Clare County Council

Tradaree Point Sludge Disposal Facility

Annual Environmental Report 2013

Waste Licence Reg. No. W0037-01

Response Group

25th February 2014

REPORT CONTROL

Document: Tradaree Point Annual Environmental Report 2013

Job Number: CE08478

Project: Tradaree Point Sludge Disposal Facility

Client: Clare County Council

Document Checking:

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Issue	Date	Status	Checked for Issue
1	25/02/14	For Issue	NR
2			
3			
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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 2013 to December 2013.

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Licence, Content of the Environmental Report, and has been prepared in accordance with the EPA (1999) Waste Licensing – Draft Guidance Note on Environmental Management Systems and Reporting to the Agency, the EPA Guidance Note for the Annual Environmental Report and the EPA AER/PRTR Guidance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 2013 to December 2013 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 and Toonagh-Inagh treatment plants.

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 and Biocore.

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 2013

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 2013 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 2013, 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 2013

Month	Quantity (Kg)
January	138000
February	130200
March	106000
April	117300
May	115600
June	146000
July	63800
August	91800
September	77900
October	178300
November	137500
December	76700
Total (kg)	1379100
TOTAL (tonnes)	1379

2.3.2 Sludge Disposed 2004-2013

Table 2.3 below details the quantities of sludge disposed at the facility between 2004 and 2013.

Year	Quantity (Tonnes) Sludge Disposed/Annum
2004	1,022
2005	954
2006	408
2007	756
2008	548
2009	732
2010	489
2011	228
2012	1055
2013	1379

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. As Cell 1 had been filled beyond capacity it was necessary to transfer sludge from Cell 1 into Cell 2 when this cell opened. Cell 2 is now nearing its capacity and it is expected that Cell 3 will need to be opened in early 2014. It is expected that Cell 1 and Cell 2 will both be capped by June 2014.
In 2013, approximately 1379 tonnes of sludge was disposed of at the facility.

The density of dewatered sludge varies depending on the dry matter concentration. In 2012, the average cake % dry matter reached in the sludge was 27.42%. 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 2013 was 1085m3.

Based on the 2013 figure, it is expected that the landfill should reach its full capacity by 2021. However, if yearly tonnages remain low this figure could be extended.

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 626 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 37,846 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 2013 are detailed in Table 2.4 below.

Table 2.4: The monthly averages of Leachate generated in 2013

Month	Flow Rate (m^3/Month)
January	12604
February	3983
March	6436
April	7506
May	909
June	731
July	287
August	1365
September	401
October	678
November	2265
December	681
Total (M^3/Year)	37846

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 27.42% dry matter in 2013. Assuming that the dry matter content would equate to the biodegradable component of the sludge and based on a total input in 2013 of 378 tonnes of biodegradable waste (27.42% of 1,379 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 05th June and 03rd July 2013. Dust monitoring locations are illustrated in Figure 2. 30-day composite samples were collected in accordance with licence requirements and forwarded to the BHP accredited laboratory for analysis. The monitoring results are summarised in Table 3.2 below. Copies of the dust monitoring results are included in Appendix A.

Table 3.2 Dust Monitoring Results 2013

Location	N1	N3	N5	SS2
	mg/m2/day			
June 2013	79	74	528	76
December 2013			29.3	

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

Location N5 was retested between 12th November and 10th December 2013 as original result was high, and may have been inaccurate as nearby location N1 was well within the limit.

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 28th February 2013. 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 2013

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	28/02/13	30 Minutes	44.8
N2	28/02/13	30 Minutes	42.4
N3	28/02/13	30 Minutes	41.8
N5	28/02/13	30 Minutes	42.1

Table 3.5 Night-time Noise Measurements 2013

Location	Date	Sampling Interval	L_{Aeq} 30min Db(A)
N1	28/02/13	30 Minutes	40.2
N2	28/02/13	30 Minutes	39.8
N3	28/02/13	30 Minutes	40.4
N5	28/02/13	30 Minutes	41.2

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 2013, 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

Monthly methane concentrations measured at gas monitoring location RD1 were all below the threshold level of 1% v/v in 2013.

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 8.1% (March) to 39.9% (April).

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 1.1% v/v (December) to 1.7% v/v (November).

Methane levels measured at RD4 exceeded the threshold level of 1% v/v in eight of the twelve monthly monitoring rounds. Methane levels above the threshold level ranged from 1.1% (April) to 9.3% (January).

Methane levels measured at RD5 exceeded the threshold level of 1% v/v in nine of the 12 monthly monitoring rounds. Methane levels above the threshold level ranged from 1.7% (April) to 33.3% (November).

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 14.5% (April) to 71.1% (October).

Methane levels measured at RD8 could not be taken in May as it was flooded. The remaining months were all below the threshold level.

Monthly recorded methane levels in the remaining monitoring boreholes (RD7, 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 5 of the 12 monthly monitoring rounds – January (5.3%), February (3.4%), April (2.1%), November (4.6%) and December (7.2%).

At RD2, carbon dioxide levels exceeded the threshold level of 1.5% v/v in 6 of the 12 monthly monitoring rounds – January (5.3%), February (2.7%), March (4.0%), April (5.6%), May (3.6%) and July (5.3%).

In RD3, carbon dioxide concentrations were above the threshold level of 1.5% v/v in 8 of the 12 monthly monitoring rounds – January (3.2%), February (2.5%), April (2.6%), August (1.7%), September (2.6%), October (2.5%), November (4.4%)and December (3.2%).

In RD4, carbon dioxide concentrations were above the threshold level of 1.5% v/v in all of the 12 monthly monitoring rounds – January (4.2%), February (2.5%), March (3.1%), April (4.2%), May (4.4%), June (2.4%), July (6.0%), August (5.9%), September (5.0%), October (5.9%), November (7.9%) and December (7.7%).

In RD5, carbon dioxide levels exceeded the threshold level of 1.5% in all of the 12 monthly monitoring rounds – January (13.2%), February (11.3%), March (7.7%), April (5.6%), May (3.0%), June (3.5%), July (7.3%), August (14.9%), September (15.8%), October (16.9%), November (16.7%) and December (14.7%).

In RD6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in all of the monthly monitoring rounds - January (12.8%), February (11.4%), March (11.6%), April (11.5%), May (11.5%), June (11.8%), July (14.0%), August (14.3%), September (10.7%), October (14.5%), November (13.2%) and December (11.8%).

In RD8, carbon dioxide levels could not be taken in May as it was flooded, all the other months were below the threshold level of 1.5% v/v.

In L6, carbon dioxide levels exceeded the threshold level of 1.5% v/v in 7 of the 12 monthly monitoring rounds – January (3.1%), February (5.1%), April(2.6%), June (6.2%), July (7.8%), August (2.4%) and October (1.8%).

Monthly recorded carbon dioxide levels in the remaining monitoring boreholes (RD7, 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 2013 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	Biennial After Yr 1	Biannually

In 2013,

- 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 2013 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 2013 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 2013

Location	N1	N3	N5	SS2
	$mg/m^2/day$			
June 2013	79	74	528	76
December 2013			29.3	

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

3.2.3 Groundwater Monitoring

3.2.3.1 Groundwater Monitoring Locations

Groundwater monitoring was conducted at five locations during 2013 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 2013 varied between 0.1m below top of casing (BTOC) (in BH4 July 2013) and 1.45m BTOC (in RD2 November 2013).

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 July and November 2013.

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

The Ph in all of the groundwater samples analysed during both monitoring rounds ranged from 6.68 to 7.42, which is within the IGV range of 6.5-9.5.

Electrical conductivity measurements ranged from 525 µS/cm in BH4 (July) to 14,940 µS/cm in BH3 (November), which are similar to previous monitoring results. The IGV of 1,000 µS/cm was exceeded in all but one (BH4 July 525µS/cm) of the samples analysed.

Ammonia concentrations detected were all above the IGV of 0.2mg/l and ranged between 0.62mg/l in RD3 (July) to 34.5mg/l in BH4 (November).

Total phosphorus concentrations exceeded the IGV for orthophosphate of 0.03 mg/l in all of the samples taken ranging from 0.07mg/l in RD 3 (November) to 11.3mg/l in BH3 (November).
Orthophosphate concentrations were all below the IGV for orthophosphate of 0.03 mg/l, all results were <0.01mg/l.

Total Oxidised Nitrogen concentrations results ranged between 0.02mg/l RD3 (July and November) and 1.24mg/l BH3 (July). These are readings are lower than those recorded last year.

Total organic carbon concentrations ranged from 16.2mg/l in BH3 (July) to 185mg/l in BH4 (July), TOC concentrations show an increase compared 2012 results but similar results to 2009 and 2011.

Chloride concentrations ranged from 439 mg/l in RD3 (November) to 5,367 mg/l in BH3 (November). Chloride concentrations in all of the samples analysed exceeded the IGV of 30 mg/l.

Sodium concentration ranged from 27.916mg/l BH3 (November) to 53.768mg/l RD3 (November), which were all below the IGV of 150 mg/l.

Potassium concentrations in all five samples analysed during the November monitoring round all exceeded the IGV of 5 mg/l. Concentrations ranged from 5.71mg/l in RD3 to 69.59mg/l in BH4.

Iron concentrations detected all exceeded the IGV of 0.2mg/l. The Iron concentration measured ranged between 0.312mg/l in RD3 and 6.153 in BH4, samples were taken in November.

Chromium concentrations in all samples were below the IGV of 0.03 mg/l. They ranged from <0.001mg/l in both RD2 and RD3 to 0.011mg/l in BH3.

Total phenol concentrations exceeded the IGV 0.0005mg/l in 6 of the 10 samples analysed during both monitoring rounds. Results that exceed the limit ranged from 0.001mg/l in both BH3 (November) and RD2 (July) to 0.021mg/l RD2. The July samples for BH3, BH4, RD3 and RD3 November sample were all <0.001mg/l.

Fluoride concentrations exceeded the IGV of 1mg/l at BH4 in November with result of 4.691mg/l. The other samples were all below the limit with results ranging from <0.01mg/l to 0.402mg/l.

Concentrations of arsenic, boron, cadmium, calcium, copper, cyanide, lead, magnesium, mercury, nickel, 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 2012 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.

TOC concentrations have increased compared to 2012 results but are broadly similar to those recorded in the preceding years.

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 July and November 2013 as per Schedule D of the licence.

The electrical conductivity was measured at 1743 µS/cm in July and 1851 µS/cm which both exceed the IGV of 1000µS/cm.

The chloride concentration was detected at 150mg/l in July and 64.554mg/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 14.2mg/l in July and 12.25mg/l in November, which both exceeds the IGV of 0.15 mg/l; Ammonia concentrations have been consistently elevated since 2004.

Potassium concentration was 6.70mg/l which exceeds the IGV of 5 mg/l. This is a change from last year when it was below its IGV, but similar to previous results going back to 2004 when it exceeded the limit.

The iron concentration was 0.958mg/l in November, which is above the IGV of 0.02 mg/l. This is similar to previous results.

Sulphate concentration was 741.4mg/l which exceeds the IGV of 200mg/l. It had been within the limit for the past few years but is similar to results that have previously been seen between 2004 and 2007.

Total Phosphorus was also detected above the lGV of 0.01mg/l at 0.03mg/l. This is similar with previous years.

Comparison of results with the results from previous years, indicate that a number of parameters (Conductivity, ammonia, chloride, Iron, 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 2013

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	28/02/13	30 Minutes	44.8
N2	28/02/13	30 Minutes	42.4
N3	28/02/13	30 Minutes	41.8
N5	28/02/13	30 Minutes	42.1

Table 3.15 Night-time Noise Measurements 2013

Location	Date	Sampling Interval	L_{Aeq} 30min dB(A)
N1	28/02/13	30 Minutes	40.2
N2	28/02/13	30 Minutes	39.8
N3	28/02/13	30 Minutes	40.4
N5	28/02/13	30 Minutes	41.2

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 2013 with differing biannual and annual parameter requirements as outlined in Table D.6.1 of the waste licence (SS1, SS2, SS4, SS6 and 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 location SS2 was dry in July 2013 and locations SS6 and SS7 were both dry in both July and November 2013, therefore no sample could be collected on the sampling date.

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 February and August 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 0.13mg/l SS4 (November) to 8.9mg/l SS1 (November).

Conductivity exceeded the IGV of 1000µS/cm in SS2 1115µS/cm was recorded in November. All other results were below the IGV.

Potassium exceeded the IGV of 5mg/l in all of the 3 samples tested. In November SS1 5.73mg/l, SS 5.73mg/l and SS4 5.78mg/l.

Sulphate exceeded the IGV of 200mg/l in SS 203.066mg/l in November.

There were no other exceedances of the relevant thresholds or EQS's for any of the parameters analysed during both monitoring rounds undertaken in 2013.

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 2013 are attached in Appendix H. Met Eireann publish meteorological data, which is obtained from their weather station at Shannon Airport.

