7268

RED INDUSTRIES LIMITED

WALLEYS LANDFILL SITE

LANDFILL GAS RISK ASSESSMENT

DECEMBER 2018

Prepared for

Red Industries Limited

Prepared by

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Document Review

Version No.	Date of Review	Prepared By	Reviewed By	Approved By
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APPENDICES

1.0 INTRODUCTION

This document provides a revision of the current Landfill Gas Risk Assessment for the purpose of obtaining a Permit Variation to increase the annual waste inputs to the landfill. Red Industries Ltd is the owner and operator of Walleys Landfill Site, a non-hazardous landfill. The Permit Variation application is to increase the annual waste inputs at the site from 250,000 tonnes to 300,000 tonnes. This proposal will not require a need to increase the overall landfill void capacity or the site footprint. There will be also no changes in the waste types which are already permitted for disposal at the Site.

Previous Landfill Gas Risk Assessments for this Site were carried out in 2010 and 2013, at the time the site was operated by Tarmac. Since these earlier studies the landfill continued to receive non-hazardous waste streams in line with the site permit, although the nature of these waste inputs and tonnages changed over time.

In response to implementation of the Waste Regulations, the current site operator is dealing with increasing inputs of industrial and commercial waste materials which cannot be recycled or otherwise recovered. As a result, the Site receives increasingly non-hazardous waste with low biodegradable material content and inert waste.

This review of the Landfill Gas Risk Assessment used the GasSim v2.05.008 software package, which is the current version of this modelling tool.

2.0 SITE

2.1 Overview of waste activities

This operational landfill site is situated near Newcastle-under-Lyme in Staffordshire, at National Grid Reference SJ831 460. Access to the landfill site is gained via Cemetery Road which forms the western boundary to the landfill.

The site was originally developed as a quarry extracting clay. Engineering work for landfill operations commenced in 2006 and waste was first accepted in Cell 1 in January 2007. Since then waste disposal operations have continued in Cells 1, 2 and 3 with engineering works complete to 110m AOD in Cells 1, 2 and 3. The upper part of Cell 1 sidewall was engineered in 2008 to provide a tipping area prior to completion of Cell 4. Cell 4 was constructed in 2010 and continues to be the operational cell.

2.2 Landfill Construction Details

The engineered lining systems in the basal sections of Cells 1, 2, 3 and 4 comprise 3 metres of engineered clay with the hydraulic conductivity of $1x10^{-10}$ to $8.9x10^{-11}$ m/s (based on CQA reports for Cells 1, 2, 3 and 4).

Each cell has a leachate collection and extraction system comprising a 300mm gravel drainage blanket together with collection pipework, a leachate collection facility, a remote leachate monitoring point and a concrete target pad to facilitate the installation (if required) of retro installed leachate infrastructure.

The sidewall construction of each cell comprises a metre-thick clay liner placed to provide engineered containment having a maximum permeability of $1x10^{-9}$ m/s, overlain by a 250mm thick soils protection layer, to help reduce erosion due to weather.

Cell 1 is temporarily capped with 0.3m of engineered clay. The current proposal for the final height capping and restoration of the site is the placement of a metre depth of clay cap having a maximum permeability of $1x10^{-9}$ m/s, compacted to specification, overlain by a metre depth of restoration soils, or an equivalent geosynthetic capping system.

The landfilling base level is around 85mAOD and the final site restoration height will be 145mAOD.

2.3 Gas Plant

Landfill gas utilisation was initiated in 2009 when a temporary Hofstetter 500m^3/h gas flare was installed. This flare was replaced with a 1000m^3/h permanent flare, in 2010.

The first 1067kWe Jenbacher (JGS320 GS-L.L) gas engine was commissioned in early 2011. It was followed by the second 1MW gas engine in 2014 and the third 1MW gas engine was installed in 2017. The landfill gas management system is progressively extended in line with landfill operational levels and additional extraction wells are added as required. Operational management of landfill gas infrastructure and the gas plant, is subcontracted to CLP Envirogas Ltd.

2.4 Environmental Settings

The environmental settings of the site are well understood and documented in the earlier permitting applications. For consistency with the previous risk assessment reports, the environmental settings are summarised and updated, below.

Local receptors

The site is located 1km to the west of the centre of Newcastle-under-Lyme in Staffordshire. The surrounding area is a mixture of landuses which are typical of an urban fringe. These comprise residential areas, industrial and commercial units, a cemetery and a garden centre and green fields/grazing paddock. These are summarised in Table 1 below and shown on Drawing EEL.7268.D03.001.

Table 1 Walleys Landfill Site – Local Receptors

	Receptors	Minimum Distance, m	Direction
1	Silverdale residential dwellings 2	300	North
2	Knutton residential dwellings along the B5044	110	North
3	Garner’s Garden Centre	20	North
4	Knutton St Mary’s Primary School	260	North, NE
5	Warehouse/Depot	300	NE
6	Newcastle under Lyme residential areas	230	South, SE
7	Proposed residential development area	50	South, SE
8	Thistleberry Parkway	190	SE
9	Silverdale Holidays Park	30	South
10	Rosemary Wood Cottage	300	South
11	Recreational grounds	250	SW
12	Silverdale residential dwellings 1	260	West
13	Allotments	60	West, SW
14	Cemetery	60	West
15	Silverdale Business Park	60	West
16	Silverdale housing estate	60	East
17	Keele Road & Orme Road Housing Estate	270	East
18	Industrial area	220	NW
19	Silverdale residential area	400	North
20	Ironbridge Drive residential area	450	NE

Geology

The geological and hydrogeological settings are summarised in Table 2 below.

Table 2 Summary of the Geological Setting

Age	Formation	Local Thickness	Description
Quaternary	Glacial till	5-30m	Variable but mainly sandy clay
Carboniferous	Etruria Formation	Circa 70m	Soft mudstones with interbedded siltstone clay and occasional sandstone lenses/ band. Sandstone is not laterally persistent
Carboniferous	Upper Coal Measures	>80m	Cyclic mudstone siltstones, sandstones, seat earths and coal

Hydrogeology and Hydrology

The strata surrounding the site are a non-aquifer with negligible permeability. The groundwater level data in the perimeter boreholes shows that there is no unsaturated zone beneath the base of the site, however the groundwater lenses relate to discrete sandstone bands and mudstones rather than one aquifer unit across the site. The groundwater levels in the deep boreholes vary between 67 mAOD to 113 mAOD, whereas the groundwater levels in the shallow boreholes range between 78 mAOD to 127 mAOD.

The groundwater is actively pumped out from a sump below the site and following its pre-treatment (aeration and sedimentation), is discharged to Silverdale Brook, as stipulated by the Site Permit.

3.0 LFG CONCEPTUAL MODEL

3.1 LFG Risk Assessment Approach

The landfill gas conceptual model was updated from the GasSim model set up for the earlier landfill risk assessments (2010 and 2013).

GasSim is a software designed to meet the requirements of Environment Agency's Guidance Management of Landfill Gas LFTGN03. It considers the following factors:

- The source parameters: annual waste input, breakdown of the waste stream, waste moisture content and geometry of the site;
- Infiltration levels based on the amount of rainfall and surface water which enter the fill;
- Engineering properties of the site and materials used for lining and capping of the fill;

- The surrounding geology, its physical properties of ground porosity and moisture content;
- Gas dispersion pathways by air and via site surface and subsurface;
- Receptors to landfill gas – the nature and distance to the receptors within a 500m radius from the landfill.

GasSim requires a substantial amount of data inputs and recognises that certain information may not be always available. It therefore allows for a range of representative values to be entered. It also provides a number of default values for inputs such as the composition of municipal, industrial, commercial etc. waste streams; it uses typical values from waste industry reference data sources. There is therefore an option to use default values where site specific data is lacking.

The model is probabilistic and presents the outputs as a range of possible outcome values (5-95%iles); these represent different levels of confidence associated with the various results of the modelling exercise. The 95%ile is used to express the 'worst case' scenario, and therefore used exclusively for risk assessment purposes. At the same time, when the assessment is used to advise decision making such as introducing a gas plant or when assessing the likely gas generation rates, then predicted 50%ile is used.

3.2 Assessment Scenarios

Two assessment scenarios were run; Scenario 1 with average waste moisture content, and Scenario 2 with a 'wet' waste assumption. The site is known to receive high rainfall, and it has no permanent cap. Therefore the 'wet' scenario is assumed to represent the most realistic scenario.

The model start year is 2007 as waste was first accepted on site in January of that year. The site is predicted to accept waste until 2026. The modelling was run for a total of 150 years allowing for the gas extraction system utilisation to be modelled until the end of its predicted lifespan.

3.3 Input Data and Assumptions

The GasSim model for assessing gas generation potential at Walleys LFS was set up using a combination of data provided by the site operator and the relevant information sourced from the earlier GasSim studies (LFG Risk Assessment (2010), ref. 1 and LFG Risk Assessment (2013) ref. 2).

Red Industries provided guidance to Egniol on the anticipated annual input tonnages and waste inputs from late 2016 to date and those projected for the remaining operational years. Where no site-specific data was not available for certain modelling parameters, GasSim default values were used. The following schedule outlines the key data inputs.

Table 2 GasSim Input Data Schedule and Description

GasSim Input	Description
Waste Input (tonne/year)	Waste inputs for 2007-2018 and future tonnage projections as advised by Red Industries. Also refer to Table 3 below.
Waste Types and percentage in the overall waste stream, %	• Waste returns for 2007-2018 in reference to LFG RA reports 2010 and 2013 and TL's Information Memorandum 2014; • Red Industries reported waste inputs for 2017 and 2018. • Projected waste types as advised by Red Industries.
Waste Composition, %	Based on GasSim default values (England 2000-2010, 2011-2013, 2014-2020, 2020+) with added compositions for 'Waste sorted at MRF' and 'Recycling Schemes' wastes in reference to earlier risk assessments and advice from Red Industries for 2017+ waste inputs.
Waste in place capped	0% capped for 2007 Temporary cap: from 2010 Permanent cap: from 2019
LFG composition, CH_4 and CO_2	CH_4 (49-52%), CO_2 (37-41%), based on LFG monitoring data.
LFG composition, trace gases	Based on LFG monitoring data.
Waste Moisture Content	Assumed as 'Average' in Scenario 1 and 'Wet' in Scenario 2.
Waste Density	0.98-1.26t/m^3, calculated from the waste input and void consumption data for 2007-2018.
Rainfall	925mm (annual 2018)
Leachate Head	2m for Scenario 1 and 2-30m for Scenario 2.
Landfill Geometry	129,600m^2 total capping area
Liner and Final Cap Characteristics	Single Clay Liner (1-1.2m) and Single Clay Cap (1-1.5m), based on LFG RA report 2010.
Biological CH_4 oxidation	GasSim default values
Infiltration rate	
Cellulose decay rate	
Hydraulic conductivity of the waste, m/s	

Waste Inputs

The earlier waste data indicates that the site accepts a variety of wastes, with the largest proportion of waste inputs being: 'Waste sorted at MRF', 'Domestic' waste and 'Inert' waste. These were followed by 'Industrial' waste and smaller fractions of 'Composted Organic' material and 'Sewage Sludge' from onsite effluent treatment.

The waste returns data for 2014-2018 showed a shift away from bulk quantities of biodegradable waste toward accepting more inert commercial wastes and wastes sorted at MRF. At the same time, the annual tonnage of waste deposited at the site has reduced to around 180,000 tonnes in 2016.

Since 2017 the current site operator is dealing with increasing demand from industrial and commercial waste producers to dispose of the waste materials which cannot be recycled or otherwise recovered, as required by the current Waste Regulations. As a result, the site receives increasingly non-hazardous waste with low biodegradable content and inert waste. The annual waste tonnages increased to 228,000 tonnes in 2017 and 250,000 tonnes by the end of 2018.

As for the future operational years, guidance on the anticipated profile of the waste streams to be landfilled at Walleys LFS going forwards was provided to Egniol by Red Industries. The waste inputs into the GasSim model are summarised further in Table 4 below.

Gas Plant

The gas plant settings were set up according to the plant operations specifications and installation dates (see section 2.3). The gas plant was set up in order of priority of gas extraction and utilisation in the gas engines. The gas flares are operated only when the engines are down for service and maintenance. In 2018 the gas flare operated for the total of 1-3% of time.

