HOARE LEA

Stephenson Way.
Camden.
Valeo Developments.

AIR QUALITY
AIR QUALITY ASSESSMENT

REVISION 03 – 25 FEBRUARY 2019

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
01	25/04/2018	First draft	BT/AD	CR	CR
02	04/05/2018	First issue	BT/AD	CR	CR
03	25/02/2019	Second issue	AD	CR	CR

Project number: 10/10439
Document reference: REP-1010439-AQ-CR-20190220-Stephenson Way Camden-R3.docx

Contents.

1. Executive Summary

Hoare Lea LLP have been commissioned to undertake an air quality assessment for the proposed development of student accommodation on Stephenson Way, London.

Camden Council has declared the entire borough an Air Quality Management Area (AQMA) for exceedences of the annual mean nitrogen dioxide (NO2) and 24-hour mean fine particulate matter (PM10) objectives.

The construction phase will have the potential to create dust. It will therefore be necessary to implement mitigation measures to minimise dust emission. With these measures in place, it is expected that any residual effects will be not significant.

The impacts due to emissions from local road traffic on the air quality for residents living in the development have been shown to be acceptable at the worst-case locations assessed, with concentrations being below the air quality objectives at all receptors.

The overall operational air quality impacts on the development are judged to be insignificant. This conclusion, which takes account of the uncertainties in future projections, in particular for NO_2, is based on the predicted concentrations being below the objectives at all of the receptors.

The proposed development has been shown to be air quality neutral with regard to buildings and transport.

There should be no constraints to the development with regard to air quality, as the proposed development is consistent with:

- The NPPF;
- The London Plan;
- Policy A1 and Policy CC4 of the Camden Local Plan.

2. Introduction

2.1 Proposed Development

Hoare Lea LLP have been commissioned to undertake an air quality assessment for the proposed development of student accommodation on Stephenson Way, London.

Camden Council has declared the entire borough an Air Quality Management Area (AQMA) for exceedences of the annual mean nitrogen dioxide (NO_2) and 24-hour mean fine particulate matter (PM_{10}) objectives.

2.2 Scope of Assessment

This report describes the existing air quality conditions in proximity to the site, and assesses the impact of road traffic emissions from the adjacent road network on residents at the proposed development. The main air pollutants of concern related to road traffic are nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$). The proposed development will only generate an additional 14 daily traffic movements; therefore, the impact of additional traffic on local air quality will be insignificant and will not be considered further.

The proposed development will be meet its energy demand via air source heat pumps (ASHP); there will be no gas fired systems and as a result no emissions from the energy centre. Therefore, an assessment of the air quality impact from the energy centre will not be undertaken.

There is the potential for construction activities to impact upon existing properties. The main pollutants of concern related to construction activities are dust and PM_{10}.

The assessment also considers the cumulative effect of the proposed development on air quality in London through an air quality neutral assessment.

The assessment has been prepared taking into account all relevant local and national guidance and regulations.

The references and a glossary of common air quality terminology used in this assessment are shown in Section 9 and Section 10 respectively.

3. Air Quality Legislation and Policy

3.1 EU Limit Values

The European Union's Directive on ambient air quality and cleaner air for Europe (European Parliament, Council of the European Union, 2008) set legally binding limit values for NO_2, PM_{10} and $PM_{2.5}$. The Air Quality Standards Regulations 2010 (The Stationary Office, 2010) implement the EU Directive limit values in English legislation. Achievement of the limit values is a national obligation rather than a local one.

The limit values are the same as the objective values (see Table 1); however, the compliance dates differ, and the limit values apply at all locations (apart from where the public does not have access, where health and safety at work provisions apply and on the road carriageway). The PM_{10} and NO_2 limit value applied from 2005 and 2010 respectively, whereas the $PM_{2.5}$ limit value applied from 2015.

3.2 The Air Quality Strategy

Part IV of The Environment Act 1995 required the UK Government to prepare an Air Quality Strategy. The Air Quality Strategy (Defra, 2007), provides an overview and outline of ambient air quality policy in the UK and the devolved administrations. The strategy sets out air quality standards and objectives intended to protect human health and the environment.

Standards are the concentrations of pollutants in the atmosphere, below which there is a minimum risk of health effects or ecosystem damage; they are set with regard to scientific and medical evidence. Objectives are the policy targets set by the Government, taking account of economic efficiency, practicability, technical feasibility and timescale, where the standards are expected to be achieved by a certain date.

The Air Quality Strategy also describes the system of Local Air Quality Management (LAQM), introduced in Part IV of the Environment Act 1995, which requires every local authority to carry out regular review and assessments of air quality in its area. Where an objective has not been, or is unlikely to be achieved, the local authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which sets out appropriate measures to be introduced in pursuit of the objectives.

The objectives for NO_2 and PM_{10}, as prescribed by the Air Quality (England) Regulations 2000 and the Air Quality (England) (Amendment) Regulations 2002 (The Stationary Office, 2000; The Stationary Office, 2002), are shown in Table 1. The objectives for PM_{10} and NO_2 were to have been achieved by 2004 and 2005 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective, also shown in Table 1, is to be achieved by 2020; however, although local authorities in London have a flexible role in working towards reducing emissions and concentrations of $PM_{2.5}$, there is no obligation for local authorities to try to meet the $PM_{2.5}$ objective, and it is not included in the Regulations.

Table 1 The Objectives for NO_2, PM_{10} and $PM_{2.5}$

Pollutant	Concentration Measured As	Objective
NO_2	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m^3
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
$PM_{2.5}$	Annual Mean	25 µg/m^3

The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. Examples of where the objectives should apply are provided in the London Local Air Quality Management Technical Guidance (Mayor of London, 2016). The annual mean NO_2 and PM_{10} objectives should apply at the building façades of residential properties, schools, hospitals, care homes etc.; they should not apply at the building façades of places of work, hotels, gardens or kerbside sites. The 24-hour mean PM_{10} objective should apply at all locations where the annual mean objective applies, as well as the gardens of residential properties and hotels. The 1-hour mean NO_2 objective should apply at all locations where the annual and 24-hour mean objectives apply, as well as at kerbside sites where the public have regular access, e.g. the pavements of busy shopping streets.

3.3 Planning Policy

National Policies and Guidance

The National Planning Policy Framework (NPPF) (DCLG, 2012) sets out planning policy for England and acts as guidance for local planning authorities in drawing up plans and as a material consideration in determining applications. It places a general presumption in favour of sustainable development, stressing that the planning system should perform an environmental role to minimise pollution.

The NPPF states that:

"The planning system should contribute to conserving and enhancing the environment and reducing pollution by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability."

The NPPF goes on the say that:

"To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account."

With specific reference to air quality, the NPPF states 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."

The NPPF is supported by Planning Practice Guidance (PPG) (DCLG, 2014). 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. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit."

The PPG goes on to state 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)."

The PPG makes clear that:

"… dust can also be a planning concern, for example, because of the effect on local amenity."

The PPG also sets out the information that may be required in an air quality assessment, stating 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, and makes clear that:

"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact."

Regional Policies

The London Plan (GLA, 2016a) sets out the spatial development strategy for London and presents a London-wide policy framework, including Policy 7.14 Improving Air Quality, which states that development proposals should:

a. "minimise increased exposure to existing poor air quality and make provision to address local problems of air quality (particularly within Air Quality Management Areas (AQMAs) and 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 as 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 from 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 be made to reduce emissions from a development, this is usually made on-site. Where it can be demonstrated that on-site 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; and

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 London Plan is supported by Supplementary Planning Guidance, (SPG) on Sustainable Design and Construction (GLA, 2014a) and The Control of Dust and Emissions during Construction and Demolition (GLA, 2014b). The SPGs include criteria that require an air quality neutral and a dust risk assessment for all major developments in London, a major residential development being defined in the London Plan as having 10 or more dwellings.

