BYRNELOOBY PHMcCARTHY

Response Engineering Ltd

Shannon Town Landfill

2016 AER

Report No. W3019-R001

April 2017

Revision 0

Document Control

Document:	2016 AER
Project:	Shannon Town Landfill
Client:	Response Engineering Ltd
Report Number:	W3019-R001
File Origin:	E:\W Files Water\W3000\W3019 PRTR for Shannon Tradalee Facility\Reports\AER PRTR Report - Landfill\2016\AER Report cover_2016.docx

Document Checking:

Revision	Revision / Review Date	Details of Issue	Authorised		
			Prepared By	Checked By	Approved By
0	05-04-2017	Issued for Review	Noreen O'Brien	Kieran Thornton	Kieran Thornton
Disclaimer: Please note that this report is based on specific information, instructions and information from our Client and should not be relied upon by third parties.					

BYRNELOOBY PHMcCARTHY

Building 2100, Cork Airport Business Park, Kinsale Road, Cork, Ireland.

Tel: +353 (0)21 2407988, e-mail: Cork@ByrneLooby.com

www.ByrneLooby.com

Clare County Council

Tradaree Point Sludge Disposal Facility

Annual Environmental Report 2016

Waste Licence Reg. No. W0037-01

Response Group

06th March 2017

REPORT CONTROL

Document: Tradaree Point Annual Environmental Report 2016

Job Number: CE08478

Project: Tradaree Point Sludge Disposal Facility

Client: Clare County Council

Document Checking:

Primary Author:	Ailish Johnston	Initialled:

Reviewed By:	Paul O' Keeffe	Initialled:

Issue	Date	Status	Checked for Issue
1	06/03/17	For Issue	POK
2			
3			
4			

Contents

1.0 INTRODUCTION

Response Group was commissioned by Clare County Council to compile an Annual Environmental Report (AER) required under Condition 11 of Waste Licence Reg. No. W0037-01 for a Sludge Disposal Facility situated at Tradaree Point, Shannon (Clonmoney South), Co. Clare for the period January 2016 to December 2016.

1.1 Background

The Environmental Protection Agency (EPA) issued Shannon Free Airport Development Company Limited with a Waste Licence on 1st May 2003. The ownership of the facility was subsequently passed onto Clare County Council under the same Waste Licence.

Under Condition 11.6, Section 11 of the W0037-01, an Annual Environmental Report (AER) must be prepared and submitted to the EPA for approval. The AER for the facility includes the information specified in Schedule F of the Waste Licence, Content of the Environmental Report, and has been prepared in accordance with the EPA (1999) Waste Licensing – Draft Guidance Note on Environmental Management Systems and Reporting to the Agency, the EPA Guidance Note for the Annual Environmental Report and the EPA AER/PRTR Guidance Document.

1.2 Reporting Period

This AER details the activities carried out at the facility in the period from January 2016 to December 2016 in accordance with W0037-01.

1.3 Site Description

The site is situated approximately 4.5km south east of Shannon Town to the south-west of Bunratty (OS National Grid Reference 143,600E, 160,100N). The site is located on a peninsula, which extends into Shannon Estuary. A grassland constructed clay embankment, average height 5.0 mOD, lies to the south of the site between Shannon Estuary and the site.

The site location is shown in **Figure 1**.

1.4 Facility Layout

The landfill (sludge disposal facility) is divided into two sections - the capped historic sludge disposal area and the four newly constructed lined cells. The area where the new cells have been constructed has an average elevation of 1.5mOD. The cells are bounded to the south-east and north-east by an open land drain. The average drain bed level is 0.6mOD. This discharges to Shannon Estuary via an outlet pipe under the clay embankment which is controlled by a sluice valve. A 10m wide buffer zone exists along the southern perimeter of the site between the edge of the catchment drain and the capped sludge cells. No sludge or restoration material is stored within this zone.

The layout of the facility is illustrated in **Figure 2**.

Tradaree Point Wastewater Treatment Plant (WWTP) provides treatment of both domestic and industrial effluent from Shannon Town and Shannon Industrial Estate. The sludge facility accepts waste sludge from the Tradaree Point WWTP. Sludge has been disposed on the site since approximately 1981.

2.0 FACILITY INFRASTRUCTURE AND OPERATION

2.1 Waste Activities Carried Out At the Facility

The facility is licensed to handle a maximum of 2,500 tonnes of waste per annum. This comprises 750 tpa (tonnes per annum) treated dewatered non-hazardous domestic sludge (EWC code 19 08 05) and 1,750 tpa of industrial sludge (EWC code 19 08 12, 19 08 14) in engineered cells within the facility boundary. Waste activities licensed at the facility under the Third and Fourth Schedules of the Waste Management Act 1996, are detailed below.

Table 2.1 Licensed Waste Disposal Activities in Accordance with the Third Schedule of the Waste Management Act

Class 1	Deposit on, in or under land (including Landfill)*. This activity is limited to the disposal of treated dewatered non-hazardous domestic and industrial sludge in the existing activity cells within the facility.
Class 4	Surface impoundment, including placement of liquid or sludge discards into pits, ponds or lagoons
Class 5	Specially engineered landfill, including placement into lined discreet cells which are capped and isolated from one another and the environment.
Class 6	Biological treatment not referred to elsewhere in the Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 5 paragraphs 8 to 10 of this Schedule (including evaporation, drying and calcination).
Class 13	Storage prior to submission to any activity referred to in a preceding paragraph of this schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced.

2.2 Methods of Deposition of Sludge

Two different waste effluent streams undergo separate treatment at Tradaree Point WWTP. Industrial wastewater is treated in the Industrial Treatment Plant and domestic wastewater is treated in the Domestic Treatment Plant.

The waste disposed of at the sludge disposal facility is treated dewatered sludge from the Tradaree WWTP, Doolough WTP & Castlelake WTP. All sludges accepted except from the Tradaree WWTP are water treatment sludge.

Sludge generated in Tradaree WWTP is sent to a dewatering building to the east of the plant. Both domestic and industrial sludge are dewatered using a centrifuge after which the sludge is conveyed into a dumper. The dewatered sludge is then transported to the landfill area and unloaded using a dumper. Sludge from off site is transported to site by Clare County Council.

The sludge is further dried naturally in the open air. Older dried sludge are excavated from their initial deposition area and heaped into mounds where they are permitted to re-vegetate by natural succession.

The new cells are being filled sequentially in a similar manner. Cell 3 is currently the active cell and sludge is transported for land filling on a daily basis between Monday and Friday by a dumper. Transportation to the landfill is facilitated by the provision of a ramp into the cell.

2.3 Quantity and Composition of Sludge Disposed

2.3.1 Sludge Disposed 2016

The facility is licensed to handle up to 2,500 tonnes of waste sludge per annum. The quantities of mixed industrial and domestic sludge disposed at the facility between January and December 2016 are presented in Table 2.2 overleaf.

As specified in Condition 1.1 of the Waste Licence, only those categories and quantities listed in Part 1 (Activities Licensed) [See also Schedule A] can be accepted at the facility. During 2016, approximately 1055 tonnes of sludge were accepted at the facility. This quantity is below the maximum 2,500 tonnes of waste per annum permitted.

Table 2.2: Quantities of Sludge Disposed in 2016

Month	Quantity (Kg)
January	58300
February	112000
March	135960
April	94750
May	122000
June	110000
July	92990
August	102500
September	81320
October	102700
November	95550
December	73460
Total (kg)	1181530
TOTAL (tonnes)	1181.53

2.3.2 Sludge Disposed 2005-2016

Table 2.3 below details the quantities of sludge disposed at the facility between 2005 and 2016.

Year	Quantity (Tonnes) Sludge Disposed/Annum
2005	954
2006	408
2007	756
2008	548
2009	732
2010	489
2011	228
2012	1055
2013	1379
2014	1144
2015	1055
2016	1181

2.4 Calculated Remaining Capacity of the Facility

The volume of sludge disposed in 2011 was 228 tonnes this low volume is due mainly to the dewatering unit being out of operation for much of the year as the belt press has been taken out of operation. The volume of sludge accepted in 2012 increased to 1055 tonnes, and increased again in 2013 to 1379 tonnes the reason for these increases has been the running of the new centrifuge in Tradaree and the acceptance of sludge from outside plants as listed in section 2.1.

The total capacity of the four lined cells is 16,464m3. Landfilling in the lined cells commenced in Cell 1 in 2005 and reached it capacity in 2013. Cell 2 was opened on 28th June 2013 & reached capacity in 2016. Cell 3 was opened on the 15 Feb 2016 and It is expected that Cell 1 and Cell 2 will both be capped by Dec 2017.
In 2016, approximately 1181 tonnes of sludge was disposed of at the facility.

The density of dewatered sludge varies depending on the dry matter concentration. In 2016, the average cake % dry matter reached in the sludge was 21%. At this rate, the bulk density is typically calculated at rate of 1.27t/m3 (assuming that the ratio of volatile and fixed sludge is 65%:35%). Therefore, at this density, the volume of waste sludge disposed of at the facility during 2016 was 855m3.

Based on the 2016 figure, it is expected that the landfill should reach its full capacity by 2022.

2.5 Restoration of Former Sludge Disposal Areas and Completed Cells/Phases

A restoration and aftercare management plan for the facility was prepared in consultation with the EPA Restoration and Aftercare Manual and was previously submitted to the Agency in January 2004. The Agency confirmed in a letter (Ref. 37-1/GEN03bd) that the plan was to their satisfaction.

All unlined sludge mounds have been capped along with all unlined cells after EPA approval. Waste sludge continues to be disposed of into the third of the newly lined active cells – Cell 2.

The total capped area occupied by waste in the facility is 20,112m2. Between 2005 and Feb 2016 a total of 6093 tonnes of waste has been deposited into Cell 1 & cell2. Since Feb 2016, a total of 1011 tonnes of waste has been deposited into Cell 3.

2.6 Topographical Survey

A topographical survey was undertaken during September 2003 as part of Licence Condition 8.10.1. The results of the survey were submitted to the Agency in the 6-month report on Drawing No.1, submitted in October 2003. No additional topographical surveys have taken place at the facility since 2003.

2.7 Leachate Management

2.7.1 Leachate Pumping Records

A total of 19,852 m3 of Leachate was pumped during the reporting period. Leachate is collected from the existing sludge disposal area (Cell 2), the inactive cells (Cells 3&4), The uncapped Cell 1 (full) and the capped unlined area via a network of drains which are connected to a Leachate collection sump and from here it is pumped to Tradaree WWTP. There is no flow meter on the Leachate line so flows are calculated based on the hours run of the pumps and the pump capacity. The pump has a capacity to pump 75m3 per hour. Heavy rainfall also leads to increased flow readings due to the rainwater captured in the inactive cells.

The monthly totals of Leachate generated during 2016 are detailed in Table 2.4 below.

Table 2.4: The monthly averages of Leachate generated in 2016

Month	Flow Rate (m^3/Month)
January	8773
February	5008
March	6223
April	1222
May	90
June	307
July	654
August	3567
September	1064
October	1114
November	5181
December	3297
Total (M^3/Year)	36500

2.8 Estimated Annual and Cumulative Quantities of Landfill Gas Emitted

Landfill gas production is a function of the biodegradable portion of the wastes and other factors including the waste density and moisture content. According to the UK EA, total gas generation depends on the waste type being deposited on site and also the degradable carbon content. However the rate of decomposition depends on the site-specific factors. The time taken to decompose will directly influence the period over which landfill gas is generated.

Emissions through the in situ clay base and side walls of the landfill facility are expected to be small. The capped sludge disposal area does not have an engineered base lining. Site investigation results indicate that in situ clay has a hydraulic conductivity of less than 1 x 10-9m/s. Gas levels are being measured in monitoring boreholes installed in the ground along the perimeter of the landfill to check if there are any emissions.

The UK Environment Agency's Guidance on the Management of Landfill Gas (November 2002) suggests that biodegradable wastes may be considered to have an approximate gas yield of between 5 - 10 m3/t/yr over the first ten years of a sites life. In this instance, the waste sludge was dried to an average of 21% dry matter in 2015. Assuming that the dry matter content would equate to the biodegradable component of the sludge and based on a total input in 2016 of 248 tonnes of biodegradable waste (21% of 1181 total tonnes), this would indicate that the following upper and lower quantities of landfill gas might be generated:

- At 5 m3/t/yr an approximate production rate of 1,890m3 per annum
- At 10 m3/t/yr an approximate production rate of 3,780m3 per annum

There are a number of significant controlling factors relating to landfill gas generation/extraction rates from biodegradable wastes including placement density, moisture content, quality of containment systems, climatic conditions and quantity of degradable cellulose available.

It must also be stressed that the above figure is based upon an estimation of the amount of available degradable waste deposited within the landfill body and therefore must only be considered to be an approximation.

The most recent landfill gas assessment at Tradaree was undertaken by Tobin Consulting Engineers in April 2008. The purpose of the assessment was to determine the total quantity of landfill gas produced at the facility in order to determine the viability of constructing a landfill gas flare on-site.

The assessment was undertaken using a landfill gas generation model GasSim 2.0. Data from previous assessments undertaken in 2004 and 2007 were used in the assessment. The results show a peak in landfill gas production in 2003 (12.5 m3/hr), with decreasing figures since that time. A total of 9.88 m3/hr was predicted for 2007. The report concluded that owing to this low volume of gas being produced from the facility, it would not be considered a viable option to install a gas collection system and flaring unit. A gas collection system to operate successfully requires a volume of gas in the order of 75 m3/hr.

A copy of the assessment report was included in the AER for the 2008 reporting period.

2.9 Estimated Annual and Cumulative Quantity of Indirect Emissions to Groundwater

Potential sources of indirect emissions into groundwater are:

Landfill Base

The naturally occurring low permeability clay underlying the site provides a natural liner for the capped area of the landfill. Previous site investigation results indicate that in situ clay has a hydraulic conductivity of less than 1 X 10m-9m/s. The new area of the landfill (Cells 1-4) is lined with a geotextile membrane as stipulated in the current waste licence consisting of a composite liner consisting of a 1m layer of compacted soil with a hydraulic conductivity of less than or equal to 1x10-9m/s. This is overlain by a geocomposite layer which in turn is overlain by a 2mm thick high density polyethylene (HDPE) layer.

Landfill Capping

The old sludge disposal areas were capped in 2004/2005. A five layer composite permanent capping was placed over all the old sludge cells as per the requirements of Condition 4.4 of the current licence. The five layers are comprised of the following;

a) Geocomposite gas collection layer
b) Barrier/Protection layer
c) Geotextile protection layer
d) Surface water drainage layer
e) Subsoil layer
f) Topsoil Layer

The capped layer is approximately 1 metre in thickness. The geosynthetic barrier has a minimum permeability of 1 x 10-9m/s. This layer prevents surface water seeping into the sludge body and also facilitates the collection of gas. The surface water drainage layer collects surface water and extends to the system of open surface water drains at the base of the slopes from where it discharges to the existing catchment drains.

Surface Water Collection and Treatment System

Clean surface water from the uncapped existing sludge cells, is collected via a network of gravel drains which is then discharged to the perimeter drain. Visual inspection of the surface water locations and drains is conducted weekly.

Leachate Collection

Leachate is collected in the Leachate pumping chamber from a series of collection drains at the site. The Leachate is pumped via a 100mm diameter pipe to the effluent treatment plant for treatment.

In summary, as the landfill is contained by the provision of the features outlined above, the risk of indirect emissions to groundwater is greatly minimised.

3.0 MONITORING RESULTS

3.1 Summary Report

This summary report has been compiled in accordance with the emission limit values (ELVs) for the following parameters as specified in Condition 6 and Schedule C of W0037-01:

- Dust
- Noise
- Landfill Gas

3.1.1 Dust Deposition

Dust deposition emission limit values as specified in W0037-01 are detailed in Table 3.1 below.

Table 3.1 Dust Deposition ELV

ELV (mg/m2/day) Note 1
350

Note 1: 30 day composite sample

Annual dust monitoring was conducted by BHP at four locations between 21st November and 19th December 2016. Dust monitoring locations are illustrated in Figure 2. 30-day composite samples were collected in accordance with licence requirements and forwarded to the BHP accredited laboratory for analysis. The monitoring results are summarised in Table 3.2 below. Copies of the dust monitoring results are included in Appendix A.

Table 3.2 Dust Monitoring Results 2016

Location	N1	N3	N5	SS2
	mg/m2/day			
Dec 2016	236	45	189	59

Measured dust levels at all of the monitoring locations were below the ELV of 350 mg/m3/day.

3.1.2 Noise Emissions

Noise emission limit values as specified in W0037-01 are detailed in Table 3.3 below. Day-time and night-time noise monitoring was conducted by Response Group at four boundary locations (N1, N2, N3, N5) on the 2nd June 2016. The noise survey report is attached in Appendix B. The monitoring results are summarised in Table 3.4 and 3.5 below.

Table 3.3 Noise ELV's

Day Db(A)L_{Aeq}(30 minutes)	Night Db(A)L_{Aeq}(30 minutes)
55	45

Table 3.4 Day-time Noise Measurements 2015

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	02/06/16	30 Minutes	43.2
N2	02/06/16	30 Minutes	43.6
N3	02/06/16	30 Minutes	43.1
N5	02/06/16	30 Minutes	42.9

Table 3.5 Night-time Noise Measurements 2015

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	02/06/16	30 Minutes	44.4
N2	02/06/16	30 Minutes	42.6
N3	02/06/16	30 Minutes	42.7
N5	02/06/16	30 Minutes	44.5

The average figures show that there are no noise issues on site. All results obtained from the measurements taken at the four locations by day and night are within the daytime and night-time limits of 55Dba and 45Dba. The noises that were most evident on site were the road traffic and the flow of water. It is clear from carrying out this report that the Waste Water Treatment Plant is having a minimal impact on the local environment in terms of Noise Pollution

3.1.3 Landfill Gas Emissions

The trigger levels for landfill gas emissions from the facility measured in any service duct or manhole on, at, or immediately adjacent to, the facility and/or at any other point located outside the body of the waste stipulated in Condition 6.3.1 of W0037-01 are detailed in Table 3.6 below:

Table 3.6 Landfill Gas Concentrations

Methane	Carbon Dioxide
20% LEL (1% v/v)	1.5% v/v

During 2016, landfill gas concentrations were measured at the following locations: RD1, RD2, RD3, RD4, RD5, RD6, RD7, RD8, L6, L8, L10 and L12.

