Air Spectrum Environmental Ltd

Odour Dispersion Model

Produced for:

Aberdeenshire Council

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Air Spectrum Environmental Limited
General Notes:

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Prepared for : Aberdeenshire Council

Site address : Peterhead AB42 5BT

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EXECUTIVE SUMMARY

Air Spectrum Environmental Limited was commissioned by Aberdeenshire Council to produce an odour dispersion model based upon odour emissions from Baluss Farm, and report on the impact which any odour release will have on the local amenity of the site. Specific emissions obtained from analysis results conducted at Spectrum OdourLab were modelled.

The air quality impacts in terms of odour concentrations; resulting from the operation of the proposed project were assessed using an advanced dispersion model software package (ADMS 5). All predicted ground level concentrations of odour were modelled in the near field environment.

All locations within a 2km by 2km area were covered by the model assessment. It was found that the level of odour concentrations were highest within the point of emission, with 2-4 OU_E/m^3 of odour visible over the nearby village when all sources are taken into account. The higher odour levels seen within the model are within the site boundary. It is noticed that the main cause of odour is from the building sources alone and not the slurry tank, of which levels of 0.55 OU_E/m^3 and below are seen. When the model was run using the buildings as the only sources there was still 2-4 OU_E/m^3 seen over the nearby village. Due to the low odour levels from the slurry tank this is below the offensiveness value of 1.5 OU_E/m^3 of the Newbiggin criteria.

Odour Levels Reported

Model Scenario 1	Highest odour level (OU_E/m^3)	Lowest odour level (OU_E/m^3)
Standard model 98th Percentile 1 hour average	26.0	2.0

Model Scenario 2	Highest odour level (OU_E/m^3)	Lowest odour level (OU_E/m^3)
Standard model 98th Percentile 1 hour average	26.0	2.0

Model Scenario 3	Highest odour level (OU_E/m^3)	Lowest odour level (OU_E/m^3)
Standard model 98th Percentile 1 hour average	0.55	0.05

The odour impact upon the local amenity from the site is considered to be below the suggested levels from the Environment Agency H4 Guidance notes. Please note: this is a computational model based upon average meteorological data. Short term meteorological variations may affect the odour dispersion.

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INTRODUCTION

Scope

Air Spectrum Environmental Limited was commissioned by Aberdeenshire Council to produce an odour dispersion model based upon odour emissions from Baluss farm and report on the impact which any odour release will have on the local amenity of the site. Specific emissions obtained from analysis results conducted at Spectrum OdourLab were modelled.

The modelling assessment takes into account, and includes a discussion of, the following key parameters/elements:

- Site Parameters
- Assessment criteria
- Emission parameters
- Modelling domain
- Meteorology

