Air Quality Consultants

Air Quality Assessment: 63-71 Hampton Hill High Street, Richmond upon Thames

November 2016

Experts in air quality management & assessment

Document Control

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Job Number	J2552

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Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J2552/1/F3	4 November 2016	Final	Prof. Duncan Laxen (Managing Director)

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Executive Summary

The air quality impacts associated with the construction and operation of the proposed residential development at 63 – 71 High Street, Hampton Hill have been assessed.

Existing conditions within the study area show poor air quality, with concentrations of nitrogen dioxide exceeding the annual mean objective at several locations within the study area, including along High Street (A311) adjacent to the development site. The site lies within an Air Quality Management Area.

The construction works will give rise to a *Medium Risk* of dust soiling impacts during demolition and earthworks and as a result of trackout by vehicles, and a *Low Risk* of dust soiling impacts during construction. There will be a Low Risk of impacts to human health and ecology during earthworks and as a result of trackout by vehicles, and *Negligible Risk* during demolition and construction. These risks will require a package of mitigation measures to minimise dust emissions. With these mitigation measures in place, the overall impacts during construction will be 'not significant'.

Air quality conditions for new residents within the proposed development have been considered. Nitrogen dioxide concentrations are predicted to be above the annual mean air quality objective at the proposed High Street-fronting apartments on the first floor of the proposed development site and mitigation is required to ensure that the site is suitable for residential development. Recommended mitigation includes providing mechanical ventilation for the affected first floor apartments, with supply from the rear or roof of the building.

The building emissions associated with the proposed development are below the relevant Air Quality Neutral benchmarks; however, the proposed development exceeds the relevant emissions benchmark for transport emissions. Provision of electric vehicle charging points will help offset these emissions.

Overall, the construction and operational air quality impacts of the proposed development are judged to be 'not significant', providing that the suggested mitigation measures are implemented.

Contents

Tables

Figures

1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed residential development of 63 – 71 High Street, Hampton Hill in Richmond upon Thames. The assessment has been carried out by Air Quality Consultants Ltd on behalf of GreatPlanet Ltd.

1.2 The proposed development comprises 31 apartments in a group of buildings on the east part of the site accessed from a pedestrian courtyard and eight houses on the west half of the site set about a landscaped inner court, together with basement parking for 45 cars. It lies within an Air Quality Management Area (AQMA) declared by the London Borough (LB) of Richmond upon Thames for exceedences of the annual mean nitrogen dioxide objective, and the annual mean and 24-hour mean particulate matter (PM_{10}) objectives.

1.3 The proposed development is not expected to significantly alter the annual average daily traffic (AADT) on the local roads. Any potential increases in AADT are anticipated to be below the screening criteria requiring an air quality assessment (i.e. an increase of >100 AADT within an AQMA), as specified by the EPUK and the Institute of Air Quality Management (IAQM)[1] Planning for Air Quality guidance (EPUK & IAQM, 2015). The traffic and associated emissions that will be generated by the development will therefore not be significant.

1.4 The new residential properties will, however, be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.5 The proposed development will include a mixture of centralised and decentralised gas-fired boiler plant for heating and hot water. An assessment of the impacts of emissions from these plant is not included in this report, but will be produced as an addendum once sufficient information on the plant specifications are available.

1.6 A railway line runs northeast to southwest approximately 110 m to the northwest of the site. Defra guidance (Defra, 2016) outlines an approach to assess the potential for exceedences of the annual mean nitrogen dioxide objective as a result of emissions from diesel locomotives. The guidance outlines that there is only the potential for an exceedence where there is long-term exposure within 30 m, and the annual mean background concentration of nitrogen dioxide is above 25 $\mu g/m^3$. The development site falls outside these criteria and thus the impact of emissions from railway locomotives on nitrogen dioxide concentrations are not considered further.

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

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

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

1.9 This report describes existing local air quality conditions (2014), 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 2018, which is the anticipated year of opening. The assessment of construction dust impacts focuses on the anticipated duration of the works.

1.10 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology agreed with the LB of Richmond upon Thames.

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) 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.

Planning Policy

National Policies

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

2.3 More specifically the NPPF makes clear that:

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

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

2.5 The PPG states that:

"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)".

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

The London Plan

2.7 The London Plan (GLA, 2015) 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.

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

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

The Mayor's Air Quality Strategy

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

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

GLA SPG: Sustainable Design and Construction

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

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

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

Local Transport Plan

2.14 The Mayor's Transport Strategy (Greater London Authority, 2010) sets out the Mayor's transport vision and describes the measures to be taken to deliver this vision. It has six key goals, including the goal of "*enhancing the quality of life for all Londoners*", in part through "*improved air quality, with health benefits for Londoners*".

2.15 Richmond upon Thames' Second Local [Transport] Implementation Plan (London Borough of Richmond upon Thames, 2011) sets out a variety of measures proposed to implement the goals set out by the Mayor's Transport Strategy in the LB of Richmond upon Thames. The plan sets seven Objectives, including Objective 2: To improve the local environment and quality of life for all residents of Richmond. As part of Objective 2 it is stated that *"Improving the environment and particularly air quality…..is critical to enhancing the quality of life in Richmond and London as a whole"* and commits to the use of the *"Air Quality Action Plan monitoring of air pollution"* as one of the interventions to be implemented in order to achieve this objective.

Local Policies

2.16 The LB of Richmond upon Thames Local Development Framework Core Strategy (London Borough of Richmond upon Thames, 2009) was adopted in April 2009, and within this there is one policy, Spatial Policy 1.D: Reducing environmental impact, which refer to air quality. As part of Spatial Policy 1.D, the plan commits that "*local environmental impacts of development with respect to factors such as…..air quality…..should be minimised*" and also states that "*the reduction and management of car travel will also assist in improving air quality…..and improving health*".

2.17 The LB of Richmond upon Thames is currently preparing a new Local Plan which will replace the existing policies within the Core Strategy (London Borough of Richmond upon Thames, 2009). In addition to maintaining the requirements of Policy 1.D, the Local Plan; Pre-Publication Version for Consultation (London Borough of Richmond upon Thames, 2016) includes the following requirements as part of the New Policy LP 10, part B 'Air Quality':

"*The Council promotes good air quality design and new technologies. Developers should commit to 'Emissions Neutral' development where practicable. 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, modelling 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."*

2.18 Air quality also forms a part of the Local Development Framework Vision: 1. A Sustainable Future, which states that as part of the Borough's responsibility towards global sustainability "*the need for travel will be minimised and non-car based travel will increase, contributing to reducing congestion and improving air quality*"

Air Quality Action Plans

National Air Quality Plans

2.19 Defra has produced Air Quality Plans to reduce nitrogen dioxide concentrations in major cities where exceedences of the EU limit values for nitrogen dioxide have been forecast in 2020 and beyond (Defra, 2015). In Greater London, Defra will continue to support and monitor the delivery of the Mayor's plans for improving air quality to meet the EU limit value for nitrogen dioxide by 2025. The proposed development is located within Greater London, and so measures specified by national air quality plans that are applicable to the Greater London Area will apply to the proposed development.

2.20 There is currently no practical way to take account of the effects of these Air Quality Plans on the modelling presented in this report, which is for assessment against the air quality objectives.

Local Air Quality Action Plan

2.21 The LB of Richmond upon Thames has declared an AQMA for nitrogen dioxide and particulate matter (PM_{10}) in December 2000 that covers the whole Borough. The LB of Richmond upon Thames has since developed an Air Quality Action Plan (London Borough of Richmond upon Thames, 2002). This sets out actions to be implemented to improve air quality, with a focus on managing road traffic, promoting sustainable transport and promoting energy efficiency and cleaner energy sources within buildings. The plan also commits to "*refuse planning consent for activities, which are likely to lead to a significant worsening of air quality in "hot spot" areas*" (the proposed development does not fall within a "hot spot" area. Progress against the Air Quality Action Pan is reviewed and reported annually, and the plan is frequently reviewed and updated as necessary.

Assessment Criteria

Health criteria

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

2.23 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour PM_{10} objective could be exceeded where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2009). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedence 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.

2.24 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2009). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour 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.

2.25 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. 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 (Directive 2008/50/EC of the European Parliament and of the Council, 2008). 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.

2.26 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, exceedences of the 24-hour mean PM_{10} objective are possible (Defra, 2009).

[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

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

Assessment of Significance

Construction Dust Significance

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

Operational Significance

2.29 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 (EPUK & IAQM, 2015) has therefore been used. 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

Consultation

3.1 The assessment follows a methodology agreed with the LB of Richmond upon Thames via email correspondence between Carol Lee (Senior Pollution Practitioner (Air Quality) at LBs of Merton and Richmond upon Thames) and Laurence Caird (Air Quality Consultants) between 17th – 20th May 2016.

Existing Conditions

3.2 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2016a) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2016). Local sources have also been identified through discussion with the LB of Richmond upon Thames' Pollution Team, as well as through examination of the Council's Air Quality Review and Assessment reports.

3.3 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. This covers both the study area and nearby sites, the latter being used to provide context for the assessment. Background concentrations have been defined using the national pollution maps published by Defra (2016b). These cover the whole country on a 1x1 km grid.

3.4 Exceedences 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 for 2014 (Defra, 2016c) and for 2020 (Defra, 2016d). These are the maps used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedences of the limit value to the EU. The maps are currently available for the past years 2001 to 2014 and the future years 2020, 2025 and 2030. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations, which are available for the years 2009 to 2014, show no exceedences of the limit values anywhere in the UK in 2014.

Construction Impacts

3.5 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 (Institute of Air Quality Management, 2014). This follows a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant impacts. Appendix A2 explains the approach in more detail.

Road Traffic Impacts

Sensitive Locations

3.6 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at the site of the proposed development. Receptors have been located on the façade of the development adjacent to the main road traffic source (i.e. High Street) in order to represent worst-case exposure.

