

**HANMER FARMS, MOSS LANE
ODOUR IMPACT ASSESSMENT**

July 2024

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1.0 INTRODUCTION

Isopleth Ltd has been instructed by Roger Parry & Partners LLP on behalf of Hanmer Farms to carry out a detailed assessment of odour impacts associated with a new (covered) cattle slurry lagoon at Moss Lane, Arowry, Hanmer, Wrexham SY13 2JX. The site lies within the administrative area of Wrexham County Borough Council.

A drawing showing the site location is included as Appendix A.

1.1 Background

Hanmer Farms is seeking to obtain planning permission for a new cattle slurry lagoon. If approved, the proposed new lagoon will help to ensure that the slurry storage capacity at the farm is consistent with legislative requirements. The lagoon will be covered with a fixed, floating cover.

The potential odour impacts at local residences associated with the proposed lagoon have been assessed. Full details of the application are available on the Wrexham County Borough Council website:

'Planning Application P/2022/1050 - Dilys o/Valid From 15/12/2022 Land At Moss Lane, Arowry, Hanmer, Whitchurch, SY13 3EH. Gosod storfa slyrl / installation of slurry store'

The intention is to install a soil bunded lagoon of maximum 50m x 30m at the top of the bunds in order to store cattle slurry from the farm. The lagoon is sized to hold a maximum of 4498 litres of slurry, however will in practice only fill during the closed spreading season (approximately October to February). The greatest volume of slurry would therefore be expected the day before the spreading season opens and the lagoon would be at a very low level on the last day of the spreading season, ready for the next closed season fill.

1.2 Aims and Objectives

The objectives of the assessment are as follows:

- To estimate odour emissions from the proposed covered slurry lagoon;
- To quantify impacts on sensitive receptors based upon the emission values;
- To assess the significance of these impacts; and
- Propose further mitigation options, if required.

1.3 Scope and Limitations

The scope of this OIA is limited to the quantification, through atmospheric dispersion modelling, of odour impacts from the proposed covered cattle slurry lagoon on local sensitive receptors based on design information and desktop emission rates.

1.4 Experience of Assessor

According to guidance issued by the IAQM, odour assessments must only be completed by a qualified assessor if they are to be considered robust. This includes both experience in the field of odour assessment as well as a defined odour acuity, where relevant.

This assessment has been completed by Matt Stoaling of Isopleth Ltd and Fellow of the IAQM. Matt has been involved in the field of odour assessment for over 25 years, including having been Head of Olfactometry at a UKAS accredited odour laboratory. During this time, Matt has also provided air quality and odour advice and services to a range of industry sectors and clients, including the chemical industry, solid waste, wastewater and agriculture. Matt has worked on behalf of local authority and government agencies advising on odour issues, including documents published by the Environment Agency, Sniffer and the IAQM.



2.0 ASSESSMENT METHODOLOGY

2.1 Assessment of Odour Exposure

In the UK, odour assessments are most commonly undertaken using the concept of the European Odour Unit (ou_E), as defined in BS EN 13725¹. This approach allows impact assessment of any odorous gas as it is independent of chemical constituents and centres instead on multiples of the detection threshold of the gas in question. As the odour unit is a Standard Unit in the same way as gram or milligram, the notation used in odour assessment follows the conventions of any mass emission unit as follows:

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

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

Odour perception, annoyance and nuisance is related to more than simply odour impact, the five 'FIDOL' factors must also be considered when assessing the acceptability of a scheme and the appropriateness of a limit criterion, defined by the IAQM as follows:

- **Frequency:** How often an individual is exposed to odour;
- **Intensity:** The individual's perception of the strength of the odour;
- **Duration:** The overall duration that individuals are exposed to an odour over time;
- **Odour unpleasantness (or 'offensiveness'):** Odour unpleasantness describes the character of an odour as it relates to the 'hedonic tone' (which may be pleasant, neutral or unpleasant) at a given odour concentration/ intensity. This can be measured in the laboratory as the hedonic tone, and when measured by the standard method and expressed on a standard nine-point scale it is termed the hedonic score;
- **Location:** The type of land use and nature of human activities in the vicinity of an odour source. Tolerance and expectation of the receptor. The 'Location' factor can be considered to encompass the receptor characteristics, receptor sensitivity, and socio-economic factors.

