H.E. POWELL

POULTRY UNIT, LLWYNGWILYM

ODOUR IMPACT ASSESSMENT

July 2020

Report Ref: 01.0190.001/OIA v1

Isopleth Ltd.
Registered in England and Wales No. 9150373

CONTENTS

1.0 INTRODUCTION

Isopleth Ltd has been commissioned by Berrys, on behalf of H & E Powell to carry out a detailed assessment of odour impacts associated with a proposed poultry unit on land near Llwyngwilym, Rhayader LD6 5NS. Site layout and location plans are shown in Appendix A of this report.

1.1 Site Location

The site lies approximately 1.5km North East of the centre of Rhayader and 3.4km south west of Harmon. The predominant land use is grassland and grazing. The site itself is located within a grassland field located off the B4518 highway at approximate site grid reference OS GR 297720, 269460. The location is shown in Appendix A.

The Llwyngwilym poultry unit is shown, alongside assessed receptors, in Drawing OIA1.

1.2 Proposed Development

One new building housing 55,000 broiler birds is proposed, adjacent to an identical building which has recently been granted planning permission (Application 18/0463/FUL):

> *'Full: Erection of a broiler unit, creation of access and all associated works. Llwyngwilym Farm, Rhayader, Powys LD6 5NS.'*

The new facility would therefore consist of 2 new broiler houses housing approximately 110,000 birds in total. It is understood that these new houses would include an acid scrubbing system such as the IPT VentMax 1200 Acid Scrubbers for odour (and ammonia) control scrubbers to ensure that emissions to air are mitigated. In the event that an alternative scrubbing system is chosen the performance would be equivalent to (or better than) that of the IPT VentMax system.

This odour assessment is based on the proposed building holding an average of 55,000 birds in a single shed of 115.8 metres long by 24.4 metres wide with a roof pitch of 15°, internal eaves height of 2.5 metres. This is identical to the recently approved building.

The proposed poultry unit will produce standard birds, based on a 35-38 day growing cycle, with an empty period at the end of each cycle for cleanout and preparation of the buildings for the incoming flock. The unit will operate with approximately 7.5 flocks per annum.

During the growing cycle temperature is controlled within the buildings. The buildings are pre-warmed to a temperature of approximately 33ºC on day 1 of the cycle typically reducing to approximately 22ºC at clear-out of the crop (for more detail refer to Table 3-4).

The facility will be of modern design, utilising the current best practice control measures for minimisation of odour impact. This includes optimisation of diet for the growing birds and the use of nipple drinkers to reduce litter moisture content, for example. High litter moisture content, low oxygen levels, small particle size, high temperatures and low pH encourage anaerobic bacterial activity and the generation of odours and the facility will be operated in a manner which discourages such activity.

1.3 Environmental Permitting

The Planning and Environmental Permitting processes are separate, but complementary, as discussed further in section 3.2 of this report. At the time of writing, an application for an Environmental Permit to cover the broiler facility has yet to be made to Natural Resources Wales (NRW). An Odour Management Plan aimed at ensuring that the operation of the facility will be acceptable in relation to odour will be prepared in support of that application. application.

Paragraph 5.13.3 of Planning Policy Wales (Edition 10, December 2018) requires that the local planning authority must assume that the Permit will operate effectively in preventing unacceptable levels of odour at relevant receptor locations.

1.4 Previous Applications / Assessments

The site benefits from planning permission for a single 55,000 broiler house which was approved on 30th June 2020 (Application 18/0463/FUL):

> *'Full: Erection of a broiler unit, creation of access and all associated works. Llwyngwilym Farm, Rhayader, Powys LD6 5NS.'*

Natural Resources Wales and the ecology department of Powys Council were consulted in relation to Application 18/0463/FUL and provided responses at that time. Any specific responses which are relevant to the current application are referenced, as appropriate.

1.5 Scope and Limitations

The scope of this OIA is limited to the prediction, through atmospheric dispersion modelling, of impacts at local sensitive receptors based on design information and desktop emission rates.

Assessment of impacts associated with emissions of ammonia on sensitive ecological sites is outside the scope of this report, which deals with issues of odour only.

1.6 Aims and Objectives

The objectives of the assessment are as follows:

- To estimate odour emissions from the proposed facility with additional sheds and birds;
- To quantify impacts on sensitive receptors based upon the emission values; and
- To assess the significance of these impacts.

2.0 ASSESSMENT METHODOLOGY

2.1 General Approach

The approach taken in this assessment is consistent with that for other broiler applications in Powys, where the same general approach has been regarded as acceptable, for example:

1. Application Ref. 19/0710/FUL. Erection of three new broiler accommodation buildings, conversion of existing free range building into a broiler accommodation building, renewables shed, feed bins, and associated yard area and infrastructure. Glanmiheli Farm Chicken Units Kerry Newtown Powys SY16 4LN
2. Application Ref. 19/0508/FUL. Erection of 2 No. agricultural buildings for poultry rearing, together with associated infrastructure including a package treatment plant. Penpound Newbridge-on-wye Llandrindod Wells Powys LD1 6HP

In the above cases Powys Council has referred to the requirement for an NRW Environmental Permit and therefore has complied with Paragraph 5.13.3 of Planning Policy Wales thus avoiding duplication between the two regulatory regimes.

The approach taken in this report is also consistent with other recent schemes such as the first broiler unit at Llwyngwilym Farm (application ref: 18/0463/FUL). The initial building also proposed the use of IPT VentMax 1200 Acid Scrubbers (or equivalent). The selection of a scrubber will be a commercial decision taken at the tendering stage prior to construction of the units. There are several suppliers of scrubbing technology for poultry buildings including IPT, DraperVENT, JF McKenna and Big Dutchman. This report assumes that, in the event that an alternative scrubbing system is chosen for the final design, the performance would be equivalent to (or better than) that of the IPT VentMax system in relation to odour scrubbing performance.

2.2 Assessment of Odour Exposure

In the UK, odour assessments for poultry facilities are most commonly undertaken using the concept of the European Odour Unit (ou_E), as defined in BS EN 13725[1]. This approach allows impact assessment of any odorous gas as it is independent of chemical constituents and centres instead on multiples of the detection threshold of the gas in question.

As the odour unit is a Standard Unit in the same way as gram or milligram, the notation used in odour assessment follows the conventions of any mass emission unit as follows:

- concentration: ou_E/m^3
- emission: ou_E/s
- specific emission (emission per unit area): $ou_E/m^2/s$

[1] BS EN 13725:2003 *Air Quality – Determination of Odour Concentration by Dynamic Olfactometry.*

Like air quality standards for individual pollutants, exposure to odour is given in terms of a percentile of averages over the course of a year. The exposure criteria most accepted in the UK at present is given in terms of (concentration) European Odour Units as a 98th percentile (C_{98}) of hourly averages. This allows 2% of the year when the impact may be above the limit criterion (175 hours). The notation for impact is therefore: $C_{98,\ 1\ hour}$ X ou_E/m^3.

Odour perception, annoyance and nuisance is related to more than simply odour impact, the five 'FIDOL' factors[2] must also be considered when assessing the acceptability of a scheme and the appropriateness of a limit criterion.

2.3 Identification of Odour Sources

Potential sources of odorous emissions from the proposed facility have been identified on the basis of a review of the proposed development design. This involves identifying sources of potential releases to atmosphere. The identified potential odour sources are as follows:

- Point sources (from the broiler house ventilation); and
- Waste product handling and spillages etc.

Control of fugitive / intermittent releases of odour will be addressed by a site Odour Management Plan as part of the Permitting process.

2.4 Derivation of Emissions

The anticipated odour emissions for the proposal have been estimated using values given in published literature in the UK and Europe for similar facilities. Ventilation flows are based on standard best practice design for UK broiler houses.