Table 4 Waste Inputs as defined in GasSim model

Year	Annual Tonnage	Waste sorted at MRF, %	Domestic, %	Industrial, %	Commercial, %	Composted Organic, %	Inert, %	Incinerator Ash, %	Recycling Schemes, %	Sewage Sludge %
2007	145,723	55	15	10	0	0.5	18	0	0	1.5
2008	132,441	55	15	10	0	0.5	18	0	0	1.5
2009	193,123	50.8	17.6	12.6	1.8	1.5	13.1	0.1	0.5	2
2010	190,779	TRI(50-55-57)	TRI(11-14-17)	TRI(8-10-12)	UNI(0-2)	UNI(1-2)	TRI(13-16-19)	0.1	UNI(0.5-0.9)	UNI(1.5-2)
2011	193,977	TRI(50-55-57)	TRI(11-14-17)	TRI(8-10-12)	UNI(0-2)	UNI(1-2)	TRI(13-16-19)	0.1	UNI(0.5-0.9)	UNI(1.5-2)
2012	146,647	TRI(50-55-57)	TRI(11-14-17)	TRI(8-10-12)	UNI(0-2)	UNI(1-2)	TRI(13-16-19)	0.1	UNI(0.5-0.9)	UNI(1.5-2)
2013	186,712	UNI(32-51)	UNI(10-17.5)	UNI(5-12.5)	UNI(0-1)	UNI(0-2)	TRI(15-29-35)	UNI(0-1)	UNI(0.5-5.5)	UNI(1.5-3)
2014	155,004	TRI(40-41-45)	TRI(5-10-15)	UNI(5-12.5)	TRI(5-16.2-20)	UNI(0-2)	TRI(35-36.8-40)	0.3	UNI(0-1)	TRI(3-3.7-5)
2015	UNI(135-140K)	TRI(40-41-45)	TRI(5-7-10)	UNI(5-12.5)	TRI(5-16.2-20)	UNI(0-2)	TRI(35-36.8-40)	0.3	UNI(0-1)	TRI(3-3.7-5)
2016	TRI(140-180-250K)	TRI(50-55-57)	TRI(1-5-7)	TRI(8-10-12)	TRI(5-16.2-20)	UNI(1-2)	TRI(13-16-19)	0.1	UNI(0.5-0.9)	UNI(1.5-2)
2017	228,000	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2018	250,000	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2019	300,000	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2020	UNI(250-300K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2021	UNI(250-300K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2022	UNI(250-300K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2023	UNI(250-300K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2024	UNI(250-300K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2025	UNI(250-300K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)
2026	UNI(0-250K)	TRI(80-83.6-85)	TRI(0.5-2-3)	TRI(7-9.6-10)	TRI(5-16.2-20)	UNI(1-2)	TRI(5-6.8-19)	0.1	UNI(0.5-0.9)	UNI(0-1)

4.0 ASSESSMENT RESULTS

4.1 Average moisture content based assumption

The modelled long-term predictions of landfill gas generation at Walleys Landfill Site is shown on Figure 1 ('average' waste moisture content) below.

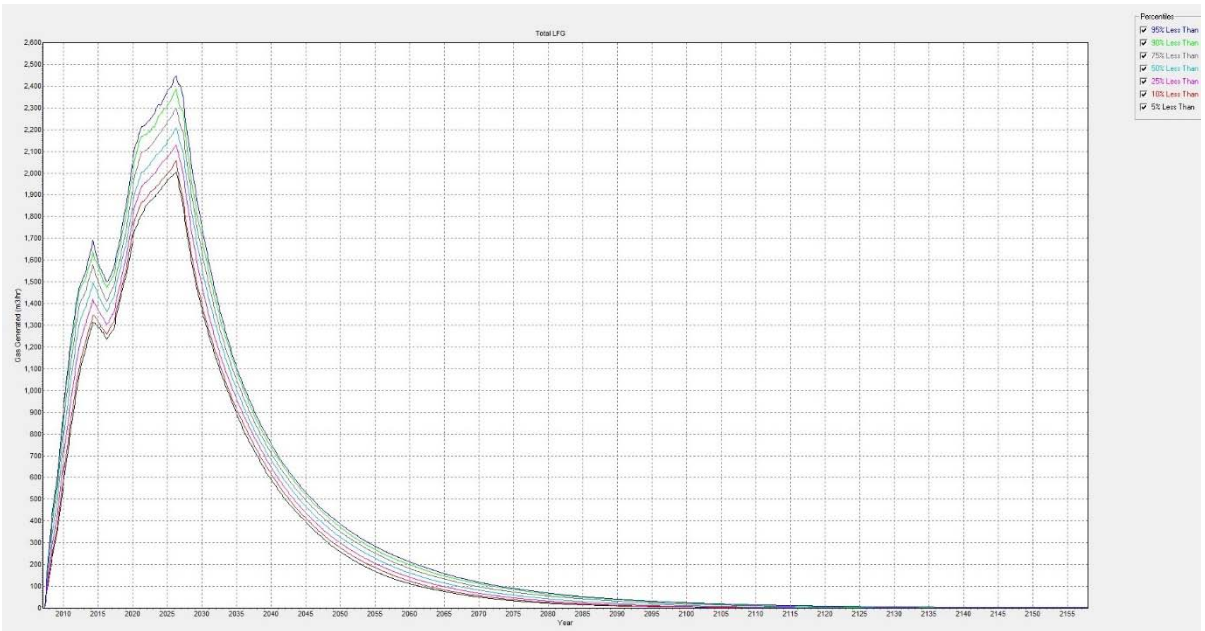


Figure 1 Gassim calculated gas generation rate at Walleys LFS (Scenario 1: 'average' moisture content)

If it is assumed that at Walleys LFS the landfill contains waste of average moisture content, then according to the model the peak landfill gas generation of about 2,440m^3/h (95th %ile) is expected during 2027, after landfilling operations at the site have ended and the site is completely capped. After this point in time gas generation will decrease over time, and by approximately 2085 the gas levels will reduce to approximately 50m^3/h at which stage active gas extraction will not be sustainable.

4.2 Wet waste based assumption

The modelled long-term predictions of landfill gas generation at Walleys Landfill Site is shown on Figure 2 ('wet waste') below.

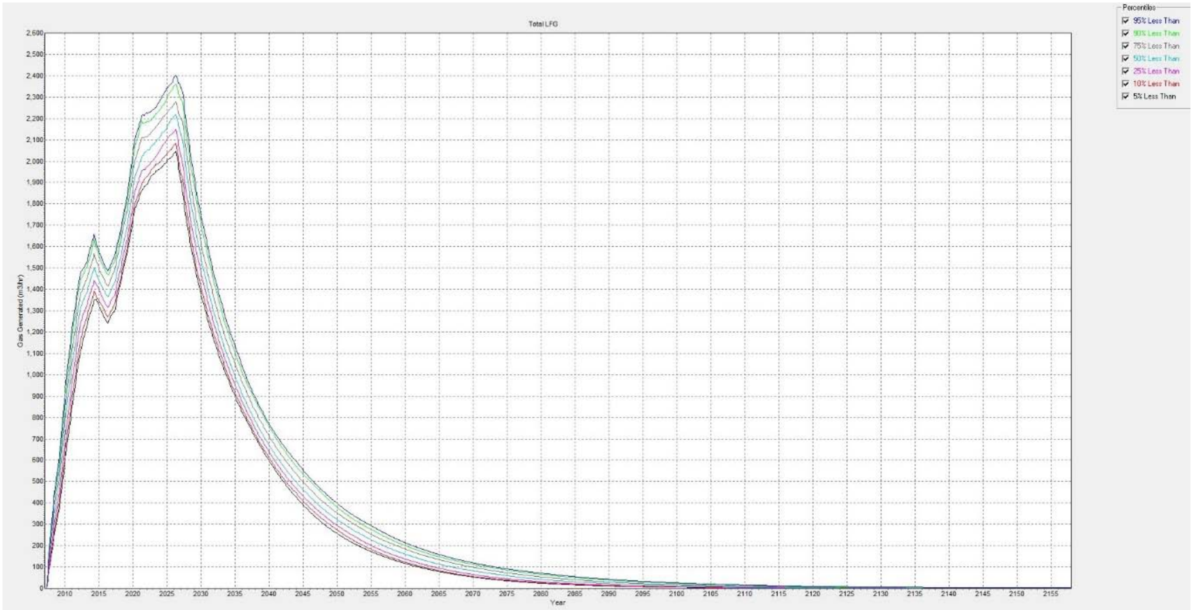


Figure 2 GasSim calculated gas generation rate at Walleys LFS (Scenario 2: wet waste)

According to the model the peak landfill gas generation in 2027 would reach 2,400m^3/h (95th %ile). The subsequent decline in gas generation is shown to be similar to that predicted to be for 'average' waste moisture content.

The model print-out is enclosed in Appendix 2.

4.3 Model validation

The modelled gas generation rates were compared with the actual landfill gas extraction rates as an indication of the generated gas levels. This is a useful way to assess how accurately the model represents the 'real world' conditions. The comparative results are summarised in Table 3 below.

Table 5 Walleys Landfill Site GasSim model validation

Year	Walleys LFS average annual gas extraction rates, total m^3/h	GasSim Scenario 1 'average' waste moisture content, gas generation rate, m^3/h	GasSim scenario 2 'wet' waste, gas generation rate, m^3/h
2017	**1420**	1560	1600
2018	**1640**	1650	1800

A modern gas management system should achieve capture of at least 85% of the generated gas. On this assumption, the actual generated volumes of the gas should be up to 1670m^3/h in 2017 and up to 1930m^3/h in 2018. Therefore, in terms of gas generation the site fits better with 'wet' waste assumption used in scenario 2.

In reality, the landfill site contains a combination of wet waste with lower layers of the fill being near or at the saturation level.

4.4 Tier 1 Screening

Tier 1 screening assesses the potential impacts of combustion gases on the local air quality. The gas plant on site is a Directly Associated Activity to the waste disposal operations; it is regulated by the current landfill permit (DP3734DC).

Tier 1 screening was carried out for the 'wet' waste scenario and included all priority trace gas components. The emissions screening was run for 2018 and 2019. Actual emission data was used for NO_2, CO, and VOCs. For other priority trace gases, GasSim default values were used. Background concentrations of PM10 and NOx were sourced out from the local air quality monitoring reports (Newcastle under Lyme Borough Council and the EA reference sources).

The Tier 1 screening of atmospheric emissions screened out the majority of gases. Emissions of nitrogen oxides (NOx) from the engines and emissions from PM10 from the engines and the flare, were screened in and warranted further modelling. Emissions of vinyl chloride although screened in but did not require detailed modelling. A print-out of the Tier 1 emissions screening is included in Appendix 3.

4.5 Tier 2 -Atmospheric Dispersion

The Tier 2 atmospheric dispersion modelling for the emissions to air from the gas plant was not carried out as part of this revised landfill gas risk assessment.

A separate detailed AERMOD assessment of the emissions from this DAA has been carried out at the time of the Permit Variation Application to add the third landfill gas engine. The third engine was commissioned in 2017.

The following extract from Air Quality Assessment report December 2013 (ref. 2), summarises conclusions of Tier 2 air quality assessment.

6.2.4 The Tier 2 modelling exercise assessed the concentration of those emissions at each defined receptor against short term and long term environmental assessment levels and environmental quality standards. It was run for the compounds that were identified as potentially significant in the Tier 1 screen of both scenarios.

6.2.5 In the 3-engine scenario, the Tier 2 results reveal that the Predicted Environmental Concentration (PEC) does not exceed the relevant short term or long term Environmental Assessment Limit (EAL) for any surface emissions at any receptor location. The engine emissions were run for PM10, SO2, NOx and NO2. There was no exceedance of any of the relevant EALs or EQSs for PM10, SO2 or NOx at any receptor location.

6.2.6 The modelling output for NO2 showed that there was no exceedance of the long term (annual) EAL, however, there were 5 exceedances at boundary receptors of the short term EAL (200µg/m3) ranging from 212µg/m3 to 264µg/m3. These boundary receptors are along the south south east of site.

6.2.7 In summary, if an additional engine was installed on site, the short term EALs for NOx would be exceeded at some boundary receptors on the south south- eastern boundary. No other short term or long term EALs would be exceeded in the model domain. As these are short term exceedances in a very limited area along a boundary where there are no or only transient receptors, the exceedances are deemed acceptable.

6.2.8 The flare scenario revealed that no exceedances of any of the short term or long term EALs would occur. However, the site would only be flaring (only) in emergencies, or when the engines are down.

4.6 Lateral Emissions

GasSim simulates lateral migration of landfill gas through the cell liner using a 1-dimensional flow model. It assumes that gas flow through geological material is governed by both advection and dispersion, while flow through a geomembrane is governed by diffusion only. The results of modelling of lateral migration of methane through the landfill liner showed that at the site boundary (20m distance), there is no risk of the gas migration off site.

These results are supported by the wealth of monitoring data from perimeter monitoring boreholes at this site. The monitoring data is reported to the EA on the regular basis as part of permit compliance requirements. A printout of GasSim lateral emissions risk assessment in enclosed in Appendix 4.

5.0 CONCLUSIONS

This revised landfill gas risk assessment was prepared in support of an application to increase the annual waste tonnage input at Walleys landfill site, while retaining the originally consented restoration levels of the site and the list of permitted wastes.

The landfill Permit currently limits the annual tonnage of waste disposal at the site to 250,000 tonnes. The site operator proposed to increase annual waste inputs to 300,000 tonnes. In response to implementation of the Waste Regulations, the site operator is dealing with increasing inputs of industrial and commercial waste materials which cannot be recycled or otherwise recovered. As a result, the site receives increasingly non-hazardous waste with high non-biodegradable content as well as inert waste.

Previous Landfill Gas Risk Assessments for this site were carried out in 2010 and 2013. Since these earlier studies the landfill continued to receive non-hazardous waste streams in line with the site permit, although the nature waste inputs and tonnages of waste changed over time, as mentioned above.

LFG conceptual model 2013 was reviewed and amended on the basis of the current (and projected) waste tonnages and waste composition. LFG conceptual model was set up using GasSim modelling tool v2.05.008. GasSim calculates bulk landfill gas generation rates (m^3/h) during the lifetime of a landfill. The model also assesses the assess environmental risks associated the gas lateral emissions and emissions to air from the gas plant.

