Centre for Children's Rare Disease Research
at Great Ormond Street Hospital

Air Quality Assessment

AQ Consultants
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Executive Summary

The air quality impacts associated with the construction and operation of the proposed development of the Centre for Children's Rare Disease Research at Great Ormond Street Hospital have been assessed.

Existing air quality conditions have been described using the results of monitoring carried out by the London Borough of Camden, and information published by Defra and the Environment Agency. The potential dust impacts arising during the construction phase have been assessed using an approach recommended by the Institute of Air Quality Management, taking into account the sensitivity of the local area and the nature and duration of the works. The operational impacts have been assessed using detailed dispersion modelling. Concentrations of the key air pollutants associated with road traffic, i.e. nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$), have been determined for a worst-case assessment year of 2013. The predicted concentrations have been compared with air quality objectives set by the Government to protect human health.

During construction it will be necessary to apply a package of mitigation measures to minimise dust emissions. IAQM guidance makes clear that, with the mitigation measures in place, the overall impacts during construction will not be significant.

Existing conditions within the study area show poor air quality, with background concentrations of nitrogen dioxide exceeding the annual mean objective in many areas, including at the proposed development site. The application site lies within an Air Quality Management Area.

Air quality conditions for users of the proposed development have been considered. The 1-hour mean nitrogen dioxide objective would not be exceeded at the worst case locations considered for the proposed development. The annual mean objective does not apply at the proposed development site, as there is no relevant exposure.

Overall, the construction and operational air quality impacts of the proposed development are judged to be insignificant.

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed Centre for Children's Rare Disease Research (CCRDR) at Great Ormond Street Hospital. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Gardiner & Theobald LLP.

1.2 The proposed development will consist of a single building, incorporating offices, laboratories and an outpatients ward. It lies within an Air Quality Management Area (AQMA) declared by the London Borough (LB) 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 flows on local roads. The proposed development will, however, be subject to the impacts of road traffic emissions from the adjacent road network, and this has been assessed. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.3 The proposals for the development also include an energy centre, consisting of a small (48kW) gas-fired CHP unit and supporting gas-fired boilers. The main pollutant of concern with respect to gas-fired plant emissions is nitrogen dioxide.

1.4 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, 2014).

1.5 This report describes existing local air quality and provides an assessment of air quality conditions at the proposed development site in 2013.

1.6 This report has been prepared taking into account all relevant local and national guidance and regulations.

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.

Clean Air Act 1993

2.2 Small combustion plants of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993. This requires the local authority to approve the chimney height. Plant which are smaller than 366kW have no such requirement.

Planning Policy

National Policies

2.3 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.

2.4 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"*.

2.5 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"*.

2.6 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)".*

2.7 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

2.8 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.

2.9 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.

2.10 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

2.11 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.

2.12 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 on Sustainable Design and Construction

2.13 The GLA's SPG on Sustainable Design and Construction (GLA, 2014) 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 2.10, above) should be implemented.

GLA SPG on the Control of Dust and Emissions During Construction and Demolition

2.14 The GLA's SPG on The Control of Dust and Emissions during Construction and Demolition (GLA, 2014) provides more detailed guidance on the implementation of all policies in the London Plan and the MAQS relating to construction and demolition activities. It defines when developers will be required to submit a dust risk assessment and dust management plan. Furthermore, it sets out the methodology for assessing the air quality impacts of emissions of dust, PM_{10} and $PM_{2.5}$ from construction and demolition activities and provides guidance for mitigating and managing the air quality impacts for the protection of human health and sensitive environments. 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*".

2.15 Additionally, to address the significant contribution of non-road mobile machinery (NRMM) to London's poor air quality, the SPG sets out a NRMM Low Emission Zone for emission standards to be implemented from 1 September 2015 onwards. These 2015 standards will initially apply to major developments in outer London but are expected to apply to smaller developments in 2020. It thus states *"developers should begin to put processes in place to ensure their supply chain can meet these standards, where possible".*

Local Policies

2.16 The Camden Local Development Framework (LDF), which replaced the Camden Unitary Development Plan (UDP) in November 2010, is a collection of planning documents that (in conjunction with national planning policy and the Mayor's London Plan) set out the strategy for managing growth and development in the borough, including where new homes, jobs and infrastructure will be located. Policy DP32: Air Quality and Camden's Clear Zone, in the Camden Development Policies LDF (London Borough of Camden, 2010) document sets out how Camden will expect developments to reduce its impact on air quality. It states:

> *'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.'*

2.17 The London Borough (LB) of Camden has also prepared a Supplementary Planning Document - Camden Planning Guidance (CPG) 6 Amenity (London Borough of Camden, 2011), 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. The Council's overarching aim is for new development to be 'air quality neutral' and not lead to further deterioration of existing poor air quality. Mitigation and offsetting measures to deal with any negative air quality impacts associated with the development proposals may be required. The development should be designed to minimise exposure of occupants to existing poor air quality. It states that the Council requires assessments for:

> *'development that could have a significant negative impact in air quality. This impact can arise during both the construction and operational stages of a development as a result of increased NOx and PM_{10} emissions.'*

Air Quality Action Plan

2.18 LB Camden has declared an AQMA for nitrogen dioxide and PM_{10} that covers the whole Borough. The Council has since developed an Air Quality Action Plan 2013 - 2015 (London Borough of Camden, 2014). This identifies actions and mitigating measures necessary to improve air quality in the borough. It sets out objectives to reduce transport emissions and any emissions associated with new development. Key objectives associated with new development include identifying the impact of new development on air quality and controlling emissions from construction sites.

Assessment Criteria

Health Criteria

2.19 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).

2.20 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.

2.21 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.; they do not apply at hotels. The 24-hour mean 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 and at hotels. 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.

2.22 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 $PM_{2.5}$.

2.23 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 µg/m^3 not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m^3
Fine Particles (PM_{10})	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m^3
Fine Particles ($PM_{2.5}$) [a]	Annual Mean	25 µg/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

2.24 The GLA SPG on the Control of Dust and Emissions during Construction and Demolition (GLA, 2014) sets out the assessment criteria for dust. Full details of the criteria are provided in Appendix A2.

Descriptors for Air Quality Impacts and Assessment of Significance

Construction Dust Significance

2.25 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.

Operational Significance

2.26 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[1] (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.

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

3 Assessment Approach

Existing Conditions

3.1 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, 2014d) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2014). Local sources have also been identified through examination of the Council's Air Quality Review and Assessment reports.

