Air Quality Assessment

DP3442QV – Union Park Data Centre Emergency Back-up Generation Facility

Bulls Bridge Industrial Estate, North Hyde Gardens, Hayes, UB3 4DG

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Air Quality Permit Assessment

DP3442QV – Union Park Data Centre

November 2024

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Air Quality Assessment

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Executive Summary

Phlorum Limited has been commissioned by HDR to undertake an Air Quality Assessment (AQA) on behalf of Amazon Data Services UK Limited (the operator) to support the Environmental Permit application (ref: DP3442QV) to operate Energy Centre 1 and Energy Centre 2 at the Union Park Data Centre Emergency Back-Up Generation Facility.

The site is located within the London Borough of Hillingdon's (LBH's) Air Quality Management Area (AQMA) and is located in close proximity to a Greater London Authority (GLA) Air Quality Focus Area (AQFA). This assessment evaluates the impacts on local air quality of the associated standby generators' (SBG) emissions during the following operating scenarios:

- **Fortnightly Routine Testing:** all generators are expected to run independently (one generator at a time) for 30 minutes per fortnight at 25% load, totalling up to 10 hours per year.
- **Quarterly Routine Testing:** all generators are expected to run independently (one generator at a time) for 1 hour per quarter at 25% load, totalling up to 4 hours per year.
- **Bi-Annual Routine Testing:** all generators are expected to run independently (one generator at a time) for up to 90 minutes twice per year, at full load.
- **Grid Failure:** 72-hour 'Grid Failure'/ power outage emergency where all generators run simultaneously at full load.

This report assesses the likely significant effects of the proposed development on the environment with respect to air quality. Air quality studies are concerned with the presence of airborne pollutants in the atmosphere. The main pollutants of concern for local air quality are oxides of nitrogen (NO_X) including nitrogen dioxide (NO_2), and particulate matter (PM_{10} and $PM_{2.5}$). Other pollutants, including ammonia (NH_3) are considered, where necessary.

The operator is committed to reducing SBG emissions as much as practically possible. To this end, the generators will be fitted with selective catalytic reduction (SCR) technology to achieve a NO_X emission concentration of 95 $mg.m^{-3}$ (5% O_2) and can operate using Hydrotreated Vegetable Oil (HVO).

The methodology applied to this assessment is considered to be highly conservative, with several assessment assumptions being 'worst-case'. Consequently, the outputs of the assessment are likely to present a worse case than would realistically be expected from the operation of the SBGs.

Long term and short-term impacts from the operation of the proposed SBGs were predicted to be **insignificant** for all scenarios at all relevant modelled receptor locations when assessed against all relevant long-term and short-term UK Air Quality Standards, Environmental Assessment Levels, Acute Exposure Guideline Levels, Critical Levels and Critical Loads.

1. Introduction

Background

1.1 Phlorum Limited has been commissioned by HDR to undertake an Air Quality Assessment on behalf of the legal operator to support the modification of the existing Environmental Permit (ref: DP3442QV) to operate Energy Centre 1 and Energy Centre 2 at the Union Park Data Centre Emergency Back-up Generation Facility.

1.2 The Data Centre is located in Bulls Bridge Industrial Estate, North Hyde Gardens, Hayes, UB3 4DG (hereafter referred to as "the site"). The National Grid Reference for the centre of the site is TQ 10500 79270. The site's location is displayed in Figure 1.

1.3 This Air Quality Assessment pertains to two of three data centres (see Figure 6), one of which has already been constructed and is operational. At the time of writing the third data centre is due to be under the control of a separate operator and is expected to be covered under a separate environmental permit.

1.4 The site is located in the administrative boundary of the London Borough of Hillingdon (LBH), who manages air quality locally.

1.5 LBH has declared one Air Quality Management Area (AQMA) that covers the southern two thirds of the Borough. This AQMA was declared in 2003 due to exceedances of the UK Air Quality Standard (AQS) for annual mean concentrations of nitrogen dioxide (NO_2).

1.6 The site, which is within this AQMA, is also located in close proximity to an Air Quality Focus Area (AQFA), which is an area of known elevated concentrations of NO_2 and high levels of human exposure.

1.7 As a result, during the planning process, the London Borough of Hillingdon (LBH) required that abatement be implemented for the proposed generators to achieve a NO_X emissions limit of 95mg.m^{-3} (at 5% O_2). In response to this planning requirement, the operator has made significant investment in NO_X abatement technology in the form of Selective Catalytic Reduction (SCR) to achieve the limit imposed by LBH. SCR has been employed for this specific scenario and does not represent Best Available Techniques (BAT) for general Data Centre developments.

1.8 Land-use in the vicinity of the site is primarily industrial and commercial. However, residential land-use can be found in close proximity to the application site along Nestlé Avenue, North Hyde Gardens and North Hyde Road.

1.9 The main pollution sources in the vicinity of the application site are vehicles travelling on the local road network, primarily the A312. Heathrow Airport is also a significant contributor to regional air pollution.

1.10 The key sources of air emissions associated with this application are the 28 No. 3.2MWe *Rolls Royce MTU DS4000 20V4000 G94LF* standby generators (locations shown in Figure 6), required to meet the electrical demand for the data centre in the event of an emergency power outage. The generators are split evenly across the two Energy Centres. It is understood that these generators will operate using Hydrotreated Vegetable Oil (HVO), unless unavailable, which gives rise to reduced emissions relative to the typical use of diesel.

Scope of Report

1.11 This assessment evaluates the likely local air quality impacts from the 28 No. SBGs during their routine testing and maintenance regime, and during unplanned emergency use.

1.12 Unplanned emergency use is to be assessed despite the understanding that the probability of a major grid failure occurring during the development's operational lifetime is very low, due to the site benefitting from a highly reliable direct connection to the national grid (99.999605% availability).

1.13 As such, the principal emissions associated with the use of the SBGs occur during routine testing and maintenance. It is understood that the 14no. generators at Energy Centre 2 will undergo the same testing and maintenance schedule as at the currently operational Energy Centre 1 (i.e. for up to 17 hours per year), through the following testing regime:

- Generators will run independently for up to 10 hours per year (20 fortnightly 25% load tests, each lasting 30 minutes);
- Generators will run independently for up to 4 hours per year (4 quarterly 25% load tests, each lasting 60 minutes); and
- Generators will run independently for up to 3 hours per year (2 bi-annual 100% load tests, each lasting 90 minutes).

2. Policy Context

The UK Air Quality Strategy

2.1 The UK Air Quality Strategy[1] (UKAQS) sets *Air Quality Standard* (AQS) concentrations for a number of key pollutants that are to be achieved at sensitive receptor locations across the UK by corresponding "air quality objective" (AQO) dates. The sensitive locations at which the standards and objectives apply are those where the population are reasonably expected to be exposed to said pollutants over a particular averaging period.

2.2 For those objectives to which an annual mean standard applies, the most common sensitive receptor locations used to compare concentrations against the standards are areas of residential housing. It is reasonable to expect that people living in their homes could be exposed to pollutants over such a period of time.

2.3 Schools and children's playgrounds are also often used as sensitive locations for comparison with annual mean objectives due to the increased sensitivity of young people to the effects of pollution (regardless of whether or not their exposure to the pollution could be over an annual period). For shorter averaging periods of between 15 minutes, 1 hour or 1 day, the sensitive receptor location can be anywhere where the public could be exposed to the pollutant over these shorter periods of time.

2.4 The objectives adopted in the UK are based on the Air Quality (England) Regulations 2000[2], as amended, for the purpose of Local Air Quality Management (LAQM). These Air Quality Regulations have been adopted into UK law from limit values required by European Union Daughter Directives on air quality. The UKAQS for $PM_{2.5}$ was amended as part of The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020[3].

2.5 The Environment Agency provides further Environmental Assessment Levels (EALs) for additional pollutants[4], which are not included in the UK Air Quality Strategy.

2.6 A summary of the AQSs and EALs relevant to this assessment are included in Table 2.1, below.

1 Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2) July 2007.
2 The Air Quality (England) (Amendment) Regulations 2002 - Statutory Instrument 2002 No.3043.
3 The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020
4 Environment Agency & Defra (2022) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#environmental-standards-for-air-emissions

Table 2.1 UK Air Quality Standards and EALs

Pollutant	Averaging Period	AQS / EAL ($\mu g.m^{-3}$)	Air Quality Objective (where applicable)
Nitrogen dioxide (NO_2)	1 hour	200	Not to be exceeded more than 18 times a year
	Annual	40	40 $\mu g.m^{-3}$
Particulate Matter (PM_{10})	24 hour	50	Not to be exceeded more than 35 times a year
	Annual	40	40 $\mu g.m^{-3}$
Particulate Matter ($PM_{2.5}$)	Annual	20	20 $\mu g.m^{-3}$
Sulphur Dioxide (SO_2)	15-minute	266	Not to be exceeded more than 35 times per calendar year
	1 hour	350	Not to be exceeded more than 24 times per calendar year
	24-hour	125	Not to be exceeded more than 3 times per calendar year
Carbon Monoxide (CO)	Maximum daily running 8-hour mean	10,000	-
	Maximum 1-hour	30,000	-
Benzene (C_6H_6)	Maximum 1 hour	195	-
	Annual	5	-
Nitrogen Monoxide (NO)	Maximum 1 hour	4,400	-
	Annual	310	-

Other Human Standards

Acute Exposure Guideline Levels

2.7 The EA also request that Air Quality Assessments give due consideration to the United States Environmental Protection Agency's (EPA's) Acute Exposure Guideline Levels (AEGLs)[5], which represent guideline concentrations at which certain toxicological health effects are considered likely to occur.

5 United States Environmental Protection Agency. (2012). Acute Exposure Guidance Levels for Selected Airborne Chemicals (Vol. 11).

2.8 Within this assessment, the primary pollutant of concern is NO_2. The EPA highlight that non-disabling adverse impacts are likely to occur when NO_2 concentrations reach 940 $\mu g.m^{-3}$. As such, this is the concentration used as an additional significance threshold within this assessment.

Ecological Standards

2.9 There are two categories of pollutants that are typically the subject of assessments for designated ecological sites. These are pollutants that have an effect on vegetation or habitats in *(1)* a gaseous form, assessed against critical levels, and *(2)* those which have an impact through deposition, assessed against critical loads.

Critical Levels

2.10 Critical levels represent the maximum concentrations of pollutants in air for the protection of vegetation. These have been adopted by, amongst others, the European Union and the United Nations Economic Commission for Europe (UNECE) and are used as regulatory standards. These critical levels are summarised in Table 2.2.

Table 2.2: Critical Levels

Pollutant	Averaging Period Critical Level	Critical Level
Oxides of nitrogen (NO_X)	24 Hour mean	75 / 200 $\mu g.m^{-3}$*
	Annual	30 $\mu g.m^{-3}$
Ammonia (NH_3)	Annual	1 $\mu g.m^{-3}$ (for lichens and bryophytes)
	Annual	3 $\mu g.m^{-3}$
Sulphur Dioxide (SO_2)	Annual	10 $\mu g.m^{-3}$ (for lichens and bryophytes)
	Annual	20 $\mu g.m^{-3}$
*The critical level is generally considered to be 75$\mu g.m^{-3}$; but this only applies where there are high concentrations of SO_2 and ozone, which is not generally the current situation in the UK, especially not in inland conurbations such as London.		

Critical Loads

2.11 Critical loads represent estimates of exposure to one or more pollutants below which significant effects are not known to occur, according to present knowledge. Whilst critical levels relate to the concentration of pollutants in air, critical loads relate to a quantity of a pollutant being deposited onto a habitat / ecosystem.

2.12 The Air Pollution Information System (APIS)[6] provides critical loads for nitrogen deposition (leading to eutrophication) and acid deposition (leading to acidification). Critical loads for nitrogen deposition are in units of kilogrammes of nitrogen per hectare per year (kg N/ha/year) and vary with habitat sensitivity. Critical loads for acid deposition are in kilogrammes of acid equivalent per hectare per year (keq H^+/ha/year). Site specific critical loads are discussed later within this report.

6 Air Pollution Information System. (2024). Available at www.apis.ac.uk

3. Baseline Air Quality

3.1 This chapter is intended to establish prevailing air quality conditions in the vicinity of the site.

3.2 Baseline air quality conditions in the vicinity of the site are established through the compilation and review of appropriately sourced background concentration estimates and local monitoring data.

3.3 Defra provides estimated background concentrations of the UKAQS pollutants at the UK Air Information Resource (UK-AIR) website[7]. These estimates are produced using detailed modelling tools and are presented as concentrations at central 1km^2 National Grid square locations across the UK. At the time of writing, the most recent background maps were from August 2020 and based on monitoring data from 2018.

3.4 Being background concentrations, the UK-AIR data are intended to represent a homogenous mixture of all emissions sources within the general area of a particular grid square location. Concentrations of pollutants at various sensitive receptor locations can, therefore, be calculated by modelling the emissions from a nearby pollution source, such as a busy road, and then adding this to the appropriate UK-AIR background datum.

3.5 LBH's automatic and non-automatic monitoring data are also considered an appropriate source for establishing baseline air quality; the most recent available data from LBH's air quality annual status report for 2024[8] have been reviewed and included within the assessment.

3.6 The London Atmospheric Emissions Inventory (LAEI) also provides modelled ground level concentrations of annual mean NO_2, PM_{10} and $PM_{2.5}$ at a 20m grid resolution across Greater London, for 2025[9], the proposed first year of operation of the SBGs. These data have also been reviewed and incorporated into the assessment.

UK-AIR Background Pollution

3.7 UK-AIR predicted background pollution concentrations of NO_2, PM_{10} and $PM_{2.5}$ for 2019 to 2029 are presented in Table 3.1. These data were taken from the central grid square location closest to the site (i.e. grid reference: 510500, 179500).

7 Defra: UK-AIR. www.uk-air.defra.gov.uk
8 LBH (2024) 2024 Air Quality Annual Status Report
9 London Atmospheric Emissions Inventory (LAEI). (2023). https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2025

Table 3.1: Projected Local Background Pollutant Concentrations

Pollutant	Predicted Annual Mean Background Concentration ($\mu g.m^{-3}$)										
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
NO_2	29.4	28.2	26.7	26.0	25.1	24.5	23.8	23.1	22.7	22.3	21.9
PM_{10}	17.9	17.4	17.0	16.8	16.6	16.4	16.2	16.0	16.0	16.0	16.0
$PM_{2.5}$	11.9	11.6	11.3	11.1	11.0	10.8	10.7	10.5	10.5	10.5	10.5

3.8 The data in Table 3.1 show that annual mean background concentrations of NO_2, PM_{10} and $PM_{2.5}$, in the vicinity of the site between 2019 and 2029, are predicted to be below their respective AQSs. The data show that in 2025, the proposed first year of operation, NO_2, PM_{10} and $PM_{2.5}$ concentrations are predicted to be below their AQSs by 40.5%, 59.5% and 46.5%, respectively.

3.9 Therefore, annual mean background concentrations are likely to be well below the respective AQSs at the site.

3.10 Concentrations of all pollutants are predicted to decline each year. These reductions are principally due to the forecast effect of the roll out of cleaner vehicles, but also due to London, UK national and international plans to reduce emissions across all sectors.

3.11 UK-AIR also provides annual mean predictions for C_6H_6, CO and SO_2, from the year 2001. These are summarised below for the UK-AIR grid square which contains the site.

- C_6H_6: 0.603 $\mu g.m^{-3}$
- CO: 406 $\mu g.m^{-3}$
- SO_2: 6.1 $\mu g.m^{-3}$

3.12 These background concentrations for C_6H_6, CO and SO_2 are all below their respective AQSs by over 80%.

London Atmospheric Emissions Inventory

3.13 The LAEI provides modelled ground level concentrations of annual mean NO_2, PM_{10} and $PM_{2.5}$ at a 20m grid resolution across Greater London. Figures 3, 4 and 5 show predicted annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ near the application site in 2025.

3.14 The LAEI predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ in the vicinity of the site exhibit reasonable levels of agreement with the UK-AIR projections included in Table 3.1.

3.15 The LAEI predictions indicate that, in 2025, NO_2 concentrations across the majority of the site will range between 22 µg.m^{-3} and 25 µg.m^{-3}, which is in agreement with the 2025 UK-AIR projected background concentration of 23.8 µg.m^{-3}.

3.16 In 2025 the LAEI predicts that PM_{10} concentrations across the majority of the site will be between 14 µg.m^{-3} and 16 µg.m^{-3}, which again shows close alignment with the 2025 UK-AIR projection of 16.2 µg.m^{-3}.

3.17 Close agreement is also displayed in the LAEI 2025 and UK-AIR 2025 predicted $PM_{2.5}$ concentrations, with the LAEI indicating that concentrations across the majority of the site will range between 9 µg.m^{-3} and 10 µg.m^{-3} and the UK-AIR projecting a concentration of 10.7 µg.m^{-3}.

Local Sources of Monitoring Data

3.18 Local air quality monitoring is considered an appropriate source of data for the purposes of describing baseline air quality.

Automatic Monitoring

3.19 LBH currently undertakes automatic (continuous) monitoring at 11 sites across the Borough. The most recent available data for NO_2, PM_{10} and $PM_{2.5}$ from the monitoring sites located within 2.5km of the application site are included in Tables 3.2, 3.3 and 3.4, respectively.

Table 3.2: NO_2 Monitoring Data from LBH Automatic Monitors

Monitor	Type	Distance from the site (km)	Annual Mean NO_2 Concentration (µg.m^{-3})				
			2017	2018	2019	2022	2023
HIL5	R	0.3	**47.0**	**43.0**	**41.0**	34.0	34.0
HI3	R	2.1	35.0	35.0	33.0	29.0	27.0
HRL	A	2.3	32.0	30.0	31.0	24.0	22.0

Note: "R" = Roadside; "A" = Airport. Exceedances of long-term AQS shown in **Bold**. Data from 2020 and 2021 were not considered, noting that air quality during this period was heavily influenced by the COVID-19 pandemic and associated lockdowns.

3.20 The data in Table 3.2 show that between 2017 and 2023 and within 2.5km of the application site, annual mean concentrations of NO_2 at HIL5 – a roadside site adjacent to the A437 – often exceeded the 40 µg.m^{-3} AQS. However, after 2019 there have been no recorded exceedances at this monitoring site. There is strong evidence of a downward trend in measured NO_2 in the above dataset; this is particularly evident following on from the COVID-19 outbreak and associated lockdowns.

3.21 According to Table I of LBH's ASR[8], there has been no exceedances of the short-term (hourly) AQS for NO_2 in recent years. Since 2018, none of the three nearest monitoring sites has recorded a single hour in exceedance of the 200 µg.m^{-3} AQS[10].

3.22 Table 3.3 includes the most recent annual mean PM_{10} results from the same automatic monitoring sites.

Table 3.3: PM_{10} monitoring data from the LBH automatic monitors

Monitor	Type	Distance from the site (km)	Annual Mean PM_{10} Concentration (µg.m^{-3})				
			2017	2018	2019	2022	2023
HIL5	R	0.3	27.0	30.0	28.0	30.0	27.0
HI3	R	2.1	19.0	24.0	24.0	22.0	26.0
HRL	A	2.3	15.0	15.0	15.0	13.0	12.0

Note: "R" = Roadside; "A" = Airport. Data from 2020 and 2021 were not considered, noting that air quality during this period was heavily influenced by the COVID-19 pandemic and associated lockdowns.

3.23 The data in Table 3.3 show that annual mean PM_{10} concentrations have been well below the 40 µg.m^{-3} AQS at all sites, between 2017 and 2023, within 2.5km of the site.

3.24 The highest concentration in 2023 was measured at HIL5, where a concentration 32.5% below the 40 µg.m^{-3} AQS was recorded.

