Air Quality Consultants

Air Quality Assessment for Environmental Permit: GB One Data Centre, Slough

April 2023

Experts in air quality
management & assessment

Document Control

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1 Introduction

1.1 This report describes the air quality assessment for the GB One data centre on land off Ajax Avenue in Slough. The assessment has been prepared to support the Environmental Permit application for the facility, which is made in accordance with Schedule 1, Part 2, Chapter 1, Section 1.1 Part A(1)(a) of the Environmental Permitting Regulations (England and Wales) Regulations 2016, as amended ('EPR'). The assessment has been carried out by Air Quality Consultants Ltd on behalf of GTR Management Services Limited.

1.2 The facility comprises 21 low sulphur diesel oil generators, each with an approximate net thermal fuel input of 11,900 kW_{th}, installed across three buildings. The generators are required for emergency back-up purposes, and thus will be operated for fewer than 50 hours for testing and maintenance. As the generators are individually less than 15 MW_{th}, they are, therefore, excluded from Chapter III of the Industrial Emissions Directive and, as they operate in an emergency back-up capacity, they are excluded from the specified generator requirements under Schedule 25B of the EPR. However, since the thermal input exceeds 1 MW_{th}, the generators are classed as Medium Combustion Plant (MCP) under Schedule 25A but, as each generator's operation is less than 500 hours per annum, the associated emission limit values do not apply. The detailed modelling of emissions associated with the generators is described in this report and the model input files have been packaged as a zip file and sent alongside this report.

1.3 The assessment primarily focuses on nitrogen dioxide (NO_2) for human health, and on nitrogen oxides (NOx) and nutrient and acid nitrogen deposition for ecological impacts, as these are the principal pollutants of concern with respect to emissions from low sulphur diesel oil generators. However, the generators will be installed with Selective Catalytic Reduction (SCR) technology to control the NOx emissions; thus, the assessment also considers the potential for emissions of ammonia (NH_3) associated with slippage[1]. The generators are fuelled by low sulphur diesel oil, which may result in low levels of emissions of sulphur dioxide and particulate matter. However, these emissions will be negligible due to the properties of the fuel, as evidenced by the absence of emission limit values for these pollutants from this fuel type under Schedule 25A of the EPR. Potential emissions of volatile organic compounds and carbon monoxide are excluded on the same basis.

1.4 Table 1 gives the site location. Table 2 summarises the modelled scenarios and sensitivity tests that have been carried out.

[1] This is a worst-case approach, since the manufacturers of the SCR equipment have guaranteed that there will be no ammonia slip.

Table 1: Site Location

Parameter	Entry
Site Name	GB One Data Centre
Site Address	Ajax Avenue, Slough, SL1 4BG
Grid Reference (Centre of Facility) (O.S. X,Y)	495964, 180761

Table 2: Summary of Model Scenarios and Sensitivity Tests

Parameter	Entry
Year for Baseline Conditions	Most recent year of available measurements/predictions [a] – no improvement assumed into the future (see Section 5)
Operating Hours	The testing and maintenance regime is based on an hourly test every month. The generators are, therefore, scheduled to operate for 12 hours per year. The dispersion model has been run assuming continuous operation, with the annual mean outputs scaled to reflect the non-continuous use. The assessment has also considered a worst-case emergency situation lasting 24 hours, and, at the request of the Environment Agency (EA), 72 hours.
Meteorological Conditions	Five separate years of meteorological data modelled.
Building Wake Effects	For each meteorological year, the model has been run with and without nearby buildings.

[a] Due to the impacts of the Covid-19 pandemic on road activities, 2019 is deemed the most appropriate baseline.

2 Site Description

Nearby Sensitive Features

2.1 The facility is located in the Slough Trading Estate, to the west of the centre of Slough. Figure 1 shows the site location and focusses on the area within 10 km of the facility, highlighting the locations of the nearest internationally-designated ecological sites (Burnham Beeches Special Area of Conservation (SAC), Windsor Forest and Great Park SAC and South West London Waterbodies Special Protection Area (SPA) and Ramsar).

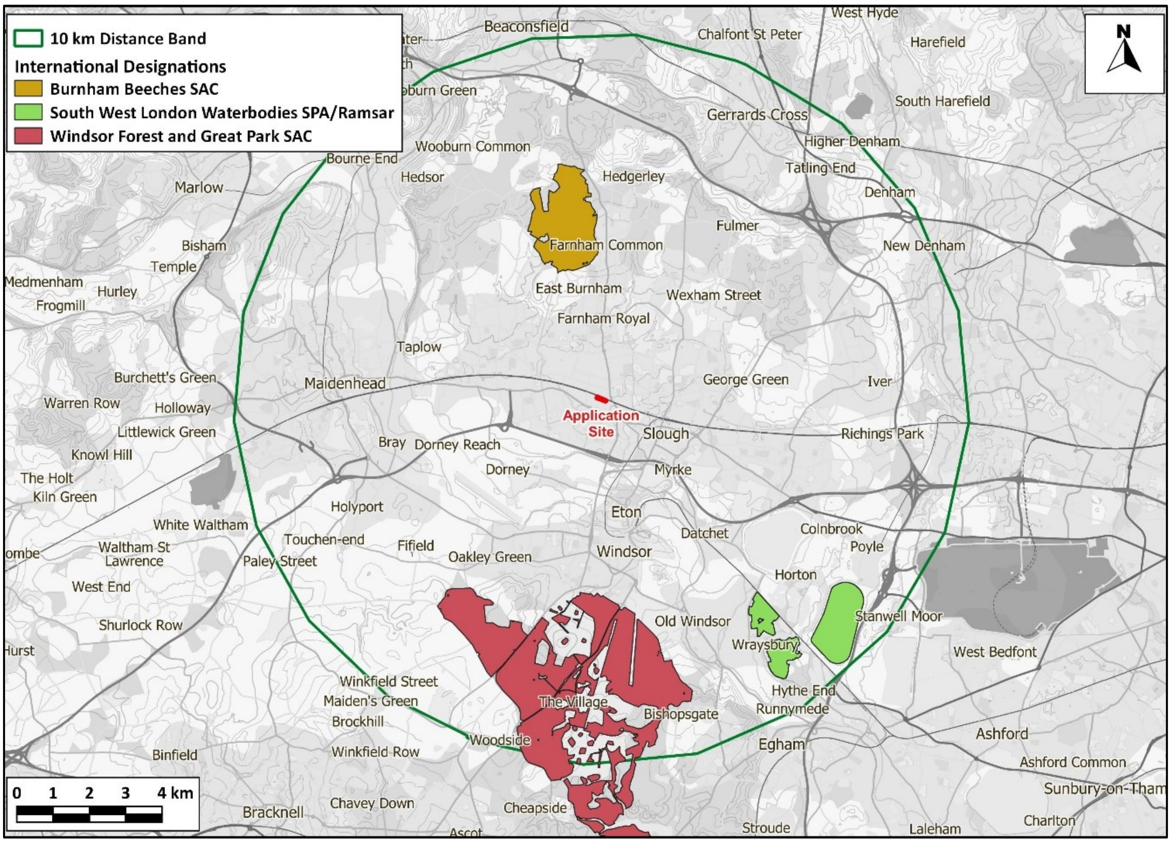

Figure 1: Site Location and Designated Habitats within 10 km

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2.2 Figure 2 presents similar information but focussing on the area within 2 km of the facility, and shows the location of locally designated habitats, including Haymill Valley Local Nature Reserve (LNR) and Local Wildlife Site (LWS), Railway Triangle LWS and Jubilee River and Dorney Wetlands LWS. Figure 2 also shows the extents of the nearest Slough Air Quality Management Areas (AQMAs).

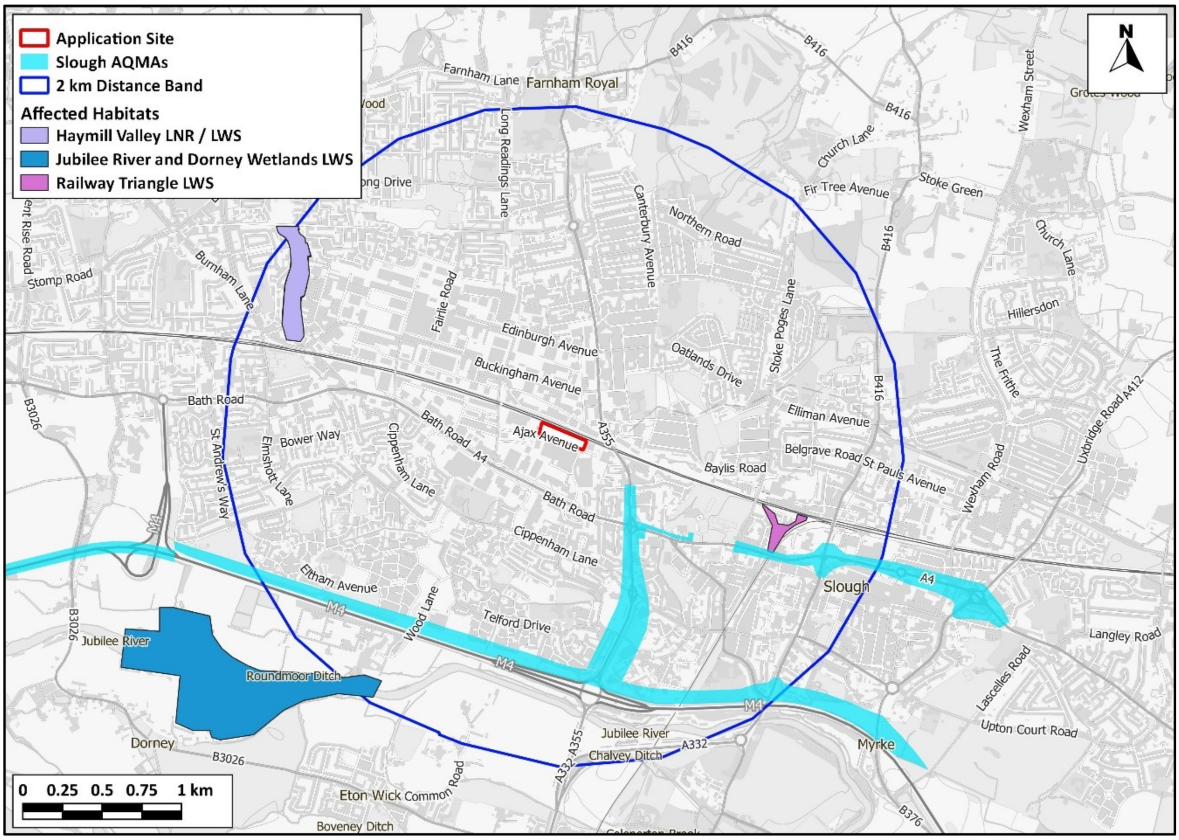

Figure 2: Site Location, Local Habitat Designations and AQMAs within 2 km

2.3 The EA's Public Register (EA, 2023a) identifies five other datacentres within 1 km of the facility that currently hold an Environmental Permit. These include:

- 628 – 635 Ajax Avenue, operated by Cyxtera Technology UK Limited, which was granted a permit (reference EPR/YTP3935QM) in 2019;
- 665 – 670 Ajax Avenue, operated by NTT Global Data Centres EMEA UK Limited, which was granted a permit (reference EPR/YP3633QA) in 2022;
- 225 Bath Road, operated by CyrusOne (London 4) UK Limited, which was granted a permit (reference EPR/EP3508PS) in 2022;
- Equinix Slough Campus, operated by Equinix (UK) Limited, which was granted a permit (reference EPR/LP3205LW) in 2021; and
- Equinix Slough Campus, operated by Equinix (UK) Limited, which was granted a permit (reference EPR/LP3303PR) in 2022.

2.4 Potential emissions from these data centres have not been explicitly modelled in this assessment due to insufficient data to parameterise the releases. The testing operation across the various data centres would have to coincide for cumulative effects to occur which, given the infrequent operation of generators in data centres, would be a low probability outcome. Notwithstanding this, even if testing operations were to coincide at more than on site simultaneously, maximum impacts from different point source emissions rarely coincide spatially or temporally.

2.5 Table 3 summarises the proximity of nearby sensitive features.

Table 3: Summary of Nearby Sensitive Features

Feature	Description	Distance from Stacks
Nearest Roadside [a] Human Receptor	Astoria Heights, adjacent to the A355 to the northeast of the stacks	250 m
Nearest Non-roadside Human Receptor	Residential property off Hadlow Court to the southeast of the stacks.	265 m
Nearest Ecological Site	Railway Triangle (off Stranraer Gardens) LWS	1,200 m
Receptors within the Downwash Cavity Length from the Nearest Edge/Side of the Building?	There are potentially receptors downwind of the building within the region of potential downwash effects (135 m)	n/a
Sensitive Receptor Setting	Urban	n/a
Sensitive Receptors Near an A Road or Motorway Network?	Yes	n/a
Sensitive Receptors within an AQMA Declared for NO_2?	Yes	n/a

[a] Defined as those receptors within 15 m of a busy road, carrying more than 10,000 vehicles daily.

Topography and Terrain

2.6 Figure 3 shows the terrain across the modelled study area using Ordnance Survey (OS) Terrain 50 data.

2.7 The area immediately surrounding the site is broadly flat, such that the bases of the buildings from which the stacks exhaust are approximately at the same elevation as the base of the nearby buildings and nearest human health receptors.

2.8 Whilst this is true for the immediate site surroundings, there are areas in the wider model domain where terrain heights exceed the height of the stacks and, consequently, terrain has been included.

