A Report on the Modelling of the Dispersion and Deposition of Ammonia from the Proposed Broiler Chicken Rearing Houses at Drefor, near Kerry in Powys

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1. Introduction

AS Modelling & Data Ltd. has been instructed by Gail Jenkins, of Roger Parry & Partners LLP, on behalf of Morton and Mandy Powell, to use computer modelling to assess the impact of ammonia emissions from the proposed broiler chicken rearing houses at Drefor, Kerry, near to Newtown, Powys. SY16 4PQ.

Ammonia emission rates from the proposed poultry houses have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors. The ammonia emission rates have then been used as inputs to an atmospheric dispersion and deposition model which calculates ammonia exposure levels and nitrogen and acid deposition rates in the surrounding area.

This report is arranged in the following manner:

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

- Section 3 provides some general information on ammonia; details of the method used to estimate ammonia emissions, relevant guidelines and legislation on exposure limits and where relevant, details of likely background levels of ammonia.

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

- Section 5 contains the results of the modelling.

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

2. Background Details

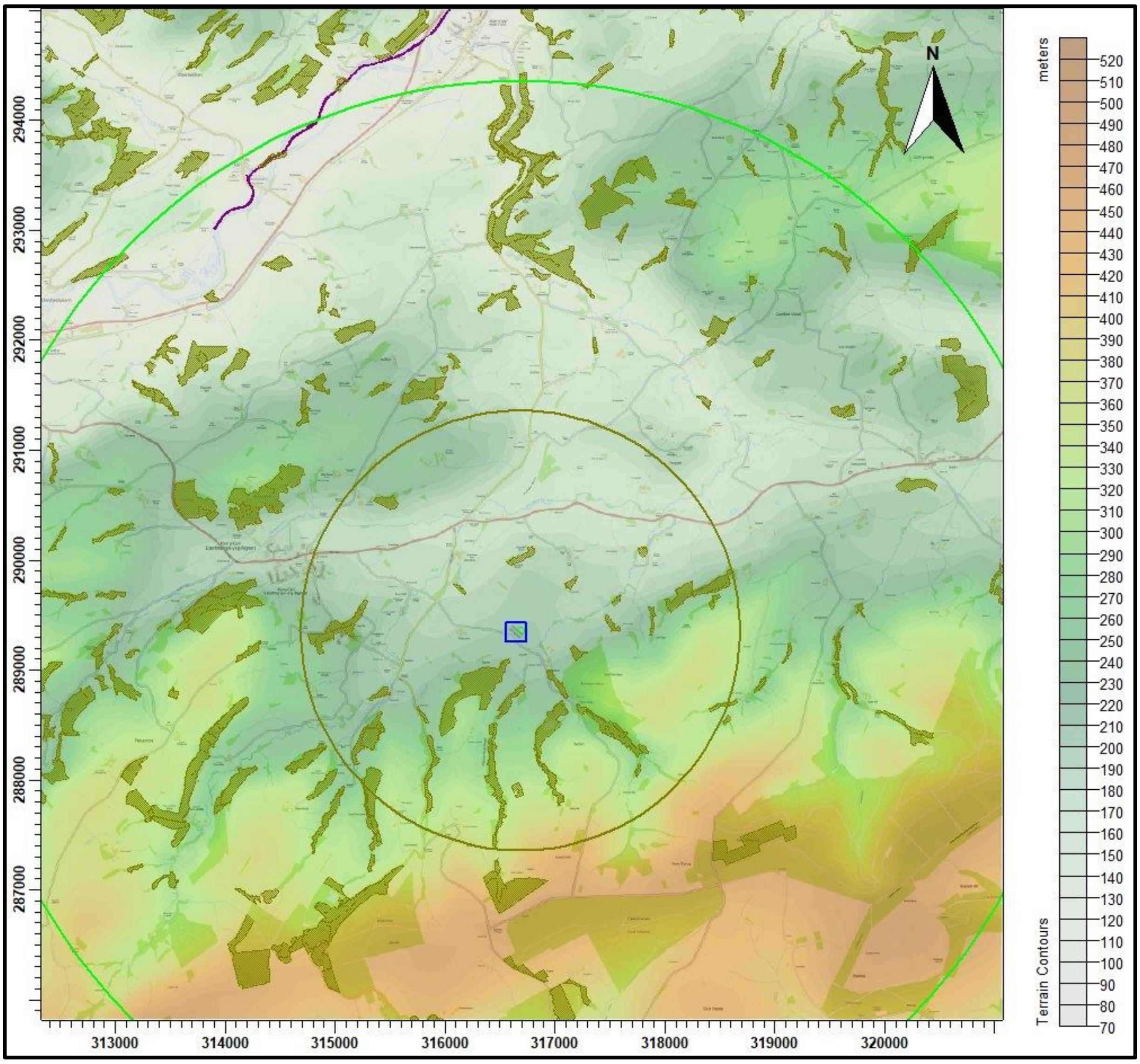
The site of the proposed broiler chicken rearing houses is in a rural area, approximately 1.8 km to the south-east of the village of Kerry, near to Newtown in Powys. The surrounding land is used largely for livestock farming, although there are also wooded areas nearby. The site is in a hilly area at an elevation of around 220 m on land above the River Mule to the north.

Under the proposal, two new poultry houses would be constructed at Drefor. The poultry houses would provide accommodation for up to 110,000 broiler chickens and would be ventilated by high speed ridge mounted fans, each with a short chimney.

There are a number of areas designated as Ancient Woodland (AW) within 2 km of the proposed poultry house at Drefor. In addition, there are also parts of Montgomery Canal, which is designated as a Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC) that are within 5 km of the farm.

A map of the surrounding area showing the positions of the proposed poultry house and the nearby wildlife sites is provided in Figure 1. In this figure, the AWs are shaded in olive, the Montgomery Canal SSSI/SAC is shaded purple and the site of the proposed poultry house is outlined in blue.

Figure 1. The area surrounding the site – concentric circles radii at 2 km (olive) and 5 km (green)



3. Ammonia, Background Levels, Critical Levels & Loads & Emission Rates

3.1 Ammonia concentration and nitrogen and acid deposition

When assessing potential impact on ecological receptors, ammonia concentration is usually expressed in terms of micrograms of ammonia per metre cubed of air (µg-NH_3/m^3) as an annual mean. Ammonia in the air may exert direct effects on the vegetation, or indirectly affect the ecosystem through deposition which causes both hyper-eutrophication (excess nitrogen enrichment) and acidification of soils. Nitrogen deposition, specifically in this case the nitrogen load due to ammonia deposition/absorption, is usually expressed in kilograms of nitrogen per hectare per year (kg-N/ha/y). Acid deposition is expressed in terms of kilograms equivalent (of H^+ ions) per hectare per year (keq/ha/y).

