



Waterfront Square Air Quality Assessment

Packaged Living Limited

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1. Introduction

Hydrock have been commissioned by Packaged Living Limited to prepare an Air Quality Assessment (AQA) to support the demolition of existing buildings and introduction of Build to Rent (BTR) residential scheme (the 'Proposed Development'), located off Vastern Road, Reading known as Waterfront Square (The 'Site'). The Site is located within Reading Borough Council (RBC). The Site is located next to the Reading train station, which is situated to the 125m South, across from Vastern Road (A329). To the west of the Site is a retail complex housing an ALDI supermarket and restaurants.

The Site is centred on the National Grid Reference (NGR); x471671, y174059 and is shown in Figure 1.



Figure 1: Site Location

1.1 Proposed Development

The proposals seek permission for:

"Demolition of the former Covea Insurance building and construction of residential-led development, access from Norman Place and associated car parking, infrastructure and landscaping"

The Proposed Development seeks to deliver 254 studio, one, two and three bedroom residential dwellings (Use Class C3), together with 278m² (GEA) of flexible Class E floorspace at ground floor level. A series of internal and external amenity spaces feature within the layout. New pedestrian accesses are proposed from Vastern Road and Norman Place and a vehicular access to a ground floor undercroft car parking area is proposed from Norman Place. Substantial public realm surrounds the development, providing significant visual improvement to Vastern Road, Norman Place and the River Thames frontage.

1.2 Purpose of Air Quality Assessment

The purpose of this AQA is to provide:

- » Review of baseline air quality to assess the risk of exceedance of Air Quality Assessment Levels (AQALs) at the Site and surrounding area;
- » Construction Phase Assessment to conclude on the requirements for mitigation to reduce the risk of impacts to negligible during this phase; and
- » Consideration of potential impacts during the operational phase.

2. Relevant Legislation

2.1 Air Quality Regulations and Objectives

There are two sets of air quality legislation which include ambient air quality thresholds for the protection of public health that apply in England, these include legally binding limit values originally set by the European Union (EU) Directive 2008/50/EC¹ on ambient air quality and cleaner air for Europe; and regulations implementing national air quality objectives as set out in the revised 2023 Air Quality Strategy for England (AQS)² which local authorities are required to work towards achieving. In Northern Ireland and Scotland, the AQS (Volume 1)³ remains in force.

The EU (Withdrawal Agreement) Act 2020 sets out arrangement for implementing air quality limit values that are included in the EU Directive on ambient air quality and cleaner air for Europe (2008/50/EC) included in the following:

- » Air Quality Regulations (SI 2010 No.1001)⁴ and amended (SI 2016 No.1184)⁵ ;
- » The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (SI 2019 74)⁶ ;
- » The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (SI 2020 1313)⁷ amend the Air Quality Regulations (SI 2010 No.1001) to account for EU withdrawal; and
- » The AQS objectives are implemented in the Air Quality (England) Regulations 2000 (SI 2000/928)⁸ and Air Quality (England) (Amendment) Regulations 2002 (SI 2002/3043)⁹.

The 2023 AQS sets out the government's policies and framework for improving air quality in England with the aim of meeting the requirements of above legislation. The Air Quality Strategy also outlines the Limit Values, Target Values, Standards, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment (collectively termed Air Quality Assessment Levels (AQALs) throughout this report). The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023¹⁰ also brought forward a new target level for PM_{2.5}. Those relevant to this assessment is provided below, in Table 1.

Table 1: National AQALs

Pollutant	Averaging Period	AQALs	
NO₂	1 Hour Mean	200µg/m ³	Not to be exceeded more than 18 times in a year.
	Annual Mean	40µg/m ³	
PM₁₀	24 Hour Mean	50µg/m ³	Not to be exceeded more than 35 times in a year.
	Annual Mean	40µg/m ³	

1 Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe Available at: <https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32008L0050>

2 Defra. "The Air Quality Strategy for England, Scotland, Wales and Northern Ireland". Available at: <https://www.gov.uk/government/publications/the-air-quality-strategy-for-england>

3 The air quality strategy for England, Scotland, Wales and Northern Ireland: Volume 1. Available at: <https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1>

4 The National Archives. "The Air Quality Standards Regulations 2010". Available at: <http://www.legislation.gov.uk/uksi/2010/1001/contents/made>

5 The National Archives. "The Air Quality Standards (Amendment) Regulations 2016". Available at: <https://www.legislation.gov.uk/uksi/2016/1184/contents/made>

6 The Air Quality (Amendment of Domestic Regulations) (EU Exit) Regulations 2019 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2019/74/contents/made>

7 The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (legislation.gov.uk). Available at: <https://www.legislation.gov.uk/uksi/2020/1313/contents/made>

8 The National Archives. "The Air Quality (England) Regulations 2000". Available at: <http://www.legislation.gov.uk/uksi/2000/928/contents/made>

9 The National Archives. "The Air Quality (England) (Amendment) Regulations 2002". Available at: <http://www.legislation.gov.uk/uksi/2002/3043/contents>

10 <https://www.legislation.gov.uk/uksi/2023/96/contents/made>

Pollutant	Averaging Period	AQALs	
PM _{2.5}	Annual Mean	20µg/m ³	
	Annual Mean Concentration Target (AMCT)	10µg/m ³	To be met across England by 2040
	-	Population Exposure Reduction Target ('exposure target')	35% reduction in population exposure by 2040 (compared to a base year of 2018).

It should be noted that, based on latest guidance from the Defra policy team, the PM_{2.5} AMCT of 10µg/m³ is not currently applicable at sensitive receptors, and is not yet integrated into the planning system. Therefore, this assessment compares against the AQAL of 20µg/m³ for PM_{2.5}.

Defra's Local Air Quality Management Technical Guidance 2022 (LAQM.TG(22))¹¹ provides guidance on where the above AQAL's should apply. This is summarised below, in Table 2.

Table 2: Summary of where AQALs should apply

Averaging Period	Objectives should apply at:	Objectives should generally NOT apply at:
Annual Mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to other locations at the building façade) or any other location where public exposure is expected to be short term.
24 Hour Mean and 8 Hour Mean	All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties	Kerbside sites (as opposed to other locations at the building façade) or any other location where public exposure is expected to be short term.
1 Hour Mean	All locations where the annual Mean and: 24 and 8-hour mean objectives apply. Kerbside site (for example, pavements of busy shopping streets). Those parts of car parks, bus stations and railways stations etc. which are not fully enclosed, where	Kerbside sites where the public would not be expected to have regular access.

¹¹ Defra, "LAQM Technical Guidance (TG22)" (Department for Food, Environment and Rural Affairs (Defra), August 2022), <https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf>

Averaging Period	Objectives should apply at:	Objectives should generally NOT apply at:
	members of the public might be expected to spend one hour or more. Any outdoor locations where members of the public might reasonably expect to spend one hour or longer.	
15 Minute Mean	All locations where member of the public might reasonably be exposed for a period of 15 minutes	

2.2 Local Air Quality Management

Obligations under the Environment Act 2021¹² (which provides an amendment to the Environment Act 1995¹³) requires local authorities to review and assess air quality in their administrative boundaries. Where AQALs are predicted to be exceeded, the local authority must declare an Air Quality Management Area (AQMA) at sensitive receptor locations and formulate an Air Quality Action Plan (AQAP) to reduce pollution concentrations to values below AQALs.

The 2024 – 2029 Air Quality Action Plan (AQAP) of RBC includes several strategies for LAQM. Key strategies and actions implemented by the council are:

- » Reducing Vehicle Emissions;
- » Improving Public Transport;
- » Measures to Reduce Traffic Volumes; and
- » Reducing Air Pollution from Industry, Commerce, and Residential Areas.

