Air Quality
CONSULTANTS

Air Quality Assessment: Turing House School, Hospital Bridge Road, Whitton

September 2018

Experts in air quality
management & assessment

Document Control

Client	Bowmer and Kirkland Ltd	**Principal Contact**	Edwin Sutton

Job Number	J3327

Report Prepared By:	Samantha Barber and Pauline Jezequel

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J3327A/1/F2	26 September 2018	Final	Stephen Moorcroft (Director)

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
119 Marylebone Road, London NW1 5PU Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

Executive Summary

The air quality impacts associated with the proposed school at Hospital Bridge Road in Whitton, Richmond have been assessed. The development will consist of a secondary school (750 places) and sixth form (300 places) with associated internal and external sports facilities.

The impact of emissions arising from traffic on Hospital Bridge Road, and from the energy plant within the proposed development, have been assessed. The assessment has demonstrated that future users of the site will experience acceptable air quality.

The proposed development will generate additional traffic on the local road network. The assessment has shown that there will be no significant effect at any existing, sensitive receptor and the impacts will be negligible.

An assessment of the emissions from the boiler plant has demonstrated that the off-site impacts of these emissions will also be negligible. On-site, the emissions from the plant will not lead to exceedances of the air quality objectives at the school.

During the construction works, a range of best practice mitigation measures will be implemented to reduce dust emissions and the overall effect will be ‘not significant’; appropriate measures have been set out in this report, to be included in the Dust Management Plan for the works.

Overall, the construction and operational air quality effects of the proposed development are judged to be ‘not significant’.

The proposed development has also been shown to meet the London Plan’s requirement that new developments are at least ‘air quality neutral’.

Contents

1 Introduction 5
2 Policy Context and Assessment Criteria 6
3 Assessment Approach 17
4 Site Description and Baseline Conditions 27
5 Construction Phase Impact Assessment 34
6 Operational Phase Impact Assessment 39
7 'Air Quality Neutral' 45
8 Mitigation 47
9 Residual Impacts and Effects 49
10 Conclusions 50
11 References 51
12 Glossary 54
13 Appendices 57
A1 London-Specific Policies and Measures 58
A2 Construction Dust Assessment Procedure 62
A3 EPUK & IAQM Planning for Air Quality Guidance 69
A4 Professional Experience 76
A5 Modelling Methodology 77
A6 London Vehicle Fleet Projections 87
A7 Energy Plant Specification 89
A8 'Air Quality Neutral' 91
A9 Construction Mitigation 94

Tables

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$ 14
Table 2: Description of Receptor Locations 19
Table 3: Summary of Nitrogen Dioxide (NO_2) Monitoring (2013-2017) [a, b] 28
Table 4: Estimated Annual Mean Background Pollutant Concentrations in 2017 and 2020 ($\mu g/m^3$) 30
Table 5: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide ($\mu g/m^3$) at Existing Receptors 31
Table 6: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors ($\mu g/m^3$) 32
Table 7: Summary of Soil Characteristics 34
Table 8: Summary of Dust Emission Magnitude 35
Table 9: Summary of the Area Sensitivity 38

Table 10: Summary of Risk of Impacts Without Mitigation 38
Table 11: Predicted Maximum Process Contributions to Pollutant Concentrations associated with Energy Plant Emissions ($\mu g/m^3$) 39
Table 12: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2020 ($\mu g/m^3$) 40
Table 13: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2020 ($\mu g/m^3$) 41
Table 14: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2020 for New Receptors in the Development Site ($\mu g/m^3$) 43
Table 15: Calculation of Building Emissions Benchmark for the Development 45
Table 16: Calculation of Transport Benchmark Trip Rates for the Development 46

Table A2.1: Examples of How the Dust Emission Magnitude Class May be Defined ... 63
Table A2.2: Principles to be Used When Defining Receptor Sensitivities 65
Table A2.3: Sensitivity of the Area to Dust Soiling Effects on People and Property 66
Table A2.4: Sensitivity of the Area to Human Health Effects 67
Table A2.5: Sensitivity of the Area to Ecological Effects 67
Table A2.6: Defining the Risk of Dust Impacts 68
Table A3.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a] 74
Table A5.1: Summary of Traffic Data used in the Assessment (AADT Flows) 78
Table A5.2: Typical Gas Fuel Composition 81
Table A5.3: Plant Specifications and Modelled Emissions and Release Conditions 81
Table A5.4: Background Concentrations used in the Verification for 2017 83
Table A5.5: 2017 AADT Traffic Data used in the Model Verification 83
Table A7.1: Energy Plant Specification 89
Table A8.1: Building Emissions Benchmarks (g/m^2 of Gross Internal Floor Area) 92
Table A8.2: Transport Emissions Benchmarks 92
Table A8.3: Average Distance Travelled by Car per Trip 92
Table A8.4: Average Road Traffic Emission Factors in London in 2010 93
Table A8.5: Average Emissions from Heating and Cooling Plant in Buildings in London in 2010 93
Table A8.6: Average Number of Trips per Annum for Different Development Categories 93

Figures

Figure 1: Proposed Receptor Locations 20
Figure 2: Existing Receptor Locations 21

Figure 3: Monitoring Locations 29
Figure 4: 20 m Distance Band around Site Boundary 36
Figure 5: 20 m Distance Band around Roads Used by Construction Traffic Within 200 m of the Site Exit 37

Figure A5.1: Modelled Road Network & Speeds 79
Figure A5.2: Flue Location & Modelled Buildings 82
Figure A5.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%. 84
Figure A5.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%. 85

1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed school at Hospital Bridge Road in Whitton, Richmond. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Bowmer and Kirkland Ltd.

1.2 The proposed development consists of the construction of a secondary school (750 places) and sixth form (300 places) with associated internal and external sports facilities. It lies within a borough-wide Air Quality Management Area (AQMA) declared by the London Borough (LB) of Richmond upon Thames for exceedances of the annual mean nitrogen dioxide (NO_2) and particulate matter (PM_{10}) objectives, as well as the 24-hour mean PM_{10} objective. The development will lead to changes in vehicle flows on local roads, which may impact on air quality at existing residential properties. Occupants of the school will also be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to road traffic emissions are nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.3 The proposals for the development include boiler plant ("energy plant"), the emissions from which could impact upon air quality at existing residential properties, as well as future occupants of the development itself. The main air pollutant of concern related to gas-fired boiler plant is nitrogen dioxide.

1.4 The Greater London Authority's (GLA's) London Plan (GLA, 2016a) requires new developments to be air quality neutral. The air quality neutrality of the proposed development has, therefore, been assessed following the methodology provided in the Greater London Authority's (GLA's) Supplementary Planning Guidance (SPG) on Sustainable Design and Construction (GLA, 2014a).

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

1.6 This report describes existing local air quality conditions (base year 2017), and the predicted air quality in the future assuming that the proposed development does, or does not proceed. The assessment of traffic-related impacts focuses on 2020, which is the anticipated year of opening. The assessment of construction dust impacts focuses on the anticipated duration of the works.

1.7 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 (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework 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.

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018

2.2 The legislation sets emission limits to be applied from December 2018 for new plant and from 2025 or 2030 for existing plant (depending on the rated input). In addition to addressing emissions from plant with a rated input of 1 to 50 MW_{th}, as required by the MCPD, the amendment also introduces emission limits on all generator plant <1 MW_{th}. Generators whose sole purpose is maintaining power supply at a site during an on-site emergency, that are operated for the purpose of testing/maintenance for no more than 50 hours per year, will be exempt from the emission limits, but will be required to apply for an exemption with the regulating authority.

2.3 The energy plant within the proposed development will not require a permit under these regulations, as the thermal input rate is below the 1 MW threshold.

Clean Air Act 1993 & Environmental Protection Act

2.4 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993 (1993). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement. The local authority's approval will, therefore, be required for the plant to be installed in the proposed development.

2.5 Measures to ensure adequate dispersion of emissions from discharging stacks and vents are included in Technical Guidance Note D1 (Dispersion) (1993), issued in support of the Environmental Protection Act (1990).

Draft Clean Air Strategy 2018

2.6 Defra launched a consultation on a new Clean Air Strategy (Defra, 2018a) in May 2018. The draft strategy sets out a wide range of actions by which the UK Government, in partnership with the Governments of Scotland, Wales and Northern Ireland, will seek to reduce pollutant emissions and improve air quality. Actions are targeted at four main sources of emissions: Transport, Domestic, Farming and Industry. Responses to the consultation will be used to inform the final UK Clean Air Strategy and detailed National Air Pollution Control Programme to be published by March 2019.

Reducing Emissions from Road Transport: Road to Zero Strategy

2.7 The Office for Low Emission Vehicles (OLEV) and Department for Transport (DfT) published a Policy Paper (DfT, 2018) in July 2018 outlining how the government will support the transition to zero tailpipe emission road transport and reduce tailpipe emissions from conventional vehicles during the transition. This paper affirms the Government's pledge to end the sale of new conventional petrol and diesel cars and vans by 2040, and states that the Government expects the majority of new cars and vans sold to be 100% zero tailpipe emission and all new cars and vans to have significant zero tailpipe emission capability by this year, and that by 2050 almost every car and van should have zero tailpipe emissions. It states that the Government wants to see at least 50%, and as many as 70%, of new car sales, and up to 40% of new van sales, being ultra-low emission by 2030.

2.8 The paper sets out a number of measures by which Government will support this transition, but is clear that Government expects this transition to be industry and consumer led. If these ambitions are realised then road traffic-related NOx emissions can be expected to reduce significantly over the coming decades, likely beyond the scale of reductions forecast in the tools utilised in carrying out this air quality assessment.

Planning Policy

National Policies

2.9 The National Planning Policy Framework (NPPF) (2018) sets out planning policy for England. It states that the purpose of the planning system is to contribute to the achievement of sustainable development, and that the planning system has three overarching objectives, one of which is an environmental objective:

"to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy".

2.10 To prevent unacceptable risks from air pollution, the NPPF states that:

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

and

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

2.11 More specifically on air quality, the NPPF makes clear that:

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

2.12 The NPPF is supported by Planning Practice Guidance (PPG) (DCLG, 2018), 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"*.

2.13 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".

2.14 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportionate 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".*

London-Specific Policies

The London Plan

2.15 The London Plan (GLA, 2016a) sets out the spatial development strategy for London consolidated with alterations made to the original plan since 2011. It brings together all relevant strategies, including those relating to air quality.

2.16 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.

2.17 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.

2.18 Consultation on a draft new London Plan (GLA, 2017) closed on 2 March 2018, with an examination in public to follow. The current timescale is that the new London Plan will be adopted in Autumn 2019. However, the draft London Plan is a material consideration in planning decisions, which will gain more weight as it moves through the process to adoption. Policy SI1 on 'Improving Air Quality' states that "*London's air quality should be significantly improved and exposure to poor air quality, especially for vulnerable people, should be reduced*". It goes on to detail that development proposals should not:

- *"lead to further deterioration of existing poor air quality*
- *create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits*
- *reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality*

- *create unacceptable risk of high levels of exposure to poor air quality".*

2.19 It also states that "*the development of large-scale redevelopment areas, such as Opportunity Areas and those subject to an Environmental Impact Assessment should propose methods of achieving an Air Quality Positive approach through the new development. All other developments should be at least Air Quality Neutral*".

London Environment Strategy

2.20 The London Environment Strategy was published in May 2018 (GLA, 2018a). The strategy considers air quality in Chapter 4; the Mayor's main objective is to create a *"zero emission London by 2050".* Policy 4.2.1 aims to *"reduce emissions from London's road transport network by phasing out fossil fuelled vehicles, prioritising action on diesel, and enabling Londoners to switch to more sustainable forms of transport".* An implementation plan for the strategy has also been published which sets out what the Mayor will do between 2018 and 2023 to help achieve the ambitions in the strategy.

Mayor's Transport Strategy

2.21 The Mayor's Transport Strategy (GLA, 2018b) sets out the Mayor's policies and proposals to reshape transport in London over the next two decades. The Strategy focuses on reducing car dependency and increasing active sustainable travel, with the aim of improving air quality and creating healthier streets. It notes that development proposals should *"be designed so that walking and cycling are the most appealing choices for getting around locally".*

The Mayor's Air Quality Strategy

2.22 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 Low Emission Zones (LEZs) are described in Appendix A1.

GLA SPG: Sustainable Design and Construction

2.23 The GLA's SPG on Sustainable Design and Construction (GLA, 2014a) provides details on delivering some of the priorities in the London Plan. Section 4.3 covers Air Pollution. It defines when developers will be required to submit an air quality assessment, explains how location and transport measures can minimise emissions to air, and provides emission standards for gas-fired boilers, Combined Heat and Power (CHP) and biomass plant. It also sets out, for the first time, guidance on how Policy 7.14B(c) of the London Plan relating to 'air quality neutral' (see Paragraph 2.17, above) should be implemented.

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

2.24 The GLA's SPG on The Control of Dust and Emissions During Construction and Demolition (GLA, 2014b) outlines a risk assessment based approach to considering the potential for dust generation from a construction site, and sets out what mitigation measures should be implemented to minimise the risk of construction dust impacts, dependent on the outcomes of the risk assessment. This guidance is largely based on the Institute of Air Quality Management's (IAQM's) guidance (IAQM, 2016), and it states that "*the latest version of the IAQM Guidance should be used*".

Air Quality Focus Areas

2.25 The GLA has identified 187 air quality Focus Areas in London. These are locations that not only exceed the EU annual mean limit value for nitrogen dioxide, but also have high levels of human exposure. They do not represent an exhaustive list of London's air quality hotspot locations, but locations where the GLA believes the problem to be most acute. They are also areas where the GLA considers there to be the most potential for air quality improvements and are, therefore, where the GLA and Transport for London (TfL) will focus actions to improve air quality. The proposed development is not located close to any of the air quality Focus Areas.

Local Policies

2.26 The LB of Richmond upon Thames Local Plan (London Borough of Richmond upon Thames, 2018b) was adopted in July 2018, and sets out the Council's detailed policies and guidance for development within the Borough for the next 15 years. Policy LP10 relates to local environmental impacts, pollution and land contamination and states:

"Local Environmental Impacts, Pollution and Land Contamination

A. The Council will seek to ensure that the local environmental impacts of all development proposals do not lead to detrimental effects on the health, safety and the amenity of existing and new users or occupiers of the development site, or the surrounding land. These potential impacts can include, but are not limited to, air pollution, noise and vibration, light pollution, odours and fumes, solar glare and solar dazzle as well as land contamination.