3.2 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 (2014a). 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 (2014e). 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

3.3 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 is that provided by the IAQM (Institute of Air Quality Management, 2014). This is based around 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

3.4 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. When selecting these receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested, and where there is a combined effect of several road links. The receptors have been located on the façade of the proposed development closest to road traffic emission sources.

3.5 These locations are shown in Figure 1. In addition to the receptors within the proposed development, concentrations have been modelled at the automatic monitoring site located on Euston Road in order to verify the modelled results (see Appendix A5 for verification method).

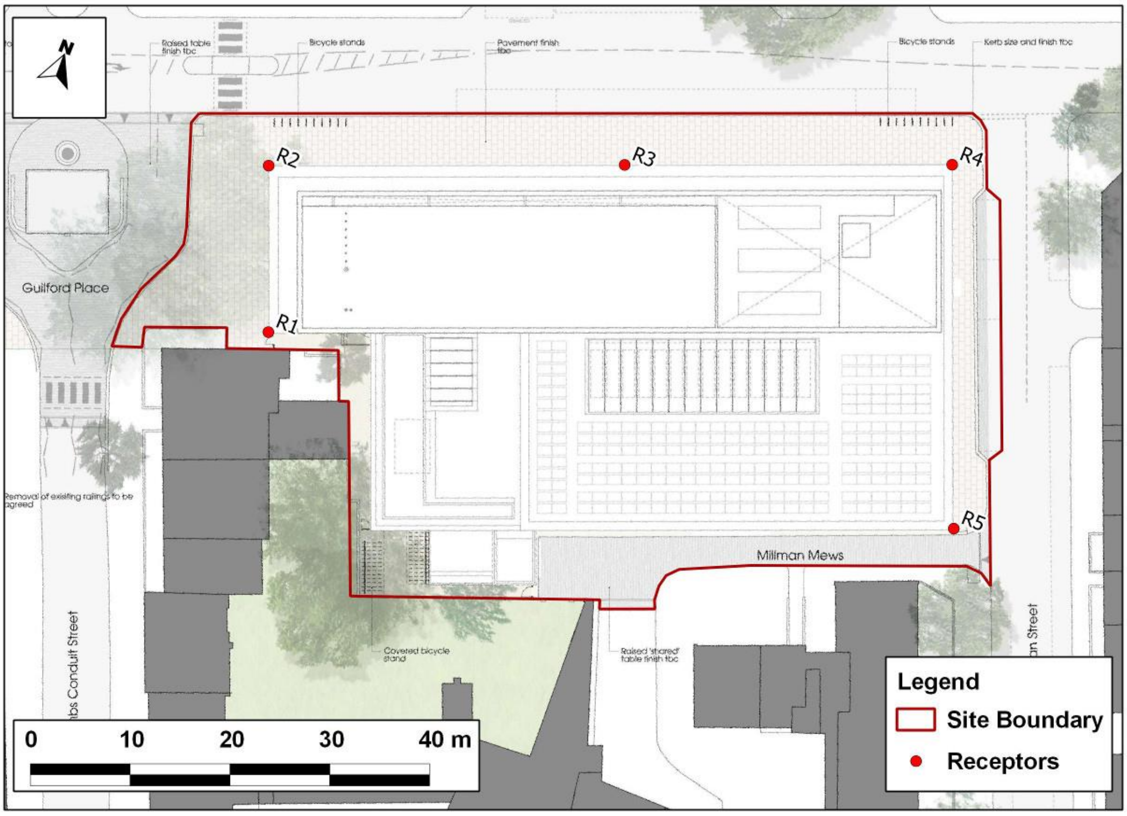

Figure 1: Receptor Locations

Contains imagery from development plan 464-PL-100 prepared by Stanton Williams.

Assessment Scenarios

3.6 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for 2013, to identify current air quality conditions at the site.

Modelling Methodology

3.7 Concentrations have been predicted 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 background nitrogen dioxide concentrations.

‘Air Quality Neutral’

3.8 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, 2014). 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, 2014).

3.9 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 adjacent to, and will be a part of, the existing Great Ormond Street Hospital along Guilford Street. The site is bounded by Guilford Street, Millman Street and Lamb's Conduit Street. It currently consists of a computer centre which is a part of the University of London. There are gardens to the north of the site and existing residential properties to the south, east and west.

4.2 The proposed development will include demolition of the existing computer centre and erection of a new single building comprising office space, laboratories and an outpatient ward.

Industrial sources

4.3 A search of the UK Pollutant Release and Transfer Register (Defra, 2014d) and Environment Agency's 'what's in your backyard' (Environment Agency, 2014) 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

4.4 LB Camden has investigated air quality within its area as part of its responsibilities under the LAQM regime. The council has declared an AQMA covering the whole borough for exceedences of the nitrogen dioxide and PM_{10} objectives. The application site is located within the AQMA.

Local Air Quality Monitoring

4.5 LB Camden operates four automatic monitoring stations within its area. Only two of these, Euston Road and Bloomsbury, lie within 1 km of the proposed development site. The Automatic monitor on Shaftsbury Avenue lies just over 1 km from 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 Tottenham Court Road, and a tube in Bloomsbury Street, west of the proposed development site. Results for the years 2008 to 2013 are summarised in Table 2 and the monitoring locations are shown in Figure 2.

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2008-2013) [a]

Site No.	Site Type	Location	2008	2009	2010	2011	2012	2013
Automatic Monitors - Annual Mean (µg/m^3) [b]								
RA	Roadside	Euston Road	**-**	**-**	**-**	**122**	**106**	**111.1**
RB	Urban Background	Bloomsbury	**55**	**54**	**55**	**50**	**55**	**51**
RC	Roadside	Shaftesbury Avenue	**80**	**88**	**89**	**76**	**71**	**77.1**
Objective			**40**					
Automatic Monitors - No. of Hours > 200 µg/m^3								
RA	Roadside	Euston Road	**-**	**-**	**-**	**726**	**295**	**398**
RB	Urban Background	Bloomsbury	0	2	1	0	1	0
RC	Roadside	Shaftesbury Avenue	9	13	**21**	15	12	10
Objective			**18**					
Diffusion Tubes - Annual Mean (µg/m^3) [c]								
RD	Kerbside	Tottenham Court Road	**84.2**	**107.7**	**92**	**91.7**	**83.3**	**86.4**
RE	Roadside	Bloomsbury Street	**76.5**	**81.3**	**41**	**76.7**	**71.7**	**74.6**
Objective			**40**					

[a] Exceedences of the objectives are shown in bold.

