Appendix 4

Air Dispersion Model

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Air Dispersion Model Report

O'Toole Composting

DOCUMENT CONTROL SHEET

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1 INTRODUCTION

O'Toole Composting Ltd. operates an existing composting plant in the townland of Ballintrane, Co. Carlow. The plant has been in operation since 2004 and provides composting service for food and organic waste for a range of industries including canteens, restaurants, food production companies and hotels.

There are a series of planned developments at the site in future years with the potential for emissions to atmosphere and each of the following are considered in this report:

- Scenario 1: Upgrade of the existing biofilter at the operational composting unit.
- Scenario 2: Composting unit biofilter in addition to the installation of a new biofilter at the skip shed.

RPS has followed the procedures presented in the EPA Guidance Note AG4 "Air Dispersion Modelling for Industrial Installations" in this assessment. RPS have employed the USEPA approved AERMOD Prime dispersion model to determine the impacts on the environment and at the nearest sensitive receptors. The results of the modelling are assessed against the relevant statutory limits, where available, and ambient air quality guidelines used internationally.

The modelling approach has allowed for the specification of emission guidelines for each phase of the development to minimise the potential for odour nuisance.

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2 EMISSIONS TO ATMOSPHERE

2.1 OVERVIEW

Given the nature if the sources on site this modelling exercise will establish the impacts of the following parameters:

- Odour emissions (OU_E/m^3) and Hydrogen Sulphide emissions from the biofilters

As all sources are proposed installations and no source specific assessment can be undertaken, standard literature sources (such as BAT/BREF, TA Luft, etc.) are employed to determine the emission rates for each source.

2.2 BAT GUIDANCE

The EPA has prepared a BAT Guidance Note for the composting industry but this is still in development and has not been published. As a result, the parent BREF Note for the Waste Treatments Industries (2006, and a review has commenced in 2013) has been employed as a reference for this assessment. Section 5.2 of this BREF Note outlines what is considered BAT for specific types of waste treatments, including biological treatments such as composting. Table 2.1 presents the BAT levels of odour emissions from biological treatment of wastes following abatement, expressed as a range of acceptable values. This BAT range will be used as the basis for determining suitable emission rates from the biofilters on site.

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Parameter	Limit for Treated Exhaust Gas
Odour (Ou_E/m^3)	<500 - 6,000

Table 2.1: BAT Emission Levels for Odour Discharges to Air

In terms of odour gases (hydrogen sulphide) there is no specified BAT limit presented in the BREF Guidance note.

2.3 TA LUFT GUIDANCE

The Technische Anleitung zur Reinhaltung der Luft, (*TA-Luft)* are German Government Guidelines for the control of air quality and are frequently used a reference in emissions assessment in Ireland. These Guidelines are also used as a reference for many EPA BAT Guidance Notes. The TA Luft Guidelines detail the technical measures expected to be applied in different sectors of industry including methods for assessment. Originally published in 1986, the 2002 revision has been referenced for this report. Paragraph 5.2.4 of TA Luft provides cross sectoral generic emission guidelines for H_2S as presented in Table 2.2.

TA Luft Class	Parameter	Concentration Limit	Mass Emission Limit
	Hydrogen Sulphide	3 mg/m^3	0.015 kg/hr

Table 2.2: TA Luft Guidelines for Inorganic Substances

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2.4 DISPERSION MODELLING

RPS has followed the procedures presented in the EPA Guidance Note AG4 "Air Dispersion Modelling for Industrial Installations" in this assessment. The model used for Air Dispersion Modelling was the US EPA approved AERMOD Prime model, which is the current regulatory model in the US and a recommended model under the EPA guidance. This model is a third generation model utilising advanced boundary-layer physics. AERMOD is run with a sequence of hourly meteorological conditions to predict concentrations at receptors for averaging times of one hour up to a year. It is necessary to use many years of hourly data to develop a better understanding of the statistics of calculated short-term hourly peaks or of longer time averages.

2.4.1 Source Information

Site specific data such as the locations and dimensions of the biofilters have been derived from the engineering drawings of the proposed operations. Where information is unknown valid assumptions have been applied and are clearly stated for each source. This information is presented in Table 2.3. Emissions from the biofilters were modelled assuming 24 hours, 365 days a year operations. It is proposed to engineer a stack (point source) from the biofilter on the composting unit as part of the planned upgrade and this source has been modelled as such.

