PARRY'S QUARRY LANDFILL ALLTAMI, FLINTSHIRE,

Environmental Permit Application

Odour Impact Assessment

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1.0 INTRODUCTION

SLR Consulting Limited (SLR) has been commissioned by Mold Investments Limited (Mold) to undertake an 'Odour Impact Assessment' of the landfilling of biodegradable wastes within the quarry void known as 'Parrys Quarry' (the site).

1.1 Background and Context

The site has been previously refused an Environmental Permit for the landfilling with biodegradable wastes by NRW, most recently in December 2016 for the following reason:

> *'Modelling has shown that there will be a significant odour impact from the normal daily operations to sensitive receptors in close proximity to the proposed site*.'

The accompanying 'Decision Document' prepared by NRW indicates that even with the inclusion of a 100m 'inert buffer' between the area for deposition of biodegradable wastes and sensitive receptors on the eastern boundary of the site, modelled odour exposures were more than 4-times the limit NRW would find acceptable.

1.2 Scope and Objective

The scope of the assessment is to assess the potential impact of odour emissions from the proposed infilling of biodegradable waste within Cell 6 of Parry's Quarry Landfill upon receptors in the surrounding area.

The principal objective is to assess whether odour emissions are effectively dispersed so that no significant detriment to amenity will occur when the plant is operational.

This report presents the approach, detailed methodology and findings of this Odour Impact Assessment.

1.3 Documents Consulted

In addition to the documents submitted in support of the most recent previous application for an Environmental Permit for the site, the subsequent refusal notice and Decision Document from NRW, the following documents were consulted during the undertaking of this assessment:

- Horizontal Guidance H4: Odour Management – How to comply with your Environmental Permit, Natural Resources Wales, 2011;
- IAQM Odour Guidance for Planning (2014); and
- Odour monitoring and control on landfill sites. SNIFFER 2013.

2.0 LEGISLATION AND RELEVANT GUIDANCE

2.1 Acceptability of Predicted Odour Impact

The potential for odorous compounds to cause nuisance is dependent upon a wide range of factors, including:

- the rate of emission of the compound(s);
- the duration and frequency of exposure;
- the time of the day that this emission occurs;
- the prevailing meteorology;
- the sensitivity of the 'receptors' to the emission, i.e. whether the odorous compound is more likely to cause nuisance, such as the sick or elderly, who may be more sensitive;
- the odour detection capacity of individuals to the various compound(s); and
- the individual perception of the odour, (i.e. whether the odour is regarded as unpleasant). This is greatly subjective, and may vary significantly from individual to individual. For example, some individuals may consider some odours as pleasant, such as petrol, paint and creosote.

There are neither European or United Kingdom (UK) specific regulatory standards for the assessment of the impact of odours. However, it may be reasonably argued that complaints are likely to occur when odours become detectable and recognisable. The longer the odour detection persists for an individual, the greater the level of complaints may be expected, particularly if the odours are unpleasant.

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. These documents typically indicate a numerical concentration limit of between 1.5 and 6ou_E/m^3, (based on the 98th percentile of hourly averages), depending on the offensiveness of the odour and sensitivity of the location. The lower criterion are typically applied to odours categorised as highly offensive in more urban areas, and higher criterion to less offensive / more pleasant odours in rural or industrial areas where odours are more likely to be tolerated.

2.1.1 NRW's H4 Odour Management Guidance

NRW's H4 Guidance[1] proposes installation-specific exposure criteria (benchmarks) on the basis that not all odours are equally offensive, and not all receptors are equally sensitive.

The H4 Guidance proposes the following benchmarks levels for the assessment and indication of unacceptable odour pollution:

- 1.5ou_E/m^3 (as a 98th percentile of 1-hour average concentrations) for the most offensive odours;
- 3ou_E/m^3 (as a 98th percentile of 1-hour average concentrations) for moderately offensive odours; and
- 6ou_E/m^3 (as a 98th percentile of 1-hour average concentrations) for less offensive odours.

The H4 Guidance refers to the application of the 1.5ou_E/m^3 criterion against the most offensive odorous sources, such as those processes involving 'biological landfill odours'.

2.1.2 IAQM – Odour Assessment for Planning Guidance

The Institute of Air Quality Management (IAQM) '*Odour assessment for planning guidance*'[2] summarises the typical requirements and approaches for undertaking an odour assessment for planning applications to

[1] Horizontal Guidance H4: Odour Management – How to comply with your Environmental Permit, NRW, 2014.
[2] IAQM Guidance on the assessment of odour for planning. IAQM 2014.

determine the potential amenity impacts. Whilst this guidance does not form Environmental Permitting guidance, it is considered that if odour exposure does not cause significant detriment to amenity, then it cannot be causing 'significant pollution'.

To facilitate the assessment of the significance of predicted odour exposure on amenity, the guidance defines receptor sensitivity and proposes 'odour effect descriptors' which combine the relative sensitivity of the receptors, the nature (or offensiveness) of the odour with quantitative predicted odour exposure levels.

The IAQM receptor sensitivity types are summarised in Table 2-1.

Table 2-1
IAQM Odour Receptor Sensitivity

Receptor Sensitivity	Example Land-uses
High sensitivity receptors	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. Examples may include residential dwellings, hospitals, schools/education and tourist/cultural
Medium sensitivity receptors	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. Examples may include places of work, commercial/retail premises and playing/recreation fields.
Low sensitivity receptors	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. Examples may include industrial use, farms, footpaths and roads

The IAQM then presents a matrix for 'most offensive' and 'moderately offensive' odour types. However, given the 'most offensive' odour type of 'landfill odours' specifically referenced by NRW's H4 Odour Management guidance, this assessment has only considered the matrix for 'most offensive' odour types and the associated IAQM effect descriptor as summarised in Table 2-2. It is noted that impacts descriptors apply equally to cases where there are increases and decreases in odour exposure as a result of a development. Therefore, the terms 'adverse' and 'beneficial' should be applied to the descriptors as appropriate.

Table 2-2
Odour Effect Descriptors – IAQM Guidance

Predicted Odour Exposure $C_{98,1\text{-hour}}$ ou_E/m^3	Receptor Sensitivity		
Most offensive	Low	Medium	High
≥10	Moderate	Substantial	Substantial

Predicted Odour Exposure $C_{98,1\text{-hour}}$ ou_E/m^3	Receptor Sensitivity		
5 – <10	Moderate	Moderate	Substantial
3 – <5	Slight	Moderate	Moderate
1.5 – <3	Negligible	Slight	Moderate
0.5 – <1.5	Negligible	Negligible	Slight
<0.5	Negligible	Negligible	Negligible

As presented in Table 2-2, in relation to the impacts of a 'high sensitivity' receptor to a 'most offensive' odour type; the IAQM matrix indicates that exposure greater than $C_{98\text{-}\%ile,\ 1\ hour}$ $1.5ou_E/m^3$ would be classified as 'moderate adverse' effect. This would be considered to represent a 'significant adverse' effect, which correlates with NRW's H4 criterion for 'significant pollution'.

For a receptor of 'medium sensitivity', the IAQM guidance indicates that for impacts of 'most offensive' odour type; exposure greater than $C_{98\text{-}\%ile,\ 1\ hour}$ $3ou_E/m^3$ would be classified as 'moderate adverse'.

Similarly, for a receptor of 'low sensitivity', the IAQM guidance indicates that for impacts of 'most offensive' odour type; exposure greater than $C_{98\text{-}\%ile,\ 1\ hour}$ $6ou_E/m^3$ would be classified as 'moderate adverse'.

3.0 ASSESSMENT METHODOLOGY

3.1 Identification of Odour Sources

Potential sources of odour from the proposed Parry's Quarry Landfill have been identified on the basis of a review of the proposed development design.

Cell 6, is designated as the cell that will accept biodegradable wastes and is the subject of this assessment. All other cells will be limited to commercial and industrial wastes that meet the <10% Loss on Ignition (LoI test).

The landfill waste streams at the landfill can be split into the 3 following categories:

- Inert Waste (as defined in the Landfill Directive) – which will be deposited into Phases 1, 2, 3, 4, 5, 7, 8.
- Non-Hazardous Non-Biodegradable Waste (meeting <10% LOI test) – which will be deposited into Phases 1, 2, 3, 4, 5, 7, 8.
- Non-Hazardous Biodegradable Waste – only deposited into Phase 6.

Reference should be made to Appendix 01 for a copy of the modelled cell layout.