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

Table 3.17 Summary Rainfall Data

Month	Rainfall (mm) Shannon Airport	Evapotranspiration (mm) Shannon Airport	Evaporation (mm)	Estimated Effective Rainfall – Capped Area (mm)	Estimated Effective Rainfall – Active Cell (mm)
JAN	107	13.7	18.2	93.3	88.8
FEB	49.6	19.4	27.5	30.2	22.1
MAR	30.2	34.4	50.7	0*	0*
APR	63.1	59	90.4	4.1	0*
MAY	68	69.6	107.1	0*	0*
JUN	64.2	80.7	116.3	0*	0*
JUL	57.4	102.4	138.2	0*	0*
AUG	72.9	69.9	97.2	3	0*
SEP	38.9	46.9	63.4	0*	0*
OCT	132.2	30.2	39.9	102	92.3
NOV	89	14.2	18.7	74.8	70.3
DEC	160.2	16	20.6	144.2	139.6
TOTAL	932.7	556.4	788.2	451.6	413.1

***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 932.7 mm of rainfall from January 2013 to December 2013.

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 2013, which was 115 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 2,716 m3 (upper bound) and 2,034 m3 (lower bound) of Leachate was produced on site in 2013. As the majority of the landfill is capped the potential for Leachate generation is reduced.

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 trucks and the tractor. Diesel is stored in a 5,000 litre capacity bunded tank located on site. Approximately 1650 litres of diesel were used in 2013.

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 2013.

Rentokil 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 2013.
- There is no problem with litter at the facility and no complaints were received in 2013 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 2013.

The only vehicles that use the site roads are a tractor owned by Response Engineering Limited and a 5-tonne sludge dumper truck. These are used to deposit the sludge to the landfill from the WWTP. The vehicles travel 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. Location N5 exceeded the 350mg/m2/day limit in July 2013 with a reading of 528mg/m^2/day so we got it retested and December result was 29.3mg/m^2/day. The other locations were all well 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 2012 AER did not specify any environmental objectives and targets for 2013.

4.3 Schedule of Environmental Objectives and Targets for 2013

The licensee conducted a review of the EMS in 2012 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 2013.

4.4 Facility Procedures

No new procedures were developed or implemented at the site between January 2013 and December 2013.

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 was undertaken for staff employed at the facility in October 2007 and copies of training records were included in the 2007 AER.

No additional environmental training was undertaken in 2013.

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 2013 to December 2013, no incidents occurred which would require reporting to the relevant authorities. No complaints or incidents were reported to the facility between January and December 2013.

5.1 Incidents

None recorded.

5.2 Non-compliances

No non-compliances were recorded.

5.3 Complaints

None Received.

5.4 Waste Record

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

The following information is recorded in the waste register;

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

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

The weighbridge was last calibrated in February 2013 by Gravitation Ltd. Test cert no. 35172.

6.0 FACILITY DEVELOPMENT

6.1 Developments during 2013

There were no other development works of note undertaken at the facility between January and December 2013.

6.2 Proposed Development of the Facility and Associated Timescales

Facility development works planned for 2014.
Cell 1 has reached its capacity and is currently inactive awaiting capping, it is planned that this capping will take place by June 2014.
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 2014.

FIGURE 1 – SITE LOCATION MAP

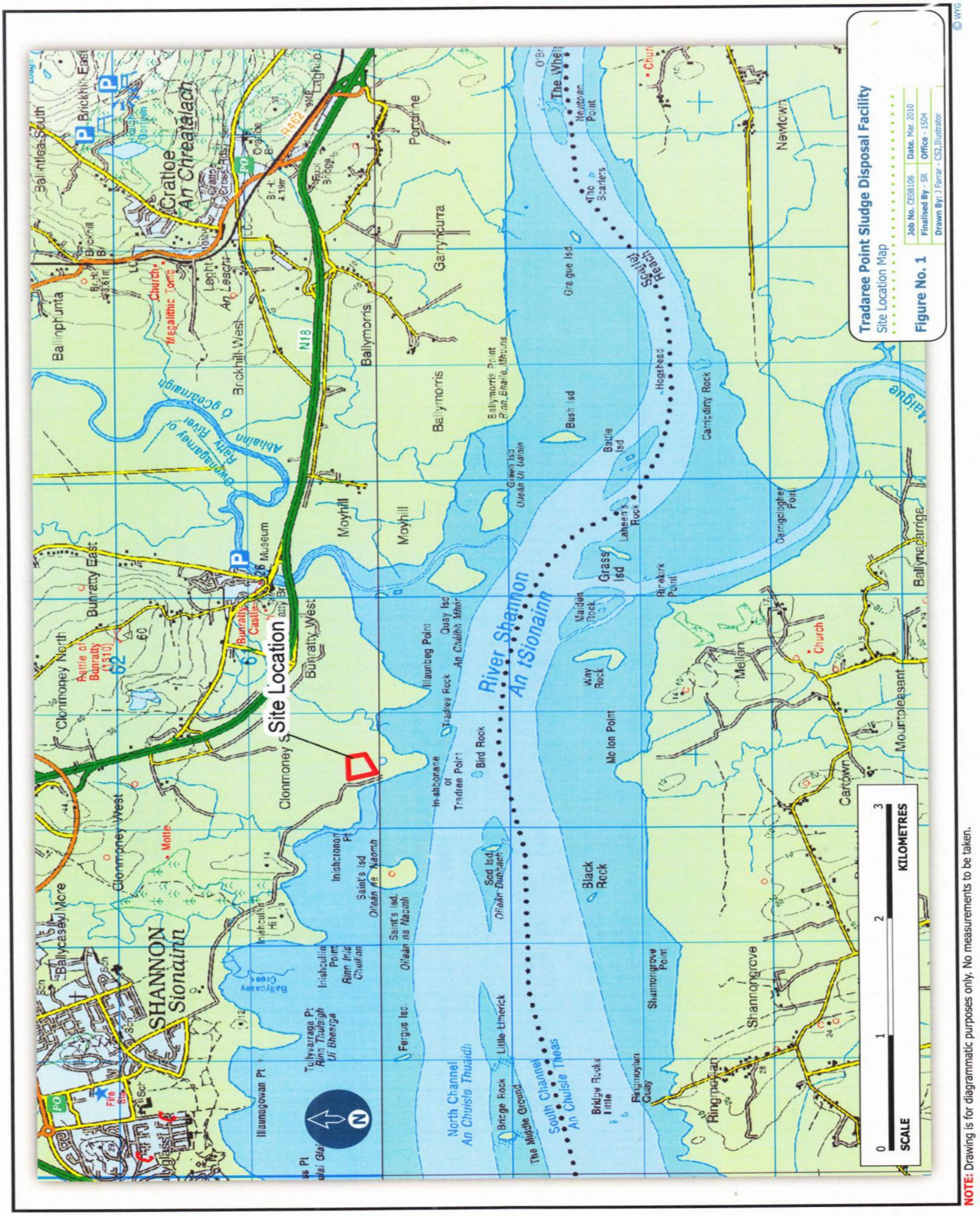
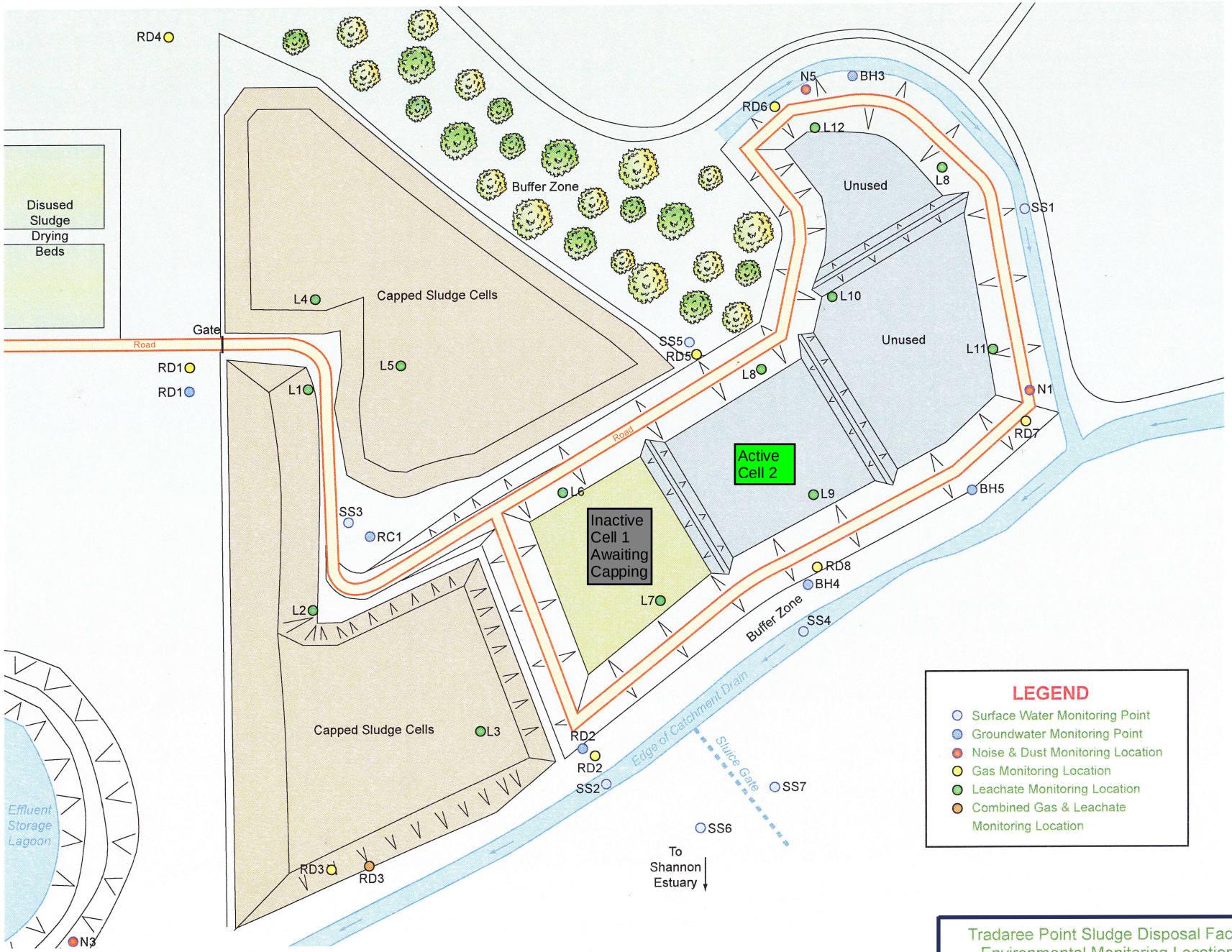

Tradaree Point Sludge Disposal Facility
Site Location Map
Figure No. 1
Site Location
River Shannon
An tSionainn
SCALE
KILOMETRES
NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

FIGURE 2 – SITE PLAN SHOWING ENVIRONMENTAL MONITORING LOCATIONS



Tradaree Point Sludge Disposal Facility
Environmental Monitoring Locations

Figure No. 2

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

APPENDICES

APPENDIX A – DUST MONITORING RESULTS

BHP/CL/02D

TEST REPORT 109865

Analysing
Testing
Consulting
Calibrating

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

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

FTAO: Ailish Johnston

BHP Ref. No.: 13/07/097-100
Order No:
Date Received: 03/07/2013
Date Tested: 08/07/2013
Test Spec: VDI 2119 Part 2
Item : Dust Deposition

TEST	Client Reference	Units	Results	Standard Reference
	Tradree Landfill			
Dust Deposition	**N1**	mg/m^2/day	79	VDI 2119 Part2
Dust Deposition	**N3**	mg/m^2/day	74	VDI 2119 Part2
Dust Deposition	**N5**	mg/m^2/day	528	VDI 2119 Part2
Dust Deposition	**SS2**	mg/m^2/day	76	VDI 2119 Part2

Additional Information: All samples are inside the EPA Limit of 350 mg/m2/day apart from N5. Sampling occurred during the period 05/06/2013-03/07/2013

Authorised by:

Paul O'Sullivan
Date of Issue: 11/07/2013

BHP/CL/02D

TEST REPORT 111716

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnston

BHP Ref. No.: 13/12/423
Order No:
Date Received: 17/12/13
Date Tested: 17/12/13
Test Spec:
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
Dust Deposition	Tradree Landfill N5	mg/m^2/day	29.3	VDI 4320 Part2

Additional Information: All samples are inside the EPA Limit of 350 mg/m2/day apart from N5. Sampling occurred during the period 12/11/13 to 10/12/13

Authorised by:

Paul O'Sullivan
Date of Issue: 06/01/14

Page 1 of 1

APPENDIX B – NOISE SURVEY REPORT

Tradaree WWTP

Environmental Noise Monitoring 28th February 2013

Code	Location	Time	Range dB	Average dB	Maximum dB	Background Noise	Compliant
N1 Daytime	Boundary @ Landfill Cell 3	11.15 - 11.45	30-90	44.8	52.1	Road Traffic	Yes
N2 Daytime	Boundary @ Landfill Cell 1	10.40 - 11.10	30-90	42.4	53.4	Road Traffic,	Yes
N3 Daytime	Boundary @ Lagoon	10.00 - 10.30	30-90	41.8	56.9	Road Traffic, Flow of Water	Yes
N5 Daytime	Boundary @ Landfill Cell 4	11.50 - 12.20	30-90	42.1	53.4	Road Traffic	Yes
N1 Night-Time	Boundary @ Landfill Cell 3	01.30 - 02.00	30-90	40.2	49.8	Road Traffic	Yes
N2 Night-Time	Boundary @ Landfill Cell 1	00.50 - 01.20	30-90	39.8	49.5	Road Traffic,	Yes
N3 Night-Time	Boundary @ Lagoon	00.10 - 00.40	30-90	40.4	47.3	Road Traffic, Flow of Water	Yes
N5 Night-Time	Boundary @ Landfill Cell 4	02.05 - 02.35	30-90	41.2	50.1	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

