# An Assessment of the Odour Impact of the Revised Plans for the Redevelopment of the Broiler Chicken Rearing Unit at Sutton Veny Farm, Warminster, Wiltshire

21st March 2014


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**Table of Contents** **Page**

**1. Introduction** ..... **3**

**2. Background** ..... **3**

2.1 The proposed poultry unit - revised plans ..... 3

2.2 Geography ..... 3

**3. Odour emissions and guidelines** ..... **5**

3.1 Proposed poultry unit - revised plans ..... 5

3.2 Peak odour emissions and mitigation measures ..... 5

3.3 Estimation of odour emission rates ..... 6

3.4 Assessment of the impact of odour ..... 6

3.5 Dispersion of odour ..... 6

3.6 Guideline values and benchmarks ..... 7

The Newbiggin Standard ..... 7

UKWIR Research ..... 8

H4 Odour Guidance ..... 8

Suggested Odour Benchmarks ..... 9

Modelling Period ..... 9

**4. Dispersion modelling methodology** ..... **10**

4.1 Model description ..... 10

4.2 Meteorology ..... 10

4.3 Model parameters ..... 13

4.3.1 Odour emissions ..... 13

4.3.2 Buildings ..... 14

4.3.3 Discrete receptors ..... 14

4.3.4 The nested Cartesian grid ..... 15

4.3.5 Terrain and roughness length ..... 15

**5. Modelling results** ..... **16**

**6. Summary and conclusions** ..... **18**

**7. References** ..... **19**

**APPENDIX 1** ..... **20**

Clearing Spent Floor Litter - Odour Mitigation Options ..... 20

# 1. Introduction

The Met Office Rural Environment Team at ADAS has been commissioned by Mr James Whilding, of ACORUS Rural Property Services Ltd., to conduct a dispersion and deposition modelling study to assess the impact of odour emissions from the revised plans for the proposed redevelopment of the broiler chicken rearing unit at Sutton Veny Farm, Warminster in Wiltshire.

Odour emissions have been assessed and quantified using an emissions 'blueprint' developed by ADAS, the Met Office and the Silsoe Research Institute. The emission figures obtained were then used in atmospheric dispersion modelling to assess the likely impact of odour in the area around the farm.

The results of the modelling of the redevelopment of the poultry unit, in the report dated 12th February 2013, found potential for unacceptable odour pollution in the area around the farm. Therefore the plans have been revised in order to reduce the impact. These revisions include changes to the layout and ventilation of the redeveloped poultry unit. In addition, more discrete receptors have been added to represent an area of allotments near to the poultry unit, to the west. This report presents the modelled odour concentrations from these revised plans.

# 2. Background

A map of the surrounding area is presented in Figure 1. The site of the poultry unit at Sutton Veny Farm is outlined in red.

## 2.1 The proposed poultry unit - revised plans

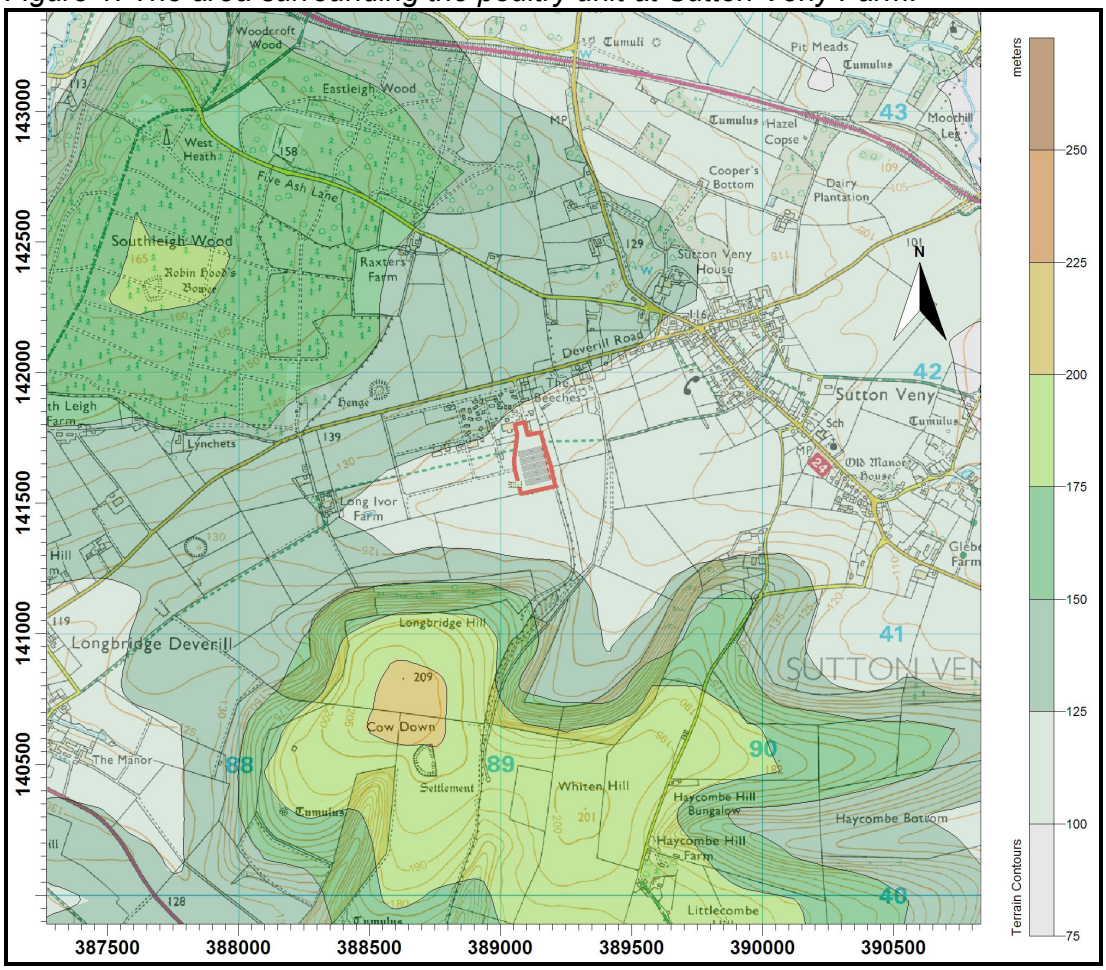
There are four existing poultry houses at Sutton Veny Farm. These are several years old, nearing the end of their life span and are currently disused. Under the proposal the poultry unit, when redeveloped, would provide accommodation for 179,120 broiler chickens in four new, state of the art, houses. These houses would be ventilated by high speed fans mounted on a ventilation tower. The houses would also be fitted with gable end fans to provide additional ventilation in hot weather.

