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Odour Assessment for Planning Permission

Deal Farm Biogas, Kenninghall Road, Bressingham, Norfolk

Deal Farm Biogas Limited

CRM.0150.002.AQP.R.004

'Experience and expertise working in union'

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Odour Assessment for Planning Permission - CRM.0150.002.AQP.R.004

Project:	Deal Farm Biogas, Kenninghall Road, Bressingham, Norfolk
For:	Deal Farm Biogas Limited
Status:	1st Issue
Date:	June 2022
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Non-Technical Summary

i. Enzygo Limited was commissioned by Deal Farm Biogas Limited to undertake an Odour Assessment in support of the application for an Anaerobic Digestion Plant (part retrospective), including 2 no. separate digestate storage lagoons at Deal Farm, Kenninghall Road, Bressingham, Norfolk.

ii. During the operation of the plant there is the potential for impacts to occur at sensitive locations due to odour emissions from a number of sources at the plant. An Odour Assessment was therefore undertaken to consider effects in the vicinity of the site.

iii. Potential odour emissions were defined based on the proposed plant operation and a review of literature and emissions used at similar facilities. Robust assumptions were used to consider odour emissions the manure types proposed in this facility.

iv. The proposals will result in the removal or control of other odour sources in the vicinity of the site and the closest sensitive receptors. These potential improvements have not been included within the assessment to provide a robust assessment.

v. These were represented within a dispersion model. Impacts at sensitive receptor locations in the vicinity of the site were quantified, the results compared with the appropriate odour benchmark level.

vi. Predicted odour concentrations were below the relevant benchmark level at all sensitive receptors in the vicinity of the site for all modelling years.

vii. In addition, using the IAQM guidance significance criteria, worst case impacts were slight at 2 receptors and negligible at all other representative sensitive receptors and overall impacts are there considered as not significant.

viii. As such, considering the results and robust assumptions made, overall potential for odour impacts generated by the AD facility can be considered as not significant, and the AD facility is therefore not considered to represent a constraint to planning permission in regard to odour.

1.0 Introduction

1.1 Background

1.1.1 Enzygo Limited was commissioned by Deal Farm Biogas Ltd to undertake an Odour Assessment in support of the application for an Anaerobic Digestion Plant (part retrospective), including 3 no. separate digestate storage lagoons at Deal Farm, Kenninghall Road, Bressingham, Diss, Norfolk.

1.1.2 During the operation of the plant there is the potential for impacts to occur at sensitive locations due to odour emissions from a number of sources at the plant. An Odour Assessment was therefore undertaken to consider effects in the vicinity of the site.

1.1.3 The report supersedes previous revisions and has been updates to take account of a known input waste mix, further emissions sources and known emissions controls.

1.1.4 It is understood that the annual mass of waste types inputted to the site are known and is as follows:

- Pig manure – 2750 tonnes per annum (tpa);
- Pig manure mixed with straw – 2750 tpa;
- Poultry manure 500 tpa;
- Straw – 9450 tpa;
- Maize – 3500 tpa; and
- Grass – 5000 tpa.

1.1.5 This waste mix has been considered in this updated assessment.

1.2 Consideration of Comments Received

1.2.1 Comments have been made by the Environmental Protection Department on the previous odour assessment submitted with the previously withdrawn application 2021/2788 and can be summarised as below:

- Further consideration should be made as both liquid and solid digestate odour emissions; and
- Comments on the use of a worst case emissions from manure.

1.2.2 This assessment now includes emissions from the liquid digestate storage in the off-site lagoons, tanker collection points and solid digestate on site prior to removal.

1.2.3 Whilst a worst case assessment would assume that 100% of the manure tank would contain poultry manure, the expected waste input to the site shown in Section 1.1.3 shows that this would be a large and unrealistic overestimate of actual emissions. Notwithstanding this, emissions from the manure storage have been based on the highest emissions rates (poultry manure) and then taken account of the straw mixing, storage cover and containment from the storage building. The resulting emission used is higher than that expected for pig manure alone and is therefore seen as a highly robust assumption from this source.

1.3 Site Location and Context

1.3.1 The facility is located on land at Deal Farm, Kenninghall Road, Bressingham, Norfolk, at National Grid Reference (NGR): 608520, 283550. Reference should be made to Figure 1 and Figure 2 for a map of the site and surrounding area.

1.3.2 The site is located in a predominantly agricultural area with a sparse mixture of working farms and residential properties in the vicinity of the site. The nearest residential property is Deal Farm itself, approximately 124 m to the southwest of the proposed facility. The nearest residential property which is not associated with the facility is Villa Farm approximately 170m to the south of the proposed facility on Kenninghall Road.

1.3.3 It is proposed to operate an AD plant that will be fuelled by biomass feedstock in form of energy crops, straw and farmyard manures (FYM). The biogas produced by the AD process will be upgraded for injection into the gas grid.

1.3.4 The proposed AD Facility will comprise of the following primary elements:

- Agricultural manure acceptance and storage;
- Crop (such as rye, grass and maize) storage in silage clamps;
- Liquid slurry acceptance via the filling station and storage in an enclosed prelim tank;
- Pasteurisation process;
- Anaerobic digestion of the feedstock and storage of digestate in digester tanks;
- Biogas collection, storage and treatment;
- Biogas combustion – back-up biogas boiler & emergency flare;
- Biogas upgrading to biomethane and injection into the gas grid;
- Transfer of digestate via pipes to off-site lagoons; and
- Natural gas combustion through a combined heat and power plant (CHP).

1.3.5 The process can briefly be described as follows:

- Feedstock - The site will operate using biomass feedstock in the form of non-waste energy crops (e.g. maize, grass and rye), straw, agricultural by-products and FYMs (e.g. duck, chicken, cattle and pigs). The crops will be transported to site during typical harvest periods prior to unloading within the three silage clamps. The clamps will be covered using oxygen barrier and protective sheeting. This will form an airtight layer to minimise emissions, ensuring the ensiling process can complete and preserve the feedstock throughout the year. The clamp cover will be open at one end to allow access to the feedstock for transportation into the feed hopper. FYMs will be imported to site and deposited in the open storage clamp, before transfer into the feed system. The manures delivered to the site are not pure and are typically mixed with a minimum 50% straw bedding. Leachate from the materials will be collected in sealed storage tanks before use in the process or removal from the site;
- Operation - The feedstock will be digested within the plant in completely sealed tanks. The biogas produced (a mixture of methane (CH_4) and carbon dioxide (CO_2) will be

stored in the fermenters prior to upgrade for export to the grid . The heat from the natural gas CHP will be used to provide heat to the pasteurisation tanks when required. A flare and a biogas boiler are also included at the plant for emergency venting of biogas during abnormal operation and as a backup heat supply when the CHP is not operating; and

- Digestate - The process will create digestate which can be used as a high quality fertiliser. This will undergo a pasteurisation process on site to remove pathogens and make the material suitable for application to land. The digestate will be separated into a "solid" and "liquid" fraction. The solid fraction is stored in a clamp before removal by tractor/trailer and the liquid fraction is reused in the digesters or transported to off-site storage by underground piping to off-site lagoons.

1.3.6 The activities associated with the proposed plant are controlled under the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. As such, the operator will be required to obtain an Environmental Permit from the Environment Agency (EA) as the appropriate regulator prior to operation.

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

1.3.8 Reference should be made to Figure 1 and Figure 2 for a site layout plan and identification of modelled odour sources.

2.0 Legislation Guidance and Policy

2.1 Odour Impact

2.1.1 The following legislation and guidance will be considered and adhered to during the preparation of the Odour Impact Assessment:

- H4: Odour Management, EA, 2011[1];
- Odour Guidance for Local Authorities (withdrawn), Department for Environment, Food and Rural Affairs (DEFRA), 2010[2]; and
- Guidance on the Assessment of Odour for Planning, IAQM, 2018[3].

2.1.2 The magnitude of odour impact depends on a number of factors and the potential for complaints varies due to the subjective nature of odour perception. The FIDOL acronym is a useful reminder of the factors that will determine the degree of odour pollution:

- Frequency of Detection - frequent odour incidents are more likely to result in complaints;
- Intensity as Perceived - intense odour incidents are more likely to result in complaints;
- Duration of Exposure - prolonged exposure is more likely to result in complaints;
- Offensiveness - more offensive odours have a higher risk of resulting in complaints; and
- Location - the type of land use and nature of human activities in the vicinity of an odour source. Tolerance and expectation of the receptor. The 'Location' factor can be considered to encompass the receptor characteristics, receptor sensitivity, and socio-economic factors.

