



Manchester University NHS Foundation Trust

North Manchester General Hospital - WP06 Substation10

Air Quality Assessment

Report No.: 445878-03 (02)

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RSK

RSK GENERAL NOTES

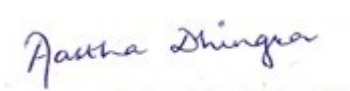
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This work has been undertaken in accordance with the quality management system of RSK Group Limited

Abbreviations

AQO	Air Quality Objective
AQS	Air Quality Standard
CLe	Critical Level
CLo	Critical Load
Defra	Department for Environment, Food and Rural Affairs
EC	European Commission
EPR	Environnemental Permit Regulations
EU	European Union
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
MCC	Manchester City Council
NPPF	National Planning Policy Framework
NO ₂	Nitrogen dioxide
NO _x	Oxides of nitrogen

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1 INTRODUCTION

RSK Environment Ltd (RSK) has been commissioned to undertake an air quality assessment to support the installation of two emergency diesel generators at North Manchester General Hospital (NMGH). These works are included in the application for the NMGH redevelopment.

The installation of two emergency diesel generators (each having a rated output of 2,750 KVA) is required as part of the proposal to create a new sub station and associated generator enclosure within the NMGH site. The new sub station (sub station 14) is required as a replacement for the existing sub station 10, which sits on the site of future development and will be demolished. The proposed emergency diesel generators will serve as the backup power source for Blocks H, I, J and K following the failure of connection from the national grid. These generators will replace an existing onsite emergency diesel generator, which will be decommissioned as part of this project.

While the likelihood that the generator will operate under a loss of offsite power (LOOP) scenario is low, the generators will be required to be routinely tested. They are required to be tested on a monthly basis for approximately 60 minutes. Furthermore, each generator will also be operated yearly for approximately 4 hours for a load bank test. This will result in the release of emissions, and an air quality assessment is required.

The following report presents the findings of the assessment of impacts from emissions of nitrogen dioxide (NO₂) on nearby human receptors and the impacts of oxides of nitrogen (NO_x), and subsequent impacts of nutrient nitrogen and acid deposition on nearby sensitive ecological receptors. As referenced within the Environment Agency's specified generator guidance¹, only emissions of NO_x (or NO₂) need to be considered from natural gas and gas-oil (diesel) fuelled engines. As such, emissions of particulate matter, carbon monoxide, sulphur dioxide and volatile organic compounds (VOC) have not been considered. This is owing to the fact that the emissions of these pollutants are considered small compared to their environmental standards.

The site lies within the jurisdiction of Manchester City Council (MCC), which has declared an Air Quality Management Area (AQMA) for exceedances of the nitrogen dioxide annual mean objective, covering the centre of the city and its major arterial roads. The proposed development is located approximately 720 m away from this AQMA, with the site's location in relation to the nearby AQMA is presented in **Figure 1.1**.

This assessment has considered both the long- and short-term air quality impacts of the proposed backup generators.

¹ [Specified generators: dispersion modelling assessment - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/364222/specification-for-dispersion-modelling-assessment.pdf)



Figure 1.1: Location of Proposed Generators, nearby Ecological Sites and the Manchester AQMA

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2 LEGISLATION & GUIDANCE

2.1 Key Legislation and Policy

2.1.1 Air Quality Regulations

The air quality standards (AQSS) and air quality objectives (AQOs) in the United Kingdom are derived from EC directives and are adopted into English law via the Air Quality (England) Regulations 2000 and Air Quality (England) Amendment Regulations 2002. Directive 2008/50/EC set limits values, and was translated into UK law in 2010 via the Air Quality Standards Regulations 2010. The European Union (Withdrawal) Act retains existing EU environmental provisions in the UK.

2.1.2 Environment Act 2021

The Environment Act provides a mechanism to set long-term, legally binding environmental targets, including those for air pollution. The Act requires the government to have an Environmental Improvement Plan (EIP) covering at least 15 years and setting out steps it intends to take to improve the environment.

As part of the Environment Act, the Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 now sets targets for PM_{2.5}.

2.1.3 Clean Air Act 1993

The Clean Air Act 1993 prohibits the burning of pulverised fuel, solid fuel at a rate of 45.4 kg/h or liquid or gaseous fuel at a rate equivalent to 366.4 kilowatts, unless the chimney height has been approved by the local authority. Combustion units requiring permitting under the Environmental Permitting Regulations (>20 MW) are exempt from the Clean Air Act as a competent authority will be required to determine the suitability of any environmental impact.

As such, MCC are required to approve the chimney height for the proposed generator.

2.1.4 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy. The 2007 *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020. It furthermore describes the role of local authorities in carrying out their duties under the Environment Act 1995 (i.e. the Local Air Quality Management (LAQM) regime).

The latest 2023 *air quality strategy: Air quality Strategy: framework for local authority delivery*, which supersedes the 2007 air quality strategy (in England only), retains the majority of the 2007 strategy but further sets out the actions that Defra expects local authorities to take in support of their long-term air quality goals, including the new PM_{2.5} targets.

2.1.5 The Clean Air Strategy 2019

The Clean Air Strategy 2019 sets out ways that the UK government will seek to tackle major sources of pollution. This latest strategy aims to have a more joined-up approach, outlining actions the Government plans to take to reduce emissions from transport, homes, agriculture and industry.

2.2 Planning Policy

The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality concern that relates to land use and its development can, depending on the details of the proposed development, be a material consideration in the determination of planning applications.

2.2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) sets out the planning policy for England and was intended to simplify the planning system and includes a presumption in favour of sustainable development. The latest major release of the NPPF is from December 2024.

Section 15 of the NPPF deals with Conserving and Enhancing the Natural Environment, and states that the intention is that the planning system should prevent ‘development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability’ and goes on to state that ‘new development [should be] appropriate for its location’ and ‘the effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account.’

With specific regard to air quality, paragraph 187 of the NPPF states that:

‘Planning policies and decisions should contribute to and enhance the natural and local environment by:

‘.... e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans’

Paragraph 199 further states that:

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

applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan’.

2.2.2 Local Planning Policy

Manchester City Council Policy

The Core Strategy² was adopted by Manchester City Council on 11th July 2012. It is the key document in Manchester's Local Development Framework and covers a period of 15 years from 2012 to 2027. It describes Manchester today and outlines the Council's vision for Manchester in 2027, along with the planning policies which will be used to deliver that vision.