2.3 National Planning Policy Framework

The National Planning Policy Framework (NPPF)¹⁴ sets out the Government's planning policy for England. It requires planning decisions for any new development to prevent new and existing development from contributing to, or being put at risk from, unacceptable levels of air pollution (paragraph 180). It also states that planning decisions should sustain and contribute towards compliance with relevant limit values or national objectives for air pollutants, taking into account the presence of AQMAs and Clean Air Zones (CAZ)s (paragraph 186), and the cumulative impacts from other sites (paragraph 191).

Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. Furthermore, planning decisions should ensure that any new development in AQMAs and CAZs is consistent with the local air quality action plan.

Also, to help reduce congestion and emissions, to improve air quality and public health, significant development should be focused on locations which are / can be made sustainable through limiting the need to travel (paragraph 109).

¹² <https://bills.parliament.uk/bills/2593/publications>

¹³ Environment Agency, "Environment Act 1995" (The Environment Agency, 2002), <http://www.legislation.gov.uk/ukpga/1995/25/contents>.

¹⁴ Ministry of Housing, Communities and Local Government, "National Planning Policy Framework," December 2023, National Planning Policy Framework – GOV.UK (www.gov.uk)

2.4 Planning Practice Guidance

Reference ID 32 (Air Quality) of the National Planning Practice Guidance (NPPG)¹⁵, which was updated in November 2019, provides guiding principles on how planning can take account of the impact of new development on air quality. The NPPG summarises the importance of air quality in planning and the key legislation relating to it.

2.5 Local Planning Policy

The Reading Borough Local Plan¹⁶, adopted in 2019 contains the planning policies for managing development in Reading up to 2036. The following policy relates to air quality:

"EN15: AIR QUALITY

Development should have regard to the need to improve air quality and reduce the effects of poor air quality.

i. Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account:

Whether the proposal, including when combined with the cumulative effect of other developments already permitted, would worsen air quality;

Whether the development is within, or accessed via, an Air Quality Management Area; and

Whether it can be demonstrated that a local worsening in air quality that would not detrimentally affect human health or the environment would be offset by an overall improvement in air quality, for instance through reduction in the need to travel.

ii. Where a development would introduce sensitive uses (such as residential, schools and nurseries, hospitals, care facilities) into, or intensify such uses within, an Air Quality Management Area, detrimental effects on that use will be mitigated. Mitigation measures should be detailed in any planning application. If there are significant detrimental effects that cannot be mitigated, the application should be refused.

iii. Where required, planning obligations will be used to secure contributions to measures to tackle poor air quality or for air quality monitoring."

¹⁵ Ministry of Housing, Communities & Local Government, "Reference ID (32) Air Quality" (Ministry of Housing, Communities & Local Government, 2023), <https://www.gov.uk/guidance/air-quality--3>.

¹⁶ Reading Borough Local Plan adopted November 2019 <https://images.reading.gov.uk/2021/07/EN15.pdf>.

3. Methodology

3.1 Consultation

Full details of the AQA approach were sent via email to RBC. To date no response has been received.

The proposed methodology is outlined below.

3.2 Guidance

The following guidance has been followed/referred to in preparing this AQA:

- » Defra's LAQM.TG(22)¹¹;
- » EPUK & IAQM Land-use Planning & Development Control: Planning for Air Quality¹⁷
- » The IAQM's guidance on assessing impacts from construction¹⁸;
- » DMRB, LA 105¹⁹; and
- » The Reading Climate Emergency Strategy 2020-25²⁰.

3.3 Baseline Air Quality

The baseline air quality conditions in the vicinity of the Site have been established through the compilation and review of the following sources. The Baseline Assessment can be found in Section 4.

- » Data from the National Atmospheric Emissions Inventory (NAEI)²¹, Environment Agency (EA)²² and Defra's Pollutant Release and Transfer Register (PRTR) data²³;
- » Defra's modelled background concentrations of AQS pollutants (UK-AIR)²⁴. These estimates are produced using detailed modelling tools and are available as concentrations at central 1km² National Grid square locations across the UK. Mapped background concentrations have been obtained based upon the 2018 base year Defra update (August 2020 publication);
- » Defra's predicted roadside concentrations of NO₂ produced from their pollution climate mapping (PCM)²⁵ model;
- » Multi Agency Geographic Information for the Countryside (MAGIC)²⁶, which incorporates Natural England's interactive maps; and,
- » RBC latest available air quality monitoring data, derived from the latest available air quality annual status report (ASR) published in 2023²⁷.

¹⁷ Land-Use Planning & Development Control:

Planning For Air Quality - <https://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf>

¹⁸ IAQM, "Guidance on the Assessment of Dust from Demolition and Construction" (Institute of Air Quality Management (IAQM)), January 2024), <https://iaqm.co.uk/wp-content/uploads/2013/02/Construction-Dust-Guidance-Jan-2024.pdf>

¹⁹ DMRB, LA 105 Air Quality, November 2019.

²⁰ The Reading Climate Emergency Strategy 2020-25, (<https://readingcan.org.uk/wp-content/uploads/2020/10/our-plan-READING-CLIMATE-EMERGENCY-STRATEGY-2020-25-Final.pdf>)

²¹ National Atmospheric Emissions Inventory, UK Emissions Interactive Map (beis.gov.uk).

²² <https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory>

²³ UK Pollutant Release and Transfer Register (PRTR) <https://prtr.defra.gov.uk/map-search>

²⁴ UK-AIR, "Background Mapping Data for Local Authorities - 2018," n.d., <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018>.

²⁵ <https://uk-air.defra.gov.uk/data/gis-mapping/>

²⁶ <https://magic.defra.gov.uk/MagicMap.aspx>

²⁷ Reading Borough Council, 2023 Air Quality Annual Status Report (ASR) June 2023

3.4 Construction Phase Assessment

3.4.1 Dust Risk Assessment

The construction dust risk assessment is provided in Section 5 and has been undertaken in line with IAQM guidance¹⁸. This considers the risk of impacts during the construction phase in terms of nuisance dust, human health (PM₁₀ exposure) and ecological impacts.

With regard to ecological receptors, risk assessment should be taken where high-sensitivity receptors are located within 50m of a Site boundary, or within 50m of any routes used by construction vehicles on the public highway, up to 500m from the Site entrance. MAGIC website²⁶ has been reviewed to identify whether any statutory ecological sensitive receptors present in the area. *No receptors were identified within 50m of the Site boundary or expected Trackout route and therefore no further consideration of ecological receptors is required.*

Sensitive receptors were identified within 350m of the Site boundary. Based on the IAQM guidance residential dwellings, museums, car parks and car show room are indicative examples of high sensitivity receptors in relation to both dust soiling and health effects of PM₁₀. Indicative examples of medium sensitivity receptors include places of work, such as offices.

The IAQM guidance states that the potential dust emission magnitude from Demolition, Earthworks, Construction and Trackout should all be assessed individually. In addition, the sensitivity of the area to adverse dust impacts should also be defined.

The overall significance of the risk of adverse impacts during the construction phase can then be defined using the 'risk of impacts matrix' for each stage of the construction phase described above.

3.4.2 Construction Traffic Emissions

The IAQM guidance states that from experience of assessing exhaust emissions from site traffic, it is unlikely that any significant adverse impacts on local air quality would be caused and in the vast majority of cases, quantitative assessment is not needed. As such, short term effects of construction traffic emissions have not been assessed, as they are also likely to be below the EPUK & IAQM traffic criteria outlined in Table 3.

3.5 Operational Phase Assessment

3.5.1 Scope of Impact Assessment

The scope of assessment has initially been determined against the EPUK and IAQM's two stage checklist criteria¹⁷. The Proposed Development meets the Stage 1 Criteria for requiring an AQA and accordingly, has been considered against the relevant Stage 2 checklist criteria shown in Table 3 which identifies whether a detailed assessment of potential air quality impacts is required.

Stage 2 includes some criteria which are not directly relevant to the Proposed Development, such as those related to the realignment of roads within an AQMA, introduction of a new bus station, new road junctions and underground car parks. These have been excluded from this assessment and only relevant screening criteria have been included. The relevant checklist criteria shown in Table 3 identifies whether a detailed assessment of potential air quality impacts is required.

