Air Quality Assessment

2-8 Danson Road, Bexleyheath

October, 2019

Strutt & Parker

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Table of Contents

List of Figures

List of Tables

Glossary of Terms

Term	Definition
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objectives
AQS	Air Quality Strategy
ASR	Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMP	Dust Management Plan
EHO	Environmental Health Officer
EPUK	Environmental Protection UK
EU	European Union
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LNR	Local Nature Reserve
LAQN	London Air Quality Network
LBB	London Borough of Bexley
NAQS	National Air Quality Strategy
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NRMM	Non-road Mobile Machinery
PM	Particulate Matter
Ramsar Sites	Designated Wetland
RBG	Royal Borough of Greenwich
SAC	Special Areas of Conservation
SPA	Special Protection Areas
SSSI	Sites of Special Scientific Interest
S&P	Strutt & Parker
WHO	World Health Organisation

1 Introduction

Strutt & Parker (S&P) are seeking planning permission for the demolition of four two-storey semi-detached dwellings, to be replaced with by a new 70-bed care home at 2-8 Danson Road, Bexleyheath. This is hereafter referred to as the proposed development.

DustScanAQ (DS) were instructed by S&P to produce an Air Quality Assessment to support the planning application, which will be determined by the London Borough of Bexley (LBB).

DS emailed a proposed scope of work to the LBB Environmental Health Officer on 18/09/19. At the time of writing, no disagreement to the proposed scope has been received.

The potential air quality impacts arising as a result of the proposed development have been assessed using the latest planning guidance from Environmental Protection UK (EPUK), the Institute of Air Quality Management (IAQM)[1] and the Department for Environment, Food and Rural Affairs (Defra)[2].

1.1 Objectives

This report provides an assessment on the following key issues associated with the construction and operational phases of the proposed development:

- Nuisance, loss of amenity and health impacts associated with the construction phase of the development on sensitive receptors;
- The suitability of the site for the introduction of new residential human health receptors;
- The impact of stack emissions associated with the central plant;
- Whether the proposed development is air quality neutral; and
- Recommendations for mitigation measures where required.

1.2 Proposed Site Location

The proposed development is located within the jurisdiction of LBB at 2-8 Danson Road, Bexleyheath, London. The proposed development is bounded by the A221/A207 to the north, residential properties to east and south and open fields to the west.

The proposed development lies within the LBB borough wide Air Quality Management Area (AQMA), declared on 1st March 2007 for exceedances of the:

- NO_2 annual mean objective;
- PM_{10} annual mean objective; and
- PM_{10} 24-hour mean objective.

There are no nationally designated ecological sites, such as Site of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC) Special Protection Areas (SPA) or

[1] IAQM (2017): 'Land Use Planning and Development Control: Planning for Air Quality v1.2'.
[2] Defra (2016): 'Local Air Quality Management – Technical Guidance (TG16)'.

designated wetlands (Ramsar Sites) within close proximity of the proposed development site. The nearest nationally designated ecological site is Oxleas Woodlands SSSI, approximately 2.8 km to the west. The proposed development site, the LBB borough wide AQMA and the Oxleas Woodlands SSSI are illustrated in Figure 1.1.

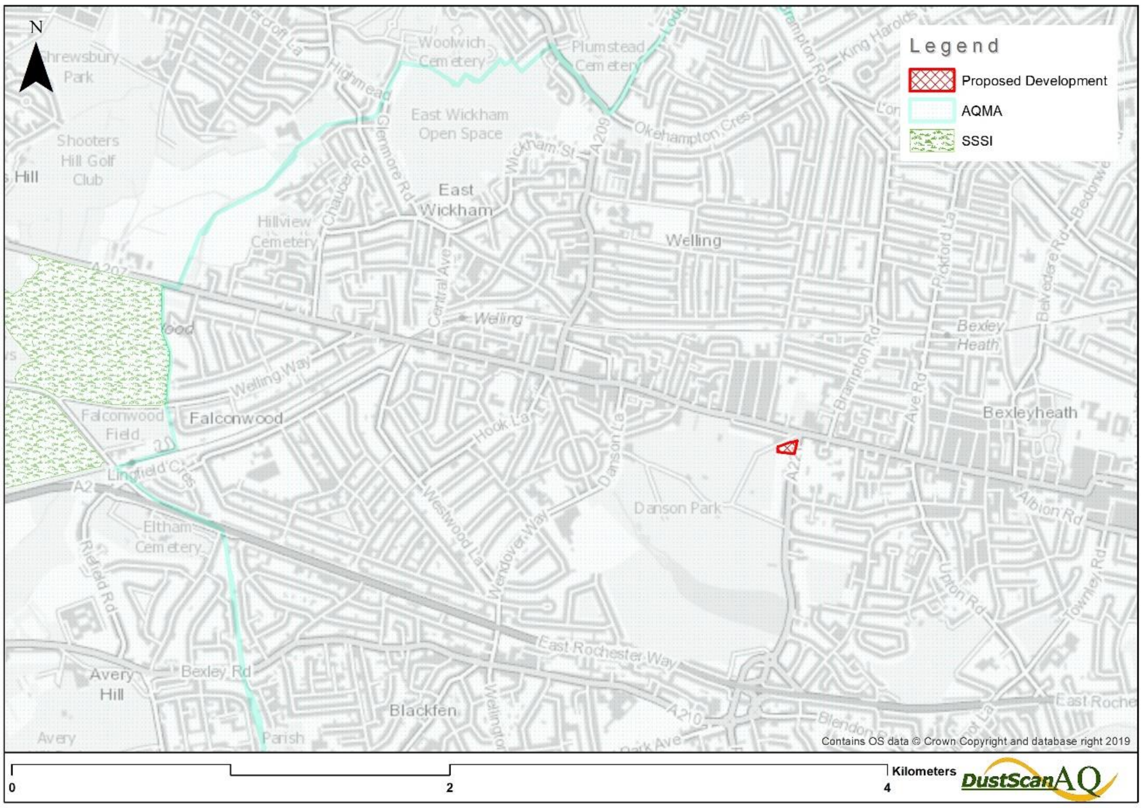


Figure 1.1: Proposed development site location

1.3 Key Pollutants

The key pollutant associated with the construction phase of the project will be 'disamenity' or 'nuisance' dust. Nitrogen dioxide (NO_2) and particulate matter ($PM_{2.5}$ and PM_{10}) may also be associated with emissions from non-road mobile machinery (NRMM) and construction related traffic.

The key pollutants associated with the operational phase of the proposed development will be road traffic emissions including NO_2 and particulate matter ($PM_{2.5}$ and PM_{10}). These pollutants are therefore considered as part of this assessment.

Further details of the key pollutants are presented below.

1.3.1 Nitrogen Dioxide (NO_2)

NO_2 and nitric oxide (NO) are collectively referred to as oxides of nitrogen (NO_x). During fuel combustion, atmospheric nitrogen combines with oxygen to form NO, which is not considered harmful. Through a chemical reaction with ozone (O_3), NO further combines with oxygen to create NO_2 which can be harmful to human health and vegetation. The foremost sources of NO_2 in the UK are combustion activities, mainly road transport and power generation.

1.3.2 Particulate Matter

Particulate matter as a term refers to a mixture of solid particles and liquid droplets suspended in the air. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, such as dust, dirt, soot or smoke, are large or dark enough to be seen with the naked eye. Others can be so small that they can only be detected using an electron microscope. Fine dust, essentially particles up to 10 microns (µm), is commonly referred to as PM_{10}.

PM_{10} is known to arise from a number of sources such as construction sites, road traffic movement, industrial and agricultural activities. Very fine particles ($PM_{0.1}$ – $PM_{2.5}$) are known to be associated with pollutants such as NO_x and sulphur dioxide (SO_2) emitted from power plants, industrial installations and road transport sources.

$PM_{2.5}$ is generally associated with combustion and traffic sources and is more likely to be associated with the operational phase of the proposed development.

1.3.3 Disamenity Dust

'Dust' is generally regarded as particulate matter up to 75 µm in diameter and in an environmental context can be considered in two size categories; coarser dust (particles greater than 10 µm) and fine particulate matter (PM_{10} and $PM_{2.5}$) as described above.

Coarser dust (particles greater than 10 µm) is generally regarded as 'disamenity dust' and can be associated with annoyance, although there are no official standards for dust annoyance[3]. Disamenity dust is more readily described than defined as it relates to the visual impact of short-lived dust clouds and the long-term soiling of surfaces.

Although it is a widespread environmental phenomenon, dust is also generated through many anthropogenic activities including materials handling, construction, demolition and vehicle use. Dust is generally produced by mechanical action on materials and is carried by moving air when there is sufficient energy in the airstream. More energy is required for dust to become airborne than for it to remain suspended.

[3] Note that the expression 'nuisance dust' refers here to 'generally visible particulate matter' rather than specifically and in a legal sense to statutory nuisance, as defined in Section 79 of the Environmental Protection Act 1990.

2 Legislation, Policy and Non-Statutory Guidance

This section summarises all legislation, policy, statutory and non-statutory guidelines relevant to the proposed development. Furthermore, the latest regional and local planning policy guidance specifically applicable to the proposed development has been reviewed.

2.1 International (European Union)

The European Union (EU) sets legally binding limit values for outdoor air pollutants to be met by EU countries by a given date. These limit values are based on the World Health Organisation (WHO) guidelines on outdoor air pollutants. These are legally binding and set out to protect human health and the environment by avoiding, preventing or reducing harmful air pollution effects.

Directive 2008/50/EC[4] on ambient air quality and cleaner air for Europe entered into force in June 2008. This merged the existing 'Daughter' Directives[5,6,7,8] (apart from the fourth Daughter Directive), maintaining existing air quality objectives set out by 'Daughter' Directives for:

- Sulphur dioxide (SO_2);
- Nitrogen dioxide (NO_2);
- Oxides of nitrogen (NO_x);
- Particulate matter ($PM_{2.5}$ and PM_{10});
- Lead (Pb);
- Benzene(C_6H_6);
- Carbon monoxide (CO); and
- Ozone (O_3).

Directive 2008/50/EC also includes related objectives, exposure concentration obligations and exposure reduction targets for $PM_{2.5}$ (fine particles). The 'Daughter' Directives were based upon requirements set out in the first EU Ambient Air Quality Framework Directive 96/92/EEC[9].

2.2 National (England)

The 2008 EU ambient air quality directive 2008/50/EC was transposed into English law through the introduction of the Air Quality (Standards) Regulations in 2010[10] which also

[4] European Union. (2008), 'Ambient air quality assessment management', Framework Directive 2004/50/EC.
[5] European Union. (1999), 'Ambient air quality assessment management', Framework Directive 1999/30/EC.
[6] European Union. (2000), 'Ambient air quality assessment management', Framework Directive 2000/3/EC.
[7] European Union. (2002), 'Ambient air quality assessment management', Framework Directive 2002/3/EC.
[8] European Union. (2004), 'Ambient air quality assessment management', Framework Directive 2004/107/EC.
[9] European Union. (1996), 'Ambient air quality assessment management', Framework Directive96/62/EC.
[10] Statutory Instrument. (2010), 'The Air Quality Standards Regulations', No. 1001. Queen's Printer of Acts of Parliament.

incorporated the fourth EU Daughter Directive (2004/107/EC) that set target values for certain toxic heavy metals and polycyclic aromatic hydrocarbons, (PAH).

The UK government has a legal responsibility to meet the EU limit values. Part IV of the 1995 Environment Act[11] sets guidelines for protecting air quality in the UK and forms the basis of local air quality management. The Environment Act requires local authorities in the UK to review air quality in their area periodically and designate AQMAs where the objectives are not being achieved or are not likely to be achieved within the relevant period. Where an AQMA is designated, local authorities are also required to produce an 'Air Quality Action Plan' (AQAP) detailing the pollution reduction measures that need to be adopted to achieve the relevant air quality objectives within an AQMA.

As part of the Environment Act, the UK Government was required to publish a National Air Quality Strategy (NAQS) to establish the system of 'local air quality management' (LAQM) for the designation of AQMAs. This led to the introduction of the first Air Quality Strategy (AQS) in 1997[12] which has since progressed through several revisions until it was replaced by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007[13]. Each revision introduced strategies and regulations that considered measures for different pollutants by tightening existing objectives and also by introducing new ones to establish a common framework to protect human health and the environment by achieving ambient air quality improvements.

2.2.1 National Planning Policy Framework

The principal national planning policy guidance in respect of the proposed development is the National Planning Policy Framework (NPPF)[14]. The most recent update of the NPPF was published on 24th July 2018 by the Department for Communities and Local Government (DCLG). The NPPF Section 170 (e) states that:

> *"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…"*

Section 180 states that:

> *"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*."

[11] Parliament of the United Kingdom. (1990), 'Environmental Protection Act', Chapter 43. Queen's Printer of Acts of Parliament.

[12] Department for Environment Food and Rural Affairs. (1997), 'The United Kingdom National Air Quality Strategy', Cm 3587, Department for Environment Food and Rural Affairs.

[13] 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.

[14] National Planning Policy Framework. Accessible at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/728643/Revised_NPPF_2018.pdf

Section 181 states that:

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

Section 183 states that:

> *"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."*

2.2.2 National Planning Practice Guidance

The DCLG published a number of supporting web based resources of Planning Practice Guidance (PPG)[15] to supplement the NPPF. With respect to air quality the PPG provides guidance on when air quality is relevant to a planning application. It states that:

> *"Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)."*

The PPG also states that, when deciding whether air quality is relevant to a planning application, the applicant should consider whether the proposal will:

- *"Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. Introduce new point sources of air pollution…..,*
- *Expose people to existing sources of air pollutants…..,*
- *Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations….,*

[15] National Planning Practice Guidance web-based resource. Accessible at: http://planningguidance.planningportal.gov.uk/

- *Affect biodiversity. In particular, is it likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site, and is not directly connected with or necessary to the management of the site, or does it otherwise affect biodiversity, particularly designated wildlife sites."*

A draft revision of the NPPF[16] was published for consultation by the DCLG on the 5th March 2018, with the consultation period closing on the 10th May 2018. The draft contains three sections which are relevant to air quality.

