



DISPERSION MODELLING ASSESSMENT OAK ROAD WREXHAM INDUSTRIAL ESTATE, WREXHAM

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EXECUTIVE SUMMARY

Resource and Environmental Consultants Ltd was commissioned by Conrad Energy (Developments) Limited to undertake a Dispersion Modelling Assessment in support of a proposed gas fired power station at Oak Road, Wrexham industrial Estate, Wrexham.

The proposals include the installation of a gas-powered electricity facility with a maximum capacity of 9.9MW, this will comprise a total of up to 6 generator units, alongside associated infrastructure. Combustion emissions from the selected plants will be released through dedicated stacks. The station may have the potential to increase pollutant concentrations in the vicinity of the site. As such, a Dispersion Modelling Assessment was required to quantify effects at sensitive locations.

Dispersion modelling was undertaken in order to quantify pollutant concentrations, throughout surrounding area to assess the potential for nearby sensitive receptors be exposed to poor air quality.

Predicted concentrations of pollutants were below the relevant EQSs at all sensitive locations representative of human exposure for all meteorological datasets modelled

Nitrogen and acid gas deposition rates were also predicted at the relevant ecological sites. Impacts upon sensitive ecological designations as a result of emissions from the installation were deemed not significant at all designations.

It should be noted that predicted impacts were based on an assessment scenario of real time operations and as such, predicted results are likely to a robust prediction of actual impacts.

Based on the assessment results, air quality issues are not considered a constraint to planning consent for the development.





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1. INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Ltd was commissioned by Conrad Energy (Developments) Limited to undertake a Dispersion Modelling Assessment in support of the installation of a gas-powered electricity station at Oak Road, Wrexham Industrial Estate, Wrexham.

1.2 Site Location and Context

The proposed development is located at Oak Road, Wrexham Industrial Estate, Wrexham, at approximate National Grid Reference (NGR): 338700, 349500. Reference should be made to Figure 1 for a map of the proposed generator locations and the surrounding area.

The proposals include the installation of a gas-powered electricity facility with a maximum capacity of 9.9MW, this will comprise a total of up to 6 generator units. Combustion emissions from the selected plants will be released through individually dedicated stacks. These have the potential to increase pollutant concentrations in the vicinity of the site. A Dispersion Modelling Assessment was therefore required to consider any effects associated with the installation. This is detailed in the following report.

1.3 Limitations

This report has been produced in accordance with REC's standard terms of engagement. REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.





2 LEGISLATION AND POLICY

2.1 European Legislation

European Union (EU) air quality legislation is provided within Directive 2008/50/EC, which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new air quality objectives for particulate matter with an aerodynamic diameter of less than 2.5µm (PM_{2.5}). The consolidated Directives include:

- ▶ Directive 99/30/EC - the First Air Quality "Daughter" Directive - sets ambient Air Quality Limit Values (AQLVs) for nitrogen dioxide (NO₂), oxides of nitrogen (NO_x), sulphur dioxide, lead and particulate matter with an aerodynamic diameter of less than 10µm (PM₁₀);
- ▶ Directive 2000/69/EC - the Second Air Quality "Daughter" Directive - sets ambient AQLVs for benzene and carbon monoxide; and
- ▶ Directive 2002/3/EC - the Third Air Quality "Daughter" Directive - seeks to establish long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

The fourth daughter Directive was not included within the consolidation and is described as:

- ▶ Directive 2004/107/EC - sets health-based limits on polycyclic aromatic hydrocarbons, cadmium, arsenic, nickel and mercury, for which there is a requirement to reduce exposure to as low as reasonably achievable.

2.2 UK Legislation

The Air Quality Standards (Amendment) Regulations (2016) came into force on 31st December 2016. These Regulations amend the Air Quality Standards Regulations 2010 and transpose the EU Directive 2008/50/EC into UK law. AQLVs were published in these regulations for 7 pollutants, as well as Target Values for an additional 6 pollutants.

Part IV of the Environment Act (1995) requires UK government to produce a national Air Quality Strategy (AQS) which contains standards, objectives and measures for improving ambient air quality. The most recent AQS was produced by the Department for Environment, Food and Rural Affairs (DEFRA) and published in July 2007¹. The AQS sets out Air Quality Objectives (AQOs) that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedances over a specified timescale. These are generally in line with the AQLVs, although the requirements for compliance vary slightly.

Table 1 presents the AQOs for pollutants considered within this assessment.

¹ The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.





Table 1 Air Quality Objectives

Pollutant	Air Quality Objective	
	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
Nitrogen Dioxide (NO_2)	40	Annual mean
	200	1-hour mean; not to be exceeded more than 18 times a year
Carbon Monoxide (CO)	10,000	Maximum daily running 8-hour mean

Table 2 summarises the advice provided in DEFRA guidance LAQM (TG16)² on where the AQOs for pollutants considered within this report apply.

Table 2 Examples of Where the Air Quality Objectives Apply

Averaging Period	Objectives Should Apply At	Objectives Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc	Building façades of offices or other places of work where members of the public do not have regular access Hotels, unless people live there as their permanent residence Gardens of residential properties Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour and 8-hour mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1-hour mean	All locations where the annual mean and 24-hour mean and 8-hour objectives apply. Kerbside sites (for example, pavements of busy shopping streets) Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	Kerbside sites where the public would not be expected to have regular access

² Local Air Quality Management Technical Guidance 2016 LAQM (TG16), DEFRA, 2016.





2.3 Local Air Quality Management

Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities (LAs) are required to periodically review and assess air quality within their area of administration under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves considering present and likely future air quality against the AQOs. If it is predicted that levels at sensitive locations where members of the public are regularly present for the relevant averaging period are likely to be exceeded, the LA is required to declare an AQMA. For each AQMA the LA is required to produce an Air Quality Action Plan (AQAP), the objective of which is to reduce pollutant concentrations in pursuit of the AQOs.

2.4 Industrial Pollution Control Legislation

Atmospheric emissions from industry are controlled in England and Wales through the Environmental Permitting (England and Wales) Regulations (2018) and subsequent amendments.

2.5 Planning Policy Wales

The Planning Policy Wales (PPW) was published on November 2016 and sets out the Welsh Government's core planning policies and principles with respect to land use planning, including air quality. The document includes the following considerations which are relevant to this assessment:

“Good design is essential to ensure that areas, particularly those where higher density development takes place, offer high environmental quality, including open and green spaces. Landscape considerations are an integral part of the design process and can make a positive contribution to environmental protection and improvement, for example to biodiversity, climate protection, air quality and the protection of water resources.”

“Where pollution considerations, which may be relevant to a pollution control authorisation or licence or result from the need to comply with any statutory environmental quality standards or objectives, affect the use and development of land they can be material planning considerations. This provision extends to air quality objectives set out under Part IV of the Environment Act 1995 and the local authority’s action plans for Air Quality Management Areas and, in the case of water, to environmental objectives developed as part of the implementation of the European Union’s Water Framework Directive. The weight attached to such considerations will depend on the scope of the pollution control system in each case and the effect on land use and amenity.”

“The potential for pollution affecting the use of land will be a material consideration in deciding whether to grant planning permission. Material considerations in determining applications for potentially polluting development are likely to include:

[...]

The risk and impact of potential pollution from the development, insofar as this might have an effect on the use of other land and the surrounding environment (the environmental regulatory regime may well have an interest in these issues, particularly if the development would impact on an Air Quality Management Area or a SAC)”





The implications of the PPW have been considered throughout this assessment.

2.6 Local Planning Policy

The Unitary Development Plan 1996 – 2011³ was adopted by Wrexham County Borough Council on the 14th February 2005 and provides framework for local decision making and the reconciliation of development and conservation interests in order that land use changes proceed coherently and with maximum community benefit.

A review of the Development Plan indicated the following policy in relation to air quality that is relevant to this assessment:

"Policy GDP1

All new development should:-

[...]

f) Ensure the safety and amenity of the public and safeguard the environment from the adverse effects of pollution of water, land or air, hazards from industry and quarrying, and associated noise, odour or vibration arising from development.

This policy has been considered throughout this report by assessing potential air quality impacts as a result of the proposed development.

³ The Unitary Development Plan 1996 – 2011, Wrexham County Borough Council, 2005.





2.7 Critical Loads and Levels

A critical load (CL) is defined by the UK Air Pollution Information System⁴ (APIS) as:

"A quantitative estimate of exposure to deposition of one or more pollutants, below which significant harmful effects on sensitive elements of the environment do not occur, according to present knowledge. The exceedance of a critical load is defined as the atmospheric deposition of the pollutant above the critical load."

A critical level is defined as:

"Threshold for direct effects of pollutant concentrations according to current knowledge. Exceedance of a critical level is defined as the atmospheric concentration of the pollutant above the critical level."

A critical load refers to deposition of a pollutant, while a critical level refers to pollutant concentrations in the atmosphere (which usually have direct effects on vegetation or human health).

When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedance. A larger exceedance is often considered to represent a greater risk of damage.

Maps of critical loads and levels and their exceedances have been used to show the potential extent of pollution damage and aid in developing strategies for reducing pollution. Decreasing deposition below the critical load is seen as means for preventing the risk of damage. However, even a decrease in the exceedance may infer that less damage will occur.

Critical loads have been designated within the UK based on the sensitivity of the receiving habitat and have been reviewed for the purpose of this assessment.

⁴ UK Air Pollution Information System, www.apis.ac.uk.





3 BASELINE

Existing air quality conditions in the vicinity of the installation were identified in order to provide a baseline for assessment. These are detailed in the following sections.