3.2 Background ammonia levels and nitrogen and acid deposition

The background ammonia concentration (annual mean) in the area around the site of the proposed poultry unit and the wildlife sites is 1.13 µg-NH_3/m^3. The background nitrogen deposition rate to woodland is 30.94 kg-N/ha/y and to short vegetation is 19.04 kg-N/ha/y. The background acid deposition rate to woodland is 2.34 keq/ha/y and to short vegetation is 1.47 keq/ha/y. The source of these background figures is the Air Pollution Information System (APIS, December 2018).

3.3 Critical Levels & Critical Loads

Critical Levels and Critical Loads are a benchmark for assessing the risk of air pollution impacts to ecosystems. It is important to distinguish between a Critical Level and a Critical Load. The Critical Level is the gaseous concentration of a pollutant in the air, whereas the Critical Load relates to the quantity of pollutant deposited from air to the ground.

Critical Levels are defined as, "concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge" (UNECE).

Critical Loads are defined as, "a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge" (UNECE).

For ammonia concentration in air, the Critical Level for higher plants is 3.0 µg-NH_3/m^3 as an annual mean. For sites where there are sensitive lichens and bryophytes present, or where lichens and bryophytes are an integral part of the ecosystem, the Critical Level is 1.0 µg-NH_3/m^3 as an annual mean.

Critical Loads for nutrient nitrogen are set under the Convention on Long-Range Transboundary Air Pollution. They are based on empirical evidence, mainly observations from experiments and gradient studies. Critical Loads are given as ranges (e.g. 10-20 kg-N/ha/y); these ranges reflect variation in ecosystem response across Europe.

The Critical Levels and Critical Loads at the wildlife sites assumed in this study are provided in Table 1. N.B. Where the Critical Level of 1.0 µg-NH_3/m^3 is assumed, it is usually unnecessary to consider the Critical Load as the Critical Level provides the stricter test. However, it may be necessary to consider nitrogen deposition should a Critical Load of 5.0 kg-N/ha/y, or lower, be appropriate. Normally, the Critical Load for nitrogen deposition provides a stricter test than the Critical Load for acid deposition.

Table 1. Critical Levels and Critical Loads at the wildlife sites

Site	Critical Level (µg-NH_3/m^3)	Critical Load Nitrogen (kg-N/ha/y)	Critical Load Acid (keq/ha/y)
Unnamed AWs	1.0 [1]	-	-
Montgomery Canal SAC	3.0 [2]	n/a	-

1. A precautionary figure used where no details of the ecology of the site are available, or the citation for the site contains reference to sensitive lichens and/or bryophytes.
2. Based upon the SSSI citation.

3.4 Guidance on the Significance of Ammonia Emissions

In March 2017, Natural Resources Wales (Regulation and Permitting Department, EPP) published Operational Guidance Note 41 (OGN 41), "Assessment of ammonia and nitrogen impacts from livestock units when applying for an Environmental Permit or Planning Permission". This guidance was intended to update the way Natural Resources Wales (NRW) assessed emissions, in particular by changing the thresholds of insignificance and the upper threshold process contributions for designated sites. These designated sites include European sites, such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites as well as Sites of Special Scientific Interest (SSSIs).

Table 1 in OGN 41 describes the revised screening distance and thresholds for livestock developments; the threshold of insignificant percentage of the designated site Critical Level or Load is given as 1%; the upper threshold percentage of the designated site Critical Level or Load is given as 8%.

Table 2 in OGN 41 describes the possible outcomes of assessment and for detailed modelling of the application alone, where process contributions, considered in isolation, are up to 1% of the designated site Critical Level or Load, then it should be determined that there is no significant environmental effect/no likely significant effect/damage to scientific interest.

Where process contributions, considered in isolation, are between 1% and 8% of the designated site Critical Level or Load, an in-combination assessment is required. Should the in-combination process contributions be between 1% and 8% of the designated site Critical Level or Load then it should be determined that the application would cause no significant environmental effect/likely significant effect/damage to scientific interest.

When considering process contributions, in isolation or in-combination, if they exceed 1% of the designated site Critical Level or Load it is necessary to consider background concentrations and whether the designated site Critical Level or Load is breached and whether additional controls may be necessary. The application will then be determined based on whether there will be significant environmental effect/adverse effect/damage to scientific interest.

For Local Nature Reserves (LNRs), Local Wildlife Sites (LWSs) and Ancient Woodlands (AWs), the current assessment procedure usually applied is based on the Environment Agency's horizontal guidance, H1 Environmental Risks Assessment, H1 Annex B - Intensive Farming. The following are taken from this document.

"An emission is insignificant where Process Contribution (PC) is <50% for local and national nature reserves (LNRs & NNRs), ancient woodland and local wildlife sites." And "Where modelling predicts a process contribution >100% at a NNR, LNR, ancient woodland or local wildlife site, your proposal may not be considered acceptable. In such cases, your assessment should include proposals to reduce ammonia emissions."

This document was withdrawn February 1st 2016 and replaced with a web-page titled "Intensive farming risk assessment for your environmental permit", which contains essentially the same criteria. It is assumed that the upper threshold and lower threshold on the web-page refers to the levels that were previously referred to as levels of insignificance and acceptability in Annex B - Intensive Farming.

Within the range between the lower and upper thresholds, whether or not the impact is deemed acceptable is at the discretion of the Environment Agency. N.B. In the case of LWSs and AWs, the Environment Agency do not usually consider other farms that may act in-combination and therefore a PC of up to 100% of Critical Level or Critical Load is usually deemed acceptable for permitting purposes and therefore the upper and lower thresholds are the same (100%).

3.5 IAQM Position Statement on the use of the 1% criterion

A Position Statement issued by the Institute of Air Quality Management (IAQM) in January 2016 further clarifies the use of the 1% criterion for the determination of an '*insignificant*' effect of air quality impacts on sensitive habitats. The Position Statement states: "*the use of a criterion of 1% of an environmental standard or assessment level in the context of habitats should be used only to screen out impacts that will have an insignificant effect. It should not be used as a threshold above which damage is implied.*" Furthermore, if the impacts are plainly above 1% then this should be regarded as potentially significant; where impacts are just slightly greater than 1% then a degree of professional judgement should be applied with regards to the theoretical risk.

