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Project No: 314766

Ammonia Assessment

For the site located at:

Crugmor,
Penparc,
Cardigan,
SA43 1QY

Prepared for:

Stepside Agricultural Contractors

Contents Amendment Record

This report has been issued and amended as follows:

Revision	Description	Date	Signed
1.0	First Issue	29 November 2024	S Carson

Acknowledgement

This report has been prepared for the sole and exclusive use of Stepside Agricultural Contractors in accordance with the scope of work presented in Mabbett & Associates Ltd (Mabbett) Letter Agreement (314766/YP/310524/3.0), dated 31st May 2024. This report is based on information and data collected by Mabbett. Should any of the information be incorrect, incomplete or subject to change, Mabbett may wish to revise the report accordingly.

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Section 1.0: Introduction

1.1 Background

Mabbett were appointed by Stepside Agricultural Contractors to prepare an Ammonia Assessment to support a planning application for the operation of two bio-fertiliser lagoons and a maturation tank to be used to store food industry process slurry (hereafter referred to as the 'Proposed Development') at Crugmor, Penparc, Cardigan, SA43 1QY.

Due to developments of this nature having the potential to impact designated sites through ammonia emissions, an ammonia assessment is required in accordance with Natural Resources Wales (NRW) guidance.

1.2 Site

The site is located at Crugmor, Penparc, approximately 1.2km east from the town of Cardigan. The site is surrounded to the north, west and south by open fields and farmlands, and to the east by ground-mounted solar developments and an existing Anaerobic Digestion (AD) plant.

An aerial view of the Proposed Development and the surrounding area is shown below in Figure 1.1.

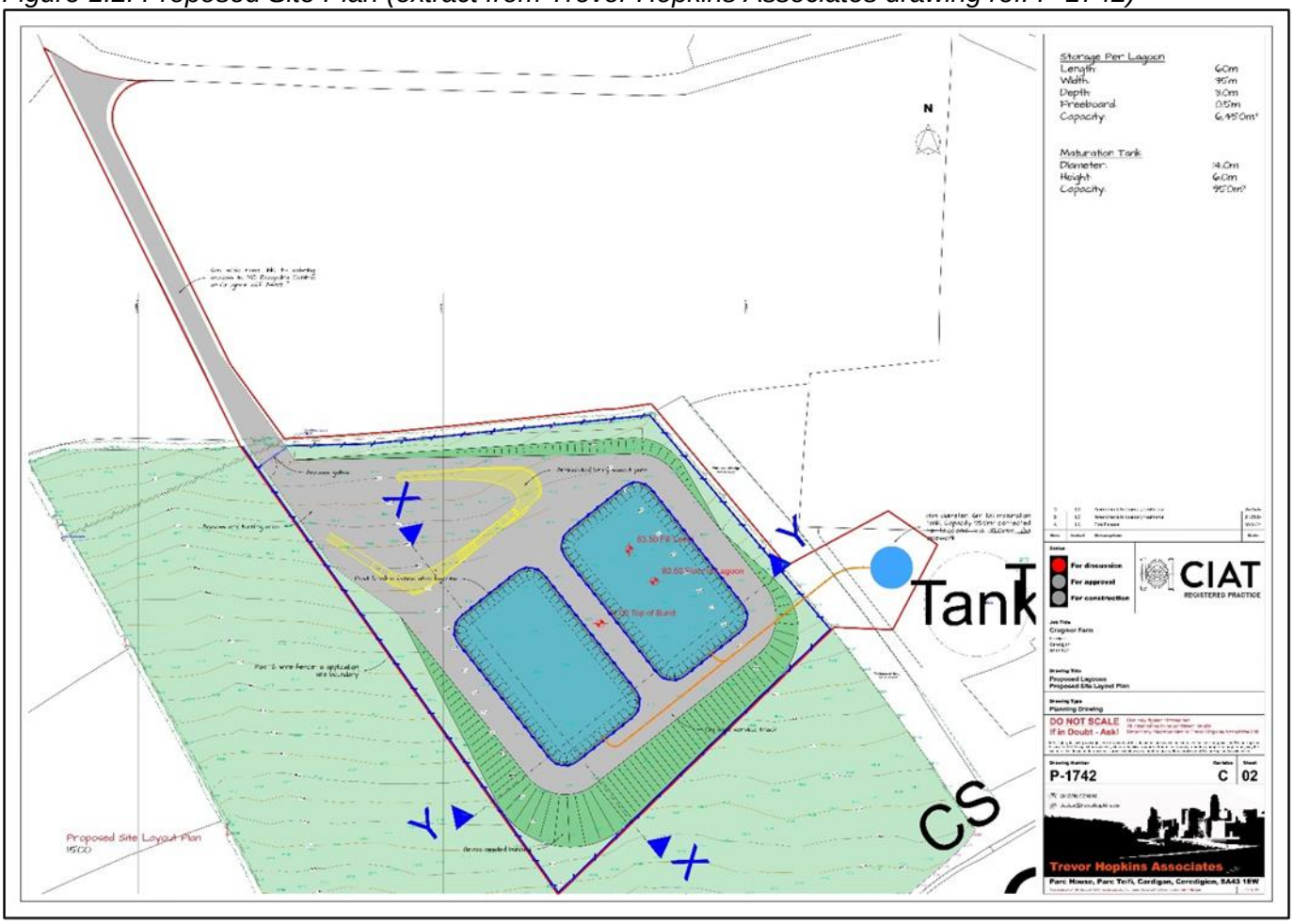
Figure 1.1: Site Location

Imagery © Google 2024

1.3 Proposed Development

The Proposed Development includes the formation of two fully lined lagoons and an associated maturation tank on land adjacent to the existing Asgard Renewables anaerobic digestion plant at Crugmor Farm. The Proposed Development will expand the biofertiliser storage capacity of the Asgard Renewables Plant and allow the conversion of its existing biofertiliser storage tank into a functioning digester tank. A site plan is shown in Figure 1.2.