3.1.3.1 Methane

Methane levels measured at RD2 exceeded the threshold level of 1% v/v in three of the monthly monitoring rounds. Methane levels above the threshold level ranged from 10.8% (Oct) to 4.7% (Dec).

Methane levels measured at RD3 exceeded the threshold level of 1% v/v in one of the monthly monitoring rounds. Methane levels above the threshold level ranged from 1.4% v/v (Oct) .

Methane levels measured at RD5 exceeded the threshold level of 1% v/v in one of the 12 monthly monitoring rounds. Methane levels above the threshold level ranged from 1.5% (Jan).

Methane levels measured at RD6 exceeded the threshold level of 1% v/v in all of the 12 monthly monitoring rounds. Methane levels ranged from 25.5% (Mar) to 45% (Nov).

Monthly recorded methane levels in the remaining monitoring boreholes (RD1, RD7, RD8, L6, L8, L10 and L12) were below 1% v/v.

3.1.3.2 Carbon Dioxide

Carbon dioxide concentrations exceeded the limit of 1.5% v/v at RD1 in 9 of the 12 monthly monitoring rounds – January (8.8%), February (7.4%), March (7.8%) April (7.8%), May (3.7%), June (3.7%), October (1.8%) November (4.4%) and December (7%).

At RD2, carbon dioxide levels exceeded the threshold level of 1.5% v/v in 6 of the 12 monthly monitoring rounds – February (2.8%), March (1.8%), April(1.8%),Oct (2.3%), Nov (3.1%), and Dec (2.9%).

In RD3, carbon dioxide concentrations were above the threshold level of 1.5% v/v in 6 of the 12 monthly monitoring rounds – July (2.6%), August (4.5%), September (3.6%), October (4.8%), November (3.9%)and December (4.6%).

In RD4, carbon dioxide concentrations were above the threshold level of 1.5% v/v in 11 of the 12 monthly monitoring rounds – January (3.7%), February (3.7%), March (2.8%), April (2.8%), May (2.8%), June (2.8%), July (3%), August (2.1%), October (1.8%), November (3.1%) and December (3.9%).

In RD5, carbon dioxide levels exceeded the threshold level of 1.5% in 11 out of the 12 monthly monitoring rounds – January (14.2%), February (12.1%), March (9.1%), April (9.1%), May (9.1%), June (9.1%), August (8.5%), September (10.1%), October (12.7%), November (13.5%) and December (14.9%).

In RD6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in all of the monthly monitoring rounds - January (9.3%), February (9.5%), March (9%), April (9%), May (9%), June (9%), July (11.1%), August (9.7%), September (6.5%), October (10%), November (10.2%) and December (9%).

Monthly recorded carbon dioxide levels in the remaining monitoring boreholes (RD7, RD8, L6, L8, L10 and L12) were below 1.5% v/v.

Landfill gas monitoring results are attached in Appendix C.

3.2 MONITORING RESULTS AND INTERPRETATION

3.2.1 Introduction

Environmental monitoring was conducted at the facility during 2016 in accordance with Schedule D of Waste Licence W0037-01. Details of monitoring and reporting frequencies are presented in Table 3.7 below.

The locations of all environmental monitoring points are illustrated on Figure 2. Monitoring results are presented in Appendices A to F. Copies of the laboratory certificates are included in Appendix G.

Table 3.7 Environmental Monitoring and Reporting Frequency

Environmental Monitoring Requirement	Monitoring Frequency	Reporting Frequency
Groundwater Quality	Biannually/Annually	Biannually
Groundwater Levels	Biannually	Biannually
Surface Water Quality	Biannually	Biannually
Surface Water Visual Inspection	Weekly	Biannually
Leachate Quality	Biannually	Biannually
Leachate Levels	Quarterly	Biannually
Landfill Gas	Monthly	Biannually
Dust Deposition	Annually	Annually
Noise Emissions	Annually	Annually
Meteorological Monitoring	Daily	Annually
Ecological Monitoring	bIannually	Biannually

In 2016,

- Dust analysis and reporting was carried out by BHP, New Road, Thomondgate, Limerick.
- Noise monitoring was carried out by Response Group.
- Groundwater and Leachate level monitoring was carried out by BHP, New Road, Thomondgate, Limerick.
- Groundwater, Leachate, Surface water and Landfill Gas analysis and reporting was carried out by BHP, New Road, Thomondgate, Limerick.
- Meteorological monitoring and surface water visual inspection is undertaken by facility management personnel at the facility.

3.2.2 Dust Monitoring

3.2.2.1 Dust Monitoring Locations

Dust monitoring was conducted at four monitoring locations in 2016 in accordance with Tables D.4.1 and D.3.1 of W0037-01. Dust monitoring locations are outlined in Table 3.8 below.

Table 3.8 Dust Monitoring Locations

Location	Easting	Northing
N1	144.001	159.988
N3	143.727	159.831
N5	143.937	160.076
SS2	143.879	159.874

3.2.2.2 Dust Monitoring Methods

Details of the dust monitoring results attached in Appendix A.

3.2.2.3 Dust Monitoring Results

The results of dust monitoring conducted at the facility during 2016 are presented in Table 3.9 below. Dust concentrations and emission limit values as detailed in Schedule C.3 of W0037-01 were discussed in Section 3.1.1.

Table 3.9 Dust Monitoring Results 2016

Location	N1	N3	N5	SS2
	$mg/m^2/day$			
Dec 2016	236	45	189	59

All monitoring results were below the ELV for dust of 350 mg/m2/day .

3.2.3 Groundwater Monitoring

3.2.3.1 Groundwater Monitoring Locations

Groundwater monitoring was conducted at five locations during 2016 in accordance with Schedule D.1.1 and D.6.1 of the current licence. Co-ordinates for all monitoring locations are detailed in Table 3.10 and locations are also illustrated on Figure 2. Monitoring results are attached in Appendix D.

Monitoring location RD2 is located at the southern boundary of the site and RD3 is located at the south-western boundary of the site adjacent to the capped sludge cells.
BH3 is located at the north eastern boundary of the site. BH4 and BH5 are both located in the buffer zone adjacent to the southern boundary of the facility and close to Shannon Estuary.

Table 3.10 Groundwater Monitoring Locations

Location	Easting	Northing
RD2	143.866	159.855
RD3	143.799	159.855
BH3	143.952	160.085
BH4	143.935	159.930
BH5	143.984	159.959

3.2.3.2 Groundwater Levels

Groundwater levels were monitored on a biannual basis in accordance with Schedule D.6.1 of W0037-01 and are included in Appendix D with the groundwater monitoring results.
Groundwater levels recorded during 2016 varied between 0.20m below top of casing (BTOC) (in BH4 Nov 2016) and 1.16m BTOC (in BH3 June 2016).

3.2.3.3 Groundwater Analytical Results

Groundwater monitoring was conducted on a biannual and annual basis in accordance with Schedule D.6.1 of the licence. Monitoring was undertaken in June and November 2016.

Groundwater analytical results are attached in Appendix D.
There are no emission limits stipulated in Waste Licence W0037-01, therefore the groundwater analytical results have been compared to the Interim Guideline Values (IGVs) specified in the EPA document: 'EPA Interim Report – Towards Setting Guideline Values for the Protection of Groundwater in Ireland' (2003).

The PH in all of the groundwater samples analysed during both monitoring rounds ranged from 6.68 to 7.53, which is within the IGV range of 6.5-9.5.

Electrical conductivity measurements ranged from 1170 µS/cm in RD2 (June) to 13910 µS/cm in BH4 (June), which are similar to previous monitoring results. The IGV of 1,000 µS/cm was exceeded in all of the samples analysed.

Ammonia concentrations detected were all above the IGV of 0.2mg/l and ranged between 1.9mg/l in RD3 (Nov) to 28mg/l in BH3 (June).

Total Oxidised Nitrogen concentrations results ranged between 0.14mg/l BH3 (June) and 1.27mg/l BH5 (June). These readings are lower than those recorded last year.

Total organic carbon concentrations ranged from 3.3mg/l in BH5 (June) to 134mg/l in RD2 (Nov).

Chloride concentrations ranged from 516 mg/l in RD3 (Nov) to 5,704 mg/l in BH4 (June). Chloride concentrations in all of the samples analysed exceeded the IGV of 30 mg/l.

Sodium concentration ranged from 599mg/l RD3 (Nov) to 2360mg/l BH4 (Nov), which were all above the IGV of 150 mg/l.

Potassium concentrations in all five samples analysed during the November monitoring round all exceeded the IGV of 5 mg/l. Concentrations ranged from 12.1g/l in RD3 to 131mg/l in BH4.

Iron concentrations detected exceeded the IGV of 0.2mg/l on all occasions. The Iron concentration measured ranged between 0.776 mg/l in RD3 and 20.1mg/l in BH4, samples were taken in November.

Chromium concentrations in all samples were below the IGV of 0.03 mg/l. They ranged from <0.002mg /l in RD2 to 0.017mg/l in BH5.

Fluoride concentrations in all samples were below the IGV of 1mg/l. They ranged from 0.05mg/l in BH3 to 0.54mg/l in BH4.

Concentrations of, cadmium, copper, cyanide, lead, mercury, sulphate, tin and zinc were below their respective IGVs and/or laboratory detection limits in all of the samples analysed.

3.2.3.4 Conclusions

Overall the groundwater results are fairly similar to the 2015 biannual and annual monitoring rounds. This represents a maintained improvement in groundwater quality at the facility since previous monitoring rounds.

Certain parameters such as electrical conductivity, ammonia, chloride, iron, potassium and total phosphorus concentrations remain elevated at most or all monitoring locations compared to the IGV's.

3.2.4 Landfill Gas Monitoring

Measurements of landfill gas were carried out at all gas monitoring boreholes (RD1 to RD8) on a monthly basis in accordance with Table D.2.1 of the Waste Licence. Combined gas and Leachate monitoring boreholes (L6, L8, L10, and L12) were also monitored on a monthly basis for gas.

All monitoring locations were sampled for methane, carbon dioxide, oxygen, temperature and pressure.

Results are compared against the EPA Guideline Emission Limits for methane (CH4) and carbon dioxide(CO2) at landfills, which are 1% v/v and 1.5% v/v, respectively (EPA Landfill Manuals: Landfill Monitoring, 2nd Edition, 2003). These are also the ELVs specified in Schedule C.2 of Waste Licence W0037-01.

3.2.4.1 Gas Monitoring Locations

Gas monitoring locations are detailed in Table 3.11 below and illustrated in Figure 2. Gas monitoring results are presented in Appendix C.

Table 3.11 Gas Monitoring Locations

Location	Easting	Northing
RD1	143.761	159.997
RD2	143.876	159.883
RD3	143.801	159.851
RD4	143.760	160.092
RD5	143.906	159.999
RD6	143.928	160.071
RD7	144.000	159.979
RD8	143.939	159.938
L6	143.867	159.959
L8	143.924	159.995
L10	143.944	160.015
L12	143.940	160.064

3.2.4.2 Gas Monitoring Boreholes

Landfill gas measurements were undertaken using an Infrared Gas Analyser. The gas emitted is analysed for its content by % volume of the following constituents:

- Methane (CH_4)
- Carbon Dioxide (CO_2)
- Oxygen (O_2)
- Atmospheric Pressure (mBar)

The LEL (lower explosive limit) for methane, atmospheric pressure (millibars) and temperature (Oc) were also recorded by the gas analyzer and relative pressure was calculated.

3.2.5 Leachate Monitoring

3.2.5.1 Leachate Monitoring Locations

In accordance with Schedule D.1 of the licence, Leachate composition and level monitoring was conducted at locations detailed in Table 3.12.

Table 3.12 Leachate Monitoring Locations

Parameter	Location	Easting	Northing
Leachate Level	L1	143.795	159.990
	L2	143.796	159.926
	L3	143.843	159.890
	L4	143.797	160.016
	L5	143.821	159.997
	L7	143.895	159.928
	L9	143.939	159.958
	L11	143.991	160.000
	L13	143.976	160.052
Leachate Composition	SS3	143.806	159.951

3.2.5.2 Leachate Composition Results

There are no emission limits stipulated in Waste Licence W0037-01, therefore the Leachate analytical results have been compared to the Interim Guideline Values (IGVs) listed in the EPA document: 'EPA Interim Report - Towards Setting Guideline Values for the Protection of Groundwater in Ireland' (2003).

Appendix E contains the annual and biannual Leachate analytical results.

Leachate monitoring at SS3 was undertaken in June and November 2016 as per Schedule D of the licence.

The electrical conductivity was measured at 1376 µS/cm in June and 1699 µS/cm in November which was above the IGV of 1000µS/cm.

The chloride concentration was detected at 158mg/l in June and 84mg/l in November, both of which exceeds the IGV of 30 mg/l; however chloride concentrations have been consistently elevated since 2004.

The ammonia concentration was detected at 8.4mg/l in June and 27mg/l in November, which both exceeds the IGV of 0.15 mg/l; Ammonia concentrations have been consistently elevated since 2004 but have reduced since 2013.

Potassium concentration was 8.82mg/l which is above the IGV of 5 mg/l.

The iron concentration was 0.655mg/l in November, which is above the IGV of 0.2 mg/l.

Sulphate concentration was 480mg/l which is above the IGV of 200mg/l.

Total Phosphorus was also detected above the lGV of 0.01mg/l at 0.36mg/l. This is similar with previous years.

Comparison of results with the results from previous years, indicate that a number of parameters (Ammonia, chloride, conductivity, potassium, sulphate and total phosphorus) remain consistently elevated above their respective IGVs.

All the other parameters tested were all below their IGV's.

3.2.6 Noise Monitoring

3.2.6.1 Noise Monitoring Locations

Day-time and night-time annual noise monitoring was conducted at four boundary locations at the facility (N1, N2, N3, N5) on the 2nd June as stipulated in Table D.4.1 of the licence. Noise monitoring locations are illustrated on Figure 2 and detailed in Table 3.13 below.

Table 3.13 Noise Monitoring Locations

Location	Easting	Northing
N1	144.001	159.988
N3	143.727	159.831
N5	143.937	160.076
SS2	143.879	159.874

The noise survey report (including details of the methodology) is attached in Appendix B.

3.2.6.2 Noise Monitoring Results

The noise monitoring results are summarised in Table 3.14 and 3.15.

Table 3.14 Day-time Noise Measurements 2016

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	02/06/16	30 Minutes	43.2
N2	02/06/16	30 Minutes	43.6
N3	02/06/16	30 Minutes	43.1
N5	02/06/16	30 Minutes	42.9

Table 3.15 Night-time Noise Measurements 2016

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	02/06/16	30 Minutes	44.4
N2	02/06/16	30 Minutes	42.6
N3	02/06/16	30 Minutes	42.7
N5	02/06/16	30 Minutes	44.5

Day-time and night time noise levels at all boundary locations did not exceed the daytime emission limit LAeq of 55dB and 45 dB respectively.

It is noted that the predominant noise source on site were non site related traffic noise and the flow of water.

3.2.7 Surface Water Monitoring

3.2.7.1 Surface Water Monitoring Locations

In total, five surface water locations were monitored in 2014 with differing biannual and annual parameter requirements as outlined in Table D.6.1 of the waste licence (SS1, SS2, SS4, SS6, SS7).

The surface water monitoring locations are located in the catchment drains along the perimeter of the facility. These drains collect surface water run-off from the site and ultimately discharge to the Shannon Estuary via a sluice gate.

Monitoring location SS1 is located in the catchment drain along the eastern boundary of the facility adjacent to Cell No. 3. Monitoring locations SS2 and SS4 are located in a drain at the southern tip of the landfill. SS6 and SS7 are both estuarine locations.

Monitoring locations are listed in Table 3.16 below and are illustrated on Figure 2.

Table 3.16 Surface Water Monitoring Locations

Location	Easting	Northing
SS1	144.000	160.040
SS2	143.879	159.874
SS4	143.936	160.003
SS6	143.907	159.862
SS7	143.927	159.873

3.2.7.2 Surface Water Monitoring

Surface water monitoring was conducted on a biannual basis at the five locations detailed in Table 3.16. Sampling involved the submergence of the designated sample container into the surface water body.

During submergence, every effort was made to keep the container steady so as to prevent sediment disturbance. Samples were collected and submitted to an accredited laboratory for analysis in June and November for the range of parameters outlined in Table D.6.1 of W0037-01.

Surface water analytical results are attached in Appendix F.

There is no surface water emission limits stipulated in waste licence W0037-01. Therefore, all surface water monitoring results have been compared to the Thresholds, AA-EQS's (Annual Average Environmental Quality Standard) and MAC-EQS's (Maximum Admissible Concentration Environmental Quality Standard Thresholds) specified in the Surface Water Quality Regulations SI 272 of 2009 applicable to transitional waters (Shannon Estuary at Shannon).

Ammonia levels exceeded the IGV of 0.02mg/l in all the sampled tested. Results ranged between 0.1mg/l SS2 (Nov) to 1.5mg/l SS4 (Nov). There was an increase the ammonia levels in 2016.

Potassium exceeded the IGV of 5mg/l in 2 samples tested. In November SS1 9.25mg/l & in November SS4 was 29.5mg/l.

BOD exceeded the IGV of 4mg/l in 1 sample tested. In November SS4 was 5.7mg/l.

Conductivity exceeded the IGV of 1000uS/cm in 1 sample tested In November SS4 was 1000Us/cm.

There were no other exceedances of the relevant thresholds or EQS's for any of the parameters analysed during both monitoring rounds undertaken in 2016.

The analytical results indicate that surface water quality is generally good at and beyond the facility boundary.

