Air Quality CONSULTANTS

Air Quality Assessment: GB1 Data Centre, Ajax Avenue, Slough

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Experts in air quality management & assessment

Document Control

Client	Desco	Principal Contact	Susana Camarão (Pell Frischmann)

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Report Prepared By:	David Bailey and Frances Marshall

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Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
24 Greville Street, Farringdon, London EC1N 8SS Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Contents

1 Introduction

1.1 This report assesses the potential air quality impacts associated with the proposed data centre at GB1 on Ajax Avenue, Slough. The proposals for the data centre include the installation of 21 no. 4.5 MVA diesel backup generators across three buildings, the emissions from which may impact on air quality at existing residential, educational, commercial, and healthcare properties in the local area.

1.2 The generators are required to provide emergency power in the event of loss of power to the site from the national grid. Grid stability is very good, hence the generators will not be frequently used, except as part of a regular planned testing regime.

1.3 The main air pollutants of concern related to the diesel generators' emissions on human health are nitrogen dioxide (NO_2). Other emissions from the diesel generators such as particulate matter, sulphur dioxide, volatile organic compounds, and carbon monoxide will be small compared to the relevant environmental standards (and very small relative to the generator's NOx emissions) and not warranting assessment[1].

1.4 The location and setting of the proposed development are shown in Figure 1, along with the relevant nearby Air Quality Management Areas (AQMAs) and air quality monitoring sites.

1.5 The Site lies within a subject Simplified Planning Zone (SPZ), which potentially means that an Air Quality Impact Assessment is not required to support a planning application or discharge associated planning conditions[2]. The SPZ Guidance at Appendix 2 advises Environmental Health issues that "*the Local Planning Authority would expect developers to consider when drawing up individual schemes. It is within the best interests of developers to confer with the Borough Council's Environmental Health Division over environmental matters, if in doubt. This may avoid the need for remedial action at a later stage."* Appendix 2 identifies *"Noise and air pollution emissions from ventilation and arrestment plant, eg. position, height of chimneys and flues"* as considerations.

1 Environment Agency guidance (EA, 2016) on emissions from specified generators advises that emissions other than NOx need not normally be considered.

2 It is recommended that a qualified Town Planner confirm the requirements and limitations of the SPZ

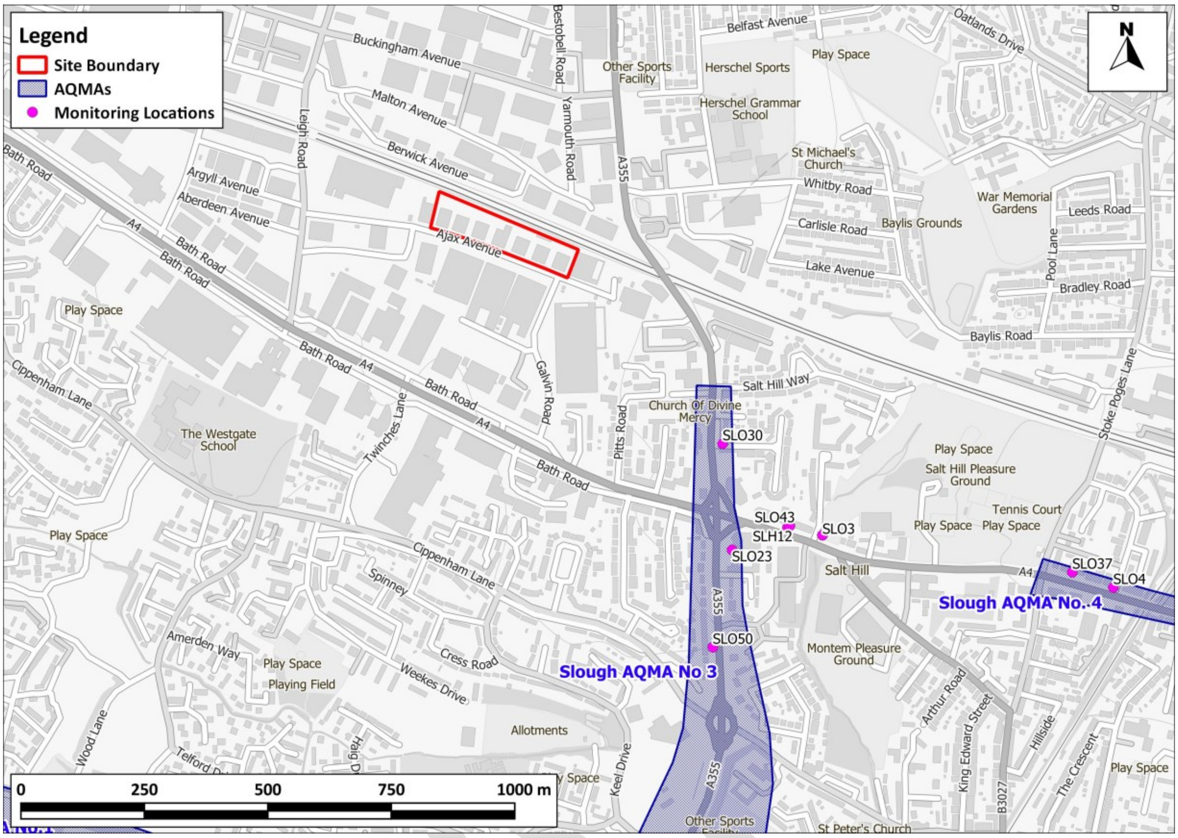

Figure 1: Proposed Development Setting in the Context of Air Quality

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1.6 This report has been prepared taking into account all relevant national and local guidance and regulations. Where appropriate, the assessment has followed a worst-case approach, so as not to underestimate the impacts of the proposed facility.

1.7 This report assesses the air quality impacts of the proposed development using an approach and structure that addresses the requirements of a planning submission. The requirements of an environmental permitting application to be submitted to the Environment Agency are specific and differ from the requirements of a planning submission. This report should not, therefore, be submitted in support of an environmental permitting application.

2 Policy Context

2.1 All European legislation referred to in this report is written into UK law and remains in place, although there is uncertainty at this point in time as to who will enforce the requirements of some of this legislation.

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 As the development will contain combustion plant with an aggregated thermal output of greater than 50 MW_{th}, the site will require an environmental permit (issued by the Environment Agency) under Part A1 of the Environmental Permitting Regulations.

Clean Air Act 1993 & Environmental Protection Act

2.4 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.

2.5 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

2.6 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.

Planning Policy

National Policies

2.7 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".

2.8 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".

2.9 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".

2.10 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".

2.11 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".

2.12 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".

2.13 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*".

2.14 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".