3.7 Eight receptor locations have been identified within the new development, which represent exposure to existing sources. These locations are described in Table 2 and shown in Figure 1. In addition, concentrations have been modelled at three roadside diffusion tube monitoring sites, located along High Street (A311), Hampton Road (A313) and Uxbridge Road (A312), in order to verify the modelled results (see Appendix A5 for verification method).

Table 2: Description of Receptor Locations

Receptor	Description
Receptor A [a]	Residential apartment within the proposed development
Receptor B [b]	Residential apartment within the proposed development
Receptor C [b]	Residential apartment within the proposed development

[a] Receptors modelled at heights of 4.5 m and 7.5 m to represent first and second floor levels.

[b] Receptors modelled at heights of 4.5 m, 7.5 m and 10.5 m to represent first, second and third floor levels

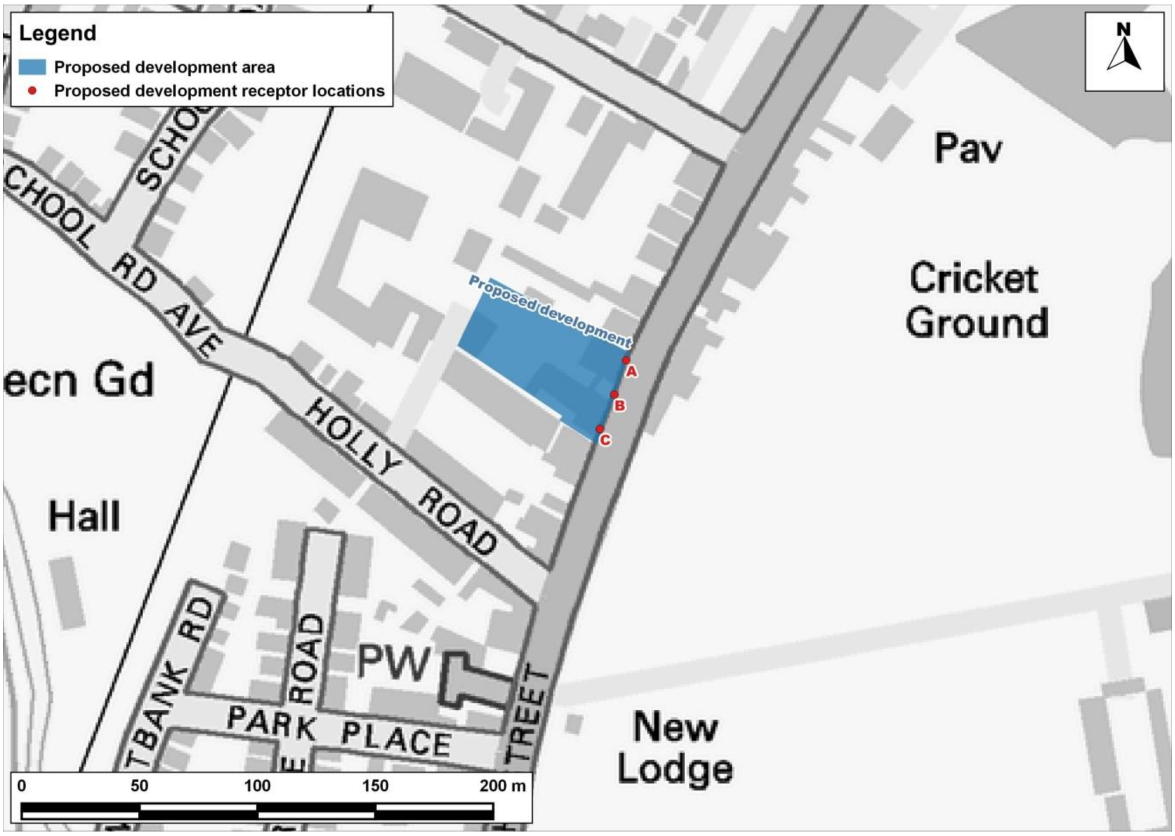

Figure 1: Receptor Locations and Proposed Development Area

Assessment Scenarios

3.8 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2014), and the proposed year of opening (2018). A base year of 2014 was selected because measured pollution concentrations during 2015 were significantly lower than average (see Table 3); therefore using 2014 as a base year will result in a more conservative assessment.

3.9 In addition to the set of 'official' predictions, a sensitivity test has been carried out for nitrogen dioxide that involves assuming much higher nitrogen oxides emissions from certain vehicles than have been predicted by Defra. This is to address the potential under-performance of emissions control technology on modern diesel vehicles (AQC, 2016a).

Modelling Methodology

3.10 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in Appendix A5, together with the method used to derive current and future year background nitrogen dioxide concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Uncertainty in Road Traffic Modelling Predictions

3.11 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.

3.12 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 baseline year (2014) concentrations.

3.13 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.

3.14 Historically, large reductions in nitrogen oxides emissions have been projected, which has led to significant reductions in nitrogen dioxide concentrations from one year to the next being predicted. Over time, it was found that trends in measured concentrations did not reflect the rapid reductions that Defra and DfT had predicted (Carslaw, Beevers, Westmoreland, & Williams, 2011). This was evident across the UK, although the effect appeared to be greatest in inner London; there was also considerable inter-site variation. Emission projections over the 6 to 8 years prior to 2009 suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25%, whereas monitoring data showed that concentrations remained relatively stable, or even showed a slight increase. Analysis of more recent data for 23 roadside sites in London covering the period 2003 to 2012 showed a weak downward trend of around 5% over the ten years (Carslaw & Rhys-Tyler, 2013), but this still falls short of the improvements that had been predicted at the start of this period. This pattern of no clear, or limited, downward trend is mirrored in the monitoring data assembled for this study, as set out later in Paragraph 4.7.

3.15 The reason for the disparity between the expected concentrations and those measured relates to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have had to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles has often been no better than that of earlier models. This has been compounded by an increasing proportion of nitrogen dioxide in the nitrogen oxides emissions, i.e. primary nitrogen dioxide, which has a significant effect on roadside concentrations (Carslaw, Beevers, Westmoreland, & Williams, 2011) (Carslaw & Rhys-Tyler, 2013).

3.16 A detailed analysis of emissions from modern diesel vehicles has been carried out (AQC, 2016a). This shows that, where previous standards had limited on-road success, the 'Euro VI' and 'Euro 6' standards that new vehicles have had to comply with from 2013/16[2] are delivering real on-road improvements. A detailed comparison of the predictions in Defra's latest Emission Factor Toolkit (EFT v6.0.2) against the results from on-road emissions tests has shown that Defra's latest predictions still have the potential to under-predict emissions from some vehicles, albeit by less than has historically been the case (AQC, 2016a). In order to account for this potential under-prediction, a sensitivity test has been carried out in which the emissions from Euro IV, Euro V, Euro VI, and Euro 6 vehicles have been uplifted as described in Paragraph A5.7 in Appendix A5. The results from this sensitivity test are likely to over-predict emissions from vehicles in the future (AQC, 2016a) and thus provide a reasonable worst-case upper-bound to the assessment.

'Air Quality Neutral"

3.17 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).

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

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

4 Site Description and Baseline Conditions

4.1 The proposed development site is located on a main road (High Street) in a predominantly residential area, with a large proportion of recreational green space in the southeast of Richmond upon Thames, in Outer London. The site is immediately bounded by High Street to the east, existing commercial properties (mostly now converted to residential use) to the south, St Clare Business Park to the west and existing commercial properties (with residential living space on the first floor) to the north. The site is more widely bounded by Holly Road (approximately 60 m to the south), Windmill Road (approximately 95 m to the north) and a railway line (approximately 110 m to the west). Across High Street to the east is a row of existing commercial properties with residential units, past which is a large area of green space (Bushy Park) (a SSSI).

Industrial and Waste Management Sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2016a) and Environment Agency's 'what's in your backyard' (Environment Agency, 2016) websites 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 Review and Assessment

4.3 LB of Richmond upon Thames has investigated air quality within its area as part of its responsibilities under the LAQM regime. In December 2000 an AQMA was declared at throughout the entire Borough for exceedences of the nitrogen dioxide annual mean objective, the PM_{10} annual mean objective and the PM_{10} 24-hour mean objective. The proposed development site is located within the AQMA. The declared AQMA is shown in Figure 2.