2.1.3 It is important to note that even infrequent emissions may cause loss of amenity if odours are perceived to be particularly intense or offensive.

2.1.4 The FIDOR factors can be further considered in conjunction with the following in regard to the potential for an odour emission to cause a nuisance:

- The rate of emission of the compound(s);
- The duration and frequency of emissions;
- The time of the day that this emission occurs;
- The prevailing meteorology;
- The sensitivity of receptors to the emission i.e. whether the odorous compound is more likely to cause nuisance, such as the sick or elderly, who may be more sensitive;
- The odour detection capacity of individuals to the various compound(s); and

[1] H4: Odour Management, Environment Agency (EA), 2011

[2] Odour Guidance for Local Authorities, DEFRA, 2010

[3] Guidance on the Assessment of Odour for Planning, IAQM, 2018 – Version 1.1.

- The individual perception of the odour (i.e. whether the odour is regarded as unpleasant). This is greatly subjective and may vary significantly from individual to individual. For example, some individuals may consider some odours as pleasant, such as petrol, paint and creosote.

2.2 Odour Measurement

2.2.1 The concentration at which an odour is just detectable to a "typical" human nose is referred to as the "threshold" concentration. This concept of a threshold concentration is the basis of olfactometry in which a quantitative sensory measurement is used to define the concentration of an odour. Standardised methods for measuring and reporting the detectability or concentration of an odour sample have been defined by European standard BS:EN 13725:2003. The concentration at which an odour is just detectable by a panel of selected human "sniffers" is defined as the detection threshold and has an odour concentration of 1 European odour unit per cubic metre (1 ou_E/m^3).

2.2.2 An odour at a strength of 1 ou_E/m^3 is in reality so weak that it would not normally be detected outside the controlled environment of an odour laboratory by the majority of people (that is individuals with odour sensitivity in the "normal" range - approximately 96% of the population). As an odour becomes more concentrated, then it gradually becomes more apparent. Some guidance as to concentrations when this occurs can be derived from laboratory measurements of intensity. The following guideline values have been stated by DEFRA2 to provide some context for discussion about exposure to odours:

1 ou_E/m^3 is the point of detection;

5 ou_E/m^3 is a faint odour; and

10 ou_E/m^3 is a distinct odour.

2.2.3 It is important to note that these values are based on laboratory measurements and in the general environment other factors affect our sense of odour perception, such as:

- The population is continuously exposed to a wide range of background odours at a range of different concentrations, and usually people are unaware of there being any background odours at all due to normal habituation. Individuals can also develop a tolerance to background and other specific odours. In an odour laboratory the determination of detection threshold is undertaken by comparison with non-odorous air, and in carefully controlled, odour-free, conditions. Normal background odours such as those from traffic, vegetation, grass mowings etc, can provide background odour concentrations from 5 to 60 ou_E/m^3 or more.

- The recognition threshold may be about 3 ou_E/m^3, although it might be less for offensive substances or higher if the receptor is less familiar with the odour or distracted by other stimuli; and

- An odour which fluctuates rapidly in concentration is often more noticeable than a steady odour at a low concentration.

2.3 Odour Legislative Control

2.3.1 The main requirement with respect to odour control from industrial activities is the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments. If a process is deemed potentially odorous then the relevant regulator will

usually include an appropriate condition in the site's Environmental Permit to restrict impacts beyond the facility boundary.

2.3.2 Enforcement of the condition is by the relevant regulator, either the EA for Part A(1) processes, or the Local Authority for Part (A2) and B processes. If the regulator is satisfied that odour from a facility is causing pollution beyond the site boundary then they can serve an improvement notice that requires remedial works to be undertaken to reduce impacts to an acceptable level. The measures that are deemed appropriate will depend on the industry sector and site-specific circumstances and will take costs and benefits into account. Should appropriate actions not be taken by the operator then the regulator has a number of available options, cumulating in the revocation of the Environmental Permit and cessation of all activities on site

2.4 Odour Benchmark Levels

Environment Agency: H4

2.4.1 The H4 guidance[1] provides benchmark levels to assess relevant exposure to determine impacts from potential operations and practices regulated under the Environmental Permitting (England and Wales) Regulations (2018) and subsequent amendments.

2.4.2 Modelled concentrations above the relevant benchmark levels detailed in Table 1 would therefore indicate unacceptable odour exposure. Benchmark levels are stated as the 98th percentile (%ile) of hourly mean concentrations in ou_E over a year. This means benchmarks should not be exceeded for more than 2% of the hours in a year or approximately 175 hours per year. This takes account of a reasonable amount of tolerance that can be expected by subjects to occasional odours.

2.4.3 EA odour benchmark levels are summarised in Table **1**.

Table 1 Odour Benchmark Levels

Relative Offensiveness of Odour	Benchmark Level as 98th%ile of 1-Hour Means (ou_E/m^3)
Most Offensive Odours: Processes involving decaying animal or fish Processes involving septic effluent or sludge Biological landfill odours	1.5
Moderately Offensive Odours: *Intensive livestock rearing* Fat frying (food processing) Sugar beet processing Well aerated green waste composting	3.0
Less Offensive Odours: Brewery Confectionery Coffee roasting Bakery	6.0

2.4.4 It is considered that odours from the facility would be similar to that for intensive livestock and therefore likely be classified as 'moderately offensive', in accordance with the criteria shown in Table 1.

2.5 Institute of Air Quality Management Guidance

2.5.1 The IAQM guidance[3] specifically deals with assessing odour impacts for planning purposes, namely potential effects on amenity. The assessment methodology outlined in the guidance has been utilised in throughout this report where relevant.

2.5.2 It is therefore considered that this is the most relevant current guidance for methodology for assessment.

2.6 National Planning Policy

2.6.1 The National Planning Policy Framework (NPPF) was revised on 20 July 2021[4] and sets out the Government's core policies and principles with respect to land use planning, including air quality. The document includes the following considerations which are relevant to this assessment:

"Planning policies and decisions should contribute to and enhance the natural and local environment by:

[…]

"Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality"

2.6.2 The implications of the NPPF have been considered during the production of this report.

[4] National Planning Policy Framework, Department for Communities and Local Government, 2021

3.0 Methodology

The operation of the AD plant will result in odour emissions during normal operations. These were assessed in accordance with the following stages:

- Identification of odour sources;
- Identification of odour emission rates;
- Dispersion modelling of odour emissions; and
- Comparison of modelling results with relevant criteria.

The following Sections outline the methodology and inputs used for the assessment.

3.1 Odour Sources

3.1.1 Potential odour sources were identified from the proposed process. These included:

- Exposed maize, grass and rye within silage clamps;
- FYM stored with the manure clamp;
- Exposed maize, grass, rye and FYM during transfer to the feeder;
- Exposed and agitated material within the feeder hopper;
- Air released during filling of the Pasteurisation Tanks;
- Emissions from liquid digestate storage lagoons; and
- Emission from road tankers at digestate filling points.

3.1.2 Deal Farm Biogas Limited confirmed that the AD process itself is sealed and therefore does not form a source of odour, or other emissions such as CH_4 or Hydrogen Sulphide (H_2S), under normal operation. Should releases of these species occur then this would indicate a fault with the plant and immediate remedial measures would be taken to eliminate the problem to avoid seriously affecting the AD process, with associated financial consequences for the operator.

3.1.3 Following the AD process, the digestate will be pasteurised to stabilise it and remove pathogens. It has been confirmed that this process does not agitate the material as assumed in previous reports. The emissions from this process will be passed through a scrubbing plant to eliminate ammonia emissions and much of the odours removed. However to consider as worst case assessment this source as the efficacy of odour removal was not known at the time of writing the report.

3.1.4 Liquid digestate created by the process will be transported off the site by underground piping to 2 off-site lagoons or 2 tanker collection points.

3.1.5 The lagoons will be covered with a 2mm impermeable floating layer to control emissions. Residual emissions will be via vents surrounding the lagoons. These emissions have been included within this updated assessment.

