A Report on the Modelling of the Dispersion and Deposition of Ammonia from the Existing and Proposed Pig Rearing Houses at Fordington Lodge, near Tollerton in North Yorkshire

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1. Introduction

AS Modelling & Data Ltd. has been instructed by Lizzie Jennings of Yorkshire Farmers Livestock Marketing Ltd., on behalf of Sheddon Farms Ltd., to use computer modelling to assess the impact of ammonia emissions from the existing and proposed pig rearing houses at Fordington Lodge, near Tollerton in North Yorkshire. YO61 1QZ.

Ammonia emission rates from the existing and proposed pig rearing houses at Fordington Lodge have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors and information from the recent Agriculture and Horticulture Development Board (AHDB) report, "Establishing ammonia emission factors for straw-based buildings". 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

Fordington Lodge is in a rural area approximately 2.2 km to the east of the village of Tollerton, in North Yorkshire. The surrounding land is used predominantly for arable cultivation and there are semi-natural woodlands in the area around the farm. The piggery is at an elevation of approximately 15 m on fairly level ground with the Huby Burn draining water away to the River Kyle to the west, which flows into the River Ouse to the south.

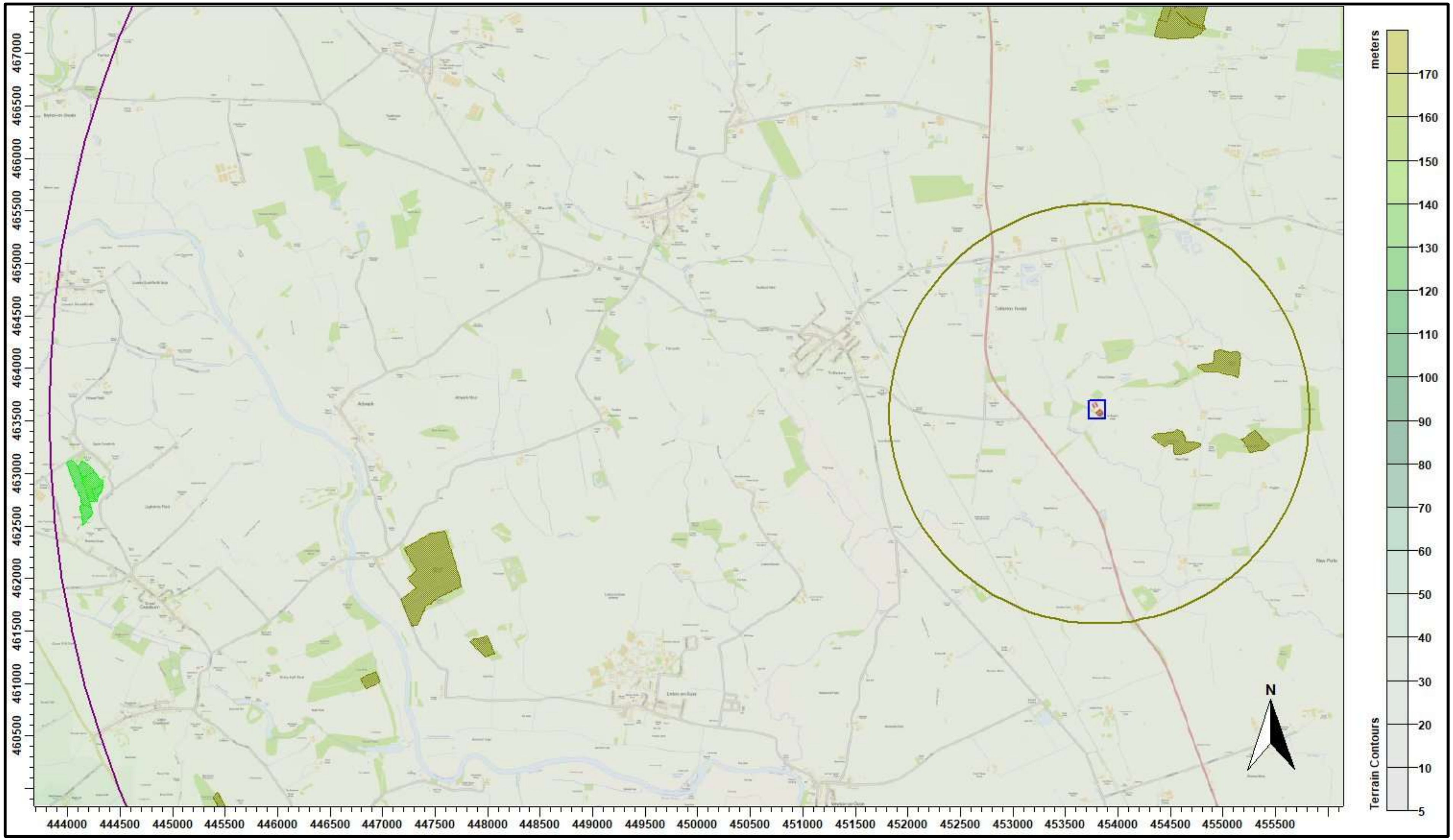
There are currently two pig houses at Fordington Lodge, these are naturally ventilated and provide accommodation for up to 1,999 pigs from a weight of 30 kg to a finishing weight of 110 kg on solid floor straw bedding. There are two manure pads at the piggery which provide storage for up to 150 tonnes, for a short time, before manure is taken off the site.

Under the proposals, three new naturally ventilated pig houses would be constructed at Fordington Lodge to the north of the existing houses which would be used to rear an additional 2,501 pigs from a weight of 30 kg to a finishing weight of 110 kg on sold floor straw bedding.

There are three areas designated as Ancient Woodlands (AWs) within 2 km of Fordington Lodge, namely Tindal Wood AW, New Parks Wood AW and Dodholm Wood AW. In addition, there is one area that is designated as a Site of Special Scientific Interest (SSSI) within 10 km of the site, namely Upper Dunsforth Carrs SSSI.

A map of the surrounding area showing the positions of the existing and proposed pig rearing houses, the AWs and the SSSI is provided in Figure 1. In this figure, the AWs are shaded in olive, the SSSI is shaded in green and the site of the pig rearing houses at Fordington Lodge is outlined in blue.

