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Office of Environmental Sustainability
Environmental Protection Agency
Headquarters PO Box 3000
Johnstown Castle Estate
County Wexford.

3rd October 2024

Re: Notice under the EPA (Industrial Emissions) (Licensing) Regulations 2013, in respect of a licence review from Starrus Eco Holdings Limited for an installation located at Starrus Eco Holdings Limited (Littleton), Ballybeg, Littleton, Tipperary, E41 WP83

Dear Sir/Madam

I refer to the Agency's Notice dated in accordance with Regulation 10(2)(b)(ii) of the EPA (Industrial Emissions) (Licensing) Regulations 2013 relating to the status of the planning applications.

The odour dispersion model is in Attachment A. In relation to the response to the EPA's Notice dated 28/11/2023 submitted on 02/02/2024 there is a typographical error in the response to item 3. List of Waste Code (LoW) 20 01 03 is referenced incorrectly. The correct LoW code is 20 03 01.

Yours Sincerely

Jim O' Callaghan

ATTACHMENT A

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ODOUR IMPACT ASSESSMENT OF PROPOSED EXTENSION TO STARRUS ECO HOLDINGS LTD FACILITY LOCATED IN BALLYBEG, LITTLETON, THURLES, CO TIPPERARY.

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF STARRUS ECO HOLDINGS LTD

PREPARED BY:	Dr. Brian Sheridan
ATTENTION:	Mr. Sam Bowden
DATE:	01st July 2024 Rev 1, 03rd Oct 2024 Rev 2
REPORT NUMBER:	20241392(2)
DOCUMENT VERSION:	Document Ver. 002
REVIEWERS:	

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Document Amendment Record

Client: ***Starrus Eco Holdings Ltd***

Title: **ODOUR IMPACT ASSESSMENT OF PROPOSED EXTENSION TO STARRUS ECO HOLDINGS LTD FACILITY LOCATED IN BALLYBEG, LITTLETON, THURLES, CO TIPPERARY.**

Project Number: 20241392(2)			**Document Reference:** ODOUR IMPACT ASSESSMENT OF PROPOSED EXTENSION TO STARRUS ECO HOLDINGS LTD FACILITY LOCATED IN BALLYBEG, LITTLETON, THURLES, CO TIPPERARY.		
20241392(1)	Document for review	BAS	JWC	BAS	01/07/2024
20241392(2)	Minor amendment	JOC	BAS	BAS	03/10/2024
Revision	**Purpose/Description**	**Originated**	**Checked**	**Authorised**	**Date**

1. Executive Summary

Odour Monitoring Ireland Ltd was commissioned by Starrus Eco Holdings Ltd to carry out an odour impact assessment of odour emissions from their proposed extension to the existing Composting facility located in Ballybeg, Littleton, Co. Tipperary. The purpose of this assessment was to determine the potential odour impact of the proposed operational facility on the surrounding population and to ascertain the levels of required odour mitigation to reduce odour impact on the surrounding population. Considered odour mitigation measures are proposed but these can change to alternative methods as long as the same or better outcomes are achieved by alternative proposed methods.

Following a site assessment utilising odour sampling and analysis techniques, one odour emission dataset was developed to determine the potential odour impact from the proposed operational Composting facility. These included:

Ref Scenario 1: Predicted overall odour and Ammonia emission rate from proposed Composting facility during routine operation (*see Table 4.1*) – **Model 1, 2 and 3.**

Details of Scenario 1 – Model 1, 2 and 3 are described in *Section 3.2*.

Aermod Prime (22112) was used to determine the overall odour impact of the proposed Composting facility operations and the odour reduction effect following the implementation of odour mitigation as set out in odour impact criteria presented in *Section 3.5*. The output data was analysed to calculate:

Proposed site operation

- **Ref Scenario 1 - Model 1** - Predicted odour emission contribution of overall proposed Composting facility following the implementation of odour mitigation (*see Table 4.1*), to odour plume dispersal at the 98th percentile for an odour concentration of less than or equal to 3.0 and 6.0 Ou_E/m^3 (*see Figure 7.2)*.

- **Ref Scenario 1 - Model 2** - Predicted Ammonia emission contribution of overall proposed Composting facility following the implementation of Ammonia mitigation (*see Table 4.1*), to Ammonia plume dispersal at the 100th percentile for an Ammonia concentration of less than or equal to 300 µg/m^3 (*see Figure 7.3*).

- **Ref Scenario 1 - Model 3** - Predicted Ammonia emission contribution of overall proposed Composting facility following the implementation of Ammonia mitigation (*see Table 4.1*), to Ammonia plume dispersal for the Annual average for an Ammonia concentration of less than or equal to 10 µg/m^3 (*see Figure 7.4*).

These computations give the odour concentration at each Cartesian grid receptor location that is predicted to be exceeded for 2% (175 hours of exceedance) over 5 years of screened hourly sequential meteorological data (Oak Park 2016 to 2020 inclusive). The Cartesian receptor grid was 20 m,100 m and 250 m spaced given a total receptor number of 1,910 over an area of 36 km^2.

The following conclusions were gathered from the study:

1. The Odour and Ammonia dispersion modelling assessment were carried out in line with recommended guidance include EPA AG4. Dispersion modelling assessment was carried out utilising the latest USEPA regulatory model Aermod Prime 22112 with five years of hourly sequential meteorological data and appropriate topographical data for the site and surrounding area.

2. With regards to the proposed Odour and Ammonia emission rate for the proposed Acorn Recycling Composting facility, the overall odour and Ammonia emission rate were 24,694 Ou_E/s and 0.176 g/s, respectively.

3. With regards to Scenario 1 – Model 1– Proposed operations, as can be observed, it is predicted that the levels of odours from the proposed Acorn Recycling facility will be less than the guideline limit value of less than or equal to 3.0 Ou_E/m^3 for the 98^{th} percentile of hourly averages. Residential receptors located in the vicinity of the operational facility will experience odour levels less than the proposed limit value (*see Figure 7.3*). With regards to detectable odour levels, residential receptors will perceive maximum odour levels up to 2.80 Ou_E/m^3 for the 98^{th} percentile of hourly averages for worst case meteorological year Oak Park 2017. This is within the proposed odour impact criterion of less than or equal to 3.0 Ou_E/m^3 for the 98^{th} percentile of hourly averages for worst case meteorological year Oak Park 2017 for proposed operations.

4. With regards to Scenario 1 – Models 2 and 3 – Proposed operations, as can be observed, it is predicted that the levels of Ammonia from the proposed Acorn Recycling facility is small and not likely to generate air quality impact in the vicinity of the facility. Residential receptors located in the vicinity of the operational facility will experience Ammonia levels less than or equal to 106.3 µg/m^3 for the max 1-hour average of hourly sequential met data. This is well within the Ammonia concentration limit value fort he protection of human health. An Annual average ground level concentration value was computed. The predicted ground level concentration value of Ammonia for the Annual average GLC was less than 1.6 µg/m^3 and 0.0219 µg/m^3 for the worst-case receptor and habitats location, respectively. These are well within the guideline limits values for < 280 µg/m^3 and 1 µg/m^3.

