Air Quality Permit Assessment

KLON06 Data Centre, Galvin Rd, Slough

February 2023

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HDR Consulting Ltd

240 Blackfriars Road
London
SE1 8NW

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Phlorum Limited

Southern Office: Unit 12, Hunns Mere Way, Woodingdean, Brighton, East Sussex, BN2 6AH

T: 01273 307 167 E: info@phlorum.com W: www.phlorum.com

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EXECUTIVE SUMMARY

Phlorum Ltd has been commissioned by HDR Consulting Ltd (HDR) to undertake an air quality assessment (AQA) on behalf of KAO Data (the operator) to support the Environmental Permit application (ref: EPR/JP3647JU/A001) to operate the KLON06 Data Centre located in Slough Trading Estate, Galvin Road, SL1 4AN.

The 'KLON-06' Data Centre has been operating since 2009 with 6no existing standby diesel generators (SDGs) installed to provide emergency power in the event of grid failure / disturbance. Kao has since purchased the site and is in the process of installing 7 no. new diesel generators, in response to increased energy capacity requirements.

The Data Centre is located in close proximity to Slough Borough Council's (SBC's) Three Tuns Air Quality Management Area (AQMA). This assessment evaluates the impacts on local air quality of the SDG emissions during two operating scenarios:

- **Scenario 1:** Regular 'Testing and Maintenance' of the SDGs. In this scenario, all generators are expected to run concurrently for 2 hours per month at 100% load.
- **Scenario 2:** 72-hour 'Grid Failure'/ power outage emergency inclusive of the testing and maintenance run times above.

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 (NOx) including nitrogen dioxide (NO_2), and particulate matter (PM_{10} and $PM_{2.5}$).

Long term impacts from the proposed SDGs were predicted to be **insignificant** for both scenarios at all relevant modelled receptor locations when assessed against all relevant long-term UK Air Quality Standards. Short term impacts were also found to be **insignificant** for scenario 1 which assesses 'business as usual' maintenance and testing operations. Exceedances of the short-term UK Air Quality Objective for NO_2 was only predicted during a prolonged 72-hour grid failure event for the following receptors: Gym Group gymnasium and Astoria Heights residences.

Prolonged 72-hour grid failure events are considered to be extremely rare events and therefore do not reflect the likely impacts from the installation. To address and mitigate the risks associated with a prolonged grid failure, it is recommended that an Air Quality Management Plan be implemented.

1. INTRODUCTION

Background

1.1 Phlorum Ltd has been commissioned by HDR to undertake an air quality assessment (AQA) on behalf of KAO Data (the operator) to support the Environmental Permit application (ref: EPR/JP3647JU/A001) to operate the KLON06 Data Centre Emergency Back-up Generation Facility. The Data Centre is located on the south-eastern corner of Slough Trading Estate, Galvin Road, Slough, SL1 4AN ("the site"). The National Grid Reference for the centre of the site is 496105, 180555. A site location plan is included in Figure 1.

1.2 The site is located in the administrative boundaries of Slough Borough Council (SBC). SBC has declared four Air Quality Management Areas (AQMAs), the closest of which, the Three Tuns AQMA, is located 200m to the east of the site. This AQMA was declared in 2011 due to exceedances of the annual mean Air Quality Standard (AQS) for nitrogen dioxide (NO_2).

1.3 Land-use in the vicinity of the site is primarily industrial, as shown in Figure 1; however, residential land-use can be found directly south-east of the site. The site is near multiple Data Centres which, alongside the surrounding arterial road network, are likely to be key sources of local air pollution.

1.4 The key sources of air emissions associated with this application are from the 13 no. emergency back-up diesel generators. Of these, 6 no. 3.0 MVA generators (Model: MTU 20V4000 G63L) already operate within the existing KLON06 Data Centre. In response to increased energy capacity requirements, an additional 3 no. 3.6 MVA generators are to be commissioned in 2023, with a further 4 no. generators now proposed (Model: Kohler KD103V20 5BES).

1.5 SDGs provide power in the event of an emergency power failure/ grid power outage. The seven new Kohler generators are to be fitted with Selective Catalytic Reduction (SCR) technology to reduce NO_X emissions concentrations to 507 $mg.m^{-3}$ (5% O_2).

Scope of Report

1.6 This assessment evaluates the likely local air quality impacts from the 13 no. standby generators at KLON06 during their regular testing and maintenance regimes, and during unplanned emergency use.

1.7 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 (99.999967% availability). This equates to approximately one incident per six years, with incidents of longer than an hour occurring every 346 years.

1.8 As such, the principal emissions associated with the use of SDGs occur during routine testing and maintenance. It is understood that each of the generators will undergo testing and maintenance for up to 24 hours per year, running concurrently for 2 hours per month.

2. POLICY CONTEXT

The UK Air Quality Strategy

2.1 The UK Air Quality Strategy (UKAQS)[1] 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 recently amended as part of The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020[3].

2.5 The Environment Agency also provides further environmental assessment levels (EALs) for additional pollutants[4], which are not included in the UKAQS.

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

Pollutant	Averaging Period	Air quality standard ($\mu g.m^{-3}$)	Air quality objective	Objective: to be achieved by
Nitrogen dioxide (NO_2)	1 hour	200	200 $\mu g.m^{-3}$ not to be exceeded more than 18 times a year	31 December 2005
	Annual	40	40 $\mu g.m^{-3}$	31 December 2005
Particulate Matter (PM_{10})	24 hour	50	50 $\mu g.m^{-3}$ not to be exceeded more than 35 times a year	31 December 2004
	Annual	40	40 $\mu g.m^{-3}$	31 December 2004
Particulate Matter ($PM_{2.5}$)	Annual	20	20 $\mu g.m^{-3}$	1 January 2020
Sulphur Dioxide	15-minute	266	Not to be exceeded more than 35 times per calendar year	1 January 2005
	1 hour	350	Not to be exceeded more than 24 times per calendar year	1 January 2005
	24-hour	125	Not to be exceeded more than 3 times per calendar year	1 January 2005
Carbon Monoxide	Maximum daily running 8-hour mean	10,000	-	1 January 2005
	Maximum 1-hour	30,000	-	1 January 2005
Benzene	Maximum 1 hour	195	-	1 January 2005
	Annual	5	-	1 January 2005
Note: For the purposes of this assessment, it has been assumed that 100% of hydrocarbons are emitted as benzene. This is a highly conservative and precautionary approach.				

Ecological Standards

2.7 There are two categories of pollutants that are typically the subject of assessments for ecological designated sites. These are pollutants that have an effect on vegetation/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

2.8 Critical levels represent 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	Averaging Period Critical Level
Oxides of nitrogen (NO_X)	24 Hour maximum mean	75/ 200 µg.m^{-3}*
	Annual	30 µg.m^{-3}
Ammonia (NH_3)	Annual	1 µg.m^{-3} (for lichens and bryophytes)
	Annual	3 µg.m^{-3}
Sulphur dioxide (SO_2)	Annual	10 µg.m^{-3} (for lichens and bryophytes)
	Annual	20 µg.m^{-3}
*The critical level is generally considered to be 75µg.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.		

Critical Loads

2.9 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.

2.10 Air Pollution Information System (APIS)[5] 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. Site specific critical loads are discussed later in this report.

2.11 Ammonia was not considered when calculating nitrogen deposition as the SCR system only starts dosing urea when the temperature sensor in the exhaust gas reaches >250°C, meaning there will be no significant “ammonia slip”.

5 Available at www.apis.ac.uk

Other Standards

Acute Exposure Guideline Levels

2.12 The EA now request that air quality assessments give due consideration to the Environmental Protection Agency's (EPA's) Acute Exposure Guideline Levels (AEGLs)[6], which represent guideline concentrations at which certain toxicological health effects are considered likely to occur.

2.13 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 a significance threshold within this assessment.

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

3. ASSESSMENT METHODOLOGY

Guidance

3.1 The Local Air Quality Management Technical Guidance (LAQM.TG(22))[7] was followed in carrying out this assessment.

3.2 The latest Environmental Protection UK (EPUK) & IAQM guidance on 'Planning for Air Quality'[8] 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.

3.3 For the assessment of emissions from the SDGs, Defra's guidance on assessing air emissions for environmental permitting[9] and the Environment Agency's guidance on assessing impacts on limited hour operations[10] has also been followed. The EA's guidance on specified generators[11] and their Data Centre FAQ headline approach guidance[12] to aide permit applications for data centres has also been reviewed.

Baseline

3.4 The 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.

3.5 Defra provides estimated background concentrations of the UKAQS pollutants at the UK Air Information Resource (UK-AIR) website[13]. 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.

7 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).
8 EPUK & IAQM. (2017). Land-Use Planning & Development Control: Planning For Air Quality.
9 Defra (2016) Air emissions risk assessment for your environmental permit. Available at: https://www.gov.uk/guidance/air-emissions-riskassessment-for-your-environmental-permit
10 Air Quality Modelling & Assessment Unit (AQMAU). (2016). Diesel generator short term NO_2 impact assessment.
11 Environment Agency (2019) Specified generators: dispersion modelling assessment
12 Environment Agency (2018) Data Centre FAQ Headline Approach
13 Defra: UK-AIR. www.uk-air.defra.gov.uk

3.6 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.

3.7 SBC's automatic and non-automatic monitoring data are also considered an appropriate source for establishing baseline air quality; the most recent available data from SBC's air quality annual status report for 2019[14] have been reviewed and included within the assessment, as this is the most recent available data which is uninterrupted by the Covid-19 pandemic.

Assessment of Impacts

Generator Emissions

3.8 The key pollutant emissions associated with the SDGs are NO_X, PM_{10}, $PM_{2.5}$, CO and hydrocarbons (as benzene). Data provided for sulphur dioxide (SO_2) was limited and, therefore, could not be fully assessed.

ADMS-5 Generator Assessment

3.9 Dispersion modelling was undertaken using ADMS-5.2 (version: 5.2.2.0), which is produced by Cambridge Environmental Research Consultants (CERC). ADMS-5.2 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

3.10 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, with each wind rose displayed in Figure 2. Meteorological data were provided by ADM Ltd.

14 SBC (2020) 2019 Air Quality Annual Status Report

3.11 The surface roughness applied to the dispersion and meteorological site was 1.0m 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 30m was used, which is representative of large towns such as Slough.

Buildings and Terrain

3.12 Buildings can have significant effects on the dispersion of pollutants and can increase ground level concentrations. The data centre buildings were included in the model, alongside all large buildings within 100m of the site. The building details, alongside a summary of other model inputs, are included in Appendix B.

3.13 Terrain can influence the dispersion of pollutants in the local area. However, ADMS-5 user guidance[15] 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

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

3.15 The seven new Kohler generators are to be fitted with Selective Catalytic Reduction (SCR) technology to reduce NO_X emissions concentrations to 507 $mg.m^{-3}$ (5% O_2). As the SCR system is only effective after temperatures reach 250°C, there is a period after start-up when emissions from the generators would be unabated. It is understood that this period should last no longer than 15 minutes. For conservative purposes, all generators are assumed to run for 15 minutes unabated, regardless of the loads the SDGs are run at.

3.16 A summary of the emission parameters for the existing MTU generators and new Kohler generators is provided in Table 3.1, below:

Table 3.1: Model Inputs for Generators

Parameter	Unit	MTU generator at 100% load	MTU generator at 50% load	Kohler generator at 100% load
Power	kW	2590	1295	3280
Stack(s) height	m	15	15	7 – 15
Stack(s) diameter	m	0.5	0.5	0.5
Exhaust gas temperature	ºC	503.6	438.5	455
Exhaust Gas Velocity	m/s	44.6*	22.3**	57.8
NO_X emission rate (unabated)	g/s	8.094	3.086	8.109

15 ADMS 5.2 User Guide

Parameter	Unit	MTU generator at 100% load	MTU generator at 50% load	Kohler generator at 100% load
NO_X emission rate (concentration post SCR not to exceed 507 $mg.Nm^{-3}$ (5% O_2))	g/s	N/A	N/A	1.375
PM_{10} and $PM_{2.5}$ emission rate	g/s	0.027	0.039	0.004
CO emission rate	g/s	0.403	0.295	0.128
Hydrocarbons (benzene) emission rate	g/s	0.094	0.122	0.237

* 100% load gas velocity provided separately by the manufacturers.