2.15 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".

2.16 Regarding sites that will operate under an Environmental Permit, PPG states that:

"It is not necessary for air quality assessments that support planning applications to duplicate aspects of air quality assessments that will be done as part of non-planning control regimes, such as under Environmental Permitting Regulations".

2.17 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

2.18 The Slough Local Development Framework Core Strategy Development Plan Document (Slough Borough Council, 2008) was adopted in December 2008, and within this, Core Policy 8, concerning sustainability and the environment, and states:

"All development in the Borough shall be sustainable, of a high quality design, improve the quality of the environment and address the impact of climate change…

3. Pollution

Development shall not:

a) Give rise to unacceptable levels of pollution including air pollution, dust, odour, artificial lighting or noise;

b) Cause contamination or a deterioration in land, soil or water quality; and

c) Be located on polluted land, areas affected by air pollution or in noisy environments unless the development incorporates appropriate mitigation measures to limit the adverse effects on occupiers and other appropriate receptors."

2.19 Within the Local Development Framework Core Strategy Development Plan, Slough Trading Estate has specifically been identified as an area for regeneration. This will be implemented through a Master Plan which is being prepared by SEGRO. Once the Master Plan has been approved it is proposed that key elements, such as the new hub, will be considered through a planning application and the rest of it will be implemented through a subsequent Local Development Order which will replace the existing SPZ.

2.20 The Council is in the process of updating its Local Plan, which will set out how to guide development in Slough through to 2036. The new Local Plan will update the existing Core Strategy, Site Allocations, and Local Plan Saved Policies. Consultation on the spatial strategy took place in early 2021, with publication and examination expected in 2022/2023.

Building Standards

2.21 Part F of the Building Regulations (Ministry of Housing, Communities & Local Government, 2020) sets legal requirements related to ventilation for buildings. It identifies performance criteria for ventilation systems for dwellings and offices, stating that nitrogen dioxide concentrations of

288 µg/m^3 as a 1-hour average and 40 µg/m^3 as a long-term average should not be exceeded. While these are building control requirements rather than planning requirements, they highlight that where ambient (outdoor) air exceeds the annual mean nitrogen dioxide objective, it is expected that an appropriate ventilation system will be installed to ensure that indoor concentrations are below the performance criterion.

Air Quality Action Plans

National Air Quality Plan

2.22 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

2.23 Slough Borough Council has declared four AQMAs for exceedances of the annual mean nitrogen dioxide objective. The Council has since developed two Air Quality Action Plans in order to improve air quality within these areas; one covering AQMAs Nos. 1 and 2 (Slough Borough Council, 2006) and one covering AQMA Nos. 3 and 4 (Slough Borough Council, 2012).

3 Assessment Criteria

3.1 The UK 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) and the Air Quality (England) (Amendment) Regulations (2002).

3.2 The UK-wide objectives for nitrogen dioxide were to have been achieved by 2005, 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, 2021a). The annual mean objectives for nitrogen dioxide are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply 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 (The European Parliament and the Council of the European Union, 2008). The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one. 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 normally recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded, unless such studies have been audited and approved by Defra and DfT’s Joint Air Quality Unit (JAQU).

3.5 The UK Government has also set workplace exposure limits (WELs) under the Control of Substances Hazardous to Health Regulations (2002), which set limits for exposure to substances experienced whilst working, and the exposure limit is set over an 8-hour reference period, however it is assessed using a time-weighted average to account for the exposure time for a worker.

3.6 The relevant air quality criteria for this assessment are provided in Table 1. The annual mean and 1-hour mean NO_2 objectives both apply at residential, healthcare, and educational receptors. The 1-hour mean NO_2 objective also applies at retail receptors, and the 8-hour mean NO_2 Workplace Exposure Limit applies at any commercial receptor.

Table 1: Air Quality Criteria for Nitrogen Dioxide

Pollutant	Time Period	Objective/WEL
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
	8-hour Mean	960 µg/m^3

4 Assessment Approach

Study Area

4.1 Impacts as a result of plant emissions have been predicted over a 10 km x 10 km model domain, centred on the generator flues within the proposed facility. The extent of this model domain defines the 'Study Area'.

Receptors

4.2 Concentrations have been predicted across the study area using nested Cartesian grids of receptors (see Figure 2). These grids have a spacing of 5 m x 5 m within 200 m of the facility, 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 of the facility. The receptor grid has been modelled at a height of 1.5 m above ground level.

