



Air Quality Assessment: International Business Park, Reading

March 2022



Experts in air quality
management & assessment

Document Control

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1 Introduction

- 1.1 This report assesses the potential air quality impacts associated with the proposed emergency back-up diesel generator within Reading International Business Park.
- 1.2 The proposals are for the installation of a single 550 kVA / 440 kW_e diesel generator, located in the southwest corner of the business park. The diesel generator will be tested monthly, for a maximum period of one hour. Outside of the routine testing and maintenance regime, the operation of the generator would be limited to emergency situations, such as power failure; the frequency and duration of any such event cannot be predicted with any degree of certainty.
- 1.3 The main air pollutants of concern from the combustion of diesel oil with respect to human health are nitrogen dioxide and particulate matter (PM₁₀). The business park is located within an Air Quality Management Area (AQMA), declared by Reading Borough Council (RBC) for exceedances of the annual mean nitrogen dioxide objective, thus emissions from the generator could impact on local air quality.
- 1.4 Whilst the combustion of diesel oil can also generate emissions of sulphur dioxide, the fuel used in the generator will have a low sulphur content, typically <0.1% by mass, such that emissions of sulphur dioxide are unlikely to have a significant effect and are thus scoped out of the assessment.
- 1.5 Owing to the limited operation of the generator, it is considered highly unlikely that there would be any significant effects on any nature conservation site. On this basis, the impact of the generator emissions on designated habitats is not discussed further within this report.
- 1.6 This report has been prepared taking into account all relevant national and local guidance and regulations; consideration has been given to the Medium Combustion Plant Directive (The European Parliament and the Council of the European Union, 2015) and the Environmental Permitting (England and Wales) (Amendment) Regulations (2018). Where appropriate, the assessment has followed a worst-case approach, so as not to underestimate the impacts of the proposed generator.

2 Policy Context

- 2.1 All European legislation referred to in this report is written into UK law and remains in place.

Air Quality Strategy

- 2.2 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an AQMA and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018

- 2.3 The Medium Combustion Plant Directive (MCPD) (The European Parliament and the Council of the European Union, 2015) regulates pollutant emissions from combustion plant with a rated input between 1 and 50 megawatts (MW_{th}) and was transposed into UK law in January 2018 through an amendment to the Environmental Permitting Regulations (EPR) (2018). The legislation sets emission limits to be applied from December 2018 for new plant and from 2025 or 2030 for existing plant (depending on the rated input).
- 2.4 Since the generator will operate for fewer than 50 hours and will not provide any balancing service or participate in any demand-side response, the generator is excluded under Schedule 25B of the EPR. The generator is, however, still considered to be MCP under Schedule 25A, as its thermal input exceeds 1 MW_{th} . However, as the generator will operate for less than 500 hours, there is no requirement to meet the emission limits in the MCPD.

Clean Air Act 1993 & Environmental Protection Act

- 2.5 Small combustion plant of less than 20 MW net rated thermal input are currently controlled under the Clean Air Act 1993 (HMSO, 1993a). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement.
- 2.6 Measures to ensure adequate dispersion of emissions from discharging stacks and vents are included in Technical Guidance Note D1 (Dispersion) (HMSO, 1993b), issued in support of the Environmental Protection Act (HMSO, 1990).

Clean Air Strategy 2019

- 2.7 The Clean Air Strategy (Defra, 2019) sets out a wide range of actions by which the UK Government will seek to reduce pollutant emissions and improve air quality. Actions are targeted at four main sources of emissions: Transport, Domestic, Farming and Industry. At this stage, there is no straightforward way to take account of the expected future benefits to air quality within this assessment.

Environment Act 2021

- 2.8 The UK's new legal framework for protection of the natural environment, the Environment Act 2021 passed into UK law on 9th November 2021. The Act gives the Government the power to set long-term, legally binding environmental targets. It also establishes an Office for Environmental Protection (OEP), responsible for holding the Government to account and ensuring compliance with these targets.
- 2.9 The Act requires the Government to set at least one long-term target (spanning a minimum of 15 years), supported by interim targets set in a five-year cycle, in each of four identified areas: Air Quality, Biodiversity, Water and Resource Efficiency and Waste Reduction. An additional target for mean levels of PM_{2.5} is also required. These targets must be set before November 2022; an initial scope for what these targets will involve has been outlined but they are not yet precisely defined. As the targets have not yet been either finalised or adopted by the Government, they cannot impact on current planning policy.

Planning Policy

National Policies

- 2.10 The National Planning Policy Framework (NPPF) (2021) sets out planning policy for England. It states that the purpose of the planning system is to contribute to the achievement of sustainable development, and that the planning system has three overarching objectives, one of which (Paragraph 8c) is an environmental objective:

“to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy”.

- 2.11 To prevent unacceptable risks from air pollution, Paragraph 174 of the NPPF states that:

“Planning policies and decisions should contribute to and enhance the natural and local environment by...preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land

instability. Development should, wherever possible, help to improve local environmental conditions such as air quality”.

2.12 Paragraph 185 states:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development”.

2.13 More specifically, on air quality, Paragraph 186 makes clear that:

“Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan”.

2.14 The NPPF is supported by Planning Practice Guidance (PPG) (Ministry of Housing, Communities & Local Government, 2019), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that:

“Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with Limit Values. It is important that the potential impact of new development on air quality is taken into account where the national assessment indicates that relevant limits have been exceeded or are near the limit, or where the need for emissions reductions has been identified”.

2.15 Regarding plan-making, the PPG states:

“It is important to take into account air quality management areas, Clean Air Zones and other areas including sensitive habitats or designated sites of importance for biodiversity where there could be specific requirements or limitations on new development because of air quality”.

2.16 The role of the local authorities through the LAQM regime is covered, with the PPG stating that a local authority Air Quality Action Plan *“identifies measures that will be introduced in pursuit of the objectives and can have implications for planning”.*

2.17 Regarding the need for an air quality assessment, the PPG states that:

“Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity”.

- 2.18 The PPG sets out the information that may be required in an air quality assessment, making clear that:

“Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific”.

- 2.19 The PPG also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that:

“Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented”.

Local Policies

- 2.20 The Reading Borough Local Plan (Reading Borough Council, 2019) sets out how Reading will develop up to 2036. It includes policy EN15 on air quality, the relevant part of which states:

“Development should have regard to the need to improve air quality and reduce the effects of poor air quality.

- i. Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account:*
 - *Whether the proposal, including when combined with the cumulative effect of other developments already permitted, would worsen air quality;*
 - *Whether the development is within, or accessed via, an Air Quality Management Area; and*
 - *Whether it can be demonstrated that a local worsening in air quality that would not detrimentally affect human health or the environment would be offset by an overall improvement in air quality, for instance through reduction in the need to travel”.*

Air Quality Action Plans

National Air Quality Plan

- 2.21 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017); a supplement to the 2017 Plan (Defra, 2018) was published in October 2018 and sets out the steps Government is taking in relation to a further 33 local authorities where shorter-term exceedances of the limit value were identified. Alongside a package of national measures, the 2017 Plan and the 2018 Supplement require those identified English Local Authorities to produce local action plans and/or feasibility studies. These plans and feasibility studies must have regard to measures to achieve the statutory limit values within the shortest possible time, which may include the implementation of a Clean Air Zone (CAZ). There is currently no straightforward way to take account of the effects of the 2017 Plan or 2018 Supplement in the modelling undertaken for this assessment; however, consideration has been given to whether there is currently, or is likely to be in the future, a limit value exceedance in the vicinity of the proposed development. This assessment has principally been carried out in relation to the air quality objectives, rather than the EU limit values that are the focus of the Air Quality Plan.

Local Air Quality Action Plan

- 2.22 Reading Borough Council has declared a single AQMA for exceedances of the annual mean nitrogen dioxide objective. The AQMA covers Reading Town Centre, areas along the major radial road routes into Reading (including J11 of the M4 motorway) and along the railway lines where they pass through built-up areas.
- 2.23 The Council since developed an Air Quality Action Plan (Reading Borough Council, 2016) which sets out what actions the Council intends to take to address air quality issues in the AQMA and across the borough generally, and to work towards meeting the nitrogen dioxide air quality objectives.

