GA Pet Food Partners Permit Variation Application EPR/SP3937PB/V010

Further requested requirements re: [redacted] comments, 20/09/19

The following document details and lists [redacted] further requested requirements for the Permit Variation EPR/SP3937PB/V010 application following the email sent 20/09/19;

1. *"Your application requires an assessment under the Habitats Regulations. The charge for this assessment is not included in your baseline application charge. You will therefore need to make an additional payment of £779."*

GA will include payment of £779 in application fee, shown in Part F1

2. *"The charge for our assessment of your odour management plan is not included in your baseline application charge. You will therefore need to make an additional payment of £1,246. Please also see the information requirements below."*

GA will include payment of £1,246 in application fee, shown in Part F1

3. *"The odour modelling assessment you submitted does not include the impacts from the proposed new biobed (Biobed 6) and is therefore not representative of the impacts from the site as a whole. You will need to re-assess (re-model) the impacts and provide us with a revised modelling assessment. Please also provide the modelling files for audit purposes."*

This has been remodelled and is within the new application as document "An Assessment of the Odour Impact of Proposed Operations at the GA Pet Food Partners Manufacturing Facility at Plocks Farm, Bretherton" dated December 2019

Modelling files now received from ADAS, these can be sent electronically to EA once application is under review, this is due to file size.

4. *You need to send us a revised Odour Management Plan that meet the requirements of our H4 Guidance (https://www.gov.uk/government/publications/environmental-permitting-h4-odour-management) and covers the full extent of the site activities and their associated odour management and control measures post variation. (Please note a more detailed review of your OMP will be taken during determination).*

Odour Management Plan has been reviewed in line with comments above, C3 appendix 1 has been updated.

5. *The application mentions that the new biobed and abatement system will serve a "new ingredients kitchen" (fully automated dry pet food production). However, there are no further details regarding this new process area. You need to provide us with further information regarding this, process flow diagrams and plans, confirmation of no. of lines and their production capacities. Please confirm what the overall production capacity will be at the site*

following the variation, together with full details of equipment and infrastructure, how this meets Best Available Techniques, from receipt of raw materials to dispatch of finished products and waste.

Full detailed processes, plans, capacities etc. have been detailed in the revised Odour Management Plan. Ingredients Kitchen flow diagram also within the new application, document referred to as 'Process Flow Diagram' created by KSE.

Ingredient Kitchen plans/P and IDs and structure can be sent electronically to EA once application is under review if necessary, this is due to file size. MB - 5

6. *Provide full details of the maintenance and monitoring regime of all abatement equipment in scope of this variation - biobeds, scrubber and SCR for CHP to ensure that the efficiency of the systems are maintained at all times and the impacts to the environment are minimised.*

Scrubber and biobed detailed in revised Odour Management Plan

CHP SCR detailed in AB document "SCR maintenance"

7. *There are ecological conservation sites within 10km of the site which have not been identified as receptors in the air quality impact assessment (Ribble & Alt Estuaries SPA and Ramsar, and Martin Mere SPA and Ramsar). Please resubmit the assessment with the predicted impacts at these receptors included.*

Documents attached in new application 'Liverpool Road, Bretherton – Air Quality Assessment Addendum Report' by RSK, MB -7

8. *Please provide the modelling files for the (revised) CHP air impact assessment, for audit.*

Modelling files now received from ADAS, these can be sent electronically to EA once application is under review, this is due to file size.

9. *Please provide a full emission point plan and site layout plan, which reflects the site post variation and can be used in Schedule 7 of the permit.*

Emission point source revised site map has also been provided in new application as document "Emission Point Site Layout Plan", MB - 9

Pet Food Partners
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C2 Appendix 1

Summary of GA Pet Food Partners Management System

Global Standard for Food Safety

GA Pet Food Partners currently operates under the Global Standard for Food Safety. This was originally published by the British Retail Consortium [BRC] in 1998, for food producers supplying own brand goods into the UK retail market. The standard has been updated at regular intervals to reflect the latest thinking in food safety, and has now attained usage worldwide as a framework for any business to assist in the production of safe food.

The Global Standard for Food Safety has been developed to specify the safety, quality and operational criteria required to be in place within a food manufacturing organisation, to fulfil its obligations with regard to legal compliance and the protection of the consumer. The format and content of the standard is designed to allow an assessment of a Company's premises, operational systems and procedures by a certification body against the requirements of the standard.

The format of the Global Standard for Food Safety

The Global Standard for Food Safety requires the development of and compliance with:

(i) A Senior Management commitment to provide resources to demonstrate the ability to achieve the requirements of the standard.

(ii) A Hazard and Critical Control Point Plan [HACCP], to provide a focus on the significant product and process food safety hazards that require specific control to ensure the safety of individual food products.

(iii) A Quality Management System (GA Standard) that details the organisational and management policies and procedures that provide a framework by which the organisation will achieve the requirements of the standard.

(iv) It is a prerequisite of the programme that the environmental and operational conditions throughout the business are in accordance with their operating Permit, and that the controls of the assessed hazards are in accordance with Good Manufacturing and Good Hygienic Practice.

(v) The standard fundamentally requires the Operator to demonstrate good practice in, training, control of operations, handling of specified risk materials, good housekeeping and hygiene systems, traceability, the ability for corrective and preventative actions, and internal audits, together with a Senior Management commitment to continual improvement.

Environmental Management Systems

In addition to the BRC Global Standard for Food Safety, the Operator keeps the following additional Environmental Management Systems:

(i) Detailed daily and weekly site inspections in accordance with the Odour Management Plan

(ii) An Odour Management Plan, together with an Accident Management Plan.

(iii) The Operator maintains a Training Schedule and details the skills and training given to each member of staff.

(iv) The Operator maintains full management systems for the recording of complaints, pollution incidents, or breaches of the Permit, together with detail as to how to deal with them.

(v) Records of calibration of critical environmental equipment

(vi) Periodic testing of odour abatement and waste water treatment in accordance to the GA the environmental permit.

(vii) The Operator maintains an Environmental Statement, Policy and Pledges, together with a commitment for continuous improvement.

C2 Appendix 2

Pet Food Partners

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HEALTH AND SAFETY POLICY

GA Pet Food Partners are committed to ensuring the health and safety of staff and anyone affected by our business activities, and to providing a safe and suitable environment for all those attending our premises.

The Health and Safety policy sets out our arrangements in relation to:

I. Assessment and control of health and safety risks arising from work activities;
II. Preventing accidents and work-related ill health;
III. Consultation with partners on matters affecting their health and safety;
IV. Provision and maintenance of a safe workplace and equipment;
V. Information, instruction, training and supervision in safe working methods and procedures;
VI. Emergency procedures in cases of fire or other major incident.

This policy does not form part of any partner's contract of employment and we may amend it at any time. We will continue to review this policy to ensure it is achieving its aims.

Your Responsibilities
All staff share responsibility for achieving safe working conditions. You must take care of your own health and safety and that of others, observe applicable safety rules and follow instructions for the safe use of equipment. You should report any health and safety concerns immediately to your line manager and you must co-operate with managers on health and safety matters, including the investigation of any incident. Failure to comply with this policy may be treated as misconduct and dealt with under our Disciplinary Procedure.

Information and Consultation
The Health and Safety Manager is responsible for informing and consulting partners about health and safety matters.

Training
We will ensure that you are given adequate training and supervision to perform your work competently and safely. Staff will be given a health and safety induction and provided with appropriate safety training.

Equipment
You must use equipment in accordance with any instructions given to you. Any equipment fault or damage must immediately be reported to your line manager. No member of staff should attempt to repair equipment unless trained to do so. The Stores Manager is responsible for ensuring equipment safety and maintenance.

Sign _____ Date 8/11/17

Andy Kettle
Joint Managing Director

C2 Appendix 3 –
Site Plan for applied variations

Ingredients Kitchen Emission to Air Point Source

Bunded Scrubber Water Tank

Wet Scrubber 6

Biobed 6

CHP Emission Point to Air Source

Additional Biofilter Chimney Stacks

FLOOD BANK RAISING PHASE 1

NEW PACKING HALL PHASE 2

NEW OFFICES & CANTEEN PHASE 2

MODIFICATIONS TO EXISTING PRODUCT STORE PHASE 3

MODIFICATIONS TO EXISTING PRODUCT STORE PHASE 1

CONCRETE YARD

PROPOSED CANOPY OVER PHASE 3

PROPOSED HEAT STEAM CHILLERS PHASE 3

PROPOSED FRIDGE PHASE 3

PROPOSED NEW PARKING CONCRETE FINISH

PROPOSED CAR PARK

PROPOSED VISITOR CENTRE PHASE 2

LEGEND

CONSTRUCTION

GRAHAM SCHOFIELD ASSOCIATES
Consulting Civil and Structural Engineers

GSA

client
GOLDEN ACRES LTD

project
PLOCKS FARM . BRETHERTON
INGREDIENTS KITCHEN

title
PROPOSED SITE LAYOUT

drawing number
2061 - 320 - A01

C2 Appendix 4 – Non-Technical Summaries

A) Additional 12m chimney stacks on five existing biofilters, five additional emission to air point sources,

GA propose the addition of a second stack on biobeds 1, 2, 3, 4 and 5 (five additional emission to air point sources), meaning each biobed would have two 12m stacks at opposing ends of the biofilters. The change is proposed as a means of improving initial distribution and dispersion of emissions by increasing the area over which the odours are released to reduce fan energy use by reducing system pressure drops through each biofilter by decreasing stack pressure drops, this proposed change also reduces the risk of the biofilter covers being torn as air distribution would not be concentrated in particularly areas causing ripping of the covers thus reducing the risk of 'uncontrolled' and non-permitted emission points to air on the biofilter.

Intact covers also ensure a better level of odour abatement as biofilters fully covered maintains temperature (25-35 degC from process air) and humidity (biobed irrigation) so it is not lost to atmosphere, meaning the better bacterium productivity and odour abatement. The proposed additional stacks would be part of package of improvements including refurbishment/replacement of damaged biofilter roof covers

Summary of reasonings;

1. To provide "pressure relief" valves, in the proposed new stacks, to prevent over-pressure damage to the biofilter roof structures. The roof covers of two of the biofilters have been damaged since they were commissioned as a result of excess pressure. This issue has become more important since the introduction of biofilters 4 and 5 with pumice stone biofilters. In addition to other advantages, pumice stone media has inherently lower pressure drops than the bark/wood chip previously used, and this results in the potential for higher airflow through one or more biofilters and the risk that roof covers are over-pressured and damaged, as has occurred with biofilters Nos. 4 and 5. The proposal is that pumice stone will in future also be used in biofilters Nos. 1, 2 and 3 as a replacement for the existing media, which is approaching the end of its useful life through biological degradation and settlement.

2. To improve the effectiveness of the odour extraction systems which will ultimately help reduce the risks of factory fugitive emissions, and to reduce fan energy use by reducing system pressure drops through each biofilter. This will be achieved by reducing bio-bed headspace and stack pressure drops. This is an important factor, in combination with the reduced pressure loses and energy use which result from the use of pumice stone media in all five biofilters, in reducing the energy consumption of the odour extraction and treatment system, as well as minimising electrical power running costs.

(An Assessment of the Odour Impact of Existing and Proposed Operations at the GA Pet Food Partners Manufacturing Facility at Plocks Farm, Bretherton, 2018).

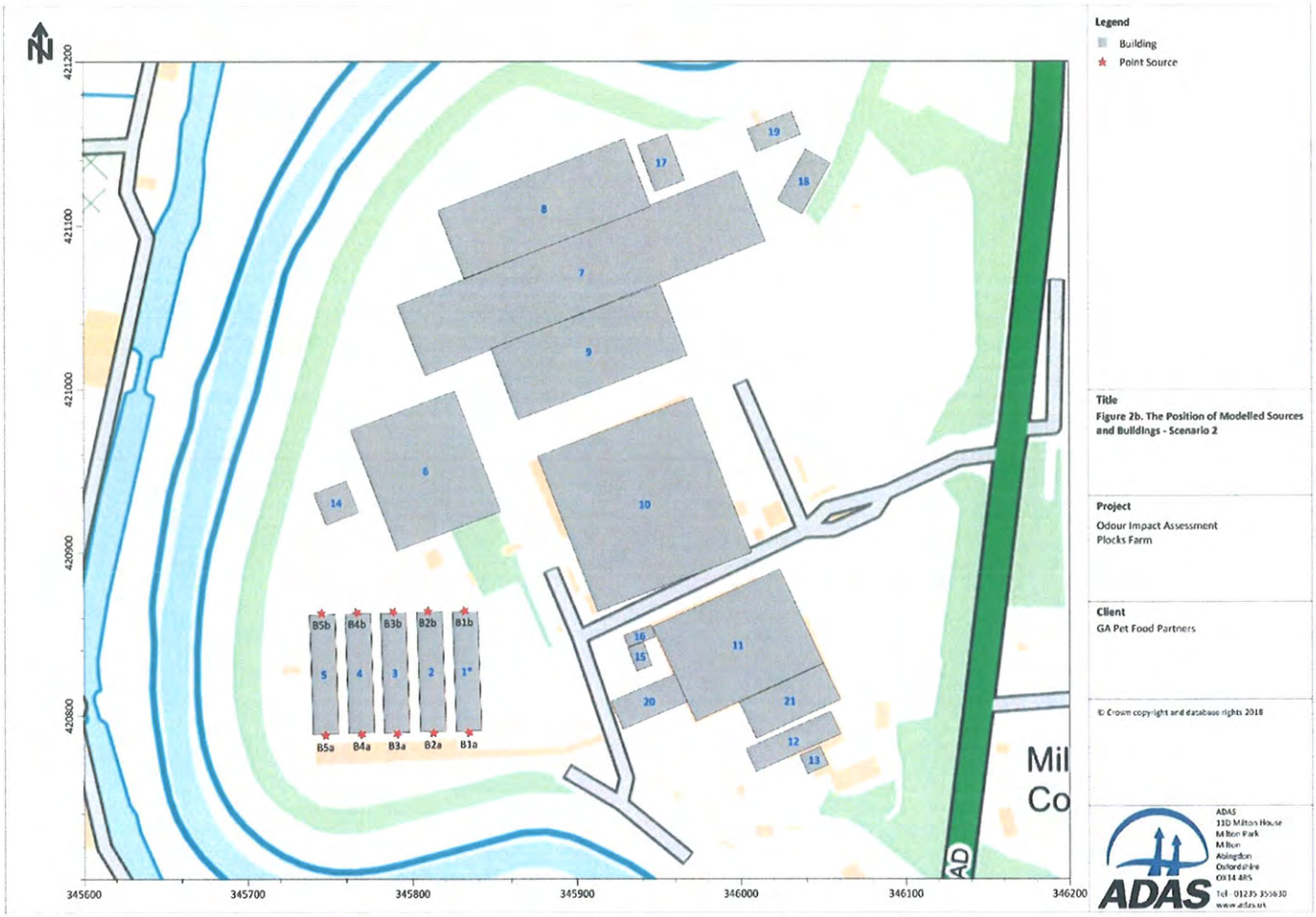


Figure 2b – Position of current (a and proposed (permit emission source A10-14) biofilter emission to air points.

