Air Quality Assessment Update:

140-146 Camden Street

February 2015

Experts in air quality
management & assessment

Document Control

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed mixed-use development at 140-146 Camden Street. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Elebro Ltd.

1.2 The proposed development will consist of 53 apartments. It lies within an Air Quality Management Area (AQMA) declared by the London Borough of Camden for exceedences of the annual mean nitrogen dioxide and daily mean PM_{10} objectives. The scale of the development is such that it will not significantly increase traffic on local roads. The new residential properties will, however, be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$), whilst that from railway lines is nitrogen dioxide.

1.3 The proposals for the development include CHP and boiler plant, the emissions from which could impact upon air quality at existing residential properties, as well as the new residential properties within the development itself. The main air pollutant of concern related to gas fired CHP and boiler plant is nitrogen dioxide. At the time of preparing this report, the detailed specification of this system has not been determined, and as such it is not possible to obtain reliable emissions data for the CHP and boiler plant. Without such data it has not been possible to carry out a robust dispersion modelling assessment of the CHP emissions, therefore it is recommended that this, and associated mitigation is handled as a pre-commencement condition.

1.4 The site is located in close proximity to a railway line which runs east to west approximately 50 m north of the site. Defra guidance (Defra, 2009) outlines an approach to assess the potential for exceedences of the annual mean nitrogen dioxide objective as a result of emissions from diesel locomotives. The guidance outlines that there is only the potential for an exceedence where there is long-term exposure within 30 m, and the annual mean background concentration of nitrogen dioxide is above 25 $\mu g/m^3$. The development site is further than 30 m from the railway line and thus the impact of emissions from railway locomotives on nitrogen dioxide concentrations are not considered further.

1.5 The air quality neutrality of the proposed development has also been assessed following the methodology provided in the Greater London Authority's (GLA's) Supplementary Planning Guidance (SPG) on Sustainable Design and Construction (GLA, 2014a).

1.6 The GLA has also released Supplementary Planning Guidance on the Control of Dust and Emissions from Construction and Demolition (GLA, 2014b). The SPG outlines a risk assessment approach for construction dust assessment and helps determine the mitigation measures that will need to be applied.

1.7 This report describes existing local air quality conditions (2013), and the predicted air quality in the future assuming that the proposed development proceeds. The assessment of traffic-related impacts focuses on 2017, which is the anticipated year of opening. The assessment of construction dust impacts focuses on the anticipated duration of the works.

1.8 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology agreed with London Borough of Camden.

2 Policy Context and Assessment Criteria

Air Quality Strategy

2.1 The Air Quality Strategy published by the Department for Environment, Food, and Rural Affairs (Defra) provides the policy framework (Defra, 2007) for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Planning Policy

National Policies

2.2 The National Planning Policy Framework (NPPF) (2012) sets out planning policy for England in one place. It places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. One of the twelve core planning principles notes that planning should *"contribute to…reducing pollution"*. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location. The NPPF states that the effects of pollution on health and the sensitivity of the area and the development should be taken into account.

2.3 More specifically the NPPF makes clear that: *"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan"*.

2.4 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2014), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values"* and *"It is important that the potential impact of new development on air quality is taken into account … where the national* *assessment indicates that relevant limits have been exceeded or are near the limit".* The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*". In addition, the PPG makes clear that *"Odour and dust can also be a planning concern, for example, because of the effect on local amenity"*.

2.5 The PPG states that *"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to 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)".*

2.6 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality"*. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that *"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact".*

The London Plan

2.7 The London Plan 2011 (GLA, 2011) sets out the spatial development strategy for London. It brings together all relevant strategies, including those relating to air quality.

2.8 Policy 7.14, 'Improving Air Quality', addresses the spatial implications of the Mayor's Air Quality Strategy and how development and land use can help achieve its objectives. It recognises that Boroughs should have policies in place to reduce pollutant concentrations, having regard to the Mayor's Air Quality Strategy.

2.9 Policy 7.14B(c), requires that development proposals should be "*at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as designated Air Quality Management Areas (AQMAs))*". Further details of the London Plan in relation to planning decisions are provided in Appendix A1.

The Mayor's Air Quality Strategy

2.10 The revised Mayor's Air Quality Strategy (MAQS) was published in December 2010 (GLA, 2010). The overarching aim of the Strategy is to reduce pollution concentrations in London to achieve compliance with the EU limit values as soon as possible. The Strategy commits to the continuation of measures identified in the 2002 MAQS, and sets out a series of additional measures. These additional measures and the role of the Low Emission Zone are described in Appendix A1.

2.11 The MAQS also addresses the issue of 'air quality neutral' and states that "*GLA will work with boroughs to assist in the development of methodologies that will allow an accurate assessment of the impacts of the emissions of new developments*" (Para 5.3.19).

GLA SPG: Sustainable Design and Construction

2.12 The GLA's SPG on Sustainable Design and Construction (GLA, 2014a) provides details on delivering some of the priorities in the London Plan. Section 4.3 covers Air Pollution. It defines when developers will be required to submit an air quality assessment, explains how location and transport measures can minimise emissions to air, and provides emission standards for gas-fired boilers, Combined Heat and Power (CHP) and biomass plant. It also sets out, for the first time, guidance on how Policy 7.14B(c) of the London Plan relating to 'air quality neutral' (see Paragraph 2.9, above) should be implemented.

GLA SPG: The Control of Dust and Emissions During Construction and Demolition

2.13 The GLA's SPG on The Control of Dust and Emissions During Construction and Demolition (GLA, 2014b) outlines a risk assessment based approach to considering the potential for dust generation from a construction site, and sets out what mitigation measures should be implemented to minimise the risk of construction dust impacts, dependent on the outcomes of the risk assessment. This guidance is largely based on the Institute of Air Quality Management's (IAQM) 2014 guidance on the Assessment of dust from demolition and construction (Institute of Air Quality Management, 2014), and it states that "*the latest version of the IAQM Guidance should be used*".

Local Transport Plan

2.14 Objective 1 of the London Borough of Camden's Transport Strategy 2011 is to:

"Reduce motor traffic levels and vehicle emissions to improve air quality, mitigate climate change and contribute to making Camden a 'low carbon and low waste borough'."

2.15 There are three polices that refer specifically to air quality to help achieve this objective these are:

"Policy 1.2 – The Council will continue to encourage travel by sustainable modes, reduce motor vehicle dependency and the dominance of motor traffic in the borough. The Council will aim to increase the permeability of streets and remove one-way gyratories.

Policy 1.4 – Camden will continue to promote Low Emission Vehicles and support the staged introduction of the Low Emissions Zone in London. The Council would also like to see further development of national policy to support local level efforts to improve air quality and tackle climate change.

Policy 1.5 – For essential car journeys, Camden will encourage more residents and businesses to change to electric vehicles, (with electricity generated by renewable sources), to help reduce air and noise pollution…."

Local Policies

2.16 Changes to the planning legislation require the Council to replace the Development Plan with a Local Development Framework (LDF). The LDF is a portfolio of planning documents, individually known as Local Development Documents, which will deliver the spatial development strategy for the London Borough of Camden and build upon existing local and regional strategies and initiatives.

2.17 The London Borough of Camden's Core Strategy 2010 – 2025 includes four policies which refer to air quality:

- *"Policy CS5 Managing the impact of growth and development: … Protecting and enhancing our environment…*
- *Policy CS9 Achieving a successful Central London:…k) continue to designate Central London as a Clear Zone Region to reduce congestion, promote walking and cycling and improve air quality…*
- *Policy CS11 Promoting sustainable and efficient travel. The Council will promote the delivery of transport infrastructure and the availability of sustainable transport choices in order to support Camden's growth, reduce the environmental impact of travel, and relieve pressure on the borough's transport network.*
- *Policy CS16 Improving Camden's health and well-being: recognise the impact of poor air quality on health and implement Camden's Air Quality Action Plan which aims to reduce air pollution levels."*

2.18 There are also two development policies referring to air quality:

- *"DP22 Promoting sustainable design and construction: The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaption measures such as: i) reducing air pollution.*
- *DP32 Air quality and Camden's clear zone: The Council will require air quality assessments where development could potentially cause significant harm to air quality. Mitigation measures will be expected in developments that are located in areas of poor air quality…"*

2.19 The London Borough of Camden has also prepared a Supplementary Planning Document – Camden Planning Guidance (CPG) 6 Amenity (London Borough of Camden, 2011b), which provides further guidance on air quality. It includes information on when an air quality assessment will be required, what an air quality assessment should cover and what measures can reduce air quality emissions and protect public exposure. It lists criteria where an air quality assessment would be required, and includes (amongst others) developments:

- *"Where people will be exposed to poor air quality for significant periods of the day, in particular developments located on busy roads …"*

Air Quality Action Plan

2.20 The London Borough of Camden has declared an AQMA for nitrogen dioxide that covers the whole Borough. The Council has since developed an Air Quality Action Plan (London Borough of Camden, 2009). There are four main objectives focused on in the plan these are:

- "*Reducing transport emissions including: encouraging the use of sustainable transport and low emission vehicles, encouraging changes in driver behaviour and supporting initiatives introduced by the Mayor.*
- *Reducing emissions associated with new development including: controlling emissions from construction sites, measures to reduce transport and gas boiler emissions.*
- *Reducing emissions from gas boilers and industrial processes including: reducing the Council's gas boiler emission and controlling air pollution form small industrial processes.*
- *Air quality awareness raising initiatives including: provision of air quality information and strengthening promotional work relating to air pollution and health.*"

2.21 The London Borough of Camden has produced an update to the action plan which covers the period 2013-2015 (London Borough of Camden, 2013b). This is currently a draft consultation document, the plan focuses on five sections:

1. *"Reducing transport emissions.*
2. *Reducing emissions associated with new development.*
3. *Reducing emissions from gas boilers and industrial processes.*
4. *Air quality awareness raising initiatives.*
5. *Lobbying and partnership working."*

2.22 The Air Quality Action Plan is also linked with the London Borough of Camden's Environmental Sustainability Plan (London Borough of Camden, 2011c) which aims to:

- *"Reduce levels of NO_2 by up to 50% by 2015 on our most polluted roads, in partnership with regional and national government, to achieve the NO_2 air quality objectives.*

- *Continue to comply with the air quality objectives for PM_{10} concentrations and endeavour to reduce these in the long term in order to protect public health."*

This will be achieved by:

- *"Lower levels of road traffic and increased use of sustainable transport*
- *Higher proportion of low emissions vehicles on our roads such as biomethane, electric, hybrid*
- *Reduced energy use from gas boilers*
- *Improved awareness of the sources and health impacts of air pollution and how to avoid generating pollution."*

Assessment Criteria

Health Criteria

2.23 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

2.24 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level.

2.25 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2009). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc. The 24-hour objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.26 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. Achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). The limit values for nitrogen dioxide are the same levels as the UK objectives, but applied from 2010 (The Air Quality Standards Regulations (No. 1001), 2010). The limit values for PM_{10} and $PM_{2.5}$ are also the same level as the UK statutory objectives, but applied from 2005 for PM_{10} and will apply from 2015 for $PM_{2.5}$.