Table 3: EPUK & IAQM Assessment Criteria

Criteria	The Development Will:	Indicative Criteria to Proceed to a Detailed AQA:
1	Cause a significant change in Light Duty Vehicle (LDV) traffic flows on local roads with relevant receptors. (LDV - cars and small vans <3.5t gross vehicle weight)	A change of LDV flows of: » more than 100 AADT within or adjacent to an AQMA » more than 500 AADT elsewhere

Criteria	The Development Will:	Indicative Criteria to Proceed to a Detailed AQA:
2	Cause a significant change in Heavy Duty (HDV) flows on local roads with relevant receptors (HDV = goods vehicles + buses >3.5t gross vehicle weight).	A change of HDV flows of: » more than 25 AADT within or adjacent to an AQMA » more than 100 AADT elsewhere.
3	Have one of more substantial combustion processes, where there is a risk of impacts at relevant receptors. NB. This includes combustion plant associated with standby emergency generators (typically associated with centralised energy centres) and shipping.	Typically, any combustion plant where the single or combined NO_x emission rate is less than 5mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent stack in a location and at a height that provides adequate dispersion. In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situation where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emissions rates. Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable.

As the Site is located within the Reading AQMA, the more stringent criteria apply. The Transport Consultants on the scheme, Stantec, have confirmed the Proposed Development is anticipated to generate negative vehicle trips of Annual Average Daily Traffic (AADT). The traffic data is discussed more in Section 6.1

With regard to screening criteria 3, the energy strategy²⁸ associated with the Proposed Development will align with planning policy and will be developed using a 'fabric first' approach through the Be Lean, Be Clean and Be Green energy hierarchy. The Site will be:

- » fossil fuel free (no combustion);
- » have Photo Voltic's (PV) at roof levels feeding into the landlords supply and back to the network, helping to decarbonise the grid; and
- » use Exhaust Air Source Heat Pumps (EASHP)

Based on the above, a detailed site suitability assessment has been undertaken due to the residential nature of the development. Impacts from scheme-generate traffic have been screened in accordance with the EPUK & IAQM guidance.

The site suitability detailed modelling methodology is outlined below.

²⁸ Norman Place, Reading, Energy and Overheating, Pre-App Meeting, Hoare Lea.

3.5.2 ADMS-Urban Dispersion Model

A detailed AQA has been undertaken using the air dispersion model ADMS-Urban v5.1 to establish the current and future air quality conditions in the area. The software is commercially available, has been validated for this type of assessment by Defra and is used extensively for AQA's.

ADMS-Urban is able to provide an estimate of air quality both before and after development, considering important input data such as background pollutant concentrations, variable emissions, meteorological data, and traffic flows.

3.5.3 Assessment Scenarios

The following scenarios have been modelled:

- » Baseline/verification 2019; and
- » 2026 Do Something (2026 DS) – Opening year traffic flows including Proposed Development traffic.

3.5.4 Model Inputs

3.5.4.1 Traffic Data

The traffic data was provided by the Transport Consultants, Stantec and comprises AADT flows for the road links surrounding the Site. The modelled road links are shown in Figure 2 below, with full details provided in Appendix A.

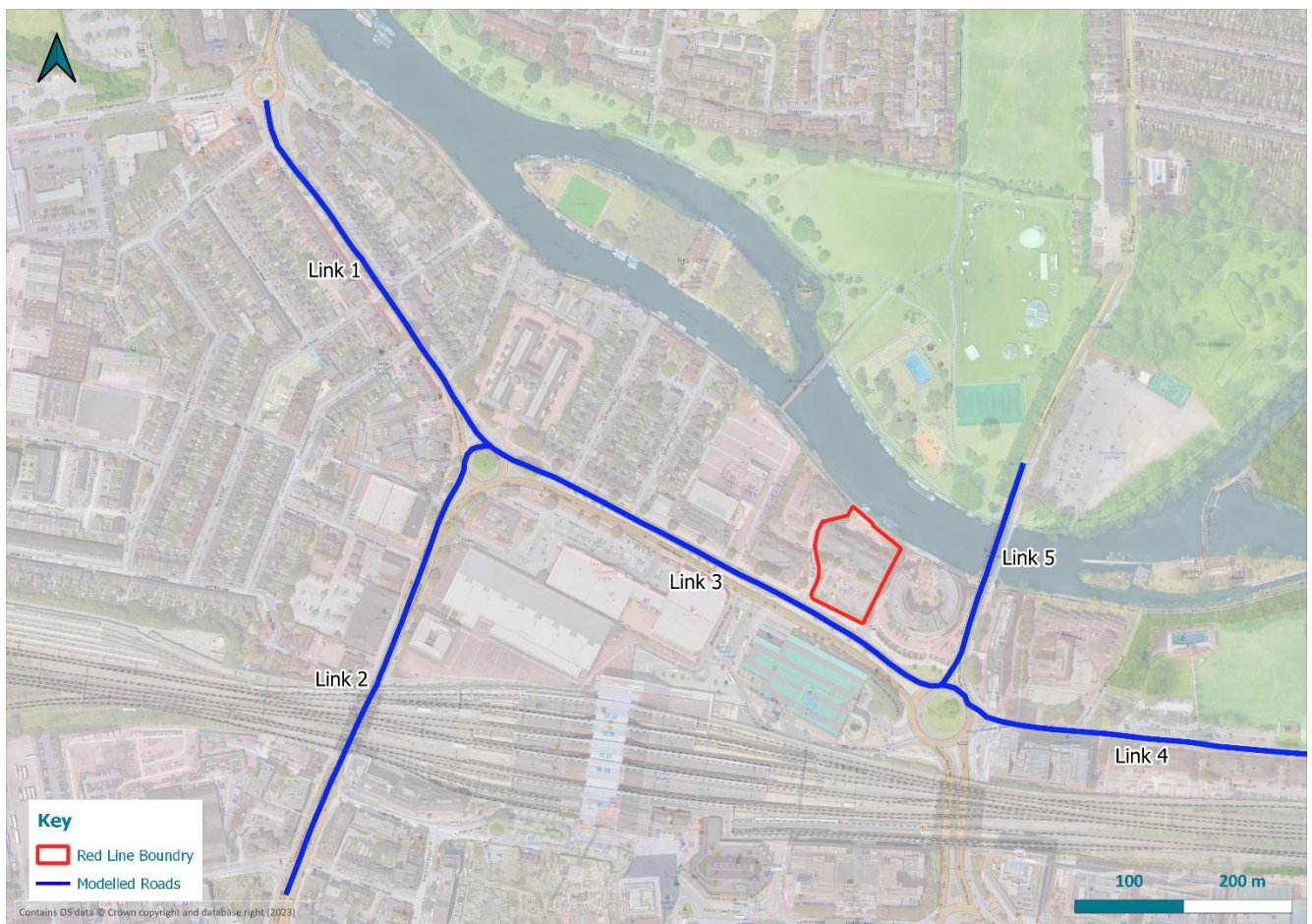


Figure 2: Links Modelled

For each road link, vehicle speeds were obtained from the speed limit for each road derived from the OpenStreet Browser v4.10²⁹, which has been used as a proxy for average speeds on the network. Vehicle speeds were reduced to 20kmph within 50m of junctions relative to the speed limit to account for queuing and congestion in the average speed profile, in accordance with LAQM.TG (22).

3.5.4.2 Emission Factors

Emission rates for NO_x, PM₁₀ and PM_{2.5} used for the dispersion modelling assessment were calculated from the latest Emissions Factor Toolkit (EFT)(v.12).

Most modern vehicles on the road in the UK meet a particular Euro emissions standard from 1 – 6, with 6 being the newest. Different parts of the country have newer or older vehicles than others. This is defined as the “fleet”. The EFT estimates this primarily based on whether the location is within or outside London or in England, Wales or Scotland. In the case of this model the vehicle fleet used was “England (urban)”.