Developers should follow any guidance provided by the Council on local environmental impacts and pollution as well as on noise generating and noise sensitive development. Where necessary, the Council will set planning conditions to reduce local environmental impacts on adjacent land uses to acceptable levels.

Air Quality

B. The Council promotes good air quality design and new technologies. Developers should secure at least 'Emissions Neutral' development. To consider the impact of introducing new developments in areas already subject to poor air quality, the following will be required:

1. an air quality impact assessment, including where necessary, modelled data;

2. mitigation measures to reduce the development's impact upon air quality, including the type of equipment installed, thermal insulation and ducting abatement technology;

3. measures to protect the occupiers of new developments from existing sources;

4. strict mitigation for developments to be used by sensitive receptors such as schools, hospitals and care homes in areas of existing poor air quality; this also applies to proposals close to developments used by sensitive receptors…

Construction and demolition

G. The Council will seek to manage and limit environmental disturbances during construction and demolition as well as during excavations and construction of basements and subterranean developments. To deliver this the Council requires the submission of Construction Management Statements (CMS) for the following types of developments:

1. all major developments;

2. any basement and subterranean developments;

3. developments of sites in confined locations or near sensitive receptors; or

4. if sustainable demolition/excavation works are proposed.

Where applicable and considered necessary, the Council may seek a bespoke charge specific to the proposal to cover the cost of monitoring the CMS."

Air Quality Action Plans

National Air Quality Plan

2.27 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017a). Alongside a package of national measures, the Plan requires those English Local Authorities (or the GLA in the case of London Authorities) that are predicted to have exceedances of the limit values beyond 2020 to produce local action plans by December 2018. These plans are undertaken in stages (the initial Stage of which was to be completed by the end of March 2018) and must have measures to achieve the statutory limit values within the shortest possible time, which may include the implementation of a Clean Air Zone (CAZ). There is currently no practical way to take account of the effects of the national Plan in the modelling undertaken for this assessment; however, consideration has been given to whether there is currently, or is likely to be in the future, a limit value exceedance in the vicinity of the proposed development. This assessment has principally been carried out in relation to the air quality objectives, rather than the EU limit values that are the focus of the Air Quality Plan.

Local Air Quality Action Plan

2.28 In December 2000, the LB of Richmond upon Thames declared an AQMA for nitrogen dioxide and particulate matter (PM_{10}) that covers the whole Borough. The Council has since developed a new Air Quality Action Plan (London Borough of Richmond upon Thames, 2017). This sets out a suite of measures to improve air quality within the Borough over the period from 2017 to 2022.

Assessment Criteria

2.29 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) and the Air Quality (England) (Amendment) Regulations (2002).

2.30 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 at roadside locations where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2018b). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour PM_{10} objective could be exceeded at roadside locations where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2018b). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.31 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, 2018b). 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.

2.32 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$ (The European Parliament and the Council of the European Union, 2008). The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one. In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.

2.33 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 [a]
Fine Particles ($PM_{2.5}$) [b]	Annual Mean	25 µg/m^3

[a] A proxy value of 32 µg/m^3 as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedances of the 24-hour mean PM_{10} objective are possible (Defra, 2018b).

[b] 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

2.34 There are no formal assessment criteria for dust. In the absence of formal criteria, the approach developed by the Institute of Air Quality Management (IAQM)[1] (2016) has been used (the GLA's SPG (GLA, 2014b) recommends that the assessment be based on the latest version of the IAQM guidance). Full details of this approach are provided in Appendix A2.

Screening Criteria for Road Traffic Assessments

2.35 EPUK and IAQM recommend a two-stage screening approach (Moorcroft and Barrowcliffe et al, 2017) to determine whether emissions from road traffic generated by a development have the potential for significant air quality impacts. The approach, as described in Appendix A3, first considers the size and parking provision of a development; if the development is residential and is for fewer than ten homes or covers less than 0.5 ha, or is non-residential and will provide less than 1,000 m^2 of floor space or cover a site area of less than 1 ha, and will provide ten or fewer parking spaces, then there is no need to progress to a detailed assessment. The second stage then

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

compares the changes in vehicle flows on local roads that a development will lead to against specified screening criteria. Where these criteria are exceeded, a detailed assessment is required, although the guidance advises that *"the criteria provided are precautionary and should be treated as indicative"*, and *"it may be appropriate to amend them on the basis of professional judgement"*.

Screening Criteria for Point Source Assessments

2.36 EPUK and IAQM have developed an approach (Moorcroft and Barrowcliffe et al, 2017) to determine whether emissions from point sources, such as energy plant, have the potential for significant air quality impacts. The first step of the approach, as described in Appendix A3, is to screen the emissions and the emissions parameters to determine whether an assessment is necessary:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

2.37 This screening approach requires professional judgement, and the experience of the consultants preparing the assessment is set out in Appendix A4.

2.38 If it is determined that an assessment of the point source emissions is required then there is a further stage of screening that can be applied to the model outputs. The approach is that any change in concentration smaller than 0.5% of the long-term environmental standard will be *negligible*, regardless of the existing air quality conditions. Any change smaller than 1.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 94% of the standard and any change smaller than 5.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 75% of the standard. The guidance also explains that:

"Where peak short term concentrations (those averaged over periods of an hour or less) from an elevated source are in the range 11-20% of the relevant Air Quality Assessment Level (AQAL), then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. In most cases, the assessment of

impact severity for a proposed development will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impacts. The severity of the impact will be substantial when there is a risk that the relevant AQAL for short-term concentrations is approached through the presence of the new source, taking into account the contribution of other local sources".

2.39 As a first step, the assessment of the emissions from the energy plant within the proposed development has considered the predicted process contributions using the following criteria:

- is the long-term (annual mean) process contribution less than 0.5% of the long-term environmental standard?; and
- is the short-term (24-hour mean or shorter) process contribution less than 10% of the short-term environmental standard?

2.40 Where both of these criteria are met, then the impacts are *negligible* and thus 'not significant'. Where these criteria are breached then a more detailed assessment, considering total concentrations (incorporating local baseline conditions), has been provided.

Descriptors for Air Quality Impacts and Assessment of Significance

Construction Dust Significance

2.41 Guidance from IAQM (2016) is that, with appropriate mitigation in place, the effects of construction dust will be 'not significant'. This is the latest version of the guidance upon which the assessment methodology set out in the GLA guidance (GLA, 2014b) is based (the GLA guidance advises that the latest version of the IAQM guidance should always be used). The assessment thus focuses on determining the appropriate level of mitigation so as to ensure that effects will normally be 'not significant'.

Operational Significance

2.42 There is no official guidance in the UK in relation to development control on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A3. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A4.

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, 2018c). 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. Background concentrations have been defined using the national pollution maps published by Defra (2018d). These cover the whole of the UK on a 1x1 km grid.

3.3 Exceedances of the annual mean EU limit value for nitrogen dioxide in the study area have been identified using the maps of roadside concentrations published by Defra (2017b) as part of its 2017 Air Quality Plan for the baseline year 2015 and for the future years 2017 to 2030, as well as from any nearby Automatic Urban and Rural Network (AURN) monitoring sites (which operate to EU data quality standards). These maps are used by the UK Government, together with the AURN results, to report exceedances of the limit value to the EU. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations (Defra, 2018e), which are available for the years 2009 to 2015, show no exceedances of the limit values anywhere in the UK in 2015.

Construction Impacts

3.4 The construction dust assessment considers the potential for impacts within 350 m of the site boundary; or within 50 m of roads used by construction vehicles. The assessment methodology follows the GLA's SPG on the Control of Dust and Emissions During Construction and Demolition (GLA, 2014b), which is based on that provided by IAQM (2016). This follows a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant impacts. Appendix A2 explains the approach in more detail.

Road Traffic Impacts

Screening

3.5 The first step in considering the road traffic impacts of the proposed development has been to screen the development and its traffic generation against the criteria set out in the EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017), as described in Paragraph 2.35 and detailed further in Appendix A3. Where impacts can be screened out there is no need to progress to a more detailed assessment. The following sections describe the approach to dispersion modelling of road traffic emissions, which has been required for this project.

Sensitive Locations

3.6 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations both within, and close to, the proposed development. Receptors have been selected to represent the worst-case locations. At the proposed development, this corresponds to the façades of the school building closest to the sources. With regards to existing 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, and close to those roads where the traffic increases as a result of the proposed development will be greatest. Attention has also been paid to selecting receptors at locations where the impacts of the energy plant emissions are likely to be greatest, to ensure that the combined effects of road traffic and energy plant emissions are considered.

3.7 Thirteen existing residential properties have been identified as receptors for the assessment. Four additional receptor locations have been identified within the new school, which represent exposure to existing and proposed sources. These locations are described in Table 2 and shown in Figure 1 and Figure 2. In addition, concentrations have been modelled at the diffusion tube monitoring sites located along Hanworth Road and A316 Lincoln Avenue (sites 12 and 57 respectively), in order to verify the model outputs (see Appendix A5 for verification method).

Table 2: Description of Receptor Locations

Receptor	Description
	Existing receptors [a]
Receptor 1	Residential property at 223 Hospital Bridge Road
Receptor 2	Residential property at 50 Evelyn Close
Receptor 3	Residential property at 97 Montrose Avenue
Receptor 4	Residential property at 221 Hospital Bridge Road
Receptor 5	Residential property at 1 Springfield Road
Receptor 6	Residential property at 177 Hospital Bridge Road
Receptor 7	Residential property at 101 Hospital Bridge Road
Receptor 8	Residential property at 8 Powder Mill Lane
Receptor 9	Residential property at 2 Crane Park Road
Receptor 10	Residential property at 5 Crane Park Road
Receptor 11	Residential property at 68 Glebe Way
Receptor 12	Residential property at 2 Willow Way
Receptor 13	Residential property at 62 Hospital Bridge Road
	Proposed receptors [b]
Receptors A to D	Façade of main school building

[a] Receptors modelled at a height of 1.5 m.

[b] Receptors modelled at heights of 1.5 m, 5.2 m and 8.9 m to represent ground, first and second floor levels of the main school building.

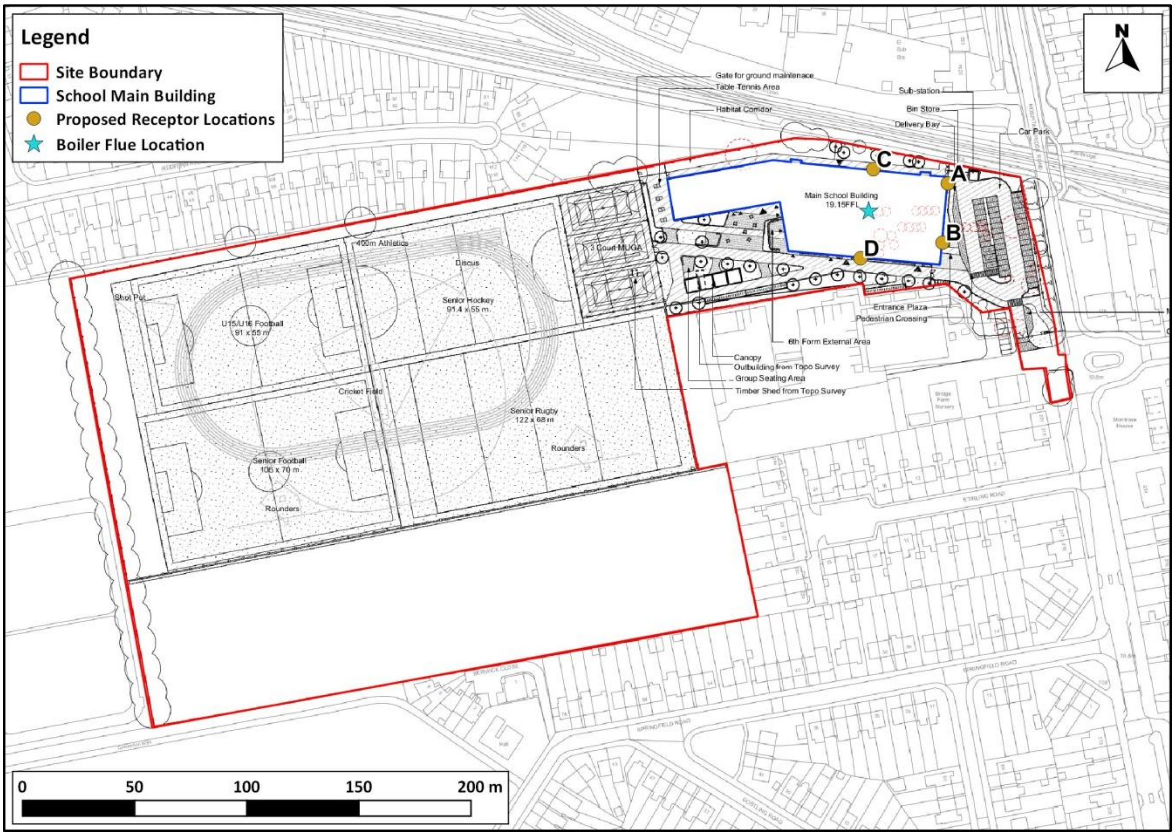

Figure 1: Proposed Receptor Locations

Contains data from Ares Landscape Architects LTD drawing no. EFATH-ALA-00-XX-DR-L-0001.

Figure 2: Existing Receptor Locations

Imagery ©2018 Google, Map data ©2018 Google.

Modelling Methodology

3.8 Concentrations have been predicted using the ADMS-Roads dispersion model, with vehicle emissions derived using Defra's latest Emission Factor Toolkit (EFT) (v8.0.1) (Defra, 2018d). Details of the model inputs, assumptions and the verification are provided in Appendix A5, together with the method used to derive base and future year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Assessment Scenarios

3.9 Nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been predicted for a base year (2017) and the proposed year of opening (2020). For 2020, predictions have been made assuming both that the development does proceed (With Scheme), and does not proceed (Without Scheme).

3.10 In addition to the set of 'official' predictions (those from Defra's EFT), a sensitivity test has been carried out for nitrogen dioxide that involves assuming higher nitrogen oxides emissions from some diesel vehicles than have been predicted by Defra, using AQC's Calculator Using Realistic Emissions for Diesels (CURED v3A) tool (AQC, 2017).

