Appendix 14

Odour Impact Assessment

ADAS

Proposed Increase in Processing Capacity at the Maelor Foods Poultry Plant, Pickhill Lane, Wrexham

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Submitted to:

Mulkh Mehta

Maelor Foods Limited

Prepared by:

RSK ADAS Ltd

Unit 1 Rubicon Square

4205 Park Approach

Thorpe Park

Leeds

LS5 8GB

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Quality Assurance

Authors:	Checked by:	Issued by:
Steve Peirson BSc, CEng, CEnv, MIAgrE	Nisha Rehm BA (hons) MSc PIEMA	Steve Peirson BSc, CEng, CEnv, MIAgrE

Disclaimer

Executive Summary

ADAS has been instructed by Mr Mulkh Mehta of Maelor Foods Ltd to carry out an odour impact assessment to evaluate the off-site odour impacts of a proposed increases in throughput at the Company's poultry processing facility at Pickhill Lane, Wrexham, LL13 0UE. Planning permission was granted for change of use of the Maelor Creamery site to a poultry processing facility on 2nd March 2015 and the facility has since then become established with Phase 1 operations commenced in 2017. The Operators are now seeking to implement Phase 2 of operation of the site to the increase the processing capacity of the plant to two million birds per week by installing a second processing line, as well as upgrading and improving the effluent treatment plant to cope with the increased arisings of effluent.

The following changes to the plant proposed as Phase 2 have been considered:

- An increase in processing capacity from one million birds per week to two million birds per week by installation of a second processing line.
- Addition of a second chemical scrubber with a 15m dispersion stack to serve the most odorous process areas of the new processing line.
- An extension to the wastewater treatment plant (WWTP) to increase on site wastewater treatment capacity and an increase in the volume of cleaned water to be discharged to the River Dee.
- Upgrading and replacing the chemical scrubber serving the WWTP, with the addition of a 15m dispersion stack, and enclosure and extraction of more odour sources at the WWTP.
- A new sludge dewatering plant to reduce sludge volumes and associated vehicle movements for transport of the sludge for off-site reuse.

This Odour Impact Assessment is based on dispersion modelling and has been commissioned to consider the potential future odour impacts of the plant if the proposed development scheme is implemented.

Process conditions of the existing and proposed extended facility were used to quantify potential odour impacts at sensitive receptor locations around the plant using dispersion modelling. The results were subsequently compared with appropriate odour benchmark levels to determine the potential for adverse effects in the vicinity of the site.

Findings

The results of dispersion modelling show that predicted odour impacts at all receptors are all well below the suggested impact benchmark range of 3.0 to 5.0 ou_E/m^3 and modelled impacts are also all below a more precautionary 1.5 ou_E/m^3 benchmark assuming 15m stacks discharging air from two chemical scrubbers serving the processing plant and a 15m scrubber stack serving the upgraded wastewater treatment plant scrubber.

The significance of the predicted odour impact is therefore assessed to be '**negligible**' at all receptor locations using the Institute of Air Quality Management (IAQM) assessment criterion.

Based on the assessment results, it is not anticipated that there is a significant risk of adverse odour impacts occurring at any sensitive location as a result of emissions from the proposed development. As such, the potential for adverse odour impacts at sensitive receptor locations is considered to be low.

1 Introduction and Plant Description

1.1 Background

RSK ADAS has been instructed by Mr Mulkh Mehta of Maelor Foods Ltd to carry out an odour impact assessment to evaluate the off-site odour impact of a proposed increases in throughput at the Company's poultry processing facility at Pickhill Lane, Wrexham, LL13 0UE. Planning permission was granted for change of use of the Maelor Creamery site to a poultry processing facility on 2nd March 2015 and the facility has since then become established with Phase 1 operations commenced in 2017. The Operators are now seeking to implement Phase 2 of operation of the site to the increase the processing capacity of the plant to two million birds per week by installing a second processing line, as well as upgrading and improving the effluent treatment plant to cope with the increased arisings of effluent.

The following changes to the plant proposed as Phase 2 have some potential to affect the odour impact of the plant:

- An increase in processing capacity from one million birds per week to two million birds per week by installation of a second processing line.
- Addition of a second chemical scrubber to serve the most odorous process areas of the new processing line.
- An extension to the wastewater treatment plant (WWTP) to increase on site wastewater treatment capacity and an increase in the volume of cleaned water to be discharged to the River Dee.
- Upgrading and replacing the chemical scrubber serving the WWTP and enclosure of odorous sources at the WWTP.
- A new sludge dewatering plant to reduce sludge volumes and associated vehicle movements for transport of the sludge for off-site reuse.

This Odour Impact Assessment has been commissioned to consider the potential future odour impacts of the plant if the proposed development scheme is implemented. The modelling assessment inputs and assumptions made are set out in the following report, along with the results of the assessment and interpretation of the results in relation to potential off-site impacts and effects.

1.2 Site Location and Context

The consented poultry processing facility is on the site of the disused Maelor Creamery, Pickhill Lane, approximately 1 km to the north-north-west of the village of Bangor-on-Dee and approximately 700m to the south-east of the residential area of Cross Lanes. The map in Figure 1 at Appendix 1 shows the locations of potentially sensitive receptors around the plant.

There are small numbers of potentially sensitive residential properties located off Pickhill Lane, to the west of the proposed main poultry processing building, and there are also a small number of individual residences to the north of the plant at Pickhill Old Hall and Whitegate Cottage. The proximity of sensitive receptors on Pickhill Lane is such that there are some risks of off-site odours being caused, and this therefore means that high standards of odour mitigation and management are required.

1.3 Proposed Site Activities

Overview

The plant is concerned with the slaughter and processing of broiler chickens to produce chicken meat and chicken meat products for the food and retail markets. The following paragraphs describe the key activities in each area of the plant, the odour risks in each area and the key control measures which are currently used with one processing line, and which it is proposed will be used to reduce odour emissions and/or disrupt the pathways for odours to potential receptors in future with two processing lines. The odour risk of each area has been assessed based on odour measurements carried out at this site as well as experience gained at other UK poultry processing plants.

Lairage/Intake

Live chickens from broiler production farms arrive at the plant in modules on HGV trailers. The HGV trailers enter a lairage area, before moving to the intake area where the modules are unloaded. Birds are transferred from the intake area to the preliminary processing area where the modules are loaded onto the intake line. The existing lairage area will be used to receive the increased number of birds that will be processed on the second slaughter and processing line, so that no significant new odour emissions will arise from this area as a result of the proposed developments.

Lairage/intake areas typically generate relatively low levels of odour emissions from the birds themselves and from their droppings. Temperature control is required to maintain good working conditions and particularly to provide comfort for the birds held in this area prior to slaughter. The internal building airspace is cooled by chilling equipment and this arrangement will continue in future.

There are no external discharges and fans blow re-circulated air within the building and around the modules to provide enhanced comfort for the birds in warmer weather. This is a LOW odour risk area of the plant.

Stunning and Bleeding

Birds are transferred from the intake area via a Linco module handling system to the preliminary processing area. Here the modules are loaded onto the intake line and the birds are gas stunned before being removed from the modules and hung-on to the “shackles” of an overhead conveyor line and transferred to a bleeding area. Here the birds are decapitated and blood drained into the blood trough, from where it is pumped away at frequent intervals during the day to an enclosed and odour extracted blood storage tank in the “offal bay“ or animal by-product (ABP) storage building collection bay. Blood is therefore removed from the bleeding area before there is any odorous decay, and this area is thoroughly washed and sanitised at the end of each processing day. These measures alleviate the risks of material levels of odours from the decay of blood residues.

The proposed extension will see the installation of a second gas stunning area at the “front” end of the second processing line.

The empty modules are transferred to the “module wash” and then transferred to the “box return” service area where they are re-loaded onto empty HGV trailers for subsequent re-use in the collection of birds from farms.

An additional module washing facility is proposed as part of the proposed second processing line.

Low intensity odour emissions arise from handling the modules and the birds as they are hung on to the conveying system but emissions are limited because: a) the area is chilled, b) there are only small numbers of birds in the stunning and hang-on areas at any one time, and c) there are no significant changes to the state or composition of the chickens within these areas. It is also noted that fresh blood has no significant odour.

The internal workplace is air conditioned on a recirculated air system while the module wash area is extracted and dispersed through roof exhaust points.

Floors and walls of the stun and bleed area are washed down and sanitised during night shifts and at weekends.

The live bird handling systems area is, and will continue to be, cleaned every night, as well as briefly in between kills so that faecal contamination of the area is, and will remain, minimal.

By use of a gas stun method there are no live birds flapping wings during bird hang on as found at electric stun sites. Dust levels and associated odour are therefore much lower.

AeroScalder and De-feather

After bleeding the birds are conveyed to an "AeroScald" de-feather room where they are scalded by a saturated steam/ hot air system. This AeroScald system is relatively new technology in the UK, but has been used successfully by Maelor since the first processing line was established.

The birds are conveyed through the scalding unit to loosen their feathers to facilitate mechanical plucking in the de-feather area. This novel technology provides a non-immersion scalding method that minimises water and energy use and has been shown by measurements at the Maelor Foods site to have much lower odour emissions than conventional scald tanks as it avoids the large volumes of water containing accumulating, decaying organic matter that are normally involved in wet "tank" scalding.

The AeroScalder is entirely enclosed and consists of two chambers; an air conditioning chamber where the moisturised hot air is prepared and, next to it, the scalding chamber itself through which birds are conveyed and into which the scalding air is blown. Moisturised hot air is blown forcefully onto the most critical parts of the broiler, preventing over scalding of fragile parts. It penetrates and separates the feather pack, transferring heat effectively to the feather follicles. Air temperature depends on whether products are to be hard, medium or soft scalded.

Scald vapours are enclosed inside the unit and vapours and odorous air is currently extracted to a chemical scrubber for abatement before dispersion to atmosphere through a 12m tall stack. The proposal is that an additional Aeroscalder will be installed as part of the proposed second processing line and that this will be extracted to a new chemical scrubber of the same type as the current scrubber. The existing scrubber stack will be extended to 15m and the new unit will also discharge at this height.

The spent scald water within the air scalder is filtered and recirculated in the system. Separated waste and overflow water may have a high organic content but the volume flow for discharge to the effluent treatment plant is low so it that the effluent treatment system has a lower flow than is the case with conventional scalders, and this helps minimise effluent balance tank capacity requirements.

Scalding has normally been a high-risk odour area of conventional poultry processing plants as residual blood, and organic matter from the chicken's feet and feathers progressively accumulates and decays in the large volumes of warm water in conventional scald tanks during each production day. Odour emissions are much lower with the AeroScalder technology, but provision is made to extract air from this area of the plant at high rates directly to a **chemical scrubber** odour abatement system. Chemical scrubbers have been used at a number of other UK poultry processing plants to treat higher intensity odour streams, and it is proposed that a scrubber of the same type as currently used will be installed to abate emissions from the proposed second AeroScalder.

There will also be fresh air inlets to provide "cooling" air, which will in turn be extracted through the system and to the chemical scrubbing abatement system.

After scalding the birds are conveyed to the de-feather area where mechanical de-feathering is undertaken in de-feathering (plucking) machines.

Feathers are rinsed from the machines with re-circulated water fed via nozzles and transported via a recirculating water flume into the ABP storage building. The flume water is drained down to the effluent treatment plant at the end of each day. The feathers are pressed to remove excess water before collection in a vehicle trailer in an ABP collection bay.

Wall and ceiling mounted fans introduce cooling air into the building. The headspace air in the de-feather area is potentially odorous so is extracted directly to the chemical scrubber odour abatement systems.