When predicting future year emissions, the toolkit includes forecasts such as anticipated advances in vehicle technology and changes in vehicle fleet composition, which assumes that vehicle emissions will reduce over time. However, there is some uncertainty over the accuracy of the future predictions.

3.5.4.3 Temporal Variation (Diurnal Traffic Profile)

Temporal variation in traffic flows along roads have been included in the dispersion model to account for the realistic differences that would occur between weekdays and weekends. Accordingly, a time varying profile was included in the model.

The diurnal profile used in the model has been calculated based on DfT Road traffic statistics (TRA) dataset. TRA0307 provides 'Motor vehicle traffic distribution by time of day and day of the week on all roads, Great Britain: 2019'³⁰, which shows the average hourly traffic flow in each combination of weekday and hour, relative to the average hour across the whole year for main roads in England. Figure 3 shows the diurnal traffic profile included in the model.

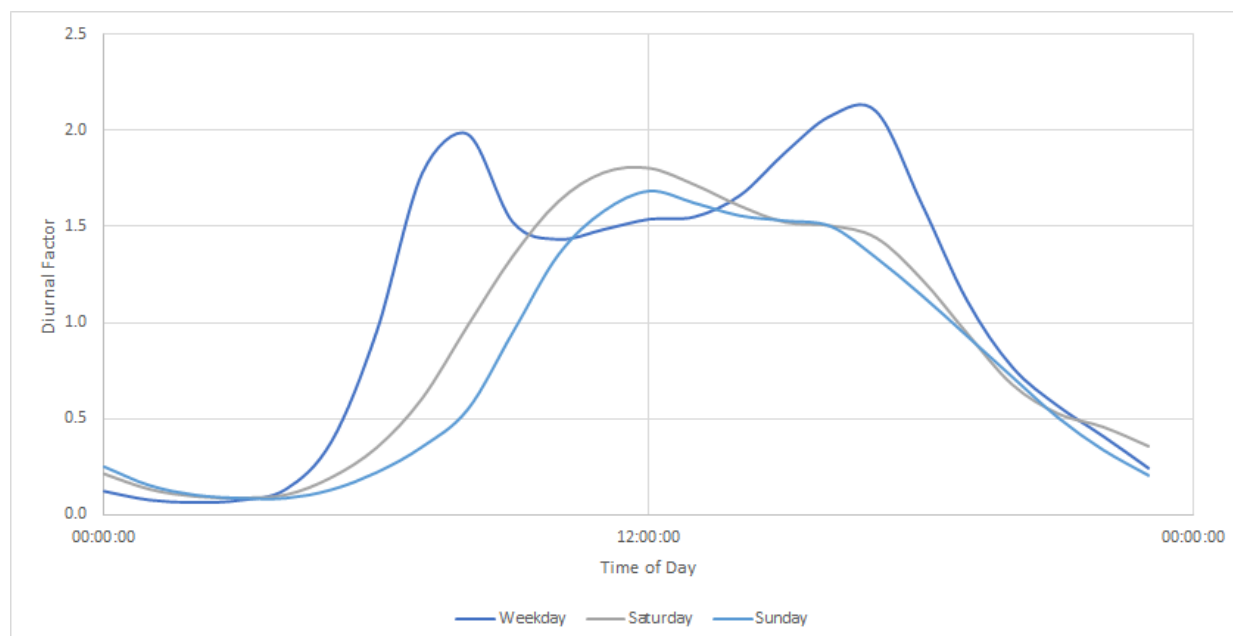


Figure 3: Diurnal traffic profile included in the dispersion model

²⁹ https://www.openstreetbrowser.org/#map=15/53.7033/-1.2698&categories=car_maxspeed

³⁰ DfT, "Average Annual Daily Flow and Temporal Traffic Distributions (TRA03) - Statistical Data Sets - GOV.UK," 2015, <https://www.gov.uk/government/statistical-data-sets/tra03-motor-vehicle-flow>.

3.5.4.4 Background concentrations

Unadjusted Mapped background concentrations of NO₂, PM₁₀ and PM_{2.5} were downloaded for the grid squares containing the Site. These can be found in Section 4.3.1, in Table 5.

Background concentrations for each modelled receptor location are shown in Appendix D.

3.5.4.5 Meteorological Parameters

To calculate pollutant concentrations at identified sensitive receptor locations the dispersion model uses hourly sequential meteorological data, including wind direction, wind speed, temperature, cloud cover and stability, which exert significant influence over atmospheric dispersion.

The dispersion modelling has been undertaken using 2019 data from Farnborough Airport. Farnborough Airport is located 24.6km south east of the Site. It is also the closest and most relevant meteorological station that records all of the parameters necessary for dispersion modelling. A Windrose is presented in Appendix B.

3.5.4.6 Surface Characteristics

The following surface roughness parameters have been applied in the model:

- » Dispersion site surface roughness = 1m (ADMS pre-set for 'cities and woodlands');
- » Met site surface roughness = 0.02m (ADMS pre-set 'open grassland')

The following Minimum Monin-Obukhov (MO) lengths were applied:

- » Dispersion site = 30m (ADMS pre-set 'cities and large towns'); and
- » Met site = 30m (ADMS pre-set: 'cites and large towns').

3.5.5 Receptors Included in the Dispersion Model

3.5.5.1 Human Receptors

Sensitive receptor locations included in the dispersion model are shown below in Figure 4 and Table 4. These are locations within the Site, based on approximate window locations. Receptors have been modelled at 1st and 2nd floor and assume a ground floor height of 4m and a breathing height of 1.5m. Residential dwellings are not proposed at ground level and therefore this height was not included within the model

Table 4: Receptor Locations

Receptor ID	Location	NGR		Z (m)
		X	Y	
R1a, b	First Floor flat, western corner, south facing window	471636	174018	5.5, 8.5
R2a, b	First Floor central southern flat, south facing window	471643	174014	5.5, 8.5
R3a, b	First Floor central southern flat, south facing window	471651	174013	5.5, 8.5
R4a, b	First Floor central southern flat, south facing window	471656	174010	5.5, 8.5
R5a, b	First Floor central southern flat, south facing window	471662	174005	5.5, 8.5

Receptor ID	Location	NGR		Z (m)
		X	Y	
R6a, b	First Floor flat, eastern corner, south facing window	471669	174001	5.5, 8.5
R7a, b	First Floor flat, western side, east facing window	471678	174008	5.5, 8.5
R8a, b	First Floor flat, western side, east facing window	471681	174014	5.5, 8.5
R9a, b	First Floor flat, western side, east facing window	471683	174019	5.5, 8.5
R10a, b	First Floor flat, western corner, west facing window	471632	174023	5.5, 8.5
R11a, b	First Floor flat, western corner, north facing window	471663	174023	5.5, 8.5
R12a, b	First Floor flat, western corner, south facing window	471657	174026	5.5, 8.5
R13a, b	First Floor flat, western side, west facing window	471634	174030	5.5, 8.5
R14a, b	First Floor flat, western side, west facing window	471636	174036	5.5, 8.5



Figure 4: Receptor Locations

3.5.6 Model Verification

A verification study has been undertaken in accordance with LAQM.TG(22) using RBC monitoring data. An adjustment factor of **1.327** was applied to modelled road NO_x concentrations.

Due to insufficient PM monitoring in the study area, the modelled road- PM_{10} and road- $\text{PM}_{2.5}$ components have been adjusted by the NO_x verification factor obtained, in accordance with LAQM.TG(22). This approach is considered likely to provide a conservative estimate of the contribution of modelled roads to ambient PM_{10} and $\text{PM}_{2.5}$ concentrations.