3.1.6 The tanker collection points will be used a maximum of once per week in total. During tanker filling there is the potential for short term odour emissions from displaced air within the tanker.

These emissions have been included within this assessment as they have the potential to affect the immediate locality over a short period although the contribution to annual mean concentrations will be very low.

3.1.7 The pasteurised solid fraction (non odourous) will be removed by tractor/trailer however it will be temporarily stored on site prior to removal. Therefore this potential odour source has now been included within the model.

3.1.8 With regards to the assessment additional emissions such as Carbon Dioxide (CO_2), H_2S and Particulate Matter (PM), Deal Farm Biogas have confirmed the plant Includes a raw gas treatment unit to remove such species from the system. The treatment plant effectively captures CO_2 emissions and scrubs both H_2S and PM emissions within the raw gas via adsorption methods, activated carbon and particulate filters. It should be noted that only H_2S is considered as a potentially odourous emission.

3.1.9 Following the capture of CO_2 the raw gas in compressed and fed into the adsorption column where it passes through a bed of activated carbon, ensuring the complete removal of H_2S, and then to a downstream filter, which ensures a complete removal of PM matter. The remaining CO_2 is then condensed and enters a liquefier where it is cooled and enclosed within the collection vessel to the transfer pump.

3.1.10 Similarly, the CHP unit and flare will only emit products of combustion which do not typically have any associated odour. As such, they have not been considered as potential sources in the context of this assessment. Reference should be made to CRM.0150.001.AQ.R.004 for the assessment of associated on-site pollutant emissions.

3.1.11 Feedstock delivery of crops, will only be undertaken for short-periods, with materials quickly compacted, covered and sealed once deposited in the clamps. Odour emissions from these sources are therefore likely to be short in duration and controlled effectively once the relevant materials are contained. As such, they are not anticipated to be significant in the context of the other sources considered with the assessment and were not included within the dispersion model.

3.1.12 Delivery of FYM will be undertaken every 7 days as a maximum. These will be transferred to site and deposited in the manure clamp within an agricultural building. Manure will be constantly covered with a thick layer of straw (or similar cover) to control odour and ammonia emissions.

3.1.13 Feedstock will be transferred from the clamps by loader into the feeding unit for 2 periods each day for a period of 2 hours for each period.

3.1.14 Digestate will be pasteurised in a total of 6 tanks. As the tanks are filled displaced air will be released via swan-neck vents on each tank. The digestate will be pasteurised to remove pathogens. It has been confirmed that this process does not agitate the material as assumed in previous reports. The emissions from this process will be passed through a scrubbing plant to eliminate ammonia emissions and much of the odours removed. However to consider as worst case assessment this source as the efficacy of odour removal was not known at the time of writing the report.

3.1.15 The pasteurised solid fraction will be deposited to a clamp be regularly removed by tractor/trailer from the site every other day.

3.2 Dispersion Modelling

3.2.1 Dispersion modelling was undertaken using ADMS 5 (v5.2), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd which is widely accepted by the EA and local authorities across the UK

3.2.2 Reference should be made to Figure 1 and Figure 2 for a graphical representation of the dispersion model inputs and parameters.

3.3 Modelling Scenarios

3.3.1 The scenarios considered in the modelling assessment are summarised in Table 2.

Table 2 Dispersion Modelling Scenarios

Pollutant	Modelled As	
	Short Term	Long Term
Odour	98th%ile 1-hour mean	n/a

3.3.2 Since the facility is not operational, it was not possible to monitor site specific emissions. In the absence of such information for specific odour sources, these were based on a review of existing literature and odour monitoring data reported at similar AD plants and are therefore considered to provide representative inputs for an assessment of this nature.

3.3.3 Odour emission rates are summarised in Table 4. Where a variation in odour rates was researched, the higher rate was used to provide a robust assessment, these are highlighted in **bold.**

Table 3 Odour Emission Rates

Source	Odour Emission Rate	Unit	Reference
Maize Silage	20.0	$ou_E/m^2/s$	Odournet UK Ltd(1)
Maize	18.7	$ou_E/m^2/s$	REC Ltd(2)
Maize, rye, barley, sugar beet, fodder beet, grass and other whole crops	**20.0**	$ou_E/m^2/s$	ADAS(3)
Chicken	**77.0**	$ou_E/m^2/s$	Sniffer (4)
Chicken	75.0	$ou_E/m^2/s$	Odournet UK Ltd(5)
Duck manure	20.0	$ou_E/m^2/s$	Sniffer (4)
Cattle manure	0.8	$ou_E/m^2/s$	Odournet UK Ltd(5)
Pig manure	1.35	$ou_E/m^2/s$	Odournet UK Ltd(5)
Dewatered Digestate	2.8	$ou_E/m^2/s$	Odournet UK Ltd(6)
Dewatered Digestate	**10.0**	$ou_E/m^2/s$	Odournet UK Ltd(5)
Liquid Digestate	**1.0**	$ou_E/m^2/s$	University of Liège and Universidad Politécnica de Valencia(7)
Liquid digestate tanker vehicle	**10,000**	ou_E/m^3	Odournet UK Ltd(6)

Notes:
(1) Odour Impact Assessment for a proposed Crop CHP Plant at Stoke Bardolph, Nottinghamshire, Odournet UK Ltd;
(2) Odour Assessment Biomass Renewable Energy Unit Spring Farm, Taverham, Resource and Environmental Consultants Ltd.
(3) An Odour Impact Study for a Proposed Agricultural Anaerobic Digester at Cleat Hill Farm, Haunton,ADAS;

(4) Sniffer ER26: Final Report March / 2014, SCAIL-Agriculture update;
(5) Odour Impact Assessment for a proposed Anaerobic Digestion facility near Kenninghall, Norfolk, Odournet UK Ltd
(6) Odour Impact Assessment for a proposed Anaerobic Digestion facility in Chatteris, Cambridgeshire, Odournet UK Ltd
(7) Multi-method Monitoring of Odor Emissions in Agricultural Biogas Facilities, Jacques Nicolas, Gilles Adam, Yolanda Ubeda, Anne-Claude Romain, University of Liège and Universidad Politécnica de Valencia

3.3.4 As indicated in Table 3 the maximum odour emissions would be derived from chicken manure. FYMs are proposed to be c.91.5% pig manure with straw and c.8.5% poultry manure. As shown in Table 3 the odour emission rate for pig manure is much lower than that for poultry manure. However to ensure a robust assessment, all odour emissions from the manure clamp, transfer route and feeder were assumed to be that from chicken manure. Actual emissions are likely to be much less than this.

3.3.5 Pig manure is estimated to approximately 50% mixed with straw which would reduce the odour emissions from this source by approximately half. In addition all manure stored is proposed to be covered with an emission controlling layer. Initially this is proposed to be straw. A layer of at least 8 inches can be expected to give an odour emission reduction of at least 50%[5]. Further emissions reductions are provided by housing the manure storage in a completely enclosed agricultural building. This reduction in air flow and containment on the manure could reduce emissions by a further 50%.

3.3.6 To use a highly conservative approach an emission of 20 $ou_E/m^2/s$ has been used to represent manure clamp odour emissions and in this assessment.

3.3.7 Table 3 shows that maize, grass and rye and similar feedstocks are likely to have comparable odour generating characteristics. As such, an emission rate of 20 $ou_E/m^2/s$ was applied to all energy crops in the dispersion model.

3.3.8 The digestate emissions from the pasteuriser tanks will be undergoing a drying process and therefore the higher of the values, 10 $ou_E/m^2/s$, was used for this assessment to represent the expelled air from these tanks. Aside from the slow emitting vents, the tanks are sealed and therefore a high level of emission control can be expected similar to that an impermeable tank under negative pressure. As such a 95% reduction in odour emissions can be expected[5]. Further emission controls will be given by the proposed ammonia scrubber although as the odour efficacy was not known at the time of writing the report no further control of this source was included.

3.3.9 Liquid digestate in the lagoons will be completely covered by impermeable floating plastic sheets which will reduce emissions considerably by avoiding exposure to meteorological conditions. To use a robust assessment this was considered to give a reduction of 50%.

3.3.10 To avoid over pressurisation, residual gases will be released via vents around the perimeter of the lagoons. It is understood that these will be spaced approximately 30 m apart and therefore each lagoon is estimated to provide six 0.1 m diameter vents. The emissions were therefore based on an emission rate of 0.5 $ou_E/m^2/s$ over the measured lagoon areas and then divided equally as point source emissions from the vents.