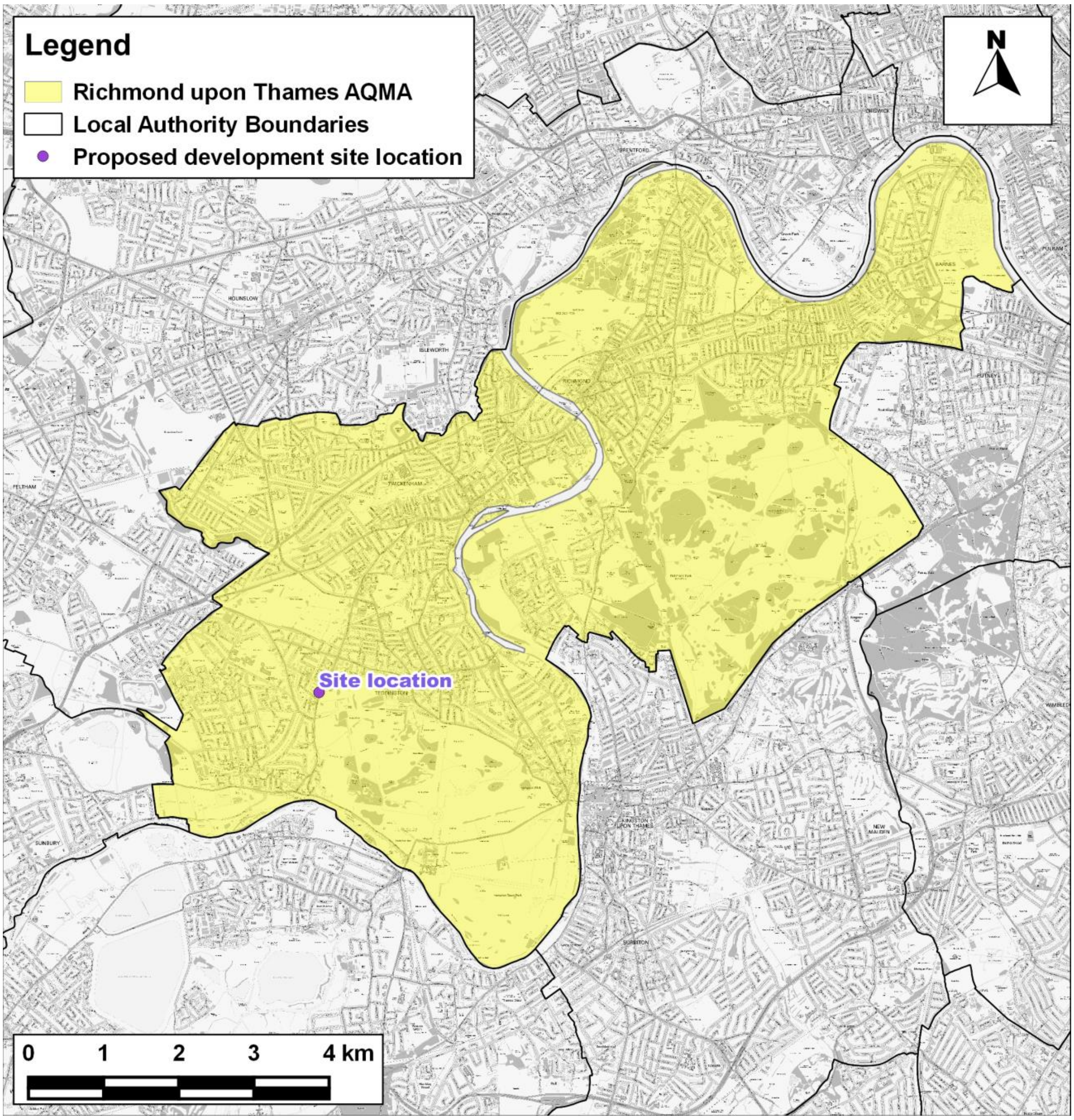

Figure 2: Declared AQMA, Proposed Development Site Location and Local Authority Boundaries

Local Air Quality Monitoring

4.4 The London Borough of Richmond upon Thames operates two stationary automatic monitoring stations and one mobile automatic monitoring station within its area. Neither of the stationary automatic monitoring stations are in close proximity to the proposed development site, and the mobile one has not been located in close proximity to the proposed development site for several years. 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 one deployed on the kerb of High Street (A311) (to the north of the proposed development site), one on the kerb of Uxbridge Road (A312) and one on the kerb of Hampton Road (A313). Results for the years 2010 to 2015 are summarised in Table 3 and the monitoring locations are shown in Figure 3.

Table 3: Summary of Nitrogen Dioxide (NO_2) Diffusion Tube Monitoring (2010-2015) [a]

Site No.	Site Type	Location	2011	2012	2013	2014	2015
Diffusion Tubes - Annual Mean (μg/m³) [b]							
3	Roadside	Uxbridge Road, Hampton	35	**44**	**44**	**44**	**41**
4	Roadside	Hampton Road, Teddington	38	**44**	**44**	**44**	36
64[c]	Roadside	High Street, Hampton	-	-	**54**	**<u>60</u>**	**55**
Objective			**40**				

[a] Exceedences of the objectives are shown in bold

[b] Data have been taken from the 2015 Updating and Screening Assessment for the London Borough of Richmond upon Thames (London Borough of Richmond upon Thames, 2015).

[c] Site no. 64 was not operative until 2013.

4.5 Measured annual mean nitrogen dioxide concentrations at all three diffusion tube monitoring sites consistently exceeded the annual mean objective from 2012 – 2015, with the exception of Site 4 in 2015 where concentrations were slightly below the objective. In 2014 the annual mean concentration at Site 64 measured 60 μg/m³, indicating a possible exceedence of the 1-hour mean nitrogen dioxide objective.

4.6 The three diffusion tube monitoring sites (Site 3, Site 4 and Site 64) are considered to be suitably representative of conditions at the site of the proposed development. All three monitoring sites are situated on kerbs adjacent to A-roads and are located within street canyons, and similarly the proposed development site is located adjacent to an A-road with one façade located within a street canyon.

4.7 Monitoring results for Site 3 and Site 4 show a trend of relatively stable concentrations over the past five years. There are no clear trends in monitoring results for Site 64 from 2013 - 2015. 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).

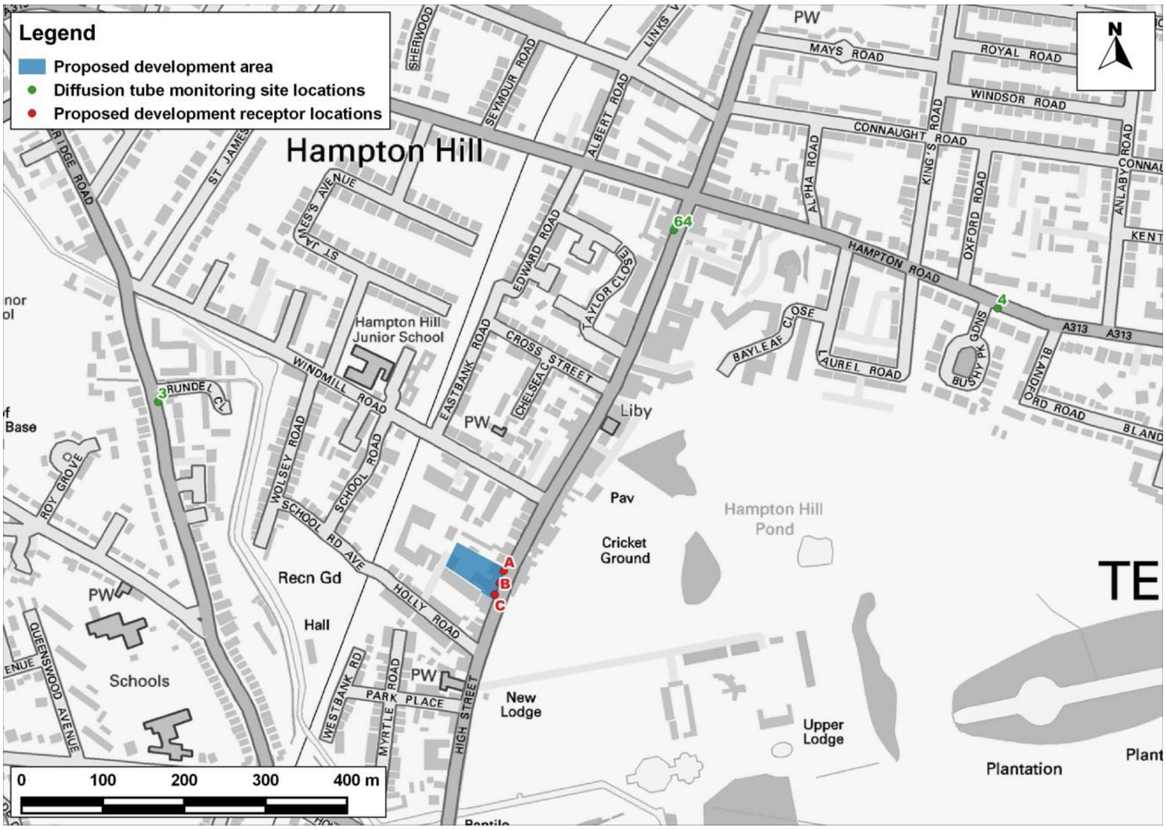

Figure 3: Diffusion Tube Monitoring Sites, Proposed Development Area and Proposed Development Receptor Locations

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4.8 There are no nearby local monitoring sites that measure PM_{10} or $PM_{2.5}$.

Exceedences of EU Limit Value

4.9 There are several AURN monitoring sites within the Greater London Urban Area that have measured exceedences of the annual mean nitrogen dioxide limit value. Furthermore, the national map of roadside annual mean nitrogen dioxide concentrations (Defra, 2016c), used to report exceedences of the limit value to the EU, identifies exceedences of this limit value in 2014 along many roads in London, but not for the roads close to the proposed development.

4.10 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 mapping for 2020, which takes account of the measures contained in its 2015 Air Quality Action Plan (Defra, 2015), does not identify any exceedences within 1 km of the development site.

Background Concentrations

4.11 In addition to locally measured concentrations, estimated background concentrations at the proposed development site have been determined for 2014 and the opening year 2018 (Table 4) using Defra's background maps (Defra, 2016b). The background concentrations 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 2014 and 2018 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2014	26.9	18.7	13.3
2018 [a]	23.7	18.0	12.6
2018 Worst-case Sensitivity Test [b]	*24.5*	*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 modern diesel vehicles as described 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 Year Dispersion Model Results

4.12 Baseline (2014) concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the receptor locations (see Figure 1 and Table 2). The results 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 modern diesel vehicles. 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).

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

Receptor	2014 [b]	*Worst-case Sensitivity Test [c]*
		2014
Receptor 1A	**48.8**	***48.8***
Receptor 1B	**49.8**	***49.8***
Receptor 1C	**49.0**	***49.0***
Receptor 2A	30.6	*30.6*
Receptor 2B	31.9	*31.9*
Receptor 2C	31.8	*31.8*
Receptor 3B	30.5	*30.4*
Receptor 3C	30.4	*30.4*
Objective	**40**	

a Exceedences of the objective are shown in bold.

b In line with Defra's forecasts.

c Assuming higher emissions from modern diesel vehicles as described in Paragraph A5.7.