Figure 1. The area surrounding Fordington Lodge – concentric circles radii 2 km (olive) and 10 km (purple)



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 Fordington Lodge is 3.68 µg-NH_3/m^3. The background nitrogen deposition rate to woodland is 44.94 kg-N/ha/y and to short vegetation is 25.62 kg-N/ha/y. The background acid deposition rate to woodland is 3.13 keq/ha/y and to short vegetation is 1.83 keq/ha/y. The source of these background figures is the Air Pollution Information System (APIS, January 2021).

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 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. 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. 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 Deposition (kg-N/ha/y)	Critical Load Acid Deposition (keq/ha/y)
Tindal Wood AW	3.0 [1]	10.0 [1]	0.357 [1]
New Parks Wood AW	1.0 [2]	10.0 [3]	-
Dodholm Wood AW	1.0 [2]	10.0 [3]	0.357 [1]
Upper Dunsforth Carrs SSSI	1.0 [2]	15.0 [3]	-

1. From Simon Wigglesworth, Environment Agency, quoted by Lizzie Bentley of Yorkshire Farmers Livestock Marketing Ltd by email; Bentley, Lizzie M. "Fwd: Citation for Beadale Wood". Message to Steve Smith. 22nd December 2020. E-mail. It should be noted that AS Modelling & Data Ltd. would normally expect woodland sites to have a Critical Level of 1.0 µg-NH_3/m^3 and that the given Critical Loads for acidification seem anomalously low.
2. 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.
3. The lower bound of the range of Critical Loads for habitats present at the site obtained from the APIS website (January 2021) or typical for this habitat.

3.4 Guidance on the significance of ammonia emissions

3.4.1 Environment Agency Criteria

The Environment Agency web-page titled "Intensive farming risk assessment for your environmental permit", contains a set of criteria, with thresholds defined by percentages of the Critical Level or Critical Load, for: internationally designated wildlife sites (Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites); Sites of Special Scientific Interest (SSSIs) and other non-statutory wildlife sites. The lower and upper thresholds are: 4% and 20% for SACs, SPAs and Ramsar sites; 20% and 50% for SSSIs and 100% and 100% for non-statutory wildlife sites.

If the predicted process contributions to Critical Level or Critical Load are below the lower threshold percentage, the impact is usually deemed acceptable.

If the predicted process contributions to Critical Level or Critical Load are in the range between the lower and upper thresholds; 4% to 20% for SACs, SPAs and Ramsar sites; 20% to 50% for SSSIs and 100% to 100% for other non-statutory wildlife sites, whether or not the impact is deemed acceptable is at the discretion of the Environment Agency. In making their decision, the Environment Agency will consider whether other farming installations might act in-combination with the farm and the sensitivities of the wildlife sites. 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%).

3.4.2 Natural England advisory criterion

Natural England are a statutory consultee at planning and usually advise that, if predicted process contributions exceed 1% of Critical Level or Critical Load at a SSSI, SAC, SPA or Ramsar site, then the local authority should consider whether other farming installations[1] might act in-combination or cumulatively with the farm and the sensitivities of the wildlife sites. This advice is based primarily upon the Habitats Directive, EIA Directive and the Countryside and Rights of Way Act.

1. The process contribution from most farming installations is already included in the background ammonia concentrations and nitrogen and acid deposition rates. Therefore, it is normally only necessary to consider new installations and installations with extant planning permission and proposed developments when understanding the additional impact of a proposal upon nearby ecologies. However, established farms in close proximity may need to be considered given the background concentrations and deposition rates are derived as an average for a 5 km by 5 km grid.

Note that a process contribution of 1% of Critical Level or Critical Load would normally be considered insignificant. A process contribution that is above 1% of Critical Level or Critical Load should be regarded as potentially significant; however, 1% of Critical Level or Critical Load should not be used as a threshold above which damage is implied.

Please also note that recent advice from Natural England [2] states that “At the screening assessment stage for agricultural proposals acting alone the threshold is 4% for both SSSI and N2K sites” and “At the detailed assessment stage where there is an in-combination assessment, the threshold for agricultural proposals is 20% for N2K sites and 50% for SSSIs”.

1. Hack, Richard M. “NE guideline screening thresholds for air pollution”. Message to Nicola Stone, cc Ian Pick. 2nd October 2020. E-mail.

3.5 Quantification of ammonia emissions

Ammonia emission rates from piggeries 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 housing emission factors used are based upon information obtained from the recent Agriculture and Horticulture Development Board (AHDB) report, “Establishing ammonia emission factors for straw-based buildings”. The manure storage emission factors used are based upon the Environment Agency’s standard emission factors. Details of the pig numbers and weights, manure storage emission factors used and calculated emission rates are provided in Table 2.

Table 2. Details of pig numbers, emission factors and ammonia emission rates for the proposed piggery

Source	Weight	No. Pigs	Housing	Emission Factor ($kg-NH_3$/place/y)	Emission Rate ($g-NH_3$/s)
Existing pig housing	30 kg to 110 kg	1,999	Solid floor straw system	2.0 (AHDB)	0.126689
Proposed pig housing	30 kg to 110 kg	2,501	Solid floor straw system	2.0 (AHDB)	0.158504
Source	Tonnes		Emission factor ($kg-NH_3$/tonne		Emission rate ($g-NH_3$/s)
Manure stores	150.0		1.49 (EA)		0.007082

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 that include: 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).

The GFS is a spectral model: the physics/dynamics model has an equivalent resolution of approximately 13 km (latterly 9 km); terrain is understood to be resolved at a resolution of approximately 2 km (with sub-13 km terrain effects parameterised). 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 records may be over represented, this is because the instrumentation used may not record wind speed 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.

A wind rose showing the distribution of wind speeds and directions in the GFS derived data is shown in Figure 2a. 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 modified. The terrain and roughness length modified wind rose for the area around the proposed pig rearing houses at the site is shown in Figure 2b. Note that, elsewhere in the modelling domain, modified wind roses may differ more or less markedly. The resolution of the wind field in terrain runs is approximately 340 m in the preliminary modelling and is 100 m in the detailed modelling. 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 in the modelling runs that include terrain.