[b] Data downloaded from the London Air website (King's College London, 2014).

[c] 2008 to 2012 data have been taken from the 2013 Air Quality Progress Report (London Borough of Camden, 2013). 2013 data have been provided by LB Camden.

4.6 None of the roadside monitoring locations are adjacent to the proposed development site. The automatic monitor located on Euston Road is the closest roadside monitor to the proposed development site, however, Euston Road has significantly greater traffic volumes and levels of congestion than Guilford Street and therefore measured nitrogen dioxide concentrations at Euston Road are not deemed to be representative of concentrations adjacent to Guilford Street. The recorded concentrations at the Shaftesbury Avenue automatic site and the two diffusion tube monitoring sites at TCR and Bloomsbury Street are likely to be more representative of concentrations at the proposed development site as these sites are adjacent to roads with similar traffic volumes to Guilford Street. All of the automatic monitors and diffusion tubes included in Table 2 have consistently exceeded the annual mean nitrogen dioxide objective in recent years.

4.7 There are no clear trends in monitoring results for the past six 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.

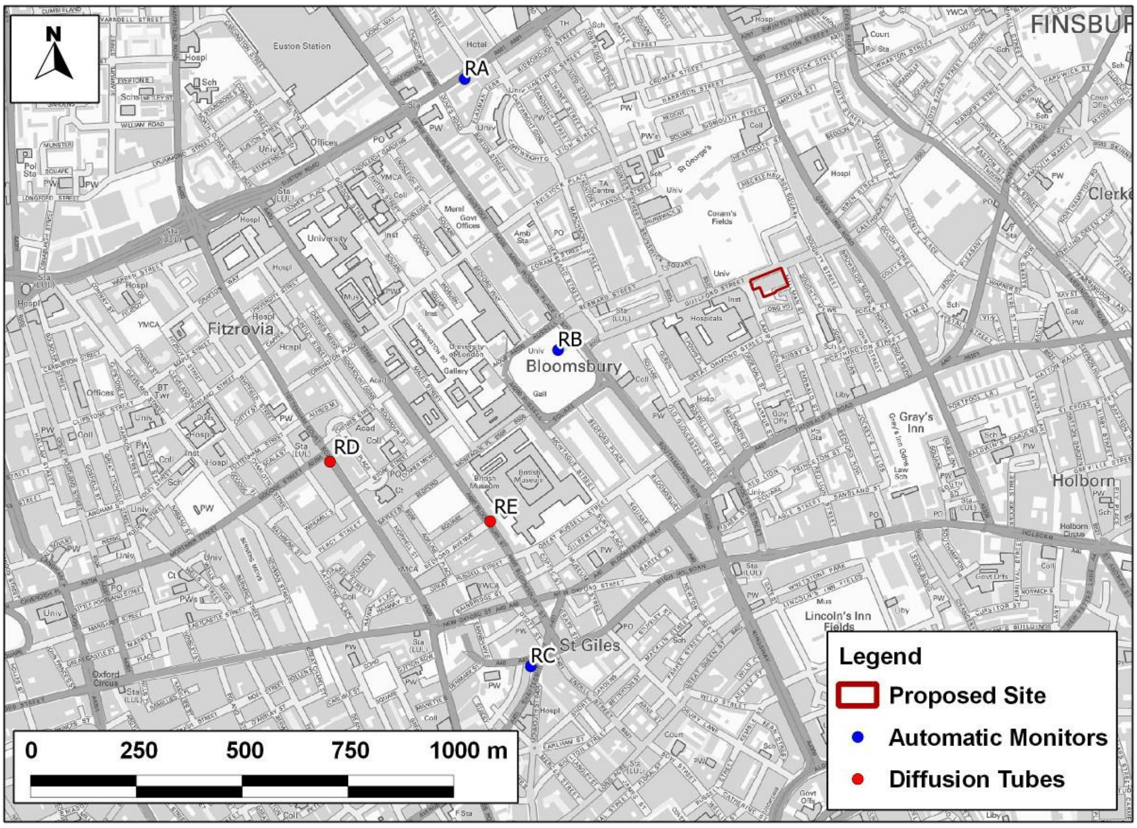

Figure 2: Monitoring Locations

Contains Ordnance Survey data © Crown copyright and database right 2014

4.8 The Bloomsbury and Shaftesbury Avenue automatic monitoring stations also measured PM_{10} concentrations between 2008 and 2013. Concentrations were well below the objectives. Results for the years 2008 to 2013 are summarised in Table 3. $PM_{2.5}$ concentrations are also measured at the Bloomsbury urban background monitor. Data for 2008-2013 are presented in Table 3.

Table 3: Summary of PM_{10} and $PM_{2.5}$ Automatic Monitoring (2008-2013) [a]

Site No.	Site Type	Location	2008	2009	2010	2011	2012	2013
PM_{10} Annual Mean ($\mu g/m^3$)								
RB	Urban Background	Bloomsbury	23	23	18	22	19	18
RC	Roadside	Shaftesbury Avenue	30	30	29	32	29	29.4
Objective			**40**					

Site No.	Site Type	Location	2008	2009	2010	2011	2012	2013
PM_{10} No. Days >50 µg/m^3								
RB	Urban Background	Bloomsbury	13	15	2	17	10	3
RC	Roadside	Shaftesbury Avenue	30	30	29	27	18	17
Objective			35					
$PM_{2.5}$ Annual Mean (µg/m^3) [c]								
RB	Urban Background	Bloomsbury	-	16.3	16.1	17.4	16.2	11.7 (22.1) [d]
Objective			25					

[a] Exceedences of the objectives are shown in bold.

[b] 2008 to 2012 data have been taken from the 2013 Air Quality Progress Report (London Borough of Camden, 2013). 2013 data have been downloaded from the London Air website (King's College London, 2014).

[c] Data downloaded from the London Air website (King's College London, 2014).

[d] Reference equivalent. Data capture was 62% in 2013, and thus the 90th percentile of daily means is provided in parentheses.

Exceedences of EU Limit Value

4.9 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, 2014e), identifies exceedences of the limit value along many roads in London, including Grey's Inn Road and Theobald's Road, which are close to the proposed development. The Greater London Urban Area has thus been reported to the EU as exceeding the limit value for annual mean nitrogen dioxide concentrations.