3.2.7.3 Surface Water Visual Inspections

Visual inspections of surface water drains are carried out on a weekly basis .

3.2.8 Meteorological Monitoring

Details of meteorological monitoring conducted at the facility in 2016 are attached in Appendix H. Met Eireann publish meteorological data, which is obtained from their weather station at Shannon Airport.

Meteorological data obtained from the Met Eireann weather station at Shannon Airport is summarised in the first three columns of Table 3.17 below.

Table 3.17 Summary Rainfall Data

Month	Rainfall (mm) Shannon Airport	Evapotranspiration (mm) Shannon Airport	Evaporation (mm)	Estimated Effective Rainfall – Capped Area (mm)	Estimated Effective Rainfall – Active Cell (mm)
JAN	107.5	16.7	22	90.8	85.5
FEB	144.7	21.5	31	123.2	113.7
MAR	64.4	38	55.1	0	0
APR	42	60.6	89.5	-18.6	0
MAY	45.5	91.8	129.8	0	0
JUN	68.2	91.6	126.9	-23.4	-58.7
JUL	66.9	83.7	117.3	-16.8	-50.4
AUG	107.4	68.7	97.6	38.7	9.8
SEP	88.4	44.7	62.1	43.7	0
OCT	35.3	31	41.2	4.3	-5.9
NOV	69	11.2	15.5	57.8	53.5
DEC	74	13.3	16.8	60.7	57.2
TOTAL	**913.3**	**572.8**	**804.8**	**360.4**	**204.7**

***Denotes months where evaporation and/or evapotranspiration exceeded total rainfall**

Rainfall data obtained from the Met Eireann weather station at Shannon Airport estimated that the site received approximately 913.3 mm of rainfall from January 2016 to December 2016.

Effective rainfall for capped and non-capped/active cells was calculated as follows:
Effective Rainfall (mm) = Net Precipitation (mm) – Loss by Evapotranspiration (mm) (for capped cells)
Effective Rainfall (mm) = Net Precipitation (mm) – Loss by Evaporation (mm) (for active cells)

3.2.9 Annual Water Balance Calculation and Interpretation for Cells

The water balance was calculated using the average monthly figure of sludge disposed in 2016, which was 99 tonnes. A water balance is used to calculate the difference between rainfall on landfilled areas and the various losses prior to Leachate generation.
Water balance calculations are attached in Appendix I.

The method used is based on equation developed by Ehring (Quality and Quantity Sanitary Landfill Leachate, 1983). This method is based on the use of a mathematical equation, which provides a conservative estimate, which caters for the worst-case scenarios.

The equation is as follows: L0 = [(ER.a) + LW + IR] – [aW]
Where:

- L_0 : Free Leachate Produced
- ER: Effective Rainfall (net precipitation after loss by evaporation)
- A: Area of Cell(s)
- LW: Liquid waste
- IR: Infiltration from restored areas
- aW: Absorptive capacity of waste
- a_A: Active area
- aR: Restored area
- AL: Lagoon area
- WA: Waste in active area
- WR: Waste in restored area

Based on the calculations it is estimated that approximately 962.26 m3 (upper bound) and 1,751.01 m3 (lower bound) of Leachate was produced on site in 2016.

3.2.10 Resource and Energy Consumption Summary

The only consumer of electricity at the facility is the Leachate pump, which pumps the Leachate from the Leachate collection sump to the WWTP. The contribution of this sump to the overall electrical output of the entire WWTP is minor. The Leachate pump is in operation for approximately 4 hrs per day.

Diesel is used to fuel the vehicles used on site namely the sludge dumper truck and ride on mower. Diesel is stored in a 5,000 litre capacity bunded tank located on site. Approximately 1500 litres of diesel were used in 2016.

Mains water is provided via the public mains supply, however water usage at the facility is not metered.

3.2.11 Tank, Pipeline and Bund Integrity Testing and Inspection

The facility contains one bunded diesel tank as outlined in Section 3.2.10. The bund was installed in 2006 and the integrity assessment report was forwarded to the Agency as part of the 2006 AER. The bund is regularly inspected and tested by site personnel to verify integrity.

3.2.12 Review of Nuisance Controls

The assistant landfill supervisor conducts daily inspections of the landfill and the facility and records any incidents in daily duty sheets which are stored at the facility. The inspections are undertaken to identify any environmental nuisances caused by vermin, birds, flies, mud, dust, litter, and odours. No complaints or incidents were received by the facility in 2016.

Pest Patrol carry out pest control in the treatment plant but no incidences of vermin have been reported on the landfill site. Birds and flies do not pose a problem at the site as there is no domestic refuse being deposited in the landfill; therefore there are no nuisance controls in place for birds or flies.

According to facility management:

- No complaints regarding odours were received in 2016.
- There is no problem with litter at the facility and no complaints were received in 2016 in this regard.
- There are no noise sensitive locations in the immediate vicinity of the facility and no complaints regarding noise from the facility were received in 2016.

The only vehicles that use the site roads are a 3-tonne sludge dumper truck. This is used to deposit the sludge to the landfill from the WWTP. The vehicle travels on a private road between the two sites and do not travel outside the boundary of the two sites.

In general, dust is not a problem encountered at the facility and thus no dust suppression measures are considered necessary. Dust monitoring is currently undertaken as per Table D.3.1 of the licence. All locations were all within the limit.

4.0 MANAGEMENT OF THE FACILITY

4.1 Management and Staffing Structure

Clare County Council has been responsible for the facility since November 2004. The facility was previously managed by Shannon Development. The facility is under the operational control of the landfill manager – Neil Ronan. The assistant landfill managers are Ailish Johnston, Paul O Keeffe and Michael Lynch. In addition, there is one weighbridge operator, John O Brien. The current management structure is outlined in Table 4.1 below.

Table 4.1 Management and Staffing Structure

Name	Position	Responsibilities	Replacement
Neil Ronan	Landfill Manager	Land Fill Management	Ailish Johnson
Ailish Johnston	Landfill Assistant Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Paul O Keeffe
Paul O'Keeffe	Landfill Assistant Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	Michael Lynch
Michael Lynch	Landfill Assistant Manager	Landfill management, monthly reporting, environmental monitoring, nuisance control	John O Brien
John O Brien	Weighbridge operator	Weighing sludge	Henry Greensmith

4.2 Environmental Management Programme/Environmental Objectives and Targets

The 2015 AER did not specify any environmental objectives and targets for 2016.

4.3 Schedule of Environmental Objectives and Targets for 2015

The licensee conducted a review of the EMS in 2015 and found that no changes to the EMS were required and therefore there are no amendments to the environmental objectives and targets required for the year 2016.

4.4 Facility Procedures

No new procedures were developed or implemented at the site between January 2016 and December 2016.

4.5 Financial Provision

In accordance with Condition 12 of the licence, Charges and Financial Provisions, Clare County Council has the ability to meet any financial commitments or liabilities incurred by the undertaking of the activities relating to the facility. Clare County Council annually in the preparation of the "Book of Estimates" and the passing of these estimates shall make provisions for any capital works and maintenance works required to fulfil the conditions of the waste licence for the facility.

Clare County Council also carries adequate insurance to deal with their liabilities. The type and level of insurance is constantly monitored and updated as required.

4.6 Staff Training

An Environmental Awareness Programme has been developed and implemented at the facility. A copy of the Programme was included in the 2006 AER. The Programme sets out environmental issues relevant to all site staff, contractors and visitors to the facility. Training for all staff involved in the operation of the facility is recorded in the training and awareness programme which includes a sign out section for staff members to record their attendance to courses.

Spill kit and chemical handling training and confined space training was undertaken for staff employed at the facility and copies of training records are kept on site.

No additional environmental training was undertaken in 2016.

4.7 Programme for Public Information

All information and correspondence supplied to the EPA (other than commercially sensitive information) and received from the EPA, is available to the public to view at Tradaree Point WWTP, Shannon (Clonmoney South), Co. Clare. This includes a copy of the waste licence, all reports, monitoring results and interpretations required by the licence and other correspondence between the EPA and the facility. Any member of the public may view the information between the hours of 10.00 and 16.00 and by appointment only, at the below address.

All requests concerning the environmental performance of the facility should be forwarded to:
Mr Neil Ronan,
Facility Manager,
Tradaree Point Sludge Disposal Facility,
Shannon (Clonmoney South),
Co. Clare
Tel: 061 364477

4.8 Facility Notice Board

In compliance with Condition 3.3 of Waste Licence W0037-01, a facility notice is in place at the entrance to the landfill site adjacent to the main gate, and contains all the details outlined in Section 3.3.3 of the licence.

5.0 REPORTED INCIDENTS AND COMPLAINTS SUMMARY

During the reporting period January 2016 to December 2016, no incidents occurred which would require reporting to the relevant authorities. No complaints or incidents were reported to the facility between January and December 2016.

5.1 Incidents

None recorded.

5.2 Non-compliances

No non-compliances were recorded.

5.3 Complaints

None Received.

5.4 Waste Record

Records of the amount and type of sludge (either industrial or domestic) disposed at the facility are kept on file at the facility. Receipts of incoming sludge are recorded at the weighbridge and filed. The weekly records from the weighbridge are then filed and stored in the administration building of the facility. The total quantity of the waste sludge is recorded on a weekly basis and is logged in a waste register that is kept on site at all times. Quantities of waste sludge disposed of to landfill are recorded in the monthly reports for the WWTP and also the AER.

The following information is recorded in the waste register;

- Name of the person transporting the load
- Date of transportation
- Sludge quantity
- Sludge type
- The name of the machine operator
- The cell in which the sludge is to be disposed

The site caretaker signs the logbook to confirm the sludge has been inspected prior to acceptance to the landfill. The records are then transferred to the site office where they are logged on a computer database.

The weighbridge was last calibrated in February 2016 by Gravitation Ltd. Test cert no. 51639

6.0 FACILITY DEVELOPMENT

6.1 Developments during 2015

There were no other development works of note undertaken at the facility between January and December 2016.

6.2 Proposed Development of the Facility and Associated Timescales

Facility development works planned for 2016.
Cell 1 & 2 have reached their capacity and is currently inactive awaiting capping, it is planned that this capping will take place by Dec 2017.
Cell 3 is currently active.

FIGURE 1 – SITE LOCATION MAP

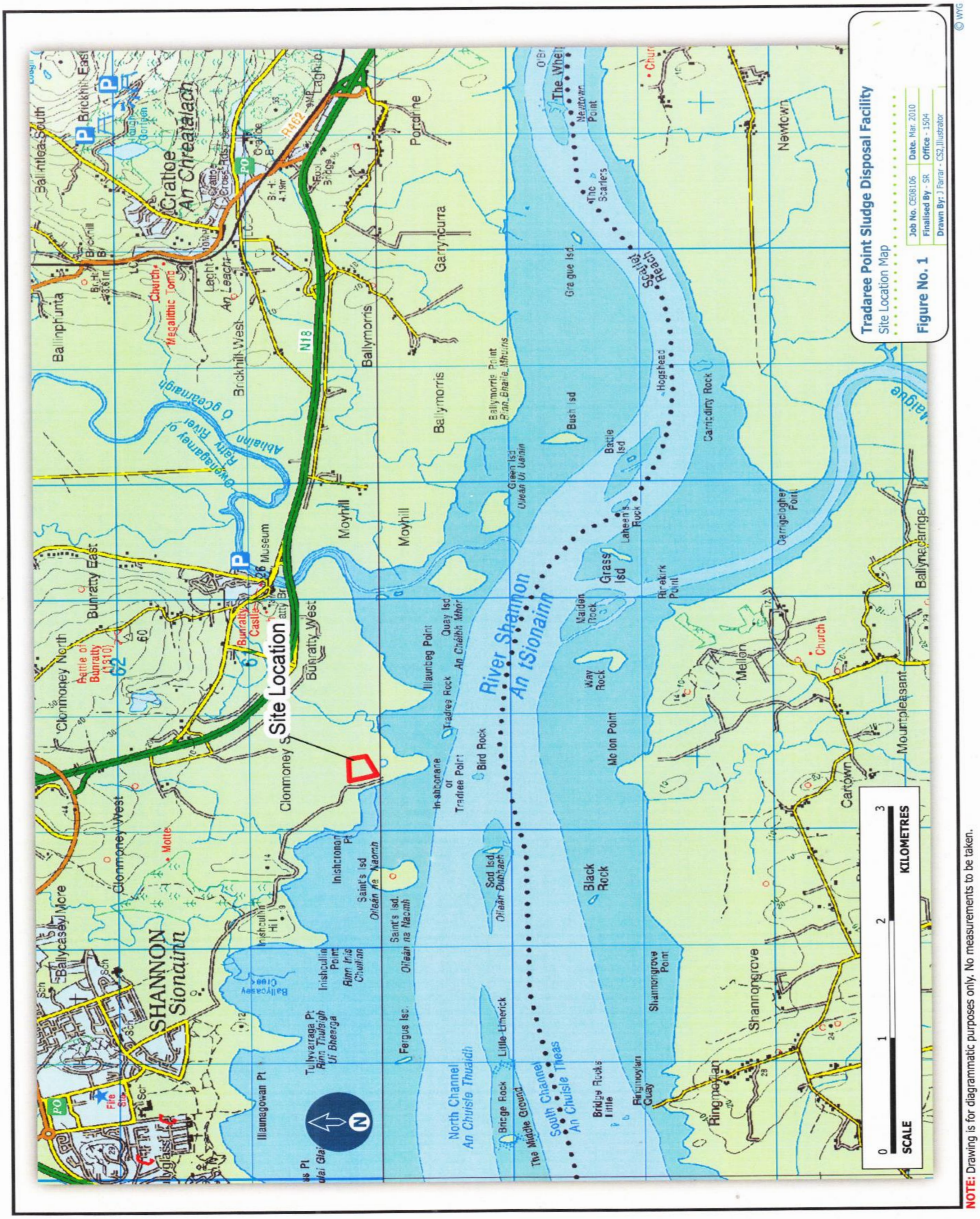
Tradaree Point Sludge Disposal Facility
Site Location Map
Figure No. 1
Job No. CE08106
Date. Mar. 2010
Finalised By - SR
Office - 1504
Drawn By: J Farrar - CS2, Illustrator
Site Location
River Shannon
An tSionainn
SHANNON
Sionainn
Bunratty Castle
Clonmoney
Bunratty West
Ballymorris
Moyhill
Cratloe
An Chreatalach
Tradree Point
Bird Rock
Fergus Isd.
North Channel
South Channel
Black Rock
Shannongrove
Mountpleasant
SCALE
KILOMETRES
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

FIGURE 2 – SITE PLAN SHOWING ENVIRONMENTAL MONITORING LOCATIONS


RD4
N5
BH3
RD6
L12
Unused
L8
CSS1
Buffer Zone
Disused Sludge Drying Beds
L4
Capped Sludge Cells
Gate
Road
RD1
L5
L1
SS5
RD5
L10
Inuse
L11
N1
RD7
L8
Full
L9
BH5
SS3
RC1
L6
Full
L7
RD8
BH4
L2
Buffer Zone
SS4
Capped Sludge Cells
L3
RD2
RD2
N2
SS2
Edge of Catchment Drain
Sluice Gate
SS7
SS6
To Shannon Estuary
RD3
RD3
RD3
Effluent Storage Lagoon
N3
LEGEND
Surface Water Monitoring Location
Groundwater Monitoring Location
Noise & Dust Monitoring Location
Gas Monitoring Location
Leachate Monitoring Location
Combined Gas & Leachate Monitoring Location
Tradaree Point Sludge Disposal Facility
Site Plan Showing Environmental Monitoring Locations
Figure No. 2
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

APPENDICES

APPENDIX A – DUST MONITORING RESULTS

BHP/CL/02D

TEST REPORT 132920

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Shannon Town WWTP
Traderee
Shannon
Co.Clare

FTAO: Ailish Johnston

BHP Ref. No.: 16/12/1204-1207
Order No:
Date Received: 19/12/16
Date Tested: 21/12/16
Test Spec: VDI 2119 Part 2
Item : Dust Deposition

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Standard Reference
	Tradree Landfill 21/11/16 to 19/12/16			
Dust Deposition	**D1**	mg/m^2/day	236	BHP AC 017
Dust Deposition	**D2**	mg/m^2/day	45	BHP AC 017
Dust Deposition	**D3**	mg/m^2/day	189	BHP AC 017
Dust Deposition	**D4**	mg/m^2/day	59	BHP AC 017

Additional Information: All Sample Locations are inside the EPA Limit of 350 mg/m2/day

Authorised by:

Colette Hannan

Colette Hannan
Date of Issue: 04/01/17

APPENDIX B – NOISE SURVEY REPORT

Tradaree WWTP

Environmental Noise Monitoring 2nd June 2016

Code	Location	Time	Range dB	Average dB	Maximum dB	Background Noise	Compliant
N1 Daytime	Boundary @ Landfill Cell 3	11.15 - 11.45	30-90	43.2	52.9	Road Traffic	Yes
N2 Daytime	Boundary @ Landfill Cell 1	10.40 - 11.10	30-90	43.6	54	Road Traffic,	Yes
N3 Daytime	Boundary @ Lagoon	10.00 - 10.30	30-90	43.1	55	Road Traffic, Flow of Water	Yes
N5 Daytime	Boundary @ Landfill Cell 4	11.50 - 12.20	30-90	42.9	52.6	Road Traffic	Yes
N1 Night-Time	Boundary @ Landfill Cell 3	01.30 - 02.00	30-90	44.4	53.5	Road Traffic	Yes
N2 Night-Time	Boundary @ Landfill Cell 1	00.50 - 01.20	30-90	42.6	44.9	Road Traffic,	Yes
N3 Night-Time	Boundary @ Lagoon	00.10 - 00.40	30-90	42.7	44.7	Road Traffic, Flow of Water	Yes
N5 Night-Time	Boundary @ Landfill Cell 4	02.05 - 02.35	30-90	44.5	44.2	Road Traffic	Yes

The weather was dry throughout the Daytime and Night-Time noise measurements.