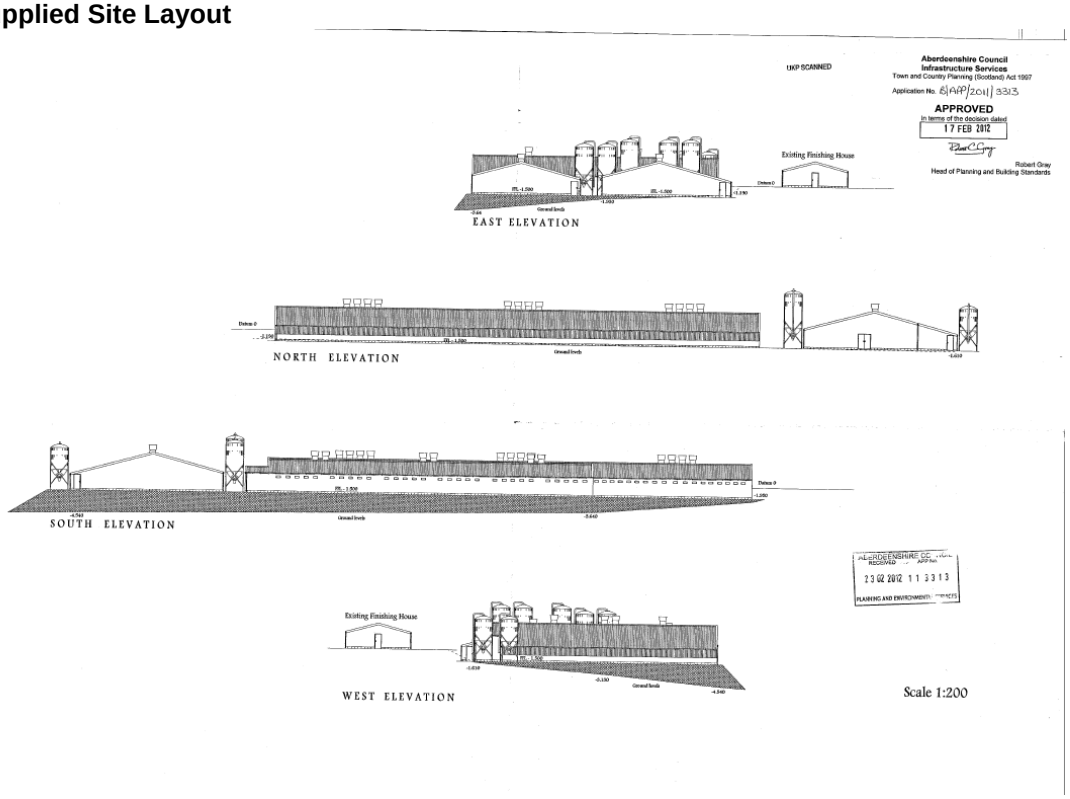
Site Description

Baluss farm is a pig farm located to the South and East of Mintlaw AB42 5BT.
(X: 400527, Y: 847440.75).

Building layout and locations were based upon the supplied drawings of planning applications passed in 2011-2012.

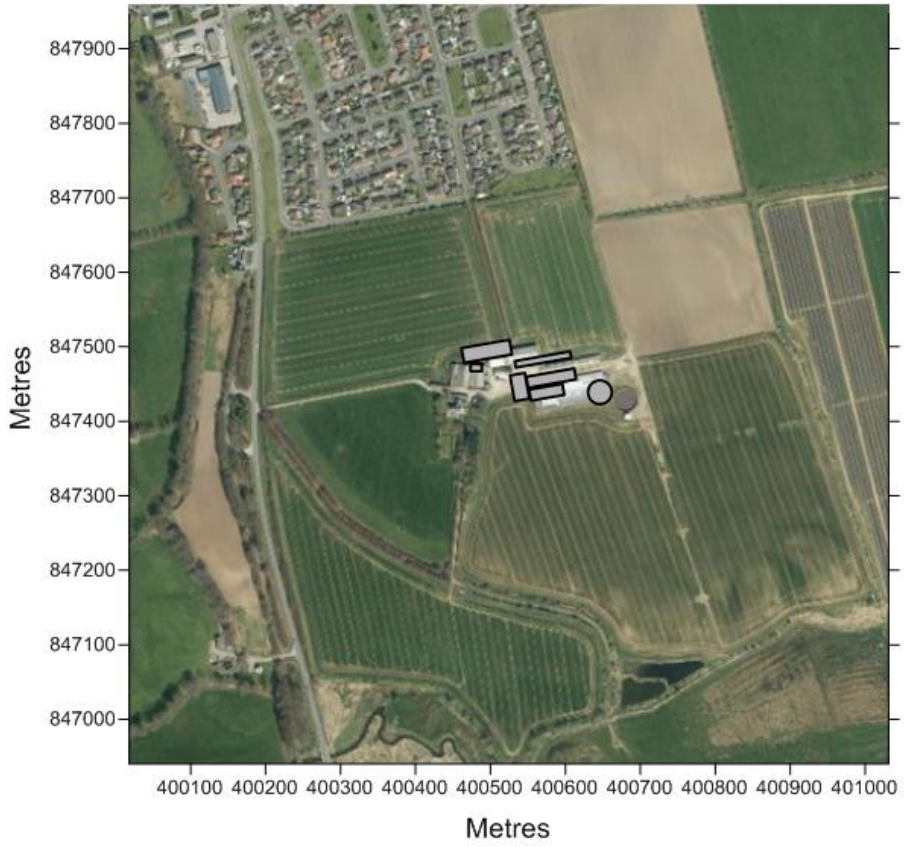
The site is described as shown below for the purposes of the modelling:

Supplied Site Layout



ADMS Building Visualisation Overlay

2km



Assessment Methodology

Assessment criteria

The environmental requirements were set out at $3.0OU_E/m^3$ measured at 98th Percentile, a predicted 1-hour average odour concentration at the sensitive receptor in accordance with EA H4 guidance.

