Odour Assessment

Brocklesby Waste Processing Facility, North Cave

Client: H&C Consultancy Ltd

Reference: 4089-1r2

Date: 19th April 2021

Report Issue

Report Title: Odour Assessment - Brocklesby Waste Processing Facility, North Cave

Report Reference: 4089-1

Field	Report Version			
	1	2	3	4
Prepared by	Ger Parry	Ger Parry		
Position	Associate Director	Associate Director		
Reviewed by	Jethro Redmore	Jethro Redmore		
Position	Director	Director		
Date of Issue	30th March 2021	19th April 2021		
Comments	Draft for comment	-		

Taylor Road, Urmston, Manchester, M41 7JQ

info@red-env.co.uk | 0161 706 0075 | www.red-env.co.uk

Executive Summary

Redmore Environmental Ltd was commissioned by H&C Consultancy Ltd to undertake an Odour Assessment in support of the Brocklesby Ltd waste processing facility, Crosslands Lane, North Cave.

Odours from a number of sources on site have the potential to cause impacts at sensitive locations. An Odour Assessment was therefore undertaken to quantify effects in the vicinity of the facility.

Emissions from the relevant sources were defined based on the size and nature of the plant. Impacts at sensitive receptors were quantified using dispersion modelling and the results compared with the relevant odour benchmark level.

The results indicated that predicted odour concentrations were below the relevant benchmark level at all sensitive locations in the vicinity of the site for all modelling years. As such, potential odour emissions from the facility are not considered to be significant.

Table of Contents

1.0 INTRODUCTION

1.1 Background

1.1.1 Redmore Environmental Ltd was commissioned by H&C Consultancy Ltd to undertake an Odour Assessment in support of the Brocklesby Ltd waste processing facility, Crosslands Lane, North Cave.

1.1.2 Odours from a number of sources on site have the potential to cause impacts at sensitive locations. An Odour Assessment was therefore undertaken to consider effects in the vicinity of the facility.

1.2 Site Location and Context

1.2.1 The Brocklesby Ltd facility is located on land off Crosslands Lane, North Cave, at National Grid Reference (NGR): 488150, 432180. Reference should be made to Figure 1 for a map of the site and surrounding area.

1.2.2 The site operates as a waste processing facility under an Environmental Permit (No. JP3931SG/V002) issued by the Environment Agency (EA). An Environmental Permit Variation Application is currently being made in order to authorise a number of changes to operations. These include the construction of a new tank farm in order to facilitate an increase in waste storage and processing capacity, as well as the replacement of two existing boilers which are used to produce steam for heat processing of materials.

1.2.3 The site operations incorporating the changes proposed under the Environmental Permit Variation can be summarised as follows:

- The site processes used cooking oil and fatty food wastes;
- The facility has the capacity to process up to 225,000tpa of waste using heat treatment, physical treatment, chemical treatment and pre-esterification. The maximum daily processing capacity is 975t;
- Waste fats and oils are received in butter portions, retail packs of spreads, 20l to 200l drums, Intermediate Bulk Containers (IBCs) and liquid tankers. Other solid food waste is delivered to the facility in sealed skips, IBCs, roll-on roll-off skips and bulk tipping trailers;

- The solid materials received are taken to a reception area within a dedicated processing building and tipped into a contained bund;
- Liquid wastes are delivered to the site by tanker. On arrival, these are directed to the tank farm reception point for offloading. The tank farm consists of sixteen 150t vessels and four 500t tanks;
- The tank farm has a total capacity of 4,400t and is used to store incoming wastes, intermediate materials prior to further processing, final wastes that are awaiting dispatch and surface waters before treatment and discharge to foul sewer or use within the process;
- Wastes are treated at the site to recover oils for further use via various combinations of heat treatment, physical treatment, chemical treatment and pre-esterification;
- The wastes are heated to achieve separation of oils from non-oil and water components. Heat utilised as part of this process is generated by two natural gas fired steam boilers. The operation also receives heat generated by a Combined Heat and Power (CHP) unit which is located within the permitted area of the adjacent Anaerobic Digestion (AD) facility;
- Physical treatment is carried out via centrifuging of heated wastes to further accelerate separation of oils and non-oil components/ water fractions;
- Chemical treatment is also carried out to achieve separation and recovery of oils from food waste. The process utilises pH correction whereby sulphuric acid is added to the materials followed by centrifuging to achieve final separation of oils and non-oil components/ water fractions. The oil element arising from the treatment is further processed in the onsite pre-esterification plant;
- In the pre-esterification plant, fatty acid wastes are received in tankers and stored in bulk storage vessels or generated as intermediaries from other processing activities. The feedstocks are processed with sulphuric acid and methanol to convert the fatty acids to methyl esters, leaving the triglycerides intact. Once the fatty acids have been processed, the materials are suitable for use as biodiesel;
- The site includes a range of existing odour abatement measures intended to manage potential impacts from operations. In addition, a number of new abatement systems will be installed to control emissions associated with proposed processes which are subject to the Environmental Permit Variation Application; and,
- Other point source emissions to atmosphere arise from the stacks on the gas fired boilers and the vent serving the vapour adsorber associated with the pre-esterification plant.

1.2.4 The operation of the facility 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.

2.0 ODOUR BACKGROUND

2.1 Odour Definition

2.1.1 The Department for Environment, Food and Rural Affairs (DEFRA) guidance[1] defines odour as follows:

> "An odour is the organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances. It is a property of odorous substances that make them perceptible to our sense of smell. The term odour refers to the stimuli from a chemical compound that is volatilised in air. Odour is our perception of that sensation and we interpret what the odour means. Odours may be perceived as pleasant or unpleasant. The main concern with odour is its ability to cause a response in individuals that is considered to be objectionable or offensive.
>
> Odours have the potential to trigger strong reactions for good reason. Pleasant odours can provide enjoyment and prompt responses such as those associated with appetite. Equally, unpleasant odours can be useful indicators to protect us from harm such as the ingestion of rotten food. These protective mechanisms are learnt throughout our lives. Whilst there is often agreement about what constitutes pleasant and unpleasant odours, there is a wide variation between individuals as to what is deemed unacceptable and what affects our quality of life."

2.1.2 Although it is recognised that the DEFRA guidance[2] has been formally withdrawn, the definition of odour provided within the document is still considered to be relevant in the context of the assessment.

2.2 Odour Impacts

2.2.1 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 **FIDOR** acronym is a useful reminder of the factors that will determine the degree of odour pollution:

1 Odour Guidance for Local Authorities, DEFRA, 2010.

2 Odour Guidance for Local Authorities, DEFRA, 2010.

- **F**requency of detection - frequent odour incidents are more likely to result in complaints;
- **I**ntensity as perceived - intense odour incidents are more likely to result in complaints;
- **D**uration of exposure - prolonged exposure is more likely to result in complaints;
- **O**ffensiveness - more offensive odours have a higher risk of resulting in complaints; and,
- **R**eceptor sensitivity - sensitive areas are more likely to have a lower odour tolerance.

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

2.2.3 The FIDOR factors can be further considered to provide the following in regards the potential for an odour emission to cause an impact:

- 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,
- 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.

2.3 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 A(2) 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

2.4.1 There is no statutory limit in the UK for ambient odour concentrations, whether set for individual chemical species or for mixtures. However, the EA has issued guidance on odour[3] which contains indicative benchmark levels for use in the assessment of potential impacts from industrial facilities.

2.4.2 Benchmark levels are stated as the 98th percentile (%ile) of hourly mean concentrations in European odour units (ou_E) over a year for odours of different offensiveness. In practice this means that for 2% of the year, or 175-hours, concentrations will be higher than this value, whilst for 98% of the year, or 8,585-hours, they will be lower. This parameter reflects the previously described FIDOR factors, where an odour is likely to be noted on several occasions above a particular threshold concentration before an annoyance occurs. 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

[3] H4: Odour Management, EA, 2011.

Relative Offensiveness of Odour	Benchmark Level as 98th %ile of 1-hour Means (ou_E/m^3)
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

2.4.3 In order to provide a worst-case assessment, an odour benchmark level of 1.5ou_E/m^3 as the 98th %ile of 1-hour mean concentrations has been utilised throughout the report.

2.4.4 In order to provide some context to the odour benchmark values, DEFRA have provided the following descriptors[4]:

- 1ou_E/m^3 is the point of detection;
- 5ou_E/m^3 is a faint odour; and,
- 10ou_E/m^3 is a distinct odour.

