Technical Note

Air & Acoustic Consultants

Edmund House
12-22 Newhall Street
Birmingham
B3 3AS
0121 389 1472
info@airandacoustics.co.uk
airandacoustics.co.uk

Victoria House

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Prepared By: CW	**Approved By:** SG	

1. Introduction

1.1. Planning permission (ref. 2022/3480/P), recently approved in November 2022, granted permission for new roof level plant (including fume stacks and replacement of a diesel generator) to support lab enabled space at levels 1 to 9 of the building. Condition 7 of the permission required approval of an air quality assessment (AQA), which has been submitted to the Council and is currently pending determination.

1.2. A subsequent planning and listed building application is being submitted to the Council which follows on from the recent November 2022 permission and seeks lab enabled space at the lower levels of the building. This technical note has been prepared to support the application.

1.3. Proposals include connection of the lower levels of the building to the consented stacks, flue and inlets. Therefore, the same conclusions of the AQA submitted under Condition 7 will apply to the AQA for this application and has been appended to this technical note."

2. Air Quality

2.1. Pre-application comments (ref. 2022/5255/PRE) on the proposals for the forthcoming application are addressed here.

Comments

> *"The Council seeks to ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough. Developments of commercial properties are expected to take account of air quality impacts on occupants of the building, and detail of this should be provided as part of the application – for example, by demonstrating that any inlets for mechanical vents are located at roof level and that air quality is such that the inlets wouldn't require additional filtration.*
>
> *Given the proposed laboratory use and likely connection to existing fume stacks, a detailed air quality assessment would be required with any future application."*

2.2. The planning application to which the pre app comments relate to will be utilising the consented stacks, flue and inlets as agreed and set out in the AQA for the wider scheme, and therefore the same conclusions will apply to this planning application. The AQA concluded that emissions as a result of the diesel generator and the fume cupboards were 'not significant,' however, it was recommended that mitigation for the inlets not located on the roof (located instead within the street canyons where poor air quality currently exists) should be in place prior to the occupation of the building. This is to ensure that exposure to poor air quality is reduced in the building for future occupants.

3. Summary

3.1. In summary, the proposals are expected to utilise the same parameters set out in the previous AQA, and therefore any conclusions will be in line with the wider scheme, including securing any mitigation measures against the recommendations set out in the report.

Appendix A – Victoria House Air Quality Assessment

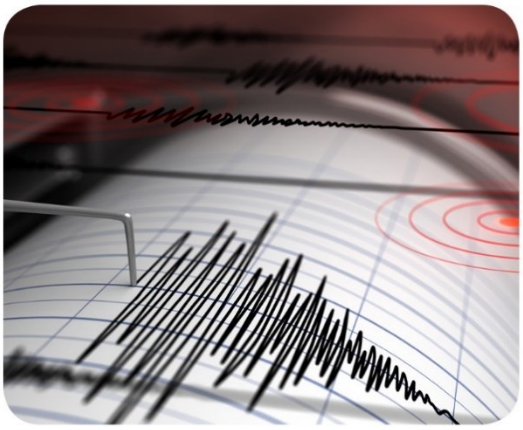
Air & Acoustic Consultants

Oxford Victoria House Limited

Victoria House, London

Air Quality Assessment

December 2022



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Oxford Victoria House Limited

Victoria House, London

Air Quality Assessment

OFFICE ADDRESS:	PROJECT NO:	DATE:
Edmund House 12-22 Newhall Street Birmingham B3 3AS	100555	December 2022

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Oxford Victoria House Limited

Victoria House, London

Air Quality Assessment

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1.1 Brief

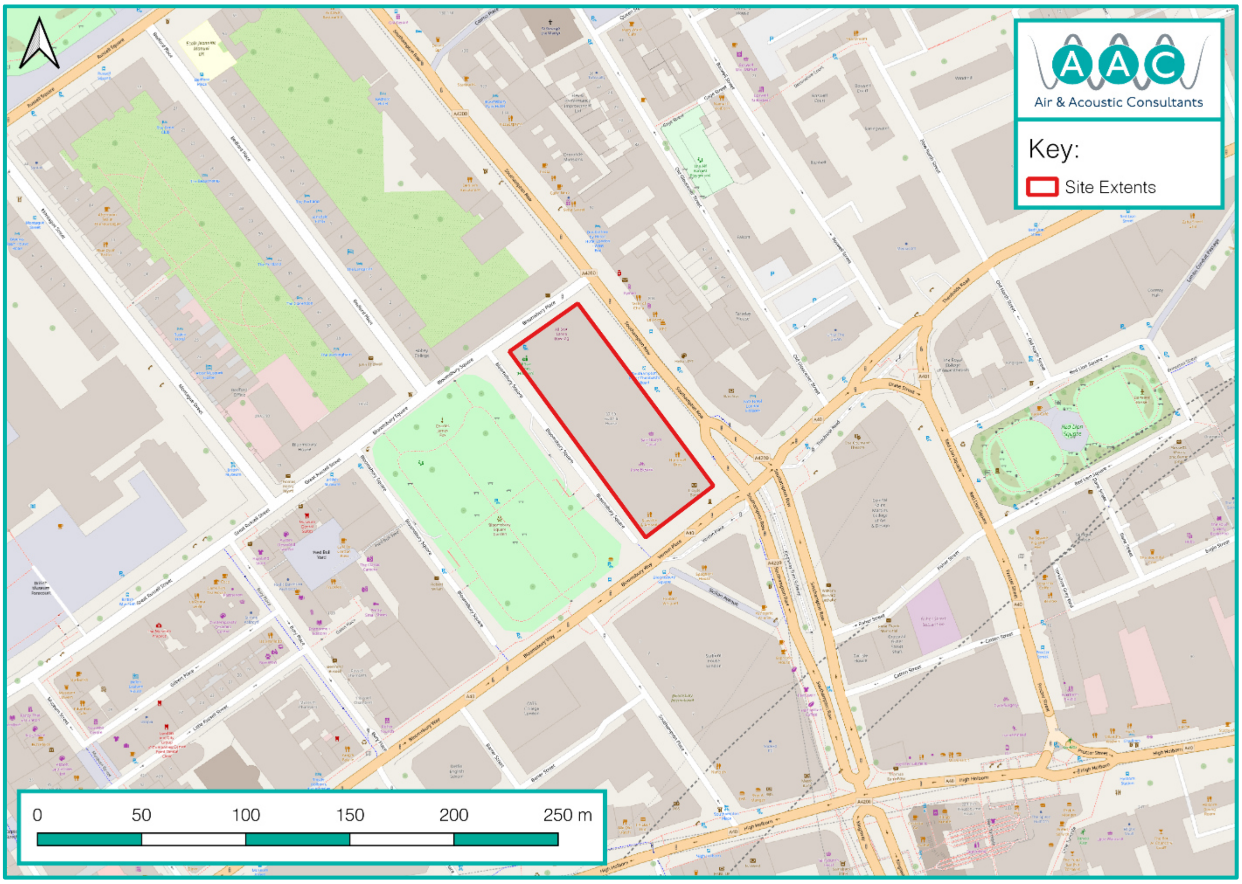
1.1.1 Air & Acoustic Consultants Limited have been commissioned by Oxford Victoria House Limited to undertake an AQA in support of a discharging a planning condition associated with a consented planning application for the installation of fume stacks and replacement of a diesel generator, located at Victoria House, Camden.

1.2 Consented Site

1.2.1 The consented site encompasses the entirety of the Victoria House building. The site is bound to the north, east and south by roads and then a mix of commercial and residential receptors, and to the west by Bloomsbury Square Gardens.

1.2.2 The site is within the administrative boundary of the London Borough of Camden (LBC) and the National Grid Reference for the centre of the site is, TQ 30402 81709 (British National Grid Coordinates E: 530402, N: 181709). The site location and surrounding area is illustrated in Figure 1.1.

Figure 1.1: Site Location



1.3 Development Proposals

1.3.1 This AQA seeks to discharge Planning Condition 7, which states:

> *"Prior to the commencement of development, excluding site preparation work:*

- *A detailed Air Quality Assessment including any appropriate mitigation, shall be submitted to and approved by the Local Planning Authority in writing.*
- *If required, full details of any mechanical ventilation system including air inlet locations shall be submitted to and approved by the Local Planning Authority in writing. Air inlet locations should be located away from busy roads and boiler stacks and as close to roof level as possible, to protect internal air quality.*

The development shall thereafter be constructed and maintained in accordance with the approved details.

Reason: To safeguard the amenities of the adjoining premises and the area generally in accordance with the requirements of policies CC4 of the London Borough of Camden Local Plan 2017 and London Plan policy SI 1.

1.3.2 The approved planning application seeked the approval for the conversion of Victoria House from office space to a mix of 50% office space and 50% laboratory space. Victoria House is planned to be equipped with laboratory fume extract stacks located on the roof. In addition, three existing standby diesel generators will be replaced with a single unit.

1.4 Assessment Approach

1.4.1 This assessment has been undertaken to assess if the proposed development is likely to give rise to any significant dust and air quality impacts, and to establish the magnitude and the significance of such impacts caused as a result of the proposed development in respect to the prevailing air quality.

1.4.2 The report is structured as follows:

- Section 2 sets out an overview of the national and local air quality policy context, in relation to the development proposals;
- Section 3 details the methodology for estimating the air quality impacts associated with point source emissions;
- Section 4 details the methodology for estimating the air quality impacts from vehicle emissions and future human exposure;
- Section 5 describes the baseline conditions;
- Section 6 considers the operational impacts as a result of the proposed development;
- Section 7 describes potential mitigation measures for the operational phase (where required); and
- Section 8 summarises and concludes the assessment.

2 Legislation and Policy Context

2.1 European Legislation

2.1.1 Air pollutants at high concentrations can give rise to adverse effects upon the health of both humans and ecosystems. The European Union (EU) legislation on air quality forms the basis for the national UK legislation and policy.

2.1.2 The EU Framework Directive 2008/50/EC came into force in May 2008 and sets out legally binding limits for concentrations of the major air pollutants that can impact on public health. This Directive came into force in England in June 2010[1]. Amendments to this Directive was made following amendments to the 2008/50/EC and 1004/107/EC on air quality made by Directive 2015/1480/EC. The updated Directive, The Air Quality Standards (Amendment) Regulations 2016, came into force on 31st December 2016[2].

2.1.1 Following the UK's departure from the EU and the Brexit transition period the previous EU Legislation has been retained in the United Kingdom. The following text is taken from the legislation.gov.uk[3] website, setting out details of the retention:

> *"The UK is no longer a member of the European Union. EU legislation as it applied to the UK on 31 December 2020 is now a part of UK domestic legislation, under the control of the UK's Parliaments and Assemblies, and is published on legislation.gov.uk.*
>
> *[…]*
>
> *EU legislation which applied directly or indirectly to the UK before 11.00 p.m. on 31 December 2020 has been retained in UK law as a form of domestic legislation known as 'retained EU legislation'. This is set out in sections 2 and 3 of the European Union (Withdrawal) Act 2018 (c. 16)."*

2.2 National Legislation, Policy and Strategy

2.2.1 Part IV of the Environment Act 1995[4] requires local authorities to review and assess the air quality within their boundaries. As a result, the Air Quality Strategy was adopted in 1997[5], with national health-based standards and objectives set out for the, then, eight key air pollutants including benzene, 1-3 butadiene, carbon monoxide, lead, nitrogen dioxide (NO_2), ozone, particulate matter and sulphur dioxide.

2.2.2 Part IV of the Environment Act 2021[6] amends both the Environment Act 1995 and the Clean Air Act 1993[7]. It builds on the foundations provided by Part IV of the Environment Act 1995 and strengthens the local air quality management framework. The act allows the Secretary of State to make provisions for, about or connect with the recall of relevant products that do not meet relevant environmental standards.

2.2.3 The government has resisted calls for the adoption of the recently updated World Health Organisation (WHO) air quality guidelines, specifically targeting particulate matter pollution. The act does introduce a duty on the government to bring forward at least two air quality targets by October 2022 for consultation

[1] Statutory Instrument, 2010. *The Air Quality Standards Regulations,' No. 1001. Queen's Printer of Acts of Parliament.*
[2] Statutory Instrument, 2016. *The Air Quality Standards Regulations,' No. 1184. Queen's Printer of Acts of Parliament.*
[3] EU legislation and UK law. Accessible at: *https://www.legislation.gov.uk/eu-legislation-and-uk-law*
[4] Parliament of the United Kingdom, 1990. *Environmental Protection Act*, Chapter 43. Queen's Printer of Acts of Parliament.
[5] Department for Environment Food and Rural Affairs, 1997. *The United Kingdom National Air Quality Strategy*, Cm 3587.
[6] UK Public General Acts, 2021. *Environmental Act 2021, Chapter 30. Queen's Printer of Acts of Parliament.*
[7] UK Public General Acts, 1993. Clean Air Act 1993, Chapter 11. Queen's Printer of Acts of Parliament.

that will be set in secondary legislation, however this has been delayed[8]. The first will aim to reduce the annual average level of fine particulate matter ($PM_{2.5}$) in ambient air. The second will be a long-term target (set a minimum of 15 years in the future), which the government says, *"will encourage long-term investment and provide certainty for businesses and other stakeholders."*

2.2.4 The purpose of the Air Quality Strategy was to identify areas where air quality was unlikely to meet the objectives prescribed in the regulations. The strategy was reviewed in 2000 and the amended Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2000)[9] was published. This was followed by an Addendum in February 2003 and in July 2007, when an updated Air Quality Strategy was published[10].

2.2.5 The pollutant standards relate to ambient pollutant concentrations in air, set on the basis of medical and scientific evidence regarding how each pollutant affects human health. Pollutant objectives are the future dates by which each standard is to be achieved, considering economic considerations, practical and technical feasibility.

Relevant Air Quality Standards and Environmental Assessment Levels

2.2.6 A summary of the relevant Air Quality Objectives (AQO) and Environment Assessment Levels (EAL)[11] for human health and environmental receptors relevant to this assessment are presented in Table 2.1.

Table 2.1: Environment Assessment Levels

Pollutant	Average Period	Objective	%ile
Methanol (CH_3OH)	Annual Mean	2,660 µg/m^3	-
	1-hour Mean	33,300 µg/m^3	-
Nitrogen Dioxide (NO_2)	Annual Mean	40 µg/m^3	-
	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year	99.79
Particles (PM_{10})	Annual Mean	40 µg/m^3	-
	24-hour Mean	50 µg/m^3 not to be exceeded more than 18 times a year	90.41
Particles ($PM_{2.5}$)	Annual Mean	25 µg/m^3	-
Notes: *Except Scotland			

World Health Organisation Guidelines

2.2.1 The WHO guidelines were updated in September 2021[12], and are a set of evidence-based recommendations of limit values for specific air pollutants developed to help countries achieve air quality

[8] UK Government, Update on Progress on Environmental Targets. Accessible at: *https://www.gov.uk/government/news/update-on-progress-on-environmental-targets*
[9] Department of the Environment, Transport and the Regions, 2000. The Air Quality Strategy for England, Scotland, Wales, and Northern Ireland
[10] Department for Environment Food and Rural Affairs, 2007. *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Cm 7169, Department for Environment Food and Rural Affairs.
[11] v Air emissions risk assessment for your environmental permit - https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit (accessed 21/07/2021)
[12] World Health Organization, 2021. *WHO global air quality guidelines.*

that protects public health. They are significantly lower than the current levels legislated within the Air Quality Objectives (as set out in Table 2.1). The WHO guideline levels are set out in Table 2.2 below.

Table 2.2: WHO Air Quality Guidelines

Pollutant	Air Quality Guidelines	
	Concentration	Measured as
NO_2	25 µg/m^3	24-hour mean (99th percentile)
	10 µg/m^3	Annual mean
PM_{10}	45 µg/m^3	24-hour mean (99th percentile)
	15 µg/m^3	Annual mean
$PM_{2.5}$	15 µg/m^3	24-hour mean (99th percentile)
	5 µg/m^3	Annual mean

2.2.2 The Committee on the Medical Effects of Air Pollutants (COMEAP)[13] has concluded the following:

"The WHO's revised AQGs for pollutants in outdoor air are suitable as long-term targets to inform policy development. We stress that the AQG values should not be regarded as thresholds below which there are no impacts on health - the current evidence has not identified thresholds for effect at the population level, meaning that even low concentrations of pollutants are likely to be associated with adverse effects on health. Therefore continued reductions, even where concentrations are below the AQGs, are also likely to be beneficial to health."

2.2.3 However, this assessment has considered the current legislation, and therefore the objectives set out in Table 2.1 have been used to inform and assess the impact of the propose development as well as future exposure As previously noted, updates to the $PM_{2.5}$ objective were due to be brought forward in October 2022, but this has now been delayed.

National Planning Policy

2.2.4 The National Planning Policy Framework (NPPF)[14] (2021) sets out the planning policy for England, to help achieve sustainable development within the planning sector.

2.2.5 Paragraph 105 states:

"The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making."

[13] Committee on the Medical Effects of Air Pollutants (COMEAP), 2022. *COMEAP statement: response to publication of the World Health Organization Air quality guidelines 2021*

[14] Ministry of Housing, Communities & Local Government, 2021. *National Planning Policy Framework.*

2.2.6 Paragraph 174 states:

"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.