** The 50% load exhaust gas velocity was not provided by the manufacturers. Using professional judgement, it has been assumed that that the velocity decreases linearly with engine load; it is probable that the velocity would be higher than 22.3 m/s, so this is considered a suitably conservative approach in the absence of detailed information.

Generator Scenarios

3.17 This assessment has modelled two scenarios, as set out below:

Scenario 1

3.18 Scenario 1 accounts for the regular 'Testing and Maintenance' of the SDGs. In this scenario, all generators are expected to run concurrently for 2 hours per month at 100% load.

Scenario 2

3.19 The second scenario accounts for the above, alongside an improbable 72-hour long 'Grid Failure'/ power outage. During a 'Grid Failure', existing MTU generators would run at 50% load, whilst Kohler generators run at 75% load. Details on temperatures and velocities at 75% load were unavailable for the Kohler generators – as there are too many uncertainties, this assessment assumes the Kohler generators always run at 100% load, for conservative purposes.

3.20 Input parameters have been time-weighted to account for the provision of SCR in the Kohler generators and the different loads at which the MTU generators are run at. A summary of these time-weighted parameters is provided in Table 3.2 below.

Table 3.2: Time-Weighted Model Inputs

Generator Scenario	Time Weighted Emission Rates ($g.s^{-1}$)				Temperature (°C)	Volumetric Flow ($m^3.s^{-1}$)
	NO_X	PM	CO	C_6H_6		
MTU Testing & Maintenance	8.094	0.027	0.403	0.094	503.6	8.8
Kohler Testing & Maintenance	2.216	0.004	0.128	0.237	455	11.4

MTU +Grid Failure	4.338	0.036	0.322	0.115	454.8	5.5
Kohler +Grid Failure	1.603	0.015	0.292	0.285	455	11.4

Modelled Receptors

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

3.22 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 existing receptors are included in Table 3.3.

Table 3.3: Modelled Human Receptors

ID	Location/Description	Distance to nearest SDG (m)	Height (m)	UK Grid Reference	
				X	Y
R1	Hadlow Court Residence	130	1.5	496182.1	180518.0
R2	Pitts Road Residence	180	1.5	496177.1	180459.6
R3	Thirkleby Close Residence	210	1.5	496101.3	180420.1
R4	Pitts Road Residence	230	1.5	496178.1	180406.7
R5	Bath Road/ Salt Hill Avenue Residence	380	1.5	496222.1	180261.8
R6	Thirkleby Close Residence	300	1.5	496091.3	180331.1
R7	Farnham Road Residence (opp. Grace Court)	340	1.5	496351.4	180357.2
R8	Farnham Road/ Salt Hill Way Residence	300	1.5	496400.7	180491.2
R9	Grace Court Residence	390	1.5	496454.6	180405.0
R10	Bath Road/ Glentworth Place Residence	470	1.5	496322.2	180191.0
R11	Bath Road/ Cranbourne Road Residence	400	1.5	496159.0	180226.4
R12	Pitts Road Residence	260	1.5	496282.3	180421.5
R13	UCB (Pharmaceuticals)	400	1.5	495709.4	180533.4
R14	Rotunda Youth Centre	300	1.5	496324.6	180869.8
R15	Phoenix House Apartments	220	1.5, 5, 8, 11	496323.9	180523.9
R16	Gym Group Slough (Gym)	180	1.5	496235.9	180772.9
R17	Frank Sutton Way Residence	420	1.5	496527.9	180777.0
R18	Hershel Grammar School	400	1.5	496422.2	180919.1
R19	Eden Girl's School	360	1.5	495912.7	180331.1
R20	Frank Sutton Way Residence	380	1.5	496502.3	180690.5
R21	Northampton Place	370	1.5, 5, 8	496327.4	180966.5
R22	Hadlow Court Residence	160	1.5	496243.7	180518.3

ID	Location/Description	Distance to nearest SDG (m)	Height (m)	UK Grid Reference	
				X	Y
R23	Astoria Heights Flats (Residence)	260	1.5, 5, 8	496225.5	180878.1

3.23 A grid of receptor points was also modelled to predict the pattern of dispersion of pollutants across the local area at 1.5m. The modelled grids originated at UK Grid Reference 495700, 180000, with 80 × 65 grid points (20m spacing) used to produce the contour plots shown in Figures 4 to 7.

Model Outputs

NO_X to NO_2 Conversion

3.24 Following Environment Agency guidance[16], 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.

3.25 Environment Agency guidance[10] suggests that within 500m, 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.

Modelling of long- and short-term emissions

Short-term emissions

3.26 With regard to short-term impacts, it is normal to assess the 1-hour mean NO_2 objective by considering the 99.79th percentile of 1-hour mean concentrations, which represents the 19th highest concentration in a year (8760 hours). However, when there are far fewer hours of operation in a year, this is an unrealistic worst-case approach and consideration should be given to the limited hours of operation through the use of hypergeometric distribution statistics.

3.27 As such, the hypergeometric distribution has been used to ascertain the likelihood of 19 or more hours of exceedance in a calendar year coinciding with the 24 normal operational hours, and highly conservative 72 grid failure hours. For the purposes of this assessment, a probability threshold of 2% (due to Monte Carlo simulations, this equates to a 5% probability) has been considered as an indicator of 'unlikely exceedance'; this is in line with EA guidance[10]. The percentile used for this assessment is 43.09% for Testing & Maintenance and 87.89% with Grid Failure.

16 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

3.28 The same statistical approach has been applied when assessing SDG impacts against the EPA's AEGL for NO_2. This AEGL has been taken as a 'not to exceed' concentration, so the hypergeometric distribution has been used to identify the likely maximum concentration for the limited generator operation. The percentile used to identify the maximum concentration was 99.97%.

Long-term emissions

3.29 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 SDGs operating at one time and the hours of operation per year.

Ecological Impacts

3.30 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 the application site, and all Sites of Special Scientific Interest (SSSI) and local nature sites within 2km.

3.31 Table 3.4, below, provides a summary of all ecological sites (including their associated critical loads for nitrogen deposition) that meet the above criteria.

Table 3.4: Ecological Sites

ID	Site Name	Distance to Site (km)	Designation	X	Y	Critical Loads (N)
Eco1	Burnham Beeches Special Area of Conservation	3.9	SAC	495262	184358	10
Eco2	Windsor Forest & Great Park	5.2	SAC	495557	175319	10
Eco3	South West London Waterbodies	6.7	SPA	500262	175319	*10
Eco4	Haymill Valley Local Nature Reserve	2.0	Local Nature Reserve (LNR)	494252	181477	10

Note: *No Critical Load has been assigned to meso/eutrophic systems in the South West London Waterbodies SPA. These systems are often P limited (or N/P co-limiting), therefore decisions should be taken at a site-specific level. It was assumed that the habitat would have the same lower critical load as other habitats in the vicinity.

3.32 The assessment of ecological sites is included in Appendix D of this document.

Deposition Velocities

3.33 The deposition rates for NO_X were based on Air Quality Technical Advisory Group guidance[17]. The NO_X deposition rate for forest habitats is $0.003 m.s^{-1}$

[17] Air Quality Advisory Group, 2014, AQTAG06 Technical guidance on detailed modelling approach for an appropriate

3.34 Nitrogen deposition rates were calculated from concentrations using standard mathematical and chemical methods.

Significance of Impacts

3.35 The significance of impacts from the proposed energy centre is determined in terms of criteria set out in Defra's 'Air emissions risk assessment for your environmental permit'[9], EPUK and IAQM's 'Planning for air quality'[8] and EPA's AEGL for NO_2[6]. 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 combined PC and existing background pollutant concentrations.

3.36 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 a sensitive receptor is <10% of the short term AQS.

3.37 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 standards minus twice the long term background concentration; and
- the long-term PEC is less than 70% of the long term environmental standards.

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

3.39 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.

3.40 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.

assessment for emissions to air.

- 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.

3.41 Regarding short term impacts, total percentile concentrations (PEC) at locations of relevant exposure below the AQS/AQO or AEGL were considered "not significant". This is considered a sufficiently robust criterion given the conservative inputs (e.g. conservative background concentrations and worst-case NO_X to NO_2 conversion rates).

Ecological Significance

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

3.43 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.

3.44 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.

3.45 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

3.46 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.

3.47 Using a validated air quality model such as ADMS-5.2 reduces the modelling uncertainty.

3.48 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.

3.49 Table 3.5 below summarises the approach to minimising the uncertainty in the conclusions drawn.

Table 3.5: 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 2019 predictions. Furthermore 2001 UK-AIR predictions for benzene and CO have been used.	Given the measures being undertaken across the UK to reduce emissions across all sectors, these inputs are considered to be highly 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 gird 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 a full 72-hour period.	Noting the reliability of the grid (99.999967% availability), grid failures are highly unlikely. As such, it is reasonable to consider a 72-hour outage to be a highly conservative modelling assumption.

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.

4. BASELINE CONDITIONS

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

UK-AIR Background Pollution

4.2 The UK-AIR predicted background pollution concentrations for NO_2, PM_{10} and $PM_{2.5}$ for 2018 to 2024 are presented in Table 4.1. These data were taken from the central grid square location closest to the application site (i.e. grid reference: 496500, 180500).

Table 4.1: 2018 to 2024 background concentrations of pollutants at the application site.

Pollutant	Predicted annual mean background concentration ($\mu g.m^{-3}$)						
	2018	2019	2020	2021	2022	2023	2024
NO_2	23.6	22.5	21.3	20.6	19.9	19.4	18.8
PM_{10}	17.4	17.0	16.6	16.4	16.2	16.1	15.9
$PM_{2.5}$	11.9	11.6	11.4	11.2	11.1	10.9	10.8

4.3 The data in Table 4.1 show that annual mean background concentrations of NO_2, PM_{10} and $PM_{2.5}$, in the vicinity of the site between 2018 and 2024, are predicted to be below their respective AQSs. The data show that in 2022, NO_2, PM_{10} and $PM_{2.5}$ concentrations were predicted to be below their AQSs by 50.3%, 59.5% and 44.5% respectively. As such, annual mean background concentrations are likely to be well below the respective AQSs at the application site.

4.4 Concentrations of all pollutants were 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 UK national and international plans to reduce emissions across all sectors.

4.5 UK-AIR also provides annual mean predictions for benzene and CO, for 2001. These are summarised below for the UK-AIR grid square which contains the application site.

- benzene: 0.83 $\mu g.m^{-3}$
- CO: 463 $\mu g.m^{-3}$

Slough Borough Council Monitoring Data

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

Automatic Monitoring

4.7 SBC 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 1km of the site are included in Tables 4.2, 4.3 and 4.4, respectively.

Table 4.2: NO_2 monitoring data from SBC automatic monitors

Monitor	Type	Distance from the application site (km)	NO_2 annual mean concentration (µg.m^{-3})				
			2015	2016	2017	2018	2019
TRL	R	0.26	33.2	32.9	-	-	-
SLH12	R	0.46	-	-	**41.5**	**42**	39.21
SLH4	UB	0.53	30.3	30	33	31	26.36

Note: "R" = Roadside; "UB" = Urban Background. Exceedances of long-term AQS shown in **Bold**.

4.8 The data in Table 4.2 show that between 2015 and 2019 and within 1km of the application site, annual mean concentrations of NO_2 at roadside sites have exceeded the 40 µg.m^{-3} AQS. The highest concentration in 2019 was measured at SLH12, which is located on the A4 Bath Road; a concentration 2% below the 40 µg.m^{-3} AQS was recorded. Being a roadside location, this site is not considered to be representative of background conditions across the site; it does, however, provide an indication of roadside concentrations of NO_2 within the Three Tuns AQMA.