## 2.2 Geography

Sutton Veny Farm is in a rural area, approximately 3 km to the south of the town of Warminster, in Wiltshire. The village of Sutton Veny lies 800 m to the east. There are also other scattered farmhouses and residences in the area and some commercial/light industrial premises immediately to the north-west of the site.

The farm is at an elevation of around 120 m, situated in a valley with wooded hills to the north, rising to 160 m, and steep escarpments within a few hundred meters to the south, which reach to over 200 m.

*Figure 1. The area surrounding the poultry unit at Sutton Veny Farm.*

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# 3. Odour emissions and guidelines

Odour emission rates from poultry houses depend upon the odour concentration within the building and the ventilation rate to the outside atmosphere. Internal odour concentrations depend upon many factors including the number of birds housed, building design and management, methods of provision of drinking water, age of the birds and manure management techniques. The minimisation of odour production is addressed by Defra in Section 4 of its Code of Good Agricultural Practice (Defra, 2009) in which paragraphs 229 and 319-328 are especially relevant.

## 3.1 Proposed poultry unit - revised plans

Under the proposal the four existing houses would be demolished and replaced with four new, “state of the art”, poultry houses, The capacity of the poultry unit would increase to 179,120 broiler chickens. The new poultry houses would all be ventilated by uncapped high speed fans mounted on a ventilation tower, which would be the primary source of odour emissions. Gable end fans would be used to provide additional ventilation in hot weather.

Modern, well-insulated poultry houses such as those proposed will help to minimise odour production at source through good temperature control and manure management. Drinking water would be supplied through low spillage nipple drinkers which have been shown to maintain low poultry litter moisture levels and, as a consequence, reduce odour emission rates. Outside the poultry houses, no spent litter would be stored on the site, thus other odour sources are expected to be insignificant.

## 3.2 Peak odour emissions and mitigation measures

Odour emissions can increase during the period when the poultry buildings are being cleared of manure, unless good management practices are deployed. Under the proposal at Sutton Veny Farm, the poultry houses will be cleared of manure once at the completion of each flock cycle (every 35 days). The time taken to complete the task would normally be less than 4 hours per house; therefore any elevated odour emissions are transitory and relatively infrequent. No manure would be stored on site.

Little factual information exists on the magnitude of odour emission rates during clearing out, and because of the short term duration of these activities it is not feasible to model them and relate the results to accepted odour impact standards.

Emission rates during clearing out are dependent upon both the management of manure throughout the rearing cycle such that the manure has low odour potential when it is cleared out and careful management of the clearing out operation. Typical controls include restricting clearing out to one shed at a time, and using sufficient ridge fan extract ventilation on that shed to draw air in through the open doorway so that emissions are dispersed to atmosphere at high level, rather than escaping at low levels through the doorway. Minimal rates of ventilation should be used in other buildings.

Odour emissions can be mitigated and minimised during clearing out by managing the process according to guidance in the Code of Good Agricultural Practice (Defra, 2009) and by adoption of an appropriate Odour Management Plan (OMP). A list of best management practices is included at Appendix 1 of this report, based on the Code of Good Agricultural Practice and additional comment from specialists.

## 3.3 Estimation of odour emission rates

Based upon many years of research and measurement, ADAS, in conjunction with the Silsoe Research Institute and the Met Office, has developed an emission 'blueprint' which covers odour emissions from a wide range of agricultural sources, including poultry farms. Odour emissions vary seasonally, diurnally and throughout the growing cycle and are also affected by litter type, feeding and drinking systems. All of these factors have been taken into account in the calculation of emission estimates.

The proposed unit will operate a 42 day rearing cycle, with approximately 25% thinning of the flock at around day 33. For this regime, the average summer odour emission rate is estimated to be 0.5781 European odour units per bird place per second ($ou_E$/bird/s).

For the proposed houses, with a total of 179,120 broiler chickens, the average summer odour emissions are calculated to be 103,550 $ou_E$/s.