Landfill Gas Analysis							
Month	January 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	OC	Pressure	
22/01/2013	RD1	5.3	0.1	13.4	7	1000	
	RD2	5.3	18.0	9.9	7	1001	
	RD3	3.2	0.4	19.7	7	1001	
	RD4	4.2	9.3	7.8	7	1000	
	RD5	13.2	22.1	2.7	7	1000	
	RD6	12.8	51.3	3.0	7	1000	
	RD7	0.1	0.1	20.6	7	999	
	RD8	0.3	0.1	20.6	7	999	
	L6	3.1	0.1	17.3	7	1001	
	L8	0.1	0.1	20.6	7	999	
	L10	0.1	0.1	20.7	7	1000	
	L12	1.0	0.1	20.7	7	1000	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	February 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
13/02/2013	RD1	3.4	0.1	16.6	8.5	1013	
	RD2	2.7	0.5	19.8	8.6	1013	
	RD3	2.5	0.1	19.9	7.5	1013	
	RD4	2.5	2.9	10.9	9	1013	
	RD5	11.3	15.6	1.5	8.8	1013	
	RD6	11.4	40.0	0.9	7.4	1013	
	RD7	0.1	0.1	20.4	7.3	1013	
	RD8	0.1	0.1	20.5	7.8	1013	
	L6	5.1	0.1	15.3	8.8	1013	
	L8	0.1	0.1	20.5	8.8	1013	
	L10	0.1	0.1	20.4	8.5	1013	
	L12	0.1	0.1	20.3	8.6	1013	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	March 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
12/03/2013	RD1	1.3	0.1	19.7	6.8	1017	
	RD2	4.0	8.1	17.3	7.8	1017	
	RD3	1.3	0.2	19.7	7.4	1017	
	RD4	3.1	0.1	15.0	10.3	1017	
	RD5	7.7	5.8	10.5	10.2	1017	
	RD6	11.6	23.9	1.8	4.1	1014	
	RD7	0.0	0.1	20.1	6	1016	
	RD8	0.2	0.1	19.9	5.4	1016	
	L6	0.2	0.1	20.1	9.4	1017	
	L8	0.1	0.1	20.1	7.8	1014	
	L10	0.0	0.1	20.2	9.4	1014	
	L12	0.0	0.1	20.3	10.8	1014	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	April 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
12/04/2013	RD1	2.1	0.1	17.2	13.2	1001	
	RD2	5.6	39.9	8.9	13	1000	
	RD3	2.6	1.3	18.5	12.2	1000	
	RD4	4.2	1.1	12.7	16.7	1000	
	RD5	5.6	1.7	15.0	16.2	1000	
	RD6	11.5	14.5	0.4	15.9	999	
	RD7	0.2	0.1	19.6	10.5	999	
	RD8	0.2	0.1	19.5	10	1000	
	L6	2.6	0.1	15.1	15.9	999	
	L8	0.1	0.1	19.8	15.8	999	
	L10	0.1	0.1	19.7	15.8	999	
	L12	0.1	0.1	19.6	14	999	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	May 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
13/05/2013	RD1	0.7	0.1	19.9	13	995	
	RD2	3.6	24.3	16.3	13	995	
	RD3	1.1	0.5	19.6	13	995	
	RD4	4.4	0.5	13.8	13	995	
	RD5	3.0	0.2	17.7	13	995	
	RD6	11.5	32.4	0.2	13	995	
	RD7	0.1	0.1	20.1	13	995	
	RD8	Water logged					
	L6	0.5	0.1	20.1	13	995	
	L8	0.2	0.1	20.1	13	995	
	L10	0.1	0.1	20.1	13	995	
	L12	0.1	0.1	20.1	13	995	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	June 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
13/06/2012	RD1	0.2	0.1	18.7	25.1	1019	
	RD2	0.2	0.1	18.7	24.1	1019	
	RD3	0.6	0.1	18.5	20.6	1019	
	RD4	2.4	0.1	15.1	26	1019	
	RD5	3.5	0.1	15.8	28	1019	
	RD6	11.8	39.8	0.3	35	1019	
	RD7	0.1	0.1	19.0	16.2	1019	
	RD8	0.1	0.1	19.0	15.4	1019	
	L6	6.2	0.4	12.4	24.8	1019	
	L8	0.1	0.1	18.9	28.9	1019	
	L10	0.1	0.1	19.1	25.8	1019	
	L12	0.1	0.1	19.0	24.1	1019	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	July 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
22/07/2013	RD1	0.3	0.1	19.5	21	1011	
	RD2	5.3	34.0	10.5	21	1011	
	RD3	1.5	0.4	18.3	21	1011	
	RD4	6.0	0.5	11.3	21	1011	
	RD5	7.3	0.4	13.1	21	1011	
	RD6	14.0	57.7	1.3	21	1011	
	RD7	0.1	0.1	19.3	21	1011	
	RD8	0.1	0.1	19.3	21	1011	
	L6	7.8	0.5	12.3	21	1011	
	L8	0.7	0.1	18.6	21	1011	
	L10	0.1	0.1	19.3	21	1011	
	L12	0.1	0.1	19.4	21	1011	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	August 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
30/08/2013	RD1	0.5	0.1	19.3	18	1017	
	RD2	0.2	0.1	19.0	18	1017	
	RD3	1.7	0.1	18.5	18	1017	
	RD4	5.9	8.2	7.3	18	1017	
	RD5	14.9	5.7	0.7	18	1017	
	RD6	14.3	65.3	1.5	18	1017	
	RD7	0.1	0.1	19.0	18	1017	
	RD8	1.0	0.1	19.0	18	1017	
	L6	2.4	0.1	17.3	18	1017	
	L8	0.1	0.1	19.0	18	1017	
	L10	0.1	0.1	19.0	18	1017	
	L12	0.1	0.1	17.9	18	1017	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	September 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
09/09/2013	RD1	0.8	0.1	18.8	13	1017	
	RD2	0.7	0.1	19.2	13	1017	
	RD3	2.6	0.7	17.6	13	1017	
	RD4	5.0	6.6	9.8	13	1017	
	RD5	15.8	8.7	0.3	13	1017	
	RD6	10.7	50.6	6.3	13	1017	
	RD7	0.1	0.1	19.3	13	1017	
	RD8	0.1	0.1	19.3	13	1017	
	L6	1.4	0.1	18.2	13	1017	
	L8	0.1	0.1	19.3	13	1017	
	L10	0.1	0.1	19.4	13	1017	
	L12	0.1	0.1	19.4	13	1017	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	October 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
07/10/2013	RD1	1.3	0.1	17.7	18	1015	
	RD2	0.4	0.1	18.9	18	1015	
	RD3	2.5	0.3	17.4	18	1015	
	RD4	5.9	6.4	9.3	18	1015	
	RD5	16.9	25.1	0.2	18	1015	
	RD6	14.5	71.1	0.1	18	1015	
	RD7	0.2	0.1	19.0	18	1015	
	RD8	0.2	0.1	18.9	18	1015	
	L6	1.8	0.1	17.7	18	1015	
	L8	0.4	0.1	18.8	18	1015	
	L10	0.1	0.1	19.0	18	1015	
	L12	0.1	0.1	19.0	18	1015	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	November 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
06/11/2013	RD1	4.6	0.2	15.0	9	995	
	RD2	0.8	0.1	19.3	9	995	
	RD3	4.4	1.7	17.7	9	995	
	RD4	7.9	3.7	6.8	9	995	
	RD5	16.7	33.3	0.9	9	995	
	RD6	13.2	68.0	1.0	9	995	
	RD7	0.1	0.1	20.0	9	995	
	RD8	0.1	0.1	20.1	9	995	
	L6	0.1	0.1	19.4	9	995	
	L8	0.1	0.1	20.1	9	995	
	L10	0.1	0.1	19.8	9	995	
	L12	0.1	0.1	20.2	9	995	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

Landfill Gas Analysis							
Month	December 2013						
Date	Location	CO2	Methane	O2	Temp	Atmosph	
		%	%	%	oC	Pressure	
17/12/2013	RD1	7.2	0.3	12.9	8	1011	
	RD2	1.2	0.2	21.8	7.9	1011	
	RD3	3.2	1.1	20.6	8.4	1011	
	RD4	7.7	6.4	1.4	8.7	1011	
	RD5	14.7	28.9	0.3	8	1011	
	RD6	11.8	51.0	0.1	9.1	1011	
	RD7	0.1	0.1	21.6	8.7	1011	
	RD8	0.5	0.1	21.6	8.5	1011	
	L6	0.3	0.1	21.6	9.2	1011	
	L8	0.1	0.1	21.6	9.6	1011	
	L10	0.1	0.1	21.5	9.2	1011	
	L12	0.1	0.1	20.4	8.1	1011	
Trigger Level		1.5% v/v	1% v/v				
Shading indicates trigger level exceeded							

APPENDIX D – GROUNDWATER MONITORING RESULTS

Biannual/Annual Groundwater Monitoring Results 2013

PARAMETER	UNIT	EPA IGV	BH 3		BH 4		BH 5		RD 2		RD 3	
			Jul	Nov	Jul	Nov	Jul	Nov	Jul	Nov	Jul	Nov
pH		≥6.5-≤9.5	6.68	6.72	7.28	6.81	6.76	6.88	7.21	7.13	7.42	7.35
Temperature	°C	25	13.1		22.5		12.7		12.7		12.5	
Conductivity	µS/cm	1000	13850	14940	525	14710	11020	11450	3450	4200	2870	2760
Nitrite	mg/l	-	<0.1	<0.01	2.7	<0.01	<0.1	<0.01	<0.1	<0.01	<0.1	<0.01
Nitrate	mg/l	-	5.5	1.131	<0.01	0.76	3.37	0.62	0.04	0.759	0.08	0.084
Total Ammonia	NH3-N	0.2	33.6	34	29.14	34.5	23.2	25.25	21.4	17	0.62	1.37
Chloride	Cl mg/l	30	4810	5367	5073	5112	3494	3986	819	953	528	439
Water Level	m	-	0.65	1.08	0.1	0.3	0.75	0.92	1.33	1.45	0.81	0.66
DO	% O_2 sat	NAC		52.6		4.6		63.5		63.6		78.1
Arsenic	As mg/l	0.01		<0.02		<0.02		<0.02		<0.02		<0.02
Boron	B mg/l	1		<0.001		<0.001		<0.001		<0.001		<0.001
Cadmium	Cd mg/l	0.005		<0.01		<0.01		<0.01		<0.01		<0.01
Calcium	Ca mg/l	200		158		134.1		152.5		127.1		154.1
Chromium	Cr mg/l	0.03		0.011		0.003		0.006		<0.001		<0.001
Copper	Cu mg/l	0.03		0.016		0.004		0.009		0.009		0.005
Cyanide	Cn mg/l	0.01		<0.001		0.001		0.002		0.009		0.004
Fluoride	F mg/l	1		<0.01		4.691		<0.01		0.402		0.319
Iron	Fe mg/l	0.2		1.803		6.153		1.172		2.336		0.312
Lead	Pb mg/l	0.01		<0.01		<0.01		<0.01		<0.01		<0.01
Magnesium	Mg mg/l	50		17.974		18.344		18.64		10.112		13.35
Mercury	Hg mg/l	0.001		<0.02		<0.02		<0.02		<0.02		<0.02
Nickel	Ni mg/l	0.02		0.001		0.004		0.004		0.005		0.003
Potassium	K mg/l	5		65.13		69.59		62.95		7.00		5.71
Sodium	Na mg/l	150		27.916		29.228		30.39		37.131		53.768
Sulphate	SO_4 mg/l	200		0.779		2.344		0.313		1.18		69.751
Tin	Sn mg/l	-		<0.001		<0.001		<0.001		<0.001		<0.001
Total Phosphorus	P mg/l	0.03		11.3		5.5		3.1		0.21		0.07
Orthophosphate	P mg/l	0.03		<0.01		<0.01		<0.01		<0.01		<0.01
Total Organic Carbon	C mg/l	NAC	16.2	65	185	58	16.3	49	16.5	17	16.6	13.8
Total Oxidised Nitrogen	N mg/l	NAC	1.24	0.26	39	0.17	0.76	0.14	0.01	0.17	0.02	0.02
Total Phenols	mg/l	0.0005	<0.001	0.001	<0.001	0.02	0.004	0.004	0.001	0.021	<0.001	<0.001
Zinc	Zn mg/l	0.1		0.012		0.013		0.008		0.036		0.04
Solids Total	mg/l	-		6639		8452		8404		2522		1559

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 03rd July and 27th November 2013.