3.2 Quantification of Odour

In the case where an emission is dominated by one particular odorous gas, the use of an indicator determinand may allow simple validation of an assessment through monitoring at source and receptor. For example, in the case of activities involving municipal wastes, methane is often used as the indicator. Whilst the presence of methane may indicate the presence of landfill gas, as methane itself is odourless, the relationship between concentration of this determinand and odour impact is often difficult to derive.

A total of 557 trace components have been identified in landfill gas. On this basis, a more appropriate approach in the case of this complex gas mixture is that of total odour. Total odour is measured using the concept of the European Odour Unit (ou_E), as defined in British Standard EN 13725[3]. This approach allows impact assessment of any odorous gas as it is independent of chemical constituents and centres instead on human response or 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 will follow the conventions of any mass emission unit as follows:

- Concentration: ou_E/m^3
- Emission: ou_E/s
- Specific emission (emission per unit area): $ou_E/m^2/s$

3.3 Quantification of Odour Emissions from Landfilling

It is inevitable that odour will be released during the landfilling of biodegradable wastes and whilst a range of control measures are available to minimise the magnitude of odour releases, given the nature of the process and the primarily open nature of many of the operations at a landfill site, residual odour emissions will still occur. Potential sources of odour associated with the site will be primarily related to the following:

- deposition of fresh waste (i.e. tipping and compaction at the active face);

[3] British Standard, Air Quality – Determination of odour concentration by dynamic olfactometry, BS EN 13725:2003, (2003)

- odours generated by previously deposited additional waste in the operational area which has been covered with daily or intermediate cover;
- odours released from leachates during processing; and
- landfill gas either passively via the surfaces of capped areas or from more concentrated vented releases from collection infrastructure.

The magnitude of the residual odour emission is dependent on:

- the nature (age and composition) of the incoming waste stream;
- the effectiveness of procedures to cover the waste following deposition;
- the nature of leachate treatment provisions on site and effectiveness of containment procedures; and
- the adequacy of measures to contain and collect landfill gas generated from the underlying waste mass.

Each potential source is discussed further below.

3.3.1 Tipping & Deposition of waste

The potential odours from the vehicles are affected by factors including the type of waste and the length of time it has been stored prior to being loaded onto the truck for final disposal. Waste acceptance procedures will include measures to abate the odour release from more odorous deliveries; these include early identification, prompt unloading and application of daily cover (or less odorous waste) as soon as practicable.

The quantification of odour emissions from landfilling are based on odour monitoring undertaken at the Bull Lane Works Waste Treatment and Transfer Station, based upon odour monitoring from those waste-streams proposed to be infilled within Parry's Quarry Landfill. Emission rates have been applied based upon the geomean of all monitored samples (i.e. 2.95$ou_E/m^2/s$).

It is noted that only Cell 6 of the landfill will receive biodegradable waste (i.e. with an odour potential), with a disposal capacity of up to 320,000 tonnes per annum (tpa). Incoming waste streams will be mixture of commercial and industrial (C&I) wastes and other public sector contracts.

3.3.2 Waste Covered with Daily or Intermediate Cover

Odour release from the deposited biodegradable waste will be predominantly driven by the movement of air over the waste causing turbulence in the near surface which will entrain the odorous compounds. Therefore, it is acknowledged that emissions from previously deposited waste can be significantly abated by the emplacement of further freshly deposited waste and appropriate cover material.

An appropriate cover material (typically soils) will be used to cover deposited waste at the end of each working day (daily cover) to control and reduce the release of odorants into the atmosphere. Where further tipping will not occur for prolonged periods (i.e. greater than 14-days) intermediate cover (daily cover to greater than 200mm depth) will be applied.

The magnitude of odour from this source will therefore vary depending upon the nature of the waste that is covered, the effectiveness of the daily cover (*i.e.* coverage and depth), and the area exposed.

Emission rates in published literature (from the UK in 2000) for waste with daily cover indicate an odour emission rate of 0.6$ou_E/m^2/s$ which is comparable to the emission rates for intermediate cover (500mm thick) of 0.5 $ou_E/m^2/s$[4].

[4] Guidance Manual for Landfill Managers on the Assessment and Control of Landfill Odours.

Given the age of the data, there is no indication that sites where this data was collected had sacrificial gas extraction systems in place which are considered to have the potential to reduce odour emission further.

As a precautionary approach, an emission rate of $0.6ou_E/m^2/s$ has been applied to reflect intermediate cover to be applied to Cell 6 during all non-working hours. The application of such remedial cover is further detailed within the Odour Management Plan for the site.

3.3.3 Parry's Quarry Landfill Operational Profile

Parry's Quarry Landfill will operate and receive wastes Monday – Friday, 7am to 7pm, and Saturday 7am to 12pm. No wastes are permitted to be received / infilled during Sundays. Therefore, in order to represent this within the dispersion modelling assessment a time vary file was applied to reflect the Cell 6 operation and associated emission as follows:

- $2.95ou_E/m^2/s$ (i.e. the 'tipping and deposition of waste' emission rate) over the hours Monday – Friday, 7am to 7pm; and Saturday, 7am to 12pm; and
- $0.6ou_E/m^2/s$ (i.e. the 'daily cover' emission rate) outside of the above operational hours.

Modelling has assumed that the entire surface area of Cell 6 is infilled and generates odour to determine maximum potential impacts.

3.3.4 Leachate

The leachate generated by the underlying waste mass will be contained and there is not considered to be a mechanism for this to contribute to odour emissions from the site under normal operating conditions.

3.3.5 Landfill gas

In accordance with the Environmental Permitting Regulations (England and Wales) the site will be engineered to contain landfill gas; measures to contain and control gas will include a combination of active gas extraction and utilisation combined with physical gas barriers.

The onset of the generation of landfill gas from the deposited biodegradable waste does not occur for some time (several months) following deposition, by which time capping and potentially protective layers consisting of soils will have been applied and appropriate sacrificial gas extraction systems employed. As such the magnitude of passive release of landfill gas from waste with a landfill gas collection system through an engineered capped surface is considered to be negligible.

The potential for release of landfill gas via 'vented' sources such as ineffective sealing of landfill gas and leachate collection infrastructure and leachate drainage blankets can be significant. Therefore, robust management procedures are required to ensure that such emissions do no occur under normal operating conditions as given the odour concentration of landfill gas (whilst highly variable $>100{,}000ou_E/m^3$ would be typical), even a small releases can result in unacceptable offsite exposure.

3.3.6 Model Uncertainty and Limitations

This assessment has incorporated a number of precautionary assumptions based upon SLR's understanding and knowledge of odorous emission from landfilling of biodegradable wastes.

Some factors cannot be included within the dispersion modelling exercise, including non-standard infrequent abnormal operations such as incidents involving loss of containment of landfill gas or leachate, abnormal waste loads etc for which detailed management procedures will be in place to prevent the risk of occurrence, their duration and severity. During such periods, it is expected that the generation of odour would be elevated for a short period of time, but with the robust application of 'all appropriate measures', it should be possible to

ensure that the likely frequency and duration of such events should not significantly compromise the amenity of the nearby area.

3.4 Topography

The topography of the surrounding area is relatively flat and open with no steep slopes (>1 in 10) and therefore as per NRW's Decision Document, no terrain data has been applied.

The potential for 'Cold-drainage flow' to affect the release of odours from the site or the formation of localised inversion layers within valleys is often of concern, but are considered to be a low risk due to the relatively flat and open surroundings and therefore have not been investigated further.

3.5 Meteorology

Meteorological data for the site is available from Hawarden observation station located approximately 7km east-southeast of the site and NRW comment in their most recent Decision Document that '*conditions are likely to be representative of those at the proposed landfill*'. Five consecutive years of hourly-sequential observation data from this location, covering the period 2012 – 2016, inclusive, have been obtained and presented as a windrose in Figure 3-1. Reference should be made to Appendix 02 for presentation of individual 2012 – 2016, inclusive, wind roses for then modelled Hawarden meteorological dataset.

