Twickenham Rediscovered Programme – Riverside

Air Quality and Odour Assessment

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1 INTRODUCTION

1.1 Entran Limited has been commissioned to undertake an assessment of air quality impacts associated with the re-development of land at Twickenham Riverside, to the south of King Street, Twickenham within the London Borough of Richmond-upon-Thames. The location of the Site is shown in Figure 1.

1.2 The Site is currently occupied by commercial buildings and a surface level car park. It is proposed to clear the Site and construct two new buildings providing commercial/retail premises at ground floor level and residential flats at 1st, 2nd and 3rd floor level. The proposals also provide a total of 38 parking spaces and 68 cycle parking spaces in a basement. An indicative layout of the Site at 1st floor level is presented in Figure 2.

1.3 The London Borough of Richmond-upon-Thames (LBRT) has declared the whole borough as an Air Quality Management Area (AQMA) due to exceedences of the nitrogen dioxide (NO_2) and particulate matter (PM_{10}) objectives. The Site therefore falls within an AQMA.

1.4 This report presents the findings of a detailed air quality and odour assessment of the potential impacts associated with the proposed development on local air quality during both construction and operational phases. For both phases the type, source and significance of potential impacts are identified and the measures that should be employed to minimise these impacts are described.

1.5 A glossary of common air quality terminology is provided in **Appendix A.**

Figure 1: Site Location Plan

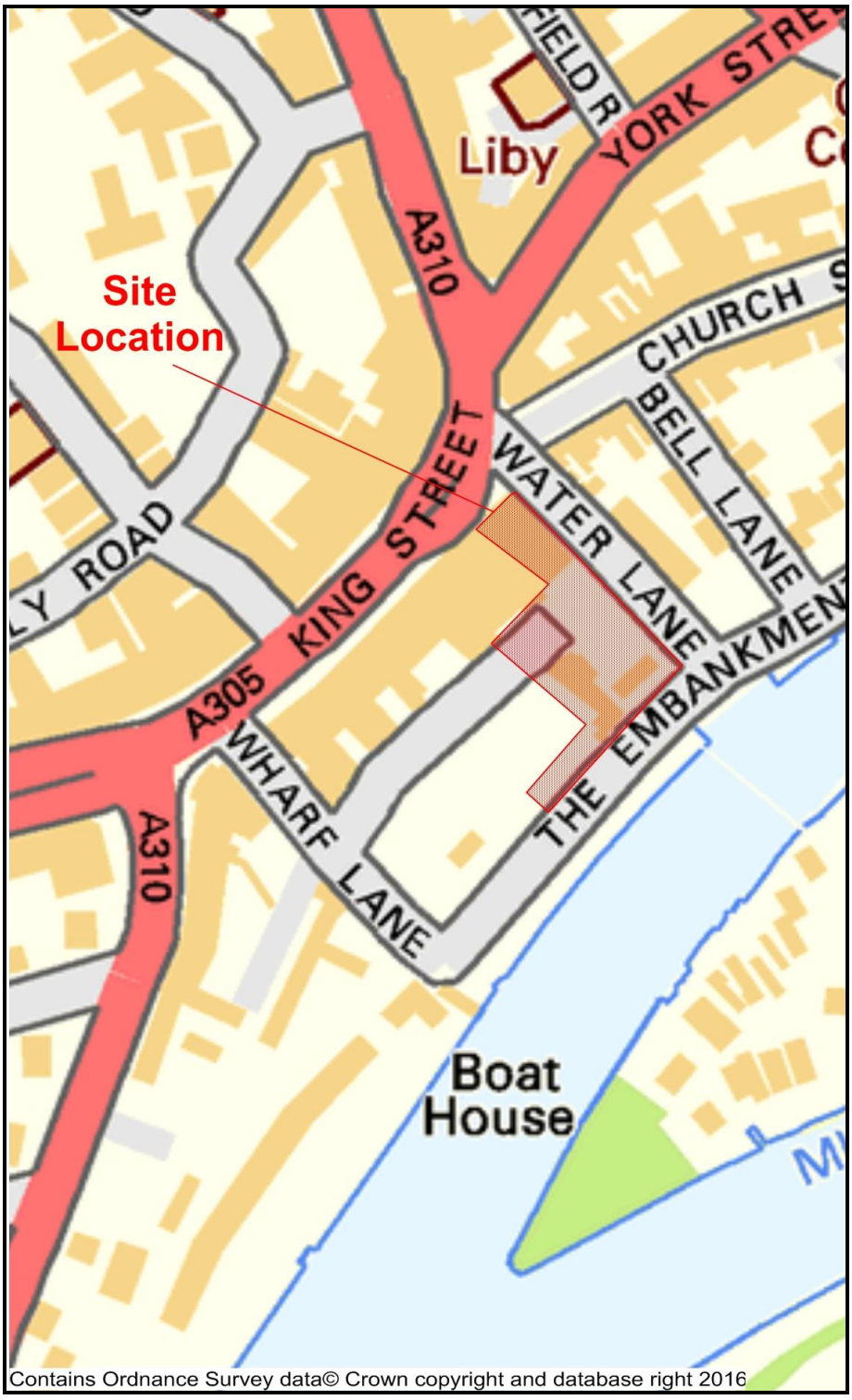


Figure 2: Proposed Development

2 LEGISLATION AND POLICY

Air Quality Strategy for England, Scotland, Wales & Northern Ireland

2.1 The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007[1], pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

2.2 The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems. These are benzene (C_6H_6), 1,3-butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10}, $PM_{2.5}$), sulphur dioxide (SO_2), ozone (O_3) and polycyclic aromatic hydrocarbons (PAHs).

2.3 The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

2.4 The air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedances of the standard over a given period.

2.5 For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of nitrogen dioxide (NO_2), the short-term standard is for a 1-hour averaging period, whereas for fine particulates (PM_{10}) it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (e.g. temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – July 2007.

2.6 The current statutory standards and objectives are set out in the table presented in **Appendix B**.

2.7 Of the pollutants included in the AQS, NO_2, PM_{10} and $PM_{2.5}$ will be particularly relevant to this project, as these are the primary pollutants associated with road traffic.

Local Air Quality Management (LAQM)

2.8 Part IV of the Environment Act 1995 also requires local authorities to periodically Review and Assess the quality of air within their administrative area. The Reviews have to consider the present and future air quality and whether any air quality objectives prescribed in Regulations are being achieved or are likely to be achieved in the future.

2.9 Where any of the prescribed air quality objectives are not likely to be achieved the authority concerned must designate that part an Air Quality Management Area (AQMA).

2.10 For each AQMA, the local authority has a duty to draw up an Air Quality Action Plan (AQAP) setting out the measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the air quality objectives. Local authorities are not statutorily obliged to meet the objectives, but they must show that they are working towards them.

2.11 The Department of Environment, Food and Rural Affairs (DEFRA) has published technical guidance for use by local authorities in their Review and Assessment work[2]. This guidance, referred to in this chapter as LAQM.TG(16), has been used where appropriate in the assessment.

National Planning Policy Framework

2.12 Published on 27th March 2012, the National Planning Policy Framework (NPPF)[3] sets out the Government's planning policies for England and how these are expected to be applied. It replaces Planning Policy Statement 23: Planning and Pollution Control[4], which provided planning guidance for local authorities with regards to air quality.

[2] Department for Environment, Food and Rural Affairs (DEFRA), (2016): Part IV The Environment Act 1995 Local Air Quality Management Review and Assessment Technical Guidance LAQM.TG(16).

[3] Communities and Local Government: *National Planning Policy Framework* (March 2012)

[4] Office of the Deputy Prime Minister: *Planning Policy Statement 23: Planning and Pollution Control* (Oct 2004).

2.13 At the heart of the NPPF is a presumption in favour of sustainable development. It requires Local Plans to be consistent with the principles and policies set out in the Framework with the objective of contributing to the achievement of sustainable development.

2.14 Current planning law requires that applications for planning permission must be determined in accordance with the relevant development plan (i.e. Local Plan or Neighbourhood Plan). The NPPF should be taken into account in the preparation of development plans and therefore the policies set out within the Framework are a material consideration in planning decisions.

2.15 The NPPF identifies 12 core planning principles that should underpin both plan-making and decision-taking, including a requirement for planning to '*contribute to conserving and enhancing the natural environment and reducing pollution'.*

2.16 Under Policy 11: Conserving and Enhancing the Natural Environment, the Framework requires the planning system to *'prevent both new and existing developments from contributing to or being put at unacceptable risk or being adversely affected by unacceptable levels of air pollution'.*

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

Control of dust and particulates associated with construction

2.18 Section 79 of the *Environmental Protection Act (1990*) states that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Statutory nuisance is defined as:

- 'Any dust or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance', and
- 'any accumulation or deposit which is prejudicial to health or a nuisance'.

2.19 Failure to comply with an abatement notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses.

2.20 In the context of the proposed development, the main potential for nuisance of this nature will arise during the construction phase – potential sources being the clearance, earthworks, construction and landscaping processes.

2.21 There are no statutory limit values for dust deposition above which 'nuisance' is deemed to exist – 'nuisance' is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred. However, research has been undertaken by a number of parties to determine community responses to such impacts and correlate these to dust deposition rates.

