COMHAIRLE CHONDAE AN CABHÁIN

Cavan County Council

Annual Environmental Report 2017

Belturbet Landfill WL 92-1

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Boylan Engineering (Eng. & Environmental Consultancy) was commissioned by Cavan County Council to prepare the following Annual Environmental Report.

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1 INTRODUCTION

Belturbet Landfill has been operated as waste disposal facility by Cavan County Council since the late 1979. The site was operated as a traditional landfill and is located on the Belturbet - Ballyconnell road (R200) approximately 4.5km west of Belturbet on the north side. The site was originally operated as a limestone quarry and comprises an area of 1.65 acres. The rock is composed of the Darty Limestone Formation from the Lower Carboniferous period.

A Waste Licence for the facility was issued by the EPA on 13th February 2002, Ref WL 92-1. Condition 11.4 of Waste Licence requires the submission of an Annual Environmental Report for Belturbet Landfill facility. This document is produced in order to comply with requirements of Condition 11.4. The site at Belturbet was closed in February 2002. Prior to closing the site a temporary cap was placed on site.

The requirements for reporting of Annual Environmental Information arise under individual EPA licences issued under the EPA Acts 1992 – 2008, the Waste Management Acts 1996 – 2008 and other legislation.

This AER will provide information as outlined in Schedule F of the Licence "Content of the Annual Environmental Report".

2 REPORTING PERIOD

The reporting period for the purposes of this AER is 1st January 2017 to 31st December 2017.

3 WASTE ACTIVITIES CARRIED OUT AT THE FACILITY

There were no waste activities carried out at the facility.

4 QUANTITY AND COMPOSITION OF THE WASTE

There is no longer any waste being accepted at the site. The quantity of waste accepted is zero tonnes.

5 SUMMARY REPORT ON EMISSIONS

The PRTR Regulations are the European Communities (European Pollutant Release and Transfer Register) Regulation 2007, S.I. No. 123 of 2007), which signed into Irish Law on 22 March 2007 the E-PRTR Regulation, (EC) No 166/2006, concerning the establishment of a European Pollutant Release and Transfer Register. The summary of emissions is detailed in the (PRTR) Report which appears in Appendix A of this report. The PRTR has been uploaded onto the EPA website in accordance with our responsibility as Licensee.

A register of Environmental Monitoring is now established and shall be maintained. Cavan County Council now carries out sampling as required by the Licence.

5.1 Surface Water

Surface water sampling is undertaken on a quarterly basis with samples retrieved from Killynaher Lake which is part of the Lough Oughter System and is a Special Area of Conservation. The lake quality is A2 status.

All parameters have been assessed against water limits as outlined in the European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989. Results in Bold Italics indicate where the assessment criteria has been exceeded.

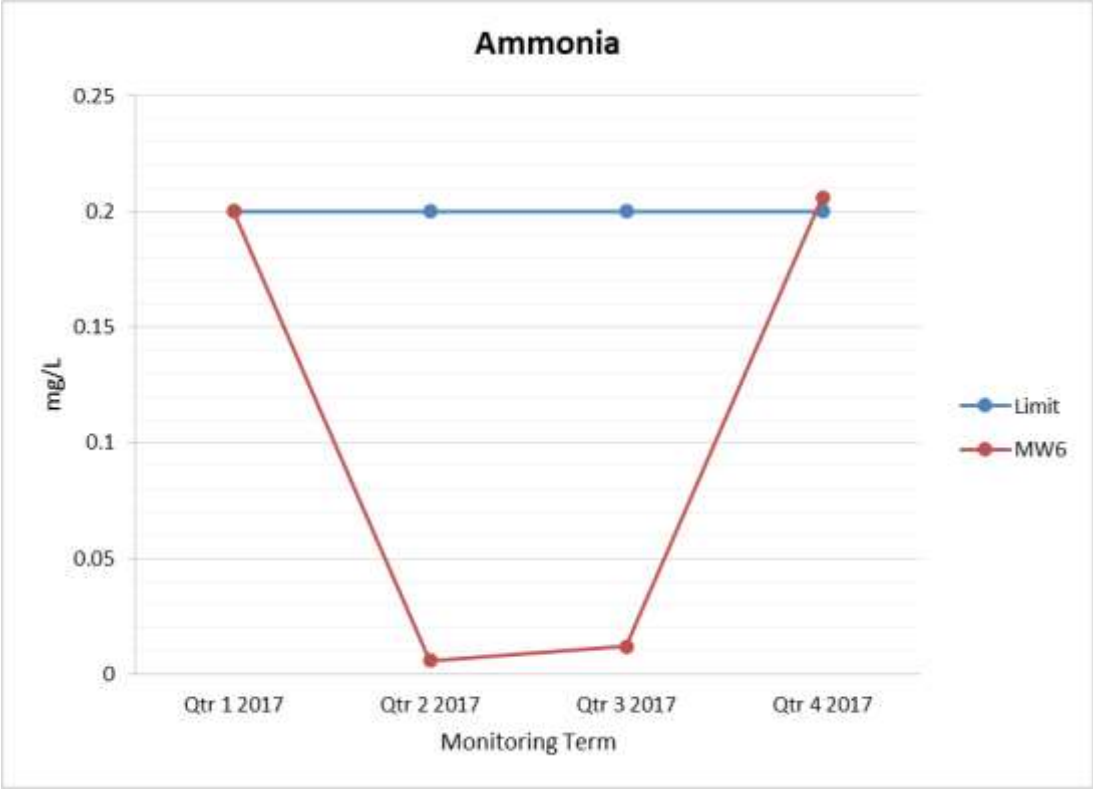
As detailed in Table 5.1 below, there were slight exceedances in the surface water analysis for parameters Ammonia and BOD.

Table 5.1 Surface Water Summary Results

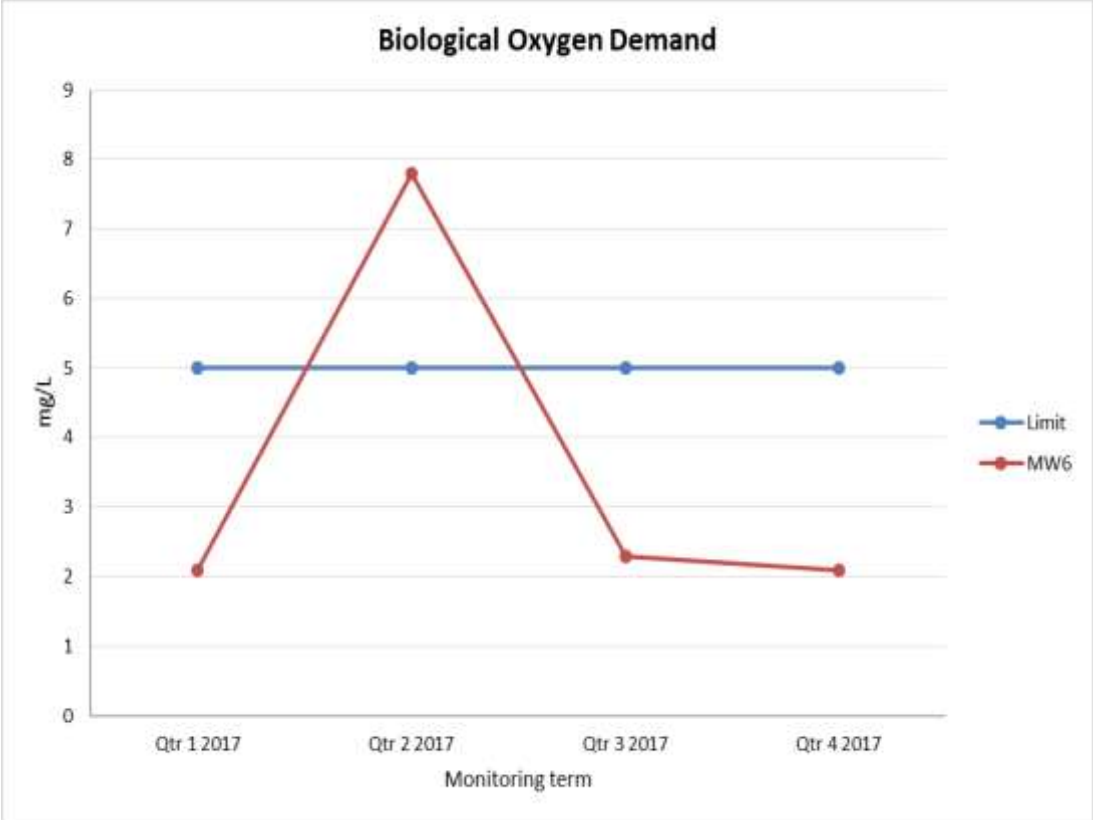
Surface Water Historical Results									
	Parameter	Ammonia	pH	Cond	BOD	COD	Total Suspended Solids	Cl	DO
	Units	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l	mg/l	mg/l
SW Killynaher Lake	Qtr 4 2017	***0.206***	8.2	313	2.1	20	5	16	8
	Qtr 3 2017	0.012	8	304	2.3	17	<5	19	9
	Qtr 2 2017	0.006	8.3	341	***7.8***	22	<5	20	9
	Qtr 1 2017	0.2	7.9	336	2.1	16	5	16	9
S.I No. 294/1989		**0.2**	**≥5.5 and ≤8.5**	**1000**	**5**	**40**	**50**	**250**	

As detailed in the table above there was a slight exceedance for the parameter ammonia during Q4 sampling, while a marginal exceedances for BOD was also detected during Q2. These exceedances can be attributed to the local farming practices in the area. The next monitoring event will be carried out during the Quarter 1 of 2018, and the results will be monitored closely.

Graph 5.1 Surface water - Ammonia



Graph 5.2 Surface water - BOD



5.2 Groundwater

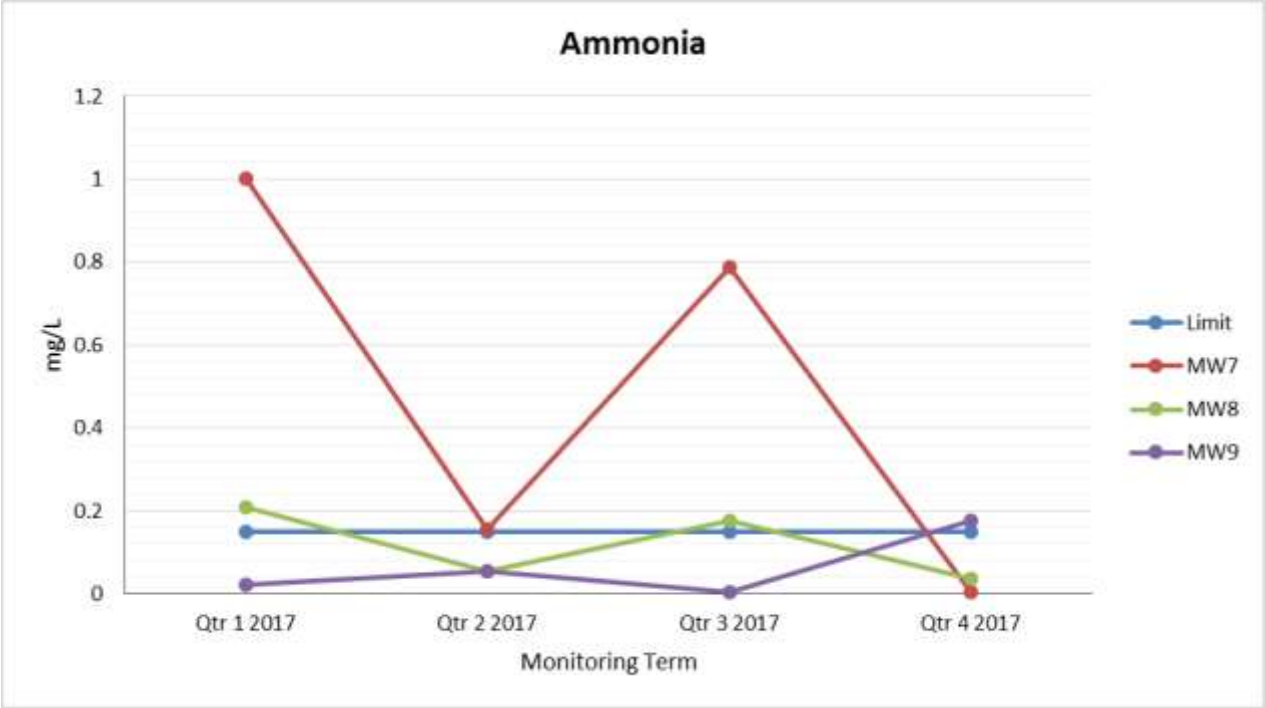
This landfill underwent the process of final capping during 2012. Groundwater samples were extracted from MW7 and MW8 as per the waste licence. An addition groundwater well was constructed along the southeast boundary between the landfill and the nearest dwelling house. This well was constructed in conjunction with the capping works and is labelled MW9. Monitoring of this well began in 2013 as per the requirements of the waste licence.

Table 5.2 summaries the quarterly groundwater monitoring results from 2017. The results where the Interim Guideline Values (IGVs) has been exceeded are identified in italic bold. The exceedances are illustrated in Graphs 5.5 – 5.9.

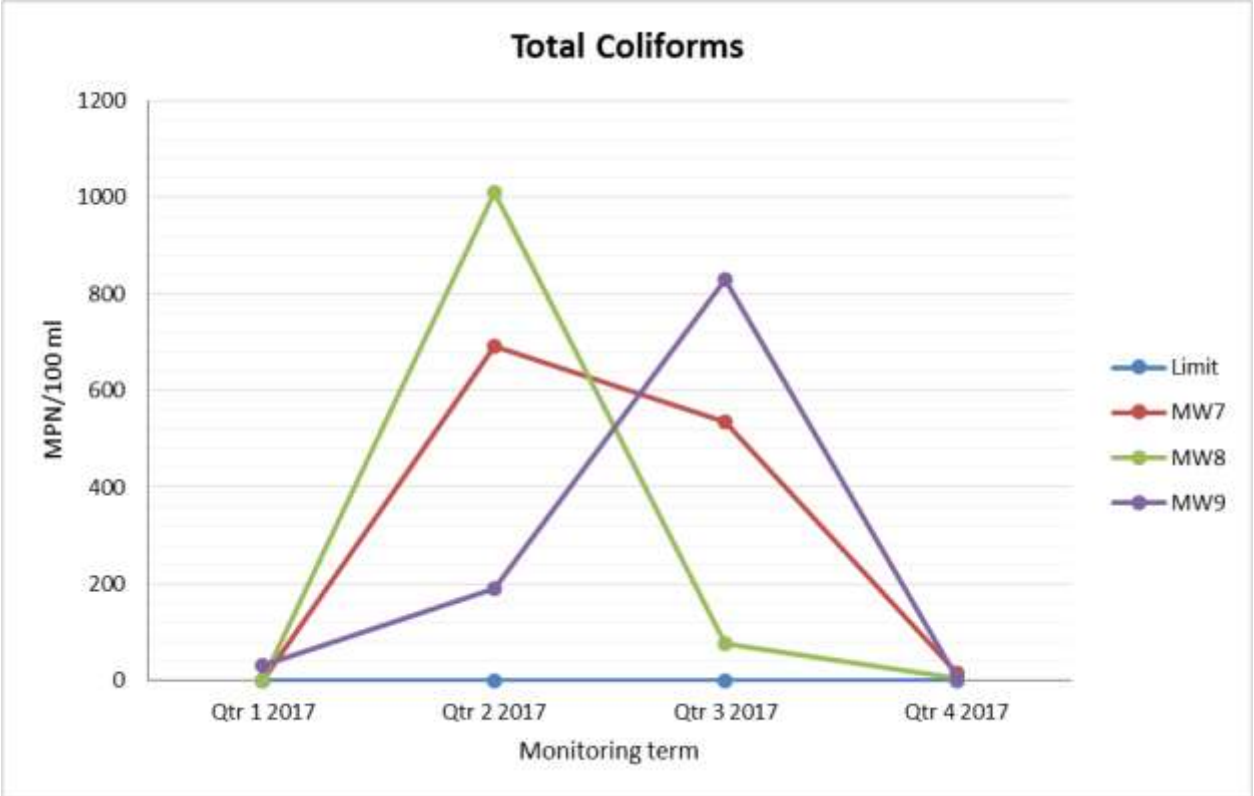
Table 5.2 Groundwater Summary Results

	Ground water Historical Data												
	Parameter	TOC	E.Coli	Ammonia	TON	Tot Coliforms	pH	Cond	Cl	DO	Fe	K	Na
	Units	mg/l	MPN/ 100ml	mg/l N	mg/l N	MPN/ 100ml	pH Units	us/cm	mg/l	mg/l	mg/l	mg/l	mg/l
MW 7	Qtr 4 2017	20.07	0	<0.005	0.19	***14***	7.1	766	11	8	<20	2.1	4.9
	Qtr 3 2017	4.49	***211***	***0.789***	<0.15	***534***	7.7	583	12	6	160	***5.8***	12.5
	Qtr 2 2017	0.92	***36***	***0.156***	1.5	***691***	7.7	578	12	5	***580***	***5.5***	21.2
	Qtr 1 2017	2.97	0	***1***	0.138	0	7.9	644	11	7	74	***6.3***	24.7
MW 8	Qtr 4 2017	46.21	0	0.036	0.17	***4***	7.2	425	12	6	<20	4.3	49.4
	Qtr 3 2017	7.96	***4***	***0.175***	<0.15	***76***	7.4	855	***120***	5	***220***	3.8	34.3
	Qtr 2 2017	7.03	***5***	0.055	<0.15	***1011***	8.4	340	22	10	45	2.1	12.8
	Qtr 1 2017	6.66	0	***0.21***	0.138	0	7.3	***1051***	***140***	9	***250***	3.7	41.2
MW 9	Qtr 4 2017	20.64	0	***0.175***	0.77	***5***	8.1	657	12	6	<20	***8***	30.6
	Qtr 3 2017	11.61	***27***	<0.005	<0.15	***830***	7.1	724	13	5	47	2	3.8
	Qtr 2 2017	12.55	***30***	0.055	<0.15	***190***	7.3	709	20	6	<20	1.7	3.9
	Qtr 1 2017	1.87	0	0.022	0.199	***30***	7.1	734	13	8	*23*	1.7	4.2
MW 10	Qtr 4 2017	1.83	0	<0.005	0.33	***3***	7.6	224	2	6	*<20*	***5.8***	16.7
Interim Guide Value		**NAC**	**0**	**0.15**	**NAC**	**0**	**≥6.5 &≤9.5**	**1000**	**30**	**NAC**	**200.0**	**5**	**150**

