Clare County Council

Tradaree Point Sludge Disposal Facility

Annual Environmental Report 2015

Waste Licence Reg. No. W0037-01

Response Group

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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 2015 to December 2015.

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Licence, Content of the Environmental Report, and has been prepared in accordance with the EPA (1999) Waste Licensing – Draft Guidance Note on Environmental Management Systems and Reporting to the Agency, the EPA Guidance Note for the Annual Environmental Report and the EPA AER/PRTR Guidance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 2015 to December 2015 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, Castlelake, Drumcliff, Kilmaley-Inagh and Toonagh Group Water Schemes. 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 an open trailer. 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 2 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 causeway at the cell entrance which provides a dry area for the unloading of the sludge.

2.3 Quantity and Composition of Sludge Disposed

2.3.1 Sludge Disposed 2015

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 2015 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 2015, 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 2015

Month	Quantity (Kg)
January	98000
February	85730
March	104700
April	84380
May	82990
June	93000
July	84860
August	67300
September	88820
October	108540
November	89880
December	66850
Total (kg)	105505
TOTAL (tonnes)	1055.05

2.3.2 Sludge Disposed 2004-2015

Table 2.3 below details the quantities of sludge disposed at the facility between 2005 and 2015.

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

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, so Cell 2 was opened on 28th June 2013. Cell 2 is now nearing its capacity and it is expected that Cell 3 will need to be opened in early 2016. It is expected that Cell 1 and Cell 2 will both be capped by Dec 2016.
In 2015, approximately 1055 tonnes of sludge was disposed of at the facility.

The density of dewatered sludge varies depending on the dry matter concentration. In 2015, the average cake % dry matter reached in the sludge was 23%. 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 2014 was 830m3.

Based on the 2015 figure, it is expected that the landfill should reach its full capacity by 2020.

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 second of the newly lined active cells – Cell 2.

The total capped area occupied by waste in the facility is 20,112m2. Between 2005 and June 2013, a total of 5,923 tonnes of waste has been deposited into Cell 1. Since June 2013, a total of 2825 tonnes of waste has been deposited into Cell 2.

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 2015 are detailed in Table 2.4 below.

Table 2.4: The monthly averages of Leachate generated in 2015

Month	Flow Rate (m^3/Month)
January	9133
February	418
March	946
April	357
May	420
June	410
July	180
August	148
September	1512
October	1244
November	3415
December	1669
Total (M^3/Year)	19852

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 23% 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 2015 of 243 tonnes of biodegradable waste (23% of 1055 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 17th August and 14th September 2015. 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. D3 was over its licence requirements due to decomposed algae matter surrounding the area, as stated in the test report. This was cut back and retested .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 2015

Location	N1	N3	N5	SS2
	mg/m2/day			
Sept 2015	204	44.8	1457	53
Nov 2015			153.3	

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 5th May 2015. 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	05/05/15	30 Minutes	41.2
N2	05/05/15	30 Minutes	44.2
N3	05/05/15	30 Minutes	42.6
N5	05/05/15	30 Minutes	44.4

Table 3.5 Night-time Noise Measurements 2015

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	05/05/15	30 Minutes	45.1
N2	05/05/15	30 Minutes	43.1
N3	05/05/15	30 Minutes	40.2
N5	05/05/15	30 Minutes	42.1

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 2015, 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 five of the monthly monitoring rounds. Methane levels above the threshold level ranged from 11.3% (Aug) to 31.2% (September).

Methane levels measured at RD3 exceeded the threshold level of 1% v/v in three of the monthly monitoring rounds. Methane levels above the threshold level ranged from 1.3% v/v (Feb) to 3.6% v/v (December).

Methane levels measured at RD4 exceeded the threshold level of 1% v/v in six of the twelve monthly monitoring rounds. Methane levels above the threshold level ranged from 1.2% (Sept) to 2.8% (January).

Methane levels measured at RD5 exceeded the threshold level of 1% v/v in five of the 12 monthly monitoring rounds. Methane levels above the threshold level ranged from 1.7% (Nov) to 3.7% (Feb).

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 28.2% (April) to 50.9% (December).

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 7 of the 12 monthly monitoring rounds – January (3.2%), February (6.5%), March (6.2%) April (7.2%), October (3.0%) November (3.7%) and December (5.3%) .

At RD2, carbon dioxide levels exceeded the threshold level of 1.5% v/v in 7 of the 12 monthly monitoring rounds – January (3.2%), February (6.5%), March (3.5%), July (3.9%), August (4.0%), Sept (4.8%), and Dec (2.4%).

In RD3, carbon dioxide concentrations were above the threshold level of 1.5% v/v in 6 of the 12 monthly monitoring rounds – July (1.6%), August (2.2%), September (6.2%), October (2.2%), November (2.2%)and December (4.2%).

In RD4, carbon dioxide concentrations were above the threshold level of 1.5% v/v in 8 of the 12 monthly monitoring rounds – January (3.8%), February (3.0%), March (3.6%), April (4.8%), July (3.2%), August (2.9%), September (4.6%) and December (5%).

In RD5, carbon dioxide levels exceeded the threshold level of 1.5% in all of the 12 monthly monitoring rounds – January (14.5%), February (14.4%), March (13.8%), April (5.2%), May (5.4%), June (9.5%), July (9.5%), August (10.9%), September (12.5%), October (10.3%), November (13.1%) and December (15%).

In RD6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in all of the monthly monitoring rounds - January (10.8%), February (9.8%), March (10.1%), April (12%), May (10.8%), June (10.2%), July (12%), August (12.2%), September (12.2%), October (11.3%), November (10.6%) and December (11.5%).

In L6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in 2 of the 12 monthly monitoring rounds – February (2.1%) and April(1.6%)

Monthly recorded carbon dioxide levels in the remaining monitoring boreholes (RD7, RD8, 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 2015 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 2015,

- 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 2015 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 2015 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 2015

Location	N1	N3	N5	SS2
	$mg/m^2/day$			
Sept 2015	204	44.8	1457	53
Nov 2015			153.3	

All monitoring results were below the ELV for dust of 350 mg/m2/day once N5 was re tested after organic matter was cut back.

3.2.3 Groundwater Monitoring

3.2.3.1 Groundwater Monitoring Locations

Groundwater monitoring was conducted at five locations during 2015 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 2015 varied between 0.05m below top of casing (BTOC) (in BH4 Dec 2015) and 1.55m BTOC (in BH3 June 2015).

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 December 2015.

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 6.66 to 7.95, which is within the IGV range of 6.5-9.5.

Electrical conductivity measurements ranged from 25340 µS/cm in RD3 (Dec) to 14,703 µS/cm in BH3 (Dec), 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 0.81mg/l in RD3 (June) to 27mg/l in BH3 (June).

Total Oxidised Nitrogen concentrations results ranged between 0.14mg/l RD2 (Dec) and 13.17mg/l BH5 (Dec). These readings are higher than those recorded last year.

Total organic carbon concentrations ranged from 9mg/l in RD3 (Dec) to 145mg/l in BH5 (Dec).

Chloride concentrations ranged from 381 mg/l in RD3 (Dec) to 5,535 mg/l in BH4 (December). Chloride concentrations in all of the samples analysed exceeded the IGV of 30 mg/l.

Sodium concentration ranged from 560mg/l RD3 (Dec) to 2170mg/l BH4 (Deember), which were all above the IGV of 150 mg/l.

Potassium concentrations in all five samples analysed during the December monitoring round all exceeded the IGV of 5 mg/l. Concentrations ranged from 7.05g/l in RD3 to 103mg/l in BH4.

Iron concentrations detected exceeded the IGV of 0.2mg/l on all occasions. The Iron concentration measured ranged between 1.1 mg/l in RD3 and 20.3mg/l in BH4, samples were taken in December.

Chromium concentrations in all samples were below the IGV of 0.03 mg/l. They ranged from <0.004mg/l in RD2 to 0.02mg/l in BH5.

Fluoride concentrations in all samples were below the IGV of 1mg/l. They ranged from 0.05mg/l in BH3 to 0.43mg/l in RD2.

Concentrations of boron, cadmium, copper, cyanide, lead, magnesium, mercuryl, 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 2014 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 2015 as per Schedule D of the licence.

The electrical conductivity was measured at 977 µS/cm in June and 1100 µS/cm in November which was above the IGV of 1000µS/cm.

The chloride concentration was detected at 57mg/l in June and 81mg/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 4.3mg/l in June and 0.51mg/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 4.07mg/l which is within the IGV of 5 mg/l. This is reduced to last year.

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

Sulphate concentration was 198mg/l which is below the IGV of 200mg/l.

Total Phosphorus was also detected above the lGV of 0.01mg/l at 0.44mg/l. This is similar with previous years.

Comparison of results with the results from previous years, indicate that a number of parameters (Ammonia, chloride, potassium 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 15th November 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 2015

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	05/05/15	30 Minutes	41.2
N2	05/05/15	30 Minutes	44.2
N3	05/05/15	30 Minutes	42.6
N5	05/05/15	30 Minutes	44.4

Table 3.15 Night-time Noise Measurements 2015

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	05/05/15	30 Minutes	45.1
N2	05/05/15	30 Minutes	43.1
N3	05/05/15	30 Minutes	40.2
N5	05/05/15	30 Minutes	42.1

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 0.05mg/l SS2 (Jun) to 0.16mg/l SS1 (June). There was a decrease in the ammonia levels in 2015.

Potassium exceeded the IGV of 5mg/l in 1 sample tested. In November SS1 7.01mg/l.

There were no other exceedances of the relevant thresholds or EQS's for any of the parameters analysed during both monitoring rounds undertaken in 2015.

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 and the visual inspection logs are available for inspection at the facility.

3.2.8 Meteorological Monitoring

Details of meteorological monitoring conducted at the facility in 2015 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	130.6	19.6	26.2	111	104.4
FEB	91.4	17.4	25.4	74	66
MAR	106.8	38.6	57.7	0*	0*
APR	63.8	67.8	97.8	0*	0*
MAY	112.2	71.2	110.4	0*	0*
JUN	37.2	86.6	126.9	0*	0*
JUL	82.7	76.8	112.1	0*	0*
AUG	93.4	69.8	100.8	23.6	0*
SEP	93.8	47	65.2	0*	0*
OCT	49.7	27.7	37.5	22	12.2
NOV	190.6	21	27.2	169.6	163.4
DEC	218.7	19.5	24.2	199.2	194.5
TOTAL	1270.9	563	811.4	595.4	540.5

***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 1270.9 mm of rainfall from January 2015 to December 2015.

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 2014, which was 1055 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 3,850 m3 (upper bound) and 2,935 m3 (lower bound) of Leachate was produced on site in 2015.

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 2000 litres of diesel were used in 2015.

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 2015.

Pest Patro; 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 2015.
- There is no problem with litter at the facility and no complaints were received in 2015 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 2015.

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 2014 AER did not specify any environmental objectives and targets for 2015.

4.3 Schedule of Environmental Objectives and Targets for 2014

The licensee conducted a review of the EMS in 2014 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 2015.

4.4 Facility Procedures

No new procedures were developed or implemented at the site between January 2015 and December 2015.

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 2015.

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 2015 to December 2015, no incidents occurred which would require reporting to the relevant authorities. No complaints or incidents were reported to the facility between January and December 2015.

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 March 2015 by Gravitation Ltd. Test cert no. 2530

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 2015.

6.2 Proposed Development of the Facility and Associated Timescales

Facility development works planned for 2016.
Cell 1 has reached its capacity and is currently inactive awaiting capping, it is planned that this capping will take place by Dec 2016.
Cell 2 is currently active and is nearing its capacity, on reaching its full capacity it will be capped and landfilling of Cell 3 will commence. It is expected that this will occur in 2016.