4.9 The automatic monitor SLH4, which is located at an urban background location, recorded concentrations consistently below the 40 µg.m^{-3} AQS between 2015 and 2019. In 2019, a concentration 34.1% below the AQS was recorded. This monitor is located just 530m from the site, but is in close proximity to the A4, so is considered likely to be representative of background conditions in the local area.

4.10 There is no strong evidence of a downward trend in measured NO_2, in the vicinity of the site.

4.11 Table 4.3 includes the most recent annual mean PM_{10} results from the automatic monitoring sites stationed in SBC.

Table 4.3: PM_{10} monitoring data from the SBC automatic monitors

Monitor	Type	Distance from the application site (km)	PM_{10} annual mean concentration (µg.m^{-3})				
			2015	2016	2017	2018	2019
SLH12	R	0.46	-	-	24.4	23.86	23.44
SLH4	UB	0.53	19	19	18	16.9	18.34

Note: "R" = Roadside; "UB" = Urban Background.

4.12 The data in Table 4.3 show that annual mean PM_{10} concentrations have been well below the 40 µg.m^{-3} AQS at monitors in close proximity to the site, between 2015 and 2019.

4.13 The highest concentration in 2019 was measured at SLH12, where a concentration 41.4% below the 40 µg.m^{-3} AQS was recorded. No exceedance of the short-term AQS was recorded between 2015 and 2019.

4.14 The automatic monitor SLH4, which is located at an urban background location, recorded concentrations consistently below the 40 µg.m^{-3} AQS between 2015 and 2019. In 2019, a concentration 54.1% below the AQS was recorded.

4.15 There is no strong evidence of a downward trend in measured PM_{10}, in the vicinity of the site.

4.16 There are no $PM_{2.5}$ monitors within 8km of the site. As such, concentrations at these monitors can reasonably be considered to be unrepresentative of those at the site and are not discussed further here. Nonetheless, it is acknowledged that all annual mean concentrations were well below the annual mean AQS between 2015 and 2019.

Non-Automatic Monitoring

4.17 SBC 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 1km of the application site are included in Table 4.4.

Table 4.4: Monitoring data from SBC NO_2 diffusion tubes

Monitor	Type	Distance from the application site (km)	NO_2 annual mean concentration (µg.m^{-3})				
			2015	2016	2017	2018	2019
SLO30	R	0.25	**40.4**	34.1	32.6	29.0	32
SLO23	UB	0.40	36.1	36.4	33.6	29.5	30.8
SLO57	K	0.46	-	-	**44.5**	**41.6**	37.9

Monitor	Type	Distance from the application site (km)	NO_2 annual mean concentration (µg.m^{-3})				
			2015	2016	2017	2018	2019
SLO43	R	0.47	39.5	**42**	37.2	34.0	33.1
SLO1	UB	0.53	31.8	33.3	32.4	28.3	27.8
SLO50	K	0.58	-	-	**45.3**	**45.8**	**42.8**

Note: "R" = roadside; K = "Kerbside"; "UB" = urban background. **Bold** denotes exceedance of the AQS.

4.18 The data in Table 4.4 indicate that annual mean NO_2 concentrations in the vicinity of the application site were often above the 40 µg.m^{-3} AQS, with 4 of the 6 closest tubes exceeding the AQS in recent years. However, these exceedances were only at the roadside or kerbside, where annual mean AQSs would not typically apply.

4.19 The highest concentration in 2019 was measured at SLO50; where a concentration 7% above the AQS was recorded. SLO50 is located adjacent to the busy A355, and is, therefore, not considered to be representative of conditions at the site.

4.20 The closest diffusion tube to the site, SLO30, is co-located with automatic monitor TRL, within the AQMA. Concentrations at this location, in 2019, were 20% below the AQS.

4.21 The nearest background diffusion tube to the application site is located approximately 400m to the southeast (SLO23), at the A355/ A4 junction. The most recent result from 2019 was below the AQS by 23%. This value is well above what was recorded by automatic monitor SLH4 and what is predicted by UK-AIR for the site in Table 4.1. However, the results from this diffusion tube are likely to be largely representative of background conditions closer to SBC's arterial road network.

Summary of Background Data used in Modelling

4.22 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 road sources in the study area.

4.23 As roads were not included in the model, it is important that background concentrations used to derive the 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.

4.24 NO_2 background concentrations used in this assessment were derived from the highest monitored background concentration in the local area, at SLO23. PM_{10} concentrations were derived from automatic monitor SLH4, which is located just 12.5m from the kerb of the A4. UK-AIR $PM_{2.5}$ concentrations were higher than those recorded by SBC monitors, so were considered suitable for this assessment.

4.25 No future improvement in baseline concentrations beyond 2019 was assumed. This is a highly conservative approach, considering that improvements in NO_2 concentrations are predicted across the UK.

4.26 A summary of the background concentrations used in the modelling assessment are set out in Table 4.5 below.

Table 4.5: Background concentrations used in this assessment

Pollutant	Concentration (μg.m^{-3})		Data Source
	Long-term	Short-term*	
NO_2	30.8	61.6	SLO23 diffusion tube
PM_{10}	18.34	36.68	SLH4 automatic monitor
$PM_{2.5}$	11.63	23.26	UK-AIR 2019
Benzene (C_6H_6)	0.83	1.66	UK-AIR 2001
CO	N/A	926	UK-AIR 2001

Note: *Short-term background concentrations are assumed to be twice long-term concentrations.

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

Scenario 1 - Testing and Maintenance

5.2 Table 5.1 below shows the predicted impact of the proposed development on annual mean NO_2, PM_{10}, $PM_{2.5}$ and benzene, during normal testing and maintenance. The annual mean AQSs for each of these pollutants are 40 µg.m^{-3}, 40 µg.m^{-3}, 20 µg.m^{-3} and 5 µg.m^{-3}, respectively.

Table 5.1: Predicted annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and benzene

Receptor Point	Annual Mean Concentration				
	PC (µg.m^{-3})	% AQS	PEC (µg.m^{-3})	% AQS	EPUK / IAQM Impact
NO_2					
R1	0.15	0.4%	30.95	77.4%	Negligible
R2	0.10	0.3%	30.90	77.3%	Negligible
R3	0.10	0.2%	30.90	77.2%	Negligible
R4	0.08	0.2%	30.88	77.2%	Negligible
R5	0.04	0.1%	30.84	77.1%	Negligible
R6	0.08	0.2%	30.88	77.2%	Negligible
R7	0.07	0.2%	30.87	77.2%	Negligible
R8	0.12	0.3%	30.92	77.3%	Negligible
R9	0.08	0.2%	30.88	77.2%	Negligible
R10	0.04	0.1%	30.84	77.1%	Negligible
R11	0.04	0.1%	30.84	77.1%	Negligible
R12	0.09	0.2%	30.89	77.2%	Negligible
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.16	0.4%	30.96	77.4%	Negligible
R18	0.16	0.4%	30.96	77.4%	Negligible
R19	0.12	0.3%	30.92	77.3%	Negligible
R20	0.19	0.5%	30.99	77.5%	Negligible
R21	0.19	0.5%	30.99	77.5%	Negligible
R22	0.16	0.4%	30.96	77.4%	Negligible
R23	0.31	0.8%	31.11	77.8%	Negligible
PM_{10}					
R1	0.00	0.0%	18.34	45.9%	Negligible

Receptor Point	Annual Mean Concentration				
	PC (µg.m^{-3})	% AQS	PEC (µg.m^{-3})	% AQS	EPUK / IAQM Impact
R2	0.00	0.0%	18.34	45.9%	Negligible
R3	0.00	0.0%	18.34	45.9%	Negligible
R4	0.00	0.0%	18.34	45.9%	Negligible
R5	0.00	0.0%	18.34	45.9%	Negligible
R6	0.00	0.0%	18.34	45.9%	Negligible
R7	0.00	0.0%	18.34	45.9%	Negligible
R8	0.00	0.0%	18.34	45.9%	Negligible
R9	0.00	0.0%	18.34	45.9%	Negligible
R10	0.00	0.0%	18.34	45.9%	Negligible
R11	0.00	0.0%	18.34	45.9%	Negligible
R12	0.00	0.0%	18.34	45.9%	Negligible
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.00	0.0%	18.34	45.9%	Negligible
R18	0.00	0.0%	18.34	45.9%	Negligible
R19	0.00	0.0%	18.34	45.9%	Negligible
R20	0.00	0.0%	18.34	45.9%	Negligible
R21	0.00	0.0%	18.34	45.9%	Negligible
R22	0.00	0.0%	18.34	45.9%	Negligible
R23	0.00	0.0%	18.34	45.9%	Negligible
$PM_{2.5}$					
R1	0.00	0.0%	11.63	58.2%	Negligible
R2	0.00	0.0%	11.63	58.2%	Negligible
R3	0.00	0.0%	11.63	58.2%	Negligible
R4	0.00	0.0%	11.63	58.2%	Negligible
R5	0.00	0.0%	11.63	58.2%	Negligible
R6	0.00	0.0%	11.63	58.2%	Negligible
R7	0.00	0.0%	11.63	58.2%	Negligible
R8	0.00	0.0%	11.63	58.2%	Negligible
R9	0.00	0.0%	11.63	58.2%	Negligible
R10	0.01	0.0%	11.63	58.2%	Negligible
R11	0.00	0.0%	11.63	58.2%	Negligible
R12	0.00	0.0%	11.63	58.2%	Negligible
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.00	0.0%	11.63	58.2%	Negligible
R18	0.00	0.0%	11.63	58.2%	Negligible
R19	0.00	0.0%	11.63	58.2%	Negligible
R20	0.00	0.0%	11.63	58.2%	Negligible
R21	0.00	0.0%	11.63	58.2%	Negligible
R22	0.00	0.0%	11.63	58.2%	Negligible
R23	0.00	0.0%	11.63	58.2%	Negligible
Benzene					

Receptor Point	Annual Mean Concentration				
	PC ($\mu g.m^{-3}$)	% AQS	PEC ($\mu g.m^{-3}$)	% AQS	EPUK / IAQM Impact
R1	0.01	0.2%	0.84	16.8%	Negligible
R2	0.01	0.1%	0.84	16.7%	Negligible
R3	0.01	0.1%	0.84	16.7%	Negligible
R4	0.00	0.1%	0.83	16.7%	Negligible
R5	0.00	0.0%	0.83	16.6%	Negligible
R6	0.00	0.1%	0.83	16.7%	Negligible
R7	0.00	0.1%	0.83	16.7%	Negligible
R8	0.01	0.1%	0.84	16.7%	Negligible
R9	0.00	0.1%	0.83	16.7%	Negligible
R10	0.00	0.0%	0.83	16.6%	Negligible
R11	0.00	0.0%	0.83	16.6%	Negligible
R12	0.00	0.1%	0.83	16.7%	Negligible
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.01	0.2%	0.84	16.8%	Negligible
R18	0.01	0.2%	0.84	16.8%	Negligible
R19	0.01	0.1%	0.84	16.7%	Negligible
R20	0.01	0.2%	0.84	16.8%	Negligible
R21	0.01	0.2%	0.84	16.8%	Negligible
R22	0.01	0.2%	0.84	16.8%	Negligible
R23	0.02	0.3%	0.85	16.9%	Negligible

Note: Any discrepancies due to rounding. Receptors which are labelled "N/A" are locations where the annual mean AQSs do not apply.

5.3 As shown in Table 5.1, annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and benzene are all modelled to be below the relevant annual mean AQSs at all locations of relevant exposure.

5.4 The data in Table 5.1 show that annual mean PCs of NO_2, PM_{10}, $PM_{2.5}$ and benzene are all 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 NO_2, PM_{10}, $PM_{2.5}$ and benzene 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}, $PM_{2.5}$ and benzene. Therefore, long-term impacts from maintenance and testing can be screened out.