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

2.2 Receptor Sensitivity

On 20th May 2014 the Institute of Air Quality Management released guidance on the assessment of odour for planning. This was updated in 2018. The guidance is for assessing odour impacts for planning purposes and is discussed further in Section 3.3 of this report. IAQM receptor sensitivity classes are shown below.

Table 2-1
IAQM Sensitivity Classes

Sensitivity Class	Description
High Sensitivity	Surrounding land where: • users can reasonably expect enjoyment of a high level of amenity; and • people would reasonably be expected to be present here continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. <i>Examples may include residential dwellings, hospitals, schools/education and tourist/cultural.</i>
Medium Sensitivity	Surrounding land where: • users would expect to enjoy a reasonable level of amenity, but wouldn't reasonably expect to enjoy the same level of amenity as in their home; or • people wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. <i>Examples may include places of work, commercial/retail premises and playing/recreation fields</i>
Low Sensitivity	Surrounding land where: • the enjoyment of amenity would not reasonably be expected; or • there is transient exposure, where the people would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. <i>Examples may include industrial use, farms, footpaths and roads.</i>

Residences would typically be regarded as being of 'high' sensitivity, although this will also depend on their setting. Research² has shown that, as would be expected, people living in rural communities are more tolerant of agricultural odours, particularly those which aren't associated with standard farming methods. This must be taken into account when considering the FIDOL factors in relation to the proposed development.

² Bongers, M.E., Van Harreveld, A.P., Jones, N., (2001B) *Recent developments in research supporting pig odour policy reviews in the Netherlands and in Ireland*, In: Proceedings of the 1st IWA International Conference on Odour and VOC's: Measurement, Regulation and Control Techniques, University of New South Wales, Sydney, March 25-28, 2001,

2.3 Quantification of Odour Impact

For this assessment the AERMOD model³ has been applied with due consideration to relevant guidance⁴. This model is widely used and accepted by the EA and UK planning authorities for undertaking such assessments and its predictions have been validated against real-time monitoring data by the USEPA. It is therefore considered a suitable model for this assessment. Dispersion modelling guidance indicates that at least 3 (and ideally 5) years of meteorological data should be applied to ensure that infrequent weather conditions do not unduly bias the results. This results in a range of predicted impacts for different years of meteorological data and the average value is used to assess compliance, with the range of impacts used to assess likely variation between years and the risk of shorter-term impacts.



³ Software used: BREEZE AERMOD Pro, v11.0.0.7

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

3.0 REGULATORY STANDARDS AND GUIDELINES

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

3.1 UK Guidance

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

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

3.2 Planning (NPPF) and Permitting

Although there is a requirement for intensive farms (pigs and poultry) to cover slurry stores when the contents have greater than 1% dry matter, this applies to Permitted sites only. There is therefore no legal requirement for dairy farms to cover slurry tanks or lagoons at the present time however this may be the case in 2027 (or possibly earlier).

3.3 IAQM Odour Guidance⁵

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

The guidance is for assessing odour impacts for planning purposes. It provides background information relating to requirements for odour impact assessments and suitable impact criteria and draws from other sources of information such research in the UK and abroad.

The IAQM odour guidance requires a degree of professional judgement when considering potential effects of environmental odours. Given the site setting and the number of residences potentially affected, the IAQM odour guidance may be used to classify the impact from a facility.

⁵ IAQM (2018) *Guidance on the assessment of odour for planning*

For example, in relation to an intensive agricultural facility (i.e. for a 'moderately offensive odour' from pigs and poultry) at a high sensitivity receptor the effect would be classed as:

- 'negligible' at below $1.5 \text{ ou}_E/\text{m}^3$;
- 'slight adverse' from $1.5 \text{ ou}_E/\text{m}^3$ – $3.0 \text{ ou}_E/\text{m}^3$ as a 98th percentile of hourly means; or
- 'moderate adverse' impact above from $3.0 \text{ ou}_E/\text{m}^3$ to $10.0 \text{ ou}_E/\text{m}^3$ as a 98th percentile of hourly means.

