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Date : 12/06/2024 **Our ref. :**

Your ref. :

Linda Cahill
Environmental Licensing Programme
Office of Environmental Sustainability

Reg. No.: P0915-02

Regulation 10(2)(b)(ii) of the EPA (Industrial Emissions) (Licensing) Regulations 2013, in respect of a licence review from Ballyfaskin Enterprises Ltd for an installation located at Ballyfauskeen, Ballylanders, County Limerick.

In response to your correspondence dated 21/12/2023;

- I have responded to Points 1 to 6 of your letter dated 21/12/2023
- I have attached amended NTS – 5 amendments as per point 1b below;
- I have attached updated Odour Impact Assessment and NH_3 Impact Assessment Reports.

RESPONSE TO POINT 1

a. Table 1.1

Animal types	Proposed Maximum Number
Farrowing / Sucking sows	725
Dry sows	275
Maiden Gilts	166
Boars	5
Weaners	4000
Production pigs	3957

b. Updated Attachment 1-2 Non-Technical Summary is attached. It is amended as follows;;
   - Table 1 – Weaner Numbers amended from 5,357 to 4,000. Slurry production figures in this table are dependent on water:feed ratios, number of breeding sows and number of finishers and therefore there is no change in slurry production due to changing weaner numbers.

- Table 1 – The manure production from the proposed 3,957 finisher pigs is amended to 0.028m^3 per finisher per week – but overall total slurry production for existing and proposed remains unchanged. This was an errata – it should have been 0.028m^3 in the original table.
- Table 9 – Reference to 167 suckling sows and 833 dry sows is changed to 1,000 suckling and dry sows. NH_3 emissions for sows is not changed in this table because existing figures are within the normal range of emissions for 725 dry sows and 275 farrowing sows.
- Table 9 – Reference to 5357 weaners is changed to 4,000 weaners. NH_3 emissions for weaners is not changed in this table because existing figures are within the normal range of emissions for 4,000 weaners.
- Table 10 - Reference to 167 suckling sows and 833 dry sows is changed to 1,000 suckling and dry sows. Odour emissions for sows is not changed in this table because existing figures are within the normal range of emissions for 725 dry sows and 275 farrowing sows.

There is no requirement to change the EIAR because results of calculations based on 5,357 weaners are within the normal range of variation for emissions (e.g. emissions to air) for 4,000 weaners. There are no significant changes to site area or building areas.

RESPONSE TO POINT No 2

The total slurry production as outlined in Table 1 remains unchanged i.e. 15,681m^3 for existing and 15,805m^3 for proposed. The slurry production is based on Table 1 of Schedule 2 of European Union (Good Practice for Protection of Waters) Regulations 2017 and 2022 (as amended);

- Existing Pig Number scenario - the storage required is 0.174m^3 per breeding unit (per sow place) and 0.034m^3 per finishing unit at a water: feed ratio of approx. 2.75:1. The breeding unit includes weaners and replacement pigs.
- Proposed Pig Number scenario - the storage required is 0.174m^3 per breeding unit (per sow place) and 0.028m^3 per finishing unit at a water: feed ratio of approx. 2.25:1. The breeding unit includes weaners and replacement pigs.

RESPONSE TO POINT No 3

A copy of the record 3 form is not attached – it can be viewed on-site or obtained from DAFM.

RESPONSE TO POINT No 4

An updated Odour Impact Assessment (OIA) Report (May 2024) is attached.

a. There are no new buildings in the attached modelling scenario. The number of pigs in the updated model is 725 dry sows, 275 farrowing sows, 166 gilts, 5 boars, 4,000 weaners and 3,957 fattener pigs.

b. The sit boundary and number of houses is unchanged from existing in the updated model (May 2024);
c. Frequent slurry removal is not a mitigation included in the updated model, although it is an option which is not ruled out for future consideration. The mitigation included in the updated model (May 2024) is lower protein diets (3% reduction) and reconfiguration of the ventilation in houses 1, 2, 3 and 7 to change to mechanical ventilation in the four houses and increase stack height to 8m in houses 1, 2 & 3 and 6.8m in house 7. There is no material change required in the existing site layout plan to reflect these mitigation requirements and the figures in the updated OIA (May 2024) correspond to the Site Layout Plans already submitted.
d. The target protein rates in the diets to achieve a 3% reduction are set out in 5.4.1.2 of the OIA, that is,
    - 14.5% for all sows and boars;
    - 17.5% for weaners;
    - 15% for fatteners and gilts;

RESPONSE TO POINT No 5

An updated Ammonia Impact Assessment (AIA) Report (May 2024) is attached.

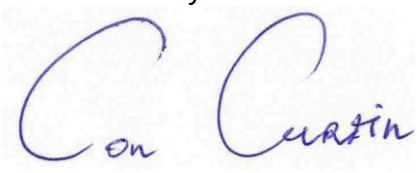
a. There are no new buildings in the attached modelling scenario. The number of pigs in the updated model is 725 dry sows, 275 farrowing sows, 166 gilts, 5 boars, 4,000 weaners and 3,957 fattener pigs.
b. There is no material differences in the existing site layout plan and the figures in the updated AIA (May 2024).
c. The mitigation included in the updated model (May 2024) is lower protein diets (3% reduction) and reconfiguration of the ventilation in houses 1, 2, 3 and 7 to change to mechanical ventilation in the four houses and increase stack height to 8m in houses 1, 2 & 3 and 6.8m in house 7. These factors are discussed in Section 5 of the AIA.
d. The emission factors are discussed in Section 5.4 of the AIA.
e. Frequent slurry removal is not a mitigation being relied upon in the model, although it is an option which is not ruled out for future consideration.
f. Slurry cooling is not a mitigation being relied upon in the model, although it is an option which is not ruled out for future consideration.
g. The mitigation of lower protein diets (3% reduction) requires the following pig protein diet levels;
    - 14.5% for all sows and boars;
    - 17.5% for weaners;
    - 15% for fatteners and gilts;

RESPONSE TO POINT No 6

The mitigation included in the updated OIA and AIA models (May 2024) is lower protein diets (3% reduction) and reconfiguration of the ventilation in houses 1, 2, 3 and 7 to change to

mechanical ventilation in the four houses and increase stack height to 8m in houses 1, 2 & 3 and 6.8m in house 7. These mitigation measures do not result in a material difference in Site Layout plans or manure storage facilities.

Yours sincerely



Con Curtin (B.Agric.Sc)

087-2588798

ATTACHMENT – 1-2- NON- TECHNICAL SUMMARY

Table of Contents

1.0 EXECUTIVE SUMMARY

This family pig farm at Ballyfauskeen (also spelt Ballyfaskin), Ballylanders, Co Limerick (V35KV12) has been in operation for over 40 years. The most recent planning application Ref No 19/1135 (accompanied with an EIAR) was granted on 29/01/2021 to increase the pig numbers to 1,000 sows, 166 gilts, 5 boars, 4,000 weaner pig places and 3,957 finisher pig places; in addition to constructing an electrical substation (approx. 22m2). The increase in pig numbers did not require an increase in the area of pig housing, however, refurbishment works on existing pig houses, involving changing in internal partitions, re-wiring, new water and feed fixtures and some internal changes in the slats and floors, will facilitate the increased number of pigs.
The proposed development will produce similar quantities of ammonia and odour emissions – after mitigation - compared to the licensed herd (see Section 8.0 Air). This can be achieved with the introduction of an adequate power supply the mill enabling specialised low protein diets for the growing pigs. Pig manure production will not change significantly. Traffic on the R662 is projected to increase by two movements per day, with a temporary increase of 6 movements during the 4 month construction period. Noise and visual impacts will not change significantly.
The farm is located in a rural setting which has good ground and surface water quality. This is an indication that the farm has a good environmental track record. It operates an Environmental Management System to insure compliance with the requirements of its EPA license and both the EPA and the Department of Agriculture, Food and The Marine monitor pig manure exports from the farm. The pig manure is land-spread according to a legal framework (SI 605 of 2017 as amended) which governs how pig manure is utilised, and within this legal framework there are adequate protections to insure that pig manure is applied without adverse environmental effects.

2.0 INTRODUCTION

2.1 Description of the Local Area

The existing pig farm is situated on a 2.6ha site located 2.8km south east of Ballylanders, 4.1kms south of Galbally and 2.6kms north west of Anglesborough as illustrated in Figure 1.1. The area is described in the Limerick County Development Plan as the *Ballyhoura/ Slieve Reagh* Landscape area. The storm water from the site drains to the Aherlow River which is 1.4km east of the pig farm. The Galtee Mountains are located 2.5km to the east and south east and eastern fringe of the Ballyhoura Mountains is located approx. 5kms to the west. The surrounding lands are entirely grassland interspersed with once off dwellings, farmsteads, forestry and settlements; typical of rural County Limerick. The site is located on a locally important aquifer and groundwater vulnerability at the site is 'medium'. The pig farm is serviced by a well located in Ballyfauskeen approx. 0.67km north west of the site as shown in Figure 1.2 of Volume 4 and this well has a capacity of 14m^3 per hour (336m^3 / day). The nearest Natura site is located 3.8 kms east of the site boundary i.e. Galtee Mountains Special Area of Conservation and proposed Natural Heritage Area. The nearest national monument, an enclosure site, is located 100m north east of the site boundary (LI049-198). The nearest dwellings (not including the developer's two family houses) are 60m and 100m to the west, 195m and 270m to the north and 390m and 400m to the south (as illustrated in Figure 1.2.

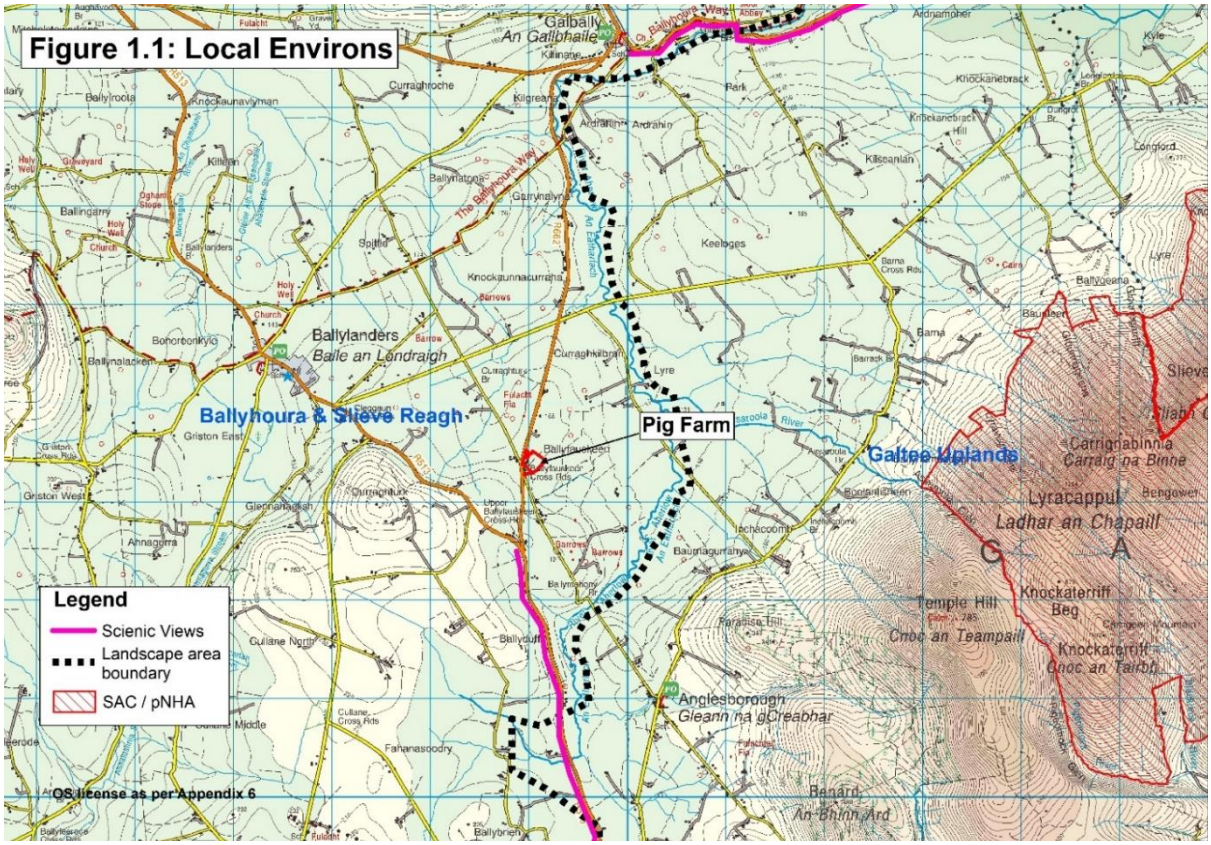


Figure 1.1: Local Environs
Ballylanders
Baile an Londraigh
Ballyhoura & Slieve Reagh
Pig Farm
Galtee Uplands
Anglesborough
Gleann na gCreabhar
Legend
Scienic Views
Landscape area boundary
SAC / pNHA
OS license as per Appendix 6

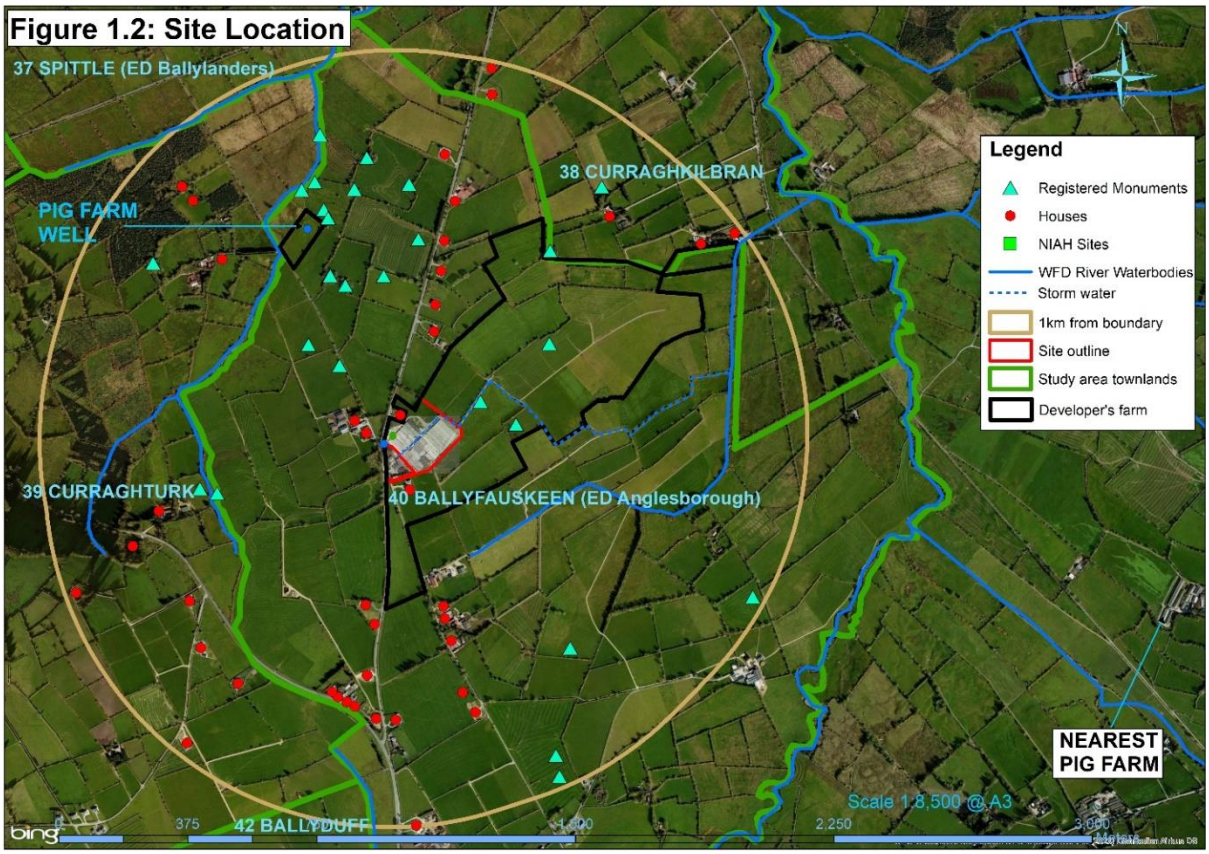
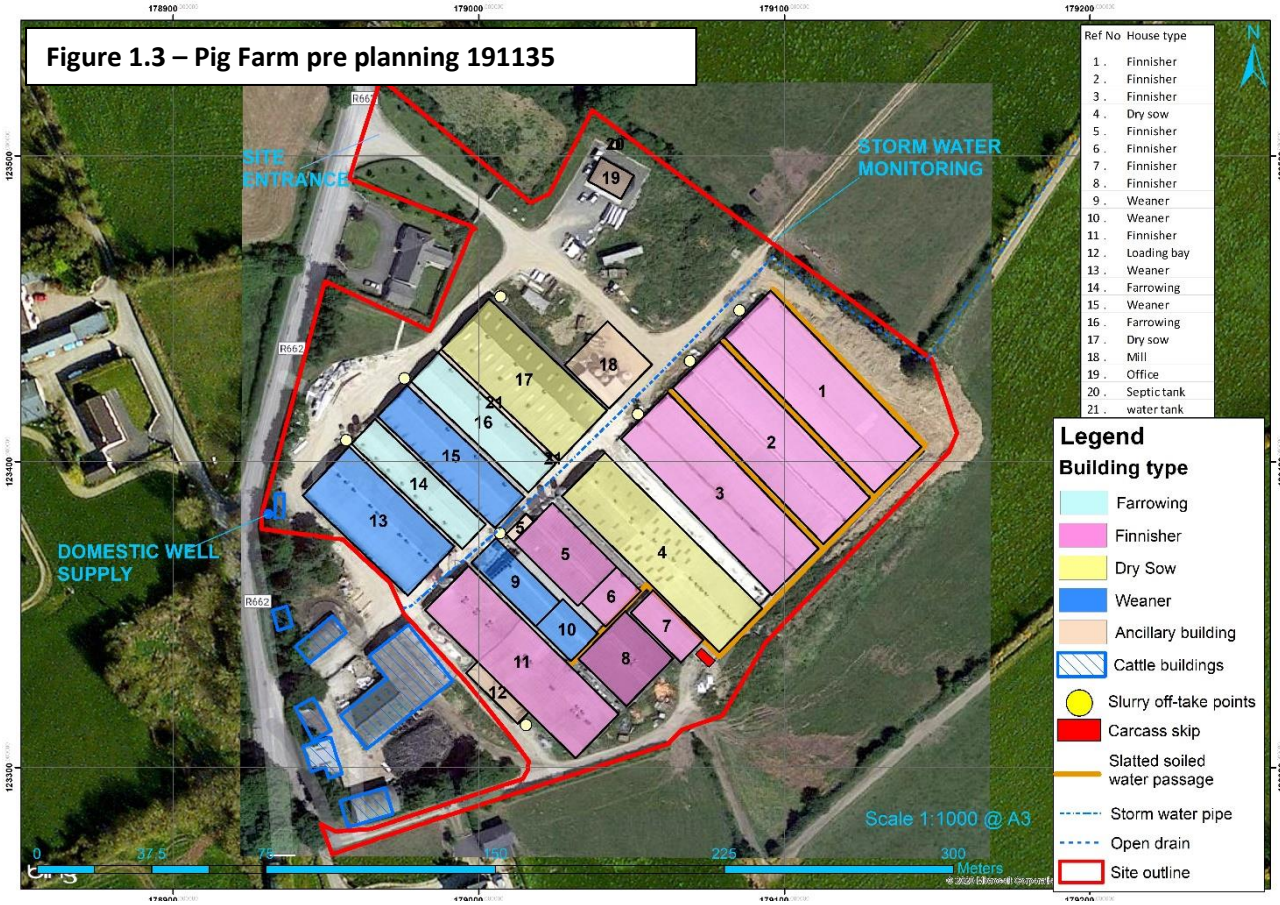


Figure 1.2: Site Location
37 SPITTLE (ED Ballylanders)
38 CURRAGHKILBRAN
PIG FARM WELL
39 CURRAGHTURK
40 BALLYFAUSKEEN (ED Anglesborough)
42 BALLYDUFF
NEAREST PIG FARM
Legend
Registered Monuments
Houses
NIAH Sites
WFD River Waterbodies
Storm water
1km from boundary
Site outline
Study area townlands
Developer's farm
Scale 1:8,500 @ A3

2.2 Operational details of the 600 sow pig farm (pre planning application 191135)

This pig farm has been operational since the 1970s. Since 2006 there are seven planning applications, including the recent application (19/1135), which are related to this site. Before 19/1135 the pig buildings, mill building, rainwater harvesting tank and office building were constructed following permission granted in 2012 (2012/306) and 2014 (2014/276). The layout of the pre 19/1135 pig farm is illustrated in Figure 1.3



There were 17 pig buildings on site which are up to 70m long and 22.5m wide and generally 5m high or less and these housed the 600 sows and their progeny. The mill building (18) is the tallest on the site at approx. 18m high. There is an office building (19) and a rainwater harvesting tank (21) between houses 16 and 17 – which captures the rain water for power washing the pig houses. All pig passages are slatted and soiled water is collected to slatted slurry tanks. There is at least 50 weeks storage for the approx. 15,681m^3 of pig manure.

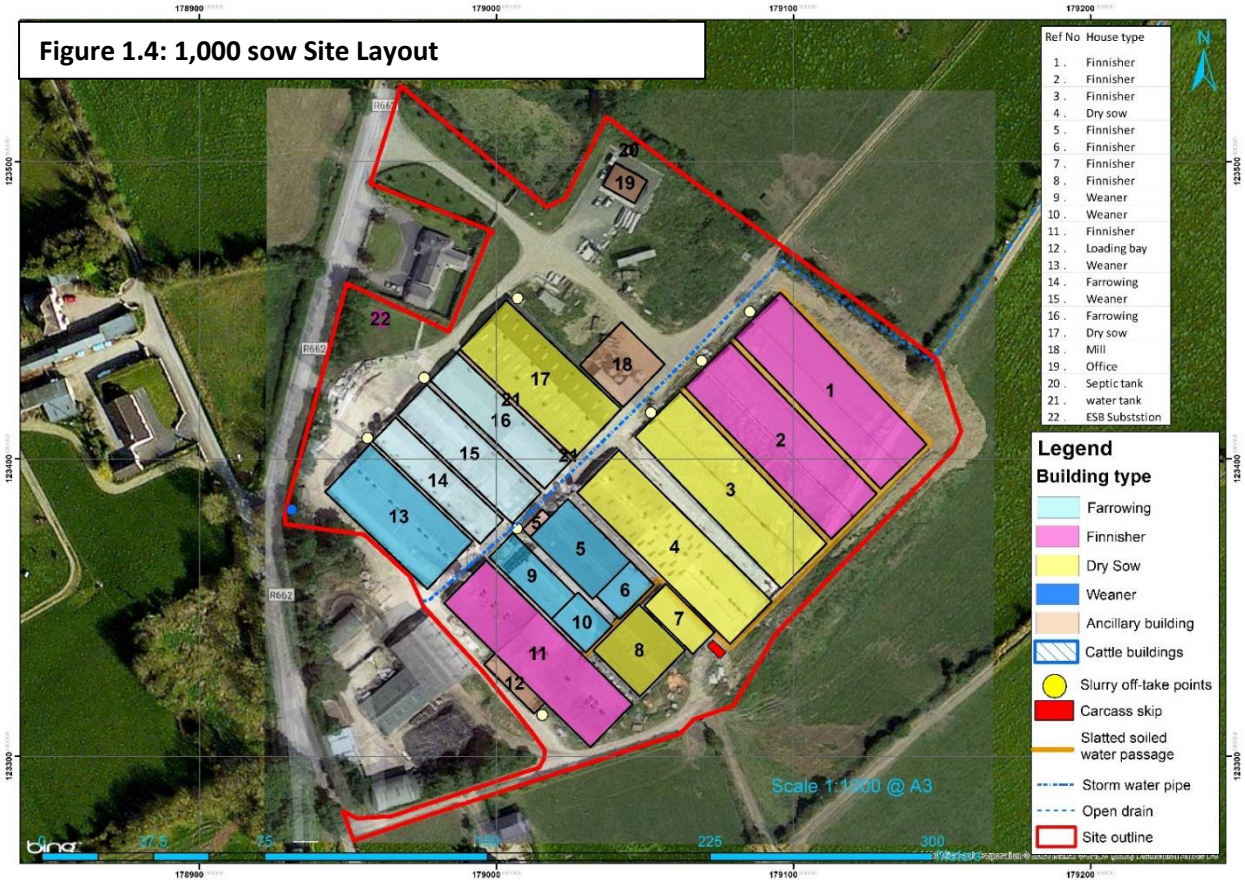
A traffic count was taken in September 2020 and the average annual daily traffic (AADT) was 923 movements. The existing pig farm contributes 14 movements per day, as follows;

- Employees - 7.4 / day (52 / week);
- Feed lorry – 1.6 / day;
- Pig transport - 0.5 / day;
- Service vans – 0.3 / day
- Slurry tankers - 3.7 / day
- Others - 0.65 / day

Existing noise levels are typical for a pig farm enterprise and are within the limits as set out by the existing EPA license which applies to the pig farm.

2.3 Description of proposed development – 1,000 sows

Figure 1.4: 1,000 sow Site Layout



In planning application 19/1135 the only new building to be constructed was a small electrical sub-station (22) - 22m^2. The electrical sub-station is to allow the up-grading of the electricity supply to the site to enable the full operation of the feed mill. The 600 sow herd produced pigs for a specialist market in Northern Ireland which required finishing weights of 135kgs. Therefore the application also proposed reconfiguring the pig herd; increasing the sow numbers from 600 to 1,000 and decreasing the number of finishers on-site to accommodate the extra sows. However this market is No longer available. This was to be accomplished by internal refurbishment and not require any new construction. The refurbishment works involves changing in internal partitions, re-wiring, new water and feed fixtures etc. The slats and floors will remain in situ with some minor exceptions. The following changes will occur;

- Houses 3, 7 and 8 will change from finisher to dry sow houses.
- Houses 5 and 6 will change from finisher houses to weaner houses; and
- House 15 will change from weaner house to farrowing house;

When these works are complete the footprint of the proposed development will increase by 22m^2, the number of sows will increase to 1,000 and the number of finisher places will be 3,957. The slurry production will increase by 1% to 15,805m^3.

Table 1: Number of pigs in 600 sow and 1000 sow herds and slurry produced

Type of pig	**600 sow unit**	**Proposed 1,000 sow unit**
sows	600	1,000
Gilts	150	166
Boars	10	5
Weaners	3,450	4,000
Finisher places	3,750	3,957
Breeding unit manure production (m^3 / sow / week)	0.174	0.174
Finishing pig production (m^3 / finisher / week)	0.034	0.028
Total manure produced from breeding unit (m^3)	5,429	5,762
Total manure produced from finisher unit (m^3)	9,257	9,048
Total (m^3) =>	**14,686**	**14,810**
Soiled water (m^3)	995	995
Total including soiled water (m^3) =>	**15,681**	**15,805**

Plate No 1: Example of single mv electrical substation

Other changes which will occur are;

- Ammonia emissions will increase by 0 - 4% after mitigation measures are employed (see Section 8.0 Air);
- Odour emissions will remain unchanged after mitigation measures are employed (see Section 8.0 Air);
- Water consumption will increase from 43m^3/day to 48m^3/day;
- Traffic will increase from 14 to 16 movements per day;
- Noise emissions will not significantly impact sensitive receptors and remain within EPA limits for this facility;
- Sharps waste will increase by 5-6kgs per annum. Municipal waste will not change significantly;
- Carcass waste will increase by 21% (but collection traffic will remain once per fortnight);
- Labour will increase by one person;
- Power usage will increase by approx. 26%; and
- Methane and Nitrous output (as calculated using EPA Intensive Agriculture Emissions Spreadsheet) will increase by approx. 25 - 30% (see Sections 8 & 9).

It is predicted that construction traffic will increase movements by approx. 6 movements per day due to construction over a 4 month period with peaks of approx. 13 movements per day.

It is estimated that approx. 10 tons of construction and demolition waste will be produced during the proposed construction of the electrical substation and the refurbishment of the pig houses.

2.4 Need

The proposed electrical substation is required to upgrade the electricity supply to the mill. By having an adequate power supply the mill the farm can produce bespoke diets to reduce protein levels and lower emissions of ammonia and odour. The increased sow numbers is in response to a marketplace change. The market for heavier pigs (135 kgs) produced by the 600 sow herd was specialized and is no longer available thereby requiring the production of lighter pigs (100 – 105 kgs). If the sow herd size remained unchanged at 600 sows then a substantial percentage of the existing housing would remain empty and consequently the business would be unviable.

The importance of agriculture to the rural economy is immense and the industry has to sustain itself with continued investment. Pig meat is 4 times more carbon efficient than beef of sheep and therefore from a climate change perspective it is essential to increase the proportion of pig and / or poultry meat in the supply chain.

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2.5 Risks from Major Accidents and Natural Disasters

There is no risk from flooding, subsidence, earthquakes or other natural disasters. The construction materials of the building will conform to national standards to withstand the strongest winds and the tanks will be leak-proof. Continuous checking of equipment and electrical installations will take place to insure the risk from fire is minimized. Fire extinguishers are installed in the pig houses and regularly maintained. There will be procedures in place to contact the emergency services if there is a fire and to remove staff and other personnel from the site. Environmental incidents, accidents and natural disasters (fire) are rare on pig farms.

2.6 Photos of the Pig Farm

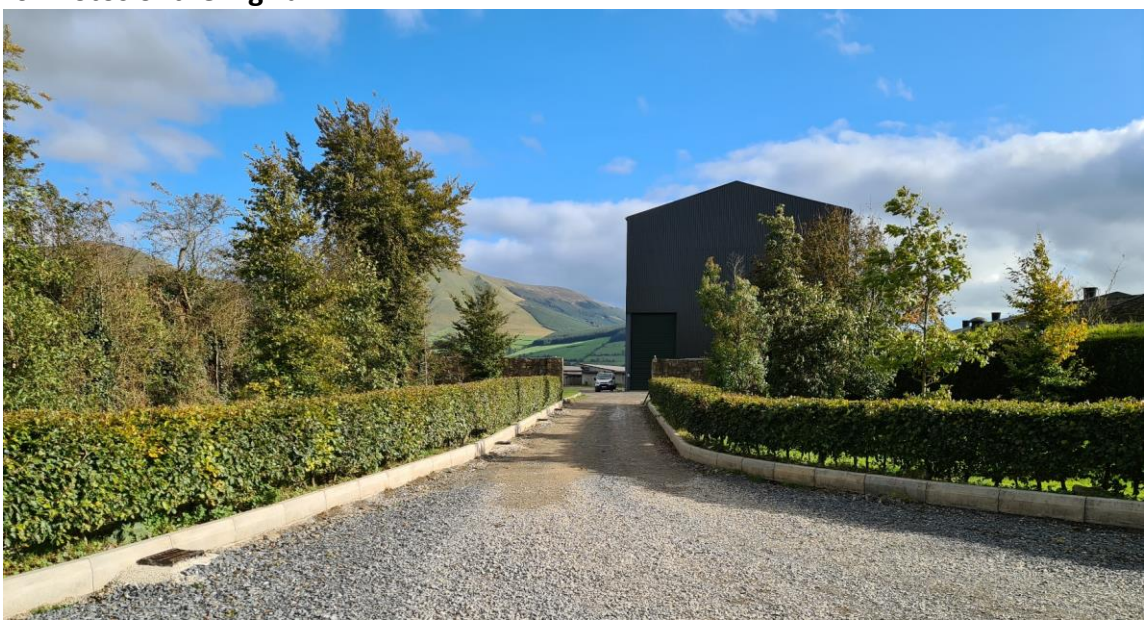


Plate 2: Entrance to 'Ballyfaskin Pig Farm' (mill House in background)

Plate 3: Site of proposed electrical substation

Plate 4: Looking south east with house 13 of left-hand-side

Plate 5: Covered slatted pig-walk passage.

Plate 6: Un-covered slatted pig-walk passage.

Plate 7: View from R662

Plate 8: Building No 11 on Left-hand-side and looking SE onto loading bay

Plate 9: Buildings 3-11 on left-hand-side and mill and buildings 13-15 on right-hand-side

3.0 ALTERNATIVES CONSIDERED

3.1 Do Nothing

The 'do-nothing alternative' has been considered. However, the vast majority of the housing infrastructure is in place. The 'do-nothing' alternative does not respond to the change in the market place which has switched from the specialized market for heavier pigs (135 kgs) towards mid-sized finisher weights (100 – 105 kgs). Therefore, in this scenario, the sow herd size remains unchanged at 600 sows and a substantial percentage of the existing housing remains empty and consequently the business becomes unviable.

The 'do-nothing' alternative has to be considered in the context that pork is 4 times more carbon efficient than beef or lamb. The density of pigs in Ireland is low compared to other European countries and pig numbers have been relatively static over the past 10+ years. Failing to maintain the viability of the existing pig farm would result in negative economic spin-offs in the wider regional economy e.g. the current pig farm maintains 30 – 35 jobs in the agri sector and produces equivalent to €140,000 of fertiliser which replaces expensive imported non-renewable chemical fertiliser.

3.2 Do Something

The 'do-something' alternative will result in the optimum enterprise mix, increasing the viability of the enterprise, it will allow the specialization required in the milling operation for the formulation of low protein diets and resulting reduction in emissions of ammonia and odour, and, it will minimise impact on traffic due to feed deliveries in larger loads. It will secure employment on and off the farm and minimise the import of chemical fertiliser.

3.3 Alternative sites and Layouts

Alternative sites and Layouts have been considered and are not be as suitable as the existing site because of the history of pig production at this site since the 1970's. This site has enough space to facilitate the proposed development, there is enough slurry storage on site and the existing layout minimises the movement of pigs, minimises visual impact and maximises the efficiency of operation.

3.4 Alternative house designs

Alternative house designs have been considered such as housing systems with under-slat scraping systems, under-slat flushing systems combined with manure gutters and vacuumed piped systems. Slurry cooling systems were considered. Exhaust air treatment systems were examined. Retrofitting to incorporate these features would be prohibitively expensive, cause major disturbance to the existing enterprise and these alternatives are considered uneconomic.

The existing design has incorporated underground slurry tanks with additional slurry storage to minimise risk of spillage and facilitate improved management of pig manure. All pig walk-ways are slated to minimise soiled water. Storm water is harvested and re used to power wash the pig houses. There is a wet feeding system which minimises dust emissions and noise. The houses use timer switches to minimise energy usage.

3.5 Alternative processes

Systems such as outdoor pig production were considered but this does not suit the soils or climate in Ireland.

3.6 Alternative emission mitigation measures

3.6.1 Alternative emission abatement techniques

As discussed alternative housing systems were considered by this would require significant retrofitting which is not economically feasible. Air treatment systems are similarly expensive and not viable.

3.6.2 Pig diet

Low protein diets are considered and will be used to reduce odour and ammonia emissions.

3.6.3 Land-spreading

Upward splash-plate and rain gun spreading is ruled out due to prevailing regulations in Ireland. Many farmers use downward splash-plate spreaders but there is a move to band-spreading and trailing shoe spreading which can reduce emissions by 35%. Also a move towards spreading in the early season reduces emissions. Alternatives such as anaerobic digestion (AD), aeration, slurry additives, scrubbing and slurry odour masking agents were considered. AD is a proven technology but requires additional state incentives to make it viable. Slurry additives are a developing technology which may offer options in the future. The pig farm will, where possible, hire only contractors that use low emission spreading equipment. The pig farm will adopt low protein diets to reduce ammonia emissions and odour.

3.7 Conclusions

Having examined the available alternatives and having considered the existing infrastructure is largely in place it is concluded that the best alternatives is to introduce low protein diets to reduce ammonia and odour emissions and where possible, use only contractors who use low emission spreading equipment.

4.0 HUMAN POPULATION AND HUMAN HEALTH

4.1 Existing Human Environment

There is a weak upward trend in the rural population (1.6% growth from 2011 – 2016) in Co Limerick. There are 40 dwellings within 1 km of the pig farm site boundary with an estimated population of 112 persons. There are approx. 30 inhabitants per sq. km of countryside around the pig farm. There are commercial and non-commercial premises such as churches, schools, banks, credit unions, manufacturing businesses, bars, community halls, guest houses, shops, post office, schools, playing/GAA pitches, pharmacies, restaurants, garage/car sales, Garda barracks and veterinary businesses. In the environs of the pig farm there are furniture manufacturing businesses in Ballylanders, a metal fabricator between Ballylanders and Spittle and two rurally based bakeries located 1.5km south and 2km south east from the site. The local environs are predominantly

agricultural with one-off houses and farms that benefit from the availability of pig manure. Local tourist services include the Galtee and Ballyhoura Mountains, the Ballyhoura Way 2.2km north of the site, guest houses near Anglesborough approx. 2.5km south of the site and there is a scenic route on the R513 as far as its junction with the R662 (0.75km south of site). There are 15 public water sources within 500m of lands used for landspreading – the closest of these being the Ballylanders ground water supplies which are 1.1km and 1.6km west of the site. The Aherlow River (1.4km east of the pig farm) is an important local fishery and other rivers such as the Arra River, Camogue River, River Funchion, Mulkear River and Morningstar Rivers are important local amenities. The area used for land-spreading is rich in Cultural heritage sites – the closest is the site of an enclosure which is 100m from the site boundary. The area used for land-spreading is well serviced by public roads.

4.2 Potential impacts

The farming community benefit to the degree of approx. €140,000 each year from the approx. 15,800m^3 of pig manure produced by the 'Ballyfaskin' Pig Farm. This is an organic renewable fertiliser source which replaces imported non-renewable chemical fertiliser. Employment on the site is projected to increase from 5 persons to 6. Local commercial businesses will generally benefit from increased economic activity and increased employment. The traffic to and from the 'Ballyfaskin' site is projected to increase from 14 to 16, increasing the average daily trips on the R662 from 923 to 925. During the 4 month construction period there will be a temporary increase of approx. 6 movements per day due to construction traffic. Without mitigation there are no significant impacts on farms, commerce, tourism or traffic.

Odour impacts from land-spreading will be typical of normal agricultural practices in the rural study area and will not have a significant impact on local communities, businesses or tourism. There is the potential for periodic odours in the vicinity of the pig farm. There are no pre-mitigation human health impacts on local residents from ammonia, methane, nitrous oxide, dust and other gases associated with the storage and land-spreading of pig manure. There are potential pre mitigation health effects on workers with in the pig confinement buildings. The mill is 150m from nearest dwellings and at this separation distance noise impacts will not be significant pre-mitigation. The noise from the pig houses will not change significantly and is predicted to be within the EPA license limits for this facility. Only workers and visitors operating inside the boundary of the pig farm may be exposed to construction noises which could exceed Health and Safety Authority guidelines which, without mitigation, could result in a slight adverse impact on human health.

The Aherlow River in the vicinity of the pig farm is good quality and not at risk of deterioration. Throughout the study area the water quality is relatively stable and is classified as mostly 'moderate – good'. Other sensitive ecosystem services such as forests, woodlands are not directly affected due to separation distance from the pig farm and will not be significantly affected by land-spreading before mitigation. Fifteen public ground water supply sources have been identified within or adjacent to the area used for land-spreading and these are very high sensitive receptors. In addition there are many private wells attached to dwellings which have not been identified. While the land spreading of organic manures is common place in rural Ireland and in the surrounding area, without good practice there is a potential slight adverse impact on human population due to potential impacts on water supplies.

Without mitigation there is the potential to damage an unknown archaeology at the site of the proposed development, leading to a slight – moderate adverse effect on the Cultural Heritage environment.

4.3 Mitigation

The pig farm, or its contractors, will be required to provide health and safety training and have a safety statement/plan. To mitigate potential impacts it is proposed to control dust and noise during construction and provide workers with personal protection safety devices. The construction hours will be restricted to 8am to 6pm Monday to Saturday. Contractors will employ measures to protect watercourses from sediment run-off and will insure soil is not transported out on to the public road by having wheel wash facilities. The pig farm management will notify adjoining land owners in advance of commencement of sudden loud construction works in case there are any sensitive livestock nearby (e.g. horses or cows at the point of calving)

During the operational phase there will be health and safety training to minimise and manage risks to farm worker's health from noise and dust within the pig houses. The pig house ventilation system will remove harmful concentrations of dust, particulate matter and toxic gases. A Noise Management Programme will be in place to monitor and manage noise emissions. During the operational phase the regulations pertaining to land-spreading as set out in Si 605 of 2017 (Nitrates Regulations) (as amended) will be adhered to, which requires setback distances of 200m, 25m and 5m from public and private water sources and watercourses respectively. A setback distance of 50m will be recommended by the pig farm around rural dwellings and any source protection zones for public water sources will be avoided. There is 50 weeks of slurry storage on site which insures that the pig manure can be spread in suitable conditions. Odour will be mitigated by use of low protein diets, implementing an Odour Management Plan (Attachment 7-1-3) and maintaining a high degree of cleanliness on-site. The pig farm will monitor complaints and advise caution when spreading manure at these locations (e.g. adjoining settlements). The pig farm will, where possible, hire contractors that use low emission slurry spreading equipment. A rodent and pest control programme will be implemented to minimise nuisance from pests.

4.4 Residual and Cumulative Impacts

The proposed development will not significantly impact on population growth within the study area. The residual impact on local business is not significant – although there may be beneficial spin offs due to increased construction activity. The residual impact on farms due to land-spreading is positive but not significant. There will be no residual impact on tourism from the proposed development due to adequate separation distance, and land-spreading pig manure will not add significantly to the existing baseline land-spreading of agricultural manures. The proposed operational pig farm will be approximately 1.5% of the traffic on the local road, with a 0.5% increase in construction traffic, and therefore residual impacts on local traffic are not significant.

After mitigation (low protein diets) the odour emissions will not change significantly compared to the licenced pig farm (see Section 8.0 Air).