[...]"

2.2.7 Paragraph 185 states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development."

2.2.8 Paragraph 186 states:

"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."

2.2.9 Paragraph 188 states:

"The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."

2.2.10 The NPPF also sets out the national planning policy on biodiversity and conservation. This emphasises that the planning system should seek to minimise effects on and provide net gains in biodiversity, wherever possible, as part of the Government's commitment to halting decline and establishing coherent and resilient ecological networks.

2.2.11 The NPPF is supported by Planning Practice Guidance (PPG)[15] (DCLG, 2021), which sets out the principles on how planning can take account of the impacts of new developments on air quality.

2.2.12 Paragraph 001 Reference ID: 32-001-20191101 states:

"The 2008 Ambient Air Quality Directive sets legally binding limits for concentrations in outdoor air of major air pollutants that affect public health such as particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2).

The UK also has national emission reduction commitments for overall UK emissions of 5 damaging air pollutants:

- *fine particulate matter ($PM_{2.5}$)*
- *ammonia (NH_3)*
- *nitrogen oxides (NO_x)*
- *sulphur dioxide (SO_2)*
- *non-methane volatile organic compounds (NMVOCs)*

As well as having direct effects on public health, habitats and biodiversity, these pollutants can combine in the atmosphere to form ozone, a harmful air pollutant (and potent greenhouse gas) which can be transported great distances by weather systems. Odour and dust can also be a planning concern, for example, because of the effect on local amenity."

2.2.13 Paragraph: 005 Reference ID: 32-005-20191101 states:

"Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity.

Where air quality is a relevant consideration the local planning authority may need to establish:

- *The 'baseline' local air quality, including what would happen to air quality in the absence of the development;*
- *whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity); and*
- *whether occupiers or users of the development could experience poor living conditions or health due to poor air quality."*

[15] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government. Planning Practice Guidance. Accessible at: http://planningguidance.planningportal.gov.uk/

National Clean Air Strategy

2.2.14 The Clean Air Strategy (CAS)[16] was published in January 2019 and sets out how the government will improve air quality nationally. The document aims to tackle the issue of air quality across all parts of government and society to protect public health and the environment, and identifies what needs to be done to achieve this. The document complements the Industrial Strategy (archived), the Clean Growth Strategy[17] and the 25 Year Environment Plan[18] and is a key part of delivering the government's 25 Year Environmental Plan.

2.2.15 The document has adopted international targets to reduce emissions of fine particulate matter, ammonia, nitrogen oxides, sulphur dioxide and non-methane volatile organic compounds by 2020 and 2030. The document proposes tougher goals to cut public exposure to particulate matter pollution, as recommended by the WHO.

2.2.16 The strategy not only targets the reduction of emissions, but also a reduction in exposure.

Reducing Emissions from Road Transport: Road to Zero Strategy

2.2.17 The *Reducing emissions from road transport: Road to Zero Strategy*[19] (2018) document produced by the Office for Low Emission Vehicles (OLEV), Office for Zero Emission Vehicles (OZEV) and the Department for Transport (DfT) sets out how the government aims to end the sale of new conventional petrol and diesel cars and vans by 2040, with almost every car and van having zero emissions by 2050. Furthermore, the aim of the government is to see at least 50%, and as many as 70%, of new car sales being ultra-low emission by 2030 (and up to 40% of new van sales).

2.2.18 A number of measures have been set out in the document which outline how the government will support this gradual transition, some of which are consumer incentives, research and development and innovation support based.

2.2.19 Since this document was released, the then Prime Minister announced that, as part of the *Ten Point Plan for a Green Industrial Revolution* (2020)[20], the government will end the sale of new petrol and diesel cars and vans from 2030, 10 years earlier than set out in the document above.

2.2.20 This ambitious plan will see road traffic-related oxides of nitrogen (NO_x) emissions to reduce significantly over the coming decades, likely beyond the scale of reductions forecast in air quality tools used to assess air quality impacts.

2.3 Regional Legislation, Planning Policy and Strategy

London Plan

2.3.1 The London Plan[21] is the third London Plan and was published in March 2021. It brings together the geographical and locational aspects of the Mayor's other strategies, which includes the environment. The plan provides an appropriate spatial strategy that plans for London's growth in a sustainable way.

2.3.2 The London Plan includes one policy that is specifically related to air quality.

[16] Department for Environment, Food and Rural Affairs, 2019. *Clean Air Strategy 2019.*
[17] Department for Business, Energy and Industrial Strategy, 2017. *The Clean Growth Strategy.*
[18] Department for Environment, Food and Rural Affairs, 2018. *A Green Future: Our 25 Year Plan to Improve the Environment.*
[19] Department for Transport, Office for Low Emission vehicles and Office for Zero Emission Vehicles, 2018. *Reducing emissions from road transport: Road to Zero Strategy*
[20] Department for Transport and Office for Zero Emission Vehicles, 2020. *The Ten Point Plan for a Green Industrial Revolution*
[21] Greater London Authority, 2021, *The London Plan 2021.*

2.3.3 Policy SI 1: *Improving air quality*, states:

A. "Development Plans, through relevant strategic, site-specific and area based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.

B. To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:

1. Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor air quality.

2. In order to meet the requirements in Part 1, as a minimum:

a) Development proposals must be at least air quality neutral

b) Development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retrofitted mitigation measures

c) Major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) Development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people, should demonstrate that design measures have been used to minimise exposure.

C. Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:

1) How proposals have considered ways to maximise benefits to local air quality, and

2) What measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D. In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

E. Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development."

2.3.4 The London Plan also has several other policies which make reference to air quality. The relevant aspects of these polices can be found in the London Plan document, and include areas such as parking, energy infrastructure and many more.

The Mayor of London Air Quality Strategy

2.3.5 The Mayor of London Air Quality Strategy[22] was published in December 2010 and aims to reduce air pollution in London so that the health of Londoners is improved. In order to achieve this the EU air quality limits values need to be achieved as soon as possible. This will be achieved through a number of measures, some of which include the Congestion charging and London Low Emission Zone (LEZ), development of electric vehicle infrastructure, funding and supporting car clubs. Additional measures are outlined in the document.

The Mayor of London Environment Strategy

2.3.6 The Mayor of London Environment Strategy[23], published in May 2018, integrates every aspect of London's environment into different categorised areas, including air quality. The document includes several transport and non-transport related policy measures outlined in Chapter 4, highlighting the need for improvement in London's air quality and ensuring London is greener, cleaner and ready for the future. The Mayor's main aim is to create a zero emission London by 2050, and aims to do this by outlining a number of proposals.

2.3.7 Policy 4.2.1 states:

> *"Reduce emissions from London's road transport network by phasing out fossil fuelled vehicles, prioritising action on diesel, and enabling Londoners to switch to more sustainable forms of transport."*

2.3.8 Policy 4.2.2 states:

> *"Reduce emissions from non-road transport sources, including by phasing out fossil fuels."*

2.3.9 Proposals for the following policies include the promotion of more sustainable forms of travel in London as well as proposing a reduction in emission from Non-Road Mobile Machinery (NRMM), construction and demolition sites, homes, workplaces and large-scale generators.

2.3.10 Policy 4.3.1 states:

> *"The Mayor will establish new targets for $PM_{2.5}$ and other pollutants where needed. The Mayor will seek to meet these targets as soon as possible, working with government and other partners."*

2.3.11 Policy 4.3.2 states:

> *"The Mayor will encourage the take up of ultra low and zero emission technologies to make sure London's entire transport system is zero emission by 2050 to further reduce levels of pollution and achieve WHO air quality guidelines."*

2.3.12 Policy 4.3.3 states:

> *"Phase out the use of fossil fuels to heat, cool and maintain London's buildings, homes and urban spaces, and reduce the impact of building emissions on air quality."*

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[22] Greater London Authority, 2010. *The Mayor's Air Quality Strategy.*
[23] Greater London Authority, 2018, *London Environment Strategy.*

2.3.13 Policy 4.3.4 states:

> *"Work to reduce exposure to indoor air pollutants in the home, schools, workplace and other enclosed spaces."*

The Mayor of London Transport Strategy

2.3.14 In March 2018, the Mayor of London published the Mayors Transport Strategy[24], setting out the Mayor's policies and proposals, enabling transport in London to be reshaped over the next 20 years. The key themes within the strategy are; healthy streets and healthy people, good public transport experiences, new homes and jobs.

2.3.15 Chapter 3, Healthy Streets and Healthy People includes policies 6 and 7 which relate to *"Improving air quality and the environment"*.

2.3.16 Policy 6 states:

> *"The Mayor, through TfL and the boroughs, and working with stakeholders, will take action to reduce emissions – in particular diesel emissions – from vehicles on London's streets, to improve air quality and support London reaching compliance with UK and EU legal limits as soon as possible. Measures may include retrofitting vehicles with equipment to reduce emissions, promoting electrification, road charging, the imposition of parking charges/ levies, responsible procurement, the making of traffic restrictions/ regulations and local actions."*

2.3.17 Policy 7 states:

> *"The Mayor, through TfL and the boroughs, and working with stakeholders, will seek to make London's transport network zero emission by 2050, contributing towards the creation of a zero carbon city, and also to deliver further improvements in air quality to help meet tighter air quality standards, including achieving a health-based target of 10 μg/m^3 for $PM_{2.5}$ by 2030. London's streets and transport infrastructure will be transformed to enable zero emission operation, and the switch to ultra low and zero emission technologies will be supported and accelerated."*

2.3.18 A number of proposals have been included in the document in order to achieve these policies, some of which include the expansion of the Ultra-Low Emission Zone (ULEZ) in 2021 (which has been implemented as of October 2021) and adoption of Ultra Low Emission vehicles in the GLA fleet. Further proposals are outlined in the document.

2.3.19 To note, the application site is located within the ULEZ.

Transport for London – Healthy Streets for London

2.3.20 The Heathy Streets for London[25] document was published in February 2017, and sets how Transport for London (TfL) will put people and their health at the centre of decision making.

2.3.21 Chapter 2, *Why Healthy Streets?,* sets out how TfL will make London's streets healthier:

> *"A sustainable city*
>
> *Improving air quality is vital to making London's streets healthier. Air pollution affects the health of everyone in London and unfairly impacts on the most vulnerable people in our community. Road transport is responsible for 50 per cent of the main air pollutants, so we have an important*

[24] Greater London Authority, 2018. *Mayor's Transport Strategy.*
[25] Transport for London, 2017. *Healthy Streets for London*

role to play in improving air quality. The Mayor is consulting on an ambitious package of air quality proposals, including bringing forward and expanding the Ultra Low Emission Zone. The 50 per cent reduction in specific harmful emissions these proposed measures are expected to deliver will help to improve London's streets. The Mayor's Air Quality Fund will continue to target pollution hotspots, the Low Emission Neighbourhoods programme will help London boroughs improve local air quality and Low Emission Bus Zones will prioritise the greenest buses on the worst polluted routes.

Introducing more trees and greenery creates more attractive public spaces, increases biodiversity and helps to mitigate the impacts of air pollution. Greener streets can deliver against all of the Healthy Streets Indicators and can contribute to London's resilience to the consequences of climate change, such as extreme weather events like flooding and heatwaves."

2.4 Local Legislation, Planning Policy and Strategy

Camden Local Plan

2.4.1 The Camden Local Plan[26] was adopted in 2017 and has a number of policies which are relevant to this assessment, as set out below:

2.4.2 Policy A1: *Managing the Impact of Development,* states:

"The Council will seek to protect the quality of life of occupiers and neighbours. We will grant permission for development unless this causes unacceptable harm to amenity.

We will:

[…]

a. require mitigation measures where necessary

[…]"

2.4.3 Policy CC4: *Air Quality,* states:

"The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

[26] London Borough of Camden, 2017. *Camden Local Plan 2016-2031.*

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan."

Camden Planning Guidance – Air Quality

2.4.4 LBC has also published their own planning guidance[27]. This provides information on air quality in the borough and supports Local Plan Policy CC4 *Air Quality*.

2.5 Air Quality Action Plans

National Air Quality Action Plan

2.5.1 The Department for Environment, Food & Rural Affairs (DEFRA) has produced an Air Quality Action Plan (AQAP)[28] to tackle roadside NO_2, throughout the United Kingdom. Along with a package of infrastructure, initiatives and grants, the plan requires local authorities to produce local action plans by March 2018, with the aim of reducing the air quality concentrations below the objective as soon as practically possible, should they be predicting exceedances of the air quality objectives beyond 2020.

Local Air Quality Action Plan

2.5.2 The Camden Clean Air Action Plan (CAAP) 2019 – 2022[29] lists a number of measures to be carried out in the jurisdiction to improve air quality. The overarching aim of the Clean Air Action Plan is to:

- Continue to meet the EU objectives for Carbon Monoxide, Benzene, 1,3-Butadiene, Lead and PM_{10};
- Continue to reduce concentrations of PM_{10} and $PM_{2.5}$ and to meet the EU Objective for NO_2; and
- Drive forward compliance with WHO Guidelines by 2030.

2.5.3 Further details of specific actions are set out in both the CAAP and the Air Quality Annual Status Report (ASR)[30].

[27] London Borough of Camden, 2021. *Camden Planning Guidance. Air Quality.*
[28] Department for Environment Food & Rural Affairs & Department for Transport, 2017. *UK plan for tackling roadside nitrogen dioxide concentrations.*
[29] London Borough of Camden. *Clean Air Action Plan 2019 – 2022.*
[30] London Borough of Camden, 2022. *London Borough Camden Air Quality Annual Status Report for 2021.*

3 Assessment Approach – Point Source Modelling

3.1 Scope of the Assessment

3.1.1 The assessment is based on the following scope of work:

- Spatial – The assessment considers the impact of emissions from the site (from the proposed fume stacks) and diesel generator on local air quality; and
- Temporal – The operational phase impacts resulting from the proposed development have been considered for the current baseline year (2022).

3.2 Screening Criteria

Point Source Emissions

3.2.1 The Environmental Protection UK (EPUK) & Institute of Air Quality Management (IAQM) (2017) Land-Use Planning and Development Control: Planning for Air Quality document[31] has a screening criteria for point source assessments, which determines if the impacts of emissions from point source are significant or not.

3.2.2 The first stage of the guidance is to determine whether a point source assessment is required based on the emissions. This is illustrated in Table 6.2 of the guidance, and states:

> *"Typically, any combustion plant where the single or combined NO_x emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion.*
>
> *In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.*
>
> *Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable."*

3.2.3 Should the point source not meet any of the conditions above, an assessment on the impacts are required.

3.2.4 Both the EPUK & IAQM and the EA risk assessment guidance[32] provides criteria for assessing the significance of emissions with respect to the background air quality and air quality standards.

Criteria for screening out insignificant Process Contributions (PCs)

3.2.5 PCs can be screened out from detailed dispersion modelling if both of the below criteria are met:

- PC long-term < 0.5% of the long-term air quality standard; and
- PC short-term < 10% of the short-term air quality standard.

[31] Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM), 2017. *Land-use Planning & Development Control: Planning for Air Quality.*
[32] Environment Agency and Department for Environment, Food and Rural Affairs, 2022. *Air emissions risk assessment for your environmental permit.*

3.2.6 If both of these criteria are met, no further assessment of the pollutant in question is required as the impacts are considered negligible and 'not significant'. If the criteria is not met, then a detailed assessment of the Predicted Environmental Concentrations (PEC) are required.

3.2.7 Detailed modelling is also required if:

- Emissions affect an Air Quality Management Area (AQMA); or
- Restrictions apply for any substance emitted in this area.

3.2.8 The results of the detailed modelling are assessed for the resulting PECs against the relevant AQO. Significance criteria are used to inform the assessment and are discussed further in this Section.