In March 2024, the 2024 Adopted Places for Everyone Joint Development Plan Document³ came into force, this includes Policy JP-S5: Clean Air, of the which states:

“A comprehensive range of measures will be taken to support improvements in air quality, focusing particularly on locations where people live, where children learn and play, where there are impacts on the green infrastructure network and where air quality targets are not being met, including:

1. *Locating and designing development, and focusing transport investment, so as to reduce reliance on forms of transport that generate air pollution;*
2. *Determining planning applications having regard to the most recent development and planning control guidance published jointly by the Institute of Air Quality Management (IAQM) and Environmental Protection UK (EPUK), and the most recent IAQM Guidance on the Assessment of Dust from Demolition and Construction, or relevant successor guidance, including the requirement for developers to submit construction management plans as appropriate;*
3. *Requiring applications for developments that could have an adverse impact on air quality to submit relevant air pollution data so that adverse impacts on air quality can be fully assessed and development only permitted where they are acceptable and/or suitable mitigation can be provided;*
4. *Restricting developments that would generate significant point source pollution such as some types of industrial activity and energy generation;*
5. *Significantly expanding the existing commercial network of electric vehicle charging points, both for public and private use, including as part of new developments;*
6. *Implementing the Clean Air Plan and associated measures;*
7. *Facilitating the more sustainable distribution of goods within the urban area, including through accommodating urban consolidation centres and urban distribution centres that use ultra-low-emission vehicles, and local delivery facilities to reduce repeat delivery attempts;*
8. *Designing streets to avoid trapping air pollution at ground level, including through the appropriate location and scale of buildings and trees;*
9. *Controlling traffic and parking within and around schools, early years sites and other locations that are particularly sensitive to air quality;*

² https://www.manchester.gov.uk/downloads/download/5672/core_strategy

³ <https://www.greatermanchester-ca.gov.uk/media/2drduk0t/places-for-everyone-joint-development-plan-dec24.pdf>

10. *Promoting actions that help remove pollutants from the air, such as enhancing the green infrastructure network and using innovative building materials that capture air pollutants; and Places for Everyone Joint Development Plan 2022 to 2039 Adopted with effect from 21 March 2024 105*
11. *Development should be located in areas that maximise the use of sustainable travel modes and be designed to minimise exposure to high levels of air pollution, particularly for vulnerable users.”*

2.3 Guidance

2.3.1 Environmental Protection UK Guidance – Development Control: Planning for Air Quality

Environmental Protection UK's (EPUK) and the IAQM jointly published a revised version of the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' in 2017 (herein the 'EPUK-IAQM guidance') to facilitate consideration of air quality within local development control processes. It provides a framework for air quality considerations, promoting a consistent approach to the treatment of air quality issues within development control decisions.

The guidance includes a method for screening the requirement for an air quality assessment, the undertaking of an air quality assessment, the determination of the air quality impact associated with a development proposal and a method for determining impact significance.

2.3.2 Local Air Quality Management Review and Assessment Technical Guidance

The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their air quality review and assessment work. This 2022 guidance, referred to in this document as the Local Air Quality Management Technical Guidance ('LAQM TG.22'), has been used to identify locations where exposure can be considered 'relevant'.

2.3.3 AQTAG06: Technical Guidance on Detailed Modelling Approach for an Appropriate Assessment for Emissions to Air

The AQTAG06 guidance, updated during 2014, provides technical guidance on how to approach detailed modelling of emissions to air when considering impacts on ecological receptors. It also includes a method which can be used to assess the potential impacts of nitrogen and acid deposition attributable to emissions of NO_x to air on local ecosystems.

2.3.4 Specified generators: dispersion modelling assessment

This guidance⁴, which was updated in 2023 by the Environment Agency (EA), outlines a procedure for undertaking detailed dispersion modelling of specified generators submission as part of any submission under Schedule 25B of the Environmental Permitting Regulations (EPR) application. It includes screening distances for assessment of specified generators on ecological sites.

⁴ <https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment>

3 ASSESSMENT CRITERIA

Based on the current regulations, the air quality standards for the pollutants proposed for assessment are presented in **Table 3.1**. Critical loads developed by the United Nations Economic Commission for Europe (UNECE) for the protection of vegetation are site-specific, and as such, they have been detailed further in **Table 4.4**.

Table 3.1: Air Quality Standards Relevant to the Assessment

Pollutant	Averaging period	Exceedances allowed per year	Ground level concentration limit ($\mu\text{g}/\text{m}^3$)	Designation
Nitrogen dioxide (NO_2)	calendar year mean	-	40	AQO ¹
	1-hour mean	18	200	AQO ¹
NOx	calendar year mean	-	30	AQO ² /CLE
	24-hour mean	-	75	Cle ³

Note ¹ The limit value is the same as the Air Quality Objective.

Note ² Only the critical level applies at locations within 20 km from agglomerations (250,000 people) or within 5 km away from other built-up areas, industrial installations (PART A) or motorways or major roads with traffic counts of more than 50,000 vehicles per day.

Note ³ Defined by the World Health Organisation and is not an Air Quality Objective.

4 ASSESSMENT METHODOLOGY

4.1 Overall Scope

The proposal includes the installation of two 2,750 kVA Cummin C2750D5BE diesel-fuelled backup generators. It is proposed that the generators will serve as a backup power source for Blocks H, I, J and K following the failure of connection from the national grid.

While the likelihood that the generators will operate under a loss of offsite power (LOOP) scenario is low, each generator will be required to be tested on a monthly basis for approximately 60 minutes. These are likely to be separate tests per generator. Furthermore, each generator will also be operated yearly for approximately 4 hours for a load bank test. Again, these will be two separate tests. Accordingly, the total hours that the generators will operate in will be 32 hours per year.

Based on the above, dispersion modelling of the emissions will be undertaken to predict local impacts for comparison against the annual and 1-hour mean NO₂ AQO and annual mean and 24-hour NO_x critical levels (in relation to ecological receptors only).