Evisceration

The birds are mechanically eviscerated to remove their intestines and other internal organs (heart, lungs, gizzards, livers etc.). Evisceration does not generate significant emissions of odours because the intestines are not broken and they, and other organs, are not odorous while fresh.

Edible offal is separated, dry chilled and packed for retail markets and transferred to the cold store awaiting distribution.

Inedible offal removed during the evisceration process is transferred by vacuum lines to the animal by-products trailer in the ABP offal collection bay where it is collected daily for off-site processing. Edible offal is transported away from the evisceration area for chilling and onward dispatch to customers. No offal is therefore allowed to accumulate in the evisceration area, minimising its potential as an odour source.

Carcasses are rinsed during evisceration and internal drains in this area have meshes to prevent scraps washing into the wastewater system and increasing the organic loading of the wastewater treatment plant. Spills of meat scraps onto floors are cleaned up promptly and collected into bins for transfer to an ABP trailer.

An enclosed air system is in place with cooling to control the working environment and a small amount of input air is provided to maintain fresh air. Any excess air from this processing area is drawn through the de-feather area to the chemical scrubber serving each Line.

Odours from evisceration are less offensive than the scalding and defeathering areas in our experience and this area is a low odour potential source and therefore highly unlikely to contribute to any off-site odours.

Treating, Processing and Packing

Under the proposed Phase 2 development flavouring rubs are to be applied to some whole bird products but there will not be any cooking of whole birds which could generate cooking odours. Ingredients will be mixed on-site and flavours such as, but not limited to, sage and onion, garlic and herb will be injected into the whole birds. Up to 30,000 birds per week will be flavoured (approximately 50 tonnes per week) which will utilise around 6-8 tonnes of marinade per week. There is no external extraction from the area where flavourings are made up and applied so that this is not an odour risk area of the plant.

Edible Offal Cold Store

Offal material which is fit for human consumption is transferred to chillers and cold storage areas, where it is stored before transport off-site. The cold storage buildings are kept refrigerated to prevent decay and are largely "sealed" by means of a cold-store type door. This is a very low odour risk area.

ABP Storage and Handling

The animal by-products (ABP) comprise of inedible offal, feathers, blood, inedible material, meat scraps, dead on arrival birds and waste/wash water screenings. These materials are all held in the ABP storage building which accommodates sufficient trailers to ensure ABPs are always stored inside and collected in a timely manner.

The proposed increase in ABP production from the second processing line will result in more frequent ABP collections , so that it will be collected before odorous decay can occur.

Inedible offal and other ABP are transferred by vacuum lines into trailers located inside the ABP storage building. Feathers are transferred in a water flume and separated from the flume water and pressed before loading into the trailers. The pressed feathers are loaded into bulk trailers inside the building to await collection for further processing off-site.

The ABP and feather trailers are collected daily to minimise degradation and odours. Dolavs and other small containers used for collecting ABP around the processing areas are emptied into the ABP trailer and then washed out.

The ABP building is large enough to accommodate the collection vehicles with the doors closed and the trailers are sheeted up inside before being driven out.

The ABP building is fully enclosed and has mechanised doors to allow vehicle access and the doors are kept closed at all other times. The building headspace air is extracted at a rate of at least 3 air changes per hour to the chemical scrubber(s) for odour abatement. This prevents fugitive escape of internal air.

This area has been shown by measurements to be a medium odour risk area of the plant as the ABP is removed whilst fresh and before there is any significant or odorous decay. The building air will continue to be extracted and chemically scrubbed by the existing system before being dispersed from the scrubber outlets by 15m tall vertical discharge stacks.

Although ABPs are removed from site daily before odorous decay becomes established, our experience is that even small traces of animal protein residues on equipment and in trailers may result in the generation of some odours. It is therefore acknowledged that due to any additional time spent in the offal building, the risk of odours from this activity is heightened to a degree and as such, a maximum ABP residence time of 48 hours is specified in cases of abnormal events. It is anticipated that under Phase 2 that there will be an average “holding” time of 8 hours as the higher throughput will result in trailers being filled more frequently.

Rigorous cleaning and house-keeping regimes are important, as well as maintenance of good rates of extraction.

Blood Storage Tank

Blood from the existing processing line bleeding area is pumped/transferred to a blood tank located inside the building housing the feather separation pit which has internal drains to the effluent treatment plant. Poultry blood is not sold on for further processing into foodstuffs for human consumption or pharmaceutical applications so the blood tank is not refrigerated.

The blood tank is enclosed, and it is fitted with a high-level interlocked alarm to prevent overfill. The tank vents to the offal bay odour extraction system. It is proposed that the blood from the proposed second processing line will be dealt with in the same way using the same system. The tank has capacity to hold at least 110% of the maximum kill capacity of blood to cover contingencies such as transport delays.

The blood tank is completely emptied at least daily and it is regularly cleaned using the integrated CIP system to prevent build-up of odorous residues. There is potential for very high intensity odour emissions from the storage of blood if the blood decays in warmer weather, although this decay is limited in larger processing plants, such as this plant, by the frequent collection and removal of blood from the site. Procedures are in place to ensure a consistent approach is taken with regards to blood collections. The use of a hopper bottomed tank means that all blood is removed each time the tank is emptied, and therefore that there are no odorous residues in the tank.

Air displaced from HGV road tankers collecting blood from the storage tank is ducted directly back into the odour extraction system. Tanker drivers connect the outlet/exhaust of their tanker vacuum pumps to a flexible hose which is directly connected to the extraction system that is ducted to the chemical scrubber abatement system.

This is a high odour risk area of the plant and in addition to direct odour extraction from the blood tank, the ABP storage building area around the tank is fully enclosed and extracted at a rate of at least 3 air changes per hour directly to the existing chemical scrubber and stack odour mitigation systems.

Cleaning Routines

The floors and walls of the processing areas are all washed down and sanitised daily during night shifts and at weekends, as required by the Meat Hygiene Regulations and the site's HACCP. These routines also help to minimise odour emissions.

Module Washing

Empty live bird modules are washed in the "module wash". Low intensity odours may arise from handling and washing of the empty modules. The building air from this area of the plant is extracted for high level dispersion.

The proposed second processing line will include an additional module washing area.

It is proposed that in future extraction from the proposed second line will be extracted at high level and dispersed to atmosphere through roof fans. This is a low odour risk area of the plant

Truck Washing

Unloaded HGV trailers move from the intake area to the internal "truck washing" area where they are completely washed down before moving to the "box return" area for re-loading with clean, empty modules. Low intensity odour emissions may arise from truck washing operations, and air is extracted directly by roof mounted extraction fans for high level dispersion. This is a low odour risk area of the plant and the same arrangements will apply after the proposed increase in plant throughput.

Module Return Area

Washed and sanitised modules are returned to the "box return" area where they are re-loaded onto clean HGV trailers. Insignificant odour emissions arise from box loading operations as both the vehicles and the modules have been washed at this stage. Air is extracted directly by roof mounted extraction fans for high level dispersion. This is a very low odour risk area of the plant, and the same arrangements will apply after the proposed increase in plant throughput.

Wastewater Treatment Plant (WWTP)

Effluent is generated predominantly as contaminated wash water from the abattoir and specifically from the de-feather areas and the feather flume system.

The WWTP is located "downhill" beyond the factory buildings, well away from any potential receptors on Pickhill Lane.

Raw effluent drains to a raw effluent pump sump and from there is pumped through an enclosed rotary drum screen on top of the balance tank to screen out larger solids from the effluent before treatment. The primary screenings fall into a skip and full skips are covered to minimise odour and keep rainwater out or are stored inside. The screenings are transferred into the ABP trailer in the ABP storage building.

The balance tank has a retention time at peak flow of around 12 hours. This allows waste streams of high and low organic loading to be combined so that the effluent plant is presented with a consistent pollutant load flow and not peak or more “concentrated” flows such as occur at the time of discharge of feather flume contents at the end of each production day. There is also a diversion tank which may be used occasionally to segregate effluent in abnormal events such as spillages or to recycle out of specification treated effluent. It is not envisaged that the diversion tank will be used other than very occasionally as a contingency because of low volumes of effluent produced by the Aeroscalder system which are adequately buffered in the balance tank.

The balance and diversion tanks are agitated by two venturi mixers to mix and aerate their contents and to maintain aerobic conditions and prevent them from going septic and becoming unacceptably odorous.

The balance and primary tanks were covered after an olfactometry survey undertaken in May 2018 identified that these uncovered tanks were a source of very high odour concentrations which could contribute to offensive offsite odours. Air has subsequently been extracted from the balance and diversion tanks to a chemical scrubber and then dispersed to atmosphere through a stack at a discharge height of approximately 6m.

From the balance tank effluent is transferred to a Dissolved Air Flotation (DAF) system to flocculate and separate/remove suspended solids, fats, oils and greases, from where the separated solids are pumped to a covered sludge storage tank.

DAF plants can generate small volumes of quite intense and offensive odours, so that in this case the DAF plant was fitted with a stainless-steel cover with removable inspection hatches and the headspace has been vented directly to a passive carbon filter for odour removal.

The separated liquid from the DAF plant is transferred to an activated sludge system tank for anoxic and aerobic (activated sludge) treatment, prior to final settlement and discharge to river.

The odours from activated sludge tanks are much less offensive than from DAF plants and sludge facilities, and odours are not usually attributable to them unless the system has been overloaded and this has adversely affected the treatment.

The activated sludge plant consists of an anoxic vessel followed by an aeration tank where the conditioned mixed liquor is injected with air via fine bubble air diffusion manifolds. A final settling clarifier tank removes the remaining suspended solids from the effluent backed up by a rotary disc ultrafilter to guarantee the final effluent quality.

It is understood that the increase in effluent arisings from the plant after the proposed addition of the second processing line will be addressed by the construction of a second activated sludge treatment system comprising anoxic, aeration and final settlement tanks of the same proportions as the existing plant. Odour emission rate measurements, as summarised in Appendix 2, have previously shown that these open tank facilities have relatively low odour emissions and that complex odour mitigation measures, such as covering and treating of extracted air, are not necessary or justified.

The existing balance and diversion tanks and DAF unit will in future serve both productions lines but with the addition of another balance tank of similar capacity. It is proposed that the chemical scrubber serving the balance tank will be replaced with a more elaborate scrubber. The new scrubber will be upgraded from the existing manual chemical dosing system to one with automatic controls which will provide automated blowdown and top-up of the scrubber liquor solution as well as automated dosing with caustic soda and sodium hypochlorite. The objectives of these improvements are to alleviate the dip in scrubber abatement performance which may currently occur towards the end of each periodic scrubber liquor flush out and replenishment cycle.

The Phase 2 developments will also include active extraction from the effluent reception pit, and from the sludge storage tank to the new scrubber. The DAF plant will be covered in a new building and odour extracted to the new scrubber, as will a new fully enclose sludge de-watering facility.

Given the controls in place and the proposed new scrubber and process enclosures/buildings, the features of the WWTP design and its relatively isolated location, there should be a low odour risk from this area of the plant providing that there are significant improvements in the abatement achieved by the proposed new scrubber.

WWTP Sludge Treatment, Storage and Handling

The combined DAF and waste or surplus activated sludge is to be thickened under the Phase 2 alterations to the effluent treatment plant before transfer off-site for land spreading or injection by contractors or other waste recovery method.

The sludge dewatering plant will be housed in a new building at the WWTP and will accommodate HGV vehicles collecting sludge cake.