The Mayor's Air Quality Strategy (GLA, 2010) explains the actions that the Mayor will take to improve air quality in London, with the aim of achieving compliance with the EU limit values as soon as possible. The Strategy includes a number of measures to improve air quality, including those that encourage the use of sustainable transport modes, promote the use of cleaner vehicles, improve traffic management and use the planning process to improve air quality.

Local Policies

The Camden Local Plan includes Policy A1 Managing the Impact of Development, which states that (Camden Council, 2017):

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

We will:

a. seek to ensure that the amenity of communities, occupiers and neighbours is protected;

b. seek to ensure development contributes towards strong and successful communities by balancing the needs of development with the needs and characteristics of local areas and communities;

c. resist development that fails to adequately assess and address transport impacts affecting communities, occupiers, neighbours and the existing transport network; and

d. require mitigation measures where necessary.

The factors we will consider include:

e. visual privacy, outlook;
f. sunlight, daylight and overshadowing;
g. artificial lighting levels;
h. transport impacts, including the use of Transport Assessments, Travel Plans and Delivery and Servicing Management Plans;
i. impacts of the construction phase, including the use of Construction Management Plans;
j. noise and vibration levels;
k. odour, fumes and dust;
l. microclimate;
m. contaminated land; and
n. impact upon water and wastewater infrastructure."

The Camden Local Plan also includes Policy CC4 Air Quality, which states that:

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

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

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

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

Camden Council has also published Supplementary Planning Documents, CPG3 Sustainability and CPG6 Amenity, which include additional information regarding what should be included in an air quality assessment (Camden Council, 2018a; Camden Council, 2018b).

Air Quality Action Plan
Camden Council has developed a Clean Air Action Plan for the AQMA (Camden Council, 2016). The Action Plan sets out measures that the council intends to implement in order to help meet the objectives. Overall, the measures aim to continue monitoring air quality in Camden, reduce emissions from transport, buildings and new development, raise awareness of air quality and promote lobbying and partnership working.

4. Methodology

4.1 Consultation

Camden Council have been contacted in order to agree the assessment methodology; however, the council were only able to provide generic information with regard to air quality assessments (email correspondence between Gabriel Berry-Khan, Senior Sustainability Officer (Planning) at Camden Council and Chris Rush, Associate at Hoare Lea, between the 3rd and 4th April 2018).

4.2 Existing Conditions

Information on existing air quality within the study area has been collated from the following sources:

- The results of monitoring and the LAQM review and assessment reports undertaken by Camden Council;
- Maps of roadside concentrations published by Defra, to identify current exceedances of the annual mean NO_2 EU limit value (Defra, 2018a); and
- Background pollutant concentration maps published by Defra (Defra, 2018b).

4.3 Construction Impacts

A construction dust risk assessment has been undertaken following the guidance in the London Plan SPG on The Control of Dust and Emissions During Construction and Demolition (GLA, 2014b), which utilises the methodology in the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014).

The guidance divides activities on construction sites into four main types: demolition, earthworks, construction and trackout. The methodology is based on a sequence of steps. Step 1 screens the requirement for more detailed assessment; if there are no receptors within 50 m of the site boundary, or within 50 m of roads used by construction vehicles, then there is no need for further assessment. Step 2 assesses the risk of dust impacts from each of the four activities, considering the scale and magnitude of the works (Step 2A), and the sensitivity of the area (Step 2B). Site-specific mitigation for each of the four activities is then determined based on a dust risk category defined at Step 2C. Appendix 1 sets out the construction dust assessment methodology in more detail.

The London Plan SPG on The Control of Dust and Emissions During Construction and Demolition is clear that the primary aim of the risk assessment is to identify site specific mitigation that, once adopted, will ensure that there will be no significant effect. Therefore, the assessment has been used to determine an appropriate level of mitigation for the construction phase.

4.4 Road Traffic Impacts

Sensitive Locations

Receptors have been identified within the proposed development, where the impact from existing sources is likely to be greatest. The receptors are described in Table 2 and are shown in Figure 1. Receptors have been included at heights of 1.5m and 4.5m to represent exposure on the ground and first floors. The current plans show that there will be no relevant exposure to annual mean concentrations on the ground floor level.

Assessment Scenarios

Concentrations of NO_2, PM_{10} and $PM_{2.5}$ have been predicted at the new receptors in 2020, which is the anticipated opening year.

Concentrations have also been predicted at the CD9 automatic monitoring site located on Euston Road in 2017 in order to verify the model (see Appendix 2).

Modelling Methodology

Concentrations have been predicted using the ADMS Roads (v4.1.1.0) dispersion model. The model requires the input of a range of data, details of which are provided in Appendix 2.

Table 2 Description of Receptors

Receptor	Location	x	y	z
R1	Proposed development front façade	529398.3	182442.9	1.5 & 4.5
R2	Proposed development front façade	529405.3	182447.1	1.5 & 4.5
R3	Proposed development front façade	529412.1	182451.2	1.5 & 4.5
R4	Proposed development front façade	529419.1	182455.4	1.5 & 4.5
R5	Proposed development front façade	529425.9	182459.5	1.5 & 4.5
R6	Proposed development rear façade	529432.4	182448.6	1.5 & 4.5
R7	Proposed development rear façade	529425.6	182444.6	1.5 & 4.5
R8	Proposed development rear façade	529418.7	182440.5	1.5 & 4.5
R9	Proposed development rear façade	529411.8	182436.3	1.5 & 4.5
R10	Proposed development rear façade	529404.9	182432.3	1.5 & 4.5