3.1 Local Air Quality Management

As required by the Environment Act (1995), Wrexham County Borough Council (WCBC) has undertaken Review and Assessment of air quality within their area of administration. This process has indicated that pollutant concentrations are below the relevant AQOs at locations of relevant exposure. As such, no AQMAs have been declared

3.2 Air Quality Monitoring

Monitoring of pollutant concentrations is undertaken by WCBC using both continuous and passive methods throughout their area of administration. There are currently 25 diffusion tubes and 3 automatic monitoring stations operated by WCBC, the closest of which is WBC-041, located at NGR: 335407, 347890 approximately 3.7km South west of the site. Due to the distance and differences in the surrounding urban context between the proposed site and the diffusion tubes similar concentrations would not be anticipated; as such this source of data has not been considered further within this report.

3.3 Background Pollutant Concentrations

Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by DEFRA for the entire of the UK to assist LAs in their Review and Assessment of air quality. The proposed development site is located in grid square NGR: 338500, 349500. Data for this location was downloaded from the DEFRA website⁵ for the purpose of this assessment and is summarised in Table 3.

Table 3 Predicted Background Pollutant Concentrations

Pollutant	2018 Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)
NO _x	14.34
NO ₂	10.63
CO	243.00

It should be noted that background concentrations of NO₂ and NO_x were predicted for 2018 in order to consider the closest possible opening year of the plant. The background concentration of CO was predicted for 2001. These are the most recent predictions available from DEFRA and are therefore considered to provide a reasonable representation of background concentrations in the vicinity of the site.

⁵ <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html>.





3.4 Sensitive Receptors

A sensitive receptor is defined as any location which may be affected by changes in air quality. These have been defined for human and ecological receptors in the following Sections.

3.4.1 Sensitive Human Receptors

A desk-top study was undertaken in order to identify any sensitive human receptor locations in the vicinity of the site that required specific consideration during the assessment. These are summarised in Table 4.

Table 4 Sensitive Human Receptors

Receptor		Height (m)	NGR (m)	
			X	Y
R1-1	Commercial Unit 1 - Ground Floor	1.5	338664	349541
R1-2	Commercial Unit 1 - Ground Floor	1.5	338677	349541
R1-3	Commercial Unit 1 - Ground Floor	1.5	338690	349542
R1-4	Commercial Unit 1 - Ground Floor	1.5	338691	349553
R1-5	Commercial Unit 1 - Ground Floor	1.5	338707	349553
R1-1	Commercial Unit 1 - First Floor	4.5	338664	349541
R1-2	Commercial Unit 1 - First Floor	4.5	338677	349541
R1-3	Commercial Unit 1 - First Floor	4.5	338690	349542
R1-4	Commercial Unit 1 - First Floor	4.5	338691	349553
R1-5	Commercial Unit 1 - First Floor	4.5	338707	349553
R1-1	Commercial Unit 1 - Second Floor	8	338664	349541
R1-2	Commercial Unit 1 - Second Floor	8	338677	349541
R1-3	Commercial Unit 1 - Second Floor	8	338690	349542
R1-4	Commercial Unit 1 - Second Floor	8	338691	349553
R1-5	Commercial Unit 1 - Second Floor	8	338707	349553
R2-1	Commercial Unit 2 - Ground Floor	1.5	338620	349532
R2-2	Commercial Unit 2 - Ground Floor	1.5	338620	349550
R2-3	Commercial Unit 2 - Ground Floor	1.5	338620	349565
R2-1	Commercial Unit 2 - First Floor	4.5	338620	349532





Receptor		Height (m)	NGR (m)	
			X	Y
R2-2	Commercial Unit 2 - First Floor	4.5	338620	349550
R2-3	Commercial Unit 2 - First Floor	4.5	338620	349565
R3-1	Commercial Unit 3 - Ground Floor	1.5	338748	349556
R3-2	Commercial Unit 3 - Ground Floor	1.5	338739	349532
R3-3	Commercial Unit 3 - Ground Floor	1.5	338731	349509
R3-1	Commercial Unit 3 - First Floor	4.5	338748	349556
R3-2	Commercial Unit 3 - First Floor	4.5	338739	349532
R3-3	Commercial Unit 3 - First Floor	4.5	338731	349509
R4-1	Commercial Unit 4 - Ground Floor	1.5	338772	349569
R4-2	Commercial Unit 4 - Ground Floor	1.5	338766	349587
R4-1	Commercial Unit 4 - First Floor	4.5	338772	349569
R4-2	Commercial Unit 4 - First Floor	4.5	338766	349587

The sensitive receptors identified in Table 4 represent worst-case locations i.e. the receptors at which air quality impacts from the proposals are expected to be the greatest. However, this is not an exhaustive list and there may be other locations within the vicinity of the site that may experience air quality impacts as a result of atmospheric emissions from the facility that have not been individually identified above. Reference should be made to Figure 1 within Appendix I for a graphical representation of sensitive human receptor locations.

3.4.2 Sensitive Ecological Receptors

With regard to receptors of ecological sensitivity, Environment Agency (EA) guidance⁶ states:

"Note that conservation sites need only be considered where they fall within set distances of the activity:

- ▶ Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation (or 15km coal or oil-fired power station);
- ▶ Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), Local Wildlife Sites (LWS) and Ancient Woodland (AW) within 2km of the location.
- ▶ Some larger emitters may be required to screen to 10km or 15km for SSSIs."

⁶ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>.





Atmospheric emissions from the facility have the potential to impact on receptors of ecological sensitivity within the vicinity of the site. A study was undertaken to identify any statutory designated sites of ecological or nature conservation importance within the distances stated above. This was completed using the Multi-Agency Geographic Information for the Countryside (MAGIC) web-based interactive mapping service⁷ which draws information on key environmental schemes and designations. It should be noted that MAGIC does not contain information on Local Wildlife Sites (LWSs) and as such, COFNOD⁸ was commissioned to identify all LWSs within 2km of the proposed development site.

The receptor points chosen represent the closest points to the proposed facility and are displayed in Table 5. Reference should be made to Figure 1 within Appendix I for a graphical representation of the ecological designations.

Table 5 Ecological Receptors

Ecological Receptor		NGR (m)	
		X	Y
E1R1	Cefn Park Land – Local Wildlife Site	338498	349499
E1R2	Cefn Park Land – Local Wildlife Site	338594	349497
E1R3	Cefn Park Land – Local Wildlife Site	338708	349459
E1R4	Cefn Park Land – Local Wildlife Site	338767	349386
E1R5	Cefn Park Land – Local Wildlife Site	338855	349375
E1R6	Cefn Park Land – Local Wildlife Site	338553	349412
E1R7	Cefn Park Land – Local Wildlife Site	338689	349364
E1R8	Cefn Park Land – Local Wildlife Site	338839	349294
E1R9	Cefn Park Land – Local Wildlife Site	338435	349336
E1R10	Cefn Park Land – Local Wildlife Site	338643	349248
E1R11	Cefn Park Land – Local Wildlife Site	338864	349182
E1R12	Cefn Park Land – Local Wildlife Site	339030	349179
E2R1	Erlas Black Wood - Ancient Woodland	337761	349922
E2R2	Erlas Black Wood - Ancient Woodland	337782	350012
E2R3	Erlas Black Wood - Ancient Woodland	337801	350091
E2R4	Erlas Black Wood - Ancient Woodland	337668	349981
E3R1	Bryn Road - Grassland	338915	350094

⁷ Multi-Agency Geographic Information for the Countryside, www.magic.gov.uk.

⁸ COFNOD - the North Wales Environmental Data Service - <http://www.cofnod.org.uk>





Ecological Receptor		NGR (m)	
		X	Y
E3R2	Bryn Road - Grassland	338877	350002
E3R3	Bryn Road - Grassland	338867	349982
E3R4	Bryn Road - Grassland	338887	349916
E3R5	Bryn Road - Grassland	338918	349901
E3R6	Bryn Road - Grassland	338948	349997

Critical loads have been designated within the UK based on the sensitivity and relevant features of the receiving habitat. A review of the Air Pollution Information System (APIS) website⁹ was undertaken in order to identify the most suitable habitat description and associated critical load for the designations considered within the model. The critical loads for nitrogen deposition are presented in Table 6.

Table 6 Nitrogen Critical Load

Ecological Designation	Feature	APIS Habitat	Nitrogen Critical Load (kgN/ha/yr)	
			Min	Max
Cefn Park Land - Wildlife site	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	10	20
Erlas Black Wood - Ancient Woodland	Broadleaved deciduous woodland	Broadleaved, Mixed and Yew Woodland	10	20
Bryn Road - Grassland	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	10	20

It should be noted that the information shown in Table 6 represents the most representative habitat within each designation for nitrogen deposition.

Table 7 shows the relevant critical loads for acid deposition.

⁹ UK Air Pollution Information System, www.apis.ac.uk.





Table 7 Acid Critical Load

Ecological Designation	Feature	APIS Habitat	Critical Load (ke/ha/yr)		
			CL _{ma} xS	CL _{ma} xN	CL _{min} N
Cefn Park Land - Wildlife site	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	4.00	1.071	5.071
Erlas Black Wood - Ancient Woodland	Broadleaved deciduous woodland	Broadleaved, Mixed and Yew Woodland	1.406	0.357	1.763
Bryn Road - Grassland	Non-Mediterranean dry acid and neutral closed grassland	Neutral Grassland	4.00	1.071	5.071

Background deposition rates at the ecological receptor location were downloaded from the APIS website⁹ and are summarised in Table 8.

Table 8 Background Deposition Rates

Ecological Designation	Background Deposition Rate		
	Nitrogen (kgN/ha/yr)	Acid (keq/ha/yr)	
		Nitrogen	Sulphur
Cefn Park Land - Wildlife site	18.06	1.29	0.25
Erlas Black Wood - Ancient Woodland	29.82	2.13	0.29
Bryn Road - Grassland	18.06	1.29	0.25





4 METHODOLOGY

Emissions associated with the proposed generators have the potential to cause increases in pollutant concentrations in the vicinity of the site. These have been quantified through dispersion modelling in accordance with the methodology outlined in the following Sections.