The Mayor of London's Air Quality Strategy

2.22 The Mayor of London's AQS[5] sets out a series of policies and proposals for the implementation of the UK AQS and for the achievement of the air quality standards and objectives in Greater London. With regards new developments the following policies are of relevance:

2.23 Policy '1 - Encouraging smarter choices and sustainable travel': *The Mayor will support a shift to public transport, by only supporting developments that generate high levels of trips in locations with good public transport accessibility, by supporting car free developments and encouraging the inclusion of infrastructure to support sustainable travel, such as cycling, electric vehicle recharging points and car clubs*;

2.24 Policy '6 - *Reducing emissions from construction and demolition sites': The London Council's Best Practice guidance will be reviewed and updated, and more vigorously implemented*;

2.25 Policy '7 - *Using the planning process to improve air quality - new developments in London as a minimum shall be 'air quality neutral': The Mayor will encourage boroughs to require emissions assessments to be carried out alongside conventional air quality assessments. Where air quality impacts are predicted to arise from developments these will have to be offset by developer contributions and mitigation measures secured through planning conditions, section 106 agreements or the Community Infrastructure Levy*;

2.26 Policy '8 - *Maximising the air quality benefits of low to zero carbon energy supply': The Mayor will apply emission limits for both PM and NOx for new biomass boilers and NOx emission*

[5] Mayor of London (2010) Clearing the Air, The Mayor's Air Quality Strategy, December 2010

limits for Combined Heat and Power Plant (CHPP). Air quality assessments will be required for all developments proposing biomass boilers or CHPPs and operators will be required to provide evidence yearly to demonstrate compliance with the emission limits;

2.27 Policy '9 - Energy efficient buildings': *The Mayor will set CO2 reduction targets for new developments which will be achieved using the Mayor's Energy Hierarchy. These measures will result in reductions of NOx emissions*; and

2.28 Policy '10 - Improved air quality in the public realm': *The Mayor will encourage the improvement of air quality in the public realm by planting vegetation to trap particulate matter. Through the planning system the Mayor will increase the number of green roofs and living walls across London. Additionally, he will encourage the planting of trees in areas of poor air quality.*

The London Plan

2.29 The London Plan 2015[6] was published in March and consolidated the London Plan 2011[7] with the Revised Early Minor Alterations to the London Plan[8] and the Further Alterations to the London Plan also published in March 2015. The Plan is the overall strategic plan for London setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. It specifically addresses how development can help support the implementation of the Mayor's Air Quality Strategy and achieve a reduction in pollutant emissions and public exposure to pollution.

2.30 Policy 7.14 - Improving Air Quality requires all development proposals to:

- *Minimise increased exposure to existing poor air quality, make provision to address local problems of air quality (particularly within AQMAs) and promote greater use of sustainable transport modes through travel plans;*

- *Promote sustainable design and construction to reduce emissions from demolition and construction of buildings including following current best practice guidance;*

[6] Greater London Authority (March 2015) The London Plan: The Spatial Development Strategy for London Consolidated with Alterations Since 2011

[7] Greater London Authority (July 2011) The London Plan: Spatial development Strategy for Greater London

[8] Mayor of London (2013) The London Plan Spatial Development Strategy for Greater London, Revised Early Minor Alterations Consistency with the NPPF

- *Be at least 'air quality neutral' and therefore not leading to further deterioration of existing poor air quality;*

- *Look, in the first instance, to implement measures on-site to reduce emissions from a development. If inappropriate or impractical, other measures should be considered and where found to provide equivalent air quality benefits, planning obligations or planning conditions should be used to ensure their implementation;*

- *Permission will only be granted where a detailed assessment of biomass boilers shows no adverse impact from emissions.*

Mayor of London Sustainable Design and Construction SPG

2.31 The Mayor's Sustainable Design and Construction Supplementary Planning Guidance (SPG)[9] sets out guidance on meeting the London Plan Policy on sustainable design and construction.

2.32 In relation to air quality the SPG sets out guidance on the following key areas:

- assessment requirements;

- construction and demolition;

- design and occupation;

- air quality neutral policy for buildings and transport; and

- emissions standards for combustion plant.

2.33 Reference has been made to the guidance set out within the SPG when undertaking this assessment.

Odour Guidance for Local Authorities

2.34 The Defra Odour Guidance for Local Authorities[10] provides guidance on preventing, investigating and managing odours. Guidance on odour assessment and control for facilities

[9] Mayor of London (2014) Sustainable Design and Construction Supplementary Planning Guidance

regulated under the Environmental Permitting Regulations 2010 is contained in the relevant Sector and Process Specific Guidance Notes and Horizontal Guidance documents. However, there are many other activities that fall outside these specific environmental regimes and 'odour' from these premises are 'regulated' by local authorities under the statutory nuisance provisions of Part III of the Environmental Protection Act (EPA) 1990. The aim of this guidance document is to provide a toolkit for local authorities to assist them in providing a consistent, effective and fair approach to their regulatory duties with regard to odours and therefore endeavors to:

- explain the basic properties of odour;
- explain the legal and regulatory framework for preventing and controlling odours;
- identify the most common sources of odour and the methods that can be used to investigate and assess them; and
- explain the administrative and practical control measures available to local authorities and to provide guidance on how best to implement the service.

Guidance on the Control of Odour from Commercial Kitchens Exhaust System

2.35 Problems associated with nuisance odour from commercial kitchen exhausts are a common problem, particularly in urban areas where housing may be adjacent to a catering premises. The Defra guidance on Control of Odour from Commercial Kitchens[11] provides best practice techniques to minimise odour from kitchen exhaust systems.

2.36 The guidance provides a background into odour, the potential sources and effects of odour from kitchens and the regulatory roles is assessing and controlling odour. Details of appropriate kitchen ventilation systems that can be installed to ensure odour is controlled to prevent statutory nuisance are also provided.

2.37 Appendix C of the Guidance sets out a risk assessment that can be used to identify the likelihood of odour nuisance occurring from a commercial kitchen facility and to assist in determining appropriate odour control requirements based on the operations carried out at the selected premises.

[10] Defra (2010) Odour Guidance for Local Authorities

[11] Defra (2005) Guidance on the Control of Odour and Noise from Commercial Kitchen Exhaust Systems

Richmond Core Strategy

2.38 The Richmond Core Strategy[12].was adopted in April 2009 and currently forms part of the boroughs local plan.

2.39 Policy CP1 Sustainable Development seeks to *'maximise the effective use of resources including land, water and energy, and assist in reducing any long term adverse environmental impacts of development'*. To achieve the policy a number of principles will be promoted including:

- *Local environmental impacts of development with respect to factors such as noise, air quality and contamination should be minimised;*

- *Environmental gain to compensate for any environmental cost of development will be sought.*

Richmond Development Management Plan

2.40 The Richmond Development Management Plan[13].sets out detailed polices which assist the Council in making planning decisions.

2.41 Policy DM DC 5 states that '*in considering proposals for development the Council will seek to protect adjoining properties from unreasonable loss of privacy, pollution, visual intrusion, noise and disturbance'*.

[12] London Borough of Richmond (2009) Local Development Framework, Core Strategy, Adopted April 2009

[13] London Borough of Richmond (2011) Local Development Framework Development Management Plan Adopted November 2011

3 METHODOLOGY

Scope of Assessment

3.1 The scope of the assessment has been determined in the following way:

- Review of air quality data for the area surrounding the site and background pollutant maps; and
- Review of the traffic flow data, which has been used as an input to the air quality modelling assessment.

3.2 The proposed development would only provide 38 parking spaces at the Site. Based on this number of spaces it is considered unlikely to result in a significant number of additional vehicle movements on the adjacent road network. Impacts on local air quality as a result of the operational development have therefore been scoped out of this assessment. However, the Site is located adjacent to King Street and the northern façade falls within the King Street Air Quality Focus Area (AQFA) as designated by the Mayor of London and monitoring in the vicinity of the Site has recorded annual mean NO_2 concentrations above the relevant objective limit. An assessment of air quality at the Site in terms of exposure of new occupants has therefore been undertaken.

3.3 The proposals would provide commercial units at ground floor level. There are concerns in relation to odour emissions arising from the commercial units should one be operated as a café or similar. At this stage it is not know who the occupiers of the commercial units will be however, any kitchen/café facility, which it is anticipated would be located to the rear of the Site in unit A5, would be fitted with an extraction system which meets the requirements of the DEFRA guidance on the '*Control of Odour from Kitchens and Exhaust Systems'* including the location of any extract flue at least 1 m above the eaves of the roof of the building in which the kitchen facility is located and the incorporation of both a fine filtration system and active carbon filters. On this basis, it is concluded that any odour emissions would be adequately mitigated and no significant impacts would occur. The impact of odour has not therefore been considered any further within this report.

3.4 All developments within London are required to be Air Quality Neutral (AQN) in accordance with the London Plan and the 2010 Mayor of London's Air Quality Strategy. Based on criteria set out within the Mayor of London's Sustainable Design and Construction SPG the proposed development is classed as a 'major' development i.e. it would provide more than 10

residential units. The development proposal have therefore been assessed against the AQN polices. As detailed above the development would not generate a significant number of additional vehicle movements during the operational phase and therefore is considered to be air quality neutral in terms of traffic emissions. The assessment has therefore assessed the development proposals in terms of building emissions only.

3.5 During the demolition and construction phase there is the potential for dust emissions to result in nuisance and health impacts at nearby sensitive receptors. The assessment has therefore included an assessment of construction related impacts.

3.6 Due to the location of the Site in relation to the King Street AQFA mitigation has been identified based on the requirements for mitigating air quality within an AQFA.

3.7 Details of the assessment methodology and the specific issues considered are provided below.

Construction Phase Methodology

Construction Traffic

3.8 During construction of the proposed development, lorries will require access to the Site to deliver and remove materials; earthmoving plant and other mobile machinery may also work on site including generators and cranes. These machines produce exhaust emissions; of particular concern are emissions of NO_2 and PM_{10}.

3.9 Based on the size of the development proposals, it is anticipated that there will be less than 25 additional HGV vehicles generated on the adjacent road network on any given day.

3.10 The criteria set out within the EPUK and IAQM guidance indicates that significant impacts on air quality are unlikely to occur where a development results in less than 25 HGV movements per day within an AQMA and 100 at locations outside of an AQMA. It is therefore anticipated that construction traffic generated by the proposed development would result in a negligible impact on local NO_2 and PM_{10} concentrations and has not been considered any further in this assessment.

Construction Dust

3.11 To assess the potential impacts associated with dust and PM_{10} releases during the construction phase and to determine any necessary mitigation measures, an assessment based on the latest guidance from the Mayor of London[14] has been undertaken. The proposed approach to assessing the risk is based on the latest guidance produced by the IAQM[15] and follows the methodology set out below.

3.12 This approach divides construction activities into the following dust emission sources:

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

[14] Mayor of London (2016) The Control of Dust and Emissions from Construction and Demolition Version 1.1, July 2016

[15] Institute of Air Quality Management (2014) Guidance on the Assessment of Dust from Demolition and Construction

3.13 The risk of dust effects (low, medium or high) is determined by the scale (magnitude) and nature of the works and the proximity of sensitive human and ecological receptors.