3 Assessment Criteria and Assessment of Significance

Assessment Criteria

- 3.1 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).
- 3.2 The UK-wide objectives for nitrogen dioxide and PM₁₀ were to have been achieved by 2005 and 2004, respectively, and continue to apply in all future years thereafter.
- 3.3 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2021). The annual mean objectives for nitrogen dioxide and PM₁₀ are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour mean objective for PM₁₀ is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.
- 3.4 The European Union has also set limit values for nitrogen dioxide and PM₁₀. The limit values for nitrogen dioxide and PM₁₀ are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.
- 3.5 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Relevant Air Quality Criteria

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m ³ not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m ³
PM ₁₀	24-hour Mean	50 µg/m ³ not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m ³ ^a

Descriptors for Air Quality Impacts and Assessment of Significance

Annual Mean Concentrations

- 3.6 The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)¹ (Moorcroft and Barrowcliffe et al, 2017) provides a method for describing the impacts on local air quality arising from development. Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration. Table 2 sets out the matrix for determining the impact descriptor for annual mean concentrations at individual receptors.

Table 2: Air Quality Impact Descriptors for Individual Receptors for All Pollutants ^a

Long-Term Average Concentration At Receptor In Assessment Year ^b	Change in concentration relative to AQAL ^c				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

^a Values are rounded to the nearest whole number.

^b This is the “Without Scheme” concentration where there is a decrease in pollutant concentration and the “With Scheme” concentration where there is an increase.

^c AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency ‘Environmental Assessment Level (EAL)’.

- 3.7 Where all impacts are negligible the overall effect will be ‘not significant’.

¹ The IAQM is the professional body for air quality practitioners in the UK.

Short-term Concentrations

- 3.8 For the purpose of this assessment, and in line with guidance from the Environment Agency (EA, 2022), the 1-hour objective for nitrogen dioxide, and the 24-hour objective for PM₁₀ are considered to be short-term objectives. Owing to the limited testing regime, it is not feasible for the generator to cause an exceedance of these objectives on its own since it will not operate on more than 12 occasions, while the objectives allow 18 and 35 short-term exceedances for nitrogen dioxide and PM₁₀ respectively (Table 1). It is possible that, if a short-term objective is close to being exceeded already, then any new emission might give rise to a new exceedance, but the generally low measured annual mean concentrations in the study area suggest that this is not the case (Defra, 2021).
- 3.9 For the purpose of this assessment, where the 100th percentile (i.e. maximum) 1-hour mean nitrogen dioxide process contribution or 24-hour mean PM₁₀ process contribution is less than 10% of the objective, the contribution is considered insignificant without the need to consider total concentrations. This is in line with the approach used by the Environment Agency for environmental permitting.
- 3.10 Where the process contribution cannot immediately be screened out, the process contribution is added to the short-term baseline concentration² to determine the total concentrations. Where this total concentration is below the short-term objective level, it can be assumed that the short-term objective will not be exceeded, and the effects are considered to be 'not significant'.

² The short-term baseline concentration is assumed to be twice the annual mean baseline concentration, in accordance with EA guidance (EA, 2022).

4 Baseline Conditions

Nitrogen Dioxide

- 4.1 Figure 1 sets out the annual mean NO₂ concentrations within 3 km of the proposed generator, as measured by RBC and Wokingham Borough Council (WBC) in 2019³; these are also tabulated in Table 3.

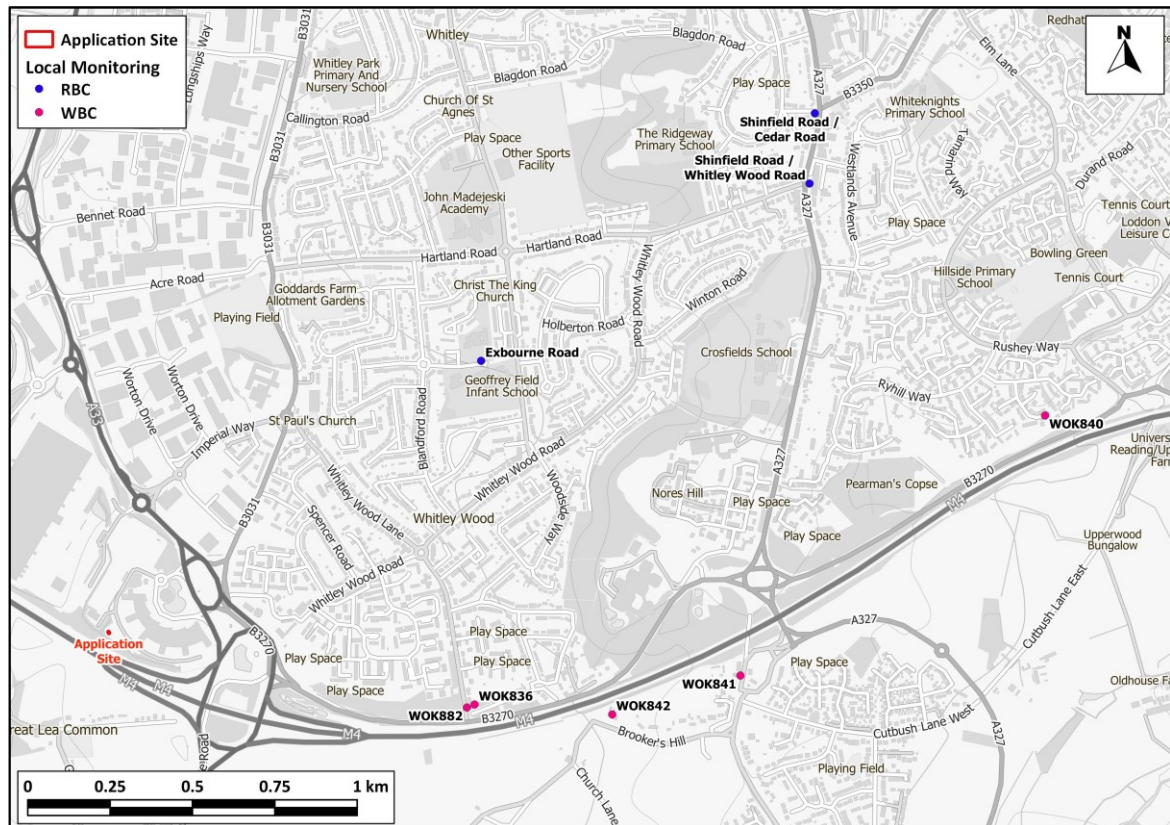


Figure 1: NO₂ Monitoring Locations within 3 km of Reading International Business Park

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³ 2020 and 2021 data have not been used owing to the effect of the Covid-19 pandemic on local air quality.

Table 3: Summary of NO₂ Monitoring ^a

Site ID	Site Type	Location	2015	2016	2017	2018	2019
RBC ^b							
-	Roadside	Exbourne Road	-	-	-	-	15
-	Kerbside	Shinfield Road / Cedar Road	30	34	31	31	26
-	Roadside	Shinfield Road / Whitley Wood Road	39	42	38	34	34
WBC ^c							
WOK836	Roadside	349 Old Whitley Wood Lane, Shinfield	38	30	34	26	27
WOK840	Suburban	30 Finbeck Way, Lower Earley	24	24	25	22	25
WOK841	Roadside	2 Lane End Villas, Shinfield	39	37	39	30	33
WOK842	Other	Foxglade, Brookers Hill, Shinfield	26	29	25	25	20
WOK882	Roadside	341 Whitley Wood Lane, Shinfield	-	31	40	33	33
Objective			40				

^a Diffusion tubes prepared and analysed by Gradko International Ltd.

^b Data taken from RBC's Air Quality Annual Status Report (ASR) (Reading Borough Council, 2022).

