Air Quality Assessment

Streetly Hall Farm, West Wickham

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Executive Summary

Redmore Environmental Ltd was commissioned by Streetly Hall Estate Partnership to undertake an Air Quality Assessment in support of a proposed Anaerobic Digestion plant at Streetly Hall Farm, West Wickham.

The plant has the potential to cause air quality impacts as a result of atmospheric emissions from activities on site. As such, an Air Quality Assessment was required in order to determine baseline conditions and quantify potential effects.

Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the plant. The results indicated that impacts on pollutant concentrations were not predicted to be significant at any human receptor location in the vicinity of the site.

Impacts were also predicted at sensitive ecological habitats. The results indicated that emissions from the plant were not predicted to significantly affect existing conditions at any designation either alone or in-combination with other plans and projects.

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1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by Streetly Hall Estate Partnership to undertake an Air Quality Assessment in support of a proposed Anaerobic Digestion (AD) plant at Streetly Hall Farm, West Wickham.

1.1.2 The facility has the potential to cause air quality impacts as a result of emissions from activities on site. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.

1.2 Site Location and Context

1.2.1 The proposed facility will be located on land at Streetly Hall Farm, West Wickham, at National Grid Reference (NGR): 560000, 248500. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The AD plant will utilise three fermenters and one post-fermenter to process the following feedstock types:

- Purpose grown crops (principally maize);
- Waste and non-waste crop residues; and,
- Animal manures/ slurries.

1.2.3 It is anticipated that approximately 70% of the feedstock will be sourced from Streetly Hall Farm, with the remainder obtained from local farms or industrial processing facilities. The plant will process between 60,000 and 75,000-tonnes per annum (tpa) of feedstock.

1.2.4 Purpose-grown crops such as maize will be delivered to the site using a tractor and trailer during typical harvest periods and deposited in three dedicated clamps. The clamps will be compacted and covered using protective plastic sheeting. This will form an airtight layer to minimise emissions and preserve the feedstock throughout the year. It should be noted that any decomposition of the material would affect its effectiveness as a feedstock. As such, the protective sheeting will be specified to prevent water and air reaching the material and hence avoid any unwanted breakdown with associated emissions. The cover on each clamp will be slightly open at both ends to allow access to the feedstock for transportation to the AD plant feed hoppers. Loading will occur twice a day, in the morning and evening.

1.2.5 Cattle manure will be stored in a clamp prior to transportation to the AD plant feed hoppers.

1.2.6 It is proposed to include two exposed feed hoppers on site. Only one will be operational at any one time with the other available as back-up.

1.2.7 The site will include a dedicated intake and processing building. This will receive poultry litter and straw bales. These will be stored and processed in a feed hopper contained within the building. Air will be extracted from the building at a rate equivalent to at least 3 air changes per hour (ac/hr) and transferred to an odour abatement system for treatment prior to exhaust to atmosphere. This arrangement will help to promote negative pressure within the structure and reduce the potential for fugitive emissions to atmosphere when doors are opened to allow access.

1.2.8 Biogas produced by the AD process will be upgraded on site to generate biomethane for export to national gas grid, as well as carbon dioxide (CO_2) which will be recovered for use in the food industry or sequestration off-site. A proportion of the biogas will be combusted within a Combined Heat and Power (CHP) unit to generate electricity and heat. Additionally, a proportion will be combusted in a Power to Heat (PTH) module to generate heat. A flare is also included at the plant for venting of biogas during abnormal operation.

1.2.9 The facility will produce liquid digestate which will be stored on site prior to removal for use in agriculture as a biofertiliser. This will be held in a covered storage lagoon before transfer off-site.

1.2.10 The AD plant may result in atmospheric emissions from a number of activities during normal operation. These have the potential to cause impacts at sensitive locations within the vicinity of the site and have therefore been assessed within this report.

2.0 LEGISLATION AND POLICY

2.1 Legislation

2.1.1 The Air Quality Standards Regulations (2010) and subsequent amendments include Air Quality Limit Values (AQLVs) for the following pollutants:

- Nitrogen dioxide (NO_2);
- Sulphur dioxide (SO_2);
- Lead;
- Particulate matter with an aerodynamic diameter of less than 10µm;
- Particulate matter with an aerodynamic diameter of less than 2.5µm ($PM_{2.5}$);
- Benzene; and,
- Carbon monoxide.

2.1.2 Air Quality Target Values were also provided for several additional pollutants. It should be noted that the AQLV for $PM_{2.5}$ stated in the Air Quality Standards Regulations (2010) was amended in the Environment (Miscellaneous Amendments) (EU Exit) Regulations (2020).

2.1.3 The Air Quality Strategy (AQS) was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published on 28th April 2023[1]. The document contains standards, objectives and measures for improving ambient air quality, including a number of AQOs. These are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedences over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

2.1.4 Table 1 presents the AQOs for pollutants considered within this assessment.

Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration (µg/m³)	Averaging Period
NO_2	40	Annual mean

[1] The AQS: Framework for Local Authority Delivery, DEFRA, 2023.

Pollutant	Air Quality Objective	
	Concentration (µg/m³)	Averaging Period
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum
SO_2	125	24-hour mean, not to be exceeded on more than 3 occasions per annum
	350	1-hour mean, not to be exceeded on more than 24 occasions per annum
	266	15-minute mean, not to be exceeded on more than 35 occasions per annum

2.1.5 Table 2 summarises the advice provided in DEFRA guidance[2] on where the AQOs for pollutants considered within this report apply.

Table 2 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean	All locations where the annual mean objective would apply, together with hotels Gardens of residential properties	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.

2 Local Air Quality Management Technical Guidance (TG22), DEFRA, 2022.

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
1-hour mean	All locations where the annual mean and 24-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer	-

2.2 Local Air Quality Management

2.2.1 Local Authorities (LAs) are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQOs. If it is predicted that levels at locations of relevant exposure, as summarised in Table 2, are likely to be exceeded, the LA is required to declare an Air Quality Management Area (AQMA). For each AQMA the LA is required to produce an Air Quality Action Plan, the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.3 Industrial Pollution Control Legislation

2.3.1 Atmospheric emissions from industry are controlled in the UK through the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. The operation of an AD plant is included within the Regulations. As such, the facility is required to operate in accordance with an Environmental Permit. Amongst conditions of operation are stated Emission Limit Values (ELVs) for various pollutants produced by the processes. Compliance with these conditions must be demonstrated through periodic monitoring requirements, which have been set in order to limit potential impacts in the surrounding area.

2.4 Critical Loads and Levels

2.4.1 A critical load is defined by the UK Air Pollution Information System (APIS)[3] as:

> "A quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"

2.4.2 A critical level is defined as:

> "Concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge"

2.4.3 A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

2.4.4 When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedence. A larger exceedence is often considered to represent a greater risk of damage.

2.4.5 Maps of critical loads and levels and their exceedences have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing the risk of damage. However, even a decrease in the exceedence may infer that less damage will occur.

2.4.6 Table 3 presents the critical levels for the protection of vegetation for pollutants considered within this assessment.

3 UK Air Pollution Information System, www.apis.ac.uk.

Table 3 Critical Levels for the Protection of Vegetation

Pollutant	Critical Level	
	Concentration (μg/m³)	Averaging Period
Oxides of nitrogen (NO_x)	30	Annual mean
	75	24-hour mean
SO_2	20	Annual mean for higher plants
	10	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity
Ammonia (NH_3)	3	Annual mean for higher plants
	1	Annual mean for sensitive lichen communities and bryophytes and ecosystems where lichens and bryophytes are an important part of the ecosystem's integrity

2.4.7 Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been identified for the relevant designations considered within the assessment in Section 3.5.

3.0 BASELINE

3.1 Introduction

3.1.1 Existing air quality conditions in the vicinity of the site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

3.2 Local Air Quality Management

3.2.1 As required by the Environment Act (1995), South Cambridgeshire District Council (SCDC) has undertaken Review and Assessment of air quality within their area of jurisdiction. This process has indicated that concentrations of all pollutants considered within the AQS are below the AQOs within the district. As such, no AQMAs have been designated.

3.3 Air Quality Monitoring

3.3.1 Monitoring of pollutant concentrations is undertaken by SCDC throughout their area of jurisdiction. The closest survey site to the proposed facility is approximately 4.5km south-west of the boundary. Due to the distance between the two locations, it is not considered likely that similar pollution levels would occur at these positions. As such, this source of data has not been considered further in the context of the assessment.

3.4 Background Pollutant Concentrations

3.4.1 Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist Local Authorities in their Review and Assessment of air quality. The site is located in grid square NGR: 560500, 248500. Data for this location was downloaded from the DEFRA website[4] for the purpose of the assessment and is summarised in Table 4.

Table 4 Background Pollutant Concentration Predictions

Pollutant	Predicted Background Pollutant Concentration (µg/m^3)
NO_2	5.98

4 http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html.

Pollutant	Predicted Background Pollutant Concentration (µg/m³)
SO_2	2.74

3.4.2 It should be noted that background NO_2 is predicted for 2023 and SO_2 for 2001. These are the most recent predictions available from DEFRA and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

3.5 Sensitive Receptors

3.5.1 A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

Human Receptors

3.5.2 A desk-top study was undertaken in order to identify any human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 5.

Table 5 Human Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Bottle Hall	560709.9	249545.8
R2	Residential - Ivy Todd Farm	561221.2	249143.9
R3	Residential - Streetly Hall Cottages	560438.4	248246.7
R4	Residential - New Hall	560434.5	248110.2
R5	Residential - Mill House	560337.5	247517.3
R6	Residential - The Lodge House	559428.6	247168.7
R7	Residential - The Farmhouse	559255.2	247708.2
R8	Residential - Dene Road Cottages	559359.3	248153.1

3.5.3 Reference should be made to Figure 2 for a map of the human receptor locations.

Ecological Receptors

3.5.4 Atmospheric emissions from the facility have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. The Conservation of Habitats and Species Regulations (2010) and subsequent amendments require competent authorities to review applications and consents that have the potential to impact on ecological sites. Consultation was undertaken with Ben Moore of Norfolk Wildlife Services on 9th March 2023 in order to identify sites for inclusion in the assessment. This identified the following:

- Balsham Wood Site of Special Scientific Interest (SSSI) and Ancient Woodland (AW);
- Furze Hill SSSI;
- Roman Road SSSI;
- Over and Lawn Woods SSSI;
- Fleam Dyke SSSI;
- Borley Wood AW; and,
- Hare Wood AW.

3.5.5 For the purpose of the modelling assessment discrete receptors were placed at the closest points of each designation to the facility to ensure the maximum potential impact was predicted. These are summarised in Table 6.

Table 6 Ecological Receptor Locations

Receptor		NGR (m)	
		X	Y
E1	Borley Wood AW	558178.4	247547.9
E2	Borley Wood AW	558374.5	248098.1
E3	Borley Wood AW	558381.1	248532.4
E4	Balsham Wood AW and SSSI	558747.5	249245.4
E5	Balsham Wood AW and SSSI	559120.6	249267.2
E6	Balsham Wood AW and SSSI	559182.8	249751.4
E7	Over and Lawn Woods SSSI	562434.3	248370.4
E8	Hare Wood AW	561984.8	248119.2

Receptor		NGR (m)	
		X	Y
E9	Hare Wood AW	562059.3	247836.4
E10	Hare Wood AW	562303.6	247623.1
E11	Furze Hill SSSI	555552.0	248395.8
E12	Furze Hill SSSI	555537.1	248552.9
E13	Furze Hill SSSI	555407.5	248737.5
E14	Roman Road SSSI	556062.0	249803.4
E15	Fleam Dyke SSSI	556951.5	252415.4

3.5.6 Reference should be made to Figure 3 for a map of the ecological receptor locations.

3.5.7 Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of the APIS[5] and Multi-Agency Geographic Information for the Countryside (MAGIC)[6] websites was undertaken in order to identify the most suitable critical loads for each designation considered in the assessment.