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

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

3.4 Odour Impact Criteria: Dairy Farming

In section 3.3 above an example of appropriate impact criteria is provided for odours from intensive livestock (pigs or poultry). Research⁶ has shown that at the same hedonic level of -1 (slightly unpleasant), the corresponding odour concentration is $14\text{--}16 \text{ ou}_E/\text{m}^3$ from intensive livestock (pigs or poultry) while it is $37 \text{ ou}_E/\text{m}^3$ from a cattle shed. This means that, for a given odour exposure, cattle slurry and housing is regarded as significantly less offensive than odours from intensive livestock (pigs or poultry). UK Guidance requires that this is taken into account when considering FIDOL and the appropriateness of limit criteria for prevention of disamenity.

Similar findings have been published by German researchers⁷ who found that:

'In the German study results of a logistic regression on annoyed and on highly annoyed people were reported for emissions from swine, poultry, and cattle farms....

...Regarding cattle, so far no complaints have been handed in, although thousands of cattle farms can be found in Styria. Reasons could be seen in the lower annoyance potency of cattle odors, as it has also been reported in the German study, with several possible causes (e.g., the amount of sulfuric odor compounds or animal density in the farms) which itself could be a topic for additional research. Due to the lack of complaints, coefficients for cattle odors cannot be established from our data, but it can safely be argued that coefficients would be rather small. Therefore, no quantitative comparison is possible with the German findings in this regard, but it should be noted that the German effect estimates for cattle were also small and not significantly different from null.'

As a result, German guidelines introduced certain weighting factors in the case of exposure to animal odours (1.5 for poultry, 0.75 for pigs and 0.5 for cattle). For these reasons, in relation

⁶ Nimmermark, S. *Influence of odour concentration and individual odour thresholds on the hedonic tone of odour from animal production*. Biosyst. Eng. 2011, 108, 211–219.

⁷ Moshhammer, H.; Oettl, D.; Mandl, M.; Kropsch, M.; Weitensfelder, L. *Comparing Annoyance Potency Assessments for Odors from Different Livestock Animals*. Atmosphere 2019, 10, 659.

to cattle odours – including slurry - the following effect descriptors are considered appropriate:

- 'negligible' at below $3.0 \text{ ou}_E/\text{m}^3$;
- 'slight adverse' from $3.0 \text{ ou}_E/\text{m}^3$ – $6.0 \text{ ou}_E/\text{m}^3$ as a 98th percentile of hourly means; or
- 'moderate adverse' impact above from $6.0 \text{ ou}_E/\text{m}^3$ to $15.0 \text{ ou}_E/\text{m}^3$ as a 98th percentile of hourly means.

As only a moderate impact (or greater) would be regarded as 'significant' for purposes of environmental assessment when considering the overall planning balance an odour from cattle housing or cattle slurry store would be considered 'significant' at above **$6.0 \text{ ou}_E/\text{m}^3$** . A 'substantial' (and therefore overriding) effect would only occur if the odour were predicted to be above $15.0 \text{ ou}_E/\text{m}^3$.



4.0 SITE DESCRIPTION

4.1 Location

The proposed Hanmer Farms cattle slurry lagoon at Moss Lane, Arowry, Hanmer, Wrexham SY13 2JX lies within the administrative area of Wrexham County Borough Council.

The lagoon is set about 400 metres north of Bettisfield Park with access via a surfaced farm track. The closest residence is Beech Tree Cottage approximately 280m to the west south west of the lagoon.

The application site is located at approximate site grid reference OS GR 346315, 338090 as shown in Appendix A.

4.2 Development Description

For purposes of this modelling, the study therefore concerns the proposed new covered cattle slurry lagoon only.