B) Non-Technical Summary of the new additional point source emission to air, wet scrubber 6 and biobed 6

GA Pet Food Partners are to implement an approved/tried and tested odour abatement system to odour abate the new 'Ingredients Kitchen'. The Ingredients Kitchen process is the same dosing, blending and grinding of raw materials as currently undertaken on-site for dry pet food production process, the only change is that this is a full automated process meaning less wastage. This is to be odour abated by dry filtering, wet air scrubber 6 and then biobed 6, biobed 6 will consist of pumice media, following this high level air treatment, the odour abated air is emitted to air by the point source emission point in this location, again the same approved and tested odour abatement process already used on-site.

All materials will be loaded in within the confines of the buildings with the doors closed prior to transfer and the building under extraction to the dry filtration and odour abatement systems. The proposed high rate grinder transfer and elevator extraction systems will be instrumental in controlling all dry dust emissions at source, with air streams to be filtered, scrubbed and then abated by Biofilter 6, and thus will provide three stages of dust mitigation. Following odour abatement, the treated air is emitted by the point source emission point, this is on the roof of the Ingredients Kitchen, stack height being 22m and release height being 25m. This high level treatment and dispersion has been modelled and concluded that it would not result in any significant loss of local residential amenity (S, Peirson 2015, *Proposed Developments at GA Pet Food Partners, Plocks Farm Bretherton 2015 Update of the 2009 EIA Environmental Statement) – Appendix 5.*

Within the wet scrubber, water is sprayed into the dry filtered air to separate out particulates and soluble volatile organic compounds prior to biofiltration treatment in biobed 6. Biobed 6 is comprised by pumice media which is kept moist to sustain a bio-film on the media, the biobed will be covered in order to maintain even temperatures and to control the rate of evaporation. The low speed of air passing through the biofilter, and the wet media and bio-film surfaces provide effective control of any particulates which are not "trapped" in the preliminary filters and the water scrubbers, following this treated air is dispersed to atmosphere via 22m stack.

A Best Available Techniques (BAT) assessment of the merits of different odour control technologies highlighted the benefits of biofilters (with preliminary water scrubbers) and stack dispersion as the best means of achieving effective odour impact mitigation without excessive energy consumption (S, Peirson 2015, *Proposed Developments at GA Pet Food Partners, Plocks Farm Bretherton 2015 Update of the 2009 EIA Environmental Statement).*

The effectiveness of this approach has been demonstrated with successful experience with the existing Biobed 1, 2, 3, 4 and 5, following pre-treatment with dry filtering (of process air) and water scrubbers. This effectiveness is displayed in table 4 below;

Table 4 Treated Air Odour Concentrations of Biofilters 2012 to 2017.

Sampling Dates	Geometric Mean Odour Concentrations (ou_E/m^3)				
	Biofilter 1	Biofilter 2	Biofilter 3	Biofilter 4	Biofilter 5
November 2017	46	<35	105	71.5	50.5
April 2017	40	<35	123	116	124
October 2016	<40	<35	89	130	124
April 2016	87	60	68	184	126
October 2015	81	67	79	-	-
April 2015	478	223	296	-	-
October 2014	144	76	462	-	-
April 2014	303	271	266	-	-
October 2013	<52	101	222	-	-
May 2013	<49	<50	<73	-	-
October 2012	89	82	76	-	-
April 2012	61	64	81	-	-
March 2012	126	107	108	-	-
February 2012	347	227	655	-	-

All previous analysis results show that the scrubbers and biofilters continue to provide a very high level of odour control, as demonstrated by very low geometric mean odour concentrations in treated air samples taken from all five biofilter stacks. With treated air off biofilters Nos. 1, 2, 3, 4 and 5 having geometric mean outlet odour concentrations of 46 ouE/m3, <35 ouE/m3, 105 ouE/m3, 71.5 ouE/m3, 50.5 ouE/m3 respectively. These results show consistent and very high levels of abatement performance. The treated air odour concentrations consistently comply with a target maximum outlet or treated air odour concentration limit of 1,000 ouE/m3.

Significant and continuous reductions in odour concentrations are shown across the scrubber and biofilter system, from scrubber inlet odour concentrations of 38,465 ouE/m3, down to treated air (outlet) odour concentrations of below 105 ouE/m3 across all biofilters, thus providing continuing evidence of a very effective odour abatement system.

Overall, the biofilters alone achieve an average 98.9% reduction in odour concentrations and the combination of scrubbers and biofilters achieve in excess of 99.9% reductions in odour concentrations.

This existing odour abatement system has provided more effective odour abatement than seen at comparable plants using wet chemical scrubbers and cold plasma systems. Further advantages of biofilters are that they are low resource (input) and waste (output) implications and the fact that they can be readily managed and maintained by relatively unskilled personnel.

Additionally, we therefore request that the odour monitoring frequency set out for biobeds 1 to 6 and the carbon filter in Schedule 3 of the V009 environmental permit is to be changed, from a measuring frequency of every 6 months to every 12 months, as discussed and agreed with Lee Collins (Local Environment Agency Officer) due to the consistently low odour emission results.

C) Combined Heat and Power Plant (CHP) emission to air point source

GA Pet Food Partners propose the installation of a 3.3mW combined heat and power engine, this is to be installed in order to significantly reduce site carbon emissions and energy costs. Carbon emission will be significantly reduced as the CHP engine will generate power on-site and heat recovery otherwise wasted heat from the engine exhaust gases and water-cooling system as steam and 90 degrees C hot water to be used in the pet food production process.

As the proposed development is a CHP plant which will add an emission to air point source from the CHP chimney stack, detailed dispersion modelling was considered appropriate to assess the potential impacts on local air quality at sensitive receptors, once operational and to ensure the CHP complies with the medium plant combustion directive.

The assessment of construction phase impacts has been undertaken following the 2014 Institute of Air Quality Management (IAQM) guidance. Demolition does not form part of this development and was screened out. The potential risk of construction phase impacts and earthworks on local air quality was predicted to be negligible for dust soiling and human health, prior to the implementation of dust control measures. Trackout has a negligible to low risk on dust soiling and human health. Mitigation measures have been recommended to reduce the risk of dust and particulate matter being generated and re-suspended. With implementation of the appropriate measures, construction activities are not anticipated to have a significant impact on air quality.

The main potential air quality impact once the proposed development is operational considered to be emissions from the operation of the proposed CHP. An assessment of operational impacts has been undertaken using ADMS-5.2, an advanced atmospheric dispersion model developed for regulatory purposes, with the use of meteorological data predicted between 2013 and 2017 using the Global Forecast System (GFS). Buildings/structures have been included to account for the effects of downwash and terrain data also included. Concentrations of key air pollutants (nitrogen oxides (NO_x), nitrogen dioxides (NO_2) and carbon monoxide (CO) for MCD compliance have been predicted at discrete human and ecological receptor locations, as applicable. Sulphur dioxide (SO_2) and ammonia (NH_3) impacts have been considered for the scenarios where selective catalytic reduction (SCR) has been incorporated into the development.

3 EXHAUST EMISSIONS

Atmospheric emissions of co-generator are:

NOx (reported at 5% O2)	450 mg/Nm³
CO (reported at 5% O2)	300 mg/Nm³
Exhaust stack height (measured from ground level)	15 m

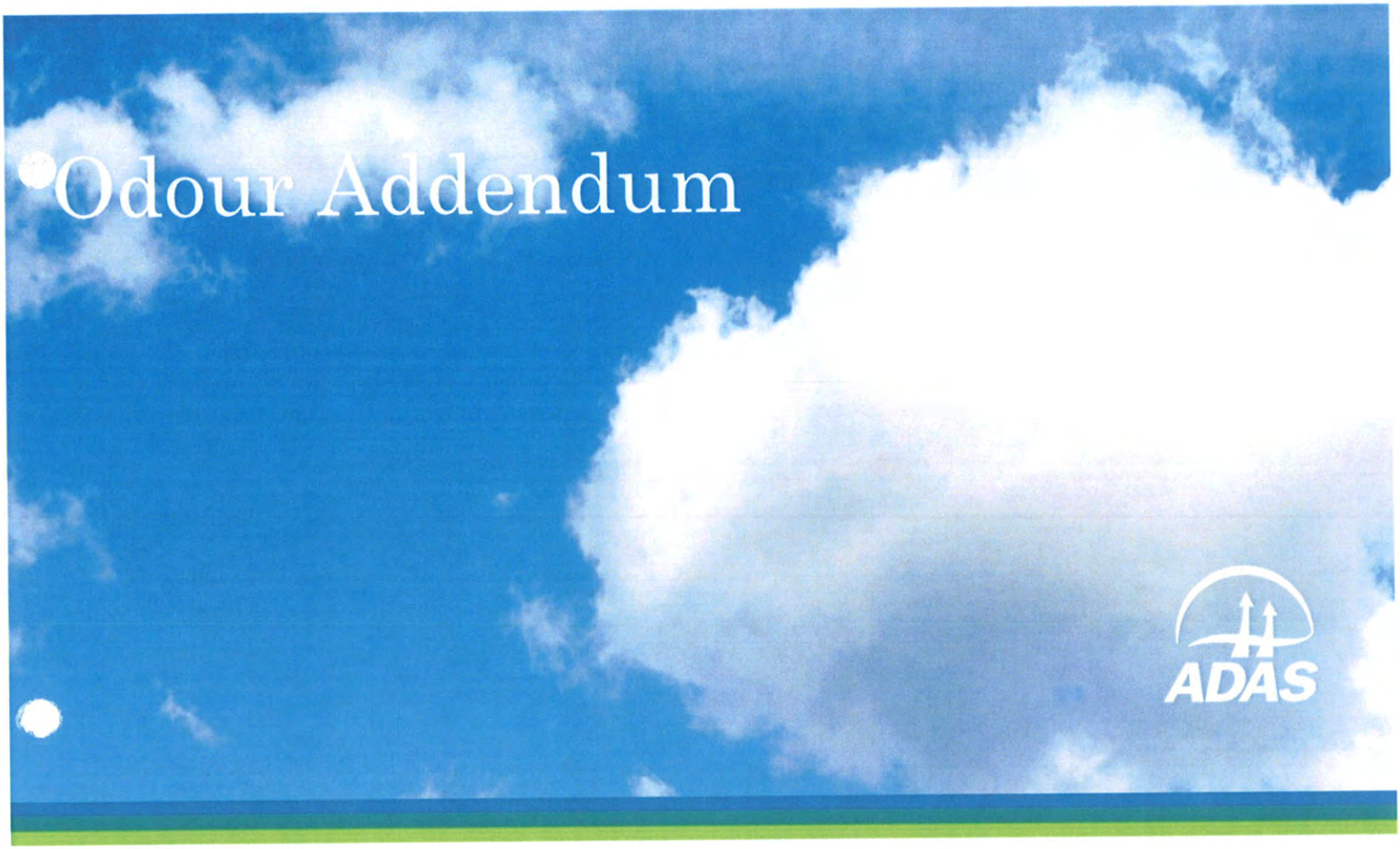
Atmospheric emissions of co-generator, **with SCR,** are:

NOx (reported at 5% O2)	75 mg/Nm³
CO (reported at 5% O2)	100 mg/Nm³
NH3 (reported at 5% O2)	5 mg/Nm³
Exhaust stack height (measured from ground level)	15 m

'GA PET FOOD-SUPPLY OFFER-REV.5' Exhaust emission gas levels to air from CHP

The development was assessed as having a minimal impact at the majority of local ecologically sensitive sites, with regards to nitrogen and acid deposition, and ambient annual and daily mean NO_x concentrations. The assessment has concluded that taking the conservative nature of the assessment into account, the overall impact on local air quality is considered to be insignificant, and due to the inclusion of the SCR unit MCD compliance for SOx, NOx and CO is well under consent emission limits.

C2 Appendix 5



An Assessment of the Odour Impact of Existing and Proposed Operations at the GA Pet Food Partners Manufacturing Facility at Plocks Farm, Bretherton

Reference No: 443031

Issued by: Steve Peirson

Date: December 2018

Submitted to:

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Plocks Farm

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MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 · ISO 14001
OHSAS 18001

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Version History

VERSION	DATE	AMENDMENTS
First Draft	December 2018	Initial Report
Final report	July 2019	Updated with June 2019 data

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APPENDIX 1: PREDICTED ODOUR CONCENTRATIONS FOR EACH YEAR OF THE MET FILE

APPENDIX 2: MEASURED BIOFILTER PERFORMANCE

Summary

ADAS was commissioned by GA Pet Food Partners to conduct a study of the potential impact of odour emissions from the existing pet food manufacturing operations and proposed new developments at the a GA Pet Food Partners Plocks Farm manufacturing site, Bretherton, Leyland in a report dated September 2015.

Since the odour modelling was carried out in 2015, GA Pet Food Partners are currently considering alternative dispersion stack arrangements on the five biofilters which would include the addition of a second stack on each biofilter, so that there would be one 12 m stack on each end of each biofilter rather than the current arrangement of one stack on one end of each biofilter. The proposed change is being considered as a means of improving initial distribution and dispersion of emissions by increasing the area over which the odours are released and primarily to reduce fan energy use by reducing system pressure drops through each biofilter by reducing stack pressure drops. The modelling reported here therefore comprises an additional odour assessment carried out to assess the effects of the proposed alternative stack arrangement. This report forms an addendum to the 2015 odour modelling report and outlines the updates to the odour assessment methodology used, describes the current (five biofilter stacks) and proposed future (ten biofilter stacks) modelling scenarios, and provides a comparison of the results of the model outputs for the two different stack arrangements.

Guideline Values and Benchmarks

Predicted odour exposures have been compared to benchmarks of 3 ou_E/m^3 and 5 ou_E/m^3 expressed as annual 98th percentiles.

Dispersion Modelling Methodology

The choice of model for this study is the UK Atmospheric Dispersion Modelling System (ADMS) Version 5.2. The ADMS model has been revised since 2015, so that change will in itself lead to some differences in the model outputs. In term of other changes made to the model set up, the modelling reported here also includes the effects of local terrain, revised surface roughness treatment to take account of the fact that residential or "urban" development is now closer to the site, and the addition of new receptors locations to include more recent residential developments. The model also includes changes to site building details and layouts to reflect recent changes.

Weather Data

In 2015 the odour modelling was based on weather records from Manchester Airport, which is a station which records all of the weather elements required for dispersion modelling and has similar exposure to the Plock Farm site, but which is approximately 49 km to the south-east. Therefore in this updated modelling site specific data has been procured. The meteorological data used in this study is obtained from assimilation and short term forecast fields of the Numerical Weather Prediction (NWP) system known as the Global Forecast System (GFS). A five-year weather file has been obtained.