The gas generation model was rerun for two assessment scenarios based on waste moisture content set as ‘average’ in scenario 1 and as ‘wet’ waste in scenario 2. The results confirmed the findings of the earlier LFG risk assessments that methanogenic process at Walleys is representative of a ‘wet’ waste condition.

According to the model, the peak landfill gas generation is expected in 2027 after filling operations at the site have ended and the site has been capped. The gas generation would reach the peak rates of about 2,400-2440m^3/h. After that, the gas production would decrease over time and by approximately 2080-2085 there would be not enough landfill gas to sustain either a gas engine or a flare.

Risk assessment of potential lateral emissions of methane through the cell liner showed that at the site boundary, there is no indication of such gas migration. These results are supported by the wealth of monitoring data from perimeter monitoring boreholes at this site.

Landfill gas is utilised in the gas plant which is operated within the permit stipulated conditions. Environmental risks of combustion emissions to air from the gas plant were assessed as part of Tier 1 screening. With the knowledge of background concentrations of NOx and PM10, these gases were screened in for further modelling. Tier 2 detailed modelling of these (and other) gases was previously carried out for the gas plant. The results showed that in an operational year of the plant NO_2 levels in combustion gases are likely to have several exceedances of short term air quality standards if measured along the adjacent section of the site boundary. The environmental risks associated with these exceedances are low and deemed acceptable.

6.0 REFERENCES

1. Walleys Landfill Site Lafarge Waste Management Ltd GasSim 2 Landfill Gas Generation Model and Risk Assessment (report 1194.1.LAL.ÅKS.JM.LRA.Rev A(0)), November 2010

2. Walleys Landfill Site Lafarge Tarmac Ltd Air Quality Assessment Increase in Landfill Gas Plant Output (report 1695.3.LAT.ÅKS.JDM. A3), November 2013

APPENDICES

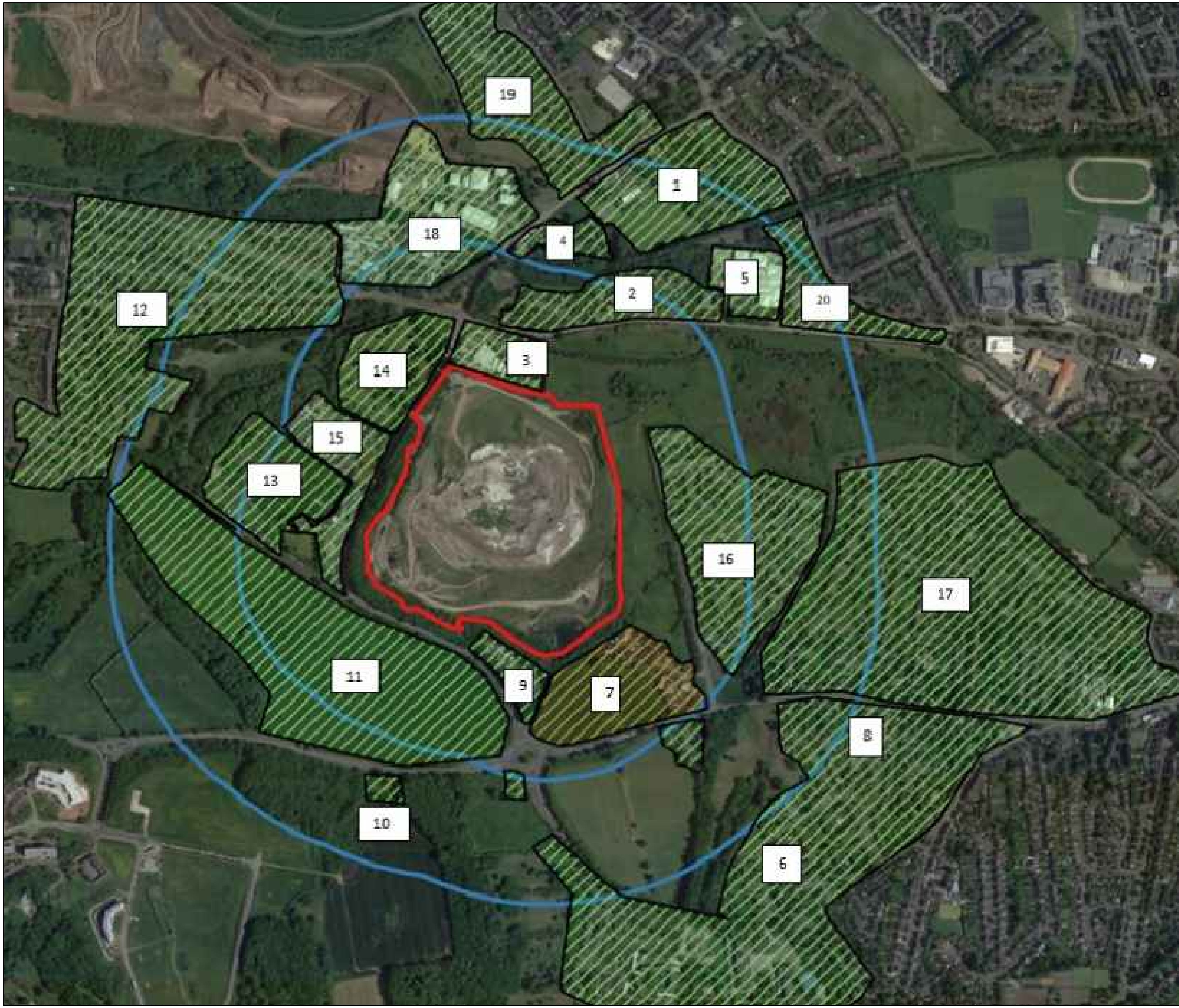
Appendix 1 Walleys LFS Local Receptors. Drawing EEL.7268.D03.001

Appendix 2 GasSim model print out

Appendix 3 Tier 1 emissions screening - GasSim model print-out

Appendix 4 Lateral emissions risk assessment – GasSim model print out

Appendix 1 Walleys LFS Local Receptors. Drawing EEL.7268.D03.001



Notes

1. OS data provided by Ordnance Survey.
2. Do not scale from this drawing.
3. Any anomalies on this drawing should be brought to the attention of Egniol Environmental Ltd.
4. Key.

Red line	Site Boundary.
Blue line	250m and 500m from site boundary.
Orange hatching	Consented residential development site.
Green hatching	Receptor area.

Rev	Modifications	By	Chk	App	Date

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Walleys Quarry Landfill Site

Local Receptors

Drawn by	Checked by	Approved by
GOJR	AC	AC
Date 11.12.2018	Date 11.12.2018	Date 11.12.2018
Status Final		Scale @ A3 Not To Scale
Drawing Number EEL.7268.D03.001		Revision -

CAD File Ref:M:\CAD Projects\7268 Walleys Quarry Permit Variation\Drawings\Current Working Drawings\EEL.7268.D03.001.dwg

Appendix 2 GasSim model print out

ProjectDetails

Project Name	Walley Landfill Site
Client	Red Industries Ltd
Model	c:\gassim temp\walleylfs default waste figures for lfg ra 031218.gss
Model Date	10/12/2018 16:57:55
Comments	To revise LFG Risk Assessment for permit variation application to increase the annual waste inputs to 300K tonnes
Start Year	2007
Operation Period	20
Simulation Period	150
Iterations	201

Confined Migration Pathway

Waste Composition

Year	Composition
2007	England 2000-2010 waste streams Lafarge1b
Newspapers	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(48.5)
Hemi-Cellulose (%)	SINGLE(9.0)
Decomposition (%)	SINGLE(35.0)
Magazines	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(42.3)
Hemi-Cellulose (%)	SINGLE(9.4)
Decomposition (%)	SINGLE(46.0)
Other paper	
Domestic	SINGLE(19.8)
Civic Amenity	SINGLE(3.3)
Commercial	SINGLE(28.8)
Industrial	SINGLE(8.8)
Residues from MRF	SINGLE(30.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(87.4)
Hemi-Cellulose (%)	SINGLE(8.4)
Decomposition (%)	SINGLE(98.0)
Liquid cartons	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Card packaging	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Other card	
Domestic	SINGLE(3.0)
Civic Amenity	SINGLE(11.2)
Commercial	SINGLE(3.3)
Industrial	SINGLE(5.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(11.0)
Decomposition (%)	SINGLE(75.0)
Wood	
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Textiles	
Domestic	SINGLE(3.3)
Civic Amenity	SINGLE(2.3)
Commercial	SINGLE(1.1)
Industrial	SINGLE(0.3)
Water (%)	SINGLE(25.0)
Cellulose (%)	SINGLE(20.0)
Hemi-Cellulose (%)	SINGLE(20.0)
Decomposition (%)	SINGLE(50.0)
Disposable nappies	
Domestic	SINGLE(3.3)
Civic Amenity	SINGLE(2.9)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Other misc. combustibles	
Domestic	SINGLE(0.3)
Civic Amenity	SINGLE(4.2)
Commercial	SINGLE(10.4)
Industrial	SINGLE(17.7)
Residues from MRF	UNIFORM(15.0, 20.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(20.0)

Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Garden waste	
Domestic	SINGLE(16.0)
Civic Amenity	SINGLE(32.1)
Commercial	SINGLE(9.8)
Industrial	SINGLE(4.7)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(25.7)
Hemi-Cellulose (%)	SINGLE(13.0)
Decomposition (%)	SINGLE(62.0)
Other putrescible	
Domestic	SINGLE(25.6)
Civic Amenity	SINGLE(14.8)
Commercial	SINGLE(10.4)
Industrial	SINGLE(6.8)
Residues from MRF	SINGLE(20.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(55.4)
Hemi-Cellulose (%)	SINGLE(7.2)
Decomposition (%)	SINGLE(76.0)
10mm fines	
Domestic	SINGLE(4.1)
Civic Amenity	SINGLE(1.2)
Commercial	SINGLE(1.9)
Industrial	SINGLE(0.5)
Residues from MRF	SINGLE(10.0)
Water (%)	SINGLE(40.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Sewage sludge	
Sewage Sludge	SINGLE(100.0)
Water (%)	SINGLE(70.0)
Cellulose (%)	SINGLE(14.0)
Hemi-Cellulose (%)	SINGLE(14.0)
Decomposition (%)	SINGLE(75.0)
Composted organic material	
Composted Organic Material	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	UNIFORM(7.47, 9.59)
Hemi-Cellulose (%)	UNIFORM(7.47, 9.59)
Decomposition (%)	SINGLE(57.0)
Incinerator ash	
Commercial	SINGLE(0.2)
Industrial	SINGLE(25.5)
Incinerator Ash	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Hemi-Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Decomposition (%)	SINGLE(57.0)
Non degradable	
Domestic	SINGLE(24.6)
Civic Amenity	SINGLE(28.0)
Commercial	SINGLE(34.1)
Industrial	SINGLE(30.7)
Inert	SINGLE(100.0)
Residues from MRF	UNIFORM(20.0, 40.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Calcium Sulphate (%)	
Iron (%)	
2008	England 2000-2010 waste streams Lafarge1b
2009	England 2000-2010 waste streams Lafarge1b
2010	England 2000-2010 waste streams Lafarge1b
2011	England 2011-2013 waste streams Lafarge1b
Newspapers	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(48.5)
Hemi-Cellulose (%)	SINGLE(9.0)
Decomposition (%)	SINGLE(35.0)
Magazines	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(42.3)
Hemi-Cellulose (%)	SINGLE(9.4)
Decomposition (%)	SINGLE(46.0)
Other paper	
Domestic	SINGLE(19.8)
Civic Amenity	SINGLE(3.3)
Commercial	SINGLE(28.8)
Industrial	SINGLE(8.8)

Residues from MRF	SINGLE(30.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(87.4)
Hemi-Cellulose (%)	SINGLE(8.4)
Decomposition (%)	SINGLE(98.0)
Liquid cartons	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Card packaging	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Other card	
Domestic	SINGLE(3.0)
Civic Amenity	SINGLE(11.2)
Commercial	SINGLE(3.3)
Industrial	SINGLE(5.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(11.0)
Decomposition (%)	SINGLE(75.0)
Wood	
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Textiles	
Domestic	SINGLE(3.3)
Civic Amenity	SINGLE(2.3)
Commercial	SINGLE(1.1)
Industrial	SINGLE(0.3)
Water (%)	SINGLE(25.0)
Cellulose (%)	SINGLE(20.0)
Hemi-Cellulose (%)	SINGLE(20.0)
Decomposition (%)	SINGLE(50.0)
Disposable nappies	
Domestic	SINGLE(3.3)
Civic Amenity	SINGLE(2.9)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Other misc. combustibles	
Domestic	SINGLE(0.3)
Civic Amenity	SINGLE(4.2)
Commercial	SINGLE(10.4)
Industrial	SINGLE(17.7)
Residues from MRF	UNIFORM(15.0, 20.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Garden waste	
Domestic	SINGLE(16.0)
Civic Amenity	SINGLE(32.1)
Commercial	SINGLE(9.8)
Industrial	SINGLE(4.7)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(25.7)
Hemi-Cellulose (%)	SINGLE(13.0)
Decomposition (%)	SINGLE(62.0)
Other putrescible	
Domestic	SINGLE(25.6)
Civic Amenity	SINGLE(14.8)
Commercial	SINGLE(10.4)
Industrial	SINGLE(6.8)
Residues from MRF	SINGLE(20.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(55.4)
Hemi-Cellulose (%)	SINGLE(7.2)
Decomposition (%)	SINGLE(76.0)
10mm fines	
Domestic	SINGLE(4.1)
Civic Amenity	SINGLE(1.2)
Commercial	SINGLE(1.9)
Industrial	SINGLE(0.5)
Residues from MRF	SINGLE(10.0)
Water (%)	SINGLE(40.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)