3.3 Modelling Parameters

Sensitive Locations

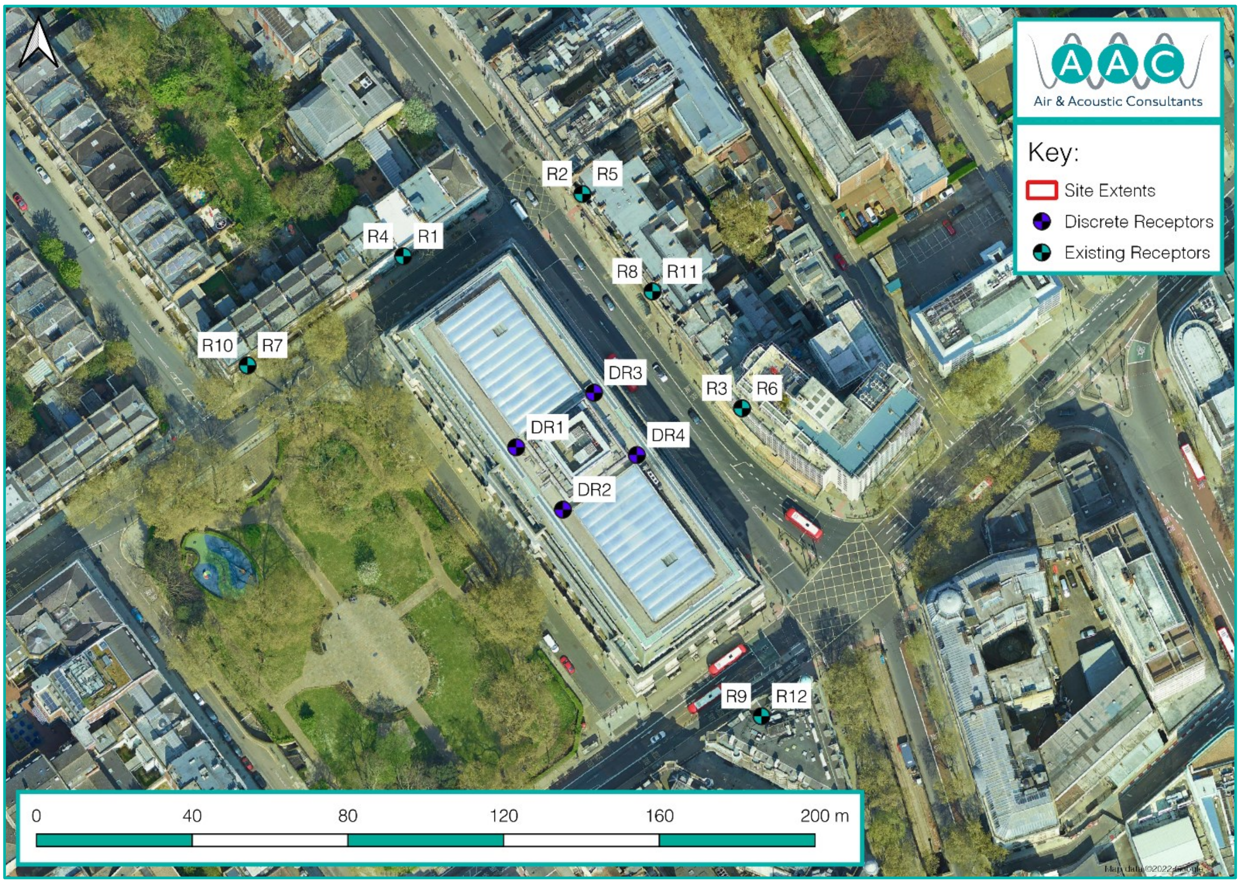
3.3.1 This assessment includes the nearest on-site (discrete) and off-site receptors. Table 3.1 presents the receptors specified for this assessment, and Figure 3.1 illustrates these receptor locations.

Table 3.1: Receptor Locations

ID	Description	Coordinates (m)		
		X	Y	Z
Existing Receptors				
DR1	Discrete Receptor	530379	181719	36.7
DR2	Discrete Receptor	530391	181703	36.7
DR3	Discrete Receptor	530399	181733	36.7
DR4	Discrete Receptor	530410	181717	36.7
R1	Residential Receptor	530350	181768	1.5
R2	Residential Receptor	530396	181784	1.5
R3	Residential Receptor	530437	181729	1.5
R4	Residential Receptor	530350	181768	12.5
R5	Residential Receptor	530396	181784	16.5
R6	Residential Receptor	530437	181729	22.6
R7	Residential Receptor	530310	181740	1.5
R8	Residential Receptor	530414	181759	1.5
R9	Residential Receptor	530442	181650	1.5
R10	Residential Receptor	530310	181740	12.5
R11	Residential Receptor	530414	181759	18.7

ID	Description	Coordinates (m)		
		X	Y	Z
R12	Residential Receptor	530442	181650	14

Figure 3.1: Modelled Receptor Locations



Assessment Scenarios

3.3.2 The following scenarios have been considered for the AQA:

- 2022 baseline; and
- 2022 baseline + proposed development.

3.4 Dispersion Model

3.4.1 Dispersion modelling was undertaken using the latest version of the air dispersion model: ADMS-5.2 (v5.2.4.0), which is developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS-5 is a PC based dispersion modelling software package that simulates a wide range of buoyant and passive releases to atmosphere from either single or multiple sources. The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology and calculates user-selected long-term and short-term averages. Building and source parameters have been taken from the architect's drawings and emissions parameters for the proposed development. The maximum predicted concentrations have been utilised for this assessment.

3.4.2 The model typically requires the following input data:

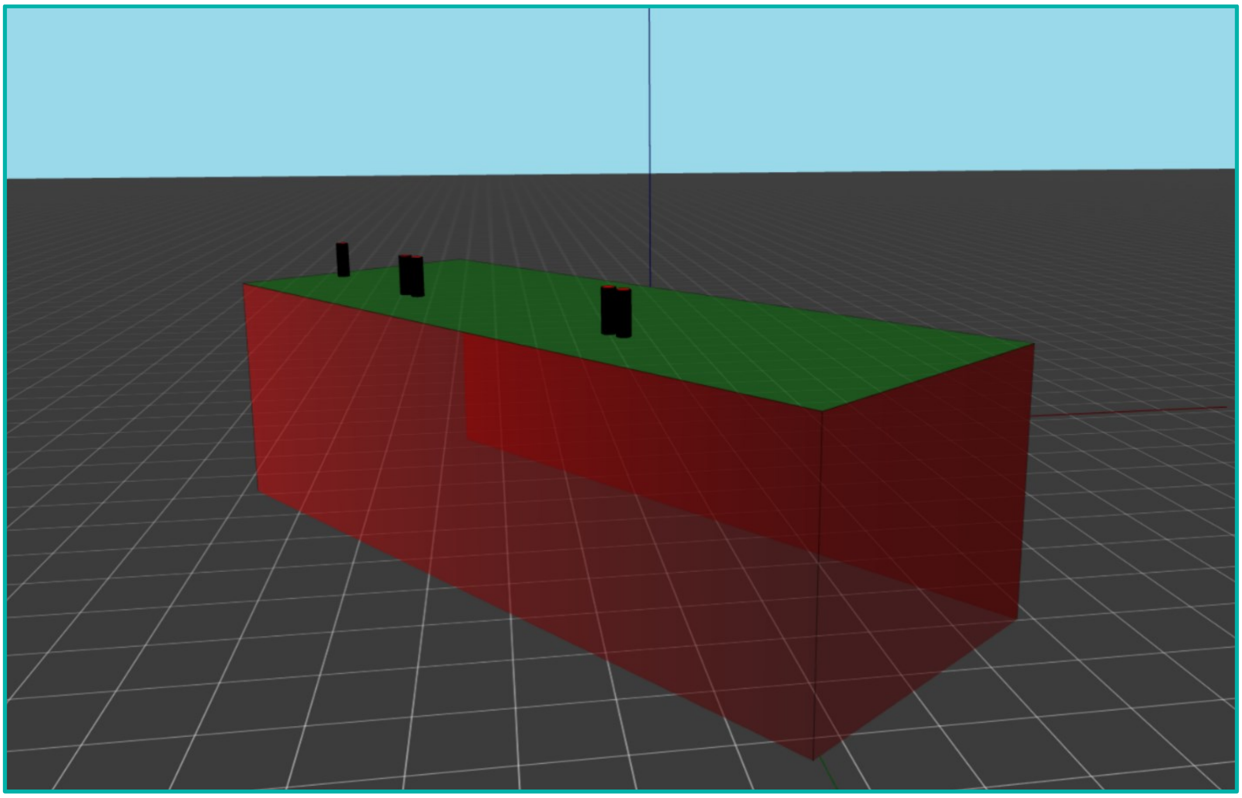
- Extent of the modelling area;
- Locations and dimensions of all sources and nearby structures;
- Output receptor locations;
- Meteorological data;
- Terrain data (if modelling terrain effects);
- Emission rates, emission parameters (e.g. temperature) and emission profiles (e.g. one hour per day) for modelled pollutants; and
- Surface roughness and Monin-Obukhov length.

3.5 Site Layout (Building and Structural Effects)

3.5.1 The dispersion of substances released from elevated sources can be influenced by the presence of buildings close to the emission point. Structures that are in excess of one third of the height of the stack can have a significant effect on dispersion by interrupting wind flows and causing significantly higher ground-level concentrations close to the source than would arise.

3.5.2 The buildings included in the dispersion model are illustrated below in Figure 3.2.

Figure 3.2: Modelled Buildings



3.6 Emission Parameters

Diesel Generator

3.6.1 The diesel generator parameters included in the model are summarised in Table 3.2, based upon the information provided by the client. The potential specification of the diesel generator (if required in the future) is set out in Appendix A, which also sets out the emission rates. For the modelling process it has been assumed that the diesel generator would operate for up to three hours on a weekday morning each month.

3.6.2 As a worst-case, an assumption has been made that the generators will run at a 100% load.

Table 3.2: Generator Stack Parameters

Parameter (unit)	Flue
Stack Location	E: 530360 N: 181751
Internal Stack Diameter (m)	0.4
Stack Height (m)	39.6
Temperature of release (°C)	498
Velocity (m/s)	30

Fume Cupboard Flue

3.6.3 Emissions from the proposed fume cupboards have been included in the modelling. 48 fume cupboards are anticipated to be used, with the ducting for these fume cupboards proposed to exhaust via four flues.

3.6.4 The client has advised that solvents are expected to be in common use in the fume cupboards in all laboratories on a daily basis. There will be regular emissions at low levels, and accidental spillages can be expected to occur occasionally.

3.6.5 Common solvents include ethanol, n-heptane and methanol. The assessment has assumed a continuous emission of methanol, expected to be one of the most commonly used solvents in the fume cupboards and the one which has the most stringent workplace exposure limits (WELs), as outlined by the Environment Agency.

3.6.6 Two modelling scenarios have been considered as follows (based upon a similar scheme as being proposed here):

- A typical event, in which 5 litres of solvent is used within each fume cupboard per day (It is understood up to 48 fume cupboards will be provided) is assumed over the four stacks. Of this 10% is assumed to evaporate and be discharged by the chemical flues. This gives a daily discharge from each fume cupboard of 500ml (liquid), calculated to be 0.02748g/s of methanol; and
- A spillage event, in which 2.5 litres of solvent is spilt in two locations in the building and discharged during a 30 second period out of two stacks, which has been calculated to be 66g/s of methanol. It is expected that this would be a rare event and is likely to occur on a less than

annual frequency. As a worst-case assessment, emissions of methanol at a rate of 66g/s have been assumed to persist for an hour-long period.

3.6.7 The flue source locations are illustrated in Figure 3.3, with the parameters included in the model (based upon estimates from the plans given) summarised in Table 3.3.

Figure 3.3: Modelled Sources

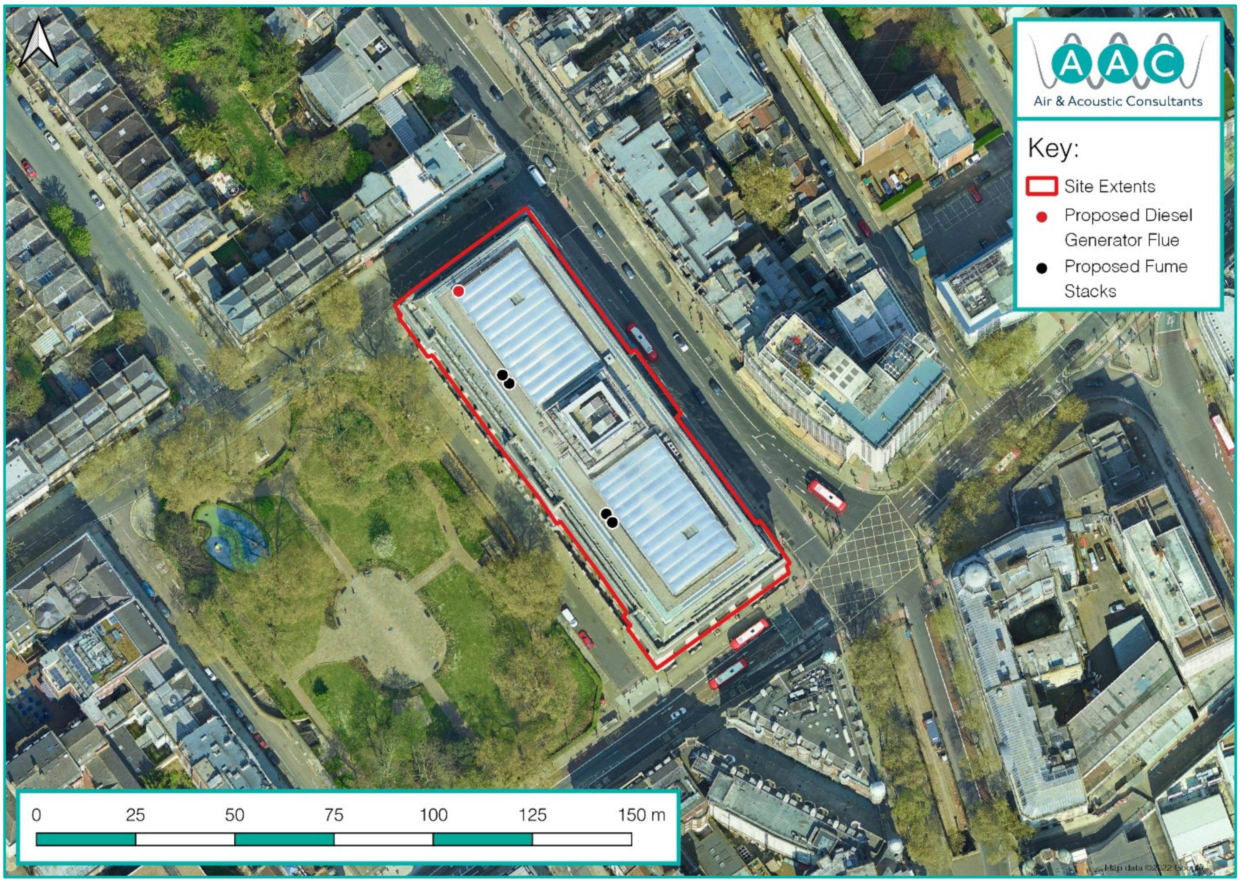


Table 3.3: Fume Cupboard Stack Parameters

Parameter (unit)	Stacks
Stack Locations	E: 530373 N: 181728 E: 530371 N: 181730 E: 530397 N: 181695 E: 530399 N: 181693
Internal Stack Diameter (m)	0.8
Stack Height (m)	39.9
Temperature of release (°C)	24
Velocity (m/s)	16.0

3.7 NO_X to NO_2 Assumptions for Annual-Mean Calculations

3.7.1 Historically, the Environment Agency has recommended that for a 'worse case scenario', a 70% conversion of NO_x to NO_2 should be considered for calculation of annual average concentrations. If a breach of the annual average NO_2 objective/limit value occurs, the Environment Agency requires a more detailed assessment to be carried out with operators asked to justify the use of percentages lower than 70%.

3.7.2 Following the withdrawal of the Environment Agency's H1 guidance document, there is no longer an explicit recommendation; however, for the purposed of this assessment a 70% conversion of NO to NO_2 has been assumed for annual average NO_2 concentrations in line with the Environment Agency's historic recommendations.

3.7.3 Emissions of NO_x will comprise contributions from both NO and NO_2. Typically, air quality assessments are made against the concentrations of NO_2 as it is more toxic than NO. However, combustion flue gases comprise 90-95% NO which, in time, will oxidise in the atmosphere into NO_2.

3.8 NO_X to NO_2 Assumptions for hourly-Mean Calculations

3.8.1 An assumed conversion of 35% follows the Environment Agency's recommendations for the calculation of 'worst case scenario' short-term NO_2 concentrations.

3.9 Meteorological Data

3.9.1 The key meteorological parameters for dispersion modelling are wind speed and wind direction. Meteorological parameters such as cloud cover, surface temperature, precipitation rate and relative humidity are also considered.

3.9.2 For dispersion modelling, hourly-resolved data are required and often it is difficult to find a local site that can provide reliable data for all the meteorological parameters at this resolution.

3.9.3 Based on the above, a suitably representative meteorological monitoring station identified is Heathrow Airport meteorological station, which is located approximately 22 km southwest of the subject site.

3.9.4 To account for variation in meteorological conditions, the qualitative assessment and dispersion modelling have been carried out with the latest available meteorological data from the period 2014 to 2018 (inclusive).

3.10 Topography

3.10.1 The presence of elevated terrain can significantly affect ground level concentrations of pollutants emitted from elevated sources, such as stacks, by reducing the distance between the plume centre line and ground level, increasing turbulence and, hence, plume mixing.

3.10.2 Guidance for the use of the ADMS-5 model suggests that terrain is normally incorporated within a modelling study when the gradient exceeds 1:10. Terrain is not included in the model.

3.11 Surface Roughness

3.11.1 The dispersion meteorological site and assessment area surface roughness length (z0) was set to 1 m (Cities).

3.12 Minimum Monin-Obukhov Length

3.12.1 The Minimum Monin-Obukhov Length (MMOL) provides a measure of the stability of the atmosphere. An MMOL value of 100 m (large conurbations > 1 million) was used in the dispersion model to describe the modelling and meteorological site areas. These values are considered representative of the respective surrounding areas.

3.13 Impact / Significance Criteria

3.13.1 Currently there is no formal guidance on the absolute magnitude and significance criteria for the assessment of air quality impacts. However, the EPUK & IAQM (2017) document have published recommendations for describing the impact at individual receptor locations and utilised to determine the description of any impact.