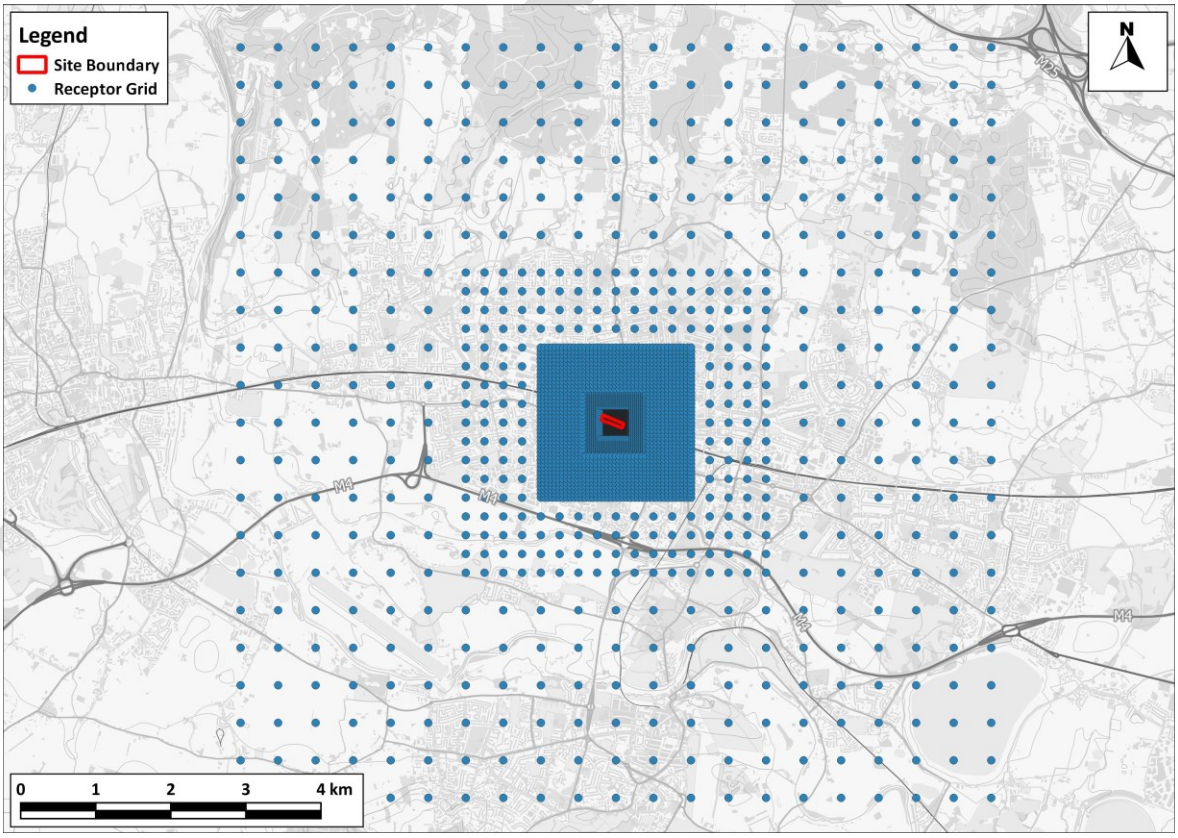

Figure 2: Nested Cartesian Grids of Receptors

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Existing Conditions

4.3 Existing sources of emissions and baseline air quality conditions within the study area have been defined using a number of approaches:

- information on existing air quality has been obtained by collating the results of monitoring carried out Slough Borough Council;
- background concentrations have been defined using Defra's 2018-based background maps (Defra, 2021b). These cover the whole of the UK on a 1x1 km grid. The background annual mean nitrogen dioxide maps for 2019 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2020). The calibration factor calculated has also been applied to future year backgrounds; and
- whether or not there are any exceedances of the annual mean EU limit value for nitrogen dioxide in the study area has been identified using the maps of roadside concentrations published by Defra (Defra, 2020; 2021c). These maps are used by the UK Government, together with the results from national Automatic Urban and Rural Network (AURN) monitoring sites that operate to EU data quality standards, to report exceedances of the limit value to the EU.

Modelling Methodology

4.4 The impacts of emissions from the proposed facility have been modelled using the ADMS-5.2 dispersion model. 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. The model input parameters are set out in Appendix A2.

Assessment Scenarios

4.5 The 21 generators within the proposed facility will provide back-up power for the data centre. Therefore, they will only operate following a loss of power from the national grid or during the testing/maintenance regime.

4.6 In order to assess the likely effects from the generators, two scenarios have been simulated to test both the routine testing regime and a hypothetical emergency event.

Routine Testing

4.7 The generators will be tested for one hour per month, totalling 12 hours of annual operation. The models have been set up with the generators combined into a number of different groups to determine the impacts of different testing regimes. The groups of sources run are as follows (see Figure 3 for source locations):

- All generators (21) operating simultaneously;

- each generator operating separately;
- groups of seven generators operating simultaneously:
  - generators within Block 1 (Sources 1 to 7);
  - generators within Block 2 (Sources 8 to 14); and
  - generators within Block 3 (Sources 15 to 21); and
- groups of three and four generators operating simultaneously:
  - 3 at the side of Block 1 at roof level (Sources 1 to 3);
  - 4 on the roof of Block 1 (Sources 4 to 7);
  - 3 at the side of Block 2 at roof level (Sources 8 to 10);
  - 4 on the roof of Block 2 (Sources 11 to 14);
  - 3 at the side of Block 3 at roof level (Sources 15 to 17); and
  - 4 on the roof of Block 3 (Sources 18 to 21).

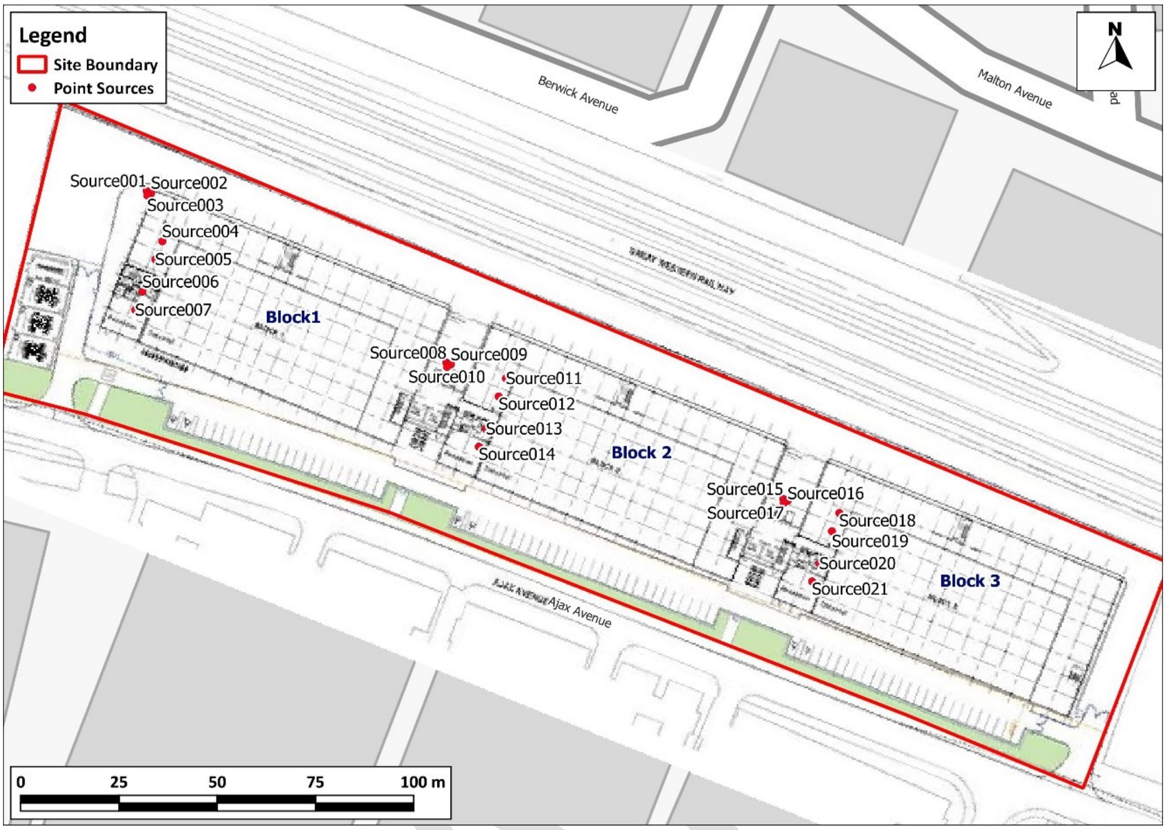

Figure 3: Generator Flue Locations

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Emergency Event

4.8 In addition to the routine testing, a hypothetical emergency event has been modelled; it is unknown whether, or when, any such emergency operation would occur. Due to the high reliability of power connections in the UK, it is not anticipated that emergency operation will be regularly required; based on the latest Ofgem electricity market report, customers went without power for around 36 minutes on average over the course of 2017-18 (Ofgem, 2019). The emergency modelling assumes a full 24-hour period of all generators operating simultaneously; therefore, this assessment is deemed to be extremely worst-case in terms of the potential air quality impacts of the generators.