## 3.4 Assessment of the impact of odour

It is important when assessing the potential impact of odours on a local community to study both the concentration of odours and their frequency of occurrence. This approach forms part of the most recent guidance from the Environment Agency. In adopting the FIDOR (Frequency, Intensity, Duration, Offensiveness and Receptor) protocol, the EA is advocating an objective methodology for the assessment of odour nuisance. The probability of complaints from odour sources depends on:-

- **Frequency of exposure**: Complaints are more likely if the frequency of exposure increases.
- **Intensity of the odour**: There is a greater probability of complaint when the odour concentration exceeds a threshold or guideline.
- **Duration of odour events**: Short or fleeting odour events are less likely to cause a nuisance than is a prolonged exposure.
- **Offensiveness of the odour**: More offensive odours have a higher risk of causing complaint.
- **Receptor sensitivity:** In particular, the sensitivity of an individual as influenced by their context. As an example, people who live or work in suburban areas (large villages or towns) may be relatively intolerant of "countryside" odours.

## 3.5 Dispersion of odour

A plume of odour naturally disperses through the turbulent motion of the atmosphere as it moves downwind from the point of release. Due to this turbulent mixing process, odour concentrations downwind from a source will

not be uniform. Characteristically, in any given hour, there are short duration peaks in concentration that last for a few seconds, separated by longer periods, when the concentrations are low or zero. Consequently, it is necessary to predict the frequency of particular odour concentrations at various points around an odour source.

Once released to the atmosphere, the direction of spread of odours is totally dependent upon the direction of the wind. The rate of dispersion depends mainly on the wind speed, but other meteorological parameters such as air temperature also influence dispersion rates. The stability of the atmosphere also plays an important role in atmospheric dispersion.

There are also non-meteorological factors which influence downwind odour concentrations.

- **Distance from odour source:** The closer a receptor is to an odour source; the higher the likely odour concentration at that location and the greater the probability of odour impact or detection.
- **The height of release:** Generally, the higher the point of release; the lower the odour concentration in the vicinity of the odour source.
- **Emission characteristics:** Stronger odour sources tend to affect a larger area than weaker sources.
- **Building downwash:** Pollutant emissions may be subject to highly turbulent wind flows in the wake of buildings.

## 3.6 Guideline values and benchmarks

Minimising waste and pollution is a key component of the National Planning Policy Framework. 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 2010 (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 98$^{th}$ percentile hourly means, and these standards have been based on “dose-response” relationships which take account of normal temporal and meteorological variations in downwind/off-site odour impacts.

### The Newbiggin Standard

This empirical standard, of 5.0 $ou_E/m^3$ at the 98$^{th}$ percentile, has been widely used in the intensive livestock and wastewater (sewage) sectors 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.

## 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 are concisely summarised in a recent Chartered Institute of Water and Environmental Management document:

> *"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 percentile hourly mean odour impacts of 5 $ou_E/m^3$ or less. These findings are consistent with the Newbiggin standard and ADAS experience of correlating odour impacts/complaints (and the absence of complaints) with dispersion modelling results.

## H4 Odour Guidance

The Environment Agency (EA) published draft guidelines on odour regulation, assessment and control (IPPC H4: Horizontal Odour Guidance Parts 1 & 2) in 2002. The 2002 documents have now been withdrawn and various updated versions, for consultation purposes, have been produced in the interim period. The final version (H4: Odour management) was published in March 2011.

Odour detection thresholds and consideration of whether or not an odour is offensive are discussed in Appendix 2 of the updated H4. In Appendix 3 (of H4), modelled odour concentration benchmark levels are presented for odours of varying degrees of offensiveness. Expressed as a $98^{th}$ percentile of the hourly mean odour concentrations over a one year period, a threshold value of 6.0 European Odour Units per cubic metre of air ($ou_E/m^3$) is suggested in H4 as being appropriate for the least offensive odours. This

means that a situation should be acceptable, provided that the value of 6.0 $ou_E/m^3$ is not exceeded on more than 2% of occasions. For moderately offensive and highly offensive odours, the equivalent threshold values are 3.0 $ou_E/m^3$ and 1.5 $ou_E/m^3$ respectively.

Odours from livestock housing are normally placed in the moderately offensive category and the target suggested in H4 for moderately offensive odours is an hourly mean odour concentration of 3.0 $ou_E/m^3$ at the $98^{th}$ percentile.

## Suggested Odour Benchmarks

ADAS has generally found that a range of odours, including those from livestock housing, are unlikely to cause unacceptable off-site impacts with annual $98^{th}$ percentile odour concentrations of less than 5.0 $ou_E/m^3$. However, as exposure exceeds 5.0 $ou_E/m^3$ at the annual $98^{th}$ percentile, there is an increasing risk of annoyance, and above 10.0 $ou_E/m^3$ (at the annual $98^{th}$ percentile), some adverse impact might be expected. These observations are consistent with an empirical standard of 5.0 $ou_E/m^3$ at the annual $98^{th}$ percentile, used in the landfill and wastewater industries in the UK and elsewhere, to assess the likelihood of community annoyance.

When assessing the impact of agricultural odours in a farming area, such as that surrounding Sutton Veny Farm, it is therefore suggested that taking account of the Newbiggin standard, the UKWIR research findings, and the H4 guidance it is reasonable to assess odour impacts against benchmarks of 3.0 $ou_E/m^3$ and 5.0 $ou_E/m^3$.

It should be noted that the prediction that any particular property lies above the guideline concentration 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 of the guideline.

## 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 $98^{th}$ percentile of the hourly mean odour concentrations, in order to represent conditions for an "average year". Comparisons of single yearly statistics will show the range, or sensitivity, of the modelled $98^{th}$ 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 $98^{th}$ percentile values. ADAS has used the mean $98^{th}$ percentile of the hourly mean odour concentrations over a five year period to provide statistically robust results, smoothing out inter-annual variations.