3.13.2 To note, the approach is that any change in concentration smaller than 0.5% of the long-term environmental standard will be negligible, regardless of the existing air quality conditions. Any change smaller than 1.5% of the long-term environmental standard will be negligible so long as the total concentration is less than 94% of the standard and any change smaller than 5.5% of the long-term environmental standard will be negligible so long as the total concentration is less than 75% of the standard. The guidance also explains that:

> *"Where peak short term concentrations (those averaged over periods of an hour or less) from an elevated source are in the range 11-20% of the relevant Air Quality Assessment Level (AQAL), then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. In most cases, the assessment of impact severity for a proposed development will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impacts. The severity of the impact will be substantial when there is a risk that the relevant AQAL for short-term concentrations is approached through the presence of the new source, taking into account the contribution of other local sources".*

3.13.3 The IAQM & EPUK (2017) document provides a framework as set out in Table 3.4, on the severity of an impact as a descriptor. Although the impacts might be considered 'Slight', 'Moderate' or 'Substantial' at one or more receptor location, the overall effects of a proposed development may not always be judged as being significant.

Table 3.4: Operational Impact Descriptors

Long Term Average Concentration at Receptor in Assessment Year	% Change in concentration relative to Air Quality Action Level (AQAL)				
	<0.5	1	2 – 5	6 – 10	>10
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

Notes:

- Values are rounded to the nearest whole number.
- 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.
- 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).'

3.13.4 The judgement of the overall significance should be made by a competent professional who is suitably qualified.

3.14 Air Pollution Exposure Criteria (APEC)

Sensitive Locations

3.14.1 The significance of emissions for the introduction of residential receptors will be determined by comparing the predicted results to the Air Pollution Exposure Criteria (APEC) detailed in the Air Quality and Planning Guidance[33] written by the London Air Pollution Planning and the Local Environment (APPLE) working group. The Air Pollution Exposure Criteria is a recognised approach to describe the significance of the impacts predicted, together with an indication as to the level of mitigation required in order for a development to be approved. The APEC table is replicated in Table 3.5 below.

Table 3.5: Air Pollution Exposure Criteria (APEC)

APEC	NO_2	PM_{10}	Recommendations
A	>5% below national annual mean objective	>5% below national annual mean objective >1-day less than national 24-hour objective	No air quality grounds for refusal; however, mitigation of any emissions should be considered.
B	Between 5% below or above national annual mean objective	Between 5% above or below national annual mean objective Between 1-day above or below national 24- hour objective	May not be sufficient air quality grounds for refusal, however appropriate mitigation must be considered.
C	>5% above national annual mean objective	>5% above national annual mean objective	Refusal on air quality grounds should be anticipated, unless the Local Authority has a

[33] The London Air Pollution Planning and the Local Environment (APPLE) working group, 2007. *Air Quality and Planning Guidance.*

APEC	NO_2	PM_{10}	Recommendations
		>1-day more than national 24-hour objective	specific policy enabling such land use and ensure best endeavours to reduce exposure are incorporated

3.15 Modelling Assumptions, Uncertainties and Exclusions

3.15.1 In addition to the parameters outlined above, some assumptions have been made for the modelling, including:

- The diesel generator will operate for three hours on a weekday morning each month; and
- Emission data and source parameters have been obtained from the client's data sheets and experience from working on similar schemes.

3.15.2 Uncertainty in dispersion modelling predictions can be associated with a variety of factors, including:

- Model limitations;
- Data uncertainty due to errors in input data, emission estimates, operational procedures, land use characteristics and meteorology; and
- Variability - randomness of measurements used.

3.15.3 Potential uncertainties in the model results were minimised as far as practicable and worst-case inputs used in order to provide a robust assessment. This included the following:

- Choice of model - ADMS-5 is a widely used atmospheric dispersion model and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Emission rates - Emission rates were calculated based upon data provided by the client. As such, they are considered to be representative of potential releases during normal operation;
- Receptor locations - Specified receptors, including discrete receptors located on the roof terrace, have been identified and modelled;
- Variability - Where site specific input parameters were not available, assumptions were made with consideration of the worst-case conditions as necessary in order to ensure a robust assessment of potential pollutant concentrations; and
- All results presented are the maximum concentrations from a 5-year modelling period, so represent the worst case.

3.15.4 The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the conservative end of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the proposed development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

4 Assessment Approach – Future Exposure

Environmental Protection UK & Institute of Air Quality Management Guidance

4.1.1 The key guidance document which has been used to determine the potential for impacts upon air quality is the Environmental Protection UK (EPUK) & IAQM (2017)[34] *Land-Use Planning and Development Control: Planning for Air Quality* document.

4.1.2 This guidance document provides indicative screening criterion for when a full impact assessment is required. The following screening criterion has been considered for this AQA:

Local Highway Network

Stage 1:

- If any of the following apply to the proposed development:
  - Contains 10 or more residential units or a site area of more than 0.5ha; or
  - Contains more than 1,000 m^2 of floor space for all other uses or a site area greater than 1ha.
- Coupled with any of the following:
  - The development has more than 10 parking spaces; or
  - The development will have a centralised energy facility or other centralised combustion process.

Stage 2:

- A change of cars / LDVs (light duty vehicles) flow of:
  - More than 100 annual average daily traffic (AADT) within or adjacent to an AQMA; or
  - More than 500 AADT elsewhere.
- A change of HDVs (heavy duty vehicles) flow of:
  - More than 25 AADT within or adjacent to an AQMA; or
  - More than 100 AADT elsewhere.

4.1.3 Should these criteria not be met, then the guidance document considers air quality impacts associated with a scheme to be 'insignificant' and no further assessment is required.

4.1.4 As the proposed development will not see an increase in floor area or parking spaces, and will be car free, the EPUK & IAQM (2017) criteria will not be exceeded and the associated impacts can be considered 'insignificant.'

4.1.5 However, as the development will introduce new (workspace) exposure into an area of existing poor air quality, an assessment on possible exposure has been conducted, with the parameters of this assessment set out below.

[34] Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM), 2017. *Land-use Planning & Development Control: Planning for Air Quality.*

4.2 Modelling Parameters

Modelled Receptor Locations

4.2.1 The concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been considered as part of this assessment. While selecting the receptor locations, careful consideration was made to receptors located near key road junctions, where congestion may occur, or where a number of highway links merge.

4.2.2 The sensitive locations at which the standards and objectives apply are places where the population is expected to be exposed to the various pollutants over the particular averaging period. Thus, for those objectives to which an annual mean standard applies, the most common sensitive receptor locations used to measure concentrations against the set standards are areas of residential housing, since it is reasonable to expect that people living in their homes could be exposed to pollutants over such a period of time.

4.2.3 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 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, such as on public footways or residential amenity areas.

4.2.4 DEFRA (2022) LAQM Technical Guidance (TG22)[35] states:

> *"Dispersion models cannot predict short-term concentrations as reliably as annual mean concentrations*
>
> *[…]*
>
> *Previous research carried out on behalf of Defra and the Devolved Administrations identified that exceedances of the NO_2 1-hour mean are unlikely to occur where the annual mean is below 60 $\mu g/m^3$ This assumption is still considered valid; therefore local authorities should refer to it."*

4.2.5 It is understood that the development will introduce a number of Air Handing Units, which will have a number of fresh air inlet points located on the façade and the roof of the building. The modelled inlet locations are illustrated in Figure 4.1 and outlined in Table 4.1.

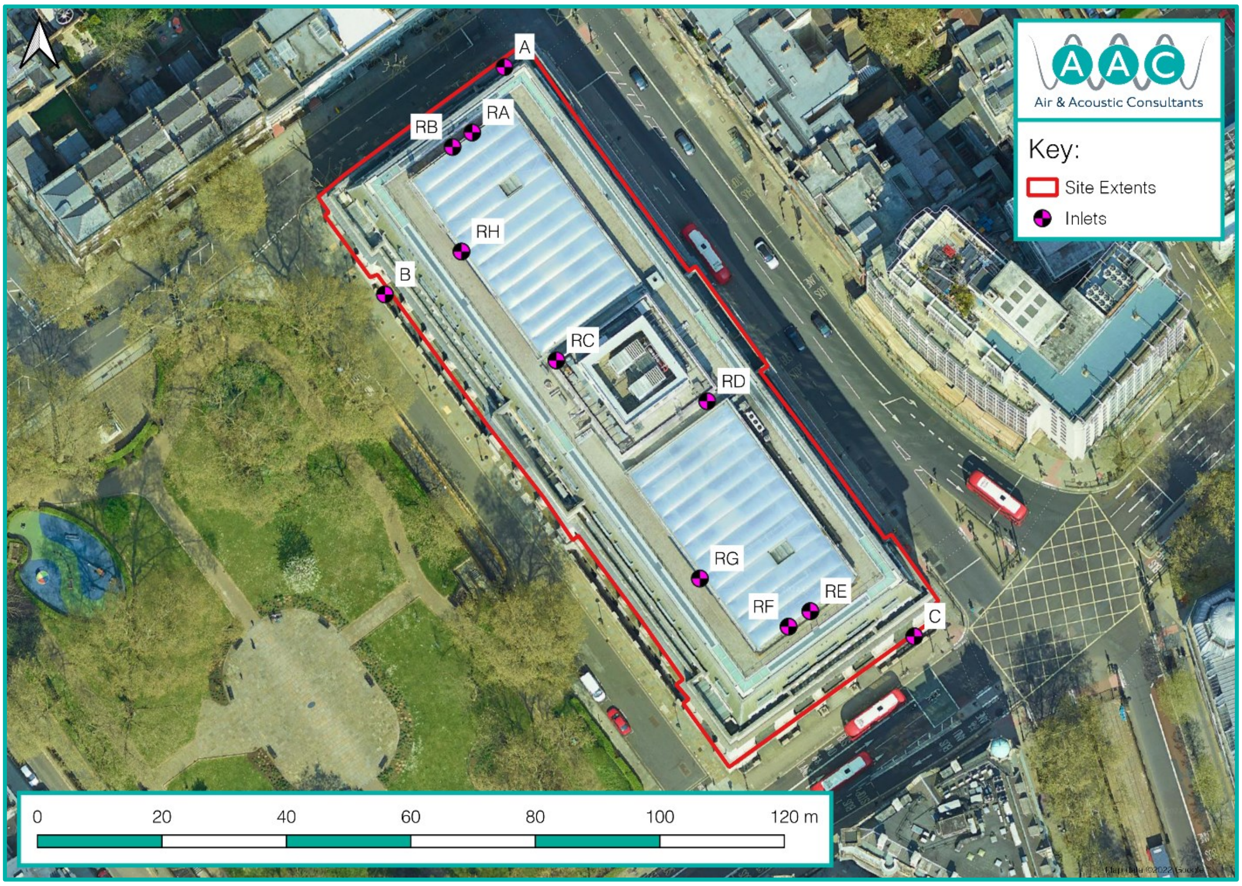
Table 4.1: Receptor Locations

Receptor ID	Description	Coordinates (m)		
		X	Y	Z
A	Bloomsbury Place	530374	181767	3.0
B	Bloomsbury Square	530355	181732	1.0
C	Vernon Place	530439	181678	3.0
RA	Roof - Bloomsbury Place	530369	181758	34.0
RB	Roof - Bloomsbury Place	530365	181755	34.0
RC	Roof - Bloomsbury Square	530382	181721	34.0
RD	Roof – Southampton Row	530406	181715	34.0

[35] Department for Environment, Food & Rural Affairs, 2022. *Local Air Quality Management. Technical Guidance (TG22).*

Receptor ID	Description	Coordinates (m)		
		X	Y	Z
RE	Roof – Vernon Place	530423	181681	34.0
RF	Roof – Vernon Place	530419	181678	34.0
RG	Roof - Bloomsbury Square	530405	181686	34.0
RH	Roof - Bloomsbury Square	530367	181739	34.0

Figure 4.1: Inlet Locations



Assessment Scenarios

4.2.6 The following scenarios have been considered for this AQA:

- 2019 verification; and
- 2022 future baseline

4.2.7 The traffic data utilised within this assessment has been obtained from air quality assessments conducted for planning applications in the surrounding area. Traffic for Bloomsbury Place has been obtained from the AQA for Planning Application 2020/3107/P, with the remaining roads obtained from the AQA for planning application 2020/2470/P.

4.2.8 Traffic data for 2019 verification has been obtained from the Department for Transport (DfT)[36] website.

4.2.9 The traffic flows are set out in Appendix B.

Modelling Methodology

4.2.10 The modelling of the release of vehicular emissions, (dispersion), into the air has been carried out using the latest version of the air dispersion model: ADMS-Roads model (v5.0.1.3). The model calculates pollution concentrations and deposition over a specified area and / or at a specified location, based upon the following input information:

- Source parameters: e.g. highway width, average speed of vehicles, the number of vehicles per hour and the diurnal traffic profile;
- Meteorological parameters: e.g. wind speed, direction, precipitation, temperature and atmospheric stability; and
- Topographical factors: e.g. ground levels, gradients, buildings and surface roughness.

4.2.11 Junctions have been modelled in line with the LAQM Technical Guidance (TG(22)), which states:

"For junctions, common sense, driving experience and local knowledge are helpful to estimate speeds. For example, for a section of road leading up to traffic lights, the aim should be to estimate average speeds over a 50 m section of road:

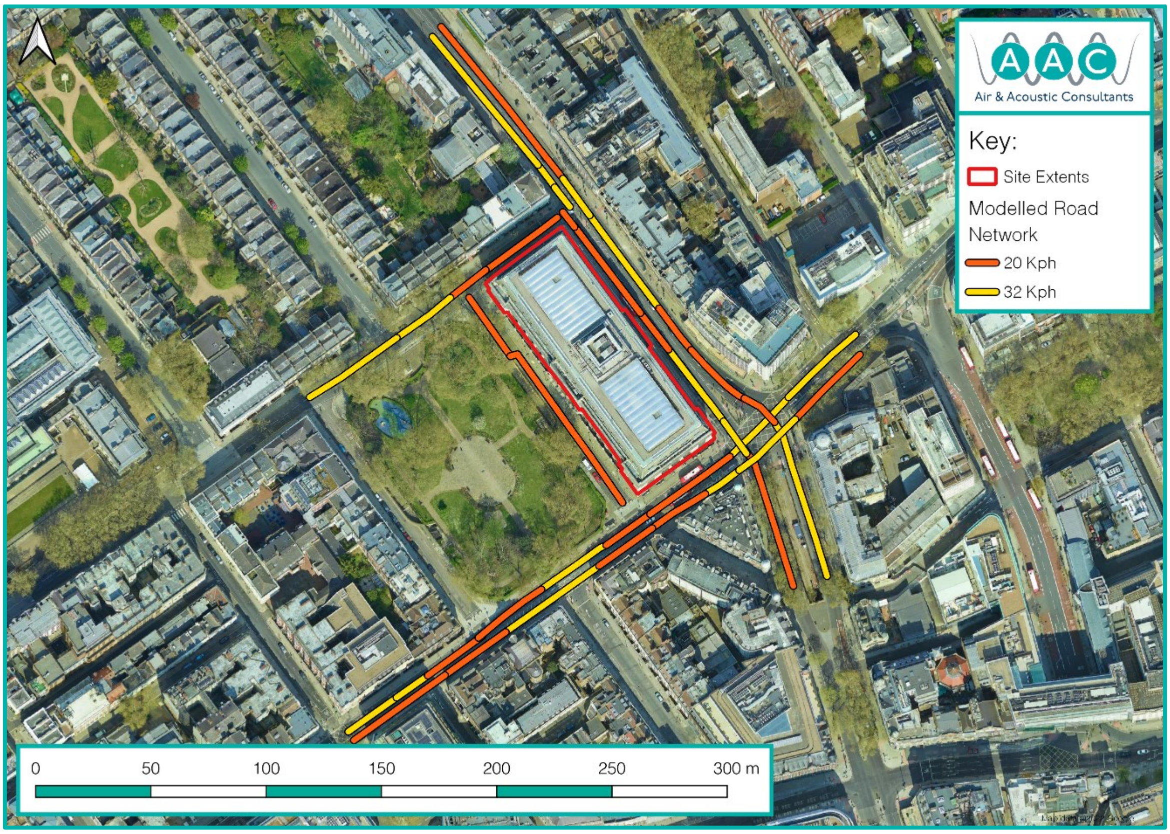
- *Traffic pulling away from the lights, e.g. 40-50 kph;*
- *Traffic approaching the lights when green, e.g. 20-50 kph; and*
- *Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and how congested the junction is.*

It is considered that the combined effect of these three conditions is likely in most instances to be a two-way average speed for all vehicles of 20 to 40 kph. Speeds in similar ranges would also apply at roundabouts, although on sections of large roundabouts, speeds may well average between 40-50 kph."

4.2.12 The modelled road network for the 2022 assessment year scenario, including the modelled speeds, are illustrated in Figure 4.2.