The existing sludge storage tank will be retained as a contingency. It is covered and a mixer keeps the sludge mixed when operational. The off gas from the tank headspace will be connected into the new WWTP area scrubber.

Displaced air from the road tanker during non-dewatered sludge transfers is fed into the WWTP area scrubber. The tank has high level alarms and our procedures cover offloading to road tanker. Tanker drivers connect the outlet/exhaust of their tank or tanker vacuum pumps to a flexible hose which is directly connected to the scrubber for treatment before release to atmosphere.

There is a low to medium odour risk from this area of the plant and although the sludge can generate unpleasant odours, the combination of a fully enclosed dewatering plant, air extraction and abatement and infrequent tanker loading events minimise the risks of off-site odour impacts.

Odour Control and Mitigation Systems

Odorous emissions from those areas of the processing plant which generate the most intense odours, and in particular the scalding/de-feather, ABP storage areas of the existing processing line, and the blood storage tank will continue to be extracted to the existing chemical scrubbing system.

It is proposed that a new, parallel scrubbing system will be used to abate the additional “higher risk” odours from the proposed new scalding and ABP transfer system. The proposed additional abatement and mitigation system will be based on a second single stage chemical scrubbing with caustic soda and sodium hypochlorite scrubbing liquor of the same design as the existing scrubber. Mitigation of the impact of treated odours off the new scrubber will be achieved by a 15m tall dispersion stack to disperse residual odours. The following odour assessment has been based on stack heights of 15m for the treated air off both stacks, and a 15m stack of the proposed new WWTP scrubber.

The scrubbing system is a moderately high odour risk area of the plant as it will be abating air extracted from the most odorous areas of the plant and therefore effective scrubber operation is critical to controlling off-site odour impacts of the processing facility. However, it is noted, from the data included at Appendix 2 that odour measurements have demonstrated that the AeroScalder system is significantly less odorous than scald tank based de-feather systems on other processing sites.

The off-site impact of air handling systems from the less odorous areas of the existing plant (lairage, hang-on area, bleeding, evisceration, and the module and trailer washing areas) are currently mitigated by internal cooling and/or dispersion of building headspace air at high level through roof mounted fans. It is proposed that these arrangements will continue with Phase 2.

2 Legislation and Policy

2.1 Odour Legislation and Guidance

The following legislation and guidance has been referred to or used in this assessment:

- H4: Odour Management, Environment Agency (EA), 2011;
- Odour Guidance for Local Authorities, Department for Environment, Food and Rural Affairs (DEFRA), 2010 (now withdrawn by Defra);
- Environmental Permitting (England and Wales) Regulations (2010); and,
- Guidance on the Assessment of Odour for Planning, Institute of Air Quality Management (IAQM), 2018.

2.2 Odour Definition

DEFRA guidance[1] defines odour as:

"An odour is the organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances. It is a property of odorous substances that make them perceptible to our sense of smell. The term odour refers to the stimuli from a chemical compound that is volatilised in air. Odour is our perception of that sensation and we interpret what the odour means. Odours may be perceived as pleasant or unpleasant. The main concern with odour is its ability to cause a response in individuals that is considered to be objectionable or offensive.

Odours have the potential to trigger strong reactions for good reason. Pleasant odours can provide enjoyment and prompt responses such as those associated with appetite. Equally, unpleasant odours can be useful indicators to protect us from harm such as the ingestion of rotten food. These protective mechanisms are learnt throughout our lives. Whilst there is often agreement about what constitutes pleasant and unpleasant odours, there is a wide variation between individuals as to what is deemed unacceptable and what affects our quality of life."

2.3 Odour Impacts

The magnitude of odour impact depends on a number of factors and the potential for adverse impacts varies due to the subjective nature of odour perception. The FIDOR acronym is a useful reminder of the factors that can be used to help determine the degree of odour pollution:

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

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

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

- The rate of emission of the compound(s);
- The duration and frequency of emissions;
- The time of the day that this emission occurs;
- The prevailing meteorology (wind direction, wind speeds etc.);

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

- The sensitivity of receptors to the emission i.e. whether the odorous compound is more likely to cause annoyance, such as the sick or elderly, who may be more sensitive;
- The odour detection capacity of individuals to the various compound(s) in odours; and,
- The individual perception of the odour (i.e. whether the odour is regarded as unpleasant). This is quite subjective, and may vary significantly from individual to individual. For example, some individuals may consider some odours as pleasant, such as petrol, paint and creosote, whilst others find them less tolerable.

2.4 Odour Measurements and Units

A number of odour concentration and emission rate measurements have been made at this site on various dates and the findings are summarised in Appendix 2. These measurements have been based on olfactometry, based on the principles and emisions set out below, and the same odour concentration concepts are the basis of odour modelling and the interpreattion of modelling results.

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

At the detection threshold, the concentration of an odour is so low that it is not recognisable as any specific odour at all, but the presence of some, very faint, odour can be sensed when the "sample" odour is compared to a clean, odour-free sample of air.

For a simple, single odorous compound (e.g. H_2S), the concentration of odour present in a sample of air can be expressed in terms of ppm, ppb or mg/m^3. More usually, odours are complex mixtures of many different compounds and the concentration of the mixture can be expressed in ou_E/m^3.

The concept of odour concentrations, expressed as ou_E/m^3, is based on a correlation between a physiological response when odour is detected by the nose and exposure to a particular sample at a specific concentration. The results of this assessment are expressed in terms of a single number. The odour sample assessed can be one of many individual odorous substances or a complex mixture of many substances, and so the odour unit or concentration will vary between test samples. A defined measurement standard for the odour unit is prescribed in the BS:EN standard on olfactometry using n-butanol. This gas is used to select and calibrate odour panel members.

An odour at a strength of 1 ou_E/m^3 is the concentration at which 50% of the population can just detect the odour and 50% cannot within the controlled environment of an odour laboratory[2]. As an odour becomes more concentrated, then it gradually becomes more apparent. Some guidance as to concentrations when this occurs can be derived from laboratory measurements of intensity. The following guideline values have been stated by DEFRA[3] to provide some context for discussion about exposure to typical odours:

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

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2 Code of Practice on Odour Nuisance from Sewage Treatment Works, DEFRA, 2006.
3 Odour Guidance for Local Authorities, DEFRA, 2010.

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

- The population is continuously exposed to a wide range of background odours at a range of different concentrations, and usually people are unaware of there being any background odours at all due to normal habituation. Individuals can also develop a tolerance to background and other specific odours. In an odour laboratory the determination of detection threshold is undertaken by comparison with non-odorous air, and in carefully controlled, odour-free, conditions. Normal background odours such as those from traffic, vegetation, grass mowings etc., can provide background odour concentrations from 5 to 60 ou_E/m^3 or more;
- The recognition threshold may be about 3 ou_E/m^3, although it might be less for offensive substances or perhaps more likely higher if the receptor is less familiar with the odour or distracted by other stimuli; and,
- An odour which fluctuates rapidly in concentration is often more noticeable than a steady odour at a low concentration.

2.5 Odour Benchmark Levels

Minimising waste and pollution is a key component of guidance, such as the National Planning Policy Framework (NPPF)[4]. There is no specific guidance for odour; however, odour is defined as pollution within the framework. It is stated in the framework that planning decisions must reflect and where appropriate promote relevant obligations and statutory requirements, for example, the Pollution Prevention and Control Act and Environmental Permitting (England and Wales) Regulations 2016 (as amended).

Since the early 1990s the technique of odour dispersion modelling has become well established as a means of assessing the off-site odour impact of a very wide range of odorous activities and particularly sewage/wastewater and intensive livestock farming (poultry and pigs). Odour impact benchmark levels have been developed as a matter of "custom and practice", of which the best established is the so-called "Newbiggin" standard.

The widely accepted convention in the UK is that odour impacts are expressed as 98th percentile (%-ile) hourly means, and these standards have been based on "dose-response"relationships which take account of normal temporal and metrological variations in downwind/off-site odour impacts.

2.5.1 The Newbiggin Standard

This empirical standard, of 5.0 ou/m^3 at the 98th %-ile, has been widely used in the wastewater (sewage) sector in the UK and elsewhere, to assess the likelihood of community annoyance. This standard was derived from an early 1990s planning appeal decision relating to an appeal by Northumberland Water for the construction of a wastewater treatment facility at Newbiggin-by-the-Sea in Northumberland in which evidence on potential off-site odour impacts was presented using odour dispersion modelling. The decision in this appeal case was the origin of the now well-established "Newbiggin" criterion that has been used, and is still used to this day, for odour impact assessments.

2.5.2 UKWIR Research

In 2001 the UK Water industry Research (UKWIR) organisation undertook research into correlations between (dispersion) modelled odour impact and the distribution of odour complaints around wastewater (sewage) treatment works. The findings of this work were concisely summarised in a Chartered Institute of Water and Environmental Management (CIWEM) document[5]:

[4] National Planning Policy Framework, Ministry of Housing, Communities & Local Government 2021..
[5] Policy Position Statement: Control of Odour. CIWEM, 2012.

"The main source of research into odour impacts in the UK has been the wastewater industry and the most in-depth study published study in the UK of the correlation between of modelled odour impacts and human response (dose-effect) was published by UK Water industry Research (UKWIR) in 2001. This was based on a review of the correlation between reported odour complaints and modelled odour impacts in relation to 9 wastewater treatment works in the UK with ongoing odour complaints. The findings of this research (and subsequent UKWIR research) indicated the following:

- *At modelled exposures of below $C_{98,\ 1\text{-hour}}$ 5ou$_E$/m^3, complaints are relatively rare, at only 3% of the total registered;*
- *At modelled exposures between $C_{98,\ 1\text{-hour}}$ 5ou$_E$/m^3 and $C_{98,\ 1\text{-hour}}$ 10ou$_E$/m^3, a significant proportion of total registered complaints occur; 38% of the total;*
- *The majority of complaints occur in areas of modelled exposure greater than $C_{98,\ 1\text{-hour}}$ 10ou$_E$/m^3, 59% of the total."*

In effect these findings demonstrated that with appropriate modelling, potential odour impact and annoyance is effectively controlled at 98th%-ile hourly mean odour impacts of 5 ou$_E$/m^3 or less. These findings are consistent with the Newbiggin standard as well as with ADAS experience of correlating odour impacts/complaints (and the absence of complaints) with dispersion modelling results.

2.5.3 Environment Agency Criteria

The EA has published the H4 guidance on odour[6] in 2011 and it contains indicative benchmark levels for use in the assessment of potential impacts from facilities regulated under the Environmental Permitting (England and Wales) Regulations (2016) and subsequent amendments.

Benchmark levels are stated as the annual 98th perecntile (%-ile) hourly mean concentrations in ou$_E$/m^3 for odours of different offensiveness. In practice this is the 175th highest hourly average recorded in the year. This parameter reflects the previously described FIDOR factors, where an odour is likely to be noted on several occasions above a particular threshold concentration before an annoyance occurs. EA odour benchmark levels are summarised in Table 1.

Table 1 Odour Benchmark Levels

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

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

2.5.4 Conclusions on Odour Benchmarks

It should be noted that the prediction that any particular property lies above a particular 98th perecntile odour concentration level does not necessarily imply that a loss of residential amenity (or a nuisance) will follow. However, it is suggested that the probability of such an occurrence is increased in proportion to the exceedence.

RSK ADAS has generally found that a range of odours are unlikely to cause adverse impacts with annual 98th percentile odour concentrations of less than 5.0 ou_E/m^3 over a five year period. However, once exposure exceeds 5.0 ou_E/m^3 at the annual 98th percentile, then there is an increasing risk of annoyance and complaints and above 10.0 ou_E/m^3 (as an hourly mean at the annual 98th percentile) some complaints would normally be expected.