Figure 2a. The wind rose. GFS derived data for 54.065 N, -1.179 W, 2016 - 2019

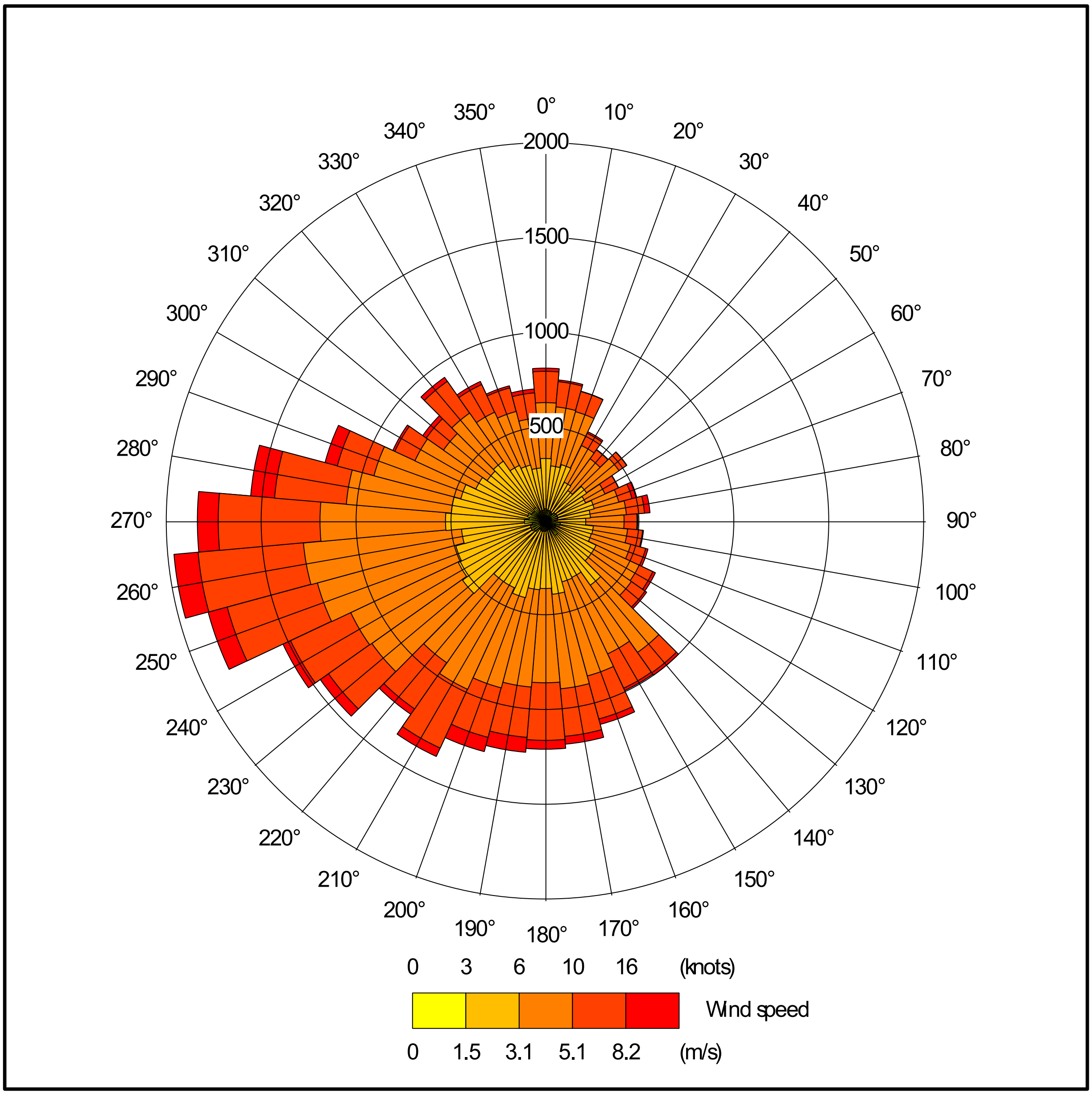
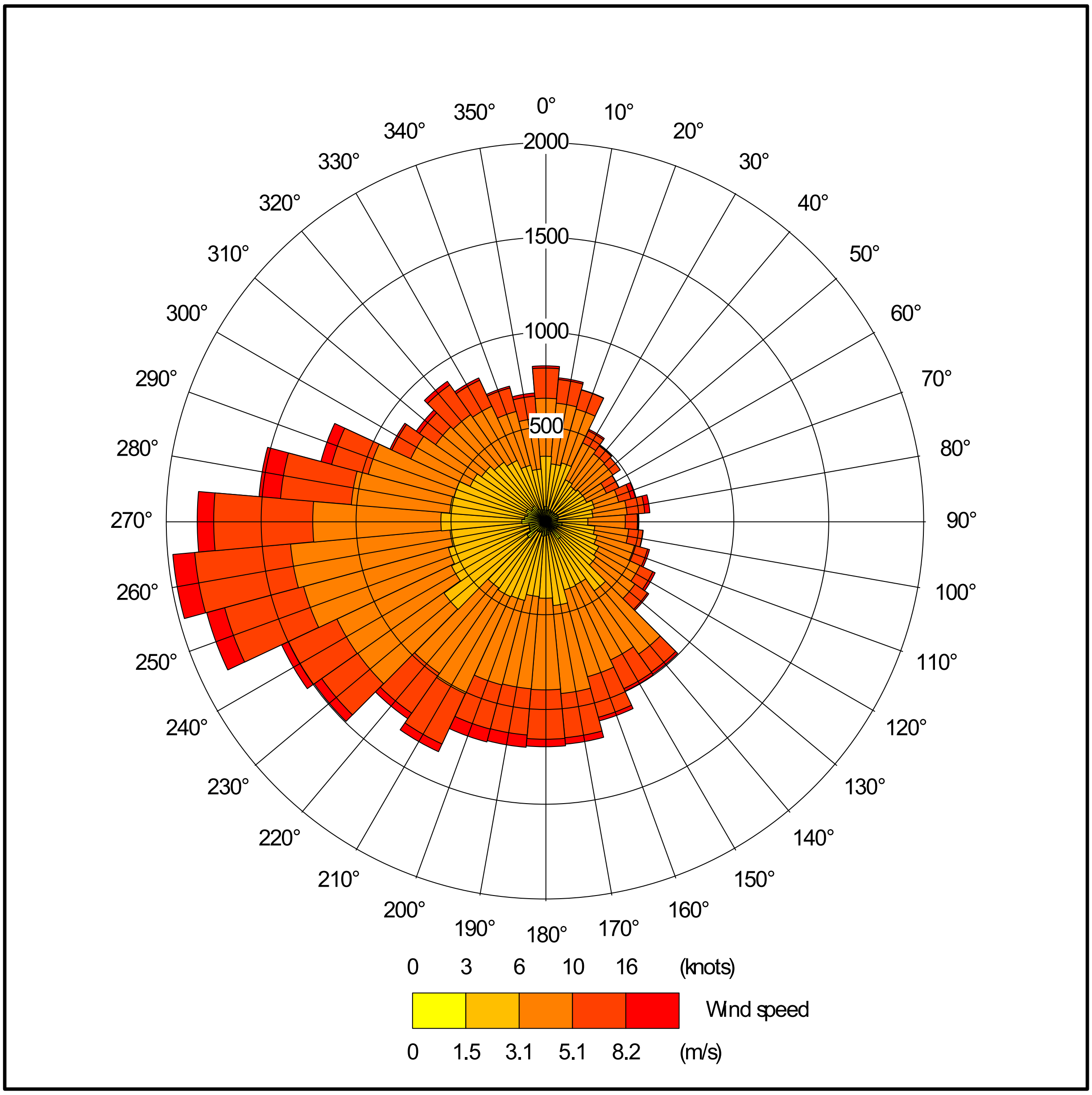