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

Receptor	PM_{10}	$PM_{2.5}$
	2014	**2014**
Receptor 1A	21.9	15.2
Receptor 1B	22.1	15.3
Receptor 1C	21.9	15.2
Receptor 2A	19.2	13.5
Receptor 2B	19.4	13.7
Receptor 2C	19.3	13.6
Receptor 3B	19.2	13.5
Receptor 3C	19.2	13.5
Objective / Criterion	**32 [a]**	**25 [b]**

a While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG16 (Defra, 2016). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

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.

2014 Baseline

4.13 The predicted concentrations of nitrogen dioxide exceed the annual mean objective in 2014 at all receptors at first-floor level; i.e. a height of 4.5 m (1A, 1B and 1C). The predicted nitrogen dioxide concentrations at all receptors at second and third-floor heights (7.5 m or more) are consistently below the annual mean objective. The predicted annual mean nitrogen dioxide concentrations are below 60 $\mu g/m^3$ at all receptors and it is therefore unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded.

4.14 The predicted annual mean concentrations of PM_{10} and $PM_{2.5}$ are consistently well below the annual mean objective in 2014 at all receptors. The annual mean PM_{10} concentrations predicted at all receptors are below 32 $\mu g/m^3$ and it is therefore unlikely that the 24-hour mean PM_{10} objective will be exceeded.

4.15 These results are consistent with the conclusions of the LB of Richmond upon Thames in the outcome of its air quality review and assessment work.

Worst-case Sensitivity Test for Nitrogen Dioxide

4.16 The results from the upper-bound sensitivity test are not materially different from those derived using the 'official' predictions.

5 Construction Phase Impact Assessment

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

Potential Dust Emission Magnitude

Demolition

5.2 There will be a requirement to demolish two brick and concrete buildings with an approximate total volume of 6,000 m^3 and an approximate maximum height of 12 m. The method of demolition has not yet been decided. A mobile crusher will not be used on site before removal of the material. Based on the example definitions set out in Table A2.1, the dust emission class for demolition is considered to be *small.*

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, 2016), as set out in Table 7. Overall, it is considered that, when dry, this soil has the potential to be slightly-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 approximately 2,400 m^2 and most of this will be subject to earthworks, involving removal of the foundations of the demolished buildings and breaking up of a paved area. The earthworks will last around four months and dust will arise mainly from the handling of dusty materials and, depending on the construction methods selected, possibly also vehicles travelling over unpaved ground. Based on the example definitions set out in Table A2.1, the dust emission class for earthworks is considered to be *small.*

Construction

5.5 Construction will involve some 39 brick and concrete residential properties, with a total building volume of around 15,000 m^3. Dust will arise from, the handling and storage of dusty materials, the cutting of concrete, piling and, depending on the construction methods selected, possibly also vehicles travelling over unpaved ground. The construction will take place over an 18 month period. Based on the example definitions set out in Table A2.1, the dust emission class for construction is considered to be *small*.

Trackout

5.6 The number of vehicles accessing the site, which may track out dust and dirt is currently unknown, but given the medium size of the site it is likely that there will be a maximum of between 10-50 outward heavy vehicle movements per day. Based on the example definitions set out in Table A2.1, the dust emission class for trackout is considered to be *medium*.

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

Table 8: Summary of Dust Emission Magnitude

Source	Dust Emission Magnitude
Demolition	Small
Earthworks	Small
Construction	Small
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). There are approximately 10 - 20 residential properties within 20 m of the site (see Figure 4). Using the matrix set out in Table A2.3, the area surrounding the onsite works is of 'high' sensitivity to dust soiling.

5.10 Table 8 shows that dust emission magnitude for trackout is 'medium' and Table A2.3 thus explains that there is a risk of material being tracked 200 m from the site exit. Since it is not known which roads construction vehicles will use, it has been assumed that all possible routes could be affected. There are >100 residential properties within 20 m of the roads along which material could be tracked (see Figure 5), and Table A2.3 thus indicates that the area is of 'high' sensitivity to dust soiling due to trackout.