The statutory regulations governing the application of organic manures contain mandatory mitigation measures which protect water sources. The pig manure will be applied in accordance to these regulations and therefore residual impacts on water sources is not significant.

Cumulative impacts from the pig farm located in Inchacoomb (2 km south east of the 'Ballyfaskin' site) and from two licensed facilities in the Glen of Aherlow 13km north west of the 'Ballyfaskin' pig farm have been considered and are not significant. The land-spreading of cattle manure in the study area is considered part of the baseline environment and with standard mitigation the potential cumulative nuisance and water quality effects are not significant.

The interaction between Human Population and Human Health with the Risk of Major Accidents or Incidents will not give rise to significant change in the assessed impacts.

5.0 BIODIVERSITY

5.1 Existing Biodiversity

Ash Ecology & Environmental Ltd carried out a survey at the site on 28th of July 2020 and a visual assessment of the study area was conducted when study area was classified according to Fossitt (2000).

The locations of designated sites within 15km of the pig farm are illustrated in Table 2 and in Figures 1.5 and 1.6. There are five designated Special Areas of Conservation within 15km of the pig farm (plus 3 proposed Natural Heritage Areas (pNHA));

1. 000646 Galtee Mountains SAC (and pNHA) (3.9km E, SE from site);
2. 002137 Lower River Suir SAC(8.9km NE from site);
3. 002257 Moanmour Mountain SAC (7.6km NE from site boundary);
4. 002037 Carrigeenamronety Hill SAC (and pNHA) (10.8km SW from site boundary); and,
5. 002036 Ballyhoura Mountains SAC (and pNHA) (12.7km SW from site boundary)

There are 6 additional pNHA sites – (002035) Glenacurrane River Valley pNHA, (002087) Ballynacourty Wood pNHA, (002089) Ballyroe Hill & Mortlestown Hill, (002090) Castleoliver Woods pNHA, (000899) Ballindangan Marsh pNHA and (000651) Mitchelstown Caves pNHA – within 5.7km SE, 9.3km SW, 10.3km SW, W, 11.7km SW, 14.2km S and 14.9km SE respectively from the pig farm. There are no designated sites in the study area.

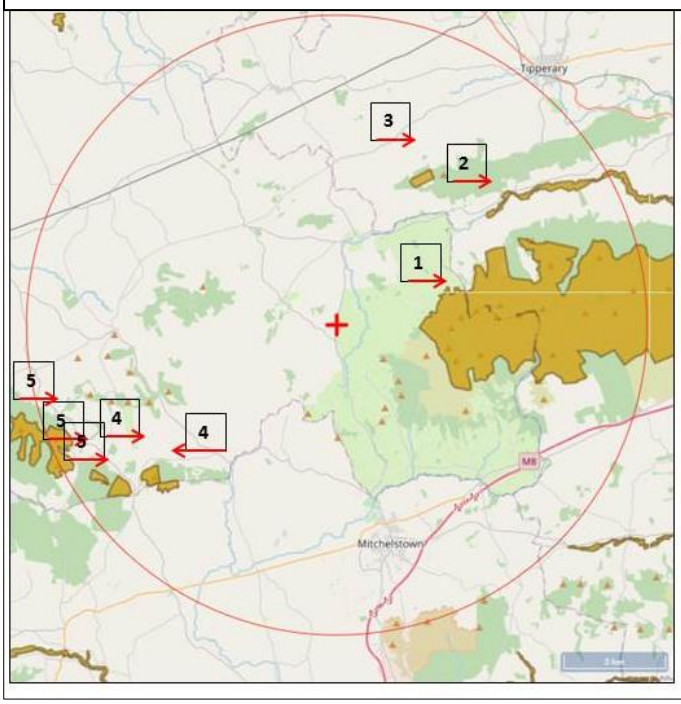
Table 2 Designated Sites and their Location Relative to the Proposed Site Works

Code	Site	Designation Status	Qualifying Interests	Approx. distance at closest point
000646	Galtee Mountains	SAC/pNHA	Northern Atlantic wet heaths with Erica tetralix [4010] European dry heaths [4030] Alpine and Boreal heaths [4060] Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] Blanket bogs (* if active bog) [7130] Siliceous scree of the montane to snow levels (Androsacetalia	3.9km E, SE No evidence of pathway from the site of proposed development to the SAC/pNHA given the distance for disturbance and lack of hydrological connection.

Code	Site	Designation Status	Qualifying Interests	Approx. distance at closest point
			alpinae and Galeopsietalia ladani) [8110] Calcareous rocky slopes with chasmophytic vegetation [8210] Siliceous rocky slopes with chasmophytic vegetation [8220]	
002137	Lower River Suir	SAC	Atlantic salt meadows (Glauco-Puccinellietalia maritimae) [1330] Mediterranean salt meadows (Juncetalia maritimi) [1410] Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430] Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0] Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0] Taxus baccata woods of the British Isles [91J0] Margaritifera margaritifera (Freshwater Pearl Mussel) [1029] Austropotamobius pallipes (White-clawed Crayfish) [1092] Petromyzon marinus (Sea Lamprey) [1095] Lampetra planeri (Brook Lamprey) [1096] Lampetra fluviatilis (River Lamprey) [1099] Alosa fallax fallax (Twaite Shad) [1103] Salmo salar (Salmon) [1106] Lutra lutra (Otter) [1355]	8.9km NE – A tenuous hydrological connection via site drainage to Lyre Stream, a tributary of the Aherlow River (which becomes part of this SAC). The Aherlow River is directly 1.3km northeast of the site as the crow flies.

Code	Site	Designation Status	Qualifying Interests	Approx. distance at closest point
002257	Moanour Mountain	SAC	Northern Atlantic wet heaths with Erica tetralix [4010] European dry heaths [4030]	7.6km NE - No evidence of pathway from the site of proposed development to the SAC given the distance for disturbance and lack of hydrological connection
002037	Carrigeen amronety Hill	SAC	European dry heaths [4030] Trichomanes speciosum (Killarney Fern) [1421]	10.8km SW – No evidence of pathway from the site of proposed development to the SAC given the distance for disturbance and lack of hydrological connection
002036	Ballyhoura Mountains	SAC/pNHA	Northern Atlantic wet heaths with Erica tetralix [4010] European dry heaths [4030] Blanket bogs (* if active bog) [7130]	12.7km SW (SAC) and 14km SW (pNHA) – No evidence of pathway from the site of proposed development to the SAC/pNHA given the distance for disturbance and lack of hydrological connection
002035	Glenacurrane River Valley pNHA	pNHA	5.7km SE - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	
002087	Ballynacourty Wood pNHA	pNHA	9.3km SW - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	
002089	Ballyroe Hill & Mortlestown Hill	pNHA	10.3km SW, W - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	
002037	Carrigeen amronety Hill pNHA	pNHA	10.8km SW - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	
002090	Castleoliver Woods pNHA	pNHA	11.7km SW - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	
000899	Ballindangan Marsh pNHA	pNHA	14.2km S - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	
000651	Mitchelstown Caves pNHA	pNHA	14.9km SE - No evidence of pathway from the site of proposed development to the pNHA given the distance for disturbance and lack of hydrological connection	

Figure 1.5 Special Areas of Conservation within 15km



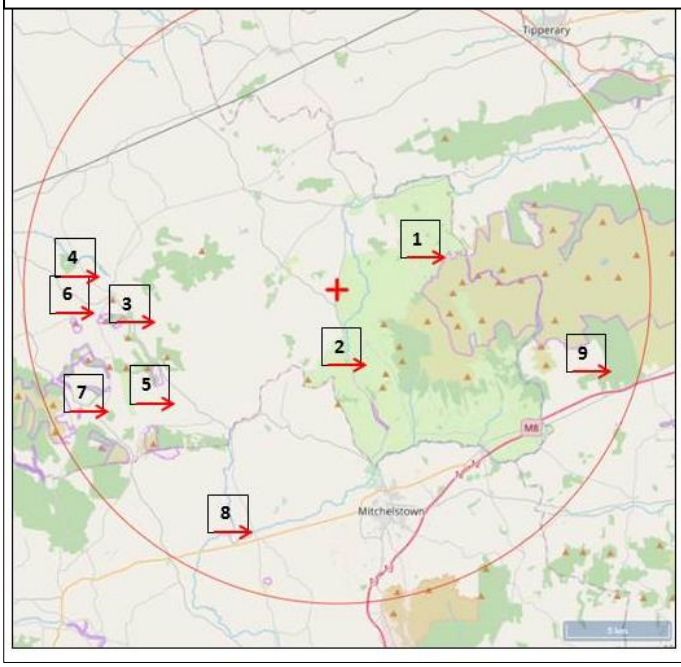
No.	Site Code	Name	Distance
1	000646	Galtee Mountains SAC	3.9km E, SE
2	002137	Lower River Suir	8.9km NE
3	002257	Moanour Mountain SAC	7.6km NE
4	002037	Carrigeenamronety Hill SAC	10.8km SW
5	002036	Ballyhoura Mountains SAC	12.7km SW

N

Special Area of Conservation (SAC)

Site Location

Figure 1.6 Proposed National Natural Heritage Areas within 15km



No.	Site Code	Name	Distance
1	000646	Galtee Mountains pNHA	3.9km E, SE
2	002035	Glenacurrane River Valley pNHA	5.7km SE
3	002087	Ballynacourty Wood pNHA	9.3km SW
4	002089	Ballyroe Hill & Mortlestown Hill	10.3km SW
5	002037	Carrigeenamronety Hill pNHA	10.8km SW
6	002090	Castleoliver Woods pNHA	11.7km SW
7	002036	Ballyhoura Mountains pNHA	14km SW
8	000899	Ballindangan Marsh pNHA	14.2km S
9	000651	Mitchelstown Caves pNHA	14.9km SE

N

Proposed Natural Heritage Area (pNHA)

Site Location

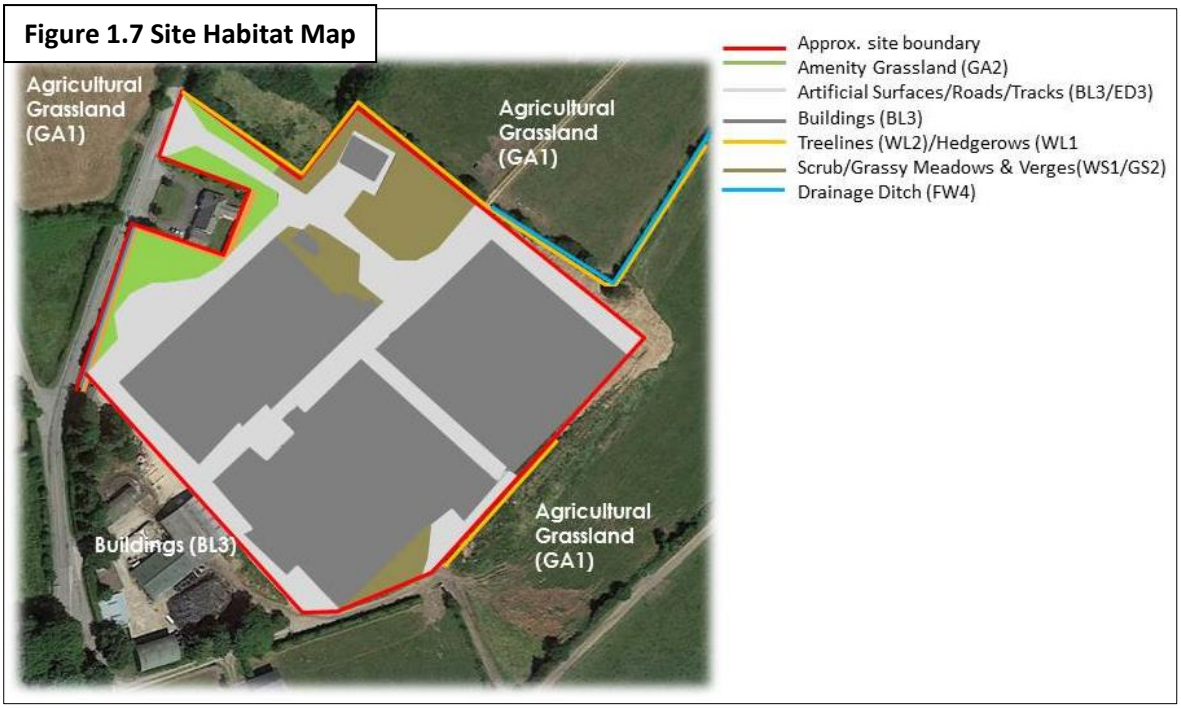
The habitats on the pig farm site are described in Figure 1.7 and Table 3 as buildings and artificial surfaces (BL3), amenity grassland (GA2), improved agricultural grassland (GA1), non-native treelines (WL2), scrub (WS1), grassy verges (WL1), trees (WL2), hedgerows (WL1) and Drainage Ditches (FW4). No rare species of flora was recorded or observed at the site. Neither were protected fauna species such as otter, badger, pygmy shrew, red squirrel, fallow deer, Irish hare, pine marten, Irish stoat or hedgehog recorded or observed. A bat survey was deemed unnecessary

as there was no demolition works. No invasive species were recorded. The drainage ditches at the northern boundary of site may contain common frog. Overall, the site of the proposed development is of local value for a range of terrestrial bird species and bats that are relatively common in the Irish countryside.

Table 3 Habitats Present within the proposed 'Ballyfaskin Pig Farm' Site and their Relative Value

HABITAT	COMMENTS	ECOLOGICAL VALUE (NRA GUIDELINES)
Buildings and artificial surfaces (BL3)/ Amenity Grassland (GA2)/ Non-Native Treeline (WL2), (southwest corner of site).	The majority of existing site is Buildings and Artificial Surfaces (BL3) made up of hardstanding and existing buildings. There are also some landscaped areas of grass best described as Amenity Grassland (GA2). These habitats are deemed to be of low biodiversity.	Local importance (Lower value)
Scrub and Grassy Verges (WS1/GS2)	Scattered about the edges of site are some areas of scrub (WS1) and grassy Verges. Some wilder areas of flora occur in these sections so can be considered of local importance.	Local importance (Higher value)
Treelines/Hedgerows (WL2/WL1)	Treelines and hedgerows abound much of the site. Treelines and hedgerows can provide important habitats for local wildlife such as birds, insects and possibly bats and also play host to numerous insect species which are prey items for both bird and bat species. Large mature trees within a woodland habitat/treeline are of particular importance as they can provide essential refuge and breeding sites for many species of mammals and birds, as well as for many invertebrates. In general, these habitats are somewhat fragmented from the wider landscape but add to the diversity in a local context.	Local importance (Higher value)
Drainage Ditches (FW4)	A drainage ditch runs along the western (run-off from road) and north-eastern boundary (residual surface water drainage after usage and collection from attenuation tank). No standing water noted.	Local importance (Lower value)

Figure 1.7 Site Habitat Map



5.2 Potential Impacts

Construction disturbance can cause sensitive species to deviate from their normal, preferred behaviour, resulting in stress, increased energy expenditure and, in some cases, increased mortality. Deterioration in water quality due to storm water discharges and land-spreading could impact on the River SACs. Construction activities could adversely affect the Aherlow River but this has been ruled out. Construction activities could lead to the introduction of non-invasive species.

5.3 Mitigation

The proposed construction phase mitigation includes measures to control water run-off and accidental spills of fuels, oils and greases and operational phase mitigation includes measures to protect groundwater and surface water features. These measures are specifically mentioned Sections 4.6 and 6.6 of Volume 2 of the EIAR. Environmental noise arising from activities on the construction site shall be controlled and minimised in accordance with the specifications of the noise management plan. Wheel wash facilities will be used to insure that vehicles entering and existing the site are clean to prevent ingress of invasive species. In the event of unintended introduction of an invasive species a person with sufficient training, experience and knowledge in the control of non-native invasive species will be employed to assist in the planning and execution of control measures. Pig manure will be handled, stored and spread according to the relevant regulations.

5.4 Residual and Cumulative Impacts

The Natura Impact Statement Report states that following a comprehensive evaluation of the potential direct, indirect and cumulative impacts on the qualifying interests and conservation objectives for Natura 2000 sites, it has been concluded that the proposed works will not have an adverse effect on the integrity of Natura 2000 sites. The habitats within the site boundary are relatively common and no Annex I or rare or uncommon habitats or floral species will be directly

affected by the proposed works. Invasive species were not noted on the site. Prevention of pollution of drainage ditches will insure no effect on the common frog.

A habitat assessment of the complete study area was mainly that of Improved Agricultural Grassland, Arable Cropping and conifer woodland. Small pockets of higher diversity habitat such as treelines, grassy verges beside rivers and watercourses occur away from the more intensive farms and would therefore not be affected by outputs from to the proposed pig farm development

With mitigation any residual impacts on the habitats and species that occur on the site due to the proposed works is considered to be neutral in the long-term and the predicted residual impact on flora and fauna will be insignificant.

Cumulative impacts from the nearest pig farm development located in Inchacoomb (2 km south east of 'Ballyfaskin' Pig Farm) are not significant due to the separation distance. The interaction between Biodiversity with other environmental topics will not give rise to significant change in the assessed impacts.

6.0 LAND AND SOILS

6.1 Existing sub-soils and soils

Within the study area there are 36 bedrock formations as illustrated in Figure 1.8 and 1.9. Bedrocks contain aquifers and aquifers are categorised in order of their importance. Firstly, the most important category are *Regionally Important Aquifers*. These bedrocks make up 16.5% of the study area. Secondly, there are *Locally Important Aquifers*. These bedrocks make up 79% of the study area and this is also the aquifer type under the site of the pig farm. Thirdly, and least important, are *Poor Aquifers* which make up 4.5% of the study area.

The bedrock has been weathered over the ages to produce top soils. There are 8 soil groups in the study area as illustrated in Table 4 and Figures 1.10 and 1.11. These include; the principle soil is the *Elton series* (39% of the study area), surface water and groundwater gleys (23% of the study area), acid brown earths (21% of the study), alluvial soils (11.5% of the study area), podzols and brown podzols (5% of the study area) and peaty type soils (1.5% of the study area). With the exception of peats and some poorly drained gleys all these soils with improved grassland are suitable for land-spreading, subject to weather and soil conditions. The main restriction in terms of land-spreading of pig manure on moderately well drained soils is going to be at the shoulders of the season – requiring additional slurry storage to avoid waterlogged soils. An application of pig manure will be equivalent to 1 - 2mm per hectare. The infiltration rates associated with brown earths and *Elton* soils can be assumed to be in excess of 100mm / hr[1]. Moderately well drained gleys and podzolics will have mid – lower infiltration rates (30+mm / hr) and poorly drained gleys and peats will have low infiltration rates of 5mm / hr or less.

[1] J.Diamond and T.Shanley, Teagasc: *Infiltration Rate Assessment of some Major Soils*; 1998; Tables 1 and 4.

Figure 1.8 Bedrock Formation and Aquifer Status

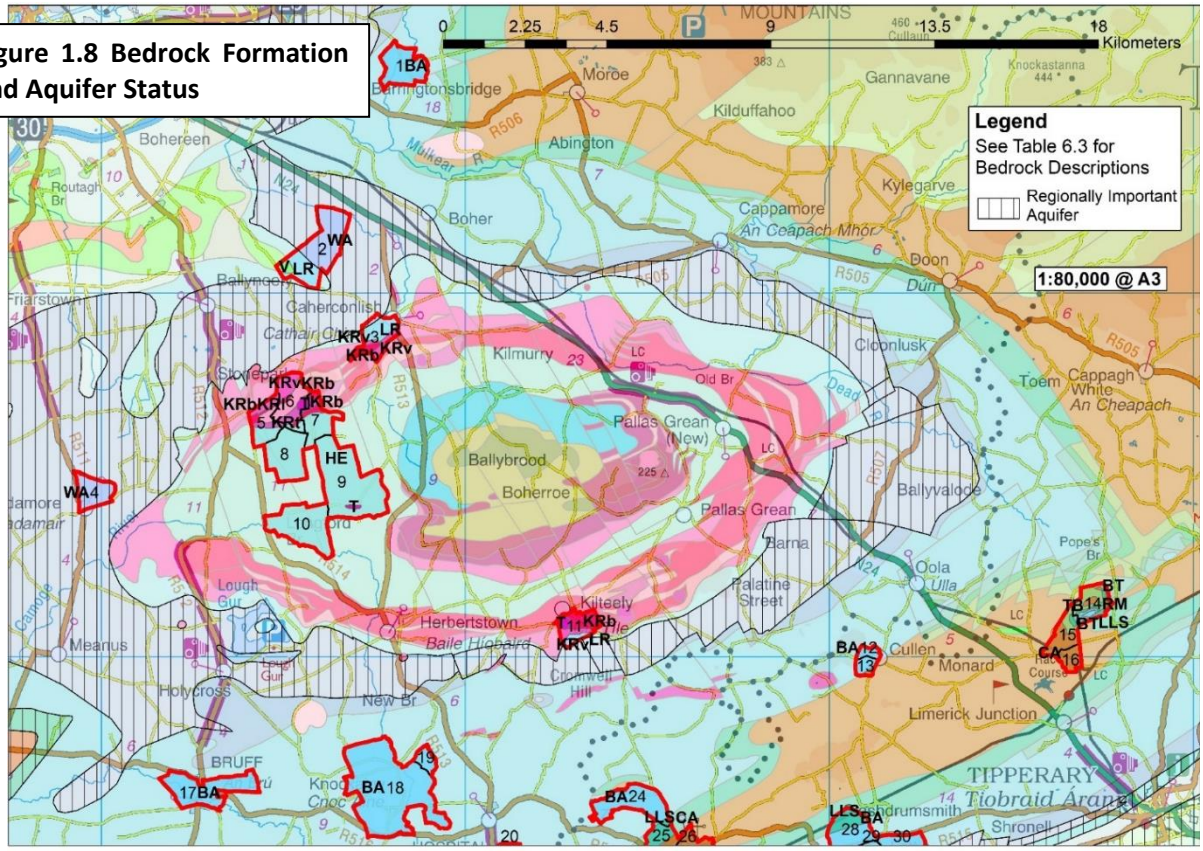
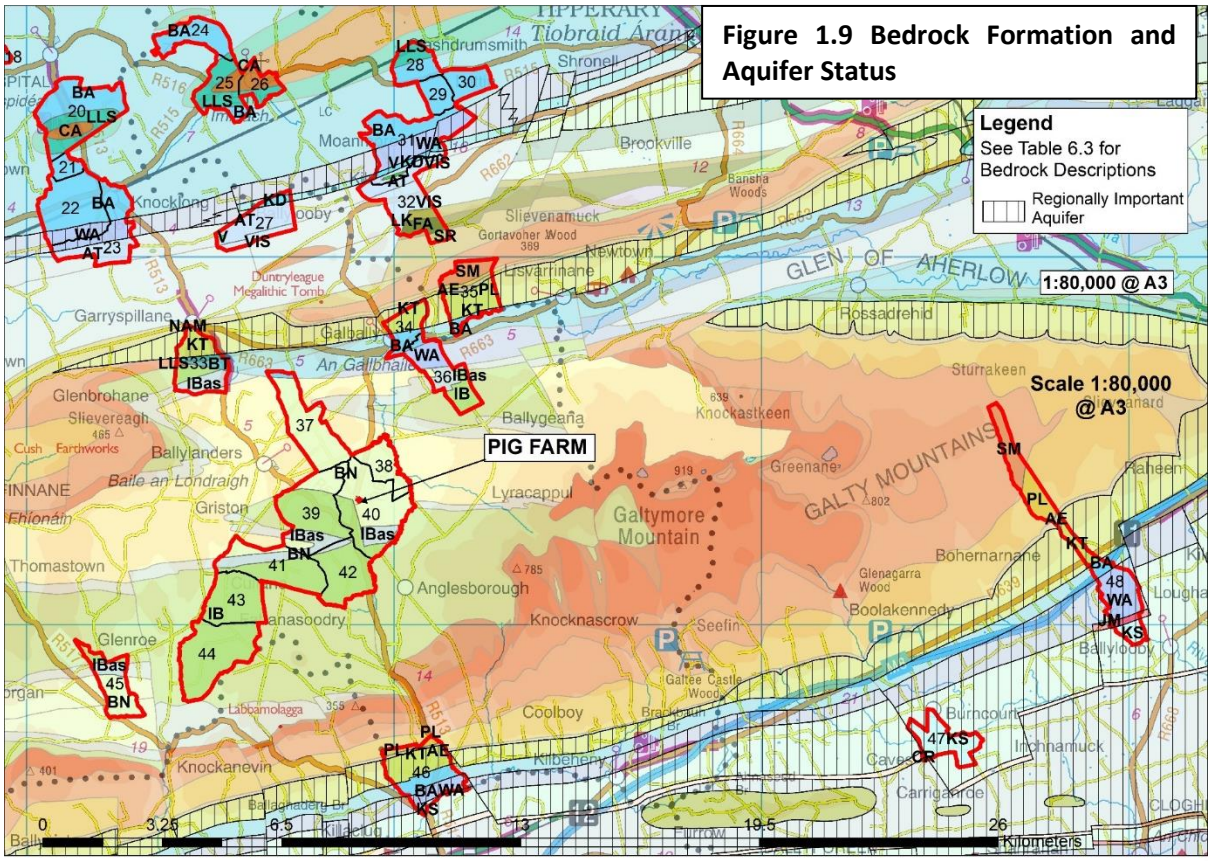


Figure 1.9 Bedrock Formation and Aquifer Status



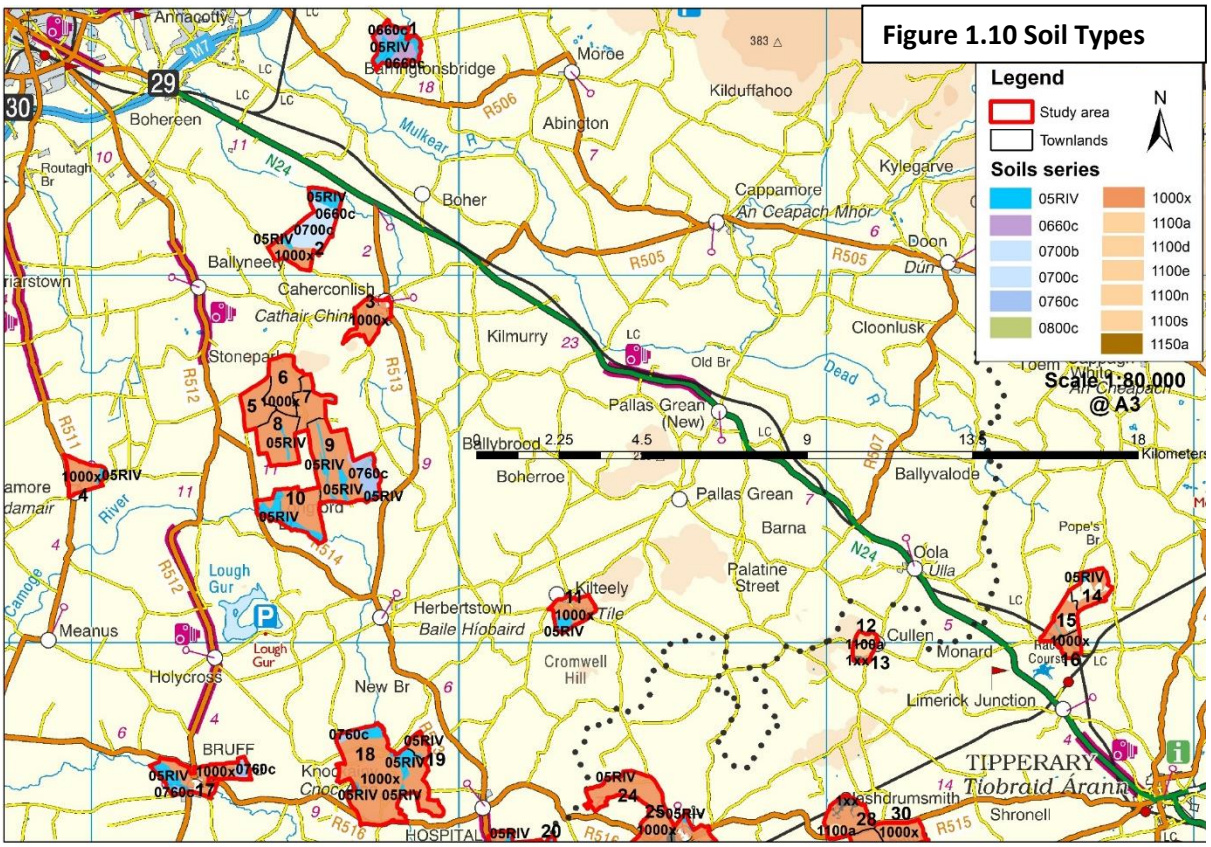
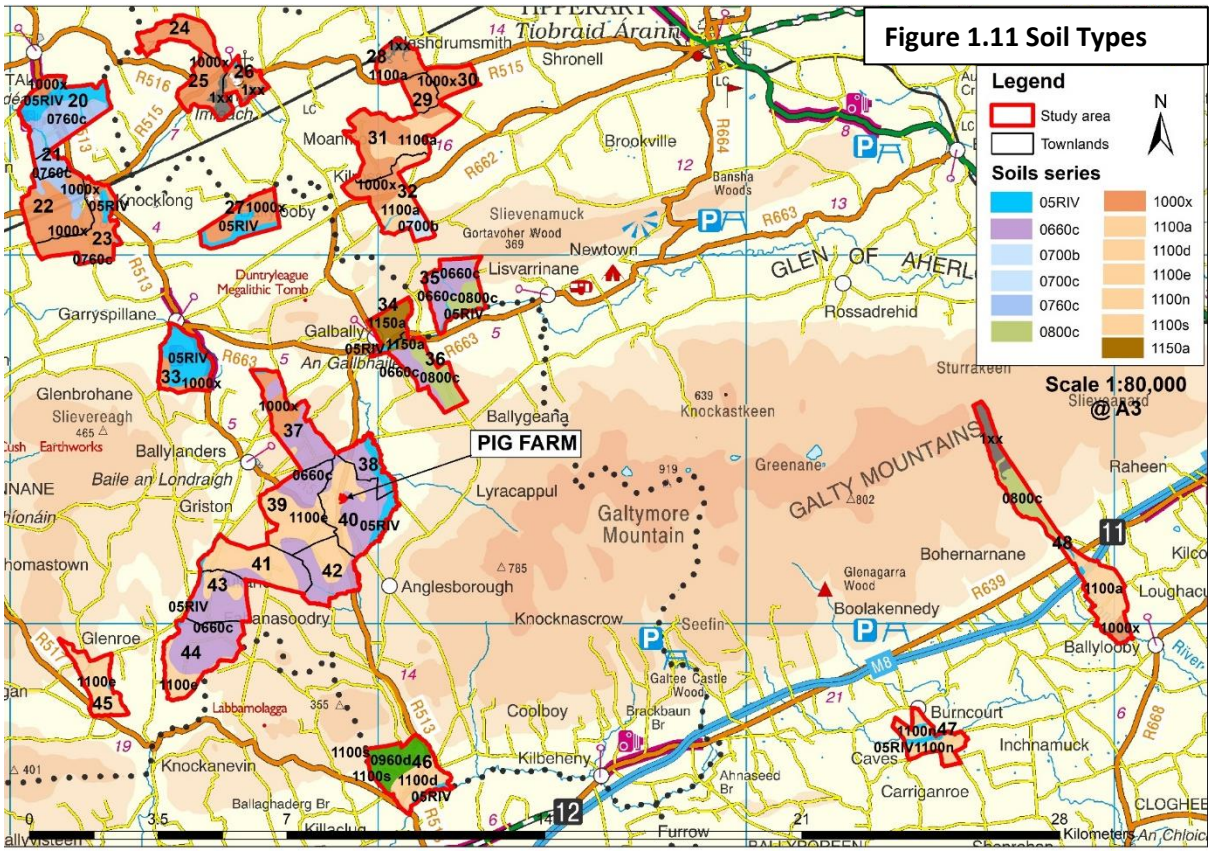


Table 4 Soil Types within the study area

Soil series	Gross Area (ha)	% of study area	Drainage
Peats *(1xx)*	143	1.5	Poorly drained. Typical summer infiltration rates of less than 5mm / hour.
Alluvial soils *(05RIV)*	953	11.5	Poor – moderate drainage, depending on location and drainage outlet. Typical summer infiltration rates vary from less than 5mm / hour – 30mm / hour.
Groundwater gleys *(0660c)*	1,316	16	Moderately - well drained. Typical summer infiltration rates of 30 mm / hour.
Surface water gleys *(0700b, 077c)*	554	7	Moderately - well drained. Typical summer infiltration rates of 30 mm / hour.
Podzols *(0880c)*	273	3	Moderately - well drained. Typical summer infiltration rates of 30 – 90mm / hr.
Brown podzols *(0900d)*	138	2	Moderately - well drained. Typical summer infiltration rates of 30 – 90mm / hr.
Luvisols *(1000x)*	3,181	39	Generally well drained. Typical summer infiltration rates of 100+mm / hour.
Brown earths *(1100a, 1100d, 1100e, 1100n, 1100s, 1150a)*	1,698	21	Generally well drained. Typical summer infiltration rates of 100+mm / hour.
Total=>	**8,250**		



6.2 Nutrient Management

The study area is comprised of approx. 8,250ha. When adjusted for forestry, roads, houses, scrub, farm yards, buffer strips, source protection zones and zones of contribution, the available land with minimal risk to water is 5,543ha. The average phosphorous (P) requirement within the study area, based on Teagasc data for soil samples in Counties Limerick and Tipperary, is approx. 14kg / ha or 77,602kgs (5543 x 14) of P. Taking a more conservative estimate based on assuming P index 3, the P requirement is approx. 55,430kgs. The pig farm will produce approx. 23% (12,644 kgs) of this requirement demonstrating the relatively low contribution that the pig manure is making to the total fertiliser requirement. The chemical nitrogen allowance for the typical receiving farmer is 206 kgs / ha - 1,142 tons of N required within the study area. The pig farm will supply 3% of this requirement.

6.3 Mitigation

There is a legal framework (SI 605 of 2017 as amended) which governs how pig manure is land-spread, and within this legal framework there are adequate protections to insure that pig manure is applied without adverse environmental effects. To minimise the risks from spreading on heavy moderately drained soils in the shoulders of the spreading season the pig farm has sufficiently extra storage so that pig manure exports are not necessary during these high risk periods, The pig farm maintains a pig manure export register for inspection by the EPA as required by the existing EPA license and gives a record of slurry movements to the Department of Agriculture, Food and the Marine (DAFM) each year so that slurry movements can be monitored. DAFM inspect approx. 5% of farmers each year for cross compliance with the relevant regulations.

6.4 Residual and cumulative impacts

The loss of approximately 0.1 hectares of agricultural grassland at the 'Ballyfaskin' site for the electrical substation development is not a significant residual impact. By adhering to the regulations chemical fertiliser requirement is replaced with pig manure and therefore nutrient over loading is avoided. Pig manure will supply a relatively small proportion of the P requirement of the study area. The pig manure will add organic matter to the receiving soils – which is beneficial.

Cumulative impacts with the nearest pig farm development in Inchacoomb, which is 2km south east of the 'Ballyfaskin' site, are assessed. The Inchacoomb pig farm delivers pig manure to some of the townlands within the study area and therefore there is a potential cumulative impact on soil nutrients. However the pig manure is applied according to the relevant regulations and therefore the nutrient requirement of the receiving environment is taken into account, thus insuring that adverse effects are avoided. The total contribution of pig manure to County Limerick organic manure levels is approx. 2%. Therefore the cumulative impact of pig farms in County Limerick is not significant.

Land and Soils has the potential for significant interactions with Human Population, Human Health, Water, Air, Climate and Material Assets, however, having considered these interactions, there is no significant change in the assessed impacts.

7.0 WATER

The water quality has been assessed by referring to Geological Survey of Ireland (GSI) data, EPA data, County Council data, Water Framework Data and water analysis results from groundwater at the pig farm. A field assessment of the study area carried out by Ash Ecology and Environmental (AAE). AAE took 30 Q-samples throughout the study area to supplement the EPA surface water data.

7.1 Groundwater

7.1.1 Receiving groundwater environment

The site overlies a Locally Important Aquifer and the groundwater vulnerability (i.e. the ease with which groundwater can be contaminated) is categorised as medium. This represents a relatively low risk to groundwater at the site. <2% the study area is categorised as extreme vulnerable land over regionally important aquifers. Extreme vulnerability represents a high risk to groundwater, however, the low percentage of the study area represents a low risk overall. See Table 5 and shown in Figures 1.12 and 1.13

Table 5 : Groundwater Vulnerability and Aquifer Status within the Study Area

Groundwater Vulnerability	% of the Study area (Gross Area)	% of the study area (Gross Area)		
		Regionally Important Aquifer	Locally Important Aquifer	Poor Aquifers
Extreme	10	1.3	8.5	0.1
High	31	7.3	23.8	0.04
Medium	38	1.2	6.8	1.9
Low	10	6.3	28.8	2.5

Groundwater Vulnerability	% of the Study area (Gross Area)	% of the study area (Gross Area)		
		Regionally Important Aquifer	Locally Important Aquifer	Poor Aquifers
Rock	11	0.6	10.9	0.3
Total	100	16.6%	78.6%	4.8%

The ground water quality was assessed by examining EPA data (https://gis.epa.ie/EPAMaps/) on ground waterbodies, the water analysis results from 22 out of 36 groundwater sources in the vicinity of the study area (https://waterquality.limerick.ie) and the water analysis results of the pig farm well.

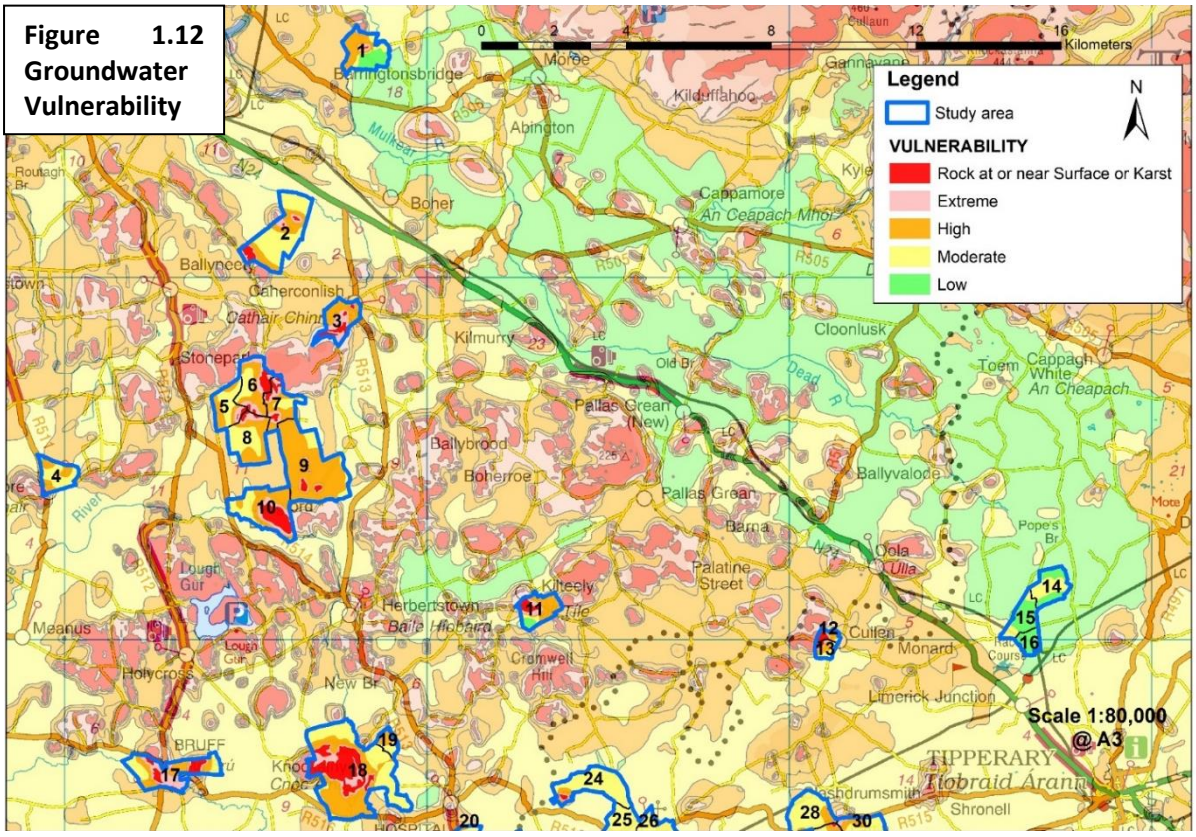
The EPA data shows that there are 21 ground waterbodies throughout the study area (as listed in Table 6 and shown in Figures 1.14 and 1.15).

Table 6 Groundwater bodies within the Study Area and their Quality and Risk Status

ID (Code)	Name of Waterbody	Occurrence within the study area	Description of waterbody	Quality Status (EPA Maps.ie)	Risk Status (EPA Maps.ie)	Agriculture is the significant pressure
SH_G_107	Hospital	20%	Pl	Good	Not at Risk	-
SE_G_087	Knockaskallen	17%	Pl	Good	Not at Risk	-
SW_G_010	Ballyhoura	10%	Pl	Good	Not at Risk	-
SH_G_055	Charleville	9%	Pl	Good	At Risk	Yes
SH_G_106	Herbertstown	8%	Rkd	Good	At Risk	-
SE_G_131	Templemore	8%	Pl	Good	Review	-
SE_G_040	Clonmel	4%	Karstic	Good	Review	-
SH_G_213	Slieve Phelim	4%	Pl	Good	Not at Risk	-
SH_G_130	Knockroe Northwest	3%	Pl	Good	Not at Risk	-
SH_G_036	Ballyneety	2%	Karstic	Good	Review	-
SH_G_193	North Kilmallock	2%	Karstic	Good	At Risk	Yes
SE_G_016	Bansha	2%	Rkd	Good	At Risk	-
SE_G_145	Tipperary	2%	Karstic	Good	Review	-
SE_G_091	Lisvarrinane	2%	Pl	Good	Review	-
SW_G_082	Mitchelstown	2%	Karstic	Poor	At Risk	Yes
SW_G_011	Ballyhoura Kiltorcan	1%	Rkd	Good	At Risk	Yes
SH_G_084	Fedamore	1%	Karstic	Good	Review	-
SH_G_138	Limerick City East	1%	Rkd	Good	At Risk	Yes
SH_G_131	Knockroe Southwest	1%	Pl	Good	Not at Risk	-
SE_G_024	Cahir	0.5%	Rkd	Good	Review	-
SH_G_219	Industrial Facility (P0331-01)	0.2%	Pl	Poor	At Risk	-

Approximately 1% of the study area overlies groundwater bodies of poor status. The Mitchelstown (SE_G_082) and Industrial Facility (SE_G_219) waterbodies are poor quality – townlands 14, 15, 16 and 46 are the relevant townlands. Approximately 55% of the study area overlies ground waterbodies that are *not at risk* from deteriorating water quality, 25% of the study area overlies groundwater bodies that are *at risk* due to deteriorating water quality and 20% of the study area overlies groundwater bodies that are under *review* due to increased pressures. This compares favourably with approx. 40%, 37% and 23% of groundwater bodies in County Limerick that are not at risk, under review and at risk. On the EPA mapping system (https://gis.epa.ie/EPAMaps/Water) there are five ground waterbodies where agriculture is the significant pressure on groundwater quality – these make up 15% of the study area.