Figure 1.2: Proposed Site Plan (extract from Trevor Hopkins Associates drawing ref: P-1742)



Section 2.0: Guidance

2.1 Guidance

A summary of some of the key guidance documents referred to in the undertaking of this assessment is provided below. Others which have been used are referenced throughout the report, as appropriate.

2.1.1 National Resource Wales – Ammonia Assessments

NRW has provided online guidance[1] and advice for carrying out ammonia assessments for permit or planning applications. This includes information on when an assessment is required and a step-by-step process guide for carrying out assessments.

NRW advises that detailed modelling should be undertaken where the existing ammonia background concentration is above the critical level.

If the ammonia process contribution and background levels do not exceed the critical level and there are no other sources to consider then the application can proceed.

If the ammonia process contribution plus the background level reaches or exceeds the critical level then NRW advises that *"abatement must be used to reduce the process contribution to below 1% of the critical level"*.

If the ammonia process contribution is below 1% of the critical level and there are no other sources of ammonia to consider, the application can then proceed regardless of background level.

2.2 SCAIL Assessment

The Simple Calculation of Atmospheric Impact Limits Agriculture (SCAIL) is an online screening tool that can be used to assess impacts of proposed developments on sensitive ecological receptors. The SCAIL tool can provide an estimate of ammonia concentrations deposited on a habitat or sensitive ecosystem. The model is used as a screening tool to indicate the requirement for a detailed air dispersion modelling assessment.

[1] Available at: https://naturalresources.wales/guidance-and-advice/business-sectors/farming/ammonia-assessments/?lang=en

Section 3.0: Ammonia Sources & Initial Screening Assessment

3.1 Identification of Ammonia Sources

The Proposed Development will store food industry process slurry, which will then be spread on surrounding fields as a fertiliser. During storage in the lagoons, the waste will go through anaerobic digestion which will lead to the release of gases including ammonia. The lagoons will have floating High-density polyethylene (HDPE) covers, to reduce the release of gases. A maturation tank will also be constructed as part of the Proposed Development; however, this will be completely sealed and will not have any emission point. As such, ammonia emissions from the lagoons are the main focus of this assessment.

3.2 Sensitive Designated Sites Screening

An initial screening assessment was undertaken in accordance with NRW guidance. The guidance recommends a screening distance of 5km for facilities like the Proposed Development. Based on this screening distance, the following designated sites were identified:

- Banc-y-Warren SSSI
- Banc y Mwldan SSSI
- Aberarth – Carreg Wylan SSSI
- Afon Teifi SSSI
- Afon Teifi / River Teifi SAC
- Coedydd a Corsydd Aber Teifi (Teifi Estuary Woodlands and Marshes) SSSI
- Gwaun Pen-Ian SSSI
- Cardigan Bay / Bae Ceredigion SAC
- Caeau Crug Bychan, Ty Gwyn a Llwyn Ysgaw SSSI

3.3 Critical Levels and Existing Levels

In order to identify weather, the designations were sensitive to ammonia emissions, the critical levels and backgrounds for the sites were obtained from the Air Pollution Information System (APIS) website[2] and the NRW Air Quality website[3]. The critical levels and backgrounds for each site, where applicable, are summarised in Table 3.1.

Table 3.1: Ammonia Critical Levels and Backgrounds

Site	Distance to Proposed Development (km)	Ammonia Background (µg/m^3)	Ammonia Critical Level (µg/m^3)
Banc-y-Warren SSSI	0.2	N/A	
Banc y Mwldan SSSI	1.1	1.6	1
Aberarth – Carreg Wylan SSSI	3.6	1.5	1
Afon Teifi / River Teifi SAC	1.8	1.8	1
Afon Teifi SSSI	1.8	1.8	1
Coedydd a Corsydd Aber Teifi (Teifi Esturary Woodlands and Marshes) SSSI	2.6	1.7	1
Gwaun Pen-Ian SSSI	3.6	1.6	3
Cardigan Bay / Bae Ceredigion SAC	4.1	1.5	3
Caeau Crug Bychan, Ty Gwyn a Llwyn Ysgaw SSSI	4.9	1.5	3

[2] APIS - https://www.apis.ac.uk/
[3] NRW - Available at https://nrw.maps.arcgis.com/apps/MapSeries/index.html?appid=c7770d2881394c899123bae210afe370

Banc-y-Warren SSSI is a geological site and as such not sensitive to ammonia. As such, impacts on this site have not been considered further in this assessment. The annual critical levels for ammonia depend on the presence of Lichens and Bryophytes at each designated site. Sites with Lichen and Bryophytes present have a critical level of 1 µg/m^3 while sites without them have a critical level of 3 µg/m^3.

The data from Table 3.1 shows that existing ammonia backgrounds exceed the critical level at five of the eight sensitive sites. Considering there is potential for cumulative impacts from Trefwtial and Ffynnoncyff Farms, detailed dispersion modelling of all identified sensitive ecological receptors has been undertaken.

3.4 Neighbouring Development Review

Mabbett note that the following new developments are proposed:

- Bio-fertiliser lagoon located at Trefwtial Farm[4], located approximately 3.6km east of the Proposed Development,
- Bio-fertiliser lagoon located at Ffynnoncyff Farm[5], located approximately 3.7km north-west of the Proposed Development.

It is considered that these developments are additional potential ammonia emission sources with the potential to cause cumulative impact on some common sensitive ecological receptors. As such, considering there is potential for cumulative impacts, the assessment is progressed to dispersion modelling.