Odours from the poultry rearing sources are commonly placed in the moderately offensive category and that might be seen to be the most appropriate H4 benchmark in this case as odours from the processing activities are likely to be dominated by poultry type odours rather than by any septic or decaying components. The target suggested in H4 for moderately offensive odours is an hourly mean odour concentration of 3.0 ou_E/m^3 at the 98th percentile.

On the other hand, it is possible to speculate that odours from the decay of offal and decay in solids in effluent, such as might occur in the effluent balance tanks may be more appropriately placed in the "most offensive" category with an impact benchmark of 1.5 ou_E/m^3 at the 98th percentile.

As a compromise between the various impact standards, and taking account of the range and types of odour emissions rates and odour "characters", hourly mean odour concentrations of 1.5 to 3.0 ou_E/m^3 at the 98th percentile are used in this study as a benchmark range to assess the levels above which some loss of residential amenity may occur.

2.6 Institute of Air Quality Management Guidance

The IAQM published the 'Guidance on the Assessment of Odour for Planning'[7] document in May 2014 and a revised version was published in July 2018. This guidance specifically deals with assessing odour impacts for planning purposes, namely potential effects on amenity. The assessment methodology outlined in the guidance has been utilised in this report to aid interpretation of the modelling results.

7 Guidance on the Assessment of Odour for Planning, IAQM, 2018.

3 Assessment Methodology

The proposed facility may result in odour emissions during normal operations. These were assessed in accordance with the following stages:

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

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

3.1 Odour Sources and Emission Rates

Odorous emissions from those areas of the plant which generate the most intense odours, and in particular the de-feather, feathers/offal/waste removal and storage areas, and the blood storage tanks will be extracted to both the existing chemical scrubbing system and a proposed new unit of the same type to abate odours. The abatement system will, therefore, in future be based on two scrubbers, with each comprising a single stage chemical scrubber with caustic soda and sodium hypochlorite scrubbing liquor and with a final mitigation stage of a tall scrubber dispersion stack to disperse residual odours.

The scrubbing systems are a potentially high odour risk area of the plant as they will be abating air extracted from the most odorous areas of the plant and therefore effective scrubber operation is critical to controlling off-site odour impacts.

The off-site impact of room extraction air from the less odorous areas of the plant (lairage, hang-on area, bleeding, evisceration, and the module and trailer washing areas) will be mitigated by in-room cooling and/or dispersion of building headspace air at high level through high level outlets. These airflows represent low odour risk areas of the plant because of the low odour concentrations associated with these activities.

Existing Processing Line Scrubber and Stack Emissions - The emission rate from the existing scrubber and stack has been calculated based on the measured air extraction rate of 35,784 m^3/hour (9.94m^3/s) for air extracted from the ABP storage building, all ABP and feather vacuum pump outlets, the defeathering/scald room and the blood tank multiplied by an odour concentration in treated air off the scrubber of 1,000 ou_E/m^3. This is a precautionary level as the odour concentration in air off the scrubber was measured in January 2022 at 764 m^3/s as set out in Appendix 2. For modelling purposes, the stack odour emissions have been "rounded up" to a precautionary emission rate 10,000 ou_E/s, and it has been assumed that the stack height will be increased to 15m.

Proposed Additional Processing Line Scrubber and Stack Emissions –

A new scrubber will be used to treat all air extracted air from the proposed new Aeroscalder and additional ABP transfer vacuum pump exhaust flows that are not treated by the existing scrubber. The Aeroscalder plant extraction rate recommended by the suppliers is approximately 4.5 m^3/s, but an extraction rate of 6.1 m^3/s was measured on the existing plant and in the interests of a precautionary design this has been assumed to be used for the proposed new unit. This scrubber will also treat all additional ABP transfer vacuum pump exhaust flows that are not treated by the existing scrubber. A total new scrubber treatment capacity of 7.0 m^3/s would suffice, but for "worst case" modelling purposes, and to provide Maelor Foods with flexibility for higher extraction rates, a second scrubber airflow output of 10 m^3/s has been modelled.

Thus total stack emissions for the proposed second scrubber stack have been based on total stack emission of 10,000 ou_E/s.

Effluent Plant Open Sources – Odour emission rates for the open tanks sources (anoxic tank, and aeration/activated sludge tanks) have been based on library data for analogous processes in wastewater treatment plants. These values were, in the main, shown to be precautionary when actual emissions were measured in May 2018, as summarised in Appendix 2.

Effluent Plant - Covered Sources and New Scrubber - Since odour emission rates were measured in 2018 the effluent balance tank and diversion tanks have been covered and an odour scrubber installed, as shown in Photo 1 below. It is now proposed that the existing scrubber will be replaced with a new scrubber of more elaborate design with automated controls over liquor blowdown and top-up, and automated control of chemical reagent dosing.

The airflow treatment capacity of the effluent plant scrubber has been calculated at 2.94 m^3/s based on extraction from tanks and buildings at rates of 3 Air Changes per hour (AC/hour) for odour-controlled buildings and 1 AC/hour for all odour-controlled tanks, based on empty tank volumes. These extraction rates are based on guidance or empirical standards used by the Environment Agency and other regulators and guidance issued by CIWEM[8].

The calculated extraction rates for these sources are as follows:

a) Balance Tanks (2) and Diversion Tank - 5,192 m^3/hour
b) Sludge Tank – 180 m^3/hour
c) Screw Press Building – 1,814 m^3/hour
d) DAF Plant Building – 2,565 m^3/hour
e) Effluent Reception Building – 840 m^3/hour

TOTAL – 10,591 m^3/hour – 2.94 m^3/s

For dispersion modelling purposes the emission rate for the proposed new scrubber has been calculated from an extraction rate rounded up to 3.0 m^3/s multiplied up by an expected treated air odour concentration of 2,500 ou_E/m^3. It has been assumed that the effluent plant facilities will be in use continuously.

Emission rates modelled are set out in Tables 2a and 2b below and the proposed future layout of the effluent plant and odour sources are shown in Figure A.

Table 2a Point Source Emission Rates from Stacks

Stack	Stack Height (m)	Diameter (m)	Emission Velocity (m/s)	Emission Temp. (°C)	Emissions Rate ou_E/s
Existing Scrubber (S1)	15	0.9	15	20	10,000
Additional Scrubber (S2)	15	0.9	15	20	10,000
WWTP Scrubber (S3 ETP)	15	0.50	15	10	7,500

[8] CIWEM Monographs on Best Practice No.2 "Odour Control"

Table 2b Tank and Area Source Emission Rates from Effluent Treatment Plant

Source	Height (m)	Length/ diameter (m)	Width (m)	Area (m^2)	Area Specific Emission Rate ($ou_E/m^2/s$)	Total Emission Rate (ou_E/s)
A. Balance Tanks	Covered and odour extracted by WWTP Scrubber discharge at Point C					
B. Diversion Tank	Covered and odour extracted by WWTP Scrubber discharge at Point C					
D. Existing Aeration Tank (D EAT)	5	18	-	254.5	10	2545
E. Existing Anoxic Tank (E EAT)	5	5	-	19.6	20	392
F. Existing Sediment Tank (F EST)	5	13	-	132.7	1	132.7
G. Proposed New Aeration Tank (G PNAT)	5	18	-	254.5	10	2545
H. Proposed New Anoxic Tank (H PNAT)	5	5	-	19.6	20	392
I. Proposed New Sediment Tank (I PNST)	5	13	-	132.7	1	132.7

Photo 1: The Existing Effluent Balance and Diversions Tanks and the Odour Scrubber and Stack

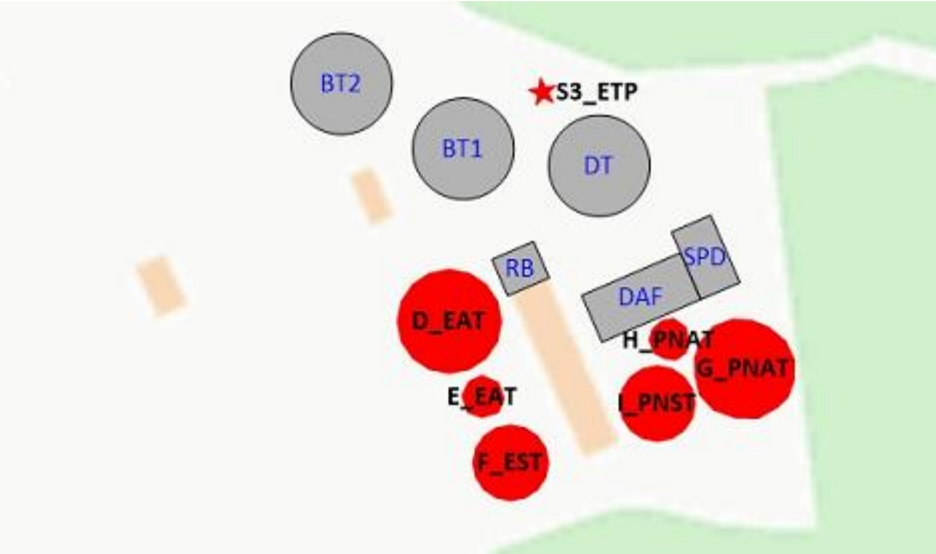

Figure A: WWTP Odour Sources

3.2 Dispersion Modelling

Dispersion modelling was undertaken using ADMS 5 (v5.2.4), which has been developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5.2 is a steady-state atmospheric dispersion model that is based on modern atmospheric physics. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

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

ADMS 5.2 has been chosen because it is "fitted for the purpose of the modelling procedure" as defined by the guidelines published by the Royal Meteorological Society[9,10]. The group that leads the development of ADMS 5.2 is CERC, but the UK Met Office and others have made significant contributions. The model has been extensively validated against site measurements. Details of these validation studies and information on the development of ADMS are available on the CERC website.

3.2.1 Modelling Scenarios

The scenarios considered in the modelling assessment are summarised in Table 3.

Table 3 Dispersion Modelling Scenarios

Scenario	Modelled As Short Term
Odour	98^{th}%-ile 1-hour mean-

3.2.2 Modelled Emissions

Model input parameters are summarised below in Table 4.

9 Guidelines issued by the Royal Meteorological Society. Meteorological Applications, 2: 83–88, Britter, R., Collier, C., Griffiths, R., Mason, P., Thomson, D., Timmis, R. and Underwood, B., 1995.

10 Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to the 1995 Royal Meteorological Society Guidance. Ireland, M.,Jones, J., Griffiths, R.,Nb, B. and Nelson, N., 2006.

Table 4 Stack Model Parameters

Parameter	Existing Scrubber (S1)	Proposed Scrubber (S2)	Effluent Plant Scrubber (S3 ETP)
Velocity (m/s)	15	15	15
Temperature (˚C)	20	20	10
Stack Terminal Diameter (m)	0.9	0.9	0.5
Stack Release Height (m)	15	15	15

3.2.3 Assessment Extents

A 1km x 1km grid has been used to produce the contour map presented in the results of this study and was defined at a resolution of 20 m. The grid points were defined at a height of 1.5 m above ground level. Figure 3 in Appendix I provides a graphical representation of the nested grid.

3.2.4 Sensitive Receptors

A sensitive receptor is defined as any location which may be affected by changes in air quality as a result of a development. These have been defined for odour impacts in the following Sections.