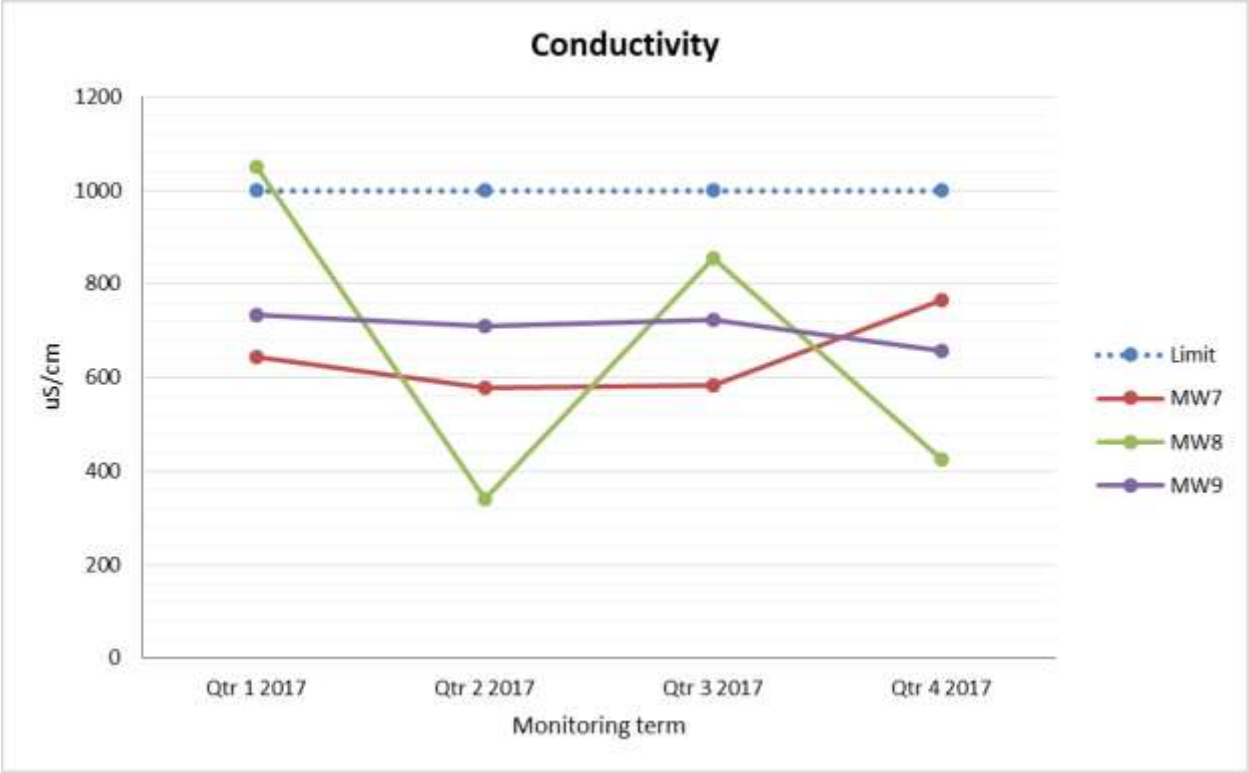
Graph 5.3 Groundwater - Ammonia



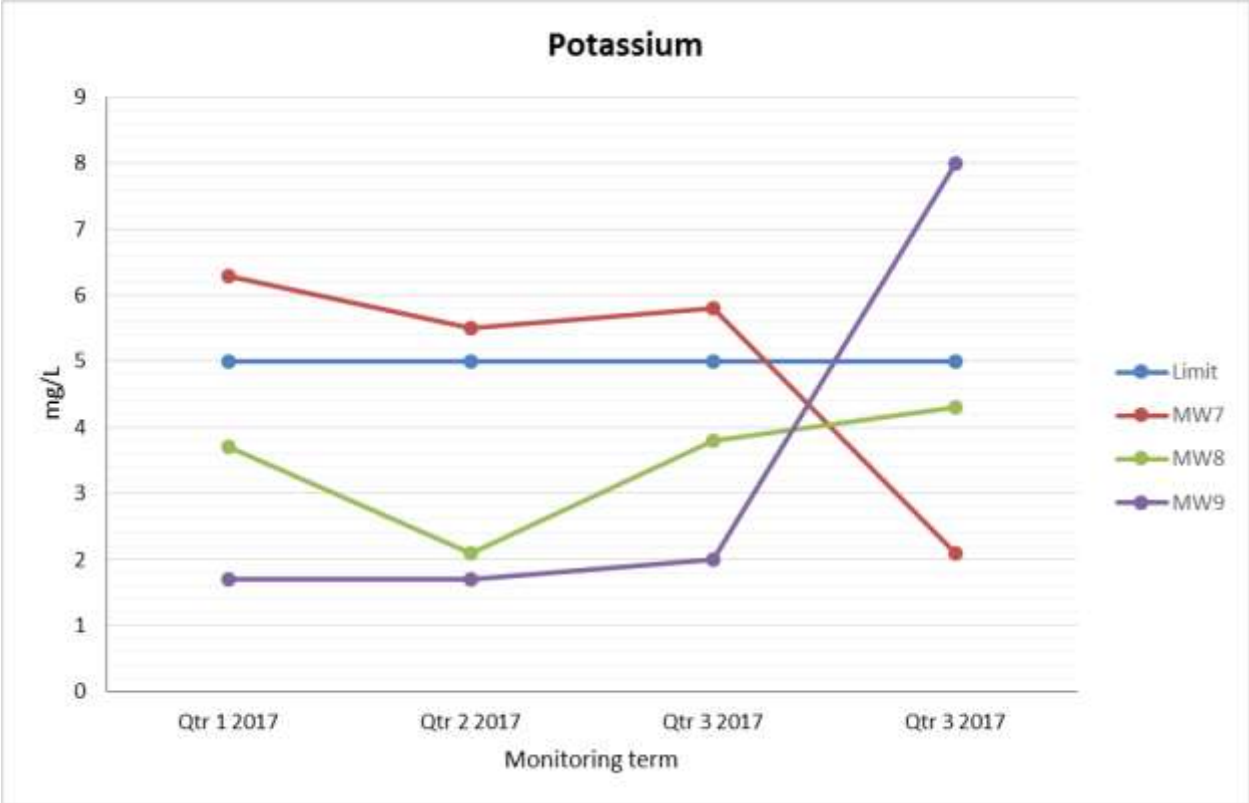
Graph 5.4 Groundwater - Total Coliforms



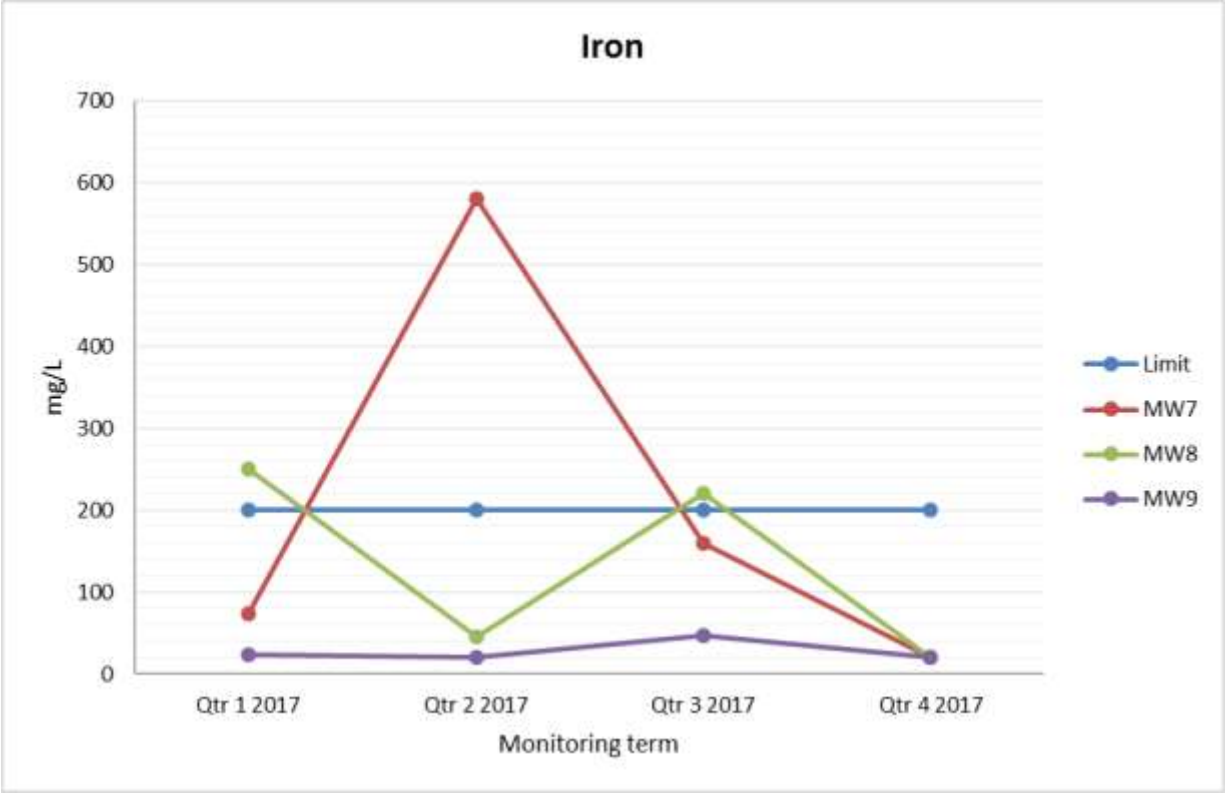
Graph 5.5 Groundwater - Conductivity



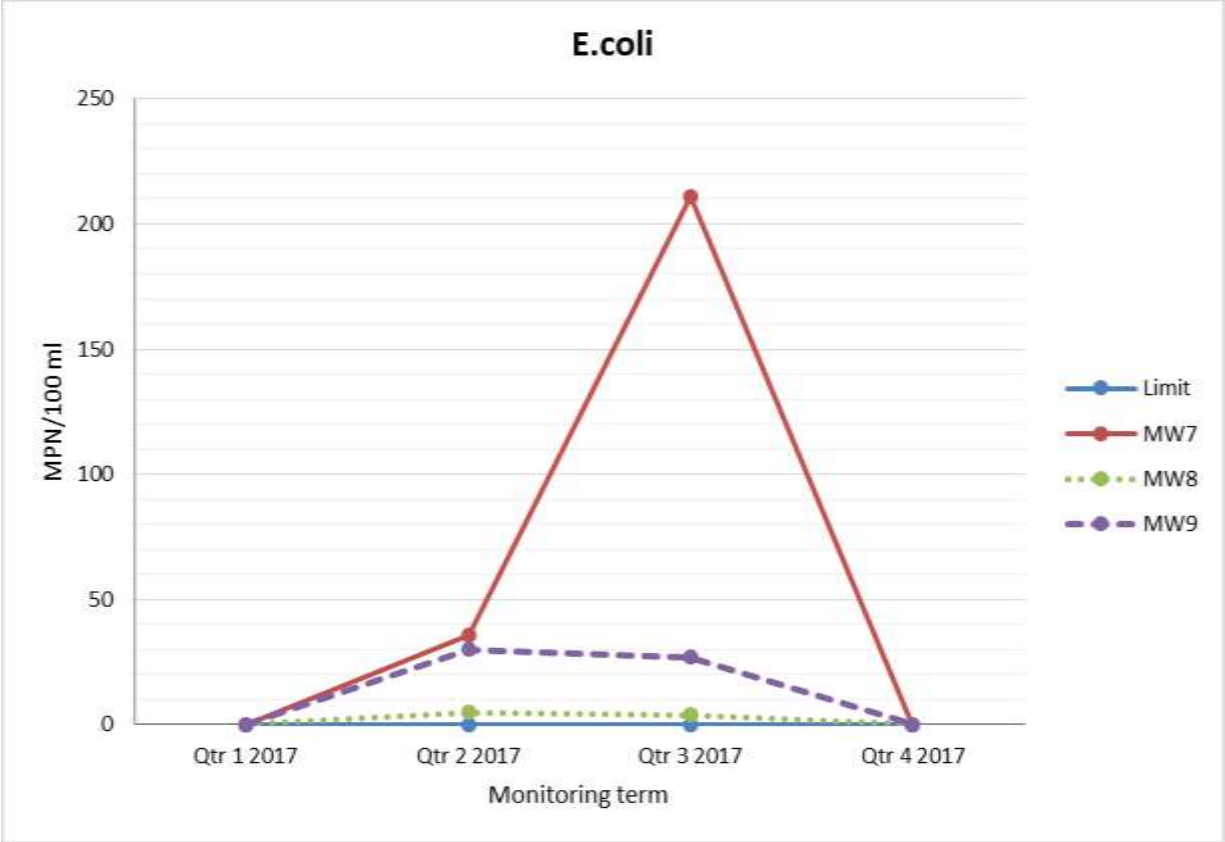
Graph 5.6 Groundwater - Potassium



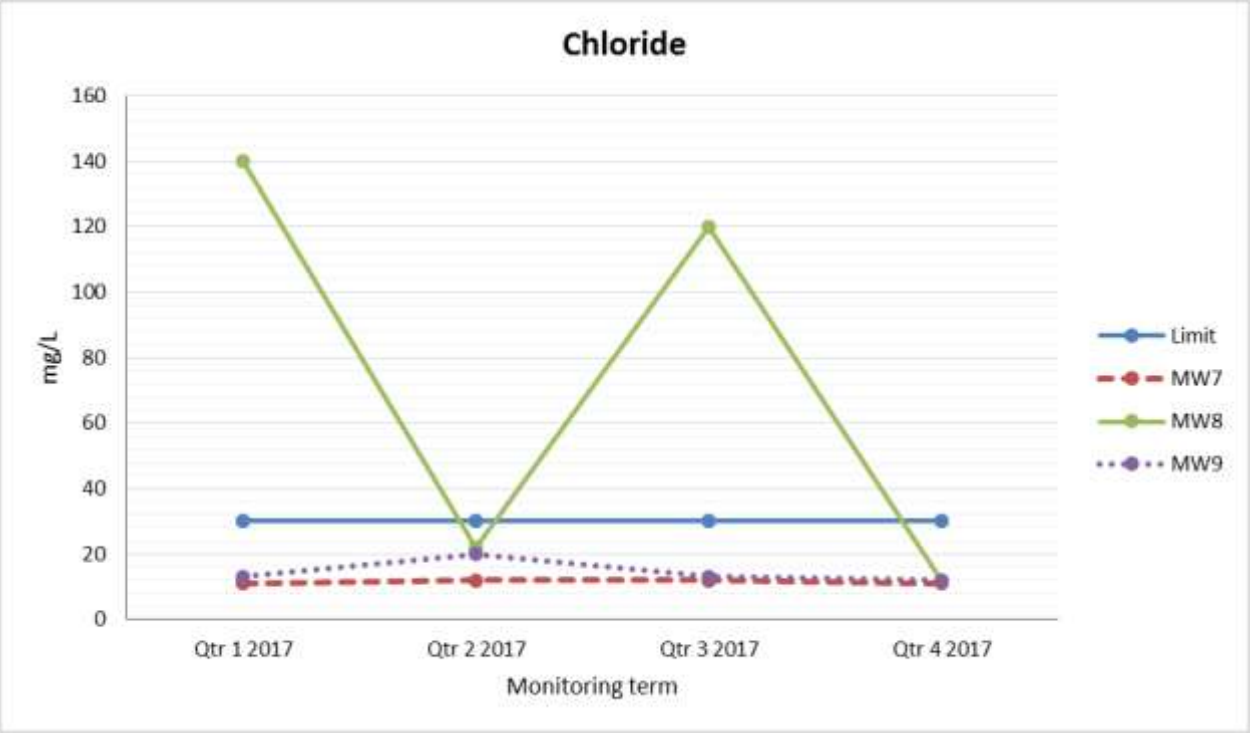
Graph 5.7 Groundwater - Iron



Graph 5.8 Groundwater - E.coli



Graph 5.9 Groundwater - Chloride



As detailed in the above graphs, there were numerous groundwater exceedances at this landfill during 2017.