An industry standard atmospheric dispersion model, ADMS 5, was used to model releases of the identified substances. The dispersion modelling procedure was as follows:

- ▶ Information on stack dimensions and position were provided by Conrad Energy (Developments) Limited;
- ▶ Process conditions were provided by Conrad Energy (Developments) Limited;
- ▶ Emission rates were provided by the technology provider;
- ▶ Appropriate data to describe meteorological conditions in the vicinity of the site were obtained from Atmospheric Dispersion Modelling (ADM) Ltd;
- ▶ The above information was entered into the dispersion model;
- ▶ The dispersion model was run to determine pollutant concentrations in the vicinity of the site; and
- ▶ The study results were compared with the relevant assessment criteria.

4.1 Dispersion Model

Dispersion modelling was undertaken using ADMS 5 (v5.2), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5 is a short-range dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology, and calculates user-selected long-term and short-term averages.

4.2 Modelling Scenarios

The scenarios considered in the modelling assessment are summarised in Table 9.

Table 9 Dispersion Modelling Scenarios

Parameter	Modelled As	
	Short Term	Long Term
NO ₂	99.79%ile 1-hour mean	Annual mean
NO _x	24 Hour Mean	Annual Mean
CO	Maximum daily running 8-hour mean	-





Some short-term air quality criteria are framed in terms of the number of occasions in a calendar year on which the concentration should not be exceeded. As such, the percentiles (%ile) shown in Table 9 were selected to represent the relationship between the permitted number of exceedances of short-period concentrations and the number of periods within a calendar year.

4.3 Stack Information

A maximum capacity of 9.9MW will be provided on site, for the purposes of the assessment it was assumed that this is spread equally across 4 units, however the capacity may be achieved through the installation of up to 6 smaller generator units. Critically, the total site capacity will not exceed a maximum of 9.9MW.

The process conditions were based on the technical data sheet for a MTU (20V4000 GS) model.

Combustion products from the proposed gas fired generators will be emitted from dedicated stacks. Relevant details are presented in Table 10.

Table 10 Stack Information

Reference			
		X	Y
G1	Generator 1	338655.7	349524.8
G2	Generator 2	338666.1	349524.9
G3	Generator 3	338676.2	349524.9
G4	Generator 4	338687.1	349525.1

Reference should be made to Figure 1 within Appendix I for a graphical representation of the stack locations.

4.4 Process Conditions

Process conditions were provided through correspondence with Conrad Energy (Developments) Limited and the technology provider and are identical for each of the generator units. A maximum capacity of 9.9MW will be provided on site, for the purposes of the assessment it was assumed that this is spread equally across 4 units. The process conditions were based on the technical data sheet for a MTU (20V4000 GS) model.

Reference should be made to Table 11 for dispersion modelling inputs, for each generator.

Table 11 Process Conditions

Category G3516	Unit	Value
Stack diameter	m	0.55
Stack height	m	10.0





Category G3516	Unit	Value
Flue gas efflux velocity (actual)	m/s	44.46
Volumetric flow rate (actual)	m ³ /s	2.63
Temperature	°C	419

4.5 Emissions

The pollutant mass emission rates for use in the assessment were provided by Conrad Energy and are summarised in Table 12. This represents a conservative assessment approach with emissions from the generators assumed to be the maximum permitted.

Table 12 Emission Rates Per Generator Unit

Pollutant	Mass Emission Rate (g/s)
NO _x	0.66
CO	2.64

4.6 Time Varied Emissions

Based on the information provided by Conrad Energy (Developments) Limited the generators would be in use typically for 1500 hours per year, as such, plant shut-down and periods of reduced workloads are fully reflected in the modelled emissions.

4.7 Assessment Extents

Ambient concentrations were predicted over the area NGR: 338450, 349250, to 338950, 349750. One Cartesian grid with a resolution of 20m and a height of 1.5m was included in the model. Results were subsequently used to produce contour plots within the Surfer software package.

4.8 Terrain Data

Ordnance Survey Landform Panorama terrain data was included for the site and surrounding area in order to take account of the specific flow field produced by variations in ground height throughout the assessment extents. This was pre-processed using the dedicated function within ADMS 5.

4.9 Building Effects

The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings.

Analysis of the site layout indicated that a number of structures in the vicinity of the stacks should be included within the model in order to take account of effects on pollutant dispersion. Building input geometries are shown in Table 13.





Table 13 Building Geometries

Building		NGR (m)		Height (m)	Length (m)	Width (m)	Angle (°)
		X	Y				
1	CHP 1	338655.8	349523.7	4.5	18.5	4.8	180.0
2	CHP 2	338666.1	349523.6	4.5	18.6	4.9	180.0
3	CHP 3	338676.2	349523.6	4.5	18.6	4.9	180.0
4	CHP 4	338687.0	349523.6	4.5	18.6	4.9	180.0
5	CHP 5	338717.9	349499.4	4.5	18.5	4.9	200.1
6	CHP 6	338726.3	349521.9	4.5	18.5	4.9	200.0
7	Gas 1	338655.4	349510.9	3.0	1.7	4.0	180.5
8	Gas 2	338661.2	349510.2	3.0	1.7	4.0	197.9
9	Waste Oil Storage	338665.7	349508.8	3.0	2.0	3.1	196.8
10	Clean Oil Storage	338669.5	349507.5	3.0	2.0	3.1	196.7
11	Amenity/Client Cabins 1	338677.0	349500.2	3.0	2.4	12.2	225.9
12	DNO 1	338687.3	349494.3	3.0	2.9	2.9	180.0
13	DNO 2	338694.3	349530.7	3.0	2.9	2.8	180.0
14	Amenity/Client Cabins 2	338699.8	349531.0	3.0	2.4	6.0	180.0
15	Surrounding Building 1	338709.3	349433.2	7.0	13.7	13.5	224.7
16	Surrounding Building 2	338598.0	349548.8	7.0	33.2	42.6	180.0
17	Surrounding Building 3	338685.8	349571.7	6.0	36.0	43.1	180.0
18	Surrounding Building 4	338677.0	349548.1	9.0	11.2	25.7	180.0
19	Surrounding Building 5	338748.1	349529.4	8.0	49.8	16.9	199.9
20	Surrounding Building 6	338585.5	349634.0	7.0	24.0	55.2	181.9
21	Surrounding Building 7	338783.4	349595.0	6.0	24.8	25.2	199.9
22	Surrounding Building 8	338782.3	349574.3	3.0	15.7	13.8	200.1
23	Surrounding Building 9	338493.7	349440.8	8.0	83.7	45.7	150.9
24	Surrounding Building 10	338476.7	349469.1	8.0	42.0	28.9	186.0
25	Surrounding Building 11	338448.0	349451.7	8.0	68.9	52.4	166.0

Reference should be made to Figure 1 within Appendix I for a graphical representation of the





modelled building layout and the ADMS 5 model input.

4.10 Meteorological Data

Meteorological data used in this assessment was taken from Hawarden meteorological station over the period 1st January 2013 to 31st December 2017 (inclusive). Hawarden meteorological station is located at approximate NGR: 381745, 383960, which is approximately 15km north of the proposed development site.

All meteorological data used in the assessment was provided by ADM Ltd, which is an established distributor of meteorological data within the UK. Reference should be made to Figure 2 within Appendix I for wind roses of utilised meteorological data.

4.11 Roughness Length

A roughness length (z_0) of 0.5m was used in the dispersion modelling study. This value of z_0 is considered appropriate for the morphology of the assessment area and is suggested within ADMS 5 as being suitable for 'Parkland, open suburbia'.

A z_0 of 0.3m was utilised to represent the morphology of the meteorological station location and is suggested as being suitable for 'agricultural areas (max)'.

4.12 Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used in the dispersion modelling study. This value is considered appropriate for the nature of the assessment area and is suggested within ADMS 5 as being suitable for 'mixed urban/industrial'.

A Monin-Obukhov length of 10m was utilised to represent the nature of meteorological station location and is suggested within ADMS 5 as being suitable for 'small towns <50,000'.

4.13 Deposition Rates

Deposition rates were calculated using the conversion factors provided within EA document "Technical Guidance on Detailed Modelling approach for an Appropriate Assessment for Emissions to Air AQTAG06". Predicted pollutant concentrations were multiplied by the relevant deposition velocity and conversion factor to calculate the speciated dry deposition flux. The conversion factors used are presented within Table 14.

Table 14 Conversion Factors to Determine Dry Deposition Flux

Pollutant	Grassland Deposition Velocity (m/s)	Forest Deposition Velocity (m/s)	Conversion Factor ($\mu\text{g}/\text{m}^2/\text{s}$ to $\text{kg}/\text{ha}/\text{yr}$ of pollutant species)
NO ₂	0.0015	0.0030	96.0

Acid deposition occurs as a result of NO₂. Predicted ground level pollutant concentrations were





converted to kilo-equivalent ion depositions (keq/ha/yr) for comparison with the critical load for acid deposition at each of the identified ecological receptors.

The conversion to units of equivalents, a measure of the potential acidifying effect of a species, was undertaken by multiplying the dry deposition flux by the standard conversion factors shown in Table 15.

Table 15 Conversion Factors to Units of Equivalents

Species	Conversion Factor from kg/ha/yr to keq/ha/yr
Nitrogen	0.07143

4.14 Assessment Criteria

Predicted ground level pollutant concentrations and deposition rates were compared with the relevant AQOs, critical levels and critical loads identified within Section 3.4.2. These criteria are collectively referred to as Environmental Quality Standards (EQSs).