Background Concentrations

National Background Pollution Maps

4.10 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for 2013 (Table 4). The derivation of background concentrations is described in Appendix A5. The background concentrations for nitrogen dioxide are already above the annual mean objective, whilst those for PM_{10} and $PM_{2.5}$ are below the objectives.

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

Year	NO_2	PM_{10}	$PM_{2.5}$
2013 [a]	**47.7**	25.7	17.7
Objectives	**40**	**40**	**25**

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

5 Construction Phase Impacts

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 3 existing concrete framed buildings with an approximate total volume of 25,000 m^3. A mobile crusher will be used on site before removal of the material. 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, 2014), 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] fine-grained clay-like.

5.4 The site is close to the boundary between two different soil types. Overall, it is considered that, when dry, this soil has the potential to be moderately dusty.

5.5 The site covers some 3,400 m^2 and most of this will be subject to earthworks. The earthworks will last around 7 months and dust will arise mainly from vehicles travelling over unpaved ground and from the handling of dusty materials. Most of the earthworks will, though, involve the removal of subsoil, which has been identified in Table 5 as having the potential to be moderately dusty. However, this will largely be damp and thus not especially prone to creating dust. Based on the example definitions set out in Table A2.1, the dust emission class for earthworks is considered to be *medium*.

Construction

5.6 Construction will involve a single mixed use building, with a total volume of around 58,500 m^3. Dust will arise from vehicles travelling over unpaved ground, the handling and storage of dusty materials, and from the cutting of concrete. The construction will take place over an 18-month period. 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 it is expected that there will be around 20 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 *medium*.

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	Medium
Construction	Medium
Trackout	Medium

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.

5.10 Figure 3 and Figure 4 below show 20 m and 50 m buffer zones around the site boundary and along trackout areas for identification of the location and number of sensitive receptors.

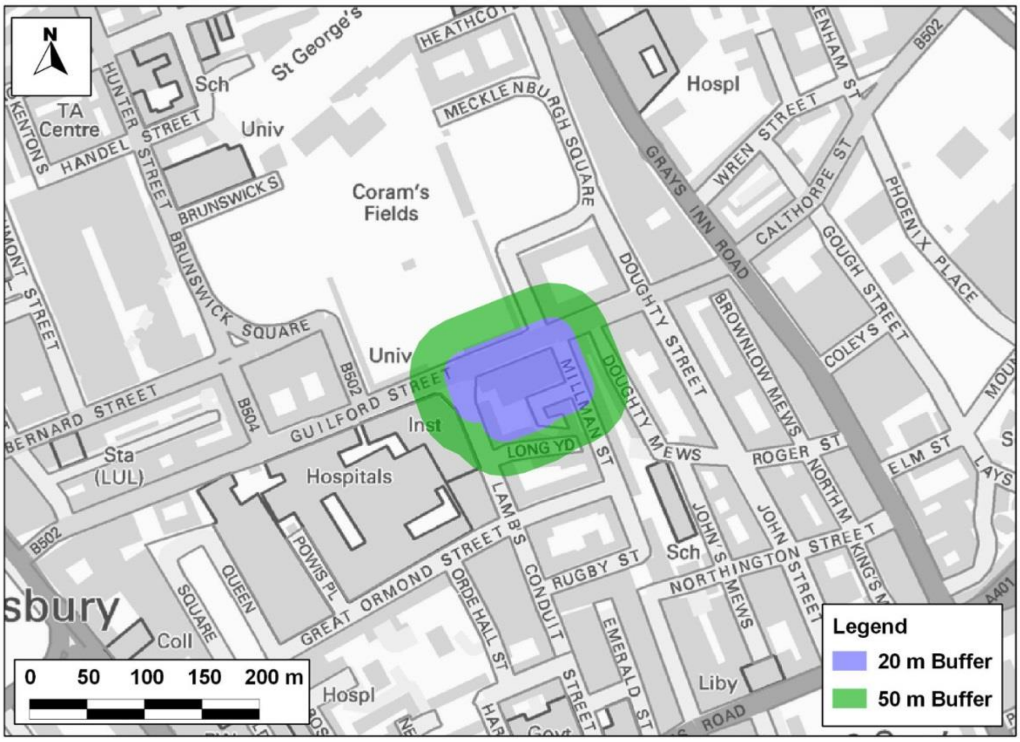

Figure 3: Areas that May be Affected by Construction Dust Without Mitigation

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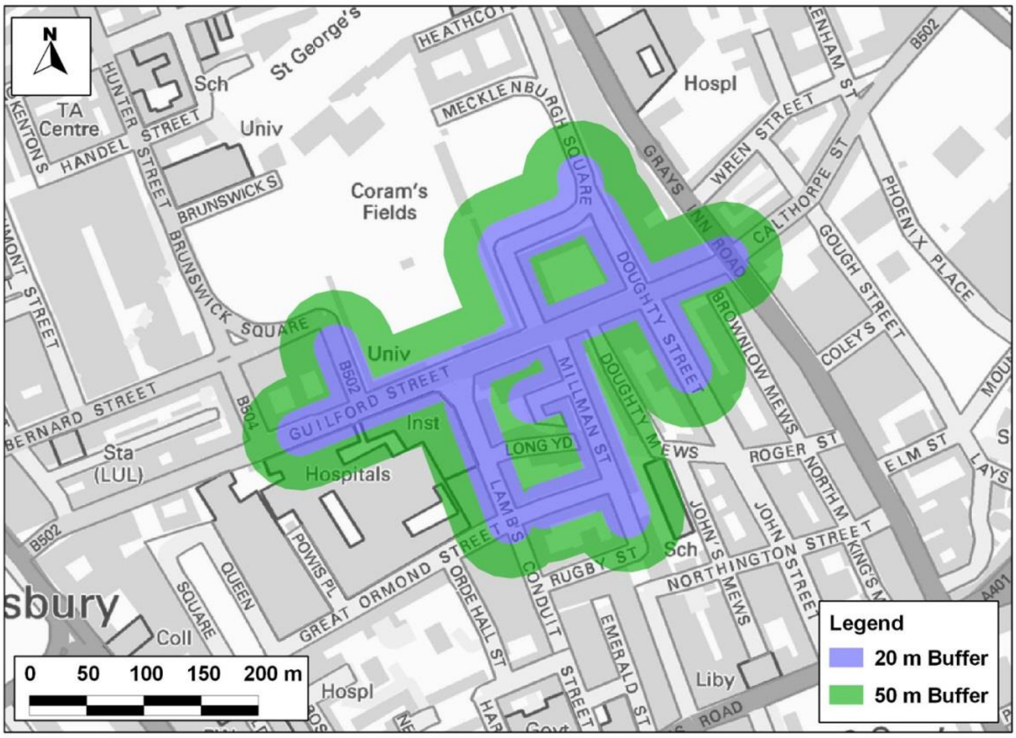