Traffic Data

3.11 Traffic data for the assessment have been provided by Robert West, who have undertaken the Transport Assessment for the proposed development. Further details of the traffic data used in this assessment are provided in Appendix A5.

Uncertainty

3.12 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion 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 models are required to simplify real-world conditions into a series of algorithms.

3.13 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A5). This can only be done for the road traffic model. Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of base year (2017) concentrations.

3.14 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.

3.15 European type approval ('Euro') standards for vehicle emissions apply to all new vehicles manufactured for sale in Europe. These standards have, over many years, become progressively more stringent and this is one of the factors that has driven reductions in both predicted and measured pollutant concentrations over time.

3.16 Historically, the emissions tests used for type approval were carried out within laboratories and were quite simplistic. They were thus insufficiently representative of emissions when driving in the real world. For a time, this resulted in a discrepancy, whereby nitrogen oxides emissions from new diesel vehicles reduced over time when measured within the laboratory, but did not fall in the real world. This, in turn, led to a discrepancy between models (which predicted improvements in nitrogen dioxide concentrations over time) and measurements (which very often showed no improvements year-on-year).

3.17 Recognition of these discrepancies has led to changes to the type approval process. Vehicles are now tested using a more complex laboratory drive cycle and also through 'Real Driving Emissions' (RDE) testing, which involves driving on real roads while measuring exhaust emissions. For Heavy Duty Vehicles (HDVs), the new testing regime has worked very well and NOx emissions from the latest vehicles (Euro VI[2]) are now very low when compared with those from older models (ICCT, 2017).

3.18 For Light Duty Vehicles (LDVs), while the latest (Euro 6) emission standard has been in place since 2015, the new type-approval testing regime only came into force in 2017. Despite this delay, earlier work by AQC (2016) showed that Euro 6 diesel cars manufactured prior to 2017 tend to emit significantly less NOx than previous (Euro 5 and earlier) models. Given the changes to the testing regime, it is reasonable to expect that diesel cars and vans registered for type approval since 2017 will, on average, generate even lower NOx emissions.

3.19 As well as reviewing information on the emissions from modern diesel vehicles in the real world (AQC, 2016), AQC has also reviewed the assumptions contained within Defra's latest EFT (v8.0.1) (AQC, 2018a). One point of note is that the EFT makes a range of assumptions, which appear to be very conservative, regarding the continued use of diesel cars into the future and the relatively slow uptake of non-conventional (e.g. electric) vehicles (AQC, 2018a). Thus, despite previous versions of Defra's EFT being over-optimistic regarding future-year predictions, it is not unreasonable to consider that EFT v8.0.1 might under-state the scale of reductions over coming years (i.e. over-predict future-year traffic emissions).

3.20 Overall, it is considered that, for assessment years prior to 2020, the EFT provides a robust method of calculating emissions. While there is still some uncertainty regarding any predictions of

[2] Euro VI refers to HDVs while Euro 6 refers to LDVs.

what will occur in the future, there are no obvious reasons to expect predictions made using the EFT to under-predict concentrations in the future up to and including 2019.

3.21 For assessment years beyond 2020, EFT v8.0.1 makes additional assumptions regarding the expected performance of diesel cars and vans registered for type approval beyond this date, reflecting further planned changes to the type approval testing. While there is currently no reason to disbelieve these assumptions, it is sensible to consider the possibility that this future-year technology might be less effective than has been assumed. A sensitivity test has thus been carried out using AQC's CURED v3A model (AQC, 2017), which assumes that this, post-2020, technology does not deliver any benefits. Further details of CURED v3A are provided in a supporting report prepared by AQC (2018a). CURED v3A is considered to provide a worst-case assessment.

3.22 It is also worth noting that the fleet projections incorporated within the EFT do not appear to reflect the Government's ambitions as set out in the Road to Zero Strategy (see Paragraphs 2.7 and 2.8), predicting a relatively low proportion of zero tailpipe emission vehicles in years up to and including 2030. If the Government's ambitions relating to the uptake of zero tailpipe emission vehicles are realised then the EFT's emissions projections for NOx are likely to be overly-conservative for the latter part of the 2020s, if not the entire decade.

3.23 The Mayor of London confirmed in June 2018 that changes will be made to the existing LEZ in 2020, and that the forthcoming Ultra Low Emission Zone (ULEZ), to be implemented in 2019, will be expanded in 2021. The changes are described in detail in Appendix A1, and can be expected to significantly reduce NOx emissions in London from 2020 onwards; however, they are not reflected in Defra's latest EFT, or the CURED model, and thus have not been considered in this assessment. The assessment presented in this report is, therefore, very much worst-case, and it is expected that background concentrations, baseline concentrations, and the impacts of the proposed development, will be lower than described in Sections 4 and 6 of this report. Appendix A6 discusses uncertainties regarding the future fleet mix in London and the scale of the reduction in NOx emissions that can be expected with the adoption of these changes.

Impacts of the Proposed Energy Plant

3.24 The proposed development will be provided with heat and hot water using two condensing natural-gas fired boilers (referred to as "energy plant") to be located in the top floor plantroom in the centre of the building. The assumed specification for this plant, upon which the assessment is based, is set out in Appendices A5 and A7.

Screening

3.25 The first step in considering the energy plant impacts has been to screen the pollutant emissions against the criteria set out in the EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017), as described in Paragraphs 2.36 and 2.37. Where plant impacts cannot be screened out against these criteria, a further stage of screening is required, whereby the modelled contributions of the plant are compared to further screening criteria, as described in Paragraphs 2.38 to 2.40. Where impacts can be screened out there is no need to progress to a more detailed assessment. The following sections describe the approach to dispersion modelling of the plant emissions, which has been required for this project.

Sensitive Locations

3.26 In terms of the potential impacts from the proposed energy plant, concentrations have initially been modelled for a 1 km x 1 km gridded area covering both on-site and off-site receptors for the year 2020. This has then allowed specific receptors to be determined at the worst-case locations where impacts of the energy plant emissions are predicted to be greatest.

Assessment Scenarios

3.27 Predictions of nitrogen dioxide concentrations have been carried out assuming that the energy plant is installed in 2020.

Modelling Methodology

3.28 The impacts of emissions from the proposed energy plant have been modelled using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model input parameters are set out in Appendix A5. The air quality modelling has been carried out based on a number of necessary assumptions, detailed further in Appendices A5 and A7. Where possible a realistic worst-case approach has been adopted.

3.29 Entrainment of the plume into the wake of buildings has been simulated within the model. ADMS-5 takes a relatively simplistic approach to modelling building downwash effects, thus additional uncertainty is introduced when using the buildings module. In order to ensure a worst-case assessment, sensitivity tests have been carried out whereby the model has been run with no buildings and with the main school building within the development. The maximum predicted concentration from either of these scenarios has been used throughout this assessment.

Emissions Data

3.30 The emissions data input into the model for the energy plant have been provided by Couch Perry Wilkes, who are the mechanical and engineering consultants for the proposed development. Further details of the emissions data used in this assessment are provided in Appendix A5.

3.31 For consideration of concentrations in relation to both the long-term and short-term objectives, the worst-case assumption has been made that the boilers will run continuously and at full (100%) load. This will have led to an over-prediction in modelled concentrations.

Uncertainty

3.32 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which in reality are variable as the plant will operate at different loads at different times. The actual plant to be installed within the development will also not be confirmed until the proposed development is definitely going ahead, and thus could be different to that assumed for this assessment. The assessment has, however, addressed this by applying worst-case assumptions where necessary, and provided that the actual plant installed adheres to the restrictions set out in Appendix A7, the conclusions of this assessment will remain valid.

3.33 There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified and it is not possible to verify the point-source model outputs. Where parameters have been estimated the approach has been to use reasonable worst-case assumptions (see Appendices A5 and A7). Sensitivity tests have also been applied to address specific uncertainties and to ensure a worst-case assessment.

‘Air Quality Neutral’

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

3.35 Appendix A8 sets out the emissions benchmarks. The approach has been to calculate the emissions from the development and to compare them with these benchmarks.

4 Site Description and Baseline Conditions

4.1 The proposed development site is located approximately 650 m to the west of Whitton Railway Station and is adjacent to Sempervirens Nursery, a garden and landscaping supplies centre. It currently consists of grassland associated to the adjacent nursery business. The site is located along Hospital Bridge Road and is bounded to the north by a railway line. There are existing residential properties to the north, east and south of the proposed development, and to the west is Borough Cemetery.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2018c) has not identified any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality.

Air Quality Management Areas

4.3 The LB of Richmond upon Thames has investigated air quality within its area as part of its responsibilities under the LAQM regime. In December 2000 a borough-wide AQMA was declared for exceedances of the nitrogen dioxide and particulate matter (PM_{10}) objectives. By definition, the proposed development lies within this AQMA.

Local Air Quality Monitoring

4.4 The LB of Richmond upon Thames operates four automatic monitoring stations within its area, including one mobile air quality monitoring unit, however, none of these are in close proximity to the proposed development. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Gradko International Ltd (using the 50% TEA in acetone method). These include several deployed within a 1 km radius of the proposed development. Results for 2013 to 2017 are summarised in Table 3 and the monitoring locations are shown in Figure 3.

Table 3: Summary of Nitrogen Dioxide (NO_2) Monitoring (2013-2017) [a, b]

Site No.	Site Type	Location	2013	2014	2015	2016	2017
Diffusion Tubes - Annual Mean (µg/m^3)							
11	Kerbside	Percy Road, Whitton (near Percy Way)	**49**	**48**	**44**	**48**	**47**
12	Kerbside	Hanworth Road, Whitton	**49**	**46**	**41**	**45**	**41**
57	Kerbside	A316 (Lincoln Avenue)	39	36	33	**44**	**42**
63	Kerbside	High Street, Whitton	**43**	**42**	38	**41**	38
Objective			**40**				

a Exceedances of the objectives are shown in bold.

b Data have been taken from the LB of Richmond upon Thames 2018 Annual Status Report (London Borough of Richmond upon Thames, 2018a).

4.5 There are no clear trends in monitoring results for the past five years. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards (the implications of this are discussed in Section 3 of this report). During this period, concentrations have been continuously exceeded at all monitoring locations, except for site 57 in 2013, 2014 and 2015, and site 63 in 2015 and 2017. The monitoring results show that concentrations are above or close to the annual mean nitrogen dioxide objective and indicate that the objective is likely to be exceeded at kerbside locations within the study area.

Figure 3: Monitoring Locations

Imagery ©2018 Google, Map data ©2018 Google.

4.6 No monitoring of PM_{10} or $PM_{2.5}$ concentrations is undertaken in close proximity to the proposed development site.

Exceedances of EU Limit Value

4.7 There are several AURN monitoring sites within the Greater London Urban Area that have measured exceedances of the annual mean nitrogen dioxide limit value. Furthermore, Defra's roadside annual mean nitrogen dioxide concentrations (Defra, 2017b), which are used to report exceedances of the limit value to the EU, and which have been updated to support the 2017 Air Quality Plan, identify exceedances of this limit value in 2015 along many roads in London, including the A316 Great Chertsey Road and A316 Chertsey Road near 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. Defra's predicted concentrations for 2020, presented for three scenarios ('baseline', 'with CAZs' and 'with CAZs and additional actions' – the latter two taking account of the measures contained in its 2017 Air Quality Plan (Defra, 2017a)), also identify continued exceedances of the limit value along the A316 Great Chertsey Road and A316 Chertsey Road. It is worth noting, however, that these roads carry significantly more traffic than Hospital Bridge Road adjacent to the development site. Whilst predicted concentrations along Hospital Bridge Road are unavailable due to this road link not being included within Defra's mapped network, it is anticipated that concentrations will be similar to those along Hanworth Road which is to the west of the development site. Concentrations along Hanworth Road are below the limit value in all three scenarios. As such, there is considered to be no risk of a limit value exceedance in the vicinity of the proposed development by the time that it is operational.

4.8 Defra's Air Quality Plan requires the GLA to prepare an action plan that will *"deliver compliance in the shortest time possible"*, and the 2015 Plan assumed that a CAZ was required. The GLA has already implemented an LEZ and an emissions surcharge, and a ULEZ comes into force in April 2019, thus the authority will have effectively implemented the required CAZ in 2019. These have been implemented as part of a package of measures including 12 Low Emission Bus Zones, Low Emission Neighbourhoods, the phasing out of diesel buses and taxis and other measures within the Mayors Transport Strategy.

Background Concentrations

4.9 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for 2017 and the opening year 2020 using Defra's background maps (Defra, 2018d). The background concentrations are set out in Table 4 and have been derived as described in Appendix A5. The background concentrations are all well below the objectives.

Table 4: Estimated Annual Mean Background Pollutant Concentrations in 2017 and 2020 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2017	21.9 - 23.1	14.9 – 15.4	9.7 – 10.0
2020 [a]	19.5 – 20.4	14.5 – 15.0	9.4 – 9.6
2020 Worst-case Sensitivity Test [b]	*19.6 – 20.6*	*N/A*	*N/A*
Objectives	**40**	**40**	**25 [c]**

N/A = not applicable. The range of values is for the different 1x1 km grid squares covering the study area.

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from future diesel cars and vans as described in Paragraph A5.5 in Appendix A5.

[c] 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.

Baseline Dispersion Model Results

4.10 Baseline concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the existing receptor locations (see Figure 1 and Table 2 for receptor locations). The results, which cover both the existing (2017) and future year (2020) baseline (Without Scheme), are set out in Table 5 and Table 6. The predictions for nitrogen dioxide include a sensitivity test which accounts for the potential under-performance of emissions control technology on future diesel cars and vans. In addition, the modelled road components of nitrogen oxides, PM_{10} and $PM_{2.5}$ have been increased from those predicted by the model based on a comparison with local measurements (see Appendix A5 for the verification methodology).

Table 5: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (µg/m^3) at Existing Receptors

Receptor	2017	2020 Without Scheme	
		'Official' Prediction [a]	*Worst-case Sensitivity Test* [b]
Receptor 1	23.6	20.9	21.1
Receptor 2	25.6	22.5	22.7
Receptor 3	25.1	22.1	22.3
Receptor 4	24.2	21.3	21.5
Receptor 5	24.7	21.8	22.0
Receptor 6	24.3	21.5	21.7
Receptor 7	26.6	23.4	23.6
Receptor 8	25.6	22.5	22.8
Receptor 9	28.9	25.2	25.5
Receptor 10	30.6	26.7	27.0
Receptor 11	38.7	34.0	34.4
Receptor 12	26.6	23.4	23.6
Receptor 13	27.8	24.4	24.7
Objective	**40**		

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from future diesel cars and vans as described in Paragraph A5.5 in Appendix A5.