3.6 Quantification of ammonia emissions

Ammonia emission rates from poultry houses depend on many factors and are likely to be highly variable. However, the benchmarks for assessing impacts of ammonia and nitrogen deposition are framed in terms of an annual mean ammonia concentration and annual nitrogen deposition rates. To obtain relatively robust figures for these statistics it is not necessary to model short term temporal variations and a steady continuous emission rate can be assumed. In fact, modelling short term temporal variations might introduce rather more uncertainty than modelling continuous emissions.

The Environment Agency provided an Intensive farming guidance note which lists standard ammonia emission factors for a variety of livestock, including broiler chickens. The emission factor for broiler chickens is 0.034 kg-NH_3/bird place/y; this figure is used to calculate the emissions from the proposed poultry houses.

Details of the poultry numbers and types and emission factors used and calculated ammonia emission rates are provided in Table 2.

Table 2. Details of poultry numbers and ammonia emission rates

Source	Animal numbers	Type or weight	Emission factor (kg-NH_3/place/y)	Emission rate (g-NH_3/s)
Proposed Housing	110,000	Broiler Chickens	0.034	0.118513

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). Observational meteorological data from Lake Vyrnwy and Shobdon have also been considered.

The GFS is a spectral model: the physics/dynamics model has an equivalent resolution of approximately 13 km; terrain is understood to be resolved at a resolution of approximately 2 km (with sub 13 km terrain effects parameterised) and data are archived at a resolution of 0.25 degrees (site specific data may be extrapolated from nearby archive grid points or a most representative grid point chosen). 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 raw GFS wind speeds are modified by the treatment of roughness lengths (see Section 4.7) and where terrain data is included in the modelling, wind speeds and directions will be further modified. The raw GFS wind rose is shown in Figure 2a and the terrain and roughness length modified wind rose for Drefor is shown in Figure 2b. Note that elsewhere in the modelling domain modified wind roses may differ more markedly and that the resolution of the wind field is approximately 300 m. Please also note that FLOWSTAR is used to obtain a local flow field, not to explicitly model dispersion in complex terrain as defined in the ADMS User Guide; therefore, the ADMS default value for minimum turbulence length has been amended.

Data from the meteorological recording stations at Lake Vyrnwy and Shobdon have also been considered. However, neither Lake Vyrnwy nor Shobdon, has an aspect that in any way could be considered similar to Drefor; therefore, it should be noted that the frequency of winds from a particular direction in the Lake Vyrnwy and Shobdon data may be either high or low in comparison to what might occur at Drefor, which means mean concentrations downwind may be either over or under predicted. Additionally, periods of light winds and calms cannot be properly modelled. Therefore, 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.

The wind roses for Lake Vyrnwy and Shobdon are shown in Figures 2c and 2d.

Figure 2a. The wind rose. Raw GFS derived data, for 52.492 N, 3.226 W, 2014 - 2017

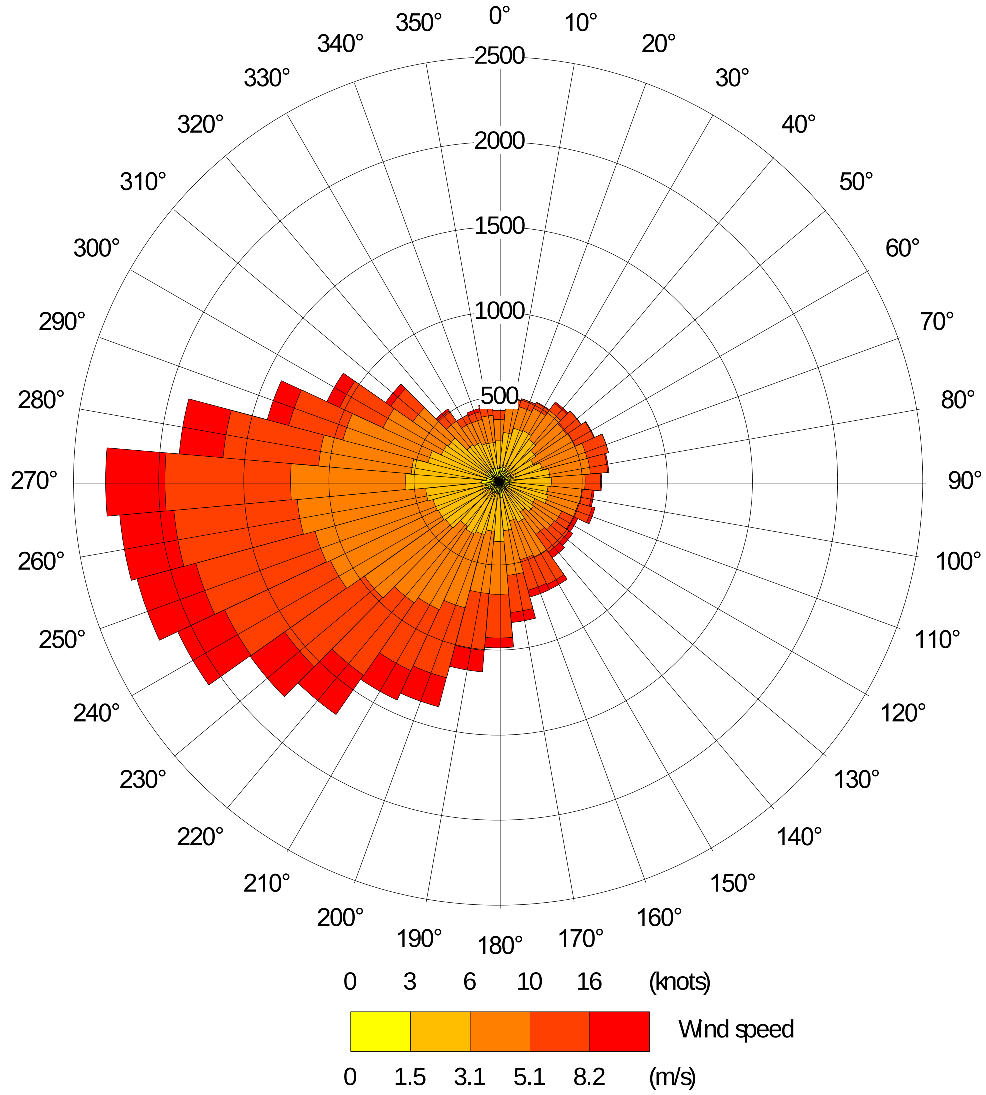


Figure 2b. The wind rose. FLOWSTAR modified GFS derived data for NGR 316700, 289400