Figure 4: Areas that May be Affected by Dust from Track-out Without Mitigation

Contains Ordnance Survey data © Crown copyright and database right 2014

Sensitivity of the Area to Effects from Dust Soiling

5.11 The GLA SPG on the Control of Dust and Emissions during Construction and Demolition (GLA, 2014) and IAQM guidance explains that residential properties are 'high' sensitivity receptors to dust soiling (Table A2.2). There are more than 10 residential properties within 20 m of the site. 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 'medium' and Table A2.3 thus explains that there is a risk of material being tracked 200 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 more than 100 residential properties within 20 m of the roads along which material could be tracked, and Table A2.3 thus indicates that the area is of 'high' sensitivity to dust soiling due to trackout (see Table 7).

Sensitivity of the Area to any Human Health Effects

5.12 Residential properties are also classified as being of 'high' sensitivity to human health effects. The IAQM matrix in Table A2.4 requires information on the baseline annual mean PM_{10} concentration in the area. The existing annual mean PM_{10} concentration is best described by the background concentration from Table 4. Using the matrix in Table A2.4, the area surrounding the onsite works is of 'medium' sensitivity to human health effects, while the area surrounding roads along which material may be tracked from the site is of 'high' sensitivity (Table 7).

Table 7: Summary of the Area Sensitivity

Effects Associated With:	Sensitivity of the Surrounding Area	
	On-site Works	Trackout
Dust Soiling	High Sensitivity	High Sensitivity
Human Health	Medium Sensitivity	High Sensitivity

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
Demolition	Medium Risk	Medium Risk
Earthworks	Medium Risk	Medium Risk
Construction	Medium Risk	Medium Risk
Trackout	Medium Risk	Medium Risk

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).

5.15 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.

6 Operational Phase Impact Assessment

Impacts on the Development

6.1 The predicted pollutant concentrations at the proposed development site are presented in Table 9. Results are presented for receptors on the ground floor of the proposed development (see Figure 1 for receptor locations) where pollutant concentrations are highest. The concentrations fall off with height between the ground floor and the roof-level, with annual mean concentrations at roof-level predicted to be within 1 µg/m^3 of the background concentrations for all pollutants. As the background levels of nitrogen dioxide are already above the annual mean objective, the predicted concentrations will exceed the objective at every floor of the proposed development.

6.2 The annual mean objective should not, however, strictly be applied at the proposed development. Although the development represents part of a hospital (which is typically relevant exposure to annual mean nitrogen dioxide concentrations), the CCRDR is a non-residential research facility, which has an outpatient ward only, along with offices and laboratories. It is therefore judged that the proposed CCRDR development represents relevant exposure to the 1-hour mean nitrogen dioxide and 24-hour mean PM_{10} objectives only. As discussed in paragraph 2.20, measurements across the UK have shown that the 1-hour mean nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 µg/m^3 (Defra, 2009). None of the predicted annual mean nitrogen concentrations at the proposed development are above 60 µg/m^3 and therefore it is judged that the 1-hour nitrogen dioxide objective will not be exceeded. In addition, there are no exceedences of the 24-hour mean PM_{10} objective at the proposed development, as shown in Table 9.

Table 9: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2013 for New Receptors on the Ground Floor in the Development Site

Receptor	NO_2 (µg/m^3)	PM_{10} (µg/m^3) [a]		$PM_{2.5}$ (µg/m^3)
	Annual Mean	Annual Mean	No. Days >50 µg/m^3	Annual Mean
R1	**52.1**	26.4	16	18.1
R2	**56.2**	27.2	18	18.6
R3	**55.5**	27.1	18	18.5
R4	**55.6**	27.1	18	18.5
R5	**50.3**	26.1	15	17.9
Objectives	40	40	35	25

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

Impacts of the Proposed Development on Local Air Quality

Heating and Energy Plant Emissions

6.3 The proposed development will be provided with heat and hot water using a small (48kW) gas-fired CHP unit and additional conventional gas boilers. The CHP will conform to a maximum NOx emission limit of 95 mg/Nm^3 in accordance with the GLA's guidance on Sustainable Design and Construction (GLA, 2014). The gas boilers will also conform to the guidance and will be ultra low-NOx units with emissions of <40 mg/kWh. The CHP and gas boilers will be contained centrally within a specifically designed plant room, and emissions will be vented by a flue that will terminate above roof level and operate with a sufficient efflux velocity to allow for good initial dispersion of emissions. The emissions from this plant are not judged to have potential for a significant local air quality impact. The emissions are, however, assessed against the Air Quality Neutral buildings benchmarks, reported in the next section.

Road Traffic Emissions

6.4 The transport consultants for the development (Pell Frischmann) have estimated that the development will generate approximately 257 total vehicle movements per day. Guilford Street is predicted to experience an increase in traffic flows of 139 vehicle movements per day both east and west of the proposed development site. Millman Street and Lamb's Conduit Street are both expected to experience an increase of 21 vehicle movements per day.

6.5 Guidance published by EPUK (Environmental Protection UK, 2010) includes screening criteria for air quality impacts from road traffic emissions. The guidance states that the impacts of emissions from road traffic can be discounted where they represent less than 5% of baseline traffic flows on roads within an AQMA.

6.6 The estimated daily vehicle movements from the proposed development can thus be compared to baseline traffic flows on Guilford Street, Millman Street and Lamb's Conduit Street to identify whether a detailed air quality assessment is required. Baseline traffic on Guilford Street in 2013 was 11,361 vehicles per day, whilst flows are 777 vehicles per day on Millman Street and 3,178 vehicles per day on Lamb's Conduit Street. The development-related vehicle trips therefore represent 1.2% of baseline flows on Guilford Street, 2.7% of baseline flows on Millman Street and 0.7% of baseline flows on Lamb's Conduit Street. It is therefore judged that the vehicle movements generated by the development will have an insignificant impact on local air quality, and no further assessment is required.

6.7 The emissions from vehicle trips generated by the development have, however, been calculated and compared to the Air Quality Neutral benchmarks in the GLA's SPG on Sustainable Design and Construction (GLA, 2014). This is discussed in the next section of this report.

