0	220	0	25	16.362
22-Jul-15	0	17.1	0	10.9	0	0.2	1007.7	6.8	0	13	0	210	0	20	16.427
23-Jul-15	0	17.1	0	9.4	0	0	1008.5	5.4	0	12	0	220	0	16	16.673
24-Jul-15	0	14.1	0	10.4	0	7.5	1006	5.7	0	10	0	340	0	16	15.23
25-Jul-15	0	16.3	0	9	0	0	1007.5	7.2	0	11	0	210	0	18	15.5
26-Jul-15	0	16.7	0	11.9	0	10.5	994.7	12.4	0	22	0	140	0	30	15.208
27-Jul-15	0	16.5	0	10.9	0	0.4	993.7	12.3	0	22	0	260	0	37	15.02
28-Jul-15	0	16.9	0	9.2	0	1.8	1000.8	9.9	0	16	0	270	0	24	14.385
29-Jul-15	0	16.7	0	9.1	0	0.1	1007.9	8	0	14	0	310	0	22	14.552
30-Jul-15	0	16	0	6.1	0	0	1013.8	5.1	0	12	0	240	0	16	14.488
31-Jul-15	0	16	0	11.4	0	0	1009.8	9.1	0	16	0	200	0	27	16.122

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

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soil - Mean 10cm soil temperature (C)

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date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	16.3	0	11.4	0	2.8	1006.4	7.4	0	14	0	210	0	21	16.03
########	0	17.4	0	13	0	4.5	1000.7	12.2	0	19	0	150	0	29	16.017
########	0	17.1	0	11.8	0	2.8	996.3	14.1	0	18	0	230	0	32	16.312
########	0	16.2	0	13.1	0	0.1	999.2	14.7	0	21	0	220	0	34	15.815
########	0	15.3	0	12.1	0	13.9	999.3	11	0	21	0	160	0	31	14.915
########	0	17.2	0	10.8	0	0.7	1003.8	7.1	0	13	0	300	0	19	15.718
########	0	17.4	0	9.1	0	0.1	1012.3	4	0	9	0	300	0	12	15.062
########	0	16.4	0	9.6	0	0.6	1013.9	9.3	0	17	0	210	0	25	15.525
########	0	17	0	14.1	0	0.2	1009.3	10.7	0	16	0	220	0	25	16.538
########	0	17.8	0	11.2	0	0.8	1007.5	9.4	0	17	0	210	0	25	17.888
########	0	16.7	0	10	0	0	1014	4.1	0	7	0	290	0	12	16.312
########	0	17.3	0	9.5	0	0	1016.3	6.6	0	10	0	40	0	14	17.503
########	0	20.5	0	11.2	0	0	1009.7	6.3	0	11	0	60	0	16	19.052
########	0	18.2	0	10	0	0	1003.3	9.8	0	14	0	300	0	19	17.472
########	0	16.6	0	7.2	0	0	1006.5	6.9	0	12	0	230	0	18	15.6
########	0	17.6	0	10	0	0	1009.9	4.7	0	9	0	160	0	13	16.66
########	0	19.2	0	12.1	0	0	1011.3	4.1	0	8	0	180	0	11	18.895
########	0	19	0	10.8	0	0	1008.4	6.4	0	12	0	210	0	18	18.747
########	0	18.1	0	13.4	0	6.1	1003.8	9.4	0	15	0	160	0	23	17.798
########	0	17.3	0	13.2	0	3.2	1006.2	9.6	0	16	0	190	0	25	16.18
########	0	18.5	0	14.1	0	0.2	1006.2	9.5	0	14	0	200	0	22	17.17
########	0	17.3	0	13	0	2.5	1002.4	3.8	0	8	0	140	0	11	16.49
########	0	15.7	0	9.9	0	6.4	994.7	6.4	0	11	0	290	0	16	15.33
########	0	17.6	0	9	0	0.2	995.8	6.3	0	12	0	220	0	19	14.762
########	0	16.3	0	8.7	0	2	994.8	8.7	0	18	0	220	0	30	14
########	0	17.2	0	11.8	0	0.7	990	11.9	0	22	0	210	0	33	15.577
########	0	16.3	0	9	0	0.1	997.1	10.3	0	19	0	210	0	29	14.818
########	0	17.1	0	10.8	0	3	1004.5	10.1	0	19	0	210	0	31	15.65
########	0	17.4	0	12.6	0	1	1009.5	7.3	0	14	0	220	0	21	16.132
########	0	16.3	0	11.1	0	0.1	1011.6	5.1	0	9	0	40	0	14	15.847
########	0	16.5	0	10.3	0	2.2	1011.5	5.3	0	9	0	300	0	12	15.108

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

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soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	17.2	0	9.6	0	0.4	1014.1	8	0	12	0	340	0	21	14.382
########	0	14.4	0	7.2	0	0	1014	7.8	0	13	0	310	0	19	13.618
########	0	14.6	0	9.3	0	0	1013	7.4	0	12	0	330	0	19	13.92
########	0	15.9	0	10.7	0	0	1014.7	7.4	0	11	0	330	0	19	14.855
########	0	14.8	0	8.5	0	0	1018.7	6.4	0	12	0	60	0	18	14.935
########	0	14.8	0	7	0	0	1023.4	4.6	0	7	0	330	0	13	14.63
########	0	14.5	0	9.6	0	0	1024.1	3.9	0	6	0	70	0	10	14.995
########	0	17.7	0	11.3	0	0	1019.1	5.4	0	12	0	140	0	16	15.98
########	0	16.2	0	10.8	0	0.1	1013.6	6.2	0	13	0	130	0	18	15.422
########	0	18.8	0	11.8	0	0	1009.7	7.4	0	13	0	130	0	19	16.14
########	0	15.7	0	13	0	10.3	1000.8	10.1	0	18	0	130	0	26	14.802
########	0	15.3	0	10.9	0	3.1	996.2	8.8	0	15	0	220	0	23	14.42
########	0	16.5	0	10.7	0	12	993.2	6.8	0	16	0	150	0	23	14.292
########	0	13.3	0	10.3	0	26.6	986.5	8.2	0	14	0	280	0	21	12.682
########	0	16.5	0	8.5	0	0	988.7	6.6	0	12	0	290	0	18	13.405
########	0	14.9	0	8.2	0	0	985.8	6.4	0	12	0	50	0	18	13.03
########	0	16.3	0	7.4	0	0	992.6	5.9	0	10	0	300	0	15	13.568
########	0	16.6	0	11.4	0	0	1006.1	6.1	0	10	0	310	0	15	14.13
########	0	17.9	0	10.9	0	0	1016.4	4.6	0	8	0	240	0	13	14.862
########	0	15.3	0	11.8	0	2.6	1012.5	9.1	0	15	0	190	0	25	14.605
########	0	15.9	0	8.4	0	3.8	1001.5	9.1	0	19	0	280	0	27	14.523
########	0	15	0	8.1	0	0.3	1000.2	9.7	0	15	0	300	0	26	12.318
########	0	17	0	8.3	0	0	1003.2	7.6	0	13	0	220	0	21	12.847
########	0	15.2	0	8.1	0	0.1	1007.1	8.1	0	15	0	260	0	22	12.337
########	0	16.1	0	8.5	0	0	1015.8	5.3	0	8	0	250	0	12	12.682
########	0	16.2	0	7.7	0	0	1020.8	3.5	0	9	0	150	0	13	13.023
########	0	16.7	0	9.4	0	0.1	1024.8	5.2	0	13	0	150	0	18	12.975
########	0	16.1	0	10.2	0	0.2	1026.5	6.7	0	14	0	130	0	20	13.038
########	0	14.7	0	10.5	0	0	1027	6.1	0	10	0	90	0	15	13.4
########	0	14.5	0	10.4	0	0.2	1026.2	8.4	0	14	0	40	0	22	13.262

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	15.4	0	9.6	0	0.2	1024.3	4.9	0	9	0	60	0	14	13.323
########	0	14.4	0	6.3	0	0.2	1018	5.3	0	8	0	40	0	13	13.047
########	0	13.1	0	8.4	0	0	1010.2	4.5	0	8	0	320	0	12	12.76
########	0	14.3	0	9.3	0	0.1	1000.2	7.5	0	14	0	140	0	21	12.96
########	0	15.3	0	13	0	9.6	988.5	10.8	0	15	0	190	0	26	13.993
########	0	15.3	0	9.8	0	5.1	991.4	8.2	0	21	0	300	0	28	14.132
########	0	14.3	0	6.8	0	0	1003.9	6.6	0	10	0	240	0	15	11.382
########	0	15.4	0	6.7	0	0.3	1011.8	4.6	0	10	0	190	0	14	11.835
########	0	15.3	0	10.7	0	0	1013.4	5.1	0	11	0	170	0	15	12.983
########	0	13.7	0	11.6	0	0	1011.8	4.8	0	10	0	90	0	15	12.34
########	0	14.1	0	9.3	0	0	1011.5	4.3	0	8	0	40	0	11	12.59
########	0	13.8	0	6.6	0	0.2	1016.5	6.6	0	10	0	340	0	17	10.892
########	0	12.9	0	5.3	0	0	1019.8	6.3	0	9	0	330	0	15	9.552
########	0	13.3	0	5.1	0	0	1018.9	4.1	0	7	0	320	0	8	9.595
########	0	13.1	0	5.4	0	0	1017.2	6.1	0	8	0	50	0	13	9.76
########	0	12.8	0	7.9	0	0	1018.3	6.7	0	11	0	40	0	17	10.31
########	0	12.7	0	10.5	0	0	1016.3	7.2	0	11	0	50	0	18	10.94
########	0	13.2	0	9.2	0	0	1015.7	5.3	0	8	0	50	0	12	11.21
########	0	15.4	0	7.8	0	0	1019.6	4.3	0	8	0	300	0	11	11.767
########	0	13	0	7.2	0	4.4	1018.4	7.1	0	14	0	210	0	22	10.555
########	0	15.5	0	12.1	0	0.8	1009.8	9.6	0	18	0	280	0	27	12.955
########	0	14.4	0	9.7	0	0.5	1009.9	7.2	0	16	0	270	0	25	11.77
########	0	13.2	0	9.1	0	1.6	1007.4	9.3	0	14	0	190	0	25	11.585
########	0	13.2	0	5.1	0	7.1	1007.8	8.6	0	18	0	300	0	28	10.735
########	0	12.6	0	6.3	0	1.1	1010.4	9.6	0	18	0	160	0	27	8.948
########	0	13.8	0	11.5	0	8.6	999.8	17.5	0	22	0	150	0	32	11.153
########	0	13.8	0	9.7	0	19	996.9	5.9	0	15	0	130	0	23	11.955
########	0	13.8	0	8.9	0	0.4	994.4	10.3	0	18	0	170	0	27	10.812
########	0	13.4	0	8.4	0	6.5	995.8	8.6	0	22	0	160	0	34	11.245
########	0	14.7	0	10.8	0	3	1002.3	12.1	0	18	0	160	0	27	11.965
########	0	15	0	12.8	0	3.3	1011.8	5.6	0	17	0	170	0	26	13.475

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

mintp: - Minimum Air Temperature (C)

rain: - Precipitation Amount (mm)

cbl: - Mean CBL Pressure (hpa)

wdsp: - Mean Wind Speed (knot)

hm: - Highest ten minute mean wind speed (knot)

ddhm: - Mean Wind Direction over 10 minutes at time of highest 10 minute mean (degree)

hg: - Highest Gust (knot)

soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	14.6	0	9.2	0	0	1019.1	2.4	0	6	0	130	0	9	12.693
########	0	14.4	0	10.1	0	0.3	1013	4.5	0	8	0	120	0	11	12.67
########	0	12.6	0	10.4	0	0.1	1006.4	4.4	0	8	0	10	0	13	12.235
########	0	13.9	0	8.5	0	2.2	1003.7	4	0	7	0	20	0	12	11.655
########	0	14.1	0	10.7	0	11.6	998.2	7.3	0	14	0	160	0	21	12.168
########	0	14.3	0	11.6	0	3.4	1001	11.3	0	17	0	220	0	29	12.565
########	0	14.1	0	9.6	0	7.6	1005.9	7.3	0	18	0	210	0	29	11.81
########	0	14.2	0	6.7	0	15.4	1006.3	12.8	0	23	0	150	0	35	11.007
########	0	14.1	0	10.1	0	3.4	1006.3	19.8	0	28	0	220	0	45	11.375
########	0	14.2	0	13.2	0	0.6	1008.6	16.1	0	21	0	220	0	36	13.15
########	0	13.5	0	9.8	0	3	1008.7	13.2	0	19	0	200	0	31	12.545
########	0	13.6	0	7.8	0	4.3	1004.8	14.7	0	23	0	190	0	40	10.455
########	0	9.4	0	4.5	0	0.6	1010.6	12.9	0	23	0	220	0	35	7.273
########	0	13.7	0	5.8	0	15.1	1008.7	13.9	0	24	0	230	0	44	9.194
########	0	13.8	0	11.6	0	2.1	996.3	20.9	0	28	0	220	0	45	12.145
########	0	11.6	0	5.9	0	2.6	998	8.5	0	17	0	240	0	27	9.267
########	0	13.9	0	4.6	0	5.9	993.4	14	0	33	0	240	0	53	9.245
########	0	13.2	0	8.4	0	0.6	998.3	15.3	0	26	0	210	0	43	10.007
########	0	11	0	6.2	0	0.1	1005.8	8.5	0	15	0	240	0	21	8.93
########	0	8.5	0	1.8	0	0.4	1005	10.5	0	20	0	300	0	31	6.748
########	0	5.5	0	1.9	0	0.1	1008.1	11.8	0	23	0	290	0	36	4.486
########	0	7.9	0	2.8	0	0.1	1011.6	8.6	0	14	0	340	0	23	4.903
########	0	10.7	0	1.5	0	6.9	1012.5	8.3	0	15	0	220	0	24	5.41
########	0	10	0	5.9	0	0	1006.9	8.9	0	17	0	260	0	25	7.815
########	0	11.5	0	8.7	0	0.6	1010.6	12.7	0	20	0	290	0	31	8.658
########	0	13.5	0	9.8	0	0	1012.7	7.1	0	16	0	290	0	24	9.88
########	0	11.5	0	2.4	0	3.4	1002.7	13.4	0	25	0	260	0	37	8.693
########	0	9.5	0	2.4	0	0.6	1001.1	13.4	0	24	0	220	0	37	6.165
########	0	11.3	0	5	0	3.8	1001.7	14.3	0	23	0	260	0	34	7.628
########	0	12.1	0	6.5	0	10.4	1004.8	12.2	0	24	0	230	0	38	8.917

Station Name: JohnstownII

Station Height: 62 M

Latitude:5 Longitude: -6.490

maxtp: - Maximum Air Temperature (C)

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soil - Mean 10cm soil temperature (C)

i: - Indicator

date	imax	maxtp	imin	mintp	irain	rain	cbl	wdsp	ihm	hm	iddhm	ddhm	ihg	hg	soil
########	0	12.2	0	8.7	0	0.1	1009.2	15.4	0	19	0	210	0	32	10.255
########	0	12.1	0	6.8	0	4.6	1008.3	10.6	0	21	0	200	0	35	10.068
########	0	12.4	0	2.7	0	36.6	1003.3	9.8	0	22	0	170	0	35	8.291
########	0	11.8	0	4.1	0	0.2	1010.2	17	0	27	0	210	0	45	7.813
########	0	11.9	0	10.4	0	13	1000.9	22.7	0	27	0	210	0	46	9.778
########	0	12	0	6.7	0	2.9	1002.1	9.8	0	23	0	210	0	39	9.785
########	0	12.8	0	11.4	0	6.4	1004.2	17.5	0	26	0	170	0	40	10.79
########	0	12.3	0	4	0	1.5	1010.3	12.7	0	22	0	240	0	34	8.415
########	0	11.6	0	6.9	0	2.1	1015.3	18.6	0	25	0	190	0	41	8.413
########	0	9.5	0	5.6	0	5.1	1011.8	8.5	0	16	0	210	0	26	8.278
########	0	7.7	0	4.7	0	0	1013.5	7.1	0	11	0	230	0	16	5.876
########	0	12.2	0	5.1	0	22.2	1006.5	11.9	0	25	0	230	0	41	7.973
########	0	10.8	0	5.2	0	4.8	1005.8	6.5	0	10	0	160	0	14	7.913
########	0	11.3	0	9.5	0	8.2	1001.9	10.4	0	19	0	130	0	28	9.22
########	0	12.5	0	10	0	11.6	997.4	13	0	23	0	200	0	38	9.788
########	0	12.5	0	11.2	0	2.1	999.9	14	0	24	0	210	0	36	11.07
########	0	12.6	0	11.3	0	3.7	1001	14.5	0	19	0	190	0	32	11.318
########	0	13	0	11.2	0	2.3	1000.9	13.9	0	18	0	190	0	30	11.12
########	0	13	0	9.6	0	13.3	992.9	14.9	0	22	0	180	0	34	11.722
########	0	10.7	0	7.2	0	1.4	995.4	13.4	0	21	0	200	0	33	9.205
########	0	11.7	0	6.9	0	8	998.8	13.1	0	23	0	220	0	39	8.267
########	0	12.5	0	6.9	0	5	995.4	15.5	0	24	0	210	0	40	9.75
########	0	11.5	0	5.3	0	0.2	999.7	16.5	0	27	0	180	0	43	7.558
########	0	11.2	0	3.3	0	4.4	998.3	12.9	0	27	0	180	0	44	7.097
########	0	12.2	0	4.1	0	24.6	1003.1	12	0	21	0	210	0	35	7.713
########	0	12.4	0	3.5	0	26.7	999.7	9.4	0	24	0	190	0	39	9.828
########	0	12	0	2.5	0	0.6	1006.2	7.6	0	20	0	160	0	29	7.33
########	0	12.8	0	7.7	0	14.3	996.5	17.9	0	23	0	140	0	37	9.845
########	0	12.1	0	8.1	0	18.3	995.8	0.1	0	0	0	180	0	0	8.752
########	0	12.4	0	3.9	0	15	987.2		0	17	0	170	0	27	9.32
########	0	8.2	0	1.4	0	7.7	999.6	9.7	0	22	0	200	0	34	5.98

Appendix G

Flare Servicing Records and Landfill Gas Survey

a SERVICE SHEET Page No 2	JOB NO 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834 www.afs-group.co.uk

SITE: Dungarvan Landfill site, Co Waterford	DATE: 30/03/2015

HEALTH AND SAFETY NOTICE

WEAR A HEAD HAT AND REFLECTIVE VEST OR JACKET ON OPERATIVE SITES

WEAR A PROTECTIVE FACE MASK WHEN WORKING IN AN AREA WHERE THERE IS ANY POSSIBILITY OF BREATHING IN CERAMIC INSULATING DUST

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS

1. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL
2. RECORD ALL CHANGES AND REPAIRS MADE
3. RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED
4. CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED
5. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE
6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

ENGINEERS NAME	Barry Cormican

ARRIVAL: FLARE OFF DUR TO TIMER.

HOURS RUN	BOOSTER 1	18092	CH4	46.2	CO2	14.1
	BOOSTER 2	N/A	O2	6.0	PRESSURE	0 mbar

INLET VALVE SETTING % OPEN

NO 1	F/O	NO 2	F/O	NO 3	N/A	NO 4	N/A	NO 5	N/A	NO 6	N/A

MAIN CONTROL VALVE SETTING % OPEN	

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT (mbarg)

NO 1	-0	NO 2	-0	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	12 °C		INLET VACUUM PRIOR TO KO POT FILTER	-0 MBAR	
VACUUM AFTER KO POT FILTER	-0 MBAR		VACUUM AFTER INLET FLAME ARRESTER	N/A	
OUTLET PRESSURE AFTER GAS BOOSTER	0 MBAR		OUTLET GAS TEMP	13 °C	
PRESSURE AFTER SLAM SHUT	0 MBAR		PRESSURE AFTER OUTLET FLAME ARRESTER	N/A	
TOTAL FLOW	1362670 M^3		BLOWER SPEED	38%	
FLOW RATE	32 M^3/hr		MEASURING INSTRUMENT	OPFM	
FLAME TEMP	8.1 °C		MOTOR TEMP	NORMAL	
FLAME QUALITY	N/A		AMBIENT TEMP	12.1 °C	

MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN	AMBIENT PRESSURE 1006

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	0.5	EMISSIONS ANALYSER NOX CELL	N/A

SERVICE SHEET Page No 2	Job No 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK FOR LEAKS WITH GAS DETECTOR		None	
CONDENSATE DRAIN SYSTEM CHECK		Yes	
DRAINS CORRECTLY	Yes	KNOCKOUT POT FILTER CLEAN	N/A
COMMENTS			
BOOSTER MODEL AND SERIAL NO	BG 30 / 34-3 GX		
MOTOR & FAN SEAL GREASED	Yes	BOOSTER CORRECT ROTATION	Yes
NOTE: USE SHELL ALVANIA 3, GREASE EVERY SERVICE **IMPORTANT DO NOT OVERGREASE**			
BOOSTER OIL CHANGED (EVERY 5000 HOURS, USE 20W50 ENGINE OIL IN DONKIN V50			N/A

BOOSTER FLEXIBLE CONNECTORS	OK	MOUNTINGS	OK	BEARING NOISE	OK

BOLTS TIGHT	Yes	SLAMSHUT SPRING	OK	GAUGES ZEROED	Yes
FLAME ARRESTER INLET	OK	OUTLET	OK	PILOT	OK
PILOT LIGHT FUNCTION	OK	UV SENSOR FUNCTION	OK	EXTERIOR LIGHT	N/A
INTERIOR LIGHT	N/A	ELECTRICAL CONNECTIONS CHECKED FOR TIGHTNESS			Yes

ALL INDICATOR BULBS FUNCTION	Yes		
HINGES & VALVES LUBRICATED	Yes		

PRESSURE SWITCH FUNCTION

SUCTION	N/A	SETTING	N/A	VENT	N/A	SETTING	N/A
BOOSTER	Yes	SETTING	1.0 mbar	OTHER (specify)	N/A	SETTING	N/A
BURNER	N/A	SETTING	N/A			SETTING	

COMMENTS

SERVICE SHEET Page No 3	1659		Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK SIGNAL, CONTROL AND TELEMETRY FUNCTION	OK
SIGNAL, CONTROL & TELEMETRY REPORT FILLED OUT AS APPROPRIATE	N/A
REPORT ALL & ANY CHANGES MADE TO TELEMETRY SYSTEM	None
REPORT ALL & ANY CHANGES MADE TO CONTROL PROGRAMME	None
CH4 ANALYSER OPERATION	OK
O2 ANALYSER OPERATION	OK
C02 ANALYSER OPERATION	OK
CO EMISSION ANALYSER	OK
REPORT ALL & ANY REPAIRS	None
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	REPAIRS	NEW PARTS FITTED
	Drained compressor	None.
	Zeroed flow meter.	

GAS ANALYSER CALIBRATION REPORT:

GAS USED: 1954 Compressed Gas.		Methane (CH4) 50 % concentration		Carbon Dioxide: Remaining Balance	
Before Calibration:	CH4	N/A %	CO2	N/A %	
After Calibration:	CH4	N/A %	CO2	N/A %	
Comments:	None				

GAS USED: 1954 Compressed Gas.	Oxygen (O_2) 20.9% Concentration		Nitrogen: Remaining Balance
Before Calibration:	O_2	N/A %	
After Calibration:	O_2	N/A %	
Comments:	None		

SERVICE SHEET Page No 4	Job No 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

REPORT ANY FURTHER REPAIRS OR ACTION NEEDED:
None.

DEPARTURE REPORT:							
HOURS RUN: 18092		RUN RIG FOR 30 MINUTES BEFORE TAKING READINGS					
CH4	51.3	CO2	17.8	O2	1.3	CO	0.5

INLET VALVE SETTING % OPEN											
NO 1	F/O	NO 2	F/O	NO 3	N/A	NO 4	N/A	NO 5	N/A	NO 6	N/A

MAIN CONTROL VALVE SETTING % OPEN											
INLET VACUUM GAUGE READINGS STARTING SIDE NEAREST KNOCKOUT POT										(mbarg)	
NO 1	-4	NO 2	-4	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	16	INLET VACUUM PRIOR TO KO POT FILTER	-4
VACUUM AFTER KO POT FILTER	-4	VACUUM AFTER INLET FLAME ARRESTER	N/A
OUTLET PRESSURE AFTER GAS BOOSTER	14	OUTLET GAS TEMP	16
PRESSURE AFTER SLAM SHUT	13	PRESSURE AFTER OUTLET FLAME ARRESTER	N/A
OTHER	BLOWER SPEED % 38		
	MANOMETER READING: 100 M3/hr		
FLOW RATE	94	FLAME QUALITY	OK
FLAME TEMP	1015	HAS RIG & COMPOUND BEEN LEFT CLEAN	Yes

NAMES OF ALL AFS & SUB CONTRACTOR STAFF CARRYING OUT WORK			
Barry Cormican			
REPORT WRITER	Barry Cormican		
SIGNATURE			
DATE	30-03-2015		

SERVICE SHEET Page No 4	JOB NO 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834 www.afs-group.co.uk

SITE: Dungarvan Landfill site, Co Waterford	DATE: 07/07/2015

HEALTH AND SAFETY NOTICE

WEAR A HEAD HAT AND REFLECTIVE VEST OR JACKET ON OPERATIVE SITES

WEAR A PROTECTIVE FACE MASK WHEN WORKING IN AN AREA WHERE THERE IS ANY POSSIBILITY OF BREATHING IN CERAMIC INSULATING DUST

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS

1. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL
2. RECORD ALL CHANGES AND REPAIRS MADE
3. RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED
4. CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED
5. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE
6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

ENGINEERS NAME	Barry Cormican

ARRIVAL: Flare running fine

HOURS RUN	BOOSTER 1	18386	CH4	49.7	CO2	17.8
	BOOSTER 2	N/A	O2	3.9	PRESSURE	15 mbar

INLET VALVE SETTING % OPEN

NO 1	F/O	NO 2	F/O	NO 3	N/A	NO 4	N/A	NO 5	N/A	NO 6	N/A

MAIN CONTROL VALVE SETTING % OPEN	

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT (mbarg)

NO 1	-6	NO 2	-5	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	16 °C		INLET VACUUM PRIOR TO KO POT FILTER	-6 MBAR	
VACUUM AFTER KO POT FILTER	-5 MBAR		VACUUM AFTER INLET FLAME ARRESTER	N/A	
OUTLET PRESSURE AFTER GAS BOOSTER	14 MBAR		OUTLET GAS TEMP	13 °C	
PRESSURE AFTER SLAM SHUT	12 MBAR		PRESSURE AFTER OUTLET FLAME ARRESTER	N/A	
TOTAL FLOW	1387827 M^3		BLOWER SPEED	38%	
FLOW RATE	83 M^3/hr		MEASURING INSTRUMENT	OPFM	
FLAME TEMP	1014 °C		MOTOR TEMP	NORMAL	
FLAME QUALITY	OK		AMBIENT TEMP	24.7 °C	

MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN	AMBIENT PRESSURE 1008

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	4.0	EMISSIONS ANALYSER NOX CELL	N/A

SERVICE SHEET Page No 2	Job No 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK FOR LEAKS WITH GAS DETECTOR		None	
CONDENSATE DRAIN SYSTEM CHECK		Yes	
DRAINS CORRECTLY	Yes	KNOCKOUT POT FILTER CLEAN	N/A
COMMENTS			
BOOSTER MODEL AND SERIAL NO	BG 30 / 34-3 GX		
MOTOR & FAN SEAL GREASED	Yes	BOOSTER CORRECT ROTATION	Yes
NOTE: USE SHELL ALVANIA 3, GREASE EVERY SERVICE **IMPORTANT DO NOT OVERGREASE**			
BOOSTER OIL CHANGED (EVERY 5000 HOURS, USE 20W50 ENGINE OIL IN DONKIN V50			N/A

BOOSTER FLEXIBLE CONNECTORS	OK	MOUNTINGS	OK	BEARING NOISE	OK

BOLTS TIGHT	Yes	SLAMSHUT SPRING	OK	GAUGES ZEROED	Yes
FLAME ARRESTER INLET	OK	OUTLET	OK	PILOT	OK
PILOT LIGHT FUNCTION	OK	UV SENSOR FUNCTION	OK	EXTERIOR LIGHT	N/A
INTERIOR LIGHT	N/A	ELECTRICAL CONNECTIONS CHECKED FOR TIGHTNESS			Yes

ALL INDICATOR BULBS FUNCTION	Yes		
HINGES & VALVES LUBRICATED	Yes		

PRESSURE SWITCH FUNCTION

SUCTION	N/A	SETTING	N/A	VENT	N/A	SETTING	N/A
BOOSTER	Yes	SETTING	1.0 mbar	OTHER (specify)	N/A	SETTING	N/A
BURNER	N/A	SETTING	N/A			SETTING	

COMMENTS

SERVICE SHEET Page No 3	Job No 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK SIGNAL, CONTROL AND TELEMETRY FUNCTION	OK
SIGNAL, CONTROL & TELEMETRY REPORT FILLED OUT AS APPROPRIATE	N/A

REPORT ALL & ANY CHANGES MADE TO TELEMETRY SYSTEM	None
REPORT ALL & ANY CHANGES MADE TO CONTROL PROGRAMME	None
CH4 ANALYSER OPERATION	OK
O2 ANALYSER OPERATION	OK
C02 ANALYSER OPERATION	OK
CO EMISSION ANALYSER	OK
REPORT ALL & ANY REPAIRS	None
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	REPAIRS	NEW PARTS FITTED
	Drained compressor	None.