The Noise meter was an INFOTECH – SLM – 1352A and was calibrated on the morning of the test.

Conclusion:

The average figures show that there are no noise issues on site. All results obtained from the measurements taken at the four locations by day and night are within the daytime and night-time limits of 55dBA and 45dBA. The noises that were most evident on site were the road traffic and the flow of water. It is clear from carrying out this report that the Waste Water Treatment Plant is having a minimal impact on the local environment in terms of Noise Pollution.

APPENDIX C – Landfill Gas Monitoring Results

Monthly Status Report

Month January-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
28-Jan	RD1	8.8	0.1	9.4	1013	8	
	RD2	0.8	0.1	20.8	1013	9.6	
	RD3	1.1	0.6	20.4	1013	9.8	
	RD4	3.7	0.1	14.4	1013	9.5	
	RD5	14.2	1.3	6.8	1013	10.2	
	RD6	9.3	33.4	3.5	1013	9.5	
	RD7	0.1	0.10	20.7	1013	10	
	RD8	0.2	0.1	20.7	1013	9.6	
	L6	0.1	0.1	20.9	1013	9.6	
	L8	0.5	0.0	20.3	1013	9.5	
	L10	0.1	0.0	20.6	1013	10.1	
	L12	0.1	0.0	20.6	1013	9.6	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month February-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
05-Feb	RD1	7.4	0.1	13.2	1004	6.4	
	RD2	2.8	0.1	20.1	1004	6.1	
	RD3	0.7	0.1	20.6	1004	8	
	RD4	3.7	0.1	16.7	1004	7.2	
	RD5	12.1	1.0	10.6	1004	6.9	
	RD6	9.5	31.5	3.8	1004	7.4	
	RD7	0.1	0.10	20.4	1004	8	
	RD8	0.3	0.1	20.5	1004	7.2	
	L6	0.1	0.1	20.8	1004	5.9	
	L8	0.1	0.1	20.7	1004	6.2	
	L10	0.1	0.1	20.3	1004	6.2	
	L12	0.1	0.1	20.3	1004	5.9	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month March-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
16-Mar	RD1	7.8	0.1	9.2	1032	15.9	
	RD2	1.8	0.1	19.2	1032	13.9	
	RD3	0.5	0.1	19.4	1032	12	
	RD4	2.8	0.1	15.8	1032	17.9	
	RD5	9.1	0.3	11.7	1032	19.4	
	RD6	9.0	25.5	4.3	1032	11.7	
	RD7	0.1	0.10	19.9	1032	15.4	
	RD8	0.1	0.1	19.9	1032	13.0	
	L6	0.1	0.1	19.6	1032	17.2	
	L8	0.5	0.1	19.4	1032	19.3	
	L10	0.1	0.1	20.2	1032	16.5	
	L12	0.1	0.1	20.2	1032	16.3	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month April-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
27-Apr	RD1	7.8	0.1	9.2	1032	15.9	
	RD2	1.8	0.1	19.2	1032	13.9	
	RD3	0.5	0.1	19.4	1032	12	
	RD4	2.8	0.1	15.8	1032	17.9	
	RD5	9.1	0.3	11.7	1032	19.4	
	RD6	9.0	25.5	4.3	1032	11.7	
	RD7	0.1	0.10	19.9	1032	15.4	
	RD8	0.1	0.1	19.9	1032	13.0	
	L6	0.1	0.1	19.6	1032	17.2	
	L8	0.5	0.1	19.4	1032	19.3	
	L10	0.1	0.1	20.2	1032	16.5	
	L12	0.1	0.1	20.2	1032	16.3	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month May-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
17-May	RD1	3.7	0.1	19.0	1012	14.6	
	RD2	0.4	0.1	20.9	1012	15.1	
	RD3	1.2	0.1	20.5	1012	14.9	
	RD4	2.8	0.1	15.8	1012	15.5	
	RD5	9.1	0.3	11.7	1012	15.4	
	RD6	9.0	25.5	4.3	1012	14.9	
	RD7	0.0	0.10	20.9	1012	15.4	
	RD8	0.1	0.1	21.0	1012	14.9	
	L6	0.1	0.1	20.8	1012	15.3	
	L8	0.1	0.1	20.9	1012	15.5	
	L10	0.1	0.1	21.0	1012	15.7	
	L12	0.1	0.1	21.0	1012	15.1	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month June-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
13-Jun	RD1	3.7	0.1	19.0	1012	14.6	
	RD2	0.4	0.1	20.9	1012	15.1	
	RD3	1.2	0.1	20.5	1012	14.9	
	RD4	2.8	0.1	15.8	1012	15.5	
	RD5	9.1	0.3	11.7	1012	15.4	
	RD6	9.0	25.5	4.3	1012	14.9	
	RD7	0.0	0.10	20.9	1012	15.4	
	RD8	0.1	0.1	21.0	1012	14.9	
	L6	0.1	0.1	20.8	1012	15.3	
	L8	0.1	0.1	20.9	1012	15.5	
	L10	0.1	0.1	21.0	1012	15.7	
	L12	0.1	0.1	21.0	1012	15.1	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month July-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
18-Jul	RD1	0.8	0.1	18.7	1019	26.1	
	RD2	0.2	0.1	19.0	1019	25.6	
	RD3	2.6	0.1	17.3	1019	26.9	
	RD4	3.0	0.6	16.0	1019	27.9	
	RD5	1.4	0.1	18.2	1019	28.7	
	RD6	11.1	43.5	2.1	1019	23.6	
	RD7	0.1	0.10	19.4	1019	25.6	
	RD8	0.1	0.1	19.5	1019	25.6	
	L6	0.1	0.1	19.3	1019	30	
	L8	0.6	0.1	18.7	1019	28.5	
	L10	0.1	0.1	19.8	1019	29.8	
	L12	0.1	0.1	20.1	1019	26.6	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month August-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
25-Aug	RD1	0.5	0.1	20.0	1015	20	
	RD2	0.4	0.1	19.7	1015	22	
	RD3	4.5	0.1	16.8	1015	21.6	
	RD4	2.1	0.2	18.5	1015	21.6	
	RD5	8.5	0.1	11.8	1015	17.8	
	RD6	9.7	42.0	4.5	1015	22.2	
	RD7	0.1	0.10	19.8	1015	22.5	
	RD8	0.2	0.1	19.8	1015	22.0	
	L6	0.4	0.1	19.6	1015	22	
	L8	0.1	0.1	19.8	1015	20.3	
	L10	0.1	0.1	19.8	1015	22.8	
	L12	0.1	0.1	19.9	1015	23	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month September-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
28-Sep	RD1	1.0	0.1	19.9	1019	18	
	RD2	0.7	0.1	19.5	1019	19.2	
	RD3	3.6	0.1	17.9	1019	19.6	
	RD4	1.3	0.1	19.6	1019	20.2	
	RD5	10.1	0.1	10.7	1019	18.1	
	RD6	6.5	30.0	11.4	1019	20.3	
	RD7	0.1	0.10	20.3	1019	19.4	
	RD8	0.2	0.1	20.3	1019	19.0	
	L6	0.1	0.1	20.2	1019	21.5	
	L8	0.1	0.1	20.2	1019	21.4	
	L10	0.1	0.1	20.4	1019	20.2	
	L12	0.1	0.1	20.4	1019	20.6	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month October-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
14-Oct	RD1	1.8	0.1	20.3	1002	11.7	
	RD2	2.3	10.8	17.3	1002	10.8	
	RD3	4.8	1.4	18.2	1002	10.6	
	RD4	1.8	0.1	20.7	1002	10.8	
	RD5	12.7	0.4	8.8	1002	11.1	
	RD6	10.0	44.1	5.0	1002	10.4	
	RD7	0.2	0.10	20.9	1002	10.7	
	RD8	0.5	0.5	20.6	1005	10.9	
	L6	0.1	0.1	20.9	1002	10.6	
	L8	0.1	0.1	21.0	1002	10.3	
	L10	0.1	0.1	21.0	1002	11.2	
	L12	0.1	0.1	20.9	1002	10.7	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month November-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
08-Nov	RD1	4.4	0.1	19.7	1007	8.4	
	RD2	3.1	8.9	17.8	1007	8.2	
	RD3	3.9	0.9	19.6	1007	7.8	
	RD4	3.1	0.1	20.4	1007	8.5	
	RD5	13.5	0.2	6.0	1007	7.5	
	RD6	10.2	45.0	3.3	1007	7.3	
	RD7	0.1	0.10	21.0	1007	7.6	
	RD8	0.5	0.1	21.1	1007	7.8	
	L6	0.1	0.1	21.5	1007	8.1	
	L8	0.1	0.1	21.4	1007	8	
	L10	0.1	0.1	21.0	1007	7.9	
	L12	0.1	0.1	20.9	1007	7.5	
Trigger Level		1.5% v/v	1% v/v				

Monthly Status Report

Month December-2016

Landfill Gas Analysis

Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
13-Dec	RD1	7.0	0.1	15.6	1007	10.6	
	RD2	2.9	4.7	18.7	1007	11.2	
	RD3	4.6	0.1	18.6	1007	11.4	
	RD4	3.9	0.1	15.8	1007	11.9	
	RD5	14.9	0.1	4.5	1007	10.6	
	RD6	9.0	36.2	6.0	1007	11.6	
	RD7	0.1	0.10	20.7	1007	11.9	
	RD8	0.3	0.1	20.6	1007	12.0	
	L6	0.1	0.1	20.8	1007	12.2	
	L8	0.1	0.1	20.7	1007	11.6	
	L10	0.1	0.1	20.6	1007	11.9	
	L12	0.1	0.1	20.6	1007	12.4	
Trigger Level		1.5% v/v	1% v/v				

APPENDIX D – GROUNDWATER MONITORING RESULTS

Biannual/Annual Groundwater Monitoring Results 2016

PARAMETER	UNIT	EPA IGV	BH 3		BH 4		BH 5		RD 2		RD 3	
			June	Nov	June	Nov	June	Nov	June	Nov	June	Nov
pH		≥6.5-≤9.5	6.89	6.78	6.68	6.72	6.93	6.83	7.25	7.37	7.53	7.34
Temperature	°C	25	12.7	10.7	13.7	9.6	13.3	10.3	13.5	9.8	14.4	10
Conductivity	µS/cm	1000	12940	13590	13910	13780	8780	9670	1170	3480	2900	2670
Nitrite	mg/l	-	<0.02	0.016	<0.02	0.016	<0.02	0.016	<0.02	0.016	0.02	0.016
Nitrate	mg/l	-	0.12	0.113	0.12	0.113	1.27	0.113	0.12	0.12	0.12	<0.113
Total Ammonia	NH3-N	0.2	28	28	17	26	20	20	12.4	14	2.7	1.9
Chloride	Cl mg/l	30	5136	5455	5704	5450	3528	3701	1170	907	611	516
Water Level	m	-	1.16	1.07	0.27	0.20	0.88	0.88	0.87	0.90	1.02	0.62
DO	% O_2 sat	NAC		27.4		15.9		22.6		73.4		62.7
Arsenic	As mg/l	0.01		0.022		0.018		0.018		0.016		0.0023
Boron	B mg/l	1		1.12		1.32		0.734		0.708		0.23
Cadmium	Cd mg/l	0.005		<0.0006		0.0006		0.0006		<0.0006		<0.0006
Calcium	Ca mg/l	200		266		252		286		55.7		40.2
Chromium	Cr mg/l	0.03		0.0048		0.0095		0.017		<0.002		<0.002
Copper	Cu mg/l	0.03		0.009		0.0184		0.024		0.009		<0.009
Cyanide	Cn mg/l	0.01		0.1		0.07		<.09		<0.05		<0.05
Fluoride	F mg/l	1		0.05		0.54		0.05		0.46		0.34
Iron	Fe mg/l	0.2		8.7		20.1		17.6		5.1		0.776
Lead	Pb mg/l	0.01		0.006		0.017		0.03		<0.006		<0.006
Magnesium	Mg mg/l	50		316		307		156		53.4		25.3
Mercury	Hg mg/l	0.001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001
Nickel	Ni mg/l	0.02		0.01		0.0156		0.031		0.0041		0.003
Potassium	K mg/l	5		126		131		75.3		45.7		12.1
Sodium	Na mg/l	150		2360		2330		1190		618		599
Sulphate	SO_4 mg/l	200		10		10		10		10		50
Tin	Sn mg/l	-		<0.007		0.007		0.011		<0.007		0.0132
Total Phosphorus	P mg/l	0.03		0.83		1.7		1.9		0.51		0.14
Orthophosphate	P mg/l	0.03		<0.01		<0.01		<0.01		<0.01		<0.01
Total Organic Carbon	C mg/l	NAC	9.8	69	9.8	83	3.3	30	20	134	7.8	16
Total Oxidised Nitrogen	N mg/l	NAC	0.14	0.129	0.14	0.129	1.27	0.129	0.14	0.129	0.14	0.129
Total Phenols	mg/l	0.0005	0.017	0.002	0.018	0.018	0.035	0.006	<0.001	0.017	0.012	<0.002
Zinc	Zn mg/l	0.1		0.0183		0.039		0.068		0.018		0.018
Solids Total	mg/l	-		4712		5667		7765		5632		3328

IGV = Interim Guideline Value – from the EPA document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland
Results are Shaded where they Exceed the EPA IGV
NAC = No Abnormal change
n/a = not analysed
n/r = not recorded
Analysis conducted by BHP Laboratories, New Road, Thomondgate, Limerick on 13th June and 17th November 2016.

APPENDIX E – LEACHATE MONITORING RESULTS

Biannual / Annual Leachate Monitoring Results 2016

Parameter	Unit	EPA IGV	SS3	
			June	November
Ammonia	mg/l	0.15	8.4	27
Arsenic	mg/l	0.01		0.0043
BOD Total 5 Day with ATU	mg/l	-	31	28
Boron	mg/l	1		<0.23
Cadmium	mg/l	0.005		0.0006
Calcium	mg/l	200		303
Chloride	mg/l	30	158	84
Chromium	mg/l	0.03		0.0054
COD Total	mg/l	-	77	209
Conductivity	uS/cm	1000	1376	1699
Copper	mg/l	0.03		<0.0253
Cyanide (Total)	mg/l	0.01		<0.05
Dissolved Oxygen	%	NAC		
Fluoride	mgF/l			0.08
Groundwater Level	m	-		
Iron	mg/l	0.2		0.655
Lead	mg/l	0.01		<0.006
Magnesium	mg/l	50		25.8
Mercury	mg/l	0.001		<0.0001
Mn (Dissolved				
Nickel	mg/l	0.02		0.041
Nitrate	mg/l		0.47	
Nitrite	mg/l		1.9	
pH Value	Units	6.5 - 9.5	7.82	6.84
Phenol	ug/l			
Potassium	mg/l	5		8.82
Sodium	mg/l	150		28.4
Solids Suspended		-		
Solids Total	mg/l			
Sulphate	mg/l	200		480
Surfactant Anionic	ug/l			
Temperature	°C	25	14.4	12.5
Tin	mg/l			0.0112
Total Organic Carbon	mg/l	NAC		
Total Oxidised Nitrogen (TON)	mg/l	NAC	0.33	24.4
Total Phosphorus	mg/l	0.01		0.36
Zinc	mg/l	0.1		0.113

IGV = Interim Guideline Value - from the EPA Document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"
Results are shaded where they exceeded the EPA IGV
NAC = No abnormal Change
n/a = not analysed
n/r = not recorded
Analysis conducted by BHP Laboratories, New Road, Thomondgate, Limerick on 13th June and 17th November 2016.

APPENDIX F – SURFACE WATER MONITORING RESULTS

Biannual/Annual Surface Water Monitoring Results 2016

Parameter	Unit	EPA IGV	SS1		SS2		SS4		SS6		SS7	
			June	Nov	June	Nov	June	Nov	June	Nov	June	Nov
Ammonia	mg/l	0.02	1.1	0.28	0.13	<0.1	0.23	1.5	n/a	n/a	n/a	n/a
Arsenic	mg/l	20		<0.001		<0.001		0.001		n/a		n/a
BOD Total 5 Day with ATU	mg/l	≤4	6.1	2	3.5	2.6	3	5.7	n/a	n/a	n/a	n/a
Boron	mg/l	1		<0.23		<0.23		<0.273		n/a		n/a
Cadmium	mg/l	5		<0.0006		<0.0006		<0.0006		n/a		n/a
Calcium	mg/l	200		134		31.3		145		n/a		n/a
Chloride	mg/l	30										
Chromium	mg/l	30		<0.002		<0.002		0.0034		n/a		n/a
COD Total	mg/l	-	30	21	31	15	12	40	n/a	n/a	n/a	n/a
Conductivity	uS/cm	1000		798		199		2640		n/a		n/a
Copper	mg/l	30		0.009		0.009		0.009		n/a		n/a
Cyanide (Total)	mg/l	0.01		<0.02		<0.01		<0.02		n/a		n/a
Dissolved Oxygen	%	NAC	109	75	114	78	142	44	n/a	n/a	n/a	n/a
Fluoride	mgF/l	5.0		0.12		0.05		0.22		n/a		n/a
Groundwater Level	m	-										
Iron	ug/l	200		0.405		0.23		0.582		n/a		n/a
Lead	ug/l	10		<0.006		<0.006		<0.006		n/a		n/a
Magnesium	mg/l	50		12.9		3.56		56.1		n/a		n/a
Mercury	ug/l	1		<0.0001		<0.0001		<0.0001		n/a		n/a
Mn (Dissolved	Ug/l											
Nickel	ug/l	50		0.003		0.003		0.0097		n/a		n/a
Nitrate	mg/l	-		0.69		0.44		0.56		n/a		n/a
Nitrite	mg/l	-		0.02		0.02		0.02		n/a		n/a
pH Value	Units	6.5 - 9.5	8.05	7.46	7.98	7.30	7.73	7.33	n/a	n/a	n/a	n/a
Phenol	mg/l											
Potassium	mg/l	5		9.25		0.603		29.5		n/a		n/a
Sodium	mg/l	150		32.8		5.87		362		n/a		n/a
Solids Suspended		50	<10	9.1	17	<10	<10	7.9	n/a	n/a	n/a	n/a
Solids Total	mg/l											
Sulphate	mg/l	200		84		13		63		n/a		n/a
Surfactant Anionic	mg/l											
Temperature	OC	25	18.3	8.1	16.5	9.0	14.4	13.6	n/a	n/a	n/a	n/a
Tin	mg/l	-		<0.0094		<0.008		<0.007		n/a		n/a
Total Organic Carbon	mg/l	NAC										
Total Oxidised Nitrogen (TON)	mg/l	NAC		2.1		0.28		0.62		n/a		n/a
Total Phosphorus	mg/l	-		0.12		0.075		0.20		n/a		n/a
Zinc	mg/l	100		0.018		0.018		0.018		n/a		n/a

IGV = Interim Guideline Value - from the EPA Document "Towards Setting Guideline Values for the Protection of Groundwater in Ireland"

Results are shaded where they exceeded the EPA IGV

NAC = No abnormal Change

n/a = not analysed Borehole was Dry

n/r = not recorded

Analysis conducted by BHP Laboratories, New Road, Thomondgate, Limerick on 13^{3h} June and on 17th November 2016.