4.15 Baseline Concentrations

A review of existing data in the vicinity of the site was undertaken in Section 3 of this report in order to define baseline pollutant levels. The background concentrations provided by DEFRA, as summarised in Table 3, were used in the assessment to represent existing pollutant levels in the vicinity of the site.

It is not possible to add short-term peak baseline and process concentrations. This is because the conditions which give rise to peak ground-level concentrations of substances emitted from an elevated source at a particular location and time are likely to be different to the conditions which give rise to peak concentrations due to emissions from other sources. This point is addressed in EA guidance⁶, which advises that an estimate of the maximum combined pollutant concentration can be obtained by adding the maximum predicted short-term concentration due to emissions from the source to twice the annual mean baseline concentration. This approach was adopted throughout the assessment.

4.16 NO_x to NO₂ Conversion

Emissions of NO_x from combustion processes are predominantly in the form of NO. Excess oxygen in the combustion gases and further atmospheric reactions cause the oxidation of NO to NO₂. Recent comparisons of ambient NO and NO₂ concentrations in the vicinity of point sources has indicated that it is unlikely that more than 30% of the emitted NO_x is present at ground level as NO₂.

Ground level NO_x concentrations were predicted through dispersion modelling. NO₂ concentrations reported in the results section assume 100% conversion from NO_x to NO₂ for annual means and 50% conversion for 1-hour concentrations, based upon Environment Agency guidance¹⁰.

¹⁰ Conversion Ratios for NO_x and NO₂, Environment Agency, undated.





4.17 Significance of Predicted Impacts

Predicted pollutant concentrations are summarised in the following formats:

- ▶ Process contribution (PC) - Predicted pollutant concentration as a result of emissions from the facility only; and
- ▶ Predicted environmental concentration (PEC) - Total predicted pollutant concentration as a result of emissions from the facility and existing baseline levels.

The significance of predicted impact has been assessed in accordance with EA criteria and through consideration of likely effects as a result of the proposals. EA guidance⁶ states that process contributions can be considered insignificant if the PC for each substance meets the following criteria:

- ▶ The short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- ▶ The long-term PC is less than 1% of the long-term environmental standard for protected conservation areas

Should the PC meet both of the above criteria, no further assessment of the substance is required. If the PC exceeds the criteria, a second stage of screening should be undertaken to determine the impact significance of the PEC.

- ▶ The short-term PC is less than 20% of the short-term environmental standards minus twice the long-term background concentration;
- ▶ The long-term PEC is less than 70% of the long-term environmental standards

Should these criteria be exceeded then the PEC should be checked against the EQS. If the predicted long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions can be considered insignificant.

If the emissions associated with the development affect SPAs, SACs, RAMSAR sites or SSSIs meet both of the following criteria, can be considered insignificant:

- ▶ the short-term PC is less than 10% of the short-term environmental standard for protected conservation areas;
- ▶ the long-term PC is less than 1% of the long-term environmental standard for protected conservation areas

Should these criteria be exceeded then the PEC should be checked against the standard for protected conservation areas. PEC is not required for short-term targets. Should the short-term PC exceed the screening criteria, a detailed modelling is required.

If the predicted long-term PC is greater than 1% and the PEC is less than 70% of the long-term environmental standard, the emissions can be considered insignificant. Should the predicted PEC be greater than 70% of the long-term environmental standard, a detailed dispersion modelling is required.





When considering impacts at local nature sites and the emissions meet both of the following criteria, impacts can be considered insignificant and there is no further assessment required:

- ▶ The short-term PC is less than 100% of the short-term environmental standard; and
- ▶ The long-term PC is less than 100% of the long-term environmental standard.

Should the PC exceed the screening criteria, detailed dispersion modelling is required. Calculations relating to the PEC of local nature sites is not required as stated with the EA guidance⁶.

4.18 Modelling Uncertainty

Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- ▶ Model uncertainty - due to model limitations;
- ▶ Data uncertainty - due to errors in input data, including emission estimates, operational procedures, land use characteristics and meteorology; and
- ▶ Variability - randomness of measurements used.

Potential uncertainties in model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- ▶ Choice of model - ADMS 5 is a commonly used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- ▶ Meteorological data - Modelling was undertaken using four annual meteorological data sets from the closest observation site to the site to take account of local conditions;
- ▶ Plant operating conditions - Plant operating conditions were provided by Conrad Energy (Developments) Limited. As such, these are considered to be representative of operating conditions;
- ▶ Emission rates - Emission rates were obtained for the proposed generators were provided by Conrad Energy (Developments) Limited. As such, these are considered to be representative of likely emissions;
- ▶ Background concentrations - Background concentrations were obtained from the DEFRA mapping study;
- ▶ Receptor locations - A Cartesian Grid was included in the model in order to calculate maximum predicted concentrations throughout the assessment extents; and
- ▶ Variability - All model inputs are as accurate as possible and worst-case conditions were considered as necessary in order to ensure a robust assessment of potential pollutant concentrations.

Results were considered in the context of the relevant Environmental Quality Standard (EQS). It is considered that the use of the stated measures to reduce uncertainty and the use of worst-case assumptions when necessary has resulted in model accuracy of an acceptable level.





4.19 Dispersion Modelling Report Requirements

Table 16 provides the checklist of dispersion modelling report requirements.

Table 16 Dispersion Modelling Report Requirements

Item	Location within Report
Location map	Figure 1
List of pollutants modelled and relevant air quality guidelines	Table 1, and Table 3
Details of modelled scenarios	Table 9
Details of relevant ambient concentrations used	Table 4
Model description and justification	Section 4.1
Special model treatments used	Section 4
Table of emission parameters used	Table 11
Details of modelled domain and receptors	Section 3.4, Section 4, Table 5 and Table 6
Details of meteorological data used (including origin) and justification	Section 4.10
Details of terrain treatment	Section 4.8
Details of building treatment	Section 4.9 and Table 14





5 RESULTS

Dispersion modelling was undertaken with the inputs described in Section 4. Reference should be made to Figure 3 to Figure 5 for graphical representations of predicted pollutant concentrations throughout the assessment extents.

5.1 Maximum Pollutant Concentrations

The maximum predicted pollutant concentrations at the most affected Human Sensitive Receptor location within the modelling extents for any meteorological data set are summarised in Table 17 for all modelled pollutants.

It should be noted that long term pollutant concentrations of NO₂ and CH₂O have not been assessed further throughout the assessment. All sensitive locations within the vicinity of the site consist of commercial and industrial land uses, where members of the public do not have regular access. As a result, annual mean exposure has not been assessed. This assessment approach accords to the LAQM TG(16)², reference should be made to Table 2 for further information.

Table 17 Maximum Predicted Pollutant Concentrations

Pollutant	Averaging Period	EQS (µg/m ³)	PC		PEC	
			Concentration (µg/m ³)	Proportion of EQS (%)	Concentration (µg/m ³)	Proportion of EQS (%)
NO ₂	1-Hour	200	121.50	142.76	60.75	71.38
CO	8-Hour Rolling	10,000	479.00	965.00	4.79	9.65

As indicated in Table 17, there are no predicted exceedances of any EQS at the most affected Human Sensitive Receptor locations throughout the assessment extents for annual and 1-hour NO₂ and 8-hour rolling CO concentrations. It should be noted that long term NO₂ has not been assessed as receptors in the vicinity of the site are not sensitive to annual mean NO₂. As such only short term concentrations have been considered.

It should be noted that the data presented in the Figures are predictions from the meteorological data set which resulted in the maximum pollutant concentrations for each calendar year.

5.2 Sensitive Human Receptors

5.2.1 Nitrogen Dioxide

Reference should be made to Figure 3 within Appendix I graphical representations of predicted concentrations throughout the assessment extents. As indicated in the figure, no exceedances of the 1-hour mean AQO for NO₂ were predicted at any location within the assessment extents. Exceedances of the criteria listed in Section 4.17 are highlighted in **bold**.

Predicted 1-hour mean NO₂ concentrations at sensitive human receptor locations are summarised in Table 18.





Table 18 Predicted 1 Hour Mean NO₂ Concentrations

Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PC*
R1-1	Commercial Unit 1 - Ground Floor	22.00	40.43	11.00	12.12
R1-2	Commercial Unit 1 - Ground Floor	41.80	60.23	20.90	23.02
R1-3	Commercial Unit 1 - Ground Floor	43.05	61.48	21.53	23.71
R1-4	Commercial Unit 1 - Ground Floor	42.40	60.83	21.20	23.35
R1-5	Commercial Unit 1 - Ground Floor	48.05	66.48	24.03	26.46
R1-1	Commercial Unit 1 - First Floor	23.20	41.63	11.60	12.78
R1-2	Commercial Unit 1 - First Floor	41.80	60.23	20.90	23.02
R1-3	Commercial Unit 1 - First Floor	46.10	64.53	23.05	25.39
R1-4	Commercial Unit 1 - First Floor	45.90	64.33	22.95	25.28
R1-5	Commercial Unit 1 - First Floor	59.00	77.43	29.50	32.49
R1-1	Commercial Unit 1 - Second Floor	84.00	102.43	42.00	46.26
R1-2	Commercial Unit 1 - Second Floor	87.50	105.93	43.75	48.19
R1-3	Commercial Unit 1 - Second Floor	117.00	135.43	58.50	64.44
R1-4	Commercial Unit 1 - Second Floor	113.50	131.93	56.75	62.51
R1-5	Commercial Unit 1 - Second Floor	121.50	139.93	60.75	66.92
R2-1	Commercial Unit 2 - Ground Floor	24.80	43.23	12.40	13.66
R2-2	Commercial Unit 2 - Ground Floor	31.05	49.48	15.53	17.10
R2-3	Commercial Unit 2 - Ground Floor	38.25	56.68	19.13	21.07
R2-1	Commercial Unit 2 - First Floor	44.80	63.23	22.40	24.67
R2-2	Commercial Unit 2 - First Floor	51.50	69.93	25.75	28.36
R2-3	Commercial Unit 2 - First Floor	54.00	72.43	27.00	29.74
R3-1	Commercial Unit 3 - Ground Floor	48.00	66.43	24.00	26.44
R3-2	Commercial Unit 3 - Ground Floor	39.20	57.63	19.60	21.59
R3-3	Commercial Unit 3 - Ground Floor	40.25	58.68	20.13	22.17
R3-1	Commercial Unit 3 - First Floor	56.00	74.43	28.00	30.84