GAS ANALYSER CALIBRATION REPORT:					
GAS USED: 1954 Compressed Gas.		Methane (CH4) 50 % concentration		Carbon Dioxide: Remaining Balance	
Before Calibration:	CH4	52.0 %	CO2	47.2 %	
After Calibration:	CH4	50.0 %	CO2	50.0 %	
Comments:	None				
GAS USED: 1954 Compressed Gas.		Oxygen (O_2) 20.9% Concentration		Nitrogen: Remaining Balance	
Before Calibration:	O_2	21.9 %			
After Calibration:	O_2	20.9 %			
Comments:	None				

SERVICE SHEET Page No 4	Job No 1659	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

REPORT ANY FURTHER REPAIRS OR ACTION NEEDED:
None.

DEPARTURE REPORT:							
HOURS RUN:	18388	RUN RIG FOR 30 MINUTES BEFORE TAKING READINGS					
CH4	48.5	CO2	18.3	O2	3.2	CO	3.9

INLET VALVE SETTING % OPEN											
NO 1	F/O	NO 2	F/O	NO 3	N/A	NO 4	N/A	NO 5	N/A	NO 6	N/A

MAIN CONTROL VALVE SETTING % OPEN	

INLET VACUUM GAUGE READINGS STARTING SIDE NEAREST KNOCKOUT POT										(mbarg)	
NO 1	-5	NO 2	-5	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	18	INLET VACUUM PRIOR TO KO POT FILTER	-5
VACUUM AFTER KO POT FILTER	-5	VACUUM AFTER INLET FLAME ARRESTER	N/A
OUTLET PRESSURE AFTER GAS BOOSTER	14	OUTLET GAS TEMP	16
PRESSURE AFTER SLAM SHUT	12	PRESSURE AFTER OUTLET FLAME ARRESTER	N/A
OTHER	BLOWER SPEED % 38		
	MANOMETER READING: 100 M3/hr		
FLOW RATE	84	FLAME QUALITY	OK
FLAME TEMP	1021	HAS RIG & COMPOUND BEEN LEFT CLEAN	Yes

NAMES OF ALL AFS & SUB CONTRACTOR STAFF CARRYING OUT WORK			
Barry Cormican			
REPORT WRITER	Barry Cormican		
SIGNATURE			
DATE	07-07-2015		

SERVICE SHEET Page No 4	JOB NO Dungarvan	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834 www.afs-group.co.uk

SITE: Dungarvan Landfill site, Co Waterford	DATE: 28/10/2015

HEALTH AND SAFETY NOTICE

WEAR A HEAD HAT AND REFLECTIVE VEST OR JACKET ON OPERATIVE SITES

WEAR A PROTECTIVE FACE MASK WHEN WORKING IN AN AREA WHERE THERE IS ANY POSSIBILITY OF BREATHING IN CERAMIC INSULATING DUST

TO BE COMPLETED FOR ALL HIRE INSTALLATION, SERVICE AND REPAIR VISITS

1. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON ARRIVAL
2. RECORD ALL CHANGES AND REPAIRS MADE
3. RECORD ALL PARTS, MATERIALS & COMPONENTS FITTED OR USED
4. CHECK THAT PRESSURE AND VACUUM GAUGES ARE ZEROED
5. RECORD ALL INSTRUMENT READINGS AND VALVE SETTINGS ON DEPARTURE
6. LEAVE SITE CLEAN AND TIDY
7. NOTE FUTURE REMEDIAL ACTION NEEDED AND SEE THAT IT IS CARRIED OUT

ENGINEERS NAME	Steve Hindle

ARRIVAL: Flare running fine

Flare type HT100

HOURS RUN	BOOSTER 1	18875	CH4	60.7	CO2	23
	BOOSTER 2	N/A	O2	0,6	PRESSURE	16 mbar

INLET VALVE SETTING % OPEN

NO 1	100%	NO 2	N/A	NO 3	N/A	NO 4	N/A	NO 5	N/A	NO 6	N/A

MAIN CONTROL VALVE SETTING % OPEN	100%

INLET VACUUM GAUGE READINGS STARING SIDE NEAREST KNOCKOUT POT (mbarg)

NO 1	-3	NO 2	N/A	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	16 °C		INLET VACUUM PRIOR TO KO POT FILTER	-3 MBAR	
VACUUM AFTER KO POT FILTER	-4 MBAR		VACUUM AFTER INLET FLAME ARRESTER	N/A	
OUTLET PRESSURE AFTER GAS BOOSTER	16 MBAR		OUTLET GAS TEMP	16 °C	
PRESSURE AFTER SLAM SHUT	12 MBAR		PRESSURE AFTER OUTLET FLAME ARRESTER	N/A	
TOTAL FLOW	1430631 M^3		BLOWER SPEED	38%	
FLOW RATE	90 M^3/hr		MEASURING INSTRUMENT	OPFM	
FLAME TEMP	1021 °C		MOTOR TEMP	NORMAL	
FLAME QUALITY	OK		AMBIENT TEMP	20.4 °C	

MANOMETER LIQUID LEVEL WITH RIG SHUT DOWN	AMBIENT PRESSURE 1001

TYPE OF LIQUID: PERFLOW

RED SG - 0.8		EMISSIONS ANALYSER CO CELL	123.0	EMISSIONS ANALYSER NOX CELL	N/A

SERVICE SHEET Page No 2	Job No Dungarvan	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK FOR LEAKS WITH GAS DETECTOR		None	
CONDENSATE DRAIN SYSTEM CHECK		Yes	
DRAINS CORRECTLY	Yes	KNOCKOUT POT FILTER CLEAN	N/A
COMMENTS			
BOOSTER MODEL AND SERIAL NO	BG 30 / 34-3 GX		
MOTOR & FAN SEAL GREASED	Yes	BOOSTER CORRECT ROTATION	Yes
NOTE: USE SHELL ALVANIA 3, GREASE EVERY SERVICE **IMPORTANT DO NOT OVERGREASE**			
BOOSTER OIL CHANGED (EVERY 5000 HOURS, USE 20W50 ENGINE OIL IN DONKIN V50			N/A

BOOSTER FLEXIBLE CONNECTORS	OK	MOUNTINGS	OK	BEARING NOISE	OK

BOLTS TIGHT	Yes	SLAMSHUT SPRING	OK	GAUGES ZEROED	
FLAME ARRESTER INLET	OK	OUTLET	OK	PILOT	OK
PILOT LIGHT FUNCTION	cleaned	UV SENSOR FUNCTION	cleaned	EXTERIOR LIGHT	N/A
INTERIOR LIGHT	N/A	ELECTRICAL CONNECTIONS CHECKED FOR TIGHTNESS			Yes

ALL INDICATOR BULBS FUNCTION	Yes		
HINGES & VALVES LUBRICATED	Yes		

PRESSURE SWITCH FUNCTION

SUCTION	N/A	SETTING	N/A	VENT	N/A	SETTING	N/A
BOOSTER	Yes	SETTING	1.0 mbar	OTHER (specify)	N/A	SETTING	N/A
BURNER	N/A	SETTING	N/A			SETTING	

COMMENTS

	Job No	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre

SERVICE SHEET Page No 3	Dungarvan		Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834

CHECK SIGNAL, CONTROL AND TELEMETRY FUNCTION	OK
SIGNAL, CONTROL & TELEMETRY REPORT FILLED OUT AS APPROPRIATE	N/A
REPORT ALL & ANY CHANGES MADE TO TELEMETRY SYSTEM	None
REPORT ALL & ANY CHANGES MADE TO CONTROL PROGRAMME	None
CH4 ANALYSER OPERATION	OK
O2 ANALYSER OPERATION	OK
C02 ANALYSER OPERATION	OK
CO EMISSION ANALYSER	OK
REPORT ALL & ANY REPAIRS	None
REPORT ALL & ANY PARTS REPLACED OR NEW PARTS FITTED INCLUDING PART NOS & SUFFICIENT DETAIL FOR THEM TO BE INVOICED	

	REPAIRS	NEW PARTS FITTED
	Changed gas analyser input filter	1 x gas analyser filter (small round)
	Cleaned emissions input filter	
	Drained compressor	

GAS ANALYSER CALIBRATION REPORT:

GAS USED: 1954 Compressed Gas.		Methane (CH4) 50 % concentration		Carbon Dioxide: Remaining Balance	
Before Calibration:	CH4	50.8 %	CO2	47.7 %	
After Calibration:	CH4	50.0 %	CO2	50.0 %	
Comments:	None				

GAS USED: 1954 Compressed Gas.	Oxygen (O_2) 20.9% Concentration		Nitrogen: Remaining Balance
Before Calibration:	O_2	N/A %	
After Calibration:	O_2	N/A %	
Comments:	None		

SERVICE SHEET Page No 4	Job No Dungarvan	**Automatic Flare Systems Ltd** Unit 8, Ensign Business Centre Coventry CV4 8JA United Kingdom Tel: +44 (0)24 7647 4877 Fax: +44 (0)24 7647 4834	

REPORT ANY FURTHER REPAIRS OR ACTION NEEDED:											
CO cell failed. Requires new CO cell fitting.											
DEPARTURE REPORT:											
HOURS RUN: 18876		RUN RIG FOR 30 MINUTES BEFORE TAKING READINGS									
CH4	53.7	CO2	23	O2	1.4	CO	123				
INLET VALVE SETTING % OPEN											
NO 1	100%	NO 2	N/A	NO 3	N/A	NO 4	N/A	NO 5	N/A	NO 6	N/A
MAIN CONTROL VALVE SETTING % OPEN								100%			
INLET VACUUM GAUGE READINGS STARTING SIDE NEAREST KNOCKOUT POT										(mbarg)	
NO 1	-3	NO 2	N/A	NO 3	N/A	NO4	N/A	NO 5	N/A	NO 6	N/A

INLET TEMP	18	INLET VACUUM PRIOR TO KO POT FILTER	-3
VACUUM AFTER KO POT FILTER	-4	VACUUM AFTER INLET FLAME ARRESTER	N/A
OUTLET PRESSURE AFTER GAS BOOSTER	16	OUTLET GAS TEMP	20
PRESSURE AFTER SLAM SHUT	13	PRESSURE AFTER OUTLET FLAME ARRESTER	N/A
DAMPER% 43	BLOWER SPEED % 38		
	MANOMETER READING: 90 M3/hr		
FLOW RATE	88	FLAME QUALITY	OK
FLAME TEMP	1013	HAS RIG & COMPOUND BEEN LEFT CLEAN	Yes

NAMES OF ALL AFS & SUB CONTRACTOR STAFF CARRYING OUT WORK			
Steve Hindle			
REPORT WRITER	Steve Hindle		

SIGNATURE			
DATE	28/10/2015		

	to be filled in by licensee		calculated by spreadsheet	

Flare No. 1

Flare type ?	AFS HT150	**If "other" enter flare description here**
Is the flare an open or enclosed flare ?	Enclosed	**Rated flare capacity ?** 250 **m3/hr**
Month /year comissioned ?	July 2010	
Month decomissioned if decomissioned in 2015 ?	Select	
What is the function of the flare ?	Extraction from capped area	**If "other" enter flare function here**

Monthly	Method M/C/E	Runtime days/month	Runtime hrs/day	Downtime hrs	Total runtime hrs/month	Average Inlet Pressure (mbg)	Average Flow Rate (m^3/hr)	Average CH_4 %v/v	Average CO_2 %v/v	Average O_2 %v/v	Combustion efficiency (%)	Total CH_4 m^3	Total CH_4 kgs
January	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
February	E	27	10.0	24.0	246	-21	90	38.00	17.00	4.00	98.0	8,245	5,575
March	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
April	E	29	10.0	24.0	266	-21	90	38.00	17.00	4.00	98.0	8,915	6,028
May	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
June	E	29	10.0	24.0	266	-21	90	38.00	17.00	4.00	98.0	8,915	6,028
July	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
August	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
September	E	29	10.0	24.0	266	-21	90	38.00	17.00	4.00	98.0	8,915	6,028
October	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
November	E	29	10.0	24.0	266	-21	90	38.00	17.00	4.00	98.0	8,915	6,028
December	E	30	10.0	24.0	276	-21	90	38.00	17.00	4.00	98.0	9,250	6,255
Total					3,242							108,659	73,469

Please note: Only fill the "Yearly" table if data is not availabe or cannot be calculated nor estimated on a monthly basis

Yearly	Method M/C/E	Runtime days/year	Runtime hrs/day	Downtime hrs	Total runtime hrs/year	Average Inlet Pressure (mbg)	Average Flow Rate m^3/hr	Average CH_4 %v/v	Average CO_2 %v/v	Average O_2 %v/v	Combustion efficiency (%)	Total CH_4 m^3	Total CH_4 kgs
2015					0						98.0	0	0

Appendix H

Management Structure

Management Structure of Waterford City and County Council

CEO Mr Michael Walsh

Director of Services

Environment & WaterServices Mr. Fergus Galvin

Senior Executive Officer Mr. Raymond Moloney

Senior Executive Engineer Mr. John Nolan

Executive Scientific Officer	Executive Engineer	Environmental Consultants
Mr. Paul Carroll	Liam Aherne	RPS

Landfill and Civic Amenity Manager

Mr. David Regan

Caretaker **1 – Site Operative**

Mr. Bill O Keeffe

Appendix I

Pollutant Release Transfer Register

Guidance to completing the PRTR workbook

PRTR Returns Workbook

Version 1.1.19

REFERENCE YEAR	2015

1. FACILITY IDENTIFICATION

Parent Company Name	Waterford City & County Council
Facility Name	Dungarvan Waste Disposal Site
PRTR Identification Number	W0032
Licence Number	W0032-03

Classes of Activity

No.	class_name
-	Refer to PRTR class activities below

Address 1	Ballynamuck Middle
Address 2	Dungarvan
Address 3	
Address 4	
	Waterford
Country	Ireland
Coordinates of Location	-7.64444 52.104
River Basin District	IESE
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	David Regan
AER Returns Contact Email Address	dregan@waterfordcouncil.ie
AER Returns Contact Position	Executive Technician
AER Returns Contact Telephone Number	058 21112
AER Returns Contact Mobile Phone Number	086 8307065
AER Returns Contact Fax Number	058 45606
Production Volume	0.0
Production Volume Units	
Number of Installations	1
Number of Operating Hours in Year	2145
Number of Employees	4
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	Activity Name
50.1	General
50.1	General

3. SOLVENTS REGULATIONS (S.I. No. 543 of 2002)

Is it applicable?	
Have you been granted an exemption ?	
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	
Is the reduction scheme compliance route being used ?	

4. WASTE IMPORTED/ACCEPTED ONTO SITE Guidance on waste imported/accepted onto site

Do you import/accept waste onto your site for on-site treatment (either recovery or disposal activities) ?	

This question is only applicable if you are an IPPC or Quarry site

PRINT THIS SHEET

HELP

CREATE AER XML RETURN & UPLOAD

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			ADD EMISSION POINT	QUANTITY		
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			ADD EMISSION POINT	QUANTITY		
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
01	Methane (CH4)	E	OTH	Estimated from Landgem Model and Flare Data	110000.0	110000.0	0.0	0.0
03	Carbon dioxide (CO2)	E	OTH	Estimated from Landgem Model and Flare Data	1700000.0	1700000.0	0.0	0.0
07	**Non-methane volatile organic compounds (NMVOC)**	E	OTH	Estimated from Landgem Model and Flare Data	20000.0	20000.0	0.0	0.0

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

EMISSIONS (As required in your Licence)

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			ADD EMISSION POINT	QUANTITY		
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

Additional Data Requested from Landfill operators

For the purposes of the National Inventory on Greenhouse Gases, landfill operators are requested to provide summary data on landfill gas (Methane) flared or utilised on their facilities to accompany the figures for total methane generated. Operators should only report their Net methane (CH4) emission to the environment under T(total) KG/yr for Section A: Sector specific PRTR pollutants above. Please complete the table below:

Landfill: Dungarvan Waste Disposal Site

Please enter summary data on the quantities of methane flared and / or utilised

	T (Total) kg/Year	M/C/E	Method Used: Method Code	Method Used: Designation or Description	Facility Total Capacity m3 per hour	
Total estimated methane generation (as per site model)	495000.0	E	OTH	Landgem	N/A	
Methane flared	445500.0	E	OTH		0.0	(Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	110000.0	E	OTH		N/A	

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	02 03 99	No	340.22	wastes not otherwise specified (Organic and Garden Waste)	R3	M	Weighed	Offsite in Ireland	O Toole Composting Ltd,W0284-01	Ballintrane,Fenagh,Co. Carlow,.,Ireland		
Within the Country	08 01 21	Yes	3.14	waste paint or varnish remover	D5	M	Weighed	Offsite in Ireland	ENVA Ireland,WCP/KK/059(A)06	Clonmanim Industrial Estate,Portlaoise,Co. Laois,.,Ireland	ENVA Ireland,WCP/KK/059(A)06,Clonmanim Industrial Estate,Portlaoise,Co. Laois,.,Ireland	Clonmanim Industrial Estate,Portlaoise,Co. Laois,.,Ireland
Within the Country	15 01 01	No	139.6	paper and cardboard packaging	R3	M	Weighed	Offsite in Ireland	Waterford Co. Council,W189-01	Shandon,Dungarvan,Co. Waterford,.,Ireland		
Within the Country	15 01 07	No	22.21	glass packaging	R5	M	Weighed	Offsite in Ireland	Rehab Recycling Ltd,Reg no. 635 Permit No. 03/07	Monaghan Road,Cork,.,.,Ireland		
To Other Countries	16 02 11	Yes	24.553	discarded equipment containing chlorofluorocarbons, HCFC, HFC - FRIDGES	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland
To Other Countries	16 02 11	Yes	0.922	discarded equipment containing chlorofluorocarbons, HCFC, HFC - Flourescent Tubes	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland
To Other Countries	16 02 13	Yes	6.2	discarded equipment containing hazardous components (16) other than those mentioned in 16 02 09 to 16 02 12 - Large Household Items	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland
To Other Countries	16 02 13	Yes	38.293	discarded equipment containing hazardous components (16) other than those mentioned in 16 02 09 to 16 02 12 - TV Monitors	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland
To Other Countries	16 02 13	Yes	40.183	discarded equipment containing hazardous components (16) other than those mentioned in 16 02 09 to 16 02 12 - Small Household Items	R4	M	Weighed	Abroad	KMK Metals Recycling,WCP/KK/069(A)/06	Cappincur Industrial Estate,Daingean Road,Tullamore,Co. Offaly,Ireland	Varies,Varies,Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland	Varies,Contact Laurence Kieran WEEE Ireland,EPA Auditor Dermot Burke,.,Ireland
Within the Country	16 06 01	Yes	2.04	lead batteries	D5	M	Weighed	Offsite in Ireland	ENVA Ireland,WCP/KK/059(A)06	Clonmanim Industrial Estate,Portlaoise,Co. Laois,.,Ireland	ENVA Ireland,WCP/KK/059(A)06,Clonmanim Industrial Estate,Portlaoise,Co. Laois,.,Ireland	Clonmanim Industrial Estate,Portlaoise,Co. Laois,.,Ireland
Within the Country	17 05 04	No	36.7	soil and stones other than those mentioned in 17 05 03 - Rubble	R3	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,.,Ireland		
Within the Country	17 05 04	No	8.26	soil and stones other than those mentioned in 17 05 03 - Clay	R3	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,.,Ireland		
Within the Country	20 01 02	No	14.74	glass	R5	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,.,Ireland		
Within the Country	20 01 10	No	3.14	clothes	R5	M	Weighed	Offsite in Ireland	Textile Recycling Ltd,WCP-DC-08-1225-01	Glenabbey Complex,Belgard Road,Tallaght,Dublin 14,Ireland		
Within the Country	20 01 38	No	136.22	wood other than that mentioned in 20 01 37	R3	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,.,Ireland		
To Other Countries	20 01 39	No	49.36	plastics	R5	M	Weighed	Abroad	Irish film Farm Plastics Group,WMP044B	Waverley Office Park,Old Naas Road,Dublin 12,.,Ireland		
Within the Country	20 01 40	No	15.52	metals	R5	M	Weighed	Offsite in Ireland	Greenstar Ltd,WCP-KK-11-54-02	Unit 6 Ballylogan Industrial Park,Ballylogan Road,Dublin 13,.,Ireland		
Within the Country	20 03 01	No	963.3	mixed municipal waste	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		
Within the Country	20 03 03	No	540.48	street-cleaning residues	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		
Within the Country	**20 03 07**	**No**	303.76	bulky waste	D1	M	Weighed	Offsite in Ireland	Bord na Mona Ltd,W0201-01	Drehid Landfill,Kilnagh Upper,Carbury,Co. Kildare,Ireland		

Appendix J

Ecological Report

Ecological Survey of Dungarvan Landfill 2013/4

Waterford County Council
Comhairle Chontae Phort Láirge

Table of Contents

EXECUTIVE SUMMARY

Dungarvan Landfill site is located at Ballynamuck Middle, Dungarvan, Co Waterford. It is mostly surrounded by agricultural land although wetland habitats occur in association with the River Colligan which flows in a west to east direction along the northern perimeter of the site before flowing down the River Colligan Estuary into Dungarvan Harbour.
The landfill site is comprised of seven principal habitats: artificial lakes and ponds (FL8), Grassland (GA/GS), spoil and bare ground (ED2), buildings and artificial surfaces (BL3), scrub

(WS1), wet grassland (GS4) and reed and large sedge swamps (FS1). The series of constructed wetlands established in autumn 2008 on the landfill cap to treat leachate are now well established with full growth of wetland vegetation.

This Ecological Report comprises a habitat and fauna survey, freshwater biological survey of the River Colligan, and the assessment of the avian fauna of the landfill and nearby Dungarvan harbour.

The results of the 2012 biological assessment of the River Colligan indicated good water quality status at the upstream sampling site (Site 1) following analysis of both the surface water quality and biological water quality data recorded. An improvement of the water quality at Site 1 (in comparison with 2006) and the increase in the diversity of species at downstream connecting sites, coupled with the review of water quality measurements taken on site and EPA chemical water quality data between 2007 and 2008, reflects good water quality indicating that Dungarvan Landfill site is not negatively impacting the River Colligan.

Dungarvan landfill and its environs support a fairly wide diversity of birds. The establishment of constructed wetlands has provided feeding and nesting grounds for a number of wetland birds such as Snipe and Moor Hen. The Colligan river corridor, with its many trees, is particularly species-rich, and it provides a good feeding area for many passerine species. It is also an ideal feeding habitat for those species that rely on the water column directly (e.g. Little Grebe, Little Egret, Common Sandpiper, Kingfisher and Dipper). Of note is the presence of Little Egret and Kingfisher, both of which are Annex I species under the EU Birds Directive. The Kingfisher is considered an indicator species or 'bioindicator' of the health of river ecosystems and will rapidly disappear from polluted waters. Its continued presence in the same area is therefore a positive sign as to the health of the river. Likewise, the presence of Little Egrets suggests a healthy and adequate fish supply.

During the winter months, Dungarvan Harbour supports four species that are listed on Annex I of the EU Birds Directive: Great Northern Diver, Little Egret, Golden Plover and Bar-tailed Godwit. Current data from the Irish Wetland Bird Survey (I-WeBS) shows that the harbour supports two species in internationally important numbers (Light-Bellied Brent Goose and Black-tailed Godwit) and a further 10 species in nationally important numbers. Review of recent and previous I-WeBS data suggests a possible trend for increase in Curlew and Black-tailed Godwits. The data also shows a trend for increase in Redshank, Little Egret and Light-bellied Brent Geese.

Mammal species previously recorded from the site include: Rabbit, Brown rat, Fox, Otter and Mink. Small mammals such as the Pygmy shrew, Field mouse, House mouse, and Bank vole are also likely to be present, but because of their small size and nocturnal habits are easily overlooked. Stoat, Hedgehog and Badger are also likely to be present in the area, although it is unlikely that they occur within the landfill site itself. Bat species such as Daubentons also probably use the river corridor as a feeding habitat.

The River Colligan is an important habitat for Otters which are protected under both Irish and European legislation. Numerous sprainting sites, some of which are obviously in long-term use, indicate that otters are resident and successful there. The high level of otter activity from previous surveys indicates that the River Colligan contains a healthy and reliable population of fish, again highlighting the biological health of the River Colligan.

1.0 INTRODUCTION

1.1 Background

An Ecological Report on Dungarvan Landfill has been prepared by Waterford County Council, as part of on- going requirements of Condition 8.11 of the Dungarvan Waste Disposal Site waste licence (Reg. No. 32-1) and updated licence Reg. No. 32-2 (2005).

After 30 years of operation, Dungarvan landfill was closed and capped in 2003. The site now operates as an integrated waste management facility and closed landfill under EPA Licence Reg. No. 32-2.

Ecological surveys and assessment are required involving the following elements;

1. Habitat quality at landfill and environs. Mapping of main habitat types and identification of main flora and fauna present. Interpretation of findings with regard to previous studies.

2. Flora (macroalgae) and fauna (including macroinvertebrtaes) at five River Colligan sites, (locations as previous years/map attached). Application of appropriate rating systems, such as the EPA-Q rating system, and estuarine evaluation systems. Interpretation of results in light of previous studies.

3. Interpretation and comment on bird count-data to be obtained from annual IWeBs counts by Birdwatch Ireland, and the landfill bird control contractor

1.2 Study Area

Dungarvan Landfill site is located at Ballynamuck Middle, Dungarvan, Co Waterford (Figure 1), north-east of the town of Dungarvan. The principal land use around the landfill site is agricultural. The River Colligan flows in a west to east direction along the northern perimeter of the site before flowing beneath a bridge (Ballyneety Bridge) down the River Colligan Estuary into Dungarvan Harbour.

For the purpose of this study, the ecological study area comprises the landfill site and its immediate surrounding habitats including the corridor of the River Colligan downstream as far as Ballyneety Bridge.

1.3 Report Format

The results of the 2013 ecological surveys are presented in the following sections of this report, separated into the various subject areas as required by the scope of works. Section 2 gives a general site overview, describes areas designated for nature conservation that occur in close proximity to the landfill site and reports on the habitat study undertaken in January 2013. Section 3 presents the results of a freshwater biological (freshwater macroinvertebrate) survey along the River Colligan. Section 4 discusses the bird communities recorded at the landfill and reviews data for Dungarvan Harbour from the Irish Wetland Bird Survey (I-WeBS).

2.0 TERRESTRIAL ECOLOGY

2.1 General Site Overview

Dungarvan Landfill site is located at Ballynamuck Middle, Dungarvan, Co Waterford (Grid ref X 245 948) to the north-east of the main settlement of Dungarvan Town. The main land use in the vicinity of the landfill site is agricultural comprising arable and grazing pasture. The major landscape feature in the vicinity of the landfill is the River Colligan which flows along the

northern perimeter of the site in a west to east direction. The river enters the Colligan Estuary south of Ballyneety Bridge eventually flowing into the wider expanse of Dungarvan Harbour. The Colligan is the largest of three rivers that enters Dungarvan Harbour. The Colligan River and estuary has considerable wildlife interest and the river is a valuable fisheries resource.

2.1.1 Designated sites for nature conservation

Dungarvan Landfill Site lies in close proximity to areas that are recognised for their ecological conservation interest. Areas designated under national and/or European laws in order to conserve habitats and species of national or international importance include the following :

Proposed Natural Heritage Areas (NHA): a national designation legally provided for by the Wildlife (Amendment) Act 2000.

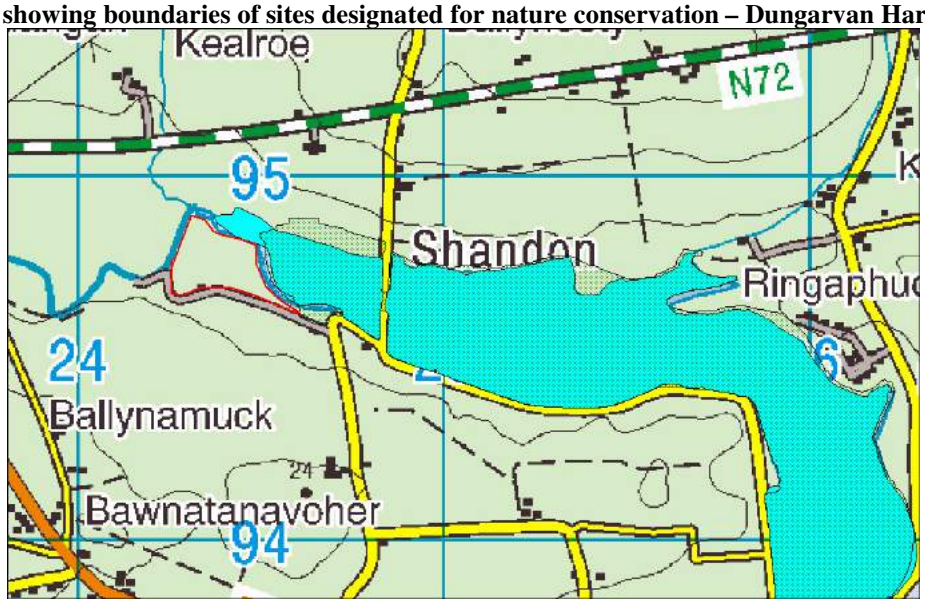
Special Areas of Conservation (SAC): areas considered of international and national importance whose legal basis is the EU Habitats Directive (92/43/EEC), transposed into Irish law through the European Union (Natural Habitats) Regulations, 1997 as amended.

Special Protection Areas (SPA) sites of international conservation importance for birds for birds whose legal basis is the EU Birds Directive (79/409/EEC).

Dungarvan Harbour is proposed for designation as a Natural Heritage Area. The pNHA boundary extends above Ballyneety Bridge and adjacent to the landfill site boundary. Appendix 1 details the site synopsis for the pNHA.

Dungarvan Harbour is a designated Special Protection Area (SPA) under the EU Birds Directive. The designated area (code 4032) covers an area of 1,041 hectares and extends along the River Colligan estuary as far upstream as Ballyneety Bridge A similar area to the SPA is a designated Ramsar Site (Site Code 835). Appendix 1 details the site synopsis.