3.14 The IAQM guidance recommends that an assessment be undertaken where there are sensitive human receptors:

- within 350 m of the Site boundary; 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).

3.15 An assessment should also be carried out where there are dust-sensitive ecological receptors:

- within 50 m of the Site boundary;
- 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).

3.16 The significance of the dust effects is based on professional judgement, taking into account the sensitivity of receptors and existing air quality.

Dust Emission Magnitude

3.17 The magnitude of the dust impacts for each source is classified as Small, Medium or Large depending on the scale of the proposed works. Table 3.1 summarises the IAQM criteria that may be used to determine the magnitude of the dust emission. These criteria are used in combination with site specific information and professional judgement.

Table 3.1: Dust Emission Magnitude Criteria

Source	Large	Medium	Small
Demolition	• Total building volume >50,000m^3 • Potentially dusty material (e.g. concrete) • Onsite crushing and screening • Demolition activities >20m above ground level.	• Total building volume 20,000 - 50,000m^3 • Potentially dusty material • Demolition activities 10 - 20m above ground level.	• Total building volume <20,000m^3 • Construction material with low potential for dust release • Demolition activities <10m above ground level • Demolition during wetter months
Earthworks	• Total site area >10,000m^2 • Potentially dusty soil type (e.g. clay) • >10 heavy earth moving vehicles active at any one time • Formation of bunds >8m in height • Total material moved >100,000 tonnes	• Total site area 2,500 -10,000m^2 • Moderately dusty soil type (e.g. silt) • 5 - 10 heavy earth moving vehicles active at any one time • Formation of bunds 4 - 8m in height • Total material moved 20,000 - 100,000 tonnes	• Total site area <2,500m^2 • Soil type with large grain size (e.g. sand) • <5 heavy earth moving vehicles active at any one time • Formation of bunds <4m in height • Total material moved <20,000 tonnes • Earthworks during wetter months
Construction	• Total building volume >100,000m^3 • On site concrete batching • Sandblasting	• Total building volume 25,000 - 100,000m^3 • Potentially dusty construction material (e.g. concrete) • On site concrete batching	• Total building volume <25,000m^3 • Material with low potential for dust release (e.g. metal cladding or timber)
Trackout	• >50 HGV movements in any one day (a) • Potentially dusty surface material (e.g. high clay content) • Unpaved road length >100m	• 10 - 50 HGV movements in any one day (a) • Moderately dusty surface material (e.g. silt) • Unpaved road length 50 - 100m	• <10 HGV movements in any one day (a) • Surface material with low potential for dust release • Unpaved road length <50m
(a) HGV movements refer to outward trips (leaving the site) by vehicles of over 3.5 tonnes.			

Receptor Sensitivity

3.18 Factors defining the sensitivity of a receptor are presented in Table 3.2.

Table 3.2: Factors Defining the Sensitivity of a Receptor

Sensitivity	Human (health)	Human (dust soiling)	Ecological
High	• Locations where members of the public are exposed over a time period relevant to the air quality objectives for PM_{10} (a) • Examples include residential dwellings, hospitals, schools and residential care homes.	• Regular exposure • High level of amenity expected. • Appearance, aesthetics or value of the property would be affected by dust soiling. • Examples include residential dwellings, museums, medium and long-term car parks and car showrooms.	• Nationally or Internationally designated site with dust sensitive features (b) • locations with vascular species (c)
Medium	• Locations where workers are exposed over a time period relevant to the air quality objectives for PM_{10} (a) • Examples include office and shop workers (d)	• Short-term exposure • Moderate level of amenity expected • Possible diminished appearance or aesthetics of property due to dust soiling • Examples include parks and places of work	• Nationally designated site with dust sensitive features (b) • Nationally designated site with a particularly important plant species where dust sensitivity is unknown
Low	• Transient human exposure • Examples include public footpaths, playing fields, parks and shopping streets	• Transient exposure • Enjoyment of amenity not expected. • Appearance and aesthetics of property unaffected • Examples include playing fields, farmland (e), footpaths, short-term car parks and roads	• Locally designated site with dust sensitive features (b)

(a) In the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day.

(b) Ecosystems that are particularly sensitive to dust deposition include lichens and acid heathland (for alkaline dust, such as concrete).

(c) Cheffing C. M. & Farrell L. (Editors) (2005), The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee.

(d) Does not include workers exposure to PM_{10} as protection is covered by Health and Safety at Work legislation.

(e) Except commercially sensitive horticulture.

3.19 The sensitivity of a receptor will also depend on a number of additional factors including any history of dust generating activities in the area, likely cumulative dust impacts from nearby construction sites, any pre-existing screening such as trees or buildings and the likely duration of the impacts. In addition, the influence of the prevailing wind direction and local topography may be of relevance when determining the sensitivity of a receptor.

Area Sensitivity

3.20 The sensitivity of the *area* to dust soiling and health impacts is dependent on the number of receptors within each sensitivity class and their distance from the source. In addition, human health impacts are dependent on the existing PM_{10} concentrations in the area. Tables 3.3 and 3.4 summarise the criteria for determining the overall sensitivity of the area to dust soiling and health impacts respectively.

Table 3.3: Sensitivity of the Area to Dust Soiling Effects on People and Property

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

(a) For trackout, the distance is measured from the side of roads used by construction traffic. Beyond 50m, the impact is negligible.

Table 3.4: Sensitivity of the Area to Human Health Impacts

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

(a) For trackout, the distance is measured from the side of roads used by construction traffic. Beyond 50m, the impact is negligible.

Table 3.5: Sensitivity of Area to Ecological Impacts

Sensitivity of Area	Distance from the Source	
	<20m	<50m
High	High Risk	Medium Risk
Medium	Medium Risk	Low Risk
Low	Low Risk	Low Risk

3.21 For each dust emission source (demolition, construction, earthworks and trackout), the worst-case area sensitivity is used in combination with the dust emission magnitude to determine the risk of dust impacts.

Risk of Dust Impacts

3.22 The risk of dust impacts prior to mitigation for each emission source is presented in Tables 3.6 and 3.7.

Table 3.6: Risk of Dust Impacts – Demolition, Earthworks and Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 3.7: Risk of Dust Impacts - Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Mitigation and Significance

3.23 The IAQM guidance provides a range of mitigation measures which are dependent on the level of dust risk attributed to the site. Site specific mitigation measures are also included where appropriate.

3.24 The significance of the impacts following appropriate mitigation is determined by professional judgement.

Operational Phase Methodology

Traffic Emissions

3.25 The prediction of local air quality has been undertaken using the ADMS Roads dispersion model. This is a commercially available dispersion model and has been widely validated for this type of assessment and used extensively in the Air Quality Review and Assessment process.

3.26 The model uses detailed information regarding traffic flows on the local road network and local meteorological conditions to predict pollution concentrations at specific locations selected by the user. Meteorological data from Heathrow Airport Meteorological Station for 2016 has been used for the assessment.

3.27 The model has been used to predict road specific concentrations of oxides of nitrogen (NO_x) and Particulate Matter (PM_{10}) at selected receptors. The predicted concentrations of NO_x have been converted to NO_2 using the LAQM calculator available on the DEFRA air quality website[16].

3.28 Traffic data for Kings Street, Wharf Lane and Water Lane have been obtained from ATC counts carried out in July 2016. Additional data for Richmond Road and London Road has been obtained from the Department of Transport (DfT) traffic data available on their website (http://www.dft.gov.uk/traffic-counts/). The data on the website is for 2014 so have been factored forward to 2016 using the National Road Traffic Forecast (NRTF) central factor of 1.03.

[16] http://uk-air.defra.gov.uk

3.29 A summary of the traffic data used in the assessment can be found in **Appendix C**. The data includes details of annual average daily traffic flows (AADT), vehicle speeds and percentage HGV for the assessment years considered.

3.30 The emission factors released by DEFRA in July 2016, provided in the emissions factor toolkit EFT2016_7.0 have been used in the ADMS model (Version 4.1, released in February 2016) to predict existing NO_2 and PM_{10} traffic emissions.

3.31 To predict local air quality, traffic emissions predicted by the model must be added to local background concentrations. Background NO_x, NO_2 and PM_{10} concentrations for use in the model have been taken from the DEFRA background maps for 2016. The data used in the assessment are set out in Table 4.5.

3.32 It is recommended, following guidance set out in LAQM.TG(16), that the model results are compared with measured data to determine whether the model results need adjusting to more accurately reflect local air quality. This process is known as verification.

3.33 LAQM.TG(16) recommends that model predictions should be within 25% (preferably 10%) of monitored concentrations for the model to be predicting with any degree of accuracy. The ADMS model has been used to predict annual mean NO_2 concentrations at three local monitoring sites.

3.34 A comparison of monitored and predicted concentrations at the site is provided below in Table 3.8.

Table 3.8: Comparison of Modelled and Monitored Nitrogen Dioxide Concentrations (µg/m^3)

Monitoring Locations	Measured Concentration	Modelled Concentration	% Difference
15 – Richmond Road	41	27.8	-32.3
32 – King Street	64	36.6	-42.9
65 – York Street	75	36.9	-50.9

3.35 The verification process shows that the modelled is under predicting NO_2 concentrations by up to 51% compared to monitored concentrations. It is therefore considered necessary to adjust the model results to better represent local concentrations. The results of the modelling

assessment have been adjusted using the methodology given in LAQM.TG(16). Full details of the verification and calculation of adjustment factors are provided in **Appendix D**.

3.36 There is no suitable monitoring of PM data to allow verification of the PM_{10} model results. However, LAQM.TG(16) suggests applying the NO_x adjustment factor to modelled road-PM where no appropriate verification against PM data can be carried out. The adjustment factors applied to the NO_x results have therefore been applied to the PM_{10} results.

3.37 LAQM.TG(16) does not provide a method for the conversion of annual mean NO_2 concentrations to 1-hour mean NO_2 concentrations. However, research[17] has concluded that exceedences of the 1-hour mean objective are generally unlikely to occur where annual mean concentrations do not exceed 60 µg/m^3. Care has been taken to ensure that locations where the 1-hour mean objective is relevant are included in the assessment.