FIGURE 1 – SITE LOCATION MAP

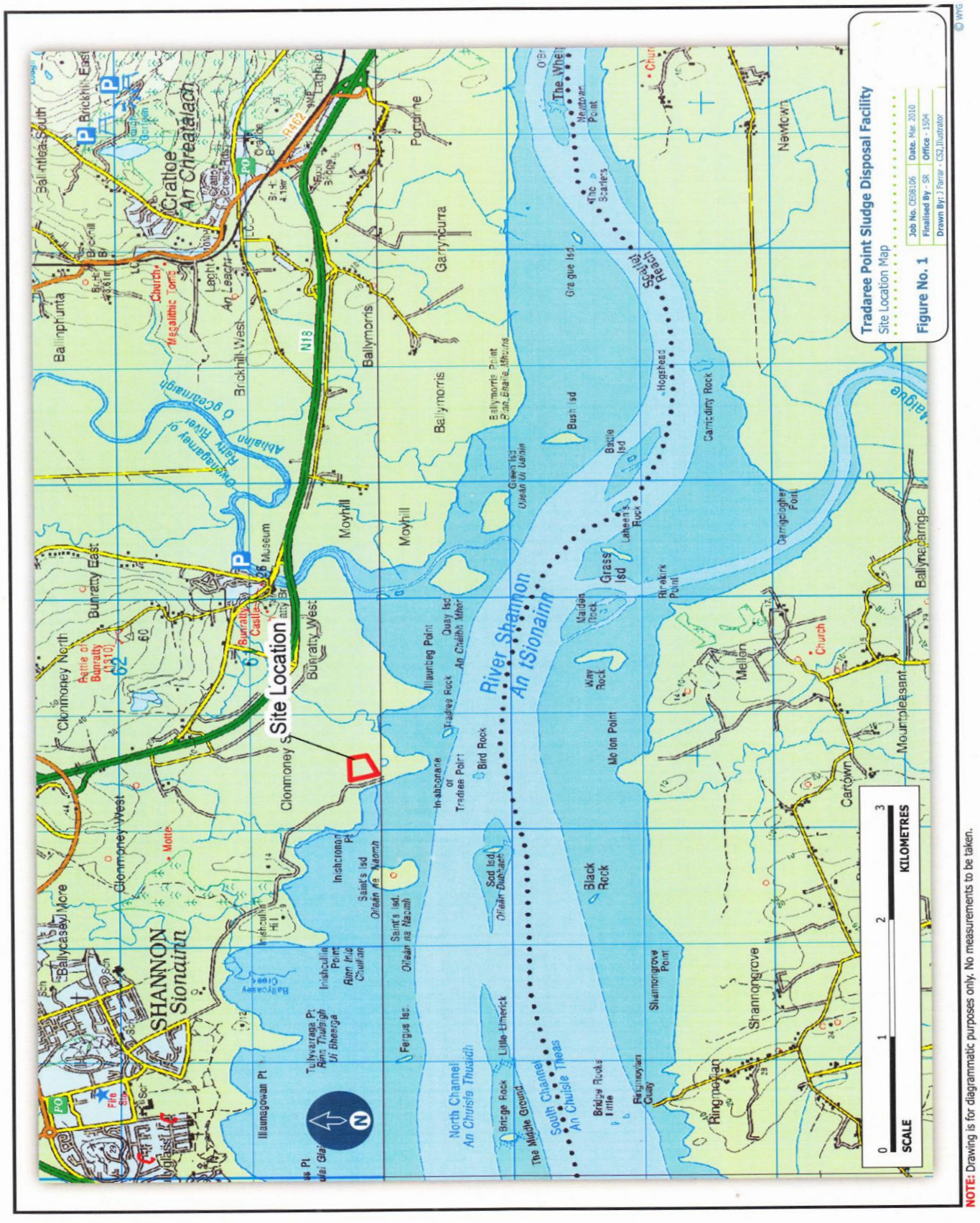
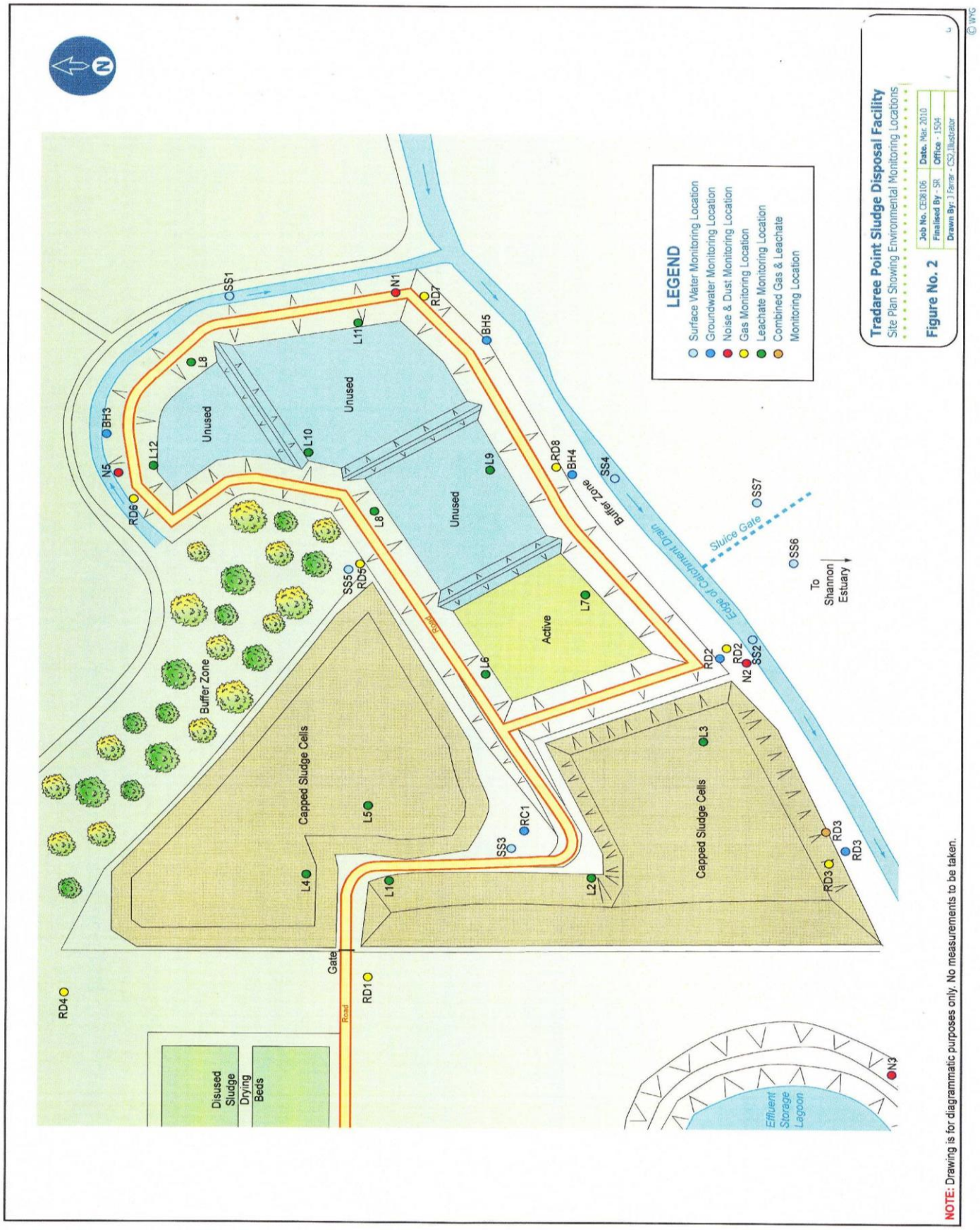

Tradaree Point Sludge Disposal Facility
Site Location Map
Figure No. 1
Job No. C636106
Date. Mar. 2010
Finalised By - SR
Office - 1504
Drawn By: J Farrar - CS2 Illustrator
Site Location
River Shannon
An tSionainn
SHANNON
Sionainn
Clonmoney South
Clonmoney West
Clonmoney North
Bunratty West
Bunratty East
Moyhill
Ballymorris
Garrynoura
Cratloe
An Creatalach
Brickhill West
Ballinphunta
Ballycasey More
Illaunagowan Pt
Tradaree Point
Illaunbeg Point
Bird Rock
Black Rock
Melon Point
Grass Isd
Bush Isd
Carrigdiny Rock
Hogsheads
Newtown
Mourtpleasant
Ballynacarrige
Carrown
Shannongrove
Ringmoylan
North Channel
An Chuisle Thuaidh
South Channel
An Chuisle Theas
Fergus Isd
Little Limerick
The Middle Ground
Bridge Rocks
Shannongrove Point
Ringmoylan Quay
Inishcrone Pt
Inishcrone
Saint's Isd
Sod Isd
Quay Isd
Maiden Rock
Laheens Rock
Carrigallogher Point
Rinakirk Point
Cratloe Woods
Bunratty Castle
Bunratty Folk Museum
Battle of Bunratty (1318)
Megalithic Tomb
Church
Motte
Fire Station
Post Office
N18
R462
SCALE
0
1
2
3
KILOMETRES
N
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

FIGURE 2 – SITE PLAN SHOWING ENVIRONMENTAL MONITORING LOCATIONS


Tradaree Point Sludge Disposal Facility
Site Plan Showing Environmental Monitoring Locations
Figure No. 2
Job No. CE08106
Date. Mar. 2010
Finalised By - SR
Office - 1504
Drawn By: J Farrar - CS2 Illustrator
LEGEND
Surface Water Monitoring Location
Groundwater Monitoring Location
Noise & Dust Monitoring Location
Gas Monitoring Location
Leachate Monitoring Location
Combined Gas & Leachate Monitoring Location
N
Unused
Unused
Unused
Active
Capped Sludge Cells
Capped Sludge Cells
Buffer Zone
Buffer Zone
Road
Gate
Road
Disused Sludge Drying Beds
Effluent Storage Lagoon
Edge of Catchment Drain
Sluice Gate
To Shannon Estuary
SS1
SS2
SS3
SS4
SS5
SS6
SS7
N1
N2
N3
N5
BH3
BH4
BH5
RD1
RD2
RD3
RD4
RD5
RD6
RD7
RD8
RC1
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

APPENDICES

APPENDIX A – DUST MONITORING RESULTS

BHP/CL/02D

TEST REPORT 118929

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnston

BHP Ref. No.: 15/09/373-376
Order No:
Date Received: 14/09/15
Date Tested: 23/09/15
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 17/08/15 to 14/09/15			
Dust Deposition	**D1**	$mg/m^2/day$	204.0	VDI 2119 Part2
Dust Deposition	**D2**	$mg/m^2/day$	44.8	VDI 2119 Part2
Dust Deposition	**D3***	$mg/m^2/day$	1457.0	VDI 2119 Part2
Dust Deposition	**D4**	$mg/m^2/day$	53.0	VDI 2119 Part2

Additional Information: Sample location D3 is outside the EPA Limit of 350 mg/m2/day
*Sample D3 showed major discolouration and turbidity due to decomposed organic matter (green algae)

Authorised by:

Colette Hannan

Colette Hannan
Date of Issue: 07/10/15

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

BHP/CL/02D

TEST REPORT 119594

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnston

BHP Ref. No.: 15/11/309
Order No:
Date Received: 10/11/15
Date Tested: 12/11/15
Test Spec: VDI 2119 Part 2
Item : Dust Deposition

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

TEST	Client Reference	Units	Results	Standard Reference
	Tradree Landfill 12/10/15 to 11/11/15			
Dust Deposition	**D3**	$mg/m^2/day$	153.3	VDI 2119 Part2

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

Authorised by:

Colette Hannan

Colette Hannan
Date of Issue: 18/12/15

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

APPENDIX B – NOISE SURVEY REPORT

Tradaree WWTP

Environmental Noise Monitoring 5th May 2015

Code	Location	Time	Range dB	Average dB	Maximum dB	Background Noise	Compliant
N1 Daytime	Boundary @ Landfill Cell 3	11.15 - 11.45	30-90	41.2	53.2	Road Traffic	Yes
N2 Daytime	Boundary @ Landfill Cell 1	10.40 - 11.10	30-90	44.2	53.5	Road Traffic,	Yes
N3 Daytime	Boundary @ Lagoon	10.00 - 10.30	30-90	42.6	51.6	Road Traffic, Flow of Water	Yes
N5 Daytime	Boundary @ Landfill Cell 4	11.50 - 12.20	30-90	44.4	54.1	Road Traffic	Yes
N1 Night-Time	Boundary @ Landfill Cell 3	01.30 - 02.00	30-90	45.1	54.2	Road Traffic	Yes
N2 Night-Time	Boundary @ Landfill Cell 1	00.50 - 01.20	30-90	43.1	45.9	Road Traffic,	Yes
N3 Night-Time	Boundary @ Lagoon	00.10 - 00.40	30-90	40.2	46.1	Road Traffic, Flow of Water	Yes
N5 Night-Time	Boundary @ Landfill Cell 4	02.05 - 02.35	30-90	42.1	45.2	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

Month	January-2015						
Landfill Gas Analysis							
Date	**Location**	**CO2**	**Methane**	**O2**	**Pressure**	**Temp**	**Atmosph**
		%	**%**	**%**	**mBar**	**oC**	**Pressure**
08-Jan	**RD1**	3.2	0.6	18.0	1018.0	7.4	
	RD2	3.6	0.9	20.3	1018.0	6.8	
	RD3	0.8	0.4	21.4	1018.0	7.4	
	RD4	3.8	2.8	8.7	1018.0	6.9	
	RD5	14.5	2.0	4.6	1018.0	7	
	RD6	10.8	41.8	0.2	1018.0	6.1	
	RD7	0.1	0.2	21.5	1018.0	7.6	
	RD8	0.1	0.2	21.4	1018.0	7	
	L6	0.3	0.2	21.2	1018.0	8.3	
	L8	0.1	0.2	21.5	1018.0	7.8	
	L10	0.1	0.2	21.5	1018.0	8.1	
	L12	0.1	0.2	21.5	1018	6.8	
Trigger Level		1.5% v/v	1% v/v				

Month	February-2015						
Landfill Gas Analysis							
Date	**Location**	**CO2**	**Methane**	**O2**	**Pressure**	**Temp**	**Atmosph**
		%	**%**	**%**	**mBar**	**oC**	**Pressure**
13-Feb	**RD1**	6.5	0.2	14.0	988.0	8	
	RD2	4.7	23.2	14.7	988.0	8.5	
	RD3	1.4	1.4	20.6	988.0	7.6	
	RD4	3.0	1.3	11.0	988.0	8.2	
	RD5	14.4	3.7	6.7	988.0	7.8	
	RD6	9.8	31.8	0.1	988.0	6.2	
	RD7	0.1	0.1	21.2	988.0	7.5	
	RD8	0.1	0.1	21.2	988.0	8	
	L6	2.1	0.1	20.6	988.0	9.5	
	L8	0.2	0.1	21.2	988.0	9.2	
	L10	0.1	0.1	21.2	988.0	9.2	
	L12	0.1	0.1	21.2	988	8.6	
Trigger Level		1.5% v/v	1% v/v				

