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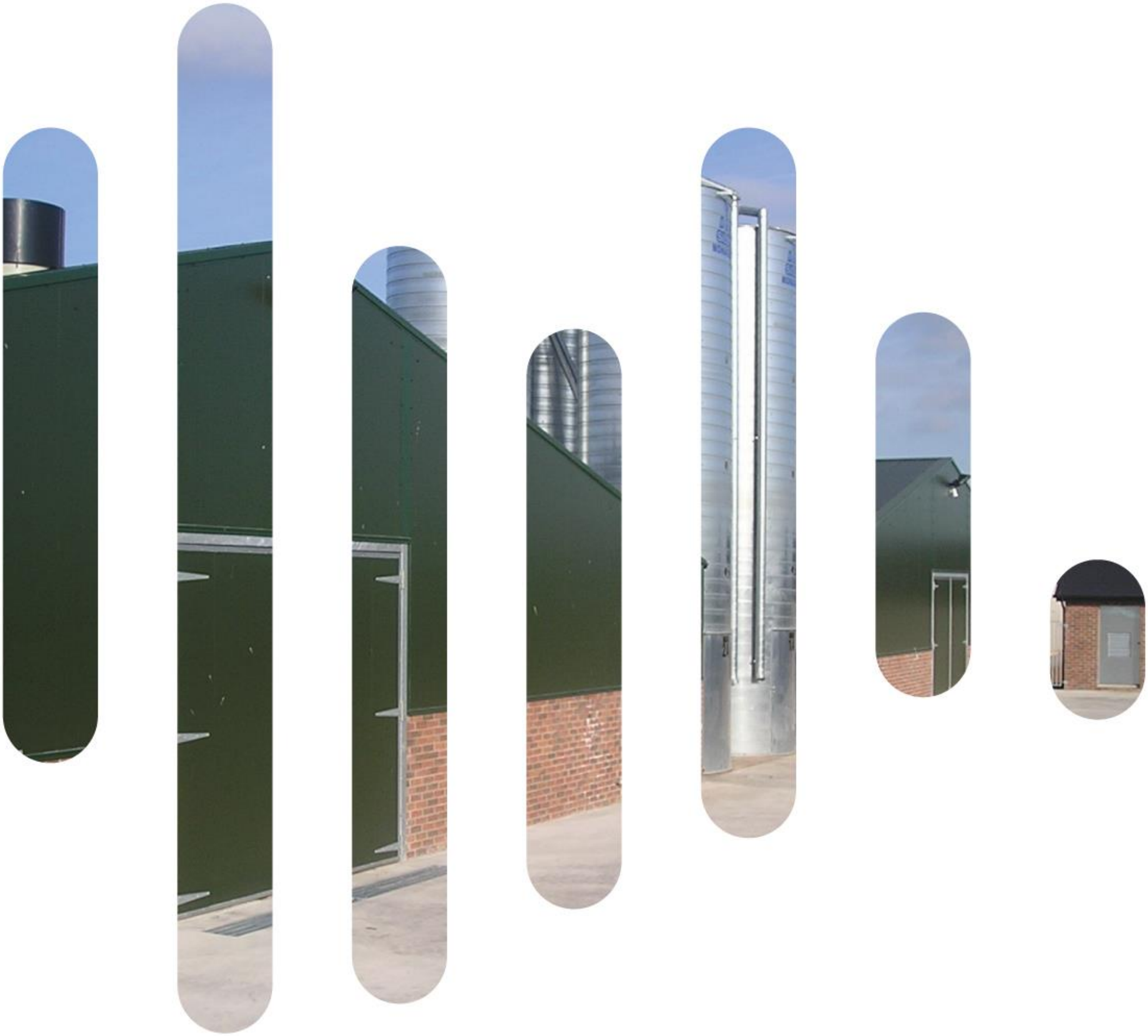

AMMONIA IMPACT ASSESSMENT
JORISTOWN PIGGERY

Rp 004 2019182 (Joristown Piggery)
7 June 2022

PROJECT: AIR QUALITY IMPACT ASSESSMENT

PREPARED FOR: JORISTOWN PIGGERY
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1 INTRODUCTION

Irwin Carr Ltd have been commissioned to undertake ammonia dispersion modelling for an amendment to an existing licence at an existing pig farm at Joristown Upper, Killucan, Co. Westmeath.

The purpose of this report is to quantify the ammonia and nitrogen levels at the ecologically sensitive areas in the vicinity of the pig farm.

The predicted impact can then be compared to an appropriate criterion and graphically illustrated in the form of 'contours of equal concentration' or isopleths which are superimposed on base maps.

1.1 Application Description

The site is currently made up of nine existing sheds and four grower/ finisher sheds (G1 – G4), and contains a total of 6,428 animals of varying size and type. As part of this assessment, the four grower/ fattener sheds, which house a total of 3,318 pigs, are under consideration for the purposes of an EPA licence application.

As part of this application, it is proposed to introduce mitigation to all sheds on the site that house pigs. The applicant has confirmed that all of the sheds on the site were built, stocked and in operation in 2013 with no mitigation incorporated.

It is now proposed to incorporate a low protein diet on all sheds on-site, the associated reductions of which are included in Section 3.2.2 below. However, as part of this assessment, which only takes account of the 4 x fattener sheds, the reductions in the 'existing sheds' will not be accurately reflected. In order to take account of the reductions from the whole site (all sheds), the following steps were carried out:

- A reduction in ammonia/ nitrogen as a result of a low protein diet is only associated with fattener pigs and sows, not weaners.
- It was necessary to determine the total number of pigs in the existing sheds (referred to as 'existing sheds' throughout this report), that were production pigs.
- Once this number was confirmed, a reduction of 30% is applied to the total ammonia being emitted from these animals.
- As the existing sheds are not included in this air quality assessment, their associated reduction in emissions had to be incorporated into the proposed sheds. In order to account for this reduction, the total ammonia was converted to equivalent number of fattener pigs, which was then taken away from the total number in the proposed sheds.

These steps are detailed and shown in Section 3.2.3 below.

In addition to the low protein diet detailed above, additional mitigation is also incorporated into the 'proposed sheds' by way of the regular removal of slurry from the sheds. This slurry will be removed from the sheds in line with the Best Available Techniques (BAT) Reference Document and transported directly off site, so there will be no external storage of slurry on the site.

1.2 Application History

The assessment is further to an original report completed by Irwin Carr, as well as a recent consultation response from the EPA dated 24 May 2021.

In their response, the EPA had queries in relation to the previous ammonia impact assessment previously undertaken, a number of which are addressed in order below:

14.a) This assessment has been updated to take account of 3,318 production pigs, rather than the 3,338 included in the previous assessment.

c) Frequent removal is applicable- EA Guidance details that sluice and vacuum tanker systems qualify as frequent removal. Additional storage capacity is off site.

d. i) Subthreshold levels are all of the sows and weaners (<30 kg) and production pigs up to up to 2018.

ii) The issue of whether or not these sites should have been operating or not is not a matter for the applicant. As they were operating, they are represented/ included in the background data, and therefore the position taken in the previous assessment is appropriate

14. e. i) The flux velocity is calculated by dividing the volume flow (m^3/s) by the area of the fans (m^2). This calculation is carried out in Table 14.

14. e. ii) The efflux temperature has been amended and is now detailed as 20ºC, which is considered conservative for the pigs housed in the sheds.

14. e. iii) The building references have been updated to match other submitted documents and drawings. Amended building labels are provided in Table 3.

14. e. iv) The contour map has been amended to include a site boundary, while still showing the boundary of each designated site in the vicinity.

This report has been updated to take account of the points above, as well as the other points in the EPA response and Industrial Installations Guidance Note (AG4)

2 ASSESSMENT CRITERIA

The proposed target levels and method of assessment is described in this section.

2.1 Ammonia

There are limitations on emissions of ammonia from such installations for the protection of vegetation. They are referenced from *Cape, J.N.; van der Eerden, L.J.; Sheppard, L.J.; Leith, I.D.; Sutton, M.A.. 2009. Evidence for changing the critical level for ammonia. Environmental Pollution, 157 (3). 1033-1037.*

Where the limits are applied to general vegetation such as herbaceous species or forest trees the limit is set at 3 ± 1 μg/m³ of ammonia (ie. 2-4 μg/m³) as a long-term (several year) concentration.

For particularly sensitive plants such as lichens and bryophytes, the limit of 1 μg/m³ is applied to ammonia as a long-term (several year) concentration

Table 1 shows the target levels for the protection of vegetation.

Table 1: Ammonia limit values

Pollutant	Reason	Guideline Value	Measured as
Ammonia	Protection of Vegetation	1-3 μg/m³	Annual Mean

2.2 Nitrogen Deposition

Critical load values for nutrient nitrogen deposition are provided by the United Nations Economic Commission for Europe (UNECE) as a range (e.g. 10-20 kg N/ha/yr for dry heaths). This table provides indicative values within the critical load range, by habitat type, for use in detailed impact assessments in Ireland.