Root Mean Square Error (RMSE) is used to define the average error or uncertainty of the model. LAQM.TG(22) states that the RMSE is acceptable where it is within 25% and ideal within 10%. The model verification process calculated a post-adjusted RMSE of **$4.2\mu\text{g}/\text{m}^3$** , which equates to **10.4%** of the annual mean AQAL for NO_2 and is therefore considered to be acceptable.

Full details of the model verification procedure are included in Appendix C.

3.5.7 NO_x to NO_2 Conversion

Ambient NO_x concentrations have been predicted through dispersion modelling. Annual NO_x concentrations have been converted NO_2 using Defra's NO_x to NO_2 conversion tool³¹ version 8.1.

³¹ Defra, "NO_x to NO₂ Calculator" (Defra, 2019), <https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc>.

3.6 Comparison with AQALs

3.6.1 Nitrogen Dioxide

To determine short term (1 hour mean) concentrations, reference was made to LAQM.TG(22)¹¹, which states if annual mean concentrations of NO₂ do not exceed 60µg/m³, it is unlikely hourly mean concentrations would exceed the relevant AQAL, which allows for 18 exceedances of the hourly standard (200µg/m³) in a calendar year.

3.6.2 Particulate Matter

Annual mean PM₁₀ concentrations were used to derive the potential number of exceedances of the 24-hour mean PM₁₀ AQAL, of which 35 are allowed per year. The method described in LAQM.TG (22) was applied, which is based on the relationship between the number of 24-hour exceedances of 50µg/m³ and the annual mean concentration. This relationship is described in Equation 1 below:

Equation 1 - Calculation of PM₁₀ 24-hour Mean Exceedances

$$\text{Number of exceedances of 24-hour mean of } 50\mu\text{g}/\text{m}^3 = -18.5 + 0.00145 * a^3 + (206/a)$$

where 'a' = total annual mean PM₁₀ concentration.

3.7 Assessment of Significance

Professional judgement has been applied to determine whether exposure to air pollution is significant or not, based on the following criteria:

- » Annual mean concentrations within 10% below or exceeding relevant AQAL = significant exposure; and
- » Annual mean concentrations more than 10% below relevant AQAL = not significant.

The 10% threshold around an AQAL is generally considered to be the range at which a 'risk of exceedance' is present, according to LAQM.TG(22).

3.8 Model Limitations

There are inherent uncertainties associated with the model (ADMS Urban) used in this assessment, including the uncertainties associated with the input data such as predicted traffic flows. The model itself simplifies complex physical systems into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS model will not take into account.

With regards to undertaking a sensitivity assessment, the withdrawn IAQM guidance on uncertainty in vehicle NO_x emissions³² provides the following statement:

"It is judged that an exclusively vehicle emissions-based sensitivity test is no longer necessary."

In addition, DEFRA COVID-19 Supplementary Guidance³³ also provides the following:

"Potential sensitivity tests that may be included within LAQM detailed modelling studies are:

Comparing results to a 2019 baseline year verification scenario; and /or

Holding vehicle fleet and / or background concentrations constant."

³² iaqm_uncertainty_vehicle_NOx_emission_withdrawn-02.pdf, July 2028 v1.1.

³³ Covid-19-Supplementary-Guidance-for-Local-Air-Quality-Management-Reporting-in-2021-v1.pdf (defra.gov.uk), April 2021 v1.0

Therefore, while an additional sensitivity assessment has not been undertaken, to account for uncertainty in future emission factors and pollutant concentrations, the precautionary principle has been adopted in the main assessment, whereby:

- » Emission Factors held at 2019 (no future improvements assumed);
- » Background pollutant concentrations held at 2019 (no future improvements assumed); and
- » 2026 development opening year traffic data utilised.

The above assumptions ensure a conservative approach has been considered in the assessment.

4. Baseline Air Quality Conditions

4.1 AQMA

The Reading Air Quality Management Area (AQMA) was declared on 19th August 2009. This AQMA is described as:

"An area covering Reading Town Centre, areas along the major radial road routes into Reading (including J11 of the M4) and along the railway lines where they pass through built-up areas."

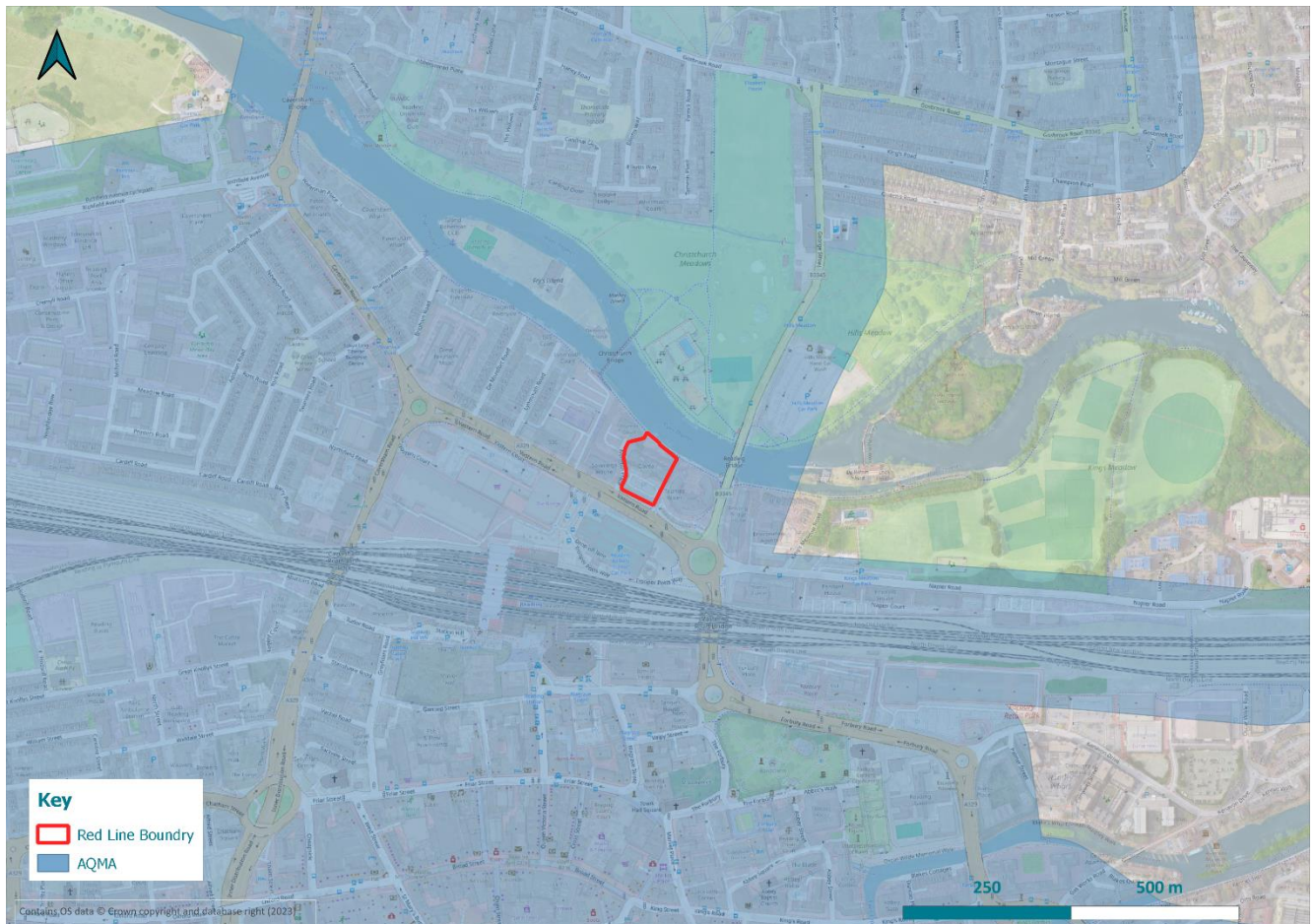


Figure 5: Reading AQMA

4.2 Local Emission Sources

The main source of air pollution in the Site locale are vehicles using the local road network, predominantly the Vastern Road (A329), located immediately south of the Site boundary.