Figures 1&2 . Location of Dungarvan Landfill in relation to the River Colligan and Ballyneety Bridge showing boundaries of sites designated for nature conservation – Dungarvan Harbour SPA and pNHA



SPA boundary pNHA boundary

Dungarvan Bay is a shellfish growing areas as delineated by the Sea-Fisheries Protection Authority. The Sea Fisheries Protection Authority is responsible for classifying shellfish production areas as required under Directive 991/492/EEC) and by the 1996 Regulations (SI No 147 of 1996). Dungarvan Bay is classified as Class B – requiring purification for 48 hours before shellfish can be placed on the market. The DoEHLG published a Pollution Reduction Programme for Dungarvan Bay in 2010 to ensure compliance with the standards and objectives established by the Quality of Shellfish Waters Regulations 2006 (S.I. No. 268) of 2001 as amended for the designated Shellfish growing waters.

2.2 Habitat survey of Dungarvan Landfill & environs

The habitat cover of Dungarvan Landfill was surveyed in 2013 to compare findings with the 2010 and 2008 habitat surveys. The 2008 survey area included the landfill site and adjacent habitats such as some farmland and the corridor of the River Colligan to the north of the site. The survey followed standard Phase 1 methodology (JNCC 2003, Heritage Council 2002). Habitats were classified using habitat description and codes set out in Fossitt (2000). Plant species lists were compiled i previous surveys in 2008 and 2010. . The 2008 survey was carried out on 22nd October i.e. well after the flowering period for most species and thus an underestimation of species may have been recorded. The 2010 botanical survey was carried out on 14th June 2010 by Paul Green BSBI[1] recorder for County Waterford. Table 1 details the species list recorded in both years. A detailed plant survey was not carried out in February 2013 due to the unsuitability of the season for recording botanical information and a survey will be carried out in early summer instead.

The landfill site (inside fenced area) comprises seven main habitat types: artificial lakes and ponds (FL8), Grassland (GA/GS), spoil and bare ground (ED2), buildings and artificial surfaces (BL3), scrub (WS1) wet grassland (GS4) and reed and large sedge swamps (FS1).

The landfill site is bordered to the north and south by agricultural lands, including improved agricultural grassland (GA1), wet grassland (GS4) and arable crops (BC1). Scrub (WS1) and hedgerows and treelines (WL1 & WL2) occur throughout the agricultural landscape. Upper saltmarsh (CM2) and mud shores (LS4) occur above Ballyneety Bridge (just east of the landfill

[1] Botanical Society of the British Isles

site). Figure 3 details the habitat cover of the landfill site.

Habitat Types

Dungarvan landfill consists of a capped mound that is now completely vegetated. The series of constructed wetland cells installed to treat leachate in autumn 2008 now exhibit dense growth of submerged and emergent wetland vegetation.

Other artificial lakes and Ponds (FL8)

A series of 6 constructed wetlands were established on the landfill cap and are designed to collect and treat residual leachate from the landfill. The wetlands installed in autumn 2008 were planted with a mix of wetland vegetation such as reeds and sedges. Another artificial pond occurs in the south east of the landfill site and supports some submerged and emergent vegetation and has an extensive reedbed behind it. Artificial lakes and ponds occupy approximately 45% of the site area.

Grassland (GA/GS)

In 2008 spoil and bare ground (ED2) were the dominant habitat in the landfill. By 2010 recolonising bare ground accounted for approximately 36% of the site when colonisation of vegetation on the landfill cap had progressed well and contained a mixture of ruderal species (Charlock, Broad-leaved Dock and Ragwort) grasses and rush species. At this stage the extent of recolonisation varied over the profile of the landfill cap with the eastern-north eastern slopes showing the least vegetation cover with up to 80% bare ground in places. The north- north western slopes had 40% bare ground while the southern slopes had 20-30% bare ground. Reprofiling works in June 2010 also resulted in more exposed soil along access paths worked by machinery but these areas gradually recolonised in 2011. An area of .75 ha at the south eastern end of the landfill was sown with native wildflower seed in May 2010 to enhance the biodiversity of the site. Monitoring of the site in 2011 showed an increase in variety of flora on the eastern facing slopes. However, poaching by horses had also impacted on the seed mix taking hold. Monitoring of the site in 2013 showed full cover of grassland on the capped mound with some small patches of bare ground due to traffic access.

Spoil and bare ground (ED2)

Spoil and bare ground are now limited to the exposed soil in access paths around the constructed wetland ponds and a 3m gravel access track from the artificial pond adjacent to the shed running along the south of the landfill between wetlands 4 and 5, 3 and 5 and ending between wetlands 2 and 3. This habitat accounts for approximately 1% of the site.

Wet Grassland (GS4)

Patches of wet grassland occur on the western and northern side of the site with a frequent presence of *Juncus* species. Wet grassland accounts for 2% of habitat cover.

Scrub (WS1)

Some small areas of scrub occur around the periphery of the landfill site. The most extensive area of scrub is found on the riverbank along the north-eastern edge of the site. This area has developed from other habitats particularly recolonising bare ground (ED3). A narrow strip of scrub also occurs along the southern boundary. Scrub habitat accounts for 4% of the site area. The ability of Gorse to spread quickly will likely mean a rapid succession from grassland to scrub cover on the landfill cap. The presence of willow around the wetland margins and eastern slopes will also encourage the acceleration of scrub cover.

Reed and large sedge swamps (FS1)

Reed swamp habitat occurs between the leachate pond and the river. This habitat is almost a monodominant stand of Common Reed. Several stands of Common Reed also occur in places along the southern riverbank outside the site. This habitat covers 1% of the landfill site.

Buildings and artificial surfaces (BL3)

This habitat category comprises areas of concrete and tarmacadam, metal storage containers, offices and ancillary structures and the road leading to the site. Due to the bare and artificial nature of this habitat plant life is scarce. This habitat covers approximately 11% of the landfill site.

Figures 3 and 4 below illustrate the habitat cover of the landfill site in 2010 and 2013

Figure 3 Habitat Map 2010

Habitat Key

Artificial lakes and ponds
Recolonising bare ground
Spoil and bareground
Reed and large sedge swamps
Scrub
Wet Grassland
River Colligan

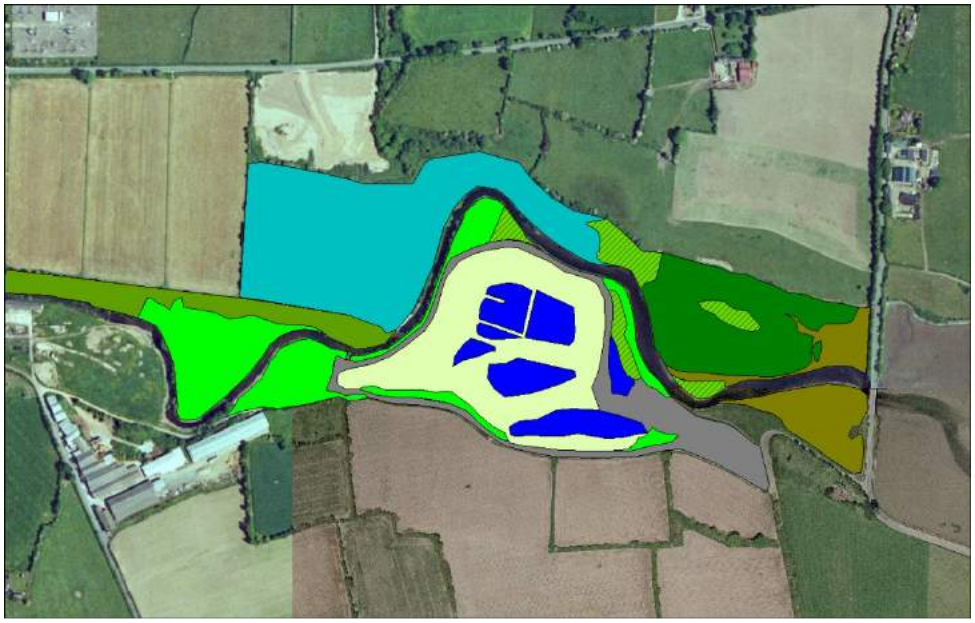


Figure 4 Habitat Map 2013

Habitat Key

Artificial lakes and ponds

Grassland
Spoil and bareground
Scrub
Reed and large sedge swamps
Wet Grassland
River Colligan

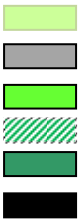


Table 1. Plant species list recorded in 2008 and 2010 (x denotes occurrence of species)

Species		**2008 (Oct 22nd)**	**2010 (14 June)**
Taxon	**Vernacular**		
Acer pseudoplatanus	Sycamore	x	x
Achillea millefolium	Yarrow	x	x
Aethusa cynapium	Fool's Parsley		x
Agrostis capillaris	Common Bent	x	
Agrostis stolonifera	Creeping Bent	x	x
Alisma plantago-aquatica	Water-plantain		x
Alnus glutinosa	Alder	x	x
Alopecurus geniculatus	Marsh Foxtail		x
Anagallis arvensis subsp. arvensis	Scarlet Pimpernel	x	x
Anthriscus sylvestris	Cow Parsley		x
Aphanes arvensis	Parsley-piert		x
Apium nodiflorum	Fool's-water-cress	x	x
Arabidopsis thaliana	Thale Cress		x
Arctium nemorosum	Wood Burdock	x	x
Arrhenatherum elatius	False Oat-Grass	x	x
Aster trifolium	Sea Aster	x	
Athyrium filix-femina	Lady-fern		x
Barbarea vulgaris	Winter-cress		x
Bellis perennis	Daisy	x	x
Berula erecta	Lesser Water-parsnip		x
Bolboschoenus maritimus	Sea Clubrush	x	
Brassica nigra	Black Mustard		x

Brassica rapa subsp. campestris	Wild Turnip	x	x
Bromus hordeaceus	Soft-brome		x
Callitriche obtusangula	Blunt-fruited Water-starwort		x
Calystegia sepium subsp. sepium	Hedge Bindweed	x	x
Calystegia silvatica	Large Bindweed		x
Capsella bursa-pastoris	Shepherd's purse	x	
Carex sp	Sedges	x	x
Carex divulsa subsp. divulsa	Grey Sedge		x
Carex echinata	Star Sedge		x
Carex flacca	Glaucous Sedge		x
Carex otrubae	False Fox-sedge		x
Carex riparia	Greater Pond-sedge		x
Centaurea nigra	Common Knapweed	x	x
Centaurium erythraea	Common Centaury		x
Cerastium fontanum	Common Mouse-ear	x	x
Cerastium glomeratum	Sticky Mouse-ear		x
Chamerion angustifolium	Rosebay Willowherb	x	x
Chenopodium album	Fat-hen	x	x
Cirsium arvense	Creeping Thistle	x	x
Cirsium palustre	Marsh Thistle	x	
Cirsium vulgare	Spear Thistle	x	x
Cochleria officinale	Common Scurvey-Grass	x	
Conium maculatum	Hemlock		x
Crataegus monogyna	Hawthorn	x	x
Crepis capillaris	Smooth Hawk's-beard		x
Crocosmia x crocosmiiflora	Montbretia (C. aurea x pottsii)	x	x
Cynosurus cristatus	Crested Dog's-tail		x
Dactylis glomerata	Cock's-foot	x	x
Daucus carota subsp. carota	Wild Carrot	x	x
Eleocharis palustris	Common Spike-rush		x
Elodea canadensis	Canadian Waterweed		x
Elytrigia repens	Common Couch	x	x
Epilobium ciliatum	American Willowherb		x
Epilobium hirsutum	Great Willowherb	x	x
Epilobium obscurum	Short-fruited Willowherb		x
Epilobium palustre	Marsh Wilowherb	x	
Epilobium parviflorum	Hoary Willowherb		x
Equisetum arvense	Field Horsetail	x	x
Equisetum fluviatile	Water Horsetail	x	x
Euphorbia helioscopia	Sun Spurge	x	x
Fallopia japonica	Japanese Knotweed	x	x

Festuca rubra agg.	Red Fescue	x	x
Filipendula ulmaria	Meadowsweet	x	x
Fraxinus excelsior	Ash	x	x
Fuchsia magellanica	Fuchsia	x	x
Galium aparine	Cleavers	X	
Galium palustre subsp. palustre	Common Marsh-bedstraw	x	x
Geranium dissectum	Cut-leaved Crane's-bill	x	x
Geranium robertianum	Herb-Robert	x	x
Geum urbanum	Wood Avens		x
Glyceria declinata	Small Sweet-grass		x
Glyceria fluitans	Floating Sweet-grass		x
Glyceria maxima	Reed Sweet-grass		x
Groenlandia densa	Opposite-leaved Pondweed		x
Hedera helix subsp. hibernica	Atlantic Ivy	x	x
Heracleum sphondylium	Hogweed	x	x
Holcus lanatus	Yorkshire-fog	x	x
Hypericum maculatum subsp. obtusiusculum	Imperforate St John's-wort		x
Hypericum perforatum	Perforate St John's-wort		x
Hypericum tetrapterum	Square-stalked St John's-wort		x
Hypochaeris radicata	Cat's-ear		x
Iris pseudacorus	Yellow Iris	x	x
Juncus acutiflorus	Sharp-flowered Rush		x
Juncus articulatus	Jointed Rush	x	x
Juncus bufonius	Toad Rush		x
Juncus conglomeratus	Compact Rush		x
Juncus effusus	Soft-rush	x	x
Juncus inflexus	Hard Rush	x	x
Lapsana communis subsp. communis	Nipplewort		x
Lathyrus pratensis	Meadow Vetchling	x	x
Lemna minor	Common Duckweed		x
Leucanthemum vulgare	Oxeye Daisy	x	x
Ligustrum vulgare	Privet	x	
Linum catharticum	Fairy Flax		x
Lolium multiflorum	Italian Rye-grass		x
Lolium perenne	Perennial Rye-grass	x	x
Lonicera periclymenum	Honeysuckle	x	
Lotus corniculatus	Common Bird's-foot-trefoil	x	x
Lotus pedunculatus	Greater Bird's-foot-		x

	trefoil		
Lychnis flos-cuculi	Ragged-Robin		x
Lythrum salicaria	Purple Loosestrife	x	
Matricaria discoidea	Pineappleweed	x	x
Medicago lupulina	Black Medick	x	x
Mentha aquatica	Water Mint	x	
Mimulus guttatus	Monkeyflower		x
Myosotis scorpiodes	Water Forget-me-knot	x	
Odontites vernus	Red Bartsia		x
Oenanthe crocata	Hemlock Water-dropwort		x
Persicaria amphibia	Amphibious Bistort		x
Persicaria maculosa	Redshank	x	x
Petasites fragrans	Winter Heliotrope		x
Phalaris arundinacea	Reed Canary-grass		x
Phragmites australis	Common Reed	x	x
Phyllitis scolopendrium	Hart's Tongue Fern	x	
Plantago lanceolata	Ribwort Plantain	x	x
Plantago major	Greater Plantain	x	x
Poa annua	Annual Meadow-grass	x	x
Poa pratensis	Smooth Meadow-grass		x
Poa trivialis	Rough Meadow-grass		x
Polygonum aviculare	Knotgrass	x	x
Polystichum setiferum	Soft Shield-fern	x	x
Potamogeton natans	Broad-leaved Pondweed		x
Potentilla anserina	Silverweed	x	x
Potentilla palustris	Marsh Cinquefoil	x	
Potentilla reptans	Creeping Cinquefoil	x	x
Primula vulgaris	Primrose		x
Prunella vulgaris	Selfheal	x	x
Prunus spinosa	Blackthorn	x	
Pteridium aquilinum	Bracken	x	x
Pulicaria dysenterica	Common Fleabane	x	x
Ranunculus acris	Meadow Buttercup		x
Ranunculus hederaceus	Ivby-leaved crowfoot	x	
Ranunculus repens	Creeping Buttercup	x	x
Ranunculus sceleratus	Celery-leaved Buttercup		x
Reseda luteola	Weld	x	x
Rorippa nasturtium-aquaticum	Water-cress	x	x
Rosa canina	Dog-rose	x	x
Rubus fruticosus agg.	Bramble	x	x
Rubus ulmifolius	Elm-leaved Bramble		x
Rumex acetosa subsp. acetosa	Common Sorrel	x	x

Rumex conglomeratus	Clustered Dock			x
Rumex crispus subsp. crispus	Curled Dock			x
Rumex obtusifolius	Broad-leaved Dock		x	x
Rumex sanguineus	Wood Dock			x
Sagina apetala	Annual Pearlwort			x
Sagina procumbens	Procumbent Pearlwort			x
Salix cinerea subsp. oleifolia	Rusty Willow		x	x
Sambucus nigra	Elder		x	x
Schoenoplectus tabernaemontani	Grey Club-rush		x	x
Scrophularia auriculata	Water Figwort		x	x
Scrophularia nodosa	Common Figwort		x	x
Senecio aquaticus	Marsh Ragwort		x	x
Senecio jacobaea	Common Ragwort		x	x
Senecio vulgaris	Groundsel		x	x
Sinapis alba	White Mustard			x
Sinapis arvensis	Charlock		x	x
Sisymbrium officinale	Hedge Mustard		x	x
Solanum dulcamara	Bittersweet		x	
Sonchus asper	Prickly Sow-thistle		x	x
Sonchus oleraceus	Smooth Sow-thistle		x	x
Sparganium erectum	Branched Bur-reed			x
Stachys palustris	Marsh Woundwort		x	x
Stachys sylvatica	Hedge Woundwort		x	x
Stellaria graminea	Lesser Stitchwort			x
Stellaria media	Common Chickweed		x	x
Taraxacum officinale	Dandeloin		x	
Trifolium dubium	Lesser Trefoil			x
Trifolium pratense		x		x
Trifolium repens	White Clover			
Tussilago farfara	Colt's-foot			x
Triglochin maritium	Sea Arrowgrass		x	
Tripleurospermum inodorum	Scentless Mayweed		x	
Typha latifolia	Bulrush		x	x
Ulex europaeus	Gorse		x	x
Urtica dioica	Common Nettle		x	x
Veronica anagallis-aquatica	Blue Water-speedwell			x
Veronica arvensis	Wall Speedwell			x
Veronica beccabunga	Brooklime			x
Veronica chamaedrys	Germander Speedwell		x	x
Veronica persica	Common Field-		x	

	Speedwell		
Veronica serpyllifolia subsp. serpyllifolia	Thyme-leaved Speedwell		x
Vicia cracca	Tufted Vetch	x	x
Vicia hirsuta	Hairy Tare		x
Vicia sativa subsp. segetalis	Common Vetch		x
Vicia sepium	Bush Vetch	x	x
Zea Mays	Maize	x	
Total no. of Species		103	162

2.3 Mammals in Dungarvan Landfill and environs

The River Colligan is an important habitat for Otters which are protected under both Irish and European legislation. Numerous sprainting sites, some of which are obviously in long-term use, indicate that otters are resident and successful there. The high level of otter activity from previous surveys indicates that the River Colligan contains a healthy and reliable population of fish, again highlighting the biological health of the River Colligan. The abundance of frogspawn provides a food source for Otter along the River Colligan. Surveys of Otter activity along the Colligan commissioned by the MISE[2] project in 2011 and 2012 indicate active use along this waterway corridor.

Bat species such as Daubentons also probably use the river corridor as a feeding habitat.

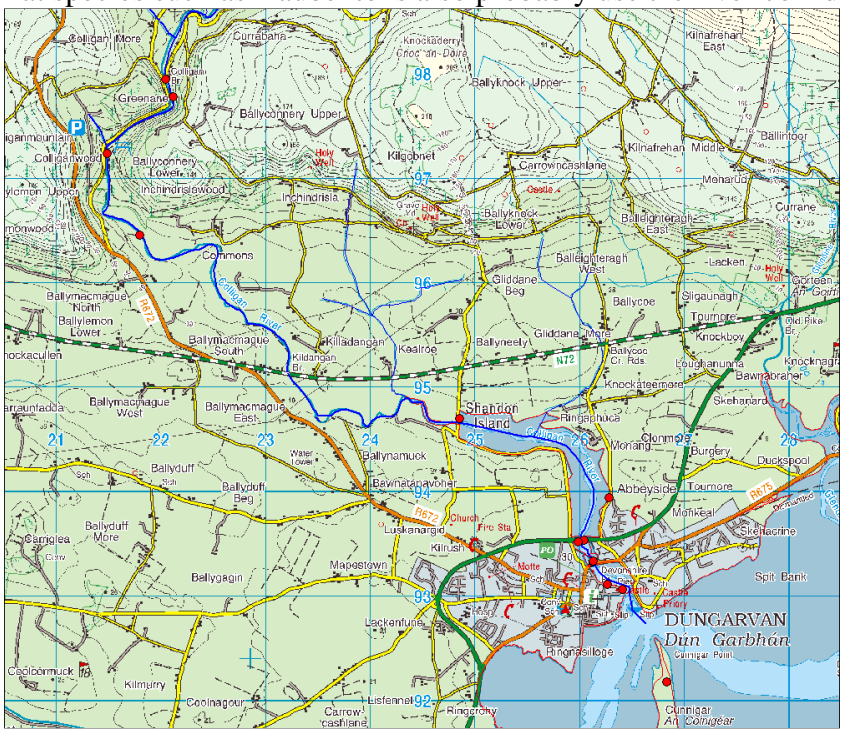


Figure 5. Evidence of Otter activity along the Colligan River (red dots) based on collection of Otter Spraints from the MISE Otter Survey 2012.

[2] Mammals in s Sustainable Environment

3.0 BIOLOGICAL ASSESSMENT OF THE RIVER COLIGAN

4.0 AVIAN FAUNA OF DUNGARVAN LANDFILL AND ENVIRONS

4.1 Field Survey

A bird survey of Dungarvan landfill and environs was undertaken in January 2011 mid way between high tide and low tide. The survey involved;

A survey of wetland birds of the river corridor adjacent to the Dungarvan landfill and extending downstream to approximately 500m below Ballyneety Bridge (undertaken midway between low tide and high tide high-tide).

A species list was compiled for all birds seen during a walk over survey at Dungarvan landfill.

A review was undertaken of annual count data for Dungarvan Harbour, from the Irish Wetland Bird Survey (Birdwatch Ireland).

Table 4.1 Bird species recorded during the survey downstream of Ballyneety Bridge

Species	Numbers
Little Grebe *Tachybaptus ruficollis*	4
Brent Goose *Branta bernicla*	3
Oystercatcher *Haematopus ostralegus*	5
Lapwing *Vanellus vanellus*	>220
Curlew *Numenius arquata*	6

Redshank *Tringa totanus*	8
Gull species *Larus*	67

Table 4.2 Bird species recorded from Dungarvan landfill site

Species	Numbers
Moorhen *Gallinula chloropus*	4
Snipe *Gallinago gallinago*	1
Jackdaw *Corvus monedula*	20
Hooded Crow *Corvus cornix*	2
Robin *Erithacus rubecula*	1
Dunnock *Prunella modularis*	2
Wood Pigeon *Columba palumbus*	1

4.2 Review of I-WeBs data

Dungarvan Harbour is a large, south-east facing circular bay, sheltered at its eastern extent, by Helvick Head to the south and Ballinacourty point to the north. The inner harbour is almost completely enclosed by the Cunnigar – a linear sand spit extending from Ballynacourty North creating a sheltered environment. The Colligan, Brickey and Glendine rivers drain into Dungarvan Harbour. The absence of a large river system entering the harbour results in a mainly marine habitat in the area.

Large expanses of intertidal mudflat and associated wetland habitats of Dungarvan harbour are important feeding and roosting areas for migratory wintering wading birds and wildfowl. The presence of "internationally" important populations of wintering waterbirds resulted in Dungarvan Harbour being designated a Special Protection Area. The qualifying interests for designation are internationally important wintering populations of Brent Goose, Black-tailed Godwit and Bar-tailed Godwit along with a range of other over wintering waterbird species.

Dungarvan Harbour is also a Ramsar site (Ramsar Convention) and recognised as an Important Bird Area (Birdlife International).

Waterbirds in Dungarvan Harbour are counted annually during winter as part of the Irish Wetland Bird Survey (I-WeBS). The count area includes the Colligan estuary as far upstream as Ballyneety Bridge. The review assesses recent waterbird data (2002/03- 20010/11) obtained from Birdwatch Ireland.

Waterbirds that occur in internationally important numbers

Internationally important numbers of birds are those that correspond to 1% or more of the individuals in a population and threshold levels are based on population status as published in Wetlands International (2006).

Current data shows that Dungarvan Harbour supports two species in internationally important numbers- Light-bellied Brent Goose and Black-tailed Godwit. The average number of Bar-tailed Godwits is close to the International threshold. Although numbers show great variety between years the majority of years show wintering populations that surpass the international threshold.

	2002/03	2004/05	2005/06	2006/07	2008/09	2009/10	2010/11	Mean
Light Bellied Brent Goose (International Threshold 260)	531	948	1009	728	1,767	1,867	1,110	1,137
Black-tailed Godwit (International Threshold 470)	1608	559	800	155	1,248	1,458	1,648	1,068

Table 4.3 Bird species that occur in numbers of international importance

Waterbirds that occur in nationally important numbers

A species that occurs in numbers that correspond to 1% or more of the individuals in the national population of a species or subspecies is said to occur in nationally important numbers. The current national threshold is defined by Birdwatch Ireland.

I-WeBS data (2002/03- 2008/09) shows that Dungarvan Harbour continues to support 10 species in nationally important numbers (based on average numbers over the past five available count years). Great-crested Grebe, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Bar-tailed Godwit, Redshank, Greenshank and Turnstone. Average numbers of Red-breasted Merganser, Oystercatcher, Ringed Plover, Lapwing and Curlew are close to the national threshold.

Waterbirds that occur that are listed on Annex 1 of the EU Birds Directive (EU/709/409)

During the winter months, Dungarvan Harbour supports four species that are listed on Annex 1 of the EU Birds Directive; Great Northern Diver, Little Egret, Golden Plover and Bar-tailed Godwit.

Total waterbird numbers across Dungarvan Harbour

The average number of total waterbirds found at Dungarvan Harbour (based on the six most recent winter counts) is 19,103. Dungarvan Harbour is currently considered the 14th most important wetland site in Ireland and the second most important wetland site in the south-east after Wexford Harbour.

	2001/02	2002/03	2004/05	2005/06	2006/07	2008/09
Total wildfowl	1,260	1,868	2,196	2,137	1,532	2,667
Total waders	18,115	21,196	18,943	16,817	12,208	15,599
Total waterbirds	19,375	23,064	21,140	19,136	13,743	18,266

Waterbirds showing a trend for decrease and increase at Dungarvan Harbour

The most recent I-WeBS data (2002/03-2010/11) show a possible trend for increase in Curlew and Bar-tailed Godwits. The data also shows a trend for decrease in Redshank and Little Egret, the latter having naturally colonised the south coast of Ireland and been steadily increasing in terms of both breeding and wintering numbers ever since. Similarly, Light-bellied Brent Geese have appeared to increase steadily in numbers in recent years having shown a decline in previous years.

	1998/99	1999/00	2001/02	2002/03	2003/04	2005/06	2006/07	2008/09	2009/2010	2010/2011
Light-bellied Brent Goose	381	527	556	531	948	1009	728	1,767	1,867	1,110
Shelduck	335	573	176	560	371	376	333	314	269	399
Little Egret	4	6	14	5	17	14	12	9	9	
Oystercatcher	952	538	994	360	789	658	780	1,055	827	1,011

Lapwing	2323	910	3542	4092	2702	3125	1246	2,345	1,768	1,564
Dunlin	4923	1905	2737	5546	5050	3118	2138	3,763	3,150	1,381
Black-tailed Godwit	944	325	1129	1608	559	800	155	1,248	1,458	1,648
Bar-tailed Godwit	899	658	797	1892	1083	905	834	621	1,023	1,000
Curlew	659	935	926	507	566	461	481	502	659	763
Redshank	654	502	724	502	951	717	1206	1,339	1,023	802

5.DISCUSSION AND CONCLUSION

Habitats occurring in the Dungarvan landfill site can be categorised as either semi-natural (e.g. scrub (WS1); wet grassland (GS4); reed and large sedge swamps, (FS1) or artificial and modified e.g. amenity grassland (GA2) recolonising bare ground (ED3), spoil and bare ground, ED2; artificial lakes and ponds (Fl8); buildings and artificial surfaces (BL3). These habitats initially had relatively low ecological value, as they were subject to intermittent disturbance. However, since 2008 with succession of habitats including establishment of 6 wetland cells, grassland and increasing scrub cover it is apparent that the site is demonstrating increased biodiversity value providing good feeding grounds for a variety of birds and some mammal and invertebrate species along with amphibians. The 2013 site visit observed an abundance of frogspawn in the wetland cells and 8 Snipe and 5 Moor Hen were noted whilst walking the site. The development of wetlands and grassland on the landfill also serves to enhance the ecological network of natural habitats surrounding the landfill including the River Colligan and adjacent areas of wet grassland, marsh, brackishwater and estuarine habitats.

The majority of plant species recorded on the landfill site is considered abundant and widespread throughout Ireland. However one of the recorded plant species is listed on the Flora Protection) Order, 1999- Opposite-leaved Pondweed (*Groenlandia densa)* which is only known to occur in a couple of places in the county.

Light-bellied Brent Goose – has shown a trend for progressive increase at Dungarvan Harbour. This is consistent with the national trend (Crowe et al. 2008).

Golden Plover – despite wide variation in annual indices, the site trend was reasonably stable or slightly increasing up to 2004/05. However, since 2004 numbers have dropped sharply.

Dunlin – numbers have declined progressively at Dungarvan Harbour. This is in line with the national trend (Crowe et al.2008) and that evident in Northern Ireland and Britain (Calbrade et al. 2010).

Bar-tailed Godwit – site numbers showed a slight increase up to 2004/05 then declined and have showed an increase since 2008/09.

Redshank – although numbers fluctuated widely between some years, the smoothed trend highlights the relatively consistent increase in numbers across the data period.

Red-breasted Merganser – numbers of this species have fluctuated widely between years. A period of higher numbers in the years 1997/98 to 1999/00 was followed by a decline. However the short-term trend suggests some recovery.