Decomposition (%)	SINGLE(50.0)
Sewage sludge	
Sewage Sludge	SINGLE(100.0)
Water (%)	SINGLE(70.0)
Cellulose (%)	SINGLE(14.0)
Hemi-Cellulose (%)	SINGLE(14.0)
Decomposition (%)	SINGLE(75.0)
Composted organic material	
Composted Organic Material	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	UNIFORM(7.47, 9.59)
Hemi-Cellulose (%)	UNIFORM(7.47, 9.59)
Decomposition (%)	SINGLE(57.0)
Incinerator ash	
Commercial	SINGLE(0.2)
Industrial	SINGLE(25.5)
Incinerator Ash	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Hemi-Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Decomposition (%)	SINGLE(57.0)
Non degradable	
Domestic	SINGLE(24.6)
Civic Amenity	SINGLE(28.0)
Commercial	SINGLE(34.1)
Industrial	SINGLE(30.7)
Inert	SINGLE(100.0)
Residues from MRF	UNIFORM(20.0, 40.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Calcium Sulphate (%)	
Iron (%)	
2012	England 2011-2013 waste streams Lafarge1b
2013	England 2011-2013 waste streams Lafarge1b
2014	walley waste streams 2014-2020
Newspapers	
Domestic	SINGLE(1.5)
Civic Amenity	SINGLE(11.2)
Commercial	SINGLE(3.3)
Industrial	SINGLE(5.0)
Residues from MRF	SINGLE(1.5)
Recycling Schemes	SINGLE(10.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(48.5)
Hemi-Cellulose (%)	SINGLE(9.0)
Decomposition (%)	SINGLE(35.0)
Magazines	
Industrial	SINGLE(8.8)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(42.3)
Hemi-Cellulose (%)	SINGLE(9.4)
Decomposition (%)	SINGLE(46.0)
Other paper	
Domestic	SINGLE(9.9)
Civic Amenity	SINGLE(3.3)
Commercial	SINGLE(38.8)
Residues from MRF	SINGLE(9.9)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(87.4)
Hemi-Cellulose (%)	SINGLE(8.4)
Decomposition (%)	SINGLE(98.0)
Liquid cartons	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Card packaging	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Other card	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Wood	
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Textiles	
Domestic	SINGLE(1.7)

Civic Amenity	SINGLE(2.3)
Commercial	SINGLE(1.1)
Industrial	SINGLE(0.3)
Residues from MRF	SINGLE(1.7)
Water (%)	SINGLE(25.0)
Cellulose (%)	SINGLE(20.0)
Hemi-Cellulose (%)	SINGLE(20.0)
Decomposition (%)	SINGLE(50.0)
Disposable nappies	
Domestic	SINGLE(1.7)
Civic Amenity	SINGLE(2.9)
Residues from MRF	SINGLE(1.7)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Other misc. combustibles	
Domestic	UNIFORM(5.0, 20.0)
Civic Amenity	SINGLE(4.2)
Commercial	SINGLE(10.4)
Industrial	SINGLE(17.7)
Residues from MRF	SINGLE(18.1)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Garden waste	
Domestic	UNIFORM(1.0, 5.0)
Civic Amenity	SINGLE(32.1)
Commercial	SINGLE(9.8)
Industrial	SINGLE(4.7)
Residues from MRF	SINGLE(8.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(25.7)
Hemi-Cellulose (%)	SINGLE(13.0)
Decomposition (%)	SINGLE(62.0)
Other putrescible	
Domestic	SINGLE(12.8)
Civic Amenity	SINGLE(14.8)
Commercial	SINGLE(10.4)
Industrial	SINGLE(6.8)
Residues from MRF	UNIFORM(6.0, 8.0)
Recycling Schemes	SINGLE(25.0)
Water (%)	SINGLE(65.0)
Cellulose (%)	SINGLE(55.4)
Hemi-Cellulose (%)	SINGLE(7.2)
Decomposition (%)	SINGLE(76.0)
10mm fines	
Domestic	UNIFORM(2.0, 3.0)
Civic Amenity	SINGLE(1.2)
Commercial	SINGLE(1.9)
Industrial	SINGLE(0.5)
Residues from MRF	SINGLE(2.1)
Water (%)	SINGLE(40.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Sewage sludge	
Sewage Sludge	SINGLE(100.0)
Water (%)	SINGLE(70.0)
Cellulose (%)	SINGLE(14.0)
Hemi-Cellulose (%)	SINGLE(14.0)
Decomposition (%)	SINGLE(75.0)
Composted organic material	
Composted Organic Material	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	UNIFORM(7.47, 9.59)
Hemi-Cellulose (%)	UNIFORM(7.47, 9.59)
Decomposition (%)	SINGLE(57.0)
Incinerator ash	
Domestic	UNIFORM(0.0, 1.0)
Commercial	SINGLE(0.2)
Industrial	SINGLE(25.5)
Incinerator Ash	SINGLE(100.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Hemi-Cellulose (%)	TRIANGULAR(0.5, 0.7, 1.5)
Decomposition (%)	SINGLE(57.0)
Non degradable	
Domestic	UNIFORM(40.0, 70.0)
Civic Amenity	SINGLE(28.0)
Commercial	SINGLE(24.1)
Industrial	SINGLE(30.7)
Inert	SINGLE(100.0)
Residues from MRF	UNIFORM(40.0, 60.0)

Recycling Schemes	SINGLE(35.0)
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Calcium Sulphate (%)	
Iron (%)	
2015	walley waste streams 2014-2020
2016	walley waste streams 2014-2020
2017	walley waste streams 2014-2020
2018	walley waste streams 2014-2020
2019	walley waste streams 2014-2020
2020	walley waste streams 2014-2020
2021	walley waste streams 2020+
Newspapers	
Domestic	SINGLE(1.1)
Civic Amenity	SINGLE(11.2)
Commercial	SINGLE(3.3)
Industrial	SINGLE(5.0)
Residues from MRF	UNIFORM(1.0, 2.0)
Recycling Schemes	SINGLE(10.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(48.5)
Hemi-Cellulose (%)	SINGLE(9.0)
Decomposition (%)	SINGLE(35.0)
Magazines	
Civic Amenity	SINGLE(3.3)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(42.3)
Hemi-Cellulose (%)	SINGLE(9.4)
Decomposition (%)	SINGLE(46.0)
Other paper	
Domestic	SINGLE(6.9)
Commercial	SINGLE(38.8)
Industrial	SINGLE(8.8)
Residues from MRF	UNIFORM(6.0, 10.0)
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(87.4)
Hemi-Cellulose (%)	SINGLE(8.4)
Decomposition (%)	SINGLE(98.0)
Liquid cartons	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Card packaging	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Other card	
Water (%)	SINGLE(30.0)
Cellulose (%)	SINGLE(57.3)
Hemi-Cellulose (%)	SINGLE(9.9)
Decomposition (%)	SINGLE(64.0)
Wood	
Water (%)	SINGLE(0.0)
Cellulose (%)	SINGLE(0.0)
Hemi-Cellulose (%)	SINGLE(0.0)
Decomposition (%)	SINGLE(0.0)
Textiles	
Domestic	UNIFORM(1.0, 5.0)
Civic Amenity	SINGLE(2.3)
Commercial	SINGLE(1.1)
Industrial	SINGLE(0.3)
Residues from MRF	UNIFORM(1.0, 2.0)
Water (%)	SINGLE(25.0)
Cellulose (%)	SINGLE(20.0)
Hemi-Cellulose (%)	SINGLE(20.0)
Decomposition (%)	SINGLE(50.0)
Disposable nappies	
Domestic	SINGLE(1.2)
Civic Amenity	SINGLE(2.9)
Residues from MRF	UNIFORM(1.0, 2.0)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)
Hemi-Cellulose (%)	SINGLE(25.0)
Decomposition (%)	SINGLE(50.0)
Other misc. combustibles	
Domestic	SINGLE(0.1)
Civic Amenity	SINGLE(4.2)
Commercial	SINGLE(10.4)
Industrial	SINGLE(17.7)
Residues from MRF	UNIFORM(10.0, 20.0)
Water (%)	SINGLE(20.0)
Cellulose (%)	SINGLE(25.0)

Hemi-Cellulose (%)		SINGLE(25.0)
Decomposition (%)		SINGLE(50.0)
Garden waste		
Domestic		UNIFORM(1.0, 5.0)
Civic Amenity		SINGLE(32.1)
Commercial		SINGLE(9.8)
Industrial		SINGLE(4.7)
Residues from MRF		UNIFORM(5.0, 6.0)
Recycling Schemes		SINGLE(25.0)
Water (%)		SINGLE(65.0)
Cellulose (%)		SINGLE(25.7)
Hemi-Cellulose (%)		SINGLE(13.0)
Decomposition (%)		SINGLE(62.0)
Other putrescible		
Domestic		SINGLE(10.0)
Civic Amenity		SINGLE(14.8)
Commercial		SINGLE(10.4)
Industrial		SINGLE(6.8)
Residues from MRF		UNIFORM(4.0, 5.0)
Recycling Schemes		SINGLE(25.0)
Water (%)		SINGLE(65.0)
Cellulose (%)		SINGLE(55.4)
Hemi-Cellulose (%)		SINGLE(7.2)
Decomposition (%)		SINGLE(76.0)
10mm fines		
Domestic		UNIFORM(1.0, 2.0)
Civic Amenity		SINGLE(1.9)
Commercial		SINGLE(0.5)
Industrial		SINGLE(0.5)
Water (%)		SINGLE(40.0)
Cellulose (%)		SINGLE(25.0)
Hemi-Cellulose (%)		SINGLE(25.0)
Decomposition (%)		SINGLE(50.0)
Sewage sludge		
Sewage Sludge		SINGLE(100.0)
Water (%)		SINGLE(70.0)
Cellulose (%)		SINGLE(14.0)
Hemi-Cellulose (%)		SINGLE(14.0)
Decomposition (%)		SINGLE(75.0)
Composted organic material		
Composted Organic Material		SINGLE(100.0)
Water (%)		SINGLE(30.0)
Cellulose (%)		UNIFORM(7.47, 9.59)
Hemi-Cellulose (%)		UNIFORM(7.47, 9.59)
Decomposition (%)		SINGLE(57.0)
Incinerator ash		
Commercial		SINGLE(0.2)
Industrial		SINGLE(25.5)
Incinerator Ash		SINGLE(100.0)
Water (%)		SINGLE(30.0)
Cellulose (%)		TRIANGULAR(0.5, 0.7, 1.5)
Hemi-Cellulose (%)		TRIANGULAR(0.5, 0.7, 1.5)
Decomposition (%)		SINGLE(57.0)
Non degradable		
Domestic		UNIFORM(65.0, 75.0)
Civic Amenity		SINGLE(28.0)
Commercial		UNIFORM(20.0, 35.0)
Industrial		SINGLE(30.7)
Inert		SINGLE(100.0)
Residues from MRF		UNIFORM(40.0, 60.0)
Recycling Schemes		SINGLE(35.0)
Water (%)		SINGLE(0.0)
Cellulose (%)		SINGLE(0.0)
Hemi-Cellulose (%)		SINGLE(0.0)
Decomposition (%)		SINGLE(0.0)
Calcium Sulphate (%)		
Iron (%)		
2022		walley waste streams 2020+
2023		walley waste streams 2020+
2024		walley waste streams 2020+
2025		walley waste streams 2020+
2026		walley waste streams 2020+
Justification:	[Changed]	CHANGED based on the previous gas RA report [CHANGED] [CHANGED] [CHANGED] [CHANGED]

Trace Gases

No Combustion Products Selected

Cell 1

Infiltration		NORMAL(555.0, 100.0)
Justification:	[Changed]	based on rainfall data for 2017-2018

Waste Input

Year	AmountDepositied (t)
2007	SINGLE(1.46E+05)
2008	SINGLE(1.32E+05)
2009	SINGLE(1.93E+05)

2010		SINGLE(1.91E+05)
2011		SINGLE(1.94E+05)
2012		SINGLE(1.47E+05)
2013		SINGLE(1.87E+05)
2014		SINGLE(1.55E+05)
2015		UNIFORM(1.35E+05, 1.40E+05)
2016		TRIANGULAR(1.40E+05, 1.80E+05, 2.50E+05)
2017		SINGLE(2.28E+05)
2018		SINGLE(2.50E+05)
2019		SINGLE(3.00E+05)
2020		UNIFORM(2.50E+05, 3.00E+05)
2021		UNIFORM(2.50E+05, 3.00E+05)
2022		UNIFORM(2.50E+05, 3.00E+05)
2023		UNIFORM(2.50E+05, 3.00E+05)
2024		UNIFORM(2.50E+05, 3.00E+05)
2025		UNIFORM(2.50E+05, 3.00E+05)
2026		UNIFORM(0.0, 250000.0)
Justification:	[Changed]	TL data, with inputs from gassim 2013 and waste returns for 2014-2018 plus projected based on range of inputs