Exceedances occurred in the following parameters:

- **Ammonia:** Elevated levels of this parameter were evident during 2017. Levels such as those recorded are not unusual in a mature landfill such as this. Levels will gradually decrease as the landfill matures.
- **Conductivity:** Only one exceedances for conductivity was detected during 2017, recorded at MW8 during Q1. Elevated levels of this parameter are commonly associated with pollution of an organic nature and therefore may be attributed to the landfill or surrounding agricultural sources.
- **Total Coliforms:** Exceedances in this parameter are attributed to the natural decomposition of the organic materials in this landfill. . It can also attributed to influx of contamination from other sources such as septic tanks, slurry spreading and animal faecal contaminations.
- **Potassium:** Elevated levels of potassium can be associated with landfill contamination but it can also be associated with contamination from agricultural sources such as fertilizers. Therefore direct contamination from the landfill cannot be concluded.
- **Iron**: Elevated levels of Iron in this instance are associated with the natural composition of the surrounding area.
- **E-coli**: It is not uncommon for wells in the vicinity of a landfill to be contaminated with *E. coli.* It can also attributed to influx of contamination from other sources such as septic tanks, slurry

spreading and animal faecal contaminations and as such the E.Coli contamination cannot be solely attributed to the landfill itself.

- **Chloride**: Elevated concentrations for chloride were detected at MW8 during Q1 and Q3 of 2017. Chloride can originate from various origins such as farmyard runoff, landspreading of organic wastes, sewage effluent, and landfill leachate.

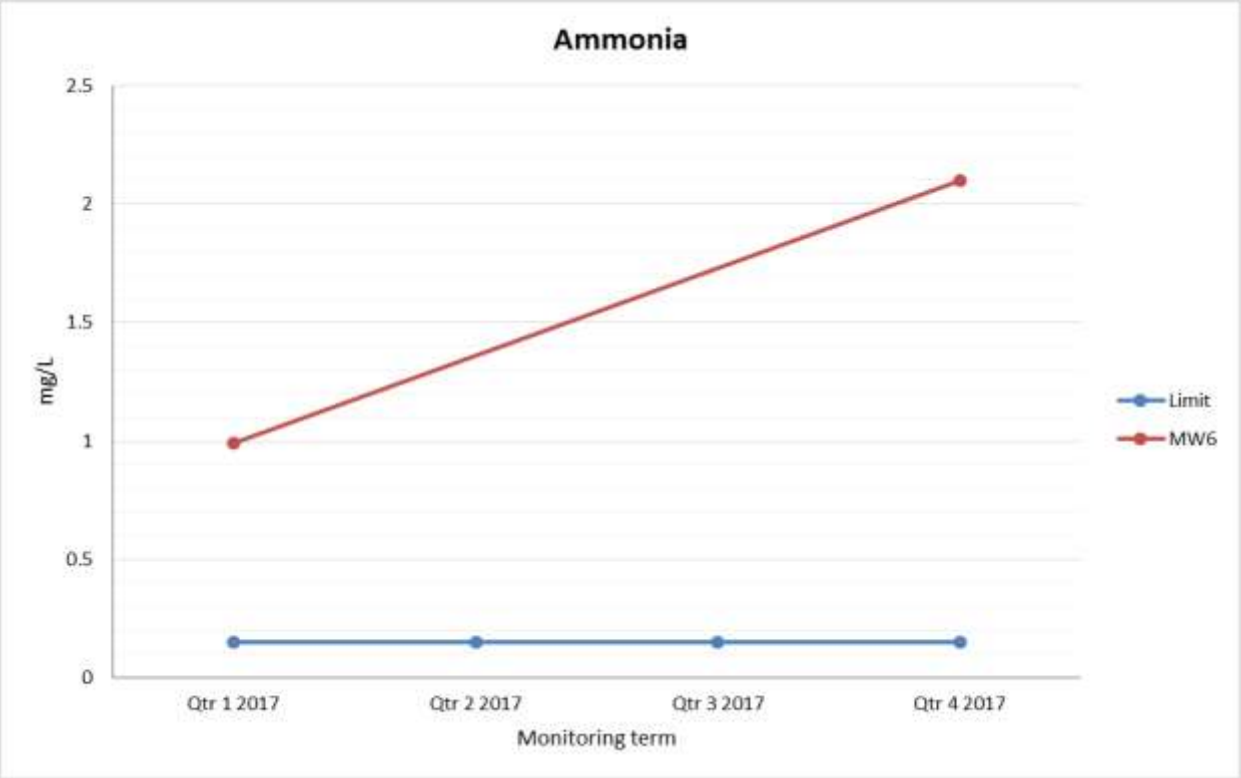
5.3 Leachate Monitoring

Leachate monitoring is undertaken on a bi-annual basis at MW6 which is presented in Table 5.3 below. MW5 was previously sampled for leachate during Quarter 1 of 2012. However, after capping of the landfill, the well was found to be dry and so samples have been obtained from MW6 since then.

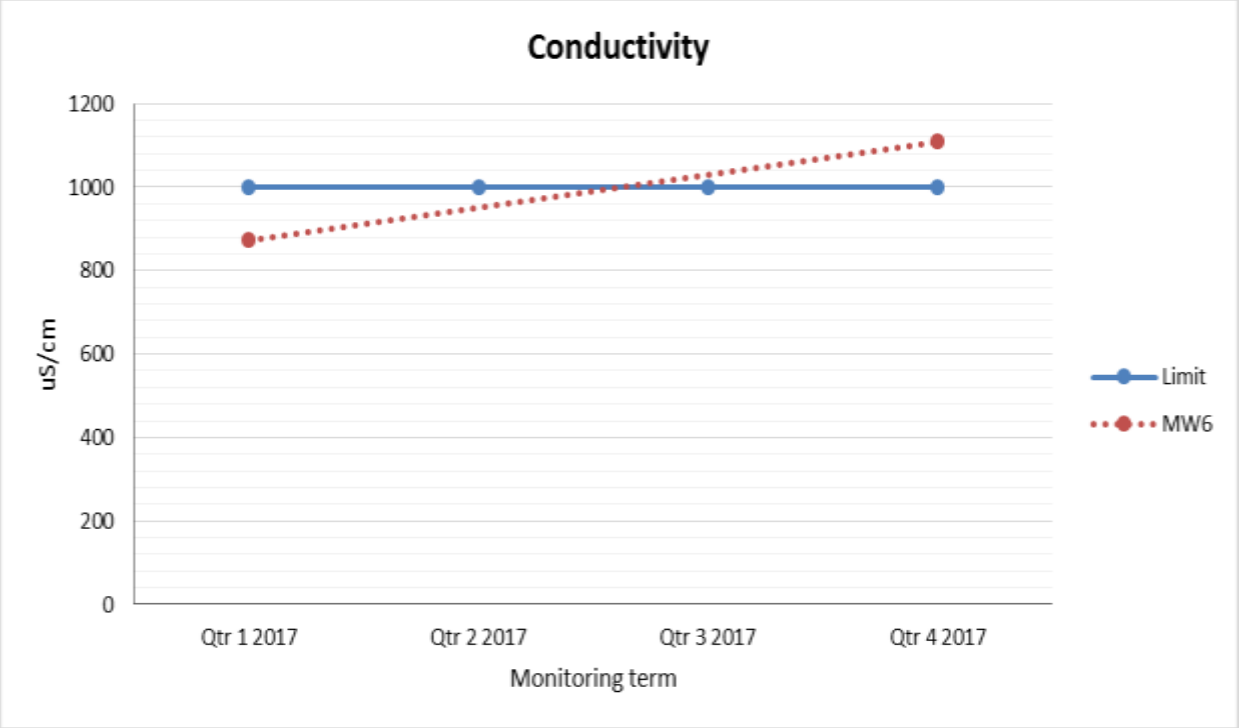
Table 5.3 Leachate summary results

	Lechate historical Results							
	Parameter	Ammonia	TON	pH	Cond	BOD	COD	Cl
	Units	mg/l N	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l
MW 6	Qtr 4 2017	***2.1***	<0.69	7.2	***1109***	<15	290	61
	Qtr 3 2017	-	-	-	-	-	-	-
	Qtr 2 2017	-	-	-	-	-	-	-
	Qtr 1 2017	***0.99***	<0.69	7.5	873	6	18	71
Interim Guide Values		**0.15**	**NAC**	**≥6.5&≤9.5**	**1000**			**200**

Graph 5.10 Leachate - Ammonia



Graph 5.11 Leachate - Conductivity



5.4 Gas Monitoring

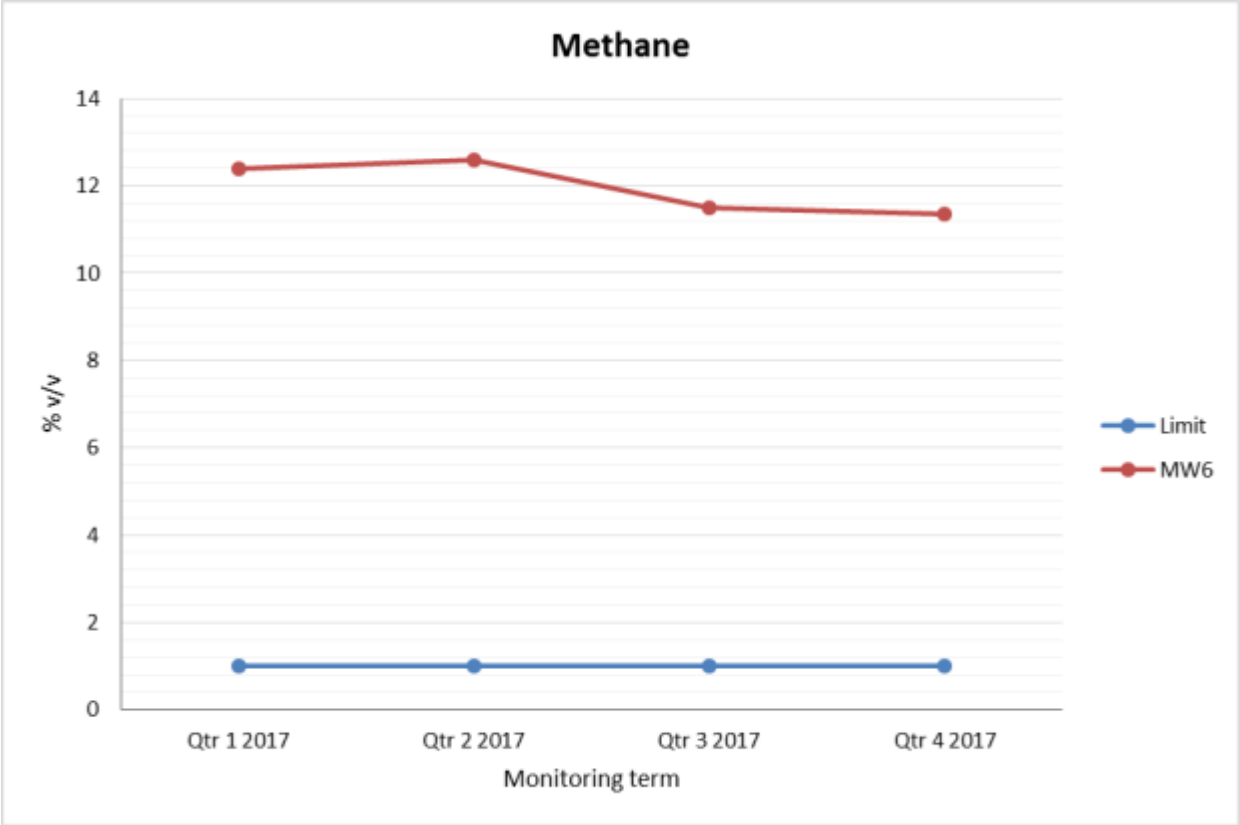
Landfill gas monitoring is undertaken on a quarterly basis at MW5, MW6 and MW9. A summary of the gas results is presented in Table 5.4 and illustrated in Graphs 5.12 and 5.13 below.

5.4 Gas Emissions Monitoring Summary Results

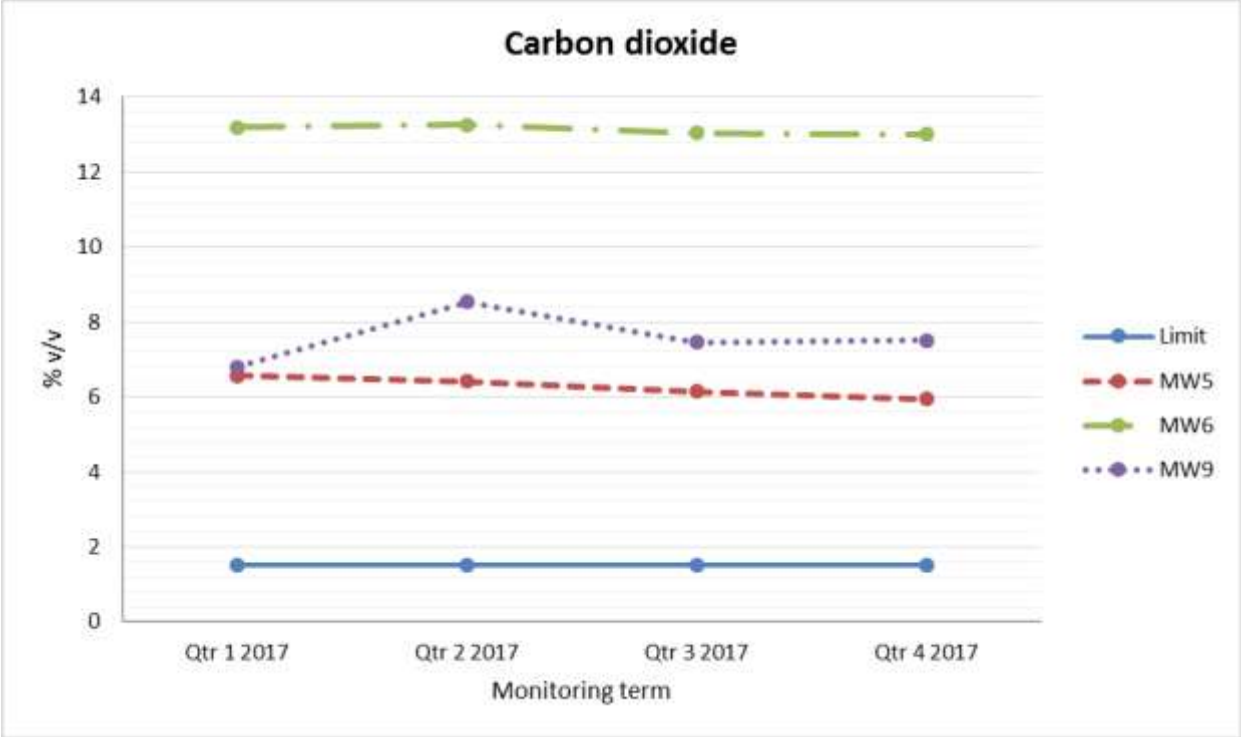
Method		GA 2000	GA 2000	GA 2000	GA 2000	GA 2000
Parameter		CH_4	CO_2	O_2	H_2S	Barometric Pressure
Units		1% v/v	1.5 % v/v	%	PPM	mb
Client Ref	**Qtr**	-	-	-	-	-
MW 5	Qtr 4 2017	0.5	5.9	16.1	0.0	998.0
	Qtr 3 2017	0.5	6.1	16.0	0.0	998.0
	Qtr 2 2017	0.5	6.4	15.4	0.0	998.0
	Qtr 1 2017	0.4	6.6	15.4	0.0	998.0
MW 6	Qtr 4 2017	11.34	13	1.06	0	998
	Qtr 3 2017	11.5	13.04	0.64	0	998
	Qtr 2 2017	12.58	13.26	0	0	998
	Qtr 1 2017	12.4	13.2	0	0	998
MW9	Qtr 4 2017	0.46	7.5	15.46	0	998
	Qtr 3 2017	0.32	7.46	15.72	0	998
	Qtr 2 2017	0.46	8.54	1.36	0	998
	Qtr 1 2017	0.6	6.8	1.4	0	998
	Limit	**1**	**1.5**			
Exceedance in licence limit						
NOTES						
1	Instrument Serial No: GA 07721					
2	Limit: Schedule C2, Licence					

Gas emissions have remained steady at locations MW5 and MW6 during 2017 and are typical of a mature landfill. Monitoring of MW 9, a newly constructed gas migration well began in Quarter 4 of 2012. Results obtained show that there is very little methane present at this location.

Graph 5.12 Gas - Methane



Graph 5.13 Gas - Carbon dioxide



6 SUMMARY OF RESULTS AND INTERPRETATION OF ENVIRONMENTAL MONITORING

As presented in the information above and in Appendix 3, apart from slight elevations in certain parameters, there appears to be no environmental pollution associated with this landfill. Monitoring will continue through 2018 and any abnormal changes in results will be noted.