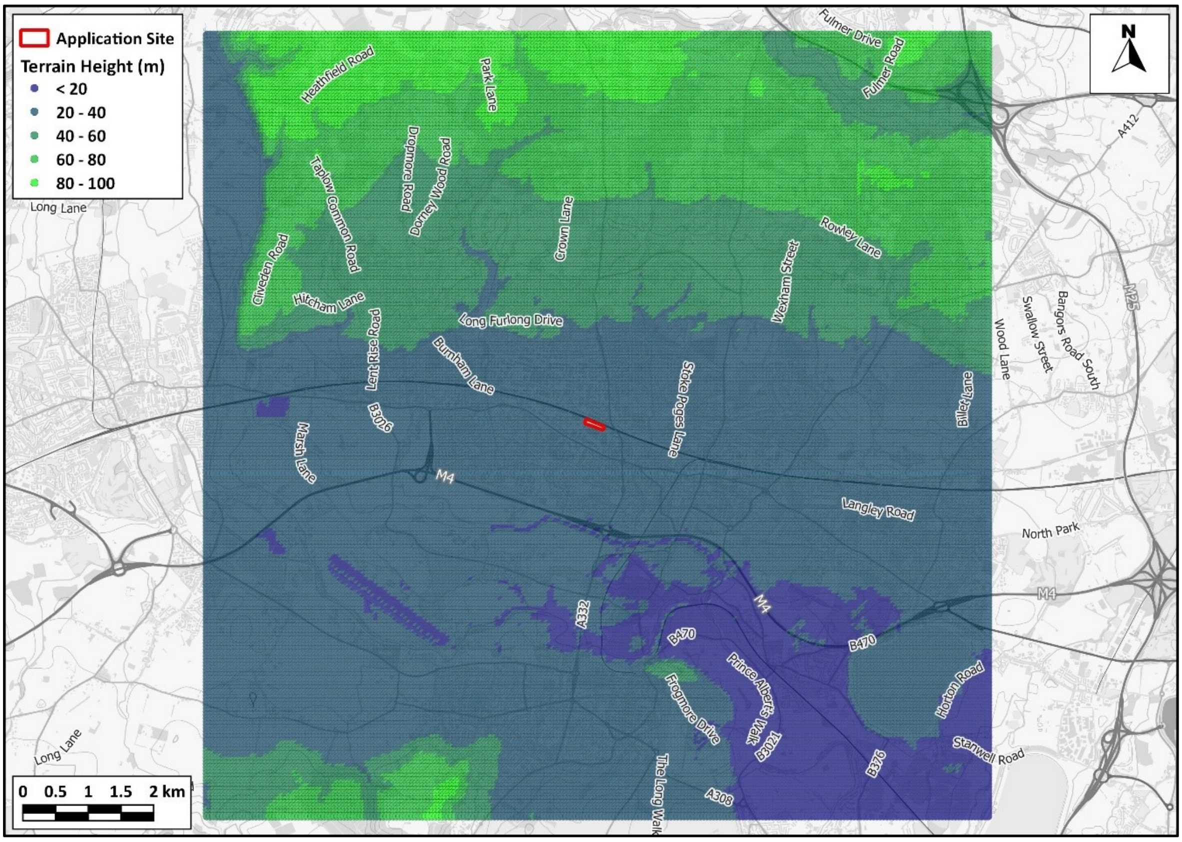

Figure 3: Terrain across Modelled Area

3 Description of Process

Overview of Plant Requiring Permit

3.1 The facility comprises 21 Kohler SDMO generators fuelled by low sulphur diesel oil. The generators each have a net thermal input capacity of ~11,918 kW_{th} (~12,720 kW_{th} gross thermal input), resulting in a total net site capacity of 250 MW_{th} in standby mode.

3.2 The combustion gases will be exhausted from individual, vertical stacks for each engine terminating at 23 m above ground level. As part of the testing and maintenance regime, the generators will be tested monthly for an hour, totalling 12 hours per year per generator. Figure 4 shows the site plan and layout. Basic plant details are given in Table 4 and Table 5.

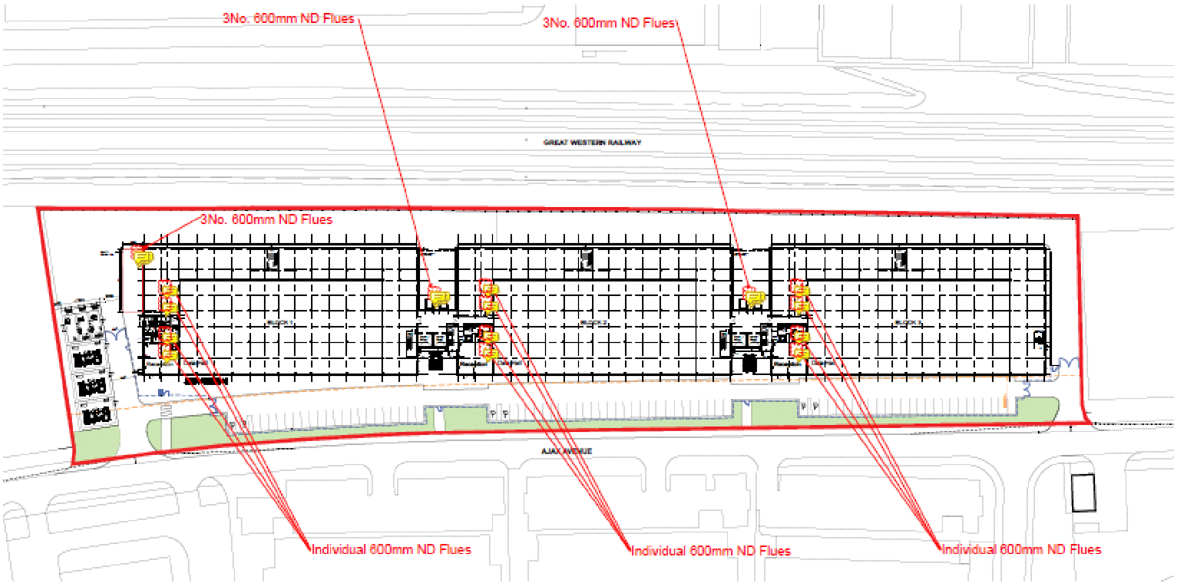

Figure 4: Site Layout

Contains data provided by Langley Hall Associates Ltd, drawing number 4640-S1-001, Revision P6

Table 4: Plant Information

Parameter	Value
Net Rated Thermal Input	250.3 MW_{th}
Operational Hours per Year [a]	12
Do the Generators have Secondary Abatement Fitted?	Yes
Unabated NOx Emission Rate (273 K, dry and 15% O_2)	1,493 mg/Nm^3 [b]
Abated NOx Emission Rate (273 K, dry and 15% O_2)	190 mg/Nm^3 [b]

[a] Comprising a monthly test for an hour.

[b] As the generators will not operate for more than 500 hours, the emission limits set out in the MCP Directive do not apply.

Table 5: Stack and Building Information

Parameter	Value
Stack Height above Ground	23 m
Internal Stack Diameter at Point of Release	600 mm
Is there One or More Buildings within 5L and with Heights More than 40% of the Stack Height?	Yes
Height of Tallest Building within 5L	23 m
Length of Tallest Building within 5L	265 m
Width of Tallest Building within 5L	37 m

Operating Conditions

3.3 Aside from an emergency loss of off-site power event, the generators will be tested monthly in groups of three or four as follows:

- Sources A1 – A3 (side of Block 1 at roof level);
- Sources A4 – A7 (on the roof of Block 1);
- Sources A8 – A10 (side of Block 2 at roof level);
- Sources A11 – A14 (on the roof of Block 2);
- Sources A15 – A17 (side of Block 3 at roof level); and
- Sources A18 – A21 (on the roof of Block 3).

3.4 During an emergency loss of off-site power situation, all of the generators may be required to operate simultaneously; the assessment has considered this scenario for two operating periods: 24 hours and 72 hours, respectively.

3.5 The generators will be installed with secondary abatement in the form of SCR. The secondary abatement needs to reach a minimum temperature (~250 ˚C) in order to be effective. As such, during each testing period, for a short period (no more than 15 minutes) between start-up of the engines and reaching a sufficient temperature for the abatement to be fully functional, emissions from the generators will be at the unabated emission concentration (1,493 mg/Nm^3). For the remaining 45 minutes of the testing regime, the emissions from the generators will meet the abated (190 mg/Nm^3) emission concentration. The emissions used in the assessment have, therefore, been time-weighted accordingly, with a time-weighted hourly average emission rate calculated based on 15-minutes operating at 1,493 mg/Nm^3 and 45 minutes operating at 190 mg/Nm^3 for each modelled hour.

4 Environmental Standards for Air

4.1 The relevant Air Quality Standards (AQS) for human health impacts are set out in Table 6 (EA, 2023b).

Table 6: AQS for Human Health

Pollutant	Averaging Period	AQS (µg/m^3)	Acceptable Exceedance Criteria
NO_2	Annual Mean	40	Zero exceedances
	1-hour Mean	200	Not to be exceeded more than 18 times a year

4.2 The AQS for NO_2 are defined as UK objectives within the Air Quality (England) Regulations (2000) and the Air Quality (England) (Amendment) Regulations (2002). The same numerical values are also set as European Limit values (The European Parliament and the Council of the European Union, 2008).

4.3 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, 2022). The annual mean objectives 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. Neither the objectives nor limit values apply in places of work where members of the public have no free access and where relevant provisions concerning health and safety at work apply (AQC, 2016).

4.4 In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values and specific monitor and receptor siting requirements apply.

4.5 Table 7 sets out the relevant critical levels and critical loads for the designated ecological sites in the study area, as taken from the Air Pollution Information System (APIS) website (APIS, 2023). Many of the habitats are designated for a number of sensitive features; the critical loads for the most sensitive features, have therefore been used in the assessment.

4.6 EA guidance (EA, 2023b) states that a value of 200 µg/m^3 for the 24-hour mean NOx AQS can be applied in locations where "*the ozone concentration is below the AOT40 critical level and sulphur dioxide concentration is below the lower critical level of 10 µg/m^3*". Baseline concentrations of these pollutants are discussed in Section 5.

4.7 The AQS for designated ecological sites apply within the boundary of each designated site.

Table 7: AQS for Designated Ecological Sites

Site	Maximum 24-hour Mean NOx	Annual Mean			
		NOx	NH_3	Nutrient Nitrogen Deposition	Acid Deposition [a]
Burnham Beeches SAC	200 µg/m^3	30 µg/m^3	1 µg/m^3 [b]	10 kgN/ha/yr [c]	2.056 keq/ha/yr [c]
Windsor Forest and Great Parks SAC				10 kgN/ha/yr [d]	1.044 keq/ha/yr [d]
South West London Waterbodies SPA and Ramsar				No comparable habitat with established critical load estimate available	Species is not sensitive due to acidity impacts on broad habitat
Haymill Valley LNR and LWS				10 kgN/ha/yr [e]	2.048 keq/ha/yr [e]
Railway Triangle LWS				10 kgN/ha/yr [f]	1.103 keq/ha/yr [f]
Jubilee River and Dorney Wetlands LWS				10 kgN/ha/yr [g]	1.103 keq/ha/yr [g]

a MinCLMaxN

b For a conservative assessment, it is assumed that lichens and bryophytes are present at all locations, and thus the lower critical level applies.

c Critical load applies to beech forests, EUNIS code G1.6 (Fagus woodland).

d Critical load applies to beech forests (EUNIS code G1.6 - Fagus woodland), oak woods (EUNIS code G1.8 - Acidophilous Quercus-dominated woodland) and limoniscus violaceus (EUNIS code G1 – Broadleaved deciduous woodland).

e Critical load applies to broadleaved deciduous woodland, EUNIS code G1. In addition to woodland, the LWS is also designated for reedbeds (fen, marsh and swamp).

f Critical load applies to acid grassland, EUNIS code E1.7. In addition to grassland, the LWS is also designated for woodland.

g Critical load applies to acid grassland, EUNIS code E1.7. In addition to grassland, the LWS is also designated for reedbeds (fen, marsh and swamp), scrapes and islands, new plantations and scrub.

5 Baseline Conditions

Human Health

Defra Backgrounds

5.1 Figure 5 sets out the background annual mean NO_2 concentrations in the study area taken from the 2018-Defra published maps for 2023 (Defra, 2023a).

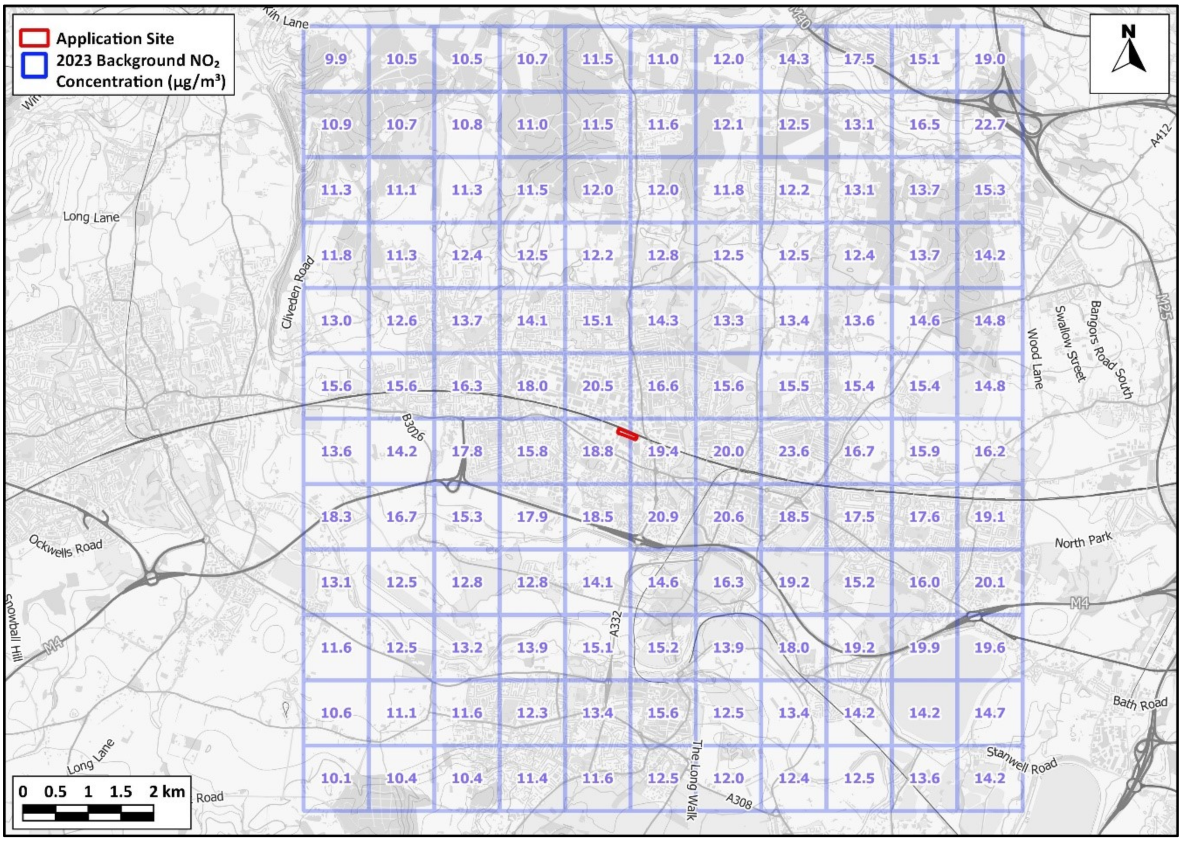

Figure 5: Defra's Predicted NO_2 Background Concentrations in 2023 (µg/m³)

Local Monitoring

5.2 Figure 6 shows the annual mean NO_2 concentrations for the nearest sites to the application site, as measured by Slough Borough Council (SBC) in 2019, which is the most recent year of available, and representative, monitoring[2]. Measurements made by SBC between 2015 and 2019 are also tabulated in Table 8.

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2 Measured concentrations of nitrogen dioxide were affected by the reduced mobility during the Covid-19 pandemic, leading to large reductions in concentrations 2020 and 2021 compared to 2019.