Receptor		Predicted Annual Mean NO ₂ Concentration (µg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PC*
R3-2	Commercial Unit 3 - First Floor	55.00	73.43	27.50	30.29
R3-3	Commercial Unit 3 - First Floor	62.00	80.43	31.00	34.15
R4-1	Commercial Unit 4 - Ground Floor	47.20	65.63	23.60	26.00
R4-2	Commercial Unit 4 - Ground Floor	49.10	67.53	24.55	27.04
R4-1	Commercial Unit 4 - First Floor	50.50	68.93	25.25	27.81
R4-2	Commercial Unit 4 - First Floor	52.00	70.43	26.00	28.64

Note: Predicted Short Term PC concentrations were assessed against the relevant EA criteria of 20% of the short term EQS of 200µg/m³ minus twice the long-term background concentration (178.74µg/m³).

As indicated in Table 18, 1-hour NO₂ concentrations were below the relevant EQS at all sensitive receptor locations.

The PC proportion of the EQS exceeded 10% at all receptor locations, in addition, the PEC proportion of the EQS exceeded 20% at 27 receptor locations. As such, 27 locations cannot be directly screened out as **insignificant** in accordance with the EA criteria⁶.

Critically, the predicted concentrations at these locations are below 75% of the relevant EQS. Therefore, the 1-hour mean NO₂ concentration are considered to be **not-significant**.

5.2.2 Carbon Monoxide

Reference should be made to Figure 4 for a graphical representation of predicted maximum daily running 8-hour mean CO concentrations throughout the assessment extents.

Predicted CO concentrations at sensitive receptor locations are summarised in Table 19.

Table 19 Predicted 8-hour Rolling Mean CO Concentrations

Receptor		Predicted Maximum Daily Running 8-hour Mean CO Concentration (mg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PC*
R1-1	Commercial Unit 1 - Ground Floor	95.00	586.11	0.95	1.00
R1-2	Commercial Unit 1 - Ground Floor	170.00	661.11	1.70	1.79





Receptor		Predicted Maximum Daily Running 8-hour Mean CO Concentration (mg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PC*
R1-3	Commercial Unit 1 - Ground Floor	178.00	669.11	1.78	1.87
R1-4	Commercial Unit 1 - Ground Floor	175.00	666.11	1.75	1.84
R1-5	Commercial Unit 1 - Ground Floor	195.00	686.11	1.95	2.05
R1-1	Commercial Unit 1 - First Floor	100.00	591.11	1.00	1.05
R1-2	Commercial Unit 1 - First Floor	170.00	661.11	1.70	1.79
R1-3	Commercial Unit 1 - First Floor	190.00	681.11	1.90	2.00
R1-4	Commercial Unit 1 - First Floor	209.00	700.11	2.09	2.20
R1-5	Commercial Unit 1 - First Floor	232.00	723.11	2.32	2.44
R1-1	Commercial Unit 1 - Second Floor	415.00	906.11	4.15	4.36
R1-2	Commercial Unit 1 - Second Floor	427.00	918.11	4.27	4.49
R1-3	Commercial Unit 1 - Second Floor	479.00	970.11	4.79	5.04
R1-4	Commercial Unit 1 - Second Floor	473.00	964.11	4.73	4.97
R1-5	Commercial Unit 1 - Second Floor	477.00	968.11	4.77	5.02
R2-1	Commercial Unit 2 - Ground Floor	136.00	627.11	1.36	1.43
R2-2	Commercial Unit 2 - Ground Floor	166.00	657.11	1.66	1.75
R2-3	Commercial Unit 2 - Ground Floor	179.00	670.11	1.79	1.88
R2-1	Commercial Unit 2 - First Floor	235.00	726.11	2.35	2.47
R2-2	Commercial Unit 2 - First Floor	253.00	744.11	2.53	2.66
R2-3	Commercial Unit 2 - First Floor	259.00	750.11	2.59	2.72
R3-1	Commercial Unit 3 - Ground Floor	210.00	701.11	2.10	2.21
R3-2	Commercial Unit 3 - Ground Floor	185.00	676.11	1.85	1.95
R3-3	Commercial Unit 3 - Ground Floor	226.00	717.11	2.26	2.38
R3-1	Commercial Unit 3 - First Floor	235.00	726.11	2.35	2.47
R3-2	Commercial Unit 3 - First Floor	274.00	765.11	2.74	2.88
R3-3	Commercial Unit 3 - First Floor	281.00	772.11	2.81	2.96





Receptor		Predicted Maximum Daily Running 8-hour Mean CO Concentration (mg/m ³)		Proportion of EQS (%)	
		PC	PEC	PC	PC*
R4-1	Commercial Unit 4 - Ground Floor	191.00	682.11	1.91	2.01
R4-2	Commercial Unit 4 - Ground Floor	196.00	687.11	1.96	2.06
R4-1	Commercial Unit 4 - First Floor	207.00	698.11	2.07	2.18
R4-2	Commercial Unit 4 - First Floor	205.00	696.11	2.05	2.16

Note: *Predicted Short Term PEC concentrations were assessed against the relevant EA criteria of 20% of the short term EQS of 10,000µg/m³ minus twice the long-term background concentration (9514µg/m³).

As indicated in Table 19, predicted CO concentrations are below the relevant EQS at all sensitive receptor locations.

The PC proportion of the EQS is less than 10% at all receptor locations, furthermore the PEC proportion of the EQS is less than 20% at all receptor locations. As such, impacts on 8-hour rolling mean CO concentrations are considered to be **insignificant** in accordance with EA screening criteria⁶.

5.3 Sensitive Ecological Receptors

Predicted concentrations and deposition rates of each pollutant at the ecological receptor locations identified in Table 5 are summarised in the following Sections.

5.3.1 Oxides of Nitrogen

Predicted annual mean and 24-hour NO_x concentrations for sensitive ecological receptors are summarised in Table 20 and Table 21. It should be noted that the results presented in Table 20 and Table 21 represent the maximum concentrations predicted across all meteorological datasets.

Table 20 Predicted Annual Mean NO_x Concentrations

Receptor	Predicted Annual Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)
	PC	PEC	PC
E1-R1	0.65	14.99	2.16
E1-R2	0.66	15.00	2.19
E1-R3	1.58	15.92	5.27
E1-R4	1.86	16.20	6.20
E1-R5	1.45	15.79	4.83





Receptor	Predicted Annual Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)
	PC	PEC	PC
E1-R6	0.50	14.85	1.68
E1-R7	0.89	15.23	2.97
E1-R8	1.12	15.46	3.73
E1-R9	0.28	14.63	0.94
E1-R10	0.36	14.71	1.21
E1-R11	0.64	14.98	2.13
E1-R12	0.53	10.49	1.76
E2-R1	0.09	14.95	0.30
E2-R2	0.10	18.73	0.32
E2-R3	0.10	18.73	0.34
E2-R4	0.08	14.93	0.26
E3-R1	0.17	18.30	0.56
E3-R2	0.22	18.36	0.75
E3-R3	0.24	14.58	0.80
E3-R4	0.32	14.67	1.08
E3-R5	0.36	14.70	1.20
E3-R6	0.24	14.58	0.80

As indicated in Table 20, predicted annual mean NO_x concentrations were below the relevant EQS at all sensitive receptor locations for all meteorological data sets.

Additionally, the PC proportion of the EQS is below the 100% EA threshold at all ecological receptor locations. As such, impacts on annual mean NO_x concentrations are considered to be **insignificant** in accordance with the EA screening criteria

Table 21 Predicted 24-hour Mean NO_x Concentrations

Receptor	Predicted 24-hour Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)
	PC	PEC	PC
E1-R1	18.00	39.26	24.00
E1-R2	14.70	35.96	19.60





Receptor	Predicted 24-hour Mean NO _x Concentration (µg/m ³)		Proportion of EQS (%)
	PC	PEC	PC
E1-R3	25.20	46.46	33.60hh
E1-R4	22.20	43.46	29.60
E1-R5	11.60	32.86	15.47
E1-R6	12.00	33.26	16.00
E1-R7	10.20	31.46	13.60
E1-R8	12.10	33.36	16.13
E1-R9	6.55	27.81	8.73
E1-R10	6.21	27.47	8.28
E1-R11	6.09	27.35	8.12
E1-R12	4.96	20.17	6.61
E2-R1	1.90	23.86	2.53
E2-R2	1.91	28.78	2.55
E2-R3	1.75	28.62	2.33
E2-R4	1.75	23.71	2.33
E3-R1	2.41	28.64	3.21
E3-R2	3.21	29.44	4.28
E3-R3	3.48	24.74	4.64
E3-R4	3.63	24.89	4.84
E3-R5	3.59	24.85	4.79
E3-R6	2.62	23.88	3.49

As indicated in Table 21, predicted 24-hour mean NO_x concentrations are below the relevant EQS at all sensitive receptor locations.

In addition, the PC proportion of the EQS is less than 100% at all receptor locations. As such, impacts on 24-Hour mean NO_x concentrations are considered to be **insignificant** in accordance with the EA screening criteria.