4.3 Receptors

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

Table 4-1
Discrete Receptor Locations Modelled

Ref	Description	National Grid Reference		Elevation (mAoD)
		OS Xm	OS Ym	
R1	Keepers Cottage	345821.8	338191.4	99.9
R2	Park Meadows	345520.2	338632.0	102.0
R3	Arowry Farm	346045.1	338815.3	99.0
R4	Mayfields	346340.0	338470.1	100.1
R5	Mossfields Farm	346542.6	338401.3	99.1
R6	Holebrook Farm	346961.7	338445.7	93.8
R7	Smithy Farm	347098.4	338198.8	95.0
R8	Lane Cottage	346873.7	337943.8	96.0
R9	Lane Farm	346566.9	337611.1	98.0
R10	Beech Tree Cottage	346104.9	337892.0	98.9
R11	3 New Road	346107.9	337824.0	98.1
R12	Lower Lodge	346127.1	337801.8	98.0
R13	Top Lodge	346343.0	337568.2	99.7
R14	Bettisfield Park	346133.8	337666.6	99.7

In addition to assessment of impact at the discrete receptors listed, a receptor grid has been used to allow the production of an odour isopleth drawing (i.e. odour contours). Modelling was carried out at 10m resolution over a 500m x 500m grid.



5.0 DISPERSION MODELLING INPUTS

Detailed dispersion modelling has been completed in line with *Guidance on modelling the concentration and deposition of ammonia emitted from intensive farming. Air Quality Modelling and Assessment Unit v3*. There is no specific odour modelling guidance for the farming of dairy cattle or from cattle slurry lagoons. The BREEZE AERMOD model has been used.

5.1 Scenarios

A single scenario has been modelled which represents the proposed lagoon. The full model inputs are presented in Appendix B.

5.2 Emission Calculations

The emissions of odour from the lagoon will be based on:

- The slurry source, in this case cattle;
- Whether the liquid is slurry or also includes dirty water / parlour washings (i.e. proportion of total solids and volatile solids). In this case the lagoon will receive slurry;
- The volume of slurry in the lagoon (and therefore surface area of emission);
- total ammonia nitrogen (TAN) / Total N Kjeldahl (TKN) ratio and degrees of biological stability;
- The season (affecting temperature and potential for volatilisation from the lagoon; and
- The presence / absence of any cover type.

Seasonal odour emission rates have been used for the lagoon which is consistent with published library data⁸ for cattle slurry.

Table 5-1
Odour Emission Factors

Season	Mean ou _E /m ² /s	St Dev ou _E /m ² /s	CV
Summer Average	3.6	1.7	0.5
Winter Average	1.8	0.9	0.5
Yearly Average	2.7	1.6	0.6

The total modelled area of emission from the lagoon reflects the maximum area up to the freeboard level. In this case an emitting area of 960m² has been modelled (80% of the total area at the top of the bunds).

⁸ Valli, Laura & Moscatelli, Giuseppe & Labartino, Nicola. (2008). *Odour emissions from livestock production facilities*. Chem. Eng. Trans.. 15.

Table 5-2
Odour Emission Factors

Month	Season	Mean (uncovered) ou _E /m ² /s	Mean (covered) ou _E /m ² /s
January	winter	1.82	0.34
February	winter	1.82	0.34
March	spring	2.72	0.52
April	spring	2.72	0.52
May	spring	2.72	0.52
June	summer	3.62	0.69
July	summer	3.62	0.69
August	summer	3.62	0.69
September	autumn	2.72	0.52
October	autumn	2.72	0.52
November	autumn	2.72	0.52
December	winter	1.82	0.34

SCAIL assumes that floating covers mitigate the ammonia emissions by 55-56%, however this refers to a light expanded clay aggregates (i.e. 'floating clay ball') type cover rather than a flexible sheeting system. Guidance for floating (flexible sheeting) covers has been prepared, albeit for intensive farming, by the Environment Agency. Although this is not an intensive farm, many of the same technical points raised in the guidance are relevant to this application⁹. Suppliers for these cover systems have indicated that their system will abate ammonia emissions by >80% and this is reflected in SCAIL emission factors (which are based on 81% reduction).

5.3 Building Downwash

The movement of air over and around buildings and other structures generates areas of flow re-circulation that can lead to increased ground level concentrations of pollutants close to the source. As the emissions from the site are from an open ground level source the dispersion model takes no account of building downwash effects as there is effectively no defined vertical release.