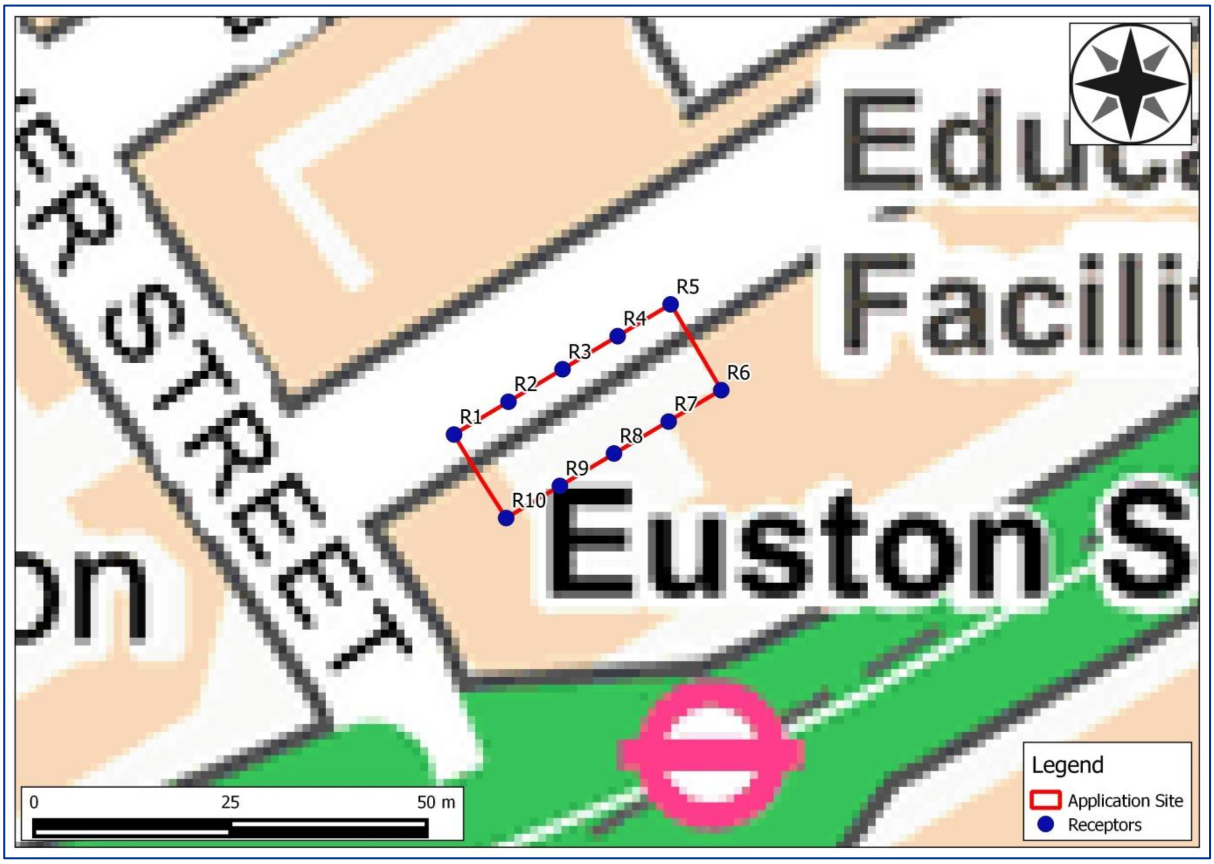

Figure 1 Location of Receptors

4.5 Assessment Criteria and Significance

Construction Dust

The IAQM construction dust assessment methodology ensures that, with appropriate mitigation in place, the residual effect from construction dust will normally be 'not significant'; therefore, the assessment has been used to determine an appropriate level of mitigation for the construction phase.

Health Criteria

There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach suggested by Environmental Protection UK (EPUK) and the IAQM in guidance on Land-Use Planning & Development Control: Planning for Air Quality (EPUK and IAQM, 2017) has been used for this assessment.

The predicted concentrations at each receptor have been compared with air quality assessment levels (AQALs) based on the objectives shown in Table 1. Measurements of PM_{10} have shown that exceedences of the 24-hour mean PM_{10} objective may occur above an annual mean PM_{10} concentration of 32 µg/m^3; therefore, 32 µg/m^3 has been used as the AQAL for PM_{10} (Mayor of London, 2016). Where an exceedence of the AQAL occurs, the effect is judged as significant, unless provision is met to reduce exposure by some means. Predicted concentrations below the air quality objectives will be considered as insignificant.

The determination of the significance of the effects includes elements of professional judgement and the professional experience of the consultant preparing the report is set out in Appendix 3.

4.6 Air Quality Neutral Assessment

To enable the implementation of the air quality neutral policy of the London Plan, emission benchmarks have been developed for buildings and transport, which are dependent on the area of London that the development is in. Developers are required to calculate emissions due to buildings operation and transport, and to compare these emissions with the benchmarks, with are set out in Appendix 4.

Where the developments emissions exceed the benchmarks, on-site mitigation is required. Where emissions continue to exceed the benchmarks after appropriate on-site mitigation, the excess emissions need to be off-set off-site through agreement with the local planning authority.

Guidance on the application of the air quality neutral policy has been followed for this assessment (AQC, 2014), and details of the assessment methodology are provided in Appendix 4.

5. Baseline Conditions

5.1 EU Limit Values

The London Marylebone urban traffic AURN site, located on Marylebone Road approximately 1.25km to the west of the application site, has measured exceedences of the annual mean and 1-hour mean limit value. North Gower Street and Stephenson Way are not included in modelling undertaken by Defra; however, Euston Road is, and 2015 annual mean concentrations greater than 60µg/m^3 have been predicted along Euston Road where it joins North Gower Street.

The London Bloomsbury AURN urban background monitoring site located in Russell Square has measured exceedences of the annual mean EU limit value (see below).

5.2 LAQM Review and Assessment

Camden Council has declared the entire borough an AQMA for exceedences of the annual mean NO_2 objective and the 24-hr mean PM_{10} objective.

5.3 Local Air Quality Monitoring

Camden Council currently operates four automatic monitoring sites. A roadside monitoring site is located on Euston Road approximately 500m to the east of the application site and the London Bloomsbury AURN monitoring site is located approximately 800m to the southeast of the application site. Camden Council also operates a number of diffusion tube monitoring sites and data from a background site located in Tavistock Square are provided. The monitoring locations are shown in Figure 2, and data are provided in Table 3, Table 4 and Table 5.

Annual mean and 1-hour mean roadside NO_2 concentrations on Euston Road have exceeded the objective in all years between 2012 and 2017. Annual mean background NO_2 concentrations have remained at or above the objective from 2012 to 2016; however, the annual mean objective was achieved at the London Bloomsbury monitoring site in 2017. There has been an overall decreasing trend in measured annual mean NO_2 concentrations for the past six years.

Annual mean and 24-hour mean roadside and background PM_{10} concentrations have remained below the objectives in all years between 2012 and 2017.