5.3.2 Nitrogen Deposition

Predicted annual mean nitrogen deposition rates are summarised in Table 22. Reference should be made to Table 8 for details of the site-specific Low and High EQSs.

Table 22 Predicted Annual Mean Nitrogen Deposition Rates

Receptor	Predicted Annual Mean Nitrogen Deposition Rate (kgN/ha/yr)		Proportion of EQS (%)	
	PC	PEC	Low EQS	High EQS
			PC	PC
E1-R1	0.09	18.15	0.93	0.47
E1-R2	0.09	18.15	0.95	0.47
E1-R3	0.23	18.29	2.28	1.14
E1-R4	0.27	18.33	2.68	1.34
E1-R5	0.21	18.27	2.09	1.04
E1-R6	0.07	18.13	0.72	0.36
E1-R7	0.13	18.19	1.28	0.64
E1-R8	0.16	18.22	1.61	0.81
E1-R9	0.04	18.10	0.41	0.20
E1-R10	0.05	18.11	0.52	0.26
E1-R11	0.09	18.15	0.92	0.46
E1-R12	0.08	18.14	0.76	0.38
E2-R1	0.03	29.85	0.26	0.13
E2-R2	0.03	29.85	0.28	0.14
E2-R3	0.03	29.85	0.29	0.15
E2-R4	0.02	29.84	0.22	0.11
E3-R1	0.02	18.08	0.24	0.12
E3-R2	0.03	18.09	0.32	0.16
E3-R3	0.03	18.09	0.35	0.17
E3-R4	0.05	18.11	0.47	0.23
E3-R5	0.05	18.11	0.52	0.26
E3-R6	0.03	18.09	0.35	0.17





As indicated in Table 22, the PC proportion of the EQS is less than 100% for receptor locations. As such, impacts on annual mean NO₂ concentrations at these locations are considered to be **insignificant** in accordance with EA screening criteria⁶.

5.3.3 Acid Deposition

Predicted acid deposition rates are summarised in Table 23. It should be noted all results relate to the maximum predicted by any meteorological dataset. It should be noted that the acid deposition rate for sulphur is the background deposition rate only, as sulphur is not emitted by the proposed installation.

Table 23 Predicted Annual Mean Acid Deposition Rates

Receptor	Predicted Annual Mean Acid Deposition Rate (keq/ha/yr)	Proportion of EQS (%)		Exceedance of CL Function (keq/ha/yr)
	N	PC	PEC	
E1-R1	0.0067	0.20	30.4	None
E1-R2	0.0068	0.20	30.4	None
E1-R3	0.0163	0.40	30.4	None
E1-R4	0.0191	0.40	30.4	None
E1-R5	0.0149	0.40	30.4	None
E1-R6	0.0052	0.20	30.4	None
E1-R7	0.0092	0.20	30.4	None
E1-R8	0.0115	0.20	30.4	None
E1-R9	0.0029	0.00	30.4	None
E1-R10	0.0037	0.00	30.4	None
E1-R11	0.0066	0.20	30.4	None
E1-R12	0.0054	0.20	30.4	None
E2-R1	0.0019	0.00	137.5	None
E2-R2	0.0020	0.00	137.5	None
E2-R3	0.0021	0.00	137.5	None
E2-R4	0.0016	0.00	137.5	None
E3-R1	0.0017	0.00	30.4	None
E3-R2	0.0023	0.00	30.4	None
E3-R3	0.0025	0.00	30.4	None
E3-R4	0.0033	0.00	30.4	None





Receptor	Predicted Annual Mean Acid Deposition Rate (keq/ha/yr)	Proportion of EQS (%)		Exceedance of CL Function (keq/ha/yr)
		PC	PEC	
E3-R5	0.0037	0.00	30.4	None
E3-R6	0.0025	0.00	30.4	None

As indicated in Table 23, acid deposition rates were below the relevant EQS at all sensitive receptor locations.

In addition, the PC proportion of the EQS is less than 100% at all receptor locations. As such, impacts on annual mean nitrogen deposition rates can be screened out as **insignificant** in accordance with the EA screening criteria. The APIS site relevant critical load tool⁹ indicated that no receptors exceeded the CL function for acid deposition





6 CONCLUSION

REC Ltd was commissioned by Conrad Energy (Developments) Limited to undertake a Dispersion Modelling Assessment in support of the proposed gas fired power station at Oak Road, Wrexham industrial estate, Wrexham.

Atmospheric emissions from the selected plants have the potential to cause increases in ground level pollutant concentrations. As such, a Dispersion Modelling Assessment was required to quantify impacts in the vicinity of the site.

Dispersion modelling of a number of pollutants was undertaken using ADMS 5 (v5.2). Impacts at sensitive receptors were quantified and the results compared with the relevant EQSs.

Predicted concentrations of NO₂ and CO for the protection of human health were below the relevant EQSs and EA significance criteria at all sensitive human receptor locations. Impacts on NO₂ and CO concentrations were therefore deemed not significant.

Nitrogen and acid gas deposition rates were also predicted at the relevant ecological sites. Impacts upon sensitive ecological designations as a result of emissions from the installation were deemed not significant at all designations.

Impacts were predicted based on a maximum concentration of all meteorological years assessed. As such, predicted results are considered to be a robust estimate.

Based on the assessment results, air quality issues are not considered a constraint to planning consent for the development.





7 ABBREVIATIONS

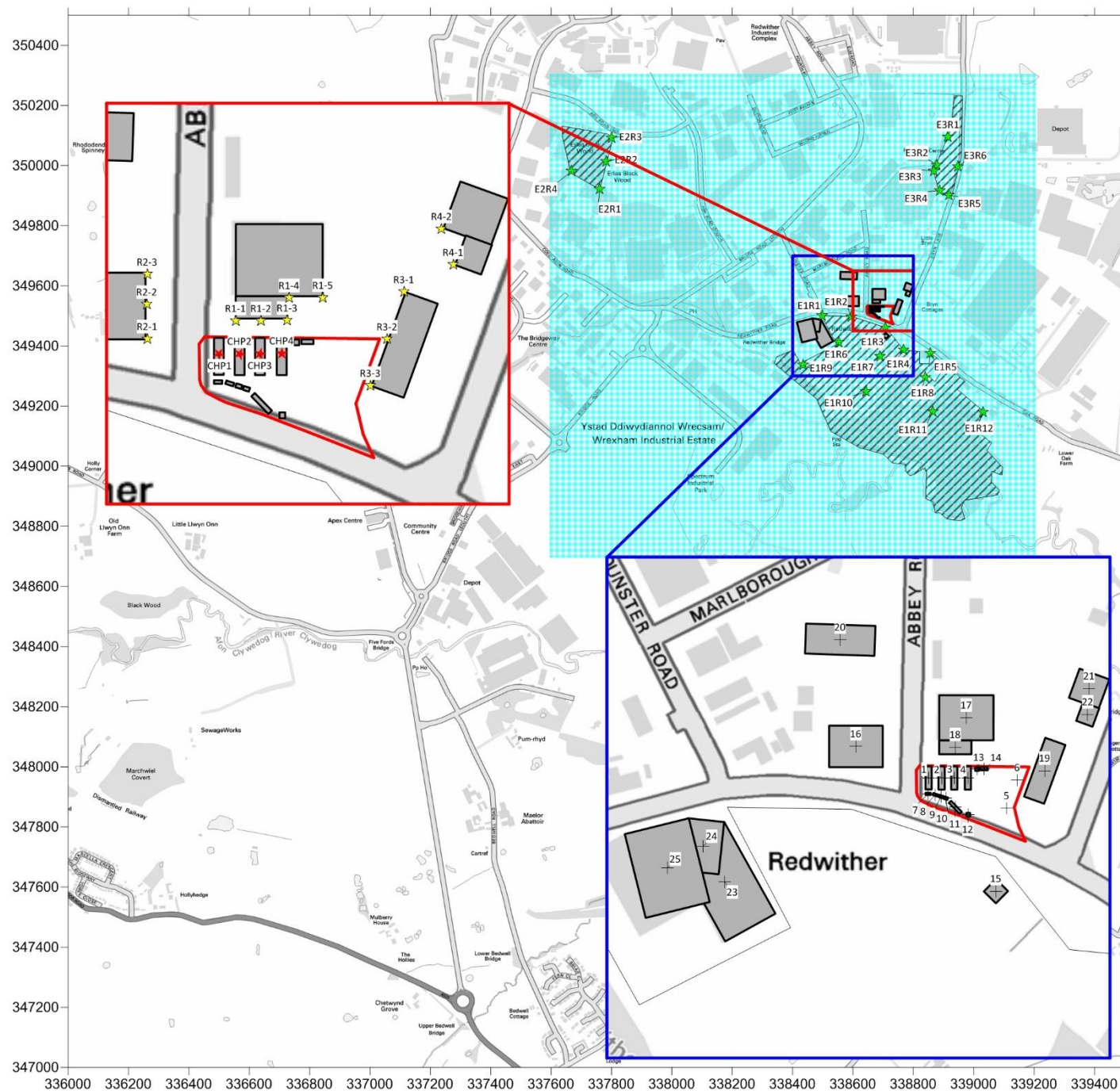
%ile	Percentile
ADM	Atmospheric Dispersion Modelling
APIS	Air Pollution Information System
AQLV	Air Quality Limit Value
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AQS	Air Quality Strategy
CERC	Cambridge Environmental Research Consultants
CO	Carbon monoxide
DEFRA	Department for Environment, Food and Rural Affairs
EQS	Environmental Quality Standard
EU	European Union
LA	Local Authority
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
MAGIC	Multi-Agency Geographic Information for the Countryside
NGR	National Grid Reference
NO	Nitric oxide
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen
PM _{2.5}	Particulate matter with an aerodynamic diameter of less than 2.5µm
PM ₁₀	Particulate matter with an aerodynamic diameter of less than 10µm
PC	Process Contribution
PEC	Predicted Environmental Concentration
REC	Resource and Environmental Consultants
SAC	Special Areas of Conservation
TOC	Total Organic Carbon
VOC	Volatile Organic Compound
WCBC	Wrexham County Borough Council
z ₀	Roughness Length