5.4 Meteorology

In accordance with current guidance, 5 years of meteorological data has been used (2018 – 2022). The site at Shawbury is the closest representative site with a >90% complete data set and this has been used in the modelling.

⁹ EPR 6.09 Sector Guidance Note. *How to comply with your environmental permit for intensive farming. Appendix 9. Producing a proposal for covering slurry stores.* Version 3 February 2012

5.5 Topography

The presence of elevated terrain can significantly affect ground level concentrations of pollutants emitted from sources in a number of ways. Elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to a source and reducing concentrations further away.

The lagoon is located at approximately 98m AoD. Information relating to the topography of the area surrounding the site has been used to assess the impact of terrain features on the dispersion of emissions from the site. Topographical data has been obtained in digital (.ntf) format and incorporated into the assessment.



6.0 IMPACTS: PROCESS CONTRIBUTION

Results may be compared against the significance criterion of 6 ou_E/m³ as a 98th percentile of hourly means appropriate for a cattle odour although this should be regarded as precautionary as should the emission rates. As described in section 3.3 appropriate magnitude of effect bands are:

- 'negligible' at below 3.0 ou_E/m³;
- 'slight adverse' from 3.0 ou_E/m³ – 6.0 ou_E/m³ as a 98th percentile of hourly means; or
- 'moderate adverse' impact above from 6.0 ou_E/m³ to 15.0 ou_E/m³ as a 98th percentile of hourly means.

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

Table 6-1
Odour Results (ou_E/m³)

Receptor	2018	2019	2020	2021	2022	average
R1	0.02	0.02	0.01	0.01	0.01	0.02
R2	0.00	0.00	0.00	0.00	0.00	0.00
R3	0.01	0.01	0.01	0.01	0.01	0.01
R4	0.02	0.02	0.02	0.02	0.03	0.02
R5	0.03	0.04	0.03	0.03	0.04	0.03
R6	0.02	0.02	0.01	0.01	0.01	0.01
R7	0.01	0.01	0.01	0.01	0.01	0.01
R8	0.01	0.01	0.01	0.01	0.01	0.01
R9	0.02	0.02	0.02	0.03	0.02	0.02
R10	0.03	0.02	0.03	0.05	0.03	0.03
R11	0.02	0.01	0.02	0.03	0.02	0.02
R12	0.02	0.01	0.02	0.03	0.02	0.02
R13	0.01	0.01	0.01	0.02	0.02	0.01
R14	0.01	0.01	0.01	0.01	0.01	0.01

The modelling indicates that the existing average odour impact from the cattle slurry does not exceed 6.0ou_E/m³ (or indeed 1.0ou_E/m³) at any receptor location.

7.0 CONCLUSIONS

Isopleth Ltd has been instructed by Roger Parry & Partners LLP on behalf of Hanmer Farms to carry out a detailed assessment of odour impacts associated with a covered cattle slurry lagoon at Moss Lane, Arowry, Hanmer, Wrexham SY13 2JX. The site lies within the administrative area of Wrexham County Borough Council.

The type, source and significance of potential impacts have been identified and detailed modelling undertaken in line with EA Guidance.

Predicted process contributions of odour are compared with relevant guidelines for the protection of human receptors against disamenity impacts.

The modelling indicates that the odour impact from the farm does not exceed $6.00 \text{ ou}_E/\text{m}^3$ (appropriate for cattle odours) or indeed $3.00 \text{ ou}_E/\text{m}^3$ (appropriate for pig and poultry odours) at any location. For this reason and given the regulatory requirements for the farm (i.e. to maintain adequate lagoon capacity for protection of the soil and water resource) it is considered that the change in odour resulting from the installation of the lagoon is acceptable in planning terms.



