A Dispersion Modelling Study of the Impact of Odour from the Existing and Proposed Free Range Egg Laying Chicken Houses at Cerrigcroes, Llanyre, near Llandrindod Wells in Powys

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1. Introduction

AS Modelling & Data Ltd. has been instructed by Steve Raasch on behalf of Ross Aberley of A.J. Abberley, to use computer modelling to assess the impact of odour emissions from the existing and proposed free range egg laying chicken houses at Cerrigcroes, Lanyre, near Llandrindod Wells in Powys. LD1 6EU.

Odour emission rates from the existing and proposed poultry houses have been assessed and quantified based upon emission rates mandated by Natural Resources Wales. The odour emission rates so obtained have then been used as inputs to an atmospheric dispersion model which calculates odour exposure levels in the surrounding area.

This report is arranged in the following manner:

- Section 2 provides relevant details of the site and potentially sensitive receptors in the area.

- Section 3 provides some general information on odour, details of the method used to estimate odour emissions from the existing and proposed poultry houses, relevant guidelines and legislation on exposure limits and where relevant, details of likely background levels of odour.

- Section 4 provides some information about ADMS, the dispersion model used for this study and details the modelling parameters and procedures.

- Section 5 contains the results of the modelling.

- Section 6 provides a discussion of the results and conclusions.

2. Background Details

Cerrigcroes is in a rural location approximately 2.0 km to the west of Llandrindod Wells, in Powys. The land around the farm is used mainly for livestock farming and there are some wooded areas. The site of the poultry unit at Cerrigcroes is at an elevation of around 230 m with the land rising towards hills and mountains to the north and west and falling towards the River Ithon Valley to the south and east.

Currently, there are two layer chicken houses at Cerrigcroes, these provide accommodation for up to 28,000 chickens in total. One of these existing houses is ventilated by capped ridge fans with gable end fans providing supplementary ventilation in hot weather, with the birds being housed in a flat deck system with the litter accumulating within the house throughout the crop. The other poultry house is ventilated by uncapped high speed ridge fans, with gable end fans providing supplementary ventilation during hot weather and the birds are housed in a multi-tier system with manure being removed by a belt system twice a week. The chickens from both houses have daytime access to outside ranging areas via a series of pop holes on the sides of the houses.

The proposal involves the construction of an extension to one of the poultry houses, converting it from a flat deck to a multi-tier system and upgrading the ventilation from capped ridge fans to uncapped high speed ridge fans, with additional ventilation being provided by gable end fans during hot weather. The other existing poultry house would remain as a multi-tier house, ventilated by uncapped high speed ridge fans with gable end fans providing supplementary ventilation. Manure would be regularly removed by a belt system from both of the poultry houses and taken off the site. The proposed changes to the poultry houses would enable the poultry unit to provide accommodation for up to 48,000 layer chickens.

The closest residential receptors are at Cerricgroes Farm, occupied by the operator. The closest receptor not associated with Cerrigcroes is at Bwlch-y-rhiw, which is approximately 225 m to the south-east of the poultry houses. Lane Cottages are approximately 365 m to the west of the poultry houses and there are further isolated residences and farmsteads in the countryside around the farm. A map of the surrounding area is provided in Figure 1; in the figure, the poultry houses at Cerrigcroes are outlined in blue.

Figure 1. The area surrounding the site of the existing and proposed poultry houses at Cerrigcroes

3. Odour, Emission Rates, Exposure Limits & Background Levels

3.1 Odour concentration, averaging times, percentiles and FIDOR

Odour concentration is expressed in terms of European Odour Units per metre cubed of air (ou_E/m^3). The following definitions and descriptions of how an odour might be perceived by a human with an average sense of smell may be useful, however, it should be noted that within a human population there is considerable variation in acuity of sense of smell.

- 1.0 ou_E/m^3 is defined as the limit of detection in laboratory conditions.
- At 2.0 – 3.0 ou_E/m^3, a particular odour might be detected against background odours in an open environment.
- When the concentration reaches around 5.0 ou_E/m^3, a particular odour will usually be recognisable, if known, but would usually be described as faint.
- At 10.0 ou_E/m^3, most would describe the intensity of the odour as moderate or strong and if persistent, it is likely that the odour would become intrusive.

The character, or hedonic tone, of an odour is also important; typically, odours are grouped into three categories.

Most offensive:

- Processes involving decaying animal or fish remains.
- Processes involving septic effluent or sludge.
- Biological landfill odours.

Moderately offensive:

- Intensive livestock rearing.
- Fat frying (food processing).
- Sugar beet processing.
- Well aerated green waste composting.

Less offensive:

- Brewery.
- Confectionery.
- Coffee roasting.
- Bakery.

Dispersion models usually calculate hourly mean odour concentrations and Environment Agency guidelines and findings from UK Water Industry Research (UKWIR) are also framed in terms of hourly mean odour concentration.

The Environment Agency guidelines and findings from UKWIR use the 98th percentile hourly mean; this is the hourly mean odour concentration that is equalled or exceeded for 2% of the time period considered, which is typically one year. The use of the 98th percentile statistic allows for some consideration of both frequency and intensity of the odours.

At some distance from a source, it would be unusual if odour concentration remained constant for an hour and in reality, due to air turbulence and changes in wind direction, short term fluctuations in concentration are observed. Therefore, although average exposure levels may be below the detection threshold, or a particular guideline, a population may be exposed to short term concentrations which are higher than the hourly average. It should be noted that a fluctuating odour is often more noticeable than a steady background odour at a low concentration. It is implicit that within the model's hourly averaging time and the Environment Agency guidelines and findings from UKWIR that there would be variation in the odour concentration around this mean, i.e. there would be short periods when odour concentration would be higher than the mean and lower than the mean.

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

- **F**requency of detection.
- **I**ntensity as perceived.
- **D**uration of exposure.
- **O**ffensiveness.
- **R**eceptor sensitivity.

3.2 Environment Agency guidelines

In April 2011, the Environment Agency published H4 Odour Management guidance (H4). In Appendix 3 – Modelling Odour Exposure, benchmark exposure levels are provided. The benchmarks are based on the 98th percentile of hourly mean concentrations of odour modelled over a year at the site/installation boundary. The benchmarks are:

- 1.5 ou_E/m^3 for most offensive odours.
- 3.0 ou_E/m^3 for moderately offensive odours.
- 6.0 ou_E/m^3 for less offensive odours.

Any modelled results that project exposures above these benchmark levels, after taking uncertainty into account, indicates the likelihood of unacceptable odour pollution.

3.3 UK Water Industry Research findings

The main source of research into odour impacts in the UK has been the wastewater industry. An in-depth study of the correlation between modelled odour impacts and human response was published by UKWIR in 2001. This was based on a review of the correlation between reported odour complaints and modelled odour impacts in relation to nine wastewater treatment works in the UK with on-going odour complaints. The findings of this research and subsequent UKWIR research indicated the following, based on the modelled 98th percentile of hourly mean concentrations of odour:

- At below 5.0 ou_E/m^3, complaints are relatively rare at only 3% of the total registered.
- At between 5.0 ou_E/m^3 and 10.0 ou_E/m^3, a significant proportion of total registered complaints occur, 38% of the total.
- The majority of complaints occur in areas of modelled exposures of greater than 10.0 ou_E/m^3, 59% of the total.

3.4 Choice of odour benchmarks for this study

Odours from poultry housing are usually placed in the moderately offensive category. Therefore, for this study, the Environment Agency's benchmark for moderately offensive odours, a 98th percentile hourly mean of 3.0 ou_E/m^3 over a one year period, is used to assess the impact of odour emissions from the proposed poultry unit at potentially sensitive receptors in the surrounding area. The UKWIR research is also considered.

3.5 Quantification of odour emissions

Odour emission rates from poultry houses depend on many factors and are highly variable. When only minimum ventilation is required, the odour emission rate may be relatively small, but in hot weather, ventilation requirements and odour emission rates are greater.

The primary source of odour from the existing poultry houses and the proposed extended poultry houses would be from the ridge or roof mounted fans, which would be used for the majority of the ventilation requirements, but in warm weather there would also be some emissions from the gable end fans. Ventilation rates of laying chicken houses are such that the houses would normally be under negative pressure and therefore any fugitive emissions would be minimal.

Peak odour emission rates occur when the housing is cleared of spent litter and manure at the end of each crop. Emissions at this time may be several times greater than normal emissions from the housing. However, although the proposed poultry houses at Cerrigcroes would be cleaned between flocks, because the manure would be collected and removed throughout the flock cycle using belt systems, the magnitude of odours during cleaning would be much lower than from more traditional houses in which manure collects within the house, such as the existing flat deck house.