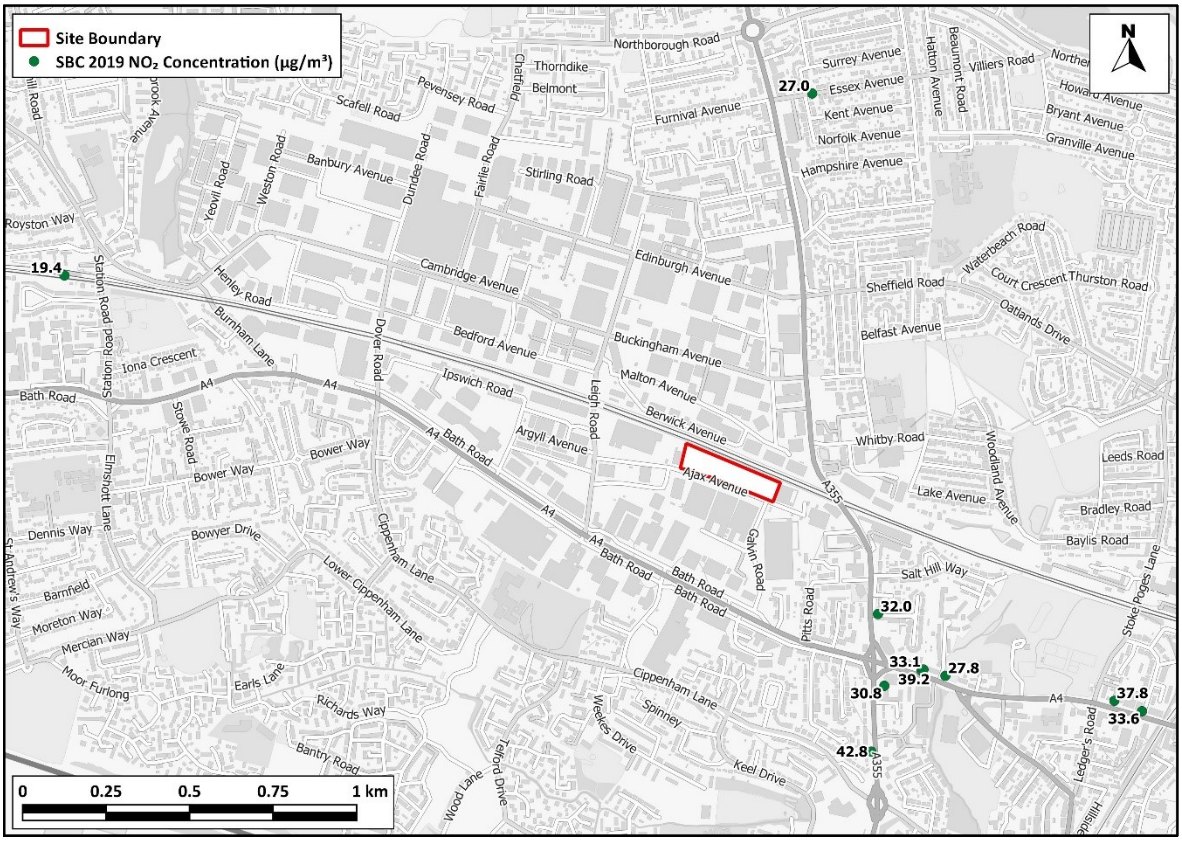

Figure 6: Measured 2019 Annual Mean NO_2 Concentrations in the Area Surrounding the Site (µg/m³)

Table 8: Summary of Annual Mean NO_2 Monitoring [a, b, c]

Site ID	Site Type	Location	2015	2016	2017	2018	2019
SLH12	Roadside	Slough Windmill Bath Road	-	-	**41.5**	**42.0**	39.2
SLO1	Urban Background	Salt Hill	32.4	32.3	31.1	28.1	27.8
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
SLO31	Suburban	Essex Avenue	30.1	30.9	28.7	27.0	27.0
SLO37	Roadside	Blair Road – Victoria Court	**43.4**	**47.6**	**45.3**	39.9	37.8
SLO41	Other	Sandringham Court	32.3	25.9	25.9	21.9	19.4
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] Data taken from the SBC Annual Status Report (Slough Borough Council, 2020).

[b] Diffusion tubes prepared and analysed by Gradko International Ltd (using the 50% TEA in acetone method) and adjusted for bias by SBC.

[c] Exceedances of the AQS are shown in bold.

Summary of Baseline NO_2 Concentrations

5.3 Table 9 sets out the baseline NO_2 concentrations used in this assessment.

Table 9: Baseline NO_2 Concentrations Used in Assessment

Location	Value (µg/m³)	Derivation
Annual Mean Concentrations		
All Receptors Close to Roads	42.8	Highest concentration across all of the roadside measurements in the study area
All Receptors Away from Roads	30.8	Highest concentration across all of the background measurements and all of the mapped background concentrations in the study area
1-hour Mean Concentrations		
All Receptors Close to Roads	85.6	2 x the annual mean
All Receptors Away from Roads	61.6	

Designated Ecological Sites

5.4 The estimated annual mean background NOx concentrations at the designated ecological sites have been derived using Defra's background maps (Defra, 2023a). The baseline annual mean NH_3 concentrations and nutrient nitrogen and acid deposition fluxes have been defined using APIS (2023) and are 1 km x 1 km grid square averages based on the three-year mean between 2018 and 2020.

5.5 The derived values are presented in Table 10. Aside from South West London Waterbodies SPA and Ramsar, the NOx concentrations are below the critical level of 30 µg/m³. Baseline ammonia concentrations exceed the critical level, assuming lichens and bryophytes are present, at all habitats. Baseline nutrient and acid nitrogen deposition fluxes at most sites are above the critical loads, which is the case for very many designated ecological sites across the UK; the exception is at Jubilee River and Dorney Wetlands LWS, where the baseline acid nitrogen deposition flux is below the critical load.

5.6 Table 11 sets out the baseline values used in this assessment.

Table 10: Background NOx and NH_3 Concentrations and Deposition Fluxes at Designated Ecological Sites

Site	Annual Mean NOx (µg/m^3)		Annual Mean NH_3 (µg/m^3)		Nutrient Nitrogen Deposition (kgN/ha/yr)		Acid Deposition (keq/ha/yr)	
	Value	Critical Level	Value	Critical Level	Value	Critical Load	Value	Critical Load
Burnham Beeches SAC	14.2 – 16.2	30	1.7 – 2.0	1	29.3 – 31.1	10	2.2 – 2.4	2.1
Windsor Forest and Great Parks SAC	12.7 – 16.8		1.6 – 1.8		26.9 – 28.2	10	2.0 – 2.1	1.0
South West London Waterbodies SPA and Ramsar	17.4 – 41.3		1.8 – 2.1		- [a]	- [a]	- [b]	- [b]
Haymill Valley LNR and LWS	19.3 – 25.7		2.2		32.8	10	2.5	2.0
Railway Triangle LWS	29.3		2.0		31.3	10	2.4	1.1
Jubilee River and Dorney Wetlands LWS	17.3 – 25.2		1.8		15.3	10	1.2	4.4

[a] No comparable habitat with established critical load estimate available.

[b] No expected negative impact on the species due to impacts on the species' broad habitat.

Table 11: Baseline NOx and NH_3 Concentrations and Deposition Fluxes Used in Assessment

Pollutant and Averaging Period	Value	Derivation
Burnham Beeches SAC		
Annual Mean NOx (µg/m^3)	16.2	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	32.4	2 x the annual mean
Annual Mean NH_3 (µg/m^3)	2.0	Maximum from Table 10
Nutrient Nitrogen Deposition (kgN/ha/yr)	31.1	Maximum from Table 10
Acid Deposition (keq/ha/yr)	2.4	Maximum from Table 10
Windsor Forest and Great Parks SAC		
Annual Mean NOx (µg/m^3)	16.8	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	33.6	2 x the annual mean
Annual Mean NH_3 (µg/m^3)	1.8	Maximum from Table 10
Nutrient Nitrogen Deposition (kgN/ha/yr)	28.2	Maximum from Table 10
Acid Deposition (keq/ha/yr)	2.1	Maximum from Table 10
South West London Waterbodies SPA and Ramsar		
Annual Mean NOx (µg/m^3)	41.3	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	82.6	2 x the annual mean

Pollutant and Averaging Period	Value	Derivation
Annual Mean NH_3 (µg/m^3)	2.1	Maximum from Table 10
Haymill Valley LNR and LWS		
Annual Mean NOx (µg/m^3)	25.7	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	51.4	2 x the annual mean
Annual Mean NH_3 (µg/m^3)	2.2	Table 10
Nutrient Nitrogen Deposition (kgN/ha/yr)	32.8	Table 10
Acid Deposition (keq/ha/yr)	2.5	Table 10
Railway Triangle LWS		
Annual Mean NOx (µg/m^3)	29.3	Table 10
Maximum 24-hour Mean NOx (µg/m^3)	58.6	2 x the annual mean
Annual Mean NH_3 (µg/m^3)	2.0	Table 10
Nutrient Nitrogen Deposition (kgN/ha/yr)	31.3	Table 10
Acid Deposition (keq/ha/yr)	2.4	Table 10
Jubilee River and Dorney Wetlands LWS		
Annual Mean NOx (µg/m^3)	25.2	Maximum from Table 10
Maximum 24-hour Mean NOx (µg/m^3)	50.4	2 x the annual mean
Annual Mean NH_3 (µg/m^3)	1.8	Table 10
Nutrient Nitrogen Deposition (kgN/ha/yr)	15.3	Table 10
Acid Deposition (keq/ha/yr)	1.2	Table 10

Ozone and Sulphur Dioxide Concentrations

5.7 The nearest monitoring site measuring concentrations of sulphur dioxide is London North Kensington, which is approximately 28 km east of the application site. Measured annual mean concentrations between 2018 and 2022 ranged from 0.6 µg/m^3 to 2.3 µg/m^3 (Defra, 2023b), which are well below the lower critical level of 10 µg/m^3.

5.8 Defra's ozone AOT40 compliance data 2021, for the Local Authorities within which the designated habitats are located, show compliance at all locations with the long-term objective (6,000 µg/m^3 hours) (Defra, 2023c).

5.9 It is, therefore, appropriate to apply a NOx daily mean critical level of 200 µg/m^3 at the assessed designated habitats as both sulphur dioxide and ozone would be expected to be below their respective critical level.

6 Modelling Methodology

6.1 Modelling has been carried out in line with EA documents:

- Air emissions risk assessment for your environmental permit (EA, 2023b); and
- Environmental permitting: air dispersion modelling reports (EA, 2023c).

Dispersion Model

6.2 There are two primary dispersion models which are used extensively throughout the UK for assessments of this nature and accepted as appropriate air quality modelling tools by the Regulators and local planning authorities alike:

- The ADMS model, developed in the UK by Cambridge Environmental Research Consultants (CERC) in collaboration with the Met Office, National Power and the University of Surrey; and
- The AERMOD model, developed in the United States by the American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee (AERMIC).

6.3 Both models are termed 'new generation' Gaussian plume models, parameterising stability and turbulence in the planetary boundary layer (PBL) by the Monin-Obukhov length and the boundary layer depth. This approach allows the vertical structure of the PBL to be more accurately defined than by the stability classification methods of earlier dispersion models. Like these earlier models, ADMS and AERMOD adopt a symmetrical Gaussian profile of the concentration distribution in the vertical and crosswind directions in neutral and stable conditions. However, unlike earlier models, the ADMS and AERMOD vertical concentration profile in convective conditions adopts a skewed Gaussian distribution to take account of the heterogeneous nature of the vertical velocity distribution in the Convective Boundary Layer (CBL).

6.4 Numerous model inter-comparison studies have demonstrated little difference between the output of ADMS and AERMOD, except in certain scenarios, such as in areas of complex terrain (Carruthers et al., 2011). For the purposes of this particular study, the use of the ADMS model (version 5.2) is adopted. ADMS is widely used for assessments of this type and has been extensively validated (CERC, 2023). Consequently, it is considered suitable for the current assessment.

Emission Parameters

6.5 Operational parameters for exhaust temperature, net fuel input and exhaust mass flow rate have been determined from the generator product specification datasheets (see Appendix A1). These have been used as the basis for the combustion, exhaust and pollutant emission calculations, alongside the emission rates for the generators before, and after, abatement is applied. The stack diameter and stack height has been provided by Desco.

6.6 The combustion parameters have been calculated for diesel oil with a composition as defined in Table 12. The specified parameters are based on the complete combustion of the fuel used. The volume of combustion air has been calculated to ensure the exhaust gas mass flow rate (kg/h) of the combustion products matches the amount stated in the technical data sheet in Appendix A1 when operating at full load.

Table 12: Typical Diesel Oil Composition

Parameter	Value
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

6.7 There will be a very small proportion of other components in the fuel, however, the main components (components with >0.1%) are included in the above. Based on this fuel, and assuming complete combustion, the plant parameters are shown in Table 13. Orange highlighted cells contain the values entered into the model, for ease of reference.

6.8 Whilst the generator manufacturer has supplied a zero ammonia slippage guarantee for the SCR system, a conservative estimate of ammonia emissions, assuming an emission concentration of 10 mg/Nm^3, has been adopted for the assessment.

Table 13: Plant Specifications, Emissions and Release Conditions (per Engine)

Parameter	Value
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 dry)	19,892
Excess Air (%)	36.4
Exhaust Mass Flow (kg/h) for Actual Flow	20,894
Molar Flow Rate (mol/s) for Actual Flow	201
Molecular Mass (g/mol) for Actual Flow	28.9
Exhaust Flow (Am^3/s) [a, b] for Actual Flow	12.0
Stack Internal Diameter (m)	0.6

Parameter	Value
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	48,509
Exhaust Flow (Nm^3/s) [c,d] for Normalised Flow	10.3
Unabated NOx Emission Concentration (mg/Nm^3) [d]	1,493
Unabated NOx Emission Rate (g/s)	15.32
Abated NOx Emission Concentration (mg/Nm^3) [d]	190
Abated NOx Emission Rate (g/s)	1.95
Average Hourly NOx Emission Rate (g/s) [e]	5.29
NH_3 Emission Concentration (mg/Nm^3) [d]	10
NH_3 Emission Rate (g/s)	0.10

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

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

[e] Assuming 15 minutes at unabated emission rate, and 45 minutes at abated emission rate.

6.9 The physical parameters for the sources included in the modelling are outlined in Table 14. The stacks have been modelled as 21 individual point sources.