Modelling Data

The following sources were used:

- Farrowing House
- Sorter Building
- Nursery
- Slurry Tank
- Background odour has not been applied to models

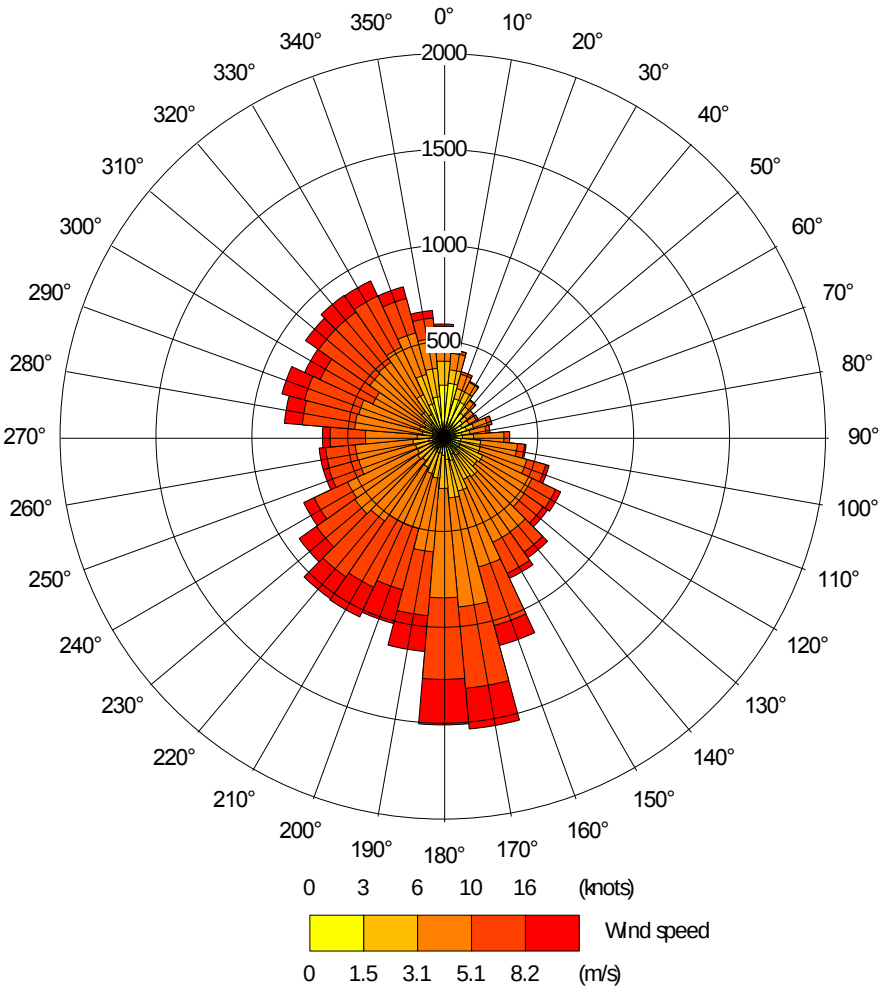
Model Data:

Table 1.0

	Height	Length / Diameter	Width	Emission	Flow	Emission Point	
	m	m	m	Ou/s	m/s	x	y
Farrowing House A	5	16.25	15	4138	4.5	400542.28	847439.24
						400542.28	847440.99
						400541.53	847445.24
						400541.03	847446.99
Farrowing House B	5	16.25	15	4138	4.5	400540.53	847448.74
						400539.78	847453.99
						400539.28	847455.49
Sorter A	5	13.75	18.75	3303	4.5	400560.28	847459.24
						400562.03	847459.24
						400563.53	847459.49
Sorter B	5	13.75	23.75	3303	4.5	400582.03	847462.99
						400583.28	847462.99
						400585.03	847463.24
Sorter C	5	13.75	20	3303	4.5	400603.28	847466.99
						400604.78	847467.49
						400606.78	847467.49
Nursery A	5	15	12.5	410	4.5	400561.00	847442.50
						400562.50	847442.75
Nursery B	5	15	12.5	410	4.5	400575.75	847445.50
						400577.00	847445.50
Nursery C	5	15	12.5	410	4.5	400590.00	847448.00
						400591.50	847448.50
Slurry Tank	2	31.8		1539	1	400646.78	847439.74