Natural Resources Wales housing emission rates

The odour emissions used in this modelling study are calculated based upon a specific emission rate of 0.47 ou_E/bird/s for chickens housed in a multi-tier system with the regular removal of litter via a belt system, and 0.94 ou_E/bird/s for chickens housed on a flat deck system with the litter collecting within the house throughout the crop. The use of these emission rates is mandated by Natural Resources Wales for permitted sites. It should be noted that for much of the time these figures are probably rather high, but conversely their use probably underestimates peaks in emissions during warm weather when ventilation rates are higher. Modelling results obtained using these figures as a basis of continuous emission rates that do not account for the variation in emission rates that are likely to occur in reality, should be treated with caution. Generally, the 98th percentile concentration will be over-predicted; however, in some situations for some receptors, it is possible they would be under-predicted.

Summaries of the Natural Resources Wales emission rates are provided in Table 1a, for the chickens housed in a multi-tier system with the regular removal of litter via a belt system, and Table 1b, for the chickens housed in a flat deck system with litter collecting in the house throughout the crop. As additional information, the 98th percentile emission rate is 0.47 ou_E/bird/s in the multi-tier houses and 0.94 ou_E/bird/s in the flat deck house. As an example, a graph of the specific emission rates over the first year of the meteorological record is shown in Figure 2; in the figure, emission rates for the chickens housed in a multi-tier system with the regular removal of litter via a belt system is represented by a red line, and emission rates for the chickens housed in a flat deck system with the litter collecting in the house throughout the crop is represented by a blue line.

Ranging area emissions

The chickens would have access to ranging areas. It is assumed that 20% of the droppings are deposited on the ranging area and an emission rate of 0.25 ou_E/bird/s is used to calculate the emission rate. The emission is assumed to be continuous with no diurnal, seasonal, or temperature dependent variations. N.B. This emission is additional to the housing emissions; as such, is probably quite precautionary and is also intended to account for any fugitive emissions from the pop holes, which might occur when ventilation rates are low.

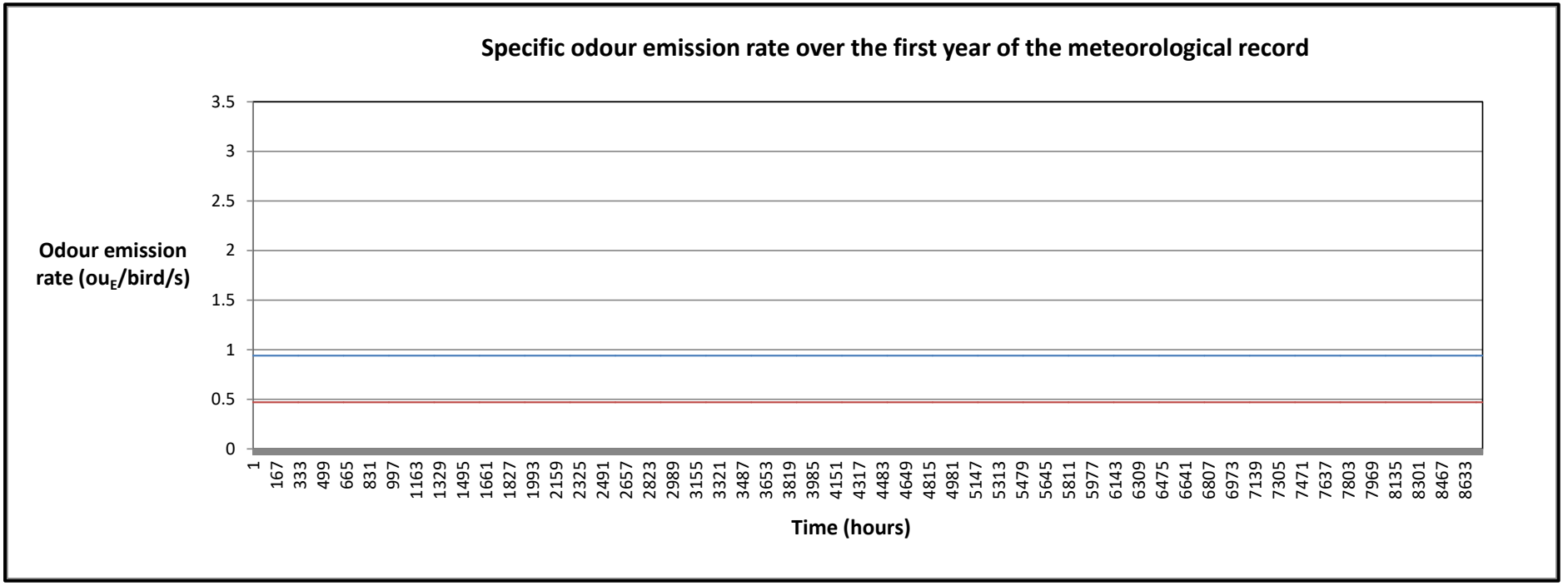
Table 1a. Summary of odour emission rates – housing in a multi-tier system with frequent litter removal

Emission rate (ou_E/bird/s)				
Season	Average	Night-time Average	Day-time Average	Maximum
Winter	0.470	0.470	0.470	0.470
Spring	0.470	0.470	0.470	0.470
Summer	0.470	0.470	0.470	0.470
Autumn	0.470	0.470	0.470	0.470

Table 1b. Summary of odour emission rates – housing in a flat deck system

Emission rate (ou_E/bird/s)				
Season	Average	Night-time Average	Day-time Average	Maximum
Winter	0.940	0.940	0.940	0.940
Spring	0.940	0.940	0.940	0.940
Summer	0.940	0.940	0.940	0.940
Autumn	0.940	0.940	0.940	0.940

Figure 2. Specific emission rate over the first year of the meteorological record (2012) - Natural Resources Wales emission rates



4. The Atmospheric Dispersion Modelling System (ADMS) and Model Parameters

The Atmospheric Dispersion Modelling System (ADMS) ADMS 5 is a new generation Gaussian plume air dispersion model, which means that the atmospheric boundary layer properties are characterised by two parameters; the boundary layer depth and the Monin-Obukhov length rather than in terms of the single parameter Pasquill-Gifford class.

Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

ADMS has a number of model options including: dry and wet deposition; NO_x chemistry; impacts of hills, variable roughness, buildings and coastlines; puffs; fluctuations; odours; radioactivity decay (and γ-ray dose); condensed plume visibility; time varying sources and inclusion of background concentrations.

ADMS has an in-built meteorological pre-processor that allows flexible input of meteorological data both standard and more specialist. Hourly sequential and statistical data can be processed and all input and output meteorological variables are written to a file after processing.

The user defines the pollutant, the averaging time (which may be an annual average or a shorter period), which percentiles and exceedance values to calculate, whether a rolling average is required or not and the output units. The output options are designed to be flexible to cater for the variety of air quality limits, which can vary from country to country and are subject to revision.

4.1 Meteorological data

Computer modelling of dispersion requires hourly sequential meteorological data and to provide robust statistics, the record should be of a suitable length; preferably four years or longer.

The meteorological data used in this study is obtained from assimilation and short term forecast fields of the Numerical Weather Prediction (NWP) system known as the Global Forecast System (GFS). Data from the observational meteorological stations at Sennybridge, Shobdon, or Trawscoed has also been considered.

The GFS is a spectral model and data are archived at a horizontal resolution of 0.25 degrees, which is approximately 25 km over the UK (formerly 0.5 degrees, or approximately 50 km). The GFS resolution adequately captures major topographical features and the broad-scale characteristics of the weather over the UK. Smaller scale topological features may be included in the dispersion modelling by using the flow field module of ADMS (FLOWSTAR). The use of NWP data has advantages over traditional meteorological records because:

- Calm periods in traditional observational records may be over represented, this is because the instrumentation used may not record wind speeds below approximately 0.5 m/s and start up wind speeds may be greater than 1.0 m/s. In NWP data, the wind speed is continuous down to 0.0 m/s, allowing the calms module of ADMS to function correctly.

- Traditional records may include very local deviations from the broad-scale wind flow that would not necessarily be representative of the site being modelled; these deviations are difficult to identify and remove from a meteorological record. Conversely, local effects at the site being modelled are relatively easy to impose on the broad-scale flow and provided horizontal resolution is not too great, the meteorological records from NWP data may be expected to represent well the broad-scale flow.