3.25 It is also relevant to note that no exceedance of the short-term (daily mean) AQS was recorded between 2017 and 2023.

3.26 Table 3.4 includes the most recent annual mean $PM_{2.5}$ results from the closest automatic monitoring site stationed in LBH.

Table 3.4: $PM_{2.5}$ monitoring data from the LBH automatic monitors

Monitor	Type	Distance from the site (km)	Annual Mean $PM_{2.5}$ Concentration (µg.m^{-3})				
			2017	2018	2019	2022	2023
HRL	A	2.3	9.0	9.0	10.0	8.0	7.0

Note: "A" = Airport. Data from 2020 and 2021 were not considered, noting that air quality during this period was heavily influenced by the COVID-19 pandemic and associated lockdowns.

10 *Note: the short-term NO_2 AQS allows up to 18 exceedance hours per year.*

3.27 The data in Table 3.4 show that annual mean $PM_{2.5}$ concentrations have been well below the 20 $\mu g.m^{-3}$ AQS at HRL, between 2017 and 2023. In 2023, a concentration 65% below the 20 $\mu g.m^{-3}$ AQS was recorded.

Non-Automatic Monitoring

3.28 LBH operates an extensive non-automatic, NO_2 diffusion tube monitoring network across the area. The most recent available monitoring data for diffusion tubes located within 2.5km of the site are included in Table 3.5.

Table 3.5: Monitoring data from LBH NO_2 diffusion tubes

Monitor	Type	Distance from the site (km)	Annual Mean NO_2 Concentration ($\mu g.m^{-3}$)				
			2017	2018	2019	2022	2023
HILL07	R	0.4	**43.3**	37.7	36.9	30.5	28.8
HILL17	UB	0.4	32.7	31.0	31.6	24.1	22.6
HILL18	R	0.6	**49.0**	38.5	37.4	28.3	25.7
HILL27	R	0.8	33.8	32.5	33.2	26.8	26.9
HILL08	R	0.8	33.4	33.9	33.9	26.7	25.9
HILL26	R	1.0	**51.5**	**42.0**	**40.0**	29.2	27.7
HILL28	R	1.0	35.7	31.7	31.7	27.1	21.4
HD208	UB	1.4	27.3	30.8	26.5	-	-
HILL09	R	2.0	39.4	37.2	24.1	28.8	26.7
HILL25	UB	2.5	**45.6**	39.3	38.7	32.8	30.2

Note: "R" = roadside; "UB" = urban background. **Bold** denotes exceedance of the AQS. Data from 2020 and 2021 were not considered, noting that air quality during this period was heavily influenced by the Covid-19 pandemic and associated lockdowns.

3.29 The data in Table 3.5 indicate that annual mean NO_2 concentrations in the vicinity of the application site were generally below the 40$\mu g.m^{-3}$ AQS, with only tube HILL26 recording exceedances of the AQS since 2018.

3.30 The nearest background monitor to the site is located approximately 0.4km to the north (HILL17). The most recent result from 2023 was below the AQS by 43.5%. This value is similar to the 2023 UK-AIR prediction for the site in Table 3.1.

4. Methodology

Guidance

4.1 Local Air Quality Management Technical Guidance (LAQM.TG(22))[11] was followed in carrying out this assessment.

4.2 The latest Environmental Protection UK (EPUK) & IAQM guidance on 'Planning for Air Quality'[12] was also referred to for the impact assessment. The criteria used to describe the impact at individual receptors were derived from this guidance, and have been included in Appendix A.

4.3 For the assessment of emissions from the SBGs, Defra's guidance on assessing air emissions for environmental permitting[13] and the Environment Agency's guidance on assessing impacts on limited hour operations[14] has also been followed. The EA's guidance on specified generators[15] and their Data Centre FAQ headline approach guidance[16] to aide permit applications for data centres has also been reviewed.

Baseline Concentrations for the Assessment

4.4 For the purposes of dispersion modelling assessments, it is important that the choice of background site captures all pollutant sources that are not being modelled, but does not capture any sources being modelled, which could result in double-counting emissions from sources in the study area.

4.5 As roads were not included in the model, it is important that background concentrations used to derive the predicted environmental concentration (PEC) include their contribution. As such, UK-AIR data, which represent general air quality (i.e. away from any major emission sources, including roads) are not always considered appropriate.

4.6 As such, NO_2, PM_{10} and $PM_{2.5}$ baseline concentrations used in this assessment were derived from 2025 LAEI predictions, noting their similarities to the UK-AIR projections and locally monitored data.

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11 Defra. 2022. Part IV of the Environment Act 1995, Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management, Technical Guidance LAQM. TG(22).
12 EPUK & IAQM. (2017). Land-Use Planning & Development Control: Planning For Air Quality.
13 Defra (2024) Air emissions risk assessment for your environmental permit. Available at: https://www.gov.uk/guidance/air-emissions-riskassessment-for-your-environmental-permit
14 Air Quality Modelling & Assessment Unit (AQMAU). (2016). Diesel generator short term NO_2 impact assessment.
15 Environment Agency (2023) Specified generators: dispersion modelling assessment
16 Environment Agency (2018) Data Centre FAQ Headline Approach

4.7 UK-AIR 2001 estimates were used for C_6H_6, CO and SO_2. Baseline concentrations for NO were obtained by subtracting UK-AIR NO_2 concentrations from UK-AIR NO_X concentrations, for 2025.

4.8 No future improvement in baseline concentrations beyond 2025 was assumed. This is a conservative approach, considering that improvements in NO_2, PM and other pollutants are predicted across the UK. Short-term background concentrations were assumed to be twice the long-term concentrations.

Assessment of Impacts

Generator Emissions

4.9 The key pollutant emissions associated with the SBGs are NO_X, PM_{10}, $PM_{2.5}$, CO, SO_2 and hydrocarbons (as C_6H_6).

ADMS-6 Generator Assessment

4.10 Dispersion modelling was undertaken using ADMS-6 (version: 6.0.0.1), which is produced by Cambridge Environmental Research Consultants (CERC). ADMS-6 is a short-range dispersion model that simulates a wide range of buoyant and passive releases to the atmosphere. It is a "new generation" dispersion model, which uses a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

Model Input Data

Meteorological Data and Surface Characteristics

4.11 Detailed, hourly sequential, meteorological data are used by the model to determine pollutant transportation and levels of dilution by the wind and vertical air movements. Meteorological data used in the model were obtained from London Heathrow Airport as it was considered to provide the most representative data of similar conditions to the site. Five years (2015-2019) of meteorological data were used in this assessment (the same five used for the associated planning application), with each wind rose displayed in Figure 2. Meteorological data were provided by ADM Ltd.

4.12 The surface roughness applied to the dispersion and meteorological site was 1.5m and 0.5m, respectively. The Minimum Monin-Obukhov length is used to help describe the stability of the atmosphere. In urban areas where there are multiple sources of heat, the air is less stable. For this model, a Minimum Monin-Obukhov length of 100m was used for the site, which is representative of large conurbations such as London.

Buildings and Terrain

4.13 Buildings can have significant effects on the dispersion of pollutants and can increase ground level concentrations. The energy centre and data centre buildings were included in the model, so building downwash effects could be considered. When compared to the height of the proposed stacks (see Appendix B for stack locations and heights), all other buildings in the vicinity of the site were considered short enough to exclude from the dispersion model. The building details, alongside a summary of other model inputs, are included in Appendix B.

4.14 Terrain can influence the dispersion of pollutants in the local area. However, ADMS-6 user guidance[17] suggests terrain effects should only be modelled where the gradient exceeds 1:10. The local area is flat and as such, the impact of complex terrain has not been modelled.

Emission Parameters

4.15 The assessment has been carried out assuming that the fuel type for all generators would be diesel, despite the understanding that these generators will run on HVO in normal circumstances. Emissions from diesel generators are generally higher than when using HVO for PM, NO_X and SO_2 and as such, this is a conservative approach.

4.16 The emission parameters of the SBGs (e.g. volumetric flow rate, exhaust temperature) were derived from the manufacturers' datasheets (20V4000G94LF). Key information is provided below and in Appendix C.

4.17 The generators are to be fitted with SCR technology and the manufacturer has warranted that an emission concentration of 95 mg $NO_X.m^{-3}$ (5% O_2) shall be achieved (see Appendix C). As the SCR system is only effective after temperatures reach 280°C, there is a period after start-up when emissions from the generators would be unabated. It is a requirement under Environmental Permitting that this period lasts for no longer than 20 mins. The manufacturer has suggested that with load steps (i.e. running generators at higher loads initially), the SCR system could warm-up in fewer than 15 minutes. For conservative purposes, all generators are assumed to run for 20 minutes unabated, regardless of the loads the SBGs are run at.

4.18 A summary of the emission parameters for the generators is provided in Table 4.1, below:

Table 4.1: Model Inputs for Generators

Parameter	Unit	Data per generator at 100% Load	Data per generator at 25% Load
Power	kW	3307	827
Stack(s) height	m	21.1	21.1
Stack(s) diameter	m	0.7	0.7

17 CERC (2023). ADMS 6 User Guide

Parameter	Unit	Data per generator at 100% Load	Data per generator at 25% Load
Exhaust gas temperature	ºC	482	403
Exhaust volumetric flow (actual)	$m^3.s^{-1}$	11.90	3.69
Exhaust volumetric flow (dry, 5% O_2)	$Nm^3.s^{-1}$	2.57	0.74
NO_X emission rate*	$g.s^{-1}$	6.063	1.011
NO_X emission rate (concentration post SCR not to exceed 95 $mg.Nm^{-3}$ (5% O_2))	$g.s^{-1}$	0.244	0.070
PM_{10} and $PM_{2.5}$ emission rate	$g.s^{-1}$	0.018	0.041
CO emission rate	$g.s^{-1}$	0.276	0.322
Hydrocarbons (C_6H_6) emission rate	$g.s^{-1}$	0.0459	0.0368
NH_3 emission rate	$g.s^{-1}$	0.103	0.029
SO_2 emission rate	$g.s^{-1}$	0.0028	0.0007

* Values based on unabated concentrations of 2362 $mg.Nm^{-3}$ (at 100% load) and 1375 $mg.Nm^{-3}$ (at 25% load)

4.19 For the purposes of this assessment, it has been assumed that 100% of hydrocarbons are emitted as benzene. It has also been assumed that 100% of PM is emitted as both PM_{10} and $PM_{2.5}$. These are highly conservative and precautionary approaches.

4.20 As is displayed in Appendix C, pollutant concentrations were provided under Normal conditions at 5% O_2, and Actual conditions at measured O_2. Using these and the given mass emission rates, volumetric flow rates were determined, which were corrected for temperature, moisture and O_2. Moisture content at 25% load was unknown, so was considered to be 0% for conservatism.

4.21 'Ammonia Slip' can occur as soon as urea dosing commences. It is expected that dosing would not commence during the first 15 to 20 minutes (generator warm-up time). However, in this case, it was assumed that ammonia slip would occur as soon as the SBGs operate. The NH_3 emission rates listed within Table 4.1 are based on the emission concentration of 5 $mg.Nm^{-3}$ (at 5% O_2), as presented in the SCR datasheet (see Appendix C).

Generator Modelling Scenarios

4.22 This operator's testing schedule is summarised in Table 4.2, below.

Table 4.2: Annual Generator Testing Schedule

Generator Test Frequency	Description	Load Profile	Individual Test Duration	Total Hours of Operation per Generator
Fortnightly	Generators run independently at 25% load to prove they start on the "start signal"	25%	30 mins	10
Quarterly	Generators run independently at 25% load	25%	60 mins	4
Bi-Annual	Generators run independently at full load to clear the system and prove full load operation	100%	90 mins	3

Note: The bi-annual and quarterly runs supersede requirements for six fortnightly tests.

4.23 Considering that that the bi-annual test occurs at different loads (100% load) to the fortnightly and quarterly tests (25% load), two separate testing models were required. A breakdown of the modelled scenarios is provided below:

- **Testing Scenario 1:** 'Fortnightly and Quarterly' testing, accounting for 14 hours of generator operation per year, per generator, at 25% load, and tested individually.
- **Testing Scenario 2:** 'Bi-Annual' testing, accounting for 3 hours of generator operation per year, per generator, at 100% load, and tested individually.
- **Emergency Scenario**: A 72-hour long 'Grid Failure'/ power outage occurs, with all generators operating simultaneously at 100% load.

4.24 Input parameters for NO_X have been time-weighted to account for the provision of SCR in the generators. A summary of these time-weighted parameters is provided in Table 4.3 below.

Table 4.3: Time-Weighted Model Inputs for NO_X

Generator Scenario	Time Weighted Emission Rates per hour (g $NO_X.s^{-1}$)
Testing Scenario 1	0.697
Testing Scenario 2	1.536
Grid Failure	0.325

Modelled Receptors

Human Receptors

4.25 Discrete model human receptors closest to the site were identified. The below table lists the human receptors included within this assessment. All modelled receptors are shown in Figure 3.

4.26 All receptors were modelled at "breathing height", which is by convention 1.5m above ground level, plus the relevant floor height, if receptors are at elevated floor levels. Details of modelled human receptors are included in Table 4.4.

Table 4.4: Modelled Human Receptors

ID	Location/Description	Height (m)	UK Grid Reference	
			X	Y
R1	Commercial Unit: Nestle Site	1.5, 4.5	510328.41	179200.16
R2	Commercial Unit: Nestle Site	1.5, 4.5	510204.25	179266.75
R3	Residential Unit: Nestle Site	1.5, 4.5, 23, 30, 35	510144.94	179311.31
R4	Residential Unit: Nestle Site	1.5, 4.5, 23, 30, 35	510093.25	179262.39
R5	Guru Nanak School	1.5, 4.5	511216.62	180007.59
R6	Commercial Unit	1.5, 4.5	510346.91	179446.55

ID	Location/Description	Height (m)	UK Grid Reference	
			X	Y
R7	Hillingdon Mosque	1.5, 4.5	510237.28	179460.62
R8	Commercial Unit – Tarmac Site	1.5, 4.5	510561.12	179467.86
R9	Commercial Unit	1.5, 4.5	510609.69	179172.95
R10	Commercial Unit	1.5, 4.5	510684.16	179316.38
R11	Residential Dwelling – Copperdale Rd	1.5, 4.5	510336.75	179714.72
R12	Residential Dwelling – Chalfont Rd	1.5, 4.5	510015.84	179619.09
R13	Commercial Unit: Nestle Site	1.5, 4.5	510253.31	179055.80
R14	Residential Dwelling – Nestle Avenue	1.5, 4.5	510273.88	178955.31
R15	Residential Dwelling – Nestle Avenue	1.5, 4.5	510099.69	179023.25
R16	Residential Dwelling – Brent Road	1.5, 4.5	511169.41	179247.81
R17	Residential Dwelling – Brent Road	1.5, 4.5	511164.28	179114.12
R18	Residential Unit: Nestle Site	1.5, 4.5, 23, 30, 35	510172.16	179143.77
R19	EC1 – Reception	1.5, 4.5	510515.81	179230.41
R20	EC3 – Reception	1.5, 4.5	510379.18	179229.38

4.27 A grid of receptor points was also modelled to predict the pattern of dispersion of pollutants across the local area at a height of 1.5m. The modelled grids originated at UK Grid Reference 509520, 178520, with 98 × 90 grid points (20m spacing) used to produce the contour plots shown in Figures 7 to 11.

Ecological Receptors

4.28 Environment Agency guidance sets out that the assessment must consider all Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites within 10km of an application site, and all Sites of Special Scientific Interest (SSSI) and local nature sites, such as Local Nature Reserves (LNRs) and Sites of Importance for Nature Conservation (SINCs), within 2km. The list of ecological sites considered in this assessment, their critical loads, and critical levels are included in Table 4.5, below.

Table 4.5: Modelled Ecological Sites

Site Name	Distance to Site (km)	Designation	X	Y	Critical Loads		Critical Levels			
					Nitrogen Deposition (Kg/Ha/Yr)	Max N Acid Deposition (Keq/Ha/Yr)	Annual Mean NO_X ($\mu g/m^3$)	Maximum 24-Hr NO_X ($\mu g/m^3$)	Annual Mean SO_2 ($\mu g/m^3$)	Annual Mean NH_3 ($\mu g/m^3$)
South West London Waterbodies	7.2	SPA	505363	174127	10	1.72	30	200	10	1
Richmond Park	9.7	SAC	518540	173833	10	1.01	30	200	10	1
Cranford Countryside Park	1.1	SINC	510068	178240	10	2.03	30	200	10	1
Minet Country Park	0.2	SINC	510659	179432	10	2.03	30	200	10	1
London Canals	0.1	SINC	510527	179122	10	2.03	30	200	10	1
Hayes Village	0.4	Priority Woodland	510125	179080	10	2.03	30	200	10	1
Cranford Lane Gravel Workings	1.4	SINC	509509	178226	10	2.05	30	200	10	1
Hartlands Wood and Lower Park Farm	1.2	SINC	510748	178120	10	2.03	30	200	10	1
Crane Corridor	0.4	SINC	510432	178853	10	2.03	30	200	10	1
Lake Farm Country Park	1.4	SINC	509461	180215	10	1.71	30	200	10	1
Airlinks Ponds	1.7	SINC	511663	178031	10	2.03	30	200	10	1
Thorncliffe Rough	2.0	SINC	511772	177665	10	2.03	30	200	10	1
Bollinbrooke Way Sunken Pasture	1.9	SINC	508800	180200	10	1.71	30	200	10	1
St Mary's, Wood End	2.0	SINC	509718	181065	10	2.04	30	200	10	1
Havelock Cemetery	2.0	SINC	512471	179239	10	2.03	30	200	10	1

4.29 The critical levels and critical loads used for this assessment, as displayed in Table 4.5, have been selected for conservatism. The critical levels are as stringent as they can be, accounting for uncertainties relating to the habitat profiles of the locally designated ecological sites (e.g. whether they contain lichens/ bryophytes). The same approach has been applied for nitrogen deposition critical loads.

4.30 For acid deposition, values were selected based on which identified habitat within each ecological site was considered to be most vulnerable to acid deposition. In all cases, this was categorised within APIS as 'Unmanaged Woodland'. The Local Nature Reserve (LNR) and Local Wildlife Sites (LWS) would likely have a considerably higher critical load for acid deposition.

Model Outputs

NO_X to NO_2/ NO Conversion

4.31 Following Environment Agency guidance[18], it has been assumed that 70% of NO_X converts to NO_2 over the long-term (i.e. annual average) and that 35% converts to NO_2 in the short-term (i.e. hourly averaging periods); these are worst-case conversion rates that assume that significant proportions of emitted NO_X converts to NO_2 in a relatively short space and time.

4.32 Environment Agency guidance[14] suggests that within 500m of a source, NO_X to NO_2 conversion can be as low as 15% in the short-term. As such, the use of a 35% short-term conversion rate is conservative.

4.33 For Nitrogen Monoxide, it has been assumed that 30% of NO_x is in the form of NO over the long-term (i.e. annual average) and 85% in the short-term (i.e. hourly averaging periods) for conservatism.

18 Environment Agency. Conversion Ratios For NO_X and NO_2. Available at: https://webarchive.nationalarchives.gov.uk/20140328232919/http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

Modelling of long- and short-term emissions

<u>Short-term emissions</u>

4.34 With regard to short-term impacts, it is normal to assess the 1-hour mean NO_2 / NO objective by considering the 99.79th percentile/ 100th percentile of 1-hour mean concentrations, which represents the 19th highest/ highest concentration in a year (8760 hours). However, when there are far fewer hours of operation in a year, this is an unrealistic approach and consideration should be given to the limited hours of operation through the use of hypergeometric distribution statistics. However, for this assessment, it was assumed that for each model scenario the generators would run all year round. This is an extreme 'worst-case' approach which does not consider the likelihood of worst-case meteorological conditions coinciding with limited operation.