Table 2: Critical Load Range for atmospheric Nitrogen

Habitat type (EUNIS code)	Critical load (CL) range (kgN/ha/yr)	Value to use at screening stage (kgN/ha/yr)	Recommended value to use at detailed assessment stage (kgN/ha/yr)
Marine habitats			
Mid-upper saltmarshes (A2.53)	20-30	20	20
Pioneer & low-mid saltmarshes (A2.54 and A2.55)	20-30	30	30
Coastal habitats			
Shifting coastal dunes (B1.3)	10 to 20	10	10
Coastal stable dune grasslands (grey dunes) (B1.4)	8 to 15	8	Acid dunes = 8 Calcareous dunes = 10
Coastal dune heaths (B1.5)	10 to 20	10	10
Moist to wet dune slacks (B1.8)	10 to 20	10	Low base availability = 10 High base availability = 15
Inland surface waters			
Softwater lakes (permanent oligotrophic waters) (C1.1)	3 to 10	Seek site specific advice	
Dune slack pools (permanent oligotrophic waters) (C1.16)	10 to 20	10	10

Permanent dystrophic lakes, ponds and pools (C1.4)	3 to 10	Seek site specific advice	
Mire, bog and fen habitats			
Raised & blanket bogs (D1)	5 to 10	5	Apply guidance
Valley mires, poor fens and transition mires (D2)	10 to 15	10	10
Rich fens (D4.1)	15 to 30	15	15
Montane rich fens (D4.2)	15 to 25	15	15
Grasslands and tall forb habitats			
Sub-atlantic semi-dry calcareous grassland (E1.26)	15 to 25	15	15
Non-Mediterranean dry acid and neutral closed grassland (E1.7)	10 to 15	10	10
Inland dune pioneer grasslands (E1.94) Inland dune siliceous grassland (E1.95)	8 to 15	8	Acid dunes = 8 Calcareous dunes = 10
Low and medium altitude hay meadows (E2.2)	20 to 30	20	20
Mountain hay meadows (E2.3)	10 to 20	10	10
Moist & wet oligotrophic grasslands:			
Molinia caerulea meadows (E3.51)	15 to 25	15	15
Heath (Juncus) meadows & humid (Nardus Stricta) swards (E3.52)	10 to 20	10	10
Moss & lichen dominated mountain summits (E4.2)	5 to 10	5	7
Alpine and subalpine acid grasslands (E4.3) Alpine and subalpine calcareous grasslands (E4.4)	5 to 10	5	5
Heathland, scrub & tundra			
Arctic, alpine and subalpine scrub habitats (F2)	5 to 15	5	5
Northern wet heaths (F4.11) Dry heaths (F4.2)	10 to 20	10	10
Forest habitats (general)			
Use if not one of specific forests in section below			
Broadleaved woodland (G1)	10 to 20	10	10
Coniferous woodland (G3)	5 to 15	5	10 (Use 5 if lichens/free-living algae important features of the site).
Forest habitats (specific)			
Fagus woodland (beech) (G1.6)	10 to 20	10	15
Acidophilous Quercus-dominated woodland (oak) (G1.8)	10 to 15	10	10

Meso- and eutrophic Quercus woodland (G1.A)	15 to 20	15	15
Pinus sylvestris woodland south of the taiga (G3.4)	5 to 15	5	12
Coniferous woodland (G3)	5 to 15	5	10 (Use 5 if lichens/free-living algae important features of the site).

3 AERMOD DISPERSION MODELLING DATA

The inputs for the dispersion modelling assessment are described in detail in this Section. A surface roughness factor of 0.2 has been used in the AERMOD modelling process, and the results in this report reflect the use of this factor.

The site layout, including the nearest residential properties, is shown in Appendix A.

3.1 AERMOD Dispersion Modelling Package Description

The AMS.EPA Regulatory Model (AERMOD) is the current US EPA regulatory model used to predict pollutant concentrations from a wide range of sources that are present at typical industrial facilities.

The model accepts hourly meteorological data to define the conditions for plume rise, transport, diffusion and deposition. It estimates the concentration or deposition value for each source and receptor combination for each hour of input meteorology and calculates user-selected short term averages. The model also takes into account the local terrain surrounding the facility. Since most air quality standards are stipulated as averages or percentiles, AERMOD allows further analysis of the results for comparison purposes.

Percentile analysis for emissions is calculated for the maximum averages using the AERMOD-percent post-processing utility. This utility calculates the maximum concentration of a pollutant from all receptors at a specific percentile, for a specific period. Employing the percentile facilitates the omission of unusual short-term meteorological events that may cause elevated pollutant concentrations and hence a more accurate representation of the likely average pollutant concentrations over an averaging period.

The following information was input into the model for the prediction of maximum ground level ambient ammonia concentrations from the pig farm.

3.2 Input Parameters

The site layout map, building plans and elevations were used as a template for all sources, relevant structures and the boundary of the facility. The AERMOD package uses the steady state Gaussian plume equation for a continuous elevated point or line source.

Table 3 below gives general details of the proposed pig houses.

Table 3: Dimensions of proposed Pig Houses

	G1	G2	G3	G4
Dimensions of each house	79.24m x 13.7m x 4m	79.24m x 13.7m x 4m	60m x 13.7 x 4m	60m x 13.7 x 4m
Total No. of Pigs*	577 x Fatteners 384 x Growers	570 x Fatteners 380 x Growers	425 x Fatteners 284 x Growers	419 x Fatteners 279 x Growers
Efflux Temperature	20 ^{o}C	20 ^{o}C	20 ^{o}C	20 ^{o}C
Emissions	Mechanically Ventilated	Mechanically Ventilated	Mechanically Ventilated	Mechanically Ventilated

**While these numbers represent the total number of animals that will be housed in each shed, they are not reflected in the AERMOD model. Further information is provided below.*

It can be seen from the Table above that the proposed sheds include both fattener and grower pigs. A recent EU Commission Implementing Decision (CID)[1] defines production pigs, which will be housed on site, as,

> *'typically reared from a live weight of 30 kg to slaughter or first service. This category includes growers, finishers and gilts that have not been serviced.'*

[1] *Commission Implementing Decision (EU) 2017/302 of 15 February 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the intensive rearing of poultry or pigs.*

This is evidence that production pigs also include grower pigs. Emission factors for grower pigs are provided in SCAIL and they are defined in BREF as ranging between 30-60kg[2].

It should be noted that not all animals on site will be at the maximum finishing weight prior to slaughter at the same time. When the sheds are fully stocked they operate on a continuous flow, rather than a batch type production system, thus at any one time there will be pigs in all the weight ranges the animals will range in weight between 30kg – market weight (c. 110-120 kg). It is expected that no more than 60% of the total animal numbers will be 'fatteners' (>60kg) at any time and therefore this assessment considers the worst case scenario of 60% fatteners and 40% growers."

3.2.1 EXISTING EMISSIONS

The rate of production of an emission, such as ammonia, is best quantified as an emission rate.

To find the emissions from the sheds, it was necessary to calculate the concentration within the buildings. The Section below details the emission rates from the proposed sheds.

3.2.2 LOW PROTEIN

It is accepted throughout the intensive agriculture industry, through robust scientific evidence, that a reduction in crude protein in animal feed, will lead to a reduction in ammonia emissions from livestock. There is also evidence to show that as ammonia from animals is decreased.

There are a number of recent scientific studies that have been carried out, and subsequent documents produced, in relation to the ammonia emissions from pig houses and the impact of mitigation measures associated with Best Available Techniques (BAT).

The recent EU CID[3] states that one of the ways in which to reduce total nitrogen excreted, and consequently ammonia emissions, is to reduce the crude protein content of the pig feed.

This statement is supported by a peer review report which has been prepared by Hayes et al[4], which cites Kay and Lee[5]:

> *'Reductions in ammonia emission equivalent to 9.8% per 10 g/kg reduction in dietary crude protein.'*

Table 4 below summarises the level of reduction which are included in the conclusions of these reports applicable to this site:

Table 4: Effect of mitigation measures

Crude Protein in feed
Each 1% reduction in CP in the range 20-12% results in a 10% reduction in ammonia emission levels

It has been confirmed that the pigs on site will be fed a diet with a crude protein level of 16%. As a result, an ammonia reduction of 30% has been applied to the sheds on site.

Table 5 below shows the category of animal and recommended emission factors per animal applicable to this project, based on the crude protein content of the feed of 16%, and the associated reduction.

[2] JRC Science for Policy Report. Best Available Techniques for the Intensive Rearing of Poultry and Pigs. Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control).

[3] *Commission Implementing Decision (EU) 2017/302 of 15 February 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the intensive rearing of poultry or pigs. Pg 7*

[4] *Hayes, E.T., Leek, A.B.G., Curran, T.P., Dodd, V.A., Carton, O.T., Beattie, V.E. and O'Doherty, J.V. (2004). The influence of diet crude protein level on odour and ammonia emissions from finishing pig houses.* Bioresource Technology, *91: 309-315*

[5] *Kay R.M., and Lee, P.A. (1997). Ammonia emissions from pig buildings and characteristics of slurry produced by pigs offered low crude protein diets. In: Voermans JAM, Monteny GJ. Editors. Ammonia and odur emission from animal production facilities. Wageningen, The Netherlands; CIGR pg 253 – 259*

Table 5: Ammonia Emission Factors

Category of Animal	Source Levels (kg/yr/animal)	Levels after Reductions (kg/yr/animal)
Fatteners	4.14	**2.90**
Growers	1.59	**1.11**

3.2.3 REDUCTIONS ASSOCIATED WITH SITE

The Table below details the total number and type of animals housed in the existing sheds on-site. The emissions are only shown from the animals that can have a reduction applied as a result of a low protein diet.

Table 6: Concentrations per Building

House No.	No. of Animals (and Type) per house	Ammonia Emission Factor (kg/yr per animal)	Ammonia Emission Rate (kg/yr per house)
A	146 x Farrowing Sows	5.84	852.6
	450 x 1st Stage Weaners	N/A	-
B & B1	110 x Farrowing Sows	5.84	642.4
	900 x 1st Stage Weaners	N/A	-
C	50 x Sows	3.01	150.5
	35 x Gilts	4.14	144.9
D	1,100 x 2nd Stage Weaners	N/A	-
F	244 x Sows	3.01	734.4
	75 x Gilts	4.14	310.5
		Total (kg/yr)	**2,835.4**

The total ammonia produced by the sows and gilts in the existing sheds is 2,835.4kg/yr. As confirmed in this assessment, these animals will be fed a low protein diet, which will reduce the total emissions by a factor of 30%, as detailed in Section 3.2.2 above.

Table 7 details the total ammonia reduction as a result of the low protein diet in the existing sheds.

Table 7: Concentrations per Building

Total Ammonia from Existing Sheds (kg/yr)	Reduction Associated with Low Protein	Updated Ammonia from Existing Sheds (kg/yr)	Reduction in Ammonia (kg/yr)
2,835.4	30%	1,984.8	**850.6**

As the existing sheds are not included in this assessment, it is not possible to account for this reduction in ammonia from these 5 sheds. As a result, the total ammonia reduction was converted to a corresponding number of fatteners, which was then removed from the proposed sheds.