Oystercatcher – exhibits a trend for consistent increase in numbers across the data period. Numbers recorded in 2008/09 and 2010/11were the highest since the data period began.

Lapwing – numbers have declined steadily which is consistent with the all-Ireland trend (Crowe et al. 2008).

Knot – numbers have fluctuated widely between years but the smoothed trend indicates a relatively stable site population across time with a recent increase; numbers recorded in 2007/08 and 2008/09 were the highest since the data period began.

Comparison of 2013 survey with 2010 survey

- The lagoons are now fully established in terms of wetland vegetation cover and in operation treating the leachate. Margins of the lagoons show full vegetation cover with mosses, grasses and vascular plant species. Willow has also set foot in a few locations around the wetland margins. The presence of wetland birds roosting and feeding in the wetland cells was noted in 2013. Eight Snipe and five Moor Hen were observed on site in March 2013 during a 1 hour visit.

- Grassland cover is now the dominant habitat on the landfill with an increase in botanical diversity on the site.

- Abundant frogspawn was noted in the wetland areas reflecting an increasing biodiversity of the site. Data is being collected on Otter activity in the area and indicates active use along the River Colligan. Frogspawn will be an important food source for Otters in the area. The presence of Otter indicates favourable ecological status of the River Colligan water corridor

- The development of wetlands and grassland on the landfill serves to enhance the ecological network of natural habitats surrounding the landfill including the River Colligan.

- The presence of Gorse continues to increase indicating (along with encroaching willow) a rapid succession to scrub cover over time. The presence of Gorse provides for increasing biodiversity being an important nectar source in early spring and early winter,

when little else is in flower. A number of invertebrates are dependent on it. The shrub also provides food and cover for passerine birds.

- The wetlands in the landfill contain Opposite-leaved Pondweed (*Groenlandia densa)* a plant species listed on the Flora Protection) Order, 1999.
- Review of I-WeBs data indicates continuing favourable conservation status of Dungarvan Bay SPA for qualifying interests including Brent Geese and Bar-tailed Godwits.

Appendix 1

SITE SYNOPSIS

SITE NAME: DUNGARVAN HARBOUR pNHA

SITE CODE: 000663

In landscape terms Dungarvan Harbour lies at the eastern end of the Blackwater valley, though this river now turns south at Cappoquin, vacating its more obvious (and former) course. All that remains to the Harbour is the small Colligan River, running south from the Comeragh Mountains to enter the bay by Dungarvan itself. The absence of the larger river means that the bay is essentially a marine habitat though it dries out at low tide to give extensive mud and sand flats. It is extremely sheltered, the linear Cunnigar spit (which almost closes the bay on the east) adding to the effect of hills in the south and south-west.

The rock type of most of the area is limestone though this is only exposed on flat rocks at Ballynacourty. Elsewhere saltmarsh, glacial drift and sand form the shore with a narrow stony beach in places. The most natural saltmarsh occurs at Kilminnin on the north shore and west of the Cunnigar on the south. It is a community in which Sea Purslane (*Atriplex portulacoides*), Sea Lavendar (*Limonium humile*), rushes (*Juncus gerardii*, *J.maritimus*) and sedges (*Carex distans, C.otrubae*) are prominent along with other typical species like Sea Spurrey (*Spergularia* spp.), Sea Arrowgrass (*Triglochin maritimum*) and, in the upper parts, Parsley Water Dropwort (*Oenanthe lachenalii*). In several places the saltmarshes, having been reclaimed for a period, have been flooded again and are reverting to their natural vegetation. There is an abundance of Sea Rush (*Juncus maritimus*) in such places often mixed with grasses, with Reed (*Phragmites australis*) or Sea Clubrush (*Bolboschoenus maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia cespitosa*), Soft rush *(J.effusus*), Brown Sedge (*Carex disticha*) and Fleabane (*Pulicaria dysenterica*). Eelgrass (*Zostera* sp.) has been recorded in the area.

There are two beach and dune systems in the area, a tiny one where the old railway line crosses the bay at Skehacrine, and the major (2.6km) Cunnigar running north from the southern shore. The latter consists of narrow and low ridges separated at the southern end to give marshy `slacks' between them but running together to the north. The beach plants include such species as Yellow Horned Poppy (*Glaucium flavum*), Sea Holly (*Eryngium maritimum*), Sea Radish (*Raphanus raphanistrum*) and Sand Sedge (*Carex arenaria*) while the large Sharp Rush (*Juncus acutus*) as well as Knotted Pearlwort (*Sagina nodosa*) occur in wetter sites.

A major part of the ecological importance of the bay is the wintering birdlife which is present in large numbers. Surveys in the winters l984/85 - 86/87 showed that Brent Goose (694), Black-tailed Godwit (l329) and Bar-tailed Godwit (l029) occurred in numbers of international importance, while thirteen other species were nationally important. These are Shelduck (l72l), Wigeon (l0l5), Red-breasted Merganser (50), Grey Plover (359), Golden Plover (l095), Lapwing (2748), Knot (705), Sanderling (83), Dunlin (4559), Redshank (930) and Turnstone (254). All figures are average peak populations. A further ten species were found in numbers of regional or local importance emphasising that Dungarvan supports a greater diversity of species than any other site on the south coast except for Wexford Harbour. It is now a Special Protection Area under the E.U. Birds Directive.

The sand flats to the east of the Cunnigar support an extensive oyster farming operation so there are clearly possible grounds for impact between these shellfish and the invertebrates on which

some of the bird species depend. There is also concern that displacement of water fowl and disturbance may be a problem on the shellfish farming area. At present the bird numbers are higher than in the previous survey (l97l-75).

13 February, 1995.

Appendix 2 Dungarvan Harbour SPA Site Synopsis

In landscape terms Dungarvan Harbour lies at the eastern end of the River Blackwater valley, though this river now turns south at Cappoquin, vacating its more obvious (and former) course. The Colligan River, running south from the Comeragh Mountains, enters the bay by Dungarvan itself. The River Brickey flows from the west while the Glendine River flows into the harbour from the north. The absence of a large river means that the bay is essentially a marine habitat though it dries out at low tide to give extensive mud and sand flats. The inner bay is extremely sheltered, the linear Cunnigar spit (which almost closes the bay on the east) adding to the effect of hills in the south and south-west.

The rock type of most of the area is limestone though this is only exposed on flat rocks at Ballynacourty. Elsewhere saltmarsh, glacial drift and sand form the shore with a narrow stony beach in places. The most natural saltmarsh occurs at Kilminnin on the north shore and west of the Cunnigar on the south. In several places the saltmarshes, having been reclaimed for a period, have been flooded again and are reverting to their natural vegetation. There is an abundance of Sea Rush (*Juncus maritimus*) in such places often mixed with grasses, with Reed (*Phragmites australis*) or Sea Club-rush (*Scirpus maritimus*) in drains. Sometimes this community gradually blends with a freshwater marsh including Tufted Hair Grass (*Deschampsia cespitosa*), Soft rush (*Juncus effusus*), Brown Sedge (*Carex disticha*) and Fleabane (*Pulicaria dysenterica*). Eelgrass (*Zostera* sp.) has been recorded in the area.

A major part of the ecological importance of the bay is the wintering birdlife which is present in large numbers. Surveys in the winters l984/85 - 1986/87 and from 1994/95

onwards showed that Brent Goose (616 in 1995), Black-tailed Godwit (l329 [952 in 1996]) and Bar-tailed Godwit (1593 in 1996) occurred in numbers of international importance, while thirteen other species were nationally important. These are Shelduck (l72l [995 in 1995]), Wigeon (l0l5), Red-breasted Merganser (50), Grey Plover (359), Golden Plover (6100 in 1996), Lapwing (3775 in 1996), Knot (996 in 1996), Sanderling (83), Dunlin (6100 in 1996), Redshank (930 [910 in 1996]) and Turnstone (254). A further ten species were found in numbers of regional or local importance emphasising that Dungarvan supports a greater diversity of species than any other site on the south coast except for Wexford Harbour. The sand flats to the east of the Cunnigar support an extensive oyster farming operation. There is concern that displacement of waterfowl and disturbance may be a problem in the shellfish farming area.

Dungarvan Harbour SPA is of major conservation significance for the large numbers of many species of waterfowl that use it. The site regularly holds over 20,000 waterfowl and this qualifies the site as of International Importance. Two species that occur in important numbers are listed on Annex I of the E.U. Birds Directive, i.e. Bartailed Godwit and Golden Plover.

Appendix 3 1-WeBS Dungarvan Harbour 2010/11

I-WeBS

Dungarvan Harbour 2010/11

Species	1% National	1% International	Jan	Feb	Annual peak
Mute Swan	110			2	2
Barnacle Goose	90	710	3		3
Light-bellied Brent Goose		400	1,110	917	1,110
Shelduck	150	3,000	399	371	399
Wigeon	820	15,000	135	203	203
Teal	450	5,000	414	290	414
Mallard	380	20,000	77	50	77
Pintail	20	600	9	5	9
Shoveler	25	400	5		5
Ring-necked Duck		1,470,000	10		10
Goldeneye	95	11,500	4	1	4
Red-breasted Merganser	35	1,700	27	31	31
Red-throated Diver	20	3,000		1	1
Great Northern Diver		50	1	4	4
Unidentified Diver			2		2
Little Grebe	25	4,000	13	5	13
Great Crested Grebe	55	3,500	36	58	58
Cormorant	140	1,200	39	37	39
Shag		2,000	1	15	15
Grey Heron	30	2,700	17		17
Moorhen	20	20,000	1		1
Oystercatcher	680	8,200	1,011	726	1,011
Ringed Plover	150	730	84	86	86
Golden Plover	1,700	9,300	692	68	692
Grey Plover	65	2,500	56	243	243
Lapwing	2,100	20,000	1,564	428	1,564
Knot	190	4,500	340	551	551
Sanderling	65	1,200	7	12	12
Dunlin	880	13,300	1,212	1,381	1,381
Jack Snipe		20,000		1	1
Snipe		20,000	9	17	17
Black-tailed Godwit	140	610	1,648	223	1,648
Bar-tailed Godwit	160	1,200	1,000	979	1,000
Curlew	550	8,400	564	763	763
Greenshank	20	2,300	10	22	22
Redshank	310	3,900	576	802	802
Turnstone	120	1,400	251	300	300

Appendix K

Wetlands Treatment Analysis/Results

EntityName	StationName	SampleDate	Ammonium(NH4)	BOD	Chemical Oxygen Demand	Chloride	Conductivity @ 20°C	Conductivity @ 25°C	Dissolved Oxygen % Saturation	Faecal Coliforms	Iron	Nitrates (N03)	Nitrites(N)	Ortho-phosphate	pH	Phenols	Potassium	Salinity	Sodium	Suspended Solids	Temperature	Total Coliforms	Total Organic Carbon	Total Oxidised Nitrogen
Dungarvan	ICW Pond 1 IN	20/02/2015	7.1		24	60.8					0.13	26.5	0.18	0.021	7.49									
Dungarvan	ICW Pond 1 IN	15/06/2015	4.97	8	23	NT		748							7.38									NT
Dungarvan	ICW Pond 1 IN	15/07/2015	3.28	6	36			655							6.8									
Dungarvan	ICW Pond 1 IN	12/08/2015	5.41	15	67										7.62									
Dungarvan	ICW Pond 1 IN	30/09/2015	19.44	2	10		1107								7.87									
Dungarvan	ICW Pond 1 IN	16/10/2015	3.9	2	5		1095								7.7									
Dungarvan	ICW Pond 1 IN	10/11/2015	9.86	3	26		800								7.47									
Dungarvan	ICW Pond 5 OUT	20/02/2015	0.09		56	62.9					0.06	1.6	0.02	0.012	7.52									
Dungarvan	ICW Pond 5 OUT	15/06/2015	0.05	4	<17	NT		657							7.7									NT
Dungarvan	ICW Pond 5 OUT	15/07/2015	BLD	4	27	NT		650							7.73									NT
Dungarvan	ICW Pond 5 OUT	12/08/2015	0.15	7	28										7.67									
Dungarvan	ICW Pond 5 OUT	30/09/2015	0.1	3	20		655								7.67									
Dungarvan	ICW Pond 5 OUT	16/10/2015	BLD	2	18		817								7.23									
Dungarvan	ICW Pond 5 OUT	10/11/2015	0.58	3	29		670								7.75									
Dungarvan	Interceptor	23/02/2015	NT	1.2	BLD	NT		693							7									NT
Dungarvan	Interceptor	09/11/2015	NT	2.5	32	NT		692							7.1									NT
Dungarvan	Interceptor	18/06/2015	NT	1.6	38	NT		721							7.3									NT
Dungarvan	Interceptor	10/08/2015	NT	BLD	32	NT		630							7.2									NT
Dungarvan	Interceptor	30/09/2015	0.32	6	24		630								7.88									
Dungarvan	Interceptor	16/10/2015	0.04	1	19		737								7.33									
Dungarvan	Interceptor	10/11/2015	0.53	2	30		649								7.65									
Dungarvan	Lagoon	28/08/2015	AR		AR	AR					AR	AR	AR	AR	AR									
Dungarvan	Lagoon	15/06/2015	0.04	6	80		632								7.48									
Dungarvan	Lagoon	15/07/2015	0.23	3	35		625								7.76									
Dungarvan	Lagoon	23/02/2015	NT	BLD	BLD	NT		699	75					NT	7.1					BLD	5.5			NT
Dungarvan	Lagoon	09/11/2015	NT	2.8	30	NT		678	51					NT	6.9					<4	11.9			NT
Dungarvan	Lagoon	18/06/2015	NT	3.6	38	NT		589	45					NT	7.3					15	15.6			NT
Dungarvan	Lagoon	10/08/2015	NT	1.9	34	NT		519	68					NT	7.1					BLD	16.4			NT
Dungarvan	Pond Outlet	18/06/2015				64		720	30	NT	990				7	NT	0.73	NT	47		17.6	NT	NT	BLD
Dungarvan	Pond Outlet	09/11/2015				NT		680	63	NT	860				7	NT	19	NT	57		12.3	NT	NT	BLD
Dungarvan	Pond Outlet	23/02/2015				80		673	35	NT	28				6.7	NT	1.2	NT	4.3		5.8	NT	NT	BLD
Dungarvan	Pond Outlet	10/08/2015				57		623	51	NT	1200				7	NT	3.5	NT	39		19.8	NT	NT	BLD
Dungarvan	RC3a	18/06/2015				119		1713	13.9	NT	4100				6.9	NT	30	NT	120		12.8	NT	NT	BLD
Dungarvan	RC3a	09/11/2015				110		1597	20	NT	3600				6.8	NT	27	NT	120		12.4	NT	NT	0.21
Dungarvan	RC3a	23/02/2015				140		1974	18	NT	500				6.9	NT	3.9	NT	15		11.8	NT	NT	1.3
Dungarvan	RC3a	10/08/2015				113		1618	17	NT	4700				6.9	NT	27	NT	110		13.1	NT	NT	BLD
Dungarvan	RC4	18/06/2015				29		644	50	NT	200				7.1	NT	1.5	NT	12		12	NT	NT	11
Dungarvan	RC4	09/11/2015				29		643	50	NT	93				6.8	NT	1.5	NT	16		12	NT	NT	11
Dungarvan	RC4	23/02/2015				32		649	50	NT	23				6.7	NT	NT	NT	1.4		10.7	NT	NT	11
Dungarvan	RC4	10/08/2015				30		615	45	NT	240				6.9	NT	1.4	NT	13		12.5	NT	NT	11
Dungarvan	RC6a	18/06/2015				112		1294	14	NT	1400				7	NT	22	NT	70		12	NT	NT	8.3
Dungarvan	RC6a	10/08/2015				105		1291	22	NT	1900				7	NT	21	NT	72		12.4	NT	NT	7.1
Dungarvan	RC6a	19/06/2015				112		1294	14	NT	1400				7	NT	22	NT	70		12	NT	NT	8.3
Dungarvan	RC6a	09/11/2015				3700		NT	30	NT	270				6.8	NT	77	6.7	2200		12.4	NT	NT	1.4
Dungarvan	RC6a	23/02/2015				136		1443	12	NT	170				6.8	NT	2.7	NT	9		11.5	NT	NT	8.1
Dungarvan	RC7	18/06/2015				2200		NT	46.1	NT	990				7.3	NT	48	3.9	1100		11.8	NT	NT	2.1
Dungarvan	RC7	09/11/2015				121		1390	15	NT	900				6.8	NT	27	NT	93		11.9	NT	NT	121
Dungarvan	RC7	10/08/2015				4700		NT	30	NT	1900				7	NT	95	8.4	2600		12.5	NT	NT	0.87
Dungarvan	RC7	19/06/2015				2200		NT	46.1	NT	990				7.3	NT	48	3.9	1100		11.8	NT	NT	2.1
Dungarvan	RC7	23/02/2015				1840		NT	77	NT	29				6.7	NT	3.4	NT	95		10.6	NT	NT	1.5
Dungarvan	RC8	18/06/2015				NT		NT	NT	NT	NT				NT	NT	NT	NT	NT		NT	NT	NT	NT
Dungarvan	SW1	23/02/2015	NT	BLD	BLD	NT		273	105					NT	7					BLD	6.1			NT
Dungarvan	SW1	10/08/2015	NT	BLD	BLD	NT		144	107					NT	7.2					BLD	14.9			NT
Dungarvan	SW1	18/06/2015	NT	BLD	25	NT		NT	118					NT	7.5					BLD	14.8			NT
Dungarvan	SW2	23/02/2015	NT	BLD	BLD	NT		231	105					NT	7.1					BLD	6.2			NT
Dungarvan	SW2	09/11/2015	NT	1.4	33	NT		134	93					NT	6.9					<4	11.2			NT
Dungarvan	SW2	18/06/2015	NT	BLD	25	NT		NT	118.1					NT	7					BLD	14.8			NT
Dungarvan	SW2	10/08/2015	NT	NT	106	NT		142	106					NT	7.2					BLD	15			NT
Dungarvan	SW280	23/02/2015	NT	BLD	BLD	NT		142	106					NT	6.7					15	5.9			NT
Dungarvan	SW280	09/11/2015	NT	1.8	28	NT		128	97					NT	7.1					BLD	11.2			NT
Dungarvan	SW280	10/08/2015	NT	BLD	BLD	NT		132	107					NT	7.2					BLD	15.2			NT
Dungarvan	SW280	18/06/2015	NT	BLD	BLD	NT		161	112					NT	7.4					BLD	14.9			NT
Dungarvan	SW300	23/02/2015	NT	1.2	27	NT		1583	98					NT	7.2					11	5.3			NT
Dungarvan	SW300	18/06/2015	NT	BLD	71	NT		NT	83					NT	7.4					BLD	13			NT

Appendix L

Environmental Liabilities Risk Assessment Review

Dungarvan Landfill

Hydrogeological Review

Document Control Sheet

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DUNGARVAN LANDFILL - HYDROGEOLOGICAL REVIEW

1 INTRODUCTION

This hydrogeological review / technical assessment has been prepared in response to Condition 6.16.1 of licence W0032-03 which was issued by the Agency on the 21/10/2014 which specified "*Within twelve months of the date of this licence, the licensee shall carry out a risk screening and where necessary a technical assessment in accordance with the Guidance on the Authorisation of Discharges to Groundwater, published by the Environmental Protection Agency. A report on the outcome of the screening and where relevant the recommendations of the technical assessment in relation to the setting of groundwater compliance points and values, shall be included in the next AER. Any actions required to demonstrate compliance with the European Communities Environmental Objectives (Groundwater) Regulations 2010, as amended shall be agreed by the Agency and implemented before 22nd December 2015. Groundwater monitoring results shall be submitted annually or as required in the Schedules to this licence*".

The scope of works undertaken as part of this assessment was as follows:-

- Desk study to establish the baseline geological and hydrogeological conditions at the site;
- Review type and nature of current and past site activities to assess the potential impact on the hydrogeological regime;
- Risk screening to determine the degree of risk posed by the landfill on the groundwater and surface water quality and receptors based on source-pathway-receptor model;
- Generic Quantitative Risk Assessment;
- Assessment of whether the hydrogeological impacts are compliant with the discharge limits;
- Remedial strategy required to ensure objectives of groundwater regulations will be met;
- Review of compliance values and monitoring regime and identification of additional mitigation measures if required.

The Groundwater Risk Assessment has been carried out in accordance with the EPA Document "*Guidance On the Authorisation of Discharges To Groundwater* (EPA, 2011). This guidance document covers point source discharges such as the escape of leachate from landfills (beyond engineered and/or geological barriers) and outlines the technical assessments that are required to permit discharges to groundwater in accordance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI No. 9 of 2010) (Groundwater Regulations).

2 ENVIRONMENTAL SITE SETTING

The Dungarvan Landfill site is located in the townland of Ballinamuck Middle approximately 2km north west of Dungarvan. The site is located adjacent to the Colligan River which forms the western, northern and eastern boundary of the site. A local access road forms the southern boundary of the site.

The landfill site occupies an area of 6.5 ha. The site was in operation from 1968 to June 2003. The site is currently utilised as a transfer station for recyclable materials. The portion of the River Colligan adjacent to the eastern and northern boundary of the site is tidal in nature. The highest point to which ordinary tides flow is located close to the northern corner of the site (close to surface water monitoring location SW2). The River Colligan discharges to Dungarvan Harbour approximately 1.5km downstream of the landfill.

The Dungarvan Harbour Special Protection Area (SPA) is located adjacent to the landfill site and includes the estuarine portion of the River Colligan and the adjoining wetlands habitats. The Clonea Beach Bathing Water Area is located approximately 6km east of the landfill site. There is a designated shellfish area located in Dungarvan Harbour, in the area immediately east of Cunnigar and Whitehouse Bank, approximately 4km south east of the landfill. Dungarvan Harbour has also been identified as a Proposed National Heritage Area (pNHA).

The farmland in the vicinity of the site is intensively farmed and composed of arable land and grazing pasture. There is an industrial unit located up gradient of the site (Waterford Joinery, IPPC licence facility PO350-01).

The landfilling of waste within the existing facility boundary took place from circa 1968 to 2003. The landfill closed on the 30th June 2003 but still acts as a transfer station for recyclable material. The landfill site accepted mainly domestic and commercial refuse. It is also reported that chromium contaminated organic sludge from a tannery in Portlaw and some lead containing sludge from a lead crystal factory in Dungarvan was also accepted. A Waste Licence W0032-01 was originally granted by the Environmental Protection Agency on 29th November 2002 for the continued acceptance of municipal waste within the existing facility. A new licence, W0032-02, was issued for the site on the 06/05/2005 which permitted the development of a Transfer Station and Composting Facilities. The most recent licence, W0032-03, was issued by the Agency on the 21/10/2014 following a licence review which authorised Waterford City and County Council to operate the constructed wetlands system at the site and to discharge treated leachate from the constructed wetlands system to the Colligan Estuary adjacent to the site.

The site is unlined and the landfilling of waste took place on top of the original ground surface resulting in the creation of a waste mound. The historic ordnance survey maps (25" 1988 – 1913) indicate the landfill has developed on an area of marshy ground adjacent the River Colligan. The low land adjacent to the river is liable to flooding. The landfilling of waste has taken place to the north and south of the former railway line. A mill race is indicated along the western portion of the site on the historic 6" map (1837 – 1842).

The Waste Licence application for the site indicated in 1998 that the landfill profile was between 6m and 9m above the river levels and 2m above the surrounding agricultural profile. The 2009 topographic survey indicates the ground elevation at the base of the waste body along the western, northern and eastern portion of the site ranges from 2m to 3m OD. While along the southern

boundary of the waste body the ground profile at the base of the waste mound ranges from 4.5m to 8m rising in a westerly direction. The ground elevation on top of the capped waste body ranges from 16.50mmOD to 10.70mOD. The landfill has no liner but there is some natural protection provided to the bedrock aquifer from the layer of overburden deposits.

The restoration of the site has been completed. A summary of the restoration works completed at the site is provided in **Table 2.1**.

Table 2.1: Summary of Phasing of Restoration and Remedial Works Completed To Date

Element	Commencement	Completion
Final Capping	July 2007	September 2008
Gas Abstraction Wells		2009
Leachate Extraction Wells		2009
Leachate Storage Tank		2009
Permanent Gas Flare		2010
Leachate Abstraction & Pumping System	December 2011	July 2012

The main capping contract works commenced in July 2007 and completed by September 2008. The installation of the gas / leachate extraction boreholes and associated pipework was completed in June 2009. The gas management system composed of 3 No. gas manifolds was installed in June 2009. A closed permanent flare 100m^3/hr has been operational at the site since July 2010.

The final capping was completed in mid 2008 and comprised of a five layer composite system as follows:

- Top soil – 150 – 300mm;
- Subsoil such that thickness of topsoil and subsoil is at least 1m thick;
- Surface Water geocomposite layer;
- 1mm LLDPE geomembrane;
- Geocomposite gas collection layer.

The layout of the leachate extraction and treatment system is shown on Drawing Leachate Extraction and Treatment System – Current System as at October 2010 (Appendix A, MDR0350/DG0712). An Integrated Constructed Wetland (ICW) of 18,000m^2 has been constructed to treat the leachate collected from the landfill. The leachate collection infrastructure (1,549m) at the site includes the leachate interceptor drain on the western, northern and eastern perimeter of the waste body between the site and the River Colligan and the leachate extraction boreholes (GW2 and GW6). Runoff and dirty water from the waste transfer station is also discharged to the leachate treatment system. Two 25m^3 glass lined leachate storage tanks were installed onsite in 2009. In May 2010 the tank on the western side of the site was brought into use and serves as the leachate monitoring and dilution tank.

A series of 6 no. constructed wetland ponds (1A, 1B, 2, 3, 4 & 5) were installed on site in 2008 for the treatment of leachate and planted with a mix of wetland vegetation such as reeds and sedges. This results in 45% of the site area being occupied by artificial lakes and ponds. A partial leachate extraction system was installed in 2010 and monitored until March 2012. The final phase was to install a full leachate extraction system with works commencing in early December 2011 and reaching substantial completion in July 2012.

The ponds were constructed by creating 1m x 3-4m wide perimeter bunds. The ponds are lined with HDPE and covered with a 500mm depth of subsoil to support the wetland vegetation. The sizing of the ICW was based on a leachate loading rate of 0.2 $l/m^2/d$. The influent volume to the constructed wetlands is reported to be 26.9m^3/d (9,818.5m^3/annum).

The leachate from the interceptor tank and leachate boreholes 2 and 6 is diluted with groundwater from RC8 and then pumped to the first ICW pond. From here it flows by gravity to each subsequent pond. The treated leachate is then discharged intermittently to the on site surface water lagoon located in the south east corner of the site.

A monitoring programme is in place at the site to monitoring the leachate composition and the groundwater and surface water quality in the vicinity of the landfill. The locations of the monitoring points are illustrated on Drawing Monitoring Locations (Appendix A, Drawing Number MDR0350/DG0505 (Rev R02).

In order to complete the assessment of the site the following reports have been consulted to obtain information on the site: -

- Annual Environmental Reports 2008 – 2014;
- Previous site investigations reports;
- Environmental monitoring data – results of groundwater, surface water and leachate monitoring 2008 – 2015.

2.1 REGIONAL GEOLOGY

The bedrock geology of the Dungarvan area is composed of rocks of Carboniferous age which form the low-lying ground adjacent to the River Colligan and River Brickey. Information on the bedrock geology has been obtained from the Geological Survey of Ireland (GSI) 1:100,000 series bedrock geology map (Sheet 22 Geology of East Cork - Waterford, GSI, 1995). The bedrock geology map indicates that the site is underlain by the Waulsortian Limestone (WA) which is composed of massive unbedded lime mudstone.

Approximately 1km to the north of the site the Ballysteen Formation (BA), a fossiliferous dark grey muddy limestone or shale is mapped as forming the bedrock. The Ballysteen Formation also forms the bedrock in the area to the north east of the site at Knockateenmore.

Moving northwards, onto the higher ground on the foothill of the Knockmealdown Mountain, outside of the study area the bedrock changes to the rocks of Devonian age (Kiltorcan formation).

In the area of the Ballinumuck Supply boreholes 500m to the west of the site the transmissivity is estimated at 900 – 13,000m^2/d. Investigations in the Dungarvan area indicate that the central area of the syncline has permeability of 15 – 180m/d while the bedrock to the north and south has values of 15 – 70m/d. The higher permeabilities are associated with a higher degree of fracturing and faulting associated with a minor anticlinal axis. Sandy till is the dominant overburden type in the area and in often > 10m thick on the valley floor.

The groundwater body description indicates that groundwater generally discharges in narrow zones along the major river in the area via springs or through sand and gravels in continuity with the rivers. The historic mapping for the area (25" series 1888 – 1913 and 6" series 1837 – 1842) indicate the presence of a springs in the south west corner of the site. At the landfill site the main groundwater discharge is to the tidal portion of the River Colligan. The regional groundwater flow direction is expected to be in an easterly direction based on the surface water drainage.

There are a number of karst features identified in the vicinity of the site as outlined in **Table 2.2**.

Table 2.2: Karst Features

GSI Feature No.	Feature Type	Feature Name	Townland	Proximity to Landfill Site
2009SEK006	Enclosed Depression	Poulmore	Ballynamuck Middle	Between northern boundary of site & River Colligan
2009SEK009	Enclosed Depression	Poulbeg	Ballynamuck Middle	Located within site
2009SEK007	Enclosed Depression	Poulnaskeha	Killadangan	Approximately 100m west of site on west side of River Colligan
2009SEK008	Enclosed Depression	Un named	Killadangan	Approximately 400m south west of landfill
2009SEK004	Cave	Un named	Ballynamuck East	Approximately 600m south east of landfill
2009SEK016	Borehole Spring	Un named	Ballynamuck West	Approximately 600m west of landfill

The GSI vulnerability map for the area indicates a moderate vulnerability classification for the majority of the landfill site. The area immediately north of the waste body adjacent to the River Colligan is classed as low vulnerability. The karst features mapped in the area are classed as having extreme vulnerability. The area of the civic amenity area in the south east of the landfill is classed as high to extreme vulnerability due to bedrock outcropping at or close to the surface in the former quarry area (as indicated on 25" map 1888 – 1913 series).