[36] Department for Transport (2021). *Road traffic statistics.*

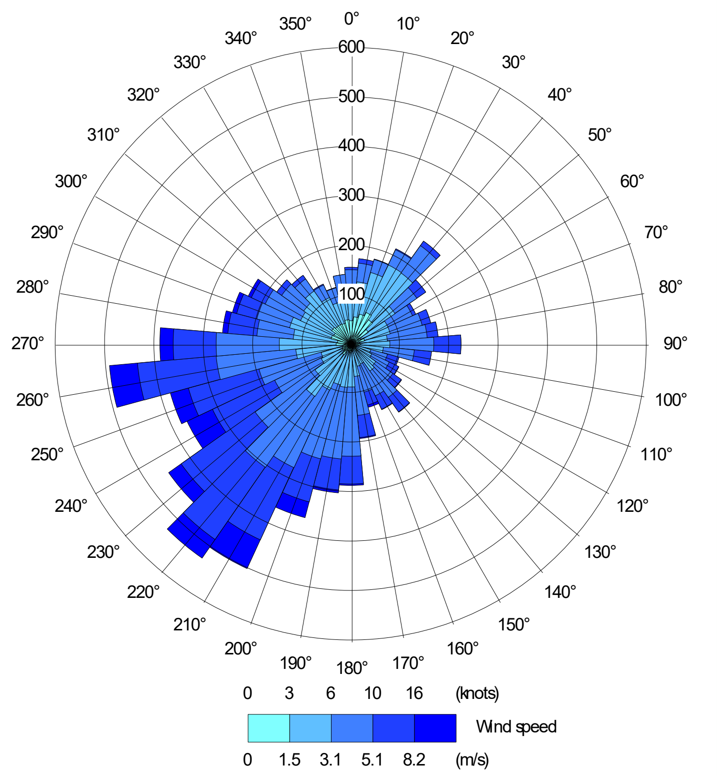
Figure 4.2: Modelled Road Network



4.2.13 The meteorological data required for the ADMS-Roads model, must be sourced from a representative location to the study site and include a full year of sequential readings. For consistency with the point source modelling, Heathrow Airport Meteorological Site has been utilised for the roads modelling. 2019 meteorological data has been utilised for this assessment in line with the verification year.

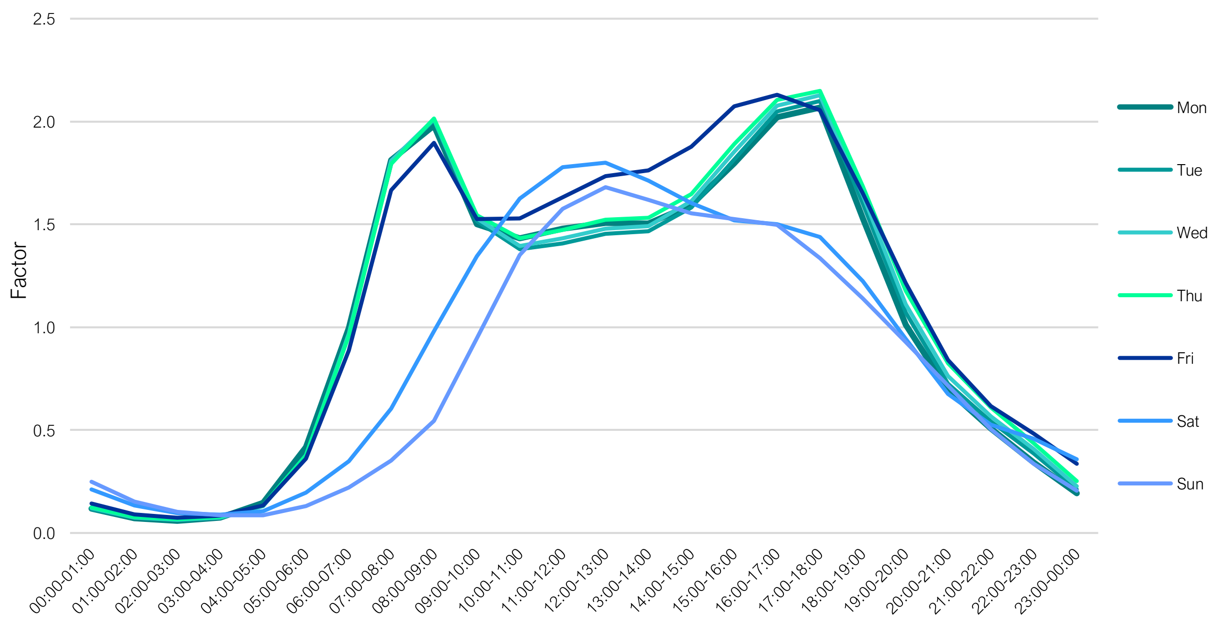
4.2.14 It is recognised that a minimum data capture of 90 % is recommended for representing hourly dispersion conditions within the dispersion model. Missing lines of meteorological data can be interpolated or filled by data for these specific hours from a neighbouring site. The data capture at Heathrow Airport Meteorological Site for 2019 was within an acceptable margin error, for all parameters. The wind rose is illustrated in Figure 4.3.

Figure 4.3: Heathrow Airport Meteorological Site Windrose



4.2.15 A standard diurnal profile from the DfT website[37] has been utilised as part of the modelling process for an average 7-day week. The 2019 diurnal profile is illustrated in Figure 4.4.

Figure 4.4: 7-Day Diurnal profile – 2019



[37] Department for Transport. Road Traffic Statistics (TRA). Accessible at: https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra

Street Canyons

4.2.16 Due to the existing building structures of the proposed development and surrounding buildings, a street canyon effect is likely to impact both existing and future receptors. Therefore, street canyons, using the advanced street canyons option in ADMS, were included within the model to account for poor dispersion. Due to this poor dispersion, concentrations at receptors can be higher than what would usually be experienced, due to the 'trapping' effect. LAQM TG(22) defines the following for street canyons:

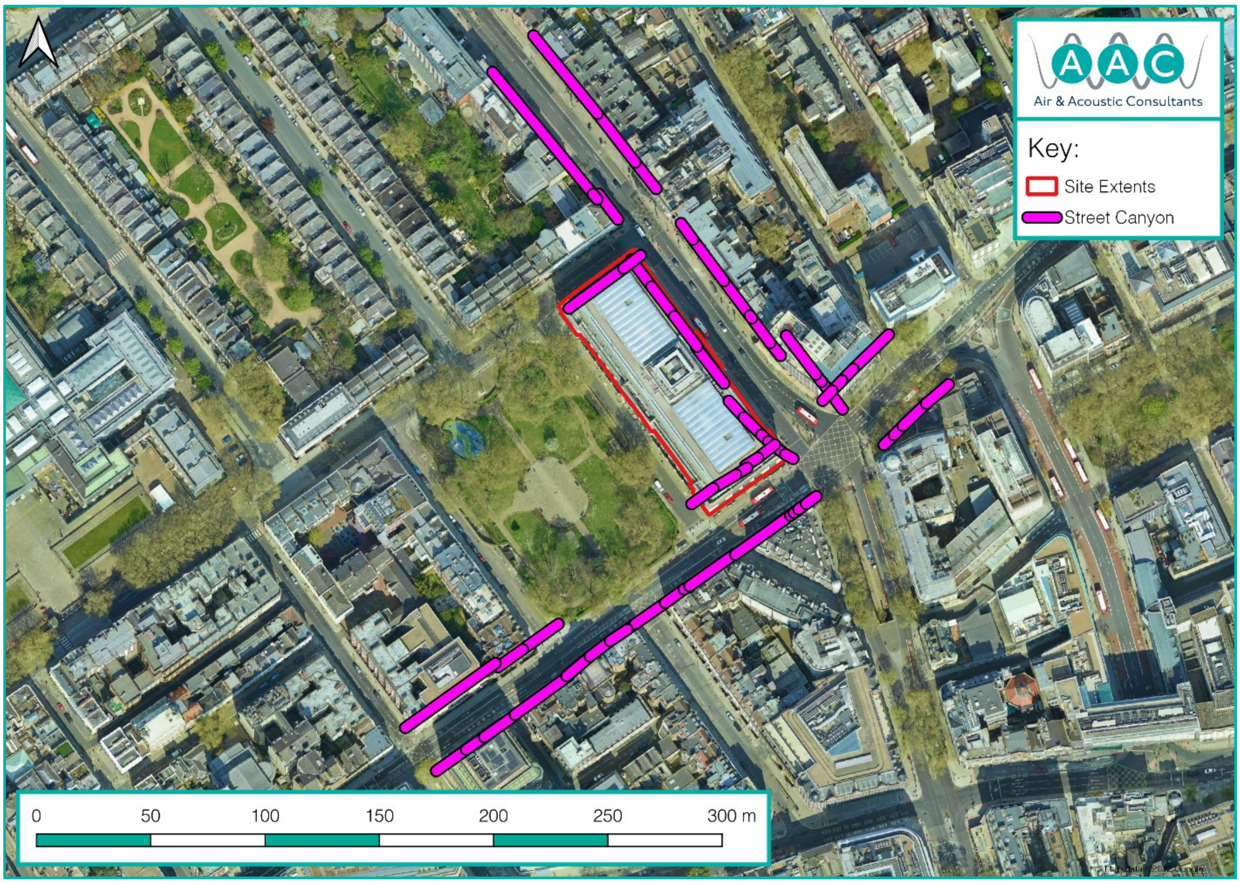
> *"Although street canyons can generally be defined as narrow streets where the height of buildings on both sides of the road is greater than the road width, there are numerous example whereby broader streets may also be considered as street canyons where buildings result in reduced dispersion and elevated concentrations (which may be demonstrated by monitoring data). Therefore, canyon effects can occur both in small towns or large cities."*

4.2.17 Parameters that have been included within the model include:

- The street canyon width, which is not the road width, but the distance measured as façade to façade of buildings on either side of the street; and
- The average height of buildings on both sides of the road.

4.2.18 The advanced street canyons option was selected in the model, and street canyons were modelled along Bloomsbury Place, Southampton Row, Vernon Place and Bloomsbury Way. This is illustrated in Figure 4.5.

Figure 4.5: Modelled Street Canyons



Emission Factors

4.2.19 There are numerous sources of NO_2, PM_{10} and $PM_{2.5}$ which include, for example, industry and domestic origins. However, the main source is usually road transport. For the purpose of this impact assessment and due to the absence of other sources in the area, only road traffic emissions have been modelled.

4.2.20 The potential impacts have been modelled using the ADMS-Roads model atmospheric dispersion model, with Emission Factor Toolkit v11.0 which is built into the ADMS-Roads model.

4.2.21 It has been widely known for some time that NO_x/NO_2 levels historically have not reduced as quickly as anticipated, and this was identified by DEFRA in 2011. This was recently reiterated in an IAQM Interim Position Statement (v1.1)[38] released in July 2018 recognising that emissions from diesel vehicles have not declined as expected by DEFRA. This document has since been formally withdrawn, stating:

> *"There is a growing body of evidence to suggest that the latest COPERT vehicle emission factors, which feed into the EFT (v9 and onwards), reflect the real-world NO_x emissions more accurately.*
>
> *It is judged that an exclusively vehicle emissions-based sensitivity test is no longer necessary.*
>
> *On this basis, the EFT may be used for future year modelling with greater confidence when considering the per vehicle emission, provided that the assessment is verified against measurements made in the year 2016 or later."*

4.2.22 Therefore, the EFT v11.0 within the ADMS model is acceptable for an assessment year of 2019 and 2027 and no sensitivity test has therefore been undertaken.

4.2.23 Vehicles emit NO_x with different proportions of NO_2. Following release into the atmosphere, chemical reactions take place between nitric oxide (NO), NO_2 and Ozone (O_3). In this AQA, the modelling of road-NO_x emissions has taken place and the resulting NO_2 concentration has been calculated post modelling using the DEFRA NO_x to NO_2 Calculator (v8.1)[39].

Verification Process

4.2.24 Whilst the ADMS-Roads model is widely accepted for its use in assessments of this nature, it is still important that a model verification process is undertaken to confirm that the model's performance is within an acceptable margin of error. Therefore, a comparison of modelled results with monitored results has been undertaken in line with LAQM.TG(22).

4.2.25 The model was found to be under-predicting NO_2, PM_{10} and $PM_{2.5}$ concentrations compared to the monitored concentrations, which is not unusual. Therefore, an adjustment factor for each pollutant has been derived.

4.2.26 The model verification process is set out in Appendix C.

Modelling Uncertainty

4.2.27 There are many uncertainties when considering both measured and predicted pollution concentrations. The model is dependent upon the traffic data provided for the project, and should this be subject to change, so may the resulting pollution concentrations.

[38] Institute of Air Quality Management, 2018. *Dealing with Uncertainty in Vehicle NO_x Emissions within Air Quality Assessments.*
[39] Department for Environment, Food & Rural Affairs. NO_x to NO_2 Calculator. Accessible at: https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

4.2.28 The background air quality concentrations have been taken from the DEFRA background mapping. The DEFRA website[40] includes estimated background air pollution data for NO_x, NO_2, PM_{10} and $PM_{2.5}$ for each 1km by 1km OS grid square. Background pollutant concentrations are modelled from the base year of 2018 and based on ambient monitoring and meteorological data from 2018. The 2018 mapping includes projections for future years, up to currently 2030. Furthermore, the concentrations are modelled at a standard 'living height,' which has been averaged across the grid square.

4.2.29 There is discrepancy between the concentrations mapped by DEFRA and those recorded at local background sites. Therefore, a calibration factor has been derived from the ratio between monitored urban background concentrations (local authority monitoring) and DEFRA background mapped concentrations for NO_2, PM_{10} and $PM_{2.5}$. NO_x concentrations have been calibrated using the Air Quality Consultants Ltd (AQC)[41] factor for the rest of the UK, which is based on data collected from Automatic Urban and Rural Network (AURN) monitors across the UK.

4.2.30 Due to the ongoing uncertainty regarding 2020 air quality monitoring data as a result of the COVID-19 global pandemic, and to ensure a conservative assessment of future exposure and impacts is made, the verification process has used 2019 monitoring data. This is supported by DEFRA and GLA, which published the LAQM COVID-19: Supplementary Guidance[42], which states:

> *"An option would be to exclude the use of 2020 as a verification year, certainly until such time as it becomes clearer what the longer-term impacts of COVID-19 are / have been. The use of 2019 as a verification year would be recommended under such a direction, as the most recent year available without the effects of the pandemic. However, there are uncertainties as to whether changes to trends in both road traffic emissions and background concentrations have taken place and whether any changes would be likely to lead to longer-term shifts. This in turn could also lead to challenges and cost implications on LAQM projects (e.g. detailed modelling assessments, AQAPs) whose outcomes would be based on this more conservative approach in contravention, it could be argued, of real-world observations."*

4.2.31 The emissions factors within the latest DEFRA Emission Factor Toolkit (EFT) are based on assumptions which were current before the occurrence of the COVID-19 pandemic. As such, this data will not reflect any changes that have occurred or may occur in the future as a result of behavioural change caused by the pandemic and / or as a result of measures implemented by governing authorities (e.g. lockdowns, travel restrictions etc.).

4.2.32 This is highlighted by a recent statement published by DEFRA, which states:

> *"Users of the updated LAQM tools should be aware that the projections in the 2018 reference year background maps and associated tools are based on assumptions which were current before the Covid-19 outbreak in the UK. In consequence these tools do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns."*

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40 Department for Environmental Food and Rural Affairs. Accessible at: *https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018*
41 Air Quality Consultants, 2020. *Calibrating Defra's 2018- based Background NO_x and NO_2 Maps against 2019 Measurements.*
42 Department for Environment, Food & Rural Affairs, 2021. LAQM Covid-19: Supplementary Guidance.

4.3 Significance Impact Criteria

Introduction of New Sensitive Receptors

4.3.1 The significance of emissions for the introduction of residential receptors will be determined by comparing the predicted results to the Air Pollution Exposure Criteria (APEC) detailed in the Air Quality and Planning Guidance[43] written by the London Air Pollution Planning and the Local Environment (APPLE) working group. The Air Pollution Exposure Criteria is a recognised approach to describe the significance of the impacts predicted, together with an indication as to the level of mitigation required in order for a development to be approved. The APEC table is replicated in Table 3.5.

[43] The London Air Pollution Planning and the Local Environment (APPLE) working group, 2007. *Air Quality and Planning Guidance.*

5 Baseline Conditions

5.1 Air Quality Review and Assessment

5.1.1 Under the Air Quality Strategy, there is a duty on all local authorities to consider the air quality within their boundaries and to report annually to DEFRA.

5.1.2 LAQM has been assessed by LBC through the national Review and Assessment process and in fulfilment of Part IV of the Environmental Act 1995.

5.1.3 At the time of writing the LBC have one AQMA covering the whole borough, declared for exceedances of the NO_2 annual mean objective, as well as the PM_{10} 24-hour mean objective.

5.1.4 The GLA have identified 187 Air Quality Focus Areas (AQFAs) where concentrations of NO_2 exceed the annual mean objective and have high levels of human exposure. These areas are identified as requiring air quality improvements and is where the GLA believe the problems to be most acute. To note, the application site is not located within an AQFA, however the application site is adjacent to the Holborn High Street and Southampton Row Junction AQFA, as illustrated in Figure 5.1.

5.2 Local Air Quality Monitoring

5.2.1 LBC have four automatic monitoring locations that have recorded concentrations of a mixture of pollutants including NO_2, PM_{10} and $PM_{2.5}$. To support the automatic monitoring, LBC has an extensive network of non-automatic NO_2 diffusion tubes, located across the jurisdiction.