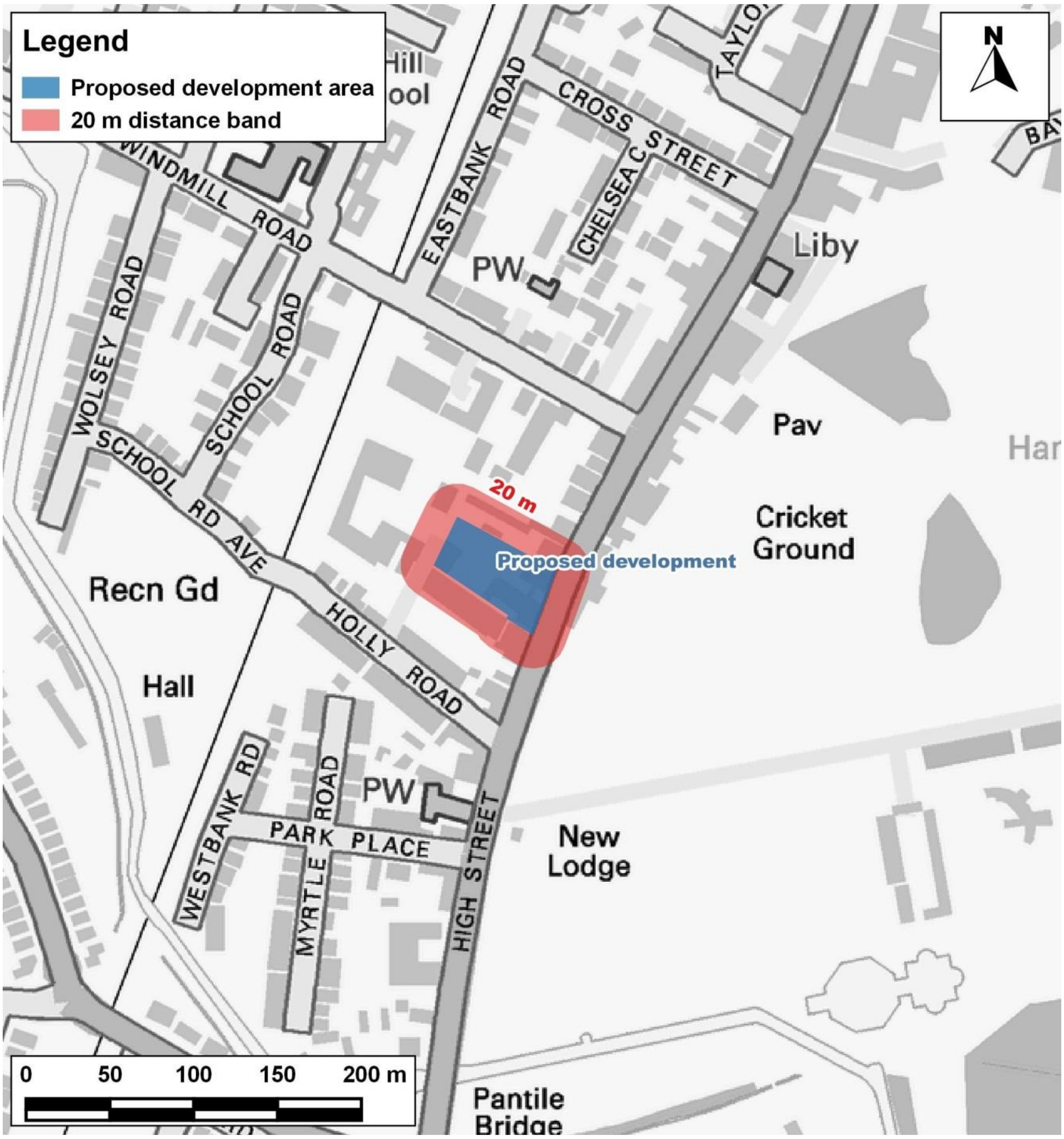

Figure 4: 20 m Distance Band around Proposed Development Site Boundary

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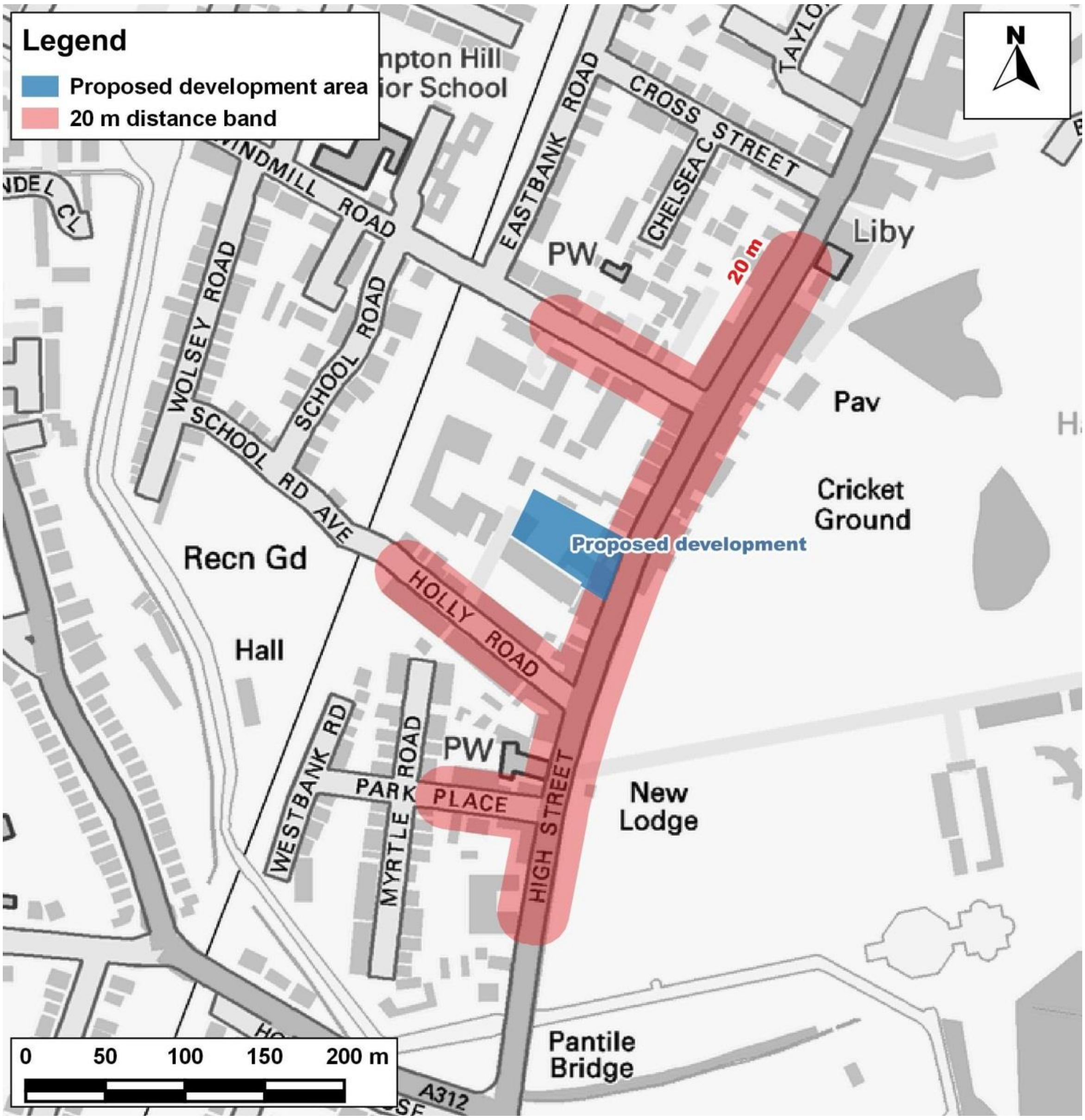

Figure 5: 20 m Distance Band around Roads Used by Construction Traffic Within 200 m of the Site Exit(s)

Sensitivity of the Area to any Human Health Effects

5.11 Residential properties are classified as being of ‘high’ sensitivity to human health effects, and commercial receptors are classed as being of “medium” sensitivity. The proposed development site is surrounded by both residential and commercial receptors, therefore the sensitivity to human health effects of the most sensitive receptors (i.e. residential) have been considered. The matrix in Table A2.4 requires information on the baseline annual mean PM_{10} concentration in the area. It is considered that the modelled baseline PM_{10} concentration at Receptor 1B (see Table 6) will best represent conditions near to the site. Using the matrix in Table A2.4, the area surrounding the onsite works is of 'low' sensitivity to human health effects, while the area surrounding roads along which material may be tracked from the site is of 'medium' sensitivity.

Sensitivity of the Area to any Ecological Effects

5.12 A SSSI (Bushy Park) is located approximately 25 m from the boundary of the proposed development site. The guidance considers SSSIs with dust-sensitive features to be of '*medium sensitivity'*. Since the SSSI is within 50 m but more than 20 m from the site boundary, Table A2.5 shows that the area is of *low* sensitivity to ecological effects during demolition, earthworks and construction. Because the SSSI is within 20 m of roads along which material may be tracked, Table A2.5 shows that the area is of *medium* sensitivity to ecological effects from trackout.

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	Medium Sensitivity
Ecological	Low Sensitivity	Medium 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 7.

Table 10: Summary of Risk of Impacts Without Mitigation

Source	Dust Soiling	Human Health	Ecology
Demolition	Medium Risk	Negligible Risk	Negligible Risk
Earthworks	Low Risk	Negligible Risk	Negligible Risk
Construction	Low Risk	Negligible Risk	Negligible Risk
Trackout	Medium Risk	Low 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' (Institute of Air Quality Management, 2014).

6 Operational Phase Impact Assessment

Impacts on the Development

6.1 Predicted air quality conditions for residents of the proposed development are set out in Table 11 for Receptors 1A to 3C (see Table 2 and Figure 1 for receptor locations). Concentrations at receptors on the first floor (receptors 1A, 1B and 1C) exceed the annual mean nitrogen dioxide objective for both the “official” and “worst-case sensitivity test” scenarios. Concentrations of nitrogen dioxide are below the objectives on the second and third floors and concentrations of PM_{10} and $PM_{2.5}$ are below the objectives at all receptors for both the “official” and “worst-case sensitivity test” scenarios.

6.2 The reason for the large decrease in concentrations between the first and second floor levels is related to the fact that at first-floor height, the proposed apartments will sit within a partial street canyon formed with the 2-storey buildings on the opposite side of the street, whereas at second and third-floor levels, the apartments will be higher than opposing buildings and therefore do not experience the same street canyon effects, which cause reduced pollutant dispersion.

6.3 Air quality for future residents within the second and third floors of the development will therefore be acceptable, however air quality within the first floor of the development will not.

Table 11: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2018 for New Receptors in the Development Site

Receptor	Annual Mean NO_2 (µg/m^3)		Annual Mean PM_{10} (µg/m^3)	Annual Mean $PM_{2.5}$ (µg/m^3)
	'Official' Prediction [a]	*Worst-case Sensitivity Test* [b]		
Receptor 1A (first floor)	**40.4**	***42.5***	20.9	14.3
Receptor 1B (first floor)	**41.2**	***43.3***	21.0	14.4
Receptor 1C (first floor)	**40.6**	***42.7***	20.9	14.3
Receptor 2A (second floor)	26.4	*27.5*	18.4	12.9
Receptor 2B (second floor)	27.3	*28.5*	18.6	13.0
Receptor 2C (second floor)	27.3	*28.4*	18.6	12.9
Receptor 3B (third floor)	26.3	*27.3*	18.4	12.9
Receptor 3C (third floor)	26.3	*27.3*	18.4	12.9
Objective / Criterion	**40**		**32** [c]	**25** [d]

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in Paragraph A5.7.

[c] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG(09) (Defra, 2009). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

[d] 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.

'Air Quality Neutral'

6.4 The heat and hot water demands of the proposed development will be provided by gas-fired boiler plant. The apartments and domestic areas will be served by a centralised gas-fired boiler system and the townhouses will have individual gas-fired combi boilers. The development will not include a biomass boiler or CHP plant, but will included photovoltaic cells and air source heat pumps.

Building Emissions

6.5 The estimated annual gas consumption of the proposed development is approximately 750,000 kWh/annum. It is proposed to use MHS Ultramax R601 boilers in the centralised system serving the apartments and domestic areas, which have a maximum NOx emission rate of 35 mg/kWh. The specifications of the individual boilers serving the townhouses is not yet decided, but these will be low-NOx (<40 mg/kWh). For the purposes of this air quality neutral assessment it has been assumed that all the gas-fired boiler plant at the proposed development will have a maximum NOx emission rate of 40 mg/KWh (consistent with The GLA's SPG on Sustainable Design and

Construction (GLA, 2014a)). The total NOx emission from all of the proposed boilers is therefore assumed to be **30.0 kg/annum** (750,000 x 40 / 1,000,000).

6.6 Table 12 sets out the calculation of the building emissions benchmark for the proposed development, which is based on GIA information provided by West and Partners.

Table 12: Calculation of Building Emissions Benchmark for the Development

	Description	Value	Reference
A	**Gross Internal Floor Area of Residential Units (m^2)**	4,845	West and Partners
B	**NOx BEB for Residential Units ($g/m^2/annum$)**	26.2	Table A6.1
C	**Gross Internal Floor Area of A1 Retail Units (m^2)**	132.4	West and Partners
D	**NOx BEB for A1 Retail Units ($g/m^2/annum$)**	22.6	Table A6.1
Total BEB NOx Emissions (kg/annum)		**129.9**	(A x B + C x D) / 1000

6.7 The Total Building NOx Emission of 30 kg/annum is less than Total BEB NOx Emission of approximately 129.9 kg/annum. The proposed development is thus better than air quality neutral in terms of building emissions.

Road Transport Emissions

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

6.9 HaskoningDHV has advised that the proposed development is expected to generate a total of 80 trips per day, which equates to 29,200 trips per year. The traffic data provided do not distinguish between trips generated by the residential properties (C3) and the retail properties (A1).

6.10 Appendix A6 provides default values for the average trip length for C3 residential properties and A1 retail properties in Outer London, as well as the average NOx and PM_{10} emissions per vehicle-kilometre. It has been assumed that all trips generated by the proposed development are associated with the residential properties (C3), as the average trip length for residential properties (as provided by Table A6.3) is greater than for retail properties, therefore providing a worst-case scenario for estimated emissions. This information has been used to calculate the transport emissions generated by the development (Table 13).

6.11 These have then been compared with the TEBs for the development set out in Table 14.

Table 13: Calculation of Transport Emissions for the Development

	Description	Value		Reference
Residential (C3)				
A	**Total Vehicle Trips per Year** [a]	29,200		HaskoningDHV
B	**Average Distance per Trip (km)**	11.4		Table A6.3
		NOx	**PM_{10}**	-
C	**Emissions per Vehicle-km (g)**	0.353	0.0606	Table A6.4
D	**Residential Transport Emissions (kg/annum)**	**117.5**	**20.2**	A x B x C / 1,000

[a] Each trip is 1-way (i.e. a return journey would be two trips).