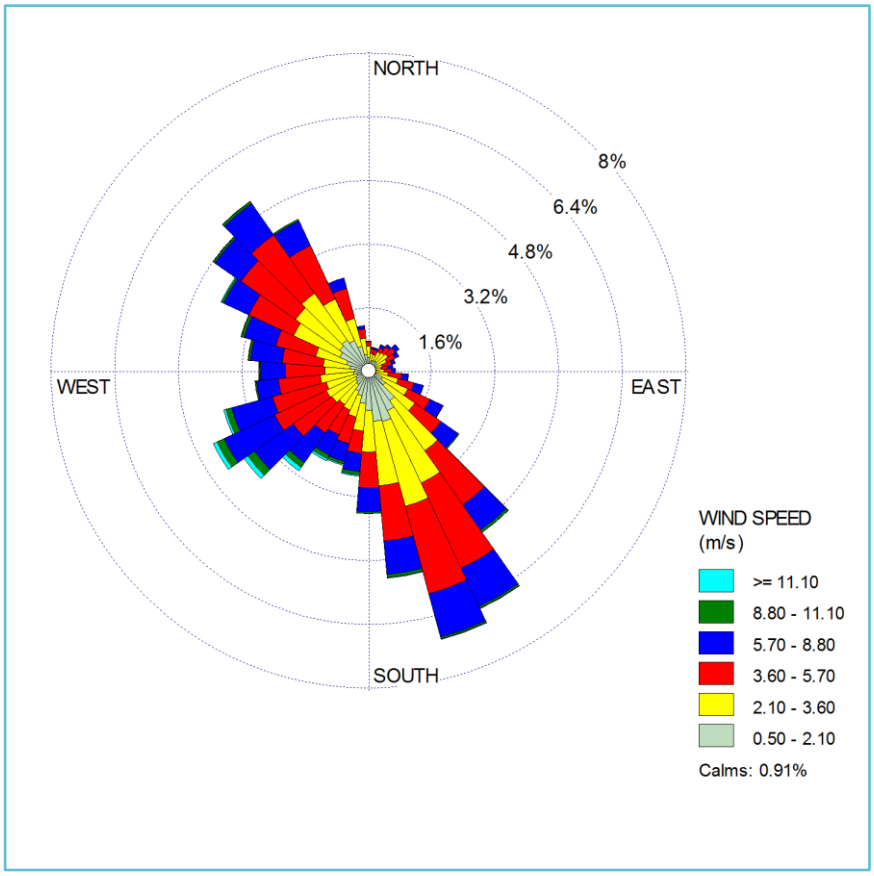

Figure 3-1
Hawarden Meteorological Station – 2012 - 2016

ADMS does not predict dispersion when wind speeds are <0.75m/s; therefore application of the 'Calms' module is required to predict impacts during these periods. Application of this module results in all wind speeds <0.3m/s (the 'calm' hours) the wind speed is increased to 0.3m/s. For wind speeds 0.3-0.5m/s the

'ADMS-Calms' module calculates impacts using a radially symmetric plume only, whereas between 0.5-0.75m/s a concentration weighted average of a normal Gaussian type plume and radially symmetric plume is used (with weighting determined by wind speed).

Table 3-1presents statistics on the meteorological dataset illustrating the number of calm hours (wind speed not measurable), wind speeds <0.75m/s, and the number of missing hours recorded within the 5-year period.

Table 3-1
Hawarden 2012 – 2016 Meteorological Data Statistics

Year	Calm Hours	Wind Speeds <0.75 m/s	Missing Hours
2012	1.18%	5.53%	9
2013	0.58%	3.89%	9
2014	0.95%	4.89%	15
2015	0.78%	4.49%	0
2016	1.05%	5.44%	28

Whilst this meteorological data is measured at the closest available meteorological station, it is considered to be 'atypical' for the UK with its prevalent south-eastern and north-western wind directions (typically the UK is subject to prevalent south-westerly winds) and high frequency of wind speeds <0.75m/s (typically approximately 1-2% low wind speeds would be expected).

For example Liverpool Speke Airport (the next closest station, 22.5km to the northeast of the site) for 2016 has only 1.4% of wind speeds <0.75m/s and application of this meteorological data results in predicted impacts at key sensitive receptors a factor of approximately 2 lower than the Hawarden data.

3.6 Prediction of Odour Impacts

To predict the impact of odour emissions at receptor locations, atmospheric dispersion modelling techniques are applied in the same way as for individual compounds. These models require information relating to the emission rate (and variation), local meteorology and topography to calculate the extent to which dispersion which will occur along the pathway between source and receptor.

The ADMS v5.2 dispersion model has been used, this is an advanced model accepted for use by NRW as referred to in their Decision Document. The model allows prediction of the frequency of exposure to particular concentration at selected receptor locations and allows the influence of onsite topography to be assessed.

The detailed dispersion modelling has been used to predict the ground level concentration of odour and has been undertaken in accordance with the relevant NRW guidance. In accordance with best practice methodology for dispersion modelling assessment, 5-years of hourly sequential consecutive meteorological data were used and the year giving the peak offsite exposure used as a worst-case.

The result of the odour impact assessment is a predicted odour concentration at each receptor location for each hour of meteorological data modelled. In the same way as air quality standards for individual pollutants, and as annoyance to odour is typically a result of repeated exposure over a prolonged period (i.e. years) rather than as a result of exposure over a shorter term (i.e. for a few weeks), exposure to odour is assessed in terms of a percentile of the predicted hourly averages over the course of a year.

The exposure criteria accepted in the UK (and widely across Europe) at present is given in terms of (concentration) European Odour Units as a 98th percentile ($C_{98,\ 1\text{-hour}}$) of hourly averages. This allows 2% (175

hours) of the year when the predicted hourly average impact may be above the limit criterion. The notation for impact is therefore:

$$C_{98\text{-}\%ile,\ 1\ hour}\ X\ ou_E/m^3$$

3.7 Assessment of Odour Impacts

The operation of Cell 6 of Parry's Quarry Landfill has the potential to generate odour during standard operation. The scenarios considered within this assessment are detailed within Table 3-2.

Table 3-2
Odour Assessment – Modelling Scenario

Modelled Pollutant	Assessment Criteria	Modelling Criteria Applied
Odour	1-hour mean not to exceed more than 2% of the time (175 hours)	98th percentile of 1-hour means

The assessment considered odour emissions from all sources during normal operating conditions, as described in the sections above.

3.7.1 Model Domain

The potential odour impact of Cell 6 of Parry's Quarry Landfill was assessed over a grid with the coordinates NGR: x327200 y328200 to x366000 y367100 (a distance of 1,000m on the X axis and 1,100m on the Y axis). The receptor grid spacing resolution used was 20m.

In addition, the identified potentially sensitive locations, detailed in Table 4-1, were modelled as discrete receptors (see Figure 4-1).

3.7.2 Presentation of Results

The results of the dispersion modelling have been presented in the form of:

- tabulated concentrations at discrete receptor locations to facilitate the discussion of results; and
- where impacts are potentially significant (i.e. in excess of the applied odour criterion), illustrations of the impact as isopleths (contours of concentration) for the criteria selected enabling determination of impact at any locations within the study area.

4.0 BASELINE ENVIRONMENT

Existing air quality conditions and sensitive receptors in the vicinity of the Site were identified in order to provide a baseline for assessment. These are detailed in the following Sections.

4.1 Site Setting

The closest residential property is Parry Houses, which lie 22m from the boundary at the southeast corner. Ewloe Wood House lies 120m northeast of the site, whilst Pottery Cottages are located 200 metres to the east of the site. Further residential properties are located approximately 280 metres northwest and on Smithy Lane, which is located 420 m east of the site.

The A55 Northop Services lie 20m from the sites eastern boundary and include a petrol station, 3 dining venues and a Holiday Inn (with residential use).

To the north, south and west of the site there are a number of industrial estates. The nearest industrial site is 20m west of the permit boundary and comprises a disused quarry. Immediately south of the site at 25 m from the site boundary, is a mixed use commercial and industrial estate which consists of several building material suppliers and a manufacturing facility. A number of commercial units are situated adjacent to the northern edge of the site including Deeside Truck Services, a Fire Door manufacturer and a self-storage facility.

4.2 Potentially Sensitive Receptors

For the purposes of this assessment, a range of receptor locations have been selected to represent the differing receptor types (sensitivity to odour) and locations as summarised in Table 4-1 and presented in Figure 4-1.