Information on the location of potential private wells in the area has been obtained from the GSI well database. There are no private wells located down gradient of the site. The groundwater down gradient of the site is expected to be discharging to the River Colligan and Dungarvan Harbour and is subject to tidal influence. The GSI Groundwater Data Viewer indicates the Source Protection Zones for the Dungarvan Water Supply (Ballinamuck Source) extend to within approximately 400m of the landfill site. Based on the expected regional groundwater flow direction the landfill is located down

gradient of this public water supply and is not located within the delineated source protection zones for the public supply boreholes.

Information on the EPA website indicates the Water Framework Directive (WFD) status 2007 – 2012 for the Dungarvan Groundwater Body indicates as "Good Status". The WFD Risk Score for the Dungarvan Groundwater Body Risk Score is category 1a "at risk of not achieving good status" however no risk score is provided for the area of the landfill site itself for which "no results returned".

2.3 SURFACE WATER FEATURES

The landfill site is located in the catchment of the Colligan-Mahon. The regional surface water drainage is in an easterly direction towards the Dungarvan Harbour

The River Colligan forms the western, northern and eastern boundary of the site. The landfill site has developed on an area of marshy ground adjacent to the River Colligan. The River Colligan is tidal along the northern boundary of the site the most northerly point of the landfill site is located close to the highest point to which ordinary tides flow (close to surface water monitoring location SW2, see Appendix A Monitoring Locations Drawing MDR0350/DG0505).

The closest EPA surface water monitoring station to the landfill site, (Station ID RS17CO10250), located at bridge near Kildangan has a Q3-4 moderate status reported for 2013. This monitoring station is located approximately 1km up gradient of the site.

The Water Framework Directive (WFD) Status (2010 – 2012) for the River Colligan is "Good Status" and "Moderate Status" for the Colligan Estuary.

The WFD risk score for the River Colligan is category 2a "expected to achieve good status" while the risk score for the Colligan Estuary is category 1a "at risk of not achieving good status". The full report for the Colligan Estuary Waterbody indicates the risks relate to morphological risk and point source from waste water treatment plant.

The Register of Hydrometric Stations in Ireland 2007 provided information for an obsolete staff gauge on the Colligan at Poulnaskeha (NGR 224019, 94663) approximately 100m up gradient of the site. The catchment area to the staff gauge is reported as 96.354 km^2. The long term average rainfall for the period 1971-2000 was 1487.5mm and the dry weather flow (DWF) is reported as 0.32 m^3/s with a 95%ile flow of 0.50 m^3/sec.

The historic maps for the area indicate that prior to the development of the landfill the alluvial flats drained by several drains and streams that discharged to Colligan River. In addition the historic maps indicate the presence of a mill race in the western area of the site.

2.4 SITE GEOLOGY

The site investigation information from the landfill site and surrounding area has been examined. The original borehole logs for the monitoring boreholes within the landfill site have been reviewed and summary details of the site investigation borehole logs are presented in Table B.1 of Appendix B. The available site investigation data has been used in the development of the conceptual site model (CSM). A cross section through the waste body is presented on Figure 3.1 to illustrate the conceptual site model. The section line has been selected through the site to transect the waste body and intercept the available site investigation boreholes in a west to east direction. The location of the section line is shown on Monitoring Points Drawing (Appendix A, Drawing No. MDR0350/DG0505).

A Geological and Hydrogeological Study of the Dungarvan Landfill was undertaken by B.J. Murphy & Associates (BMA) in March 1999 as part of the Waste Licence Application. Background information on the geology of the site has been obtained from this report which included schematic cross sections of the geology at the site based on the site investigation data. A copy of these cross sections are included in Appendix B.

Bedrock outcrops are limited in the area but the Waulsortian Limestone is seen to outcrop immediately south-east of the site. The site investigation confirm the presence of limestone bedrock at depth ranging from 2.80m below ground level (mbgl) at RC1 in the south east corner of the site to 24.90mbgl at RC5 in the north east corner of the site with the depth to bedrock increasing towards the River Colligan. The rotary drilling indicated massive (unbedded) brown to grey fine grained limestone which correlates with the mapped geology (Waulsortian Formation). Typically the top 10m of the limestone was weathered and fractured. Cavities were found in the limestone bedrock across the site with localised sand, silt and clay infill which lead to unstable drilling conditions due to the extensive fracturing and karstification. The site investigation confirmed the presence of the Waulsortian Limestone Formation at the site except for the south west corner at RC3 and RC4 where black shales interbedded with dark argillaceous limestone with a well developed cleavage interpreted as Ballysteen Formation was encountered. The depth to top of bedrock is seen to increase moving northwards across the site from 8.15mbgl at RC3 to 13mbgl at RC2 and 24.90m at RC5.

The natural overburden material beneath the waste deposits at the site includes boulder clay, silty clay, silty sand and occasional silty gravel. Stiff brown sandy boulder clay was encountered in south west part of site in RC3 and RC4 and as far north as TP1 and RC2 with a maximum depth 4m. The thickness of the gravel deposits is seen to increase moving northwards towards the river. The site investigation data has been interpreted as indicating on average 4m to 7m of overburden deposits beneath the waste body. The BMA report indicated that the alluvial deposits had a permeability of 1.98E-4m/d (2.3E-7cm/s) (An Foras Forbartha, 1985).

The site investigation data indicates there is a protective layer of overburden deposits present across the site between the waste body and the bedrock aquifer across the site. The only exception to this is at RC1 where made ground / waste is lying directly on bedrock however this is located outside of the main waste body and this area has been developed as the civic amenity / waste transfer area in an area which is now surfaced and from where waste material would have been removed prior to the construction of the hardstanding area.

The 1998 site investigation boreholes within the waste body confirm average waste thickness ranging from 4.40m (L5) to 6.60m (L2).

2.5 SITE HYDROGEOLOGY

Information on the site specific hydrogeology has been obtained from a review of the available site investigation information. A summary of the results of the site investigation boreholes is provided in Table B.1, Appendix B.

Groundwater Flow Zones

The main water bearing horizons are (1) the groundwater in the overburden deposits composed of sandy clayey gravel with cobbles (2) the upper 30m to 40m of bedrock where karst features and fracturing are dominant in the bedrock aquifer. The groundwater levels data indicates Confined conditions were encountered in RC4 and RC6A while unconfined confined conditions at RC3A.

There are no sand and gravel aquifers delineated by the GSI in the area. The aquifer of interest is the bedrock aquifer. Based on the site specific data the aquifer vulnerability for the bedrock aquifer would be classed extreme at RC1 and moderate at RC3, RC4, GW1, GW2 and GW5.

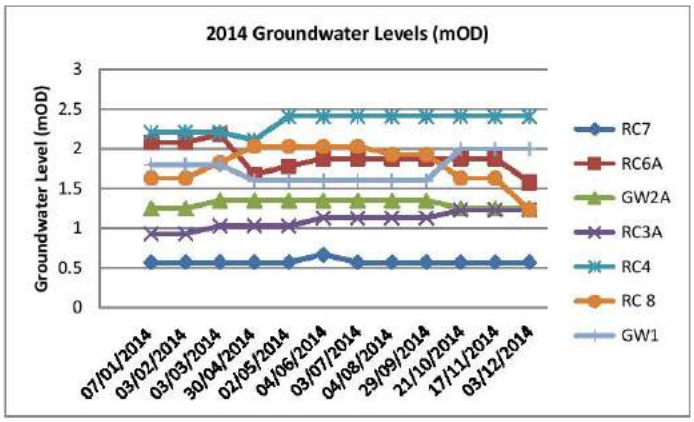
Groundwater Flow Direction

Monthly monitoring groundwater of groundwater levels takes place at the site and the data for 2014 is presented in **Table 2.3**, the data indicates limited seasonal variation in the groundwater levels. Pumping of groundwater is taking place on site from RC8 to dilute the leachate prior to leachate treatment within the constructed wetlands. The greatest fluctuation is seen at RC8 where a variation of 0.8m was measured in 2014.

Table 2.3: Groundwater Level Monitoring 2014

Date	RC7 Overburden	RC6A Rock	GW2A Overburden	RC3A Rock	RC4 Rock	RC 8 Overburden	GW1 Overburden
07/01/2014	0.570	2.080	1.250	0.930	2.210	1.630	1.800
03/02/2014	0.570	2.080	1.250	0.930	2.210	1.630	1.800
03/03/2014	0.570	2.180	1.350	1.030	2.210	1.830	1.800
30/04/2014	0.570	1.680	1.350	1.030	2.110	2.030	1.600
02/05/2014	0.570	1.780	1.350	1.030	2.410	2.030	1.600
04/06/2014	0.670	1.880	1.350	1.130	2.410	2.030	1.600
03/07/2014	0.570	1.880	1.350	1.130	2.410	2.030	1.600
04/08/2014	0.570	1.880	1.350	1.130	2.410	1.930	1.600
29/09/2014	0.570	1.880	1.350	1.130	2.410	1.930	1.600
21/10/2014	0.570	1.880	1.250	1.230	2.410	1.630	2.000
17/11/2014	0.570	1.880	1.250	1.230	2.410	1.630	2.000
03/12/2014	0.570	1.580	1.250	1.230	2.410	1.230	2.000

Figure 2.1: Groundwater Level Monitoring 2014



A seasonal variation of 0.10m to 0.80m is demonstrated **Figure 2.1**. The groundwater quality monitoring indicates that RC7 and RC8 are affected by saline intrusion from the estuary as seen in the intermittently high electrical conductivity levels due to the proximity of the Colligan Estuary which is tidal as far as SW2.

Hydraulic Parameters

There is no site specific information available on the hydraulic parameters from the previous site investigations undertaken at the site. Information on the hydrogeological parameters for the same geological units is available from the investigations at the Ballinamuck Public Supply which is located 500m west of the landfill site. Pump test data from the Dungarvan Public Supply at Ballinamuck indicates aquifer transmissivity in the range of 900 – 13,000m^2/d. Permeabilities within the Waulsortian Limestone in the Dungarvan area have been assessed by the GSI as ranging from 25 to 190m/d with an effective porosity of 2.5% and a hydraulic gradient of 0.0015 being typical.

Geological Units of Interest

The main geologic units of interest with respect to groundwater flow and contaminant transport at the site are considered to be (i) sandy clayey gravel and cobbles layer within the overburden deposits (ii) the regionally important karstified bedrock aquifer.

The landfill site is unlined and leachate from the waste body is discharging to the shallow groundwater in the overburden deposits and the deep groundwater in the bedrock aquifer beneath the site. Both the shallow groundwater and deep groundwater are discharging to the Colligan Estuary in the vicinity of the site. The proximity of the landfill to the tidally influenced section of the River Colligan results in the groundwater down gradient of the site being subject to saline intrusion.

The limestone bedrock beneath the site is classed as a Regionally Important Karst Aquifer. The main groundwater movement in the bedrock is expected to be top weathered interval and in the fractured and karstified intervals in the top 30m to 40m. The site specific data indicates significant development of cavities and karstification.

The historic maps for the site and surrounding area have been examined. The 25" map (1888 – 1913) indicate potential for preferential flow zones former railway line which extended through the site in a west to east direction; there was a mill race parallel to the River Colligan along the western site boundary. There is a spring shown in the south west corner of site; spring to north of site on north side of River Colligan; and a former quarry in the south east corner of the site. The area to the north east of the site on the north side of River Colligan is prone to flooding during spring tides.

The available site investigation information indicates 4m to 7m of overburden present beneath the waste body. Based on the guidelines published by the Department of Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland in the 1999 publication Groundwater Protection Schemes the site specific vulnerability for the bedrock aquifer is classed as moderate which agrees with the GSI map.

3 CONCEPTUAL SITE MODEL

A cross section has been prepared to graphically illustrate the conceptual site model for the Dungarvan Landfill Site and is presented as **Figure 3.1**. The section line was selected to intersect the available borehole locations in an approximate west to east direction.

3.1 POTENTIAL SOURCE AREAS

3.1.1 Landfill Source Area

The landfill site at Dungarvan operated from 1968 to 2003. The landfill ceased accepting waste for disposal in June 2003 but is currently being used as a civic amenity centre and transfer station for recyclable materials. It is estimated that 363,770 tonnes of waste has been landfilled at the site based on the 193,984 tonnes landfilled at the time of the licence application and a further 169,786 tonnes to be deposited post grant of licence. The landfill site is unlined and covers an area of approximately 6.5 hectares. The extent of the waste body for the licensed site is shown on the Site Location & Site Layout Plan (Appendix A). The facility accepted mainly domestic and commercial refuse. It is also reported that chromium contaminated organic sludge from a tannery in Portlaw and some lead containing sludge from a lead crystal factory in Dungarvan was also deposited.

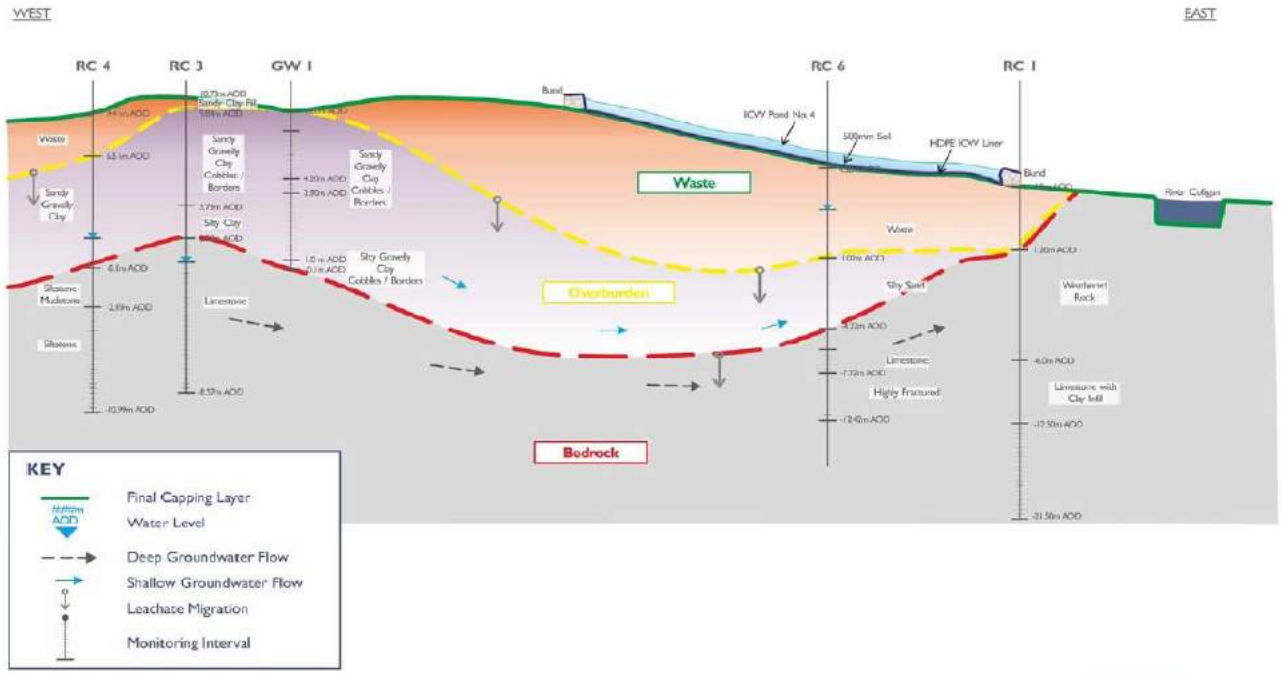
The source for potential groundwater contamination at the site is the leachate being generated from the degradation of the landfilled material. Prior to the installation of the final capping layer in 2008 rainfall was percolating through the waste body and generating leachate which subsequently discharged to the groundwater beneath the site and the River Colligan adjacent to the site. The installation of the engineered cap has significantly reduced the quantity of rainfall percolating through the waste body and consequently reduced the volume of leachate being generated. The original waste licence application calculated that the annual leachate generation at the site between 1985 and 2002 ranged from 41,709m^3/annum to 63,910m^3/annum. The EPA Landfill Site Design Manual (EPA, 2000) indicates a upper bound of 10% infiltration of effective rainfall for restored areas. Based on a site area of 69,143m^2 and an effective rainfall of 820mm per annum (GSI website) this equates to into restored area The water balance estimated the leachate generation post capping to be of the order of 5,670m^3/annum.

Since the waste licence was granted for the site in 2002 a number of specified engineering works have taken place at the site to reduce the potential for leachate generation including the installation of surface water drains, leachate abstraction and collection system and final engineered capping layer in accordance with the licence conditions for the site. The leachate levels converted to mOD have been provided by Waterford City and County Council. Only data is available from L4 which indicates the leachate level is higher than groundwater elevations indicating the potential for migration of leachate to the shallow groundwater and the deeper groundwater through the base of the unlined waste body.

Table 3.1: Leachate Level Monitoring 2014

Date	L5A	L4	L1A
07/01/2014	0.83	2.3	0.26
03/02/2014	0.83	2.3	0.26
03/03/2014	0.83	2.4	0.26
30/04/2014	0.83	2.4	0.26
02/05/2014	0.83	2.7	0.26
04/06/2014	1.63	2.3	2.16
03/07/2014	1.63	2.3	2.16
04/08/2014	1.63	2.4	2.16
29/09/2014	1.63	2.4	2.16
21/10/2014	1.23	2.4	0.96
17/11/2014	1.23	2.4	0.96
03/12/2014	1.23	2.4	0.96

Figure 3.1: Dungarvan Landfill Conceptual Site Model



Dungarvan Landfill - Conceptual Site Model Cross Section n.t.s.

3.1.2 Leachate Composition

The leachate monitoring data for the period 2014 and 2015 has been reviewed to identify the contaminants of potential concern (COPC) at the site. The Waste Licence (W0032-03) requires the monitoring of the leachate composition at the leachate sumps (undiluted leachate) and the Lagoon Marsh. Monitoring at Lagoon Marsh is required until a discharge pipe from the constructed wetland system is commissioned and operational. Leachate monitoring data is available from Waterford City and County Council from the following leachate monitoring locations: Interceptor; ICW Pond 1 In; ICW Pond 2 In; ICW Pond 3 In; ICW Pond 4 In; ICW Pond 5 In and ICW Pond Out however this data represents diluted and treated leachate and is not representative of the leachate discharging through the base of the waste mound. A copy of the available data is presented in Appendix E, Table E.1 for information purposes.

The data for the interceptor sampling location has been compared to the Environmental Objectives Groundwater Regulations (SI No. 9 of 2010) threshold values and the typical leachate compositions (Landfill Site Design Manual, Table 7.2, EPA 2000) (Appendix E, Table E.2). The data indicates the leachate composition is at the lower end of the range reported for methanogenic leachate (Landfill Site Design Manual, EPA 2000). The available data from 2010 to 2015 for the Interceptor was reviewed and identified the following potential contaminants of concern: ammonia (< 0.02 to 59 mg/l), chloride (70 – 173 mg/l), electrical conductivity (530 – 1,720 us/cm), iron (610 – 1,300 ug/l), manganese (510 – 600 ug/l), potassium (12 – 26 mg/l). No List I / II substances were detected at concentrations above the detection limit. No hazardous substances have been detected at concentrations above the screening values.

3.2 PATHWAYS

The Dungarvan Landfill site is an unlined site. The deposition of waste has taken place on top of the original ground surface in an area of reclaimed estuarine land. The waste body is separated from the underlying bedrock aquifer by 4m to 7m of overburden deposits.

The main pathway for the discharge of leachate from the site is expected to be to be via the shallow groundwater in the overburden deposits and the deeper groundwater in the bedrock aquifer to the estuarine portion of the River Colligan adjacent to the landfill site. The site investigation data indicate that the main pathways for the preferential migration of leachate off-site as shown on **Figure 3.1** are:-

- Leachate vertically migrating to the shallow groundwater in the sandy clayey gravel layer within the overburden deposits.
- Leachate in the shallow groundwater vertically migrating to the deeper groundwater in the regionally important karstified limestone aquifer (groundwater flow concentrated in top 30 – 40m of bedrock).
- Shallow groundwater in the overburden deposits horizontally migrating to the River Colligan / Colligan Estuary.
- Deeper groundwater in the bedrock aquifer horizontally migrating to the Colligan Estuary and Dungarvan Harbour.

The vulnerability of the groundwater in the bedrock aquifer beneath the waste body landfill, as per the GSI vulnerability classification scheme, is moderate.

3.3 RECEPTORS

The following receptors have been assessed:-

- Drinking Water Supplies.
- Recreational Waters.
- Designated Sites.

Drinking Water Supplies

The landfill site is located on a Regionally Important Aquifer (Rkd). In addition to the current groundwater usage in the area the future resource potential needs to be considered as the groundwater body is classed under the WFD Register of Protected Areas as Groundwater for Drinking Water.

The wells which supply groundwater to the Dungarvan Public Supply are located 500m west of the landfill site. The GSI delineated the Groundwater Source Protection Zones for the Dungarvan Supply (June 1998). The landfill site is indicated as being down gradient and outside of the zone of contribution for the public supply.

No private well users have been identified down gradient of the site. There are no properties located hydraulically down gradient of the site between the landfill and the River Colligan. There are a number of private wells located on the north side of the River Colligan, north of the landfill site in the vicinity of the N72. These boreholes are not located down gradient of the waste body as groundwater flow in this area is expected to be towards the River Colligan in addition the landfill site would not be located within the zone of contribution of these private wells.

Recreational Waters

The Clonea Beach Bathing Water Area is located approximately 6km from the landfill site. The inner portion of Dungarvan Harbour is not included in "Surface Water in Bathing Locations". The groundwater from the vicinity of the landfill site is not included in "Groundwater In Bathing Locations". The landfill site does not directly discharge to the Surface Water in Bathing Locations however the landfill site may be indirectly linked to the Clonea Beach Bathing Water Area. Groundwater from the beneath the landfill site discharges to the River Colligan which subsequently discharges to Dungarvan Harbour which is classed as a Surface water in Bathing Locations.

Shellfish Waters

The EPA online mapping indicates a Shellfish Area (Protected Area Code PA2_0045) located approximately 4km from the landfill site. The Colligan Estuary (Transitional Water) is included as a surface water within this Shellfish Area. The Shellfish Area is located immediately east of Cunnigar and Whitehouse Bank.

Designated Sites

Dungarvan Harbour is a designated Special Protection Area (SPA) under the EU Birds Directive. The designated site covers an area of 1,041 ha located along the River Colligan Estuary as far upstream as the highest point to which ordinary tides flow (surface water monitoring location SW2). The River Colligan and groundwater are classed as contributing to SPA habitats.

Dungarvan Harbour is proposed for designation as a Natural Heritage Area (pNHA). The pNHA boundary extends above Ballyneety Bridge and adjacent to the landfill site boundary.

There is potential for the discharge of groundwater and surface water from the landfill to discharge to the Dungarvan Harbour SPA and pNHA. There is no designated Special Area of Conservation (SAC) located down gradient of the landfill.

3.4 SPR LINKAGES - RISK SCREENING

The risk screening process is based on the Source – Pathway – Receptor model. This requires the assessment of whether the source (waste body) and receptors are linked by one or more pathways as summarised in **Table 3.2.**

The assessment of risk as low, medium or high has been carried out by examining the link between each risk factor and a review of the site specific water quality monitoring data.

Table 3.2: Risk Assessment

Source	Pathway	Receptor	Risk
Waste body composed of domestic, commercial and construction and demolition waste. The site is unlined but the waste body is capped. The main contaminant of concern is ammonia. Elevated concentrations of iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead have also been measured.	Leachate vertically migrating to shallow groundwater	**Drinking Water Supplies** No potential groundwater users have been identified for the shallow groundwater down gradient of site.	The site is unlined and waste is directly located on overburden deposits. Evidence from groundwater quality monitoring in the overburden indicates that leachate is discharging to shallow groundwater beneath the landfill site. No potential shallow groundwater users have been identified down gradient of the site. **No risk identified**.
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m)	**Drinking Water Supplies** No potential groundwater users have been identified for the deeper groundwater down gradient of site.	The site is unlined and the waste is separated from the deeper groundwater by the 4m to 7m of overburden deposits. The groundwater quality monitoring from RC3A and RC6A for 2014 & 2015 indicates elevated concentrations in the deeper groundwater beneath the landfill site. It is recommended that an additional monitoring borehole be installed at the landfill site to monitor the composition of the groundwater in the bedrock aquifer for compliance monitoring purposes. **No risk identified to drinking water supplies as no supplies at present.**
	Leachate vertically migrating to shallow groundwater	**Recreational Waters** There is potential for shallow groundwater from beneath the site to indirectly discharge to the Clonea Beach Bathing Water which is located 6km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of

Source	Pathway	Receptor	Risk
			contaminants of potential concern in the immediate vicinity of the site at SW2 and EPA Station No. 300. The most recent Bathing Water Status for 2015 for Clonea Strand is classed as excellent. **No Risk identified to Clonea Beach Bathing Water.**
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m)	**Recreational Waters** There is potential for the deeper groundwater from beneath the site to discharge indirectly to the Clonea Beach Bathing Water which is located 6km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of contaminants of potential concern in the immediate vicinity of the site at SW2 and EPA Station No. 300. The most recent Bathing Water Status for 2015 for Clonea Strand is classed as excellent. **No Risk identified to Clonea Beach Bathing Water.**
	Leachate vertically migrating to shallow groundwater	**Shellfish Waters** There is potential for the shallow groundwater from beneath the site to indirectly discharge to the Shellfish area within Dungarvan Harbour located 4km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of contaminants of potential concern in the immediate vicinity of the site at SW2 and EPA Station No. 300. **No Risk identified to Shellfish Waters.**

Source	Pathway	Receptor	Risk
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m).	**Shellfish Waters** There is potential for the deeper groundwater from beneath the site to indirectly discharge to the Shellfish area within Dungarvan Harbour located 4km down gradient of the landfill site.	The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. In addition further dilution is available within Dungarvan Harbour. The surface water quality data indicates no issue with elevated concentrations of contaminants of potential concern in the immediate vicinity of the site at SW2 and EPA Station No. 300. **No Risk identified to Shellfish Waters.**
	Leachate vertically migrating to shallow groundwater	**Designated Sites** There is potential for the shallow groundwater from beneath the site to discharge to the Dungarvan Harbour Special Protection Area (SPA) which is located immediately adjacent to the landfill site. There is potential for landfill to impact on surface water quality due to elevated concentrations (i.e. elevated ammonia) and on the aquatic habitats.	The 2014 & 2015 monitoring data indicates no issues with surface water quality adjacent to the site. The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. **The risk is classed as Low Risk.**
	Leachate vertically migrating to deeper groundwater in bedrock aquifer (top 30m to 40m).	**Designated Sites** There is potential for the deeper groundwater from beneath the site to discharge to the Dungarvan Harbour Special Protection Area (SPA) which is located immediately adjacent to the landfill site. There is potential for landfill to impact on surface water quality due to elevated concentrations (i.e. elevated ammonia) and on the aquatic habitats.	The 2014 & 2015 monitoring data indicates no issues with surface water quality adjacent to the site. The volume of leachate being produced is low in terms of the dilution available within the River Colligan and Colligan Estuary. **The risk is classed as Low Risk.**

3.5 APPROPRIATE TIER OF ASSESSMENT

The Source Pathway Receptor methodology has been followed. The EPA "Hydrogeological Review / Technical Assessment Report Template" outlines that a tiered approach is recommended in assessing potential impacts on groundwater and other potential receptors.

3.6 CONCLUSION

The monitoring data indicates that the following parameters are present at concentrations above the screening levels: ammonia, iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead. The main contaminant of concern at the site is ammonia.

Prior to the completion of this report a Generic Quantitative Risk Assessment (GQRA) had not been prepared for this site. Generally all landfills are required undertake a Tier 3 assessment, which is considered to be analogous to a DQRA unless there is clear evidence that the risk to groundwater is low.

The risk screening indicates that the site represents a low risk to the identified receptors. Immediately down gradient of the site the groundwater is discharging to the tidal portion of the River Colligan. No groundwater users have been identified down gradient of the site and due to the proximity of saline water and none are likely to be developed in the future. The landfill site does not represent a risk to the Clonea Beach Bathing Water Area or the Shellfish Waters in Dungarvan due to the distance from the landfill site and the dilution available. The risk to the adjacent designated sites, Dungarvan harbour SPA and pNHA, is classed as low based on the existing water quality data, the low strength of the leachate and the dilution available in the River Colligan.

The results of the risk screening indicate no risk or a low risk to the all of the identified receptors at the site. A detailed quantitative risk assessment has not been undertaken at the site. Based on the identified low risks at the site and the results of the groundwater and surface water monitoring the undertaking of a Detailed Quantitative Risk Assessment (DQRA) is not considered necessary. The existing monitoring programme (existing surface water and groundwater) is considered to be adequate to monitor changing groundwater composition.

It is recommended that the current environmental monitoring programme be continued. It is recommended that an additional groundwater monitoring borehole be installed down gradient of the site to monitor the groundwater quality in the bedrock aquifer.

APPENDIX A

DRAWINGS

1. Monitoring Locations Drawing No. MDR0350/DG0505
2. Leachate Extraction & Treatment System – Drawing MDR0350/Dg0712.

7 SUMMARY, CONCLUSIONS & RECOMMENDATIONS

The conceptual site model has been presented in Chapter 3 of this report and is illustrated on **Figure 3.1**. There is considered to be sufficient site investigation data available for the development of the conceptual site model and the identification of the groundwater flow intervals.

The limit objective under the Groundwater Regulations requires that all necessary measures should be taken to limit inputs of non hazardous substances to groundwater to ensure that such inputs do not cause pollution, deterioration in status of groundwater bodies or cause sustained upward trends in groundwater concentrations. The site is considered to be compliant with the limit objective of the Water Framework Directive and Groundwater Directive.