Meteorological Data:

Aberdeen Windrose



Model Description

ADMS is a state-of-the-science dispersion modelling system that simulates essential atmospheric physical processes and provides refined concentration estimates over a wide range of meteorological conditions and modeling scenarios. It is based on atmospheric boundary layer turbulence structure and scaling concepts, including treatment of multiple ground-level and elevated point, area and volume sources. It handles flat or complex, rural or urban terrain and includes algorithms for building effects and plume penetration of inversions aloft. It uses Gaussian dispersion for stable atmospheric conditions (i.e., low turbulence) and non-Gaussian dispersion for unstable conditions (high turbulence).

ADMS includes two data pre-processors for streamlining data input. A meteorological pre-processor, computes boundary layer and other necessary parameters for use with ADMS and uses standard hourly sequential data supplied from the UK met office. There is also a terrain preprocessor option that simplifies the computation of receptor elevations and effective height scales for numerous types of digital data formats, including OS Landform Panorama digital terrain maps. The model is considered appropriate by the UK Environment Agency for assessments of the nature described in this report.

The dispersion model for the facility was established using plans of the site, the site information was input into ADMS to determine the relationship between the facility and the proposed development land. Emission data and meteorological data were then fed into the model to enable the level of exposure to odours at locations surrounding the site to be predicted, under the normal operational regime for the facility. The results of the modeling were presented in the form of contours (or isopleths - lines connecting points with equal frequency of occurrence) for a 1-hour average limit concentration of x ou_E/m^3 as a 98%ile (percentile) (C_{98}, 1-hour = X ou_E/m^3) which defines the area where odour nuisance may occur.

[1] IPPC Technical guidance note, H4. EA.

Modelled Scenarios

In order to characterise the impact of the odour emissions from the collective odour emissions from the proposed site, the following scenarios were modelled as follows:

- **Scenario 1 (2km Grid):** Full dispersion model with all sources used and odour emissions rates as defined in table 1.0. Annual hourly sequential meteorological data from Aberdeen weather station.
- **Scenario 2 (2km Grid):** Full dispersion model with building sources only and odour emissions rates as defined in table 1.0. Annual hourly sequential meteorological data from Aberdeen weather station.
- **Scenario 3 (2km Grid):** Full dispersion model with slurry tank source only and odour emissions rates as defined in table 1.0. Annual hourly sequential meteorological data from Aberdeen weather station.

Note: Buildings data based upon Environment Agency Guidance document AQTAQ 06 “Technical guidance on detailed modelling approach for an appropriate assessment of emissions to air”

Modelled Domain

Two near field domains were incorporated in the dispersion model to predict the odour concentrations within the proposed site. The near field domains cover an area of 2km by 2km and had a grid resolution of 50m. Normally the modelled domain would be in the region of 1km square, but this was extended to ensure that the whole area surrounding Baluss farm was covered.

Modelled Domain

2km

Assessment of Odours

Odour concentration is measured in European Odour Units, OU_E/m^3.

By definition 1 OU_E/m^3 is the threshold of odour for that specific sample.

As guidance only, 3 – 5 OU_E/m^3 will be detectable and 5 – 10 OU_E/m^3 will become annoying.

1000 odour units represent an odour 1000 times greater than the concentration at which the odour in the sample would be first detected.

Note, the odour concentration is not a linear measure for the intensity of an odour.
Thus, for one specific gas there will not be a direct relationship between OU_E/m^3 and mg/m^3 (or PPM) over a range of readings.