4.35 For the assessment of SBG impacts against the EPA's AEGL for NO_2, a 100th percentile concentration (maximum hourly if generators ran all hours of the year) was obtained. Again, this is a 'worst-case' approach.

4.36 If these worst-case approaches identify a risk of exceedance of any short-term concentration threshold, hypergeometric distribution shall be used to ascertain the realistic number of hours exceeding that threshold concentration, accounting for the actual hours of operation per year. The methodological approach adheres to that listed within EA guidance[14].

<u>Long-term emissions</u>

4.37 To calculate the long-term process contribution, the modelled output, which is based on the model running for every hour in the year, was scaled down to account for the actual number of SBGs operating and the hours of operation per year.

<u>Deposition Velocities</u>

4.38 For the assessment of ecological impacts, deposition velocities were obtained from AQTAG06[19] and velocities for forested areas were assumed for all ecological sites, for conservative purposes. The velocities used are provided below:

- NO_X = 0.003 $m.s^{-1}$
- SO_2 = 0.024 $m.s^{-1}$
- NH_3 = 0.030 $m.s^{-1}$

4.39 Nitrogen and acid deposition fluxes were also obtained from the AQTAG06[19] document:

- N deposition (as NO_X) = 95.9 kg $N.ha^{-1}.yr^{-1}$
- N deposition (as NH_3) = 260 kg $N.ha^{-1}.yr^{-1}$

[19] Habitats Directive (2014). AQTAG06 Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air.

- Acid deposition (as NO_X) = 6.84 $keq.ha^{-1}.yr^{-1}$
- Acid deposition (as NH_3) = 18.5 $keq.ha^{-1}.yr^{-1}$
- Acid deposition (as SO_2) = 9.84 $keq.ha^{-1}.yr^{-1}$

Significance of Impacts

Impacts at Human Receptors

4.40 The significance of impacts from the proposed SBGs is determined in terms of criteria set out in Defra's 'Air emissions risk assessment for your environmental permit'[13], EPUK and IAQM's 'Planning for air quality'[12] and the EPA's AEGL for NO_2[5]. The significance of impacts is considered both in terms of the:

- **Process Contribution (PC):** the impact of direct, additional emissions associated with the new processes only, and
- **Predicted Environmental Concentration (PEC):** the impact associated with the PC combined with existing background pollutant concentrations.

4.41 Defra's guidance advocates that when undertaking detailed modelling, the PC can be considered *insignificant* if:

- the long-term PC at a sensitive receptor is <1% of the long term AQS; and
- the short-term PC at a sensitive receptor is <10% of the short term AQS.

4.42 If the above criteria are exceeded, significant impacts can be screened out if:

- the short-term PC is less than 20% of the short term environmental standard minus twice the long term background concentration; and
- the long-term PEC is less than 70% of the long term environmental standard.

4.43 The EA, however, provide no guidance (at detailed modelling stage) to determine whether the PC or PEC is *significant*.

4.44 Joint EPUK & IAQM guidance provides impact descriptors that also offer a means to communicate the numerical output of detailed modelling. The impact descriptor used to describe the change in long term average concentrations is derived from both the magnitude of change at a sensitive receptor and the ambient concentration at that receptor. The impact can either be '*adverse*' or '*beneficial*' and be described as '*negligible*', '*slight*', '*moderate*' or '*substantial*. These descriptors are summarised In Appendix A.

4.45 The impact descriptors described in Appendix A are intended for application at a series of individual receptors. The assessment of overall significance is, however, based on professional judgement and the reasons for reaching an overall judgement of significance must be clear, set out logically and will take into consideration factors such as:

- the existing and future air quality in the absence of the development.

- the extent of current and future population exposure to the impacts;
- the spatial and temporal extent of any impacts; and
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts.

4.46 Regarding short term impacts, total percentile concentrations (PEC) at locations of relevant exposure below the AQS/AQO, AEL or AEGL were considered "not significant". This is considered a sufficiently robust approach given the conservative inputs (see Table 4.6).

Impacts at Ecological Receptors

4.47 The EA provides different screening criteria for assessing changes in pollution concentrations and deposition depending on the sensitivity of the habitat.

4.48 For SPAs, SACs, Ramsar sites or SSSIs, changes can be considered insignificant if:

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

4.49 EA guidance provides the following commentary if the standards above are exceeded:

"If you do not meet these requirements you need to calculate the PEC and check the PEC against the standard for protected conservation areas.

You do not need to calculate PEC for short term targets.

If your short term PC exceeds the screening criteria of 10%, you need to do detailed modelling.

If your long term PC is greater than 1% and your PEC is less than 70% of the long term environmental standard, the emissions are insignificant – you do not need to assess them any further.

If your PEC is greater than 70% of the long term environmental standard, you need to do detailed modelling."

4.50 For Local Nature sites, changes can be considered insignificant if:

- the short term PC is less than 100% of the short term environmental standard for protected conservation areas; and/or
- the long term PC is less than 100% of the long term environmental standard for protected conservation areas.

Model Uncertainties and Assumptions

4.51 There are a number of inherent uncertainties associated with the modelling process, including:

- Model uncertainty – due to model formulations;
- Data uncertainty – due to inaccuracies in input data, including emissions estimates, background estimates and meteorology; and
- Variability – randomness of measurements used.

4.52 Using a validated air quality model such as ADMS-6 reduces the modelling uncertainty.

4.53 The choices of the practitioner throughout the air quality assessment process are also essential to the management of uncertainty, including the decision to bias the predicted impact towards a worst-case estimate or a central estimate. This assessment has used inputs tending towards 'worst-case', where appropriate, to provide a conservative and robust assessment.

4.54 Table 4.6 below summarises the approach to minimising the uncertainty in the conclusions drawn.

Table 4.6: Summary of conservative methods used in assessment

Source of uncertainty	Approach	Comments
Future Background Concentrations	It has been assumed that there will be no improvement in background conditions from the 2025 predictions. Furthermore, 2001 UK-AIR predictions for benzene, CO and SO_2 have been used.	Given the measures being undertaken across the UK to reduce emissions across all sectors, these inputs are considered to be conservative.
Meteorological Data	The model has been run with 5 years of meteorological data to account for potential differences in meteorology from year to year. The maximum concentration from 5 years' worth of data, at each receptor or grid point was used in the analysis, increasing the probability that worst-case meteorological conditions are identified.	This is the recommended approach for Environmental Permitting.
Length of possible Grid Failure	An Emergency Grid Failure scenario has been modelled in which the failure lasts for a full 72-hour period.	Noting the reliability of the grid (99.999605% availability), grid failures are highly unlikely. As such, it is reasonable to consider a 72-hour outage to be a highly conservative modelling assumption.

Source of uncertainty	Approach	Comments
NO_X to NO_2 Conversion factors	The EA's recommended conversion factor of 35% was used for short-term NO_2.	AQMAU suggest that within 500m of a pollutant source, the conversion rate is likely to be closer to 15%. All modelled receptors are within 500m of the site.
Surface Roughness and Minimum Monin Obukhov Length	Sensitivity testing exploring the impact of surface roughness ranging between 1.5m or 1.0m and MO between 30m and 100m was undertaken, with values being chosen on the basis of those that led to the most conservative outputs.	Environmental Permitting guidance recommends carrying out sensitivity tests to explore the impact of varying uncertain parameters.

5. Assessment of Impacts

5.1 The proposed development's predicted impact on air quality under normal testing and maintenance, and under an emergency grid failure operation, is presented below.

Long Term Impacts at Human Receptors

Testing and Maintenance

5.2 Table 5.1 below shows the predicted impact of the proposed development on annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, benzene and NO, during normal testing and maintenance (the cumulative process contributions from the fortnightly, quarterly and bi-annual tests). The annual mean AQSs / EALs for each of these pollutants are 40 µg.m^{-3}, 40 µg.m^{-3}, 20 µg.m^{-3}, 5 µg.m^{-3} and 310 µg.m^{-3}, respectively.

Table 5.1: Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, C_6H_6 and NO – Testing and Maintenance

Receptor Point	Annual Mean Concentration				
	PC (µg.m^{-3})	% AQS	PEC (µg.m^{-3})	% AQS	EPUK / IAQM Impact
NO_2					
R3	0.043	0.108%	22.01	55.01%	Negligible
R4	0.041	0.102%	21.92	54.81%	Negligible
R5	0.022	0.055%	20.44	51.10%	Negligible
R11	0.037	0.092%	22.17	55.43%	Negligible
R12	0.018	0.046%	21.74	54.36%	Negligible
R14	0.092	0.230%	22.76	56.91%	Negligible
R15	0.047	0.116%	22.34	55.86%	Negligible
R16	0.047	0.117%	21.48	53.70%	Negligible
R17	0.038	0.094%	21.25	53.14%	Negligible
R18	0.067	0.167%	22.08	55.20%	Negligible
PM_{10}					
R3	0.0018	0.0045%	14.44	36.09%	Negligible
R4	0.0017	0.0042%	14.39	35.97%	Negligible
R5	0.0009	0.0022%	14.26	35.65%	Negligible
R11	0.0016	0.0040%	14.76	36.90%	Negligible
R12	0.0008	0.0020%	14.56	36.40%	Negligible
R14	0.0042	0.0105%	14.75	36.88%	Negligible
R15	0.0020	0.0051%	14.52	36.31%	Negligible
R16	0.0020	0.0050%	14.61	36.51%	Negligible
R17	0.0016	0.0041%	14.39	35.97%	Negligible
R18	0.0028	0.0071%	14.41	36.04%	Negligible
$PM_{2.5}$					
R3	0.0018	0.0090%	9.27	46.33%	Negligible

Receptor Point	Annual Mean Concentration				
	PC ($\mu g.m^{-3}$)	% AQS	PEC ($\mu g.m^{-3}$)	% AQS	EPUK / IAQM Impact
R4	0.0017	0.0085%	9.24	46.21%	Negligible
R5	0.0009	0.0045%	9.15	45.76%	Negligible
R11	0.0016	0.0079%	9.42	47.10%	Negligible
R12	0.0008	0.0040%	9.28	46.42%	Negligible
R14	0.0042	0.0209%	9.40	47.02%	Negligible
R15	0.0020	0.0102%	9.31	46.53%	Negligible
R16	0.0020	0.0100%	9.31	46.56%	Negligible
R17	0.0016	0.0082%	9.24	46.20%	Negligible
R18	0.0028	0.0142%	9.27	46.33%	Negligible
Benzene					
R3	0.0024	0.048%	0.91	18.27%	Negligible
R4	0.0023	0.045%	0.91	18.27%	Negligible
R5	0.0012	0.024%	0.94	18.72%	Negligible
R11	0.0020	0.041%	0.91	18.26%	Negligible
R12	0.0010	0.020%	0.91	18.24%	Negligible
R14	0.0052	0.104%	0.92	18.32%	Negligible
R15	0.0026	0.052%	0.91	18.27%	Negligible
R16	0.0026	0.052%	0.93	18.63%	Negligible
R17	0.0021	0.042%	0.93	18.62%	Negligible
R18	0.0037	0.074%	0.91	18.29%	Negligible
Nitrogen Monoxide					
R3	0.018	0.006%	11.97	3.86%	Negligible
R4	0.017	0.006%	11.96	3.86%	Negligible
R5	0.009	0.003%	9.10	2.94%	Negligible
R11	0.016	0.005%	11.96	3.86%	Negligible
R12	0.008	0.003%	11.96	3.86%	Negligible
R14	0.039	0.013%	11.99	3.87%	Negligible
R15	0.020	0.006%	11.97	3.86%	Negligible
R16	0.020	0.006%	10.07	3.25%	Negligible
R17	0.016	0.005%	10.07	3.25%	Negligible
R18	0.029	0.009%	11.98	3.86%	Negligible

Note: Any discrepancies due to rounding. Receptors which are not included in this table are locations where the annual mean AQSs/ AELs do not apply.

5.3 As shown in Table 5.1, annual mean concentrations (PEC) of NO_2, PM_{10}, $PM_{2.5}$, C_6H_6 and NO are all modelled to be below relevant annual mean AQSs at all locations of relevant exposure.

5.4 The data in Table 5.1 show that annual mean PCs of all of these pollutants are anticipated to be less than the 1% screening criterion at all discrete receptors in the vicinity of the site.

5.5 All increases in annual mean concentrations would be considered 'negligible' with reference to EPUK and IAQM's impact descriptors, which considers both the PC and the PEC.

5.6 Considering the above, emissions associated with maintenance and testing would not have a significant impact on annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, C_6H_6 and NO. Therefore, long-term impacts from maintenance and testing can be screened out.

Emergency Operation

5.7 Table 5.2 below shows the predicted impact of the proposed development on annual mean NO_2, PM_{10}, $PM_{2.5}$, benzene and NO, after 72 hours of operation during a grid failure. The annual mean AQSs / EALs for each of these pollutants are 40 µg.m^{-3}, 40 µg.m^{-3}, 20 µg.m^{-3}, 5 µg.m^{-3} and 310 µg.m^{-3}, respectively.

Table 5.2: Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, C_6H_6 and NO – Grid Failure

Receptor Point	Annual Mean Concentration				
	PC (µg.m^{-3})	% AQS	PEC (µg.m^{-3})	% AQS	EPUK / IAQM Impact
NO_2					
R3	0.03	0.07%	21.99	54.98%	Negligible
R4	0.03	0.07%	21.91	54.77%	Negligible
R5	0.02	0.04%	20.43	51.08%	Negligible
R11	0.02	0.06%	22.16	55.40%	Negligible
R12	0.01	0.03%	21.74	54.34%	Negligible
R14	0.06	0.15%	22.73	56.82%	Negligible
R15	0.03	0.08%	22.33	55.82%	Negligible
R16	0.03	0.08%	21.47	53.66%	Negligible
R17	0.02	0.06%	21.24	53.10%	Negligible
R18	0.04	0.11%	22.06	55.15%	Negligible
PM_{10}					
R3	0.0022	0.0056%	14.44	36.09%	Negligible
R4	0.0021	0.0053%	14.39	35.97%	Negligible
R5	0.0012	0.0030%	14.26	35.65%	Negligible
R11	0.0019	0.0048%	14.76	36.90%	Negligible
R12	0.0009	0.0023%	14.56	36.40%	Negligible
R14	0.0046	0.0115%	14.75	36.89%	Negligible
R15	0.0024	0.0060%	14.52	36.31%	Negligible
R16	0.0025	0.0062%	14.61	36.52%	Negligible
R17	0.0019	0.0048%	14.39	35.97%	Negligible
R18	0.0035	0.0087%	14.42	36.04%	Negligible
$PM_{2.5}$					
R3	0.0022	0.0112%	9.27	46.33%	Negligible
R4	0.0021	0.0106%	9.24	46.21%	Negligible
R5	0.0012	0.0061%	9.15	45.76%	Negligible
R11	0.0019	0.0097%	9.42	47.11%	Negligible
R12	0.0009	0.0047%	9.28	46.42%	Negligible
R14	0.0046	0.0231%	9.40	47.02%	Negligible
R15	0.0024	0.0119%	9.31	46.53%	Negligible
R16	0.0025	0.0124%	9.31	46.56%	Negligible
R17	0.0019	0.0096%	9.24	46.20%	Negligible

Receptor Point	Annual Mean Concentration				
	PC ($\mu g.m^{-3}$)	% AQS	PEC ($\mu g.m^{-3}$)	% AQS	EPUK / IAQM Impact
R18	0.0035	0.0174%	9.27	46.33%	Negligible
Benzene					
R3	0.0004	0.0075%	0.91	18.23%	Negligible
R4	0.0003	0.0068%	0.91	18.23%	Negligible
R5	0.0001	0.0021%	0.94	18.70%	Negligible
R11	0.0003	0.0051%	0.91	18.23%	Negligible
R12	0.0001	0.0025%	0.91	18.22%	Negligible
R14	0.0006	0.0116%	0.91	18.23%	Negligible
R15	0.0003	0.0070%	0.91	18.23%	Negligible
R16	0.0002	0.0031%	0.93	18.58%	Negligible
R17	0.0001	0.0026%	0.93	18.58%	Negligible
R18	0.0005	0.0105%	0.91	18.23%	Negligible
Nitrogen Monoxide					
R3	0.012	0.004%	11.96	3.86%	Negligible
R4	0.012	0.004%	11.96	3.86%	Negligible
R5	0.007	0.002%	9.10	2.93%	Negligible
R11	0.010	0.003%	11.96	3.86%	Negligible
R12	0.005	0.002%	11.95	3.86%	Negligible
R14	0.025	0.008%	11.97	3.86%	Negligible
R15	0.013	0.004%	11.96	3.86%	Negligible
R16	0.013	0.004%	10.07	3.25%	Negligible
R17	0.010	0.003%	10.07	3.25%	Negligible
R18	0.019	0.006%	11.97	3.86%	Negligible

Note: Any discrepancies due to rounding. Receptors which are not included in this table are locations where the annual mean AQSs/ AELs do not apply.

5.8 As shown in Table 5.2, annual mean concentrations (PEC) of NO_2, PM_{10}, $PM_{2.5}$, C_6H_6 and NO are all modelled to be below the relevant annual mean AQSs at all locations of relevant exposure, even with a prolonged grid failure.

5.9 The data in Table 5.2 show that annual mean PCs are all estimated to be less than the 1% screening criterion at discrete receptors in the vicinity of the site.

5.10 Emissions associated with a prolonged grid failure would not have an overall significant impact on annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$, C_6H_6 and NO. Therefore, long-term impacts from a 72-hour prolonged grid failure can be screened out.

Short Term Impacts at Human Receptors

Testing and Maintenance – Scenario 1 (Fortnightly and Quarterly Testing)

NO_2

5.11 Table 5.3 below shows the predicted impacts of the site's SBGs, with reference to the hourly mean AQS and AEL for NO_2.

Table 5.3: Predicted short term percentile mean concentrations of NO_2 – Scenario 1

Receptor Point	99.79th Percentile Hourly Mean NO_2				100th Percentile Hourly Mean NO_2			
	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS
R1	15	8%	60	30%	17	2%	61	6%
R2	7	3%	51	25%	7	1%	51	5%
R3	5	3%	49	25%	7	1%	51	5%
R4	5	2%	48	24%	5	1%	49	5%
R5	1	1%	42	21%	2	0%	42	5%
R6	12	6%	57	28%	15	2%	60	6%
R7	6	3%	50	25%	7	1%	52	6%
R8	8	4%	55	27%	9	1%	55	6%
R9	16	8%	76	38%	19	2%	80	9%
R10	11	6%	59	30%	12	1%	60	6%
R11	3	2%	48	24%	4	0%	48	5%
R12	3	1%	46	23%	3	0%	47	5%
R13	8	4%	52	26%	8	1%	53	6%
R14	6	3%	51	26%	6	1%	52	5%
R15	4	2%	49	24%	5	1%	49	5%
R16	2	1%	45	23%	3	0%	46	5%
R17	2	1%	45	22%	2	0%	45	5%
R18	8	4%	52	26%	8	1%	52	6%
R19	35	18%	83	41%	53	6%	100	11%
R20	28	14%	73	36%	30	3%	75	8%

Note: Any discrepancies due to rounding.

5.12 The data in Table 5.3 show that the 99.79th percentile PECs (i.e. the 19th highest concentration in a year, assuming constant generator operation) do not exceed the 200 $\mu g.m^{-3}$ hourly AQS for NO_2. Noting that the 100th percentile concentration (PEC) also falls below 200 $\mu g.m^{-3}$, it is reasonable to suggest that one hourly concentration exceeding 200 $\mu g.m^{-3}$, much less nineteen such instances, is unlikely.