Table 8: Concentrations per Building

Reduction in Ammonia (kg/yr)	Fattener Ammonia Emission Factor (kg/yr)	Equivalent No. of Fatteners
850.6	2.17*	392

*This emission factor also accounts for the regular removal of slurry in sheds G1 – G4.

By incorporating a low protein diet into the existing sheds, the applicant has made an equivalent reduction of 392 fattener pigs. For the purposes of the AERMOD assessment, a total of 392 fatteners have been removed from the proposed sheds, as detailed in the Table below.

Table 9: Updated Animal Numbers

House No.	Original No. of Fatteners per house	No. of Fatteners as a Result of Low Protein in Existing Sheds
G1	577	463
G2	570	458
G3	425	341
G4	419	337
Total	**1,991**	**1,599**

3.2.4 PROPOSED EMISSIONS

The emission factors for pigs have been outlined in Guidance published by the Environment Agency[6], which is used to inform the emission factors detailed in the SCAIL[7] screening tool/ reference report.

There are various housing systems included in the document and the Table below details some the emission factors associated with the housing system proposed on this site, which are compared to standard emissions for a Fully Slatted Floor (FSF).

Table 10: Source Ammonia Emission Factors for Fatteners

Category of Animal	Baseline Emissions for FSF (kg/yr/animal)	Housing Type	Source Levels (kg/yr/animal)	Reduction
Fatteners	4.14	Fully Slatted Floor (FSF) with vacuum system for frequent slurry removal	3.11	25%

It can be seen from the Table above that the housing system which accounts for the frequent removal of slurry (in line with the Best Available Techniques (BAT) Reference Document) results in a 25% reduction in ammonia emissions, when compared to the baseline emission factor for a fully slatted floor.

The emission factors included in the Table above, which already take account of the frequent removal of slurry, have been corrected in the Table below to account for the low protein diet that will be fed to the pigs on site.

It has been confirmed that the pigs on site will be fed a diet with a crude protein level of 16%. As a result, an ammonia reduction of 30% has been applied to the animals.

Table 11 below shows the category of animal and recommended emission factors per animal applicable to this project, based on the regular removal of slurry and a feed crude protein content of 16%.

Table 11: Final Ammonia Emission Factors

Category of Animal	Housing Type	Source Levels (kg/yr/animal)	Low Protein Reduction (16% Crude Protein)	Levels after Reductions (kg/yr/animal)
Fatteners	Fully Slatted Floor (FSF) with vacuum system for frequent slurry removal	3.11	30%	2.17
Growers		1.19*		0.83

**This factor has been calculated by reducing the baseline factor of 1.59kg/yr (for FSF) by 25% to account for the regular removal of slurry.*

[6] *Pollution Inventory Reporting- Intensive Farming Guidance Note. Environment agency, January 2013, Version 5.*

[7] *SCAIL-Agriculture Update, Sniffer ER26: Final Report March 2014*

Table 12 below details the total emission rates per shed, based on the emission factors calculated above. The total emission rates are set as the pollutant leaving the building each second.

Table 12: Concentrations per Building

House No.	Animal Type (and Number)	Ammonia Emission Factor (kg/yr per animal)	Ammonia Emission Rate (kg/yr per animal type)	Ammonia Emission Rate (kg/yr per house)	Ammonia Emission Rate (g/s per house)
G1	463 x Fatteners	2.17	1,006.3	1,328.5	0.042
	386 x Growers	0.83	322.2		
G2	458 x Fatteners	2.17	995.5	1,314.3	0.042
	382 x Growers	0.83	318.9		
G3	341 x Fatteners	2.17	741.2	979.1	0.031
	285 x Growers	0.83	237.9		
G4	337 x Fatteners	2.17	732.5	967.0	0.031
	281 x Growers	0.83	234.6		

For the purposes of the modelling process, the emission rate per house was divided by the number of emissions points to obtain the emission value for each source. Table 13 below shows the emission rates coming out of emission point.

Table 13: Emission Rates for each stack

House No.	Ammonia Emission Rate (g/s per house)	No of Fans (and type)	Ammonia per fan (g/s)
G1	0.042	11 x Ridge	0.0038
G2	0.042	11 x Ridge	0.0038
G3	0.031	8 x Ridge	0.0039
G4	0.031	8 x Ridge	0.0038

3.2.5 STACK EMISSIONS VELOCITY

There is one type of fan on the proposed site, Table 14 below shows the ventilation rates for the chosen fan type.

Table 14: Ventilation Rates for fan

Fan Type	Stack Diameter (m)	Cross Sectional Area (m^2)	Exit Velocity (m/s)	Volume Flow (m^3/s)
Ridge (DA 600 LPC-11)*	0.6	0.283	11.79	3.3

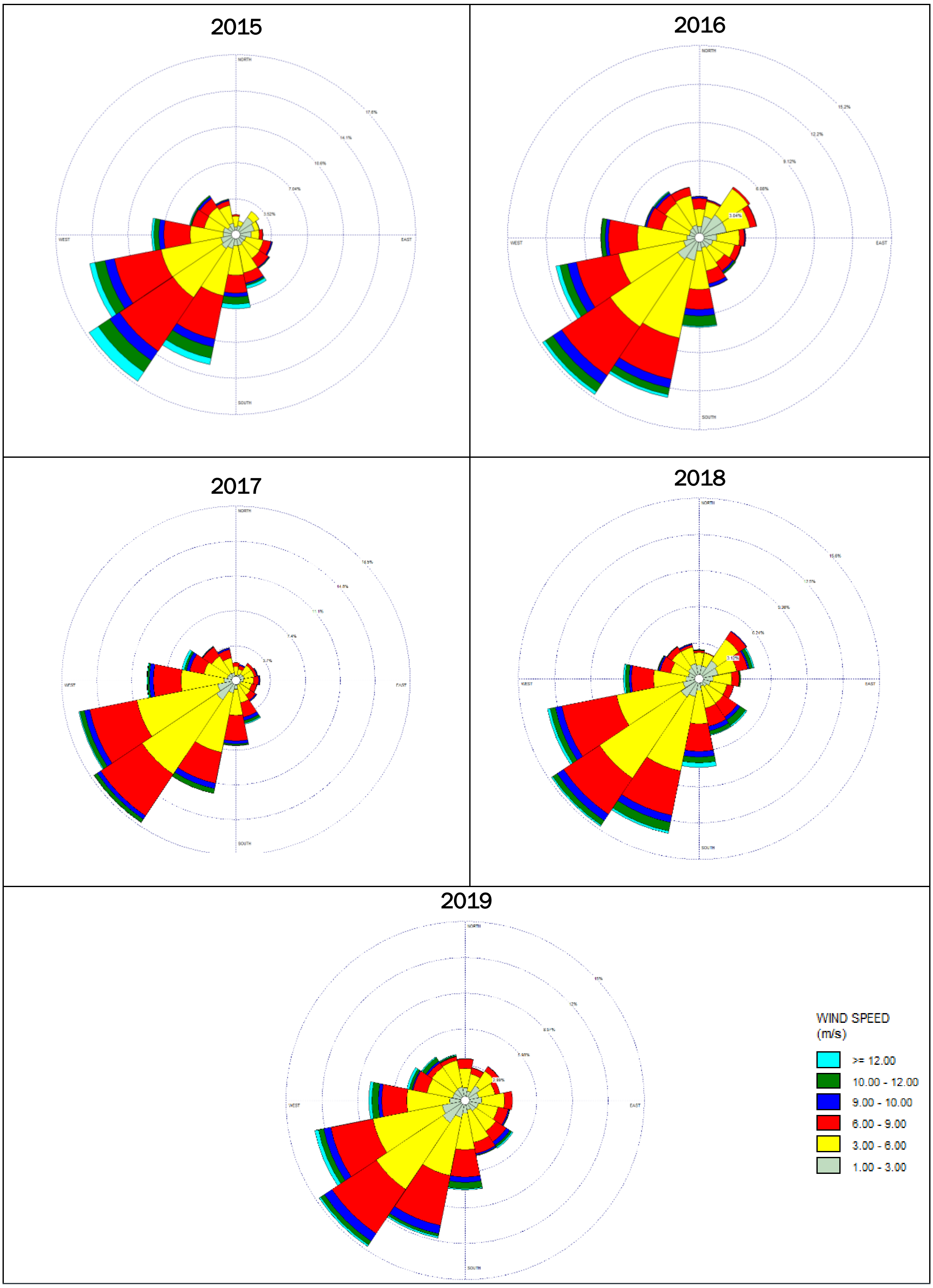
**The technical specification of this fan is provided in Appendix C.*

3.3 Meteorological Data

Five years of hourly sequential meteorological data was used for the AERMOD dispersion modelling assessment. The closest weather station to the proposed site can be identified on Figure 6.1 of the EPA's AG4 Guidance Note as Mullingar. However, it is noted that the annual mean wind speed at this location is 4.3m/s, which is within 1m/s of the annual wind speed at Ballyhaise (3.3m/s).

Given that the Ballyhaise weather station is within 1m/s of the Mullingar station, it was seemed representative of the average wind in the vicinity of the site. This allowed for the determination of the predicted overall average impact of emissions from the facility. The windrose data for each individual year is presented in Figure 1 below.

Figure 1: Annual Windrose Data- Ballyhaise



3.4 Building Downwash

When one or more buildings in the vicinity of a point source interrupt wind flow, an area of turbulence known as a building wake is created. Pollutants emitted from a relatively low level can be caught in this turbulence, affecting their dispersion. This phenomenon is called building downwash. In order to conduct an analysis of downwash effects of the point sources created to mimic the release of odorous air from the pig farm, the dimensions (including heights) of the proposed pig house and other existing buildings on-site was obtained from drawings.