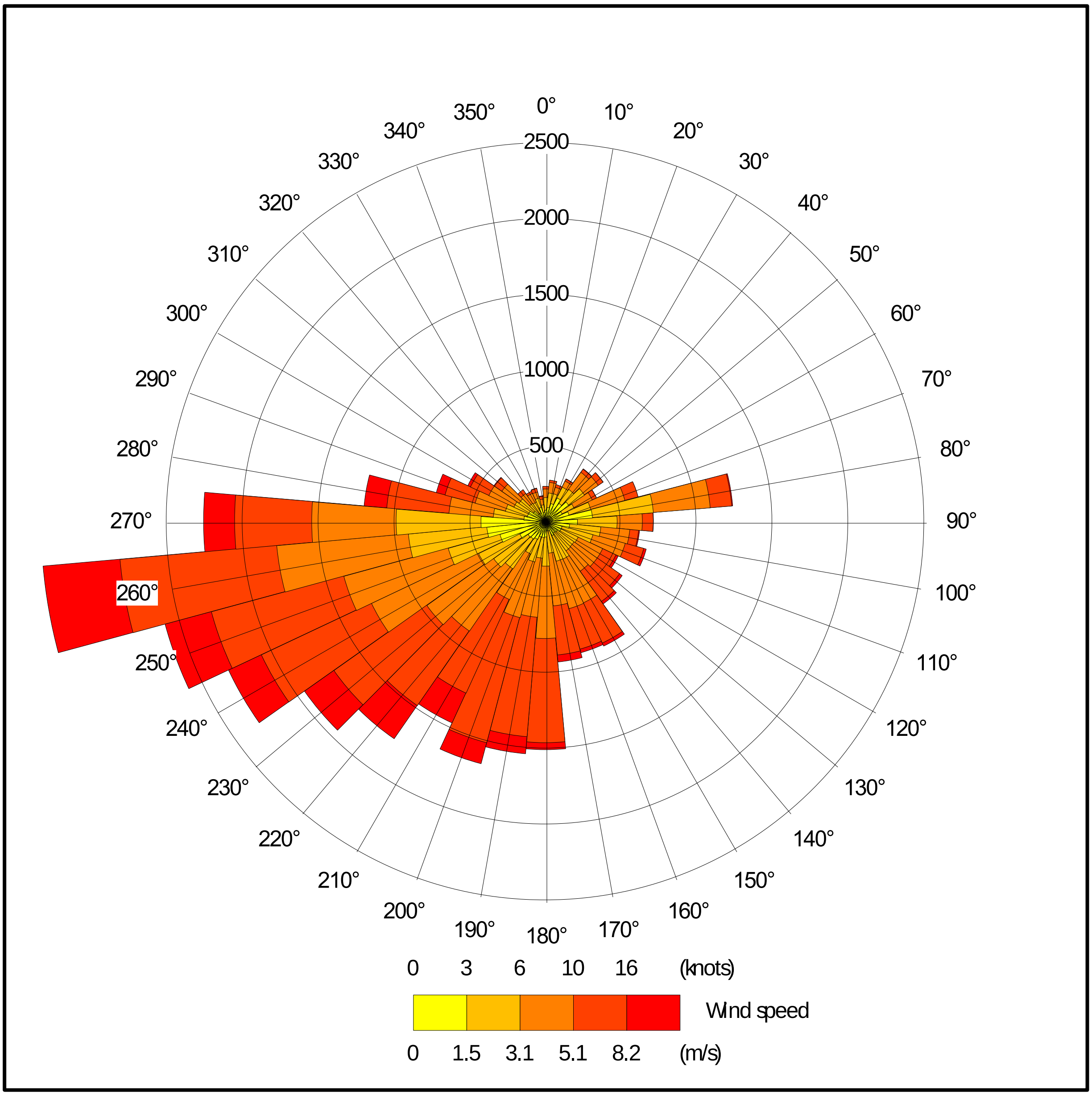


Figure 2c. The wind rose. Lake Vyrnwy, 2014 – 2017

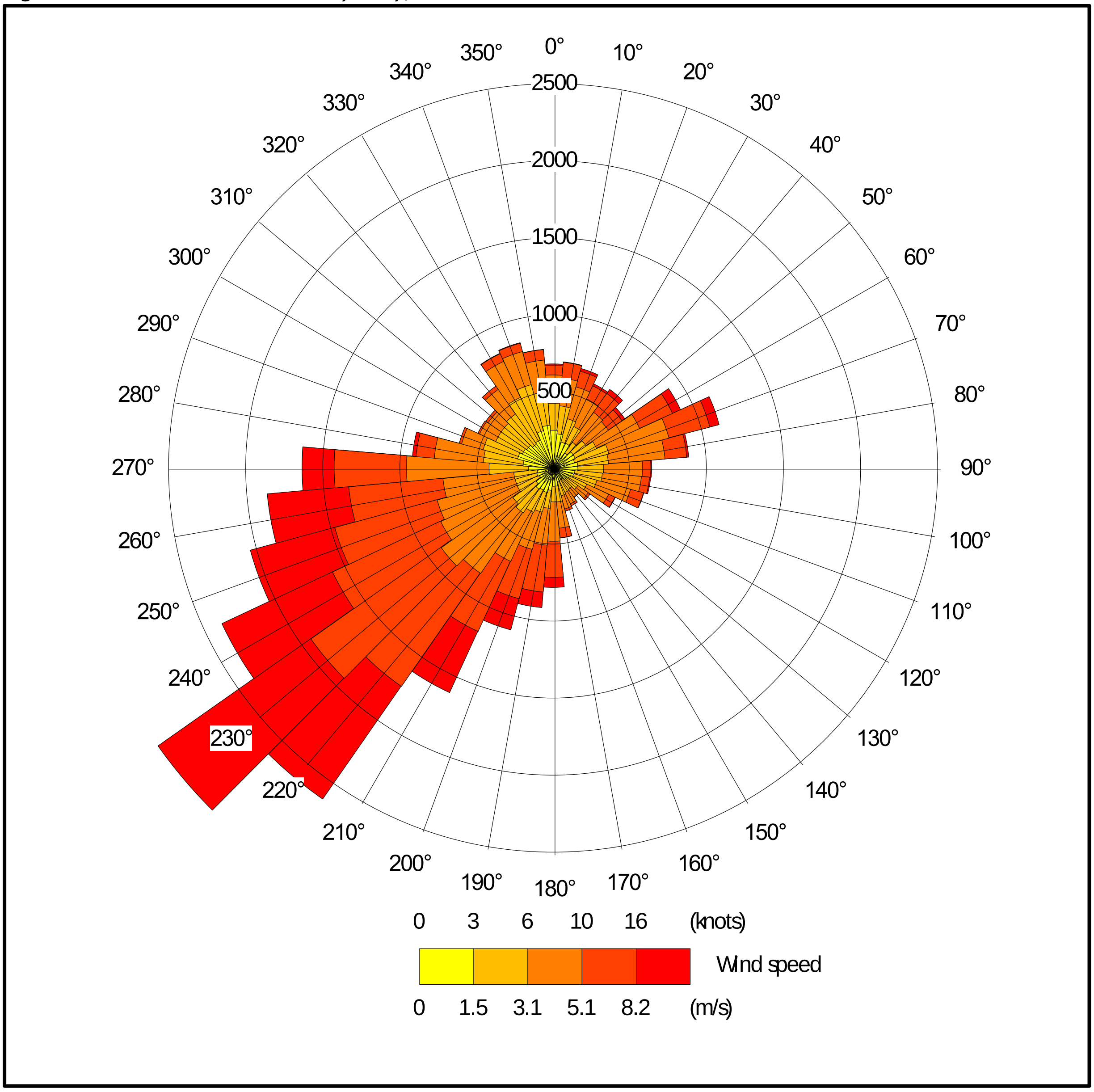
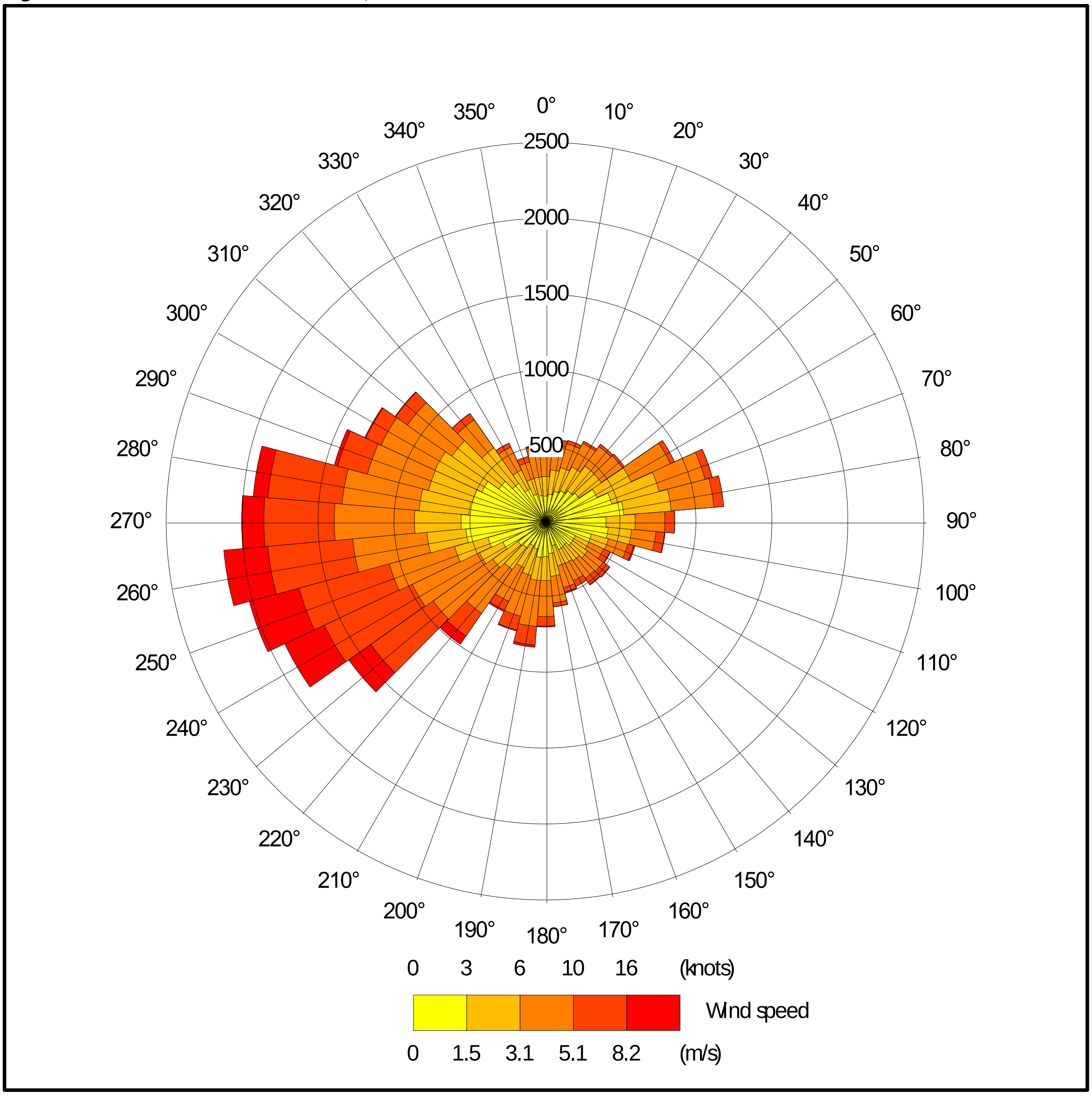