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

Table 5 Sensitive Receptor Locations

Receptor		National Grid Reference (Coordinates) (m)	
ID	Location	X	Y
R1	Residential Properties to west-south-west	338397.5	346727
R2	Residential Properties to west-south-west	338303.7	346663.5
R3	Residential Properties to west-south-west	338283.5	346643.3
R4	Residential Properties to west-south-west	338264.7	346624.5
R5	Industrial premise to south	338635.8	346396.4
R6	Residential and agricultural properties to north-east	338801.8	346962.4
R7	Whitegate Cottage	338643	347075
R8	Residential and agricultural property off A525	338214.2	346452.7
R9	Residential property off A525	338074.1	346496
R10	Residential property off A525	337955.7	346602.8
R11	Residential property off A525	337900.8	346644.7
R12	Residential property off A525	337827.2	346722.7
R13	School Farm	337962.9	347079.3
R14	Mayfield House	338084.2	347293
R15	Mangre Cottages	338153.5	347337.8

Figure 4 in Appendix 1 provides a graphical representation of the modelled receptor locations.

The sensitive receptors identified in Table 5 represent the most obvious potential receptor locations. However, this is not an exhaustive list and there may be other locations within the vicinity of the site that may experience odour impacts as a result of the development that have not been individually identified above. Impact at any other locations of interest can be assessed from the odour contours in Figure 5 in Appendix 1.

3.2.5 Terrain Data

Ordnance Survey Landform Panorama terrain data was not included in the main model for the site as the area around the site is very flat and does not contain any slope greater than 1:10.

3.2.6 Building Effects

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

Analysis of the site layout indicated that the plant structures should be included within the model in order to take account of effects on pollutant dispersion. As the buildings are not in a simple layout, they have been divided up into smaller rectangles using an average building height of 8m. Building input geometries are shown in Table 6.

Table 6 Building Geometries

Building		NGR (m)		Height (m)	Length/ Diameter (m)	Width (m)	Angle (˚)
Description	ID	X	Y				
Main Building	MB1	338561	346739	8	56.9	69.1	66.18
Main Building	MB2	338505	346724	8	58.8	87.1	65.92
Main Building	MB3	338552	346687	8	73.5	20.7	66.17
Main Building	MB4	338587	346759	8	8.2	22.1	65.52
DAF Building	DAF	338714	346683	5	19	9	246.6
Sludge Dewatering Building	SPD	338726	346690	6.2	13	7.5	246.5
Reception Building	RB	338693	346688	3	8	7	246.6
Existing Divert Tank	DT	338707	346706	8.4	17.9		
Existing Balance Tank	BT1	338683	346709	8.4	17.9		
New Balance Tank	BT2	338662	346721	8.4	17.9		

Figure 2 in Appendix 1 provides a graphical representation of the modelled building layout as used in the ADMS 5.2 model input.

3.2.7 Roughness Length

A roughness length (z_0) of 0.2 m was used in the dispersion modelling study. This value of z_0 is considered appropriate for the morphology of the assessment area and the meteorological station and is suggested within ADMS 5 as being suitable for 'agricultural areas (max)'.

3.2.8 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 the meteorological station and is suggested within ADMS 5 as being suitable for 'small towns < 50,000'.

3.2.9 Meteorological Data

Meteorological data used in this assessment was taken from Shawbury meteorological station, over the period 1st January 2017 to 31st December 2021(inclusive). Shawbury meteorological station is located at NGR: 355597, 322475 which is approximately 20 km to the south-east of the proposed development and is at a similar elevation to the proposed site.

All meteorological data used in the assessment was provided by the ADM Ltd. Figure 6 in Appendix 1 shows the wind rose for Shawbury meteorological data. It is important to note that the wind rose shows the direction from which the wind blows. The windrose shows that the prevailing wind direction is westerly, that is wind blowing from the west.

3.2.10 Modelling Uncertainty

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 5.2 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 5-years of annual meteorological data sets from the closest observation site to the facility to take account of local conditions;
- Plant operating conditions - Plant operating conditions were provided Maelor Poultry. As such, these are considered to be representative of operating conditions;
- Receptor locations - A Nested Grid was included in the model in order to calculate maximum predicted concentrations throughout the assessment extents. Receptor points were also included at sensitive locations to provide additional consideration of these areas; and,
- Variability - All model inputs are predicted as accurately as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential odour concentrations.

Results are considered in the context of the relevant odour benchmark level. It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.

Two alternative scenarios have been modelled and the results are presented in Appendix 1. Table 11 considers the effects of an alternative "main building" with the main processing building (MB1) used as the main building in relation to the odour release from the WWTP Scrubber rather than the existing Balance Tank (BT1).

Table 12 presents the model run using the "calms" module of ADMS. This involves enabling the "calms model" within ADMS. Within ADMS, wind speeds of less than 0.75 m/s are considered calms and ADMS skips the meteorological data for those hour runs if the wind speed is below 0.75 m/s unless the "calms module" is used.

3.2.11 Modelling Period

The EA, in the H4 guidance, recommends that a minimum of three years, and preferably five years, should be used to calculate the 98th percentile of the hourly mean odour concentrations, in order to represent conditions for an "average year". The Institute of Air Quality Management (IAQM) (2018) also recommends 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 used the mean 98th percentile of the hourly mean odour concentrations over a five year period to provide statistically robust results, smoothing out inter-annual variations.

3.2.12 Assessment of Significance

In accordance with the IAQM (2018) guidance on the assessment of odour, the significance of the odour impact has been 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 7.

It is important to note however that there is 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 7. 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 7 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

3.3 Assessment Criteria

In order to provide a robust assessment, predicted ground level odour concentrations have been compared with an odour benchmark range of 3.0 to 5.0 ou_E/m^3 as a 98th%-ile of 1-hour mean as a guideline to assess the point above which some loss of residential amenity may start to occur.

4 Results

4.1 Odour Impacts

Dispersion modelling of odour emissions was undertaken with the inputs described in Section 3 over the five-year weather file so that the results represent "average year" data as set out in the H4 guidance.

Figures 5 in the Appendix shows a graphical representation of predicted odour concentrations as contours in the area around the site based.

Five-year average mean 98th%-ile 1-hour mean odour concentrations based on processing line scrubber emissions through 15m stacks and the effluent treatment plant (with 15m scrubber stack) individually and in combination at modelled discrete receptor locations are summarised in Table 8.

In addition to the long-term average data, Table 10 in Appendix 1 also details individual year average mean 98th%-ile 1-hour odour concentrations.

Tables 11 and 12 in Appendix 1 provide the results of sensitivity testing for the alternative main building scenario and for the model with the ADMS calms module in use respectively.

Table 8 Predicted Odour Concentrations

Receptor		Predicted Five year Average Mean 98th%-ile 1-hour mean Odour Concentrations (ou_E/m^3)		
		All Sources	Processing Scrubbers	WWTP Stack & Tanks
R1	Residential Properties to west-south-west	1.11	0.61	0.92
R2	Residential Properties to west-south-west	0.82	0.37	0.66
R3	Residential Properties to west-south-west	0.77	0.32	0.60
R4	Residential Properties to west-south-west	0.73	0.29	0.58
R5	Industrial premise to south	0.75	0.32	0.59
R6	Residential and agricultural properties to north-east	0.93	0.55	0.89
R7	Whitegate Cottage	0.75	0.47	0.55
R8	Residential and agricultural property off A525	0.45	0.12	0.32
R9	Residential property off A525	0.42	0.13	0.29
R10	Residential property off A525	0.41	0.15	0.26
R11	Residential property off A525	0.38	0.14	0.23
R12	Residential property off A525	0.32	0.13	0.19
R13	School Farm	0.33	0.13	0.17
R14	Mayfield House	0.32	0.14	0.15
R15	Mangre Cottages	0.33	0.15	0.16

The results set out in Table 8 show that predicted odour impacts, assuming 15m stacks discharging air from three chemical scrubbers, at all receptors are all well below the odour impact benchmark range of 3.0 ou_E/m^3 to 5.0 ou_E/m^3 and are also all below a more precautionary 1.5 ou_E/m^3 benchmark.

Figure 5 in Appendix 1 provides a graphical representation of 5-year average mean predicted odour concentrations throughout the assessment area. This map shows the highest odour impacts in close proximity to the odour sources, with concentrations reducing over short distances from the plant.

The results set out in Table 11 and Table 12i show that results for sensitivity testing for the alternative main building scenario and for the model with the ADMS calms module in use are all well below the impact benchmark range of 3.0 to 5.0 ou_E/m^3 and are also below a more precautionary 1.5 ou_E/m^3 benchmark.

4.2 Assessment of Significance

An assessment of the significance of odour impacts from the proposed development scenario at each receptor are assessed below in Table 9 using the IAQM criterion. As a precautionary measure a sensitivity rating of 'high' has been applied to all receptors considered in the modelling.

Table 9 Significance of Modelled Odour Emissions at Surrounding Receptors

Receptor		Predicted 98th%-ile 1-hour mean Odour Concentrations (ou_E/m^3)	Significance
R1	Residential Properties to west-south-west	1.11	Negligible
R2	Residential Properties to west-south-west	0.82	Negligible
R3	Residential Properties to west-south-west	0.77	Negligible
R4	Residential Properties to west-south-west	0.73	Negligible
R5	Industrial premise to south	0.75	Negligible
R6	Residential and agricultural properties to north-east	0.93	Negligible
R7	Whitegate Cottage	0.75	Negligible
R8	Residential and agricultural property off A525	0.45	Negligible
R9	Residential property off A525	0.42	Negligible
R10	Residential property off A525	0.41	Negligible
R11	Residential property off A525	0.38	Negligible
R12	Residential property off A525	0.32	Negligible
R13	School Farm	0.33	Negligible
R14	Mayfield House	0.32	Negligible
R15	Mangre Cottages	0.33	Negligible

At all discrete receptor points included in the assessment, the significance of the predicted odour impact are assessed to be 'negligible'. It is therefore very unlikely that there would be any loss of local residential amenity as a result of the proposed addition of a second slaughter and processing line at the poultry processing facility.

Based on the assessment results, it is not anticipated that there is a significant risk of adverse odour impacts occurring at any sensitive location as a result of emissions from the proposed development. As such, the potential for adverse odour impacts at sensitive receptor locations is considered to be low.

5 Conclusions

RSK ADAS has been instructed by Mr Mulkh Mehta of Maelor Foods Ltd to carry out an odour impact assessment to evaluate the off-site odour impact of a proposed increases in throughput at the Company's poultry processing facility at Pickhill Lane, Wrexham, LL13 0UE. Planning permission was granted for change of use of the Maelor Creamery site to a poultry processing facility on 2nd March 2015 and the facility has since then become established. The Operators are now seeking to increase the processing capacity of the plant by installing a second processing line, as well as upgrading and improving the effluent treatment plant to cope with the increased arisings of effluent.

Process conditions of the proposed facility were used to quantify potential odour impacts at sensitive receptor locations around the proposed plant using dispersion modelling. The results were subsequently compared with appropriate odour benchmark levels to determine the potential for adverse effects in the vicinity of the site.

The results of dispersion modelling show that predicted odour impacts at all receptors are all well below the suggested impact benchmark range of 3.0 to 5.0 ou_E/m^3 and modelled impacts are also all below a more precautionary 1.5 ou_E/m^3 benchmark assuming 15m stacks discharging air from two chemical scrubbers serving the processing plant and a 15m scrubber stack serving the upgraded wastewater treatment plant chemical scrubber.

The significance of the predicted odour impact is therefore assessed to be '**negligible**' at all receptor locations using the IAQM assessment criterion.