3.5 Digital Terrain Data

AERMOD contains a terrain data pre-processor called AERMAP. Receptor and source elevation data from AERMAP output is formatted for direct insertion into an AERMOD control file. The elevation data are used by AERMOD when calculating air pollutant concentrations.

Regulatory dispersion models applicable for simple to complex terrain situations require information about the surrounding terrain. With the assumption that terrain will affect air quality concentrations at individual receptors, AERMAP first determines the base elevation at each receptor and source. For complex terrain situations, AERMOD captures the essential physics of dispersion in complex terrain and therefore needs elevation data that convey the features of the surrounding terrain. In response to this need, AERMAP searches for the terrain height and location that has the greatest influence on dispersion for each individual receptor. This height is the referred to as the hill height scale. Both the base elevation and hill height scale data are produced by AERMAP as a file or files which can be directly inserted into an AERMOD input control file.

4 AMMONIA

The ammonia levels were assessed in areas of specific interest in relation to vegetation.

All areas within approximately 7.5km of the site were searched on the EPA website for the four types of designated areas listed below:

- **Special Areas of Conservation (SAC)**

  These areas are given special protection under the European Union's Habitats Directive to protect some of the most seriously threatened habitats and species across Europe.

- **Special Protection Areas (SPA)**

  Areas designated under the European Commission on the conservation of wild birds (the Birds Directive). All EU member states are required to identify internationally important areas for breeding, over-wintering and migrating birds and designate them as SPA's.

- **Natural Heritage Area (NHA)**

  This is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection.

- **Proposed Natural Heritage Area (pNHAs)**

  These proposed sites are of significance for wildlife and habitats. The pNHAs cover approximately 65,000ha and designation will proceed on a phased basis over the coming years.

There was five designated sites located within 7.5km of the pig sheds which is shown in Table 15 below.

Table 15: Designated areas in vicinity of the proposed site

Location	Description	Approx. distance to shed (km)	ING Grid Co-ordinates	
1	River Boyne & River Blackwater SAC (Otter & Kingfisher)	1.13	259895	253365
2	River Boyne & River Blackwater SPA (Otter & Kingfisher)	1.16	259923	253374
3	Royal Canal (Proposed NHA)	3.08	258556	249981
4	Mount Hevey Bog (SAC)	4.19	260281	249094
5	River Boyne & River Blackwater SAC/ SPA (Alkaline Fen)	4.34	255839	256277

Ammonia modelling was carried out for each individual year with the results at the nearest identified locations presented in Table 16 below. All results are the Ammonia concentration in µg/m³.

Table 16: Annual Average Ammonia Concentrations at Identified locations

Location	2015	2016	2017	2018	2019	Average
1	0.123	0.109	0.168	0.109	0.142	**0.130**
2	0.117	0.104	0.160	0.104	0.135	**0.124**
3	0.010	0.015	0.006	0.013	0.013	**0.011**
4	0.011	0.013	0.009	0.010	0.012	**0.011**
5	0.010	0.010	0.007	0.009	0.010	**0.009**

All of the predicted Ground Level Concentrations of ammonia detailed in the Tables above are significantly below the limit values as provided in Table 1 in relation to the protection of vegetation.

4.1 Results

Table 17 below compares the highest annual average predicted levels at the designated areas where:

- The Process contribution (PC), the maximum modelled concentration of the substance due to process emissions alone.
- Predicted Environmental Concentration (PEC) – that is, the maximum modelled concentration (of ammonia) due to process emissions combined with estimated baseline concentrations.
- PC and PEC as a percentage of the objective or guideline.

For the assessment of annual mean concentrations, the annual mean contribution of the process can be added to the annual mean estimate for background.

Table 17: Ammonia concentration at EPA designated ecologically sensitive location from pig sheds

	Location	Guideline (µg/m-3)	Background (µg/m-3)	Highest PC (µg/m-3)	PEC (µg/m-3)	PC/ Guideline level (%)	PEC/ Guideline level (%)
1	River Boyne & River Blackwater (Otter & Kingfisher)	3	3.11	0.168	3.278	**5.6***	109
2	River Boyne & River Blackwater (Otter & Kingfisher)	3	3.11	0.160	3.270	**5.3***	109
3	Royal Canal	3	3.01	0.015	3.025	**0.5**	101
4	Mount Hevey Bog	1	2.89	0.013	2.903	**1.3**	290
5	River Boyne & River Blackwater (Alkaline Fen)	1	2.99	0.010	3.000	**1.0**	300

**At Locations 1 & 2, which are the closest areas of the River Boyne & Blackwater to the site, the predicted impacts are 5.6% and 5.3% respectively. However, it should be noted that these areas are likely to only host the otter and kingfisher, neither of which will be significantly affected by ammonia from the site. The closest part of the designated site that is considered sensitive to ammonia is Location 5- Alkaline fen habitat. At this location the deposition of ammonia is <4% and therefore considered to be insignificant.*

At the other sites included in the assessment, the maximum PC of the proposed site is 1.3% of the Guideline level, and as a result the impacts at all locations are considered insignificant for the purposes of this assessment.

The ammonia concentrations at the sites are dominated by the background concentrations, which are approximately 101– 300% of the air quality guideline for ammonia.

5 NITROGEN DEPOSITION

The Critical Load specifies the annual amount of ammonia that can be deposited for a given area per year. Below this level, sensitive habitat should not be affected.

The dry deposition flux (µg/m²/s of ammonia) was calculated using AQTAG06[8] where the predicted ground level of ammonia (in µg/m³) was multiplied by the relevant deposition velocity.

The dry deposition was then multiplied by the conversion factor provided in the guidance to convert to the levels of kgN/ha/yr. The conversion factors are provided in Table 8.1 and 8.2 of the AQTAG06 as presented in the Table 18 below.

Table 18: Conversion Factors

Pollutant	NH_3 Deposition Velocity (m/s)	Conversion Factor
NH_3 to N	0.02 (short vegetation)	260

Table 19 below converts the highest Process Contribution in µg/m^{-3} to kg.N/ha/yr, using the conversion factors detailed in Table 16 above.

Table 19: Conversion of Highest NH_3 Results

Location	Pollutant	Highest PC (µg/m^{-3})	NH_3 Deposition Velocity (m/s)	Conversion Factor	Highest PC (kg.N/ha/yr)
1	NH_3 to N	0.168	0.02 (short vegetation)	260	0.87
2		0.160			0.83
3		0.015			0.08
4		0.013			0.07
5		0.010			0.05

Using similar methodology to the ammonia assessment in Section 4 above the PC and PEC can be seen in Table 20 below.

[8] Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air, AQTAG06

Table 20: Nitrogen concentration at designated ecologically sensitive locations

	Location	Guideline (kg N/ha/yr)	Background (kg N/ha/yr)	Highest PC (kg.N/ha/yr)	PEC (kg N/ha/yr)	PC/ Guideline level (%)	PEC/ Guideline level (%)
1	River Boyne & River Blackwater (Otter & Kingfisher)	15	7.74	**0.87***	8.61	5.8	57
2	River Boyne & River Blackwater (Otter & Kingfisher)	15	7.74	**0.83***	8.57	5.5	57
3	Royal Canal	10	7.64	**0.08**	7.72	0.8	77
4	Mount Hevey Bog	5	7.3	**0.07**	7.37	1.4	147
5	River Boyne & River Blackwater (Alkaline Fen)	15	7.56	**0.05**	7.61	0.4	51

**At Locations 1 & 2, which are the closest areas of the River Boyne & Blackwater to the site, the predicted impacts are 0.87 and 0.83kg.N/ha/yr respectively. However, it should be noted that these areas are likely to only host the otter and kingfisher, neither of which will be significantly affected by nitrogen from the site. The closest part of the designated site that is considered sensitive to nitrogen is Location 5- Alkaline fen habitat. At this location the deposition of nitrogen is <0.3kg.N/ha/yr and therefore considered to be insignificant.*

It can be seen from Table 20 that the nitrogen concentrations at the sites are dominated by the background concentrations.

The PC at Locations 3 - 5 is less than 0.1kg.N/ha/yr, and as a result would be considered deminimus for the purposes of the Nitrogen assessment.