A review of the NAEI²¹, EA²² and Defra's PRTR²³ data indicates a potential point source to the immediate east of the Site associated with Thames Water Utilities Ltd. However, this location is associated with the Thames Water offices and not any water and sewage. Thames Water have all of the relevant Environmental Permits in place associated with all operations in Reading³⁴. Therefore, this point source has not been considered further.

³⁴ [Results of searching All Registers \(data.gov.uk\)](#)

4.3 Defra Mapped Concentrations

4.3.1 Background Concentrations

Mapped background concentrations of NO₂, PM₁₀ and PM_{2.5} were downloaded for the grid square containing the Site.

Background pollutant concentrations for 2019 (the base year), 2023 (the assessment year), and 2026 (the earliest opening year of the Proposed Development) are displayed in Table 5.

Table 5: Defra Mapped Background Concentrations

Grid Square (x,y)	Pollutant	AQAL (µg/m ³)	Annual Mean Concentration (µg/m ³)		
			2019	2023	2026
471500, 174500	NO ₂	40	22.7	20.3	19.1
	PM ₁₀	40	17.6	16.7	16.3
	PM _{2.5}	20	9.2	9.2	9.2

The data show that annual mean background concentrations of NO₂, PM₁₀ and PM_{2.5} at the grid square within which the Site is located are below the AQALs in all years.

Concentrations of all pollutants are predicted to decline incrementally each year. These reductions are principally due to the forecast effect of the roll out of cleaner vehicles and strategies to reduce emissions across all sectors.

4.3.2 Pollution Climate Mapping

Defra's PCM model provides estimates of roadside concentrations of annual mean NO₂, which are used in reporting compliance with limit values. The model provides projected roadside concentrations of pollutants, for the years 2018-2030 inclusive, based on a 2018 base year.

Vastern Road (A329) has been included as PCM model links as illustrated in Figure 6. The maximum 2019 roadside annual mean NO₂ concentrations are projected to be 29.0µg/m³ along Vastern Road and therefore below the annual mean AQAL. Roadside concentrations are predicted to decline incrementally year on year.



Figure 6: Defra 2019 Modelled PCM Roadside NO₂ Concentrations (µg/m³)

4.4 Air Quality Monitoring Data

4.4.1 Automatic Monitoring

The Reading New Town monitoring station (AURN UK-AIR ID: UKA00462), forms part of the Automatic Urban and Rural Monitoring Network (AURN). It is located within a self-contained, air-conditioned housing in a cemetery surrounded by trees. This cemetery is at the junction of two busy main roads (A4 and A329), east of the town centre, in a high-density residential area, (NGR: x473468, y173207) located approximately 1.6km south-east-east of the Site. The Reading New Town AURN is classified as an 'urban background' monitor defined by LAQM.TG(22) as, "An urban location distanced from sources and therefore broadly representative of city-wide background conditions, e.g. urban residential areas". Recent results from the AURN are shown below in Table 8.

RBC also undertake automatic monitoring as part of their network. However, these monitors are all at 'roadside' locations and not considered representative of the Site. Therefore, they haven't been considered further within this AQA.

Table 6: Automatic Monitoring Results

Monitor	Pollutant	AQAL	AQAL ($\mu\text{g}/\text{m}^3$)	Concentration ($\mu\text{g}/\text{m}^3$)				
				2018	2019	2020	2021	2022
AURN	NO ₂	Annual Mean	40	26	22	15	20	23
		1-hour Mean	200 ^(A)	0	0	0	0	0
	PM ₁₀	Annual Mean	40	13	13	15	15	16
		24-Hour Mean	50 ^(B)	1	0	0	1	0
	PM _{2.5}	Annual Mean	20	7	8	8	8	8

Notes:

^(A) 200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times/year

^(B) 50 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 35 times/year

As shown in the Table above, there are no exceedances of the annual mean or 1-hour mean at the AURN monitor. Concentrations remain similar over the 5-year period with the exception of a slight decline in 2020 as a result of the COVID-19 pandemic. Therefore, 2020 and 2021 data should be treated with caution due to changes in traffic flow as a result of the COVID-19 pandemic.

4.4.2 Passive Monitoring

Passive NO₂ diffusion tube monitoring is currently undertaken by RBC at numerous locations throughout the Council's area as part of their commitment to LAQM.

Those tubes within 1km of the Site are shown in Figure 7 and the data presented in Table 7.



Figure 7: Local Authority Monitoring

Table 7: Passive Diffusion Tube Monitoring Concentrations

Site ID	Site Name	Site Type	X (m)	Y (m)	Annual Mean NO ₂ Concentration (µg/m ³)				
					2018	2019	2020	2021	2022
DT43	Malcolm Place	Kerbside	471169	173869	39.2	52.4	40.0	42.1	43.3
DT53	131 Caversham Rd	Roadside	471261	174236	34.8	32.0	22.2	27.3	26.2
DT52	31a Vastern Rd	Roadside	471420	174129	33.0	27.9	23.7	25.4	24.8
DT51	108 Caversham Rd	Roadside	471293	174236	41.5	35.3	26.5	28.7	29.4
DT47	197 Caversham Rd	Roadside	471161	174379	33.5	30.5	25.0	29.7	29.3

Table 7 illustrates that some of the monitored sites have exceeded the NO₂ annual mean AQAL. Specifically, site DT43 at Malcolm Place has shown consistent exceedances with NO₂ concentrations reaching a

maximum $52.4\mu\text{g}/\text{m}^3$ in 2019. The diffusion tube is located at the 'kerbside' and within the Reading AQMA and therefore concentrations would be expected to be elevated.

Within the RBC ASR, NO_2 concentrations show a general downward trend. The data for 2020 and 2021 warrants cautious interpretation due to potential anomalies caused by the irregular traffic conditions during the COVID-19 lockdowns.

5. Construction Phase Assessment

5.1 Overview

The construction phase of the Proposed Development will involve a number of activities that will release polluting emissions to air. Predominantly, these will be emissions of dust. As such, a qualitative construction dust risk assessment has been carried out in accordance with IAQM guidance¹⁸. Where detailed information was unknown, the dust emission magnitude has been estimated based on professional judgement.

Construction activities typically include:

- » material export and import;
- » temporary stockpiling of materials;
- » groundwork for foundations and services;
- » construction of buildings;
- » landscaping works; and
- » vehicle movements (with the potential to track-out material from site).

5.2 Potential Dust Emission Magnitude

5.2.1 Demolition

It is understood that demolition of the existing building is required prior to any earthworks and construction. The total building volume to be demolished is estimated to be between 12,000m³ – 75,000m³ and comprises potential dusty materials

Based on the above, the potential dust emission magnitude for demolition is considered to be **"Medium"**.

5.2.2 Earthworks

Earthworks will primarily involve excavating material, haulage, tipping and stockpiling. This may also involve levelling the Site and landscaping. As stated within the proposed layout drawing within the Pre-Planning document³⁵ the total area of the Site has not yet been finalised but expected to be within the IAQM's 'Small' criteria (<18,000m²). The underlying soil texture is *"Freely draining slightly acid loamy soils"*³⁶ which has a medium potential for dust release when due to the smaller particle size.

The number of heavy earth moving vehicles active during earthworks is unknown. However, based on the size of the Site it has been estimated to be <5 vehicles.

Based on the above, the potential dust emission magnitude for earthworks is considered to be **"Small"**.

5.2.3 Construction

The key issues when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction, construction materials, and duration of build. An estimation of the total volume of buildings to be constructed has been estimated based on the Pre-Planning Development³⁵.

The total area of buildings to be constructed is considered to fall within the IAQM's "Large" category (>75,000m³). Specific construction materials are not known but are expected to be potentially dusty.

Based on the above, the potential dust emission magnitude for construction is considered to be **'Large'**.