APPENDIX E – LEACHATE MONITORING RESULTS

Biannual / Annual Leachate Monitoring Results 2013

Parameter	Unit	EPA IGV	SS3	
			July	November
Ammonia	mg/l	0.15	14.2	12.25
Arsenic	mg/l	0.01		<0.02
BOD Total 5 Day with ATU	mg/l	-	62	11
Boron	mg/l	1		<0.001
Cadmium	mg/l	0.005		<0.01
Calcium	mg/l	200		167.5
Chloride	mg/l	30	150	64.554
Chromium	mg/l	0.03		<0.001
COD Total	mg/l	-	122	105
Conductivity	uS/cm	1000	1743	1851
Copper	mg/l	0.03		0.0
Cyanide (Total)	mg/l	0.01		<0.001
Dissolved Oxygen	%	NAC		
Fluoride	mgF/l			0.185
Groundwater Level	m	-		
Iron	mg/l	0.2		0.958
Lead	mg/l	0.01		<0.01
Magnesium	mg/l	50		18.934
Mercury	mg/l	0.001		<0.02
Mn (Dissolved				
Nickel	mg/l	0.02		0.002
Nitrate	mg/l		0.33	118.539
Nitrite	mg/l		<0.1	0.2
pH Value	Units	6.5 - 9.5	6.58	6.71
Phenol	ug/l			
Potassium	mg/l	5		6.70
Sodium	mg/l	150		32.384
Solids Suspended		-		
Solids Total	mg/l			
Sulphate	mg/l	200		741.4
Surfactant Anionic	ug/l			
Temperature	°C	25	14.5	13.5
Tin	mg/l			<0.001
Total Organic Carbon	mg/l	NAC		
Total Oxidised Nitrogen (TON)	mg/l	NAC	0.07	26.83
Total Phosphorus	mg/l	0.01		0.03
Zinc	mg/l	0.1		0.005

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 03rd July and 27th November 2013.

APPENDIX F – SURFACE WATER MONITORING RESULTS

Biannual/Annual Surface Water Monitoring Results 2013

Parameter	Unit	EPA IGV	SS1		SS2		SS4		SS6		SS7	
			Jul	Nov	Jul	Nov	Jul	Nov	Jul	Nov	Jul	Nov
Ammonia	mg/l	0.02	0.28	8.9	n/a	0.28	0.18	0.13	n/a	n/a	n/a	n/a
Arsenic	ug/l	20		<0.02		<0.02		<0.02		n/a		n/a
BOD Total 5 Day with ATU	mg/l	≤4	1.4	2	n/a	3.2	1.4	2	n/a	n/a	n/a	n/a
Boron	ug/l	1000		<0.001		<0.001		<0.001		n/a		n/a
Cadmium	ug/l	5		<0.01		<0.01		<0.01		n/a		n/a
Calcium	mg/l	200		100.9		150.4		103.5		n/a		n/a
Chloride	mg/l	30										
Chromium	ug/l	30		<0.001		<0.001		<0.001		n/a		n/a
COD Total	mg/l	-	5	12	n/a	32	16	11	n/a	n/a	n/a	n/a
Conductivity	uS/cm	1000		847		1115		882		n/a		n/a
Copper	ug/l	30		0.0		0.0		0.0		n/a		n/a
Cyanide (Total)	mg/l	0.01		0.002		0.001		0.001		n/a		n/a
Dissolved Oxygen	%	NAC	55.9	102.9	n/a	110.1	49.6	104.0	n/a	n/a	n/a	n/a
Fluoride	mgF/l	5.0		0.097		0.158		0.106		n/a		n/a
Groundwater Level	m	-										
Iron	ug/l	200		0.213		0.221		0.224		n/a		n/a
Lead	ug/l	10		<0.01		<0.01		<0.01		n/a		n/a
Magnesium	mg/l	50		10.145		15.118		10.896		n/a		n/a
Mercury	ug/l	1		<0.02		<0.02		<0.02		n/a		n/a
Mn (Dissolved	Ug/l											
Nickel	ug/l	50		0.004		0.001		0.005		n/a		n/a
Nitrate	mg/l	-		14.667		2.135		12.843		n/a		n/a
Nitrite	mg/l	-		0.031		<0.01		0.018		n/a		n/a
pH Value	Units	6.5 - 9.5	7.62	7.72	n/a	7.83	7.40	7.83	n/a	n/a	n/a	n/a
Phenol	ug/l											
Potassium	mg/l	5		5.73		5.73		5.78		n/a		n/a
Sodium	mg/l	150		26.754		50.973		28.179		n/a		n/a
Solids Suspended		50	6	<0	n/a	35	5.5	5	n/a	n/a	n/a	n/a
Solids Total	mg/l											
Sulphate	mg/l	200		81.033		203.066		108.44		n/a		n/a
Surfactant Anionic	ug/l											
Temperature	OC	25	14.2	8.9	n/a	9.8	14.4	9.0	n/a	n/a	n/a	n/a
Tin	ug/l	-		<0.001		<0.001		<0.001		n/a		n/a
Total Organic Carbon	mg/l	NAC										
Total Oxidised Nitrogen (TON)	mg/l	NAC		3.322		0.482		2.906		n/a		n/a
Total Phosphorus	mg/l	-		<0.01		<0.01		<0.01		n/a		n/a
Zinc	ug/l	100		0.01		0.036		0.029		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 03rd July and on 27th November 2013.

APPENDIX G – COPIES OF LABORATORY REPORTS

Groundwater Monitoring Test Reports

BHP/CL/02C

TEST REPORT 109866.3

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/07/103
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
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	Standard Reference
	Biannual Landfill Monitoring BH3			
Water Level		m	0.65	ISO 5667 - 11
pH		-	6.68	APHA - 4500 - H^+
Temperature		^0C	13.1	APHA - 2550 - B
Total Ammonia		mg/l	33.6	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	13850	APHA - 2510 - B
T.O.C		mg/l	16.2	APHA - 5310 - C
Phenols		mg/l	<0.001	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.1	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	5.5	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	1.24	APHA - 4110 - B
Chloride		mg/l	4810	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/2014
Supplement to Report No. 109866.3

BHP/CL/02C

TEST REPORT 111501.3 Iss 2

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/11/729-733
Order No.:
Date Received: 27/11/13
Date Completed: 05/12/13
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring BH3			
Water Level		m	1.08	ISO 5667 - 11
pH		-	6.72	APHA - 4500 - H^+
Total Ammonia		mg/l	34	APHA-4500-NH_3-D
Conductivity		µScm^{-1}	14940	APHA - 2510 - B
T.O.C		mg/l	65	APHA - 5310 - C
Phenols		mg/l	0.001	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.01	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	1.131	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.26	APHA - 4110 - B
Chloride		mg/l	5367.163	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/14

Supplement to Report No. 111501.3

BHP/CL/02C

TEST REPORT NO: 111504.3

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Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water BH3			
Dissolved Oxygen		% O_2 sat	52.6	APHA - 4500-O-G
List I Organics		mg/l	<0.01	GC-MS
List II Organics		mg/l	<0.01	GC-MS
Detergents (as MBAS)		mg/l	0.034	APHA - 5540 - C
Arsenic		mg/l	<0.02	APHA - 3120 - B
Boron		mg/l	<0.001	APHA - 3120 - B
Cadmium		mg/l	<0.01	APHA - 3120 - B
Calcium		mg/l	158.0	APHA - 3120 - B
Total Chromium		mg/l	0.011	APHA - 3120 - B
Copper		mg/l	0.016	APHA - 3120 - B
Cyanide		mg/l	<0.001	APHA - 4500 - CN-E
Fluoride		mg/l	<0.01	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT NO: 111504.3

Analysing
Testing
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Calibrating

Client: Response Engineering
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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

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TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water BH3			
Iron		mg/l	1.803	APHA - 3120 - B
Lead		mg/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	17.974	APHA - 3120 - B
Mercury		mg/l	<0.02	APHA - 3120 - B
Nickel		mg/l	0.001	APHA - 3120 - B
Potassium		mg/l	65.13	APHA - 3120 - B
Sodium		mg/l	27.916	APHA - 3120 - B
Tin		mg/l	<0.001	APHA - 3120 - B
Zinc		mg/l	0.012	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	0.779	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	11.3	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Residue on Evaporation		mg/l	6639	APHA - 2540- B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT 109971 Iss 2

Analysing
Testing
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Client: Response Engineering
Traderee TP
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BHP Ref. No.: 13/07/344
Order No.:
Date Received: 11/07/2013
Date Completed: To complete
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring BH4			
Water Level		m	0.1	ISO 5667 - 11
pH		-	7.28	APHA - 4500 - H^+
Temperature		^0C	22.5	APHA - 2550 - B
Total Ammonia		mg/l	29.14	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	525	APHA - 2510 - B
T.O.C		mg/l	185	APHA - 5310 - C
Phenols		mg/l	<0.001	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	2.7	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	<0.01	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	39.0	APHA - 4110 - B
Chloride		mg/l	5073.23	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/2014
Supplement to Report No. 109971

BHP/CL/02C

TEST REPORT 111501.4 Iss 2

Analysing
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Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/11/729-733
Order No.:
Date Received: 27/11/13
Date Completed: 05/12/13
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring BH4			
Water Level		m	0.30	ISO 5667 - 11
pH		-	6.81	APHA - 4500 - H^+
Total Ammonia		mg/l	34.50	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	14710.00	APHA - 2510 - B
T.O.C		mg/l	58.00	APHA - 5310 - C
Phenols		mg/l	0.02	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.01	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.76	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.17	APHA - 4110 - B
Chloride		mg/l	5112.49	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/14
Supplement to Report No. 111501.4

BHP/CL/02C

TEST REPORT NO: 111504.4

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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water BH4			
Dissolved Oxygen		% O_2 sat	4.6	APHA - 4500-O-G
List I Organics		mg/l	<0.01	GC-MS
List II Organics		mg/l	<0.01	GC-MS
Detergents (as MBAS)		mg/l	0.061	APHA - 5540 - C
Arsenic		mg/l	<0.02	APHA - 3120 - B
Boron		mg/l	<0.001	APHA - 3120 - B
Cadmium		mg/l	<0.01	APHA - 3120 - B
Calcium		mg/l	134.1	APHA - 3120 - B
Total Chromium		mg/l	0.003	APHA - 3120 - B
Copper		mg/l	0.004	APHA - 3120 - B
Cyanide		mg/l	0.001	APHA - 4500 - CN-E
Fluoride		mg/l	4.691	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT NO: 111504.4

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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water BH4			
Iron		mg/l	6.153	APHA - 3120 - B
Lead		mg/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	18.344	APHA - 3120 - B
Mercury		mg/l	<0.02	APHA - 3120 - B
Nickel		mg/l	0.004	APHA - 3120 - B
Potassium		mg/l	69.59	APHA - 3120 - B
Sodium		mg/l	29.228	APHA - 3120 - B
Tin		mg/l	<0.001	APHA - 3120 - B
Zinc		mg/l	0.013	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	2.344	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	5.5	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Residue on Evaporation		mg/l	8452	APHA - 2540- B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT 109866.4

Analysing
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Client: Response Engineering
Traderee TP
Shannon
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BHP Ref. No.: 13/07/104
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring BH5			
Water Level		m	0.75	ISO 5667 - 11
pH		-	6.76	APHA - 4500 - H^+
Temperature		^0C	12.7	APHA - 2550 - B
Total Ammonia		mg/l	23.2	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	11020	APHA - 2510 - B
T.O.C		mg/l	16.3	APHA - 5310 - C
Phenols		mg/l	0.004	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.1	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	3.37	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.76	APHA - 4110 - B
Chloride		mg/l	3494	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/2014
Supplement to Report No. 109866.4

Page 5 of 5

BHP/CL/02C

TEST REPORT 111501.5 Iss 2

Analysing
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Client: Response Engineering
Traderee TP
Shannon
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BHP Ref. No.: 13/11/729-733
Order No.:
Date Received: 27/11/13
Date Completed: 05/12/13
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring BH5			
Water Level		m	0.92	ISO 5667 - 11
pH		-	6.88	APHA - 4500 - H^+
Total Ammonia		mg/l	25.25	APHA-4500-NH_3-D
Conductivity		µScm^{-1}	11450	APHA - 2510 - B
T.O.C		mg/l	49	APHA - 5310 - C
Phenols		mg/l	0.004	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.01	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.62	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.14	APHA - 4110 - B
Chloride		mg/l	3985.748	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/14
Supplement to Report No. 111501.5

BHP/CL/02C

TEST REPORT NO: 111504.5

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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water BH5			
Dissolved Oxygen		% O_2 sat	63.5	APHA - 4500-O-G
List I Organics		mg/l	<0.01	GC-MS
List II Organics		mg/l	<0.01	GC-MS
Detergents (as MBAS)		mg/l	0.069	APHA - 5540 - C
Arsenic		mg/l	<0.02	APHA - 3120 - B
Boron		mg/l	<0.001	APHA - 3120 - B
Cadmium		mg/l	<0.01	APHA - 3120 - B
Calcium		mg/l	152.5	APHA - 3120 - B
Total Chromium		mg/l	0.006	APHA - 3120 - B
Copper		mg/l	0.009	APHA - 3120 - B
Cyanide		mg/l	0.002	APHA - 4500 - CN-E
Fluoride		mg/l	<0.01	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT NO: 111504.5

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BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water BH5			
Iron		mg/l	1.172	APHA - 3120 - B
Lead		mg/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	18.64	APHA - 3120 - B
Mercury		mg/l	<0.02	APHA - 3120 - B
Nickel		mg/l	0.004	APHA - 3120 - B
Potassium		mg/l	62.95	APHA - 3120 - B
Sodium		mg/l	30.39	APHA - 3120 - B
Tin		mg/l	<0.001	APHA - 3120 - B
Zinc		mg/l	0.008	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	0.313	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	3.1	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Residue on Evaporation		mg/l	8404	APHA - 2540- B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT 109866.1