Figure 2b. The wind rose for Fordington Lodge, NGR 453825, 463570, derived from FLOWSTAR output



4.2 Emission sources

Emissions from the existing and proposed pig houses, which are, or would be, naturally ventilated, are represented by a single volume source per house with ADMS (EX1_v, EX2_v, PR3_v, PR4_v and PR5_v). Emissions from the manure pads are also represented by area sources within ADMS (MP1 and MP2).

Details of the volume source parameters are shown in Table 3a and the area source parameters are shown in Table 3b. The positions of the area and volume sources may be seen in Figure 3, where they are indicated by red hatched rectangles.

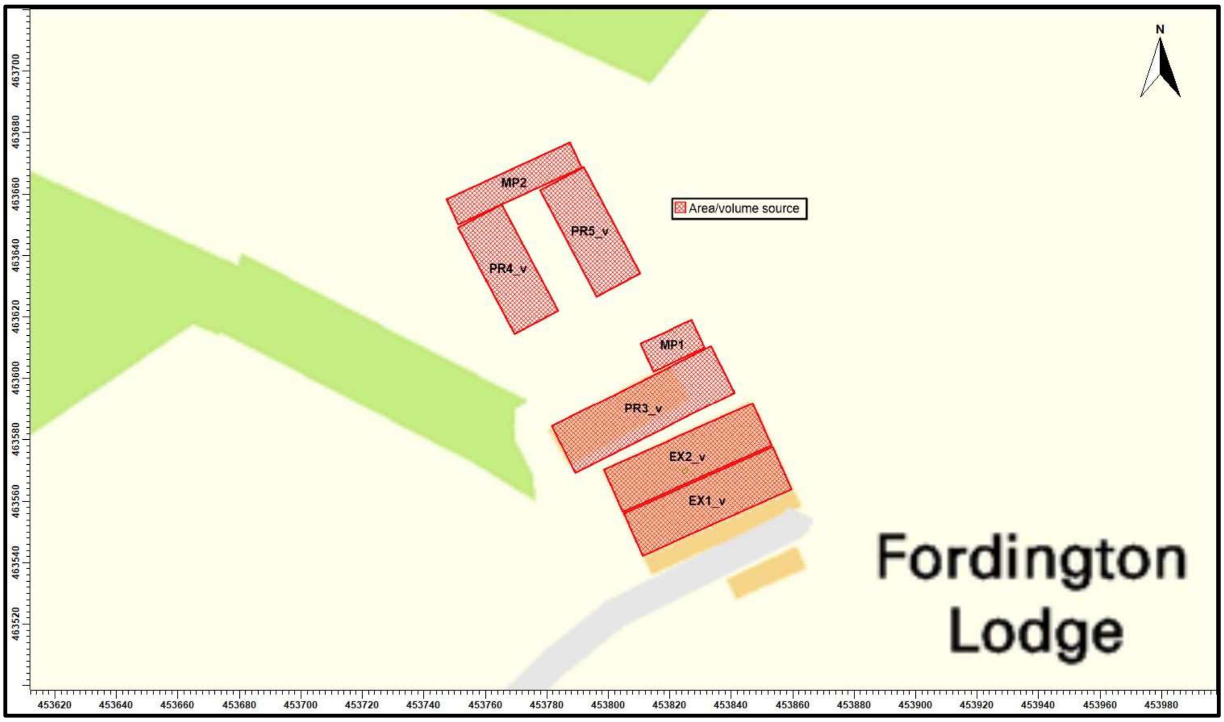
Table 3a. Volume source parameters

Source ID	Length (m)	Width (m)	Depth (m)	Base height (m)	Emission temperature	Emission rate per source ($g-NH_3/s$)
EX1_v & EX2_v	53.0	15.0	4.0	0.0	Ambient	0.063344
PR3_v	58.0	17.0	4.0	0.0	Ambient	0.069957
PR4_v & PR5_v	39.0	16.0	4.0	0.0	Ambient	0.044273

Table 3b. Area source parameters

Source ID	Area (m^2)	Base height (m)	Emission temperature (°C)	Emission rate ($g-NH_3/s$)
MP1	185	0.0	Ambient	0.002255
MP2	396	0.0	Ambient	0.004827

Figure 3. The positions of the modelled sources



4.3 Modelled buildings

Not modelled.

4.4 Discrete receptors

Eleven discrete receptors have been defined: ten at the AWs (1 to 10) and one at the SSSI (11)). These receptors are defined at ground level within ADMS. The positions of the discrete receptors may be seen in Figure 4, where they are marked by enumerated pink rectangles.

4.5 Cartesian grid

To produce the contour plot presented in Section 5 of this report a regular Cartesian grid has been defined within ADMS. The individual grid receptors are defined at ground level within ADMS. The position of the regular Cartesian grid may be seen in Figure 4, where it is marked by a grey rectangular grid.