2.27 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 $\mu g/m^3$ not to be exceeded more than 18 times a year
	Annual Mean	40 $\mu g/m^3$
Fine Particles (PM_{10})	24-hour Mean	50 $\mu g/m^3$ not to be exceeded more than 35 times a year
	Annual Mean	40 $\mu g/m^3$
Fine Particles ($PM_{2.5}$) [a]	Annual Mean	25 $\mu g/m^3$

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Construction Dust Criteria

2.28 There are no formal assessment criteria for dust. In the absence of formal criteria, the approach developed by the Institute of Air Quality Management[1] (IAQM) (2014), on which the assessment methodology outlined in the GLA's SPG (GLA, 2014b) is based, has been used. Full details of this approach are provided in Appendix A2.

Descriptors for Air Quality Impacts and Assessment of Significance

Construction Dust Significance

2.29 Guidance from the IAQM (Institute of Air Quality Management, 2014) is that, with appropriate mitigation in place, the impacts of construction dust will not be significant. The assessment thus focuses on determining the appropriate level of mitigation so as to ensure that impacts will normally not be significant.

[1] The IAQM is the professional body for air quality practitioners in the UK.

Operational Significance

2.30 There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach developed by the IAQM[2] (Institute of Air Quality Management, 2009), and incorporated in Environmental Protection UK's (EPUK's) guidance document on planning and air quality (Environmental Protection UK, 2010), has therefore been used. This approach includes elements of professional judgement. Full details of this approach are provided in Appendix A3, with the professional experience of the consultants preparing the report set out in Appendix A4.

[2] The IAQM is the professional body for air quality practitioners in the UK.

3 Assessment Approach

Consultation

3.1 The assessment follows a methodology agreed with the London Borough of Camden via email correspondence between Adam Webber (Sustainability Officer at the London Borough of Camden) and Dr Imogen Heard (Air Quality Consultants) on 12th January 2014.

Existing Conditions

3.2 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2015b) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2015). Local sources have also been identified through discussion with the London Borough of Camden's Sustainability Team, as well as through examination of the Council's Air Quality Review and Assessment reports.

3.3 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. This covers both the study area and nearby sites, the latter being used to provide context for the assessment. The background concentrations across the study area have been defined using the national pollution maps published by Defra (2015a). These cover the whole country on a 1x1 km grid. Current exceedences of the annual mean EU limit value for nitrogen dioxide have been identified using the maps of roadside concentrations published by Defra (2015c). These are the maps, currently based on 2012 data, used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedences of the limit value to the EU.

Construction Impacts

3.4 The construction dust assessment considers the potential for impacts within 350 m of the site boundary; or within 50 m of roads used by construction vehicles. The assessment methodology follows the GLA's SPG on the Control of Dust and Emissions During Construction and Demolition (GLA, 2014b), which is based on that provided by the IAQM (Institute of Air Quality Management, 2014). This follows a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant impacts. Appendix A2 explains the approach in more detail.

Road Traffic Impacts

Sensitive Locations

3.5 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations within the proposed development. Receptors have been identified to represent worst-case exposure within these locations. The receptors have been located on the façades of the properties closest to the sources.

3.6 Seven receptor locations have been identified within the new development, which represent exposure to existing sources. These locations are described in Table 2 and shown in Figure 1. Receptors have been modelled at a number of different elevations representing different floor levels. In addition, concentrations have been modelled at the diffusion tube monitoring site located on Camden Road in order to verify the modelled results (see Appendix A5 for verification method).

Table 2: Description of Receptor Locations

Receptor	Description
Receptor A	Wheelchair accessible ground-floor apartment
Receptor B	Residential apartment on Bonny Street
Receptor C	Residential apartment on Camden Street
Receptor D	Residential apartment adjacent to the canal
Receptor E	Residential apartment at the rear of the building
Receptor F	Residential apartment at the rear of the building
Receptor G	Residential apartment at the rear of the building

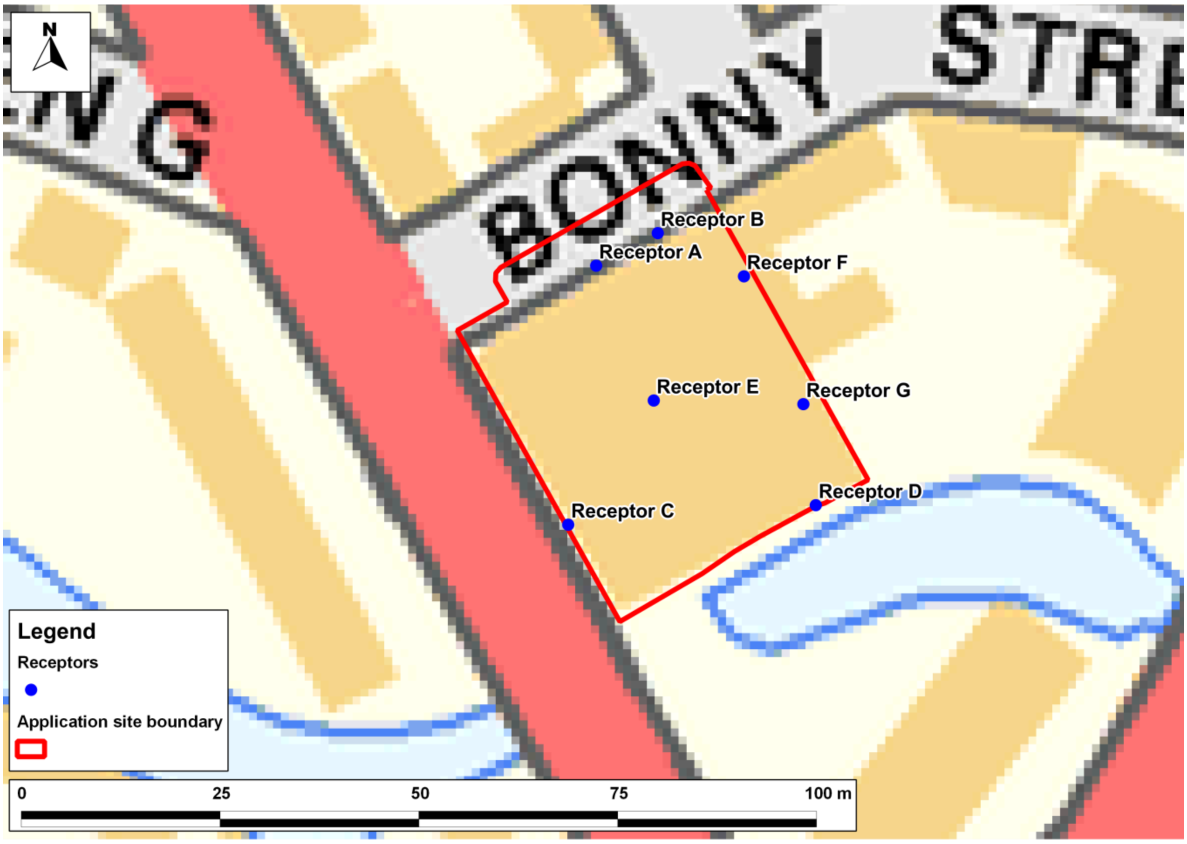

Figure 1: Receptor Locations

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Assessment Scenarios

3.7 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2013), and the proposed year of opening (2017). A 2017 sensitivity test has been carried out for nitrogen dioxide that involves assuming no reduction in emission factors for road traffic from the baseline year. This is to address the issue identified by Defra (Carslaw et al., 2011) that road traffic emissions have not been declining as expected (see later section on uncertainty). Nitrogen dioxide concentrations in 2017 are thus presented for two scenarios: 'With Emissions Reduction' and 'Without Emissions Reduction'.

Modelling Methodology

3.8 Concentrations have been predicted for the baseline and future years using the ADMS-Roads dispersion model. Details of the model inputs and the model verification are provided in Appendix A5, together with the method used to derive current and future year background nitrogen dioxide concentrations.

'Air Quality Neutral'

3.9 The guidance relating to air quality neutral follows a tiered approach, such that all developments are expected to comply with minimum standards for gas boilers, combined heat and power (CHP) and biomass (GLA, 2014a). Compliance with 'air quality neutral' is then founded on emissions benchmarks that have been derived for both building (energy) use and road transport in different areas of London. Developments that exceed the benchmarks are required to implement on-site or off-site mitigation to offset the excess emissions (GLA, 2014a).

3.10 Appendix A6 of this report sets out the emissions benchmarks. The approach has been to calculate the emissions from the development and to compare them with these benchmarks.

4 Site Description and Baseline Conditions

4.1 The proposed development site is located approximately 1 km to the northeast of Regent's Park. The site is bounded by Camden Street to the west, Bonny Street to the north and Regent's Canal to the south. It currently consists of commercial properties, with residential properties in the immediate, surrounding area.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2015b) and Environment Agency's 'what's in your backyard' (Environment Agency, 2015) websites did not identify any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality.

Air Quality Review and Assessment

4.3 The London Borough of Camden has investigated air quality within its area as part of its responsibilities under the LAQM regime. In 2000, an Air Quality Management Area (AQMA) was declared across the whole borough for exceedences of the annual mean nitrogen dioxide and daily mean PM_{10} objectives.

Local Air Quality Monitoring

4.4 The London Borough of Camden operates four automatic monitoring stations within its area. None of these are in close proximity to the proposed development site. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Gradko Environmental (using the 50% TEA in acetone method). These include one deployed on Camden Road approximately 75 m east of the proposed development. Up until 2010 there was also a diffusion tube located on Inverness Street, approximately 320 m south-west of the proposed development. Data for these sites have been provided by the London Borough of Camden. Results for Camden Road for the years 2008 to 2013 are summarised in Table 3 . The results for Inverness Street from 2008 to 2010 are also presented for information. The monitoring locations are shown in Figure 2.

Table 3: Summary of Nitrogen Dioxide (NO_2) Monitoring (2008-2013) [a]

Site No.	Site Type	Location	2008	2009	2010	2011	2012	2013
Diffusion Tubes - Annual Mean (μg/m^3) [b]								
CA19	Roadside	Inverness Street	**41.5**	**45.7**	**55.0**	-	-	-
CA20	Roadside	Camden Road	**66.5**	**73.0**	**84.0**	**72.2**	**67.4**	**77.9**
Objective			40					

[a] Exceedences of the objectives are shown in bold

[b] Data for Inverness Street have been taken from the 2010 Air Quality Progress Report (London Borough of Camden, 2011a) and data for Camden Road have been taken from the 2013 Air Quality Progress Report (London Borough of Camden, 2013a) and 2014 Air Quality Progress Report (London Borough of Camden, 2014). All results adjusted for diffusion tube bias by the London Borough of Camden.