Analysing
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Client: Response Engineering
Traderee TP
Shannon
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BHP Ref. No.: 13/07/101
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring RD2			
Water Level		m	1.33	ISO 5667 - 11
pH		-	7.21	APHA - 4500 - H^+
Temperature		^0C	12.7	APHA - 2550 - B
Total Ammonia		mg/l	21.4	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	3450	APHA - 2510 - B
T.O.C		mg/l	16.5	APHA - 5310 - C
Phenols		mg/l	0.001	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.1	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.04	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.01	APHA - 4110 - B
Chloride		mg/l	819	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/2014
Supplement to Report No. 109866.1

BHP/CL/02C

TEST REPORT 111501.1 Iss 2

Analysing
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Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/11/729-733
Order No.:
Date Received: 27/11/13
Date Completed: 05/12/13
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring RD2			
Water Level		m	1.45	ISO 5667 - 11
pH		-	7.13	APHA - 4500 - H^+
Total Ammonia		mg/l	17	APHA-4500-NH_3-D
Conductivity		µScm^{-1}	4200	APHA - 2510 - B
T.O.C		mg/l	17	APHA - 5310 - C
Phenols		mg/l	0.021	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.01	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.759	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.17	APHA - 4110 - B
Chloride		mg/l	953.067	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/14
Supplement to Report No. 111501.1

BHP/CL/02C

TEST REPORT NO: 111504.1

Analysing
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Client: Response Engineering
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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

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TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water RD2			
Dissolved Oxygen		% O_2 sat	63.6	APHA - 4500-O-G
List I Organics		mg/l	<0.01	GC-MS
List II Organics		mg/l	<0.01	GC-MS
Detergents (as MBAS)		mg/l	0	APHA - 5540 - C
Arsenic		mg/l	<0.02	APHA - 3120 - B
Boron		mg/l	<0.001	APHA - 3120 - B
Cadmium		mg/l	<0.01	APHA - 3120 - B
Calcium		mg/l	127.1	APHA - 3120 - B
Total Chromium		mg/l	<0.001	APHA - 3120 - B
Copper		mg/l	0.009	APHA - 3120 - B
Cyanide		mg/l	0.009	APHA - 4500 - CN-E
Fluoride		mg/l	0.402	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT NO: 111504.1

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BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water RD2			
Iron		mg/l	2.336	APHA - 3120 - B
Lead		mg/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	10.112	APHA - 3120 - B
Mercury		mg/l	<0.02	APHA - 3120 - B
Nickel		mg/l	0.005	APHA - 3120 - B
Potassium		mg/l	7.00	APHA - 3120 - B
Sodium		mg/l	37.131	APHA - 3120 - B
Tin		mg/l	<0.001	APHA - 3120 - B
Zinc		mg/l	0.036	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	1.18	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	0.21	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Residue on Evaporation		mg/l	2522	APHA - 2540- B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT 109866.2

Analysing
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Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/07/102
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring RD3			
Water Level		m	0.87	ISO 5667 - 11
pH		-	7.42	APHA - 4500 - H^+
Temperature		^0C	12.5	APHA - 2550 - B
Total Ammonia		mg/l	0.62	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	2870	APHA - 2510 - B
T.O.C		mg/l	16.6	APHA - 5310 - C
Phenols		mg/l	<0.001	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.1	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.08	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.02	APHA - 4110 - B
Chloride		mg/l	528	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/2014
Supplement to Report No. 109866.2

BHP/CL/02C

TEST REPORT 111501.2 Iss 2

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/11/729-733
Order No.:
Date Received: 27/11/13
Date Completed: 05/12/13
Test Specification: Nil
Item : Biannual GW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring RD3			
Water Level		m	0.66	ISO 5667 - 11
pH		-	7.35	APHA - 4500 - H^+
Total Ammonia		mg/l	1.37	APHA-4500-NH_3-D
Conductivity		µScm^{-1}	2760	APHA - 2510 - B
T.O.C		mg/l	13.8	APHA - 5310 - C
Phenols		mg/l	<0.001	APHA - 5530 - D
Nitrite (as NO_2)		mg/l	<0.01	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.084	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.02	APHA - 4110 - B
Chloride		mg/l	438.853	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 22nd Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 21/02/14

Supplement to Report No. 111501.2

BHP/CL/02C

TEST REPORT NO: 111504.2

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

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TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water RD3			
Dissolved Oxygen		% O_2 sat	78.1	APHA - 4500-O-G
List I Organics		mg/l	<0.01	GC-MS
List II Organics		mg/l	<0.01	GC-MS
Detergents (as MBAS)		mg/l	0.002	APHA - 5540 - C
Arsenic		mg/l	<0.02	APHA - 3120 - B
Boron		mg/l	<0.001	APHA - 3120 - B
Cadmium		mg/l	<0.01	APHA - 3120 - B
Calcium		mg/l	154.1	APHA - 3120 - B
Total Chromium		mg/l	<0.001	APHA - 3120 - B
Copper		mg/l	0.005	APHA - 3120 - B
Cyanide		mg/l	0.004	APHA - 4500 - CN-E
Fluoride		mg/l	0.319	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT NO: 111504.2

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Client: Response Engineering
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BHP Ref. No.: 13/11/738-742
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Ground Water RD3			
Iron		mg/l	0.312	APHA - 3120 - B
Lead		mg/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	13.35	APHA - 3120 - B
Mercury		mg/l	<0.02	APHA - 3120 - B
Nickel		mg/l	0.003	APHA - 3120 - B
Potassium		mg/l	5.71	APHA - 3120 - B
Sodium		mg/l	53.768	APHA - 3120 - B
Tin		mg/l	<0.001	APHA - 3120 - B
Zinc		mg/l	0.04	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	69.751	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	0.07	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Residue on Evaporation		mg/l	1559	APHA - 2540- B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

Leachate Monitoring Test Reports

BHP/CL/02C

TEST REPORT 109868.1

Analysing
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Client: Response Engineering
Traderee TP
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FTAO: Ailish Johnson

BHP Ref. No.: 13/07/109
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual Leachate

TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring SS3-Leachate			
pH		-	6.58	APHA - 4500 - H^+
Temperature		^0C	14.5	APHA - 2550 - B
Total Ammonia		mg/l	14.2	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	1743	APHA - 2510 - B
B.O.D		mg/l	62	APHA - 5210 - B
C.O.D		mg/l	122	APHA - 5220 - D
Nitrite (as NO_2)		mg/l	<0.1	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	0.33	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	0.07	APHA - 4110 - B
Chloride		mg/l	150	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 11/07/2013

BHP/CL/02C

TEST REPORT 111503

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/737
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item : Biannual Leachate

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring SS3-Leachate			
pH		-	6.71	APHA - 4500 - H^+
Temperature		°C	13.5	APHA - 2550 - B
Total Ammonia		mg/l	12.25	APHA-4500-NH_3-D
Conductivity		μScm^{-1}	1851	APHA - 2510 - B
B.O.D		mg/l	11	APHA - 5210 - B
C.O.D		mg/l	105	APHA - 5220 - D
Nitrite (as NO_2)		mg/l	0.2	APHA - 4110 - B
Nitrate (as NO_3)		mg/l	118.539	APHA - 4110 - B
Total oxidised Nitrogen (as N)		mg/l	26.83	APHA - 4110 - B
Chloride		mg/l	64.554	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 05/12/13

Page 1 of 1

BHP/CL/02C

TEST REPORT NO: 111506

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Client: Response Engineering
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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/746
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring **Annual Leachate SS3**			
Arsenic		mg/l	<0.02	APHA - 3120 - B
Boron		mg/l	<0.001	APHA - 3120 - B
Cadmium		mg/l	<0.01	APHA - 3120 - B
Calcium		mg/l	167.5	APHA - 3120 - B
Total Chromium		mg/l	<0.001	APHA - 3120 - B
Copper		mg/l	0.0	APHA - 3120 - B
Cyanide		mg/l	<0.001	APHA - 4500 - CN-E
Fluoride		mg/l	0.185	APHA - 4110 - B
Iron		mg/l	0.958	APHA - 3120 - B
Lead		mg/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	18.934	APHA - 3120 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

BHP/CL/02C

TEST REPORT NO: 111506

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/746
Order No.:
Date Received: 27/11/13
Date Completed: 06/12/13
Test Specification: Nil
Item :See below

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TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring Annual Leachate SS3			
Mercury		mg/l	<0.02	APHA - 3120 - B
Nickel		mg/l	0.002	APHA - 3120 - B
Potassium		mg/l	6.70	APHA - 3120 - B
Sodium		mg/l	32.384	APHA - 3120 - B
Tin		mg/l	<0.001	APHA - 3120 - B
Zinc		mg/l	0.005	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	741.4	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	0.03	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Detergents		mg/l	0.064	APHA - 5540 - C

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 10/12/13

Surface Water Monitoring Test Reports

BHP/CL/02C

TEST REPORT 109867.1

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/07/105
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual SW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring SS1			
pH		-	7.62	APHA - 4500 - H^+
Temperature		^0C	14.2	APHA - 2550 - B
Total Ammonia		mg/l	0.28	APHA-4500-NH_3-D
B.O.D		mg/l	1.4	APHA - 5210 - B
C.O.D		mg/l	5	APHA - 5220 - D
Total Suspended Solids		mg/l	6	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	55.9	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 11/07/2013

BHP/CL/02C

TEST REPORT 111502.1

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/734
Order No.:
Date Received: 27/11/13
Date Completed: 28/11/13
Test Specification: Nil
Item : Biannual SW Monitoring

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring Surface Water SS1			
pH		-	7.72	APHA - 4500 - H^+
Temperature		^0C	8.9	APHA - 2550 - B
Total Ammonia		mg/l	0.14	APHA-4500-NH_3-D
B.O.D		mg/l	2	APHA - 5210 - B
C.O.D		mg/l	12	APHA - 5220 - D
Total Suspended Solids		mg/l	<0	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	102.9	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 05/12/13

BHP/CL/02C

TEST REPORT NO: 111505.1

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Client: Response Engineering
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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/743
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS1			
Conductivity		μScm^{-1}	847	APHA - 2510 - B
Arsenic		ug/l	<0.02	APHA - 3120 - B
Boron		ug/l	<0.001	APHA - 3120 - B
Cadmium		ug/l	<0.01	APHA - 3120 - B
Calcium		mg/l	100.9	APHA - 3120 - B
Total Chromium		ug/l	<0.001	APHA - 3120 - B
Copper		ug/l	0.0	APHA - 3120 - B
Cyanide		mg/l	0.002	APHA - 4500 - CN-E
Fluoride		mg/l	0.097	APHA - 4110 - B
Iron		ug/l	0.213	APHA - 3120 - B
Lead		ug/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	10.145	APHA - 3120 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 04/12/13

BHP/CL/02C

TEST REPORT NO: 111505.1

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/743
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

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TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS1			
Mercury		ug/l	<0.02	APHA - 3120 - B
Nickel		ug/l	0.004	APHA - 3120 - B
Potassium		mg/l	5.73	APHA - 3120 - B
Sodium		mg/l	26.754	APHA - 3120 - B
Tin		ug/l	<0.001	APHA - 3120 - B
Zinc		ug/l	0.01	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	81.033	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	<0.01	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Nitrate (as NO_3)		mg/l	14.667	APHA - 4110 - B
Nitrite (as NO_2)		mg/l	0.031	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/l	3.322	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 04/12/13

BHP/CL/02C

TEST REPORT 109867.2

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/07/106
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual SW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring SS2			
pH		-	dry	APHA - 4500 - H^+
Temperature		^0C	dry	APHA - 2550 - B
Total Ammonia		mg/l	dry	APHA-4500-NH_3-D
B.O.D		mg/l	dry	APHA - 5210 - B
C.O.D		mg/l	dry	APHA - 5220 - D
Total Suspended Solids		mg/l	dry	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	dry	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 11/07/2013

BHP/CL/02C

TEST REPORT 111502.2

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/735
Order No.:
Date Received: 27/11/13
Date Completed: 28/11/13
Test Specification: Nil
Item : Biannual SW Monitoring

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring Surface Water SS2			
pH		-	7.83	APHA - 4500 - H^+
Temperature		^0C	9.8	APHA - 2550 - B
Total Ammonia		mg/l	0.28	APHA-4500-NH_3-D
B.O.D		mg/l	3.20	APHA - 5210 - B
C.O.D		mg/l	32.00	APHA - 5220 - D
Total Suspended Solids		mg/l	35.00	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	110.10	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 05/12/13

BHP/CL/02C

TEST REPORT NO: 111505.2

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Client: Response Engineering
Traderee TP
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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/744
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS2			
Conductivity		μScm^{-1}	1115	APHA - 2510 - B
Arsenic		ug/l	<0.02	APHA - 3120 - B
Boron		ug/l	<0.001	APHA - 3120 - B
Cadmium		ug/l	<0.01	APHA - 3120 - B
Calcium		mg/l	150.4	APHA - 3120 - B
Total Chromium		ug/l	<0.001	APHA - 3120 - B
Copper		ug/l	0.0	APHA - 3120 - B
Cyanide		mg/l	0.001	APHA - 4500 - CN-E
Fluoride		mg/l	0.158	APHA - 4110 - B
Iron		ug/l	0.221	APHA - 3120 - B
Lead		ug/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	15.118	APHA - 3120 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 04/12/13