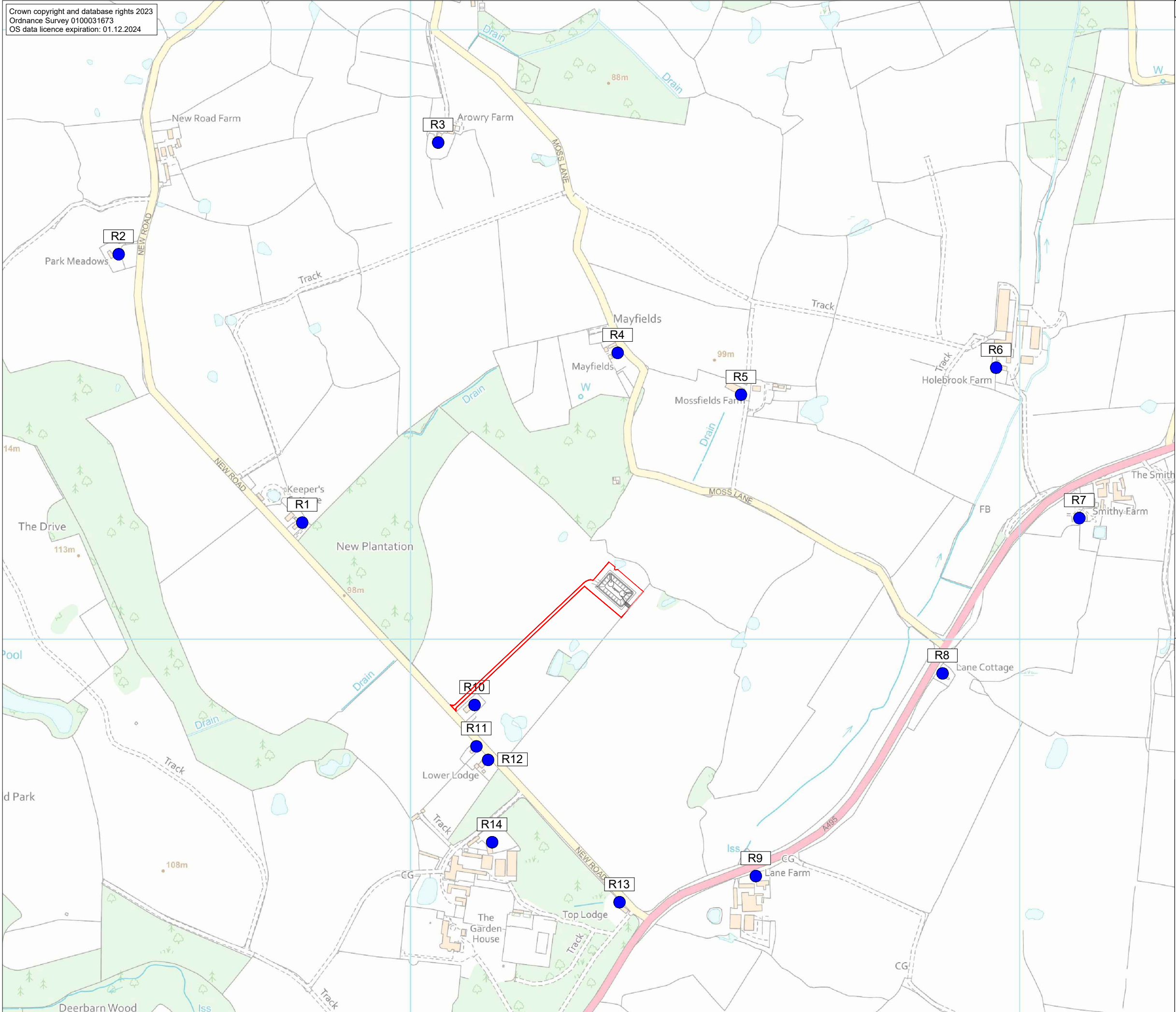
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APPENDIX A





LEGEND

SITE BOUNDARY

RECEPTOR LOCATIONS

North arrow pointing up.