4.9 The 100th percentile (maximum) of 1-hour mean concentrations has been run based on all 21 generators operating simultaneously (see Paragraph 4.26), and factored to an equivalent maximum 24-hour mean concentration using a conversion factor of 0.59, following guidance issued by the Environment Agency (2016). The model has then predicted locations which exceed 200 μg/m^3 to identify locations where an emergency event could lead to an exceedance of the 1-hour mean objective.

Sensitivity Testing

Meteorological Data

4.10 In order to allow for uncertainties in local and future-year meteorological conditions, the dispersion model has been run three times, with each run using a different full year of hour-by-hour meteorological data from an appropriate meteorological station.

4.11 Further details of this approach, as well as the meteorological datasets used, are provided in Appendix A2.

Buildings

4.12 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.

4.13 The model has been run once with buildings included, and once without, for each meteorological year. Further details of the modelled buildings are provided in Appendix A2.

Post-Processing

4.14 For each individual receptor point on the nested Cartesian grids, the maximum predicted concentration across any of the three meteorological datasets and either building scenario has been determined. It is these maxima which are presented in this report. This approach provides a degree of conservatism and will tend to over-predict the impacts of the facility.

4.15 Details on how the model outputs have been processed, including the NOx to NO_2 relationship and how the short-term operating hours have been accounted for, are set out in Appendix A2. Where appropriate, the assessment has followed a worst-case approach, so as not to underestimate the impacts of the proposed facility.

Uncertainty

4.16 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which in reality are variable. 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.

4.17 On balance, when taking into account the assumed number of operating hours, meteorological conditions, building downwash and the assumed NOx to NO_2 relationship, the assessment can be expected to over-predict the impacts of the facility. The approach used thus provides a robust assessment.

Assumptions

4.18 The following assumptions have been made in carrying out the modelling, with the assumptions generally seeking to reflect a realistic worst-case scenario:

- all three buildings and 21 generators will be installed and fully operational in the year 2022; in reality, a phased opening will take place;
- the generators are fitted with Selective Catalytic Reduction systems (SCR), which will reduce the NOx emission rate to 190 mg/Nm^3 after the generators have been operating for 15 minutes. As such, each hourly test will be assumed to have a full unabated NOx emission rate for 15 minutes, and an abated emission rate for 45 minutes; and
- the temperature of the exhaust emissions will not vary significantly between the point of exhaust from the engine and the point of release to the atmosphere.

Descriptors for Air Quality Impacts and Assessment of Significance

Annual Mean Concentrations

4.19 The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[3] (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, having been adapted from the table presented in the guidance document.

4.20 From this, some initial screening criteria can be derived:

- any change in concentration smaller than 0.5% of the long-term (annual mean) environmental standard will be *negligible*, regardless of the existing air quality conditions;
- any change smaller than 1.5% of the long-term environmental standard will be *negligible* so long as the total (with-scheme) concentration is less than 94% of the environmental standard; and
- any change smaller than 5.5% of the long-term environmental standard will be *negligible* so long as the total (with-scheme) concentration is less than 75% of the environmental standard.

[3] The IAQM is the professional body for air quality practitioners in the UK.

Table 2: Air Quality Impact Descriptors for Individual Receptors for Annual Mean Nitrogen Dioxide Concentrations

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

4.21 Where all impacts are negligible the overall effect will be 'not significant'.

Short-term (1-hour mean) Nitrogen Dioxide Concentrations

4.22 Given that the hourly mean nitrogen dioxide objective allows a certain number of hours with concentrations exceeding the standard, rather than being a single concentration not to be exceeded, it is not possible to usefully assign a magnitude of change. The objective and limit value allow 18 hours a year to exceed the standard of 200 µg/m^3 (the "objective value").

4.23 For the purposes of this assessment, the maximum process contribution (100th percentile) from the testing of the generators has been used to determine whether there could be an exceedance of the 1-hour mean objective value of 200 µg/m^3.

4.24 EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al., 2017) and Environment Agency guidance (Environment Agency, 2016a) both recommend a screening criterion of 10% of the short-term environmental standard when assessing short-term concentrations. Thus, if the 100th percentile of hourly mean process contributions from the facility is less than 10% of the objective level (20 µg/m^3), the contribution can be considered insignificant without the need to consider total concentrations.

4.25 Where the process contribution cannot immediately be screened out, it is added to the baseline concentration[4] to determine the 100th percentile of total hourly mean concentrations. Where this total concentration is below 200 µg/m^3, it can be assumed that the short-term objective will not be exceeded, and the effects are considered to be 'not significant'.

Short-term (24-hour mean) Nitrogen Dioxide Concentrations

4.26 In the event of a full power grid failure, the generators may be required to run for 24 hours; there is, however, no objective set for 24 hour mean NO_2. For the purposes of this assessment, the 1-hour mean objective level (which allows for 18 exceedances of 200 µg/m^3) has been used.

4 The 1-hour mean baseline concentration is calculated as two times the annual mean baseline concentration.

4.27 Where the 24-hour mean value is below 200 µg/m^3 the effect from the 24-hour operation of the generators during an emergency can be described as ‘not significant’.

5 Baseline Conditions

Relevant Features

5.1 The proposed facility is located in the Slough Trading Estate to the west of the town. There is a railway line to the north, and existing commercial properties to the east, south, and west.

5.2 As highlighted in Figure 1, the proposed facility is located near to two of Slough Borough Council's AQMAs.

Local Air Quality Monitoring

5.3 Slough Borough Council operates eleven automatic monitoring stations within its area, SLH12 on Bath Road is within close proximity of the proposed development. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Gradko (using the 50% TEA in acetone method). Annual mean results for the years 2015 to 2019 are summarised in Table 3, while results relating to the 1-hour mean objective are summarised in Table 4. Exceedances of the objectives are shown in bold. The monitoring locations are shown in Figure 1. The monitoring data have been taken from Slough Borough Council's 2020 Annual Status Report (Slough Borough Council, 2020).