APPENDIX G – COPIES OF LABORATORY REPORTS

Groundwater Monitoring Test Reports

BHP/CL/02C

TEST REPORT 122111.3

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: **Ailish Johnson**

BHP Ref. No.: 16/06/368
Order No.:
Date Received: 13/06/16
Date Completed: 16/06/16
Test Specification: Nil
Item: Biannual GW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring BH3				
Water Level		m	1.16	13/06/2016	ISO 5667 - 11
pH		-	6.89	13/06/2016	BHP AC 067
Temperature		°C	12.7	13/06/2016	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	28	14/06/2016	BHP AC 095
Conductivity		µS/cm (25 °C)	12940	13/06/2016	BHP AC 067
Total Organic Carbon		mg/L	9.8	14/06/2016	BHP AC 016
Phenols		mg/L	0.017	16/06/2016	BHP AC 044
Salinity		ppt	10.0	13/06/2016	Calculation
Nitrite (as N)		mg/L	<0.02	14/06/2016	BHP AC 019
Nitrate (as N)		mg/L	<0.12	14/06/2016	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	<0.14	14/06/2016	BHP AC 065
Chloride		mg/L	5136	15/06/2016	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date: 24/06/16

BHP/CL/02C

TEST REPORT 122111.4

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: **Ailish Johnson**

BHP Ref. No.: 16/06/369
Order No.:
Date Received: 13/06/16
Date Completed: 16/06/16
Test Specification: Nil
Item: Biannual GW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring BH4				
Water Level		m	0.27	13/06/2016	ISO 5667 - 11
pH		-	6.68	13/06/2016	BHP AC 067
Temperature		°C	13.7	13/06/2016	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	17	14/06/2016	BHP AC 095
Conductivity		µS/cm (25 °C)	13910	13/06/2016	BHP AC 067
Total Organic Carbon		mg/L	9.8	14/06/2016	BHP AC 016
Phenols		mg/L	0.018	16/06/2016	BHP AC 044
Salinity		ppt	10.5	13/06/2016	Calculation
Nitrite (as N)		mg/L	<0.02	20/06/2016	BHP AC 095
Nitrate (as N)		mg/L	<0.12	20/06/2016	BHP AC 095
Total Oxidised Nitrogen (as N)		mg/L	<0.14	20/06/2016	BHP AC 065
Chloride		mg/L	5704	15/06/2016	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date: 24/06/16

BHP/CL/02C

TEST REPORT 122111.5

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: **Ailish Johnson**

BHP Ref. No.: 16/06/370
Order No.:
Date Received: 13/06/16
Date Completed: 16/06/16
Test Specification: Nil
Item: Biannual GW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring BH5				
Water Level		m	0.88	13/06/2016	ISO 5667 - 11
pH		-	6.93	13/06/2016	BHP AC 067
Temperature		°C	13.3	13/06/2016	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	20	14/06/2016	BHP AC 095
Conductivity		µS/cm (25 °C)	8780	13/06/2016	BHP AC 067
Total Organic Carbon		mg/L	3.3	14/06/2016	BHP AC 016
Phenols		mg/L	0.035	16/06/2016	BHP AC 044
Salinity		ppt	6.5	13/06/2016	Calculation
Nitrite (as N)		mg/L	<0.02	20/06/2016	BHP AC 095
Nitrate (as N)		mg/L	1.27	20/06/2016	BHP AC 095
Total Oxidised Nitrogen (as N)		mg/L	1.27	20/06/2016	BHP AC 065
Chloride		mg/L	3528	15/06/2016	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date: 24/06/16

BHP/CL/02C

TEST REPORT 122111.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: **Ailish Johnson**

BHP Ref. No.: 16/06/366
Order No.:
Date Received: 13/06/16
Date Completed: 16/06/16
Test Specification: Nil
Item: Biannual GW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring RD2				
Water Level		m	0.87	13/06/2016	ISO 5667 - 11
pH		-	7.25	13/06/2016	BHP AC 067
Temperature		°C	13.5	13/06/2016	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	12.4	14/06/2016	BHP AC 095
Conductivity		µS/cm (25 °C)	4190	13/06/2016	BHP AC 067
Total Organic Carbon		mg/L	20	14/06/2016	BHP AC 016
Phenols		mg/L	0.001	16/06/2016	BHP AC 044
Salinity		ppt	2.9	13/06/2016	Calculation
Nitrite (as N)		mg/L	<0.02	14/06/2016	BHP AC 019
Nitrate (as N)		mg/L	<0.12	14/06/2016	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	<0.14	14/06/2016	BHP AC 065
Chloride		mg/L	1170	15/06/2016	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date: 24/06/16

BHP/CL/02C

TEST REPORT 122111.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: **Ailish Johnson**

BHP Ref. No.: 16/06/367
Order No.:
Date Received: 13/06/16
Date Completed: 16/06/16
Test Specification: Nil
Item: Biannual GW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring RD3				
Water Level		m	1.02	13/06/2016	ISO 5667 - 11
pH		-	7.53	13/06/2016	BHP AC 067
Temperature		°C	14.4	13/06/2016	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	2.7	14/06/2016	BHP AC 095
Conductivity		µS/cm (25 °C)	2900	13/06/2016	BHP AC 067
Total Organic Carbon		mg/L	7.8	14/06/2016	BHP AC 016
Phenols		mg/L	0.012	16/06/2016	BHP AC 044
Salinity		ppt	<2	13/06/2016	Calculation
Nitrite (as N)		mg/L	<0.02	14/06/2016	BHP AC 019
Nitrate (as N)		mg/L	<0.12	14/06/2016	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	<0.14	14/06/2016	BHP AC 065
Chloride		mg/L	611	15/06/2016	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date: 24/06/16

BHP/AC/F115

TEST REPORT NO: 131964 .3

Client: Response Engineering

Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1379
Quote Ref:	QC000656
Order No:	To Follow
Sales Order:	18791
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	24/11/2016
Sample Type:	Bore

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Bi-annually_ Bore
Client Ref: BH3

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@b

Test		Units	Results	Customer Limits	Date Analysed	Meth
Total Ammonia (as N)	Acc.	mg/L	28		17/11/2016	BHP A
Chloride (as Cl^-)		mg/L	5455		18/11/2016	BHP A
Salinity - Field		ppt	11.1		17/11/2016	Calcul
Conductivity (25 °C) - Field		µS/cm	13590		17/11/2016	BHP A
pH - Field		pH Units	6.78		17/11/2016	BHP A
Temperature - Field		°C	10.7		17/11/2016	BHP A
Nitrite (as NO_2-N)		mg/L	<0.016		18/11/2016	BHP A
Nitrate (as NO_3-N)	Acc.	mg/L	<0.113		18/11/2016	BHP A
Total Oxidised Nitrogen (as N)		mg/L	<0.129		18/11/2016	BHP A
Total Organic Carbon		mg/L	69		24/11/2016	BHP A
Total Phenols		mg/L	<0.002		24/11/2016	BHP A
Water Level		meters	1.07		17/11/2016	On-Site

Authorised by: John O'Halloran, Technical Manager — **Date Authorised:** 01/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition: Acceptable

BHP/AC/F115

TEST REPORT NO: 131964 .4

Client: Response Engineering
Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1380
Quote Ref:	QC000656
Order No:	To Follow
Sales Order:	18791
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	24/11/2016
Sample Type:	Bore

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@b

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Bi-annually_ Bore
Client Ref: BH4

Test		Units	Results	Customer Limits	Date Analysed	Meth
Total Ammonia (as N)	Acc.	mg/L	26		17/11/2016	BHP A
Chloride (as Cl^-)		mg/L	5450		18/11/2016	BHP A
Salinity - Field		ppt	11.6		17/11/2016	Calcul
Conductivity (25 °C) - Field		µS/cm	13780		17/11/2016	BHP A
pH - Field		pH Units	6.72		17/11/2016	BHP A
Temperature - Field		°C	9.6		17/11/2016	BHP A
Nitrite (as NO_2-N)		mg/L	<0.016		18/11/2016	BHP A
Nitrate (as NO_3-N)	Acc.	mg/L	<0.113		18/11/2016	BHP A
Total Oxidised Nitrogen (as N)		mg/L	<0.129		18/11/2016	BHP A
Total Organic Carbon		mg/L	83		24/11/2016	BHP A
Total Phenols		mg/L	0.018		24/11/2016	BHP A
Water Level		meters	0.20		17/11/2016	On-Site

Authorised by: John O'Halloran — Technical Manager — **Date Authorised:** 01/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition: Acceptable

BHP/AC/F115

TEST REPORT NO: 131964 .5

Client: Response Engineering
Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1381
Quote Ref:	QC000656
Order No:	To Follow
Sales Order:	18791
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	24/11/2016
Sample Type:	Bore

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Bi-annually_ Bore
Client Ref: BH5

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@bl

Test		Units	Results	Customer Limits	Date Analysed	Meth
Total Ammonia (as N)	Acc.	mg/L	20		17/11/2016	BHP AC
Chloride (as Cl^-)		mg/L	3701		18/11/2016	BHP AC
Salinity - Field		ppt	7.8		17/11/2016	Calcula
Conductivity (25 °C) - Field		µS/cm	9670		17/11/2016	BHP AC
pH - Field		pH Units	6.83		17/11/2016	BHP AC
Temperature - Field		°C	10.3		17/11/2016	BHP AC
Nitrite (as NO_2-N)		mg/L	<0.016		18/11/2016	BHP AC
Nitrate (as NO_3-N)	Acc.	mg/L	<0.113		18/11/2016	BHP AC
Total Oxidised Nitrogen (as N)		mg/L	<0.129		18/11/2016	BHP AC
Total Organic Carbon		mg/L	30		24/11/2016	BHP AC
Total Phenols		mg/L	0.006		24/11/2016	BHP AC
Water Level		meters	0.88		17/11/2016	On-Site M

Authorised by: John O'Halloran
Technical Manager

Date Authorised: 01/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition: Acceptable

BHP/AC/F115

TEST REPORT NO: 131964 .1

Client: Response Engineering
Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1377
Quote Ref:	QC000656
Order No:	To Follow
Sales Order:	18791
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	24/11/2016
Sample Type:	Bore

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@b

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Bi-annually_ Bore
Client Ref: RD2

Test		Units	Results	Customer Limits	Date Analysed	Meth
Total Ammonia (as N)	Acc.	mg/L	14		17/11/2016	BHP A
Chloride (as Cl^-)		mg/L	907		17/11/2016	BHP A
Salinity - Field		ppt	2.6		17/11/2016	Calcul
Conductivity (25 °C) - Field		µS/cm	3480		17/11/2016	BHP A
pH - Field		pH Units	7.37		17/11/2016	BHP A
Temperature - Field		°C	9.8		17/11/2016	BHP A
Nitrite (as NO_2-N)		mg/L	<0.016		18/11/2016	BHP A
Nitrate (as NO_3-N)	Acc.	mg/L	<0.113		18/11/2016	BHP A
Total Oxidised Nitrogen (as N)		mg/L	<0.129		18/11/2016	BHP A
Total Organic Carbon		mg/L	134		24/11/2016	BHP A
Total Phenols		mg/L	0.017		24/11/2016	BHP A
Water Level		meters	0.90		17/11/2016	On-Site

Authorised by: John O'Halloran — Technical Manager — **Date Authorised:** 01/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition: Acceptable

BHP/AC/F115

TEST REPORT NO: 131964 .2

Client: Response Engineering
Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1378
Quote Ref:	QC000656
Order No:	To Follow
Sales Order:	18791
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	24/11/2016
Sample Type:	Bore

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@b

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Bi-annually_ Bore
Client Ref: RD3

Test		Units	Results	Customer Limits	Date Analysed	Meth
Total Ammonia (as N)	Acc.	mg/L	1.9		17/11/2016	BHP A
Chloride (as Cl^-)		mg/L	516		17/11/2016	BHP A
Salinity - Field		ppt	<2		17/11/2016	Calcul
Conductivity (25 °C) - Field		µS/cm	2670		17/11/2016	BHP A
pH - Field		pH Units	7.34		17/11/2016	BHP A
Temperature - Field		°C	10.0		17/11/2016	BHP A
Nitrite (as NO_2-N)		mg/L	<0.016		18/11/2016	BHP A
Nitrate (as NO_3-N)	Acc.	mg/L	<0.113		18/11/2016	BHP A
Total Oxidised Nitrogen (as N)		mg/L	<0.129		18/11/2016	BHP A
Total Organic Carbon		mg/L	16		24/11/2016	BHP A
Total Phenols		mg/L	<0.002		24/11/2016	BHP A
Water Level		meters	0.62		17/11/2016	On-Site

Authorised by: John O'Halloran — Technical Manager — **Date Authorised:** 01/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition: **Acceptable**

BHP/CL/02C

TEST REPORT NO: 131964.3

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 16/11/1384
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH3				
Dissolved Oxygen		% O_2 sat	27.4	17/11/2016	BHP AC 039
Detergents (as MBAS)		mg/L	0.097	21/11/2016	BHP AC 071
Arsenic		mg/L	0.022	29/11/2016	WAS060*
Boron		mg/L	1.12	27/11/2016	WAS049*
Cadmium		mg/L	<0.0006	27/11/2016	WAS049*
Calcium		mg/L	266	27/11/2016	WAS049*
Chromium		mg/L	0.0048	27/11/2016	WAS049*
Copper		mg/L	<0.009	27/11/2016	WAS049*
Cyanide		mg/L	0.11	22/11/2016	BHP AC 095
Fluoride		mg/L	<0.05	18/11/2016	BHP AC 019
Iron		mg/L	8.7	27/11/2016	WAS049*
Lead		mg/L	<0.006	27/11/2016	WAS049*
Magnesium		mg/L	316	27/11/2016	WAS049*
Mercury		mg/L	0.00012	03/12/2016	WAS013*
Nickel		mg/L	0.010	27/11/2016	WAS049*
Potassium		mg/L	126	27/11/2016	WAS049*
Sodium		mg/L	2360	27/11/2016	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.3

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1384
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH3				
Tin		mg/L	0.0072	27/11/2016	WAS049*
Zinc		mg/L	0.0183	27/11/2016	WAS049*
Sulphate (as SO_4)		mg/L	<10	17/11/2016	BHP AC 095
Total Phosphorus (as P)		mg/L	0.83	21/11/2016	BHP AC 010
Residue on Evaporation		mg/L	12160	22/11/2016	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloroethane		mg/L	<0.001	07/12/2016	GEO32*
Bromomethane		mg/L	<0.001	07/12/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
Dichloromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	07/12/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
2,2-Dichloropropane		mg/L	N/A**	08/12/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier
**Unable to analyse due to QC failure

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.4

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1385
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH4				
Dissolved Oxygen		% O_2 sat	15.9	17/11/2016	BHP AC 039
Detergents (as MBAS)		mg/L	0.056	21/11/2016	BHP AC 071
Arsenic		mg/L	0.018	29/11/2016	WAS060*
Boron		mg/L	1.32	27/11/2016	WAS049*
Cadmium		mg/L	<0.0006	27/11/2016	WAS049*
Calcium		mg/L	252	27/11/2016	WAS049*
Chromium		mg/L	0.0095	27/11/2016	WAS049*
Copper		mg/L	0.0184	27/11/2016	WAS049*
Cyanide		mg/L	0.07	22/11/2016	BHP AC 095
Fluoride		mg/L	0.54	23/11/2016	BHP AC 019
Iron		mg/L	20.1	27/11/2016	WAS049*
Lead		mg/L	0.0179	27/11/2016	WAS049*
Magnesium		mg/L	307	27/11/2016	WAS049*
Mercury		mg/L	<0.0001	03/12/2016	WAS013*
Nickel		mg/L	0.0156	27/11/2016	WAS049*
Potassium		mg/L	131	27/11/2016	WAS049*
Sodium		mg/L	2330	27/11/2016	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.4

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1385
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH4				
Tin		mg/L	<0.007	27/11/2016	WAS049*
Zinc		mg/L	0.0393	27/11/2016	WAS049*
Sulphate (as SO_4)		mg/L	<10	17/11/2016	BHP AC 095
Total Phosphorus (as P)		mg/L	1.7	21/11/2016	BHP AC 010
Residue on Evaporation		mg/L	14860	22/11/2016	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloroethane		mg/L	<0.001	07/12/2016	GEO32*
Bromomethane		mg/L	<0.001	07/12/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
Dichloromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	07/12/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
2,2-Dichloropropane		mg/L	N/A**	08/12/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier
**Unable to report due to QC failure