Section 104 states that:

> *"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."*

Section 168 states that:

> *"Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *…*
>
> *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air quality."*

Section 179 states that:

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

2.2.3 Relevant Air Quality Standards

[16] Department for Communities and Local Government (2018) https://www.gov.uk/government/consultations/draft-revised-national-planning-policy-framework

A summary of the relevant AQO and where they are applicable are presented in Table 2.1 and Table 2.2 respectively. The AQO listed in Table 2.1 are only applicable at locations where a member of the public could be reasonably expected to spend the relevant averaging period. Further examples of this are presented in Table 2.2.

Table 2.1: AQO relevant to the proposed development

Pollutant	Averaging Period	AQO (µg/m^3)	Exceedance Allowance	Percentile Equivalent
Nitrogen Dioxide (NO_2)	Annual	40	-	-
	1-hour	200	18 per annum	99.8th
Particulate Matter (as PM_{10})	Annual	40	-	-
	24-hour	50	35 per annum	90.4th
Pariculate Matter (as $PM_{2.5}$)[a]	Annual	25	-	-

Notes: [a] This is a target value set for a 15% reduction in concentrations at urban background aimed to achieve between 2010 and 2020

Source: Department for Environment Food and Rural Affairs (2016): 'Local Air Quality Management Technical Guidance' (TG.16).

Table 2.2: Examples of where the AQO should apply

Averaging period	Objectives should apply at	Objectives should not apply at
Annual	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
24 Hour	All locations where the annual mean objective would apply, together with hotels and gardens of residential properties[a].	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.
1 Hour	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the	Kerbside sites where the public would not be expected to have regular access.

Averaging period	Objectives should apply at	Objectives should not apply at
	public might reasonably be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably have expected to spend one hour or longer.	

Note:

(a) "*Such locations should represent parts of the garden where relevant public exposure to pollutants is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.*"

Source:

Department for Environment Food and Rural Affairs (2016): 'Local Air Quality Management Technical Guidance' (TG.16).

2.2.4 Statutory Nuisance

It is recognised that the planning system presents a way of protecting amenity. However, in cases where planning conditions are not applicable to a development/installation, the requirements of the Environmental Protection Act 1990 still apply. Under Part III of the Environmental Protection Act 1990, local authorities have a statutory duty to investigate any complaints of:

- *"any premises in such a state as to be prejudicial to health or a nuisance*
- *smoke emitted from premises so as to be prejudicial to health or a nuisance*
- *fumes or gases emitted from premises so as to be prejudicial to health or a nuisance*
- *any dust, steam, smell or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance*
- *any accumulation or deposit which is prejudicial to health or a nuisance"*

Where the local authority establishes that any one of these issues constitutes a statutory nuisance and believes it to be unreasonably interfering with the use or enjoyment of someone's premises and/or is prejudicial to health, an abatement notice will be served on the person responsible for the offence or the owner / occupier. Failure to comply with the notice could lead to a prosecution. It is however considered as a defence if the best practicable means to prevent or to counteract the effects of the nuisance are employed.

2.3 Local (LBB)

2.3.1 London Borough of Bexley Core Strategy

The LBB Core Strategy[17], adopted by LBB in February 2012, sets out how LBB propose the borough develops over the next 15 years.

[17] London Borough of Bexley. (2012), 'Bexley Core Strategy'.

The Local Plan contains one policy which relates directly to air quality with regards to the proposed development. Policy CS01: Achieving sustainable development, states that:

"The Council will seek to achieve sustainable development, in line with the vision set out in Bexley's Sustainable Community Strategy, to create a 'strong, sustainable and cohesive community', in order to provide people equal access to a better quality of life, protect the environment, promote the local economy and encourage an active and healthy lifestyle.

Developers will be required to address the sustainable development principles set out below.

In conjunction with the requirements identified in this Core Strategy, as well as the requirements of all other documents that make up Bexley's Development Plan, sustainable development will be achieved by applying the following principles:

a. adapting to and mitigating the effects of climate change, including sustainably retrofitting existing building stock where possible;
b. maximising the effective and efficient use of natural and physical resources, including land, water and energy, whilst addressing pollution issues, such as contamination, noise and air quality, to contribute to the health and well being of the community and the environment".

LBB is currently consulting on a new local plan, which will replace the LBB Core Strategy when it is adopted. The current consultation document contains preferred detailed policy approaches, but no draft policies.

2.3.2 Air Quality Action Plan

The LBB Air Quality Action Plan, contained with the status reports, details a number of actions to improve air quality across the borough.

The actions are split into 7 categories:

- Working in partnership with the Environment Agency;
- Working in partnership with businesses;
- Vehicle cleaning;
- Road surface cleaning;
- Speed reduction;
- Development control; and
- Road surface contamination.

3 Methodology

This section sets out the approach taken to assess the potential impacts on air quality during the construction and operational phases of the proposed development.

3.1 Scope of the Assessment

The assessment is based on the following scope of work presented in Table 3.1:

Table 3.1: Scope of Work

Scope	Consideration
Spatial	The assessment considers those roads which have the potential to significantly change traffic as a result of the proposed development. Impacts on air quality arising from traffic related emissions are considered unnoticeable above background concentrations beyond 200 m from the source[18]. Hence, this assessment only considered receptors within 200 m from a road source. Sensitive receptors that are likely to experience greatest change in concentration in terms of traffic related emission as a result of the proposed development are considered within this assessment. The assessment considers the impact of NO_2, PM_{10} and $PM_{2.5}$ emissions from the local roads on the residential suitability of the proposed development location. This assessment considers the air quality impact on receptors from the continuous running of installed plant.
Temporal	The construction phase impacts resulting from the proposed development have been considered for the earliest anticipated construction year (2020). The operational phase impacts resulting from the proposed development have been considered for the earliest possible year of occupation (2022).

3.2 Construction Phase Assessment

The proposed development has the potential to generate dust during the construction phase of the project. Although there are no standards (such as AQO) for dust disamenity or annoyance, various 'customs and practice' criteria have become established.

For the purposes of this assessment, IAQM's 2016 Construction Dust Risk guidance[19] has been used to carry out a construction dust risk assessment. The IAQM guidance provides

[18] Highways England (2007), Design Manual for Roads and Bridges (DMRB), Volume 11 Section 3 Part 1 Air Quality. Available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf.
[19] Institute of Air Quality Management (2016): 'Guidance on the Assessment of Dust from Demolition and Construction'

a methodology (Appendix B) to evaluate potential risk of dust generation for a development and the level of mitigation required. The impact of the development is described using one of the following three categories: ‘Low Risk’, ‘Medium Risk’ and ‘High Risk’. Based on the risk level, appropriate mitigation measures can be considered to minimise any risk of dust impacts from the construction phase.

3.3 Operational Phase Assessment

As discussed in Section 1.1, the elements of the assessment which require dispersion modelling are:

- The suitability of the site for the introduction of new residential human health receptors; and
- The impact of stack emissions associated with the central plant.

This assessment assesses both road and point source emissions and their impact at four worst-case human health receptors at the façade of the proposed development. Road and point sources have been modelled separately using ADMS-Roads and ADMS 5 respectively. These contributions have then been combined to assess the total impact at these receptors.

3.4 Road traffic emissions

3.4.1 Modelled Scenarios

The number of daily vehicular movements associated with the operational phase of the proposed development triggers the indicative criteria necessitating modelling of transport emissions (see section 3.4.3).Therefore, road source modelling has been undertaken to assess the impact of the development on local air quality as well as the residential suitability of the proposed development.

The earliest possible year of occupation is 2022. Based on the above, the following scenarios have been considered:

- 2017 Model Verification Year; and
- 2022 With Proposed Development.

According to the guidance provided by Defra in their Air Quality Strategy, vehicle emissions are expected to decrease in future years as a result of advancement in abatement technologies. It is also expected that more stringent emission limits will be imposed upon manufacturers.

Based on the above, the 2022 operational year scenario was considered to be the worst case and therefore no additional future year scenario was considered in this assessment.

3.4.2 Dispersion Model Selection

The assessment on identifying the impact of current traffic related emissions sources in the area of the proposed development has been carried out using the latest version of ‘ADMS-

Roads' Dispersion Modelling PC based software (version 4.1.1) developed by Cambridge Environmental Research Consultants (CERC). This model is commonly used in planning application and regulatory assessment of traffic related emissions.

3.4.3 Road Traffic Data

The IAQM and EPUK planning guidance which informs this assessment contains indicative criteria on when to proceed to a Detailed Air Quality Assessment (AQA). The criteria relating to changes in traffic flow are as follows:

A change of HDV flows of:

- More than 25 annual average daily traffic (AADT) flows within, or adjacent to, an AQMA;
- More than 100 AADT elsewhere.

A change of LDV flows of:

- More than 100 AADT within or adjacent to an AQMA;
- More than 500 AADT elsewhere.

The proposed development is located within an AQMA; therefore, the more stringent criteria apply. There is parking provision for 17/18 vehicles associated with the proposed development, with an anticipated AADT of 133 vehicles. Based on the IAQM/EPUK criteria set out in Appendix A, the need for detailed traffic modelling has been scoped into this assessment.

Traffic data related to the operation of the proposed development has been provided by the appointed transport consultant, Ardent Consulting Engineers Limited.

Traffic data required for modelled links has been acquired from Department for Transport (DfT) manual count points[20] 26805, 46794, 56786 and 26102. These count points are representative of the A221, A207 and A2 respectively.

The A2 was required for verification purposes and the A221 and A207 are the principle pollution source of concern with respect to the residential suitability of the proposed development location.

Vehicle traffic generated by the proposed development will travel along the A221 and/or the A207. For modelling purposes, the total anticipated AADT has been applied to all modelled links along the A221 and A207 as a conservative measure and in the absence of data on vehicle splits between these roads.

For verification, manual count data from 2017 was used. For modelled links in the 'with proposed development 2022' model, traffic data has been factored up from the latest DfT manual count figures. TEMPro v7.2 was used to produce the applied factors. Table 3.2 below presents for each DfT count point the road it corresponds to, the latest year of manual count data and the TEMPro factor applied.

[20] Department for Transport. Accessible at: https://www.dft.gov.uk/traffic-counts/

Road dimensions were determined from digital satellite images.

Table 3.2: TEMPro factors

DfT Count Point	Road	Manual Count Year	TEMPro Factor
26805	A221	2017	1.0489
46794	A207	2013	1.0894
56786	A207	2016	1.0591

Vehicle speeds at 'busy' junctions (defined by Defra as those with over 10,000 AADT) were assumed to be 20 kph and vehicle speeds at minor junctions were assumed to be 10 kph below the road speed limit.

Table 3.3 shows the traffic data for the 'with proposed development 2022' scenario and Figure 3.1 shows the extent of the ADMS-Roads dispersion modelling network.

Table 3.3: Traffic data

Link Name	With Proposed Development (2022)		
	AADT	HDV%	Speed (kph)
A221	28835	1.82	48.3
A207 (W)	17618	5.45	48.3
A207 (E)	14103	6.80	48.3

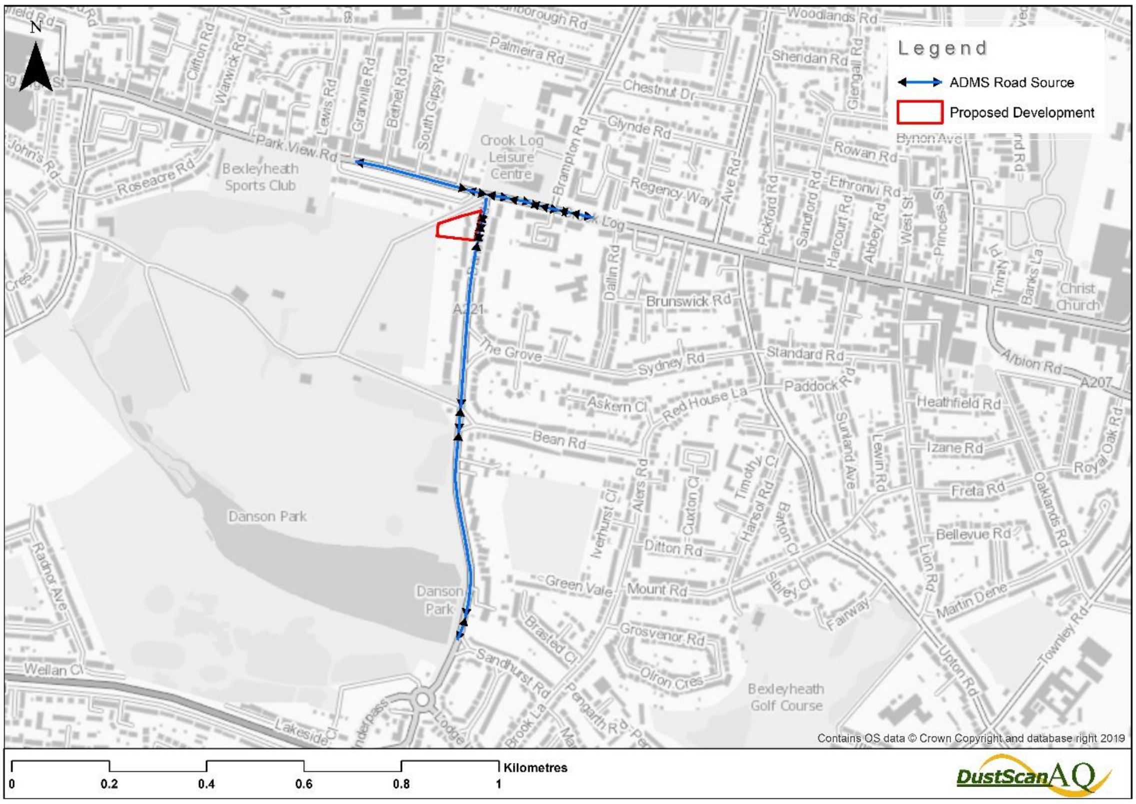


Figure 3.1: Modelled road network

3.4.4 Emission Factors

The NO_x, PM_{10} and $PM_{2.5}$ road source emissions are calculated from traffic flow data using the latest Defra Emission Factor Toolkit (EFT 9.0, May 2019). The EFT Version 9.0 has been developed for the UK by the National Atmospheric Emissions Inventory (NAEI) and Transport for London (TfL). The EFT is based on data collected from a number of sources including the European Environment Agency (EEA) COPERT (Computer Programme to calculate Emissions from Road Transport) emission calculator.