³⁵ Norman Place / Reading Pre-application Meeting 02, Assael, September 2023

³⁶ Cranfield University, "Cranfield Soil and Agrifood Institute," n.d., <http://www.landis.org.uk/soilscapes/>.

5.2.4 Trackout

The risk of impacts occurring during Trackout is predominantly dependent on the number of vehicles accessing the Site on a daily basis. However, vehicle size, speed and the duration of activities are also factors which are used to determine the risk of impacts.

The number of outward HDV movements in one day is considered to be between <20, due to the size of the Site. Any unpaved road length is considered to be <50m.

Based on the above, the potential dust emission magnitude during Trackout is considered to be '**Small**'.

5.2.5 Summary

Table 8 below shows a summary of the potential dust emission magnitudes from each activity.

Table 8: Dust Emission Magnitude Summary

Activity	Dust Emission Magnitude
Demolition	Medium
Earthworks	Small
Construction	Large
Trackout	Small

5.3 Sensitivity of Area

The prevailing wind direction for the closest regionally representative meteorological measurement station to the Site, at Farnborough Airport, is shown in Appendix B for 2019. The wind rose shows that the prevailing winds are from the south west.

Figure 8 shows the construction phase distance buffers (20m, 50m, 100m and 250m) around the Site boundary, as well as identified high and medium sensitivity receptor locations within these buffers.



Figure 8: Construction Phase Receptors

5.3.1 Dust Soiling Impacts

Figure 8 illustrates there are between 1 -100 high sensitivity human receptor within 250m of the Site boundary and >1 medium sensitivity receptor within 20m of the Site boundary. As such, the overall sensitivity of the surrounding area to nuisance dust soiling effects during Demolition, Earthworks and Construction, according to IAQM guidance, is defined as **'Medium'**.

With regard to Trackout, the sensitivity for Large size sites is assessed where receptors are located within 50m from Trackout routes up to 500m from the Site. As there are between 10-100 high-sensitivity receptors within 50m of potential Trackout routes from the Site, the sensitivity to dust soiling impacts from Trackout is defined as **'Medium'**.

5.3.2 Human Health Impacts

Defra mapped background predictions (Table 5) show that annual mean concentrations of PM_{10} are not likely to exceed $24\mu g/m^3$ in the vicinity of the Site³⁷, based on 2019 estimates. According to IAQM guidance, where PM_{10} concentrations are $<24\mu g/m^3$ and there are less than 100 high sensitivity receptors within 50m of construction works, the overall sensitivity of the surrounding area to human health impacts is defined as **'Low'** for Demolition, Earthworks, Construction and Trackout.

³⁷ The values are based on $32\mu g/m^3$ being the annual mean concentration at which an exceedance of the 24-hour objective is likely in England, Wales and Northern Ireland

5.3.3 Summary of Area Sensitivity

The sensitivity of the surrounding area for the potential impacts discussed above is summarised in Table 9 below.

Table 9: Sensitivity of Local Area

Potential Impact	Sensitivity of Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Medium	Medium	Medium
Human Health	Low	Low	Low	Low

5.4 Risk of Impacts

Using the methodology prescribed in the IAQM guidance, the overall risk of impacts can be defined by combining the sensitivity of the area with the potential dust emission magnitude of each stage of the construction phase as described above.

Table 10 provides a summary of the construction dust risk assessment. Overall, the development is considered to be **Medium Risk** for nuisance dust soiling effects and a **Low Risk** for PM₁₀ health effects in the absence of mitigation.

Table 10: Risk of Adverse Impacts During Construction Phase

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Low	Medium	Low
Human Health	Low	Negligible	Low	Negligible

6. Operational Phase Assessment

6.1 Proposed Trip Generation and Distribution

The Proposed Development is changing from office use to residential use. As a result of this change of use, the Transport Consultants for the scheme, Stantec, have confirmed a net reduction in trips as a result of the proposals. The change in flows for the surrounding road links is shown below.

Table 11: Trip Generation (AADT)

Road Link	Net Change in Trips		
	LDV	HDV	Total
A4155	-29	0	-29
Caversham Road	-41	4	-37
Forbury Road	-41	4	-37
Napier Road	-6	0	-6

As shown in Table 11, there is a reduction in trips on all road links within the Site vicinity. As such trips are considered to be 'not significant' and detailed modelling of adverse impacts is not required.

6.2 Impact on Future Occupants – Site Suitability

Due to the location of the Site, within the RBC AQMA and in close proximity to major road links, detailed modelling has been undertaken in order to ensure that the Site is suitable for residential use.

Maximum modelled annual mean NO₂, PM₁₀ and PM_{2.5} concentrations at each modelled floor height are shown in Table 12. As a worst-case, background concentrations have been held at the 2019 base year. Modelled concentrations at each individual receptor are presented in Appendix D.

In line with the London City Air Quality³⁸ document, air quality improves with height (at roadside locations) up to the fourth floor of typical buildings. Beyond this a further reduction is minimal. As such, the heights modelled are considered worst-case.

Table 12: Maximum Model Predicted Annual Mean Concentrations

Floor	NO ₂ (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
First	24.6	12.9	8.5
Second	22.2	12.4	8.3

As can be seen from Table 12, no exceedances of the AQALs are predicted for any pollutants across the Proposed Development. Higher concentrations of annual mean NO₂, and other pollutants, are found along the existing highways. With regards to concentration at the Proposed Development, the maximum annual mean NO₂ concentration of 24.6µg/m³ is predicted on the first floor at R1a and R2a which is 62% of the relevant AQAL.

³⁸ CITY AIR QUALITY AT HEIGHT – Lessons for Developers & Planners, WSP and Parsons Brinkerhoff.

The maximum annual mean PM_{10} concentration is $12.9\mu g/m^3$ which is 32% of the relevant AQAL and the maximum annual mean $PM_{2.5}$ concentration is $8.5\mu g/m^3$ which is 42% of the relevant AQAL.

With regard to the short-term 1-hour NO_2 AQAL, Defra's LAQM.TG(22) states where the annual means are below $60\mu g/m^3$, it is unlikely exceedances of the 1-hour mean will occur. As all modelled results are below this threshold, it is unlikely that the 1-hour NO_2 AQAL will be exceeded at any of the receptor locations.

Additionally, the predicted annual mean PM_{10} concentrations are well below $32\mu g/m^3$. Therefore, in accordance with relevant guidance 24-hour mean PM_{10} concentrations greater than $50\mu g/m^3$ are unlikely to occur more than 35 times a year.