[4] Mabbett Ammonia Assessment for site located at Trefwtial Ffarm (314247), November 2023
[5] Mabbett Ammonia Assessment for site located at Ffynnocyff Farm (314038), October 2023

Section 4.0: Dispersion Modelling Assessment Methodology

4.1 Model Choice

ADMS 6.0, the model used to undertake this exercise, is a new generation Gaussian plume air dispersion model. The atmospheric boundary layer properties are characterised by two parameters (the boundary layer depth and the Monin-Obukhov length) rather than in terms of the single parameter Pasquill-Gifford class. Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

4.2 Modelling Scenarios

Table 4.1 summaries the scenarios considered in the air quality assessment of ecological receptors.

Table 4.1: Assessment of Ecological Receptors

Air Quality Standard	Short Term	Long Term
Ammonia	-	Annual mean

4.3 Emission Parameters

The modelled emissions parameters are summarised in Table 4.2. The emission parameters are based on information provided by Stepside Agricultural Contractors for both the Proposed Development, Trefwtial Farm and the Ffynnoncyff Farm site.

Table 4.2: Proposed Development Modelled Emission Parameters

Parameter	Proposed Development (Crugmor)**	Trefwtial Farm	Ffynnoncyff Farm
Source Type	Area	Area	Area
Source Area (m^2)	6,450	1,900	3,800
Efflux Velocity - actual (m/s)	0.01*	0.01*	0.01*
Temperature (°C)	Ambient	Ambient	Ambient
Ammonia content (mg/kg)[6]	101	101	101
Tonnes per annum (t/annum)	10,000	3,500	3,500
Ammonia Emissions (kg/annum)	1,010	353.5	353.5
Ammonia Emissions ($g/m^2/s$)	$4.97x10^{-6}$	$5.90x10^{-6}$	$2.95x10^{-6}$
* Assumed minimum velocity for area source. ** Inputs per lagoon			

Both lagoons will have a floating HDPE cover to reduce the release of gases. As per the Defra emissions inventory[7], this mitigation can reduce ammonia emissions from uncovered slurry lagoons by up to 60%. The proposed lagoons at Trefwtial Farm and Ffynnoncyff Farm will also have a floating cover. All model results were therefore factored to account for this mitigation.

[6] NRM Slurry / Sludge Analysis Results Report 25450, 20 July 2022
[7] Inventory of Ammonia Emissions from UK Agriculture 2021 Available at: https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2307061001_UK_Agriculture_Ammonia_Emission_Report_1990-2021_Final.pdf

4.4 Modelled Domain

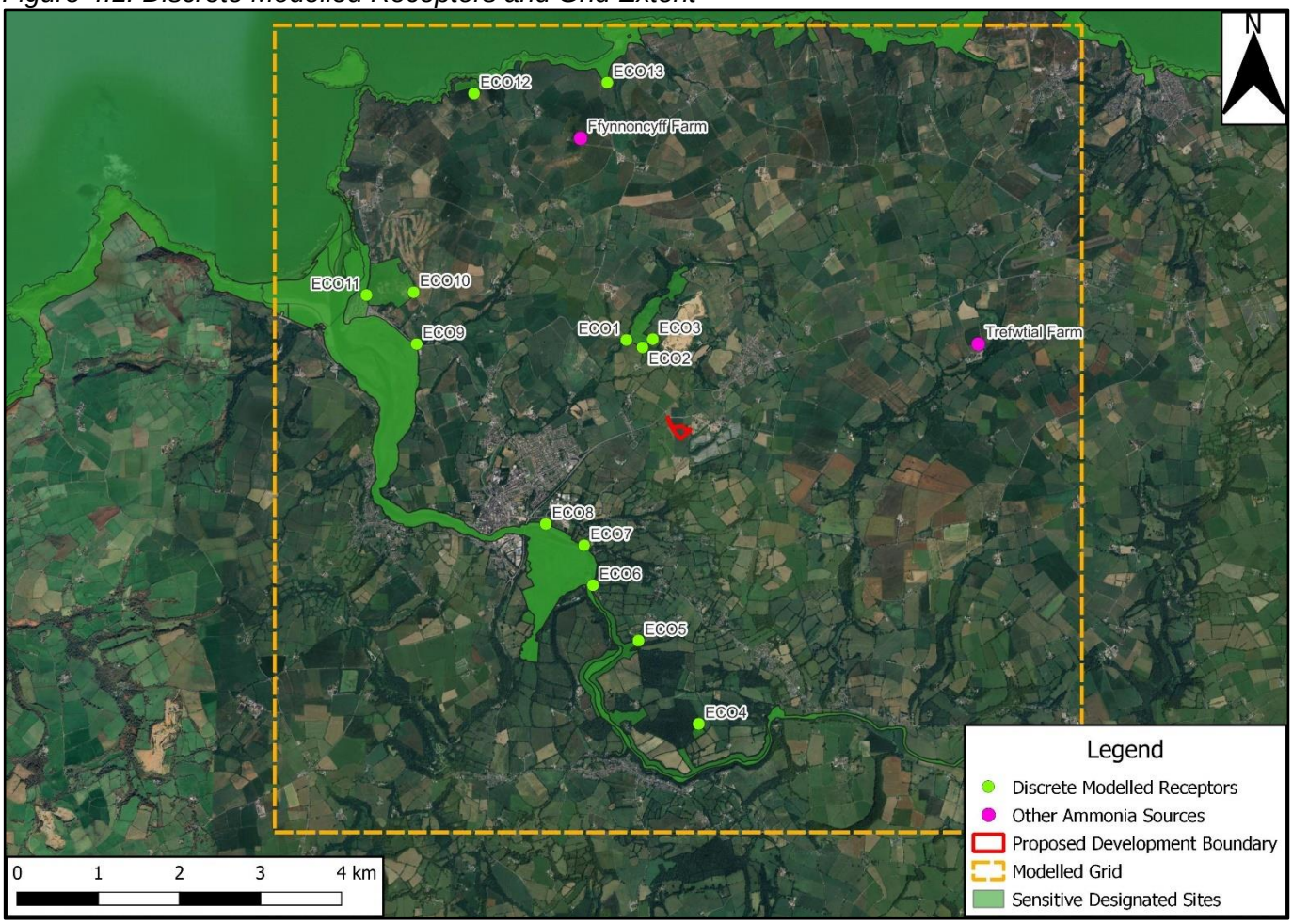
In order to adequately assess impacts on designated ecological sites a grid was included in the dispersion modelling assessment. The grid was modelled from easting 215130 and northing 242144 (10 km by 10 km) giving a grid spacing of 40 m. This was to create an adequately large domain to encompass a variety of different land uses/receptors around the site whilst maintaining sufficiently short grid spacing. The size of the grid ensures that any potential cumulative impacts from the Proposed Development, Ffynnoncyff Farm and Trefwtial Farm will be captured in the modelling. The grid was modelled at a height of 0m which is the point of maximum impact for sensitive ecological receptors.