^c Data taken from WBC's Air Quality ASR (Wokingham Borough Council, 2020).

- 4.2 The nearest sensitive receptors to the proposed generator, such as Busy Bees at Reading International, are located adjacent to the M4. As such, the most representative monitoring sites are those operated by WBC close to the M4 (which are a similar distance from the M4 as the sensitive receptors). Measured concentrations at all five monitoring sites have been below the annual mean objective, with concentrations at WOK882 and WOK841 measuring the highest (33 µg/m³) concentrations in 2019. In addition to being close to the M4, these sites are adjacent to other busy roads which will also contribute to measured concentrations. The remaining three WBC sites (WOK836, WOK840 and WOK842) are adjacent to residential streets or set back further from the road edge. As such, it is likely that baseline concentrations at Busy Bees and residential properties are between 20 µg/m³ (measured at WOK842) and 27 µg/m³ (measured at WOK836) since the nearest major road is the M4. Nonetheless, to ensure a conservative assessment of total concentrations, a baseline value of 33 µg/m³ has been assumed across the study area.

PM₁₀

- 4.3 RBC measures concentrations of PM₁₀ at one location within the study area, at an automatic monitor located on London Road (RD4). Measured concentrations have ranged between 17 and 19 µg/m³ across the period 2016 – 2019 (Reading Borough Council, 2022).

Summary of Baseline Concentrations

- 4.4 Table 4 sets out the baseline NO₂ and PM₁₀ concentrations used in this assessment.

Table 4: Baseline Concentrations Used in Assessment

Averaging Period	Value ($\mu\text{g}/\text{m}^3$)	Derivation
NO₂		
Annual Mean	33.0	Highest concentration in 2019 across the monitoring sites operated by WBC adjacent to the M4
1-hour Mean	66.0	2 x the annual mean
PM₁₀		
Annual Mean	19.0	Highest concentration measured at the RBC automatic monitor between 2016 and 2019
24-hour Mean	38.0	2 x the annual mean

5 Modelling Methodology

Dispersion Model

- 5.1 Impacts have been predicted using the ADMS-5.2 dispersion model developed by Cambridge Environmental Research Consultants (CERC). ADMS-5.2 is a next generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. ADMS is widely used for assessments of this type and has been extensively validated (CERC, 2022). It is considered suitable for the current assessment.

Emission Parameters

- 5.2 Operational parameters for exhaust temperature, net fuel consumption, exhaust mass flow rate and emission rates have been determined from the generator product specification datasheet (see Appendix A1). This has been used as the basis for the combustion, exhaust and pollutant emission calculations. The stack height has been derived from drawings provided by Hutchison Kivotos Architects, whilst the stack diameter has been calculated to result in a conservative exhaust velocity.

Table 5: Plant Specifications, Emissions and Release Conditions

Parameter	Value
Electrical Power Output (kW _{out})	440
Net Input Fuel Rate (kW _{in})	1,013.0
Gross Input Fuel Rate (kW _{in})	1,081.1
Gross Fuel Consumption (kg/hr)	85.2
Combustion Air _{in} (kg/h wet)	2,585.2
Excess Air (%)	108.5
Exhaust Mass Flow (kg/h) for Actual Flow ^a	2,670.3
Molar Flow Rate (mol/s) for Actual Flow ^a	25.7
Molecular Mass (g/mol) for Actual Flow ^a	28.9
Exhaust Flow (Am ³ /s) ^b for Actual Flow ^a	1.5
Flue Internal Diameter (m) ^c	0.3
Exhaust Velocity (Am/s) for Actual Flow	25.0
Exhaust Temperature (°C)	455
Actual Exhaust O ₂ Content (%)	10.5
Actual Exhaust H ₂ O Content (%)	6.9
NO _x Emission Concentration (mg/kWh)	5,460

Parameter	Value
NO_x Emission Rate (g/s)	0.667
PM₁₀ Emission Concentration (mg/kWh)	90
PM₁₀ Emission Rate (g/s)	0.011

- ^a Actual flow conditions in the exhaust at the stated exhaust O₂ and H₂O contents.
- ^b Calculated from molar flow rate $\times 8.3145 \times (T+273.13) / 101,325$, where T is the temperature in °C.
- ^c Set to achieve an exhaust velocity of 25 m/s.

5.3 The physical parameters included in the modelling are outlined in Table 6. The stack has been modelled as a single vertical point source.

Table 6: Modelled Physical Release Emission Parameters for the Facility

Parameter	Modelled Release Emission Parameters
Source Type	Point
X-Coordinate	471210.6
Y-Coordinate	168906.8
Height above Ground (m)	2.3

Study Area

5.4 The study area covers a 10 km x 10 km model domain centred on the generator flue and described further in Paragraph 5.5.

Receptors

5.5 Concentrations have been predicted across the study area using nested Cartesian grids (see Figure 2). These grids have a spacing of:

- 5 m x 5 m within 200 m of the generator;
- 25 m x 25 m within 400 m;
- 50 m x 50 m within 1,000 m;
- 250 m x 250 m within 2,000 m; and
- 500 m x 500 m within 5,000 m.

5.6 The receptor grid has been modelled at a height of 1.5 m above ground level.

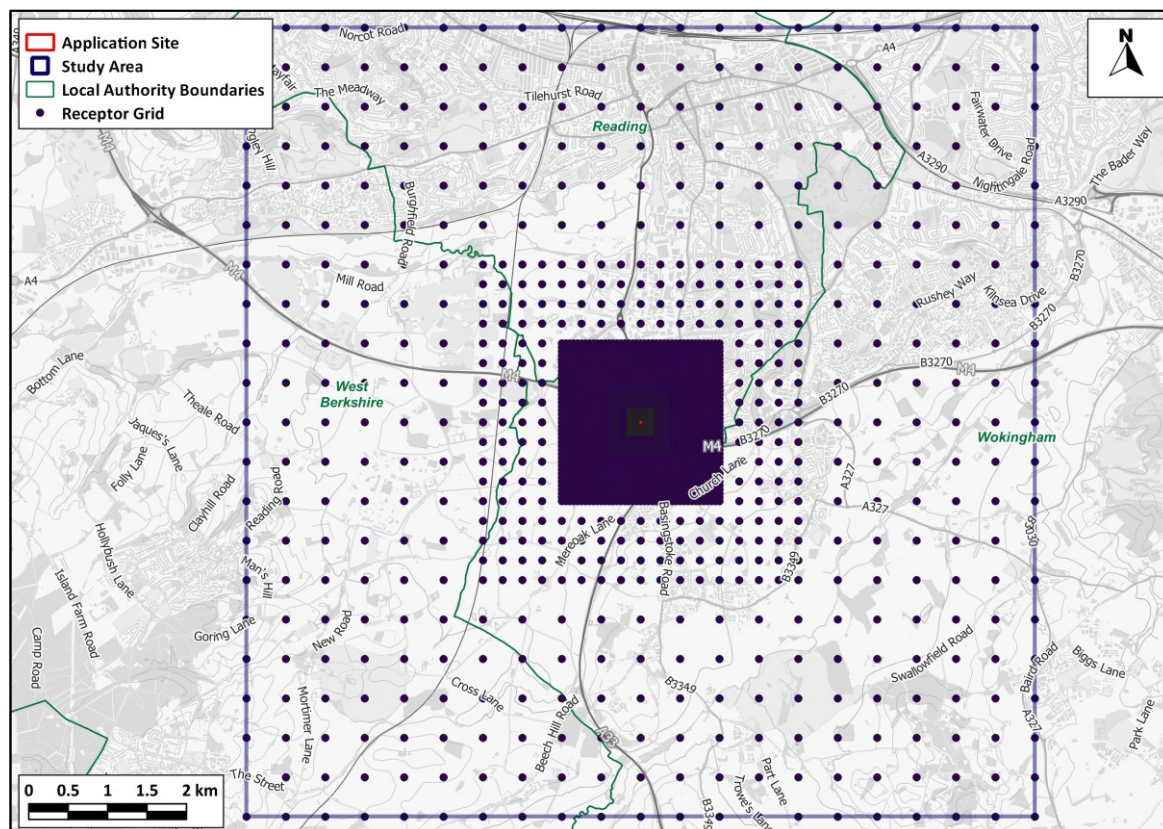


Figure 2: Nested Cartesian Grids of Receptors

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- 5.7 Specific receptors have also been selected to determine impacts at locations where the objectives apply. The specific receptors identified are detailed in Table 7 and shown in Figure 3.