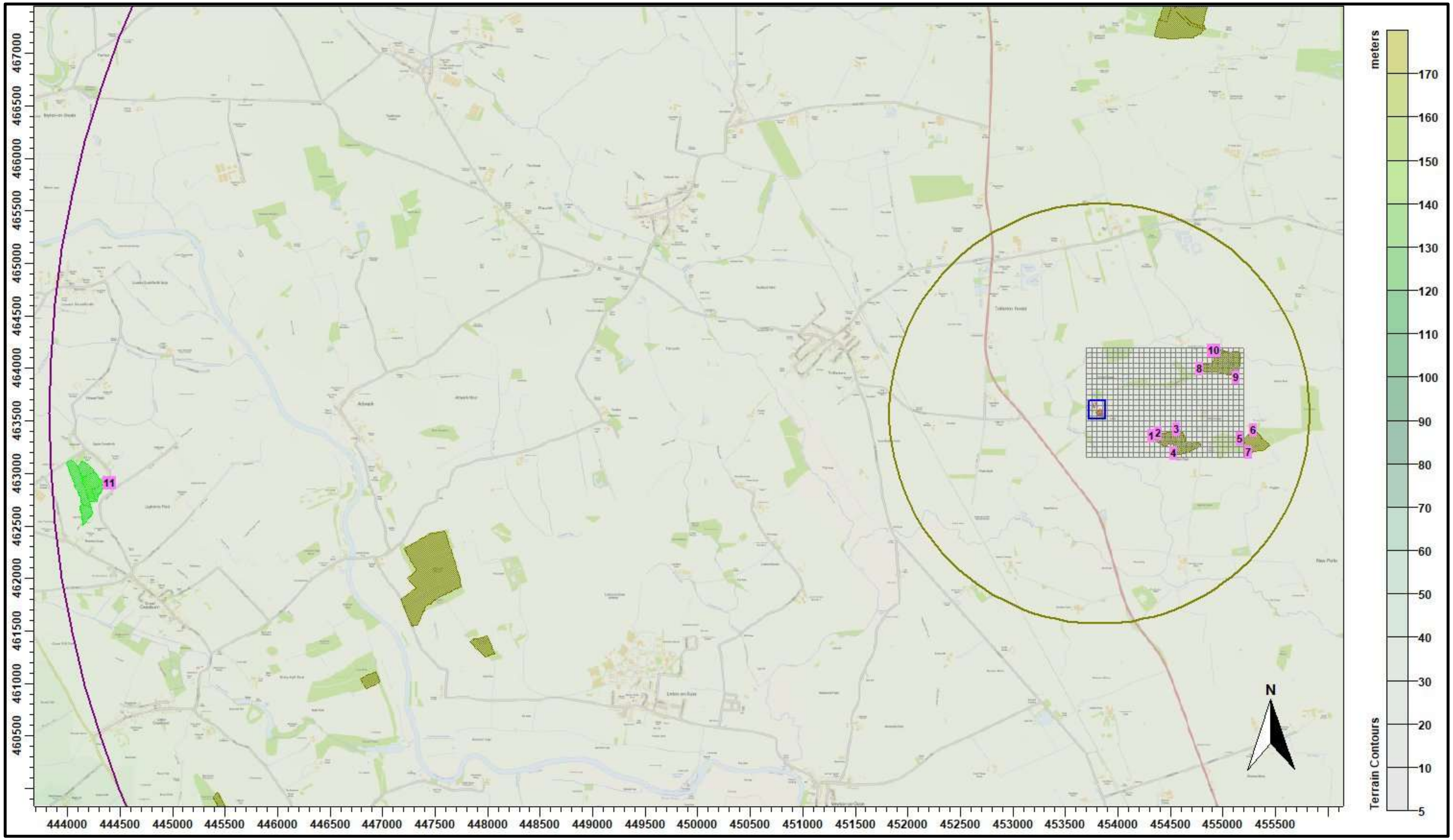
4.6 Terrain data

Terrain has been considered in the modelling. The terrain data are based upon the Ordnance Survey 50 m Digital Elevation Model. A 22.0 km by 22.0 km domain has been resampled at 100 m horizontal resolution for use within ADMS for the preliminary modelling terrain runs and a 6.4 km by 6.4 km domain has been resampled at 50 m for use within ADMS for the detailed modelling. The resolution of FLOWSTAR is 64 by 64 grid points; therefore, the effective resolution of the wind field for the terrain runs is approximately 340 m for the preliminary modelling terrain runs and is 100 m for the detailed modelling.

4.7 Roughness Length

A fixed surface roughness length of 0.275 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 0.25 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.

Figure 4. The discrete receptors and regular Cartesian grid



5. Details of the Model Runs and Results

5.1 Preliminary modelling and model sensitivity tests

ADMS was run a total of sixteen times, once for each year of the meteorological record and in the following four modes:

- In basic mode without calms and without terrain – GFS data.
- With calms and without terrain – GFS data.
- Without calms and with terrain – GFS data.
- Without calms (but with correction applied), with terrain and fixed deposition at 0.003 m/s – GFS data.

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 4. In the Table, predicted ammonia concentrations (or concentrations equivalent to deposition rates) that are in excess of the Environment Agency's upper threshold percentage of the relevant Critical Level or Critical Load (100% for a non-statutory site or 50% for a SSSI) are coloured red. Concentrations (or concentrations equivalent to deposition rates) in the range between the Environment Agency's lower and upper threshold percentages of the relevant Critical Level or Critical Load (100% and 100% for a non-statutory site or 20% and 50% for a SSSI) are coloured blue. Additionally, predicted ammonia concentrations (or ammonia concentrations equivalent to nitrogen deposition rates) that exceed 1% of the relevant Critical Level or Critical Load at a statutory site are highlighted with bold text. For convenience, cells referring to the AWs are shaded olive and cells referring to SSSI are shaded green.

Note, the modelling was run with emissions from 500 tonnes of manure being held in the manure stores, whereas under the proposals, manure stored at Fordington Lodge would be limited to 150 tonnes. The predicted impact of this component of the emissions has been reduced by a factor of 0.3 (150/500 tonnes) to correct this.