- Information on the state of the atmosphere above ground level which would otherwise be estimated by the meteorological pre-processor may be included explicitly.

The closest meteorological recording station that records all the parameters required for atmospheric dispersion modelling is at Sennybridge, approximately 34 km to the south of Cerrigcroes. Data from the meteorological recording stations at Shobdon and Trawscoed have also been considered; Shobdon is around 36 km to the east of the site, and Trawscoed around 38 km to the west of Cerrigcroes. However, neither Sennybridge, Shobdon nor Trawscoed has an aspect that in any way could be considered similar to Cerrigcroes; therefore, it should be noted that the frequency of winds from a particular direction in the Sennybridge, Shobdon or Trawscoed data may be either high or low in comparison to what might occur at Cerrigcroes, which means mean concentrations downwind may be either over or under predicted. Additionally, periods of light winds and calms cannot be properly modelled and are usually over recorded, which depending on source and treatment of calm periods parameters can lead to either over prediction, or under prediction of downwind concentrations. Therefore, it is the opinion of AS Modelling & Data Ltd. that the results obtained using the GFS data, particularly when modified by using FLOWSTAR, should be given more weight when interpreting the results of the modelling.

A wind rose showing the distribution of wind speeds and directions in the GFS derived data is shown in Figure 3a.

The raw GFS wind speeds are modified by the treatment of roughness lengths (see Section 4.7) and because terrain data is included in the modelling, wind speeds and directions will be further modified. The terrain and roughness length modified wind rose for the site of Cerrigcroes is shown in Figure 3b. Note that elsewhere in the modelling domain the modified wind roses may differ more markedly and that the resolution of the wind field in terrain runs is 200 m.

The wind roses for Sennybridge, Shobdon and Trawscoed are shown in Figures 3c, 3d and 3e respectively.

Figure 3a. The wind rose. Raw GFS derived data, for 52.242 N, 3.414 W, 2012 – 2015

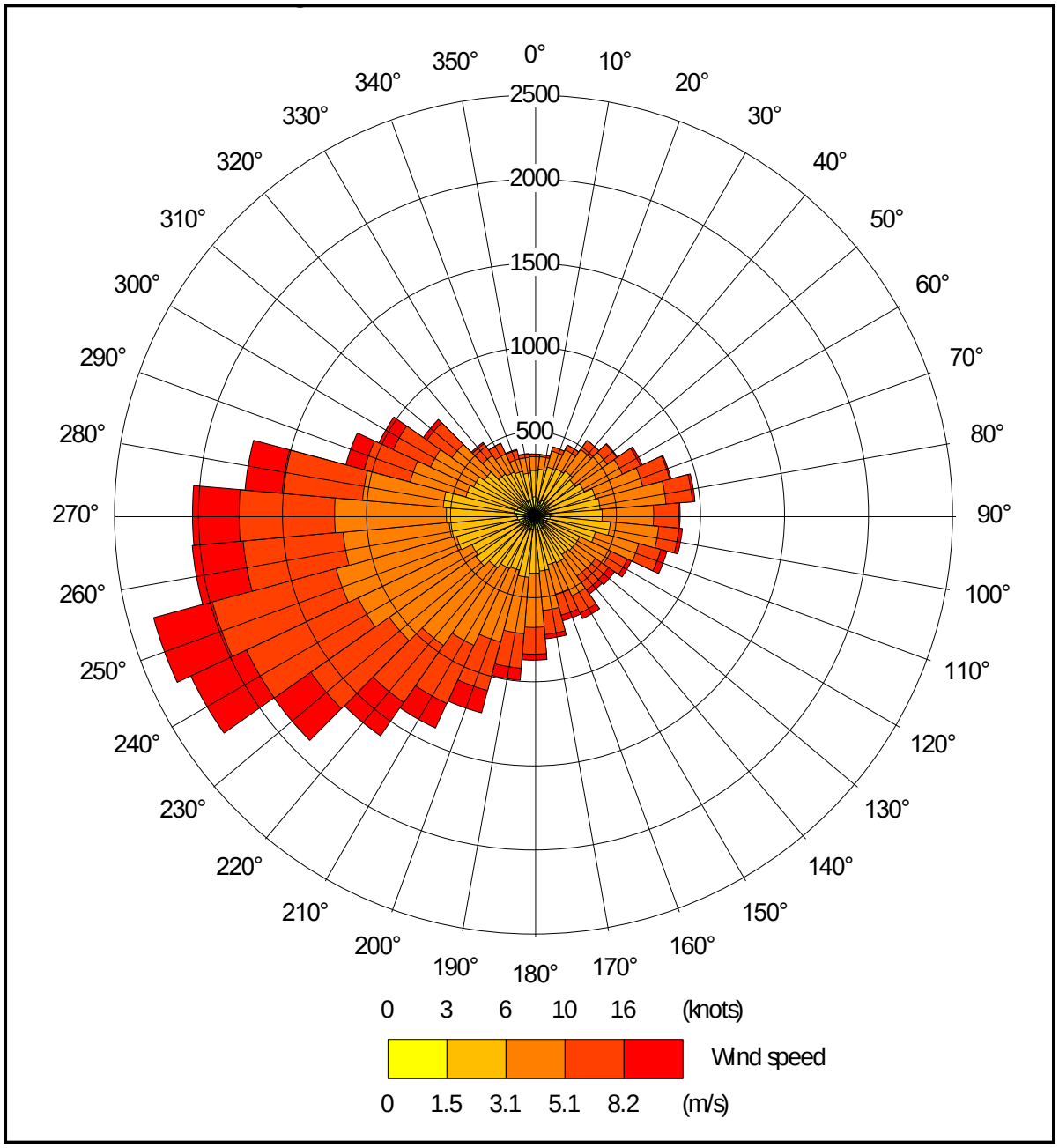


Figure 3b. The wind rose. FLOWSTAR modified GFS derived data for 52.242 N, 3.414 W, 2012-2015