Scenario 2 - Emergency Operation

5.7 Table 5.2 below shows the predicted impact of the proposed development on annual mean NO_2, PM_{10}, $PM_{2.5}$ and benzene, adding 72 hours of operation during a grid failure. The annual mean AQSs for each of these pollutants are 40 µg.m^{-3}, 40 µg.m^{-3}, 20 µg.m^{-3} and 5 µg.m^{-3}, respectively.

Table 5.2: Predicted annual mean concentrations of NO_2, PM_{10} $PM_{2.5}$ and benzene

Receptor Point	Annual Mean Concentration				
	PC (µg.m^{-3})	% AQS	PEC (µg.m^{-3})	% AQS	EPUK / IAQM Impact
			NO_2		
R1	0.46	1.2%	31.26	78.2%	Negligible
R2	0.30	0.8%	31.10	77.8%	Negligible
R3	0.28	0.7%	31.08	77.7%	Negligible
R4	0.22	0.6%	31.02	77.6%	Negligible
R5	0.12	0.3%	30.92	77.3%	Negligible
R6	0.21	0.5%	31.01	77.5%	Negligible
R7	0.18	0.5%	30.98	77.5%	Negligible
R8	0.34	0.8%	31.14	77.8%	Negligible
R9	0.21	0.5%	31.01	77.5%	Negligible
R10	0.10	0.3%	30.90	77.3%	Negligible
R11	0.12	0.3%	30.92	77.3%	Negligible
R12	0.26	0.6%	31.06	77.6%	Negligible
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.42	1.0%	31.22	78.0%	Negligible
R18	0.41	1.0%	31.21	78.0%	Negligible
R19	0.33	0.8%	31.13	77.8%	Negligible
R20	0.51	1.3%	31.31	78.3%	Negligible
R21	0.50	1.2%	31.30	78.2%	Negligible
R22	0.46	1.1%	31.26	78.1%	Negligible
R23	0.81	2.0%	31.61	79.0%	Slight
			PM_{10}		
R1	0.00	0.0%	18.34	45.9%	Negligible
R2	0.00	0.0%	18.34	45.9%	Negligible
R3	0.00	0.0%	18.34	45.9%	Negligible
R4	0.00	0.0%	18.34	45.9%	Negligible
R5	0.00	0.0%	18.34	45.9%	Negligible
R6	0.00	0.0%	18.34	45.9%	Negligible
R7	0.00	0.0%	18.34	45.9%	Negligible
R8	0.00	0.0%	18.34	45.9%	Negligible
R9	0.00	0.0%	18.34	45.9%	Negligible
R10	0.00	0.0%	18.34	45.9%	Negligible
R11	0.00	0.0%	18.34	45.9%	Negligible
R12	0.00	0.0%	18.34	45.9%	Negligible
R13	N/A	N/A	N/A	N/A	N/A

Receptor Point	Annual Mean Concentration				
	PC (µg.m^{-3})	% AQS	PEC (µg.m^{-3})	% AQS	EPUK / IAQM Impact
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.00	0.0%	18.34	45.9%	Negligible
R18	0.00	0.0%	18.34	45.9%	Negligible
R19	0.00	0.0%	18.34	45.9%	Negligible
R20	0.00	0.0%	18.34	45.9%	Negligible
R21	0.00	0.0%	18.34	45.9%	Negligible
R22	0.00	0.0%	18.34	45.9%	Negligible
R23	0.01	0.0%	18.35	45.9%	Negligible
$PM_{2.5}$					
R1	0.00	0.0%	11.63	58.2%	Negligible
R2	0.00	0.0%	11.63	58.2%	Negligible
R3	0.00	0.0%	11.63	58.2%	Negligible
R4	0.00	0.0%	11.63	58.2%	Negligible
R5	0.00	0.0%	11.63	58.2%	Negligible
R6	0.00	0.0%	11.63	58.2%	Negligible
R7	0.00	0.0%	11.63	58.2%	Negligible
R8	0.00	0.0%	11.63	58.2%	Negligible
R9	0.00	0.0%	11.63	58.2%	Negligible
R10	0.00	0.0%	11.63	58.2%	Negligible
R11	0.00	0.0%	11.63	58.2%	Negligible
R12	0.00	0.0%	11.63	58.2%	Negligible
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.00	0.0%	11.63	58.2%	Negligible
R18	0.00	0.0%	11.63	58.2%	Negligible
R19	0.00	0.0%	11.63	58.2%	Negligible
R20	0.00	0.0%	11.63	58.2%	Negligible
R21	0.00	0.0%	11.63	58.2%	Negligible
R22	0.00	0.0%	11.63	58.2%	Negligible
R23	0.01	0.1%	11.64	58.3%	Negligible
Benzene					
R1	0.04	0.8%	0.87	17.4%	Negligible
R2	0.03	0.5%	0.86	17.1%	Negligible
R3	0.03	0.5%	0.86	17.1%	Negligible
R4	0.02	0.4%	0.85	17.0%	Negligible
R5	0.01	0.2%	0.84	16.8%	Negligible
R6	0.02	0.4%	0.85	17.0%	Negligible
R7	0.01	0.3%	0.84	16.9%	Negligible
R8	0.03	0.6%	0.86	17.2%	Negligible
R9	0.02	0.3%	0.85	16.9%	Negligible
R10	0.01	0.2%	0.84	16.8%	Negligible
R11	0.01	0.2%	0.84	16.8%	Negligible
R12	0.02	0.4%	0.85	17.0%	Negligible

Receptor Point	Annual Mean Concentration				
	PC ($\mu g.m^{-3}$)	% AQS	PEC ($\mu g.m^{-3}$)	% AQS	EPUK / IAQM Impact
R13	N/A	N/A	N/A	N/A	N/A
R14	N/A	N/A	N/A	N/A	N/A
R15	N/A	N/A	N/A	N/A	N/A
R16	N/A	N/A	N/A	N/A	N/A
R17	0.04	0.8%	0.87	17.4%	Negligible
R18	0.04	0.7%	0.87	17.3%	Negligible
R19	0.03	0.5%	0.86	17.1%	Negligible
R20	0.05	0.9%	0.88	17.5%	Negligible
R21	0.04	0.9%	0.87	17.5%	Negligible
R22	0.04	0.7%	0.87	17.3%	Negligible
R23	0.07	1.5%	0.90	18.1%	Negligible

Note: Any discrepancies due to rounding. Receptors which are labelled "N/A" are locations where the annual mean AQSs do not apply.

5.8 As shown in Table 5.2, annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and benzene 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 of NO_2, PM_{10}, $PM_{2.5}$ and benzene are mostly estimated to be less than the 1% screening criterion at discrete receptors in the vicinity of the site.

5.10 An NO_2 increase of 0.81 $\mu g.m^{-3}$ was modelled at Receptor R23 (Astoria Heights residential apartments) which, when acknowledging the PEC, would be considered to be a 'Slight Adverse' impact, with reference to the EPUK and IAQM's descriptors.

5.11 All other increases in annual mean NO_2, PM_{10}, $PM_{2.5}$ and benzene would be considered 'negligible' with reference to the EPUK and IAQM's impact descriptors.

5.12 With only one receptor anticipated to be 'slightly' impacted at a location anticipated to be below the annual mean NO_2 AQS, emissions associated with a prolonged grid failure would not have an overall significant impact on annual mean concentrations of NO_2, PM_{10}, $PM_{2.5}$ and benzene. Therefore, long-term impacts from a 72-hour prolonged grid failure can be screened out.

Short Term Impacts

Scenario 1 - Testing and Maintenance

5.13 For concision, the short-term impacts of the Testing and Maintenance modelling scenario are summarised in the paragraph below.

5.14 All short-term pollutant concentrations (NO_2, PM_{10}, CO and Benzene) from normal SDG operations fell well within the 10% criterion for screening short-term air quality impacts at discrete receptors. This is unsurprising, noting that the full Testing and Maintenance schedule is carried out over just 24 hours per year.

5.15 As such, the impacts of Testing and Maintenance of the SDGs at the site are anticipated to be not significant.

Scenario 2 - Emergency Operation

5.16 Upon the addition of 72 hours of emergency operation (taking the total annual hours to 96), short-term impacts are more likely.

NO_2

5.17 Table 5.3 below shows the predicted impacts of the site's SDGs, with reference to the hourly mean AQO for NO_2.

Table 5.3: Predicted short term percentile mean concentrations of NO_2

Receptor Point	87.89 Percentile Hourly Mean NO_2				
	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PC % of (AQS – 2* background)	PEC % of AQS
R1	51.7	**26%**	113.3	**37%**	57%
R2	10.8	5%	72.4	8%	36%
R3	7.2	4%	68.8	5%	34%
R4	4.5	2%	66.1	3%	33%
R5	2.5	1%	64.1	2%	32%
R6	6.7	3%	68.3	5%	34%
R7	10.7	5%	72.3	8%	36%
R8	40.6	**20%**	102.2	**29%**	51%
R9	18.4	9%	80.0	13%	40%
R10	2.7	1%	64.3	2%	32%
R11	2.1	1%	63.7	2%	32%
R12	11.3	6%	72.9	8%	36%
R13	7.1	4%	68.7	5%	34%
R14	104.3	**52%**	165.9	**75%**	83%
R15	60.4	**30%**	122.0	**44%**	61%
R16	195.6	**98%**	257.2	**141%**	**129%**
R17	71.0	**35%**	132.6	**51%**	66%
R18	66.7	**33%**	128.3	**48%**	64%
R19	44.0	**22%**	105.6	**32%**	53%
R20	88.5	**44%**	150.1	**64%**	75%
R21	82.5	**41%**	144.1	**60%**	72%
R22	42.2	**21%**	103.8	**31%**	52%
R23	139.2	**70%**	200.8	**101%**	**100%**

Note: Values in **Bold** denote exceedances of EA screening thresholds.

5.18 The data in Table 5.3 show that the hourly percentile mean PC of NO_2 is greater than the 10% screening criterion at 12 of 23 discrete receptors. Furthermore, all 12 of these receptors are anticipated to exceed the second screening criterion.

5.19 The 18th highest concentrations at Receptor R16 (The Gym Group) and R23 (Astoria Heights Apartments) were predicted to be in exceedance of the short-term AQO of 200 $\mu g.m^{-3}$. As such, impacts from the prolonged 72 hours of emergency operations could have a significantly adverse impact on short-term air quality at the gym and at these apartments.

5.20 All other receptor locations are anticipated to be below the 200 $\mu g.m^{-3}$ AQO, so all other locations can reasonably be anticipated to not experience significant short-term impacts.

Assessing against the AEGL for NO_2

5.21 It is also noted that all concentrations of NO_2 are lower than the US EPA's Acute Exposure Guidance Levels (AEGLs)[6]. The model was run for every hour, with the maximum modelled concentration being 420.6 $\mu g.m^{-3}$, at Receptor R22 (Hadlow Court residence). The AEGL for non-disabling impacts is at 940 $\mu g.m^{-3}$.

5.22 As such, toxicological health effects are not anticipated as a result of these SDGs, and impacts can be considered insignificant.

CO

5.23 Predicted impacts of the facility with reference to the 1-hour mean and 8-hour rolling daily maximum mean AQOs for CO are tabulated in Appendix E and summarised below.

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

5.25 The data in Table E.1 of Appendix E show that all short-term increases in CO are significantly less than the 10% screening criterion, even when assuming constant operation all year around.

5.26 As such, significant short-term impacts on CO are not anticipated and can be screened out.

Daily maximum mean PM_{10}

5.27 Predicted impacts of the facility with reference to the daily maximum mean AQO for PM_{10} is tabulated in Appendix E and summarised below.

5.28 The data in Table E.2 of Appendix E show that all short-term increases in PM_{10} are less than the 10% screening criterion, even when assuming constant operation all year round.

5.29 As such, significant short-term impacts on PM_{10} are not anticipated and can be screened out.

Maximum hourly Hydrocarbons (Benzene)

5.30 Predicted impacts of the facility with reference to the hourly maximum mean AQO for benzene is tabulated in Appendix E and summarised below.