3.38 Quantitative assessment of the impacts on local air quality from road traffic emissions associated with the operation of the development have been completed against the current statutory standards and objectives set out in **Appendix B** for NO_2, PM_{10} and $PM_{2.5}$.

Sensitive Receptors

3.39 LAQM.TG(16) describes in detail typical locations where consideration should be given to pollutants defined in the Regulations. Generally, the guidance suggests that all locations '*where members of the public are regularly present'* should be considered. At such locations, members of the public will be exposed to pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for assessment purposes.

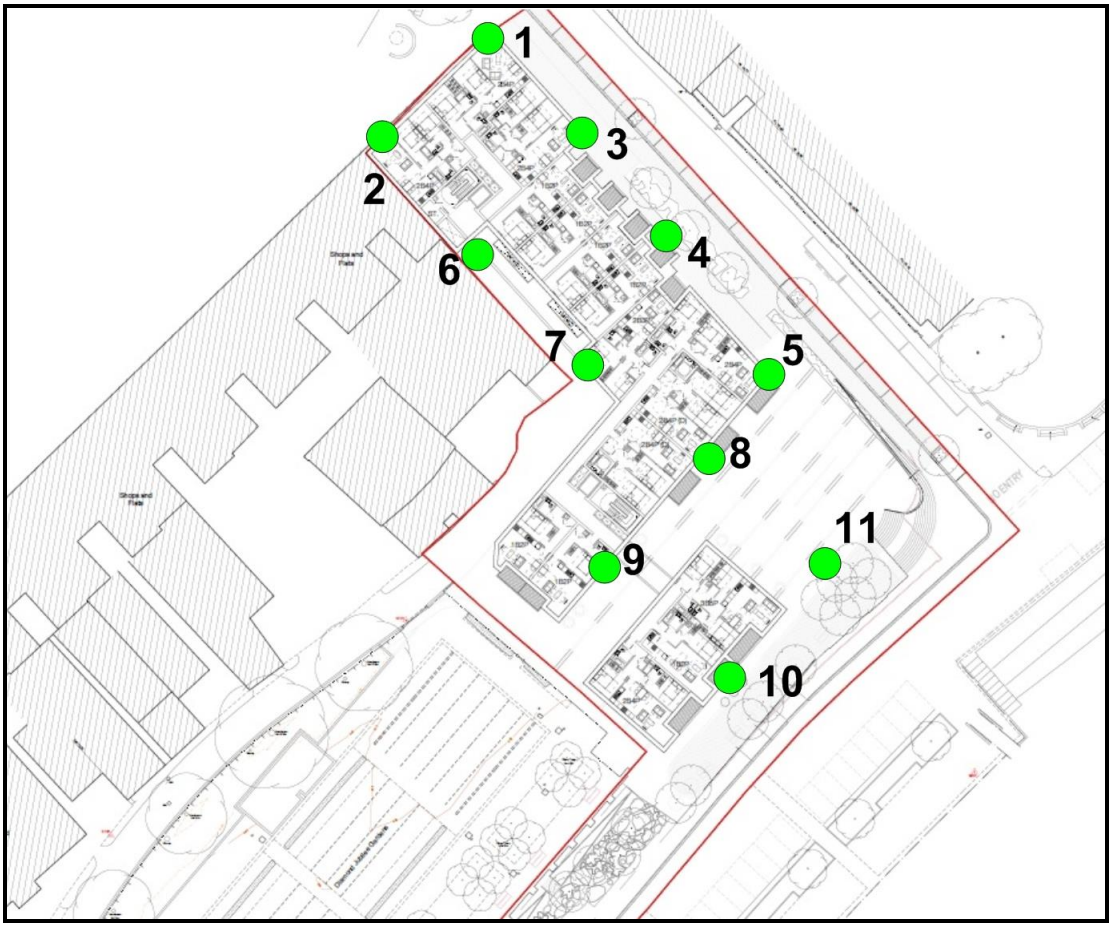
3.40 For instance, on a footpath, where exposure will be transient (for the duration of passage along that path) comparison with short-term standards (i.e. 15 minute mean or 1 hour mean) may be relevant. In a school, or adjacent to a private dwelling, however; where exposure may be for longer periods, comparison with long-term standards (such as 24 hour mean or annual mean) may be most appropriate. In general terms, concentrations associated with long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

3.41 To assess air quality at the Site concentrations of NO_2 and PM_{10} have been predicted at the facades of the new buildings, the locations of whicha re shown in Figure 3.1. Concentraitons

[17] D Laxen and B Marner: *Analysis of the relationship between 1-hour and annual mean nitrogen dioxide at UK roadside and kerbside monitoring sites* (July 2003).

have been predicted at each floor of the new building at an equivalent height of 1.5 m above floor level. Concentrations have also been predicted as a contour plot at ground floor level across the Site. The contour plots are presented in Figures 5.2 and 5.3.

Figure 3.1: Location of Receptors used in Modelling



Air Quality Neutral Assessment

3.42 The Mayor's Sustainable Design and Construction SPG sets out guidance on assessing developments against the AQN policy. The SPG requires developments to be assessed for both building and transport emissions and sets out benchmarks for different land use classes against which the calculated emissions from a development can be compared. Where a development falls below these benchmarks it can be classed as AQN and no mitigation is considered necessary.

3.43 The SPG refers the assessor to additional guidance development by Air Quality Consultants (AQC)[18] on calculating the building and transport emission from a development. This guidance has been used to calculate the relevant building emission from the proposed development. As detailed previously the development is considered to be air quality neutral in terms of traffic emissions so no further assessment has been undertaken in terms of the AQN calculations.

3.44 To calculate the building emissions the following data has been collated:

- gross floor area (GFA) (m^2) of each element, i.e. residential and commercial;
- annual on-site energy demand for space heating and hot water (kWh/annum) for each element;
- NO_x emission factor for gas - it has been assumed that all boilers on the site would meet the emission limit set out within the SPG of 40 $mgNO_x/kWh$ therefore an emission factor of 0.00004 $kgNO_x/kWh$ has been used.

3.45 Emissions of PM_{10} are not considered to be significant from natural gas and therefore the assessment of building emissions has concentrated on emissions of NOx.

3.46 The development would provide a mix of residential and commercial uses. The commercial units would provide a mix of A1 to A5, B1 and D1 uses. The calculated building emissions for the residential element have been compared against the building emissions benchmarks (BEB) for the C1 (residential) land use class, which is provided in Table 3.9.

3.47 The energy demand for the commercial units has not been provided for each land use class therefore, as a work-case assessment the calculated building emissions for the commercial element has been compared against the BEB for A1 uses as this is the lowest for all commercial uses.

[18] Air Quality Consultants and Environ (2014) Air Quality Neutral Planning Support Update: GLA 80371, April 2014

Table 3.9: Building Emission Benchmarks (BEB)[18]

Land Use Class	NO_x (g/m^2)	PM_{10} (g/m^2)
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
Class D1 (a)	43.0	2.47
Class D1 (b)	75.0	4.30
Class D1 (c-h)	31.0	1.78
Class D2 (a-d)	90.3	5.18
Class D2 €	284	16.3

4 BASELINE CONDITIONS

Richmond Review and Assessment of Air Quality

4.1 LBR has carried out detailed assessments of air quality and as a result has declared the whole borough an AQMA due to exceedences of the NO_2 and PM_{10} objectives. There is therefore the potential for pollutant concentrations at the Site to be exceeding the relevant air quality objectives.

Automatic Local Monitoring Data

4.2 LBR operate three static automatic monitoring sites and one mobile automatic site within the borough which record concentrations of both NO_2 and PM_{10}. As there are other monitoring sites in closer proximity to the Site monitoring NO_2 concentrations the automatic sites have not been used to assess baseline concentrations of this pollutant.

4.3 PM_{10} concentrations are measured at two of the automatic sites. Details of these are set out in Table 4.1 below and monitored concentrations of PM_{10} are set out in Table 4.2.

Table 4.1: Details of Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	Relevant Exposure	Distance to Kerb of nearest road
RI1 Castelnau Library, Barnes	Roadside	522500, 177165	NO_2, PM_{10}	8 m	3 m
RI2 Wetlands Centre, Barnes	Suburban	522991, 176495	NO_2, PM_{10}	Children in adjacent play area	n/a

Table 4.2: PM_{10} automatic monitoring results

Monitoring Site	Objective	Year					
		2011	2012	2013	2014	2015	2016
RI1 Castelnau Library, Barnes	Annual Mean	23	21	22	20	22	20
	Hourly Exceedences of 200 µg/m^3	15	14	10	4	5	7
RI2 Wetlands Centre, Barnes	Annual Mean	22	18	20	18	17	16
	Hourly Exceedences of 200 µg/m^3	17	13	6	3	1	3
[1] data is still provisional							

4.4 The data presented in Table 4.2 shows roadside and urban PM_{10} concentrations to be less than 75% of the annual mean objective of 40 µg/m^3. The data shows a downward trend in PM_{10} concentrations between 2011 and 2016.

4.5 Both sites have recorded exceedences of the 24-hour objective limit of 50 µg/m^3. The objective allows for up to 35 exceedences in any given year therefore the objective has been met at both locations during years.

4.6 Based on the data recorded at the two automatic sites it is expected that PM_{10} concentrations at the Site will meet the annual mean and 24-hour objectives.

Non-Automatic Monitoring

4.7 LBR operates an extensive network of diffusion tubes across the borough measuring concentrations of NO_2. Those closest to the development site are set out in Table 4.3 along with concentrations recorded between 2011 and 2015.

4.8 All the diffusion tube data has been bias corrected using bias adjustment factors derived from diffusion tubes collocated with the Councils automatic monitoring sites.

Table 4.3: Annual Mean NO_2 Concentrations Measured by Diffusion Tube (µg/m^3)[19]

Site Name	Site Type	OS Grid Reference	Annual mean concentrations (µg/m^3)					
			2011	2012	2013	2014	2015	2016
15 – Richmond Road	Kerbside	517197, 173939	41	44	40	40	37	41
32 – King Street	Kerbside	516226, 173195	75	77	74	73	62	64
65 – York Street	Kerbside	516356, 173365	-	-	-	-	-	75

4.9 The data presented in Table 4.3 shows annual mean NO_2 concentrations consistently above the 40 µg/m^3 objective limit at all three monitoring sites. The data shows a gradual decline in concentrations on King Street although concentrations have remained relatively stable at the Richmond Road site.