Table 4-1
Sensitive Receptors - Odour

ID	Receptor	Type	Sensitivity to Odour	X-coordinate	Y-coordinate
R_1	Parry's Cottage	Residential	High	327787	366321
R_2	Holiday Inn	Leisure	High	327897	366607
R_3	Service Station	Commercial	Medium	327799	366746
R_4	The Box	Residential	High	327606	366919
R_5	Alltami House	Residential	High	327443	366807
R_6	Pinfold Cottage	Residential	High	327439	366837
R_7	Ewloe Wood House	Residential	High	327455	366919
R_8	Services (Subway/Costa)	Commercial	Medium	327838	366600
R_9	Ewloe Barns Industrial Estate	Industrial	Low	327744	366232
R_10	SCANIA units	Industrial	Low	327567	366762
R_11	AH Plant Hire	Industrial	Low	327467	366357
R_12	Services (Diner)	Commercial	Medium	327826	366664

ID	Receptor	Type	Sensitivity to Odour	X-coordinate	Y-coordinate
R_13	Services (future development)	Commercial	Medium	327861	366533
R_14	RAP Pumps	Commercial	Medium	327451	366273
R_15	FCC Depot	Commercial	Medium	327444	366233
R_16	Pottery Cottages	Residential	High	328046	366320
R_17	Unnamed House	Residential	High	327889	366499

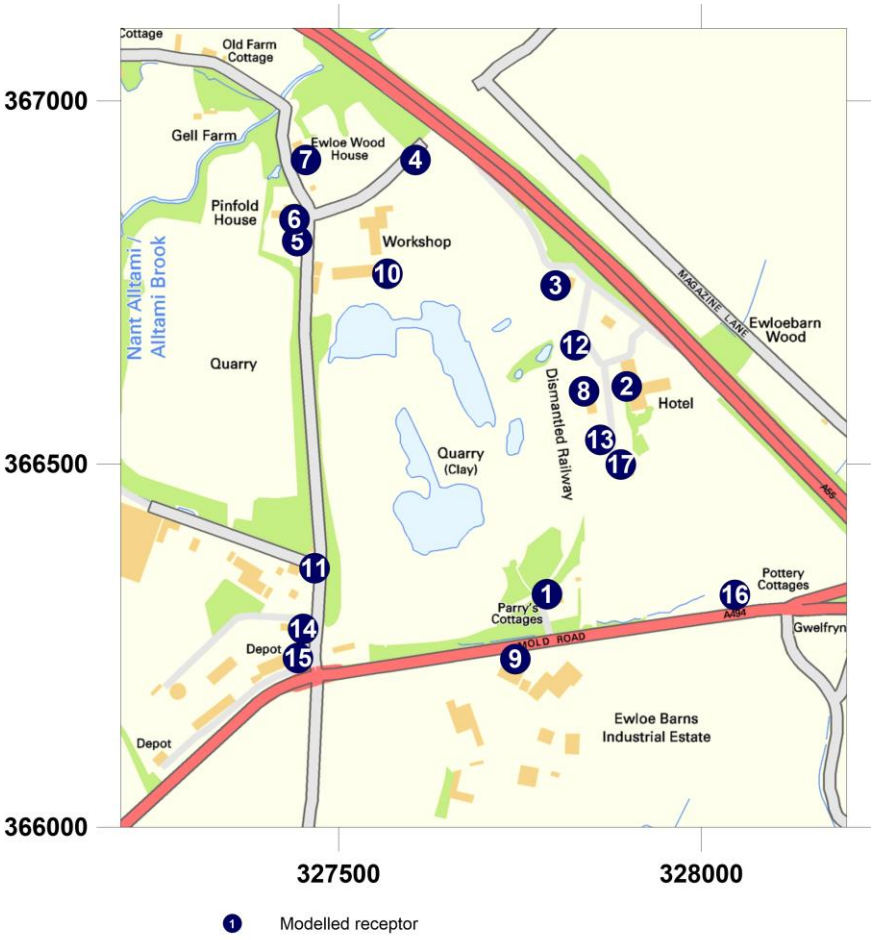

Figure 4-1
Receptor Locations - Odour

5.0 PREDICTION OF IMPACTS

This section provides a presentation of the predicted odour impact of Parry's Quarry Landfill, as determined through the detailed dispersion modelling study.

5.1 Detailed Modelling – Odour Impacts

The odour exposures predicted as a result of emissions from Cell 6 of Parry's Quarry Landfill are presented in Table 6 1 below.

Results may be compared against the benchmark criterion of $1.5ou_E/m^3$ as a 98th percentile of 1-hour mean concentrations appropriate for a 'more offensive' odour, as a worst-case assessment. Any exceedences of the applied benchmark criterion of $1.5ou_E/m^3$ are displayed in bold text.

Table 5-1
Predicted Odour Impact – Parry's Quarry Landfill Cell 6

Receptor	Predicted Odour Concentration ($C_{98,\ 1\text{-hour}}$ ou_E/m^3)					
	2012	2013	2014	2015	2016	Average 5-years
R1	0.92	0.74	0.88	0.68	1.12	0.87
R2	0.64	0.64	0.64	0.64	0.65	0.64
R3	0.82	0.82	0.82	0.82	0.90	0.84
R4	0.99	0.91	0.98	0.77	1.14	0.96
R5	1.03	1.16	1.13	0.87	1.08	1.05
R6	0.94	1.05	1.07	0.81	1.05	0.98
R7	0.82	0.83	0.95	0.73	0.93	0.86
R8	0.99	0.99	0.99	0.98	1.00	0.99
R9	0.45	0.38	0.39	0.39	0.49	0.42
R10	**2.64**	**2.64**	**2.65**	**2.48**	**2.89**	**2.66**
R11	0.40	0.40	0.40	0.40	0.67	0.45
R12	0.97	0.97	0.97	0.97	1.03	0.98
R13	0.81	1.00	0.87	0.81	1.04	0.91
R14	0.25	0.25	0.25	0.25	0.42	0.29
R15	0.21	0.21	0.21	0.21	0.34	0.24
R16	0.33	0.42	0.47	0.33	0.48	0.40
R17	0.63	0.91	0.83	0.63	0.95	0.79

The results of the assessment indicate that the odour impact from Cell 6 of the proposed Parry's Quarry Landfill is above the benchmark criterion of $1.5ou_E/m^3$ as a 98th percentile of 1-hour mean concentrations at receptor

R10 (SCANIA units). However, it is noted that that this receptor is of an industrial use-class and considered to be of low sensitivity to potential odour impacts / exposure following the IAQM guidance. At this location following the IAQM guidance as odour impacts are predicted to be $C_{98,1\text{-hour}}$ <3.0ou_E/m^3 the associated impact descriptor is 'slight' and a 'not significant' effect. This predicted effect descriptor and significance is considered to accord to NRW's H4 Odour Management guidance for 'no risk of significant pollution'.

At all other considered receptors, below the $C_{98,1\text{-hour}}$ 1.5ou_E/m^3 at all considered discrete receptors for all considered meteorological years. Therefore, in accordance with NRW's Odour Guidance there is no risk of significant pollution at all other receptors.

Reference should be made to Appendix 03 for presentation of the modelled isopleth contour plots (as $C_{98,1\text{-hour}}$ >1.5ou_E/m^3) for each individual considered meteorological year in addition to an average of the modelled 5-year dataset (2012 – 2016).

6.0 SUMMARY AND CONCLUSION

SLR Consulting has undertaken an Odour Impact Assessment of potential odour associated with the operation of the Parry's Quarry Landfill, and infilling of biodegradable waste within Cell 6.

The potential impacts of odours from the standard operation of Cell 6 of Parry's Quarry Landfill has been predicted at potentially sensitive receptors identified in the area using atmospheric dispersion modelling techniques, using ADMS v5.2.

Dispersion modelling indicates that predicted the odour impact from Cell 6 of Parry's Quarry Landfill is less than $C_{98,1\text{-hour}}$ $1.5ou_E/m^3$ impact criterion at all sensitive residential receptor locations. At one receptor location (R10 (SCANIA units)) the results of the assessment indicate that the odour impact from Cell 6 of the proposed Parry's Quarry Landfill is above the benchmark criterion of $1.5ou_E/m^3$ as a 98th percentile of 1-hour mean concentrations at receptor R10 (SCANIA units). However, it is noted that that this receptor is of an industrial use-class and considered to be of low sensitivity to potential odour impacts / exposure following the IAQM guidance. At this location following the IAQM guidance as odour impacts are predicted to be $C_{98,1\text{-hour}}$ $<3.0ou_E/m^3$ the associated impact descriptor is 'slight' and a 'not significant' effect.

Therefore, in accordance with NRW's H4 Odour Management Guidance there is no risk of significant pollution.