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.5

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1386
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH5				
Dissolved Oxygen		% O_2 sat	22.6	17/11/2016	BHP AC 039
Detergents (as MBAS)		mg/L	0.054	21/11/2016	BHP AC 071
Arsenic		mg/L	0.018	29/11/2016	WAS060*
Boron		mg/L	0.734	27/11/2016	WAS049*
Cadmium		mg/L	<0.0006	27/11/2016	WAS049*
Calcium		mg/L	286	27/11/2016	WAS049*
Chromium		mg/L	0.0173	27/11/2016	WAS049*
Copper		mg/L	0.0243	27/11/2016	WAS049*
Cyanide		mg/L	0.09	22/11/2016	BHP AC 095
Fluoride		mg/L	<0.05	18/11/2016	BHP AC 019
Iron		mg/L	17.6	27/11/2016	WAS049*
Lead		mg/L	0.0352	27/11/2016	WAS049*
Magnesium		mg/L	156	27/11/2016	WAS049*
Mercury		mg/L	<0.0001	03/12/2016	WAS013*
Nickel		mg/L	0.0321	27/11/2016	WAS049*
Potassium		mg/L	75.3	27/11/2016	WAS049*
Sodium		mg/L	1190	27/11/2016	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.5

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1386
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH5				
Tin		mg/L	0.0118	27/11/2016	WAS049*
Zinc		mg/L	0.0688	27/11/2016	WAS049*
Sulphate (as SO_4)		mg/L	10	17/11/2016	BHP AC 095
Total Phosphorus (as P)		mg/L	1.9	21/11/2016	BHP AC 010
Residue on Evaporation		mg/L	11900	22/11/2016	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloroethane		mg/L	<0.001	07/12/2016	GEO32*
Bromomethane		mg/L	<0.001	07/12/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
Dichloromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	07/12/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
2,2-Dichloropropane		mg/L	N/A**	08/12/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier
**Unable to report due to QC failure

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.1

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1382
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD2				
Dissolved Oxygen		% O_2 sat	73.4	17/11/2016	BHP AC 039
Detergents (as MBAS)		mg/L	0.298	21/11/2016	BHP AC 071
Arsenic		mg/L	0.016	29/11/2016	WAS060*
Boron		mg/L	0.708	27/11/2016	WAS049*
Cadmium		mg/L	<0.0006	27/11/2016	WAS049*
Calcium		mg/L	55.7	27/11/2016	WAS049*
Chromium		mg/L	<0.002	27/11/2016	WAS049*
Copper		mg/L	<0.009	27/11/2016	WAS049*
Cyanide		mg/L	<0.05	22/11/2016	BHP AC 095
Fluoride		mg/L	0.46	18/11/2016	BHP AC 019
Iron		mg/L	5.1	27/11/2016	WAS049*
Lead		mg/L	<0.006	27/11/2016	WAS049*
Magnesium		mg/L	53.4	27/11/2016	WAS049*
Mercury		mg/L	<0.0001	03/12/2016	WAS013*
Nickel		mg/L	0.0041	27/11/2016	WAS049*
Potassium		mg/L	45.7	27/11/2016	WAS049*
Sodium		mg/L	618	27/11/2016	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 16/11/1382
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD2				
Tin		mg/L	<0.007	27/11/2016	WAS049*
Zinc		mg/L	<0.018	27/11/2016	WAS049*
Sulphate (as SO_4)		mg/L	<10	17/11/2016	BHP AC 095
Total Phosphorus (as P)		mg/L	0.51	21/11/2016	BHP AC 095
Residue on Evaporation		mg/L	2236	22/11/2016	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloroethane		mg/L	<0.001	07/12/2016	GEO32*
Bromomethane		mg/L	<0.001	07/12/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
Dichloromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	07/12/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
2,2-Dichloropropane		mg/L	N/A**	08/12/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier
**Unable to report due to QC failure

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1383
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD3				
Dissolved Oxygen		% O_2 sat	62.7	17/11/2016	BHP AC 039
Detergents (as MBAS)		mg/L	0.346	21/11/2016	BHP AC 071
Arsenic		mg/L	0.0023	29/11/2016	WAS060*
Boron		mg/L	<0.23	27/11/2016	WAS049*
Cadmium		mg/L	<0.0006	27/11/2016	WAS049*
Calcium		mg/L	40.2	27/11/2016	WAS049*
Chromium		mg/L	<0.002	27/11/2016	WAS049*
Copper		mg/L	<0.009	27/11/2016	WAS049*
Cyanide		mg/L	<0.05	22/11/2016	BHP AC 095
Fluoride		mg/L	0.34	18/11/2016	BHP AC 019
Iron		mg/L	0.776	27/11/2016	WAS049*
Lead		mg/L	<0.006	27/11/2016	WAS049*
Magnesium		mg/L	25.3	27/11/2016	WAS049*
Mercury		mg/L	<0.0001	03/12/2016	WAS013*
Nickel		mg/L	<0.003	27/11/2016	WAS049*
Potassium		mg/L	12.1	27/11/2016	WAS049*
Sodium		mg/L	599	27/11/2016	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

BHP/CL/02C

TEST REPORT NO: 131964.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/11/1383
Order No.:
Date Received: 17/11/16
Date Completed: 08/12/16
Test Specification: Nil
Item: Groundwater

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD3				
Tin		mg/L	0.0132	27/11/2016	WAS049*
Zinc		mg/L	<0.018	27/11/2016	WAS049*
Sulphate (as SO_4)		mg/L	50.0	17/11/2016	BHP AC 095
Total Phosphorus (as P)		mg/L	0.14	21/11/2016	BHP AC 010
Residue on Evaporation		mg/L	1820	22/11/2016	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloromethane		mg/L	<0.001	07/12/2016	GEO32*
Chloroethane		mg/L	<0.001	07/12/2016	GEO32*
Bromomethane		mg/L	<0.001	07/12/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
Dichloromethane		mg/L	<0.001	07/12/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	07/12/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	07/12/2016	GEO32*
2,2-Dichloropropane		mg/L	N/A**	08/12/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier
**Unable to report due to QC failure

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/16

Leachate Monitoring Test Reports

BHP/CL/02C

TEST REPORT NO.: 122114

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 16/06/380
Order No.:
Date Received: 13/06/16
Date Completed: 21/06/16
Test Specification: Nil
Item: Biannual Leachate

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS3-2016				
pH		-	6.82	13/06/2016	BHP AC 067
Temperature		°C	14.4	13/06/2016	BHP AC 067
Total Ammonia (as N)		mg/L	8.4	14/06/2016	BHP AC 095
Conductivity		µS/cm (25 °C)	1376	13/06/2016	BHP AC 067
B.O.D		mg/L	31	15/06/2016	BHP AC 005
C.O.D		mg/L	77	14/06/2016	BHP AC 006
Total Oxidised Nitrogen (as N)		mg/L	0.33	14/06/2016	BHP AC 065
Chloride		mg/L	158	21/06/2016	BHP AC 095

Additional information :

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 08/07/16

BHP/AC/F115

TEST REPORT NO: 131964

Client: Response Engineering
Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1375
Quote Ref:	QC000656
Order No:	To Follow
Sales Order:	18789
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	30/11/2016
Sample Type:	Leachate

Testing
Analysing
Consulting
BHP
BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@bhp

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Bi-annually_ Leachate
Client Ref: SS3

Test	Units	Results	Customer Limits	Date Analysed	Metho
Total Ammonia (as N)	mg/L	27		17/11/2016	BHP AC 0
B.O.D.	mg/L	28		23/11/2016	BHP AC 0
C.O.D.	mg/L	209		30/11/2016	BHP AC 0
pH - Field	pH Units	6.84		17/11/2016	BHP AC 0
Temperature - Field	°C	12.5		17/11/2016	BHP AC 0
Chloride (as Cl^-)	mg/L	84		17/11/2016	BHP AC 0
Conductivity (25 °C) - Field	µS/cm	1699		17/11/2016	BHP AC 0
Total Oxidised Nitrogen (as N) **	mg/L	24.4		23/11/2016	BHP AC 0

Authorised by: John O'Halloran, Technical Manager — Date Authorised: 01/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition: Acceptable

01/12/2016

BHP/AC/F115

TEST REPORT NO: 131964

Client: Response Engineering

Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1376
Quote Ref:	QC000751
Order No:	To Follow
Sales Order:	18790
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	03/12/2016
Sample Type:	Leachate

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@bhp

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Annually_ Leachate
Client Ref: SS3

Test		Units	Results	Customer Limits	Date Analysed	Metho
Detergents (as MBAS)		mg/L	0.517		21/11/2016	BHP AC
Arsenic (Total as As)	*	mg/L	0.0043		29/11/2016	WAS06
Boron (Total as B)	*	mg/L	<0.23		27/11/2016	WAS04
Cadmium (Total as Cd)	*	mg/L	<0.0006		27/11/2016	WAS04
Calcium (Total as Ca)	*	mg/L	303		27/11/2016	WAS04
Chromium (Total as Cr)	*	mg/L	0.0054		27/11/2016	WAS04
Copper (Total as Cu)	*	mg/L	0.0253		27/11/2016	WAS04
Iron (Total as Fe)	*	mg/L	0.655		27/11/2016	WAS04
Lead (Total as Pb)	*	mg/L	<0.006		27/11/2016	WAS04
Magnesium (Total as Mg)	*	mg/L	25.8		27/11/2016	WAS04
Mercury (Total as Hg)	*	mg/L	<0.0001		03/12/2016	WAS01
Nickel (Total as Ni)	*	mg/L	0.0412		27/11/2016	WAS04
Potassium (Total as K)	*	mg/L	8.82		27/11/2016	WAS04
Sodium (Total as Na)	*	mg/L	28.4		27/11/2016	WAS04
Tin (Total as Sn)	*	mg/L	0.0112		27/11/2016	WAS04
Zinc (Total as Zn)	*	mg/L	0.113		27/11/2016	WAS04
Cyanide		mg/L	0.05		22/11/2016	BHP AC
Sulphate (as SO_4^{2-})		mg/L	480		17/11/2016	BHP AC
Total Phosphorus (as P)		mg/L	0.36		21/11/2016	BHP AC

Authorised by: John O'Halloran — Technical Manager — **Date Authorised:** 06/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition Acceptable

06/12/2016

BHP/AC/F115

TEST REPORT NO: 131964

Client: Response Engineering

Railway Road
Charleville
Co. Cork

BHP Ref. No:	16/11/1376
Quote Ref:	QC000751
Order No:	To Follow
Sales Order:	18790
Date Received:	17/11/2016
Date Sampled:	17/11/2016
Date Completed:	03/12/2016
Sample Type:	Leachate

Testing
Analysing
Consulting

BHP Laboratories
New Road
Thomondgate
Limerick
Tel: +353 61 455399
Fax: +353 61 455447
EMail: johnohalloran@bhp

FTAO: Ailish Johnston
Site: Traderee
BHP Ref: Annually_ Leachate
Client Ref: SS3

Test	Units	Results	Customer Limits	Date Analysed	Metho
OrthoPhosphate (as P)	mg/L	0.11		18/11/2016	BHP AC 0
Fluoride (as F^-)	mg/L	0.08		18/11/2016	BHP AC 0

Authorised by: John O'Halloran — Technical Manager — Date Authorised: 06/12/2016

Additional Information:(Opinions, where stated, are not covered by accreditation)

Acc.:	INAB Accredited
ND:	None detected in volume analysed
^	Potable water matrix
*	Subcontracted to an approved accredited laboratory
**	This sample has been analysed outside recommended stability times. It is therefore possible that the results provided may be compromised.
~	Result is expressed as 'Present' since all plates contained less than 10 colonies and total number of colonies was less than 4.
~~	Result is expressed as 'Estimated' since all plates contained less than 10 colonies but total number of colonies was 4 or more.

Sample Condition Acceptable

06/12/2016

Surface Water Monitoring Test Reports

BHP/CL/02C

TEST REPORT 117921.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 15/06/594
Order No.:
Date Received: 18/06/15
Date Completed: 22/06/15
Test Specification: Nil
Item: Biannual SW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Date Analysed	Standard Reference*
	Biannual Landfill Monitoring SS1				
pH		-	7.67	18/06/2015	APHA - 4500 - H^+
Temperature		°C	14.7	18/06/2015	APHA - 2550 - B
Total Ammonia (as NH_3-N)		mg/L	0.16	19/06/2015	APHA - 4500 - NH_3 - G
B.O.D		mg/L	2.2	19/06/2015	APHA - 5210 - B
C.O.D		mg/L	23	19/06/2015	APHA - 5220 - D
Total Suspended Solids		mg/L	<6.25	22/06/2015	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	42	18/06/2015	APHA - 4500 - O - G

Additional information : *Documented in-house methods based on stated standard references

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 06/07/15

BHP/CL/02C

TEST REPORT 119590.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/290
Order No.:
Date Received: 10/11/15
Date Completed: 18/11/15
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS1				
pH		-	7.56	10/11/2015	BHP AC 067
Temperature		°C	13.6	10/11/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	<0.1	11/11/2015	BHP AC 095
B.O.D		mg/L	2.0	11/11/2015	BHP AC 005
C.O.D		mg/L	33	11/11/2015	BHP AC 006
Total Suspended Solids		mg/L	<25	18/11/2015	BHP AC 012
Dissolved Oxygen		% O_2 sat	38	10/11/2015	BHP AC 067

Additional information :

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/15

BHP/CL/02C

TEST REPORT NO: 119591.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/296
Order No.:
Date Received: 10/11/15
Date Completed: 12/01/16
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS1				
Conductivity		µS/cm (25 °C)	840	10/11/2015	BHP AC 009
Arsenic		mg/L	<0.001	18/11/2015	WAS060*
Boron		mg/L	<0.23	19/11/2015	WAS049*
Cadmium		mg/L	<0.0006	19/11/2015	WAS049*
Calcium		mg/L	138	12/01/2016	WAS049*
Chromium		mg/L	<0.002	19/11/2015	WAS049*
Copper		mg/L	<0.009	19/11/2015	WAS049*
Cyanide		mg/L	<0.05	21/12/2015	BHP AC 095
Fluoride		mg/L	0.13	12/11/2015	BHP AC 019
Iron		mg/L	0.727	19/11/2015	WAS049*
Lead		mg/L	<0.006	19/11/2015	WAS049*
Magnesium		mg/L	11.5	19/11/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT NO: 119591.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/296
Order No.:
Date Received: 10/11/15
Date Completed: 12/01/16
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS1				
Mercury		mg/L	<0.0001	13/11/2015	WAS013*
Nickel		mg/L	0.004	19/11/2015	WAS049*
Potassium		mg/L	7.01	19/11/2015	WAS049*
Sodium		mg/L	27.4	19/11/2015	WAS049*
Tin		mg/L	<0.007	19/11/2015	WAS049*
Zinc		mg/L	<0.018	19/11/2015	WAS049*
Sulphate (as SO_4)		mg/L	64	17/11/2015	BHP AC 019
Total Phosphorus (as P)		mg/L	0.11	23/11/2015	WAS 010
Nitrate (as N)		mg/L	1.9	12/11/2015	BHP AC 019
Nitrite (as N)		mg/L	<0.02	12/11/2015	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	1.9	12/11/2015	BHP AC 065

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT 117871.1

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 15/06/485
Order No.:
Date Received: 16/06/15
Date Completed: 17/06/15
Test Specification: Nil
Item: Biannual SW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Date Analysed	Standard Reference*
	Biannual Landfill Monitoring SS2				
pH		-	7.87	16/06/2015	APHA - 4500 - H^+
Temperature		°C	13.7	16/06/2015	APHA - 2550 - B
Total Ammonia (as NH_3-N)		mg/L	0.05	17/06/2015	APHA - 4500 - NH_3 - G
B.O.D.		mg/L	2.1	17/06/2015	APHA - 5210 - B
C.O.D.		mg/L	29	17/06/2015	APHA - 5220 - D
Total Suspended Solids		mg/L	7.6	17/06/2015	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	58	16/06/2015	APHA - 4500 - O - G

Additional information : *Documented in-house methods based on stated standard references

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 25/06/15

BHP/CL/02C

TEST REPORT 119590.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/291
Order No.:
Date Received: 10/11/15
Date Completed: 18/11/15
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS2				
pH		-	7.62	10/11/2015	BHP AC 067
Temperature		°C	13.3	10/11/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	<0.1	11/11/2015	BHP AC 095
B.O.D		mg/L	<2	11/11/2015	BHP AC 005
C.O.D		mg/L	12	11/11/2015	BHP AC 006
Total Suspended Solids		mg/L	<25	18/11/2015	BHP AC 012
Dissolved Oxygen		% O_2 sat	41	10/11/2015	BHP AC 067

Additional information :

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/15

BHP/CL/02C

TEST REPORT NO: 119591.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/297
Order No.:
Date Received: 10/11/15
Date Completed: 12/01/16
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS2				
Conductivity		µS/cm (25 °C)	376	10/11/2015	BHP AC 009
Arsenic		mg/L	<0.001	18/11/2015	WAS060*
Boron		mg/L	<0.23	19/11/2015	WAS049*
Cadmium		mg/L	<0.0006	19/11/2015	WAS049*
Calcium		mg/L	54.6	12/01/2016	WAS049*
Chromium		mg/L	<0.002	19/11/2015	WAS049*
Copper		mg/L	<0.009	19/11/2015	WAS049*
Cyanide		mg/L	<0.05	21/12/2015	BHP AC 095
Fluoride		mg/L	0.08	12/11/2015	BHP AC 019
Iron		mg/L	0.277	19/11/2015	WAS049*
Lead		mg/L	<0.006	19/11/2015	WAS049*
Magnesium		mg/L	5.51	19/11/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT NO: 119591.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/297
Order No.:
Date Received: 10/11/15
Date Completed: 12/01/16
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS2				
Mercury		mg/L	<0.0001	13/11/2015	WAS013*
Nickel		mg/L	0.0183	19/11/2015	WAS049*
Potassium		mg/L	1.3	19/11/2015	WAS049*
Sodium		mg/L	12.4	19/11/2015	WAS049*
Tin		mg/L	<0.007	19/11/2015	WAS049*
Zinc		mg/L	<0.018	19/11/2015	WAS049*
Sulphate (as SO_4)		mg/L	31	17/11/2015	BHP AC 019
Total Phosphorus (as P)		mg/L	0.06	23/11/2015	WAS 010
Nitrate (as N)		mg/L	0.27	12/11/2015	BHP AC 019
Nitrite (as N)		mg/L	<0.02	12/11/2015	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	0.27	12/11/2015	BHP AC 065