The laboratory analysis result does not give a definite result. The given answer is subject to an error tolerance. For a result of 1000 OU_E/m^3 and a 95% confidence level, the actual possible range is:

For duplicate samples the possible range is 571 to 1752.
For triplicate samples the possible range is 633 to 1580.

In general terms, odour impact is recognised as a symptom that develops as a result of intermittent but regular exposure to odours that are recognisable and have an offensive character. The key factors that contribute to the development of odour annoyance can be usefully summarised by the acronym FIDOL:

- **F**requency of exposure
- **I**ntensity or strength of exposure
- **D**uration of exposure
- **O**ffensiveness
- **L**ocation sensitivity

In acknowledgement of these factors, a number of odour impact criteria have been developed that enable the odour impact risk of proposed facilities to be predicted using dispersion modelling techniques. These criteria are generally defined in terms of a minimum concentration of odour (reflecting the intensity/strength element of FIDOL) that occurs for a defined minimum period of time (reflecting duration and frequency element of FIDOL) over a typical meteorological year. The concentration element of these criteria can be increased or lowered to reflect variations in the offensiveness of the odours released from a specific type of facility, and the sensitivity of nearby sensitive locations.

In the UK, odour impact criteria are generally expressed in terms of a European odour unit concentration that occurs for more than 2% of the hours of a typical meteorological year, and have been designed for application to permanent residential properties which are considered to be the most sensitive from an impact risk perspective.

The most commonly applied criterion from this perspective is the 'Newbiggin criterion'. This criterion was originally introduced into a public inquiry for a new sewage works at Newbiggin- by-the-sea in 1995, and equates to an odour exposure level of 5 European odour units per cubic meter (C_{98}, 1-hour > 5 OU_E/m^3). The Newbiggin criteria has been successfully applied during numerous planning and nuisance assessment studies since 1995 for sewage, waste, food and a range of other industrial and agricultural activities.

These indicative criteria aim to differentiate between odours of different offensiveness, and range from C_{98}, 1-hour > 1.5 $OU\__E/m^3$ (for highly offensive odours) to C_{98}, 1-hour > 6 $OU\__E/m^3$ (for low offensive odours). It should be noted that the sewage treatment sector does not currently fall under the IPPC regime and that these criteria are based on relatively limited data and have not undergone any robust validation in terms of their applicability to the sewage treatment sector in the UK.

The comparison of odour exposure levels generated by the works before and after completion of the proposed sludge dewatering schemes was focused on the Newbiggin criterion (C98, 1- hour = 5 PU_E/m^3), and the most stringent EA criterion (C_{98}, 1-hour = 1.5 OU_E/m^3).