Figure 1.12 Groundwater Vulnerability



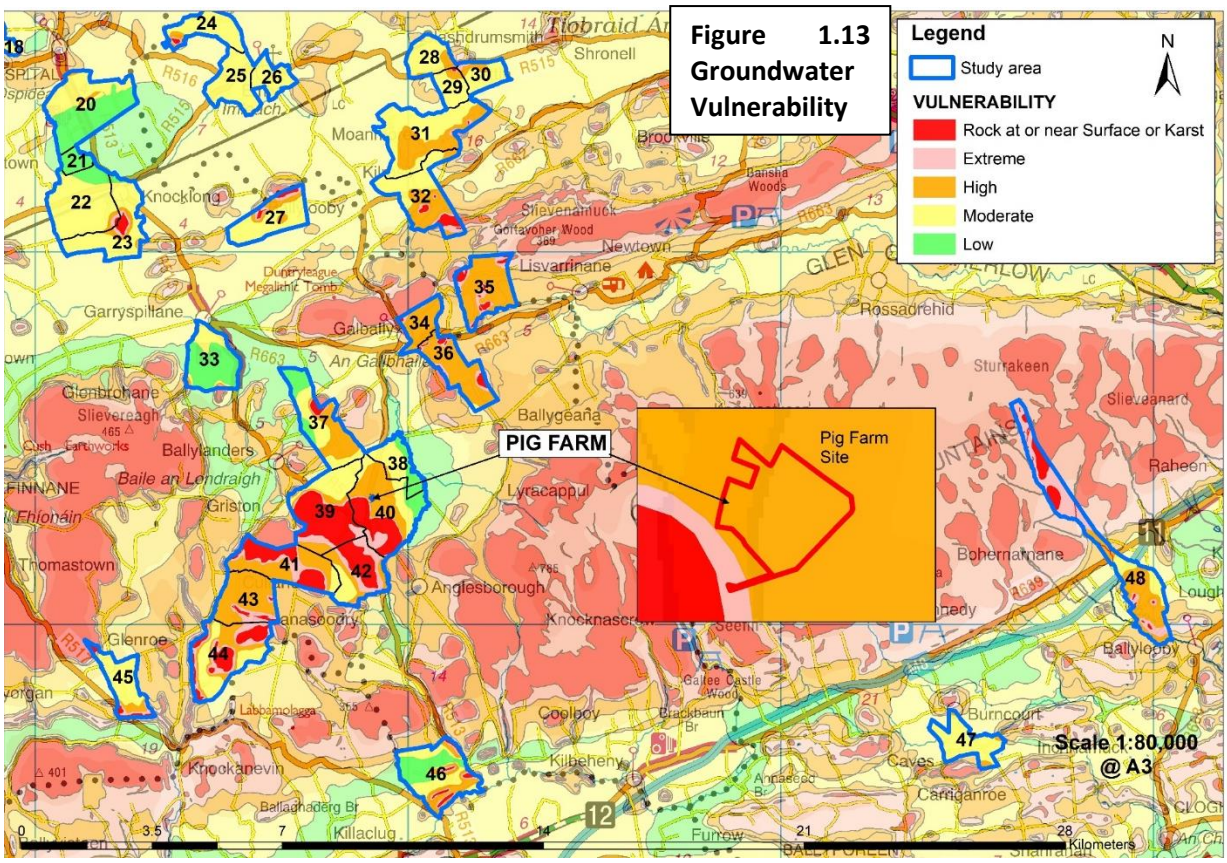


Figure 1.13 Groundwater Vulnerability

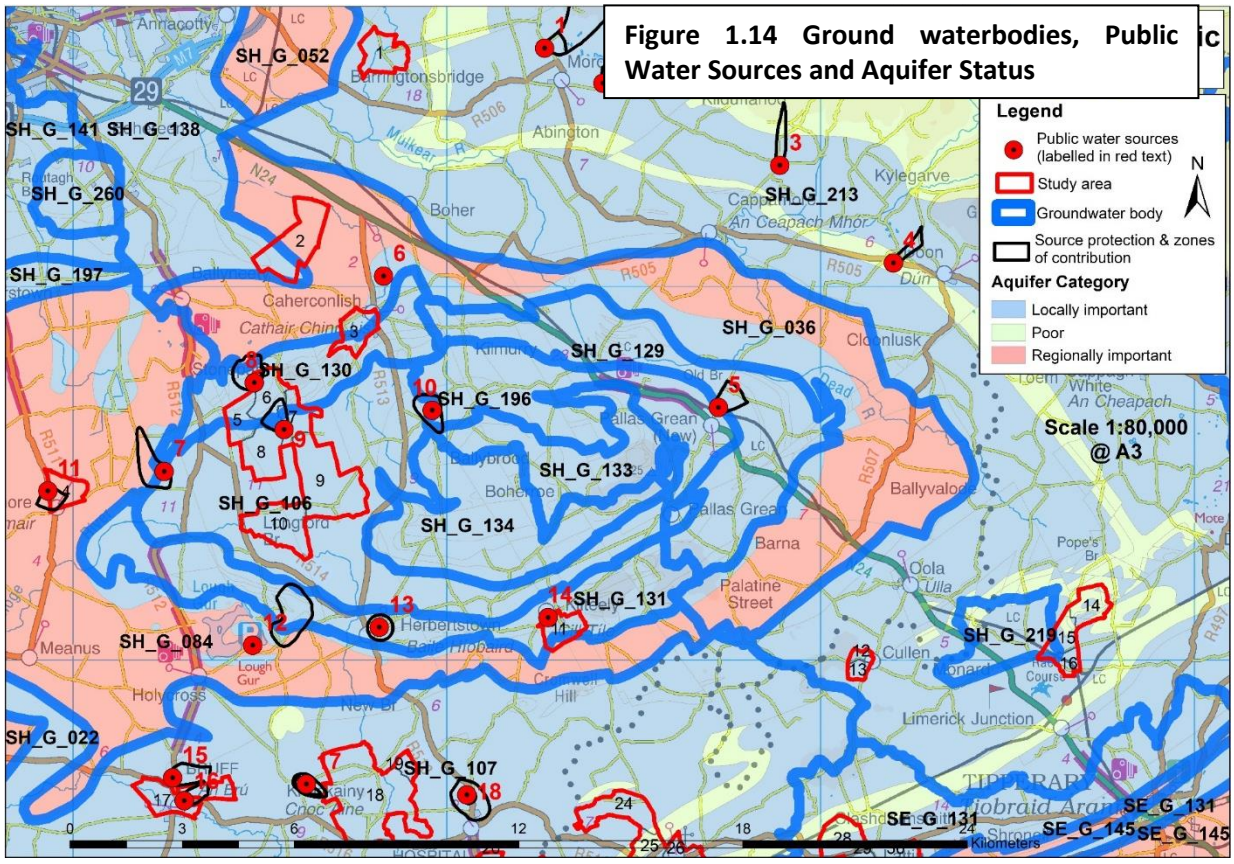


Figure 1.14 Ground waterbodies, Public Water Sources and Aquifer Status

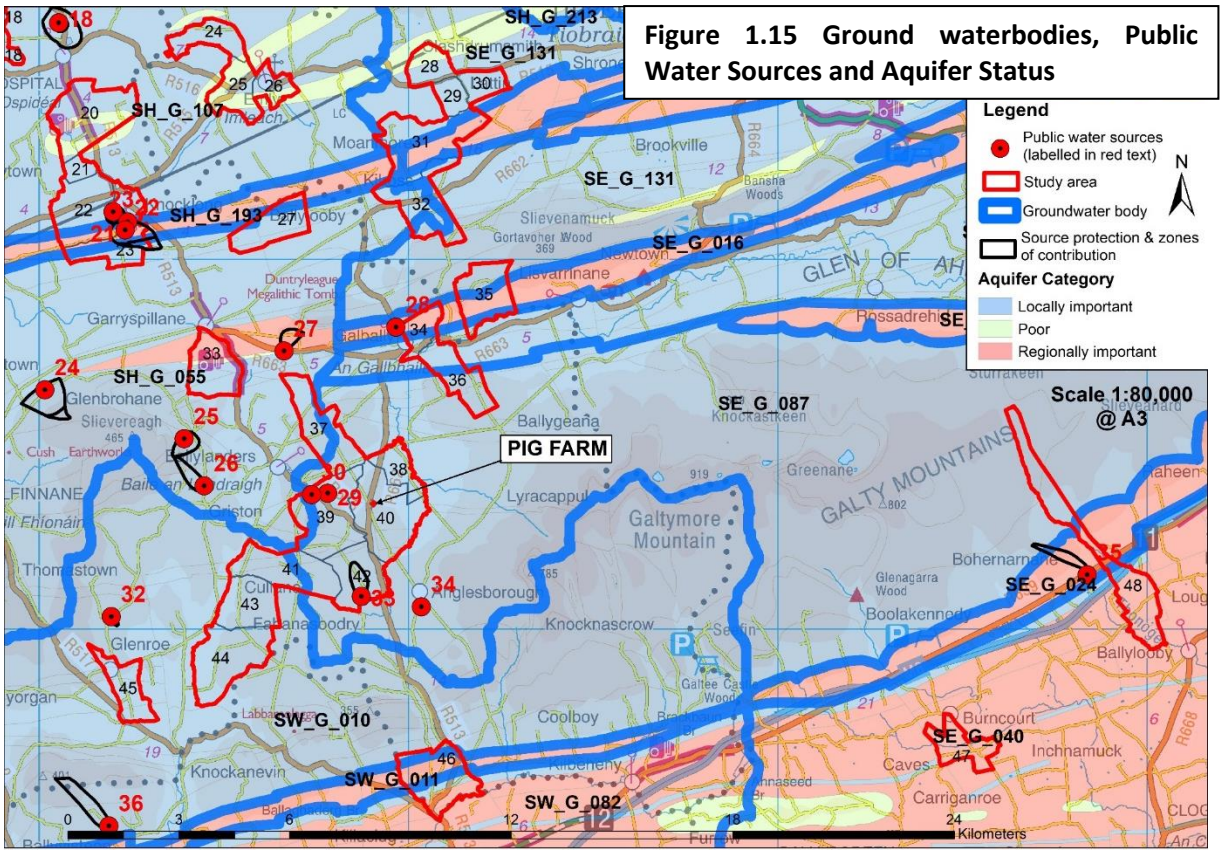


Figure 1.15 Ground waterbodies, Public Water Sources and Aquifer Status

Table 7[2] shows the average water analysis results for 22 out of 36 public water sources in the vicinity of the study area. Ammonium–N (NH_4-N), Coliforms, E.coli Nitrate-N (NO_3-N) and phosphates can indicate contamination of groundwater from agricultural (and other) sources.

Table 7: Summary of Water analysis for Public Groundwater Supplies in the vicinity of the Study Area

	NH_4-N (mg/l)	Coliforms	E.coli	NO_3 (mg/l)	Ortho P (mg/l)
Threshold values	0.3	0	0	37.5	0.03
Average	**0.02**	**8.14**	**3.11**	**15.3**	**0.03**
Maximum	0.03	75	62	24	0.21
Minimum	0.02	0.03	0	2.6	0

Average Ammonium–N levels in the study area are satisfactory and below threshold levels. The presence of Coliform and or E.coli bacteria indicates contamination from agricultural or human excrement. Therefore the threshold for these bacteria is zero. Many of the wells have had one-off spikes in bacterial counts, but generally levels are acceptably low. There is no bacterial contamination at the pig farm well. Nitrate–N levels are generally satisfactory, ranging from 7 to 24 mg / l NO_3 –N and averaging 16.4 mg / l NO_3 –N. There is a weak upward trend in Nitrates in the groundwater bodies in the vicinity of the study area. Ortho – Phosphate levels are generally low with the average increased to threshold levels due to one high Phosphate source in Knocklong (labelled 21, 22 & 23 in Figures 1.14 and 1.15).

[2] Summarised from Table 6.6 of Volume 2 of the EIAR

Overall, the ground water analysis reflects the EPA 'good' status for ground water in the study area.

7.2 Surface water

7.2.1 Receiving surface water environment

River water quality is assessed by taking samples at monitoring points along a river to investigate the presence or absence of macroinvertebrates (tiny animals without backbones e.g. insects, snails and worms). The presence or absence of these macroinvertebrates can be assessed to give a q-rating or value (1/poor – 5/high) at that sampling point – and therefore a q-value for that segment of river body.

The available storm water analysis results (Attachment 7-7-2) indicates that storm water emissions are within the guidelines. The water quality in the vicinity of the pig farm is represented by the Aherlow River quality results downstream from the piggery at *Br SW of Keeloges*. The monitoring results indicate 'good' quality and 'not at risk' status due historic samples being 'good' also.

Table 8: Summary of surface water body quality status & risk categories

Catchment	Number of rivers	2010 – 2015 Status						Risk Category		
		High	Good	Mod	Poor	Bad	Unassigned	Not at risk	Review	At Risk
		Number								
Total for four catchments	**469**	30 (6%)	190 (41%)	84 (18%)	57 (12%)	0	108 (23%)	202 (43%)	93 (20%)	174 (37%)
Within the Study Area (2013-2018 Data)	**30 River Sub-basins**	0	14 (47%)	8 (27%)	5 (17%)	0	3 (10%)	16 (53%)	3 (10%)	11 (37%)

The EPA data for the regional is determined by examining the water quality status for the four main relevant catchments (Shannon Estuary South Catchment (HA24), Munster Blackwater (HA18), Suir Catchment (HA16) and Lower Shannon & Mulkear Catchment (HA25D)) that intersect with the study area. These larger catchments are sub divided into sub-basins - each sub-basin represents one river body catchment. The study area is represented by 30 sub-basins (30 river / stream catchments). Table 3 above compares the study area with the wider regional data.

In general the study area reflects both the quality status and the risk status of the wider region. Therefore the baseline surface water quality is mostly 'Moderate – Good' and is reflective of the wider surface water quality in County Limerick. Of the 30 sub-basins there are 7 river sub-basins where Agriculture is listed as the main pressure (or partial pressure).

When the water quality of the sub-basins is expressed in relation to the individual townlands within the study area the water quality is as follows;

- 29% of townlands contain river sub-basins classed as 'Good'
- 17% of townlands contain river sub-basins classed as 'Moderate'
- 10% of townlands contain river sub-basins classed as 'Poor'

- 29% of townlands contain river sub-basins classed as 'Unassigned'

The 29% unassigned represent a gap in the EPA data. Therefore Ash Ecology and Environmental (AAE) took 30 additional Q samples in 2020 to reduce unassigned data. When this exercise was complete there were 45 Q-monitoring points relevant to the study area, 15 EPA points and 30 AAE points. The results for the 45 monitoring points combined were;

5% - High Quality
40% - Good Quality
42% - Moderate Quality
13% - Poor Quality

Again, the results indicate mostly 'Moderate – Good' quality status in the study area.

7.3 Potential impacts on groundwater and surface water

The potential effects on groundwater include contamination with pig manure nutrients at the site of the pig farm and throughout the study area. Negative effects on groundwater are only likely where there is poor practise in the storage or application of pig manure. Run-off of nutrients from the site (via storm water) or from land-spreading could result in a slight adverse effect on surface water quality before mitigation. Deposition of NH_3 could affect surface waters.

7.4 Mitigation

A suite of standard construction mitigation measures is proposed, including; controlling silt and sediment runoff, re fuelling in a bunded area on-site, avoiding having machinery that leaks oil or fuel on-site, and removing any contaminated soil to a licensed waste facility using a licensed waste contractor. During the operation phase mitigation measures to protect water quality at the site of the pig farm include on-going monitoring of ground and surface waters, bunding all over ground liquid and slurry storage tanks, monitoring installed leak detection facilities underneath slurry tanks, collecting the run-off from concreted pig manure off-take points, slatted pig walk-ways and carrying out a tank and pipeline assessment every 5 years, as per the EPA license requirements, to insure pig manure storage tanks are leak-proof.

During the operation phase measures to protect water quality during land-spreading include adherence to the regulations (SI 605 of 2017). In addition the pig farm will insure that leaking slurry spreading equipment is not allowed on site. There is 50 weeks of slurry storage on site which insures that slurry can be stored long enough to avoid having to spread in unsuitable conditions and at sensitive times (e.g. at the shoulders of the season). The spreading of pig manure is monitored by DAFM to insure compliance with the regulations. The surface (storm) water quality and groundwater quality will be monitored as required by existing EPA license.

7.5 Residual and cumulative impacts

Pig manure has been spread in the study area for 40 years. Overall the baseline **groundwater** water quality in the study area is good. The water quality in public water supplies in Ballylanders, which is the closest the pig farm, has low NH_4-N (0.02mg/l), low NO_3-N (6mg/l) and E.coli = zero. This confirms EPA 'good' status of groundwater in this area. The pig manure replaces chemical fertiliser and therefore with adherence to the regulations there is no significant pre-mitigation

residual impact on baseline ground water quality. The proposed water extraction rate of 48m^3 / day will not significantly affect aquifer where local well yields average 62m^3 / day and the pig farm well can supply 330m^3 / day.

Overall the baseline **surface water quality** is reflective of regional water quality and the operation of the proposed pig farm is not expected to adversely affect the existing water environment. Water quality in the upper Aherlow River is good and the status is not at risk. With the mitigation of adherence to SI 605 of 2017 (as amended), which means that pig manure is used to replace chemical fertiliser, land spreading will not significantly affect the baseline water quality.

The nearest pig farm is located in Inchacoomb 2km south east of the 'Ballyfaskin' site. There are potential cumulative effects on surface waters such as the Aherlow River. However the water quality downstream from both of these piggeries is 'good' and the status is 'not at risk'. Therefore there are no significant **cumulative effects**. There are two EPA licensed pig farms in the Glen of Aherlow, further along the Aherlow River. The baseline water quality in the upper Aherlow is good, indicating that the 'Ballyfaskin' farm will not have an in-combination effect with these two piggeries.

Interactions with Water and Biodiversity, Material Assets and Major Accidents and Natural Disasters have been considered and are not significant.

8.0 AIR

8.1 Receiving Air environment

The rural air quality in for the study area is rated as 'good' by the EPA Air Quality Index for Health (http://www.epa.ie/air/quality/). The sensitive receptors within the study area are agricultural land holdings, rural dwellings, commercial businesses, tourist services, settlements, public water sources, ecosystems (watercourses, rivers, woodlands/forests, clean air, habitats) and cultural heritage assets.

8.2 Predicted emissions to Air

The main gaseous emissions with potential impacts on receptors are; ammonia (NH_3), methane (CH_4), nitrous oxide (N_2O), dust, particulate matter (PM) and malodour. Other gaseous emissions which are released in very small concentrations include Sulphur Dioxide, Hydrogen Sulphide, Carbon Monoxide and Non-Methane Volatile Fatty Acids. Ammonia, methane, nitrous oxide and malodour are emitted from land-spreading and ammonia, methane, nitrous oxide, dust, PM and malodour are emitted from the pig houses.

8.2.1 Ammonia (NH3)

The baseline ammonia deposition levels for the study area is approximately 21[3] kgs / ha / year of NH_3. Most of this is from agricultural sources. Ammonia is emitted from pig houses and land-spreading. With the proposed increase in sow numbers the total NH_3 levels will increase by approx. 6% before mitigation.

[3] Figure 2.3 'N deposition map' in page 6 of EPA Report; Ambient Atmospheric Ammonia in Ireland, 2013-2014. NH_3 = atomic weight 14 for N and 3 for H_3, therefore N makes up 82% of NH_3 => 21 x 0.85 = 17.5kgs N

Table 9: Annual emission figures; NH_3, CH_4 and N_2O for the 600 sow unit and the 1000 sow unit based on AER/PRTR spreadsheet tool

Category of pig	Number	NH_3 (kgs)
600 sows		
Suckling sow & litter	190	893
Dry sow	410	1312
Boars	10	34
Maiden gilts	150	390
Weaners	3450	3450
Fattening pigs	3750	9750
Total =>		**15,829**
1000 sows		
Dry Sows & Suckling sows	1,000	3451
Boars	5	17
Maiden gilts	166	432
Weaners	4000	5357 (*4286)
Fattening pigs	3957	10289 (*8231)
Total =>		**19,545 (*16,415)**
% change		**+ 23% (pre mitigation)**
% change		**+ 4% (*post mitigation)**

Ammonia can have a deleterious effect on human health and the Occupational Safety and Health Administration (OSHA) in the USA (ATSDR, 2004) have an 8 hours exposure concentration limit of 17,000 µg / m^3. The ambient air concentration measurements from the UK at sites near pig and poultry farms were 8.68 µg NH_3 / m^3. Without mitigation, there are no known significant effects on rural residents, businesses, cultural heritage assets or tourist services at these acceptably low levels. There are no significant effects before mitigation on water sources or ecosystems from land-spreading and no sensitive ecosystems are close enough to the pig buildings to be affected.

8.2.2 Methane and Nitrous Oxide

These greenhouse gases are set to increase by 25 - 30% after mitigation (see Section 9 Climate). These emissions are not at levels directly harmful to human health.

8.2.3 Dust and other gaseous emissions

Most of the construction dust will be generated inside the pig houses, and externally, low levels dust emissions may occur where exposed soil is exposed to drying conditions. Generally without mitigation the impact from construction dust will not be significant. During the operational phase the dust generated within pig buildings may contain many types of particles which can be harmful to human health and contribute to malodour emissions. Along with dust particulate matter PM_{10} and $PM_{2.5}$ are sometimes found in emissions from pig buildings. However these are expected to dissipate to harmless levels within a few meters of the ventilation outlets.

Other gaseous emissions such as Sulphur Dioxide, Hydrogen Sulphide, Carbon Monoxide and Non-Methane Volatile Fatty Acids are released in very small concentrations from the surface of slurry. Outside of the pig confinement buildings the concentrations of these gases is miniscule.

8.2.4 Odour

Table 10: Annual odour emission figures for the 600 sow unit and the 1000 sow (based on Table 5 of Odournet UK Report[4])

Category of pig	Number	Odour emissions / animal (o.u.)	Total Odour emissions (o.u.)
600 sows Suckling sow & litter	190	18	3420
Dry sow	410	19	7790
Boars	10	20	200
Maiden gilts	150	20	3000
Weaners	3450	6	20700
Fattening pigs	3750	22.5	84375
Total =>			**119,485**
1000 sows 1000 Suckling sows and dry sows & litter	1000	18.8	18,833
Boars	5	20	100
Maiden gilts	166	20	3320
Weaners	4000	6	32143 (*25714)
Fattening pigs	3957	22.5	89036 (*71229)
Total =>			**143,432** (*119,193)
% change		-	**+ 20% (pre mitigation)**
% change		-	**0% (*post mitigation)**

Malodour substances are released from pig houses and at land-spreading. Odour nuisance from land-spreading is generally related to weather conditions, rates of application and proximity to sensitive receptors. Effects from land-spreading are generally dissipated within a few hours, are temporary and do not result in significant impacts.

The main source of odour at the pig farm is from the finisher pigs (22 odour units per pig) compared to the sows (19 odour units per pig). Therefore as illustrated in Table 10 the proposed development will increase odour units by 20% – before mitigation – above the current licensed emissions.

8.3 Mitigation

To mitigate emissions at land-spreading the pig farm will encourage spreading of pig manure early in the season and where possible will employ contractors who use band spreaders and / or trailing shoes. Through its discussions with customer farmers the pig farm will collaborate with them to

[4] Odour Impacts and Odour Emission Control Measures for Intensive Agriculture

insure that the requirements as specified in SI 605 of 2017 (as amended) are adhered to and setback distances around rural dwellings are also adhered to. Applying pig manure in adherence to the regulations means that chemical nitrogen will be replaced thus off-setting NH_3 and N_2O emissions from chemical fertiliser. The Department of Agriculture, Food and the Marine will monitor records of pig manure exports from pig farms and inspect farmers who use it to ensure that the land spreading of pig manure is in compliance with the Regulations. These records will also be available for inspection by the EPA who monitor operation of this facility.

The low protein diet (2% reduction in protein) will reduce ammonia and odour emissions by 20% from the weaner and finisher pigs. These pigs account for approx. 80% of NH_3 emissions on the farm and therefore the overall reduction is 16% of the before mitigated total. The result is that the 1,000 sow unit will have similar odour emissions to the to 600 sow unit farm; and ammonia will be 0 – 4% higher .

During the operational phase dust in the pig confinement buildings will be mitigated by using an automatic sealed wet feed system, which takes feed from sealed containers (silos) and distributes it via sealed pipes/augers to ad-lib feeders in the rooms, as per pig's natural requirements, reducing the dust levels and thereby also mitigating odour. The feed silos and augers are completely housed in the new mill building, thus confining dust. Pig houses will be adequately ventilated. The health and safety of workers is addressed in the safety statement of the pig farm which includes administrative controls to minimise the amount of time workers are exposed to dust, NH_3 and particulate matter and insures adequate cleaning of pig houses, safety and awareness training and the provision of personal protection equipment i.e. dust masks and eye and ear protection. Training will provide awareness of the dangers associated with agitation of slurry and particularly in relation to hydrogen sulphide and carbon monoxide gases. The ventilation system will efficiently ventilate the pig houses removing harmful concentrations of dust, particulate matter and toxic gases.

The pig farm commits to adhere to the current draft of the '*Code of Good Agricultural Practise for reducing Ammonia Emissions from Agriculture*' *(November 2019)* as published by DAFM (and contained in Appendix 3 of Volume 3).

Table 11: Summary of existing and proposed pre and post mitigation gaseous emission from 'Ballyfaskin Pig Farm'

Gaseous emission	Licenced	Proposed	
		Pre-mitigation	Post-mitigation
NH_3 (tons)	15.8 (100%)	19.5 (123%)	16.4 (104%)
Odour (odour units)	119,485 (100%)	143,428 (120%)	119,196 (100%)
Dust & PM	Not significant	Not significant	Not significant
Other[5]	Not significant	Not significant	Not significant

8.4 Residual and cumulative impacts

The residual impacts from ammonia emissions will not be significant. Odour will reduce significantly due to the proposed mitigation. The adverse effects from other gaseous emissions such as dust,

[5] SO_2, H_2S, CO, Non-methane Volatile Fatty Acids

particulate matter and other toxic slurry gases will be imperceptible outside of the pig houses. With adequate training and personal protection equipment the residual effects within the pig houses is not significant. There are no significant cumulative effects from other pig farms due to separation distance of 2km.

9.0 CLIMATE

Chapter 8 of the EIAR assesses the impacts from the proposed emissions on Climate and Air Quality. Ireland's climate obligations and Nation Policy on Climate Action in relation to carbon dioxide emissions, and Clean Air commitments (relating mainly to ammonia limits) are considered.

9.1 National Commitments

Ireland's Greenhouse Gas (GHG) emission reduction targets are a 20% reduction on 2005 levels for in 2020 and 30% below the 2005 levels by 2030. In order to achieve these binding targets the Government published the 'Climate Action Plan' in June 2019. The 2019 report recognises that there are no zero emissions options for agriculture and sets a target of 10 - 15% reduction in CO_2 emissions for agriculture in page 101 of the plan.

The National Emissions Ceilings (NEC) Directive entered into force on 31/12/2016. In Ireland the national ceiling for ammonia is 116 kilo tons. Under the NEC Directive Ireland has to adopt and implement a '*Code of Good Agricultural Practise for reducing Ammonia Emissions from Agriculture*' – the current EU approved code of practice is available on the DAFM website (a copy of which is contained in Appendix 3 of Volume 3.

9.2 Proposed emissions

The emissions of greenhouse gases (GHG) (methane and nitrous oxide) will increase by approx. 20 -30% above licenced levels for the pig farm. Ammonia emissions will increase by approx. 4%.

Table 12: Summary of existing and proposed pre and post mitigation gaseous emission from 'Ballyfaskin Pig Farm'

Gaseous emission	Licenced	Proposed	
		Pre-mitigation	Post-mitigation
NH_3 (tons)	15.8 (100%)	19.6 (123%)	16.4 (89%)
CH_4 (tons)	95.6 (100%)	124,3 (130%)	124.3 (130%)
N_2O (kgs)	92 (100%)	116 (127%)	116 (127%)

9.3 Mitigation measures

The most recent EPA Report (July 2020): *Ireland's Greenhouse Gas Emissions Projections; 2019 – 2040* predicts that Ireland can and will meet its 2030 commitments by early adoption of a '*with additional measures scenario*' and a reduction of 12% in agricultural GHGs. The pig sector is responsible for approx. 2% of agricultural GHG emissions. Achieving the 12% reduction in agricultural emissions requires a focus on the main sectors responsible for GHG emissions, i.e. beef, dairy and sheep. The additional measures mentioned in Section 3.3 of the July 2020 report in relation to agriculture are;

- *nitrogen use efficiency;* This measure applies mainly to grass based agricultural enterprises and is not relevant to pig farming;
- *use of protected urea products;* This measure applies mainly to grass based agricultural enterprises and is not relevant to pig farming – however pig manure replaces and therefore reduces nitrogen usage;
- *improved animal health;* This is very relevant to the pig farm. As verified by the recent EU 2020 Grand Prix award in relation to Health Management and the use of Slaughter Data Dashboard System to improve Pig Herd Health; this farm complies with the 'improved animal health' measure. Also, genetic improvements in the Irish sow herd since 2011[6] has seen the quantity of pig meat produced per sow has increase by 21% - this genetic improvement also leads to a reduction in greenhouse gases
- *extended grazing;* This measure applies mainly to grass based agricultural enterprises and is not relevant to pig farming;
- *reducing crude protein in pigs:* The pig farm commits to reduce the protein in the growing pig diet by 2%, thus complying with the additional measures targets;
- *low emission slurry spreading;* The pig farm commits to using only contractors who have low emission slurry spreading, where possible and
- *inclusion of clover in pasture swards;* This measure applies mainly to grass based agricultural enterprises and is not relevant to pig farming;

Mitigation measures to reduce GHG emissions during the operational phase involve implementing an Energy Management System and carrying out regular energy audits, turning off machinery and motors when not in use, using thermostatic controls on all heating and lighting systems, using automatic controls on the ventilation system to insure optimum efficiency, using night rate electricity where possible, using high U-value insulation materials, using low energy equipment and lighting (LED lights) with timers and continued investment in advanced genetics and improved management systems to achieve improvements in feed efficiency with resulting reductions of inputs and emissions.

Good operational practise such as cleanliness and dryness will mitigate impacts from ammonia, dust and particulate matter emissions. Using an automatic wet feed system, which takes feed from sealed containers and distributes through sealed pipes/augers to the feeders in the rooms, reduces the dust and particulate matter levels. The pig farm will commit to adhering to *Code of Good Agricultural Practise for reducing Ammonia Emissions from Agriculture* as published by the Department of Agriculture, Food and the Marine in November 2019.

9.4 Residual and cumulative impacts

Supplying the increasing demand for meat protein with pork produces 4 times less CO_2 emissions compared to beef or lamb – therefore the proposed development is in line with the overall objectives of the national climate plan. The proposed CO_2 emissions represents <0.02% of the total national agricultural GHG emissions and therefore the residual impact is not significant. Furthermore, the most recent EPA greenhouse gas publication (July 2020): *Ireland's Greenhouse Gas Emissions Projections; 2019 – 2040* predicts that Ireland can and will meet its 2030 commitments by early adoption of a '*with additional measures scenario'.* These additional measures focuses on the main GHG emitting sectors (dairy, beef, sheep) which is logical since the pig sector produces on 2% of the national agricultural GHGs. These additional measures

[6] Teagasc National Pig Herd Performance Report 2017

specifically mention low protein diets for the pig sector, adoption of low emission slurry spreading, improved nitrogen use efficiency and improved heard health. The proposed development is compliant with all these measures and therefore in line with policy that will allow Ireland to meet its 2030 GHG commitments.

Beyond 2030 commitments that it is possible to mitigate a further 19% of the annual CO_2 produced using alternative technologies such as solar panel energy, however, these mitigation options will require State incentives before they are viable.

Post mitigation total emissions of NH_3 can be reduced by reducing protein in the diet by a further 1%.

The cumulative Climate impacts of the nearest pig farm at Inchacoomb, which is 2 km south east of the 'Ballyfaskin' site, along with two EPA licensed pig farms in the Glen of Aherlow located 13km from the 'Ballyfaskin Pig Farm' site, are part of the national pig sector which contributes 2% of the national agricultural CO_2 emissions. Therefore cumulative impacts are considered not significant. Cattle GHGs emissions are considered and assessed as part of the baseline and therefore not considered a cumulative effect.

Agriculture contributes less than 1% to national SO_2 emissions, less than 2% carbon monoxide (CO), approx. 41% of the national non-methane volatile organic compounds (NMVOCs) emissions, 32% of the national PM_{10} production and 9% of the national $PM_{2.5}$ production in 2017. The pig sector is responsible for a tiny proportion of the total agricultural sector. Ireland is generally well below EU thresholds for these emissions. The existing air quality is rated as good by the EPA. Therefore residual impacts from these gaseous emissions is not significant.

GHG emissions to air has the potential for significant interactions with Human Population and Human Health and Biodiversity, however, having considered these interactions, there is no significant change in the assessed impacts.

10.0 MATERIAL ASSETS

10.1 Existing material assets

The material assets identified in the vicinity of the study area are roads, public utilities and services (fifteen groundwater sources), 13 settlements, rural dwellings, commercial premises, farms, commercial forestry & woodland, tourism services, national monuments, structures listed on the National Inventory of Architectural Heritage and waste facilities.

The townlands within the study area are linked with a network of 125km of regional roads and approx. 250km of local roads. The study area is linked to Limerick City and Tipperary Town via the N24 and the M8 and N73 into Mitchelstown provide connections from the south. The traffic on the R662 at the pig farm entrance is approx. 923 movements per day. The existing pig farm contributes 14 movements and will increase to 16 during operational phase of the proposed development and an additional 6 movements during the 4 month construction phase.

Public utilities include two overhead transmission lines (110 kV and 220 kV) which cross the study area from the Mitchelstown area to Limerick City. There is a gas pipeline within 150m of the pig farm. There is a small windfarm 3.5km west of the pig farm. There are at least 15 public ground

water sources located within the study area (Figures 1.14 and 1.15). There are waste water treatment facilities in Bruff, Caherconlish, Emly and Knocklong, Hospital, Oola and Limerick junction. There is a range of small business within the 13 settlements and the rural areas in the vicinity of the study area. These include furniture manufacturing businesses in Ballylanders, a metal fabricator between Ballylanders and Spittle and two rurally based bakeries located 1.5km south and 2km south east from the pig farm. The Ballyhoura way passes within 2.2 kms of the pig farm (to the north) and there are guest houses within 2kms to the south.

The study area is rich in architectural and archaeological heritage with one national monument within 100m of the pig farm and 12 bridges within the study area listed on the National Inventory of Architectural Heritage.

Outside the study area there are potential impacts on waste facilities due to construction waste material produced during the construction phase and waste materials produced during the operational phase.

10.2 Potential impacts

The average daily traffic on the R662 road at the pig farm entrance will increase from 923 to 925 due to the proposed development. There will be a temporary increase of 6 movements per day experienced during the construction period which will last 4 months. Regional roads (125 km in total) and local roads (250 km in total) within the study area are in good condition and suitable for both agricultural traffic (tractors and slurry tankers) and heavy goods vehicles and the impact is not significant before mitigation.

The pre-mitigation impact on water material assets is not significant – slight adverse where pig manure is not land-spread according to the relevant regulations.

Impacts on water services, transport/road services, gas lines, power services or nuisance from odour could potentially affect settlements, rural dwellings and businesses. The nearest settlement to the pig farm is Ballylanders, which although outside the study area, is approx. 2.8km north west of the pig farm. At this separation distance there is no impact from the pig houses and the potential pre mitigation impact from land spreading is not significant. There may be positive spin-offs from the capital investment involved in the development. Rural dwellers who share the road network with tractors and slurry tankers may be affected by this traffic. Without mitigation, there will be no significant impact on the road network either during construction or during the operational phase of the proposed development because the site is serviced by a regional road (R662) which has the capacity to accommodate the existing and proposed traffic. Rural dwellers may be affected by odour emissions from the pig farm. Without mitigation there will be no significant effect on the potential to develop private property in the study area as a result of the proposed development. The land around the pig farm is entirely in agricultural use without significant development potential. The proposed development will not involve the demolition of property. There will be no effect on tourist services such guest houses, Ballyhoura Way or the scenic routes on the R513 or R663. The proposed development will have a positive effect on the agricultural material assets through the provision of an organic renewable fertiliser to replace chemical fertiliser. There will be no effect on the forestry, woodlands or cultural heritage sites. The increased quantities of construction waste and operational waste (carcass wastes and sharps & veterinary waste) are considered to be not significant in the context of the capacity of receiving waste facilities to take this waste from the pig farm.

10.3 Mitigation

To mitigate impacts on material assets construction waste materials will be segregated and recycled where possible. Building materials will be secured and covered on site to prevent weather damage. Haul distances will be minimised by selecting locally sourced materials where possible and materials will be ordered in bulk to minimise deliveries and resulting wear and tear on local road network. On site materials will be recycled where possible. Only licensed waste contractors will be used to remove waste and the pig farm will adopt a policy of waste reduction. Sediment control measures will be implemented to protect surface waters. During the operational phase the impacts on material assets will be minimised by using low energy equipment and lighting with automatic controls and timing switches to reduce consumption of energy. Machinery will be turned off when not in use. In relation to the land-spreading and storage of pig manure there will be adherence to regulations Si 605 of 2017 (as amended) to maintain soil nutrient balance and protect water sources. Water usage will be minimised on the pig farm by maintaining water fixtures in good working order and maintaining a low water to feed ratio, thus minimising volume pig manure production and metering the private water supply. Low protein diets and an odour management plan will be implemented to minimise odour impacts.

10.4 Residual and cumulative impacts

The residual impacts are considered to be not significant with standard mitigation measures. Potential cumulative impacts on traffic, air emissions, noise, ground water sources, tourist services and agricultural land from the next nearest pig farm located in Inchacoomb (2km south east of the 'Ballyfaskin' site) are not significant. Cattle organic manures are considered and assessed as part of the baseline and therefore not considered a cumulative effect.

Material assets (particularly generated traffic and construction activity) has the potential for significant interactions with Human Population and Human Health and Cultural Heritage, however, having considered these interactions, there is no significant change in the assessed impacts.

11.0 LANDSCAPE

11.1 Existing landscape

In Section 7.3.4 of the Limerick County Development Plan the landscape around the pig farm is categorised as '*Landscape Area No 2 Ballyhoura / Slieve Reagh'*. The site is located in the lowland component of this landscape area, approx. 1.4km from the eastern boundary with the Galtee Uplands. This area is generally a farmed landscape but a range of hills provides an upland backdrop. The lower reaches of Ballyhoura are pastoral in character but this changes as altitude increases and the vegetation cover changes to commercial forestry interspersed with upland grassland and the remnants of peat bogs. The pig buildings are generally low profile, being less than 5m high, and clustered into a 2.6ha site. The most prominent feature the site is the mill house which is dark green colour and approx. 18m high.

11.2 Predicted impacts

There will be no impact from the construction of the electrical substation which will be approx. 3m high, 22m^2 and hidden behind a tall screening hedge. The refurbishment of the pig houses will not

create a visual impact. Any potential impact arises from the existing pig houses, and in particular the mill. The following are some general views of the existing pig farm. There are no views of the pig farm from the scenic route on the R513

Plate 10: View at main entrance to pig farm on R662

Plate 11: View from Ballyfauskeen Cross Roads looking north along R662 (Site of substation behind tree line)

Plate 12: View from nearest neighbour west of cross roads

Plate 13:View from the east near Curraghkilbran

Plate 14: Views looking north west towards pig farm from near Paradise Hill

Plate 15: Views from farmyard south east of pig farm in Ballyfauskeen

Plate 16: View of the Galtee Mountains from the back of the pig farm site

11.3 Mitigation

There is natural mitigation due to tree lines around the pig farm. The western half of the site is surrounded by dense hedgerows 4+m tall and is also screened by cattle sheds to the west of the site. Similarly hedgerows and tree lines to the north of the site screen the pig buildings. Against these dark green tree lines the dark green colour of the mill effectively mitigates any adverse visual impacts. Tall feed silos can be visually intrusive and containing these within the mill building also reduces visual impact. The design includes native species planting mitigation as specified in the Landscaping Plan in Appendix 8 of Volume 3 of the EIAR. Around the south east boundary of the site there will be screening planting with hedgerow and native and indigenous trees, which will include alder, common birches, common oaks, mountain ash and willow species. Some pines are recommended for screening mill from east and south east views.

11.4 Residual and cumulative impacts

Overall the significance of impact on Landscape is not significant because the landscape has the ability to absorb this development due to natural screening and the dark green colour of the mill. Also, the pig farm does not interfere with views of the Galtees, which are very high sensitivity. The proposed landscaping will further mitigate impacts. Cumulative impacts with a pig farm in Inchaccomb 2km south east of the 'Ballfaskin' site is assessed as not significant.