4.10 The Development Site is located to the south of King Street. Based on concentrations recorded at the King Street monitoring sites NO_2 concentrations are expected to exceed the annual mean objective across the development site.

4.11 Diffusion tubes cannot monitor short-term NO_2 concentrations, however, as previously discussed, research has concluded that exceedences of the 1-hour mean objective are generally unlikely to occur where annual mean concentrations do not exceed 60 µg/m^3. Based on annual mean concentrations recorded at the King Street monitoring sites there is the potential for the 1-hour objective to be exceeded in this location. There is therefore the risk that NO_2 concentrations are exceeding the 1-hour objective across the development site.

[19] London Borough of Richmond (2017) Air Quality Annual Status Report 2017

DEFRA Background Maps

4.12 Background concentrations have been obtained from the 2013 DEFRA background pollutant maps. The maps provide an estimate of background concentrations between 2013 and 2030. The average 2016 background concentrations for the grid squares 516500, 173500, which includes the development site are presented in Table 4.4. These background concentrations have been used to assess air quality at the Site and at the King Street and York Street monitoring locations.

4.13 Additional background concentrations have been obtained for the grid square 517500, 173500 for the Richmond Road monitoring site.

Table 4.4: Estimated background concentrations from DEFRA maps (µg/m^3)

Pollutant	516500, 173500	517500, 173500
NO_2	24.9	21.1
NO_x	38.7	31.6
PM_{10}	18.1	16.4

4.14 The data presented in Table 4.4 shows that annual mean background concentrations of NO_2 and PM_{10} are below the relevant objective limits.

5 ASSESSMENT OF IMPACT, MITIGATION AND RESIDUAL EFFECTS

IMPACT – CONSTRUCTION PHASE

Area Sensitivity

5.1 There are a number of commercial buildings currently located on the Site. These will need to be demolished as part of the development process. Impacts associated with demolition have therefore been considered within this assessment.

5.2 The assessment of dust impacts is dependent on the proximity of the most sensitive receptors to the site boundary. A summary of the receptors and area sensitivity to health and dust soiling impacts is presented in Table 5.1.

5.3 There are no dust-sensitive habitat sites within 50m of the proposed development, therefore the impact of dust emissions on ecologically sensitive receptors has not been considered further in this assessment.

Table 5.1: Sensitivity of Receptors and the Local Area to Dust Impacts

Receptor	Distance from Site Boundary (m)	Approx. Number of Receptors	Sensitivity to Health Impacts (a)		Sensitivity to Dust Soiling Impacts	
			Receptor	Area	Receptor	Area
Residential Properties Water Lane	< 20 m	5-10	High	Medium	High	Low
Residential Properties King Street	<20 m	5-6	High	Medium	High	Low
	20-50 m	5-10	High	Medium	High	Low
Residential Properties Bell Lane	20-50 m	–0 - 15	High	Medium	High	Low
Overall Sensitivity of the Area			**Medium**		**Low**	

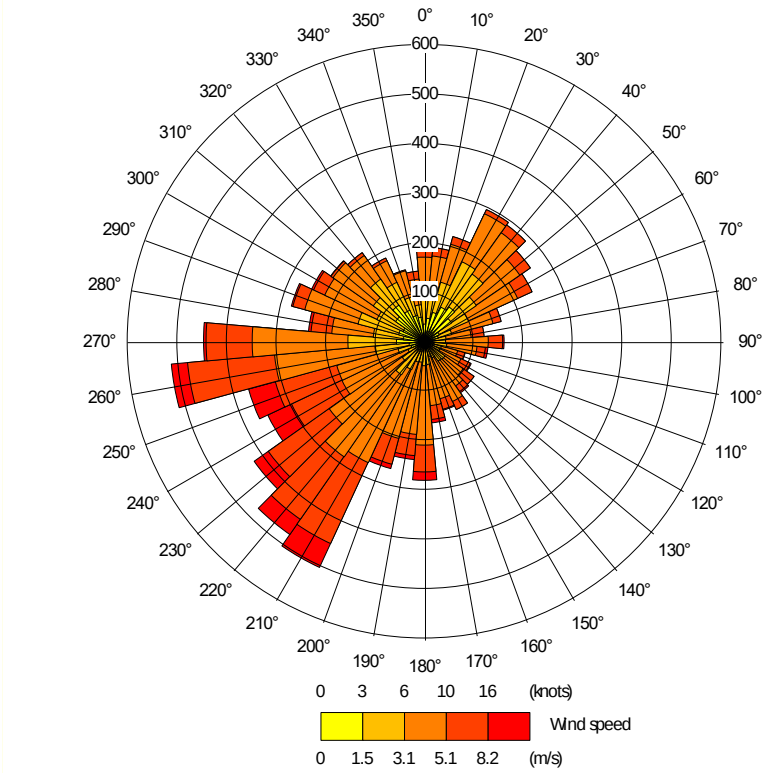
(a) Estimated background PM_{10} concentration is 18 µg/m^3. Taking into account local sources concentrations are expected to be 20-24 µg/m^3

5.4 The precise behaviour of the dust, its residence time in the atmosphere, and the distance it may travel before being deposited will depend upon a number of factors. These include wind direction and strength, local topography and the presence of intervening structures (buildings,

etc.) that may intercept dust before it reaches sensitive locations. Furthermore, dust would be naturally suppressed by rainfall.

5.5 A wind rose from Heathrow Airport is provided below in Figure 5.1, which shows that the prevailing wind is from the southwest, therefore receptors to the northeast of the site are the most likely to experience dust impacts from the site which includes flats located along King Street and houses along Water Lane.

Figure 5.1: Wind Rose for Heathrow Airport Meteorological Station (2016)



Dust Emission Magnitude

5.6 Dust emissions from demolition can arise from a number of activities including the de-construction of buildings, on-site crushing and screening and general disturbance of potentially dusty materials. The buildings that would be demolished are mainly constructed from bricks and concrete which are potentially dusty materials, however they have a total volume of less than 10,000 m^3 and are less than 10 m in height. The site is therefore determined as having a dust magnitude of *small* in relation to demolition activities

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling of the site and landscaping. The area of the Site is approximately 4000 m^2 and it is expected that there will be between 3-5 earth moving vehicles on site at any one time which would stock pile material in bund which are likely to be no more than 4 m in height. Part of the earthworks would include the breaking up and clearing of the surface level concrete which can create a significant amount of dust. The magnitude of the dust emission for the earthworks phase is therefore considered to be *mediu*

5.7 *m*.

5.8 Dust emissions during construction will depend on the scale of the works, method of construction, construction materials and duration of build. The proposed residential buildings will be up to 3 storeys. Based on the size and construction materials the dust emission magnitude is considered to be *medium*.

5.9 Factors influencing the degree of trackout and associated magnitude of effect include vehicle size, vehicle speed, vehicle numbers, geology and duration. Construction traffic will travel along King Street onto Water Lane to gain access to the Site. There are a number of residential premises along Water Lane which would be sensitive to dust effects. The number of HGV movements (leaving the site) is unlikely to be more than 25 per day, therefore dust emission magnitude due to trackout is considered to be *medium.*

Dust Risk Effects

5.10 A summary of the potential risk of dust impacts, based on the low overall sensitivity of the area to human health impacts and high overall sensitivity to dust soiling impacts, is presented in Table 5.2.

Table 5.2: Risk of Dust Impacts Prior to Mitigation

Source	Impact Magnitude	Human Health Risk	Dust Soiling Risk
Demolition	Small	Low	Medium
Earthworks	Medium	Low	Medium
Construction	Medium	Low	Medium
Trackout	Medium	Low	Medium

IMPA–T - OPERATIONAL PHASE

Traffic Emissions

NO_2 Concentrations

5.11 Annual mean NO_2 concentrations predicted across the Site at ground floor level are shown in Figure 5.2. Concentrations predicted at the facades of the new buildings up to 3rd floor level are set out in Table 5.3.

Table 5.3: Predicted Annual Mean NO_2 Concentrations (µg/m^3)

Receptor Number	Floor	NO_2 Concentration (µg/m^3)
1	Ground	55.2
	1st	43.7
	2nd	34.2
	3rd	29.7
2	Ground	58.1
	1st	44.5
	2nd	34.2
	3rd	29.6
3	Ground	46.8
	1st	40.6
	2nd	34.0
	3rd	29.9
4	Ground	39.0
	1st	36.3
	2nd	32.8
	3rd	29.9
5	Ground	33.8
	1st	32.6
	2nd	30.9
6	Ground	42.0
	1st	38.2
	2nd	33.4
	3rd	29.9
7	Ground	35.8
	1st	34.2
	2nd	31.8
8	Ground	31.8

Receptor Number	Floor	NO_2 Concentration (µg/m^3)
	1st	31.0
	2nd	29.8
9	Ground	32.1
	1st	31.4
	2nd	30.1
10	Ground	30.9
	1st	30.2
	2nd	29.3
11	Ground	31.1
	1st	30.2
	2nd	29.2

5.12 Concentrations presented in Figure 5.2 show exceedence of the annual mean NO_2 objective at ground floor level across the northern part of the Site. This is confirmed by concentrations predicted at receptors 1, 2 and 3 at ground floor level which are more than 115% of the objective. However concentrations decline with increasing distance from Kings Street, falling to below the objective at the remaining 8 receptors at ground floor level.