5.13 As such, routine fortnightly and quarterly testing is not anticipated to have a significant adverse effect on local air quality, with respect to the hourly NO_2 AQS.

5.14 It is also noted that all concentrations of NO_2 are lower than the US EPA's Acute Exposure Guidance Levels (AEGLs)[5]. The model was run for every hour, with the maximum modelled concentration (PEC) being 100 $\mu g.m^{-3}$, at Receptor R19. The AEGL for non-disabling impacts is at 940 $\mu g.m^{-3}$.

5.15 As such, toxicological health effects are not anticipated as a result of the routine monthly testing of the SBGs, and impacts can be considered insignificant.

PM_{10}, C_6H_6, CO, NO and SO_2

5.16 Short-term impacts against the AQSs/ EALs for PM_{10}, C_6H_6, CO, NO and SO_2 are presented in Appendix D. All process contributions remained below the EA's initial screening thresholds, so the site can reasonably be considered to have an insignificant effect on short-term PM_{10}, CO, NO, C_6H_6 and SO_2 concentrations.

Testing and Maintenance – Scenario 2 (Bi-annual Testing)

NO_2

5.17 Table 5.4 below shows the predicted impacts of the site's SBGs, with reference to the hourly mean AQS and AEL for NO_2.

Table 5.4: Predicted short term percentile mean concentrations of NO_2 – Scenario 2

Receptor Point	99.79th Percentile Hourly Mean NO_2				100th Percentile Hourly Mean NO_2			
	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS
R1	20	10%	65	32%	21	2%	66	7%
R2	10	5%	54	27%	10	1%	54	6%
R3	9	4%	52	26%	11	1%	55	6%
R4	7	4%	51	26%	8	1%	52	6%
R5	2	1%	43	22%	3	0%	44	5%
R6	16	8%	61	30%	22	2%	66	7%
R7	8	4%	52	26%	8	1%	53	6%
R8	12	6%	58	29%	12	1%	59	6%
R9	19	9%	79	40%	28	3%	89	9%
R10	16	8%	64	32%	17	2%	65	7%
R11	5	2%	49	24%	5	1%	50	5%
R12	4	2%	47	24%	4	0%	48	5%
R13	11	5%	55	28%	12	1%	56	6%
R14	9	4%	54	27%	9	1%	55	6%
R15	6	3%	51	25%	7	1%	52	6%
R16	3	2%	46	23%	5	0%	47	5%
R17	3	2%	46	23%	4	0%	46	5%
R18	12	6%	56	28%	13	1%	57	6%
R19	32	16%	79	40%	88	9%	135	14%
R20	24	12%	69	34%	32	3%	77	8%

Note: Any discrepancies due to rounding.

5.18 The data in Table 5.4 show that the 99.79th percentile PECs (i.e. the 19th highest concentration in a year, assuming constant generator operation) do not exceed the 200 µg.m^{-3} hourly AQS for NO_2. Noting that the 100th percentile concentration (PEC) also falls below 200 µg.m^{-3}, it is reasonable to suggest that one hourly concentration exceeding 200 µg.m^{-3}, much less nineteen such instances, is unlikely.

5.19 As such, bi-annual testing is not anticipated to have a significant adverse effect on local air quality, with respect to the hourly NO_2 AQS.

5.20 It is also noted that all concentrations of NO_2 are lower than the US EPA's Acute Exposure Guidance Levels (AEGLs)[5]. The model was run for every hour, with the maximum modelled concentration (PEC) being 135 µg.m^{-3}, at Receptor R19. The AEGL for non-disabling impacts is at 940 µg.m^{-3}.

5.21 As such, toxicological health effects are not anticipated as a result of the routine annual testing of the SBGs, and impacts can be considered insignificant.

<u>PM_{10}, C_6H_6, CO, NO and SO_2</u>

5.22 Short-term impacts against the AQSs / EALs for PM_{10}, C_6H_6, CO, NO and SO_2 are presented in Appendix D. Process contributions for all pollutants remained below the EA's initial screening thresholds, so the site can reasonably be considered to have an insignificant effect on short-term concentrations.

72-hour Prolonged Grid Failure

<u>NO_2</u>

5.23 Table 5.5 below shows the predicted impacts of the site's SBGs, with reference to the hourly mean AQS for NO_2.

Table 5.5: Predicted short term percentile mean concentrations of NO_2 – Grid Failure

Receptor Point	99.79th Percentile Hourly Mean NO_2				100th Percentile Hourly Mean NO_2			
	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS
R1	87	43%	131	66%	96	10%	141	15%
R2	44	22%	88	44%	48	5%	92	10%
R3	41	21%	85	43%	49	5%	93	10%
R4	36	18%	79	40%	41	4%	85	9%
R5	12	6%	53	26%	13	1%	54	6%
R6	59	30%	104	52%	64	7%	108	12%
R7	37	18%	81	41%	40	4%	84	9%
R8	57	28%	103	52%	58	6%	105	11%
R9	72	36%	133	67%	75	8%	135	14%
R10	61	30%	109	54%	64	7%	112	12%
R11	24	12%	68	34%	27	3%	71	8%
R12	19	10%	63	31%	22	2%	65	7%
R13	49	25%	94	47%	52	6%	97	10%
R14	41	21%	87	43%	44	5%	89	9%
R15	30	15%	75	37%	35	4%	79	8%
R16	16	8%	59	30%	25	3%	68	7%
R17	16	8%	59	29%	23	2%	66	7%
R18	51	25%	95	47%	60	6%	104	11%
R19	103	51%	150	75%	108	11%	155	17%
R20	69	35%	114	57%	82	9%	127	13%

Note: Any discrepancies due to rounding.

5.24 The data in Table 5.5 show that the 99.79th percentile PECs (i.e. the 19th highest concentration in a year, assuming constant generator operation) do not exceed the 200 $\mu g.m^{-3}$ hourly AQS for NO_2. Noting that the 100th percentile concentration (PEC) also falls below 200 $\mu g.m^{-3}$, it is reasonable to suggest that one hourly concentration exceeding 200 $\mu g.m^{-3}$, much less nineteen such instances, is unlikely.

5.25 As such, a prolonged (72 hour) grid failure is not anticipated to have a significant adverse effect on local air quality, with respect to the hourly NO_2 AQS.

5.26 It is also noted that all concentrations of NO_2 are lower than the US EPA's Acute Exposure Guidance Levels (AEGLs)[5]. The model was run for every hour, with the maximum modelled concentration (PEC) being 155 $\mu g.m^{-3}$, at Receptor R19. The AEGL for non-disabling impacts is at 940 $\mu g.m^{-3}$.

5.27 As such, toxicological health effects are not anticipated as a result of a prolonged (72 hour) grid failure, and impacts can be considered insignificant.

PM_{10}, C_6H_6, CO, NO and SO_2

5.28 Short-term impacts against the AQSs / EALs for PM_{10}, C_6H_6, CO, NO and SO_2 are presented in Appendix D. Process contributions for C_6H_6, CO, NO and SO_2 remained below the EA's initial screening thresholds, so the site can reasonably be considered to have an insignificant effect on short-term concentrations. PM_{10} concentrations were above the 10% screening threshold at Receptor R19, but well below the AQS.

Air Quality Impacts at Ecological Receptors

5.29 The proposed development's predicted impact on air quality at ecological sites during routine testing and maintenance of the generators, as well as during prolonged 72-hour emergency operation, is presented below.

Annual Mean Air Quality Impacts

5.30 Tables 5.6, 5.7 and 5.8, below, show the modelled impacts on annual mean NO_x NH_3 and SO_2 concentrations, respectively.

Table 5.6: Annual mean NO_x impacts from routine testing and a prolonged grid failure.

Modelled Receptor	Annual Mean NO_X ($\mu g.m^{-3}$)				Potentially Significant
	NO_X	%CL	PEC	%CL	
Testing and Maintenance					
South West London Waterbodies SPA	0.0007	0.0023%	N/A	N/A	No
Richmond Park SAC	0.0004	0.0014%	N/A	N/A	No
Cranford Countryside Park SINC	0.0113	0.0378%	N/A	N/A	No
Minet Country Park SINC	0.1562	0.5207%	N/A	N/A	No
London Canals SINC	0.1169	0.3898%	N/A	N/A	No
Hayes Village Priority Woodland	0.0389	0.1296%	N/A	N/A	No
Cranford Lane Gravel SINC	0.0077	0.0257%	N/A	N/A	No
Hartlands Wood SINC	0.0054	0.0179%	N/A	N/A	No
Crane Corridor SINC	0.0397	0.1324%	N/A	N/A	No
Lake Farm Country Park SINC	0.0039	0.0129%	N/A	N/A	No
Airlinks Ponds SINC	0.0044	0.0146%	N/A	N/A	No
Thorncliffe Rough SINC	0.0032	0.0106%	N/A	N/A	No
Bollinbrooke Way SINC	0.0019	0.0062%	N/A	N/A	No
St Marys Wood End SINC	0.0027	0.0091%	N/A	N/A	No
Havelock Cemetery SINC	0.0071	0.0238%	N/A	N/A	No
Grid Failure					
South West London Waterbodies SPA	0.0011	0.0035%	N/A	N/A	No

Richmond Park SAC	0.0006	0.0022%	N/A	N/A	No
Cranford Countryside Park SINC	0.0141	0.0470%	N/A	N/A	No
Minet Country Park SINC	0.2012	0.6706%	N/A	N/A	No
London Canals SINC	0.0965	0.3218%	N/A	N/A	No
Hayes Village Priority Woodland	0.0472	0.1572%	N/A	N/A	No
Cranford Lane Gravel SINC	0.0101	0.0337%	N/A	N/A	No
Hartlands Wood SINC	0.0062	0.0206%	N/A	N/A	No
Crane Corridor SINC	0.0459	0.1529%	N/A	N/A	No
Lake Farm Country Park SINC	0.0051	0.0170%	N/A	N/A	No
Airlinks Ponds SINC	0.0055	0.0184%	N/A	N/A	No
Thorncliffe Rough SINC	0.0042	0.0140%	N/A	N/A	No
Bollinbrooke Way SINC	0.0026	0.0086%	N/A	N/A	No
St Marys Wood End SINC	0.0039	0.0129%	N/A	N/A	No
Havelock Cemetery SINC	0.0101	0.0335%	N/A	N/A	No

Note: Any discrepancies are due to rounding.

5.31 As shown in Table 5.6, the largest annual mean NO_X concentration increase from process contributions was 0.2012 $\mu g.m^{-3}$ (grid failure scenario), which is just 0.67% of the 30 $\mu g.m^{-3}$ critical level.

5.32 As all increases (process contributions) are less than 1% of the critical level at internationally designated sites, and less than 100% of the critical level at locally designated sites, the EA's screening criteria[13] have not been exceeded and all impacts in relation to annual mean NO_X can be considered insignificant.

Table 5.7: Annual mean NH_3 impacts from routine testing and a prolonged grid failure.

Modelled Receptor	Annual Mean NH_3 ($\mu g.m^{-3}$)				Potentially Significant
	NH_3	%CL	PEC	%CL	
Testing and Maintenance					
South West London Waterbodies SPA	0.0000	0.0005%	N/A	N/A	No
Richmond Park SAC	0.0000	0.0003%	N/A	N/A	No
Cranford Countryside Park SINC	0.0001	0.0075%	N/A	N/A	No
Minet Country Park SINC	0.0010	0.1020%	N/A	N/A	No
London Canals SINC	0.0007	0.0735%	N/A	N/A	No
Hayes Village Priority Woodland	0.0002	0.0245%	N/A	N/A	No
Cranford Lane Gravel SINC	0.0001	0.0053%	N/A	N/A	No
Hartlands Wood SINC	0.0000	0.0034%	N/A	N/A	No
Crane Corridor SINC	0.0003	0.0255%	N/A	N/A	No

Lake Farm Country Park SINC	0.0000	0.0026%	N/A	N/A	No
Airlinks Ponds SINC	0.0000	0.0030%	N/A	N/A	No
Thorncliffe Rough SINC	0.0000	0.0020%	N/A	N/A	No
Bollinbrooke Way SINC	0.0000	0.0012%	N/A	N/A	No
St Marys Wood End SINC	0.0000	0.0017%	N/A	N/A	No
Havelock Cemetery SINC	0.0000	0.0050%	N/A	N/A	No
Grid Failure					
South West London Waterbodies SPA	0.0000	0.0043%	N/A	N/A	No
Richmond Park SAC	0.0000	0.0024%	N/A	N/A	No
Cranford Countryside Park SINC	0.0006	0.0575%	N/A	N/A	No
Minet Country Park SINC	0.0082	0.8164%	N/A	N/A	No
London Canals SINC	0.0039	0.3938%	N/A	N/A	No
Hayes Village Priority Woodland	0.0019	0.1857%	N/A	N/A	No
Cranford Lane Gravel SINC	0.0004	0.0425%	N/A	N/A	No
Hartlands Wood SINC	0.0002	0.0243%	N/A	N/A	No
Crane Corridor SINC	0.0019	0.1854%	N/A	N/A	No
Lake Farm Country Park SINC	0.0002	0.0210%	N/A	N/A	No
Airlinks Ponds SINC	0.0002	0.0226%	N/A	N/A	No
Thorncliffe Rough SINC	0.0002	0.0169%	N/A	N/A	No
Bollinbrooke Way SINC	0.0001	0.0101%	N/A	N/A	No
St Marys Wood End SINC	0.0001	0.0149%	N/A	N/A	No
Havelock Cemetery SINC	0.0004	0.0434%	N/A	N/A	No

Note: Any discrepancies are due to rounding.

5.33 As shown in Table 5.7, the largest annual mean NH_3 concentration increase from process contributions was 0.0082 $\mu g.m^{-3}$ (grid failure scenario), which is 0.82% of the 1 $\mu g.m^{-3}$ critical level (assuming the habitat includes lichens / bryophytes).

5.34 As all increases (process contributions) are less than 1% of the critical level at internationally designated sites, and less than 100% of the critical level at locally designated sites, the EA's screening criteria[13] have not been exceeded and all impacts in relation to annual mean NH_3 can be considered insignificant.

Table 5.8: Annual mean SO_2 impacts from routine testing and a prolonged grid failure.

Modelled Receptor	Annual Mean SO_2 ($\mu g.m^{-3}$)				Potentially Significant
	SO_2	%CL	PEC	%CL	
Testing and Maintenance					
South West London Waterbodies SPA	0.00000	0.00001%	N/A	N/A	No
Richmond Park SAC	0.00000	0.00001%	N/A	N/A	No

Cranford Countryside Park SINC	0.00001	0.00013%	N/A	N/A	No
Minet Country Park SINC	0.00019	0.00186%	N/A	N/A	No
London Canals SINC	0.00013	0.00131%	N/A	N/A	No
Hayes Village Priority Woodland	0.00005	0.00046%	N/A	N/A	No
Cranford Lane Gravel SINC	0.00001	0.00009%	N/A	N/A	No
Hartlands Wood SINC	0.00001	0.00006%	N/A	N/A	No
Crane Corridor SINC	0.00005	0.00047%	N/A	N/A	No
Lake Farm Country Park SINC	0.00000	0.00005%	N/A	N/A	No
Airlinks Ponds SINC	0.00001	0.00005%	N/A	N/A	No
Thorncliffe Rough SINC	0.00000	0.00004%	N/A	N/A	No
Bollinbrooke Way SINC	0.00000	0.00002%	N/A	N/A	No
St Marys Wood End SINC	0.00000	0.00003%	N/A	N/A	No
Havelock Cemetery SINC	0.00001	0.00009%	N/A	N/A	No
Grid Failure					
South West London Waterbodies SPA	0.00001	0.00009%	N/A	N/A	No
Richmond Park SAC	0.00001	0.00005%	N/A	N/A	No
Cranford Countryside Park SINC	0.00012	0.00120%	N/A	N/A	No
Minet Country Park SINC	0.00171	0.01708%	N/A	N/A	No
London Canals SINC	0.00082	0.00819%	N/A	N/A	No
Hayes Village Priority Woodland	0.00040	0.00400%	N/A	N/A	No
Cranford Lane Gravel SINC	0.00009	0.00086%	N/A	N/A	No
Hartlands Wood SINC	0.00005	0.00052%	N/A	N/A	No
Crane Corridor SINC	0.00039	0.00389%	N/A	N/A	No
Lake Farm Country Park SINC	0.00004	0.00043%	N/A	N/A	No
Airlinks Ponds SINC	0.00005	0.00047%	N/A	N/A	No
Thorncliffe Rough SINC	0.00004	0.00036%	N/A	N/A	No
Bollinbrooke Way SINC	0.00002	0.00022%	N/A	N/A	No
St Marys Wood End SINC	0.00003	0.00033%	N/A	N/A	No
Havelock Cemetery SINC	0.00009	0.00085%	N/A	N/A	No

Note: Any discrepancies are due to rounding.

5.35 As shown in Table 5.8, the largest annual mean SO_2 concentration increase from process contributions was 0.00171 µg.m^{-3} (grid failure scenario), which is just 0.017% of the 10 µg.m^{-3} critical level (assuming the habitat includes lichens / bryophytes).

5.36 As all increases (process contributions) are less than 1% of the critical level at internationally designated sites, and less than 100% of the critical level at locally designated sites, the EA's screening criteria[13] have not been exceeded and all impacts in relation to annual mean SO_2 can be considered insignificant.

Short Term Air Quality Impacts

5.37 Short-term impacts for NO_X are provided in Table 5.9, below, assessed against the maximum daily critical level of 200 $\mu g.m^{-3}$.

Table 5.9: 24-hour mean NO_x impacts from routine testing and a prolonged grid failure.

Modelled Receptor	24-Hour NO_X ($\mu g.m^{-3}$)		Potentially Significant
	NO_X	%CL	
Testing Scenario 1			
South West London Waterbodies SPA	0.0	0.0%	No
Richmond Park SAC	0.0	0.0%	No
Cranford Countryside Park SINC	0.2	0.1%	No
Minet Country Park SINC	3.3	1.7%	No
London Canals SINC	3.0	1.5%	No
Hayes Village Priority Woodland	0.8	0.4%	No
Cranford Lane Gravel SINC	0.1	0.1%	No
Hartlands Wood SINC	0.1	0.0%	No
Crane Corridor SINC	0.8	0.4%	No
Lake Farm Country Park SINC	0.1	0.0%	No
Airlinks Ponds SINC	0.1	0.0%	No
Thorncliffe Rough SINC	0.1	0.0%	No
Bollinbrooke Way SINC	0.0	0.0%	No
St Marys Wood End SINC	0.0	0.0%	No
Havelock Cemetery SINC	0.1	0.1%	No
Testing Scenario 2			
South West London Waterbodies SPA	0.0	0.0%	No
Richmond Park SAC	0.0	0.0%	No
Cranford Countryside Park SINC	0.3	0.2%	No
Minet Country Park SINC	5.2	2.6%	No
London Canals SINC	2.6	1.3%	No
Hayes Village Priority Woodland	1.2	0.6%	No
Cranford Lane Gravel SINC	0.2	0.1%	No
Hartlands Wood SINC	0.1	0.1%	No
Crane Corridor SINC	1.1	0.5%	No
Lake Farm Country Park SINC	0.1	0.1%	No
Airlinks Ponds SINC	0.1	0.1%	No
Thorncliffe Rough SINC	0.1	0.0%	No
Bollinbrooke Way SINC	0.1	0.0%	No
St Marys Wood End SINC	0.1	0.0%	No
Havelock Cemetery SINC	0.2	0.1%	No
Grid Failure			
South West London Waterbodies SPA	0.1	0.1%	No
Richmond Park SAC	0.1	0.0%	No

Modelled Receptor	24-Hour NO_X ($\mu g.m^{-3}$)		Potentially Significant
	NO_X	%CL	
Cranford Countryside Park SINC	1.7	0.9%	No
Minet Country Park SINC	24.3	12.1%	No
London Canals SINC	12.0	6.0%	No
Hayes Village Priority Woodland	5.7	2.8%	No
Cranford Lane Gravel SINC	1.2	0.6%	No
Hartlands Wood SINC	0.7	0.4%	No
Crane Corridor SINC	5.7	2.8%	No
Lake Farm Country Park SINC	0.6	0.3%	No
Airlinks Ponds SINC	0.7	0.3%	No
Thorncliffe Rough SINC	0.5	0.3%	No
Bollinbrooke Way SINC	0.3	0.2%	No
St Marys Wood End SINC	0.5	0.2%	No
Havelock Cemetery SINC	1.2	0.6%	No

Note: Any discrepancies are due to rounding.