11.0 CULTURAL HERITAGE

From examination of earlier maps it is apparent that there were at least two farms at the cross roads. None of these buildings are likely to predate the 18th or early 19th century. There are no known monuments within the development area, but there are a considerable number of known sites in the vicinity, the nearest of which is 100m east of the site boundary. The National Inventory of Architectural Heritage has no buildings of interest within 1km radius of the site

The likelihood of material of archaeological interest existing in the footprint of the proposed substation is small, but must be considered. Whilst the development will have no impact on known archaeological monuments, there is the small risk of a significant or profound impact on a currently unknown site (within the small footprint of the new building a prehistoric burial could be fully removed by groundworks).

The proposed **mitigation** is monitoring the removal of topsoil in the footprint of the proposed electricity substation by an experienced field archaeologist.

The desktop assessment indicates that the **residual and cumulative impacts** of the proposed works and earlier works on site is unknown but probably not significant.

12. INTERACTIONS, CUMULATIVE EFFECTS AND TRANSBOUNDARY EFFECTS

All environmental factors are inter-related to some extent, and the relationships can range from tenuous to inextricable.

Table 13 Typical Relationships between the Environmental Topics

Typical Inter-Relationship Matrix – Environmental Elements	Human Population, and Human Health	Biodiversity	Land & Soils	Water	Air	Climate	Material Assets	Landscape, Visual	Cultural Heritage, Archaeology	Risk of Major Accident / Natural Disaster
Human Population and Human Health		N	N	N	N	N	N	N	N	CO
Biodiversity	N		N	N	N	N	N	N	N	N
Land & Soils	O	N		O	O	O	O	N	N	N
Water	CO	O	N		N	N	CO	N	N	CO
Air	CO	CO	N	O		O	N	N	N	N
Climate	CO	CO	N	N	N		N	N	N	N
Material Assets	CO	N	N	N	N	N		N	C	N
Landscape, Visual	O	N	N	N	N	N	N		N	N
Cultural Heritage, Archaeology	N	N	N	N	N	N	N	N		N
Risk of Major accident / disaster	CO	CO	N	CO	N	N	CO	N	N	

Table 13 examines the potential for environmental factor interactions. The information in this table can be summarised as follows;

1. There are potential interactions between *Human Population and Human Health* and *Risk of Major Accident and Natural Disaster* if workers do not adhere to health and safety guidelines;
2. There are potential interactions between *Land and Soils* and *Human Population and Human Health* due to potential leaching of nutrients to groundwater and or run-off of nutrients and pathogens to surface waters;
3. There are potential interactions between *Land and Soils* and *Water* due to due to potential leaching of nutrients to groundwater and run-off of nutrients to surface waters;
4. There are potential interactions between *Land and Soils* and *Air* due to due to emissions at land-spreading and from emissions of malodour, ammonia and nitrous oxide;
5. There are potential interactions between *Land and Soils* and *Climate* due to due to emissions at land-spreading and from the land of methane, ammonia and nitrous oxide;
6. There are potential interactions between *Land and Soils* and *Material Assets* due to potential impacts on private and public water sources, impact on agricultural land nutrient status and impacts due to slurry spreading traffic from the proposed development;
7. There are potential interactions between *Water* and *Human Population and Human Health* due to the potential of the pig farm groundwater and surface water to contaminate other water sources and due to the increased extraction of groundwater;
8. There are potential interactions between *Water* and *Biodiversity* due to the potential of the pig farm groundwater and surface water to adversely impact on aquatic habitats;
9. There are potential interactions between *Water* and *Material Assets* due to the potential of the pig farm groundwater and surface water to contaminate water supplies to residences and businesses;
10. There are potential interactions between *Water* with *Risk of Major Accidents / Natural Disasters* due to the potential for a slurry or fuel spill, a burst tank or contaminated storm water affecting adjoining land or wells;
11. There are potential interactions between *Air* with *Human Population and Human Health* due to the potential for air emissions (including dust and particulate matter) from land spreading and the pig houses affecting human health;
12. There are potential interactions between *Air* with *Biodiversity* due to the potential for ammonia or dust deposition to affect biodiversity and aquatic habitats;
13. There are potential interactions between *Air* with *Water* due to the potential for ammonia or dust deposition to affect water quality;
14. There are potential interactions between *Air* with *Climate* due to the potential for increasing greenhouse gases and other gaseous emissions to atmosphere such as (ammonia, dust, hydrogen sulphide, carbon monoxide, non-methane volatile fatty acids);
15. There are potential interactions between *Climate* with *Human Population and Human Health* due to the potential for increasing greenhouse gases and Global Warming;
16. There are potential interactions between *Climate* with *Biodiversity* due to the potential for increasing greenhouse gases and Global Warming;
17. There are potential Interactions between Material Assets with Human Population and *Human Health* due to the potential for additional construction and operational traffic and noise;
18. There are potential interactions between *Material Assets* with *Cultural Heritage* due to the potential for construction work and land spreading pig manure to damage archaeology;
19. There are potential interactions between *Landscape* with *Human Population and Human Health* due to the potential for spoiling views of local residents;

20. There are potential interactions between *Risk of Major Accidents* / *Natural Disasters* with *Human Population and Human Health* due to the potential impact on health from construction accidents, accidents relating to fumes from slurry, accidents relating to machinery on the pig farm, fires and environmental incidents such as fuel or pig manure spills;
21. There are potential interactions between *Risk of Major Accidents* / *Natural Disasters* with *Biodiversity* due to the potential for contamination of aquatic habitats as a result of a spill of pig manure or fuel on site;
22. There are potential interactions between *Risk of Major Accidents* / *Natural Disasters* with *Water* due to the potential for contamination of water as a result of a spill of pig manure or fuel on site; and
23. There are potential interactions *between Risk of Major Accidents* / *Natural Disasters* with *Material Assets* due to the potential impact on material assets from accidents, fires and environmental incidents such as fuel or pig manure spills.

These interactions have been assessed in the individual chapters of the EIAR and there are no additional impacts or required mitigation as a result of these potential interactions.

Cumulative impacts have been assessed in the individual chapters of the EIAR and there are no additional impacts or required mitigation as a result of the potential cumulative or in-combination impacts from other pig farms in the vicinity of the 'Ballyfaskin' Pig Farm development, such as Inchacoomb Pig Farm (2km south east of the proposed development) and two licensed facilities in the Glen of Aherlow. Within County Limerick pig manure organic Nitrogen (N) is 2 – 3% of the total organic N from all livestock, therefore, there are no significant cumulative/in-combination effects from pig and cattle manure.

Given the location of the proposed pig development and the extent of its zone of influence no transboundary impacts will arise.

13.0 SUMMARY OF RESIDUAL IMPACTS AND ENVIRONMENTAL COMMITMENTS (MITIGATION)

13.1 Human Population and Human Health

Before mitigation there are not significant impacts on farms due to the value of pig manure to the receiving farmers or impact of soil nutrients. Before mitigation there are potential slight adverse impacts on human population and health due to potential impacts on ecosystem services and water supplies from poor land-spreading practices. There is a slight to moderate adverse effect before mitigation on the health of farm operatives due to air emissions and potential spread of pathogens within the pig confinement buildings. There will be an economic benefit to the local and wider economy but these impacts are not significant. After standard mitigation these potential adverse impacts are not significant.

To mitigate potential impacts it is proposed to provide health and safety training to construction workers, to control dust and noise during construction and provide workers with personal protection safety devices. Adjoining landowners will be notified in advance of commencement of construction. During the operational phase there will be adherence to the regulations as set out in Si 605 of 2017 (Nitrates Regulations) which will protect water sources. There is 50 weeks of slurry storage on site which insures that the pig manure can be spread in suitable conditions. Odour and ammonia

emissions will be mitigated by the feeding of low protein diets, a high degree of cleanliness and implementing an odour management plan. The pig farm commits to move towards low emission spreading where possible. A rodent and pest control programme will be implemented. A noise management programme will be implemented at the pig farm. There will be health & safety training for workers to show how to minimise and manage risks to their health, how to prevent exposure to slurry gases and minimise effects from dust and particulate matter.

13.2 Water

There are potential slight adverse impacts on surface waters at the site of the pig farm and in the study area which are not significant after standard mitigation.

To mitigate potential impacts on surface water a suite of standard construction and demolition mitigation measures will be implemented including controlling silt and sediment runoff, re fuelling in a bunded area on site, avoiding having machinery that leaks oil or fuel on site, and removing any contaminated soil (e.g. after an accidental fuels spill) to a licensed waste facility using a licensed waste contractor. All construction wastes will be segregated for re-use or re cycling and land-fill. During the operation phase mitigation measures to protect water quality at the site of the pig farm include on-going monitoring of ground and surface waters, bunding all over ground liquid and slurry storage tanks, monitoring existing leak-proof facilities under concrete tanks, collecting the run-off from concreted pig manure off-take points and pig walk-ways to slurry tanks and carrying out a tank and pipeline assessment every 5 years as per the EPA license requirements to insure pig manure storage tanks are leak-proof. During the operation phase there is a legal framework (SI 605 of 2017 as amended), which governs how pig manure is land-spread, and within this legal framework there are adequate protections to insure that pig manure is applied without adverse environmental effects. The waste water treatment system on site will be regularly inspected as per EPA license requirements to show that it is functioning properly. In addition the pig farm will monitor the slurry spreading equipment entering the site to insure it is not leaking. There will be 50 weeks of slurry storage on site which insures that slurry can be stored long enough to avoid having to spread in unsuitable conditions. The exports of pig manure will be monitored by DAFM to insure compliance.

13.3 Air & Climate

Before mitigation there is a slight to moderate adverse impact on workers due to potential health effects from dust and particulate matter. There is the potential for periodic odours in the vicinity of the pig farm.

To mitigate potential impacts during construction a water tanker will be available to douse exposed soil to control dust emissions. Workers will be equipped with the relevant personal protection equipment at all times (eye and ear protection and dust masks). During the operational phase dust and particulate matter will be mitigated by using an automatic sealed wet feed system. Pig houses will be effectively ventilated. The health and safety of workers is addressed by health and safety training, provision of personal protection equipment and administrative controls to minimise the amount of time workers are exposed to dust, ammonia (NH_3) and particulate matter. There will be adequate cleaning of pig houses. The 2% reduction in the growing pig diets will effectively reduce odour levels and NH_3 emissions.

After mitigation the proposed development at Ballyfauskeen will result in an increase in greenhouse gases of 25-30% compared to the existing pig farm. This represents a negative but not significant impact. However, pork is four times more efficient from a carbon emissions point of view (5 kgs CO_2 eq. / kg) than beef or sheep meat. This has to be considered as an underlying cumulative effect and advantage that pork has from a climate change perspective. Also the pig farm by reducing protein in the diets, improving pig health and genetics and using more low emission slurry spreading is achieving the additional measures outlined in Section 3.3 of the July 2020 EPA Report: *Ireland's Greenhouse Gas Emissions Projections; 2019 – 2040.* This report predicts that Ireland can and will meet its 2030 commitments by early adoption of a '*with additional measures scenario*' and a reduction of 12% in agricultural GHGs, requiring the pig sector to reduce protein and improve health status. Therefore with mitigation the impacts on Climate are not significant.

13.4 Material Assets

Before mitigation there is a positive but not significant impact on farms due to the value of pig manure to the receiving farmers. There is the potential for pre mitigation slight adverse impacts on public water supplies as a result of poor land spreading practices. After standard mitigation this potential adverse effect is not significant.

To mitigate potential impacts on public water supplies there is a suite of standard construction and operational mitigation measures as discussed under the heading 'Water' above

13.5 Landscape

Before mitigation there is a not significant impact on landscape because of the scale of the electrical substation and the screening effect of existing tree lines and buildings.

The impact on Landscape from the existing pig farm is not significant because the landscape has the ability to absorb the existing development due to natural screening, the dark green colour of the mill and the not significant impact on views of the Galtees. The mill mitigates the visual impact of feed silos by containing the silos within this building. There will be native species planting mitigation as specified in the planning drawings around the boundary of the proposed site and along the entrance road to screen visual effects.

13.6 Cultural Heritage

There are no known monuments on or beside the development site, but there is the possibility of early settlement or burial remains on site. The desktop assessment indicates the residual impact is unlikely to be significant, but archaeological monitoring is proposed to mitigate potential effects.

Ammonia Impact Assessment – Integrated Pig Farm at Ballylanders, Limerick

Prepared for:

Ballyfaskin Enterprises Ltd

May 2024

Final

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Glossary

Term	Definition
g/s	gram per second
kg	kilogram
kg/m³	Kilogram per cubic meter
km	kilometre
km/hr	kilometre per hour
m	metre
m/s	metres per second
m^2	square metres
m^3	cubic metres
m^3/s	cubic metres per second
m³/hr	cubic metres per hour
mg	milligram
Z_0	roughness length
$\mu g/m^3$	micrograms per cubic meter

Abbreviations	Definition
AG4	Air Guidance 4
BAT	Best available techniques
EPA	Environmental Protection Agency
EF	Emission factor
EU	European Union

EXECUTIVE SUMMARY

Ballyfaskin Enterprises commissioned Katestone to complete an ammonia impact assessment (AIA) for a pig farm located at Ballylanders, County Limerick (Site). Ballyfaskin Enterprises proposes to:

- Increase pig numbers with the addition of new housing units immediately at the Site.
- Reconfigure the exhausts of existing naturally ventilated sheds at the Site with mechanically ventilated chimney stacks to reduce the impact of emissions exhausted to the atmosphere.

The assessment is required to determine the potential impact of ammonia emissions from the proposed development at the pig farm on ecologically sensitive locations on nearby Natura 2000 sites. The assessment will be submitted as part of an application for an EPA licence review for the pig farm.

The AIA was conducted in accordance with the stepwise assessment procedure described in EPA's Ammonia and Nitrogen Assessment Guidance (EPA, 2021) for intensive agricultural installation (IAI) and recognised techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4).

The stepwise procedure is designed to evaluate IAIs based on risk of adverse impacts due to ammonia emissions. Low risk projects can be evaluated using simple screening procedures (Step 1, Step 2 or Step 3). If an IAI does not meet the evaluation criteria of Step 1, Step 2 or Step 3, a detailed dispersion modelling assessment as described in Step 4, Step5 or Step 6 may be required and presented to EPA to consider the application.

Once an assessment meets the requirements of the evaluation criteria for any of the steps, the applicant does not need to consider the requirements of subsequent steps and an application can be made for EPA's consideration. If an assessment does not meet the evaluation criteria of a step, the applicant must undertake assessment described in subsequent steps to determine if the application can be presented for EPA's consideration.

For the proposed development, the results of Step 1 of EPA's Ammonia and Nitrogen Assessment Guidance indicates background levels of ammonia and nitrogen deposition exceed the critical level for ammonia or the critical load for nitrogen deposition at some locations on nearby Natura 2000 sites. Accordingly, the applicant was required to skip Step 2 and Step 3 and complete a Step 4 assessment. The Step 4 assessment indicated the following:

- The results exceeded the Step 4 evaluation criteria indicating that a cumulative assessment (Step 5 Assessment) would be required for the following locations:
    - The Galtee Mountains SAC (Receptors 1 - 31)
    - The Moanour Mountain SAC (Receptors 38 - 46)
- The results of the assessment were below the Step 4 evaluation criteria at all modelled locations on the River Suir SAC (Receptors 32 - 37) indicating that no further assessment would be required on this SAC.

An assessment was undertaken in accordance with the requirements of Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance. The results of the Step 5 assessment indicated that the cumulative impact of the pig farm with other IAIs was well below the in-combination evaluation criteria defined in Step 5 at all modelled locations.

Final Report Findings

In summary, the results of the assessment under EPA's Ammonia and Nitrogen Assessment Guidance indicate that the proposed pig farm **complies** with the EPA evaluation criteria at all sensitive locations, namely:

- River Suir SAC
- The Galtee Mountains SAC
- The Moanour Mountains SAC.

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by Ballyfaskin Enterprises Limited (Ballyfaskin Enterprises) to complete an assessment of the impact of ammonia and nitrogen on Natura 2000 sites in the vicinity of a pig farm it operates at Ballylanders, County Limerick (Site).

Ballyfaskin Enterprises proposes to:

- Increase pig numbers at the Site.
- Reconfigure the exhausts of naturally ventilated sheds at the Site with mechanically ventilated chimney stacks to reduce the potential impact of emissions of ammonia and nitrogen exhausted to the atmosphere.

The pig farm is operated under an Industrial Emissions License (IEL). EPA issued an Integrated Pollution Prevention and Control (IPPC) licence (Register number P0915-01) for the housing units on 10 June 2013 (EPA, 2013a). The IPPC licence was amended to an IEL, which was issued by EPA to Ballyfaskin Enterprises on 16 December 2013 (EPA, 2013b). Ballyfaskin Enterprises submitted an application for a licence review to EPA in 2022. This ammonia and nitrogen impact assessment will be submitted to EPA as part of that licence review application.

This ammonia and nitrogen impact assessment was undertaken using dispersion modelling techniques. The dispersion modelling has been completed in accordance with the requirements of EPA's Air Dispersion Modelling Guidance Note (AG4). The assessment has also been conducted in accordance with Licence Application guidance issued by EPA titled: Assessment of the impact of ammonia and nitrogen on Natura 2000 sites from intensive agricultural installations (EPA, 2002), which is referred to here as EPA's Ammonia and Nitrogen Assessment Guidance.

2. OVERVIEW OF THE PIG FARM

The pig farm is located approximately 2.2 km east of the village of Ballylanders, Co. Limerick. It is located in an area of complex terrain being close to the lowest point of the valley. The Site is surrounded by elevated terrain, predominantly the Galtee Mountains. There are number of rural residences in the vicinity of the Site. The licence boundary of the Site and its environs are presented in Figure 1. All pig housing units will be located within the licence boundary of the Site.

A Site plan illustrating the layout of the existing housing units is presented in Figure 2.

The housing units will have the following maximum animal holding capacity as part of the licence review application:

- 1,000 sows (725 dry sows and 275 farrowing sows)
- 166 gilts
- 5 boars
- 4,000 weaners
- 3,957 Fattener pigs (Growers and finishers).

A number of the housing units at the Site are naturally ventilated. As part of the proposed development, emissions from all housing units will be captured and ventilated through elevated chimney stacks. This will significantly reduce the potential impact of emissions in the vicinity of the Site.

The following buildings identified in Figure 2 are currently naturally ventilated and will be upgraded with a mechanical ventilation system as part of the proposed development.

- Building 1 (Stack Height of 8 m)
- Building 2 (Stack Height of 8 m)
- Building 3 (Stack Height of 8 m)
- Building 7 (Stack Height of 6.8 m).

Figure 1 **Ballyfaskin pig farm proposed Site boundary (red line) and the surrounding environment**

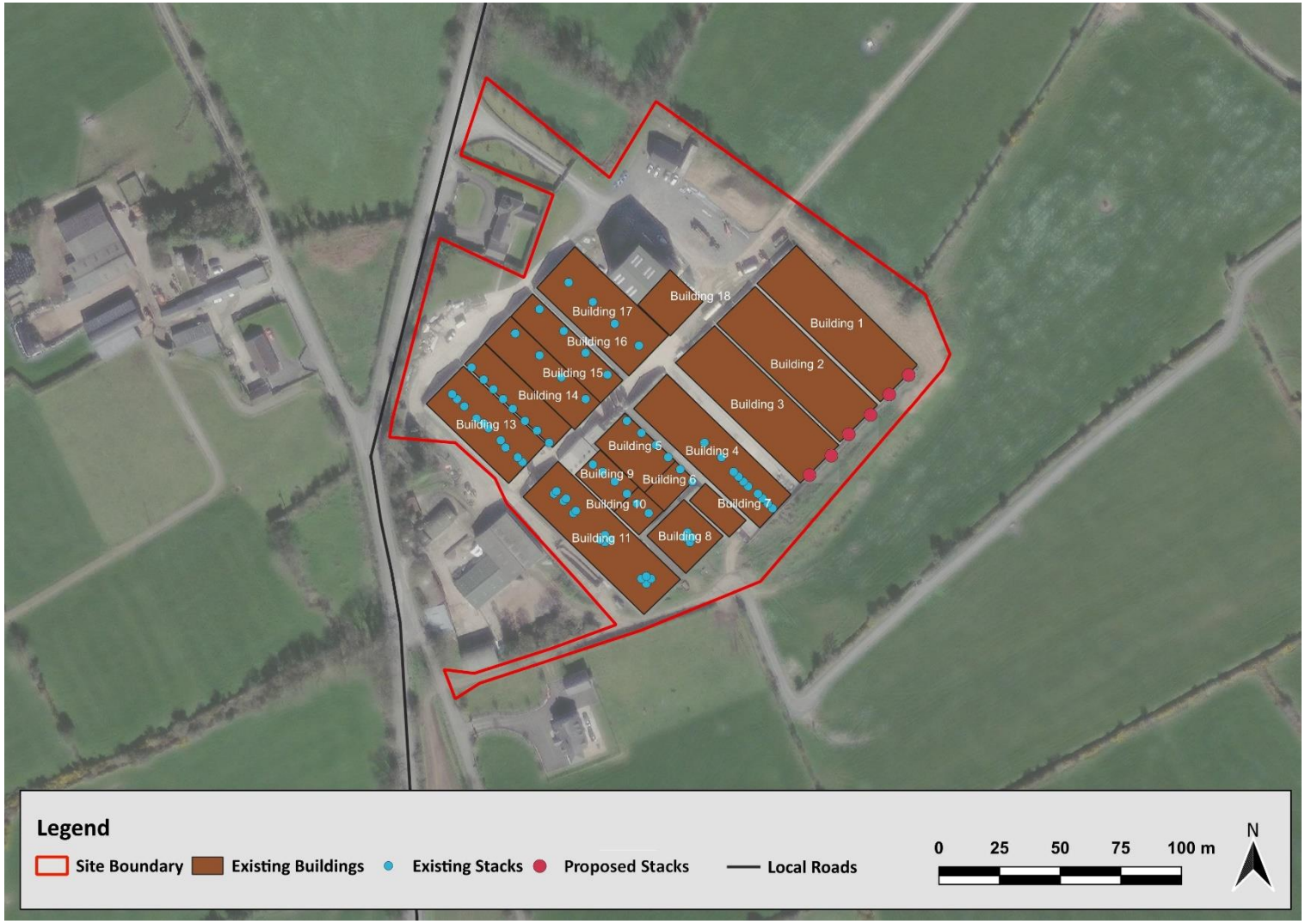

Figure 2 **Ballyfaskin pig farm Site plan – existing and proposed housing units and existing and proposed chimney stacks**

3. REGULATORY FRAMEWORK AND ASSESSMENT CRITERIA

3.1 *Environmental Protection Agency Acts 1992 and 2003*

The *Environmental Protection Agency Act 1992 (EPA Act)* and Part 2 of the *Protection of the Environment Act 2003* are collectively referred to as the *Environmental Protection Agency Acts 1992 and 2003*. These Acts provide for the management of air emissions from activities (meaning any process, development or operation) that are listed in the First Schedule of the Acts.

Section 4 (2) of the *Environmental Protection Agency Acts 1992 and 2003* defines Air Pollution as follows:

> *"…the direct or indirect introduction to an environmental medium, as a result of human activity, of substances, heat or noise which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment, and includes –*
>
> *(a) 'air pollution' for the purposes of the Air Pollution Act 1987,*
>
> *(b) ……..*
>
> *(c) ……..."*

The *Air Pollution Act 1987* (AP Act) provides for the control of air pollution and other matters connected with air pollution. Under the AP Act 'pollutant' means any substance that is specified in the First Schedule or any other substance (including a substance which gives rise to odour) or energy which, when emitted into the atmosphere either by itself or in combination with any other substance, may cause air pollution.

Section 4 of the AP Act defines air pollution as follows:

> *"Air pollution" in this Act means a condition of the atmosphere in which a pollutant is present in such a quantity as to be liable to —*
>
> (1) *be injurious to public health, or*
>
> *(ii) have a deleterious effect on flora or fauna or damage property, or*
>
> *(iii) impair or interfere with amenities or with the environment."*

Section 24 of the AP Act details the obligations of the occupier of a premises in respect to preventing emissions, nuisance and what constitutes defences against prosecution:

> *(1) The occupier of any premises, other than a private dwelling, shall use the best practicable means to limit and, if possible, to prevent an emission from such premises.*
>
> *(2) The occupier of any premises shall not cause or permit an emission from such premises in such a quantity, or in such a manner, as to be a nuisance.*
>
> *(3) In any prosecution for a contravention of this section, it shall be a good defence to establish that—*
>
> *(a) the best practicable means have been used to prevent or limit the emission concerned, or*
>
> *(b) the emission concerned was in accordance with a licence under this Act, or*
>
> *(c) the emission concerned was in accordance with an emission limit value, or*
>
> *(d) the emission concerned was in accordance with a special control area order in operation in relation to the area concerned, or*

I in the case of an emission of smoke, the emission concerned was in accordance with regulations under section 25, or

(f) the emission did not cause air pollution.

Section 75 (1) of the *Environmental Protection Agency Acts 1992 and 2003* requires the EPA to publish reasonable and desirable quality objectives to protect the environment, namely:

"The Agency shall, in relation to any environmental medium and without prejudice to its functions under section 103, specify and publish quality objectives which the Agency considers reasonable and desirable for the purposes of environmental protection."

3.2 Birds Directive and Habitats Directive

Concerned with the decline of wild bird species, EU Member States unanimously adopted the Birds Directive (79/409/EEC) in April 1979 that aims to conserve species of wild birds and the habitats that are crucial for their conservation. The Birds Directive was amended in 2009 (2009/147/EC).

The Habitats Directive (92/43/EEC) aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas.

The Habitats Directive requires EU Member States to take measures to maintain or restore natural habitats and wildlife species at a favourable conservation status. Sites designated under the Birds Directive and the Habitats Directive form the Natura 2000 network. Maintaining or restoring the Natura 2000 network is an obligation that must be considered concurrently with requirements for increased food production and economic growth targets set for agricultural sectors in EU Member States.

The main aim of the Habitats Directive is to contribute towards the conservation of biodiversity by requiring EU Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status. These annexes list habitats (Annex I) and species (Annexes II, IV and V) that are considered threatened in the EU territory. The listed habitats and species represent a considerable proportion of biodiversity in Ireland and the Habitats Directive itself is one of the most important pieces of legislation governing the conservation of biodiversity in Europe.

The protection and conservation duties of EU Member States for Natura 2000 sites are specified in Article 6 of the Habitats Directive and are summarised below:

- Article 6(1): establish necessary conservation measures, management plans and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitats and species present at the sites
- Article 6(2): take appropriate steps to avoid deterioration of Natura 2000 sites
- Article 6(3) and 6(4): assess the impact of new plans and projects and only agree to the plan or project if it will not adversely affect the integrity of the site unless the plan or project is imperative for reasons of overriding public interest.

The European Communities (Birds and Natural Habitats) Regulations 2011 to 2015, as amended (Birds and Natural Habitats Regulations) give effect to the Habitats Directive in Irish law. The regulations require, inter alia, that a public authority carry out screening for Appropriate Assessment of a plan or project for which an application for consent is received, to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the European site. Where it is determined that an Appropriate Assessment is required, the Birds and Natural Habitats Regulations require that the assessment carried out by a public authority include a determination

pursuant to Article 6(3) of the Habitats Directive as to whether or not the plan or project would adversely affect the integrity of a European site.

3.3 Ammonia impact assessment – Guidance

In May 2021, due to a high volume of intensive agriculture applications/reviews and licenses, the Environmental Protection Agency (EPA) published EPA's Ammonia and Nitrogen Assessment Guidance. It describes how applicants should assess, the impact of air emissions, as part of a licence application for the following activities listed under the First Schedule of the Environmental Protection Agency Acts 1992 as amended:

- Class 6.1 (the rearing of poultry in an installation, where the capacity exceeds 40,000 places)
- Class 6.2 (the rearing of pigs in an installation where the capacity exceeds – (a) 750 places for sows, or. (b) 2,000 places for production pigs).

EPA's guidance was revised in 2023 (EPA, 2023)

EPA's Ammonia and Nitrogen Assessment Guidance describes a six-step process for the assessment of emissions of ammonia to the atmosphere from intensive agricultural installations (IAIs). Step 1 needs to be completed for all applications to inform the additional steps that need to be completed.

Compliance with the criteria defined in the subsequent steps means that no further steps need to be undertaken and the compliant results can be presented to EPA for review as part of the approvals process.

EPA's Ammonia and Nitrogen Assessment Guidance provides instructions on the steps needed to determine the information required to allow for an AA Stage 1 screening process and where necessary, a Stage 2 AA assessment for Natura 2000 sites (EPA, 2023). The six (6) steps are described in detail and in graphical summary format in EPA's Ammonia and Nitrogen Assessment Guidance.

The graphical summary format of the step-wise approach is reproduced here in Figure 3. Katestone followed the step-wise approach described in EPA's Ammonia and Nitrogen Assessment Guidance in this assessment. The methodology adopted to complete this assessment is described in Section 6.

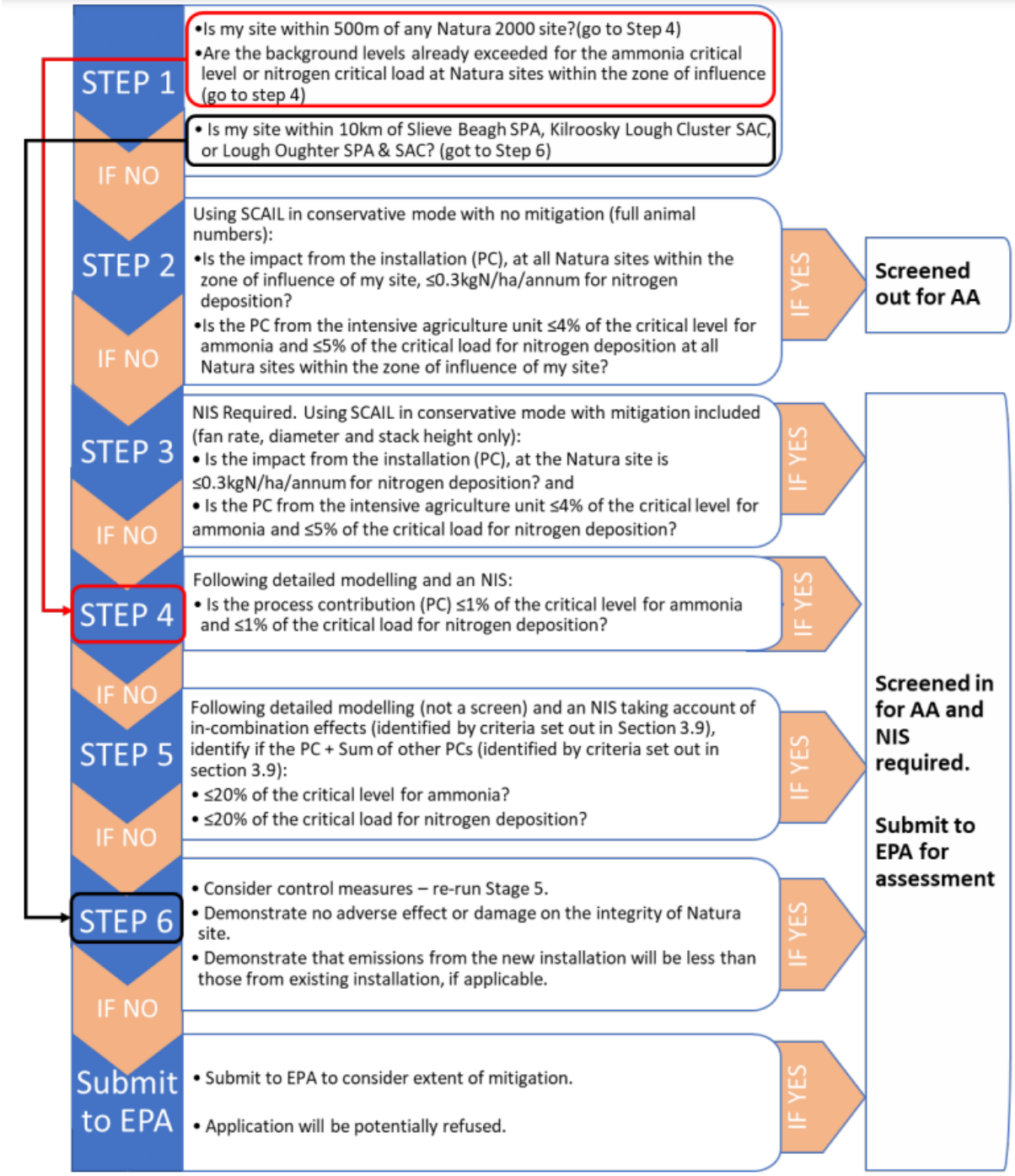

Figure 3 **The steps involved in the assessment process described in EPA's Ammonia and Nitrogen Assessment Guidance (reproduced from EPA, 2023)**

3.4 Assessment Criteria

The compliance criteria adopted in the assessment are based on critical limits. A critical limit, in its simplest form, is a threshold set to indicate when impacts on the terrestrial environment occur from air pollution. These can be used as part of the regulatory process for the assessment of impacts of air quality on terrestrial ecology (Kelleghan *et al.*, 2022). The EPA's Ammonia and Nitrogen Assessment Guidance adopts criteria based on critical limits including:

- Critical levels for ammonia
- Empirical critical loads for nitrogen deposition.

Both critical levels and loads are international guidelines used to protect habitats, primarily across Europe. Critical levels here, refer specifically to the threshold for impacts that can occur directly from atmospheric ammonia, allowing for an acute measurement of direct effects. Critical levels are defined as "the concentration in the atmosphere above which direct adverse effects on receptors, such as plants, ecosystems or materials, may occur according to present knowledge" (Posthumus, 1988; Kelleghan *et al.*, 2022).

Empirical critical loads are based on total nitrogen deposition. A critical load is defined as a deposition rate below which, significant harmful effects do not occur "according to present knowledge" (Posthumus, 1988).

The critical level for ammonia and the critical load for nitrogen deposition for each of the species and habitat are presented in Section 4.4 for the modelled discrete receptors.

4. EXISTING ENVIRONMENT

This section presents information on the existing environment in the vicinity of the Site, within the dispersion modelling domain and within the meteorological modelling domain. The meteorological modelling domain has been generated using geophysical data (terrain and land use) and meteorological data.

The extents of the dispersion modelling domain were determined based on the locations of the nearest ecological receptors in all directions from the Site.

4.1 Local terrain and land-use

The Site is in a remote rural location surrounded by pasture. There is a small amount of forestry located between the pig farm and the village of Ballylanders approximately 700 m west of the pig farm.

The pig farm is located in an area of complex terrain that will have significant effects on the meteorological patterns in the vicinity of the of the Site. The location of the Site in a valley and proximity to numerous hills and mountain ranges around the Site will result in unique weather patterns.

The pig farm is located in a valley at an elevation of approximately 170 m. The valley is bound by a number of mountains and hills including:

- The Galtee Mountains that rise to almost 800 m, 6 km east of the pig farm
- The Moanour Mountain that rises to approximately 370 m, 7.8 km northeast of the pig farm
- The Slievereagh Mountains that rise to 465 m, 6.7 km northwest of the pig farm
- Fear Breagach Mountains that rises to 362 m, 8.7 km northwest of the pig farm
- The Ballyhoura Mountains that rise to 528 m 13 km southwest of the pig farm
- Elevated land that runs west to east between the Ballyhoura Mountains and the Galtee Mountains south of the pig farm.

The terrain of the modelling domain is presented as:

- A 2-dimenstional surface plot in in Figure 4
- A 3-dimenstional surface plot in in Figure 5.

The mountains and hills of the modelling domain will affect synoptic scale wind patterns in the area by:

- Blocking wind coming from certain directions
- Channelling winds along the valleys created by the hills and mountains
- Creating very specific local air flows under low windspeed conditions due to katabatic and anabatic air flows created by the slopes of the complex terrain.

The predominant valley in which the pig farm is located is created by the Ballyhoura Mountains and Galtee Mountains, which result in a north-south oriented valley.

The proximity of the Site to local terrain and multiple water bodies is likely to have an important effect on dispersion conditions near the Site and across the modelling domain.

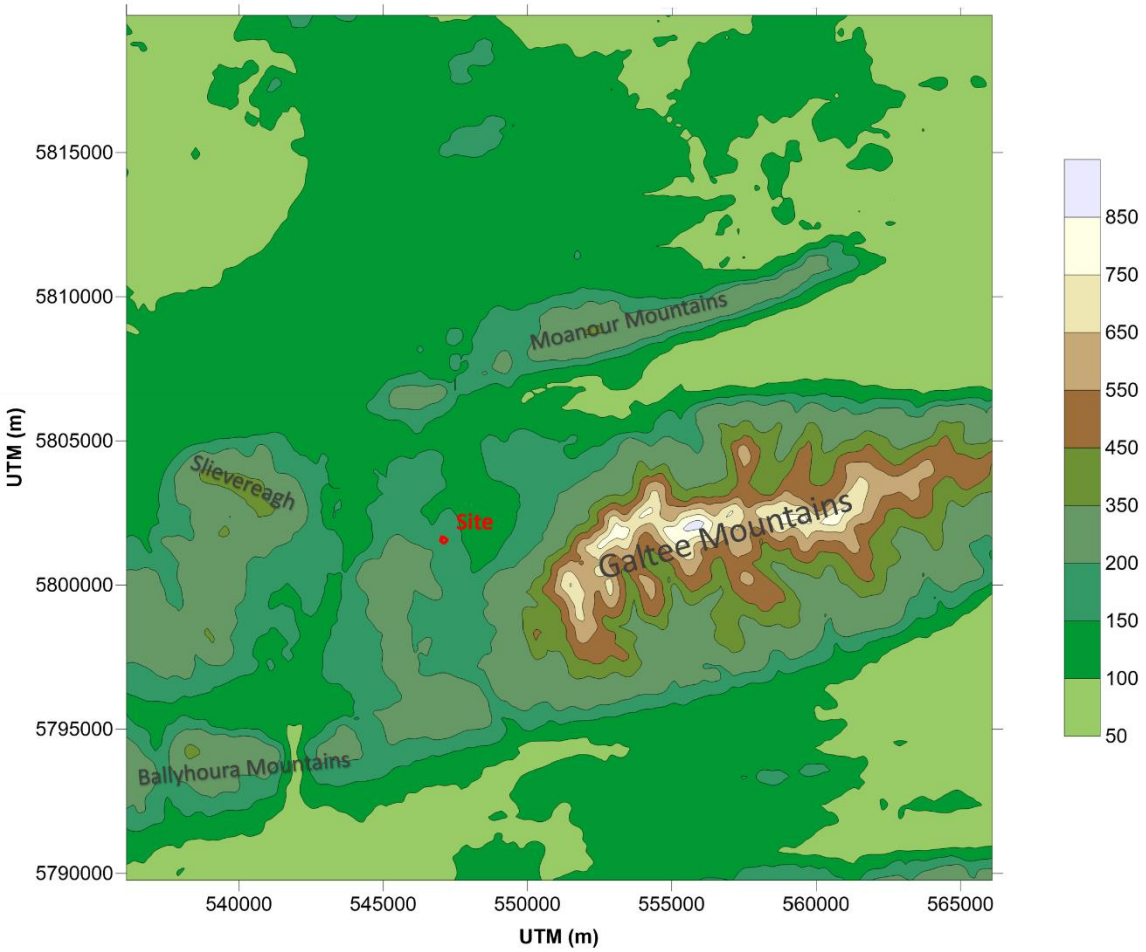

Figure 4 **2-dimensional terrain of the modelled domain**

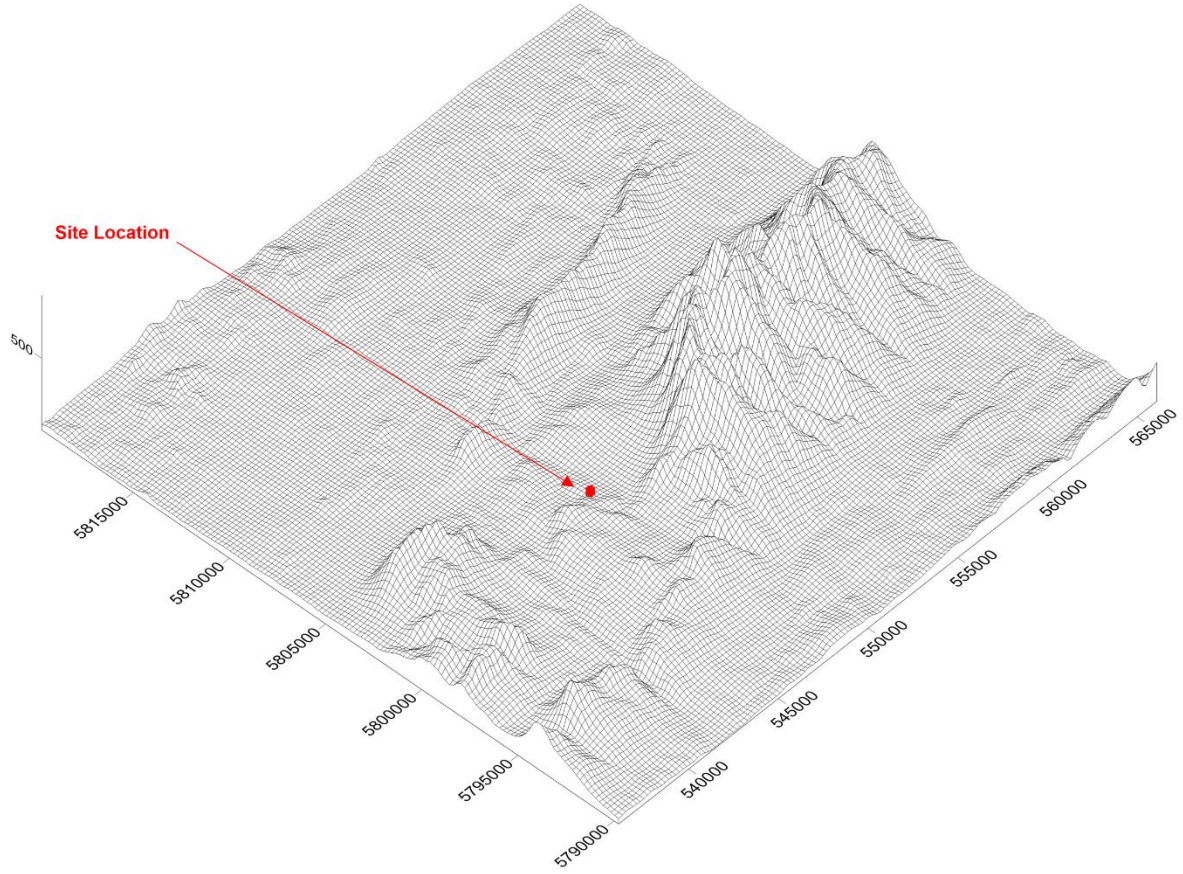

Figure 5 3-dimensional terrain of the modelled domain

4.2 Meteorology

Wind speed and wind direction are important parameters for the transport and dispersion of air pollutants from a source. The winds in the vicinity of the Site have been characterised using a three-dimensional meteorological model called CALMET. The 1-hour average wind speed for the modelling period is 4.33 m/s. This compares to a 1-hour average wind speed of 3.0 m/s at Moore Park between 2011 and 2018 and 4.3 m/s at Gurteen between 2008 and 2018 (EPA, 2020). A wind rose representing the annual distribution of 1-hour average winds is presented in Figure 6.