Source	Source Type	Dimensions	Height (m)	Temp. (^{0}C)	Flow (Nm^3/hr)
Composting Unit Biofilter	Point	1m (diameter)	10	25	60,000
Skip Shed Biofilter	Area	20.5 x 8.0 m	2	25	10,000

Table 2.3: Emission point details for dispersion model

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2.4.2 Background Concentrations

There is no database of information available on background odour concentrations. Given the rural location of the site, it is possible that agricultural activities in the area may give rise to occasional odours. However, for the purposes of this assessment, background odours have been assumed as zero, as per standard practice.

While there are agricultural sources in the area, which would represent a source of H_2S, these sources are intermittent and as such, the typical background is assumed as zero in this model assessment.

2.4.3 Pathway (Meteorological files)

The most important parameters governing dispersion in the atmosphere are wind speed, wind-direction and the stability or turbulence of the atmosphere. These parameters along with the ambient temperature and inferred mixing heights for each hour were included in the modelling using data from an appropriate met station with validated met data.

The nearest met station to the site is the Kilkenny Station approximately 30km the west of the site. Model ready data was unavailable for this station so data from an alternative location was sought in accordance with the requirements of Section 6.1 of the AG4 Guidance. Section 6.1 of the AG4 Guidance Note requires that a meteorological station may be chosen with a mean annual wind speed ratio between 0.9 – 1.1 to estimate dispersion from the site.

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Annual average wind speeds in the Carlow/Kilkenny area are recorded as 3.34 m/s at the Kilkenny Met Station (based on the 30 year average). Data from Birr indicates an annual average wind speed of 3.60 m/s (based on the 30 year average). As such the ratio between the two stations is 1.1 and within the recommended tolerance presented in the AG4 Guidance.

The AG4 Guidance requires a minimum of three years of met data to run a reliable dispersion model. In order to meet these requirements, three years worth of meteorological data (2003-2005) from the met station at Birr were employed in this modelling assessment. The 30-year average wind profile at Birr Met Station is presented as a windrose in Figure 2.1.

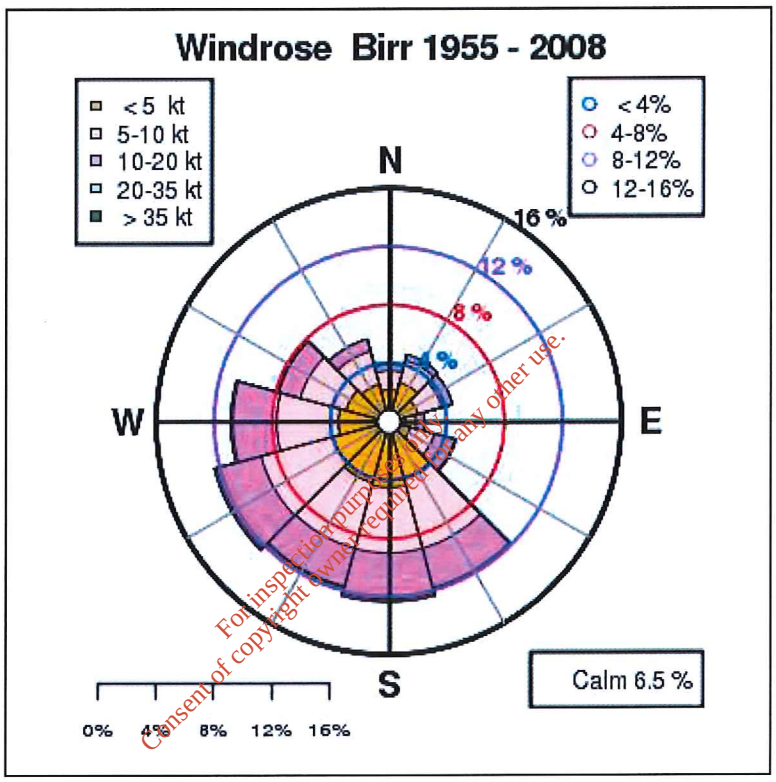

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Figure 2.1: Windrose for the Birr Met Station for 1955-2008

2.4.4 Geophysical Data

Any physical structure (such as a building) that is in close proximity to an exhaust point may hinder the dispersion characteristics through a phenomenon known as "building downwash". The potential for building downwash is dependent on the relative differences in height between the stack and the building. In this assessment the analysis suggests that the emission heights of the biofilters are not sufficient to meet the good engineering practice (GEP) recommendation of the US EPA and there is the potential for building downwash to occur. The AERMOD BPIP processor has been applied to all emission scenarios to ensure that building downwash has been fully accounted.