2.4.5 An odour at a strength of 1ou_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[5]). 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. These include:

- 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

[4] Odour Guidance for Local Authorities, DEFRA, 2010.

[5] Odour Guidance for Local Authorities, DEFRA, 2010.

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 mowing etc, can provide background odour concentrations from 5 to 60ou_E/m^3 or more[6];

- The recognition threshold may be about 3ou_E/m^3 [7], 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.

---

6 Odour Guidance for Local Authorities, DEFRA, 2010.

7 Odour Guidance for Local Authorities, DEFRA, 2010.

3.0 METHODOLOGY

3.1 Introduction

3.1.1 The facility may result in odour emissions during normal operation. 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.

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

3.2 Odour Sources

3.2.1 Potential odour sources were identified through a visit to the facility and discussions with Brocklesby Ltd. These are summarised in Table 2.

Table 2 Odour Sources

Source		Source Description	Emission Point	Emission Characteristics
1	Chemical scrubber	Emissions from a proposed new chemical scrubber which will be used to treat air extracted from the IBC cleaning area within the main processing building	A1	Treated air from the scrubber will be released to atmosphere via a dedicated stack at a height of 10m
2	Unprocessed and processed oil storage tanks - Carbon Filter 1	Odours generated by oils contained within the existing storage tanks	A5	Air displaced from the tanks during filling is treated by an existing carbon filter prior to discharge to atmosphere at a height of 2.5m
3	Unprocessed and processed oil storage tanks - Carbon Filter 2	Odours generated by oils contained within the existing storage tanks	A6	Air displaced from the tanks during filling is treated by an existing carbon filter prior to discharge to atmosphere at a height of 2.5m

Source		Source Description	Emission Point	Emission Characteristics
4	New tank farm - Carbon filter 1	Odours generated by unprocessed and processed materials contained within eight 150t vessels sited within the new tank farm	A7	Air displaced from the tanks during filling will be treated by a carbon filter prior to discharge to atmosphere at a height of 1m
5	New tank farm - Carbon filter 2	Odours generated by unprocessed and processed materials contained within eight 150t vessels sited within the new tank farm	A8	Air displaced from the tanks during filling will be treated by a carbon filter prior to discharge to atmosphere at a height of 1m
6	New tank farm - Carbon filter 3	Odours generated by unprocessed and processed materials contained within two 500t vessels sited within the new tank farm	A9	Air displaced from the tanks during filling will be treated by a carbon filter prior to discharge to atmosphere at a height of 1m
7	New tank farm - Carbon filter 4	Odours generated by unprocessed and processed materials contained within two 500t vessels sited within the new tank farm	A10	Air displaced from the tanks during filling will be treated by a carbon filter prior to discharge to atmosphere at a height of 1m
8	Solid waste reception area - Extract point 1	Odours generated by solid waste materials within the reception area of the processing building	A11	Air is extracted from the reception area and treated by a carbon filter prior to horizontal discharge to atmosphere at a height of 7.8m
9	Solid waste reception area - Extract point 2	Odours generated by solid waste materials within the reception area of the processing building	A12	Air is extracted from the reception area and treated by a carbon filter prior to horizontal discharge to atmosphere at a height of 7.8m
10	Collection tankers	Odours generated by processed materials	-[a]	Air displaced from vacuum tankers during collections
11	Pre-esterification vapour adsorber	Odours generated by the pre-esterification process	A4	Emissions generated by the pre-esterification process are treated by an existing carbon filter prior to vertical discharge to atmosphere via a dedicated stack at a height of 10m

Source		Source Description	Emission Point	Emission Characteristics
12	Gas fired boiler 1	Combustion emissions from proposed replacement boiler 1	A2	Emissions will be discharged to atmosphere vertically via a dedicated stack at a height of 10m
13	Gas fired boiler 2	Combustion emissions from proposed replacement boiler 1	A3	Emissions will be discharged to atmosphere vertically via a dedicated stack at a height of 10m

NOTE: (a) Emission point reference not provided.

3.2.2 As shown in Table 2, vapours generated by the pre-esterification process are discharged to atmosphere via a dedicated stack at a height of 10.5m. Information provided by the operator indicates that all extract air from the process is subject to carbon filtration prior to release and that emissions from the stack only occur for approximately 2-hours each day. Based on the stated factors, it is considered that there is a low risk of impact as a result of residual releases from the adsorber. As such, emissions have not been considered further in the context of the assessment.

3.2.3 Emissions from the proposed replacement gas boilers will be discharged to atmosphere via two dedicated stacks. The combustion of natural gas produces a number of different pollutants, including oxides of nitrogen (NO_x), carbon monoxide (CO), and carbon dioxide (CO_2). Of these species, CO and CO_2 are odourless and as such have not been considered further in the context of this assessment.

3.2.4 The odour threshold value for nitrogen dioxide (NO_2) is shown in Table 3.

Table 3 Odour Threshold Values

Pollutant	Odour Threshold Value[a]	
	ppm	µg/m³
NO_2	5.0	9,560

NOTE: (a) Source - United States of America Centre for Disease Control.

3.2.5 As shown in Table 3, the odour threshold for NO_2 is relatively high.

3.2.6 Dispersion modelling of emissions from the proposed replacement boilers was undertaken by Redmore Environmental in support of the Environmental Permit Variation Application and reported within an Air Quality Assessment (reference: 4089). The maximum predicted concentration of NO_2 from the study is summarised in Table 4.

Table 4 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	Predicted Concentration (μg/m³)
NO_2	99.8th %ile 1-hour	60.35

3.2.7 It should be noted that the concentration shown in Table 4 is the maximum value at any point within the assessment extents and impacts at sensitive receptor locations were predicted to be significantly lower. Although it is accepted the averaging period is presented as a percentile, this is close to the maximum and as such is considered representative for an assessment of this nature.

3.2.8 As shown in Table 4, the maximum predicted concentration of NO_2 was well below the odour threshold value. As such, impacts associated with emissions from the boilers are not considered to be significant and have not been considered further in the context of the assessment.

3.2.9 Reference should be made to Figure 2 for a graphical representation of the remaining source locations.

3.3 Odour Abatement Plant

3.3.1 As detailed in the previous Section, a number of existing and proposed abatement systems will be utilised at the site in order to provide control of odour emissions. These are summarised as follows:

- Air displaced from the unprocessed and processed oil storage tanks will be treated by two existing carbon filters prior to discharge to atmosphere via individual vents. The filters include Envirocarb AP3 coal based activated carbon pellets which provide a high loading capacity for adsorption of a wide range of organic compounds;
- Air extracted from the solid waste reception area of the processing building will be treated using an existing loose-fill carbon panel filter system prior to discharge to atmosphere via two dedicated vents;

- Air displaced from the 150t vessels within the new tank farm will be treated by two AAC Eurovent PV900 carbon filters prior to discharge to atmosphere. The filters will include either granular or pelletised activated media and each unit will have capacity to treat up to 430m^3/hr of air, which exceeds the maximum anticipated displacement rate for each group of tanks served;
- Air displaced from the 500t vessels within the new tank farm will be treated by two AAC Eurovent PV300 carbon filters prior to discharge to atmosphere. The filters will include either granular or pelletised activated media and each unit will have capacity to treat up to 70m^3/hr of air, which exceeds the maximum anticipated displacement rate for each group of tanks served; and,
- Air extracted from the IBC cleaning area within the main processing building will be treated by a new Forbes Technologies chemical scrubber prior to release to atmosphere via a dedicated stack. The system has been designed to process up to 1,200m^3/hr of air and will utilise a sodium hydroxide (NaOH) dosing system in order to neutralise acid gas emissions generated by cleaning operations.

3.3.2 Adsorption using activated carbon is recognised within EA guidance[8] as an appropriate technique for the treatment of emissions generated by biowaste processes. In addition, carbon filtration is identified as an effective odour abatement option within the European Commission (EC) 'Best Available Techniques (BAT) Reference Document for Waste Treatment'[9], with reported reduction efficiencies which range between 70% and 99%. As such, the stated existing and proposed carbon filters are considered to represent suitable emission control systems.

3.3.3 Chemical scrubbing using alkaline recirculating solutions, such as NaOH, is also recognised within EA guidance[10] as an appropriate technology for the treatment of acid gas emissions generated by waste processes. In addition, wet scrubbing is identified as an effective odour abatement option within EC guidance[11], with reported reduction efficiencies which range between 60% and 85%. As such, use of the proposed scrubber system to treat emissions generated by IBC cleaning operations is considered to represent a suitable control technique.