The prevailing wind direction in Ireland is between south and west. It is clear from Figure 6 that these winds influence wind patterns at the Site; however, due to the elevated terrain the modelling indicates that the south-westerly winds are channelled in a predominant southerly direction at the Site. Daytime winds between 6 am and 6 pm are heavily influenced by the prevailing winds and channelling due to local terrain. During late evening and early morning, prevailing winds also dominate; however, there is also a substantial proportion of winds from the northwest as indicated in the diurnal wind roses (Figure 7).

The seasonal distribution of wind speed and wind direction is presented in Figure 8. The strongest winds at the Site occur most frequently from the south during the winter months. The greatest proportion of light winds occur during summer. There is a distinct north-westerly component to the wind rose in all seasons. A significant proportion of light north-westerly winds occur during spring months.

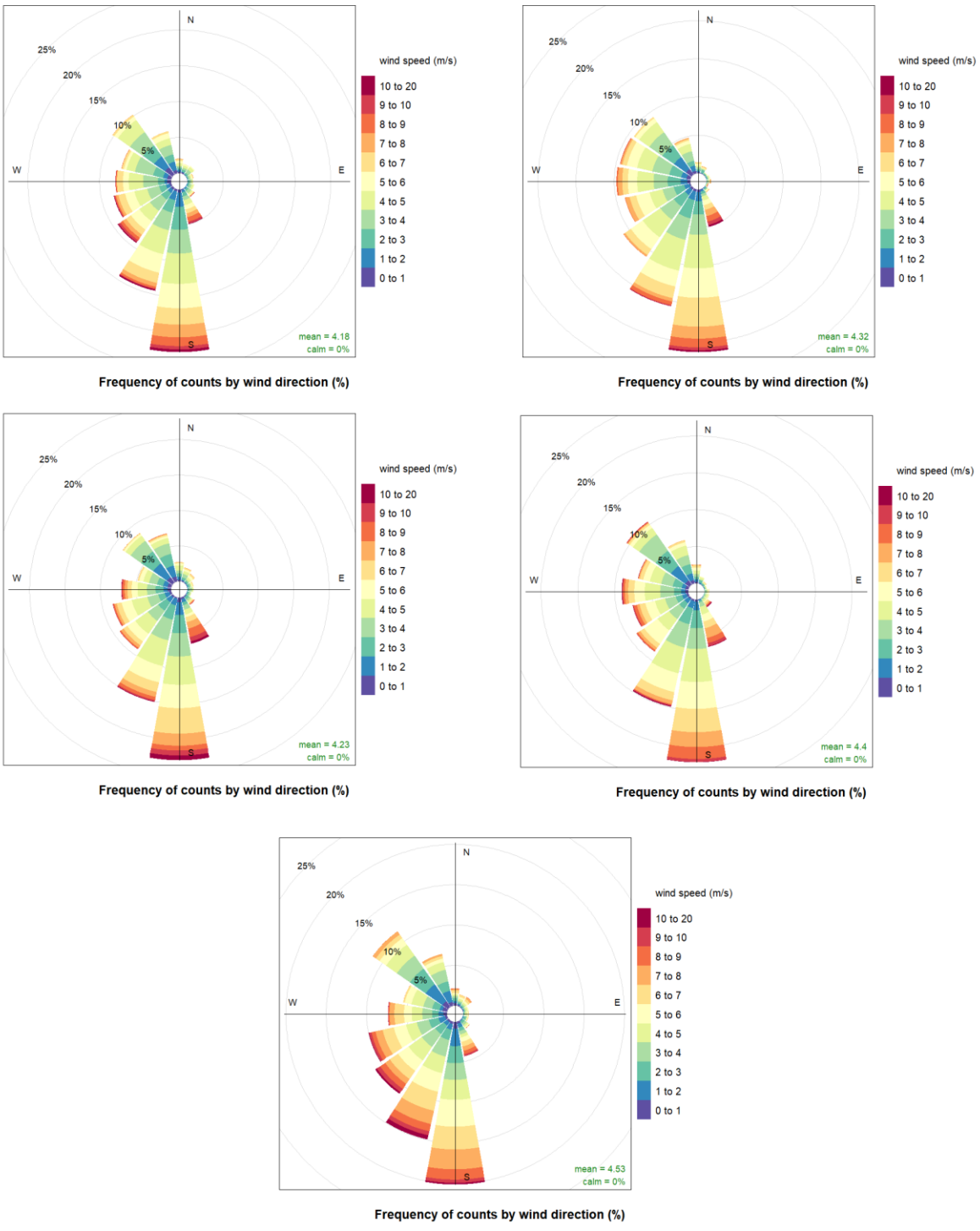

Figure 6 **Annual wind distribution predicted at the Site using CALMET for 2016 (top-left), 2017 (top-right), 2018 (mid-left), 2019 (mid-right) and 2020 (bottom)**

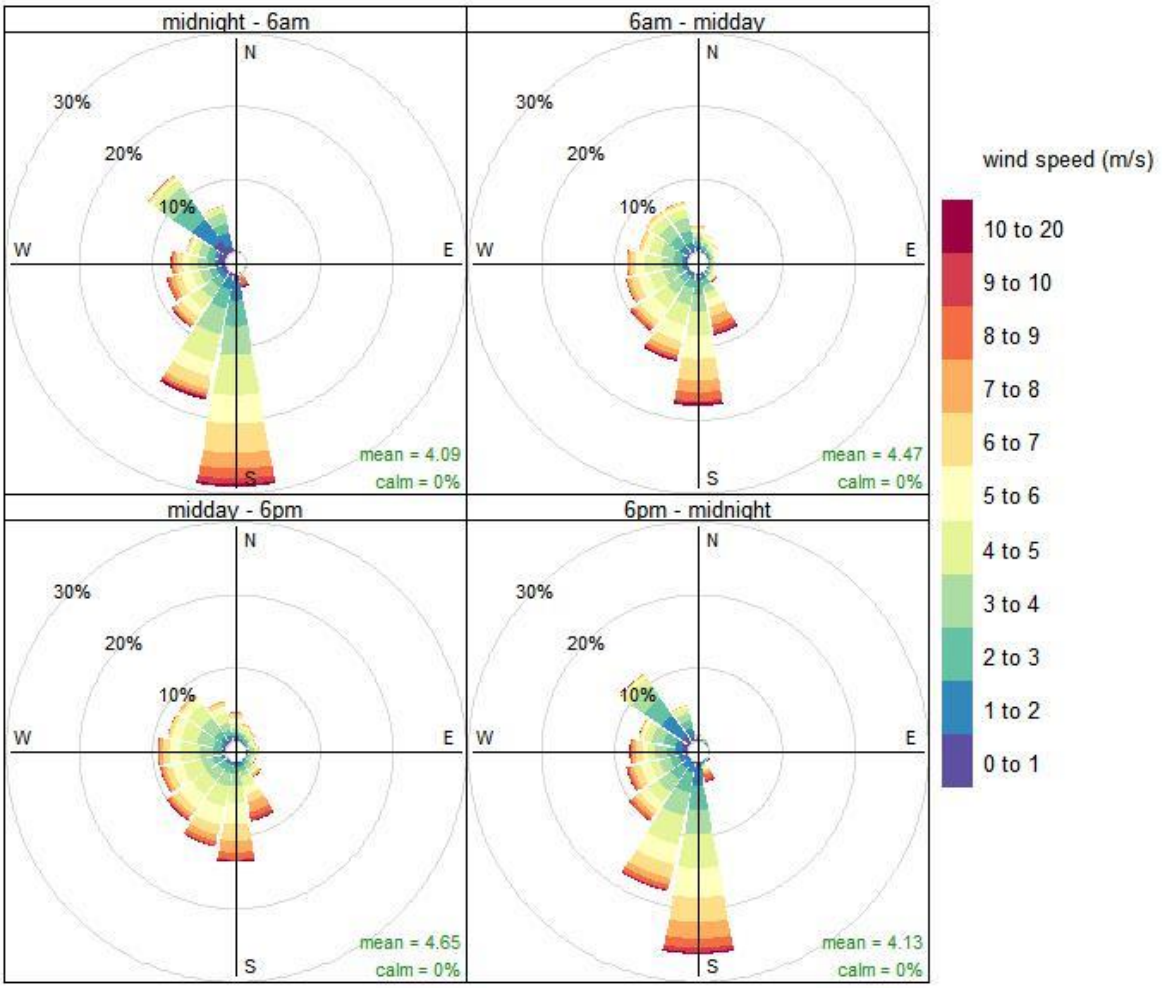

Figure 7 Diurnal wind distribution predicted at the Site using CALMET

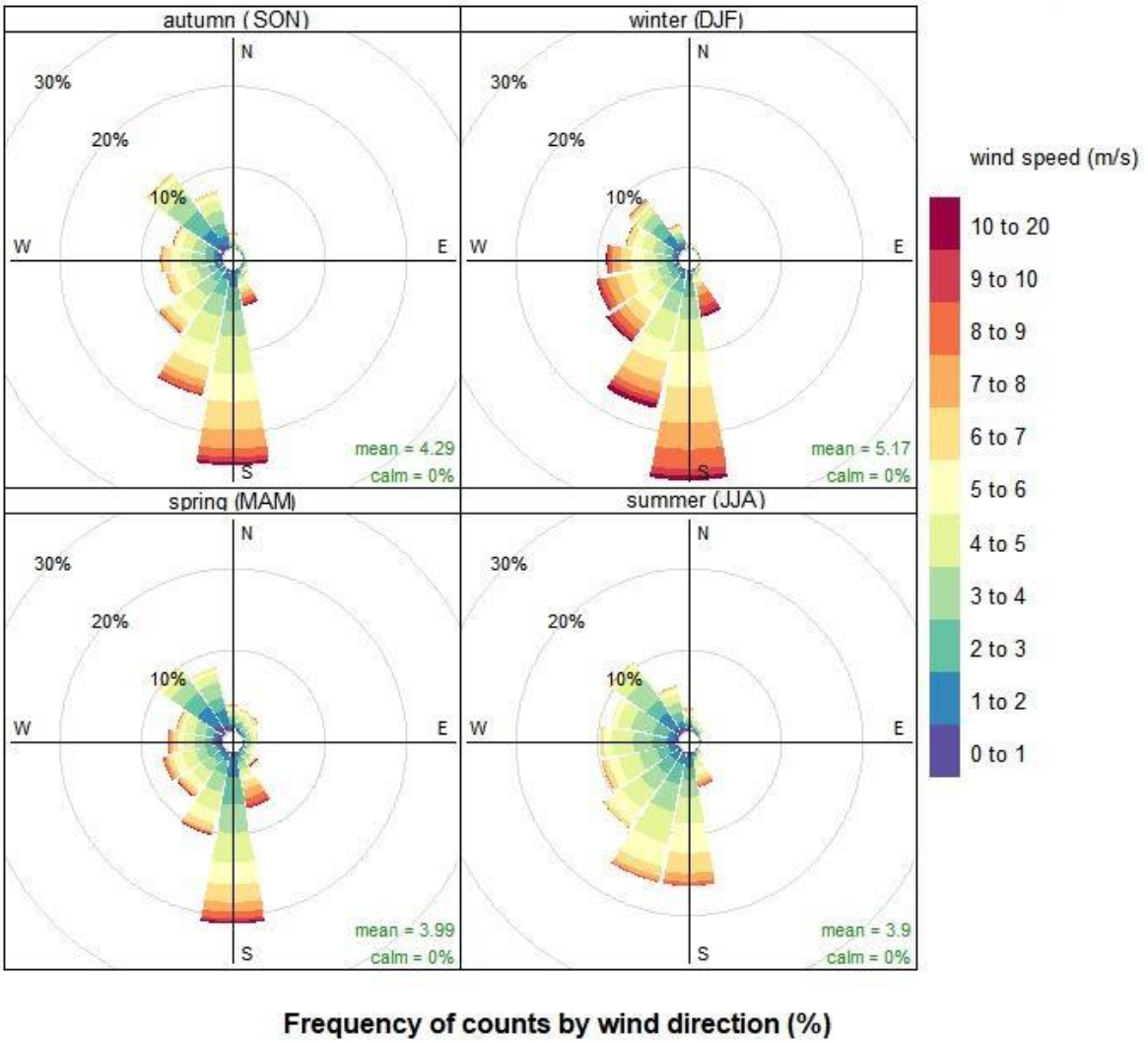

Figure 8 Seasonal wind distribution predicted at the Site using CALMET

4.3 Background concentrations of ammonia and nitrogen deposition

The background ammonia concentration and nitrogen deposition flux rates at each modelled sensitive receptor were obtained from the Simple Calculation of Atmospheric Impacts Limits (SCAIL) online tool as recommended in EPA's Ammonia and Nitrogen Assessment Guidance (EPA, 2021). The background concentrations of ammonia and nitrogen deposition levels adopted in the assessment are presented in Table 1.

Background ammonia concentration and nitrogen deposition flux rates adopted in the assessment were included in the assessment methodology defined in EPA's Ammonia and Nitrogen Assessment Guidance.

Table 1 The background concentrations of ammonia and nitrogen deposition levels adopted in the assessment (based on SCAIL)

Receptor	SCAIL Background	
	Concentration of ammonia (µg/m³)	Nitrogen Deposition Flux (kg/ha/yr)
DR1	1.87	8.78
DR2	1.75	8.7
DR3	1.75	8.7
DR4	1.75	8.7
DR5	1.67	8.64
DR6	1.74	8.02
DR7	1.74	8.02
DR8	1.74	8.02
DR9	1.74	8.02
DR10	1.74	8.02
DR11	1.98	7.84
DR12	1.98	7.84
DR13	1.98	7.84
DR14	1.68	8.73
DR15	1.98	7.84
DR16	1.98	7.84
DR17	2.28	7.56
DR18	1.9	7.97
DR19	1.9	7.97
DR20	2.22	7.51
DR21	1.9	7.97
DR22	2.22	7.51
DR23	1.7	8.8
DR24	1.91	7.78
DR25	2.28	7.58
DR26	1.8	8.06
DR27	2.1	7.51
DR28	2.54	7.63
DR29	2.1	7.62
DR30	2.1	7.61
DR31	2.37	7.6
DR32	2.37	7.59
DR33	2.63	7.51
DR34	2.63	7.51
DR35	2.63	7.51
DR36	2.48	7.09
DR37	2.61	7.26

Receptor	SCAIL Background	
	Concentration of ammonia (µg/m³)	Nitrogen Deposition Flux (kg/ha/yr)
DR38	2.52	7.42
DR39	2.52	7.42
DR40	2.52	7.42
DR41	2.31	7.42
DR42	2.31	7.42
DR43	2.31	7.42
DR44	2.31	7.42
DR45	2.31	7.42
DR46	2.31	7.42

4.4 Sensitive receptors

The sensitive receptors that are nearest to the Site are presented in Figure 9. The sensitive receptors included in the dispersion modelling assessment are at locations on Natura 2000 sites in the vicinity of the pig farm. EPA's Ammonia and Nitrogen Assessment Guidance required Natura 2000 sites within 10 km of an intensive agricultural installation to be included in a screening assessment. The Natura 2000 sites within 10 km of the pig farm that were considered in this assessment include:

- The Galtee Mountains SAC (00646)
- The Lower River Suir SAC (002137)
- The Moanour Mountains SAC (002257).

Approximately 40% of the Galtee Mountains SAC is within 10 km of the pig farm. A very small portion of the River Suir SAC is within 10 km of the pig farm. The entire Moanour Mountains SAC is within 10 km of the pig farm.

The Galtee Mountains SAC and the Moanour Mountains SAC that are within 10 km of the pig farm contain a range of ammonia and nitrogen sensitive species and habitats that are listed as conservation interests for these sites. The portion of the River Suir SAC within 10 km of the pig farm is a stretch of the Aherlow River (a tributary of the River Suir) that is less than 1 km in length. This stretch of the Aherlow River flows through agricultural land. A review of the conservation objectives published by NPWS for this portion of the River Suir SAC indicate that there are no ammonia and nitrogen sensitive species or habitats identified along the stretch of the Aherlow River within 10 km of the pig farm (NPWS, 2017).

The site-specific conservation objectives of a Natura 2000 site aim to define favourable conservation condition for particular habitats or species at that Natura 2000 site.

The habitats and species listed as conservation objectives at the Natura 2000 within 10 km of the pig farm and with sensitivity to atmospheric ammonia and nitrogen deposition include:

- Northern Atlantic wet heaths with Erica tetralix [4010] (Wet Heath)
- European dry heaths [4030] (European Dry Heath)
- Alpine and Boreal heaths [4060] (Alpine and Subalpine Heaths)
- Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe) [6230] (Species-rich Nardus Grassland)
- Blanket bogs (* if active bog) [7130] (Blanket Bogs (If Active))

- Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani) [8110] (Siliceous Scree)
- Calcareous rocky slopes with chasmophytic vegetation [8210] (Calcareous Rocky Slopes)
- Siliceous rocky slopes with chasmophytic vegetation [8220] (Siliceous Rocky Slopes).

These habitats are located as conservation objectives at the Natura 2000 sites as follows:

- The Galtee Mountains SAC (NPWS, 2017).
    - Wet heath
    - European dry heaths
    - Alpine and Subalpine Heaths
    - Blanket Bogs (* if active)
    - Siliceous Scree
    - Calcareous Rocky Slopes
    - Siliceous Rocky Slopes.
- The Moanour Mountains SAC (NPWS, 2019)
    - Wet heath
    - European dry heaths.

The Lower River Suir SAC includes areas of habitats and species with sensitivity to atmospheric ammonia and nitrogen deposition. However, none of the mapped areas of these habitats and species on the River Suir SAC are within 10 km of the pig farm (NPWS, 2017).

The critical level for ammonia and the critical load for nitrogen deposition for each of the species and habitat is presented in Table 2.

Table 2 The critical level for ammonia and the critical load for nitrogen deposition for each of the species and habitat within 10 km of the pig farm

Habitat or Species	Critical Level	Critical Load
	µg/m³	kg/ha/year
Wet heath	1.0	10
European dry heaths	1.0	10
Alpine and Subalpine Heaths	1.0	5
Blanket Bogs (* if active)	1.0	5
Siliceous Scree	1.0	5
Calcareous Rocky Slopes	1.0	5
Siliceous Rocky Slopes	1.0	5

The sensitive receptor locations included in the dispersion modelling assessment are presented graphically in a map in Figure 9. The sensitive receptors are presented in tabular format in Table 3, which includes for each location:

- The conservation objectives of the habitats or species identified at that point
- The critical level for ammonia adopted in the modelling assessment
- The critical load for nitrogen deposition adopted in the modelling assessment.

Table 3 **Sensitive receptor locations included in the dispersion modelling assessment, the conservation interest at each location, the critical level for ammonia adopted in the modelling assessment and the critical load for nitrogen deposition at each location**

Receptor	Species or Habitat							Relevant Criteria	
	Wet Heaths	Dry Heaths	Active blanket bogs	Alpine and Boreal Heaths	Siliceous Scree	Calcareous Rocky Slopes	Siliceous Rocky Slopes	Ammonia Concentration	Nitrogen Deposition
								µg/m³	kg/ha/yr
DR1	✓	✓			✓			1.0	5
DR2	✓				✓			1.0	5
DR3	✓				✓			1.0	5
DR4	✓				✓			1.0	5
DR5	✓		✓	✓	✓			1.0	5
DR6	✓		✓	✓				1.0	5
DR7	✓	✓	✓		✓			1.0	5
DR8	✓	✓	✓		✓			1.0	5
DR9	✓	✓						1.0	10
DR10	✓	✓	✓	✓				1.0	5
DR11	✓	✓	✓	✓				1.0	5
DR12	✓							1.0	10
DR13	✓	✓			✓	✓	✓	1.0	5
DR14			✓	✓	✓			1.0	5
DR15	✓	✓	✓					1.0	5
DR16	✓							1.0	10
DR17	✓	✓						1.0	10
DR18		✓						1.0	10
DR19	✓	✓	✓					1.0	5
DR20	✓	✓	✓	✓				1.0	5

Receptor	Species or Habitat							Relevant Criteria	
	Wet Heaths	Dry Heaths	Active blanket bogs	Alpine and Boreal Heaths	Siliceous Scree	Calcareous Rocky Slopes	Siliceous Rocky Slopes	Ammonia Concentration	Nitrogen Deposition
								µg/m³	kg/ha/yr
DR21	✓	✓		✓				1.0	5
DR22	✓	✓						1.0	10
DR23	✓	✓			✓	✓		1.0	5
DR24	✓	✓		✓				1.0	5
DR25	✓							1.0	10
DR26	✓				✓			1.0	5
DR27	✓				✓			1.0	5
DR28	✓							1.0	10
DR29	✓	✓						1.0	10
DR30		✓						1.0	10
DR31	✓	✓						1.0	10
DR32								3.0	30
DR33								3.0	30
DR34								3.0	30
DR35								3.0	30
DR36								3.0	30
DR37								3.0	30
DR38	✓	✓						1.0	10
DR39	✓	✓						1.0	10
DR40	✓	✓						1.0	10
DR41	✓	✓						1.0	10
DR42	✓	✓						1.0	10
DR43	✓	✓						1.0	10

Receptor	Species or Habitat							Relevant Criteria	
	Wet Heaths	Dry Heaths	Active blanket bogs	Alpine and Boreal Heaths	Siliceous Scree	Calcareous Rocky Slopes	Siliceous Rocky Slopes	Ammonia Concentration	Nitrogen Deposition
								µg/m³	kg/ha/yr
DR44	✓	✓						1.0	10
DR45	✓	✓						1.0	10
DR46	✓	✓						1.0	10

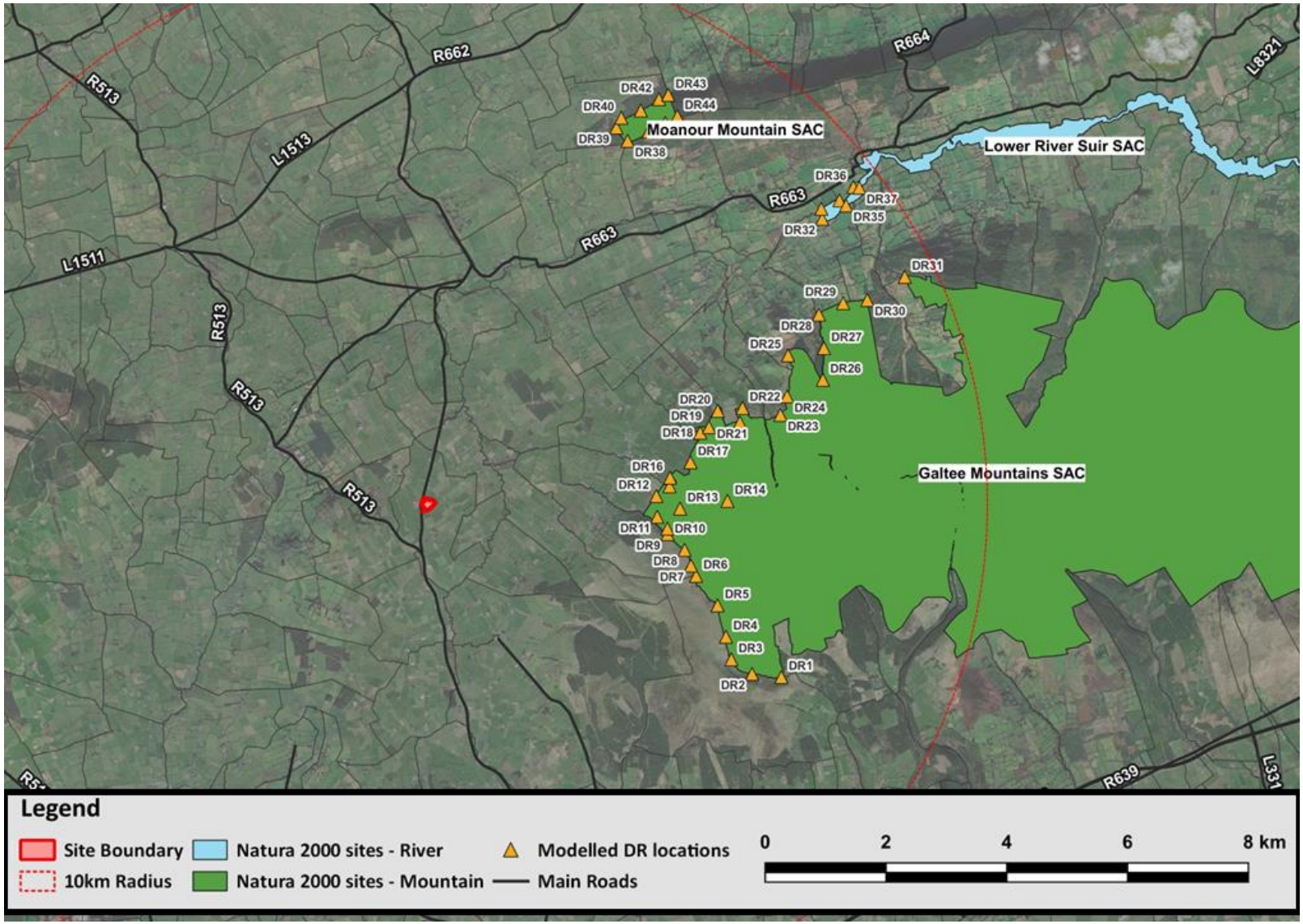

Figure 9 **The sensitive receptors included in the dispersion modelling assessment to represent locations on Natura 2000 sites**

5. ASSESSMENT

5.1 Dispersion modelling methodology

The following section describes the dispersion modelling methodology that was adopted to determine concentrations of ammonia and deposition rates of nitrogen from the pig farm in combination with background levels at ecologically sensitive locations near the Site. The methodology is based on a dispersion modelling study incorporating source characteristics and operational activity data of the pig farm with meteorological data that is representative of the Site and surrounding region. The dispersion modelling assessment has been prepared in accordance with industry standards, regulatory requirements and best practice approaches.

The assessment methodology has included:

- Determination of the locations and emission characteristics at the pig farm.
- Derivation of an emissions inventory based on its design and data from the literature for the pig farm.
- Generation of a representative meteorological dataset using prognostic meteorological modelling techniques.
- Characterisation of meteorological conditions in the region using prognostic meteorological data.
- Dispersion modelling using the regulatory dispersion model, CALPUFF, to predict ground-level concentrations of ammonia and nitrogen deposition:
    - At sensitive receptor locations
    - Across a cartesian grid that covers the modelling domain.

5.2 SCAIL-Agriculture

The baseline levels of ammonia and flux rates of nitrogen deposition at the sensitive ecological receptor locations were determined using SCAIL- Agriculture for Step 1 of EPA's Ammonia and Nitrogen Assessment Guidance.

SCAIL-Agriculture is a tool for assessing impacts of atmospheric nitrogen from agricultural installations in the UK and Ireland. It is a model underpinned by a detailed air dispersion model, AERMOD (Kelleghan *et al.*, 2022).

SCAIL-Agriculture includes estimates of baseline levels of ammonia and flux rates of nitrogen deposition across Ireland. The SCAIL-Agriculture ambient concentration model (1 x 1 km grid) has been updated to include modelled 2018 emissions by the UKCEH on behalf of the EPA. Similarly, the coarser international 2018 European Monitoring and Evaluation Programme (EMEP) national concentration and deposition models for Ireland have been made available through the AmmoniaN2K website (AmmoniaN2K, 2021). Both these models currently rely on the MapEire emissions model, which utilises cattle and sheep distribution from 2010 and locations of pig and poultry farms from 2015 according to the Irish Wildlife Manual 135 (Kelleghan *et al.*, 2022).

5.3 Meteorological modelling

5.3.1 Overview

EPA's Air Dispersion Modelling Guidance Note (AG4) states that the dispersion process is dependent on the underlying meteorological conditions and ensuring that the air dispersion model includes representative meteorological data is critical. In the absence of Site-specific meteorological data, AG4 requires the use of representative data observed at a Met Eireann monitoring location. AG4 states:

The USEPA (24) has defined meteorological representativeness as:

> *"the extent to which a set of {meteorological} measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application"*

and has expanded on this definition by outlining the factors to consider in the selection of appropriate meteorological data:

- *Proximity of the meteorological station to the modelling domain;*
- *The complexity of the terrain;*
- *The exposure of the meteorological monitoring Site;*
- *The period of time during which data is collected."*

The modelling domain includes areas of complex terrain. The meteorological parameters that affect dispersion are likely to vary spatially and temporally across the modelling domain due to the complexity of the terrain.

The closest Met Eireann monitoring location to the Site is at Moore Park, Co. Cork, which is 22 km south of the pig farm. This monitoring station is in rural rolling landscape. It sits at a low point in the local terrain and is close to the Blackwater River. Meteorological data at Moore Park is characterised by frequent easterly and westerly winds that occur due to the east-west orientation of the valley in which the monitoring station is located. The meteorological station at Moore Park is not likely to be representative of meteorological conditions at the Site as the terrain at both locations is very different.

A review by Katestone indicates that there are no other meteorological observation stations on the Met Eireann Network that meet the requirements specified in AG4 to be considered representative of the modelling domain.

Where site-specific or representative meteorological data is not available, AG4 provides the following alternatives:

> *Prognostic meteorological data should be considered in locations where there is no comparable representative Met Eireann station particularly in areas of complex terrain or at a land / sea interface.*

and

> *Prognostic meteorological data may be useful in locations where there is no comparable representative Met Eireann station. Locations where prognostic meteorological data may be required include regions of complex terrain and at a land/sea interface in circumstances where the nearest meteorological stations are outside of the modelling domain. As outlined by the USEPA, meteorological data should be spatially representative of the modelling domain and in particular of the pathway from the source to the most impacted receptor.*

Accordingly, prognostic meteorological data was generated for the Site due to the complexity of the terrain. The approach adopted to generate representative site-specific data used a numerical model to generate a 3-dimensional grid of spatially varying meteorological parameters to represent conditions surrounding the Site. The approach is described in Appendix A1.

5.3.2 Meteorology

The prognostic model TAPM (developed in Australia by the Commonwealth Scientific and Industrial Research Organisation [CSIRO], version 4.0.5) and the diagnostic meteorological model CALMET (developed by EarthTec, version 6.5) were used to generate the three-dimensional meteorological dataset for the region.

The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the innermost nest. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial

guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

The three-dimensional wind field produced by TAPM/CALMET was then used to create a meteorological file suitable for us with the CALPUFF dispersion model.

Details of the model configuration and evaluation are presented in Appendix A.

The TAPM/CALMET approach has been used in jurisdictions like Australia to generate suitable meteorological data for modelling impacts for over 15 years. It has been adopted in the assessment of a number proposed projects in Ireland in the last 5 years. There is significant experience using these approaches in jurisdictions such as Australia. Industry specific guidance on modelling odour dispersion from sources such as intensive poultry farms and cattle feedlots recommend the use of TAPM/CALMET to generate representative site-specific data. Research in Europe indicates that meteorological data generated using a numerical model provided a better indication of locations where odour nuisance occurred (Feliubadaló et al, 2008). In that study, locations of likely odour nuisance were determined using the German VDI grid assessment approach. The correlation between observed and modelled odour concentrations was significantly better using the TAPM/CALMET approach compared to traditional steady state gaussian models such as AERMOD.

5.4 Emissions

The derivation of the ammonia emissions inventory adopted for the dispersion modelling assessment is presented in this section. Ammonia emission inventories were derived for the old housing units and the new housing units at the pig farm.

There are no emissions monitoring data available for the pig farm. Ammonia emission rates from the pig housing units at pig farms vary considerably depending on factors such as:

- The ventilation rate which is heavily influenced by:
    - The target temperature of the pigs in the unit which is influenced by:
        - Type of pig (sow, weaner, fattener).
        - The age of the pigs
    - The ambient temperature outside the pig unit.
- The design of the housing system including but not limited to the following:
    - Depth of manure holding pits
    - Frequency on manure removal
    - Ventilation design
    - Surface area of manure exposed beneath the slats.
- The depth of manure in the house, which varies considerably with season.

The ammonia emission inventory derived for the pig farm is based on:

- The design and operation of the old housing units and the new housing units at the pig farm.
- Ammonia emission rates for housing units presented in the latest Best Reference (BREF) document for the intensive rearing of poultry or pigs (IRPP) (EC, 2017).

The existing housing units are operated as traditional deep pit housing units. The pig diets at the existing housing units are formulated with reduced protein content to limit emissions. The pig diets at the existing housing units will continue to be formulated with reduced protein content to limit emissions.

The new housing units will be operated with reduced dietary crude protein feeds and with shallow tanks for slurry storage, which will require frequent removal to external slurry storage. These controls will ensure that the new housing units will operate in accordance with the requirements of BAT 30 in the BREF for IRPP.

The ammonia emission rates adopted in the dispersion modelling assessment are based on the emission rates of BAT compliant pig farms presented in the BREF for IRPP including the following based on data from Table 5.4 of the BAT conclusions, which presents the Bat Acceptable Emission limits (AELs) for piggeries that are designed and operated in accordance with BAT. The BAT-AELs for various BAT techniques are presented in the BAT conclusions as ranges. The upper limit of the ranges that is applicable to the BAT-compliant housing units are as follows:

- 2.7 kg.animal^{-1}.year^{-1} for dry sows
- 2.7 kg.animal^{-1}.year^{-1} for gilts
- 5.6 kg.animal^{-1}.year^{-1} for farrowing sows
- 0.53 kg.animal^{-1}.year^{-1} for weaners
- 2.6 kg.animal^{-1}.year^{-1} for fatteners.

The BAT-AELs for housing units that pre-date the current BAT are also presented in the BREF for IRPP including the following based on data from Table 5.4 of the BAT conclusions. The upper limit for emission rates that is applicable to the housing units with deep pits in combination with nutritional management techniques are as follows:

- 4.0 kg.animal^{-1}.year^{-1} for dry sows
- 4.0 kg.animal^{-1}.year^{-1} for gilts
- 7.5 kg.animal^{-1}.year^{-1} for farrowing sows
- 0.7 kg.animal^{-1}.year^{-1} for weaners
- 3.6 kg.animal^{-1}.year^{-1} for fatteners.

The ammonia emission rates for housing units with deep pits in combination with nutritional management techniques were adopted for all housing units at the site.

5.5 Dispersion modelling

The assessment was conducted in accordance with recognized techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). CALPUFF was used to predict ground-level concentrations of ammonia and nitrogen deposition rates across the modelling domain and at sensitive ecological receptor locations on nearby Natura 2000 site due to sources at the pig farm.

The details of source characterization utilized for the pig farm in the modelling assessment are provided in Section 5.9.

5.6 Deposition

Deposition flux rates of nitrogen at sensitive receptors were estimated based on the predicted concentrations of ammonia across the modelled domain and using the following calculation methodology that is described in AG4:

> *The critical loads in ecologically sensitive areas such as SPAs, SACs and NHAs can be determined using the methodology outlined in the UK publication "AQTAG06 – Technical Guidance on Detailed Modelling Approach For An Appropriate Assessment For Emissions To Air" (Environment Agency, 2014)(64) . The approach is based on using the maximum annual average ground level concentration within the*

ecologically sensitive area and converting this concentration into a deposition flux based on a chemical species specific deposition velocity (m/s) as outlined in Table A3.

The recommended dry deposition velocities for ammonia in Table A3 of AG4 are:

- 0.02 m/s for grassland
- 0.03 m/s for forest.

Dry deposition flux (µg m^{-2} s^{-1}) is calculated as the product of the ground-level process contribution (µg/m^3) and the deposition velocity (m/s).

The dry deposition velocities adopted in the modelling assessment were assumed to be 0.02 m/s for all modelled sensitive locations as the modelled locations do not contain forestry.

5.7 Building downwash

When modelling emissions from an industrial installation it should be borne in mind that stacks that are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800m) (EPA, 2020).

A plume of a short stack is likely to be downwashed if its height is less than two and a half times the height of nearby buildings within a distance of 10 x L from each source, where L is the lesser of the height or width of the building. A Building Profile Input Program (BPIP) was used to determine the effects of buildings on the point sources of emissions at the pig farm. The Plume Rise Model Enhancements (PRIME) algorithm is recommended in EPA Guidance for use with AERMOD. PRIME was used in the dispersion modelling assessment to determine the effect of building induced turbulence on plumes from point sources at the pig farm.

The PRIME algorithm takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10º intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model.

Twenty onsite buildings/structures have been included in the BPIP program to represent pig housing units and other onsite buildings. The coordinates used in the configuration of the pig housing units and onsite buildings in the PRIME BPIP model for this assessment are presented in Table 4.

Table 4 Pig housing units included and configuration of the pig housing units in BPIP

Building	Easting	Northing	Height (m)
	UTM (m)	UTM (m)	
B1	547184.3	5801543	5.2
	547133.6	5801592	
	547149.9	5801607	
	547199.7	5801558	
B2	547167.8	5801526	5.2
	547117	5801575	
	547132.9	5801590	
	547183.3	5801542	
B3	547151.5	5801509	5.2
	547100	5801559	

Building	Easting	Northing	Height (m)
	UTM (m)	UTM (m)	
	547116.1	5801574	
	547167.4	5801525	
B4	547134.8	5801491	7.2
	547082.8	5801540	
	547096.5	5801554	
	547147.7	5801505	
B5	547087.3	5801505	4.5
	547066.7	5801526	
	547079.2	5801538	
	547100.1	5801518	
B6	547095.3	5801498	4.5
	547087.2	5801505	
	547100	5801518	
	547107.8	5801511	
B7	547122.2	5801487	4.0
	547105.8	5801502	
	547112.3	5801509	
	547129.1	5801494	
B8	547104.3	5801472	4.0
	547088.3	5801488	
	547103.5	5801503	
	547119.6	5801488	
B9	547074.8	5801498	4.0
	547058.8	5801513	
	547069	5801523	
	547084.8	5801508	
B10	547085	5801488	4.0
	547074.8	5801498	
	547084.7	5801508	
	547095.1	5801498	
B11	547087	5801455	7.0
	547037.2	5801504	
	547051.6	5801518	
	547102.1	5801470	
B13	547031.3	5801509	6.0
	546997.3	5801542	
	547012.6	5801558	
	547046.6	5801526	
B14	547049.3	5801524	3.4
	547013.2	5801558	

Building	Easting	Northing	Height (m)
	UTM (m)	UTM (m)	
	547021.4	5801567	
	547057.3	5801532	
B15	547058.5	5801531	4.0
	547021.4	5801567	
	547032.1	5801578	
	547069.2	5801543	
B16	547069.2	5801542	4.0
	547032.3	5801578	
	547041.1	5801587	
	547078.4	5801552	
B17	547080.9	5801554	7.0
	547042.9	5801590	
	547058.6	5801607	
	547097.2	5801570	
B18	547097.9	5801570	18.3
	547084.5	5801583	
	547097.8	5801597	
	547111.4	5801584	

5.8 Sources of Emissions

The pig housing units included in the dispersion modelling assessment are presented in Table 5, which specifies:

- The housing unit at the pig farm
- The type of pigs housed (proposed development as modelled)
- The type of ventilation (development as modelled)
- The number of pigs housed in the building (proposed development as modelled)
- The number of sources used to represent the mechanical ventilation points in the modelling assessment.

All pig housing units at the Site will be mechanically ventilated sheds and were configured as point sources in the modelling assessment.

The sources included in the modelling assessment, the number of pigs per source and the ammonia emission rate per source are presented in Table 6.