4.2 Dispersion Modelling Methodology

4.2.1 Modelling Software

The model used in this study is the Atmospheric Dispersion Modelling System (ADMS) Version 6, developed by the Cambridge Environmental Research Consultants (CERC). ADMS is a steady-state new-generation Gaussian plume atmospheric dispersion model; that being, it characterises the atmospheric boundary layer properties using the boundary layer depth and Monin-Obukhov length rather than the Pasquill-Gifford stability classes.

The ADMS model can include the treatment of both surface and elevated sources, complex terrain, buildings and chemistry effects. The model calculates downwind pollutant concentrations in the surrounding area for each hour of the day and night. Statistics on the frequency and concentration of pollutants at the receptor sites are based on hourly calculations.

Along with the AERMOD dispersion model, ADMS is commonly used within the UK for regulatory purposes and is judged fit for purpose for this assessment.

4.2.2 Emission Sources

All physical stack parameters (stack heights and diameters etc.) and efflux parameters (flow rates and stack temperature etc.) have been provided by the Project Team (Turley & ARUP).

The NO_x emission rate has been calculated using the in-stack emission concentration

provided (in g/kWhr, equivalent to 2023 EPA Tier 2, as per the technical specifications)⁶ and the power output rating of the generator. Furthermore, the stack exit velocity has been calculated based on the provided stack diameter and actual flow rate.

All emission rates and stack parameters entered into the model have been presented in **Table 4.1**.

Table 4.1: Stack Parameters

Parameter	Per Cummin C2750D5BE Genset (QSK60-G23 2750 KVA Engine) ²	Per Cummin C2750D5BE Genset (QSK60-G23 2750 KVA Engine) ²
Stack Location (X, Y)	384963, 402403	384962 , 402403
Stack Height (m)	20.0	20.0
Stack Diameter (m)	0.5	0.5
Standby Power Output (kW)	2,200	2,200
Exhaust Temperature (°C)	480	480
Exit Velocity (m/s)	34.37	34.37
Actual Flow (m ³ /s)	6.75	6.75
NOx Concentration (g/kWhr) ¹	6.4	6.4
NOx Emission Rate (g/s)	3.91	3.91

Note 1 Taken from the US EPA's nonroad compression-ignition engine exhaust standards⁷

Note 2 The two stacks are wrapped in together which have been accounted in the model within ADMS's combine stack module.

4.2.3 Meteorological Data

Hourly sequential meteorological data from Manchester Airport meteorological station from between 2020 - 2024 has been used within the model. The Manchester Airport station is the nearest suitable meteorological station to the site; both the meteorological station and the proposed development are located in areas of flat-lying topography. Furthermore, the data capture is above the recommended >85%.

Each year has been modelled separately, with the worst-case prediction presented at each receptor presented within the report.

Examination of the wind roses indicates that the winds are predominantly from the directions of between 180° and 215, i.e., predominantly southerly winds. This is typical of the conditions generally experienced in this part of the UK. The wind rose diagram for the entire modelled period (2020 – 2024) is presented in **Figure 4.1**.

⁶ <https://cdn.ade-power.com/assets/pdf/generators/cummins/cummins-c2750d5be-data-sheet.pdf>

⁷ <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100OA05.pdf>

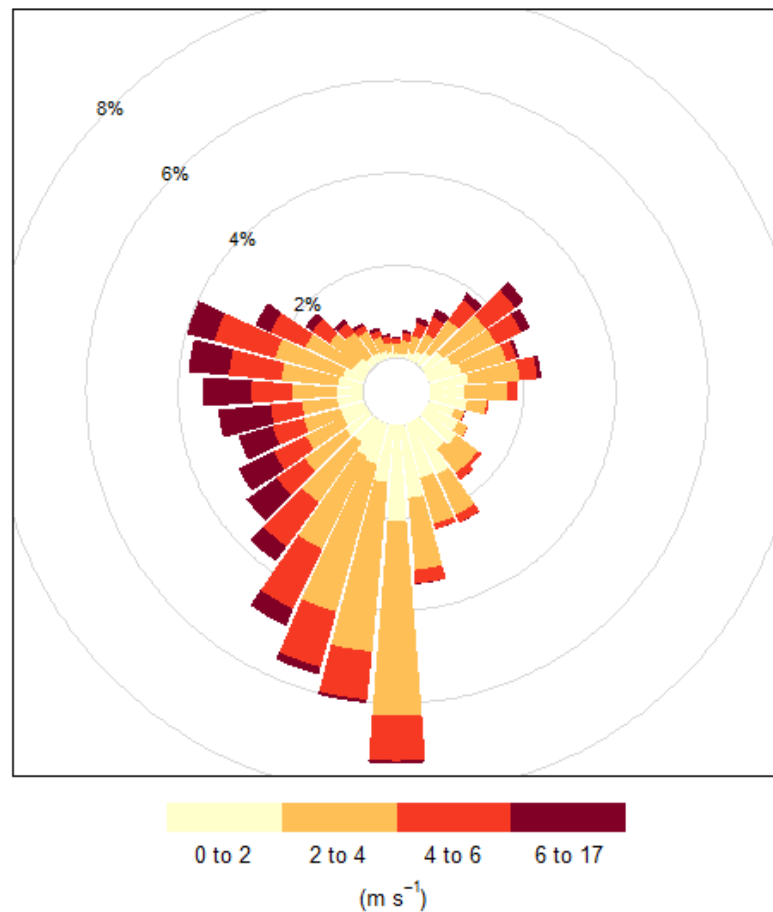


Figure 4.1: Wind Rose for Manchester Airport Meteorological Station (2020 - 2024)

The Monin-Obukhov Length is the height above ground where mechanically produced (by vertical shear) turbulence is in balance with the dissipative effect of negative buoyancy. The minimum Monin-Obukhov Length parameter is an important component of the ADMS model, which allows the user to account for the heat production of cities and can have significant effects on the modelling results. For this assessment, the minimum Monin-Obukhov Length of 30 m was used for the meteorological site location (representing urban areas with a population of less than 1 million), and 100 m was used for the dispersion site location (representing a large conurbation urban area with a population greater than 1 million).

4.2.4 Terrain and Land Use

The topographical features surrounding a site will have an influence on the dispersion of pollution within the area. This is accounted for in the surface roughness length (z_0) specified in the model input.