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT 117871.2

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 15/06/486
Order No.:
Date Received: 16/06/15
Date Completed: 17/06/15
Test Specification: Nil
Item: Biannual SW Monitoring

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Date Analysed	Standard Reference*
	Biannual Landfill Monitoring SS4				
pH		-	7.76	16/06/2015	APHA - 4500 - H^+
Temperature		°C	15.2	16/06/2015	APHA - 2550 - B
Total Ammonia (as NH_3-N)		mg/L	0.08	17/06/2015	APHA - 4500 - NH_3 - G
B.O.D.		mg/L	3.6	17/06/2015	APHA - 5210 - B
C.O.D.		mg/L	16	17/06/2015	APHA - 5220 - D
Total Suspended Solids		mg/L	7.1	17/06/2015	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	39	16/06/2015	APHA - 4500 - O - G

Additional information : *Documented in-house methods based on stated standard references

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 25/06/15

BHP/CL/02C

TEST REPORT 119590.3

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/292
Order No.:
Date Received: 10/11/15
Date Completed: 18/11/15
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS4				
pH		-	7.54	10/11/2015	BHP AC 067
Temperature		°C	13.6	10/11/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	<0.1	11/11/2015	BHP AC 095
B.O.D		mg/L	2.0	11/11/2015	BHP AC 005
C.O.D		mg/L	24	11/11/2015	BHP AC 006
Total Suspended Solids		mg/L	<25	18/11/2015	BHP AC 012
Dissolved Oxygen		% O_2 sat	38	10/11/2015	BHP AC 067

Additional information :

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/15

BHP/CL/02C

TEST REPORT NO: 119591.3

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/298
Order No.:
Date Received: 10/11/15
Date Completed: 12/01/16
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS4				
Conductivity		µS/cm (25 °C)	569	10/11/2015	BHP AC 009
Arsenic		mg/L	<0.001	18/11/2015	WAS060*
Boron		mg/L	<0.23	19/11/2015	WAS049*
Cadmium		mg/L	<0.0006	19/11/2015	WAS049*
Calcium		mg/L	86.2	12/01/2016	WAS049*
Chromium		mg/L	<0.002	19/11/2015	WAS049*
Copper		mg/L	<0.009	19/11/2015	WAS049*
Cyanide		mg/L	<0.05	21/12/2015	BHP AC 095
Fluoride		mg/L	0.11	12/11/2015	BHP AC 019
Iron		mg/L	0.54	19/11/2015	WAS049*
Lead		mg/L	<0.006	19/11/2015	WAS049*
Magnesium		mg/L	9.49	19/11/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT NO: 119591.3

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/298
Order No.:
Date Received: 10/11/15
Date Completed: 12/01/16
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS4				
Mercury		mg/L	<0.0001	13/11/2015	WAS013*
Nickel		mg/L	0.0112	19/11/2015	WAS049*
Potassium		mg/L	4.29	19/11/2015	WAS049*
Sodium		mg/L	21.3	19/11/2015	WAS049*
Tin		mg/L	<0.007	19/11/2015	WAS049*
Zinc		mg/L	<0.018	19/11/2015	WAS049*
Sulphate (as SO_4)		mg/L	63	17/11/2015	BHP AC 019
Total Phosphorus (as P)		mg/L	0.20	23/11/2015	BHP AC 010
Nitrate (as N)		mg/L	0.62	12/11/2015	BHP AC 019
Nitrite (as N)		mg/L	<0.02	12/11/2015	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	0.62	12/11/2015	BHP AC 065

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT 117921.3

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/06/596
Order No.:
Date Received: 18/06/15
Date Completed: N/A**
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Date Analysed	Standard Reference*
	Biannual Landfill Monitoring SS6				
pH		-	N/A**	N/A**	APHA - 4500 - H^+
Temperature		°C	N/A**	N/A**	APHA - 2550 - B
Total Ammonia (as NH_3-N		mg/L	N/A**	N/A**	APHA - 4500 - NH_3 - G
B.O.D		mg/L	N/A**	N/A**	APHA - 5210 - B
C.O.D		mg/L	N/A**	N/A**	APHA - 5220 - D
Total Suspended Solids		mg/L	N/A**	N/A**	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	N/A**	N/A**	APHA - 4500 - O - G

Additional information : *Documented in-house methods based on stated standard references
**Sample location dry

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 06/07/15

BHP/CL/02C

TEST REPORT 119590.5

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/294
Order No.:
Date Received: 10/11/15
Date Completed: N/A**
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS6				
pH		-	N/A*	N/A*	BHP AC 067
Temperature		°C	N/A*	N/A*	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	N/A*	N/A*	BHP AC 095
B.O.D		mg/L	N/A*	N/A*	BHP AC 005
C.O.D		mg/L	N/A*	N/A*	BHP AC 006
Total Suspended Solids		mg/L	N/A*	N/A*	BHP AC 012
Dissolved Oxygen		% O_2 sat	N/A*	N/A*	BHP AC 067

Additional information : *Sample location dry

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/15

BHP/CL/02C

TEST REPORT NO: 119591.5

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/300
Order No.:
Date Received: 10/11/15
Date Completed: N/A**
Test Specification: Nil
Item: Surface Water

FTAO: Ailish Johnson

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS6				
Conductivity		µS/cm (25 °C)	N/A**	N/A**	BHP AC 009
Arsenic		mg/L	N/A**	N/A**	WAS060*
Boron		mg/L	N/A**	N/A**	WAS049*
Cadmium		mg/L	N/A**	N/A**	WAS049*
Calcium		mg/L	N/A**	N/A**	WAS049*
Chromium		mg/L	N/A**	N/A**	WAS049*
Copper		mg/L	N/A**	N/A**	WAS049*
Cyanide		mg/L	N/A**	N/A**	BHP AC 095
Fluoride		mg/L	N/A**	N/A**	BHP AC 019
Iron		mg/L	N/A**	N/A**	WAS049*
Lead		mg/L	N/A**	N/A**	WAS049*
Magnesium		mg/L	N/A**	N/A**	WAS049*

Additional information : *Subcontracted to an approved accredited supplier
**Sample location dry

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

BHP/CL/02C

TEST REPORT 117921.4

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/06/597
Order No.:
Date Received: 18/06/15
Date Completed: N/A**
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Date Analysed	Standard Reference*
	Biannual Landfill Monitoring SS7				
pH		-	N/A**	N/A**	APHA - 4500 - H^+
Temperature		°C	N/A**	N/A**	APHA - 2550 - B
Total Ammonia (as NH_3-N		mg/L	N/A**	N/A**	APHA - 4500 - NH_3 - G
B.O.D		mg/L	N/A**	N/A**	APHA - 5210 - B
C.O.D		mg/L	N/A**	N/A**	APHA - 5220 - D
Total Suspended Solids		mg/L	N/A**	N/A**	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	N/A**	N/A**	APHA - 4500 - O - G

Additional information : *Documented in-house methods based on stated standard references
**Sample location dry

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 06/07/15

BHP/CL/02C

TEST REPORT 119590.6

Analysing
Testing
Consulting
Calibrating

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/11/295
Order No.:
Date Received: 10/11/15
Date Completed: N/A**
Test Specification: Nil
Item: Biannual SW Monitoring

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS7				
pH		-	N/A*	N/A*	BHP AC 067
Temperature		°C	N/A*	N/A*	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	N/A*	N/A*	BHP AC 095
B.O.D		mg/L	N/A*	N/A*	BHP AC 005
C.O.D		mg/L	N/A*	N/A*	BHP AC 006
Total Suspended Solids		mg/L	N/A*	N/A*	BHP AC 012
Dissolved Oxygen		% O_2 sat	N/A*	N/A*	BHP AC 067

Additional information : *Sample location dry

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 21/12/15

BHP/CL/02C

TEST REPORT NO: 119591.6

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax + 353 61 455447

Client: **Response Engineering**
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 15/11/301
Order No.:
Date Received: 10/11/15
Date Completed: N/A**
Test Specification: Nil
Item: Surface Water

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS7				
Conductivity		µS/cm (25 °C)	N/A**	N/A**	BHP AC 009
Arsenic		mg/L	N/A**	N/A**	WAS060*
Boron		mg/L	N/A**	N/A**	WAS049*
Cadmium		mg/L	N/A**	N/A**	WAS049*
Calcium		mg/L	N/A**	N/A**	WAS049*
Chromium		mg/L	N/A**	N/A**	WAS049*
Copper		mg/L	N/A**	N/A**	WAS049*
Cyanide		mg/L	N/A**	N/A**	BHP AC 095
Fluoride		mg/L	N/A**	N/A**	BHP AC 019
Iron		mg/L	N/A**	N/A**	WAS049*
Lead		mg/L	N/A**	N/A**	WAS049*
Magnesium		mg/L	N/A**	N/A**	WAS049*

Additional information : *Subcontracted to an approved accredited supplier
**Sample location dry