Table 14: Modelled Physical Release Emission Parameters for the Facility

Source	Modelled Release Emission Parameters				
	Source Type	X-Coordinate	Y-Coordinate	Height above Ground (m)	Associated Building
A1	Point	495844.4	180828.6	23	Block 1
A2		495845.5	180828.1		
A3		495844.6	180827.5		
A4		495848.4	180815.8		
A5		495846.6	180811.2		
A6		495843.3	180803.0		
A7		495841.5	180798.4		
A8		495920.7	180785.0		Block 2
A9		495921.8	180784.5		
A10		495920.8	180783.9		
A11		495935.8	180781.0		
A12		495934.0	180776.4		
A13		495930.7	180768.2		
A14		495928.9	180763.6		
A15		496006.4	180750.3		Block 3
A16		496007.5	180749.9		
A17		496006.5	180749.2		
A18		496020.6	180746.7		
A19		496018.8	180742.1		
A20		496015.6	180733.9		
A21		496013.7	180729.3		

Receptors and Study Area

6.10 Impacts have been predicted over a 10 km x 10 km model domain, with the facility at the centre. Concentrations have been predicted over this area using nested Cartesian grids (see Figure 7). 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 of the facility;
- 50 m x 50 m within 1,000 m of the facility;
- 250 m x 250 m within 2,000 m of the facility; and

- 500 m x 500 m within 5,000 m of the facility.

6.11 This grid is considered to provide a sufficiently high resolution to enable the identification of worst-case impacts throughout the study area. The receptor grid has been modelled at a height of 1.5 m above ground level.

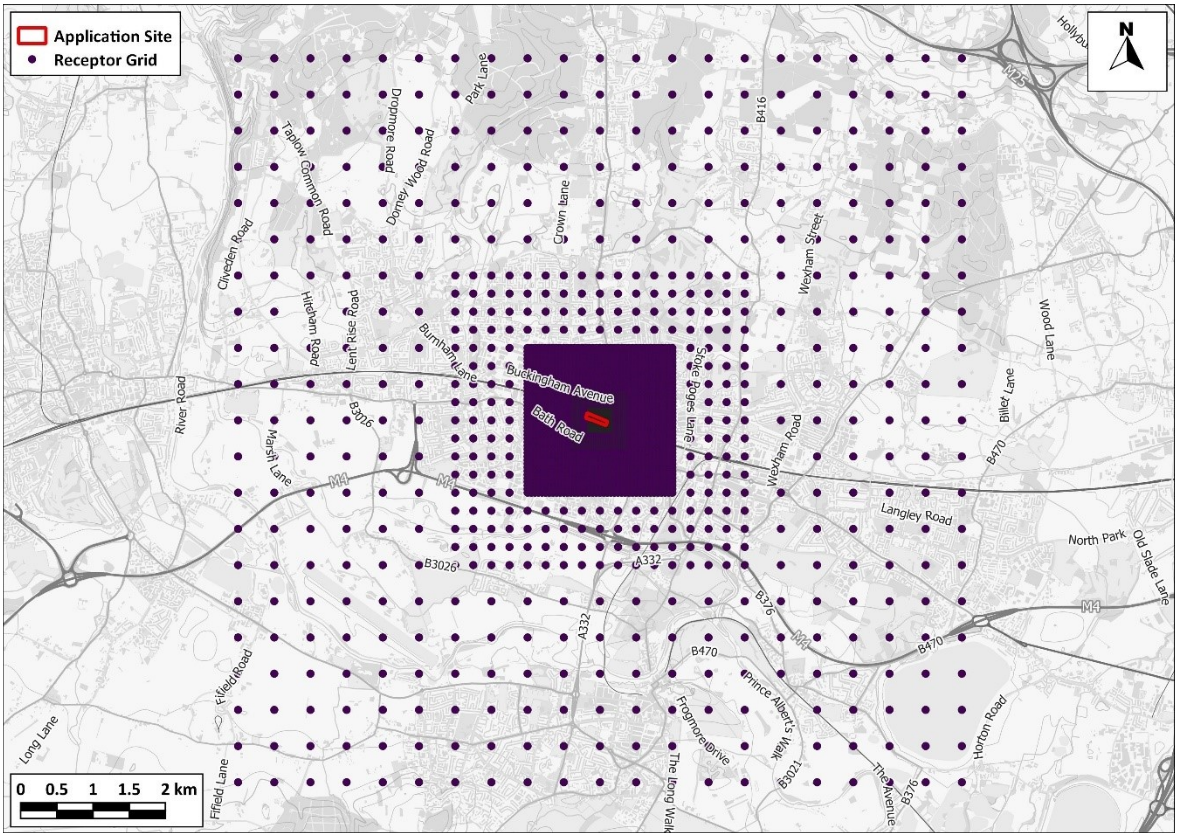

Figure 7: Nested Grid of Modelled Receptors

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6.12 Specific receptors have also been selected to determine impacts at locations where the AQS apply. The specific receptors identified are detailed in Table 15 and shown in Figure 8.

Table 15: Specific Human Health Receptor Coordinates

Receptor ID	Description	Baseline Setting	X Coordinate	Y Coordinate
R1	Residential property on Thirkleby Close	Away from roads	496073.4	180422.3
R2	Residential property on Hadlow Court	Away from roads	496177.5	180522.0
R3	The Gym Group, Slough	Away from roads	496285.6	180793.6

Receptor ID	Description	Baseline Setting	X Coordinate	Y Coordinate
R4	Residential property on Buckingham Avenue East	Away from roads	496241.7	181028.4
R5	Kent House, Berwick Avenue	Away from roads	495636.6	180984.4
R6	Bright Horizons Slough Day Nursery	Away from roads	495289.5	181014.3
R7	Residential property on A4	Roadside	495090.3	180826.3
R8	Residential property on Egremont Gardens	Away from roads	495249.9	180510.3
R9	Herschel Grammar School on Northampton Avenue	Away from roads	496384.3	180909.5
R10	Residential property on Twinches Lane	Away from roads	495672.5	180321.9
R11	Judds House on Whitby Road	Away from roads	496255.9	180893.1
R12	Astoria Heights Apartments on A355	Roadside	496213.7	180875.6

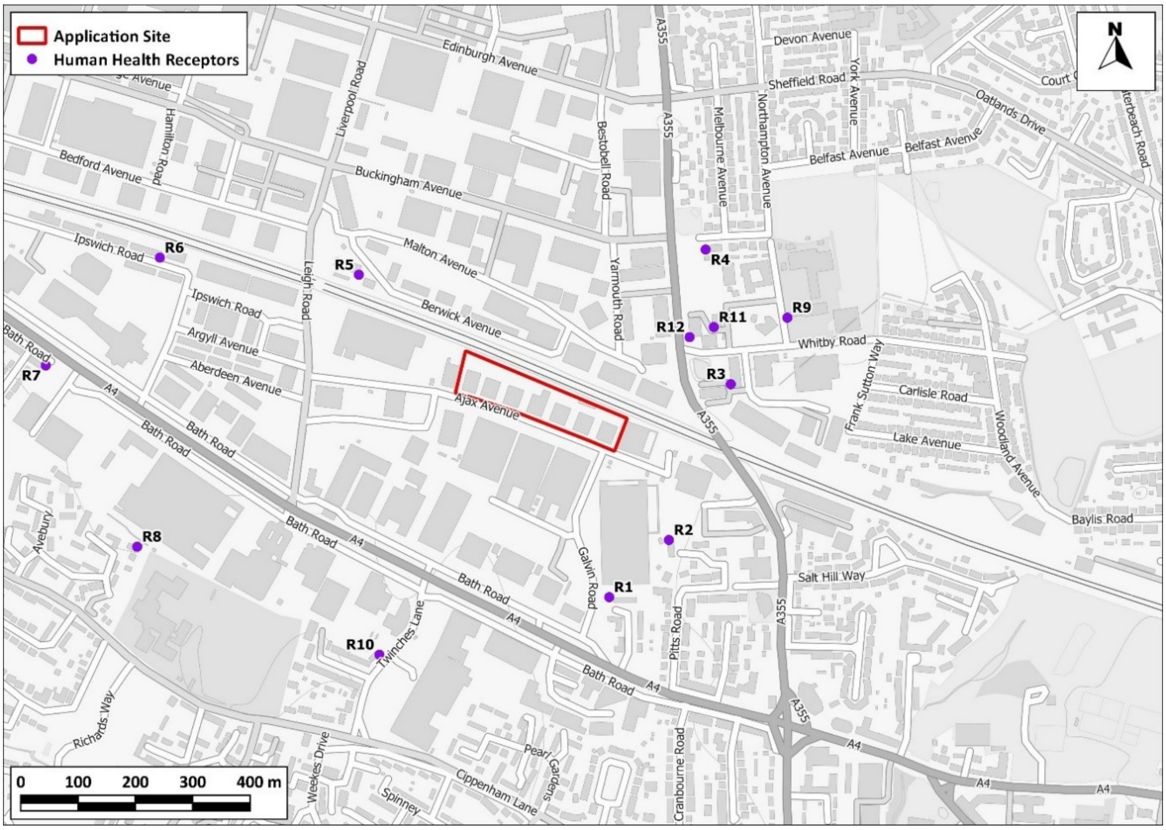

Figure 8: Modelled Discrete Human Health Receptors

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6.13 In addition, specific receptors have been modelled at the boundaries of the designated ecological sites closest to the facility. Receptors have been modelled at 1.5 m above ground level to be consistent with Defra's national modelling of ecosystem impacts. The grid references for these specific locations are presented in Table 16, and their locations are shown in Figure 9.

Table 16: Specific Ecological Receptor Coordinates

Receptor ID	Designated Ecological Site	X Coordinate	Y Coordinate
JR1	Jubilee River and Dorney Wetlands	494812.4	179223.0
HV2	Haymill Valley	494322.6	181393.4
HV3	Haymill Valley	494365.6	181898.0
BB4	Burnham Beeches	494748.1	184243.4
BB5	Burnham Beeches	495626.3	184486.1
RT6	Railway Triangle	497212.9	180323.7
RT7	Railway Triangle	497245.2	180041.1
SW8	South West London Waterbodies	500242.5	175444.2
WF9	Windsor Forest and Great Park	495842.1	175418.3
WF10	Windsor Forest and Great Park	492409.2	175520.3

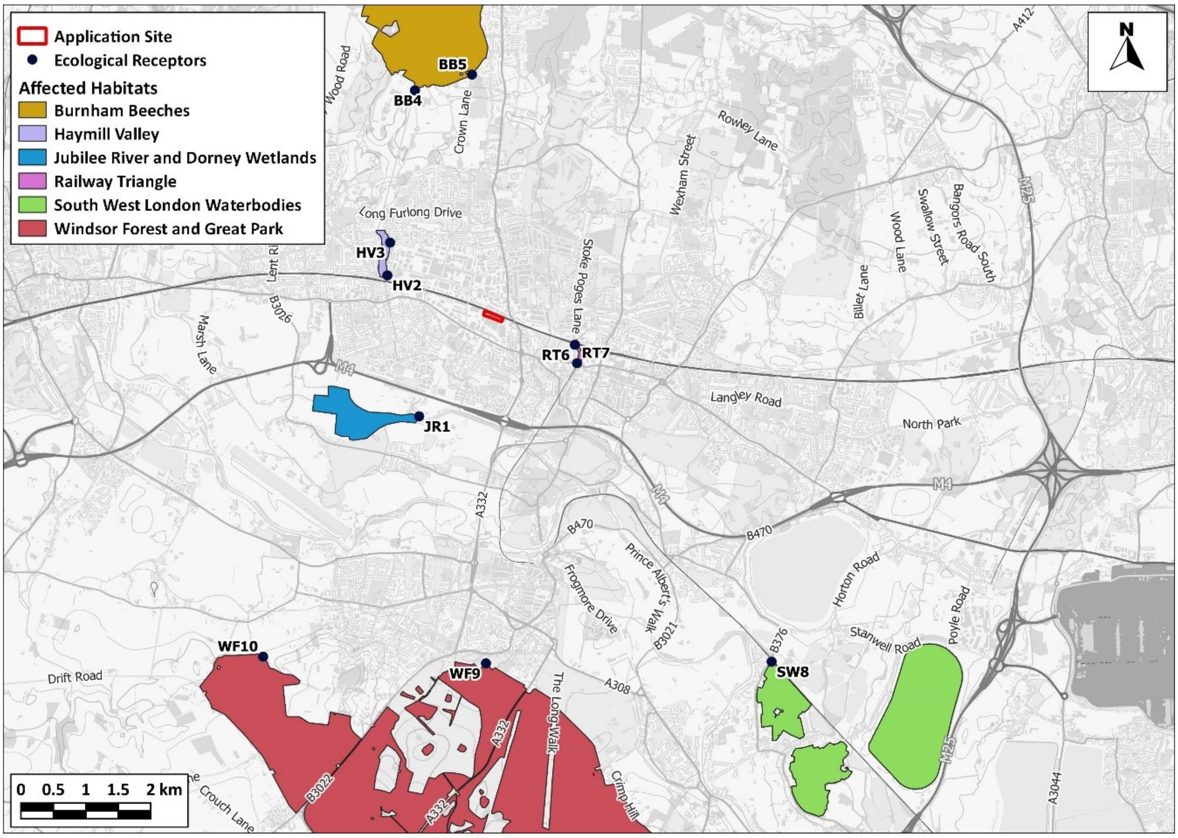

Figure 9: Modelled Ecological Receptors

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Meteorological Data

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

6.15 Hourly sequential meteorological data from Cippenham have been used for the years 2018-2022 inclusive. The Cippenham meteorological monitoring station is located approximately 2.3 km to the southwest of the facility. It is deemed to be the nearest monitoring station representative of meteorological conditions at the site.

6.16 The Cippenham 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.

6.17 The meteorological parameters entered into the model are shown in Table 17. Wind roses for each year are presented in Appendix A2.

Table 17: Meteorological Parameters Entered into the ADMS Model

Parameter	Modelled Receptors	Meteorological Site
Surface Roughness	Variable Surface Roughness File	0.2 m
Minimum MO Length	30 m	1 m
Surface Albedo	0.23 [a]	0.23 [a]
Priestly-Taylor Parameter	1 [a]	1 [a]

[a] Model default value

Variable Surface Roughness File

6.18 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 10. 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.