Table 7: Specific Human Health Receptor Coordinates

Receptor ID	Description	X Coordinate	Y Coordinate	Modelled Height (m)
1	Busy Bees Childcare	471176.6	168942.3	0.5, 1.5
2 ^a	Reading International Business Park	471266.6	168936.6	1.5
3	Residential Property on Kingsley Close	471584.2	169048.4	1.5
4	Residential Property on Harness Close	471882.3	168766.4	1.5
5	Residential Property on Hartley Court Road	471375.8	168657.2	1.5
6	Residential Property on Hartley Court Road	471086.7	168654.5	1.5

^a Receptor only relevant exposure to the 1-hour mean objective.

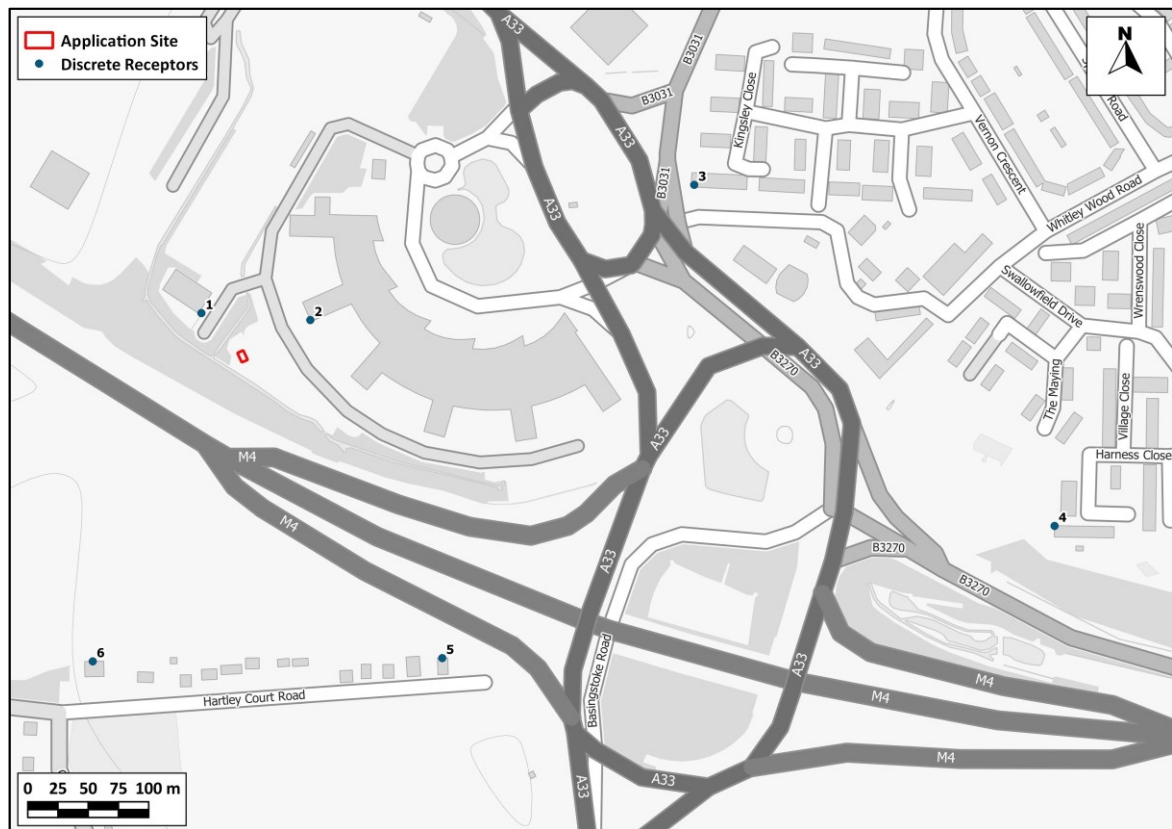


Figure 3: Modelled Discrete Receptors

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Meteorological Data

- 5.8 In order to allow for uncertainties in local and future-year conditions, the dispersion model has been run three times, with each run using a different full year of hour-by-hour meteorological data from the nearest appropriate meteorological site.
- 5.9 Hourly sequential meteorological data from Farnborough have been used for the years 2018-2020 inclusive. The Farnborough meteorological monitoring station is located approximately 21 km to the southeast of the site. The topography of the model domain is similar to that around the meteorological monitoring station and measurements from this site are considered to provide the most robust basis to predict meteorology within the model domain. The Farnborough meteorological station is operated by the UK Meteorological Office. Raw data were provided by the Met Office, and processed by AQC for use in ADMS.
- 5.10 The meteorological parameters entered into the model are shown in Table 8. Wind roses for each year are presented in Appendix A2.

Table 8: Meteorological Parameters Entered into the ADMS Model

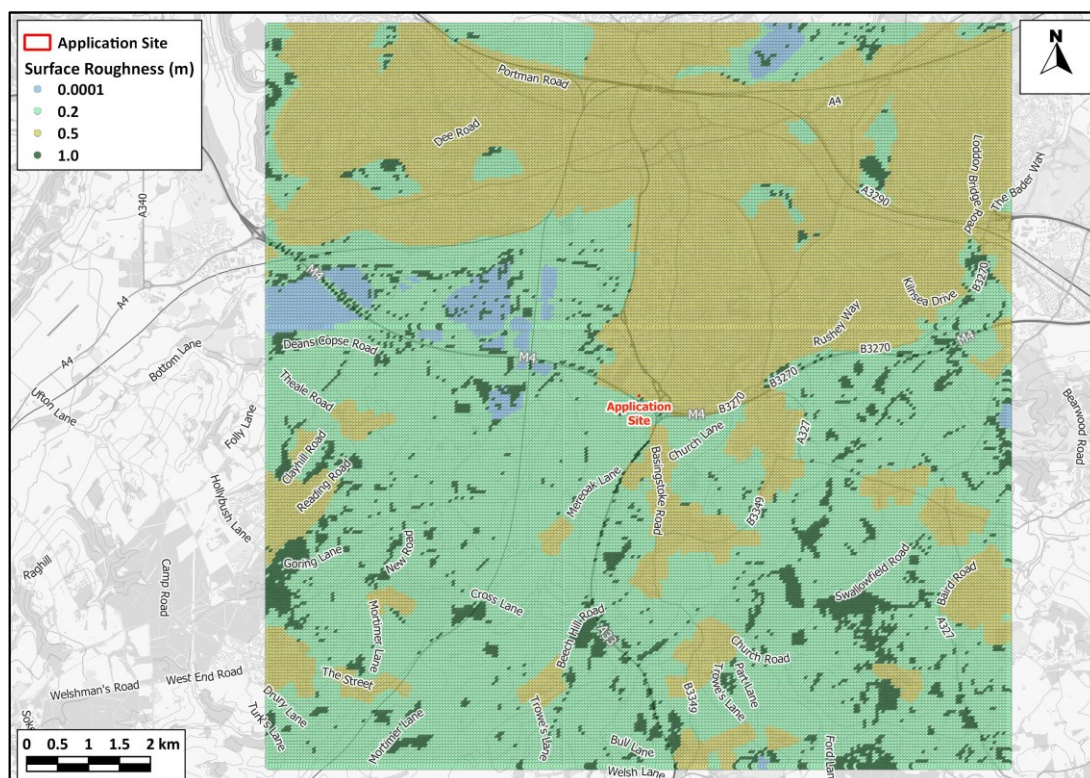
Parameter	Modelled Receptors	Meteorological Site
Surface Roughness	Variable Surface Roughness File	0.1 m
Minimum MO length	30 m	10 m
Surface Albedo	0.23 ^a	0.23 ^a
Priestly-Taylor Parameter	1 ^a	1 ^a

^a Model default value, which is considered suitable for the current study.