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 27/01/16

Appendix H – Meteorological Data

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.01.2016	999.6	15	110	0.6	0.9
02.01.2016	993.9	10.1	300	0.5	0.6
03.01.2016	981.4	11.7	110	0.6	0.8
04.01.2016	974.2	6.5	220	0.4	0.5
05.01.2016	985.9	7	320	0.5	0.6
06.01.2016	983.7	11.5	130	0.2	0.3
07.01.2016	983.1	11	260	0.5	0.6
08.01.2016	988.6	7.3	150	0.4	0.4
09.01.2016	981.1	7	100	0.3	0.5
10.01.2016	976.9	7.1	220	0.3	0.3
11.01.2016	986.2	7.5	320	0.3	0.4
12.01.2016	1005.4	11.6	300	0.7	0.8
13.01.2016	1008.8	8.2	260	0.3	0.4
14.01.2016	1014	6.2	290	0.2	0.3
15.01.2016	1026	5	320	0.4	0.5
16.01.2016	1025.9	4.6	120	0.2	0.3
17.01.2016	1012.7	13.9	140	0.4	0.6
18.01.2016	1006.4	5.8	100	0.4	0.5
19.01.2016	1011.8	6.5	100	0.3	0.5
20.01.2016	1009	13.9	120	0.5	0.8
21.01.2016	1001.2	13.7	150	0.6	0.8
22.01.2016	1006.7	12.9	230	0.6	0.7
23.01.2016	1014.2	11	150	0.6	0.8
24.01.2016	1009.3	14.8	150	1	1.2
25.01.2016	1005.8	16	160	0.9	1.1
26.01.2016	999.6	17.8	220	0.9	1.2
27.01.2016	1001.8	14.8	220	0.7	1
28.01.2016	1012.3	17	230	0.8	1.1
29.01.2016	1007.2	19.4	240	1	1.4
30.01.2016	1006.7	12.2	250	0.9	1.1
31.01.2016	1003	19.2	240	0.7	1
Total	**31022.4**	**346.2**	**6230**	**16.7**	**22**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.02.2016	1006.9	27.2	230	1.2	1.8
02.02.2016	1014.6	14.7	250	0.9	1.2
03.02.2016	1022.8	12.2	280	0.7	0.9
04.02.2016	1020.6	12	260	0.7	0.9
05.02.2016	1006.4	11	180	0.5	0.7
06.02.2016	985.3	16.2	230	0.7	1.1
07.02.2016	978.1	18.7	230	0.9	1.3
08.02.2016	978.3	26.5	230	1.1	1.8
09.02.2016	988.9	16	270	0.9	1.3
10.02.2016	997.8	5.9	270	0.5	0.7
11.02.2016	995.7	5	110	0.4	0.6
12.02.2016	986.4	5.1	40	0.4	0.6
13.02.2016	982.8	5.8	110	0.4	0.6
14.02.2016	1003.5	9.7	20	0.7	1
15.02.2016	1026.5	4.9	160	0.6	0.9
16.02.2016	1019.8	12.9	170	0.7	1
17.02.2016	1011.4	5.6	260	0.7	1
18.02.2016	1012.3	7.4	280	0.7	1
19.02.2016	1008.8	12.3	240	0.5	0.8
20.02.2016	1005.8	17.5	240	1.3	1.7
21.02.2016	1005.9	20.2	240	0.6	1.1
22.02.2016	1011.2	6.6	280	0.8	1.2
23.02.2016	1017.3	4.6	40	0.8	1.1
24.02.2016	1018.8	3.4	300	0.7	1
25.02.2016	1012.2	6.2	120	0.6	0.9
26.02.2016	1003.3	7.3	150	0.8	1.1
27.02.2016	1011	5.9	30	0.7	1
28.02.2016	1021.3	5	160	1.1	1.5
29.02.2016	1016.3	11.9	210	0.9	1.2
Total	**29170**	**317.7**	**5590**	**21.5**	**31**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.03.2016	1005.3	17.5	280	0.7	1.2
02.03.2016	1005.3	21.8	260	1.5	2.4
03.03.2016	1003.2	10.2	290	0.7	1
04.03.2016	998.8	11.1	350	1	1.4
05.03.2016	1009.2	10	330	1.1	1.7
06.03.2016	1008	4.5	300	0.5	0.8
07.03.2016	1012.2	9.6	320	1.3	1.8
08.03.2016	1005.5	8.3	260	0.8	1.1
09.03.2016	1008.3	12.6	310	1.3	2.1
10.03.2016	1020	3.3	180	0.8	1.1
11.03.2016	1021.8	7.5	170	1.3	1.7
12.03.2016	1024.5	8.7	200	1.3	1.6
13.03.2016	1029.6	6.5	130	1.2	1.6
14.03.2016	1028.8	8	110	1.8	2.5
15.03.2016	1028.4	8	100	1.8	2.7
16.03.2016	1029.1	6.5	40	1.4	1.9
17.03.2016	1028.2	7.3	100	1.2	1.7
18.03.2016	1026.8	3.7	30	1.4	2.1
19.03.2016	1027.1	6.3	30	1.1	1.4
20.03.2016	1026.5	3.3	30	0.8	1.1
21.03.2016	1022.8	2.5	300	0.8	1.2
22.03.2016	1017.3	5	140	1.1	1.4
23.03.2016	1012.3	7.7	260	1.4	2
24.03.2016	1006.8	9.5	280	1	1.5
25.03.2016	1002.6	13.9	190	1.6	2.4
26.03.2016	987.6	14.8	250	1.1	1.7
27.03.2016	983.9	13	230	1.3	2.1
28.03.2016	988	7.1	230	1.5	2.3
29.03.2016	996	9.7	210	1.7	2.5
30.03.2016	1005.9	7	300	1.9	2.7
31.03.2016	1013.6	6.8	170	1.6	2.4
Total	**31383.4**	**271.7**	**6380**	**38**	**55.1**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.04.2016	1005.2	13.9	160	1	1.5
02.04.2016	1001.6	5.5	30	0.8	1.2
03.04.2016	996.4	3.9	140	1.2	1.6
04.04.2016	1000.6	4.4	310	1.4	1.9
05.04.2016	1006	8	250	1.7	2.4
06.04.2016	1006.8	17.5	270	1.5	2.7
07.04.2016	1013.4	15.2	290	2	3.4
08.04.2016	1008.5	9.8	280	1.1	1.7
09.04.2016	999	6.4	240	1.5	2.3
10.04.2016	996.3	16.5	80	1.4	2.2
11.04.2016	1002.4	10.2	70	1.3	1.6
12.04.2016	1003.1	4.7	160	2.4	3.3
13.04.2016	1004.8	6.7	150	2	2.9
14.04.2016	1005.9	7.7	40	1.8	2.5
15.04.2016	1004.8	9.2	330	2.1	3.2
16.04.2016	1010.6	7.5	20	2.2	3.3
17.04.2016	1016.3	6.5	280	1.6	2.4
18.04.2016	1021.3	9	280	2	3.2
19.04.2016	1025.8	3.7	120	2.5	3.5
20.04.2016	1024.8	7.1	110	3.2	4.5
21.04.2016	1021.5	7.3	30	2.3	3
22.04.2016	1020.2	6.8	40	2.9	3.9
23.04.2016	1023.5	7.5	330	3.1	4.4
24.04.2016	1022.6	8.1	270	2.1	3.1
25.04.2016	1016.9	10.3	350	3.1	4.7
26.04.2016	1016.8	10.9	330	2.8	4.2
27.04.2016	1016.5	8.1	320	2.2	3.3
28.04.2016	1012.5	13.8	290	1.9	3.2
29.04.2016	1013.9	9.8	300	2.6	4
30.04.2016	1020.1	8.7	240	2.9	4.4
Total	**30338.1**	**264.7**	**6110**	**60.6**	**89.5**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.05.2016	1015.6	11.1	210	2.2	3.1
02.05.2016	1015.8	15.5	240	2.7	4.7
03.05.2016	1021.9	9.8	240	2.7	3.9
04.05.2016	1017.6	12.1	170	2	3
05.05.2016	1015	7.9	220	3.3	4.9
06.05.2016	1011.6	6	30	3.5	5
07.05.2016	1003.7	6.8	30	1.1	1.5
08.05.2016	1000.5	10.3	110	3.2	4.4
09.05.2016	1003.8	8.8	110	2.8	3.6
10.05.2016	1004.2	5.3	20	1.6	2.1
11.05.2016	1003.3	6.2	30	1.6	2.1
12.05.2016	1005.9	9.1	20	3.3	4.4
13.05.2016	1011.6	6	340	4.1	5.6
14.05.2016	1018.2	5	120	3.3	4.5
15.05.2016	1021.6	4.8	250	3.4	4.7
16.05.2016	1019.2	3.6	250	3	4
17.05.2016	1008.2	8.3	240	1.9	2.7
18.05.2016	1003.8	8.5	280	3	4.5
19.05.2016	1006.6	12.7	250	2.3	3.5
20.05.2016	1002.5	10.6	230	1.7	2.4
21.05.2016	999.1	9.2	230	3.1	4.8
22.05.2016	1009.3	8.8	300	3.4	5.2
23.05.2016	1019.2	3.4	250	2.4	3.3
24.05.2016	1018.8	8.1	110	4.1	5.8
25.05.2016	1017.6	8.5	40	4.1	6.1
26.05.2016	1015.4	3.7	40	1.4	1.9
27.05.2016	1014.3	4.9	120	4	5.4
28.05.2016	1012.9	4.3	350	3.9	5.2
29.05.2016	1015	4.8	300	3.9	5.3
30.05.2016	1020.2	5.6	310	4.4	6
31.05.2016	1024.8	6.7	340	4.4	6.2
Total	**31377.2**	**236.4**	**5780**	**91.8**	**129.8**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.06.2016	1025.9	5.6	330	4.5	6.2
02.06.2016	1021.6	6.6	70	4.7	6.4
03.06.2016	1015.8	4.9	130	4.6	6.1
04.06.2016	1016	3.2	170	5.6	7.4
05.06.2016	1017.2	8.6	160	4.5	6.4
06.06.2016	1017.4	5.8	130	2.6	3.4
07.06.2016	1021	4.7	320	3.3	4.2
08.06.2016	1021.8	4.2	240	4.5	5.9
09.06.2016	1016.7	6.9	130	3.3	4.1
10.06.2016	1010.6	3.8	280	2.7	3.6
11.06.2016	1005.6	5	190	2.2	2.9
12.06.2016	1004.2	8.5	270	2.8	3.9
13.06.2016	1000.2	12.1	280	2	3
14.06.2016	996.7	11.2	280	2.5	3.7
15.06.2016	997.4	10.1	320	3	4.2
16.06.2016	1005	11.9	320	2.7	3.6
17.06.2016	1013.6	9	330	2.6	3.6
18.06.2016	1019.3	5.4	230	2.3	3.2
19.06.2016	1014.1	10.9	240	1.6	2.4
20.06.2016	1009.9	10.7	270	2.8	4.2
21.06.2016	1010.8	10	190	2.5	3.5
22.06.2016	1012.5	8.5	240	3.7	5.2
23.06.2016	1013.2	10.6	240	2.4	3.4
24.06.2016	1015.7	13	280	2.8	4.2
25.06.2016	1019.5	10.3	300	2.8	3.8
26.06.2016	1017.4	10.6	260	1.6	2.3
27.06.2016	1017.1	10	230	3.5	5
28.06.2016	1010.4	9.6	270	2.6	3.7
29.06.2016	1001.7	12	230	3.2	5
30.06.2016	1003.8	9.6	230	1.7	2.4
Total	**30372.1**	**253.3**	**7160**	**91.6**	**126.9**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.07.2016	1005.6	12.8	250	2.9	4.6
02.07.2016	1010.5	10.5	270	2.9	4.4
03.07.2016	1015.2	6.2	240	4.1	5.8
04.07.2016	1013.3	10.7	220	2.2	3
05.07.2016	1018.8	5	230	3.1	4.2
06.07.2016	1016.9	8.5	170	2.2	3
07.07.2016	1012.5	6.1	250	3.9	5.2
08.07.2016	1011.6	10.8	240	2.6	3.7
09.07.2016	1006.3	11.4	230	2.9	4.2
10.07.2016	998	13.4	240	1.8	2.9
11.07.2016	1005.3	12.1	270	2.3	3.4
12.07.2016	1014.3	7.9	280	4	5.8
13.07.2016	1020.9	9.4	290	2.9	4.1
14.07.2016	1023	6.3	140	2.4	3.2
15.07.2016	1020.2	10	240	2.4	3.3
16.07.2016	1021.8	6.5	240	2.1	2.9
17.07.2016	1020.6	5.4	240	1.9	2.6
18.07.2016	1017.4	3.6	150	4.4	5.7
19.07.2016	1011.2	7.2	240	4.7	6.1
20.07.2016	1008.7	9.7	240	3.1	4.4
21.07.2016	1011.5	9.2	180	2	2.9
22.07.2016	1016.1	4.8	280	2.3	3.1
23.07.2016	1016.9	6.7	240	2.2	3
24.07.2016	1014.7	10.5	230	2.7	4
25.07.2016	1017.1	8.8	250	1.9	2.6
26.07.2016	1015.2	8.7	230	2	2.8
27.07.2016	1014.7	6.2	230	2.5	3.4
28.07.2016	1010.4	11.5	240	1.9	3
29.07.2016	1011.3	7.4	10	2.8	3.8
30.07.2016	1015.3	6.3	280	2.7	3.7
31.07.2016	1017	6	250	1.9	2.5
Total	**31432.3**	**259.6**	**7090**	**83.7**	**117.3**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.08.2016	1010.2	8.9	120	1.2	1.9
02.08.2016	1003.5	9.5	250	1.7	2.4
03.08.2016	1001.1	16.9	230	1.4	2.4
04.08.2016	1009.9	11.2	270	2.6	4.1
05.08.2016	1018.9	6.2	250	2.7	3.6
06.08.2016	1019.7	11.7	240	2.6	3.7
07.08.2016	1019.3	17.6	230	3	4.7
08.08.2016	1024.4	11.2	290	3.2	4.7
09.08.2016	1028.9	9.7	300	2.7	3.8
10.08.2016	1026.3	10.4	270	2	2.8
11.08.2016	1023.2	12.7	240	1.7	2.6
12.08.2016	1019.4	11.8	220	2	2.9
13.08.2016	1021.7	7.8	270	1.9	2.5
14.08.2016	1023.3	4.8	150	1.7	2.2
15.08.2016	1018.7	12	150	4	5.7
16.08.2016	1011.8	12.3	130	3.9	5.3
17.08.2016	1008.3	8.9	120	1.1	1.5
18.08.2016	1004.8	7.8	110	1.9	2.5
19.08.2016	991.8	17.8	110	2.2	3.3
20.08.2016	996.6	21.7	230	1.8	2.9
21.08.2016	1010.6	10.4	260	1.5	2.2
22.08.2016	1015.2	7.1	240	2.4	3.5
23.08.2016	1018.5	4.1	270	1.6	2.1
24.08.2016	1018.5	5	110	2.7	3.6
25.08.2016	1014.5	6	240	2.4	3.2
26.08.2016	1013.7	7.5	230	2.6	3.6
27.08.2016	1012	6	110	1.9	2.5
28.08.2016	1013.6	6.4	270	2.7	3.7
29.08.2016	1020	5.6	260	1.6	2.2
30.08.2016	1016.8	10.3	180	2.4	3.4
31.08.2016	1017.5	7.9	280	1.6	2.1
Total	**31452.7**	**307.2**	**6630**	**68.7**	**97.6**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.09.2016	1017.2	9.1	190	1.2	1.7
02.09.2016	1013	10.1	240	2.5	3.6
03.09.2016	1006.2	10.3	240	1.7	2.2
04.09.2016	1008.7	7.7	150	1.6	2.1
05.09.2016	1010.2	8.2	240	2.1	2.9
06.09.2016	1015.7	7.5	180	1.9	2.5
07.09.2016	1007.9	10.3	140	1.7	2.2
08.09.2016	1002.5	11.4	240	2	2.8
09.09.2016	1000.9	13.3	170	1.2	1.6
10.09.2016	1008.7	7.7	230	2	2.7
11.09.2016	1002.6	17.5	160	1.3	2.2
12.09.2016	999.3	7.6	160	1	1.5
13.09.2016	1010.2	4	330	2.1	2.9
14.09.2016	1011.5	5.3	340	0.9	1.3
15.09.2016	1011.6	5.7	260	1.5	2
16.09.2016	1018.6	8.4	290	1.6	2.3
17.09.2016	1021.2	5.2	230	1.2	1.6
18.09.2016	1019.4	7.9	320	1.1	1.6
19.09.2016	1023.2	3	230	1.2	1.6
20.09.2016	1016.9	6.9	160	1.4	1.9
21.09.2016	1010.2	9.1	160	1.1	1.6
22.09.2016	1014.5	9	200	1.4	1.9
23.09.2016	1009.6	13.8	170	1.3	1.8
24.09.2016	1000.1	13.2	170	1	1.3
25.09.2016	1006.6	12.5	250	1.8	2.6
26.09.2016	1010.8	6.4	130	1.3	1.7
27.09.2016	1014.7	11	250	1.6	2.3
28.09.2016	1016.1	12.7	230	1.4	2
29.09.2016	1010.3	13.9	250	1.5	2.2
30.09.2016	1005.8	6.9	230	1.1	1.5
Total	**30324.2**	**275.6**	**6540**	**44.7**	**62.1**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.10.2016	1007.8	6	320	1.3	1.9
02.10.2016	1012.9	10.4	140	1.3	1.8
03.10.2016	1016.1	18.3	140	1.8	2.3
04.10.2016	1021	9.8	140	1.3	1.6
05.10.2016	1022.4	11.2	140	1.7	2.2
06.10.2016	1020.7	11.7	120	1.4	2
07.10.2016	1019	8.6	140	1.5	2
08.10.2016	1024.7	5.6	110	0.9	1.2
09.10.2016	1027.9	2.8	150	0.8	1.1
10.10.2016	1024.5	5.2	90	1	1.3
11.10.2016	1019.7	11.7	110	1.4	1.9
12.10.2016	1019.4	6.2	70	0.9	1.2
13.10.2016	1011.7	4.2	100	0.8	1.2
14.10.2016	1001.5	9.8	100	0.9	1.2
15.10.2016	996.8	7.1	140	1.1	1.5
16.10.2016	996.3	10.8	230	0.8	1.1
17.10.2016	1009.2	12.1	260	1.2	1.6
18.10.2016	1020.6	8.8	280	1.2	1.5
19.10.2016	1025.2	3.1	290	0.7	0.9
20.10.2016	1023	1.5	310	0.6	0.9
21.10.2016	1018.2	5.7	160	0.7	0.9
22.10.2016	1013.5	8.3	110	0.9	1.1
23.10.2016	1009.9	10.3	70	1.1	1.4
24.10.2016	1013.3	8.2	30	0.8	1.1
25.10.2016	1018.6	2.8	110	0.4	0.6
26.10.2016	1023.3	6.3	230	0.5	0.7
27.10.2016	1026.2	9.7	240	1	1.2
28.10.2016	1029.8	5.3	230	0.7	0.8
29.10.2016	1028.8	9.5	150	0.9	1.2
30.10.2016	1024.8	6.8	130	0.8	1
31.10.2016	1024.1	6.1	30	0.6	0.8
Total	**31550.9**	**243.9**	**4870**	**31**	**41.2**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.11.2016	1026.8	8.9	20	0.4	0.6
02.11.2016	1025.2	1.9	200	0.4	0.7
03.11.2016	1017.6	6.8	240	0.7	0.9
04.11.2016	1010	6	290	0.4	0.6
05.11.2016	1013.2	8.2	350	0.7	0.9
06.11.2016	1017.3	7.2	340	0.5	0.7
07.11.2016	1017.9	2.8	330	0.3	0.5
08.11.2016	1006.5	9.3	300	0.5	0.7
09.11.2016	1003.1	8.2	280	0.6	0.8
10.11.2016	1010.9	7.2	300	0.4	0.6
11.11.2016	1010.9	11	160	0.3	0.4
12.11.2016	1014.9	5.5	280	0.2	0.4
13.11.2016	1025.5	4	220	0.5	0.6
14.11.2016	1025.6	6.4	240	0.5	0.7
15.11.2016	1021.2	9.3	240	0.4	0.5
16.11.2016	1011.5	13.8	240	0.9	1.1
17.11.2016	997.4	14	250	0.3	0.4
18.11.2016	994.7	7.8	270	0.5	0.6
19.11.2016	994.4	5.3	230	0.2	0.3
20.11.2016	991.8	3.1	330	0.2	0.2
21.11.2016	996.8	9.2	350	0.4	0.6
22.11.2016	1007.5	8.9	340	0.3	0.4
23.11.2016	1020	3.7	30	0	0.1
24.11.2016	1024.9	7.4	30	0.1	0.1
25.11.2016	1024.1	3.8	360	0	0.1
26.11.2016	1021.4	3.9	20	0.2	0.3
27.11.2016	1023.3	4	100	0.4	0.5
28.11.2016	1027.2	6.7	90	0.6	0.8
29.11.2016	1031.3	2.6	130	0.3	0.4
30.11.2016	1033.2	2.3	130	0	0
Total	**30446.1**	**199.2**	**6690**	**11.2**	**15.5**

Shannon Airport Weather Records 2016					
Date	Mean CBL Pressure (hpa)	Mean Wind Speed (kt)	Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
01.12.2016	1029.7	1.9	90	0.1	0.2
02.12.2016	1024.8	4.6	130	0	0
03.12.2016	1020.6	7	90	0.5	0.7
04.12.2016	1017.8	9.3	80	0.7	0.8
05.12.2016	1017.3	6.6	140	0.4	0.5
06.12.2016	1014.7	12.9	140	0.6	0.8
07.12.2016	1012.3	11.1	170	0.6	0.8
08.12.2016	1015.5	7.5	160	0.2	0.3
09.12.2016	1013.3	10.1	160	0.5	0.7
10.12.2016	1018.4	5.6	250	0.3	0.4
11.12.2016	1019.7	6.2	150	0.1	0.1
12.12.2016	1013.7	7.4	140	0.4	0.5
13.12.2016	1006.1	10.9	140	0.5	0.6
14.12.2016	1007.8	5.5	240	0.4	0.5
15.12.2016	1007.8	9.7	140	0.3	0.4
16.12.2016	1020.7	4.1	60	0	0
17.12.2016	1033.2	6.8	130	0.3	0.3
18.12.2016	1030.2	7.9	150	0.4	0.4
19.12.2016	1025.5	4.7	150	0	0.1
20.12.2016	1014.9	7.9	140	0.2	0.3
21.12.2016	1012.5	9	250	0.4	0.5
22.12.2016	1020.2	9.5	220	0.6	0.7
23.12.2016	1013.5	16.8	250	1	1.3
24.12.2016	1019.3	14.2	250	0.9	1.1
25.12.2016	1017.3	15.5	230	0.9	1.1
26.12.2016	1029.2	8.2	280	0.8	1
27.12.2016	1036.6	7.8	150	0.5	0.5
28.12.2016	1033.7	6.8	140	0.3	0.4
29.12.2016	1029.9	8	170	0.5	0.6
30.12.2016	1029.6	7.7	230	0.5	0.6
31.12.2016	1023.8	8	230	0.4	0.6
Total	**31629.6**	**259.2**	**5250**	**13.3**	**16.8**

Appendix I – Water Balance Calculations

Water Balance Calculations 2016

Upper Bound 10% infliltration of actual rainfall on the area covered with capping and Cell 1,2 & 3

Period (Jan 2016 - Dec 2016)	Active cell (m2)	Effective Rainfall (m) - Active Cell	Volume of waste (t)	Effective Rainfall x Active Area	Absorptive Capacity (m3)	Volume of free leachate	Final Capped Area (m2)	Effective Rainfall (m) - Capped Area	Volume of Leachate Capped (m3)	Total Leachate produced
January	5135	0.0855	99	85.5	3.468	82.03	15742	0.0908	142.94	224.97
February	5135	0.1137	99	113.7	3.468	110.23	15742	0.1232	193.94	304.17
March	5135	0	99	0	3.468	0.00	15742	0	0	0.00
April	5135	0	99	0	3.468	0.00	15742	0.0000	0	0.00
May	5135	0	99	0	3.468	0.00	15742	0	0.00	0.00
June	5135	0.0000	99	-58.7	3.468	0.00	15742	0.0000	0.00	0.00
July	5135	0.0000	99	-50.4	3.468	0.00	15742	0.0000	0	0.00
August	5135	0.0098	99	9.8	3.468	6.33	15742	0.0387	61	67.25
September	5135	0	99	0	3.468	0.00	15742	0.0437	68.79	68.79
October	5135	0.0000	99	-5.9	3.468	0.00	15742	0.0043	6.77	6.77
November	5135	0.0535	99	53.5	3.468	50.03	15742	0.0578	90.99	141.02
December	5135	0.0572	99	57.2	3.468	53.73	15742	0.0607	95.55	149.29
TOTAL						**302.36**			**659.90**	**962.26**

Lower Bound 2% infliltration of actual rainfall on the area covered with capping and Cell 1,2 & 3

Period (Jan 2016 - Dec 2016)	Active cell (m2)	Effective Rainfall (m) - Active Cell	Volume of waste (t)	Effective Rainfall x Active Area	Absorptive Capacity (m3)	Volume of free leachate	Final Capped Area (m2)	Effective Rainfall (m) - Capped Area	Volume of Leachate Capped (m3)	Total Leachate produced
January	5135	0.0855	99	439.043	3.468	435.57	15742	0.0908	28.59	464.16
February	5135	0.1137	99	583.850	3.468	580.38	15742	0.1232	38.79	619.17
March	5135	0	99	0	3.468	0.00	15742	0	0	0.00
April	5135	0	99	0	3.468	0.00	15742	0.0000	0	0.00
May	5135	0	99	0	3.468	0.00	15742	0	0.00	0.00
June	5135	0.0000	99	0	3.468	0.00	15742	0.0000	0.00	0.00
July	5135	0.0000	99	0	3.468	0.00	15742	-0.0168	-5	-5.29
August	5135	0.0098	99	50	3.468	46.86	15742	0.0387	12	59.04
September	5135	0	99	0.000	3.468	0.00	15742	0.0437	13.76	13.76
October	5135	0.0000	99	0.000	3.468	0.00	15742	0.0043	1.35	1.35
November	5135	0.0535	99	274.723	3.468	271.25	15742	0.0578	18.20	289.45
December	5135	0.0572	99	293.722	3.468	290.25	15742	0.0607	19.11	309.36
TOTAL						**1624.32**			**126.69**	**1751.01**