Table 14: Calculation of Transport Emissions Benchmarks for the Development

	Description	Value		Reference
Residential (C3)				
A	**Number of Dwellings**	39		Great Planet Ltd
		NOx	**PM_{10}**	-
B	**Benchmark Emissions (g/dwelling/annum)**	1553	267	Table A6.2
C	**Residential TEBs**	60.6	10.4	A x B / 1000
Retail (A1)				
D	**Gross Internal Floor Area (m^2) of Retail**	132.4		West and Partners
		NOx	**PM_{10}**	
E	**Benchmark Emissions (g/m^2/annum)**	249	42.9	Table A6.2
F	**Retail TEBs**	33.0	5.7	D x E / 1000
Entire Development				
Total TEBs (kg/annum)		**93.6**	**16.1**	C + F

6.12 The Total Transport Emissions are greater than the Total Transport Emissions Benchmarks for both NOx and PM_{10}. The proposed development therefore does not meet the requirements of air quality neutral in terms of transport emissions.

Significance of Operational Air Quality Impacts

6.13 The operational air quality impacts without mitigation are judged to be ‘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.

6.14 More specifically, the judgement that without mitigation air quality impacts will be 'significant' takes account of the assessment that concentrations are predicted to be above the annual mean nitrogen dioxide objective at receptors located on the first floor of the development. It is therefore necessary to consider mitigation for this scheme.

7 Mitigation

Construction Mitigation

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

7.2 The construction works will give rise to a *Medium Risk* of dust soiling impacts during demolition and earthworks and as a result of trackout by vehicles, and a *Low Risk* of dust soiling impacts during construction, as set out in Table 10. The risk of impacts to human health and ecology during construction works will be *Low Risk* during earthworks and as a result of trackout by vehicles, and *Negligible Risk* during demolition and construction, also 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 that should be undertaken during the construction phase. This reflects best practice experience and has been used, together with the professional experience of the consultant and the findings of the dust impact assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in Appendix A7.

7.3 The mitigation measures should be written into a dust management plan (DMP). This will form part of the First Stage Construction Logistics Plan that will be submitted with the planning application.

7.4 Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There should not be any excess to potentially contaminate local watercourses.

Operational Mitigation

7.5 The assessment has demonstrated that proposed apartments on the first floor of the proposed development facing the High Street may experience nitrogen dioxide concentrations that exceed the annual mean objective.

7.6 In order to mitigate these impacts, it is recommended that first-floor apartments fronting onto the High Street are supplied with a clean air using a mechanical ventilation system. The system should draw air from the roof or rear of the building where the nitrogen dioxide concentrations are below the objective.

7.7 Mitigation measures to reduce pollutant emissions from road traffic are principally being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation. The LB of Richmond upon Thames' Air Quality Action Plan (London Borough of

Richmond upon Thames, 2002), the Richmond upon Thames Second Local [Transport] Implementation Plan (London Borough of Richmond upon Thames, 2011) and certain other local policies will also be helping to deliver improved air quality.

Air Quality Neutral

7.8 While the development itself has no adverse impacts on local air quality, the road traffic movements predicted for the scheme cause the development to exceed the benchmark derived for an average development of this nature in outer London.

7.9 Policy 6.13 of the London Plan (GLA, 2015) outlines that *"developments must…ensure that 1 in 5 spaces (both active and passive) provide an electrical charging point to encourage the uptake of electric vehicles"*. Table 6.2 of the London Plan further emphasises this, stating that, for residential developments, 20% of all car parking spaces must be for electric vehicles, with an additional 20% passive provision for electric vehicles and that for retail developments, 10% of all car parking spaces must be for electric vehicles, with an additional 10% passive provision for electric vehicles. The proposed development will include a passive provision for up to 100% of spaces to be equipped with electric vehicle charging facilities, which will assist in minimising the impacts on the development and contribute to making the scheme air quality neutral, as the uptake of electric vehicles increases.

7.10 It should also be borne in mind that the vehicle generation of the proposed development is lower than that of the existing offices at the site.

7.11 Although not related to transport emissions, the development will provide provision for photovoltaic cells for emission-free energy, and will utilised air source heat pumps for cooling of some dwellings, therefore reducing the demand on combustion plant and reducing the emissions footprint of the development.

8 Residual Impacts

Construction

8.1 The IAQM guidance is clear that, with appropriate mitigation in place, the residual effects will normally be 'not significant'. The mitigation measures set out in Section 7 and Appendix A7 are based on the IAQM guidance. With these measures in place and effectively implemented the residual effects are judged to be 'not significant'.

8.2 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'.

Operational Impacts

8.3 Without appropriate mitigation in place, residents of first-floor fronting onto the High Street may be exposed to exceedences of the annual mean nitrogen dioxide objective. With mitigation provided in the form of a mechanical ventilation system, the residual air quality impacts on the scheme are judged to be 'not significant'.

9 Conclusions

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

9.2 The impacts of traffic emissions from local roads on the air quality for future residents have been assessed. 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 modern diesel vehicles.

9.3 Concentrations of PM_{10} and $PM_{2.5}$ will remain below the objectives at all existing receptors in 2018 (the likely year of occupation). In the case of nitrogen dioxide, the annual mean concentrations are above the annual mean objective at High Street-facing apartments on the first floor level, but are below the annual mean objective oat all apartments on the second and third floors.

9.4 The impacts of local traffic on the air quality for residents living in the first floor of the proposed development are considered to be 'significant' without mitigation. As such, mitigation is recommended in the form of mechanical ventilation to supply clean air from the rear or roof of the building to first-floor apartments fronting onto High Street. With such mitigation in place, the residual air quality impacts will be 'not significant'.

9.5 With mitigation in place it is concluded that road traffic emissions do not provide any constraints to the proposed scheme. The proposed development is consistent with the NPPF and the scheme does not conflict with the requirements of Spatial Policy 1.D of the LB of Richmond upon Thames Local Development Framework Core Strategy (London Borough of Richmond upon Thames, 2009), nor does it conflict with, or render unworkable, any elements of the Air Quality Action Plan (London Borough of Richmond upon Thames, 2002).

9.6 The building emissions associated with the proposed development are below the relevant benchmarks; however, the proposed development exceeds the relevant emissions benchmark for transport emissions. This exceedence is not by a large margin, and is based on worst case assumptions applied to the calculations. The installation of electric charge points to encourage uptake of electric vehicles will help the development become air quality neutral.

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11 Glossary

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

NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PHV	Private Hire Vehicle
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide
TEB	Transport Emissions Benchmark
TRAVL	Trip Rate Assessment Valid for London
ULEZ	Ultra Low Emission Zone

12 Appendices

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-sire provision is impractical or inappropriate, and that it is possible to put in place measures having clearly demonstrated equivalent air quality benefits, planning obligations or planning conditions should be used as appropriate to ensure this, whether on a scheme by scheme basis or through joint area-based approaches;

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

The Mayor's Air Quality Strategy

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

Policy 1 – Encouraging smarter choices and sustainable travel;

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

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

Supporting car free developments.

Policy 2 – Promoting technological change and cleaner vehicles:

Supporting the uptake of cleaner vehicles.

Policy 4 – Reducing emissions from public transport:

Introducing age limits for taxis and PHVs.

Policy 5 – Schemes that control emissions to air:

Implementing Phases 3 and 4 of the LEZ from January 2012

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

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

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

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

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

Applying emissions limits for biomass boilers across London;

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

Low Emission Zone (LEZ)

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

Ultra Low Emission Zone (ULEZ)

A1.4 The Mayor has confirmed the introduction of the Ultra Low Emission Zone (ULEZ) in the Capital on 7 September 2020. 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.

A2 Construction Dust Assessment Procedure

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

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

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

STEP 1: Screen the Need for a Detailed Assessment

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

A2.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will 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 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level
Small	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months
Earthworks	
Large	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes
Medium	Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes
Small	Total site area <2,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <10,000 tonnes, earthworks during wetter months
Construction	
Large	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting
Medium	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching
Small	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout [a]	
Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

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

Step 2B – Define the Sensitivity of the Area

A2.8 The sensitivity of the area is defined taking account of a number of factors:

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

A2.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM 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 A7.

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' (Institute of Air Quality Management, 2014).

A2.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will 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	Low	Low	Low	Low
Low	>1	Low	Low	Low	Low

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/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

[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 large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table A2.5: Sensitivity of the Area to Ecological Effects [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[4] (EPUK & IAQM, 2015) 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:

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

- 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 follow apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use;
- 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;
- 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, the criteria for which are set out below. 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 is likely to be more appropriate.

- 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;
- 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;
- the development will have one or more substantial combustion processes where the combustion unit is:
  - any centralised plant using bio fuel;
  - any combustion plant with single or combined thermal input >300 kW; or
  - a standby emergency generator associated with a centralised energy centre (if likely to be tested/used >18 hours a year).
- the development will have a combustion unit of any size where emissions are at a height that may give rise to impacts through insufficient dispersion, e.g. through nearby buildings.

A3.10 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.

A3.11 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.

Assessment of Significance

A3.12 There is no official guidance in the UK in relation to development control on how to assess the significance of air quality impacts. The approach developed by EPUK and IAQM[5] (EPUK & IAQM, 2015) has therefore been used. The guidance is that the assessment of significance should be based on professional judgement, with the overall air quality impact of the scheme described as either 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. 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.

A3.13 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.

A3.14 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.

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

A4 Professional Experience

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

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

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

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

Nicole Holland, BSc (Hons) AIEMA

Miss Holland is an Assistant Consultant with AQC, having joined the company in March 2016. Nicole is gaining experience of undertaking air quality assessments for a range of developments, including the use of dispersion modelling. Prior to joining AQC she worked for 3 years as an environmental consultant, gaining particular experience of Environmental and Social Management System (ESMS) and Environmental and Social Impact Assessment (ESIA).

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 (v4.0). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width and street canyon height, width and porosity, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 6.0.2) published by Defra (2016b).