SITE Moss Lane, Arowry, Hanmer, Wrexham SY13 2JX	
PROJECT Air Quality Assessment	
DRAWING TITLE Site Setting and Receptors Locations	
DRAWING NUMBER OIA1	REVISION 0
SCALE 1:6000 @ A3	DATE 01.12.2023

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APPENDIX B

Table B-1
Sources

ID	Description	OS Xm	OS Ym	Z (mAoD)
SL1	Lagoon 1	346313.2	338085.6	98.1

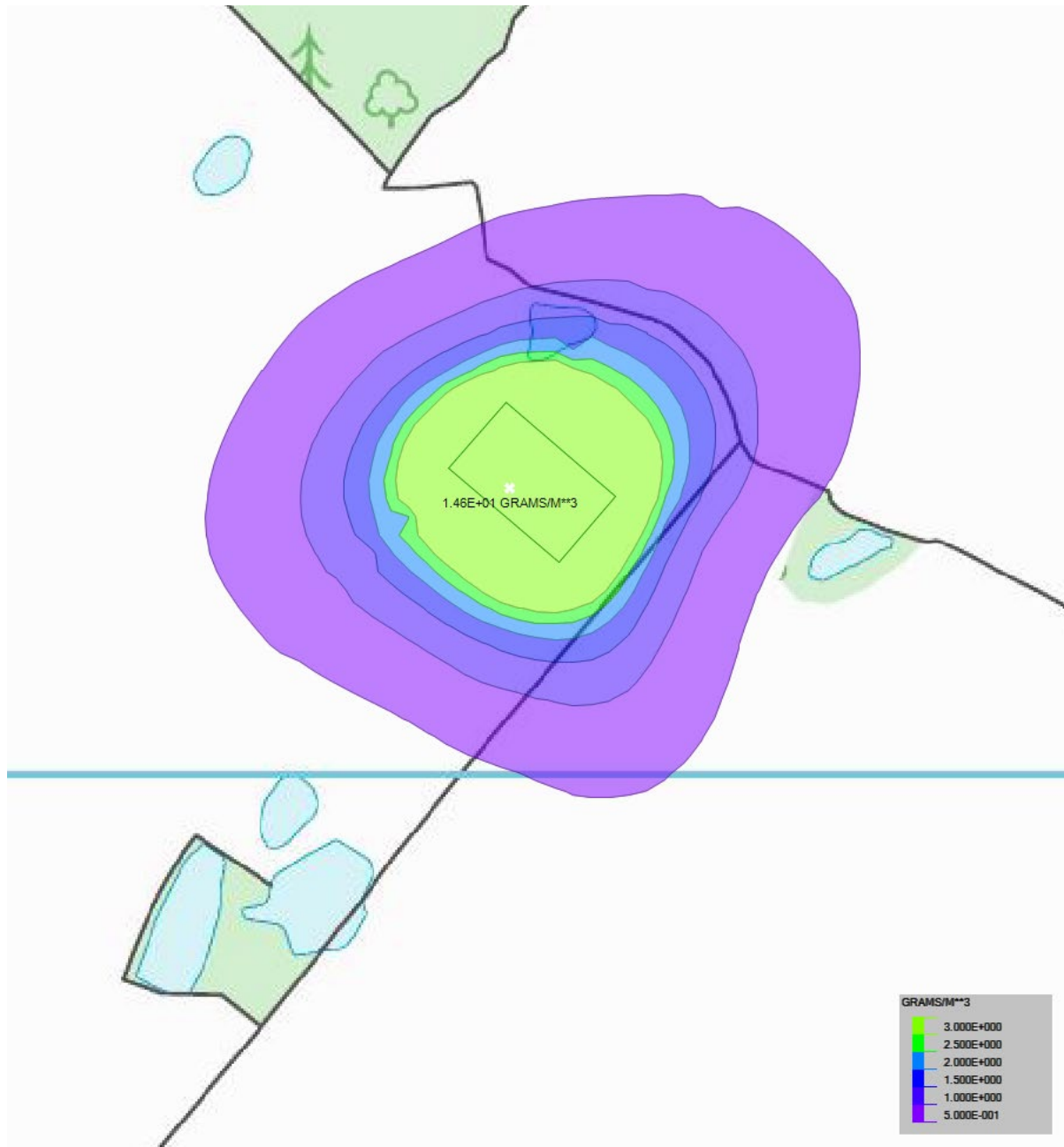
Table B-2
Source Attributes (Rectangular Area)

ID	Description	Height (m)	Length (m)	Width (m)	Angle (°)
SL1	Lagoon 1	0.5	40	24	40.7



APPENDIX C

Figure C-1
5-Year Average Odour Impacts (C_{98} 1-hour ou_E/m^3)



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