# 4. Dispersion modelling methodology

## 4.1 Model description

The choice of model for this study is UK Atmospheric Dispersion Modelling System (ADMS) Version 5. ADMS is a steady-state atmospheric dispersion model that is based on modern atmospheric physics. It can include treatment of both surface and elevated sources and both simple and complex terrain. ADMS is one of the few models capable of simulating all the important atmospheric processes. Importantly, ADMS 5 can take into account spatially varying deposition of pollutants and consequent plume depletion. The model calculates downwind pollutant concentration in the surrounding area for each hour of the day and night over an appropriate period. Statistics on the frequency and concentration of pollutants at the receptor sites are based upon the hourly calculations. A grid referencing system within the computer model allows the location of both sources and receptors to be specified to an accuracy of within 1m. If necessary, the model also incorporates the effects of buildings on the pollutant plume, known as building downwash.

ADMS 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 (Britter et al, 1995 and Ireland et al, 2006). The group that leads the development of ADMS is Cambridge Environmental Research Consultants (CERC), but the UK Met Office and others have made additional contributions. The model has been extensively validated against site measurements. Details of these validation studies and the formulation of the ADMS are available on the CERC website.

Published studies have shown that atmospheric dispersion models are reliable at predicting the pattern of downwind pollutant concentrations and deposition rates (as statistical distributions) over a period of time (H.R. Olesen, 1997). The ADAS modelling study reported here is based on calculations made over a period of 43,800 hours (5 years) and represents a suitably long period for such a statistical study.

## 4.2 Meteorology

A statistical dispersion modelling run requires hourly meteorological records, preferably over a minimum of five years. There is a requirement to limit the amount of missing records through station selection and pre-processing the weather file (Defra, 2009). Where only a small number of missing records arise, Defra recommends a procedure of ‘in-fill’ by interpolation or near-neighbour substitution. The occurrence of calm conditions must also be considered so that they are not unnecessarily excluded from the modelling study.

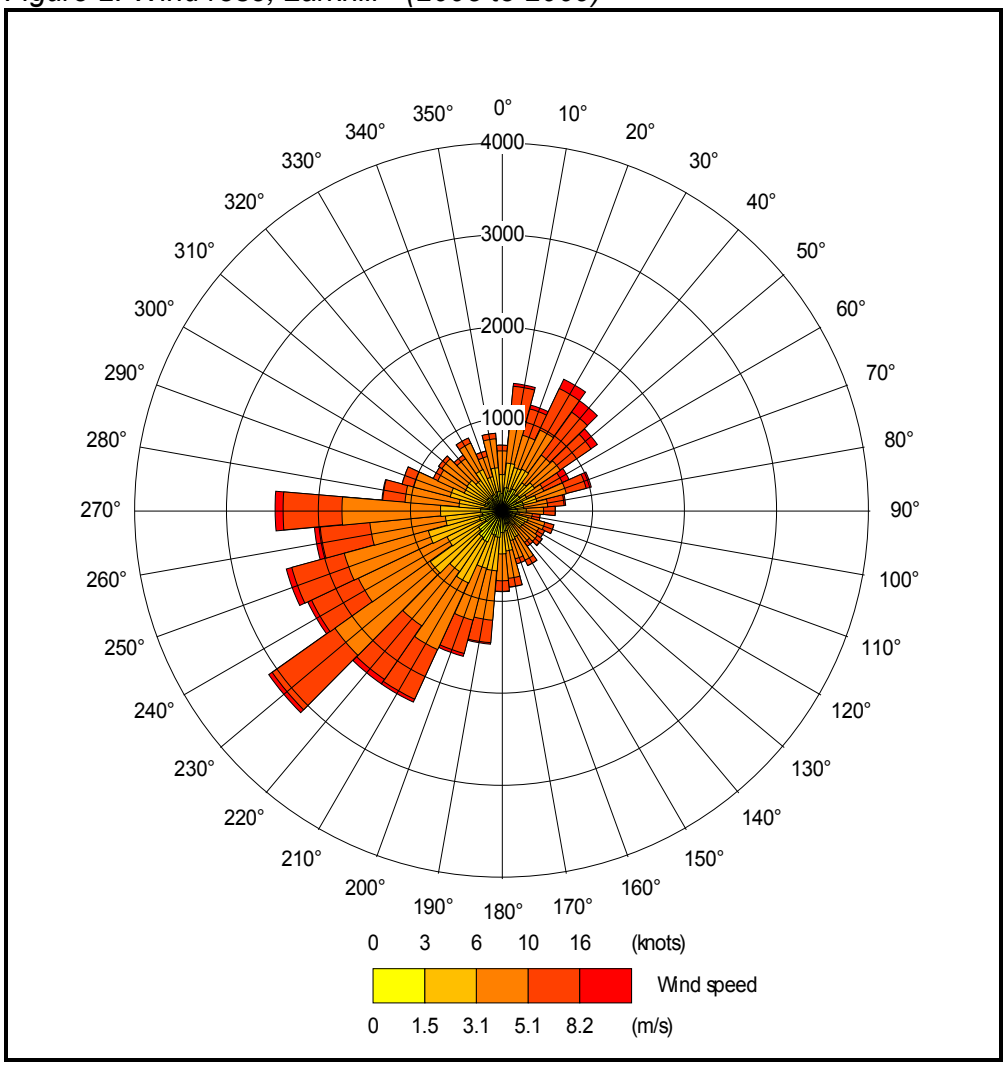
The nearest meteorological station to the area shown in Figure 1 which regularly records all the weather elements required for dispersion modelling is at Larkhill, which is approximately 25 km to the east. It has a similar exposure and is likely to experience similar weather to the area around Sutton Veny

Farm. In our opinion as meteorologists, weather records from Larkhill provide a reasonably good representation of the weather in this area.