5.38 As shown in Table 5.9, maximum 24-hour NO_x concentrations (PCs) are modelled to be below the critical level at each ecological site during testing and maintenance and prolonged grid failure.

5.39 All increases (PCs) are less than 10% of the critical level at internationally designated sites, and less than 100% of the critical level at locally designated sites, so impacts in relation to daily maximum NO_x can be considered insignificant.

Deposition

5.40 Tables 5.10 and 5.11, below, show modelled impacts on nitrogen and acid deposition, respectively. Nitrogen deposition and acid deposition considers the cumulative contributions of NO_X and NH_3 (and SO_2 for acid deposition).

Table 5.10: Nitrogen deposition impacts from routine testing and a prolonged grid failure.

Modelled Receptor	Nitrogen deposition (Kg N/ha/yr.)				Potentially Significant
	N Deposition PC	%CL	N Deposition PEC	%CL	
Testing and Maintenance					
South West London Waterbodies SPA	0.0002	0.0023%	N/A	N/A	No
Richmond Park SAC	0.0001	0.0014%	N/A	N/A	No
Cranford Countryside Park SINC	0.0038	0.0385%	N/A	N/A	No
Minet Country Park SINC	0.0529	0.5289%	N/A	N/A	No
London Canals SINC	0.0394	0.3938%	N/A	N/A	No
Hayes Village Priority Woodland	0.0131	0.1309%	N/A	N/A	No
Cranford Lane Gravel SINC	0.0026	0.0262%	N/A	N/A	No
Hartlands Wood SINC	0.0018	0.0181%	N/A	N/A	No

Modelled Receptor	Nitrogen deposition (Kg N/ha/yr.)				Potentially Significant
	N Deposition PC	%CL	N Deposition PEC	%CL	
Crane Corridor SINC	0.0134	0.1342%	N/A	N/A	No
Lake Farm Country Park SINC	0.0013	0.0131%	N/A	N/A	No
Airlinks Ponds SINC	0.0015	0.0149%	N/A	N/A	No
Thorncliffe Rough SINC	0.0011	0.0107%	N/A	N/A	No
Bollinbrooke Way SINC	0.0006	0.0062%	N/A	N/A	No
St Marys Wood End SINC	0.0009	0.0092%	N/A	N/A	No
Havelock Cemetery SINC	0.0024	0.0244%	N/A	N/A	No
Grid Failure					
South West London Waterbodies SPA	0.0006	0.0063%	N/A	N/A	No
Richmond Park SAC	0.0004	0.0037%	N/A	N/A	No
Cranford Countryside Park SINC	0.0085	0.0855%	N/A	N/A	No
Minet Country Park SINC	0.1216	1.2156%	N/A	N/A	No
London Canals SINC	0.0585	0.5849%	N/A	N/A	No
Hayes Village Priority Woodland	0.0280	0.2805%	N/A	N/A	No
Cranford Lane Gravel SINC	0.0062	0.0622%	N/A	N/A	No
Hartlands Wood SINC	0.0037	0.0367%	N/A	N/A	No
Crane Corridor SINC	0.0277	0.2766%	N/A	N/A	No
Lake Farm Country Park SINC	0.0031	0.0311%	N/A	N/A	No
Airlinks Ponds SINC	0.0034	0.0336%	N/A	N/A	No
Thorncliffe Rough SINC	0.0025	0.0252%	N/A	N/A	No
Bollinbrooke Way SINC	0.0015	0.0153%	N/A	N/A	No
St Marys Wood End SINC	0.0023	0.0227%	N/A	N/A	No
Havelock Cemetery SINC	0.0063	0.0627%	N/A	N/A	No

Note: Any discrepancies are due to rounding.

5.41 As shown in Table 5.10, the largest nitrogen deposition increase from process contributions is 0.126 kg $N.Ha^{-1}.Yr^{-1}$ (grid failure scenario), which is 1.26% of the 10 kg $N.Ha^{-1}.Yr^{-1}$ critical load.

5.42 As all increases are less than 1% of the critical load at internationally designated sites, and less than 100% of the critical load at locally designated sites, the EA's screening criteria[13] have not been exceeded and all impacts in relation to nitrogen deposition can be considered insignificant.

Table 5.11: Acid deposition impacts from routine testing and a prolonged grid failure.

Modelled Receptor	Acid deposition (Keq H^+/ha/yr)				Potentially Significant
	Acid Deposition	%CL	Acid Deposition	%CL	

	PC		PEC		
Testing and Maintenance					
South West London Waterbodies SPA	0.00002	0.00098%	N/A	N/A	No
Richmond Park SAC	0.00001	0.00101%	N/A	N/A	No
Cranford Countryside Park SINC	0.00028	0.01368%	N/A	N/A	No
Minet Country Park SINC	0.00382	0.18799%	N/A	N/A	No
London Canals SINC	0.00284	0.13986%	N/A	N/A	No
Hayes Village Priority Woodland	0.00094	0.04654%	N/A	N/A	No
Cranford Lane Gravel SINC	0.00019	0.00921%	N/A	N/A	No
Hartlands Wood SINC	0.00013	0.00643%	N/A	N/A	No
Crane Corridor SINC	0.00097	0.04772%	N/A	N/A	No
Lake Farm Country Park SINC	0.00009	0.00554%	N/A	N/A	No
Airlinks Ponds SINC	0.00011	0.00530%	N/A	N/A	No
Thorncliffe Rough SINC	0.00008	0.00381%	N/A	N/A	No
Bollinbrooke Way SINC	0.00005	0.00264%	N/A	N/A	No
St Marys Wood End SINC	0.00007	0.00325%	N/A	N/A	No
Havelock Cemetery SINC	0.00018	0.00867%	N/A	N/A	No
Grid Failure					
South West London Waterbodies SPA	0.00005	0.00275%	N/A	N/A	No
Richmond Park SAC	0.00003	0.00274%	N/A	N/A	No
Cranford Countryside Park SINC	0.00064	0.03142%	N/A	N/A	No
Minet Country Park SINC	0.00906	0.44655%	N/A	N/A	No
London Canals SINC	0.00436	0.21485%	N/A	N/A	No
Hayes Village Priority Woodland	0.00209	0.10311%	N/A	N/A	No
Cranford Lane Gravel SINC	0.00046	0.02257%	N/A	N/A	No
Hartlands Wood SINC	0.00027	0.01350%	N/A	N/A	No
Crane Corridor SINC	0.00206	0.10171%	N/A	N/A	No
Lake Farm Country Park SINC	0.00023	0.01357%	N/A	N/A	No
Airlinks Ponds SINC	0.00025	0.01235%	N/A	N/A	No
Thorncliffe Rough SINC	0.00019	0.00928%	N/A	N/A	No
Bollinbrooke Way SINC	0.00011	0.00669%	N/A	N/A	No

St Marys Wood End SINC	0.00017	0.00830%	N/A	N/A	No
Havelock Cemetery SINC	0.00047	0.02301%	N/A	N/A	No

Note: Any discrepancies are due to rounding.

5.43 As shown in Table 5.11, the largest acid deposition increase from process contributions was 0.00906 Keq $H^+.Ha^{-1}.Yr^{-1}$ (grid failure scenario), which is 0.45% of the critical load for that habitat.

5.44 As all increases are less than 1% of the critical load at internationally designated sites, and less than 100% of the critical load at locally designated sites, the EA's screening criteria[13] have not been exceeded and all impacts in relation to acid deposition can be considered insignificant.

Results Summary and Discussion

5.45 The model results have determined that there will be no significant effects on air quality, with respect to any long-term or short-term AQS, EAL, AEGL, Critical Level or Critical Load. The testing regime is not predicted to cause even a single exceedance (up to 18 exceedances are allowed) of the short-term AQS for NO_2. As such, it can reasonably be expected that the generators will not significantly affect local air quality when operating as planned.

5.46 An additional scenario has been considered, whereby the generators run for an additional 72 consecutive hours per year (i.e. unplanned emergency operations). Results again determined that there will be an extremely low risk of the generators exceeding any AQS / EAL during prolonged generator use. As such, it can reasonably be expected that the generators will not significantly affect local air quality even when operating during unplanned power outage events.

6. Conclusions

6.1 Phlorum Ltd has been commissioned by HDR to undertake an air quality assessment (AQA) to support the permit application to operate Energy Centre 1 and Energy Centre 2 at the Union Park Data Centre Emergency Back-up Generation Facility.

6.2 A dispersion modelling assessment of the 28 No. standby generators was undertaken. Concentrations of NO_2, PM, CO, C_6H_6, NO and SO_2 were predicted at selected human receptors using a detailed dispersion model and compared with relevant long and short-term AQSs, EALs and AEGLs. Concentrations of NO_x, NH_3 and SO_2 were predicted at selected ecological receptors.

6.3 Long-term and short-term impacts from the operation of the generators were predicted to be insignificant during testing and maintenance and a prolonged grid failure at all relevant modelled receptor locations when assessed against all relevant long-term and short-term exceedance thresholds.

6.4 As such, this AQA demonstrates that the operational activities at these Data Centres will have an insignificant effect on air quality and, therefore, be compliant with the relevant air quality permit.

Figures

Figure 1: Site Location Plan

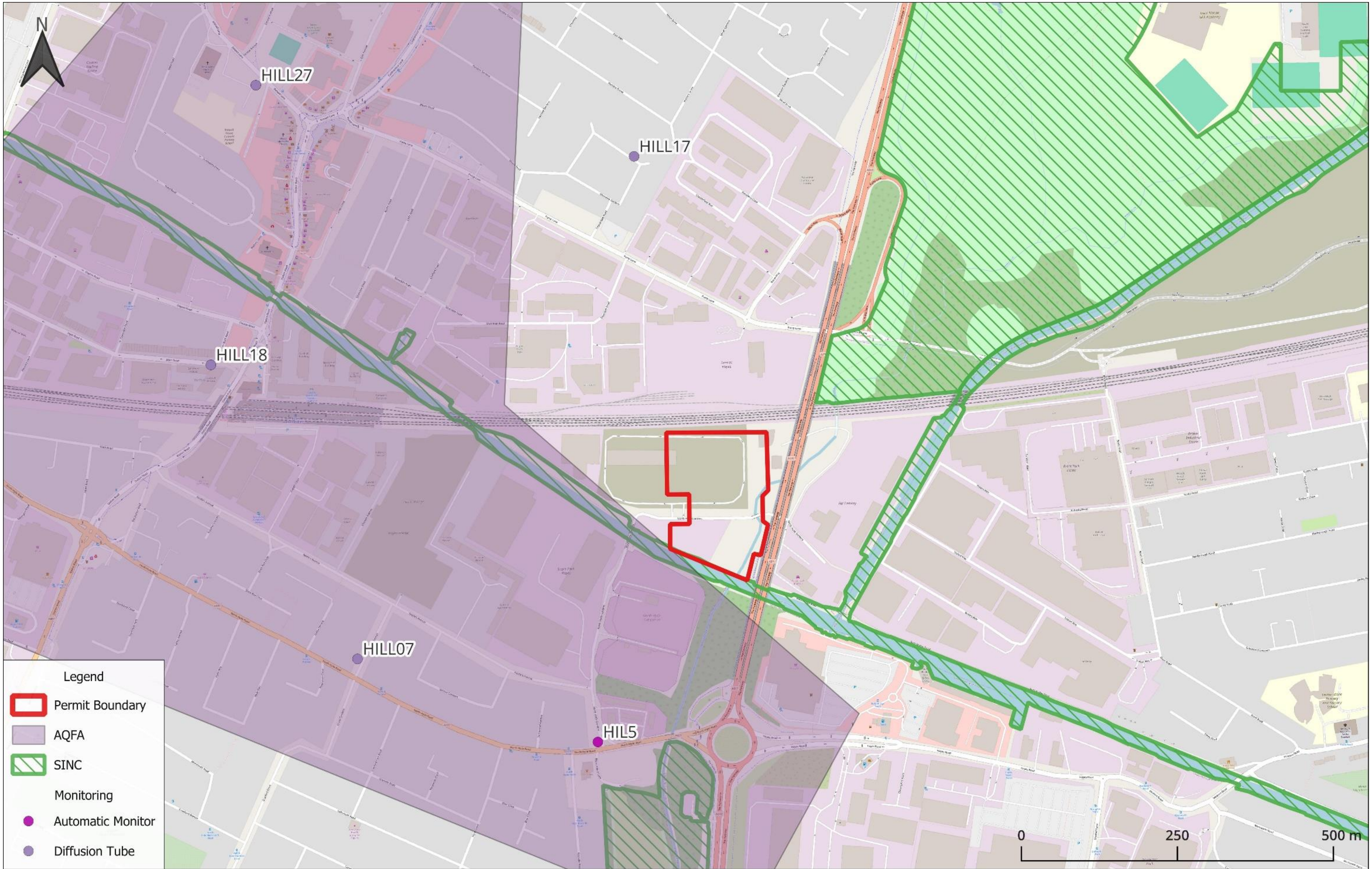

Figure 1: Site Location Plan

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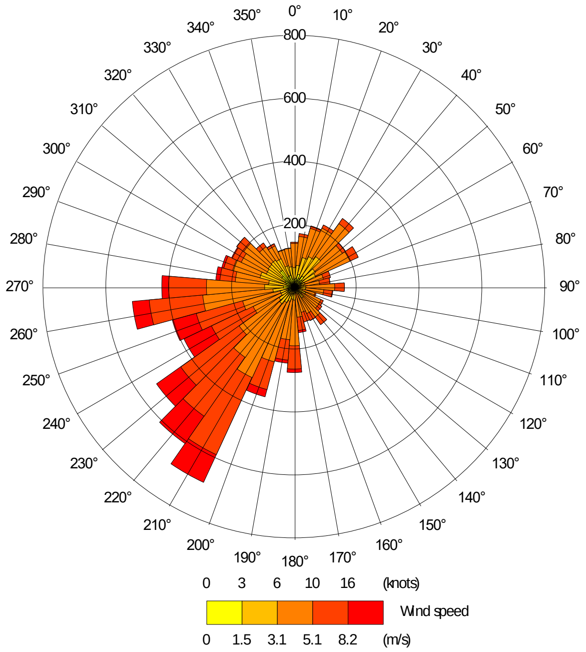
Figure 2: Heathrow Airport Wind Roses (2015 – 2019)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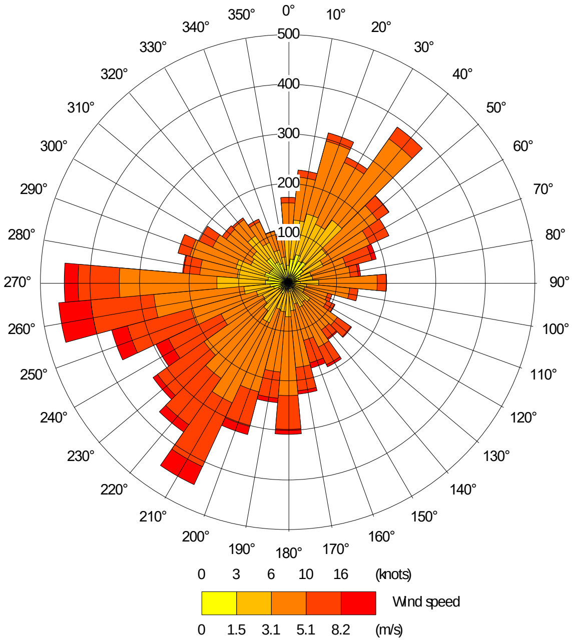
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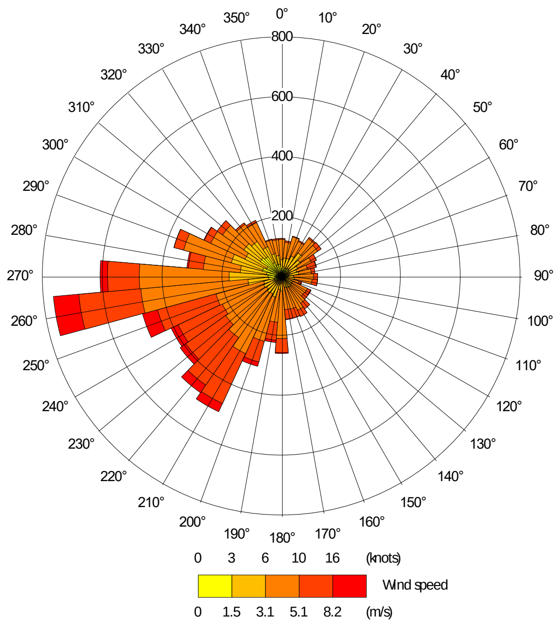
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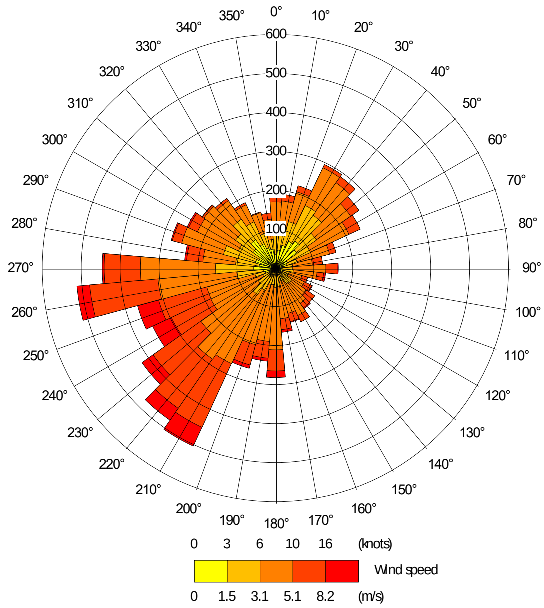
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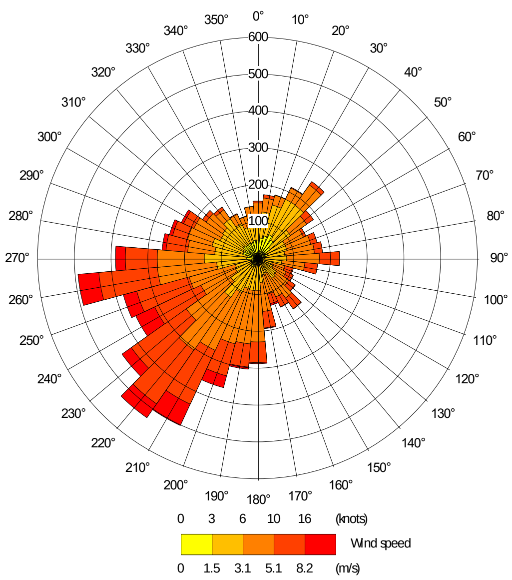
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Figure 3: LAEI NO_2 Concentration Contours (2025)