Table 4. 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	GFS Calms No Terrain	GFS No Calms Terrain	GFS Calms Correction Terrain Fixed depo 0.003 m/s [1]
1	454318	463353	Tindal Wood AW	**2.017**	**2.271**	**2.120**	**1.364**
2	454385	463385	Tindal Wood AW	**1.732**	**1.967**	**1.811**	**1.178**
3	454555	463418	Tindal Wood AW	**1.164**	**1.338**	**1.210**	**0.857**
4	454534	463186	Tindal Wood AW	**1.020**	**1.147**	**1.052**	0.622
5	455164	463328	New Parks Wood AW	0.419	0.484	0.437	0.287
6	455291	463412	New Parks Wood AW	0.383	0.422	0.400	0.269
7	455243	463202	New Parks Wood AW	0.368	0.424	0.384	0.229
8	454775	463992	Dodholm Wood AW	**0.740**	**0.796**	**0.799**	0.529
9	455129	463913	Dodholm Wood AW	0.474	0.511	0.528	0.342
10	454917	464167	Dodholm Wood AW	0.528	0.568	0.540	0.352
11	444403	462905	Upper Dunsforth Carrs SSSI	0.008	**0.012**	0.009	0.003

1. Results have been multiplied by a factor of the average increase for the impacts of calms, 1.12.

5.2 Detailed modelling

The detailed modelling, which includes ammonia deposition and the consequent plume depletion, was carried out over a restricted domain covering the existing and proposed pig rearing houses, Tindal Wood AW and Dodholm Wood AW.

Terrain effects may be significant at some receptors; therefore, the detailed deposition runs were made with terrain included. Calms cannot be used with terrain or spatially varying deposition and have not been included in the detailed modelling. The results of the preliminary modelling indicate that the effect of calms may be significant, therefore the results of the modelling have been increased by a factor of 1.12, the average increase for the impact of calms at the nearby AWs derived from the preliminary modelling.

The predicted process contributions to maximum annual mean ground level ammonia concentrations and nitrogen deposition rates and acid deposition rates at the discrete receptors included within the detailed modelling are shown in Table 5. In the Table, predicted ammonia concentrations or nitrogen deposition rates that are in excess of the Environment Agency upper threshold percentage of the relevant Critical Level or Critical Load for nitrogen or acid deposition (100% for a non-statutory site) are coloured red. Concentrations or deposition rates that are in the range between the Environment Agency lower and upper threshold percentages of the Critical Level or Critical Loads (100% to 100% for a non-statutory site) are coloured blue.

Contour plots of the predicted process contributions to ground level maximum annual mean ammonia concentration, maximum annual mean nitrogen deposition rate and the maximum acid deposition rate are shown in Figure 6a, Figure 6b and Figure 6c, respectively.

Table 5. Predicted process contribution to maximum annual mean ammonia concentrations and nitrogen deposition rates

Receptor number	X(m)	Y(m)	Name	Site Parameters				Maximum annual ammonia concentration		Maximum annual nitrogen deposition rate		Maximum annual acid deposition rate	
				Deposition Velocity	CLe ($\mu g/m^3$)	CLo_N (kg/ha)	CLo_A (keq/ha)	PC ($\mu g/m^3$)	%age of CLe	PC (kg/ha)	%age of CLo_N	PC (keq/ha)	%age of CLo_A
1	454318	463353	Tindal Wood AW	0.03	3.0	10.0	0.357	1.034	34.5	8.06	80.6	0.58	**161.2**
2	454385	463385	Tindal Wood AW	0.03	3.0	10.0	0.357	0.885	29.5	6.89	68.9	0.49	**137.9**
3	454555	463418	Tindal Wood AW	0.03	3.0	10.0	0.357	0.594	19.8	4.63	46.3	0.33	92.6
4	454534	463186	Tindal Wood AW	0.03	3.0	10.0	0.357	0.385	12.8	3.00	30.0	0.21	60.0
8	454775	463992	Dodholm Wood AW	0.03	1.0	10.0	0.357	0.340	34.0	2.65	26.5	0.19	53.0
9	455129	463913	Dodholm Wood AW	0.03	1.0	10.0	0.357	0.217	21.7	1.69	16.9	0.12	33.8
10	454917	464167	Dodholm Wood AW	0.03	1.0	10.0	0.357	0.234	23.4	1.82	18.2	0.13	36.4