Variable Surface Roughness File

5.11 The study area encompasses a range of land types. A variable surface roughness file has been used to represent the spatial variation of the surface roughness over each land type as shown in Figure 4. The following parameters have been used regarding surface roughness and land type:

- forest – 1 m;
- built-up area – 0.5 m;
- grassland – 0.2 m; and
- water – 0.0001 m.

**Figure 4: Surface Roughness across Modelled Area**

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Buildings

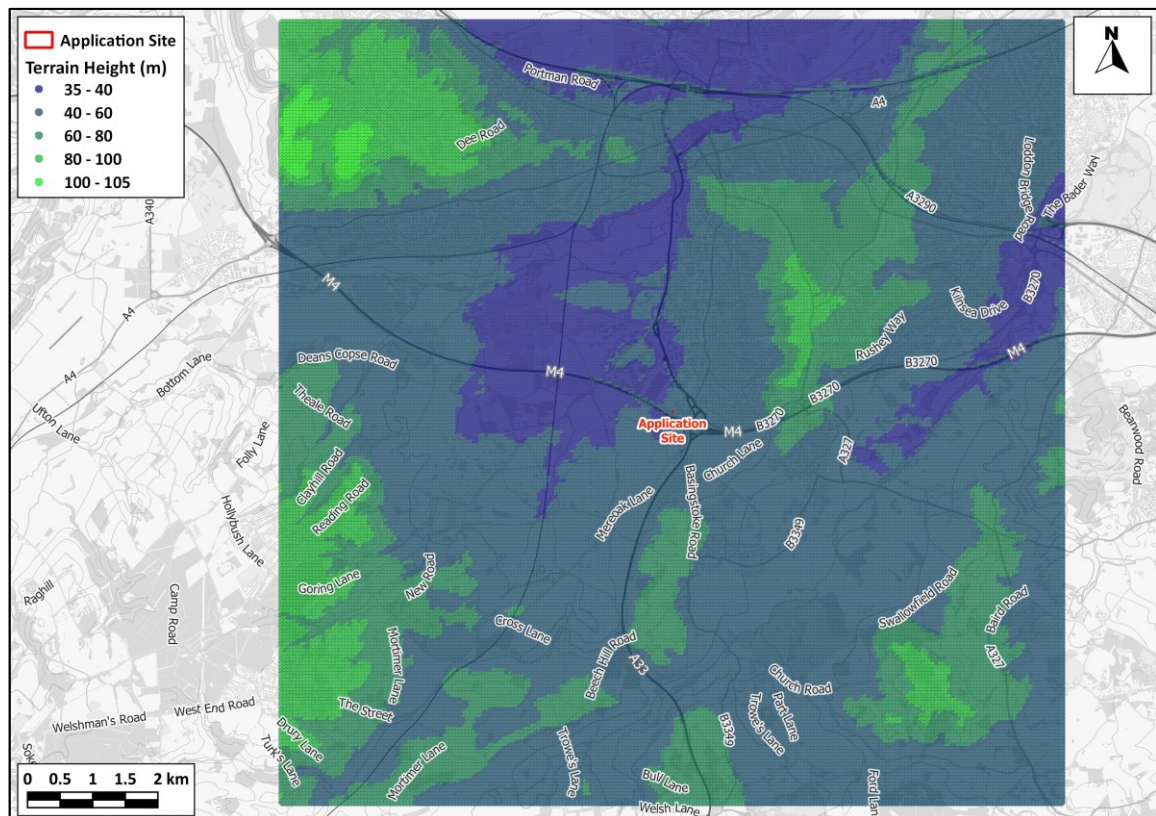
- 5.12 Where buildings are a significant height relative to the stack height, building downwash effects may occur. The downwash effects should be accounted for within modelling where the stack is less than 2.5 times the height of the buildings within a distance which is five times the minimum of the stack height and the maximum projected width of the building.
- 5.13 For each of the three meteorological years, the model has been run for the following scenarios:
- with no buildings included;
 - the generator housing included as a building; and
 - with the generator housing and the surrounding sound attenuating enclosure as buildings.
- 5.14 Modelled buildings are shown in Figure 5, and the dimensions of all buildings are given in Table 9.



Figure 5: Buildings and Modelled Flue Included in the Model. Inset Shows 3D Image.

Contains imagery provided by Hutchison Kivotos Architects, drawing number 401.PL.05, Revision P1.

Building	Height (m)	Length (m)	Width (m)	Rotation (°)
Generator Housing	2.2	1.6	4.9	68
Sound Attenuating Enclosure	2.4	1.0	9.3	65
Sound Attenuating Enclosure	2.4	1.0	8.0	337
Sound Attenuating Enclosure	2.4	1.0	9.3	246
Sound Attenuating Enclosure	2.4	8.0	1.0	65



- 5.16 A sensitivity test has been carried out to assess the effect of terrain on the predicted concentrations. For each meteorological year and building scenario the model has been run once with terrain, and once without terrain.

NO_x to NO₂ conversion

- 5.17 NO_x emissions will be in the form of nitric oxide (NO) and primary NO₂. Over time, the NO emissions will react with available ozone (O₃) to form NO₂. In close proximity to the source, the ratio will be similar to the primary NO₂ proportion; with increasing distance from the source the ratio will increase, depending on the availability of O₃.
- 5.18 The EA (2022) recommends that, as a conservative approach:
- 70% of the NO_x emitted from the generators converts to NO₂ for the annual mean average concentrations; and
 - 35% of the 1-hour mean NO_x emitted from the generators converts to NO₂ for the 1-hour mean average concentrations.
- 5.19 The EA Guidance on dispersion modelling for oxides of nitrogen assessment from specified generators Version 1 (EA, 2018) states: *“For primary NO₂ to NO_x ratios of 10% or less, worst case NO_x to NO₂ conversion ratios of 35% for short term assessment and 70% for long term assessment can be used as a conservative approach in the modelling study.”*
- 5.20 The primary NO₂ from the generator is likely to be in the region of 5-12% of the total NO_x; therefore, the 70% (long-term) and 35% (short-term) conversion ratios used represent a conservative approach.

Model Post-Processing

- 5.21 For each individual receptor, the maximum predicted concentration across any of the three meteorological datasets, three building scenarios and terrain sensitivity test has then been determined. These maxima are the results which are presented in this report, thus ensuring a worst-case assessment.

Annual Mean PCs

- 5.22 The model has been run assuming constant operation. Annual mean Process Contributions (PCs) have then been reduced to account for the fact that the generator will only operate for an hour each month as part of the testing and maintenance regime, equivalent to an annual operational profile of 12 hours. The annual mean PCs have thus been factored by multiplying the annual mean model outputs by 0.001 (i.e. 12 / 8,760).

Short-term PCs

- 5.23 The AQS for 1-hour mean NO₂ is based on the number of hours (18) that a threshold concentration (200 µg/m³) can be exceeded in a year. The testing of the generator cannot, therefore, cause an exceedance of the 1-hour mean objective on its own (i.e. as a PC). Similarly, the 24-hour mean PM₁₀ objective allows for 35 exceedances of 50 µg/m³; since the generator will operate on fewer than 35 days, the generator cannot, on its own, cause an exceedance of the objective.
- 5.24 In order to assess the magnitude of the PCs during each period of testing, the model has been run to output the 100th percentile, i.e. the maximum predicted hourly or daily concentration in any modelled hour or day of the year.

Uncertainty

- 5.25 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for the source, all of which are both variable and uncertain. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified, and it is not possible to verify the point-source model outputs. Where these parameters have been estimated the approach has been to use reasonable worst-case assumptions.
- 5.26 On balance, when taking into account the assumed number of operating hours; the approach taken to meteorological conditions and the sensitivity testing for building downwash and terrain, the assessment can be expected to over-predict the impacts of the generator. The approach has been designed to provide a robust and conservative assessment.