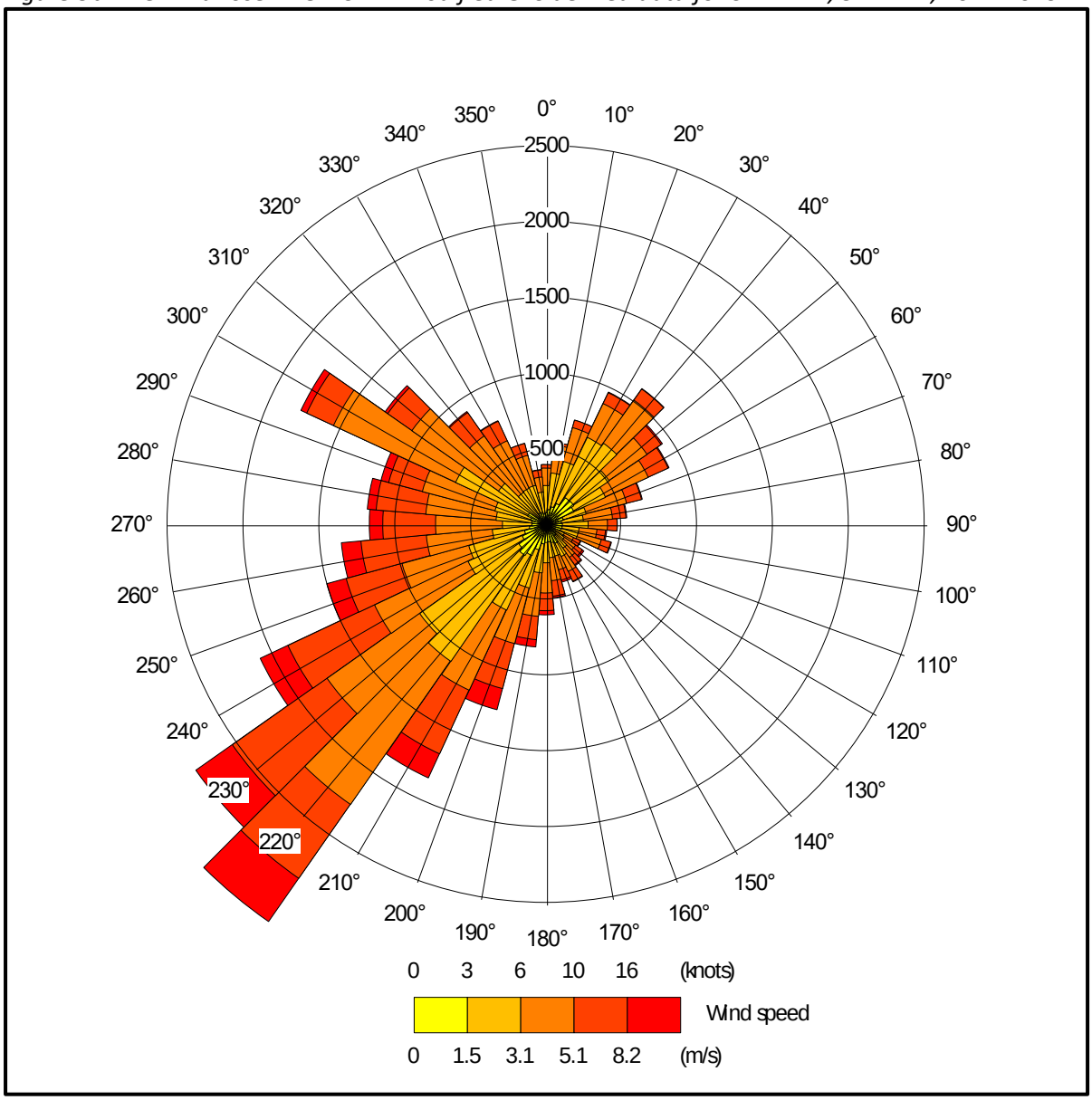


Figure 3c. The wind rose. Recorded meteorological data at Sennybridge, 2012-2015

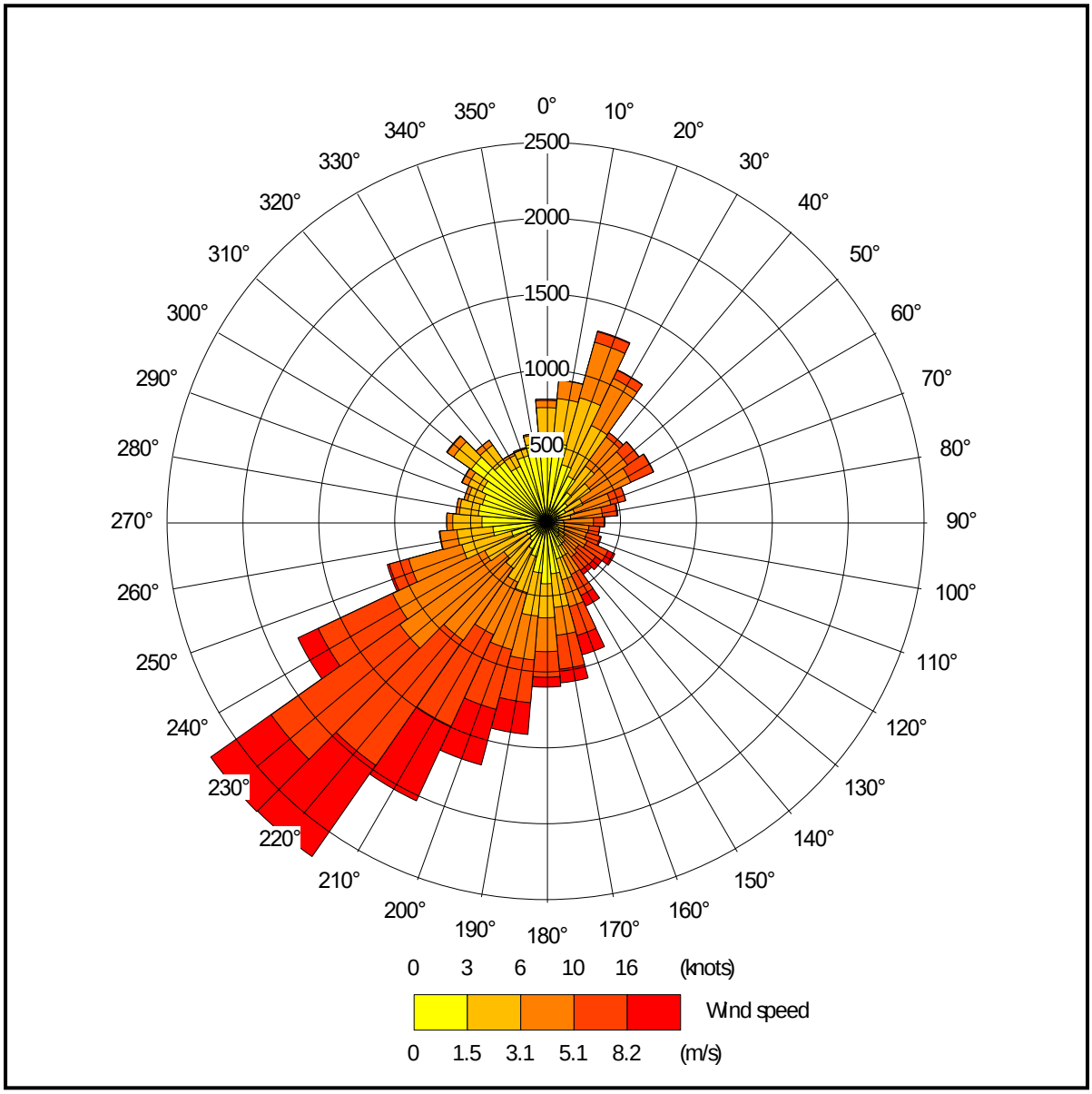


Figure 3d. The wind rose. Recorded meteorological data at Shobdon, 2012-2015

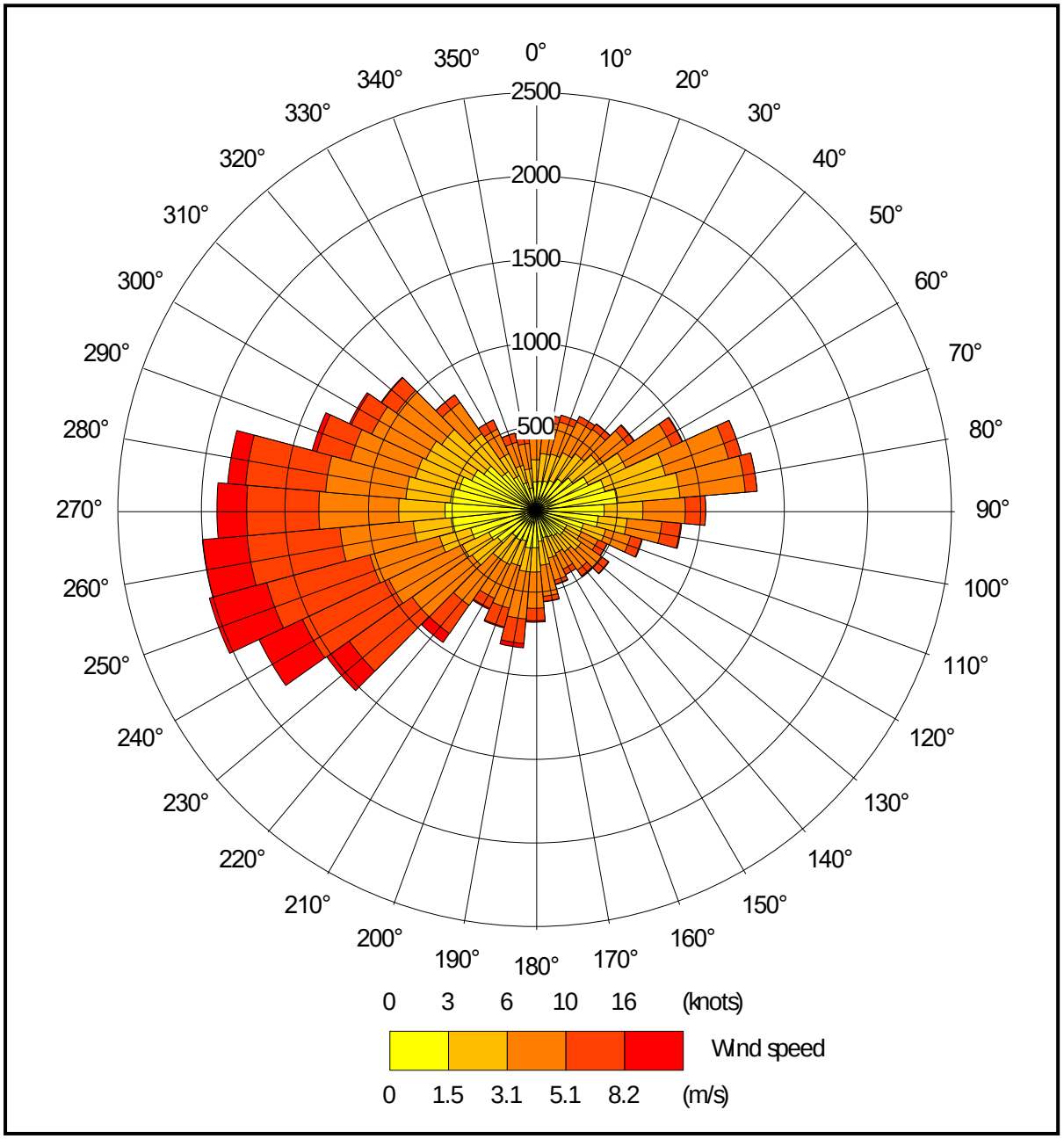
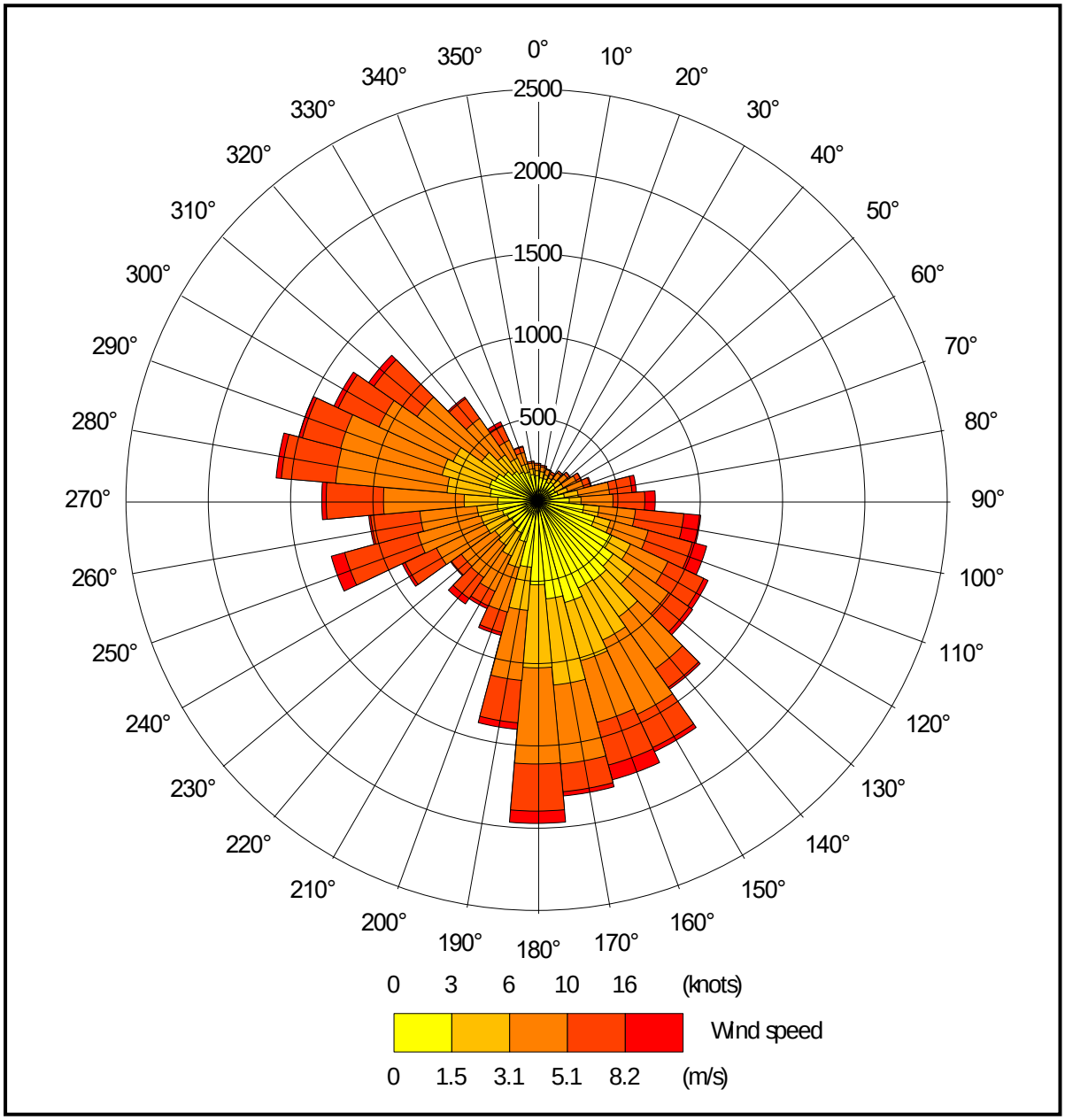


Figure 3e. The wind rose. Recorded meteorological data at Trawscoed, 2012-2015



4.2 Emission sources

Emissions from the capped ridge fans and the chimneys of the uncapped high speed fans that are, or would be, used as the primary source of ventilation for the existing poultry houses and the proposed extended poultry house are represented by three point sources per house within ADMS (EX1, EX2 and PR1; a, b & c).

Details of these point source parameters are shown in Table 2a. The positions of the point sources are shown in Figure 4a, for the existing scenario and Figure 4b, for the proposed scenario, where they are marked by red star symbols.

Table 2a. Point source parameters

Source ID (scenario)	Height (m)	Diameter (m)	Efflux velocity (m/s)	Emission temperature (˚C)	Emission rate per source (g-NH_3/s)
EX1 a, b & c (existing and proposed)	5.5	0.8	11.0	22.0	2,506.67 [1]
EX2 a, b & c (existing)	5.5	2.0	0.1	22.0	3,760.00 [1]
PR1 a, b & c (proposed)	5.5	0.8	11.0	22.0	5,103.33 [1]

1. Reduced by 50% when the ambient temperature equals or exceeds 21 Celsius.

Both the existing poultry houses and proposed extended poultry house are fitted with gable end fans, which are, or would be, used to augment the primary ventilation during hot weather. The emissions from the gable end fans are represented by a single volume source per house within ADMS (EX1_gab, EX2_gab and PR1_gab). These volume sources are assumed to emit 50% of the total emission only when the ambient temperature equals or exceeds 21 Celsius; when the volume sources are emitting, emissions from the associated point sources are reduced by 50%.

Details of the volume source parameters are shown in Table 2b. The positions of the volume sources are shown in Figure 4a, for the existing scenario and Figure 4b, for the proposed scenario, where they are represented by red rectangles.

Table 2b. Volume source parameters