The odour emission rates applied should be considered worst case as they have been measured at facilities which do not apply the same odour prevention measures as will be adopted at the facility at Llwyngwilym. In reality emission rates would be expected to be significantly lower.

2.5 Quantification of Odour Impact

Data derived from the previous stages is input to an atmospheric dispersion model. For this assessment the AERMOD model[3] has been applied with due consideration to relevant guidance[4]. This model is widely used and accepted by the NRW and UK planning authorities for undertaking such assessments and its predictions have been validated against real-time monitoring data by the USEPA. It is therefore considered a suitable model for this assessment.

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[2] The FIDOL factors are defined as **F**requency, **I**ntensity (and therefore concentration), **D**uration, relative **O**ffensiveness (hedonic tone/character) and **L**ocation,

[3] Software used: BREEZE AERMOD Pro, v8.1.0.17

[4] USEPA, Aermod Implementation Workgroup, Aermod Implementation Guide, (EPA-454/B-18-003 April, 2018).

Dispersion modelling guidance indicates that at least 3 (and ideally 5) years of meteorological data should be applied to ensure that infrequent weather conditions do not unduly bias the results. This results in a range of predicted impacts for different years of meteorological data and the average value is used to assess compliance, with the range of impacts used to assess likely variation between years and the risk of shorter-term impacts. This is particularly important in relation to odour, where acceptability of impacts is assessed by receptor over long time periods rather than as a result of infrequent or unusual meteorological conditions.

2.6 Assessment Scenarios

Two scenarios have been modelled to represent the existing emissions from the extant (single shed) free-range layer facility and also the typical operation of the proposed facility, with the maximum proposed number of broilers (110,000 across 2 sheds) on a 36 day cycle with thinning at day 30.

The results of the dispersion modelling have been presented in the form of:

- illustrations of the odour footprint as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area; and
- tabulated odour concentrations ($C_{98,\ 1\text{-hour}}$ X ou_E/m^3) at discrete receptor locations to facilitate the discussion of results.

3.0 REGULATORY STANDARDS AND GUIDELINES

Currently, in the UK there are no statutory numerical standards for assessing the acceptability of predicted odour impacts from quantitative odour impact assessments. On this basis, odour impact criteria are typically based upon guideline documents (predominately based on research from outside of the UK), case law and research which differ depending on the regime i.e. planning (to avoid significant detriment to amenity) or permitting (to avoid unacceptable pollution).

The numerical limits applied have largely been derived from the findings of a limited number of epidemiological assessments where modelled odour impacts have been compared to the findings of quality of life surveys; a dose-effect study. These dose-effect studies have only been undertaken for a limited number of odour types; however they have been used as the foundation for the setting of acceptable odour standards in many countries.

The actual acceptable level of impact will be dependent on the nature (offensiveness) of the odour and the broad sensitivity of the population. To account for this differing numerical limits are often set not only depending on the offensiveness of the odour but also the broad sensitivity of the environment.

3.1 UK Guidance

UK guidance identifies a range of odour impact criteria depending primarily on the nature of the odour (i.e. its pleasantness/unpleasantness) and the likelihood of causing unacceptable impacts based on the 98th percentile of predicted hourly average concentrations over a year.

It is therefore evident that such criteria apply only to locations where an individual's exposure is likely to occur for prolonged periods of time i.e. residential properties. Where exposure is more transient (i.e. roads, footpaths etc.) the direct application of such criteria should be treated with caution and further consideration should be given to how the duration and frequency of exposure of the individual will influence the acceptability of the predicted impact.

3.2 Planning vs. Permitting: Planning Policy Wales

The Welsh Government released Planning Policy Wales (Edition 10) in December 2018. As described above, this includes information for sites which will fall under the Environmental Permitting regime, regulated by NRW:

> *'5.13.3 Planning authorities, other relevant local authority departments and Natural Resources Wales (NRW) must work closely together to ensure that conditions attached to planning permissions and those attached to Environmental Permits are complementary and do not duplicate one another. Sufficient information should accompany development proposals in order for planning authorities to be satisfied that proposals are capable of effective regulation. NRW should assist the planning authority in establishing this position through the provision of appropriate advice. The parallel tracking of planning and environmental permitting applications should be the*

> *preferred approach, particularly where proposals are complex, so as to assist in mitigating delays, refusal of applications or conditions which may duplicate the permit/licence.'*

This is the approach that has been adopted in relation to similar applications in Powys.

3.3 NRW H4 guidance

NRW has published a number of guidance documents relating to odour assessment. These include the Horizontal Guidance EPR H4 – Odour Management[5].

The H4 guidance proposes the use of installation-specific exposure criteria (benchmarks) on the basis that not all odours are equally offensive, and not all receptors are equally sensitive. The conditions of a Permit will balance these installation-specific odour exposure criteria against what is realistically achievable in accordance with the concept of Best Available Techniques (BAT).

The Guidance states:

> *'..benchmarks are based on the 98th percentile of hourly average concentrations of odour modelled over a year at the site/installation boundary. The benchmarks are:*
>
> *1.5 odour units for most offensive odours;*
>
> *3 odour units for moderately offensive odours;*
>
> *6 odour units for less offensive odours.'*

Examples of these three categories are:

'Highly offensive:

processes involving 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'

These benchmark limits are precautionary and may be relaxed in cases where the source is familiar to the location. This is particularly the case in relation to intensive agriculture in a rural setting. For example, research relating to broiler farms indicates that a more representative nuisance threshold for an agricultural area should be anywhere from 3.3 – 8.8

5 H4 Odour Management: How to comply with your environmental permit.

ou_E/m^3 as a 98th percentile of hourly means[6], or even 9.7 ou_E/m^3 (as a 98th percentile)[7]. This is consistent with guidance published by the EA in relation to nuisance thresholds as a function of site setting[8,9] and also regulation applied in Ireland, where the Environmental Protection Agency (EPA, Ireland) recommended criterion is 6.0 ou_E/m^3 as a 98th percentile of hourly means for existing units. The H4 (and IPPC SRG 6.02, below) benchmarks should therefore be seen as a guide of the relative likelihood of an odour issue being caused rather than an absolute limit value, particularly in an agricultural setting.

3.4 IAQM Odour Guidance[10]

On 20th May 2014 the Institute of Air Quality Management released guidance on the assessment of odour for planning. This was updated in 2018.

The guidance is for assessing odour impacts for planning purposes. It provides background information relating to requirements for odour impact assessments and suitable impact criteria and draws from other sources of information such as that described in the H4 guidance (Section 3.3, above).

The IAQM odour guidance requires a degree of professional judgement when considering potential effects of environmental odours. Given the site setting and the number of residences potentially affected, the IAQM odour guidance may be used to classify to the impact from an intensive agricultural facility (i.e. for a 'moderately offensive odour') at a high sensitivity receptor as:

- 'negligible' at below 1.5 ou_E/m^3;
- 'slight adverse' from 1.5 ou_E/m^3 – 3.0 ou_E/m^3 as a 98th percentile of hourly means; or
- 'moderate adverse' impact above from 3.0 ou_E/m^3 to 5.0 ou_E/m^3 as a 98th percentile of hourly means.

Only a moderate impact (or greater) would be regarded as 'significant' for purposes of environmental assessment when considering the overall planning balance.

This document is not intended to provide guidance on odour for environmental protection regulatory purposes (e.g. Environmental Permitting).

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6 Misselbrook, Clarkson and Pain (1993) *Relationship between concentration and intensity of odours for pig slurry and broiler houses.*

7 Hayes, E.T., Curran, T.P and Dodd, V.A. (2006) *Odour and ammonia emissions from intensive poultry units in Ireland*. Bioresource Technology 97 pp933-939

8 EPA (2001) Odour Impacts and Odour Emission Control Measures for Intensive Agriculture. R&D REPORT SERIES No. 14. pp31.