Month	March-2015						
Landfill Gas Analysis							
Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
03-Mar	RD1	6.2	0.8	17.0	1011.0	3.5	
	RD2	3.5	14.6	18.1	1011.0	3.7	
	RD3	0.7	0.3	21.0	1011.0	3.4	
	RD4	3.6	0.1	5.6	1011.0	4.5	
	RD5	13.8	3.1	6.7	1011.0	2.2	
	RD6	10.1	31.3	0.1	1011.0	1.6	
	RD7	0.1	0.0	21.8	1011.0	2.5	
	RD8	0.1	0.0	21.8	1011.0	3	
	L6	0.1	0.0	21.9	1011.0	3.2	
	L8	0.1	0.0	21.8	1011.0	2.2	
	L10	0.1	0.0	21.8	1011.0	2.5	
	L12	0.1	0.0	21.8	1011	2.8	
Trigger Level		1.5% v/v	1% v/v				

Month	April-2015						
Landfill Gas Analysis							
Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
15-Apr	RD1	7.2	0.1	13.2	1021.0	10.7	
	RD2	0.6	0.1	20.3	1021.0	10.4	
	RD3	0.7	0.1	20.2	1021.0	10.7	
	RD4	4.8	0.1	4.1	1021.0	11.4	
	RD5	5.2	0.2	17.0	1021.0	13.7	
	RD6	12.0	28.2	0.0	1021.0	10.2	
	RD7	0.1	0.1	20.5	1021.0	11.9	
	RD8	0.1	0.1	20.5	1021.0	11	
	L6	1.6	0.1	18.9	1021.0	11.1	
	L8	0.2	0.1	20.3	1021.0	11.8	
	L10	0.1	0.1	20.5	1021.0	10.9	
	L12	0.1	0.1	20.5	1021	10.6	
Trigger Level		1.5% v/v	1% v/v				

Month	May-2015						
Landfill Gas Analysis							
Date	**Location**	**CO2**	**Methane**	**O2**	**Pressure**	**Temp**	**Atmosph**
		%	**%**	**%**	**mBar**	**oC**	**Pressure**
26-May	**RD1**	1.0	0.0	19.5	1029.0	15.6	
	RD2	1.5	0.6	18.4	1029.0	19.4	
	RD3	0.6	0.0	19.6	1029.0	18.8	
	RD4	1.2	0.0	19.5	1029.0	19	
	RD5	5.4	0.0	16.8	1029.0	17.4	
	RD6	10.8	31.8	0.5	1029.0	15.5	
	RD7	0.1	0.0	19.6	1029.0	19.3	
	RD8	0.1	0.0	19.6	1029.0	17	
	L6	0.3	0.0	19.7	1029.0	21.5	
	L8	0.3	0.0	19.5	1029.0	24.2	
	L10	0.1	0.0	19.9	1029.0	22	
	L12	0.1	0.0	20.3	1029	21.5	
Trigger Level		1.5% v/v	1% v/v				

Month	June-2015						
Landfill Gas Analysis							
Date	**Location**	**CO2**	**Methane**	**O2**	**Pressure**	**Temp**	**Atmosph**
		%	**%**	**%**	**mBar**	**oC**	**Pressure**
16-Jun	**RD1**	0.4	0.0	20.2	1025.0	19.7	
	RD2	1.1	1.3	19.6	1025.0	19.4	
	RD3	0.8	0.0	19.7	1025.0	18.3	
	RD4	0.3	0.0	20.3	1025.0	16.9	
	RD5	9.5	0.3	14.7	1025.0	20.3	
	RD6	10.2	31.9	4.3	1025.0	18.8	
	RD7	0.1	0.0	21.1	1024.0	18.6	
	RD8	0.1	0.0	21.0	2024.0	17	
	L6	0.6	0.0	19.5	1025.0	21.3	
	L8	0.2	0.0	20.4	1025.0	20.3	
	L10	0.1	0.0	2024.0	2024.0	19.3	
	L12	0.0	0.0	21.0	1024	19.6	
Trigger Level		1.5% v/v	1% v/v				

Month	July - 2015						
Landfill Gas Analysis							
Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
15-Jul	RD1	0.2	0.0	20.4	1017.0	21.2	
	RD2	3.9	23.1	13.4	1017.0	19.9	
	RD3	1.6	0.0	19.3	1017.0	19.9	
	RD4	3.2	1.3	16.3	1017.0	16.8	
	RD5	9.9	0.6	10.6	1017.0	19.1	
	RD6	12.0	44.0	0.4	1017.0	18.5	
	RD7	0.1	0.0	20.4	1017.0	19.3	
	RD8	0.0	0.0	20.4	1017.0	19	
	L6	0.1	0.0	20.4	1017.0	18.7	
	L8	0.2	0.0	20.3	1017.0	18.3	
	L10	0.0	0.0	20.4	1017.0	18.3	
	L12	0.1	0.0	20.5	1017	20.8	
Trigger Level		1.5% v/v	1% v/v				

Month	August - 2015						
Landfill Gas Analysis							
Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
15-Aug	RD1	0.9	0.0	19.4	1019	17.6	
	RD2	4.0	11.3	14.7	1019	19.6	
	RD3	2.2	0.0	18.5	1019	14.5	
	RD4	2.9	1.8	12.8	1019	18	
	RD5	10.9	0.3	8.7	1019	18.2	
	RD6	12.2	46.5	2.8	1019	19.8	
	RD7	0.1	0.0	20.2	1019	18.4	
	RD8	0.2	0.0	20.1	1019	18.1	
	L6	1.5	0.0	20.1	1019	21.6	
	L8	0.4	0.0	20.2	1019	19.6	
	L10	0.1	0.0	20.2	1019	21.3	
	L12	0.1	0.0	20.2	1019	20.2	
Trigger Level		1.5% v/v	1% v/v				

Month	September-2015						
Landfill Gas Analysis							
Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
15-Sep	RD1	0.4	0.0	21.1	995	11.7	
	RD2	4.8	31.2	13.0	995	11.3	
	RD3	6.2	3.4	17.8	995	10.8	
	RD4	4.6	1.2	10.8	995	11.5	
	RD5	12.4	0.8	8.2	995	11	
	RD6	12.2	49.1	0.8	995	10.5	
	RD7	0.1	0.0	20.9	995	10.2	
	RD8	0.1	0.0	20.9	995	10.6	
	L6	0.1	0.0	21.4	995	10.2	
	L8	0.4	0.0	21.0	995	10.6	
	L10	0.1	0.0	20.9	995	10.8	
	L12	0.1	0.0	20.8	995	11.2	
Trigger Level		1.5% v/v	1% v/v				

Month	October-2015						
Landfill Gas Analysis							
Date	Location	CO2	Methane	O2	Pressure	Temp	Atmosph
		%	%	%	mBar	oC	Pressure
15-Oct	RD1	3.0	0.0	19.1	1027	12.5	
	RD2	0.6	0.0	20.3	1027	13.6	
	RD3	2.2	0.0	19.1	1027	12.7	
	RD4	0.8	0.0	20.5	1027	14.5	
	RD5	10.3	0.9	7.6	1027	14.1	
	RD6	11.3	49.6	0.4	1027	10.5	
	RD7	0.1	0.0	20.3	1027	12.5	
	RD8	0.1	0.0	20.3	1027	12.7	
	L6	1.3	0.0	19.5	1027	16.5	
	L8	0.1	0.0	20.4	1027	16.9	
	L10	0.0	0.1	20.4	1027	15	
	L12	0.1	0.0	20.4	1027	14.5	
Trigger Level		1.5% v/v	1% v/v				

Month	November-2015						
Landfill Gas Analysis							
Date	**Location**	**CO2**	**Methane**	**O2**	**Pressure**	**Temp**	**Atmosph**
		%	**%**	**%**	**mBar**	**oC**	**Pressure**
10-Nov	**RD1**	3.7	0.0	18.7	1014	15.1	
	RD2	0.3	0.0	20.4	1014	15.3	
	RD3	2.2	0.0	18.9	1014	14.2	
	RD4	1.2	0.0	20.3	1014	15.2	
	RD5	13.1	1.7	5.3	1014	15.1	
	RD6	10.6	47.2	0.4	1014	14.9	
	RD7	0.1	0.00	20.5	1014	15.3	
	RD8	0.2	0.0	20.4	1014	15.5	
	L6	0.1	0.0	20.5	1014	16.4	
	L8	0.5	0.0	20.3	1014	16.5	
	L10	0.1	0.0	20.6	1014	16.5	
	L12	0.1	0.0	20.6	1014	16.4	
Trigger Level		1.5% v/v	1% v/v				

Month	December-2015						
Landfill Gas Analysis							
Date	**Location**	**CO2**	**Methane**	**O2**	**Pressure**	**Temp**	**Atmosph**
		%	**%**	**%**	**mBar**	**oC**	**Pressure**
12-Dec	**RD1**	5.3	0.5	17.6	996.0	5.1	
	RD2	2.4	0.4	21.0	996.0	4.7	
	RD3	4.2	3.6	20.0	996.0	5.5	
	RD4	5.0	7.3	3.3	996.0	3.9	
	RD5	15.0	1.7	3.3	996.0	4.2	
	RD6	11.5	50.9	2.8	996.0	5.2	
	RD7	0.1	0.1	21.7	996.0	5.5	
	RD8	0.1	0.2	21.7	996.0	5	
	L6	0.2	0.2	21.8	996.0	4.6	
	L8	0.1	0.2	21.7	996.0	4.8	
	L10	0.1	0.2	21.7	996.0	5.2	
	L12	0.2	0.2	21.6	996	4.9	
Trigger Level		1.5% v/v	1% v/v				

APPENDIX D – GROUNDWATER MONITORING RESULTS

Biannual/Annual Groundwater Monitoring Results 2015

PARAMETER	UNIT	EPA IGV	BH 3		BH 4		BH 5		RD 2		RD 3	
			June	Dec	June	Dec	June	Dec	June	Dec	June	Dec
pH		≥6.5-≤9.5	6.91	6.68	7.26	7.00	7.08	6.66	7.84	7.54	7.95	7.64
Temperature	°C	25	11.6	11.1	11.6	11.1	11.8	11	12.5	11.1	12.9	11
Conductivity	µS/cm	1000	7133	14703	9697	9360	14200	11061	3209	3700	2752	2534
Nitrite	mg/l	-	<0.05	0.02	<0.05	0.02	<0.05	0.02	<0.05	0.02	0.05	0.02
Nitrate	mg/l	-	1.6	3.13	0.5	2.59	0.5	13.17	0.5	0.12	0.5	<0.12
Total Ammonia	NH3-N	0.2	27	22	20	17	18	19	14	15	0.81	1
Chloride	Cl mg/l	30	2283	4443	2349	5535	2027	3623	409	954	417	381
Water Level	m	-	1.55	1.34	0.37	0.05	0.81	0.6	1.4	0.67	0.83	0.30
DO	% O_2 sat	NAC		6		11		5		36		9
Arsenic	As mg/l	0.01		0.053		0.041		0.037		0.011		0.003
Boron	B mg/l	1		0.755		1.16		0.818		0.729		0.23
Cadmium	Cd mg/l	0.005		<0.0006		0.0006		0.0006		<0.0006		<0.0006
Calcium	Ca mg/l	200		190		270		215		57.5		46.6
Chromium	Cr mg/l	0.03		0.0164		<0.015		0.021		<0.004		<0.0047
Copper	Cu mg/l	0.03		0.0193		0.021		0.024		0.009		<0.009
Cyanide	Cn mg/l	0.01		0.01		<0.05		<0.05		<0.05		<0.05
Fluoride	F mg/l	1		0.05		0.05		0.32		0.43		0.36
Iron	Fe mg/l	0.2		16.2		20.3		18.4		1.9		1.1
Lead	Pb mg/l	0.01		0.0218		<0.02		<0.03		<0.006		<0.006
Magnesium	Mg mg/l	50		20.8		278		173		62.5		18.3
Mercury	Hg mg/l	0.001		<0.0001		<0.0001		<0.0001		<0.0001		<0.0001
Nickel	Ni mg/l	0.02		0.0279		0.0335		0.039		0.012		0.0133
Potassium	K mg/l	5		74.4		103		72.9		46.7		7.05
Sodium	Na mg/l	150		1600		2170		1330		677		560
Sulphate	SO_4 mg/l	200		29		26.3		17.9		69.5		72
Tin	Sn mg/l	-		<0.007		0.007		<0.007		<0.007		<0.007
Total Phosphorus	P mg/l	0.03		0.06		0.06		0.06		0.66		0.11
Orthophosphate	P mg/l	0.03		<0.01		<0.01		<0.01		<0.01		<0.01
Total Organic Carbon	C mg/l	NAC	100	109	117	114	74	145	30	23	36	9
Total Oxidised Nitrogen	N mg/l	NAC	1.6	3.13	0.55	2.59	0.55	13.17	0.55	0.14	0.55	0.14
Total Phenols	mg/l	0.0005	0.001	0.001	<0.001	0.031	0.001	0.02	<0.001	0.022	0.001	<0.005
Zinc	Zn mg/l	0.1		<0.0482		0.0515		0.069		0.020		0.018
Solids Total	mg/l	-		3654		8712		9876		4123		3483

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 16th June and 9th December 2015.