---

8 How to comply with your environmental permit. Additional guidance for Anaerobic Digestion, EA, 2013.

9 Best Available Techniques (BAT) Reference Document for Waste Treatment, EC, 2018.

10 How to comply with your environmental permit. Additional guidance for Anaerobic Digestion, EA, 2013.

11 Best Available Techniques (BAT) Reference Document for Waste Treatment, EC, 2018.

3.4 Odour Emissions Data

3.4.1 There are no Emission Limit Values (ELVs) for odour and in the absence of site-specific monitoring data for the facility, estimations of releases from the identified sources had to be made to inform the dispersion model. These were based on odour monitoring data reported at similar installations. As such, they are considered to provide representative inputs for an assessment of this nature. A summary of the data is provided in Table 5.

Table 5 Odour Emissions Data

Source	Data Description	Odour Emission	Unit	Reference
1, 8 and 9	AD biotreatment	12,967.0	ou_E/m^3	EC[1]
2 to 7 and 10	Liquified food waste	43,251.6	ou_E/m^3	V. Orzi a et al[2]

NOTES: (1) Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.
(2) Best available Techniques (BAT) Reference Document for Waste Treatment, EC, 2018.

3.5 Dispersion Modelling

3.5.1 Dispersion modelling was undertaken using ADMS-5.2 (v5.2.4.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-5 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.

3.5.2 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.

3.5.3 The model requires input data that details the following parameters:

- Assessment area;
- Process conditions;
- Pollutant emission rates;
- Terrain information;
- Building dimensions;
- Meteorological data;
- Roughness length (z_0); and,
- Monin-Obukhov length.

3.5.4 These are detailed in the following Sections.

3.6 Modelling Scenarios

3.6.1 The scenarios considered in the modelling assessment are summarised in Table 6.

Table 6 Assessment Scenarios

Parameter	Modelled As	
	Short Term	Long Term
Odour	98th %ile 1-hour mean	-

3.7 Process Conditions

3.7.1 The inputs used to describe the relevant emission sources within the model were derived from the odour emissions data shown in Table 5 and information provided by Brocklesby Ltd. A summary of the data is provided in the following Sections.

Chemical Scrubber

3.7.2 Air extracted from the IBC cleaning area within the main processing building will be treated by a Forbes Environmental Technologies chemical scrubber prior to release to atmosphere. This will utilise a sodium hydroxide dosing system in order to neutralise acid gas emissions associated with the process. Treated air will be discharged via a dedicated dispersion stack represented by emission point A1.

3.7.3 The following assumptions were utilised to describe releases from A1 within the model:

- The maximum volumetric flow rate through the system is 1,200m^3/hr. This was derived from the plant specification provided by Forbes Environmental Technologies;
- The odour concentration in untreated air extracted from the IBC cleaning area is 12,967ou$_E$/m^3. This value was derived from EC guidance[12] in lieu of site specific data and represents the maximum odour concentration reported for AD biotreatment processes. It is recognised that the IBC cleaning process is not an AD operation. However, odour conditions within the building are expected to be comparable to those at an AD facility due to similarities in regards the types of waste materials handled. As such, use of the stated value is considered to be appropriate; and,
- It was assumed that the scrubber achieves a 72.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for wet scrubbing systems in EC guidance[13].

3.7.4 The model input data for A1 is summarised in Table 7.

Table 7 Chemical Scrubber Model Input - A1

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488162.8, 432178.4
Emission point height	m	10.0
Emission point diameter	m	0.2
Emission temperature	°C	Ambient
Volumetric flow rate	m^3/hr	1,200
Volumetric flow rate	m^3/s	0.33
Efflux velocity	m/s	10.61
Odour emission concentration	ou$_E$/m^3	3,565.9
Odour emission rate	ou$_E$/s	1,188.6

12 BAT Reference Document for Waste Treatment, EC, 2018.

13 BAT Reference Document for Waste Treatment, EC, 2018.

3.7.5 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to overestimate impacts as periods of reduced operating capacity are not reflected.

Unprocessed and Processed Oil Storage Tanks - Carbon Filter 1

3.7.6 Air displaced from a number of the existing unprocessed and processed oil storage tanks is treated by a carbon filter prior to discharge to atmosphere via a dedicated vent represented by emission point A5.

3.7.7 The following assumptions were utilised to describe releases from A5 within the model:

- The maximum volumetric flow rate of air displaced from the tanks and treated by the carbon filter is 90m^3/hr;
- The odour concentration in untreated air displaced from the tanks is 43,251.6ou$_E$/m^3. This value was based on data collected at a similar site[14] utilising liquified wastes in lieu of plant specific information; and,
- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[15].

3.7.8 The model input data for A5 is summarised in Table 8.

Table 8 Unprocessed and Processed Oil Storage Tanks - Carbon Filter 1: A5

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488074.4, 432222.4
Emission point height	m	2.5
Emission point diameter	m	0.05
Emission temperature	°C	Ambient

14 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

15 BAT Reference Document for Waste Treatment, EC, 2018.

Parameter	Unit	Value
Volumetric flow rate	m^3/hr	90
Volumetric flow rate	m^3/s	0.025
Efflux velocity	m/s	12.73
Odour emission concentration	ou_E/m^3	6,704.0
Odour emission rate	ou_E/s	167.6

3.7.9 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tank filling operations will not be undertaken continuously.

Unprocessed and Processed Oil Storage Tanks - Carbon Filter 2

3.7.10 Air displaced from the remaining unprocessed and processed oil storage tanks is treated by a carbon filter prior to discharge to atmosphere via a dedicated vent represented by emission point A6.

3.7.11 The following assumptions were utilised to describe releases from A6 within the model:

- The maximum volumetric flow rate of air displaced from the tanks and treated by the carbon filter is $60m^3/hr$;
- The odour concentration in untreated air displaced from the tanks is $43,251.6ou_E/m^3$. This value was based on data collected at a similar site[16] utilising liquified wastes in lieu of plant specific information; and,
- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[17].

3.7.12 The model input data for A6 is summarised in Table 9.

16 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

17 BAT Reference Document for Waste Treatment, EC, 2018.

Table 9 Unprocessed and Processed Oil Storage Tanks - Carbon Filter 2: A6

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488086.1, 432227.2
Emission point height	m	2.5
Emission point diameter	m	0.05
Emission temperature	°C	Ambient
Volumetric flow rate	m^3/hr	60
Volumetric flow rate	m^3/s	0.027
Efflux velocity	m/s	8.49
Odour emission concentration	ou_E/m^3	6,704.0
Odour emission rate	ou_E/s	111.7

3.7.13 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tank filling operations will not be undertaken continuously.

New Tank Farm - Carbon Filter 1

3.7.14 Air displaced from eight of the 150t vessels within the new tank farm will be treated by a carbon filter prior to discharge to atmosphere via a dedicated vent represented by emission point A7.

3.7.15 The following assumptions were utilised to describe releases from A7 within the model:

- The maximum volumetric flow rate of air displaced from the tanks and treated by the carbon filter is 430m^3/hr;
- The odour concentration in untreated air displaced from the tanks is 43,251.6ou_E/m^3. This value was based on data collected at a similar site[18] utilising liquified wastes in lieu of plant specific information;

18 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[19]; and,
- The carbon filter will feature a cowled outlet to prevent rainwater ingress. This may limit initial dilution and dispersion of emissions from the source. As such, an efflux velocity of 0.0m/s was utilised in order to provide a worst-case assessment of potential impacts.

3.7.16 The model input data for A7 is summarised in Table 10.

Table 10 New Tank Farm - Carbon Filter 1: A7

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488142.2, 432165.6
Emission point height	m	1.0
Emission point diameter	m	1.2
Emission temperature	°C	Ambient
Volumetric flow rate	m^3/hr	430
Volumetric flow rate	m^3/s	0.12
Efflux velocity	m/s	0.0
Odour emission concentration	ou_E/m^3	6,704.0
Odour emission rate	ou_E/s	800.8

3.7.17 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tank filling operations will not be undertaken continuously.

19 BAT Reference Document for Waste Treatment, EC, 2018.

New Tank Farm - Carbon Filter 2

3.7.18 Air displaced from the remaining 150t vessels within the new tank farm will be treated by a carbon filter prior to discharge to atmosphere via a dedicated vent represented by emission point A8.