3.5.8 The relevant critical loads for nitrogen deposition are presented in Table 7.

Table 7 Critical Loads for Nitrogen Deposition

Designation	Site Feature	Relevant Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Balsham Wood SSSI and AW	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland	Carpinus and Quercus mesic Deciduous Forest	15	20
Furze Hill SSSI	Festuca Ovina - Agrostis Capillaris - Rumex Acetosella Grassland	Inland Sanddrift and Dune with Siliceous Grassland	5	15

5 www.apis.ac.uk.

6 www.magic.gov.uk.

Designation	Site Feature	Relevant Nitrogen Critical Load Class	Nitrogen Critical Load (kgN/ha/yr)	
			Low	High
Roman Road SSSI	Bromus Erectus Lowland Calcareous Grassland	Semi-dry Perennial Calcareous Grassland (Basic Meadow Steppe).	10	20
Over and Lawn Woods SSSI	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland	Carpinus and Quercus mesic Deciduous Forest	15	20
Fleam Dyke SSSI	Bromus Erectus Lowland Calcareous Grassland	Semi-dry Perennial Calcareous Grassland (Basic Meadow Steppe).	10	20
Borley Wood AW	Broadleaved, Mixed and Yew Woodland	Coniferous Woodland	5	10
Hare Wood AW	Broadleaved, Mixed and Yew Woodland	Acidophilous Quercus-dominated Woodland	10	15

3.5.9 The relevant acid deposition critical loads are presented in Table 8.

Table 8 Critical Loads for Acid Deposition

Designation	Site Feature	Relevant Acidity Critical Load Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Balsham Wood SSSI and AW	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland	Carpinus and Quercus mesic Deciduous Forest	0.142	10.741	10.901
Furze Hill SSSI	Festuca Ovina - Agrostis Capillaris - Rumex Acetosella Grassland	Inland Sanddrift and Dune with Siliceous Grassland	0.928	4.000	4.928
Roman Road SSSI	Bromus Erectus Lowland Calcareous Grassland	Semi-dry Perennial Calcareous Grassland (Basic Meadow Steppe).	0.856	4.000	4.856

Designation	Site Feature	Relevant Acidity Critical Load Class	Acid Critical Load (keq/ha/yr)		
			CLMinN	CLMaxS	CLMaxN
Over and Lawn Woods SSSI	Fraxinus Excelsior - Acer Campestre - Mercurialis Perennis Woodland	Carpinus and Quercus mesic Deciduous Forest	0.214	10.787	10.901
Fleam Dyke SSSI	Bromus Erectus Lowland Calcareous Grassland	Semi-dry Perennial Calcareous Grassland (Basic Meadow Steppe).	0.856	4.000	4.856
Borley Wood AW	Broadleaved, Mixed and Yew Woodland	Coniferous Woodland	0.142	10.740	10.882
Hare Wood AW	Broadleaved, Mixed and Yew Woodland	Acidophilous Quercus-dominated Woodland	0.214	10.789	11.003

3.5.10 The lowest annual mean critical level of 1µg/m^3 for NH_3 was assigned to all ecological designations in order to provide a worst-case assessment.

3.5.11 Baseline pollutant concentrations and deposition rates at each ecological receptor were obtained from the APIS website[7] and are summarised in Table 9.

Table 9 Baseline Pollution Levels

Receptor		Annual Mean NO_x Conc. (µg/m^3)	Annual Mean SO_2 Conc. (µg/m^3)	Annual Mean NH_3 Conc. (µg/m^3)	Baseline Deposition Rate	
					Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)
E1	Borley Wood AW	9.47	0.80	2.15	33.46	2.46
E2	Borley Wood AW	9.36	0.80	2.15	33.46	2.46
E3	Borley Wood AW	9.36	0.80	2.15	33.46	2.46
E4	Balsham Wood AW and SSSI	9.36	0.80	2.15	33.46	2.46

[7] www.apis.ac.uk.

Receptor		Annual Mean NO_x Conc. (µg/m³)	Annual Mean SO_2 Conc. (µg/m³)	Annual Mean NH_3 Conc. (µg/m³)	Baseline Deposition Rate	
					Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)
E5	Balsham Wood AW and SSSI	9.22	0.78	2.15	33.46	2.46
E6	Balsham Wood AW and SSSI	9.2	0.78	2.15	33.46	2.46
E7	Over and Lawn Woods SSSI	9.01	0.74	1.97	32.76	2.40
E8	Hare Wood AW	9.24	0.78	1.97	32.76	2.40
E9	Hare Wood AW	9.13	0.75	1.97	32.69	2.40
E10	Hare Wood AW	9.13	0.75	1.97	32.76	2.40
E11	Furze Hill SSSI	9.99	0.90	2.15	18.76	1.38
E12	Furze Hill SSSI	9.99	0.90	2.15	18.76	1.38
E13	Furze Hill SSSI	9.99	0.90	2.15	18.76	1.38
E14	Roman Road SSSI	9.63	0.83	2.15	18.76	1.38
E15	Fleam Dyke SSSI	9.62	0.81	2.00	18.48	1.38

4.0 METHODOLOGY

4.1 Introduction

4.1.1 Activities at the proposed AD plant, including combustion processes and material storage, have the potential to cause increases in pollutant concentrations at sensitive locations in the vicinity of the site. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

4.2 Dispersion Model

4.2.1 Dispersion modelling was undertaken using ADMS-6.0 (v6.0.0.1), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-6 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

4.2.2 The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages.

4.3 Modelling Scenarios

4.3.1 The scenarios considered in the modelling assessment for human receptors are summarised in Table 10.

Table 10 Human Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_2	99.8th percentile (%ile) 1-hour mean	Annual mean
SO_2	99.9th %ile 15-minute mean	-

Parameter	Modelled As	
	Short Term	Long Term
	99.7th %ile 1-hour mean	
	99.2nd %ile 24-hour mean	

4.3.2 Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the %iles shown in Table 10 were selected to represent the relationship between the permitted number of exceedences of short-period concentrations and the number of periods within a calendar year.

4.3.1 The scenarios considered for ecological receptors in the modelling assessment are summarised in Table 11.

Table 11 Ecological Receptor Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO_x	100th %ile 24-hour mean	Annual mean
SO_2	-	Annual mean
NH_3	-	Annual mean
Nitrogen deposition	-	Annual deposition
Acid deposition	-	Annual deposition

4.3.2 Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level as a result of emissions from the facility only; and,
- Predicted environmental concentration (PEC) - Total predicted pollutant level as a result of emissions from the facility and existing baseline conditions.

4.3.3 Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, critical loads and critical levels. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.4 Assessment Area

4.4.1 The assessment area was defined based on the facility location, anticipated pollutant dispersion patterns and the positioning of sensitive receptors. Ambient concentrations were predicted over NGR: 558770, 247160 to 561270, 249660. One Cartesian grid with a resolution of 20m was used within the model to produce data suitable for contour plotting using the Surfer software package.

4.4.2 Reference should be made to Figure 4 for a graphical representation of the assessment grid extents.

4.5 Emissions

4.5.1 The following sources were included within the dispersion model:

- CHP unit;
- PTH module;
- Intake and processing building;
- Liquid digestate storage lagoon;
- Exposed maize within clamp 1 and clamp 2;
- Exposed maize during transfer from clamp 1 and clamp 2 to feed hopper;
- Exposed whole crop cereal within clamp 3;
- Exposed whole crop cereal during transfer from clamp 3 to feed hopper;
- Exposed cattle manure within clamp 4;
- Exposed cattle manure during transfer from clamp 4 to feed hopper; and,
- Exposed material in feed hopper.

4.5.2 Plandescil Ltd, the Project Engineers, confirmed that loading of material from the clamps to the feed hoppers will occur twice per day. As such, it was assumed that material will be transferred for a consecutive period of 12-hours a day on all four routes. This is considered to represent a conservative over-estimation based on the proposed loading schedule.

4.5.3 Emissions were assumed to be constant for remaining sources, with the CHP unit and boiler in operation 24-hours per day, 365-days per year. This is considered to be a worst-case assessment scenario as plant shut-down or periods of reduced work load are not reflected in the modelled emissions.

4.5.4 The specific inputs for each source are summarised in the following Sections. These were obtained from Plandescil Ltd and Streetly Hall Estate Partnership.

4.5.5 Reference should be made to Figure 4 for a map of the emission source locations.

CHP Unit

4.5.6 A summary of the CHP unit inputs is summarised in Table 12. These were obtained from the technical data sheet for the unit and information provided by Streetly Hall Estate Partnership.

Table 12 CHP Unit Process Conditions

Parameter	Unit	Value
Stack position	NGR	559980.3, 248532.4
Stack height	m	3.6
Stack diameter	m	0.4
Exhaust gas temperature	°C	125
Exhaust gas moisture content	%	11.49
Exhaust gas flow rate	Nm^3/s	1.11
Exhaust gas flow rate	m^3/s	1.83
Exhaust gas efflux velocity	m/s	14.53

4.5.7 The relevant ELVs for exhaust gas pollutant concentrations for the CHP unit are shown in Table 13. These are the maximum permitted levels and therefore provide a worst case representation of potential emissions.

Table 13 CHP Unit Emission Concentrations

Pollutant	Pollutant Emission Concentration (mg/Nm^3)
NO_x	250
SO_2	40

4.5.8 The pollutant mass emission rates for use in the assessment were derived from the concentrations shown in Table 13 and the flow rates shown in Table 12. These are summarised in Table 14.

Table 14 CHP Unit Pollutant Mass Emission Rates

Pollutant	Pollutant Mass Emission Rate (g/s)
NO_x	0.2771
SO_2	0.0443

4.5.9 Reference should be made to Figure 4 for the emission source location.

PTH Module

4.5.10 A summary of the PTH module process conditions is summarised in Table 15. These were obtained from the technical data sheet for a similar PTH module.

Table 15 PTH Module Process Conditions

Parameter	Unit	Value
Stack position	NGR	559990.9, 248543.6
Stack height	m	1.00
Stack diameter	m	0.2
Exhaust gas temperature	°C	120
Exhaust gas flow rate	Nm^3/s	0.218
Exhaust gas flow rate	m^3/s	0.31
Exhaust gas efflux velocity	m/s	10.00

4.5.11 The relevant ELVs for exhaust gas pollutant concentrations for the PTH module are shown in Table 16.

Table 16 PTH Module Emission Concentrations

Pollutant	Pollutant Emission Concentration (mg/Nm^3)
NO_x	200
SO_2	100

4.5.12 The pollutant mass emission rates for use in the assessment were derived from the concentrations shown in Table 16 and the flow rate shown in Table 15. These are summarised in Table 17.

Table 17 PTH Module Pollutant Mass Emission Rates

Pollutant	Pollutant Mass Emission Rate (g/s)
NO_x	0.0436
SO_2	0.0218

Intake and Processing Building

4.5.13 The intake and processing building abatement system was included in the model as a point source. The exact specification has not been finalised at the time of reporting. As such, the process conditions shown in Table 18 were utilised to represent anticipated parameters.

Table 18 Intake and Processing Building Process Conditions

Parameter	Unit	Value
Stack position	NGR	560052.2, 248462.0
Stack height	m	4.0
Stack diameter	m	1.5
Exhaust gas efflux velocity	m/s	15.83

4.5.14 The following NH_3 emission rate was obtained from the EA[8]:

8 EA, Pollution Inventory reporting, 2013.

- Manure - deep pit - 2.38kgNH_3/tonne.