APPENDIX I FIGURES





Legend

- Site Boundary
- Ecological Location
- Cartesian Grid
- Stack Location
- Human Sensitive Receptor Locations
- Ecological Sensitive Receptor Locations
- Building Location

Title

Figure 1
Site Location

Project

Air Quality Assessment
Proposed Gas Fired Power Station
Oak Road, Wrexham

Project Number

AQ106349

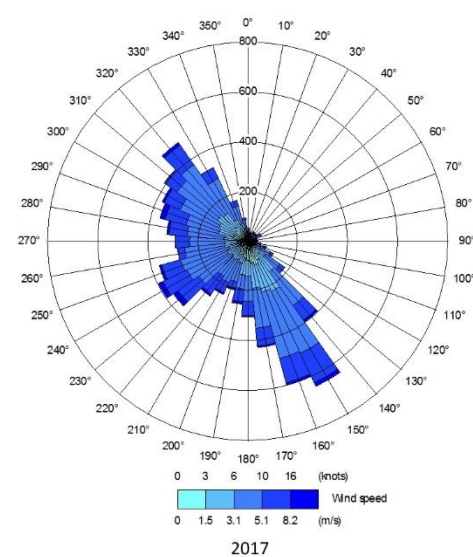
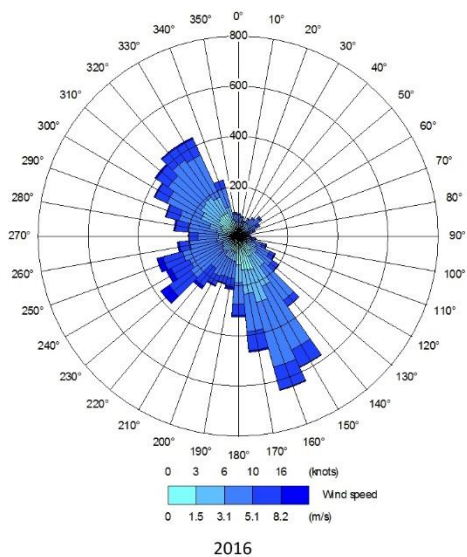
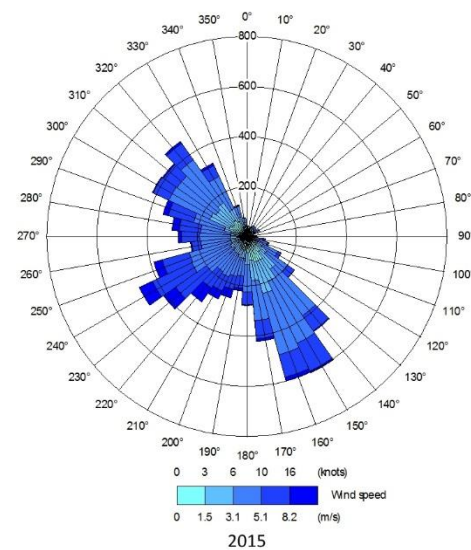
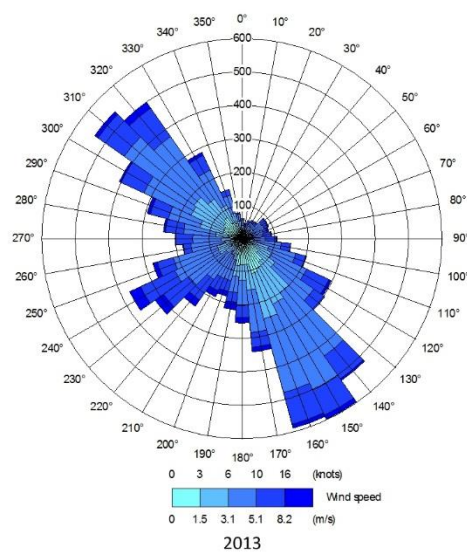
Client

Conrad Energy (Developments) Limited

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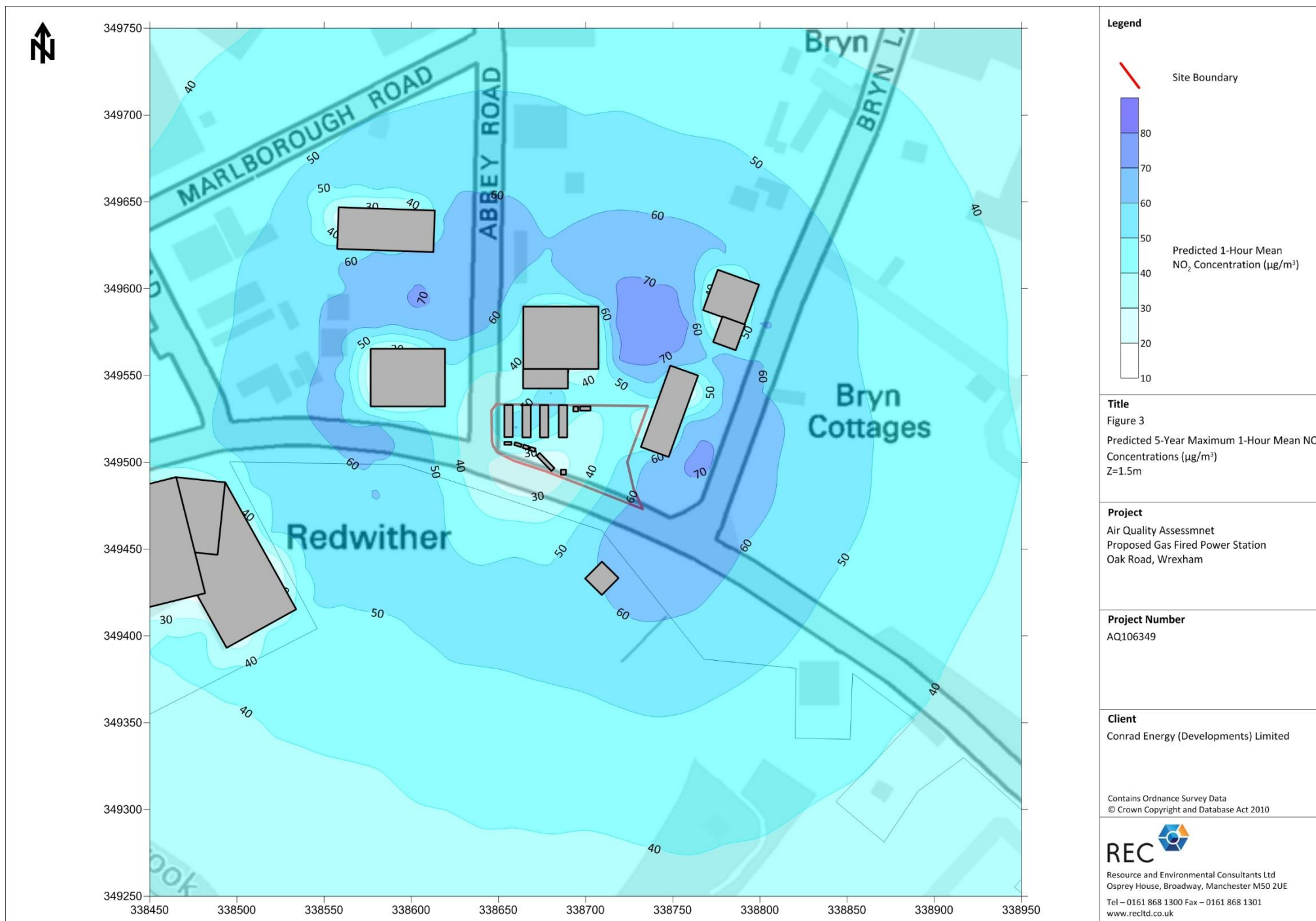