3.3.11 Following separation to solid portion of the digestate collects in a clamp which is regularly removed from the site by tractor/trailer. However to assume a worst case approach an emission of the higher odour rate of 10 $ou_E/m^2/s$ over the tank area. It is proposed to provide a roof over the tank with an extract vent to the ammonia scrubber. This is likely to reduce

[5] https://extension.umn.edu/manure-air-and-water-quality/covers-manure-storage. University of Minnesota. 2018

emissions from this source significantly however to consider a worst case these controls have not been included within the assessment.

3.3.12 The emission rates shown in Table 3 were utilised with additional information provided by Deal Farm Biogas Limited to define emissions within the dispersion model. These are summarised in Table 4.

Table 4 Emissions

Source	Odour Emission	Unit	Characteristics
Silage Clamps	20.0	$ou_E/m^2/s$	c. 330m^2 of silage exposed constantly within clamp
Manure Clamp	20.0	$ou_E/m^2/s$	c. 227m^2 of manure mixed with hay exposed within the clamp
Depositing of Manure	385.0	$ou_E/m^2/s$	c. 227m^2 of manure disturbed within clamp for 1 hour per week
Transfer from Silage Clamps to Feed Hoppers	38.5	$ou_E/m^2/s$	2 hours transfer from clamps to feeder twice per day
Agitated material within Feeder Hopper	385.0	$ou_E/m^2/s$	c. 33m^2 agitated material in each feeder for 2 hour period twice per day
Digestate within each pasteurisation tank	0.5	$ou_E/m^2/s$	c. 4.91m^2 exposed area within each 2.5m diameter tank. 95% odour emission control from tank. With an air exchange within each tank of 15.7 hours this would give a concentration within a half full tank of 14137 ou_E/m^3.
Emission from each tank	4.91	ou_E/s	19.63m^3 volume of air in tank with 1.25m^3/hr air expelled
Liquid digestate lagoon vents	0.5	$ou_E/m^2/s$	2155 m^3 and 2250 m^3 lagoon areas emitted as 179.6 ou/s and 187.5 ou/s from lagoons A and B respectively
Liquid digestate tanker filling point	122.22	ou_E/s	22 m^3 tank air expelled over 1800 seconds.
Solid digestate	10.0	$ou_E/m^2/s$	Exposed area in tank of material

3.3.13 The emission characteristics summarised within Table 4 include the following assumptions:

- The area of the silage clamp constantly uncovered represents an exposed face of the silage along its entire length. The uncovered clamp area will vary throughout operation depending on the levels and type of stored feedstock. As such, the assumption that three clamps will be exposed at all times is considered to provide a conservative over estimation;
- The emissions for FYMs are given for pure and raw manures and based on 100% poultry manure. Deal Farm Biogas Ltd have confirmed that FYMs are delivered to the site a manure/hay mixture comprises of at least 50% straw. Therefore, the emissions rates for manures have been reduced by 50% to take account of this. Further 50% reductions could be provided by a straw covering and a housing building respectively.
- The delivery and subsequent agitation of FYMs was represented by an increased emission of 10 times that from the manure clamp for a 1 hour period each week.

- The feedstock transfer routes from the proposed clamps to the dry feeder was modelled as a 1.3m wide area source, the maximum distance was used from the path from the manure clamp to the feeder hopper;

- The emissions from the pasteurisation tanks are based on an average air flow of 1.25 m^3/hr from each tank and an average headspace in the tank of 2m (half full). This equates to an air exchange every 15.7 minutes and an odour concentration in each half full tank of 14,137 ou_E/m^3;

- The pasteurisation tanks emit via a swan neck valve. To consider this release characteristic emissions were modelled at release height with ambient velocity and a diameter of 0.1 m;

- The liquid digestate collection points cause emissions as air expelled from the tankers when filled. Tankers are understood to be 22 m^3 capacity and a filling time of 30 minutes has been used to calculate an air flow rate from the tanker of 22 m^3 / 1800 s = 0.0012 m^3/s; and

- All odour emissions were at ambient velocity and temperature as a robust assumption.

3.3.14 It is important to note that the operation of the proposed facility would result in the removal or control of other odour sources in the vicinity of the site namely:

- Existing 'muck pads' – these currently hold all manures from Deal Farm that are proposed to go the AD plant as part of this development. The closest of which to the site is adjacent to the most sensitive receptors and emits controlled odours that would impact upon properties to the south of Deal Farm. The proposals would provide better containment of these odour sources as well as effectively moving them some 190 m to the north; and

- Existing silage – this is currently located c. 100 m to the north of the closest sensitive receptors directly on bare ground. Moving this material into the proposed silage clamp would not only move the source to a greater distance from these receptors but provide a hardstanding and leachate collection facility to contain pollution and the spread of odours.

3.3.15 The removal of these sources has not been considered in this assessment and provides a further indication that the findings of this assessment can be considered as robust.

3.4 Time Varied Emissions

3.4.1 Emissions for the silage and FYM clamps were assumed to be constant, with the plant in operation 24-hours per day, 365-days per year, with the FYM clamp disturbed for a maximum of 1 hour per week during deliveries. Emission releases from the pasteurisation tanks were also assumed to be constant.

3.4.2 Deal Farm Biogas Ltd confirmed that the filling of the feeder unit, as well as the transfer of feedstock from the silage and FYM clamps would occur for approximately twice and for a maximum of 2 hours per day. A time-varied file was therefore applied to represent these conditions.

3.4.3 Deal Farm Biogas Ltd confirmed that the collection of liquid digestate from the 2 designated points will occur from either site for a maximum of 1 once per week. It is not known which

collection point would be used and there a time-varied file was therefore applied to represent a collection from both locations each week.

3.4.4 Modelling of all sources is therefore considered to provide conservative short-term pollutant concentration predictions which do not account for periods of reduced workload.

3.5 Assessment Extents

3.5.1 Ambient concentrations were modelled over the following area using the gridded output function with ADMS-5 model:

- NGR: 607500, 282570 to 609560, 284350.

3.5.2 Results were subsequently used to produce contour plots within the Surfer® visualisation software package.

3.5.3 Sensitive receptor locations in the vicinity of the AD plant were identified following a desk top survey and assigned a relevant sensitivity based on the appropriate land use category.

3.5.4 The IAQM document Guidance on the Assessment of Odour for Planning[3] provides descriptions of relevant sensitivity as summarised in Table 5.

Table 5 Odour Receptor Sensitivity

Sensitivity	Description
High	**Surrounding land where:** • Users can reasonably expect enjoyment of a high level of amenity; and • People would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land • Examples may include residential dwellings, hospitals, schools/education and tourist/cultural
Medium	**Surrounding land where:** • Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • People would not reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land • Examples may include places of work, commercial/retail premises and playing/recreation fields
Low	**Surrounding land where:** • The enjoyment of amenity would not reasonably be expected; or • There is transient exposure, where the people would reasonably be expected to present only for limited periods of time as part of the normal pattern of use of the land. • Examples may include industrial use, farms, footpaths and roads

3.5.5 Relevant sensitive receptors are summarised in Table 6. Reference should be made to Figure 2 within Appendix A for a graphical representation of the receptor locations.