4.5.15 The plant is proposed to process 12,000tpa of poultry litter in the intake and processing building. As such, it was assumed that the intake and processing building constantly stores the maximum stocking volume. Additionally, any reduction in emission associated with the odour abatement system was not considered to ensure a worst case representation of atmospheric emissions from the proposed intake and processing building. The model input data is summarised in Table 19.

Table 19 Intake and Processing Building Model Input

Parameter	Unit	Value
NH_3 emission rate	g/s	0.000000906

Liquid Digestate Storage Lagoon

4.5.16 The digestate lagoon was included in the model as an area source. The following NH_3 emission rate was obtained from the SCAIL database[9]:

- Lagoon - no cover - 1.4kgNH_3/m^2/yr.

4.5.17 The lagoon will be covered. Information obtained from SCAIL[10] indicated that completely covering lagoons with an engineered cover reduces NH_3 emissions by 90%. This is due to the reduced air exchange with the atmosphere through the provision of an enclosed environment. The relevant factor was therefore applied to the calculated emission rate to account for reduced releases from the lagoon. This was then converted into an area emission rate suitable for input into the model.

4.5.18 The model input data is summarised in Table 20.

9 SCAIL-Agriculture Update Sniffer ER26: Final Report, Sniffer, 2014.

10 SCAIL-Agriculture Update Sniffer ER26: Final Report, Sniffer, 2014.

Table 20 Liquid Digestate Storage Lagoon Model Input

Parameter	Unit	Value
NH_3 emission rate	$g/m^2/s$	0.00000444

Exposed Maize

4.5.19 Maize will be exposed at the proposed AD plant in the following sources:

- Clamp 1;
- Clamp 2; and,
- Transfer from clamp 1 and clamp 2 to feed hopper.

4.5.20 As such, the processing of maize was included in the model as four area sources representing the clamps and two line sources representing the transfer process.

4.5.21 An NH_3 emission rate was obtained from Natural Resources Wales (NRW)[11] as follows:

- Feedstock - 0.009kgNH_3/kgN in feedstock.

4.5.22 The plant is proposed to process 16,000tpa of maize. The nitrogen content of maize is 0.0046kgN/kg[12]. As such, the feedstock will contain 73,600kgN. Multiplying this by the emission rate above provided an annual NH_3 emission of 662.4kgNH_3/yr. The release was apportioned to the clamp and transfer line sources.

4.5.23 It should be noted that the clamps will be covered, with two open ends. Each open end has a modelled area of 148.2m^2. This has been taken into account in the model inputs summarised in Table 21.

Table 21 Exposed Maize Model Inputs

Source		NH_3 Emission Rate ($g/m^2/s$)
1	Clamp 1 - open end	0.000000000142

11 Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

12 Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

Source		NH_3 Emission Rate (g/m²/s)
2	Clamp 1 - open end	0.000000000142
3	Clamp 2 - open end	0.000000000142
4	Clamp 2 - open end	0.000000000142
5	Transfer from clamp 1 to feed hopper	0.000000001050
6	Transfer from clamp 2 to feed hopper	0.000000001050

Exposed Whole Crop Cereal

4.5.24 Whole crop cereal material will be exposed at the proposed AD plant in the following sources:

- Clamp 3; and,
- Transfer from clamp 3 to feed hopper.

4.5.25 As such, the processing of whole crop cereal was included in the model as two area sources representing the clamps and two line sources representing the transfer process.

4.5.26 An NH_3 emission rate was obtained from NRW[13] as follows:

- Feedstock - 0.009kgNH_3/kgN in feedstock.

4.5.27 The plant is proposed to process 15,000tpa of whole crop cereal. The nitrogen content of whole crop cereal is 0.0051kgN/kg[14]. As such, the feedstock will contain 76,500kgN. Multiplying this by the emission rate above provided an annual NH_3 emission of 688.5kgNH_3/yr. The release was apportioned for the clamp and transfer line sources.

4.5.28 It should be noted that the clamp will be covered with two open ends. Each open end has an exposed area of 126.0m². This has been taken into account in the model inputs summarised in Table 22.

13 Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

14 Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

Table 22 Exposed Whole Crop Cereal Model Inputs

Source		NH_3 Emission Rate ($g/m^2/s$)
1	Clamp 3 - open end	0.000000000173
2	Clamp 3 - open end	0.000000000173
3	Transfer from clamp 3 to feed hopper	0.000000010920
4	Transfer from clamp 4 to feed hopper	0.000000010920

Exposed Cattle Manure

4.5.29 Exposed cattle manure in the feedstock area was included in the model as an area source. A NH_3 emission rate was obtained from Natural Resources Wales (NRW)[15] as follows:

- Feedstock - 0.009kgNH_3/kgN in feedstock.

4.5.30 The plant is proposed to process 5,000tpa of cattle manure. The nitrogen content of cattle manure is 0.0052kgN/kg[16]. As such, the feedstock will contain 26,000kgN. Multiplying this by the emission rate above provided an annual NH_3 emission of 234.0kgNH_3/yr. The release was apportioned over the feedstock area of 800.0m^2 to determine an area emission rate suitable for inclusion within ADMS-6.

4.5.31 The model input data is summarised in Table 23.

Table 23 Exposed Cattle Manure

Parameter	Unit	Value
NH_3 emission rate	$g/m^2/s$	0.000000000009

15 Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

16 Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

Exposed Material in Feed Hopper

4.5.32 As discussed in Section 1.2, there will be a mixture of exposed maize, whole crop cereal and cow manure in the feed hopper. The annual NH_3 emission rates calculated in the previous sections for each material are shown in Table 24.

Table 24 Exposed Material in Feed Hopper Annual NH_3 Emission Rate

Material		Annual NH_3 Emission Rate ($kgNH_3/yr$)
1	Maize	662.4
2	Whole crop cereal	688.5
3	Cattle manure	234.0

4.5.33 The annual NH_3 emission rate of 688.5$kgNH_3$/yr for whole crop cereal is the highest value shown in Table 24. As such, this was used to provide a worst case representation of emissions from the feed hopper. The release was apportioned over the area of 116.8m^2 and the agitation process represented by factoring the emission rate by 10. This was taken into account in the model input summarised in Table 25.

Table 25 Exposed Material in Feed Hopper Model Input

Parameter	Unit	Value
NH_3 emission rate	$g/m^2/s$	0.00000000173

4.6 NO_x to NO_2 Conversion

4.6.1 Emissions of total NO_x from combustion processes are predominantly in the form of nitric oxide (NO). Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO_2. Comparisons of ambient NO and NO_2 concentrations in the vicinity of point sources in recent years has indicated that it is unlikely that more than 30% of the NO_x is present at ground level as NO_2.

4.6.2 Ambient NO_x concentrations were predicted through dispersion modelling. Concentrations of NO_2 shown in the results section assume 70% conversion from NO_x to

NO2 for annual means and 35% conversion for 1-hour concentrations, based upon EA guidance[17].

4.7 Building Effects

4.7.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

4.7.2 Analysis of the site layout indicated that a number of structures should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 26.

Table 26 Building Geometries

Building	NGR (m)		Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
	X	Y				
Proposed Fertiliser	559986.6	248582.2	16.1	30.0	-	-
Proposed Fertiliser	560015.2	248563.8	16.1	30.0	-	-
Proposed Fertiliser	559996.9	248535.2	16.1	30.0	-	-
Proposed Post Fertiliser	559968.3	248553.5	16.1	30.0	-	-
Proposed CHP Container	559984.8	248529.5	2.6	12.2	3.0	122.7
Proposed Boiler Building	559940.8	248577.7	2.8	3.0	9.0	212.6

4.7.3 Reference should be made to Figure 4 for a map of the building locations.

4.7.4 It should be noted that the digesters specified in Table 26 are circular structures. As such, widths and angles for these structures have not been defined.

17 https://www.gov.uk/guidance/environmental-permitting-air-dispersion-modelling-reports.

4.8 Meteorological Data

4.8.1 Meteorological data used in the assessment was taken from Andrewsfield meteorological station over the period 1st January 2016 to 31st December 2020 (inclusive). This observation station is located at NGR: 568732, 222996, which is approximately 25km south of the facility. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.

4.8.2 All meteorological files used in the assessment were provided by Atmospheric Dispersion Modelling Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 5 for wind roses of the utilised meteorological records.

4.9 Roughness Length

4.9.1 A roughness length (z_0) of 0.2m was used within the model to describe the modelling extents and meteorological site. This is considered appropriate for the morphology of both areas and is suggested within ADMS-6 as being suitable for 'agricultural areas (min)'.

4.10 Monin-Obukhov Length

4.10.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 1m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-6 as being suitable for 'rural areas'.

4.11 Terrain Data

4.11.1 Ordnance Survey OS Terrain 50 data was included in the model for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the method suggested by CERC[18].

18 Note 105: Setting up Terrain Data for Input to CERC Models, CERC, 2016.

4.12 Deposition

4.12.1 Pollutant deposition was modelled in accordance with the approach outlined in the following Sections. It should be noted that the variable NH_3 concentration dependent deposition velocity function within ADMS-6 was utilised throughout the assessment as outlined within EA guidance[19]. This utilised predicted concentrations to determine location specific deposition velocities throughout the assessment extents. This provided predicted annual mean NH_3 concentrations and deposition rates for comparison with the relevant criteria.

Nitrogen Deposition

4.12.2 Nitrogen deposition rates were calculated using the conversion factors provided within EA document 'Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06'[20]. Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used for the determination of nitrogen deposition are presented within Table 27.

Table 27 Conversion Factors to Determine Dry Deposition Flux for Nitrogen Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (μg/m²/s to kg/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	95.9
NH_3	0.02	0.03	260

4.12.3 The relevant deposition velocity for each ecological receptor was selected from Table 27 based on the vegetation type present within the designation.

19 Guidance on Modelling the Concentration and Deposition of Ammonia Emitted from Intensive Farming, Environment Agency, 2010.

20 Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG 06, EA, 2014.

Acid Deposition

4.12.4 Acid deposition occurs as result of NO_2, NH_3 and SO_2. Predicted ground level pollutant concentrations of these species were converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors. The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken using the standard conversion factors shown in Table 28.

Table 28 Conversion Factors to Determine Dry Deposition Flux for Acid Deposition

Pollutant	Deposition Velocity (m/s)		Conversion Factor (μg/m²/s to keq/ha/yr of pollutant species)
	Grassland	Forest	
NO_2	0.0015	0.003	6.84
SO_2	0.012	0.024	9.84
NH_3	0.02	0.03	18.50

4.12.5 The following formula was used to calculate predicted PCs as a proportion of the critical load function where PECs were identified to be greater than the CLminN value.

PC as %CL function = ((PC of S+N deposition)/CLmaxN) x 100

4.12.6 The above formula was obtained from the APIS website[21].

4.12.7 It should be noted that CLminN is defined as the 'minimum critical load for nitrogen' on the APIS website[22].

4.13 Background Concentrations

4.13.1 Review of existing data in the vicinity of the site was undertaken in Section 3.0 in order to identify suitable background values for use in the assessment. This indicated the closest monitor is positioned a significant distance from the facility and therefore results are

21 http://www.apis.ac.uk/.

22 http://www.apis.ac.uk/.

considered unlikely to be representative of the site location. As such, the background concentrations predicted by DEFRA were utilised to represent existing concentrations in the vicinity of the site.

4.13.2 Background levels at the ecological receptors were obtained from the APIS website, as summarised in Table 9.

4.13.3 It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in EA guidance 'Air emissions risk assessment for your environmental permit'[23], which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

4.14 Air Quality Assessment Criteria

Human Receptors

4.14.1 The significance of predicted air quality impacts at human receptors was determined in accordance with the guidance provided within the Institute of Air Quality Management (IAQM) document 'Land-Use Planning & Development Control: Planning for Air Quality'[24]. Using this methodology impacts are defined based on the interaction between the predicted pollutant concentration with the development in place (PEC) and the magnitude of change (PC), as outlined in Table 29 for annual mean concentrations.