APPENDIX 01

Parry's Quarry Landfill Cell Layout (separate to this report)

APPENDIX 02

Hawarden Meteorological Station 2011 – 2015 Individual Wind Roses

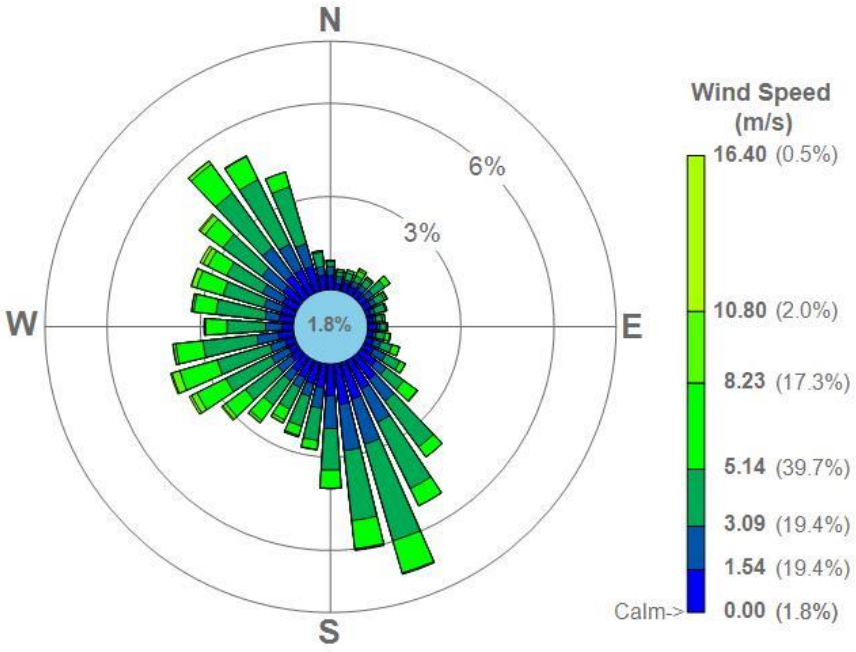

Figure AQ1-1
Wind-rose for Hawarden Meteorological Station (2012)

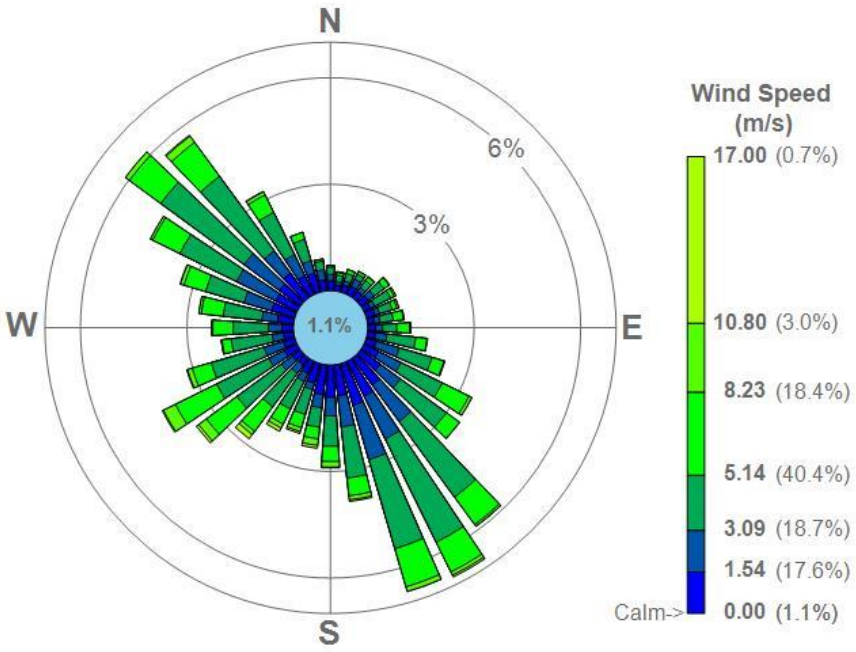

Figure AQ1-2
Wind-rose for Hawarden Meteorological Station (2013)

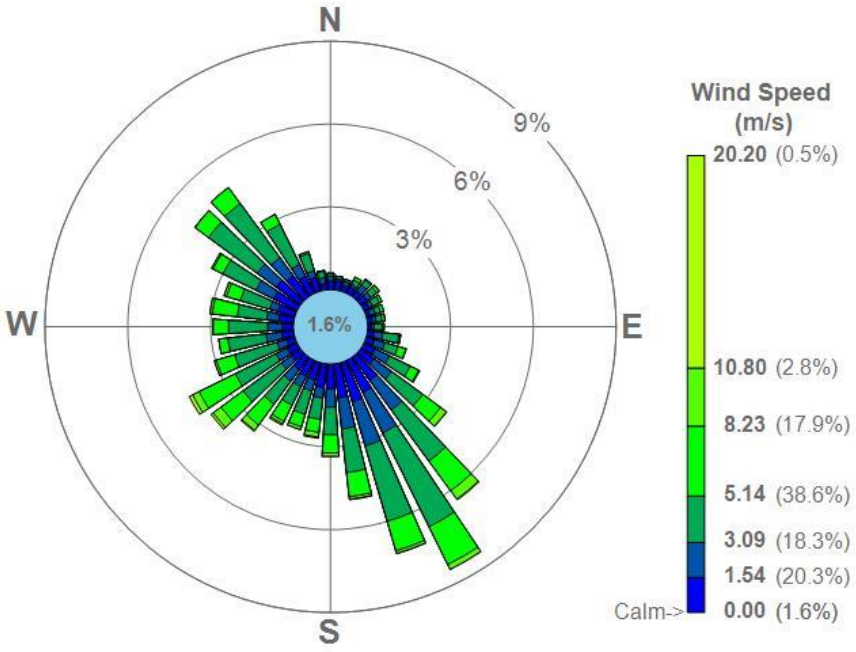

Figure AQ1-3
Wind-rose for Hawarden Meteorological Station (2014)

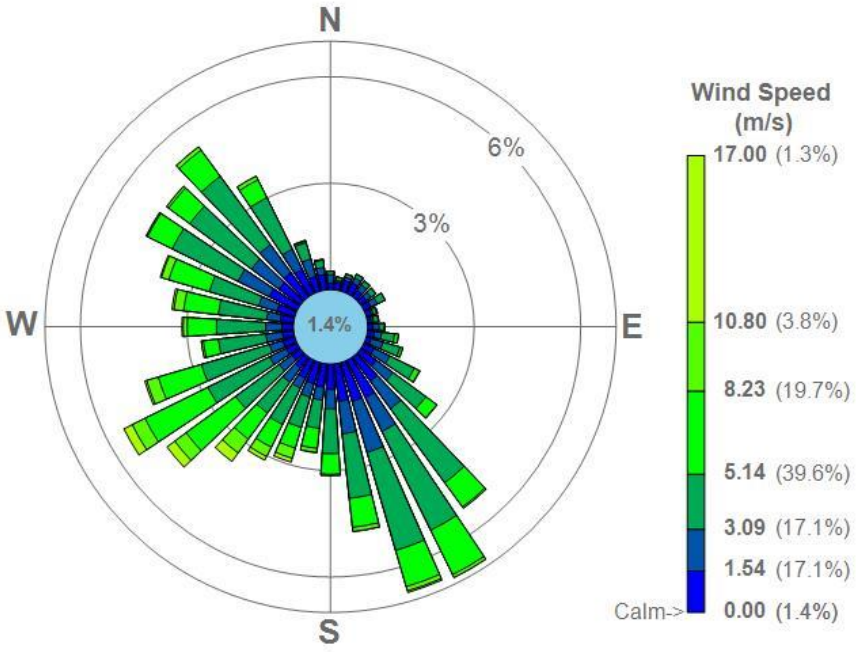

Figure AQ1-4
Wind-rose for Hawarden Meteorological Station (2015)