In addition to the modelled grid, thirteen discrete ecological receptor points have been included in the model and have been modelled at a height of 0m. The discrete modelled receptors are detailed in Table 4.3 and shown in Figure 4.1.

Table 4.3: Discrete Modelled Receptors

Receptor ID	Site	Grid Reference		Modelled Height (m)
		X	Y	
ECO1	Banc y Mwldan	219466	248267	0
ECO2	Banc y Mwldan	219665	248175	0
ECO3	Banc y Mwldan	219793	248277	0
ECO4	Gwuan Pen-Ian	220360	243528	0
ECO5	Coedydd a Corsydd Aber Teifi	219616	244556	0
ECO6	Coedydd a Corsydd Aber Teifi	219054	245239	0
ECO7	Afon Teifi	218945	245732	0
ECO8	Afon Teifi	218472	245995	0
ECO9	Afon Teifi	216877	248216	0
ECO10	Aberarth - Carreg Wylan	216842	248856	0
ECO11	Cardigan Bay / Bae Ceredigion	216258	248821	0
ECO12	Caeau Crug Bychan | Ty Gwyn a Llywn Ysgaw	217586	251309	0
ECO13	Cardigan Bay / Bae Ceredigion	219230	251443	0

Figure 4.1: Discrete Modelled Receptors and Grid Extent



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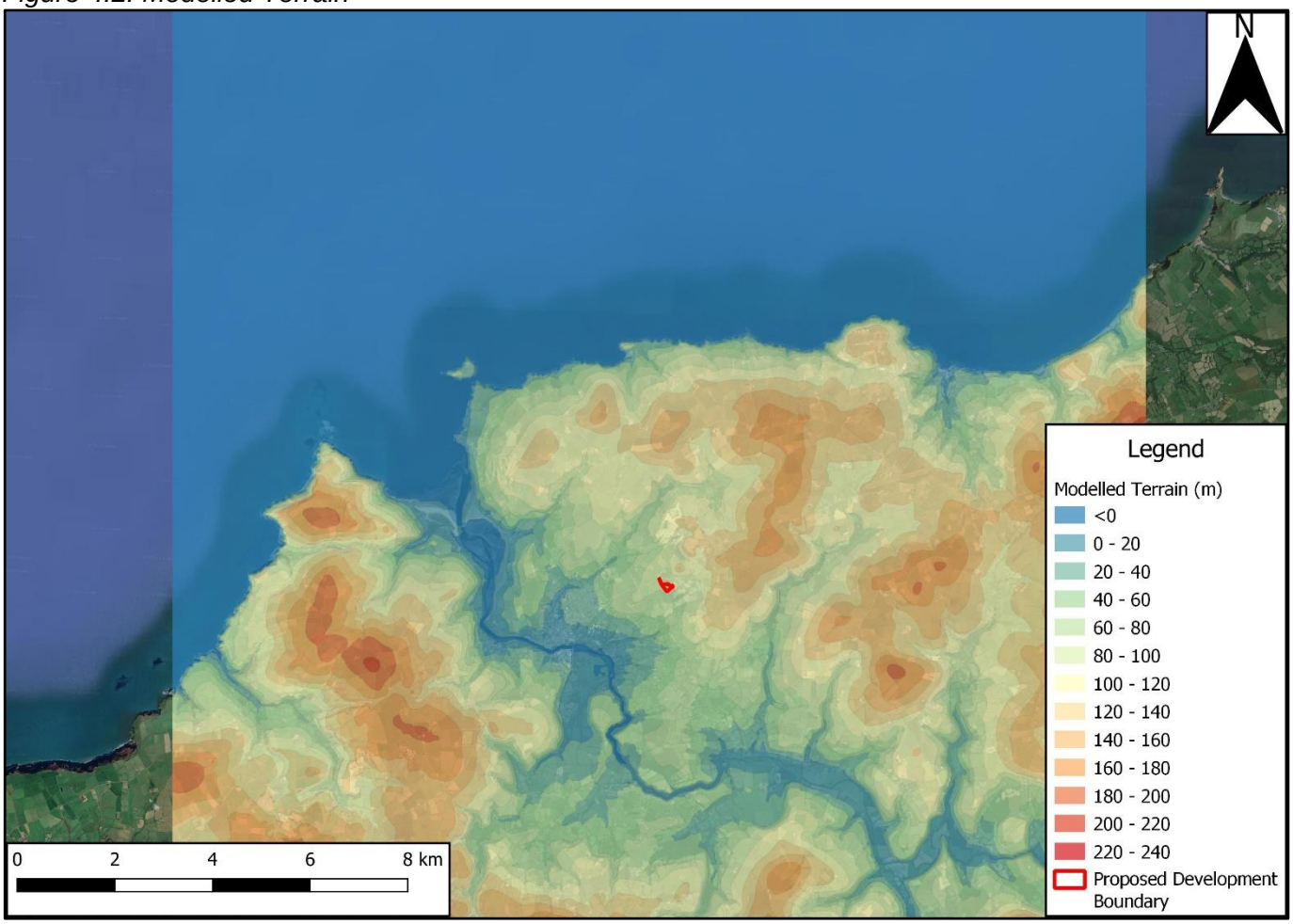
4.5 Modelled Terrain

The terrain around the site is variable in all directions and has the potential to impact dispersion and requires inclusion in the model as it may impact dispersion of pollutants. Terrain data was obtained from Ordnance Survey in 'OS Terrain 50, ASCII Grid and GML' format. The terrain grid is necessarily larger than the modelled domain. The terrain grid was modelled at a resolution of 100m. The terrain data is visualised in Figure 4.2.