A z_0 surface value of 0.5m was used for the land use around the site, which the model guidance indicates is appropriate for 'open suburbia'. Furthermore, a surface roughness length of 0.3 m has been used to represent the land use around the meteorological site. Furthermore, model default values were used for surface albedo (0.23) and the Priestley-

Taylor parameter (1).

The model author (CERC) advises that slopes with a gradient of greater than 1:10 can affect dispersion. Examination of digital terrain data for the study area suggests that there are no terrain gradients greater than 1:10 between the stack and the receptors; therefore, terrain effects have not been accounted for within the model.

4.2.5 Buildings

Buildings have the potential to disrupt atmospheric flow. In the case of emissions from a stack, they can entrain pollutants into the leeward side of the building (known as a cavity region). This cavity region is highly turbulent, often bringing pollutants rapidly towards ground level, increasing their concentrations. These concentrations will then reduce with diminishing turbulent wake. ADMS has the capability to model the impacts of stack pollutants being entrained into the cavity region (stack is downwind of the building) or plume impacts hitting the side of a building (stack is upwind) for a single effective building per met line.

To capture the potential influence of buildings/structures on the dispersion profile of emissions (e.g. building 'downwash' effects), fifteen nearby onsite buildings have been included. The parameters of the modelled buildings and structures are summarised in **Table 4.2**.

Table 4.2: Buildings Included in the Model

Building ID	X (m)	Y (m)	Height (m)	Width (m)	Length (m)	Angle (degree)
Proposed Substation	384949.29	402411.10	4.50	37.30	17.00	119.00
1	384986.58	402405.05	18.00	18.70	40.86	119.00
2	385004.17	402380.31	18.00	34.62	19.06	119.00
3	385011.71	402342.57	18.00	30.45	25.23	119.00
4	384964.60	402336.44	18.00	19.50	88.00	119.00
5	384935.63	402354.99	18.00	19.50	88.00	119.00
6	384896.16	402376.43	18.00	51.12	88.32	119.00
7	384847.73	402393.75	18.00	30.61	56.78	119.00
8	384813.91	402446.41	18.00	58.56	69.05	62.00
9	384849.35	402483.02	18.00	33.97	18.95	62.00
10	384862.58	402458.01	18.00	37.88	29.05	62.00
11	384898.76	402444.26	18.00	33.64	22.84	119.00
12	384879.75	402425.87	18.00	24.69	26.63	119.00
13	384967.39	402501.69	4.00	17.18	37.72	78.01

14	384996.57	402477.04	4.00	34.75	17.88	74.76
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4.2.6 Model Output Grid

A uniform cartesian grid measuring 4 km x 4 km with 50 m increments centering over the stack was used. The receptor heights were set at 1.5 m.

4.2.7 Human Receptors

The discrete receptors considered were chosen based on where people may be located and judged in terms of the likely duration of their exposure to pollutants and proximity to the site, following the guidance given in section 2.3.2. **Table 4.3** and **Figure 4.2** details the discrete human receptors included within the model.

Table 4.3: Discrete Human Receptors Included in the Model

Receptor ID	X (m)	Y (m)	Height (m)
R1	384968	402393	1.5 ¹
R2	384978	402409	1.5 ¹
R3	384987	402428	1.5 ¹
R4	385007	402361	1.5 ¹
R5	385025	402351	1.5 ¹
R6	384985	402376	1.5 ¹
R7	384959	402393	1.5 ¹
R8	384940	402404	1.5 ¹
R9	384907	402422	1.5 ¹
R10	384912	402430	1.5 ¹
R11	384966	402481	1.5
R12	384984	402463	1.5
R13	384901	402663	1.5
R14	384857	402613	1.5
R15	384800	402553	1.5
R16	384970	402608	1.5
R17	384707	402455	1.5
R18	384683	402299	1.5
R19	384809	402066	1.5
R20	385335	402183	1.5
R21	385383	402473	1.5
R22	385344	402617	1.5

R23	385198	402730	1.5
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Note 1: Receptor were modelled at heights of 1.5, 4.5, 7.5, 10.5, 13.5, 16.5 and 18 m to represent multiple floors in the proposed development.

4.2.8 Ecological Receptors

The chosen ecological receptors have been determined using distance-based screening criteria from the Environment Agency's specified generator guidance⁸. Distances vary based on the size of the engine, the fuel used and the designation of the habitat. The maximum screening distance provided in this guidance is 2500 m for engines fired on natural gas or diesel for sizes between 10 - 20 MW (assuming a thermal input capacity of 5.7 MW for each generator). Therefore, all ecological sites within this distance have been considered for assessment.

Reviewing Defra's MAGIC mapping website⁹, the ecological receptors within 2500 m of the proposed generators are Blackley Forest Local Nature Reserve (LNR), Boggart Hole Clough LNR and Boggart Hole Clough Ancient Woodlands.

The ecological receptors included within this assessment and their associated critical loads (taken from APIS¹⁰) are presented in **Table 4.4** and **Figure 4.2**.

Table 4.4: Discrete Ecological Receptors Included in the Model

ID	Receptor Description	X (m)	Y (m)	Height (m)	Nutrient Nitrogen Dep Critical Load (kgN/ha/yr) ¹	Acid Dep Critical Load (Keq/ha/yr) ²
E1	Blackley Forest Local Nature Reserve (LNR)	384228	403137	1.5	10	2.99
E2	Boggart Hole Clough Local Nature Reserve (LNR)	385991	402501	1.5	10	3.04
E3	Boggart Hole Clough Ancient Woodlands	386322	403053	1.5	10	3.05

Note 1: No data is available, so a typical value for broadleaved deciduous forest¹¹ from APIS has been used.

Note 2: Represents the MinCLMaxN from APIS's location specific acidity critical load for unmanaged woodland.

⁸ Specified generators: dispersion modelling assessment - GOV.UK (www.gov.uk)

⁹ MAGIC website - <https://magic.defra.gov.uk/home.htm>

¹⁰ <https://www.apis.ac.uk/>

¹¹ https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2022-10-12_texte_110-2022_review_revison_empirical_critical_loads.pdf



Figure 4.2: Location of Modelled Receptors

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4.2.9 Baseline Air Quality

MCC has declared one AQMA for exceedances of the annual mean NO₂ objective, with the proposed development approximately 720 m from this AQMA. The area surrounding the proposed development contains hospital and residential uses.