'Air Quality Neutral'

6.8 The air quality neutrality of the proposed development has been tested against the building emissions and transport emissions benchmarks contained within the GLA sustainable design and construction SPG. The development is to be classified in the planning application as sui generis; however, this does not have specific building or transport emissions benchmarks in the SPG and therefore is has been necessary to assign a building use class for the purposes of this air quality neutral appraisal. The proposed development will include elements of B1 and D1 uses. It has been assumed for the purposes of this assessment that the primary building use class for the proposed development would be D1a use (non-residential institutions for the provision of any medical or health services).

Building Emissions

6.9 The proposed development will contain a gas-fired CHP and boiler plant, which is expected to serve the entire development. Hoare Lea has advised that an Energimizer 48 kW CHP unit will be used, and that any installed gas-boiler plant will meet the maximum NOx emission of 40 mg/kWh given in the SPG. Hoare Lea has advised that the annual fuel use of the building will be 2,000,000 kWh. If the CHP was to run continuously at 100% load, representing a worst case, then it would consume 1,226,400 kWh of fuel (based on a CHP fuel consumption of 140 kW per hour). The associated NOx emissions for this fuel use would be 206.0 kg/yr. If the remaining 773,600 kWh of fuel was fully consumed by a boiler, then NOx emissions from the boiler would be 30.9 kg/yr. Hence, the worst-case total NOx emission from the proposed CHP and boiler units would be 237.0 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 Development (m^2)	13,045	Stanton Williams Architects
B	NOx BEB for D1a use ($g/m^2/yr$)	43	Table A6.1
C	Total BEB NOx Emissions (kg/yr)	560.9	(A x B) / 1000

6.10 The Total Building NOx Emission of 237.0 kg/yr is less than Total BEB NOx Emission of 560.9 kg/yr. The proposed development is thus better than air quality neutral in terms of building emissions.

Road Transport Emissions

6.11 The Transport Emission Benchmarks (TEBs), as specified in the SPG, are based on the number of trips generated by different land-use classes, together with the associated trip lengths and vehicle emission rates. Where TEBs have not been derived for specific land-use classes, such as is the case with D1a use, it is possible to compare scheme-related trip rates with benchmarked trip rates.

6.12 Pell Frischmann has advised that the proposed development is expected to generate a total of 86,140 trips per year. This has then been compared with the benchmark trip rate for the development set out in Table 11.

6.13 The development trip rate (86,140 per annum) is significantly lower than the benchmark trip rate (849,230 per annum). The proposed development is thus better than air quality neutral in terms of transport emissions.

Table 11: Calculation of Transport Emissions Benchmark for the Development

	Description	Value	Reference
	Non-residential Institution (D1a)		
A	Gross Internal Floor Area (m^2)	13,045	Stanton Williams Architects
B	Benchmark Trips ($trips/m^2/yr$)	65.1	Table A1.1 of the Air Quality Neutral Planning Support Document (GLA, 2013)
C	Benchmark Trips for Development (trips/yr)	849,230	A x B

Uncertainty in Road Traffic Modelling Predictions

6.14 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). The level of confidence in the verification process is necessarily enhanced when data from an automatic analyser have been used, as has been the case for this assessment (see Appendix A5). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2013) concentrations.

6.15 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 4.7.

6.16 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[2] 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[3] and includes a separate slow-speed cycle for heavy duty vehicles. Nonetheless, in order to account for this uncertainty, the dispersion modelling and resultant recommendations within this report are based on the assessment of current (2013) conditions at the site, over which there is a reasonable level of certainty. The proposed development will not in reality be used until the end of 2017 at the earliest, by which time nitrogen dioxide concentrations

2 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.

3 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.

at the site may be beginning to decrease under the influence of Euro VI/6 vehicles, which is taken into account when drawing conclusions in this assessment.

Significance of Operational Air Quality Impacts

6.17 The operational air quality impacts are judged to be *insignificant*. 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.

6.18 More specifically, the judgement that the air quality impacts will be *insignificant* takes account of the assessment that the 1-hour nitrogen dioxide objective will not be exceeded at the proposed development. Although annual mean nitrogen dioxide concentrations at the proposed development site exceed the objective, the annual mean nitrogen dioxide objective does not strictly apply at the proposed development.

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.	The proposed development does not represent relevant exposure to annual mean objectives. Users of the development will not be subjected to exceedences of the 1-hour mean nitrogen dioxide objective or the 24-hour mean PM_{10} objective.
Uncertainty, including the extent to which worst-case assumptions have been made.	The assessment has been based on 2013 and no future-year assessment has been undertaken. This represents a worst-case assessment of air quality at the site and accounts for any uncertainty in future year predictions.
The extent to which an objective is exceeded.	It is predicted that the 1-hour mean nitrogen dioxide objective and 24-hour mean PM_{10} objective will not be exceeded at the site. Annual mean objectives do not apply for this development.

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 as set out in Table 8. The GLA Best Practice Guidance (GLA, 2006) describes best practice measures that should be employed, as appropriate, to reduce the impact of a *medium* risk site. However, more comprehensive guidance has been published by IAQM (Institute of Air Quality Management, 2014), and on monitoring during demolition and construction (Institute of Air Quality Management, 2012b). 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).

7.4 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

7.5 The assessment of air quality at the proposed development has demonstrated that there will not be any exceedences of the 1-hour nitrogen dioxide objective. The annual mean objective does not apply at the proposed development and therefore it is judged that there is no requirement for air quality mitigation from road traffic emissions.

Air Quality Neutral

7.6 The proposed development will be better than air quality neutral and thus no specific mitigation is required.

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*.

9 Conclusions

9.1 The air quality for future users has been assessed at a number of worst-case locations within the proposed development.

9.2 It is concluded that concentrations of PM_{10} and $PM_{2.5}$ will remain below the objectives at all existing receptors in the assessment year (2013).

9.3 In the case of nitrogen dioxide, the annual mean concentrations are predicted to be above the objective at worst-case locations on the façades of all floors of the proposed development.

9.4 The building- and transport-related emissions associated with the proposed development are 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.

9.5 The overall air quality impacts of the development, with mitigation in place are judged to be *insignificant*.

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11 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System
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	Emissions 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
LB	London Borough
LDF	Local Development Framework
LEZ	Low Emission Zone
$\mu g/m^3$	Microgrammes per cubic metre
MAQS	Mayor's Air Quality Strategy
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

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;

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 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 A7.