The prevent objective of the Groundwater Regulations requires that hazardous substances should not be permitted to enter the groundwater. Arsenic was the only hazardous substance identified at concentrations above the threshold set in the groundwater regulations but this was limited to one sampling date and there is no evidence of a widespread issue with arsenic at the site.

Remedial measures have been undertaken at the site between 2008 and 2012 which have included the installation of a leachate abstraction system, surface water management system and engineered final cap. The purpose of these remedial works has been to prevent or limit the input of pollutants into groundwater beneath the site and surface water down gradient of the site. The installation of the engineered cap has reduced the volume of leachate being generated at the site.

The available groundwater monitoring data for 2014 and 2015 has been reviewed to identify the potential contaminants of concern. The potential contaminants of concern include: ammonia, iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead. Ammonia is the main contaminant of concern. It is recommended that monitoring of COPC be undertaken at the frequencies outlined in Table 6.1 and at the proposed compliance monitoring locations in addition to the monitoring specified by the waste licence.

There is no evidence of an upward trend in contaminant concentrations at the site or an expanding plume of contamination. As the site is located in an estuarine location the area affected by the plume is limited to the immediate vicinity of the waste body as the groundwater and leachate is discharging to the adjacent estuarine waters where significant dilution is available (1:1,780).

There is no evidence of the existing surface water quality being impacted from leachate discharges from the landfill site.

No existing down gradient groundwater users have been identified and based on the proximity of site to the Colligan Estuary and the proximity of saline water groundwater is not expected to be developed down gradient of the site.

Parameter	Standard To be Achieved In Surface Water	Proposed Compliance Value
Iron	There is no specific standard set for iron in S.I. No. 272 of 2009 Surface Water Regulations. There is no threshold specified for iron in S.I. No. 9 of 2010 Groundwater Regulations. The GSI / EPA publication Towards Setting indicated an EQS of 1.0mg/l for iron in surface water.	1,780 mg/l
Nickel	The threshold specified for nickel S.I. No. 9 of 2010 Groundwater Regulations is 15 ug/l.	26.7 mg/l
Manganese	There is no specific standard set for manganese in S.I. No. 272 of 2009 Surface Water Regulations. There is no threshold specified for manganese in S.I. No. 9 of 2010 Groundwater Regulations. The GSI / EPA publication Towards Setting indicated an EQS of 0.3mg/l for manganese in surface water.	534 mg/l
Potassium	There is no threshold specified for potassium in S.I. No. 9 of 2010 Groundwater Regulations. The IGV is set as 5 mg/l.	8,900 mg/l
Aluminium	There is no threshold specified for aluminium in S.I. No. 9 of 2010 Groundwater Regulations. The IGV is set as 200 ug/l.	356 mg/l
Barium	There is no threshold specified for barium in S.I. No. 9 of 2010 Groundwater Regulations. The IGV is set as 100 ug/l.	178 mg/l

It is recommended that a new down gradient monitoring borehole be provided for monitoring of the groundwater composition in the bedrock aquifer down gradient of the landfill.

The standards which have been considered in the setting of compliance values for the groundwater include the following:-

- European Communities (Drinking Water) Regulations 2014 (S.I. No. 144 of 2014);
- European Communities Environmental Objectives (Groundwater) Regulations 2010 (S.I. No. 9 of 2010) (groundwater threshold values for assessment of whether groundwater intended for human consumption in drinking water protected areas is impacted by pollutants and / or is showing a significant and sustained rise in pollutant levels);
- European Communities Environmental Objectives (Surface Waters) Regulation 2009 (S.I. No. 272 of 2009);
- Bathing Water Quality Regulations S.I. No. 79 of 2008.

On this basis the compliance values outlined in **Table 6.2** have been set for groundwater. The use of these compliance values will ensure the Environmental Quality Standards for Surface Water are also met based on the available dilution in the down gradient surface water body.

The EPA online mapping indicates that the landfill site is located in the Hydrometric Area 17 catchment of Colligan-Mahon. The catchment area to the staff gauge located 100m up gradient of the site is 96.354km^2. The dry weather flow is reported as 0.32m^3/s with a 95%ile flow of 0.50m^3/sec. The volume of leachate being generated at the site is estimated to be of the order of 5,670m^3/annum. This equates to a dilution factor of 1: 1,780 taking the dry weather flow. This excludes the effect of dilution from the tidal action within the Colligan Estuary and is therefore a conservative estimate.

The dilution factor of 1,780 has been taken in to account in the back calculations of the compliance values for the contaminants of potential concern. This indicates compliance values are significantly higher than the current concentrations in the groundwater at the site. On this basis, the current groundwater quality is compliant with the proposed compliance values.

Table 6.2: Compliance Values for Contaminants of Potential Concern

Parameter	Standard To be Achieved In Surface Water	Proposed Compliance Value
Ammonia	There is no specific standard set for ammonia in S.I. No. 272 of 2009 Surface Water Regulations. The 65 ug/l (0.065 mg/l) threshold value for assessment of adverse impacts of chemical inputs from groundwater on associated surface water bodies has been used as a more conservative measure.	115 mg/l
Arsenic	There limit for arsenic is in surface water is 20ug/l (0.02 mg/l) based on annual average environmental quality standard, Table 10 S.I. 272 of 2009 for Other Surface Waters.	35.6 mg/l
Chloride	The limit specified for chloride in S.I. No. 272 of 2009 Surface Water Regulations is 187.5 mg/l.	333,750 mg/l

6 GROUNDWATER COMPLIANCE MONITORING

The proposed monitoring frequencies and the proposed parameters for compliance monitoring for groundwater analysis are outlined in **Table 6.1**. Details of the current groundwater monitoring programme are also included in **Table 6.1** for information purposes. The contaminants of concern are highlighted in bold in Table 6.1.

Table 6.1: Compliance Monitoring

Parameter	Recommended Compliance Groundwater Monitoring	Current Groundwater Monitoring as per Licence W0032-03
Borehole Locations	Shallow groundwater: RC8 & RC7. Deep groundwater: RC6A and New Borehole.	GW1, GW2A, RC3A, RC4, RC6A, RC7, RC8a.
Visual Inspection / Odour	Quarterly	Quarterly
Groundwater Level	Monthly	Monthly
Ammonia	Quarterly	Quarterly
Arsenic	Quarterly	Not Required
Cadmium	Annually	Annually
Chloride	Quarterly	Quarterly
Chromium (total)	Annually	Annually
Copper	Annually	Annually
Dissolved Oxygen	Quarterly	Annually
Electrical Conductivity	Quarterly	Quarterly
Iron	Quarterly	Quarterly
Lead	Annually	Annually
Nickel	Annually	Annually
Magnesium	Annually	Annually
Manganese	Quarterly	Annually
Mercury	Annually	Annually
Ortho-phosphate	Annually	Annually
Total Phosphorus	Annually	Annually
pH	Quarterly	Quarterly
Potassium	Quarterly	Annually
Sulphate	Annually	Annually
Temperature	Quarterly	Quarterly
Total Oxidised Nitrogen	Quarterly	Quarterly
Total Alkalinity	Annually	Annually
Zinc	Annually	Annually
Aluminium	Quarterly	Not Required
Barium	Quarterly	Not Required
Fluoride	Biannually	Biannually

5 REMEDIAL STRATEGY

The purpose of this report is to demonstrate compliance with the Groundwater Regulations (S.I. No. 9 of 2010). The aim of the Groundwater Regulations is to ensure the objectives for groundwater set by the Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/EC) are achieved. There are currently no authorised discharges of groundwater at the site.

The risk screening has determined no risk or a low level of risk at the site to potential receptors. The groundwater from beneath the landfill site is discharging to Colligan Estuary and Dungarvan Harbour. There is no evidence of a significant risk to the surface water quality down gradient of the site, to shellfish waters, bathing waters or to the designated sites (SPA and pNHA).

The site is considered to be compliant in terms of the limit objective of the groundwater regulations. The installation of the engineered final cap, leachate abstractions system and integrated constructed wetlands have significantly reduced the volume and strength of the leachate being generated at the site.

The site is considered to be compliant in terms of the prevent objective in terms of the discharge of hazardous substances. Arsenic was the only hazardous substance identified at concentrations above the threshold set in the groundwater regulations but this was limited to one sampling date and there is no evidence of a widespread issue with arsenic at the site. It is recommended that quarterly monitoring of arsenic be undertaken to monitor the situation.

It has not been possible to locate the borehole logs for RC7 and RC8 but they are reported to be monitoring the groundwater composition in the overburden deposits. There is currently no groundwater monitoring borehole in the bedrock aquifer located down gradient of the waste body outside of the landfill site. It is recommended that a monitoring borehole in the bedrock aquifer be installed along the eastern site boundary to serve as a compliance monitoring point in the bedrock aquifer. It is proposed that the monitoring borehole will be installed in Spring 2016 following receipt of approval from the EPA to progress.

It is recommended that a groundwater monitoring borehole be installed in the bedrock aquifer down gradient of the waste body to serve as a compliance monitoring point in the bedrock aquifer.

Due to the proximity of the site to the Colligan Estuary both the shallow groundwater in the overburden deposits and the deeper groundwater in the bedrock aquifer will be discharging to the estuarine waters. This results in significant dilution of the groundwater. This limits the extent of the groundwater contamination to the groundwater in the immediate vicinity of the site.

4.3 CHEMICAL STATUS OF GROUNDWATER BODY

4.3.1 Direct Discharges to Groundwater

Dungarvan Landfill site was developed as an unlined landfill site. Monitoring of the leachate composition at the site indicates a number of contaminants are above the groundwater threshold values. The site is unlined and leachate is discharging to the shallow and deep groundwater beneath the site. There is between 4m and 7 of overburden present across the site beneath the waste body. Previously waste was encountered at RC1 on top of bedrock in the south east corner of the site however this area is now occupied by the waste transfer station and surfaced resulting in no percolation of rainfall in this area. On this basis there are no direct discharges to groundwater. There are indirect discharges of pollutants to groundwater after percolation through the overburden deposits across the remainder of the site.

4.3.2 Impact on Surface Water Bodies

Of the parameters of potential concern ammonia has been identified as the main parameter of concern due to the fact that its concentration in the groundwater beneath the landfill site is in excess of 100 times the screening value (0.065 mg/l S.I. 9 2010 GW Regs Limits Column 2 Adverse Impact on Surface Water Bodies). The ammonia concentration in both the shallow and deep groundwater is contributing to the River Colligan / Colligan Estuary at concentrations that are significantly higher than the river water standard for good status (0.065 mg/l). There are no standards specified for ammonia concentration in coastal waters. The results of surface water quality monitoring within River Colligan indicate no impact on the down gradient surface water quality.

The Water Framework Directive (WFD) Status (2010 – 2012) for the River Colligan is "Good Status" and "Moderate Status" for the Colligan Estuary.

The WFD risk score for the River Colligan is category 2a "expected to achieve good status" while the risk score for the Colligan Estuary is category 1a "at risk of not achieving good status". The full report for the Colligan Estuary Waterbody indicates the risks relate to morphological risk and point source from waste water treatment plant.

4.3.3 Impact on Groundwater Bodies

Information on the EPA website indicates the Water Framework Directive (WFD) status 2007 – 2012 for the Dungarvan Groundwater Body indicates as "Good Status". The WFD Risk Score for the Dungarvan Groundwater Body Risk Score is category 1a "at risk of not achieving good status" however no risk score is provided for the area of the landfill site itself for which "no results returned".

Information on the groundwater shallow quality down gradient of the site is available from monitoring location RC7 which indicates no issue with the groundwater quality down gradient of the site. The available data for 2014 and 2015 for this monitoring location indicates the ammonia concentration is generally less than the 0.065 mg/l threshold value set in the groundwater regulations (highest concentration 0.85 mg/l Q3, 201).

Monitoring of the quarterly surface water composition includes the analysis of: BOD, COD, electrical conductivity, dissolved oxygen, pH, suspended solids and temperature. The available results of the quarterly monitoring for 2014 and 2015 are presented in Tables C.1 to C.5 in Appendix C. The results of the quarterly monitoring at the surface water monitoring locations indicate no issues with the water quality. The changing tidal conditions in the vicinity of the site can be seen in the variation of the electrical conductivity. Low biochemical oxygen demand and chemical oxygen demand results were obtained on all sampling dates.

SI No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations outlines that for river water bodies the dissolved oxygen concentration should be between 80% and 120% saturation for 95%ile. The dissolved oxygen concentrations on all sampling dates (except SW Lagoon) were within the range specified for both river water bodies and transitional water bodies. The pH was within the range specified for river water bodies. The BOD was below the 1.0mg/l detection limit at all of the sampling locations within the River Colligan and Colligan Estuary. The BOD concentration is within the limit set for high status for river water bodies. The concentration within the surface water lagoon ranged from < 1.0 to 3.6 mg/l and is within the limit of 4.0mg/l specified for transitional water body.

Information on the biological assessment of the surface water is available from the 2013 / 2014 Ecology Report from the 2014 Annual Environmental Report states "the results of the 2012 biological assessment of the River Colligan indicated good quality status at the upstream site (Site 1) following analysis of both the surface water quality and biological water quality data. An improvement of the water quality at Site 1 (in comparison with 2006) and the increase in the diversity of species at downstream connecting sites, coupled with the review of water quality measurements taken on site and the EPA chemical water quality data between 2007 and 2008, reflects good water quality indicating that the Dungarvan Landfill site is not negatively impacting the River Colligan".

The EPA surface water quality monitoring data 2010 – 2012 for the Colligan Estuary Transitional Water Body indicate "intermediate" status. The river water quality data 2004 to present indicates a Q3-4 moderate status for the closest monitoring point to the site which is Kildangan Bridge which is located approximately 1km up gradient of the site.

The WFD status 2010 – 2012 for the Colligan River is classed as "Good". The WFD status for Colligan Estuary Transitional Waterbody Status 2010 – 2012 is classed as "Moderate".

The WFD risk score for the Colligan River is classed as 2a "expected to achieve good status". The WRF risk score for the Transitional Water Body is 1a " at risk of not achieving good status".

The results of the surface water quality monitoring at EPA Station No. 280, SW2 and EPA Station No. 300 indicate no impact on the surface water quality in the River Colligan and Colligan Estuary.

There are no identified drinking water sources down gradient of the site. Due to the proximity of the site to the estuarine section of the River Colligan and the saline conditions adjacent to the site there is no potential for the development of groundwater resources for drinking water purposes down gradient of the landfill site. No impact on drinking water sources has been identified.

There is potential for impact on the surface water bodies down gradient of the site due to the discharge of groundwater to the surface water bodies. Clonea Beach is located approximately 6km down gradient of the landfill site and is designated as a Bathing Water Area. The Bathing Water Quality In Ireland Report (EPA, 2015) indicates the Clonea Strand Bathing Water Area has an overall status assessment of excellent. No impact on bathing water down gradient of the site has been identified. Due to the distance from the landfill site and the dilution available in the Colligan Estuary and Dungarvan Harbour the landfill site is not considered to represent a risk to the Bathing Water Quality.

There is a shellfish area located 4km down gradient of the site. No impact on the shellfish water has been identified. Due to the distance from the landfill site and the dilution available in the Colligan Estuary and Dungarvan Harbour the landfill site is not considered to represent a risk to the shellfish area.

The Dungarvan Harbour SPA includes the Colligan Estuary which is located immediately adjacent to the site. The SPA extends to the highest point to which ordinary tides flow. There is potential for the leachate to impact on the surface water quality in the River Colligan and Colligan Estuary adjacent to the site. In particular increase nutrients such as ammonia could impact on the aquatic habitats. Surface water quality monitoring is undertaken by WCC at 5 no. locations as shown on Drawing MDR0350/DG0505 Monitoring Points (Appendix A):-

- SW1 – northern eastern boundary of site in Colligan Estuary in area indicated as transitional water body with saline effects / brackish water expected;
- SW2 – northern boundary of site also indicated as being within Colligan Estuary located to point to "highest point to which ordinary tides flow" based on historic maps;
- EPA Station No. 280 located on River Colligan upstream of landfill located in area of River Colligan unaffected by tidal conditions;
- EPA Station No. 300 located at Ballyneety Bridge in Colligan Estuary located downstream of landfill and subject to saline conditions;
- Surface water lagoon.

The surface water results have been compared to a number of limits for screening purposes:-

- EQS for surface water based on the EPA / GSI 2003 publication Towards Setting Guideline Values for the Protection of Groundwater In Ireland;
- Category A1 limits, i.e. least treatment, set by the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989;
- European Union (Drinking Water) Regulations 2014 (SI No. 122 of 2014).
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations 2009 (Table 10 physico-chemcial conditions supporting the biological elements).
- European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2012.

Lead

Lead was not listed in EPA publication (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010). Lead was previously listed as List II i.e. substances that are to be controlled to prevent groundwater pollution. The Groundwater Regulations set the threshold value for lead at 18.75 ug/l. At RC6a elevated concentration of 200 ug/l reported on Q2 2014 but the levels subsequently reduced to less than screening value. In general the concentration of lead was below the screening values at the site.

Conclusion

The installation of the final capping has significantly reduced the volume of leachate being generated. The original waste licence application calculated that the annual leachate generation at the site between 1985 and 2002 ranged from 41,709m^3/annum to 63,910m^3/annum while post capping based on the upper bound figure of 10% infiltration of effective rainfall leachate generation is expected to be of the order of 5,670m^3/annum. On this basis the site is considered to be meeting the limit objective with respect to the discharge of non hazardous substances (ammonia, iron, manganese, aluminium, chloride, potassium, nickel, barium and lead).

The dissolved oxygen levels and the iron and manganese concentrations indicate that natural attenuation is taking place at the site with reductions seen at RC7 the down gradient monitoring location in the overburden deposits.

No list I / II organic substances have been detected at concentrations above the detection limits at the site during the 2014 / 2015 monitoring rounds. Arsenic is the only hazardous substance identified to exceed the screening values at the site and the exceedance related to monitoring locations RC3a in the groundwater in the bedrock beneath the waste body during Q3 2014. The arsenic concentrations at the other monitoring locations were within the screening values and arsenic contamination is not considered to be an issue at the site. It is recommended that monitoring of arsenic levels be increased to quarterly and the situation monitored.

The contamination plume is limited to the area in the immediate vicinity of the waste body as the groundwater and leachate is discharging to the adjacent surface water (River Colligan/Colligan Estuary) where significant dilution is available.

4.2 IMPACT ON RECEPTORS

Prior to the preparation of this hydrogeological review a Generic Quantitative Risk Assessment had not been undertaken at the site. As part of this report the results of the 2014 and 2015 groundwater monitoring at the site have been reviewed and compared to screening values as part of the risk assessment process. The results indicate there is potential for impact on the groundwater quality beneath the landfill site.

The landfill site is unlined and the results of the groundwater monitoring at the site indicate that the shallow groundwater in the overburden deposits and the deeper groundwater in the bedrock aquifer beneath are contaminated based on the results from the current groundwater monitoring boreholes. Ammonia has been identified as the main contaminant of concern as it occurs in concentrations which exceed the 100 times the screening value (threshold value of 0.065 mg/l).

Chloride

RC4 indicates background chloride concentration of 29 to 33 mg/l in the groundwater in the bedrock. Down gradient of the waste body the chloride concentration in the deeper groundwater is seen to increase at RC3a (range 95 to 165 mg/l) and at RC6A (range 98 to 443 mg/l).

In the shallower groundwater in the overburden deposits the concentration at GW1 ranged from 16 to 54 mg/l. Monitoring location RC7 down gradient of the landfill site compared displayed a range of 670 to > 7,333 mg/l. Monitoring location RC7 is tidal in nature and the chloride concentration will be affected by saline conditions. Chloride is not classed as a hazardous substance.

Arsenic

Arsenic is classed as a hazardous substance (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010). Concentrations in excess of the IGV of 10 ug/l and the threshold value (SI No. 9 of 2010) were measured at RC3a 21 ug/l in Q3 2014. No other exceedances were seen at any of the monitoring points for the remainder of the 2014 and 2015 samples date. On this basis arsenic not considered to be an issue at the site. It is recommended that the situation be monitored to confirm that arsenic is not an issue at the site with the quarterly monitoring of arsenic at the compliance monitoring points.

Potassium

The background potassium concentration at RC4 ranged from < 0.25 to 1.6 mg/l. Potassium elevated in bedrock aquifer at RC3a (range 3.9 to 43 mg/l) and RC6a (range 2.7 to 50 mg/l) indicating impact on groundwater from landfill. In RC7 in the shallower groundwater the concentration ranged from 3.4 to 230 mg/l and is affected by saline conditions. Potassium is not classed as a hazardous substance.

Nickel

At RC4 which is considered to represent background concentrations a nickel concentration < 1.0 ug/l (detection limit). Concentrations above the 15 ug/l threshold set in the groundwater regulations were measured at RC3a. At RC3a the nickel concentration in Q2 2014 was 38 ug/l and 43 ug/l in Q3 2014. The concentration subsequently reduced to 3.8 ug/l in Q1 2015. No indication of widespread nickel contamination in the groundwater with all other sampling locations indicting concentrations within the screening values. Nickel is listed as non hazardous substance (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010).

Barium

Barium is listed as non-hazardous substance (Classification of Hazardous and Non Hazardous Substances In Groundwater, EPA December 2010). Barium concentrations above the IGV of 100 ug/l were measured at a number of locations. At GW1 in Q3 2014 a concentration of 120 ug/l was reported. At RC3a in Q2 2014 a level of 110 ug/l was measured with 210 ug/l in Q3 2014 however the levels subsequently reduced in Q1 2015 to 18 ug/l. At RC7 in Q3 2014 a concentration of 120 ug/l was detected.

Low iron concentrations are seen at RC4 which is considered to represent the background groundwater quality in the bedrock aquifer. The other groundwater monitoring boreholes in the bedrock indicated elevated concentrations. The iron concentration at RC3a indicated a range of 500 to 9,700 ug/l with a range of 170 to 6,000 ug/l at RC6a. Higher concentrations were seen in the groundwater in the overburden at GW1 where levels of 400 to 45,000 ug/l were observed but generally < 20,000 ug/l. RC7 in overburden deposits down gradient of site indicates a typical iron concentration of 730 to 1,900 ug/l. The elevated iron concentrations in the groundwater within the landfill site are as a result of the low levels of dissolved oxygen and indicate that natural attenuation processes are taking place beneath the waste body particularly within the overburden deposits.

The concentration of iron is currently monitored on a quarterly basis in accordance with the Waste Licence and it is recommended that this monitoring frequency be maintained at the compliance monitoring points.

Manganese

There are no groundwater threshold values specified for manganese in the Groundwater Regulations. Manganese is not classed as a hazardous substance in the EPA publication "Classification of Hazardous and Non Hazardous Substances In Groundwater" (EPA, December 2010). The IGV for manganese is 50 ug/l. The manganese concentration is only above 100 times the screening value at GW1 in Q3 2014.

RC4 which is considered to represent the background concentration in the bedrock aquifer indicated a concentration range of < 5 to 20 ug/l. Elevated manganese concentrations were measured in bedrock aquifer beneath the waste body at RC3a (range of 210 to 2,300 ug/l) and RC6a (range 14 to 450 ug/l). Significantly higher levels are seen in the groundwater in the overburden deposits at GW1 (range 350 to 5,500 ug/l). The concentrations are seen to significantly reduce at RC7 (range < 5 to 81 ug/l) down gradient of the landfill. The monitoring results indicate elevated manganese concentrations in the groundwater as a result of the low levels of dissolved oxygen and indicate that natural attenuation processes are taking place beneath the waste body particularly within the overburden deposits.

The Waste Licence for the site requires annual monitoring of manganese. It is recommended that the compliance monitoring include quarterly monitoring of manganese for monitoring of trends at the compliance monitoring points.

Aluminium

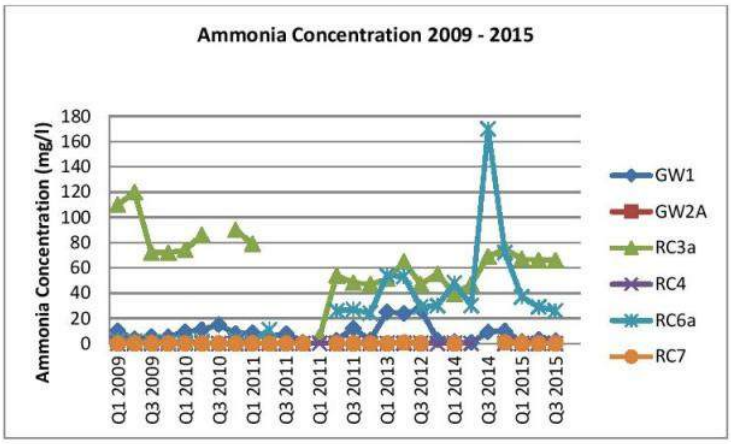
The aluminium concentration is monitored at the site even though it is not listed as a requirement of the waste licence. Elevated concentrations were measured at a number of locations on the same sampling dates. Elevated concentrations were measured at : GW1 in Q2 2014 1,700 ug/l and 1,000 ug/l in Q3 2014; RC6a Q2 2014 1,000 ug/l and 260 ug/l in Q3 2014 and RC7 Q2 2014 concentration of 1,000 ug/l and Q3 2014 1,200 ug/l. Aluminium is not classed as a hazardous substance in the EPA publication "Classification of Hazardous and Non Hazardous Substances In Groundwater" (EPA, December 2010).

Ammonia

S.I. No. 9 of 2010 – European Communities Environmental Objectives (Groundwater) regulations, 2010, Schedule 5 specifies a threshold value of 0.065 mg/l for ammonia under the test "Assessment of adverse impacts of chemical inputs from groundwater on associated surface water bodies". Due to the proximity of the adjacent Dungarvan Harbour SPA this has been taken as the screening value.

Ammonia is not classed as a hazardous substance but it has been identified as the main parameter of concern at the site. Concentrations greater than 100 times the threshold value of 0.065 mg/l have been measured at the site at monitoring locations RC3a (bedrock) and RC6a (bedrock) on all sampling dates and at GW1 in Q3 2014. On this basis the monitoring data for ammonia for the period 2008 to 2015 was reviewed and is presented on **Figure 4.1** to demonstrate trends to determine if there is any evidence of an expanding or shrinking plume at the site. Similar ammonia concentrations are seen at RC3a (range 39 to 75mg/) and RC6a (range 26 to 72 mg/l) for the 2014 and 2015 data. There is no borehole log is available for monitoring borehole RC7 but it is reported to be monitoring the shallow groundwater in the overburden deposits down gradient of the site. Monitoring at RC7 indicates there is no issue with elevated ammonia concentrations in the shallow groundwater in the overburden deposits down gradient of the site.

Figure 4.1: Ammonia Concentration 2009 - 2015



The concentration of ammonia is currently monitored on a quarterly basis in accordance with the Waste Licence and it is recommended that this monitoring frequency be maintained. It is recommended that a groundwater monitoring borehole be installed in the bedrock aquifer down gradient of the site to serve as a compliance monitoring point.

Iron

There are no groundwater threshold values specified for iron in the Groundwater Regulations. Iron is not classed as a hazardous substance in the EPA publication "Classification of Hazardous and Non Hazardous Substances In Groundwater" (EPA, December 2010). The IGV for iron is 200 ug/l. A concentration (45,000 ug/l) in excess of 100 times IGV was measured at GW1 in Q1, 2014

BH Code	Interpretation of Monitoring Results 2014 & Q1 2015	Monitoring Interval
RC6a	The dissolved oxygen concentration is low ranged from 12 to 25% saturation. The electrical conductivity is high ranging from 1,291 to 2,170 us/cm. The ammonia concentration is high 26 to 72 mg/l. The chloride ranged from 98 to 443 mg/l. Iron concentration is elevated 2014 range 2,600 to 6,000 ug/l and 2015 range 170 to 1,900 ug/l above IGV 200 ug/l. Lead Q2 2014 200 ug/l above IGV 100 ug/l and threshold 18.75 ug/l but significantly lower in Q3 2014 and Q1 2015. Manganese in Q2 450 ug/l, 140 ug/l in Q3 but 14 ug/l in Q1 2015. Potassium elevated ranged from 2.7 to 50 mg/l. Aluminium elevated Q2 2014 1,000 ug/l and Q3 260 ug/l. but was < IGV in Q1 2015 with concentration of 11 ug/l.	Located in south eastern area of site. Monitoring interval groundwater in bedrock aquifer but waste fill present between ground level and 5.60mbgl.
RC7	The dissolved oxygen concentration ranged from 29.6 to 77% saturation. This monitoring location is influenced by the proximity to the Colligan Estuary and this results in elevated salinity with subsequent effects on electrical conductivity, chloride, boron, sodium, potassium and aluminium. The ammonia concentrations at this point are generally < IGV of 0.15 mg/l with only one sampling date Q3 2014 at 0.85mg/l being slightly above threshold value. The iron concentration is typically above the 200 ug/l IGV except Q1 2015 but typically > 700 ug/l. The manganese concentration is only slightly elevated with concentrations of 52 to 81 ug/l.	This borehole is located outside of the landfill site down gradient of site adjacent to River Colligan. There is no borehole log available but it is reported to be monitoring the groundwater composition in the overburden deposits. This monitoring location is affected by tidal influence.
RC8	This borehole is not currently being sampled. There is no sampling tubing present. This borehole is used to provide top up water for leachate dilution in the ICW.	There is no borehole log available for this monitoring location. It is reported to be monitoring the groundwater composition in the overburden deposits.

The assessment of the available groundwater monitoring data for 2014 and 2015 confirms that the following parameters are present at concentrations above the screening levels: ammonia, iron, manganese, aluminium, chloride, arsenic, potassium, nickel, barium and lead. The main contaminant of concern at the site is ammonia. The monitoring indicates low levels of dissolved oxygen. Of these parameters only arsenic is listed as hazardous in the EPA publication "Classification of Hazardous and Non Hazardous Substances in Groundwater" (EPA, December 2010). Based on the available monitoring results there is evidence that the landfill site is impacting on the composition of both the shallow and deep groundwater at the site.