Modelled Scenarios

Two scenarios have been modelled. Scenario 1 represents the current (five) stack arrangement and scenario 2 represents the proposed alternative (ten) stack arrangement.

Modelled emission rates are the same for both scenarios and have been based on the design airflow throughputs through each biofilter (m^3/s) multiplied up by a nominal biofilter treated air (outlet) odour concentration of 1,000 ou_E/m^3, as used in the 2015 odour impact assessment report.

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Comparisons of Impacts with Emissions at an Odour Concentrations of 1,000 ou_E/m^3

Scenario 1 (Emissions through five existing stacks)

Modelling of the existing stack arrangement predicts that the five-year maximum and average annual 98th percentile hourly mean odour impacts or concentrations are below the suggested benchmark of 3 ou_E/m^3 at all modelled discrete receptor points apart from the discrete receptor locations at Meadow Park and Fairclough Drive, the closest receptors to the west of the site. Predicted impacts or odour concentrations are however below the upper benchmark of 5 ou_E/m^3.

Scenario 2 (Emissions through five existing + five additional stacks)

Modelling of the alternative stack arrangements predicts a slight increase in odour impacts at all of the discrete receptor points. Odour concentrations at the majority of the discrete receptor points are still below the lower benchmark of 3 ou_E/m^3 apart from at Meadow Park and Fairclough Drive. Under the alternative stack arrangement the highest 5-year average 98th percentile odour concentration is at receptor point 44 on Fairclough Drive, at 4.26 ou_E/m^3, and the maximum individual year odour concentration is also at receptor point 44 at 4.57 ou_E/m^3. Odour concentrations are however still below the upper benchmark of 5 ou_E/m^3.

Impacts with Measured Odour Emission Concentrations

An assessment of the potential significance of odour impact for the existing and proposed stack arrangements can be assessed by considering the potential odour impacts of the actual biofilter emissions based on the actual measured levels of biofilter emissions by simple proportion from the modelling outputs with outlet odour concentrations of 1,000 ou_E/m^3. Thus, as measurements have shown that actual biofilter performance is now such that the emission concentrations do not exceed 250 ou_E/m^3 then the off-site impacts predicted can be reduced by a factor of four, by simple proportion, to more realistically assess the off-site impact predicted by modelling. The effects of this adjustment are that predicted 5-year average 98th percentile impacts are all well below 3 ou_E/m^3 for both stack scenarios.

The modelling demonstrates that the proposed stack layout would marginally increase off-site odour impacts above in comparison with the existing arrangement. The highest impacts are in the recently developed residential areas to west of the GA Pet Food Partners site, but the predicted off-site odour impacts would remain very low providing that the biofilters continue to perform at the very high levels of abatement shown in Appendix 2. In effect, the modelling demonstrates that the factor of two reduction in stack emission velocity or air discharge speed that results from doubling the number of stacks is NOT compensated for by the increase in initial dispersion or spread of the emissions that results from having stacks at both ends of the biofilters.

The significance of odour impacts for the existing and proposed future stack scenarios using the IAQM methodology for "moderately offensive" odours and the precautionary assumption that a "high" sensitivity rating can be applied to all receptors considered in the modelling. With emission odour concentrations of ≤250 ou_E/m^3 'negligible' effects are predicted at all discrete receptor with both five stack and ten stack scenarios.

Recommendation

It is recommended that the proposed additional stacks should be with pressure operated valves/shutters to ensure that they close down the additional stacks so that optimal use is made of the existing stacks when the production plant and extractions systems are operating at less than full capacity. The proposed pressure relief valves would thus help ensure that the existing stacks continue to disperse odours at a reasonably high emission velocity. Pressure operated valves would also help ensure that the roof covers would be maintained sufficiently "taut" to prevent wind damage, by maintaining reasonable pressure within the biofilter headspaces.

1 Introduction

ADAS was commissioned by GA Pet Food Partners to conduct a study of the potential impact of odour emissions from the existing pet food manufacturing operations and proposed new developments at the a GA Pet Food Partners Plocks Farm manufacturing site, Bretherton, Leyland in a reported dated September 2015. The aim of the 2015 odour study was to assess how odour emissions from the proposed developments and associated air extraction and odour abatement plant at the factory may affect residential receptors in the surrounding area.

The 2015 odour assessment included odour emissions from five biofilters used to treat odours from the factory headspace extraction from the process lines B, C and D, the process odours from line B, C and D and the meat kitchen. This is how the plant has been built, with each of the five biofilters discharging and dispersing treated air through a single 12 m stack.

GA Pet Food Partners are currently considering alternative dispersion stack arrangements on the five biofilters which would including the addition of a second stack on each biofilter, so that there would be one 12 m stack on each end of each biofilter rather than the current arrangement of one stack on one end of each biofilter. The proposed additional stacks would be part of package of improvements including refurbishment/replacement of damaged biofilter roof covers, and the proposed stacks would also be added for the following reasons:

1. To provide "pressure relief" valves, in the proposed new stacks, to prevent over-pressure damage to the biofilter roof structures. The roof covers of two of the biofilters have been damaged since they were commissioned as a result of excess pressure. This issue has become more important since the introduction of biofilters 4 and 5 with pumice stone biofilters. In addition to other advantages, pumice stone media has inherently lower pressure drops than the bark/wood chip previously used, and this results in the potential for higher airflow through one or more biofilters and the risk that roof covers are over-pressured and damaged, as has occurred with biofilters Nos. 4 and 5. The proposal is that pumice stone will in future also be used in biofilters Nos. 1, 2 and 3 as a replacement for the existing media, which is approaching the end of its useful life through biological degradation and settlement.

2. To improve the effectiveness of the odour extraction systems which will ultimately help reduce the risks of factory fugitive emissions, and to reduce fan energy use by reducing system pressure drops through each biofilter. This will be achieved by reducing bio-bed headspace and stack pressure drops. This is an important factor, in combination with the reduced pressure loses and energy use which result from the use of pumice stone media in all five biofilters, in reducing the energy consumption of the odour extraction and treatment system, as well as minimising electrical power running costs.

3. As a means of improving initial distribution and dispersion of emissions by increasing the area over which the odours are released

The modelling reported here therefore comprises an additional odour assessment carried out to assess the effects of the proposed alternative stack arrangements. This report forms an addendum to the 2015 odour modelling report and outlines the updates to the odour assessment methodology used, describes the current (5 biofilter stacks) and proposed future (10 biofilter stacks) modelling scenarios, and provides a comparison of the results of the model outputs for the two different stack arrangements.

The calculation of odour emissions and the benchmarks used to assess odour emissions are the same as those used in the original report, but with commentary provided on the resulting model outputs based

on actual measured biofilter outlet odour concentrations and emission rates. This report is an addendum to the original report produced in 2015 and should be read in conjunction with that report.

As background to this report it is noted that only two of the current biofilter roof structures are intact and that emissions from the other three biofilters have been discharged in a relatively uncontrolled manner over the last 2 to 3 years, that is without the benefits of high level vertical dispersion that occurs with stack emission releases. Despite the "uncontrolled" releases that have occurred through the damaged roof covers, there have been no significant or substantiated incidents of biofilter odours impacting on off-site odour receptors. It can be quite logically reasoned that the proposed refurbishment of roof covers and the provision of additional stacks will be a positive improvement over the current baseline.

2 Assessment of Significance

Since the previous odour assessment in 2015, the Institute of Air Quality Management (IAQM) has revised their guidance on the assessment of odour. In accordance with the new IAQM guidance (Bull et. al, v1.1, July 2018), the significance of odour effects can be assessed in relation to the magnitude of the impact and the sensitivity of the receptor. The magnitude scale has been developed based on the suggested odour benchmarks above for odours in the moderately offensive category. The magnitude is combined with the receptor sensitivity to determine the significance of the impact as shown in Table 1.

It is important to note, however, that there is relatively limited evidence of the dose related odour impact in the community and therefore assigning significance is not as straightforward as simply following the matrix in Table 1. Although the matrix acts as a guide, professional judgement still needs to be used to take into account various factors such as a community's existing tolerance of odours.

Table 1. Matrix for Assessing the Significance of Impacts Predicted by Modelling

Odour Exposure Level C_{98}, ou_E/m^3	Receptor Sensitivity		
	Low	Medium	High
>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
<0.5	Negligible	Negligible	Negligible

3 Dispersion Modelling Methodology

3.1 Model Description

The model used in this study is UK Atmospheric Dispersion Modelling System (ADMS) Version 5.2. ADMS is a steady-state atmospheric dispersion model that is based on modern atmospheric physics.

3.2 Modelling Period

The Environment Agency, in their H4 odour guidance, sets out in Appendix 3 (of H4) that a minimum of three years, and preferably five years weather data, should be used to calculate the 98th percentile of the

hourly mean odour concentrations, in order to represent conditions for an average year. The IAQM guidance (Bull et. al., 2018) also suggests that five years of data should be used and that individual years should be modelled. Comparisons of single yearly statistics will show the range, or sensitivity, of the modelled 98th percentile odour concentrations to meteorological data. For example, a particular year may have a number of periods where dispersion conditions are very poor, leading to higher annual 98th percentile values. ADAS has reported the mean or average 98th percentile of the hourly mean odour concentrations over a five-year period to provide statistically robust results, smoothing out inter-annual variations as specified in the H4 guidance. However, individual year data is also included in Appendix 1.

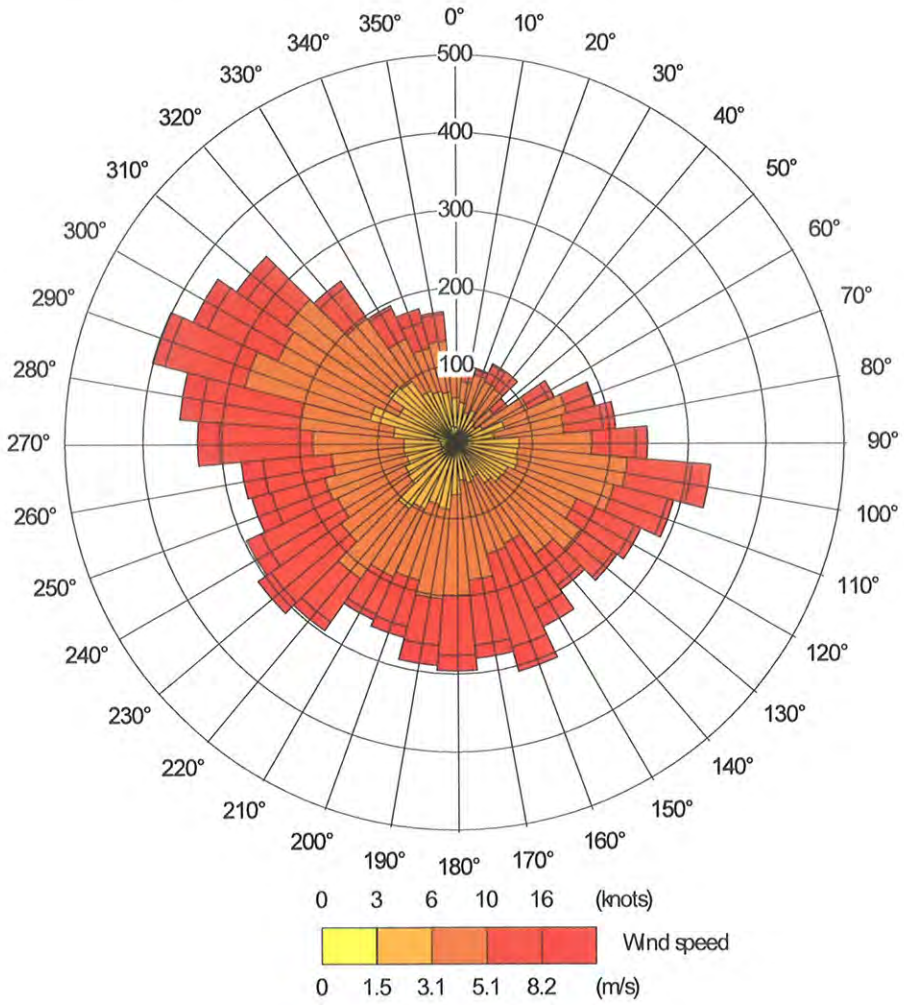
3.3 Meteorology

A statistical dispersion modelling run requires a minimum of five years of hourly meteorological records. The closest meteorological stations to Plocks Farm which regularly records all the elements required for dispersion modelling to a suitable standard are at Crosby and Blackpool, which are approximately 25 km to the south-east and 19 km to the north-west respectively. These meteorological stations are both situated at coastal locations which are exposed to conditions that are potentially not representative of weather in the area around the application site. In 2015 the odour modelling was based on weather records from Manchester Airport, which is a station which records all of the weather elements required for dispersion modelling and has similar exposure to the Plock Farm sites, but it is approximately 49 km to the south-east. Therefore in this updated modelling site specific weather data has been procured and used in the modelling.

The meteorological data used in this study is obtained from assimilation and short term forecast fields of the Numerical Weather Prediction (NWP) system known as the Global Forecast System (GFS).

The GFS is a spectral model and data are archived at a horizontal resolution of 0.25 degrees, which is approximately 25 km over the UK (formerly 0.5 degrees, or approximately 50 km). The GFS resolution adequately captures major topographical features and the broad-scale characteristics of the weather over the UK. Smaller scale topographical features may be included in the dispersion modelling by using the flow field module of ADMS (FLOWSTAR). The wind rose for the weather file, derived from data from the GFS data is shown in Figure 1. This shows the direction FROM which winds blows and illustrates the relative frequency of wind directions and wind speeds used in the modelling study.

Figure 1. Wind Rose Derived from GFS Data 53.681 N, -2.82 W (2013 - 2017)



3.4 Model Parameters

3.4.1 Odour Emissions

Two scenarios have been modelled to provide a comparative assessment of the impact of odour emissions from the existing five stack arrangement (Scenario 1) and from the proposed new ten stack arrangement (Scenario 2). The existing scenario has been remodelled following the original report to take account of more up to date information on the actual stack diameters (2 m diameter rather than the 1.7 m diameters modelled in the 2015 modelling) and to provide a comparison with the proposed alternative stack arrangements.

Odour emissions from the biofilter stacks have been represented as point sources within ADMS. Details of the point source parameters are provided for the existing stack arrangements (Scenario 1) in Table 2a and emissions from the proposed new stack arrangements (Scenario 2) are provide in Table 2b below. For consistency the modelled emission rates for each biofilter have again been based on a design "maximum" air flow rate of 27 m^3/s per biofilter and a nominal stack emission odour concentration of 1,000 ou_E/m^3, and it is important to recognise that the key objective is to provide a comparative

assessment of the relative off-site odour impacts of the 5 and 10 stack scenarios, not to provide precise quantitative assessments of actual off-site impacts.