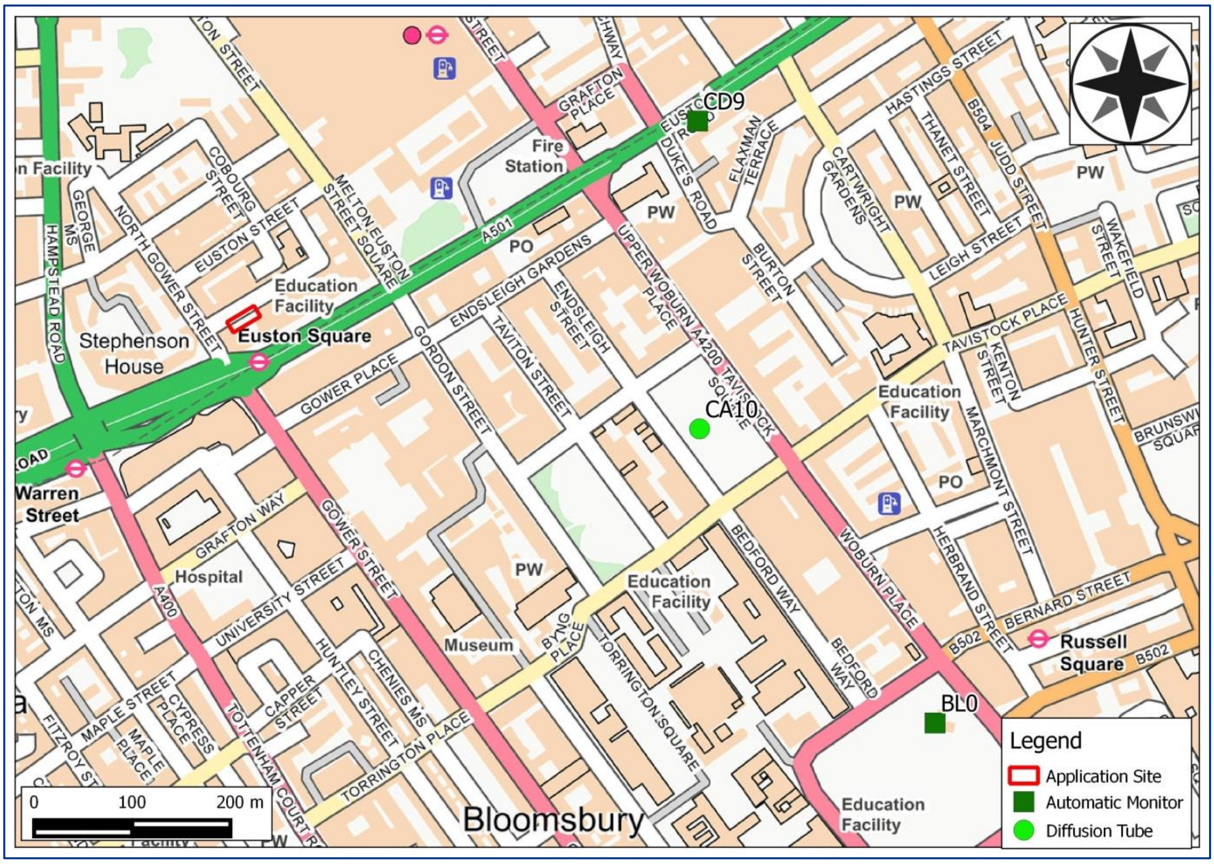

Figure 2 Air Quality Monitoring Sites

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Table 3 Measured Annual Mean NO_2 Concentrations (2012 to 2017) a

Site ID	Location	Site Type	Annual Mean (µg/m^3)					
			2012	2013	2014	2015	2016	2017
CD9	Euston Road	R	**106**	**106**	**98**	**90**	**88**	**83**
BL0	London Bloomsbury	UB	**55**	**44**	**45**	**48**	**42**	38
CA10	17 Grand Drive	UB	40	**49**	**47**	**45**	40	-
Objective			40					

a Exceedences are shown in bold. R = roadside, UB = urban background.

Table 4 Exceedence Statistics for the 1-hour Mean NO2 Objective (2012 to 2017) a

Site ID	Location	Site Type	Number of Hours > 200 µg/m^3					
			2012	2013	2014	2015	2016	2017
CD9	Euston Road	R	**295**	**296**	**170**	**54**	**39**	**26**
BL0	London Bloomsbury	UB	1	0	0	0	0	0
Objective			**18**					

a Exceedences are shown in bold. R = roadside, UB = urban background.

Table 5 Summary of PM10 Monitoring Data (2012 to 2017) a

Site ID	Location	Site Type	2012	2013	2014	2015	2016	2017
Annual Mean (µg/m^3)								
CD9	Euston Road	R	-	-	29	18	24	20
BL0	London Bloomsbury	UB	19	18	20	22	20	19
Objective			40					
Number of Days > 50 µg/m^3								
CD9	Euston Road	R	-	-	5	5	10	3
BL0	London Bloomsbury	UB	10	4	11	6	9	6
Objective			35					

5.4 Background Concentrations

Estimated background concentrations at the application site are shown in Table 6. The background concentrations have been derived from data in the national maps published by Defra, calibrated against measurements made at the London Bloomsbury AURN monitor (see Appendix 2). The background concentrations are all below the objectives.

Table 6 Estimated Annual Mean Background Concentrations in 2017 and 2020 (µg/m^3)

Year	NOx	NO_2	PM_{10}	$PM_{2.5}$
2017	63.2	38.6	18.4	13.4
2020	48.0	31.5	17.7	12.6
Objective	-	40	40	25

6. Impact Assessment

6.1 Construction Phase

Without mitigation, there is a risk that the construction phase of the development will lead to dust soiling and elevated concentrations of PM_{10}. These impacts may occur during demolition, earthworks and construction, as well as from trackout of dust onto the public highway, as vehicles leave the construction site.

Screening

There are human receptors within 50 m of the application site and receptors within 50 m of the route used by construction vehicles on the public highway, up to 500 m from the site entrance. Therefore, further assessment of the construction phase impacts is necessary. There are no sensitive ecological receptors within 50 m of the site boundary; therefore, the impacts on ecology will not be considered further.

Risk of Dust Impacts

Potential Dust Emission Magnitude

The application site is currently a ground level car park and the only works during the demolition phase will be the removal of tarmac; therefore, based on the example definitions in Table 14 in Appendix 1, the dust emission class for demolition is considered to be small.

Earthworks are likely to take place across the application site, which has a total area of around 400 m^2. Data from the UK Soil Observatory (NERC, 2017) have been used to determine that the soil at the site is a light to medium sand to sandy loam, which would be less prone to suspension when dry. Given the small scale of the site, there are likely to be less than 5 heavy earth moving vehicles at any one time. Based on the example definitions in definitions in Table 14 in Appendix 1, the dust emission class for earthworks is considered to be small.

The proposed development involves the construction of building with a total volume of less than 25,000 ^{m3}. Based on the example definitions in Table 14 in Appendix 1, the dust emission class for construction is considered to be small.

The number of daily outward heavy duty vehicle (HDV) movements from the application site during the construction phase is currently unknown; however, given the small size of the site, it is likely to be less than 10; therefore, based on the example definitions in Table 14 in Appendix 1, the dust emission class for trackout is considered to be small.

A summary of the likely dust emission magnitudes is shown in Table 7.

Table 7 Likely Dust Emission Magnitudes

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

Trackout Small

Sensitivity of the Area

The sensitivity of the area depends on the specific sensitivities of local receptors, the proximity and number of receptors, local PM_{10} background concentrations and other site specific factors, e.g. natural screening by trees.

Sensitivity of the Area to Dust Soiling

Residential properties are considered to be 'high' sensitivity receptors to dust soiling (see Table 15 in Appendix 1).

There are between 10-100 high sensitivity residential receptors between 20m and 50m of the application site, and a number of medium sensitivity office blocks within 20m of the application site boundary. With reference to Table 18 in Appendix 1, the area is thus considered to be of medium sensitivity to dust soiling.

Table 7 shows that the dust emission magnitude for trackout is small; therefore, there is a risk of material being tracked up to 50 m from the site exit. Stephenson Way is a one-way street, and vehicles leaving the site would need to travel east along it. There is a residential block approximately 35m to the east of the application site within which there may be between 10-100 residential properties within 20 m of the roads along which material could be tracked. With reference to Table 18 in Appendix 1, the area is thus considered to be of high sensitivity to dust soiling from trackout.

Sensitivity of the Area to the Health Effects of PM_{10}

Residential properties are considered to be 'high' sensitivity receptors to the health effects of PM_{10} (see Table 16 in Appendix 1).

Annual mean PM_{10} concentrations have been predicted to be 18.6µg/m^3 in 2017 at the ground level façade facing onto Stephenson Way. With reference to Table 19 in Appendix 1, the area is thus described to be of low sensitivity to the health effects of PM_{10} from on-site works and from trackout.

A summary of the sensitivity of the area to the effects of the construction works is shown in Table 8.

Table 8 Summary of the Area Sensitivity

Potential Effect	Sensitivity of the Area	
	On-site Works	Trackout
Dust Soiling	Medium	High
Health	Low	Low

Risk of Impact and Significance

The dust emission magnitudes in Table 7 have been combined with the area sensitivities in Table 8 and a risk category has been assigned to each construction activity using the matrix in Table 21 in Appendix 1. The resultant risk categories, shown in Table 9, have then been used to determine the appropriate level of mitigation necessary for a residual effect that is likely to be 'not significant'.

Table 9 Summary of the Risk of Impacts Without Mitigation

Construction Activity	Dust Soiling	Health
Demolition	Low	Negligible
Earthworks	Low	Negligible
Construction	Low	Negligible
Trackout	Low	Negligible

6.2 Operational Phase

Predicted concentrations at each of the modelled receptor heights at the proposed development are shown in Table 10.

Annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ are predicted to be below the AQALs at all of the receptors. Concentrations decrease with height; therefore, air quality for future residents of the proposed development will be acceptable at all levels.

Table 10 Predicted Impacts on the Development in 2020

Receptor	Annual Mean (µg/m^3)					
	NO_2		PM_{10}		$PM_{2.5}$	
	1.5 m	4.5 m	1.5 m	4.5 m	1.5 m	4.5 m
R1	33.3	33.1	17.9	17.9	12.7	12.7
R2	33.2	33.1	17.9	17.9	12.7	12.7
R3	33.2	33.0	17.9	17.9	12.7	12.7
R4	33.1	33.0	17.9	17.9	12.7	12.7
R5	33.1	33.0	17.9	17.9	12.7	12.7
R6	32.7	32.7	17.8	17.8	12.7	12.7
R7	32.7	32.7	17.8	17.8	12.7	12.7
R8	32.8	32.7	17.8	17.8	12.7	12.7
R9	32.9	32.8	17.8	17.8	12.7	12.7
R10	33.0	32.9	17.9	17.8	12.7	12.7
AQAL	40		32		25	

Uncertainty

There are many factors that contribute to uncertainty when predicting pollutant concentrations. The emission factors utilised in the air quality model are dependent on traffic data, which have inherent uncertainties associated with them. There are also uncertainties associated with the model itself, which simplifies real world conditions into a series of algorithms. The model verification process, as described in Appendix 2, minimises the uncertainties related to current year (2017) predictions.

Future year predictions are subject to greater uncertainty, as projected traffic data, emissions data, and background concentrations are used. The most recent emission factors and background data have been used in this assessment; however, there are still uncertainties associated with this data.

Data analysis has shown a disparity between historical monitoring data and the projected background concentrations published by Defra (Carslaw et al., 2011). Overall, there is little evidence of the consistent downward trend in NO_2 and NOx concentrations suggested by the emission inventory estimates.

This disparity is believed to have arisen due to the actual on-road performance of diesel vehicles when compared with emissions calculations based on the Euro standards and published in the Emissions Factor Toolkit (EFT) used for modelling. Real-world emissions test results suggest that emissions from the most recent

EFT (v8.0.1) accurately represent on-road emissions from the pre-2017 diesel fleet; however, there is still uncertainty with regard to how well post-2017 diesel cars and vans will perform in the real world (AQC, 2018).

To account for this uncertainty, a sensitivity analysis has been undertaken, which assumes that there are no reductions in emission factors for road traffic from the baseline year. Details of the sensitivity analysis methodology are provided in Appendix 2. The assumption that there are no emissions reductions from any vehicles (petrol and diesel) between 2017 and 2020 is highly conservative.

The results of the sensitivity analysis are shown in Table 11. Assuming no emissions reductions from road traffic, the predicted annual mean NO_2 concentrations remain below the AQAL and air quality for future residents of the proposed development will be acceptable at all levels.

Table 11 Predicted NO_2 Impacts on the Development in 2020 'No Emissions Reduction'

Receptor	Annual Mean (µg/m^3)	
	1.5 m	4.5 m
R1	39.4	39.2
R2	39.3	39.1
R3	39.3	39.1
R4	39.2	39.0
R5	39.2	39.0
R6	38.6	38.6
R7	38.6	38.6
R8	38.7	38.7
R9	38.8	38.8
R10	39.0	38.9
AQAL	40	

6.3 Air Quality Neutral Assessment

Building Emissions

The calculation of the building emissions benchmark (BEB) for the development is shown in Table 12. The total building emissions (TBE) for the proposed development will be 0 kg/yr because the energy demand will be met with an all-electric approach using ASHP. The TBE is less than the BEB of 56.9 kg/yr; therefore, the proposed development is air quality neutral with regard to building emissions.

Table 12 Calculation of TBE and BEB

Description		Value	Unit
A	Gross Internal Floor Area	2,170	m^2
B	NOx BEB for Class C3 (residential dwellings)	26.2 [a]	$g/m^2/yr$
C (A x B)	BEB NOx	56,854	g/yr
		56.9	kg/yr

a Default value from Table 26 in Appendix 4.

Transport Emissions

The calculation of the total transport emissions (TTE) and the comparison with the transport emissions benchmark (TEB) for the development is shown in Table 13. The TTE of 9.3 kgNOx/yr and 1.6 $kgPM_{10}$/yr are less than the TEB of 18.3 kgNOx/yr and 3.2 $kgPM_{10}$/yr; therefore, the proposed development is air quality neutral with regard to transport emissions.

Table 13 Calculation of TTE and TEB

Description		Value		Unit
A	Residential Vehicle Trips [a]	5,110		trips/yr
B	Average Distance per Trip [b]	4.3		km
C	Emission Factor [c]	NOx	PM_{10}	g/vehicle/km
		0.4224	0.0733	
D = (A x B x C)	TTE	9,281	1,611	g/yr
		9.3	1.6	kg/yr
E	Number of dwellings	78		units
F	TEB for Class C3 (residential dwellings) [d]	NOx	PM_{10}	g/dwelling/yr
		234	40.7	
G = (E x F)	Total TEB	18,252	3,175	g/yr
		18.3	3.2	kg/yr
L = (F – K)	Excess Emissions	-9.0	-1.6	kg/yr

a Based on traffic data provided by Robert West Consulting Ltd.

b CAZ value for class C3 from Table 29 in Appendix 4

c CAZ value from Table 28 in Appendix 4

d CAZ value from Table 30 in Appendix 4

7. Mitigation

7.1 Construction Phase

The application site has been identified as a low risk site during the construction phase, as set out in Table 9. The dust risk category has been used, along with the professional judgement of the consultant, to determine the appropriate level of mitigation at the site. The mitigation measures, taken from the London Plan SPG on

The Control of Dust and Emissions During Construction and Demolition (GLA, 2014b), are described in Appendix 5.

The mitigation measures will be included in an Air Quality and Dust Management Plan (AQDMP), which should be submitted to the local planning authority for approval prior to commencement of work on site.

7.2 Operational Phase

The assessment has demonstrated that the scheme will not introduce sensitive receptors into an area where the objectives are exceeded. Mitigation measures to reduce pollutant emissions from road traffic are principally being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation. It is not considered appropriate to propose further mitigation measures for this scheme.

7.3 Air Quality Neutral

The air quality neutral benchmarks for buildings and transport have been met, and no further mitigation is necessary, however deliveries and servicing should be limited to a maximum of one additional HDV movement per day.

8. Residual Impacts

8.1 Construction Phase

The London Plan SPG is clear that, with appropriate mitigation in place, the residual effect will normally be 'not significant'. With the implementation of the mitigation measures set out in Appendix 5, the residual effects are judged to be insignificant.

During adverse weather conditions, or where there is an interruption to the water supply, there may be occasional, short-term dust annoyance; however, the likely scale and duration of these effects would not change the conclusion that the residual effects are insignificant.

8.2 Operational Phase

The residual impacts will be the same as those identified in Section 5.

9. Summary & Conclusions

The construction phase will have the potential to create dust. It will therefore be necessary to implement mitigation measures to minimise dust emission. With these measures in place, it is expected that any residual effects will be not significant.

The impacts due to emissions from local road traffic on the air quality for residents living in the development have been shown to be acceptable at the worst-case locations assessed, with concentrations being below the air quality objectives at all receptors.

The overall operational air quality impacts on the development are judged to be insignificant. This conclusion, which takes account of the uncertainties in future projections, in particular for NO_2, is based on the predicted concentrations being below the objectives at all of the receptors.