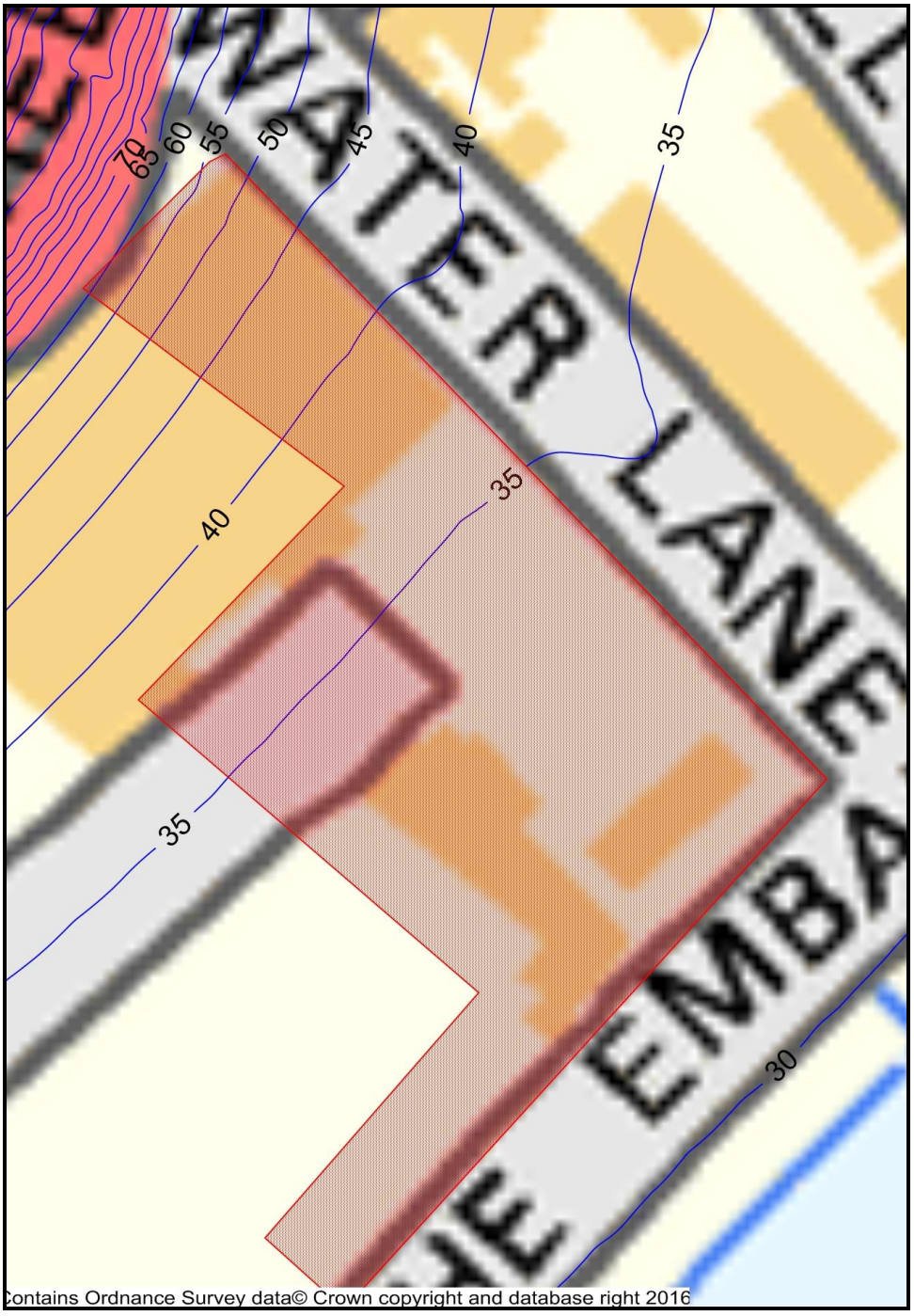
5.13 The development would provide commercial and retail units at ground floor level. Based on guidance set out within LAQM.TG(16) commercial and retail premises are not considered to be sensitive receptors in terms of annual mean concentrations therefore the annual mean objective is not of relevance at ground floor level across the Site. However, residential receptors are sensitive in terms of annual mean exposure. Residential units would be located at 1st floor and above within the new development. The model is predicting exceedence of the objective at receptors 1, 2 and 3 at 1st floor level.

5.14 At all other receptors (4 to 11) at 1st floor level and at all locations at 2nd and 3rd floor level the annual mean objective would be met.

5.15 As previously discussed, the ADMS model cannot predict short-term NO_2 concentrations. However, as the model is predicting annual mean NO_2 concentrations below 60 µg/m^3 at all locations across the Site it is considered unlikely that the 1-hour objective will be exceeded.

5.16 Based on the predicted annual mean concentrations the proposed development result in new exposure above the annual mean objective within those flats located at 1st floor level within the northern part of the Site. Appropriate mitigation measures are therefore required to reduce exposure of future occupants of these dwellings.

Figure 5.2: Annual Mean NO_2 Concentrations predicted across the Site



PM_{10} Concentrations

5.17 Predicted annual mean PM_{10} concentrations across the Site at ground floor level are presented in Figure 5.3. Concentrations predicted at the facades of the building are provided in Table 5.4.

Table 5.4: Predicted Annual Mean PM_{10} Concentrations ($\mu g/m^3$)

Receptor Number	Floor	PM_{10} Concentration ($\mu g/m^3$)
1	Ground	23.5
	1st	21.1
	2nd	19.4
	3rd	18.6
2	Ground	24.1
	1st	21.2
	2nd	19.4
	3rd	18.6
3	Ground	21.7
	1st	20.5
	2nd	19.3
	3rd	18.6
4	Ground	20.2
	1st	19.7
	2nd	19.1
	3rd	18.6
5	Ground	19.3
	1st	19.1
	2nd	18.8
6	Ground	20.8
	1st	20.1
	2nd	19.2
	3rd	18.6
7	Ground	19.6
	1st	19.4
	2nd	18.9
8	Ground	19.0
	1st	18.8
	2nd	18.6
9	Ground	19.0
	1st	18.9
	2nd	18.7
10	Ground	18.8
	1st	18.7
	2nd	18.5
11	Ground	18.9
	1st	18.7
	2nd	18.5

5.18 The ADMS model is predicting annual mean PM_{10} concentrations at less than 75% of the 40 µg/m^3 objective at all locations across the Site as shown in Figure 5.3 and based on the predicted concentrations set out in Table 5.4.

5.19 The number of exceedences of 50 µg/m^3, as a 24-hour mean PM_{10} concentration, has been calculated from the annual mean following the approach set out by DEFRA in LAQM.TG(09):

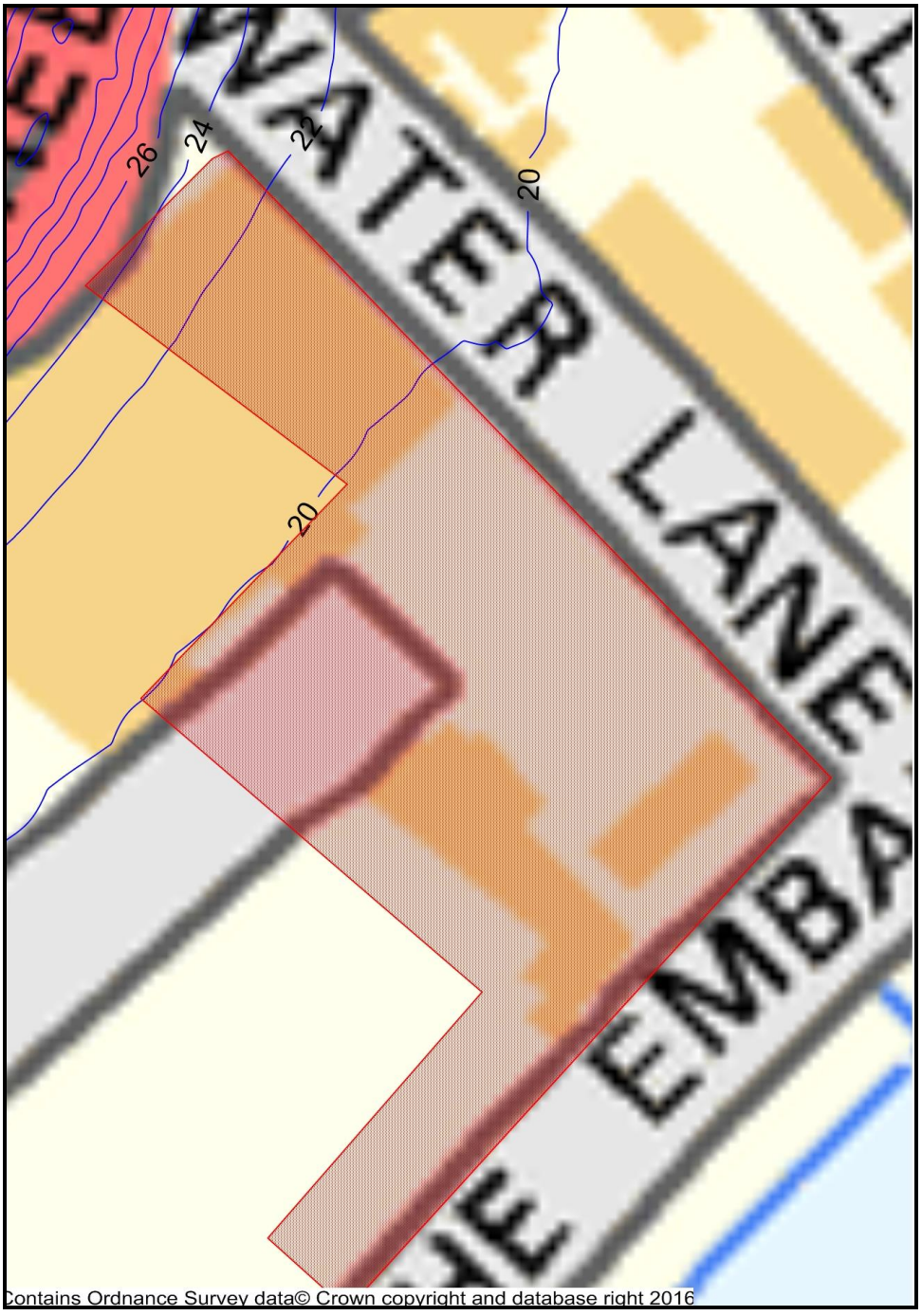
A = -18.5 + 0.00145 x annual mean3 + (206/annual mean)

where A is the number of exceedences of 50 µg/m^3 as a 24-hour mean PM_{10} concentration.