7 RESOURCES AND ENERGY CONSUMPTION

There is no energy consumption or resource use on the site. There is no landfill gas of any value produced as can be seen from the PRTR Report.

8 VOLUME OF LEACHATE PRODUCED

The volume of Leachate produced is unknown.

9 REPORT ON DEVELOPMENT WORKS UNDERTAKEN DURING THE REPORTING PERIOD AND A TIMESCALE FOR THOSE PROPOSED DURING THE COMING YEAR.

Final capping of this landfill was completed during 2012. However, the final phase of works is on hold pending negotiations with the surrounding land owner. The proposed works will involve the installation of a piped conduit for the surface water cap discharge to Killynaher Lake and the addition of monitoring boreholes on adjacent farmlands. This included the installation of MW10 to the south of the site in 2017.

10 REPORT ON THE RESTORATION OF COMPLETED CELLS/PHASES

Belturbet Landfill was capped in 2012 according to specifications submitted and approved by the EPA Castlebar office.

A fully engineered and lined system was installed and the site has been improved significantly.

There is however some outstanding works unfinished. The cap surface water collection system and monitoring boreholes are due to be installed on Mr Reilly's lands as soon as agreement can be reached. Agreement was reached previously but other queries have arisen in the meantime.

11 SITE SURVEY SHOWING THE EXISTING LEVELS OF THE FACILITY AT THE END OF THE REPORTING PERIOD

The topographical levels at this site are static as the landfill is closed and no longer accepting waste. A monitoring location map is instead included in Appendix B.

12 ESTIMATED ANNUAL AND CUMULATIVE GAS EMITTED FROM THE FACILITY

This information is reported in the PRTR Report attached in Appendix A. The estimated quantity of Methane released is 11,700kgs/yr. Page one from the Annual Gas Survey is also presented in Appendix A.

13 FULL TITLE AND A WRITTEN SUMMARY OF ANY PROCEDURES DEVELOPED BY THE LICENCE IN THE YEAR WHICH RELATES TO THE FACILITY

There are no written procedures required for this site.

14 TANK AND BUND TESTING INSPECTION

There are no tanks or bunds on site.

15 REPORTING INCIDENTS AND COMPLAINTS SUMMARIES

There were no complaints reported or recorded for this site during the reporting period.

16 REPORTS ON FINANCIAL PROVISION MADE UNDER THE LICENCE, MANAGEMENT AND STAFFING STRUCTURE OF THE FACILITY AND A PROGRAMME FOR PUBLIC INFORMATION.

Executive Engineer Brona Keating from Cavan County Council deals with in full with any issues identified by the Agency Inspectors or any other party. Brona is a Chartered Waste Manager with many years' experience managing the compliance of landfill and waste sites. Brona carries a Safe Pass and has been trained in Landfill Gas Management.

Table 16.1 Management Structure 2017-2018

Position	Name	Duties
Director of Services Environment	Paddy Connaughton	Oversee and assign responsibilities to staff regarding the landfill.
Senior Executive Engineer	Colm O'Callaghan	Oversee general supervision, monitoring and reporting of the site.
Executive Engineer / Landfill Operations Manager	Brona Keating	Responsible for general supervision, monitoring and reporting of the site.

Contact Person for Sanitary Authority for 2017 / 2018:

Brona Keating

Executive Engineer

Waste Management Section

Cavan County Council

Farnham Street,

Cavan

17 FINANCIAL PROVISION

Provision will be made in Cavan County Council Official Estimates for Charges as required under Condition 12 of Waste Licence Ref. 91-1.

18 ANY OTHER ITEMS SPECIFIED BY THE AGENCY

As requested by the Agency we have included in Appendix B a copy of the most recent map of the site showing all Monitoring locations. One new borehole MW10 was installed to the south of the site prior to Q4 of 2017. This borehole is located up gradient of the landfill. It is proposed that it will be included in the monitoring schedule going forward.

Appendix A

PRTR Emissions Report and Gas Survey

Guidance to completing the PRTR workbook

PRTR Returns Workbook

Version 1.1.19

REFERENCE YEAR	2017

1. FACILITY IDENTIFICATION

Parent Company Name	Cavan County Council
Facility Name	Belturbet Landfill
PRTR Identification Number	W0092
Licence Number	W0092-01

Classes of Activity

No.	**class_name**
-	Refer to PRTR class activities below

Address 1	Rahaghan
Address 2	Belturbet
Address 3	
Address 4	
	Cavan
Country	Ireland
Coordinates of Location	-7.51132 54.0873
River Basin District	GBNIIENW
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	Gareth O'Brien
AER Returns Contact Email Address	g.obrien@boylanengieering.ie
AER Returns Contact Position	046-9286000
AER Returns Contact Telephone Number	046-9286000
AER Returns Contact Mobile Phone Number	087-1045333
AER Returns Contact Fax Number	
Production Volume	0.0
Production Volume Units	0
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	1
User Feedback/Comments	None to report
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	**Activity Name**
5(c)	Installations for the disposal of non-hazardous waste
50.1	General

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

Is it applicable?	No
Have you been granted an exemption ?	No
If applicable which activity class applies (as per Schedule 2 of the regulations) ?	NA
Is the reduction scheme compliance route being used ?	NA

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) ?	No

4.1 RELEASES TO AIR Link to previous years emissions data | PRTR# : W0092 | Facility Name : Belturbet Landfill | Filename : W0092_2017 (2).xls | Return Year : 2017 | 10/04/2018 17:09

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD				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
03	Carbon dioxide (CO2)	C	OTH	GASSIM	0.0	33000.0	0.0	33000.0
01	**Methane (CH4)**	C	OTH	GASSIM	0.0	11700.0	0.0	11700.0

* 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				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

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

SECTION C : REMAINING POLLUTANT EMISSIONS (As required in your Licence)

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD				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

* 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: Belturbet Landfill

Please enter summary data on the quantities of methane flared and / or utilised	**T (Total) kg/Year**	**M/C/E**	**Method Used**		**Facility Total Capacity m3 per hour**	
			Method Code	**Designation or Description**		
Total estimated methane generation (as per site model)	11700.0	C	OTH	Gassim Lite	N/A	
Methane flared	0.0				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)	0.0				N/A	

Do you import/accept waste onto your site for on-site treatment (either recovery or disposal activities) ?	No

Environmental Protection Agency

A survey of landfill sites to determine the quantity of methane flared and or recovered in utilisation plants for 2017

Please choose from the drop down menu the license number for your site	W0092
Please choose from the drop down menu the name of the landfill site	Belturbet Landfill
Please enter the number of flares operational at your site in 2017	0
Please enter the number of engines operational at your site in 2017	0
Total methane flared	0 kg/year
Total methane utilised in engines	0 kg/year

Please note that the closing date for reciept of completed surveys is 31/03/2018

Introduction

The Office of Environmental Sustainability (OES) of the Environmental Protection Agency acts as the inventory agency in Ireland with responsibility for compiling and reporting national greenhouse gas inventories to the European Commission and the United Nations Framework Convention on Climate Change. In addition to meeting international commitments Ireland's national greenhouse gas inventory informs national agencies and Government departments as they face the challenge to curb emissions and meet Ireland's emission reduction targets under the Effort Sharing Decision (No. 406/2009/EC). The national inventory also informs data suppliers, making them aware of the importance of their contributions to the inventory process and a means of identifying areas where input data may be improved.

It is on this basis that the Environmental Protection Agency is asking landfill operators to partake in this survey so that the most uptodate information on methane flaring and recovery in utilisation plants at landfills sites is used in calculating the contribution of the landfill sector to national greenhouse gas emissions

The Environmental Protection Agency wishes to thank you for partaking in this survey. If you have any questions about the survey and how to complete it please view the "Help sheet" worksheet. If however, your query is not answered by viewing the "Help sheet" worksheet please contact:
LFGProject@epa.ie

Once completed please send the completed file as an attachment clearly stating the name and or license number of the landfill site (e.g. W000 Xanadu landfill_2017) to:
LFGProject@epa.ie

Appendix B

Monitoring Location Plan

RAHAGHAN

0 25 50 75 Metres

Killynaher Lake

Belturbet closed landfill, outlined in red

ADJACENT AGRICULTURAL LANDS

Quarry

Quarry

Quarry

GWMW 5
GWMW 6
GWMW 7
GWMW 8
GWMW 9
GWMW 10
MW 11
SW 1

SW06 CL 66.00 IL 63.15
SW06/1 CL 66.00 IL 64.42
SW06/2 CL 66.00 IL 64.62
SW06/3 CL 66.00 IL 64.85
SW07 CL 66.00 IL 64.38
SW08 CL 66.00 IL 64.57
SW09 CL 66.00 IL 64.75

Gas 1
Gas 2
Gas 3
Gas 4
Gas 5
Gas 6
Gas 7
Gas 8
Gas 9
Gas 10
Gas 11
Gas 12

LMW B
LMW B

3.14
0.70
0.21
0.23
0.23
0.76
0.30
0.38
0.29
0.23
0.33

FF
CD
UND
ACCESS LANEWAY
N87
N87

Please Note
Do not scale from drawing.
All dimensions should be verified on site before construction and any discrepancies found brought to the attention of the Engineer.

All drawings remain the property of the Boylan Engineering, permission must be sought to copy any drawing or section there of.

NOTES / LEGEND

01	20.02.18	Addition of GWMW 9, 10, 11

Client: Cavan County Council

Project:
Belturbet Landfill

Boylan engineering
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Website: www.boylanengineering.ie

Drawn By	Approved by
A. Clarke	B. Keating

Drawing No.	Drawing Name
001	Monitoring Well Locations

Date	Scale	Rev.
06.04.2012	1:1000	001

Appendix C

Quarter 4 Monitoring Report

GROUND WATER MONITORING REPORT
BELTURBET LANDFILL
W0092-01
Quarter 4 2017

Document No.: CCC-04-01-07-02-03-03-Rev 1

Project No.: CCC-04-01

Client: Cavan County Council

Project Name: Rahaghan, Belturbet

Summary of Document Revisions		
Rev No.	**Date Revised**	**Revision Description**
1	20.02.18	Amendments

Prepared by	Terry Keating	26/01/18
Approved by	Gareth O'Brien	19/02/18

CONTENTS

LIST OF TABLES

1 SUMMARY

Boylan Engineering (Eng. & Environmental Consultancy) was commissioned by Cavan County Council to carry out environmental monitoring at, Belturbet landfill W0092-01, Rahaghan, Belturbet , Co Cavan for Quarter 4 (Annual) 2017. This report documents the finding from the groundwater sampling and monitoring undertaken at Belturbet Landfill on 08th of November and 28th of November 2017 for Q4.

2 INTRODUCTION

Belturbet landfill was operated as a disposal facility by Cavan County Council from 1979 until its closure in February 2002. The facility was operated as a traditional landfill and is located on the Belturbet Ballyconnell road (R200) approximately 4.5 kilometres West of Belturbet town. The site which was originally a limestone quarry comprises some 0.65 hectares. The bedrock surrounding the landfill is Darty Limestone Formation from the Lower Carboniferous period. A waste licence was issued by the EPA on the 13th of February 2002. Some remedial works were carried out after the closure of the site.

Condition 8.1 of the waste licence requires that monitoring be carried out in accordance with Schedule D of the licence. The following report give details of the groundwater, sampling programme conducted on site and also summarises findings and analytical results for Quarter 4 2017.

The purpose of environmental monitoring at closed landfills is to:

- Ensure the facility is compliant with the waste license
- Ensure the facility is not causing environmental pollution
- Ensure the facility is not posing a risk to human health
- Ensure the facility is not creating an unacceptable risk to atmosphere, water, soil, plants or animals
- Ensure the facility is not adversely affecting the countryside or places of interest
- Compare actual site behaviour with expected/modelled behaviour
- Establish a reliable database of information for the landfill throughout its life

According to the Response matrix for landfills, Belturbet landfill is situated in the R4 Zone. This zone was categorized using a vulnerability rating combined with the aquifer category for the area. Landfills situated in R4 Zones are unacceptable in accordance with today's standards detailed in the EPA Landfill Design Manual or conditions of a waste license - (EPA, groundwater protection Responses for Landfills).Unfortunately this landfill was constructed prior to this guidance and conditions were issued only after its closure.

The generation of Leachate is one of the main hazards to groundwater from the disposal of waste by land filling. The conditions within a landfill vary over time from aerobic to anaerobic thus allowing for different chemical reactions to take place. Most landfill leachates have a high BOD, COD, Ammonia, Chloride, Sodium, Potassium, Hardness and Boron levels - (EPA, groundwater protection Responses for Landfills)

3 METHODOLOGY

3.1 Environmental Monitoring and Sampling

The following procedures were conducted by Boylan Engineering to ensure accurate groundwater monitoring:

- ISO 5667: Guidance on sampling of groundwaters is adhered to.
- Prior to sampling, the depth of water in groundwater wells is measured by dipping. Dipping the wells before sampling allows for calculation of the volume of water in the well. This data is recorded on the field sheet for volume calculation which is presented in appendix 3.
- Once the volume was calculated the boreholes are purged three times their volume before sampling.
- Sampling were conducted using a Waterra inertial lift pump and associated tubing, pumping water directly from the borehole to the appropriate sampling bottles.
- Designated tubing is used at each location.
- Having obtained a representative sample the following parameters are measured on-site using a Hanna HI 98129 combination waterproof high accuracy probe.
    - Conductivity
    - Temperature
    - pH

3.2 Laboratory Analysis

- Samples were sent to Environmental Laboratory Service (ELS) (Ireland) for analysis of the required parameters in designated cool boxes with ice packs. These boxes ensure that samples are maintained at a consistent temperature between 0^{o}C and 4^{o}C on their journey to the laboratory.
- On arrival at the laboratory, samples are stored between 0^{o}C and 4^{o}C.
- All samples received are inspected by Laboratory Manager Mr. Brendan Murray.
- All samples are assigned a unique reference number and are recorded on the Laboratory Information Management System (LIMS)
- All staff involved in the analysis of samples hold a minimum honours science degree.
- In the event of a Quality Control Check failure for a given parameter, a note will be included on the analysis report detailing the QC fail.
- Analysis of samples is conducted under the INAB accreditation and associated quality control procedures are employed in every aspect of analysis.
- Analysis methods are listed in Appendix 2.

3.3 Weather Report

The weather report from Q4 is presented in the table below.

Table 1 Groundwater Weather report Q4 of 2017

REPORTS FROM BALLYHAISE (A)							
Date	Rainfall	Max	Min	Grass Min Temp	Mean Wind Speed	Maximum Gust	Sunshine
	(mm)	Temp	Temp	(°C)	(knots)	(if >= 34 knots)	(hours)
		(°C)	(°C)				
08/11/2017	2.6	11.3	0.7	-3.1	5.3		

REPORTS FROM BALLYHAISE (A)							
Date	Rainfall	Max	Min	Grass Min Temp	Mean Wind Speed	Maximum Gust	Sunshine
	(mm)	Temp	Temp	(°C)	(knots)	(if >= 34 knots)	(hours)
		(°C)	(°C)				
28/11/2017	0.1	6.3	1.8	-1.7	9		

3.4 Monitoring Locations

The groundwater monitoring locations from Q4 (Annual) of 2017 are presented in the tables below. As noted below, an additional well GW/MW10 was added to the monitoring round at the request of Cavan County Council.

Table 2 Q4-Groundwater Monitoring Locations of 2017

Quarter 4 2017					
Monitoring Well	Sample Type	Cover Level M (OD Malin Head)	Water Level M (OD Malin Head)	Water Depth M (Top of Casing)	National Grid Co-Ordinates
MW1	GW	TBC		TBC	TBC
MW7	Gas & GW	TBC		4.8	TBC
MW 8	GW	TBC		7.23	TBC
MW 9	Gas & GW	TBC		6.1	TBC
MW 10	GW	TBC		2.1	TBC

4 SUMMARY OF RESULTS

A summary of the groundwater monitoring results from Q4 (Annual) of 2017 are presented in Table 3 below.