The proposed development has been shown to be air quality neutral with regard to buildings and transport.

There should be no constraints to the development with regard to air quality, as the proposed development is consistent with:

- The NPPF;
- The London Plan;
- Policy A1 and Policy CC4 of the Camden Local Plan.

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11. Glossary

AQAL	Air quality assessment level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DMP	Dust Management Plan
EPUK	Environmental Protection UK
Exceedance	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
IAQM	Institute of Air Quality Management
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LEZ	Low Emission Zone
$\mu g/m^3$	Micrograms 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
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
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

Appendix 1 – Construction Dust Assessment Methodology

The London Plan SPG on the Control of Dust and Emissions During Construction and Demolition (GLA, 2014b) divides activities on construction sites into four types to reflect their different potential impacts:

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

A series of steps then consider the potential impact due to:

- annoyance due to dust soiling;
- the risk of health effects due to increased exposure to PM_{10}; and
- harm to ecological receptors.

Step 1: Screen the Need for a Detailed Assessment
An assessment is required where there is a human receptor within 50 m of the site boundary, 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 site boundary, 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).

Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is negligible, and any effects will be not significant.

Step 2: Assess the Risk of Dust Impacts
A site is allocated to a risk category based on two factors:

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

These two factors are combined at Step 2C to determine the risk of dust impacts from each type of construction activity, with no mitigation applied.

Step 2A: Potential Dust Emissions Magnitude
The dust emission magnitude is classified as small, medium or large. Examples of how the potential dust emission magnitude for each activity can be defined are shown in Table 1.

Table 14 Examples of How the Dust Emission Magnitude can be Defined

Class	Example
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 <20,000 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), 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
The sensitivity of the area takes account of:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10}, the local background concentrations; and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

The specific sensitivities of different types of receptor to dust soiling and PM_{10} are shown Table 15, Table 16 and Table 17. Professional judgement should be used to identify where on the spectrum of sensitivity a receptor lies, taking account of specific circumstances, i.e. the first occupants of residential units on a phased development may be expected to be less sensitive to dust soiling.

The sensitivity of the area is then determined from the specific sensitivities of the receptors using the matrices set out in Table 18, Table 19 and Table 20.

Professional judgement should be used to determine the final sensitivity of the area, taking account of:

- any history of dust generating activities in the area:
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between source and receptors;
- any conclusions drawn from analysing local meteorological data which accurately represents the area; and if relevant, the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any other known specific receptor sensitivities.

Step 2C: Define the Risk of Impacts
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 level of risk for each activity is determined using the matrix in Table 21.

Determine Site Specific Mitigation
The dust risk category determined at Step 2C has been used, along with the professional judgement of the consultant, to determine the appropriate level of mitigation at the site. The highly recommended and desirable mitigation measures set out in the London Plan SPG form the basis of the mitigation set out in Appendix 5.

The mitigation measures will inform an Air Quality and Dust Management Plan (AQDMP), which will be submitted to the local authority for approval prior to works commencing on-site.

The London Plan SPG is clear that the primary aim of the risk assessment is to identify site specific mitigation that, once adopted, will ensure that there will be no significant effect.

Table 15 Sensitivities of People to Dust Soiling

Class	Principles	Examples
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 property 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.

Table 16 Sensitivities of People to PM_{10}

Class	Principles	Examples
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.	Office and shop workers, but will generally not include workers occupationally exposed to PM10
Low	Locations where human exposure is transient.	Public footpaths, playing fields, parks and shopping streets.

Table 17 Sensitivities of Receptors to Ecological Effects

Class	Principles	Examples
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 (SAC) 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 (SSSI) with dust sensitive features.

Class	Principles	Examples
Low	Locations with a local designation where the features may be affected by dust deposition.	Local Nature Reserves with dust sensitive features.

Table 18 Sensitivity of the Area to Dust Soiling Effects on People and Property

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	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 19 Sensitivity of the Area to Human Health Effects

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

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
Low	-	>1	Low	Low	Low	Low	Low

Table 20 Sensitivity of the Area to Ecological Effects

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

Table 21 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

Appendix 2 – Modelling Methodology

Model Inputs

Traffic Data

AADT flows and vehicle fleet composition data have been provided by Robert West Consulting Ltd, with average traffic speeds derived from the 2013 data in the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016b). The traffic data are shown in Table 22 and the modelled road network is shown in Figure 3. Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by the DfT (DfT, 2017).

In order to allow for building effects on the dispersion of pollutants from the road sources, all of the roads have been modelled as street canyons using the ADMS Roads advanced street canyon option. The building heights have been derived using LIDAR data published by the Environment Agency. A summary of the street canyon model parameters are shown in Table 23.

Table 22 Summary of Traffic Data used in the Assessment a

Road	AADT		% HDV	Speed (km/h)
	2017	2020		
Stephenson Way	180	198	6.0	32
N Gower St S of Stephenson Way	708	736	1.5	32
Euston Rd W of N Gower St	59,949	61,525	2.7	22
Euston Rd E of N Gower St	55,853	57,321	3.1	12-19
N Gower St N of Stephenson Way	866	904	2.5	32

Table 23 Details of Street Canyon Model Inputs a

Road Link	Canyon Width (m)	Canyon Height (m)		
		Average	Min.	Max
Stephenson Way	9	15	15	15
N Gower St S of Stephenson Way	17	20	15	25
Euston Rd W of N Gower St	58	73	25	121
Euston Rd E of N Gower St	31-90	10-39	5-36	15-54
N Gower St N of Stephenson Way	17	14	12	15

a Euston Road east of North Gower Street has been modelled as six separate links.