Figure 6a. Maximum annual mean ammonia concentration

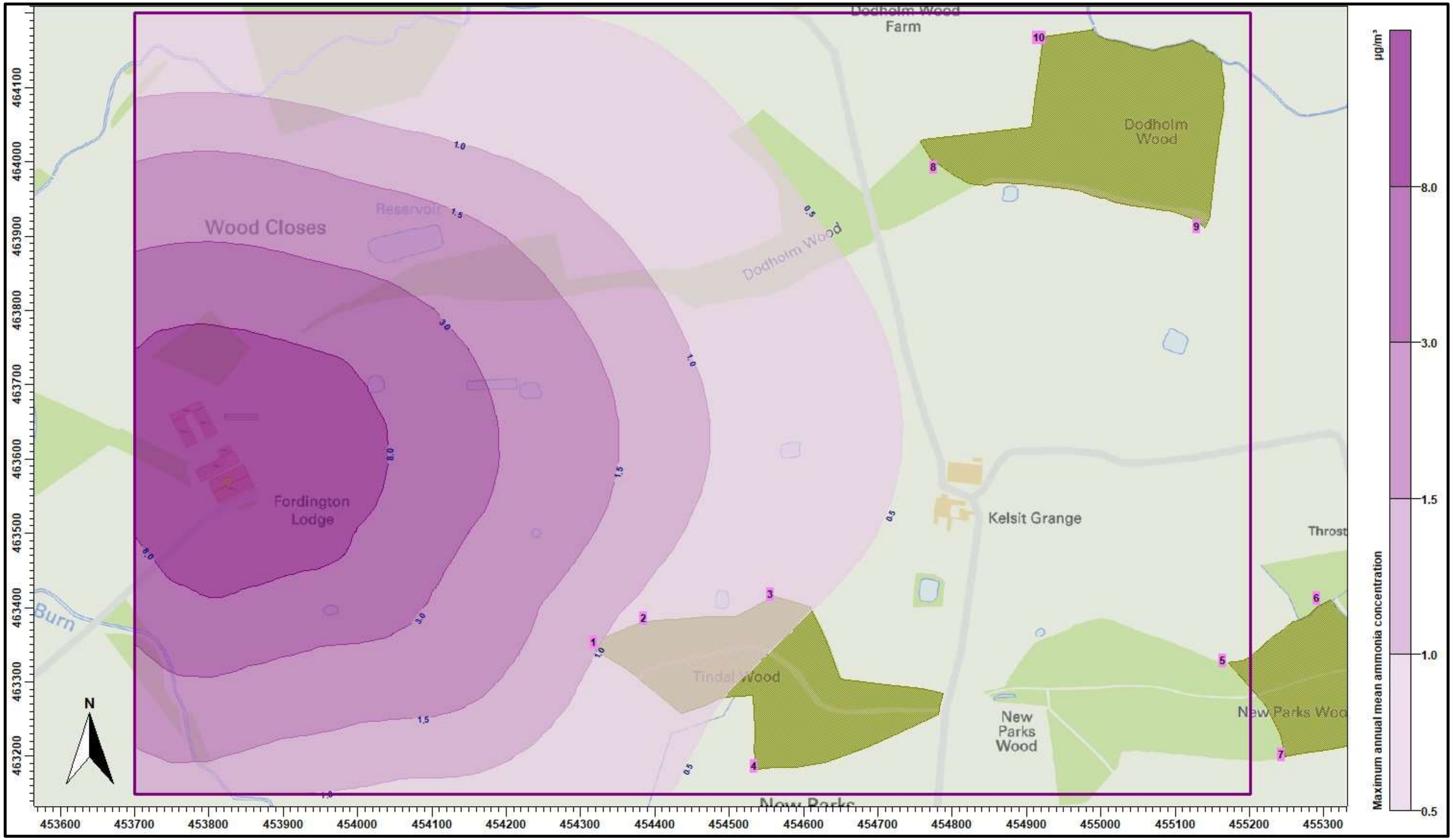


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Figure 6b. Maximum annual mean nitrogen deposition rate