Figure 4.2: Modelled Terrain



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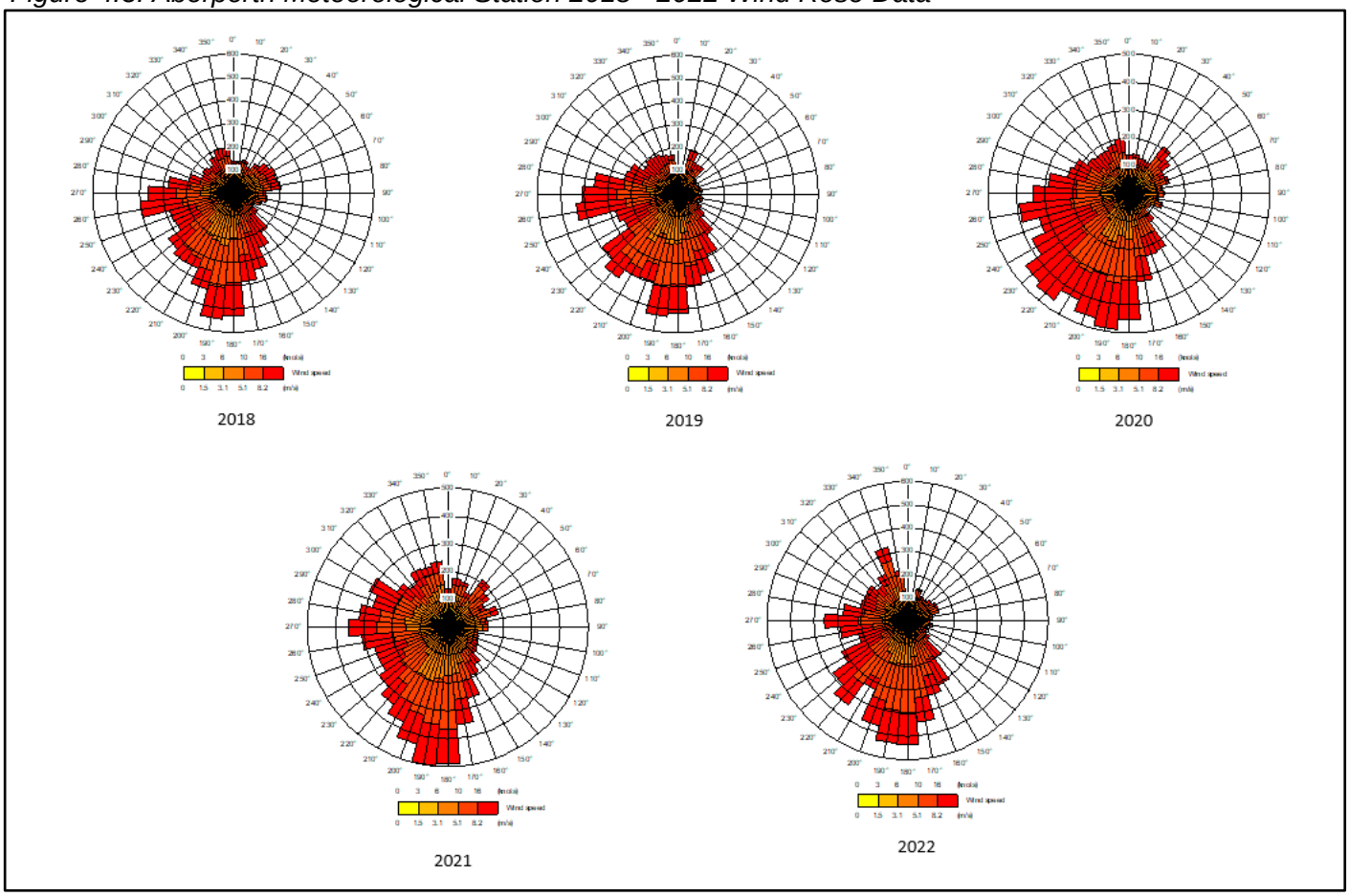
4.6 Meteorology

Aberporth weather station (approximately 6.5 km to the northeast of the site) was used to provide hourly sequential meteorological data for the dispersion model.

Five full years of Aberporth meteorological data from years 2018 - 2022 were used in the dispersion modelling; the wind rose for each year is shown in Figure 4.3.

Figure 4.3: Aberporth Meteorological Station 2018 - 2022 Wind Rose Data



4.7 Surface Characteristics

A surface roughness length is used to characterise the texture of land as this can impact dispersion of pollutants. With respect to the site, a length of 0.2 m (e.g. agricultural areas min) has been used. Around the weather station, a value of 0.2 m has also been used.

4.8 Special Treatments

No special treatment (such as: dry or wet deposition; short-term releases; fluctuations; or chemistry) were deemed appropriate or used within the dispersion model.

Section 5.0: Dispersion Model Results

5.1 Introduction

Table 5.1 summarises the impact assessments which were undertaken.