Table 3-Q4 Summary of Groundwater Monitoring Analytical Results 2017

Report Number	119646 - 1 & 120685 - 1
Monitoring Date:	8.11.17/28.11.17

Method		Site Tests	Site Tests	Site Tests	Site Tests	Site Tests	Total Organic Carbon (TOC)	Coliforms	Ammonia	AQ2-UP1	Coliforms	Titralab		AQ2-UP2	Dissolved Oxygen	Ion Chromatography	Titralab
Method Number		**Site Tests**	**Site Tests**	**Site Tests**	**Site Tests**	**Site Tests**	**EW123**	**MIC133**	**EW154M**	**EW154M**	**MIC133**	**EW153**		**EW154M-1**	**EW043**	**EW137**	**EW153**
Parameter		Sample temperature (to be tested onsite)	Cond	pH	Water Level from TOC	Visual Inspection	Total Organic Carbon (TOC)	E. Coli	Ammonia (as N)	TON (as N)(Calc)	Total Coliforms	pH	Conductivity @20 DegC	Chloride	Dissolved Oxygen	Fluoride	Alkalinity Total (R2 pH4.5)
Units		Deg C	us/cm	pH units	Meter's		mg/L	MPN/100ml	mg/l N	mg/l N	MPN/100ml	pH Units	uscm-1@20	mg/L	mg/L	mg/L	mg/L CaCO3
Limit of Detection		-	-	-	-	-	0.25	0	0.007	0.138	0	0.3	25	2.6	1.0	0.1	10
Date Testing Initiated		8.11.17/28.11.17					09.11.17/29.11.17										
ELS Ref	**Client Ref**																
119646/002	GW/MW7	11.9	524	7.2	4.6	Clear	20.07	0	<0.005	0.19	***14***	7.1	766	11	8	0.2	361
119646/003	GW/MW8	11.4	905	7.3	7.3	Clear	46.21	0	0.036	0.17	***4***	7.2	425	12	6	0.4	346
119646/004	GW/MW9	11.7	841	7.1	5.8	Clear	20.64	0	***0.175***	0.77	***5***	8.1	657	12	6	***1.6***	356
119646/005	GW/MW10	9	352	7.3	3.8	Clear	1.83	0	<0.005	0.33	***3***	7.6	224	2	6	0.8	321
IGV			1000	≥6.5 and ≤9.5			NAC	0	0.15		0	≥6.5 and ≤9.5	1000	30	NAC	1	NAC

Method		Metals-Dissolved													AQ2-UP2	Total Cyanide High (Sub)	Total Phosphorus-TP
Method Number		**EM130**													**EW154M-1**	**DEFAULT**	**EW146**
Parameter		Iron-Dissolved	Potassium-Dissolved	Sodium-Dissolved	Cadmium-Dissolved	Chromium-Total	Manganese-Dissolved	Calcium-Dissolved	Copper-Dissolved	Lead-Dissolved	Magnesium-Dissolved	Mercury-Dissolved	Zinc-Dissolved	Boron-Dissolved	Sulphate	Total Cyanide High	Total Phosphorus-TP
Units		ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	mg/L	mg/L	ug/L	mg/L	ug/L	ug/L	mg/L	mg/L	ug/L	mg/l P
Limit of Detection		20.0	0.2	0.5	0.1	1	1	1	0.003	0.3	0.3	0.02	1	0.02	5	9	0.1
Date Testing Initiated																	
ELS Ref	**Client Ref**																
102201/002	GW/MW7	<20	2.1	4.9	<0.1	<3.0	1.8	160	<0.003	<0.3	19.2	<0.02	9.1	0.03	8.3	<9	0.03
102201/003	GW/MW8	<20	4.3	49.4	<0.1	<3.0	46	170	<0.003	<0.3	36.9	<0.02	15	0.05	63	<9	<0.01
102201/004	GW/MW9	<20	***8***	30.6	<0.1	<3.0	11	100	<0.003	<0.3	46.4	<0.02	8.3	0.2	16	<9	<0.01
102201/004	GW/MW10	<20	***5.8***	16.7	<0.1	<3.0	***140***	120	<0.003	<0.3	28.8	<0.02	***1100***	0.13	17	<9	0.05
IGV		200	5	150	5	30	50	200	0.03	10	50	1	100	1	200	10	-

Exceedance

NOTES

NAC- No Abnormal Change

IGV - Interim Guideline Value

As there are no limits set in the waste licence for groundwater, results are compared to the Interim Guide Values (IGVs) for the protection of Groundwater.

5 DISCUSSION OF RESULTS

5.1 Discussion of Results

Monitoring of groundwater is a common and necessary event at landfill sites both during their active life and post closure. The significance of such monitoring is so the facilities can demonstrate that there is no potential for the migration of hazardous contaminants from the unit into the groundwater systems.

Monitoring for Q4 was conducted on the 08th of November and 28th November 2017. The results from Q4 (Annual) monitoring are presented in Table 3 in Section 4 above with any parameters that exceeded the Interim Guide Values (IGVs) highlighted in bold italic.

5.2 Q4 Analysis

The Results from Q4 annual monitoring for 2017 have been compared to the IGVs as outlined in the table above. The analysis from Q4 revealed elevated concentrations for several parameters which included ammonia, total coliforms, fluoride, potassium, zinc and manganese. It should be noted as there are no limits specified by the waste licence, these results cannot be deemed as non-compliant with the licence conditions.

As noted in Section 3.4, a new groundwater monitoring well GWMW10 was included in the monitoring round for Q4. GWMW10 is an up gradient well, located to the south of the landfill.

Elevated concentrations of total coliforms were recorded at GW/MW7, GW/MW8, GW/MW9 and GW/MW10 during Q4, however a marked decrease from Q2 and Q3 was noted. Exceedances for total coliforms at these monitoring wells have been encountered historically, as the area surrounding the landfill is predominately agricultural and therefore the elevated concentrations are likely to have been caused by activities such as land spreading.

The samples retrieved from GW/MW9 returned a slightly elevated concentrations for ammonia (0.175 mg/l), marginally exceeding the IGV of 0.15 mg/l. No similar exceedances were noted during Q1 – Q3 of 2017 at GW/MW9, however, exceedances were noted at the location in 2016. As noted in the EPA IGV guidance document, elevated ammonia concentrations can be attributed to agricultural practices (e.g. fertilisers, farmyard runoff, landspreading etc.) and given the increased rainfall experienced during the time of year, this may have contributed to the leaching of agricultural contaminants to the underlying groundwater.

The samples retrieved from GW/MW9 and GW/MW10 returned elevated concentrations for potassium. No exceedances for potassium were noted at GW/MW9 during Q1 – Q3 of 2017, however, historical results from 2013 and 2014 revealed similar elevated concentrations. As GW/MW10 has not been historically sampled there are no historic results available to compare the results to. It should be noted that the exceedance was marginal and given that it is up gradient of the landfill this exceedances cannot be attributed to the landfill. Additionally, the EPA IGV outlines that potassium contamination can be attributed to agricultural activities (e.g. farmyard runoff, landspreading) and therefore high rainfall may have contributed to the leaching of agricultural contaminants to the underlying groundwater.

A marginally elevated concentration for fluoride was also noted at GW/MW9 (1.6 mg/l). This result slightly exceeded the IGV of 1 mg/l and is not considered significant.

The sample retrieved from GW/MW10 also marginally exceeded the assessment criteria for manganese and zinc. The EPA guidance outlines that elevated manganese concentrations can be attributed to organic contamination from silage and sewage; however, they are also naturally occurring. As noted

above, GW/MW10 was not monitored previously and given that its located upgradient of the landfill, the elevated concentrations cannot be attributed to the landfill.

Historical results for comparison purposes are presented in tabular and graphic form in the Appendix 4.

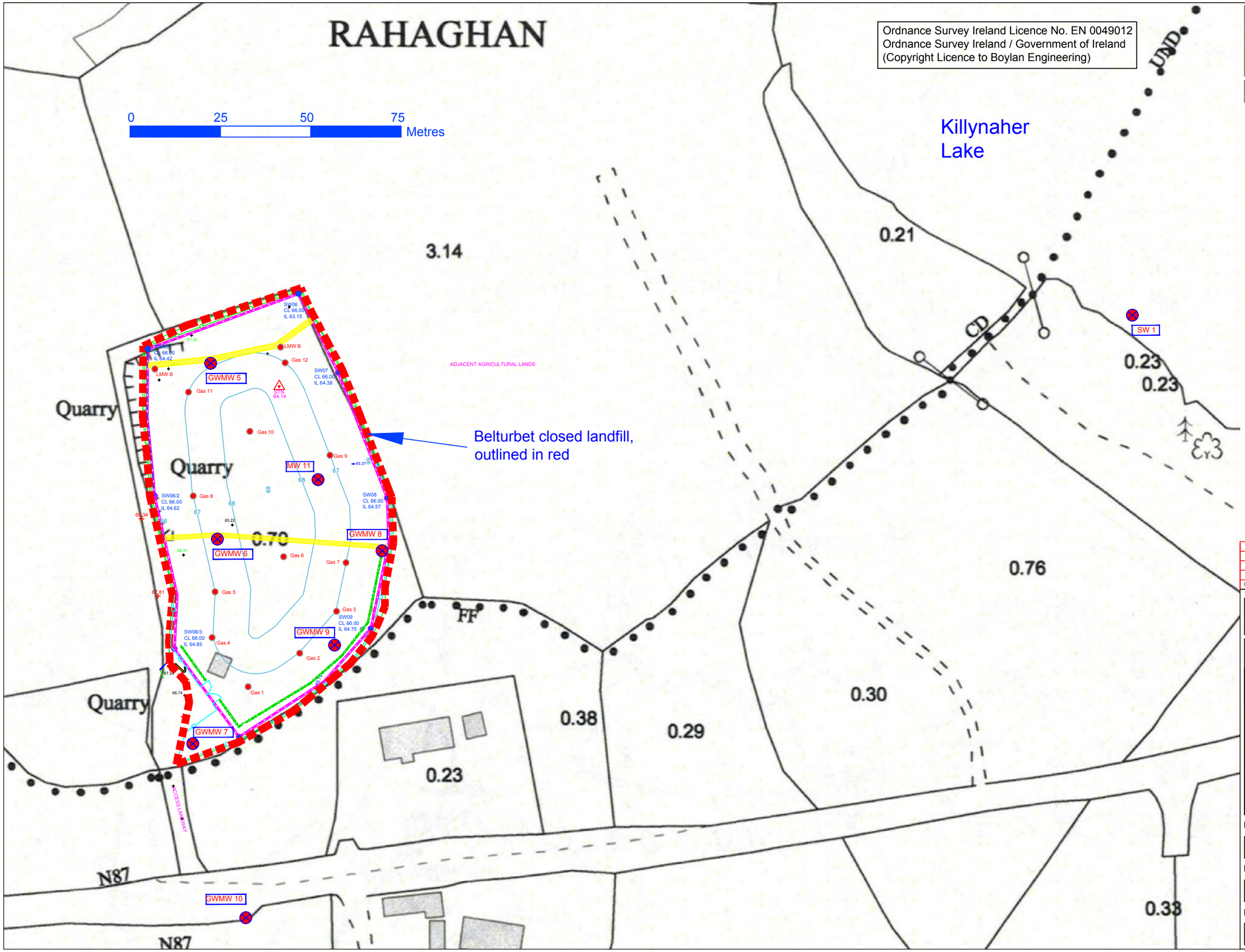
6 CONCLUSION

The groundwater results obtained were generally consistent with previous monitoring events and do not show any signs of dramatic exceedances. It should be noted that GW/MW10 is a new monitoring well and there are no historic results for this well. Additionally, given that it is located up gradient of the landfill the results are therefore not comparable to the results obtained from the wells within the landfill.

The next monitoring event will be carried out in Quarter 1 in 2018. Information relating to previous results can be seen in the historical data tables in Appendix 4.

Appendix 1

Monitoring Location Plan



Please Note
Do not scale from drawing.
All dimensions should be verified on site before construction and any discrepancies found brought to the attention of the Engineer.

All drawings remain the property of the Boylan Engineering, permission must be sought to copy any drawing or section there of.

NOTES / LEGEND

01	20.02.18	Addition of GWMW 9, 10, 11

Client: Cavan County Council

Project:
Belturbet Landfill

Boylan engineering
Main St., Mullagh, Kells, Co. Meath.
Phone: 046 - 928 6000
Email: info@boylanengineering.ie
Website: www.boylanengineering.ie

Drawn By	Approved by
A. Clarke	B. Keating

Drawing No.	Drawing Name
001	Monitoring Well Locations

Date	Scale	Rev.
06.04.2012	1:1000	001

Appendix 2

Field Monitoring Results

Groundwater Sampling ref.

Site Reference: Belturbet **Permit No.** W00-92 **Date: 08.11.2017** **Personnel: Terry Keating**

Sample Ref	Depth of Well	Depth of water below Ground Level	Depth of water column	Diameter of well	Radius of well	Radius squared	Volume of water in well	Volume of water in well	Volume of water to purge	Time to purge
	(m)	(m) B	A-B=h	(m)	(m)	(m^2)	(m3) π r2h	litres	(litres x 3)	(mins)
(Shallow/Deep)	A	B		C	(C/2) = r	r^2		(m^3 x 1000)		
7	31.2	4.6	26.6	0.05	0.025	0.00063	0.052	52.2	156.6	26
8	31.12	7.3	23.8	0.05	0.025	0.00063	0.047	46.7	140.2	23
9	10.2	5.8	4.4	0.05	0.025	0.00063	0.009	8.64	25.91	4

Quarter 4

ON SITE SAMPLING FORM

Facility Name: Belturbet | **Waste Licence No:** W0092-01

Report To:

Sampling Date: 08.11.2017 | **Sample Type (GW, SW, Leachate)** All

Personnel: Terry Keating | **Weather:** Dry

Other Remarks: | **GPS:**

Sample Ref No	Sample Type	Time	DO Level	Elec Cond (us)	pH pH units	Temp ^{o}C	Visual
MW7	GW		-	524	7.2	11.9	Clear
MW8	GW		-	905	7.3	11.4	Clear
MW9	GW		-	841	7.1	11.7	Clear
MW10	GW		-	352	7.31	9	Clear

COMMENTS:

Appendix 3

Laboratory Analytical Results

ELS LTD INAB ACCREDITATION SCHEDULE SUMMARY SHEET

Miscellaneous (P,G,W,S)
Ammonia/Ammonium 0.007-1mg/l N EW154
Chloride 2.6-250 mg/l EW154
Flouride 0.1 - 2 mg/l EW137
COD 8-1500 mg/l EW094
Nitrate 0.12-50 mg/l N EW154
Nitrite 0.013-1 mg/l N EW154
pH 4 – 10 pH Units EW153
Phosphate 0.009-1 mg/l P EW154
Alkalinity 10-1000mg/l EW153
TOC 0.25-100mg/l EW123
BOD 1-1300mg/l EW001
Total Nitrogen 1-100mg/l N EW140
Total Phosphorous 0.01-40 mg/l P EW143
Suspended Solids 5-1000mg/l EW013
Dissolved Oxygen 1 to 10 mg/l EW043
Conductivity 25-6000 us/cm EW154

Miscellaneous (P,G,S)
Bromate 1 to 50ug/l BRO3 EW137
Colour 2.5-50mg/l PtCCo EW154
Sulphate 1-250mg/l SO4 EW154
Total Dissolved Solids 15-1000mg/l EW046
Total Hardness 3-330mg/l CaCO3 EM099
Total Oxidised Nitrogen 0.138-51mg/l N EW051
Turbidity 0.11-150 NTU EW136
TKN Calculation 1-49 mg/l EW010

Metals EM130 (P,G,S)
Aluminium 5.0 – 500 µg/l
Antimony 0.1 – 10µg/l
Arsenic 0.2 - 20µg/l
Barium 1.0 - 100µg/l
Boron 0.02 – 2mg/l
Cadmium 0.1 – 10µg/l
Calcium 1.0 – 100mg/l
Chromium 1.0 - 100µg/l
Cobalt 1.0 - 100µg/l
Copper 3 - 4000µg/l
Iron 20.0 - 500µg/l
Lead 0.3 - 30µg/l
Magnesium 0.3 – 20mg/l
Manganese 1.0 - 100µg/l
Mercury 0.02 - 2µg/l
Molybdenum 1.0 - 100µg/l
Nickel 0.5 - 50µg/l
Potassium 0.2 – 20mg/l
Selenium 0.2 - 20µg/l
Sodium 0.5 – 50mg/l
Strontium 1.0 - 100µg/l
Tin 1.0 - 100µg/l
Vanadium 1.0 - 100µg/l
Zinc 1.0 - 100µg/l

SI439 Potable Water VOCs & THM
EO025 (P,G,S,W)
Benzene 0.1-35 µg/l
1.2-Dichloroethane 0.1-35 µg/l
Tetrachloroethene 0.1-35 µg/l
Trichloroethene 0.1-35 µg/l
Chloroform 1.0-150 µg/l
Bromoform 1.0-35 µg/l
Dibromochloromethane 1.0-35 µg/l
Bromodichloromethane 2.0-35 µg/l