4.5 Concentrations at both Inverness Street and Camden Road have exceeded the annual mean nitrogen dioxide objective in all years presented. Although the Camden Road site is within 100 m of the proposed development, concentrations are expected to be lower across the development site because the volume of traffic along Camden Street is lower than on Camden Road.

4.6 There are no clear trends in monitoring results for the past five years. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards. The implications of this are discussed in Section 5 of this report.

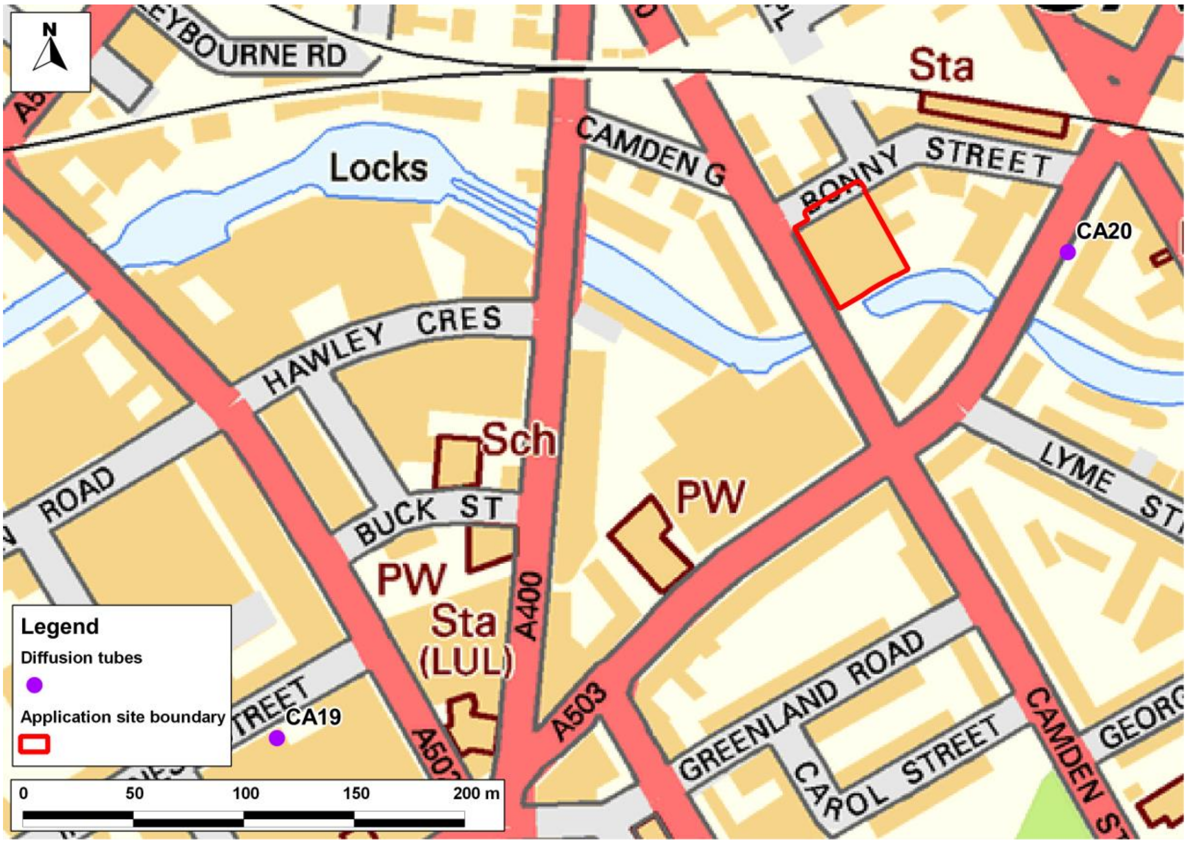

Figure 2: Monitoring Locations

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Exceedences of EU Limit Value

4.7 There are several AURN monitoring sites within the Greater London Urban Area which have measured exceedences of the annual mean nitrogen dioxide limit value. Furthermore, the national map of roadside annual mean nitrogen dioxide concentrations, used to report exceedences of the limit value to the EU (Defra, 2015c) identifies exceedences of this limit value in 2012 along many roads in London, including Camden Street. The Greater London Urban Area has thus been reported to the EU as exceeding the limit value for annual mean nitrogen dioxide concentrations. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations show no exceedences of the limit values anywhere in London. These maps are for 2012 concentrations; detailed maps of predicted future year exceedences are not available (Defra, 2015c).

Background Concentrations

National Background Pollution Maps

4.8 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for 2013 and the opening year 2017 (Table 4). In the case of nitrogen dioxide, two sets of future-year backgrounds are presented to take into account uncertainty in future year vehicle emission factors. The derivation of background concentrations is described in Appendix A5. The background concentrations are all below the objectives.

Table 4: Estimated Annual Mean Background Pollutant Concentrations in 2013 and 2017 (μg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2013 [a]	39.1	24.1	16.4
2017 – Without Reductions in Traffic Emissions [b]	37.3	n/a	n/a
2017 – With Reductions in Traffic Emissions [c]	34.6	22.9	15.3
Objectives	**40**	**40**	**25**

n/a = not applicable

[a] This assumes that road vehicle emission factors in 2013 remain the same as in 2011 (See Appendix A5).

[b] This assumes that road vehicle emission factors in 2017 remain the same as in 2011.

[c] This assumes that road vehicle emission factors reduce between 2013 and 2017 at the current 'official' rates.

5 Construction Phase Impact Assessment

5.1 The construction works will give rise to a risk of dust impacts during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway.

Potential Dust Emission Magnitude

Demolition

5.2 There will be a requirement to demolish buildings with an approximate total volume of 17,000 m^3. The method of demolition has not yet been decided. A mobile crusher may be used on site before removal of the material, but this has not yet been decided. Based on the example definitions set out in Table A2.1, the dust emission class for demolition is considered to be *medium.*

Earthworks

5.3 The characteristics of the soil at the development site have been defined using the British Geological Survey's UK Soil Observatory website (British Geological Survey, 2015), as set out in Table 5.

Table 5: Summary of Soil Characteristics

Category	Record
Soil layer thickness	Deep
Grain Size (and Soil Parent Material)	Argillaceous [a]
European Soil Bureau Description	Prequaternary Marine/Estuarine Sand and Silt
Soil Group	Medium to Light (Silty) to Heavy
Soil Texture	Clay to Silt

[a] grain size < 0.06 mm.

5.4 Overall, it is considered that, when dry, this soil has the potential to be moderately dusty.

5.5 The site covers some 1,400 m^2 and most of this will be subject to earthworks, involving removal of the foundations of the demolished buildings. Dust will arise mainly from vehicles travelling over unpaved ground and from the handling of dusty materials. Based on the example definitions set out in Table A2.1, the dust emission class for earthworks is considered to be *small*.

Construction

5.6 Construction will involve a total building volume of around 31,700 m^3. Dust will arise from the handling and storage of dusty materials, and from the cutting of concrete. Based on the example definitions set out in Table A2.1, the dust emission class for construction is considered to be *medium*.

Trackout

5.7 The number of vehicles accessing the site, which may track out dust and dirt is currently unknown, but given the size of the site it is likely that there will be a maximum of 10 outward heavy vehicle movements per day. Based on the example definitions set out in Table A2.1, the dust emission class for trackout is considered to be *small*.

5.8 Table 6 summarises the dust emission magnitude for the proposed development.

Table 6: Summary of Dust Emission Magnitude

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

Sensitivity of the Area

5.9 This assessment step combines the sensitivity of individual receptors to dust effects with the number of receptors in the area and their proximity to the site. It also considers additional site-specific factors such as topography and screening, and in the case of sensitivity to human health effects, baseline PM_{10} concentrations.

Sensitivity of the Area to Effects from Dust Soiling

5.10 The IAQM guidance, upon which the GLA's guidance is based, explains that residential properties are 'high' sensitivity receptors to dust soiling (Table A2.2). There are approximately 11 residential properties within 20 m of the site (see Figure 3). Using the matrix set out in Table A2.3, the area surrounding the onsite works is of 'high' sensitivity to dust soiling. Table 6 shows that dust emission magnitude for trackout is 'small' and Table A2.3 thus explains that there is a risk of material being tracked 50 m from the site exit. Since it is not known which roads construction vehicles will use, it has been assumed that all possible routes could be affected. There are approximately nine residential properties within 20 m of the roads along which material could be tracked (see Figure 4), and Table A2.3 thus indicates that the area is of 'medium' sensitivity to dust soiling due to trackout (Table 7).