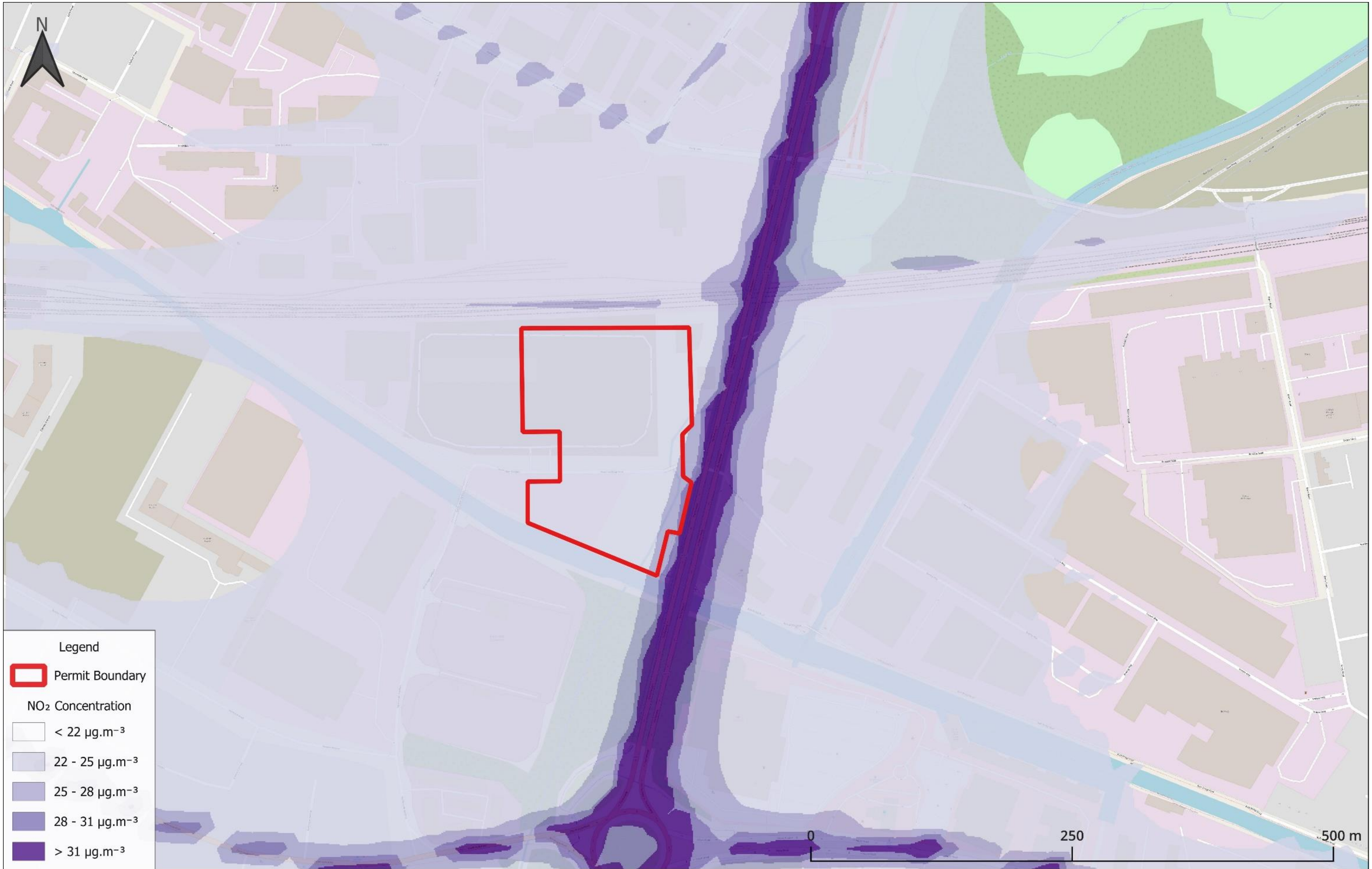

Figure 3: LAEI NO_2 Concentration Contours (2025)

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Figure 4: LAEI PM_{10} Concentration Contours (2025)

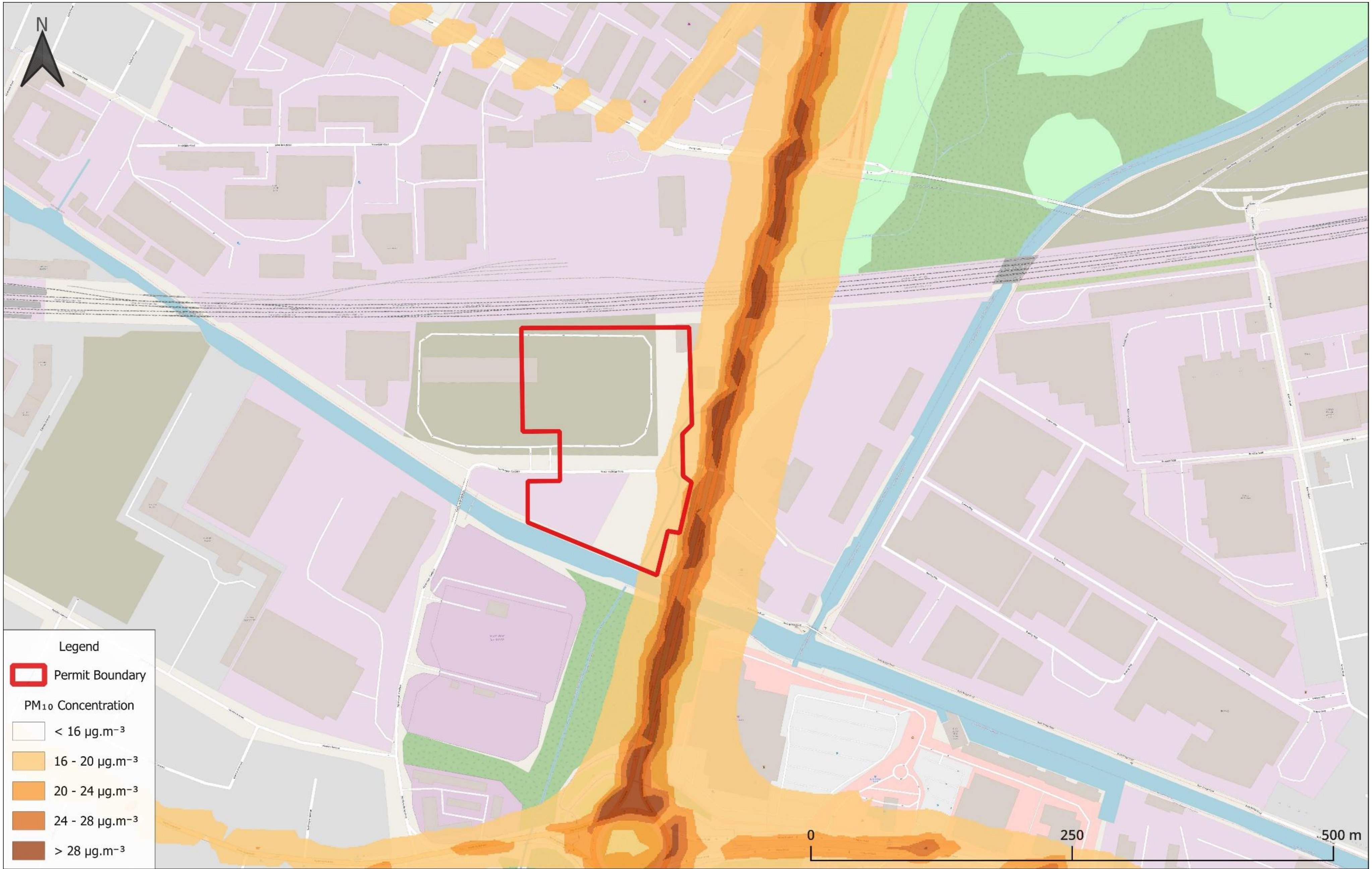

Figure 4: LAEI PM_{10} Concentration Contours (2025)

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Figure 5: LAEI $PM_{2.5}$ Concentration Contours (2025)

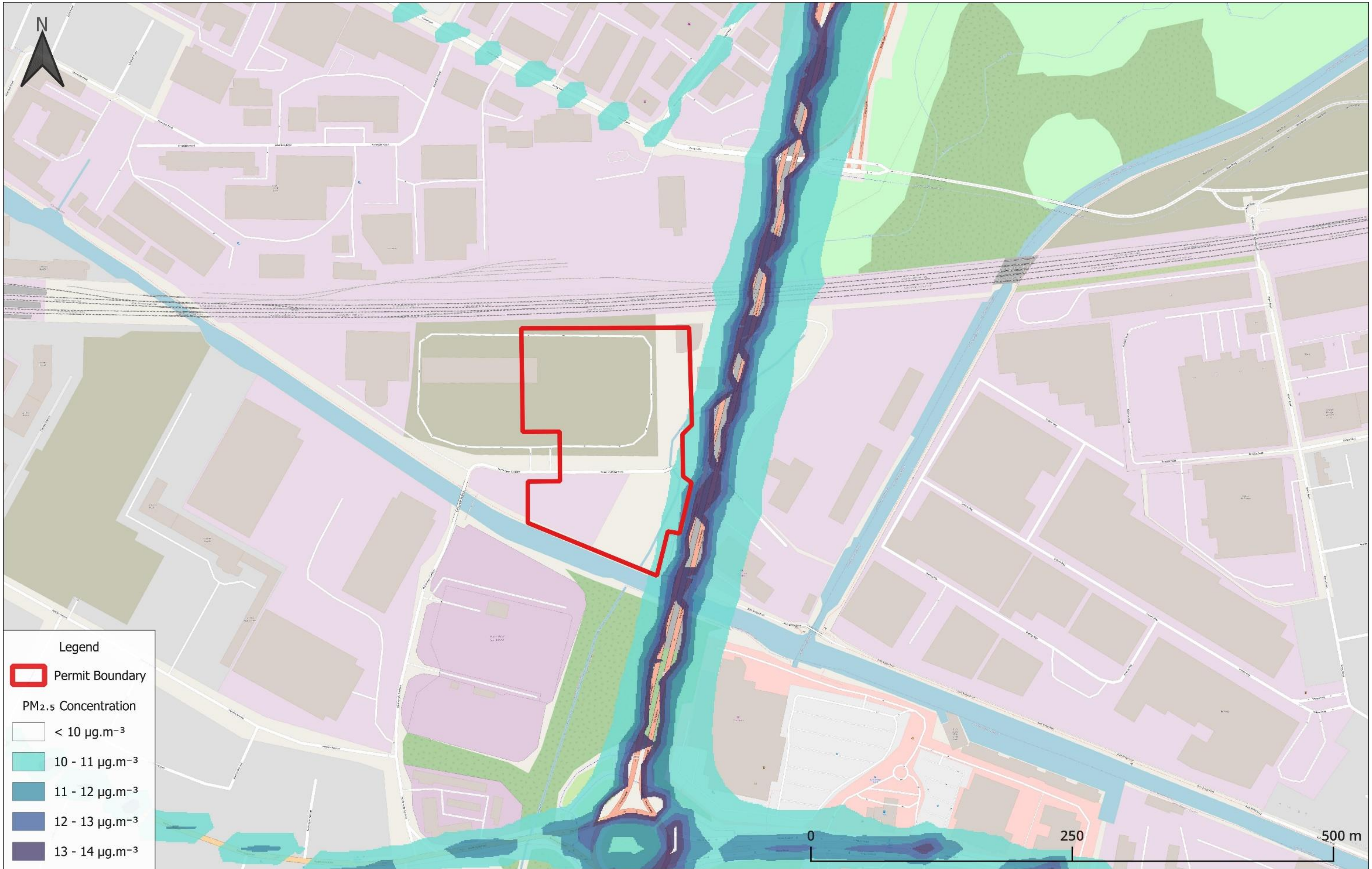

Figure 5: LAEI $PM_{2.5}$ Concentration Contours (2025)

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Figure 6: Model Domain

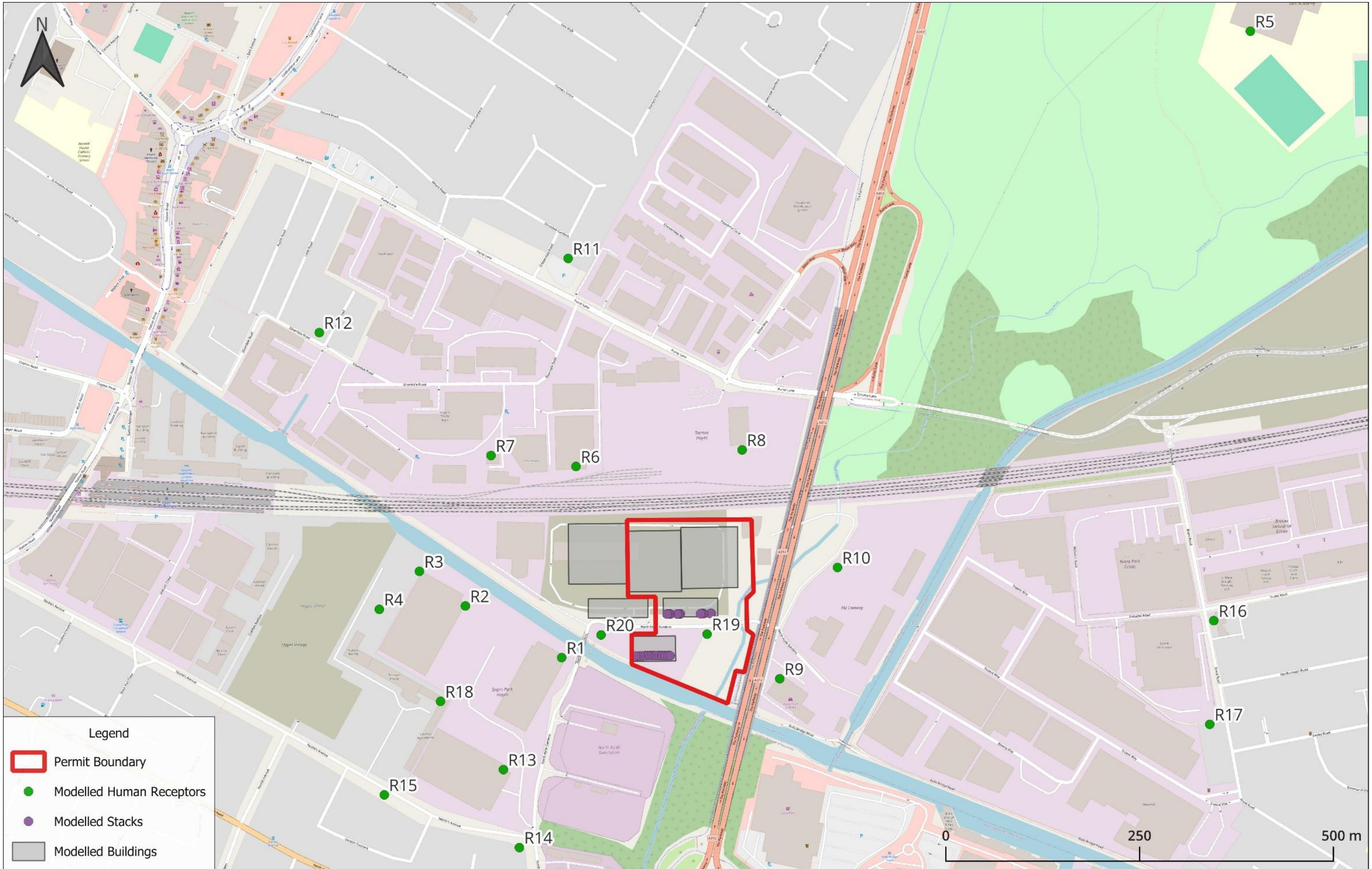

Figure 6: Model Domain

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Figure 7: Annual Mean NO_2 Process Contribution – Testing and Maintenance (1.5m)

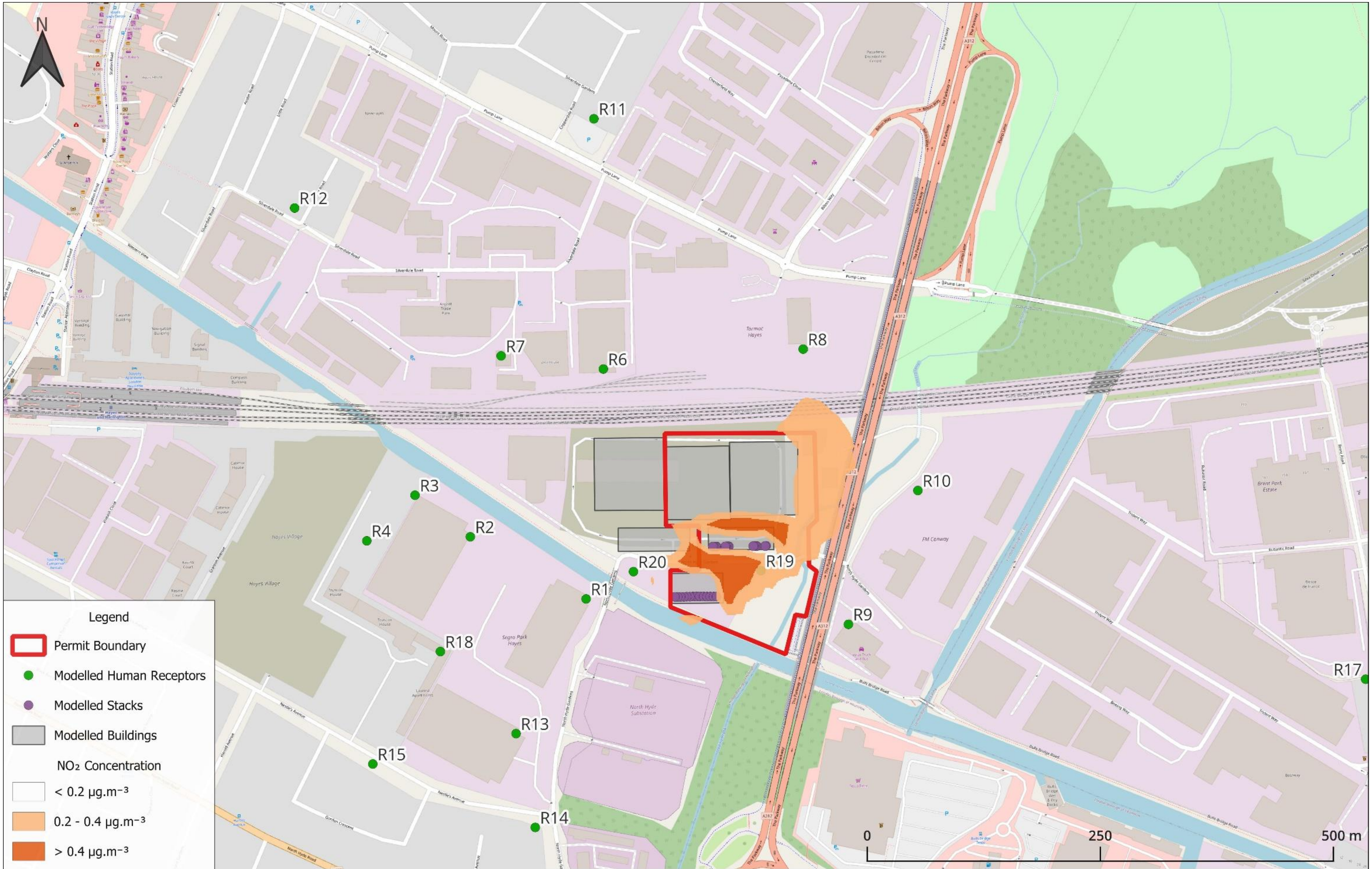

Figure 7: Annual Mean NO_2 Process Contribution - Routine Testing

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Figure 8: Annual Mean NO_2 Process Contribution – Grid Failure (1.5m)