The ADAS/Met Office method of dealing with calm periods in the modelled weather files is to set a wind speed of 1.0 m/s and use the last known “good” wind direction (or set to the direction of known katabatic winds if appropriate). However, many of the periods of calms reported in traditional climatological data are not true calms, but represent wind speeds below the minimum recording capabilities of the anemometers, or below the start up speed of the anemometers. This is part of the justification for our standard treatment of calms. Atmospheric dispersion models have internal procedures for dealing with calm periods; however our experience has been that the ADAS method results in the prediction of a larger exposure footprint in the surrounding area the model’s calms procedures. The ADAS/Met Office calms treatment also produces more cautious outcomes than “ignoring” calms by not modelling for hours when there is a calm recorded. The ADAS/Met Office calms treatment has been used in this study.

The wind rose for the weather file is shown in Figure 2. This illustrates the relative frequency of wind directions and wind speeds used in the modelling study. NB Within ADMS, the FLOWSTAR module has been used to modify the wind flow so that it better reflects the impact of the local terrain around Sutton Veny Farm. This should mitigate the effects of any differences between the winds at Larkhill and those in the local area.

*Figure 2. Wind rose, Larkhill - (2005 to 2009)*



## 4.3 Model parameters

### 4.3.1 Odour emissions

All figures presented below represent the average of summer daytime emission rates though the growing cycle and they are varied seasonally and diurnally within ADMS.

#### 4.3.1.1 Point Sources

Emissions from the chimneys on the ventilation tower mounted fans are represented by three point sources per house. Further details of the point source parameters are provided in Table 1a.

#### 4.3.1.2 Volume Sources

The emissions from the gable end fans on the proposed houses are each represented by a single volume source within ADMS. Under normal operation the emission rate from these volume sources is zero. When the ambient temperature exceeds 22 C, the volume sources representing the gable end fans are assumed to emit 50% of the total emission from the shed and the emissions from the point sources representing the ridge fans are reduced by 50%. Further details of the volume source parameters are provided in Table 1b. The position of the modelled sources can be seen in Figure 3.

*Table 1a. Point source parameters*

| Source ID | Height (m) | Diameter (m) | Efflux velocity (m/s) | Temperature (°C) | Emission Rate (per source) ($ou_E/s$) |
|---|---|---|---|---|---|
| SH2 a,b & c | 8.0 | 0.9 | 16.0 | 22 | 8629.1 [1] |
| SH3 a,b & c | 8.0 | 0.9 | 16.0 | 22 | 8629.1 [1] |
| SH4 a,b & c | 8.0 | 0.9 | 16.0 | 22 | 8629.1 [1] |
| SH5 a,b & c | 8.0 | 0.9 | 16.0 | 22 | 8629.1 [1] |

[1] Reduced by 50% when temperature equals or exceeds 22 ºC

*Table 1b. Volume source parameters*

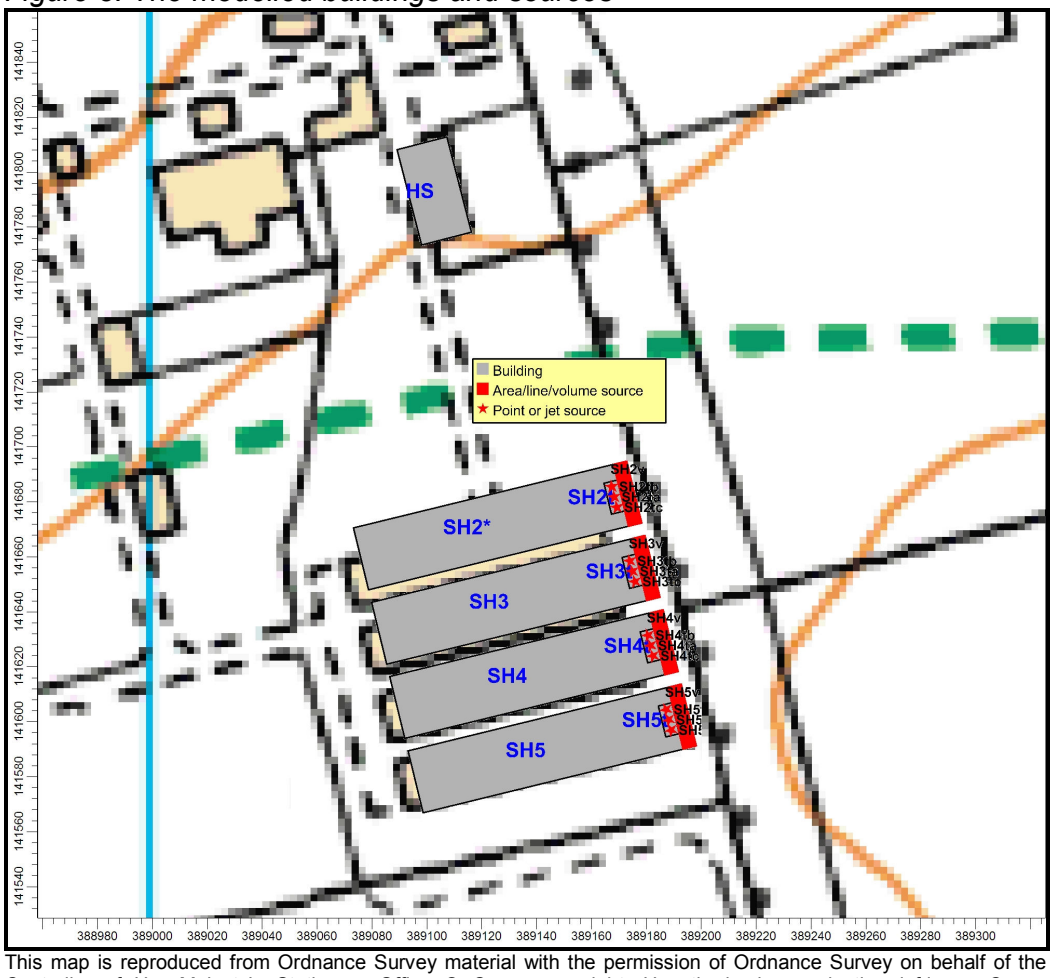
| Source ID | Base Height (m) | Depth (m) | Volume ($m^3$) | Emission rate ($ou_E/s$) | Specific Emission Rate ($ou_E/m^3/s$) |
|---|---|---|---|---|---|
| SH2v | 0.0 | 3.0 | 348.0 | 12943.6 [2] | 37.19454 [2] |
| SH3v | 0.0 | 3.0 | 348.0 | 25887.3 [2] | 74.38907 [2] |
| SH4v | 0.0 | 3.0 | 348.0 | 25887.3 [2] | 74.38907 [2] |
| SH5v | 0.0 | 3.0 | 348.0 | 25887.3 [2] | 74.38907 [2] |