A review of the topography of the area indicates that the surrounding terrain is flat ("simple") with no complex features such as valleys, mountains, etc. As such, there is no requirement for importation of a terrain file into this model.

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2.4.5 Receptors

A 3km x 3km Cartesian receptor grid has been incorporated into the model to simulate the spatial emissions trends from the proposed operation. In addition, discrete receptors have been identified as the nearest dwelling houses or groups of dwelling houses. The discrete receptors employed in the model are listed in Table 2.4 and presented in Figure 2.2.

Reference	Receptor
R1	Dwelling House to south of the site (Burrin Equestrian Supplies)
R2	Group of Dwelling Houses to the east of the site at Ballintrane Cross Roads on the N80
R3	Tinnaclash House to the north of the site
R4	Dwelling house to the west of the site on the N80

Table 2.4: Discreet Receptors employed in the model

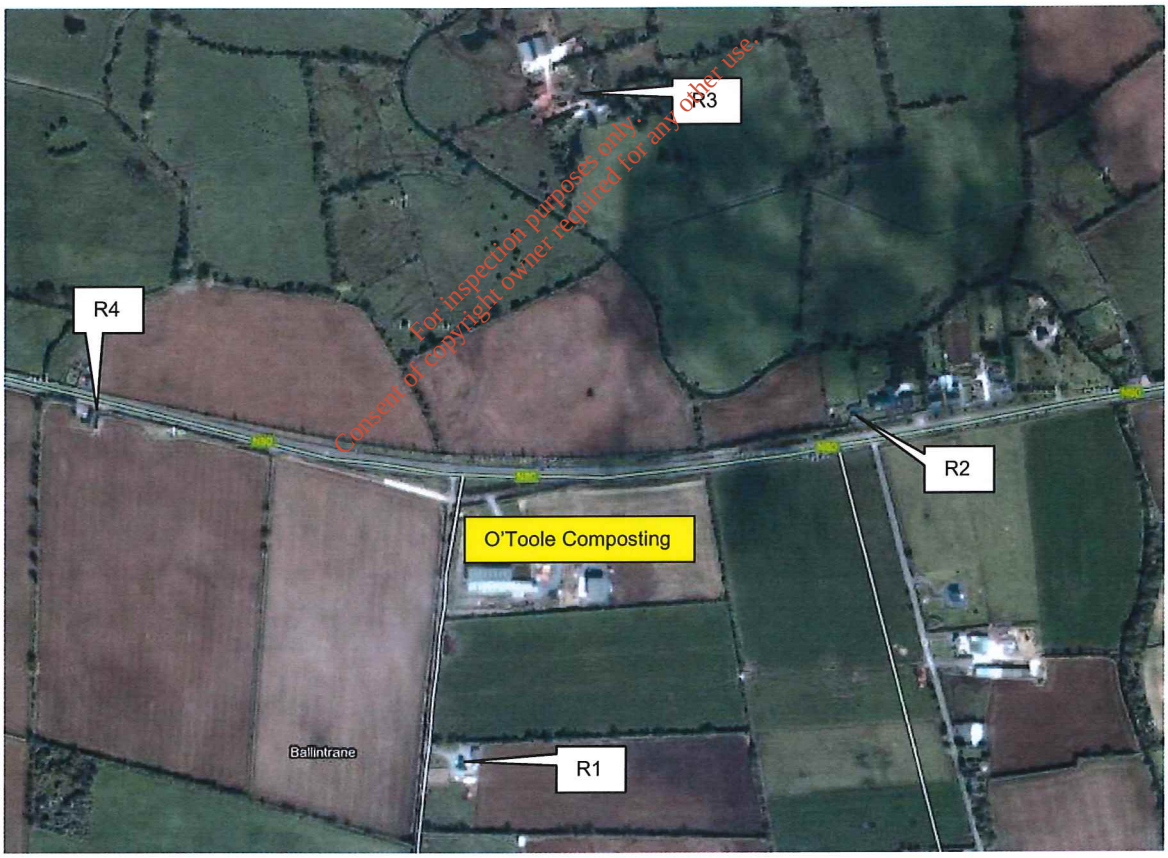

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Figure 2.2: Locations of Discrete Receptors

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2.4.6 Assessment Criteria

Odour

There are no legislative limits relating to the impact of odour on residential or other receptors. Irish and UK guidance use a series of annoyance criteria for odours from various waste and industrial sources. These bands are described in Table 2.5. In general, the higher the odour risk posed by a facility the more stringent the annoyance criteria (e.g. a landfill would have to comply with annoyance criteria of 1.5 Ou_E/m^3, whereas a bakery would only have to comply with 6.0 Ou_E/m^3 due to the less unpleasant nature of the odour).