Other VOC's EO025 (P,G,S,W)
Bromomethane 0.5 - 35 µg/l
Ethyl Ether/Diethyl Ether 0.5 - 35 µg/l
11 Dichloroethene 0.5 - 35 µg/l
Iodomethane/Mehyl Iodide 0.5 - 35 µg/l
Carbon Disulphide 0.5 - 35 µg/l
Allyl Chloride 0.5 - 35 µg/l
Methylene Chloride/DCM 5.0 - 35 µg/l
2-Propenenitrile/Acrylonitrile 2.0 - 35 µg/l
Chlormethyl Cyanide 0.5 - 35 µg/l
Hexachlorobutadiene 0.5 - 35 µg/l
Trans-1,2 Dichloroethene 0.5 - 35 µg/l
MtBE 0.5 - 35 µg/l
11 Dichloroethane 0.5 - 35 µg/l
Cis-12 Dichloroethene 0.5 - 35 µg/l
Methyl Acrylate 5.0 - 35 µg/l
Bromochloromethane 0.5 - 35 µg/l
Tetrahydrofuran 5.0 - 35 µg/l
111 Trichloroethane 0.5 - 35 µg/l
1-Chlorobutane 0.5 - 35 µg/l
Carbon Tetrachloride 0.5 - 35 µg/l
11 Dichloropropene 0.5 - 35 µg/l
12 Dichloropropane 0.5 - 35 µg/l
Dibromomethane 0.5 - 35 µg/l
Methyl Methacrylate 0.5 - 35 µg/l
13 Dichloropropene, cis 2.0 - 35 µg/l
MIBK/4 Methyl 2 Pentanone 2.0 - 35 µg/l
Toluene 0.5 - 35 µg/l
13 Dichloropropene,trans 2.0 - 35 µg/l
Ethyl Methacrylate 2.0 - 35 µg/l
112 Trichloroethane 0.5 - 35 µg/l
13 Dichloropropane 0.5 - 35 µg/l
2 Hexanone 1.0 - 35 µg/l
12 Dibromoethane 0.5 - 35 µg/l
Chlorobenzene 0.5 - 35 µg/l
1112 Tetrachloroethane 2.0 - 35 µg/l
Ethyl Benzene 0.5 - 35 µg/l
m & p Xylene 0.5 - 35 µg/l
O Xylene 0.5 - 35 µg/l
Stryene 2.0 - 35 µg/l
Isopropyl Benzene 0.5 - 35 µg/l
Bromobenzene 0.5 - 35 µg/l
1122 Tetrachloroethane 0.5 - 35 µg/l
123 Trichloropropane 2.0 - 35 µg/l
Propyl Benzene 0.5 - 35 µg/l
2-Chlorotoluene 0.5 - 35 µg/l
4 Chlorotoluene 0.5 - 35 µg/l
135 Trimenthylbenzene 0.5 - 35 µg/l
Tert Butyl Benzene 0.5 - 35 µg/l
124 Trimethlbenzene 0.5 - 35 µg/l
Sec Butyl Benzene 0.5 - 35 µg/l
13 Dichlorobenzene 0.5 - 35 µg/l
P Isopropyltoluene 0.5 - 35 µg/l
14 Dichlorobenzene 0.5 - 35 µg/l
12 Dichlorobenzene 0.5 - 35 µg/l
N Butyl Benzene 0.5 - 35 µg/l
Hexachloroethane 5.0 - 35 µg/l
12 Dibromo 3Chloropropane 2.0 - 35 µg/l
124 Trichlorobenzene 0.5 - 35 µg/l
123 Trichlorobenzene 0.5 - 35 µg/l

Other VOC's EO025 (P,G,S)
22 Dichloropropane 0.5 - 35 µg/l

PAH EO129 (P,G,S)
Range 0.01 - 0.2 µg/l
Acenaphthene
Benzo (a) Anthracene
Benzo (a) Pyrene
Benzo (b) Fluoranthene
Benzo (ghi) Perylene
Benzo (k) Fluoranthene
Chrysene
Dibenzo (ah) Anthracene
Fluoranthene
Fluorene
Indeno (123-cd) Pyrene
Phenanthrene
Pyrene

Acid Herbicides (P,G,S)
Range 0.01 - 0.2 µg/l
2,4,5-T H
2,4-D H
2,4-DB H

Organophosphorus Pesticides(P,G,S)
Range 0.01 - 0.2 µg/l
Famphur OP
Methyl Parathion OP
Parathion OP

Organochlorine Pesticides (P,G,S)
Range 0.01 - 0.2 µg/l
Aldrin
BHC Alpha isomer OC
BHC Beta isomer OC
BHC Delta isomer OC
Dieldrin OC
Endosulphan Alpha isomer OC
Endosulphan Beta isomer OC
Endosulphan Sulphate OC
Endrin OC
Heptachlor Epoxide OC
Heptachlor OC
Lindane OC
P,P' DDE OC
P,P'-DDD OC
P,P'-DDT OC

Notes
1.Sample Matrix:P=Potable Water (Drinking) , G=Ground Water , S=Surface Water, W=Waste Water

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/001
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	GW07		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Coliforms									
	Total Coliforms		MIC133	0		14	MPN/100ml	INAB	
	Analyst Micro Comment: The start date for this micro test is 09.11.2017								
	E. Coli		MIC133	0		0	MPN/100ml	INAB	
Dissolved Oxygen									
	Dissolved Oxygen		EW043	1		8	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		0.19	mg/l N	INAB	
	Nitrate as N		EW175	0.15		0.19	mg/l N	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Chloride mg/L		EW175	1.0		11	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		8.3	mg/L	INAB	
	Fluoride mg/L		EW175	0.1		0.2	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		1.8	ug/L	INAB	
	Boron-Dissolved		EW188	0.02		0.03	mg/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Calcium-Dissolved		EW188	1.0		160	mg/L		
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		19.2	mg/L	INAB	
	Zinc-Dissolved		EW188	1.0		9.1	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		2.1	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		4.9	mg/L	INAB	
Metals-Total									
	Chromium-Total		EW187	3.0		<3.0	ug/L	INAB	
Residue on Evaporation (Tot Solids-TS)									
	Residue on Evaporation (Tot Solids-TS)		EW060	10.0		390.0	mg/L		
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153	0.0		7.1	pH Units	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/001
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	GW07		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Titralab									
	Conductivity @20 DegC		EW153	25		766	uscm-1@20	INAB	
	Alkalinity Total (R2 pH4.5)		EW153	10		361	mg/L CaCO3	INAB	
Total Cyanide High (Sub)									
	Total Cyanide High	*	Default	10		<9	ug/L	YES	
Total Organic Carbon (TOC)									
	Total Organic Carbon (TOC)		EW123	0.25		20.07	mg/L	INAB	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.01		0.03	mg/l P	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/002
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	GW08		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Coliforms									
	Total Coliforms		MIC133	0		4	MPN/100ml	INAB	
	E. Coli		MIC133	0		0	MPN/100ml	INAB	
Dissolved Oxygen									
	Dissolved Oxygen		EW043	1		6	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.036	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		0.17	mg/l N	INAB	
	Nitrate as N		EW175	0.15		0.16	mg/l N	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Chloride mg/L		EW175	1.0		12	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		63	mg/L	INAB	
	Fluoride mg/L		EW175	0.1		0.4	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		46	ug/L	INAB	
	Boron-Dissolved		EW188	0.02		0.05	mg/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Calcium-Dissolved		EW188	1.0		170	mg/L		
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		36.9	mg/L		
	Zinc-Dissolved		EW188	1.0		15	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		4.3	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		49.4	mg/L	INAB	
Metals-Total									
	Chromium-Total		EW187	3.0		<3.0	ug/L	INAB	
Residue on Evaporation (Tot Solids-TS)									
	Residue on Evaporation (Tot Solids-TS)		EW060	10.0		520.0	mg/L		
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153	0.0		7.2	pH Units	INAB	
	Conductivity @20 DegC		EW153	25		425	uscm-1@20	INAB	
	Alkalinity Total (R2 pH4.5)		EW153	10		346	mg/L CaCO3	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/002
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	GW08		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Cyanide High (Sub)									
	Total Cyanide High	*	Default	10		<9	ug/L	YES	
Total Organic Carbon (TOC)									
	Total Organic Carbon (TOC)		EW123	0.25		46.21	mg/L	INAB	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.01		<0.01	mg/l P	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/003
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	GW09		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Coliforms									
	Total Coliforms		MIC133	0		5	MPN/100ml	INAB	
	E. Coli		MIC133	0		0	MPN/100ml	INAB	
Dissolved Oxygen									
	Dissolved Oxygen		EW043	1		6	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.175	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		0.77	mg/l N	INAB	
	Nitrate as N		EW175	0.15		0.69	mg/l N	INAB	
	Nitrite as N		EW175	0.005		0.078	mg/l N	INAB	
	Chloride mg/L		EW175	1.0		12	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		16	mg/L	INAB	
	Fluoride mg/L		EW175	0.1		1.6	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		11	ug/L	INAB	
	Boron-Dissolved		EW188	0.02		0.20	mg/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Calcium-Dissolved		EW188	1.0		100	mg/L		
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		46.4	mg/L		
	Zinc-Dissolved		EW188	1.0		8.3	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		8.0	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		30.6	mg/L	INAB	
Metals-Total									
	Chromium-Total		EW187	3.0		<3.0	ug/L	INAB	
Residue on Evaporation (Tot Solids-TS)									
	Residue on Evaporation (Tot Solids-TS)		EW060	10.0		340.0	mg/L		
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153	0.0		8.1	pH Units	INAB	
	Conductivity @20 DegC		EW153	25		657	uscm-1@20	INAB	
	Alkalinity Total (R2 pH4.5)		EW153	10		356	mg/L CaCO3	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/003
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	GW09		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Cyanide High (Sub)									
	Total Cyanide High	*	Default	10		<9	ug/L	YES	
Total Organic Carbon (TOC)									
	Total Organic Carbon (TOC)		EW123	0.25		20.64	mg/L	INAB	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.01		<0.01	mg/l P	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/004
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	Michael Reilly		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Coliforms									
	Total Coliforms		MIC133	0		8	MPN/100ml	INAB	
	E. Coli		MIC133	0		0	MPN/100ml	INAB	
Dissolved Oxygen									
	Dissolved Oxygen		EW043	1		8	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.438	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		<0.15	mg/l N	INAB	
	Nitrate as N		EW175	0.15		<0.15	mg/l N	INAB	
	Nitrite as N		EW175	0.005		<0.005	mg/l N	INAB	
	Chloride mg/L		EW175	1.0		14	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		23	mg/L	INAB	
	Fluoride mg/L		EW175	0.1		1.6	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		41	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		12	ug/L	INAB	
	Boron-Dissolved		EW188	0.02		0.13	mg/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Calcium-Dissolved		EW188	1.0		94	mg/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		22.5	mg/L		
	Zinc-Dissolved		EW188	1.0		6.0	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		4.4	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		22.7	mg/L	INAB	
Metals-Total									
	Chromium-Total		EW187	3.0		<3.0	ug/L	INAB	
Residue on Evaporation (Tot Solids-TS)									
	Residue on Evaporation (Tot Solids-TS)		EW060	10.0		325.0	mg/L		
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153	0.0		7.7	pH Units	INAB	
	Conductivity @20 DegC		EW153	25		601	uscm-1@20	INAB	
	Alkalinity Total (R2 pH4.5)		EW153	10		307	mg/L CaCO3	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**119646 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119646/004
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	Michael Reilly		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Total Cyanide High (Sub)									
	Total Cyanide High	*	Default	10		<9	ug/L	YES	
Total Organic Carbon (TOC)									
	Total Organic Carbon (TOC)		EW123	0.25		5.40	mg/L	INAB	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.01		<0.01	mg/l P	INAB	

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Contact Name	Gareth O Brien	**Report Number**	**120685 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	120685/001
		Date of Receipt	29/11/2017
		Date Started	29/11/2017
Tel No	046 9286000	**Received or Collected**	Fastway
Customer PO	Per Batch	**Date of Report**	14/12/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	MW 10		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Coliforms									
	Total Coliforms		MIC133	0		3	MPN/100ml	INAB	
	Analyst Micro Comment: The start date for this micro test is 29.11.2017								
	E. Coli		MIC133	0		0	MPN/100ml	INAB	
Dissolved Oxygen									
	Dissolved Oxygen		EW043	1		6	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		<0.005	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		0.33	mg/l N	INAB	
	Nitrate as N		EW175	0.15		0.32	mg/l N	INAB	
	Nitrite as N		EW175	0.005		0.008	mg/l N	INAB	
	Chloride mg/L		EW175	1.0		2	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		17	mg/L	INAB	
	Fluoride mg/L		EW175	0.1		0.8	mg/L	INAB	
Metals-Dissolved									
	Iron-Dissolved		EW188	20		48	ug/L	INAB	
	Manganese-Dissolved		EW188	1.0		140	ug/L		
	Boron-Dissolved		EW188	0.02		0.13	mg/L	INAB	
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Calcium-Dissolved		EW188	1.0		120	mg/L		
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		28.8	mg/L		
	Zinc-Dissolved		EW188	1.0		1100	ug/L		
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		5.8	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		16.7	mg/L	INAB	
Metals-Total									
	Chromium-Total		EW187	3.0		<3.0	ug/L	INAB	
Residue on Evaporation (Tot Solids-TS)									
	Residue on Evaporation (Tot Solids-TS)		EW060	10.0		435.0	mg/L		
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153	0.0		7.6	pH Units	INAB	

Signed : 14/12/2017

Domenico Giliberti-Technical Manager

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email:info@elsltd.com

Contact Name	Gareth O Brien	**Report Number**	**120685 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	120685/001
		Date of Receipt	29/11/2017
		Date Started	29/11/2017
Tel No	046 9286000	**Received or Collected**	Fastway
Customer PO	Per Batch	**Date of Report**	14/12/2017
Quotation No	QN006598	**Sample Type**	Ground Waters
Customer Ref	MW 10		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Titralab									
	Conductivity @20 DegC		EW153	25		224	uscm-1@20	INAB	
	Alkalinity Total (R2 pH4.5)		EW153	10		321	mg/L CaCO3	INAB	
Total Cyanide High (Sub)									
	Total Cyanide High	*	Default	10		<9	ug/L	YES	
Total Organic Carbon (TOC)									
	Total Organic Carbon (TOC)		EW123	0.25		1.83	mg/L	INAB	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.01		0.05	mg/l P	INAB	

Signed : 14/12/2017

Domenico Giliberti-Technical Manager

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Appendix 4

Historical Results

	Ground water Historical Data												
	Parameter	TOC	E.Coli	Ammonia	TON	Tot Coliforms	pH	Cond	Cl	DO	Fe	K	Na
	Units	mg/l	MPN/ 100ml	mg/l N	mg/l N	MPN/ 100ml	pH Units	us/cm	mg/l	mg/l	mg/l	mg/l	mg/l
MW 7	Qtr 4 2017	20.07	0	<0.005	0.19	***14***	7.1	766	11	8	<20	2.1	4.9
	Qtr 3 2017	4.49	***211***	***0.789***	<0.15	***534***	7.7	583	12	6	160	***5.8***	12.5
	Qtr 2 2017	0.92	***36***	***0.156***	1.5	***691***	7.7	578	12	5	***580***	***5.5***	21.2
	Qtr 1 2017	2.97	0	***1***	0.138	0	7.9	644	11	7	74	***6.3***	24.7
MW 8	Qtr 4 2017	46.21	0	0.036	0.17	***4***	7.2	425	12	6	<20	4.3	49.4
	Qtr 3 2017	7.96	***4***	***0.175***	<0.15	***76***	7.4	855	***120***	5	***220***	3.8	34.3
	Qtr 2 2017	7.03	***5***	0.055	<0.15	***1011***	8.4	340	22	10	45	2.1	12.8
	Qtr 1 2017	6.66	0	***0.21***	0.138	0	7.3	***1051***	***140***	9	***250***	3.7	41.2
MW 9	Qtr 4 2017	20.64	0	***0.175***	0.77	***5***	8.1	657	12	6	<20	***8***	30.6
	Qtr 3 2017	11.61	***27***	<0.005	<0.15	***830***	7.1	724	13	5	47	2	3.8
	Qtr 2 2017	12.55	***30***	0.055	<0.15	***190***	7.3	709	20	6	<20	1.7	3.9
	Qtr 1 2017	1.87	0	0.022	0.199	***30***	7.1	734	13	8	*23*	1.7	4.2
MW 10	Qtr 4 2017	1.83	0	<0.005	0.33	***3***	7.6	224	2	6	*<20*	***5.8***	16.7
Interim Guide Value		**NAC**	**0**	**0.15**	**NAC**	**0**	**≥6.5 &≤9.5**	**1000**	**30**	**NAC**	**200.0**	**5**	**150**

SURFACE WATER MONITORING REPORT
BELTURBET LANDFILL
W0092-01
Quarter 4 of 4 2017

Document No.: CCC-04-01-07-02-03-03-Rev 0

Project No.: CCC-04-01

Client: Cavan County Council

Project Name: Rahaghan, Belturbet

Summary of Document Revisions		
Rev No.	**Date Revised**	**Revision Description**

Prepared by	Terry Keating	26/01/18
Approved by	Gareth O'Brien	19/02/18

CONTENTS

LIST OF TABLES

1 SUMMARY

Boylan Engineering (Eng. & Environmental Consultancy) was commissioned by Cavan County Council to carry out environmental monitoring at, Belturbet landfill W0092-01, Rahaghan, Belturbet , Co Cavan for Quarter 4 (Annual) 2017. This report documents the finding from the surface water sampling and monitoring undertaken at Belturbet Landfill on 08th of November 2017 (Q4).

2 INTRODUCTION

Belturbet landfill was operated as a disposal facility by Cavan County Council from 1979 until its closure in February 2002. The facility was operated as a traditional landfill and is located on the Belturbet Ballyconnell road (R200) approximately 4.5 kilometres West of Belturbet town. The site which was originally a limestone quarry comprises some 0.65 hectares. The bedrock surrounding the landfill is Darty Limestone Formation from the Lower Carboniferous period. A waste licence was issued by the EPA on the 13th of February 2002. Some remedial works were carried out after the closure of the site.

Condition 8.1 of the waste licence requires that monitoring be carried out in accordance with Schedule D of the licence. The following report give details of the groundwater, sampling programme conducted on site and also summarises findings and analytical results for Quarter 4 2017.