Table 6 Human Sensitive Receptors

Receptor		Use	NGR (m)		Distance from Centre of Site (m)	Sensitivity
			X	Y		
R1	Deal Farm	Residential	608354.7	283491.8	205.6	Low
R2	Acorn Lodge	Residential	608575.5	283309.9	244.3	High
R3	Villa Farmhouse	Residential	608672.5	283305.4	275.8	High
R4	The Oaks	Residential	608710.0	283054.6	523.1	High
R5	Holly Farm Bungalow	Residential	608611.5	283154.5	403.0	High
R6	Holly Farm	Residential	608887.7	283203.5	485.3	High
R7	Clay Hall	Residential	607897.3	283270.3	712.2	High
R8	Crown Farm	Residential	607665.7	283608.4	887.0	High
R9	Devereux House	Residential	607960.3	283886.9	678.5	High
R10	Stone Lane Farm House	Residential	608112.1	283947.9	590.4	High
R11	Old Boyland Hall Farm	Residential	608518.1	284335.8	783.5	High
R12	Villa Cottage	Residential	609158.9	284402.2	1044.4	High
R13	Westhall Farm	Residential	609486.7	284099.4	1083.6	High
R14	Shelfanger Hall	Residential	610168.2	283162.5	1663.7	High
R15	Common Farm	Residential	608923.2	282501.6	1115.3	High
R16	The Mill House	Residential	609223.9	282634.4	1138.7	High
R17	Folly Farm	Residential	607931.6	282164.3	1520.6	High
R18	Willow Farm	Residential	607308.9	282388.6	1702.5	High
R19	Fenners Farm	Residential	607406.7	281971.3	1952.3	High

3.5.6 It should be noted that surrounding land use is predominantly agricultural so silage and FYM odours and a higher level of tolerance would reasonably be expected. Many of the receptors are working farms however some receptors represent a group of properties and range of uses (for example Villa Farm can be taken as representing Villa Farm Guesthouse) and have therefore been classified as the highest sensitivity in that group.

3.5.7 We can only confirm that Deal Farm is a working farm and the receptor represents the farm and farmhouse and, as such, this property has been defined as a low sensitive receptor in accordance with the guidelines given in Table 5.

3.6 Terrain Data

3.6.1 Areas of complex terrain have potential to affect the dispersion of pollutants which vary dependent on the height and location of modelled emission sources. The ADMS-5 user guidance suggest that terrain height effect should only be included where gradient exceed 1:10.

3.6.2 Ordnance Survey Landform Panorama terrain data processed within the ADMS-5 model and covers the AD plant and surround receptor locations. .

3.7 Building Effects

3.7.1 Buildings can influence the dispersion of pollutant and may lead to increases to ground level concentrations. A review of adjacent buildings was therefore undertaken and subsequently included within the model and are summarised in Table 7. Onsite building heights were provided by the project architect and considered to an accurate representation. Offsite buildings, including Deal Farm, were estimated using Google Earth.

Table 7 Building Geometries

Building		NGR (m)		Height (m)	Length/ Diameter (m)	Width (m)	Angle (°)
		X	Y				
1	Silage Clamps	608488.4	283535.8	3.0	99.7	70.7	189.4
2	Acorn Lodge	608511.9	283598.7	4.8	23.6	9.6	189.3
3	CHP	608557.3	283582.1	3.1	3.5	15.1	191.1
4	Boiler	608568.0	283582.5	2.9	9.7	2.9	189.3
5	Gas to Grid Plant	608603.5	283576.3	2.7	8.9	20.6	189.4
6	Feeder Unit	608540.8	283513.9	4.8	2.7	29.8	259.8
7	Digestor 1	608561.2	283510.9	17.0	36.0	Circular	N/A
8	Secondary Digester	608583.6	283550.7	17.0	36.0	Circular	N/A
9	Buffer Tank	608553.8	283555.1	5.6	5.5	Circular	N/A
10	Preliminary Pit Tank	608550.4	283539.7	6.0	5.0	Circular	N/A
11	Deal Farm Sheds A	608442.4	283458.5	7.0	46.4	82.4	189.1
12	Deal Farm Sheds B	608379.6	283456.0	7.0	45.4	58.2	208.6
13	Pasteuriser Tank 1	608556.4	283567.6	4.5	2.5	Circular	N/A
14	Pasteuriser Tank 2	608552.5	283568.3	4.5	2.5	Circular	N/A
15	Pasteuriser Tank 3	608556.9	283570.4	4.5	2.5	Circular	N/A
16	Pasteuriser Tank 4	608552.9	283571.2	4.5	2.5	Circular	N/A
17	Pasteuriser Tank 5	608553.5	283574.0	4.5	2.5	Circular	N/A
18	Pasteuriser Tank 6	608557.4	283573.3	4.5	2.5	Circular	N/A
19	Flare Building	608578.3	283579.4	3.0	3.4	6.9	189.9

3.7.2 Reference should be made to Figure 1 and Figure 2 within Appendix A for a graphical representation of the modelled building layout and the ADMS 5 model input.

3.8 Meteorological Data

3.8.1 Hourly sequential data used in this assessment was obtain from Wattisham meteorological station, located 32 km southwest of the AD plant at approximate NGR: 602270, 251590.

3.8.2 Although there is some distance between the application site and meteorological station, both sites are located within similar rural contexts and share comparable topographies. The choice of this parameter therefore provides a suitable representative of metrological conditions across the modelled domain.

3.8.3 Maximum emissions across the five years of meteorological data (2014 – 2018) were utilised to ensure a worse case assessment. Reference should be made to Figure 3 within Appendix A for wind roses of utilised meteorological data.

3.8.4 All meteorological data used in the assessment was provided by ADM Ltd.

3.9 Roughness Length

3.9.1 The specific roughness length (z_0) values specified with the ADMS-5 model are summarised in Table 8.

Table 8 Utilised Roughness Length

Location	Roughness length (m)	ADMS Description
Application Site and Meteorological Station	0.2	Agricultural (min)

3.9.2 Both the AD plant and meteorological station are located within rural locations and surround by agricultural fields. Given the surrounding area is void of significant building structures, which could increase turbulence, a value of 0.2m is considered appropriate for the morphology of the assessment area.

3.10 Monin-Obukhov Length

3.10.1 The Monin-Obukhov length values are summarised in Table 9.

Table 9 Utilised Monin-Obukhov Lengths

Location	Monin-Obukhov length (m)	ADMS Description
Application Site and Meteorological Station	10	Small Towns <50,000

3.10.2 The application of Monin-Obukhov values considers the effect of heat production in populated areas which will influence atmospheric stability. The rural context of both the AD plant and meteorological site suggest a stable conditions and a value of 10 is deemed appropriate.

3.11 Significance of Odour Impacts

3.11.1 The significance of impacts was assessed through the interaction of the predicted 98th%ile of 1-hour mean odour concentrations and receptor sensitivity, as outlined in the IAQM guidance3. The relevant assessment matrix for “moderately offensive odours” as defined in Section 2.4 is summarised in Table 10.

Table 10 Odour Impact Descriptors

Odour Exposure Level as 98th%ile of 1-Hour Means (ou_E/m^3)	Receptor Sensitivity		
	Low	Medium	High
Greater than 10	Moderate	Substantial	Substantial
5 - 10	Slight	Moderate	Moderate
3 - 5	Negligible	Slight	Moderate
1.5 - 3	Negligible	Negligible	Slight
0.5 - 1.5	Negligible	Negligible	Negligible
Less than 0.5	Negligible	Negligible	Negligible

3.11.2 The IAQM guidance 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, the impact is likely to be considered not significant.

3.11.3 It should be noted that this is a binary judgement of either it is significant or it is not significant. This has been considered to determine the overall magnitude of potential odour impacts associated with the facility.

3.12 Modelling Uncertainties

3.12.1 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.

3.12.2 Whilst uncertainty in the model inputs and parameters cannot be fully reduced, the analysis of maximum emissions across the five years of meteorological data (2014 – 2018) provides sensitivity analysis which sufficiently accounts for variations in modelled predictions. Additionally, worse case assumptions regarding the application of emission rates within the model also minimise podetial uncertainties. As such, a sufficient degree of confidence can be placed in the results.

3.13 Dispersion Modelling Report Requirements

3.13.1 Table 11 provides the checklist of dispersion modelling report requirements.

Table 11 Dispersion Modelling Report Requirements

Item	Location within Report
Location map	Figure 1, Figure 2
List of odours modelled and relevant odour guidelines	Section 3.1, Section 2.3 and Section 2.4
Details of modelled scenarios	Section 3.3
Details of relevant ambient concentrations used	Not relevant to odour
Model description and justification	Section 3.2
Special model treatments used	Section 3.0
Table of emission parameters used	Table 3; Table 4
Details of modelled domain and receptors	Section 3.5, Table 6
Details of meteorological data used	Section 3.8
Details of terrain treatment	Section 3.6
Details of building treatment	Section 3.7, Table 7

4.0 Assessment

4.1 Sensitive Receptor Results

4.1.1 Predicted odour concentrations at receptor locations are summarised in Table 12. Odour concentrations are presented as a 98th%ile of 1-hour mean values over the relevant assessment year. The maximum concentration over the 5 year meteorological dataset has been used to determine the overall assessment significance.