2. Introduction

Odour Monitoring Ireland Ltd was commissioned by Starrus Eco Holdings Ltd to perform an odour impact and dispersion modelling assessment of the operational Acorn Recycling Composting facility utilising odour sampling techniques and dispersion modelling software Aermod Prime (22112). Like the majority of facilities, the operation of the facility is faced with the issue of preventing odours causing impact to the public at large.

Following on from the assessment of the existing facility, the impact of proposed considered odour mitigation technique. The impact on perceived odour concentration levels in the vicinity of the facility were assessed utilising dispersion modelling impact assessment and impact reductions were compared against acceptable odour guideline limit values. Dispersion modelling assessment was carried out in accordance with EPA guidance AG4 (EPA, 2019).

One odour emission scenario was developed to take account of the routine operations in the proposed facility. This odour emission rate and specified source characteristics were inputted into Aermod Prime dispersion model (22112) in order to determine the overall odour impact at and/or beyond the boundary of the facility.

This assessment was performed in accordance with currently recommended international guidance and practice for the assessment of odours (Environment Agency H4 and Irish EPA AG4 guidance documents).

This report will present the Materials and Methods, Results and Discussion, Conclusions and high level considered recommendations gathered throughout the assessment.

3. Materials and Methods

This section will describe the materials and methods used for the odour sampling and dispersion modelling assessment.

3.1. Odour sampling and analysis

This section will provide the materials and methods used to sample and analyse odours from the operational Composting facility.

3.1.1. Odour sampling

Point sampling and Area flux monitoring

In order to obtain air samples for odour assessment, a static sampling method was used where air samples were collected in 40 to 60 litre pre-conditioned Nalophan^{NA} bags using a vacuum sampling device over a 15/20 minute period. The sampler operates on the 'lung principle', whereby the air is removed from a rigid container around the bag by a battery powered SKC vacuum pump at a rate of 4 *l* min^{-1}. This caused the bag to fill through a stainless steel and PTFE tube whose inlet is placed in source air, with the volume of sample equal to the volume of air evacuated from the rigid container. All odour-sampling bags were pre-conditioned and flushed with odourous air to remove any interference from the sample material.

Area sampling

In order to measure the flux odour emission rate from area odour surfaces located within the Waste Water Treatment Plant, a calibrated wind tunnel method was used. This calibrated sampling hood allowed for the accurate determination of odour emission rate from the surface of the tanks. In combination with the point source static sampling method, a 60-litre sample over a fifteen to twenty-minute period was obtained (Jiang et al., 2002). Area source mass emission rates/flux was presented as $Ou_E/m^2/s^1$.

3.1.2. Olfactometry

Olfactometry using the human sense of smell is the most valid means of measuring odour (Dravniek et al, 1986) and at present is the most commonly used method to measure the concentration of odour in air (Hobbs et al, 1996). Olfactometry is carried out using an instrument called an olfactometer. Three different types of dynamic dilution olfactometers exist:

- Yes/No Olfactometer
- Forced Choice Olfactometer
- Triangular Forced Choice Olfactometer.

In the dynamic dilution olfactometer, the odour is first diluted and is then presented to a panel of screened panellists of no less than four (CEN, 2003) Panellists are previously screened to ensure that they have a normal sense of smell (Casey et al., 2003). According to the CEN standard this screening must be performed using a certified reference gas *n*-butanol. This screening is applied to eliminate anosmia (low sensitivity) and super-noses (high sensitivity). The odour analysis has to be undertaken in a low odour environment such as an air-conditioned odour free laboratory. Analysis should be performed within 30 hours of sampling.

3.1.3. Odour measurement in accordance with the EN13725:2003

An ECOMA TO8 dynamic yes/no olfactometer was used throughout the measurement period to determine the odour threshold concentration of the sample air. The odour threshold concentration is defined as the dilution factor at which 50% of the panel can just detect the odour. Only those panel members who pass screening tests with n-butanol (certified reference gas, CAS 72-36-3) and who adhered to the code of behaviour were selected as panellists for olfactometry measurements (CEN, 2003). Odour measurement was carried out in an odour free laboratory in accordance with EN13725:2003. The analyses were carried out in the laboratory of Odour Monitoring Ireland Ltd in Trim Co. Meath.

3.1.4. What is an odour unit?

The odour concentration of a gaseous sample of odourant is determined by presenting a panel of selected screened human panellists with a sample of odourous air and varying the concentration by diluting with odourless gas, in order to determine the dilution factor at the 50% detection threshold. The Z_{50} value (threshold concentration) is expressed in odour units (Ou_E m^{-3}).

The European odour unit is that amount of odourant(s) that, when evaporated into one cubic metre of neutral gas (nitrogen), at standard conditions elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM) evaporated in one cubic meter of neutral gas at standard conditions. One EROM is that mass of a substance (n-butanol) that will elicit the Z_{50} physiological response assessed by an odour panel in accordance with this standard. *N*-Butanol is one such reference standard and is equivalent to 123µg of n-butanol evaporated in one cubic meter of neutral gas at standard conditions (CEN, 2003).

3.1.5. Odour and Ammonia emission rate calculation.

The measurement of the strength of a sample of odourous air is, however, only part of the problem of quantifying odour. Just as pollution from a stack is best quantified by a mass emission rate, the rate of production of an odour is best quantified by the odour emission rate. For a chimney or ventilation stack, this is equal to the odour threshold concentration (Ou_E/m^3) of the discharge air multiplied by its flow-rate (m^3/s^1). It is equal to the volume of air contaminated every second to the threshold odour limit (Ou_E/s^1). For an area odour source, this is equal to the odour emission flux ($Ou_E/m^2/s$) multiplied by the total surface area (m^2) of the odour source to provide an odour emission rate in Ou_E/s.

The odour and Ammonia emission rate is used in conjunction with the dispersion model to generate odour / Ammonia concentration contours for comparison with the proposed guideline limit values for the proposed facility operations. It will also estimate the approximate radius of impact for the existing and proposed facility (Hobson et al, 1995).

The overall odour and Ammonia emission rates for the proposed Scenario 1 are presented in *Table 4.1*.

3.2. Model assumptions

The following model assumptions were used to construct and generate the output results from the dispersion model. These include:

- The input data used within the dispersion model was obtained from engineering design specifications supplied by the client. The total treatment capacity of the proposed biofilter will be 127,000 Nm^3/hr. The exhaust odour threshold concentration will be no greater than 700 Ou_E/m^3.

- One assessment scenario was assessed to take account of client requirements.

<u>Proposed site operation</u>

  - **Ref Scenario 1 - Model 1** - Predicted odour emission contribution of overall proposed operational Composting facility during routine operation (*see Table 4.1*), to odour plume dispersal at the 98th percentile for an odour concentration of less than or equal to 3.0 and 6.0 Ou_E/m^3 (*see Figure 7.2*).
  - **Ref Scenario 1 - Model 2** - Predicted Ammonia emission contribution of overall proposed Composting facility following the implementation of Ammonia mitigation (*see Table 4.1*), to Ammonia plume dispersal at the 100th percentile for an Ammonia concentration of less than or equal to 300 $\mu g/m^3$ (*see Figure 7.3*).
  - **Ref Scenario 1 - Model 3** - Predicted Ammonia emission contribution of overall proposed Composting facility following the implementation of Ammonia mitigation (*see Table 4.1*), to Ammonia plume dispersal for the Annual average for an Ammonia concentration of less than or equal to 10 $\mu g/m^3$ (*see Figure 7.4*).