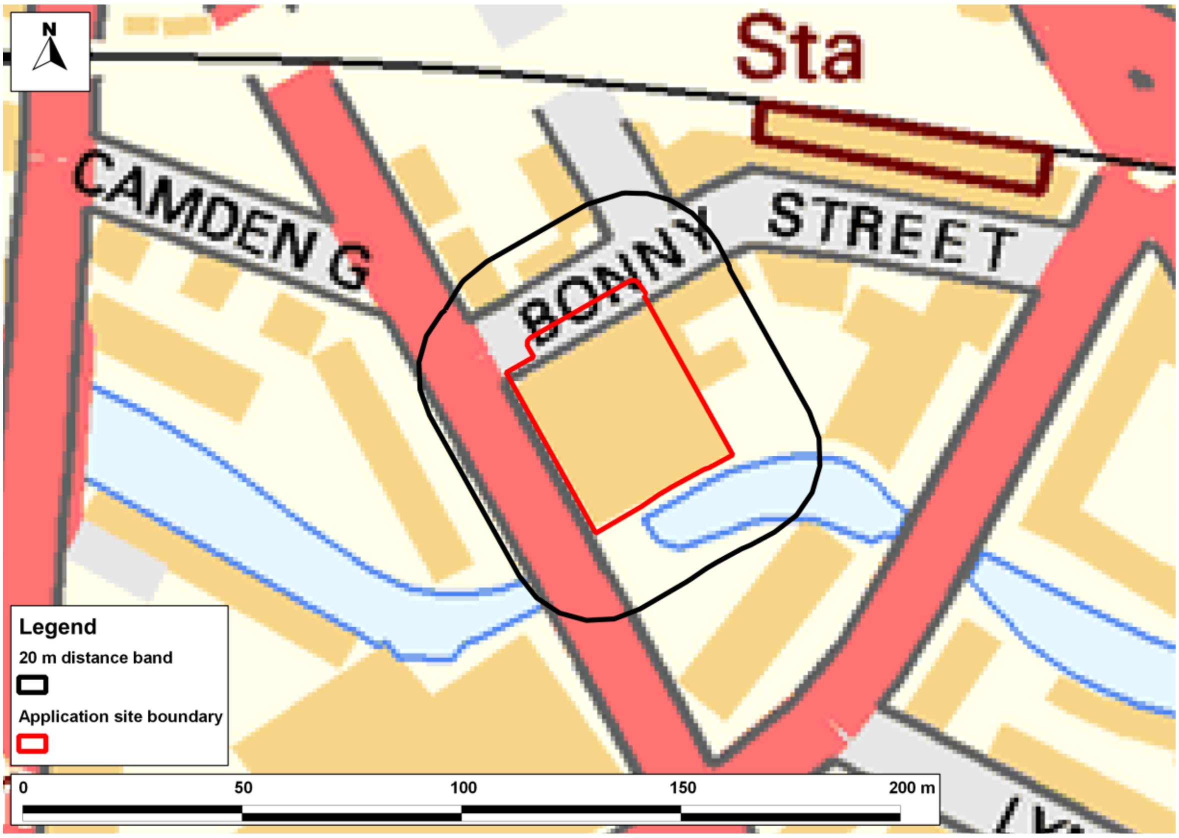

Figure 3: 20 m Distance Band around Site Boundary

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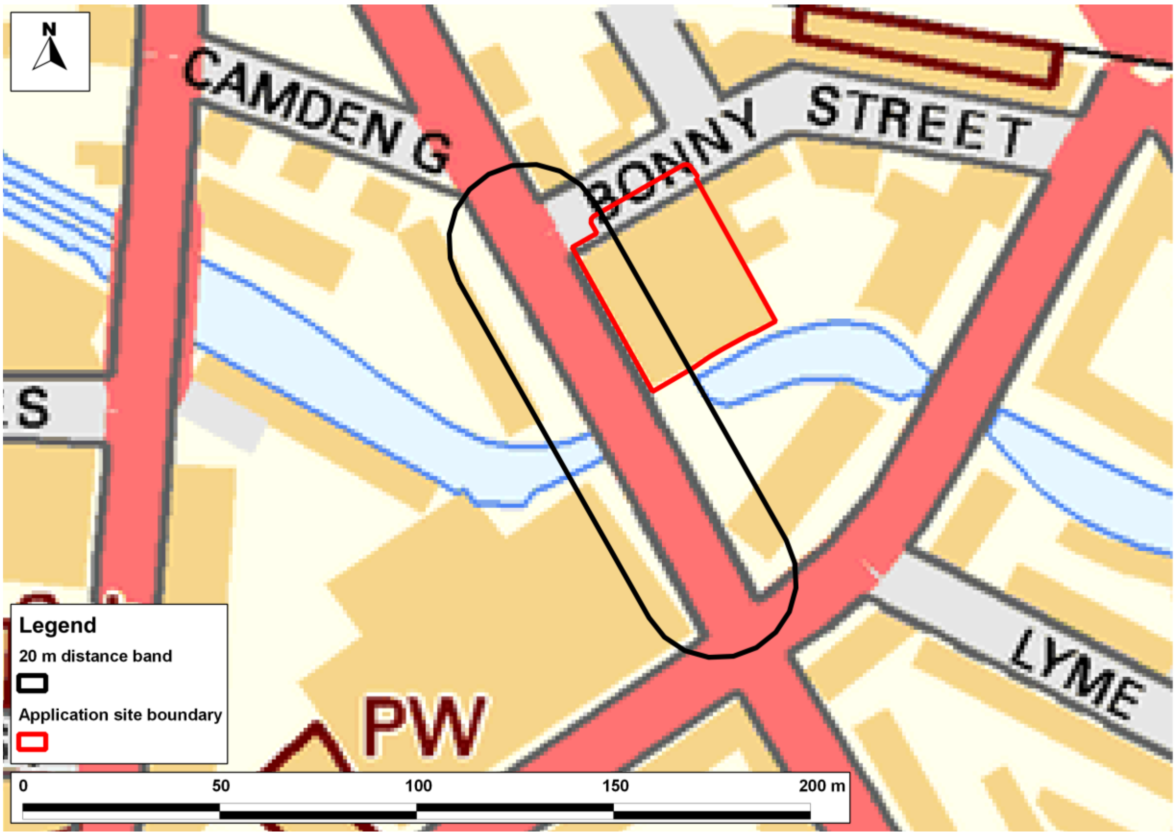

Figure 4: **20 m Distance Band around Roads Used by Construction Traffic within 50 m of the Site Boundary**

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Sensitivity of the Area to any Human Health Effects

5.11 Residential properties are also classified as being of 'high' sensitivity to human health effects. The matrix in Table A2.4 requires information on the baseline annual mean PM_{10} concentration in the area. It is considered that the modelled baseline PM_{10} concentration at Receptor E in Table 9 will best represent conditions near to the site. Using the matrix in Table A2.4, the area surrounding the onsite works is of 'high' sensitivity to human health effects, while the area surrounding roads along which material may be tracked from the site is of 'medium' sensitivity (Table 7).

Sensitivity of the Area to any Ecological Effects

5.12 The guidance only considers designated ecological sites within 50 m to have the potential to be impacted by the construction works. There are no designated ecological sites within 50 m of the site boundary or those roads along which material may be tracked, thus ecological impacts will not be considered further.

Table 7: Summary of the Area Sensitivity

Effects Associated With:	Sensitivity of the Surrounding Area	
	On-site Works	Trackout
Dust Soiling	High Sensitivity	Medium Sensitivity
Human Health	High Sensitivity	Medium Sensitivity
Ecological	None	None

Risk and Significance

5.13 The dust emission magnitudes in Table 6 have been combined with the sensitivities of the area in Table 7 using the matrix in Table A2.6 in Appendix A2, in order to assign a risk category to each activity. The resulting risk categories for the four construction activities, without mitigation, are set out in Table 8. These risk categories have been used to determine the appropriate level of mitigation as set out in Section 7.

Table 8: Summary of Risk of Impacts Without Mitigation

Source	Dust Soiling	Human Health	Ecology
Demolition	Medium Risk	Medium Risk	None
Earthworks	Low Risk	Low Risk	None
Construction	Medium Risk	Medium Risk	None
Trackout	Negligible	Negligible	None

5.14 The IAQM does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally not be significant (Institute of Air Quality Management, 2014).

6 Operational Phase Impact Assessment

CHP Plant Impacts

6.1 The proposals for the development include CHP and boiler plant, the emissions from which could impact upon air quality at existing residential properties, as well as the new residential properties within the development itself. At the time of preparing this report, the detailed specification of this system has not been determined, and as such it has not been possible to carry out a robust dispersion modelling assessment of the CHP emissions. It is recommended that a full dispersion modelling assessment of the impacts of the proposed CHP plant is undertaken as a pre-commencement condition.

Impacts on the Development

6.2 The modelled impacts of the existing traffic sources on air quality conditions for residents of the proposed development are set out in Table 9 (see Table 2 and Figure 1 for receptor locations). For the 'with emissions reduction' scenario, the annual mean nitrogen dioxide concentration exceeds the objective at all receptors up to and including the third floor, while for the 'without emissions reduction' scenario, the objective is exceeded at all receptors below roof level, albeit marginally at the 6th floor. The objective is not exceeded at roof level in either scenario. Concentrations of PM_{10} and $PM_{2.5}$ are all below the relevant objectives. Air quality for future residents within the development will thus not be acceptable, indicating a requirement for mitigation.

Table 9: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2017 for New Receptors in the Development Site

Receptor [b]	Annual Mean NO_2 ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$) [a]		$PM_{2.5}$ ($\mu g/m^3$)
	With 'Official' Emissions Reduction [c]	Without Emissions Reduction [d]	Annual Mean	No. Days >50 $\mu g/m^3$	Annual Mean
Receptor A_0	**48.2**	**53.8**	24.3	11	16.2
Receptor B_1	**45.4**	**50.4**	24.0	10	16.0
Receptor C_1	**50.9**	**57.0**	24.5	11	16.4
Receptor C_2	**44.4**	**49.2**	23.9	10	16.0
Receptor C_3	**41.2**	**45.3**	23.6	9	15.8
Receptor C_4	39.4	**43.1**	23.4	9	15.6
Receptor C_5	38.2	**41.7**	23.3	9	15.6
Receptor C_6	37.4	**40.7**	23.2	8	15.5
Receptor C_r	36.5	39.8	23.1	8	15.5
Receptor D_1	**45.8**	**50.9**	24.1	10	16.1
Receptor E_1	**46.7**	**52.0**	24.1	10	16.1
Receptor E_2	**43.9**	**48.6**	23.8	10	15.9
Receptor E_3	**41.5**	**45.7**	23.6	9	15.8
Receptor E_4	39.7	**43.5**	23.4	9	15.7
Receptor E_5	38.4	**41.9**	23.3	9	15.6
Receptor E_6	37.5	**40.8**	23.2	8	15.5
Receptor E_r	36.6	39.9	23.1	8	15.5
Receptor F_1	**45.0**	**50.0**	24.0	10	16.0
Receptor F_2	**43.8**	**48.5**	23.8	10	15.9
Receptor F_3	**42.3**	**46.7**	23.7	9	15.8
Receptor G_1	**44.8**	**49.6**	23.9	10	16.0
Receptor G_2	**43.0**	**47.5**	23.8	10	15.9
Objectives	**40**		**40**	**35**	**25**

[a] The numbers of days with PM_{10} concentrations greater than 50 $\mu g/m^3$ have been estimated from the relationship with the annual mean concentration described in LAQM.TG (09) (Defra, 2009)

[b] The number denotes the floor that the receptor is on; 'r' denotes roof-level.

[c] This assumes that road vehicle emission factors reduce between 2013 and 2017 at the current 'official' rates.

[d] This assumes that road vehicle emission factors in 2017 will remain the same as in 2013.

'Air Quality Neutral'

Building Emissions

6.3 In terms of the minimum standards, the proposed development will need to comply with the SPG, which states that boiler plant must achieve an emission rate of <40 mg/kWh and requires NOx emissions from CHP plant to be less than 95 mg NOx/Nm^3 for developments in Band B (GLA, 2014a). The exact specifications of the CHP plant are not known at this stage; for the purposes of this assessment it is assumed that it will meet the emission standard of 0.4 g/kWh as set out in the Air Quality Neutral methodology report (AQC, 2014).

6.4 The total gas usage is expected to be 167,472 kWh/yr for the CHP plant and 66,975 kWh/yr for the supporting boiler plant, leading to a total NOx emission from the proposed development of 69.7 kg/yr. Appendix 6 shows the Building Emission Benchmarks (BEBs) for each land use category. Table 10 shows the calculation of the BEBs for this development.

Table 10: Calculation of Building Emissions Benchmark for the Development

	Description	Value	Reference
A	Gross Internal Floor Area of Residential Units (m^2)	3,617	CgMs Consulting
B	NOx BEB for Residential Units (g/m^2/yr)	26.2	Table A6.1
C	Gross Internal Floor Area of Offices (m^2)	1,959	CgMs Consulting
D	NOx BEB for B1 Offices (g/m^2/yr)	30.8	Table A6.1
E	Total BEB NOx Emissions (kg/yr)	**155.1**	(A x B + C x D) / 1000

6.5 The Total Building NOx Emission of 69.7 kg/yr is less than Total BEB NOx Emission of 155.1 kg/yr. The proposed development is thus better than air quality neutral in terms of building emissions.

Road Transport Emissions

6.6 The Transport Emission Benchmarks (TEBs) are based on the number of trips generated by different land-use classes, together with the associated trip lengths and vehicle emission rates.