A typical national diurnal profile derived from the latest available DfT data is shown below in Figure 3.2. The profile applies a multiplying factor to calculated emissions data to represent changes in traffic patterns throughout the day on weekdays, Saturdays and Sundays.

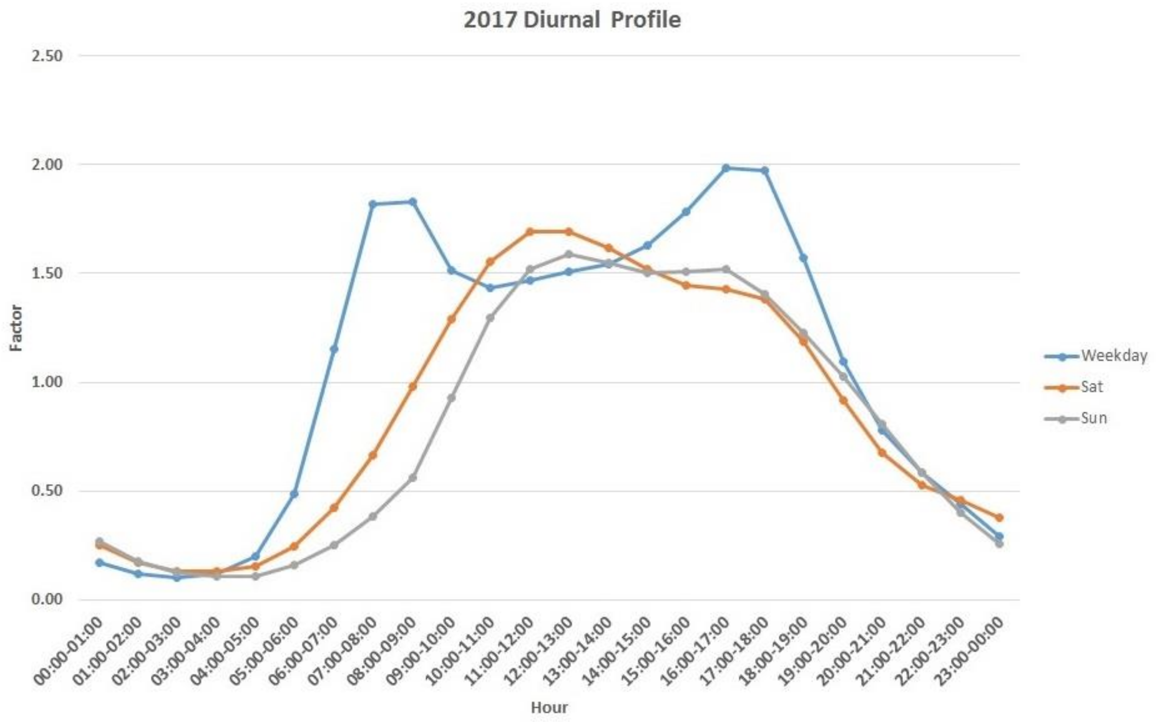


Figure 3.2: Diurnal traffic profile based on DfT 2017 traffic data

3.4.5 Meteorological Data

The key meteorological parameters for dispersion modelling are wind speed and wind direction. Other meteorological parameters, such as cloud cover, surface temperature, precipitation rate and relative humidity are also taken into account.

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.

Based on the above, the most representative meteorological monitoring station with sufficient data is Heathrow, which is located approximately 38 km west of the site.

In order to account for a variety of meteorological conditions, the qualitative assessment and dispersion modelling have been carried out with the latest available meteorological data from the period 2016 to 2018.

Figure 3.3 below presents the wind rose for each modelling year.

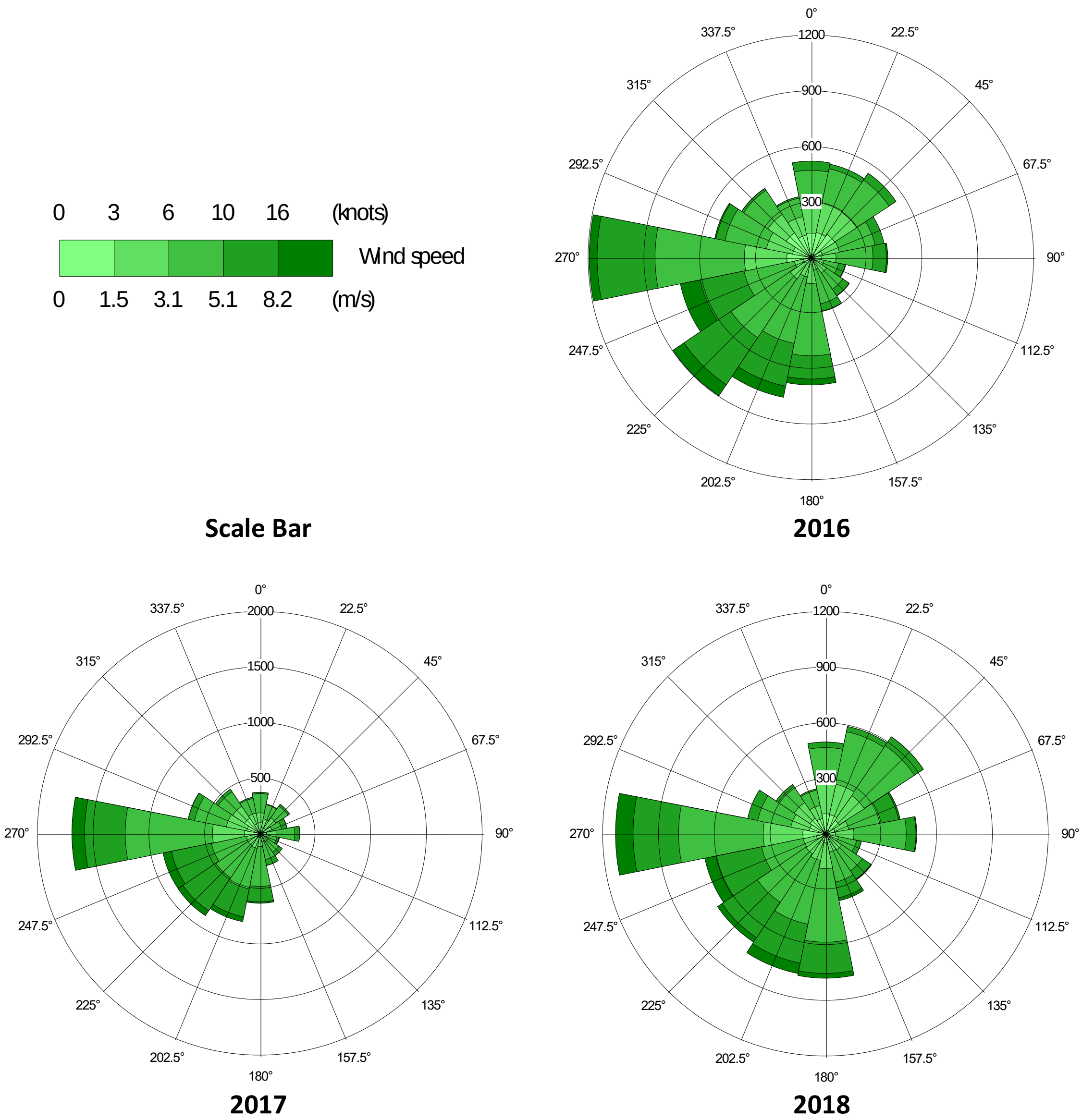


Figure 3.3: Heathrow Meteorological Station Windrose Plots 2016 - 2018

3.4.6 Surface Roughness

The roughness length (z0) was set to 0.5 m (parkland, open suburbia) for both the dispersion site and meteorological site.

3.4.7 Minimum Monin-Obukhov Length

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 modelling study to describe both the dispersion site and the meteorological site. This value is considered appropriate for the nature of the surrounding areas.

3.4.8 NO_x to NO_2 Relationship

As discussed in Section 1.5.1, emissions of NO_x will comprise contributions from both NO and NO_2. This assessment uses the latest NO_x to NO_2 conversion factor toolkit (Version 7.1 released April 2019), provided by Defra as a Microsoft Excel based calculation tool which is available from Defra's web-based air quality resource centre[21]. This method is considered the most appropriate technique of determining NO_2 concentrations from road NO_x contributions.

3.4.9 Estimating Hourly and Daily Mean Concentrations

The latest Local Air Quality Management (LAQM) Technical Guidance TG (16) has been used for predicting 1 hourly and 24-hourly pollutant concentrations.

The guidance states that the one hour mean NO_2 AQO of 200 µg/m^3 is not likely to be exceeded at any roadside locations if the annual mean concentration is below 60 µg/m^3. Based on this guidance, the hourly mean NO_2 AQO is only considered when the annual mean NO_2 concentrations are over 60 µg/m^3.

In accordance with the guidance, the short term 24 hourly PM_{10} mean concentration can be calculated using the following equation as presented below:

$$Number\ \ of\ 24\ hour\ mean\ exceedences = 18.5 + 0.00145\ x\ annual\ mean^3 + (\frac{206}{annual\ mean})$$

3.5 Point-source emissions

3.5.1 Dispersion Model Selection

Dispersion modelling was undertaken using ADMS-5.2 (v5.2.2.0), 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.

The model typically requires the following input data:

- Extent of the modelling area;
- Locations and dimensions of all sources and nearby structures;
- Output grid and 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;
- Surface roughness; and
- Monin-Obukhov length.

3.5.2 Modelled Scenarios

[21] Department for Environment Food and Rural Affairs. Air Quality Information Resource (Air) Website, available at: http://uk-air.defra.gov.uk/

The modelling scenarios considered for this assessment are:

- 2022 (worst-case scenario).

The model outputs have been set up for both the long-term (annual mean) NOx concentration and the short-term (one hour mean) 99.79th %ile NOx concentration.

Further details on the NOx to NO_2 relationship and conversion rates are in Section 3.5.9.

3.5.3 Site Layout (Building and Structural Effects)

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.

Advice was sought from the CERC helpdesk on which buildings to include in the model and which building should be selected as the 'main' building. Following their advice, a sensitivity test was carried out and the main building was selected as 'New Building 1'.

The grid references and the size dimensions of all buildings included in the dispersion model are set out below in Table 3.4. The modelled buildings are represented visually in Figure 3.4.

Table 3.4: Modelled building dimensions

Name	Shape	X (m)	Y (m)	Height (m)	Length (m)	Width (m)	Angle (°)
Building 1	Rectangular	547608.6	175503.1	9	23.0	14.9	171
Building 2		547606.2	175480.1	9	16.0	26.4	95
Building 3		547582.0	175496.6	6	40.5	15.3	261

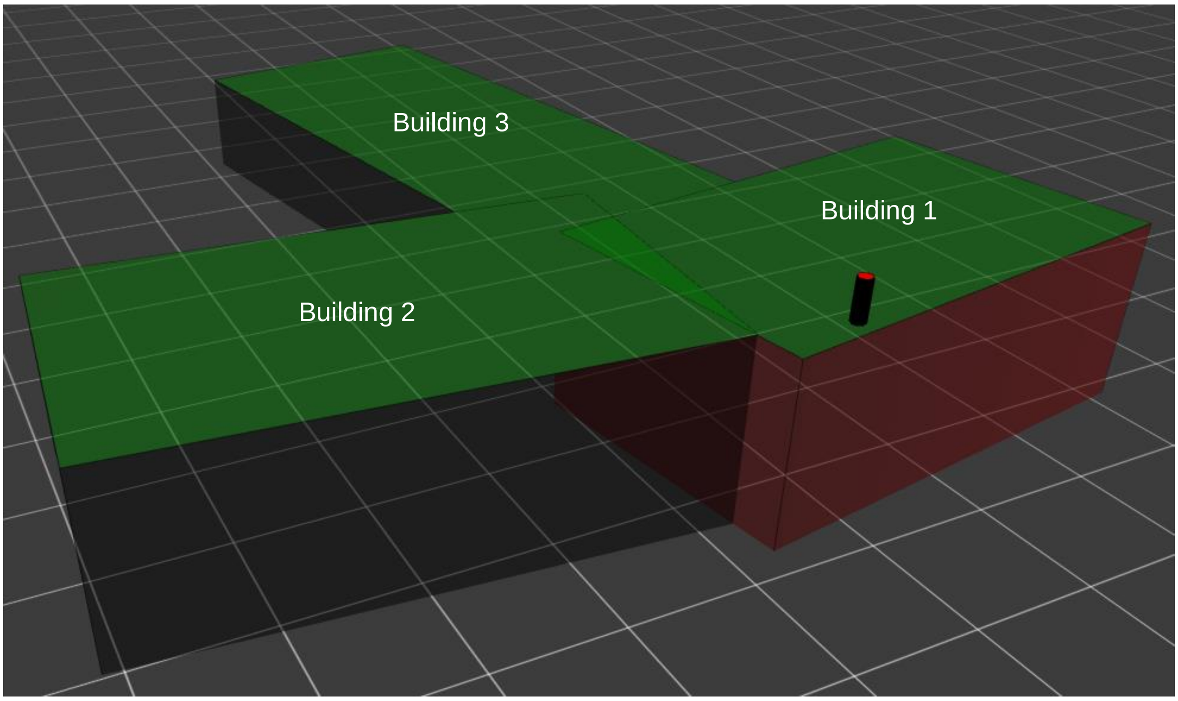


Figure 3.4: Modelled Buildings

3.5.4 Source and Emission Parameters

At the time of writing, there are no project specific source parameters or emissions data. Therefore, data has been taken from an air quality assessment produced by MLM Consulting Engineers Limited (MLM) for a 55-unit extra care facility in Kensington[22]. This consented development has the same usage class and is of a similar size to the proposed development, therefore the plant and energy use is likely to be comparable. In the absence of site-specific data, these data have therefore been deemed a suitable proxy for the purpose of point source modelling.