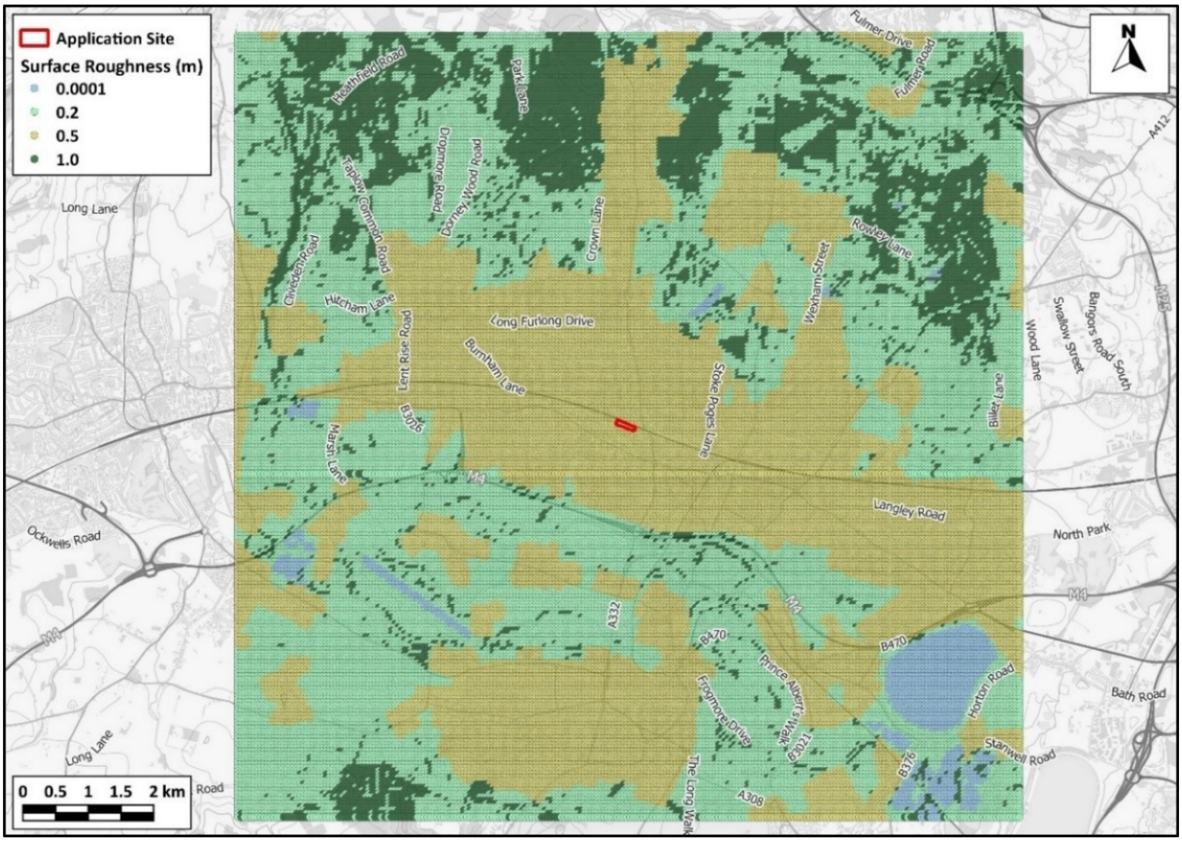

Figure 10: Surface Roughness across Modelled Area

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Buildings

6.19 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.

6.20 In order to test the sensitivity of the model domain to building downwash effects, the model has been run based on the following building configurations:

- With no buildings; and
- With buildings within 100 m of the facility boundary.

6.21 The 'main' building has been selected as the data centre building itself (shown in blue, below), since this is the closest building to the generator flues, and is the most likely to influence the dispersion parameters since it is one of the largest buildings, in terms of projected width and height, in the model domain. Modelled buildings are shown in Figure 11, and the dimensions of all buildings are given in Table 18.

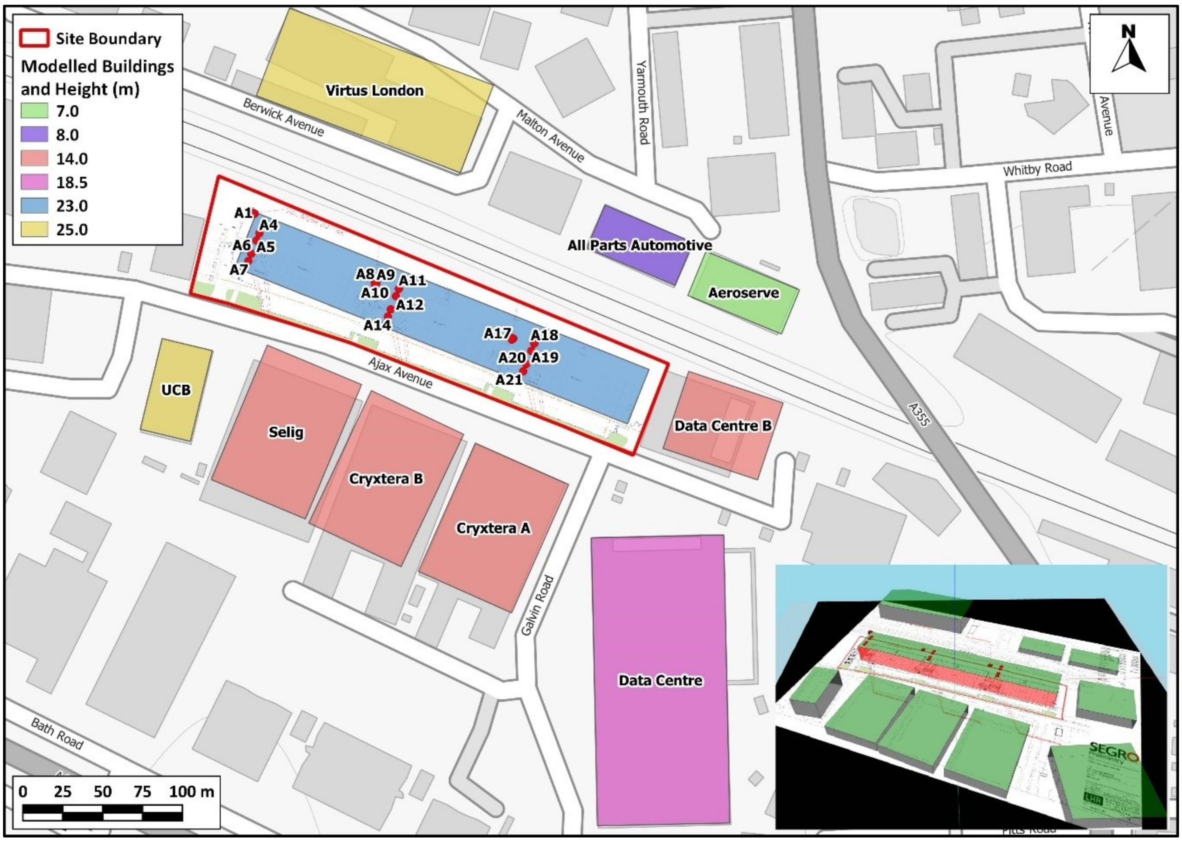

Figure 11: Buildings Included in the Model. Inset shows 3D Image, including Buildings (Green-topped Objects) and Modelled Stacks (Red-topped Cylinders)

Table 18: Modelled Building Dimensions

Building	X Coordinate	Y Coordinate	Height (m)	Length (m)	Width (m)	Rotation (º)
GB One	495962.8	180762.5	23.0	36.7	264.8	21.8
Cryxtera A	495995.1	180631.2	14.0	64.0	88.0	114.0
Cryxtera B	495927.9	180662.1	14.0	64.0	91.7	295.3
Selig	495865.3	180691.3	14.0	64.0	91.2	112.7
UCB	495796.3	180717.7	25.0	32.3	58.5	103.6
Aeroserve	496151.9	180778.6	7.0	29.9	63.4	202.4
All Parts Automotive	496086.9	180808.3	8.0	60.0	29.3	112.9
Data Centre	496099.8	180535.7	18.5	83.0	180.5	88.8
Data Centre B	496139.0	180695.3	14.0	50.9	62.4	198.4
Virtus London	495920.8	180905.3	25.0	136.7	58.7	290.7

Terrain Effects

6.22 The ADMS User Guide recommends that the effect of terrain should be included if the gradient in the study area exceeds 1:10. The area immediately surrounding the site is broadly flat, such that the bases of the buildings from which the stacks exhaust are approximately at the same elevation as the base of the nearby buildings and nearest human health receptors.

6.23 Whilst this is true for the immediate site surroundings, there are areas in the wider model domain where terrain heights exceed the height of the stacks and, consequently, terrain has been included within the model based on OS Terrain 50 data, as shown in Figure 3.

NO_X to NO_2 Conversion

6.24 NOx emissions will be in the form of nitric oxide (NO) and primary NO_2. The primary NO_2 from diesel oil-fuelled generators is likely to be in the region of 5-12% of the total NOx. Over time, the NO emissions will react with available ozone (O_3) to form NO_2. In close proximity to the source, the ratio will be similar to the primary NO_2 proportion; with increasing distance from the source the ratio will increase, depending on the availability of O_3.

6.25 The EA (2023b) recommends that, as a conservative approach:

- 70% of the NOx emitted from the generators converts to NO_2 for the annual mean average concentrations; and
- 35% of the 1-hour mean NOx emitted from the generators converts to NO_2 for the 1-hour mean average concentrations.

6.26 The EA guidance (EA, 2023c) states: "*For combustion processes where no more than 10% of nitrogen oxides are emitted as nitrogen dioxide, you can assume worst case conversion ratios to nitrogen dioxide of 35% for short-term average concentrations and 70% for long-term average concentrations*."

6.27 Given the size of the generators and their fuel, it is likely that the primary NO_2:NOx ratio will be 10% or less; therefore, the 70% (long-term) and 35% (short-term) conversion ratios used represent a conservative approach.

Model Post-Processing

6.28 The maximum predicted concentrations from either building scenario, and any meteorological year, have been determined and presented for each receptor point.

Annual Mean Process Contributions (PCs)

6.29 The model has been run assuming constant operation. Annual mean Process Contributions (PCs) have then been reduced to account for the fact that under normal circumstances (the testing and maintenance regime) the generators will not operate for more than 12 hours per year. This has been done by multiplying the annual mean model outputs by 0.001 (i.e. 12 / 8,760).

Short-term PCs

6.30 The AQS for 1-hour mean NO_2 is based on the number of hours (18) that a threshold concentration (200 µg/m^3) can be exceeded in a year.

6.31 For the routine testing scenario, the 1-hour mean AQS has been assessed by assuming constant operation of each bank of generators separately (described in Paragraph 3.3) and considering the maximum 99.79th percentile of 1-hour mean concentrations, which represents the 19th highest hour from a full year (8,760 hours), from any of the banks.

6.32 For the 24-hour and 72-hour loss of off-site power scenarios, the assessment has assumed continuous operation of all generators simultaneously, and considered the 99.79th percentile of hourly mean concentrations (i.e. the 19th highest concentration from a full year) for human health impacts and the 100th percentile 24-hour mean impacts for ecological impacts. Due to the modelling approach, absolute concentrations arising from the 72-hour scenario will be the same as the absolute concentrations arising from the 24-hour scenario, since they are independent of the number of 24-hour periods considered.

Probability of Exceedance

6.33 In practice, the potential for exceeding the AQS on any individual hour relates to the likelihood of the plant operating during meteorological conditions which are conducive to adverse impacts. As it is not known precisely when the plant will be required to operate, or what the meteorological conditions will be occurring during these periods, as a conservative assumption it is initially assumed the generators operate continuously throughout the year allowing “worst-case” meteorological conditions to be considered. However, such an approach is likely to produce an overly pessimistic estimate of impact for a source which only operates infrequently. Consequently, where the PCs and PECs exceed the AQS assuming continuous operation, a probability-based approach has been used. This takes account of the likelihood of emissions coinciding with worst-case meteorological conditions.

6.34 The EA has previously assumed a hypergeometric probability distribution when considering the likelihood of short-term-operating plant giving rise to AQS exceedances (EA, 2016). The approach taken here follows that used by the EA and involves using a cumulative hypergeometric distribution to calculate the probability of 19 or more hours exceeding 200 µg/m^3.

6.35 The approach uses the ADMS-5 model (Paragraph 6.4), and, assuming constant operation to ensure that all potential meteorological conditions are accounted for and after applying the 1-hour mean baseline concentrations to each receptor location, as described in Table 9, calculates the number of exceedances of 200 µg/m^3 that occur in each year.

6.36 Using the hypergeometric distribution function, a probability of more than 19 or more exceedances of 200 µg/m^3 is then calculated based on the generators operating in either 24 or 72 separate hours each year. In accordance with the EA’s guidance, since during the assumed 24-hour or 72-hour loss of off-site power event the generators would operate for more than one hour at a time, the probability derived from the hypergeometric distribution has been multiplied by 2.5 to account for the fact that generator operating hours during a loss of off-site power scenario are not completely random or independent.

Deposition

6.37 Deposition of NO_2 has not been included within the dispersion model because NO_2 has been calculated from NOx outside of the model. Instead, deposition has been calculated from the predicted ambient concentrations using the deposition velocity set out in Table 19. This means that depletion effects are ignored, resulting in a worst-case assessment.

6.38 Deposition velocities refer to a height above ground, typically 1 or 2 m, although in practice the precise height makes little difference and here, they have been applied to concentrations predicted at a height of 1.5 m above ground, which is the average height of the monitors which underpin the Concentration Based Estimated Deposition (CBED) model which generates predictions used by UK Government. The velocities are applied simply by multiplying a concentration (µg/m^3) by the velocity (m/s) to predict a deposition flux (µg/m^2/s). Subsequent calculations required to present the data as kg/ha/yr of nitrogen as keq/ha/yr for acidity follow basic chemical and mathematical rules[3].

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3 i.e. 1 kg N/ha/yr = 0.071 keq/ha/yr

Table 19: Deposition Velocities Used in this Assessment

Pollutant	Deposition Velocity (m/s)	Reference
Nitrogen Dioxide	0.0015 m/s (Grassland)	AQTAG06 (2011)
	0.003 m/s (Forest)	
Ammonia	0.02 m/s (Grassland)	
	0.03 m/s (Forest)	

6.39 Wet deposition of emissions from the facility has been discounted. Wet deposition of the emitted pollutants this close to the emission source will be restricted to wash-out, or below cloud scavenging. For this to occur, rain droplets must come into contact with the gas molecules before they hit the ground. Falling raindrops displace the air around them, effectively pushing gasses away.

Uncertainty and Sensitivity Analysis

6.40 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 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.

6.41 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, the assessment can be expected to over-predict the impacts of the facility. The approach has been designed to provide a robust and conservative assessment.

6.42 Sensitivity tests have been applied to address specific uncertainties in key model treatments and to ensure a worst-case assessment. In this case, sensitivity analysis has been performed on the treatment of building induced effects.

7 Assessment Approach

7.1 The Environment Agency's *air emissions risk assessment for your environmental permit* (previously Horizontal Guidance Note H1) provides methods for quantifying the environmental impacts of emissions to air. This compares predicted process contributions (PC) and predicted environmental concentrations (PEC, i.e., PC in addition to background) to both long- and short-term environmental standards. These standards primarily include guideline EALs and statutory AQS.