6 CUMULATIVE ASSESSMENT

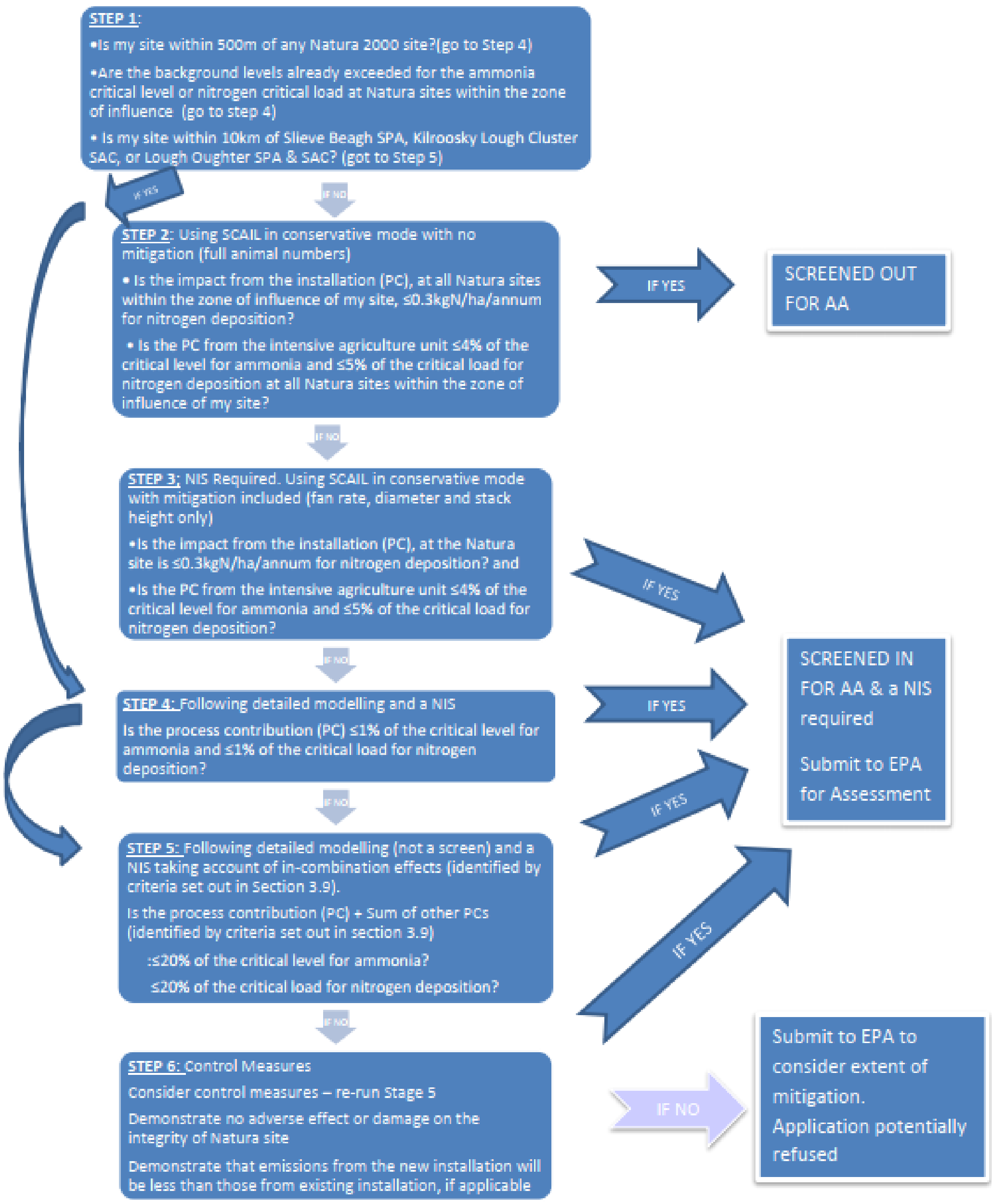
Within the EPA Guidance, specific information is provided in relation to the consideration of Cumulative Impact Assessments. Section 3.2 notes that,

> *'As a first step the applicant/licensee should confirm the background ammonia concentrations and nitrogen deposition levels at the sensitive receptor and indicate whether there is already an exceedance of the ammonia critical level or nitrogen critical load.*
>
> *Where background levels are already exceeded at sensitive receptors, detailed modelling of emissions, including in-combination effects, a Natura Impact Statement (NIS) and additional mitigation measures are likely to be required. This is dependent on the sensitivity of the habitat at the Natura impacted area'.*

Annex 1 of the document shows a flowchart for undertaking a cumulative impact assessment of a nearby industrial installation, which is shown below:

Figure 2: Flowchart for undertaking a Cumulative Assessment of a nearby Industrial Installation.

Annex 1: Flow Chart



The following points detail whether or not a cumulative assessment is necessary as part of this assessment.

- It is noted that Step 1 of the flowchart states "Are the background levels already exceeded for the ammonia critical level or nitrogen critical load at Natura sites within the zone of influence? (Go to step 4).

It can be seen from Tables 17 and 20 above that the backgrounds are exceeded for each of the designated sites, and therefore the assessment continues to Step 4:

- 'Following detailed modelling and a NIS, is the process contribution (PC) ≤1% of the critical level for ammonia and ≤1% of the critical load for nitrogen deposition?

This threshold is exceeded at Locations 1 & 2 for both ammonia and nitrogen, as well as Location 4 for nitrogen, which will therefore require a cumulative/ in-combination assessment, taking into account IAI which meet the following criteria:

- All below threshold installations within 5km of the Natura site.
- All licensed installations within 10km of the Natura site.

In order to carry out a cumulative assessment it was necessary to identify any nearby installations that also have the potential to contribute a significant ammonia impact. There were 3 such sites in the vicinity of the proposed installation:

- P0713-03: Granted in 2012 and operating prior to 2018.
- P0874: Granted in 2010 and operating prior to 2018.
- P0984-01: Granted in 2016 and operating prior to 2018. An appropriate assessment was also submitted in support of the application which concluded that an adverse effect from the pig rearing facility was highly unlikely at the designated sites in the vicinity.
- Approved Planning Application Ref 186221: Granted a new pig house at Hogestown, Killucan. Application was only for improved welfare standards and didn't result in an increase in animal numbers. Existing site was operating prior to 2018.

Given that all sites in the vicinity were operational prior to 2018, their impact will be included in the background level of nitrogen and ammonia, and the approval of the associated licences will not impact on the existing ammonia levels or nitrogen critical load in the vicinity.

In addition, there are no known newly constructed intensive agricultural sites completed within the last 10 years that are in proximity to the current site, or any section of the Natura 2000 site where the impact from the development is >4%.

As the nearby installations do not have the potential to contribute a significant impact at the River Boyne & Blackwater SAC/ SPA or Mount Hevey Bog SAC, no further assessment is required, in line with Step 4 of the flowchart shown in Figure 2 above.

7 CONCLUSIONS

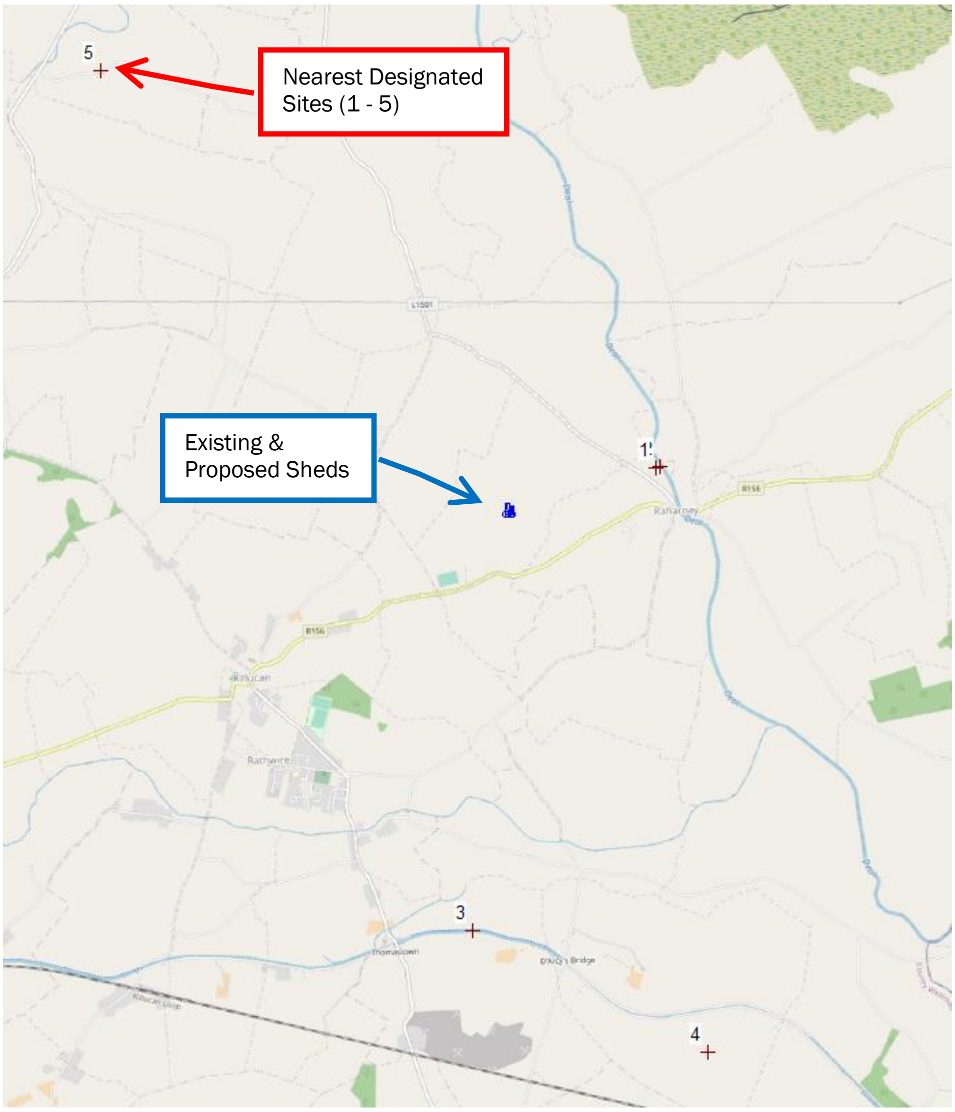
An air quality impact assessment has been undertaken for an amendment to an existing licence at an existing pig farm at Joristown Upper, Killucan, Co. Westmeath.

The predicted results of the ammonia modelling process show that the limits for the protection of vegetation are not exceeded at the designated habitats within the vicinity of the pig farm. Thus, any areas of ecological interest will not be adversely affected from the ammonia emissions for the operation of the farm.

Appendix D indicates the predicted dispersion of the ammonia plume for 2019 at the site.

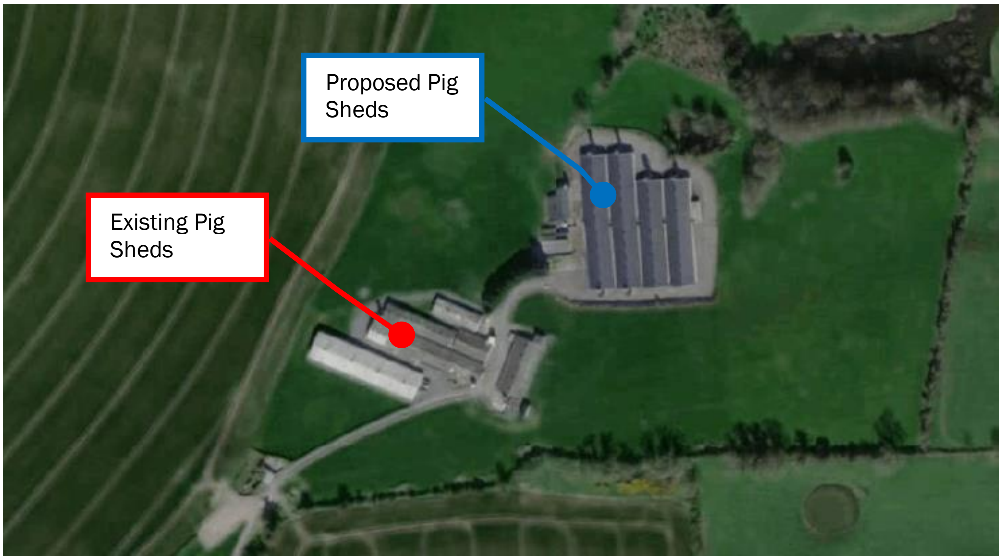
APPENDIX A SITE LAYOUT

Figure 3: Site Layout & Nearest Designated Sites.