6.7 CgMs Consulting has advised that the proposed development will be car free and will thus not generate any transport emissions. The TEBs for the development are set out in Table 11.

Table 11: Calculation of Transport Emissions Benchmark for the Development

Description		Value		Reference
Residential (C3)				
A	**Number of Dwellings**	53		CgMs Consulting
		NOx	**PM_{10}**	-
B	**Benchmark Emissions (g/dwelling/yr)**	558	100	Table A6.2
C	**Residential TEBs**	29.6	5.3	A x B / 1000
Office (B1)				
D	**Gross Internal Floor Area (m^2) of Offices**	1,959		CgMs Consulting
		NOx	**PM_{10}**	
E	**Benchmark Emissions (g/m^2/yr)**	11.4	2.05	Table A6.2
F	**Office TEBs**	22.3	4.0	D x E / 1000
Entire Development				
Total TEBs (kg/yr)		**51.9**	**9.3**	C + F

6.8 The Total Transport Emissions of the car free development are less than the Total Transport Emissions Benchmarks for both NOx/PM_{10}. The proposed development is thus better than air quality neutral in terms of transport emissions.

Uncertainty in Road Traffic Modelling Predictions

6.9 There are many components that contribute to the uncertainty of modelling predictions. The model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as the model is required to simplify real-world conditions into a series of algorithms. An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A5). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2013) concentrations.

6.10 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations, and vehicle emissions. A disparity between the road transport emission projections and measured annual mean concentrations of nitrogen oxides and nitrogen dioxide has been identified by Defra (Carslaw et al., 2011). This is evident across the UK, although the effect appears to be greatest in inner London; there is also considerable inter-site variation. Whilst the emission projections suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25% over the 6 to 8 years prior to 2009, at many monitoring sites levels remained relatively stable, or even showed a slight increase. This pattern is mirrored in the monitoring data assembled for this study, as set out in Paragraph 4.5.

6.11 The reason for the disparity is thought to relate to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles is often no better than that of earlier models (Carslaw et al., 2011). The best current evidence is that, where previous standards have had limited on-road success, the 'Euro VI' and 'Euro 6' standards that new vehicles will have to comply with from 2013/15[3] will achieve the expected on-road improvements, as, for the first time, they will require compliance with the World Harmonized Test Cycle, which better represents real-world driving conditions[4] and includes a separate slow-speed cycle for heavy duty vehicles.

6.12 The forecast reductions in nitrogen oxides emissions may still be optimistic in the near-term. To account for this uncertainty, a sensitivity test has been conducted assuming that the future (2017) road traffic emissions per vehicle are unchanged from 2013 values. The predictions within this sensitivity test are likely to be over-pessimistic, as new, lower-emission Euro VI and Euro 6 vehicles will be on the road from 2013/15; according to Defra's Emission Factors Toolkit (Defra, 2015a), by 2017 it is forecast that there will be a roughly 45% penetration of Euro VI HDVs and a roughly 32% penetration of Euro 6 LDVs. These new vehicles are expected to deliver real on-road reductions in nitrogen oxides emissions.

Significance of Operational Air Quality Impacts

6.13 The operational air quality impacts without mitigation are judged to be *moderate adverse*. This professional judgement is made in accordance with the methodology set out in Paragraph A3.1 (Appendix A3), taking into account the factors set out in Table 12, and also taking into account the uncertainty over future projections of traffic-related nitrogen dioxide concentrations, which may not decline as rapidly as expected. The latter has been addressed by giving consideration to both sets of modelled results for nitrogen dioxide; those with and without reductions in traffic emissions.

6.14 More specifically, the judgement that the air quality impacts will be *moderate adverse* without mitigation takes account of the assessment that concentrations are predicted to remain above the

[3] Euro VI refers to heavy duty vehicles, while Euro 6 refers to light duty vehicles. The timings for meeting the standards vary with vehicle type and whether the vehicle is a new model or existing model.

[4] The test cycle for real-world emissions for Euro 6 vehicles will not be implemented until about 2017. However, there is still expected to be a substantial improvement in NOx emissions from Euro 6 vehicles (as compared with Euro 5) from 2015 onwards.

objective at all receptors up to and including the third floor if emissions reduce as predicted, and at all receptors if emissions to not reduce.

Table 12: Factors Taken into Account in Determining the Overall Significance of the Scheme on Local Air Quality

Factors	Outcome of Assessment
The number of people exposed to levels above the objective, where new exposure is being introduced.	There will be introduction of a significant number of people exposed to exceedences of the objectives.
Uncertainty, including the extent to which worst-case assumptions have been made.	The inclusion of the two scenarios for nitrogen dioxide covers the uncertainty over vehicle emission factors.
The extent to which an objective is exceeded.	The annual mean nitrogen dioxide objective is exceeded at multiple receptors.

7 Mitigation

Construction Impacts

7.1 Measures to mitigate dust emissions will be required during the construction phase of the development in order to reduce impacts upon nearby sensitive receptors.

7.2 The site has been identified as a *Medium* Risk site during demolition and construction and *Low* Risk during earthworks and from trackout, as set out in Table 8. The GLA's SPG on *The Control of Dust and Emissions During Construction and Demolition* (GLA, 2014b) describes best practice measures that should be employed, as appropriate, to reduce the impacts, along with guidance on what monitoring should be undertaken during the construction phase. This reflects best practice experience and has been used, together with the professional experience of the consultant and the findings of the dust impact assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in Appendix A7.

7.3 The mitigation measures should be written into a dust management plan (DMP) and secured by Section 106 agreement. Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There should not be any excess to potentially contaminate local watercourses.

Road Traffic Impacts

7.4 The assessment has demonstrated that the scheme will introduce new residential accommodation into an area where the annual mean nitrogen dioxide objective is likely to be exceeded. It is recommended that mitigation be applied in the form of mechanical ventilation for dwellings located on the ground to the fifth floors. The predicted exceedences at the sixth floor are marginal and are based on the overly-conservative assumption that there will be no reductions in emissions by 2017. In reality, it is expected that the introduction of Euro 6/VI vehicles will deliver some benefits, and the levels predicted under the "no emissions reduction" scenario are therefore overstated.

7.5 Cleaner air for the residential units in the block adjacent to Camden Street can be drawn from a location on the sixth floor or above, to the rear of the building, in the vicinity of Receptor E, where annual mean nitrogen dioxide concentrations are below the objective. The ventilation inlet should be sited away from any exhaust flues, the locations of which are to be determined as a pre-commencement condition. This ventilation should be supplied to all the residential units up to and including the fifth floor.

7.6 Concentrations at the roof-top level of the lower level blocks to the rear of the scheme, in the vicinity of Receptors F and G, exceed the annual mean nitrogen dioxide objective. If it is necessary to supply the air for these lower units from the fourth floor roof or below then it is recommended that a NOx scrubbing system is installed at the ventilation intake. NOx scrubbing systems typically have an efficiency of 75%. Any NOx Scrubbing units would need to be routinely checked and maintained to ensure that they continue to operate effectively.

7.7 Mitigation measures to reduce pollutant emissions from road traffic are also being delivered at a national level, by the introduction of more stringent emissions standards, largely via European legislation. This will help ensure that concentrations decline with time after the opening year.

8 Residual Impacts

Construction

8.1 The IAQM guidance is clear that, with appropriate mitigation in place, the residual effect will normally be 'not significant'. The mitigation measures set out in Section 7 are based on the IAQM guidance. With these measures in place and effectively implemented the residual effects are judged to be *insignificant*.

8.2 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. During these events, short-term dust annoyance may occur, however, the scale of this would not normally be considered sufficient to change the conclusion that the effects will be *insignificant*.

Road Traffic Impacts

8.3 An indication of how the proposed mitigation is likely to reduce concentrations of nitrogen dioxide at each receptor is shown in Table 13, which draws upon the data in Table 9. The results describe the predicted nitrogen dioxide concentrations assuming that ventilated air is drawn from the roof at the rear of the building in line with the approximate location of receptor E for use in the block adjacent to Camden Street, and that ventilated air is drawn from the building façade at the remaining residential units and scrubbed (assuming 75% efficiency) for use in the blocks to the rear of the scheme.

8.4 With mechanical ventilation, and use of NOx scrubbing if required, air quality will be acceptable for all residents of the proposed scheme, and the air quality impact is judged to be *insignificant*. This professional judgement is made in accordance with the methodology set out in in Appendix A3 taking into account the factors set out in Table 14.

Table 13: Predicted Concentrations of Nitrogen Dioxide (NO_2) in 2017 for New Receptors in the Development Site With and Without Mitigation

Receptor [c]	Annual Mean NO_2 ($\mu g/m^3$)			
	Without ventilation		With ventilation	
	With 'Official' Emissions Reduction [a]	Without Emissions Reduction [b]	With 'Official' Emissions Reduction [a]	Without Emissions Reduction [b]
Receptor A_0	**48.2**	**53.8**	12.0 [d]	13.5 [d]
Receptor B_1	**45.4**	**50.4**	11.3 [d]	12.6 [d]
Receptor C_1	**50.9**	**57.0**	36.6	39.9
Receptor C_2	**44.4**	**49.2**	36.6	39.9
Receptor C_3	**41.2**	**45.3**	36.6	39.9
Receptor C_4	39.4	**43.1**	36.6	39.9
Receptor C_5	38.2	**41.7**	36.6	39.9
Receptor C_6	37.4	**40.7**	36.6	39.9
Receptor D_1	**45.8**	**50.9**	11.5 [d]	12.7 [d]
Receptor E_1	**46.7**	**52.0**	36.6	39.9
Receptor E_2	**43.9**	**48.6**	36.6	39.9
Receptor E_3	**41.5**	**45.7**	36.6	39.9
Receptor E_4	39.7	**43.5**	36.6	39.9
Receptor E_5	38.4	**41.9**	36.6	39.9
Receptor E_6	37.5	**40.8**	36.6	39.9
Receptor F_1	**45.0**	**50.0**	11.3 [d]	12.5 [d]
Receptor F_2	**43.8**	**48.5**	11.0 [d]	12.1 [d]
Receptor F_3	**42.3**	**46.7**	10.6 [d]	11.7 [d]
Receptor G_1	**44.8**	**49.6**	11.2 [d]	12.4 [d]
Receptor G_2	**43.0**	**47.5**	10.8 [d]	11.9 [d]
Objectives	**40**			

[a] This assumes that road vehicle emission factors reduce between 2013 and 2017 at the current 'official' rates.

[b] This assumes that road vehicle emission factors in 2017 will remain the same as in 2013.

[c] The number denotes the floor that the receptor is on.

[d] Assuming 75% reduction due to use of a NOx scrubber.

Table 14: Factors Taken into Account in Determining the Overall Significance of the Scheme on Local Air Quality With Mitigation

Factors	Outcome of Assessment
The number of people exposed to levels above the objective, where new exposure is being introduced.	None of the new residents would be exposed to concentrations above the objectives.
Uncertainty, including the extent to which worst-case assumptions have been made	The inclusion of the two scenarios for nitrogen dioxide covers the uncertainty over vehicle emission factors.
The extent to which an objective is exceeded	With mitigation the objectives will not be exceeded.