Table 29 Significance of Impact - Annual Mean Concentrations

Concentration at Receptor in Assessment Year (PEC)	Predicted Concentration Change as Proportion of EQS (PC) (%)			
	1	2 - 5	6 - 10	> 10
75% or less of EQS	Negligible	Negligible	Slight	Moderate

23 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

24 Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

Concentration at Receptor in Assessment Year (PEC)	Predicted Concentration Change as Proportion of EQS (PC) (%)			
	1	2 - 5	6 - 10	> 10
76 - 94% of EQS	Negligible	Slight	Moderate	Moderate
95 - 102% of EQS	Slight	Moderate	Moderate	Substantial
103 - 109% of EQS	Moderate	Moderate	Substantial	Substantial
110% or more of EQS	Moderate	Substantial	Substantial	Substantial

4.14.2 The matrix shown in Table 29 is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which makes it clearer which cell the impact falls within. It should be noted that changes of 0%, i.e. less than 0.5%, are described as **negligible**.

4.14.3 The significance of impacts on short-term pollutant concentrations at human receptors was determined in accordance with the criteria outlined in the IAQM document 'Land-Use Planning & Development Control: Planning for Air Quality'[25], as summarised in Table 30.

Table 30 Significance Criteria - Short Term Concentrations

Predicted Concentration Change as Proportion of EQS (PC) (%)	Significance of Impact
Less than 10	Negligible
11 - 20	Slight
21 - 50	Moderate
Greater than 51	Substantial

4.14.4 Following the prediction of impacts at discrete receptor locations, the IAQM[26] provide guidance on determining the overall air quality impact significance of the operation of a development and states that an assessment must reach a conclusion on the likely significance of the predicted impact. Where the overall effect is **moderate** or **substantial**, the effect is likely to be considered **significant**, whilst if the impact is **slight** or **negligible**,

25 Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

26 Land-Use Planning & Development Control: Planning for Air Quality, IAQM, 2017.

the impact is likely to be considered **not significant**. It should be noted that this is a binary judgement of either it is **significant** or it is **not significant.**

4.14.5 The determination of significance relies on professional judgement and reasoning has been provided as far as practicable. This has been considered throughout the assessment when defining predicted impacts.

Ecological Receptors

4.14.6 EA guidance 'Air emissions risk assessment for your environmental permit'[27] states that PCs at SSSIs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas; or,
- The long-term PC is greater than 1% and the long term PEC is less than 70% of the long term environmental standard.

4.14.7 It should be noted that the 1% criterion is also recommended in Natural England (NE) guidance[28] as an appropriate threshold for screening out likely significant effects either alone or in-combination with other plans and projects at ecological designations.

4.14.8 The EA guidance states that PCs at AWs can be screened as insignificant if they meet the following criteria:

- The short-term PC is less than 100% of the short-term environmental standard for protected conservation areas; and,
- The long-term PC is less than 100% of the long-term environmental standard for protected conservation areas.

27 https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

28 Air quality risk assessment interim guidance, NE, 2022.

4.14.9 Predicted PCs have been compared to the relevant EQSs and the criteria stated above. Where the impact is within these parameters, the EA concludes that impacts associated with an installation are acceptable.

4.15 In-Combination Assessment

4.15.1 NE require competent authorities to consider potential impacts on ecological designations in-combination with other plans or projects that may cause similar impacts as a result of NH_3 emissions. NE guidance[29] identifies the following sources of information that project proposers or competent authorities can use to identify plans or projects that might act in-combination:

- Planning Portals to locate applications awaiting permissions;
- Environmental Permits Register of Applications and Register of Issued Permits; and,
- Local Plans (including brownfield registers with permission in principle) and any allocations not yet permitted.

4.15.2 Review of planning applications submitted to SCDC and the Environmental Permit register was undertaken to identify the following projects within 10km of the site:

- Any intensive agriculture proposals; and,
- Combustion emission proposals.

4.15.3 It should be noted that a review period of mid 2020 onwards was selected to correlate with the latest background pollution data information available from APIS.

4.15.4 The above searches did not indicate any specific plans or projects for consideration. As such, the modelled PCs can be considered to represent impacts both alone and in-combination with other relevant plans and projects.

[29] Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations, NE, 2018.

4.16 Modelling Uncertainty

4.16.1 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model uncertainty - due to model limitations;
- Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

4.16.2 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-6 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Meteorological data - Modelling was undertaken using five annual meteorological data sets from an observation station local to the site to account for inter-year variability. The assessment was based on the worst-case year to ensure maximum concentrations were considered;
- Surface characteristics - The z_0 and Monin-Obukhov length were determined for both the dispersion and meteorological sites based on the surrounding land uses and guidance provided by CERC. Terrain data was included and processed using the method outlined by CERC;
- Plant operating conditions - Operational parameters were derived from relevant plant specifications and information provided by Streetly Hall Estate Partnership and Plandescil Ltd. As such, these are considered to be representative of likely operating conditions;
- Emission rates - Emission rates were derived from the relevant ELVs for the CHP unit and PTH module. As such, these are considered to be representative of maximum releases. EA[30], SCAIL[31] and NRW[32] resources were reviewed to provide NH_3 emission

[30] EA, Pollution Inventory reporting, 2013.

[31] SCAIL-Agriculture Update Sniffer ER26: Final Report, Sniffer, 2014.

[32] Emission factor for anaerobic digestion feedstock and digestate for modelling and reporting, NRW, 2022.

rates. As these are commonly used library data sources, the relevant values are considered appropriate for an assessment of this nature;

- Background concentrations - Background pollutant levels were obtained from the DEFRA and APIS websites. These are considered representative of baseline air quality conditions at sensitive locations within the vicinity of the site;
- Receptor locations - A Cartesian Grid was included in the model in order to provide suitable data for contour plotting. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs were as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

4.16.3 Results were considered in the context of the relevant EQSs and IAQM, EA or NE significance criteria. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

5.0 RESULTS

5.1 Introduction

5.1.1 Dispersion modelling was undertaken with the inputs described in Section 4.0. The results are outlined in the following Sections.

5.2 Maximum Pollutant Concentrations

5.2.1 Maximum predicted off-site pollutant concentrations for any meteorological data set are summarised in Table 31.

Table 31 Maximum Predicted Off-Site Pollutant Concentrations

Pollutant	Averaging Period	EQS (μg/m³)	PC (μg/m³)	PC Proportion of EQS (%)	PEC (μg/m³)	PEC Proportion of EQS (%)
NO_2	Annual	40	7.94	19.9	13.92	34.8
	99.8th %ile 1-hour	200	28.44	14.2	40.40	20.2
SO_2	99.2nd %ile 24-hour	125	14.00	11.2	16.74	13.4
	99.73rd %ile 1-hour	350	20.11	5.7	25.59	7.3
	99.9th %ile 15-minute	266	22.58	8.5	28.06	10.5

5.2.2 As shown in Table 31, there were no predicted exceedences of the relevant EQSs for NO_2 and SO_2.

5.2.3 Reference should be made to Figures 6 to 10 for graphical representations of predicted pollutant concentrations, inclusive of background pollutant levels, throughout the assessment extents. It should be noted that the values shown in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentration for that species. For example, the maximum annual mean NO_2 concentration was predicted using the 2017 meteorological data set. As such, the contours shown in Figure 6 were produced from these outputs.

5.3 Human Receptors

5.3.1 Predicted concentrations of each pollutant at the human receptor locations identified in Table 5 are summarised in the following sections.

Nitrogen Dioxide

5.3.2 Predicted annual mean NO_2 PECs at the human receptor locations, inclusive of background levels, are summarised in Table 32.

Table 32 Predicted Annual Mean NO_2 Concentrations

Receptor		Predicted Annual Mean NO_2 PEC (µg/m^3)				
		2016	2017	2018	2019	2020
R1	Residential - Bottle Hall	6.12	6.12	6.12	6.14	6.12
R2	Residential - Ivy Todd Farm	6.13	6.17	6.13	6.16	6.14
R3	Residential - Streetly Hall Cottages	6.34	6.42	6.27	6.33	6.28
R4	Residential - New Hall	6.24	6.32	6.20	6.25	6.23
R5	Residential - Mill House	6.11	6.09	6.09	6.13	6.08
R6	Residential - The Lodge House	6.07	6.02	6.09	6.06	6.05
R7	Residential - The Farmhouse	6.11	6.04	6.11	6.10	6.10
R8	Residential - Dene Road Cottages	6.15	6.08	6.13	6.14	6.13

5.3.3 As indicated in Table 32, predicted NO_2 concentrations were below the annual mean EQS of 40µg/m^3 at all human receptor locations for all meteorological data sets. Reference should be made to Figure 6 for a graphical representation of predicted concentrations throughout the assessment extents.

5.3.4 The significance of predicted impacts on annual mean NO_2 concentrations at the human receptors are summarised in Table 33. These consider the maximum predicted change in concentration from the five meteorological datasets as a worst-case.

Table 33 Predicted Impacts on Annual Mean NO_2 Concentrations

Receptor		Predicted Concentration (PEC)	Predicted Concentration Change as Proportion of EQS (PC) (%)	Impact Significance
R1	Residential - Bottle Hall	Below 75% of AQO	0	Negligible
R2	Residential - Ivy Todd Farm	Below 75% of AQO	0	Negligible
R3	Residential - Streetly Hall Cottages	Below 75% of AQO	1	Negligible
R4	Residential - New Hall	Below 75% of AQO	1	Negligible
R5	Residential - Mill House	Below 75% of AQO	0	Negligible
R6	Residential - The Lodge House	Below 75% of AQO	0	Negligible
R7	Residential - The Farmhouse	Below 75% of AQO	0	Negligible
R8	Residential - Dene Road Cottages	Below 75% of AQO	0	Negligible

5.3.5 As indicated in Table 33, impacts on annual mean NO_2 concentrations as a result of the proposed development were predicted to be **negligible** at all human receptor locations. These are considered to be **not significant** in accordance with the IAQM guidance.

5.3.6 Predicted 99.8th %ile 1-hour mean NO_2 PECs at the sensitive human receptors, inclusive of background levels, are summarised in Table 34.

Table 34 Predicted 99.8th %ile 1-hour Mean NO_2 Concentrations

Receptor		Predicted 99.8th %ile 1-hour Mean NO_2 PEC ($\mu g/m^3$)				
		2016	2017	2018	2019	2020
R1	Residential - Bottle Hall	14.93	14.68	14.95	15.07	14.61
R2	Residential - Ivy Todd Farm	15.31	15.38	15.36	15.37	15.33
R3	Residential - Streetly Hall Cottages	16.95	16.82	16.51	16.86	16.72
R4	Residential - New Hall	17.19	17.40	17.31	17.13	17.30
R5	Residential - Mill House	16.19	15.46	15.93	16.22	15.79
R6	Residential - The Lodge House	14.45	13.92	14.56	14.41	14.23
R7	Residential - The Farmhouse	14.62	14.10	14.56	15.15	14.51

Receptor		Predicted 99.8th %ile 1-hour Mean NO_2 PEC (µg/m³)				
		2016	2017	2018	2019	2020
R8	Residential - Dene Road Cottages	15.36	14.83	15.05	15.41	15.21

5.3.7 As indicated in Table 34, predicted 99.8th %ile 1-hour mean NO_2 concentrations were below the EQS of 200µg/m³ at all human receptor locations. Reference should be made to Figure 7 for a graphical representation of predicted concentrations throughout the assessment extents.

5.3.8 The significance of predicted impacts on predicted 99.8th %ile 1-hour mean NO_2 concentrations at the human receptors are summarised in Table 35. These consider the maximum predicted change in concentration from the five meteorological datasets as a worst-case.