The purpose of environmental monitoring at closed landfills is to:

- Ensure the facility is compliant with the waste license
- Ensure the facility is not causing environmental pollution
- Ensure the facility is not posing a risk to human health
- Ensure the facility is not creating an unacceptable risk to atmosphere, water, soil, plants or animals
- Ensure the facility is not adversely affecting the countryside or places of interest
- Compare actual site behaviour with expected/modelled behaviour
- Establish a reliable database of information for the landfill throughout its life

According to the Response matrix for landfills, Belturbet landfill is situated in the R4 Zone. This zone was categorized using a vulnerability rating combined with the aquifer category for the area. Landfills situated in R4 Zones are unacceptable in accordance with today's standards detailed in the EPA Landfill Design Manual or conditions of a waste license - (EPA, groundwater protection Responses for Landfills).Unfortunately this landfill was constructed prior to this guidance and conditions were issued only after its closure.

The generation of Leachate is one of the main hazards to groundwater from the disposal of waste by land filling. The conditions within a landfill vary over time from aerobic to anaerobic thus allowing for different chemical reactions to take place. Most landfill leachates have a high BOD, COD, Ammonia, Chloride, Sodium, Potassium, Hardness and Boron levels - (EPA, groundwater protection Responses for Landfills)

3 METHODOLOGY

3.1 Environmental Monitoring and Sampling

The following procedure were conducted by Boylan Engineering to ensure accurate surface water monitoring:

- Surface water samples were taken by grab sample using a Telescoup and Pendulum beaker.
- Having obtained a representative sample the following parameters are measured on-site using a Hanna HI 98129 combination waterproof high accuracy.
    - Conductivity
    - Temperature
    - pH
- Boylan Engineering operate a Sample Submission/Chain of Custody form, which accompanies the samples at all times.

3.2 Laboratory Analysis

- Samples are sent to Environmental Laboratory Service (ELS) (Ireland) for analysis of the required parameters in designated cool boxes with ice packs. These boxes ensure that samples are maintained at a consistent temperature between 0^{o} C and 4^{o} C on their journey to the laboratory.
- On arrival at the laboratory, samples are stored between 0^{o} C and 4^{o} C.
- All samples received are inspected by Laboratory Manager Mr. Brendan Murray.
- All samples are assigned a unique reference number and are recorded on the Laboratory Information Management System (LIMS)
- All staff involved in the analysis of samples hold a minimum honours science degree.
- In the event of a Quality Control Check failure for a given parameter, a note will be included on the analysis report detailing the QC fail.
- Analysis of samples is conducted under the INAB accreditation and associated quality control procedures are employed in every aspect of analysis.
- Analysis methods are listed in Appendix 2.

3.3 Weather Report

The weather report from Q4 is presented in the table below.

Table 1 Surface water Weather Report Q4 of 2017

REPORTS FROM BALLYHAISE (A)							
Date	Rainfall	Max	Min	Grass Min Temp	Mean Wind Speed	Maximum Gust	Sunshine
	(mm)	Temp	Temp	(°C)	(knots)	(if >= 34 knots)	(hours)
		(°C)	(°C)				
08/11/2017	2.6	11.3	0.7	-3.1	5.3		

3.4 Monitoring Locations

The surface water monitoring location from Q4 of 2017 is presented in the table below.

Table 2 Q4 Surface Water Monitoring Location of 2017

Quarter 4 2017					
Monitoring Well	**Sample Type**	**Cover Level M (OD Malin Head)**	**Water Level M (OD Malin Head)**	**Water Depth M (Top of Casing)**	**National Grid Co-Ordinates**
Killynaher Lake	SW	TBC		TBC	TBC

4 SUMMARY OF RESULTS

A summary of the surface water monitoring results from Q3 of 2017 are presented in Table 3 below.

Table 3 Q4 (Annual) Summary of Surface water Monitoring Analytical Results for 2017

Report Number	119643/001
Monitoring Date:	08.11.2017

Method		Site Tests	Site Tests	Site Tests	AQ2	Titralab		5-Day	HACH	Gravimetric	AQ2	Inolab	Titralab	AQ2-UP2	Total Phosphorus-TP	AQ2-UP1
Method Number		**Site Tests**			**EW003**	**EW138**	**EW139**	**EW001**	**EW094**	**EW013**	**EW015**	**EW043**	**EW153**	**EW154M-1**	**EW146**	**EW154M**
Parameter		Sample temperature (to be tested onsite)	Cond	pH	Ammonia	pH	Cond	BOD	COD	Total Suspended Solids	Cl	DO	Alkalinity Total (R2 pH4.5)	Sulphate	Total Phosphorus-TP	TON (as N)(Calc)
Units		Deg C	us/cm	pH units	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/L CaCO3	mg/L	mg/l P	mg/l N
Limit of Detection		-	-	-	0.007	25	25	1	8	5	2.6	1.0	10	5	0.1	0.138
Date Testing Initiated		8.11.17			09.11.17											
ELS Ref	**Client Ref**															
119643/001	SW1 Lake	8.3	345	7.58	0.022	8.4	343	<2.0	28	<5	19	9	154	11	0.02	<0.15
S.I No. 294/2009					0.2	≥5.5 and ≤8.5	1000	5	40	50	250	-	NAC	200	-	

Method		Metals-Dissolved											Metals-Total
Method Number													
Parameter		Iron-Dissolved	Manganese-Dissolved	Potassium-Dissolved	Sodium-Dissolved	Cadmium-Dissolved	Calcium-Dissolved	Copper-Dissolved	Lead-Dissolved	Magnesium-Dissolved	Mercury-Dissolved	Zinc-Dissolved	Chromium-Total
Units		ug/L	ug/L	mg/L	mg/L	ug/L	mg/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L
Limit of Detection		20	1	0.5	0.5	0.1	1	0.003	0.3	0.3	0.02	1	1
Date Testing Initiated		09.11.17											
ELS Ref	**Client Ref**												
119643	SW1 Lake	<20	6.2	2.6	13.4	<0.1	63.5	<0.003	<0.3	5	<0.02	7.4	<3.0
S.I No. 294/2009		200	50	-	-	5	-	0.03	0.01	-	1	100	30

Exceedance of waste licence

NOTES

1 Sub-contract analysis denoted by *

2 ND - Concentration was below the limit of detection

3 NAC- No Abnormal Change

As there are no limits set in the waste licence for surface water, results are compared to S.I. No. 294/1989 — European Communities (Quality of Surface Water Intended For The Abstraction of Drinking Water) Regulations, 1989.

5 DISCUSSION OF RESULT

5.1 Q4 Analysis

As there are no limits set in the waste licence for surface water, results are compared to limits detailed in S.I. No. 294/1989 — European Communities (Quality of Surface Water Intended or The Abstraction of Drinking Water) Regulations, 1989.

A surface water sample was taken at SW1 (Killynaher lake) which is located to the east of the landfill. Results from Quarter 3 2017 revealed no exceedances were detected for any of the parameters analysed during this monitoring round. All parameters were within levels stipulated by the document mentioned above.

Historical results for comparison purposes are presented in tabular form in the Appendix 4.

6 CONCLUSION

The results obtained are relatively consistent with previous monitoring events and therefore there is no evidence of any adverse environmental impact associated with this landfill. The next surface water monitoring event at the landfill will take place during Quarter 1 of 2018.

Appendix 1

Monitoring Location Plan

Appendix 2

Field Monitoring Results

Quarter 4

ON SITE SAMPLING FORM

Facility Name: Belturbet | **Waste Licence No:** W0092-01

Report To:

Sampling Date: 08.11.2017

Sample Type (GW, SW, Leachate) All

Personnel: Terry Keating

Weather: Dry

Other Remarks:

GPS:

Sample Ref No	Sample Type	Time	DO Level	Elec Cond (us)	pH pH units	Temp °C	Visual
SW1 Lake	SW		-	345	7.58	8.3	Clear

COMMENTS:

Appendix 3

Laboratory Analytical Results

ENVIRONMENTAL LABORATORY SERVICES
Acorn Business Campus
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Ireland
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Fax: +353 21 453 6149
Web: www.elsltd.com
email:info@elsltd.com

Contact Name	Gareth O Brien	**Report Number**	**119643 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119643/001
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	21/11/2017
Quotation No	QN006598	**Sample Type**	Surface Waters
Customer Ref	SW 1 Lake		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
BOD									
	BOD		EW001	1.0		<2.0	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		28	mg/L	INAB	
	Samples for batch 119643 were tested for COD on accredited method EW094								
Dissolved Oxygen									
	Dissolved Oxygen		EW043	1		9	mg/L	INAB	
Gallery Plus-Suite A									
	Ammonia as N		EW175	0.005		0.022	mg/l N	INAB	
	Total Oxidised Nitrogen (TON) as N		EW175	0.15		<0.15	mg/l N	INAB	
	Nitrate as N		EW175	0.15		<0.15	mg/l N	INAB	
	Nitrite as N		EW175	0.005		0.007	mg/l N	INAB	
	Chloride mg/L		EW175	1.0		19	mg/L	INAB	
	Sulphate mg/L		EW175	1.0		11	mg/L	INAB	
Metals-Dissolved									
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L	INAB	
	Calcium-Dissolved		EW188	1.0		63.5	mg/L	INAB	
	Copper-Dissolved		EW188	0.003		<0.003	mg/L	INAB	
	Iron-Dissolved		EW188	20		<20	ug/L	INAB	
	Lead-Dissolved		EW188	0.3		<0.3	ug/L	INAB	
	Magnesium-Dissolved		EW188	0.3		5.0	mg/L	INAB	
	Manganese-Dissolved		EW188	1.0		6.2	ug/L	INAB	
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L	INAB	
	Potassium-Dissolved		EW188	0.2		2.6	mg/L	INAB	
	Sodium-Dissolved		EW188	0.5		13.4	mg/L	INAB	
	Zinc-Dissolved		EW188	1.0		7.4	ug/L	INAB	
Metals-Total									
	Chromium-Total		EW187	3.0		<3.0	ug/L	INAB	
Suspended Solids									
	Suspended Solids		EW013	5		<5	mg/L	INAB	
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153	0.0		8.0	pH Units	INAB	
	Conductivity @20 DegC		EW153	25		343	uscm-1@20	INAB	

Signed : 21/11/2017

Domenico Giliberti-Technical Manager

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Contact Name	Gareth O Brien	**Report Number**	**119643 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119643/001
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
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Quotation No	QN006598	**Sample Type**	Surface Waters
Customer Ref	SW 1 Lake		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Titralab									
	Alkalinity Total (R2 pH4.5)		EW153	10		154	mg/L CaCO3	INAB	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.01		0.02	mg/l P	INAB	

Signed : 21/11/2017

Domenico Giliberti-Technical Manager

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Appendix 4

Historical Results

Surface Water Historical Results									
	Parameter	Ammonia	pH	Cond	BOD	COD	Total Suspended Solids	Cl	DO
	Units	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l	mg/l	mg/l
SW Killynaher Lake	Qtr 4 2017	***0.206***	8.2	313	2.1	20	5	16	8
	Qtr 3 2017	0.012	8	304	2.3	17	<5	19	9
	Qtr 2 2017	0.006	8.3	341	***7.8***	22	<5	20	9
	Qtr 1 2017	0.2	7.9	336	2.1	16	5	16	9
S.I No. 294/1989		**0.2**	**≥5.5 and ≤8.5**	**1000**	**5**	**40**	**50**	**250**	

LEACHATE MONITORING REPORT
BELTURBET LANDFILL
W0092-01
BI-ANNUAL 2 of 2 2017

Document No.: CCC-04-01-07-02-03-03-Rev 0

Project No.: CCC-04-01

Client: Cavan County Council

Project Name: Rahaghan, Belturbet

Summary of Document Revisions		
Rev No.	**Date Revised**	**Revision Description**

Prepared by	Terry Keating	26/01/18
Approved by	Gareth O'Brien	19/02/18

CONTENTS

LIST OF TABLES

1 SUMMARY

Boylan Engineering (Eng. & Environmental Consultancy) was commissioned by Cavan County Council to carry out environmental monitoring at, Belturbet landfill W0092-01, Rahaghan, Belturbet , Co Cavan for leachate (bi-annual) 2 of 2 2017. This report documents the finding from the leachate sampling and monitoring undertaken at Belturbet Landfill on 08th of November 2017.

2 INTRODUCTION

Belturbet landfill was operated as a disposal facility by Cavan County Council from 1979 until its closure in February 2002. The facility was operated as a traditional landfill and is located on the Belturbet Ballyconnell road (R200) approximately 4.5 kilometres West of Belturbet town. The site which was originally a limestone quarry comprises some 0.65 hectares. The bedrock surrounding the landfill is Darty Limestone Formation from the Lower Carboniferous period. A waste licence was issued by the EPA on the 13th of February 2002. Some remedial works were carried out after the closure of the site.

Condition 8.1 of the waste licence requires that monitoring be carried out in accordance with Schedule D of the licence. The following report give details of the groundwater, sampling programme conducted on site and also summarises findings and analytical results for leachate bi-annual 2 of 2 2017.

The purpose of environmental monitoring at closed landfills is to:

- Ensure the facility is compliant with the waste license
- Ensure the facility is not causing environmental pollution
- Ensure the facility is not posing a risk to human health
- Ensure the facility is not creating an unacceptable risk to atmosphere, water, soil, plants or animals
- Ensure the facility is not adversely affecting the countryside or places of interest
- Compare actual site behaviour with expected/modelled behaviour
- Establish a reliable database of information for the landfill throughout its life

According to the Response matrix for landfills, Belturbet landfill is situated in the R4 Zone. This zone was categorized using a vulnerability rating combined with the aquifer category for the area. Landfills situated in R4 Zones are unacceptable in accordance with today's standards detailed in the EPA Landfill Design Manual or conditions of a waste license - (EPA, groundwater protection Responses for Landfills).Unfortunately this landfill was constructed prior to this guidance and conditions were issued only after its closure.

The generation of Leachate is one of the main hazards to groundwater from the disposal of waste by land filling. The conditions within a landfill vary over time from aerobic to anaerobic thus allowing for different chemical reactions to take place. Most landfill leachates have a high BOD, COD, Ammonia, Chloride, Sodium, Potassium, Hardness and Boron levels - (EPA, groundwater protection Responses for Landfills)

3 METHODOLOGY

3.1 Environmental Monitoring and Sampling

The following procedures were conducted by Boylan Engineering to ensure accurate leachate monitoring:

- Leachate samples were taken by grab sample using a Telescoup and Pendulum beaker.
- Having obtained a representative sample the following parameters are measured on-site using a Hanna HI 98129 combination waterproof high accuracy.
    - Conductivity
    - Temperature
    - pH
- Boylan Engineering operate a Sample Submission/Chain of Custody form, which accompanies the samples at all times.

3.2 Laboratory Analysis

- Samples were sent to Environmental Laboratory Service (ELS) (Ireland) for analysis of the required parameters in designated cool boxes with ice packs. These boxes ensure that samples are maintained at a consistent temperature between 0^{o}C and 4^{o}C on their journey to the laboratory.
- On arrival at the laboratory, samples are stored between 0^{o}C and 4^{o}C.
- All samples received are inspected by Laboratory Manager Mr. Brendan Murray.
- All samples are assigned a unique reference number and are recorded on the Laboratory Information Management System (LIMS)
- All staff involved in the analysis of samples hold a minimum honours science degree.
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- Analysis of samples is conducted under the INAB accreditation and associated quality control procedures are employed in every aspect of analysis.
- Analysis methods are listed in Appendix 2.

3.3 Weather Report

The weather report from Q4 is presented in the tables below.

Table 1 Leachate Weather Report Bi-annual 2 of 2 2017

REPORTS FROM BALLYHAISE (A)							
Date	Rainfall	Max	Min	Grass Min Temp	Mean Wind Speed	Maximum Gust	Sunshine
	(mm)	Temp	Temp	(°C)	(knots)	(if >= 34 knots)	(hours)
		(°C)	(°C)				
08/11/2017	2.6	11.3	0.7	-3.1	5.3		

3.4 Monitoring Locations

The leachate monitoring location from Bi-annual 2 of 2 2017 is presented in the table below.

Table 2 Leachate Monitoring Location bi-annual 2 of 2 2017

Quarter 4 2017					
Monitoring Well	**Sample Type**	**Cover Level M (OD Malin Head)**	**Water Level M (OD Malin Head)**	**Water Depth M (Top of Casing)**	**National Grid Co-Ordinates**
MW6	Gas & Leachate	TBC		TBC	TBC

4 SUMMARY OF RESULTS

A summary of the leachate monitoring results from Bi-annual 2 of 2 of 2017 are presented in Table 3 below.