7.2 Air emission risk assessments for environmental permits require a three-tiered approach to assessing the significance of emissions to atmosphere. The first stage is to 'screen out' insignificant emissions to air using the H1 screening tool; these are emissions which are emitted in such small quantities that they are unlikely to cause a significant impact on ground level concentrations. The Environment Agency's guidance suggests that emissions are insignificant where PCs are less than:

- 1% of a long-term environmental standard; or
- 10% of a short-term environmental standard

7.3 This is the case regardless of the total concentration or deposition flux (i.e. the PC + the local baseline, or the Predicted Environmental Concentration 'PEC').

7.4 For local nature conservation sites and ancient woodlands, the EA (2023b) states that PCs are insignificant where they are less than 100% of either a long-term or short-term standard.

7.5 For those emissions that cannot be screened out as insignificant, the guidance indicates that further modelling of emissions may be appropriate for long term effects where the PEC is greater than 70% of the long-term environmental benchmark. For short-term effects, further modelling of emissions is required where the PC is more than 20% of the difference between twice the (long term) background concentration and the relevant short term environmental benchmark (i.e., more than 20% of the model 'headroom').

7.6 In any resultant modelling assessment, the EA guidance explains no further action is required where the assessment shows that both of the following apply:

- Emissions comply with Best Available Technique Associated Emission Levels (BAT-AELs) or the equivalent requirements where there is no BAT-AEL; and
- The resulting PECs will not exceed environmental standards.

7.7 For human health receptors, the approach has been to provide contour plots which highlight the area within which PCs cannot be considered insignificant using the criteria outlined in Paragraph 7.2. Consideration is also given to the maximum PCs at locations with relevant exposure to the AQS, and to the PECs. A judgement of significance has then reached based on the potential for the facility to cause an exceedance of the AQS.

7.8 As explained in Paragraph 6.36, a hypergeometric probability distribution approach has been used to determine the likelihood of the testing and maintenance programme and emergency loss-of-offsite power situations causing more than 19 or more exceedances of 200 μg/m^3, and therefore, the 1-hour mean nitrogen dioxide AQS. Where the probability is 5% or less, an exceedance of the 1-hour mean AQS is considered unlikely over a twenty-year period; for a probability of 1% or less, an exceedance is deemed unlikely over a hundred-year period.

7.9 For the designated ecological sites, the assessment has focused on the maximum PCs within the designated sites.

8 Results

Human Health Receptors

Annual Mean (12 hours Routine Testing and Maintenance per Generator)

8.1 The maximum PC at any location across the ground level (1.5 m) receptor grid is 0.38 µg/m^3, equivalent to 0.9% of the AQS; as such, the PCs are described as insignificant, irrespective of the PEC. As there are no locations where the PCs exceed 1% of the AQS, contours have not been provided.

8.2 The predicted annual mean PCs and PECs at the assessed locations identified in Figure 8 and Table 15, including the maximum across the model domain, are set out in Table 20. The maximum PCs at all receptors are less than 1%, thus insignificant. For completeness, the PECs at all receptors have been presented; the PECs at most receptors are below the AQS. However, at roadside receptors (R7 and R12), the PECs exceed the AQS due to the elevated baseline concentrations (42.8 µg/m^3, which is above the AQS). However, PCs at these locations are less than 1% of the AQS and, consequently, considered insignificant.

Table 20: Annual Mean PCs and PECs at Specific Receptors [a]

Receptor ID	PC		PEC [b]	
	µg/m^3	% AQS [c]	µg/m^3	% AQS [c]
Maximum on Grid	0.38	0.9	31.18	77.9
R1	0.02	<0.1	30.82	77.0
R2	0.03	0.1	30.83	77.1
R3	0.10	0.3	30.90	77.3
R4	0.15	0.4	30.95	77.4
R5	0.04	0.1	30.84	77.1
R6	0.02	0.1	30.82	77.1
R7	0.03	0.1	42.83	107.1
R8	0.03	0.1	30.83	77.1
R9	0.11	0.3	30.91	77.3
R10	0.03	0.1	30.83	77.1
R11	0.17	0.4	30.97	77.4
R12	0.19	0.5	42.99	107.5

[a] Rows where the AQS does not apply have been greyed out.

[b] After adding the baseline concentration from Table 9.

[c] Based on unrounded numbers.

99.79th Percentile of 1-hour Means – Routine Testing Assuming Tests Performed in Banks of 3 or 4 Generators

Process Contributions

8.3 Figure 12 presents the area where the PCs to the 99.79th percentile of 1-hour mean NO_2 concentrations are greater than 20 µg/m³ (10% of the AQS) and 200 µg/m³ (100% of the AQS).

8.4 The area where the PCs are more than 10% of the AQS extends up to approximately 2,400 m from the generator stacks and encompasses a number of high sensitivity receptors, including residential properties and their gardens, schools and medical centres. Locations where the PCs are greater than the AQS extend up to approximately 240 m from the generator stacks and cover commercial units and industrial warehouses.

Figure 12: Contour Plot of the 99.79th Percentile of 1-hour Mean NO_2 PCs (Routine Testing)

8.5 The predicted 99.79th percentile of 1-hour mean NO_2 PCs and PECs at the specific receptors identified in Figure 8 and Table 15, including the maximum across the model domain, are set out in Table 21.

8.6 The maximum 99.79th percentile of 1-hour means from any testing bank (described in Paragraph 3.3), and from any model scenario (buildings and meteorological year) has been presented.

Table 21: 1-hour Mean PCs and PECs at Specific Receptors (Routine Testing) [a]

Receptor ID	PC		PEC [b]	
	µg/m³	% AQS [c]	µg/m³	% AQS [c]
Maximum on Grid [d]	348.20	174.1	409.80	204.9
R1	73.28	36.6	134.88	67.4
R2	106.75	53.4	168.35	84.2
R3	116.80	58.4	178.40	89.2
R4	79.45	39.7	141.05	70.5
R5	102.31	51.2	163.91	82.0
R6	47.28	23.6	108.88	54.4
R7	53.84	26.9	139.44	69.7
R8	47.79	23.9	109.39	54.7
R9	81.55	40.8	143.15	71.6
R10	53.07	26.5	114.67	57.3
R11	111.53	55.8	173.13	86.6
R12	131.06	65.5	216.66	108.3

[a] 99.79th percentile of 1-hour means.

[b] After adding the baseline concentrations from Table 9.

[c] Based on unrounded numbers.

[d] This row has been greyed out as the AQS does not apply at this location, since it occurs in the middle of Malton Avenue.

8.7 The maximum PCs at all receptors exceed 10% of the short-term AQS. The PECs at the majority of the assessed receptor locations are below the short-term AQS. As such, there is considered to be negligible risk of an exceedance from the routine testing and maintenance of the generators at these receptors.

8.8 At the worst-case location on the modelled grid (which is on Malton Avenue, and therefore not relevant exposure), and Receptor R12, where the PCs to the 99.79th percentile of 1-hour mean concentrations exceed the screening criteria, the PECs also exceed the short-term AQS.

8.9 As such, further consideration, taking account of the probability of an exceedance occurring, is required at Receptor R12, based on the assumed testing regime.

Probability of Exceedances

8.10 At Receptor R12, where the PC to the 99.79th percentile of 1-hour means cannot immediately be discounted, and the PEC exceeds the AQS, a probabilistic approach has been adopted.

8.11 Table 22 presents the probability of the testing programme contributing to more than 18 exceedances of the hourly mean NO_2 air quality objective concentration. This approach uses a cumulative hypergeometric probability function to estimate the probability of contributing to more than 18 exceedances of the hourly mean NO_2 air quality standard; based on the number of annual operating hours (i.e., 72, assuming each of the six banks are tested for one hour each month), the number of hourly exceedances predicted by the model assuming continuous operation, and the number of exceedances allowed before the air quality objective itself is considered to have been exceeded (18).

Table 22: Number of Exceedances and Associated Probability (Routine Testing) [a]

Receptor ID	Annual Number of Exceedances	Probability of Exceedance
R12	305	<0.01%

[a] Assuming a roadside baseline concentration from Table 9 at both locations.

8.12 The maximum probability is calculated as less than 1% and, based on EA guidance, it is highly unlikely that an exceedance of the 1-hour mean objective will occur over a hundred-year period based on the regular testing and maintenance programme.

99.79th Percentile of Hourly Mean Concentrations - Emergency Loss of Power Situation

Process Contributions

8.13 During an emergency off-site loss of power situation, all generators may need to run concurrently for either 24 hours or 72 hours. Since the 99.79th percentile of hourly means assuming continuous operation has been presented, absolute concentrations arising from the 72-hour scenario will be the same as those arising from the 24-hour scenario, as concentrations are independent of the number of 24-hour operational periods considered.

8.14 Figure 13 presents the area where the PCs to the 99.79th percentile of hourly mean NO_2 concentrations are greater than 20 $\mu g/m^3$ (10% of the hourly AQS) and 200 $\mu g/m^3$ (100% of the hourly AQS).

8.15 The area where the PCs are more than 10% of the AQS extends up to the edge of the modelled grid domain and encompasses a number of high sensitivity receptors, including residential properties and their gardens, schools and medical centres. Locations where the PCs are greater than the AQS extend up to approximately 1,200 m from the generator stacks and cover a number of residential streets (for instance, Melbourne Avenue, Northampton Avenue, Belfast Avenue, York Avenue and Sheffield Road) to the northeast of the stacks.

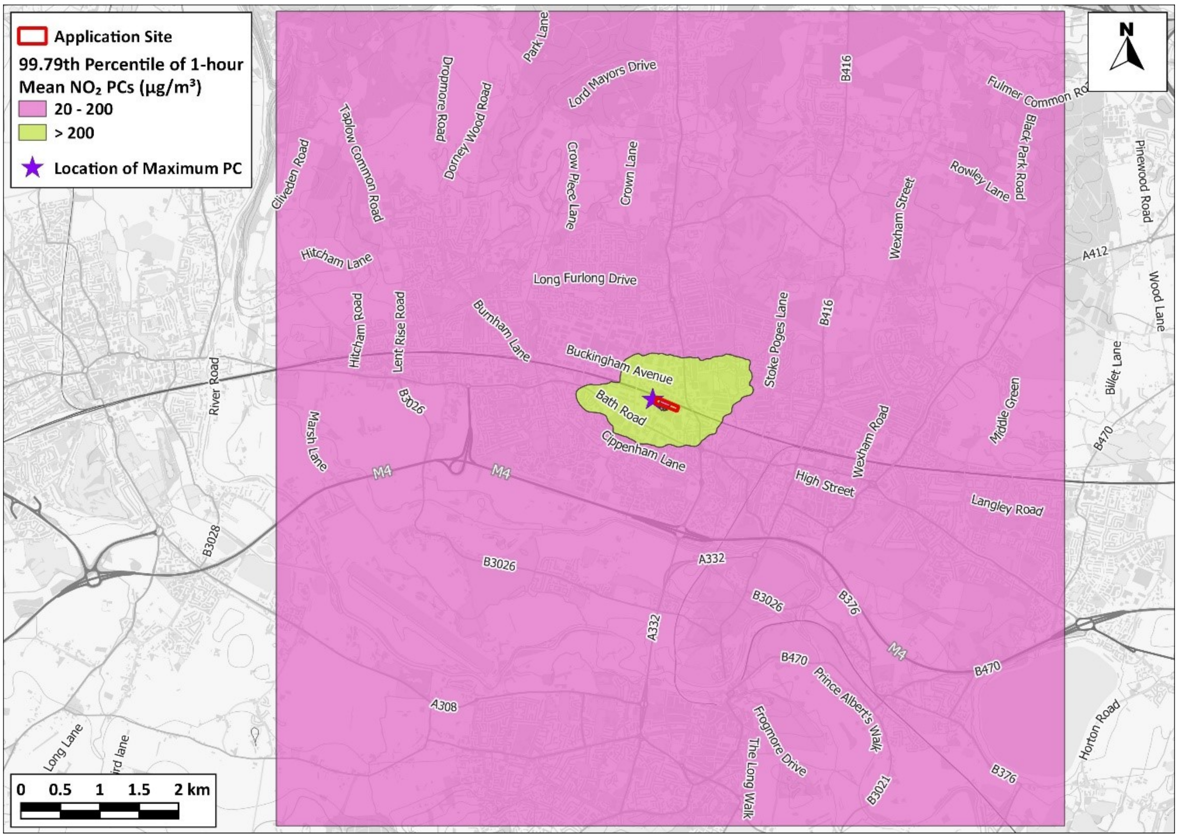

Figure 13: Contour Plot of the 99.79th Percentile of Hourly Mean NO_2 PCs (Loss of Off-site Power Scenario)

8.16 The predicted 99.79th percentile of hourly mean NO_2 PCs and PECs at the specific receptors identified in Figure 8 and Table 15 are set out in Table 23.

Table 23: 99.79th Percentile of Hourly Mean PCs and PECs at Specific Receptors (Loss of Off-site Power Scenario) [a]

Receptor ID	PC		PEC [b]	
	µg/m³	% AQS [c]	µg/m³	% AQS [c]
Maximum on Grid [d]	805.94	403.0	867.54	433.8
R1	272.82	136.4	334.42	167.2
R2	336.15	168.1	397.75	198.9
R3	451.17	225.6	512.77	256.4
R4	317.09	158.5	378.69	189.3
R5	411.55	205.8	473.15	236.6
R6	212.82	106.4	274.42	137.2
R7	235.47	117.7	321.07	160.5

Receptor ID	PC		PEC [b]	
	µg/m³	% AQS [c]	µg/m³	% AQS [c]
R8	202.38	101.2	263.98	132.0
R9	330.00	165.0	391.60	195.8
R10	221.67	110.8	283.27	141.6
R11	416.30	208.1	477.90	238.9
R12	460.69	230.3	546.29	273.1

[a] 99.79th percentile of 1-hour means.

[b] After adding the baseline concentrations from Table 9.

[c] Based on unrounded numbers.

[d] This row has been greyed out as the AQS does not apply at this location, since it occurs within the premises of Bidfood Slough Head Office, where members of the public will not have access.

Probability of Exceedances

8.17 Where the PCs to the 99.79th percentile of hourly means cannot immediately be discounted with all generators operating concurrently, and the PECs exceed the AQS, a probabilistic approach has been adopted.

8.18 Table 24 presents the probability of the loss of off-site power scenario contributing to more than 18 exceedances of the hourly mean NO_2 air quality objective concentration. This approach uses a cumulative hypergeometric probability function to estimate the probability of contributing to more than 18 exceedances of the hourly mean NO_2 air quality standard; based on the number of actual operating hours (either 24 or 72, depending on scenario), the number of hourly exceedances predicted by the model assuming continuous operation, and the number of exceedances allowed before the air quality objective itself is considered to have been exceeded (18).