According to the MCC's 2024 Air Quality Annual Status Report (ASR), there were four automatic monitoring stations operating in 2023; however, the closest automatic monitor (Manchester Piccadilly) was 4km away from the development site. The closest monitoring location to the proposed site is diffusion tube MAN101BNO, approximately 1 km from the proposed development. It is noted that four diffusion tube locations are located within 2 km of the proposed redevelopment. The annual average NO₂ concentrations for these four diffusion tube sites for the years 2019 - 2023 are reproduced in **Table 4.5** and **Figure 4.4**. It is noted that all these four diffusion tubes are located on busy A-roads and are not necessarily representative of the majority of receptors in the vicinity of the proposed development. The data from these tubes show that there were no exceedances of the annual mean NO₂ during 2023, with only one exceedance recorded at these sites in the last five years.

With the lack of receptor-specific data, Defra background data has been used within the assessment; however, the nearest 2023 monitoring tube concentration (32.2 µg/m³) has been used within this assessment for the roadside receptors (R13-R15).

Table 4.5: Annual Mean NO₂ Selected Local Monitoring (2019 – 2023). Bold Value Highlights the Concentration used within this Assessment

Site ID	Location	Site type	Approximate Distance from Site (km)	Annual Mean NO ₂ Concentrations (µg/m ³)				
				2019	2020	2021	2022	2023
Manchester Piccadilly	MAN3	Urban Centre	4.12	36	27	30	29	27
MA100BNO	100	Roadside	1.36	-	31.2	33.6	33.0	30.6
MA101BNO	101	Roadside	1.10	-	28.1	35.9	35.6	34.9
MA102BNO	102	Roadside	0.99	-	28.3	31.0	32.8	32.2
MA103BNO	103	Roadside	1.81	-	35.5	39.6	40.1	37.9

Table 4.6 presents the 1-hour mean NO₂ monitoring results (number of 1-hour mean concentrations greater than 200 µg/m³) for the automatic monitor located at Manchester Piccadilly. There have been no exceedances of the 1-hour mean NO₂ AQO concentrations standard in the last five years; this includes two years less likely to be impacted by the restrictions placed on people and industry due to the 2020/2021 COVID-19 pandemic.

Table 4.6: MCC 1-hour mean NO₂ Monitoring Results (2019 – 2023)

Monitor ID	Site Name	Site Type	Annual Mean Concentration (µg/m ³)				
			2019	2020	2021	2022	2023
MAN3	Manchester Piccadilly	Urban Centre	0	0	0	0	0

LAQM Background Data

In addition to the local monitoring data, estimated background air quality data is available from the Local Air Quality Management (LAQM) website operated by Defra.

This website provides estimated annual average background concentrations of NO₂ on a 1 km² grid basis. **Table 4.7** reproduces estimated annual average background concentrations for the grid square containing the proposed development site for 2025.

Table 4.7: Estimated Background Annual Average NO₂ Concentrations at the Proposed Development Site (from the 2021 base maps)

Assessment Year	Annual Average NO ₂
2025	14.3
AQS	40

Note: Presented concentrations for 1 km² grid centred on 384500, 402500.

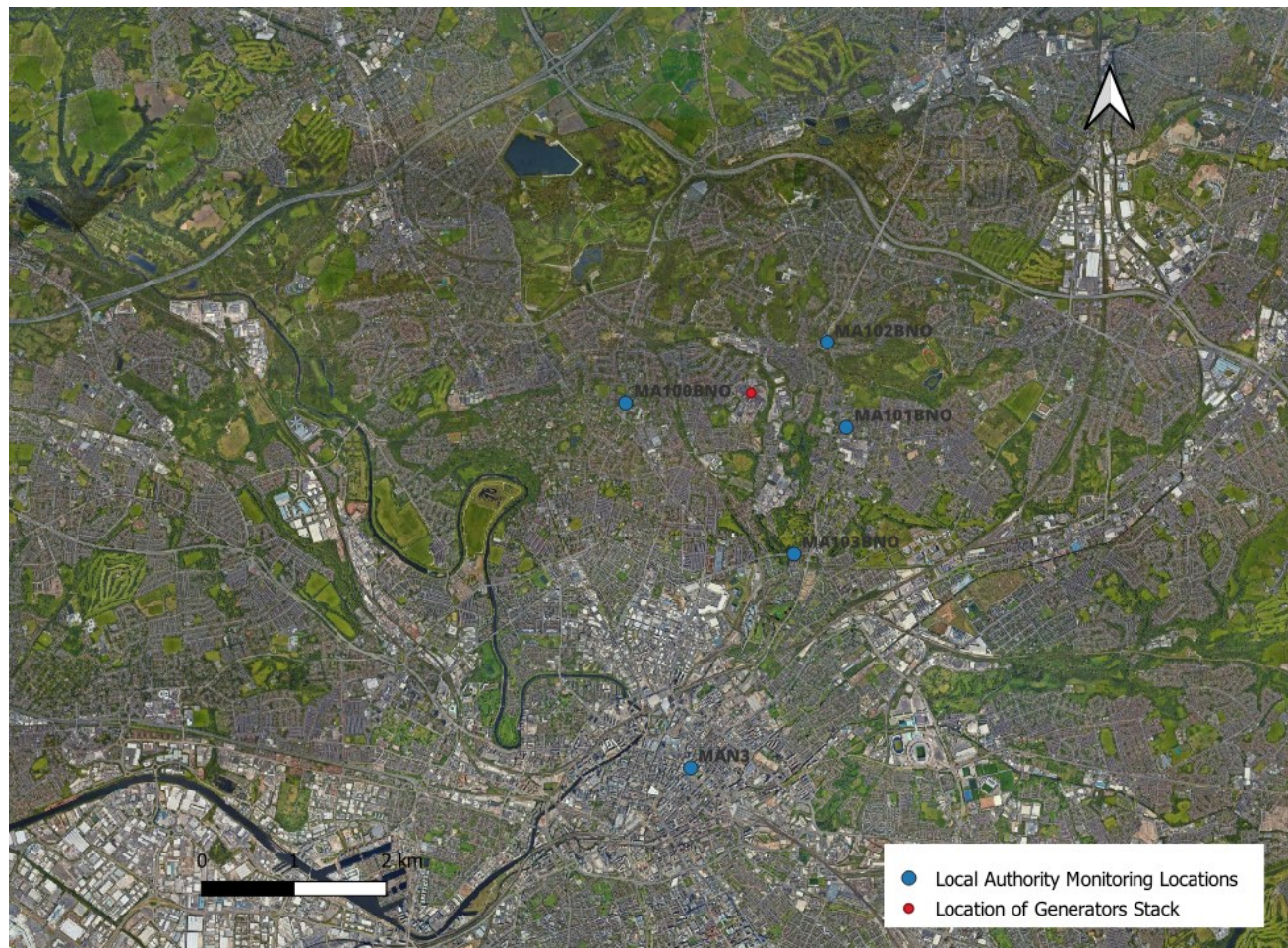


Figure 4.3: Location of Local MCC Monitoring

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4.2.10 Conversion of NO to NO₂ and Results Processing