[2] 50% of total emissions; only emitted when the temperature equals or exceeds 22 ºC

### 4.3.2 Buildings

The structure of the proposed poultry houses, the ventilation tower, and one other nearby building will have a significant effect on the behaviour of the plumes from the point sources. Therefore, the buildings are modelled as rectangular blocks within ADMS. The height of the modelled poultry houses is 4.6 m, and the height of the modelled ventilation tower on each poultry house is 7.5 m. There is also a house to the north of the proposed poultry unit, which has been modelled with a height of 4.5 m. The position of the modelled buildings can be seen in Figure 3, where they are marked by grey rectangles.

*Figure 3. The modelled buildings and sources*

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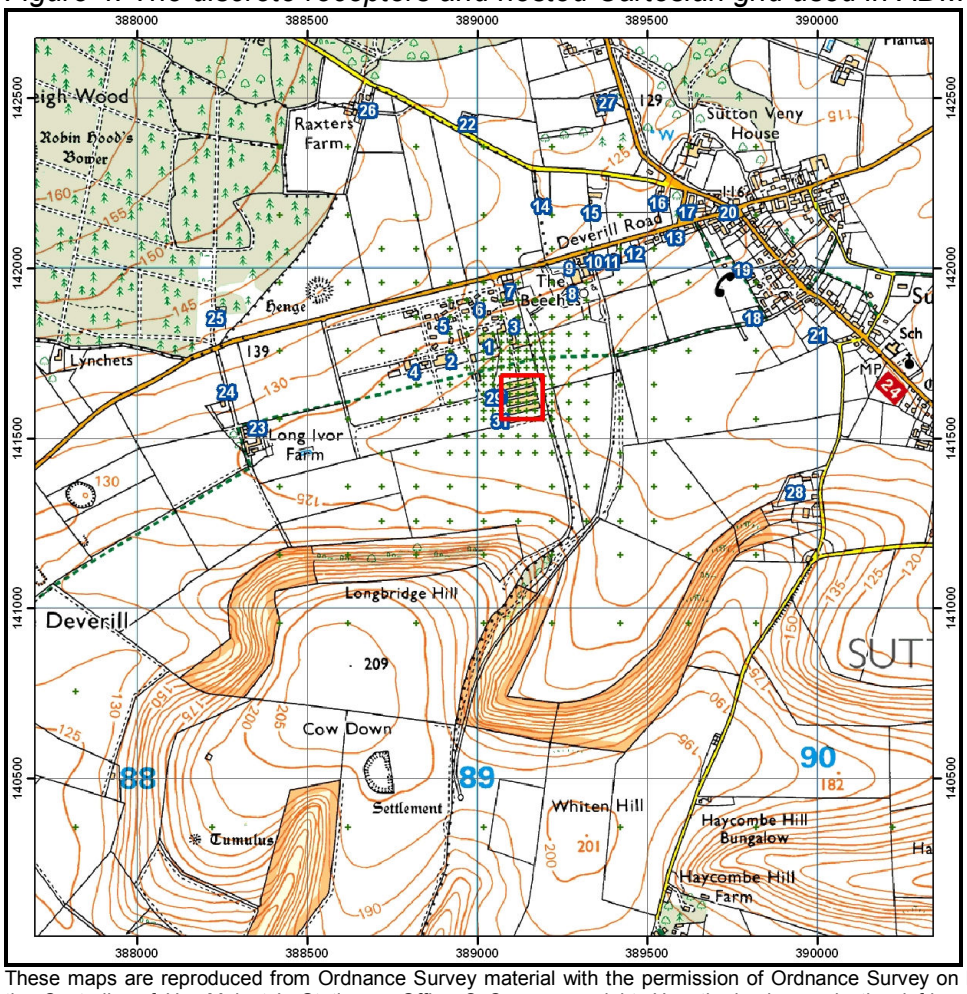
### 4.3.3 Discrete receptors

Thirty-one discrete receptor points have been defined within the model at nearby residences. These discrete receptors are defined at 1.5 m above ground level and their positions are shown in Figure 4, marked by haloed blue labels. The exact positions of the discrete receptors are given in Table 2, in Section 5.