The model inputs are summarised in Table 3.5 and Table 3.6.

Table 3.5: Source Parameters

Parameter	Boiler	CHP
Internal Stack Diameter (m)	0.5	0.1
Stack Height (m)	11	11
Stack area (m^2)	0.20	0.01
Temperature of release (ºC)	71	120
Emission Velocity at Stack Exit (m/s)	1.0	5.8

Table 3.6: Emissions Data

Point Source	NOx Emission Rate (g/s)

[22] Royal Borough of Kensington and Chelsea planning portal reference PP/17/00583

Boiler	0.00821
CHP	0.00750

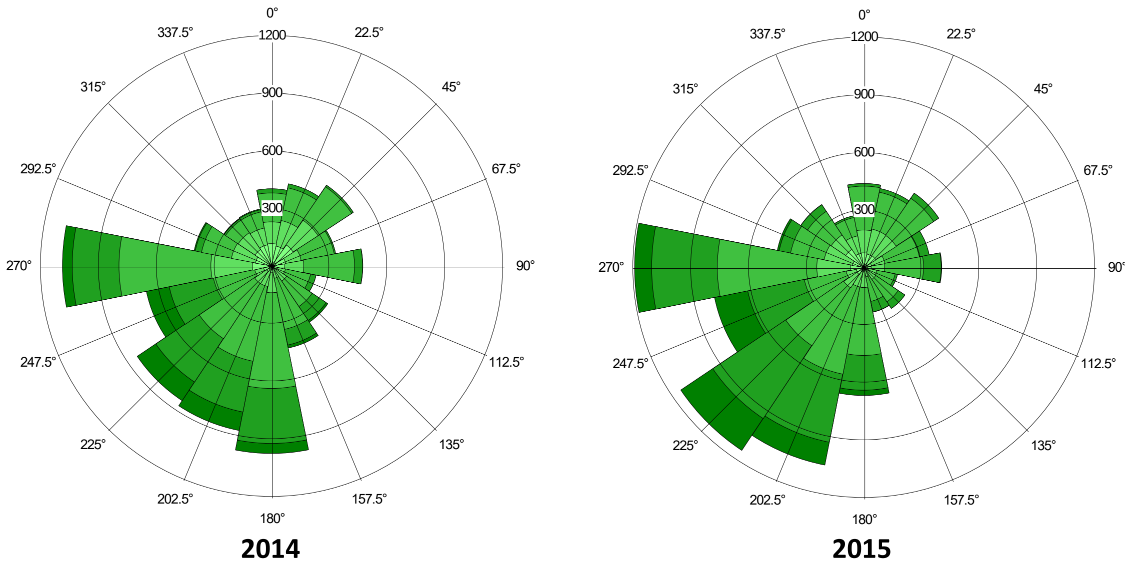
3.5.5 Meteorological Data

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 taken into account.

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.

Based upon the above, the most representative meteorological monitoring station identified is Heathrow meteorological station, which is located approximately 38 km west of the proposed development.

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. Figure 3.5 below presents the wind rose for each modelled year.



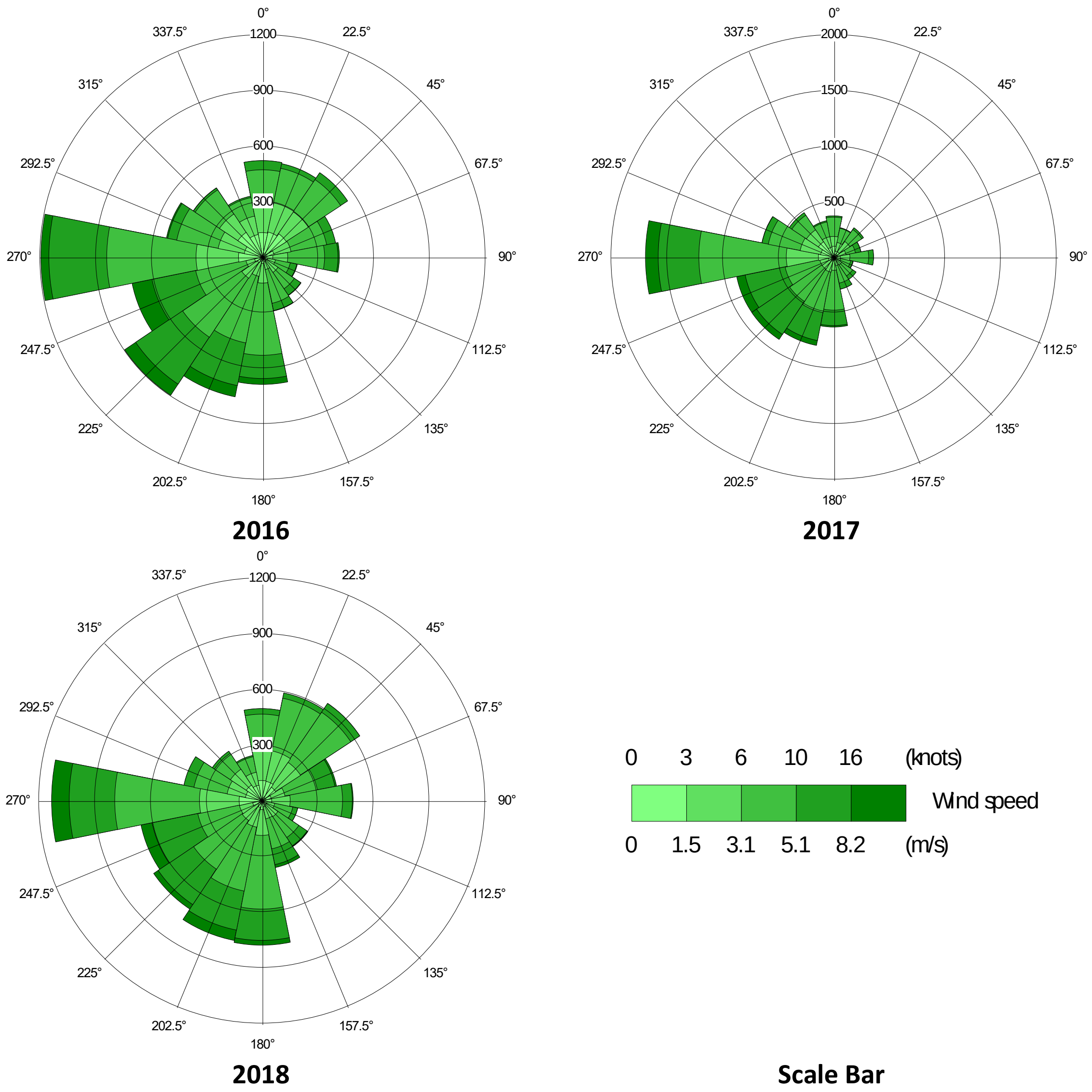


Figure 3.5: Heathrow meteorological station Windrose Plots: 2014 - 2018

3.5.6 Topography

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.

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 in the region surrounding the proposed development is generally flat and therefore no terrain data has been used in the model.

3.5.7 Surface Roughness

The surface roughness length (z0) was set to 0.5 m (parkland, open suburbia) for both the dispersion and meteorological sites.

3.5.8 Minimum Monin-Obukhov Length

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 both the modelling area and the metrological station location. This value is considered representative of the respective surrounding areas.

3.5.9 NOx to NO_2 Relationship

As discussed in Section 1.5.1, 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.

As NO_2 emissions from the engines are only one constituent of the total NO_x emissions, an allowance of the NO_2 proportion of NO_x needs to be made. The exact proportion of NO_2 in NO_x emissions from the development is unknown.

Empirical estimates made by Janssen et al[23], which are based on a comprehensive study of observations within power station plumes. This method, which is considered to be more realistic, suggests that the conversion would be in the order of 10 – 20% within 1 – 2km of the release point.

In accordance with guidance provided by the Environment Agency Air Quality Modelling and Assessment Unit[24], it is assumed that 70% of the total NO_x emissions from the plant will be converted into NO_2 over the long-term period, with 35% of the of the total NO_x emissions from the plant will be converted into NO_2 over the short-term period. This is a 'worst case' approach when compared to other research.

3.6 Modelled Receptors

Worst-case human health receptors have been considered within this assessment in order to carry out a comparison against the AQO. Receptors have been located on the facade of the proposed development fronting the A221 at four worst-case locations at heights representative of each floor of the proposed development. Lower floors are those receptors closest to the road source are most vulnerable to road source air quality impacts. Upper floors are assessed due to their proximity to point-source emissions. These receptors, R1-R12, principally assess residential suitability at the proposed development.

Receptors at residential dwellings close to the proposed development have also been considered to assess the impact of the proposed development on existing receptors.

Table 3.7 details the modelled discreet receptors, with Figure 3.6 and Figure 3.7 illustrating their locations.

LAQM guidance clarifies where likely exceedances of the objectives should be assessed and states that Review and Assessment should focus on *"locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time*

[23] L.H.J.M. Janssen, J.H.A. Van Wakeren, H. Van Duuren and A.J. Elshout, A Classification of NO Oxidation Rates in Power Plant Plumes Based on Atmospheric Conditions, Atmospheric Environment Vol. 22, No. 1, pp. 43 – 53. 1988.

[24] Environment Agency: Air Quality Modelling and Assessment Unit, Conversion rates for NO_x and NO_2. http://webarchive.nationalarchives.gov.uk/20140328232919/http:/www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

appropriate to the averaging period of the relevant air quality objective" [25]. The receptors most likely to experience the greatest change in pollution concentrations from the proposed development were selected based on professional judgement.

Table 3.7: List of receptors

Receptor ID	X (m)	Y (m)	Z (m)
R1	547616.5	175504.1	1.5
R2	547616.5	175504.1	4.5
R3	547616.5	175504.1	7.5
R4	547616.2	175492.6	1.5
R5	547616.2	175492.6	4.5
R6	547616.2	175492.6	7.5
R7	547614.4	175478.5	1.5
R8	547614.4	175478.5	4.5
R9	547614.4	175478.5	7.5
R10	547613.6	175471.9	1.5
R11	547613.6	175471.9	4.5
R12	547613.6	175471.9	7.5
R13	547608.9	175435.7	1.5
R14	547644.9	175457.2	1.5
R15	547655.4	175499.6	1.5
R16	547669.2	175538.3	1.5
R17	547620.4	175578.5	1.5

[25] Department for Environment, Food and Rural Affairs (2016), Local Air Quality Management – Technical Guidance (16)