Table 35 Predicted Impacts on 99.79th %ile 1-hour Mean NO_2 Concentrations

Receptor		Predicted Concentration Change as Proportion of EQS (PC) (%)	Impact Significance
R1	Residential - Bottle Hall	Less than 10	Negligible
R2	Residential - Ivy Todd Farm	Less than 10	Negligible
R3	Residential - Streetly Hall Cottages	Less than 10	Negligible
R4	Residential - New Hall	Less than 10	Negligible
R5	Residential - Mill House	Less than 10	Negligible
R6	Residential - The Lodge House	Less than 10	Negligible
R7	Residential - The Farmhouse	Less than 10	Negligible
R8	Residential - Dene Road Cottages	Less than 10	Negligible

5.3.9 As indicated in Table 35, impacts on the 99.79th %ile 1-hour mean NO_2 concentrations as a result of the proposed development were predicted to be **negligible** at all human receptor locations. These are considered to be **not significant** in accordance with the IAQM guidance.

Sulphur Dioxide

5.3.10 Predicted 99.2nd %ile 24-hour mean SO_2 PECs at the human receptor locations, inclusive of background levels, are summarised in Table 36.

Table 36 Predicted 99.2nd %ile 24-hour Mean SO_2 Concentrations

Receptor		Predicted 99.2nd %ile 24-hour Mean SO_2 PEC (μg/m³)				
		2016	2017	2018	2019	2020
R1	Residential - Bottle Hall	5.76	5.80	5.89	5.87	5.76
R2	Residential - Ivy Todd Farm	5.79	5.84	5.91	5.83	5.86
R3	Residential - Streetly Hall Cottages	6.55	6.45	6.42	6.46	6.43
R4	Residential - New Hall	6.33	6.28	6.11	6.24	6.39
R5	Residential - Mill House	5.91	5.94	5.86	6.11	6.00
R6	Residential - The Lodge House	5.76	5.66	5.83	5.80	5.77
R7	Residential - The Farmhouse	5.92	5.89	5.84	5.88	5.80
R8	Residential - Dene Road Cottages	5.97	6.11	5.94	6.03	5.95

5.3.11 As indicated in Table 36, predicted 99.2nd %ile 24-hour mean SO_2 PECs were below the EQS of 125μg/m³ at all human receptor locations. Reference should be made to Figure 8 for a graphical representation of predicted concentrations throughout the assessment extents.

5.3.12 The significance of predicted impacts on 99.2nd %ile 24-hour mean SO_2 concentrations at the human receptors are summarised in Table 37. These consider the maximum predicted change in concentration from the five meteorological datasets as a worst-case.

Table 37 Predicted Impacts on 99.2nd %ile 24-hour Mean SO_2 Concentrations

Receptor		Predicted Concentration Change as Proportion of EQS (PC) (%)	Impact Significance
R1	Residential - Bottle Hall	Less than 10	Negligible
R2	Residential - Ivy Todd Farm	Less than 10	Negligible

Receptor		Predicted Concentration Change as Proportion of EQS (PC) (%)	Impact Significance
R3	Residential - Streetly Hall Cottages	Less than 10	Negligible
R4	Residential - New Hall	Less than 10	Negligible
R5	Residential - Mill House	Less than 10	Negligible
R6	Residential - The Lodge House	Less than 10	Negligible
R7	Residential - The Farmhouse	Less than 10	Negligible
R8	Residential - Dene Road Cottages	Less than 10	Negligible

5.3.13 As indicated in Table 37, impacts on 99.2nd %ile 24-hour mean SO_2 concentrations as a result of the proposed development were predicted to be **negligible** at all human receptor locations. These are considered to be **not significant** in accordance with the IAQM guidance.

5.3.14 Predicted 99.73rd %ile 1-hour mean SO_2 PECs at the human receptor locations, inclusive of background levels, are summarised in Table 38.

Table 38 Predicted 99.73rd %ile 1-hour Mean SO_2 Concentrations

Receptor		Predicted 99.73rd %ile 1-hour Mean SO_2 PEC (μg/m^3)				
		2016	2017	2018	2019	2020
R1	Residential - Bottle Hall	7.40	7.17	7.39	7.47	7.10
R2	Residential - Ivy Todd Farm	7.25	7.60	7.59	7.61	7.39
R3	Residential - Streetly Hall Cottages	8.97	9.06	8.55	8.92	8.84
R4	Residential - New Hall	8.94	9.49	9.04	8.91	9.03
R5	Residential - Mill House	7.76	7.58	7.72	7.81	7.64
R6	Residential - The Lodge House	6.93	6.42	7.09	6.95	6.92
R7	Residential - The Farmhouse	7.21	6.78	7.21	7.40	6.96
R8	Residential - Dene Road Cottages	7.49	7.23	7.39	7.78	7.33

5.3.15 As indicated in Table 38, predicted 99.73rd %ile 1-hour mean SO_2 PECs were below the EQS of 350μg/m^3 at all human receptor locations. Reference should be made to Figure 9 for a graphical representation of predicted concentrations throughout the assessment extents.

5.3.16 The significance of predicted impacts on 99.73rd %ile 1-hour mean SO_2 concentrations at the human receptors are summarised in Table 39. These consider the maximum predicted change in concentration from the five meteorological datasets as a worst-case.

Table 39 Predicted Impacts on 99.73rd %ile 1-hour Mean SO_2 Concentrations

Receptor		Predicted Concentration Change as Proportion of EQS (PC) (%)	Impact Significance
R1	Residential - Bottle Hall	Less than 10	Negligible
R2	Residential - Ivy Todd Farm	Less than 10	Negligible
R3	Residential - Streetly Hall Cottages	Less than 10	Negligible
R4	Residential - New Hall	Less than 10	Negligible
R5	Residential - Mill House	Less than 10	Negligible
R6	Residential - The Lodge House	Less than 10	Negligible
R7	Residential - The Farmhouse	Less than 10	Negligible
R8	Residential - Dene Road Cottages	Less than 10	Negligible

5.3.17 As indicated in Table 39, impacts on 99.73rd %ile 1-hour mean SO_2 concentrations as a result of the proposed development were predicted to be **negligible** at all human receptor locations. These are considered to be **not significant** in accordance with the IAQM guidance.

5.3.18 Predicted 99.9th %ile 15-min mean SO_2 PECs, inclusive of background levels, at the sensitive human receptors are summarised in Table 40.

Table 40 Predicted 99.9th %ile 15-min Mean SO_2 Concentrations

Receptor		Predicted 99.9th %ile 15-min Mean SO_2 PEC ($\mu g/m^3$)				
		2016	2017	2018	2019	2020
R1	Residential - Bottle Hall	8.83	8.63	9.01	8.96	8.63
R2	Residential - Ivy Todd Farm	9.27	9.47	9.27	9.50	8.86

Receptor		Predicted 99.9th %ile 15-min Mean SO_2 PEC (μg/m³)				
		2016	2017	2018	2019	2020
R3	Residential - Streetly Hall Cottages	12.23	12.17	12.03	12.01	11.90
R4	Residential - New Hall	12.43	13.38	12.35	11.86	12.94
R5	Residential - Mill House	9.92	9.75	9.75	9.93	9.83
R6	Residential - The Lodge House	8.51	7.99	8.52	8.52	8.46
R7	Residential - The Farmhouse	9.10	8.14	9.27	9.47	9.12
R8	Residential - Dene Road Cottages	10.30	8.97	8.91	10.26	9.11

5.3.19 As indicated in Table 40, predicted 99.9th %ile 15-minute mean SO_2 PECs were below the EQS of 266μg/m³ at all human receptor locations. Reference should be made to Figure 10 for a graphical representation of predicted concentrations throughout the assessment extents.

5.3.20 The significance of predicted impacts on 99.9th %ile 15-minute mean SO_2 concentrations at the human receptors are summarised in Table 41. These consider the maximum predicted change in concentration from the five meteorological datasets as a worst-case.

Table 41 Predicted Impacts on 99.9th %ile 15-min Mean SO_2 Concentrations

Receptor		Predicted Concentration Change as Proportion of EQS (PC) (%)	Impact Significance
R1	Residential - Bottle Hall	Less than 10	Negligible
R2	Residential - Ivy Todd Farm	Less than 10	Negligible
R3	Residential - Streetly Hall Cottages	Less than 10	Negligible
R4	Residential - New Hall	Less than 10	Negligible
R5	Residential - Mill House	Less than 10	Negligible
R6	Residential - The Lodge House	Less than 10	Negligible
R7	Residential - The Farmhouse	Less than 10	Negligible
R8	Residential - Dene Road Cottages	Less than 10	Negligible

5.3.21 As indicated in Table 41, impacts on 99.9th %ile 15-minute mean SO_2 concentrations as a result of the proposed development predicted to be **negligible** at all human receptor locations. These are considered to be **not significant** in accordance with the IAQM guidance.

5.4 Ecological Receptors

5.4.1 Predicted concentrations and deposition rates of each relevant pollutant at the ecological receptor locations identified in Table 6 are summarised in the following Sections.

Nitrogen Oxides

5.4.2 Predicted annual mean NO_x PECs at the ecological receptor locations are summarised in Table 42.

Table 42 Predicted Annual Mean NO_x Concentrations

Receptor		Predicted Annual Mean NO_x PEC (µg/m³)				
		2016	2017	2018	2019	2020
E1	Borley Wood AW	9.52	9.50	9.51	9.52	9.51
E2	Borley Wood AW	9.43	9.40	9.42	9.42	9.42
E3	Borley Wood AW	9.44	9.42	9.45	9.44	9.44
E4	Balsham Wood AW and SSSI	9.45	9.45	9.49	9.46	9.43
E5	Balsham Wood AW and SSSI	9.33	9.35	9.39	9.35	9.32
E6	Balsham Wood AW and SSSI	9.30	9.30	9.31	9.29	9.29
E7	Over and Lawn Woods SSSI	9.08	9.10	9.07	9.07	9.08
E8	Hare Wood AW	9.33	9.36	9.32	9.33	9.33
E9	Hare Wood AW	9.21	9.22	9.19	9.20	9.20
E10	Hare Wood AW	9.19	9.20	9.18	9.18	9.18
E11	Furze Hill SSSI	10.01	10.00	10.01	10.01	10.01
E12	Furze Hill SSSI	10.01	10.00	10.01	10.01	10.01
E13	Furze Hill SSSI	10.01	10.00	10.01	10.01	10.01

Receptor		Predicted Annual Mean NO_x PEC (µg/m³)				
		2016	2017	2018	2019	2020
E14	Roman Road SSSI	9.65	9.65	9.66	9.65	9.65
E15	Fleam Dyke SSSI	9.64	9.64	9.64	9.64	9.63

5.4.3 As indicated in Table 42, predicted NO_x concentrations were below the annual mean EQS of 30µg/m³ at all ecological receptor locations.

5.4.4 Maximum predicted annual mean NO_x concentrations at the ecological receptor locations are summarised in Table 43.

Table 43 Maximum Predicted Annual Mean NO_x Concentrations

Receptor		Maximum Predicted Annual Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Borley Wood AW	0.05	9.52	0.16	31.73
E2	Borley Wood AW	0.07	9.43	0.22	31.42
E3	Borley Wood AW	0.09	9.45	0.30	31.50
E4	Balsham Wood AW and SSSI	0.13	9.49	0.43	31.63
E5	Balsham Wood AW and SSSI	0.17	9.39	0.58	31.31
E6	Balsham Wood AW and SSSI	0.11	9.31	0.36	31.03
E7	Over and Lawn Woods SSSI	0.09	9.10	0.30	30.33
E8	Hare Wood AW	0.12	9.36	0.39	31.19
E9	Hare Wood AW	0.09	9.22	0.30	30.74
E10	Hare Wood AW	0.07	9.20	0.22	30.66
E11	Furze Hill SSSI	0.02	10.01	0.06	33.36
E12	Furze Hill SSSI	0.02	10.01	0.07	33.37
E13	Furze Hill SSSI	0.02	10.01	0.07	33.37
E14	Roman Road SSSI	0.03	9.66	0.09	32.19

Receptor		Maximum Predicted Annual Mean NO_x Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E15	Fleam Dyke SSSI	0.02	9.64	0.06	32.13

5.4.5 As shown in Table 43, PCs were below 1% of the EQS at all SSSIs and 100% of the EQS at all AWs. As such, predicted impacts on annual mean NO_x concentrations are not considered to be significant either alone or in-combination with other plans and projects, in accordance with the stated criteria.