Figure 2d. The wind rose. Shobdon, 2014 – 2017



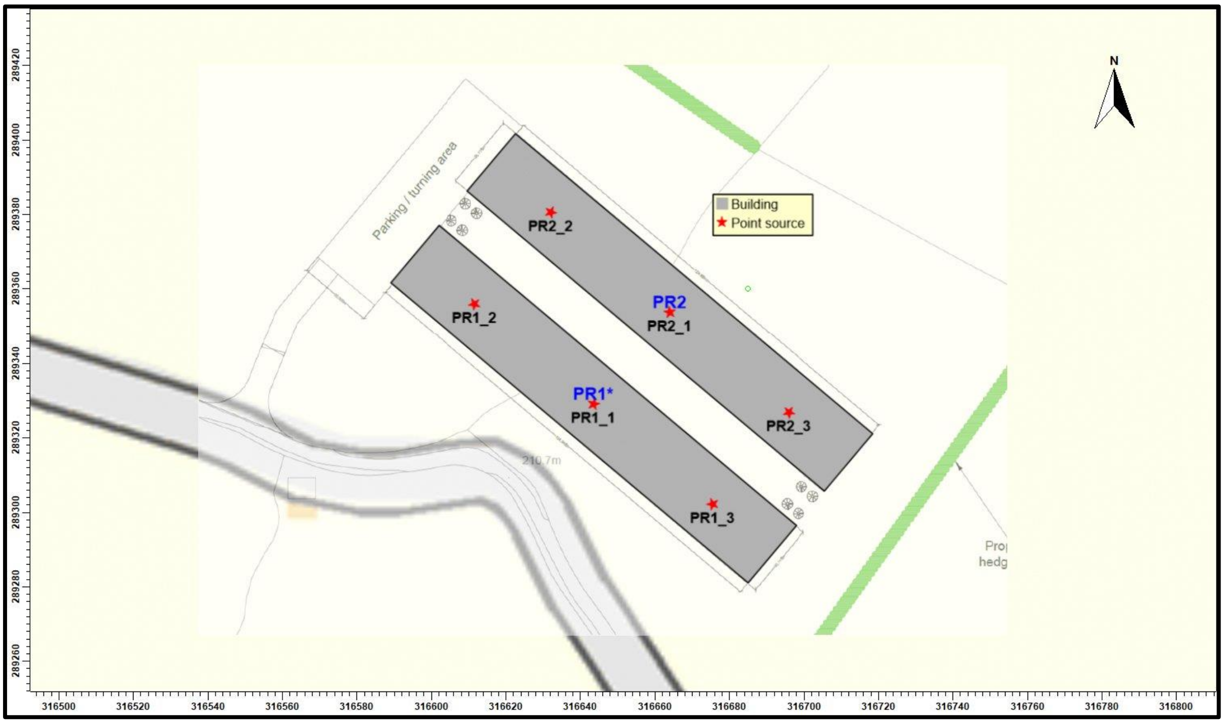
4.2 Emission sources

Emissions from the high speed ridge/roof fans that would be used to ventilate the proposed poultry houses are represented by three point sources within ADMS (PR1 and PR2; a, b & c). Details of the point source parameters are shown in Table 3 and the positions of the point sources may be seen in Figure 3, where they are indicated by red star symbols.

Table 3. Point source parameters

Source ID	Height (m)	Diameter (m)	Efflux velocity (m/s)	Emission temperature (˚C)	Emission rate per source ($g\text{-}NH_3/s$)
PR1 & PR2; a, b & c	5.5	0.8	11.0	22.0	0.019752

Figure 3. The positions of the modelled building and sources