- AERMOD Prime (22112) dispersion model was used to assess the predicted odour concentrations on the surrounding area. This is the latest USEPA regulatory model.

- Five years of hourly sequential meteorological data was screened within the dispersion model in order to provide statistical sound predictions for the impact assessment. Oak Park 2016 to 2020 inclusive was used for the operation of the dispersion model while Oak Park 2017 was determined as worst-case impact year. This is in keeping with current national and international recommendations (EPA Guidance AG4 and Environment Agency). In addition, AERMOD incorporates a meteorological pre-processor AERMET PRO. The AERMET PRO meteorological preprocessor requires the input of surface characteristics, including surface roughness (z0), Bowen Ratio and Albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. The values of Albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc.) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the meteorological station for Bowen Ratio and Albedo and to a distance of 1km for surface roughness in line with USEPA recommendations

- The 98th percentile of maximum hourly predicted concentrations was used to provide the output data from the odour dispersion model. The 100th percentile and Annual average of maximum hourly predicted concentrations was used to provide the output data from the Ammonia dispersion model.

- Emissions to the atmosphere from the operations were assumed to occur 24 hours each day / 7 days per week over a standard year at 100% output for all sources.

- All building wake affects were assessed within the dispersion model especially given the nature of the structures located within the Composting facility. USEPA regulatory model BPIP 04274 was utilised.

- Terrain effects were accounted within the dispersion model using AERMAP software and digital data from the client and OSI (10 m spaced). This provided accurate topographical profile of the surrounding area inside and outside the site boundary

- Flagpole receptors were established at an elevation of 1.8 m above ground level in order to take account of average breathing level of receptors.

- 40 Individual sensitive receptors were also incorporated within the dispersion modelling assessment for indicative purposes. Results at each of these sensitive receptors are presented in *Section 5* of this report for the proposed assessment scenarios.

3.3. Dispersion modelling assessment

3.3.1. Atmospheric dispersion modelling of odours: What is dispersion modelling?

Any material discharged into the atmosphere is carried along by the wind and diluted by wind turbulence, which is always present in the atmosphere. This process has the effect of producing a plume of air that is roughly cone shaped with the apex towards the source and can be mathematically described by the Gaussian equation. Atmospheric dispersion modelling has been applied to the assessment and control of odours for many years, originally using Gaussian form ISCST 3 and more recently utilising advanced boundary-layer physics models such as ADMS and AERMOD (Keddie et al. 1992). Once the odour emission rate from the source is known, ($Ou_E\ s^{-1}$), the impact on the vicinity can be estimated. These models can effectively be used in three different ways: firstly, to assess the dispersion of odours and to correlate with complaints; secondly, in a “reverse” mode, to estimate the maximum odour emissions which can be permitted from a site in order to prevent odour complaints occurring; and thirdly, to determine which process is contributing greatest to the odour impact and estimate the amount of required abatement to reduce this impact within acceptable levels (McIntyre et al. 2000). In this latter mode, models have been employed for imposing emission limits on industrial processes, odour control systems and intensive agricultural processes (Sheridan et al., 2002).

3.3.2. AERMOD Prime

The AERMOD model was developed through a formal collaboration between the American Meteorological Society (AMS) and U.S. Environmental Protection Agency (U.S. EPA). AERMOD is a Gaussian plume model and replaced the ISC3 model in demonstrating compliance with the National Ambient Air Quality Standards (Porter et al., 2003) AERMIC (USEPA and AMS working group) is emphasizing development of a platform that includes air turbulence structure, scaling, and concepts; treatment of both surface and elevated sources; and simple and complex terrain. The modelling platform system has three main components: AERMOD, which is the air dispersion model; AERMET, a meteorological data pre-processor; and AERMAP, a terrain data pre-processor (Cora and Hung, 2003).

AERMOD is a Gaussian steady-state model which was developed with the main intention of superseding ISCST3 (NZME, 2002). The AERMOD modeling system is a significant departure from ISCST3 in that it is based on a theoretical understanding of the atmosphere rather than depend on empirical derived values. The dispersion environment is characterized by turbulence theory that defines convective (daytime) and stable (nocturnal) boundary layers instead of the stability categories in ISCST3. Dispersion coefficients derived from turbulence theories are not based on sampling data or a specific averaging period. AERMOD was especially designed to support the U.S. EPA's regulatory modeling programs (Porter at al., 2003)

Special features of AERMOD include its ability to treat the vertical in-homogeneity of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources, a three-plume model for the convective boundary layer, limitation of vertical mixing in the stable boundary layer, and fixing the reflecting surface at the stack base (Curran et al., 2006). A treatment of dispersion in the presence of intermediate and complex terrain is used that improves on that currently in use in ISCST3 and other models, yet without the complexity of the Complex Terrain Dispersion Model-Plus (CTDMPLUS) (Diosey et al., 2002).

3.4. Odour and Ammonia impact criterion

The predicted air quality impact from the operation of the Composting facility is compared to relevant odour and air quality objectives and limits. Air quality standards and guidelines referenced in this report include:

- Irish EPA 2002 and Environment Agency 2002 Guideline limit of less than 6.0 and 3.0 Ou_E/m^3 at the 98^{th} percentile of hourly averages for medium risk odours –Proposed.
- EPR H1 (2008) – Environmental Risk Assessment Part 1 – Simple assessment of environmental risk for accidents, odour, noise and fugitive emissions.
- EPR H1 (2008) - Environmental Risk Assessment Part 2 – Assessment of point source release and cost benefit analysis.
- Irish EPA Guidance document (2020) – Air Dispersion Modelling from Industrial Installations Guidance Note (AG4).

Air quality is judged relative to the relevant Air Quality Standards, which are concentrations of pollutants in the atmosphere, which achieve a certain standard of environmental quality. Air quality Standards are formulated on the basis of an assessment of the effects of the pollutant on public health and ecosystems.

In general terms, air quality standards have been framed in two categories, limit values and guideline values. Limit values are concentrations that cannot be exceeded and are based on WHO guidelines for the protection of human health. Guideline values have been established for long-term precautionary measures for the protection of human health and the environment. European legislation has also considered standards for the protection of vegetation and ecosystems.

Where ambient air quality criteria do not exist as in the case for some of the substances of interest, it is usual to use 1/100th of the occupational exposure limit (OEL) for an eight-hour reference period to compare with the annual average predictions. The one-hour predictions are generally compared with a standard derived from 1/40th of the Short-Term Exposure Limit (STEL). Occupational exposure limits are published by the Occupational Safety and Heath Authority (i.e. EH 40).

The relevant air quality standards are presented in *Table 3.1*.

With regards to Ammonia impact assessment, the output from the dispersion model will be assessed against the following:

- The limit value of less than 2,700 $\mu g/m^3$ at the 100th percentile of hourly averages should be utilised to provide protection against Ammonia impact at residential receptors.
- The limit value of less than 1 and 3 $\mu g/m^3$ for an Annual average should be utilised to provide protection against Ammonia impact at Natura sites.