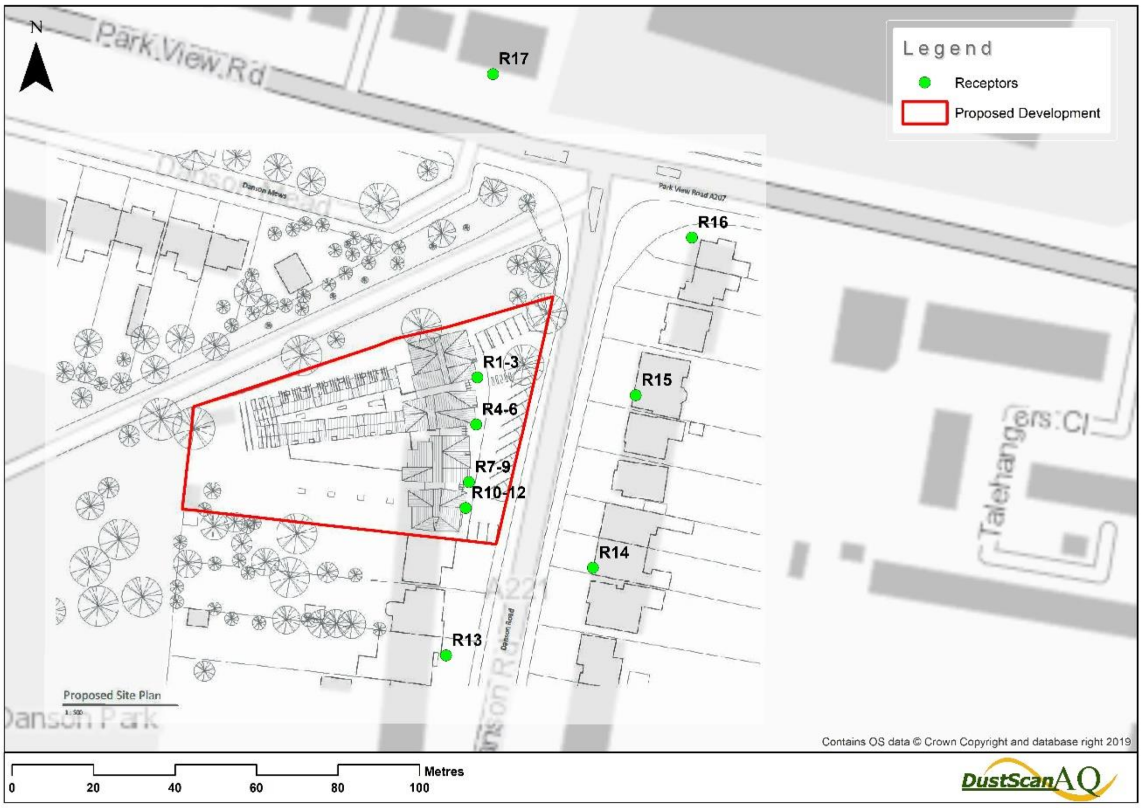


Figure 3.6: Receptors with respect to the proposed development

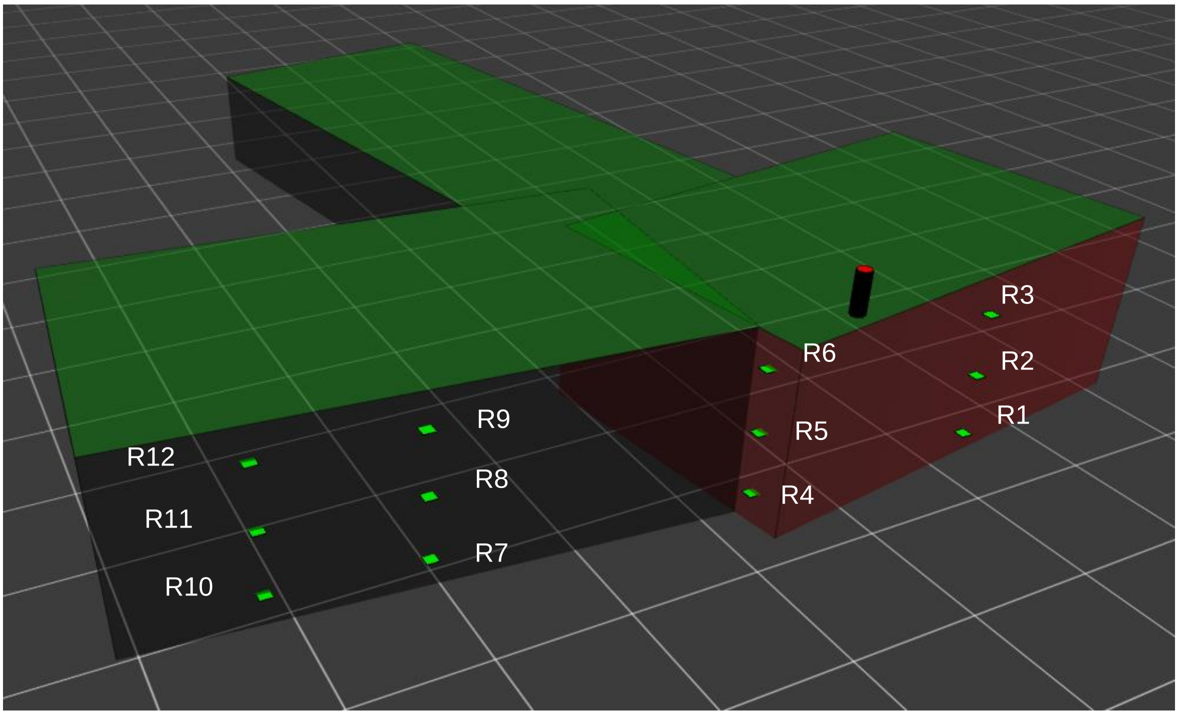


Figure 3.7: 3D view of receptors R1-R12 with respect to the point sources

3.7 Significance Criteria

For the purposes of this assessment, the IAQM and EPUK (2017) criteria have been used for calculating the magnitude descriptors for predicted change in annual mean concentrations at individual receptors (Table 3.8). The IAQM recognise that professional judgement is required in the interpretation of air quality assessment significance. Table 3.8 is intended to be used as a tool to assist with interpretation of the air quality assessment.

Table 3.8: Impact descriptors for predicted change in annual mean concentrations at individual receptors (Reproduced from EPUK and IAQM Guidance)

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

Notes: [1] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.

[2] The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The numbers are treated with their likely accuracy in order to avoid assumption of false level of precision. For example, Changes of 0%, i.e. less than 0.5% will be described as Negligible.

[3] The Table is only designed to be used with annual mean concentrations.

[4] Descriptors are used for individual receptors only; the overall significance is determined using professional judgement. For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.

[5] When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.

The IAQM/EPUK guidance also provides advice for determining the magnitude of change for hourly mean NO_2 concentrations, with in regard to the proposed on-site combustion plant and particularly impacts at height. Table 3.9 recreates the guidance into a matrix.

The impact descriptor is determined by considering the process contribution only. However, consideration is also given to total pollutant concentrations, including background concentrations, and comparison of these with the hourly mean NO_2 objective.

Table 3.9: Magnitude of Change for Hourly Mean NO_2 Concentrations

Change in Hourly Mean Concentrations in the Assessment Year	Magnitude of Change	Impact Descriptor
<10 % of hourly mean NO_2 threshold	Imperceptible	Negligible
11-20 % of hourly mean NO_2 threshold	Small	Slight

Change in Hourly Mean Concentrations in the Assessment Year	Magnitude of Change	Impact Descriptor
21-50 % of hourly mean NO_2 threshold	Medium	Moderate
>51 % of hourly mean NO_2 threshold	Large	Substantial

3.8 Modelling Assumptions, Uncertainties and Exclusions

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

Roads:

- Uncertainties regarding vehicle emissions;
- Uncertainties with recorded meteorological data; and
- Simplifications made in the model algorithms or post processing of the data that describe atmospheric dispersion or chemical reactions.

Plant:

- This assessment has been carried out based on the current understanding of the current operating profile;
- All plant operates for 24 hours a day throughout the year;
- Emission data and source parameters has been obtained from an assessment by MLM of a similar facility and used as a proxy, further details in section 3.5.4; and
- The assessment has been carried out with the assumption of worst-case emissions concentrations. However, the potential for lower emissions discharge exists, which could result in a reduced air quality impact.

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.

For modelling of road sources model verification, a two-stage process, is therefore applied. First, modelled concentrations are compared with monitored concentrations to identify any disparity. Where disparity occurs, the model inputs are revisited to identify any potential errors or opportunity for improvement of the model. Second, where disparity remains following the first stage, model results can be adjusted to account for systematic bias. Further details of the second stage of the model verification carried out for this assessment are presented within Appendix D.

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-Roads and ADMS-5 are widely used atmospheric dispersion models and results have been verified through a number of studies to ensure predictions are as accurate as possible;
- Emission rates - Emissions rates has been calculated to represent a worst-case scenario;
- Receptor locations - Representative rectors are also included to assess NO_2 concentration at each floor of the proposed development;
- 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.
- NOx to NO_2 relationship: NO_x has been converted to NO_2 for both road and point source modelling according to methods outlined in sections 3.4.8 and 3.5.9 respectively; and
- Results were considered in relation to AQO.

4 Baseline Conditions

The following section sets out the baseline conditions in relation to air quality at the proposed development site. For the purpose of this assessment, data has been obtained from the 2016 LBB Annual Status Report (ASR)[26], 2017 Royal Borough of Greenwich (RBG) ASR[27] and the Defra air quality resource website[28].

Defra provides background pollution concentration estimates to assist local authorities in undertaking their 'Review and Assessment' work. This data is available to download from the Defra air quality resource website for NO_x, NO_2, PM_{10} and $PM_{2.5}$ for every 1 km X 1 km grid square for all local authorities. The current dataset is based on 2015 background data and future year projections are available for 2017 to 2030. The background dataset provides breakdown of pollution concentrations by different sources (both road and non-road sources).

4.1 LBB Automatic Monitoring

The latest publicly available LBB ASR details automatic monitoring across the borough in 2016 at four locations. Automatic monitor GB6 located at Falconwood is on the border between LBB and RBG and consequently features in ASRs for both boroughs. The latest data for GB6 is from the latest RBG ASR for 2017.

All four locations are illustrated below in Figure 4.1.

[26] London Borough of Bexley. (2017), 'London Borough of Bexley Air Quality Annual Status Report for 2016'.

[27] Royal Borough of Greenwich. (2018), 'Royal Borough of Greenwich Air Quality Annual Status Report for 2017'.

[28] Department for Environmental Food and Rural Affairs. Accessible at: https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2017

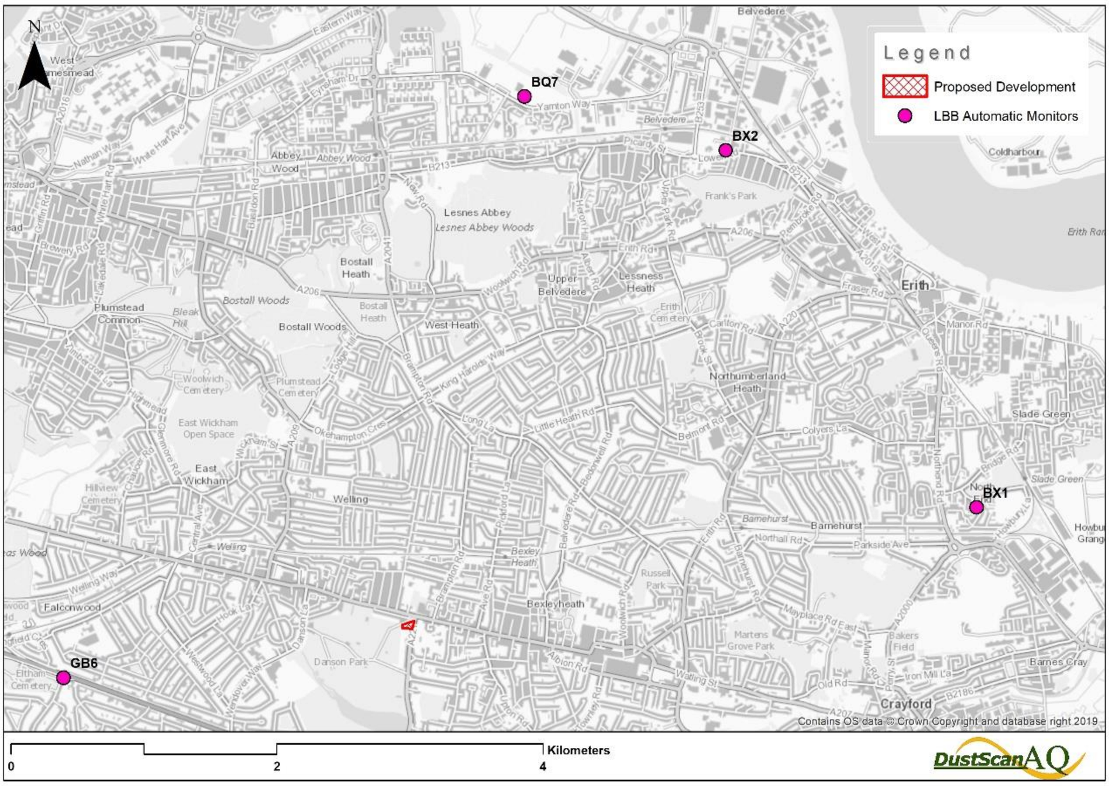


Figure 4.1: LBB Automatic Monitor Locations

All four sites monitor NO_2 and PM_{10}; $PM_{2.5}$ is monitored by only two sites. Table 4.1 to Table 4.5 present the latest three years of available monitoring site for these sites.

Table 4.1: LBB Automatic Monitoring NO_2 Annual Mean Concentrations

Site ID	Site Classification	Annual mean NO_2 Concentration (µg/m^3)		
		2015	2016	2017
BX1	Suburban background	26	25	-
BX2	Urban background	24	29	-
BX7	Urban background	22	24	-
GB6	Kerbside	**41**	**45**	40

Note: Exceedances of annual mean objectives are highlighted in **bold**. All means have been annualised as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%.

Table 4.2: LBB Automatic Monitoring NO_2 1-Hour Mean Concentrations

Site ID	Site Classification	NO_2 1-Hour Means >200 µg/m³ (µg/m³)		
		2015	2016	2017
BX1	Suburban background	0	0	-
BX2	Urban background	0	0	-
BX7	Urban background	0	0	-
GB6	Kerbside	2	3	1

Note: Exceedances of 24-hour mean objectives are highlighted in **bold**.

Table 4.3: LBB Automatic Monitoring PM_{10} Annual Mean Concentrations

Site ID	Site Classification	Annual mean PM_{10} Concentration (µg/m³)		
		2015	2016	2017
BX1	Suburban background	14	18	-
BX2	Urban background	14	14	-
BX7	Urban background	18	15	-
GB6	Kerbside	*22*	*22*	*18*

Note: Exceedances of annual mean objectives are highlighted in **bold**. All means have been annualised as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%.

Values for GB6 are in italics owing to disagreement between the ASRs of LBB and RBG. These values are not used in the assessment.

Table 4.4: LBB Automatic Monitoring PM_{10} 24-Hour Mean Concentrations

Site ID	Site Classification	PM_{10} 24-Hour Means >50 µg/m³ (µg/m³)		
		2015	2016	2017
BX1	Suburban background	1	3	-
BX2	Urban background	1	3	-
BX7	Urban background	2	5	-
GB6	Kerbside	*15*	*7*	*2*

Note: Exceedances of 24-hour mean objectives are highlighted in **bold**.

Values for GB6 are in italics owing to disagreement between the ASRs of LBB and RBG. These values are not used in the assessment.

Table 4.5: LBB Automatic Monitoring $PM_{2.5}$ Annual Mean Concentrations

Site ID	Site Classification	Annual mean $PM_{2.5}$ Concentration ($\mu g/m^3$)		
		2015	2016	2017
BX1	Suburban background	15	11	-
GB6	Kerbside	14	15	13

Note: Exceedances of annual mean objectives are highlighted in **bold**. All means have been annualised as per LAQM.TG16 if valid data capture for the full calendar year is less than 75%.

4.2 LBB Non-Automatic (Diffusion Tube) Monitoring

LBB do not undertake any passive diffusion tube monitoring.