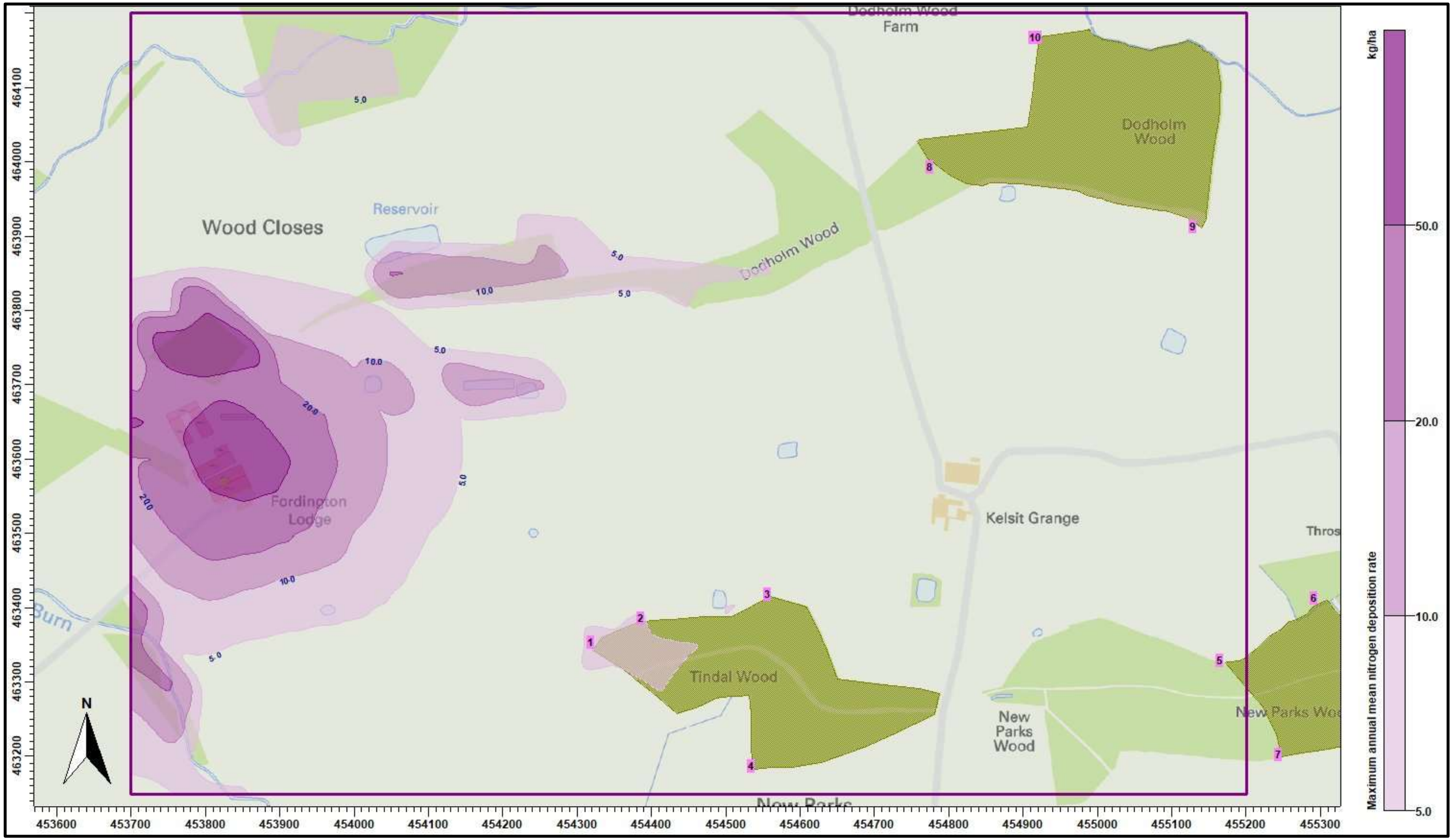

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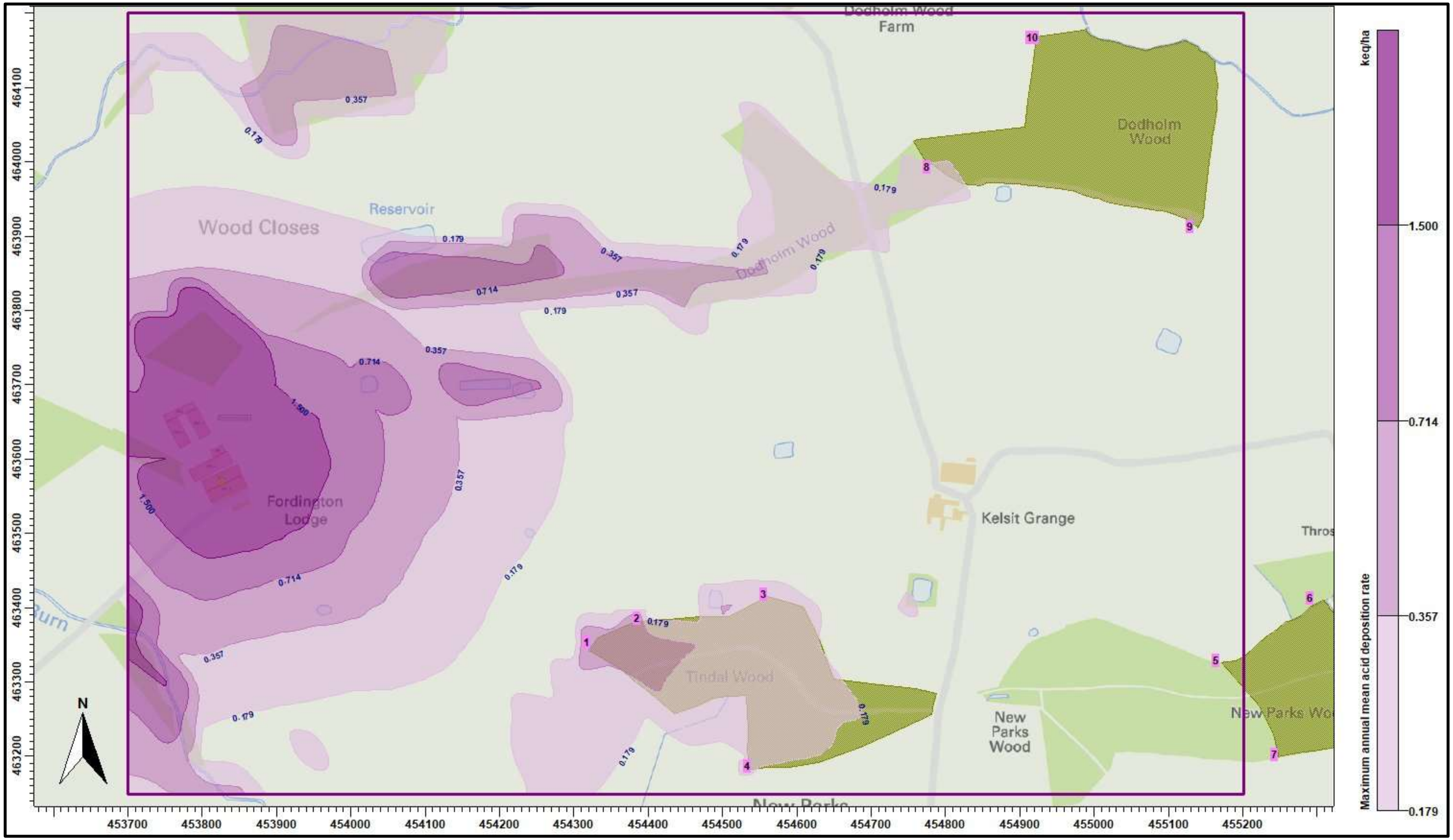
Figure 6c. Maximum annual mean acid deposition rate



6. Summary and Conclusions

AS Modelling & Data Ltd. has been instructed by Lizzie Jennings of Yorkshire Farmers Livestock Marketing Ltd., on behalf of Sheddon Farms Ltd., to use computer modelling to assess the impact of ammonia emissions from the existing and proposed pig rearing houses at Fordington Lodge, near to Tollerton in North Yorkshire. YO61 1QZ.

Ammonia emission rates from the existing and proposed pig rearing houses at Fordington Lodge have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors and information from the recent Agriculture and Horticulture Development Board (AHDB) report, "Establishing ammonia emission factors for straw-based buildings". 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 modelling predicts that, should the piggery at Fordington Lodge be expanded as proposed, the process contributions to maximum annual mean ammonia concentrations and nitrogen deposition rates would not exceed the Environment Agency lower threshold percentage of the relevant Critical Level or Critical Load at Tindal Wood AW or Dodholm Wood AW.

The predicted process contribution to acid deposition does exceed the Environment Agency upper threshold percentage of the Critical Load of 0.357 keq/ha at Tindal Wood AW. This exceedance is predicted to impact upon approximately 0.67 ha of the AW. There is no predicted exceedance of the Environment Agency's lower threshold percentage of the Critical Load by process contributions by the expanded piggery to acid deposition at Dodholm Wood AW. Please note that AS Modelling & Data ltd. considers the Critical Load of 0.357 keq/ha to be an anomalously low figure and has no information on from where or how the Environment Agency derived this figure.

Where exceedances of the upper threshold are predicted at non-statutory sites, such as at the Tindal Wood AW, then some form of mitigation is usually required. AS Modelling & Data Ltd. would recommend that, if available, to compensate for possible detrimental effects on the nearby AW, the wildlife site is actively managed for wildlife, and/or, that land of at least a similar area to the exceedance of 100% of the Critical Level is set aside for nature conservation and planted with native species. Alternatively, or additionally, unfertilised and only lightly grazed buffer zones and corridors could be set up around and between the AWs; such buffer zones and corridors can greatly enhance bio-diversity over time. Additionally, Beasley et al, 2013 (Defra project AC0201) have found that tree planting locally can be used as a measure to help protect downwind sensitive ecosystems from ammonia emissions from agricultural installations.

7. References

Agriculture and Horticulture Development Board. Establishing ammonia emission factors for the shallow pit, fully-slatted finisher buildings 2018.

Beasley. et al. Agroforestry Systems for Ammonia Abatement. Defra project AC0103.

Best Available Techniques (BAT) Reference Document for the Intensive Rearing of Poultry or Pigs. Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control). 2017.

Cambridge Environmental Research Consultants (CERC) (website).

Environment Agency H1 Risk Assessment (website).

M. A. Sutton *et al*. Measurement and modelling of ammonia exchange over arable croplands.

United Nations Economic Commission for Europe (UNECE) (website).

UK Air Pollution Information System (APIS) (website).