6 Impact Assessment

Annual Mean Concentrations

Nitrogen Dioxide

- 6.1 Figure 7 shows annual mean nitrogen dioxide concentration contours defining the areas within which the generator's emissions are predicted to add more than $0.2 \mu\text{g}/\text{m}^3$ (0.5% of the objective) and 1.5% $0.6 \mu\text{g}/\text{m}^3$ (1.5% of the objective) (aligning with the EPUK/IAQM impact descriptor matrix set out in Table 2), assuming 12 hours operation per year.

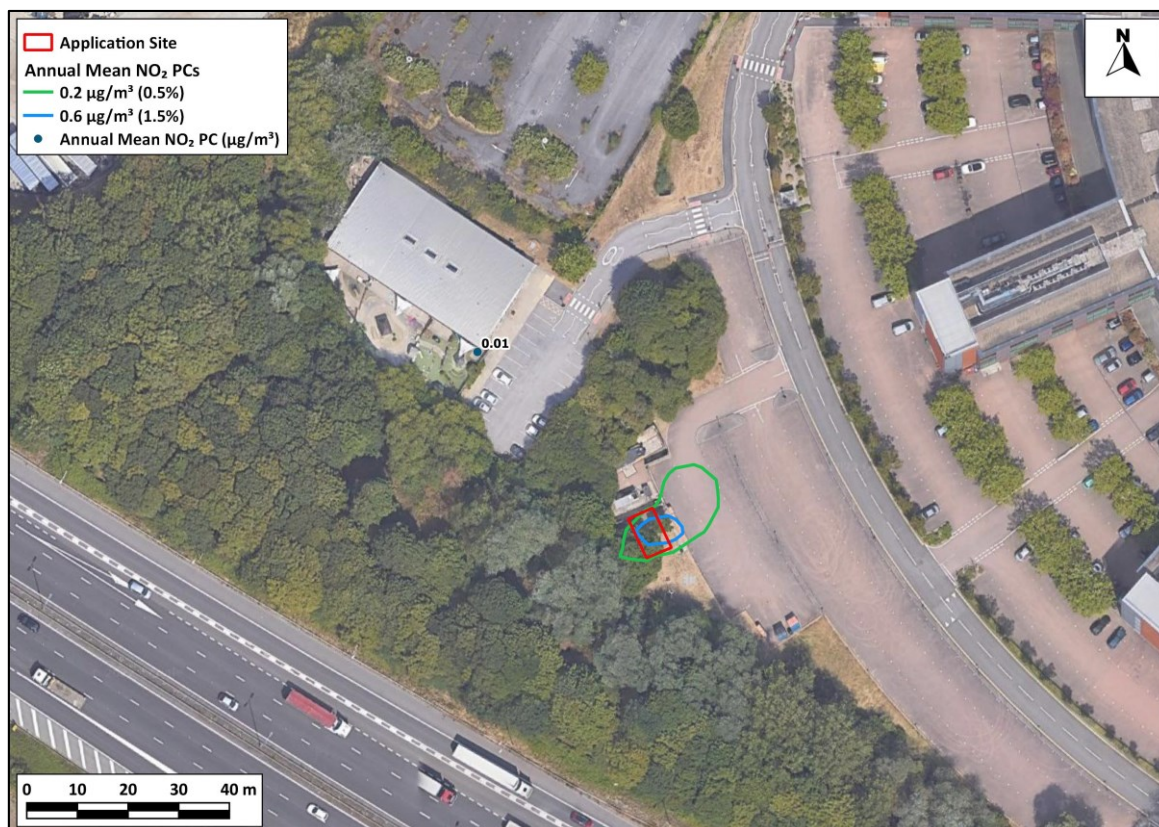


Figure 7: Annual Mean Nitrogen Dioxide Process Contribution Contours and PC at Busy Bees Nursery ($\mu\text{g}/\text{m}^3$)

Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group.

- 6.2 Table 10 sets out the nitrogen dioxide Process Contribution (PC), baseline concentration (from Table 4), Predicted Environmental Concentration (PEC) and impact descriptor at each specific receptor (described in Table 7 and Figure 3).

Table 10: Maximum Nitrogen Dioxide PCs and PECs at Specific Receptors

Receptor ^a	PC (µg/m ³)	PC (% of Objective) ^b	PEC (µg/m ³) ^c	PEC (% of Objective) ^b	Impact Descriptor ^d
1 (0.5 m)	0.01	0.04	33.0	82.5	Negligible
1 (1.5 m)	0.01	0.04	33.0	82.5	Negligible
2 (1.5 m)	- ^e	- ^e	- ^e	- ^e	- ^e
3 (1.5 m)	<0.01	0.01	33.0	82.5	Negligible
4 (1.5 m)	<0.01	<0.01	33.0	82.5	Negligible
5 (1.5 m)	<0.01	<0.01	33.0	82.5	Negligible
6 (1.5 m)	<0.01	0.01	33.0	82.5	Negligible

^a Modelled height included in parentheses.

^b Based on unrounded numbers.

^c After adding the baseline concentration from Table 4.

^d Derived from the impact descriptors in Table 2.

^e Offices are not relevant exposure with respect to the annual mean objective.

- 6.3 The contours in Figure 7 cover an area of scrubland and the car park for the Reading International Business Park; these are not considered to be locations of relevant exposure to the annual mean objective.
- 6.4 At the specific receptors, the annual mean nitrogen dioxide PCs are well below 0.5% of the annual mean objective, thus the impacts are described as *negligible* at all nearby sensitive receptors. Total concentrations will also remain below the objective.
- 6.5 Overall, it can be concluded that the effect of the operation of the generator for testing and maintenance will be 'not significant' with respect to annual mean nitrogen dioxide concentrations.

PM₁₀

- 6.6 Table 11 sets out the PM₁₀ PC, baseline concentration (from Table 4), PEC and impact descriptor at each specific receptor (described in Table 7 and Figure 3).

Table 11: Maximum PM₁₀ PCs and PECs at Specific Receptors

Receptor ^a	PC (µg/m ³)	PC (% of Objective) ^b	PEC (µg/m ³) ^c	PEC (% of Objective) ^b	Impact Descriptor ^d
1 (0.5 m)	<0.01	<0.01	19.0	47.5	Negligible
1 (1.5 m)	<0.01	<0.01	19.0	47.5	Negligible
2 (1.5 m)	- ^e	- ^e	- ^e	- ^e	- ^e
3 (1.5 m)	<0.01	<0.01	19.0	47.5	Negligible
4 (1.5 m)	<0.01	<0.01	19.0	47.5	Negligible

5 (1.5 m)	<0.01	<0.01	19.0	47.5	Negligible
6 (1.5 m)	<0.01	<0.01	19.0	47.5	Negligible

- ^a Modelled height included in parentheses.
- ^b Based on unrounded numbers.
- ^c After adding the baseline concentration from Table 4.
- ^d Derived from the impact descriptors in Table 2.
- ^e Offices are not relevant exposure with respect to the annual mean objective.

- 6.7 Since the annual mean PM₁₀ PCs are well below 0.5%, the impacts are described as *negligible*. The PECs will also remain well below the annual mean PM₁₀ objective. Overall, the effect of the operation of the generator for testing and maintenance on annual mean PM₁₀ concentrations will be 'not significant'.

Short-term Impact Assessment

- 6.8 Relevant locations for the short-term objectives are locations where members of the public are likely to regularly spend 1-hour (for nitrogen dioxide) or 24-hours (for PM₁₀).

Nitrogen Dioxide

- 6.9 Figure 8 shows contours representing the 100th percentile of 1-hour mean nitrogen dioxide process contributions from the generator emissions. The 100th percentile represents the highest PC in any modelled hour, and from any of the sensitivity tests.