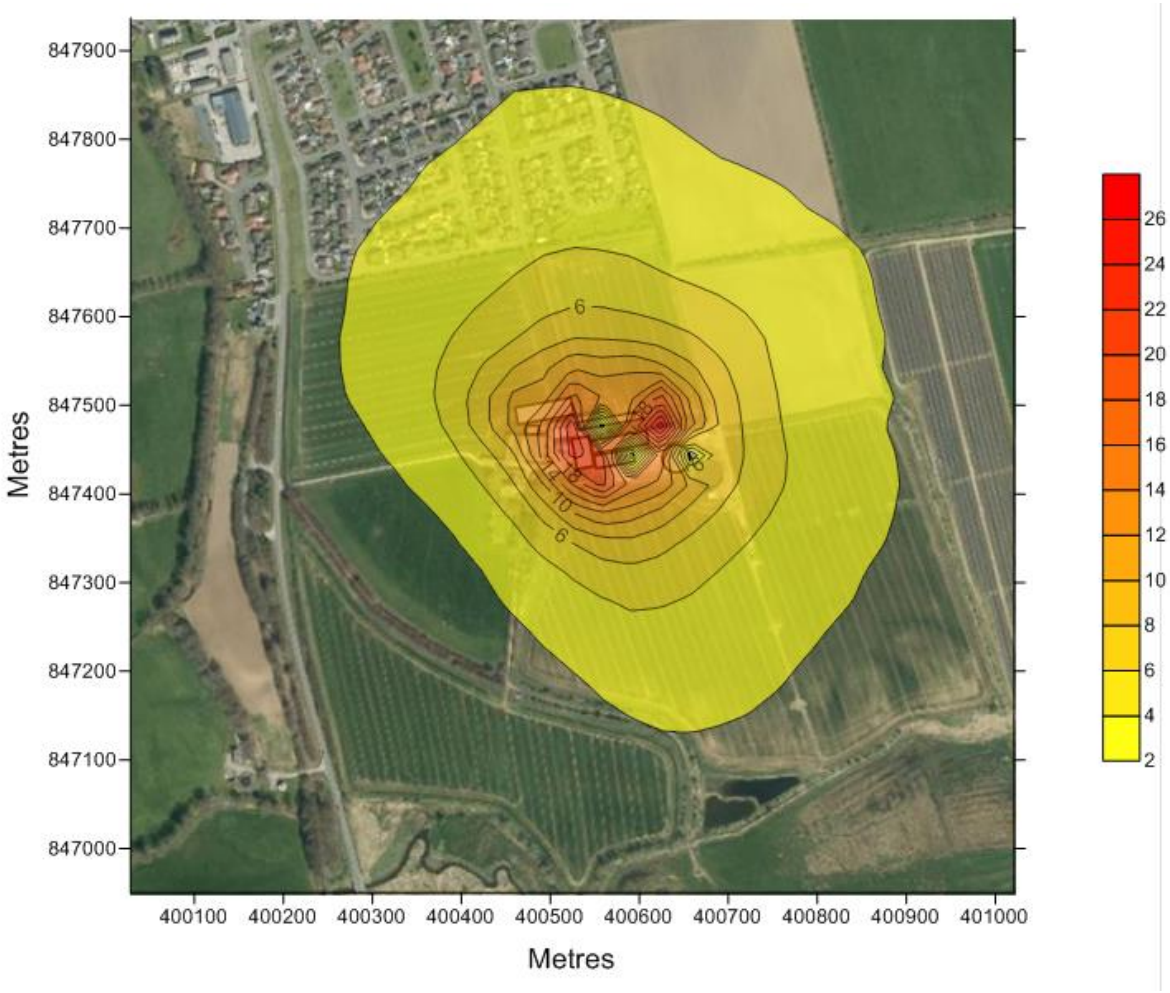
Newbiggin Criterion Table

Relative Offensiveness	Indicative Criteria
High	1.5 OU_E/m^3 98th Percentile (hourly average)
Medium	3 OU_E/m^3 98th Percentile (hourly average)
Low	6 OU_E/m^3 98th Percentile (hourly average)