BHP/CL/02C

TEST REPORT NO: 111505.2

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Client: Response Engineering
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FTAO: Ailish Johnson

BHP Ref. No.: 13/11/744
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS2			
Mercury		ug/l	<0.02	APHA - 3120 - B
Nickel		ug/l	0.001	APHA - 3120 - B
Potassium		mg/l	5.73	APHA - 3120 - B
Sodium		mg/l	50.973	APHA - 3120 - B
Tin		ug/l	<0.001	APHA - 3120 - B
Zinc		ug/l	0.036	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	203.066	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	<0.01	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Nitrate (as NO_3)		mg/l	2.135	APHA - 4110 - B
Nitrite (as NO_2)		mg/l	<0.01	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/l	0.482	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 04/12/13

BHP/CL/02C

TEST REPORT 109867.3

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/07/107
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual SW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring SS4			
pH		-	7.40	APHA - 4500 - H^+
Temperature		^0C	14.4	APHA - 2550 - B
Total Ammonia		mg/l	0.18	APHA-4500-NH_3-D
B.O.D		mg/l	1.4	APHA - 5210 - B
C.O.D		mg/l	16	APHA - 5220 - D
Total Suspended Solids		mg/l	5.5	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	49.6	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 11/07/2013

BHP/CL/02C

TEST REPORT 111502.3

Analysing
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Consulting
Calibrating

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Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: 13/11/736
Order No.:
Date Received: 27/11/13
Date Completed: 28/11/13
Test Specification: Nil
Item : Biannual SW Monitoring

TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring Surface Water SS4			
pH		-	7.83	APHA - 4500 - H^+
Temperature		^0C	9	APHA - 2550 - B
Total Ammonia		mg/l	0.13	APHA-4500-NH_3-D
B.O.D		mg/l	2	APHA - 5210 - B
C.O.D		mg/l	11	APHA - 5220 - D
Total Suspended Solids		mg/l	5	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	104.0	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 05/12/13

BHP/CL/02C

TEST REPORT NO: 111505.3

Analysing
Testing
Consulting
Calibrating

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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.: 13/11/745
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS4			
Conductivity		μScm^{-1}	882	APHA - 2510 - B
Arsenic		ug/l	<0.02	APHA - 3120 - B
Boron		ug/l	<0.001	APHA - 3120 - B
Cadmium		ug/l	<0.01	APHA - 3120 - B
Calcium		mg/l	103.5	APHA - 3120 - B
Total Chromium		ug/l	<0.001	APHA - 3120 - B
Copper		ug/l	0.0	APHA - 3120 - B
Cyanide		mg/l	0.001	APHA - 4500 - CN-E
Fluoride		mg/l	0.106	APHA - 4110 - B
Iron		ug/l	0.224	APHA - 3120 - B
Lead		ug/l	<0.01	APHA - 3120 - B
Magnesium		mg/l	10.896	APHA - 3120 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 04/12/13

BHP/CL/02C

TEST REPORT NO: 111505.3

Analysing
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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.: 13/11/745
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS4			
Mercury		ug/l	<0.02	APHA - 3120 - B
Nickel		ug/l	0.005	APHA - 3120 - B
Potassium		mg/l	5.78	APHA - 3120 - B
Sodium		mg/l	28.179	APHA - 3120 - B
Tin		ug/l	<0.001	APHA - 3120 - B
Zinc		ug/l	0.029	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	108.437	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	<0.01	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	<0.01	APHA - 4500 - P-E
Nitrate (as NO_3)		mg/l	12.843	APHA - 4110 - B
Nitrite (as NO_2)		mg/l	0.018	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/l	2.906	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 04/12/13

BHP/CL/02C

TEST REPORT 109867.4

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: 13/07/108
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual SW 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	Standard Reference
	Biannual Landfill Monitoring SS6			
pH		-	dry	APHA - 4500 - H^+
Temperature		^0C	dry	APHA - 2550 - B
Total Ammonia		mg/l	dry	APHA-4500-NH_3-D
B.O.D		mg/l	dry	APHA - 5210 - B
C.O.D		mg/l	dry	APHA - 5220 - D
Total Suspended Solids		mg/l	dry	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	dry	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 11/07/2013

Page 4 of 4

BHP/CL/02C

TEST REPORT 111502.4

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: n/a
Order No.:
Date Received: 27/11/13
Date Completed: 28/11/13
Test Specification: Nil
Item : Biannual SW Monitoring

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New Road
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E Mail bhpcem2@bhp.ie

TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring SS6			
pH		-	dry	APHA - 4500 - H^+
Temperature		^0C	dry	APHA - 2550 - B
Total Ammonia		mg/l	dry	APHA-4500-NH_3-D
B.O.D		mg/l	dry	APHA - 5210 - B
C.O.D		mg/l	dry	APHA - 5220 - D
Total Suspended Solids		mg/l	dry	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	dry	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 05/12/13

Page 4 of 4

BHP/CL/02C

TEST REPORT NO: 111505.4

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

FTAO: Ailish Johnson

BHP Ref. No.: N/A
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

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

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS6			
Conductivity		μScm^{-1}	Dry	APHA - 2510 - B
Arsenic		ug/l	Dry	APHA - 3120 - B
Boron		ug/l	Dry	APHA - 3120 - B
Cadmium		ug/l	Dry	APHA - 3120 - B
Calcium		mg/l	Dry	APHA - 3120 - B
Total Chromium		ug/l	Dry	APHA - 3120 - B
Copper		ug/l	Dry	APHA - 3120 - B
Cyanide		mg/l	Dry	APHA - 4500 - CN-E
Fluoride		mg/l	Dry	APHA - 4110 - B
Iron		ug/l	Dry	APHA - 3120 - B
Lead		ug/l	Dry	APHA - 3120 - B
Magnesium		mg/l	Dry	APHA - 3120 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.
*Sample could not be taken as location was dry.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 12/02/14

BHP/CL/02C

TEST REPORT NO: 111505.4

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: N/A
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS6			
Mercury		ug/l	Dry	APHA - 3120 - B
Nickel		ug/l	Dry	APHA - 3120 - B
Potassium		mg/l	Dry	APHA - 3120 - B
Sodium		mg/l	Dry	APHA - 3120 - B
Tin		ug/l	Dry	APHA - 3120 - B
Zinc		ug/l	Dry	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	Dry	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	Dry	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	Dry	APHA - 4500 - P-E
Nitrate (as NO_3)		mg/l	Dry	APHA - 4110 - B
Nitrite (as NO_2)		mg/l	Dry	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/l	Dry	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.
*Sample could not be taken as location was dry.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 12/02/14

BHP/CL/02C

TEST REPORT 109867.5

Analysing
Testing
Consulting
Calibrating

Client: Response Engineering
Traderee TP
Shannon
Co. Clare

BHP Ref. No.: N/A
Order No.:
Date Received: 03/07/2013
Date Completed: 09/07/2013
Test Specification: Nil
Item : Biannual SW Monitoring

FTAO: Ailish Johnson

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring			
	SS7			
pH		-	dry	APHA - 4500 - H^+
Temperature		^0C	dry	APHA - 2550 - B
Total Ammonia		mg/l	dry	APHA-4500-NH_3-D
B.O.D		mg/l	dry	APHA - 5210 - B
C.O.D		mg/l	dry	APHA - 5220 - D
Total Suspended Solids		mg/l	dry	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	dry	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.
*Sample could not be taken as location was dry.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 12/02/14

Page 1 of 1

BHP/CL/02C

TEST REPORT 111502.5

Analysing
Testing
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Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: n/a
Order No.:
Date Received: 27/11/13
Date Completed: 28/11/13
Test Specification: Nil
Item : Biannual SW Monitoring

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TEST	Client Reference	Units	Results	Standard Reference
	Biannual Landfill Monitoring			
	SS7			
pH		-	dry	APHA - 4500 - H^+
Temperature		^0C	dry	APHA - 2550 - B
Total Ammonia		mg/l	dry	APHA-4500-NH_3-D
B.O.D		mg/l	dry	APHA - 5210 - B
C.O.D		mg/l	dry	APHA - 5220 - D
Total Suspended Solids		mg/l	dry	APHA - 2540 - B
Dissolved Oxygen		% O_2 sat	dry	APHA - 4500-O-G

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.
*Sample could not be taken as location was dry.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 12/02/14

Page 1 of 1

BHP/CL/02C

TEST REPORT NO: 111505.5

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Client: Response Engineering
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Shannon
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FTAO: Ailish Johnson

BHP Ref. No.: N/A
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS7			
Conductivity		μScm^{-1}	Dry	APHA - 2510 - B
Arsenic		ug/l	Dry	APHA - 3120 - B
Boron		ug/l	Dry	APHA - 3120 - B
Cadmium		ug/l	Dry	APHA - 3120 - B
Calcium		mg/l	Dry	APHA - 3120 - B
Total Chromium		ug/l	Dry	APHA - 3120 - B
Copper		ug/l	Dry	APHA - 3120 - B
Cyanide		mg/l	Dry	APHA - 4500 - CN-E
Fluoride		mg/l	Dry	APHA - 4110 - B
Iron		ug/l	Dry	APHA - 3120 - B
Lead		ug/l	Dry	APHA - 3120 - B
Magnesium		mg/l	Dry	APHA - 3120 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.
*Sample could not be taken as location was dry.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 12/02/14

BHP/CL/02C

TEST REPORT NO: 111505.5

Analysing
Testing
Consulting
Calibrating

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

FTAO: Ailish Johnson

BHP Ref. No.: N/A
Order No.:
Date Received: 27/11/13
Date Completed: 29/11/13
Test Specification: Nil
Item :See below

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

TEST	Client Reference	Units	Results	Standard Reference
	Annual Landfill Monitoring SS7			
Mercury		ug/l	Dry	APHA - 3120 - B
Nickel		ug/l	Dry	APHA - 3120 - B
Potassium		mg/l	Dry	APHA - 3120 - B
Sodium		mg/l	Dry	APHA - 3120 - B
Tin		ug/l	Dry	APHA - 3120 - B
Zinc		ug/l	Dry	APHA - 3120 - B
Sulphate (as SO_4)		mg/l	Dry	APHA - 4110 - B
Total Phosphorus (as P)		mg/l	Dry	APHA - 4500 - P
OrthoPhosphate (as P)		mg/l	Dry	APHA - 4500 - P-E
Nitrate (as NO_3)		mg/l	Dry	APHA - 4110 - B
Nitrite (as NO_2)		mg/l	Dry	APHA - 4110 - B
Total Oxidised Nitrogen (as N)		mg/l	Dry	APHA - 4110 - B

Additional information : All Methods are from Standard Methods for the Examination of Water and Wastewater, 20th Edition.
*Sample could not be taken as location was dry.

For and on behalf of BHP laboratories :

Paul O'Sullivan
Issue Date 12/02/14

Appendix H – Meteorological Data

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	1	1	85.5	1011.8	8.5	275	0.2	0.2
2013	1	2	98	1022.3	9.4	235	0.3	0.4
2013	1	3	94.2	1030.8	6.4	200	0.1	0.2
2013	1	4	88.4	1032.7	10.2	165	0.6	0.7
2013	1	5	91	1028.6	10.2	150	0.4	0.5
2013	1	6	92.8	1024.6	11.4	145	0.4	0.6
2013	1	7	94.8	1016.6	9.8	140	0.5	0.6
2013	1	8	92.8	1021.3	5.8	255	0	0.1
2013	1	9	97.2	1021.5	5.6	115	0.2	0.3
2013	1	10	86.2	1014.3	9.2	125	0.4	0.4
2013	1	11	92.1	1011.8	9.4	120	0.4	0.5
2013	1	12	87.7	1010	8.2	15	0.3	0.4
2013	1	13	93.3	1021.7	4.3	295	0.3	0.4
2013	1	14	85.7	1017.6	9.4	295	0.4	0.5
2013	1	15	93	1011.8	6.9	105	0.3	0.4
2013	1	16	96.8	1007.7	8	125	0.3	0.5
2013	1	17	94.9	1004.6	10	115	0.4	0.5
2013	1	18	93.1	991.4	7.6	245	0.4	0.2
2013	1	19	95.2	997.6	4	100	0.3	0.4
2013	1	20	79.9	996.3	9.9	100	0.6	0.8
2013	1	21	90.4	994	5.1	110	0.2	0.3
2013	1	22	97.8	1000.7	3.6	120	0.2	0.3
2013	1	23	87.6	1005.8	8.5	110	0.4	0.6
2013	1	24	89.3	1012.8	8.9	125	0.5	0.7
2013	1	25	90.2	1002	13	150	0.5	0.8
2013	1	26	90.4	998.2	11	160	0.5	0.7
2013	1	27	80	990.3	18	230	0.6	0.8
2013	1	28	78.9	993.5	21.1	235	1	1.4
2013	1	29	86	993	13	190	0.7	0.9
2013	1	30	74.5	1003	18.3	240	1.1	1.5
2013	1	31	77.2	1006.6	20	240	1.2	1.6
January							13.7	18.2