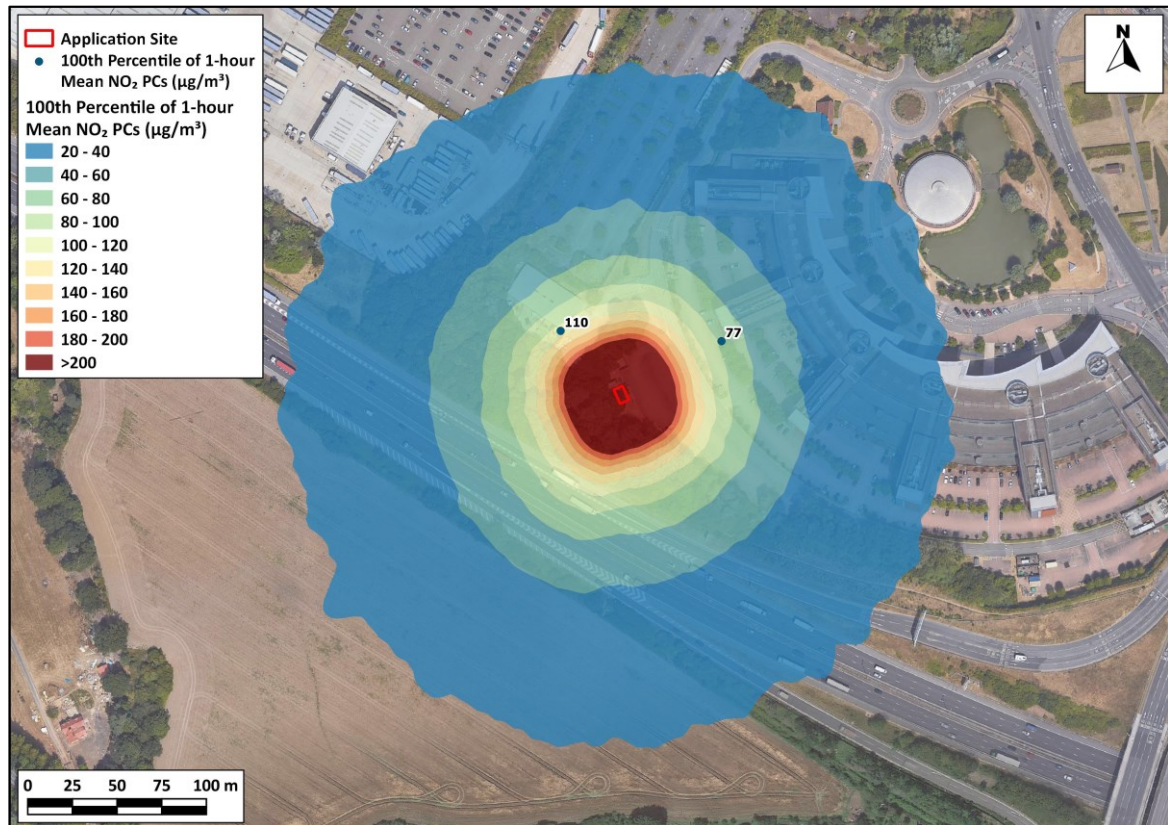


Figure 8: 100th Percentile of 1-hour Mean Nitrogen Dioxide Process Contributions and PCs at Nearby Receptors ($\mu\text{g}/\text{m}^3$)

Imagery ©2022 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies, The GeoInformation Group.

- 6.10 Table 12 sets out the 100th percentile of 1-hour mean PC, baseline concentration (from Table 4) and PEC at each specific receptor (described in Table 7 and Figure 3). As set out in Paragraph 3.10, where the short-term objective level will not be exceeded, effects are considered to be 'not significant'.

Table 12: 100th Percentile of 1-hour Mean NO₂ PCs and PECs at Specific Receptors

Receptor ^a	PC (µg/m ³)	PC (% of Objective) ^b	PEC (µg/m ³) ^c	PEC (% of Objective) ^b
1 (0.5 m)	110.0	55.0	176.0	88.0
1 (1.5 m)	109.8	54.9	175.8	87.9
2 (1.5 m)	77.2	38.6	143.2	71.6
3 (1.5 m)	11.9	5.9	77.9	38.9
4 (1.5 m)	7.1	3.6	73.1	36.6
5 (1.5 m)	14.0	7.0	80.0	40.0
6 (1.5 m)	15.1	7.5	81.1	40.5

^a Modelled height included in parentheses.

^b Based on unrounded numbers.

^c After adding the baseline concentration from Table 4.

6.11 There are no locations of relevant exposure within the areas where the PCs exceed the objective level (200 µg/m³). Based on the short-term baseline concentration of 66 µg/m³ (see Table 4 for the derivation), the maximum total concentration will exceed the objective level where the predicted PCs exceed 134 µg/m³⁴. A small area of the Busy Bees Nursery playground is located within the 120 – 140 µg/m³ contour, thus there is the potential for maximum hourly concentrations to exceed 200 µg/m³ at the edge of the nursery playground. This is based on the assumption that the generator will run for every hour of the year, rather than the 12 hours during which it will run. In practice, it is highly unlikely that the maximum hourly PC at Busy Bees would be more than a fraction of that shown, since the chance of any hour of testing coinciding with the worst-case meteorology which might give rise to these concentrations is extremely small. However, to completely eliminate impacts on Busy Bees nursery, it is recommended that the testing of the generator takes place outside of nursery opening hours. On this basis, the effect will be 'not significant'.

6.12 Whilst the PCs exceed 10% of the objective level (20 µg/m³) at Receptors 1 and 2, total concentrations will remain below the objective level; the effect will, therefore, be 'not significant'. At Receptors 3 to 6, the PC is less than 10% of the objective, thus the effect in terms of hourly mean nitrogen dioxide concentrations can be screened as insignificant following the approach set out in Paragraph 3.8.

PM₁₀

6.13 The maximum 24-hour mean PM₁₀ process contribution at any specific receptor is 3.0 µg/m³, equivalent to a percentage change, relative to the objective, of 6.1%. Since this is well below 10%

⁴ 200 µg/m³ (objective level) minus 66 µg/m³ (short term baseline concentration) equals 134 µg/m³.

of the objective, the impacts in terms of 24-hour mean PM_{10} concentrations can be screened as insignificant following the approach set out in 3.8.

7 Conclusions

- 7.1 The impacts associated with the proposed emergency generator at Reading International Business Park have been assessed in relation to the air quality objectives set to protect human health. The assessment has assumed that the generator will be operated for one hour per month for testing and maintenance, resulting in a total of 12 hours per year.
- 7.2 The assessment has demonstrated that the generator will not lead to any exceedances of the air quality objectives. The impacts in terms of annual mean nitrogen dioxide and PM₁₀ concentrations at all local, sensitive receptors will be *negligible*. The hourly mean nitrogen dioxide and 24-hour mean PM₁₀ objectives will not be exceeded due to the limited hours of operation.
- 7.3 Whilst the assessment has demonstrated that the short-term objectives will not be exceeded, owing to the proximity between the proposed generator and Busy Bees Nursery, and in line with best practice to minimise exposure, testing of the generator should take place outside of nursery hours.
- 7.4 Overall, it is considered that the air quality effects associated with the proposed generator will be 'not significant'.