5.20 Based on the above approach, the maximum number of days >50 µg/m^3 PM_{10} is predicted to be between 1-9 at all locations within the Site. The objective allows for up to 35 exceedences of the 50 µg/m^3 limit therefore concentrations are not exceeding the 24-hour objective.

5.21 Future occupants of the Site would not be exposed to PM_{10} concentrations above the relevant air quality objectives therefore the impact of the development with regards new exposure to this pollutant is considered to be negligible.

Figure 5.3: Annual Mean PM_{10} Concentrations predicted across the Site



Air Quality Neutral Assessment

5.22 The building emissions calculated from the proposed development are set out in Table 5.5 below, along with the parameters required to undertake the calculation.

Table 5.5: Calculated Building Emissions

Building Element	Emissions Factor ($kgNO_x/kWh$) [1]	Annual Energy Demand (kWh/annum)[2]	Gross Floor Area of Site (m^2)	Calculated Building Emissions (g/m^2)	BEB[3]
Residential Uses					
C3	0.0004	139569	2712	20.6	26.2
Commercial Uses (assumed as all A1)					
A1	0.0004	4457	1252	0.14	22.5

[1] it has been assumed that all boilers on site would meet the SPG of 40 $kgNO_x/kWh$

[2] total energy demand for gas fired heating and hot water

[3]BEB – Building Emissions Benchmark taken from the AQN Planning Support Update document

5.23 The proposed energy strategy for the Site includes the use of energy saving passive design measures such as low U-Values for all external walls, roofs, doors and windows, a high level of air tightness and high performing thermal bridging. To reduce energy demand from heating and hot water all boilers will be of at least 90% efficiency. Mechanical ventilation with heat recovery will also be used throughout in combination with 100% low energy lighting and time and temperature zone control. Further savings will also be achieved through the installation of Solar Photovoltaics to generate electricity from renewable sources.

5.24 All space heating and hot water would be provided by efficient gas fired boilers and it has been assumed that they would meet the SPG emissions criteria of 40 $kgNO_x/kWh$.

5.25 Following the implementation of the measures set out above the building emissions for the Site have been calculated as 20.6 g/m^2 for the residential element and 0.14 g/m^2 for the commercial element. As set out within Table 5.5, the BEB for residential dwellings (C1) is 26.2 g/m^2 and for commercial premises (A1) is 22.5 g/m^2. The Site is therefore considered to be AQN in terms of building emissions.

5.26 The development therefore meets the AQN requirements of Policy 7.14 of the London Plan and Policy 7 of the Mayor of London's Air Quality Strategy.

MITIGATION

Construction Phase

5.27 The control of dust emissions from construction site activities relies upon management provision and mitigation techniques to reduce emissions of dust and limit dispersion. Where dust emission controls have been used effectively, large-scale operations have been successfully undertaken without impacts to nearby properties.

5.28 An overall medium risk of impacts is predicted at adjacent residential properties during construction of the proposed development. Appropriate mitigation measures for the Site have been identified following the IAQM guidance and based on the risk effects presented in Table 5.2. It is recommended that the 'highly recommended' measures set out in **Appendix E** are incorporated into a DMP and approved by LBR prior to commencement of any work on site.

5.29 In addition to the 'recommended' measures, the IAQM guidance also sets out a number of 'desirable' measures which should also be considered for inclusion within the DMP. These are also set out in **Appendix E**.

5.30 Following implementation of the measures recommended for inclusion within the DMP the impact of emissions during construction of the proposed development would be negligible.

Operational Phase

5.31 The modelling assessment is predicting NO_2 concentrations above the annual mean objective at 1st floor level within the northern part of the Site. Appropriate mitigation is therefore required to reduce exposure of future occupants of the flats within this part of the building to NO_2.

5.32 It is recommended that the flats on the 1st floor within this part of the new building (i.e. fronting on to Kings Street and within the AQFA) are fitted with sealed windows and mechanical ventilation, with air intakes located at roof height to ensure a clean supply of intake air (i.e. where NO_2 concentrations are below the annual mean objective). This is in line with the requirements for locations within AQFA's.

5.33 At all other locations within the Site where there would be relevant exposure NO_2 concentrations are predicted to meet the annual mean objective therefore no other mitigation measures in relation to exposure are required.

5.34 As previously discussed the proposals would provide a limited number of parking spaces. These would be provided for existing residents and businesses, disabled use and use by Electric Vehicle car clubs only. No additional parking would be provided for new residents or business users of the Site.

5.35 In terms of building and on-site emission the scheme would provide electric space and water heating, some of which would be generated from renewable energy sources.

5.36 The AQN assessment has found that the development will be AQN in terms of building emissions and further mitigation would be required.

RESIDUAL EFFECTS

Construction phase

5.37 The greatest potential for dust nuisance problems to occur will generally be within 200m of the construction site perimeter. There may be limited incidences of increased dust deposited on property beyond this distance.

5.38 By following the mitigation measures outlined within this appraisal the impact will be substantially minimised. Residual impacts are therefore considered to be negligible.

Operational Phase

5.39 Following implementation of the mitigation measures set out in this report residual impact are considered to be negligible.

6 CONCLUSIONS

6.1 An air quality impact assessment has been carried out to assess both construction and operational impacts of the proposed development.

6.2 An assessment of the potential impacts during the construction phase has been carried out. This has shown that during this phase of the proposed development releases of dust and PM_{10} are likely to occur during site activities. Through good site practice and the implementation of suitable mitigation measures, the impact of dust and PM_{10} releases may be effectively mitigated and the resultant impacts are considered to be negligible.

6.3 ADMS Roads dispersion modelling has been carried out to predict NO_2 and PM_{10} concentrations at the development site. The assessment has found concentrations of NO_2 are exceeding the annual mean objective at 1st floor level within the northern part of the Site, although the 1-hour objective would be met at all locations and concentrations of PM_{10} would also meet the relevant objective at all locations within the Site. As the proposed development would locate residential receptors at 1st floor level appropriate mitigation measures are required to reduce exposure of future occupants in these locations. It is therefore recommended that the flats on the 1st floor within this part of the new building are fitted with sealed windows and mechanical ventilation, with air intakes located at roof height to ensure a clean supply of intake air (i.e. where NO_2 concentrations are below the annual mean objective).

6.4 As previously discussed the proposals would provide a limited number of parking spaces. These would be provided for existing residents and businesses, disabled use and use by Electric Vehicle car clubs only. No additional parking would be provided for new residents or business users of the Site.

6.5 In terms of building and on-site emission the scheme would provide electric space and water heating, some of which would be generated from renewable energy sources.

6.6 The development proposals have been assessed against the Air Quality Neutral policy set out within the London Plan and the Mayor of London's Air Quality Strategy. The proposed energy strategy for the development would reduce building related emissions through the use of energy efficient design, low energy fictures and fittings and the installation of Solar PV.

6.7 Following the implementation of the measures set out above the building emissions for the residential element of the development have been calculated as 20.6 g/m^2, below the BEB of 26.2 m^2 set for residential development. For the commercial element the building emissions would be 0.14 g/m^2, below the BEB of 22.5 g/m^2. The Site therefore meetsPolicy 7.14 of the London Plan and Policy 7 of the Mayor of London's Air Quality Strategy.

APPENDIX A - AIR QUALITY TERMINOLOGY

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
DEFRA	Department for Environment, Food and Rural Affairs.
Exceedance	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO_2	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O_3	Ozone.
Percentile	The percentage of results below a given value.
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
ppb parts per billion	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppb means that for every billion (10^9) units of air, there is one unit of pollutant present.
ppm parts per million	The concentration of a pollutant in the air in terms of volume ratio. A concentration of 1 ppm means that for every billion (10^6) units of air, there is one unit of pollutant present.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
µg/m^3 micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1ug/m3 means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

APPENDIX B - AIR QUALITY STANDARDS AND OBJECTIVES

Air Quality Objectives currently included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purpose of Local Air Quality Management (LAQM)						
Pollutant	**Applies to**	**Standard**		**Objective**		**EU AQ Daughter Directive**
		Concentration	***Measured as***	***Annual exceedances allowed***	**Target date**	
Nitrogen dioxide (NO_2)[1]	All UK	200 µg/m^3	1 hour mean	18	31.12.2005	As objective. target: 01.01.2010
Nitrogen dioxide (NO_2)	All UK	40 µg/m^3	annual mean		31.12.2005	As standard. target: 01.01.2010
Particulate Matter (PM_{10}) (gravimetric)	All UK	40 µg/m^3	annual mean		31.12.2004	As standard. target: 01.01.2005
	All UK	50 µg/m^3	24 hour mean	35	31.12.2004	As objective. target: 01.01.2005
	Scotland	50 µg/m^3	24 hour mean	7	31.12.2010	As objective. target: 01.01.2010
	Scotland	18 µg/m^3	annual mean		31.12.2010	
Particulate Matter ($PM_{2.5}$) (gravimetric)	All UK	25 µg/m^3	annual mean			As standard. target 01.01.2020

APPENDIX C - SUMMARY OF TRAFFIC DATA

Traffic data utilised for the air quality assessment (AADT)

Road Link	Speed (kph)	% HGV	2016 Base
London Road	35	5.2	11307
Richmond Road	35	8.4	14093
Kings Street	35	7.0	29084
Water Lane	35	0.7	965
Wharf Lane (assumed same along The Embankment)	35	1.1	798

APPENDIX D – VERIFICATION AND ADJUSTMENT OF MODELLED CONCENTRATIONS

Nitrogen Dioxide

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. Verification of concentrations predicted by the ADMS model has followed the methodology presented in LAQM.TG(09).

The model has been run to predict annual mean road-NO_x concentrations at the three monitoring sites. DT15 Richmond Road, DT32 Kings Street and DT65 York Street.

The model output of road-NOx (i.e. the component of total NO_x coming from road traffic) has been compared to the 'measured' road-NO_x (Figure D1). The 'measured' road NO_x has been calculated from the measured NO_2 concentrations by using the DEFRA NO_x from NO_2 calculator available on the UK-AIR website.