9 Environment Agency (2002) Assessment of Community Response to Odorous Emissions. R&D Technical Report P4-095/TR. pp63

10 IAQM (2018) *Guidance on the assessment of odour for planning*

4.0 RECEPTORS, VENTILATION FLOWS AND EMISSIONS

4.1 Site Setting

Discrete receptor locations have been selected for comparative purposes to facilitate the discussion of predicted odour impacts; in general they represent the closest residential locations in each direction. These are as presented in Table 4-1 and shown in Drawing OIA1.

Table 4-1
Discrete Receptor Locations Modelled

Reference	Description	National Grid Reference	
		OS Xm	OS Ym
D1	coed-cochion	297349.3	269631.9
D2	coed-yr-ardd	297447.8	269266.5
D3	cefnfaes house	297520.1	268980.7
D4	Residence (unnamed)	297605.2	269048.0
D5	Bryn Pedol	298019.6	269388.9
D6	Beili Gof 1	297879.3	269271.5
D7	Ffos-mascal	298041.4	269214.5
D8	Beili-bedw	298298.2	269325.9

In addition to assessment of impact at discrete receptors, a receptor grid has been used to allow the production of and odour isopleth drawing.

4.2 Maximum Scrubber Treatment Capacity

The maximum treatment capacity of the units means that under extreme circumstances (i.e when the ventilation exceeds the maximum design capacity of the scrubbers) a proportion of the air will be vented out of ridge vents to atmosphere. This is similar to the relationship between ridge and gable end fans for a standard (i.e. unscrubbed) poultry building.

Details of the IPT Ventmax system assumed for purposes of this assessment are included as Appendix D to this report. The IPT system has a maximum ventilation capacity of 120,000m^3/hr (33.33m^3/s).

The air quality assessment provided in support of application ref: 18/0463/FUL stated the following in relation to the flow of air from the building:

> *'The ventilation rates used in the calculations are based on industry practices and standard bird growth factors. Minimum ventilation rates are as those of an operational poultry house and maximum ventilation rates are based on Defra guidelines. Target internal temperature is 33 Celsius at the beginning of the crop and is decreased to 22 Celsius by day 34 of the crop. If the external temperature is 7 Celsius, or more, lower than the target temperature, minimum ventilation only is assumed for the calculation. Above this, ventilation rates are increased in proportion to the difference between ambient temperature and target internal temperature. A*

maximum transitional ventilation rate (35% of the maximum possible ventilation rate) is reached when the ambient temperature is equal to the target temperature. A high ventilation rate (70% maximum possible ventilation rate) is reached when the temperature is 4 degrees above target and if external temperature is above 33 Celsius the maximum ventilation rate is assumed.'

On this basis, the following ideal dry bulb temperature values are of relevance and are taken from the optimal values detailed in the Aviagen guide for Ross broilers. Note that these are based on a suggested relative humidity value of 50% RH.

Table 4-2
Optimal House Temperatures (Aviagen)

Age	Suggested indoor temperature	minimum ventilation	transitional ventilation	maximum ventilation
1	33.2	26.2	33.0	33.0
3	31.2	24.2	31.2	33.0
6	29.9	22.9	29.9	33.0
9	28.6	21.6	28.6	32.6
12	27.8	20.8	27.8	31.8
15	26.8	19.8	26.8	30.8
18	25.5	18.5	25.5	29.5
21	24.7	17.7	24.7	28.7
24	23.5	16.5	23.5	27.5
27+	22.7	15.7	22.7	26.7

Based on 50% RH, the optimal temperatures in the Aviagen guide the bird number and husbandry strategy proposed (55,000 birds average, 36 day cycle with thinning at day 30) and the ventilation strategy accepted for application ref: 18/0463/FUL, the key ambient temperatures would be as follows and these values are also shaded in table 3-4, above:

- Irrespective of bird age, the unit would be operated at minimum ventilation up to an ambient temperature of 15.7°C;
- The maximum transitional ventilation (33% of overall maximum) would not be exceeded until the ambient temperature of 22.7°C. At maximum transitional ventilation the capacity of the IPT Ventmax system would not be exceeded until Day 25 of the crop, when the ambient temperature would have to be greater than 23.5°C;
- For the largest birds (>27 days), maximum ventilation capacity would be required when the ambient temperature of reaches 26.7°C. At maximum ventilation the capacity of the IPT Ventmax system would not be exceeded until Day 19 of the crop, when the ambient temperature would have to be greater than 29.5°C;

Analysis of 5 years (2015-2019) meteorological data recorded at Sennybridge that temperatures very rarely exceed 22.7°C and have not exceeded 29.2°C over the 5 year data set.

Table 4-3
Sennybridge Meteorological Summary (2015-19)

Minimum Temp °C	Maximum Temp °C	Number of Hours	% of year	% of year cumulative	Average hours per year
	<15.7	38542	90.4%	90.4%	7708
15.7	22.7	3786	8.9%	99.3%	757
22.7	23.5	79	0.2%	99.5%	16
23.5	26.7	200	0.5%	100.0%	40
26.7	29.5	18	0.0%	100.0%	4
	TOTAL	**42625**	**100%**		**8525**

It can be seen that, at this location (and particularly this altitude, which is the same for Sennybridge as it is for Llwyngwilym) the facility would be operating at the minimum ventilation for over 90% of the year. The temperature at which the maximum transitional ventilation would be reached for the bird older than 27 days would only be exceeded for fewer than 60 hours (or 0.7%) of the average year. This would need to coincide with one of the 72 days (assuming 8 crops) or 20% of the year when the bird of that age are being housed. There are only 18 hours in the 5 year data set (<4 hours per year) when the ambient temperature is above the 26.7°C required before the crop is at maximum ventilation for the largest birds.

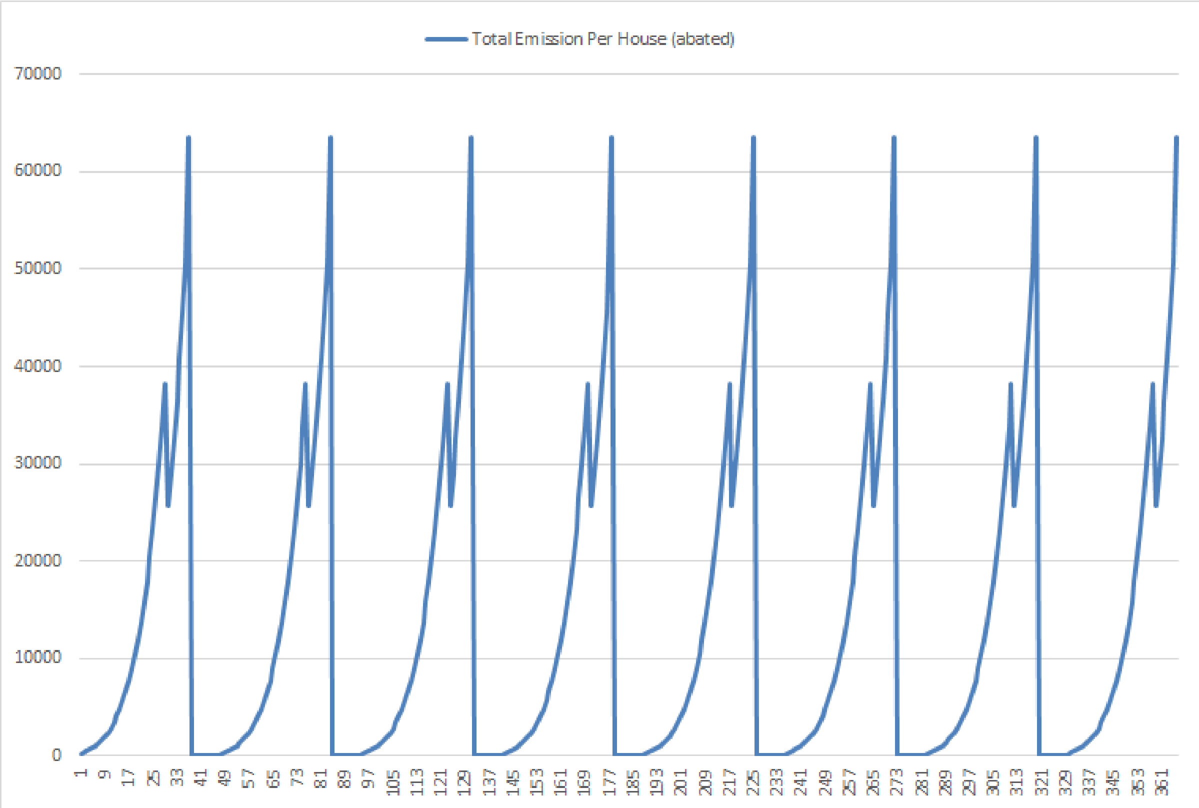
For the above reasons it is considered appropriate to model the emissions from the scrubber unit stacks with no odour emitted from the roof vents as the chances of this occurring are very small and therefore the total mass emission of odour from the roof vents over any one year will be insignificant when compared with the emissions from the scrubber. The 40% average odour abatement factor for scrubbing systems such as the IPT and equivalent units is consistent with that for other applications in Powys.