APPENDIX E – LEACHATE MONITORING RESULTS

Biannual / Annual Leachate Monitoring Results 2015

Parameter	Unit	EPA IGV	SS3	
			June	November
Ammonia	mg/l	0.15	4.3	0.51
Arsenic	mg/l	0.01		0.001
BOD Total 5 Day with ATU	mg/l	-	13	3
Boron	mg/l	1		<0.23
Cadmium	mg/l	0.005		0.0006
Calcium	mg/l	200		187
Chloride	mg/l	30	57	81
Chromium	mg/l	0.03		<0.002
COD Total	mg/l	-	82	52
Conductivity	uS/cm	1000	977	1100
Copper	mg/l	0.03		<0.027
Cyanide (Total)	mg/l	0.01		<0.05
Dissolved Oxygen	%	NAC		
Fluoride	mgF/l			0.21
Groundwater Level	m	-		
Iron	mg/l	0.2		0.2
Lead	mg/l	0.01		<0.006
Magnesium	mg/l	50		20.3
Mercury	mg/l	0.001		<0.0001
Mn (Dissolved				
Nickel	mg/l	0.02		0.206
Nitrate	mg/l		0.55	
Nitrite	mg/l		1.3	
pH Value	Units	6.5 - 9.5	7.69	6.85
Phenol	ug/l			
Potassium	mg/l	5		4.07
Sodium	mg/l	150		25
Solids Suspended		-		
Solids Total	mg/l			
Sulphate	mg/l	200		198
Surfactant Anionic	ug/l			
Temperature	°C	25	13.7	12.8
Tin	mg/l			<0.007
Total Organic Carbon	mg/l	NAC		
Total Oxidised Nitrogen (TON)	mg/l	NAC	0.55	1.53
Total Phosphorus	mg/l	0.01		0.44
Zinc	mg/l	0.1		0.0437

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 16th June and 10th November 2015.

APPENDIX F – SURFACE WATER MONITORING RESULTS

Biannual/Annual Surface Water Monitoring Results 2015

Parameter	Unit	EPA IGV	SS1		SS2		SS4		SS6		SS7	
			June	Nov	June	Nov	June	Nov	June	Nov	June	Nov
Ammonia	mg/l	0.02	0.16	0.1	0.05	0.1	0.08	0.1	n/a	n/a	n/a	n/a
Arsenic	ug/l	20		<0.001		<0.001		0.001		n/a		n/a
BOD Total 5 Day with ATU	mg/l	≤4	2.2	2	2.1	2	3.6	2	n/a	n/a	n/a	n/a
Boron	ug/l	1000		<0.23		<0.23		<0.23		n/a		n/a
Cadmium	ug/l	5		<0.0006		<0.0006		<0.0006		n/a		n/a
Calcium	mg/l	200		138		54.6		86.2		n/a		n/a
Chloride	mg/l	30										
Chromium	ug/l	30		<0.002		<0.002		0.002		n/a		n/a
COD Total	mg/l	-	23	33	29	12	16	24	n/a	n/a	n/a	n/a
Conductivity	uS/cm	1000		840		376		569		n/a		n/a
Copper	ug/l	30		0.009		0.009		0.009		n/a		n/a
Cyanide (Total)	mg/l	0.01		<0.05		<0.05		<0.05		n/a		n/a
Dissolved Oxygen	%	NAC	42	38	58	41	39	38	n/a	n/a	n/a	n/a
Fluoride	mgF/l	5.0		0.13		0.08		0.11		n/a		n/a
Groundwater Level	m	-										
Iron	ug/l	200		0.727		0.277		0.54		n/a		n/a
Lead	ug/l	10		<0.006		<0.006		<0.006		n/a		n/a
Magnesium	mg/l	50		11.5		5.51		9.49		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		0.004		0.0183		0.0112		n/a		n/a
Nitrate	mg/l	-		1.9		0.27		0.62		n/a		n/a
Nitrite	mg/l	-		0.02		0.02		0.02		n/a		n/a
pH Value	Units	6.5 - 9.5	7.67	7.56	7.87	7.62	7.76	7.54	n/a	n/a	n/a	n/a
Phenol	ug/l											
Potassium	mg/l	5		7.01		1.3		4.29		n/a		n/a
Sodium	mg/l	150		27.4		12.4		21.3		n/a		n/a
Solids Suspended		50	6	25	7.6	25	3.2	25	n/a	n/a	n/a	n/a
Solids Total	mg/l											
Sulphate	mg/l	200		64		31		63		n/a		n/a
Surfactant Anionic	ug/l											
Temperature	OC	25	14.7	13.6	13.7	13.3	14.1	13.6	n/a	n/a	n/a	n/a
Tin	ug/l	-		<0.007		<0.007		<0.007		n/a		n/a
Total Organic Carbon	mg/l	NAC										
Total Oxidised Nitrogen (TON)	mg/l	NAC		1.9		0.27		0.62		n/a		n/a
Total Phosphorus	mg/l	-		0.11		0.06		0.20		n/a		n/a
Zinc	ug/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 16th June and on 10th November 2015.

APPENDIX G – COPIES OF LABORATORY REPORTS

Groundwater Monitoring Test Reports

BHP/CL/02C

TEST REPORT 117873.3

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/06/495
Order No.:
Date Received: 16/06/15
Date Completed: 25/06/15
Test Specification: Nil
Item: Biannual GW 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 BH3				
Water Level		m	1.55	16/06/2015	ISO 5667 - 11
pH		-	6.91	16/06/2015	APHA - 4500 - H^+
Temperature		°C	11.6	16/06/2015	APHA - 2550 - B
Total Ammonia (as NH_3-N)		mg/L	27	17/06/2015	APHA - 4500 - NH_3 - G
Conductivity		µS/cm (25 °C)	7133	16/06/2015	APHA - 2510 - B
T.O.C		mg/L	100	25/06/2015	APHA - 5310 - C
Phenols		mg/L	<0.001	18/06/2015	APHA - 5530 - D
Salinity		mg/L	5408	08/07/2015	Calculation
Nitrite (as N)		mg/L	<0.05	25/06/2015	APHA - 4110 - B
Nitrate (as N)		mg/L	1.6	25/06/2015	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/L	1.60	25/06/2015	APHA - 4110 - B
Chloride		mg/L	2283	25/06/2015	APHA - 4500 - Cl^- - E

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

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 08/07/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT 119906.3

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/230
Order No.:
Date Received: 09/12/15
Date Completed: 16/12/15
Test Specification: Nil
Item: Biannual GW 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 BH3				
Water Level		m	1.34	09/12/2015	ISO 5667 - 11
pH		-	6.68	09/12/2015	BHP AC 067
Temperature		°C	11.1	09/12/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	22	10/12/2015	BHP AC 095
Conductivity		µS/cm (25 °C)	14703	09/12/2015	BHP AC 067
Total Organic Carbon		mg/L	109	11/12/2015	BHP AC 016
Phenols		mg/L	<0.001	10/12/2015	BHP AC 044
Salinity		ppt	12.0	09/12/2015	Calculation
Nitrite (as N)		mg/L	<0.02	09/12/2015	BHP AC 019
Nitrate (as N)		mg/L	3.13	09/12/2015	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	3.13	09/12/2015	BHP AC 065
Chloride		mg/L	4443	16/12/2015	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 23/12/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT NO: 119907.3

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/235
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

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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				
Tin		mg/L	<0.007	18/12/2015	WAS049*
Zinc		mg/L	0.0482	18/12/2015	WAS049*
Sulphate (as SO_4)		mg/L	29.0	16/12/2015	BHP AC 095
Total Phosphorus (as P)		mg/L	<0.06	10/12/2015	BHP AC 010
Residue on Evaporation		mg/L	15,850	10/12/2015	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.002	08/01/2016	GEO32*
Chloromethane		mg/L	<0.002	08/01/2016	GEO32*
Chloroethane		mg/L	<0.002	08/01/2016	GEO32*
Bromomethane		mg/L	<0.002	08/01/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.002	08/01/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.002	08/01/2016	GEO32*
Dichloromethane		mg/L	<0.002	08/01/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.002	08/01/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.002	08/01/2016	GEO32*
2,2-Dichloropropane		mg/L	<0.002	08/01/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT NO: 119907.3

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/235
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
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	6	09/12/2015	BHP AC 067
Detergents (as MBAS)		mg/L	<0.002	14/12/2015	BHP AC 071
Arsenic		mg/L	0.053	24/12/2015	WAS060*
Boron		mg/L	0.755	18/12/2015	WAS049*
Cadmium		mg/L	<0.0006	24/12/2015	WAS049*
Calcium		mg/L	190	18/12/2015	WAS049*
Chromium		mg/L	0.0164	18/12/2015	WAS049*
Copper		mg/L	0.0193	18/12/2015	WAS049*
Cyanide		mg/L	<0.05	11/12/2015	BHP AC 095
Fluoride		mg/L	<0.05	14/12/2015	BHP AC 019
Iron		mg/L	16.2	18/12/2015	WAS049*
Lead		mg/L	0.0218	18/12/2015	WAS049*
Magnesium		mg/L	20.8	18/12/2015	WAS049*
Mercury		mg/L	<0.0001	18/12/2015	WAS013*
Nickel		mg/L	0.0279	18/12/2015	WAS049*
Potassium		mg/L	74.4	18/12/2015	WAS049*
Sodium		mg/L	1600	18/12/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT 117873.4

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/06/496
Order No.:
Date Received: 16/06/15
Date Completed: 06/07/15
Test Specification: Nil
Item: Biannual GW Monitoring

TEST	Client Reference	Units	Results	Date Analysed
	Biannual Landfill Monitoring BH4			
Water Level		m	0.37	16/06/2015
pH		-	7.26	16/06/2015
Temperature		°C	11.6	16/06/2015
Total Ammonia (as NH_3-N)		mg/L	20	17/06/2015
Conductivity		µS/cm (25 °C)	9697	16/06/2015
T.O.C		mg/L	117	25/06/2015
Phenols		mg/L	<0.001	18/06/2015
Salinity		mg/L	7523	08/07/2015
Nitrite (as N)		mg/L	<0.05	06/07/2015
Nitrate (as N)		mg/L	<0.5	06/07/2015
Total Oxidised Nitrogen (as N)		mg/L	<0.55	06/07/2015
Chloride		mg/L	2349	25/06/2015

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

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 08/07/15

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BHP/CL/02C

TEST REPORT 119906.4

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 15/12/231
Order No.:
Date Received: 09/12/15
Date Completed: 16/12/15
Test Specification: Nil
Item: Biannual GW Monitoring

FTAO: Ailish Johnson

TEST	Client Reference	Units	Results	Date Analysed
	Biannual Landfill Monitoring BH4			
Water Level		m	0.05	09/12/2015
pH		-	7.00	09/12/2015
Temperature		°C	11.1	09/12/2015
Total Ammonia (as NH_3-N)		mg/L	17	10/12/2015
Conductivity		µS/cm (25 °C)	9360	09/12/2015
Total Organic Carbon		mg/L	114	11/12/2015
Phenols		mg/L	0.031	10/12/2015
Salinity		ppt	7.3	09/12/2015
Nitrite (as N)		mg/L	<0.02	09/12/2015
Nitrate (as N)		mg/L	2.59	09/12/2015
Total Oxidised Nitrogen (as N)		mg/L	2.59	09/12/2015
Chloride		mg/L	5535	16/12/2015

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 23/12/15

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BHP/CL/02C

TEST REPORT NO: 119907.4

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/236
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

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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				
Tin		mg/L	<0.007	18/12/2015	WAS049*
Zinc		mg/L	0.0515	18/12/2015	WAS049*
Sulphate (as SO_4)		mg/L	26.3	16/12/2015	BHP AC 095
Total Phosphorus (as P)		mg/L	<0.06	10/12/2015	BHP AC 010
Residue on Evaporation		mg/L	12,112	10/12/2015	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloromethane		mg/L	0.001	08/01/2016	GEO32*
Chloroethane		mg/L	0.001	08/01/2016	GEO32*
Bromomethane		mg/L	<0.001	08/01/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
Dichloromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	08/01/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
2,2-Dichloropropane		mg/L	<0.001	08/01/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT NO: 119907.4

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/236
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

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New Road
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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	11	09/12/2015	BHP AC 067
Detergents (as MBAS)		mg/L	<0.002	14/12/2015	BHP AC 071
Arsenic		mg/L	0.041	24/12/2015	WAS060*
Boron		mg/L	1.16	18/12/2015	WAS049*
Cadmium		mg/L	<0.0006	24/12/2015	WAS049*
Calcium		mg/L	270	18/12/2015	WAS049*
Chromium		mg/L	0.015	18/12/2015	WAS049*
Copper		mg/L	0.021	18/12/2015	WAS049*
Cyanide		mg/L	<0.05	11/12/2015	BHP AC 095
Fluoride		mg/L	<0.05	14/12/2015	BHP AC 019
Iron		mg/L	20.3	18/12/2015	WAS049*
Lead		mg/L	0.02	18/12/2015	WAS049*
Magnesium		mg/L	278	18/12/2015	WAS049*
Mercury		mg/L	<0.0001	18/12/2015	WAS013*
Nickel		mg/L	0.0335	18/12/2015	WAS049*
Potassium		mg/L	103	18/12/2015	WAS049*
Sodium		mg/L	2170	18/12/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

Analysing
Testing
Consulting
Calibrating

TEST REPORT 117873.5

BHP
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Fax + 353 61 455447
E Mail bhpcem2@bhp.ie

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 15/06/497
Order No.:
Date Received: 16/06/15
Date Completed: 25/06/15
Test Specification: Nil
Item: Biannual GW Monitoring