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9 Glossary

ADMS-5	Atmospheric Dispersion Modelling System model for point sources
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
CAZ	Clean Air Zone
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
EU	European Union
HMSO	Her Majesty's Stationery Office
IAQM	Institute of Air Quality Management
JAQU	Joint Air Quality Unit
kW	Kilowatt
LAQM	Local Air Quality Management
µg/m³	Microgrammes per cubic metre
MCPD	Medium Combustion Plant Directive
NO	Nitric oxide
NO₂	Nitrogen dioxide
NO_x	Nitrogen oxides (taken to be NO ₂ + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PC	Process Contribution

PEC	Predicted Environmental Concentration
PPG	Planning Practice Guidance
RBC	Reading Borough Council
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
WBC	Wokingham Borough Council
WHO	World Health Organisation

10 Appendices

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A1 Engine Technical Data



V550C2

ENGINE CHARACTERISTICS

GENERAL ENGINE DATA

Engine brand	VOLVO
Engine ref.	TAD1641GE
Air inlet system	Turbo
Cylinders configuration	L
Number of cylinders	6
Displacement (L)	16,12
Charge Air coolant	Air/Air DC
Bore (mm) x Stroke (mm)	144 x 165
Compression ratio	16.5 : 1
Speed (RPM)	1500
Pistons speed (m/s)	8,25
Maximum stand-by power at rated RPM (kW)	484
Frequency regulation, steady state (%) +/- 0.25%	
BMEP at Max Power (bar)	21,80
Governor type	Electronic

COOLING SYSTEM

Radiator & Engine capacity (L)	60
Fan power (kW)	11
Fan air flow w/o restriction (m3/s)	8,80
Available restriction on air flow (mm H2O)	20
Type of coolant	Glycol-Ethylene

EMISSIONS

Emission PM (g/kW.h)	0,09
Emission CO (g/kW.h)	1,15
Emission HC+NOx (g/kWh)	5,46
Emission HC (g/kW.h)	0,12

EXHAUST

Exhaust gas temperature @ ESP 50Hz (°C)	455
Exhaust gas flow @ ESP 50 Hz (L/s)	1533
Max. exhaust back pressure (mm H2O)	1000

FUEL

Consumption @ 110% load (L/h)	112,60
Consumption @ 100% load (L/h)	102
Consumption @ 75% load (L/h)	75,40
Consumption @ 50% load (L/h)	51
Maximum fuel pump flow (L/h)	170

OIL

Oil system capacity including filters (L)	48
Min. oil pressure (bar)	0,70
Max. oil pressure (bar)	6,50
Oil consumption 100% ESP (L/h)	0,10
Oil sump capacity (L)	42

HEAT BALANCE

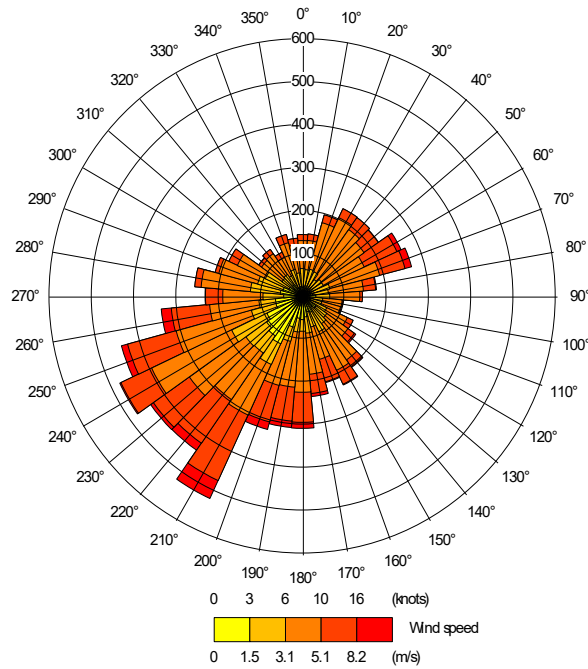
Heat rejection to exhaust (kW)	326
Radiated heat to ambient (kW)	20
Heat rejection to coolant HT (kW)	184

AIR INTAKE

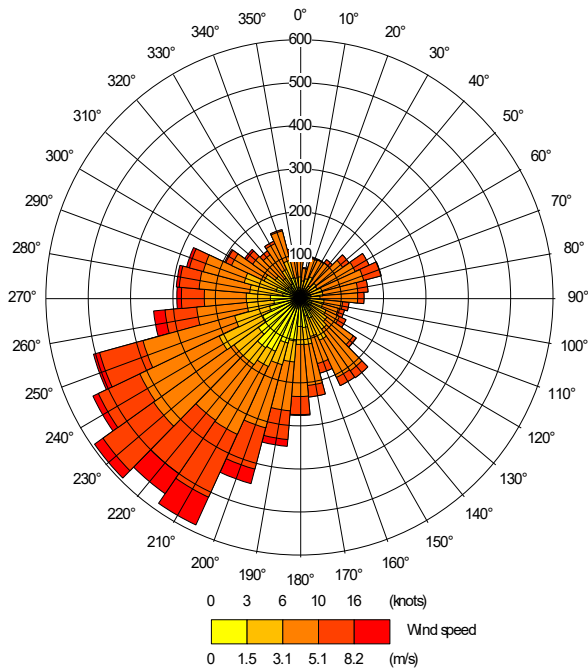
Max. intake restriction (mm H2O)	500
Intake air flow (L/s)	633

A2 Wind Roses for Farnborough

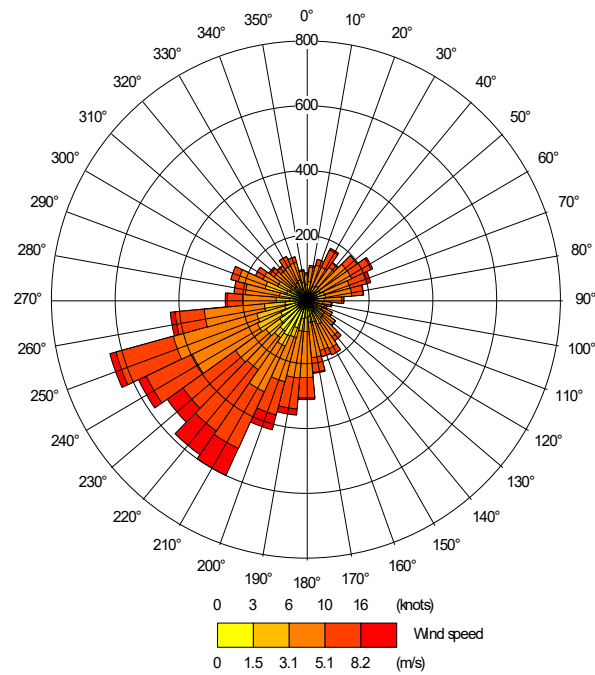
2018



2019



2020



A3 Professional Experience

Dr Ben Marner, BSc (Hons) PhD CSci MEnvSc MIAQM

Dr Marner is the Director of Air Quality Modelling and Assessment at AQC and has over 20 years' relevant experience. He has been responsible for air quality and greenhouse gas assessments of road schemes, rail schemes, airports, power stations, waste incinerators, commercial developments and residential developments in the UK and abroad. He has acted as expert witness at public inquiries, where he has presented evidence on health-related air quality impacts, the impacts of air quality on sensitive ecosystems, and greenhouse gas impacts. He has developed a range of widely-used air quality models and contributed to the development of best practice. Dr Marner has provided support and advice to foreign governments, Highways England, Transport Scotland, Transport for London, Greater London Authority, the Joint Nature Conservation Committee, the Environment Agency, and numerous local authorities. He is a Member of the Institute of Air Quality Management and a Chartered Scientist. He currently advises the UK Government on air quality as part of its Air Quality Expert Group (AQEG), where his specific area of expertise relates to air quality assessment in the development control process.

Laurence Caird, MEarthSci CSci MEnvSc MIAQM

Mr Caird is an Associate Director with AQC, with 14 years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Dr Frances Marshall, MSci PhD MEnvSc MIAQM

Dr Marshall is a Senior Consultant with AQC with over eight years' relevant experience. Prior to joining AQC, she spent four years carrying out postgraduate research into atmospheric aerosols at the University of Bristol. Dr Marshall has experience preparing air quality assessments for a range of projects, including residential and commercial developments, road traffic schemes, energy centres, energy from waste schemes and numerous power generation schemes. She has experience in producing air quality assessments for EIA schemes, and has also assessed the impacts of Local Plans on designated ecological areas, prepared Annual Status Reports for Local Authorities, and undertaken diffusion tube monitoring studies. She is a Member of both the Institute of Air Quality Management and the Institution of Environmental Sciences.