5.31 As with the generator operation for testing and maintenance, the emergency operation of the generators also causes no exceedances of the maximum hourly AQS for C_6H_6 (195 $\mu g.m^{-3}$). The highest concentration, assuming the generators ran for all hours of the year, was 91.62 $\mu g.m^{-3}$, 53% below the AQS.

5.32 As such, significant short-term impacts from hydrocarbons are not anticipated and can be screened out.

Ecological Impacts

5.33 The results of the Ecological Assessment are displayed in Appendix D. All changes in annual mean NO_X and Nutrient nitrogen are less than 1% of the screening criterion at SPAs and SACs, and less than 100% at LNRs. As such, changes in annual mean pollutants as a result of maintenance and testing and a prolonged grid failure are not significant.

5.34 Although changes in daily-maximum mean NO_X are above 10% of the relevant critical load at the Windsor Forest SAC, this model assumes the SDGs operate for all hours of the year, rather than up to 96 hours. As such, it is reasonable to consider the impacts on all nature conservation sites as insignificant.

6. CONCLUSIONS

6.1 Phlorum Ltd has been commissioned by HDR to undertake an air quality assessment (AQA) to support the permit application (ref: EPR/JP3647JU/A001) to increase the energy capacity of the KLON06 data centre located in Slough Trading Estate, Galvin Road, SL1 4AN.

6.2 A dispersion modelling assessment of the 13 no. SDGs was undertaken, with flues at a height of 7m and 15m above ground level and SCR incorporated into the 6 no. new generators to achieve a NO_X efficiency of 507 mg/Nm^3 (5% O_2). Concentrations of NO_2, PM, CO and benzene were predicted at selected receptors using a detailed dispersion model and compared with the relevant long and short-term AQOs.

6.3 Long term impacts from the proposed SDGs 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 UK Air Quality Standards. Short term impacts were also found to be insignificant during testing and maintenance operations. Exceedances of the short-term UK Air Quality Objective for NO_2 was only predicted during a prolonged 72-hour grid failure event for the following receptors: Gym Group gymnasium and Astoria Heights residences.

6.4 Prolonged 72-hour grid failure events are considered to be extremely rare events and therefore do not reflect the likely impacts from the installation. To address and mitigate the risks associated with a prolonged grid failure, it is recommended that an Air Quality Management Plan be implemented.

Figures

Figure 1: Site Location Plan

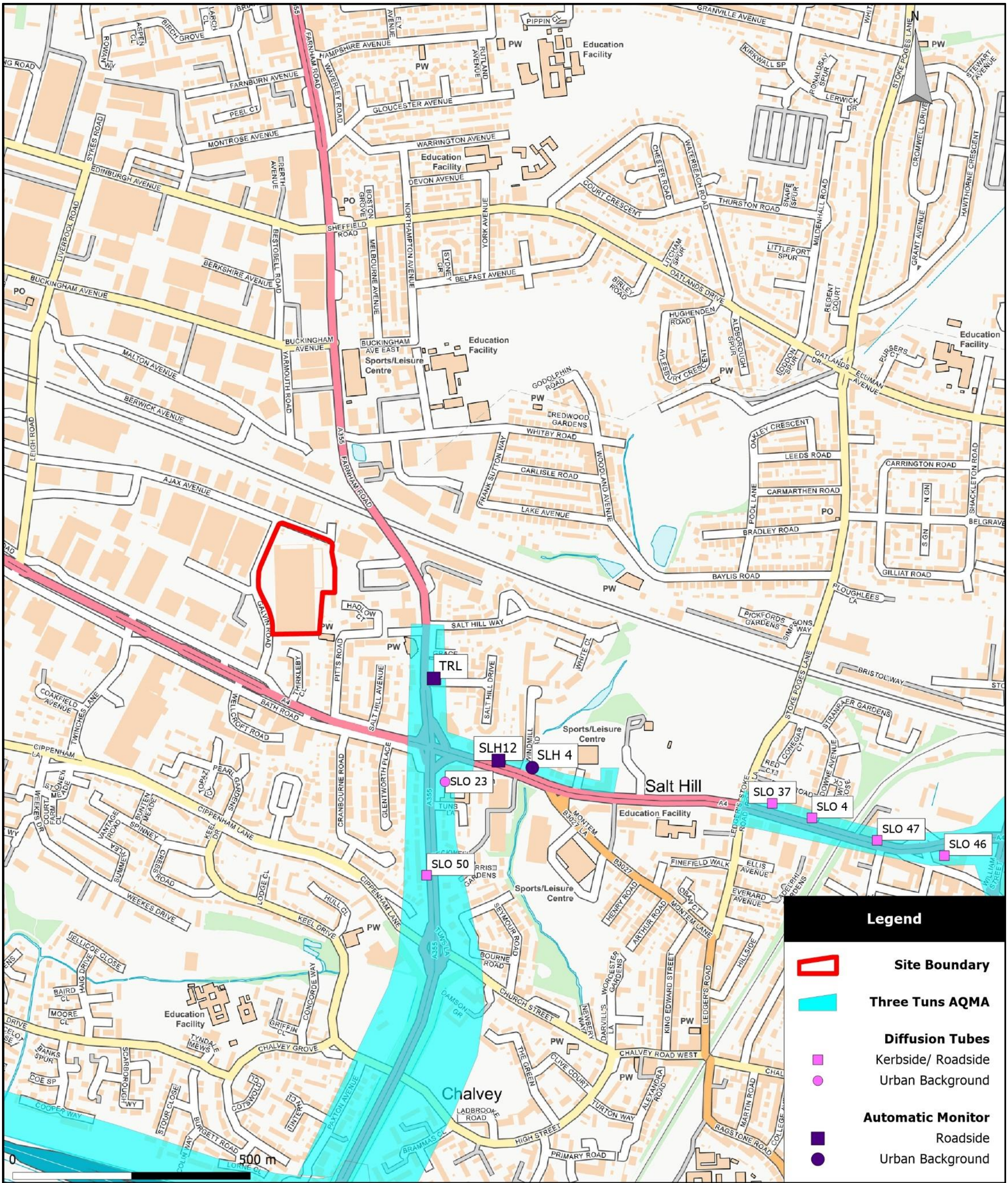

Figure 1: Site Location Plan

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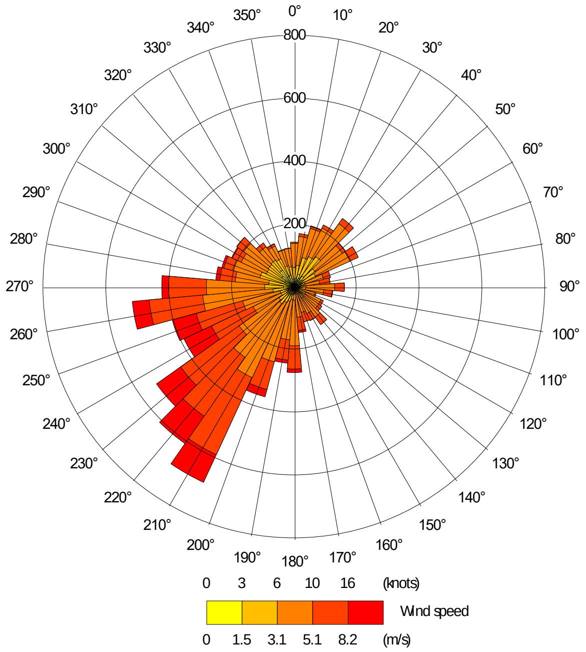
Figure 2: Heathrow Airport Wind Roses (2015 – 2019)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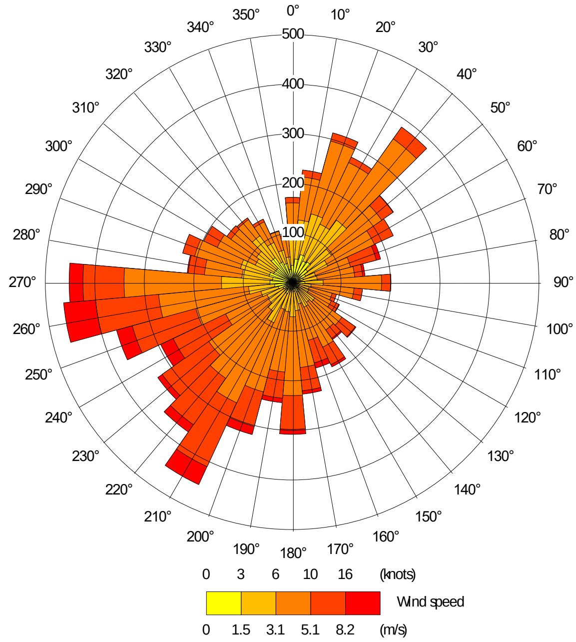
200
400
600
800
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)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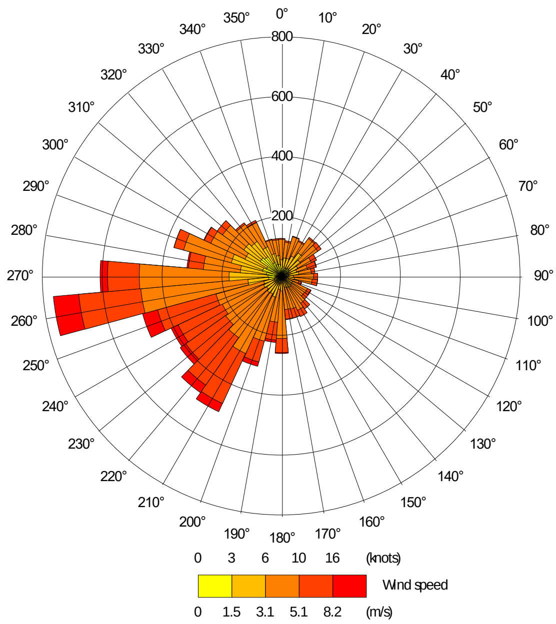
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)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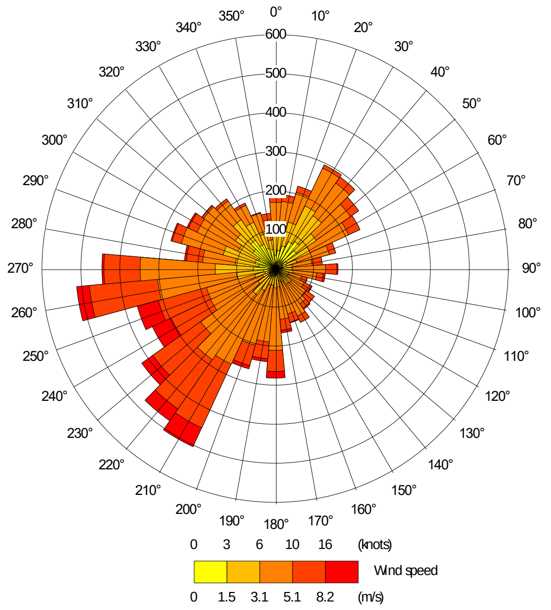
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)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Wind speed
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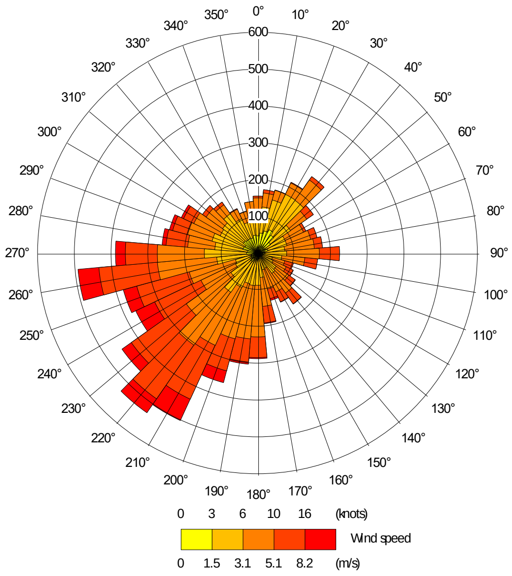
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100
200
300
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600
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