4.3 Modelled buildings

The structure of the proposed poultry houses may affect the plumes from the point sources; therefore, this building is modelled within ADMS. The position of the modelled building may be seen in Figure 3, where it is marked by a grey rectangle.

4.4 Discrete receptors

Fifty discrete receptors have been defined: forty-six at the AWs (1 to 46) and four at the SAC (47 to 50). These receptors are defined at ground level within ADMS. The positions of the discrete receptors may be seen in Figures 4a and 4b, where they are marked by enumerated pink rectangles.

4.5 Cartesian grid

Not used.

Figure 4a. The discrete receptors – a broad scale view

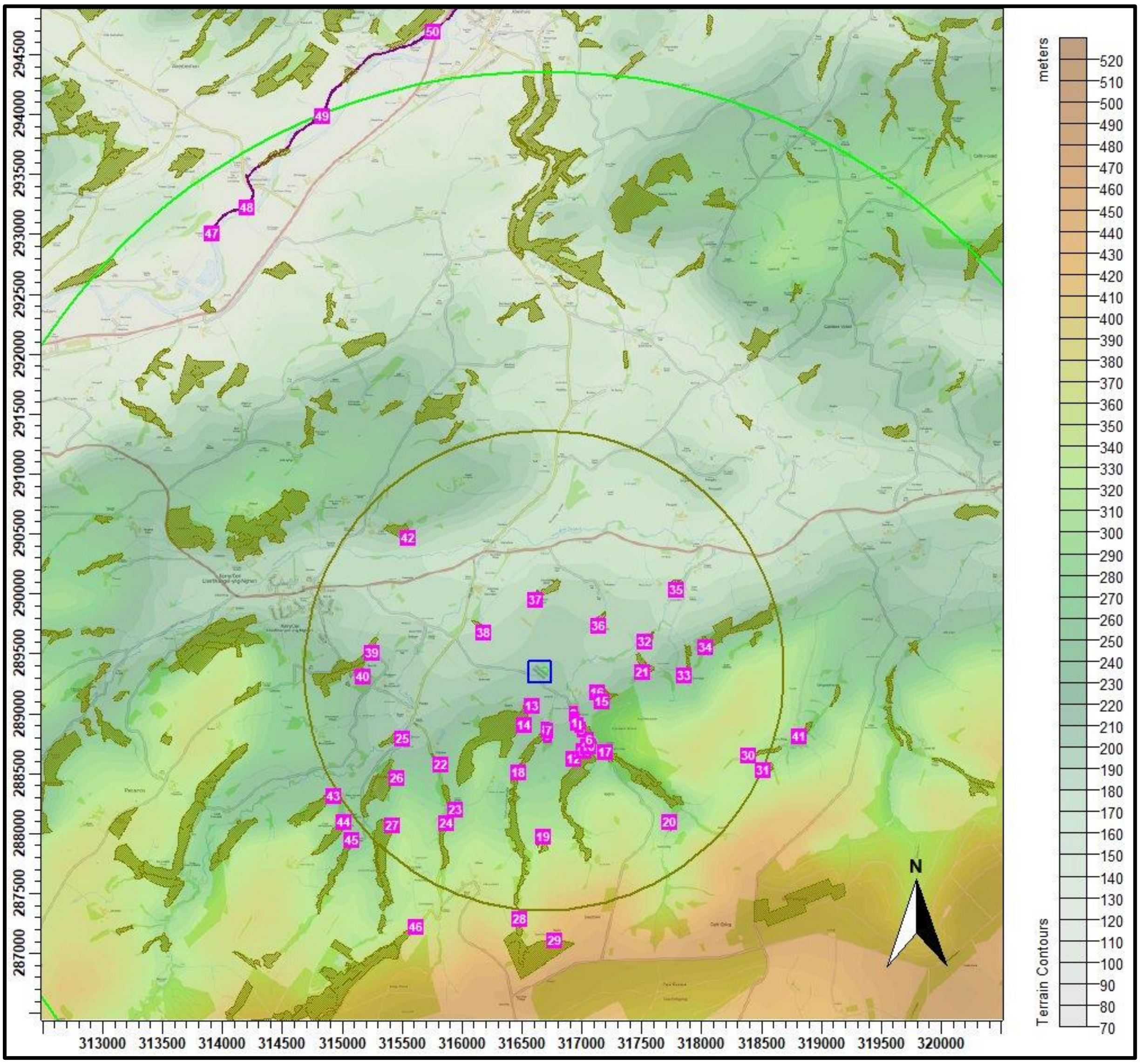
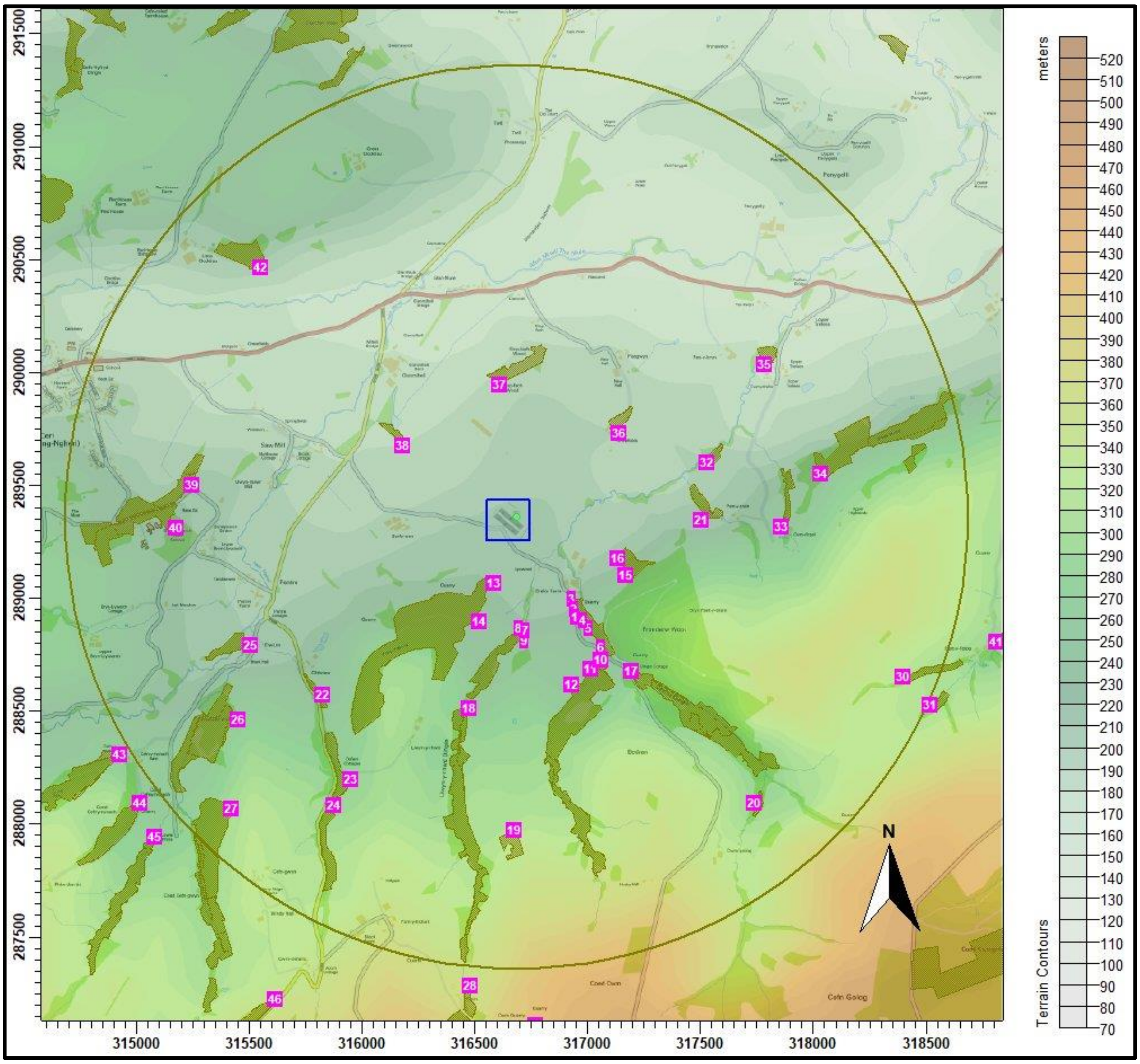