Source ID (scenario)	Length Y (m)	Width X (m)	Depth (m)	Base height (m)	Emission temperature (°C)	Emission rate (ou_E/s)
EX1_gab (existing and proposed)	5.0	19.5	3.0	0.0	Ambient	3,760 [1]
EX2_gab (existing)	5.0	19.5	3.0	0.0	Ambient	2,820 [1]
PR1_gab (proposed)	5.0	19.5	3.0	0.0	Ambient	7,520 [1]

[1] 50% of the total emission is emitted when the ambient temperature equals or exceeds 21 Celsius.

Each of the existing and proposed extended poultry houses has ranging areas. Emissions from these ranging areas are assumed to occur constantly and in addition to those from the houses and have been represented as area sources within ADMS. Note that the area sources cover the parts of the ranges most likely to be used frequently and not the whole ranging area.

Details of the area source parameters are provided in Table 2c. The positions of the area sources are shown in Figure 4a, for the existing scenario and Figure 4b, for the proposed scenario, where they are represented by red polygons.

Table 2c. Area source parameters

Source ID (scenario)	Area (m^2)	Base height (m)	Emission temperature (°C)	Emission rate (ou_E/s)
EX1_ran (existing and proposed)	3,242.8	0.0	Ambient	800.0
EX2_ran (existing)	2,776.5	0.0	Ambient	600.0
PR1_ran (proposed)	4,163.5	0.0	Ambient	1,600.0

4.3 Modelled buildings

The structure of the poultry houses and other nearby buildings may affect the odour plumes from the point sources. Therefore, these buildings are modelled within ADMS. The positions of the modelled buildings may be seen in Figure 4, where they are marked by grey rectangles.

4.4 Discrete receptors

Seventeen discrete receptors have been defined at a selection of nearby residences and commercial properties that are within approximately 1 km of Cerrigcroes. These receptors are defined at a height of 1.5 m above ground level within ADMS and their positions may be seen in Figure 5, where they are marked by enumerated pink rectangles.

4.5 Nested Cartesian grid

To produce the contour plots presented in Section 5 of this report, a nested Cartesian grid has been defined within ADMS. The grid receptors are defined at 1.5 m above ground level within ADMS. The positions of the receptors may be seen in Figure 5, where they are marked by green crosses bounded by a purple rectangle.