4.3 Emission Rates

The emission rates used are calculated from an internal concentration of odour taken from published values which indicate a likely range for a well run modern farm of 300ou_E/m^3 – 2300 ou_E/m^3 across a 36 day growth cycle. The use of this concentration range has been accepted for multiple sites by both Powys Council and NRW. The time varying emission rates used represent the emissions for each sheds (housing 55,000 birds) is as shown below and these are based on transitional ventilation rates.

It can be seen in Figure 4-2 that the relative proportion of emissions will vary across the cycle, with the peak during clearing out (as would be expected).

Figure 4-1
Emission rate (ou_E/s per house)



Research has shown that the use of indirect heating, will result in a significantly improved building environment and lower emissions, particularly of ammonia and carbon dioxide. This in turn improves the growth rate and performance of the birds. The quality of the litter and in particular the moisture content, will also determine the overall odour emission.

5.0 ODOUR IMPACT ASSESSMENT

The dispersion model was constructed based on the input parameters described below.

5.1 Model Domain

Modelling was carried out at 20m resolution over a 0.6 km by 0.6 km grid. In addition, the identified potentially sensitive locations, detailed in Table 4-1, were modelled as discrete receptors.

5.2 Model Assumptions

The release parameters for each stack are as shown below.

5.2.1 Source Parameters

The emission parameters are as shown in Table 5-1 below and they are identical for all stacks.

Table 5-1
Stack Details

Building	Stack height (m)	Stack diameter (m)	Velocity (m/s)
Proposed Building scrubber	5.5	1.5	6.22

The temperature of all emissions has been taken as 22°C for all hours of the year which represents 'worst case' in terms of thermal buoyancy from the stacks given that it is at the lower end of the range for the entire cycle (the younger birds will typically be housed at a temperature slightly above this). The velocity and stack diameter results in a flow per stack of 11 m^3/s, which represents 118710 m^3/h for the 3 stacks modelled (the maximum throughput of the unit is 120000m3/h).

5.2.2 Emission Rate

The process contribution is calculated as a result of the emissions from the proposed buildings. The maximum emission rates for each building are shown below and these would be relevant on the last day of each cycle as per Figure 4-1, above.

Table 5-2
Emission Rate

Building	No. of Birds	Maximum Emission (ou_E/s) to scrubber	% abatement	Maximum Emission (ou_E/s) per stack
Shed 1 scrubbers	55000	84477	40%	16895.3
Shed 2 scrubbers	55000	84477	40%	16895.3

5.3 Building Downwash / Entrainment

The movement of air over and around buildings and other structures generates areas of flow re-circulation that can lead to increased ground level concentrations of pollutants close to the source. Where the stack height is less than 2.5 times the height of any nearby building (within 5 stack heights), downwash effects and entrainment can be significant.

The site details have been provided by the applicant and the specifications for the new buildings are consistent with those for planning application 18/0463/FUL. The detailed dispersion model was constructed on this basis and includes the recently approved building as this has the potential to influence dispersion.

Table 5-3
Building Details

Building	Width (m)	Length (m)	Basal Height (mAoD)	Angle (°)	No. of stacks
Proposed building	24.4	115.8	315	57.2	0
Extant Building	24.4	115.8	315	57.2	0
Proposed Building scrubber	24.4	4	315	57.2	3
Extant Building scrubber	24.4	4	315	57.2	3

The heights of the buildings have been taken as 5.2m for the buildings and 4.5m for the scrubbing units for purposes of downwash.

5.4 Wind Speed and Direction Data

In accordance with current guidance, 5 years of meteorological data has been used (2015 – 2019). The closest meteorological data sites to the scheme are:

- Trawsgoed WMO Identifier 3503 (62m AoD)
- Shobdon Airfield WMO Identifier 3520 (99m AoD); and
- Sennybridge NO2 WMO Identifier 3507 (307m AoD).

The closest of these data sets with similar characteristics to the application site (such as altitude) is Sennybridge NO2. This site lies approximately 40km from the proposed development site.

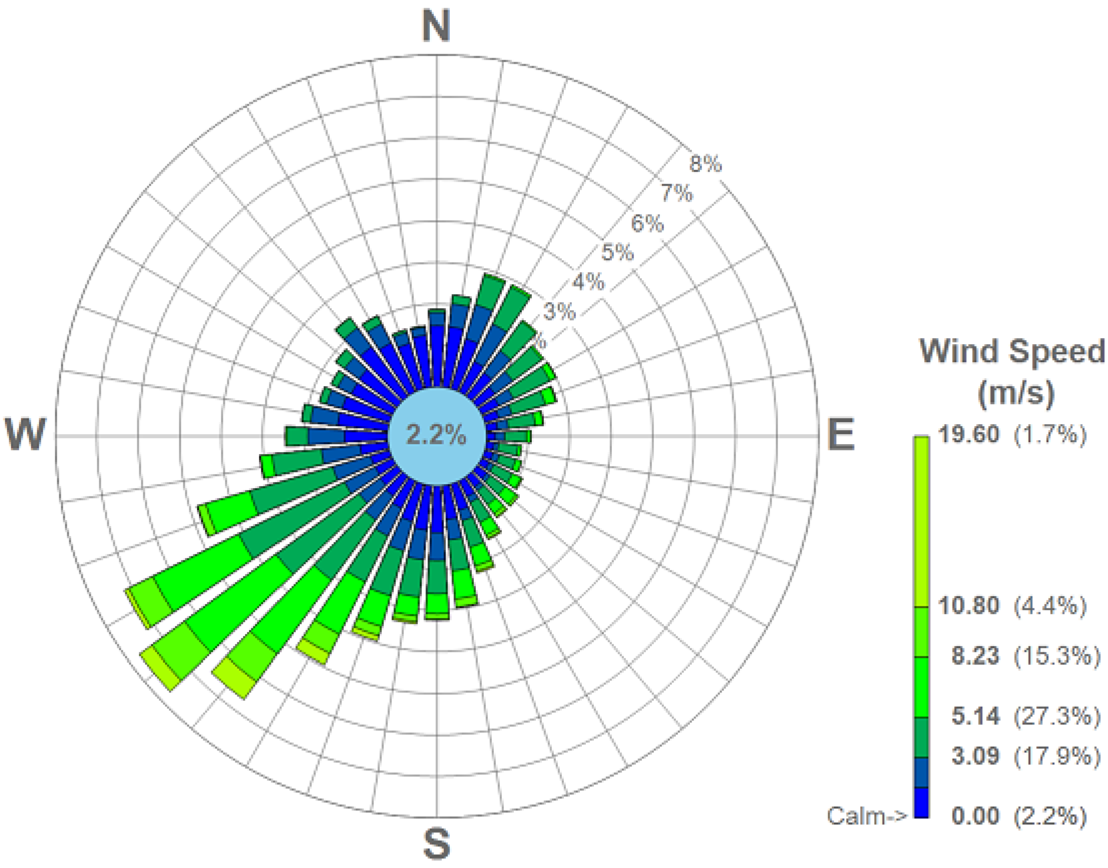
Meteorological data for Sennybridge NO2 was obtained in .met format and converted to .sfc and .pfl formats for use in AERMOD using AERMET Pro according to US EPA methodology[11]. Surface roughness length is based upon land use characteristics 1km from the point source. The determination of Bowen ratio and albedo is defined by a 10km by 10km region around the site. In this case the site is characterised by forest, cultivated land and grassland. A site

[11] US Environmental Protection Agency (2008). AERMOD Implementation Guide, AERMOD Implementation Group.

roughness of 0.225m has been used for the modelling, which is consistent with the roughness length used for planning application ref 18/0463/FUL.