Table 5 Pig housing units included in the dispersion modelling assessment

Housing Unit	Type of Pig	Type of Ventilation	Number of Housed Pigs	Number of modelled sources
B1	Fattener	Mechanical	1360	2
B2	Fattener	Mechanical	1360	2
B3	Dry Sow	Mechanical	325	2
B4	Gilt	Mechanical	166	10
B5	Weaner	Mechanical	904	4
B6	Weaner	Mechanical	324	2
B7	Dry Sow	Mechanical	52	1
B8	Dry Sow	Mechanical	99	4
B9	Weaner	Mechanical	581	3
B10	Weaner	Mechanical	339	3
B11	Fattener	Mechanical	1238	14
B13	Weaner	Mechanical	1852	10
B14	Farrowing	Mechanical	81	8
B15	Farrowing	Mechanical	97	4
B16	Farrowing	Mechanical	97	4
B17	Dry Sow	Mechanical	253	4

Table 6 Sources and ammonia emission rate of sources included in the modelling assessment

Housing Unit	Source Number	Number of pigs per source	Ammonia Emission rate (g/s)
B1	B1_1	680	0.0776
	B1_2	680	0.0776
B2	B2_1	680	0.0776
	B2_2	680	0.0776
B3	B3_1	163	0.0206
	B3_2	163	0.0206
B4	B4_1	17	0.0021
	B4_2	17	0.0021
	B4_3	17	0.0021
	B4_4	17	0.0021
	B4_5	17	0.0021
	B4_6	17	0.0021
	B4_7	17	0.0021
	B4_8	17	0.0021
	B4_9	17	0.0021
	B4_10	17	0.0021
B5	B5_1	226	0.0050
	B5_2	226	0.0050
	B5_3	226	0.0050

Housing Unit	Source Number	Number of pigs per source	Ammonia Emission rate (g/s)
	B5_4	226	0.0050
B6	B6_1	162	0.0036
	B6_2	162	0.0036
B7	B7_1	52	0.0066
B8	B8_1	25	0.0032
	B8_2	25	0.0032
	B8_3	25	0.0032
	B8_4	25	0.0032
B9	B9_1	194	0.0043
	B9_2	194	0.0043
	B9_3	194	0.0043
B10	B10_1	113	0.0025
	B10_2	113	0.0025
	B10_3	113	0.0025
B11	B11_1	88	0.0101
	B11_2	88	0.0101
	B11_3	88	0.0101
	B11_4	88	0.0101
	B11_5	88	0.0101
	B11_6	88	0.0101
	B11_7	88	0.0101
	B11_8	88	0.0101
	B11_9	88	0.0101
	B11_10	88	0.0101
	B11_11	88	0.0101
	B11_12	88	0.0101
	B11_13	88	0.0101
	B11_14	88	0.0101
B13	B13_1	185	0.0041
	B13_2	185	0.0041
	B13_3	185	0.0041
	B13_4	185	0.0041
	B13_5	185	0.0041
	B13_6	185	0.0041
	B13_7	185	0.0041
	B13_8	185	0.0041
	B13_9	185	0.0041
	B13_10	185	0.0041
B14	B14_1	10	0.0024
	B14_2	10	0.0024

Housing Unit	Source Number	Number of pigs per source	Ammonia Emission rate (g/s)
	B14_3	10	0.0024
	B14_4	10	0.0024
	B14_5	10	0.0024
	B14_6	10	0.0024
	B14_7	10	0.0024
	B14_8	10	0.0024
B15	B15_1	24	0.0058
	B15_2	24	0.0058
	B15_3	24	0.0058
	B15_4	24	0.0058
B16	B16_1	24	0.0058
	B16_2	24	0.0058
	B16_3	24	0.0058
	B16_4	24	0.0058
B17	B17_1	63	0.0080
	B17_2	63	0.0080
	B17_3	63	0.0080
	B17_4	63	0.0080

5.9 Source configuration

The pig housing units at the pig farm are all mechanically ventilated and were, therefore, modelled as point sources in the modelling assessment. This section describes the configuration of the point sources included in the CALPUFF modelling assessment.

Table 7 lists the point sources included in the modelling assessment and relevant modelling parameters including:

- The source coordinates
- The base elevations
- Stack height
- Stack diameter
- Exhaust temperature
- Exhaust velocity.

The building locations, configuration and heights were determined from Site plans provided by Ballyfaskin Enterprises, correspondence between Katestone and Ballyfaskin Enterprises and from satellite imagery.

Table 7 Source parameters for the point sources at the pig farm

Source Number	x-coordinate	y-coordinate	Base Elevation	Stack Height	Diameter	Temperature	Velocity
	km	km	m	m	m	°C	m/s
B1_1	547.196	5801.554	164.7	8.00	1.75	20	6.1
B1_2	547.188	5801.546	165.1	8.00	1.75	20	6.1
B2_1	547.180	5801.537	165.5	8.00	1.75	20	6.1
B2_2	547.171	5801.529	165.9	8.00	1.75	20	6.1
B3_1	547.163	5801.521	166.2	8.00	1.75	20	6.1
B3_2	547.155	5801.512	166.6	8.00	1.75	20	6.1
B4_1	547.140	5801.499	167.3	5.65	0.6	20	6.8
B4_2	547.138	5801.501	167.3	5.65	0.6	20	6.8
B4_3	547.136	5801.503	167.4	5.65	0.6	20	6.8
B4_4	547.134	5801.505	167.4	5.65	0.6	20	6.8
B4_5	547.130	5801.508	167.6	5.65	0.6	20	6.8
B4_6	547.128	5801.51	167.6	5.65	0.6	20	6.8
B4_7	547.126	5801.512	167.7	5.65	0.6	20	6.8
B4_8	547.124	5801.514	167.7	5.65	0.6	20	6.8
B4_9	547.119	5801.52	167.9	5.65	0.6	20	6.8
B4_10	547.112	5801.526	168.1	5.65	0.6	20	6.8
B5_1	547.080	5801.535	169.3	4.80	0.6	21	6.8
B5_2	547.086	5801.53	169.1	4.80	0.6	21	6.8
B5_3	547.092	5801.525	168.9	4.80	0.6	21	6.8
B5_4	547.097	5801.52	168.7	4.80	0.6	21	6.8
B6_1	547.102	5801.515	168.5	4.80	0.6	21	6.8
B6_2	547.107	5801.51	168.4	4.80	0.6	21	6.8
B8_1	547.105	5801.489	168.6	4.80	0.6	20	6.8
B8_2	547.104	5801.487	168.7	4.80	0.6	20	6.8
B8_3	547.106	5801.485	168.6	4.80	0.6	20	6.8
B8_4	547.107	5801.487	168.6	4.80	0.6	20	6.8
B9_1	547.066	5801.517	170.2	4.50	0.6	21	6.8
B9_2	547.070	5801.514	170.1	4.50	0.6	21	6.8
B9_3	547.075	5801.51	169.9	4.50	0.6	21	6.8
B10_1	547.080	5801.505	169.7	4.50	0.6	21	6.8
B10_2	547.084	5801.501	169.5	4.50	0.6	21	6.8
B10_3	547.089	5801.497	169.2	4.50	0.6	21	6.8
B11_1	547.088	5801.468	169.6	5.50	0.6	20	6.8
B11_2	547.090	5801.47	169.4	5.50	0.6	20	6.8
B11_3	547.086	5801.47	169.7	5.50	0.6	20	6.8
B11_4	547.088	5801.471	169.5	5.50	0.6	20	6.8
B11_5	547.071	5801.485	170.4	5.50	0.6	20	6.8

Source Number	x-coordinate	y-coordinate	Base Elevation	Stack Height	Diameter	Temperature	Velocity
	km	km	m	m	m	°C	m/s
B11_6	547.069	5801.486	170.5	5.50	0.6	20	6.8
B11_7	547.071	5801.488	170.3	5.50	0.6	20	6.8
B11_8	547.073	5801.486	170.3	5.50	0.6	20	6.8
B11_9	547.058	5801.497	170.9	5.50	0.6	20	6.8
B11_10	547.059	5801.498	170.9	5.50	0.6	20	6.8
B11_11	547.054	5801.502	171.1	5.50	0.6	20	6.8
B11_12	547.055	5801.503	171.0	5.50	0.6	20	6.8
B11_13	547.050	5801.505	171.2	5.50	0.6	20	6.8
B11_14	547.051	5801.506	171.2	5.50	0.6	20	6.8
B13_1	547.037	5801.518	171.7	4.50	0.6	21	6.8
B13_2	547.035	5801.52	171.7	4.50	0.6	21	6.8
B13_3	547.030	5801.524	171.9	4.50	0.6	21	6.8
B13_4	547.028	5801.527	171.9	4.50	0.6	21	6.8
B13_5	547.023	5801.532	172.0	4.50	0.6	21	6.8
B13_6	547.021	5801.534	172.1	4.50	0.6	21	6.8
B13_7	547.018	5801.536	172.2	4.50	0.6	21	6.8
B13_8	547.013	5801.541	172.3	4.50	0.6	21	6.8
B13_9	547.010	5801.544	172.3	4.50	0.6	21	6.8
B13_10	547.008	5801.546	172.4	4.50	0.6	21	6.8
B14_1	547.048	5801.526	171.0	4.00	0.45	22	5.6
B14_2	547.043	5801.531	171.1	4.00	0.45	22	5.6
B14_3	547.038	5801.535	171.3	4.00	0.45	22	5.6
B14_4	547.033	5801.54	171.4	4.00	0.45	22	5.6
B14_5	547.029	5801.544	171.5	4.00	0.45	22	5.6
B14_6	547.025	5801.548	171.6	4.00	0.45	22	5.6
B14_7	547.021	5801.552	171.7	4.00	0.45	22	5.6
B14_8	547.016	5801.557	171.7	4.00	0.45	22	5.6
B15_1	547.063	5801.544	170.0	4.00	0.6	22	6.8
B15_2	547.053	5801.553	170.3	4.00	0.6	22	6.8
B15_3	547.044	5801.562	170.5	4.00	0.6	22	6.8
B15_4	547.034	5801.571	170.7	4.00	0.6	22	6.8
B16_1	547.072	5801.554	169.5	4.50	0.6	22	6.8
B16_2	547.063	5801.563	169.7	4.50	0.6	22	6.8
B16_3	547.054	5801.572	169.9	4.50	0.6	22	6.8
B16_4	547.044	5801.581	170.2	4.50	0.6	22	6.8
B17_1	547.085	5801.566	168.8	5.50	0.6	20	6.8
B17_2	547.075	5801.575	169.1	5.50	0.6	20	6.8
B17_3	547.066	5801.584	169.3	5.50	0.6	20	6.8
B17_4	547.056	5801.592	169.6	5.50	0.6	20	6.8

5.10 In-combination modelling assessment

An in-combination assessment is a requirement of Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance.

The in-combination modelling assessment needs to include other sources which may act in-combination with the application/review installation. The other sources that need to be included in the in-combination modelling assessment are defined in Section 3.9 of EPA's Ammonia and Nitrogen Assessment Guidance, which is reproduced here:

> *Other sources of nitrogen and ammonia (other PCs) to the Natura 2000 site(s), which could act in combination with emissions from the proposed/expanded installation, to impact the protected habitat, must be accounted for at relevant stages of the appropriate assessment process (screening stage details are set in Section 4 of this document). The in-combination assessment which needs to be conducted, is dependent on the size of the activity and the distance from the Natura site.*
>
> *At the target Natura 2000 site(s) (i.e. that/those identified, as possibly impacted by emissions from the applicant/review installation), all IAIs, which meet the following two criteria and which (with abatement in place), have a PC of ≥4% of the critical level for ammonia and/or ≥5% of the critical load for nitrogen deposition at the relevant Natura site must be included:*
>
> 1) *Developments that have planning permission and/or licences but are not yet (fully) operating; including those both above and below licensing thresholds that may contribute to ammonia and nitrogen emissions; and*
> 2) *Developments that started operating/increased their numbers, after the most recent update of background levels; including those both above and below licensing thresholds, that may contribute to ammonia and nitrogen emissions*
>
> *The criteria to use in order to determine the geographical range of the installations, which meet the above criteria, to include in the in-combination assessment is outlined below. (see Figure 1):*
>
> - *All below threshold installations within 5km of the Natura site*
> - *All licensed installations within 10km of the Natura site*

6. AMMONIA AND NITROGEN ASSESSMENT RESULTS

The results of the assessment are presented in this section. Katestone followed the step-wise approach described in EPA's Ammonia and Nitrogen Assessment Guidance in this assessment. The results of each step considered in the modelling assessment are presented in this section.

In summary, following the step-wise approach described in EPA's Ammonia and Nitrogen Assessment Guidance required the following steps to be completed:

- Step 1
- Step 4
- Step 5.

6.1 Results of Step 1

Question 2 of Step 1 in the EPA's Ammonia and Nitrogen Assessment Guidance asks:

> *Are the background levels already exceeded for the ammonia critical level or nitrogen critical load at Natura sites within the zone of influence of my site (as reported by SCAIL)?*

The background concentrations of ammonia and the background nitrogen deposition flux as determined using the SCAIL screening tool are presented along with the appropriate critical level for ammonia and critical load for nitrogen deposition fluxes in Table 8.

The results show that the background concentrations of ammonia and the background nitrogen deposition flux exceed the relevant critical level for ammonia and critical load for nitrogen deposition fluxes at a number of the modelled discrete receptor locations.

According to Step 1 of EPA's Ammonia and Nitrogen Assessment Guidance:

- The approaches using the SCAIL-Agriculture model described in Step 2 and Step 3 of the EPA's Ammonia and Nitrogen Assessment Guidance are not applicable.
- A detailed assessment completed in accordance with Step 4 of EPA's Ammonia and Nitrogen Assessment Guidance is, therefore, required to be completed. The results of the Step 4 assessment are presented in Section 6.2.

Table 8 Background concentrations of ammonia and the background nitrogen deposition flux as determined using the SCAIL screening tool are presented along with the appropriate critical level for ammonia and critical load for nitrogen deposition fluxes

Receptor	SCAIL background concentration of ammonia	Critical Level	SCAIL background nitrogen deposition flux	Critical Load
	µg/m³		kg/ha/yr	
DR1	**1.9**	1.0	**8.8**	5.0
DR2	**1.8**	1.0	**8.7**	5.0
DR3	**1.8**	1.0	**8.7**	5.0
DR4	**1.8**	1.0	**8.7**	5.0
DR5	**1.7**	1.0	**8.6**	5.0
DR6	**1.7**	1.0	**8.0**	5.0
DR7	**1.7**	1.0	**8.0**	5.0

Receptor	SCAIL background concentration of ammonia	Critical Level	SCAIL background nitrogen deposition flux	Critical Load
	µg/m³		kg/ha/yr	
DR8	**1.7**	1.0	**8.0**	5.0
DR9	**1.7**	1.0	8.0	10.0
DR10	**1.7**	1.0	**8.0**	5.0
DR11	**2.0**	1.0	**7.8**	5.0
DR12	**2.0**	1.0	7.8	10.0
DR13	**2.0**	1.0	**7.8**	5.0
DR14	**1.7**	1.0	**8.7**	5.0
DR15	**2.0**	1.0	**7.8**	5.0
DR16	**2.0**	1.0	7.8	10.0
DR17	**2.3**	1.0	7.6	10.0
DR18	**1.9**	1.0	8.0	10.0
DR19	**1.9**	1.0	**8.0**	5.0
DR20	**2.2**	1.0	**7.5**	5.0
DR21	**1.9**	1.0	**8.0**	5.0
DR22	**2.2**	1.0	7.5	10.0
DR23	**1.7**	1.0	**8.8**	5.0
DR24	**1.9**	1.0	**7.8**	5.0
DR25	**2.3**	1.0	7.6	10.0
DR26	**1.8**	1.0	**8.1**	5.0
DR27	**2.1**	1.0	**7.5**	5.0
DR28	**2.5**	1.0	7.6	10.0
DR29	**2.1**	1.0	7.6	10.0
DR30	**2.1**	1.0	7.6	10.0
DR31	**2.4**	1.0	7.6	10.0
DR32	2.4	3.0	7.6	30.0
DR33	2.6	3.0	7.5	30.0
DR34	2.6	3.0	7.5	30.0
DR35	2.6	3.0	7.5	30.0
DR36	2.5	3.0	7.1	30.0
DR37	2.6	3.0	7.3	30.0
DR38	**2.5**	1.0	7.4	10.0
DR39	**2.5**	1.0	7.4	10.0
DR40	**2.5**	1.0	7.4	10.0
DR41	**2.3**	1.0	7.4	10.0
DR42	**2.3**	1.0	7.4	10.0
DR43	**2.3**	1.0	7.4	10.0
DR44	**2.3**	1.0	7.4	10.0
DR45	**2.3**	1.0	7.4	10.0

Receptor	SCAIL background concentration of ammonia	Critical Level	SCAIL background nitrogen deposition flux	Critical Load
	µg/m³		kg/ha/yr	
DR46	**2.3**	1.0	7.4	10.0
Note: Bold text indicates where SCAIL background exceeds the critical level or critical load.				

6.2 Results of Step 4

Step 4 of EPA's Ammonia and Nitrogen Assessment Guidance requires a licensee/applicant to complete a detailed dispersion modelling assessment.

Dispersion modelling has been conducted for five years of meteorological data. The following sections present the highest concentrations across the five-year modelled period as Required by EPA dispersion modelling guidance.

The predicted ground-level concentrations of ammonia and annual average flux rate of nitrogen deposition at the nearest ecologically sensitive locations due to the pig farm are presented in Table 9.

The results in Table 9 are compared against the Step 4 criteria identified in EPA's Ammonia and Nitrogen Assessment Guidance, which require the process contribution of the pig farm (PC) to be:

- ≤1% of the critical level for ammonia
- ≤1% of the critical load for nitrogen deposition?

The results presented in Table 9 show that, in relation to the 1% threshold identified in Step 4 of EPA's Ammonia and Nitrogen Assessment Guidance, the PC due to the expanded pig farm:

- Exceeds for ammonia and nitrogen deposition at a number of modelled discrete receptor locations on:
    - The Galtee Mountains SAC (Receptors – 1 - 31)
    - The Moanour Mountain SAC (Receptors – 38 - 46).
- Does not exceed at any of the modelled discrete receptor locations on the River Suir SAC (Receptors – 32 - 37).

If the criteria identified in Step 4 of EPA's Ammonia and Nitrogen Assessment Guidance are exceeded, the licensee/applicant is required to undertake the assessment defined in Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance. Step 5 requires detailed modelling that takes account of in-combination effects. Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance is presented in Section 6.3 for the modelled sensitive locations on the Galtee Mountains SAC and the Moanour Mountains SAC.

Table 9 The predicted ground-level concentrations of ammonia and annual average flux rate of nitrogen deposition at the nearest ecologically sensitive locations due to the pig farm

Receptor	Concentration of ammonia (µg/m³)		PC as a percentage of Critical Level	Nitrogen Deposition Flux (kg/ha/yr)		PC as a percentage of Critical Load
	Process Contribution (Pig Farm)	Critical Level		Process Contribution (Pig Farm)	Critical Load	
DR1	0.0050	1.0	0.5%	0.036	5.0	0.6%
DR2	0.0055	1.0	0.6%	0.040	5.0	0.7%

Receptor	Concentration of ammonia (µg/m³)		PC as a percentage of Critical Level	Nitrogen Deposition Flux (kg/ha/yr)		PC as a percentage of Critical Load
	Process Contribution (Pig Farm)	Critical Level		Process Contribution (Pig Farm)	Critical Load	
DR3	0.0061	1.0	0.6%	0.031	5.0	0.8%
DR4	0.0066	1.0	0.7%	0.035	5.0	0.8%
DR5	0.0073	1.0	0.7%	0.039	5.0	0.9%
DR6	0.0091	1.0	0.9%	0.041	5.0	1.1%
DR7	0.0099	1.0	1.0%	0.046	5.0	1.2%
DR8	0.0106	1.0	1.1%	0.057	5.0	1.3%
DR9	0.0123	1.0	1.2%	0.062	10.0	0.8%
DR10	0.0125	1.0	1.3%	0.067	5.0	1.6%
DR11	0.0148	1.0	1.5%	0.077	5.0	1.9%
DR12	0.0156	1.0	1.6%	0.079	10.0	1.0%
DR13	0.0106	1.0	1.1%	0.093	5.0	1.3%
DR14	0.0070	1.0	0.7%	0.098	5.0	0.9%
DR15	0.0126	1.0	1.3%	0.067	5.0	1.6%
DR16	0.0128	1.0	1.3%	0.044	10.0	0.8%
DR17	0.0104	1.0	1.0%	0.079	10.0	0.7%
DR18	0.0118	1.0	1.2%	0.081	10.0	0.7%
DR19	0.0115	1.0	1.2%	0.066	5.0	1.5%
DR20	0.0125	1.0	1.2%	0.074	5.0	1.6%
DR21	0.0094	1.0	0.9%	0.073	5.0	1.2%
DR22	0.0102	1.0	1.0%	0.078	10.0	0.6%
DR23	0.0076	1.0	0.8%	0.059	5.0	1.0%
DR24	0.0079	1.0	0.8%	0.064	5.0	1.0%
DR25	0.0086	1.0	0.9%	0.048	10.0	0.5%
DR26	0.0067	1.0	0.7%	0.050	5.0	0.8%
DR27	0.0070	1.0	0.7%	0.054	5.0	0.9%
DR28	0.0085	1.0	0.8%	0.042	10.0	0.5%
DR29	0.0077	1.0	0.8%	0.044	10.0	0.5%
DR30	0.0066	1.0	0.7%	0.053	10.0	0.4%
DR31	0.0060	1.0	0.6%	0.048	10.0	0.4%
DR32	0.0127	3.0	0.4%	0.041	30.0	0.1%
DR33	0.0129	3.0	0.4%	0.038	30.0	0.1%
DR34	0.0127	3.0	0.4%	0.027	30.0	0.1%
DR35	0.0125	3.0	0.4%	0.027	30.0	0.1%
DR36	0.0128	3.0	0.4%	0.027	30.0	0.1%
DR37	0.0125	3.0	0.4%	0.026	30.0	0.1%
DR38	0.0168	1.0	1.7%	0.027	10.0	1.1%

Receptor	Concentration of ammonia (µg/m³)		PC as a percentage of Critical Level	Nitrogen Deposition Flux (kg/ha/yr)		PC as a percentage of Critical Load
	Process Contribution (Pig Farm)	Critical Level		Process Contribution (Pig Farm)	Critical Load	
DR39	0.0176	1.0	1.8%	0.026	10.0	1.1%
DR40	0.0169	1.0	1.7%	0.106	10.0	1.1%
DR41	0.0149	1.0	1.5%	0.111	10.0	0.9%
DR42	0.0134	1.0	1.3%	0.106	10.0	0.8%
DR43	0.0128	1.0	1.3%	0.094	10.0	0.8%
DR44	0.0124	1.0	1.2%	0.084	10.0	0.8%
DR45	0.0132	1.0	1.3%	0.080	10.0	0.8%
DR46	0.0146	1.0	1.5%	0.078	10.0	0.9%

6.3 Results of Step 5

Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance requires detailed modelling to determine the in-combination effects of:

- The pig farm
- Intensive agricultural installations (AIA) built or approved since the most recent update of background levels (determined using SCAIL-Agriculture)

The results of the in-combination assessment are assessed against the criteria identified in Step 5.

The most recent update to background levels of ammonia and nitrogen deposition was in 2018 with data used based on the locations of pig and poultry farms up to 2015 (Kelleghan *et al.*, 2022).

A review of nearby IAIs (IAI Review) was undertaken to identify all IAI developments that received licence/planning approval since 2015 or IAI developments that were built since 2015 within the following set-back distances identified in Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance:

- Licensed IAI within 10 km of the closest point of 1) The Galtee Mountains SAC and 2) the Moanour Mountains SAC to the pig farm.
- Sub-threshold Licensed IAI within 5 km of the closest point of 1) The Galtee Mountains SAC and 2) the Moanour Mountains SAC to the pig farm.

The IAI Review included detailed searches of satellite imagery, the EPA licence database and the planning systems of:

- Limerick County Council
- Tipperary County Council
- Cork County Council.

The areas searched were determined using the methodology defined in EPA's Ammonia and Nitrogen Assessment Guidance and are presented in Figure 10.

The IAI Review identified:

- There are a small number of IAI in the areas searched
- There have been no new EPA licence approvals for IAI within the search areas since 2015
- EPA has not approved any increases in stocking numbers at any EPA licensed IAI in the search areas after 2015
- EPA has not approved any licence amendments/reviews for any EPA licensed IAI in the search areas after 2015
- No planning approvals for sub-threshold IAI within a 5 km setback distance from the Galtee Mountains SAC have been issued after 2015
- A single IAI within the 5 km setback distance of the Moanour Mountains SAC has been built since 2015 and a planning application for further expansion of this facility was submitted in January 2023.

The results of the IAI Review identified:

- There is no requirement for a cumulative assessment of impacts on the Galtee Mountains SAC as no IAI meets the requirements of Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance to be included. Accordingly, the cumulative impact on the Galtee Mountains SAC of all IAI as defined in Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance is equal to the impact of the pig farm in isolation.

- The single IAI within the 5 km setback distance of the Moanour Mountains SAC that meets the requirements of Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance should be included in a cumulative assessment of the impacts on Moanour Mountains SAC.

The single IAI is a poultry facility used to house egg laying hens. It was included in the CALPUFF dispersion modelling assessment to determine its impacts on the Moanour Mountain SAC. A description of the poultry farm and its configuration in the modelling assessment is presented in Appendix B.

The results of the cumulative impact assessment described in this section was determined and presented against the Step 5 criteria for:

- The Galtee Mountains (Receptors–1 - 31) SAC in Section 6.3.1
- The Moanour Mountain SAC (receptors–8 - 46) in 6.3.2.

The results have been assessed against the Step 5 criteria identified in EPA's Ammonia and Nitrogen Assessment Guidance that require the cumulative impact to be less than:

- 20% of the critical level for ammonia
- 20% of the critical load for nitrogen deposition.

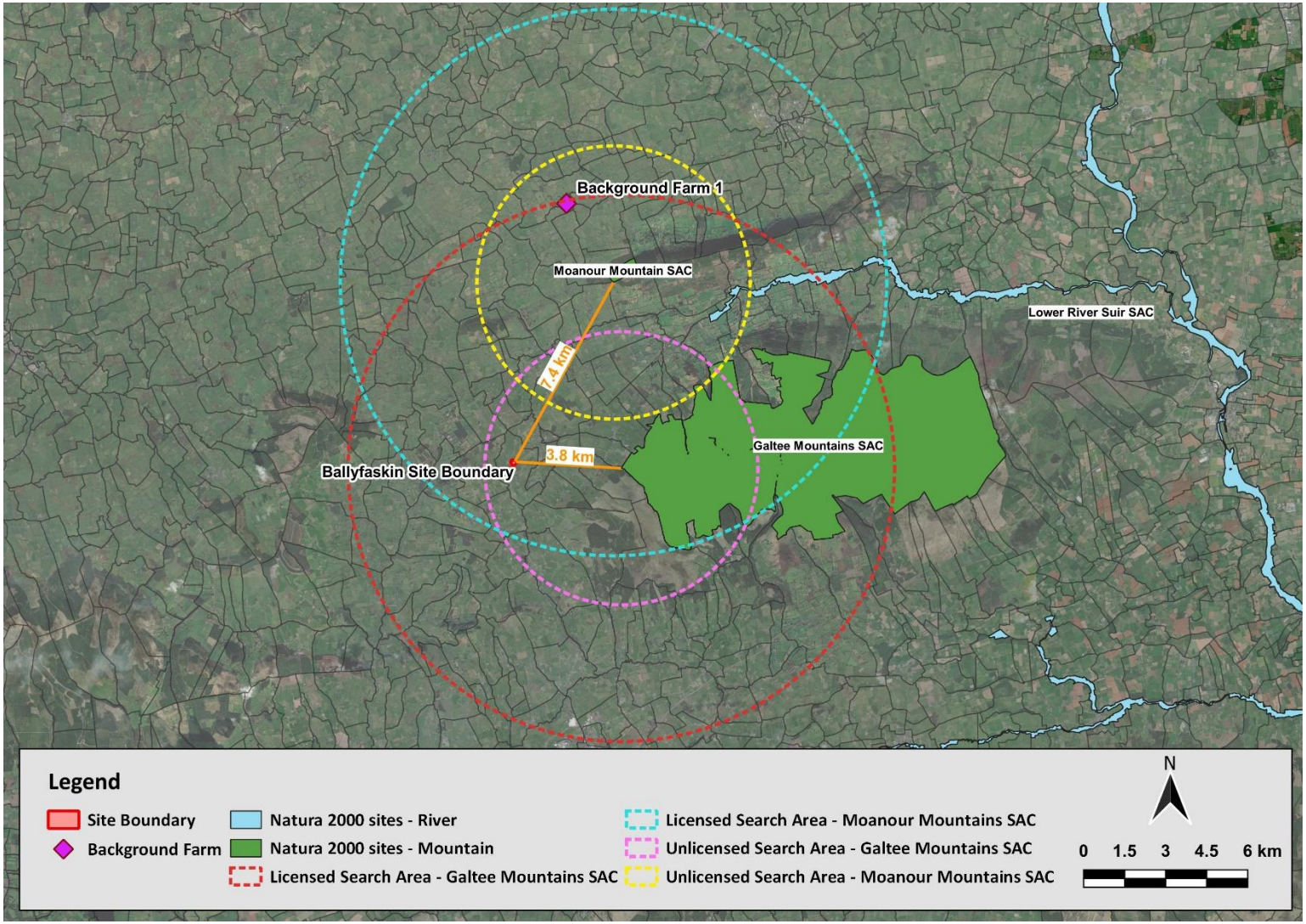

Figure 10 **Areas searched and background IAIs that were included in the cumulative assessment using the methodology defined in EPA's Ammonia and Nitrogen Assessment Guidance**

6.3.1 Step 5 Cumulative Assessment – Galtee Mountains SAC

The results of the Step 5 cumulative assessment on ecologically sensitive receptors on the Galtee Mountain SAC are presented in Table 10.

The results show that the worst-case cumulative impact due to the pig farm in combination with other IAIs that meet the requirements of Step 5 are:

- 1.8% of the critical level for ammonia
- 2.1% of the critical load for nitrogen deposition.

The predicted impacts are considerably lower than the 20% threshold level defined in Step 5 EPA's Ammonia and Nitrogen Assessment Guidance at all ecologically sensitive receptor locations modelled on the Galtee Mountain SAC.

Table 10 **The predicted cumulative ground-level concentrations of ammonia and annual average flux rate of nitrogen deposition at the ecologically sensitive locations on the Galtee Mountain SAC due to the pig farm in combination with background facilities that meet the requirements of Step 5**

Receptor	Concentration of ammonia (µg/m³)		PC as a percentage of Critical Level	Nitrogen Deposition Flux (kg/ha/yr)		PC as a percentage of Critical Load
	Process Contribution (Pig Farm)	Critical Level		Process Contribution (Pig Farm)	Critical Load	
DR1	0.0050	1.0	0.5%	0.031	5.0	0.6%
DR2	0.0055	1.0	0.6%	0.035	5.0	0.7%
DR3	0.0061	1.0	0.6%	0.039	5.0	0.8%
DR4	0.0066	1.0	0.7%	0.041	5.0	0.8%
DR5	0.0073	1.0	0.7%	0.046	5.0	0.9%
DR6	0.0091	1.0	0.9%	0.057	5.0	1.1%
DR7	0.0099	1.0	1.0%	0.062	5.0	1.2%
DR8	0.0106	1.0	1.1%	0.067	5.0	1.3%
DR9	0.0123	1.0	1.2%	0.077	10.0	0.8%
DR10	0.0125	1.0	1.3%	0.079	5.0	1.6%
DR11	0.0148	1.0	1.5%	0.093	5.0	1.9%
DR12	0.0156	1.0	1.6%	0.098	10.0	1.0%
DR13	0.0106	1.0	1.1%	0.067	5.0	1.3%
DR14	0.0070	1.0	0.7%	0.044	5.0	0.9%
DR15	0.0126	1.0	1.3%	0.079	5.0	1.6%
DR16	0.0128	1.0	1.3%	0.081	10.0	0.8%
DR17	0.0104	1.0	1.0%	0.066	10.0	0.7%
DR18	0.0118	1.0	1.2%	0.074	10.0	0.7%

Receptor	Concentration of ammonia (µg/m³)		PC as a percentage of Critical Level	Nitrogen Deposition Flux (kg/ha/yr)		PC as a percentage of Critical Load
	Process Contribution (Pig Farm)	Critical Level		Process Contribution (Pig Farm)	Critical Load	
DR19	0.0115	1.0	1.2%	0.073	5.0	1.5%
DR20	0.0125	1.0	1.2%	0.078	5.0	1.6%
DR21	0.0094	1.0	0.9%	0.059	5.0	1.2%
DR22	0.0102	1.0	1.0%	0.064	10.0	0.6%
DR23	0.0076	1.0	0.8%	0.048	5.0	1.0%
DR24	0.0079	1.0	0.8%	0.050	5.0	1.0%
DR25	0.0086	1.0	0.9%	0.054	10.0	0.5%
DR26	0.0067	1.0	0.7%	0.042	5.0	0.8%
DR27	0.0070	1.0	0.7%	0.044	5.0	0.9%
DR28	0.0085	1.0	0.8%	0.053	10.0	0.5%
DR29	0.0077	1.0	0.8%	0.048	10.0	0.5%
DR30	0.0066	1.0	0.7%	0.041	10.0	0.4%
DR31	0.0060	1.0	0.6%	0.038	10.0	0.4%
Cumulative assessment criteria			**20%**	**Cumulative assessment Criteria**		**20%**

6.3.2 Step 5 Cumulative Assessment – Moanour Mountains SAC

The results of the Step 5 cumulative assessment on ecologically sensitive receptors on the Moanour Mountain SAC are presented in Table 11.

The results show that the worst-case cumulative impact due to the pig farm in combination with other IAIs that meet the requirements of Step 5 are:

- 2.1% of the critical level for ammonia
- 3.3% of the critical load for nitrogen deposition.

The predicted impacts are considerably lower than the 20% threshold level defined in Step 5 EPA's Ammonia and Nitrogen Assessment Guidance at all ecologically sensitive receptor locations modelled on the Moanour Mountain SAC.

Table 11 **The predicted cumulative ground-level concentrations of ammonia and annual average flux rate of nitrogen deposition at the ecologically sensitive locations on the Galtee Mountain SAC due to the pig farm in combination with background facilities that meet the requirements of Step 5**

Receptor	Concentration of ammonia (µg/m³)				PC as a percentage of Critical Level	Nitrogen Deposition Flux (kg/ha/yr)				PC as a percentage of Critical Load
	Process Contribution (Pig Farm)	Background Farm	Cumulative	Critical Level		Process Contribution (Pig Farm)	Background Farm	Cumulative	Critical Load	
DR38	0.017	0.006	0.023	1.0	2.3%	0.11	0.04	0.14	10.0	1.4%
DR39	0.018	0.007	0.025	1.0	2.5%	0.11	0.05	0.16	10.0	1.6%
DR40	0.017	0.008	0.025	1.0	2.5%	0.11	0.05	0.16	10.0	1.6%
DR41	0.015	0.011	0.026	1.0	2.6%	0.09	0.07	0.16	10.0	1.6%
DR42	0.013	0.016	0.029	1.0	2.9%	0.08	0.10	0.18	10.0	1.8%
DR43	0.013	0.018	0.031	1.0	3.1%	0.08	0.11	0.19	10.0	1.9%
DR44	0.012	0.013	0.025	1.0	2.5%	0.08	0.08	0.16	10.0	1.6%
DR45	0.013	0.010	0.024	1.0	2.4%	0.08	0.07	0.15	10.0	1.5%
DR46	0.015	0.008	0.023	1.0	2.3%	0.09	0.05	0.14	10.0	1.4%
Cumulative assessment criteria					**20%**	**Cumulative assessment criteria**				**20%**

7. CONCLUSIONS

Ballyfaskin Enterprises commissioned Katestone to complete an ammonia impact assessment (AIA) for a pig farm located at Ballylanders, County Limerick, V35 KV12 (Site).

Ballyfaskin Enterprises proposes to:

- Increase pig numbers at the Site.
- Reconfigure the exhausts of naturally ventilated sheds at the Site with mechanically ventilated chimney stacks to reduce the potential impact of emissions to the atmosphere.

The assessment is required to determine the potential impact of ammonia emissions from the proposed development at the pig farm on ecologically sensitive locations on nearby Natura 2000 sites. The assessment will be submitted as part of planning and licensing applications for the pig farm.

The AIA was conducted in accordance with:

- The stepwise procedure described in EPA's Ammonia and Nitrogen Assessment Guidance (EPA, 2021).
- Recognised techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). The dispersion model, CALPUFF, was used to predict ground-level concentrations of ammonia and nitrogen deposition flux rates across the model domain due to the pig farm.

The results of the AIA are presented here:

- The results of the Step 1 assessment indicated that:
    - The approaches using the SCAIL-Agriculture model described in Step 2 and Step 3 of the EPA's Ammonia and Nitrogen Assessment Guidance are not applicable
    - A detailed assessment completed in accordance with Step 4 of EPA's Ammonia and Nitrogen Assessment Guidance is, therefore, required to be completed.
- The results of the Step 4 assessment show that, in relation to the 1% threshold identified in Step 4 of EPA's Ammonia and Nitrogen Assessment Guidance, the PC due to the expanded pig farm:
    - Exceeds for ammonia and nitrogen deposition at a number of modelled discrete receptor locations on:
        - The Galtee Mountains SAC (Receptors – 1 - 31)
        - The Moanour Mountain SAC (Receptors – 38 - 46).
    - Does not exceed at any of the modelled discrete receptor locations on the River Suir SAC (Receptors –32 - 37).
- The results of the Step 4 assessment indicate that a Step 5 assessment, involving detailed modelling that takes account of in-combination effects, is required for the modelled sensitive locations on the Galtee Mountains SAC and the Moanour Mountains SAC.
- The Step 5 assessment requires a review of background IAIs that needed to be included in the in-combination assessment. This review determined:
    - There is no requirement for a cumulative assessment of impacts on the Galtee Mountains SAC as no IAI meets the requirements of Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance to be included. Accordingly, the cumulative impact on the Galtee Mountains SAC of all IAI as defined in Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance is equal to the impact of the pig farm in isolation.

    - The single IAI within the 5 km setback distance of the Moanour Mountains SAC that meets the requirements of Step 5 of EPA's Ammonia and Nitrogen Assessment Guidance should be included in a cumulative assessment of the impacts on Moanour Mountains SAC.

- The Step 5 assessment included an in-combination assessment of the pig farm and IAIs that met the requirement for inclusion in the modelling assessment. The results of the in-combination assessments show that:
    - At the Galtee Mountains SAC the worst-case cumulative impact due to the pig farm in combination with other IAIs that meet the requirements of Step 5 was well below in-combination assessment level of 20% with the highest modelled results at any of the modelled sensitive locations being:
        - 1.6% of the critical level for ammonia
        - 1.9% of the critical load for nitrogen deposition.
    - At the Moanour Mountains SAC the worst-case cumulative impact due to the pig farm in combination with other IAIs that meet the requirements of Step 5 was well below in-combination assessment level of 20% with the highest modelled results at any of the modelled sensitive locations being:
        - 3.1% of the critical level for ammonia
        - 1.9% of the critical load for nitrogen deposition.

The results of the assessment therefore indicate that:

- The impacts of the proposed pig farm in isolation are under EPA limits and therefore **complies** with the Step 4 evaluation criteria at all modelled locations on the River Suir SAC
- The cumulative impacts of the proposed pig farm with background IAIs are under EPA limits and therefore **complies** with the Step 5 evaluation criteria at all modelled locations on:
    - The Galtee Mountains SAC
    - The Moanour Mountains SAC.

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APPENDIX A MODELLING METHODOLOGY

A1 METEOROLOGICAL MODELLING

A1.1 TAPM

The meteorological model, TAPM (The Air Pollution Model) Version 4.0.5, was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, southeast Asia, North America and Ireland. Katestone has used the TAPM model throughout Australia and has performed well for simulating regional winds patterns. Katestone has recently used the TAPM model to generate gridded data over Cork city and Harbour. The data generated correlated well with observed data at Cork Airport. TAPM has proven to be a useful model for simulating meteorology in locations where monitoring data is unavailable.

TAPM requires synoptic meteorological information for the region surrounding the project. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data are supplied on a grid resolution of approximately 75 km, and at elevations of 100 metres to five kilometres above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM resolves local terrain and land-use features that may influence local meteorology and generates a meteorological dataset that is representative of Site-specific geographic conditions. A year of synoptic data must be selected as input for TAPM. The selection of this year should be such that the year is representative of typical meteorological conditions (and therefore is not necessarily the most recent year of available data) and whether monitoring data is available for the time period to validate the output dataset. In addition, Katestone's experience elsewhere suggests that variability of dispersion meteorological conditions from year to year are unlikely to change the outcome of the air quality assessment.

TAPM was configured as follows:

- 40 x 40 grid point domain with an outer grid resolution of 30 kilometres and nesting grids of 10, 3. 1 and 0.3 kilometres.
- 5 modelled years (1 January 2016 to 31 December 2020)
- Grid centered near the Project Site at latitude 52°23’30 and longitude -8°15’0
- US Geological Survey EROS global terrain height database
- TAPM default land use database, modified to be consistent with aerial imagery in the innermost grid
- 25 vertical grid levels
- No data assimilation.

A1.2 CALMET meteorological modelling

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple Sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.5.0) was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 1 km grid. CALMET treats the prognostic model

output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was configured with twelve vertical levels with heights at 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres at each grid point.

All options and factors were selected in accordance with NSW EPA CALPUFF Guidance released by TRC Environmental in 2011 except where noted below.

Key features of CALMET used to generate the wind fields are as follows:

- Domain area of 151 x 151 grid cells at 200m spacing
- 5 years modelled (1 January 2016 to 31 December 2020)
- Prognostic wind fields input as MM5/3D.dat for “initial guess” field (as generated by TAPM)
- Gridded cloud cover from prognostic relative humidity at all levels
- No extrapolation of surface wind observations to upper layers (not used in no-obs mode)
- Terrain radius of influence set to 5 km
- Maximum search radius of 10 grid cells in averaging process
- Use prognostic relative humidity
- Land use data modified to be consistent with aerial imagery.

All other options set to default.

A2 CALPUFF DISPERSION MODELLING

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 20 x 20 grid cells at 200m spacing, which is a sub-set of the CALMET domain centred on the Site
- 5 years modelled (1 January 2016 to 31 December 2020)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables.

All other options set to default.

APPENDIX B – BACKGROUND FARM

A single sub-licence threshold IAI was identified that:

- Is within the 5 km setback distance for sub-licence threshold facilities of the Moanour Mountain SAC
- Was constructed since 2015, which is the year that current baseline levels identified in SCAIL-Agriculture are based on.

The IAI identified is a poultry facility (background farm) used to house egg laying hens. It was included in the CALPUFF dispersion modelling assessment to determine its impacts on the Moanour Mountain SAC. A description of the poultry farm and its configuration in the modelling assessment is presented here.