Standard Reference*	TEST	Client Reference	Units	Results	Date Analysed
		Biannual Landfill Monitoring BH5			
ISO 5667 - 11	Water Level		m	0.81	16/06/2015
APHA - 4500 - H^+	pH		-	7.08	16/06/2015
APHA - 2550 - B	Temperature		°C	11.8	16/06/2015
APHA - 4500 - NH_3 - G	Total Ammonia (as NH_3-N)		mg/L	18	17/06/2015
APHA - 2510 - B	Conductivity		µS/cm (25 °C)	14200	16/06/2015
APHA - 5310 - C	T.O.C		mg/L	74	25/06/2015
APHA - 5530 - D	Phenols		mg/L	<0.001	18/06/2015
Calculation	Salinity		mg/L	11299	08/07/2015
APHA - 4110 - B	Nitrite (as N)		mg/L	<0.05	25/06/2015
APHA - 4110 - B	Nitrate (as N)		mg/L	<0.5	25/06/2015
APHA - 4110 - B	Total Oxidised Nitrogen (as N)		mg/L	<0.55	25/06/2015
APHA - 4500 - Cl^- - E	Chloride		mg/L	2027	25/06/2015

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

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 08/07/15

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BHP/CL/02C

Analysing
Testing
Consulting
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Tel +353 61 455399
Fax + 353 61 455447

TEST REPORT 119906.5

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/12/232
Order No.:
Date Received: 09/12/15
Date Completed: 16/12/15
Test Specification: Nil
Item: Biannual GW Monitoring

Test Method	TEST	Client Reference	Units	Results	Date Analysed
		Biannual Landfill Monitoring BH5			
ISO 5667 - 11	Water Level		m	0.60	09/12/2015
BHP AC 067	pH		-	6.66	09/12/2015
BHP AC 067	Temperature		°C	11.0	09/12/2015
BHP AC 095	Total Ammonia (as NH_3-N)		mg/L	19	10/12/2015
BHP AC 067	Conductivity		µS/cm (25 °C)	11061	09/12/2015
BHP AC 016	Total Organic Carbon		mg/L	145	11/12/2015
BHP AC 044	Phenols		mg/L	0.029	10/12/2015
Calculation	Salinity		ppt	8.8	09/12/2015
BHP AC 019	Nitrite (as N)		mg/L	<0.02	09/12/2015
BHP AC 019	Nitrate (as N)		mg/L	13.17	09/12/2015
BHP AC 065	Total Oxidised Nitrogen (as N)		mg/L	13.17	09/12/2015
BHP AC 019	Chloride		mg/L	3623	16/12/2015

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 23/12/15

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BHP/CL/02C

TEST REPORT NO: 119907.5

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/237
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

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New Road
Thomondgate
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Tel +353 61 455399
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TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH5				
Tin		mg/L	<0.007	18/12/2015	WAS049*
Zinc		mg/L	0.0693	18/12/2015	WAS049*
Sulphate (as SO_4)		mg/L	17.9	16/12/2015	BHP AC 095
Total Phosphorus (as P)		mg/L	<0.06	10/12/2015	BHP AC 010
Residue on Evaporation		mg/L	12,980	10/12/2015	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloroethane		mg/L	<0.001	08/01/2016	GEO32*
Bromomethane		mg/L	<0.001	08/01/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
Dichloromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	08/01/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
2,2-Dichloropropane		mg/L	<0.001	08/01/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT NO: 119907.5

Analysing
Testing
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Fax + 353 61 455447

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

BHP Ref. No.: 15/12/237
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring BH5				
Dissolved Oxygen		% O_2 sat	5	09/12/2015	BHP AC 067
Detergents (as MBAS)		mg/L	<0.002	14/12/2015	BHP AC 071
Arsenic		mg/L	0.037	24/12/2015	WAS060*
Boron		mg/L	0.818	18/12/2015	WAS049*
Cadmium		mg/L	<0.0006	24/12/2015	WAS049*
Calcium		mg/L	215	18/12/2015	WAS049*
Chromium		mg/L	0.0214	18/12/2015	WAS049*
Copper		mg/L	0.0246	18/12/2015	WAS049*
Cyanide		mg/L	<0.05	11/12/2015	BHP AC 095
Fluoride		mg/L	0.32	14/12/2015	BHP AC 019
Iron		mg/L	18.4	18/12/2015	WAS049*
Lead		mg/L	0.0333	18/12/2015	WAS049*
Magnesium		mg/L	173	18/12/2015	WAS049*
Mercury		mg/L	<0.0001	18/12/2015	WAS013*
Nickel		mg/L	0.0398	18/12/2015	WAS049*
Potassium		mg/L	72.9	18/12/2015	WAS049*
Sodium		mg/L	1330	18/12/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT 117873.1

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/06/493
Order No.:
Date Received: 16/06/15
Date Completed: 25/06/15
Test Specification: Nil
Item: Biannual GW Monitoring

FTAO: Ailish Johnson

BHP
New Road
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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 RD2				
Water Level		m	1.4	16/06/2015	ISO 5667 - 11
pH		-	7.84	16/06/2015	APHA - 4500 - H^+
Temperature		°C	12.5	16/06/2015	APHA - 2550 - B
Total Ammonia (as NH_3-N)		mg/L	14	17/06/2015	APHA - 4500 - NH_3 - G
Conductivity		µS/cm (25 °C)	3209	16/06/2015	APHA - 2510 - B
T.O.C		mg/L	30	25/06/2015	APHA - 5310 - C
Phenols		mg/L	<0.001	18/06/2015	APHA - 5530 - D
Salinity		mg/L	2253	08/07/2015	Calculation
Nitrite (as N)		mg/L	<0.05	06/07/2015	APHA - 4110 - B
Nitrate (as N)		mg/L	<0.5	06/07/2015	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/L	<0.55	06/07/2015	APHA - 4110 - B
Chloride		mg/L	409	24/06/2015	APHA - 4500 - Cl^- - E

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

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 08/07/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT 119906.1

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/228
Order No.:
Date Received: 09/12/15
Date Completed: 16/12/15
Test Specification: Nil
Item: Biannual GW Monitoring

FTAO: Ailish Johnson

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New Road
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Tel +353 61 455399
Fax + 353 61 455447

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring RD2				
Water Level		m	0.67	09/12/2015	ISO 5667 - 11
pH		-	7.54	09/12/2015	BHP AC 067
Temperature		°C	11.1	09/12/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	15	10/12/2015	BHP AC 095
Conductivity		µS/cm (25 °C)	3700	09/12/2015	BHP AC 067
Total Organic Carbon		mg/L	23	11/12/2015	BHP AC 016
Phenols		mg/L	0.022	10/12/2015	BHP AC 044
Salinity		ppt	2.7	09/12/2015	Calculation
Nitrite (as N)		mg/L	<0.02	09/12/2015	BHP AC 019
Nitrate (as N)		mg/L	<0.12	09/12/2015	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	<0.14	09/12/2015	BHP AC 065
Chloride		mg/L	954	16/12/2015	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 23/12/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT NO: 119907.1

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/12/233
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
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 RD2				
Tin		mg/L	<0.007	18/12/2015	WAS049*
Zinc		mg/L	0.0203	18/12/2015	WAS049*
Sulphate (as SO_4)		mg/L	69.5	16/12/2015	BHP AC 095
Total Phosphorus (as P)		mg/L	0.66	10/12/2015	BHP AC 010
Residue on Evaporation		mg/L	2,232	10/12/2015	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloroethane		mg/L	<0.001	08/01/2016	GEO32*
Bromomethane		mg/L	<0.001	08/01/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
Dichloromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	08/01/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
2,2-Dichloropropane		mg/L	<0.001	08/01/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT NO: 119907.1

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/12/233
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

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

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD2				
Dissolved Oxygen		% O_2 sat	36	09/12/2015	BHP AC 067
Detergents (as MBAS)		mg/L	0.012	14/12/2015	BHP AC 071
Arsenic		mg/L	0.011	24/12/2015	WAS060*
Boron		mg/L	0.729	18/12/2015	WAS049*
Cadmium		mg/L	<0.0006	24/12/2015	WAS049*
Calcium		mg/L	57.5	18/12/2015	WAS049*
Chromium		mg/L	0.0043	18/12/2015	WAS049*
Copper		mg/L	<0.009	18/12/2015	WAS049*
Cyanide		mg/L	<0.05	11/12/2015	BHP AC 095
Fluoride		mg/L	0.43	14/12/2015	BHP AC 019
Iron		mg/L	1.9	18/12/2015	WAS049*
Lead		mg/L	<0.006	18/12/2015	WAS049*
Magnesium		mg/L	62.5	18/12/2015	WAS049*
Mercury		mg/L	<0.0001	18/12/2015	WAS013*
Nickel		mg/L	0.012	18/12/2015	WAS049*
Potassium		mg/L	46.7	18/12/2015	WAS049*
Sodium		mg/L	677	18/12/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT 117873.2

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/06/494
Order No.:
Date Received: 16/06/15
Date Completed: 06/07/15
Test Specification: Nil
Item: Biannual GW Monitoring

FTAO: Ailish Johnson

BHP
New Road
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Limerick
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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 RD3				
Water Level		m	0.83	16/06/2015	ISO 5667 - 11
pH		-	7.95	16/06/2015	APHA - 4500 - H^+
Temperature		°C	12.9	16/06/2015	APHA - 2550 - B
Total Ammonia (as NH_3-N)		mg/L	0.81	17/06/2015	APHA - 4500 - NH_3 - G
Conductivity		µS/cm (25 °C)	2752	16/06/2015	APHA - 2510 - B
T.O.C		mg/L	36	25/06/2015	APHA - 5310 - C
Phenols		mg/L	<0.001	18/06/2015	APHA - 5530 - D
Salinity		mg/L	1895	08/07/2015	Calculation
Nitrite (as N)		mg/L	<0.05	06/07/2015	APHA - 4110 - B
Nitrate (as N)		mg/L	<0.5	06/07/2015	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/L	<0.55	06/07/2015	APHA - 4110 - B
Chloride		mg/L	417	24/06/2015	APHA - 4500 - Cl^- - E

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

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 08/07/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT 119906.2

Analysing
Testing
Consulting
Calibrating

BHP
New Road
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Tel +353 61 455399
Fax + 353 61 455447

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

BHP Ref. No.: 15/12/229
Order No.:
Date Received: 09/12/15
Date Completed: 16/12/15
Test Specification: Nil
Item: Biannual GW Monitoring

FTAO: Ailish Johnson

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring RD3				
Water Level		m	0.30	09/12/2015	ISO 5667 - 11
pH		-	7.64	09/12/2015	BHP AC 067
Temperature		°C	11.0	09/12/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	1.0	10/12/2015	BHP AC 095
Conductivity		µS/cm (25 °C)	2534	09/12/2015	BHP AC 067
Total Organic Carbon		mg/L	9.0	11/12/2015	BHP AC 016
Phenols		mg/L	0.029	10/12/2015	BHP AC 044
Salinity		ppt	<2	09/12/2015	Calculation
Nitrite (as N)		mg/L	<0.02	09/12/2015	BHP AC 019
Nitrate (as N)		mg/L	<0.12	09/12/2015	BHP AC 019
Total Oxidised Nitrogen (as N)		mg/L	<0.14	09/12/2015	BHP AC 065
Chloride		mg/L	381	16/12/2015	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date 23/12/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT NO: 119907.2

Analysing
Testing
Consulting
Calibrating

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

BHP Ref. No.: 15/12/234
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

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

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD3				
Tin		mg/L	<0.007	18/12/2015	WAS049*
Zinc		mg/L	<0.018	18/12/2015	WAS049*
Sulphate (as SO_4)		mg/L	72.0	16/12/2015	BHP AC 095
Total Phosphorus (as P)		mg/L	0.11	10/12/2015	BHP AC 010
Residue on Evaporation		mg/L	1,632	10/12/2015	BHP AC 040
Volatile Organic Compounds					
Dichlorodifluoromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloromethane		mg/L	<0.001	08/01/2016	GEO32*
Chloroethane		mg/L	<0.001	08/01/2016	GEO32*
Bromomethane		mg/L	<0.001	08/01/2016	GEO32*
Trichlorofluoromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
Dichloromethane		mg/L	<0.001	08/01/2016	GEO32*
1,1-Dichloroethane		mg/L	<0.001	08/01/2016	GEO32*
cis-1,2-Dichloroethene		mg/L	<0.001	08/01/2016	GEO32*
2,2-Dichloropropane		mg/L	<0.001	08/01/2016	GEO32*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

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BHP/CL/02C

TEST REPORT NO: 119907.2

Analysing
Testing
Consulting
Calibrating

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Fax + 353 61 455447

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

BHP Ref. No.: 15/12/234
Order No.:
Date Received: 09/12/15
Date Completed: 08/01/16
Test Specification: Nil
Item: Groundwater

FTAO: Ailish Johnson

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring RD3				
Dissolved Oxygen		% O_2 sat	9	09/12/2015	BHP AC 067
Detergents (as MBAS)		mg/L	<0.002	14/12/2015	BHP AC 071
Arsenic		mg/L	0.003	24/12/2015	WAS060*
Boron		mg/L	<0.23	18/12/2015	WAS049*
Cadmium		mg/L	<0.0006	24/12/2015	WAS049*
Calcium		mg/L	46.6	18/12/2015	WAS049*
Chromium		mg/L	0.0047	18/12/2015	WAS049*
Copper		mg/L	<0.009	18/12/2015	WAS049*
Cyanide		mg/L	<0.05	11/12/2015	BHP AC 095
Fluoride		mg/L	0.36	14/12/2015	BHP AC 019
Iron		mg/L	1.1	18/12/2015	WAS049*
Lead		mg/L	<0.006	18/12/2015	WAS049*
Magnesium		mg/L	18.3	18/12/2015	WAS049*
Mercury		mg/L	<0.0001	18/12/2015	WAS013*
Nickel		mg/L	0.0133	18/12/2015	WAS049*
Potassium		mg/L	7.05	18/12/2015	WAS049*
Sodium		mg/L	560	18/12/2015	WAS049*