Table 24: Number of Exceedances and Associated Probability (Loss of Off-site Power Scenario) [a]

Receptor ID	Annual Number of Exceedances	Probability of Exceedance	
		72-hour Emergency Loss-of-Power Scenario	24-hour Emergency Loss-of-Power Scenario
R1	158	<0.01	<0.01
R2	279	<0.01	<0.01
R3	864	0.01	<0.01
R4	1,422	4.66	<0.01
R5	326	<0.01	<0.01
R6	186	<0.01	<0.01
R7	196	<0.01	<0.01
R8	237	<0.01	<0.01
R9	1,064	0.18	<0.01
R10	322	<0.01	<0.01

Receptor ID	Annual Number of Exceedances	Probability of Exceedance	
		72-hour Emergency Loss-of-Power Scenario	24-hour Emergency Loss-of-Power Scenario
R11	1,486	7.12	<0.01
R12	1,523	8.94	<0.01

[a] Assuming the roadside baseline concentration from Table 9 at all locations, to ensure a worst-case approach.

8.19 The probability of exceeding the hourly mean NO_2 AQS concentration more than 18 times for the 24-hour scenario is less than 1% at all receptors. There is, therefore, considered to be a negligible risk of an exceedance of the short-term objective as a result of an emergency loss of off-site power situation lasting 24-hours.

8.20 In the 72-hour scenario, the probability of exceeding the hourly mean NO_2 AQS is less than 1% at most receptors. The exceptions are Receptors R4, R11 and R12. At Receptor R4, the probability of exceeding the hourly mean NO_2 AQS concentration is less than 5%, equivalent to a possible exceedance once every 21 years. For Receptors R11 and R12, the probabilities exceed 5%, and equate to possible exceedances once every 14 years and 11 years, respectively.

Designated Ecological Sites

8.21 Table 25 presents the PCs at each assessed receptor within the designated ecological sites based on the routine testing and maintenance of the generators.

8.22 At locations representing internationally designated sites (BB4, BB5, SW8, WF9 and WF10), the PCs for all pollutants are less than 1% of the long-term AQS and less than 10% of the short-term AQS, thus the PCs are insignificant regardless of the PEC.

8.23 At the locally designated habitats (JR1, HV2, HV3, RT6 and RT7), the PCs are all less than 100% of the long-term and short-term AQS, thus the PCs are also insignificant, irrespective of the PECs.

Table 25: Maximum PCs at Designated Ecological Sites (Routine Testing)

Receptor	X Coordinate	Y Coordinate	PC	PC (% of AQS) [a]	AQS
Annual Mean NOx (µg/m^3)					
JR1	494812.4	179223.0	0.02	0.1	30
HV2	494322.6	181393.4	0.02	0.1	
HV3	494365.6	181898.0	0.01	<0.1	
BB4	494748.1	184243.3	<0.01	<0.1	
BB5	495626.3	184486.1	0.01	<0.1	
RT6	497212.9	180323.7	0.02	0.1	
RT7	497245.2	180041.1	0.02	0.1	
SW8	500242.5	175444.2	<0.01	<0.1	
WF9	495842.1	175418.3	<0.01	<0.1	
WF10	492409.2	175520.3	0.01	<0.1	
24-hour Mean NOx (µg/m^3)					
JR1	494812.4	179223.0	30.24	15.1	200
HV2	494322.6	181393.4	48.25	24.1	
HV3	494365.6	181898.0	29.63	14.8	
BB4	494748.1	184243.3	13.76	6.9	
BB5	495626.3	184486.1	11.77	5.9	
RT6	497212.9	180323.7	41.89	20.9	
RT7	497245.2	180041.1	38.93	19.5	
SW8	500242.5	175444.2	8.69	4.3	
WF9	495842.1	175418.3	16.76	8.4	
WF10	492409.2	175520.3	7.95	4.0	
Annual Mean NH_3 (µg/m^3)					
JR1	494812.4	179223.0	<0.01	<0.1	**1**
HV2	494322.6	181393.4	<0.01	<0.1	
HV3	494365.6	181898.0	<0.01	<0.1	
BB4	494748.1	184243.3	<0.01	<0.1	
BB5	495626.3	184486.1	<0.01	<0.1	
RT6	497212.9	180323.7	<0.01	<0.1	
RT7	497245.2	180041.1	<0.01	<0.1	
SW8	500242.5	175444.2	<0.01	<0.1	
WF9	495842.1	175418.3	<0.01	<0.1	
WF10	492409.2	175520.3	<0.01	<0.1	
Annual Mean Nutrient Nitrogen (kgN/ha/yr)					
JR1	494812.4	179223.0	0.004	<0.1	10

Receptor	X Coordinate	Y Coordinate	PC	PC (% of AQS) [a]	AQS
HV2	494322.6	181393.4	0.006	0.1	10
HV3	494365.6	181898.0	0.004	<0.1	
BB4	494748.1	184243.3	0.002	<0.1	10
BB5	495626.3	184486.1	0.002	<0.1	
RT6	497212.9	180323.7	0.006	0.1	10
RT7	497245.2	180041.1	0.005	0.1	
SW8	500242.5	175444.2	Habitat not sensitive to nutrient nitrogen deposition		
WF9	495842.1	175418.3	0.001	<0.1	10
WF10	492409.2	175520.3	0.002	<0.1	
Annual Mean Acid Nitrogen (keq/ha/yr)					
JR1	494812.4	179223.0	<0.001	<0.1	1.103
HV2	494322.6	181393.4	<0.001	<0.1	2.048
HV3	494365.6	181898.0	<0.001	<0.1	
BB4	494748.1	184243.3	<0.001	<0.1	2.056
BB5	495626.3	184486.1	<0.001	<0.1	
RT6	497212.9	180323.7	<0.001	<0.1	1.103
RT7	497245.2	180041.1	<0.001	<0.1	
SW8	500242.5	175444.2	Habitat not sensitive to acid nitrogen deposition		
WF9	495842.1	175418.3	<0.001	<0.1	1.044
WF10	492409.2	175520.3	<0.001	<0.1	

[a] Based on unrounded numbers.

Emergency Loss of Off-site Power Situation

8.24 During an emergency loss of off-site power situation, all of the generators will operate simultaneously. Table 26 presents the 100th percentile of 24-hour mean PCs and PECs based on all generators operating simultaneously. As described in Paragraph 8.13, the maximum 24-hour mean concentration will be the same when considering either the 24-hour or 72-hour loss of power scenario.

Table 26: Maximum 24-hour Mean PCs during Loss of Off-site Power Scenario ($\mu g/m^3$)

Receptor	X Coordinate	Y Coordinate	PC	PC (% of AQS) [a]	PEC [b]	PEC (% of AQS) [a]	AQS
JR1	494812.4	179223.0	143.92	72.0	194.32	97.2	200
HV2	494322.6	181393.4	242.26	121.1	293.66	146.8	
HV3	494365.6	181898.0	150.38	75.2	201.78	100.9	

Receptor	X Coordinate	Y Coordinate	PC	PC (% of AQS) [a]	PEC [b]	PEC (% of AQS) [a]	AQS
BB4	494748.1	184243.3	71.38	35.7	103.78	51.9	
BB5	495626.3	184486.1	58.31	29.2	90.71	45.4	
RT6	497212.9	180323.7	194.15	97.1	252.75	126.4	
RT7	497245.2	180041.1	185.67	92.8	244.27	122.1	
SW8	500242.5	175444.2	44.62	22.3	127.22	63.6	
WF9	495842.1	175418.3	82.22	41.1	115.82	57.9	
WF10	492409.2	175520.3	39.83	19.9	73.43	36.7	

[a] Based on unrounded numbers.

[b] After adding the baseline concentrations presented in Table 11.

8.25 The 24-hour mean NOx critical level does not allow for any exceedances of the critical level; therefore, it is not appropriate to consider probabilities of exceedances.

8.26 The PCs exceed 10% at all internationally-designated habitats, however, the PEC will remain below the AQS (200 µg/m^3). At the majority of the nationally-designated habitats, the PCs are less than 100% of the AQS, thus insignificant; the exception is an area of Haymill Valley LNR and LWS, where the PCs and PECs exceed the AQS.

8.27 The assessment has assumed that, for every hour of operation, emissions from the generators are unabated during the first 15 minutes of the hour; this assumption will, therefore, over-estimate the daily mean PCs and PECs, since the unabated emission will only occur for the first 15-minutes of operation with the remaining 23 hours and 45 minutes having abated emissions. Based on the actual mass emitted in a 24-hour period (i.e. only one unabated 15-minute period during the entire 24-hour period) compared to the modelled mass emitted in the model, the PCs would be approximately 61% lower. The PC at Haymill Valley LNR and LWS would, therefore, be 94.5 µg/m^3, equivalent to 47% of the AQS. The PC would, therefore, be considered insignificant.

9 Discussion

Human Health Receptors

Annual Mean AQS

9.1 Table 20 shows that the PCs are all less than 1% of the long-term AQS; the PCs are, therefore, insignificant. There is thus negligible risk that the AQS will be exceeded as a result of emissions from the facility, and the effect is considered to be not significant.

1-hour Mean AQS (Routine Testing)

9.2 Table 21 shows that, assuming continuous operation, the PC exceeds 10% of the short-term AQS at all specific receptor locations; however, the PECs will remain below the AQS at the majority of receptors.

9.3 At Receptor R12, where the PEC exceeds the AQS, the probability of an exceedance, assuming that the testing regime takes place across 72 hours (six banks of generators, each being tested for one hour every month), is calculated to be less than 1%. The EA guidance is, therefore, that a risk of an exceedance is highly unlikely.

9.4 Based on the regular testing and maintenance programme, there is negligible risk that the AQS will be exceeded as a result of the facility.

1-hour Mean AQS (Emergency Loss-of-Power Situation)

9.5 Table 23 shows that, assuming continuous operation for either 24 hours or 72 hours as a result of an emergency loss-of-power scenario, the PECs exceed the AQS at the majority of receptors.

9.6 Assuming a 24-hour scenario, the probability of an exceedance is calculated to be less than 1% at all specific receptors, equivalent to an exceedance less than once every 100 years. The EA guidance is, therefore, that a risk of an exceedance is highly unlikely.

9.7 Assuming a 72-hour scenario, the probabilities of an exceedance are greater than for the 24-hour scenario; however, for the majority of receptors, the probabilities are still less than 1%. At Receptor R4, the probability of an exceedance is 4.7%, thus an exceedance of the hourly AQS is unlikely over a 21-year period. At Receptors R11 and R12, where the probabilities of an exceedance are 7.1% and 8.9%, respectively, an exceedance is possible every 11 – 14 years.

Designated Ecological Sites

9.8 Table 25 shows that during routine operation, the maximum PCs are less than 1% of the long-term AQS and less than 10% of the short-term AQS at internationally-designated habitats, and less than

100% of the long-term and short-term AQS at nationally-designated habitats. The EA guidance is thus that these PCs are insignificant regardless of the PEC.

9.9 During the emergency scenario, the maximum 24-hour mean NOx PECs at the internationally-designated habitats are below the AQS. At the nationally-designated habitats, the PCs are less than 100% at the majority of habitats, thus the PCs are insignificant; the exception is an area of Haymill Valley LNR and LWS, where the PCs and PECs exceed the AQS. However, this is based on the assumption that every hour includes 15 minutes of unabated emissions. Accounting for the actual mass emissions, the PCs at Haymill Valley are insignificant.

10 Conclusions

10.1 There is a negligible risk that the NO_2 annual mean AQS will be exceeded as a result of routine testing and maintenance of the generators. On this basis, the long-term effects are judged to be not significant.

10.2 There is a negligible risk that the 1-hour mean NO_2 AQS will be exceeded as a result of the routine testing and maintenance programme at the facility. An exceedance of the hourly AQS is also considered unlikely during a 24-hour loss-of-offsite power scenario. Assuming a 72-hour loss of off-site power scenario, the probabilities of an exceedance range from less than 1% to 8.9%, equivalent to a maximum possible exceedance once every 11 years.

10.3 During routine operation, the PCs at designated ecological sites are predicted as less than 1% of the long-term AQS and less than 10% of the short-term AQS at internationally-designated habitats, and less than 100% of the long-term and short-term AQS at nationally-designated habitats. The EA guidance is thus that these PCs are insignificant regardless of the PEC. During the emergency loss of off-site power scenario, the PECs at internationally designated habitats are predicted to be less than the AQS, whilst the PCs at the nationally-designated habitats are predicted to be less than 100% of the AQS. The exception is an area of Haymill Valley LNR and LWS, where the PCs and PECs exceed the AQS, although it has been demonstrated that this is based on a worst-case assumption regarding emission rates. Accounting for the actual expected emission over a 24-hour period in a loss of off-site power scenario, all PCs are considered to be insignificant.

10.4 The assessment includes a number of conservative assumptions and takes account of the maximum predicted impacts across several sensitivity tests. In particular:

- the assessment of short-term impacts assumes constant operation of the plant in banks of three or four across a range of meteorological conditions;
- the results presented are the maxima from modelling with five separate years of meteorological data;
- the results presented are the maxima from modelling both with and without including surrounding buildings within the dispersion model;
- the assessment assumes that the SCR technology takes 15 minutes to be fully effective;
- the assessment has considered ammonia slip, assuming an emission concentration of 10 mg/Nm^3, however, the manufacturers have guaranteed that there will be no ammonia slip;
- for the emergency loss-of-offsite power scenarios, the assessment assumes that every hour includes 15 minutes of unabated emissions, whereas in reality, this will only be the case for the very first hour;

- depletion has not been included in the model. This will cause a tendency for impacts to be over-predicted; and
- a conservative approach has been taken to calculating NO_2 concentrations from modelled NOx concentrations.