5.4.6 Predicted 24-hour mean NO_x PECs at the ecological receptor locations are summarised in Table 44.

Table 44 Predicted 24-hour Mean NO_x Concentrations

Receptor		Predicted 24-hour Mean NO_x PEC (µg/m³)				
		2016	2017	2018	2019	2020
E1	Borley Wood AW	19.94	19.98	19.66	19.66	19.72
E2	Borley Wood AW	20.03	19.62	19.60	19.52	19.69
E3	Borley Wood AW	20.03	20.27	20.10	20.06	20.25
E4	Balsham Wood AW and SSSI	20.07	20.21	21.04	19.95	20.05
E5	Balsham Wood AW and SSSI	20.35	20.04	21.20	21.22	20.80
E6	Balsham Wood AW and SSSI	20.57	21.02	20.01	19.59	19.83
E7	Over and Lawn Woods SSSI	18.71	18.89	18.68	18.74	18.69
E8	Hare Wood AW	19.71	19.67	19.51	20.08	19.35
E9	Hare Wood AW	19.66	19.21	19.03	19.48	19.06
E10	Hare Wood AW	19.31	19.03	18.92	19.06	19.00
E11	Furze Hill SSSI	20.35	20.36	20.32	20.33	20.33
E12	Furze Hill SSSI	20.37	20.38	20.35	20.35	20.35
E13	Furze Hill SSSI	20.39	20.39	20.37	20.35	20.38
E14	Roman Road SSSI	19.62	19.59	19.74	19.81	19.74

Receptor		Predicted 24-hour Mean NO_x PEC (μg/m³)				
		2016	2017	2018	2019	2020
E15	Fleam Dyke SSSI	19.67	19.66	19.51	19.47	19.52

5.4.7 As indicated in Table 44, predicted NO_x concentrations were below the 24-hour mean EQS of 75μg/m³ at all ecological receptor locations.

5.4.8 Maximum predicted 24-hour mean NO_x concentrations at the ecological receptor locations are summarised in Table 45.

Table 45 Maximum Predicted 24-hour Mean NO_x Concentrations

Receptor		Maximum Predicted 24-hour Mean NO_x Concentration (μg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Borley Wood AW	1.04	19.98	1.38	26.64
E2	Borley Wood AW	1.31	20.03	1.74	26.70
E3	Borley Wood AW	1.55	20.27	2.07	27.03
E4	Balsham Wood AW and SSSI	2.32	21.04	3.10	28.06
E5	Balsham Wood AW and SSSI	2.78	21.22	3.70	28.29
E6	Balsham Wood AW and SSSI	2.62	21.02	3.49	28.03
E7	Over and Lawn Woods SSSI	0.87	18.89	1.16	25.18
E8	Hare Wood AW	1.60	20.08	2.14	26.78
E9	Hare Wood AW	1.40	19.66	1.87	26.22
E10	Hare Wood AW	1.05	19.31	1.40	25.74
E11	Furze Hill SSSI	0.38	20.36	0.50	27.14
E12	Furze Hill SSSI	0.40	20.38	0.53	27.17
E13	Furze Hill SSSI	0.41	20.39	0.55	27.19
E14	Roman Road SSSI	0.55	19.81	0.74	26.42
E15	Fleam Dyke SSSI	0.43	19.67	0.57	26.22

5.4.9 As shown in Table 45, PCs were below 10% of the EQS at all SSSIs and 100% of the EQS at all AWs. As such, predicted impacts on 24-hour mean NO_x concentrations are not considered to be significant either alone or in-combination with other plans and projects, in accordance with the stated criteria.

Sulphur Dioxide

5.4.10 Predicted annual mean SO_2 PECs at the ecological receptor locations are summarised in Table 46.

Table 46 Predicted Annual Mean SO_2 Concentrations

Receptor		Predicted Annual Mean SO_2 PEC (µg/m^3)				
		2016	2017	2018	2019	2020
E1	Borley Wood AW	0.81	0.81	0.81	0.81	0.81
E2	Borley Wood AW	0.81	0.81	0.81	0.81	0.81
E3	Borley Wood AW	0.82	0.81	0.82	0.82	0.82
E4	Balsham Wood AW and SSSI	0.82	0.82	0.83	0.82	0.81
E5	Balsham Wood AW and SSSI	0.80	0.81	0.82	0.81	0.80
E6	Balsham Wood AW and SSSI	0.80	0.80	0.80	0.80	0.80
E7	Over and Lawn Woods SSSI	0.75	0.76	0.75	0.75	0.75
E8	Hare Wood AW	0.80	0.81	0.80	0.80	0.80
E9	Hare Wood AW	0.77	0.77	0.76	0.76	0.76
E10	Hare Wood AW	0.76	0.76	0.76	0.76	0.76
E11	Furze Hill SSSI	0.90	0.90	0.90	0.90	0.90
E12	Furze Hill SSSI	0.90	0.90	0.90	0.90	0.90
E13	Furze Hill SSSI	0.90	0.90	0.90	0.90	0.90
E14	Roman Road SSSI	0.83	0.83	0.84	0.84	0.83
E15	Fleam Dyke SSSI	0.81	0.81	0.81	0.81	0.81

5.4.11 As indicated in Table 46, predicted annual mean SO_2 concentrations were below the annual mean EQS of 10µg/m^3 at all ecological receptor locations.

5.4.12 Maximum predicted annual mean SO_2 concentrations at the ecological receptor locations are summarised in Table 47.

Table 47 Maximum Predicted Annual Mean SO_2 Concentrations

Receptor		Maximum Predicted Annual Mean SO_2 Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Borley Wood AW	0.01	0.81	0.10	8.10
E2	Borley Wood AW	0.01	0.81	0.14	8.14
E3	Borley Wood AW	0.02	0.82	0.20	8.20
E4	Balsham Wood AW and SSSI	0.03	0.83	0.28	8.28
E5	Balsham Wood AW and SSSI	0.04	0.82	0.38	8.18
E6	Balsham Wood AW and SSSI	0.02	0.80	0.24	8.04
E7	Over and Lawn Woods SSSI	0.02	0.76	0.19	7.59
E8	Hare Wood AW	0.03	0.81	0.25	8.05
E9	Hare Wood AW	0.02	0.77	0.19	7.69
E10	Hare Wood AW	0.01	0.76	0.14	7.64
E11	Furze Hill SSSI	0.00	0.90	0.04	9.04
E12	Furze Hill SSSI	0.00	0.90	0.04	9.04
E13	Furze Hill SSSI	0.00	0.90	0.04	9.04
E14	Roman Road SSSI	0.01	0.84	0.06	8.36
E15	Fleam Dyke SSSI	0.00	0.81	0.04	8.14

5.4.13 As shown in Table 47, PCs were below 1% of the EQS at all SSSIs and 100% of the EQS at all AWs. As such, predicted effects on annual mean SO_2 concentrations are not considered to be significant either alone or in-combination with other plans and projects, in accordance with the stated criteria.

Ammonia

5.4.14 Predicted annual mean NH_3 concentrations at the ecological receptor locations are summarised in Table 48.

Table 48 Predicted Annual Mean NH_3 Concentrations

Receptor		Predicted Annual Mean NH_3 PEC ($\mu g/m^3$)				
		2016	2017	2018	2019	2020
E1	Borley Wood AW	2.152	2.151	2.151	2.151	2.152
E2	Borley Wood AW	2.152	2.152	2.152	2.152	2.152
E3	Borley Wood AW	2.151	2.152	2.152	2.152	2.151
E4	Balsham Wood AW and SSSI	2.152	2.152	2.153	2.153	2.152
E5	Balsham Wood AW and SSSI	2.152	2.152	2.152	2.152	2.152
E6	Balsham Wood AW and SSSI	1.971	1.972	1.971	1.971	1.971
E7	Over and Lawn Woods SSSI	1.972	1.972	1.972	1.972	1.972
E8	Hare Wood AW	1.971	1.972	1.971	1.971	1.971
E9	Hare Wood AW	1.971	1.971	1.971	1.971	1.971
E10	Hare Wood AW	2.152	2.151	2.151	2.151	2.152
E11	Furze Hill SSSI	2.152	2.152	2.152	2.152	2.152
E12	Furze Hill SSSI	2.151	2.152	2.152	2.152	2.151
E13	Furze Hill SSSI	2.152	2.152	2.153	2.153	2.152
E14	Roman Road SSSI	2.152	2.152	2.152	2.152	2.152
E15	Fleam Dyke SSSI	1.971	1.972	1.971	1.971	1.971

5.4.15 As indicated in Table 48, predicted NH_3 concentrations were above the most precautionary critical level of 1$\mu g/m^3$ at all ecological receptor locations. It should be noted that the critical level is exceeded as baseline at all designations.

5.4.16 Maximum predicted annual mean NH_3 concentrations at the ecological receptor locations are summarised in Table 49.

Table 49 Maximum Predicted Annual Mean NH_3 Concentrations

Receptor		Maximum Predicted Annual Mean NH_3 Concentration (µg/m³)		Proportion of EQS (%)	
		PC	PEC	PC	PEC
E1	Borley Wood AW	0.001	2.151	0.10	215.10
E2	Borley Wood AW	0.002	2.152	0.16	215.16
E3	Borley Wood AW	0.002	2.152	0.24	215.24
E4	Balsham Wood AW and SSSI	0.002	2.152	0.20	215.20
E5	Balsham Wood AW and SSSI	0.003	2.153	0.33	215.33
E6	Balsham Wood AW and SSSI	0.002	2.152	0.23	215.23
E7	Over and Lawn Woods SSSI	0.002	1.972	0.19	197.19
E8	Hare Wood AW	0.002	1.972	0.24	197.24
E9	Hare Wood AW	0.002	1.972	0.16	197.16
E10	Hare Wood AW	0.001	1.971	0.11	197.11
E11	Furze Hill SSSI	0.000	2.150	0.02	215.02
E12	Furze Hill SSSI	0.000	2.150	0.02	215.02
E13	Furze Hill SSSI	0.000	2.150	0.02	215.02
E14	Roman Road SSSI	0.000	2.150	0.03	215.03
E15	Fleam Dyke SSSI	0.000	2.000	0.02	200.02

5.4.17 As shown in Table 49, PCs were below 1% of the EQS at all SSSIs and 100% of the EQS at all AWs. As such, predicted effects on annual mean NH_3 concentrations are not considered to be significant either alone or in-combination with other plans and projects, in accordance with the stated criteria.