Table 3: Summary of Annual Mean NO_2 Monitoring (μg/m^3)

Site No.	Site Type	Location	2015	2016	2017	2018	2019
SLH12	Roadside	Slough Windmill Bath Road	-	-	**41.5**	**42.0**	39.2
SLO1 [a]	Urban Background	Salt Hill	32.4	32.3	31.1	28.1	27.2
SLO4	Roadside	Lansdowne Avenue	38.4	38.6	37.9	33.8	33.6
SLO23	Urban Background	Tuns Lane	36.1	36.4	33.6	29.5	30.8
SLO30	Roadside	Farnham Road	**40.4**	34.1	32.6	29.0	32.0
SLO37	Roadside	Blair Road - Victoria Court	**43.4**	**47.6**	**45.3**	39.9	37.8
SLO43	Roadside	Windmill (Bath Road)	39.5	**42.0**	37.2	34.0	33.1
SLO50	Kerbside	Windsor Road (B)	-	-	**45.3**	**45.8**	**42.8**
Objective			**40**				

[a] Average of triplicate diffusion tubes.

Table 4: Number of Hours with NO_2 Concentrations Above 200 µg/m^3

Site No.	Site Type	Location	2015	2016	2017	2018	2019
SLH12	Roadside	Slough Windmill Bath Road	-	-	0 (117)	0	0
Objective			**18 (200) [a]**				

[a] Value in brackets is the 99.79th percentile, which is presented as data capture was <85%.

5.4 Measured NO_2 concentrations are below the annual mean objective at all monitors in 2019, except SLO50. SLO50 is located adjacent to the busy Tuns Lane, and thus is representative of roadside receptors along Tuns Lane. Receptors at most other locations in the study area are likely to experience concentrations below the objective. There has been a clear reduction in NO_2 concentrations between 2015 and 2019.

5.5 There have been no exceedances of the 1-hour mean objective at the automatic monitor since it was commissioned in 2017.

Exceedances of EU Limit Value

5.6 There are no AURN monitoring sites within 1 km of the application site with which to identify exceedances of the annual mean nitrogen dioxide limit value. Defra's roadside annual mean nitrogen dioxide concentrations (Defra, 2021c), which are used to report exceedances of the limit value to the EU, do not identify any exceedances within the study area in 2021. As such, there is considered to be no risk of a limit value exceedance in the vicinity of the proposed development by the time that it is operational.

Background Concentrations

5.7 Estimated background concentrations in the study area are set out in Table 5 and are all well below the objectives. A range of values is presented as the study area covers multiple 1x1 km grid squares.

Table 5: Estimated Annual Mean Background NO_2 Concentrations in 2019 and 2022 (µg/m^3)

Year	NO_2
2019	13.3 - 30.6
2022	11.8 - 26.1
Objective	**40**

6 Impact Assessment

Annual Mean Concentrations

6.1 Figure 4 shows annual mean nitrogen dioxide concentration contours defining the areas within which the proposed development's emissions are predicted to add more than 0.2 µg/m³ to annual mean nitrogen dioxide concentrations (aligning with 0.5% of the objective level in the EPUK/IAQM impact descriptor matrix set out in Table 2), assuming 12 hours operation per year per generator.

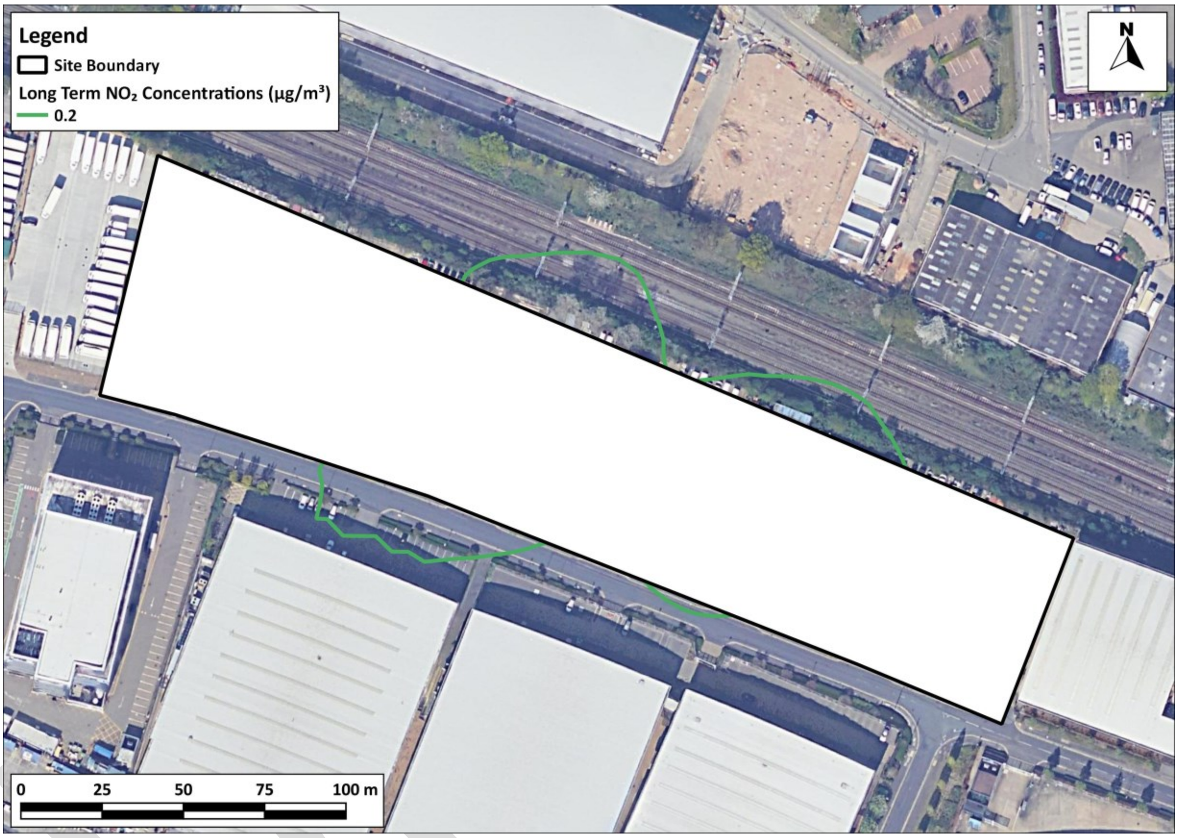

Figure 4: Annual Mean Nitrogen Dioxide Concentration Contours (µg/m³)

Imagery ©2021 Google, Imagery ©2021 Getmapping plc, Infoterra Ltd & BLuesky, Maxar Technologies, The GeoInformation Group.

6.2 Figure 4 demonstrates that the contours cover the proposed facility itself and the neighbouring railway line, which are not relevant exposure to the annual mean objective. On this basis, there will be no impacts, and the overall effect of the operation of the generators for testing and maintenance on annual mean concentrations will be 'not significant'.