Based on the assessment results, it is not anticipated that there is a significant risk of adverse odour impacts occurring at any sensitive location as a result of emissions from the proposed development. As such, the potential for adverse odour impacts at sensitive receptor locations is considered to be low

Appendix I Figures and Tables

Figure 1. Location Plan

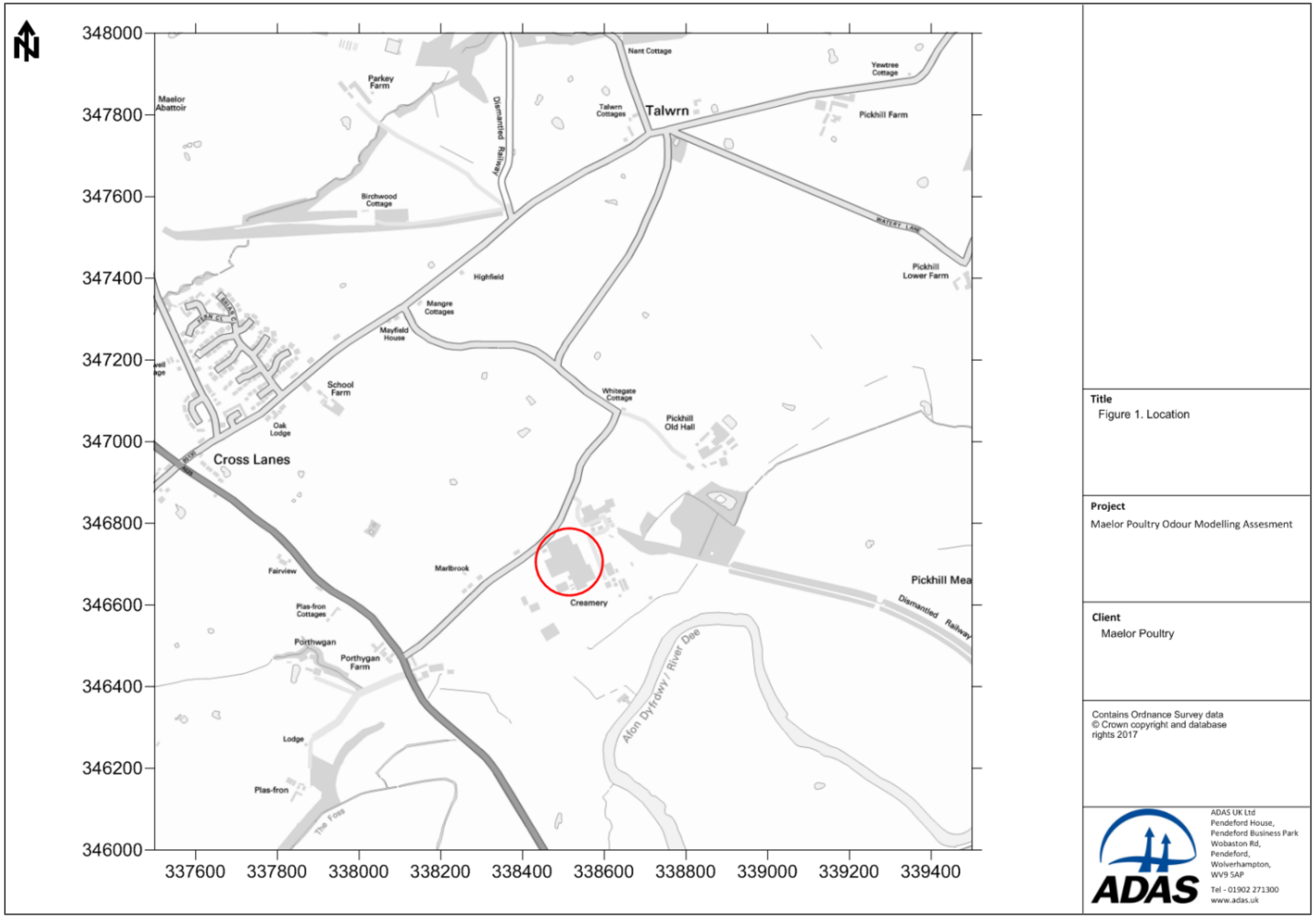

Figure 2. Modelled Sources