3.7.19 The following assumptions were utilised to describe releases from A8 within the model:

- The maximum volumetric flow rate of air displaced from the tanks and treated by the carbon filter is 430m^3/hr;
- The odour concentration in untreated air displaced from the tanks is 43,251.6ou$_E$/m^3. This value was based on data collected at a similar site[20] utilising liquified wastes in lieu of plant specific information;
- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[21]; and,
- The carbon filter will feature a cowled outlet to prevent rainwater ingress. This may limit initial dilution and dispersion of emissions from the source. As such, an efflux velocity of 0.0m/s was utilised in order to provide a worst-case assessment of potential impacts.

3.7.20 The model input data for A8 is summarised in Table 11.

Table 11 New Tank Farm - Carbon Filter 2: A8

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488164.6, 432165.1
Emission point height	m	1.0
Emission point diameter	m	1.2
Emission temperature	°C	Ambient

20 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

21 BAT Reference Document for Waste Treatment, EC, 2018.

Parameter	Unit	Value
Volumetric flow rate	m^3/hr	430
Volumetric flow rate	m^3/s	0.12
Efflux velocity	m/s	0.0
Odour emission concentration	ou_E/m^3	6,704.0
Odour emission rate	ou_E/s	800.8

3.7.21 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tank filling operations will not be undertaken continuously.

New Tank Farm - Carbon Filter 3

3.7.22 Air displaced from two of the 500t vessels within the new tank farm will be treated by a carbon filter prior to discharge to atmosphere via a dedicated vent represented by emission point A9.

3.7.23 The following assumptions were utilised to describe releases from A9 within the model:

- The maximum volumetric flow rate of air displaced from the tanks and treated by the carbon filter is 70m^3/hr;
- The odour concentration in untreated air displaced from the tanks is 43,251.6ou_E/m^3. This value was based on data collected at a similar site[22] utilising liquified wastes in lieu of plant specific information;
- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[23]; and,
- The carbon filter will feature a cowled outlet to prevent rainwater ingress. This may limit initial dilution and dispersion of emissions from the source. As such, an efflux

22 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

23 BAT Reference Document for Waste Treatment, EC, 2018.

velocity of 0.0m/s was utilised in order to provide a worst-case assessment of potential impacts.

3.7.24 The model input data for A9 is summarised in Table 12.

Table 12 New Tank Farm - Carbon Filter 3: A9

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488175.9, 432171.4
Emission point height	m	1.0
Emission point diameter	m	0.5
Emission temperature	°C	Ambient
Volumetric flow rate	m^3/hr	70
Volumetric flow rate	m^3/s	0.019
Efflux velocity	m/s	0.0
Odour emission concentration	ou_E/m^3	6,704.0
Odour emission rate	ou_E/s	130.4

3.7.25 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tank filling operations will not be undertaken continuously.

New Tank Farm - Carbon Filter 4

3.7.26 Air displaced from the remaining two 500t vessels within the new tank farm will be treated by a carbon filter prior to discharge to atmosphere via a dedicated vent represented by emission point A10.

3.7.27 The following assumptions were utilised to describe releases from A10 within the model:

- The maximum volumetric flow rate of air displaced from the tanks and treated by the carbon filter is 70m^3/hr;

- The odour concentration in untreated air displaced from the tanks is 43,251.6ou$_E$/m^3. This value was based on data collected at a similar site[24] utilising liquified wastes in lieu of plant specific information;
- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[25];
- The carbon filter will feature a cowled outlet to prevent rainwater ingress. This may limit initial dilution and dispersion of emissions from the source. As such, an efflux velocity of 0.0m/s was utilised in order to provide a worst-case assessment of potential impacts.

3.7.28 The model input data for A10 is summarised in Table 13.

Table 13 New Tank Farm - Carbon Filter 4: A10

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488179.8, 432162.0
Emission point height	m	1.0
Emission point diameter	m	0.5
Emission temperature	°C	Ambient
Volumetric flow rate	m^3/hr	70
Volumetric flow rate	m^3/s	0.019
Efflux velocity	m/s	0.0
Odour emission concentration	ou$_E$/m^3	6,704.0
Odour emission rate	ou$_E$/s	130.4

3.7.29 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tank filling operations will not be undertaken continuously.

24 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

25 BAT Reference Document for Waste Treatment, EC, 2018.

Solid Waste Reception Area Extract Points

3.7.30 Air is extracted from the solid waste reception area and treated by a carbon filter prior to horizontal discharge to atmosphere via two dedicated vents which are represented as follows:

- EP A11 - Solid waste reception area vent 1; and,
- EP A12 - Solid waste reception area vent 2.

3.7.31 The following assumptions were utilised to describe releases from A11 and A12 within the model:

- The maximum volumetric flow rate of air released via each emission point is 8,515m^3/hr;
- The odour concentration in untreated air extracted from the solid waste reception area is 12,967ou_E/m^3. This value was derived from EC guidance[26] in lieu of site specific data and represents the maximum odour concentration reported for AD biotreatment processes. It is recognised that the solid waste reception process is not an AD operation. However, odour conditions within the building are expected to be comparable to those at an AD facility due to similarities in regards the types of waste materials handled. As such, use of the stated value was considered to be appropriate;
- It was assumed that the carbon filter achieves an 84.5% reduction in untreated air odour concentrations. This is equivalent to the median abatement efficiency reported for adsorption in EC guidance[27]; and,
- An efflux velocity of 0.0m/s was utilised in order to provide a worst-case assessment of initial dilution and dispersion of emissions as a result of horizontal discharge of air from the vents.

3.7.32 The model input data for the emission points A11 and A12 is summarised in Table 14.

26 BAT Reference Document for Waste Treatment, EC, 2018.

27 BAT Reference Document for Waste Treatment, EC, 2018.

Table 14 Solid Waste Reception Area Extract Points: A11 and A12

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	As shown on Figure 2
Number of emission points	-	2
Emission point height (per point)	m	7.8
Emission point diameter (per point)	m	0.63
Emission temperature (per point)	°C	Ambient
Volumetric flow rate (per point)	m^3/hr	8,515
Volumetric flow rate (per point)	m^3/s	2.37
Efflux velocity (per point)	m/s	0.0
Odour emission concentration (per point)	ou_E/m^3	2,009.9
Odour emission rate (per point)	ou_E/s	4,753.9

3.7.33 Emissions from the sources were assumed to be constant, 24-hours per day, 365-days per year.

Collection Tanker

3.7.34 Air is displaced from collection tankers during filling. The following assumptions were utilised to describe releases within the model:

- Air is displaced to atmosphere via a vent on a single tanker whilst filling is undertaken. The vent has a diameter of 0.15m and is situated on the top of the tanker at a height of 3.5m;
- The tanker has a capacity of 25m^3 and takes 45-minutes to fill;
- Air is expelled at a constant rate throughout filling; and,
- The odour concentration in the air expelled from the tanker is 43,251.6ou_E/m^3. This value was based on data collected at a similar site[28] utilising liquified wastes in lieu of

28 Potential odour emission measurement in organic fraction of municipal solid waste during anaerobic digestion: Relationship with process and biological stability parameters, V. Orzi a, E. Cadena b, G. D'Imporzano a, A. Artola b, E. Davoli c, M. Crivelli d, F. Adani a, Bioresource Technology, 2010.

plant specific information.

3.7.35 The model input data for the collection tanker is summarised in Table 15.

Table 15 Collection Tanker Model Input

Parameter	Unit	Value
Source type	-	Point
Position (centre point)	NGR	488163.7, 432142.7
Emission point height	m	3.5
Emission point diameter	m	0.15
Emission temperature	°C	Ambient
Volumetric flow rate	m^3/s	0.009
Efflux velocity	m/s	0.52
Odour emission concentration	ou_E/m^3	43,251.6
Odour emission rate	ou_E/s	400.5

3.7.36 Emissions from the source were assumed to be constant, 24-hours per day, 365-days per year. This is likely to significantly overestimate impacts as tanker filling operations will not be undertaken continuously.

3.8 Assessment Area

3.8.1 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: 487445, 431475 to 488945, 432975. One Cartesian grid with a resolution of 10m was used within the model to produce data suitable for contour plotting using the Surfer software package.

3.8.2 Reference should be made to Figure 2 for a graphical representation of the assessment grid extents.

3.8.3 A desk-top study was undertaken in order to identify any sensitive receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 16.