Table 5.1: Impact Assessment Summary

Assessment Type	Section	Relevant Tables/Figures	Comment
Prediction of maximum concentrations (µg/m^3) across the modelled grid	5.2	Figure A.1 – A.2	Assessment of pollutant impact relative to the critical levels as detailed in Table 3.1.
Prediction of maximum concentrations (µg/m^3) at discrete sensitive ecological receptors	5.3	Table 5.2	

Predicted pollutant concentrations were summarised in the following formats:

- Process contribution (PC) - Predicted pollutant level due to emissions from the Proposed Development, the proposed lagoon at Trefwtial Farm, and the proposed lagoon at Ffynnoncyff Farm; and,
- Predicted environmental concentration (PEC) - Total predicted pollutant level due to emissions from the Proposed Development, proposed lagoon at Trefwtial Farm, the proposed lagoon at Ffynnoncyff Farm and existing baseline conditions.

In each instance a screening exercise using only the PC value relative to the applicable environmental standard was undertaken i.e. not considering background concentrations. Where screening occurs, the associated impact is considered negligible. The screening criteria are as follows:

- For long term (annual mean) assessment, screening occurred where the PC value was <1% of the relevant environmental standard.

As summarised in Section 4.6, five years of weather data have been run to help account for the variation in weather conditions which will be experienced at site. The results presented below represent the maximum predicted concentrations from these five modelled years.

5.2 Gridded Ammonia Results

As summarised in Table 3.1, critical levels of ammonia range from 1 µg/m^3 to 3 µg/m^3 across the study area. As a worse case approach the minimum critical level of 1 µg/m^3 has been applied to all modelled grid results.

A contour plot of annual mean ammonia PC (combined Proposed Development lagoons, proposed Trefwtial Farm lagoon and proposed Ffynnoncyff Farm lagoon) as a percentage of the limit value is provided in Figure A.1. The results show that exceedances of the 1% screening criteria are predicted. Exceedances are predicted to drop below 1% of the critical level approximately 0.8km from the Proposed Development boundary, approximately 0.7km from the Trefwtial Farm lagoon boundary, and approximately 0.8km from the Ffynnoncyff Farm lagoon boundary.

As shown in Figure A.1, none of the identified sensitive designated sites are located in any of the exceedance areas.

A contour plot of annual mean ammonia PC is provided in Figure A.2. and Figure A.3. The results show that exceedances of the 1 µg/m^3 are predicted; however, these are largely contained to the site boundaries. Concentrations are expected to drop below the 1 µg/m^3 critical level approximately 20m from the Proposed Development boundary. Concentrations are expected to drop below the 1 µg/m^3 critical level approximately 40m from the Trefwtial Farm lagoon boundary, and approximately 35m from the Ffynnoncyff Farm lagoon boundary.

5.3 Discrete Ecological Receptors

The maximum predicted annual mean ammonia concentrations at the discrete ecological receptor locations are summarised in Table 5.2.

Table 5.2: Maximum Predicted Annual Mean Ammonia Impacts at Discrete Ecological Receptors

Receptor	Critical Level (µg/m^3)	PC (µg/m^3)	PC % of Critical Level	PEC (µg/m^3)	PEC % of Critical Level
ECO1	1	0.01	<1%	SCREENED	
ECO2	1	0.01	<1%	SCREENED	
ECO3	1	0.01	<1%	SCREENED	
ECO4	3	<0.01	<1%	SCREENED	
ECO5	1	<0.01	<1%	SCREENED	
ECO6	1	<0.01	<1%	SCREENED	
ECO7	1	<0.01	<1%	SCREENED	
ECO8	1	<0.01	<1%	SCREENED	
ECO9	1	<0.01	<1%	SCREENED	
ECO10	1	<0.01	<1%	SCREENED	
ECO11	3	<0.01	<1%	SCREENED	
ECO12	3	<0.01	<1%	SCREENED	
ECO13	3	0.01	<1%	SCREENED	

The annual mean ammonia PCs (combined Proposed Development, proposed Trefwtial Farm lagoon, and proposed Ffynnoncyff Farm lagoon) are below 1% of the critical level at all modelled receptors. Given the above, predicted effects of annual mean ammonia concentrations on discrete sensitive ecological receptors are considered insignificant.

Section 6.0: Conclusion

An assessment of the potential ammonia impacts from two proposed bio-fertiliser lagoon was undertaken. The assessment considered potential impacts on designated ecological sites within 5km of the Proposed Development.

Dispersion modelling was undertaken using ADMS-6 to assess potential impacts of ammonia emissions from the Proposed Development on the identified ecological sites. Emissions from nearby ammonia sources at Trefwtial Farm and Ffynnoncyff Farm were also included in the model.

The dispersion model results were compared against the relevant ammonia critical levels, as summarised below:

- The annual mean ammonia combined PCs are above 1% of the critical level at the worst-case grid locations. However, no sensitive designated sites are located in the 1% exceedance areas. PCs are predicted to drop below the 1 µg/m^3 approximately 20m from the Proposed Development boundary, 40m from the Trefwtial Farm lagoon boundary and 35m from the Ffynnoncyff Farm lagoon boundary.
- Annual mean ammonia combined PCs are below 1% of the critical level at all discrete modelled receptors. As such, predicted effects of annual mean ammonia concentrations on discrete modelled receptors are considered insignificant.
- Given the results of the modelled assessment, potential cumulative impacts are considered to be insignificant.

The overall impacts of ammonia emissions from the Proposed Development on sensitive ecological receptors is predicted to be insignificant.