5.2.2 Table 5.1, Table 5.2, Table 5.3 sets out the NO_2, PM_{10}, $PM_{2.5}$ annual mean monitoring data collected for the past 5 years for the closest monitoring locations to the application site, as illustrated in Figure 5.1. Table 5.4 and Table 5.5 set out the number of exceedances of the NO_2 1-hour mean objective and PM_{10} 24-hour mean objective respectively, at the closest automatic site for the past 5 years of available data.

Table 5.1: Summary of NO_2 Annual Mean Air Quality Monitoring

ID	Type	Annual Mean (µg/m^3)				
		2017	2018	2019	2020	2021
Automatic Monitors						
BL0	Urban Background	38	36	32	28	27
Diffusion Tubes						
CA11	Kerbside	**<u>74.0</u>**	**<u>65.8</u>**	**<u>62.6</u>**	**43.3**	**44.4**
CA21	Kerbside	**<u>71.2</u>**	**59.4**	**49.6**	29.5	33.2
Objective		40				

Notes:

Bold indicates exceedances of the NO_2 annual mean objective. **<u>Bold and underlined</u>** indicates exceedances of 60 µg/m^3 (which is an indication the hourly mean objective could be being breached).

Table 5.2: Summary of PM_{10} Annual Mean Air Quality Monitoring

ID	Type	Annual Mean (µg/m³)				
		2017	2018	2019	2020	2021
Automatic Monitors						
BL0	Urban Background	19	17	18	16	16
Objective		40				

Notes:
Bold indicates exceedances of the PM_{10} annual mean objective

Table 5.3: Summary of $PM_{2.5}$ Annual Mean Air Quality Monitoring

ID	Type	Annual Mean (µg/m³)				
		2017	2018	2019	2020	2021
Automatic Monitors						
BL0	Urban Background	13	10	11	9	9
Objective		25				

Notes:
Bold indicates exceedances of the $PM_{2.5}$ annual mean objective

Table 5.4: Summary of NO_2 1-Hour Mean Air Quality Monitoring

ID	Type	Number of 1-Hour Mean Exceedances				
		2017	2018	2019	2020	2021
Automatic Monitors						
BL0	Urban Background	0	0	0	0	0
Objective		18 times/year				

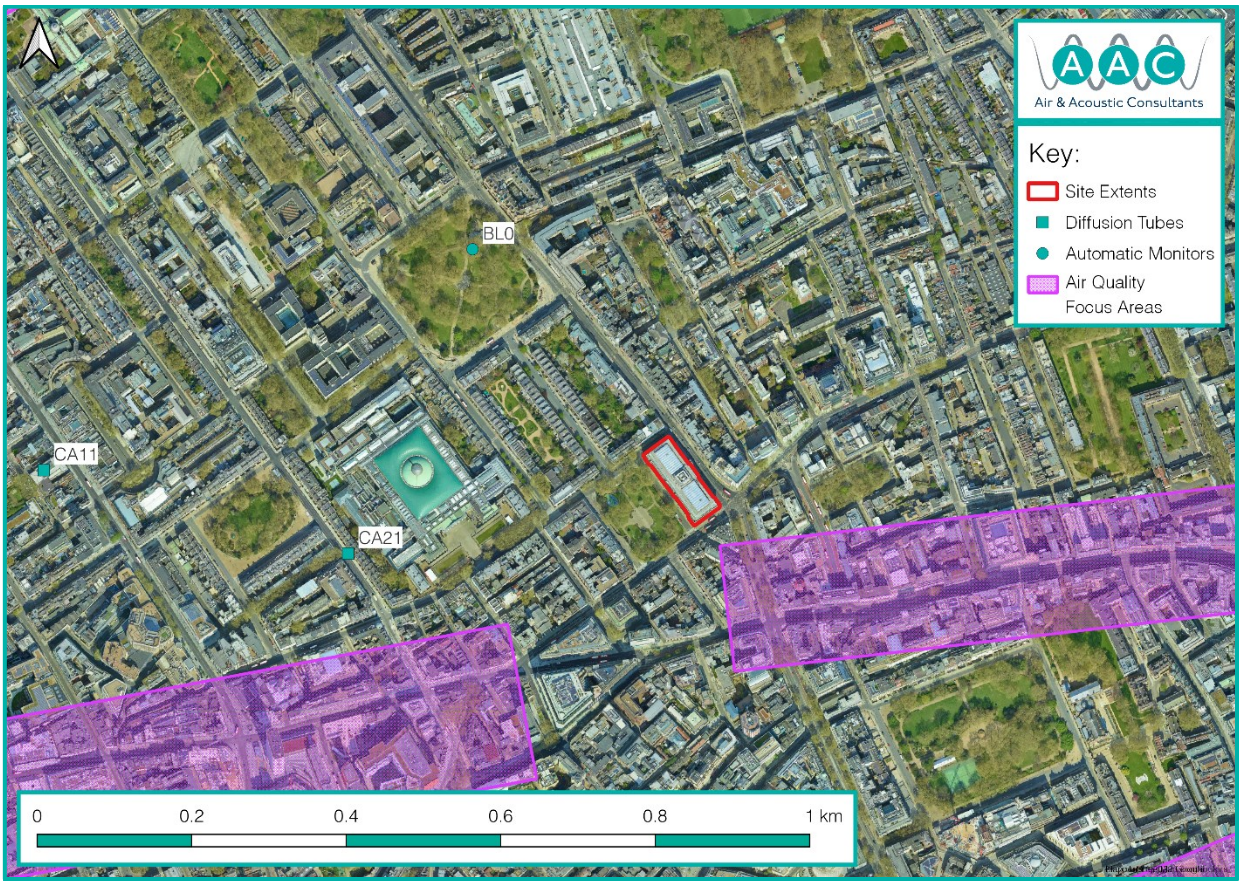
Notes:
Bold indicates exceedances of the NO_2 1-hour mean objective (not to be exceeded more than 18 times a year).

Table 5.5: Summary of PM_{10} 24 - Hour Mean Air Quality Monitoring

ID	Type	Number of 24-Hour Mean Exceedances				
		2017	2018	2019	2020	2021
Automatic Monitors						
BL0	Urban Background	6	1	9	4	0
Objective		35 times/year				

Notes:
Bold indicates exceedances of the PM_{10} 24-hour mean objective (not to be exceeded more than 35 times a year)

Figure 5.1: Local Authority Monitoring Locations



5.2.3 The air quality monitoring carried out closest to the application site shows a general non-compliance of the NO_2 annual mean objective, for the past 5 years of available data. Monitor BL0 showed compliance for both the NO_2 annual mean and the hourly mean objectives.

5.2.4 The air quality monitoring carried out closest to the application site shows compliance of the PM_{10} and $PM_{2.5}$ annual mean objective, and the PM_{10} 24-Hour mean objective

5.2.5 It should be noted that 2020 and 2021 concentrations have been impacted as a result of the COVID-19 pandemic, and therefore caution should be used when considering if concentrations are representative of the application site and the local area.

5.3 Mapped Background Concentrations

DEFRA Background Concentrations

5.3.1 The DEFRA website includes estimated background air pollution data for NO_x, NO_2, PM_{10} and $PM_{2.5}$ for each 1km-by-1km OS grid square. Background pollutant concentrations are modelled from the base year of 2018 and based on ambient monitoring, meteorological data from 2018 and then projected for future years.

5.3.2 As per a recent statement from DEFRA, as set out in paragraph 4.2.30, the DEFRA background concentrations do not consider short term variations as a result on the COVID-19 outbreak in the UK:

5.3.3 The background NO_2 concentrations have been calibrated against data measured in 2019 at four diffusion tubes and one automatic urban background monitoring sites operated by LBC. Background

PM_{10} concentrations have been calibrated against data measured in 2019 at two automatic urban background monitoring sites. Background PM_{10} concentrations have been calibrated against data measured in 2019 at one automatic urban background monitoring site. 2020 and 2021 concentrations have not been utilised due to the impact of COVID-19.

5.3.4 Measured annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations at these monitoring locations have been compared against the annual mean concentration predicted by DEFRA's background maps to find a calibration factor for each pollutant. The calibration factor is then applied to the relevant DEFRA background concentration.

5.3.5 The background calibration factors for NO_2, PM_{10} and $PM_{2.5}$ are set out in Table 5.6, Table 5.7 and Table 5.8. The adjusted projected pollutant concentrations for 2022, covering the closest OS grid square to the application site, are then provided in Table 5.9.

5.3.6 To note, methanol background concentrations are not available.

Table 5.6: NO_2 Background Calibration Factor

NO_2	Monitoring Sites				
	Automatic Monitor	Diffusion Tube Monitors			
	BL0	CA6	CA7	CA10	CA28
Measured Concentration (µg/m^3)	32	24.7	22.8	33.1	27.7
Mapped Concentration (µg/m^3)	39.3	39.3	26.3	39.3	39.3
Calibration Factor	0.8	0.6	0.9	0.8	0.7
Average Calibration Factor	0.8				

Notes: Data rounded.
Mapped concentrations taken from the closest grid square derived from the DEFRA background maps for 2019

Table 5.7: PM_{10} Background Calibration Factor

PM_{10}	Monitoring Sites	
	Automatic Monitors	
	BL0	KGX
Measured Concentration (µg/m^3)	18	15
Mapped Concentration (µg/m^3)	20.3	19.9
Calibration Factor	0.9	0.8
Average Calibration Factor	0.8	

Notes: Data rounded.
Mapped concentrations taken from the closest grid square derived from the DEFRA background maps for 2019.

Table 5.8: $PM_{2.5}$ Background Calibration Factor

PM_{10}	Monitoring Sites
	Automatic Monitors
	BL0
Measured Concentration (µg/m^3)	11
Mapped Concentration (µg/m^3)	12.9
Calibration Factor	0.9
Average Calibration Factor	0.9

Notes: Data rounded.
Mapped concentrations taken from the closest grid square derived from the DEFRA background maps for 2019.

Table 5.9: Estimated Annual Mean Background Pollutant Concentrations (µg/m^3)

Pollutant	Averaging Period	2022
NO_2	Annual Mean	31.3
	1 – Hour Mean	62.5
PM_{10}	Annual Mean	15.5
	24– Hour Mean	30.9
$PM_{2.5}$	Annual Mean	10.4

Notes: Data presented are derived from the ordinance survey grid references E: 530500, N: 182500

6 Operational Impacts

6.1 Diesel Generator

6.1.1 For the typical usage of the diesel generator, annual mean concentrations have been predicted and compared to the long-term air quality objectives for NO_2, PM_{10} and $PM_{2.5}$ for both the discrete receptors and surrounding residential receptors, identified in Table 3.1 and illustrated in Figure 3.1.

6.1.2 As the generator is anticipated to be used largely for testing for one-hour periods, the hourly concentrations of NO_2 and PM_{10} have been compared to the relevant hourly objectives for both the discrete receptors and existing residential receptors.

Process Contribution Screening

6.1.3 Dispersion modelling for the discrete receptors and residential receptors of a diesel generator has been carried out. Table 6.1 sets out the predicted maximum Process Contribution (PC) of the relevant pollutant concentrations, and have been compared to the relevant EAL's set out in Table 2.1 in order to be screened (as set out in the EPUK & IAQM (2017)) guidance.

Table 6.1: Maximum PC for Modelled Receptors

Process Contribution		
Pollutant	Max concentration (µg/m^3)	Percentage of Objective (%)
Annual Mean NO_2	1.1	2.7
99.79th percentile of 1-hour NO_2	29.1	14.5
Annual Mean PM_{10}	0.1	0.3
90.4th percentile of 24-hour PM_{10}	0	0
Annual Mean $PM_{2.5}$	0.1	0.5

6.1.4 The concentrations are compared to the screening criteria set out EPUK & IAQM (2017) as set out previously. This is set out in Table 6.2.

Table 6.2: Assessment Against Screening Criteria

Process Contribution		
Pollutant	Screening Criteria (%)	Exceeded?
Annual Mean NO_2	0.5	Yes
99.79th percentile of 1-hour NO_2	10	Yes
Annual Mean PM_{10}	0.5	No
90.4th percentile of 24-hour PM_{10}	10	No
Annual Mean $PM_{2.5}$	0.5	Yes

6.1.5 The predicted impacts as a result of the generator for the annual mean NO_2 and $PM_{2.5}$ process contributions as well as the 99.79th percentile of 1-hour NO_2 exceeds the relevant criteria, and therefore requires further investigation. The annual mean PM_{10} and 90.4th percentile of 24-hour PM_{10} do not exceed the relevant criteria, thus the impacts are considered to be negligible and have not been considered further.

Annual Mean NO_2 Concentrations (PEC)

6.1.6 As per Table 5.2, an assessment on the Predicted Environmental Contribution (PEC) at the identified discrete receptors and residential receptors as a result of the diesel generator is required for the NO_2 annual mean. Table 6.3 sets out the NO_2 annual concentrations.

Table 6.3: Predicted Environmental Contribution Annual Mean NO_2 Concentrations

Predicted Environmental Contribution					
Receptor	Annual Mean NO_2 (µg/m^3)	MAX PEC as % of AQS	Polluant Concentration Change (µg/m^3)	% Change Relative to AQAL	2022 Impact Descriptor
DR1	32.3	80.8	1.1	2-5%	Slight
DR2	32.0	80.0	0.7	2-5%	Slight
DR3	31.9	79.8	0.6	2-5%	Slight
DR4	31.8	79.4	0.5	1%	Negligible
R1	31.3	78.3	0.1	0%	Negligible
R2	31.4	78.5	0.1	0%	Negligible
R3	31.5	78.9	0.3	1%	Negligible
R4	31.3	78.3	0.1	0%	Negligible
R5	31.4	78.5	0.1	0%	Negligible
R6	31.5	78.9	0.3	1%	Negligible
R7	31.3	78.3	0.0	0%	Negligible
R8	31.5	78.7	0.2	1%	Negligible
R9	31.4	78.6	0.2	0%	Negligible
R10	31.3	78.3	0.0	0%	Negligible
R11	31.5	78.7	0.2	1%	Negligible
R12	31.4	78.6	0.2	0%	Negligible

6.1.7 Table 6.3 shows the maximum predicted annual mean NO_2 at the discrete receptors and residential receptors fall below the annual mean objective, with the impacts assessed as slight to negligible for all receptors. The impacts on all modelled receptors are considered '**not significant**'.

1-Hour Mean NO_2 Concentrations (PEC)

6.1.8 As per Table 5.2, an assessment on the Predicted Environmental Contribution (PEC) at the identified discrete receptors and residential receptors as a result of the diesel generator is required for the NO_2 1-hour mean. Table 6.4 sets out the NO_2 1 hour mean concentrations.

6.1.9 TG(22) states:

"Dispersion models cannot predict short-term concentrations as reliably as annual mean concentrations."

6.1.10 TG(22) then goes on to state:

"A study carried out on behalf of Defra and the Devolved Administrations identified that exceedances of the NO_2 1-hour mean are unlikely to occur where the annual mean is below 60 $\mu g/m^3$."

6.1.11 However, on the basis this modelling assessment is considering point source emissions, the use of the annual mean concentrations cannot be conducted. Therefore, the PEC for the NO_2 1-hour mean objective for each receptor is set out below.

Table 6.4: Predicted Environmental Contribution 1-Hour Mean NO_2 Concentrations

Predicted Environmental Contribution			
Receptor	1-Hour Mean NO_2 ($\mu g/m^3$)	MAX PEC as % of AQS	Polluant Concentration Change ($\mu g/m^3$)
DR1	62.5	31.3	0.0
DR2	62.5	31.3	0.0
DR3	62.5	31.3	0.0
DR4	62.5	31.3	0.0
R1	62.5	31.3	0.0
R2	65.4	32.7	2.9
R3	91.6	45.8	29.1
R4	62.5	31.3	0.0
R5	65.7	32.9	3.2
R6	91.6	45.8	29.1
R7	62.5	31.3	0.0
R8	88.9	44.4	26.4
R9	62.5	31.3	0.0
R10	62.5	31.3	0.0
R11	88.9	44.4	26.4
R12	62.5	31.3	0.0

6.1.12 Table 6.4 shows the maximum predicted 1-hour mean NO_2 at the discrete receptors and residential receptors fall below the 1-hour mean objective.

Annual Mean $PM_{2.5}$ Concentrations (PEC)

6.1.13 As per Table 5.2, an assessment on the Predicted Environmental Contribution (PEC) at the identified discrete receptors and residential receptors as a result of the diesel generator is required for the $PM_{2.5}$ annual mean. Table 6.5 sets out the $PM_{2.5}$ annual mean concentrations.