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	2	1	83.8	1006.6	10	240	0.7	0.9
2013	2	2	84.4	1023.2	4.7	280	0.5	0.7
2013	2	3	97.4	1018.9	13.2	250	0.4	0.6
2013	2	4	79.7	1015.5	19.8	260	0.6	0.9
2013	2	5	81.2	1007	18.3	270	0.8	1.2
2013	2	6	78.9	1023.2	9.3	315	0.6	0.8
2013	2	7	86.1	1024.1	9	270	0.5	0.8
2013	2	8	85.2	1027.2	6.1	280	0.6	0.8
2013	2	9	93.2	1016.7	5.9	115	0.4	0.6
2013	2	10	88.2	996.1	8.2	265	0.6	0.8
2013	2	11	93.1	1001.8	6.2	320	0.4	0.6
2013	2	12	93.6	1013	6.7	235	0.5	0.7
2013	2	13	97	1009.1	11.1	225	0.5	0.7
2013	2	14	87.6	1013.3	10.5	245	0.7	1
2013	2	15	89	1019.3	6.8	130	0.6	0.8
2013	2	16	89.9	1015.6	13.1	145	0.8	1.1
2013	2	17	77.6	1010.9	19.2	140	1.1	1.6
2013	2	18	76.3	1012.4	13.2	115	0.9	1.3
2013	2	19	81.6	1015.9	10.7	105	0.8	1.2
2013	2	20	80.4	1015.7	12.6	100	0.8	1.2
2013	2	21	70.4	1016.6	16.6	105	1.3	1.8
2013	2	22	64.2	1021	11.3	95	1.2	1.5
2013	2	23	69.1	1025.5	2.7	20	0.6	0.9
2013	2	24	75.1	1029	4.5	105	0.8	1.1
2013	2	25	71.5	1033.5	4	95	0.8	1.2
2013	2	26	83	1035.9	3.9	95	0.6	0.9
2013	2	27	84.2	1037.8	4.5	30	0.7	0.9
2013	2	28	86.3	1034.8	7	20	0.6	0.9
February							19.4	27.5

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	3	1	81.1	1032.5	5.5	45	0.9	1.1
2013	3	2	77.8	1029.3	3.6	10	0.9	1.4
2013	3	3	77.1	1021.2	6	95	0.9	1.2
2013	3	4	84.3	1009.8	7.2	80	0.7	1.1
2013	3	5	82.2	1001.6	6	95	0.9	1.2
2013	3	6	92.2	995.4	11	100	0.7	1.1
2013	3	7	93.5	989.8	12.3	100	0.6	0.8
2013	3	8	88.5	989.7	11	115	1	1.3
2013	3	9	84.4	997.3	13	90	1.2	1.6
2013	3	10	80.2	1005.5	15	60	1.2	1.7
2013	3	11	62.3	1015.9	15.9	35	1.5	2.5
2013	3	12	70.4	1019.8	6.4	325	0.9	1.4
2013	3	13	82.6	1018.2	5.3	305	1	1.5
2013	3	14	83.8	1016.8	8.9	245	1.1	1.7
2013	3	15	85.2	999.4	9.6	230	1.1	1.7
2013	3	16	81.5	992.9	5	350	1.1	1.7
2013	3	17	86.5	990.9	7.6	290	1	1.5
2013	3	18	86.5	992.8	5	345	1.1	1.5
2013	3	19	86.6	999.3	6.2	345	0.6	0.9
2013	3	20	76	1005.8	4.1	120	1.2	1.7
2013	3	21	84.3	1000.9	19.9	100	0.9	1.5
2013	3	22	89.9	992.6	17.5	115	0.7	1.2
2013	3	23	86.8	1004.5	15.1	90	0.9	1.3
2013	3	24	75.1	1012.3	12.3	80	0.9	1.3
2013	3	25	62.5	1016.7	10.8	70	1.5	2
2013	3	26	66.7	1017.4	8.5	55	1.3	1.8
2013	3	27	75.4	1015.7	8.6	35	1.2	1.9
2013	3	28	67.4	1013.2	11	95	1.8	2.8
2013	3	29	60.1	1008.2	15.2	95	2	3
2013	3	30	55	1011.3	12.5	110	2.3	3.3
2013	3	31	75.1	1007.2	15.8	115	1.3	2
March							34.4	50.7

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	4	1	63.5	1007.7	16.2	100	1.6	2.3
2013	4	2	56.2	1015.1	12.4	95	2.2	3.3
2013	4	3	57	1021	9.4	55	2.6	3.8
2013	4	4	55.8	1022.8	9.7	30	2.2	3.3
2013	4	5	63.9	1024.1	6.1	25	1.8	2.6
2013	4	6	64.2	1024.8	7	130	2.2	3.2
2013	4	7	69.5	1012.5	13.8	100	1.7	2.7
2013	4	8	65.3	999.1	17.5	90	2.3	3.7
2013	4	9	66.3	998.2	10.1	55	1.5	2
2013	4	10	85.2	998.9	7.1	100	1.5	2.1
2013	4	11	89.4	991.6	6.8	105	1.2	1.6
2013	4	12	79.7	999.8	7.9	265	1.8	2.9
2013	4	13	90.4	997.3	11.4	95	0.9	1.5
2013	4	14	76.2	994.8	19.2	165	2.2	3.6
2013	4	15	77.8	1003	16.5	190	2.4	3.6
2013	4	16	64.3	1007.4	17	240	3.1	4.8
2013	4	17	86	995.4	21.7	160	1.4	2.6
2013	4	18	81.2	1011.6	18.3	255	2	3.4
2013	4	19	74.8	1029.1	7	255	2.3	3.3
2013	4	20	76.5	1028.3	9.4	180	1.8	2.7
2013	4	21	80.4	1017.9	11.2	240	1.9	3
2013	4	22	88.6	1014.2	13.8	250	1.9	3.3
2013	4	23	85.8	1019.7	8.8	235	2.5	3.9
2013	4	24	91.7	1021.9	7.8	300	0.7	0.9
2013	4	25	80	1023.1	9.6	280	2.1	3.3
2013	4	26	75.1	1023.3	10.3	290	2.3	3.7
2013	4	27	69.1	1023.3	7.9	300	2.7	4
2013	4	28	77.4	1016.5	14.4	275	1.4	1.9
2013	4	29	71	1021.2	13.8	280	2.7	4.5
2013	4	30	76.2	1027.9	4.8	245	2.1	2.9
April							59	90.4

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	5	1	76.8	1026.3	7.5	270	2.4	3.6
2013	5	2	78.5	1023.3	8	215	1.9	2.8
2013	5	3	83	1015.9	14.5	220	1.2	1.6
2013	5	4	85	1014.8	12.6	235	1.2	1.7
2013	5	5	81.9	1017.7	10.9	205	1.5	2
2013	5	6	77.2	1016.3	9.1	140	3.4	5
2013	5	7	84.1	1009.8	10.8	115	2	2.8
2013	5	8	89.2	995.9	17.2	215	1.3	2.4
2013	5	9	83.3	996	20.5	265	1.7	3.1
2013	5	10	79.8	1007.3	15.7	245	2	3.6
2013	5	11	78.3	1012.6	16.1	275	2.1	3.9
2013	5	12	90.3	1013.9	14.5	245	1.5	2.5
2013	5	13	77.2	1011.8	15.6	250	2.5	4.2
2013	5	14	77.6	1001.3	11.4	265	2.3	3.9
2013	5	15	76.7	1002.5	11.1	310	2.3	3.6
2013	5	16	84.5	999	5.4	185	1.9	2.8
2013	5	17	77.5	1010.1	6.5	10	2.9	4.1
2013	5	18	86.5	1012.4	8.7	325	1.5	2.2
2013	5	19	84.2	1014	3.2	80	1.7	2.3
2013	5	20	87.6	1020.6	8.4	330	1.7	2.4
2013	5	21	80.5	1024.1	9	275	3.1	4.7
2013	5	22	76	1026.5	10.6	290	3.1	5
2013	5	23	64.3	1024.4	11.1	300	3.4	5.3
2013	5	24	65.2	1022.4	10.2	325	3.4	5
2013	5	25	85.5	1022.8	4.9	240	1.6	2.2
2013	5	26	83.5	1016.4	8.3	150	2.1	3
2013	5	27	82.2	999.8	12.2	235	2.7	4.6
2013	5	28	83	1003.3	11.2	280	2.9	4.8
2013	5	29	72.5	1013.1	9.2	320	3.7	5.3
2013	5	30	78.3	1021.3	9.8	280	3.1	4.8
2013	5	31	78.9	1025	9.1	285	1.5	1.9
May							69.6	107.1

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	6	1	80.9	1029.1	9.2	260	2	2.9
2013	6	2	84.1	1031.4	5	255	2.3	3.2
2013	6	3	76.8	1031.8	3.7	120	2.3	3.1
2013	6	4	60.8	1027.4	5.6	115	4.7	6.3
2013	6	5	68.2	1020.9	5.5	130	4.1	5.6
2013	6	6	66.8	1021.2	4.5	50	4.1	5.5
2013	6	7	63.6	1024.1	6.2	40	4.7	6.3
2013	6	8	66.6	1022.1	3.3	280	4.7	6.2
2013	6	9	73.2	1015	7	130	4.7	6.3
2013	6	10	80.4	1009	15.5	120	2.1	3.2
2013	6	11	92	1004.3	8.3	60	1.6	2.4
2013	6	12	88.8	1003.5	5.5	60	2.1	3
2013	6	13	78.3	1009.8	11.6	245	2.6	4.1
2013	6	14	87.5	1004.4	11.4	145	1.6	2.4
2013	6	15	86	1004.1	14	245	1.8	3
2013	6	16	87.4	1008.9	8.1	50	1.8	2.8
2013	6	17	84	1015	7.3	20	2.2	3
2013	6	18	86.1	1016.7	6	265	2.8	3.9
2013	6	19	80.4	1019	5.9	260	3.5	5.1
2013	6	20	84.6	1012.1	7.6	125	2.2	3
2013	6	21	80	1009.6	10.5	255	2.7	4
2013	6	22	86.3	1001	18	235	2.1	3.8
2013	6	23	78	1018.4	18.8	290	2.9	5.3
2013	6	24	75.8	1025.6	5.5	245	2.6	3.6
2013	6	25	82.4	1029.4	7.2	245	2.5	3.6
2013	6	26	75.2	1034	5.9	280	3.8	5.4
2013	6	27	93.9	1031.1	8	250	1.4	2
2013	6	28	97	1025.1	11.7	250	0.7	1.1
2013	6	29	90.6	1025.9	10.2	250	1.9	2.8
2013	6	30	81	1020.5	12.9	225	2.2	3.4
June							80.7	116.3

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	7	1	77.2	1016.8	9.5	245	2.8	4.1
2013	7	2	93.3	1003.3	11.5	195	1.4	2
2013	7	3	87.8	1009.2	8.9	245	2	3
2013	7	4	81.9	1018.3	12.7	240	2.2	3.6
2013	7	5	80	1027.8	5.1	160	3.3	4.5
2013	7	6	81.1	1029.3	5.9	250	3.1	4.2
2013	7	7	86.6	1034.3	3.4	5	3	3.8
2013	7	8	74.8	1033.7	2.9	315	5.1	6.5
2013	7	9	72.3	1029.7	5.3	15	5	6.5
2013	7	10	68.7	1026.7	4.4	20	5.1	6.6
2013	7	11	74.5	1025.4	3.7	120	4.8	6.3
2013	7	12	88.5	1025.9	5.6	225	3.4	4.6
2013	7	13	81.8	1027.2	4.9	320	4.6	6.2
2013	7	14	86.8	1026.7	6.7	230	3	4.2
2013	7	15	75.6	1026	5.9	250	2.3	3
2013	7	16	79.8	1025.4	5.3	255	3.1	4.1
2013	7	17	79.6	1027.2	4.5	255	5.1	6.9
2013	7	18	79	1028.1	3.3	290	3.6	4.6
2013	7	19	65.1	1025.1	4.7	115	4.9	6.3
2013	7	20	65.6	1021.9	6.6	115	5.2	6.8
2013	7	21	76.8	1017.9	6	105	2.5	3.2
2013	7	22	80.4	1013.2	6.3	125	2.5	3.4
2013	7	23	85.4	1009.8	7.5	135	3	4
2013	7	24	89.5	1008	10.2	130	2.1	3
2013	7	25	86.1	1009.3	4.9	230	3.2	4.4
2013	7	26	82.8	1009.6	5.2	115	2.9	3.9
2013	7	27	85.5	1005.6	7.3	115	3	4.1
2013	7	28	85.9	1001.2	6.1	130	2.7	3.6
2013	7	29	80.7	1006.6	9.5	230	3	4.4
2013	7	30	77	1010.7	10.3	225	3	4.3
2013	7	31	92.7	1007.3	8.4	135	1.5	2.1
July							102.4	138.2