For example, the reality is that measurements over the last seven years have shown that only on one occasion, and that was during initial commissioning of the biofilters in 2012, have treated air odour concentrations exceeded 500 ou_E/m^3, and more recently odour concentrations in biofilter emissions have been so low as to be barely measureable, and quite consistently less than 200 ou_E/m^3 since October 2015.

It is also understood that the volumes of air treated by each biofilter are varied by the fan control systems, depending on which production lines are in use, so that airflows treated by each biofilter vary from between 35,000 and 90,000m^3/hr (9.72 m^3/s to 25 m^3/s), so that they are usually below the 27.4 m^3/s (98,640 m^3/hour) design level that has been modelled. The practical implications of the modelling on actual emissions are discussed in section 5 below.

The position of the modelled sources are shown in Figures 2a and 2b.

Table 2a. Scenario 1 Point Source Parameters

Source ID	Stack Height (m)	Release Height (m)	Diameter (m)	Efflux Velocity (m/s)	Temperature (°C)	Emission Rate (ou_E/s)
B1	12.0	12.0	2	8.72	25.0	27,400
B2	12.0	12.0	2	8.72	25.0	27,400
B3	12.0	12.0	2	8.72	25.0	27,400
B4	12.0	12.0	2	8.72	25.0	27,400
B5	12.0	12.0	2	8.72	25.0	27,400

Table 2b. Scenario 2 Point Source Parameters

Source ID	Stack Height (m)	Release Height (m)	Diameter (m)	Efflux Velocity (m/s)	Temperature (°C)	Emission Rate (ou_E/s)
B1a	12.0	12.0	2	4.36	25.0	13,700
B1b	12.0	12.0	2	4.36	25.0	13,700
B2a	12.0	12.0	2	4.36	25.0	13,700
B2b	12.0	12.0	2	4.36	25.0	13,700
B3a	12.0	12.0	2	4.36	25.0	13,700
B3b	12.0	12.0	2	4.36	25.0	13,700
B4a	12.0	12.0	2	4.36	25.0	13,700
B4b	12.0	12.0	2	4.36	25.0	13,700
B5a	12.0	12.0	2	4.36	25.0	13,700
B5b	12.0	12.0	2	4.36	25.0	13,700

3.4.2 Buildings

The structure of the biofilters and other buildings at the factory will have some effect on the behaviour of the odour plumes from the point sources representing emissions from the biofilters. Therefore, the

biofilters and a selection of other nearby buildings have been included as rectangular blocks within ADMS. The building details have been updated since the 2015 odour report to take into account changes at the factory since the previous assessment. The modelled building details are shown below in Table 3 and the positions are shown on Figures 2a and 2b.

Table 3. Building Geometries

Building/Structure		NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
ID	Description	X	Y				
1	Building 1	345833.1	420827.1	15.5	4	73	268.3
2	Building 2	345811.4	420826.8	15.5	4	73	268.3
3	Building 3	345789.5	420826.1	15.5	4	73	268.3
4	Building 4	345768.1	420825.9	15.5	4	73	268.3
5	Building 5	345746.5	420825.2	15.5	4	73	268.3
6	Building 6	345808.3	420949.9	79	16	67.5	159.2
7	Building 7	345903.4	421070.9	46.1	19.4	223.1	158.4
8	Building 8	345880.8	421110.3	44.5	18.15	122.1	159
9	Building 9	345907.9	421022.7	46.5	19.4	110.4	159.2
10	Building 10	345941.7	420929.2	101.9	12	100.8	159
11	Building 11	345998.3	420843.0	85.18	15	63.59	155.53
12	Building 12	346031.9	420784.0	15.1	11	56.3	156
13	Building 13	346044.4	420772.5	12.1	11	13.5	156
14	Building 14	345754.0	420930.2	20.67	3.3	21.2	68.74
15	Building 15	345938.7	420836.0	15.2	11	9.9	159.6
16	Building 16	345938.5	420848.5	7.5	19	18	159.2
17	Building 17	345952.3	421138.3	30	10	19.4	159.5
18	Building 18	346039.1	421126.7	17.2	13	35.5	119.2
19	Building 19	346021.1	421157.0	14.8	11	29	158.7
20	Building 20	345944.1	420808.4	18.51	15	42.46	246.9
21	Building 21	46029.9	420808.8	56.26	15	24.23	154.98

3.4.3 Terrain and Roughness Length

The land immediately around the facility is gently undulating. The recommendation of the ADMS software developer (CERC) is that terrain data should only be included in the model if the gradient of surrounding land exceeds 1:10, therefore terrain data has not been used within the ADMS for this assessment.

A fixed surface roughness length of 0.4 m is used over the entire modelling domain to reflect the mixed agricultural land urban land use in the area surrounding the site.

3.4.4 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10 m was used in the dispersion modelling study and is suggested within ADMS 5.2 as being suitable for 'small towns < 50,000'.

3.4.5 Discrete Receptors

Forty-six discrete receptor points were defined within the model to represent a selection of nearby receptor sites. These are defined at 1.5 m above ground level within ADMS. The positions of these receptor points are shown in Figure 3 and grid reference provided in Table 4.

3.4.6 The Assessment Extents

A nested Cartesian grid, centred on the plant, has been used to produce the contour maps presented in the results of this study. The central grid extends approximately 1 km from the site at a horizontal resolution of approximately 20 m; an approximately 50 m horizontal resolution grid extends a further 1 km from the central grid. The nested grid receptor points are defined at a height (above ground) of 1.5 m within ADMS.

3.5 Uncertainties and Assumptions

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, land use characteristics and meteorology; and,
- Variability - randomness of measurements used.

Potential uncertainties in model results have been 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 years of annual meteorological data sets to take account of local conditions and to allow 'smoothing' of atypical short-term weather conditions which may otherwise influence the modelling results;
- 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.

  The most significant variable is likely to be emission rates as discussed at 3.4.1, because the output of the extract ventilation system varies depending on the production lines that are in use. A precautionary approach has been taken by modelling with the maximum design extraction system outputs or airflow rates.

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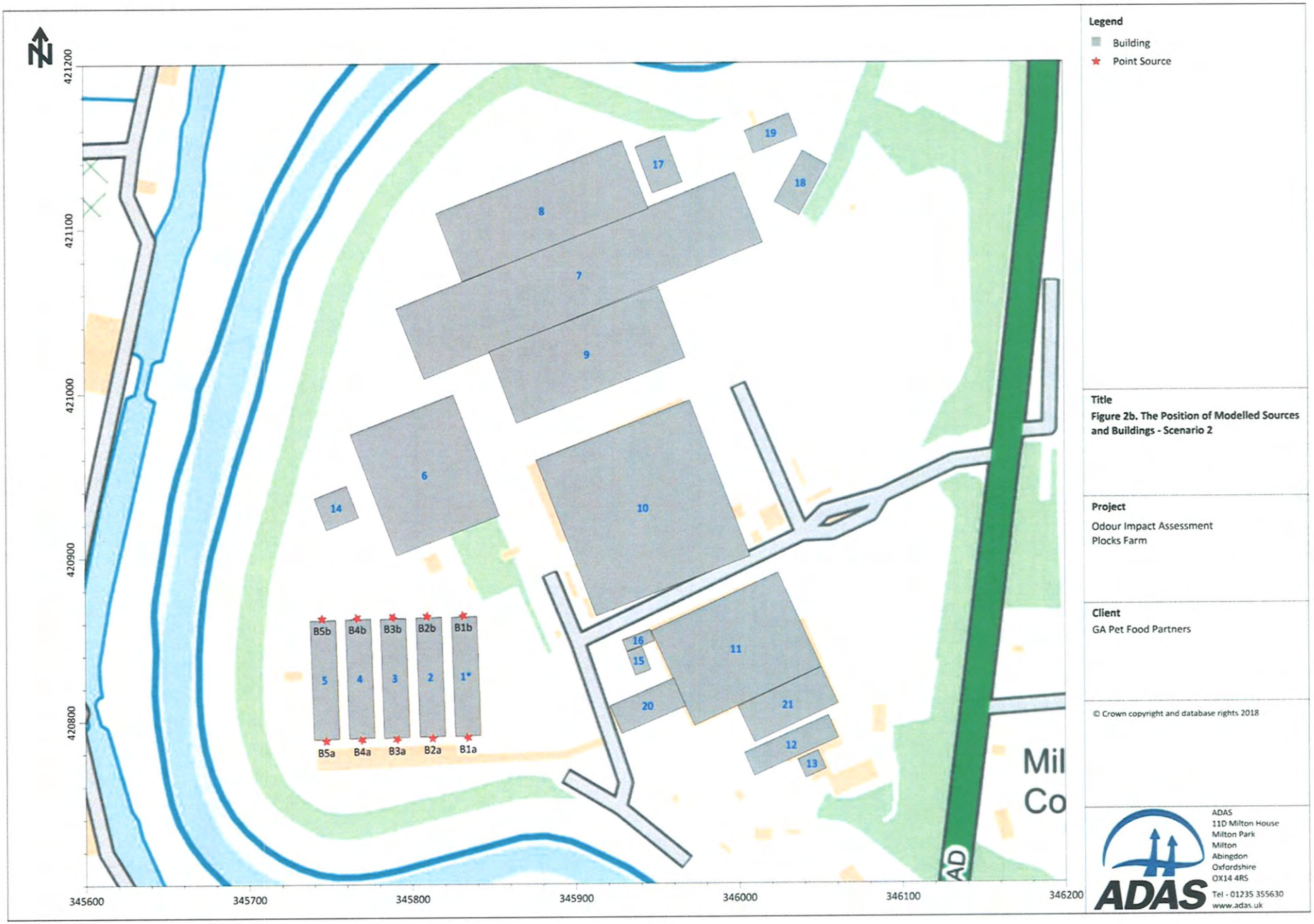

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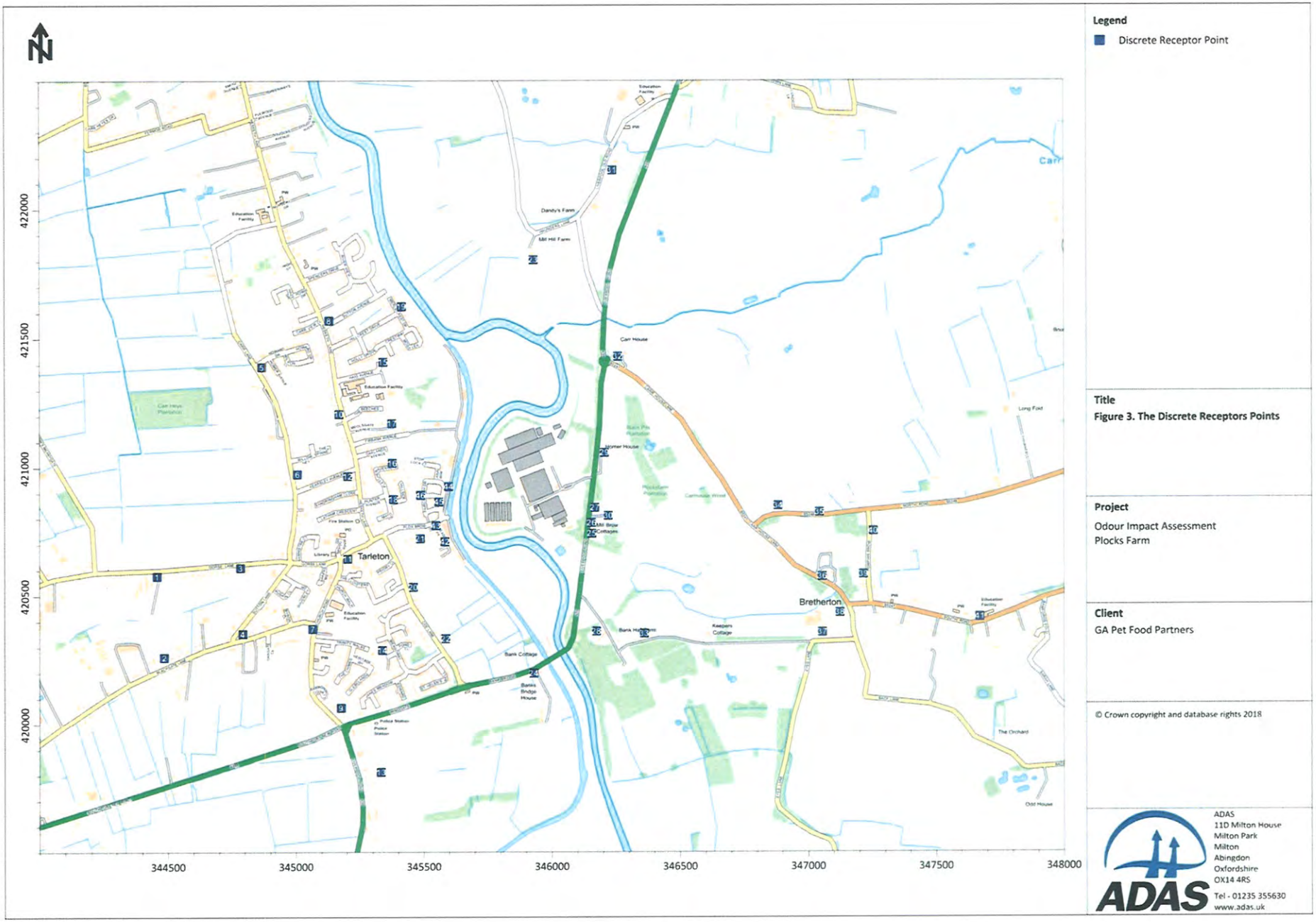

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4 Modelling Results

ADMS calculates hourly average odour concentrations at the grid points and the discrete receptor points for each hour over a five-year period. From these calculations, statistics have been produced of the predicted five-year average annual 98th percentile hourly mean odour concentrations. That is, the odour concentration which is exceeded for only 2% of all hours (around 14 hours per month on average).

Five runs, one for each year in the meteorological record (2013 – 2017) were performed for both scenarios. For each of the discrete receptors, the predicted five-year average annual 98th percentile hourly mean odour concentrations are shown in Table 4 for the impacts with odour emission concentrations of 1,000 ou_E/m^3.

The annual 98th percentile hourly mean odour concentrations for each individual year in the meteorological file are provided in Appendix 1.

4.1 Scenario 1 - Existing Stack Arrangement (Emission Concentrations of 1,000 ou_E/m^3)

The modelling predicts that the five-year maximum and average annual 98th percentile hourly mean odour concentrations are below the suggested benchmark of 3 ou_E/m^3 at all modelled discrete receptor points apart from the discrete receptor points at Meadow Park and Fairclough Drive, the closest receptors to the west of the site. The five-year maximum and average annual 98th percentile hourly mean odour concentrations are however below the upper benchmark of 5 ou_E/m^3 at all discrete receptor points.

The highest average odour concentration is at receptor point 44 on Fairclough Drive at 3.33 ou_E/m^3, while the maximum odour concentration is at receptor point 43 and 46 at 3.62 ou_E/m^3.