9 Conclusions

9.1 The construction works have the potential to create dust. During construction it will therefore be necessary to apply a package of mitigation measures to minimise dust emission. With these measures in place, it is expected that any residual effects will be 'not significant'.

9.2 The impacts of traffic from local roads on the air quality for future residents have been assessed at seven worst-case locations within the new development itself. In the case of nitrogen dioxide, the modelling has been carried out assuming both that vehicle emissions decrease (using 'official' emission factors), and that they do not decrease in future years. This is to allow for uncertainty over emission factors for nitrogen oxides identified by Defra (Carslaw et al., 2011).

9.3 It is concluded that concentrations of PM_{10} and $PM_{2.5}$ will remain below the objectives at all new receptors in 2017.

9.4 In the case of nitrogen dioxide, and without mitigation, there is a risk that annual mean concentrations will exceed the objective at all receptors, albeit marginally at the 6th floor.

9.5 The overall operational air quality impacts of the development without mitigation are judged to be *moderate*. This conclusion, which takes account of the uncertainties in future projections, in particular for nitrogen dioxide, is based on the concentrations being above the objectives at the majority of receptors.

9.6 Mitigation is to be applied in the form of mechanical ventilation, with NOx scrubbing if necessary, for dwellings located up to and including the fifth floor. With this mitigation in place it is concluded that road traffic emissions do not provide any constraints to the proposed scheme.

9.7 The building and transport related emissions associated with the proposed development are both below the relevant benchmarks. The proposed development therefore complies with the requirement that all new developments in London should be at least air quality neutral.

9.8 The proposed development is consistent with the NPPF. Furthermore, it is better than air quality and is thus compliant with Policy 7.14 of the London Plan.

10 References

AQC (2014) *Air Quality Neutral Planning Support Update: GLA 80371*.

British Geological Survey (2015) *UK Soil Observatory Map Viewer*, [Online], Available: http://mapapps2.bgs.ac.uk/ukso/home.html.

Carslaw, D., Beevers, S., Westmoreland, E. and Williams, M. (2011) *Trends in NOx and NO2 emissions and ambient measurements in the UK*, [Online], Available: uk-air.defra.gov.uk/reports/cat05/1108251149_110718_AQ0724_Final_report.pdf.

DCLG (2014) *Planning Practice Guidance*, [Online], Available: http://planningguidance.planningportal.gov.uk/blog/guidance/.

Defra (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Defra.

Defra (2009) *Review & Assessment: Technical Guidance LAQM.TG(09)*, Defra.

Defra (2015a) *Defra Air Quality Website*, [Online], Available: http://laqm.defra.gov.uk/.

Defra (2015b) *UK Pollutant Release and Transfer Register*, [Online], Available: prtr.defra.gov.uk.

Defra (2015c) *UK Ambient Air Quality Interactive Map*, [Online], Available: http://uk-air.defra.gov.uk/data/gis-mapping.

DfT (2011) *DfT Automatic traffic Counters Table TRA0305-0307*, [Online], Available: http://www.dft.gov.uk/pgr/statistics/datatablespublications/roads/traffic.

Directive 2008/50/EC of the European Parliament and of the Council (2008).

Directive 97/68/EC of the European Parliament and of the Council (1997).

Environment Agency (2015) *'what's in your backyard'*, [Online], Available: http://www.environment-agency.gov.uk/homeandleisure/37793.aspx.

Environmental Protection UK (2010) *Development Control: Planning for Air Quality*, EPUK.

GLA (2010) *Mayor's Air Quality Strategy: Cleaning the Air*.

GLA (2011) *London Plan*, [Online], Available: www.london.gov.uk/sites/default/files/The%20London%20Plan%202011.pdf.

GLA (2013) *London Atmospheric Emissions Inventory (LAEI) 2010*.

GLA (2014a) *Sustainable Design and Construction Supplementary Planning Guidance*, [Online], Available: https://www.london.gov.uk/sites/default/files/Revised%20SD%26C%20SPG_0.pdf.

GLA (2014b) *The Control of Dust and Emissions from Construction and Demolition SPG*, [Online], Available: https://www.london.gov.uk/sites/default/files/Dust%20and%20Emissions%20SPG%208%20July%202014_0.pdf.

Institute of Air Quality Management (2009) *Position on the Description of Air Quality Impacts and the Assessment of their Significance*, IAQM.

Institute of Air Quality Management (2014) *Guidance on the Assessment of Dust from Demolition and Construction*.

London Borough of Camden (2009) *Air Quality Action Plan Report 2009 - 2012*.

London Borough of Camden (2011a) *2010 Air Quality Progress Report for the London Borough of Camden*.

London Borough of Camden (2011b) *Camden Planning Guidance Amenity CPG 6*.

London Borough of Camden (2011c) *Green Action for Change Camden's Environmental Sustainability Plan (2011 - 2020)*.

London Borough of Camden (2013a) *2013 Air Quality Progress Report*.

London Borough of Camden (2013b) *Camden's Draft Clean Air Action Plan 2013-2015, for public consultation*.

London Borough of Camden (2014) *2014 Air Quality Progress Report*.

National Planning Policy Framework (2012), DCLG.

The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043 (2002), HMSO.

The Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000), HMSO.

The Air Quality Standards Regulations (No. 1001) (2010), Stationery Office.

11 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CHP	Combined Heat and Power
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMP	Dust Management Plan
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LDF	Local Development Framework
LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
$\mu g/m^3$	Microgrammes per cubic metre
MAQS	Mayor's Air Quality Strategy
NRMM	Non-road Mobile Machinery
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)

NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PHV	Private Hire Vehicle
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide

12 Appendices

A1 Extracts from the London Plan and Mayor's Air Quality Strategy, and Description of the Low Emission Zone (LEZ)

London Plan [5]

A1.1 The London Plan sets out the following points in relation to planning decisions:

"Development proposals should:

a) minimise increased exposure to existing poor air quality and make provision to address local problems of air quality (particularly within AQMAs or where development is likely to be used by large numbers of those particularly vulnerable to poor air quality, such as children or older people) such by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans (see Policy 6.3);

b) promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance in the GLA and London Councils "The control, of dust and emissions form construction and demolition";

c) be at least "air quality neutral" and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs));

d) ensure that where provision needs to made to reduce emissions from a development, these usually are made on site. Where it can be demonstrated that on-sire provision is impractical or inappropriate, and that it is possible to put in place measures having clearly demonstrated equivalent air quality benefits, planning obligations or planning conditions should be used as appropriate to ensure this, whether on a scheme by scheme basis or through joint area-based approaches;

e) where the development requires a detailed air quality assessment and biomass boilers are included, the assessment should forecast pollutant concentrations. Permission should only be granted if no adverse air quality impacts from the biomass boiler are identified."

The Mayor's Air Quality Strategy

A1.2 The Mayor's Air Quality Strategy commits to the continuation of measures identified in the 2002 MAQS, and sets out a series of additional measures, including:

Policy 1 – Encouraging smarter choices and sustainable travel;

[5] The GLA has outlined a number of draft alterations to the London Plan, but no changes are proposed to any policies relating to air quality.

Measures to reduce emissions from idling vehicles focusing on buses, taxis, coaches, taxis, PHVs and delivery vehicles;

Using spatial planning powers to support a shift to public transport;

Supporting car free developments.

Policy 2 – Promoting technological change and cleaner vehicles:

Supporting the uptake of cleaner vehicles.

Policy 4 – Reducing emissions from public transport:

Introducing age limits for taxis and PHVs.

Policy 5 – Schemes that control emissions to air:

Implementing Phases 3 and 4 of the LEZ from January 2012

Introducing a NOx emissions standard (Euro IV) into the LEZ for Heavy Goods Vehicles (HGVs), buses and coaches, from 2015.

Policy 7 – Using the planning process to improve air quality:

Minimising increased exposure to poor air quality, particularly within AQMAs or where a development is likely to be used by a large number of people who are particularly vulnerable to air quality;

Ensuring air quality benefits are realised through planning conditions and section 106 agreements and Community Infrastructure Levy.

Policy 8 – Creating opportunities between low to zero carbon energy supply for London and air quality impacts:

Applying emissions limits for biomass boilers across London;

Requiring an emissions assessment to be included at the planning application stage.

Low Emission Zone (LEZ)

A1.3 A key measure to improve air quality in Greater London is the Low Emission Zone (LEZ). This entails charges for vehicles entering Greater London not meeting certain emissions criteria, and affects older, diesel-engined lorries, buses, coaches, large vans, minibuses and other specialist vehicles derived from lorries and vans. The LEZ was introduced on 4th February 2008, and was phased in through to January 2012. From January 2012 a standard of Euro IV was implemented for lorries and other specialist diesel vehicles over 3.5 tonnes, and buses and coaches over 5 tonnes. Cars and lighter Light Goods Vehicles (LGVs) are excluded. The third phase of the LEZ, which applies to larger vans, minibuses and other specialist diesel vehicles, was also implemented in January 2012. As set out in the 2010 MAQS, a NOx emissions standard (Euro IV) will be included into the LEZ for HGVs, buses and coaches, from 2015.

A2 Construction Dust Assessment Procedure

A2.1 The criteria developed by IAQM, upon which the GLA's guidance is based, divide the activities on construction sites into four types to reflect their different potential impacts. These are:

- demolition;
- earthworks;
- construction; and
- trackout.

A2.2 The assessment procedure includes the four steps summarised below:

STEP 1: Screen the Need for a Detailed Assessment

A2.3 An assessment is required where there is a human receptor within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s), or where there is an ecological receptor within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A2.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will not be significant. No mitigation measures beyond those required by legislation will be required.

STEP 2: Assess the Risk of Dust Impacts

A2.5 A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- the sensitivity of the area to dust effects (Step 2B).

A2.6 These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

Step 2A – Define the Potential Dust Emission Magnitude

A2.7 Dust emission magnitude is defined as either 'Small', 'Medium', or 'Large'. The IAQM explains that this classification should be based on professional judgement, but provides the examples in Table Table A2.1.

Table A2.1: Examples of How the Dust Emission Magnitude Class May be Defined

Class	Examples
Demolition	
Large	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
Medium	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level
Small	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	
Large	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due 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
Medium	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
Small	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 <10,000 tonnes, earthworks during wetter months
Construction	
Large	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting
Medium	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching
Small	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout [a]	
Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

[a] These numbers are for vehicles that leave the site after moving over unpaved ground.

Step 2B – Define the Sensitivity of the Area

A2.8 The sensitivity of the area is defined taking account of 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 local background concentration; and
- site-specific factors, such as whether there are natural shelters to reduce the risk of wind-blown dust.