Figure 4b. The discrete receptors and regular Cartesian grid – a closer view



4.6 Terrain data

Terrain has been considered in the modelling. The terrain data are based upon the Ordnance Survey 50 m Digital Elevation Model. A 20.0 km x 20.0 km domain has been resampled at 100 m horizontal resolution for use within ADMS. N.B. The resolution of FLOWSTAR is 64 x 64 grid points; therefore, the effective resolution of the wind field is approximately 300 m.

4.7 Roughness Length

A fixed surface roughness length of 0.3 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 0.275 m. The effect of the difference in roughness length is precautionary as it increases the frequency of low wind speeds and stability and therefore increases predicted ground level concentrations.

4.8 Deposition

The method used to model deposition of ammonia and consequent plume depletion is based on a document titled "Guidance on modelling the concentration and deposition of ammonia emitted from intensive farming" from the Environment Agency's Air Quality Modelling and Assessment Unit, 22 November 2010. In this case, it proves unnecessary to model deposition of ammonia explicitly and where deposition figures are quoted, these are obtained by multiplying the predicted ammonia concentration by an appropriate deposition velocity and a factor of 259.7 to convert units. Please note that, because deposition of ammonia and the consequent plume depletion are not accounted for, this is a precautionary approach. Therefore, predicted ammonia concentrations (and nitrogen and acid deposition rates) are always higher than if deposition were modelled explicitly, particularly where there is some distance between the source and a receptor. Please also note that where a fixed deposition velocity of 0.003 m/s is used, predicted ammonia concentrations (and nitrogen and acid deposition rates) are always higher than if the spatially varying deposition is modelled as per the Environment Agency's guidance.

5. Details of the Model Runs and Results

5.1 Preliminary modelling

ADMS was run a total of twenty-four times; once for each year of the meteorological record and in the following six modes:

- In basic mode without calms or terrain – GFS data.
- In basic mode without calms or terrain – Lake Vyrnwy data.
- In basic mode without calms or terrain – Shobdon data.
- With calms and without terrain – GFS data.
- Without calms and with terrain – GFS data.
- Without calms and with terrain and a fixed deposition velocity of 0.003 m/s.

For each mode, statistics for the maximum annual mean ammonia concentration at each receptor were compiled.

Details of the predicted annual mean ammonia concentrations at each receptor are provided in Table 5. In the Table, predicted ammonia concentrations that are in excess of the Natural Resources Wales upper threshold (8% of Critical Level for a SAC/SSSI or 100% of the Critical Level for a non-statutory site) are coloured red. Concentrations that are in the range between the Natural Resources Wales lower and upper threshold (1% and 8% for a SAC/SSSI or 50% [1] to 100% for a non-statutory site) are coloured blue. For convenience, cells referring to the AWs are shaded olive and cells referring to the SAC are shaded lilac.