Table 6.5: Predicted Environmental Contribution Annual Mean $PM_{2.5}$ Concentrations

Predicted Environmental Contribution					
Receptor	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)	MAX PEC as % of AQS	Polluant Concentration Change ($\mu g/m^3$)	% Change Relative to AQAL	2022 Impact Descriptor
DR1	10.5	26.3	0.1	1%	Negligible
DR2	10.5	26.2	0.1	0%	Negligible
DR3	10.5	26.2	0.1	0%	Negligible
DR4	10.5	26.1	0.0	0%	Negligible
R1	10.4	26.0	0.0	0%	Negligible
R2	10.4	26.1	0.0	0%	Negligible
R3	10.4	26.1	0.0	0%	Negligible
R4	10.4	26.0	0.0	0%	Negligible
R5	10.4	26.1	0.0	0%	Negligible
R6	10.4	26.1	0.0	0%	Negligible
R7	10.4	26.0	0.0	0%	Negligible
R8	10.4	26.1	0.0	0%	Negligible
R9	10.4	26.1	0.0	0%	Negligible
R10	10.4	26.0	0.0	0%	Negligible
R11	10.4	26.1	0.0	0%	Negligible
R12	10.4	26.1	0.0	0%	Negligible

6.1.14 Table 6.5 shows the maximum predicted annual mean $PM_{2.5}$ at the discrete receptors and residential receptors fall below the annual mean objective, with the impacts assessed as negligible for all receptors. The impacts on all modelled receptors are considered '**not significant**'.

6.2 Fume Cupboard Emissions

6.2.1 For the typical daily usage of the fume cupboards, annual mean concentrations have been predicted and compared to the long-term environmental assessment level (EAL). The predicted annual mean methanol process contributions for the discrete receptors and surrounding residential receptors are shown below.

6.2.2 For the spillage event, the point of maximum impact on the discrete receptors and residential receptors has been calculated for a worst-case hourly period, and the greatest concentration of methanol is predicted to be. This is a conservative and pessimistic assessment, as the emission was assumed to persist for one hour, whereas the spillage event is likely to occur for only 30 seconds.

Process Contribution Screening

6.2.3 Dispersion modelling of emissions related to the fume cupboards has been carried out at the discrete receptors and surrounding residential receptors identified in Table 3.1. Table 6.6 sets out the precited maximum Process Contribution of methanol, and have been compared to the relevant environmental assessment levels (EALs).

Table 6.6: Maximum PC at Modelled Receptors

Process Contribution			
Pollutant	Max Concentration ($\mu g/m^3$)	Objective ($\mu g/m^3$)	% of Objective
Annual Mean CH_3OH	4.7	2,660	0.2
Hourly CH_3OH	2962.6	33,000	9.0

6.2.4 The concentrations are compared to the screening criteria set out previously in Section 3. This is set out in Table 6.7.

Table 6.7: Maximum PC at Modelled Receptors

Process Contribution		
Pollutant	Screening Criteria (%)	Exceeded?
Annual Mean CH_3OH	0.5	No
1-hour CH_3OH	10	No

6.2.5 The predicted impacts as a result of operation of the fume cupboards for the annual mean and hourly methanol mean do not exceed the relevant EALs. A further assessment is therefore not required for the impacts on the discrete receptors and residential receptors.

6.2.6 The spillage event is based upon a worst-case isolated spillage, and unlikely to be a regular occurrence. Therefore, on this basis deemed necessary as the impact is considered to be negligible and the impacts on all modelled receptors are considered '**not significant**'.

6.3 Traffic Emissions – Future Exposure

London Atmospheric Emissions Inventory

6.3.1 The London Atmospheric Emissions Inventory (LAEI)[44] provides modelled 2019 ground level concentration of annual mean NO_x, NO_2, PM_{10} and $PM_{2.5}$ at a 20 m grid resolution. These modelled grid squares, which cover the whole of Greater London, have been used to inform concentrations at the application site and the surrounding area. The modelled 2019 annual mean concentrations are set out in Figure 6.1, Figure 6.2 and Figure 6.4, with the number of annual 24-hour PM_{10} exceedances illustrated in Figure 6.3.

6.3.2 To note, the LAEI concentrations are based on 20 m grid resolution, and therefore the concentration is assumed to be the same across this 20 m grid, which in reality is unlikely to happen

[44] Greater London Authority and Transport for London. London Atmospheric Emissions (LAEI) 2019. Accessible at: https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019

Figure 6.1: LAEI 2019 NO_2 Annual Mean Concentrations

Figure 6.2: LAEI 2019 PM_{10} Annual Mean Concentrations

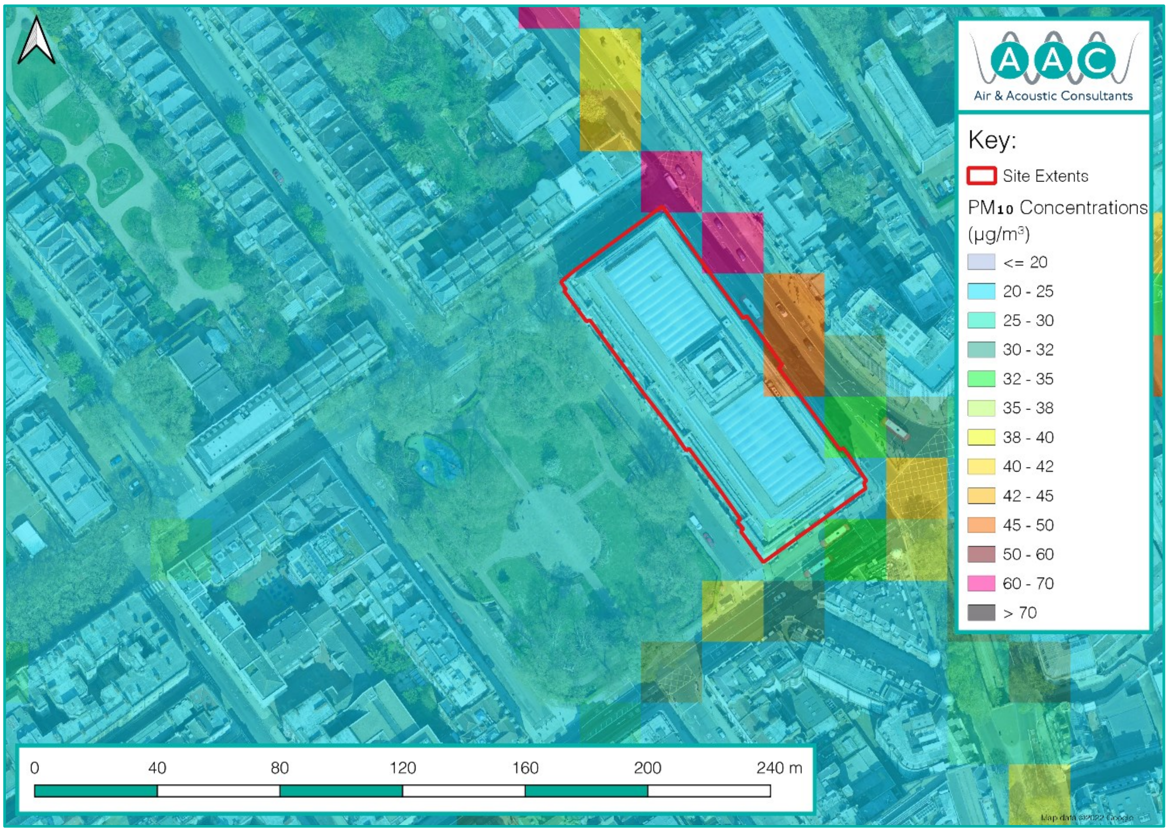


Figure 6.3: LAEI 2019 PM_{10} Number of Daily Mean Exceedances

Figure 6.4: LAEI 2019 $PM_{2.5}$ Annual Mean Concentrations

NO_2

6.3.3 The modelled LAEI NO_2 concentrations in Figure 6.1 shows a mixture of compliance and non-compliance of the NO_2 annual mean objective (40 µg/m^3),with exceedances modelled at the façade of the development building along Bloomsbury Place, Southampton Row and the A40 (Vernon Place). Concentrations of NO_2 drop off from the roads, with the majority of the application site below the annual mean objective.

6.3.4 In some of the modelled grid squares along the façade of the building, the NO_2 concentrations are above 60 µg/m^3, therefore, as per the LAQM TG(22) guidance, the 1-hour mean nitrogen dioxide objective is likely to be being exceeded.

PM_{10}

6.3.5 The modelled LAEI PM_{10} concentrations in Figure 6.2 shows a mixture of compliance and non-compliance of the PM_{10} annual mean objective (40 µg/m^3), with exceedances modelled at the façade of the development building along Bloomsbury Place, Southampton Row and the A40 (Vernon Place). Concentrations of PM_{10} drop off from the roads, with the majority of the application site below the annual mean objective.

6.3.6 The highest number of daily exceedances in Figure 6.3 is modelled along Southampton Row, with the highest modelled at 169 daily exceedances, which exceeds the PM_{10} 24-hour mean objectives (>50 µg/m^3 35 times per year). Exceedances were also modelled along Vernon Place. It should be noted that the number of exceedances drops off from these roads, with the majority of the site predicted to meet the 24-hour mean objective.

$PM_{2.5}$

6.3.7 The modelled LAEI $PM_{2.5}$ Figure 6.4 shows a mixture of compliance and non-compliance of the PM_{10} annual mean objective (20 µg/m^3), with exceedances modelled at the façade of the development building along Southampton Row and the A40 (Vernon Place). The concentrations drop off from these roads, with concentrations across the majority of the application site modelled below the $PM_{2.5}$ annual mean objective.

Modelled Inlet Points

6.3.8 As noted previously, the development will have a number of Air Handling Units, with fresh air inlets located on the northern, southern and western façades, as well as on the roof. The approximate location of these inlets is illustrated in Figure 4.1. As indicated by the LAEI concentrations, the concentrations of NO_2 are particularly high along the northern and southern facades and therefore a detailed assessment on the concentrations at these inlets has been conducted, which will then inform the level of mitigation required.

6.3.9 The predicted 2022 future baseline NO_2, PM_{10} and $PM_{2.5}$ concentrations at the proposed inlet locations are set out in Table 6.8, Table 6.9 and Table 6.10. The tables also set out the percentage above or below the respective annual mean objective/target at each inlet location.

Table 6.8: Predicted 2022 NO_2 Concentrations at Proposed Inlets

Calculated NO_2 Annual Mean (µg/m^3)		
Receptor	Predicted Concentration	% of Objective
A	**47.0**	117
B	34.2	85
C	**53.3**	133
RA	32.5	81
RB	32.5	81
RC	32.0	80
RD	32.6	81
RE	33.0	83
RF	32.8	82
RG	32.2	80
RH	32.0	80
Objective	40	
Note: **Bold** indicates exceedance of the NO_2 annual mean objective.		

Table 6.9: Predicted 2022 PM_{10} Concentrations at Proposed Inlets

Calculated PM_{10} Annual Mean (µg/m^3)		
Receptor	Predicted Concentration	% of Objective
A	18.8	47
B	16.1	40
C	20.6	52
RA	15.7	39
RB	15.7	39
RC	15.6	39
RD	15.7	39
RE	15.8	40
RF	15.8	39
RG	15.7	39
RH	15.6	39
Objective	40	
Note: **Bold** indicates exceedance of the PM_{10} annual mean objective.		

Table 6.10: Predicted 2022 $PM_{2.5}$ Concentrations at Proposed Inlets

Calculated $PM_{2.5}$ Annual Mean (µg/m^3)		
Receptor	Predicted Concentration	% of Objective
A	12.1	61
B	10.7	54
C	13.1	65
RA	10.5	53
RB	10.5	53
RC	10.5	52
RD	10.5	53
RE	10.6	53
RF	10.6	53
RG	10.5	53
RH	10.5	52
Objective	20	

Note: **Bold** indicates exceedance of the $PM_{2.5}$ annual mean objective.

NO_2

6.3.10 The modelled NO_2 concentrations in Table 6.8 show that NO_2 concentrations at two inlet points, located along Bloomsbury Place and Vernon Place, are above the annual mean objective (40 µg/m^3), with the remaining inlet located on the western façade and on the roof remaining within the objective.

6.3.11 Based on the annual average mean concentration at all receptors being below 60 µg/m^3, it is unlikely that any modelled receptor identified would experience an exceedance of the 1-hour mean objective, in line with paragraph 7.97 of LAQM.TG(22).

PM_{10}

6.3.12 The modelled PM_{10} concentrations in Table 6.9 do not predict any exceedances of the annual mean objective (40 µg/m^3) at any of the specified receptor locations.

6.3.13 For PM_{10}, the following equation can be used to derive the number of days that the 24-hour mean objective (50 µg/m^3) is likely to be exceeded.

$$\text{Num. 24-hour exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + \left(\frac{206}{\text{annual mean}}\right)$$

6.3.14 The highest annual mean PM_{10} concentration is 20.6 µg/m^3, predicted at Inlet C in 2022. Based on the formula above, this predicts 4.2 exceedance days, which is below the 35-days annual limit. It is therefore thought that none of the receptors would be exposed to any material impact from the short-term concentrations of PM_{10}.

$PM_{2.5}$

6.3.15 The modelled $PM_{2.5}$ concentrations in Table 6.10 do not predict any exceedances of the Stage 2 Post 2020 annual mean objective (20 µg/m^3) at any of the specified receptor locations.

Significance of Impacts

6.3.16 On the basis that two of the Inlet locations are exceeding the NO_2 annual mean objective, mitigation measures will be required to ensure that occupants are not exposed to high concentrations of pollutants.

6.3.17 The concentrations of NO_2 at Inlets A and C fall within APEC C, which states:

> *"Refusal on air quality grounds should be anticipated, unless the Local Authority has a specific policy enabling such land use and ensure best endeavours to reduce exposure are incorporated."*

6.3.18 The remaining Inlets on the western façade and on the roof fall within APEC A, which states:

> *"No air quality grounds for refusal; however, mitigation of any emissions should be considered."*

6.3.19 This Is further discussed in Section 7.

7 Mitigation Measures

7.1 Operational

Generator Impacts

7.1.1 The assessment has demonstrated that the diesel generator will have, at worst, a slight impact on air quality at the discrete receptors and a negligible impact at the residential receptor locations, and will not lead to exceedances of the air quality objectives outlined in Table 2.1, thus no additional mitigation measures are required.

7.1.2 The diesel generator to be installed should meet the specifications set out and utilised in this assessment. If the installed generator does not conform to these specifications, an additional assessment may be necessary, which will be used to inform any mitigation that may be required.

Fume Cupboard Impacts

7.1.3 Methanol is considered to be the main substance used in the fume cupboards. The resulting concentrations at the discrete receptors and surrounding residential receptors as a result of the operation of 48 fume cupboards are predicted to be below the relevant EALs. The impacts are anticipated to be negligible on these receptors. Therefore, it is considered that additional mitigation is not required.

7.1.4 It is recommended that the fume cupboards comply with British Standards EN 14175. To ensure effective dispersion and compliance with this British Standard, fume cupboards should be regularly inspected at least every 14 months.

7.1.5 To ensure no recirculation of emissions in the building from the fume cupboards or the combustion plant, it is recommended that ventilation air handling unit intakes are distanced from flue openings.

Future Exposure

7.1.6 The modelled 2019 LAEI concentrations suggest that exceedances of the annual mean objectives for NO_2 PM_{10} and $PM_{2.5}$ are possible along the façade of the building along Bloomsbury Place/Square, Southampton Row and the A40 (Vernon Place).

7.1.7 Some of the inlets are located within the street canyons along Bloomsbury Place and Vernon Place, which suffer from high air quality contractions, as illustrated in the LAEI figures and the modelled concentrations at the inlet points. Due to the constraints of the site, these inlets are required to be positioned in these locations, and therefore it is anticipated a filtration system will be required.

7.1.8 The modelled concentrations at the proposed inlet points suggest that along Bloomsbury Place and Vernon Place, the NO_2 annual mean objective will be exceeded. It is understood that each Air Handling Unit will have standard F7 type filtration. Further filtration will be required, in line with the relevant standards BS EN ISO 16890:2016 and BS EN ISO 10121-2:2013, to ensure that occupiers are not exposed to concentrations exceeding the relevant air quality objectives. AN example of filtration that could be used is the Swiftpack with Nitrosorb®[45] media for NO_2 and NO_x removal.

7.1.9 The position of inlets, as well as any proposed filtration, should be agreed with the council.

[45] AAC Eurovent. AAC Nitrosorb Swiftpack. Accessible at: https://www.aaceurovent.co.uk/product/aac-nitrosorb-swiftpack-system/

8 Summary & Conclusions

8.1 Baseline

8.1.1 The application site is situated within an AQMA, declared for exceedances of the NO_2 annual mean and PM_{10} 24-hour mean objectives. The application site is located adjacent to the Holborn High Street and Southampton Row Junction AQFA.

8.1.2 The closest air quality monitoring to the application site carried out by LBC showed a mixture of compliance and non-compliance with the NO_2 annual mean objective in 2019. The closest air quality monitoring to the application site showed a compliance with the PM_{10} annual mean and 24-hour mean objectives in 2019.

8.2 Operational Phase – Traffic Emissions

Diesel Generation Assessment

8.2.1 The results of the dispersion modelling show that the operation of the diesel generator will result in, at worst, a slight adverse impact on baseline air quality concentrations at the specified discrete and residential receptor locations, with a negligible to slight adverse impact predicted at the surrounding modelled residential receptors. Concentrations are predicted to remain within the relevant objectives set out in Table 2.1, with the impacts on all modelled receptors considered to be '**not significant**'.