Table 6: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors ($\mu g/m^3$)

Receptor	PM_{10} [a]		$PM_{2.5}$	
	2017	2020 Without Scheme	2017	2020 Without Scheme
Receptor 1	15.2	14.8	9.9	9.5
Receptor 2	15.5	15.1	10.1	9.7
Receptor 3	15.4	15.0	10.0	9.6
Receptor 4	15.3	14.9	9.9	9.6
Receptor 5	15.3	14.9	10.0	9.6
Receptor 6	15.3	14.9	9.9	9.6
Receptor 7	15.6	15.2	10.1	9.7
Receptor 8	15.5	15.1	10.1	9.7
Receptor 9	16.3	15.9	10.5	10.1
Receptor 10	16.6	16.2	10.7	10.3
Receptor 11	18.9	18.4	12.1	11.6
Receptor 12	16.0	15.6	10.4	10.0
Receptor 13	16.3	15.9	10.5	10.1
Objective / Criterion	32 [a]		25 [b]	

[a] While the annual mean PM_{10} objective is 40 $\mu g/m^3$, 32 $\mu g/m^3$ is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2018b). A value of 32 $\mu g/m^3$ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[b] 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.

2017 Baseline

4.11 The predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are below the respective objectives in 2017 at all receptors. The annual mean PM_{10} concentrations are below 32 $\mu g/m^3$ and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

2020 Baseline

4.12 The predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are well below the respective objectives in 2020 at all receptors. The annual mean PM_{10} concentrations are below 32 $\mu g/m^3$ and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

Worst-case Sensitivity Test for Nitrogen Dioxide

4.13 The results from the upper-bound sensitivity test are not materially different from those derived using the ‘official’ predictions; with annual mean concentrations of nitrogen dioxide predicted to be well below the objective in 2020 at all receptors.

5 Construction Phase Impact Assessment

5.1 The construction works will give rise to a risk of dust impacts during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway. Step 1 of the assessment procedure is to screen the need for a detailed assessment. There are receptors within the distances set out in the guidance (see Appendix A2), thus a detailed assessment is required. The following section sets out Step 2 of the assessment procedure.

Potential Dust Emission Magnitude

Demolition

5.2 There is no requirement for demolition on site.

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, 2018), as set out in Table 7. Overall, it is considered that, when dry, this soil has the potential to be moderately dusty.

Table 7: Summary of Soil Characteristics

Category	Record
Soil Layer Thickness	Deep
Soil Parent Material Grain Size	Mixed (Arenaceous [a] – Rudaceous [b])
European Soil Bureau Description	River Terrace Sand/Gravel
Soil Group	Light (Sandy) to Medium (Sandy)
Soil Texture	Sand to Sandy Loam [c]

[a] grain size 0.06 – 2.0 mm.

[b] grain size > 2.0 mm.

[c] a loam is composed mostly of sand and silt.

5.4 The site covers some 9,500 m^2 and most of this will be subject to earthworks. The earthworks will last around 20 weeks and dust will arise mainly from vehicles travelling over unpaved ground and from the handling of dusty materials (such as dry soil). Based on the example definitions set out in Table A2.1 in Appendix A2, the dust emission class for earthworks is considered to be *medium*.

Construction

5.5 The school building will be constructed using brick cladding, with a total building volume of around 29,600 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 a 61-

week period. Based on the example definitions set out in Table A2.1 in Appendix A2, the dust emission class for construction is considered to be *medium*.

Trackout

5.6 The number of heavy vehicles accessing the site, which may track out dust and dirt, is estimated to be a maximum of 20 per day. Based on the example definitions set out in Table A2.1 in Appendix A2, the dust emission class for trackout is considered to be *medium*.

5.7 Table 8 summarises the dust emission magnitude for the proposed development.

Table 8: Summary of Dust Emission Magnitude

Source	Dust Emission Magnitude
Demolition	None
Earthworks	Medium
Construction	Medium
Trackout	Medium

Sensitivity of the Area

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

Sensitivity of the Area to Effects from Dust Soiling

5.9 The IAQM guidance, upon which the GLA's guidance is based, explains that residential properties are 'high' sensitivity receptors to dust soiling (Table A2.2 in Appendix A2). There are between 30 and 60 residential properties within 20 m of the site (see Figure 4). Using the matrix set out in Table A2.3 in Appendix A2, the area surrounding the onsite works is of 'high' sensitivity to dust soiling.

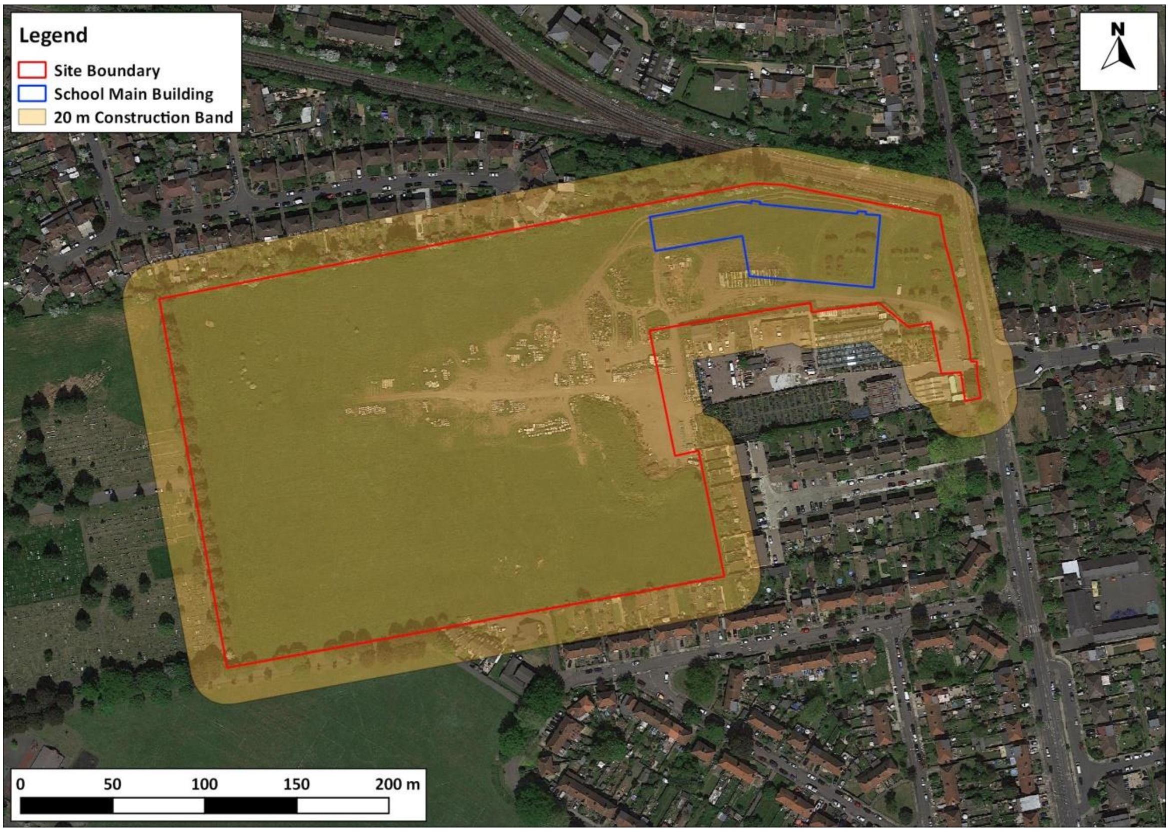

Figure 4: 20 m Distance Band around Site Boundary

Imagery ©2018 Google, Map data ©2018 Google.

5.10 Table 8 shows that the dust emission magnitude for trackout is *medium* and Table A2.3 in Appendix A2 thus explains that there is a risk of material being tracked 200 m from the site exit. It has been assumed that all construction related traffic will travel along Hospital Bridge Road. There are between 40 and 50 residential properties within 20 m of the roads along which material could be tracked (see Figure 5), and Table A2.3 in Appendix A2 thus indicates that the area is of 'high' sensitivity to dust soiling due to trackout.

Figure 5: 20 m Distance Band around Roads Used by Construction Traffic Within 200 m of the Site Exit

Imagery ©2018 Google, Map data ©2018 Google.

Sensitivity of the Area to any Human Health Effects

5.11 Residential properties are also classified as being of 'high' sensitivity to human health effects. The matrix in Table A2.4 in Appendix A2 requires information on the baseline annual mean PM_{10} concentration in the area. The maximum predicted existing baseline PM_{10} concentration at these receptors is 18.9 µg/m^3 (Table 6), and this value has been used. Using the matrix in Table A2.4 in Appendix A2, the areas surrounding the onsite works and the roads along which material may be tracked from the site are of 'low' sensitivity to human health effects.

Sensitivity of the Area to any Ecological Effects

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

Summary of the Area Sensitivity

5.13 Table 9 summarises the sensitivity of the area around the proposed construction works.

Table 9: 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	Low Sensitivity	Low Sensitivity

Risk and Significance

5.14 The dust emission magnitudes in Table 8 have been combined with the sensitivities of the area in Table 9 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 10. These risk categories have been used to determine the appropriate level of mitigation as set out in Section 8 (step 3 of the assessment procedure).

Table 10: Summary of Risk of Impacts Without Mitigation

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

5.15 The IAQM guidance 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 be ‘not significant’ (IAQM, 2016).

6 Operational Phase Impact Assessment

Impacts at Existing Receptors

Initial Screening Assessment of Development-Generated Road Traffic Emissions

6.1 The trip generation of the proposed development on local roads (as provided by Robert West) has initially been compared to the screening criteria set out in the EPUK/IAQM guidance (Moorcroft and Barrowcliffe et al, 2017) (see Paragraphs A3.7 to A3.10 in Appendix A3). The proposed development will increase Annual Average Daily Traffic (AADT) flows by more than 100 LDVs vehicles (the screening threshold for inside an AQMA) along Hospital Bridge Road, Montrose Avenue, Powder Mill Lane and A316 Great Chertsey Road, thus a detailed assessment is required.

Initial Screening Assessment of Energy Plant Emissions

6.2 The calculated total NOx emission rate from the energy plant (16.36 mg/s of NOx in total) exceeds the screening threshold of 5 mg/s set out in the EPUK/IAQM guidance (see Paragraph A3.11 in Appendix A3). As such, dispersion modelling has been undertaken. Further details of the energy plant emissions are provided in Appendices A5 and A7.

6.3 The maximum predicted nitrogen dioxide contributions at existing receptors associated with emissions from the energy plant, taking into account the sensitivity test, are shown in Table 11.

Table 11: Predicted Maximum Process Contributions to Pollutant Concentrations associated with Energy Plant Emissions (μg/m^3)

Pollutant/Averaging Period	Maximum Process Contribution		Objective
	μg/m^3	% of Objective	
Annual Mean NO_2	1.67	4.2	**40**
99.79th %ile of 1-hour NO_2	4.50	2.3	**200**

6.4 These predicted maximum concentrations can be compared with the EPUK/IAQM screening criteria, as previously described in Section 2, and the following conclusions can be drawn:

- the predicted maximum annual mean nitrogen dioxide concentration (4.2% of the objective) is above the screening criterion (0.5%); and
- the predicted maximum 99.79th percentile of 1-hour mean nitrogen dioxide concentrations (2.3% of the objective) is below the screening criterion (10%).

6.5 The predicted impacts exceed the screening criterion for annual mean nitrogen dioxide concentrations, and thus require further detailed assessment. No further assessment is required for 1-hour mean nitrogen dioxide concentrations.

Combined Detailed Assessment of Development-Generated Road Traffic and Energy Plant Emissions

6.6 Predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ at existing receptors are presented in Table 12 and Table 13 for both the "Without Scheme" and "With Scheme" scenarios. The concentrations presented include the impacts of local traffic sources and the assumed worst-case emissions associated with plant provision for the site. Concentrations have been calculated following the methodology set out in Section 3 and in Appendix A5.

Table 12: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2020 (µg/m³)

Receptor	Without Scheme [a]	With Scheme [a]	% Change [a,b]	Impact Descriptor [a]	*Worst-case Sensitivity Test [c]*			
					Without Scheme	*With Scheme*	*% Change [b]*	*Impact Descriptor*
Receptor 1	20.9	21.4	1	Negligible	21.1	21.6	1	*Negligible*
Receptor 2	22.5	22.9	1	Negligible	22.7	23.1	1	*Negligible*
Receptor 3	22.1	22.4	1	Negligible	22.3	22.7	1	*Negligible*
Receptor 4	21.3	21.6	1	Negligible	21.5	21.8	1	*Negligible*
Receptor 5	21.8	21.9	0	Negligible	22.0	22.1	0	*Negligible*
Receptor 6	21.5	21.5	0	Negligible	21.7	21.7	0	*Negligible*
Receptor 7	23.4	23.5	0	Negligible	23.6	23.7	0	*Negligible*
Receptor 8	22.5	22.6	0	Negligible	22.8	22.9	0	*Negligible*
Receptor 9	25.2	25.4	0	Negligible	25.5	25.6	0	*Negligible*
Receptor 10	26.7	26.8	0	Negligible	27.0	27.1	0	*Negligible*
Receptor 11	34.0	34.1	0	Negligible	34.4	34.5	0	*Negligible*
Receptor 12	23.4	23.4	0	Negligible	23.6	23.7	0	*Negligible*
Receptor 13	24.4	24.5	0	Negligible	24.7	24.8	0	*Negligible*
Objective	**40**		**-**	**-**	***40***		**-**	**-**

[a] In line with Defra's forecasts.

[b] % changes are relative to the objective and have been rounded to the nearest whole number.

[c] Assuming higher emissions from future diesel cars and vans as described in Paragraph A5.5 in Appendix A5.