Table 12 Predicted Odour Concentrations

Receptor		Predicted 98th%ile 1-hour Mean Concentration (ou_E/m^3)					
		2014	2015	2016	2017	2018	5-Year Maximum Mean
R1	Deal Farm	2.42	2.34	2.73	1.43	2.64	2.73
R2	Sunnyside	1.99	1.53	2.21	1.32	1.87	2.21
R3	Villa Farm	1.41	1.31	1.78	2.03	1.19	2.03
R4	The Oaks	0.57	0.43	0.67	0.50	0.50	0.67
R5	Holly Farm Bungalow	0.71	0.58	0.82	0.53	0.67	0.82
R6	Holly Farm	0.44	0.44	0.60	0.70	0.41	0.70
R7	Clay Hall	0.22	0.24	0.30	0.13	0.23	0.30
R8	Crown Farm	0.21	0.11	0.19	0.08	0.16	0.21
R9	Devereux House	0.34	0.26	0.25	0.24	0.35	0.35
R10	Stone Lane Farm House	0.49	0.35	0.36	0.35	0.52	0.52
R11	Old Boyland Hall Farm	0.30	0.20	0.30	0.26	0.29	0.30
R12	Villa Cottage	0.22	0.21	0.19	0.19	0.23	0.23
R13	Westhall Farm	0.23	0.23	0.23	0.24	0.26	0.26
R14	Shelfanger Hall	0.05	0.06	0.08	0.09	0.06	0.09
R15	Common Farm	0.15	0.13	0.16	0.13	0.13	0.16
R16	The Mill House	0.11	0.11	0.14	0.15	0.11	0.15
R17	Folly Farm	0.06	0.06	0.06	0.03	0.08	0.08
R18	Willow Farm	0.05	0.05	0.06	0.02	0.05	0.06
R19	Fenners Farm	0.04	0.04	0.04	0.02	0.04	0.04

4.1.2 As indicated in Table 12, predicted odour concentrations were below the appropriate odour benchmark of 3.0 ou_E/m^3 at all highly sensitive receptor locations throughout the considered modelling years. Whilst odours maybe detectable for some periods at receptors R2 and R3, it is considered unlikely that the odours would cause annoyance at such concentrations.

4.1.3 The highest predicted odour concentration was also below 3.0 ou_E/m^3 at Deal Farm House. In addition as detained in Section 3.5.6 and Table 6, this property is considered as a low sensitive receptor being a working livestock farm and critically is also within the curtilage to the proposed AD plant operation.

4.1.4 In addition, as robust assumptions have been used for the odour emissions from materials and in particular manure, and that some odour sources closest to those most affected will be

removed, better contained or moved it is considered that actual maximum odour impacts will be less than those predicted in Table 12.

4.2 Impact Significance

4.2.1 The significance of predicted odour impacts at the sensitive receptors based on 5-year maximum concentrations is summarised in Table 13. It should be noted that the IAQM guidance[3] has been compiled on the assumption that the odour in question is deemed moderately offensive. As shown in Table 1, odours from the proposed plant would be categorised within the 'moderately offensive' category.

Table 13 Predicted Impact Significance at Receptors

Receptor		Predicted 98th%ile Maximum 1-hour Mean Concentration (ou_E/m^3)	Odour Exposure Level as 98th%ile of 1-Hour Means (ou_E/m^3)	Receptor Sensitivity	Significance of Impact
R1	Deal Farm	2.73	1.5 - 3	Low	Negligible
R2	Sunnyside	2.21	1.5 - 3	High	Slight
R3	Villa Farm	2.03	1.5 - 3	High	Slight
R4	The Oaks	0.67	0.5 - 1.5	High	Negligible
R5	Holly Farm Bungalow	0.82	0.5 - 1.5	High	Negligible
R6	Holly Farm	0.70	0.5 - 1.5	High	Negligible
R7	Clay Hall	0.30	Less than 0.5	High	Negligible
R8	Crown Farm	0.21	Less than 0.5	High	Negligible
R9	Devereux House	0.35	Less than 0.5	High	Negligible
R10	Stone Lane Farm House	0.52	0.5 - 1.5	High	Negligible
R11	Old Boyland Hall Farm	0.30	Less than 0.5	High	Negligible
R12	Villa Cottage	0.23	Less than 0.5	High	Negligible
R13	Westhall Farm	0.26	Less than 0.5	High	Negligible
R14	Shelfanger Hall	0.09	Less than 0.5	High	Negligible
R15	Common Farm	0.16	Less than 0.5	High	Negligible
R16	The Mill House	0.15	Less than 0.5	High	Negligible
R17	Folly Farm	0.08	Less than 0.5	High	Negligible
R18	Willow Farm	0.06	Less than 0.5	High	Negligible
R19	Fenners Farm	0.04	Less than 0.5	High	Negligible

4.2.2 As indicated in Table 13, the significance of odour impacts as a result of the AD facility was predicted to be slight at 2 sensitive locations and negligible at all other sensitive receptor locations. In addition, the 2 receptors where the impacts were considered as ‘slight’ would benefit from the removal of closer odour sources, namely current Deal Farm manure muck pads and silage piles.

4.2.3 Based on the assessment results, the overall odour impact associated with the proposed activities are considered **not significant**, in accordance with the stated methodology and the IAQM impact descriptors listed in Table 10.

5.0 Conclusions

5.1.1 Enzygo Limited was commissioned by Deal Farm Biogas Limited to undertake an Odour Assessment in support of the application for an Anaerobic Digestion Plant (part retrospective), including 2 no. separate digestate storage lagoons at Deal Farm, Kenninghall Road, Bressingham, Norfolk.

5.1.2 This report includes the assessment of off site storage lagoons, collection points and an on-site digestate clamp.

5.1.3 During the operation of the plant there is the potential for impacts at sensitive locations due to odour emissions from a number of sources at the plant. An Odour Assessment was therefore undertaken to consider effects in the vicinity of the site.

5.1.4 Potential odour emissions were defined based on the proposed plant operation and a review of literature and emissions used at similar facilities. Where appropriate robust assumptions were made to give an increased confidence in the results.

5.1.5 These were represented within a dispersion model produced using ADMS 5 and using 5 years' meteorological data. Impacts at sensitive receptor locations in the vicinity of the site were quantified, the maximum predicted results compared with the appropriate odour benchmark level.

5.1.6 The proposals will result in the removal or control of other odour sources in the vicinity of the site and the closest sensitive receptors. These potential improvements have not been included within the assessment to provide a robust assessment.

5.1.7 Predicted odour concentrations were below the relevant benchmark level of 3.0 ou_E/m^3 at all sensitive receptors in the vicinity of the site for all modelling years including Deal Farm. This receptor is considered as a low sensitivity receptor, within the curtilage of the AD facility.