Additional information : *Subcontracted to an approved accredited supplier

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date : 29/01/16

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

Leachate Monitoring Test Reports

BHP/CL/02C

Analysing
Testing
Consulting
Calibrating

TEST REPORT 117872.6

BHP
New Road
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Tel +353 61 455399
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E Mail bhpcem2@bhp.ie

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 15/06/492
Order No.:
Date Received: 16/06/15
Date Completed: 06/07/15
Test Specification: Nil
Item: Biannual Leachate

Standard Reference	TEST	Client Reference	Units	Results	Date Analysed
		Biannual Landfill Monitoring SS3-2015			
APHA - 4500 - H^+	pH		-	7.69	16/06/2015
APHA - 2550 - B	Temperature		°C	13.7	16/06/2015
APHA - 4500 - NH_3 - G	Total Ammonia (as NH_3-N)		mg/L	4.3	17/06/2015
APHA - 2510 - B	Conductivity		µS/cm (25 °C)	977	16/06/2015
APHA - 5210 - B	B.O.D		mg/L	13	17/06/2015
APHA - 5220 - D	C.O.D		mg/L	82	17/06/2015
APHA - 4110 - B	Total Oxidised Nitrogen (as N)		mg/L	<0.55	06/07/2015
APHA - 4500 - Cl^- - E	Chloride		mg/L	57	23/06/2015

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

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 16/07/15

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BHP/CL/02C

TEST REPORT 119592.6

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/11/307
Order No.:
Date Received: 10/11/15
Date Completed: 17/11/15
Test Specification: Nil
Item: Biannual Leachate

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

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Biannual Landfill Monitoring SS3-2015				
pH		-	6.85	10/11/2015	BHP AC 067
Temperature		°C	12.8	10/11/2015	BHP AC 067
Total Ammonia (as NH_3-N)		mg/L	0.51	11/11/2015	BHP AC 095
Conductivity		µS/cm (25 °C)	1100	10/11/2015	BHP AC 067
B.O.D		mg/L	3.0	11/11/2015	BHP AC 005
C.O.D		mg/L	52	11/11/2015	BHP AC 006
Total Oxidised Nitrogen (as N)		mg/L	1.53	12/11/2015	BHP AC 065
Chloride		mg/L	81	17/11/2015	BHP AC 019

Additional information :

For and on behalf of BHP laboratories :

John O'Halloran
Issue Date 21/12/15

This Test Report shall not be duplicated except in full and then only with the permission of the test laboratory

BHP/CL/02C

TEST REPORT NO.: 119593

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/11/308
Order No.:
Date Received: 10/11/15
Date Completed: 21/12/15
Test Specification: Nil
Item: Tradaree Leachate

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 SS3				
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	187	19/11/2015	WAS049*
Chromium		mg/L	<0.002	19/11/2015	WAS049*
Copper		mg/L	0.0273	19/11/2015	WAS049*
Cyanide		mg/L	<0.05	21/12/2015	BHP AC 095
Fluoride		mg/L	0.21	12/11/2015	BHP AC 019
Iron		mg/L	<0.23	19/11/2015	WAS049*
Lead		mg/L	<0.006	19/11/2015	WAS049*
Magnesium		mg/L	20.3	19/11/2015	WAS049*

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 21/12/2015

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

BHP/CL/02C

TEST REPORT NO.: 119593

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 15/11/308
Order No.:
Date Received: 10/11/15
Date Completed: 21/12/15
Test Specification: Nil
Item: Tradaree Leachate

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

TEST	Client Reference	Units	Results	Date Analysed	Test Method
	Annual Landfill Monitoring SS3				
Mercury		mg/L	<0.0001	13/11/2015	WAS013*
Nickel		mg/L	0.206	19/11/2015	WAS049*
Potassium		mg/L	4.07	19/11/2015	WAS049*
Sodium		mg/L	25.4	19/11/2015	WAS049*
Tin		mg/L	0.0	19/11/2015	WAS049*
Zinc		mg/L	0.0437	19/11/2015	WAS049*
Sulphate (as SO_4)		mg/L	198	27/11/2015	BHP AC 019
Total Phosphorus (as P)		mg/L	0.44	26/11/2015	BHP AC 010
Detergents		mg/L	0.035	19/11/2015	BHP AC 071

Additional information :

For and on behalf of BHP laboratories :

John O' Halloran
Issue Date : 21/12/2015

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
Thomondgate
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
Thomondgate
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

BHP/CL/02C

TEST REPORT NO: 119591.2

Analysing
Testing
Consulting
Calibrating

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New Road
Thomondgate
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Tel +353 61 455399
Fax + 353 61 455447

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

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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

BHP/CL/02C

TEST REPORT 117871.2

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

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

FTAO: Ailish Johnson

BHP
New Road
Thomondgate
Limerick
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
Thomondgate
Limerick
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
Thomondgate
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

BHP/CL/02C

TEST REPORT NO: 119591.5

Analysing
Testing
Consulting
Calibrating

BHP
New Road
Thomondgate
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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
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Tel +353 61 455399
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

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

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New Road
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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

BHP/CL/02C

TEST REPORT NO: 119591.6

Analysing
Testing
Consulting
Calibrating

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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

Test results relate only to this/these items. This test report shall not be duplicated in full without the permission of the test laboratory.

Appendix H – Meteorological Data

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	1	1	85.5	1013	15.5	240	1	1.3
2015	1	2	98	1024.6	11.4	260	1.2	1.4
2015	1	3	94.2	1020.1	8.1	30	0.1	0.2
2015	1	4	88.4	1026.4	7.3	150	0.2	0.2
2015	1	5	91	1016.3	10.5	270	0.5	0.6
2015	1	6	92.8	1014	9.1	290	0.3	0.4
2015	1	7	94.8	1009	15.6	220	0.8	1.1
2015	1	8	92.8	1015.2	12.2	230	0.7	0.9
2015	1	9	97.2	1010.8	23.5	240	0.9	1.3
2015	1	10	86.2	1011.2	19.7	230	1.1	1.4
2015	1	11	92.1	1013.9	16.8	270	1.1	1.5
2015	1	12	87.7	1000.9	15.7	220	1	1.3
2015	1	13	93.3	995.7	12.5	240	0.6	0.8
2015	1	14	85.7	983.5	17.4	240	0.6	0.9
2015	1	15	93	983.7	20.1	230	1.2	1.6
2015	1	16	96.8	1002	8	220	0.4	0.5
2015	1	17	94.9	1009.2	6.5	230	0.3	0.4
2015	1	18	93.1	1016.7	6.8	360	0.2	0.3
2015	1	19	95.2	1012.2	8.1	110	0.2	0.4
2015	1	20	79.9	1001.8	5.2	280	0.4	0.5
2015	1	21	90.4	1007.9	5.5	290	0.3	0.4
2015	1	22	97.8	1016.4	6.3	140	0.3	0.4
2015	1	23	87.6	1017.8	9.2	290	0.5	0.7
2015	1	24	89.3	1025.7	6.2	230	0.7	0.9
2015	1	25	90.2	1023.6	9.8	220	0.6	0.8
2015	1	26	90.4	1025.6	8.4	280	0.6	0.7
2015	1	27	80	1020.4	7.4	230	0.3	0.5
2015	1	28	78.9	1003.8	21	250	0.7	1.1
2015	1	29	86	990.2	19.7	300	1.3	1.8
2015	1	30	74.5	986.8	12	290	0.7	0.9
2015	1	31	77.2	999	11.8	330	0.8	1
January							**19.6**	**26.2**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	2	1	83.8	1008.7	4.4	300	0.5	0.7
2015	2	2	84.4	1007.7	1.8	110	0.3	0.5
2015	2	3	97.4	1013.7	5.8	0	0.4	0.6
2015	2	4	79.7	1025.7	4.7	330	0.4	0.6
2015	2	5	81.2	1030.6	3.8	330	0.3	0.5
2015	2	6	78.9	1033.6	4.7	40	0.5	0.6
2015	2	7	86.1	1038.6	5.7	30	0.6	0.8
2015	2	8	85.2	1040.3	2.9	320	0.2	0.4
2015	2	9	93.2	1035.8	3	240	0.6	0.8
2015	2	10	88.2	1027.2	6	110	0.5	0.7
2015	2	11	93.1	1019.5	6	110	0.6	0.7
2015	2	12	93.6	1006.3	12.1	150	0.9	1.2
2015	2	13	97	993.2	9.7	150	0.6	0.9
2015	2	14	87.6	1002.7	4.8	100	0.5	0.8
2015	2	15	89	1006.8	9.6	160	0.5	0.7
2015	2	16	89.9	1018.1	6.7	300	0.5	0.7
2015	2	17	77.6	1031.2	8	210	0.8	1
2015	2	18	76.3	1024	11.4	180	0.9	1.2
2015	2	19	81.6	1012.5	9.9	240	0.6	0.9
2015	2	20	80.4	1005.8	8.4	290	0.8	1.1
2015	2	21	70.4	1005.3	9	290	0.8	1.2
2015	2	22	64.2	996.3	16.6	250	0.9	1.3
2015	2	23	69.1	986.5	24.4	270	1.1	1.9
2015	2	24	75.1	1000.6	14.1	280	0.8	1.2
2015	2	25	71.5	1009.8	14.7	230	0.4	0.8
2015	2	26	83	1010.8	14.3	260	0.8	1.3
2015	2	27	84.2	1011.7	11	170	0.7	1
2015	2	28	86.3	996.5	16.4	230	0.9	1.3
February							**17.4**	**25.4**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	3	1	81.1	994.5	13.7	290	1	1.4
2015	3	2	77.8	1002.1	15.9	260	1.1	1.7
2015	3	3	77.1	1014.8	13.3	270	1.1	1.6
2015	3	4	84.3	1028.4	7.8	260	1.1	1.5
2015	3	5	82.2	1031.5	10.7	210	1.5	1.9
2015	3	6	92.2	1021	13.9	180	1.8	2.4
2015	3	7	93.5	1010.8	16.9	200	1.4	2
2015	3	8	88.5	1016.6	8.4	270	1.1	1.5
2015	3	9	84.4	1014.5	18.2	230	1.2	1.9
2015	3	10	80.2	1023.8	8.7	130	1.4	2
2015	3	11	62.3	1014.9	14.5	130	1.1	1.8
2015	3	12	70.4	1014.2	11.1	120	0.7	1
2015	3	13	82.6	1025.9	2.6	230	1.1	1.7
2015	3	14	83.8	1030.9	5.6	100	1.5	2.2
2015	3	15	85.2	1028.2	6.6	110	1	1.4
2015	3	16	81.5	1021.8	5.3	100	0.9	1.2
2015	3	17	86.5	1024	3.5	100	1.4	2
2015	3	18	86.5	1031.4	2.5	110	1.3	1.8
2015	3	19	86.6	1033.2	3.3	280	1.3	1.9
2015	3	20	76	1029.4	6.6	310	1.2	1.8
2015	3	21	84.3	1028.4	5.8	20	1.6	2.3
2015	3	22	89.9	1021.7	6.3	260	1.5	2.2
2015	3	23	86.8	1015.5	9.6	280	1.4	2.2
2015	3	24	75.1	1014.2	8.5	340	1.3	1.9
2015	3	25	62.5	1005.5	10	150	0.5	0.9
2015	3	26	66.7	1006.5	12.9	290	1.4	2.4
2015	3	27	75.4	1012.4	8.4	150	1.1	1.6
2015	3	28	67.4	1004.6	20.8	240	1.6	2.7
2015	3	29	60.1	998.3	18.5	240	1.1	1.8
2015	3	30	55	1002.8	18	250	1.1	1.8
2015	3	31	75.1	1012.3	21.1	270	1.8	3.2
March							**38.6**	**57.7**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	4	1	63.5	1021.8	14.2	240	1.1	1.8
2015	4	2	56.2	1016.2	11.5	260	1.2	1.7
2015	4	3	57	1019.5	14.2	310	1.9	3.2
2015	4	4	55.8	1024.9	3.2	10	1.5	2.1
2015	4	5	63.9	1026.1	6	150	2.3	3.3
2015	4	6	64.2	1031.5	2.9	340	2.1	2.9
2015	4	7	69.5	1033.6	3.1	330	2.4	3.4
2015	4	8	65.3	1028.4	7.1	150	2.6	3.6
2015	4	9	66.3	1020.9	7	120	2.9	3.9
2015	4	10	85.2	1010	9.3	280	2.5	3.4
2015	4	11	89.4	1013.2	13.3	240	2.2	3.5
2015	4	12	79.7	1016.6	6.4	200	1.3	1.9
2015	4	13	90.4	1023.1	10.6	200	2	2.8
2015	4	14	76.2	1019.2	7.3	260	2	2.7
2015	4	15	77.8	1016	5.9	350	1.6	2.3
2015	4	16	64.3	1013.7	4.9	110	2.9	4
2015	4	17	86	1018.2	7.6	40	2.6	3.7
2015	4	18	81.2	1023.8	9.9	110	3.3	4.8
2015	4	19	74.8	1023.9	7.2	20	3	4.4
2015	4	20	76.5	1028.3	3.2	320	2.6	3.5
2015	4	21	80.4	1032.8	4.8	120	3.1	4.2
2015	4	22	88.6	1026.9	6.1	120	3.5	4.7
2015	4	23	85.8	1016.3	5.5	150	3	4.2
2015	4	24	91.7	1005.5	8.8	250	1.8	2.7
2015	4	25	80	1004.5	8.4	20	1.2	1.9
2015	4	26	75.1	1011.2	6.8	320	2.5	3.7
2015	4	27	69.1	1011.8	10.7	290	1.8	2.9
2015	4	28	77.4	1010.7	11.8	230	2	3.1
2015	4	29	71	1008.6	12.6	260	2.4	4
2015	4	30	76.2	1009.6	5.1	100	2.5	3.5
April							**67.8**	**97.8**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	5	1	76.8	1005.7	11.6	120	1.9	2.8
2015	5	2	78.5	996.7	13.2	130	0.9	1.3
2015	5	3	83	990.5	11.1	240	2.3	3.5
2015	5	4	85	991.7	11.2	170	2.3	3.4
2015	5	5	81.9	986	11.3	240	2.6	4
2015	5	6	77.2	998.8	14.6	270	2.4	4
2015	5	7	84.1	1011.4	4	20	3	4.1
2015	5	8	89.2	1007	7.9	40	1.1	1.5
2015	5	9	83.3	1010.9	5.6	150	2.5	3.5
2015	5	10	79.8	1008.9	13.6	170	1.5	2.2
2015	5	11	78.3	1007.4	17.1	230	3.4	5.5
2015	5	12	90.3	1014.8	12.7	250	2.8	4.5
2015	5	13	77.2	1012.1	9.5	110	3.7	5.4
2015	5	14	77.6	1008.1	10.5	110	2.3	3.1
2015	5	15	76.7	1018.2	10.2	240	1.5	2.2
2015	5	16	84.5	1023.9	12.9	280	2.8	4.3
2015	5	17	77.5	1017.2	12.7	260	1.9	3
2015	5	18	86.5	1004.9	16.1	270	2.5	4.7
2015	5	19	84.2	1008.8	14.5	290	2.8	4.7
2015	5	20	87.6	1018.8	9.7	280	2.2	3.4
2015	5	21	80.5	1024.1	9.7	250	2.1	3.3
2015	5	22	76	1025.8	9.6	250	2	3.1
2015	5	23	64.3	1023.4	7	250	2.2	3
2015	5	24	65.2	1020.5	10.5	290	2.1	3.2
2015	5	25	85.5	1021.8	10.8	290	2.1	3.2
2015	5	26	83.5	1026.2	8.1	270	3.4	5.2
2015	5	27	82.2	1021.2	9.9	270	1.6	2.6
2015	5	28	83	1011	11.2	280	2.5	3.9
2015	5	29	72.5	1008.5	11.3	290	3.1	5.3
2015	5	30	78.3	1005.3	10.1	140	1.3	2.2
2015	5	31	78.9	1004.7	14.2	260	2.4	4.3
May							**71.2**	**110.4**