Nitrogen Deposition

5.4.18 Predicted annual nitrogen PC deposition rates at the receptor locations are summarised in Table 50.

Table 50 Predicted Annual Nitrogen Deposition Rates

Receptor		Predicted Annual Nitrogen PC Deposition Rate (kgN/ha/yr)				
		2016	2017	2018	2019	2020
E1	Borley Wood AW	33.48	33.47	33.48	33.48	33.48
E2	Borley Wood AW	33.49	33.48	33.48	33.48	33.49
E3	Borley Wood AW	33.49	33.49	33.50	33.49	33.49
E4	Balsham Wood AW and SSSI	33.49	33.49	33.50	33.49	33.48
E5	Balsham Wood AW and SSSI	33.50	33.50	33.52	33.51	33.50
E6	Balsham Wood AW and SSSI	33.49	33.49	33.50	33.49	33.49
E7	Over and Lawn Woods SSSI	32.78	32.79	32.78	32.78	32.78
E8	Hare Wood AW	32.79	32.80	32.79	32.79	32.79
E9	Hare Wood AW	32.72	32.72	32.71	32.71	32.71
E10	Hare Wood AW	32.78	32.78	32.77	32.78	32.78
E11	Furze Hill SSSI	18.76	18.76	18.76	18.76	18.76
E12	Furze Hill SSSI	18.76	18.76	18.76	18.76	18.76
E13	Furze Hill SSSI	18.76	18.76	18.76	18.76	18.76
E14	Roman Road SSSI	18.76	18.76	18.76	18.76	18.76
E15	Fleam Dyke SSSI	18.48	18.48	18.48	18.48	18.48

5.4.19 Maximum predicted annual nitrogen deposition rates at the ecological receptor locations are summarised in Table 51.

Table 51 Maximum Predicted Annual Nitrogen Deposition Rates

Receptor		Maximum Predicted Annual Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of Low EQS (%)	
		PC	PEC	PC	PEC
E1	Borley Wood AW	0.02	33.48	0.17	334.77
E2	Borley Wood AW	0.03	33.49	0.25	334.85

Receptor		Maximum Predicted Annual Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of Low EQS (%)	
		PC	PEC	PC	PEC
E3	Borley Wood AW	0.04	33.50	0.37	334.97
E4	Balsham Wood AW and SSSI	0.04	33.50	0.27	223.34
E5	Balsham Wood AW and SSSI	0.06	33.52	0.41	223.47
E6	Balsham Wood AW and SSSI	0.04	33.50	0.27	223.33
E7	Over and Lawn Woods SSSI	0.03	32.79	0.22	218.62
E8	Hare Wood AW	0.04	32.80	0.42	328.02
E9	Hare Wood AW	0.03	32.72	0.31	327.21
E10	Hare Wood AW	0.02	32.78	0.22	327.82
E11	Furze Hill SSSI	0.00	18.76	0.06	375.26
E12	Furze Hill SSSI	0.00	18.76	0.06	375.26
E13	Furze Hill SSSI	0.00	18.76	0.06	375.26
E14	Roman Road SSSI	0.00	18.76	0.05	187.65
E15	Fleam Dyke SSSI	0.00	18.48	0.03	184.83

5.4.20 As shown in Table 51, PCs were below 1% of the EQS at all SSSIs and 100% of the EQS at all AWs. As such, predicted effects on nitrogen deposition are not considered to be significant either alone or in-combination with other plans and projects, in accordance with the stated criteria.

5.4.21 It should be noted that PECs are predicted to exceed the relevant EQSs at all receptor locations as a base condition.

Acid Deposition

5.4.22 Maximum predicted annual acid deposition rates at the ecological receptor locations are summarised in Table 52.

Table 52 Predicted Annual Acid Deposition Rates

Receptor		Maximum Predicted Annual Acid PC Deposition Rate (keq/ha/yr)		PC Proportion of EQS (%)
		Nitrogen	Sulphur	
E1	Borley Wood AW	0.001	0.002	0.03
E2	Borley Wood AW	0.002	0.003	0.05
E3	Borley Wood AW	0.003	0.005	0.07
E4	Balsham Wood AW and SSSI	0.003	0.007	0.09
E5	Balsham Wood AW and SSSI	0.004	0.009	0.12
E6	Balsham Wood AW and SSSI	0.003	0.006	0.08
E7	Over and Lawn Woods SSSI	0.002	0.005	0.06
E8	Hare Wood AW	0.003	0.006	0.08
E9	Hare Wood AW	0.002	0.005	0.06
E10	Hare Wood AW	0.002	0.003	0.04
E11	Furze Hill SSSI	0.000	0.000	0.01
E12	Furze Hill SSSI	0.000	0.001	0.01
E13	Furze Hill SSSI	0.000	0.001	0.02
E14	Roman Road SSSI	0.000	0.001	0.02
E15	Fleam Dyke SSSI	0.000	0.000	0.01

5.4.23 As shown in Table 52, PCs were below 1% of the EQS at all SSSIs and 100% of the EQS at all AWs. As such, predicted effects on annual acid deposition are not considered to be significant either alone or in-combination with other plans and projects, in accordance with the stated criteria.

6.0 CONCLUSION

6.1.1 Redmore Environmental Ltd was commissioned by Streetly Hall Estate Partnership to undertake an Air Quality Assessment in support of a proposed AD plant at Streetly Hall Farm, West Wickham.

6.1.2 The facility has the potential to cause air quality impacts as a result of emissions from activities on site. As such, an Air Quality Assessment was undertaken in order to determine baseline conditions and quantify potential effects.

6.1.3 Dispersion modelling was undertaken in order to predict pollutant concentrations at sensitive locations as a result of emissions from the development. Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs and significance criteria.

6.1.4 Predicted concentrations of all pollutants were below the relevant EQSs at all locations of human exposure for all meteorological data sets modelled. Resultant impacts were classified as **not significant** in accordance with the IAQM criteria.

6.1.5 Impacts were also predicted at sensitive ecological habitats. Predicted effects on pollutant concentrations and deposition rates were not considered to be significant at all designations, either alone or in-combination with other plans or projects, in accordance with the EA and NE criteria.

7.0 ABBREVIATIONS

APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
AW	Ancient Woodland
BAT	Best Available Technique
CERC	Cambridge Environmental Research Consultants
CHP	Combined Heat and Power
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EAL	Environmental Assessment Levels
EC	European Commission
ELV	Emission Limit Value
EQS	Environmental Quality Standard
LAQM	Local Air Quality Management
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PC	Process Contribution
PEC	Predicted Environmental Concentration
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5µm
PTH	Power to Heat
SCDC	South Cambridgeshire District Council
SO_2	Sulphur dioxide
SSSI	Site of Special Scientific Interest
tpa	Tonnes per annum
z_0	Roughness length
%ile	Percentile

Figures

Legend

Site Boundary

Title

Figure 1 - Site Location Plan

Project

Air Quality Assessment
Streetly Hall Farm, West Wickham

Project Reference

5949-1

Client

Streetly Hall Estate Partnership

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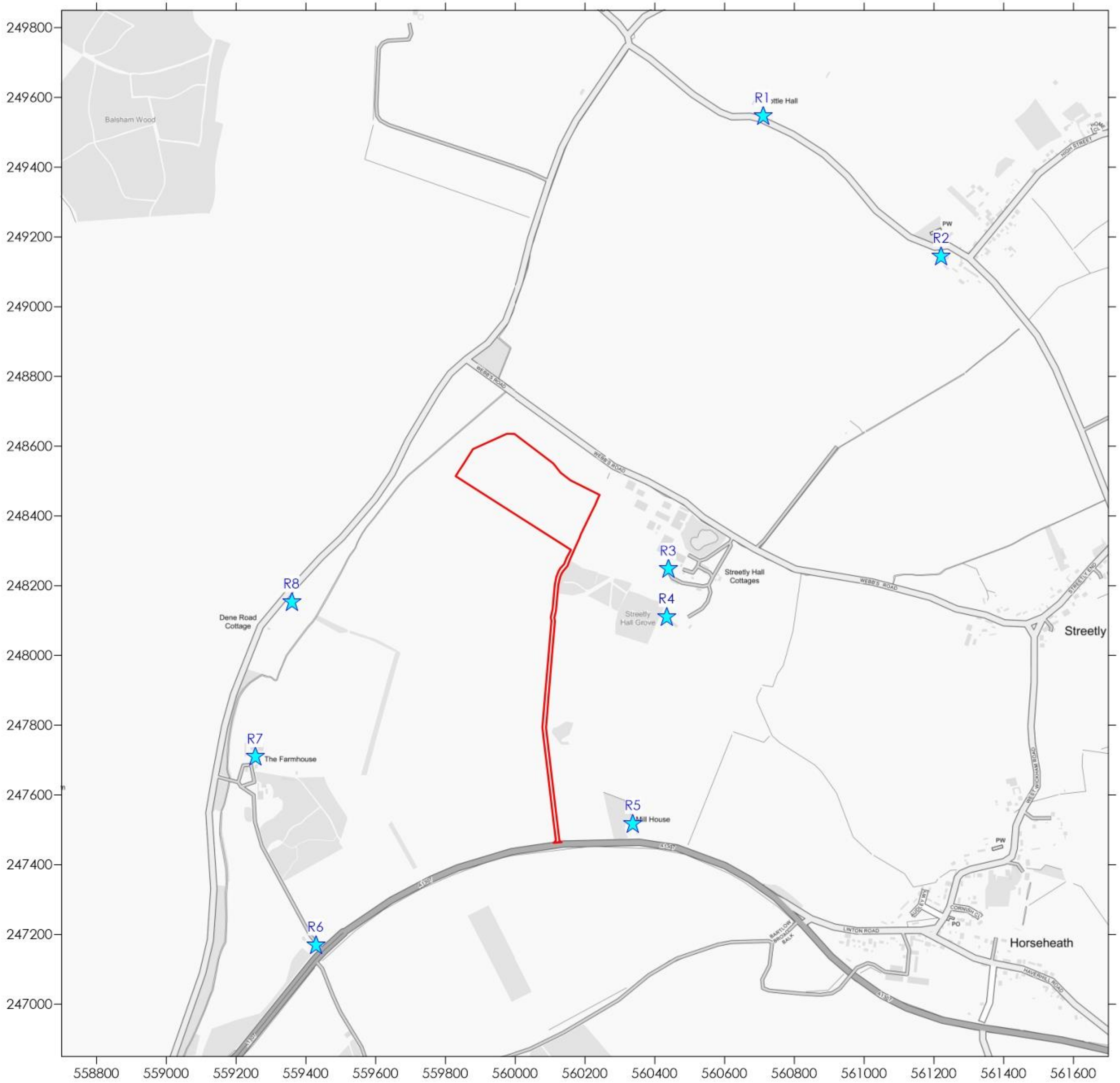