Figure 3: Model Domain

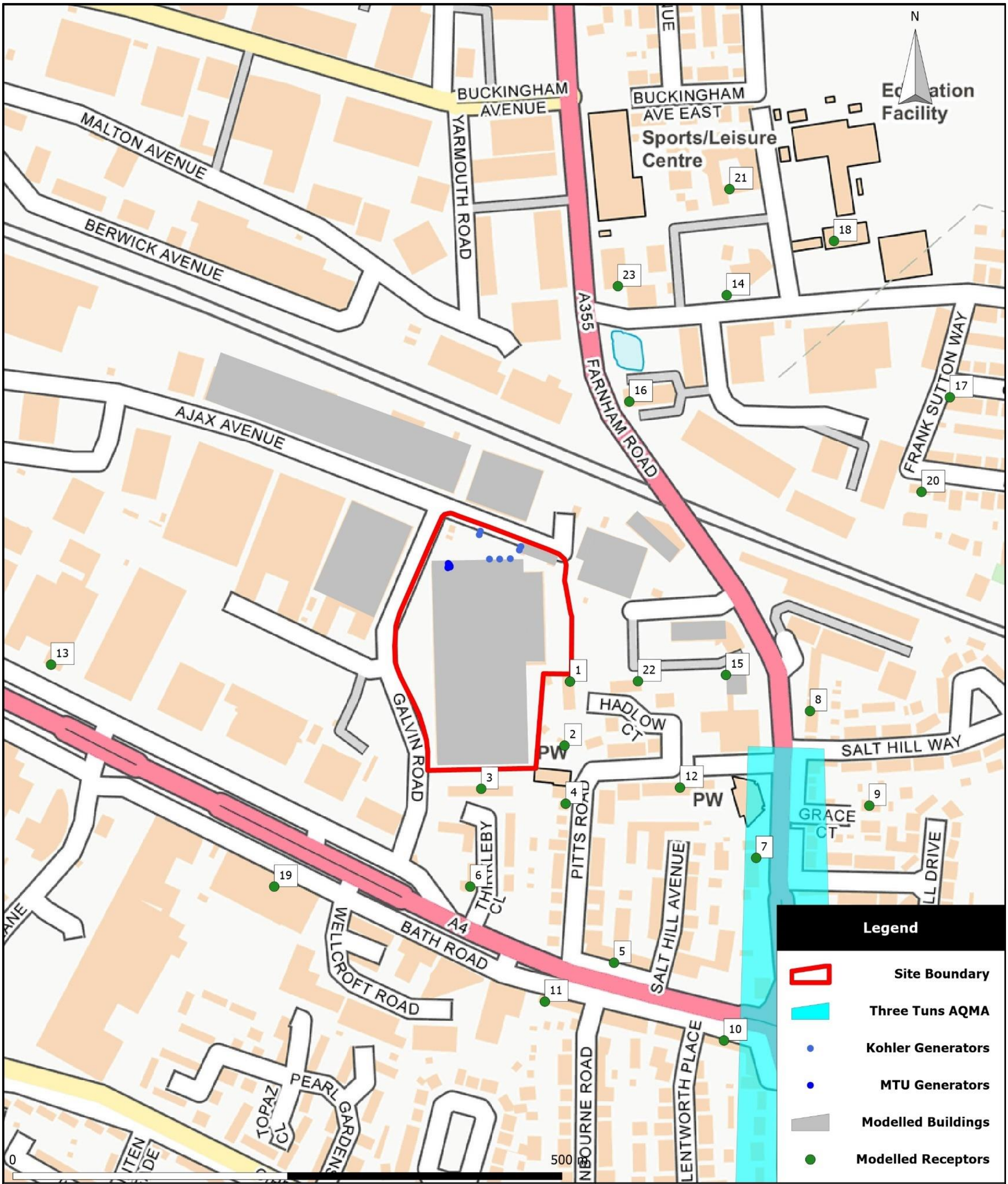

Figure 3: Model Domain

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Figure 4: Annual Mean NO_2 Process Contribution – Testing and Maintenance (1.5m)

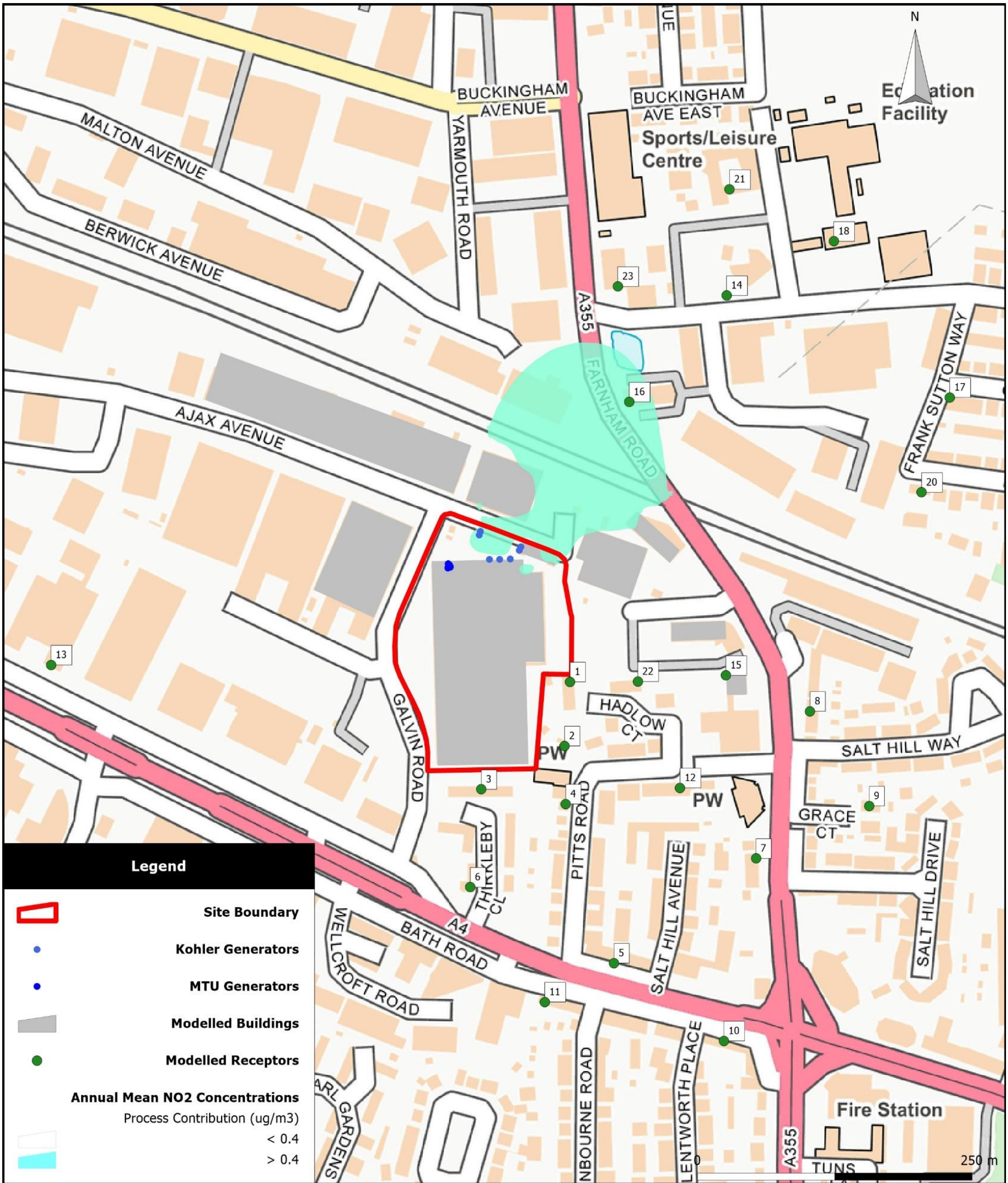

Figure 4: Annual Mean NO2 Process Contribution Testing and Maintenance (1.5m)

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Figure 5: Annual Mean NO_2 Process Contribution – With Emergency Operation (1.5m)

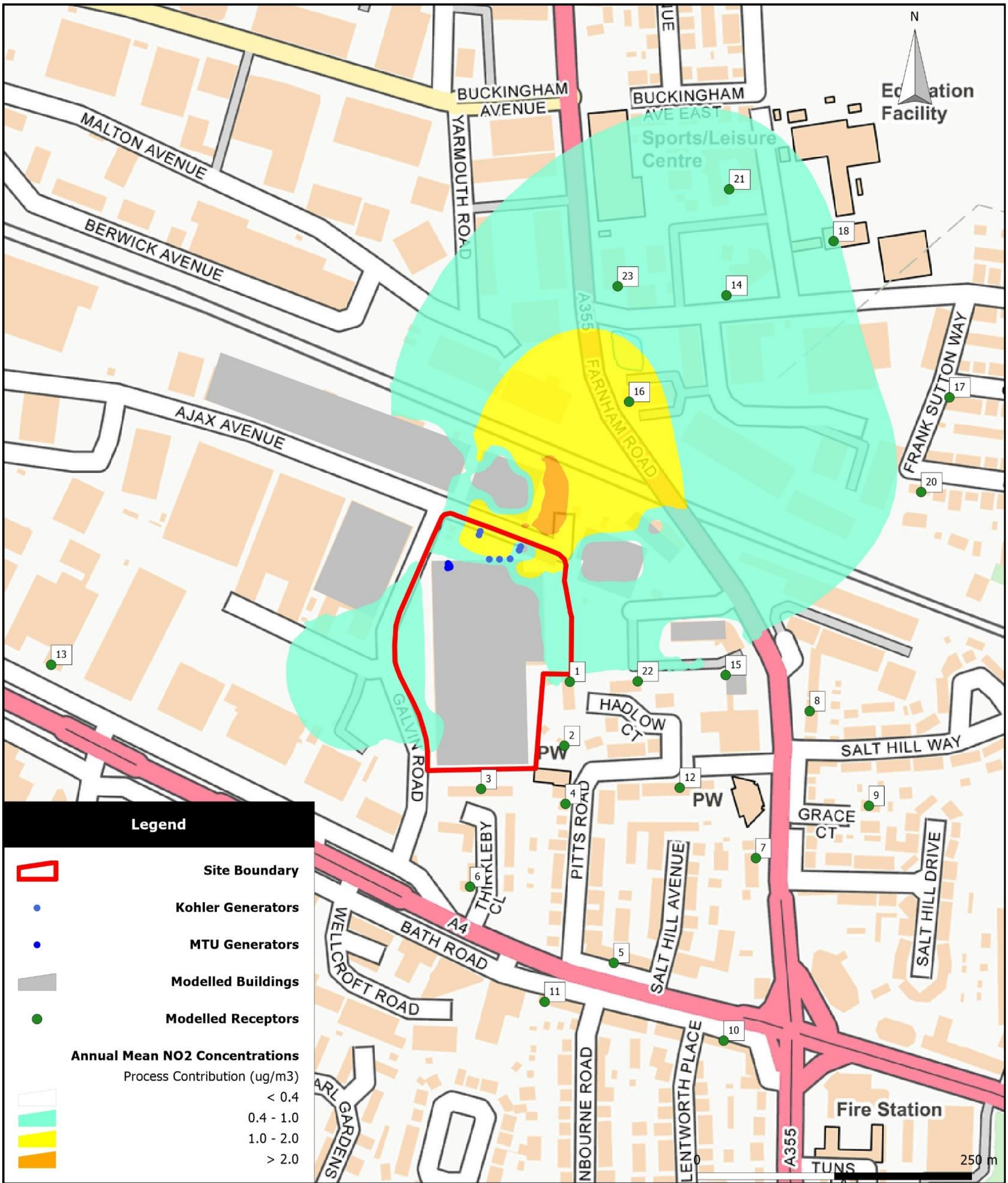

Figure 5: Annual Mean NO2 Process Contribution With Emergency Operation (1.5m)