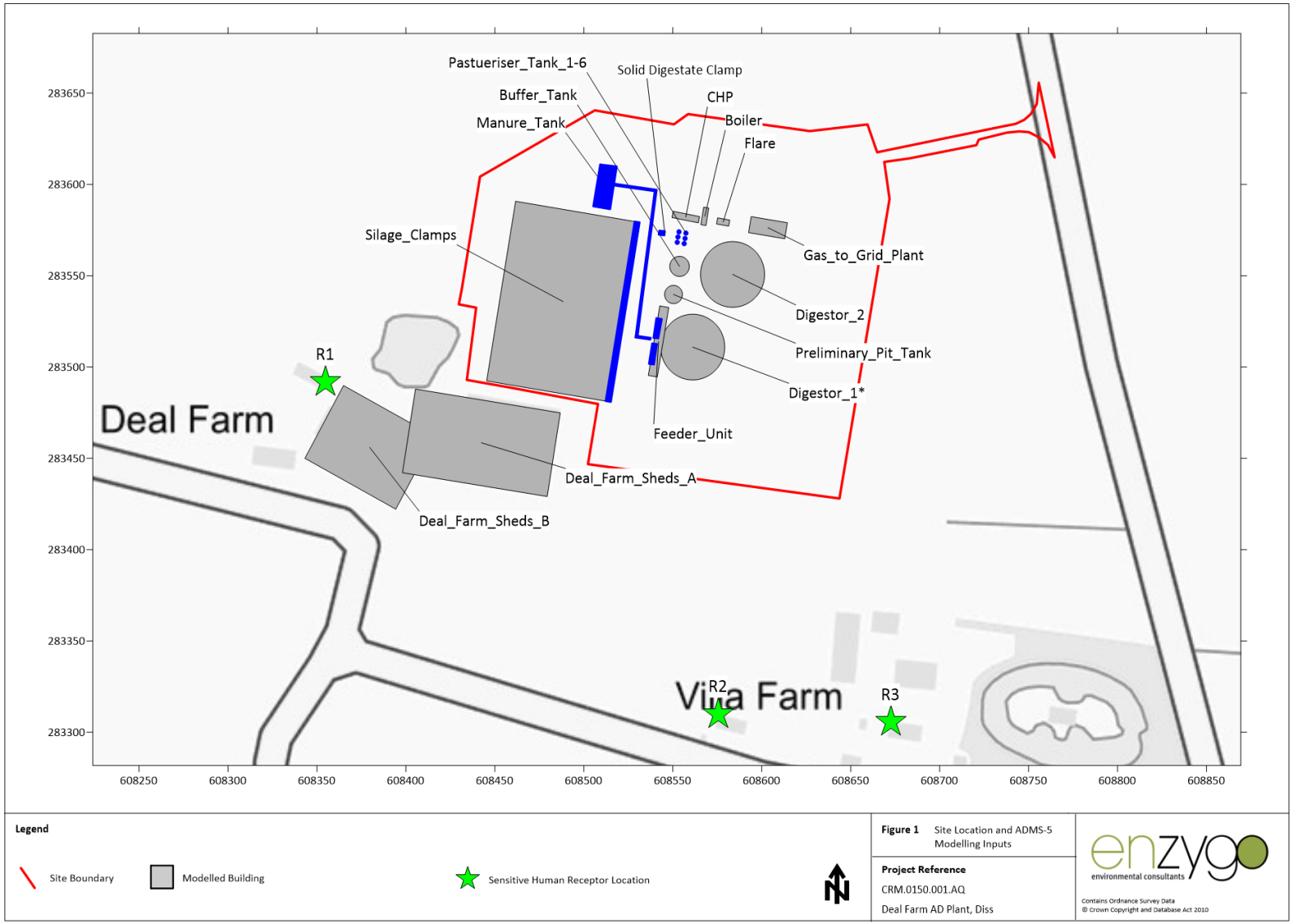
5.1.8 In addition, using the IAQM guidance[3] significance criteria, worst case impacts were slight at 2 receptors and negligible at all other representative sensitive receptors. In addition, the 2 receptors where the impacts were considered as 'slight' would benefit from the removal of closer odour sources, namely current Deal Farm manure muck pads and silage piles.

5.1.9 As such, given the robust assumptions made for odour emissions, the overall potential for odour impacts generated by the AD facility can be considered as **not significant**, and the AD facility is therefore not considered to represent a constraint to planning permission with regard to odour.

6.0 Abbreviations

%ile	Percentile
AD	Anaerobic Digestion
ADM	Atmospheric Dispersion Modelling
CERC	Cambridge Environmental Research Consultants
CH_4	Methane
CO_2	Carbon Dioxide
CHP	Combined Heating and Power
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EPUK	Environmental Protection UK
FYM	Farmyard Manure
H_2S	Hydrogen Sulphide
IAQM	Institute of Air Quality Management
NGR	National Grid Reference
ou_E	European Odour Unit
z_0	Roughness Length