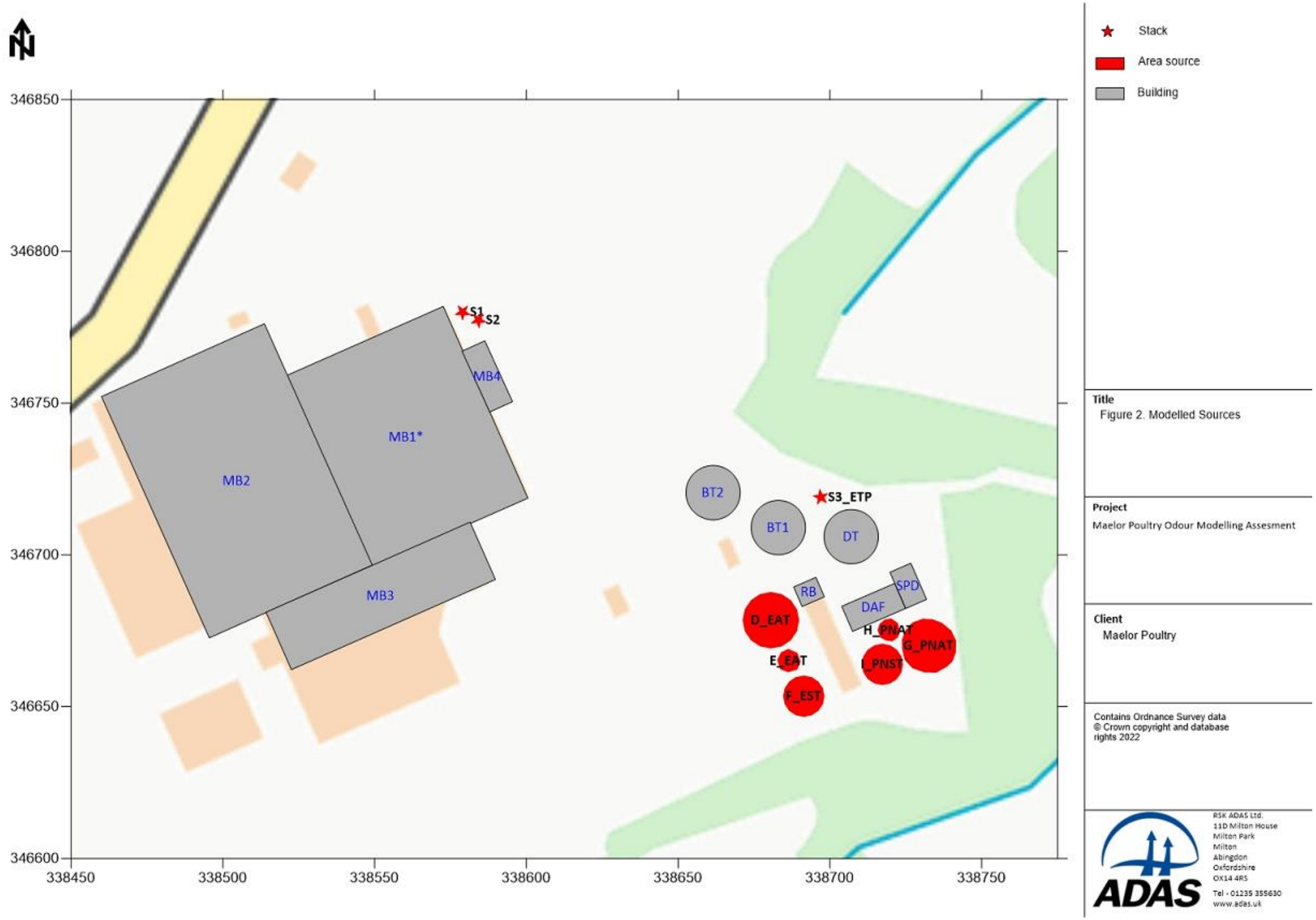

Figure 3. Nested Grid

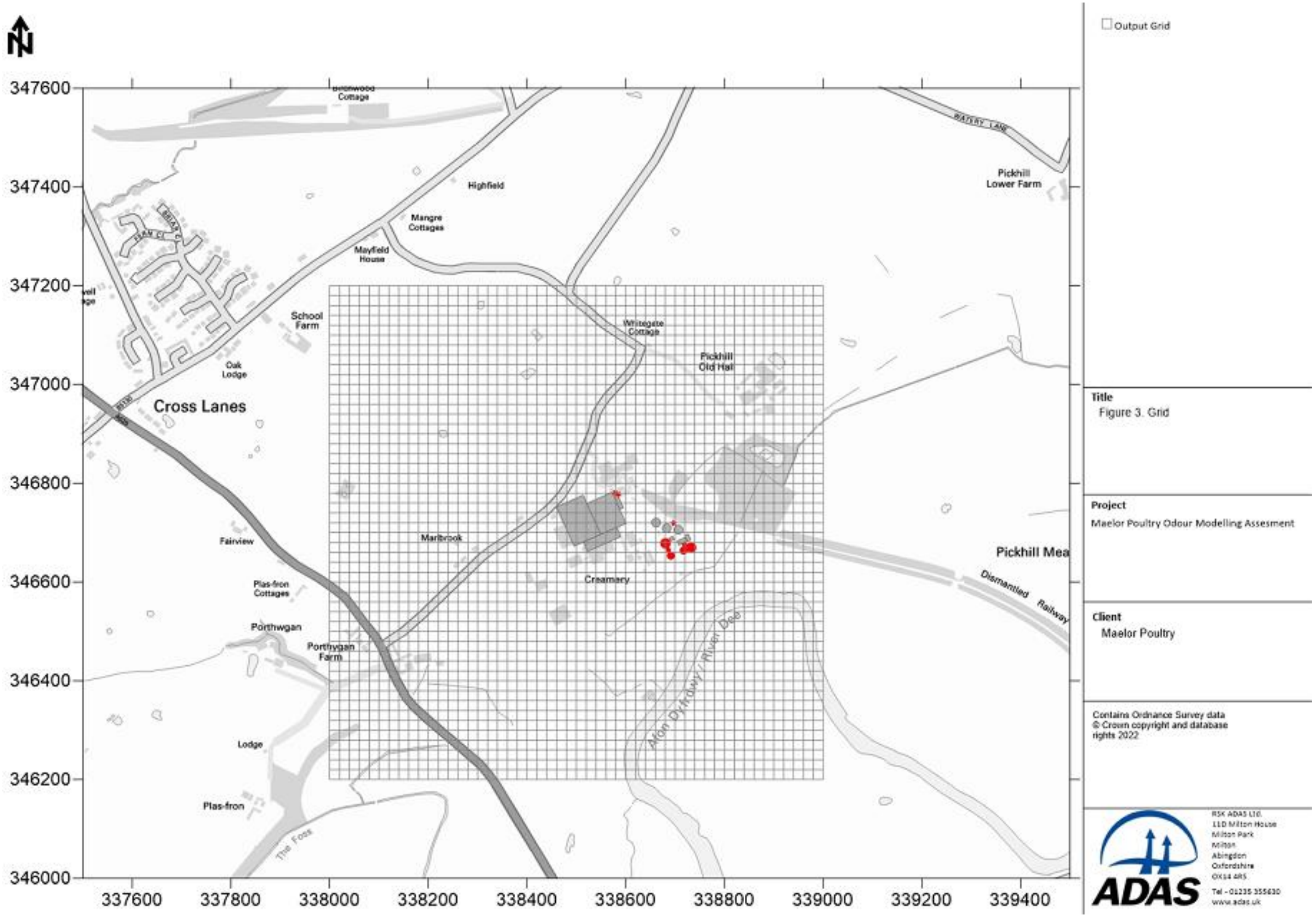

Figure 4. Identified Sensitive Receptors

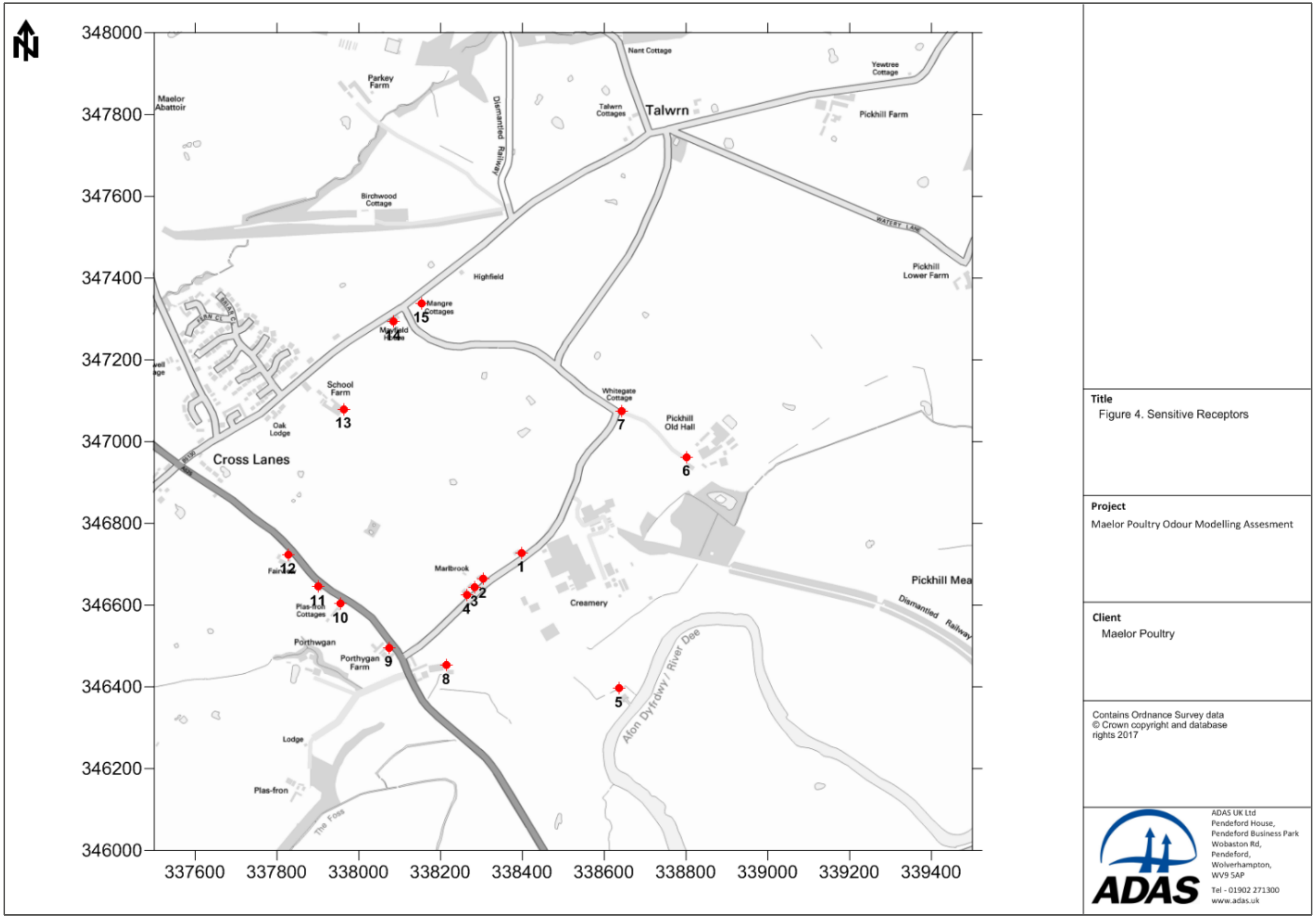

Figure 5. Five Year Average Mean 98th%-ile 1-hour Mean Odour Concentrations

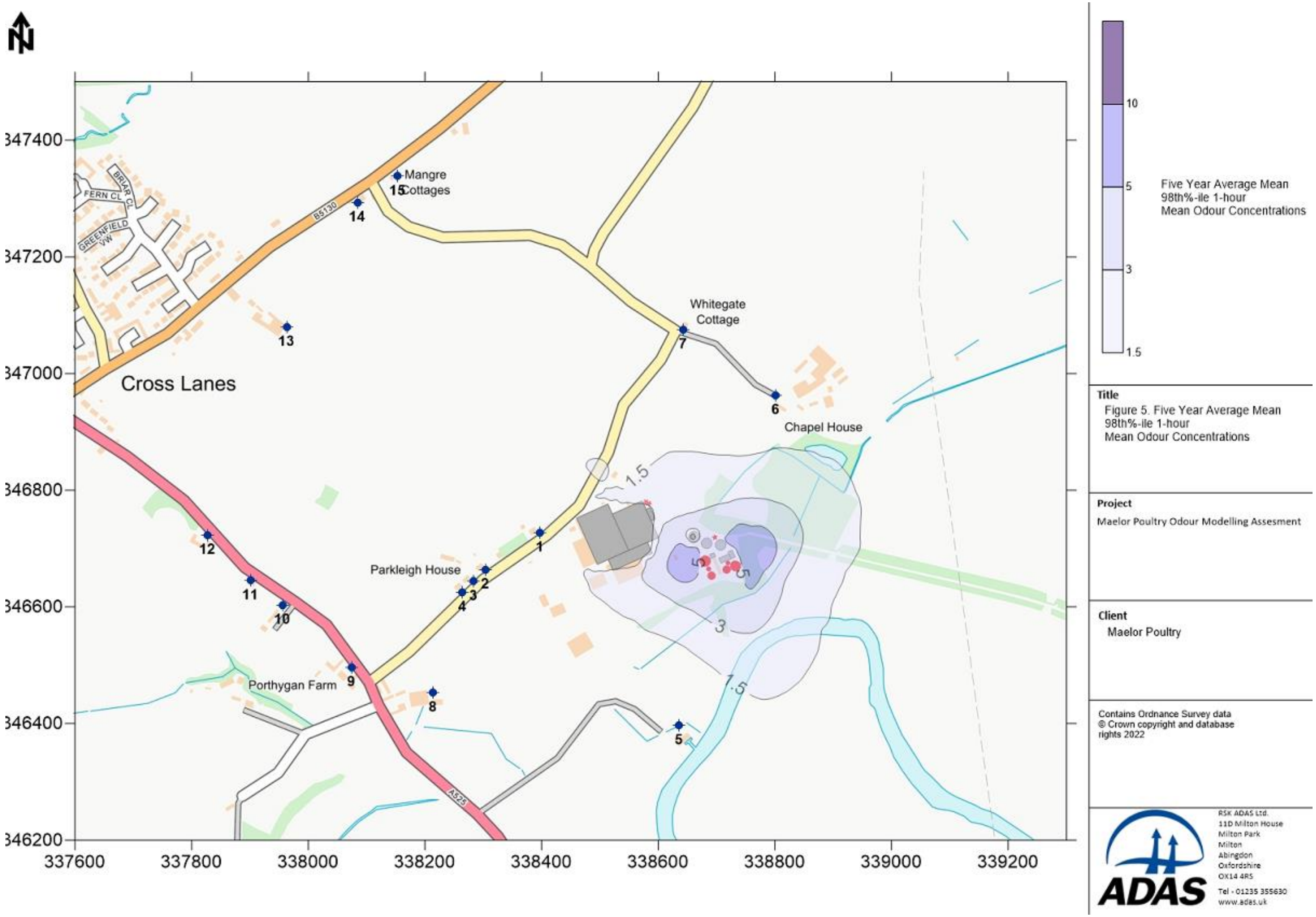

Figure 6. Windrose for Shawbury 2017-2021

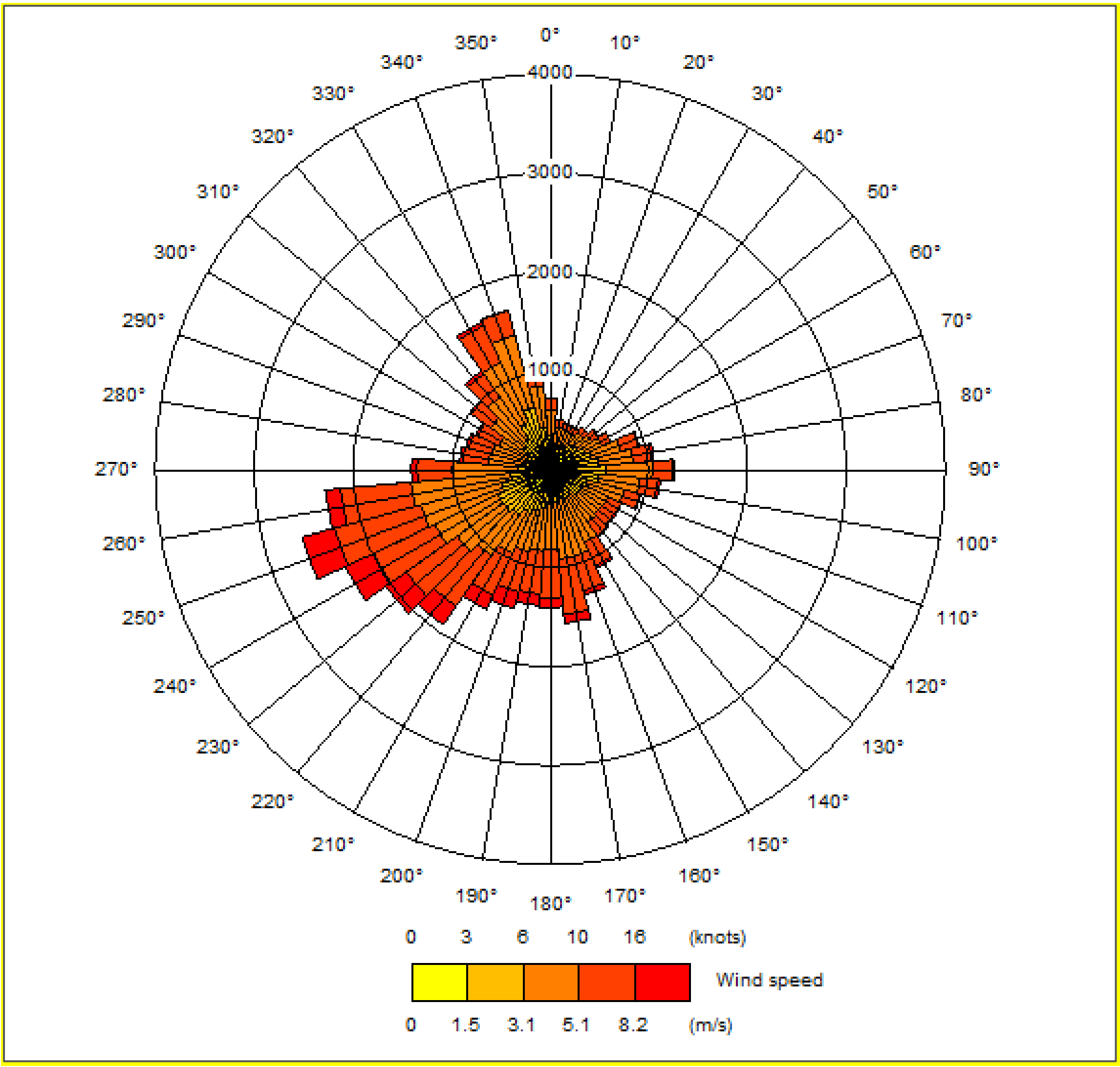

Table 10. Individual Year Predicted Odour Concentrations (All Sources)