**Exact co-ordinates of the designated sites were taken from SCAIL and are detailed in Table 13.*

Figure 4: Site Locations



***Note- The above diagram is not to scale and is for illustrative purposes only.*

APPENDIX B SOURCE AND RECEPTOR LOCATIONS

The information below details the AERMOD model inputs, specifically in relation to source locations, building inputs and grid receptor inputs.

Table 21: Building Location

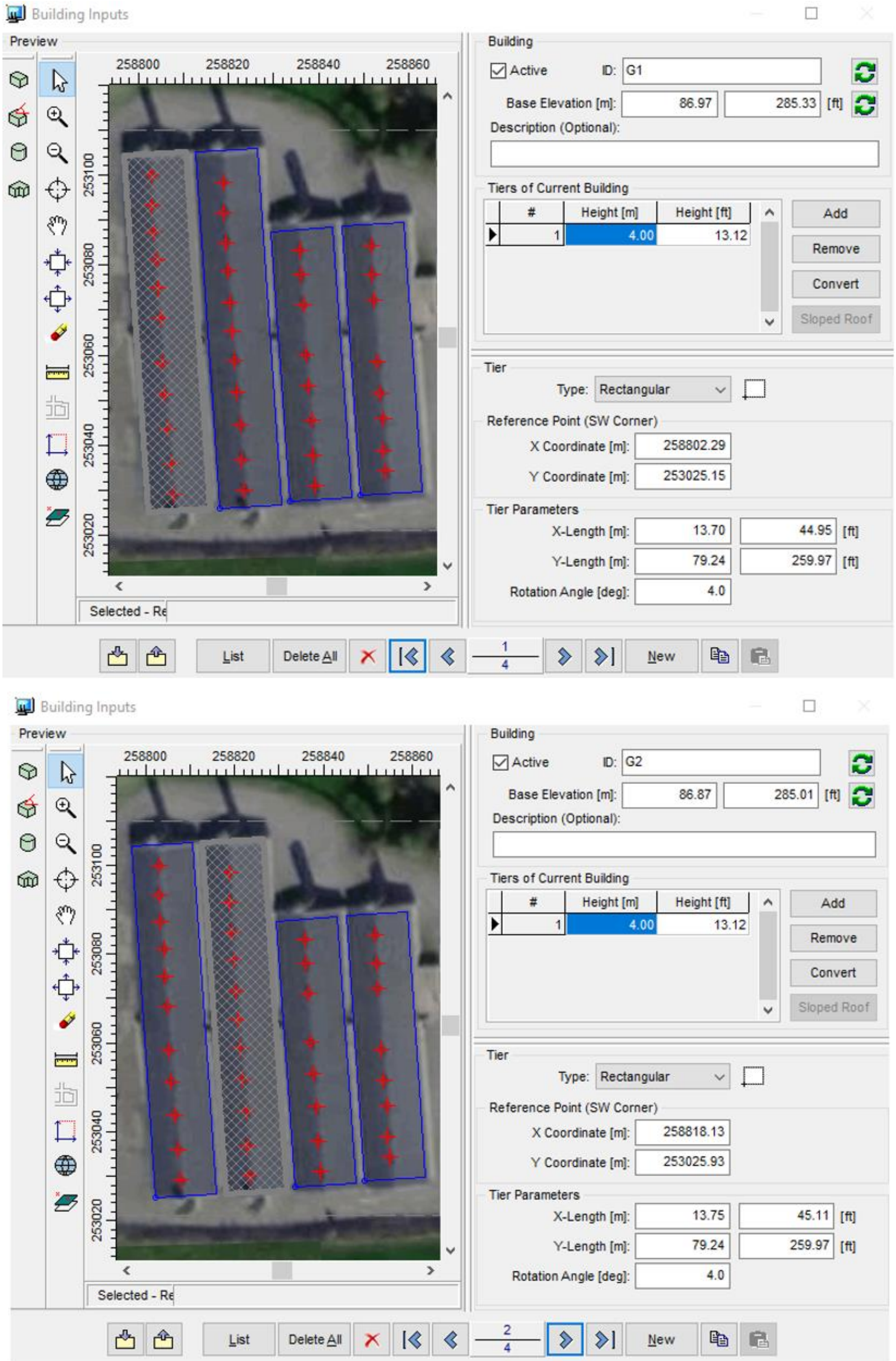
Building Number	Irish Grid Co-ordinates (SW Corner)
G1	258802 253025
G2	258818 253026
G3	258834 253028
G4	258849 253029