Appendix A: Contour Plots

Figure A.1 Annual Mean Ammonia Process Contribution as Percentage of the Critical Level (1 µg/m^3)

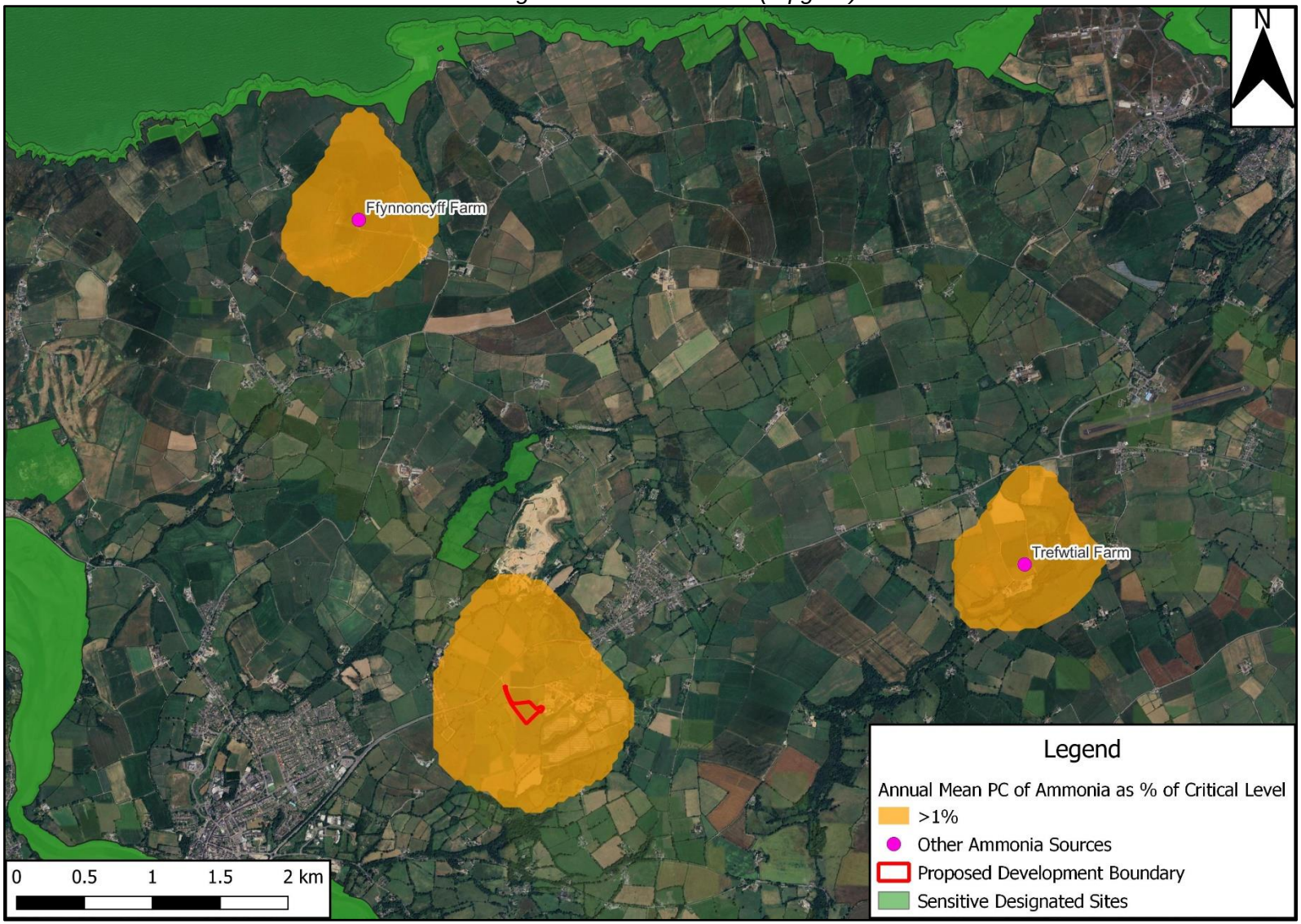


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Figure A.2 Annual Mean Ammonia Process Contribution (µg/m^3) at Proposed Development