Table 4.2: Summary of Groundwater Monitoring 2014 - 2015

BH Code	Interpretation of Monitoring Results 2014 & Q1 2015	Monitoring Interval
GW1	Dissolved oxygen levels low. Ammonia is elevated 0.67 to 9.9 mg/l in 2014 and 1.4 to 3.3 mg/l in 2015 which is above the 0.15 mg/l IGV. Iron concentration high 5,500 to 45,000 ug/l in 2014 and 400 to 17,000 ug/l in 2015 which is significantly above the IGV of 200 ug/l. Manganese also elevated 1,800 to 5,500ug/l in 2014 and 350 ug/l in 2015 above the IGV of 50 ug/l. Aluminium elevated 13 to 1,700 ug/l. With exception of iron, manganese and aluminium metals are not elevated. Electrical conductivity higher than IGV but less than drinking water limit. List I/II substances not detected. No hazardous substances at concentrations above screening levels.	Located close to southern boundary of landfill site. Expected to be monitoring up gradient groundwater quality in the overburden deposits. No evidence of waste in borehole log.
GW2a	GW2a was dry on all sampling dates in 2014 and 2015. No data available.	Located in southern area of site. This monitoring borehole is within overburden. Some made ground / waste material encountered between GL and 1.50m. Monitoring interval 1.00m to 11.00m monitoring shallow groundwater and possible leachate.
RC3a	Low dissolved oxygen. Electrical conductivity, chloride and potassium elevated. Ammonia ranged from 39 to 75 mg/l which is significantly higher than the level in the adjacent monitoring borehole GW1. Arsenic 21 ug/l Q3 2014 slightly above IGV 10 ug/l. The chloride concentration ranged from 85 to 165 mg/l which is above the IGV and significantly higher than concentration in adjacent GW1. Iron range 2014 1,200 to 9,700 ug/l and in 2015 ranged from 500 to 4,700 ug/l above 200 ug/l IGV. Manganese 210 – 2,300 2014 / 2015 higher than IGV 50 ug/l. Arsenic 21 ug/l in Q3 2014 but less than IGV on other sampling dates. The potassium concentration ranged from 3.9 to 43 mg/l above IGV of 5 mg/l. Nickel Q2 and Q3 elevated 38/43 ug/l above 20 ug/l IGV. Barium ranged from 18 to 210 ug/l above IGV of 100 ug/l.	Located in southern area of landfill, close to GW1. Monitoring groundwater in bedrock aquifer.
RC4	Dissolved oxygen levels higher than RC3a and GW1. Electrical conductivity closer to expected background levels. Ammonia ranged from 0.025 to 0.65 mg/l. Chloride ranged from 29 to 33 mg/l. TON a lot higher than GW1 and RC3a. Iron ranged from 23 to 8,900 ug/l but generally less than 200 ug/l IGV. Manganese less than IGV on all sampling dates. Aluminium ranged from < 10 to 13 ug/l which is less than IGV of 200 ug/l.	Located in south west area of site. Some waste encountered in top of borehole but monitoring interval in bedrock aquifer. Considered to be most representative location in terms of natural background concentrations in bedrock aquifer.

The screening values which have been used for the identification of the contaminants of potential concern are summarised in **Table 4.1** below. The IGV values have been taken as the screening levels (GAC). Where an IGV has not been specified the Drinking Water Limit has been taken as the screening value (GAC).

Table 4.1: Screening Values Used To Identify Contaminants of Potential Concern

Parameter	EPA / GSI IGV Limits	Drinking Water Regulations S.I. No. 122 of 2014	S.I. 9 2010 GW Regs Limits Column 2 Adverse Impact on SW Bodies	S.I. 9 2010 GW Regs Limits Column 3 Drinking Water Protected Area	S.I. 9 2010 GW Regs Limits Column 4 Ability to Support Human Uses
Ammonia (mg/l)	0.15	0.30	0.065	0.175	0.175
Aluminium (ug/l)	200	200			
Chloride (mg/l)	30	250		187.5	
Electrical Conductivity (us/cm)	1,000	2,500		1,875	
Iron (ug/l)	200	200			
Manganese (ug/l)	50	50			
Dissolved Oxygen	No Abnormal Change				
Sodium (mg/l)	150	200		150	
Potassium (mg/l)	5				
Total Organic Carbon (mg/l)	No Abnormal Change	No Abnormal Change			
Total Oxidised Nitrogen (mg/l)	No Abnormal Change				
Boron (ug/l)	1,000	1,000		750	750
Calcium (mg/l)	200	200			
Arsenic (ug/l)	10	10			7.5
Iron (ug/l)	200	200			
Lead (ug/l)	100	100			18.75
Magnesium (mg/l)	50	50			
Manganese (ug/l)	50	50			
Nickel (ug/l)	20	20			15
Potassium (mg/l)	5	12			
Selenium (ug/l)		10			
Phenols (ug/l)	0.5				
T Coli (Cfu/100ml)	0	0			
E Coli (CFu/100ml)	0	0			

The available results of the groundwater monitoring for 2014 and 2015 are presented in Appendix D. The assessment of the groundwater monitoring results to the screening values is presented in **Table 4.2** below.

4 ASSESSMENT OF GROUNDWATER IMPACTS & COMPLIANCE WITH GROUNDWATER REGULATIONS

The EPA guidance document outlines the technical assessments that are required to permit discharges to groundwater in accordance with the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI No. 9 of 2010) (Groundwater Regulations).

The objectives of the groundwater regulations are to:-

1. Prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater.
2. Protect, enhance and restore all bodies of groundwater to achieve good groundwater quantitative status and good groundwater chemical status by 22nd December, 2015.
3. Reverse any significant sustained upward trend in concentration of any pollutant to reduce pollution of groundwater.
4. Achieve compliance with any standards and objectives established for groundwater dependent protected area.

The technical assessment has included a review of the following data:-

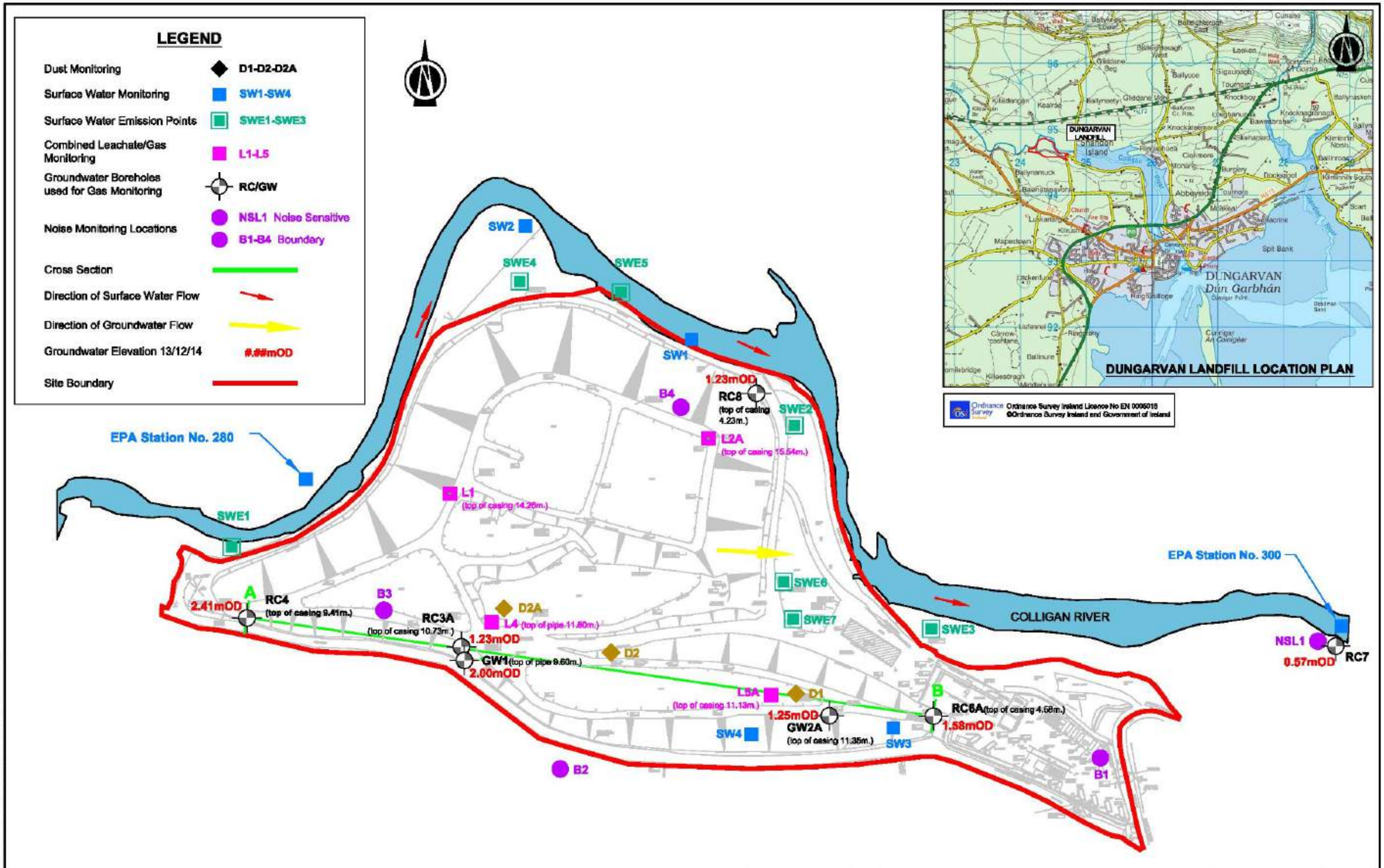
- All previous relevant reports for the Dungarvan Landfill including Annual Environmental Reports (2008 – 2014).
- All relevant historical groundwater levels and quality data and relevant surface water data.
- Relevant site investigation data.

4.1 EXTENT OF PLUME AND TRENDS

The available results of the groundwater monitoring for 2014 and 2015 have been compared to the limits specified in the following regulations and guidance in order to identify the contaminants of potential concern:-

- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (SI No. 9 of 2010).
- Towards Setting Guideline Values for the Protection of Groundwater In Ireland (EPA / GSI, 2003).
- Drinking Water Regulations (SI No. 122 of 2014).

The monitoring of the composition of the shallow groundwater in the overburden deposits is carried out at GW1,GW2A, RC7 and RC8. While the monitoring of the deeper groundwater in the bedrock aquifer takes place at RC3, RC4, RC6A. Monitoring location RC4 is considered to represent the groundwater quality up gradient of the site. The locations of the groundwater monitoring boreholes are illustrated on the Monitoring Locations Plan (Appendix A, Drawing MDR0350/DG0505).



NOTES

No.	Date	Amendment / Issue
R03		As Built Issue
R02		As Built Issue
R01		As Built Issue
F01		Final Issue

Client: WATERFORD COUNTY COUNCIL

Drawn By	Checked By	Approved By	Date
RH	SO'K	MS	April 2008

RPS

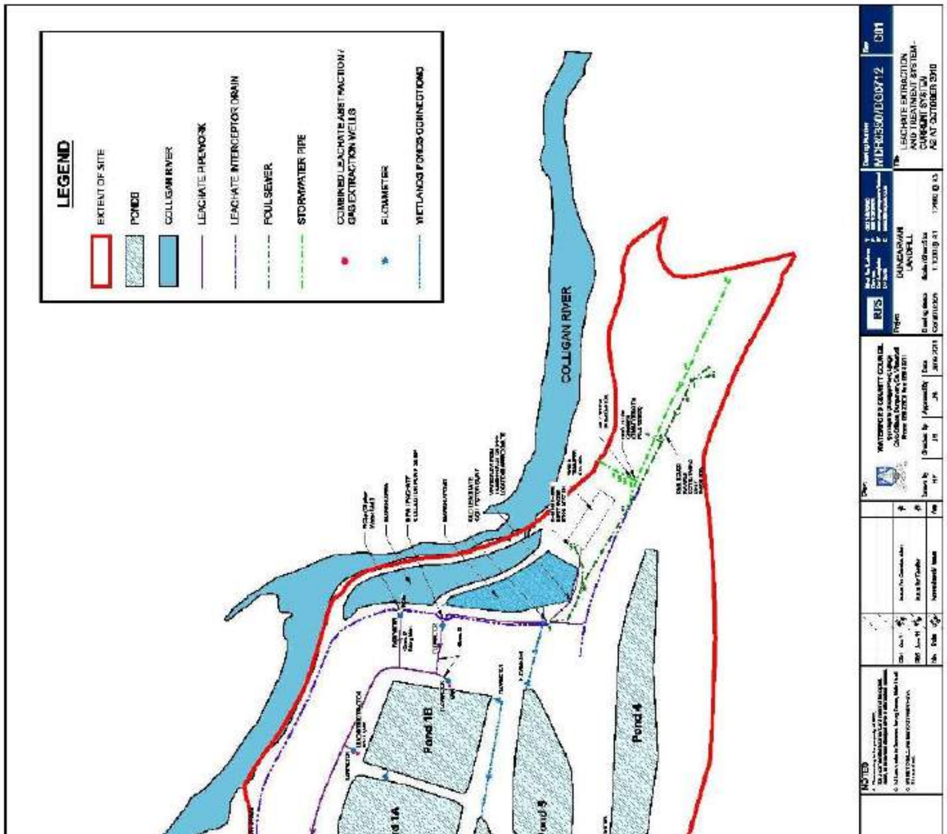
Project: DUNGARVAN LANDFILL

Drawing Status	Scale / Sheet Size	
As Built	1:1000 @ A1	1:2000 @ A3

Drawing Number: MDR0350/DG0505

Rev: R03

Title: MONITORING LOCATIONS


LEGEND
EXTENT OF SITE
PONDS
COLLIGAN RIVER
LEACHATE PIPEWORK
LEACHATE INTERCEPTOR DRAIN
FOUL SEWER
STORMWATER PIPE
COMBINED LEACHATE ABSTRACTION / GAS EXTRACTION WELLS
FLOWMETER
WETLANDS PONDS CONNECTIONS
COLLIGAN RIVER
Pond 1A
Pond 1B
Pond 2
Pond 3
Pond 4
Pond 5
WATERFORD COUNTY COUNCIL
DUNGARVAN LANDFILL
LEACHATE EXTRACTION AND TREATMENT SYSTEM - CURRENT SYSTEM AS AT OCTOBER 2010

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APPENDIX B

SITE INVESTIGATION DATA

Table B.1: Summary Details of Site Investigation Boreholes Dungarvan Landfill

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
GW1 Current	9.70m	9.60mOD		Water strike 5.60m Water strike 8.60m	1.00m to 9.00m in overburden	GL to 5.40m reddish brown sandy silty CLAY with occ large gravel & cobbles. 5.40m to 5.70m brown sandy gravely CLAY. 5.70m to 8.60m brown sandy clayey GRAVEL with cobbles. 8.60m to 9.70m brown silty CLAY with fragments of cobbles & boulders.
GW2A Current	11.50m	11.35mOD	1.25mOD	Water strike 7.60m Water strike 9.70m	1.00m to 11.00m in overburden & possible leachate	GL to 1.50m Made ground (domestic refuse plastic and glass). 1.50m to 4.40m reddish brown silty SAND with occ fine gravel. 4.40m to 7.50m reddish brown silty sandy CLAY. 7.50m to 8.30m brown silty clayey GRAVEL with cobbles. 8.30m to 9.20m brown silty CLAY with some cobbles. 9.20m to 11.50m fine to coarse brown clayey GRAVEL.
RC1 Not monitored	25.50m			Not being monitored	16.50m to 25.50m groundwater in bedrock.	GL to 2.80m Made ground domestic waste in clayey matrix. 2.80m to 10.0m brown grey, fine grained moderately weathered LIMESTONE. Cavity present 5.90m to 6.30m. 10.0m to 25.50m light grey white, calcitic LIMESTONE with localised clay infill.

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
				30.30m. Cavity 33.20m to 34.70m. Increasingly fractured from 33m.Water encountered at 6.55m, 11.60m and 25.10 prominant seepage.		11.00m to 24.90m purple brown clayey GRAVEL. 24.90m to 35.00m light medium grey, fine grained LIMESTONE.
RC6A Current Groundwater in bedrock	17.00m	4.58mOD	2.08mOD confined. Top of rock -4.32mOD.	Cavity 10.70m to 11.40m, 11.90m to 12.30m, 13.00m to 14.00m, 15.10m to 16.90m.	9.90m to 12.0m	GL to 0.30m Overburden / brown clay fill. 0.30m to 5.60m Overburden / domestic waste. 5.60m to 8.80m brown silty SAND. 8.90m to 17.00m light grey, fine to medium grained fresh to slightly weathered LIMESTONE. Highly weathered and fractured from 12.30m to 12.90m.
RC7		2.12mOD	0.57mOD		Reported to be monitoring overburden	No borehole log
RC8			1.63mOD		Reported to be monitoring overburden	No borehole log
L1 Leachate	6.00m	14.26m			1.00m to 6.00m	GL to 0.20m Made ground brown gravely clay. 0.20m to 6.00m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay.
L2 Leachate	7.50m	15.54m			1.00m to 7.00m	GL to 1.00m Made ground composed of brown gravely clay. 1.00m to 6.60m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay.

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
RC2 Not monitored Groundwater in bedrock	23.00m			Borehole collapsing due to cavities 17.00m to 23.00m. Cavity 14.20m to 14.90m. Cavity 17.00m to 17.90m. Cavity 19.20m to 19.60m.	13.90m to 17.00m	GL to 1.60m brown sandy, gravely clay fill. 1.60m to 6.55m domestic waste. 6.55m to 13.00m brown sandy gravely CLAY. 13.00m to 23.00m grey fine grained slightly weathered LIMESTONE with prominent cavities throughout. 21.12 to 21.40m sand infill in matrix of limestone.
RC3 Current Groundwater in bedrock	19.30m	10.73mOD	0.93mOD. Top of rock 2.58mOD.	Cavity 9.10m to 9.40m and 9.90m to 10.00m. Cavities 10.81 to 10.82m and 11.00m to 11.10m. Highly fractured 14.37m to 14.60m. At 18.60m 20mm thick calcite vein.	8.90m to 19.30m	GL to 0.89m Overburden brown sandy clay fill with some concrete. 0.89m to 7.00m stiff brown sandy gravely CLAY with cobbles / boulders. 7.00m to 8.15m soft brown silty CLAY. 8.15m to 19.30m fine grained moderately weathered LIMESTONE with occasional localised clay infill.
RC4 Current Groundwater in bedrock	20.40m	9.41mOD	WL 2.21mOD confined. Top of rock 0.11mOD.	11.90m to 12.20m sand / gravel infill. At 18m soft silt / clay infill.	11.40m to 20.40m.	GL to 2.90m Overburden / domestic waste. 2.90m to 9.30m brown sandy, gravely CLAY (boulder clay). 9.30m to 11.60m grey brown moderately weathered SILTSTONE / MUDSTONE. 11.60m to 20.40m dark grey, quartz rich sandy SILTSTONE.
RC5 Not monitored Groundwater in bedrock	35.00m			Cavity 25.10m to 26.80m with clay infill. Cavity 28.90m to	25.90m to 28.60m. Borehole collapsing below 28.60m.	GL to 0.83m overburden / clay fill. 0.83m to 6.55m overburden / domestic waste. 6.55m to 11.00m dark grey silty peaty CLAY.

Table D.7: Summary of Groundwater Composition Groundwater Pond Outlet

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	^{0}C	6.0	11.0	14.2	5.8	17.6	19.8			
Dissolved Oxygen % sat		14.3	37	11	35	30	51.0			
pH	pH units	6.9	6.8	6.9	6.7	7.0	7.0	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	426	521	925	673	720	623	1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$									
Ammonia	mg/l	0.053	0.12	< 0.02	9.5	0.03	0.069	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	40	56	106	80	64	57	30	24 – 187.5	250
TON	mg/l	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20			No abnormal change
TOC	mg/l									
Arsenic	ug/l		< 1.0	< 1.0	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		62	120	11			1,000	750	1,000
Cadmium	ug/l		< 0.02	< 0.02	< 0.02			5	3.75	5
Calcium	mg/l		51	86	8.3			200		200
Cobalt	ug/l		< 1.0	< 1.0	< 1.0					
Iron	ug/l	440	650	710	28	990	1,200	200		200
Lead	ug/l		< 1.0	< 1.0	< 1.0			100	18.75	100
Magnesium	mg/l		6.7	18	< 0.25			50		50
Manganese	ug/l		760	300	28			50		50
Nickel	ug/l		1.7	2.9	< 1.0			20	15	20

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		390	6,500	95	1,100	2,600	150	150	150
Strontium	ug/l		440	5,400	86					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	2	< 1.0			9		
Vanadium	ug/l		1.4	< 10	< 1.0					
Phenol	ug/l							0.5		
Nitrite	mg/l		-					0.1		0.50
Ortho-phosphate	mg/l		0.026					0.03	0.035 MRP	
Alkalinity	mg/l		212							
Fluoride	mg/l		< 0.75					1.0		0.8 / 1.5
Sulphate	mg/l		100					200	187.5	250
List I / II	ug/l									
Aluminium	ug/l		1,000	1,200	22			200	150	200
Barium	ug/l		11	120	1.5			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		2					30	37.5	50
Copper	ug/l		2.5					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		16					100		

Table D.6: Summary of Groundwater Composition RC7

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	^{0}C	11.1	11.1	14.0	10.6	11.8	12.5			
Dissolved Oxygen % sat		29.6	30	42	77	46.1	30			
pH	pH units	7.3	7.2	7.1	6.7	7.3	7.0	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	2840	2800	NM	NM	NM	NM	1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$	1.3	1.3	22.3	3.1	3.9	8.4			
Ammonia	mg/l	0.02	< 0.02	0.85	0.026	< 0.02	< 0.02	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	670	NR	> 7,333	1,840	2,200	4,700	30	24 – 187.5	250
TON	mg/l	3.6	4.2	1.6	1.5	2.1	0.87			No abnormal change
TOC	mg/l									
Arsenic	ug/l		< 1.0	< 10	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		230	2,500	43			1,000	750	1,000
Cadmium	ug/l		0.05	0.49	< 0.02			5	3.75	5
Calcium	mg/l		82	350	9.7			200		200
Cobalt	ug/l		< 1.0	1.8	< 1.0					
Iron	ug/l	1,500	730	1,500	29	990	1,900	200		200
Lead	ug/l		1.1	1.1	< 1.0			100	18.75	100
Magnesium	mg/l		50	820	11			50		50
Manganese	ug/l		52	81	< 5.0			50		50
Nickel	ug/l		1.8	3.1	< 1.0			20	15	20
Potassium	mg/l		20	230	3.4	48	95	5		12

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		61	150	9	70	72	150	150	150
Strontium	ug/l		240	300	36					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	< 1.0	< 1.0			9		
Vanadium	ug/l		2	1	< 1.0					
Nitrite	mg/l							0.1		0.50
Ortho-phosphate	mg/l		0.01					0.03	0.035 MRP	
Alkalinity	mg/l		395							
Fluoride	mg/l		0.5					1.0		0.8 / 1.5
Sulphate	mg/l		32					200	187.5	250
List I / II	ug/l		BLD							
Aluminium	ug/l		1,000	260	11			200	150	200
Barium	ug/l		34	37	3.9			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		14					30	37.5	50
Copper	ug/l		12					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		88					100		

Table D.5: Summary of Groundwater Composition RC6a

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	^{0}C	10.9	12.0	12.2	11.5	12.0	12.4			
Dissolved Oxygen % sat		25.0	21.0	16	12.0	14.0	22			
pH	pH units	7.1	6.9	7.2	6.8	7.0	7.0	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	1,529	1,226	2,170	1,443	1,294	1,291	1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$	-	-	-	-	-	-			
Ammonia	mg/l	48	30	72	37	29	26	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	120	98	443	136	112	105	30	24 – 187.5	250
TON	mg/l	9	8.9	8	8.1	8.3	7.1			No abnormal change
TOC	mg/l									
Arsenic	ug/l		2.1	1.2	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		170	350	25			1,000	750	1,000
Cadmium	ug/l		0.55	0.1	< 0.02			5	3.75	5
Calcium	mg/l		100	110	12			200		200
Cobalt	ug/l		2.6	2.6	< 1.0					
Iron	ug/l	6,000	4,900	2,600	170	1,400	1,900	200		200
Lead	ug/l		200	6.5	2.5			100	18.75	100
Magnesium	mg/l		19	27	1			50		50
Manganese	ug/l		450	140	14			50		50
Nickel	ug/l		5.4	4.2	< 1.0			20	15	20
Potassium	mg/l		23	50	2.7	22	21	5		12

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		12	13	1.4	12	13	150	150	150
Strontium	ug/l		320	330	35					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	< 1.0	< 1.0			9		
Vanadium	ug/l		< 1.0	< 1.0	< 1.0					
Nitrite	mg/l		< 0.004					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		216							
Fluoride	mg/l		< 0.25					1.0		0.8 / 1.5
Sulphate	mg/l		20					200	187.5	250
List I / II	ug/l									
Aluminium	ug/l		11	13	< 10			200	150	200
Barium	ug/l		8.6	9	1.3			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		1.1					30	37.5	50
Copper	ug/l		< 1.0					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		12					100		

Table D.4: Summary of Groundwater Composition RC4

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	^{0}C	10.8	11.3	11.7	10.7	12.0	12.5			
Dissolved Oxygen % sat		50.5	64	56	50	50	45			
pH	pH units	7.3	7.1	6.9	6.7	7.1	6.9	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	679	649	640	649	644	615	1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$	-								
Ammonia	mg/l	0.12	0.08	0.065	0.65	0.27	0.025	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	33	32	29	32	29	30	30	24 – 187.5	250
TON	mg/l	16	13	11	11	11	11			No abnormal change
TOC	mg/l									
Arsenic	ug/l		< 1.0	< 1.0	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		29	27	< 10			1,000	750	1,000
Cadmium	ug/l		0.02	0.03	< 0.02			5	3.75	5
Calcium	mg/l		96	100	11			200		200
Cobalt	ug/l		< 1.0	< 1.0	< 1.0					
Iron	ug/l	8,900	110	180	23	200	240	200		200
Lead	ug/l		< 1.0	< 1.0	< 1.0			100	18.75	100
Magnesium	mg/l		10	10	< 0.25			50		50
Manganese	ug/l		9.9	20	< 5.0			50		50
Nickel	ug/l		< 1.0	< 1.0	< 1.0			20	15	20
Potassium	mg/l		1.5	1.6	< 0.25	1.5	1.4	5		12

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		100	150	15	120	110	150	150	150
Strontium	ug/l		410	510	54					
Thallium	ug/l		1.4	< 1.0	< 1.0					
Uranium	ug/l		1.8	1.9	< 1.0			9		
Vanadium	ug/l		< 1.0	< 1.0	< 1.0					
Nitrite	mg/l		< 0.004					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		563							
Fluoride	mg/l		1					1.0		0.8 / 1.5
Sulphate	mg/l		29					200	187.5	250
List I / II	ug/l									
Aluminium	ug/l		17	24	< 10.0			200	150	200
Barium	ug/l		110	210	18			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		3.9					30	37.5	50
Copper	ug/l		1.5					30	1500	2,000
Molybdenum	ug/l		1.5							
Zinc	ug/l		18					100		

Table D.3: Summary of Groundwater Composition RC3a

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	^{0}C	11.8	11.2	12.5	11.8	12.8	13.1			
Dissolved Oxygen % sat		14.6	21.0	16.0	18.0	13.9	17.0			
pH	pH units	7.0	6.8	7.0	6.9	6.9	6.9	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	1,360	1,520	2,210	1,974	1,713	1,618	1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$	-								
Ammonia	mg/l	39	47	75	67	66	66	0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l	95	112	165	140	119	113	30	24 – 187.5	250
TON	mg/l	0.24	0.67	< 0.20	1.3	< 0.20	< 0.20			No abnormal change
TOC	mg/l									
Arsenic	ug/l		4.1	21	1.6			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		230	400	49			1,000	750	1,000
Cadmium	ug/l		0.36	0.18	< 0.02			5	3.75	5
Calcium	mg/l		110	120	11			200		200
Cobalt	ug/l		7.4	11	< 1.0					
Iron	ug/l	4,000	1,200	9,700	500	4,100	4,700	200		200
Lead	ug/l		< 1.0	< 1.0	< 1.0			100	18.75	100
Magnesium	mg/l		19	24	0.94			50		50
Manganese	ug/l		1,600	2,300	210			50		50
Nickel	ug/l		38	43	3.8			20	15	20
Potassium	mg/l		24	43	3.9	30	27	5		12

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Potassium	mg/l							5		12
Selenium	ug/l									10
Sodium	mg/l							150	150	150
Strontium	ug/l									
Thallium	ug/l									
Uranium	ug/l							9		
Vanadium	ug/l									
Phenol	ug/l							0.5		
Nitrite	mg/l							0.1		0.50
Ortho-phosphate	mg/l							0.03	0.035 MRP	
Alkalinity	mg/l									
Fluoride	mg/l							1.0		0.8 / 1.5
Sulphate	mg/l							200	187.5	250
List I / II	ug/l									
Aluminium	ug/l							200	150	200
Barium	ug/l							100		
Mercury	ug/l							1	0.75	1
Antimony	ug/l									5
Chromium	ug/l							30	37.5	50
Copper	ug/l							30	1500	2,000
Molybdenum	ug/l									
Zinc	ug/l							100		

Table D.2: Summary of Groundwater Composition GW2A

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
		No sample	No sample	No sample	Dry					
Date		22/01/14	07/04/14	15/09/14						
Temp	^{0}C									
Dissolved Oxygen % sat										
pH	pH units							6.5 – 9.5		6.5 to 9.5
EC	Us/cm							1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$									
Ammonia	mg/l							0.15mg/l	65 – 175 ug/l	0.30 mg/l
Chloride	mg/l							30	24 – 187.5	250
TON	mg/l									No abnormal change
TOC	mg/l									
Arsenic	ug/l							10	7.5	10
Beryllium	ug/l									
Boron	ug/l							1,000	750	1,000
Cadmium	ug/l							5	3.75	5
Calcium	mg/l							200		200
Cobalt	ug/l									
Iron	ug/l l							200		200
Lead	ug/l							100	18.75	100
Magnesium	mg/l							50		50
Manganese	ug/l							50		50
Nickel	ug/l							20	15	20

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Potassium	mg/l		2.7	5	0.3	3.7	3.8	5		12
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		9.6	15	1.3	15	13	150	150	150
Strontium	ug/l		230	340	44					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		1.7	< 1.0	< 1.0			9		
Vanadium	ug/l		4.1	2.2	< 1.0					
Nitrite	mg/l		0.008					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		317							
Fluoride	mg/l		< 0.25					1.0		0.8 / 1.5
Sulphate	mg/l		6.5					200	187.5	250
List I / II	ug/l		BLD							
Aluminium	ug/l		1,700	1,000	13			200	150	200
Barium	ug/l		70	120	10			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		2.8					30	37.5	50
Copper	ug/l		43					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		43					100		

List I / II BLD except Q2 toluene 0.7 ug/l but is less than IGV of 10 ug/l.