Given the nature of the waste operations at the site, it is considered appropriate to place the site in the high risk category and the relevant criteria for this assessment is 1.5 Ou_E/m^3 at the 98th percentile. These criteria are at the 98th percentile of the 1-hour average concentrations, which means they must be complied with 98% of the time. At this criteria the odours from the plant are not predicted to "give reasonable cause for annoyance" at the nearest sensitive receptors.

Activity	Risk	Indicative Criterion
Activities involving putrescible waste (eg Landfill), Processes involving animal or fish remains, Brickworks, Creamery, Fat & grease processing, Wastewater treatment, Oil refining, Livestock feed factory	High Risk	1.5 Ou_E/m^3 at the 98th percentile of 1-hour averages
Intensive livestock rearing, Fat frying (food processing), Sugar beet processing	Medium Risk	3.0 Ou_E/m^3 at the 98th percentile of 1-hour averages
Chocolate manufacture, Brewery, Confectionery, Fragrance and flavourings, Coffee roasting, Bakery	Low Risk	6.0 Ou_E/m^3 at the 98th percentile of 1-hour averages

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Table 2.5: Odour Annoyance Criteria

Hydrogen Sulphide (H_2S)

Hydrogen sulphide is one of the key odour compounds that can cause nuisance impacts from waste facilities. H_2S is a colourless, flammable, extremely hazardous gas with a "rotten egg" odour. It occurs naturally in crude petroleum and natural gas. In addition, H_2S is produced by bacterial breakdown of organic materials (e.g. compost) and human and animal wastes (e.g. sewage and slurry). There are no statutory limits for the protection of human health for H_2S so guidelines are applied. Two thresholds are employed in this assessment – the threshold for odour nuisance and the threshold for health impacts as presented in Table 2.6 (source WHO "*Air Quality Guidelines for Europe*", 2000).

Parameter	Averaging Period	Guideline	Source
Health Effects	24 hours	150 $\mu g/m^3$	World Health Organisation
Odour Annoyance	30 mins	7 $\mu g/m^3$	World Health Organisation

Table 2.6: Health and Odour Guidelines for H_2S

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3 MODELLING RESULTS

3.1 SCENARIO 1

Scenario 1 consists of the upgrade of the existing biofilter at the composting unit. The input parameters for the biofilter are presented in Table 3.1 below. These emission values represent the operating scenario when only this emission source is operational. The odour emission factor employed in the model is based on the recommended BAT emission limit range (Table 2.1). The H_2S emission level is derived as the maximum concentration to allow for compliance with the relevant assessment criteria (Table 2.6). The results of the model assessment are presented in Table 3.2 for the discrete receptors.

Parameter	Input
Source Type	Point
Dimensions (diameter)	1 m
Height	10 m
Temperature	25^0C (298K)
Volumetric Flow Rate	60,000 m^3/hr
Odour Emission Concentration	3,300 Ou_E/m^3
H_2S Emission Concentration	5.7 mg/m^3

Table 3.1: Input Emission Factors for Scenario 1

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Ref	Receptor	Receptor Type	Predicted Odour Concentration (Ou_E/m^3) 98th Percentile of 1-hour averages	Predicted H_2S Concentration ($\mu g/m^3$) 1-hour max	Predicted H_2S Concentration ($\mu g/m^3$) 24-hour max
R1	Dwelling House to south of the site (Burrin Equestrian Supplies)	Residential	1.13	6.87	1.59
R2	Group of Dwelling Houses to the east of the site at Ballintrane Cross Roads on the N80	Residential	1.44	3.45	1.40
R3	Tinnaclash House to the north of the site	Residential	0.42	2.70	0.72
R4	Dwelling house to the west of the site on the N80	Residential	0.54	2.90	0.97
Guideline			**1.50**	**7**	**150**

Table 3.2: Results of dispersion modelling on discreet receptors for Scenario 1.

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The model indicates that the predicted odour emissions from the biofilter will be within the standard annoyance criteria for odour nuisance. The worst affected receptor are the group of dwelling houses to east of the site (R2) in line with the prevailing westerly wind. Odours are not predicted to "give reasonable cause for annoyance" at this property under the operating conditions presented in Table 3.1. The other receptors in the area will experience a lower impact and will not give rise to odour nuisance at these properties.