Table 16 Sensitive Receptor Locations

Receptor		NGR (m)	
		X	Y
R1	Residential - Newport Road	488282.1	431986.0
R2	Residential - Newport Road	488301.3	431984.8
R3	Residential - Newport Road	488331.0	432001.7
R4	Residential - Newport Road	488446.2	432091.6
R5	Residential - Bungalow Farm	488581.9	432276.0
R6	Residential - Walnut Grove	488106.8	431839.8
R7	Residential - Breck Lane	487747.8	432038.1
R8	Residential - Dryham	487551.0	432769.1
R9	Residential - Townend Lane	488808.4	432460.7

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

3.9 Terrain Data

3.9.1 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.

3.10 Building Effects

3.10.1 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.

3.10.2 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 17.

Table 17 Building Geometries

Building	NGR (m)		Height (m)	Length / Diameter (m)	Width (m)	Angle (°)
	X	Y				
B1	488113.8	432127.2	15.8	16.8	16.8	158.0
B2	488102.0	432159.5	7.6	46.0	14.1	158.0
B3	488126.3	432166.4	15.4	18.5	14.5	158.0
B4	488150.8	432199.3	18.4	42.6	44.3	158.0
B5	488120.2	432187.0	9.0	20.4	20.8	158.0
B6	488101.7	432220.2	10.0	12.1	6.2	158.0
B7	488147.1	432157.9	14.5	16.9	4.6	158.0
B8	488154.1	432160.9	14.5	16.8	8.8	158.0
B9	488161.1	432163.8	14.5	16.8	4.5	158.0
B10	488106.9	432209.8	10.0	6.8	-	-
B11	488098.7	432209.8	10.0	7.8	-	-
B12	488075.7	432232.9	15.0	2.5	-	-
B13	488078.3	432219.8	15.0	2.5	-	-
B14	488081.0	432213.3	15.0	2.5	-	-
B15	488082.3	432229.0	8.0	2.5	-	-
B16	488084.8	432222.5	8.0	2.5	-	-
B17	488170.0	432173.1	10.0	8.5	-	-
B18	488174.0	432163.4	10.0	8.5	-	-
B19	488178.8	432176.7	10.0	8.5	-	-
B20	488183.1	432166.9	10.0	8.5	-	-

3.11 Meteorological Data

3.11.1 Meteorological data used in the assessment was taken from Leconfield meteorological station over the period 1st January 2015 to 31st December 2019 (inclusive). Leconfield observation station is located at NGR: 503329, 442674, which is approximately 18.1km north-east 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.

3.11.2 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 4 for wind roses of utilised meteorological records.

3.12 Roughness Length

3.12.1 A z_0 of 0.3m was used to describe the modelling extents and the meteorological site. This value is considered appropriate for the morphology of both areas and is suggested within ADMS-5 as being suitable for 'agricultural areas (max)'.

3.13 Monin-Obukhov Length

3.13.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10m 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-5 as being suitable for 'small towns < 50,000'.

3.14 Assessment Criteria

3.14.1 Predicted ground level odour concentrations were compared with the odour benchmark level of 1.5ou_E/m^3 as a 98th percentile of 1-hour means, as a worst-case.

3.15 Modelling Uncertainty

3.15.1 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.

3.15.2 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-5 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 the closest observation station 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;
- Operating conditions - Information was provided by Brocklesby Ltd to describe the activities undertaken at the facility and associated durations. As such, these are considered to be representative of likely operating conditions;
- Emission rates - Emission rates were derived from monitoring undertaken at similar plants. As such, they are considered to be representative of potential releases during normal operation;
- 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 are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

3.15.3 Results were considered in the context of the relevant odour benchmark level. 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.

4.0 ASSESSMENT

4.1.1 Dispersion modelling of potential odour emissions was undertaken using the input data specified previously. Predicted odour concentrations at the discrete receptor locations are summarised in Table 18. It should be noted that the odour concentrations are presented as a 98th %ile of 1-hour mean values over the relevant assessment year. The maximum concentration across the five years of results is highlighted in **bold**.

Table 18 Predicted Odour Concentrations

Receptor		Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)				
		2015	2016	2017	2018	2019
R1	Residential - Newport Road	**0.95**	0.85	0.54	0.86	0.87
R2	Residential - Newport Road	**0.84**	0.78	0.51	0.72	0.76
R3	Residential - Newport Road	0.82	**0.87**	0.49	0.70	0.81
R4	Residential - Newport Road	**0.73**	**0.73**	0.63	0.68	**0.73**
R5	Residential - Bungalow Farm	0.75	0.66	0.63	0.66	**0.79**
R6	Residential - Walnut Grove	0.39	**0.44**	0.21	0.37	0.34
R7	Residential - Breck Lane	0.18	0.22	0.15	**0.23**	0.19
R8	Residential - Dryham	0.14	0.13	0.17	0.20	**0.19**
R9	Residential - Townend Lane	0.23	0.28	0.25	0.23	**0.29**

4.1.2 As indicated in Table 18, predicted odour concentrations were below the EA odour benchmark of $1.5ou_E/m^3$ at all receptor locations for all modelling years.

4.1.3 Reference should be made to Figure 5 to Figure 9 for graphical representations of predicted odour concentrations throughout the assessment extents. These indicate maximum levels in close proximity to the odour sources, with levels reducing sharply over a short distance.

5.0 CONCLUSION

5.1.1 Redmore Environmental Ltd was commissioned by H&C Consultancy Ltd to undertake an Odour Assessment in support of the Brocklesby Ltd waste processing facility, Crosslands Lane, North Cave.

5.1.2 Odours from a number of sources on site have the potential to cause impacts at sensitive receptors. An Odour Assessment was therefore undertaken to consider effects in the vicinity of the facility.

5.1.3 Potential odour sources were identified and emissions defined based on the size and nature of the plant. Impacts at sensitive receptors were quantified using dispersion modelling and the results compared with the relevant odour benchmark level.

5.1.4 Predicted odour concentrations were below the relevant EA odour benchmark level at all receptor locations for all modelling years. As such, impacts associated with potential odour emissions from the facility are not considered to be significant.

6.0 ABBREVIATIONS

AD	Anaerobic Digestion
CERC	Cambridge Environmental Research Consultants
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EC	European Commission
IBC	Intermediate Bulk Container
NaOH	Sodium Hydroxide
NGR	National Grid Reference
z_0	Roughness length
%ile	Percentile

Figures

Legend

Site Boundary

Title

Figure 1 - Site Location

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075

Legend

Site Boundary

Building

ADMS-5 Output Grid

Point Source

Title
Figure 2 - ADMS-5 Inputs

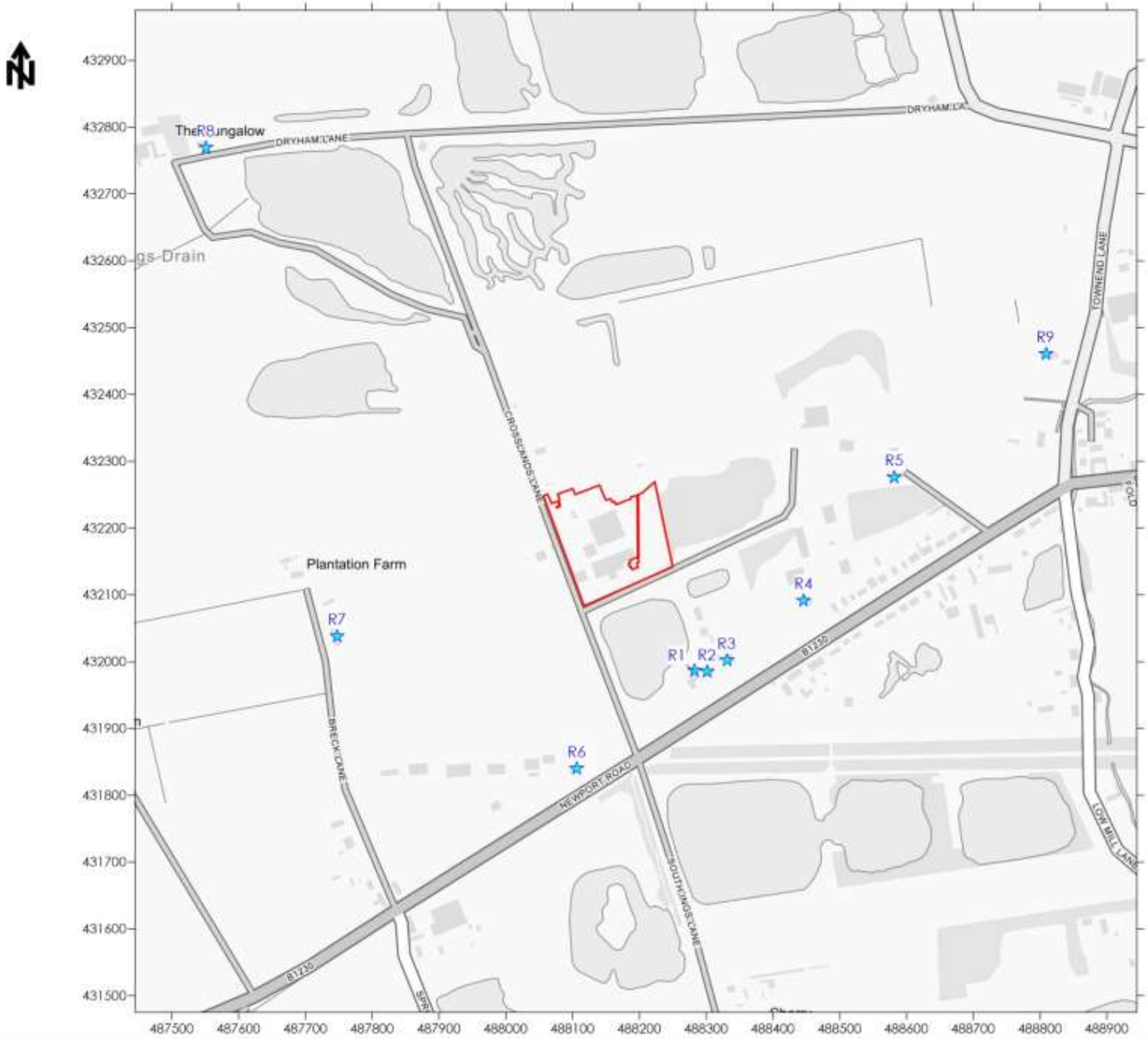
Project
Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference
4089-1