Table 13: Predicted Impacts on Annual Mean PM_{10} and $PM_{2.5}$ Concentrations in 2020 ($\mu g/m^3$)

Receptor	Annual Mean PM_{10} ($\mu g/m^3$)				Annual Mean $PM_{2.5}$ ($\mu g/m^3$)			
	Without Scheme	With Scheme	% Change [a]	Impact Descriptor	Without Scheme	With Scheme	% Change [a]	Impact Descriptor
Receptor 1	14.8	14.8	0	Negligible	9.5	9.5	0	Negligible
Receptor 2	15.1	15.1	0	Negligible	9.7	9.7	0	Negligible
Receptor 3	15.0	15.0	0	Negligible	9.6	9.7	0	Negligible
Receptor 4	14.9	14.9	0	Negligible	9.6	9.6	0	Negligible
Receptor 5	14.9	14.9	0	Negligible	9.6	9.6	0	Negligible
Receptor 6	14.9	14.9	0	Negligible	9.6	9.6	0	Negligible
Receptor 7	15.2	15.2	0	Negligible	9.7	9.8	0	Negligible
Receptor 8	15.1	15.1	0	Negligible	9.7	9.7	0	Negligible
Receptor 9	15.9	15.9	0	Negligible	10.1	10.1	0	Negligible
Receptor 10	16.2	16.2	0	Negligible	10.3	10.3	0	Negligible
Receptor 11	18.4	18.4	0	Negligible	11.6	11.6	0	Negligible
Receptor 12	15.6	15.6	0	Negligible	10.0	10.0	0	Negligible
Receptor 13	15.9	15.9	0	Negligible	10.1	10.1	0	Negligible
Criterion	32 [b]		-	-	25 [c]		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 $\mu g/m^3$, 32 $\mu g/m^3$ is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2018b). A value of 32 $\mu g/m^3$ is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[c] 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.

Nitrogen Dioxide

6.7 The annual mean nitrogen dioxide concentrations are below the objective at all receptors, with or without the proposed development.

6.8 The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 1% at Receptors 1 to 4, and zero at all remaining receptors. Using the matrix in Table A3.1 (Appendix A3), these impacts are described as *negligible*.

Worst-case Sensitivity Test

6.9 The results from the sensitivity test show are not materially different from those derived using the 'official' predictions and these impacts are also described as *negligible*.

6.10 The changes to the LEZ and ULEZ described in Paragraphs A1.4 and A1.6, which the Mayor of London has confirmed are to be implemented, will result in significant reductions in NOx emissions across London. It has not, however, been possible to account for these in this assessment. Consequentially, both sets of results for nitrogen dioxide presented in Table 12 are likely to represent a significant over-prediction both in terms of total concentrations and impact magnitude (see Paragraph 3.23 and Appendix A6).

PM_{10} and $PM_{2.5}$

6.11 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the annual mean criteria at all receptors, with or without the proposed development. Furthermore, as the annual mean PM_{10} concentrations are below 32 $\mu g/m^3$, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors.

6.12 The percentage changes in both PM_{10} and $PM_{2.5}$ concentrations, relative to the applied annual mean criteria (when rounded), are predicted to be zero at all of the receptors. Using the matrix in Table A3.1 (Appendix A3), these impacts are described as *negligible.*

Impacts of Existing Sources on Future Occupants of the Development

Initial Screening Assessment of Traffic Emissions

6.13 The proposed development is located within an AQMA (see Section 4), thus a detailed assessment is required.

Initial Screening Assessment of Plant Emissions

6.14 As previously discussed in Paragraph 6.2, the calculated total NOx emission rate from the energy plant (16.36 mg/s of NOx in total) exceeds the screening thresholds set out in the EPUK/IAQM guidance (see Paragraph A3.11 in Appendix A3). As such, dispersion modelling has been undertaken. Initial model contours show the maximum plant contribution impacts to occur at the facades of the main school building; concentrations at these locations will thus be the highest across the development site. Further details of the energy plant emissions are provided in Appendices A5 and A7.

Detailed Assessment of Air Quality at Receptors Within the Development

6.15 Predicted air quality conditions for future occupants of the proposed development, taking account of emissions from both the adjacent road network and the energy plant within the proposed development, are set out in Table 14 for Receptors A to D (see Table 2 and Figure 1 for receptor locations). All of the values at the worst-case locations assessed are well below the objectives; air quality for future occupants across the whole site will thus be acceptable.

Table 14: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2020 for New Receptors in the Development Site (µg/m^3)

Floor Level	Receptor	Annual Mean NO_2		99.79th %ile of Hourly Mean NO_2 [c]	Annual Mean PM_{10}	Annual Mean $PM_{2.5}$
		'Official' Prediction [a]	*Worst-case Sensitivity Test* [b]			
Ground (1.5 m)	Receptor A	20.4	*20.6*	43.3	14.7	9.5
	Receptor B	20.3	*20.5*	43.1	14.7	9.4
	Receptor C	20.1	*20.2*	43.0	14.6	9.4
	Receptor D	20.0	*20.2*	42.8	14.6	9.4
First (5.2 m)	Receptor A	20.3	*20.4*	43.0	14.7	9.4
	Receptor B	20.2	*20.4*	42.9	14.7	9.4
	Receptor C	20.0	*20.2*	42.9	14.6	9.4
	Receptor D	20.0	*20.1*	42.8	14.6	9.4
Second (8.9 m)	Receptor A	20.0	*20.2*	43.5	14.6	9.4
	Receptor B	20.0	*20.2*	43.7	14.6	9.4
	Receptor C	19.9	*20.1*	44.7	14.6	9.4
	Receptor D	19.9	*20.1*	44.4	14.6	9.4
Objective / Criterion		40		200	32 [d]	25 [e]

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from future diesel cars and vans as described in Paragraph A5.5 in Appendix A5.

[c] Calculated by adding the 99.79th percentile of 1-hour mean nitrogen dioxide process contributions from the energy plant to two times the predicted annual mean concentration at each receptor (including the contribution of road traffic emissions), which is common practice. The annual mean concentration predicted using the worst-case sensitivity test has been used, which is worst-case.

[d] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2018b). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

[e] 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.

6.16 The changes to the LEZ and ULEZ described in Paragraphs A1.4 and A1.6, which the Mayor of London has confirmed are to be implemented, will result in significant reductions in NOx emissions across London. It has not, however, been possible to account for these in this assessment.

Consequentially, both sets of results for nitrogen dioxide presented in Table 14 are likely to represent a significant over-prediction both in terms of total concentrations and impact magnitude (see Paragraph 3.23 and Appendix A6).

Significance of Operational Air Quality Effects

6.17 The operational air quality effects without mitigation are judged to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A3, and also takes into account the results of the worst-case sensitivity test for nitrogen dioxide. Future year concentrations are expected to lie between the two sets of results, but in order to provide a reasonable worst-case assessment, the judgement of significance focuses primarily on the results from the sensitivity test.

6.18 More specifically, the judgement that the air quality effects will be 'not significant' without mitigation takes account of the assessment that:

- pollutant concentrations at worst-case locations within the proposed development will all be below the objectives, thus future occupants will experience acceptable air quality; and
- pollutant concentrations at all of the selected worst-case existing receptors along the local road network, taking into account impacts from the proposed energy plant within the development, will be well below the air quality objectives; all of the impacts are predicted to be *negligible*.

7 'Air Quality Neutral'

7.1 The purpose of the London Plan's requirement that development proposals be 'air quality neutral' is to prevent the gradual deterioration of air quality throughout Greater London. The 'air quality neutrality' of a proposed development, as assessed in this section, does not directly indicate the potential of the proposed development to have significant impacts on human health (this has been assessed separately in the previous section).

Building Emissions

7.2 The installed plant will be required to meet the emission standards set out in the Sustainable Design and Construction SPG (GLA, 2014a). Gas-fired boiler plant must achieve an emission rate of <40 mg/kWh.

7.3 Couch Perry Wilkes has confirmed that the total annual energy demand (thermal) of the development is anticipated to be around 700,000 kWh. This level of usage has been calculated to generate a total annual NOx emission of 28.0 kg.

7.4 Appendix A8 shows the Building Emissions Benchmarks (BEBs) for each land use category. Table 15 shows the calculation of the BEBs for this development.

Table 15: Calculation of Building Emissions Benchmark for the Development

Description		Value	Reference
A	**Gross Internal Floor Area of D1 School (m^2)**	8,225	Bowmer and Kirkland Ltd
B	**NOx BEB for D1 School (g/m^2/annum)**	43.0	Table A8.1
Total BEB NOx Emissions (kg/annum)		**353.7**	(A x B) / 1000

7.5 The Total Building NOx Emission of 28.0 kg/annum is less than Total BEB NOx Emission of 353.7 kg/annum. The proposed development is thus better than air quality neutral in terms of building emissions.

Road Transport Emissions

7.6 The Transport Emissions Benchmarks (TEBs) are based on the number of car trips generated by different land-use classes, together with the associated trip lengths and vehicle emission rates. However, the guidance (AQC, 2014) only provides trip lengths and emission rates for A1, B1 and C3 uses, thus a TEB cannot be calculated for the proposed school development. The guidance does provide an alternative methodology, based on trip rates only, and this has been followed in considering the air quality neutrality of the proposed development in terms of transport emissions.

7.7 Table A8.6 in Appendix A8 provides default trip rates for different development categories. This information has been used to calculate a benchmark trip rate for the proposed development in Table 16. This has then been compared with the actual trip rate of the development.

Table 16: Calculation of Transport Benchmark Trip Rates for the Development

Description		Value	Reference
School (D1)			
A	**Gross Internal Floor Area (m^2)**	8,225	Bowmer and Kirkland Ltd
B	**Benchmark Trip Rate (trips/m^2/annum)**	46.1	Table A8.6
C	**Benchmark Trip Rate (trips/annum)**	**379,173**	A x B

7.8 Robert West has advised that the total development trip rate in the opening year of 2020 will be 102,800 vehicles per annum. The total development trip rate is expected to decrease with time, thus the worst-case value has been taken; the Total Transport Trip Rate is less than the Total Transport Trip Rate Benchmark and thus the proposed development is better than air quality neutral in terms of transport emissions.

8 Mitigation

Mitigation Included by Design

8.1 The EPUK/IAQM guidance advises that good design and best practice measures should be considered, whether or not more specific mitigation is required. The proposed development incorporates the following good design and best practice measures:

- adoption of a Construction Management System (CMS) to minimise the environmental impacts of the construction works;
- setting back of the development buildings from roads by at least 40 m;
- provision of a detailed travel plan setting out measures to encourage sustainable means of transport (public, cycling and walking);
- use of photovoltaic (PV) systems to reduce the demand for on-site combustion;
- installation of low NOx boilers, with emission rates below 40 mg/kWh, meeting the requirements of the Sustainable Design and Construction SPG (GLA, 2014a);
- running of the boiler flue to 1 m above roof level to ensure the best possible dispersion environment; and
- use of exhaust flues for the boilers that discharge vertically upwards, unimpeded by any fixture on top of the stack (e.g. rain cowls), meeting the requirements of the Sustainable Design and Construction SPG (GLA, 2014a).

Recommended Mitigation

Construction Impacts

8.2 Measures to mitigate dust emissions will be required during the construction phase of the development in order to minimise effects upon nearby sensitive receptors.

8.3 The site has been identified as a *Medium* Risk site during earthworks, construction and trackout, as set out in Table 10. The GLA's SPG on *The Control of Dust and Emissions During Construction and Demolition* (GLA, 2014b) describes measures that should be employed, as appropriate, to reduce the impacts, along with guidance on what monitoring should be undertaken during the construction phase. This reflects best practice experience and has been used, together with the professional experience of the consultant who has undertaken the dust impact assessment and the findings of the assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in Appendix A9.

8.4 The mitigation measures should be written into a dust management plan (DMP). The GLA's guidance suggests that, for a Medium Risk site, automatic monitoring of particulate matter (as PM_{10}) may be required. It also states that, on certain sites, it may be appropriate to determine the existing (baseline) pollution levels before work begins. However, the guidance is clear that the Local Authority should advise as to the appropriate air quality monitoring procedure and timescale on a case-by-case basis.

8.5 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

8.6 The assessment has demonstrated that the proposed development will not cause any exceedances of the air quality objectives and that the overall effect of the proposed development will be 'not significant'. It is, therefore, not considered appropriate to propose further mitigation measures for this development.

8.7 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 (which is written into UK law). The local air quality plan that the GLA is required to produce in order to address limit value exceedances in its area will also help to improve air quality. The Council's Air Quality Action Plan will also be helping to deliver improved air quality.

Energy Plant

8.8 The assessment has demonstrated that the emissions from the energy plant within the proposed development will have an insignificant impact on air quality at existing nearby properties, and will not lead to any objective exceedances within the development itself. As such, there is no requirement for mitigation beyond the best practice design measures highlighted above. The energy plant installed within the development should, however, meet the specification set out in Appendix A7; if the installed plant does not conform to this specification, additional assessment and/or mitigation may be required.

9 Residual Impacts and Effects

Construction

9.1 The IAQM guidance, on which the GLA's guidance is based, is clear that, with appropriate mitigation in place, the residual effects will normally be 'not significant'. The mitigation measures set out in Section 8 and Appendix A9 are based on the GLA guidance. With these measures in place and effectively implemented the residual effects are judged to be 'not significant'.

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

Energy Plant Impacts

9.3 The residual impacts will be the same as those identified in Section 6. The overall effects of the proposed development will be 'not significant'.

Road Traffic Impacts

9.4 The residual impacts will be the same as those identified in Section 6. The overall effects of the proposed development will be 'not significant'.

10 Conclusions

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

10.2 The proposed development will increase traffic on local roads and will also include energy plant. Concentrations have been modelled for thirteen worst-case receptors, representing existing properties where impacts associated with emissions from these sources are expected to be greatest. In the case of nitrogen dioxide, a sensitivity test has also been carried out which considers the potential under-performance of emissions control technology on future diesel cars and vans. The assessment has shown that the impacts will be negligible and there will be no significant effect.

10.3 Future air quality for occupants of the development has also been assessed, taking into account emissions from existing sources as well as the proposed energy plant. Concentrations will be below the relevant objectives and thus the effects will be 'not significant'.

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

10.5 The proposed development will have no adverse effects on local air quality conditions, and does not introduce new exposure within an area of poor air quality, thus no additional mitigation has been proposed for the operational impacts. The proposed development is consistent with the NPPF. Furthermore, the proposed development does not conflict with the requirements of Policy LP10 of the Local Plan, nor does it conflict with, or render unworkable, any elements of the Air Quality Action Plan. The proposed development is also air quality neutral and is thus compliant with Policy 7.14 of the London Plan.