4.6 Terrain data

There are some significant slopes and hills that may affect wind flow and dispersion of odour; therefore, terrain has been considered in the modelling. The terrain data used are derived from the Ordnance Survey 50 m Digital Elevation Model. The terrain domain is 6.4 km by 6.4 km and FLOWSTAR is run at a resolution of 32 x 32 points; therefore, the effective model resolution is 200 m.

4.7 Other model parameters

A fixed surface roughness length of 0.25 m has been applied over the entire modelling domain. As a precautionary measure, the GFS meteorological data is assumed to have a roughness length of 0.225 m. The effect of the difference in roughness length is precautionary as it increases the frequency of low wind speeds and the stability and therefore increases predicted ground level concentrations. Note, the roughness length of the meteorological data that has been used for sensitivity modelling is assumed to be the same as the modelling domain; 0.25 m.

Figure 4a. The positions of modelled buildings & sources – existing scenario

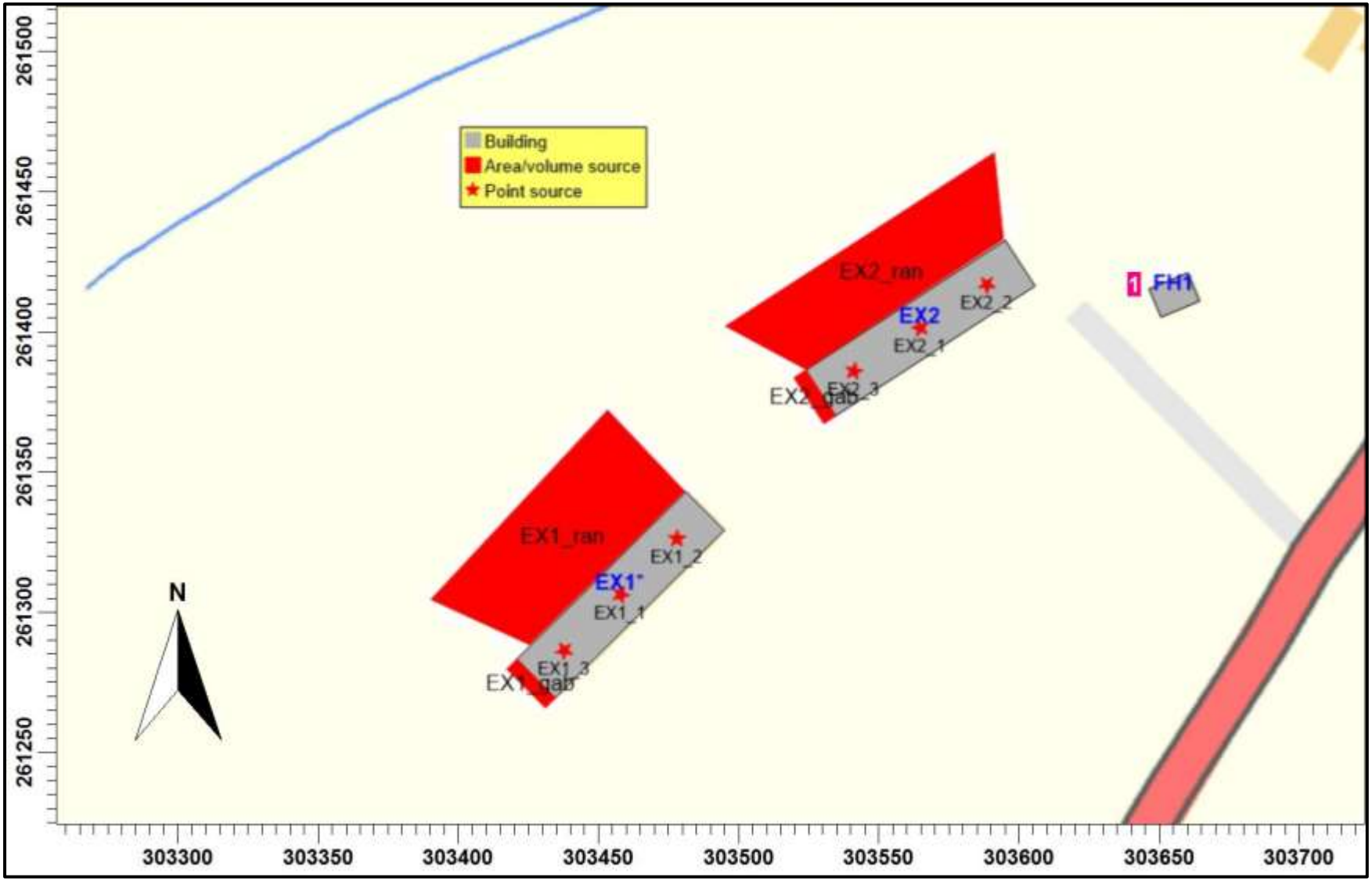


Figure 4b. The positions of modelled buildings & sources – proposed scenario

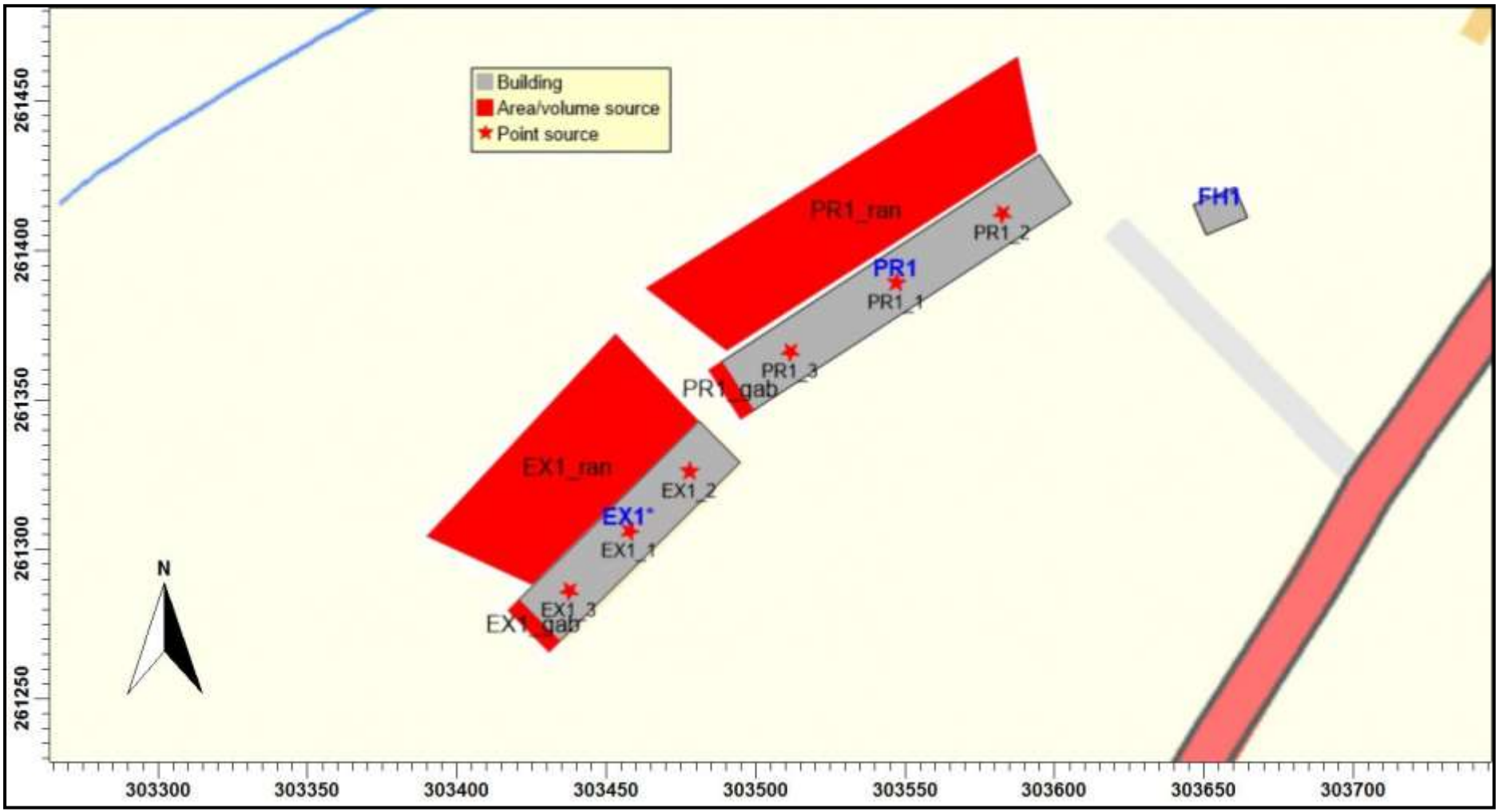
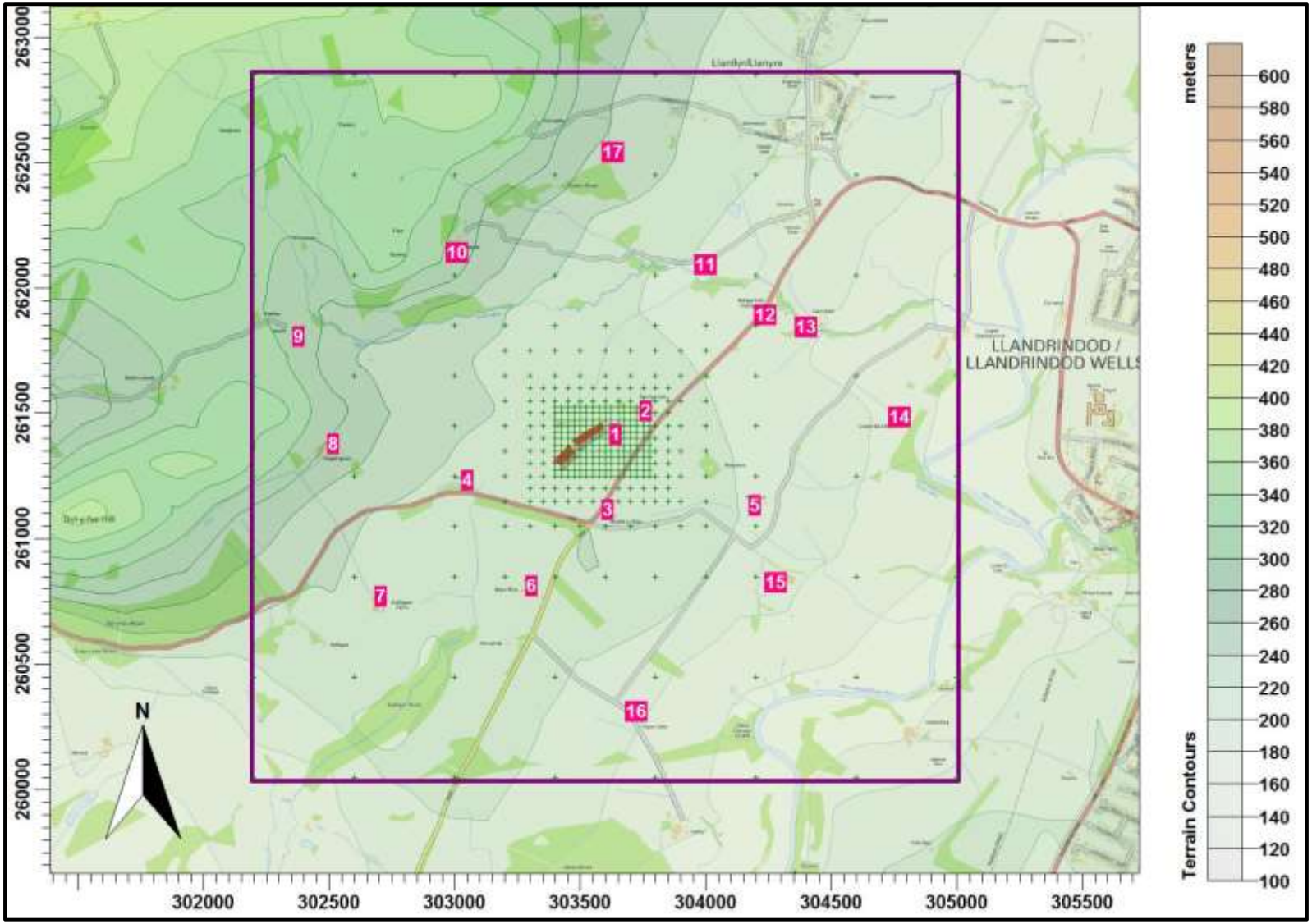


Figure 5. The discrete receptors and nested Cartesian grid receptors



5. Details of the Model Runs and Results

For this study, ADMS was run with calms module of ADMS and with terrain. ADMS was run a total of thirty-two times, once for each year of the four year meteorological record, for both the existing and proposed scenarios and in the following four modes:

- With calms and with terrain – GFS data – Natural Resources Wales emissions.
- With calms and with terrain – Sennybridge data – Natural Resources Wales emissions.
- With calms and with terrain – Shobdon data – Natural Resources Wales emissions.
- With calms and with terrain – Trawscoed data – Natural Resources Wales emissions.

A summary of the results of these runs at the discrete receptors is provided in Table 3 where the maximum annual 98th percentile hourly mean odour concentration is shown. Contour plots of the maximum annual 98th percentile hourly mean odour concentrations for the GFS model runs is shown in Figure 6a, for the existing scenario and Figure 6b, for the proposed scenario.