4.3 Defra Modelled Background Pollution Concentrations

Table 4.6 presents the predicted background concentrations for the latest year of available monitoring data (2017) and the earliest anticipated year of occupation (2022) for the proposed development.

Table 4.6: Defra Projected Background Concentrations at proposed development

Year	Annual mean Concentration ($\mu g/m^3$)		
	NO_2	PM_{10}	$PM_{2.5}$
2017	21.0	16.8	11.7
2022	16.6	15.8	10.9

Note: Data presented within the table are derived from the following ordinance survey grid square: 547500,175500.

4.4 Baseline Summary

LBB carries out air quality monitoring at four locations across its borough; there is no passive monitoring. For modelling purposes, the LBB Environmental Health Officer (EHO) has requested that background values are taken from one of the LBB automatic monitors rather than from Defra background modelling.

LBB monitor BX1 was chosen to be representative of background air quality at the proposed development. Monitored concentrations of NO_2 and PM_{10} at BX1 are in line with other background monitors in the borough. BX1 also monitors the concentration of $PM_{2.5}$ unlike the other background monitors.

Data has been taken from the latest publicly available LBB ASR for BX1, containing data for 2016. As can be seen from Defra projected background concentrations in Table 4.6, concentrations of NO_2, PM_{10} and $PM_{2.5}$ are forecast to reduce with time. The selected background concentrations therefore represent a worst-case allowing for no improvement in ambient air quality.

5 Potential Impacts

5.1 Construction Phase

The earliest construction year is likely to be 2020. As demolition activities are anticipated, impacts from demolition have been considered further.

The impacts from earthworks, construction and track-out have also been considered. To assess the worst-case scenario, it has been assumed that all activities will be carried out for the duration of the construction period. Figure 5.1 shows the construction dust assessment study area based on the recommended distances by IAQM.

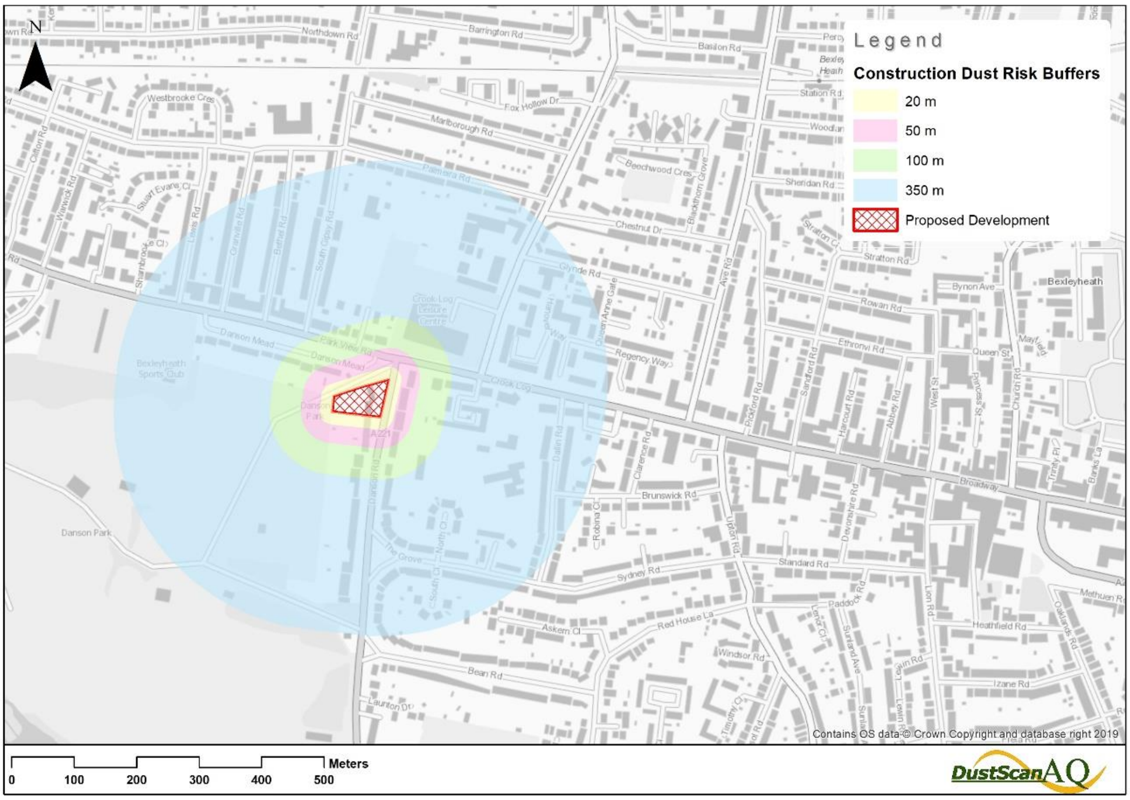


Figure 5.1: Construction Dust Risk Assessment Buffers

Magnitude and sensitivity descriptors that have been applied to assess the overall impact of the construction phase are presented in Appendix B.

The dust emission magnitude for earthworks is expected to be 'Small', as the total site area is less than 20,000 m^3.

The dust emission magnitude for earthworks is expected to be 'Medium', as the total site area is between 2,500 – 10,000 m^2.

The dust emission magnitude for construction is expected to be 'Small', with the total building volume of new buildings expected to be less than 25,000 m^3.

The number of peak daily HGV movements is not known and therefore the dust emission magnitude for trackout has been conservatively assigned as 'Medium'.

There are no ecological receptors within 50 m of the site, therefore the risk of construction dust impacts on ecological receptors are considered to be negligible and are not considered further within the construction dust risk assessment.

Table 5.1: Dust Emission Magnitude

Activity	Dust Emission Magnitude
Demolition	Small
Earthworks	Medium
Construction	Small
Trackout	Medium

It is considered that the residential receptors have a 'High' sensitivity to dust soiling and human health impacts. Table 5.2 presents the sensitivity of the surrounding area to effects caused by construction activities and is based on the criteria presented in Table B.2 within Appendix B.

Table 5.2: Sensitivity of Study Area

Potential Impact	Sensitivity of the surrounding area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Medium	Medium	High
Human Health	Low	Low	Low	Low

The overall risk of dust soiling and human health impacts to high sensitivity receptors are presented in Table 5.3. The risk is based on the criteria presented in Table B.3 to Table B.6 within Appendix B.

Table 5.3: Summary of the Risk of Construction Dust Effects

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low Risk	Medium Risk	Low Risk	Medium Risk
Human Health	Negligible	Low Risk	Negligible	Low Risk

Based upon the above, the greatest risks associated with construction activities are dust soiling from earthworks and trackout which are considered a 'Medium risk'. With respect to human health impacts the risk is no greater than 'Low risk'.

Mitigation measures appropriate for the proposed development have been presented in Appendix C.

Following the implementation of these mitigation measures, the impacts from the construction phase of the proposed development on dust soiling and human health are considered to be not significant.

5.2 Operational Phase

5.2.1 Air Quality Neutral Assessment

Policy within the London Plan requires developments to be 'air quality neutral', the aim of which is to bring forward developments that are air quality neutral or better and that do not degrade air quality in areas where air quality objectives are not currently being achieved.

Guidance for undertaking the assessment are given in the following two documents:

- *The Air Quality Neutral Planning Support Update 2014*
- *Mayor of London Sustainable Design and Construction Supplementary Planning Guidance 2014*

The Sustainable Design and Construction SPG provides typical emission rates of NO_x and PM_{10} for transport and building emissions for each land-use class. The Transport Emission Benchmarks (TEB) are location dependant: as per the guidance typical emission rates have been applied for a development within Inner London. The Buildings Emissions Benchmark (BEB) is not location dependant.

5.2.1.1 Building Emissions

At the time of writing, the energy plant associated with proposed development has not been determined, so the annual emissions in kg/yr associated is not available.

5.2.1.2 Transport Emissions

The TEB for the residential land use (C3) were calculated by combining the SPG typical emission rates of NO_x and PM_{10} with the number of residential units. The TEB is presented in Table 5.4.

Table 5.4: Transport Emission Benchmarks (TEB) for the Proposed Development

Land Use	Number of dwellings or land use GIA (m^2)	(g/dwelling/annum)		Annual Emissions (kg/yr)	
		NO_x	PM_{10}	NO_x	PM_{10}
Residential (C2)	70	1553	267	108.7	18.7

The daily values for cars and motorcycles (133) have been combined and multiplied by 365, to obtain the total number of trips generated per annum.

This value was combined with SPG typical emission rates of NO_x and PM_{10} and trip lengths to provide the Total Transport Emissions (TTE) presented in Table 5.5.

Table 5.5: Total Transport Emissions (TTE) for the Proposed Development

Land Use	Total trips per annum	Emission rate (g/veh/km)		Average distance travelled by vehicle per trip (km)	All Vehicle (Annual Emissions (kg/yr)	
		NO_x	PM_{10}		NO_x	PM_{10}
Residential (C3)	41610	0.353	0.0606	11.4	195.4	33.5

As presented in Table 5.6, the proposed development is above the transport benchmarks for both NO_x and PM_{10}.

Table 5.6: Comparison of TTE against TEB

Land Use	TTE All Vehicle (Annual Emissions (kg/yr)		TEB All Vehicle Annual Emissions (kg/yr)		Is transport benchmark met? (TTE < TEB)	
	NO_x	PM_{10}	NO_x	PM_{10}	NO_x	PM_{10}
Residential (C3)	195.4	33.5	108.7	18.7	No	No

5.2.1.3 Conclusion

The residential element of the proposed development does not meet the transport benchmark. The vast majority of trip generation is from care staff arriving to the proposed development, as well as the delivery of medicines etc.

It would not be possible to reduce vehicle numbers, but emissions could be offset in other ways. Mitigation measures to lower the residential transport emissions are detailed in Section 6.2.2.

As detailed in 5.2.1.1, it has not been possible to determine the building emissions benchmarks.

5.2.2 Modelling Results

As discussed in Section 3.4.3, the A221 and A207 have the potential to impact air quality at the new residential receptors, particularly those on lower storeys. Point source emissions have the potential to impact air quality at new residential receptors at upper storeys of the proposed development.

Additional vehicle trips and the introduction of plant also have the potential to adversely impact existing residential receptors.

The traffic generated by the proposed development and the new point source emissions also have the potential to impact existing receptors. Table 5.7 sets out NO_2, PM_{10} and $PM_{2.5}$ concentrations at modelled receptors for the without and with proposed development scenarios.

Table 5.7: Modelled NO_2, PM_{10} and $PM_{2.5}$ Concentrations in 2022 without and with proposed development

Receptor ID	Without proposed development (2022)				With proposed development (2022)			
	Annual Mean (µg/m³)			No. of exceedances of 24-hour mean PM_{10} AQO	Annual Mean (µg/m³			No. of exceedances of 24-hour mean PM_{10} AQO
	NO_2	PM_{10}	$PM_{2.5}$		NO_2	PM_{10}	$PM_{2.5}$	
R1	28.6	18.9	11.5	2	31.0	18.9	11.5	2
R2	27.5	18.6	11.4	2	29.9	18.6	11.4	2
R3	26.5	18.4	11.2	2	29.0	18.4	11.2	2
R4	28.8	19.0	11.6	2	31.1	19.0	11.6	2
R5	27.5	18.6	11.4	2	29.9	18.6	11.4	2
R6	26.5	18.4	11.2	2	28.8	18.4	11.2	2
R7	28.8	19.0	11.6	2	30.3	19.0	11.6	2
R8	27.5	18.7	11.4	2	29.0	18.7	11.4	2
R9	26.4	18.4	11.2	2	27.9	18.4	11.2	2
R10	28.9	19.0	11.6	2	29.7	19.0	11.6	2
R11	27.5	18.7	11.4	2	28.4	18.7	11.4	2
R12	26.4	18.4	11.2	2	27.3	18.4	11.2	2
R13	29.2	19.2	11.7	2	29.5	19.2	11.7	2
R14	30.1	19.4	11.8	3	30.5	19.4	11.8	3
R15	30.3	19.4	11.8	3	31.0	19.4	11.8	3
R16	31.3	19.4	11.8	3	31.7	19.4	11.8	3

Receptor ID	Without proposed development (2022)				With proposed development (2022)			
	Annual Mean (µg/m³)			No. of exceedances of 24-hour mean PM_{10} AQO	Annual Mean (µg/m³			No. of exceedances of 24-hour mean PM_{10} AQO
	NO_2	PM_{10}	$PM_{2.5}$		NO_2	PM_{10}	$PM_{2.5}$	
R17	29.2	19.0	11.6	2	29.4	19.0	11.6	2
Corresponding AQO	**40**	**40**	**25**	**35**	**40**	**40**	**25**	**35**

Note: Exceedances of annual mean objective highlighted in Bold

The modelled concentrations presented in Table 5.7 show that all modelled receptors will meet the NO_2 annual mean objective.

According to Defra LAQM.TG (16) guidance, exceedance of the one-hour NO_2 mean objective is generally unlikely to occur where annual mean concentrations do not exceed 60 µg/m³. The annual mean NO_2 concentration at all modelled receptors falls well below 60 µg/m³ in the 'with proposed development' scenario.

The PM_{10} and $PM_{2.5}$ concentrations are also forecast to meet their respective long and short term AQO by a considerable margin.

Significance has been determined for NO_2, PM_{10} and $PM_{2.5}$ using the impact descriptors matrix illustrated in Table 3.8. This is shown below in Table 5.8, Table 5.9, and

Table 5.10 respectively. Impact descriptors apply where there is a change of air quality at an existing receptor and therefore impact descriptors are not assigned to receptors located at the proposed development.