A2.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM recommends that this should be based on professional judgment, taking account of the principles in Table A2.2. These receptor sensitivities are then used in the matrices set out in Table A2.3, Table A2.4, and Table A2.5 to determine the sensitivity of the area. Finally, the sensitivity of the area is considered in relation to any other site-specific factors, such as the presence of natural shelters etc., and any required adjustments to the defined sensitivities are made.

Step 2C – Define the Risk of Impacts

A2.10 The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the *risk* of impacts with no mitigation applied. The IAQM provides the matrix in Table A2.6 as a method of assigning the level of risk for each activity.

STEP 3: Determine Site-specific Mitigation Requirements

A2.11 The IAQM provides a suite of recommended and desirable mitigation measures which are organised according to whether the outcome of Step 2 indicates a low, medium, or high risk. The list provided by the IAQM has been used as the basis for the requirements set out in Appendix **Error! Reference source not found.**.

STEP 4: Determine Significant Effects

A2.12 The IAQM does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally not be significant (Institute of Air Quality Management, 2014).

A2.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will not be significant.

Table A2.2: Principles to be Used When Defining Receptor Sensitivities

Class	Principles	Examples
Sensitivities of People to Dust Soiling Effects		
High	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 a to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium	users would expect to enjoy a reasonable level of amenity, but would not reasonably expect 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 to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land	parks and places of work
Low	the enjoyment of amenity would not reasonably be expected; or there is property that would not reasonably be expected 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	playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads
Sensitivities of People to the Health Effects of PM_{10}		
High	locations where members of the public may be exposed for eight hours or more in a day	residential properties, hospitals, schools and residential care homes
Medium	locations where the people exposed are workers, and where individuals may be exposed for eight hours or more in a day.	may include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}
Low	locations where human exposure is transient	public footpaths, playing fields, parks and shopping streets
Sensitivities of Receptors to Ecological Effects		
High	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	Special Areas of Conservation with dust sensitive features
Medium	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	Sites of Special Scientific Interest with dust sensitive features
Low	locations with a local designation where the features may be affected by dust deposition	Local Nature Reserves with dust sensitive features

Table A2.3: Sensitivity of the Area to Effects on People and Property from Dust Soiling [6]

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Low	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table A2.4: Sensitivity of the Area to Human Health Effects [6]

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

[6] For demolition, earthworks and construction, distances are taken either from the dust source or from the boundary of the site. For trackout, distances are measured from the sides of roads used by construction traffic. Without mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table A2.5: Sensitivity of the Area to Ecological Effects [6]

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table A2.6: Defining the Risk of Dust Impacts

Sensitivity of the Area	Dust Emission Magnitude		
	Large	**Medium**	**Small**
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

A3 Assessment of Significance

A3.1 There is no official guidance in the UK on how to assess the significance of air quality impacts of existing sources on a new development. The approach developed by the Institute of Air Quality Management[7] (Institute of Air Quality Management, 2009), and incorporated in Environmental Protection UK's guidance document on planning and air quality (Environmental Protection UK, 2010), has therefore been used. The guidance is that the assessment of significance should be based on professional judgement, with the overall air quality impact of the scheme described as either, *insignificant*, *minor*, *moderate* or *major*. In drawing this conclusion, the factors set out in Table A3.1 should be taken into account. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A4.

Table A3.1: Factors Taken into Account in Determining Air Quality Significance

Factors
The number of people exposed to levels above the objective, where new exposure is being introduced.
Uncertainty, including the extent to which worst-case assumptions have been made.
The extent to which an objective is exceeded, e.g. an annual mean NO_2 of 41 µg/m^3 should attract less significance than an annual mean of 51 µg/m^3.

[7] The IAQM is the professional body for air quality practitioners in the UK.

A4 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

Ms Wilson is a Principal Consultant with AQC, with more than thirteen years' relevant experience in the field of air quality. She has been responsible for air quality assessments of a wide range of development projects, covering retail, housing, roads, ports, railways and airports. She has also prepared air quality review and assessment reports and air quality action plans for local authorities and appraised local authority assessments and air quality grant applications on behalf of the UK governments. Ms Wilson has arranged air quality and dust monitoring programmes and carried out dust and odour assessments. She has provided expert witness services for planning appeals and is a Chartered Scientist and Member of the Institute of Air Quality Management.

Dr Imogen Heard, BSc (Hons) MSc PhD MInstPhys

Dr Heard is a Consultant with AQC, having joined the company in 2013. Prior to joining she worked as a scientist in the Atmospheric Dispersion and Air Quality area at the UK Met Office for four years, modeling the dispersion of a range of pollutants over varying spatial and temporal scales. She now works in the field of air quality assessment and is involved in a range of development projects that include using ADMS dispersion models to study nitrogen dioxide, PM_{10} and $PM_{2.5}$ impacts, and the preparation of air quality assessment reports.

A5 Modelling Methodology

Background Concentrations

A5.1 The background concentrations across the study area have been defined using the national pollution maps published by Defra (2015a). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic. As noted in Paragraph 3.7, there are some concerns that Defra may have over-predicted the rate at which road traffic emissions of nitrogen oxides will fall in the future. The maps currently in use were verified against measurements made during 2011 at a large number of automatic monitoring stations and so there can be reasonable confidence that the maps are representative of conditions during 2011. Similarly, there is reasonable confidence that the reductions which Defra predicts from other sectors (e.g. rail) will be achieved.

A5.2 Background concentrations in 2013 have been calculated for the development site, and in order to carry out the verification process (see next section on Model Verification). They have also been used to calculate the 'with emissions reduction' background concentrations for 2017. To do this, it has been assumed that there was no reduction in the road traffic component of backgrounds between 2011[8] and 2013. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2015a). For each grid square, the road traffic component has been held constant at 2011 levels, while 2013 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2015a) publishes to accompany the maps. The result is a set of 'adjusted 2013 background' concentrations.

A5.3 As an additional step, the 'adjusted 2013 background' mapped values have been calibrated against national background measurements made as part of the AURN during 2013 (see Figure A5.1). Based on the 52 sites with more than 90% data capture for 2013, the maps under-predict the background concentrations by 5.5%, on average. This has been allowed for in production of the calibrated 'adjusted' 2013 background concentrations and 2017 background concentrations.

[8] This approach assumes that has been no reduction in emissions per vehicle but also that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. Overall, this discrepancy is unlikely to influence the overall conclusions of the assessment.

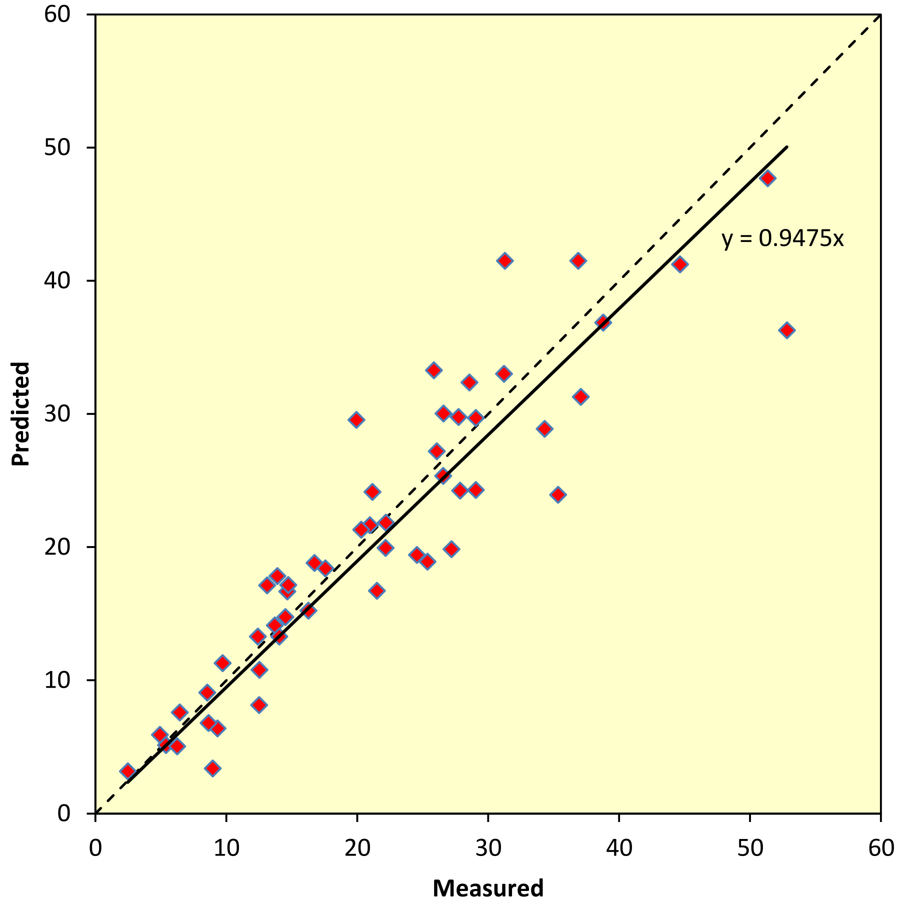

Figure A5.1: Predicted Mapped versus Measured Concentrations at AURN Background Sites in 2013

A5.4 Two separate sets of 2017 background nitrogen dioxide and nitrogen oxides concentrations have been used for the future-year assessment. The 2017 background 'without emissions reduction' has been calculated using the same approach as described for the 2013 data: the road traffic component of background nitrogen oxides has been held constant at 2011 values, while 2017 data are taken for the other components. Nitrogen dioxide has then been calculated using Defra's background nitrogen dioxide calculator. This has been adjusted by a national factor of 1.0554 for the background calibration, as described in Paragraph A5.3. The 2017 background 'with emissions reduction' assumes that Defra's predicted reductions occur from 2013 onward. This dataset has been derived first by calculating the ratio of the unadjusted mapped value for 2017 to the unadjusted mapped value for 2013. This ratio has then been applied to the 'adjusted 2013 background' value (as derived in Paragraph A5.3).

A5.5 For PM_{10} and $PM_{2.5}$, there is no strong evidence that Defra's predictions are unrealistic and so the year-specific mapped concentrations have been used in this assessment.

Model Inputs

Roads

A5.6 Predictions have been carried out using the ADMS-Roads dispersion model (v3.2). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width and street canyon height, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 6.0.1) published by Defra (2015a). For nitrogen dioxide, future-year concentrations have been predicted once using year-specific emission factors from the EFT, and once using emission factors for 2013[9], which is the year for which the model has been verified.

A5.7 The model has been run using the full year of meteorological data that corresponds to the most recent set of nitrogen dioxide monitoring data (2013). The meteorological data have been taken from the monitoring station located at Heathrow Airport, which is considered suitable for this area.

A5.8 Traffic data have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2013). Traffic speeds have been based on those presented in the LAEI, with some having been adjusted based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction.