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Figure 6: Hourly Mean NO_2 Process Contribution – Testing and Maintenance (1.5m)

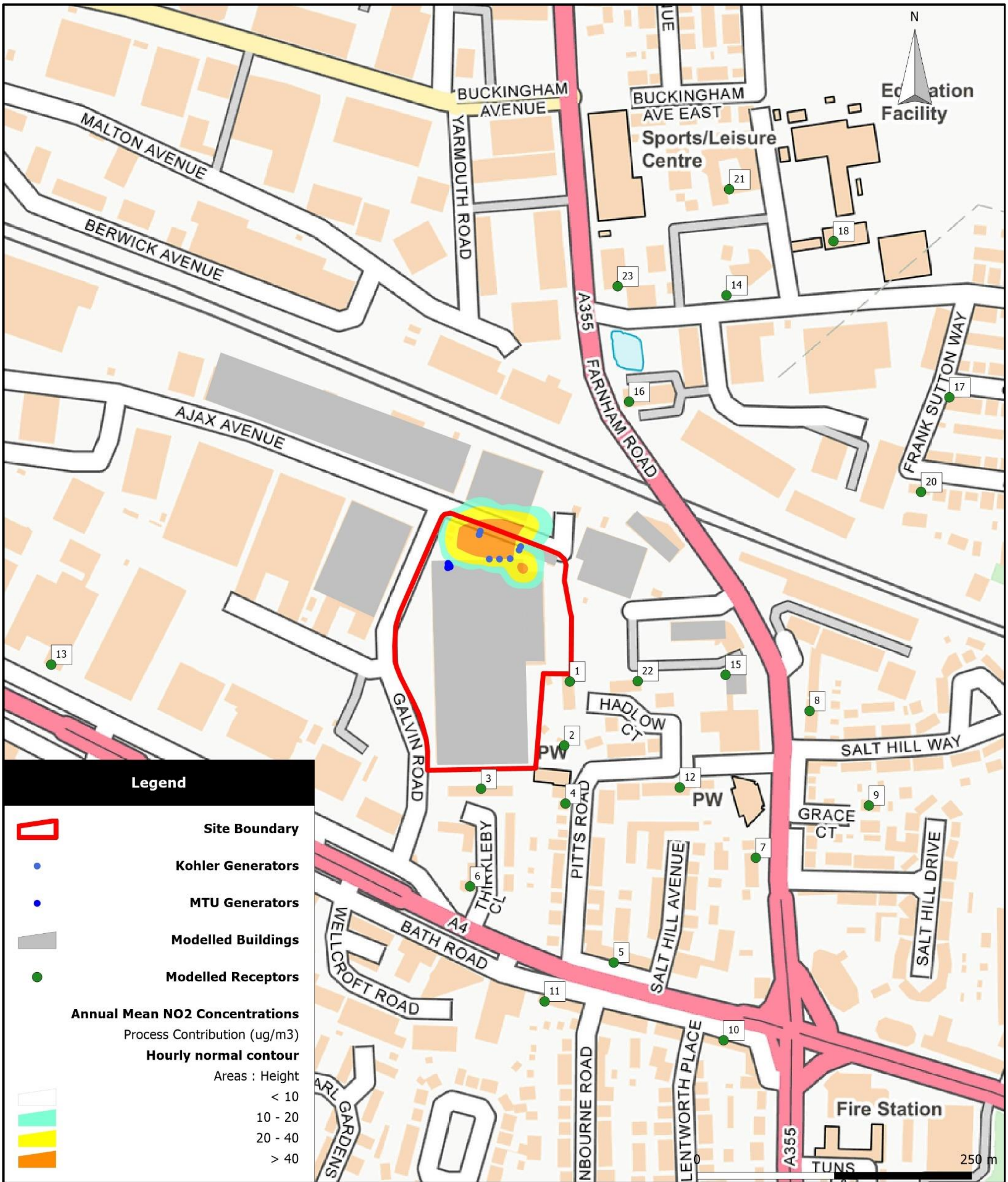

Figure 6: Hourly Mean NO2 Process Contribution Testing and Maintenance (1.5m)

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Figure 7: Hourly Mean NO2 Process Contribution – With Emergency Operation

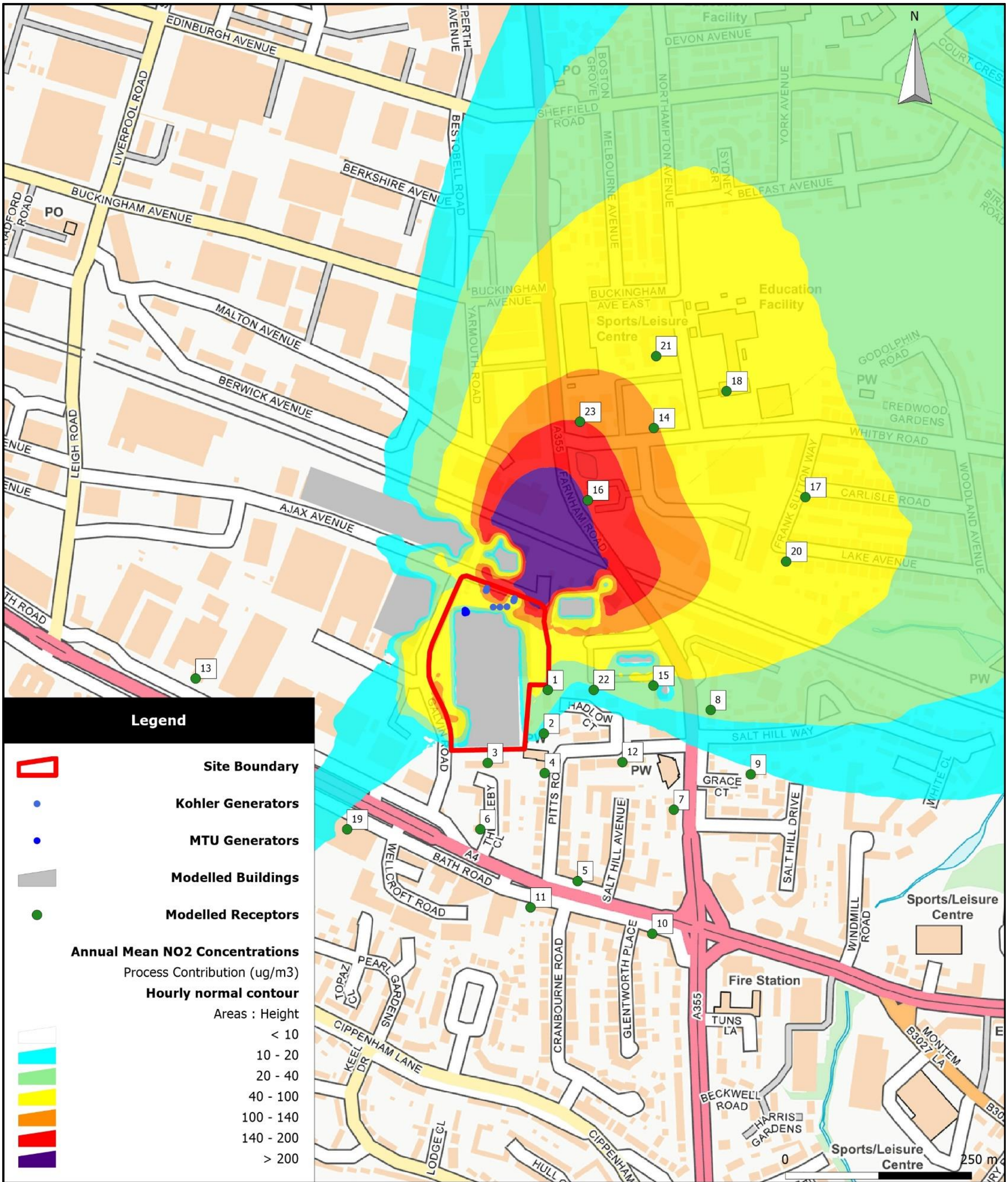

Figure 7: Hourly Mean NO2 Process Contribution With Emergency Operation (1.5m)

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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[8])

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				
KLON06 Data Centre	496100.2	180536	14	186	82	359
KLON06 Data Centre Extension	496148.6	180577.3	11	80	16	359
Cyxtera Data Centre	495993	180629	10	85	58	22
NTT Data Centre	496122	180696	10	45	55	20
Gyron Data Centre	496220	180624	10	45	50	20
New Data Centre in Construction	495966.7	180753.2	10	240	40	110
Gyron Data Centre Extension	496196.9	180643.1	10	25	6	20
Motoring World	496257.5	180654.9	8	50	15	135
Arvato CRM Solutions	496300	180565	16	56	20	90
Phoenix House	496337.4	496337.4	17	20	20	0
KLON06 Data Centre Outbuilding	496155	180634.9	4	34	10	110

Table B.2 Stack Locations

Stack	Type	X	Y	Height above ground (m)
S1 – Existing	MTU 20V4000 G63L	496071	180622	15
S2 – Existing	MTU 20V4000 G63L	496071	180623	15
S3 – Existing	MTU 20V4000 G63L	496072	180625	15
S4 – Existing	MTU 20V4000 G63L	496071	180625	15
S5 – Existing	MTU 20V4000 G63L	496073	180623	15
S6 – Existing	MTU 20V4000 G63L	496073	180622	15
S7 – New Roof level	Kohler KD103V20 5BES	496118	180630	15
S8 – New Roof level	Kohler KD103V20 5BES	496109	180630	15
S9 – New Roof level	Kohler KD103V20 5BES	496128	180630	15
S10 – New External	Kohler KD103V20 5BES	496136	180638	7
S11 – New External	Kohler KD103V20 5BES	496137	180641	7
S12 – New External	Kohler KD103V20 5BES	496099	180652	7
S13 – New External	Kohler KD103V20 5BES	496100	180655	7

Appendix C: Generator Specification Sheets

Specifications for MTU Generators

Engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G63L				
Application Group	3B, 3E, 3F, 3G				
Legislative body	Fuel-consumption optimized				
Test cycle	D2 + 110%				
Fuel sulphur content [ppm]	5				
mg/mN^3 values base on residual oxygen value of [%]	5				

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6
Power	kW	2848	2590	1942	1295	647	259
Power relative	[-]	1.1	1	0.75	0.5	0.25	0.1
Engine speed	1/min	1499	1500	1500	1500	1500	1500
Engine speed relative	[-]	1	1	1	1	1	1
Filter smoke number	Bosch	0.18	0.23	0.2	0.3	0.69	0.19
Exhaust temperature after ETC	grdC	515.1	503.6	483.3	438.5	344.9	222.5
Exhaust back pressure after ETC (static)	mbar	31	30	17	8	3	2
Exhaust mass flow wet	kg/h	13698	12175	9590	7515	5647	4778
NOX-Emissions specific	g/kWh	9.19	11.25	11.53	8.58	6.39	10.2
SO2-Emissions specific	g/kWh	0.002	0.002	0.002	0.002	0.002	0.003
CO-Emissions specific	g/kWh	0.69	0.56	0.33	0.41	1.21	3.87
HC1-Emissions specific	g/kWh	0.1	0.13	0.14	0.17	0.36	1.1
CO2-Emissions specific	g/kWh	610.4	599.9	603.6	628.6	702.9	901.7
PM-Emissions specific (Meas.)	g/kWh	0.024	0.038	0.029	0.054	0.204	0.5
NOX-Emissions (based on 5% O2)	mg/m3N	3484	4237	4323	3105	2028	2499

Specifications for Kohler Generators

KOHLER®

KD4000-E

50 Hz. Diesel Generator Set
EMMISSIONS OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD103V20	Bore:	175 mm (6.89 in.)
Type:	4-Cycle, 20-V Cylinder	Stroke:	215 mm (8.46 in.)
Aspiration:	Turbocharged, Charge Air Cooled	Displacement:	103 L (6311 cu. in.)
Compression ratio:	16:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

EXHAUST EMISSION DATA:	EPA D2 Cycle 5-mode weighted
HC	0.4 g/kWh
NO_x (Oxides of Nitrogen as NO_2)	6 g/kWh
CO (Carbon Monoxide)	0.7 g/kWh
PM (Particulate Matter)	0.1 g/kWh

EMISSION DATA

Cycle point	100% ESP		100% PRP		75% ESP		75% PRP		50% PRP	
Power [kW]	3608		3280		2706		2460		1640	
Speed [rpm]	1500		1500		1500		1500		1500	
NOx [g/kWh]	11.3		8.9		5.32		5.1		5.23	
CO [g/kWh]	0.11		0.14		0.34		0.38		1.0	
HC [g/kWh]	0.25		0.26		0.30		0.33		0.5	
PM [g/kWh]	0.004		0.004		0.017		0.02		0.07	
	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2
HC [mg/Nm³]	87	32	87	33	93	35	101	38	151	56
NOx [mg/Nm³]	3916	1469	2991	1122	1641	615	1567	588	1575	590
CO [mg/Nm³]	39	15	46	17	105	39	117	44	302	113
PM [mg/Nm³]	1.4	0.5	1.3	0.5	5.2	2.0	5.8	2.2	21.2	7.9

Appendix D: Assessment of Ecological Sites

The proposed development's predicted impact on the ecological receptors in Table 3.4, under normal testing and maintenance, and under an emergency operation, is presented below.