Table 3 BI-ANNUAL 2 of 2 2017 Leachate Monitoring Results 2017

Report Number	119645/001
Monitoring Date	08.11.2017

Method		Site Tests	Site Tests	Site Tests	AQ2							Coliforms		Ion Chromatography	AQ2-UP2	Total Cyanide High (Sub)
Method Number		**Site Tests**	**Site Tests**	**Site Tests**	**EW003**	**EW051**	**EW138**	**EW139**	**EW001**	**EW094**	**EW015**	**MIC133**		**EW137**	**EW154M-1**	**DEFAULT**
Parameter		Sample temperature (to be tested onsite)	Water Level from TOC	Visual Inspection	Ammonia	TON	pH	Cond	BOD	COD	Cl	E. Coli	Total Coliforms	Fluoride	Sulphate	Total Cyanide High
Units		Deg C	Meter's		mg/l N	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l	MPN/100ml		mg/L	mg/L	ug/L
Limit of Detection		-	-	-	0.035	0.69	0.3	25	1	8	13	10	10	0.1	5	9
Date Testing Initiated		8.11.17			09.11.17											
ELS Ref	**Client Ref**															
119645/001	MW6	8.4	2.1	Straw	***1.1***	<0.69	7.5	916	11	97	70	***500***	***24190***	***1.65***	53	<9
IGV					0.15	NAC	≥6.5&≤9.5	1000	-	-	200	0	0	1	200	10

Method		Total Phosphorus-TP	Metals-Total	Metals-Dissolved											
Method Number		**EW146**	**EM130**												
Parameter		Total Phosphorus-TP	Chromium-Total	Manganese-Dissolved	Potassium-Dissolved	Sodium-Dissolved	Cadmium-Dissolved	Calcium-Dissolved	Copper-Dissolved	Lead-Dissolved	Magnesium-Dissolved	Mercury-Dissolved	Zinc-Dissolved	Boron-Dissolved	Iron-Dissolved
Units		mg/l P	ug/L	ug/L	ug/L	mg/L	ug/L	mg/l	mg/L	ug/L	mg/l	ug/L	ug/L	ug/L	ug/L
Limit of Detection		0.1	1	1	0.2	0.5	0.1	1	0.003	0.3	0.3	0.02	1	0.02	20
Date Testing Initiated		09.11.17													
ELS Ref	**Client Ref**														
119645/001	MW6	6.9	5.9	8.3	***7.6***	28.6	<0.1	135.5	<0.003	<0.3	***69.2***	<0.02	14	0.21	49
IGV		-	30	50	5	150	5	200	0.03	10	50	1	100	1	200

Exceedance

NOTES

1 Sub-contract analysis denoted by *
2 ND - Concentration was below the limit of detection
3 NAC- No Abnormal Change
4 IGV - Interim Guideline Value

5 DISCUSSION OF RESULT

Leachate consists of water that has become contaminated as it passes through a waste disposal site. It contains insoluble waste constituents which have not degraded chemically or biochemically. Leachate can therefore adversely impact surrounding surface and ground waters. The composition of leachate will vary depending on the age of the landfill. As there are no limits set in the waste licence for leachate, results are compared to the Interim Guideline Values for the protection of Groundwater in Ireland, where available.

A leachate sample was retrieved from GW/MW6 during the Bi-annual 2 of 2 monitoring round 2017. The results revealed a number of exceedances which included ammonia, e-coli, total coliforms, fluoride, potassium and magnesium. All other results are within limits as per Interim Guideline Values. This is in line with previous monitoring events, however, they are not of concern at present as leachate by its nature is often highly contaminated with various compounds.

Historical results for comparison purposes are presented in tabular form in Appendix 3.

6 CONCLUSION

The results obtained are relatively consistent with previous monitoring events and do not show any signs of dramatic exceedances. Therefore there is no evidence of any major negative environmental impact associated with this landfill. The next environmental monitoring event will take place in 2018 (Bi-annual 1 of 2).

Appendix 1

Monitoring Location Plan

Appendix 2

Laboratory Analytical Results

ENVIRONMENTAL LABORATORY SERVICES
Acorn Business Campus
Mahon Industrial Park,
Blackrock,
Cork
Ireland
Tel: +353 21 453 6141
Fax: +353 21 453 6149
Web: www.elsltd.com
email:info@elsltd.com

Contact Name	Gareth O Brien	**Report Number**	**119645 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119645/001
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Waste Water
Customer Ref	WW06		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Ammonia									
	Ammonia (as N)		EW154M-1	0.035		1.1	mg/l N	INAB	
AQ2-UP1									
	Nitrate (as N)		EW154M-1	0.60		<0.60	mg/l N	INAB	
	Nitrite (as N)		EW154M-1	0.065		<0.065	mg/l N	INAB	
	TON (as N)		EW154M-1	0.69		<0.69	mg/l N		
AQ2-UP2									
	Chloride		EW154M-1	13		70	mg/L	INAB	
	Sulphate		EW154M-1	5.0		53	mg/L	INAB	
BOD									
	BOD		EW001	1		11	mg/L	INAB	
COD-Chemical Oxygen Demand									
	COD		EW184	8		97	mg/L	INAB	
	Samples for batch 119645 were tested for COD on accredited method EW094								
Coliforms									
	Total Coliforms		MIC133	10		24190	MPN/100ml		
	Analyst Micro Comment: The start date for this micro test is 09.11.2017								
	E. Coli		MIC133	10		500	MPN/100ml		
Ion Chromatography									
	Fluoride		EW137	0.10		1.65	mg/L	INAB	
Metals-Dissolved									
	Boron-Dissolved		EW188	0.02		0.21	ug/L		
	Calcium-Dissolved		EW188	1.0		135.5	mg/L		
	Iron-Dissolved		EW188	20		49	ug/L		
	Magnesium-Dissolved		EW188	0.3		69.2	mg/L		
	Manganese-Dissolved		EW188	1.0		8.3	ug/L		
	Potassium-Dissolved		EW188	0.2		7.6	mg/L		
	Sodium-Dissolved		EW188	0.5		28.6	mg/L		
	Cadmium-Dissolved		EW188	0.1		<0.1	ug/L		
	Copper-Dissolved		EW188	0.003		<0.003	mg/L		
	Lead-Dissolved		EW188	0.3		<0.3	ug/L		
	Zinc-Dissolved		EW188	1.0		14	ug/L		
	Mercury-Dissolved		EW188	0.02		<0.02	ug/L		
Metals-Total									

Signed : 27/11/2017

Domenico Giliberti-Technical Manager

NOTES
1.This Report shall not be Reproduced except in full, without the permission of the laboratory and only relates to the items tested.
2.SPEC= Allowable limit or parametric value
3.OOS=Result which is outside specification highlighted as OOS-A
4.LOQ=Limit of Quantification or lowest value that can be reported
5.ACCRED=Indicates matrix accreditation for the test,a blank field indicates not accredited
6."*" Indicates sub-contract test

ENVIRONMENTAL LABORATORY SERVICES
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email:info@elsltd.com

Contact Name	Gareth O Brien	**Report Number**	**119645 - 1**
Address	Boylan Engineering & Environmental Ltd. Main Street,	**Sample Number**	119645/001
		Date of Receipt	09/11/2017
		Date Started	09/11/2017
Tel No	046 9286000	**Received or Collected**	Courier
Customer PO	Per Batch	**Date of Report**	27/11/2017
Quotation No	QN006598	**Sample Type**	Waste Water
Customer Ref	WW06		

CERTIFICATE OF ANALYSIS

TEST	ANALYTE	SUB	METHOD	LOQ	SPEC	RESULT	UNITS	ACCRED.	OOS
Metals-Total									
	Chromium-Total		EW187	3.0		5.9	ug/L	INAB	
Temperature (Site)									
	Temperature (Site)		Default	0.0		Not Analyzed	Deg C		
Titralab									
	pH		EW153			7.5	pH Units	INAB	
	Conductivity @20 DegC		EW153	25		916	uscm-1@20	INAB	
Total Cyanide High (Sub)									
	Total Cyanide High	*	Default	9		<9	ug/L	YES	
Total Phosphorus-TP									
	Total Phosphorus-TP		EW146	0.1		6.9	mg/l P	INAB	

Signed : 27/11/2017

Domenico Giliberti-Technical Manager

NOTES
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4.LOQ=Limit of Quantification or lowest value that can be reported
5.ACCRED=Indicates matrix accreditation for the test,a blank field indicates not accredited
6."*" Indicates sub-contract test

Appendix 3

Historical Results

		Lechate historical Results						
	Parameter	Ammonia	TON	pH	Cond	BOD	COD	Cl
	Units	mg/l N	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l
MW 6	Qtr 4 2017	***2.1***	<0.69	7.2	***1109***	<15	290	61
	Qtr 3 2017	**-**	-	-	**-**	-	-	-
	Qtr 2 2017	**-**	-	-	**-**	-	-	-
	Qtr 1 2017	***0.99***	<0.69	7.5	873	6	18	71
Interim Guide Values		**0.15**	**NAC**	**≥6.5&≤9.5**	**1000**			**200**

		Lechate historical Results						
	Parameter	Ammonia	TON	pH	Cond	BOD	COD	Cl
	Units	mg/l N	mg/l N	pH Units	us/cm	mg/l	mg/l	mg/l
MW 6	Qtr 4 2016	***2.1***	<0.69	7.2	***1109***	<15	290	61
	Qtr 3 2016	-	-	-	-	-	-	-
	Qtr 2 2016	-	-	-	-	-	-	-
	Qtr 1 2016	***2.8***	<0.69	7.1	***1018***	<5	8	28
Interim Guide Values		**0.15**	**NAC**	**≥6.5&≤9.5**	**1000**			**200**

GAS MONITORING REPORT
BELTURBET LANDFILL
W0092-01
Quarter 4 2017

Document No.: CCC-04-01-07-02-03-04-Rev 0

Project No.: CCC-04-01

Client: Cavan County Council

Project Name: Rahaghan, Belturbet

Summary of Document Revisions		
Rev No.	**Date Revised**	**Revision Description**

Prepared by	Terry Keating	26/01/18
Approved by	Gareth O'Brien	19/02/18

CONTENTS

LIST OF TABLES

1 SUMMARY

Boylan Engineering (Eng. & Environmental Consultancy) was commissioned by Cavan County Council to carry out environmental monitoring at, Belturbet landfill W0092-01, Rahaghan, Belturbet , Co Cavan for Quarter 4 2017. This report documents the finding from gas monitoring undertaken at Belturbet Landfill on 14th of December 2017 (Q4).

2 INTRODUCTION

Belturbet landfill was operated as a disposal facility by Cavan County Council from 1979 until its closure in February 2002. The facility was operated as a traditional landfill and is located on the Belturbet Ballyconnell road (R200) approximately 4.5 kilometres West of Belturbet town. The site which was originally a limestone quarry comprises some 0.65 hectares. The bedrock surrounding the landfill is Darty Limestone Formation from the Lower Carboniferous period. A waste licence was issued by the EPA on the 13th of February 2002. Some remedial works were carried out after the closure of the site.

Condition 8.1 of the waste licence requires that monitoring be carried out in accordance with Schedule D of the licence. The following report give details of the groundwater, sampling programme conducted on site and also summarises findings and analytical results for Quarter 3 2017.

The purpose of environmental monitoring at closed landfills is to:

- Ensure the facility is compliant with the waste license
- Ensure the facility is not causing environmental pollution
- Ensure the facility is not posing a risk to human health
- Ensure the facility is not creating an unacceptable risk to atmosphere, water, soil, plants or animals
- Ensure the facility is not adversely affecting the countryside or places of interest
- Compare actual site behaviour with expected/modelled behaviour
- Establish a reliable database of information for the landfill throughout its life

According to the Response matrix for landfills, Belturbet landfill is situated in the R4 Zone. This zone was categorized using a vulnerability rating combined with the aquifer category for the area. Landfills situated in R4 Zones are unacceptable in accordance with today's standards detailed in the EPA Landfill Design Manual or conditions of a waste license - (EPA, groundwater protection Responses for Landfills).Unfortunately this landfill was constructed prior to this guidance and conditions were issued only after its closure.

The generation of Leachate is one of the main hazards to groundwater from the disposal of waste by land filling. The conditions within a landfill vary over time from aerobic to anaerobic thus allowing for different chemical reactions to take place. Most landfill leachates have a high BOD, COD, Ammonia, Chloride, Sodium, Potassium, Hardness and Boron levels - (EPA, groundwater protection Responses for Landfills).

3 METHODOLOGY

3.1 Landfill Gas Analysis

The following procedures were employed by Boylan Engineering to ensure accurate monitoring:

- EPA, Landfill Manual, landfill monitoring 2nd Edition is adhered to.
- GA 2000 landfill gas analyser is used to measure the gas levels.
- The analyser is purged and connected to the sealed well monitoring nozzle.
- The monitoring nozzle is turned to the open position and the analyser measured the gas levels at 60 second intervals for no less than 10 minutes. The analyser is allowed to run for this period of time to allow for a representative average to be obtained.
- All data is recorded on the Gas Analysis field sheet.
- The instrument is removed after 10 minutes and the monitoring nozzle returned to the closed position.
- The GA2000 is switched off between each monitoring location so as to allow the instrument to purge.
- This process is repeated at each monitoring location.
- Data for the GA 2000 was downloaded in the Boylan Engineering office.

3.2 Weather Report

The weather report from Q4 is presented in the table below.

Table 1 Gas Weather Report Q4 of 2017

REPORTS FROM BALLYHAISE (A)							
Date	Rainfall (mm)	Max Temp (°C)	Min Temp (°C)	Grass Min Temp (°C)	Mean Wind Speed (knots)	Maximum Gust (if >= 34 knots)	Sunshine (hours)
14/12/2017	10.4	5.6	1	-0.4	9.3		

3.3 Monitoring Locations

The gas monitoring locations from Q4 of 2017 are presented in the table below.

Table 2 Q4 Gas Monitoring Locations of 2017

Quarter 4 2017					
Monitoring Well	Sample Type	Cover Level M (OD Malin Head)	Water Level M (OD Malin Head)	Water Depth M (Top of Casing)	National Grid Co-Ordinates
MW5	Gas & Leachate	TBC		TBC	TBC
MW6	Gas & Leachate	TBC		TBC	TBC
MW 9	Gas & GW	TBC		6.1	TBC

4 SUMMARY OF RESULTS

A summary of the gas monitoring results from Q4 of 2017 is presented in Table 3 below.

Table 3 Q4 Summary of Gas Monitoring Results of 2017

Method		**GA 2000**	**GA 2000**	**GA 2000**	**GA 2000**	**GA 2000**
Parameter		CH_4	CO_2	O_2	H2S	Barometric Pressure
Units		% v/v	% v/v	%	PPM	mb
Date Testing Initiated		14/12/2017				
GA 2000 Ref	**Client Ref**					
2	**MW 5**	0.5	5.9	16.1	0.0	998.0
3	**MW 6**	11.34	13	1.06	0	998
1	**MW9**	0.46	7.5	15.46	0	998
	Limit	**1**	**1.5**			
Exceedance in licence limit						
NOTES						
1	Instrument Serial No: GA 07721					
2	Limit: Schedule C2, Licence					

5 DISCUSSION OF RESULT

The rate of gas generation at a landfill site varies through the life of a landfill and is dependent on several factors such as waste type, depths, moisture content, degree of compaction, landfill pH, temperature and the length of time since the waste was deposited. Landfill gas can move in any direction within the waste body and migrate from a site. The potential for gas migration will depend on the gas quality, volume, the site engineering works, geological characteristics of the surrounding strata and on man-made pathways such as sewers and drains.

Results obtained from monitoring during Quarter 4 of 2017 show elevated reading for methane and carbon dioxide at well MW 6, however this location is located within waste mass and such levels are not uncommon. An elevated reading was noted for carbon dioxide at MW9 and MW5, however there were no elevated concentrations of methane detected at these locations. These wells are located at the peripheries of the waste mass and as such may be susceptible to gas migration. There is no alarming rise in methane gas levels occurring and therefore it is not considered problematic. The results obtained are relatively consistent with previous readings as presented in Appendix 2.

6 CONCLUSION

The results obtained from landfill gas analysis are also relatively consistent with previous monitoring events and do not show any signs of dramatic exceedances; therefore there is no evidence of any major negative environmental impact associated with this landfill. However, it is important to monitor the trend in exceedance of Methane at this landfill and any dramatic increase in the parameter should be regarded as critical. The Methane content of landfill gas is flammable, forming potentially explosive mixtures in certain conditions, which raises concern about its uncontrolled migration and release. The next environmental and landfill gas monitoring will be conducted in Quarter 1 of 2018.

Appendix 1

Monitoring Location Plan

Appendix 2

Historical Results

Method		GA 2000	GA 2000	GA 2000	GA 2000	GA 2000
Parameter		CH_4	CO_2	O_2	H_2S	Barometric Pressure
Units		1% v/v	1.5 % v/v	%	PPM	mb
Client Ref	**Qtr**	-	-	-	-	-
MW 5	Qtr 4 2017	0.5	5.9	16.1	0.0	998.0
	Qtr 3 2017	0.5	6.1	16.0	0.0	998.0
	Qtr 2 2017	0.5	6.4	15.4	0.0	998.0
	Qtr 1 2017	0.4	6.6	15.4	0.0	998.0
MW 6	Qtr 4 2017	11.34	13	1.06	0	998
	Qtr 3 2017	11.5	13.04	0.64	0	998
	Qtr 2 2017	12.58	13.26	0	0	998
	Qtr 1 2017	12.4	13.2	0	0	998
MW9	Qtr 4 2017	0.46	7.5	15.46	0	998
	Qtr 3 2017	0.32	7.46	15.72	0	998
	Qtr 2 2017	0.46	8.54	1.36	0	998
	Qtr 1 2017	0.6	6.8	1.4	0	998
	Limit	**1**	**1.5**			

Exceedance in licence limit

NOTES

1 Instrument Serial No: GA 07721

2 Limit: Schedule C2, Licence