A5.2 Hourly sequential meteorological data from Heathrow for 2014 have been used in the model. The Heathrow meteorological monitoring station is located at Heathrow Airport, approximately 10.5 km to the northwest of the proposed development site. It is deemed to be the nearest monitoring station representative of meteorological conditions at the proposed development site; both the development site and the Heathrow meteorological monitoring station are located at urban inland locations in the southwest of England where they will be influenced by the effects of inland meteorology on urban topography.

A5.3 For the purposes of modelling, it has been assumed that the front façade of the proposed development is within a street canyon formed by the buildings on High Street. This road has a number of canyon-like features, which reduce dispersion of traffic emissions, and can therefore lead to concentrations of pollutants being higher here than they would be in areas with greater dispersion. High Street has, therefore, been modelled as a street canyon using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from plans, local mapping and satellite imagery. The degree to which dispersion is limited within a canyon is influenced by its width, height and porosity, all of are considered within the model.

A5.4 Traffic data for High Street (A311), Hampton Road (A313), Uxbridge Road (A312) and Windmill Road have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016). Traffic speeds have been based on those presented in the LAEI, with some having been adjusted based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A5.1.

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

Road Link	2014		2018	
	AADT	%HDV	AADT	%HDV
High Street	14,274	1.1	14,474	1.1
Park Road	14,830	1.2	15,031	1.2
Wellington Road	9,560	1.8	9,692	1.8

Hampton Road	19,231	2.4	19,493	2.4
Windmill Road	5,030	0.2	5,100	0.2
Uxbridge Road	15,855	2.2	16,077	2.2

[a] This is just a summary of the data entered into the model, which have been input as daily average flows of petrol cars, diesel cars, taxis, Light Goods Vehicles (LGVs), Rigid Heavy Goods Vehicles (HGVs), Artic HGVs and motorbikes, as well as diurnal flow profiles for these vehicles.

A5.5 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2015).

A5.6 Figure A5.1 shows the road network included within the model.

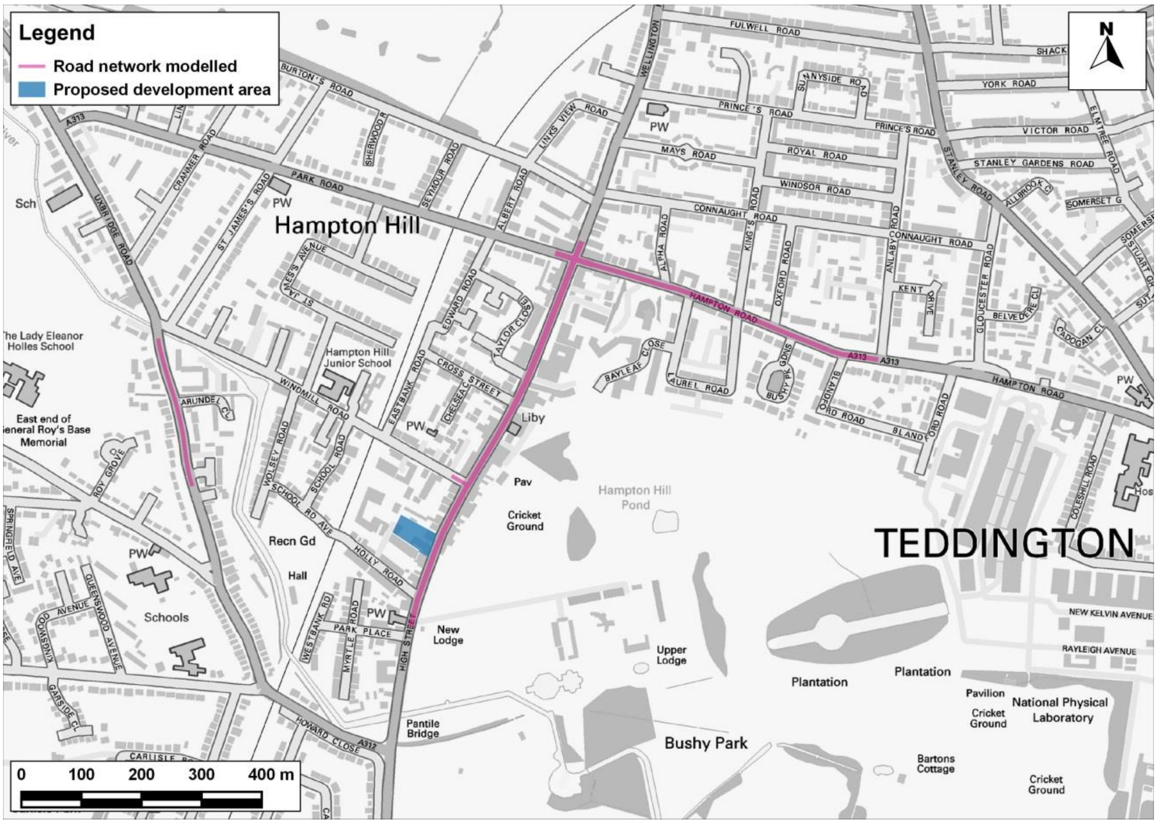

Figure A5.1: Modelled Road Network and Proposed Development Site Area

Sensitivity Test for Nitrogen Oxides and Nitrogen Dioxide

A5.7 As explained in Section 3, AQC has carried out a detailed analysis which showed that, where previous standards 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, 2016a). Furthermore, these improvements are expected to increase as the Euro 6 standard is fully implemented. Despite this, the detailed analysis suggested that, in addition to modelling using the

EFT, a sensitivity test using elevated nitrogen oxides emissions from certain diesel vehicles should be carried out (AQC, 2016a). A worst-case sensitivity test has thus been carried out by applying the adjustments set out in Table A5.2 to the emission factors used within the EFT[6]. The justifications for these adjustments are given in AQC (2016a). Results are thus presented for two scenarios: first the ‘official prediction’, which uses the EFT with no adjustment, and second the ‘worst-case sensitivity test’, which applies the adjustments set out in Table A5.2. The results from this sensitivity test are likely to over-predict emissions from vehicles in the future and thus provide a reasonable worst-case upper-bound to the assessment.

Table A5.2: Summary of Adjustments Made to Emission Factor Toolkit

Vehicle Type		Adjustment Applied to Emission Factors
All Petrol Vehicles		No adjustment
Light Duty Diesel Vehicles	**Euro 5 and earlier**	No adjustment
	Euro 6	Increased by 60%
Heavy Duty Diesel Vehicles	**Euro III and earlier**	No adjustment
	Euro IV and V	Set to equal Euro III values
	Euro VI	Set to equal 20% of Euro III emissions [a]

[a] Taking account of the speed-emission curves for different Euro classes as explained in AQC (2016a).

Background Concentrations

A5.8 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2016b). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. Nitrogen dioxide concentrations provided by the background maps for 2014 have been calibrated against local measurements made at the TD0 background automatic monitoring site (see Figure A.5.2). The measured nitrogen dioxide concentration at this site in 2014 was 27.0 µg/m^3, while the mapped background was 20.9 µg/m^3. All mapped background nitrogen dioxide concentrations have therefore been adjusted by applying a factor of 1.29.

A5.9 PM_{10} and $PM_{2.5}$ concentrations provided by the background maps for 2014 have not been calibrated.

6 All adjustments were applied to the COPERT functions. Fleet compositions etc. were applied following the same methodology as used within the EFT.

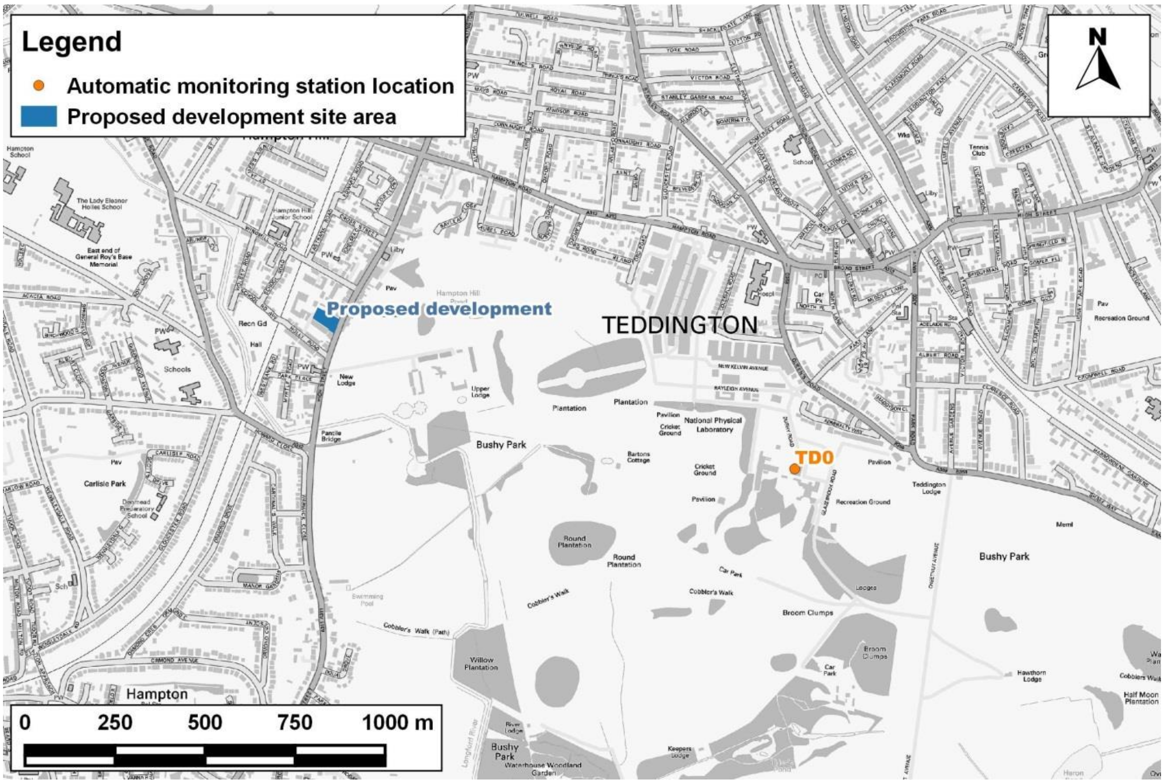

Figure A5.2: Automatic Monitoring Station and Proposed Development Area Locations

Background NO_2 and NOx Concentrations for Sensitivity Test

A5.10 The road-traffic components of nitrogen oxides and nitrogen dioxide in the background maps have been uplifted in order to derive future year background nitrogen dioxide and nitrogen oxides concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2016b).