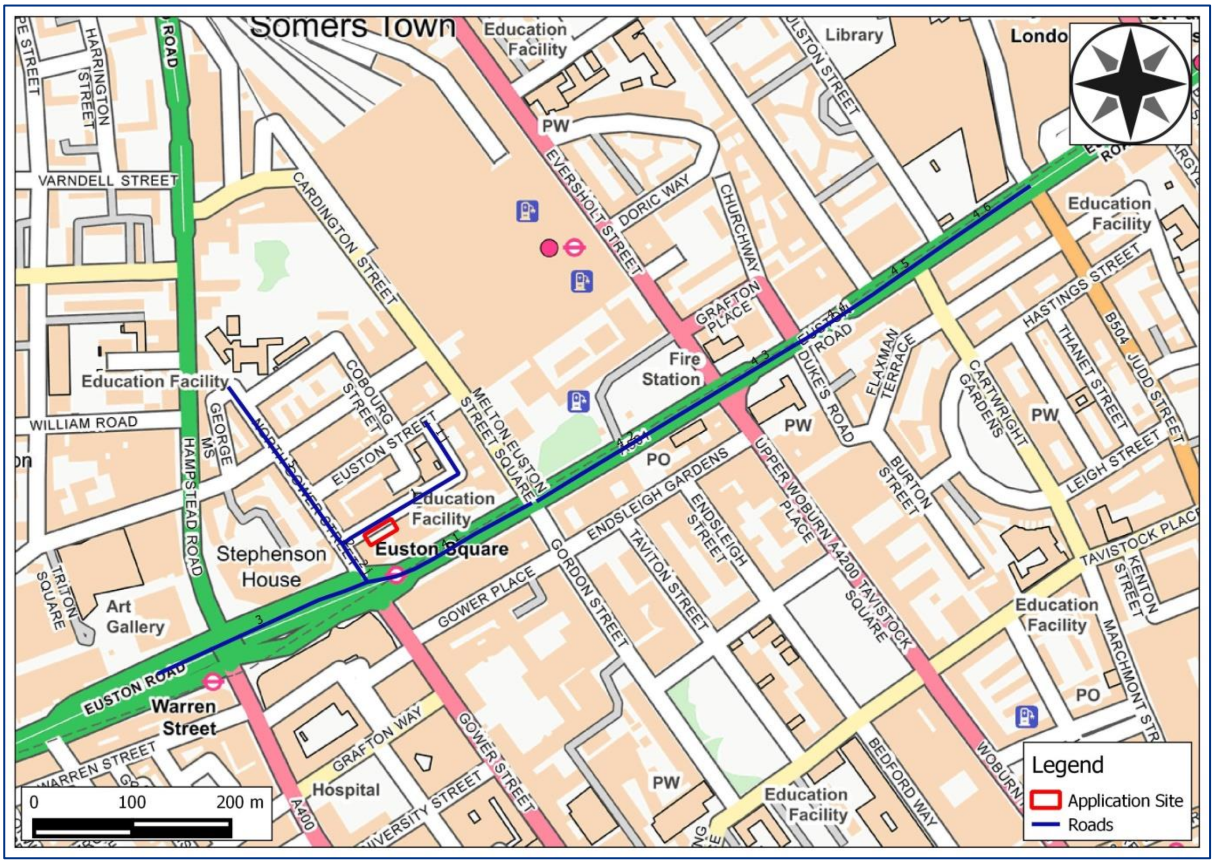

Figure 3 Modelled Roads

Contains Ordnance Survey data © Crown copyright and database right 2018

Emissions

Emissions have been calculated using the most recent version of the Emissions Factor Toolkit (EFT) v8.0.1 (Defra, 2018b). The traffic data were entered into the EFT in order to calculate a combined emission rate for each of the road links in the modelled network.

Meteorological Data

The model has been run using the full year of meteorological data that corresponds with the most recent set of nitrogen dioxide monitoring data (2017). The meteorological data has been taken from the monitoring station located at Heathrow Airport, which is considered suitable for the area.

Background Concentrations

Background concentrations have been derived from those published by Defra (Defra, 2018b). These cover the whole country on a 1 km by 1 km grid and are published for each year from 2015 to 2030. The current maps have been verified against measurements undertaken during 2015.

The background maps have been calibrated against measurements undertaken at the London Bloomsbury AURN monitoring site in 2017. A factor has been calculated by comparing the measured background concentrations at the AURN monitoring site with the predicted background concentration provided by Defra for the grid within which the monitor is located. The factor has then been applied to the Defra background data for the study area.

Table 24 Calibration of Background Data

Pollutant	OS Grid	Measured Concentration	Defra Concentration	Factor (Measured /Defra)
		2017	2020	
NO_x	530500,182500	61.4	75.6	0.81
NO_2		37.7	42.9	0.88
PM_{10}		18.5	20.9	0.89
$PM_{2.5}$		13.5	13.2	1.02

Verification

The verification process seeks to minimise uncertainties associated with the air quality model by comparing the model output with locally measured concentrations. The model has been verified against 2017 data from the automatic monitoring site located on Euston Road (as described in Table 3, and shown in Figure 2). The verification methodology is described below.

NO_2

Most 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 (NO_x = NO + NO_2). The model has been run to predict the 2017 annual mean NOx concentrations at the Euston Road automatic monitoring site.

The model output of road-NOx has been compared with the 'measured' road-NOx, calculated from the measured annual mean NO_2 concentrations and the background concentrations using the NOx from NO_2 calculator v6.1 published by Defra (Defra, 2018b).

An adjustment factor has been determined as the ratio of the 'measured' road-NOx contribution and the model derived road-NOx 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 background NO_2 concentrations within the NOx to NO_2 calculator.

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

- Measured NO_2 : 82.8 µg/m^3
- Background NO_2 : 38.6 µg/m^3
- 'Measured' road-NOx (from NOx from NO_2 calculator): 130.7 µg/m^3
- Modelled road-NOx = 69.4 µg/m^3
- Road-NOx adjustment factor: 130.7/69.4 = 1.883

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 $PM_{2.5}$

Data from the Euston Road automatic monitoring site have also been used to determine verification factors for PM_{10} and $PM_{2.5}$, as shown below:

- Measured PM_{10} : 20.3 µg/m^3
- Background PM_{10} : 18.4 µg/m^3
- Measured road-PM_{10} : 1.9 µg/m^3
- Modelled road-PM_{10} = 4.1 µg/m^3

- Road-PM_{10} adjustment factor: 1.9/4.1 = 0.4595

- Measured $PM_{2.5}$: 13.6 µg/m^3
- Background $PM_{2.5}$: 13.4 µg/m^3
- Measured road-$PM_{2.5}$: 0.1 µg/m^3
- Modelled road-$PM_{2.5}$ = 2.6 µg/m^3
- Road-PM_{10} adjustment factor: 0.1/2.6 = 0.0538

The factors imply that the model is over-predicting the road PM contribution; therefore, in order to provide a conservative assessment, no adjustment has been made to the modelled road output of PM.

Model Post-processing

NO_2

The NOx to NO_2 calculator v6.1 published by Defra (Defra, 2018b) has been used to convert the modelled, verified road-NOx output for each receptor to road-NO_2. The background NO_2 concentrations have then been added to the predicted road-NO_2 concentrations and adjusted using the secondary verification factor to give the final predicted concentrations.

PM_{10} and $PM_{2.5}$

The verified road-PM outputs need no further processing, and have been added to the background concentrations to give the final predicted concentrations.

Sensitivity Analysis

As described in Section 5.2, there is some uncertainty with regard to future reductions in road traffic NOx emissions used in the EFT and the background maps. Therefore a sensitivity analysis has been undertaken which assumes that there are no reductions in emission factors for road traffic from the baseline year.

The model inputs are as described above; however, emission factors from the verification year (2017) have been used with the future year traffic data to predict 'no emissions reduction' NO_2 concentrations.

The future year road traffic component of background NOx and NO_2 concentrations have also been held constant at the verification year (2017) level in order to calculate 'no emissions reduction' background concentrations. This has been done using the source-specific background nitrogen oxides maps provided by Defra (Defra, 2018a). For each grid square, the road traffic component has been held constant at 2017 levels, while 2020 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (Defra, 2018a) publishes to accompany the maps.

For PM, there is no strong evidence that Defra's predictions are unrealistic and so the year-specific mapped concentrations have been used.

The 'no emissions reduction' background concentrations, calibrated using data from the London Bloomsbury AURN, are shown in Table 25.

Table 25 Estimated Annual Mean 'No Emissions Reduction' Background Concentrations in 2020 (µg/m^3)

Year	NOx	NO_2
2020	58.5	37.0
Objective	-	40

Appendix 3 – Professional Experience

Chris Rush (Hoare Lea), BSc (Hons), MSc, PG Dip Acoustics, CEnv, MIOA, MIEMA, MIEnvSc, AMIAQM

Chris is an Associate Air Quality Consultant with Hoare Lea. He is a Chartered Environmentalist, a Member of the Institute of Acoustics, a Full Member of the Institute of Environmental Management and Assessment, a Member of the Institution of Environmental Sciences and an Associate Member of the Institute of Air Quality Management.

He has a diverse portfolio of experience and has worked on a range of projects from initial site feasibility, through planning and development to construction and operation. Chris's expertise covers planning, noise and air quality, specifically in relation to residential developments, industrial fixed installations such as waste management centres and transportation environmental impact on developments including air traffic. Chris is involved in the testing and assessment of the impact of indoor air quality and how building design contributes to this.