Shannon Airport Weather Records 2015								
Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	6	1	80.9	999.2	14	190	1.3	2.2
2015	6	2	84.1	1000.5	16.2	240	2.7	4.8
2015	6	3	76.8	1015.9	7.2	260	2.6	3.8
2015	6	4	60.8	1015.8	10.4	150	2.6	3.8
2015	6	5	68.2	1010.8	16	240	3.2	5.5
2015	6	6	66.8	1020.9	15.8	240	2.6	4.2
2015	6	7	63.6	1032.6	6.9	320	4	5.9
2015	6	8	66.6	1035.9	6	20	3.3	4.7
2015	6	9	73.2	1033.7	5.2	320	4	5.7
2015	6	10	80.4	1027.7	5.3	20	4.2	5.8
2015	6	11	92	1018	7.1	60	3.1	4.4
2015	6	12	88.8	1010.7	7	20	2.2	3
2015	6	13	78.3	1011.4	8.4	350	2.6	3.8
2015	6	14	87.5	1016	5.2	330	3.5	5
2015	6	15	86	1019.9	4.9	260	3.7	5.1
2015	6	16	87.4	1021.4	6.9	250	2.5	3.3
2015	6	17	84	1021.7	10	270	2	2.9
2015	6	18	86.1	1023.9	9.5	270	2.9	4.3
2015	6	19	80.4	1023.2	8.2	250	2	2.9
2015	6	20	84.6	1019.7	11.8	260	3.2	4.8
2015	6	21	80	1015.2	11.7	270	2.2	3.4
2015	6	22	86.3	1013.9	6.8	320	3.4	4.9
2015	6	23	78	1015.8	3.6	250	2.8	3.8
2015	6	24	75.8	1015.4	5	120	2.9	3.9
2015	6	25	82.4	1012.1	11	160	2	2.7
2015	6	26	75.2	1010.2	11.8	260	3.8	6
2015	6	27	93.9	1010.9	11	190	2.2	3
2015	6	28	97	1012	13.7	250	3.4	5.3
2015	6	29	90.6	1013.8	12.2	150	2.6	3.8
2015	6	30	81	1009.9	9.9	160	3.1	4.2
June							**86.6**	**126.9**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	7	1	77.2	1007.7	3.6	210	2.1	2.7
2015	7	2	93.3	1013.6	8.2	170	3.3	4.7
2015	7	3	87.8	1012.1	14	140	3.6	5.2
2015	7	4	81.9	1007.8	12	240	3.2	4.9
2015	7	5	80	1011	7.3	240	3	4.2
2015	7	6	81.1	1006.2	12.8	120	2.6	3.7
2015	7	7	86.6	1004	16.9	240	2	3.4
2015	7	8	74.8	1013.8	11.2	300	1.9	2.8
2015	7	9	72.3	1018.8	7.2	160	2	2.7
2015	7	10	68.7	1012.5	10.9	160	2.1	2.9
2015	7	11	74.5	1010.3	11.4	200	1.4	2.2
2015	7	12	88.5	1011.6	9.6	250	2.8	3.9
2015	7	13	81.8	1010.4	8.5	250	2.2	3.2
2015	7	14	86.8	1016.2	4.6	30	2.2	2.9
2015	7	15	75.6	1018.3	4.3	160	3.7	4.9
2015	7	16	79.8	1006.8	12	110	1.9	2.6
2015	7	17	79.6	1004	19.2	240	2.7	4.8
2015	7	18	79	1008.6	11.5	220	2.1	2.9
2015	7	19	65.1	1006.8	7.9	260	2.3	3.4
2015	7	20	65.6	1002	12.8	230	2.5	3.9
2015	7	21	76.8	1006.6	9.9	230	2.6	3.9
2015	7	22	80.4	1013	9.4	250	2.9	4.1
2015	7	23	85.4	1013.7	6.6	240	2.5	3.4
2015	7	24	89.5	1013.2	9	310	2.9	4.3
2015	7	25	86.1	1010.5	6.5	130	2.5	3.6
2015	7	26	82.8	998	14	120	1.2	1.7
2015	7	27	85.5	1000.2	18.8	280	1.7	2.9
2015	7	28	85.9	1008.3	11.9	270	2.7	4.2
2015	7	29	80.7	1015.2	10	280	3.3	5
2015	7	30	77	1019	7.1	260	2.8	4
2015	7	31	92.7	1014.1	10.4	230	2.1	3.1
July							**76.8**	**112.1**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	8	1	93.5	1010.5	8.4	250	2.7	3.9
2015	8	2	77.8	1002.2	15.7	150	1.5	2.4
2015	8	3	81.5	997	18	200	3	4.9
2015	8	4	81.4	1001.2	17.3	240	2.3	3.7
2015	8	5	78	1001.9	9.1	140	1.2	1.7
2015	8	6	75.9	1010.1	5.6	290	2.6	3.6
2015	8	7	72.4	1018.2	4	290	2.8	3.8
2015	8	8	83.8	1018.4	9.3	190	1.7	2.7
2015	8	9	72.7	1012.8	7.2	250	2.4	3.3
2015	8	10	81.8	1012.5	11.2	240	2.4	3.9
2015	8	11	77.6	1020.1	4.2	300	1.8	2.5
2015	8	12	72.8	1022.5	3.3	330	2.1	2.8
2015	8	13	79.5	1016.6	5	290	2.9	4
2015	8	14	93.1	1010.8	9.7	290	3.2	5
2015	8	15	91.9	1011.4	8.2	250	2.8	4
2015	8	16	79.2	1013.8	6.7	130	1.3	1.9
2015	8	17	85.5	1015.7	6.6	130	2.4	3.3
2015	8	18	76.8	1012.1	5.5	170	2.3	3
2015	8	19	80.3	1007.7	9.1	240	1.5	2.1
2015	8	20	80.2	1008.4	11.6	240	2.7	3.7
2015	8	21	84.6	1009.2	9.3	220	2.5	3.6
2015	8	22	83.6	1007.5	5.1	120	1.7	2.3
2015	8	23	83	1000.8	8.5	300	1.6	2.1
2015	8	24	85.8	1000.5	9.7	260	2.9	4.4
2015	8	25	85.6	998	10.5	210	1.5	2.1
2015	8	26	86.8	994.3	10.8	240	2.6	3.8
2015	8	27	86.4	1000.8	11.6	250	2.7	4.3
2015	8	28	81.8	1007.7	11.6	250	2.4	3.4
2015	8	29	89.3	1013.7	6.8	250	2.6	3.7
2015	8	30	84.5	1017.2	3.7	140	1.8	2.4
2015	8	31	70.2	1018.8	4.5	30	1.9	2.5
August							**69.8**	**100.8**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	9	1	73.3	1021.8	6.8	310	2	2.8
2015	9	2	87.2	1021.5	6.2	300	1.7	2.3
2015	9	3	75.9	1020.8	7.9	320	1.6	2.1
2015	9	4	78.4	1022.4	8.4	340	2	2.7
2015	9	5	80.8	1025.9	7.5	360	2	3
2015	9	6	82.4	1030.1	2.5	330	1.1	1.5
2015	9	7	84.8	1029	3	100	1.3	1.8
2015	9	8	78.3	1023	12	130	2.9	4
2015	9	9	88.6	1016.8	11	120	2.3	3.1
2015	9	10	81.5	1012.1	12.4	140	1.9	2.5
2015	9	11	92.7	1003.2	11.1	270	1	1.6
2015	9	12	96	1001.4	10.1	230	1.9	2.7
2015	9	13	84.2	997.4	8.5	130	1	1.4
2015	9	14	80.4	994.2	9.5	290	0.9	1.4
2015	9	15	82	994.7	3.2	310	1.6	2.1
2015	9	16	71.2	992.2	5.1	290	1.3	1.8
2015	9	17	91.2	998.9	6	280	2	2.9
2015	9	18	77.3	1012.6	6	290	1.3	1.8
2015	9	19	79.2	1021.6	5	170	1.4	1.9
2015	9	20	75.7	1016.8	9	160	0.9	1.3
2015	9	21	88.3	1007.8	9.8	230	1.6	2.3
2015	9	22	82.5	1007.1	8.6	310	1.8	2.5
2015	9	23	86.3	1008.2	10.5	260	1.3	1.9
2015	9	24	90.2	1012	10.8	260	1.6	2.2
2015	9	25	90.7	1020.3	4.3	220	1	1.4
2015	9	26	87.8	1024.3	7.9	160	1.6	2
2015	9	27	87	1028.2	9.7	150	1.6	2.1
2015	9	28	75.2	1029.2	10.5	150	1.9	2.7
2015	9	29	79.6	1031.2	6.3	120	1.3	1.7
2015	9	30	93.7	1031.7	4.5	40	1.2	1.7
September							**47**	**65.2**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	10	1	89.8	1030.1	2.8	40	1	1.4
2015	10	2	86	1024.1	3	20	0.7	1
2015	10	3	91.5	1015.4	3	100	1	1.3
2015	10	4	89.9	1004.3	9.2	120	1.3	1.7
2015	10	5	79.9	992.5	6.4	100	0.8	1.1
2015	10	6	92.1	996.5	9	280	0.8	1.2
2015	10	7	87.8	1010.1	4.9	230	1.1	1.5
2015	10	8	87.8	1015.8	6	200	1.1	1.5
2015	10	9	79.1	1016.8	8.2	140	1.1	1.4
2015	10	10	78.5	1016.6	6.5	110	0.9	1.2
2015	10	11	83.8	1017.5	3.2	320	1	1.4
2015	10	12	89.5	1023.3	4.9	10	0.8	1.2
2015	10	13	88.6	1025.8	3.3	340	0.9	1.4
2015	10	14	84.5	1023.5	5	170	0.9	1.2
2015	10	15	81.6	1022.8	6.2	110	1.2	1.5
2015	10	16	84.5	1024.6	3	20	0.7	1
2015	10	17	88.8	1022.4	4.9	40	0.9	1.1
2015	10	18	92.3	1021.9	4.2	30	0.8	1
2015	10	19	89.8	1025.5	3.2	310	0.7	1
2015	10	20	92.5	1023.3	6.7	230	0.5	0.7
2015	10	21	94.5	1014.8	14.7	250	0.7	1
2015	10	22	89.8	1015.3	9.9	270	1.4	1.7
2015	10	23	74.7	1010.1	11.1	190	0.9	1.2
2015	10	24	91.5	1012	9.7	280	0.6	0.9
2015	10	25	89.7	1012.3	11.6	140	0.9	1.2
2015	10	26	85.7	999.4	15.2	130	1.1	1.4
2015	10	27	84.8	999.8	8.5	130	0.7	0.9
2015	10	28	82.7	995.6	12.5	140	0.8	1.2
2015	10	29	82.2	997.3	10	230	0.7	1
2015	10	30	85.8	1003.8	14.5	140	1.1	1.4
2015	10	31	85.1	1014.5	5.4	170	0.6	0.8
October							**27.7**	**37.5**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	11	1	80.8	1023.3	6.2	150	0.5	0.7
2015	11	2	83.5	1016.8	7.8	130	0.8	1
2015	11	3	85.1	1011	3.7	130	0.4	0.6
2015	11	4	94	1008.1	4	110	0.5	0.7
2015	11	5	84.8	1002.2	6.8	220	0.7	0.8
2015	11	6	94.5	1003.3	10.4	150	0.8	1
2015	11	7	83.8	1009.7	6.9	240	0.6	0.8
2015	11	8	87.2	1008.3	13.7	150	0.9	1.1
2015	11	9	92.4	1008.9	18.1	220	1.1	1.4
2015	11	10	97.2	1011.5	13.7	220	0.6	0.8
2015	11	11	94.5	1011.3	9	230	0.6	0.7
2015	11	12	84.1	1006.9	16.3	210	1.2	1.5
2015	11	13	84.8	1015	16.5	260	1	1.3
2015	11	14	77.4	1012.7	15.7	230	0.8	1
2015	11	15	83.4	998.7	20.4	250	0.9	1.3
2015	11	16	89	1002.5	9.7	230	0.8	1
2015	11	17	96.9	996.4	16.8	240	0.6	0.8
2015	11	18	90.5	1002.4	19.4	230	0.7	0.9
2015	11	19	80.9	1010.9	8.9	250	0.8	1
2015	11	20	79.2	1012.2	10.5	310	0.7	0.9
2015	11	21	77.9	1017.4	7.7	320	0.5	0.6
2015	11	22	88.6	1018.5	4.8	320	0.2	0.3
2015	11	23	96.6	1018.7	6.5	230	0.2	0.4
2015	11	24	96.7	1014.2	14	290	0.7	0.9
2015	11	25	90.8	1018.2	15	290	0.6	0.6
2015	11	26	88.5	1018	9.2	290	0.4	0.5
2015	11	27	85.6	1008	13.8	290	0.6	0.8
2015	11	28	87.7	1006.1	19	230	1	1.4
2015	11	29	81.3	1005.8	20	240	1.4	1.8
2015	11	30	88.2	1008.3	13.2	230	0.4	0.6
November							**21**	**27.2**