Client
H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Sensitive Receptor

Title

Figure 3 - Sensitive Receptor Locations

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

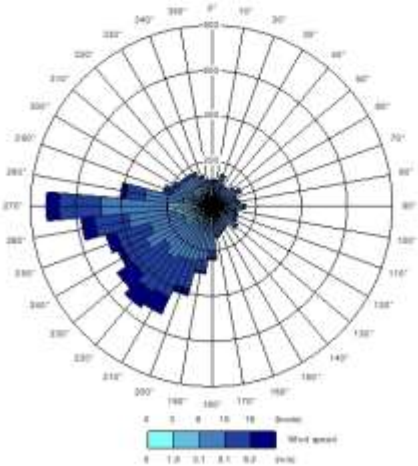
4089-1

Client

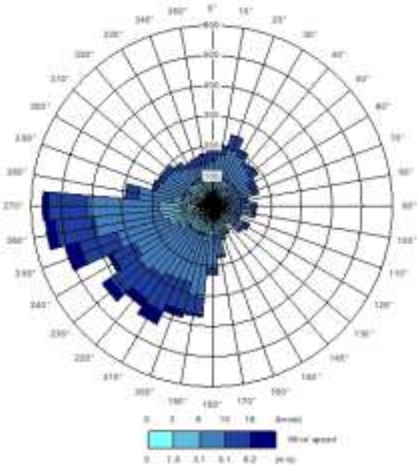
H&C Consultancy Ltd

Redmore environmental

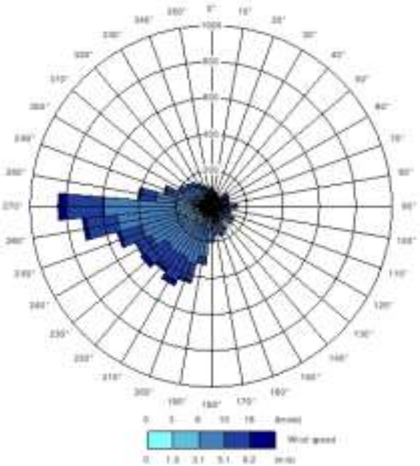
www.red-env.co.uk | 0161 7060075



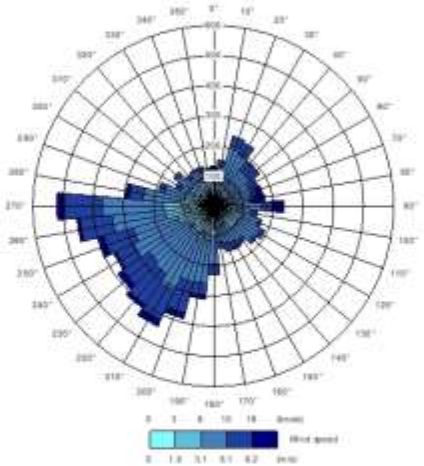
2015 Meteorological Data



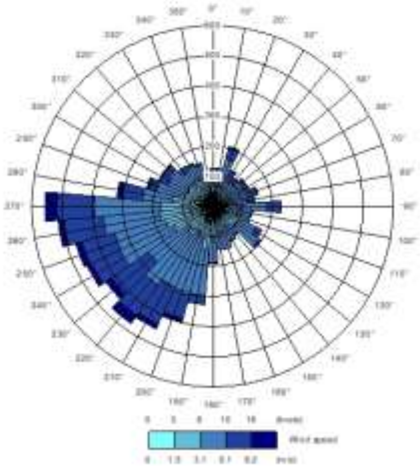
2016 Meteorological Data



2017 Meteorological Data



2018 Meteorological Data



2019 Meteorological Data

Legend

Title

Figure 4 - Wind Roses of 2015 to 2019 Leconfield Meteorological Data

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

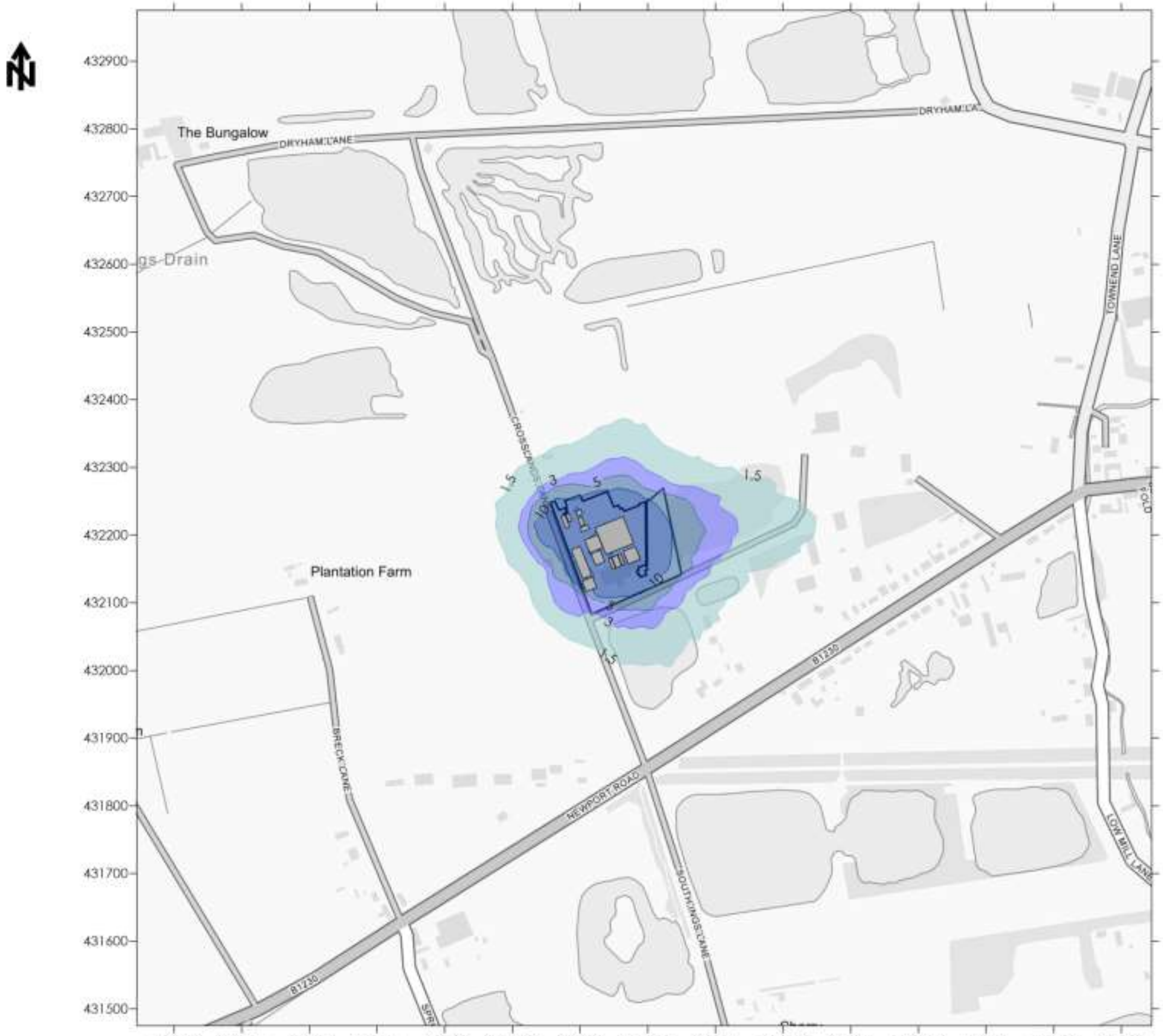
4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou$_E$/m³)