Table 5.8: NO_2 Annual Mean Concentration Changes and Associated Impact at Existing Modelled Receptors in 2022

Receptor ID	Predicted Annual Mean NO_2 Concentration (µg/m³)	Long Term Average Concentration at Receptor	Pollutant Concentration Change (µg/m³)	% Change Relative to AQAL	Impact Descriptor
R13	29.5	75% or less of AQAL	0.25	1%	Negligible
R14	30.5	76-94% of AQAL	0.41	1%	Negligible
R15	31.0	76-94% of AQAL	0.74	2-5%	Slight Adverse
R16	31.7	76-94% of AQAL	0.36	1%	Negligible

Receptor ID	Predicted Annual Mean NO_2 Concentration (µg/m³)	Long Term Average Concentration at Receptor	Pollutant Concentration Change (µg/m³)	% Change Relative to AQAL	Impact Descriptor
R17	29.4	75% or less of AQAL	0.21	1%	Negligible

Table 5.9: PM_{10} Annual Mean Concentration Changes and Associated Impact at Existing Modelled Receptors in 2022

Receptor ID	Predicted Annual Mean PM_{10} Concentration (µg/m³)	Long Term Average Concentration at Receptor	Pollutant Concentration Change (µg/m³)	% Change Relative to AQAL	Impact Descriptor
R13	19.2	75% or less of AQAL	0.00	<0.5%	Negligible
R14	19.4	75% or less of AQAL	0.00	<0.5%	Negligible
R15	19.4	75% or less of AQAL	0.00	<0.5%	Negligible
R16	19.4	75% or less of AQAL	0.00	<0.5%	Negligible
R17	19.0	75% or less of AQAL	0.01	<0.5%	Negligible

Table 5.10: $PM_{2.5}$ Annual Mean Concentration Changes and Associated Impact at Existing Modelled Receptors in 2022

Receptor ID	Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³)	Long Term Average Concentration at Receptor	Pollutant Concentration Change (µg/m³)	% Change Relative to AQAL	Impact Descriptor
R13	11.7	75% or less of AQAL	0.00	<0.5%	Negligible
R14	11.8	75% or less of AQAL	0.00	<0.5%	Negligible
R15	11.8	75% or less of AQAL	0.00	<0.5%	Negligible
R16	11.8	75% or less of AQAL	0.00	<0.5%	Negligible

Receptor ID	Predicted Annual Mean $PM_{2.5}$ Concentration (µg/m³)	Long Term Average Concentration at Receptor	Pollutant Concentration Change (µg/m³)	% Change Relative to AQAL	Impact Descriptor
R17	11.6	75% or less of AQAL	0.00	<0.5%	Negligible

As shown in Table 5.8, there is a slight increase in NO_2 concentrations at all of the modelled existing receptors in the 2022 with proposed development future scenario. The largest increase in NO_2 concentrations at an existing receptor is 0.74 µg/m³, which equates to 1.9 % of the AQAL. This small increase results in a 'Slight Adverse' impact descriptor at this modelled receptor.

As shown in Table 5.9 and

Table 5.10, there is a negligible change in PM_{10} and $PM_{2.5}$ concentrations at all of the modelled existing receptors in the 2022 with development future scenario. The percentage change in concentrations relative to the AQAL is 1 % or below, which results in a 'negligible' impact descriptor at all modelled receptors.

Table 5.11 below shows the maximum change in hourly mean NO_2 concentration at each modelled existing receptor as a percentage of the 1 hour mean NO_2 objective. Magnitude and impact descriptors are assigned to each modelled existing receptor in accordance with guidance, as set out in section 3.7.

Table 5.11: Point-source impact on hourly mean NO_2 concentrations

Receptor	Maximum 1 Hour NO_2 Process Contribution 2022	Change in hourly mean NO_2 concentration as % of AQL	Magnitude of Change	Impact Descriptor
R13	1.8	0.9%	Imperceptible	Negligible
R14	2.9	1.5%	Imperceptible	Negligible
R15	2.8	1.4%	Imperceptible	Negligible
R16	1.7	0.9%	Imperceptible	Negligible
R17	1.2	0.6%	Imperceptible	Negligible

Table 5.11 above shows that the impact of installed plant at all existing receptors is 'Negligible' with respect to hourly mean NO_2 concentrations.

It should be noted that results presented in Table 5.7 to Table 5.11 are the maximum forecast over a three year modelling period with respect to road source modelling and five-year period with respect to point source emissions. Additionally, background concentrations included in the model are taken from 2016 monitoring data, and therefore do not take into account the expected improvement in ambient air quality by 2022. This modelling is therefore representative of the worst case.

6 Mitigation Measures

6.1 Construction Phase

Particle generation from construction and demolition activities can be substantially reduced through carefully selected mitigation techniques and effective management. The most effective technique is to control at source, as once particles are airborne, it is difficult to prevent them from dispersing into the surrounding area. However, once airborne, water sprays are probably the most effective method for suppression.

Pre-project planning, implementation and on-site management issues are an essential requirement for effective dust control. This includes for example environmental risk assessments, method statements, training and satisfying planning requirements. Before the start of a project, it is also important to identify which construction activities are likely to generate dust and to draw up action plans to minimise emissions to the atmosphere. Dust emissions from construction sites will mainly be the sum of a large number of small activities. Therefore, attention to detail is a critical feature of effective management of the total site emissions.

The Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance (SPG)[29] provides extensive coverage on the possible dust and emissions control measures. Stakeholder engagement is important, such that local sensitive receptors are notified and consulted properly before any work commences. Site layout should be carefully planned, ensuring dust generating activities and the associated machineries are located away from receptors as far as possible. Green infrastructure is also recommended to control the dispersion of dust, and at the same time improve the local environment.

Any vehicles accessing the site during the construction phase should comply with the Low Emission Zone standards as a minimum requirement. Engine idling should be avoided through careful site vehicles management. Construction Logistics Plans (CLPs) / Construction Traffic Management Plans should be considered, especially for larger developments.

As part of the planning application, the appointed contractor will prepare a Construction Environmental Management Plan (CEMP) and agree this with LBB. This will ensure that the construction phase will cause minimal disruption to the surrounding area and neighbours.

Site specific mitigation measures should be set up based on the risk effects as outlined in Table 5.3. Examples of these measures are provided in the IAQM guidance document and summarised in Appendix C.

[29] Greater London Authority. (July 2014) The Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance.

6.2 Operational Phase

According to the London Councils Air Quality and Planning Guidance, the Air Pollution Exposure Criteria (APEC) for the proposed development is APEC-A. This guidance suggests that "No air quality grounds for refusal; however, mitigation of any emissions should be considered." Mitigation measures are presented below.

6.2.1 Boilers

Maintenance of the boiler and CHP should be in accordance with an approved service schedule which will ensure that emissions from the plant remain within the manufacturer's stated limit

6.2.2 Reducing Vehicle Emissions

A travel plan is expected to be produced by the transport consultant. The travel plan will contain measures to further reduce the total transport emissions.

The proposed development could also be "electromotive ready" with car parking spaces providing electrical charging services ready for plug in electric and hybrid cars.

Secure bicycle storage could also be provided for all units.

6.2.3 Reducing Health Related Impacts

There are several services which provide real time daily information on air pollution, UV, pollen and temperature forecasts for Greater London. Provision of the information displayed on a screen in the main entrance area will provide a suitable means of raising awareness about air pollution and associated health impacts.

This service will allows the susceptible residents and visitors to make informed decisions relating to any air quality related health impacts and to take appropriate remedial action.

7 Conclusion

This report provides an assessment of the following potential key impacts associated with the construction and operational phase of the proposed development at 2-8 Danson Road, Bexleyheath.

This report has assessed:

- Nuisance, loss of amenity and health impacts associated with the construction phase of the development on sensitive receptors;
- The suitability of the site for the introduction of new residential human health receptors;
- The impact of stack emissions associated with the central plant;
- Whether the proposed development is air quality neutral; and
- Recommendations for mitigation measures where required.

An assessment of the construction and operational air quality impacts was undertaken for the proposed development.

A qualitative assessment on the construction phase activities has been carried out. The largest risk of these activities towards dust soiling were considered to be 'Medium Risk' and towards human health considered to be 'Low Risk'. Following proper implementation of the mitigation measures recommended in Appendix C, the risk of construction dust impacts during construction is likely to be 'Negligible' and therefore 'Not Significant'.

The work undertaken as part of this assessment has assumed the worst-case scenario with regards to ambient concentrations vehicle emissions and point-source emissions, in that there is no reduction in ambient concentrations from 2016; no reduction in vehicle emissions from 2022 onwards; and plant is assumed to operate constantly . In reality, ambient concentrations and vehicle emissions are expected to decrease from the proposed occupation year of 2022 onwards.

The annual mean and one hour mean NO_2 objectives are forecast to be comfortably met at all modelled receptors. The PM_{10} and $PM_{2.5}$ concentrations are also forecast to meet their respective long and short term AQO by a considerable margin.

The impact on air quality at existing receptors is considered to be a maximum of 'Slight Adverse' with respect to NO_2 and 'Negligible' with respect to PM_{10} and $PM_{2.5}$. No new exceedances of the air quality objective occur as a result of the proposed development. The maximum impact on the NO_2 one-hour mean at existing receptors from the installed plant is 'Negligible'.

An Air Quality Neutral Assessment was compiled to support the planning application. The predicted total NO_x and PM_{10} emissions from road traffic vehicles associated with the residential element of the proposed development are above the calculated benchmark.

With the implementation of the mitigation measures listed in paragraph 6.2.2, the proposed development could be considered 'air quality neutral'.

It can therefore be concluded that the overall impact on air quality from the proposed development is compliant with all national, regional and local planning policy.

Appendix A: Operational Impact Assessment

Methodology

The EPUK & IAQM guidance refers to the Town and Country Planning (Development Management Procedure) Order (England) 2010 [(Wales) 2012] for a definition of a 'major' development when scoping assessments required for the planning process. Based on the guidance, a 'major' development is such development where:

- The number of dwellings is 10 or above;
- The residential development is carried out of a site of more than 0.5ha where the number of dwellings is unknown;
- The provision of more than 1,000 m^2 commercial floorspace; or,
- Development carried out on land of 1ha or more.

It is recommended that consideration should be given to reduce impacts from any 'major' developments by considering:

- The impact of existing sources in the local area on the proposed development; and
- The impacts of the proposed development on the local area.

The assessment process involves two stages where:

Stage 1 scope out the need for an air quality assessment and **Stage 2** provide guidance of determining the level of assessment required for a project.

Table A 1 below sets out the Stage 1 criteria to determine the need to assess impacts arising from small developments and **Table A 2** provides more specific guidance as to when an air quality assessment is likely to be required to assess the impacts of the proposed development on the local area.

Table A 1: Stage 1 Criteria to Proceed to Stage 2

Criteria to Proceed to Stage 2	
A	If any of the following apply: • 10 or more residential units of a site area of more than 0.5ha • More than 1,000m^2 of floor space for all other uses or a site area greater than 1ha
B	Coupled with any of the following: • The development has more than 10 parking spaces • The development will have a centralised energy facility or other centralised combustion process

Table A 2: Indicative Criteria for Requiring an Air Quality Assessment

The development will	Indicative Criteria to Proceed to an Air Quality Assessment
1. Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV = cars and small vans <3.5t gross vehicle weight).	A change of LDV flows of: - more than 100 AADT within or adjacent to an AQMA - more than 500 AADT elsewhere.
2. Cause a significant change in Heavy Duty Vehicle (HDV) flows on local roads with relevant receptors. (HDV = goods vehicles + buses >3.5t gross vehicle weight).	A change of HDV flows of: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.
3. Realign roads, i.e. changing the proximity of receptors to traffic lanes.	Where the change is 5m or more and the road is within an AQMA.
4. Introduce a new junction or remove an existing junction near to relevant receptors.	Applies to junctions that cause traffic to significantly change vehicle accelerate/decelerate, e.g. traffic lights, or roundabouts.
5. Introduce or change a bus station.	Where bus flows will change by: - more than 25 AADT within or adjacent to an AQMA - more than 100 AADT elsewhere.
6. Have an underground car park with extraction system.	The ventilation extract for the car park will be within 20 m of a relevant receptor. Coupled with the car park having more than 100 movements per day (total in and out).
7. Have one or more substantial combustion processes, where there is a risk of impacts at relevant receptors. NB. this includes combustion plant associated with standby emergency generators (typically associated with centralised energy centres) and shipping.	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.

Appendix B: Construction Dust Risk Assessment Criteria

IAQM guidance framework on assessing the risk of dust proposes the construction phase should be split into phases dependent on their potential impacts, determining the risk for each individually. Therefore, this assessment has determined the risk of the four construction categories put forward by the IAQM guidance:

- Demolition;
- Earthworks;
- Construction; and
- Track out (transport of dust and dirt onto the public road network).

The IAQM guidance framework states that the risk of dust impacts from the four categories can be defined as 'negligible', 'low risk', 'medium risk' or 'high risk' depending upon the scale and nature of the construction activity and the sensitivity and proximity of receptors to the construction site boundary. This categorisation is used to put forward appropriate mitigation measures, reducing the level of effects from the dust impacts so they are not significant.

The assessment of dust impacts using the IAQM guidance considers three separate effects from dust:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to significant increase in exposure to PM_{10}.

Step 1 of the assessment is set out to screen for the requirement for a more detailed assessment for the proposed development. The screening criteria states:

A 'human receptor' within:

- 350 m of the boundary of the application site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

An 'ecological receptor' within:

- 50 m of the boundary of the application site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

Where there are no receptors and the level of risk is deemed 'negligible', there is no need for further assessment.

Step 2A of the assessment enables the overall dust emission magnitude (small, medium or large) from each dust source (demolition, earthworks, construction and trackout) to be identified in relation with the criteria outlined in Table B.1.