NO_x emitted to the atmosphere as a result of combustion will consist largely of nitric oxide (NO). Once released into the atmosphere, NO is oxidised to NO₂, which is of concern with respect to health and other impacts. The proportion of NO converted to NO₂ depends on a number of factors, including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as ozone (O₃). The dispersion modelling exercise predicts concentrations of NO_x, which subsequently require conversion to NO₂ for comparison with objectives for human health.

Based on Environment Agency recommendations¹¹, NO_x Process Contributions (PCs) have been converted to the respective NO₂ concentrations using 70% for long-term emissions and 35% for short-term emissions based on 'worst case' conversion criteria. Based on the size of the engine, the fuel used, and the likely primary NO_x:NO₂ ratio, these factors are judged to be conservative and appropriate for use in this assessment.

4.2.11 Calculation of Contribution to Critical Loads

Deposition rates were calculated using empirical methods recommended by the EA AQTAG06¹². Dry deposition flux was calculated using the following equation:

$$\text{Dry deposition flux } (\mu\text{g}/\text{m}^2/\text{s}) = \text{ground level concentration } (\mu\text{g}/\text{m}^3) \times \text{deposition velocity } (\text{m}/\text{s})$$

Wet deposition occurs via the incorporation of the pollutant into water droplets which are then removed in rain or snow and is not considered significant over short distances compared with dry deposition and therefore for the purposes of this assessment (in accordance with AQTAG06), wet deposition has not been considered.

The applied deposition velocities for the relevant chemical species are as shown in **Table 4.8**.

Table 4.8: Applied Deposition Velocities

Pollutant	Deposition Velocity (m s ⁻¹)
	Long Vegetation/Forest
NO _x	0.003

For the purposes of this assessment, dry deposition rates of nitrogen and acidic equivalents at the identified ecological receptors have been calculated by applying the 'forest' deposition velocities to the modelled annual mean concentrations of NO₂.

The critical loads for nitrogen (N) are recorded in units of kgN/ha/yr. The deposition PC is converted from μg/m²/s to units of kgN/ha/year by multiplying the dry deposition flux by the standard conversion factor of 95.9.

The acid critical loads are provided in units of equivalents (keq/ha/year), which is a measure of how acidifying the chemical species can be. The deposition PC is converted from μg/m²/s to units of keq/ha/year by a standard conversion factors for N of 6.84.

¹¹ <https://www.gov.uk/guidance/specified-generators-dispersion-modelling-assessment>

¹² AQTAG06 – Technical Guidance on detailed modelling approach for an appropriate assessment for emissions to air. Environment Agency, March 2014 version.

4.2.12 Results Processing

As previously detailed, the generators are only likely to be operational for 32 hours of the year. Therefore, the generators' process contribution (PC) from the dispersion modelling results, which are based on constant operations, have been reduced to account for its annual operational hours (32 hours per year). This has been done by multiplying the model output by 0.00365 (32/8760).

The raw NO_x PC from the generator has then been converted to NO₂, using the factor detailed in Section 4.2.10 and then added to the background value detailed in Section 4.2.9 to estimate the total concentration at each receptor.

4.2.13 Interpretation of Modelled Results

The impact at each human receptor has been described using the criteria in EPUK/IAQM's Land-Use Planning & Development Control: Planning For Air Quality guidance. The method in this guidance derives the magnitude of impacts using the percentage of change in pollutant concentration relative to an Air Quality Assessment Level (AQAL) and long-term average pollutant concentration at the receptor, as presented in **Table 4.9**.

Table 4.9: Impact Descriptors for Individual Receptors

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
79 – 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

There is no official guidance on how to determine the significance of air quality impacts; therefore, recommendations from the IAQM's planning guidance have been used. This guidance highlights that the significance of air quality impacts should be based on professional judgement, which should be transparent and logically set out. However, it is common practice that the above magnitudes of impact are a starting point for determining significance, with impacts less than 'moderate', typically considered not significant. However, this is not always the case, and judgement considering the number of receptors impacted, the number of nearby cumulative schemes, local exceedances of any objectives and any uncertainties and the conservativeness of the assessment also considered.

To determine the significance of impacts on ecological sites, again guidance from the IAQM has been used to determine significance. The IAQM's *A guide to the assessment of air quality impacts on designated nature conservation sites* states that where the impacts or PCs from the proposed development are less than 1% of the standard, the impacts can be considered insignificant, with no further consideration of the Predicted Environmental Concentrations (PECs)¹³ required. While this guidance has been used in this case, it is

¹³ PC + Baseline

acknowledged that there are other guidance from the Environment Agency, Natural England, CEH, and National Highways that have varying criteria; however, the 1% threshold is mentioned both in Natural England's guidance¹⁴ and Environmental Agency guidance¹⁵, with respect to European designated site (SACs, SPAs and Ramsar etc.).

Furthermore, when screening out short-term impacts on ecological sites, the Environment Agency's 10% threshold has been used to screen out impacts, where further consideration of the PEC is not needed.

Where PCs exceed the IAQM/EA insignificance criteria (either 1% or 10%¹⁶ of the critical levels or loads), PECs have been calculated.

4.3 Uncertainties and Assumptions

The following uncertainties and assumptions have been made in the air quality assessment:

- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at Manchester Airport meteorological monitoring station for the years 2020 to 2024 were representative of wind conditions at the site; and
- There is an element of uncertainty in all measured and modelled data. All values presented within the report are the best possible estimates.