11 References

AQC (2014) *Air Quality Neutral Planning Support Update: GLA 80371*, Available: http://www.aqconsultants.co.uk/getattachment/Resources/Download-Reports/GLA-AQ-Neutral-Policy-Final-Report-April-2014.pdf.aspx.

AQC (2016) *Emissions of Nitrogen Oxides from Modern Diesel Vehicles*, Available: http://www.aqconsultants.co.uk/getattachment/Resources/Download-Reports/Emissions-of-Nitrogen-Oxides-from-Modern-Diesel-Vehicles-210116.pdf.aspx.

AQC (2017) *CURED v3A*, [Online], Available: http://www.aqconsultants.co.uk/Resources/Download-Reports.aspx.

AQC (2018a) *Development of the CURED v3A Emissions Model*, [Online], Available: http://www.aqconsultants.co.uk/Resources/Download-Reports.aspx.

AQC (2018b) *Calibrating Defra's 2015-based Background NOx and NO2 Maps against 2016 and 2017 Measurements*, Available: http://www.aqconsultants.co.uk/AQC/media/Reports/Background-Calibration-News-F2.pdf.

AQC (2018c) *Adjusting Background NO2 Maps for CURED v3A*, [Online], Available: http://www.aqconsultants.co.uk/Resources/Download-Reports.aspx.

British Geological Survey (2018) *UK Soil Observatory Map Viewer*, [Online], Available: http://mapapps2.bgs.ac.uk/ukso/home.html.

Clean Air Act 1993 (1993), HMSO, Available: http://www.legislation.gov.uk/ukpga/1993/11/contents.

DCLG (2018) *Planning Practice Guidance*, [Online], Available: http://planningguidance.planningportal.gov.uk/blog/guidance/.

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

Defra (2017a) *Air quality plan for nitrogen dioxide (NO2) in the UK*, Available: https://www.gov.uk/government/publications/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2017.

Defra (2017b) *2017 NO2 projections data (2015 reference year)*, Available: https://uk-air.defra.gov.uk/library/no2ten/2017-no2-projections-from-2015-data.

Defra (2018a) *Clean Air Strategy 2018 (Draft)*, Available: https://consult.defra.gov.uk/environmental-quality/clean-air-strategy-consultation/.

Defra (2018b) *Review & Assessment: Technical Guidance LAQM.TG16 February 2018 Version*, Defra, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf.

Defra (2018c) *UK Pollutant Release and Transfer Register*, [Online], Available: http://prtr.defra.gov.uk/map-search.

Defra (2018d) *Local Air Quality Management (LAQM) Support Website*, [Online], Available: http://laqm.defra.gov.uk/.

Defra (2018e) *UK Ambient Air Quality Interactive Map*, [Online], Available: https://uk-air.defra.gov.uk/data/gis-mapping.

DfT (2017) *DfT Automatic traffic Counters Table TRA0305-0307*, Available: https://www.gov.uk/government/statistical-data-sets/tra03-motor-vehicle-flow.

DfT (2018) *The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy*.

Environment Agency (2005) *Conversion ratios for NOx and NO2*, Available: http://webarchive.nationalarchives.gov.uk/20140328084622/http:/www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf.

Environmental Protection Act 1990 (1990), Available: http://www.legislation.gov.uk/ukpga/1990/43/contents.

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

GLA (2014a) *Sustainable Design and Construction Supplementary Planning Guidance*, Available: https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/sustainable-design-and.

GLA (2014b) *The Control of Dust and Emissions from Construction and Demolition SPG*, Available: https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/control-dust-and.

GLA (2016a) *The London Plan: The Spatial Development Strategy for London Consolidated with Alterations Since 2011*, Available: https://www.london.gov.uk/what-we-do/planning/london-plan/current-london-plan.

GLA (2016b) *London Atmospheric Emissions Inventory (LAEI) 2013*, Available: https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2013.

GLA (2017) *Draft New London Plan*, [Online], Available: https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan/.

GLA (2018a) *London Environment Strategy*, Available: https://www.london.gov.uk/what-we-do/environment/london-environment-strategy.

GLA (2018b) *Mayor's Transport Strategy*, [Online], Available: https://www.london.gov.uk/sites/default/files/mayors-transport-strategy-2018.pdf.

IAQM (2016) *Guidance on the Assessment of Dust from Demolition and Construction v1.1*, Available: http://iaqm.co.uk/guidance/.

ICCT (2017) *NOx emissions from heavy-duty and light-duty diesel vehicles in the EU: Comparison of real-world performance and current type-approval requirements*, [Online], Available: http://www.theicct.org/nox-europe-hdv-ldv-comparison-jan2017.

Jacobs (2017) *Integrated Impact Assessment, Ultra Low Emission Zone - Further Proposals*, Available: https://consultations.tfl.gov.uk/environment/air-quality-consultation-phase-3b/user_uploads/integrated-impact-assessment.pdf.

London Borough of Richmond upon Thames (2017) *Air Quality Action Plan 2017-2022*.

London Borough of Richmond upon Thames (2018a) *Air Quality Annual Status Report for 2017*.

London Borough of Richmond upon Thames (2018b) *Local Plan*.

Ministry of Housing, Communities and Local Government (2018) *National Planning Policy Framework*, Available: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf.

Moorcroft and Barrowcliffe et al (2017) *Land-Use Planning & Development Control: Planning For Air Quality v1.2*, IAQM, London, Available: http://iaqm.co.uk/guidance/.

Technical Guidance Note D1 (Dispersion) (1993), HMSO.

The Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002), HMSO, Available: https://www.legislation.gov.uk/uksi/2002/3043/contents/made.

The Air Quality (England) Regulations 2000 Statutory Instrument 928 (2000), HMSO, Available: http://www.legislation.gov.uk/uksi/2000/928/contents/made.

The European Parliament and the Council of the European Union (1997) *Directive 97/68/EC of the European Parliament and of the Council*, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:31997L0068.

The European Parliament and the Council of the European Union (2008) *Directive 2008/50/EC of the European Parliament and of the Council*, Available: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0050.

12 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
ADMS-5	Atmospheric Dispersion Modelling System model for point sources
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
BEB	Building Emissions Benchmark
CAZ	Clean Air Zone
CMS	Construction Management Statement
CURED	Calculator Using Realistic Emissions for Diesels
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMP	Dust Management Plan
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
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
EU	European Union
EV	Electric Vehicle
Focus Area	Location that not only exceeds the EU annual mean limit value for NO_2 but also has a high level of human exposure
GLA	Greater London Authority
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	Her Majesty's Stationery Office
HGV	Heavy Goods Vehicle

IAQM	Institute of Air Quality Management
ICCT	International Council on Clean Transportation
kph	Kilometres Per hour
kW	Kilowatt
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LB	London Borough
LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
LGV	Light Goods Vehicle
µg/m^3	Microgrammes per cubic metre
MAQS	Mayor's Air Quality Strategy
MCPD	Medium Combustion Plant Directive
MW_{th}	Megawatts Thermal
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
NRMM	Non-road Mobile Machinery
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
OLEV	Office for Low Emission Vehicles
PC	Process Contribution
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

RDE	Real Driving Emissions
SCR	Selective Catalytic Reduction
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
T-Charge	Toxicity Charge
TEA	Triethanolamine – used to absorb nitrogen dioxide
TEB	Transport Emissions Benchmark
TfL	Transport for London
TRAVL	Trip Rate Assessment Valid for London
ULEZ	Ultra Low Emission Zone
ZEC	Zero Emission Capable

13 Appendices

A1 London-Specific Policies and Measures 58

A2 Construction Dust Assessment Procedure 62

A3 EPUK & IAQM Planning for Air Quality Guidance 69

A4 Professional Experience 76

A5 Modelling Methodology 77

A6 London Vehicle Fleet Projections 87

A7 Energy Plant Specification 89

A8 ‘Air Quality Neutral’ 91

A9 Construction Mitigation 94

A1 London-Specific Policies and Measures

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-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;

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 (MAQS)

A1.2 The 2010 MAQS 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 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 4 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) is included in the LEZ for HGVs, buses and coaches, from 2015.

A1.4 The Mayor of London confirmed in June 2018 that the LEZ will be amended such that a Euro VI standard will apply for heavy vehicles from 26 October 2020. Requirements relating to larger vans, minibuses and other specialist diesel vehicles will not change.

Ultra Low Emission Zone (ULEZ)

A1.5 London's ULEZ is to be introduced on 8 April 2019. The ULEZ will operate 24 hours a day, 7 days a week in the same area as the current Congestion Charging zone. All cars, motorcycles, vans, minibuses and Heavy Goods Vehicles will need to meet exhaust emission standards (ULEZ standards) or pay an additional daily charge to travel within the zone. The ULEZ standards are Euro 3 for motorcycles; Euro 4 for petrol cars, vans and minibuses; Euro 6 for diesel cars, vans and minibuses; and Euro VI for HGVs, buses and coaches.

A1.6 The Mayor of London confirmed in June 2018 that, from 25 October 2021, the ULEZ will cover the entire area within the North and South Circular roads, applying the emissions standards set out in Paragraph A1.5 for light vehicles. The ULEZ will not include any requirements relating to heavy vehicle emissions beyond 26 October 2020, as these will be addressed by the amendments to the LEZ described in Paragraph A1.4.

Other Measures

A1.7 The Mayor introduced an Emissions Surcharge (also known as the Toxicity Charge, or T-Charge) in October 2017, which added an extra £10 charge for vehicles using the congestion charge zone that do not meet the Euro 4/IV emission standards. The Emissions Surcharge aims to discourage the use of older, more polluting vehicles driving into and within central London. It is the first step towards the introduction of the ULEZ.

A1.8 From 2018 all taxis presented for licencing for the first time must be zero emission capable (ZEC). This means they must be able to travel a certain distance in a mode which produces no air pollutants. From 2018 all private hire vehicles (PHVs) presented for licensing for the first time must meet Euro 6 emissions standards. From 1 January 2020, all newly manufactured PHVs presented for licensing for the first time must be ZEC (with a minimum zero emission range of 10 miles). The Mayor's aim is that the entire taxi and PHV fleet will be made up of ZEC vehicles by 2033.

A1.9 The Mayor has also proposed to make sure that TfL leads by example by cleaning up its bus fleet, implementing the following measures:

- TfL will procure only hybrid or zero emission double-decker buses from 2018;
- a commitment to providing 3,100 double decker hybrid buses by 2019 and 300 zero emission single-deck buses in central London by 2020;
- introducing 12 Low Emission Bus Zones by 2020;
- investing £50m in Bus Priority Schemes across London to reduce engine idling; and

- retrofitting older buses to reduce emissions (selective catalytic reduction (SCR) technology has already been fitted to 1,800 buses, cutting their NOx emissions by around 88%).

A2 Construction Dust Assessment Procedure

A2.1 The criteria developed by IAQM (2016), upon which the GLA's guidance is based, divide the activities on construction sites into four types to reflect their different potential impacts. These are:

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

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

STEP 1: Screen the Need for a Detailed Assessment

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

A2.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will be 'not 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 guidance explains that this classification should be based on professional judgement, but provides the examples in 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 m3 – 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 guidance 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 guidance 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 guidance 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 in the IAQM guidance has been used as the basis for the requirements set out in Appendix A9.

STEP 4: Determine Significant Effects

A2.12 The IAQM guidance 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 be 'not significant'.

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 be 'not 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 Dust Soiling Effects on People and Property [3]

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

3 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 sites with a *large* dust emission magnitude, 200 m from sites with a *medium* dust emission magnitude and 50 m from sites with a *small* dust emission magnitude, 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 A2.4: Sensitivity of the Area to Human Health Effects [3]

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A2.5: Sensitivity of the Area to Ecological Effects [3]

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 EPUK & IAQM Planning for Air Quality Guidance

A3.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A3.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A3.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A3.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;

- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mgNOx/Nm^3;
  - Compression ignition engine: 400 mgNOx/Nm^3;
  - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A3.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

A3.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A3.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A3.8 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or

- the development will have a centralised energy facility or other centralised combustion process.

A3.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere; and
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor.

A3.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A3.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A3.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

A3.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

A3.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A3.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A3.16 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A3.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A3.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

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

Assessment of Significance

A3.17 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*'

impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and

- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A3.18 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A3.19 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A4.

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.

Pauline Jezequel, MSc MIEnvSc AMIAQM

Miss Jezequel is a Senior Consultant with AQC with eight years' relevant experience. Prior to joining AQC she worked as an air quality consultant at AECOM. She has also worked as an air quality controller at Bureau Veritas in France, undertaking a wide range of ambient and indoor air quality measurements for audit purposes. She now works in the field of air quality assessment, undertaking air quality impact assessments for a wide range of development projects in the UK and abroad, including for residential and commercial developments, transport schemes (rail, road and airport), waste facilities and industrial sites. Miss Jezequel has also undertaken a number of odour surveys and assessments in the context of planning applications. She has experience in monitoring construction dust, as well as indoor pollutant levels for BREEAM purposes.

Samantha Barber, MChem

Miss Barber is an Assistant Consultant with AQC, having joined the company in November 2017. She is gaining experience of air quality assessments for a range of developments using air quality monitoring and modelling techniques. Prior to joining AQC she completed her MChem in Chemistry and has also worked for a year as a Technical Services Officer at BOC Gases Ltd.

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

A5 Modelling Methodology

Model Inputs

Road Traffic

A5.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 8.0.1) published by Defra (2018d).

A5.2 Hourly sequential meteorological data from Heathrow 2017 have been used in the model. The Heathrow meteorological monitoring station is located approximately 6.5 km to the north west of the proposed development site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site; both the development site and the Heathrow meteorological monitoring station are located in the south of England where they will be influenced by the effects of inland meteorology over urban topography.

A5.3 AADT flows, and the proportions of HDVs, for the local road network have been provided by Robert West, who are the transport consultants for the proposed development. Traffic speeds have been estimated 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. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2017).