Waste Breakdown

2007

Domestic	SINGLE(15.0)
Industrial	SINGLE(10.0)
Inert	SINGLE(18.0)
Sewage Sludge	SINGLE(1.5)
Composted Organic Material	SINGLE(0.5)
Residues from MRF	SINGLE(55.0)

2008

Domestic	SINGLE(15.0)
Industrial	SINGLE(10.0)
Inert	SINGLE(18.0)
Sewage Sludge	SINGLE(1.5)
Composted Organic Material	SINGLE(0.5)
Residues from MRF	SINGLE(55.0)

2009

Domestic	SINGLE(17.6)
Commercial	SINGLE(1.8)
Industrial	SINGLE(12.6)
Inert	SINGLE(13.1)
Sewage Sludge	SINGLE(2.0)
Composted Organic Material	SINGLE(1.5)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	SINGLE(50.8)
Recycling Schemes	SINGLE(0.5)

2010

Domestic	TRIANGULAR(11.0, 14.0, 17.0)
Commercial	UNIFORM(0.0, 2.0)
Industrial	TRIANGULAR(8.0, 10.0, 12.0)
Inert	TRIANGULAR(13.0, 16.0, 19.0)
Sewage Sludge	UNIFORM(1.5, 2.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(50.0, 55.0, 57.0)
Recycling Schemes	UNIFORM(0.5, 0.9)

2011

Domestic	TRIANGULAR(11.0, 14.0, 17.0)
Commercial	UNIFORM(0.0, 2.0)
Industrial	TRIANGULAR(8.0, 10.0, 12.0)
Inert	TRIANGULAR(13.0, 16.0, 19.0)
Sewage Sludge	UNIFORM(1.5, 2.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(50.0, 55.0, 57.0)
Recycling Schemes	UNIFORM(0.5, 0.9)

2012

Domestic	TRIANGULAR(11.0, 14.0, 17.0)
Commercial	UNIFORM(0.0, 2.0)
Industrial	TRIANGULAR(8.0, 10.0, 12.0)
Inert	TRIANGULAR(13.0, 16.0, 19.0)
Sewage Sludge	UNIFORM(1.5, 2.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(50.0, 55.0, 57.0)
Recycling Schemes	UNIFORM(0.5, 0.9)

2013

Domestic	UNIFORM(10.0, 17.5)
Commercial	UNIFORM(0.0, 1.0)
Industrial	UNIFORM(5.0, 12.5)
Inert	TRIANGULAR(15.0, 29.0, 35.0)
Sewage Sludge	UNIFORM(1.5, 3.0)
Composted Organic Material	UNIFORM(0.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	UNIFORM(32.0, 51.0)
Recycling Schemes	UNIFORM(0.5, 5.5)

2014

Domestic	TRIANGULAR(5.0, 10.0, 15.0)

Commercial	TRIANGULAR(5.0, 16.2, 20.0)
Industrial	UNIFORM(5.0, 12.5)
Inert	TRIANGULAR(35.0, 36.8, 40.0)
Sewage Sludge	TRIANGULAR(3.0, 3.7, 5.0)
Composted Organic Material	UNIFORM(0.0, 2.0)
Incinerator Ash	SINGLE(0.3)
Residues from MRF	TRIANGULAR(40.0, 41.0, 45.0)
Recycling Schemes	UNIFORM(0.0, 1.0)
2015	
Domestic	TRIANGULAR(5.0, 7.0, 10.0)
Commercial	TRIANGULAR(5.0, 16.2, 20.0)
Industrial	UNIFORM(5.0, 12.5)
Inert	TRIANGULAR(35.0, 36.8, 40.0)
Sewage Sludge	TRIANGULAR(3.0, 3.7, 5.0)
Composted Organic Material	UNIFORM(0.0, 2.0)
Incinerator Ash	SINGLE(0.3)
Residues from MRF	TRIANGULAR(40.0, 41.0, 45.0)
Recycling Schemes	UNIFORM(0.0, 1.0)
2016	
Domestic	TRIANGULAR(1.0, 5.0, 7.0)
Commercial	TRIANGULAR(5.0, 16.2, 20.0)
Industrial	TRIANGULAR(8.0, 10.0, 12.0)
Inert	TRIANGULAR(13.0, 16.0, 19.0)
Sewage Sludge	UNIFORM(1.5, 2.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(50.0, 55.0, 57.0)
Recycling Schemes	UNIFORM(0.5, 0.9)
2017	
Domestic	TRIANGULAR(0.5, 2.0, 3.0)
Commercial	TRIANGULAR(5.0, 16.2, 20.0)
Industrial	TRIANGULAR(7.0, 9.6, 10.0)
Inert	TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge	UNIFORM(0.0, 1.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes	UNIFORM(0.5, 0.9)
2018	
Domestic	TRIANGULAR(0.5, 1.0, 3.0)
Commercial	TRIANGULAR(5.0, 16.2, 20.0)
Industrial	TRIANGULAR(7.0, 9.6, 10.0)
Inert	TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge	UNIFORM(0.0, 1.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes	UNIFORM(0.5, 0.9)
2019	
Domestic	TRIANGULAR(0.5, 1.0, 3.0)
Commercial	TRIANGULAR(5.0, 16.2, 20.0)
Industrial	TRIANGULAR(7.0, 9.6, 10.0)
Inert	TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge	UNIFORM(0.0, 1.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes	UNIFORM(0.5, 0.9)
2020	
Domestic	TRIANGULAR(0.5, 1.0, 3.0)
Commercial	UNIFORM(0.0, 2.0)
Industrial	TRIANGULAR(7.0, 9.6, 10.0)
Inert	TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge	UNIFORM(0.0, 1.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes	UNIFORM(0.5, 0.9)
2021	
Domestic	TRIANGULAR(0.5, 1.0, 3.0)
Commercial	UNIFORM(0.0, 2.0)
Industrial	TRIANGULAR(7.0, 9.6, 10.0)
Inert	TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge	UNIFORM(0.0, 1.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)
Residues from MRF	TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes	UNIFORM(0.5, 0.9)
2022	
Domestic	TRIANGULAR(0.5, 1.0, 3.0)
Commercial	UNIFORM(0.0, 2.0)
Industrial	TRIANGULAR(7.0, 9.6, 10.0)
Inert	TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge	UNIFORM(0.0, 1.0)
Composted Organic Material	UNIFORM(1.0, 2.0)
Incinerator Ash	SINGLE(0.1)

Residues from MRF		TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes		UNIFORM(0.5, 0.9)
2023		
Domestic		TRIANGULAR(0.5, 1.0, 3.0)
Commercial		UNIFORM(0.0, 2.0)
Industrial		TRIANGULAR(7.0, 9.6, 10.0)
Inert		TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge		UNIFORM(0.0, 1.0)
Composted Organic Material		UNIFORM(1.0, 2.0)
Incinerator Ash		SINGLE(0.1)
Residues from MRF		TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes		UNIFORM(0.5, 0.9)
2024		
Domestic		TRIANGULAR(0.5, 1.0, 3.0)
Commercial		UNIFORM(0.0, 2.0)
Industrial		TRIANGULAR(7.0, 9.6, 10.0)
Inert		TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge		UNIFORM(0.0, 1.0)
Composted Organic Material		UNIFORM(1.0, 2.0)
Incinerator Ash		SINGLE(0.1)
Residues from MRF		TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes		UNIFORM(0.5, 0.9)
2025		
Domestic		TRIANGULAR(0.5, 1.0, 3.0)
Commercial		UNIFORM(0.0, 2.0)
Industrial		TRIANGULAR(7.0, 9.6, 10.0)
Inert		TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge		UNIFORM(0.0, 1.0)
Composted Organic Material		UNIFORM(1.0, 2.0)
Incinerator Ash		SINGLE(0.1)
Residues from MRF		TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes		UNIFORM(0.5, 0.9)
2026		
Domestic		TRIANGULAR(0.5, 1.0, 3.0)
Commercial		UNIFORM(0.0, 2.0)
Industrial		TRIANGULAR(7.0, 9.6, 10.0)
Inert		TRIANGULAR(5.0, 6.8, 10.0)
Sewage Sludge		UNIFORM(0.0, 1.0)
Composted Organic Material		UNIFORM(1.0, 2.0)
Incinerator Ash		SINGLE(0.1)
Residues from MRF		TRIANGULAR(80.0, 83.6, 85.0)
Recycling Schemes		UNIFORM(0.5, 0.9)
Justification:	[Default]	as per waste inputs

Trace Gases

Source Gases	Concentration [mg/m3]
Acetalehyde (ethanal)	LOGUNIFORM(0.075, 2.546)
Benzene	LOGTRIANGULAR(3.1, 15.0, 73.0)
Butadiene (modelled as 1,3-Butadiene)	LOGUNIFORM(1.00E-30, 2.00E-02)
Butene isomers	LOGTRIANGULAR(1.00E-03, 2.00E-01, 1.80E+00)
Carbon disulphide	LOGUNIFORM(0.9, 170.0)
Carbon monoxide	LOGTRIANGULAR(0.11, 1.1, 5000.0)
Carbon tetrachloride (tetrachloromethane)	LOGUNIFORM(1.00E-30, 2.00E-02)
Chlorobenzene	LOGUNIFORM(0.002, 3000.0)
Chlorofluorocarbons (CFCs) (Total)	LOGTRIANGULAR(0.06, 102.3, 1230.0)
Chloroform (trichloromethane)	LOGTRIANGULAR(1.00E-03, 2.00E-01, 7.00E+01)
Dichloromethane (methylene chloride)	LOGTRIANGULAR(1.00E-03, 2.00E-02, 1.52E+03)
Dimethyl disulphide	LOGTRIANGULAR(0.03, 0.17, 12.0)
Ethyl toluene (all isomers)	LOGTRIANGULAR(1.00E-03, 1.00E-02, 8.30E+00)
Ethylene	UNIFORM(0.2, 5.8)
Ethylene dichloride	LOGTRIANGULAR(0.006, 0.01, 1820.0)
Formaldehyde (methanal)	LOGTRIANGULAR(0.026, 0.068, 0.188)
Halons	SINGLE(0.0)
Hexachlorocyclohexane (all isomers)	SINGLE(0.0)
Hydrochlorofluorocarbons (HCFCs) (Total	LOGTRIANGULAR(0.02, 128.8, 916.2)
Hydrofluorocarbons (HFCs) (Total)	SINGLE(0.0)
Methyl chloride (chloromethane)	LOGTRIANGULAR(0.006, 0.2, 10.0)
Methyl chloroform (1,1,1-Trichloroethane)	LOGTRIANGULAR(1.00E-03, 1.80E+02, 1.60E+03)
PAH (reported as Naphthalene)	LOGTRIANGULAR(1.00E-03, 2.00E-01, 1.70E+01)
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene)	LOGTRIANGULAR(0.006, 0.05, 2.7)
Pentane	LOGTRIANGULAR(0.02, 0.3, 105.0)
Pentene (all isomers)	LOGTRIANGULAR(0.24, 3.5, 12.0)
Perfluorocarbons (PFCs) (Total)	SINGLE(0.0)
Phenol	SINGLE(0.0)
PM10s	SINGLE(0.0)
Tetrachloroethane (modelled as 1,1,2,2-Tetrachloroethane)	LOGUNIFORM(1.00E-03, 5.00E+01)
Tetrachloroethylene (Tetrachloroethene)	LOGTRIANGULAR(1.00E-03, 1.00E-02, 7.70E+03)
Toluene	LOGTRIANGULAR(0.01, 0.1, 1250.0)
Trichlorobenzene (all isomers)	LOGTRIANGULAR(0.01, 0.01, 0.13)
Trichloroethylene (trichloroethene)	LOGTRIANGULAR(0.25, 1.65, 88.0)
Trimethylbenzene (all isomers)	LOGTRIANGULAR(1.00E-03, 1.00E-02, 1.87E+02)
Vinyl chloride (chloroethene, chloroethylene)	LOGTRIANGULAR(1.1, 31.0, 730.0)
Xylene (all isomers)	LOGTRIANGULAR(1.00E-03, 1.00E-03, 6.18E+04)
Justification: [Default]	Default Value

VOC Halflife		NORMAL(4.11, 1.56)
Justification:	[Default]	Default Value

Waste Moisture Content

Degradation rate - Filling Phase		Wet
Justification:	[Changed]	Not Justified
Degradation rate - after change		User Defined 2
Justification:	[Changed]	Not Justified
Waste Density		TRIANGULAR(0.98, 1.0, 1.26)
Justification:	[Default]	Advised by TL's reports and Red Industries waste inputs
Leachate Head		UNIFORM(2.0, 30.0)
Justification:	[Changed]	as per EP in Scenario 1 and based on monitroing data in Scenario 2
Hydraulic Conductivity		LOGUNIFORM(1.00E-09, 1.00E-05)
Justification:	[Default]	Default Value

Engineered Controls

Cap		Single Clay
Cap Thickness		UNIFORM(1.0, 1.5)
Cap Hydraulic Conductivity		LOGUNIFORM(8.90E-11, 1.00E-09)
Justifications		
Cap	[Changed]	Red Industried info
Cap Thickness	[Default]	Site info
Cap Hydraulic Conductivity	[Changed]	design specs and CQA reports
liner		Single Clay
Liner Thickness		SINGLE(3.0)
Liner Hydraulic Conductivity		LOGUNIFORM(8.90E-11, 1.00E-09)
Justifications		
Liner	[Default]	Default Value
Liner Thickness	[Changed]	Red Industries info
Liner Hydraulic Conductivit	[Changed]	design specs and CQA reports
Justification:	[Default]	Default Value
Methane Oxidation %		SINGLE(10.0)
Justification:	[Default]	Default Value
Land Raise Depth		#UNDEFINED?