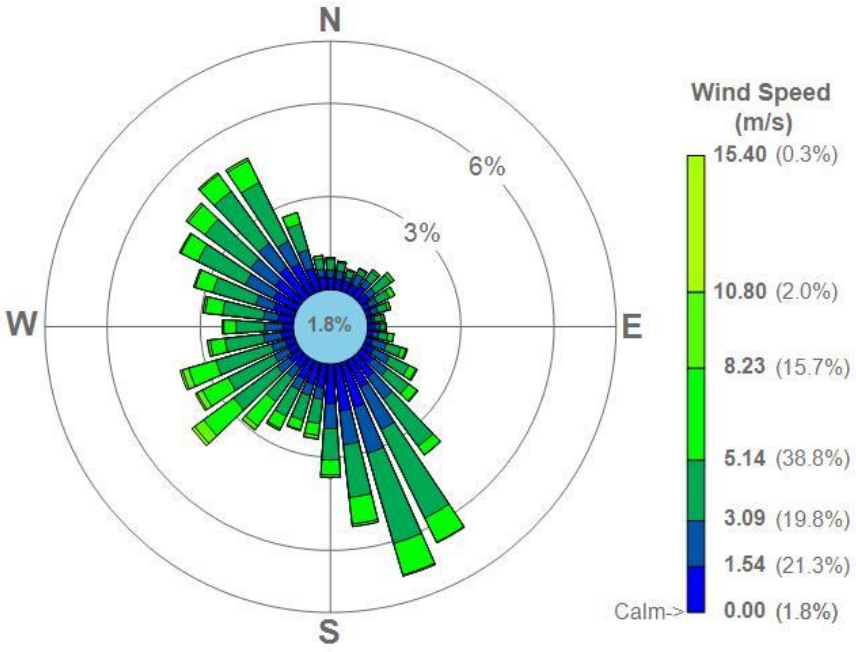

Figure AQ1-5
Wind-rose for Hawarden Meteorological Station (2016)

APPENDIX 03

Modelled Odour Impact Contour Plots

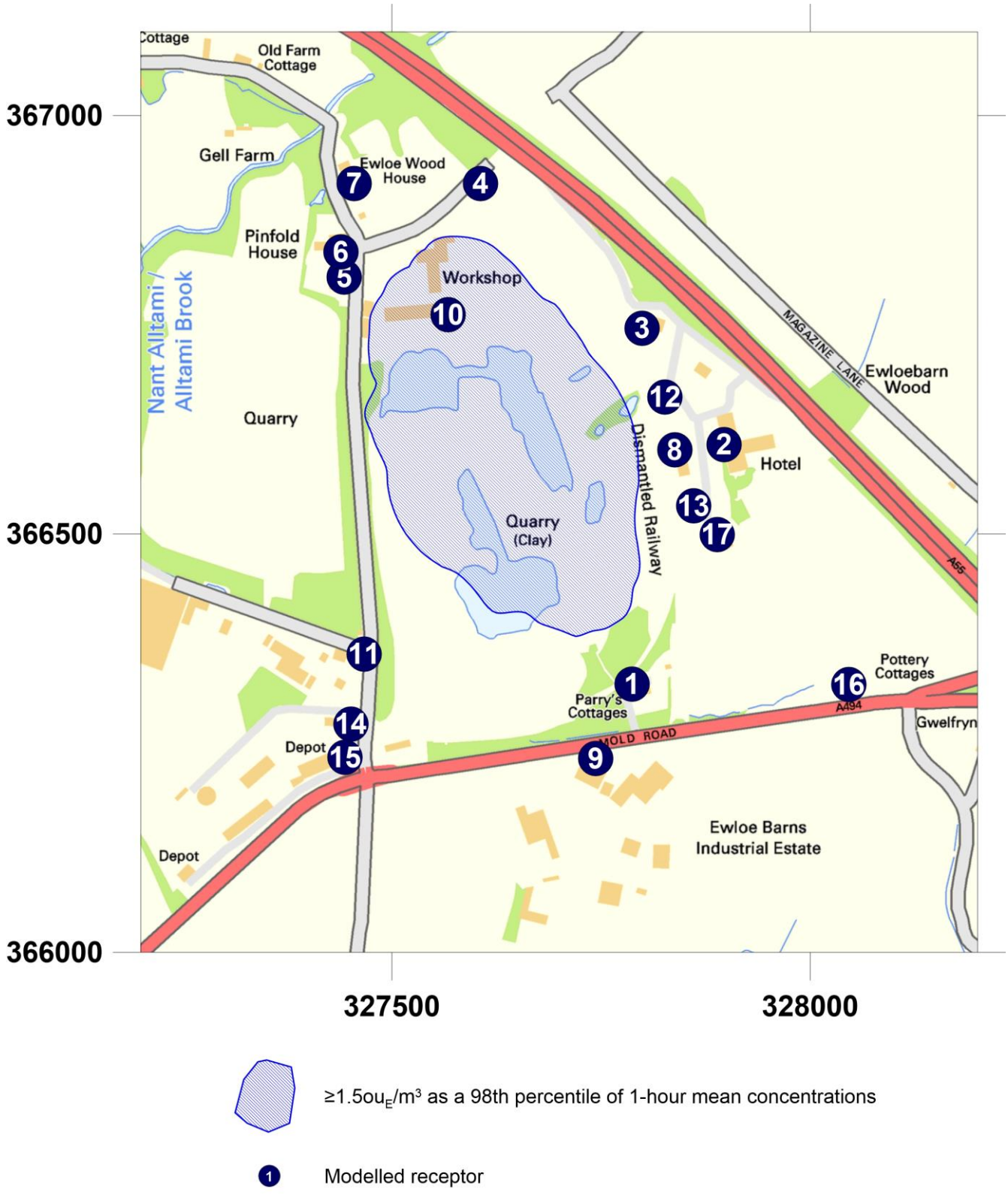

Figure AQ2-1
Modelled $C_{98\ 1\text{-}hour}$ Odour Impact – 2012 Meteorological Data, Parry's Quarry Landfill Cell 6

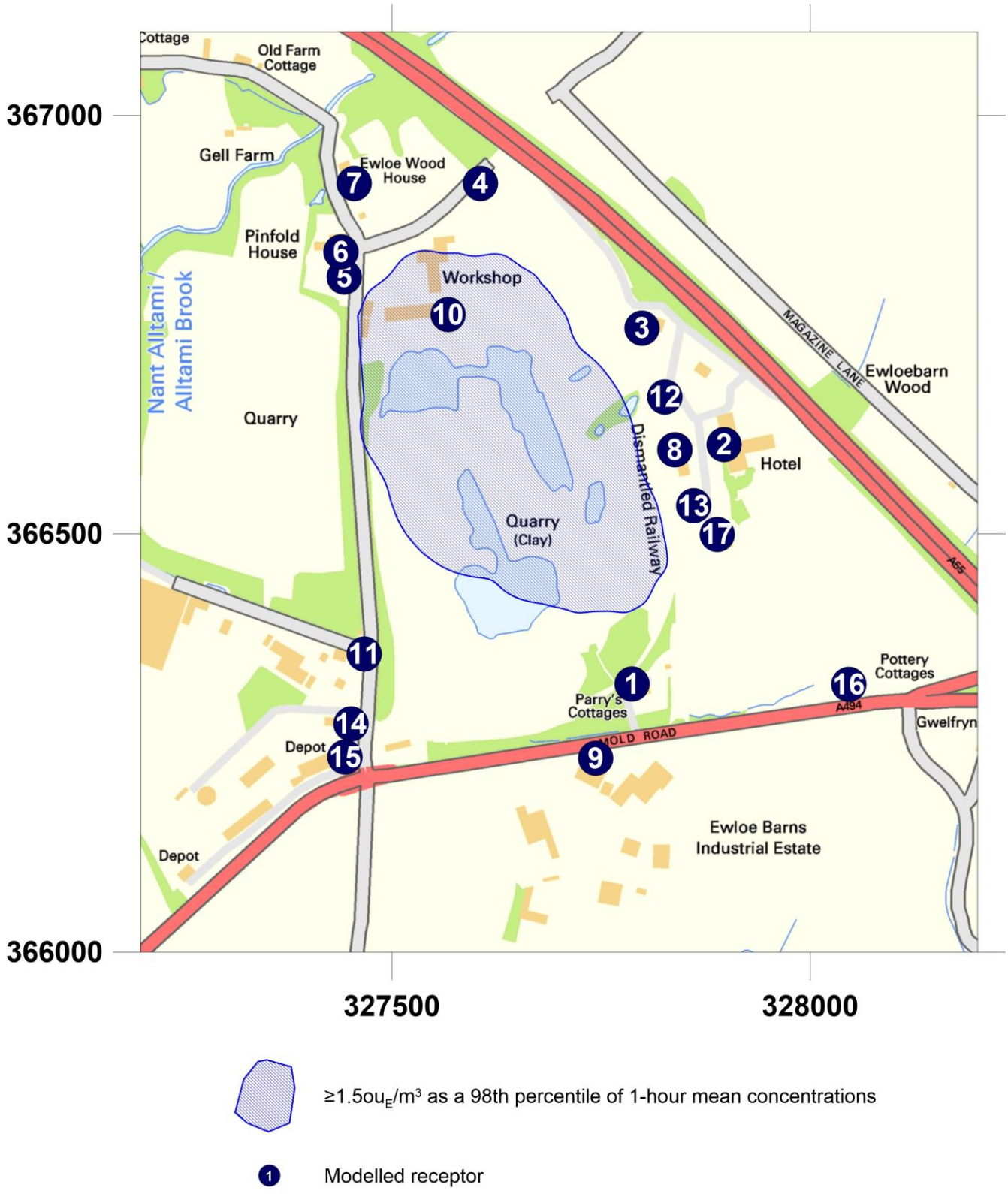

Figure AQ2-2
Modelled $C_{98\ 1\text{-}hour}$ Odour Impact – 2013 Meteorological Data, Parry's Quarry Landfill Cell 6