3.4.1 Air Quality Guidelines for air pollutants in Ireland

Table 3.1 illustrates the guideline and limit values for air quality pollutants in Ireland.

Table 3.1. Limit and guideline values laded out in AG4 and EPR H1 Parts 1 and 2.

POLLUTANT	Objective			
	Concentration	**Maximum No. Of exceedances allowed**	**Exceedance expressed as percentile**	**Measured as**
Ammonia1	3,600 µg m^{-3} NH_3 280 µg m^{-3} NH_3 3 µg m^{-3} NH_3 1 µg m^{-3} NH_3	-- Critical level – Higher plants1 Critical level –Sensitive lichens etc.[1]	100th percentile Annual mean -- --	1 hour mean Annual mean Annual mean Annual mean
Odours[2]	less than or equal to 3.0 Ou_E/m^3	175 times in a year	98th percentile	1 hour mean

Notes: [1] denotes EPR H1 (2008) – Environmental Risk Assessment Part 1 – Simple assessment of environmental risk for accidents, odour, noise and fugitive emissions and EPR H1 (2008) - Environmental Risk Assessment Part 2 – Assessment of point source release and cost benefit analysis.
[2] denotes – Guidance for Operators on Odour Management at Intensive Livestock IPPC installations, Version 2, May 2006. pg 24, and AG4

3.5. Meteorological data.

Oak Park met station 2016 to 2020 inclusive was used for the operation of Aermod Prime 22112. This allowed for the determination of dispersion for 5 years of meteorological data for the determination of overall odour impact from the existing and proposed Composting facility operations at and/or beyond the boundary of the facility.

Section 9 presents the windrose and tabular statistics for Oak Park meteorological station for years 2016 to 2020 inclusive.

3.6. Terrain data.

Topography affects within and in the vicinity of the site were accounted for in the model utilising topo data as gathered by the client and from Ordnance Survey Ireland (i.e. 0.50m and 10 m spaced). A 0.50 m grid spacing was required in order to take account of the significant topographical features located within the boundary of the facility.

All building wake effects are accounted for in the modelling scenario (i.e. building effects on point sources) as this can have a major effect on the odour plume dispersion at short distances. This was performed using the BPIP Prime algorithm 04247 within the dispersion model.

4. Results

This section will present the results obtained from the odour and Ammonia dispersion modelling study.

4.1. Odour and Ammonia emission dataset for Scenario 1 – Model 1, 2 and 3

One data set for Odour and Ammonia emission rates were calculated to determine the potential Odour and Ammonia impact of the proposed operational Acorn Recycling Composting facility utilising Odour and Ammonia emission data. These scenarios include:

Ref Scenario 1: Predicted overall odour and Ammonia emission rate from proposed Composting facility during routine operation (*see Table 4.1*) – **Model 1, 2 and 3.**

Aermod Prime (22112) was used to determine the overall odour impact of the proposed Acorn Recycling Composting facility as set out in Odour and Ammonia impact criteria's presented in *Section 3.4.*

Table 4.1 illustrates the Odour and Ammonia emission input data calculated and utilised within the dispersion model for Scenario 1 Models 1, 2 and 3 – Proposed Acorn Recycling Composting facility following the implementation of proposed odour mitigation.

The measured overall odour emission rate from the proposed Acorn Recycling Composting facility was 24,694 Ou_E/s.

Table 4.1. Proposed Odour and Ammonia emission rates for proposed Starrus Eco Holdings Ltd .

Parameter	**Value**
X coordinate (m)	618899.4
y coordinate (m)	651952.9
Finish floor level (m)	119
Above ground level height (m)	120
Total treatment volume (Nm^3/hr, 273.15K, 101.3KPa, wet gas)	**127,000**
Total biofilter surface area (m^2)	2,060
Efflux velocity (m/s)	0.017125
Receptor height (m)	1.8
Worst case building height (m)	11.336
Odour limit value (Ou_E/m^3)	**700**
Ammonia limit value (mg/Nm^3)	**5**
Odour emission rate (Ou_E/s)	**24,694**
Ammonia emission rate (g/s)	**0.1764**

With regards to the odour and Ammonia emission rate for the proposed Acorn Recycling Composting facility, the overall odour and Ammonia emission rate was 24,694 Ou_E/s and 0.1764 g/s during routine operations. With regards to the odour and Ammonia mitigation techniques, the overall facility biofilter will be extended to a total surface area of 2,060 m^2. Based on estimated bed volume size, the overall retention time of gas within the filter will be circa 75 sec.

4.2. Results of Odour / Ammonia dispersion modelling for Scenario 1 – Model 1, 2 and 3

Aermod Prime (22112) was used to determine the overall Odour and Ammonia impact of the proposed Acorn Recycling Composting facility as set out in the impact criteria in *Section 3.4*. The output data was analysed to calculate:

Proposed site operation

- **Ref Scenario 1 - Model 1** - Predicted odour emission contribution of overall proposed Composting facility following the implementation of odour mitigation (*see Table 4.1*), to odour plume dispersal at the 98th percentile for an odour concentration of less than or equal to 3.0 and 6.0 Ou_E/m^3 (*see Figure 7.2)*.

- **Ref Scenario 1 - Model 2** - Predicted Ammonia emission contribution of overall proposed Composting facility following the implementation of Ammonia mitigation (*see Table 4.1*), to Ammonia plume dispersal at the 100th percentile for an Ammonia concentration of less than or equal to 300 $\mu g/m^3$ (*see Figure 7.3*).

- **Ref Scenario 1 - Model 3** - Predicted Ammonia emission contribution of overall proposed Composting facility following the implementation of Ammonia mitigation (*see Table 4.1*), to Ammonia plume dispersal for the Annual average for an Ammonia concentration of less than or equal to 10 $\mu g/m^3$ (*see Figure 7.4*).

These computations give the odour concentration at each Cartesian grid receptor location that is predicted to be exceeded for 2% (175 hours of exceedance) and 0.5% (44 hours of exceedance) over 5 years of screened hourly sequential meteorological data (Oak Park 2016 to 2020 inclusive). The Cartesian receptor grid was 20 and 100 m spaced given a total receptor number of 1,918 over an area of 1.96 km^2.

This will allow for the predictive analysis of any potential impact on the neighbouring sensitive locations while the facility is in operation. It will also allow the operators of the facility site to assess the effectiveness of their odour abatement/minimisation strategies. The intensity of the odour from two or more sources from the facility operation will depend on the strength of the initial odour threshold concentration from the sources and the distance downwind at which the prediction and/or measurement is being made. Where the odour emission plumes from a number of sources combine downwind, then the predicted odour concentrations may be higher than that resulting from an individual emission source. It is important to note that various odour sources have different odour characters. This is important when assessing those odour sources to minimise and/or abate. Although an odour source may have a high odour emission rate, the corresponding odour intensity (strength) may be low and therefore it is easily diluted. Those sources that express the same odour character, as an odour impact should be investigated first for abatement/minimisation before other sources are examined as these sources are the driving force behind the character of the perceived odour.