10

5

3

1.5

Title

Figure 5 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou$_E$/m³) 2015 Meteorological Data

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

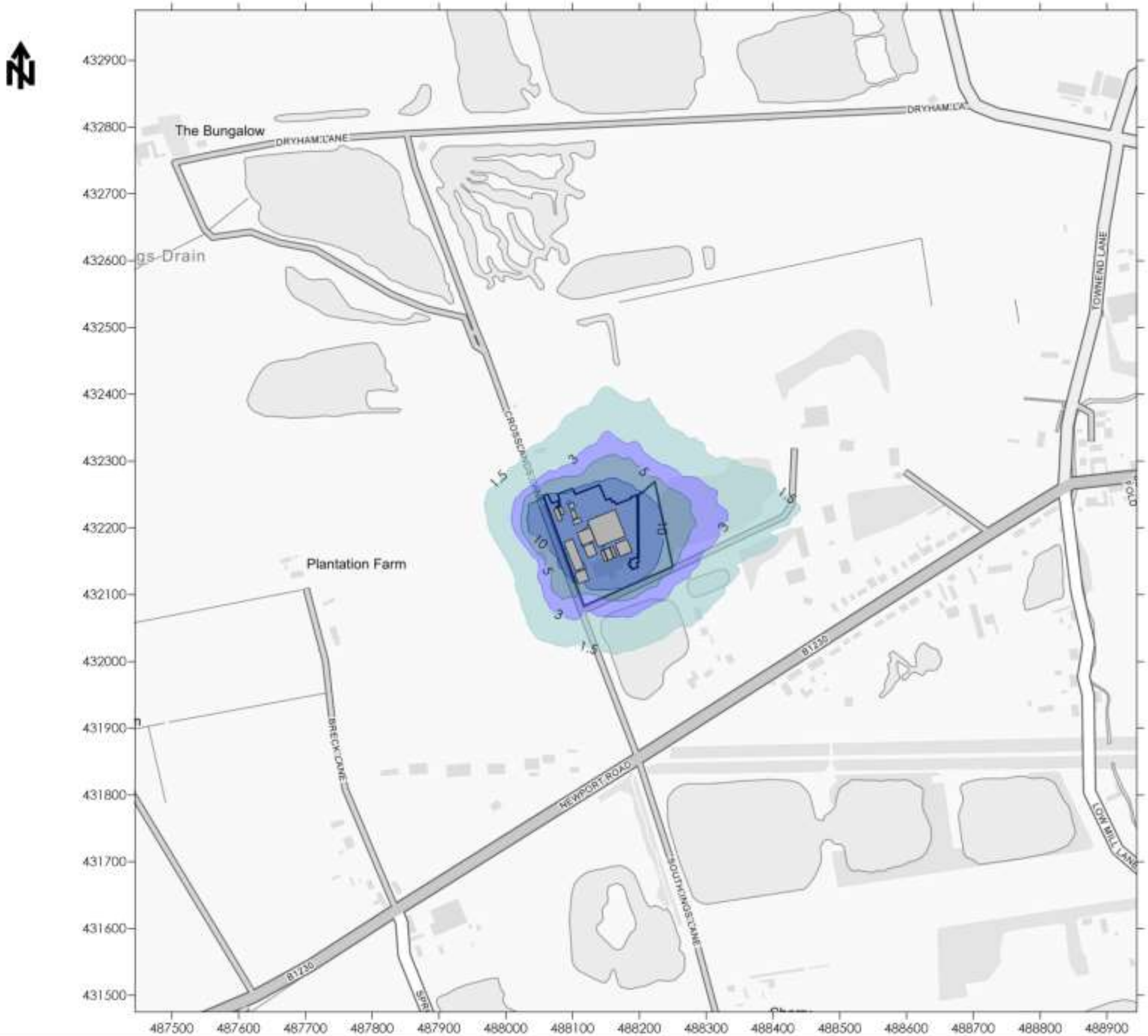
4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou$_E$/m^3)

10
5
3
1.5

Title

Figure 6 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou$_E$/m^3) 2016 Meteorological Data

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

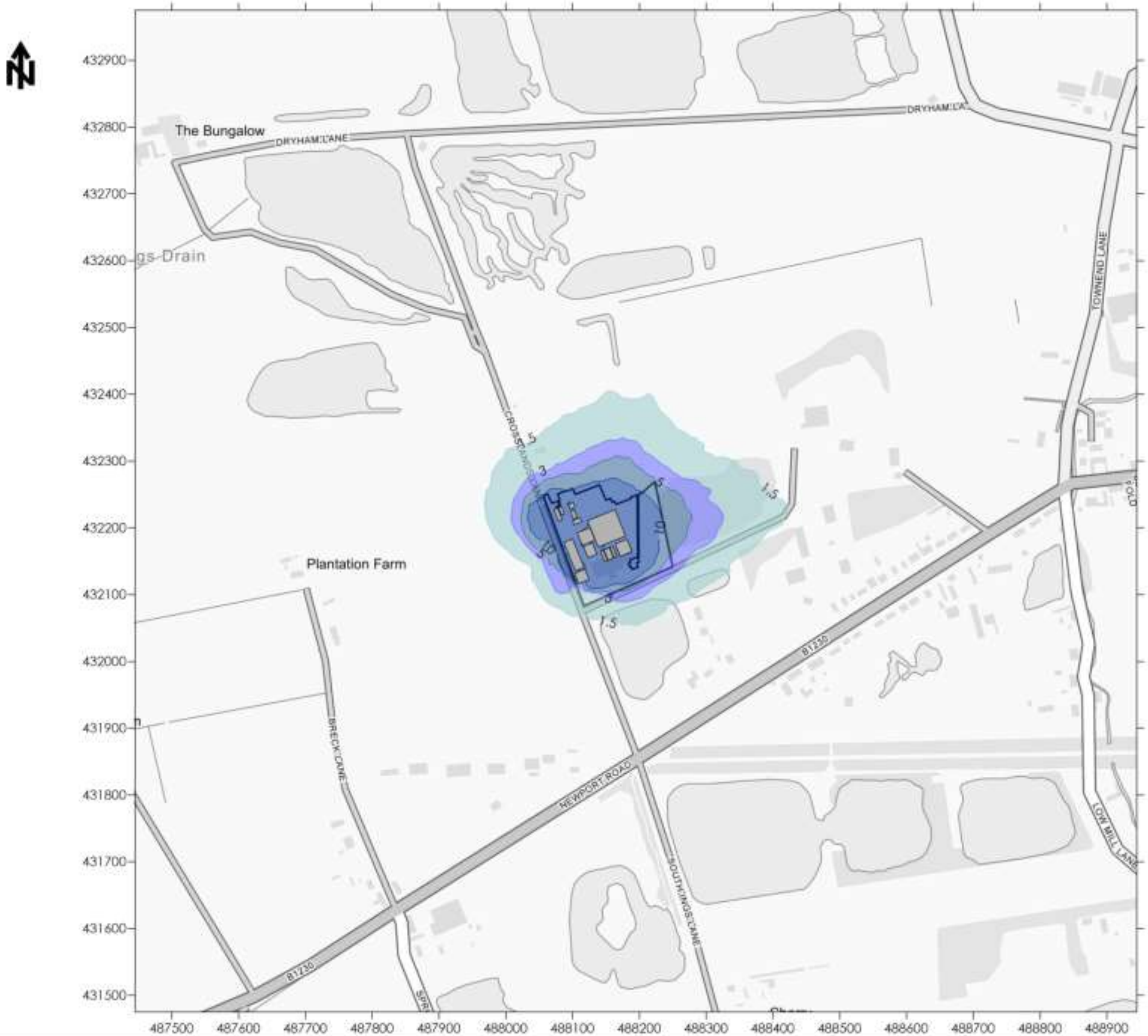
4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10