Short-term Impact Assessment

1-hour Mean Nitrogen Dioxide Objective

6.3 Relevant locations for the short-term objectives are locations where members of the public are likely to regularly spend 1 hour or more. Figure 5 shows contours representing the maximum 1-hour mean nitrogen dioxide process contributions from the generator emissions when testing the generators in groups of three and four (as described in Paragraph 4.7). Process contributions from testing the generators in groups of 7 are considered to be unacceptable, and as such are not considered further.

6.4 The contours presented in Figure 5 present the maximum process contribution at each receptor from any of the groups within the testing scenario, and as such present a worst-case contour for the testing regime; in reality the process contributions from the individual testing regime of each group of generators may be slightly lower in some locations.

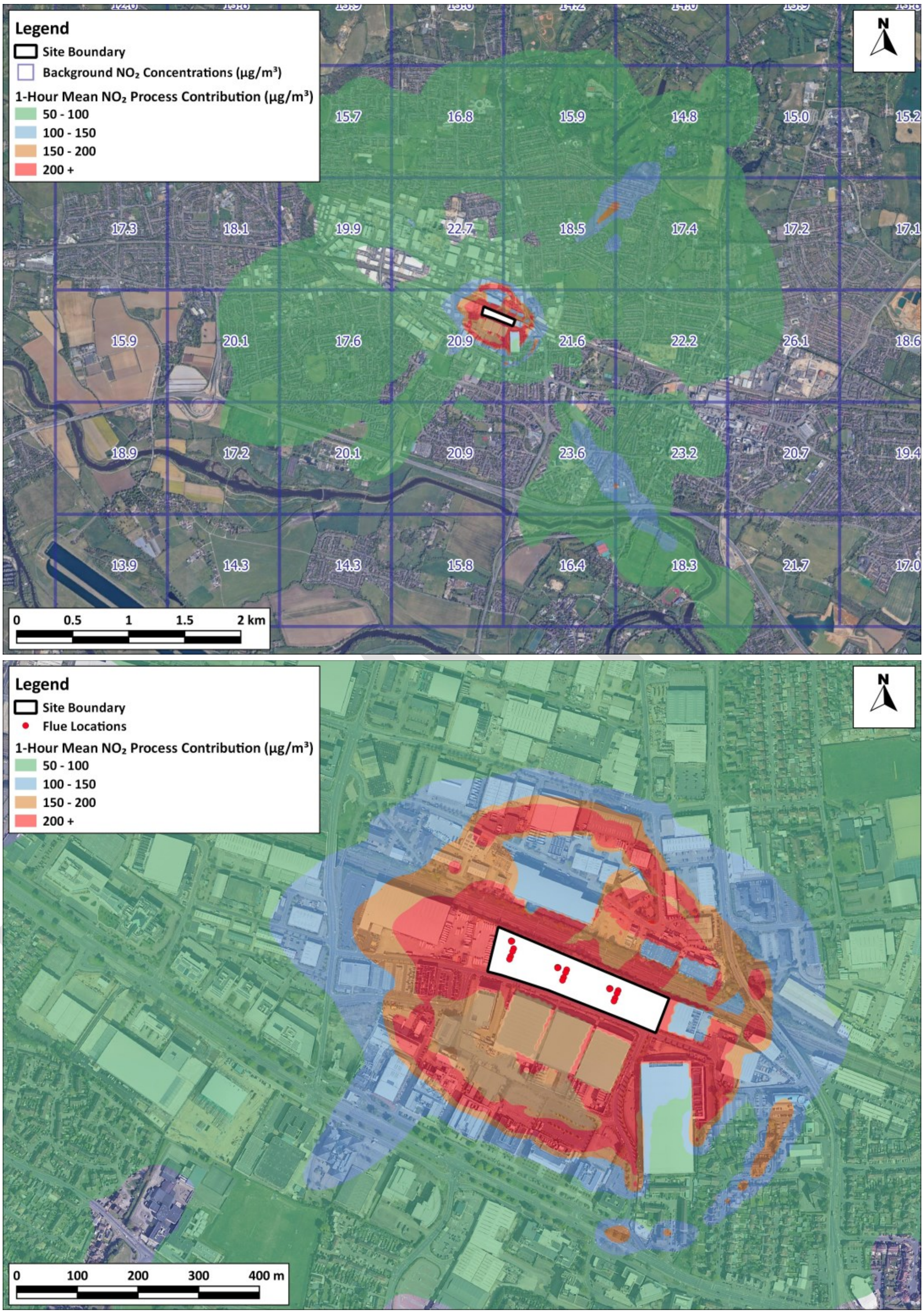

Figure 5: Maximum 1-hour Mean Nitrogen Dioxide Process Contributions from Testing Generators in Groups of Three and Four (µg/m³). Upper Image Shows the Full Extent of the Contours, and Lower Image Shows Zoomed in Area

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6.5 There are no locations within the 200 µg/m^3 contour (red) when testing the generators in groups of three and four (see Figure 5). Within the orange contour (which represents process contributions between 150 and 200 µg/m^3), there are seven residential properties on Pitts Road, two residential properties on Hadlow Close, a location within Slough and Eton Church of England Business & Enterprise College, twenty-four residential properties on Granville Avenue, and the northern extent of one apartment building along Thirkleby Close. These locations are all set well back from any busy roads, and so baseline NO_2 concentrations are likely to be close to background concentrations. The background annual mean NO_2 concentration at these receptors is 21.6 µg/m^3 (see Table 5). Using a short-term baseline concentration of twice the annual mean baseline as described in Paragraph 4.25, the short-term baseline concentration is 43.2 µg/m^3. Where the process contribution from the generators is less than 157.8 µg/m^3 there will be no exceedances of the 1-hour mean NO_2 objective value[5]. Process contributions are only predicted to exceed 150 µg/m^3 at any of these receptors in one group of generator tests (out of six), and as such the risk of concentrations greater than 150 µg/m^3 is considered to be low. The likelihood of meteorological conditions under which these maximum process contributions will happen occurring whilst the generators are being tested is low, and due to the generators only being tested for 12 hours per year, there will remain no risk of an exceedance of the 1-hour mean objective (18 hours greater than 200 µg/m^3 in a year).