A windrose providing the frequency of wind speed and direction for 5 years of data is presented in Figure 5-1, below.

Figure 5-1
Windrose (5 years)



5.5 Met Data Preparation

Meteorological data was obtained in .met format and converted to .sfc and .pfl formats for use in AERMOD using AERMET Pro. GFS (NWP) meteorological data has been processed according to US EPA methodology[12]. Surface roughness length is based upon land use characteristics 1km from the point source.

The determination of Bowen ratio and albedo is defined by a 10km by 10km region around the site. In this case the site is characterised by forest, cultivated land and grassland. A site roughness of 0.225m has been used for the modelling, which is consistent with the roughness length used for planning application ref 18/0463/FUL.

[12] US Environmental Protection Agency (2008). AERMOD Implementation Guide, AERMOD Implementation Group.

5.6 Topography

Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away. The site is set on ground at approximately 315m AOD and the height of the surrounding land is highly variable. Information relating to the topography of the area surrounding the site has been used to assess the impact of terrain features on the dispersion of emissions from the site. Topographical data has been obtained in digital (.ntf) format and incorporated into the assessment.

6.0 RESULTS

Results may be compared against the benchmark criterion of 3 ou_E/m^3 as a 98th percentile of hourly means appropriate for a 'moderately offensive' odour although this should be regarded as precautionary as should the emission rates. Given the site setting and the number of residences potentially affected, the IAQM odour guidance would regard the impact as:

- 'negligible' at below 1.5 ou_E/m^3;
- 'slight adverse' from 1.5 ou_E/m^3 – 3.0 ou_E/m^3 as a 98th percentile of hourly means; or
- 'moderate adverse' impact above from 3.0 ou_E/m^3 to 5.0 ou_E/m^3 as a 98th percentile of hourly means.

The 5-year average odour exposures predicted as a result of emission from the facility are presented in Table 6-1 below and Appendix C.

Table 6-1
Results: Existing Site (1 Shed)

Ref	2015	2016	2017	2018	2019
D1	0.05	0.06	0.05	0.06	0.06
D2	0.23	0.36	0.23	0.35	0.12
D3	0.21	0.22	0.09	0.24	0.14
D4	0.31	0.31	0.10	0.29	0.22
D5	0.28	0.22	0.36	0.36	0.33
D6	0.31	0.29	0.33	0.24	0.29
D7	0.19	0.14	0.16	0.09	0.17
D8	0.09	0.07	0.14	0.13	0.12

The odour impacts associated with the single shed operation are predicted to be low (negligible) for all years.

Table 6-2
Results: Proposed Site (2 Sheds)

Ref	2015	2016	2017	2018	2019
D1	0.10	0.12	0.10	0.12	0.14
D2	0.46	0.71	0.46	0.75	0.28
D3	0.43	0.42	0.16	0.44	0.28
D4	0.60	0.55	0.19	0.56	0.42
D5	0.58	0.45	0.69	0.71	0.63
D6	0.64	0.61	0.66	0.44	0.56
D7	0.37	0.27	0.32	0.17	0.32
D8	0.17	0.14	0.25	0.24	0.22

The odour impacts associated with the two shed operation are predicted to remain low (negligible) for all years.

Table 6-3
Results: Comparison

Ref	Description	Existing Impact (ou_E/m^3)	Future Impact (ou_E/m^3)	Increase
D1	coed-cochion	0.05	0.12	0.06
D2	coed-yr-ardd	0.26	0.53	0.27
D3	cefnfaes house	0.18	0.35	0.17
D4	Residence (unnamed)	0.25	0.46	0.21
D5	Bryn Pedol	0.31	0.61	0.30
D6	Beili Gof 1	0.29	0.58	0.29
D7	Ffos-mascal	0.15	0.29	0.14
D8	Beili-bedw	0.11	0.21	0.10

If additional measures are taken to mitigate this odour, particularly in relation to prevention of odour within the houses through effective litter management (particularly when cleaning out the buildings at the end of the cropping cycle) this would be reduced still further.

These additional operational measures (i.e. control of processes or emissions) remain matters for the environmental permitting process and therefore regulated through the Environmental Permit as detailed in a site Odour Management Plan to be submitted with the Permit application.