5. Discussion of results

This section will discuss the results obtained during the dispersion modelling study.

5.1. Odour plume dispersal for Scenario 1 – Model 1

The plotted odour concentrations of ≤ 3.0 Ou_E m^{-3} for the 98th percentile of hourly averages for the worst-case meteorological year Oak Park 2017 for the proposed Composting facility is illustrated in *Figure 7.2*. Model 1 include the odour contour representation of less than or equal to 3.0 and 6.0 Ou_E/m^3 contours, respectively.

With regards to the odour impact from the proposed Acorn Recycling Composting facility, the odour plume spread is approximately 300 to 600 m radial spread from the boundary of the operational facility. All receptors will perceive odour concentrations less than the guideline odour limit values of 3.0 Ou_E/m^3 for the 98th percentile of hourly averages for meteorological year Oak Park 2017 (*see Figure 7.2*).

A number of discrete sensitive receptors were incorporated into the model (R1 to H7). All sensitive receptors will perceive odour concentrations less than 3.0 Ou_E/m^3 for the 98th percentile of hourly averages for the worst-case meteorological year Oak Park 2017. *Table 5.1* presents the predicted odour concentration at each of these receptor locations for each of the Model Scenario 1 and also the maximum predicted odour level at all screened sensitive receptors.

5.2. Ammonia plume dispersal for Scenario 1 – Model 2 and 3

The plotted Ammonia concentrations of ≤ 300 $\mu g/m^{-3}$ for the 100th percentile 1 hour max for the worst-case meteorological year Oak Park 2017 for the proposed Composting facility is illustrated in *Figure 7.3*. As can be observed, the plume spread is radial with the plume spread distances of up to 250m. All sensitive receptors will perceive an ambient air concentration of Ammonia of less than 106.3 $\mu g/m^3$. The Annual average ground level concertation of Ammonia can be observed in *Figure 7.4*. As can be observed, all sensitive receptors in the vicinity of the facility will perceive an Ammonia concentration less than 1.6 $\mu g/m^3$. All screened Habitats receptors will perceive Ammonia concentration of less than 0.0219 $\mu g/m^3$, which is 2.188% of the worst-case ground level impact criterion.

Table 5.1. Predicted ground level odour concentrations at identified sensitive receptors located in the vicinity of Acorn Recycling Composting facility for Scenario 1 Model 1 and Scenario 2 Model 2.

Receptor ID	X coordinate (m)	Y coordinate (m)	Predicted 98th %ile GLC for Odour (Ou_E/m^3)	Predicted max 1 hr GLC for NH_3 ($\mu g/m^3$)	Predicted max Annual average GLC for NH_3 ($\mu g/m^3$)
R1	619248	652109	1.7	106.3	1.2
R2	619314	652190	1.2	92.7	0.8
R3	619329	652058	1.5	100.0	1.1
R4	619362	652064	1.4	96.4	1.0
R5	619356	651751	2.4	90.4	1.3
R6	618738	652461	2.8	82.9	1.6
R7	618696	652473	2.7	86.7	1.5
R8	618556	651475	0.4	102.7	0.5
R9	618621	652530	2.4	79.1	1.2
R10	618482	652489	2.3	77.4	1.0
R11	619624	652019	0.9	83.7	0.6
R12	619616	651795	1.1	56.0	0.6
R13	618442	652628	1.8	72.2	0.9
R14	618475	652663	1.6	74.8	0.8
R15	618444	652671	1.6	77.6	0.8
R16	618372	652651	1.5	67.9	0.8
R17	619730	651670	1.0	59.6	0.5
R18	619763	651640	0.9	53.4	0.5
R19	619860	651781	0.6	35.0	0.4
R20	619846	651648	0.7	55.5	0.4
R21	617848	651580	0.1	50.4	0.2
R22	617818	651646	0.1	51.3	0.2
R23	618182	652734	1.0	60.7	0.6
R24	617777	651701	0.1	52.8	0.2
R25	619869	651631	0.7	51.7	0.4
R26	617962	652533	0.8	43.8	0.4
R27	617859	651657	0.1	54.6	0.2
R28	617751	651732	0.1	44.4	0.2
R29	617723	651772	0.1	48.4	0.2
R30	617692	651846	0.1	41.6	0.1
R31	617895	652574	0.7	40.8	0.4
C1	618143	652534	1.2	56.9	0.6
C2	617859	651514	0.1	49.1	0.1
H1	611082	655333	0.006	1.3	0.0079
H2	629622	645754	0.008	0.8	0.0067
H3	619333	647019	0.011	4.6	0.0219
H4	611501	651203	0.001	1.4	0.0024
H5	612092	659831	0.016	1.0	0.0101
H6	629624	657993	0.002	1.3	0.0028
H7	615751	638354	0.003	0.6	0.0052
Predicted worst case GLC at receptor ($\mu g/m^3$)	-	-	**2.8**	**106.3**	**1.6**
Predicted worst case GLC at habitats ($\mu g/m^3$)	-	-	0.016	4.649	0.0219
Limit value - Receptors	-	-	3.0	2,700	280.0
Limit value - Habitats	-	-	--	--	1
% of impact criteria for receptors	-	-	**92.8**	**3.9**	**0.0078**
% of impact criteria for habitats	-	-	-	-	**2.1885**

As can be observed in *Table 5.1*, the levels of odours predicted at a number of sensitive receptor locations are in excess of the proposed limit value for the existing facility operations and within the guideline limit value for the proposed facility operations.

6. Conclusions

The following conclusions were gathered from the study:

1. The Odour and Ammonia dispersion modelling assessment were carried out in line with recommended guidance include EPA AG4. Dispersion modelling assessment was carried out utilising the latest USEPA regulatory model Aermod Prime 22112 with five years of hourly sequential meteorological data and appropriate topographical data for the site and surrounding area.

2. With regards to the proposed Odour and Ammonia emission rate for the proposed Acorn Recycling Composting facility, the overall odour and Ammonia emission rate were 24,694 Ou_E/s and 0.176 g/s, respectively.

3. With regards to Scenario 1 – Model 1– Proposed operations, as can be observed, it is predicted that the levels of odours from the proposed Acorn Recycling facility will be less than the guideline limit value of less than or equal to 3.0 Ou_E/m^3 for the 98^{th} percentile of hourly averages. Residential receptors located in the vicinity of the operational facility will experience odour levels less than the proposed limit value (*see Figure 7.3*). With regards to detectable odour levels, residential receptors will perceive maximum odour levels up to 2.80 Ou_E/m^3 for the 98^{th} percentile of hourly averages for worst case meteorological year Oak Park 2017. This is within the proposed odour impact criterion of less than or equal to 3.0 Ou_E/m^3 for the 98^{th} percentile of hourly averages for worst case meteorological year Oak Park 2017 for proposed operations.