A contour plot of the predicted five-year average annual 98th percentile concentrations at all grid points in the area surrounding the facility are shown in Figures 4a.

It must be stressed that these predictions are based on a nominal treated air or outlet odour concentration of 1,000 ou_E/m^3, whereas the actual outlet odour concentrations measured at the plant over the last six years, as summarised in Appendix 2, have consistently been less than 500 ou_E/m^3 since the initial commissioning tests were carried out in February 2012, and less than 250 ou_E/m^3 since October 2015. The equivalent potential impacts of the measured levels of emissions are set out in Section 5 below.

4.2 Scenario 2 - Ten Stacks Layout (Emission Concentrations of 1,000 ou_E/m^3)

The modelling predicts a slight increase in odour concentrations at all of the discrete receptor points under the alternative stack scenario. The modelling predicts that the five-year maximum and average annual 98th percentile hourly mean odour concentrations are below the suggested benchmark of 3 ou_E/m^3 at all modelled discrete receptor points apart from the receptor points at Meadow Park and Fairclough Drive for emission outlet concentrations of 1,000 ou_E/m^3. However the five-year maximum and average annual 98th percentile hourly mean odour concentrations are below the upper benchmark of 5 ou_E/m^3 at all discrete receptor points.

The highest average odour concentration is at receptor point 44 on Fairclough Drive at 4.26 ou_E/m^3, while the maximum odour concentration is also at receptor point 44 at 4.57 ou_E/m^3.

A contour plot of the predicted five-year average annual 98th percentile concentrations at all grid points in the area surrounding the facility for a nominal emission outlet odour concentration of 1,000 ou_E/m^3 are shown in Figures 4b.

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Table 4. Five-Year Average and Maximum Annual 98th Percentile Hourly Mean Odour Concentration at Discrete Receptors with Nominal Emission Concentrations of 1,000 ou_E/m^3

Rec no.	Receptor	National Grid Coordinates		5-Year Annual 98th Percentile Hourly Mean Odour Impacts/Concentration (ou_E/m^3)			
		X (m)	Y (m)	Scenario 1: Average	Scenario 1: Max	Scenario 2: Average	Scenario 2: Max
1	Gorse Lane	344458	420575	0.28	0.35	0.32	0.41
2	Blackgate Lane	344486	420261	0.24	0.36	0.27	0.41
3	Gorse Lane	344784	420607	0.41	0.51	0.48	0.60
4	Blackgate Lane	344792	420351	0.35	0.50	0.39	0.58
5	Carr Lane	344868	421390	0.44	0.55	0.51	0.64
6	Sutton Lane	345007	420973	0.67	0.81	0.77	0.95
7	Church Road	345066	420371	0.44	0.65	0.51	0.74
8	Sutton Avenue	345131	421569	0.48	0.50	0.56	0.59
9	Church Road	345176	420063	0.28	0.34	0.33	0.41
10	Hesketh lane	345169	421208	0.76	0.90	0.90	1.08
11	Gorse Lane	345203	420643	0.86	1.05	0.98	1.22
12	Kearsley Avenue	345203	420965	0.99	1.14	1.16	1.40
13	Liverpool Road	345333	419813	0.23	0.30	0.26	0.35
14	Meadoway	345338	420287	0.45	0.54	0.54	0.62
15	Haig Avenue	345342	421410	0.73	0.77	0.88	0.92
16	Fletcher Avenue	345378	421017	1.42	1.63	1.74	1.96
17	Meolsgate Avenue	345377	421171	1.13	1.18	1.41	1.57
18	Hillside	345382	420875	1.68	1.99	1.92	2.31
19	Merlecrest Drive	345415	421624	0.60	0.64	0.73	0.80
20	Coe Lane	345459	420532	1.04	1.39	1.13	1.36
21	Plox Brow	345486	420721	2.17	2.54	2.40	2.86
22	Coe Lane	345585	420332	0.64	0.92	0.79	1.06
23	Mill Hill Farm	345929	421804	0.51	0.55	0.63	0.70
24	Banks Bridge House	345929	420197	0.83	0.96	0.95	1.06
25	Liverpool Road	346155	420741	2.05	2.19	2.22	2.39
26	Liverpool Road	346155	420782	2.08	2.26	2.28	2.46
27	Liverpool Road	346168	420842	1.94	2.14	2.19	2.41
28	Bank Hall Farm	346173	420360	1.13	1.19	1.23	1.35
29	Homer House	346206	421056	1.40	1.54	1.67	1.80
30	Liverpool Road	346220	420810	1.64	1.81	1.83	2.02
31	Liverpool Old Road	346237	422152	0.33	0.38	0.39	0.47
32	Carr House	346258	421430	0.76	0.80	0.94	1.03

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Rec no.	Receptor	National Grid Coordinates		5-Year Annual 98th Percentile Hourly Mean Odour Impacts/Concentration (ou_E/m^3)			
		X (m)	Y (m)	Scenario 1: Average	Scenario 1: Max	Scenario 2: Average	Scenario 2: Max
33	Bank Hall Farm	346359	420352	0.86	0.94	0.96	1.05
34	North Road	346882	420849	0.42	0.46	0.47	0.55
35	North Road	347044	420823	0.34	0.39	0.38	0.45
36	Bretherton, Carr House Ln	347054	420571	0.33	0.38	0.37	0.43
37	Eyes lane	347055	420356	0.33	0.36	0.39	0.46
38	Bretherton, Carr House Ln	347123	420432	0.31	0.34	0.35	0.39
39	Pompian Brow	347215	420580	0.28	0.32	0.31	0.36
40	Pompian Brow	347254	420749	0.27	0.31	0.30	0.35
41	South Road, Education Facility	347671	420414	0.19	0.21	0.21	0.24
42	Meadow Park	345583	420709	3.01	3.70	3.23	3.98
43	Meadow Park	345548	420772	3.09	3.62	3.36	3.71
44	Fairclough Drive	345597	420925	3.33	3.57	4.26	4.57
45	Fairclough Drive	345560	420866	3.27	3.62	3.74	4.20
46	Fairclough Drive	345487	420891	2.40	2.69	2.79	3.20

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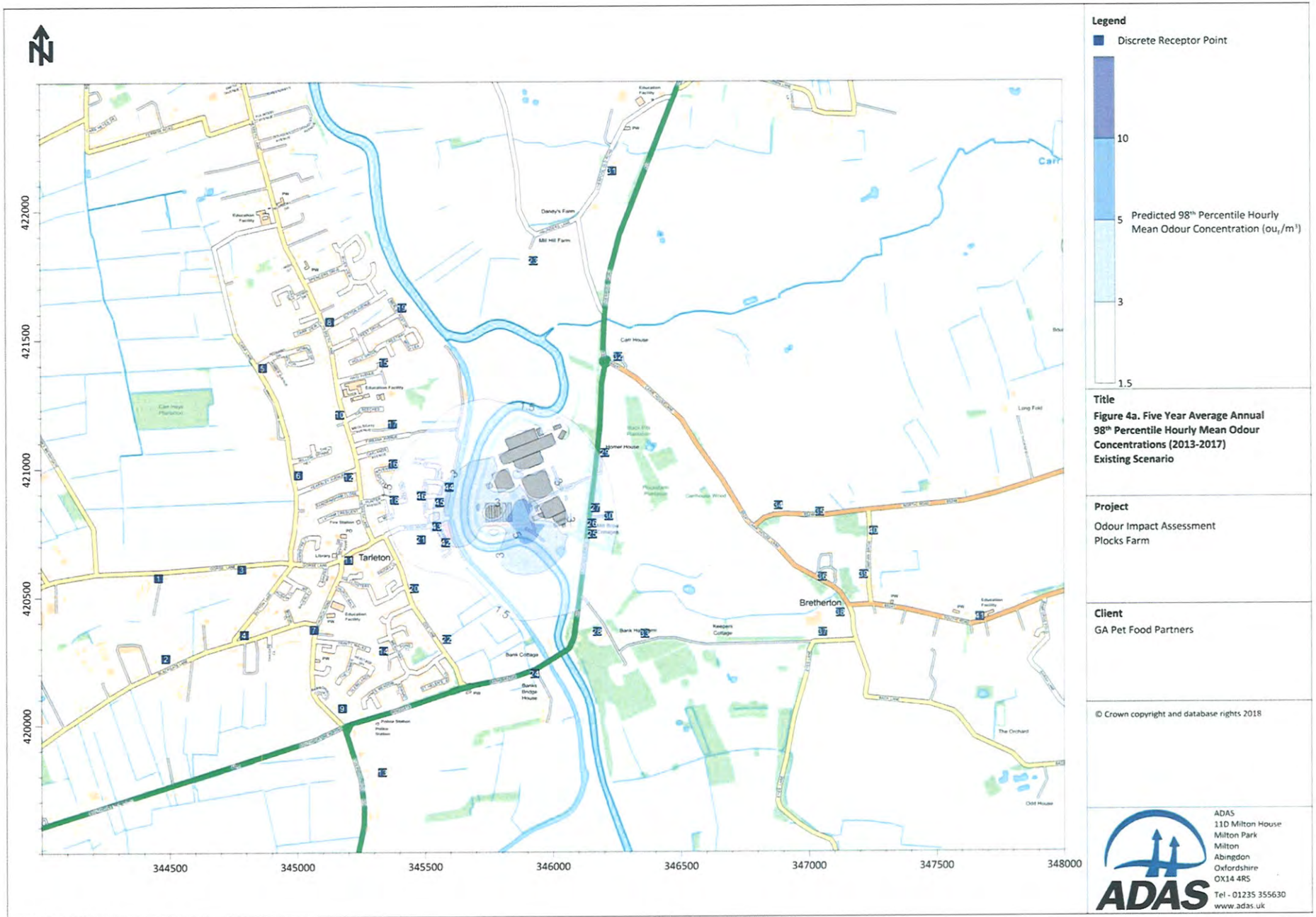

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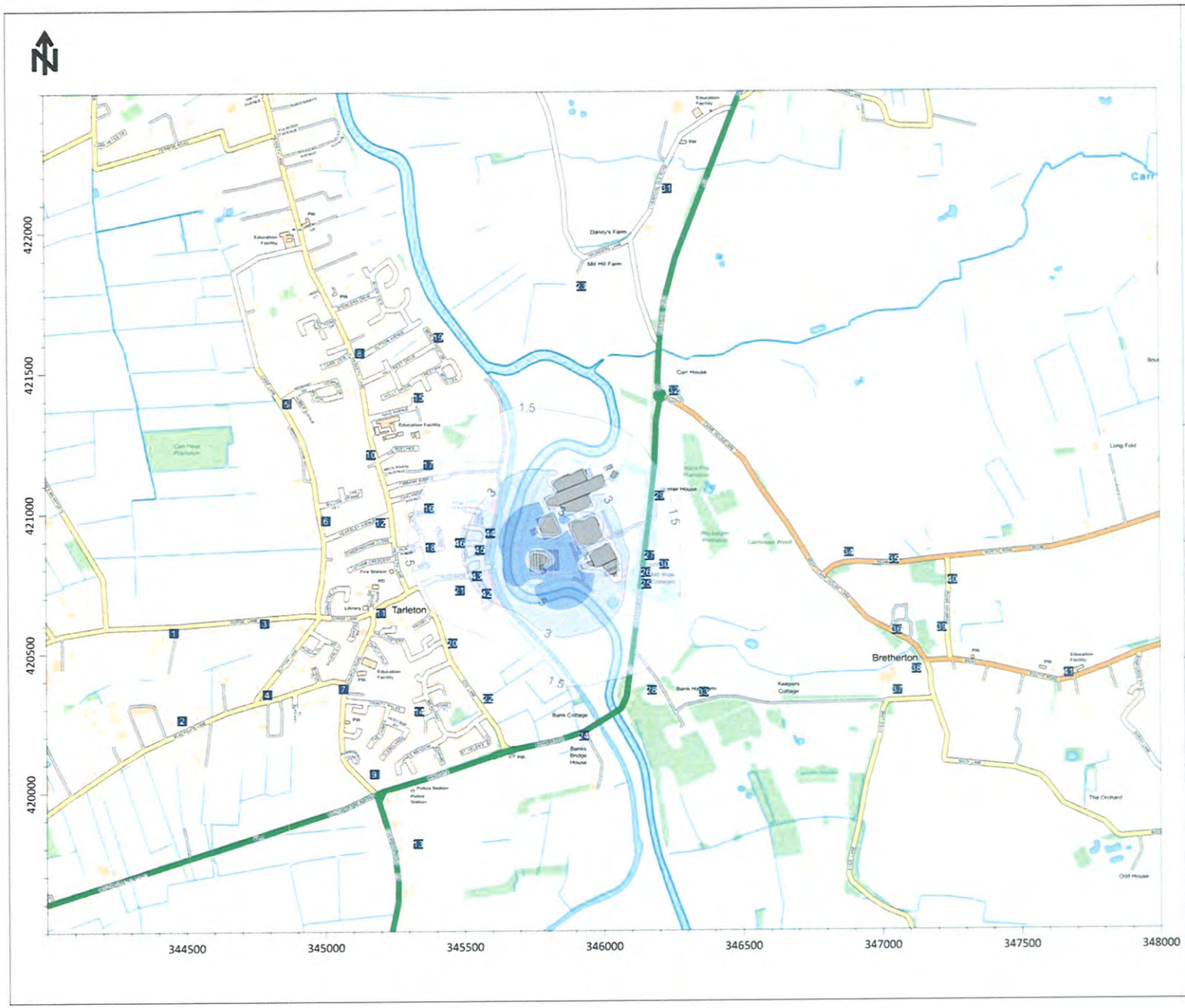

Legend

Discrete Receptor Point

10

5 Predicted 98th Percentile Hourly Mean Odour Concentration (ou_f/m^3)

3

1.5

Title

Figure 4b. Five Year Average Annual 98th Percentile Hourly Mean Odour Concentrations (2013-2017) Alternative Scenario

Project

Odour Impact Assessment
Plocks Farm

Client

GA Pet Food Partners

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5 Assessment of the Significance of Odour Effects

5.1 Assessment Based on Measured Emissions

Measured Odour Concentrations

An assessment of the potential significance of odour effects for the existing and proposed stack arrangements can be assessed by considering the potential odour impacts of the actual biofilter emissions based on the measured levels of biofilter emissions by simple proportion from the modelling outputs set out in Section 4 above.

Thus, if the actual biofilter performance is such that the emission odour concentrations do not exceed 250 ou_E/m^3 then the off-site impacts predicted in Table 4 above can, by simple proportion, be reduced by a factor of four, to more realistically assess the off-site impact predicted by modelling. The effects of this change are shown below in Table 5, and it can be seen that predicted 5-year average 98th percentile impacts are all well below 3 ou_E/m^3 for both stack scenarios. This still represents a precautionary assessment of relative impacts because the reality is that measured biofilter outlet odour concentrations have been consistently below 200 ou_E/m^3 since October 2015.