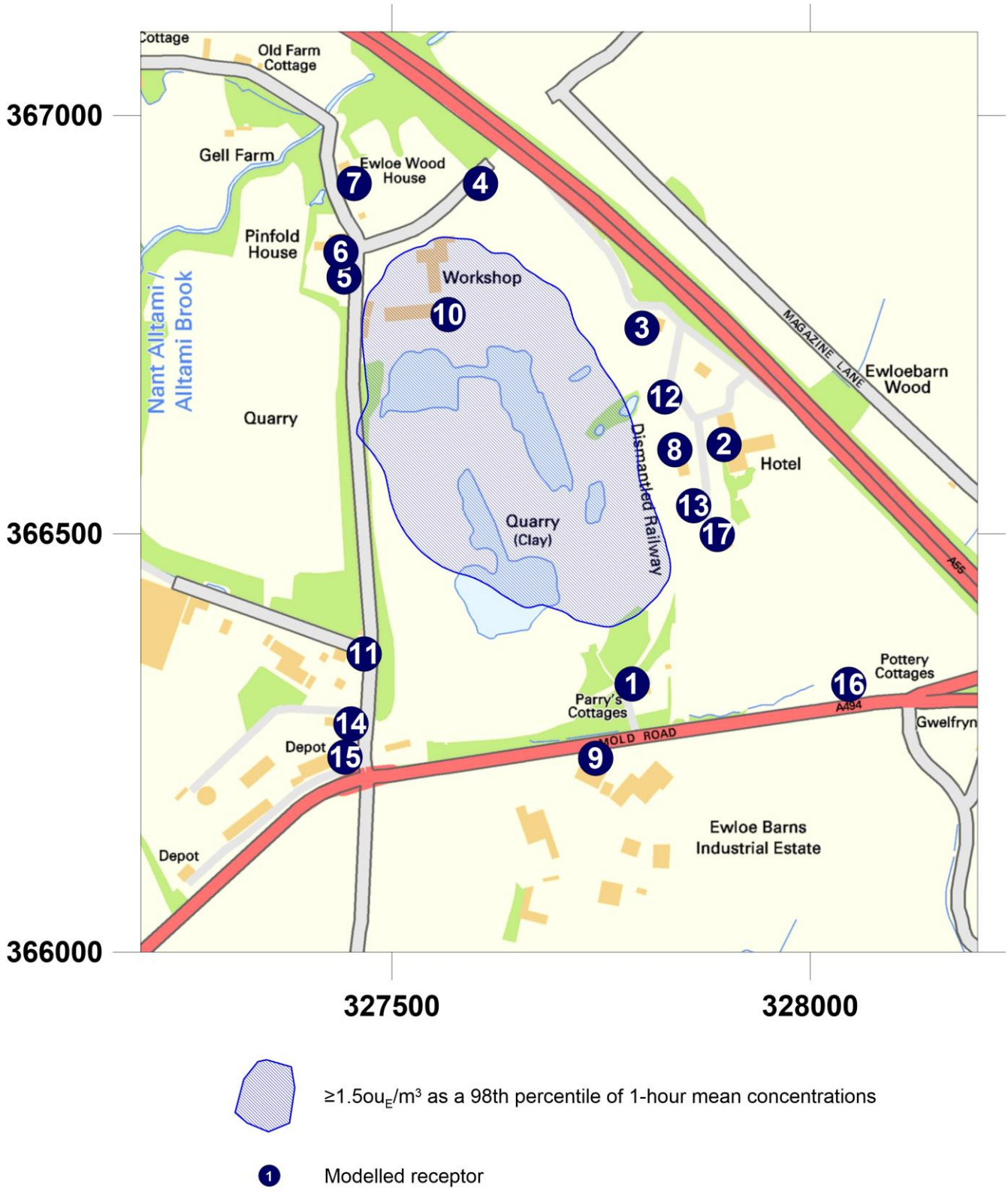

Figure AQ2-3
Modelled $C_{98\ 1\text{-}hour}$ Odour Impact – 2014 Meteorological Data, Parry's Quarry Landfill Cell 6

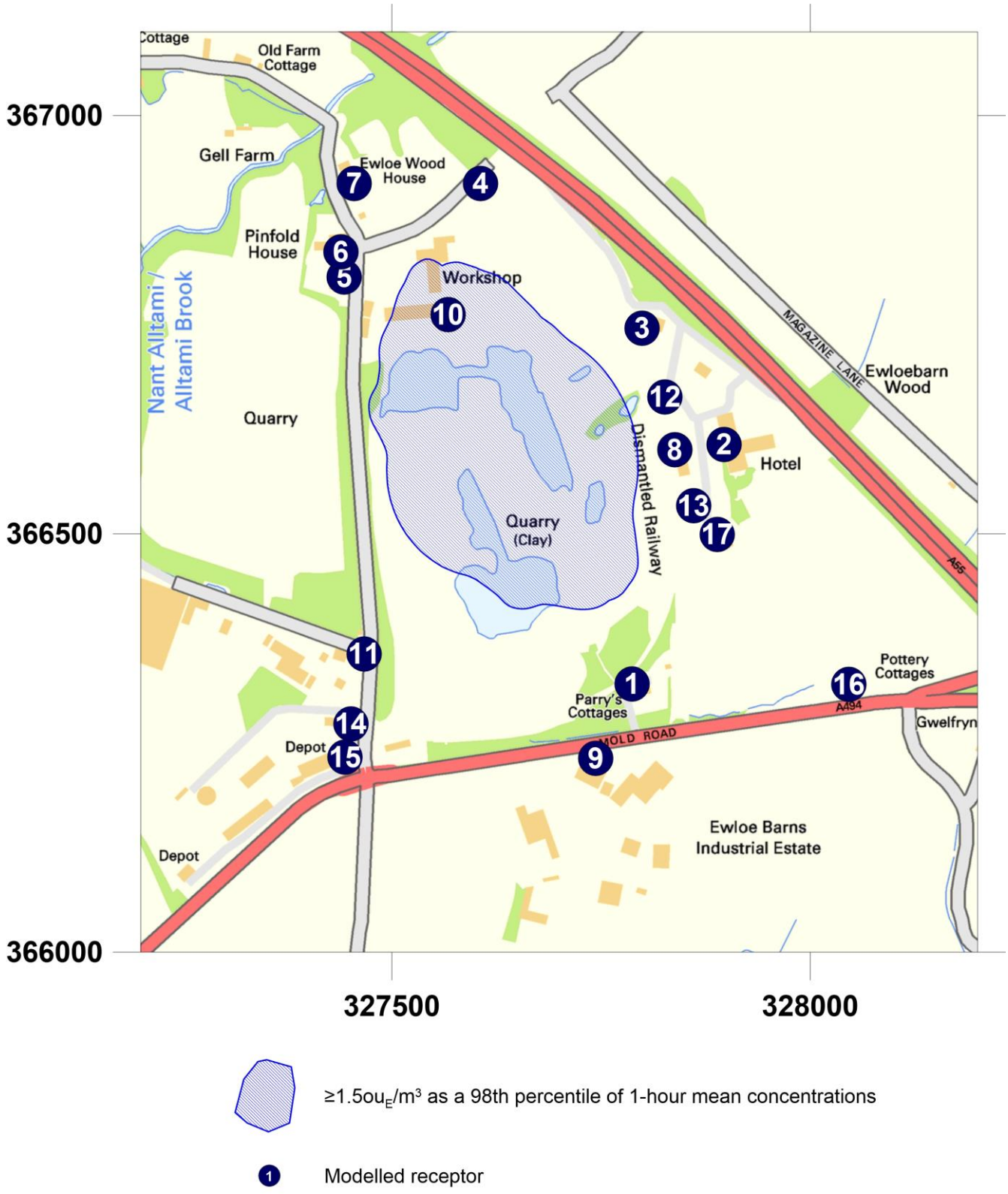

Figure AQ2-4
Modelled $C_{98\ 1\text{-}hour}$ Odour Impact – 2015 Meteorological Data, Parry's Quarry Landfill Cell 6