The background farm includes two housing units used to accommodate egg laying hens. A single housing unit was approved by Tipperary County Council in 2009 (Planning Reference 09696). This housing unit was built in 2020. A further planning application was made in 2022 (Planning Reference 22545) for a second housing unit at the site that would increase bird numbers at the site to 17,500 laying hens.

The modelling parameters and emission rates used to represent the two housing units in the CALPUFF assessment are presented in this section. The modelling parameters

The ammonia emission factor used to estimate emissions from these houses was 0.29 kg/bird place/year which is the emission factor for barn and free range laying hens published in the SCAIL-Agriculture model. This is the highest ammonia emission factor for any type of egg laying hen in the SCAIL-Agriculture model and is considered to provide a conservative basis for the determination of emissions from the background farm. There are 10 exhaust stacks on each poultry house and total ammonia emissions from the site were distributed evenly from each of these exhaust stacks resulting in an ammonia emission rate of 0.00804 g/s/stack.

Table B1 Modelling parameters adopted for the background farm in the CALPUFF modelling assessment

Source Number	x-coordinate	y-coordinate	Base Elevation	Stack Height[1]	Diameter[1]	Temp	Velocity
	km	km	m	m	m	°C	m/s
BG_1_1_1	549003	5811028	126.6	5.11	0.6	18	3.0
BG_1_1_2	549010	5811033	126.7	5.11	0.6	18	3.0
BG_1_1_3	549017	5811039	126.7	5.11	0.6	18	3.0
BG_1_1_4	549024	5811043	126.7	5.11	0.6	18	3.0
BG_1_1_5	549031	5811048	126.8	5.11	0.6	18	3.0
BG_1_1_6	549038	5811053	126.8	5.11	0.6	18	3.0
BG_1_1_7	549044	5811059	126.8	5.11	0.6	18	3.0
BG_1_1_8	549051	5811064	126.7	5.11	0.6	18	3.0
BG_1_1_9	549058	5811069	126.7	5.11	0.6	18	3.0
BG_1_1_10	549065	5811074	126.7	5.11	0.6	18	3.0
BG_1_2_1	549018	5811009	126.6	5.11	0.6	18	3.0
BG_1_2_2	549025	5811014	126.7	5.11	0.6	18	3.0
BG_1_2_3	549031	5811019	126.7	5.11	0.6	18	3.0
BG_1_2_4	549038	5811024	126.7	5.11	0.6	18	3.0
BG_1_2_5	549045	5811029	126.7	5.11	0.6	18	3.0
BG_1_2_6	549052	5811035	126.8	5.11	0.6	18	3.0
BG_1_2_7	549059	5811039	126.8	5.11	0.6	18	3.0
BG_1_2_8	549066	5811044	126.8	5.11	0.6	18	3.0
BG_1_2_9	549073	5811049	126.7	5.11	0.6	18	3.0
BG_1_2_10	549079	5811055	126.7	5.11	0.6	18	3.0

[1] The stack heights and diameters were taken from site drawings submitted with Tipperary Co. Co. planning application 22545
[2] A temperature of 18°C was used to represent the exhaust velocity for egg laying birds. This is the target temperature for the efficient production of eggs from egg laying birds
[3] There is limited data on the types of fans used to ventilate the poultry sheds in Tipperary Co. Co. planning application 22545. A conservative air flowrate of 3.0 m/s was adopted in the assessment which is highly conservative

Odour Impact Assessment – Integrated Pig Farm at Ballylanders, Limerick

Prepared for:

Ballyfaskin Enterprises Ltd

May 2024

Final

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Glossary

Term	Definition
g/s	gram per second
kg	kilogram
kg/m³	Kilogram per cubic meter
km	kilometre
km/hr	kilometre per hour
m	metre
m/s	metres per second
m^2	square metres
m^3	cubic metres
m^3/s	cubic metres per second
m³/hr	cubic metres per hour
mg	milligram
Z_0	roughness length
ou_E/m^3	European odour unit per cubic meter
ou_E/s	European odour unit per second
µg/m³	micrograms per cubic meter

Abbreviations	Definition
AG4	Air Guidance 4
BAT	Best available techniques
EPA	Environmental Protection Agency
EF	Emission factor
EU	European Union

EXECUTIVE SUMMARY

Ballyfaskin Enterprises commissioned Katestone to complete an odour impact assessment (OIA) for a pig farm located at Ballylanders, County Limerick (Site).

Ballyfaskin Enterprises proposes to:

- Increase pig numbers at the Site
- Reconfigure the exhausts of naturally ventilated sheds at the Site with mechanically ventilated chimney stacks to reduce the potential impact of emissions to the atmosphere.

The assessment is required to determine the potential impact of odorous emissions from the proposed development at the pig farm on nearby residential locations. The assessment will be submitted as part of an application for an EPA licence review for the pig farm.

The odour assessment was conducted in accordance with recognised techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). The dispersion model, CALPUFF, was used to predict ground-level concentrations of odour across the model domain due to the pig farm. The assessment of odour has also been conducted in accordance with EPA's instruction note for the assessment of odour emissions from intensive agriculture pig installations (EPA, 2022).

Final Report Findings

The odour modelling assessment found that the predicted concentrations of odour at all sensitive receptors are under EPA limits and, therefore, **comply** with odour criterion recommended by EPA for existing pig farms of $5.0ou_E/m^3$ at all modelled sensitive receptor locations.

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by Ballyfaskin Enterprises Limited (Ballyfaskin Enterprises) to complete an odour impact assessment of a pig farm located at Ballylanders, County Limerick (Site).

Ballyfaskin Enterprises proposes to:

- Increase pig numbers at the Site.
- Reconfigure the exhausts of naturally ventilated sheds at the Site with mechanically ventilated chimney stacks to reduce the potential impact of emissions to the atmosphere.

The assessment is required to determine the potential impact of odorous emissions from the pig farm and to inform the design of the farm to ensure concentrations of odour due to emissions from onsite sources are within the acceptable odour level defined by the Environmental Protection Agency (EPA) in Ireland at nearby sensitive receptors.

The pig farm is operated in accordance with the requirements of an Industrial Emissions License (IEL). EPA issued an Integrated Pollution Prevention and Control (IPPC) licence (Register number P0915-01) for the housing units on 10 June 2013 (EPA, 2013a). The IPPC licence was amended to an IEL, which was issued by EPA to Ballyfaskin Enterprises on 16 December 2013 (EPA, 2013b).

This odour impact assessment was undertaken using dispersion modelling techniques. The dispersion modelling has been completed in accordance with the requirements of EPA's Air Dispersion Modelling Guidance Note (AG4). The assessment of odour has also been conducted in accordance with EPA's instruction note for the assessment of odour emissions from intensive agriculture pig installations (EPA, 2022).

2. OVERVIEW OF THE PIG FARM

The pig farm is located approximately 2.2 km east of the village of Ballylanders, Co. Limerick. It is located in an area of complex terrain being close to the lowest point of the valley. The Site is surrounded by elevated terrain, predominantly the Galtee Mountains. There are number of rural residences in the vicinity of the Site. The licence boundary of the Site and its environs are presented in Figure 1. All pig housing units will be located within the licence boundary of the Site.

A Site plan illustrating the layout of the housing units is presented in Figure 2.

The housing units will have the following maximum animal holding capacity as part of the licence review application:

- 1,000 sows (725 dry sows and 275 farrowing sows)
- 166 gilts
- 5 boars
- 4,000 weaners
- 3,957 Fattener pigs (Growers and finishers).

A number of the housing units at the Site are naturally ventilated. As part of the proposed development, emissions from all housing units will be captured and ventilated through elevated chimney stacks. This will significantly reduce the potential impact of emissions in the vicinity of the Site.

The following buildings identified in Figure 2 are currently naturally ventilated and will be upgraded with a mechanical ventilation system as part of the proposed development.

- Building 1 (Stack Height of 8 m)
- Building 2 (Stack Height of 8 m)
- Building 3 (Stack Height of 8 m)
- Building 7 (Stack Height of 6.8 m).

Figure 1 **Ballyfaskin pig farm proposed Site boundary (red line) and the surrounding environment**

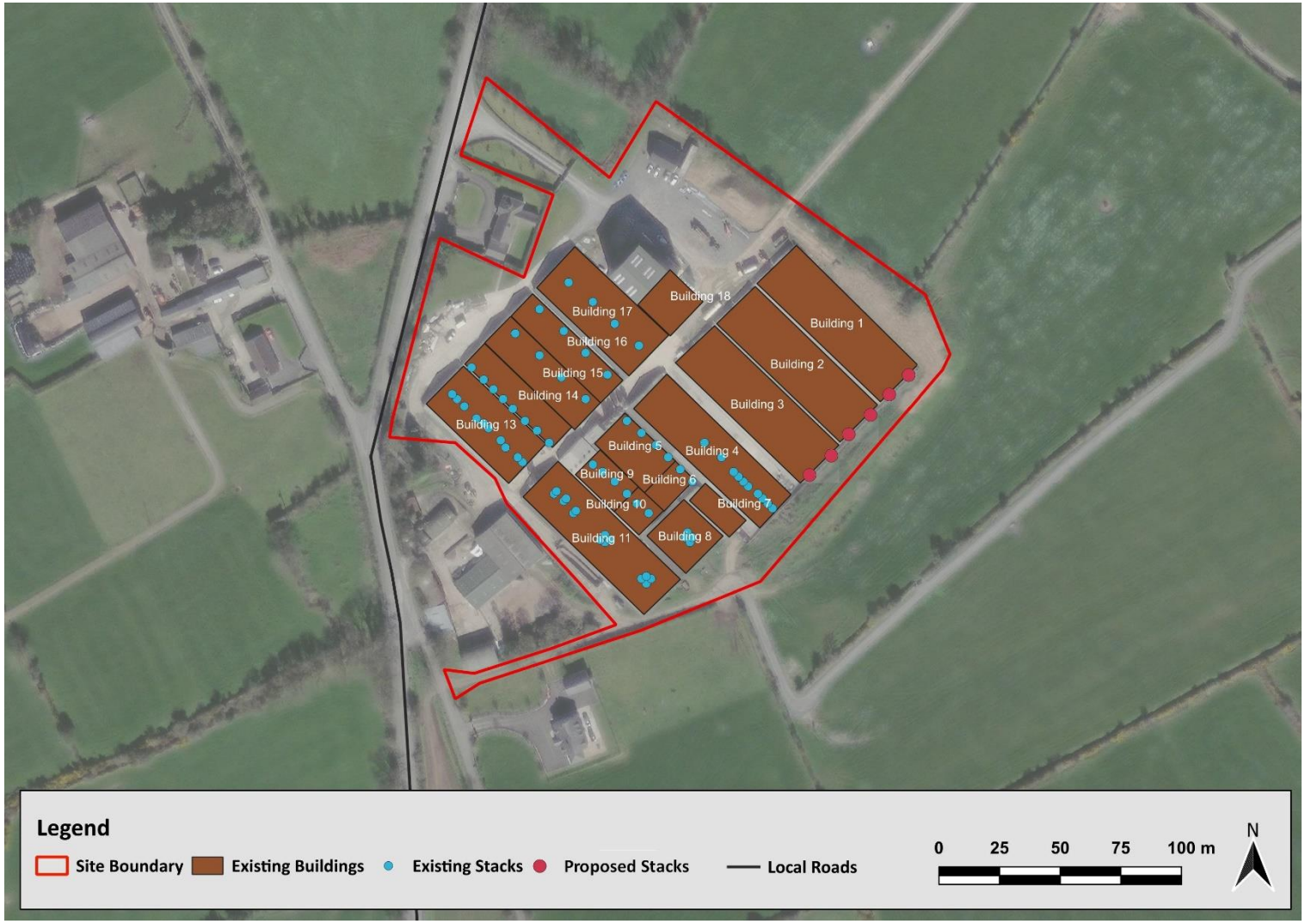

Figure 2 **Ballyfaskin pig farm Site plan – existing and proposed housing units and existing and proposed chimney stacks**

3. REGULATORY FRAMEWORK AND ASSESSMENT CRITERIA

3.1 *Environmental Protection Agency Acts 1992 and 2003*

The *Environmental Protection Agency Act 1992 (EPA Act)* and Part 2 of the *Protection of the Environment Act 2003* are collectively referred to as the *Environmental Protection Agency Acts 1992 and 2003*. These Acts provide for the management of air emissions from activities (meaning any process, development or operation) that are listed in the First Schedule of the Acts.

Section 4 (2) of the *Environmental Protection Agency Acts 1992 and 2003* defines Air Pollution as follows:

> *"…the direct or indirect introduction to an environmental medium, as a result of human activity, of substances, heat or noise which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment, and includes -*
>
> *(a) 'air pollution' for the purposes of the Air Pollution Act 1987,*
>
> *(b) ……..*
>
> *(c) ……."*

The *Air Pollution Act 1987* (AP Act) provides for the control of air pollution and other matters connected with air pollution. Under the AP Act 'pollutant' means any substance that is specified in the First Schedule or any other substance (including a substance which gives rise to odour) or energy which, when emitted into the atmosphere either by itself or in combination with any other substance, may cause air pollution.

Section 4 of the AP Act defines air pollution as follows:

> *"Air pollution" in this Act means a condition of the atmosphere in which a pollutant is present in such a quantity as to be liable to —*
>
> *(i) be injurious to public health, or*
>
> *(ii) have a deleterious effect on flora or fauna or damage property, or*
>
> *(iii) impair or interfere with amenities or with the environment."*

Section 24 of the AP Act details the obligations of the occupier of a premises in respect to preventing emissions, nuisance and what constitutes defences against prosecution:

> *(1) The occupier of any premises, other than a private dwelling, shall use the best practicable means to limit and, if possible, to prevent an emission from such premises.*
>
> *(2) The occupier of any premises shall not cause or permit an emission from such premises in such a quantity, or in such a manner, as to be a nuisance.*
>
> *(3) In any prosecution for a contravention of this section, it shall be a good defence to establish that—*
>
> *(a) the best practicable means have been used to prevent or limit the emission concerned, or*
>
> *(b) the emission concerned was in accordance with a licence under this Act, or*
>
> *(c) the emission concerned was in accordance with an emission limit value, or*

(d) the emission concerned was in accordance with a special control area order in operation in relation to the area concerned, or

(e) in the case of an emission of smoke, the emission concerned was in accordance with regulations under section 25, or

(f) the emission did not cause air pollution.

Section 75 (1) of the *Environmental Protection Agency Acts 1992 and 2003* requires the EPA to publish reasonable and desirable quality objectives to protect the environment, namely:

"The Agency shall, in relation to any environmental medium and without prejudice to its functions under section 103, specify and publish quality objectives which the Agency considers reasonable and desirable for the purposes of environmental protection."

3.2 Odour

In 2001, the EPA issued an assessment framework that "*aims to define a set of criteria for odour exposure to achieve a common environmental quality objective in licencing procedures"* (EPA, 2001). This framework is specific to intensive pig units; however, in the absence of other environmental quality objectives specified by EPA, the criterion for odour exposure to intensive pig units has been adopted for this assessment. The Environmental Quality criteria are:

- *Target value:* $C_{98,\ 1\text{-}hour} \leq 1.5\ ou_E/m^3$
    - *The target value provides a general level of protection against odour annoyance for the general public, aiming to limit the percentage of people experiencing some form of odour-induced annoyance to 10% or less. The target value is to be used as an environmental quality target for all situations.*
    - *The target value is achieved when the calculated odour exposure for all locations of odour sensitive receptors is less than an hourly average odour concentration of 1.5* ou_E/m^3 *in 98% of all hours in an average meteorological year.*
- *Limit value for new pig production units:* $C_{98,\ 1\text{-}hour} \leq 3.0\ ou_E/m^3$
    - *The limit value for new pig production units provides a minimum level of protection against odour annoyance, aiming to limit the percentage of those experiencing some form of odour-induced annoyance to 10% or less in the general public, assuming some degree of acceptance of the rural nature of their living environment.*
    - *The limit value for new pig production units shall not be exceeded in the vicinity of new pig production units to ensure a minimum environmental quality. The limit value for new pig production units is complied with when for all locations of odour sensitive receptors the calculated odour exposure is less than an hourly average odour concentration of 3.0* ou_E/m^3 *in 98% of all hours in an average meteorological year.*
- *Limit value for existing pig production units:* $C_{98,\ 1\text{-}hour} \leq 6.0\ ou_E/m^3$
    - *The limit value for existing pig production units provides a minimum level of protection against odour annoyance, aiming to limit the percentage of people experiencing some form of odour-induced annoyance to 10% or less*
    - *The limit value for existing pig production units shall not be exceeded in the vicinity of existing pig production units to ensure the minimum environmental quality in an agricultural setting. A phased plan must be made to reduce the odour impact, with time, to the limit value for new pig production units and, eventually, the target value. The limit value for existing production units is complied with when for all locations of odour sensitive receptors the calculated odour exposure*

is less than an hourly average odour concentration of 6.0 ou_E/m^3 in 98% of all hours in an average meteorological year.

In 2020, EPA released an updated version of its dispersion modelling guidance titled Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA, 2020a). AG4 includes an appendix that describes *Relevant Odour Standards*. It states:

Currently there is no general statutory odour standard in Ireland relating to industrial installations. The EPA(53) has issued guidance specific to intensive agriculture which has outlined the following standards:

- *Target value for new pig-production units of 1.5 OUE/m3 as a 98th%ile of one hour averaging periods,*
- *Limit value for new pig-production units of 3.0 OUE/m3 as a 98th%ile of one hour averaging periods,*
- *Limit value for existing pig-production units of 6.0 OUE/m3 as a 98th%ile of one hour averaging periods.*

Guidance from the UK (EA, 2011, and adapted for Irish EPA use) recommends that odour standards should vary from 1.5 – 6.0 OUE/m3 as a 98th%ile of one hour averaging periods at the worst-case sensitive receptor based on the offensiveness of the odour and with adjustments for local factors such as population density (54). A summary of the indicative criterion is given below in Table A4:

In 2022, EPA issued a document titled "Instruction note for the assessment of odour emissions from Intensive Agriculture pig installations" (EPA, 2022) which is referred to here as the EPA 2022 Pig Instruction Note. Its stated objective is to:

"provide applicants with a methodology on how to screen for and assess odour impacts from the licensable intensive agriculture pig sector, as well as assisting in how applicants can demonstrate compliance with BAT 13 (to reduce odour emissions and / or odour impact) of the Commission Implementing Decision (CID) 2017/302. This instruction note replaces the EPA's 2001 'Odour Impacts and Odour Emission Control Measures for Intensive Agriculture' guidance document and screening methodology.".

The EPA 2022 Pig Instruction Note sets out acceptable odour levels, below which licenced Sites can operate without generating unacceptable odour pollution at sensitive receptors. According to the EPA 2022 Pig Instruction Note, the acceptable odour levels specific to intensive agriculture are defined as follows:

- 3.0 ou_E/m^3 for new pig-production units
- 5.0 ou_E/m^3 for existing pig-production units (includes Sites licensed by the EPA between 2001 and 15th February 2017 only)
- 6.0 ou_E/m^3 for existing pig-production units (includes Sites licensed by the EPA prior to 2001 and not reviewed since this date only).

The acceptable odour levels are based on the 98th percentile of hourly mean concentrations of odour modelled over a year at the odour-sensitive locations.

The EPA 2022 Pig Instruction Note states that applicability of the above levels will be at odour-sensitive locations only. Note, for the purposes of this instruction note, the applicant's dwelling and farmyard are not considered to be odour sensitive locations. Where there are no third-party odour-sensitive receptors present, a higher odour level may be considered acceptable e.g., at the applicant's dwelling, farmyard, or countryside.

The odour level that is applicable to the pig farm is 5.0 ou_E/m^3 reported at the 98th percentile of hourly mean concentrations of odour modelled over a year at the odour-sensitive locations.

4. EXISTING ENVIRONMENT

This section presents information on the existing environment in the vicinity of the Site, within the dispersion modelling domain and within the meteorological modelling domain. The meteorological modelling domain has been characterised using geophysical data (terrain and land use) and meteorological data.

The extents of the dispersion modelling domain were determined based on the locations of the nearest sensitive odour receptors in all directions from the Site. If the dispersion modelling assessment shows compliance with the acceptable odour level at the nearest sensitive receptors it indicates that odour levels will be lower at sensitive receptor locations further afield

4.1 Local terrain and land-use

The Site is in a remote rural location surrounded by pasture. There is a small amount of forestry located between the pig farm and the village of Ballylanders approximately 700 m west of the pig farm.

The pig farm is located in an area of complex terrain that will have significant effects on the meteorological patterns in the vicinity of the of the Site. The location of the Site in a valley and proximity to numerous hills and mountain ranges around the Site will result in unique weather patterns.

The pig farm is located in a valley at an elevation of approximately 170 m. The valley is bound by a number of mountains and hills including:

- The Galtee Mountains that rise to almost 800 m, 6 km east of the pig farm
- The Moanour Mountain that rises to approximately 370 m, 7.8 km northeast of the pig farm
- The Slievereagh Mountains that rise to 465 m, 6.7 km northwest of the pig farm
- Fear Breagach Mountains that rises to 362 m, 8.7 km northwest of the pig farm
- The Ballyhoura Mountains that rise to 528 m 13 km southwest of the pig farm
- Elevated land that runs west to east between the Ballyhoura Mountains and the Galtee Mountains south of the pig farm.

The complexity of the terrain of the modelling domain is presented as:

- A 2-dimenstional surface plot in in Figure 3
- A 3-dimenstional surface plot in in Figure 4.

The mountains and hills on the modelling domain will affect synoptic scale wind patterns in the area by:

- Blocking wind coming from certain directions
- Channelling winds along the valleys created by the hills and mountains
- Creating very specific local air flows under low windspeed conditions due to katabatic and anabatic air flows created by the slopes of the complex terrain.

The predominant valley in which the pig farm is located is created by the Ballyhoura Mountains and Galtee Mountains, which result in a north-south oriented valley.

The complexities of the Site in terms of local terrain and proximity to multiple water bodies are likely to have an important effect on dispersion conditions near the Site and across the modelling domain.

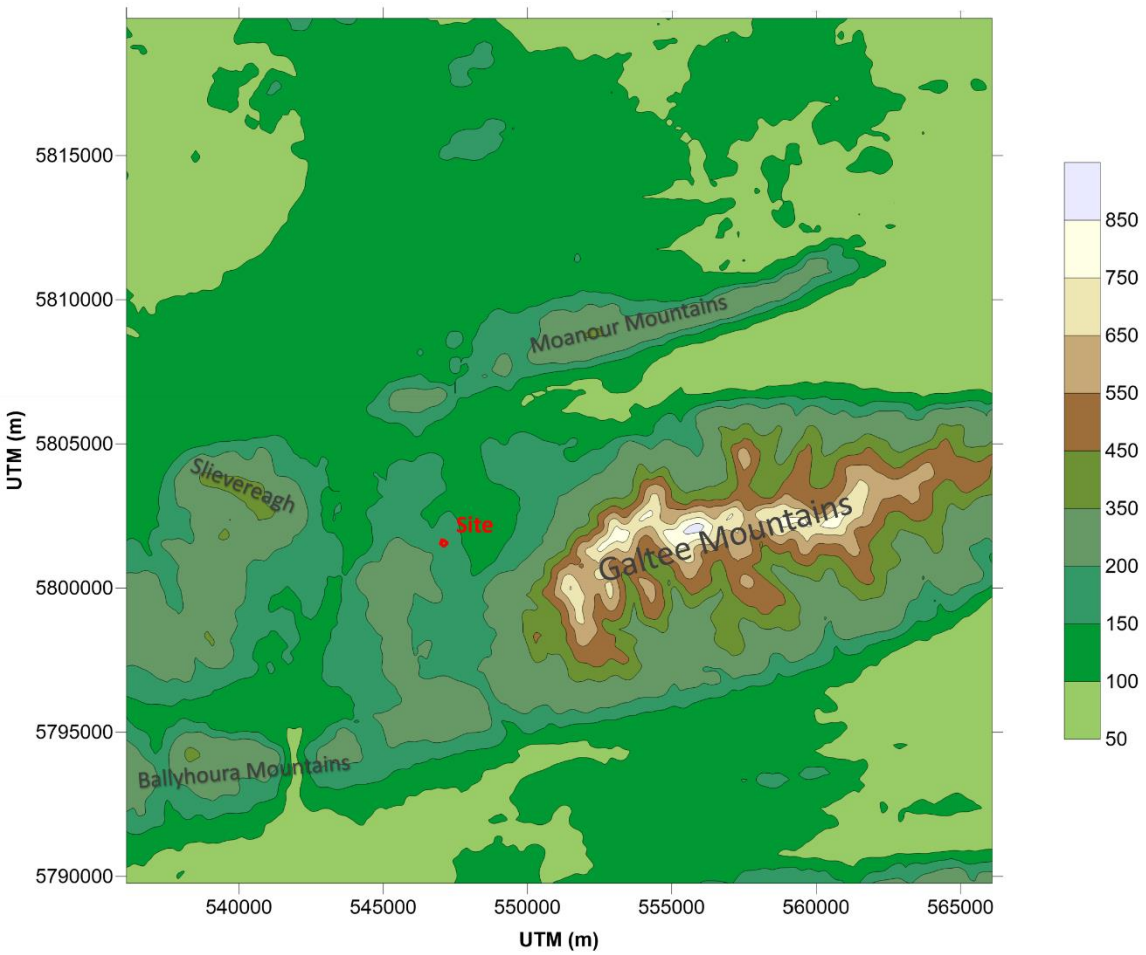

Figure 3 **2-dimensional terrain of the modelled domain**

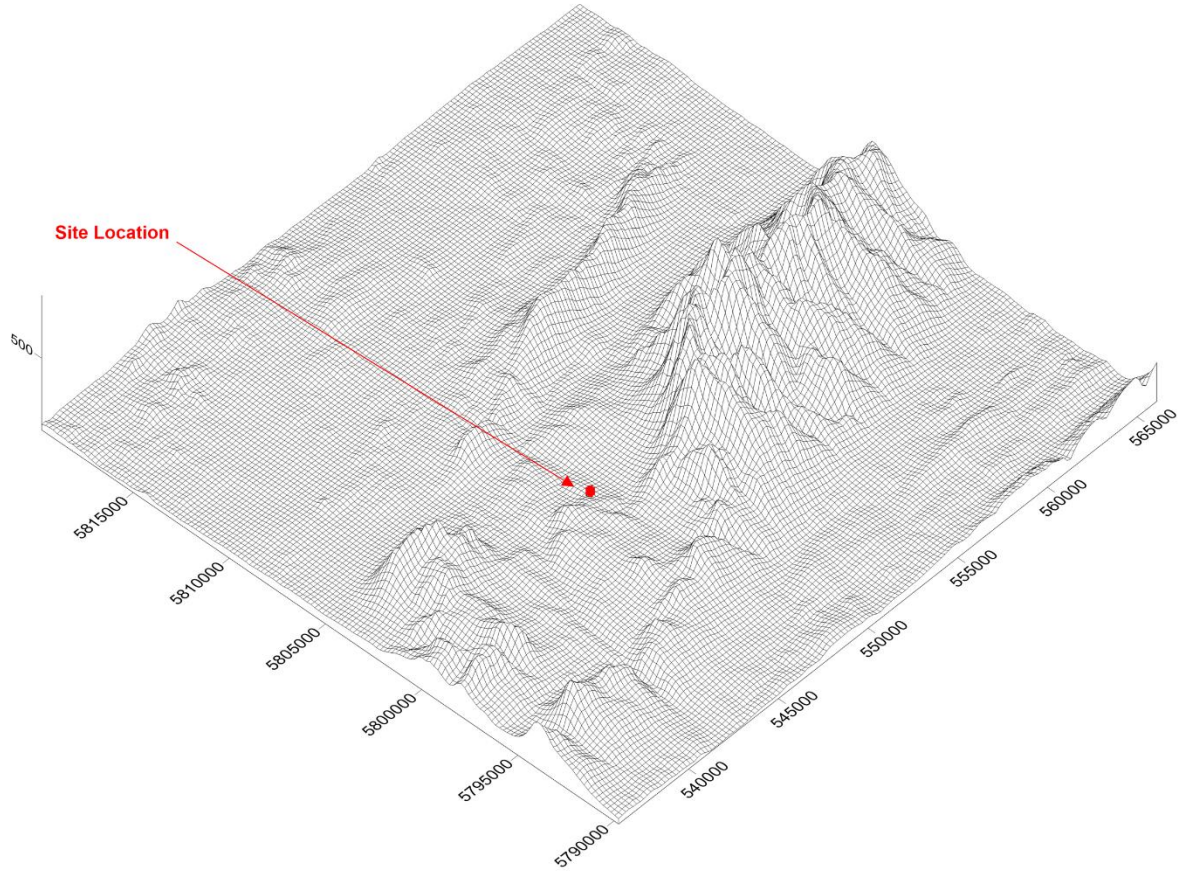

Figure 4 3-dimensional terrain of the modelled domain

4.2 Meteorology

Wind speed and wind direction are important parameters for the transport and dispersion of air pollutants from a source. The winds in the vicinity of the Site have been characterised using a three-dimensional meteorological model called CALMET. The 1-hour average wind speed for the modelling period is 4.33 m/s. This compares to a 1-hour average wind speed of 3.0 m/s at Moore Park between 2011 and 2018 and 4.3 m/s at Gurteen between 2008 and 2018 (EPA, 2020). A wind rose representing the annual distribution of 1-hour average winds is presented in Figure 5.

The prevailing wind direction in Ireland is between south and west. It is clear from Figure 5 that these winds influence wind patterns at the Site; however, due to the elevated terrain the modelling indicates that the south-westerly winds are channelled in a predominant southerly direction at the Site. Daytime winds between 6 am and 6 pm are heavily influenced by the prevailing winds and channelling due to local terrain. During late evening and early morning, prevailing winds also dominate; however, there is also a substantial proportion of winds from the northwest as indicated in the diurnal wind roses (Figure 6).

The seasonal distribution of wind speed and wind direction is presented in Figure 7. The strongest winds at the Site occur most frequently from the south during the winter months. The greatest proportion of light winds occur during summer. There is a distinct north-westerly component to the wind rose in all seasons. A significant proportion of light north westerly winds occur during spring months.

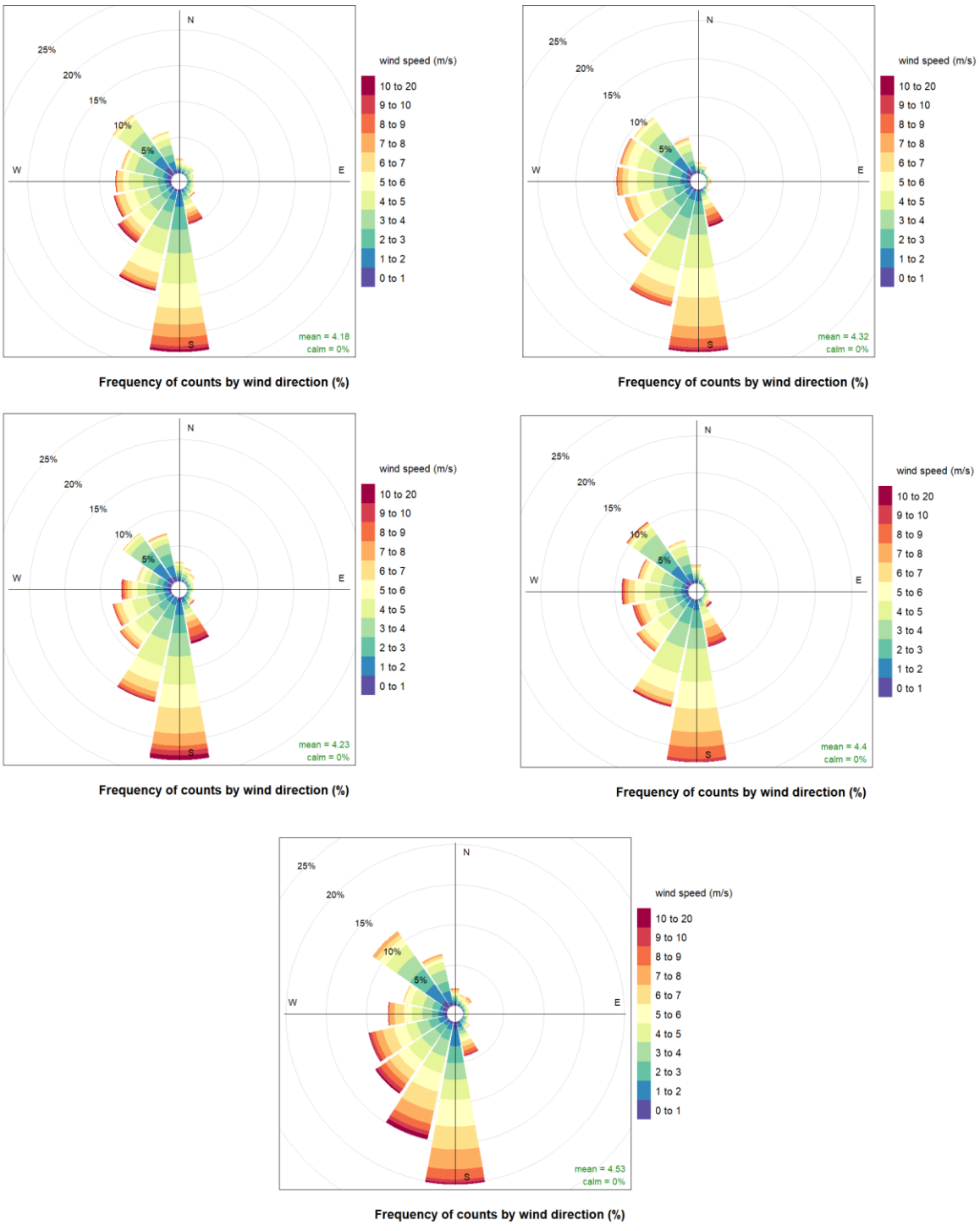

Figure 5 **Annual wind distribution predicted at the Site using CALMET for 2016 (top-left), 2017 (top-right), 2018 (mid-left), 2019 (mid-right) and 2020 (bottom)**

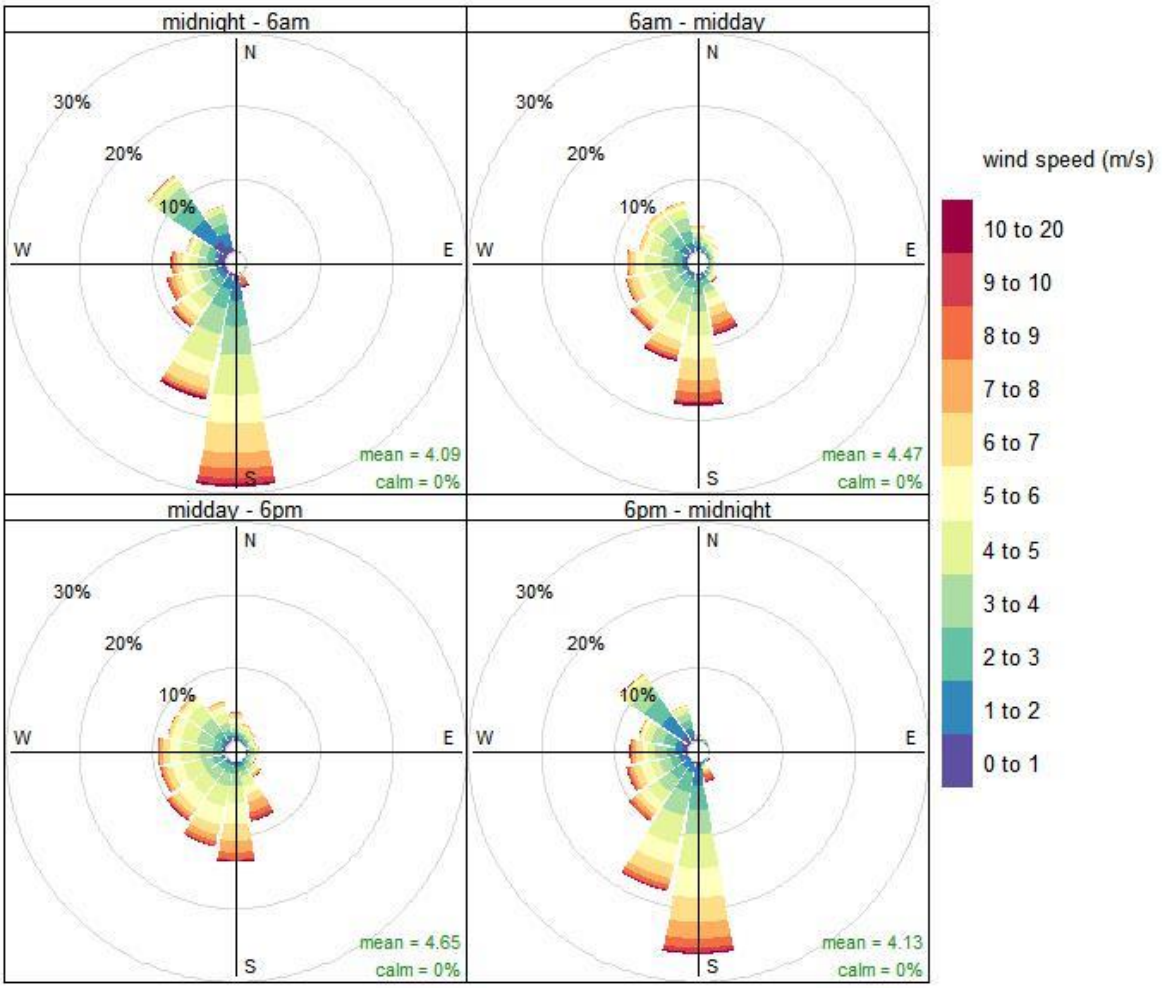

Figure 6 Diurnal wind distribution predicted at the Site using CALMET

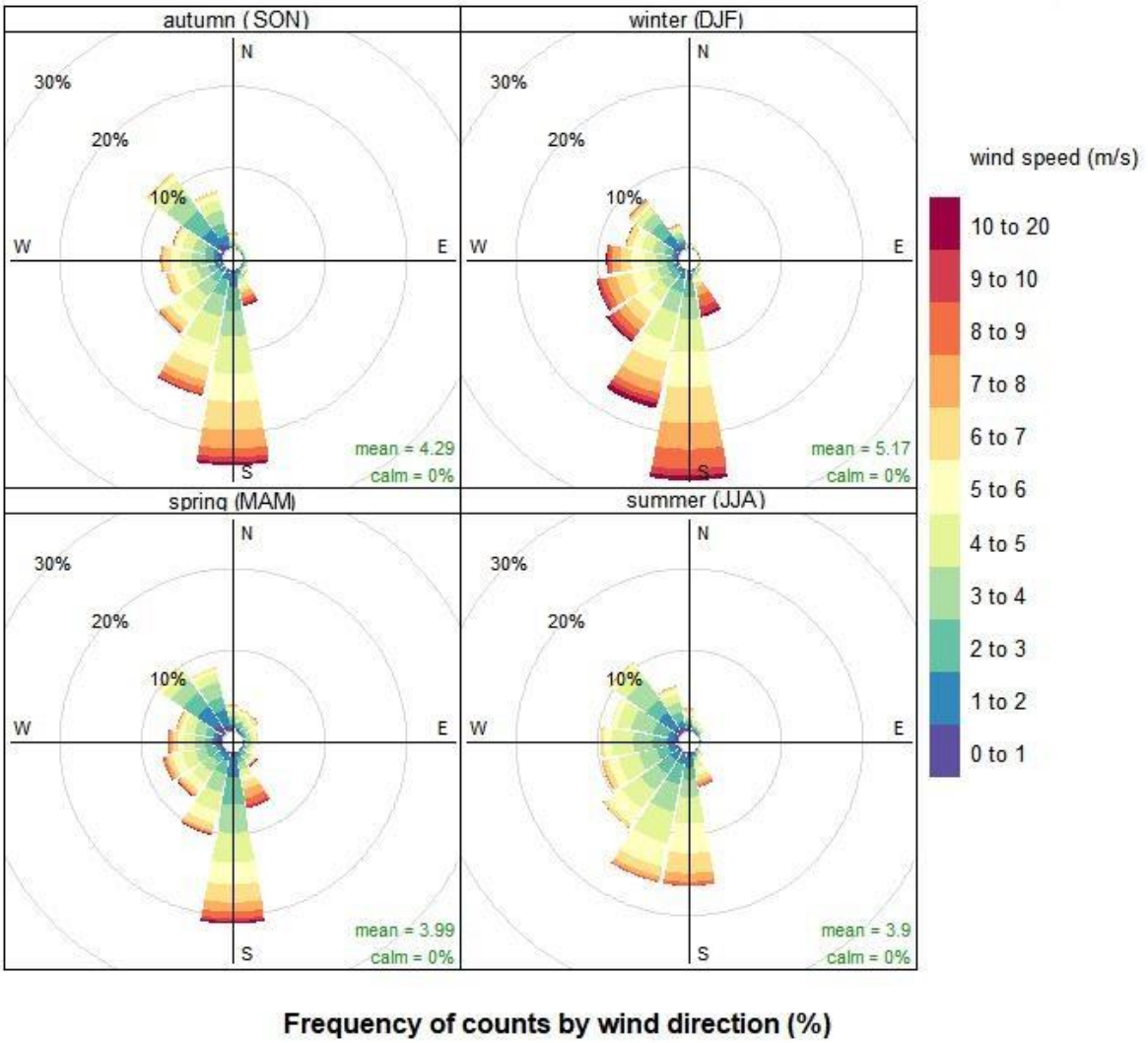

Figure 7 Seasonal wind distribution predicted at the Site using CALMET

4.3 Sensitive receptors

The sensitive receptors that are nearest to the Site are presented in Figure 8. The closest sensitive receptor is 43 m west of the Site boundary and 60 m west of the closest pig housing unit at the Site. Other sensitive receptors are located further away to the north, northeast, east, southeast and south were included in the modelling assessment.