10.5 It is thus concluded that the air quality effects of the proposed facility will be not significant.

Table 27: EA Checklist for Dispersion Modelling Report for Installations

Item	Included	Comment
Location map	✓	See Figure 1 and Figure 2
Site plan	✓	See Figure 4
List of emissions modelled	✓	See Paragraph 1.3
Details of modelled scenarios	✓	See Table 2 and Section 6
Details of relevant ambient concentrations used	✓	See Section 5
Model description and justification	✓	See Paragraphs 6.2 to 6.4
Special model treatments used	✓	See Section 6
Table of emission parameters used	✓	See Table 14
Details of modelled domain receptors	✓	See Paragraphs 6.10 to 6.13, Figure 7 to Figure 9, and Table 15
Details of meteorological data used (including origin) and justification	✓	See Paragraphs 6.14 to 6.17
Details of terrain treatment	✓	See Paragraphs 2.6 to 2.8, Figure 3 and Paragraph 6.22
Details of building treatment	✓	See Paragraphs 6.19 to 6.21, Figure 11 and Table 18
Sensitivity analysis	✓	See Table 2 and Section 6
Assessment of impacts	✓	See Sections 8 and 9
Model input files	✓	Sent electronically

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12 Appendices

A1 Engine Technical Data

GROSS RATINGS RANGE		
Standby	kVA	4240 - 4603
	kWe	3392 - 3682
Data Center / Mission Critical	kVA	4240 - 4603
	kWe	3392 - 3682
Prime	kVA	4000 – 4184
	kWe	3200 - 3347

KOHLER SDMO

Industrial Diesel Generator Set – KD4500-E
50 Hz - Emission Optimized – EPA Tier 2 Compliant
PRELIMINARY DATASHEET
01/2020

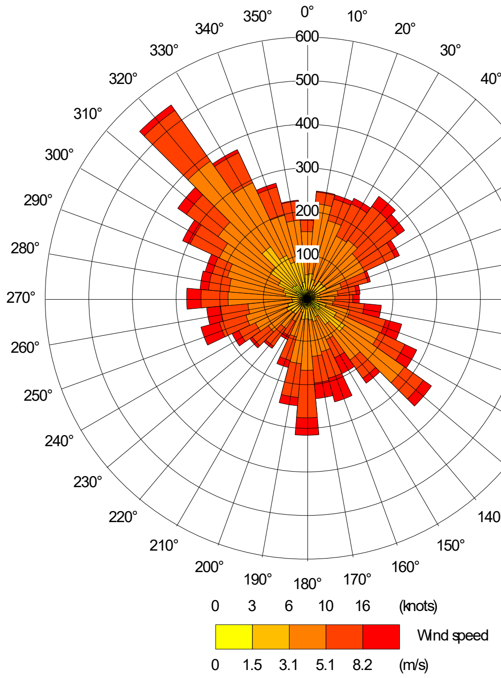
Engine

General		
Engine brand	KOHLER KD Series	
Engine reference*	KD103V20-5CES	
Air inlet system	Turbo	
Fuel	Diesel Fuel	
Engine optimization	Emission optimization	
Cylinders configuration	V	
Number of cylinders	20	
Displacement (L)	103.43	
Bore (mm) * Stroke (mm)	175 * 215	
Compression ratio	16 : 1	
Speed (RPM)	1500	
Maximum stand-by power at rated RPM (kW)	3800	
Piston type & material	Steel	
Charge Air coolant	Air/Water	
Frequency regulation, steady state (%)	+/- 0.25%	
Injection Type	Direct	
Governor type	Electronic	
Air cleaner type, models	Dry	
Fuel system		
Maximum fuel pump flow (L/h)	1200	
Fuel Inlet Minimum recommended size (mm)	TBC	
Fuel Outlet Minimum recommended size (mm)	TBC	
Max head on fuel return line (m)	3.50	
Maximum allowed inlet fuel temperature (°C)	70	
Engine specific fuel consumption	PRP engine	ESP engine
Consumption @ 100% load (g/kWh)	196	194
Consumption @ 75% load (g/kWh)	207	207
Consumption @ 50% load (g/kWh)	216	213
Consumption @ 25% load (g/kWh)	242	238

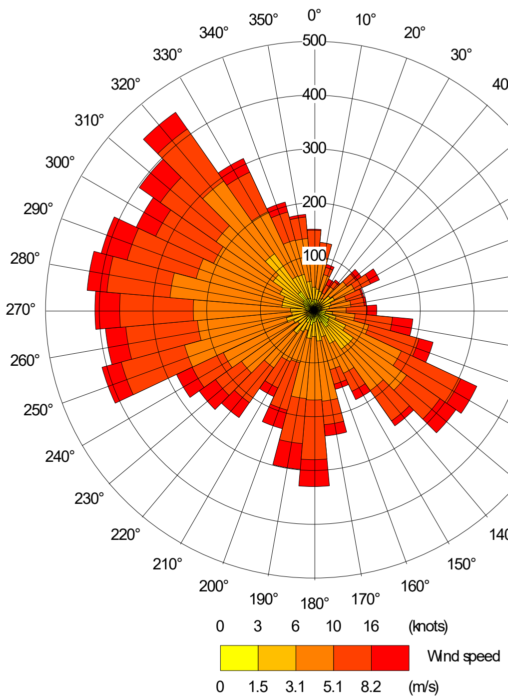
Lubrication System		
Oil system capacity including filters (L)	700	
Min. oil pressure (bar)	3.7	
Max. oil pressure (bar)	11	
Oil sump capacity (L)	575	
Oil consumption (g/kWh)	0.4	
Air Intake system		
Max. intake restriction (mm H2O)	510	
Intake air flow (L/s)	4850	
Exhaust system		
	PRP engine	ESP engine
Heat rejection to exhaust (kW)	2480	2630
Exhaust gas temperature (°C)	455	465
Exhaust gas flow (L/s)	11985	12749
Max. exhaust back pressure (mm H2O)	850	
Optional cooling system (HT/LT)		
Type of coolant	GENCOOL	
Radiated heat to ambiant (kW)	170	
Heat rejection to coolant HT (kW)	1220	
Flow on the HT circuit at 0.7Bars pressure drop off engine (L/min)	1950	
Outlet coolant temperature (°C)	95	
Coolant capacity HT, engine only (L)	295	
Max coolant temperature, Shutdown (°C)	103	
Restriction pressure drop off engine – HT circuit (mbar)	700	
Minimal pressure before HT pump (mbar)	400	
Max. pressure at inlet of HT water pump (mbar)	2500	
Thermostat begin of opening HT (°C)	71	
Thermostat end of opening HT (°C)	81	
HT Standard pressure cap setting (kPa)	100	
Heat rejection to coolant LT (kW)	1100	
Flow on the LT circuit at 0.7Bars pressure drop off engine (L/min)	650	
Temperature of inlet to LT engine water circuit (°C)	55	
Coolant capacity LT, engine only (L)	105	
Restriction pressure drop off engine – LT circuit (mbar)	700	
Minimal pressure before LT pump (mbar)	400	
Max. pressure at inlet of LT water pump (mbar)	2500	
LT Standard pressure cap setting (kPa)	100	

A2 Wind Roses for Cippenham

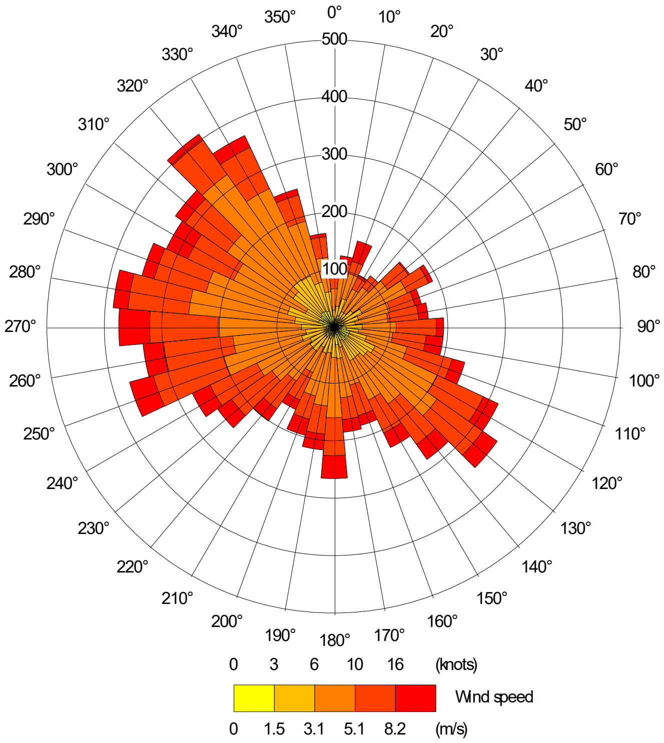
2018



2019



2020


0°
10°
20°
30°
40°
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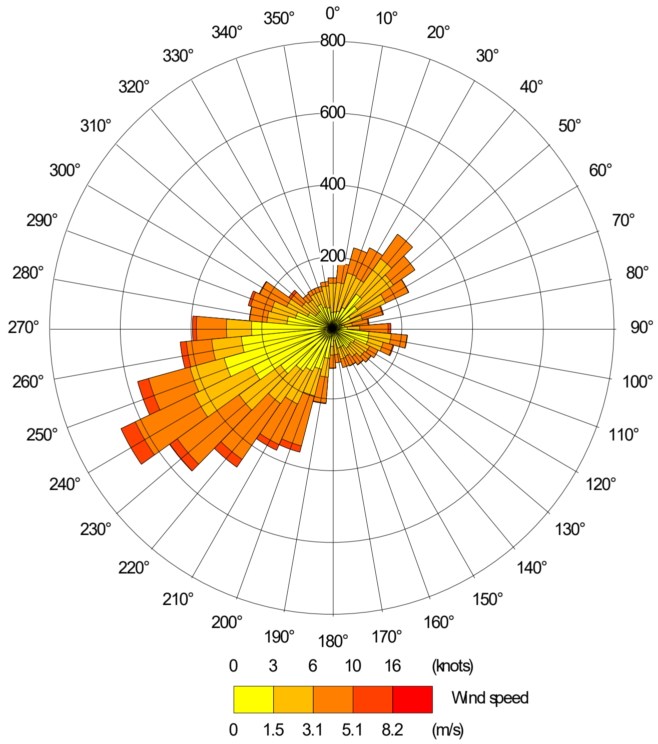
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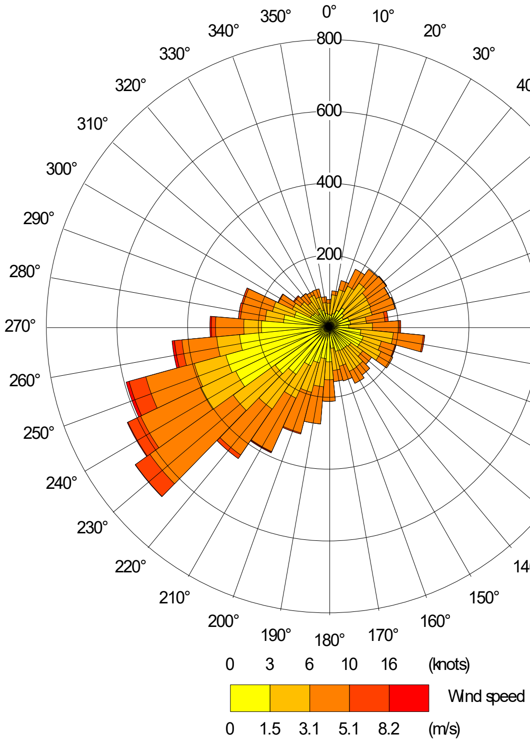
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A3 100th Percentile of 1-hour Mean PCs (Routine Testing)

A3.1 Table A3.1 presents the maximum 100th percentile of 1-hour Mean NO_2 PCs at the assessed specific receptors, while Figure A3.1 presents a contour plot of these PCs.

A3.2 The AQS for 1-hour mean NO_2 concentrations allows 18 exceedances of 200 µg/m³ in each calendar year. The 100th percentile of 1-hour means (i.e. the maximum in any hour of the year) is thus not directly comparable with the AQS. Results are provided here for information only.

Table A3.1: Maximum 100th Percentile of 1-hour Mean NO_2 PCs (Routine Testing)

Receptor	X Coordinate	Y Coordinate	PC (µg/m³)	PC (% of AQS)
Maximum on Grid	496095.0	180835.0	776.85	388.4
R1	496073.4	180422.3	84.51	42.3
R2	496177.5	180522.0	147.01	73.5
R3	496285.6	180793.6	123.98	62.0
R4	496241.7	181028.4	85.13	42.6
R5	495636.6	180984.4	111.23	55.6
R6	495289.5	181014.3	65.38	32.7
R7	495090.3	180826.3	63.68	31.8
R8	495249.9	180510.3	56.64	28.3
R9	496384.3	180909.5	83.53	41.8
R10	495672.5	180321.9	75.19	37.6
R11	496255.9	180893.1	115.75	57.9
R12	496213.7	180875.6	137.75	68.9

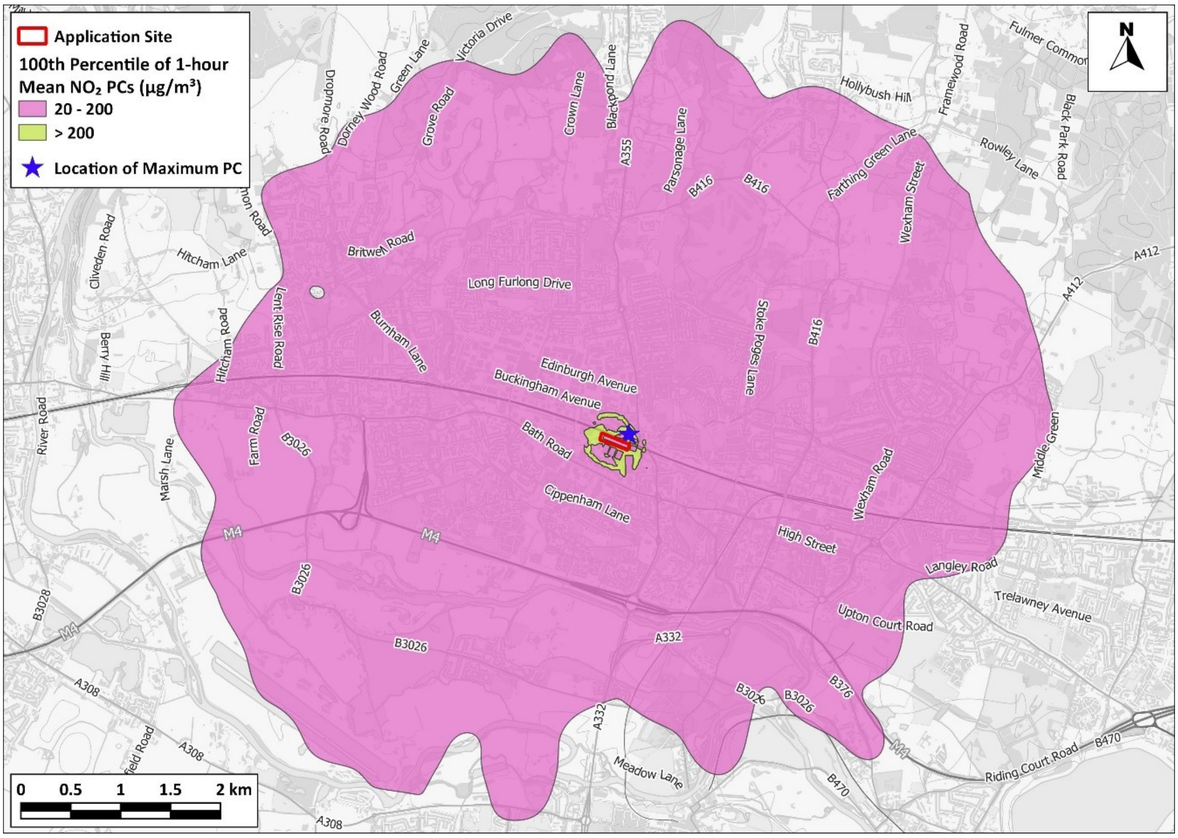

Figure A3.1: Contour Plot of the 100th Percentile of 1-hour Mean NO_2 PCs (Routine Testing)