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 [4]

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 [4]

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

4 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 [4]

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 describe the nature of air quality impacts, nor how to assess their significance. The approach developed by the Institute of Air Quality Management[5] (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. This involves three distinct stages: the application of descriptors for magnitude of change; the description of the impact at each sensitive receptor; and then the assessment of overall significance of the scheme.

Impact Descriptors

A3.2 The definition of ***impact magnitude*** is solely related to the degree of change in pollutant concentrations, expressed in microgrammes per cubic metre, but originally determined as a percentage of the air quality objective. ***Impact description*** takes account of the impact magnitude and of the absolute concentrations and how they relate to the air quality objectives or other relevant standards. The descriptors for the magnitude of change due to the scheme are set out Table A3.1, while Table A3.2 sets out the impact descriptors. These tables have been designed to assist with describing air quality impacts at each specific receptor. They apply to the pollutants relevant to this scheme and the objectives against which they are being assessed.

Table A3.1: Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude of Change	Annual Mean NO_2/PM_{10}	No. days with PM_{10} concentration greater than 50 µg/m^3	Annual Mean $PM_{2.5}$
Large	Increase/decrease ≥4 µg/m^3	Increase/decrease >4 days	Increase/decrease ≥2.5 µg/m^3
Medium	Increase/decrease 2 - <4 µg/m^3	Increase/decrease 3 or 4 days	Increase/decrease 1.25 - <2.5 µg/m^3
Small	Increase/decrease 0.4 - <2 µg/m^3	Increase/decrease 1 or 2 days	Increase/decrease 0.25 - <1.25 µg/m^3
Imperceptible	Increase/decrease <0.4 µg/m^3	Increase/decrease <1 day	Increase/decrease <0.25 µg/m^3

5 The IAQM is the professional body for air quality practitioners in the UK.

Table A3.2: Air Quality Impact Descriptors for Changes to Annual Mean Nitrogen Dioxide, PM_{10} and $PM_{2.5}$ Concentrations and Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m^3 at a Receptor [a]

Absolute Concentration [b] in Relation to Objective	Change in Concentration/day [c]		
	Small	Medium	Large
Above Objective [d]	Slight	Moderate	Substantial
Just Below Objective [e]	Slight	Moderate	Moderate
Below Objective [f]	Negligible	Slight	Slight
Well Below Objective [g]	Negligible	Negligible	Slight

[a] Criteria have been adapted from the published criteria to remove overlaps at transitions.

[b] The 'Absolute Concentration' relates to the 'With-Scheme' air quality where there is an increase in concentrations and to the 'Without-Scheme' air quality where there is a decrease in concentrations.

[c] Where the Impact Magnitude is *Imperceptible*, then the Impact Description is *Negligible*.

[d] 'Above': >40 µg/m^3 annual mean NO_2 or PM_{10}, >25 µg/m^3 annual mean $PM_{2.5}$, or >35 days with PM_{10} > 50 µg/m^3.

[e] 'Just below': >36 – ≤40 µg/m^3 of annual mean NO_2 or PM_{10}, >22.5 - ≤25 µg/m^3 annual mean $PM_{2.5,}$ or >32 – ≤35 days with PM_{10} >50 µg/m^3.

[f] 'Below': >30 – ≤36 µg/m^3 of annual mean NO_2 or PM_{10}, >18.75 - ≤22.5 µg/m^3 annual mean $PM_{2.5,}$ or >26 – ≤32 days with PM_{10} >50 µg/m^3.

[g] 'Well below': ≤30 µg/m^3 annual mean NO_2 or PM_{10}, ≤18.75 µg/m^3 annual mean $PM_{2.5,}$ or ≤26 days with PM_{10} >50 µg/m^3.

Assessment of Significance

A3.3 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[6] (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 A3.3 should be taken into account. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A4.

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

Table A3.3: 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.

A4 Professional Experience

Stephen Moorcroft, BSc (Hons) MSc DIC MIEnvSc MIAQM CEnv

Mr Moorcroft is a Director of Air Quality Consultants, and has worked for the company since 2004. He has over thirty-five years' postgraduate experience in environmental sciences. Prior to joining Air Quality Consultants, he was the Managing Director of Casella Stanger, with responsibility for a business employing over 100 staff and a turnover of £12 million. He also acted as the Business Director for Air Quality services, with direct responsibility for a number of major Government projects. He has considerable project management experience associated with Environmental Assessments in relation to a variety of development projects, including power stations, incinerators, road developments and airports, with particular experience related to air quality assessment, monitoring and analysis. He has contributed to the development of air quality management in the UK, and has been closely involved with the LAQM process since its inception. He has given expert evidence to numerous public inquiries, and is frequently invited to present to conferences and seminars. He is a Member of the Institute of Air Quality Management.

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Principal Consultant with AQC, with eight years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Joshua Nunn, MSci (Hons) AMRSC

Mr Nunn is an Assistant Consultant with AQC. Prior to joining he conducted over three years of scientific research at the University of Bristol, examining the use of sustainable materials in chemical processes using a range of analytical tools and computational modelling. He now works in the field of air quality assessment and has been involved in the analysis and assessment of air quality impacts for a number of residential and commercial developments. These have included the use of ADMS dispersion models to study the impacts of a variety of sources of nitrogen dioxide, PM_{10} and $PM_{2.5}$, and the preparation of air quality assessment reports.

Full CVs are available at www.aqconsultants.co.uk.

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 (2014a). 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 3.6, 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). This has been done using the source-specific background nitrogen oxides maps provided by Defra (2014a). Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2014a) publishes to accompany the maps.

A5.3 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

A5.4 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) published by Defra (2014a). For nitrogen dioxide, concentrations have been predicted using year-specific emission factors from the EFT for 2013[7], which is the year for which the model has been verified.

A5.5 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 has been taken from the monitoring station located at London City Airport, which is considered suitable for this area.

7 i.e. combining current-year emission factors with future-year traffic data.

A5.6 AADT flows, diurnal flow profiles, and vehicle fleet composition data for Guilford Street, Millman Street and Lamb's Conduit Street have been provided by Pell Frischmann. These have been derived from weekday counts, which may over-predict annual average flows. Traffic data for Euston Road has been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2013). Traffic speeds for all roads 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. The traffic data used in this assessment are summarised in Table A5.1.