4. With regards to Scenario 1 – Models 2 and 3 – Proposed operations, as can be observed, it is predicted that the levels of Ammonia from the proposed Acorn Recycling facility is small and not likely to generate air quality impact in the vicinity of the facility. Residential receptors located in the vicinity of the operational facility will experience Ammonia levels less than or equal to 106.3 µg/m^3 for the max 1-hour average of hourly sequential met data. This is well within the Ammonia concentration limit value fort he protection of human health. An Annual average ground level concentration value was computed. The predicted ground level concentration value of Ammonia for the Annual average GLC was less than 1.6 µg/m^3 and 0.0219 µg/m^3 for the worst-case receptor and habitats location, respectively. These are well within the guideline limits values for < 280 µg/m^3 and 1 µg/m^3.

7. *Appendix I* – Odour and Ammonia dispersion modelling contour results

7.1. Facility layout and receptor locations

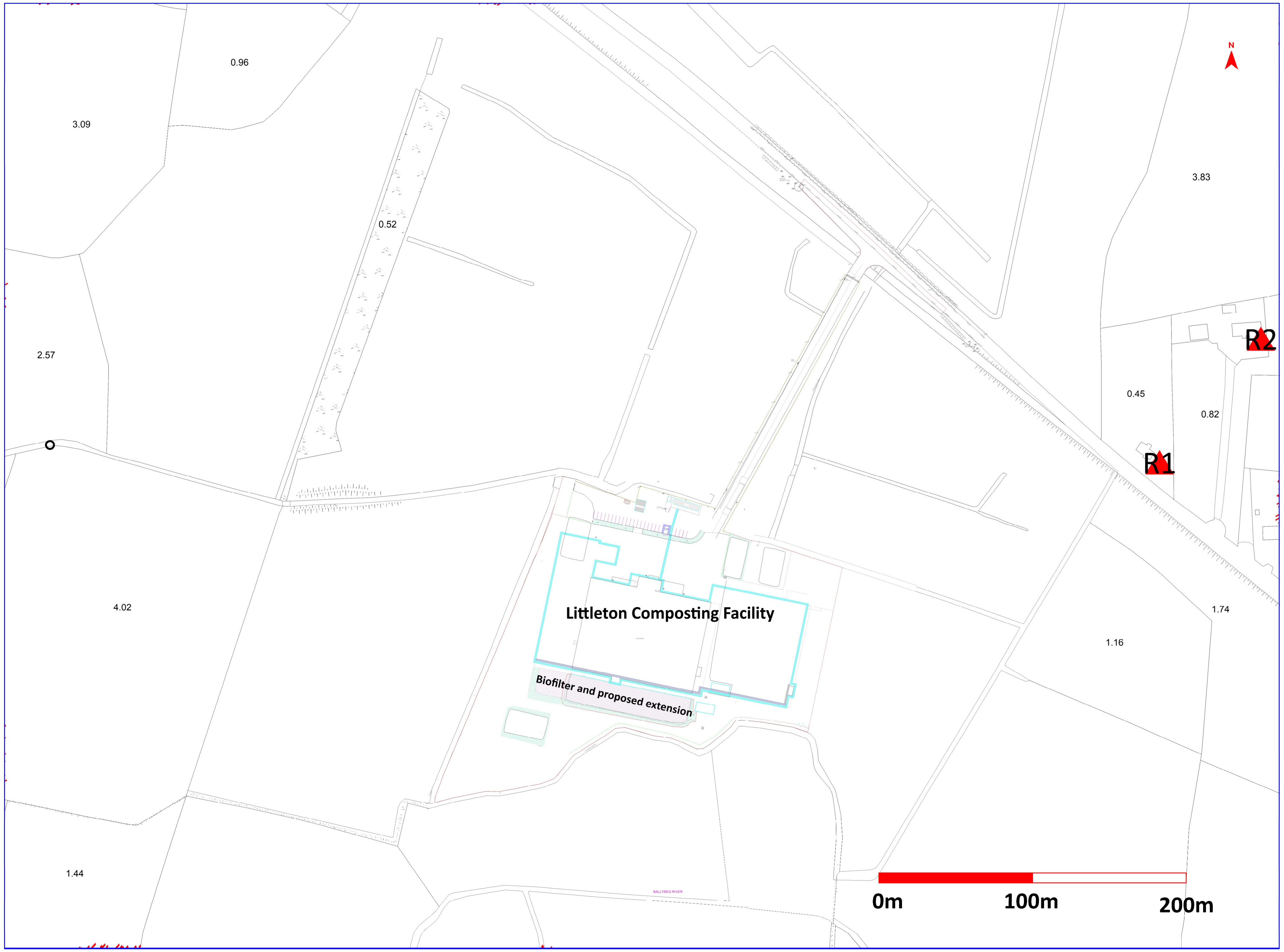

Figure 7.1. Acorn Recycling Composting facility layout and receptor locations.

7.2. Predicted odour contour plots for odour emissions for Scenario 1 – Model 1

Figure 7.2. Predicted odour emission contribution of proposed Acorn Recycling Composting facility odour sources for Model 1 to odour plume dispersal for an odour concentration of less than or equal to 3.0 Ou_E/m^3 (blue line) & 6.0 Ou_E/m^3 (green line) for the 98th percentile of hourly averages for worst case meteorological year Oak Park 2017.