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	8	1	93.5	1000	10.7	145	1.8	2.6
2013	8	2	77.8	1000.9	14.1	220	3.1	4.6
2013	8	3	81.5	1010.3	10	225	2.6	3.8
2013	8	4	81.4	1012	5.1	115	2.8	3.9
2013	8	5	78	1013.4	7.8	305	2.8	4
2013	8	6	75.9	1014	7.8	170	2.8	3.8
2013	8	7	72.4	1015.7	4.8	100	2.7	3.5
2013	8	8	83.8	1015.9	9.4	135	2.2	3.1
2013	8	9	72.7	1021.9	8.9	250	2.5	3.3
2013	8	10	81.8	1022	8	225	2.6	3.5
2013	8	11	77.6	1019.9	11	255	2.7	3.8
2013	8	12	72.8	1021.1	10.2	265	3.2	4.5
2013	8	13	79.5	1022.4	7.8	240	2.6	3.5
2013	8	14	93.1	1017.9	7	215	1.7	2.4
2013	8	15	91.9	1012.6	8.6	175	1.4	1.9
2013	8	16	79.2	1014	9.7	235	3	4.2
2013	8	17	85.5	1004.4	12.5	240	1.8	2.7
2013	8	18	76.8	1009.7	10.7	240	2.6	3.7
2013	8	19	80.3	1021.1	9.8	230	2.3	3.3
2013	8	20	80.2	1023.6	10.3	160	2.1	3
2013	8	21	84.6	1020.5	12.4	240	1.8	2.7
2013	8	22	83.6	1017	6.8	130	2.7	3.7
2013	8	23	83	1013.2	10	265	2	2.6
2013	8	24	85.8	1016.4	6.5	260	1	1.3
2013	8	25	85.6	1021	6.5	295	1.6	2.2
2013	8	26	86.8	1022.6	3.3	240	1.6	2
2013	8	27	86.4	1022.7	5.9	255	1.5	2
2013	8	28	81.8	1024.1	5.3	190	2.4	3.2
2013	8	29	89.3	1021	8.4	240	1.5	2.1
2013	8	30	84.5	1020.2	10.5	265	2.1	3.1
2013	8	31	70.2	1030.6	8.6	270	2.4	3.2
August							69.9	97.2

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	9	1	73.3	1031.7	11.6	240	2.4	3.4
2013	9	2	87.2	1028.8	10.6	235	1.5	2.1
2013	9	3	75.9	1025.8	5.2	195	2.8	3.8
2013	9	4	78.4	1017.3	9.1	130	3	4.1
2013	9	5	80.8	1015.9	5.2	265	1.7	2.3
2013	9	6	82.4	1014.6	7	325	2.1	2.9
2013	9	7	84.8	1015.3	8.9	290	1.2	1.7
2013	9	8	78.3	1014.7	6.2	220	1.7	2.3
2013	9	9	88.6	1020.9	4.8	340	1.3	1.7
2013	9	10	81.5	1029.5	7.2	285	1.5	1.9
2013	9	11	92.7	1026.2	8.8	255	1.2	1.6
2013	9	12	96	1020.2	9.5	235	0.9	1.3
2013	9	13	84.2	1020.9	2.8	325	1	1.3
2013	9	14	80.4	1020.6	3.6	215	1.2	1.6
2013	9	15	82	1007.4	17.5	265	1.3	1.9
2013	9	16	71.2	1007.3	17.3	270	2.3	3.4
2013	9	17	91.2	1000.7	15.2	260	1.2	1.7
2013	9	18	77.3	1009.4	9.8	285	1.6	2.3
2013	9	19	79.2	1010.5	13.3	275	1.1	1.7
2013	9	20	75.7	1017	7.8	150	1.9	2.5
2013	9	21	88.3	1020.4	6.6	215	1.5	1.9
2013	9	22	82.5	1024.5	10.1	140	2	2.7
2013	9	23	86.3	1019.6	11.7	120	1.9	2.6
2013	9	24	90.2	1013.4	7.7	105	1.1	1.5
2013	9	25	90.7	1011.2	3.6	105	1	1.2
2013	9	26	87.8	1012.7	6.2	105	1.2	1.4
2013	9	27	87	1011.8	7.3	90	1.3	1.6
2013	9	28	75.2	1006.3	6.8	90	1.5	1.9
2013	9	29	79.6	1004.4	10	85	1.6	1.9
2013	9	30	93.7	1000.8	11.6	100	0.9	1.2
September							46.9	63.4

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	10	1	89.8	999.7	12.1	115	1.3	1.6
2013	10	2	86	998.6	12.5	135	1.6	2.1
2013	10	3	91.5	999.5	7.8	130	0.7	1
2013	10	4	89.9	1008.4	6.7	255	1.1	1.6
2013	10	5	79.9	1019.1	7.5	175	1.8	2.4
2013	10	6	92.1	1020.5	7.6	155	0.9	1.2
2013	10	7	87.8	1019	10	175	1.3	1.6
2013	10	8	87.8	1025.1	6.9	260	0.9	1.2
2013	10	9	79.1	1026.9	8.7	305	1.1	1.5
2013	10	10	78.5	1029.9	6.1	335	1.2	1.6
2013	10	11	83.8	1029.2	5.8	30	1.1	1.4
2013	10	12	89.5	1024.8	5.6	20	0.6	0.8
2013	10	13	88.6	1018.3	3.9	15	0.7	0.9
2013	10	14	84.5	1014.3	4	40	0.9	1.2
2013	10	15	81.6	1010	8.8	85	1.1	1.5
2013	10	16	84.5	1003.9	10.7	220	1.1	1.4
2013	10	17	88.8	1009.5	7.6	115	1	1.4
2013	10	18	92.3	1001.5	12.5	105	0.7	0.9
2013	10	19	89.8	994.7	8.6	105	0.9	1.2
2013	10	20	92.5	994.1	7.9	240	0.8	1.1
2013	10	21	94.5	991.5	8.9	100	0.6	0.8
2013	10	22	89.8	984.7	8.3	140	0.9	1.2
2013	10	23	74.7	998.3	9.6	255	1.1	1.4
2013	10	24	91.5	1004.9	10.2	80	0.7	0.9
2013	10	25	89.7	995.2	8.8	120	0.9	1.2
2013	10	26	85.7	994.4	11	165	0.8	1
2013	10	27	84.8	986.4	16.5	215	1.2	1.5
2013	10	28	82.7	993.1	11.8	255	0.9	1.2
2013	10	29	82.2	1013.2	8.7	265	0.8	1.1
2013	10	30	85.8	1011.6	11.9	160	0.6	0.9
2013	10	31	85.1	1010.7	10.4	185	0.9	1.1
October							30.2	39.9

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	11	1	80.8	1006.3	5.9	175	0.7	0.9
2013	11	2	83.5	991.9	16.5	255	0.9	1.2
2013	11	3	85.1	997.1	9.3	230	0.6	0.8
2013	11	4	94	996.1	6.1	125	0.3	0.5
2013	11	5	84.8	995.4	12.4	250	0.7	0.9
2013	11	6	94.5	997.9	6.1	225	0.3	0.5
2013	11	7	83.8	1002.7	11	200	0.8	1
2013	11	8	87.2	1003.9	7.5	185	0.6	0.8
2013	11	9	92.4	1004.3	5.4	195	0.4	0.5
2013	11	10	97.2	1014.6	7.3	105	0.2	0.4
2013	11	11	94.5	1018	8.8	235	0.3	0.4
2013	11	12	84.1	1030	6.2	245	0.4	0.5
2013	11	13	84.8	1028	11.9	170	0.8	1
2013	11	14	77.4	1033.4	10.9	290	1.1	1.3
2013	11	15	83.4	1035.9	5.3	235	0.6	0.8
2013	11	16	89	1031.6	5.6	210	0.6	0.7
2013	11	17	96.9	1022.8	5.4	150	0.3	0.4
2013	11	18	90.5	1016.2	6.3	295	0.2	0.3
2013	11	19	80.9	1021.6	7.3	295	0.4	0.5
2013	11	20	79.2	1014	15.2	310	0.7	0.9
2013	11	21	77.9	1018.2	7.8	340	0.4	0.5
2013	11	22	88.6	1024.9	4.1	25	0.2	0.3
2013	11	23	96.6	1030.3	1.8	350	0.2	0.3
2013	11	24	96.7	1035.8	2.8	340	0.3	0.4
2013	11	25	90.8	1041.5	1.5	100	0.3	0.4
2013	11	26	88.5	1042.1	3.8	120	0.3	0.4
2013	11	27	85.6	1038.8	4.5	235	0.5	0.6
2013	11	28	87.7	1037.9	2.5	205	0.3	0.5
2013	11	29	81.3	1034.2	9.6	290	0.6	0.7
2013	11	30	88.2	1034.6	4.2	295	0.2	0.3
November							14.2	18.7

Shannon Airport Weather Records 2013

Year	Month	Day	Mean Realative Humidity (%)	Mean MSL Pressure (hpa)	Mean Wind Speed (kt)	Predominant Wind Direction (degrees)	Potential Evapotranspiration (mm)	Evaporation (mm)
2013	12	1	90.2	1035.6	2.5	150	0.2	0.3
2013	12	2	85.1	1032.3	5.4	130	0.5	0.6
2013	12	3	92.6	1027.7	7	115	0.3	0.4
2013	12	4	86.8	1033.6	4.9	290	0.2	0.2
2013	12	5	81.8	1028.3	17.6	250	1	1.3
2013	12	6	90.6	1030.5	6.9	245	0.3	0.4
2013	12	7	91.3	1024.9	7.4	195	0.3	0.4
2013	12	8	87.3	1021.5	9.7	205	0.4	0.5
2013	12	9	86.8	1021.4	9.3	135	0.5	0.6
2013	12	10	84.2	1019	14.5	150	0.8	1
2013	12	11	82.9	1017.1	15.7	145	0.8	1
2013	12	12	88.2	1011	13	145	0.7	0.9
2013	12	13	83	1010.1	13.2	180	0.4	0.4
2013	12	14	86.4	1007.5	17.2	165	0.9	1.2
2013	12	15	86	1006.4	12.1	150	0.8	0.9
2013	12	16	82.3	1011.5	9.2	195	0.3	0.4
2013	12	17	81.4	1014.3	13.6	155	0.6	0.8
2013	12	18	86.9	989.8	17.6	150	0.6	0.9
2013	12	19	84.5	997.5	13.7	215	0.6	0.8
2013	12	20	85.6	1006.2	15.5	190	0.5	0.7
2013	12	21	84.8	1000.5	14.1	205	0.8	1
2013	12	22	84.5	1002.9	14.4	215	0.6	0.7
2013	12	23	86	978	16.2	170	0.6	0.7
2013	12	24	80.7	966.9	16.9	200	0.8	1.1
2013	12	25	92.5	980.1	5.2	115	0	0
2013	12	26	86.4	984.6	14	225	0.3	0.4
2013	12	27	81.2	973.9	25.6	235	0.9	1.4
2013	12	28	90.7	996.8	6.5	215	0.2	0.2
2013	12	29	90.2	1005.5	10.9	165	0.4	0.5
2013	12	30	88.2	998.4	9.6	180	0.3	0.4
2013	12	31	86.5	989	11.6	160	0.4	0.5
December							16	20.6

Appendix I – Water Balance Calculations

Water Balance Calculations 2013

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

Period (Jan 2013 - Dec 2013)	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	4370	0.0888	115	388.056	3.468	384.59	15742	0.0933	146.87	531.46
February	4370	0.0221	115	96.577	3.468	93.11	15742	0.0302	47.54	140.65
March	4370	0.0000	115	0	3.468	0.00	15742	0.0000	0	0.00
April	4370	0.0000	115	0	3.468	0.00	15742	0.0041	6	6.45
May	4370	0.0000	115	0	3.468	0.00	15742	0.0000	0.00	0.00
June	4370	0.0000	115	0	3.468	0.00	15742	0.0000	0.00	0.00
July	4621	0.0000	115	0	3.468	0.00	20112	0.0000	0	0.00
August	4621	0.0000	115	0	3.468	0.00	20112	0.0030	6	6.03
September	4621	0.0000	115	0	3.468	0.00	20112	0.0000	0.00	0.00
October	4621	0.0923	115	426.5183	3.468	423.05	20112	0.1020	205.14	628.19
November	4621	0.0703	115	324.8563	3.468	321.39	20112	0.0748	150.44	471.83
December	4621	0.1396	115	645.0916	3.468	641.62	20112	0.1442	290.02	931.64
TOTAL						1863.76			852.50	2716.26

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

Period (Jan 2013 - Dec 2013)	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	4370	0.0888	115	388.056	3.468	384.59	15742	0.0933	29.37	413.96
February	4370	0.0221	115	96.577	3.468	93.11	15742	0.0302	9.51	102.62
March	4370	0.0000	115	0	3.468	0.00	15742	0.0000	0	0.00
April	4370	0.0000	115	0	3.468	0.00	15742	0.0041	1	1.29
May	4370	0.0000	115	0	3.468	0.00	15742	0.0000	0.00	0.00
June	4370	0.0000	115	0	3.468	0.00	15742	0.0000	0.00	0.00
July	4621	0.0000	115	0	3.468	0.00	20112	0.0000	0	0.00
August	4621	0.0000	115	0	3.468	0.00	20112	0.0030	1	1.21
September	4621	0.0000	115	0.000	3.468	0.00	20112	0.0000	0.00	0.00
October	4621	0.0923	115	426.518	3.468	423.05	20112	0.1020	41.03	464.08
November	4621	0.0703	115	324.856	3.468	321.39	20112	0.0748	30.09	351.48
December	4621	0.1396	115	645.092	3.468	641.62	20112	0.1442	58.00	699.63
TOTAL						1863.76			170.50	2034.26