In Table 3, predicted odour exposures in excess of the Environment Agency's benchmark of 3.0 ou_E/m^3 as an annual 98th percentile hourly mean are coloured blue; those in the range that UKWIR research suggests gives rise to a significant proportion of complaints, 5.0 ou_E/m^3 to 10.0 ou_E/m^3 as an annual 98th percentile hourly mean, are coloured orange and predicted exposures likely to cause annoyance and complaint are coloured red.

Table 3. Predicted maximum annual 98th percentile hourly mean odour concentrations at the discrete receptors

Receptor number	X(m)	Y(m)	Site	Maximum annual mean 98th percentile odour concentration (ou_E/m^3)							
				Existing				Proposed			
				GFS	Sennybridge	Shobdon	Trawscoed	GFS	Sennybridge	Shobdon	Trawscoed
1	303641	261417	Residence, Cerricgoes Farm	**6.67**	**8.55**	**8.09**	**6.60**	**4.16**	**8.04**	**9.20**	**4.85**
2	303760	261509	Cerricgoes Farm House	1.89	**5.74**	**3.54**	1.53	1.60	1.73	2.53	1.31
3	303610	261116	Bwlch-y-rhiw	1.55	**3.40**	1.52	0.75	1.03	1.73	1.16	0.71
4	303051	261231	Lane Cottages	0.73	1.35	2.13	0.37	0.72	0.36	1.43	0.40
5	304195	261132	The Court	0.45	1.68	1.21	0.55	0.36	0.37	0.70	0.45
6	303305	260813	Bryn-Ffyn	0.56	2.21	0.58	0.13	0.59	0.95	0.61	0.13
7	302708	260769	Gelligarn Farm	0.26	1.26	0.98	0.09	0.23	0.18	0.55	0.10
8	302516	261378	Pistyll-Gwyn	0.11	0.18	0.31	0.10	0.12	0.07	0.36	0.11
9	302378	261807	Duarth	0.08	0.14	0.09	0.14	0.09	0.05	0.08	0.12
10	303010	262139	Fronhir	0.07	0.53	0.07	0.32	0.09	0.09	0.08	0.44
11	304000	262092	Residence	0.24	1.85	0.24	0.28	0.25	0.36	0.23	0.26
12	304236	261890	Bridge End Cottages	0.41	1.78	0.57	0.29	0.44	0.45	0.49	0.33
13	304398	261843	Cwm-Nant	0.32	1.54	0.63	0.24	0.37	0.35	0.39	0.22
14	304771	261485	Lower Dol-llwyn-hir	0.21	0.62	0.48	0.15	0.19	0.17	0.26	0.13
15	304278	260827	Beili	0.30	1.17	0.69	0.24	0.27	0.22	0.46	0.23
16	303722	260313	Upper Lletty	0.21	1.25	0.13	0.08	0.16	0.30	0.12	0.06
17	303630	262541	Residence, off Punt Y Rhiwen Lane	0.15	1.07	0.13	0.84	0.12	0.34	0.11	0.28

Figure 6a. Predicted maximum annual mean 98th percentile hourly mean odour concentration – existing scenario