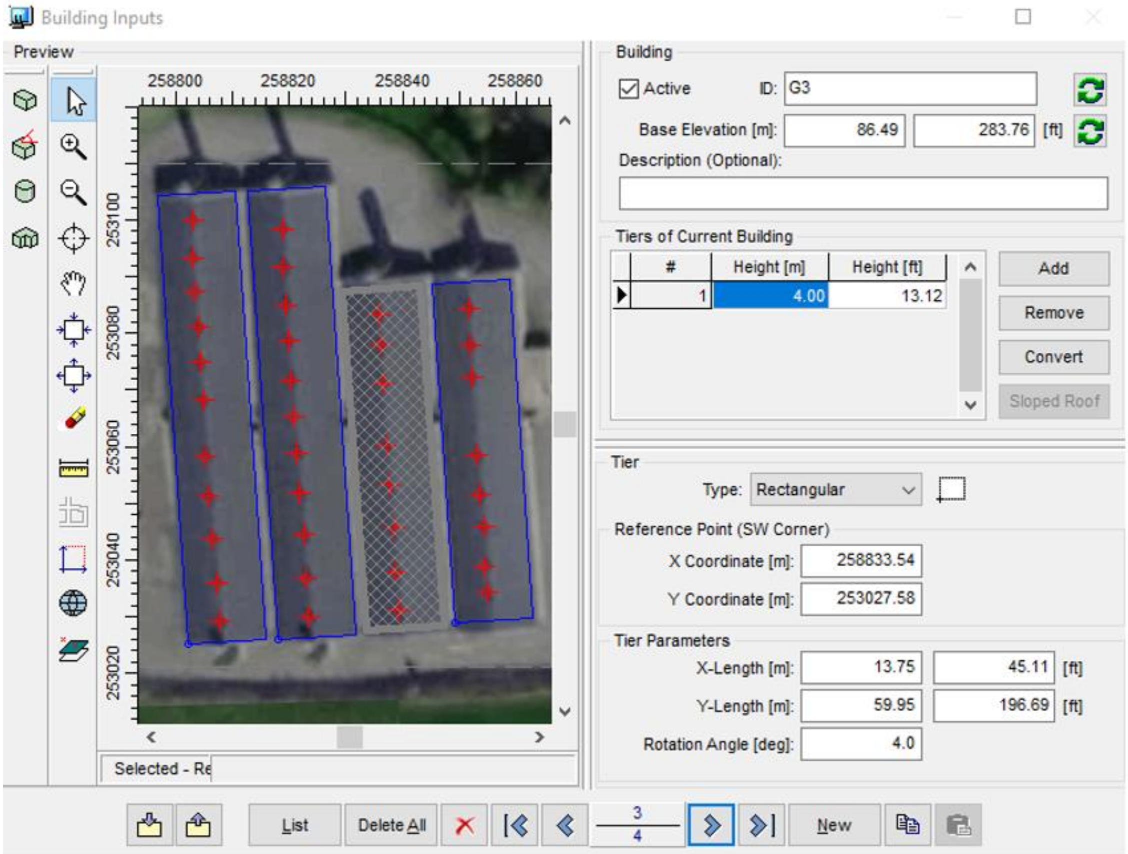
Table 22: Source Locations

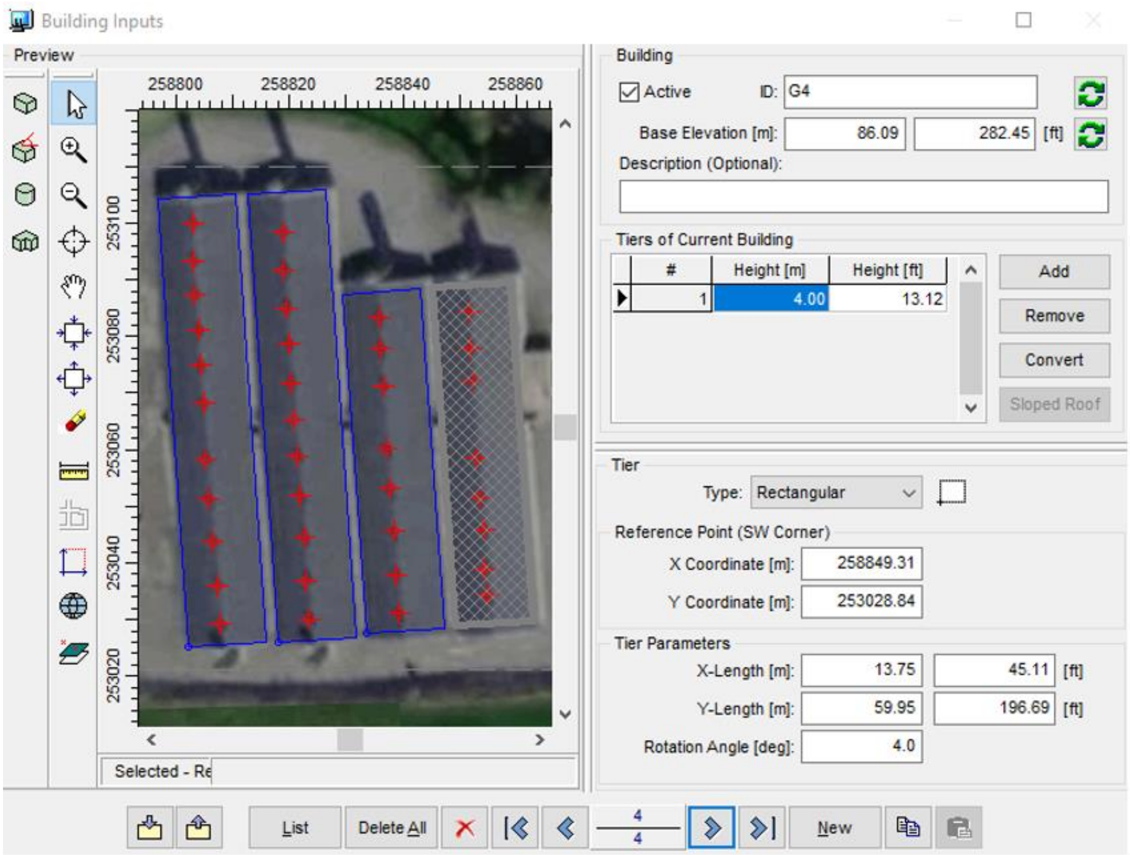
Building Number	Source	Approx. Irish Grid Co-ordinates (to the nearest 1m)	
G1	1	258803	253100
	2	258803	253093
	3	258803	253087
	4	258804	253081
	5	258804	253075
	6	258805	253068
	7	258805	253058
	8	258806	253051
	9	258807	253044
	10	258807	253036
	11	258808	253029
G2	1	258819	253098
	2	258819	253092
	3	258819	253085
	4	258820	253079
	5	258820	253072
	6	258821	253065
	7	258821	253059
	8	258822	253052
	9	258823	253045
	10	258823	253037
	11	258823	253030
	1	258836	253083
	2	258836	253078

Building Number	Source	Approx. Irish Grid Co-ordinates (to the nearest 1m)	
G3	3	258837	253071
	4	258837	253060
	5	258838	253053
	6	258839	253046
	7	258839	253038
	8	258839	253031
G4	1	258852	253084
	2	258852	253078
	3	258852	253072
	4	258853	253059
	5	258854	253052
	6	258854	253046
	7	258854	253039
	8	258855	253034

Figure 5: Building Inputs







It can be seen from the Figures above that the building locations input in the model reflect a rotation angle of approximately 4 degrees respectively.

Figure 6: Details of Nested Grid Receptors

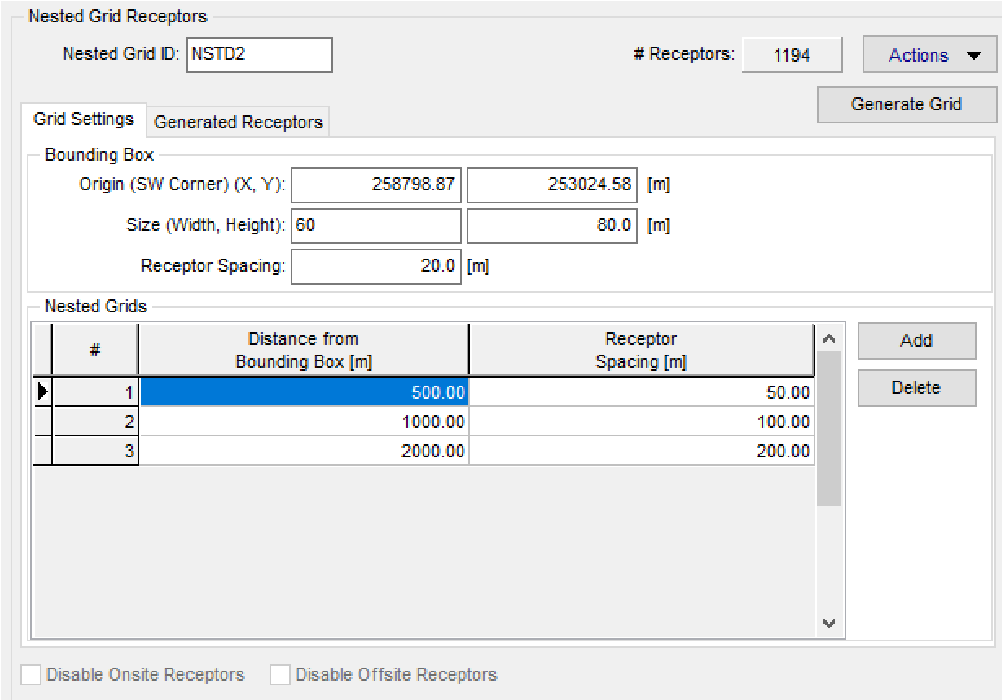
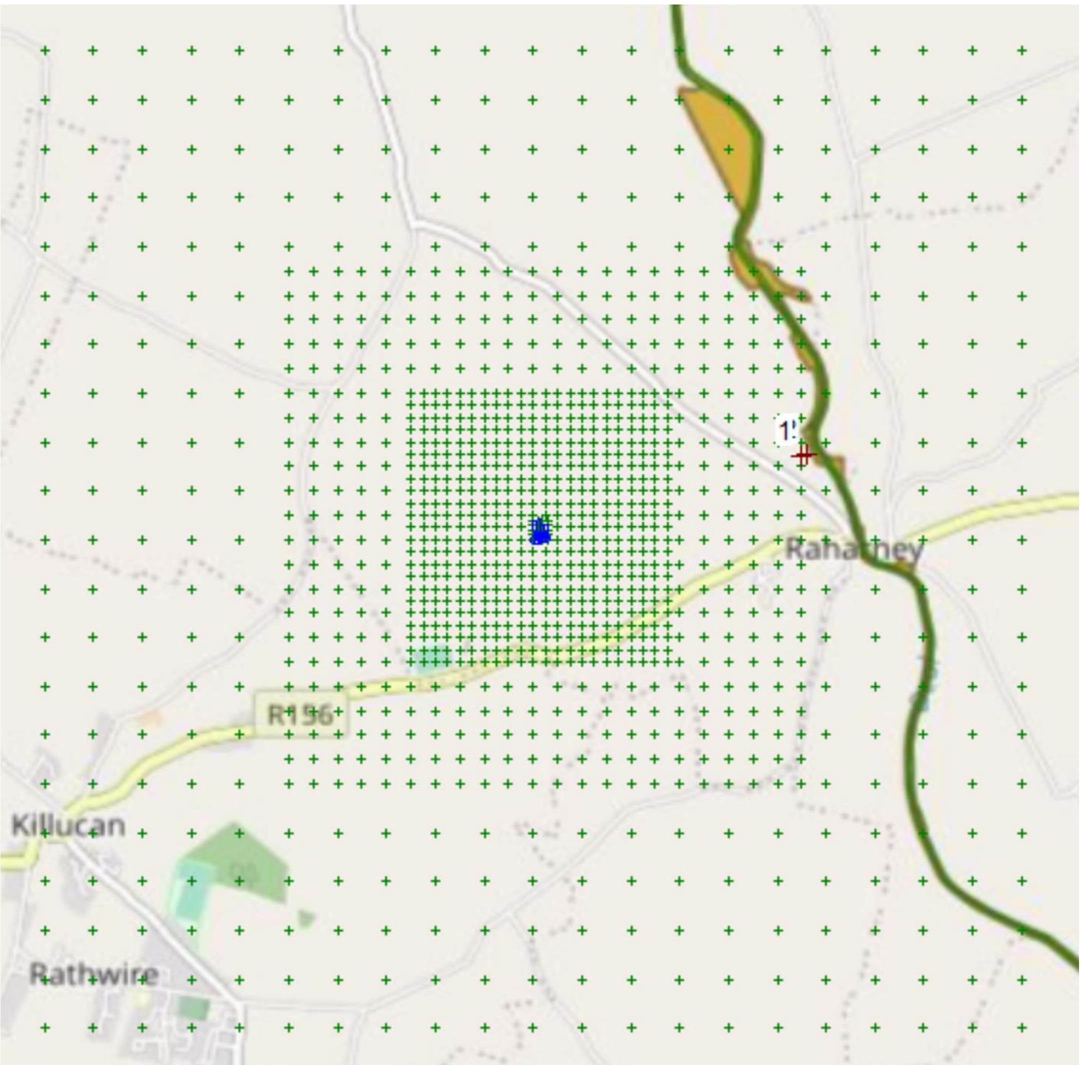
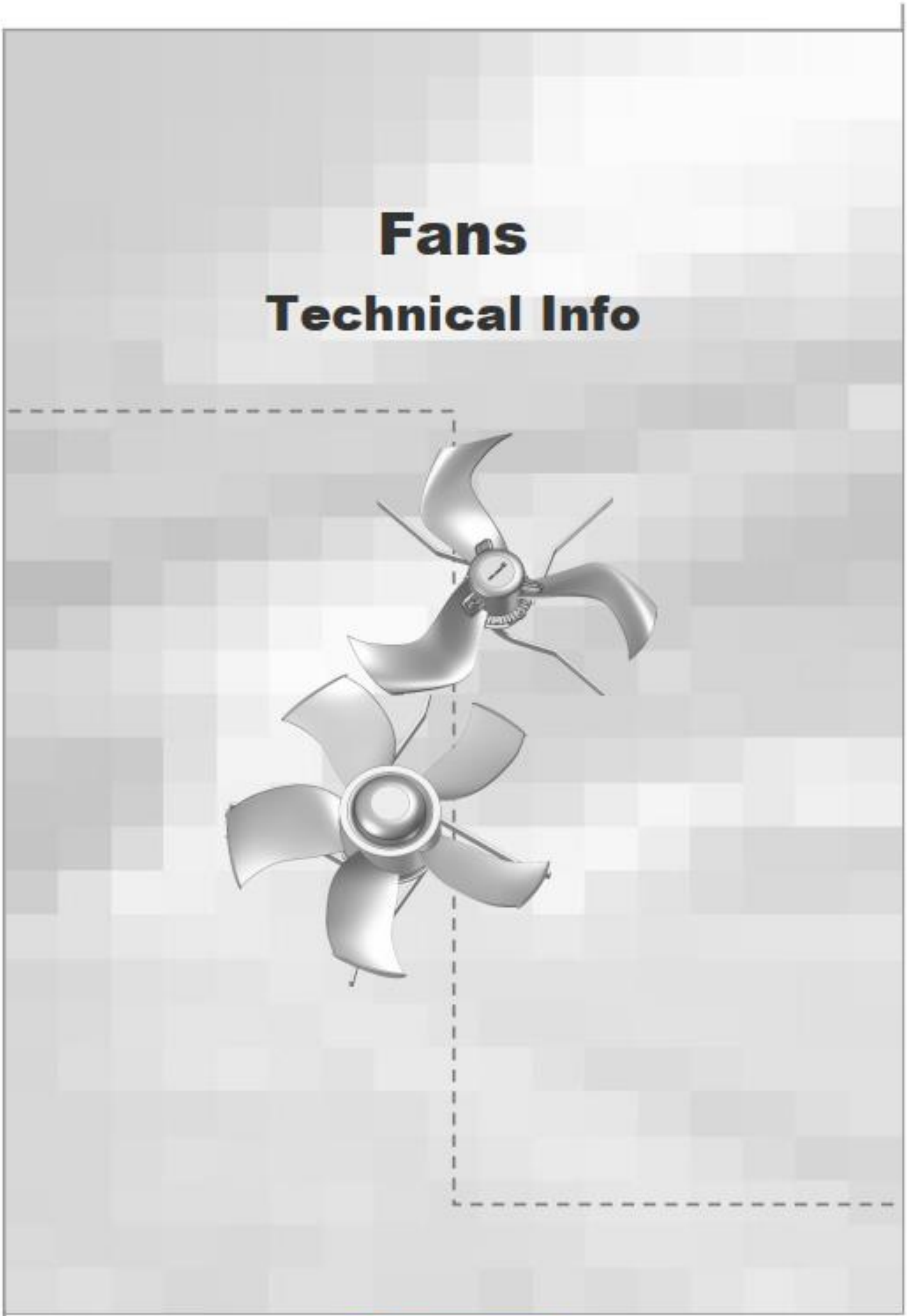