Fume Cupboard Assessment

8.2.2 Modelling was undertaken using emissions information provided by the client, and a series of conservative assumptions. The development was modelled to operate continuously and in the event of a spill.

8.2.3 The results of the dispersion modelling show that the operation of the fume cupboards are anticipated to result in a negligible adverse impact at the specified discrete receptor and residential receptor locations, and therefore the associated impacts are considered to be '**not significant**.'

Future Exposure

8.2.4 The existing modelled ground level LAEI concentrations set out in Section 6 show possible exceedances of the NO_2 annual mean objective, as well as the PM_{10} 24-hour mean objective, along the façade of the building along Bloomsbury Place/Square, Southampton Row and the A40 (Vernon Place). Furthermore, the concentrations modelled at the inlets indicate that the NO_2 annual mean objective will be exceeded. Due to the site constraints, mitigation measures, as set out in Section 7, should be adopted to aid in reducing future exposure.

APPENDICES

APPENDIX A –DIESEL GENERATOR

	Cummins Inc. Columbus, Indiana 47201 **EXHAUST EMISSIONS DATA SHEET**	Basic Engine Model: **VTA28-G6**	Curve Number: **FR-5196**	*G-DRIVE* **V28** **1**
		Engine Critical Parts List: **CPL: 5713**	Date: **19Sep11**	

Displacement : **28.0** litre (**1710** in^3)	Bore : **140** mm (**5.5** in.) Stroke : **152** mm (**6.0** in.)
No. of Cylinders : **12**	Aspiration : **Turbocharged and Aftercooled**
Emissions Control Device : **Turbocharging and Aftercooling**	

Engine Speed	Standby Power		Prime Power		Continuous Power	
RPM	kWm	BHP	kWm	BHP	kWm	BHP
1500	733	982	N.A.	N.A.	N.A.	N.A.

Exhaust Emissions Data @ 1500 RPM

	Standby Power			Prime Power			Continuous Power		
Component	g/BHP·h	mg/m^3	PPM	g/BHP·h	mg/m^3	PPM	g/BHP·h	mg/m^3	PPM
HC (Total Unburned Hydrocarbons)	1.23	536	685	Not available for Prime Power			Not available for Continuous Power		
NOx (Oxides of Nitrogen as NO_2)	12.71	5545	2072						
CO (Carbon Monoxide)	9.49	4336	2922						
PM (Particulate Matter)	0.85	370	N.A.						
SO_2 (Sulfur Dioxide)	0.16	59	25						

Note: mg/m^3 and PPM numbers are measured dry and corrected to 5% O_2 content.

Test Methods and Conditions

Test Methods:
Steady-State emissions recorded per ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/-2%) with engine temperatures, pressures and emission rates stabilized.

Fuel Specification:
40 - 48 Cetane Number, 0.05 Wt.% Sulfur; Reference ISO8178-5, 40CFR86.1313-98 Type 2-D and ASTM D975 No. 2-D.

Reference Conditions:
25°C (77°F) Air Inlet Temperature, 40°C (104°F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H_20/lb) of dry air Humidity (required for NOx correction); Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back Pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subject to engine-to-engine variability. Tests conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data Subject to Change Without Notice.

Appendix B – Traffic Flows

Verification 2019

Link	Speed (Kph)	Total Vehicles	HGV	HGV %
Tottenham Court Road	32	7829	2132	27%
Euston Road Eastbound	48	23669	2186	9%
Euston Road Westbound - no buses	48	26492	784	3%
Euston Road Westbound- with buses	48	27904	2196	8%
Euston Road Westbound- buses only	48	1412	1412	100%

Future Baseline 2022

Link	Speed (Kph)	Total Vehicles	HGV	HGV %
Southampton Row N northbound	32	13547	1382	10%
Southampton Row N southbound	32	12642	1075	9%
Southampton Row S northbound	32	13547	1368	10%
Southampton Row S southbound	32	13580	991	7%
Theobalds Road eastbound	32	14071	1871	13%
Theobalds Road westbound	32	1190	1190	100%
Bloomsbury Way eastbound	32	13133	1957	15%
Bloomsbury Way westbound	32	1190	1190	100%
Great Russell Street	32	6428	739	12%

APPENDIX C – VERIFICATION

Model verification studies are undertaken in order to check the performance of dispersion models and, where modelled concentrations are significantly different to monitored concentrations, a factor can be established by which the modelled results can be adjusted in order to improve their reliability. The model verification process is detailed in LAQM.TG(22).

According to TG(22), no adjustment factor is necessary where the results of the model all lie within 25% of the monitored concentrations, but ideally within 10%.

Model verification can only be undertaken where there is sufficient roadside monitoring data in the vicinity of the subject scheme being assessed. TG(22) recommends that a combination of automatic and diffusion tube monitoring data is used; although this may be limited by data availability. For this assessment, one automatic monitor and two NO_2 diffusion tube sites were used to verify against. These monitoring locations are located within Camden.

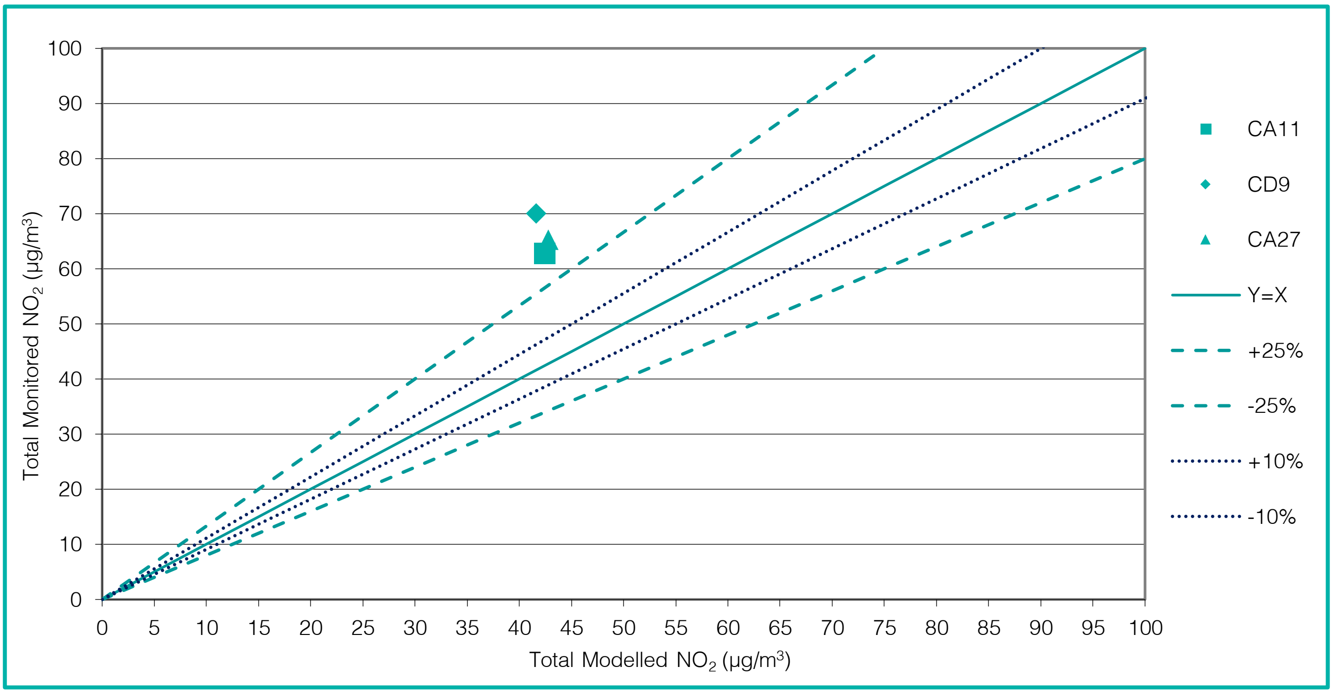
NO_2 VERIFICATION

Table B 1 compares the monitored and modelled NO_2 concentrations at these monitoring locations.

Table B 1: Comparison of Monitored and Modelled NO_2 Concentrations

Site ID	Type	Concentrations (µg/m^3)		
		Monitored	Modelled	% Difference
CD9	Automatic Monitor	70.0	41.6	-40.6
CA11	Diffusion Tube	62.6	42.4	-32.3
CA27	Diffusion Tube	65.3	42.7	-34.5

Figure D.1: Comparison of Monitored and Modelled NO_2 Concentrations Before Adjustment



The data in Table B 1shows that the model is under-predicting NO_2 concentrations. This is not unusual and is likely to be the result of local dispersion conditions.

As the difference for all sites is greater than +/- 10%, an adjustment factor has been derived to ensure a conservative assessment is undertaken.

As it is primary NO_x rather than secondary NO_2 emissions that are modelled, an adjustment factor must be derived for the road contribution of NO_x. A ratio of the modelled versus monitored NO_x concentrations using the least squares statistical method has been undertaken to derive an adjustment factor, as set out in Table B 2.

Table B 2: Deriving the Adjustment Factor

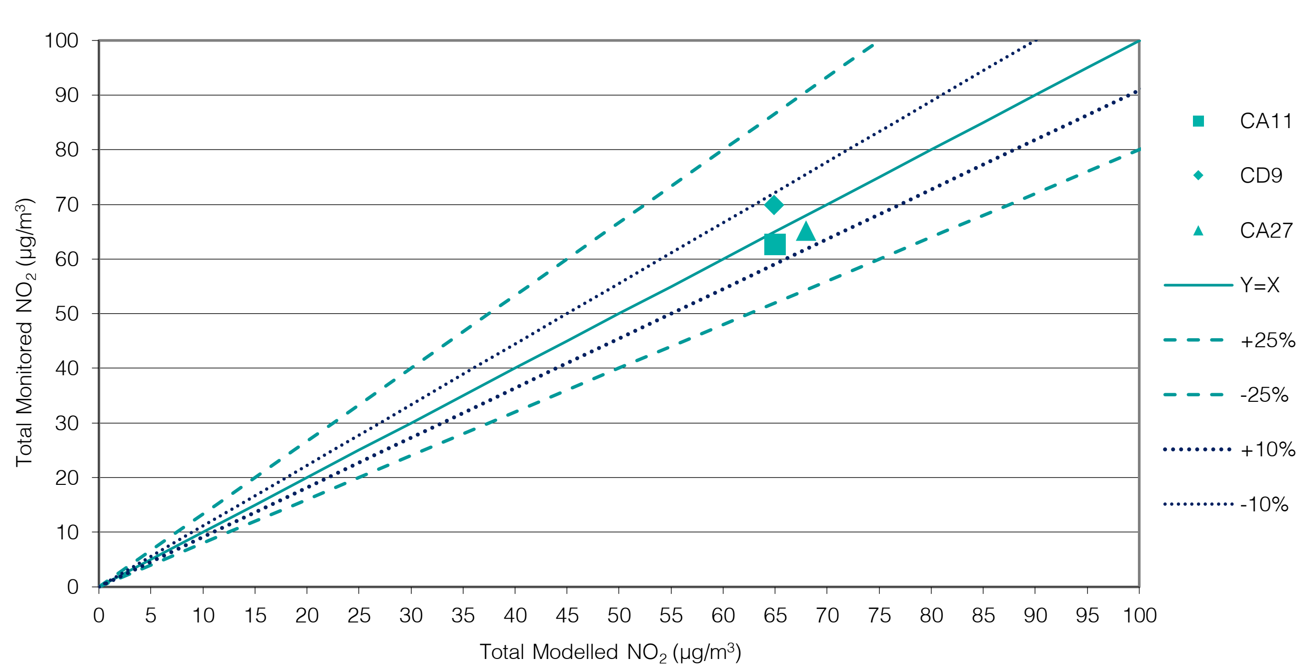
Site	Monitored Road NO_x (µg/m³)	Modelled Road NO_x (µg/m³)	Ratio
CD9	108.4	25.3	3.615
CA11	81.0	24.5	
CA27	92.8	28.1	

Table B 3 compares monitored and modelled NO_2 concentrations at the monitoring location after the adjustment factor has been applied.

Table B 3: Comparison of Monitored and Adjusted Modelled NO_2 Concentrations

Site ID	Type	Concentrations (µg/m³)		
		Monitored	Modelled	% Difference
CD9	Automatic Monitor	70.0	64.9	-7.3
CA11	Diffusion Tube	62.6	65.0	3.8
CA27	Diffusion Tube	65.3	67.9	4.1

Figure D.2: Comparison of Monitored and Modelled NO_2 Concentrations After Adjustment



The data in Table B 3 shows that the NO_2 concentrations in the model are within the ideal 10% of the monitored concentration, indicating that the model is performing acceptably.

ROOT MEAN SQUARE ERROR

A Root Mean Square Error (RMSE) has been calculated in Table B 4 to determine the error within the calculations before Road-NO_x adjustment, based upon the following calculation:

$$\text{RMSE} = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(\text{obs}_i - \text{Pred}_i)^2}$$

Table B 4: Root Mean Squared Error

Site	Predictions	Observations	Difference
CD9	64.9	70.0	-5.1
CA11	65.0	62.6	2.4
CA27	67.9	65.3	2.7
		RMSE:	3.6

The calculated RMSE is 3.6 µg/m^3, which correlates to an 9.0% error ratio. The RMSE means that modelled results could be under or over predicting pollution concentrations between +/- 3.6 µg/m^3. The RMSE means that modelled results are acceptable, as they are within a 25% margin of error (as advised in TG(22)), and therefore no further adjustment factor is required.

FRACTIONAL BIAS

The fractional bias has been calculated to identify if the model shows a systematic tendency to over or under-predict. The following formula has been used to calculate the fractional bias:

$$\text{FB} = \frac{(\text{Avg.Obs} - \text{Avg.Pred})}{0.5\,(\text{Avg.Obs} + \text{Avg.Pred})}$$

Table B 5: Fractional Bias

Average Predicted Values	Average Observed Values	Fractional Bias
66.0	65.9	0.001

The calculated fractional bias is 0.001, which indicates that the model is slightly underpredicting. However, the fraction bias is close to the ideal value of 0, which suggests that the model is performing acceptably.

PM_{10} Verification

Table B 6 compares the monitored and modelled PM_{10} concentrations at the monitoring locations.

Table B 6: Comparison of Monitored and Modelled PM_{10} Concentrations

Site ID	Type	Concentrations (µg/m^3)		
		Monitored	Modelled	% Difference
CD9	Automatic Site	22.0	18.4	-16.6

The data in Table B 6 shows that the model is under-predicting PM_{10} concentrations. This is not unusual and is likely to be the result of local dispersion conditions.

As the difference for all of the sites is greater than +/- 10%, an adjustment factor has been derived to ensure a conservative assessment is undertaken.

An adjustment factor must be derived for the road contribution of PM_{10}. A ratio of the modelled versus monitored PM_{10} concentrations using the least squares statistical method has been undertaken to derive an adjustment factor, as set out in Table B 7.

Table B 7: Deriving the Adjustment Factor

Site	Monitored Road PM_{10} (µg/m^3)	Modelled Road PM_{10} (µg/m^3)	Ratio
CD9	5.5	1.8	2.987

Table B 8 compares monitored and modelled PM_{10} concentrations at the monitoring location after the adjustment factor has been applied.

Table B 8: Comparison of Monitored and Adjusted Modelled PM_{10} Concentrations

Site ID	Type	Concentrations (µg/m^3)		
		Monitored	Modelled	% Difference
CD9	Automatic Site	22.0	22.0	0.0

As the adjusted difference for the site is now less than +/- 25% and within the ideal +/- 10%, an adjustment factor is not deemed necessary for the modelling.

$PM_{2.5}$ Verification

Table B 9 compares the monitored and modelled $PM_{2.5}$ concentrations at the monitoring locations.

Table B 9: Comparison of Monitored and Modelled $PM_{2.5}$ Concentrations

Site ID	Type	Concentrations (µg/m^3)		
		Monitored	Modelled	% Difference
CD9	Automatic Site	14.0	12.1	-13.6

The data in Table B 9 shows that the model is under-predicting $PM_{2.5}$ concentrations. This is not unusual and is likely to be the result of local dispersion conditions.

As the difference for all of the sites is greater than +/- 10%, an adjustment factor has been derived to ensure a conservative assessment is undertaken.

An adjustment factor must be derived for the road contribution of $PM_{2.5}$. A ratio of the modelled versus monitored PM_{10} concentrations using the least squares statistical method has been undertaken to derive an adjustment factor, as set out in Table B 10.

Table B 10: Deriving the Adjustment Factor

Site	Monitored Road $PM_{2.5}$ (µg/m^3)	Modelled Road $PM_{2.5}$ (µg/m^3)	Ratio
CD9	3.0	1.1	2.713

Table B 11 compares monitored and modelled $PM_{2.5}$ concentrations at the monitoring location after the adjustment factor has been applied.

Table B 11: Comparison of Monitored and Adjusted Modelled PM_{10} Concentrations

Site ID	Type	Concentrations (µg/m^3)		
		Monitored	Modelled	% Difference
CD9	Automatic Site	14.0	14.0	0.0

As the adjusted difference for the site is now less than +/- 25% and within the ideal +/- 10%, an adjustment factor is not deemed necessary for the modelling.

Birmingham
0121 389 1472

London
0203 968 9817

info@airandacoustics.co.uk
airandacoustics.co.uk