Model Verification

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

Background Concentrations

A5.12 The 2014 background concentrations for the diffusion tube sites have been derived from the national maps, having been calculated using the same approach as described in Paragraphs A5.8 and A5.9. The background concentrations for each of the diffusion tube locations are presented in Table A5.3.

Table A5.3: Background Concentrations used in the Verification for 2014

Tube ID	Grid square	NOx	NO_2	PM_{10}	$PM_{2.5}$
DT3	513500,171500	33.28	28.88	19.03	13.47
DT4	514500,171500	33.60	29.11	19.17	13.55
DT64	514500,171500	33.60	29.11	19.17	13.55

Traffic Data

A5.13 AADT flows, and the proportions of HDVs, for the A-roads adjacent to the monitoring sites, have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2013). Traffic speeds have been based on those presented in the LAEI, with some having been adjusted based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction.

A5.14 The 2013 and predicted 2020 traffic data have been interpolated to estimate traffic data for 2014. Traffic data used in the model verification are presented in Table A5.4.

Table A5.4: AADT Traffic Data used in the Model Verification

Road Link	2014 AADT
Hampton Road (adjacent to DT4)	19,231
Uxbridge Road (adjacent to DT3)	15,855
High Street (adjacent to DT64)	14,274

Nitrogen Dioxide

A5.15 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 2014 at the DT3, DT4 and DT64 diffusion tube monitoring sites. Concentrations have been modelled at 2.3 m, 2.5 m and 2.1 m for DT3, DT4 and DT64 respectively, as these are the approximate heights of the monitors.

A5.16 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 4.1) available on the Defra LAQM Support website (Defra, 2016b).

A5.17 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 2.000 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A5.18 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.

A5.19 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.

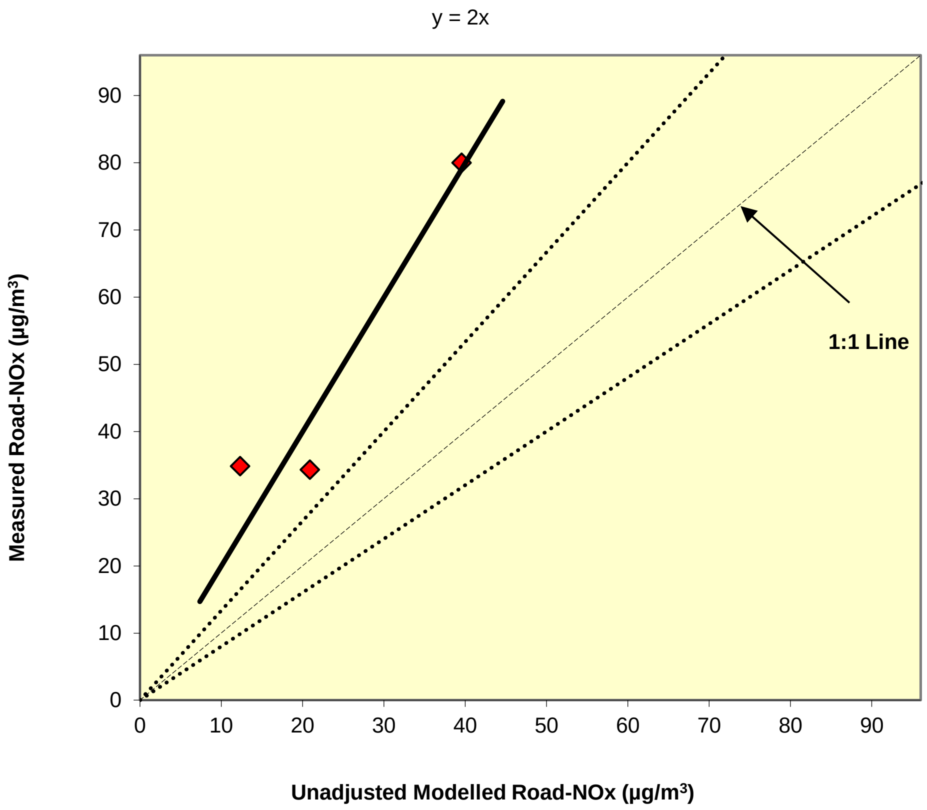

Figure A5.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

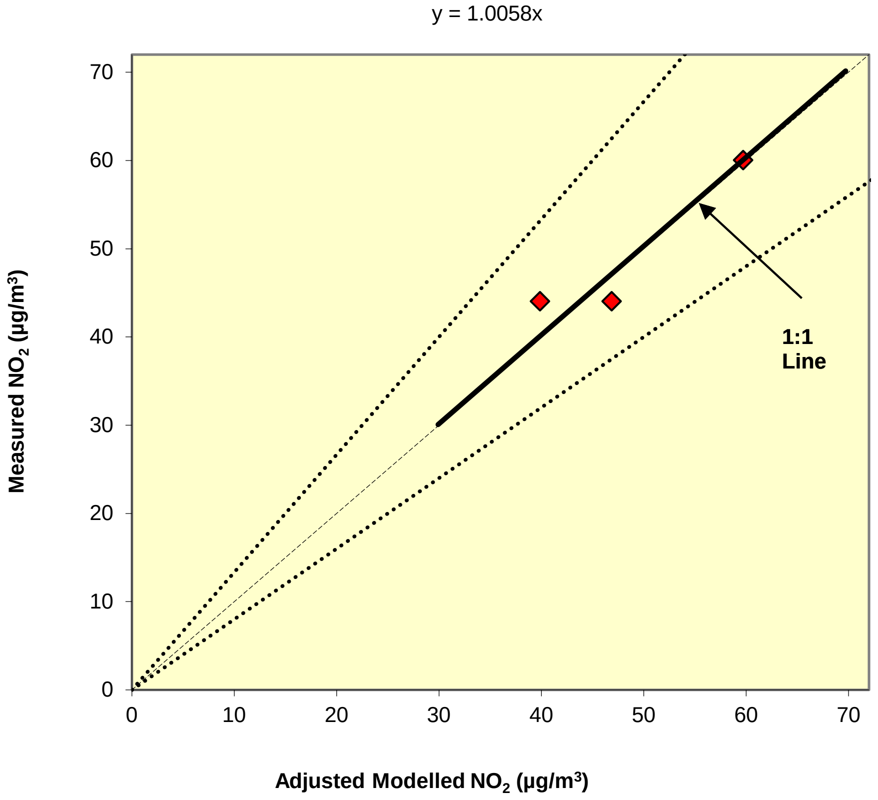

Figure A5.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A5.20 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 Verification for NOx and NO_2 Sensitivity Test

A5.21 The approach set out above has been repeated using the predicted road-NOx and background concentrations specific to the sensitivity test. This has resulted in an adjustment factor of 1.781, which has been applied to all modelled road-NOx concentrations within the sensitivity test.

Model Post-processing

A5.22 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, 2016b). 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.

A6 'Air Quality Neutral'

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

A6.2 The benchmarks for heating and energy plant (termed 'Building Emissions Benchmarks' or 'BEBs') are set out in Table A6.1, while the 'Transport Emissions Benchmarks' ('TEBs') are set out in Table A6.2. In order to assess against the TEBs, it is necessary to combine the expected trip generation from the development with estimates of average trip length and average emission per vehicle. So as to ensure a consistent methodology, the report which accompanies the SPG (AQC, 2014) recommends that the information in Table A6.3 and Table A6.4 (upon which the TEBs are based) is used. Similarly, the information in Table A6.5 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 A6.6 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 A6.1: Building Emissions Benchmarks (g/m^2 of Gross Internal Floor Area)

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

Table A6.2: Transport Emissions Benchmarks

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

[a] Central Activity Zone

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

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

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

Table A6.4: Average Road Traffic Emission Factors in London in 2010

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

Table A6.5: Average 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 A6.6: Average Number of Light Vehicle 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

A7 Construction Mitigation

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

Site Management

- develop 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;
- 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;
- 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 phase begins.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone;
- ensure all Non-road Mobile Machinery (NRMM) comply with the standards set within the GLA's Control of Dust and Emissions During Construction and Demolition SPG. This outlines that, from 1st September 2015, all NRMM of net power 37 kW to 560 kW used on the site of a major development in Greater London must meet Stage IIIA of EU Directive 97/68/EC (Directive 97/68/EC of the European Parliament and of the Council, 1997) and its subsequent amendments as a minimum. NRMM used on any site within the Central Activity Zone or Canary Wharf will be required to meet Stage IIIB of the Directive as a minimum. From 1st September 2020 NRMM used on any site within Greater London will be required to meet Stage IIIB of the Directive as a minimum, while NRMM used on any site within the Central Activity Zone or Canary Wharf will be required to meet Stage IV of the Directive as a minimum;
- ensure all vehicles switch off engines when stationary – no idling vehicles;
- avoid the use of diesel- or petrol-powered generators and use mains electricity or battery-powered equipment where practicable;
- 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 Demolition

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

Measures Specific to Earthworks

- Where practical, 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; and
- ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.

Measures Specific to Trackout

- Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site;
- avoid dry sweeping of large areas;
- ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport; and
- access gates should be located at least 10 m from receptors, where possible.