*Figure 4. The discrete receptors and nested Cartesian grid used in ADMS*

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### 4.3.4 The nested Cartesian grid

A nested grid has been used to produce the contour maps presented in the results of this study. In this case a 200 m x 250 m area around the farm was defined at 25 m horizontal resolution; a 50 m resolution grid extends 100 m from the central grid; a 100 m grid extends a further 300 m, a 200 m grid extends a further 600 m and beyond this the resolution is reduced to 400 m. The nested grid points are defined at a height of 1.5 m above ground level within ADMS. Details of the nested grid can be seen in Figure 4, the grid points are marked by green crosses.

### 4.3.5 Terrain and roughness length

The terrain, to the north-west, and the south of Sutton Veny Farm, is hilly, with slopes that are likely to have an effect on both wind flow patterns and ground level odour concentrations. Consequently, terrain data has been used within ADMS. This is based on the SRTM3 data which is derived from Space Shuttle mission RADAR measurements and has a resolution of approximately 90m. The data have been re-sampled at a horizontal resolution of 100m for use within ADMS.

# 5. Modelling results

ADMS calculates hourly average odour concentrations at the nested Cartesian 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 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). Five runs, one for each year (2005 to 2009) in the meteorological record were performed.

For each discrete receptor, the five year mean annual 98$^{th}$ percentile hourly average odour concentration is shown in Table 2; values in excess of the Environment Agency's guideline (3.0 $ou_E/m^3$) are coloured blue, those that are in the range where ADAS has previously found that there is an increasing risk of complaint are coloured orange, and those that are in the range where ADAS has previously found that some complaints are expected are coloured red.

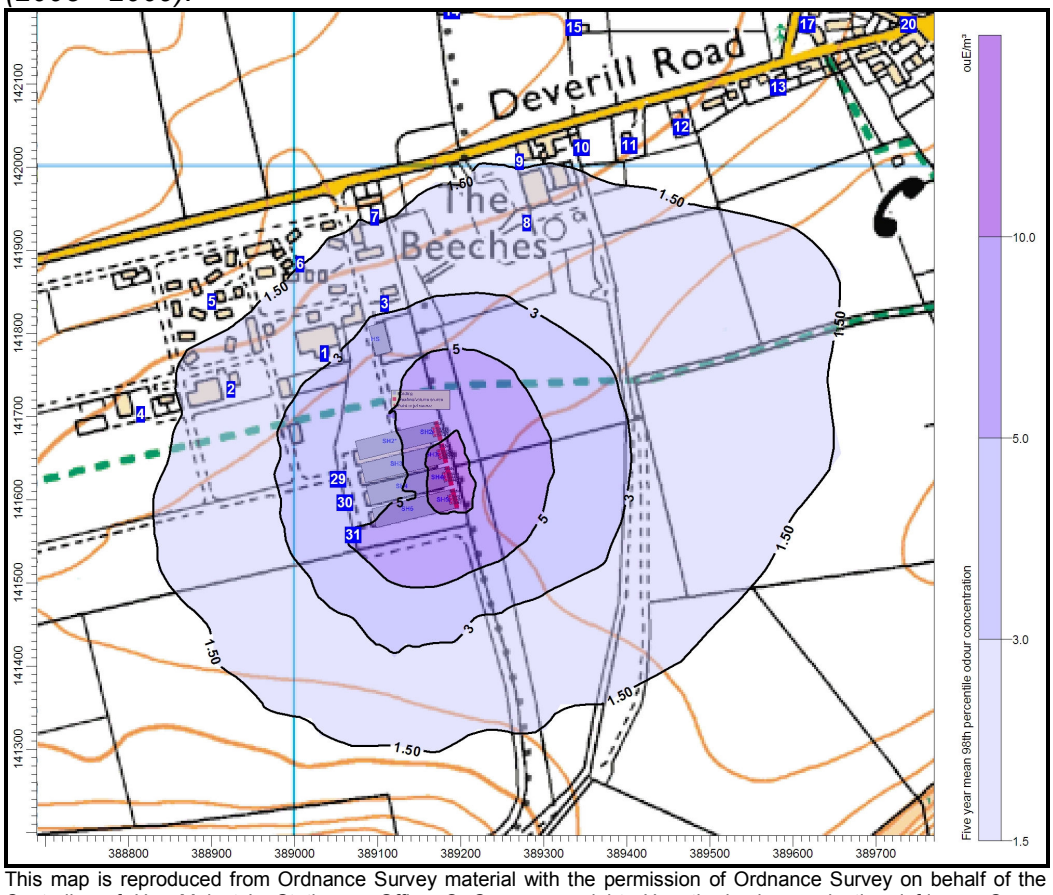
A contour plots of the modelled five year mean 98$^{th}$ percentile hourly average annual odour concentrations at the grid receptor points in the area surrounding Sutton Veny Farm is shown in Figure 5.