Table A5.1: Summary of Traffic Data used in the Assessment (AADT) [a]

Road Link	AADT		%HDV
	2013	2017	
Camden Street north of Camden Road	17,396	17,646	11.7
Camden Street south of Camden Road	20,319	20,610	2.9
Camden Road east of Royal College Street	27,450	27,846	7.5
Camden Road between Camden Street and Royal College Street	27,573	27,970	7.7
Camden Road west of Camden Street	24,188	24,536	13.5
Kentish Town Road	8,538	8,662	9.7
Royal College Street north of Camden Road	8,047	8,163	6.8
Royal College Street south of Camden Road	11,121	11,282	6.5

[a] This is just a summary of the data entered into the model, which have been input as hourly average flows of motorcycles, cars, buses, Light Goods Vehicles and Heavy Goods Vehicles, as well as diurnal flow profiles for these vehicles.

[9] i.e. combining current-year emission factors with future-year traffic data.

A5.9 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (DfT, 2011).

A5.10 Figure A5.2 shows the road network included within the model and defines the study area.

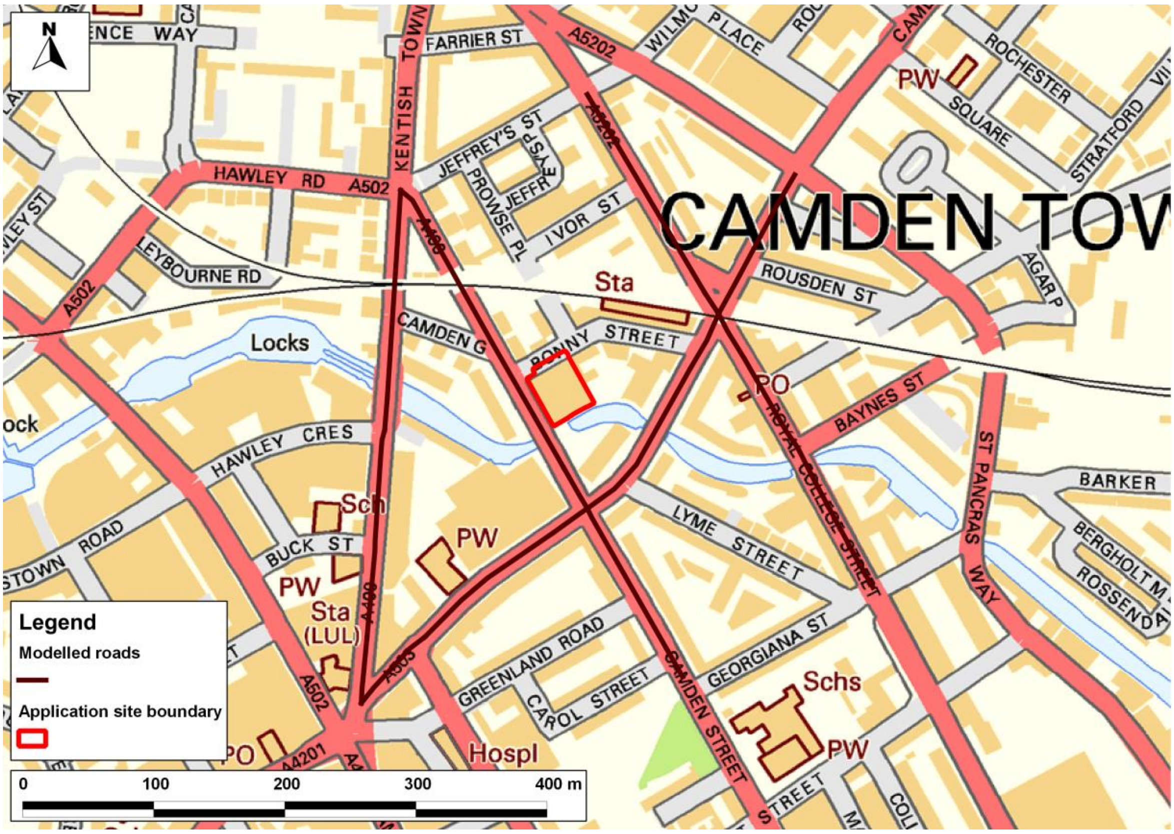

Figure A5.2: Modelled Road Network

Contains Ordnance Survey data © Crown copyright and database right 2015

Model Verification

A5.11 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. The verification methodology is described below.

Nitrogen Dioxide

A5.12 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2013 at the Camden Road diffusion tube monitoring site. Concentrations have been modelled at 2.5 m, the height of the monitor.

A5.13 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentration and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 4.1) available on the Defra LAQM Support website (Defra, 2015a).

A5.14 An adjustment factor has been determined as the ratio of the ‘measured’ road contribution and the model derived road contribution. This factor has then been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator (Defra, 2015a).

A5.15 The data used to calculate the adjustment factor are provided below:

- Measured NO_2 : 77.9 μg/m^3
- Background NO_2 : 39.1 μg/m^3
- ‘Measured’ road-NOx (from NOx to NO_2 calculator): 117.9 μg/m^3
- Modelled road-NOx = 45.0 μg/m^3
- Road-NOx adjustment factor: 117.9/45.0 = **2.621**

A5.16 The factor implies that the unadjusted model is under-predicting the road-NOx contribution. This is a common experience with this and most other models.

PM_{10} and $PM_{2.5}$

A5.17 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the primary adjustment factor calculated for road NOx.

Model Post-processing

Nitrogen oxides and nitrogen dioxide

A5.18 The model predicts road-NOx concentrations at each receptor location. These concentrations have then been adjusted using the primary adjustment factor, which, along with the background NO_2, is processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2015a). The traffic mix within the calculator has been set to “All London traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2. This is then adjusted by the secondary adjustment factor to provide the final predicted concentrations.

PM_{10} and $PM_{2.5}$

A5.19 The number of exceedences of 50 μg/m^3 as a 24-hour mean PM_{10} concentration has been calculated from the adjusted-modelled total annual mean concentration following the relationship advised by (Defra, 2009):

$$A = -18.5 + 0.00145\ B^3 + 206/B$$

where A is the number of exceedences of 50 μg/m^3 as a 24-hour mean PM_{10} concentration and B is the annual mean PM_{10} concentration. The relationship is only applied to annual mean concentrations greater than 16.5 μg/m^3. Below this concentration, the number of 24-hour exceedences is assumed to be zero.

A6 'Air Quality Neutral'

A6.1 The GLA's SPG on Sustainable Design and Construction (GLA, 2014a), and its accompanying Air Quality Neutral methodology report (AQC, 2014), provide an approach to assessing whether a development is air quality neutral. The approach is to compare the expected emissions from the building energy use and the car use associated with the proposed development against defined emissions benchmarks for buildings and transport in London.

A6.2 The benchmarks for heating and energy plant (termed 'Building Emission Benchmarks' or 'BEBs') are set out in Table A6.5, while the 'Transport Emission Benchmarks' ('TEBs') are set out in Table A6.2. In order to assess against the TEBs, it is necessary to combine the expected trip generation from the development with estimates of average trip length and average emission per vehicle. So as to ensure a consistent methodology, the report which accompanies the SPG (AQC, 2014) recommends that the information in Table A6.3 and Table A6.4 (upon which the TEBs are based) is used. Similarly, the information in Table A6.1 may be used if site-specific information are not available (AQC, 2014).

Table A6.1: Building Emissions Benchmarks (g/m^2 of Gross Internal Floor Area)

Land Use Class	NOx	PM_{10}
Class A1	22.6	1.29
Class A3 - A5	75.2	4.32
Class A2 and Class B1	30.8	1.77
Class B2 - B7	36.6	2.95
Class B8	23.6	1.90
Class C1	70.9	4.07
Class C2	68.5	5.97
Class C3	26.2	2.28
D1 (a)	43.0	2.47
D1 (b)	75.0	4.30
Class D1 (c -h)	31.0	1.78
Class D2 (a-d)	90.3	5.18
Class D2 (e)	284	16.3

Table A6.2: Transport Emissions Benchmarks

Land use	CAZ [a]	Inner [b]	Outer [b]
NOx (g/m^2/annum)			
Retail (A1)	169	219	249
Office (B1)	1.27	11.4	68.5
NOx (g/dwelling/annum)			
Residential (C3)	234	558	1553
PM_{10} (g/m^2/annum)			
Retail (A1)	29.3	39.3	42.9
Office (B1)	0.22	2.05	11.8
PM_{10} (g/dwelling/annum)			
Residential (C3,C4)	40.7	100	267

[a] Central Activity Zone

[b] Inner London and Outer London (as defined in the London Atmospheric Emissions Inventory) (GLA, 2013)

Table A6.3: Average Distance Travelled by Car per Trip

Land use	Distance (km)		
	CAZ	Inner	Outer
Retail (A1)	9.3	5.9	5.4
Office (B1)	3.0	7.7	10.8
Residential (C3)	4.3	3.7	11.4

Table A6.4: Average Road Traffic Emission Factors in London in 2010 (AQC, 2014)

Pollutant	g/vehicle-km		
	CAZ	Inner	Outer
NOx	0.4224	0.370	0.353
PM_{10}	0.0733	0.0665	0.0606

Table A6.5: Average Emission from Heating and Cooling Buildings in London in 2010 (AQC, 2014)

	Gas (kg/kWh)		Oil (kg/kWh)	
	NOx	PM_{10}	NOx	PM_{10}
Domestic	0.0000785	0.00000181	0.000369	0.000080
Industrial/Commercial	0.000194	0.00000314	0.000369	0.000080

A7 Construction Mitigation

A7.1 The following is a set of measures that should be incorporated into the specification for the works:

Site Management

- Develop a Dust Management Plan (DMP);
- 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 dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions are being carried out and during prolonged dry or windy conditions; and
- record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and ensure that the action taken to resolve the situation is recorded in the log book.

Preparing and Maintaining the Site

- Plan the site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible;
- erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site;
- fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
- avoid site runoff of water or mud;
- keep site fencing, barriers and scaffolding clean using wet methods; and
- remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.

Operating Vehicle/Machinery and Sustainable Travel

- 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 the GLA's Control of Dust and Emissions During Construction and Demolition SPG. This outlines that, from 1st September 2015, all NRMM of net power 37 kW to 560 kW used on the site of a major development in Greater London must meet Stage IIIA of EU Directive 97/68/EC (Directive 97/68/EC of the European Parliament and of the Council, 1997) and its subsequent amendments as a minimum. NRMM used on any site within the Central Activity Zone or Canary Wharf will be required to meet Stage IIIB of the Directive as a minimum. From 1st September 2020 NRMM used on any site within Greater London will be required to meet Stage IIIB of the Directive as a minimum, while NRMM used on any site within the Central Activity Zone or Canary Wharf will be required to meet Stage IV of the Directive as a minimum;
- 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 practicable; and
- implement a Travel Plan that supports and encourages sustainable staff travel (public transport, cycling, walking, and car-sharing).

Operations

- 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 suppression/mitigation, using recycled water where possible and appropriate;
- 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; and
- 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.

Waste Management

- Reuse and recycle waste to reduce dust from waste materials; and
- avoid bonfires and burning of waste materials.

Measures Specific to Demolition

- 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; and
- bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces), if possible; and
- 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.