5

3

1.5

Title

Figure 7 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2017 Meteorological Data

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

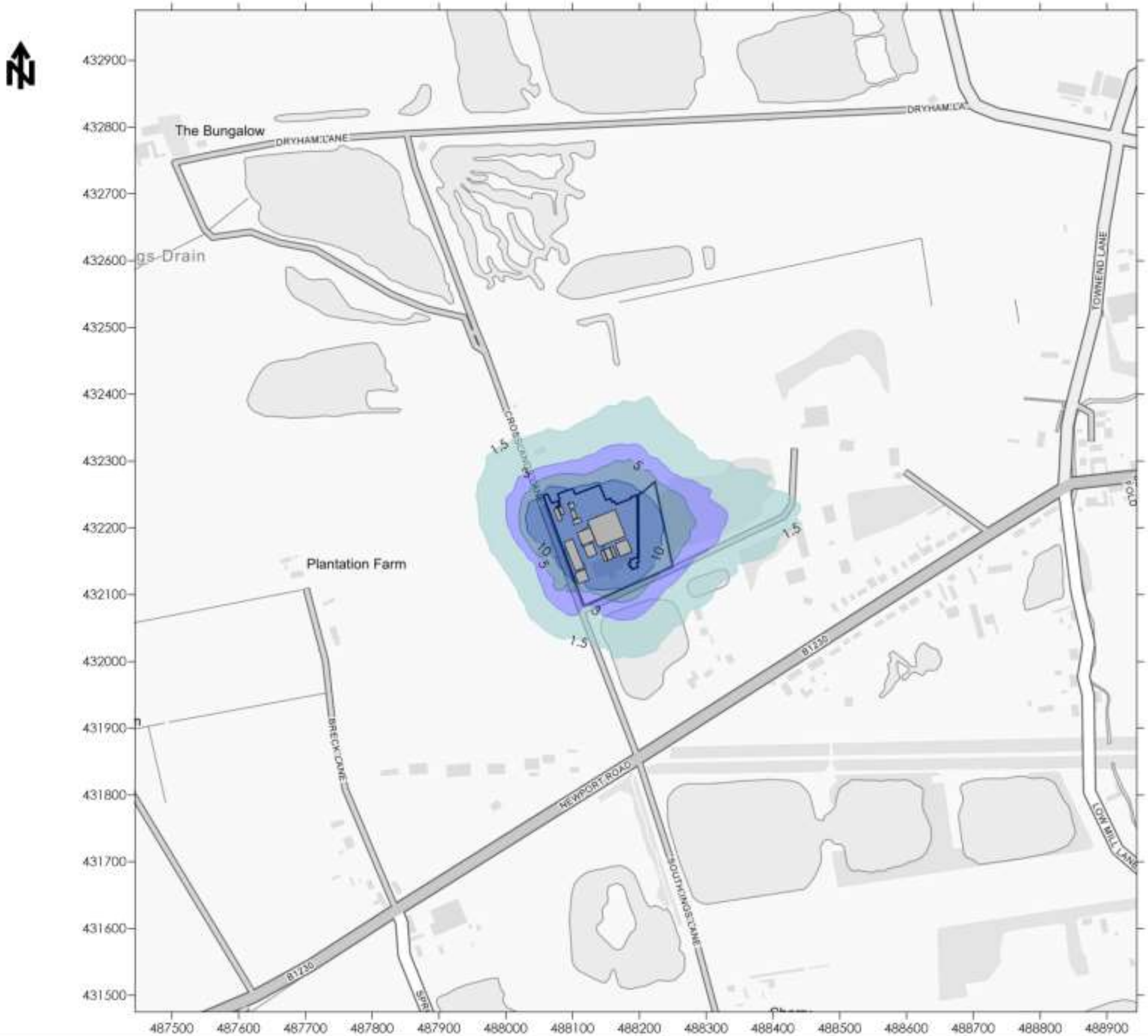
4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou$_E$/m³)

10

5

3

1.5

Title

Figure 8 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou$_E$/m³) 2018 Meteorological Data

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

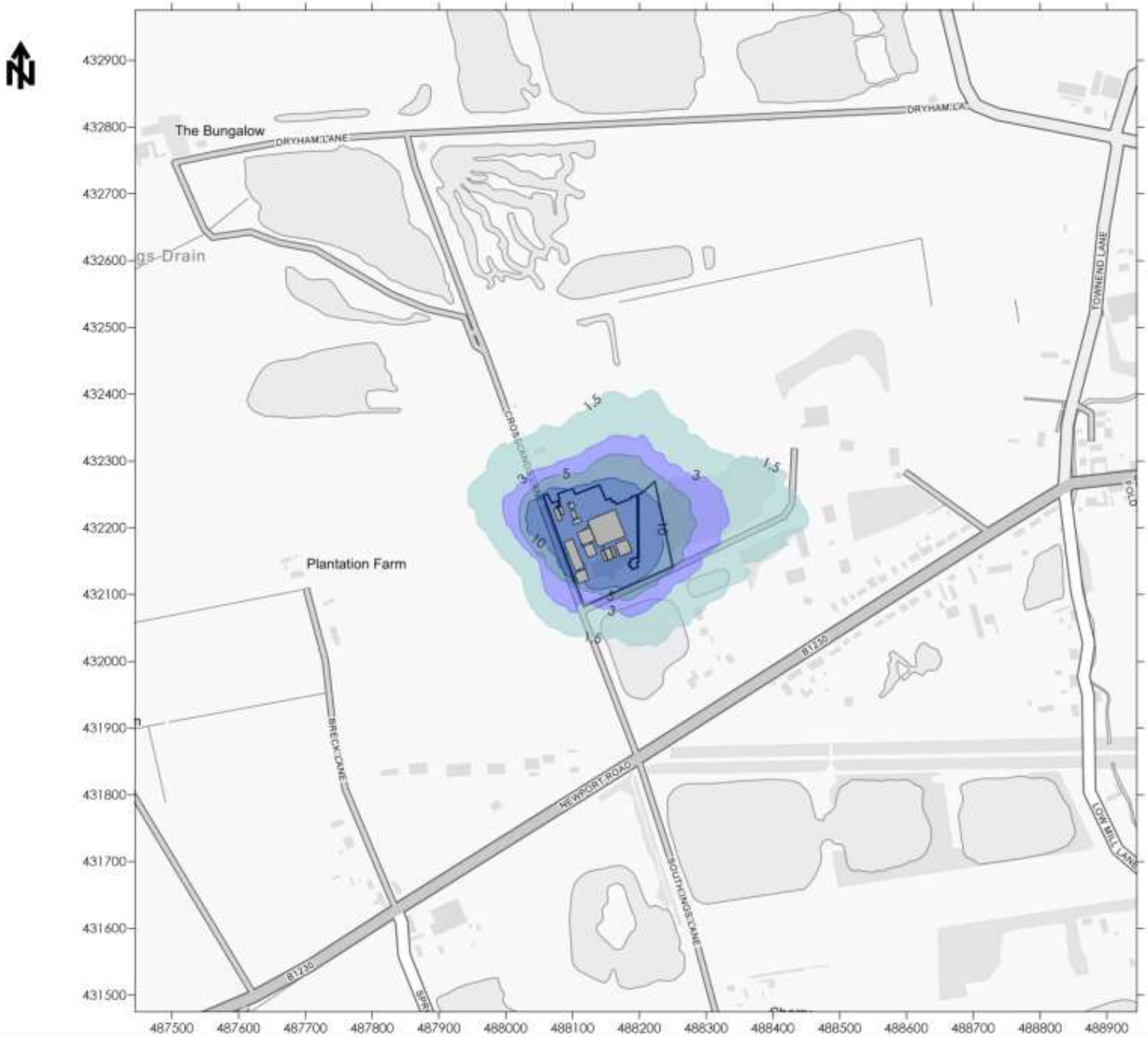
4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075



Legend

Site Boundary

Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3)

10
5
3
1.5

Title

Figure 9 - Predicted 98th %ile 1-hour Mean Odour Concentration (ou_E/m^3) 2019 Meteorological Data

Project

Odour Assessment
Brocklesby Waste Processing Facility, North Cave

Project Reference

4089-1

Client

H&C Consultancy Ltd

Redmore environmental

www.red-env.co.uk | 0161 7060075