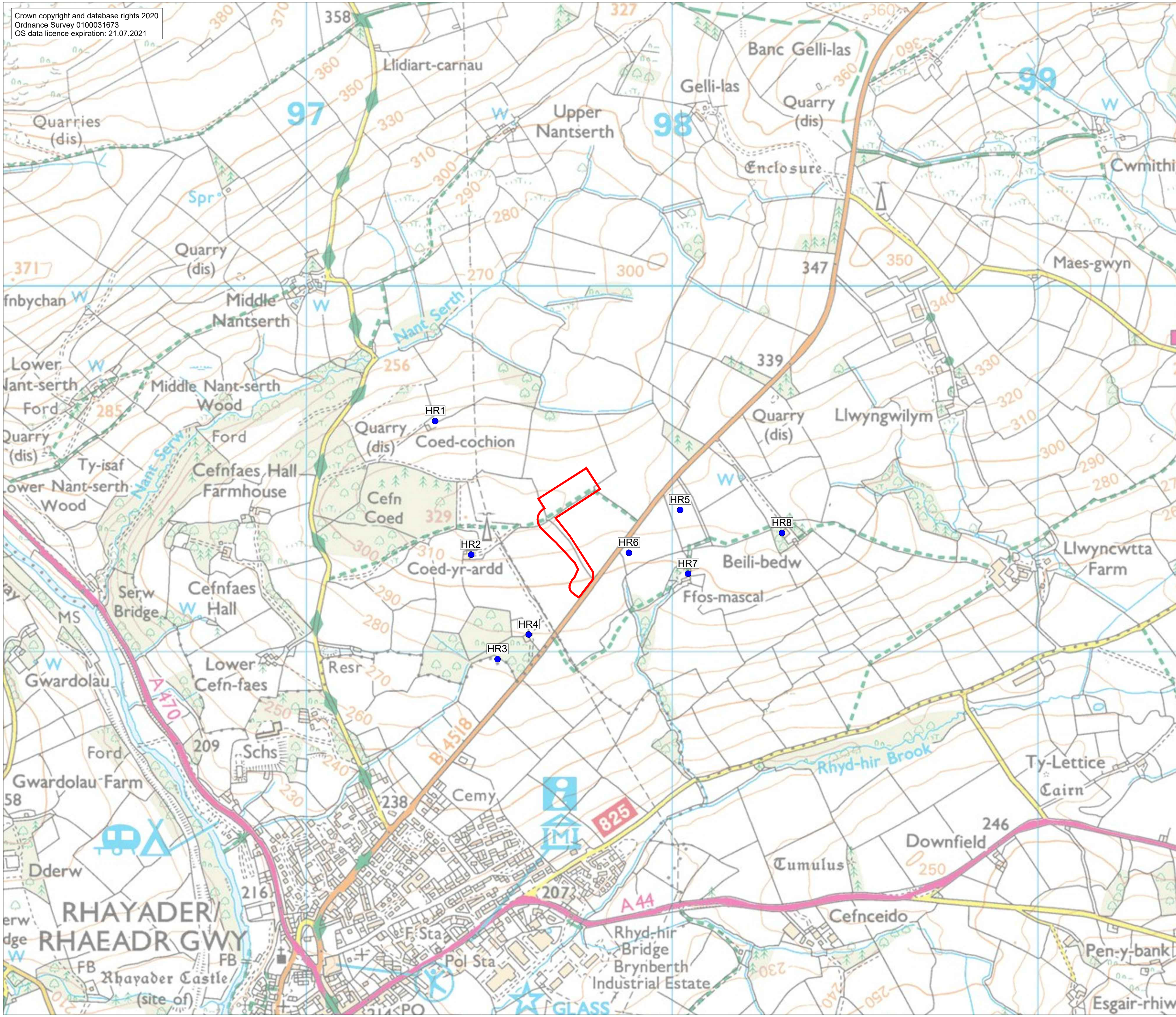
7.0 CONCLUSIONS

This report presents a detailed odour impact assessment (OIA) of the proposed extension to the poultry development at Llwyngwilym, Powys.

Dispersion modelling has been completed, which predicts that the proposed development is unlikely to lead to odour impacts at a level which would be regarded as unacceptable, when operated in accordance with best practice.

Should the odour control measures detailed in a site odour management plan be followed during typical operation and abnormal events, these potential impacts will be reduced even further.

APPENDIX A



LEGEND

SITE BOUNDARY

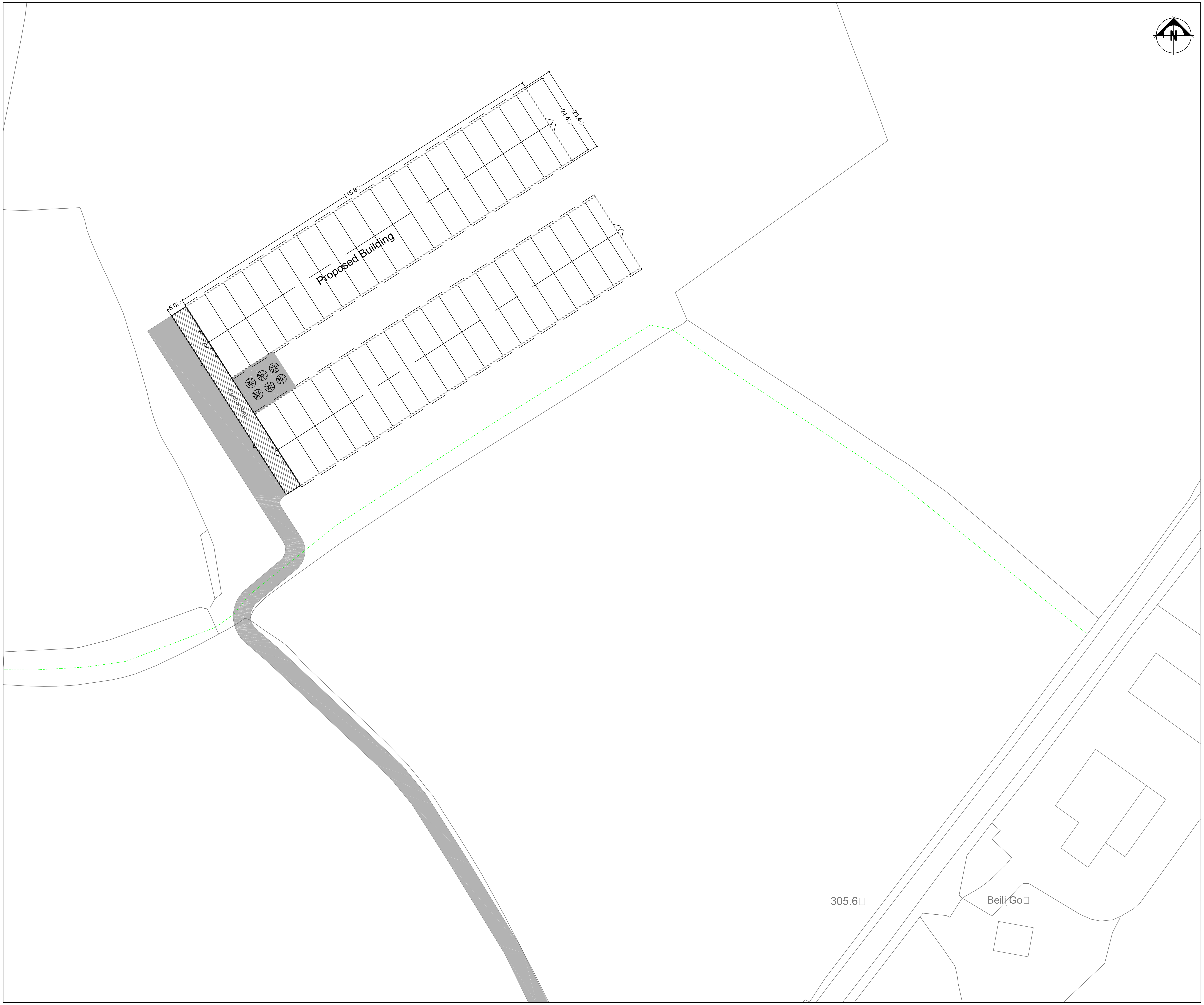
HUMAN RECEPTOR LOCATION

N
W
E
S

H & E Powell

SITE	**Proposed Poultry Unit at Llwyngwilym**
PROJECT	**Air Quality Assessment**
DRAWING TITLE	**Site Setting and Human Receptor Locations**
DRAWING NUMBER: AQ1	REVISION: 0
SCALE: 1:10000 @ A3	DATE: 23.07.2020

ISOPLETH



□ootpath

Rev	Description	Date	Dr by	App by
Original by				

Roger Parry & Partners

Residential □Agricultural □Co□□ercial

Job	Proposed Broiler Unit
Title	Proposed Bloc□Plan
Location	Land near Llwyngwily□ Rhayader Powys LD6 5NS
Client	J Powell
Scales	1:500 @ A1
Drawing No.	GEL□JP□BU□002
Drawn by	GEL□M□246□02 Date 21□01□201□

HOGSTOW HALL, MINSTERLEY
SHREWSBURY, SHROPSHIRE. SY5 0HZ
Tel: 01743 791336 Fax: 01743 792770
email: mail@rogerparry.net
Web address: www.rogerparry.net

APPENDIX B

Table B-1
Stack Locations:

ID	Reference	OS GR X	OS GR Y	Base Height (m AoD)
NBSV1	New Building stack 1	297748.2	269508.1	315
NBSV2	New Building stack 2	297752.5	269501.2	315
NBSV3	New Building stack 3	297757.3	269493.9	315
EDSV1	Existing Building stack 1	297767.5	269478.2	315
EDSV2	Existing Building stack 2	297772.0	269470.7	315
EDSV3	Existing Building stack 3	297777.2	269462.9	315