1. The pre-February 2016 value is used.

Table 5. Predicted maximum annual mean ammonia concentration at the discrete receptors

Receptor number	X(m)	Y(m)	Designation	Maximum annual mean ammonia concentration (µg/m³)					
				GFS No Calms No terrain	Lake Vyrnwy No Calms No terrain	Shobdon No Calms No terrain	GFS Calms No Terrain	GFS No Calms Terrain	GFS No Calms Terrain Fixed Dep
1	316946	288916	Unnamed AW	0.099	0.165	0.147	0.098	0.086	0.059
2	316939	288952	Unnamed AW	0.116	0.173	0.173	0.115	0.098	0.068
3	316931	288995	Unnamed AW	0.141	0.179	0.212	0.140	0.115	0.080
4	316979	288902	Unnamed AW	0.097	0.148	0.149	0.096	0.088	0.059
5	317003	288868	Unnamed AW	0.087	0.136	0.135	0.086	0.089	0.058
6	317061	288781	Unnamed AW	0.068	0.114	0.108	0.067	0.109	0.059
7	316726	288858	Unnamed AW	0.081	0.139	0.092	0.081	0.070	0.057
8	316695	288868	Unnamed AW	0.085	0.134	0.100	0.085	0.073	0.059
9	316719	288813	Unnamed AW	0.072	0.121	0.083	0.072	0.064	0.050
10	317059	288726	Unnamed AW	0.057	0.112	0.089	0.057	0.085	0.046
11	317016	288688	Unnamed AW	0.048	0.115	0.072	0.048	0.064	0.037
12	316930	288618	Unnamed AW	0.043	0.106	0.053	0.043	0.045	0.029
13	316586	289066	Unnamed AW	0.211	0.305	0.245	0.209	0.151	0.131
14	316520	288897	Unnamed AW	0.122	0.172	0.128	0.121	0.081	0.062
15	317169	289102	Unnamed AW	0.222	0.137	0.257	0.220	0.131	0.094
16	317134	289178	Unnamed AW	0.313	0.178	0.314	0.310	0.170	0.137
17	317193	288674	Unnamed AW	0.055	0.084	0.095	0.055	0.076	0.038
18	316473	288511	Unnamed AW	0.057	0.081	0.057	0.057	0.037	0.025
19	316677	287972	Unnamed AW	0.022	0.054	0.027	0.022	0.015	0.009
20	317737	288093	Unnamed AW	0.025	0.041	0.051	0.024	0.022	0.010
21	317504	289346	Unnamed AW	0.190	0.111	0.182	0.188	0.162	0.129
22	315826	288571	Unnamed AW	0.044	0.048	0.054	0.044	0.033	0.023
23	315950	288198	Unnamed AW	0.034	0.044	0.035	0.034	0.030	0.018
24	315874	288080	Unnamed AW	0.031	0.040	0.032	0.030	0.024	0.014
25	315504	288791	Unnamed AW	0.036	0.053	0.075	0.035	0.066	0.044
26	315453	288461	Unnamed AW	0.029	0.038	0.047	0.029	0.027	0.017
27	315421	288069	Unnamed AW	0.024	0.027	0.033	0.024	0.014	0.010
28	316481	287285	Unnamed AW	0.017	0.037	0.019	0.017	0.006	0.004
29	316771	287108	Unnamed AW	0.012	0.037	0.015	0.012	0.004	0.003
30	318395	288651	Unnamed AW	0.046	0.040	0.070	0.045	0.017	0.010
31	318515	288528	Unnamed AW	0.039	0.037	0.064	0.038	0.016	0.009
32	317530	289598	Unnamed AW	0.152	0.106	0.136	0.150	0.217	0.191
33	317858	289314	Unnamed AW	0.112	0.067	0.121	0.111	0.076	0.055
34	318035	289548	Unnamed AW	0.086	0.055	0.094	0.084	0.093	0.071
35	317785	290033	Unnamed AW	0.073	0.069	0.063	0.072	0.116	0.102
36	317141	289728	Unnamed AW	0.214	0.231	0.170	0.211	0.327	0.305
37	316610	289945	Unnamed AW	0.134	0.075	0.096	0.132	0.149	0.140
38	316178	289674	Unnamed AW	0.101	0.056	0.083	0.100	0.095	0.090
39	315246	289502	Unnamed AW	0.036	0.028	0.036	0.036	0.038	0.031
40	315177	289309	Unnamed AW	0.037	0.031	0.044	0.037	0.052	0.036
41	318813	288807	Unnamed AW	0.043	0.034	0.061	0.042	0.016	0.011
42	315550	290466	Unnamed AW	0.024	0.013	0.020	0.024	0.021	0.018
43	314927	288305	Unnamed AW	0.019	0.029	0.041	0.019	0.028	0.017
44	315016	288093	Unnamed AW	0.019	0.025	0.032	0.019	0.015	0.010
45	315083	287943	Unnamed AW	0.019	0.023	0.030	0.019	0.012	0.008

Receptor number	X(m)	Y(m)	Designation	Maximum annual mean ammonia concentration (µg/m³)					
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46	315614	287221	Unnamed AW	0.019	0.028	0.018	0.019	0.009	0.005
47	313913	293004	Montgomery Canal SAC/SSSI	0.006	0.003	0.007	0.006	0.004	0.003
48	314203	293216	Montgomery Canal SAC/SSSI	0.007	0.003	0.007	0.007	0.004	0.003
49	314838	293984	Montgomery Canal SAC/SSSI	0.007	0.003	0.006	0.007	0.005	0.004
50	315759	294689	Montgomery Canal SAC/SSSI	0.007	0.005	0.006	0.007	0.008	0.006

6. Summary and Conclusions

AS Modelling & Data Ltd. has been instructed by Gail Jenkins, of Roger Parry & Partners LLP, on behalf of Morton and Mandy Powell, to use computer modelling to assess the impact of ammonia emissions from the proposed broiler chicken rearing houses at Drefor, Kerry, Newtown, Powys. SY16 4PQ.

Ammonia emission rates from the proposed poultry houses have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors. The ammonia emission rates have then been used as inputs to an atmospheric dispersion and deposition model which calculates ammonia exposure levels and nitrogen and acid deposition rates in the surrounding area.

The results of the ammonia modelling predict that, at all of the ecological sites considered, the predicted process contribution of the proposed broiler chicken rearing houses at Drefor to ammonia concentrations and nitrogen deposition rates would be below the Natural Resources Wales lower threshold of the Critical Level or Critical Load (1% for a SSSI/SAC and 100% for AWs).

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