*Table 2. Maximum annual 98$^{th}$ percentile hourly mean odour concentration at the discrete receptors*

| Rec | X (m) | Y (m) | Mean 98$^{th}$ percentile hourly mean odour concentration ($ou_E/m^3$) |
|---|---|---|---|
| 1 | 389036 | 141775 | 2.77 |
| 2 | 388924 | 141732 | 1.88 |
| 3 | 389109 | 141835 | 2.63 |
| 4 | 388815 | 141702 | 1.22 |
| 5 | 388901 | 141838 | 1.25 |
| 6 | 389007 | 141883 | 1.49 |
| 7 | 389097 | 141939 | 1.44 |
| 8 | 389280 | 141932 | 1.91 |
| 9 | 389271 | 142006 | 1.45 |
| 10 | 389346 | 142023 | 1.40 |
| 11 | 389404 | 142025 | 1.35 |
| 12 | 389466 | 142048 | 1.23 |
| 13 | 389583 | 142095 | 1.07 |
| 14 | 389190 | 142188 | 0.79 |
| 15 | 389337 | 142167 | 0.96 |
| 16 | 389533 | 142198 | 0.88 |
| 17 | 389618 | 142171 | 0.93 |
| 18 | 389812 | 141860 | 1.23 |
| 19 | 389781 | 142002 | 1.20 |
| 20 | 389740 | 142171 | 0.90 |
| 21 | 390004 | 141809 | 0.94 |
| 22 | 388974 | 142429 | 0.41 |
| 23 | 388357 | 141537 | 0.53 |
| 24 | 388267 | 141643 | 0.38 |
| 25 | 388235 | 141858 | 0.29 |
| 26 | 388682 | 142471 | 0.29 |

| Rec | X (m) | Y (m) | Mean 98th percentile hourly mean odour concentration ($ou_E/m^3$) |
|---|---|---|---|
| 27 | 389385 | 142494 | 0.54 |
| 28 | 389937 | 141348 | 0.51 |
| 29 | 389053 | 141624 | **4.32** |
| 30 | 389061 | 141596 | **4.45** |
| 31 | 389071 | 141557 | **5.16** |

*Figure 5. Maximum annual 98th percentile hourly mean odour concentration (2005 - 2009).*

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# 6. Summary and conclusions

The Met Office Rural Environment Team at ADAS has been commissioned by Mr James Whilding, of ACORUS Rural Property Services Ltd., to conduct a dispersion and deposition modelling study to assess the impact of odour emissions from the revised plans for the proposed redevelopment of the broiler chicken rearing unit at Sutton Veny Farm, Warminster in Wiltshire.

Odour emissions have been assessed and quantified using an emissions 'blueprint' developed by ADAS, the Met Office and the Silsoe Research Institute. The emission figures obtained were then used in atmospheric dispersion modelling to assess the likely impact of odour in the area around the farm.

The modelling of the original plans for the redevelopment of the poultry unit, in the report dated 12th February 2013, found potential for unacceptable odour pollution in the area around the farm. Therefore the plans have been revised in order to reduce the impact. These revisions include changes to the layout and ventilation of the redeveloped poultry unit. In addition, more discrete receptors have been added to represent an area of allotments near to the poultry unit, to the west. This report has presented the modelled odour concentrations from these revised plans.

The results show that from the revised plans for the redevelopment of the poultry unit, there are no residential receptors where the modelled five year mean 98$^{th}$ percentile hourly average odour concentration exceeds the Environment Agency's benchmark of 3.0 $ou_E/m^3$ for unacceptable odour pollution, and are below levels which would cause any significant impact upon residential ammenity.

There are three discrete receptors where the modelled odour concentrations from the revised plans for the redevelopment of the poultry unit exceed the Environment Agency's benchmark for unacceptable odour pollution, receptors 29 to 31, which represent allotments to the west of the unit. At one of these discrete receptors, receptor the modelled odour concentrations marginally exceed 5.0 $ou_E/m^3$, the level above which ADAS has previously found the likelihood of adverse impact increases.

The Environment Agency, in the H4 document, considers receptor sensitivity. It is possible that, on occasion, the allotments may be occupied for up to 6 hours. As an allotment is not occupied to the same extent as a residence, the sensitivity is reduced, and it is therefore less likely that odours from the proposed redeveloped poultry unit would have an adverse impact upon amenity.

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# APPENDIX 1

## Clearing Spent Floor Litter - Odour Mitigation Options

- A dry (moisture content ~ 35%), friable floor litter during the rearing part of the cycle reduces the potential odour emissions during mucking out, as well as throughout the rearing cycle.

- Avoid clearing spent floor litter during weekends, public holidays or in the evening unless it is absolutely necessary.

- Avoid clearing if the wind direction is blowing in the direction of near neighbours if at all possible.

- Once started, the clearing process should be completed in as little time as possible while taking account of the above recommended restrictions.

- Maintain minimal fan ventilation during cleaning, while remaining consistent with health and safety requirements of the cleaning personnel.

- If an elevator is used for loading litter into lorries, the drop height should be minimised and the elevator covered, thus removing the risk of dust blowing on windy days.

- If a loader vehicle is used, litter should be carefully tipped into lorry trailers positioned at the entrance to each house or, if possible, inside the building.

- The litter should be tipped into the trailer from minimal height and, when full, the trailer should be covered and sealed immediately.

- Surrounding concrete aprons and surfaces should be cleaned immediately after clearing.

- Only Defra approved, non-tainting disinfectants should be used during the clean-out of the houses.

- Dirty water should be transported off-site and ultimately be disposed of, or field spread, in accordance with the guidelines in the Code of Practice (Defra, 2009).