Figure 7: Graphical Representation of Nested Grid Receptors



APPENDIX C TECHNICAL SPECIFICATION



Fans

Technical Info

2015.04.07 • 604061

SKOV

3 Technical Data

3.1 DA 600 LPC

Fan type	445091/445092 DA 600 LPC-11	445086/445087 DA 600 LPC-12	445088/445089 DA 600 LPC-13
Electric			
Voltage [V]	230 -10 % / +15%	230 -10 % / +15%	230 -10 % / +15%
Frequency [Hz]	50/60	50/60	50/60
Motor current [A] (for Motor relay)	4.2	4.2	4.2
Power [W]	800	800	800
Adjustment ability	Adjustable	Adjustable	Adjustable
Motor protection	Thermistor	Thermistor	Thermistor
Motor relay	None	None	None
Mechanic			
Cable length [m]	Max. 2m shielded cable	Max. 2m shielded cable	Max. 2m shielded cable
Min. duct diameter [mm]	636	636	636
Blade diameter [mm]	625	625	625
Number of blades [pcs.]	3	3	3
Blade pitch [°]	Periferi 25 Nav 45	Periferi 25 Nav 45	Periferi 25 Nav 45
Fan output			
Revolutions [per minute] (mark)	300-1,100	300-1,200	300-1,300
Air output [m³/h] (at –10 Pa]	13,400	14,600	15,800
Air output [m³/h] (at –20 Pa]	13,100	14,400	15,500
Air output [m³/h] (at –30 Pa]	12,900	14,100	15,200
Air output [m³/h] (at –40 Pa]	12,500	13,800	15,100
Air output [m³/h] (at –50 Pa]	12,000	13,400	14,700
Air output [m³/h] (at –60 Pa]	11,600	13,000	14,400
Power consumption [W] (at -10 Pa)	416	527	645
Specific output [m³/kWh] (at -10 Pa)	32,300	27,700	24,500
Specific energy [Watt/1000 m³/h] (at -10 Pa)	31	36	41
Pressure stability, change from 0 to -20 Pa [%]	4	3	3
Test authorities	Bygholm AAU/ SKOV A/S	Bygholm AAU/ SKOV A/S	Bygholm AAU/ SKOV A/S
Environment			
Operating temperature	÷ 40 °C to +40 °C (÷40 to 104 °F)		
Start temperature	÷ 40 °C to +50 °C (÷40 to 122 °F)		
Storage temperature	÷ 40 °C to +70 °C (÷40 to 158 °F)		
Ambient humidity, operation	10-95 % RH		

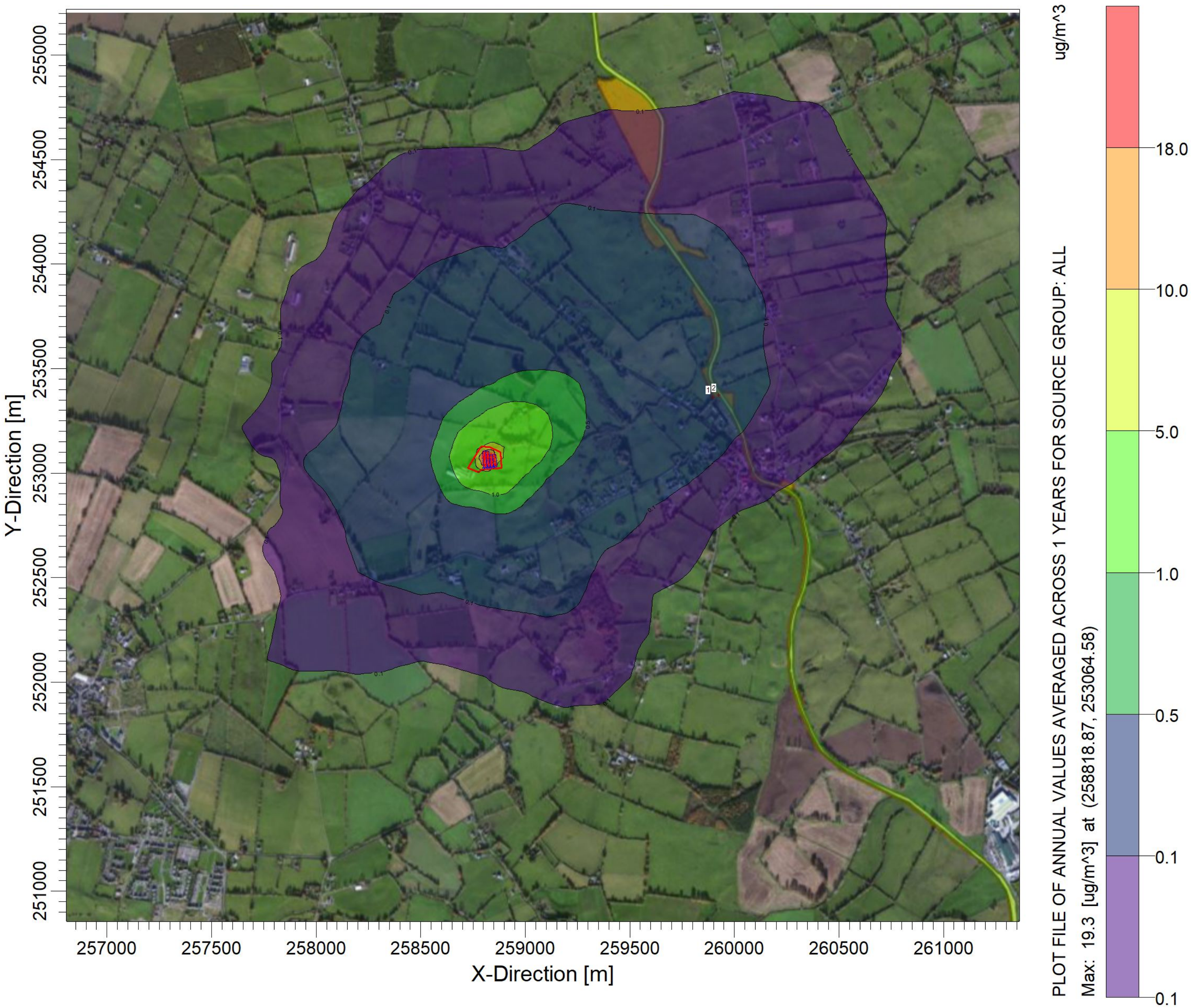
APPENDIX D MODELLING RESULTS

The Figure below details the predicted impact of the proposed sheds based on Section 3.2 of this report.

It should be noted that the outermost contour (0.058µg /m^3) corresponds to a nitrogen deposition of 0.3kg.N/ha/yr, which is considered deminimus for the purposes of a Nitrogen assessment.

PROJECT TITLE:

Joristown Piggery
Annual Average Ground Level Ammonia Concentrations (ug/m3) (2019)



COMMENTS:

Outermost contour (0.058ug/m3) is equivalent to the deminimus Nitrogen level of 0.3kg/ha/yr

SOURCES:

38

RECEPTORS:

1206

OUTPUT TYPE:

Concentration

MAX:

19.3 ug/m^3

MODELER:

Christy Carr

DATE:

28/10/2021

SCALE: 1:29,727

0 1 km

IRWIN CARR CONSULTANTS

PROJECT NO.:

2019182

AERMOD View - Lakes Environmental Software