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

Road Link	2017		2020 (Without Scheme)		2020 (With Scheme)	
	AADT	%HDV	AADT	%HDV	AADT	%HDV
Nelson Road (west of Hospital Bridge Road)	15,826	3.9	16,314	3.9	16,322	3.9
Nelson Road (east of Hospital Bridge Road)	6,677	1.6	6,883	1.6	6,914	1.6
Hospital Bridge Road (north of Montrose Avenue)	9,556	7.6	9,851	7.6	9,890	7.6
Montrose Avenue	1,672	2.3	1,724	2.3	1,964	2.0
Hospital Bridge Road (between Montrose Avenue and Powder Mill Lane/Percy Road)	8,457	3.8	8,718	3.8	9,001	3.8
Powder Mill Lane	3,881	4.3	4,000	4.3	4,168	4.1
Hospital Bridge Road (between Powder Mill Lane/Percy Road and Hospital Bridge Roundabout)	5,631	7.9	5,804	7.9	6,255	7.4
Hospital Bridge Road (south of Hospital Bridge Roundabout)	7,869	4.7	8,112	4.7	8,322	4.7
A316 Chertsey Road	25,351	2.5	26,078	2.5	26,138	2.6
A316 Great Chertsey Road	25,512	3.2	26,243	3.2	26,432	3.2
Percy Road [a]	12,747	3.1	12,877	3.1	12,877	3.1

[a] Traffic data for Percy road have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016b).

A5.4 Figure A5.1 shows the road network included within the model, along with the speed at which each link was modelled, and defines the study area.

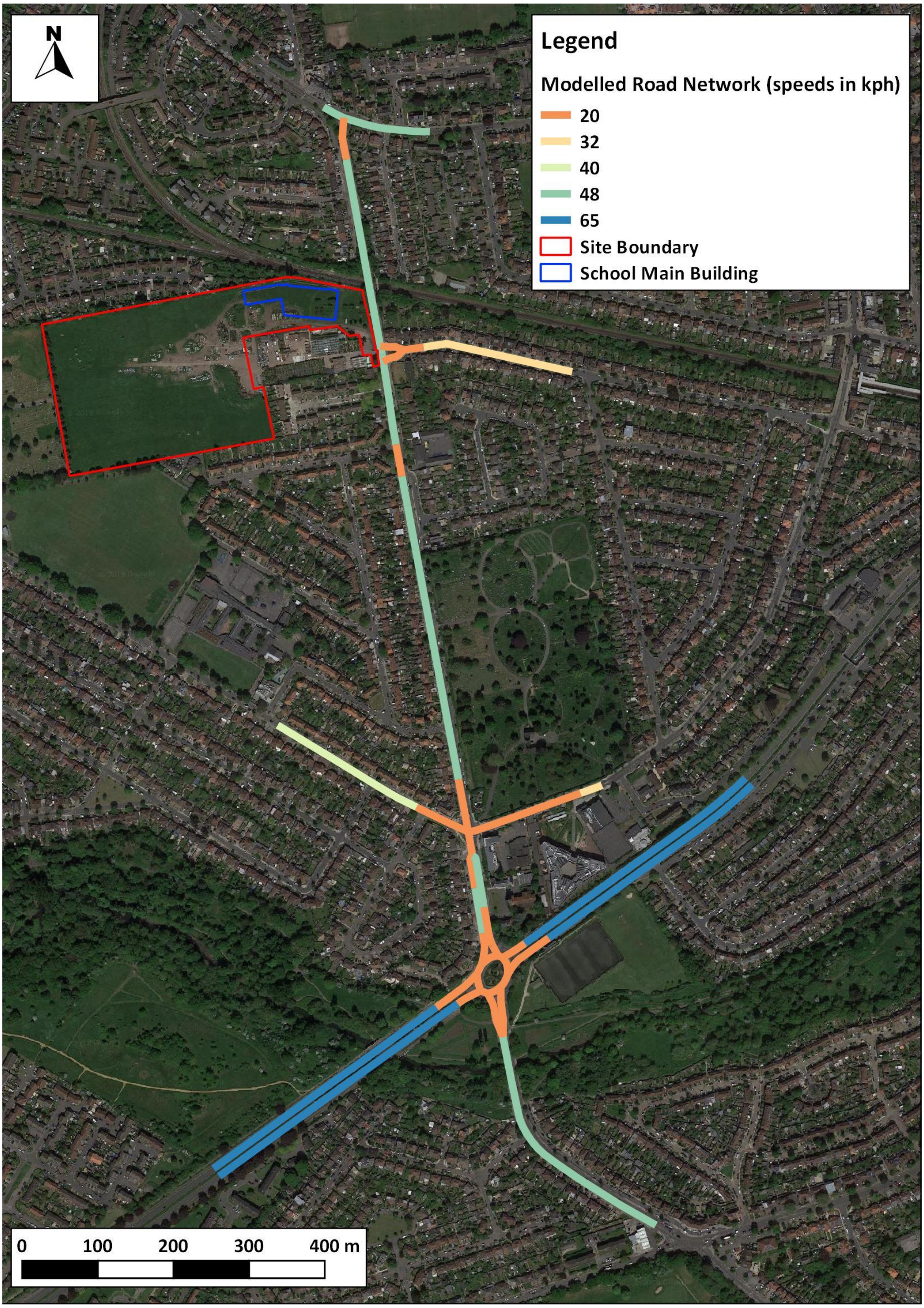

Figure A5.1: Modelled Road Network & Speeds

Imagery ©2018 Google, Map data ©2018 Google.

Sensitivity Test for Nitrogen Oxides and Nitrogen Dioxide

A5.5 As explained in Section 3, AQC has carried out a detailed analysis which showed that, whereas previous standards had had limited on-road success in reducing nitrogen oxides emissions from diesel vehicles, the ‘Euro VI’ and ‘Euro 6’ standards are delivering real on-road improvements (AQC, 2016). Defra’s EFT v8.0.1 takes account of these observed improvements, but also makes additional assumptions regarding the performance of diesel cars and vans that will be produced in the future. In particular, it assumes that diesel cars and vans registered for type approval after 2020 will, on average, emit significantly less NOx than earlier models. A sensitivity test has been carried out using AQC’s CURED v3A model (AQC, 2017), which assumes that this post-2020 technology does not deliver any benefits (as a worst-case assumption). Further details of CURED v3A are provided in the supporting report prepared by AQC (2018a).

Point Sources

A5.6 The impacts of emissions from the proposed energy plant have been predicted using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model has been run to predict the contribution of the proposed energy plant emissions to annual mean and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations.

A5.7 The gas-fired energy plant that will be installed into the development will have an assumed net fuel input of 1329.8 kW (calculated gross input of 1472.8 kW) delivering 1308 kW_{th} output. The energy plant will conform to the Sustainable Design and Construction SPG (GLA, 2014a) requiring NOx emissions to be <40 mg/kWh[4]. Emissions will rise to roof level in a single dedicated flue. A fan assisted flue may be required to aid this. The exhaust volume flow rate for the natural-gas fired plant has been calculated based on the complete combustion of the assumed natural gas composition in Table A5.2 and the following typical values for boilers of this size:

- 100% load;
- 55 ˚C exit temperature;
- 35% excess air in; and
- Condensing plant removing 50% of the water from the exhaust.

[4] Maximum NOx emission rate permitted within the Sustainable Design and Construction SPG (GLA, 2014a).

Table A5.2: Typical Gas Fuel Composition

Component	Natural Gas
Methane	90.76%
Ethane	4.64%
Propane	1.22%
Carbon Dioxide	1.07%
Nitrogen	2.32%
Net Calorific Value (LHV) (MJ/kg)	46.5
Gross Calorific Value (HHV) (MJ/kg)	51.5
HHV/LHV	1.11
Molecular Mass (g/mol)	17.61

A5.8 The emissions parameters employed in the modelling are set out in Table A5.3. Further details of the energy plant parameters are provided in Appendix A7.

Table A5.3: Plant Specifications and Modelled Emissions and Release Conditions

Parameter	Value
Gas Boilers (2 x Remeha ECOPRO 610 Boilers)	
Calculated Flue Internal Diameter (m) [a]	0.35
Calculated Actual Exhaust Volume Flow (m^3/s) [b]	0.578
Calculated Exit Velocity (m/s)	6.01
Specified NOx Emission Rate (mg/kWh)	40
Calculated Gross Fuel Input (kW)	1472.8
Calculated NOx Emission Rate (g/s)	0.01636
Specified Exhaust Temperature (°C)	55
Flue Location (x,y)	513488.13, 173666.54
Modelled Flue Height (m)	12.1

[a] This is the internal flue diameter required to achieve an efflux velocity of 6 m/s, as required by the GLA's Sustainable Design and Construction SPG (GLA, 2014a).

[b] Not normalised.

A5.9 Entrainment of the plume into the wake of the buildings (the so-called building downwash effect) has been taken into account in the model. The building dimensions and flue location have been obtained from drawings provided by Stride Treglown. The location of the flue is shown in Figure A5.2 along with the modelled buildings. The flue has been modelled at a height of 12.1 m (1 m above the roof level).

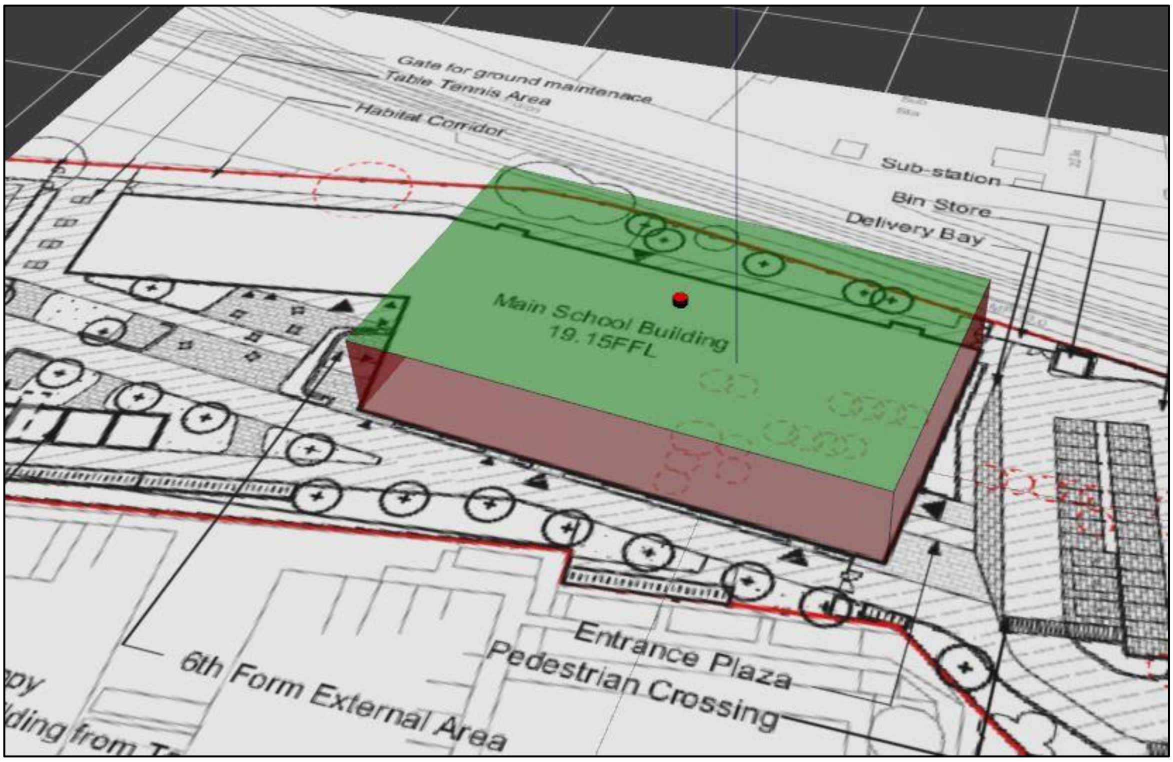

Figure A5.2: Flue Location & Modelled Buildings

Contains data from Ares Landscape Architects LTD drawing no. EFATH-ALA-00-XX-DR-L-0001.

A5.10 Hourly sequential meteorological data from Heathrow for 2017 have been used in the model. As previously discussed in Paragraph A5.2, the Heathrow meteorological monitoring station is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site.

Modelling Assumptions

A5.11 ADMS-5 modelling has been completed assuming the two boiler units (referred to as “energy plant”) are operational with 100% usage. This will over-predict the long-term concentrations.

Background Concentrations

A5.12 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2018d). These cover the whole of the UK on a 1x1 km grid and are published for each year from 2015 until 2030. The background annual mean nitrogen oxides and nitrogen dioxide maps for 2017 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2018b). The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted nitrogen oxides and nitrogen dioxide concentrations for the future assessment year than those derived from the Defra maps.

Background NO_2 Concentrations for Sensitivity Test

A5.13 The road-traffic components of nitrogen dioxide in the background maps have been uplifted in order to derive future year background nitrogen dioxide concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2018c).

Model Verification

A5.14 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. It is not practical, nor usual, to verify the ADMS-5 model, and, because ADMS-5 does not rely on estimated road-vehicle emission factors, the adjustment used for ADMS-Roads cannot be applied to ADMS-5. Predictions made using ADMS-5 have thus not been verified.

Background Concentrations

A5.15 The 2017 background concentrations for the monitoring sites have been derived from the national maps, having been calculated using the same approach as described in Paragraph A5.12, and are presented in Table A5.4.

Table A5.4: Background Concentrations used in the Verification for 2017

Site	NO_2
DT12	21.7
DT57	23.1
Objectives	**40**

Traffic Data

A5.16 AADT flows, and the proportions of HDVs, for A314 Hanworth Road and A316 Chertsey Road adjacent to monitoring sites 12 and 57 respectively, have been provided by Robert West. Traffic data used in the model verification are summarised in Table A5.5.

Table A5.5: 2017 AADT Traffic Data used in the Model Verification

Road Link	AADT	%HDV
A314 Hanworth Road	23,562	5.0
A316 Chertsey Road	25,351	2.5

Nitrogen Dioxide

A5.17 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 2017 at the diffusion tube monitoring sites located along A314 Hanworth Road and A316 Chertsey Road (sites 12 and 57 respectively). Concentrations have been modelled at 2.2 m, the height of the monitors.

A5.18 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 6.1) available on the Defra LAQM Support website (Defra, 2018d).

A5.19 An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A5.3). The calculated adjustment factor of 2.075 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A5.20 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. Figure A5.4 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

A5.21 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.