Figure D1: Comparison of Modelled Road NO_x with measured Road NO_x

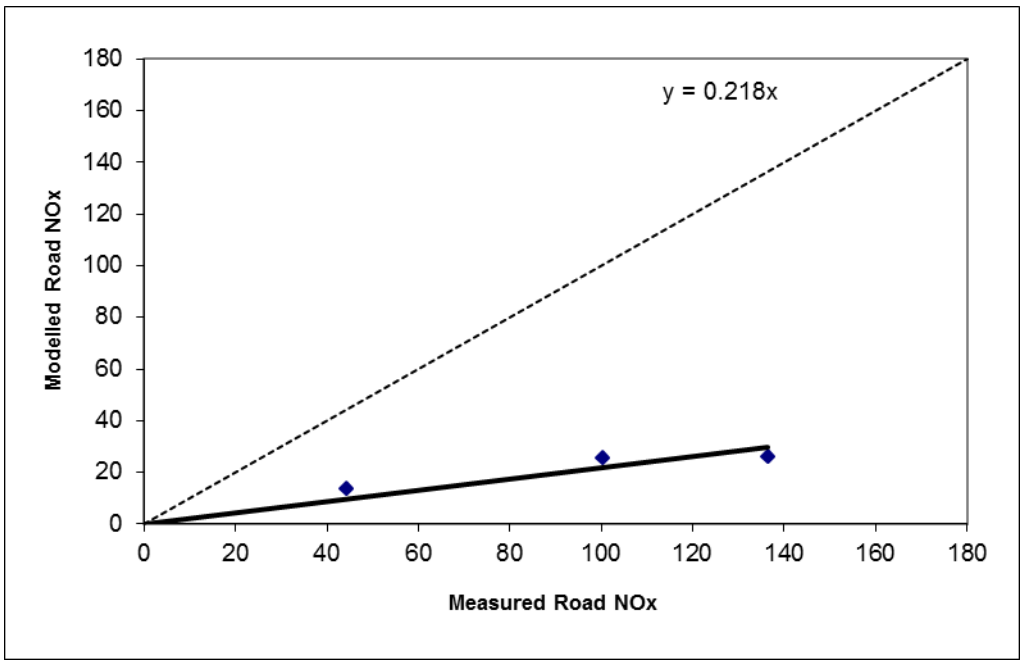
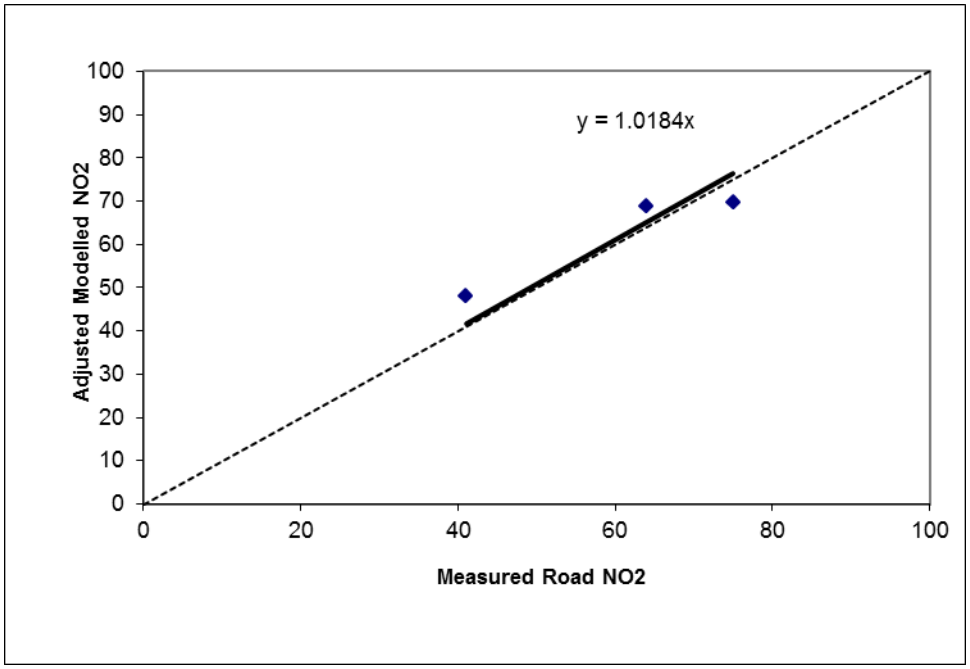


Figure D1 shows that the ADMS model under-predicted the road NO_x concentrations at the selected monitoring sites. An adjustment factor was therefore determined as the ratio between the measured road-NO_x contribution and the modelled road-NO_x contribution, forced through zero (1/0.218 = 4.59). This factor has then been applied to the modelled road-NO_x concentration for each location to provide an adjusted modelled road-NO_x concentration.

The annual mean road-NO_2 concentration was determined using the DEFRA NO_x:NO_2 spread sheet calculation tool and added to the background NO_2 concentration to produce a total adjusted NO_2 concentration.

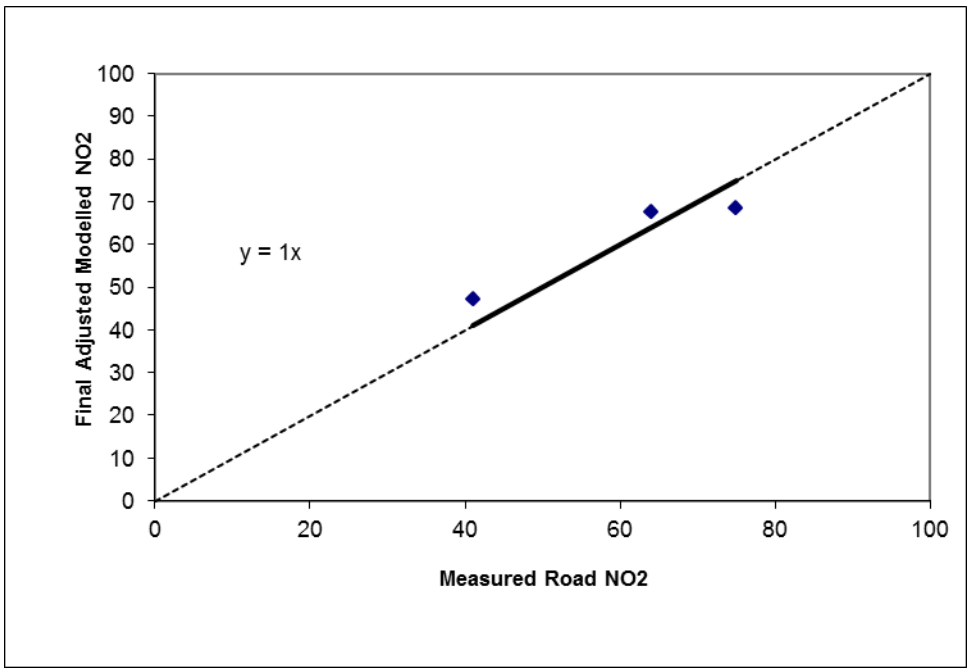
Figure D2 shows the adjusted modelled total NO_2 vs monitored NO_2. There is good agreement, but the best fit line forced through zero still has a slight departure from a 1:1 line, thus a secondary adjustment factor, to be applied to the adjusted modelled total NO_2, was calculated(1/1.0184= 0.982).

Figure D2: Comparison of Modelled NO_2 with measured NO_x



After carrying out an initial adjustment there was a need for only a very small secondary adjustment of NO_2. The final adjustment modelled values are shown in Figure D3.

Figure D3: Comparison of Final Modelled NO_2 with measured NO_x



The adjustment factor of 4.59 has been applied to the modelled NO_x-road concentrations predicted at the Site. The predicted NO_2-road concentrations, calculated using the NO_x-NO_2 converter tool, have subsequently been added to background NO_2 concentrations and adjusted by 0.982 to provide the final predicted annual mean NO_2 concentrations at each receptor.

Predicted PM_{10} concentrations where adjusted using the same adjustment factors as set out above.

APPENDIX E – CONSTRUCTION MITIGATION MEASURES

It is recommended that the 'highly recommended' measures set out below are incorporated into a DMP and approved by LBR prior to commencement of any work on site:

- display the name and contact details of the person accountable for air quality and dust issues on the site boundary (i.e. the environment manager/engineer or site manager);
- display the head or regional office contact information on the site boundary;
- record all dust and air quality complaints, identify cause, take appropriate measures to reduce emissions in a timely manner and record the measures taken;
- make the complaints log available to the local authority when asked;
- record any exceptional incidents that cause dust and/or air emissions, either on- or off- site and the action taken to resolve the situation in the log book;
- carry out regular site inspections to monitor compliance with the DMP, record inspection results and make inspection log available to LBR when asked;
- increase frequency of site inspection by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged periods of dry or windy conditions;
- plan 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 as necessary that are at least as high as any stockpiles;
- undertake daily on-site and off-site inspection, where receptors area nearby, to monitor, record inspection results and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of the site boundary;
- 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 being re-used on site, cover as detailed below;
- soft strip inside buildings before demolition;
- avoid site runoff of water or mud;
- cover, seed or fence stockpiles to prevent wind whipping;
- 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;

- 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;
- keep site fencing, barriers and scaffolding clean using wet methods;
- avoid scabbling (roughening of concrete surfaces) if possible;
- ensure vehicles entering and leaving the site are covered to prevent the escape of materials during transport;
- record all inspections of haul routes and any subsequent action in a site log book;
- use water-assisted dust sweepers on the access and local roads, to remove, as necessary, any material tracked out of the site;
- avoid dry sweeping of large areas;
- record all inspections of haul routes and any subsequent action in a site log book;
- implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud) as required;
- ensure all vehicles switch off engines when stationary - no idling vehicles;
- the use of diesel or petrol powered generators will not be permitted and the use of mains electricity or battery powered equipment will instead be required;
- 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 effective water suppression is used during demolition operations;
- Avoid explosive blasting;
- Bag and remove biological debris or damp down such material before demolition;
- ensure an adequate water supply on site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate;
- use enclosed chutes and 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;
- bonfires and burning of waste materials will not be permitted at the Site;
- ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit
- the river will be used for deliveries to avoid peak hour delivery periods on the adjacent roads;

- all on-road vehicles will comply with the requirements of the London Low Emissions Zone and the London NRMM standards.