¹⁴ <https://publications.naturalengland.org.uk/publication/4720542048845824>

¹⁵ <https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit>

¹⁶ For long-term and short-term standards, respectively.

5 ASSESSMENT OF IMPACTS

This section sets out the results of the dispersion modelling, which was undertaken in line with the methodology described in Section 4. The results have been compared against the ambient air quality objectives, critical loads and levels, as well as the IAQM's Impact Descriptors. The results presented in this section represent the worst-case impacts across five years of meteorological data.

5.1 Impacts on Human Receptors

5.1.1 Annual Mean

Table 5.1 shows the comparison of annual mean NO₂ concentrations between the no development (baseline as described in Section 4.2.9) and With Development (baseline + generator PC) at the assessed receptor locations.

Table 5.1: Predicted Annual Mean NO₂ Impacts at Discrete Receptors

Receptor ID	Without development (µg/m ³) ^{1,2,3}	With Development (µg/m ³)	Change		
			µg/m ³	% of Objective	Impact Descriptor
R1	14.3	14.39	0.09	0.21%	Negligible
R2	14.3	14.44	0.13	0.34%	Negligible
R3	14.3	14.61	0.31	0.77%	Negligible
R4	14.3	14.36	0.05	0.14%	Negligible
R5	14.3	14.35	0.05	0.13%	Negligible
R6	14.3	14.37	0.07	0.17%	Negligible
R7	14.3	14.38	0.08	0.21%	Negligible
R8	14.3	14.39	0.09	0.21%	Negligible
R9	14.3	14.34	0.04	0.10%	Negligible
R10	14.3	14.33	0.03	0.08%	Negligible
R11	14.3	14.39	0.08	0.21%	Negligible
R12	14.3	14.38	0.08	0.20%	Negligible
R13	32.2	14.33	0.03	0.07%	Negligible
R14	32.2	14.32	0.02	0.05%	Negligible
R15	32.2	14.31	0.01	0.03%	Negligible
R16	14.3	14.36	0.06	0.16%	Negligible
R17	14.3	14.31	0.01	0.02%	Negligible
R18	14.3	14.31	0.01	0.03%	Negligible

Receptor ID	Without development ($\mu\text{g}/\text{m}^3$) ^{1,2,3}	With Development ($\mu\text{g}/\text{m}^3$)	Change		
			$\mu\text{g}/\text{m}^3$	% of Objective	Impact Descriptor
R19	14.3	14.31	0.01	0.01%	Negligible
R20	14.3	14.31	0.01	0.03%	Negligible
R21	14.3	14.32	0.02	0.04%	Negligible
R22	14.3	14.31	0.01	0.04%	Negligible
R23	14.3	14.32	0.02	0.06%	Negligible
AQO			40 $\mu\text{g}/\text{m}^3$		

Note 1 The highest nearby monitored NO₂ concentration in 2023 has been used for roadside receptors (R13, R14 & R15) (see Section 4.2.9)

Note 2 The DEFRA 2025 Background Concentration has been used for all other receptors.

Note 3 The maximum concentration at any modelled height has been presented

In the case of long-term NO₂, the model predicts that the greatest impact as a result of the development was at receptor R3 (0.31 $\mu\text{g}/\text{m}^3$). This results in negligible impacts at all nearby modelled receptors, with all 'With Development' concentrations below the annual NO₂ objective. Impacts are therefore judged as not significant.

5.1.2 1-hour Mean

Table 5.2 shows the comparison of 1-hour mean NO₂ concentrations between the no development (baseline as described in Section 4.2.9) and With Development (baseline + generator 99.79th 1-hour PC) at the assessed receptor locations.

The below results represent the impacts assuming that the generators were operating 8760 hours of the year. As in reality, they will only operate within 32 hours of the year, any predicted 'With Development' concentrations that are exceeding the objective (in bold **Table 5.2**) have been further investigated using a hypergeometric probability distribution approach to consider the likelihood of the 32 hours of operation causing an exceedance.

Table 5.2: Predicted 99.79th Hourly Mean NO₂ Impacts at Discrete Receptors

Receptor ID	Without development ($\mu\text{g}/\text{m}^3$) ^{1,2}	99.79 th With Development Concentration ($\mu\text{g}/\text{m}^3$)	Change
			% of Objective
R1	28.6	233	116%
R2	28.6	491	246%
R3	28.6	568	284%
R4	28.6	264	132%
R5	28.6	227	113%

Receptor ID	Without development ($\mu\text{g}/\text{m}^3$) ^{1,2}	99.79 th With Development Concentration ($\mu\text{g}/\text{m}^3$)	Change
			% of Objective
R6	28.6	349	175%
R7	28.6	220	110%
R8	28.6	511	255%
R9	28.6	303	151%
R10	28.6	296	148%
R11	28.6	134	67%
R12	28.6	158	79%
R13	64.6	118	59%
R14	64.6	123	61%
R15	64.6	123	61%
R16	28.6	105	52%
R17	28.6	79	40%
R18	28.6	70	35%
R19	28.6	60	30%
R20	28.6	55	27%
R21	28.6	58	29%
R22	28.6	58	29%
R23	28.6	59	30%
AQO			200 $\mu\text{g}/\text{m}^3$

Note 1 2 x the annual mean background inline with EA guidance

Note 2 The maximum concentration at any modelled height has been presented

As it cannot be determined when the generators will run, the model has been run with the generators operating for 8760 hours of the year to account for worst-case meteorological conditions (as presented in **Table 5.2**). In order to avoid undertaking an overly conservative assessment, i.e., assuming the generator would run all year, a hypergeometric probability distribution approach has been undertaken to determine the probability of exceeding the 1-hour air quality standard.

The model was configured to predict the number of exceedances of the 1-hour air quality standard while accounting for the background NO_2 concentration. In this case, the model predicted the number of exceedances of 171.4 $\mu\text{g}/\text{m}^3$ (200 $\mu\text{g}/\text{m}^3$ – short-term background (28.6 $\mu\text{g}/\text{m}^3$).