In relation to H_2S, at the emission concentration of 5.7mg/m^3 the levels at the nearest sensitive receptor (R1) will remain below the WHO odour annoyance criteria. By default, at this emission level the concentrations at the sensitive receptors will be less than 1% of the WHO health protection limit. Levels at other houses will be lower and will not breach the odour annoyance or health impact criteria set by the WHO. In short, while this emission level is above BAT guidance, the level shows no odour or health impact for this scenario.

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3.2 SCENARIO 2

Scenario 2 represents the emissions from the composting biofilter in addition to the installation of a new biofilter at the skip shed. The input parameters for the biofilters are presented in Table 3.3 below. The emission factors employed in the model are based on the recommended BAT emission limit range for odour (Table 2.1) and hydrogen sulphide (Table 2.2). The results of the model assessment are presented in Table 3.4 for the discrete receptors.

Parameter	Composting Biofilter	Skip Shed Biofilter
Source Type	Point	Area
Dimensions	1 m (diameter)	20.5 x 8.0 m
Height	10 m	3 m
Temperature	25^0C (298K)	25^0C (298K)
Volumetric Flow Rate	60,000 m^3/hr	10,000 m^3/hr
Odour Emission Concentration	3,000 Ou_E/m^3	800 Ou_E/m^3
H_2S Emission Concentration	3 mg/m^3	0.9 mg/m^3

Table 3.3: Input Emission Factors for Scenario 2

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Ref	Receptor	Receptor Type	Predicted Odour Concentration (Ou_E/m^3) 98th Percentile of 1-hour averages	Predicted H_2S Concentration ($\mu g/m^3$) 1-hour max	Predicted H_2S Concentration ($\mu g/m^3$) 24-hour max
R1	Dwelling House to south of the site (Burrin Equestrian Supplies)	Residential	1.21	4.65	0.84
R2	Group of Dwelling Houses to the east of the site at Ballintrane Cross Roads on the N80	Residential	1.46	6.85	0.96
R3	Tinnaclash House to the north of the site	Residential	0.44	3.69	0.42
R4	Dwelling house to the west of the site on the N80	Residential	0.54	3.00	0.33
Guideline			**1.50**	**7**	**150**

Table 3.4: Results of dispersion modelling on discreet receptors for Scenario 2.

The model indicates that the predicted cumulative odour emissions from the biofilters will be within the standard annoyance criteria for odour nuisance. The emission value for the composting biofilter is reduced to account for the additional contribution of the skip shed biofilter. Odours are not predicted to "give reasonable cause for annoyance" at any property.

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In relation to H_2S, at the BAT emission concentration of 3mg/m^3 at the composting biofilter stack and an emission rate from the skip shed biofilter of 0.9mg/m^3, the levels at the nearest sensitive receptor (R2) will remain below the WHO odour annoyance criteria and health protection limit. As with the odour levels, the H_2S emission concentration for the composting biofilter stack has reduced from Scenario 1 to account for the additional emissions from the skip shed biofilter.

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4 CONCLUSIONS

A refined dispersion model assessment has been undertaken to simulate the emissions from the proposed developments at O'Toole Composting, Carlow. The modelling procedure has followed that presented by the EPA in Guidance Note AG4. The modelling has assessed the impact of odours from the existing biofilter at the composting unit and the proposed biofilter at the skip shed.

As all sources are planned, a review of suitable emission concentrations has been carried out using standard BREF, BAT and TA Luft references. For all sources the emission concentrations employed comply with these reference documents. The results of the modelling exercise indicate that emissions at the concentrations outlined in the following table will not give rise to odour nuisance from the operational facility.

Table 4.1 outlines the modelled emission rates of the two biofilters at the facility. Emission values are presented on a phased basis as modelled in this report and emissions at these values will not give rise to odour nuisance in the vicinity of the development. These odour emission concentrations are based on the acceptable emission range outlined in the BREF Note for the Waste Treatment Industries. H_2S emission rates are based on TA Luft. The results indicate that at these levels the impact of all biofilters operating under the various phases will be within the acceptable criteria for odour nuisance and health impact.

Source	Parameter	Emission Value with only this unit operating	Emission Value with both units operating
Composting Unit Biofilter	Odour (Ou_E/m^3)	3,300	3,000
	Hydrogen Sulphide (mg/m^3)	5.7	3
Skip Shed Biofilter	Odour (Ou_E/m^3)	-	800
	Hydrogen Sulphide (mg/m^3)	-	0.90

Table 4.1: Modelled Odour Emission Values for the Biofilters

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In summary, the proposed operation of the O'Toole Composting facility at the emission levels prescribed above will not result in odour nuisance at the nearest sensitive receptors.

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