Geosphere

Ground Surface (mAOD)	0
Water Table (mAOD)	0
Geosphere Moisture Content	UNIFORM(10.0, 30.0)
Geosphere Porosity	UNIFORM(15.0, 35.0)

Site Characteristics

Proportion to CO2 [%]		UNIFORM(37.0, 41.0)
Justification:	[Default]	Site info
Proportion to CH4 [%]		UNIFORM(49.0, 52.0)
Justification:	[Default]	Site info

Cellulose Decay Rates

		Slow	Moderate	Fast
Dry		SINGLE(0.013)	SINGLE(0.046)	SINGLE(0.076)
Average		SINGLE(0.046)	SINGLE(0.076)	SINGLE(0.116)
Wet		SINGLE(0.076)	SINGLE(0.116)	SINGLE(0.694)
Saturated		SINGLE(0.013)	SINGLE(0.046)	SINGLE(0.076)
User Defined 1		SINGLE(0.046)	UNIFORM(0.046, 0.076)	UNIFORM(0.076, 0.116)
User Defined 2		UNIFORM(0.046, 0.076)	UNIFORM(0.076, 0.116)	UNIFORM(0.116, 0.694)
Justification:	[Default]	Default Value		

Gas Plant

Engine A1 (J320)		Spark Ignition Engine	
January 2011 to December 2100		300 to 650	Downtime [%]: UNIFORM(1.0, 3.0)
Justification:	[Changed]	CLP info	
Destruction Efficiency CH4	[Changed]	Not Justified	
Destruction Efficiency H2	[Changed]	Not Justified	
Properties	[Changed]	CLP Info	
Engine A2 (J320)		Spark Ignition Engine	
January 2013 to December 2100		300 to 650	Downtime [%]: UNIFORM(1.0, 3.0)
Justification:	[Changed]	CLP info	
Destruction Efficiency CH4	[Changed]	Not Justified	
Destruction Efficiency H2	[Changed]	Not Justified	
Properties	[Changed]	CLP info	
Engine A4 (J320)		Spark Ignition Engine	
November 2017 to December 2100		300 to 650	Downtime [%]: UNIFORM(3.0, 5.0)
Justification:	[Changed]	CLP info	
Destruction Efficiency CH4	[Changed]	CLP info	
Destruction Efficiency H2	[Changed]	CLP info	
Properties	[Changed]	CLP info	
Initial Flare		Flare	
April 2009 to March 2010		100 to 500	Downtime [%]: UNIFORM(1.0, 3.0)
Justification:	[Changed]	LFG RA 2010	
Destruction Efficiency CH4	[Changed]	CLP data	
Destruction Efficiency H2	[Changed]	CLP data	
Properties	[Changed]	Not Justified	
Flare A3		Flare	
April 2010 to December 2100		500 to 2000	Downtime [%]: UNIFORM(95.0, 97.0)
Justification:	[Changed]	CLP data	
Destruction Efficiency CH4	[Changed]	Not Justified	
Destruction Efficiency H2	[Changed]	Not Justified	
Properties	[Changed]	Not Justified	

Temporary Flare		Flare	
January 2016 to December 2100		100 to 500	Downtime [%]: UNIFORM(98.0, 100.0)
Justification:	[Changed]	CLP data	
Destruction Efficiency CH4	[Changed]	Not Justified	
Destruction Efficiency H2	[Changed]	Not Justified	
Properties	[Changed]	CLP Info	
Engine/Flare Order	[Changed]	CLP info	

Trace Gas Plant

Acetalehyde (ethanal)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Benzene		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Benzo(a)pyrene		
Spark Ignition Engine:	combustion products	LOGUNIFORM(1.10E-12, 9.60E-10)
Dual Fuel Engine:	combustion products	LOGUNIFORM(1.10E-12, 9.60E-10)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	LOGUNIFORM(1.00E-06, 6.00E-04)
Butadiene (modelled as 1,3-Butadiene)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Butene isomers		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Carbon disulphide		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Carbon monoxide		
Spark Ignition Engine:	combustion products	UNIFORM(971.0, 1131.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	UNIFORM(3.52, 20.6)
Carbon tetrachloride (tetrachloromethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chlorobenzene		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chlorofluorocarbons (CFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Chloroform (trichloromethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Dichloromethane (methylene chloride)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Dimethyl disulphide		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Dioxins and furans (modelled as 2,3,7,8-TCDD)		
Spark Ignition Engine:	combustion products	LOGUNIFORM(7.00E-10, 2.30E-06)
Dual Fuel Engine:	combustion products	LOGUNIFORM(7.00E-10, 2.30E-06)
Other Engine:	combustion products	SINGLE(0.36)
Flare:	combustion products	LOGTRIANGULAR(9.00E-09, 3.10E-08, 3.60E-07)
Ethyl toluene (all isomers)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Ethylene		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)

Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Ethylene dichloride		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Formaldehyde (methanal)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Halons		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hexachlorocyclohexane (all isomers)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hydrochlorofluorocarbons (HCFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hydrofluorocarbons (HFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Hydrogen chloride, or (Total chloride (reported as HCl))		
Spark Ignition Engine:	combustion products	LOGTRIANGULAR(5.00E-04, 1.00E+01, 5.84E+02)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	LOGUNIFORM(0.5, 36.0)
Hydrogen fluoride, or (Total fluoride (reported as HF))		
Spark Ignition Engine:	combustion products	LOGTRIANGULAR(2.00E-04, 7.00E+00, 4.50E+01)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	LOGUNIFORM(0.4, 21.0)
Methyl chloride (chloromethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Methyl chloroform (1,1,1-Trichloroethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Nitrogen dioxide (NO2)		
Spark Ignition Engine:	combustion products	UNIFORM(439.0, 618.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	UNIFORM(78.8, 90.6)
Nitrogen monoxide (NO)		
Spark Ignition Engine:	combustion products	SINGLE(0.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	SINGLE(0.0)
Nitrogen oxides (NOx)		
Spark Ignition Engine:	combustion products	LOGUNIFORM(330.0, 2132.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	TRIANGULAR(43.0, 85.0, 149.0)
PAH (reported as Naphthalene)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Pentane		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Pentene (all isomers)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)

Flare:	non-combustion products	SINGLE(99.0)
Perfluorocarbons (PFCs) (Total)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Phenol		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
PM10s		
Spark Ignition Engine:	combustion products	TRIANGULAR(1.2, 4.6, 12.5)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	UNIFORM(1.0, 10.0)
Sulphur dioxide		
Spark Ignition Engine:	combustion products	SINGLE(0.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	SINGLE(0.0)
Tetrachloroethane (modelled as 1,1,2,2-Tetrachloroethane)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Tetrachloroethylene (Tetrachloroethene)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Toluene		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Total non-methane volatile organic compounds (NMVOCs)		
Spark Ignition Engine:	combustion products	SINGLE(0.0)
Dual Fuel Engine:	combustion products	TRIANGULAR(0.0118, 18.1, 90.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	LOGUNIFORM(1.0, 30.0)
Total volatile organic compounds (VOCs)		
Spark Ignition Engine:	combustion products	UNIFORM(439.0, 618.0)
Dual Fuel Engine:	combustion products	SINGLE(0.0)
Other Engine:	combustion products	SINGLE(0.0)
Flare:	combustion products	UNIFORM(0.65, 3.68)
Trichlorobenzene (all isomers)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Trichloroethylene (trichloroethene)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Trimethylbenzene (all isomers)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Vinyl chloride (chloroethene, chloroethylene)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)
Xylene (all isomers)		
Spark Ignition Engine:	non-combustion products	SINGLE(99.0)
Dual Fuel Engine:	non-combustion products	SINGLE(99.0)
Other Engine:	non-combustion products	SINGLE(99.0)
Flare:	non-combustion products	SINGLE(99.0)

Justification: [Changed] Not Justified

Global Impact

Bulk Gases

Global Warming Potential

Carbon Dioxide [t]:		1
Methane [t carbon dioxoide]:		21
Hydrogen [t carbon dioxide]:		0
Justification:	[Default]	Default Value

Ozone Depletion Potential

Carbon Dioxide [t trichlorofluoromethane]:		0
Methane [t trichlorofluoromethane]:		0
Hydrogen [t trichlorofluoromethane]:		0
Justification:	[Default]	Default Value

Trace Gases

Gas	Global Warming Potential	Ozone Depletion Potential
Acetalehyde (ethanal)	1.3	0
Benzene	0	0
Benzo(a)pyrene	0	0
Butadiene (modelled as 1,3-Butadiene)	0	0
Butene isomers	0	0
Carbon disulphide	0	0
Carbon monoxide	0	0
Carbon tetrachloride (tetrachloromethane)	1400	0.73
Chlorobenzene	0	0
Chlorofluorocarbons (CFCs) (Total)	0	0
Chloroform (trichloromethane)	30	0
Dichloromethane (methylene chloride)	9	0
Dimethyl disulphide	0	0
Dioxins and furans (modelled as 2,3,7,8-TCDD)	0	0
Ethyl toluene (all isomers)	0	0
Ethylene	3.7	0
Ethylene dichloride	0	0
Formaldehyde (methanal)	0	0
Halons	0	0
Hexachlorocyclohexane (all isomers)	0	0
Hydrochlorofluorocarbons (HCFCs) (Total	0	0
Hydrofluorocarbons (HFCs) (Total)	0	0
Hydrogen chloride, or (Total chloride (reported as HCl))	0	0
Hydrogen fluoride, or (Total fluoride (reported as HF))	0	0
Methyl chloride (chloromethane)	146	0
Methyl chloroform (1,1,1-Trichloroethane)	0	0
Nitrogen dioxide (NO2)	0	0
Nitrogen monoxide (NO)	0	0
Nitrogen oxides (NOx)	0	0
PAH (reported as Naphthalene)	0	0
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene)	0	0
Pentane	0	0
Pentene (all isomers)	0	0
Perfluorocarbons (PFCs) (Total)	0	0
Phenol	0	0
PM10s	0	0
Sulphur dioxide	0	0
Tetrachloroethane (modelled as 1,1,2,2-Tetrachloroethane)	0	0
Tetrachloroethylene (Tetrachloroethene)	0	0
Toluene	2.7	0
Total non-methane volatile organic compounds (NMVOCs)	0	0
Total volatile organic compounds (VOCs)	0	0
Trichlorobenzene (all isomers)	0	0
Trichloroethylene (trichloroethene)	0	0
Trimethylbenzene (all isomers)	0	0
Vinyl chloride (chloroethene, chloroethylene)	0	0
Xylene (all isomers)	0	0

Lateral Migration

Bulk Gases

Air Diffusion Coefficients		
CO2 Dispersivity		SINGLE(0.1613)
CH4 Dispersivity		SINGLE(0.2192)
H2 Dispersivity		#UNDEFINED?
Justification:	[Default]	Default values

Geosphere

Cell		Cell 1
Geosphere Moisture Content		UNIFORM(10.0, 30.0)
Geosphere Porosity		UNIFORM(15.0, 35.0)
Justification:	[Changed]	LFG RA 2010

Trace Gases

Gas	Air Diffusion Coefficient
Acetalehyde (ethanal)	SINGLE(0.1235)
Benzene	SINGLE(0.088)
Benzo(a)pyrene	SINGLE(0.043)
Butadiene (modelled as 1,3-Butadiene)	SINGLE(0.102)
Butene isomers	SINGLE(0.0977)
Carbon disulphide	SINGLE(0.108)
Carbon monoxide	SINGLE(0.2013)
Carbon tetrachloride (tetrachloromethane)	SINGLE(0.078)
Chlorobenzene	SINGLE(0.073)
Chlorofluorocarbons (CFCs) (Total)	SINGLE(0.0826)
Chloroform (trichloromethane)	SINGLE(0.104)
Dichloromethane (methylene chloride)	SINGLE(0.099)
Dimethyl disulphide	SINGLE(0.0898)
Dioxins and furans (modelled as 2,3,7,8-TCDD)	SINGLE(0.104)
Ethyl toluene (all isomers)	SINGLE(0.0796)