7.3. Predicted Ammonia contour plots for Scenario 1 – Model 2 and 3

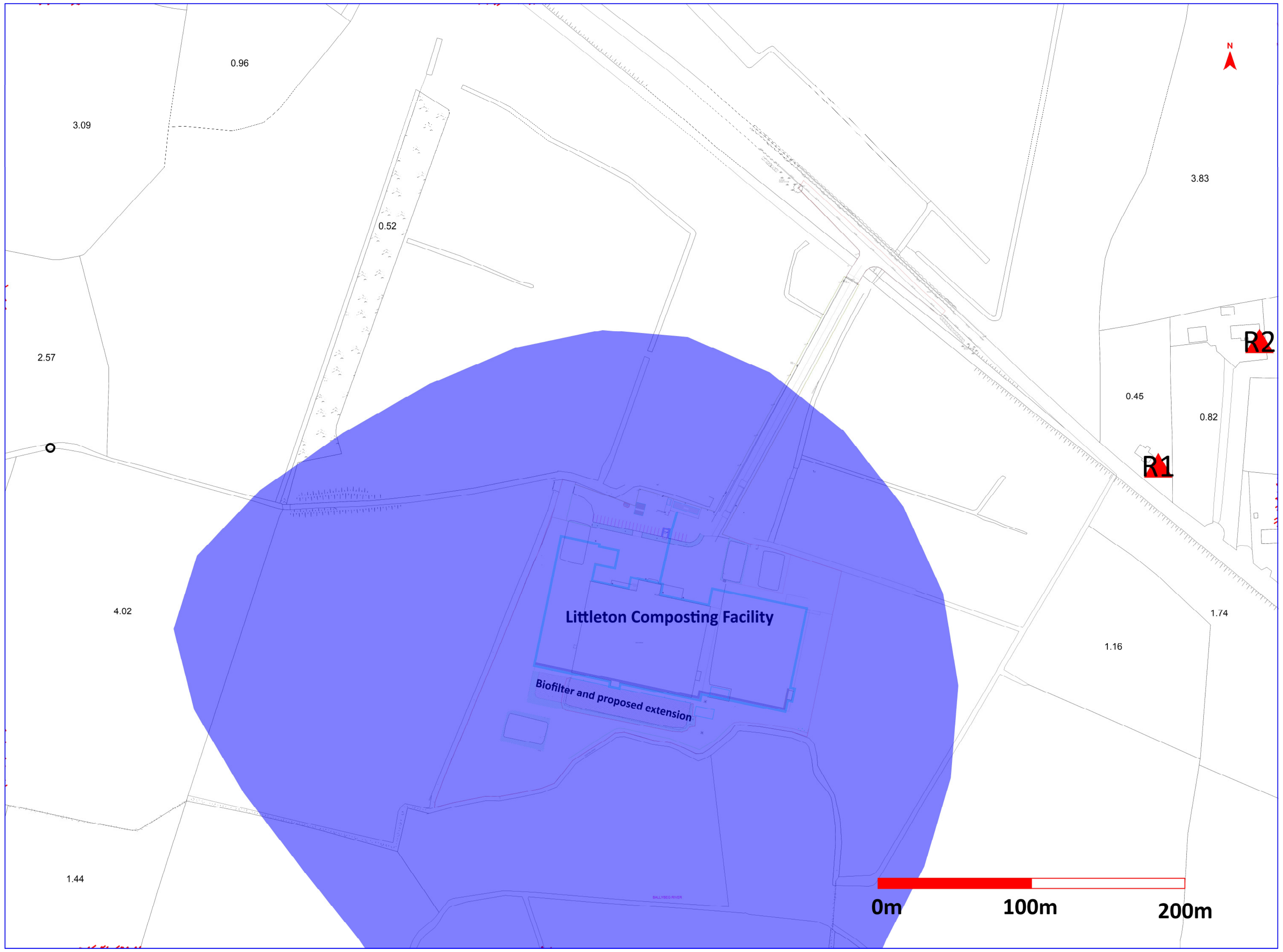

Figure 7.3. Predicted Ammonia emission contribution of proposed Acorn Recycling Composting facility Ammonia sources for Model 2 to Ammonia plume dispersal for an Ammonia concentration of less than or equal to 300µg/m³ (▬) for the 100th percentile of hourly averages for worst case meteorological year Oak Park 2017.

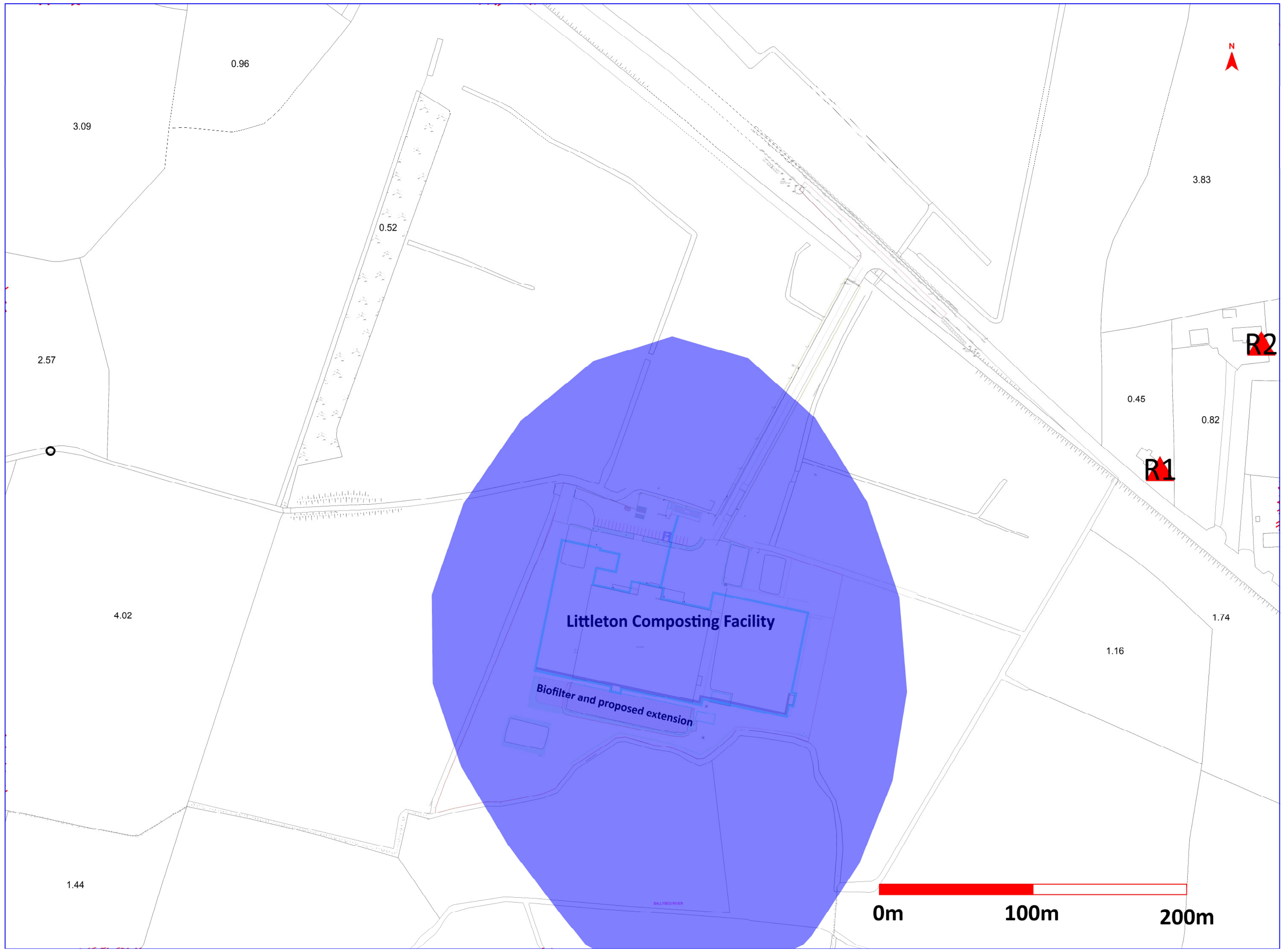

Figure 7.4. Predicted Ammonia emission contribution of proposed Acorn Recycling Composting facility Ammonia sources for Model 3 to Ammonia plume dispersal for an Ammonia concentration of less than or equal to 10µg/m³ (▬) for the Annual averages for worst case meteorological year Oak Park 2017.

8. References

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9. *Appendix III* - Meteorological data examined and used in the dispersion modelling exercise

Table 9.1. Tabular illustration of Oak Park meteorological files for Years 2016 to 2020 inclusive (5 years).