The modelling demonstrates that the proposed ten stack layout would marginally increase off-site odour impacts in comparison with the existing arrangement. The highest impacts are in the recently developed residential areas to the west of the GA Pet Food Partners site, but the predicted off-site odour impacts would remain very low providing that the biofilters continue to perform at the very high levels of abatement shown in Appendix 2. In effect, the modelling demonstrates that the factor of two reduction in stack emission velocity or air discharge speed that results from doubling the number of stacks, which is taken account of in Scenario 2, is NOT compensated for by the increase in the area of initial dispersion or spread of the emissions that results from having stacks at both ends of the biofilters.

Effects of Lower Extraction Rates

The effects of reduced stack emission velocity also need to be considered when the airflow treated by the biofilters is reduced, that is at times when the production plant is not operating at full capacity, as is discussed above at 3.4.1. Under these circumstances the use of the proposed additional stacks would further reduce the emission velocity achieved at the stack.

It is quite likely that the consequential reduction in emissions that arise at lower airflows through the biofilters would more than compensate for the reduction in emissions velocity in terms of off-site odour impacts. However, the off-site odour impacts could be reduced in these circumstances by taking the additional stacks out of use, as is proposed by the use of pressure operated valves in the proposed five additional stacks.

Thus, the proposed stacks with pressure operated valves/shutters would ensure that when the production plant and extractions systems are operating at full capacity, all ten stacks would be in use, and as a benefit there would be a lower back pressure on the ventilation system than currently. Otherwise, at times when the production lines and air extraction systems are operating at less than full capacity, then the proposed pressure relief valves would ensure that optimal use is made of the existing stacks to disperse odours at a reasonably high emission velocity, and also help ensure that the roof covers would be maintained sufficiently "taut" to prevent wind damage, by maintaining reasonable pressure within the biofilter headspaces. It is likely that a suitable target headspace pressure to be maintained/limited by the second stack pressure relief "valves" would be between one third and one half of the 133 Pa pressure that RSK ADAS measured on 25 June 2019 in the headspace of Biofilter No. 1 which currently has an intact roof cover.

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IAQM Assessment of odour impact effects

The significance of odour effects for the existing and proposed future stack scenarios have been assessed using the IAQM methodology in Table 5 below on the precautionary basis of odour emissions having concentrations of 250 ou_E/m^3, using the IAQM criterion for moderately offensive odours and the precautionary assumption that a "high" sensitivity rating should be applied to all receptors considered in the modelling. IAQM "negligible" effects are predicted at all discrete receptor points with both five stack (Scenario 1) and ten stack (Scenario 2) scenarios.

Table 5. Significance of Predicted Odour Impacts at Surrounding Receptors with an Odour Emission Concentrations of 500 ou_E/m^3

Rec no.	Receptor	Sensitivity	5-Year Annual 98th Percentile Hourly Mean Odour Impacts/Concentration (ou_E/m^3) & Significance of Effect			
			Scenario 1: Average	IAQM Significance	Scenario 2: Average	IAQM Significance
1	Gorse Lane	High	0.07	Negligible	0.08	Negligible
2	Blackgate Lane	High	0.06	Negligible	0.07	Negligible
3	Gorse Lane	High	0.10	Negligible	0.12	Negligible
4	Blackgate Lane	High	0.09	Negligible	0.10	Negligible
5	Carr Lane	High	0.11	Negligible	0.13	Negligible
6	Sutton Lane	High	0.17	Negligible	0.19	Negligible
7	Church Road	High	0.11	Negligible	0.13	Negligible
8	Sutton Avenue	High	0.12	Negligible	0.14	Negligible
9	Church Road	High	0.07	Negligible	0.08	Negligible
10	Hesketh lane	High	0.19	Negligible	0.23	Negligible
11	Gorse Lane	High	0.22	Negligible	0.25	Negligible
12	Kearsley Avenue	High	0.25	Negligible	0.29	Negligible
13	Liverpool Road	High	0.06	Negligible	0.07	Negligible
14	Meadoway	High	0.11	Negligible	0.14	Negligible
15	Haig Avenue	High	0.18	Negligible	0.22	Negligible
16	Fletcher Avenue	High	0.36	Negligible	0.44	Negligible
17	Meolsgate Avenue	High	0.28	Negligible	0.35	Negligible
18	Hillside	High	0.42	Negligible	0.48	Negligible
19	Merlecrest Drive	High	0.15	Negligible	0.18	Negligible
20	Coe Lane	High	0.26	Negligible	0.28	Negligible
21	Plox Brow	High	0.54	Negligible	0.60	Negligible
22	Coe Lane	High	0.16	Negligible	0.20	Negligible
23	Mill Hill Farm	High	0.13	Negligible	0.16	Negligible
24	Banks Bridge House	High	0.21	Negligible	0.24	Negligible
25	Liverpool Road	High	0.51	Negligible	0.56	Negligible
26	Liverpool Road	High	0.52	Negligible	0.57	Negligible

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Rec no.	Receptor	Sensitivity	5-Year Annual 98th Percentile Hourly Mean Odour Impacts/Concentration (ou_E/m^3) & Significance of Effect			
			Scenario 1: Average	IAQM Significance	Scenario 2: Average	IAQM Significance
27	Liverpool Road	High	0.49	Negligible	0.55	Negligible
28	Bank Hall Farm	High	0.28	Negligible	0.31	Negligible
29	Homer House	High	0.35	Negligible	0.42	Negligible
30	Liverpool Road	High	0.41	Negligible	0.46	Negligible
31	Liverpool Old Road	High	0.08	Negligible	0.10	Negligible
32	Carr House	High	0.19	Negligible	0.24	Negligible
33	Bank Hall Farm	High	0.22	Negligible	0.24	Negligible
34	North Road	High	0.11	Negligible	0.12	Negligible
35	North Road	High	0.09	Negligible	0.10	Negligible
36	Bretherton, Carr House Lane	High	0.08	Negligible	0.09	Negligible
37	Eyes Lane	High	0.08	Negligible	0.10	Negligible
38	Bretherton, Carr House Lane	High	0.08	Negligible	0.09	Negligible
39	Pompian Brow	High	0.07	Negligible	0.08	Negligible
40	Pompian Brow	High	0.07	Negligible	0.08	Negligible
41	South Road, Education Facility	High	0.05	Negligible	0.05	Negligible
42	Meadow Park	High	0.75	Negligible	0.81	Negligible
43	Meadow Park	High	0.77	Negligible	0.84	Negligible
44	Fairclough Drive	High	0.83	Negligible	1.07	Negligible
45	Fairclough Drive	High	0.82	Negligible	0.94	Negligible
46	Fairclough Drive	High	0.60	Negligible	0.70	Negligible

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6 Summary and Conclusions

ADAS has been commissioned by GA Petfood Partners to conduct a study of the potential impact of odour emissions from existing and proposed pet food manufacturing operations at the GA Plocks Farm manufacturing site, Bretherton, Leyland.

Modelling of the existing (five) stack arrangement predicts that with the nominal emission odour concentration of 1,000 ou_E/m^3 the five-year maximum and average annual 98th percentile hourly mean odour concentrations are below the suggested benchmark of 3.0 ou_E/m^3 at all modelled discrete receptor points apart from the discrete receptor points at Meadow Park and Fairclough Drive, the closest receptors to the west of the site. Modelling of the alternative (ten) stack arrangements predicts a slight increase in odour concentrations at all of the discrete receptor points. Under the alternative stack arrangement, the highest average odour concentration is at receptor point 44 on Fairclough Drive at 4.26 ou_E/m^3, while the maximum odour concentration is also at receptor point 44 at 4.57 ou_E/m^3.

An assessment of the potential significance of odour effects for the existing and proposed stack arrangements can be assessed by considering the potential odour impacts of the actual biofilter emissions based on the actual measured levels of biofilter emissions by simple proportion from the modelling outputs with outlet odour concentrations of 1,000 ou_E/m^3. Thus, as measurements have shown that actual biofilter performance is now such that the emission concentrations do not exceed 250 ou_E/m^3 then the off-site impacts predicted in the modelling can be reduced by a factor of four, by simple proportion, to more realistically assess the off-site impact predicted by modelling. The effects of this adjustment are that predicted 5-year average 98th percentile impacts are all well below 3 ou_E/m^3 for both stack scenarios.

The modelling demonstrates that the proposed (ten) stack layout would marginally increase off-site odour impacts above in comparison with the existing five stack arrangement. The highest impacts are in the recently developed residential areas to west of the GA Pet Food Partners site, but the predicted off-site odour impacts would remain very low providing that the biofilters continue to perform at the very high levels of abatement measured in recent years, and as shown in Appendix 2. In effect, the modelling demonstrates that the factor of two reduction in stack emission velocity or air discharge speed that would result from doubling the number of stacks is NOT quite compensated for by the increase in initial dispersion or spread of the emissions that results from having stacks at both ends of the biofilters.

The significance of odour effects for the existing and proposed future stack scenarios using the IAQM methodology for "moderately offensive" odours and the precautionary assumption that a "high" sensitivity rating can be applied to all receptors considered in the modelling. With emission odour concentrations of ≤250 ou_E/m^3 "negligible" effects are predicted at all discrete receptor points under both the existing five stack scenario and the proposed ten stack scenario.

By way of validation of the findings set out in this report it is noted that only two of the current biofilter roof structures are intact and that emissions from the other three biofilters have been discharged in a relatively uncontrolled manner over the last 2 to 3 years, that is without the benefits of high level vertical dispersion that occurs with stack emission releases. Despite the "uncontrolled" releases that have occurred through the damaged roof covers, the low odour concentrations of emissions have been such that there have been no significant or substantiated incidents of biofilter odours impacting on off-site odour receptors. It can be quite logically reasoned that the proposed refurbishment of roof covers and the provision of additional stacks will be a positive improvement over the current baseline.

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Recommendation

It is recommended that the proposed additional stacks should be with pressure operated valves/shutters to ensure that they close down the additional stacks so that optimal use is made of the existing stacks when the production plant and extractions systems are operating at less than full capacity. The proposed pressure relief valves would thus help ensure that the existing stacks continue to disperse odours at a reasonably high emission velocity. Pressure operated valves would also help ensure that the roof covers would be maintained sufficiently "taut" to prevent wind damage, by maintaining reasonable pressure within the biofilter headspaces.

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APPENDIX 1: PREDICTED ODOUR CONCENTRATIONS FOR EACH YEAR OF THE MET FILE

Table A1.1. Scenario 1 (at Nominal Emissions Odour Concentrations of 1,000 ou_E/m^3)

Rec No	X (m)	Y (m)	Annual 98th Percentile Hourly Mean Odour Concentration (ou_E/m^3)						
			2013	2014	2015	2016	2017	Mean	Max
1	344458	420575	0.28	0.35	0.26	0.34	0.15	0.28	0.35
2	344486	420261	0.25	0.29	0.18	0.36	0.15	0.24	0.36
3	344784	420607	0.43	0.51	0.38	0.51	0.25	0.41	0.51
4	344792	420351	0.36	0.39	0.26	0.50	0.23	0.35	0.50
5	344868	421390	0.45	0.55	0.39	0.42	0.39	0.44	0.55
6	345007	420973	0.76	0.81	0.63	0.73	0.41	0.67	0.81
7	345066	420371	0.47	0.49	0.29	0.65	0.32	0.44	0.65
8	345131	421569	0.49	0.45	0.46	0.50	0.50	0.48	0.50
9	345176	420063	0.34	0.31	0.29	0.30	0.17	0.28	0.34
10	345169	421208	0.78	0.90	0.69	0.71	0.69	0.76	0.90
11	345203	420643	0.88	1.00	0.75	1.05	0.63	0.86	1.05
12	345203	420965	1.14	1.13	0.92	1.07	0.70	0.99	1.14
13	345333	419813	0.30	0.23	0.26	0.23	0.14	0.23	0.30
14	345338	420287	0.54	0.44	0.43	0.50	0.31	0.45	0.54
15	345342	421410	0.71	0.69	0.71	0.76	0.77	0.73	0.77
16	345378	421017	1.51	1.63	1.29	1.44	1.21	1.42	1.63
17	345377	421171	1.16	1.18	1.06	1.11	1.12	1.13	1.18
18	345382	420875	1.90	1.99	1.61	1.79	1.13	1.68	1.99
19	345415	421624	0.58	0.61	0.59	0.60	0.64	0.60	0.64
20	345459	420532	1.13	1.14	0.79	1.39	0.73	1.04	1.39
21	345486	420721	2.25	2.47	1.90	2.54	1.71	2.17	2.54
22	345585	420332	0.92	0.62	0.69	0.66	0.32	0.64	0.92
23	345929	421804	0.55	0.50	0.44	0.50	0.55	0.51	0.55
24	345929	420197	0.83	0.55	0.89	0.93	0.96	0.83	0.96
25	346155	420741	2.10	2.05	1.88	2.01	2.19	2.05	2.19
26	346155	420782	2.19	2.10	1.88	2.00	2.26	2.08	2.26
27	346168	420842	2.00	1.91	1.75	1.90	2.14	1.94	2.14
28	346173	420360	1.16	1.09	1.08	1.12	1.19	1.13	1.19
29	346206	421056	1.41	1.46	1.21	1.40	1.54	1.40	1.54
30	346220	420810	1.72	1.62	1.49	1.57	1.81	1.64	1.81
31	346237	422152	0.38	0.32	0.28	0.31	0.34	0.33	0.38
32	346258	421430	0.80	0.78	0.67	0.73	0.80	0.76	0.80
33	346359	420352	0.86	0.94	0.76	0.86	0.86	0.86	0.94
34	346882	420849	0.44	0.43	0.36	0.39	0.46	0.42	0.46
35	347044	420823	0.36	0.35	0.29	0.31	0.39	0.34	0.39
36	347054	420571	0.34	0.33	0.29	0.32	0.38	0.33	0.38

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37	347055	420356	0.36	0.36	0.29	0.31	0.34	**0.33**	**0.36**
38	347123	420432	0.33	0.31	0.26	0.30	0.34	**0.31**	**0.34**
39	347215	420580	0.29	0.28	0.24	0.26	0.32	**0.28**	**0.32**
40	347254	420749	0.29	0.29	0.23	0.25	0.31	**0.27**	**0.31**
41	347671	420414	0.19	0.19	0.16	0.18	0.21	**0.19**	**0.21**
42	345583	420709	3.34	3.24	2.19	3.70	2.55	**3.01**	**3.70**
43	345548	420772	3.23	3.62	3.16	3.22	2.24	**3.09**	**3.62**
44	345597	420925	3.38	3.57	3.24	3.32	3.12	**3.33**	**3.57**
45	345560	420866	3.48	3.62	3.16	3.48	2.59	**3.27**	**3.62**
46	345487	420891	2.62	2.69	2.28	2.53	1.88	**2.40**	**2.69**