Annual Mean Changes: Testing and Maintenance

Table D.1: Annual Mean NO_X

Receptor	Designation	Annual Mean NO_X ($\mu g.m^{-3}$)		Potentially Significant?
		NO_X	%AQS	
ECO1	Burnham Beeches SAC	0.01	0.02%	No
ECO2	Windsor Forest & Great Park SAC	0.00	0.01%	No
ECO3	South West London Waterbodies SPA	0.00	0.01%	No
ECO4	Haymill Valley LNR	0.01	0.02%	No

Table D.2: Nutrient Nitrogen Deposition

Receptor	Designation	N deposition ($kg.N.ha^{-1}.yr$-1)			Potentially Significant?
		PC	CL	% of CL	
ECO1	Burnham Beeches SAC	0.00	10.00	0.02%	No
ECO2	Windsor Forest & Great Park SAC	0.00	10.00	0.01%	No
ECO3	South West London Waterbodies SPA	0.00	10.00	0.01%	No
ECO4	Haymill Valley LNR	0.00	10.00	0.02%	No

Annual Mean Changes: With Emergency Operation

Table D.3: Annual Mean NO_X

Receptor	Designation	Annual Mean NO_X ($\mu g.m^{-3}$)		Potentially Significant ?
		NO_X	%AQS	
ECO1	Burnham Beeches SAC	0.01	0.04%	No
ECO2	Windsor Forest & Great Park SAC	0.01	0.04%	No
ECO3	South West London Waterbodies SPA	0.01	0.03%	No
ECO4	Haymill Valley LNR	0.02	0.06%	No

Table D.4 Nutrient Nitrogen Deposition

Receptor	Designation	N deposition ($kg.N.ha^{-1}.yr$-1)			Potentially Significant?
		PC	CL	% of CL	
ECO1	Burnham Beeches SAC	0.00	10.00	0.04%	No
ECO2	Windsor Forest & Great Park SAC	0.00	10.00	0.03%	No
ECO3	South West London Waterbodies SPA	0.00	10.00	0.03%	No
ECO4	Haymill Valley LNR	0.01	10.00	0.05%	No

Short Term Changes: Testing and Maintenance

Table D.5: 24-hour mean NO_X

Receptor	Designation	24-hour Mean NO_X ($\mu g.m^{-3}$)		Potentially Significant?
		NO_X	%AQS	
ECO1	Burnham Beeches SAC	22	10.8%	No
ECO2	Windsor Forest & Great Park SAC	74	36.8%	No
ECO3	South West London Waterbodies SPA	15	7.7%	No
ECO4	Haymill Valley LNR	67	33.5%	No

Note: the results in Table C.5 assume all generators operate for all hours of the year. During Testing and Maintenance, the sum of hours of operation is only 24 hours. As such, it is reasonable to assume the above results can be considered as insignificant where the standard is not exceeded from Process Contributions alone.

Short Term Changes: With Emergency Operation

Table D.6: 24-hour mean NO_X

Receptor	Designation	24-hour Mean NO_X ($\mu g.m^{-3}$)		Potentially Significant?
		NO_X	%AQS	
ECO1	Burnham Beeches SAC	14	6.9%	No
ECO2	Windsor Forest & Great Park SAC	54	27.1%	No
ECO3	South West London Waterbodies SPA	9	4.7%	No
ECO4	Haymill Valley LNR	41	20.5%	No

Note: the results in Table C.6 assume all generators operate for all hours of the year. During Testing and Maintenance, plus prolonged grid failure, the total hours of operation is only 96 hours. As such, it is reasonable to assume the above results can be considered as insignificant where the standard is not exceeded from Process Contributions alone.

Results Summary

All changes in annual mean NO_X and Nutrient nitrogen are less than 1% of the screening criterion at SPAs and SACs, and less than 100% at LNRs. As such, changes in annual mean pollutants as a result of maintenance and testing and a prolonged grid failure are not significant.

Although changes in daily-maximum mean NO_X are above 10% of the relevant critical load at the Windsor Forest SAC, this model assumes the SDGs operate for all hours of the year, rather than up to 96. As such, it is reasonable to consider the impacts on all nature conservation sites as insignificant.

Appendix E: Tabulated short-term results for CO, PM_{10} and C_6H_6

Carbon Monoxide

Table E.1 below shows the predicted impact of the facility with reference to the 1-hour mean and 8-hour rolling daily maximum mean AQOs for CO.

Table E.1: Predicted percentile mean concentrations of CO

Receptor Point	8-hour maximum daily rolling mean				1-hour maximum mean			
	PC (μg.m^{-3})	PC % of AQS	PEC (μg.m^{-3})	PEC % of AQS	PC (μg.m^{-3})	PC % of AQS	PEC (μg.m^{-3})	PEC % of AQS
R1	67.3	0.7%	993.3	9.9%	74.5	0.2%	1000.5	3.3%
R2	56.6	0.6%	982.6	9.8%	63.8	0.2%	989.8	3.3%
R3	55.9	0.6%	981.9	9.8%	61.7	0.2%	987.7	3.3%
R4	50.6	0.5%	976.6	9.8%	57.1	0.2%	983.1	3.3%
R5	30.1	0.3%	956.1	9.6%	34.4	0.1%	960.4	3.2%
R6	43.1	0.4%	969.1	9.7%	47.0	0.2%	973.0	3.2%
R7	29.6	0.3%	955.6	9.6%	36.6	0.1%	962.6	3.2%
R8	36.3	0.4%	962.3	9.6%	53.4	0.2%	979.4	3.3%
R9	27.6	0.3%	953.6	9.5%	35.9	0.1%	961.9	3.2%
R10	22.1	0.2%	948.1	9.5%	30.3	0.1%	956.3	3.2%
R11	28.9	0.3%	954.9	9.5%	35.8	0.1%	961.8	3.2%
R12	41.2	0.4%	967.2	9.7%	48.5	0.2%	974.5	3.2%
R13	31.7	0.3%	957.7	9.6%	37.3	0.1%	963.3	3.2%
R14	37.1	0.4%	963.1	9.6%	47.6	0.2%	973.6	3.2%
R15	47.2	0.5%	973.2	9.7%	57.6	0.2%	983.6	3.3%
R16	65.5	0.7%	991.5	9.9%	77.9	0.3%	1003.9	3.3%
R17	24.0	0.2%	950.0	9.5%	30.9	0.1%	956.9	3.2%
R18	25.2	0.3%	951.2	9.5%	33.0	0.1%	959.0	3.2%
R19	36.7	0.4%	962.7	9.6%	43.4	0.1%	969.4	3.2%
R20	30.5	0.3%	956.5	9.6%	35.5	0.1%	961.5	3.2%
R21	28.6	0.3%	954.6	9.5%	38.5	0.1%	964.5	3.2%
R22	61.4	0.6%	987.4	9.9%	81.8	0.3%	1007.8	3.4%
R23	45.0	0.5%	971.0	9.7%	50.9	0.2%	976.9	3.3%

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

Particulate Matter

Table E.2 below shows the predicted impact of the site's SDGs, with reference to the 90.41st percentile (i.e., the 36th worst day in the year) daily maximum mean AQO for PM_{10} (50 µg.m^{-3} not to be exceeded more than 35 days in a year).

Table E.2: Predicted percentile mean concentrations of PM_{10} (for comparison with daily maximum mean AQO)

Receptor Point	90.41st daily maximum Mean PM_{10}			
	PC (µg.m^{-3})	PC % of AQS	PEC (µg.m^{-3})	PEC % of AQS
R1	1.4	2.7%	38.0	76%
R2	1.0	2.1%	37.7	75%
R3	1.0	2.0%	37.7	75%
R4	0.8	1.5%	37.4	75%
R5	0.4	0.8%	37.1	74%
R6	0.7	1.5%	37.4	75%
R7	0.6	1.2%	37.3	75%
R8	0.9	1.8%	37.6	75%
R9	0.6	1.2%	37.3	75%
R10	0.4	0.7%	37.0	74%
R11	0.4	0.8%	37.1	74%
R12	0.8	1.6%	37.5	75%
R13	0.7	1.4%	37.4	75%
R14	1.4	2.8%	38.1	76%
R15	1.3	2.5%	37.9	76%
R16	2.5	5.1%	39.2	78%
R17	1.0	2.0%	37.7	75%
R18	0.9	1.9%	37.6	75%
R19	1.3	2.5%	37.9	76%
R20	1.2	2.4%	37.9	76%
R21	1.2	2.4%	37.9	76%
R22	1.4	2.7%	38.0	76%
R23	1.9	3.9%	38.6	77%

At no location is the daily maximum mean concentration of PM_{10} predicted to exceed the relevant AQS.

Benzene

Table E.3 below shows the predicted impact of the facility with reference to the maximum 1-hour AQO for C_6H_6.

Table E.3: Predicted percentile mean concentrations of C_6H_6

Receptor Point	Hourly maximum Mean Benzene			
	PC ($\mu g.m^{-3}$)	PC % of AQS	PEC ($\mu g.m^{-3}$)	PEC % of AQS
R1	59.8	31%	61.4	32%
R2	55.1	28%	56.8	29%
R3	53.8	28%	55.4	28%
R4	54.1	28%	55.7	29%
R5	27.5	14%	29.2	15%
R6	36.8	19%	38.5	20%
R7	28.8	15%	30.5	16%
R8	66.8	34%	68.5	35%
R9	27.1	14%	28.7	15%
R10	21.1	11%	22.8	12%
R11	27.1	14%	28.7	15%
R12	39.0	20%	40.7	21%
R13	27.4	14%	29.1	15%
R14	37.9	19%	39.6	20%
R15	47.4	24%	49.1	25%
R16	67.9	35%	69.6	36%
R17	24.9	13%	26.6	14%
R18	27.7	14%	29.4	15%
R19	32.3	17%	33.9	17%
R20	30.9	16%	32.6	17%
R21	91.6	47%	93.3	48%
R22	30.9	16%	32.6	17%
R23	44.0	23%	45.7	23%

At no location is the daily maximum mean concentration of PM_{10} predicted to exceed the relevant AQS.

Phlorum Limited

Head Office & Registered Office:
Unit 12
Hunns Mere Way
Woodingdean
Brighton
East Sussex
BN2 6AH
T: 01273 307 167

Northern Office:
Ground Floor
Adamson House
Towers Business Park
Wilmslow Road
Didsbury
Manchester
M20 2YY
T: 0161 955 4250

Western Office:
One Caspian Point
Pierhead Street
Cardiff Bay
Cardiff
CF10 4DQ
T: 029 2092 0820

info@phlorum.com
www.phlorum.com

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