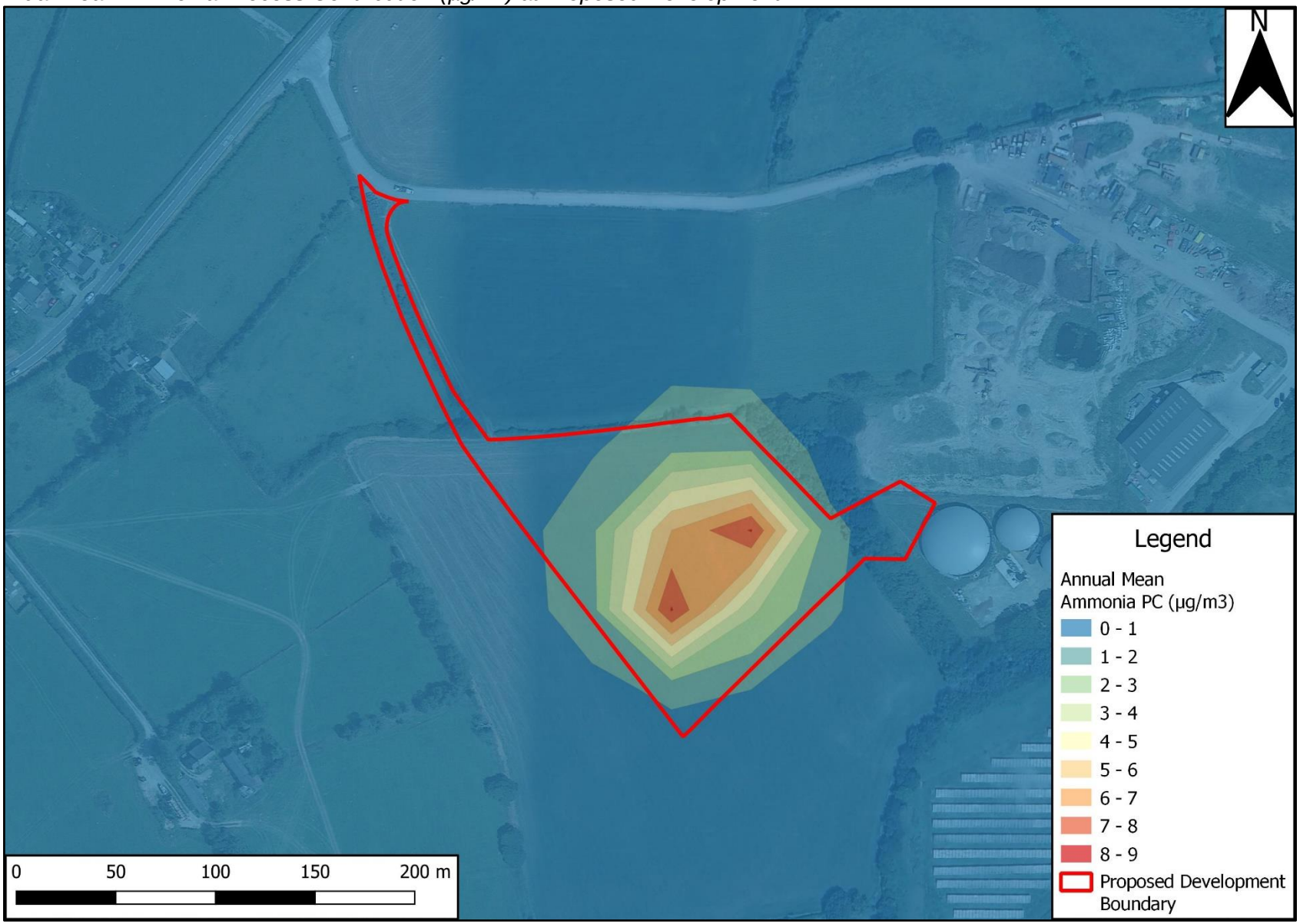

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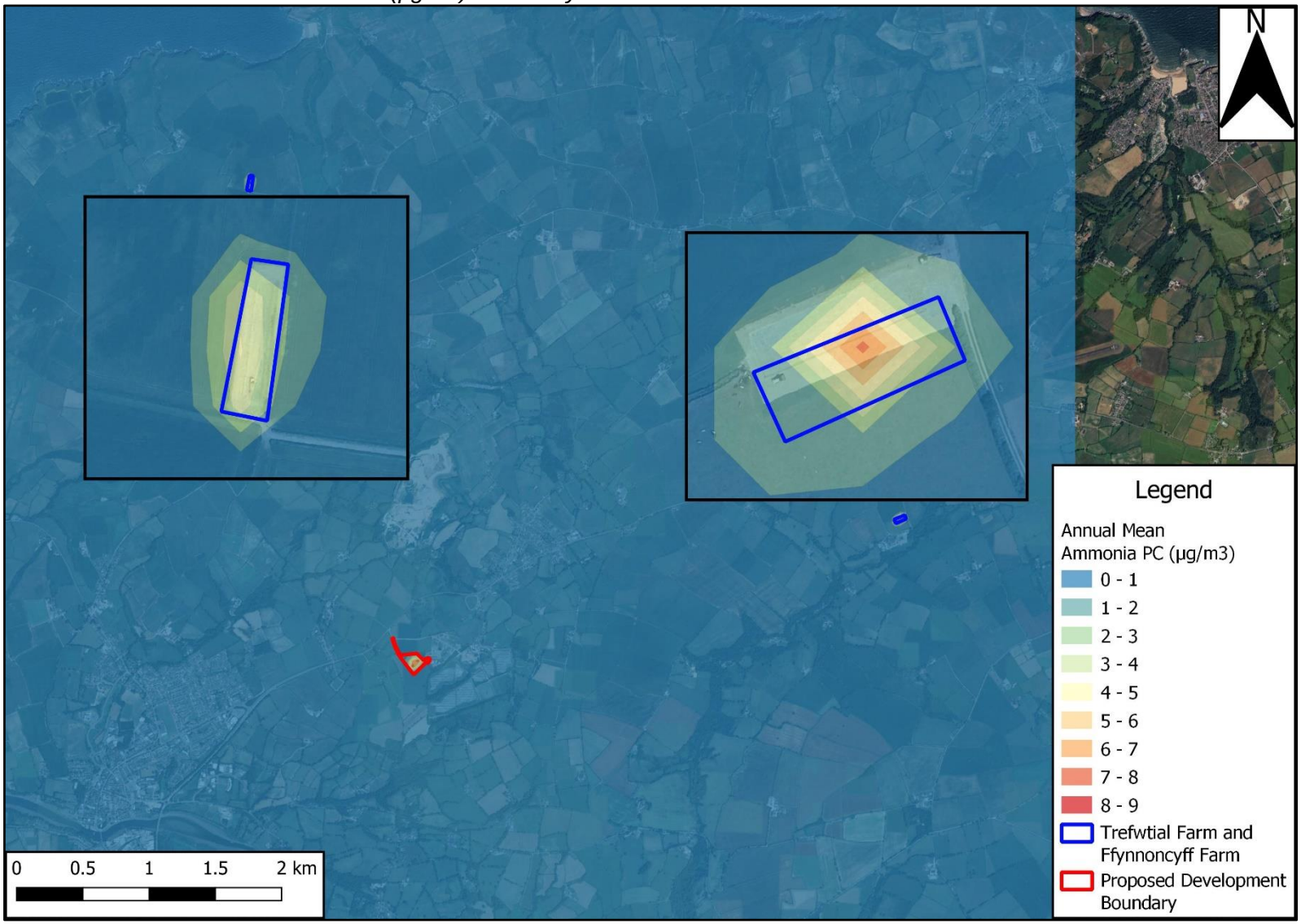
Figure A.3 Annual Mean Ammonia Process Contribution (µg/m^3) at Nearby Ammonia Sources



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