There are two properties located in close proximity to the pig farm, immediately north and south of the Site boundary that are not sensitive receptors. These properties owned by Ballyfaskin Enterprises (owner and father of owner of Ballyfaskin Enterprises).

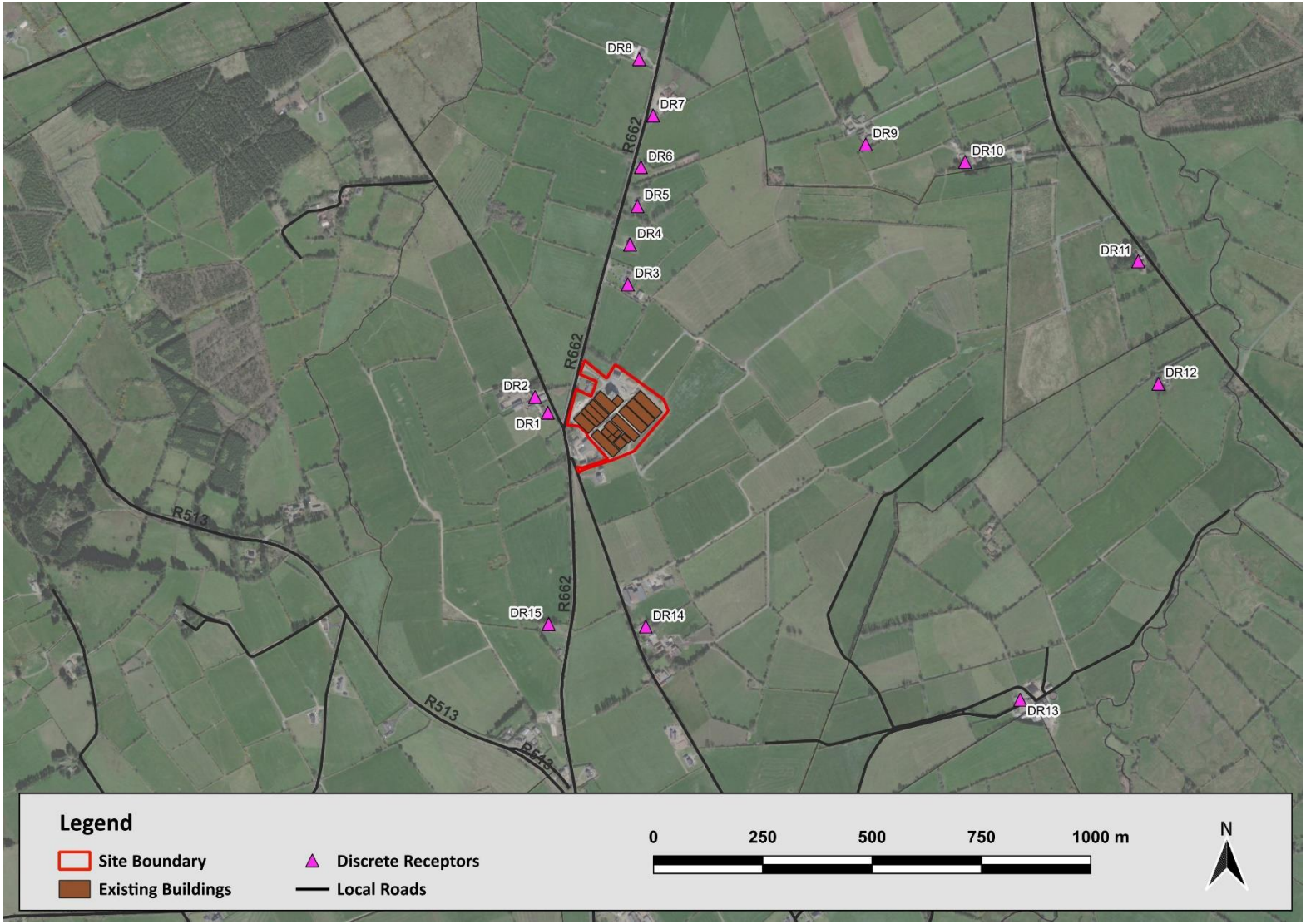

Figure 8 **Nearest sensitive odour receptors to the pig farm**

5. ODOUR IMAPCT ASSESSMENT

5.1 Methodology

The following section describes the modelling methodology that was adopted to assess the potential impacts of odour from the pig farm. The methodology is based on a dispersion modelling study incorporating source characteristics and operational activity data with meteorological data that is representative of the Site and surrounding region. The assessment has been prepared in accordance with industry standards, regulatory requirements and best practice approaches.

The assessment methodology has included:

- Selection of odour assessment criteria from Irish guidance.
- Derivation of an emissions inventory for the pig farm based on:
    - The layout and design of the housing units and sources
    - Emission factors from the EPA 2022 Pig Instruction Note.
- Generation of a representative meteorological dataset using prognostic meteorological modelling techniques.
- Characterisation of meteorological conditions in the region using prognostic meteorological data.
- Dispersion modelling using the regulatory dispersion model, CALPUFF, to predict ground-level concentrations of odour across a Cartesian grid that covers the study area.
- Comparison of the predicted ground-level concentrations of odour against the odour assessment criteria.

5.2 Meteorological modelling

5.2.1 Overview

EPA's Air Dispersion Modelling Guidance Note (AG4) states that the dispersion process is dependent on the underlying meteorological conditions and ensuring that the air dispersion model includes representative meteorological data is critical. In the absence of Site-specific meteorological data, AG4 requires the use of representative data observed at a Met Eireann monitoring location. AG4 states:

> *The USEPA (24) has defined meteorological representativeness as:*
>
> > *"the extent to which a set of {meteorological} measurements taken in a space-time domain reflects the actual conditions in the same or different space-time domain taken on a scale appropriate for a specific application"*
>
> *and has expanded on this definition by outlining the factors to consider in the selection of appropriate meteorological data:*
>
> - *Proximity of the meteorological station to the modelling domain;*
> - *The complexity of the terrain;*
> - *The exposure of the meteorological monitoring Site;*
> - *The period of time during which data is collected."*

The modelling domain includes areas of complex terrain. The meteorological parameters that affect dispersion are likely to vary spatially and temporally across the modelling domain due to the complexity of the terrain.

The closest Met Eireann monitoring location to the Site is at Moore Park, Co. Cork which is 22 km south of the pig farm. This monitoring station is in rural rolling landscape. It sits at a low point in the local terrain and is close to the Blackwater River. Meteorological data at Moore Park is characterised by frequent easterly and westerly winds that occur due to the east-west orientation of the valley in which the monitoring station is located. The meteorological station at Moore Park is not likely to be representative of meteorological conditions at the Site as the terrain at both locations is very different.

A review by Katestone indicates that there are no other meteorological observation stations on the Met Eireann Network that meet the requirements specified in AG4 to be considered representative of the modelling domain.

Where Site specific or representative meteorological data is not available, AG4 provides the following alternatives:

> *Prognostic meteorological data should be considered in locations where there is no comparable representative Met Eireann station particularly in areas of complex terrain or at a land / sea interface.*

and

> *Prognostic meteorological data may be useful in locations where there is no comparable representative Met Eireann station. Locations where prognostic meteorological data may be required include regions of complex terrain and at a land/sea interface in circumstances where the nearest meteorological stations are outside of the modelling domain. As outlined by the USEPA, meteorological data should be spatially representative of the modelling domain and in particular of the pathway from the source to the most impacted receptor.*

Accordingly, prognostic meteorological data was generated for the Site due to the complexity of the terrain. The approach adopted to generate representative Site-specific data utilised a numerical model to generate a 3-dimensional grid of spatially varying meteorological parameters to represent conditions surrounding the Site. The approach is described in Appendix A1.

5.2.2 Meteorology

The prognostic model TAPM (developed in Australia by the Commonwealth Scientific and Industrial Research Organisation [CSIRO], version 4.0.5) and the diagnostic meteorological model CALMET (developed by EarthTec, version 6.5) were used to generate the three-dimensional meteorological dataset for the region.

The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the innermost nest. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

The three-dimensional wind field produced by TAPM/CALMET was then used to create a meteorological file suitable for us with the CALPUFF dispersion model.

Details of the model configuration and evaluation are presented in Appendix A.

The TAPM/CALMET approach has been used in jurisdictions like Australia to generate suitable meteorological data for modelling odour impacts for over 15 years. It has been adopted in for the assessment of a number proposed projects in Ireland in the last 5 years. There is significant experience using these approaches in jurisdictions such as Australia. Industry specific guidance on modelling odour dispersion from sources such as intensive poultry farms and cattle feedlots recommend the use of TAPM/CALMET to generate representative Site-specific data. Research in Europe indicates that meteorological data generated using a numerical model provided a better indication of locations where odour nuisance occurred (Feliubadaló et al, 2008). In that study, locations of likely odour nuisance

were determined using the German VDI grid assessment approach. The correlation between observed and modelled odour concentrations was significantly better using the TAPM/CALMET approach compared to traditional steady state gaussian models such as AERMOD.

5.3 Emissions

5.4 Overview

The derivation of an odour emissions inventory for the Site is presented in this section.

There is no emissions monitoring data available for the pig farm. Odour emission rates from the pig housing units at pig farms vary considerably depending on factors such as:

- The ventilation rate which is heavily influenced by:
    - The target temperature of the pigs in the unit which is influenced by:
        - Type of pig (sow, weaner, finisher)
        - The age of the pigs.
    - The ambient temperature outside the pig unit.
- The design of the housing system including but not limited to the following:
    - Depth of manure holding pits
    - Frequency on manure removal
    - Ventilation design
    - Surface area of manure exposed beneath the slats.
- The depth of manure in the house, which varies considerably with season.

The odour emission rates for the pig farm were derived from EPA recommended emission factors published in the EPA 2022 Pig Instruction Note. Whilst a site-specific odour emissions inventory could be developed by sampling the subject Site, it would require a significant amount of sampling to be conducted over different seasons and farm operating conditions, which is not economically viable.

5.4.1 Odour Emission Rates

The EPA 2022 Pig Instruction Note presents recommended approaches for the assessment of odour impact from pig farms in Ireland using:

- A screening tool approach (Screening Approach)
- A detailed modelling for odour assessment approach (detailed modelling approach).

The screening tool approach defined in the EPA 2022 Pig Instruction Note mandates the use of screening odour emission rates to determine if a pig farm is compliant with the relevant odour impact criterion.

The detailed modelling approach described in the EPA 2022 Pig Instruction Note presents lower emission factors that may be used in a detailed modelling assessment. Lower emission factors may be used when applicable emission reduction techniques are adopted on a pig farm.

The odour emission rates adopted in this assessment are based on screening odour emission rates presented in EPA 2022 Pig Instruction Note, which are reproduced in Table 1 below.

5.4.1.1 Screening odour emission rates

The EPA 2022 Pig Instruction Note requires the calculation of a baseline odour emission rate by pig type based on the odour emission rates presented in Table 1.

Table 1 Odour emission factors for the different pig types used in the screening tool described in the EPA 2022 Pig Instruction Note

Type of Pig	Recommended odour emission Factor
	OU_E/s/pig
Dry Sow	21.0
Farrowing Sows	20.0
Weaners	6.0
Growers	12.0
Finishers	20.0
Fatteners[1]	17.3
Maiden Gilts	20.0

[1] In this document fatteners refer to the combined number of growers and finishers, which are defined in the EPA 2022 Pig Instruction Note. Growers and finisher are reared in the same housing units on pig farms. The emission rates for growers and finishers are therefore modelled using a single emission factor, presented for fatteners, which is calculated as a weighted average odour emission rate based on the proportion of growers/finishers on a pig farm and the odour emission rate specified in the EPA 2022 Pig Instruction Note for each category of pig

The typical pig weights by animal category are defined in the EPA 2022 Pig Instruction Note as:

- Between 8 kg and 30 kg for weaners
- Between 30 kg and 60 kg for growers
- Between 60 kg and 120 kg for finishers.

The typical pig weights by animal category defined in the EPA 2022 Pig Instruction Note indicate that in relation to pigs between 30 kg and 120 kg:

- 33.3% are growers weighing between 30 kg and 60 kg for
- 66.6% are finishers weighing between 60 kg and 120 kg.

Pig farms in Ireland generally separate pigs in dedicated houses for weaners (8 kg and 30 kg) and pigs above 30 kg classified as fatteners (which includes growers and finishers).

Considering that growers and finishers are housed in the same housing units at the subject pig farm, a weighted average odour emission rate has been determined for fatteners based on:

- The odour emission rates for growers and finishers defined in the EPA 2022 Pig Instruction Note
- The proportion of fatteners made up of growers and finishers as per the EPA 2022 Pig Instruction Note.

A screening odour emission rate of 17.33 ou_E/s/pig has been determined for fatteners at the pig farm.

5.4.1.2 Detailed dispersion modelling odour emission rate

On 15 February 2017, the European Commission adopted Commission Implementing Decision (EU) 2017/302 (2017 CID). The 2017 CID establishes 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. The 2017 CID and its associated BAT Reference document (BREF document) include the theory behind the sources of odour and possible odour control techniques available for the intensive agriculture (poultry and pigs) sector.

The EPA 2022 Pig Instruction Note states

> *The 2017 CID and BREF note include techniques to reduce emissions of odour (BAT 13) from the whole farm and to reduce ammonia (BAT 30) from animal housing. Whilst BAT 30 is specific to reducing ammonia emissions, the BREF outlines how odour emissions can also be reduced by implementing various BAT 30 techniques*
>
> *The BREF note describes how emissions associated with standard housing with a deep pit can be reduced for existing animal housing through their use in combination with other techniques (e.g., nutritional management, an air cleaning system, pH reduction of slurry, or slurry cooling).*

Further detail of pig housing types and housing systems to reduce emissions of odour are presented in the EPA 2022 Pig Instruction Note (EPA, 2022).

The EPA 2022 Pig Instruction Note presents recommended levels of mitigation (odour emission reduction factors) that can be applied to the screening odour emission rates presented for the screening approach.

The odour emission mitigation measures that will be employed at the pig farm include:

- Manipulation of dietary protein and supplements
- The use of reduced manure volume pit.

In relation to the Manipulation of dietary protein and supplements, the EPA 2022 Pig Instruction Note states

> *Manipulating animal feed by reducing dietary protein will reduce the amount of unused protein that passes through a pig's digestive system. Fewer precursor compounds present in the slurry will reduce potential odour.*
>
> *For detailed modelling, it would be reasonable to apply a reduction factor of 10% on the basis of a reduction of 1% crude protein in the diet. The maximum reduction factor that can be applied is 30% linked to a reduction of 3% crude protein in the diet.*

If dietary crude protein exceeds the dietary requirements of a pig, it will be excreted resulting in higher levels of nitrogen in slurry. It is therefore desirable to optimise the level of crude protein in diets to meet the pig's nutritional requirements for growth while minimising nitrogen levels in excrement. For weaner and finisher pigs, the level of crude protein required in the diet declines with age and as growth slows. Younger pigs therefore require more crude protein than older pigs in each of the weaner (8kg to 30kg) and finisher (30kg to 120kg) categories.

The site will adopt low protein diets as a BAT technique to reduce odour emissions to the atmosphere. The level of protein in diets at the pig farm will be limited (as a weighted average) to:

- 14.5% for sows
- 17.5% for weaners
- 15% for fatteners.

The crude protein levels stated here are weighted average levels across the diets fed to sows, weaners and finishers because the overall level of nitrogen that ends up in the slurry tanks of pig housing units is correlated with the average level of crude protein in the diets fed to pigs in the housing unit.

The diets of younger pigs in each of the weaner and fattener categories will be above the levels specified and the diets of older pigs in each of these categories will be below the levels specified overall. However, the weighted average crude protein levels for the categories of pigs will be maintained below the levels specified above.

Ballyfaskin Enterprises has worked with animal nutritionists to reduce crude protein and supplements in the pigs' diet. The levels of crude protein and supplements has been optimised at levels that minimise the amount of unused protein that passes through the pig's digestive system. This approach has reduced dietary crude protein by levels

that surpass 3%. A reduction of 30%, which is the maximum reduction factor that can be applied as specified in the EPA 2022 Pig Instruction Note, has, therefore, been applied to the emission factors for all pig types at the pig farm as part of the detailed modelling assessment.

The EPA 2022 Pig Instruction Note has a comprehensive section on odour mitigation offered when multiple odour mitigation techniques are adopted and states:

> *The main focus of odour mitigation used to abate odour from a pig rearing activity seeks to either prevent the amount of precursor compounds present which will degrade or to manipulate the anaerobic environment to avoid any precursors degrading, and odorous compounds being released. It can therefore be seen that when dietary manipulation is used in conjunction with a system integrated housing technique, there would be a degree of 'double counting' if the applicant were to add the individual reductions set out above.*
>
> *Until further scientific evidence is available to the contrary, where two mitigation techniques are operated on the same pig rearing installation, the applicant should be limited to:*
>
> - *100% of the odour reduction offered by the first mitigation technique; and*
> - *no more than 50% of the odour reduction offered by the second mitigation technique.*

The odour emission rates adopted for the existing housing units at the pig farm were determined as the screening odour emission factors specified in the EPA 2022 Pig Instruction Note reduced by 30% to account for dietary manipulation, which will be adopted by Ballyfaskin Enterprises

The odour emission rates adopted in the detailed dispersion modelling assessment for the existing housing units are presented in Table 2.

Table 2 The odour emission rates adopted for each category of pig in the existing housing units at the pig farm

Type of Pig	Recommended odour emission Factor
	OU_E/s/pig
Dry Sow	14.7
Farrowing Sows	14.0
Weaners	4.2
Growers	8.4
Finishers	14.0
Fatteners[1]	12.1
Maiden Gilts	14.0

[1] In this document fatteners refer to the combined number of growers and finishers, which are defined in the EPA 2022 Pig Instruction Note. Growers and finisher are reared in the same housing units on pig farms. The emission rates for growers and finishers are therefore modelled using a single emission factor, presented for fatteners, which is calculated as a weighted average odour emission rate based on the proportion of growers/finishers on a pig farm and the odour emission rate specified in the EPA 2022 Pig Instruction Note for each category of pig

5.5 Dispersion modelling

The assessment was conducted in accordance with recognised techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). CALPUFF was used to predict ground-level concentrations of odour across the modelling domain and at sensitive receptor locations due to sources at the pig farm.

The details of source characterisation utilised for the pig farm in the modelling assessment are provided in Section 5.8.

5.6 Building downwash

When modelling emissions from an industrial installation it should be borne in mind that stacks which are relatively short can be subjected to additional turbulence due to the presence of nearby buildings. Buildings are considered nearby if they are within five times the lesser of the building height or maximum projected building width (but not greater than 800m) (EPA, 2020).

A plume of a short stack is likely to be downwashed if its height is less than two and a half times the height of nearby buildings within a distance of 10 x L from each source, where L is the lesser of the height or width of the building. A Building Profile Input Program (BPIP) was used to determine the effects of buildings at the Site on the point sources of emissions at the pig farm. The Plume Rise Model Enhancements (PRIME) algorithm is recommended in EPA Guidance for use with AERMOD. PRIME was used in the dispersion modelling assessment to determine the effect of building induced turbulence on plumes from point sources at the pig farm.

The PRIME algorithm takes into account the position of each stack relative to each relevant building and the projected shape of each building for 36 wind directions (at 10º intervals). The model determines the change in plume centreline location with downwind distance based on the slope of the mean streamlines and coupled to a numerical plume rise model.

There were 20 onsite buildings/structures included in the BPIP program to represent pig housing units and other onsite buildings. The coordinates used in the configuration of the pig housing units and onsite buildings in the PRIME BPIP model for this assessment are presented in Table 3.

Table 3 Pig housing units included and configuration of the pig housing units in BPIP

Building	Easting	Northing	Height (m)
	UTM (m)	UTM (m)	
B1	547184.3	5801543	5.2
	547133.6	5801592	
	547149.9	5801607	
	547199.7	5801558	
B2	547167.8	5801526	5.2
	547117	5801575	
	547132.9	5801590	
	547183.3	5801542	
B3	547151.5	5801509	5.2
	547100	5801559	
	547116.1	5801574	
	547167.4	5801525	
B4	547134.8	5801491	7.2
	547082.8	5801540	
	547096.5	5801554	
	547147.7	5801505	
B5	547087.3	5801505	4.5
	547066.7	5801526	
	547079.2	5801538	
	547100.1	5801518	
B6	547095.3	5801498	4.5
	547087.2	5801505	
	547100	5801518	
	547107.8	5801511	
B7	547122.2	5801487	4.0
	547105.8	5801502	
	547112.3	5801509	
	547129.1	5801494	
B8	547104.3	5801472	4.0
	547088.3	5801488	
	547103.5	5801503	
	547119.6	5801488	
B9	547074.8	5801498	4.0
	547058.8	5801513	
	547069	5801523	
	547084.8	5801508	
B10	547085	5801488	4.0
	547074.8	5801498	
	547084.7	5801508	

Building	Easting	Northing	Height (m)
	UTM (m)	UTM (m)	
	547095.1	5801498	
B11	547087	5801455	7.0
	547037.2	5801504	
	547051.6	5801518	
	547102.1	5801470	
B13	547031.3	5801509	6.0
	546997.3	5801542	
	547012.6	5801558	
	547046.6	5801526	
B14	547049.3	5801524	3.4
	547013.2	5801558	
	547021.4	5801567	
	547057.3	5801532	
B15	547058.5	5801531	4.0
	547021.4	5801567	
	547032.1	5801578	
	547069.2	5801543	
B16	547069.2	5801542	4.0
	547032.3	5801578	
	547041.1	5801587	
	547078.4	5801552	
B17	547080.9	5801554	7.0
	547042.9	5801590	
	547058.6	5801607	
	547097.2	5801570	
B18	547097.9	5801570	18.3
	547084.5	5801583	
	547097.8	5801597	
	547111.4	5801584	

5.7 Sources of Emissions

The pig housing units included in the dispersion modelling assessment are presented in Table 4, which specifies:

- The housing unit at the pig farm (existing and proposed)
- The type of pigs housed (proposed development as modelled)
- The type of ventilation (proposed development as modelled)
- The number of pigs housed in the building (proposed development as modelled)
- The number of sources used to represent the mechanical ventilation points in the modelling assessment.

All pig housing units at the Site will be mechanically ventilated sheds and were configured as point sources in the modelling assessment.

The sources included in the modelling assessment, the number of pigs per source and the odour emission rate per source included in the modeling assessment are presented in Table 5.

Table 4 Pig housing units included in the dispersion modelling assessment

Housing Unit	Type of Pig	Type of Ventilation	Number of Housed Pigs	Number of modelled sources
B1	Fattener	Mechanical	1360	2
B2	Fattener	Mechanical	1360	2
B3	Dry Sow	Mechanical	325	2
B4	Gilt	Mechanical	166	10
B5	Weaner	Mechanical	904	4
B6	Weaner	Mechanical	324	2
B7	Dry Sow	Mechanical	52	1
B8	Dry Sow	Mechanical	99	4
B9	Weaner	Mechanical	581	3
B10	Weaner	Mechanical	339	3
B11	Fattener	Mechanical	1238	14
B13	Weaner	Mechanical	1852	10
B14	Farrowing	Mechanical	81	8
B15	Farrowing	Mechanical	97	4
B16	Farrowing	Mechanical	97	4
B17	Dry Sow	Mechanical	253	4

Table 5 Sources and odour emission rate of sources included in the modelling assessment

Housing Unit	Source Number	Number of pigs per source	Odour Emission rate (ou/s)
B1	B1_1	680	8249
	B1_2	680	8249
B2	B2_1	680	8249
	B2_2	680	8249
B3	B3_1	163	2391
	B3_2	163	2391
B4	B4_1	17	244
	B4_2	17	244
	B4_3	17	244
	B4_4	17	244
	B4_5	17	244
	B4_6	17	244
	B4_7	17	244
	B4_8	17	244
	B4_9	17	244
	B4_10	17	244
B5	B5_1	226	949
	B5_2	226	949
	B5_3	226	949
	B5_4	226	949

Housing Unit	Source Number	Number of pigs per source	Odour Emission rate (ou/s)
B6	B6_1	162	681
	B6_2	162	681
B7	B7_1	52	769
B8	B8_1	25	365
	B8_2	25	365
	B8_3	25	365
	B8_4	25	365
B9	B9_1	194	813
	B9_2	194	813
	B9_3	194	813
B10	B10_1	113	474
	B10_2	113	474
	B10_3	113	474
B11	B11_1	88	1073
	B11_2	88	1073
	B11_3	88	1073
	B11_4	88	1073
	B11_5	88	1073
	B11_6	88	1073
	B11_7	88	1073
	B11_8	88	1073
	B11_9	88	1073
	B11_10	88	1073
	B11_11	88	1073
	B11_12	88	1073
	B11_13	88	1073
	B11_14	88	1073
B13	B13_1	185	778
	B13_2	185	778
	B13_3	185	778
	B13_4	185	778
	B13_5	185	778
	B13_6	185	778
	B13_7	185	778
	B13_8	185	778
	B13_9	185	778
	B13_10	185	778
B14	B14_1	10	142
	B14_2	10	142
	B14_3	10	142

Housing Unit	Source Number	Number of pigs per source	Odour Emission rate (ou/s)
	B14_4	10	142
	B14_5	10	142
	B14_6	10	142
	B14_7	10	142
	B14_8	10	142
B15	B15_1	24	340
	B15_2	24	340
	B15_3	24	340
	B15_4	24	340
B16	B16_1	24	340
	B16_2	24	340
	B16_3	24	340
	B16_4	24	340
B17	B17_1	63	930
	B17_2	63	930
	B17_3	63	930
	B17_4	63	930

5.8 Source configuration

The pig housing units at the pig farm are all mechanically ventilated and were, therefore, modelled as point sources in the modelling assessment. This section describes the configuration of the point sources included in the CALPUFF modelling assessment.

Table 6 lists the point sources included in the modelling assessment and relevant modelling parameters including:

- The source coordinates
- The base elevations
- Stack height
- Stack diameter
- Exhaust temperature
- Exhaust velocity.

The building locations, configuration and heights were determined from Site plans provided by Ballyfaskin Enterprises, correspondence between Katestone and Ballyfaskin Enterprises and from satellite imagery.

Table 6 Source parameters for the point sources at the pig farm

Source Number	x-coordinate	y-coordinate	Base Elevation	Stack Height	Diameter	Temperature	Velocity
	km	km	m	m	m	°C	m/s
B1_1	547.196	5801.554	164.7	8.00	1.75	20	6.1
B1_2	547.188	5801.546	165.1	8.00	1.75	20	6.1
B2_1	547.180	5801.537	165.5	8.00	1.75	20	6.1
B2_2	547.171	5801.529	165.9	8.00	1.75	20	6.1
B3_1	547.163	5801.521	166.2	8.00	1.75	20	6.1
B3_2	547.155	5801.512	166.6	8.00	1.75	20	6.1
B4_1	547.140	5801.499	167.3	5.65	0.6	20	6.8
B4_2	547.138	5801.501	167.3	5.65	0.6	20	6.8
B4_3	547.136	5801.503	167.4	5.65	0.6	20	6.8
B4_4	547.134	5801.505	167.4	5.65	0.6	20	6.8
B4_5	547.130	5801.508	167.6	5.65	0.6	20	6.8
B4_6	547.128	5801.51	167.6	5.65	0.6	20	6.8
B4_7	547.126	5801.512	167.7	5.65	0.6	20	6.8
B4_8	547.124	5801.514	167.7	5.65	0.6	20	6.8
B4_9	547.119	5801.52	167.9	5.65	0.6	20	6.8
B4_10	547.112	5801.526	168.1	5.65	0.6	20	6.8
B5_1	547.080	5801.535	169.3	4.80	0.6	21	6.8
B5_2	547.086	5801.53	169.1	4.80	0.6	21	6.8
B5_3	547.092	5801.525	168.9	4.80	0.6	21	6.8
B5_4	547.097	5801.52	168.7	4.80	0.6	21	6.8
B6_1	547.102	5801.515	168.5	4.80	0.6	21	6.8
B6_2	547.107	5801.51	168.4	4.80	0.6	21	6.8
B7_1	547.117	5801.498	168.1	4.80	0.6	20	6.8
B8_1	547.105	5801.489	168.6	4.80	0.6	20	6.8
B8_2	547.104	5801.487	168.7	4.80	0.6	20	6.8
B8_3	547.106	5801.485	168.6	4.80	0.6	20	6.8
B8_4	547.107	5801.487	168.6	4.80	0.6	20	6.8
B9_1	547.066	5801.517	170.2	4.50	0.6	21	6.8
B9_2	547.070	5801.514	170.1	4.50	0.6	21	6.8
B9_3	547.075	5801.51	169.9	4.50	0.6	21	6.8
B10_1	547.080	5801.505	169.7	4.50	0.6	21	6.8
B10_2	547.084	5801.501	169.5	4.50	0.6	21	6.8
B10_3	547.089	5801.497	169.2	4.50	0.6	21	6.8
B11_1	547.088	5801.468	169.6	5.50	0.6	20	6.8
B11_2	547.090	5801.47	169.4	5.50	0.6	20	6.8
B11_3	547.086	5801.47	169.7	5.50	0.6	20	6.8
B11_4	547.088	5801.471	169.5	5.50	0.6	20	6.8

Source Number	x-coordinate	y-coordinate	Base Elevation	Stack Height	Diameter	Temperature	Velocity
	km	km	m	m	m	°C	m/s
B11_5	547.071	5801.485	170.4	5.50	0.6	20	6.8
B11_6	547.069	5801.486	170.5	5.50	0.6	20	6.8
B11_7	547.071	5801.488	170.3	5.50	0.6	20	6.8
B11_8	547.073	5801.486	170.3	5.50	0.6	20	6.8
B11_9	547.058	5801.497	170.9	5.50	0.6	20	6.8
B11_10	547.059	5801.498	170.9	5.50	0.6	20	6.8
B11_11	547.054	5801.502	171.1	5.50	0.6	20	6.8
B11_12	547.055	5801.503	171.0	5.50	0.6	20	6.8
B11_13	547.050	5801.505	171.2	5.50	0.6	20	6.8
B11_14	547.051	5801.506	171.2	5.50	0.6	20	6.8
B13_1	547.037	5801.518	171.7	4.50	0.6	21	6.8
B13_2	547.035	5801.52	171.7	4.50	0.6	21	6.8
B13_3	547.030	5801.524	171.9	4.50	0.6	21	6.8
B13_4	547.028	5801.527	171.9	4.50	0.6	21	6.8
B13_5	547.023	5801.532	172.0	4.50	0.6	21	6.8
B13_6	547.021	5801.534	172.1	4.50	0.6	21	6.8
B13_7	547.018	5801.536	172.2	4.50	0.6	21	6.8
B13_8	547.013	5801.541	172.3	4.50	0.6	21	6.8
B13_9	547.010	5801.544	172.3	4.50	0.6	21	6.8
B13_10	547.008	5801.546	172.4	4.50	0.6	21	6.8
B14_1	547.048	5801.526	171.0	4.00	0.45	22	5.6
B14_2	547.043	5801.531	171.1	4.00	0.45	22	5.6
B14_3	547.038	5801.535	171.3	4.00	0.45	22	5.6
B14_4	547.033	5801.54	171.4	4.00	0.45	22	5.6
B14_5	547.029	5801.544	171.5	4.00	0.45	22	5.6
B14_6	547.025	5801.548	171.6	4.00	0.45	22	5.6
B14_7	547.021	5801.552	171.7	4.00	0.45	22	5.6
B14_8	547.016	5801.557	171.7	4.00	0.45	22	5.6
B15_1	547.063	5801.544	170.0	4.00	0.6	22	6.8
B15_2	547.053	5801.553	170.3	4.00	0.6	22	6.8
B15_3	547.044	5801.562	170.5	4.00	0.6	22	6.8
B15_4	547.034	5801.571	170.7	4.00	0.6	22	6.8
B16_1	547.072	5801.554	169.5	4.50	0.6	22	6.8
B16_2	547.063	5801.563	169.7	4.50	0.6	22	6.8
B16_3	547.054	5801.572	169.9	4.50	0.6	22	6.8
B16_4	547.044	5801.581	170.2	4.50	0.6	22	6.8
B17_1	547.085	5801.566	168.8	5.50	0.6	20	6.8
B17_2	547.075	5801.575	169.1	5.50	0.6	20	6.8
B17_3	547.066	5801.584	169.3	5.50	0.6	20	6.8

Source Number	x-coordinate	y-coordinate	Base Elevation	Stack Height	Diameter	Temperature	Velocity
	km	km	m	m	m	°C	m/s
B17_4	547.056	5801.592	169.6	5.50	0.6	20	6.8

6. ASSESSMENT RESULTS

Dispersion modelling has been conducted for five years of meteorological data. The following sections present the highest concentrations across the five-year modelled period.

Predicted ground-level concentrations of odour (1-hour average, 98th percentile) at the nearest sensitive receptors due to the pig farm are presented in Table 7. Plate 1 is a contour plot that presents the highest ground-level concentrations (1-hour average, 98th percentile) across the model domain during the five-year period.

The results show that predicted concentrations **comply** with the odour criterion recommended by EPA for new pig farms of 5.0ou$_E$/m^3 at all sensitive receptors included in the modelling assessment.

Table 7 Predicted ground-level concentrations of odour (1-hour average, 98th percentile) at the nearest sensitive receptors due to the pig farm

Receptor	1-hour 98th Odour Concentrations (ou$_E$/m^3)					
	2015	2016	2017	2018	2019	Maximum 5-year
DR1	3.5	1.1	3.2	2.0	3.0	3.5
DR2	2.3	0.7	2.0	1.2	2.0	2.3
DR3	4.0	4.2	4.4	4.3	3.5	4.4
DR4	0.3	0.5	0.4	0.4	0.3	0.5
DR5	0.8	0.8	0.5	0.7	0.6	0.8
DR6	0.7	0.4	0.8	0.5	0.6	0.8
DR7	0.0	0.0	0.0	0.0	0.0	0.0
DR9	3.0	3.2	3.2	3.4	2.4	3.4
DR10	2.1	2.4	2.2	2.5	1.7	2.5
DR11	1.6	1.9	1.7	1.9	1.3	1.9
DR12	1.2	1.3	1.3	1.3	0.9	1.3
DR13	0.9	1.0	1.0	1.0	0.7	1.0
DR14	0.8	1.0	0.8	0.8	0.8	1.0
DR15	0.5	0.7	0.6	0.6	0.6	0.7
Odour Criteria	**5.0 ou$_E$/m^3**					

7. CONCLUSIONS

Ballyfaskin Enterprises commissioned Katestone to complete an odour impact assessment (OIA) for a pig farm located at Ballylanders, County Limerick, V35 KV12 (Site).

Ballyfaskin Enterprises proposes to:

- Increase pig numbers at the Site.
- Reconfigure the exhausts of naturally ventilated sheds at the Site with mechanically ventilated chimney stacks to reduce the potential impact of emissions to the atmosphere.

The assessment is required to determine the potential impact of odorous emissions from the proposed development at the pig farm on nearby residential locations. The assessment will be submitted as part of an application for an EPA licence review for the pig farm.

The odour assessment was conducted in accordance with recognised techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). The dispersion model, CALPUFF, was used to predict ground-level concentrations of odour across the model domain due to the pig farm. The assessment of odour has also been conducted in accordance with EPA's instruction note for the assessment of odour emissions from intensive agriculture pig installations (EPA, 2022).

The odour modelling assessment found that the predicted concentrations of odour at all sensitive receptors are under EPA limits and, therefore, **comply** with odour criterion recommended by EPA for existing pig farms of $5.0ou_E/m^3$ at all modelled sensitive receptor locations.

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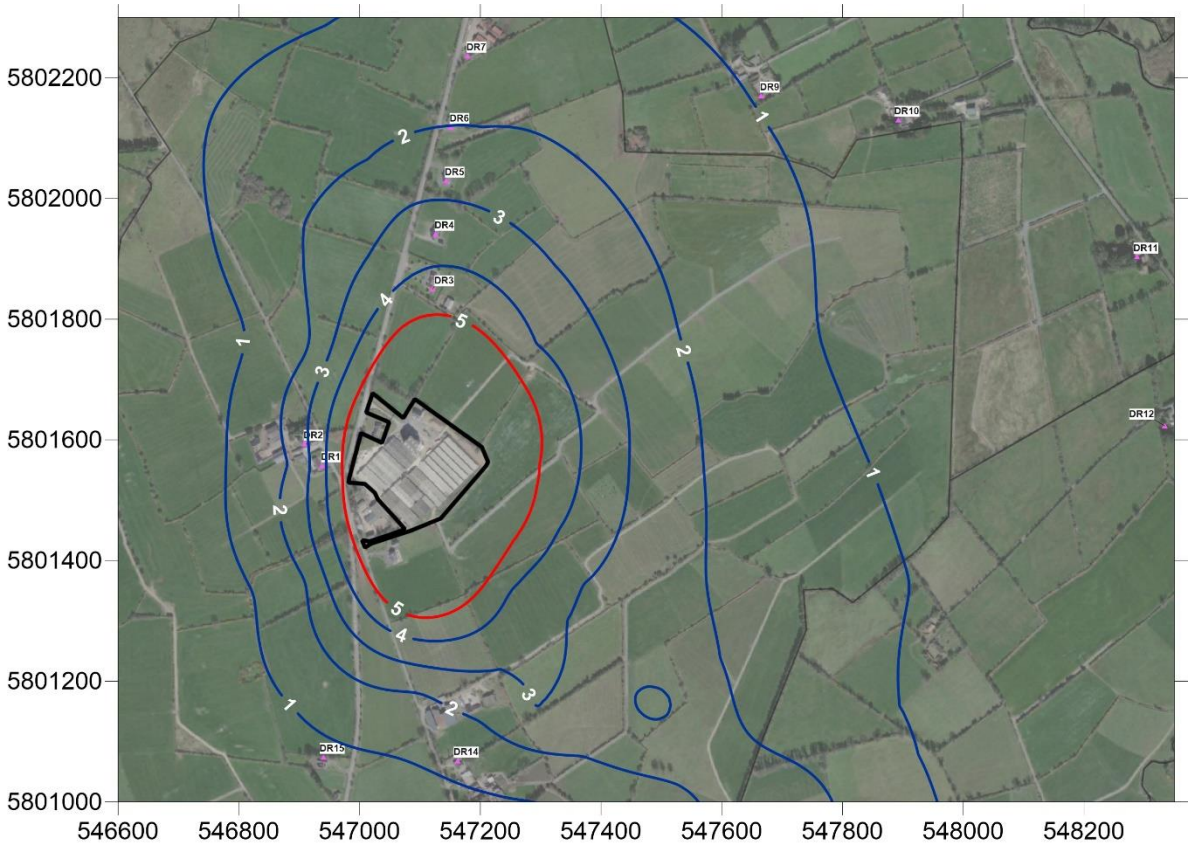

Plate 1 **Highest predicted 98th percentile 1-hour average ground-level concentrations of odour of five modelled years due to the pig farm**

Location:	**Averaging period:**	**Data source:**	**Units:**
Ballylanders, Co. Limerick	1-hour	CALPUFF	ou_E/m^3
Type:	**Criterion level:**	**Prepared by:**	**Date:**
98th percentile	5 ou (Red Line)	P McDowell	May 2024

APPENDIX A MODELLING METHODOLOGY

A1 METEOROLOGICAL MODELLING

A1.1 TAPM

The meteorological model, TAPM (The Air Pollution Model) Version 4.0.5, was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, southeast Asia, North America and Ireland. Katestone has used the TAPM model throughout Australia and has performed well for simulating regional winds patterns. Katestone has recently used the TAPM model to generate gridded data over Cork city and Harbour. The data generated correlated well with observed data at Cork Airport. TAPM has proven to be a useful model for simulating meteorology in locations where monitoring data is unavailable.

TAPM requires synoptic meteorological information for the region surrounding the project. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data are supplied on a grid resolution of approximately 75 km, and at elevations of 100 metres to five kilometres above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM resolves local terrain and land-use features that may influence local meteorology and generates a meteorological dataset that is representative of Site-specific geographic conditions. A year of synoptic data must be selected as input for TAPM. The selection of this year should be such that the year is representative of typical meteorological conditions (and therefore is not necessarily the most recent year of available data) and whether monitoring data is available for the time period to validate the output dataset. In addition, Katestone's experience elsewhere suggests that variability of dispersion meteorological conditions from year to year are unlikely to change the outcome of the air quality assessment.

TAPM was configured as follows:

- 40 x 40 grid point domain with an outer grid resolution of 30 kilometres and nesting grids of 10, 3. 1 and 0.3 kilometres.
- 5 modelled years (1 January 2016 to 31 December 2020)
- Grid centered near the Project Site at latitude 52°23’30 and longitude -8°15’0
- US Geological Survey EROS global terrain height database
- TAPM default land use database, modified to be consistent with aerial imagery in the innermost grid
- 25 vertical grid levels
- No data assimilation.

A1.2 CALMET meteorological modelling

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple Sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.5.0) was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 1 km grid. CALMET treats the prognostic model

output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was configured with twelve vertical levels with heights at 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres at each grid point.

All options and factors were selected in accordance with NSW EPA CALPUFF Guidance released by TRC Environmental in 2011 except where noted below.

Key features of CALMET used to generate the wind fields are as follows:

- Domain area of 151 x 151 grid cells at 200m spacing
- 5 years modelled (1 January 2016 to 31 December 2020)
- Prognostic wind fields input as MM5/3D.dat for “initial guess” field (as generated by TAPM)
- Gridded cloud cover from prognostic relative humidity at all levels
- No extrapolation of surface wind observations to upper layers (not used in no-obs mode)
- Terrain radius of influence set to 5 km
- Maximum search radius of 10 grid cells in averaging process
- Use prognostic relative humidity
- Land use data modified to be consistent with aerial imagery.

All other options set to default.

A2 CALPUFF DISPERSION MODELLING

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 20 x 20 grid cells at 200m spacing, which is a sub-set of the CALMET domain centred on the Site
- 5 years modelled (1 January 2016 to 31 December 2020)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables.

All other options set to default.