Legend

Site Boundary

Human Receptor

Title

Figure 2 - Human Receptor Locations

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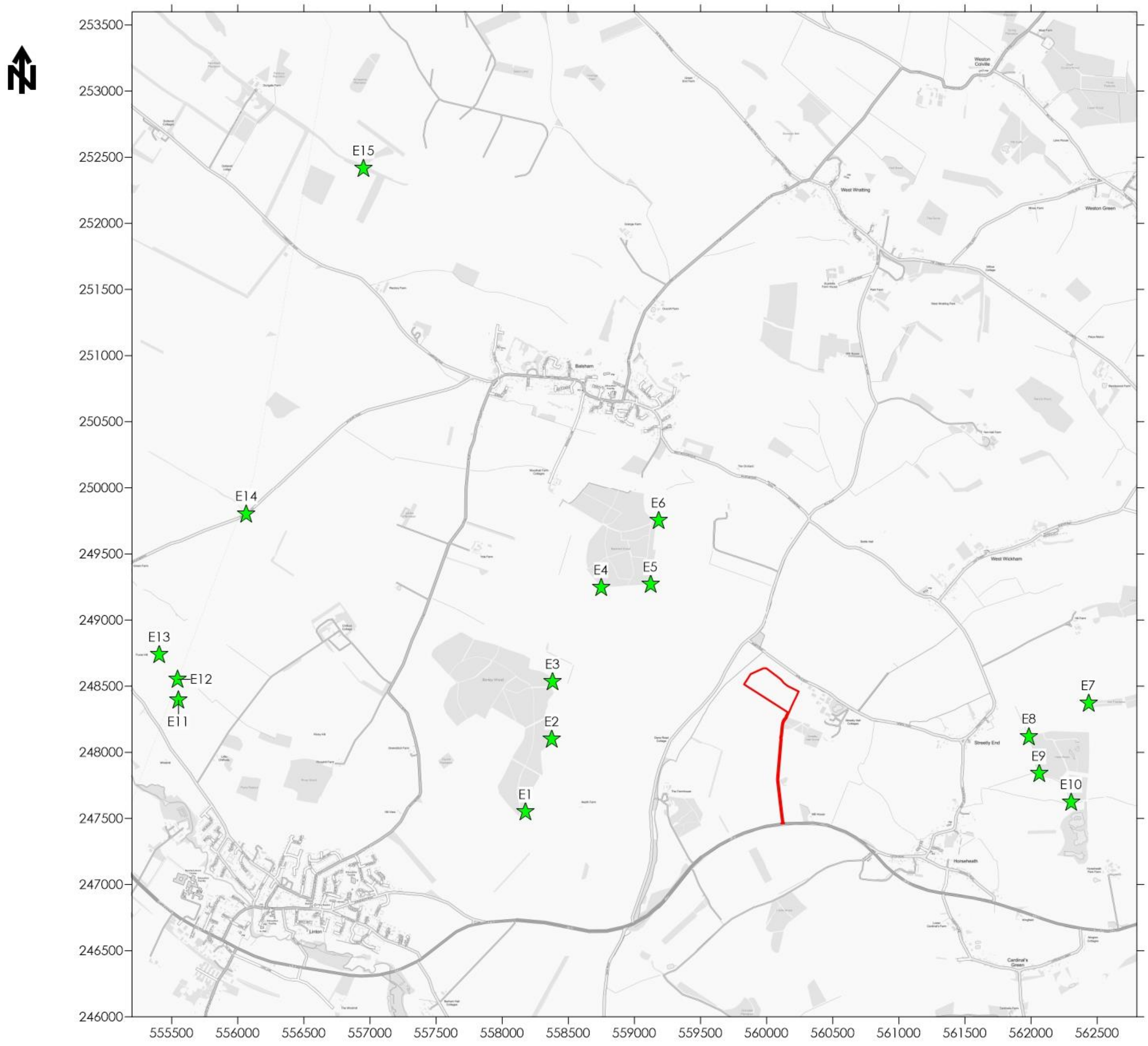

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Site Boundary

Ecological Receptor

Title

Figure 3 - Ecological Receptor Locations

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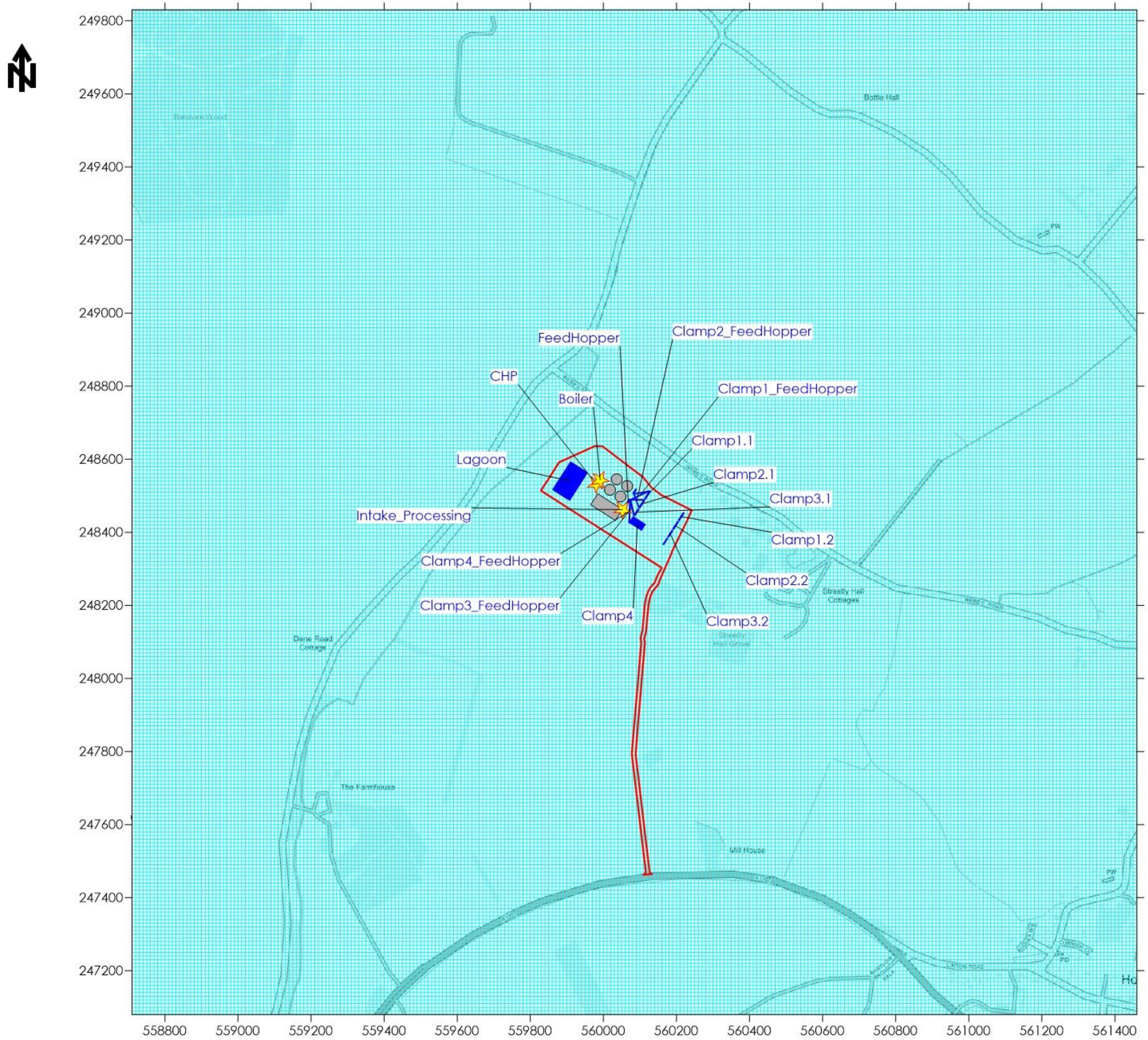

Legend

Site Boundary

Output Grid

Area/ Line Source

Building

Point Source

Title

Figure 4 - ADMS-6 Inputs

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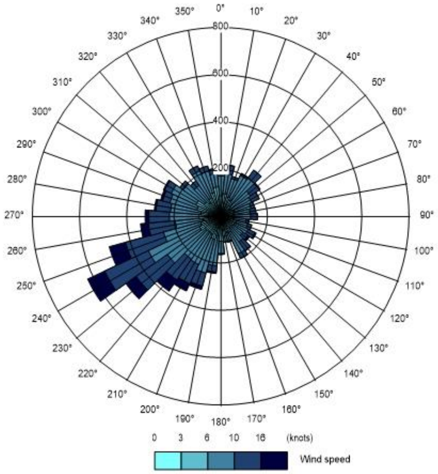
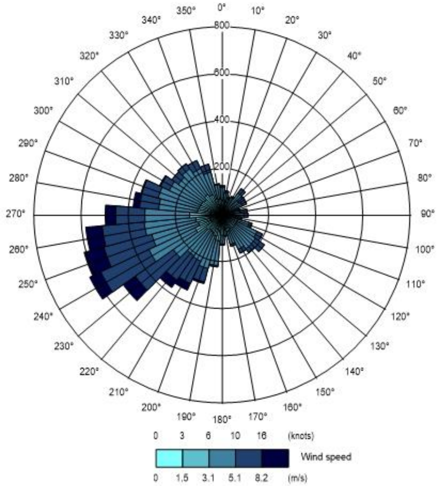
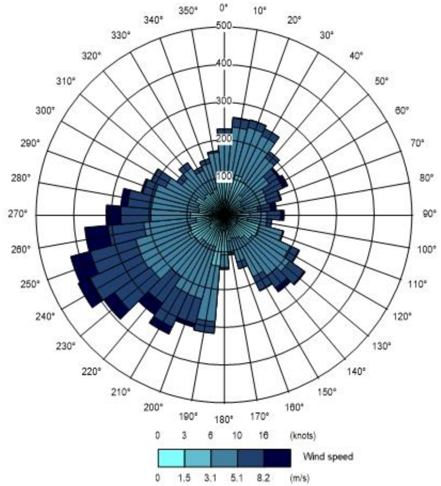


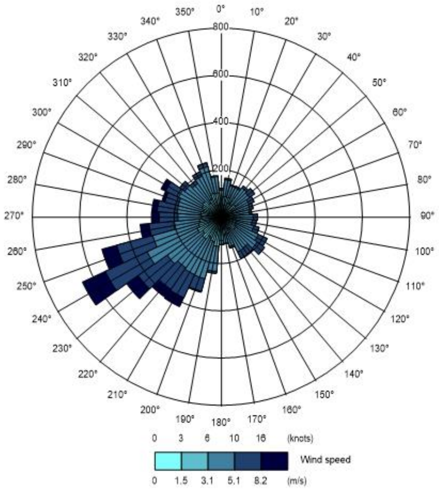
2016 Meteorological Data



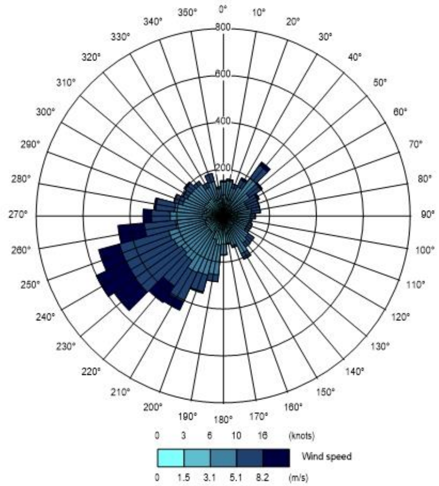
2017 Meteorological Data



2018 Meteorological Data



2019 Meteorological Data



2020 Meteorological Data

Legend

Title

Figure 5 - Wind Roses of 2016 to 2020 Andrewsfield Meteorological Station Data

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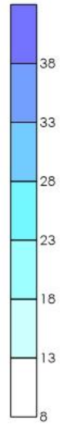
Site Boundary



Annual Mean NO_2 Concentration ($\mu g/m^3$)

Title

Figure 6 - Predicted Annual Mean NO_2 Concentrations ($\mu g/m^3$) 2017 Meteorological Data

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Legend

Site Boundary

100
90
80
70
60
50
40
30
20

99.8th %ile 1-Hour Mean NO_2 Concentration (µg/m³)

Title

Figure 7 - Predicted 99.8th %ile 1-Hour Mean NO_2 Concentrations (µg/m³) 2017 Meteorological Data

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Legend

Site Boundary

39
35
31
27
23
19
15
11
7

99.2nd %ile 24-Hour Mean SO_2 Concentration (µg/m³)

Title

Figure 8 - Predicted 99.2nd %ile 24-Hour Mean SO_2 Concentrations (µg/m³) 2016 Meteorological Data

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Site Boundary

70
60
50
40
30
20
10

99.73rd %ile 1-Hour Mean SO_2 Concentration (µg/m³)

Title

Figure 9 - Predicted 99.73rd %ile 1-Hour Mean SO_2 Concentrations (µg/m³) 2020 Meteorological Data

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Legend

Site Boundary

15
25
35
45
55
65
75

99.9th %ile 15-Minute Mean SO_2 Concentration (µg/m³)

Title

Figure 10 - Predicted 99.9th %ile 15-Minute Mean SO_2 Concentrations (µg/m³) 2020 Meteorological Data

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