To calculate the probability of the generator operations exceeding the 1-hour air quality standard, the number of allowable exceedances of the 1-hour objective (18), the number

of possible exceedances (in this case, a maximum of 813; see **Table 5.3**), the number of operating hours (32) and the total possible hours in a year (8760) were inputted into the hypergeometric probability distribution function. The number of predicted exceedances of 1-hour 200 µg/m³ standard and the percentage chance of an exceedance based on the hypergeometric probability calculation is shown in **Table 5.3** for the receptors where exceedance of hourly air quality objectives was predicted.

Table 5.3: Hypergeometric Probability Distribution to assess the probability of exceedance of hourly objective due to proposed operation of the back up generators

Receptor ID	Number of exceedances of 200 (µg/m ³) per annum ¹	Probability of Exceedance
R1	31	<0.01%
R2	346	<0.01%
R3	813	<0.01%
R4	82	<0.01%
R5	51	<0.01%
R6	86	<0.01%
R7	27	<0.01%
R8	79	<0.01%
R9	126	<0.01%
R10	83	<0.01%

Note ¹ The maximum at any modelled height has been presented

The hypergeometric probability distribution calculated that there is a less than 1% chance of the 1-hour air quality standard being exceeded, based on their proposed operations. UK EA guidance¹ suggests that exceedances are highly unlikely, being a more than 100-year event.

Furthermore, based on no recently reported exceedances of the 1-hour mean NO₂ AQO objective value (200 µg/m³) at the nearest automatic monitoring location (see **Table 4.6**) and no nearby major point source emissions¹⁷, it is judged to be highly unlikely that the proposed development's 32 hours of operation will combine with other sources to cause 18 exceedances of the objective value at locations near the proposed generators. Therefore, the generator's impact towards the 1-hour mean NO₂ objective is also judged to be not significant.

¹⁷ As contained within Defra's Pollutant Release and Transfer Register (Search by map - Defra, UK)

5.2 Site-wide Impacts on Ecological Receptors

5.2.1 NO_x Impacts

Table 5.4 details the results of the NO_x assessment at nearby ecology sites, with an assessment against the annual mean (30 µg/m³) and 100th percentile 24-hour mean critical level (CL_e) (75 µg/m³) undertaken.

Only where PCs exceed the IAQM/EA insignificance criteria (either 1% or 10%¹⁸ of the critical levels or loads) have PECs been calculated.

Table 5.4: Predicted Long Term and Short Term NO_x Concentrations at Nearby Ecological Receptors

Receptor	24- hour Mean NO _x				Annual Mean NO _x			
	PC µg/m ³	% PC of CL _e	PEC µg/m ³	% PEC of CL _e	PC µg/m ³	% PC of CL _e	PEC µg/m ³	% PEC of CL _e
ER1 (LNR)	16.3	22%	55.1	73%	0.003	0.01%	n/a	n/a
ER2 (LNR)	12.7	17%	51.6	69%	0.006	0.02%	n/a	n/a
ER3 (AW)	5.9	8%	44.8	60%	0.003	0.01%	n/a	n/a
AQS	75 µg/m³				30 µg/m³			

Note ¹ Assuming the 2025 NO_x background concentration of 19.4 µg/m³, taken from Defra 2021 background maps.

5.2.2 Critical Loads for Nutrient Nitrogen and Acidity

Table 5.5 and **Table 5.6** present the results for total nutrient nitrogen and acid deposition fluxes at each ecological receptor. The PCs are assessed against the minimum critical load (CL_o) for each site. Again, where PCs are below the insignificance criteria, PECs have not been presented. All calculations assume forest deposition values.

¹⁸ For long-term and short-term standards, respectively.

Table 5.5: Modelled Nutrient Nitrogen Deposition at Nearby Ecological Receptors

Site ID	Critical load	Site PC Dry deposition flux (kg N/ha/year ⁻¹)	Site PC % of minimum Critical load	PEC Dry deposition flux (kg N/ha/year ⁻¹)	PEC % of minimum Critical load
ER1 (LNR)	10	0.0006	0.01%	n/a	n/a
ER2 (LNR)	10	0.0011	0.01%	n/a	n/a
ER3 (AW)	10	0.0006	0.01%	n/a	n/a

Table 5.6: Modelled Acid Deposition at Nearby Ecological Receptors

Site ID	CL Function (keq/ha/year) CLmaxN	PC (keq/ha/year)	PC % of CLo	PEC (keq/ha/year)	PEC % of CLF
ER1 (LNR)	2.99	0.00004	<0.01%	n/a	n/a
ER2 (LNR)	3.04	0.00008	<0.01%	n/a	n/a
ER3 (AW)	3.05	0.00005	<0.01%	n/a	n/a

¹Has been calculated assuming forest deposition velocities.

Based on the results presented, which demonstrate no exceedances of relevant annual mean 1% insignificance threshold, the generator impacts on local ecological receptors are judged to be not significant. For the 24-hour mean NO_x critical level, while there are exceedances of the 10% insignificance threshold when accounting for background concentrations, there are predicted exceedances of the 24-hour mean NO_x critical level. In this case, given the generator will only operate for 32 hours, the predicted 24-hour mean impact, which represents the generator running 8760 hours of the year, is highly unlikely to occur.

6 MITIGATION

This assessment has demonstrated no significant impacts due to the routine testing of the proposed generators. However, as the EPUK/IAQM's Land-Use Planning Guidance advises that good design and best practice measures should be considered for all developments to reduce both pollutant emissions and human exposure, the following measures have been recommended for consideration to reduce nearby ground-level concentrations:

- Ensure the generator flue extends to 1 m above the roof level of the nearby building; and
- Ensure the generator flue discharges vertically and unimpeded. This is understood to already be the case and has been considered in the modelling for this assessment.

7 CONCLUSIONS

An air quality assessment to support a planning application for two emergency diesel generators associated with North Manchester General Hospital development has been prepared with reference to existing air quality in the area and relevant air quality legislation, policy and guidance.

Concentrations of oxides of nitrogen and nitrogen dioxide associated with the emissions from the flues were predicted at nearby relevant human and ecological receptor locations using dispersion modelling. The assessment has accounted for the proposed operational hours of the generator.

The assessment has demonstrated negligible and no significant impacts from the operation of the generator at nearby receptors, with nitrogen dioxide concentrations staying well below the air quality objectives. As such, no mitigation is judged to be required.

As such, the scheme is judged to be compliant with local council policies and consistent with the NPPF.