Receptor		Predicted 5 year Average Mean 98th%-ile 1-hour Odour Concentrations (ou_E/m^3)				
		2017	2018	2019	2020	2021
R1	Residential Properties to west-south-west	0.98	1.16	1.16	1.13	1.12
R2	Residential Properties to west-south-west	0.70	0.81	0.89	0.88	0.82
R3	Residential Properties to west-south-west	0.65	0.75	0.84	0.83	0.77
R4	Residential Properties to west-south-west	0.60	0.72	0.80	0.79	0.72
R5	Industrial premise to south	0.62	0.82	0.69	0.78	0.84
R6	Residential & agricultural properties to north-east	1.01	0.91	0.91	0.87	0.94
R7	Whitegate Cottage	0.78	0.74	0.74	0.73	0.76
R8	Residential and agricultural property off A525	0.29	0.43	0.49	0.49	0.55
R9	Residential property off A525	0.26	0.43	0.48	0.46	0.45
R10	Residential property off A525	0.30	0.39	0.49	0.46	0.41
R11	Residential property off A525	0.28	0.37	0.45	0.43	0.36
R12	Residential property off A525	0.25	0.33	0.37	0.35	0.32
R13	School Farm	0.34	0.34	0.35	0.32	0.30
R14	Mayfield House	0.35	0.31	0.32	0.29	0.32
R15	Mangre Cottages	0.36	0.31	0.35	0.30	0.32

Table 11. Sensitivity Analysis for Alternative Main Building: Predicted 98th Percentile Odour Concentrations (All Sources)

Receptor		Predicted 5 year Average Mean 98th%-ile 1-hour Odour Concentrations (ou_E/m^3)				
		2017	2018	2019	2020	2021
R1	Residential Properties to west-south-west	0.99	1.16	1.16	1.14	1.12
R2	Residential Properties to west-south-west	0.71	0.82	0.82	0.89	0.82
R3	Residential Properties to west-south-west	0.66	0.76	0.76	0.83	0.77
R4	Residential Properties to west-south-west	0.60	0.72	0.72	0.78	0.73
R5	Industrial premise to south	0.62	0.82	0.82	0.78	0.84
R6	Residential & agricultural properties to north-east	1.01	0.91	0.91	0.87	0.94
R7	Whitegate Cottage	0.78	0.74	0.74	0.73	0.76
R8	Residential and agricultural property off A525	0.29	0.43	0.43	0.49	0.55
R9	Residential property off A525	0.25	0.43	0.43	0.46	0.45
R10	Residential property off A525	0.30	0.39	0.39	0.46	0.41
R11	Residential property off A525	0.28	0.38	0.38	0.43	0.36
R12	Residential property off A525	0.25	0.33	0.33	0.35	0.32
R13	School Farm	0.34	0.34	0.34	0.32	0.30
R14	Mayfield House	0.35	0.31	0.31	0.29	0.32
R15	Mangre Cottages	0.36	0.31	0.31	0.30	0.32

Table 12. Sensitivity Analysis with Calms Module in Use: Predicted 98th Percentile Odour Concentrations (All Sources)

Receptor		Predicted 5 year Average Mean 98th%-ile 1-hour Odour Concentrations (ou_E/m^3)				
		2017	2018	2019	2020	2021
R1	Residential Properties to west-south-west	0.95	1.14	1.16	1.11	1.08
R2	Residential Properties to west-south-west	0.68	0.80	0.86	0.87	0.81
R3	Residential Properties to west-south-west	0.63	0.74	0.82	0.80	0.76
R4	Residential Properties to west-south-west	0.58	0.71	0.77	0.75	0.71
R5	Industrial premise to south	0.68	0.92	0.86	1.00	1.00
R6	Residential & agricultural properties to north-east	0.98	0.90	0.90	0.90	0.90
R7	Whitegate Cottage	0.77	0.73	0.72	0.72	0.75
R8	Residential and agricultural property off A525	0.36	0.42	0.46	0.47	0.53
R9	Residential property off A525	0.28	0.41	0.47	0.43	0.43
R10	Residential property off A525	0.27	0.38	0.47	0.45	0.39
R11	Residential property off A525	0.26	0.35	0.42	0.40	0.35
R12	Residential property off A525	0.24	0.32	0.35	0.33	0.31
R13	School Farm	0.33	0.33	0.34	0.31	0.28
R14	Mayfield House	0.34	0.29	0.31	0.28	0.31
R15	Mangre Cottages	0.35	0.30	0.34	0.29	0.30

Appendix 2: Additional Odour Sampling & Analysis 2022

Odour Sampling

Main processing plant chemical scrubber 19 January 2022

Triplicate odour samples have been collected concurrently from both the scrubber inlet duct and outlet duct. The inlet samples were taken after a bend immediately upstream of the scrubber with samples extracted through a new and inert PET sample tube using the lung method with a "barrel" and 12v pump. Outlet (treated air) samples off the scrubber outlet were collected after the fan at the base of the stack so that mixed samples were obtained. These samples enabled odour concentrations in the untreated inlet air and the treated outlet air to be measured so that scrubber abatement performance could be assessed and emissions rates calculated.

Airflow measurements were also made on a straight section of scrubber outlet ducting using a pitot tube and micro-manometer so that emissions could be quantified for assessment of plant performance and modelling purposes.

This plant had already been tested on a number of occasions in the past.

Odour in Airflows Treated by the Scrubber 16 March 2022

Additional samples were collected on the inlet duct o the scrubber to assess the odour concentrations in the different components of airflows treated by the existing scrubber and airflow were measured to inform the specification of any additional scrubbing plant to serve the Phase 2 extension in processing.

Odour Sample Analysis

The odour sample bags were transported to the UKAS accredited Silsoe Odours odour analysis laboratory and analysed within 30 hours of collection in accordance with the British/European Standard BS EN 13725.

Odour Analysis (sample bag in foreground)

Odour concentrations are determined by presenting the samples to a panel of six human "sniffers" who sniff the diluted sample at a range of dilution rates, starting at a high dilution ratio so that the panellists don't initially detect the odour and then sequentially decreasing the dilution rations increasing until the odours are just detected. The presentations are carried out through a pair of sniffing horns, as shown in Figure 4, with the diluted sample randomly switched between the two sniffing horns for each different dilution presentation. The panellists select which sniffing horn they think is presenting the sample at each dilution rate and they also provide a response about the certainty of their decision, choosing from a "guess", an "inkling" or a "certain" choice. The objective is to determine the number of dilutions of a sample which is required to just make the sample detectable to 50% of the panel of sniffers and this number (or dilutions) equates to an odour concentration in European odour units per cubic metre of air (ou_E/m^3).

Results

The results are summarised the table below. Table S2.1 present the 2022 results and a comparison with previous performance testing data from 2018 and 2019. Table A2.2 presents a summary of the odour concentrations and flow data for the flows treated by the existing scrubber.

Table A2.1 Primary Processing Area Scrubber Odour Analysis Results for 19 January 2022

	March 2022	January 2022	2019	2018
Geometric mean untreated/inlet air odour concentrations ou_E/m^3	4,902	3,820	3,457	1,364
Geometric mean treated/outlet air odour concentrations ou_E/m^3		764	1,202	536
Percentage reduction in odours %		79.99%	65.2%	60.7
Airflow through or to scrubber m^3/s	9.94 (35,784m^3/hr)	9.83 (35,388 m^3/hr)	8.75 (32,500 m^3/hr)	9.612 (34,600 m^3/hr)
Treated air emissions ou_E/s		7520	10,522	5,157

Table A2.2 Primary Processing Area Scrubber Inlet Odour Analysis Results for 16 March 2022

	Composite flow to scrubber	Aeroscalder Extraction	Offal Extract No. 1	Offal Extract No. 2	Vacuum Pump Outlet
Airflow to Scrubber m^3/s	9.94	6.10	2.94	1.22	0.08
Approximate percentage of total flow to scrubber (%)	100%	63%	29%	12%	1%
Untreated air odour concentrations ou_E/m^3	4,902	5,866	1,911	2,368	10,831
Untreated air emissions (ou_E/s)	48,708	36,847	5,446	2,786	1,011
Approximate percentage of odour load to scrubber (%)		75.6	11.2	5.7	2

Comments on 2022 Results

a) The Aeroscalder, which is to be duplicated as part of Phase 2 is the single most important source of odour emissions in terms of odour concentrations and the airflow rate, but is it remains much less odorous than in conventional scald tanks systems at other plants where extracted odour concentrations can be as high as 20,000 to 60,000 ou_E/m^3. The measured airflow is around 60% of the total airflow to the scrubber. The untreated air odour concentration in air off the Aeroscalder of 5,866 ou_E/m^3 is too high to simply disperse through a stack (without treatment) unless a much higher stack is installed (probably around 25 – 30m). It was concluded that the consequence is that an additional scrubber will be required to abate emissions from the proposed second Aeroscalder line.

b) Odour concentrations in the offal bay extraction airflow were low, and comparable with those measured in offal buildings elsewhere at other poultry processing plants with good hygiene and frequent offal/feathers removal. Odour concentrations and emission rates may be higher in warmer weather conditions, but these emissions are in any case abated by the existing scrubber

c) The outlet odour concentrations in vacuum transfer pump exhaust flows was relatively high at 10,831 ou_E/m^3, although the flows are very small, so that the magnitude of emissions is consequently small. All vacuum pump outlet airflows associated with the Phase 2 development should be ducted to scrubber abatement by either the existing scrubber or by the proposed new scrubber.

Previous Odour Emission Rate Measurements – Wastewater Treatment Plant

The results of odour sampling and emission rate measurements made in 2018 are included in the following table, along with the precautionary emission rates modelled in this report, and previously.

Table A2.3 Area Source Emission Rates from Effluent Treatment Plant

	Modelled in 2017				Measured (May 2018)	
Source	Diameter (m)	Area (m^2)	Area Specific Emission Rate ($ou_E/m^2/s$)	Tank Emission Rate (ou_E/s)	Area Specific Emission Rate ($ou_E/m^2/s$)	Tank Emission Rate (ou_E/s)
Sediment Tank 1	13	132.7	1	133	0.25	33
Aeration Tank	18	254.5	10	2,545	0.54	137
Anoxic Tank	5	19.6	20	392	49	960

Aeration Tank and Final Settlement Tank - The measured emission rates for the final settlement tank and the aeration tank were substantially lower than the rates modelled using “library” data. The emission rates represent 25% and 5% of the modelled emission rates for the final settlement and aeration tanks respectively. These findings of very low emissions for these sources are entirely consistent with ADAS experience of effective effluent treatment plants elsewhere in the rendering and slaughterhouse sectors, and demonstrates that these facilities have negligible potential to cause off-site odour impacts.

Anoxic Tank - the specific emission rate of 49 $ou_E/m^2/s$ measured in 2018 was appreciably higher than the modelled emission rate of 20 $ou_E/m^2/s$, but the surface area of this tank is relatively small, so that the anoxic tank is unlikely to make a material contribution to off-site odours with this emission rate. The relative unimportance of this tank can be illustrated by multiplying this emission rate up by the surface area of the tank, resulting in a tank emission rate of 960 ou_E/s, which is only around 13% of the previously modelled emissions from the aeration and balance tanks.