Table D.1: Summary of Groundwater Composition GW1

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Date		22/01/14	07/04/14	15/09/14	23/02/15	18/06/15	10/08/15			
Temp	^{0}C	10.5	10.5	12.6	10.8	13.3	14.2			
Dissolved Oxygen % sat		20.2	13.4	21.0	45	33.8	22			
pH	pH units	6.7	6.7	6.5	6.6	6.6	6.5	6.5 – 9.5		6.5 to 9.5
EC	Us/cm	905	680	930	1,049	1,145	1,108	1,000	800 - 1875	1,500
Salinity	$^{0}/_{00}$	-	-	-	-	-	-			
Ammonia	mg/l	1.6	0.67	9.9	1.4	3.3	2.2	0.15mg/l	0.065 – 0.175 mg/l	0.30 mg/l
Chloride	mg/l	22	19	54	32	21	16	30	24 – 187.5	250
TON	mg/l	< 0.20	< 0.20	0.57	< 0.20	< 0.20	< 0.20			No abnormal change
Arsenic	ug/l		2.8	4.9	< 1.0			10	7.5	10
Beryllium	ug/l		< 1.0	< 1.0	< 1.0					
Boron	ug/l		22	37	< 10			1,000	750	1,000
Cadmium	ug/l		0.36	0.05	< 0.02			5	3.75	5
Calcium	mg/l		120	150	21			200		200
Cobalt	ug/l		4.7	5.9	< 1.0					
Iron	ug/l l	45,000	5,500	15,000	400	17,000	13,000	200		200
Lead	ug/l		12	1.6	< 1.0			100	18.75	100
Magnesium	mg/l		7.4	12	< 0.25			50		50
Manganese	ug/l		1,800	5,500	350			50		50
Nickel	ug/l		5.7	2.7	< 1.0			20	15	20

APPENDIX D

GROUNDWATER QUALITY MONITORING DATA

Table C.10: Surface Water Quality Monitoring Annual Parameters Surface Water Lagoon

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS Inland Surface Waters	SI No. 272 of 2009 AA-EQS Other Surface Waters	SI No. 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	Station 300 2015	Station 300 2014	Station 300 2013	Station 300 2012	Station 300 2011	Station 300 2010
Sampling Date										07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		0.078				
Chloride	mg/l	250	250	250	-	-	-	-		52				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		0.009				
Ortho-phosphate	mg/l	-			-	-	-	-		0.011				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		< 0.20				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		3.4	10			

Table C.9: Surface Water Quality Monitoring Annual Parameters EPA Station No. 300

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS Inland Surface Waters	SI No. 272 of 2009 AA-EQS Other Surface Waters	SI No. 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	Station 300 2015	Station 300 2014	Station 300 2013	Station 300 2012	Station 300 2011	Station 300 2010
Sampling Date										07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		No sample				
Chloride	mg/l	250	250	250	-	-	-	-						
Nitrite	mg/l	0.2	-	0.50	-	-	-	-						
Ortho-phosphate	mg/l	-			-	-	-	-						
Total Oxidised Nitrogen	mg/l	-			-	-	-	-						
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-			3.3			
Sulphate	mg/l	200	200	250	-	-	-	-			110			

Table C.8: Surface Water Quality Monitoring Annual Parameters EPA Station No. 280

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS Inland Surface Waters	SI No. 272 of 2009 AA-EQS Other Surface Waters	SI No. 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	Station 280 2015	Station 280 2014	Station 280 2013	Station 280 2012	Station 280 2011	Station 280 2010
Sampling Date										07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		< 0.02				
Chloride	mg/l	250	250	250	-	-	-	-		17				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		< 0.004				
Ortho-phosphate	mg/l	-			-	-	-	-		0.013				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		2.2				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		4.6	5.2			

Table C.7: Surface Water Quality Monitoring Annual Parameters SW2

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS Inland Surface Waters	SI No. 272 of 2009 AA-EQS Other Surface Waters	SI No. 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	SW2 2015	SW2 2014	SW2 2013	SW2 2012	SW2 2011	SW2 2010
Sampling Date										07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		0.021				
Chloride	mg/l	250	250	250	-	-	-	-		16				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		< 0.004				
Ortho-phosphate	mg/l	-			-	-	-	-		0.014				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		2.2				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		4.8	5.9			

Table C.6: Surface Water Quality Monitoring Annual Parameters SW1

Parameter	Units	EQS Surface Waters GSI / EPA	Cat A1 SI 294 of 1989 Limits	SI No. 122 of 2014 Drinking Water Limits	SI No. 272 of 2009 AA-EQS Inland Surface Waters	SI No. 272 of 2009 AA-EQS Other Surface Waters	SI No. 272 of 2009 MAC EQS Inland Surface Waters	SI No. 272 of 2009 MAC EQS Other Surface Waters	SW1 2015	SW1 2014	SW1 2013	SW1 2012	SW1 2011	SW1 2010
Sampling Date										07/04/14	13/05/13	No data	No data	No data
Ammonia	mg/l	0.02NH_3	0.2 NH_4	0.30	-	-	-	-		< 0.02	-			
Chloride	mg/l	250	250	250	-	-	-	-		16				
Nitrite	mg/l	0.2	-	0.50	-	-	-	-		< 0.004				
Ortho-phosphate	mg/l	-			-	-	-	-		0.011				
Total Oxidised Nitrogen	mg/l	-			-	-	-	-		2.2				
Fluoride	mg/l	5.0	1	0.8 / 1.5	0.5	1.5	-	-		< 0.25	< 0.25			
Sulphate	mg/l	200	200	250	-	-	-	-		5.4	6.9			

Table C.5: Quarterly Parameters SW300 Colligan Estuary

	Q1 2014	Q2 2014	Q3 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date			03/07/14		23/02/15	18/06/15			
BOD (mg/l)			< 1.0		1.2	< 1.0			5
COD (mg/l)			85		27	71			
Conductivity (us/cm)			7,820		1,583	NM		1,000	1,000
Dissolved Oxygen (% saturation)			103		98	83			> 60%
pH (pH units)			6.8		7.2	7.4			5.5 – 8.5
Suspended Solids (mg/l)			< 4		11	< 8			50
Temperature (deg C)			17.0		5.3	13.0			25
Salinity	$^{0}/_{00}$				0.6	2.8			

Table C.3: Quarterly Parameters SW1 – Colligan Estuary

	Q1 2014	Q2 2014	Q3 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date	22/01/14	07/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
BOD (mg/l)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		5
COD (mg/l)	< 20	< 20	< 20	< 20	< 20	25	< 20		
Conductivity (us/cm)	168	150	1,403	1,093	273	NM	144	1,000	1,000
Dissolved Oxygen (% saturation)	100.2	114	105	102	105	118	107		> 60%
pH (pH units)	7.3	7.3	6.8	6.8	7.0	7.5	7.2		5.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	< 8	< 8	< 4		50
Temperature (deg C)	7.6	10.0	15.9	14.1	6.1	14.8	14.9		25
Salinity	$^{0}/_{00}$				-	0.6			

Table C.4: Quarterly Parameters SW2 – Colligan Estuary

	Q1 2014	Q2 2014	Q3 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date	22/01/14	07/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
Ammonia (mg/l)								0.02	0.2
BOD (mg/l)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		5
COD (mg/l)	< 20	< 20	< 20	< 20	< 20	25	< 20		
Chloride (mg/l)								250	250
Conductivity (us/cm)	168	151	1,257	766	231	NM	142	1,000	1,000
Dissolved Oxygen (% saturation)	100.3	115	106	102	105	118.1	106		> 60%
pH (pH units)	7.2	7.3	6.7	6.8	7.1	7.0	7.2		5.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	< 4	< 4	< 4		50
Temperature (deg C)	7.6	10.1	16.0	14.6	6.2	14.8	15.0		25
Salinity	$^{0}/_{00}$				-	0.5			

Table C.1: Quarterly Parameters SW Lagoon

	SW lagoon Q1 2014	SW lagoon Q2 2014	SW lagoon Q3 2014	SW lagoon Q3 2014	SW lagoon Q1 2015	SW lagoon Q2 2015	SW lagoon Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date	22/01/14	07/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
BOD (mg/l)	2	1.4	< 1	1.2	< 1.0	3.6	1.9		5
COD (mg/l)	27	< 20	48	33	< 20	38	34		
Conductivity (us/cm)	537	483	565	923	699	589	519	1,000	1,000
Dissolved Oxygen (% saturation)	32.8	93	57	72	75.0	45	68		> 60%
pH (pH units)	7.4	7.1	7.0	7.1	7.1	7.3	7.1		5.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	< 4	15	< 4		50
Temperature (deg C)	5.6	11.5	17.1	14.2	5.5	15.6	16.4		25
Salinity	$^{0}/_{00}$				-	-			

Table C.2: Quarterly Parameters SW 280 River Colligan

	Q1 2014	Q2 2014	Q3 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	EQS EPA / GSI	Cat A1 SI 294 of 1989
Sample Date	22/01/14	07/04/14	03/07/14	15/09/14	23/02/15	18/06/15	10/08/15		
BOD (mg/l)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		5
COD (mg/l)	< 20	< 20	< 20	< 20	< 20	< 20	< 20		
Conductivity (us/cm)	158	143	160	155	142	161	132	1,000	1,000
Dissolved Oxygen (% saturation)	100.7	106.6	105	105	106	112	107		> 60%
pH (pH units)	7.2	7.3	6.7	6.8	6.7	7.4	7.2		5.5 – 8.5
Suspended Solids (mg/l)	< 4	< 4	< 4	< 4	15	< 4	< 4		50
Temperature (deg C)	7.6	10.2	15.9	14.1	5.9	14.9	15.2		25
Salinity	$^{0}/_{00}$				-	-			

APPENDIX C

SURFACE WATER QUALITY MONITORING DATA

Borehole Code	Total Depth	Elevation Top Of Casing	Groundwater Level 07/01/14	Comment	Groundwater Monitoring Interval	Strata Encountered
						6.60m to 7.50m brown silty sandy gravely CLAY.
L3 Leachate	10.00m			Water strike 9.50m rose to 8.10m after 30 mins.	1.00m to 9.00m	GL to 0.20m Made ground composed of brown gravely clay. 0.20m to 8.00m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay. 8.00m to 9.00m Made ground composed of decaying domestic waste. 9.00m to 10.00m Black silty (oily) GRAVEL with occ pockets of peaty clay with roots.
L4 Leachate	6.60m	11.80m		Water strike 3.80m rose to 3.20m in 30 mins.	1.00m to 6.00m	GL to 0.30m Made ground composed of brown gravely clay. 0.30m to 4.60m Made ground composed of domestic refuse with brick, plastic, wood, concrete and some gravely clay. 4.60m to 6.60m brown black silty CLAY with roots and occ large cobbles.
L5 Leachate	5.70m	11.13m		Water strike 3.80m.	1.00m to 5.00m	GL to 0.30m Made ground composed of brown gravely clay. 0.30m to 4.40m Made ground composed of domestic refuse with brick, plastic, wood and paper. 4.40m to 5.70m black silty CLAY with roots.

Range	Units	2015	2014	2013	2012	2011	2010	Interim Guideline Value for Groundwater GSI / EPA	Environmental Objectives Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit	Methanogenic Leachate Landfill Site Design Manual (EPA, 2000 Table 7.2)
Selenium	ug/l		< 1.0			3.7				10	
Sodium	mg/l		49			110			150	150	474 to 3,650
Strontium	ug/l		100								
Sulphate	mg/l		< 2.5	9.5		20		200	187.5	250	< 5 to 322
T Coli	Cfu/100							0		0	
Thallium	ug/l		< 1.0			1.7					
TOC	mg/l										
TON	mg/l		< 0.20	1.28		< 0.50				No abnormal change	
Vanadium	ug/l		< 1.0			2.4					
Zinc	ug/l		13			13		100		5,000	0.03 to 6.7

Range	Units	2015	2014	2013	2012	2011	2010	Interim Guideline Value for Groundwater GSI / EPA	Environmental Objectives Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit	Methanogenic Leachate Landfill Site Design Manual (EPA, 2000 Table 7.2)
Cobalt	ug/l		< 1.0			2.8					
COD	mg/l			31		147					
Copper	ug/l		< 1.0			3.5		30	1,500	2,000	< 0.02 to 0.62 mg/l
Cyanide	ug/l							10	37.5	50	
EC	Us/cm		530	703		1,720			800 - 1875	1,500	5,990 to 19,300
F Coli	Cfu/100							0		0	
Fluoride	mg/l		< 0.25	< 0.25		< 0.5		1.0		1,000	
Iron	ug/l l		610			1,300				200	1.6 to 160 mg/l
Lead	ug/l		3.1			2.4			18.75	100	< 0.04 to 1.9 mg/l.
List I / II organics			BLD								
Magnesium	mg/l		7.2			7.9		50		50	40 to 1,580
Manganese	ug/l		600			510		20		50	0.04 to 3.59 mg/l
Mercury	ug/l		< 0.50			< 0.5		1	0.75	1	< 0.0001 to 0.0008 mg/l
Molybdenum	ug/l		< 1.0			1					
Nitrite	mg/l			< 0.002							
Nickel	ug/l		2.2			5.1			15	20	< 0.03 to 0.6 mg/l
Ortho-phosphate	mg/l		< 0.01	0.02		0.23					
Potassium	mg/l		12			26				12	100 to 1,580

Table E.2: Summary of Leachate Composition Interceptor

Range	Units	2015	2014	2013	2012	2011	2010	Interim Guideline Value for Groundwater GSI / EPA	Environmental Objectives Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit	Methanogenic Leachate Landfill Site Design Manual (EPA, 2000 Table 7.2)
Date			07/04/14	13/05/13	No data	14/03/11	No data				
Temp	^{0}C		13.6	11.3		8.0					
pH	pH units		6.8	7.3		7.3				6.5 to 9.5	6.8 to 8.2
Alkalinity	mg/l					565		No abnormal change			3,000 to 9,130
Aluminium	ug/l		40	--		< 25		200		200	
Ammonia	mg/l		< 0.02	0.11		59			0.065 to 0.175	0.30	283 to 2,040 ammoniacal nitrogen-N
Antimony	ug/l		< 1.0	-		1.7				5	
Arsenic	ug/l		< 1.0	-		3.6			7.5	10	< 0.001 to 0.485mg/l
Barium	ug/l		12			27		100			
Beryllium	ug/l		< 1.0			1.4					
BOD	mg/l		2.1	1.9							
Boron	ug/l		78			170		1000	750	1,000	
Cadmium	ug/l		< 0.02			< 0.5		5	3.75	5	< 0.01 to 0.08 mg/l
Calcium	mg/l		44			43		200		200	23 to 501
Chloride	mg/l		70	90		173			24 – 187.5	250	570 to 4,710
Chromium	ug/l		1.3			8.3		30	37.5	50	< 0.03 to 0.56 mg/l

EntityName	StationName	StationLocalCode	SamplePurpose	SampleLabCode	SampleDate	Ammonia(N)	Ammonium(NH4)	BOD	Chemical Oxygen Demand	Chloride	Conductivity @ 20°C	Conductivity @ 25°C	Dissolved Oxygen % Saturation	Iron	pH	Potassium	Sodium	Suspended Solids	Temperature	Total Oxidised Nitrogen
Dungarvan	SW1		2 Landfill SW quarterly	1556 SW1 230215	23/02/2015		NT	BLD	BLD	NT	NT	273	105	NT	7	NT	NT	BLD	6.1	NT
Dungarvan	SW2		3 Landfill SW quarterly	1556 Sw2 230215	23/02/2015		NT	BLD	BLD	NT	NT	231	105	NT	7.1	NT	NT	BLD	6.2	NT
Dungarvan	SW300		5 Landfill SW quarterly	1556 SW300 230215	23/02/2015			1.2	27	NT	NT	1583	98	NT	7.2	NT	NT	11	5.3	NT
Dungarvan	GW1		5 landfil GW quarterly	1556 GW1gw230215	23/02/2015	1.4			NT	32	NT	1040	45	400	6.6	0.3	1.3	NT	10.8	BLD
Dungarvan	Interceptor		1 LANDFILL LEACHATE QUARTERLY	1556 Interceptor	23/02/2015		NT	1.2	BLD	NT	NT	693	NT	NT	7	NT	NT	NT	NT	NT
Dungarvan	Lagoon		1 Landfill SW quarterly	1556 Lagoon 230215	23/02/2015		NT	BLD	BLD	NT	NT	699	75	NT	7.1	NT	NT	BLD	1.5	1.5
Dungarvan	Pond Outlet		8 landfil GW quarterly	1556 Pond Outlet 23	23/02/2015	9.5			NT	80	NT	673	35	28	6.7	1.2	0.3	NT	5.8	BLD
Dungarvan	RC3a		2 landfil GW quarterly	1556 RC3agw 230215	23/02/2015	67			NT	140	NT	1974	18	500	6.9	3.9	15	NT	11.8	1.3
Dungarvan	RC4		1 landfil GW quarterly	1556 RC4gw 230215	23/02/2015	0.65			NT	32	NT	649	50	23	6.7	NT	1.4	NT	10.7	11
Dungarvan	SW280		3 Landfill SW quarterly	1556 SW280 230215	23/02/2015		NT	BLD	BLD	NT	NT	142	106	NT	6.7	NT	NT	15	5.9	NT
Dungarvan	GW1		5 landfil GW quarterly	1556 GW1gw 230215	23/02/2015	1.4		NT	NT	32	NT	1049	45	400	6.6	0.3	1.3	NT	10.8	BLD
Dungarvan	RC6a		4 landfil GW quarterly	1556 RC6gw 230215	23/02/2015	37		NT	NT	136	NT	1443	12	170	6.8	2.7	9	NT	11.5	8.1
Dungarvan	RC7		3 landfil GW quarterly	1556 RC7gw 230215	23/02/2015	0.026		NT	NT	1840	NT	NT	77	29	6.7	3.6	95	NT	10.6	1.5
Dungarvan	Pond Outlet		8 landfil GW quarterly	1556 Pond Outlet T	18/06/2015	0.03		NT	NT	64	NT	710	30	990	7	0.73	47	NT	17.6	BLD
Dungarvan	RC8		8 landfil GW quarterly	1556 RC8 160615	18/06/2015	NT		NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Dungarvan	GW1		5 landfil GW quarterly	1556 GW1 160615	18/06/2015	3.3		NT	NT	21	NT	1145	33.8	17000	6.6	3.7	15	NT	13.3	BLD
Dungarvan	RC3a		2 landfil GW quarterly	1556 RC3a 160615	18/06/2015	66		NT	NT	119	NT	1713	13.9	4100	6.9	30	120	NT	12.8	BLD
Dungarvan	RC4		1 landfil GW quarterly	1556 RC4 160615	18/06/2015	0.27		NT	NT	29	NT	644	50	200	7.1	1.5	12	NT	12	11
Dungarvan	RC6a		4 landfil GW quarterly	1556 RC6a 160615	18/06/2015	29		NT	NT	112	NT	1298	14	1400	7	22	70	NT	12	8.3
Dungarvan	RC7		3 landfil GW quarterly	1556 RC7 160615	18/06/2015	BLD		NT	NT	2200	NT	NT	46.1	990	7.3	48	1100	NT	11.8	2.1
Dungarvan	SW1		2 Landfill SW quarterly	1556 SW1 180615	18/06/2015		NT	BLD	25	NT	NT	NT	118	NT	7.5	NT	NT	BLD	16.8	NT
Dungarvan	SW2		3 Landfill SW quarterly	1556 SW2 180615	18/06/2015		NT	BLD	25	NT	NT	NT	118.1	NT	7	NT	NT	BLD	16.8	NT
Dungarvan	SW300		5 Landfill SW quarterly	1556 SW300 180615	18/06/2015		NT	BLD	71	NT	NT	NT	83	NT	7.4	NT	NT	BLD	13	NT
Dungarvan	Interceptor		1 LANDFILL LEACHATE QUARTERLY	1556 Interceptor LT	18/06/2015		NT	1.6	38	NT	NT	721	NT	NT	7.3	NT	NT	NT	NT	NT
Dungarvan	Lagoon		1 Landfill SW quarterly	1556 Lagoon 180615	18/06/2015		NT	3.6	38	NT	NT	589	45	NT	7.3	NT	NT	35	15.6	NT
Dungarvan	SW280		3 Landfill SW quarterly	1556 SW280 180615	18/06/2015		NT	BLD	BLD	NT	NT	161	112	NT	7.4	NT	NT	BLD	19.9	NT
Dungarvan	ICW Pond 1 IN		11 LANDFILL LEACHATE QUARTERLY	1556429	15/06/2015		4.97	8	23	NT	NT	748	NT	NT	7.38	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 2 IN		12 LANDFILL LEACHATE QUARTERLY	1556424	15/06/2015		0.22	2	22	NT	NT	681	NT	NT	7.48	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 3 IN		13 LANDFILL LEACHATE QUARTERLY	1556425	15/06/2015		0.23	3	29	NT	NT	701	NT	NT	7.52	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 4 IN		14 LANDFILL LEACHATE QUARTERLY	1556426	15/06/2015		0.06	2	26	NT	NT	681	NT	NT	7.68	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 IN		15 LANDFILL LEACHATE QUARTERLY	1556427	15/06/2015		0.02	3	22	NT	NT	673	NT	NT	7.37	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 OUT		16 LANDFILL LEACHATE QUARTERLY	1556428	15/06/2015		0.05	4	<17	NT	NT	657	NT	NT	7.7	NT	NT	NT	NT	NT
Dungarvan	Lagoon		1 Landfill Monitoring - Surface Water	1556429	15/06/2015		0.04	6	80	NT	632	NT	NT	NT	7.48	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 1 IN		11 LANDFILL LEACHATE QUARTERLY	15702015O508	15/07/2015		3.28	6	36	NT	NT	665	NT	NT	6.8	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 2 IN		12 LANDFILL LEACHATE QUARTERLY	15702015O509	15/07/2015		1.33	5	29	NT	NT	675	NT	NT	6.97	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 3 IN		13 LANDFILL LEACHATE QUARTERLY	15702015O510	15/07/2015		0.88	16	73	NT	NT	663	NT	NT	7.06	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 4 IN		14 LANDFILL LEACHATE QUARTERLY	15702015O511	15/07/2015		BLD	6	29	NT	NT	666	NT	NT	7.9	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 IN		15 LANDFILL LEACHATE QUARTERLY	15702015O512	15/07/2015		BLD	2	22	NT	NT	654	NT	NT	7.89	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 OUT		16 LANDFILL LEACHATE QUARTERLY	15702015O513	15/07/2015		BLD	4	27	NT	NT	650	NT	NT	7.73	NT	NT	NT	NT	NT
Dungarvan	Lagoon		1 Landfill Monitoring - Surface Water	15702015O514	15/07/2015		0.23	3	35	NT	625	NT	NT	NT	7.76	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 1 IN		11 Landfill Monitoring - Leachates	15562015O562	12/08/2015		5.41	15	67	NT	NT	NT	NT	NT	7.62	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 2 IN		12 Landfill Monitoring - Leachates	15562015O563	12/08/2015		1.49	8	41	NT	NT	NT	NT	NT	7.32	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 3 IN		13 Landfill Monitoring - Leachates	15562015O564	12/08/2015		0.35	8	42	NT	NT	NT	NT	NT	7.38	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 4 IN		14 Landfill Monitoring - Leachates	15562015O565	12/08/2015		0.09	10	45	NT	NT	NT	NT	NT	7.5	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 IN		15 Landfill Monitoring - Leachates	15562015O566	12/08/2015		0.14	9	48	NT	NT	NT	NT	NT	7.46	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 OUT		16 Landfill Monitoring - Leachates	15562015O567	12/08/2015		0.15	7	28	NT	NT	NT	NT	NT	7.67	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 1 IN		11 Landfill Monitoring - Leachates	15562015O743	30/09/2015		19.44	2	10	NT	1107	NT	NT	NT	7.87	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 2 IN		12 Landfill Monitoring - Leachates	15562015O744	30/09/2015		2.48	2	23	NT	757	NT	NT	NT	7.84	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 3 IN		13 Landfill Monitoring - Leachates	15562015O745	30/09/2015		2.64	3	35	NT	811	NT	NT	NT	7.76	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 4 IN		14 Landfill Monitoring - Leachates	15562015O746	30/09/2015		0.35	3	31	NT	811	NT	NT	NT	7.82	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 IN		15 Landfill Monitoring - Leachates	15562015O747	30/09/2015		0.13	2	23	NT	706	NT	NT	NT	7.49	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 OUT		16 Landfill Monitoring - Leachates	15562015O748	30/09/2015		0.1	3	20	NT	655	NT	NT	NT	7.67	NT	NT	NT	NT	NT
Dungarvan	Interceptor (should be Lagoon)		1 Landfill Monitoring - Leachates	15562015O749	30/09/2015		0.32	6	24	NT	630	NT	NT	NT	7.88	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 1 IN		11 Landfill Monitoring - Leachates	15562015O798	16/10/2015		3.9	2	5	NT	1095	NT	NT	NT	7.7	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 2 IN		12 Landfill Monitoring - Leachates	15562015O799	16/10/2015		4.2	1	16	NT	869	NT	NT	NT	7.44	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 3 IN		13 Landfill Monitoring - Leachates	15562015O800	16/10/2015		3.5	1	24	NT	837	NT	NT	NT	7.39	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 4 IN		14 Landfill Monitoring - Leachates	15562015O801	16/10/2015		2.1	BLD	20	NT	825	NT	NT	NT	7.41	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 IN		15 Landfill Monitoring - Leachates	15562015O802	16/10/2015		BLD	2	18	NT	834	NT	NT	NT	7.23	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 OUT		16 Landfill Monitoring - Leachates	15562015O803	16/10/2015		BLD	2	18	NT	837	NT	NT	NT	7.23	NT	NT	NT	NT	NT
Dungarvan	Interceptor (should be Lagoon)		1 Landfill Monitoring - Leachates	15562015O804	16/10/2015		0.04	1	19	NT	737	NT	NT	NT	7.33	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 4 IN		14 Landfill Monitoring - Leachates	15562012001	10/11/2015		1.48	3	29	NT	635	NT	NT	NT	7.42	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 1 IN		11 Landfill Monitoring - Leachates	15562015O998	10/11/2015		9.86	3	26	NT	800	NT	NT	NT	7.47	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 2 IN		12 Landfill Monitoring - Leachates	15562015O999	10/11/2015		3.14	4	30	NT	691	NT	NT	NT	7.65	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 3 IN		13 Landfill Monitoring - Leachates	15562015I000	10/11/2015		3.18	2	36	NT	685	NT	NT	NT	7.47	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 IN		15 Landfill Monitoring - Leachates	15562015I002	10/11/2015		1.46	2	28	NT	703	NT	NT	NT	7.2	NT	NT	NT	NT	NT
Dungarvan	ICW Pond 5 OUT		16 Landfill Monitoring - Leachates	15562015I003	10/11/2015		0.58	3	29	NT	670	NT	NT	NT	7.75	NT	NT	NT	NT	NT
Dungarvan	Interceptor (should be Lagoon)		1 Landfill Monitoring - Leachates	15562015I004	10/11/2015		0.53	2	30	NT	649	NT	NT	NT	7.65	NT	NT	NT	NT	NT

APPENDIX E

LEACHATE MONITORING DATA

Range	Units	Q1 2014	Q2 2014	Q3 2014	Q1 2015	Q2 2015	Q3 2015	IGV	Groundwater Regulations SI No. 9 of 2010 Threshold Range	Drinking Water Limit
Potassium	mg/l		9.3	4	1.2	0.73	3.5	5		12
Selenium	ug/l		< 1.0	< 1.0	< 1.0					10
Sodium	mg/l		38	78	4.3	47	39	150	150	150
Strontium	ug/l		110	270	25					
Thallium	ug/l		< 1.0	< 1.0	< 1.0					
Uranium	ug/l		< 1.0	< 1.0	< 1.0			9		
Vanadium	ug/l		< 1.0	< 1.0	< 1.0					
Phenol	ug/l							0.5		
Nitrite	mg/l		< 0.004					0.1		0.50
Ortho-phosphate	mg/l		< 0.01					0.03	0.035 MRP	
Alkalinity	mg/l		188							
Fluoride	mg/l		< 0.25					1.0		0.8 / 1.5
Sulphate	mg/l		2.5					200	187.5	250
List I / II	ug/l									
Aluminium	ug/l		18	< 10.0	< 10.0			200	150	200
Barium	ug/l		13	7.4	1.5			100		
Mercury	ug/l		< 0.50					1	0.75	1
Antimony	ug/l		< 1.0							5
Chromium	ug/l		1.1					30	37.5	50
Copper	ug/l		< 1.0					30	1500	2,000
Molybdenum	ug/l		< 1.0							
Zinc	ug/l		13					100		