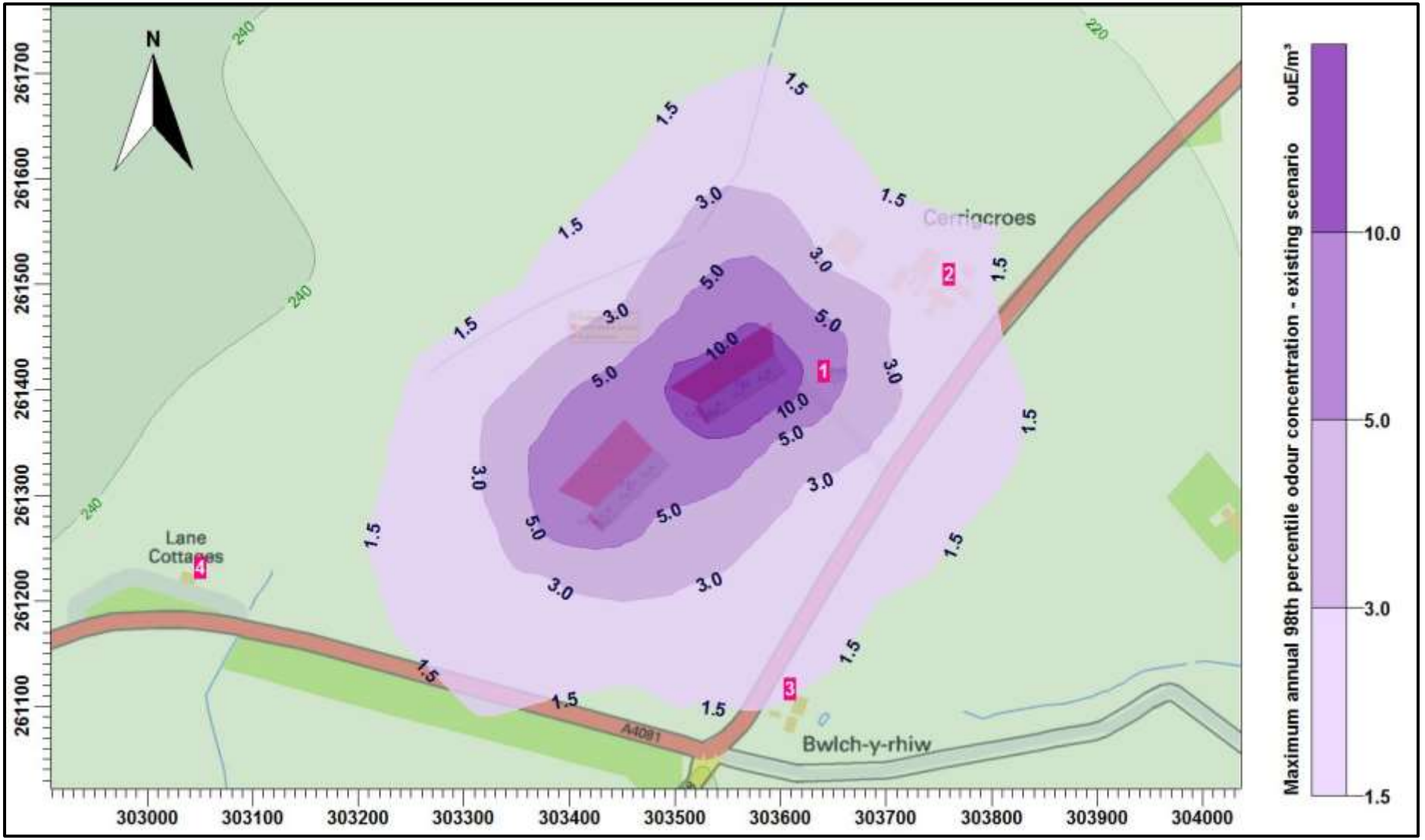
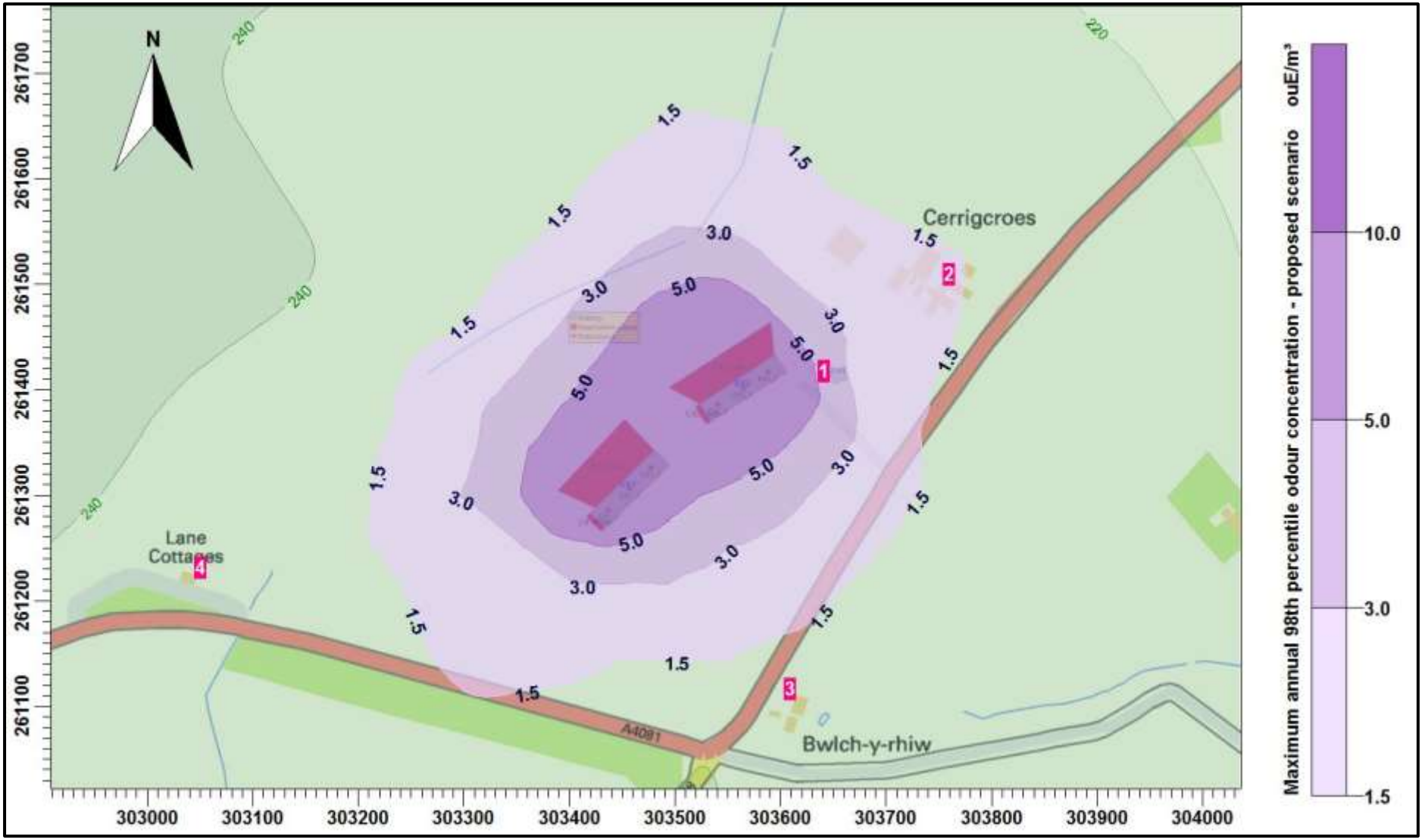


Figure 6b. Predicted maximum annual mean 98th percentile hourly mean odour concentration – proposed scenario



6. Summary and Conclusions

AS Modelling & Data Ltd. has been instructed by Steve Raasch on behalf of Ross Aberley of A.J. Abberley, to use computer modelling to assess the impact of odour emissions from the existing and proposed free range egg laying chicken houses at Cerrigcroes, Lanyre, near Llandrindod Wells in Powys. LD1 6EU.

Odour emission rates from the existing and proposed poultry houses have been assessed and quantified based upon emission rates mandated by Natural Resources Wales. The odour emission rates so obtained have then been used as inputs to an atmospheric dispersion model which calculates odour exposure levels in the surrounding area.

The modelling predicts that, at all nearby residences not associated with Cerrigcroes, the odour concentrations would be below the Environment Agency's benchmark for moderately offensive odours, a maximum annual 98^{th} percentile hourly mean concentration of 3.0 ou_E/m^3, for both the existing and proposed scenarios.

The modelling predicts that, for both the existing and proposed scenarios, there is one residence, at Cerrigcroes Farm, where there is an exceedance of the Environment Agency's benchmark for moderately offensive odours. For the existing scenario, the modelled odour concentration at this receptor is predicted to be in the range which UKWIR research suggests gives rise to a significant proportion of complaints. However, the modelled odour concentration at this receptor is less than this range in the proposed scenario.

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