Ethylene	SINGLE(0.0796)
Ethylene dichloride	SINGLE(0.104)
Formaldehyde (methanal)	SINGLE(0.1591)
Halons	SINGLE(0.0754)
Hexachlorocyclohexane (all isomers)	#UNDEFINED?
Hydrochlorofluorocarbons (HCFCs) (Total	SINGLE(0.0967)
Hydrofluorocarbons (HFCs) (Total)	#UNDEFINED?
Hydrogen chloride, or (Total chloride (reported as HCl))	SINGLE(0.1763)
Hydrogen fluoride, or (Total fluoride (reported as HF))	SINGLE(0.2081)
Methyl chloride (chloromethane)	SINGLE(0.1724)
Methyl chloroform (1,1,1-Trichloroethane)	SINGLE(0.078)
Nitrogen dioxide (NO2)	SINGLE(0.2276)
Nitrogen monoxide (NO)	SINGLE(0.2276)
Nitrogen oxides (NOx)	SINGLE(0.2276)
PAH (reported as Naphthalene)	SINGLE(0.059)
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene)	SINGLE(0.069)
Pentane	SINGLE(0.1999)
Pentene (all isomers)	SINGLE(0.1999)
Perfluorocarbons (PFCs) (Total)	SINGLE(0.071)
Phenol	#UNDEFINED?
PM10s	#UNDEFINED?
Sulphur dioxide	SINGLE(0.1289)
Tetrachloroethane (modelled as 1,1,2,2-Tetrachloroethane)	SINGLE(0.071)
Tetrachloroethylene (Tetrachloroethene)	SINGLE(0.072)
Toluene	SINGLE(0.087)
Total non-methane volatile organic compounds (NMVOCs)	#UNDEFINED?
Total volatile organic compounds (VOCs)	#UNDEFINED?
Trichlorobenzene (all isomers)	SINGLE(0.03)
Trichloroethylene (trichloroethene)	SINGLE(0.079)
Trimethylbenzene (all isomers)	SINGLE(0.0619)
Vinyl chloride (chloroethene, chloroethylene)	SINGLE(0.1126)
Xylene (all isomers)	SINGLE(0.0684)
Justification: [Default]	Default Value

Appendix 3 Tier 1 emissions screening - GasSim model print-out

Year of Interest: 2018
Distance from Flare to Nearest Boundary: 72
Distance from Flare to Nearest Receptor: 144
Distance from Gas Engine to Nearest Boundary: 72
Distance from Gas Engine to Nearest Receptor: 144
Distance from Operational Area to Nearest Boundary: 20
Distance from Operational Area to Nearest Receptor: 55

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
Acetalehyde (ethanal) - surface	2018	9200	370	0
Benzene - surface	2018	0	5	0
Benzo(a)pyrene - engine	2018	0	0.00025	0
Benzo(a)pyrene - flare	2018	0	0.00025	0
Butadiene (modelled as 1,3-Butadiene) - surface	2018	0	2.25	0
Carbon disulphide - surface	2018	100	64	0
Carbon monoxide - engine	2018	10000	0	0
Carbon monoxide - flare	2018	10000	0	0
Carbon monoxide - surface	2018	10000	0	0
Carbon tetrachloride (tetrachloromethane) - surface	2018	3900	130	0
Chloroform (trichloromethane) - surface	2018	2970	99	0
Dichloromethane (methylene chloride) - surface	2018	3000	700	0
Ethylene dichloride - surface	2018	700	42	0
Formaldehyde (methanal) - surface	2018	100	5	0
Hydrogen chloride, or (Total chloride (reported as HCl)) - engine	2018	750	0	0
Hydrogen chloride, or (Total chloride (reported as HCl)) - flare	2018	750	0	0
Hydrogen fluoride, or (Total fluoride (reported as HF)) - engine	2018	160	16	0
Hydrogen fluoride, or (Total fluoride (reported as HF)) - flare	2018	160	16	0
Methyl chloride (chloromethane) - surface	2018	21000	1050	0
Methyl chloroform (1,1,1-Trichloroethane) - surface	2018	222000	11100	0
Nitrogen oxides (NOx) - engine	2018	200	40	17.38
Nitrogen oxides (NOx) - flare	2018	200	40	17.38
PAH (reported as Naphthalene) - surface	2018	8000	530	0
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene) - surface	2018	30600	1530	0
Phenol - surface	2018	3900	200	0
PM10s - engine	2018	50	40	37
PM10s 24 hour - engine	2018	50		37
PM10s - flare	2018	50	40	37

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
PM10s 24 hour - flare	2018	50		37
Sulphur dioxide - engine	2018	350	0	0
Sulphur dioxide 15 min - engine	2018	266		0
Sulphur dioxide 24 hour - engine	2018	125		0
Sulphur dioxide - flare	2018	350	0	0
Sulphur dioxide 15 min - flare	2018	266		0
Sulphur dioxide 24 hour - flare	2018	125		0
Tetrachloroethylene (Tetrachloroethene) - surface	2018	8000	3450	0
Toluene - surface	2018	8000	1910	0
Trichlorobenzene (all isomers) - surface	2018	2280	76	0
Trichloroethylene (trichloroethene) - surface	2018	1000	1100	0
Trimethylbenzene (all isomers) - surface	2018	37500	1250	0
Vinyl chloride (chloroethene, chloroethylene) - surface	2018	1851	159	0
Xylene (all isomers) - surface	2018	66200	4410	0

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Acetalehyde (ethanal) - surface - 2018	1.82699(20m)	1.78131(55m)	Yes	No	0.0376816(20m)	0.0357404(55m)	Yes	No
Benzene - surface - 2018	46.7782(20m)	45.6087(55m)	No EAL	No EAL	0.9648(20m)	0.915098(55m)	No	No
Benzo(a)pyrene - engine - 2018	3.39404e-010(72m)	1.53177e-010(144m)	No EAL	No EAL	2.28473e-011(72m)	1.51453e-011(144m)	Yes	No
Benzo(a)pyrene - flare - 2018	1.54203e-007(72m)	6.83316e-008(144m)	No EAL	No EAL	6.39467e-009(72m)	5.18882e-009(144m)	Yes	No
Butadiene (modelled as 1,3-Butadiene) - surface - 2018	0.000230817(20m)	0.000225047(55m)	No EAL	No EAL	4.7606e-006(20m)	4.51536e-006(55m)	Yes	No
Carbon disulphide - surface - 2018	123.816(20m)	120.721(55m)	No	Yes	2.55371(20m)	2.42216(55m)	No	No
Carbon monoxide - engine - 2018	862.409(72m)	389.216(144m)	Yes	No	58.0538(72m)	38.4834(144m)	No EAL	No EAL
Carbon monoxide - flare - 2018	0.534536(72m)	0.236868(144m)	Yes	No	0.0221668(72m)	0.0179868(144m)	No EAL	No EAL
Carbon monoxide - surface - 2018	552.066(20m)	538.264(55m)	Yes	No	11.3864(20m)	10.7998(55m)	No EAL	No EAL
Carbon tetrachloride (tetrachloromethane) - surface - 2018	0.000458051(20m)	0.000446599(55m)	Yes	No	9.4473e-006(20m)	8.96062e-006(55m)	Yes	No
Chloroform (trichloromethane) - surface - 2018	10.1091(20m)	9.85635(55m)	Yes	No	0.2085(20m)	0.197759(55m)	Yes	No
Dichloromethane (methylene chloride) - surface - 2018	91.9286(20m)	89.6304(55m)	Yes	No	1.89603(20m)	1.79835(55m)	Yes	No
Ethylene dichloride - surface - 2018	60.8114(20m)	59.2911(55m)	Yes	No	1.25423(20m)	1.18962(55m)	No	No
Formaldehyde (methanal) - surface - 2018	0.112965(20m)	0.11014(55m)	Yes	No	0.00232989(20m)	0.00220987(55m)	Yes	No
Hydrogen chloride, or (Total chloride (reported as HCl)) - engine - 2018	49.4446(72m)	22.315(144m)	Yes	No	3.32841(72m)	2.20638(144m)	No EAL	No EAL
Hydrogen chloride, or (Total chloride (reported as HCl)) - flare - 2018	0.0160047(72m)	0.00709212(144m)	Yes	No	0.000663701(72m)	0.000538546(144m)	No EAL	No EAL
Hydrogen fluoride, or (Total fluoride (reported as HF)) - engine - 2018	9.44744(72m)	4.26375(144m)	Yes	No	0.635963(72m)	0.421575(144m)	No	No
Hydrogen fluoride, or (Total fluoride (reported as HF)) - flare - 2018	0.00770374(72m)	0.00341374(144m)	Yes	No	0.000319468(72m)	0.000259225(144m)	Yes	No
Methyl chloride (chloromethane) - surface - 2018	3.10627(20m)	3.02861(55m)	Yes	No	0.0640667(20m)	0.0607663(55m)	Yes	No
Methyl chloroform (1,1,1-Trichloroethane) - surface - 2018	443.92(20m)	432.822(55m)	Yes	No	9.15585(20m)	8.68419(55m)	Yes	No
Nitrogen oxides (NOx) - engine - 2018	500.212(72m)	225.752(144m)	No	Yes	67.3444(72m)	44.6421(144m)	No	Yes
Nitrogen oxides (NOx) - flare - 2018	0.03055(72m)	0.0135375(144m)	Yes	No	0.00253377(72m)	0.00205597(144m)	Yes	No
PAH (reported as Naphthalene) - surface - 2018	2.38165(20m)	2.32211(55m)	Yes	No	0.0491215(20m)	0.046591(55m)	Yes	No
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene) - surface - 2018	0.908687(20m)	0.88597(55m)	Yes	No	0.0187417(20m)	0.0177762(55m)	Yes	No
Phenol - surface - 2018	0(20m)	0(55m)	Yes	No	0(20m)	0(55m)	Yes	No
PM10s - engine - 2018	5.17249(72m)	2.33441(144m)	Yes (at receptor)	Yes	0.348191(72m)	0.230813(144m)	Yes	Yes
PM10s 24 hour - engine - 2018	3.05177(72m)	1.3773(144m)	Yes	Yes				
PM10s - flare - 2018	0.00699847(72m)	0.00310122(144m)	Yes	Yes	0.000290221(72m)	0.000235493(144m)	Yes	Yes
PM10s 24 hour - flare - 2018	0.0041291(72m)	0.00182972(144m)	Yes	Yes				
Sulphur dioxide - engine - 2018	168.046(72m)	75.8415(144m)	No	Yes	11.3122(72m)	7.49877(144m)	No EAL	No EAL
Sulphur dioxide 15 min - engine - 2018	225.182(72m)	101.628(144m)	No	Yes				
Sulphur dioxide 24 hour - engine - 2018	99.1474(72m)	44.7465(144m)	No	Yes				
Sulphur dioxide - flare - 2018	0.214506(72m)	0.0950535(144m)	Yes	No	0.00889538(72m)	0.00721797(144m)	No EAL	No EAL
Sulphur dioxide 15 min - flare - 2018	0.287438(72m)	0.127372(144m)	Yes	No				

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Sulphur dioxide 24 hour - flare - 2018	0.126558(72m)	0.0560816(144m)	Yes	No				
Tetrachloroethylene (Tetrachloroethene) - surface - 2018	183.723(20m)	179.129(55m)	Yes	No	3.78928(20m)	3.59407(55m)	Yes	No
Toluene - surface - 2018	91.2955(20m)	89.0131(55m)	Yes	No	1.88297(20m)	1.78597(55m)	Yes	No
Trichlorobenzene (all isomers) - surface - 2018	0.0566862(20m)	0.0552691(55m)	Yes	No	0.00116915(20m)	0.00110892(55m)	Yes	No
Trichloroethylene (trichloroethene) - surface - 2018	23.8528(20m)	23.2565(55m)	Yes	No	0.491964(20m)	0.46662(55m)	Yes	No
Trimethylbenzene (all isomers) - surface - 2018	4.95903(20m)	4.83505(55m)	Yes	No	0.10228(20m)	0.097011(55m)	Yes	No
Vinyl chloride (chloroethene, chloroethylene) - surface - 2018	246.009(20m)	239.859(55m)	No	No	5.07394(20m)	4.81255(55m)	No	No
Xylene (all isomers) - surface - 2018	613.932(20m)	598.583(55m)	Yes	No	12.6623(20m)	12.01(55m)	Yes	No

Not Modelled:

1,1,1,2-Tetrafluorochloroethane
1,1,1-Trichlorotrifluoroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,1-Dichlorotetrafluoroethane
1,2-Dichloropropane
1,2-Dichlorotetrafluoroethane
1-butanethiol
1-Chloro-1,1-difluoroethane
2-butoxy ethanol
2-Chloro-1,1,1-trifluoroethane
2-Propanol
Bromodichloromethane
Butene isomers
Butyric acid
Carbonyl sulphide
Chlorobenzene
Chlorodifluoromethane
Chloroethane
Chlorofluorocarbons (CFCs) (Total)
Chlorofluoromethane
Chlorotrifluoromethane
Dichlorodifluoromethane
Dichlorofluoromethane
Diethyl disulphide
Dimethyl disulphide
Dimethyl sulphide
Dioxins and furans (modelled as 2,3,7,8-TCDD)
Ethane
Ethanethiol (ethyl mercaptan)
Ethanol
Ethyl butyrate
Ethyl toluene (all isomers)
Ethylene
Ethylene dibromide
Fluorotrichloromethane
Freon 113
Furan
Halons
Hexachlorocyclohexane (all isomers)
Hydrochlorofluorocarbons (HCFCs) (Total)
Hydrofluorocarbons (HFCs) (Total)
Limonene

Not Modelled:

Methanethiol (methyl mercaptan)
Methyl isobutyl ketone
Nitrogen dioxide (NO_2)
Nitrogen monoxide (NO)
Odour Units (Predicted)
Pentane
Pentene (all isomers)
Perfluorocarbons (PFCs) (Total)
Propane
Propanethiol
Sulphide, total simulations with H_2S
Sulphide, total simulations without H_2S
t-1,2-Dichloroethene
Tetrachloroethane (modelled as 1,1,2,2-Tetrachloroethane)
Total non-methane volatile organic compounds (NMVOCs)
Total volatile organic compounds (VOCs)
Trichlorofluoromethane
Trichlorotrifluoroethane