6.6 At receptors adjacent to the busy Bath Road, Tuns Road, and Farnham Road, where baseline annual mean concentrations could be as high as 42.4 µg/m^3 (see Paragraph 5.4), process contributions from the proposed generator plant need to be less than 115.2 µg/m^3 (200 – (42.2 x 2)) to ensure there is no risk of an exceedance of the 1-hour mean NO_2 objective value. There is only one location where process contributions are predicted to exceed 100 µg/m^3 close to any busy road, which is at the apartment building on Thirkleby Close. This apartment building is, however, set back from Bath Road by approximately 27 m, and thus annual mean baseline concentrations are unlikely to be as high as 42.4 µg/m^3, however there is still a small risk of an exceedance of the 1-hour mean NO_2 objective value at this location. Process contributions of NO_2 exceed 115.2 µg/m^3 in three of the six generator testing scenarios at this location. As stated above, the meteorological conditions that lead to these maxima occurring is extremely unlikely to coincide with the testing, and as such, although there is a risk of an exceedance of the 1-hour mean objective value, the risk is considered to be low, and as such it is considered to be an acceptable risk.

6.7 Testing the generators in groups of three and four is judged to not cause any significant impacts to 1-hour mean concentrations at any existing receptors. Testing the generators in groups smaller than three and four is also therefore not predicted to cause any significant impacts to the 1-hour mean NO_2 objective (as the process contributions will be smaller).

5 157.8 + 43.2 = 200

8-hour mean nitrogen dioxide

6.8 There are no locations within the grid of receptors where process contributions from the generators will exceed 960 µg/m^3 within any testing regime, and as such there are predicted to be no exceedances of the Workplace Exposure Limits at any existing receptor, or any location within the proposed facility where the Workplace Exposure Limits will apply.

24-hour mean nitrogen dioxide

6.9 During an emergency scenario (loss of grid electricity), the development might be required to use all 21 generators simultaneously. It is not possible to predict when, or for how long a loss of grid electricity will occur. The UK has a very high level of grid stability as evidenced by Ofgem data (Ofgem, 2019), such that power failures are unlikely to occur every year and will typically occur for a period of minutes, rather than hours. However, in order to provide a very conservative assessment of the operation of generators in an emergency event, a 24-hour continuous operation period has been modelled.

6.10 As described in 4.26, the assessment examines the probability that an emergency event lasting for 24-hours would lead to an exceedance of the 1-hour mean objective value for NO_2. The results are presented in Figure 6.

6.11 Figure 6 shows there are a large number of sensitive locations (including residential dwellings, one nursery, one school, and one healthcare centre) where the maximum 24-hour mean concentration could exceed 200 µg/m^3 under worst-case meteorological conditions. Grid failures lasting 24-hours may never occur and are certainly not (based on Ofgem data (Ofgem, 2019)) likely to happen as frequently as once a year. As such it is judged to be very unlikely that an exceedance of the 1-hour mean NO_2 objective would ever occur and the effects are judged to be not significant.

Figure 6: Maximum 24-hour Mean Nitrogen Dioxide Process Contributions from 24-hour Operation of all Generators (µg/m³). Upper Image Shows the Full Extent of the Contours, and Lower Image Shows Zoomed in Area

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Significance of Operational Air Quality Effects

6.12 The operational air quality effects with designed mitigation (detailed in Section 7) are judged to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A1, and takes account of the assessment that:

- annual mean impacts of NO_2 at existing receptors are predicted to be *negligible*;
- during routine testing of the generators (provided they are tested in banks of three and four or fewer), it is highly unlikely pollutant concentrations will cause an exceedance of the 1-hour mean NO_2 air quality objective;
- during routine testing of the generators (provided they are tested in banks of three and four or fewer) there is no risk of an exceedance of the Workplace Exposure Limit;
- based on modelling within this assessment, the chance of an exceedance of the 1-hour mean NO_2 air quality objective occurring during emergency operations are demonstrated to be very low and judged to be not significant; and
- the scenarios and model setup has been based on very conservative assumptions, including that the operation of the generators will occur during the worst meteorological conditions (for dispersion) from any of the three years of chosen meteorological data.

7 Mitigation

Good Design and Best Practice

7.1 The EPUK/IAQM guidance advises that good design and best practice measures should be considered, whether or not more specific mitigation is required. The proposed facility incorporates the following good design and best practice measures, which have been accounted for in the assessment as far as is possible:

- installation of a SCR abatement system for all generators;
- designed systems to operate with a minimum efflux velocity of 40 m/s, to allow for good dispersion of emissions;
- running of the generator flues to roof level (23 m) to enhance the dispersion environment; and
- use of exhaust flues that discharge vertically upwards, unimpeded by any fixture on top of the stack (e.g. rain cowls).

Generator Testing

7.2 Each generator should only be tested for 12 hours per year. The generators should be tested in groups of a maximum of three and four (as described in Paragraph 4.7) to limit the potential for an exceedance of the 1-hour mean threshold concentration of 200 µg/m^3.

8 Conclusions

8.1 The impacts associated with the proposed diesel backup generators at the GB1 Data Centre in Slough have been assessed in relation to the air quality objectives set to protect human health. The assessment has considered an operational scenario of 12 hours testing per generator per year, and an emergency scenario replicating a full power grid failure and 24-hours of continuous operation from all 21 generators.

8.2 The assessment has demonstrated that there will be no impacts in terms of annual mean NO_2 concentrations. The risk of an exceedance of the hourly mean nitrogen dioxide is considered to be low. There is also no risk of an exceedance of the Workplace Exposure Limit.

8.3 Overall, it is considered that the air quality effects associated with the proposed diesel backup generators at GB1 Data Centre, with the generators being tested for 12 hours per year, will be ‘not significant’, as long as the generators are tested in groups of three and four, or fewer.

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10 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
AURN	Automatic Urban and Rural Network
CAZ	Clean Air Zone
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
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/m^3	Microgrammes per cubic metre
MCPD	Medium Combustion Plant Directive
MW$_{th}$	Megawatts Thermal
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	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

OLEV	Office for Low Emission Vehicles
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
RDE	Real Driving Emissions
SCR	Selective Catalytic Reduction
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide

11 Appendices

A1 Professional Experience

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

Ms Wilson is an Associate Director with AQC, with more than 20 years' relevant experience in the field of air quality. She has been responsible for numerous assessments for a range of infrastructure developments including power stations, road schemes, ports, airports and residential/commercial developments. The assessments have covered operational and construction impacts, including odours. She also provides services to local authorities in support of their LAQM duties, including the preparation of Review and Assessment and Action Plan reports, as well as audits of Air Quality Assessments submitted with planning applications. She has provided expert evidence to a number of Public Inquiries, and is a Member of the Institute of Air Quality Management and a Chartered Scientist.

Dr Frances Marshall, MSci PhD MIEnvSc 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.