Table A1.2. Scenario 2 (at Nominal Emissions Odour Concentrations of 1,000 ou_E/m^3)

Rec No	X (m)	Y (m)	Annual 98th Percentile Hourly Mean Odour Concentration (ou_E/m^3)						
			2013	2014	2015	2016	2017	Mean	Max
1	344458	420575	0.33	0.41	0.30	0.40	0.17	**0.32**	**0.41**
2	344486	420261	0.29	0.32	0.20	0.41	0.15	**0.27**	**0.41**
3	344784	420607	0.48	0.60	0.44	0.59	0.28	**0.48**	**0.60**
4	344792	420351	0.40	0.44	0.28	0.58	0.25	**0.39**	**0.58**
5	344868	421390	0.52	0.64	0.43	0.50	0.44	**0.51**	**0.64**
6	345007	420973	0.88	0.95	0.72	0.83	0.48	**0.77**	**0.95**
7	345066	420371	0.49	0.58	0.40	0.74	0.35	**0.51**	**0.74**
8	345131	421569	0.57	0.53	0.54	0.59	0.58	**0.56**	**0.59**
9	345176	420063	0.41	0.36	0.35	0.35	0.20	**0.33**	**0.41**
10	345169	421208	0.93	1.08	0.79	0.88	0.80	**0.90**	**1.08**
11	345203	420643	1.01	1.14	0.84	1.22	0.69	**0.98**	**1.22**
12	345203	420965	1.30	1.40	1.09	1.24	0.76	**1.16**	**1.40**
13	345333	419813	0.35	0.25	0.30	0.24	0.18	**0.26**	**0.35**
14	345338	420287	0.62	0.57	0.56	0.59	0.37	**0.54**	**0.62**
15	345342	421410	0.86	0.83	0.86	0.92	0.92	**0.88**	**0.92**
16	345378	421017	1.91	1.96	1.56	1.84	1.41	**1.74**	**1.96**
17	345377	421171	1.44	1.57	1.29	1.39	1.33	**1.41**	**1.57**
18	345382	420875	2.09	2.31	1.99	1.93	1.30	**1.92**	**2.31**
19	345415	421624	0.70	0.74	0.71	0.73	0.80	**0.73**	**0.80**
20	345459	420532	1.22	1.20	1.05	1.36	0.82	**1.13**	**1.36**
21	345486	420721	2.47	2.60	2.14	2.86	1.91	**2.40**	**2.86**
22	345585	420332	1.06	0.75	0.87	0.76	0.52	**0.79**	**1.06**
23	345929	421804	0.70	0.63	0.54	0.61	0.70	**0.63**	**0.70**
24	345929	420197	0.95	0.67	1.01	1.05	1.06	**0.95**	**1.06**
25	346155	420741	2.30	2.20	2.03	2.20	2.39	**2.22**	**2.39**
26	346155	420782	2.36	2.28	2.05	2.27	2.46	**2.28**	**2.46**
27	346168	420842	2.33	2.15	1.93	2.14	2.41	**2.19**	**2.41**

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28	346173	420360	1.26	1.19	1.16	1.21	1.35	**1.23**	**1.35**
29	346206	421056	1.74	1.73	1.42	1.66	1.80	**1.67**	**1.80**
30	346220	420810	1.91	1.86	1.61	1.76	2.02	**1.83**	**2.02**
31	346237	422152	0.47	0.39	0.31	0.36	0.42	**0.39**	**0.47**
32	346258	421430	0.99	0.96	0.79	0.90	1.03	**0.94**	**1.03**
33	346359	420352	0.98	1.05	0.85	0.96	0.96	**0.96**	**1.05**
34	346882	420849	0.51	0.48	0.38	0.42	0.55	**0.47**	**0.55**
35	347044	420823	0.41	0.39	0.31	0.34	0.45	**0.38**	**0.45**
36	347054	420571	0.39	0.39	0.31	0.35	0.43	**0.37**	**0.43**
37	347055	420356	0.43	0.46	0.33	0.35	0.38	**0.39**	**0.46**
38	347123	420432	0.39	0.37	0.29	0.33	0.38	**0.35**	**0.39**
39	347215	420580	0.33	0.31	0.26	0.30	0.36	**0.31**	**0.36**
40	347254	420749	0.33	0.32	0.24	0.27	0.35	**0.30**	**0.35**
41	347671	420414	0.23	0.22	0.17	0.19	0.24	**0.21**	**0.24**
42	345583	420709	3.46	3.40	2.57	3.98	2.75	**3.23**	**3.98**
43	345548	420772	3.37	3.69	3.24	3.71	2.76	**3.36**	**3.71**
44	345597	420925	4.36	4.57	4.10	4.41	3.86	**4.26**	**4.57**
45	345560	420866	3.98	4.20	3.75	3.81	2.95	**3.74**	**4.20**
46	345487	420891	3.05	3.20	2.72	2.92	2.07	**2.79**	**3.20**

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Appendix 2: Measured Biofilter Performance

Table A2.1: Treated Air Odour Concentrations off the Biofilters 2012 to 2018

Sampling Dates	Geometric Mean Odour Concentrations (ou_E/m^3)				
	Biofilter 1	Biofilter 2	Biofilter 3	Biofilter 4	Biofilter 5
June 2019	38	23	47	20	26
October 2018	64	<41	56	46	59
May 2018	43	<39	158	59	69
November 2017	46	<35	105	71.5	50.5
April 2017	40	<35	123	116	124
October 2016	<40	<35	89	130	124
April 2016	87	60	68	184	126
October 2015	81	67	79	-	-
April 2015	478	223	296	-	-
October 2014	144	76	462	-	-
April 2014	303	271	266	-	-
October 2013	<52	101	222	-	-
May 2013	<49	<50	<73	-	-
October 2012	89	82	76	-	-
April 2012	61	64	81	-	-
March 2012	126	107	108	-	-
February 2012	347	227	655	-	-

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TECHNICAL DESCRIPTION OF ECOMAX® 33 NATURAL GAS MODULAR OUTDOOR SOLUTION FOR:

GA Pet Food Partners

Plocks Farm, UK.

Offer: 17-05-2018

Rev. 5

ECOMAX® 33 NATURAL GAS

This technical description describes the ECOMAX® 33 Natural gas cogeneration module with an electrical power output of 3.352 kW, complete with balance of plant equipment and auxiliary systems, outlined by the conditions in the Commercial Offer (included in this document).

1 STANDARD REFERENCE CONDITIONS

Seismic area	No
Design temperature	+ 25 °C
Design pressure	1 bar(a) / 100 a.s.l.
Relative humidity	30%
Maximum operating external temperature	+ 30 °C
Minimum operating external temperature	- 10 °C
Exhaust stack height (measured from ground level)	10 m

2 PERFORMANCE

The engine is subject to derating depending on temperature according to the manufacturer's specifications:

Ecomax® 33 - Electrical output (at generator terminals)	3.352 kW
Total thermal output as saturated steam at 10 barg (184,1 °C)	1.133 kW
Steam flow	1.814 kg/h
Total thermal output as hot water at 90 °C	1.996 kW
Island mode operation	Not included
Black start capability	Not included

3 EXHAUST EMISSIONS

Atmospheric emissions of co-generator are:

NOx (reported at 5% O2)	450 mg/Nm³
CO (reported at 5% O2)	300 mg/Nm³
Exhaust stack height (measured from ground level)	15 m

Atmospheric emissions of co-generator, **with SCR**, are:

NOx (reported at 5% O2)	75 mg/Nm³
CO (reported at 5% O2)	100 mg/Nm³
NH3 (reported at 5% O2)	5 mg/Nm³
Exhaust stack height (measured from ground level)	15 m

4 ECOMAX® MODULE EFFICIENCY AND RELIABILITY

In order to achieve the best possible return on investment, a cogeneration plant has to reliably perform at maximum efficiency. While focusing on high quality and cost-effective technologies, AB is able to offer project-specific innovative solutions to meet the customer's needs. The choices made during the design process are able to prevent performance issues and reduce equipment downtime, therefore also reducing the need for maintenance. AB applies this attention to technical detail to the entire CHP plant, including the purpose-built enclosure, the manufacturing process, equipment and component selection, and other plant design details. The end result is a state of the art cogeneration plant that delivers maximum performance and reliability.

4.1 CARBON STEEL CASING

The cogeneration system is housed in purpose-built enclosures which are designed for outdoor installation. The enclosures are made of carbon steel and equipped with a high strength frame to support the generator set. Among the main construction characteristics are:

- walls and a roof made with externally galvanized corrugated metal layers;
- corner lifting points for crane use;
- doors throughout the plant to enable easy access for maintenance operations; and
- manufacturing according to a high precision AB engineering and production process.

4.2 NOISE INSULATION

Rock wool panels covered by perforated steel sheets form the walls and ceiling of the ECOMAX® housing unit. This noise dampening insulation is specifically designed to achieve the required residual noise level.

Residual noise level in free field without acoustic reflex (according to the standard reference conditions) and with soundproofing barrier will respect the values indicated on your document "*Energy Centre. Guidance on Sound Emissions and Insulation, 15th June 2018.*

4.3 VENTILATION SYSTEM

The superior quality of ECOMAX® systems is also reflected in the ventilation system, which is designed in order to ensure the performance of the engine and its continuous operation throughout a wide range of ambient conditions.

4.3.1 Inlet air system, equipped with:

- galvanized steel, weatherproof louvres;
- replaceable air filters;
- sound insulating baffles;
- VFD controlled blade fans.

4.3.2 Outlet air systems, equipped with:

- galvanized steel, weatherproof louvres;
- modulating air dampers;
- sound insulating baffles;

4.4 PAINTWORK

The external paint guarantees a high standard of durability and resistance to extreme weather conditions for the ECOMAX® module. The design has been laboratory tested and has proven to be resistant to salt spray corrosion (ISO 7253) for a duration greater than 1,000 hours. The painting process for external components includes the following:

- surface preparation and washing;
- a primer coating suitable for galvanized surfaces;
- a rustproof epoxy layer; and;
- a polyurethane enamel layer, RAL 7035.

Visible internal surfaces are painted with a primer layer and a polyurethane enamel layer on visible parts, RAL color 7035.

4.5 MAIN THERMAL CIRUITS

To ensure the reliability and functionality of the thermal recovery and dissipation circuits, AB uses carefully dimensioned, seamless steel piping. This applies to the following connecting piping:

- connecting piping on jacket water circuit up to the plate heat exchanger;
- connecting piping on exhaust gas heat exchanger recovery circuit up to decoupling plate heat exchanger;
- connecting piping on recovery circuit up to edge package flanges;
- connecting piping on jacket water circuit up to its own emergency dry cooler;
- connecting piping on after cooler circuit up to its own emergency dry cooler;

4.6 PLATE HEAT EXCHANGER ON HT RECOVERY CIRCUIT

A decoupling plate heat exchanger is placed on the module's HT hot water recovery circuit. The technical characteristics are to be decided during the executive design.

4.7 PLATE HEAT EXCHANGER ON LT RECOVERY CIRCUIT

A decoupling plate heat exchanger is placed on the module's LT hot water recovery circuit. The technical characteristics are to be decided during the executive design.

4.8 LUBE OIL SYSTEM

To ensure the continuity of service, the ECOMAX® module is equipped with a lube oil system composed of two storage tanks, one for fresh and one for used oil. Each tank has a capacity of 1.000 litres and is equipped with pumps, valves, and pipes connecting to the engine.

4.9 COMPONENT DOCKING

In order to ensure a robust and long-lasting assembly, all components placed on the roof of the ECOMAX® are held in place by galvanized steel support structures. These supports are prefabricated at the AB factory.

4.10 EXHAUST GAS PIPING

The ECOMAX® is supplied with piping to connect the engine to the installed exhaust system components. This exhaust gas piping is sized to accommodate the exhaust gas flow rate and pressure losses. Expansion joints which are necessary to absorb thermal expansion caused by high temperatures, or other factors, are included. A sampling point and condensate drain system are also provided. The exhaust gas piping terminates at the exhaust stack, with an outlet height as indicated in the exhaust parameters (section 3).

4.11 EXHAUST GAS SILENCERS

To reduce the acoustic emissions of the engine, are supplied and installed on exhaust gas circuit, three top-quality exhaust gas silencers (two built on horizontal configuration and the other one in vertical configuration), made of stainless steel welded cylinders and shell, designed to comply with the required residual noise level.

PRACTICALITY AND SAFETY

The ECOMAX® product line has taken engineered CHP systems to the next level. It reduces the footprint needed while housing all internal components in a manner which facilitates maintenance activities thanks to amply dimensioned doors placed on the enclosure. AB has given special attention to safety and security as well; each ECOMAX® contains proven and reliable devices and systems that guarantee safe operation in all working conditions.

4.12 MODULE-INTEGRATED SAFETY

The enclosure's constructive characteristics include a series of solutions to protect the plant's personnel. These features include a galvanized steel railing along the perimeter of the roof, a caged ladder for roof access, and a floor designed to hold accidental oil spillage.

4.13 SMOKE AND GAS DETECTION SYSTEM

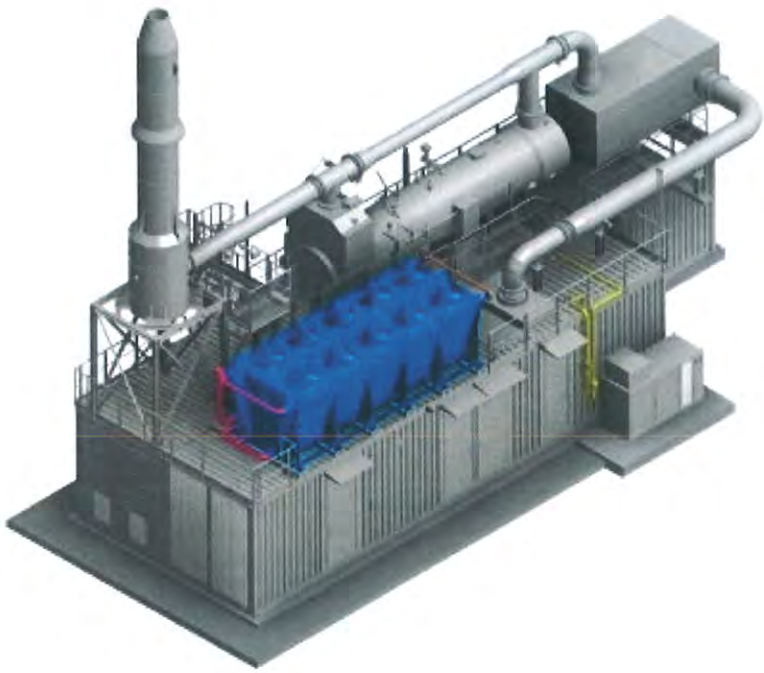
The module is equipped with smoke and gas detectors, installed inside the ECOMAX® module. The system consists spot-type smoke sensors, one gas sensor inside the engine room near the gas train, and an electronic detection and alarm unit. The smoke and gas detection system is only for engine use.