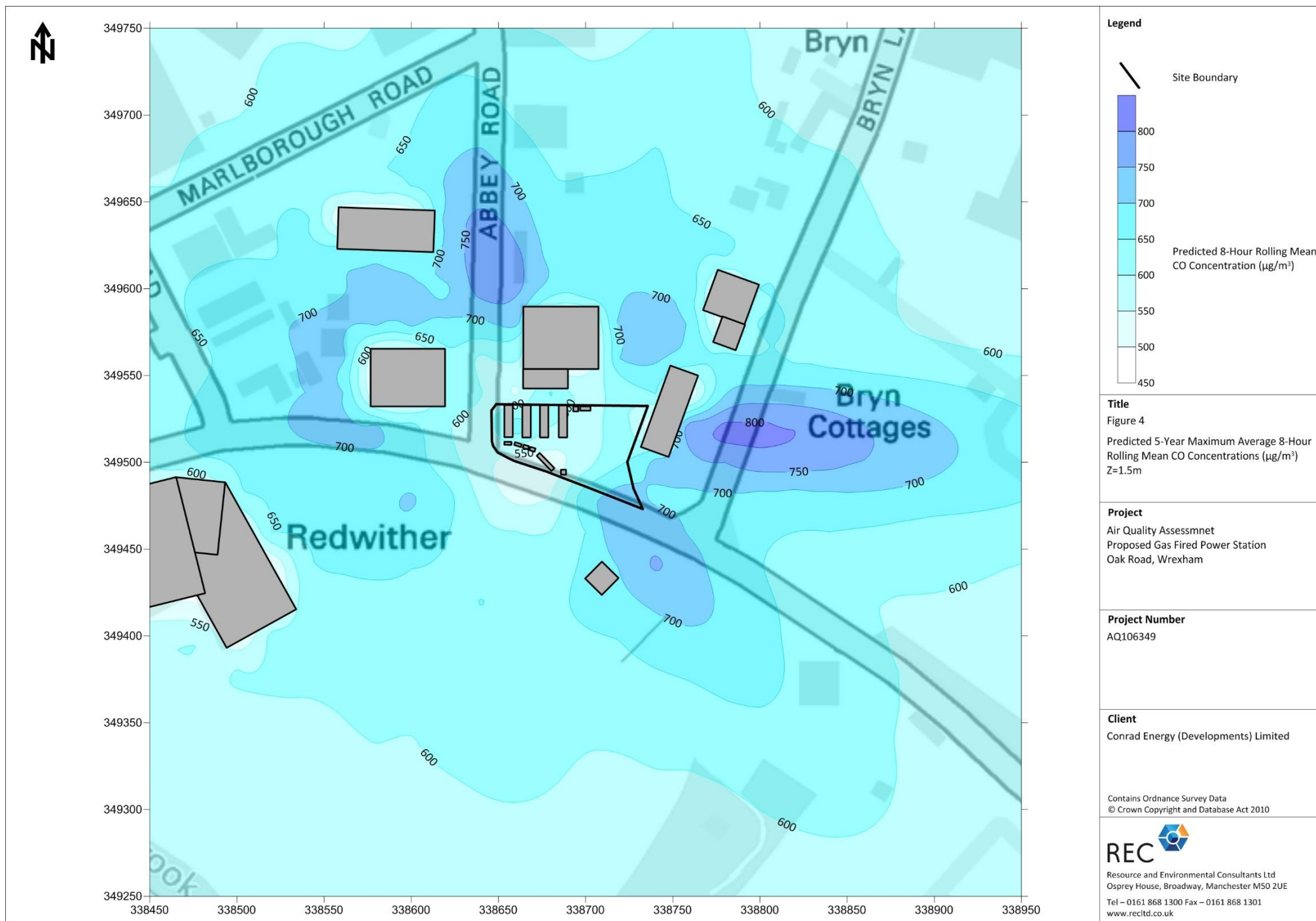
Title
Figure 2
Wind Rose
Hawarden Meteorological Station
2013 to 2017

Project
Air Quality Assessment
Proposed Gas Fired Power Station
Oak Road, Wrexham

Project Number
AQ106349

Client
Conrad Energy (Developments) Limited







Dispersion Modelling Assessment
Oak Road, Wrexham Industrial Estate, Wrexham
October 2018
AQ106349r5

APPENDIX II ASSESSOR'S CURRICULUM VITAE





CONAL KEARNEY

Associate Director

BEng(Hons), MSc, MIAQM, MIEEnvSc

KEY EXPERIENCE:

Conal is an Associate Director with specialist experience in the air quality and odour sector. His key capabilities include:

- ▶ Advanced atmospheric air dispersion modelling of road vehicle and industrial emissions using ADMS-ROADS and AIRVIO.
- ▶ Preparation of factual and interpretative Air Quality Assessment reports and Air Quality Environmental Statement chapters in the vicinity of proposed schemes and developments in accordance with DEFRA, Environment Agency and Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) methodologies.
- ▶ Management and delivery of project work on key, land development and urban regeneration projects.
- ▶ Assessment of road vehicle exhaust emissions using the Design Manual for Roads and Bridges (DMRB) calculation spreadsheet.
- ▶ Assessment of dust impacts from construction sites to the Institute of Air Quality Management (IAQM) methodology.
- ▶ Dust and Odour impact assessments from minerals and waste sites
- ▶ Representing clients at public inquiries and planning hearings as an expert witness.

QUALIFICATIONS:

- ▶ Bachelor of Engineering
- ▶ Master of Science
- ▶ Member of Institute of Air Quality Management
- ▶ Member of the Institute of
- ▶

SELECT PROJECTS SUMMARY:

Industrial Developments

Land at Mossdown Road, Oldham – energy from waste incinerator. Industrial and road impacts on air quality dust and odour.

Buck Park, Denholme - AQA and dust assessment for proposed mineral extraction and site restoration project.

Messingham Quarry, North Lincolnshire - AQA and dust impacts for proposed new sand extraction site.

Arden Quarry, Derbyshire - AQA for proposed mineral extraction and site restoration

Granta Park, Oxfordshire. Assessment of VOC fume emissions.

University of Birmingham. Permit application for CHP scheme.

Arbroath Road, Carnoustie. Odour and AQA for biogas CHP scheme.

Brenda Road, Hartlepool – Dispersion modelling to inform stack design for biogas AD facility environmental permit.

Highways Developments

Alderley Edge Bypass, Cheshire - AQA for major new road scheme.

South Heywood – EIA for new link road and mixed use joint development

Residential and Mixed-Use Developments

Orchard Close, Knaresborough. AQA and public inquiry evidence.

Friars School, Southwark, London. School development for mixed use education and residential building in AQMA.

Fairoaks Garden Village – ES chapter and input for major mixed use development

Westcraig, Edinburgh - EIA chapter and input for major residential development

Queensway, Lytham St Annes. Dust and odour assessment for development.

Public Inquiry expert witness

Manor Place, London. Road and energy generation dispersion emissions

Craven Park, London. Mitigation statement and planning hearing expert opinion

Public Sector

Technical advisor on Manchester Airport Consultative Committee - advise members on environmental technical matters in relation to the airport's operations.

Cheshire County Council - compile AQ chapters for Local Transport Plan

Cheshire East Council - specialist AQ advice on highways, minerals and waste projects

Local Air Quality Management

Broughton Gyratory, Chester - dispersion model for City Centre detailed assessment report

Congleton town centre - dispersion modelling assessment for detailed and further assessment reports.

Disley - dispersion modelling assessment for detailed and further assessments

Holmes Chapel - dispersion modelling assessment for detailed and further assessment reports for road and rail sources.

Crewe - town centre dispersion modelling for detailed and further assessment reports.

Commercial Developments

Granta Park Daycare Centre, Oxfordshire. AQA for new build daycare centre adjacent to major road.

Curzon Cinema, Colchester. Air quality assessment for town centre new build cinema.

Newfoundland Circus, Bristol - AQA for hotel development in city centre

Salesians School, Chertsey - AQA for school extension near M25.

Cathedral Street and Thistle Street, Glasgow. University energy generation emission assessments.





LEWIS ELLISON

Air Quality Consultant

MOcean.Geo (Hons)

KEY EXPERIENCE:

Lewis is an Environmental Consultant with specialist experience in the air quality sector. His key capabilities include:

- ▶ Production of Air Quality Assessments to the Department for Environment, Food and Rural Affairs (DEFRA), Environment Agency and Environmental Protection UK (EPUK) methodologies for clients from the residential, retail and commercial sectors.
- ▶ Detailed dispersion modelling of road vehicle emissions using ADMS-Roads. Studies have included impact assessment of pollutant concentrations at various floor levels and assessment of suitability of development sites for proposed end-use.
- ▶ Assessment of road vehicle exhaust emissions using the Design Manual for Roads and Bridges (DMRB) calculation spreadsheet.
- ▶ Assessment of dust impacts from construction sites to the Institute of Air Quality Management (IAQM) methodology.
- ▶ Production of air quality mitigation strategies for developments throughout the UK.
- ▶ Defining baseline air quality conditions and identification of sensitive areas.

QUALIFICATIONS:

- ▶ Master of Science

SELECT PROJECTS SUMMARY:

Residential Development:

AGFA Works, Seagate – Air Quality Assessment using ADMS-Roads in support of an 83 residential unit development with the potential to cause air quality impacts at sensitive locations.

Andrew Avenue, Breahead – Air Quality Assessment using ADMS-Roads in support of a 77 residential unit development in close proximity to the M8.

Clothorn Road, Didsbury – Air Quality assessment for a residential development consisting of 12 units in close proximity to an AQMA declared by Manchester city council.

Downend Road, Portchester – Air Quality Assessment in support of a 350 residential unit development in close proximity to the M27.

Great Leighs, Chelmsford- Baseline scoping report in support of several proposed large scale residential developments totalling 1300 residential units, with the potential to impact on nearby sensitive locations.

Parkview, Lofthouse Gate – Air Quality Assessment in support of a proposed 160 residential unit development in close proximity to two AQMA declared by Wakefield Metropolitan District Council.

Shields Road, Walkergate - Air Quality Assessment using ADMS-Roads in support of a 40 residential unit development in close proximity to the Shields Road.

Environmental impact assessment:

Bower Farm, Bridgewater – Production of an Air Quality Assessment with relevant mitigation measures for inclusion in an EIA report for part of the east Sedgemoor development.

Commercial Development:

ALDI, Hertford – Air Quality Assessment for the Proposed Aldi Superstore at Hertfordshire using ADMS-Roads.

Hortonwood West, Telford – Construction Environmental Management Plan (CEMP) for the expansion of the current factory on site.

Inverness Airport Business Park – Air Quality Scoping Report for a proposed hotel and commercial office space.

Odour assessment:

Wren Park Care Home, Shefford – Qualitative Odour Assessment of industrial units in the vicinity of a proposed extension to the current care home.

Marsh Farm, Basildon – Qualitative Odour Assessment of an anaerobic digesting unit in support of a follow up assessment for the unit.

Mixed-Use Development:

Coldharbour Land, Lambeth – Air Quality Assessment for a proposed mixed use development with the implementation of mitigation measures.

Old Fire Station, Newham, London- Air Quality Assessment using ADMS-Roads for a proposed mixed use development with the implementation of mitigation measures, in support of a redevelopment of the previous fire station.

Ordsall Lane, Salford – Air Quality Assessment in support of a mixed use development using ADMS-Roads.





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