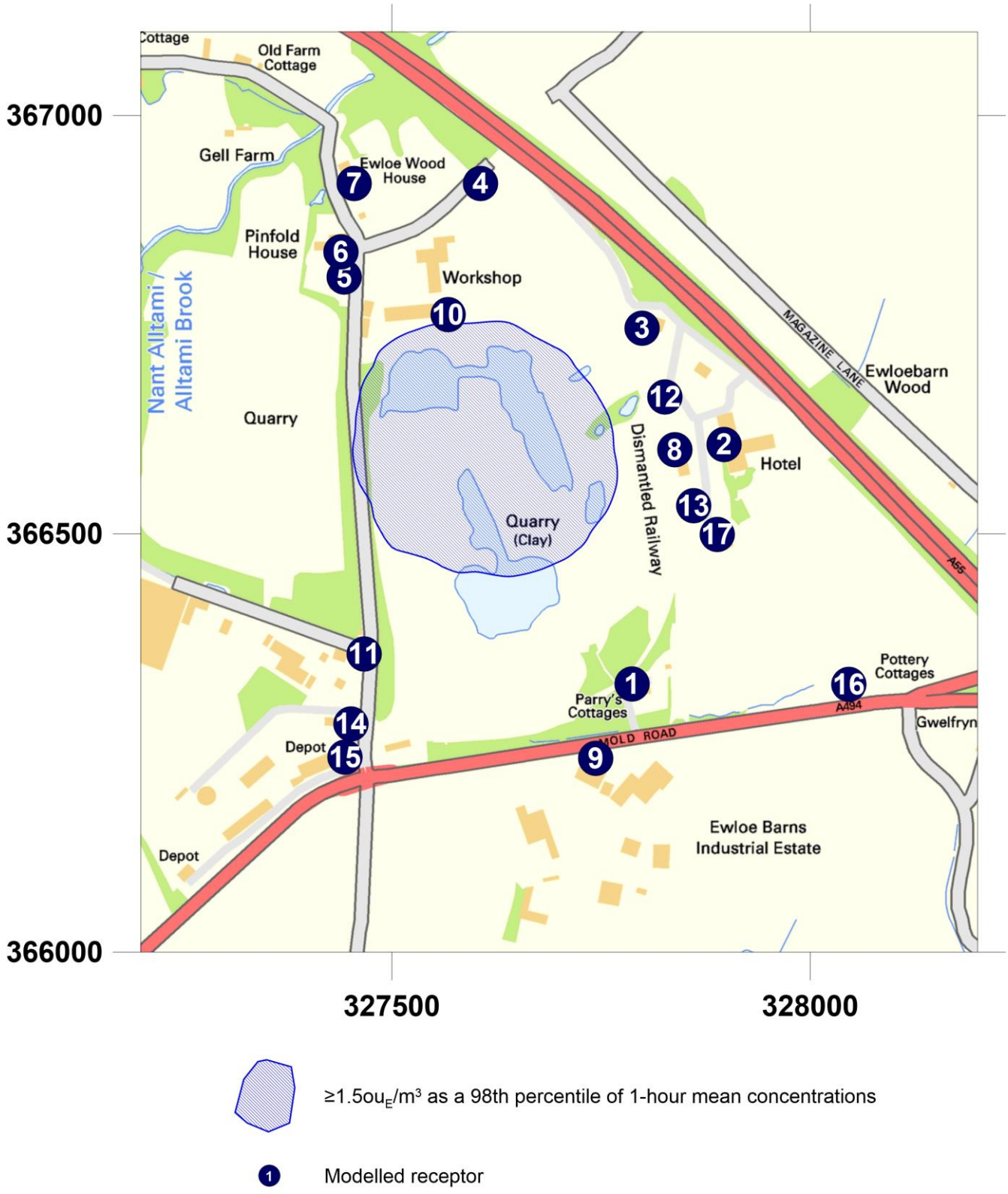

Figure AQ2-5
Modelled $C_{98\ 1\text{-}hour}$ Odour Impact – 2016 Meteorological Data, Parry's Quarry Landfill Cell 6

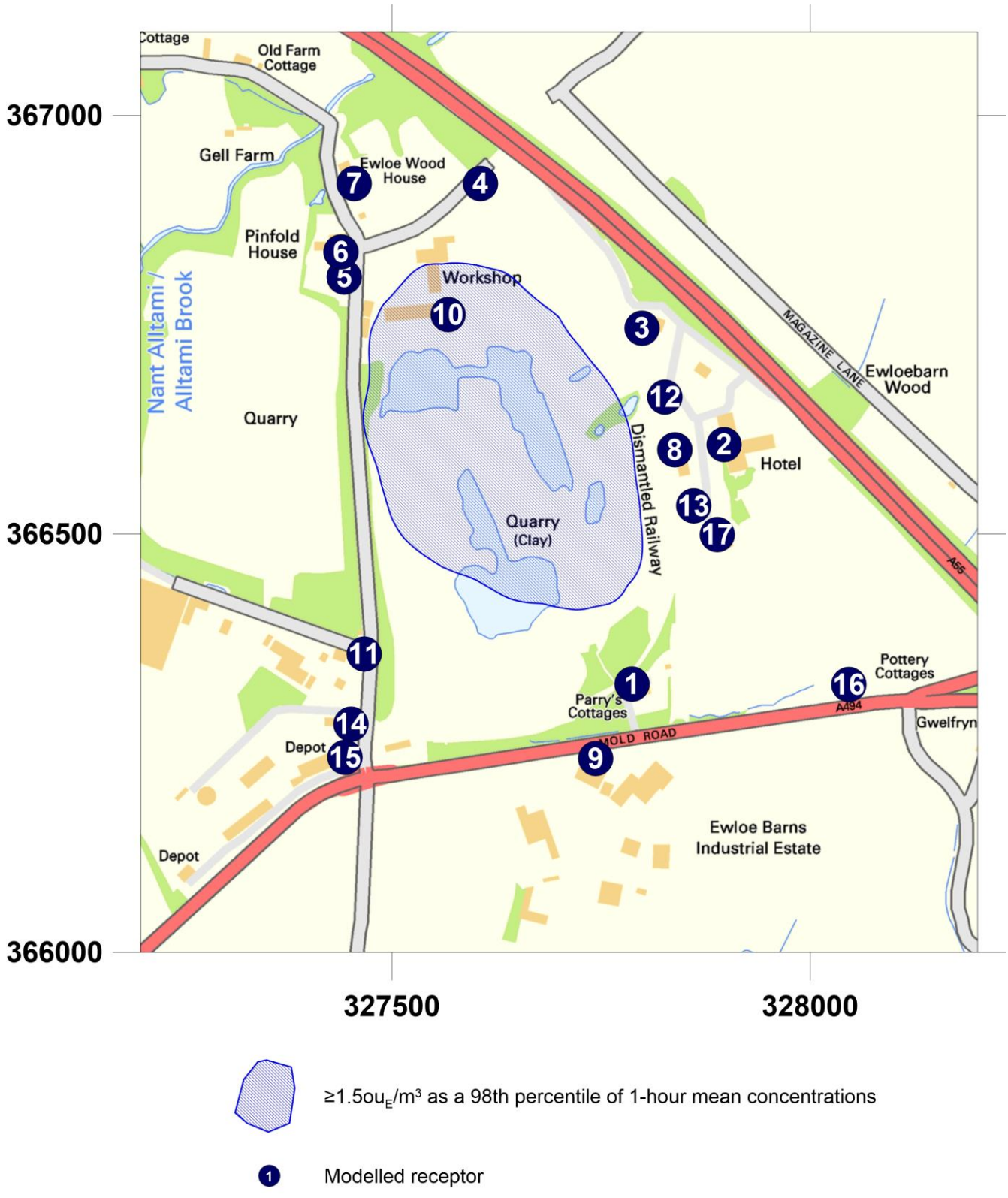

Figure AQ2-6
Modelled $C_{98\ 1\text{-}hour}$ Odour Impact – Average of 2012–2016 Meteorological Data, Parry's Quarry Landfill Cell 6

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