Appendix A Figures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Digestor_2
Preliminary_Pit_Tank
Digestor_1*
Feeder_Unit
R1
Deal Farm
Deal_Farm_Sheds_A
Deal_Farm_Sheds_B
R2
R3
Vina Farm
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283550
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608350
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608600
608650
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608750
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608850
Legend
Site Boundary
Modelled Building
Sensitive Human Receptor Location
N
Figure 1 Site Location and ADMS-5 Modelling Inputs
Project Reference
CRM.0150.001.AQ
Deal Farm AD Plant, Diss
enzygo
environmental consultants
Contains Ordnance Survey Data
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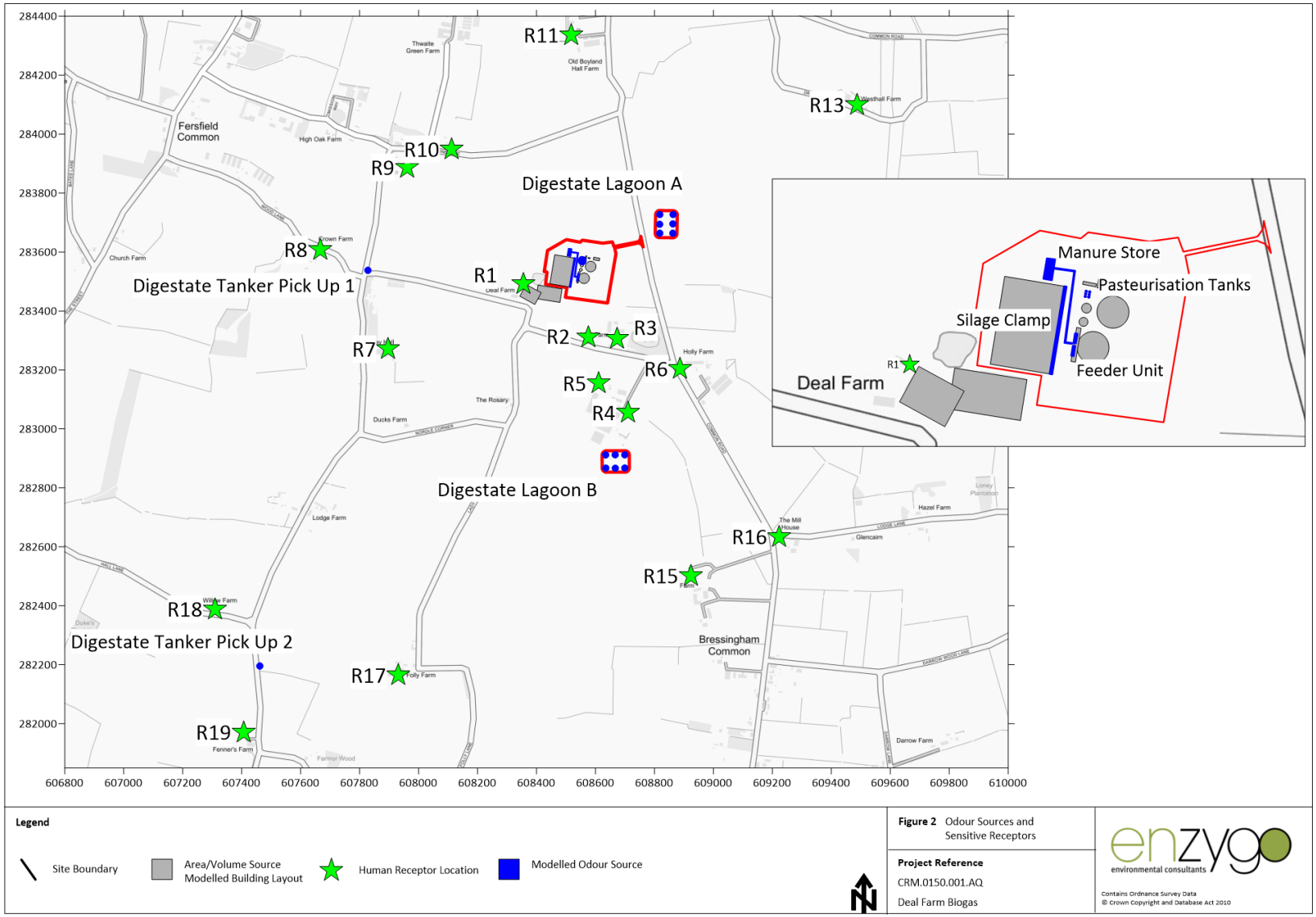
R11
R13
R10
R9
Digestate Lagoon A
Fersfield Common
R8
Digestate Tanker Pick Up 1
R1
R2
R3
R7
R6
R5
R4
Digestate Lagoon B
R16
R15
R18
Digestate Tanker Pick Up 2
Bressingham Common
R17
R19
Manure Store
Pasteurisation Tanks
Silage Clamp
Feeder Unit
Deal Farm
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284000
283800
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283200
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282400
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607800
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608200
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609000
609200
609400
609600
609800
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Legend
Site Boundary
Area/Volume Source
Modelled Building Layout
Human Receptor Location
Modelled Odour Source
Figure 2 Odour Sources and Sensitive Receptors
Project Reference
CRM.0150.001.AQ
Deal Farm Biogas
environmental consultants
Contains Ordnance Survey Data
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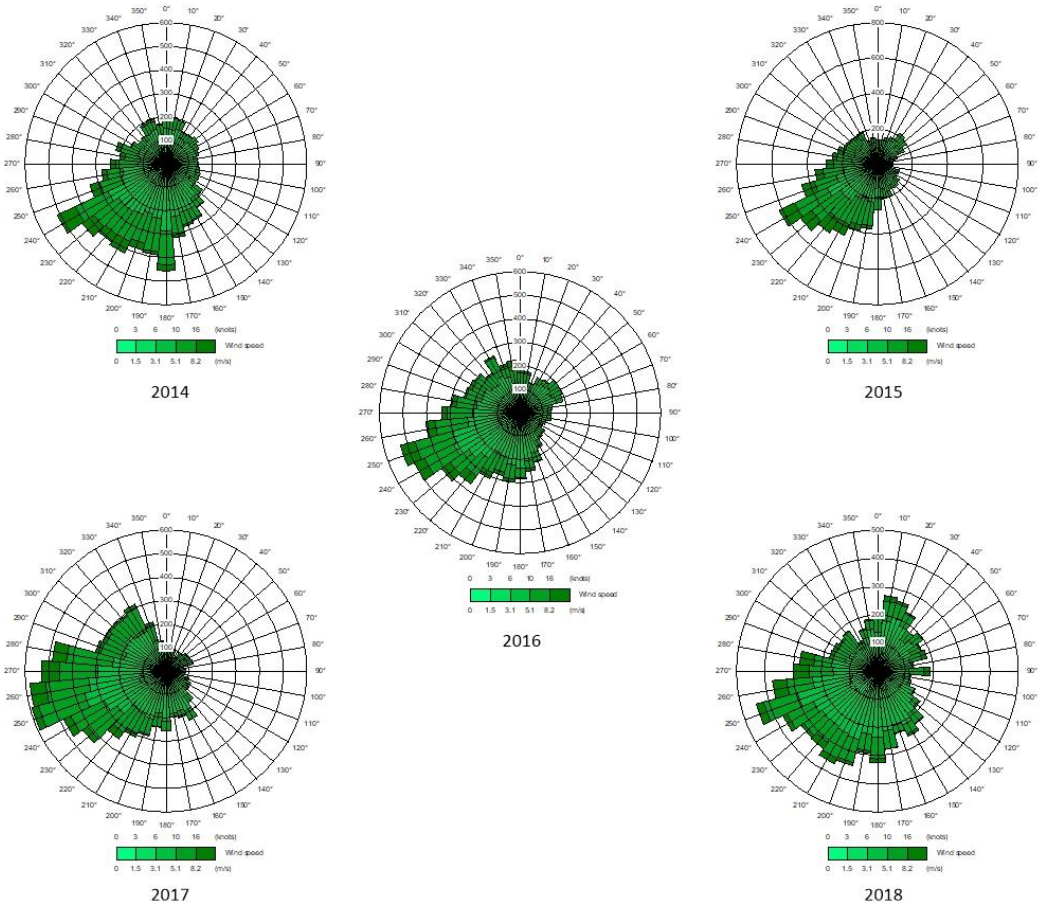
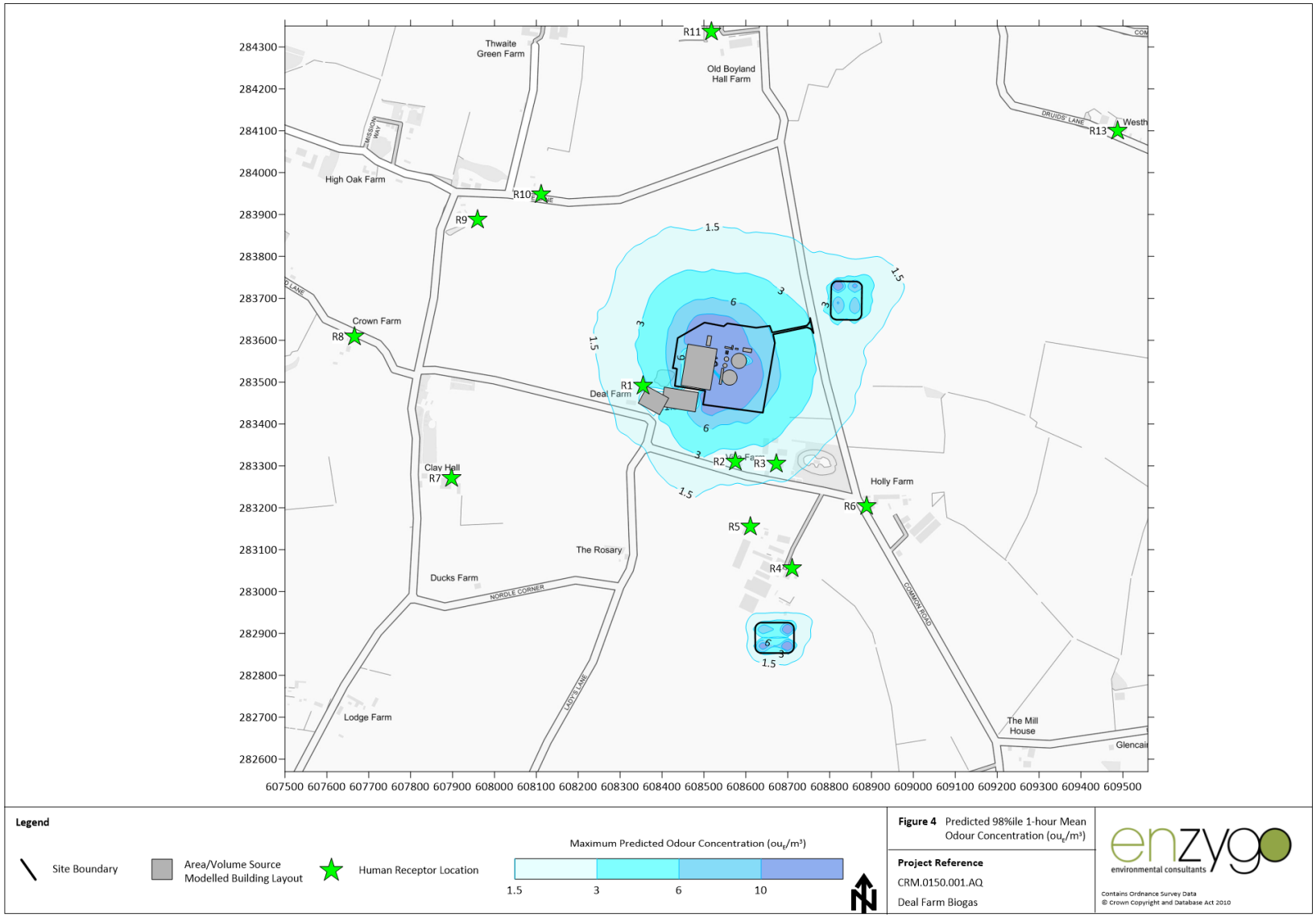


Figure 3 2014 to 2018 Wattisham eteorological Data

Project Reference
CRM.0150.001.AQ
Deal Farm Biogas


Thwaite Green Farm
Old Boyland Hall Farm
High Oak Farm
Crown Farm
Deal Farm
Clay Hall
Holly Farm
The Rosary
Ducks Farm
Lodge Farm
The Mill House
NORDLE CORNER
COMMON ROAD
DRUIDS' LANE
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R13
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1.5
3
6
Legend
Site Boundary
Area/Volume Source
Modelled Building Layout
Human Receptor Location
Maximum Predicted Odour Concentration (ou$_E$/m^3)
1.5
3
6
10
N
Figure 4 Predicted 98%ile 1-hour Mean Odour Concentration (ou$_E$/m^3)
Project Reference
CRM.0150.001.AQ
Deal Farm Biogas
environmental consultants
Contains Ordnance Survey Data
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