Shannon Airport Weather Records 2015

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2015	12	1	90.2	1010.3	16.8	220	1.2	1.3
2015	12	2	85.1	1011.1	8.5	180	0.4	0.5
2015	12	3	92.6	1012	6.8	210	0.6	0.8
2015	12	4	86.8	1011.9	18.2	210	1	1.2
2015	12	5	81.8	1001.1	20.9	200	0.8	1.1
2015	12	6	90.6	1004.2	9.8	220	0.4	0.5
2015	12	7	91.3	1004.3	17.6	160	0.8	1
2015	12	8	87.3	1011.3	12.5	210	0.9	1
2015	12	9	86.8	1016.8	16.1	200	0.8	1.1
2015	12	10	84.2	1015.7	10.9	250	0.5	0.7
2015	12	11	82.9	1017.7	9.1	260	0.7	0.8
2015	12	12	88.2	1010.1	9.5	110	0.4	0.5
2015	12	13	83	1009.9	8.5	100	0.5	0.6
2015	12	14	86.4	1003.7	12.9	90	0.7	0.9
2015	12	15	86	998.6	15	120	0.7	1
2015	12	16	82.3	1004	12.7	160	0.5	0.7
2015	12	17	81.4	1003	11	150	0.5	0.6
2015	12	18	86.9	1001.2	14.6	150	0.7	0.9
2015	12	19	84.5	993.4	13	170	0.6	0.7
2015	12	20	85.6	998.5	12	190	0.6	0.7
2015	12	21	84.8	1001.3	13.6	160	0.5	0.5
2015	12	22	84.5	998.1	15.2	210	0.3	0.4
2015	12	23	86	1000.8	16.8	170	0.7	0.8
2015	12	24	80.7	1001.7	13.4	210	0.4	0.5
2015	12	25	92.5	1006.2	7	30	0.6	0.8
2015	12	26	86.4	1005.9	3.4	320	0.3	0.4
2015	12	27	81.2	1006.3	12	140	0.6	0.7
2015	12	28	90.7	997.2	15.8	150	1	1.3
2015	12	29	90.2	994.8	18.3	150	0.7	0.9
2015	12	30	88.2	988.2	12.7	270	0.4	0.5
2015	12	31	86.5	1003.2	11.8	280	0.7	0.8
December							**19.5**	**24.2**

Appendix I – Water Balance Calculations

Water Balance Calculations 2015

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

Period (Jan 2015 - Dec 2015)	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	4621	0.1044	95	104.4	3.468	100.93	20112	0.1110	223.24	324.18
February	4621	0.0660	95	66	3.468	62.53	20112	0.0740	148.83	211.36
March	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0	0.00
April	4621	0.0000	95	0	3.468	0.00	20112	0.0040	8	8.04
May	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0.00	0.00
June	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0.00	0.00
July	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0	0.00
August	4621	0.0000	95	0	3.468	0.00	20112	0.0236	47	47.46
September	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0.00	0.00
October	4621	0.0122	95	12.2	3.468	8.73	20112	0.0220	44.25	52.98
November	4621	0.1634	95	163.4	3.468	159.93	20112	0.1696	341.10	501.03
December	4621	0.1945	95	194.5	3.468	191.03	20112	0.1992	400.63	591.66
TOTAL						**523.16**			**1213.56**	**1736.72**

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

Period (Jan 2015 - Dec 2015)	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	4621	0.1044	95	482.432	3.468	478.96	20112	0.0933	37.53	516.49
February	4621	0.0660	95	304.986	3.468	301.52	20112	0.0302	12.15	313.67
March	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0	0.00
April	4621	0.0000	95	0	3.468	0.00	20112	0.0041	2	1.65
May	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0.00	0.00
June	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0.00	0.00
July	4621	0.0000	95	0	3.468	0.00	20112	0.0000	0	0.00
August	4621	0.0000	95	0	3.468	0.00	20112	0.0030	1	1.21
September	4621	0.0000	95	0.000	3.468	0.00	20112	0.0000	0.00	0.00
October	4621	0.0122	95	56.376	3.468	52.91	20112	0.1020	41.03	93.94
November	4621	0.1634	95	755.071	3.468	751.60	20112	0.0748	30.09	781.69
December	4621	0.1945	95	898.785	3.468	895.32	20112	0.1442	58.00	953.32
TOTAL						**2480.31**			**181.65**	**2661.96**

Response Engineering Ltd

Shannon Town Landfill

2015 PRTR

Project No. W3019

April 2016

BYRNE LOOBY PH McCarthy

consulting engineers

Guidance to completing the PRTR workbook

PRTR Returns Workbook

Version 1.1.19

REFERENCE YEAR	2015

1. FACILITY IDENTIFICATION

Parent Company Name	Clare County Council
Facility Name	Tradaree Point E.T.P.
PRTR Identification Number	W0037
Licence Number	W0037-01

Classes of Activity

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

Address 1	Tradaree Point E.T.P.
Address 2	Shannon, (Clonmoney South)
Address 3	
Address 4	
	Clare
Country	Ireland
Coordinates of Location	-8.83337 52.6899
River Basin District	IEGBNISH
NACE Code	3821
Main Economic Activity	Treatment and disposal of non-hazardous waste
AER Returns Contact Name	Ms Ailish Johnston, Response Group
AER Returns Contact Email Address	ajohnston@response-group.ie
AER Returns Contact Position	Environmental Manager
AER Returns Contact Telephone Number	061-364477
AER Returns Contact Mobile Phone Number	086-0400765
AER Returns Contact Fax Number	063-33401
Production Volume	0.0
Production Volume Units	
Number of Installations	0
Number of Operating Hours in Year	0
Number of Employees	1
User Feedback/Comments	
Web Address	

2. PRTR CLASS ACTIVITIES

Activity Number	**Activity Name**
50.1	General
50.1	General

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

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

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

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

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

4.1 RELEASES TO AIR Link to previous years emissions data #N/A 21/04/2016 14:55

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

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

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD				QUANTITY		
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
03	Carbon dioxide (CO2)	E	ESTIMATE	Modelled by Tobin Consulting Engineers	3148.0	3148.0	0.0	0.0
01	Methane (CH4)	E	ESTIMATE	Modelled by Tobin Consulting Engineers	1630.0	1630.0	0.0	0.0

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

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

RELEASES TO AIR					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD				QUANTITY		
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
210	**Dust**	M	ALT		1632.2	1632.2	0.0	0.0

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

Additional Data Requested from Landfill operators

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

Landfill: Tradaree Point E.T.P.

Please enter summary data on the quantities of methane flared and / or utilised			Method Used			
	T (Total) kg/Year	**M/C/E**	**Method Code**	**Designation or Description**	**Facility Total Capacity m3 per hour**	
Total estimated methane generation (as per site model)	1630.0	E	Estimate	Modelled by Tobin Consulting Engineers	N/A	
Methane flared	0.0				0.0	(Total Flaring Capacity)
Methane utilised in engine/s	0.0				0.0	(Total Utilising Capacity)
Net methane emission (as reported in Section A above)	1630.0	E	Estimate	Modelled by Tobin Consulting Engineers	N/A	

4.2 RELEASES TO WATERS

Link to previous years emissions data

SECTION A : SECTOR SPECIFIC PRTR POLLUTANTS

RELEASES TO WATERS	
POLLUTANT	
No. Annex II	Name

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

SECTION B : REMAINING PRTR POLLUTANTS

RELEASES TO WATERS	
POLLUTANT	
No. Annex II	Name

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

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

RELEASES TO WATERS	
POLLUTANT	
Pollutant No.	Name

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

#N/A

Data on ambient monitoring of storm/surface water or groundwater, conducted as part of your licence requirements, should N(

			Please enter all quantities in this section in KGs	
	Method Used			
M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year
			0.0	0.0

) then click the delete button

			Please enter all quantities in this section in KGs	
	Method Used			
M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year
			0.0	0.0

) then click the delete button

			Please enter all quantities in this section in KGs	
	Method Used			
M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year
			0.0	0.0

) then click the delete button

OT be submitted under AER / PRTR Reporting as this only concerns Releases from your facility

QUANTITY	
A (Accidental) KG/Year	F (Fugitive) KG/Year
0.0	0.0

QUANTITY	
A (Accidental) KG/Year	F (Fugitive) KG/Year
0.0	0.0

QUANTITY	
A (Accidental) KG/Year	F (Fugitive) KG/Year
0.0	0.0

4.3 RELEASES TO WASTEWATER OR SEWER

Link to previous years emissions data

#N/A

21/04/2016 14:55

SECTION A : PRTR POLLUTANTS

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
No. Annex II	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

OFFSITE TRANSFER OF POLLUTANTS DESTINED FOR WASTE-WATER TREATMENT OR SEWER					Please enter all quantities in this section in KGs			
POLLUTANT		METHOD			QUANTITY			
			Method Used					
Pollutant No.	Name	M/C/E	Method Code	Designation or Description	Emission Point 1	T (Total) KG/Year	A (Accidental) KG/Year	F (Fugitive) KG/Year
					0.0	0.0	0.0	0.0

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

4.4 RELEASES TO LAND

Link to previous years emissions data

SECTION A : PRTR POLLUTANTS

RELEASES TO LAND	
POLLUTANT	
No. Annex II	Name

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

SECTION B : REMAINING POLLUTANT EMISSIONS (as required in your Licence)

RELEASES TO LAND	
POLLUTANT	
Pollutant No.	Name

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

#N/A

			Please enter all quantities
METHOD			
	Method Used		
M/C/E	Method Code	Designation or Description	Emission Point 1
			0.0

) then click the delete button

			Please enter all quantities
METHOD			
	Method Used		
M/C/E	Method Code	Designation or Description	Emission Point 1
			0.0

) then click the delete button

in this section in KGs	
QUANTITY	
T (Total) KG/Year	A (Accidental) KG/Year
0.0	0.0

in this section in KGs	
QUANTITY	
T (Total) KG/Year	A (Accidental) KG/Year
0.0	0.0

5. ONSITE TREATMENT & OFFSITE TRANSFERS OF WASTE

#N/A

21/04/2016 14:55

Please enter all quantities on this sheet in Tonnes

Transfer Destination	European Waste Code	Hazardous	Quantity (Tonnes per Year)	Description of Waste	Waste Treatment Operation	Method Used		Location of Treatment	Haz Waste : Name and Licence/Permit No of Next Destination Facility Non Haz Waste: Name and Licence/Permit No of Recover/Disposer	Haz Waste : Address of Next Destination Facility Non Haz Waste: Address of Recover/Disposer	Name and License / Permit No. and Address of Final Recoverer / Disposer (HAZARDOUS WASTE ONLY)	Actual Address of Final Destination i.e. Final Recovery / Disposal Site (HAZARDOUS WASTE ONLY)
						M/C/E	Method Used					
Within the Country	19 07 03	No	23822.0	landfill leachate other than those mentioned in 19 07 02	D8	C	Volume Calculation	Offsite in Ireland	Shannon Town Wastewater Treatment Plant,D0045	Tradaree point,Clonmoney South,Shannon,Co. Clare,Ireland		

* Select a row by double-clicking the Description of Waste then click the delete button

Link to previous years waste data
Link to previous years waste summary data & percentage change
Link to Waste Guidance