David Bailey, BSc (Hons) AMIEnvSc

Mr Bailey is a Consultant with AQC, having joined the Company in 2018. Prior to joining AQC he gained a degree in Environmental Science from the University of Brighton, where his studies included modules focused on Air Quality Management. He has experience in air quality and greenhouse gas assessments, with the use of the ADMS-Roads and ADMS-5 dispersion modelling software in many assessments. He has assessed a wide variety of schemes, including large residential EIA developments, gas power generation facilities and agricultural facilities, as well as preparing detailed assessments for Local Authorities. He also has experience in diffusion tube and automatic monitoring, including data ratification.

A2 Modelling Methodology

Model Inputs

A2.1 Model input selections are summarised in Table A2.1, and, where considered necessary, discussed further below. Input emission parameters are presented later in Table A2.2.

Table A2.1: Summary of Model Inputs

Model Parameter	Value Used
Terrain Effects Modelled?	Yes – 12km x 12km Cartesian grid at 50 m resolution
Variable Surface Roughness File Used?	Yes – 12km x 12km Cartesian grid at 50 m resolution
Urban Canopy Flow Used?	No
Building Downwash Effects Modelled?	Yes
Meteorological Monitoring Site	Cippenham S Wks
Meteorological Data Years	2018, 2019, 2020
Dispersion Site Surface Roughness Length (m)	N/A (variable surface roughness file used)
Dispersion Site Minimum MO Length (m)	30
Met Site Surface Roughness Length (m)	0.2
Met Site Surface Minimum MO Length (m)	1

Emissions and Release Conditions

A2.2 The model input parameters for the proposed generators have been derived from the generator datasheets for a Kohler 3,682 kW engine (KD4500-E). Within the proposed development, there will be twenty-one 3,682 kW engines.

A2.3 The pollutant emission rates have been provided by Desco, who confirmed the generators will have an unabated NOx emission rate of 1,493 mg/Nm^3 at 15% O_2. When operating with SCR, the generators will have a reduced NOx emission rate to 190 mg/Nm^3 at 15% O_2.

A2.4 The emissions parameters employed in the modelling are given in Table A2.2; orange highlighted cells contain the values entered into the model. The model input parameters have been calculated based on the complete combustion of the assumed diesel composition in Table A2.3.

Table A2.2: Plant Specifications, Emissions and Release Conditions (per Generator)

Parameter	Kohler KD4500-E
Electrical Power Output (kW_{out})	3,682
Net Input Fuel Rate (kW_{in})	11,918
Gross Input Fuel Rate (kW_{in})	12,720
Gross Fuel Consumption (kg/hr)	1,002
Combustion Air_{in} (kg/h)	19,892
Excess Air (%)	36.4
Exhaust Mass Flow (kg/h) for Actual Flow	20,894
Molar Flow Rate (mol/s) for Actual Flow	200.5
Molecular Mass (g/mol) for Actual Flow	28.9
Exhaust Flow (Am^3/s) for Actual Flow [a,b]	11.99
Flue Internal Diameter (m)	0.6
Exhaust Velocity (Am/s) for Actual Flow	42.4
Exhaust Temperature (ºC)	455
Actual Exhaust O_2 Content (%)	5.3
Actual Exhaust H_2O Content (%)	10.0
Molar Flow Rate (mol/s) for Normalised Flow [c]	457.8
Exhaust Flow (Nm^3/s) for Normalised Flow [c,d]	10.3
NOx Emission Concentration Without SCR (mg/Nm^3) [c]	1,493
NOx Emission Concentration With SCR (mg/Nm^3) [c]	190
PM_{10} Emission Concentration (mg/Nm^3) [c]	0.4
NOx Emission Rate (g/s) Without SCR	15.321
NOx Emission Rate (g/s) With SCR	1.950

Note: The number of significant figures presented should not be taken to represent the accuracy of the information used.

[a] Actual flow conditions in the exhaust at the stated exhaust O_2 and H_2O contents.

[b] Calculated from molar flow rate x 8.3145 x (T+273.13) / 101,325, where T is the temperature in ºC.

[c] At 0 ºC, 101.325 kPa, 15% oxygen, dry.

[d] Calculated from normalised molar flow rate x 8.3145 x (273.13) / 101,325.

Table A2.3: Typical Diesel Fuel Composition

Component	Composition
Carbon	86.5%
Hydrogen	13.2%
Oxygen	0.3%
Net Calorific Value (LHV) (MJ/kg)	42.82
Gross Calorific Value (HHV) (MJ/kg)	45.70
HHV/LHV	1.07
Liquid Density @ 15°C (kg/m^3)	835

Spatial Configuration

A2.5 The stacks have been modelled as twenty-one individual point sources as shown in Figure 3.

A2.6 Entrainment of the plume into the wake of the generator housings (the so-called building downwash effect) and other nearby structures has been taken into account by including these as buildings within the model. Two separate modelling scenarios have been run, with the maximum contribution from any scenario; with on site and nearby buildings, and without any buildings.

Figure A2.1: Modelled Generator Flue Outlet Layout (Red Circles) and Modelled Buildings (Green Rectangles)

A2.7 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. The following parameters have been used in creating this file:

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

A2.8 Local terrain has been included within the model based on OS Terrain 50 data.

Meteorological Inputs

A2.9 Hourly sequential meteorological data from Cippenham S Wks for the years 2018-2020 have been used. The Cippenham S Wks meteorological monitoring station is located approximately 2.3 km to the southwest of the proposed facility site. It is deemed to be the nearest monitoring station representative of meteorological conditions at the proposed facility. Raw data were provided by the Met Office and processed by AQC for use in ADMS.

Model Post-processing

A2.10 The maximum concentrations predicted using any of the three years of meteorological data and the two building scenarios have been used in the preparation of the results set out in Section 5.

A2.11 Emissions from the generators will be predominantly in the form of nitrogen oxides (NOx). ADMS-5 has been run to predict the contribution of the generators to annual mean concentrations of nitrogen oxides and the 100th of 1-hour mean nitrogen oxides. The approach recommended by the Environment Agency (2005) has been used to predict annual mean nitrogen dioxide contributions and the 100th percentile of 1-hour mean nitrogen dioxide contributions. This assumes that:

- annual mean nitrogen dioxide contributions = annual mean nitrogen oxides x 0.7; and
- 100th percentile of 1-hour mean nitrogen dioxide contributions = 100th percentile of 1-hour mean nitrogen oxides x 0.35.

A2.12 These NOx to NO_2 ratios are likely to be overly pessimistic within close proximity of the facility. The NOx emissions require time and O_3 available to react and convert to NO_2, thus 35% NO_X to NO_2 ratio for short-term impacts is considered worst-case for receptors within 500 m of the site.