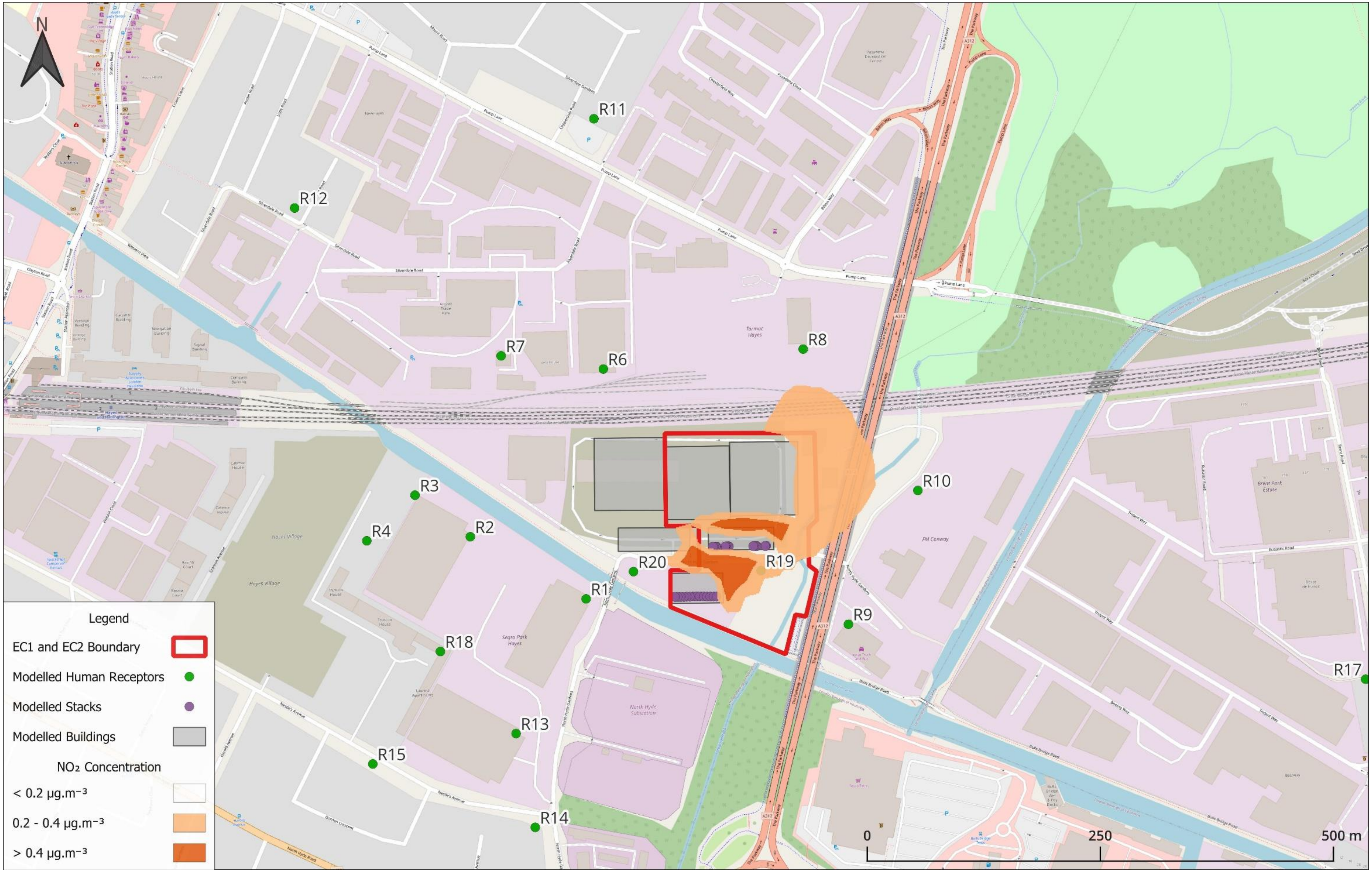

Figure 8: Annual Mean NO_2 Process Contribution - Grid Failure

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Figure 9: 99.79th Percentile Mean NO_2 Process Contribution – Testing Scenario 1 (1.5m)

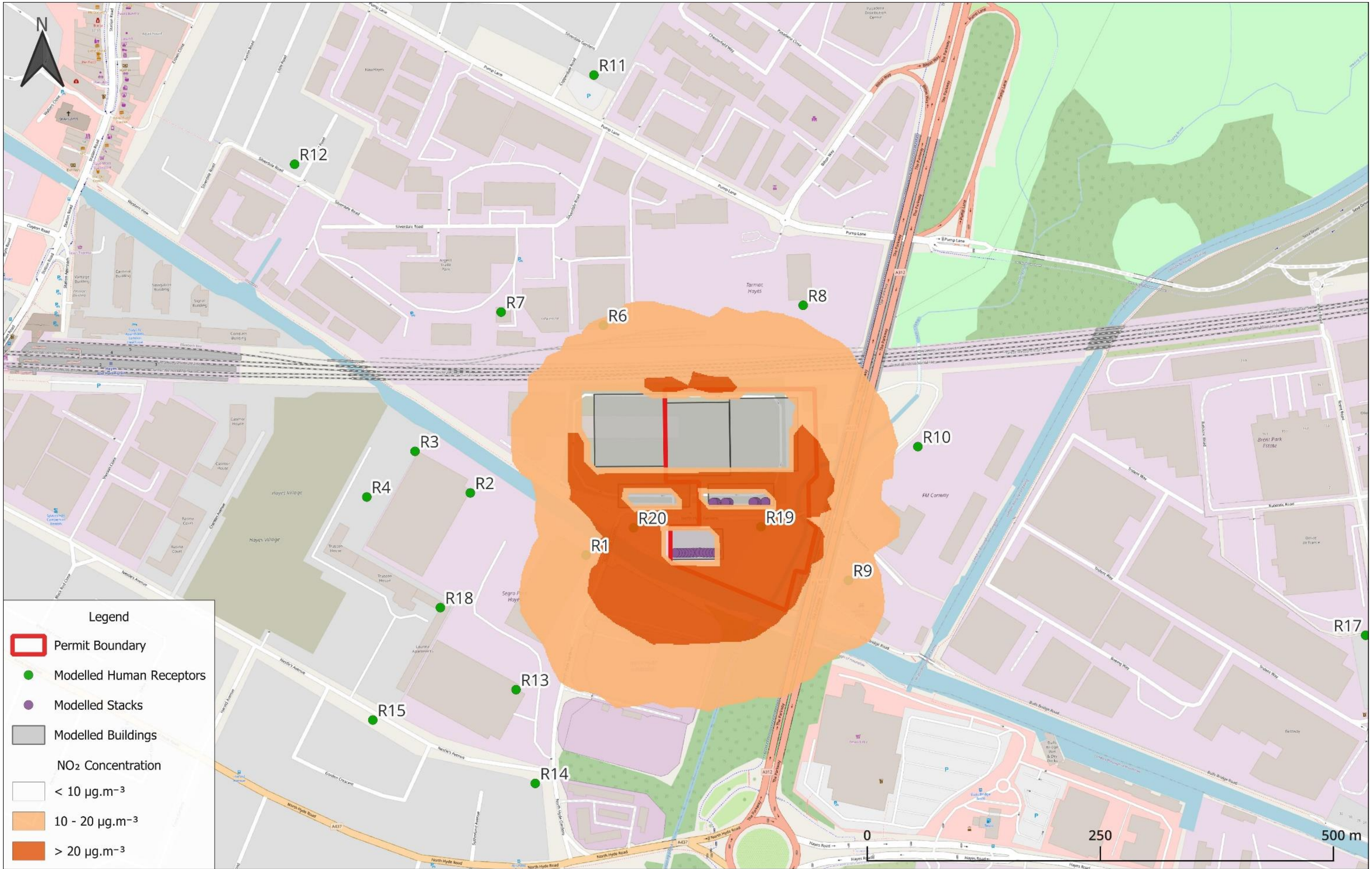

Figure 9: 99.79th %ile NO_2 Process Contribution - Testing Scenario 1

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Figure 10: 99.79th Percentile Mean NO_2 Process Contribution – Testing Scenario 2 (1.5m)

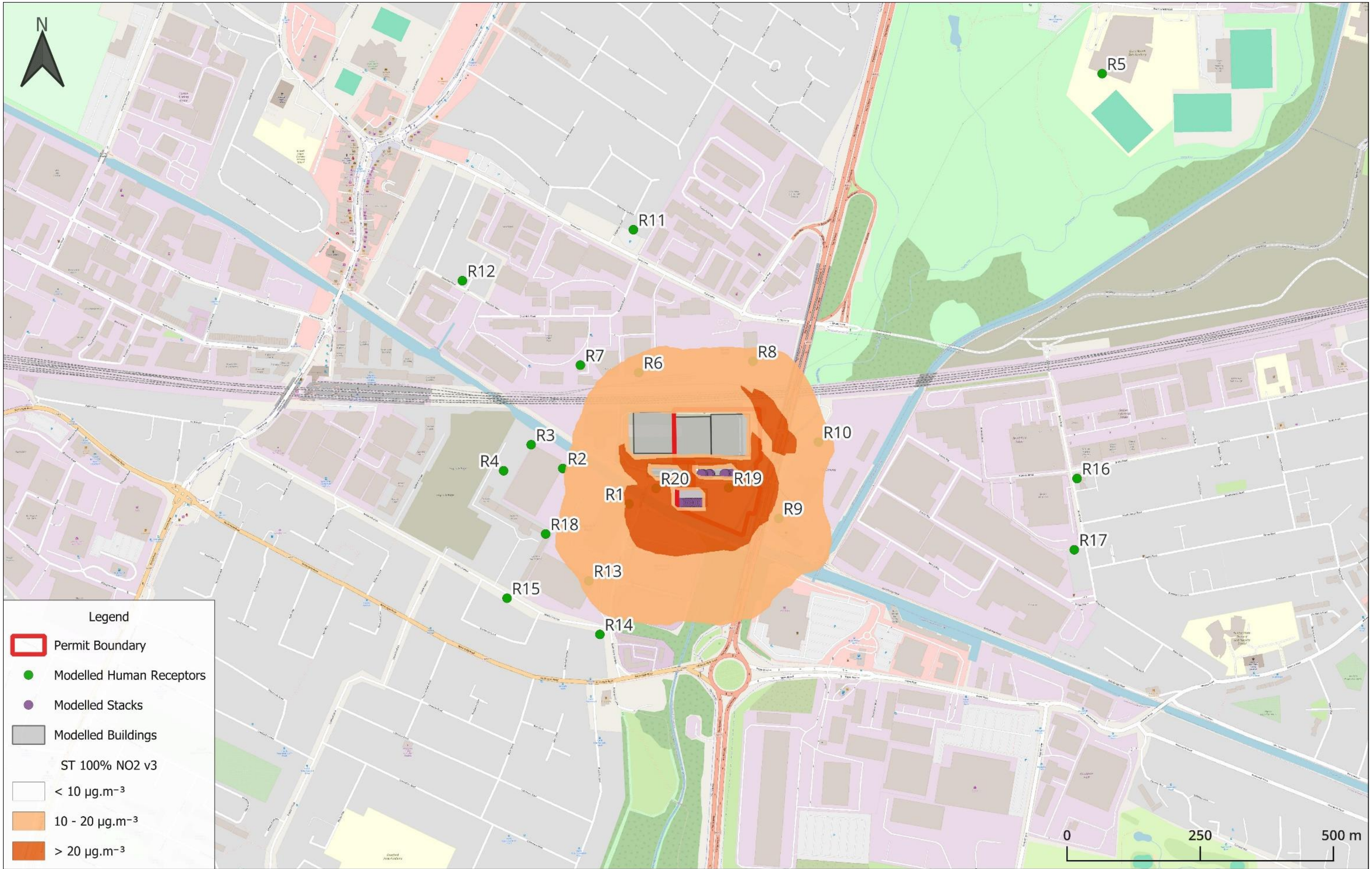

Figure 10: 99.79th %ile NO_2 Process Contribution - Testing Scenario 2

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Figure 11: 99.79th Percentile NO_2 Process Contribution – Grid Failure (1.5m)

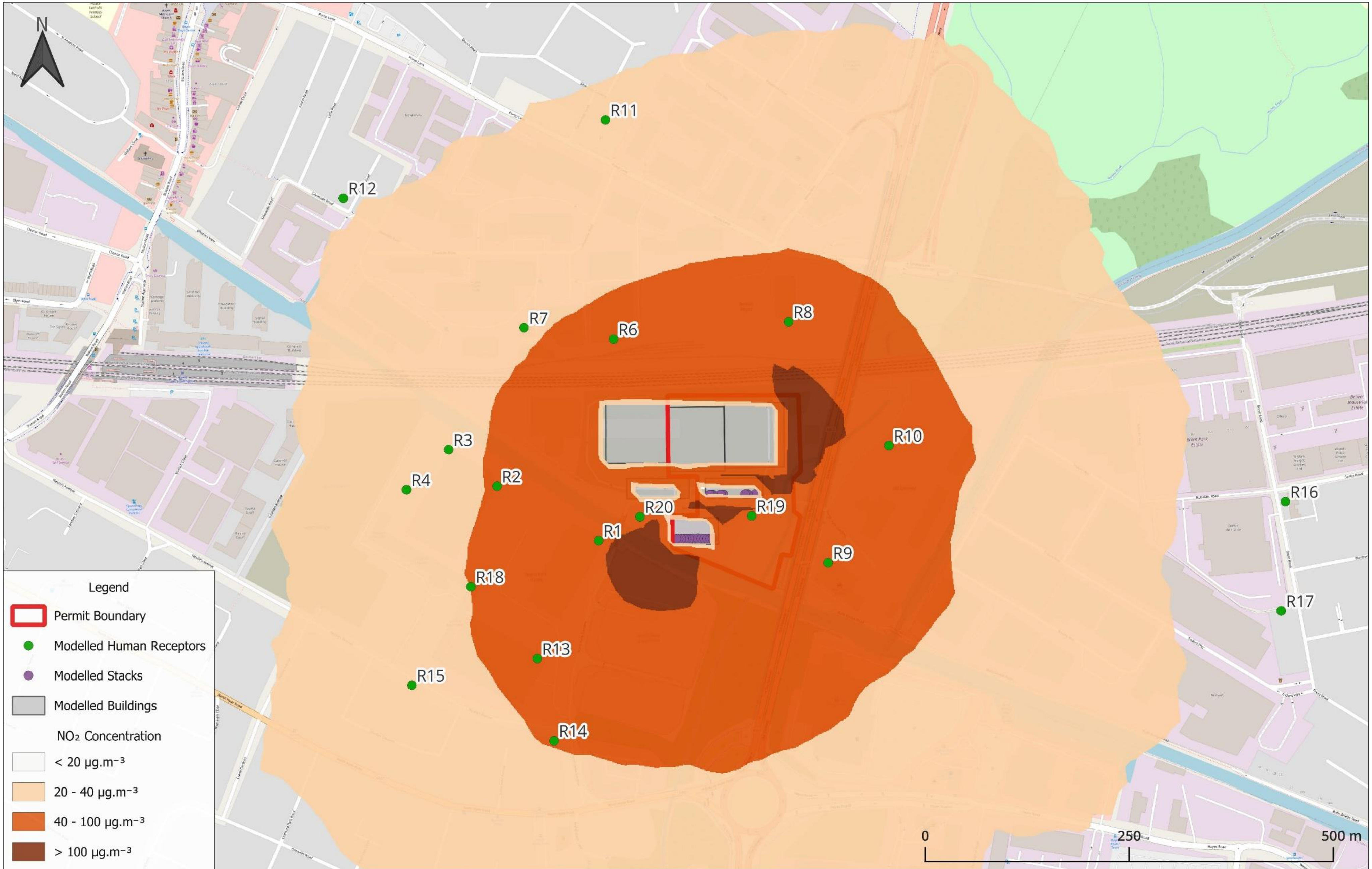

Figure 11: 99.79th %ile NO_2 Process Contribution - Grid Failure

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Appendices

Appendix A: EPUK & IAQM Impact Descriptors

Table A.1: IAQM Impact Descriptors for Individual Receptors (Based on Table 6.3 from the EPUK & IAQM guidance[12])

Long-term average concentration at receptor in assessment year	% Change in concentration relative to AQAL			
	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

1. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
2. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5%, will be described as Negligible.
3. The Table is only designed to be used with annual mean concentrations.
4. Descriptors for individual receptors only; the overall significance is determined using professional judgement (see Chapter 7). For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
5. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.
6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.
7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

Appendix B: Model Input Data

Table B.1 Modelled Buildings

Building	Centroid		Height (m)	Length(m)	Width(m)	Angle(degrees)
	X	Y				
Energy Centre 1	510401.2	179263.7	21.1	76	24	90
Energy Centre 3	510447.6	179211.4	21.1	56	32	90
Data Centre W	510375.2	179333.8	34.3	77	78	90
Data Centre	510448.3	179324.2	34.3	70	78	90
Data Centre E	510519.1	179329.1	32.5	74	78	90
Energy Centre 2	510494.6	179264.8	21.1	70	24	89

Table B.2 Stack Locations

Stack	X	Y	Height above ground
EC1-S1	510521.5	179257.0	21.1
EC1-S2	510520.2	179256.9	21.1
EC1-S3	510511.5	179256.8	21.1
EC1-S4	510510.2	179256.8	21.1
EC1-S5	510508.7	179256.8	21.1
EC1-S6	510507.6	179256.8	21.1
EC1-S7	510481.5	179256.5	21.1
EC1-S8	510480.2	179256.5	21.1
EC1-S9	510478.6	179256.5	21.1
EC1-S10	510477.5	179256.4	21.1
EC1-S11	510468.5	179256.3	21.1
EC1-S12	510467.3	179256.3	21.1
EC1-S13	510465.7	179256.3	21.1
EC1-S14	510464.3	179256.3	21.1
EC2-S1	510443.2	179202.8	21.1
EC2-S2	510423.6	179202.8	21.1
EC2-S3	510468.3	179202.8	21.1
EC2-S4	510426.4	179202.8	21.1
EC2-S5	510429.8	179202.8	21.1
EC2-S6	510433.2	179202.8	21.1
EC2-S7	510436.3	179202.8	21.1
EC2-S8	510439.7	179202.8	21.1
EC2-S9	510465.2	179202.8	21.1
EC2-S10	510461.6	179202.8	21.1
EC2-S11	510458.0	179202.8	21.1
EC2-S12	510454.4	179202.8	21.1
EC2-S13	510450.4	179202.8	21.1
EC2-S14	510446.7	179202.8	21.1

Appendix C: Generator Specification Sheets

Specifications for *MTU 20V4000 G94LF*

Revision *Change index*					

Motordaten
engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	7				
mg/mN³ values base on residual oxygen value of [%]	measured				

Motor Rohemissionen*
*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	3307	2480	1653	827	331			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1500	1499	1499	1500	1499			
Exhaust temperature after turbine	[°C]	482	427	434	403	268			
Exhaust massflow	[kg/h]	19196	15930	12083	7485	5323			
Exhaust back pressure (total)	[mbar]	52	32	14	5	0			
NOx	[g/kWh]	6,6	5,9	4,8	4,4	9,1			
	[mg/mN³]	1641	1326	930	676	776			
CO	[g/kWh]	0,3	0,4	1,0	1,4	2,8			
	[mg/mN³]	77	85	192	219	233			
HC	[g/kWh]	0,05	0,07	0,09	0,16	0,72			
	[mg/mN³]	13	14	16	25	60			
O2	[%]	9,9	11,2	11,9	13,1	15,8			
Particulate measured	[g/kWh]	0,02	0,03	0,10	0,18	0,05			
	[mg/mN³]	5	6	19	27	4			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,2	0,6	1,0	0,1			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	645,7	632,1	669,3	721,6	844,5			
	[mg/mN³]	155278	136196	126261	109200	70577			
SO2	[g/kWh]	0,003	0,003	0,003	0,003	0,004			
	[mg/mN³]	0,7	0,6	0,6	0,5	0,3			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission.
Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	20.09.2017 09:35:43	zwiderp
Bearb. Change	20.09.2017 13:37:26	zwiderp
Inhalt Content	10.04.2017	Locher
Gepr. Checked	20.09.2017	Kneifel