Assessment of Impacts

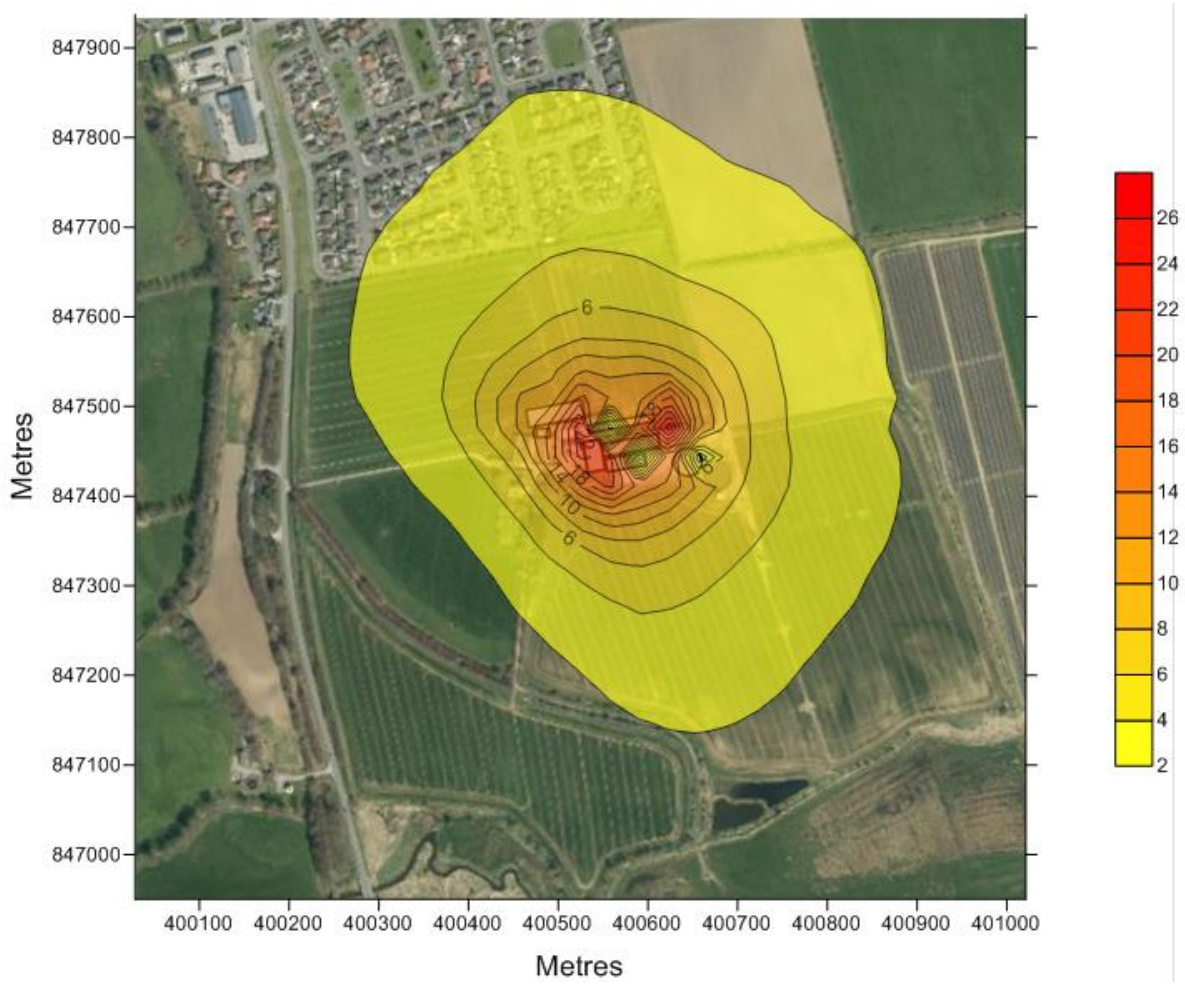
Scenario 1

Scenario 1 Odour Dispersion Contour Overlay on a 2km grid square from all sources (Aerial View) 98th percentile