Year of Interest: 2019
Distance from Flare to Nearest Boundary: 72
Distance from Flare to Nearest Receptor: 144
Distance from Gas Engine to Nearest Boundary: 72
Distance from Gas Engine to Nearest Receptor: 144
Distance from Operational Area to Nearest Boundary: 20
Distance from Operational Area to Nearest Receptor: 60

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
Acetalehyde (ethanal) - surface	2019	9200	370	0
Benzene - surface	2019	0	5	0
Benzo(a)pyrene - engine	2019	0	0.00025	0
Benzo(a)pyrene - flare	2019	0	0.00025	0
Butadiene (modelled as 1,3-Butadiene) - surface	2019	0	2.25	0
Carbon disulphide - surface	2019	100	64	0
Carbon monoxide - engine	2019	10000	0	0
Carbon monoxide - flare	2019	10000	0	0
Carbon monoxide - surface	2019	10000	0	0
Carbon tetrachloride (tetrachloromethane) - surface	2019	3900	130	0
Chloroform (trichloromethane) - surface	2019	2970	99	0
Dichloromethane (methylene chloride) - surface	2019	3000	700	0
Ethylene dichloride - surface	2019	700	42	0
Formaldehyde (methanal) - surface	2019	100	5	0
Hydrogen chloride, or (Total chloride (reported as HCl)) - engine	2019	750	0	0
Hydrogen chloride, or (Total chloride (reported as HCl)) - flare	2019	750	0	0
Hydrogen fluoride, or (Total fluoride (reported as HF)) - engine	2019	160	16	0
Hydrogen fluoride, or (Total fluoride (reported as HF)) - flare	2019	160	16	0
Methyl chloride (chloromethane) - surface	2019	21000	1050	0
Methyl chloroform (1,1,1-Trichloroethane) - surface	2019	222000	11100	0
Nitrogen oxides (NOx) - engine	2019	200	40	21
Nitrogen oxides (NOx) - flare	2019	200	40	21
PAH (reported as Naphthalene) - surface	2019	8000	530	0
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene) - surface	2019	30600	1530	0
Phenol - surface	2019	3900	200	0
PM10s - engine	2019	50	40	37
PM10s 24 hour - engine	2019	50		37
PM10s - flare	2019	50	40	37

		Short Term EQS or EAL µg/m3	Long Term EQS or EAL µg/m3	Background Concentration µg/m3
PM10s 24 hour - flare	2019	50		37
Sulphur dioxide - engine	2019	350	0	0
Sulphur dioxide 15 min - engine	2019	266		0
Sulphur dioxide 24 hour - engine	2019	125		0
Sulphur dioxide - flare	2019	350	0	0
Sulphur dioxide 15 min - flare	2019	266		0
Sulphur dioxide 24 hour - flare	2019	125		0
Tetrachloroethylene (Tetrachloroethene) - surface	2019	8000	3450	0
Toluene - surface	2019	8000	1910	0
Trichlorobenzene (all isomers) - surface	2019	2280	76	0
Trichloroethylene (trichloroethene) - surface	2019	1000	1100	0
Trimethylbenzene (all isomers) - surface	2019	37500	1250	0
Vinyl chloride (chloroethene, chloroethylene) - surface	2019	1851	159	0
Xylene (all isomers) - surface	2019	66200	4410	0

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Acetalehyde (ethanal) - surface - 2019	1.76412(20m)	1.67592(60m)	Yes	No	0.036385(20m)	0.0326363(60m)	Yes	No
Benzene - surface - 2019	39.1911(20m)	37.2316(60m)	No EAL	No EAL	0.808317(20m)	0.725036(60m)	No	No
Benzo(a)pyrene - engine - 2019	3.62481e-010(72m)	1.63592e-010(144m)	No EAL	No EAL	2.44007e-011(72m)	1.6175e-011(144m)	Yes	No
Benzo(a)pyrene - flare - 2019	2.28413e-008(72m)	1.01216e-008(144m)	No EAL	No EAL	9.47211e-010(72m)	7.68594e-010(144m)	Yes	No
Butadiene (modelled as 1,3-Butadiene) - surface - 2019	0.00263513(20m)	0.00250337(60m)	No EAL	No EAL	5.43495e-005(20m)	4.87498e-005(60m)	Yes	No
Carbon disulphide - surface - 2019	123.858(20m)	117.665(60m)	No	Yes	2.55457(20m)	2.29137(60m)	No	No
Carbon monoxide - engine - 2019	572.806(72m)	258.514(144m)	Yes	No	38.5589(72m)	25.5604(144m)	No EAL	No EAL
Carbon monoxide - flare - 2019	0.0052654(72m)	0.00233324(144m)	Yes	No	0.000218352(72m)	0.000177177(144m)	No EAL	No EAL
Carbon monoxide - surface - 2019	347.908(20m)	330.512(60m)	Yes	No	7.17559(20m)	6.43629(60m)	No EAL	No EAL
Carbon tetrachloride (tetrachloromethane) - surface - 2019	0.000600489(20m)	0.000570465(60m)	Yes	No	1.23851e-005(20m)	1.11091e-005(60m)	Yes	No
Chloroform (trichloromethane) - surface - 2019	12.1587(20m)	11.5507(60m)	Yes	No	0.250773(20m)	0.224936(60m)	Yes	No
Dichloromethane (methylene chloride) - surface - 2019	69.6088(20m)	66.1284(60m)	Yes	No	1.43568(20m)	1.28776(60m)	Yes	No
Ethylene dichloride - surface - 2019	61.3955(20m)	58.3257(60m)	Yes	No	1.26628(20m)	1.13582(60m)	No	No
Formaldehyde (methanal) - surface - 2019	0.127427(20m)	0.121056(60m)	Yes	No	0.00262818(20m)	0.0023574(60m)	Yes	No
Hydrogen chloride, or (Total chloride (reported as HCl)) - engine - 2019	68.0452(72m)	30.7096(144m)	Yes	No	4.58052(72m)	3.03639(144m)	No EAL	No EAL
Hydrogen chloride, or (Total chloride (reported as HCl)) - flare - 2019	0.00371628(72m)	0.00164679(144m)	Yes	No	0.000154111(72m)	0.00012505(144m)	No EAL	No EAL
Hydrogen fluoride, or (Total fluoride (reported as HF)) - engine - 2019	7.15284(72m)	3.22817(144m)	Yes	No	0.4815(72m)	0.319183(144m)	No	No
Hydrogen fluoride, or (Total fluoride (reported as HF)) - flare - 2019	0.00188275(72m)	0.000834301(144m)	Yes	No	7.80763e-005(72m)	6.33534e-005(144m)	Yes	No
Methyl chloride (chloromethane) - surface - 2019	2.73818(20m)	2.60127(60m)	Yes	No	0.056475(20m)	0.0506564(60m)	Yes	No
Methyl chloroform (1,1,1-Trichloroethane) - surface - 2019	378.558(20m)	359.63(60m)	Yes	No	7.80776(20m)	7.00332(60m)	Yes	No
Nitrogen oxides (NOx) - engine - 2019	496.261(72m)	223.969(144m)	No	Yes	66.8124(72m)	44.2895(144m)	No	Yes
Nitrogen oxides (NOx) - flare - 2019	0.0171318(72m)	0.00759157(144m)	Yes	No	0.00142088(72m)	0.00115294(144m)	Yes	No
PAH (reported as Naphthalene) - surface - 2019	2.85124(20m)	2.70868(60m)	Yes	No	0.0588068(20m)	0.052748(60m)	Yes	No
para-Dichlorobenzene (modelled as 1,4-Dichlorobenzene) - surface - 2019	0.86379(20m)	0.8206(60m)	Yes	No	0.0178157(20m)	0.0159801(60m)	Yes	No
Phenol - surface - 2019	0(20m)	0(60m)	Yes	No	0(20m)	0(60m)	Yes	No
PM10s - engine - 2019	5.80031(72m)	2.61775(144m)	Yes (at receptor)	Yes	0.390453(72m)	0.258828(144m)	Yes	Yes
PM10s 24 hour - engine - 2019	3.42218(72m)	1.54447(144m)	Yes	Yes				
PM10s - flare - 2019	0.00278242(72m)	0.00123297(144m)	Yes	Yes	0.000115385(72m)	9.36264e-005(144m)	Yes	Yes
PM10s 24 hour - flare - 2019	0.00164163(72m)	0.000727451(144m)	Yes	Yes				
Sulphur dioxide - engine - 2019	0(72m)	0(144m)	Yes	No	0(72m)	0(144m)	No EAL	No EAL
Sulphur dioxide 15 min - engine - 2019	0(72m)	0(144m)	Yes	No				
Sulphur dioxide 24 hour - engine - 2019	0(72m)	0(144m)	Yes	No				
Sulphur dioxide - flare - 2019	0(72m)	0(144m)	Yes	No	0(72m)	0(144m)	No EAL	No EAL
Sulphur dioxide 15 min - flare - 2019	0(72m)	0(144m)	Yes	No				

	Short Term				Long term			
	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?	Predicted Boundary Concentration µg/m3	Predicted Nearest Receptor Concentration µg/m3	Is the emission rate Insignificant?	Is detailed modelling required?
Sulphur dioxide 24 hour - flare - 2019	0(72m)	0(144m)	Yes	No				
Tetrachloroethylene (Tetrachloroethene) - surface - 2019	239.688(20m)	227.704(60m)	Yes	No	4.94357(20m)	4.43424(60m)	Yes	No
Toluene - surface - 2019	82.5621(20m)	78.434(60m)	Yes	No	1.70284(20m)	1.5274(60m)	Yes	No
Trichlorobenzene (all isomers) - surface - 2019	0.0651467(20m)	0.0618894(60m)	Yes	No	0.00134365(20m)	0.00120521(60m)	Yes	No
Trichloroethylene (trichloroethene) - surface - 2019	28.508(20m)	27.0826(60m)	Yes	No	0.587978(20m)	0.527399(60m)	Yes	No
Trimethylbenzene (all isomers) - surface - 2019	8.95802(20m)	8.51012(60m)	Yes	No	0.184759(20m)	0.165723(60m)	Yes	No
Vinyl chloride (chloroethene, chloroethylene) - surface - 2019	197.856(20m)	187.963(60m)	No	No	4.08079(20m)	3.66034(60m)	No	No
Xylene (all isomers) - surface - 2019	224.959(20m)	213.711(60m)	Yes	No	4.63978(20m)	4.16174(60m)	Yes	No

Not Modelled:

1,1,1,2-Tetrafluorochloroethane
1,1,1-Trichlorotrifluoroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,1-Dichlorotetrafluoroethane
1,2-Dichloropropane
1,2-Dichlorotetrafluoroethane
1-butanethiol
1-Chloro-1,1-difluoroethane
2-butoxy ethanol
2-Chloro-1,1,1-trifluoroethane
2-Propanol
Bromodichloromethane
Butene isomers
Butyric acid
Carbonyl sulphide
Chlorobenzene
Chlorodifluoromethane
Chloroethane
Chlorofluorocarbons (CFCs) (Total)
Chlorofluoromethane
Chlorotrifluoromethane
Dichlorodifluoromethane
Dichlorofluoromethane
Diethyl disulphide
Dimethyl disulphide
Dimethyl sulphide
Dioxins and furans (modelled as 2,3,7,8-TCDD)
Ethane
Ethanethiol (ethyl mercaptan)
Ethanol
Ethyl butyrate
Ethyl toluene (all isomers)
Ethylene
Ethylene dibromide
Fluorotrichloromethane
Freon 113
Furan
Halons
Hexachlorocyclohexane (all isomers)
Hydrochlorofluorocarbons (HCFCs) (Total)
Hydrofluorocarbons (HFCs) (Total)
Limonene

Not Modelled:

Methanethiol (methyl mercaptan)
Methyl isobutyl ketone
Nitrogen dioxide (NO2)
Nitrogen monoxide (NO)
Odour Units (Predicted)
Pentane
Pentene (all isomers)
Perfluorocarbons (PFCs) (Total)
Propane
Propanethiol
Sulphide, total simulations with H2S
Sulphide, total simulations without H2S
t-1,2-Dichloroethene
Tetrachloroethane (modelled as 1,1,2,2-Tetrachloroethane)
Total non-methane volatile organic compounds (NMVOCs)
Total volatile organic compounds (VOCs)
Trichlorofluoromethane
Trichlorotrifluoroethane

Appendix 4 Lateral emissions risk assessment – GasSim model print out

Lateral Migration of Cell 1 CH4 at distance 20m			
95% of the iterations were less than	0.00		
90% of the iterations were less than	0.00	Mean	0.00
75% of the iterations were less than	0.00	SD	0.00
50% of the iterations were less than	0.00	Variance	0.00
25% of the iterations were less than	0.00	Minimum	0.00
10% of the iterations were less than	0.00	Maximum	0.00
05% of the iterations were less than	0.00		
File Name : c:\gassim temp\walleylfs default waste figures for lfg ra 031218.gss		**Date :**	**10/12/2018 12:42:38**