APPENDIX C

Figure C-1
Impacts: New Building Only

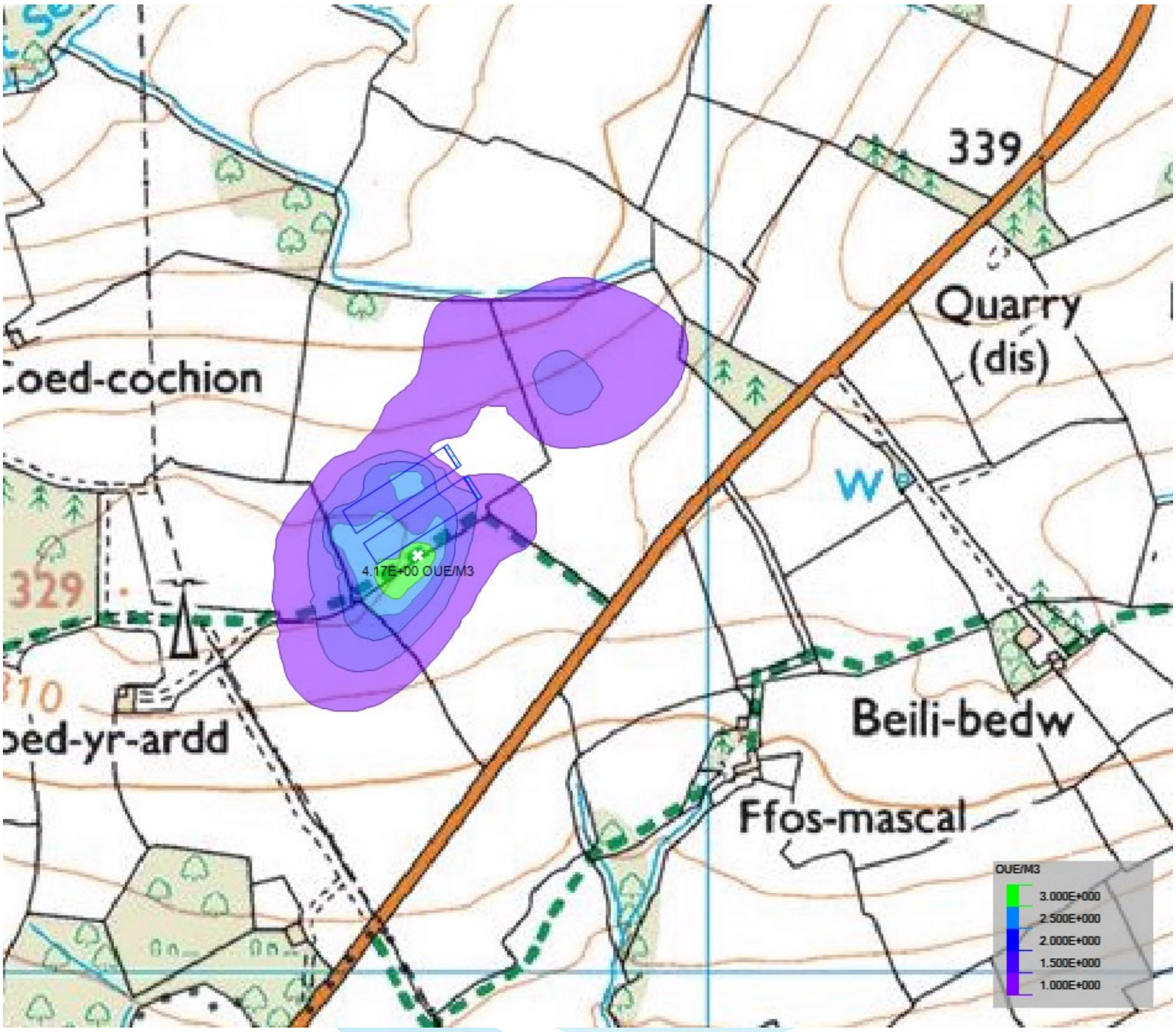
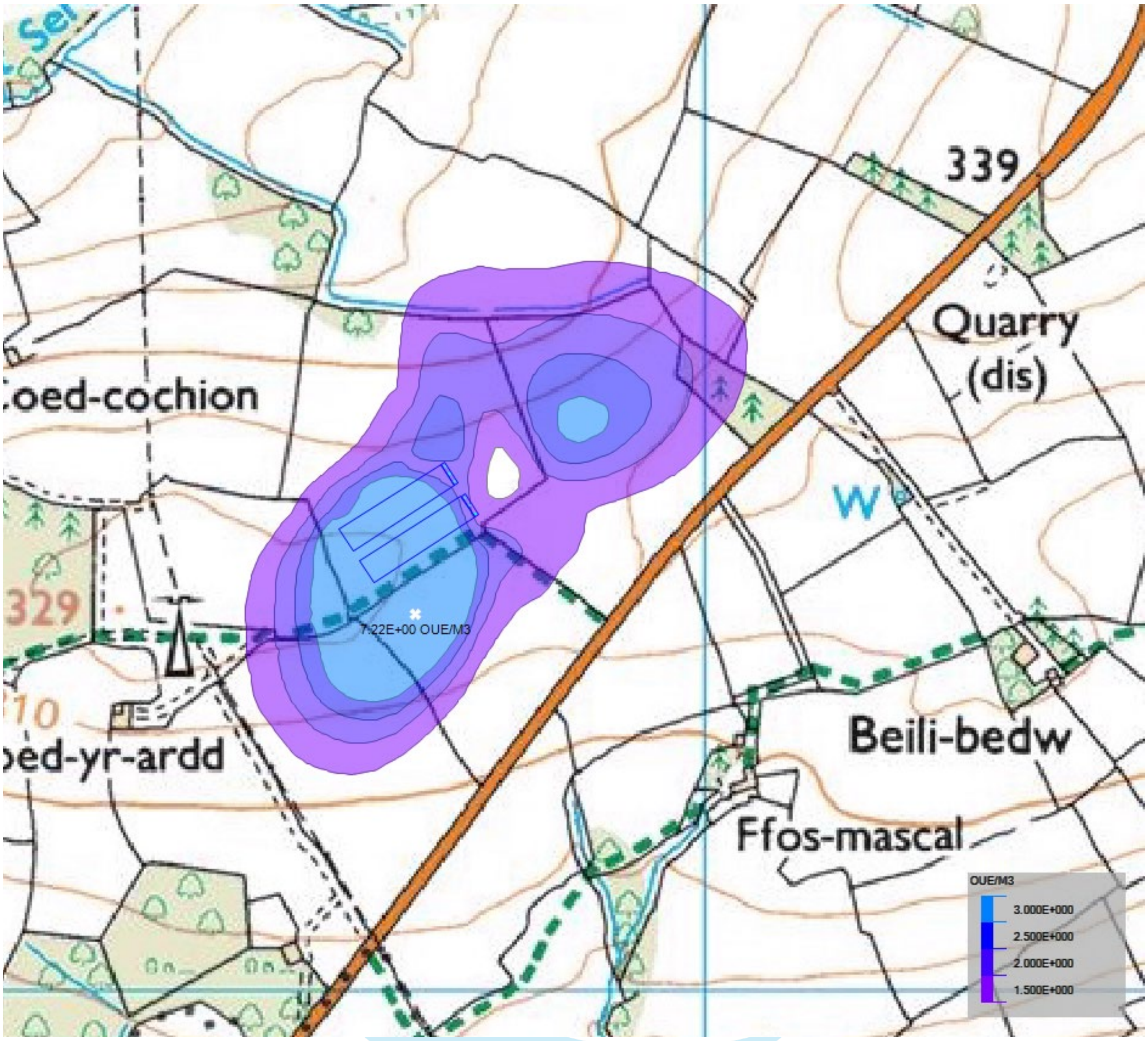


Figure C-2
Impacts: Scenario 2 (Both Sheds)



APPENDIX D

VentMax 1200 Acid Scrubbers for Poultry

Introduction

IPT VentMax end of house wet acid scrubbers and are identified as an appropriate BAT for reducing ammonia emissions to air from broiler, broiler breeder houses and layers (Commission Implementing Decision (EU) 2017/302 – **BAT 31 c.1**)

These units are designed to provide all the ventilation needs of the fully stocked houses across the normal range of operating conditions. Each air scrubber unit is equipped with 4 high-velocity fans mounted for a high velocity throw as required. Air is drawn into the houses via inlets located along the sides of the building. It is then drawn into the air scrubber units through a single large internal inlet where it passes through a filter system before being expelled through the fans.