Table B.1: Dust emission magnitude

Source	Large	Medium	Small
Demolition	Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities <10 – 20 m above ground level.	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months.
Earthworks	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes.	Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes.	Total site area <2,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.
Construction	Total building volume >100,000 m^3, on site concrete batching or sandblasting.	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Track out	>50 HDV (>3.5t) outward movements[a] in any one day[b], potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.	10-50 HDV (>3.5t) outward movements[a] in any one day[b], moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.	<10 HDV (>3.5t) outward movements[a] in any one day[b], surface material with low potential for dust release, unpaved road length <50 m.

Notes:
[a] Vehicle movement is a one-way journey. i.e. from A to B, and excludes the return journey.
[b] HDV movements during a construction project vary over its lifetime, and the number of movements is the maximum not the average.

Step 2B allows for the sensitivity of the area (high, medium or low) to be assessed and takes into account a number of factors:

- The specific sensitivities of receptors in the area;
- The proximity and number of those receptors;
- In the case of PM_{10}, the existing local background concentration; and

- Site specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

Receptor sensitivity has been based on the highest of any criteria being met thus, the assessment is considered as robust. The sensitivity of the area is further determined for dust soiling, human health and ecosystem effects by considering the criteria presented in Table B.2.

Table B.2: Magnitude of Receptor Sensitivity

Source	High	Medium	Low
Sensitivities of people to dust soiling effects	• Users can reasonably expect enjoyment of a high level of amenity; or • The appearance, aesthetics or value of their property would be diminished by soiling; and • The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks[b] and car showrooms.	• Users would expect[a] to enjoy a reasonable level of amenity, but would not reasonably expect[a] to enjoy the same level of amenity as in their home; or • The appearance, aesthetics or value of their property could be diminished by soiling; or • The people or property wouldn't reasonably be expected[a] to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. • Indicative examples include parks and places of work.	• The enjoyment of amenity would not reasonably be expected[a]; or • Property would not reasonably be expected[a] to be diminished in appearance, aesthetics or value by soiling; or • There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. • Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks[b] and roads.
Sensitivities of people to health effects of PM_{10}	• Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).[c] • Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	• Locations where the people exposed are workers[d], and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	• Locations where human exposure is transient.[e] • Indicative examples include public footpaths, playing fields, parks and shopping streets.

Source	High	Medium	Low
Sensitivities of receptors to ecological effects	• Locations with an international or national designation and the designated features may be affected by dust soiling; or • Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain. • Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.	• Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or • Locations with a national designation where the features may be affected by dust deposition. • Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.	• Locations with a local designation where the features may be affected by dust deposition. • Indicative example is a local Nature Reserve with dust sensitive features.

Notes:
[a] People's expectations will vary depending on the existing dust deposition in the area, see Section 4.2.
[b] Car parks can have a range of sensitivities depending on the duration and frequency that people would be expected to park their cars there, and the level of amenity they could reasonably expect whilst doing so. Car parks associated with work place or residential parking might have a high level of sensitivity compared to car parks used less frequently and for shorter durations, such as those associated with shopping. Cases should be examined on their own merits.
[c] This follows Defra guidance as set out in LAQM.TG (09).
[d] Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM_{10}. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers have been included in the medium sensitivity category.
[e] There are no standards that apply to short-term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.
[f] Cheffing C. M. & Farrell L. (Editors) (2005), The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee.

The final step, Step 2C allows for the risk of impacts to be defined. The dust emission magnitude derived in Step 2A is combined with the sensitivity of the area defined in step 2B to determine the risk of effects on:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to an increase in exposure to PM_{10}.

The criteria for each of the dust sources are presented in Table B.3, Table B.4, Table B.5 and Table B.6.

Table B.3: Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table B.4: Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table B.5: Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table B.6: Track out

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Appendix C: Construction Phase Mitigation Measures

The mitigation measures set out below are from IAQM's 2016 guidance for construction dust and are appropriate for the mitigation of the risk determined. The points below can be formerly adopted into a construction dust management plan.

Mitigation Measures:

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Develop a Dust Management Plan.
- Display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the site boundary.
- Display the head or regional office contact information.
- Record and respond to all dust and air quality pollutant emissions complaints.
- Make a complaints log available to the local authority when asked.
- Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked.
- Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions and dust are being carried out, and during prolonged dry or windy conditions.
- Record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and the action taken to resolve the situation is recorded in the logbook.
- Plan site layout: machinery and dust causing activities should be located away from receptors.
- Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site.
- Fully enclosure site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Install green walls, screens or other green infrastructure to minimise the impact of dust and pollution.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials from site as soon as possible.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Carry out regular dust soiling checks of buildings within 100m of site boundary and cleaning to be provided if necessary.
- Agree monitoring locations with the Local Authority.
- Where possible, commence baseline monitoring at least three months before phase begins.
- Put in place real-time dust and air quality pollutant monitors across the site and ensure they are checked regularly.
- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone.
- Ensure all non-road mobile machinery (NRMM) comply with the standards set within this guidance.
- Ensure all vehicles switch off engines when stationary – no idling vehicles.
- Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where possible.

- Impose and signpost a maximum-speed-limit of 10mph on surfaced haul routes and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter mitigation (using recycled water where possible).
- Use enclosed chutes, conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
- Reuse and recycle waste to reduce dust from waste materials.
- Avoid bonfires and burning of waste materials.
- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
- Ensure water suppression is used during demolition operations.
- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.
- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces.
- Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil.
- Only remove secure covers in small areas during work and not all at once.
- Avoid scabbling (roughening of concrete surfaces) if possible.
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport.
- Record all inspections of haul routes and any subsequent action in a site logbook.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems and regularly cleaned.
- Inspect haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.

- Access gates to be located at least 10m from receptors where possible.
- Apply dust suppressants to locations where a large volume of vehicles enter and exit the construction site.

Appendix D: Verification

Overview

Model verification is a process by which checks are carried out to determine the performance of a dispersion model at a local level, primarily by comparison of modelled results with monitoring data. Differences between modelled and monitored data may occur as a result of uncertainties associated with a number of model inputs including:

- Traffic flows, speeds and vehicle splits;
- Emissions estimates;
- Background concentrations;
- Meteorological data; and
- Surface roughness length and terrain.

The verification process benefits an assessment by investigating uncertainties and minimising them either through informed refinement of model input parameters or adjustment of the model output if it is deemed necessary.

Verification of NO_2 concentrations has been carried out using 2017 monitored results from LBB/RBG automatic monitor GB6. Data from Heathrow meteorological station in 2017 was used in the modelling, with all other inputs as per the main assessment.

Methodology

Guidance produced by Defra provides a methodology for model verification including calculation methods and directions on the suitability of monitoring data.

The automatic monitor used for verification, GB6, is classified as Kerbisde as it is situated just 1.0 m from the kerb of an A2 slip road. However, for the verification model, data has been used from the A2 rather than the slip road and therefore GB6 lies 8.0 m from the modelled link, effectively making it a roadside site. Verification against kerbside sites tends to result in over prediction at non-kerbside locations which are the primary focus of this assessment.

Verification of NO_2 concentrations has been carried out using 2017 results from one kerbside automatic monitoring site.

In accordance with guidance, the model verification has been based on 2017 meteorological data. Background concentrations used in the model verification have been taken from Defra, with individual background concentrations being obtained for each monitoring location. These are presented in Table D.1.

Table D.1: Background Concentrations used in Model Verification

Site Name	Annual Mean Concentration 2017 (µg/m³)	
	NO_x	NO_2

GB6	36.8	23.9

Table D.2 presents the monitored pollutant concentrations used within the verification.

Table D.2: Monitored Data used in Model Verification

Site Name	Type of Monitor	Annual Mean Concentration 2017 (µg/m³)	
		NO_x	NO_2
GB6	Automatic Monitor	74.3	40.0

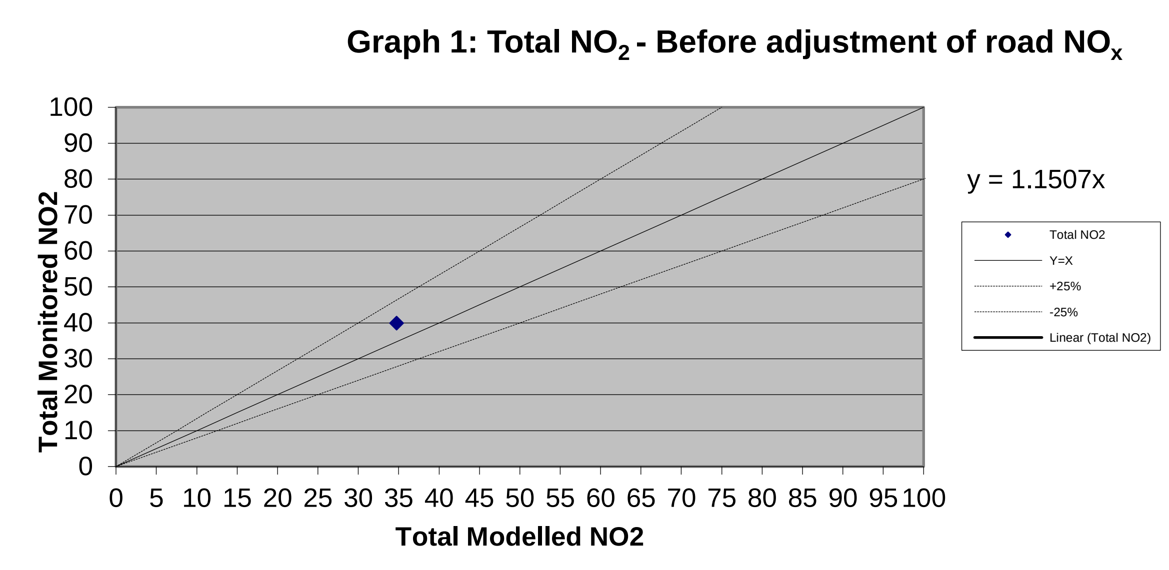
Verification Results

Table D.3 and Figure D.1 present the results of the model verification for NO_2. It can be seen that the modelled NO_2 concentration is below the monitored value. On this basis it has been concluded that the model is under predicting annual mean NO_2 concentrations within the study area. Therefore, an adjustment factor has been calculated.

Table D.3: Model Verification Results for NO_2

Site Name	Monitored Total NO_2 (µg/m³)	Modelled Total NO_2 (µg/m³)	% Difference
GB6	40.0	34.76	-13.1

Figure D.1: Model Verification Results for NO_2



To derive the adjustment factor for this assessment the modelled road NO_x contribution has been compared to monitored road NO_x contribution. An adjustment has been applied to the study area, which gives a modelled road NO_x contribution adjustment factor of 1.538.

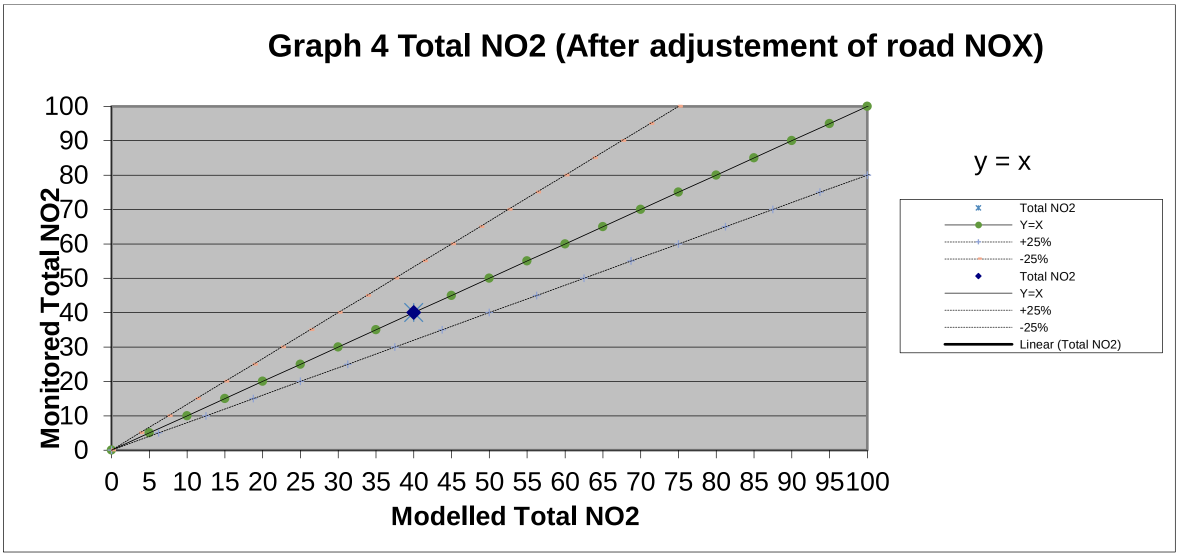
The adjustment factor has been applied to the modelled road NO_x contributions and added to background NO_x concentrations to give total corrected NO_x at each of the verification sites.

The final stage of the verification process involves applying the NO_x to NO_2 relationship presented in Section 3.4.8. Table D.4 presents the total adjusted modelled NO_2 and the monitored NO_2 after the adjustment factor has been applied. Figure D.2 presents the correlation between the total corrected NO_2 and the monitored NO_2. Following the application of the adjustment factor, all of the sites are within 25% of monitored concentrations, with a good overall agreement. This indicates that the model is performing acceptably.

Table D.4: Adjusted Modelled NO_2 Results

Site Name	Monitored Total NO_2 (µg/m³)	Modelled Total NO_2 (µg/m³)	% Difference
GB6	40.0	40.0	0.00

Figure D.2: Adjusted Model NO_2 Verification Results



Summary

Following the model verification, it is considered that the model is performing acceptably with all modelled concentrations with + or – 10% of monitored concentrations.

In accordance with Defra guidance, the road contributed NO_x adjustment factor was also applied to the road contributed PM concentration. The total PM_{10} and $PM_{2.5}$ concentrations are derived by adding the adjusted road contribution value to the Defra background concentrations.

An adjustment factor of 1.538 has been applied across the study area for NO_2, PM_{10} and $PM_{2.5}$.