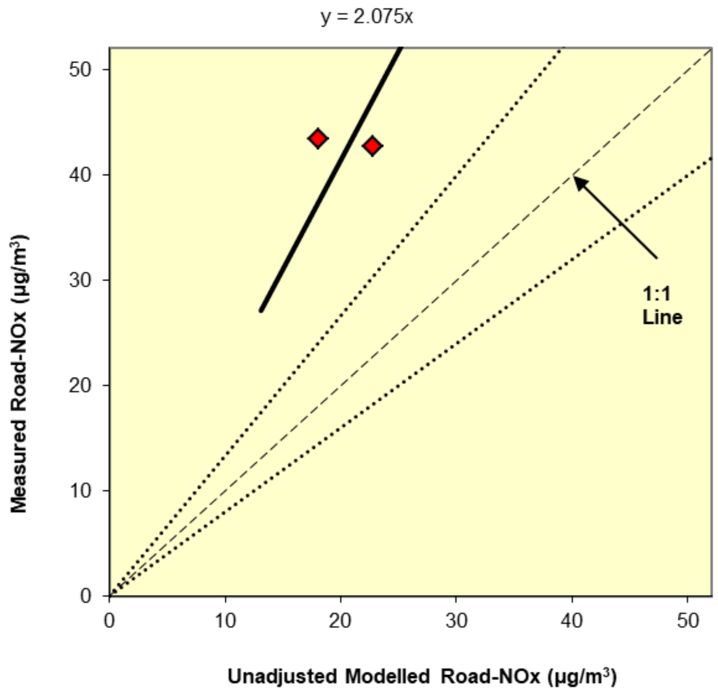

Figure A5.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

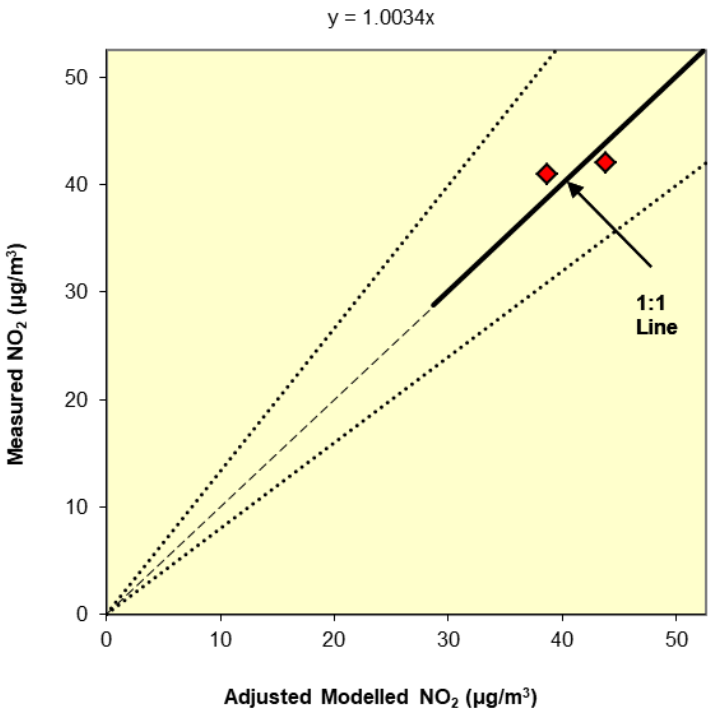

Figure A5.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A5.22 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the adjustment factor calculated for road NOx.

Model Post-processing

Road Traffic

A5.23 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2018d). 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.

Point Sources

A5.24 Emissions from the energy plant will be predominantly in the form of nitrogen oxides (NOx). ADMS-5 has been run to predict the contribution of the proposed energy centre emissions to annual mean and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations. For the initial screening of the process contributions, the approach recommended by the Environment Agency (2005) has been used to predict nitrogen dioxide concentrations, assuming that:

- annual mean NO_2 concentration = annual mean NOx concentration multiplied by 0.7; and
- 99.79^{th} percentile of 1-hour mean NO_2 concentrations = 99.79^{th} percentile of 1-hour mean NOx concentrations multiplied by 0.35.

Short-term

A5.25 Where short-term objectives need to be assessed the following post-processing has been carried out:

A5.26 Total concentration = 99.79^{th} percentile process contribution NO_2 + 2 x ‘baseline’ annual mean nitrogen dioxide concentration

A6 London Vehicle Fleet Projections

A6.1 TfL has published an Integrated Impact Assessment (Jacobs, 2017) setting out the impacts of the changes to the LEZ and ULEZ described in Paragraphs A1.4 and A1.6. The assessment predicts that the changes will reduce overall NOx emissions from vehicles in London by 28% in 2021 (32% in Inner London and 27% in Outer London) and by 21% in 2025 (24% in Inner London and 21% in Outer London). The percentage reduction reduces with time due to the natural turnover of the fleet that would have occurred regardless of the introduction of the proposed changes. The proposed changes will not significantly affect emissions in Central London, where the ULEZ will already be implemented, but concentrations here will still reduce due to the lower emissions in surrounding areas.

A6.2 The report projects that the changes will reduce exposure to exceedances of the annual mean nitrogen dioxide objective by 40% and 21% in Central London in 2021 and 2025, respectively; by 4% and 0% in Inner London in 2021 and 2025, respectively; and by 23% and 27% in Outer London in 2021 and 2025, respectively, when compared to the baseline scenario.

A6.3 The changes are not projected to have a significant effect on PM_{10} and $PM_{2.5}$ concentrations, although a small reduction is predicted.

A6.4 AQC's report on the development of the CURED v3A Emissions Model (AQC, 2018a) also highlighted that the EFT's assumptions regarding future fleet composition in London and across the UK may be over-pessimistic in terms of NOx emissions. The future fleet projection derived from the EFT for Outer London, for example, shows a very small reduction in the proportion of diesel cars between 2016 and 2030, and a very limited uptake of electric cars. The AQC report highlights that this contrasts with the expectations of many observers, as well as the most recent trends publicised by the media. When considered alongside the future requirements of the LEZ and ULEZ, these future fleet projections seem all the more unrealistic (i.e. worst-case in terms of emissions), as the changes to the LEZ and ULEZ would reasonably be expected to significantly increase the uptake of lower emissions vehicles in London.

A6.5 As outlined in Paragraph 3.23, the changes to the LEZ and ULEZ announced by the Mayor of London in June 2018 are not reflected in Defra's latest EFT, or the CURED model, and thus have not been considered in this assessment. The potentially over-pessimistic fleet projections built in to the EFT and CURED have not been addressed in this report either. Paragraphs A6.1 and A6.2 highlight that the changes to the LEZ and ULEZ will result in significant reductions in vehicle nitrogen oxides emissions and resultant nitrogen dioxide concentrations. The changes might reasonably also be expected to expedite the uptake of cleaner vehicles well beyond that projected in the EFT's fleet projections for London. As such, while the results presented in this report represent a reasonably conservative reflection of likely concentrations and impacts in the absence of the changes to the LEZ and ULEZ, they almost certainly represent an unrealistically worst-case assessment of likely concentrations and impacts bearing in mind the implementation of these changes.

A7 Energy Plant Specification

A7.1 The proposed development will be provided with heat and hot water using two condensing natural gas-fired boilers to be located in the top floor plantroom in the centre of the building. Specification for this plant, upon which the assessment has been based, is shown in Table A7.1.

Table A7.1: Energy Plant Specification

Parameter	Value	Restriction
Gross Fuel Input (kW)	1,472.8	Max
Hours of Use per Annum	8,760	Max
Annual Fuel Input (kWh/annum)	12,901,885	Max
Exhaust Temperature (°C)	55	Min
Flue Internal Diameter (m)	0.35	Max
Efflux Velocity (m/s)	6.01	Min
NOx Emission Rate (mg/kWh)	40.0	Max
Condensing	Yes	-

A7.2 The restrictions set out in Table A7.1 should be adhered in order to ensure that the final plant design does not lead to impacts greater than those modelled. To further emphasise these, the final design should adhere to the following minimum specifications:

- a boiler system with a maximum total of 1472.8 kW fuel input must share a common flue outlet with a maximum internal diameter of 0.35 m at the exit point, terminating at least 1 m above the roof level;
- all stacks should discharge vertically upwards and be unimpeded by any fixture on top of the stack (e.g., rain cowls);
- the system must be designed to conform to the requirements of the GLA's guidance on sustainable design and construction (GLA, 2014a). The gas boilers must conform to a maximum NOx emission of <40 mg/kWh. The SPG makes clear that the emission standards are 'end-of-pipe' concentrations expressed at specific reference conditions for temperature, pressure, oxygen and moisture content. Compliance with these standards will be confirmed prior to occupation, based on:
    - monitoring undertaken on the actual installed plant; or
    - manufacturer guaranteed performance levels supported by type approval monitoring undertaken by the equipment supplier.
- in order to attain these values, relevant catalyst or alternative abatement may be required.

A7.3 If the design of the energy centre deviates significantly from the modelled specification, additional future modelling may be required in order to ensure that there are no significant adverse air quality impacts.

A7.4 The GLA's Sustainable Design and Construction SPG (GLA, 2014a) also states that the measures set out in Technical Guidance Note D1 (Dispersion) (1993) should also be adhered to in order to ensure adequate dispersion of emissions from discharging stacks and vents. These include the following:

- Discharges should be vertically upwards and unimpeded by cowls or any other fixtures on top of the stack. However, the use of coning or of flame traps at the tops of stacks is acceptable. In the case of discharge stacks (whether single or multiple stack) with shrouds or casings around the stack(s), the stack(s) alone should extend above the shroud or casing. This extension should be at least 50% of the shroud or casing's greatest lateral dimension;
- Irrespective of the pollutant discharge, there are minimum discharge stack heights based on the heat release and the discharge momentum. These can be calculated following calculations set out in the guidance note, but the absolute minimum value is 1 m;
- No discharge stack should be less than 3 m above the ground or any adjacent area to which there is general access. For example, roof areas and elevated walkways;
- A discharge stack should never be less than the height of any building within a distance of 5 times the stack height; and
- A discharge stack should be at least 3 m above any opening windows or ventilation air inlets within a distance of 5 times the stack height.

A8 'Air Quality Neutral'

A8.1 The GLA's SPG on Sustainable Design and Construction (GLA, 2014a), and its accompanying Air Quality Neutral methodology report (AQC, 2014), provide an approach to assessing whether a development is air quality neutral. The approach is to compare the expected emissions from the building energy use and the car use associated with the proposed development against defined emissions benchmarks for buildings and transport in London.

A8.2 The benchmarks for heating and energy plant (termed 'Building Emissions Benchmarks' or 'BEBs') are set out in Table A8.1, while the 'Transport Emissions Benchmarks' ('TEBs') are set out in Table A8.2. 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 A8.3 and Table A8.4 (upon which the TEBs are based) is used. Similarly, the information in Table A8.5 may be used if site-specific information are not available (AQC, 2014). For use classes other than A1, B1 and B3, trip lengths and average emissions per vehicle are not provided, thus the trip rates in Table A8.6 alone may be used to consider the air quality neutrality of a development. These have been derived from the Trip Rate Assessment Valid for London (TRAVL) database.

Table A8.1: 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 A8.2: 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 LAEI (GLA, 2016b).

Table A8.3: 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 A8.4: Average Road Traffic Emission Factors in London in 2010

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

Table A8.5: Average Emissions from Heating and Cooling Plant in Buildings in London in 2010

	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

Table A8.6: Average Number of Trips per Annum for Different Development Categories

Land use	Number of Trips (trips/m^2/annum)		
	CAZ	Inner	Outer
A1	43	100	131
A3	153	137	170
A4	2.0	8.0	-
A5	-	32.4	590
B1	1	4	18
B2	-	15.6	18.3
B8	-	5.5	6.5
C1	1.9	5.0	6.9
C2	-	3.8	19.5
D1	0.07	65.1	46.1
D2	5.0	22.5	49.0
Number of Trips (trips/dwelling/annum)			
C3	129	407	386

A9 Construction Mitigation

A9.1 The following is a set of best-practice measures from the GLA guidance (GLA, 2014b) that should be incorporated into the specification for the works. These measures should be written into a Dust Management Plan. Some of the measures may only be necessary during specific phases of work, or during activities with a high potential to produce dust, and the list should be refined and expanded upon in liaison with the construction contractor when producing the Dust Management Plan.

Site Management

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

Preparing and Maintaining the Site

- Plan the site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible;
- erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site;
- fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;

- install green walls, screens or other green infrastructure to minimise the impact of dust and pollution;
- avoid site runoff of water or mud;
- keep site fencing, barriers and scaffolding clean using wet methods;
- remove materials 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;
- cover, seed, or fence stockpiles to prevent wind whipping;
- carry out regular dust soiling checks of buildings within 100 m of site boundary and provide cleaning if necessary;
- put in place real-time dust and air quality pollutant monitors across the site and ensure they are checked regularly;
- agree monitoring locations with the Local Authority; and
- where possible, commence baseline monitoring at least three months before work begins.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all on-road vehicles comply with the requirements of the London LEZ (and ULEZ);
- ensure all Non-road Mobile Machinery (NRMM) comply with the standards set within the GLA's Control of Dust and Emissions During Construction and Demolition SPG. This outlines that, from 1 September 2015, all NRMM of net power 37 kW to 560 kW used on the site of a major development in Greater London must meet Stage IIIA of EU Directive 97/68/EC (The European Parliament and the Council of the European Union, 1997) and its subsequent amendments as a minimum. From 1 September 2020 NRMM used on any site within Greater London will be required to meet Stage IIIB of the Directive as a minimum;
- ensure all vehicles switch off engines when stationary – no idling vehicles;
- avoid the use of diesel- or petrol-powered generators and use mains electricity or battery-powered equipment where practicable;
- impose and signpost a maximum-speed-limit of 10 mph on surfaced haul routes and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the Local Authority, where appropriate);
- produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and

- implement a Travel Plan that supports and encourages sustainable staff travel (public transport, cycling, walking, and car-sharing).

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems;
- ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using recycled water where possible and appropriate;
- use enclosed chutes, conveyors and covered skips;
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate; and
- ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

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

Measures Specific to 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

- 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;
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable);
- ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits;
- access gates should be located at least 10 m from receptors, where possible; and
- apply dust suppressants to locations where a large volume of vehicles enter and exit the construction site.