5-year Meteorological file for Oak Park 2016 to 2020 inclusive							
Dir \ Speed	**<= 1.54 m/s**	**<= 3.09 m/s**	**<= 5.14 m/s**	**<= 8.23 m/s**	**<= 10.80 m/s**	**> 10.80 m/s**	**Total**
0.0	1.64	1.12	1.61	0.39	0.02	0.00	4.78
22.5	1.32	0.43	0.67	0.18	0.00	0.00	2.60
45.0	0.73	0.24	0.37	0.12	0.00	0.00	1.47
67.5	0.74	0.31	0.50	0.13	0.00	0.00	1.68
90.0	0.79	0.44	0.78	0.11	0.01	0.00	2.12
112.5	1.25	0.93	1.21	0.21	0.01	0.00	3.60
135.0	2.44	2.34	3.01	1.14	0.14	0.02	9.09
157.5	1.99	2.66	3.58	1.56	0.32	0.06	10.16
180.0	1.04	1.79	6.76	3.92	0.89	0.22	14.60
202.5	0.66	0.78	3.94	2.05	0.49	0.14	8.05
225.0	0.48	0.55	2.14	1.18	0.34	0.12	4.82
247.5	0.59	0.67	2.42	1.82	0.54	0.19	6.23
270.0	1.02	1.05	3.59	2.67	0.56	0.16	9.05
292.5	1.54	1.38	2.95	1.38	0.23	0.05	7.55
315.0	1.61	1.76	2.12	0.42	0.01	0.00	5.92
337.5	1.69	2.39	3.56	0.49	0.01	0.00	8.14
Total	**19.54**	**18.84**	**39.20**	**17.77**	**3.56**	**0.96**	**99.87**
Calms	**-**	**-**	**-**	**-**	**-**	**-**	**0.13**
Missing	**-**	**-**	**-**	**-**	**-**	**-**	**0.00**
Total	**-**	**-**	**-**	**-**	**-**	**-**	**100.00**

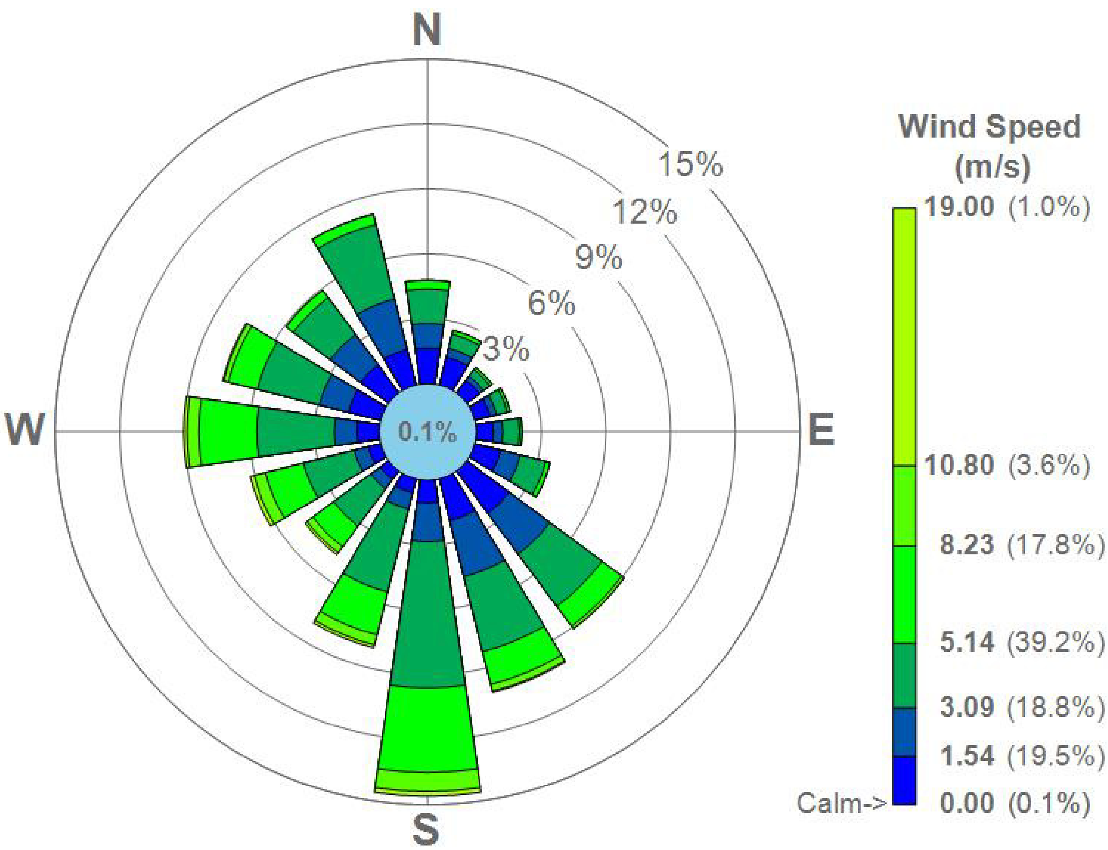

Figure 9.1. Windrose illustration of meteorological files Oak Park 2016 to 2020 inclusive.

10. *Appendix IV* – Grid extent

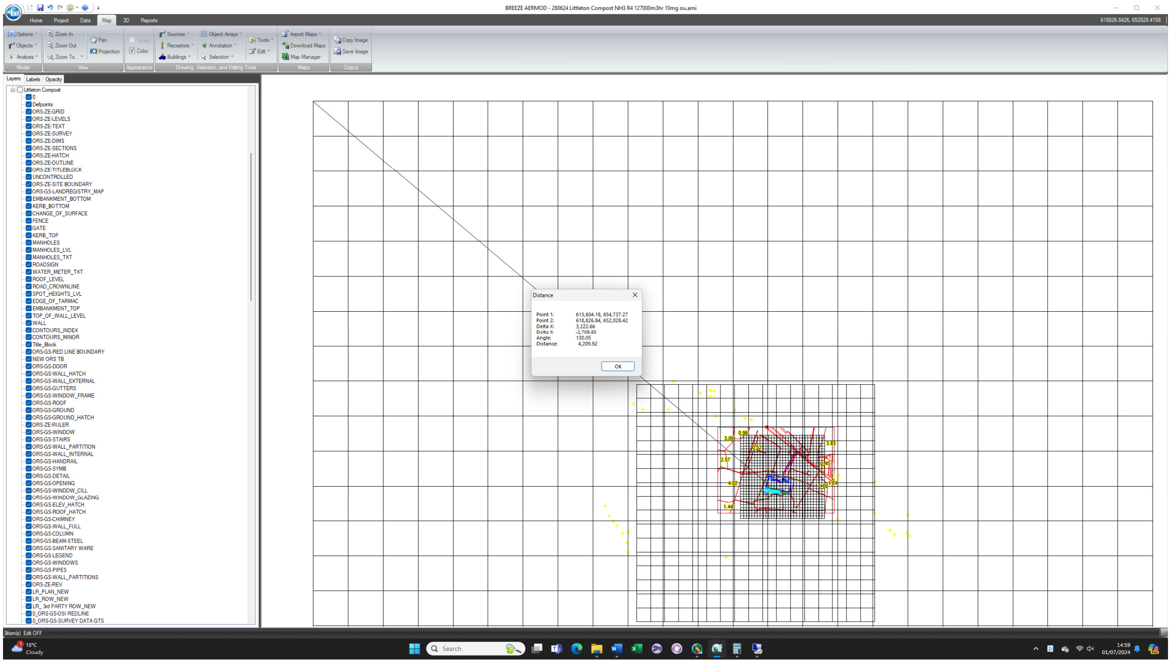

Figure 10.1. Grid extent.