4.14 EMERGENCY DRY COOLER

An emergency dry cooler will be installed on the roof of the unit. The exact technical specifications of this component will be determined during the executive design phase to ensure optimal performance.

4.15 ANTI-EXPLOSION SERVO ACTUATED VALVE

To ensure maximum security, AB provides an automatic detection valve on the gas train, certified according to ATEX regulations.



CONTROL AND MANAGEMENT

To ensure complete, precise, and continuous management and control of the plant and all its performance parameters, AB Engineering has designed an integrated system, which can be used remotely, that allows for the monitoring of elements essential to operations. All components on the command and control system are directly installed by AB technicians and are part of the commitment to quality which distinguishes ECOMAX® systems from the rest of the market. The control panels, placed in a specially designed, air-conditioned room inside the module, provide a responsive and user-friendly interface for the service staff.

4.16 UNIT CONTROL PANEL

The automatic auxiliary control system, developed by AB, manages the ECOMAX® unit's basic functions and its interface with the main power grid. The system acquires all analogue and digital signals coming from the engine and is responsible for the control and management of the plant auxiliaries. Signals relating to the principal safety systems are controlled by hardwired logic.

The system acquires measurements from the ECOMAX® unit directly. The main parameters which are made available and processed by our monitoring system are the following:

- generator circuit breaker status;
- engine cooling water temperature and pressure;
- lube oil temperature and pressure;
- exhaust gas average temperature inside cylinders;
- return water temperature;
- exhaust gas temperature from each cylinder;
- number of starts;
- mixture intercooler temperature;
- engine and generator rpm;
- generator power factor;
- generator frequency;
- avarge generator current;
- average generator line voltage and line to neutral voltage;
- active, reactive and apparent generator power;

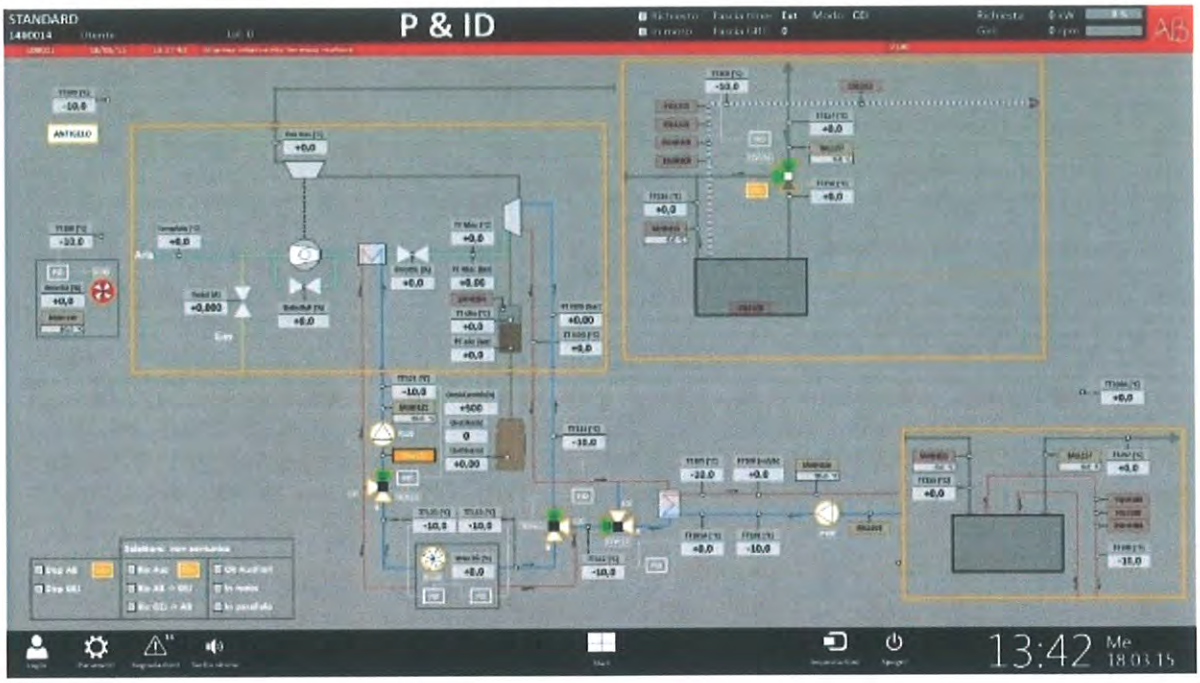
The above parameters will be processed, recorded, and displayed by the monitoring system. Through the monitoring PC, it will be possible to set operating parameters and to acquire data to be displayed. The panel will be equipped with variable speed drive units to control the fans for both the ventilation and the dry coolers. The system will also be fitted with electronic synchronization equipment, in order to automatically enter parallel operation with the electrical grid.

A G59 grid protection relay will be provided.

4.17 SCADA SUPERVISION SYSTEM

The architecture in the automation system found in the ECOMAX® has been designed to ensure the integration of components and the security of performance. During the development of the SCADA system, it has been a fundamental consideration to provide the following:

- easy control and adjustment operations;
- clear and simple reading of alarms;
- separation of circuit equipment and different systems to prevent operating and/or reading errors; and
- easy interventions for maintenance and component replacement.



The electric network monitoring system will also perform the following functions:

- local and remote command management;
- functional calculations;
- regulation of operational parameters;
- electrical network monitoring; and
- automatic diagnosis of system data.

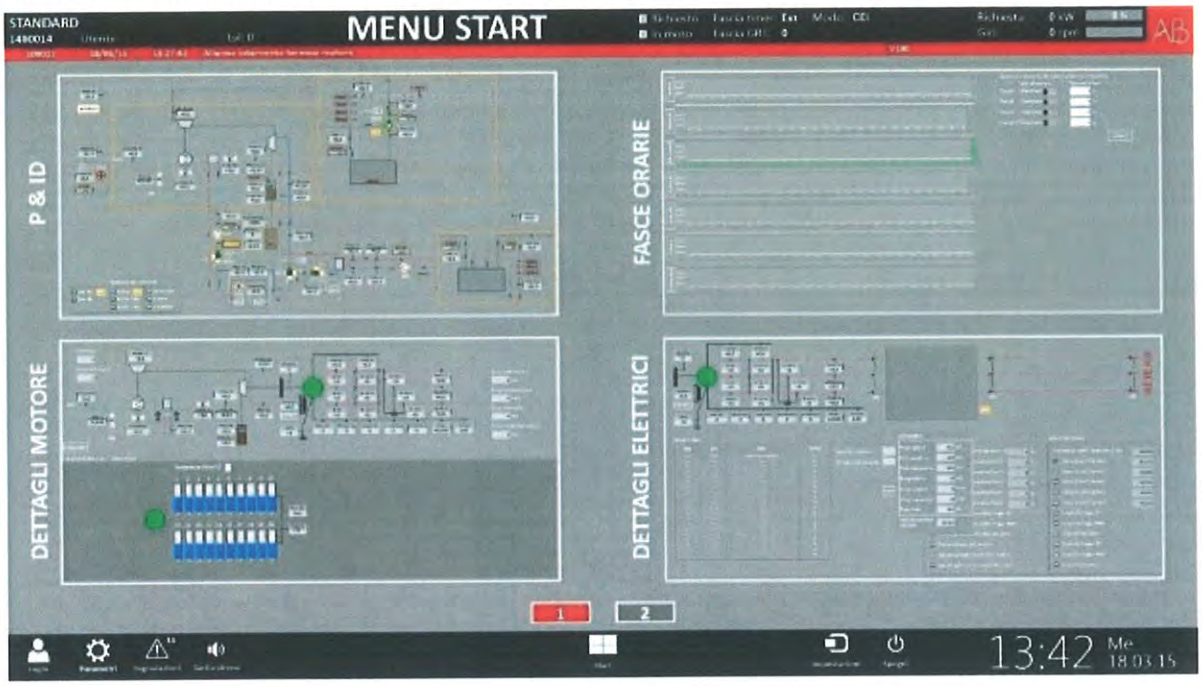
4.17.1 Supervision

The plant supervision system is based on the Siemens WinCC SCADA software, a platform with which AB Impianti has extensive experience in automation applications. This choice is derived from the adoption of Windows as the standard for automation systems and the need to use a Windows compatible platform; it has enabled AB to provide effective technical support, both on-site and remotely.

The design of the automation system monitoring the ECOMAX® ensures that all components are integrated and safely operating in unison. The supervision system is designed considering the following fundamental functions:

- display of plant performance;
- execution of operator commands;
- clear and simple reading of alarms; and
- display of data trends.

The software system will provide all functions in a simple and continuous format for the operator. The software has been designed in a way to guarantee a high level of reliability and availability. The system is flexible to allow for expansions and future updates. It is possible to connect to the system through the internet for remote monitoring, using security provided by a firewall.



4.17.2 Graphics Pages

Care is given to the design of the graphics pages so that data and information is presented in a clear and logical manner to the operator. Each page will consist of a graphical window showing a P&ID or single line diagram to represent the specific mechanical or electrical system. An overview page is included to provide a summary of the entire cogeneration system. Each metric will have a historical graph which will allow for the review of past and present performance. The detailed pages for each subsystem will display metrics for individual pieces of equipment, including the desired setpoint, the actual operating point, and any present alarm or shutdown conditions. An alarm log will be available to give a visual record of past alarm and shutdown conditions with a date and time stamp. Alarm and shutdown conditions will be prominently displayed and will remain active until acknowledged by the operator.

4.17.3 PROFINET/Profibus network

The Profinet network will connect control systems, group management, the auxiliary PLC, and other necessary components using the Profibus protocol. The communications system will allow net information checks where alteration to information in transit should be avoided.

4.18 OPERATION AND MAINTENANCE MANUAL

The operation and maintenance manual is intended to provide guidelines for basic maintenance procedures for the ECOMAX®. The manual is divided into chapters, each having a different topic. It gives information on the operation and maintenance of the product over the lifetime of the system, while considering the following:

- the proper application of standards, and
- efficacy in communicating content according to the need, the sector of operation, and operator qualification.

5 ECOMAX® ACCESSORIES

ENVIRONMENTALLY FRIENDLY TECHNOLOGY

Cogeneration is globally recognized as an application that can contribute significantly to reducing emissions into the atmosphere through energy efficiency and a reduction in overall energy consumption. AB's attention to this aspect has always been a driving factor in its mission and it is what its plant design, scrupulously oriented towards maximizing energy efficiency and minimizing emissions, is derived from. When it comes to pollution reduction, ECOMAX® systems make use of a range of technologies to meet relevant regulations.

5.1 EXHAUST GAS CLEANING SYSTEM (SCR).

In order to reduce CO and NOx emissions to the required levels, a urea-based exhaust gas treatment system is included. The system uses a closed loop to control the dosage of urea which is injected directly into the exhaust gas. Here it is mixed by static mixers which are installed inside the pipe. The mixture then goes through the reduction section where the NOx reduction reaction occurs on the porous surface of a catalyst, leading to the formation of water and nitrogen.
Downstream of the reduction section, an oxidation catalyst with a ceramic honeycomb matrix is installed. This section ensures that the quantity of carbon monoxide, unburned hydrocarbons (non-methane, non-ethane VOCs), and ammonia are reduced to the necessary levels.

A urea storage system is provided in a special enclosure, complete with two (2) tanks with a capacity of 2000 liters each, a pump, and connecting piping.

System operation is guaranteed for 16000 working hours or 24 months from the first ignition, whichever comes first.

THERMAL EFFICIENCY TECHNOLOGIES

5.2 EXHAUST HEAT RECOVERY UNIT FOR STEAM PRODUCTION

The exhaust heat recovery unit for the production of saturated steam consists of a horizontally oriented heat exchanger with external insulation, and is designed with the following characteristics:

- annealed tubesheets, submitted to normalisation heat treatment;
- large diameter, carbon steel fire-tubes secured to the tubesheet by expansion with no need for a welding belt;
- plates reinforcement through ribbing;
- double jacketed feedwater pipe;
- exhaust gas inlet and outlet chambers made from Cor-Ten A steel, compete with doors for maintenance operations;
- valves (2nd safety valve included);
- control and regulation accessories;
- water level control panel;
- IP65 electric control panel;
- feedwater pump complete with necessary valves and filters;
- standby feedwater pump;
- continuous conductivity control system;
- pressure release valve;
- automatic blow-down system;
- economizer; and
- second stage economizer.

5.3 EXHAUST GAS CIRCUIT WITH BY-PASS

Properly sized exhaust gas piping connects the engine to the exhaust heat recovery unit. A bypass circuit is included, made from AISI 304 stainless steel piping and equipped with a 3-way servo valve. Flexible bellows are included as needed.

5.4 CONDENSARET DRAINAGE.

We provide a condensate drain from the exhaust gases pipeline, by welded joint piping. Terminal point at HRSG edge. Condensate discharge in local condensate traps should be arranged by Customer.

5.5 THERMAL INSULATION

To support superior performance, avoid spills, and protect operators from potential accidents, the supply will include the realization of the thermal insulation. The insulation density and thickness, as well as the outer surface coating, are to be defined according to the specific configuration of the plant and to the type of circuit to be insulated. Insulation for the following components is included:

- thermal recovery circuits (hot water);
- the exhaust gas piping;
- the exhaust gas cleaning system;
- exhaust gas heat exchanger for steam production.

MEASURE TECHNOLOGIES

5.6 NATURAL GAS FLOW METER

This measurement system, installed on the natural gas supply system, features the following:

- a volumetric flow meter, complete with transmitter; and
- an electronic volume corrector, able to automatically correct the measured volume of gas to the volume at given reference conditions (Sm3/h) by using measured values of pressure and temperature acquired by the built-in sensors, complete with factory inspection certificate.

5.7 HOT WATER FLOW METER (HT CIRCUIT)

This measurement system, installed on the hot water circuit, features the following:

- a magnetic flow meter, complete with transmitter and LCD display;
- a pair of temperature sensors with respective thermowells; and
- a thermal energy calculator, with a display for visualization of energy consumption, instantaneous measurements, and error messages.

5.8 HOT WATER FLOW METER (LT CIRCUIT)

This measurement system, installed on the hot water circuit, features the following:

- a magnetic flow meter, complete with transmitter and LCD display;
- a pair of temperature sensors with respective thermowells; and
- a thermal energy calculator, with a display for visualization of energy consumption, instantaneous measurements, and error messages.

5.9 STEAM FLOW METER

This measurement system, installed on the steam circuit, features the following:

- a factory calibration certificate;
- a vortex precession flow meter, complete with transmitter and LCD display;
- a temperature sensor with respective thermowell;
- a pressure measurement device, complete with transmitter; and
- a thermal energy calculator, to calculate of the steam mass flow and the thermal power.

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