Andy Day (Hoare Lea), BSc (Hons), MSc, AMIEnvSc, AMIAQM

Andy is an Air Quality Consultant with Hoare Lea. He is an Associate Member of the Institute of Environmental Sciences and an Associate Member of the Institute of Air Quality Management. He is a chemistry graduate with a Master's specialising in the catalysed removal of harmful volatile organic compounds (VOCs) often generated from the combustion of fuel in car engines.

Andy provided input to the research for a scientific paper involving the use of catalysts prepared by a low NOx method for the complete removal of propane and naphthalene in lab based experiments. He has contributed to research as part of his degree into the causes and effects of poor outdoor air quality as well as exposure to poor indoor air quality.

Bob Thomas, BSc (Hons) PgDip MSc MIEnvSc MIAQM CSci

Bob Thomas is a Director at AQA, with over ten years' experience in the field of air quality management and assessment. He has carried out air quality assessments for a wide range of developments, including residential, commercial, industrial, minerals and waste developments. He has been responsible for air quality projects that include ambient air quality monitoring of nitrogen dioxide, dust and PM_{10}, the assessment of nuisance odours and dust, and the preparation of Review and Assessment reports for local authorities. He has extensive dispersion modelling experience for road traffic, energy centre and industrial sources, and has completed many stand-alone reports and chapters for inclusion within an Environmental Statement.

Bob has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers, architects and process operators, and has provided expert witness services at public inquiry. He is a Chartered Scientist, a Member of the Institute of Air Quality Management and a Member of the Institution of Environmental Sciences.

Appendix 4 – Air Quality Neutral

The methodology report that supports the GLA's SPG on Sustainable Design and Construction provides guidance on the application of the air quality neutral policy (AQC, 2014). The developments emissions are compared with the relevant emissions benchmarks to determine whether the development is air quality neutral.

Building Emissions

The building emissions benchmarks (BEB) are shown in Table 26.

Table 26 Building Emissions Benchmarks (BEB)

Land Use Class	BEB (g/m^2/annum [a])	
	NOx	PM_{10}
Class A1 (Retail)	22.6	1.29
Class A3 to Class A5 (Restaurants, drinking establishments, hot food takeaway)	75.2	4.32
Class A2 and Class B1 (Financial/professional services/business)	30.8	1.77
Class B2 to Class B7 (General industrial)	36.6	2.95
Class B8 (Storage and distribution)	23.6	1.9
Class C1 (Hotels)	70.9	4.07
Class C2 (Residential institutions)	68.5	5.97
Class C3 (Residential dwellings)	26.2	2.28
Class D1 (a) (Medical and health services)	43	2.47
Class D1 (b) (Crèche, day centres etc.)	75	4.3
Class D1 (c-h) (Schools, libraries etc.)	31	1.78
Class D2 (a-d) (Cinemas, concert halls etc.)	90.3	5.18
Class D2 (e) (Swimming pools, gymnasium etc.)	284	16.3

a The area refers to the Gross Internal Floor Area (GIFA)

The BEB for the development is calculated by multiplying the gross internal floor area of each land use class by the relevant BEB from Table 26, and summing the results.

The building related emissions (BRE) for each land use category are calculated using the:

- Gross internal floor area of the development (m^2);
- On-site emissions of NOx associated with building use (kg/annum), calculated from energy use (kWh/annum) using default (see Table A14) or site specific emission factors (kg/kWh); and
- On-site emissions of PM_{10} associated with oil or solid fuel use (kg/annum) calculated from energy use (kWh/annum) using default (see Table A14) or site specific emission factors (kg/kWh).

Table 27 Default Emission Factors for Buildings

Development	Gas (kg/kWh)	Oil (kg/kWh)	
	NOx	NOx	PM_{10}
Domestic	0.0000785	0.0003690	0.0000800
Industrial/Commercial	0.0001940	0.0003690	0.0000800

The NOx and PM_{10} emissions for each land use class are summed to give the total building emissions (TBE) for the development. If the TBE for the development are less than the BEB for the development, then the development building emissions are deemed to be air quality neutral.

Transport Emissions

The transport emissions benchmarks (TEB) are shown in Table 28.

Table 28 Transport Emissions Benchmarks (TEB)

Land use	TEB		
	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	1,553
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 and Outer London, as defined in the London Atmospheric Emissions Inventory (GLA, 2016b).

The TEB for the development is calculated by multiplying the number of dwellings or the gross internal floor area of each land use class by the relevant TEB from Table 28, and summing the results.

The transport related emissions (TRE) for each land use category are calculated using the:

- Gross internal floor area (m^2) of the development (A1-A5, B1), and/or the number of dwellings (C3, C4);
- Development trip rate (trips/m^2/annum or trips/dwelling/annum)
- Average distance travelled (km) for each land-use class (see Table 29);
- Average road traffic emissions of NOx and PM_{10} (see Table 30),

Table 29 Average Distance Travelled by Car per Trip

Land use	Distance (km)		
	CAZ [a]	Inner [b]	Outer [b]
Retail (A1)	9.3	5.9	5.4
Office (B1)	3	7.7	10.8
Residential (C3)	4.3	3.7	11.4

a Central Activity Zone.

b Inner and Outer London, as defined in the London Atmospheric Emissions Inventory (GLA, 2016b).

Table 30 Average Road Traffic Emission Factors

Pollutant	g/vehicle-km		
	CAZ [a]	Inner [b]	Outer [b]
NOx	0.4224	0.37	0.353
PM_{10}	0.0733	0.0665	0.0606

a Central Activity Zone.

b Inner and Outer London, as defined in the London Atmospheric Emissions Inventory (GLA, 2016b).

The NOx and PM_{10} emissions for each land use class are summed to give the total transport emissions (TTE) for the development. If the TTE for the development are less than the TEB for the development, then the development transport emissions are deemed to be Air Quality Neutral.

Appendix 5 – Construction Mitigation

The following is a set of measures that should be incorporated into the Air Quality and Dust Management Plan for the works:

Site Management
Develop a dust management plan;

- display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the site boundary;
- display the head or regional office contact information;
- Record and respond to all dust and air quality pollutant emissions complaints;
- make a complaints log available to the local authority when asked;
- carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked;
- increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions and dust are being carried out, and during prolonged dry or windy conditions; and
- record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and the action taken to resolve the situation in the log book.

Preparing and Maintaining the Site
- Plan the site layout: machinery and dust-causing activities should be located away from receptors;
- erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site;
- fully 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 from site as soon as possible; 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;
- Ensure all non-road mobile machinery (NRMM) comply with the standards set within the London Plan SPG on The Control of Dust and Emissions During Construction and Demolition;
- 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 possible; and
- implement a Travel Plan that supports and encourages sustainable 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 mitigation (using recycled water where possible);
- use enclosed chutes, conveyors and covered skips; and
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.

Waste Management
- Reuse and recycle waste to reduce dust from waste materials; and
- No bonfires and burning of waste materials.

Measures Specific to Demolition
- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust);
- ensure water suppression is used during demolition operations;
- avoid explosive blasting, using appropriate manual or mechanical alternatives; and
- bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Construction
- Avoid scabbling (roughening of concrete surfaces) if possible; and
- ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.

Measures Specific to Trackout
- Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site;
- avoid dry sweeping of large areas;
- ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport; and
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

CHRIS RUSH
ASSOCIATE

+44 161 672 7132
chrisrush@hoarelea.com

HOARELEA.COM

Royal Exchange
Manchester
M2 7FL
England