Each poultry house will require roof ridge mounted high-velocity fans and gable end fans which are provided as emergency back-up to the continuous ventilation system. Under the normal range of operating conditions, the ridge fans and gable-end fans are shut down. The emergency back-up system is available to maintain the house environment and ensure bird welfare in the event of extreme heat or system failure.

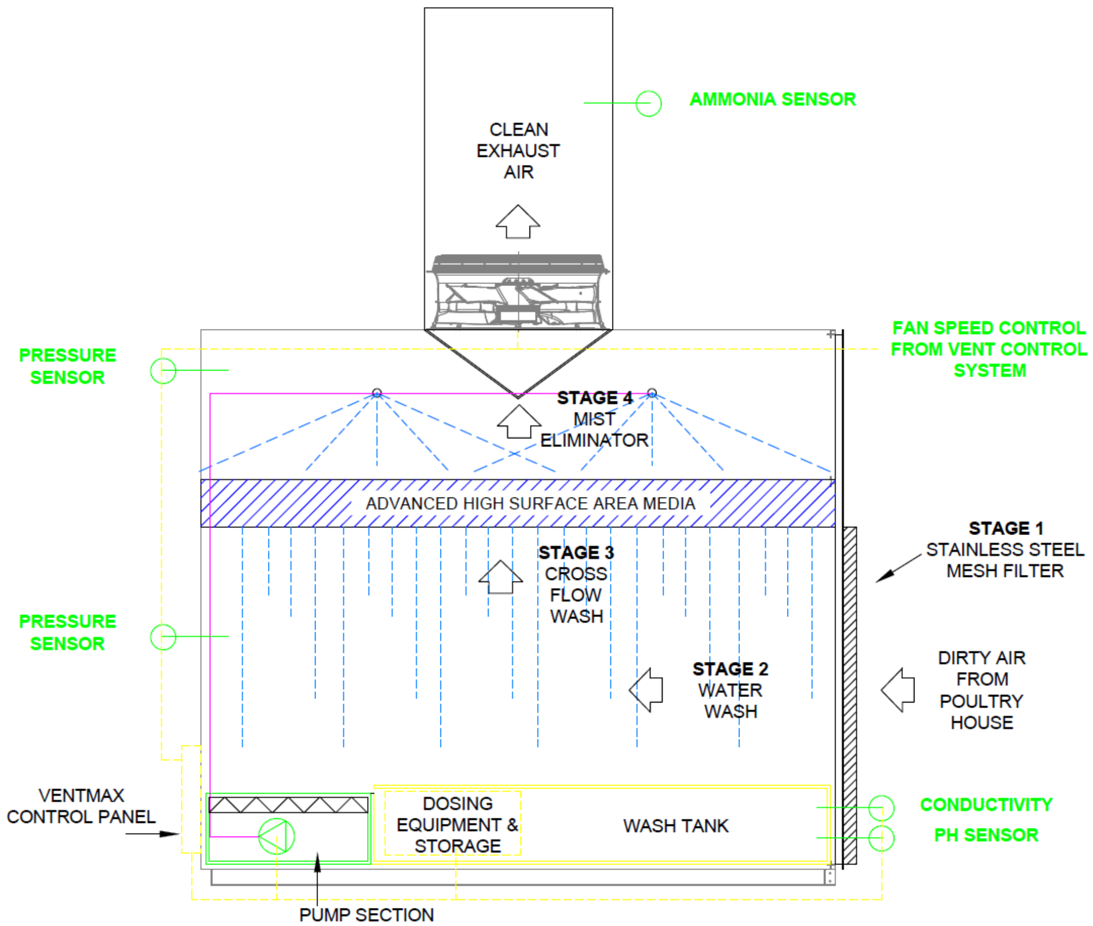
The whole ventilation system is automatically controlled via the shed "building management system" that is normally accessed from the main electronic panel located in the control room/entrance to each house. Continuous recording via an electronic logbook is in place and can be accessed remotely.

Ammonia Scrubbing Technology

1. **General**
   A continuous ventilation system draws air (by suction principle) through a single point of outlet from the poultry house and across the air scrubber. Ammonia in the air extracted from the house reacts with and dissolves into the acidic substrate within the reactor core. The wet acid scrubber units use sulphuric acid (96%) to maintain a pH value below 4 in the scrubbing liquid at the reactor. The solution is sprayed over a filter media as the air is passed through the system and extracted through high pressure fans and end of house chimneys. The solution is automatically dosed and regulated using a PH sensor. A dirty water filtration system and electrolytic metering ensures continuous operation while discharging treated water to the dirty water tank storage system.

2. How it Works - Scrubber Unit Components

- Air is drawn in through an opening at the end of the poultry house through a stainless-steel filter mesh which removes large particulates. **Stage 1**
- The air is then passed though a water cascade which removes dust and particulate matter before being drawn up through the media filter. **Stage 2**
- The air is then passed through a cross flow packed filter arrangement also known as the reactor. (Advanced High Surface Media), where more dust is removed, and the ammonia gas reacts and is absorbed into the water. **Stage 3**
- The air is finally passed through a mist eliminator to ensure water droplets remain within the unit, before being expelled to atmosphere through a high-pressure fan. **Stage 4**
- A wash tank with pump provides continuous distribution and recirculation of water to the top of the packed tower.
- A self-cleaning and replaceable in-line filtration system removes any solids and replacement with fresh water.
- A dosing station to introduces the chemical to the wash cycle to react with and remove ammonia.
- The scrubber has a built-in acid storage tank for no handling problems which are delivered using a specialist contractor according to use but normally once every 2 months
- The dirty water must be discharged into an onsite dirty water storage tank and removed accordingly once full.
- The unit will require a three-phase electrical supply, connection to a drain to dirty water tank and fresh water supply.



IPT Technology ltd
Corbett Business Park
Shaw Lane
Stoke Prior
Bromsgrove
B60 4EA

VentMax 1200 Scrubber Data sheet

Capacity	Maximum Air Capacity	A30/H65	120,000 m^3/h
	Minimum Air Capacity	A30/H65	24,000 m^3/h
	Scrubbing residence time	A30/H65	0.76 sec
	Outlet concentration	$NH_3$7 @ 33m^3S	2.00 PPM
	Number of fans		4.00
	Packed filter media		9.60 m^3
	Packed Bed Surface		150.00 m^2
	Maximum Power Consumption	400V	15.00 kW
	Acid holding tank	(B2/W45)	800 ltr

Operating efficiency	Maximum Removal Efficiency	NH_3	100 %
	Minimum Removal Efficiency	NH_3	76 %
	Average Removal Efficiency	NH_3	92 %
	Average Dust Removal Efficiency	$PM_{2.5}$	97 %
	Average Odour Removal Efficiency	ouE	40 %
	Average water consumption	Fresh	1 m^3/d
	Average acid consumption	96%	7 ltrs/d
	Maximum Power Consumtion	Daily	290 kWh
	Average Power Consumption	Annual	35 MWh

Sensors and monitoring	Water PH Value control	Continuous - pH sensor AO
	Water discharge control	Continuous - EC meter DO
	Ammonia sensors	Continuous - Mid range sensor AO
	Wash tank low level sensor	Continuous - Level sensor AO
	Air temperature sensor	Continuous - temperature sensor
	Pressure Sensors	Continuous - Pressure sensors AO

System	Frame	Stainless Steel
	Wash Tank	Fibreglass
	Lining	Plastic
	Controls	Carell
	Pipework	Stainless Steel
	Acid Tank	Plastic double lined
	Filter media	Plastic

Dimensions	Height (mm)	3500	Length (mm)	8000
	Width (mm)	4000	Weight (kg)	4000

Isopleth Ltd
Ulverston,
53 Englishcombe Lane,
Bath
BA2 2EE
www.isopleth.co.uk

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