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

Road Link	2013	
	AADT	%HDV
Guilford Street	11,361	1.3
Millman Street	777	1.5
Lamb's Conduit Street	3,178	1.2
Euston Road	53,606	4.0

[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.

A5.7 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (DfT, 2011).

A5.8 Figure A5.1 shows the road network included within the model and defines the study area.

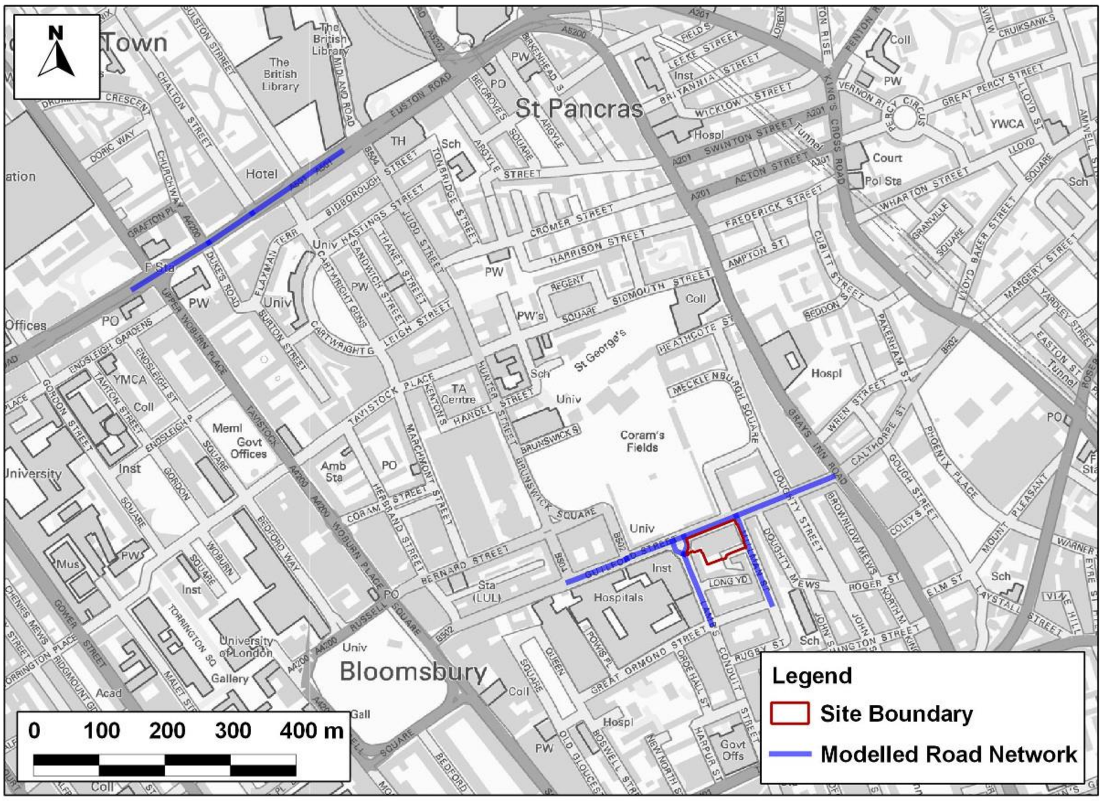

Figure A5.1: Modelled Road Network

Contains Ordnance Survey data © Crown copyright and database right 2014

Model Verification

A5.9 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.

Background Concentrations

A5.10 The 2013 background concentrations for the Euston Road automatic monitoring station have been derived from the national maps, and are calculated using the same approach as described in Paragraph 4.10: the road traffic component of background nitrogen oxides is held constant at 2011, while 2013 data are taken for the other components. Nitrogen dioxide is then calculated using Defra's background nitrogen dioxide calculator. The background concentrations at the Euston Road automatic monitor location are presented in Table A5.2.

Table A5.2: Background Concentrations used in the Verification (2013)

Monitor	Grid square	NO_2	PM_{10}	$PM_{2.5}$
RA	529500 182500	47.7	25.8	17.7

Nitrogen Dioxide

A5.11 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 Euston Road automatic monitoring site. Concentrations have been modelled at 2.5 m, the height of the monitor inlet.

A5.12 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 NOx concentration and the predicted background NOx concentration.

A5.13 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, 2014a).

A5.14 The data used to calculate the adjustment factor are provided below:

- Measured NO_2 : 111.1 µg/m^3
- Background NO_2 : 47.7 µg/m^3
- 'Measured' road-NOx (from NOx to NO_2 calculator): 227.4 µg/m^3
- Modelled road-NOx = 76.2 µg/m^3
- Primary Road-NOx adjustment factor: 227.4/76.2 = **2.983**[8]

A5.15 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 $PM_{2.5}$

A5.16 There are no relevant 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.

8 Based on un-rounded values

Model Post-processing

Nitrogen oxides and nitrogen dioxide

A5.17 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, 2014a). 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.

PM_{10} and $PM_{2.5}$

A5.18 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, 2014), 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:

Communications

- develop and implement a stakeholder communications plan that includes community engagement before and during work on site;
- display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environmental manager/engineer or the site manager; and
- display the head or regional office contact information.

Dust Management Plan

- Develop and implement a Dust Management Plan (DMP) approved by the Local Authority which documents the mitigation measures to be applied, and the procedures for their implementation and management.

Site Management

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken;
- make the complaints log available to the local authority when asked;
- record any exceptional incidents that cause dust and/or air emissions, either on- or off- site, and the action taken to resolve the situation in the log book.

Monitoring

- Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust. Record inspection results, and make the log available to the Local Authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of the site boundary, with cleaning to be provided if necessary;
- carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the Local Authority when asked;
- increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions; and

- agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction (Institute of Air Quality Management, 2012b).

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;
- 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; and
- cover, seed, or fence stockpiles to prevent wind whipping.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone, and the London Non-road Mobile Machinery standards, where applicable;
- ensure all vehicles switch off their 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;
- impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate);
- produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; 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 non-potable 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

- 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 effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground;
- 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 Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable; and
- only remove the cover from small areas during work, not all at once.

Measures Specific to Construction

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

- ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery; and
- for smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures Specific to Trackout

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use;
- avoid dry sweeping of large areas;
- ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
- inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable;
- record all inspections of haul routes and any subsequent action in a site log book;
- install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems or mobile water bowsers, and regularly cleaned;
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable);
- ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits; and
- access gates should be located at least 10 m from receptors, where possible.