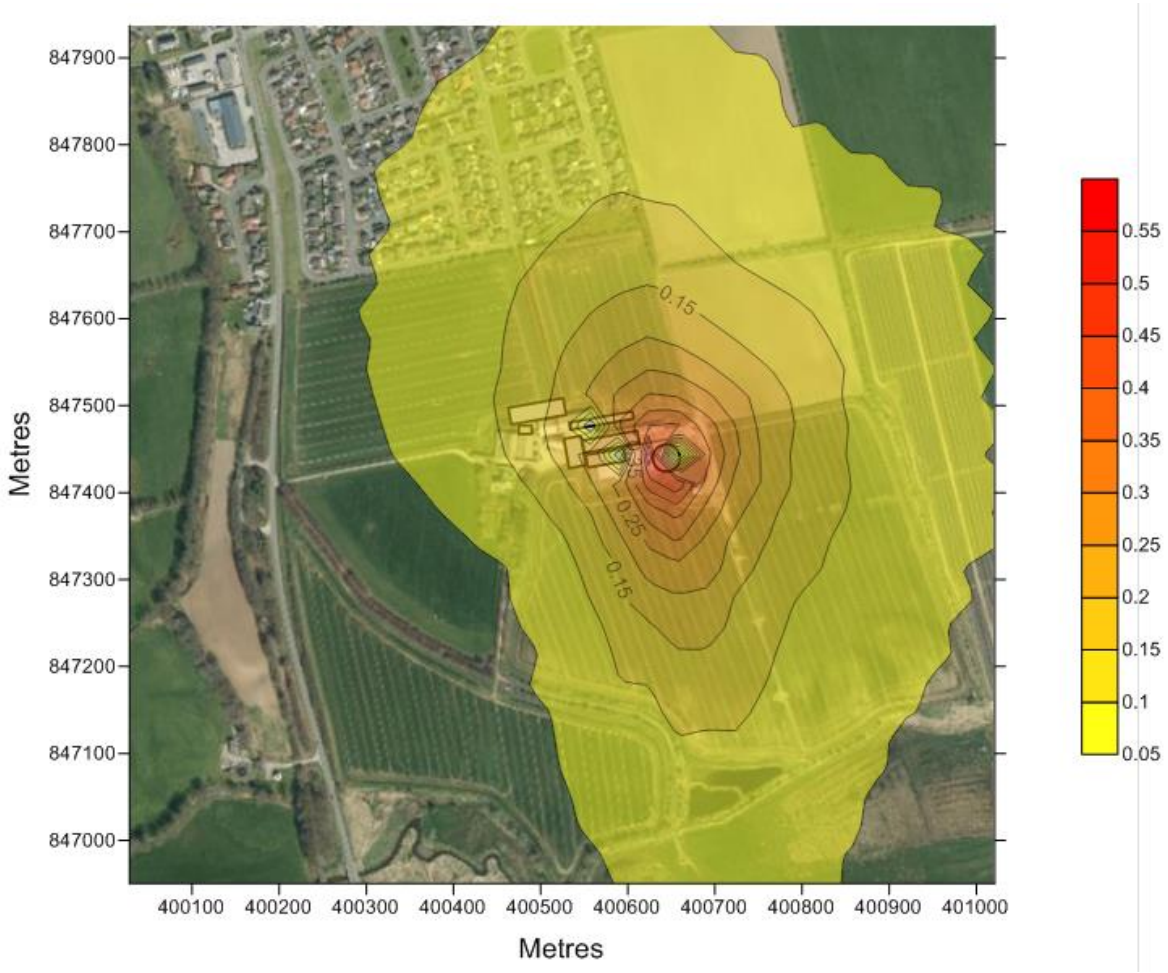
The above image shows the contour overlaid on an overhead aerial photograph

Scenario 2: Odour Dispersion Contour Overlay on a 2km grid square from building sources only (Aerial View) 98th percentile



The above image shows the contour overlaid on an overhead aerial photograph

Scenario 3: Odour Dispersion Contour Overlay on a 2km grid square from the slurry tank source only (Aerial View) 98th percentile



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Summary

All locations within a 2km by 2km area were covered by the model assessment. It was found that the level of odour concentrations were highest within the point of emission, with 2-4 OU_E/m^3 of odour visible over the nearby village when all sources are taken into account. The higher odour levels seen within the model are within the site boundary. It is noticed that the main cause of odour is from the building sources alone and not the slurry tank, of which levels of 0.55 OU_E/m^3 and below are seen. When the model was run using the buildings as the only sources there was still 2-4 OU_E/m^3 seen over the nearby village. Due to the low odour levels from the slurry tank this is below the offensiveness value of 1.5 OU_E/m^3 of the Newbiggin criteria.

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Model Scenario 3	Highest odour level (OU_E/m^3)	Lowest odour level (OU_E/m^3)
Standard model 98th Percentile 1 hour average	0.55	0.05

The odour impact upon the local amenity from the proposed development is considered to be below the suggested levels from the Environment Agency H4 Guidance notes. Please note: this is a computational model based upon average meteorological data. Short term Meteorological variations may affect the odour dispersion.

GLOSSARY

1:
Integrated pollution prevention and control (IPPC) H4 Horizontal guidance for odour part 2 – Assessment and control.

A guidance document produced by the Environment Agency and other agencies. Part 2 provides details regarding odour measurement, collection of samples, methodologies etc. currently still in draft format.

3:
Dynamic olfactometry

This is also known as dynamic dilution Olfactometry and is the most commonly used form of odour measurement.
Olfactometry involves the step-wise dilution of a sample of odorous gas with odour-free air and subsequent presentation to a panel of observers in order to determine the number of dilutions for the odour to be just perceived by 50% of the panel.

4:
ADMS

Dedicated software for producing dispersion model data to produce visual indications on the level of odour perceived. Detailed terrain, meteorological and process data can be included to produce an “odour footprint” to overlay on mapping layouts.