Projekt-/Auftrags-Nr. Project/Order No.
Verwendbar f.Typ Applicable to Model
Format/Size A3
Material-Nr./Material No. EDS 4000 1162
Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet
Motortyp / Engine Type 20V4000G94LF
Zeichnungs-Nr./Drawing No. ZNG00005084
Beschreibung/Description
Blatt/ Sheet 2 von/of 6

Aenderungsbeschreibung/Description of Revision	Kommt von/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
b.1		In Arbeit

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	7				
mg/mN³ values base on residual oxygen value of [%]	5				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point		[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)		[-]	1	0,75	0,50	0,25	0,10			
Power		[kW]	3307	2480	1653	827	331			
Speed (n/nN)		[-]	1	1	1	1	1			
Speed		[rpm]	1500	1499	1499	1500	1499			
Exhaust temperature after turbine		[°C]	482	427	434	403	268			
Exhaust massflow		[kg/h]	19196	15930	12083	7485	5323			
Exhaust back pressure (total)		[mbar]	52	32	14	5	0			
NOx		[g/kWh]	6,6	5,9	4,8	4,4	9,1			
		[mg/mN³]	2362	2172	1639	1375	2411			
CO		[g/kWh]	0,3	0,4	1,0	1,4	2,8			
		[mg/mN³]	111	139	339	445	723			
HC		[g/kWh]	0,05	0,07	0,09	0,16	0,72			
		[mg/mN³]	19	23	29	50	187			
O2		[%]	5,0	5,0	5,0	5,0	5,0			
Particulate measured		[g/kWh]	0,02	0,03	0,10	0,18	0,05			
		[mg/mN³]	7	10	33	55	13			
Particulate calculated		[g/kWh]	-	-	-	-	-			
		[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)		[mg/mN³]	-	-	-	-	-			
FSN		[-]	0,2	0,2	0,6	1,0	0,1			
NO/NO2**		[-]	-	-	-	-	-			
CO2		[g/kWh]	645,7	632,1	669,3	721,6	844,5			
		[mg/mN³]	223605	223061	222522	222035	219215			
SO2		[g/kWh]	0,003	0,003	0,003	0,003	0,004			
		[mg/mN³]	1,0	1,0	1,0	1,0	1,0			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission.
Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

MTU Friedrichshafen GmbH	WORD	Datum/ Date	Name
	Erstell. Drawn	20.09.2017 09:39:43	zwisterp
	Bearb. Change	20.09.2017 13:37:26	zwisterp
	Inhalt Content	10.04.2017	Locher
	Gepr. Checked	20.09.2017	Kneifel

Projekt-/Auftrags-Nr. Project/Order No.
Verwendbar f. Typ Applicable to Model
Format/Size A3
Material-Nr./Material No. **EDS 4000 1162**
Benennung/ Title **Emissionsdatenblatt** **Emission Data Sheet**
Motortyp / Engine Type **20V4000G94LF**
Zeichnungs-Nr./Drawing No. **ZNG00005084**
Blatt/ Sheet **5** von/of **6**
Beschreibung/Description

Aenderungsbeschreibung/Description of Revision	Komm von/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
a.1		In Arbeit

Pos. 2	CATALYST	SCR-700/1-A-S816.45-50-A48.7,5-10-DK

general data

Engine:	MTU 20V4000G94LF	
Fuel:	Diesel	
Operation of engine:	λ > 1	
Exhaust gas mass flow:	19196	kg/h
Exhaust gas temperature:	475	°C
Maximum Exhaust gas temperature:	505	°C
Maximum Exhaust gas pressure:	0,1	barg
Pressure Los (total):	**45**	**mbar**
Urea consumption (32,5%):	appr. 52,3	L/h
Urea consumption (32,5%):	appr. 10 at 200h	m³/a
sound pressure level at SCR inlet *	**91 @ 1 m**	**dB(A)**
sound pressure level after SCR *	**70 @ 1 m**	**dB(A)**

*only achieved when honeycombs are built in the SCR.

Emissions [5% O2]

	Before Catalytic Converter	After Catalytic Converter	
CO	< 111	< 111	mg/Nm³
NOx	< 2362	< 95	mg/Nm³
CH_2O	< 19	< 19	mg/Nm³
NH_3		< 5	mg/Nm³

Equipment SCR

SCR

Number of rows SCR	5	pc.
Number of empty rows	0	pc.

Oxi

Number of rows Oxi	1	pc.
Number of empty rows	0	pc.

Material

Material injection	Stainless steel
Material flanges injection	Stainless steel
Material housing	Steel
Material flanges housing	Steel

Installation and connection

Place of installation	Inside installation; no ex zone Outdoor installation by arrangement	
Min. ambient temperature	5	°C
Max. ambient temperature	40	°C
Exhaustgas piping inlet	700/10	DN/PN
Exhaustgas piping outlet	800/10	DN/PN

Appendix D: Tabulated short-term results for PM, CO, C_6H_6, NO and SO_2

Particulate Matter

Table D.1 below shows the predicted impact of the facility with reference to the daily mean AQS for PM_{10}, if the generators ran all hours of the year. Results represent the theoretical 36th highest daily concentration.

Table D.1: Predicted daily percentile mean concentrations of PM_{10}

Receptor Point	Daily Mean PM_{10} (90.41st Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	1	2%	30	60%	0	0%	29	59%	3	7%	32	65%
R2	0	0%	29	58%	0	0%	29	58%	2	3%	30	61%
R3	0	0%	29	58%	0	0%	29	58%	1	2%	30	60%
R4	0	0%	29	58%	0	0%	29	58%	1	2%	30	60%
R5	0	0%	29	57%	0	0%	29	57%	0	1%	29	58%
R6	0	1%	30	59%	0	0%	29	59%	2	4%	31	63%
R7	0	0%	29	59%	0	0%	29	58%	1	2%	30	61%
R8	1	1%	31	62%	0	0%	31	61%	4	8%	35	69%
R9	1	2%	33	66%	0	0%	33	65%	4	8%	37	74%
R10	1	2%	33	66%	0	0%	33	65%	5	9%	37	74%
R11	0	0%	30	59%	0	0%	30	59%	1	2%	30	61%
R12	0	0%	29	58%	0	0%	29	58%	0	1%	30	59%
R13	1	1%	30	59%	0	0%	29	58%	3	6%	32	64%
R14	0	1%	30	60%	0	0%	30	59%	2	5%	32	64%
R15	0	0%	29	58%	0	0%	29	58%	1	2%	30	61%
R16	0	0%	29	59%	0	0%	29	58%	1	2%	30	60%
R17	0	0%	29	58%	0	0%	29	58%	1	1%	29	59%
R18	0	1%	29	58%	0	0%	29	58%	2	4%	31	61%
R19	2	5%	30	60%	0	1%	30	59%	7	14%	33	65%
R20	1	2%	30	60%	0	0%	30	59%	3	6%	33	65%

Table D.1 shows that the 36th highest PM_{10} concentration is comfortably below the relevant AQS.

Carbon Monoxide

Table D.2 below shows the predicted impact of the facility with reference to the 1-hour maximum mean AQS for CO, if the generators ran all hours of the year.

Table D.2: Predicted hourly percentile mean concentrations of CO

Receptor Point	Hourly Mean CO (100th Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	22	0%	946	3%	11	0%	935	3%	78	0%	1002	3%
R2	10	0%	934	3%	5	0%	929	3%	39	0%	963	3%
R3	9	0%	933	3%	6	0%	930	3%	40	0%	964	3%
R4	7	0%	931	3%	4	0%	928	3%	33	0%	957	3%
R5	2	0%	934	3%	1	0%	933	3%	11	0%	943	3%
R6	20	0%	944	3%	11	0%	935	3%	51	0%	975	3%
R7	10	0%	934	3%	4	0%	928	3%	32	0%	956	3%
R8	11	0%	935	3%	6	0%	930	3%	47	0%	971	3%
R9	25	0%	949	3%	14	0%	938	3%	60	0%	984	3%
R10	16	0%	940	3%	9	0%	933	3%	51	0%	975	3%
R11	6	0%	930	3%	3	0%	927	3%	22	0%	946	3%
R12	4	0%	928	3%	2	0%	926	3%	18	0%	942	3%
R13	11	0%	935	3%	6	0%	930	3%	42	0%	966	3%
R14	8	0%	932	3%	5	0%	929	3%	35	0%	959	3%
R15	6	0%	930	3%	4	0%	928	3%	28	0%	952	3%
R16	4	0%	936	3%	2	0%	934	3%	20	0%	952	3%
R17	3	0%	935	3%	2	0%	934	3%	19	0%	951	3%
R18	11	0%	935	3%	7	0%	931	3%	48	0%	972	3%
R19	70	0%	994	3%	45	0%	969	3%	87	0%	1011	3%
R20	40	0%	964	3%	16	0%	940	3%	66	0%	990	3%

At no location of relevant exposure is a short-term concentration of CO predicted to exceed the relevant AQS.

Table D.3 below shows the predicted impact of the facility with reference to the 8-hour rolling daily maximum mean AQS for CO, if the generators ran all hours of the year.

Table D.3: Predicted 8-hour rolling daily percentile mean concentrations of CO

Receptor Point	8-hour Rolling Daily Mean CO (100th Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	19	0%	943	9%	10	0%	934	9%	203	2%	1127	11%
R2	7	0%	931	9%	4	0%	928	9%	98	1%	1022	10%
R3	6	0%	930	9%	3	0%	927	9%	75	1%	999	10%
R4	5	0%	929	9%	3	0%	927	9%	69	1%	993	10%
R5	1	0%	933	9%	1	0%	933	9%	20	0%	952	10%
R6	13	0%	937	9%	8	0%	932	9%	137	1%	1061	11%
R7	7	0%	931	9%	4	0%	928	9%	87	1%	1011	10%
R8	10	0%	934	9%	6	0%	930	9%	126	1%	1050	10%
R9	19	0%	943	9%	9	0%	933	9%	169	2%	1093	11%
R10	12	0%	936	9%	7	0%	931	9%	133	1%	1057	11%
R11	4	0%	928	9%	2	0%	926	9%	47	0%	971	10%
R12	3	0%	927	9%	2	0%	926	9%	43	0%	967	10%
R13	10	0%	934	9%	5	0%	929	9%	114	1%	1038	10%
R14	7	0%	931	9%	4	0%	928	9%	91	1%	1015	10%
R15	6	0%	930	9%	3	0%	927	9%	63	1%	987	10%
R16	2	0%	934	9%	1	0%	933	9%	37	0%	969	10%
R17	3	0%	935	9%	1	0%	933	9%	35	0%	967	10%
R18	9	0%	933	9%	6	0%	930	9%	110	1%	1034	10%
R19	45	0%	969	10%	14	0%	938	9%	228	2%	1152	12%
R20	36	0%	960	10%	12	0%	936	9%	170	2%	1094	11%

At no location of relevant exposure is a short-term concentration of CO predicted to exceed the relevant AQS.

Benzene

Table D.4 below shows the predicted impact of the facility with reference to the maximum 1-hour AQS for C_6H_6, if the generators ran all hours of the year.

Table D.4: Predicted hourly percentile mean concentrations of C_6H_6

Recept or Point	Hourly Maximum C_6H_6 (100th Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	2	1%	4	2%	2	1%	4	2%	13	7%	15	8%
R2	1	1%	3	1%	1	0%	3	1%	6	3%	8	4%
R3	1	1%	3	1%	1	0%	3	1%	7	3%	8	4%
R4	1	0%	3	1%	1	0%	3	1%	6	3%	7	4%
R5	0	0%	2	1%	0	0%	2	1%	2	1%	4	2%
R6	2	1%	4	2%	2	1%	4	2%	9	4%	10	5%
R7	1	1%	3	2%	1	0%	3	1%	5	3%	7	4%
R8	1	1%	3	2%	1	1%	3	1%	8	4%	10	5%
R9	3	1%	4	2%	2	1%	3	2%	10	5%	10	5%
R10	2	1%	4	2%	1	1%	3	2%	9	4%	10	5%
R11	1	0%	2	1%	0	0%	2	1%	4	2%	5	3%
R12	0	0%	2	1%	0	0%	2	1%	3	2%	5	2%
R13	1	1%	3	2%	1	1%	3	1%	7	4%	9	5%
R14	1	0%	3	1%	1	0%	3	1%	6	3%	8	4%
R15	1	0%	3	1%	1	0%	2	1%	5	2%	7	3%
R16	0	0%	2	1%	0	0%	2	1%	3	2%	5	3%
R17	0	0%	2	1%	0	0%	2	1%	3	2%	5	3%
R18	1	1%	3	2%	1	1%	3	1%	8	4%	10	5%
R19	7	4%	6	3%	6	3%	4	2%	15	7%	13	7%
R20	5	2%	6	3%	3	1%	4	2%	11	6%	13	7%

At no location is the hourly maximum concentration of benzene predicted to exceed the relevant AQS.

Nitrogen Monoxide

Table D.5 below shows the predicted impact of the facility with reference to the maximum 1-hour EAL for NO, assuming generators run all hours of the year.

Table D.5: Predicted hourly percentile mean concentrations of NO

Receptor Point	Hourly Maximum NO (100th Percentile) (µg.m^{-3})											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of EAL	PEC	PEC % of EAL	PC	PC % of EAL	PEC	PEC % of EAL	PC	PC % of EAL	PEC	PEC % of EAL
R1	40	1%	64	1%	52	1%	76	2%	233	5%	257	6%
R2	18	0%	41	1%	25	1%	49	1%	116	3%	140	3%
R3	17	0%	41	1%	26	1%	50	1%	119	3%	143	3%
R4	13	0%	37	1%	20	0%	44	1%	101	2%	125	3%
R5	4	0%	22	0%	6	0%	25	1%	32	1%	50	1%
R6	37	1%	60	1%	53	1%	76	2%	155	4%	178	4%
R7	18	0%	42	1%	20	0%	44	1%	97	2%	121	3%
R8	21	0%	45	1%	30	1%	54	1%	142	3%	166	4%
R9	47	1%	53	1%	68	2%	65	1%	182	4%	178	4%
R10	29	1%	53	1%	41	1%	65	1%	154	4%	178	4%
R11	10	0%	34	1%	13	0%	37	1%	65	1%	89	2%
R12	8	0%	32	1%	10	0%	34	1%	53	1%	77	2%
R13	21	0%	45	1%	29	1%	52	1%	127	3%	150	3%
R14	15	0%	39	1%	23	1%	47	1%	106	2%	130	3%
R15	12	0%	35	1%	17	0%	41	1%	84	2%	108	2%
R16	8	0%	28	1%	11	0%	31	1%	60	1%	81	2%
R17	6	0%	26	1%	10	0%	30	1%	56	1%	77	2%
R18	20	0%	44	1%	31	1%	55	1%	145	3%	169	4%
R19	129	3%	97	2%	213	5%	101	2%	262	6%	223	5%
R20	73	2%	97	2%	77	2%	101	2%	199	5%	223	5%

At no location is the hourly maximum concentration of NO predicted to exceed the relevant EAL.

Sulphur Dioxide

Table D.6 below shows the predicted impact of the facility with reference to the 15-minute AQS for SO_2, if the generators ran all hours of the year.

Table D.6: Predicted 15-minute percentile mean concentrations of SO_2

Receptor Point	15-minute mean SO_2 (99.9th Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	0	0%	12	5%	0	0%	12	5%	2	1%	14	5%
R2	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R3	0	0%	12	5%	0	0%	12	5%	1	0%	14	5%
R4	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R5	0	0%	10	4%	0	0%	10	4%	0	0%	10	4%
R6	0	0%	12	5%	0	0%	12	5%	2	1%	14	5%
R7	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R8	0	0%	12	5%	0	0%	12	5%	1	1%	14	5%
R9	0	0%	12	5%	0	0%	12	5%	2	1%	14	5%
R10	0	0%	12	5%	0	0%	12	5%	2	1%	14	5%
R11	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R12	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R13	0	0%	12	5%	0	0%	12	5%	1	1%	14	5%
R14	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R15	0	0%	12	5%	0	0%	12	5%	1	0%	13	5%
R16	0	0%	11	4%	0	0%	11	4%	1	0%	12	4%
R17	0	0%	11	4%	0	0%	11	4%	1	0%	12	4%
R18	0	0%	12	5%	0	0%	12	5%	2	1%	14	5%
R19	0	0%	12	5%	0	0%	12	5%	3	1%	15	6%
R20	0	0%	12	5%	0	0%	12	5%	2	1%	14	5%

At no location of relevant exposure is a short-term concentration of SO_2 predicted to exceed the relevant AQS.

Table D.7 below shows the predicted impact of the facility with reference to the 1-hour mean AQS for SO_2, if the generators ran all hours of the year.

Table D.7: Predicted hourly percentile mean concentrations of SO_2

Receptor Point	Hourly mean SO_2 (99.73[rd] Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	0	0%	12	4%	0	0%	12	4%	1	0%	13	4%
R2	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R3	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R4	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R5	0	0%	10	3%	0	0%	10	3%	0	0%	10	3%
R6	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R7	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R8	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R9	0	0%	12	4%	0	0%	12	4%	1	0%	13	4%
R10	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R11	0	0%	12	3%	0	0%	12	4%	0	0%	12	4%
R12	0	0%	12	3%	0	0%	12	4%	0	0%	12	4%
R13	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R14	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R15	0	0%	12	4%	0	0%	12	4%	0	0%	12	4%
R16	0	0%	11	3%	0	0%	11	3%	0	0%	11	3%
R17	0	0%	11	3%	0	0%	11	3%	0	0%	11	3%
R18	0	0%	12	4%	0	0%	12	4%	0	0%	13	4%
R19	0	0%	12	4%	0	0%	12	4%	1	0%	13	4%
R20	0	0%	12	4%	0	0%	12	4%	1	0%	13	4%

At no location of relevant exposure is a short-term concentration of SO_2 predicted to exceed the relevant AQS. Table

D.8 below shows the predicted impact of the facility with reference to the 24-hour mean AQS for SO_2, if the generators ran all hours of the year.

Table D.8: Predicted daily percentile mean concentrations of SO_2

Receptor Point	Daily mean SO_2 (99.18th Percentile) ($\mu g.m^{-3}$)											
	Testing Scenario 1				Testing Scenario 2				Grid Failure			
	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS	PC	PC % of AQS	PEC	PEC % of AQS
R1	0	0%	12	10%	0	0%	12	10%	0	0%	13	10%
R2	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R3	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R4	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R5	0	0%	10	8%	0	0%	10	8%	0	0%	10	8%
R6	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R7	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R8	0	0%	12	10%	0	0%	12	10%	0	0%	13	10%
R9	0	0%	12	10%	0	0%	12	10%	0	0%	13	10%
R10	0	0%	12	10%	0	0%	12	10%	0	0%	13	10%
R11	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R12	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R13	0	0%	12	10%	0	0%	12	10%	0	0%	13	10%
R14	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R15	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R16	0	0%	11	9%	0	0%	11	9%	0	0%	11	9%
R17	0	0%	11	9%	0	0%	11	9%	0	0%	11	9%
R18	0	0%	12	10%	0	0%	12	10%	0	0%	12	10%
R19	0	0%	12	10%	0	0%	12	10%	1	0%	13	10%
R20	0	0%	12	10%	0	0%	12	10%	0	0%	13	10%

At no location of relevant exposure is a short-term concentration of SO_2 predicted to exceed the relevant AQS.

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