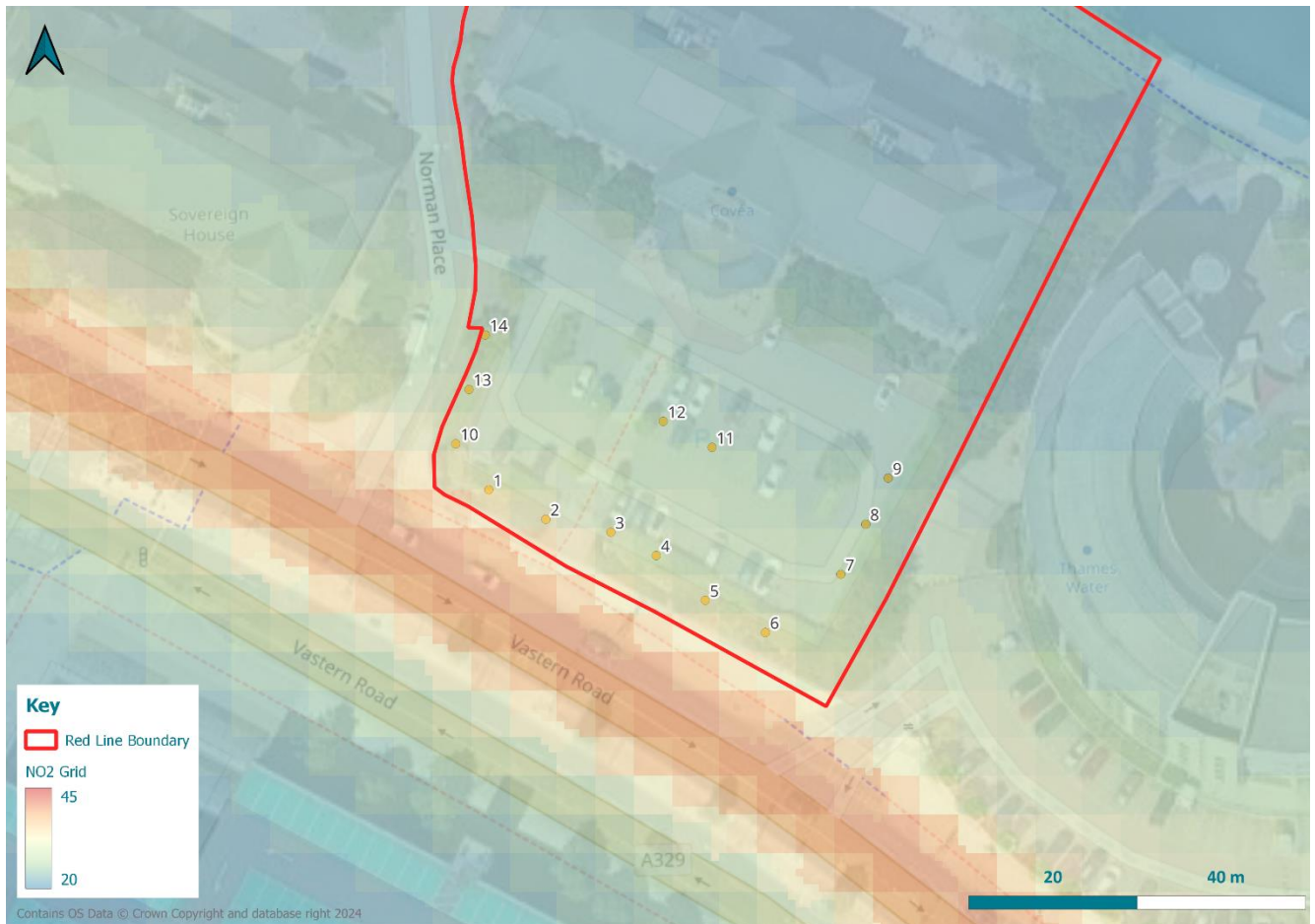


Figure 9: Modelled NO_2 Contour Plot – Ground Floor

The above figure demonstrates the highest concentration of NO_2 are at the road centre line. These disperse to approximately $26\mu g/m^3$ before reaching the building façade. Note that this grid is at ground floor height (1.5m), where no residential uses are proposed and is therefore worst-case.

6.3 Summary

The results of this assessment show that:

- » The Site is not located within 20m from roads expected to experience pollutant concentrations at or above the relevant AQAL (determined by Defra's PCM model);
- » The Proposed Development will not introduce any new receptors into an area of exceedance of any relevant AQAL;
- » Exceedances of the 1-hour mean NO_2 and 24-hour mean PM_{10} AQALs are considered unlikely, based upon absolute concentrations predicted through the dispersion modelling study;

- » Modelling has been based on robust assumptions including holding background concentrations at a 2019 base year but forecasting emission factors and traffic data to the proposed 2026 opening year; and
- » all modelled concentrations have been verified against RBC monitoring data.

Based on the above, the Proposed Development is not expected to introduce new receptors into an area likely to be exposed to exceedances of the relevant AQALs

7. Mitigation Measures

7.1 Construction Phase

The qualitative construction dust risk assessment shows that the works are **Medium Risk** for adverse impacts during construction, in the absence of mitigation.

To effectively reduce the risk of impacts to Negligible, appropriate mitigation measures should be adopted. The IAQM's highly recommended mitigation measures for Medium-Risk sites are provided at Appendix E of this report. Implementing these measures, such as within a Construction Environment Management Plan (CEMP), should effectively reduce the risk of impacts to negligible during the construction phase.

7.2 Operational Phase

7.2.1 Sustainable Travel Measures

The Transport Technical Note³⁹ was prepared by Stantec and outlines plans for enhancing active travel routes associated with a proposed development. Key points include:

- » **Enhancement of Existing Routes:** The strategy emphasizes improving the existing footway/cycleway along the western boundary of the Site, extending from Vastern Road to the River;
- » **Development Enhancements:** Proposed enhancements include work along Norman Place, which is part of RBC Cycle Route R4;
- » **New Shared Foot/Cycleway:** The plan includes creating a new shared foot/cycleway of 3.5 meters width along the eastern edge of Norman Place; and
- » **Improved Connectivity:** The existing alley connecting Norman Place to the river will be widened to 4 meters. This enhancement aims to improve connectivity between the Thames Towpath (Cycle Route R41), Reading Town Centre, and Reading Railway Station.

It is also understood that there will be 10% provision for electric vehicle charging. All of the above will help improve sustainable travel options and as a result help to improve air quality.

³⁹ Stantec, Norman Place, Reading, TECHNICAL NOTE, Job No: 332610561 January 2024

8. Discussion and Conclusion

Hydrock were commissioned by Packaged Living Limited to prepare an AQA to support the planning application for a residential scheme, off Vastern Road, Reading.

A qualitative construction dust risk assessment has been undertaken in line with IAQM guidance¹⁸. Through implementation of appropriate mitigation measures as outlined in this report, it is expected that the release of dust would be effectively controlled and mitigated, with residual effects considered to be 'not significant'. All dust impacts are considered to be temporary and short-term in nature.

An operational phase assessment has been undertaken by following screening criteria provided in EPUK & IAQM guidance. Vehicle traffic movements generated by the Proposed Development are below the relevant EPUK & IAQM guidance criteria and as such, it is not anticipated that any significant adverse impacts on local air quality will occur and the Proposed Development is considered to be compliant with the NPPF and relevant clauses within adopted local planning policy.

A site suitability assessment has been undertaken due to the location of the Site within the RBC AQMA. Emissions of NO₂, PM₁₀ and PM_{2.5} from traffic travelling along local roads were modelled in ADMS-Urban (version 5.1). The dispersion modelling undertaken was conservative as it applied robust assumptions by holding background concentrations at the 2019 base year. The results demonstrated that there are not predicted to be any exceedances of the relevant AQALs at the Proposed Development.

Based on the assessment, the Proposed Development is not expected to introduce new receptors into an area of poor air quality and air quality should not present a constraint at the Site. Therefore, the Proposed Development is expected to comply with all relevant air quality policy. As such, air quality should not pose any significant obstacles to the planning process.

Appendix A Traffic Data

The traffic data, supplied by Stantec is shown in below in Table 13. Data was provided for the following scenarios:

- » 2019 Verification; and
- » 2026 DS.

Table 13: Traffic Data

Link ID	Road Link	Speed (kph)	2019 Model Verification		2026 DS	
			AADT	% HDV	AADT	% HDV
Road001	Eastern arm of Caversham Bridge Roundabout	20	27,911	4%	29,213	4%
Road002	Eastern arm of Caversham Bridge Roundabout	48	27,911	4%	29,213	4%
Road003	Eastern arm of Caversham Bridge Roundabout	20	27,911	4%	29,213	4%
Road004	Eastern arm of Caversham Bridge Roundabout	48	27,911	4%	29,213	4%
Road005	Vastern Road south of site off western Roundabout	20	27,911	4%	29,213	4%
Road006	Vastern Road south of site	48	27,911	4%	29,213	4%
Road007	Vastern Road south of site	20	27,911	4%	29,213	4%
Road008	South of Railway Bridge	20	27,911	4%	29,213	4%
Road009	Over the bridge	48	27,911	4%	29,213	4%
Road010	Caversham Road before roundabout	20	35,770	3%	37,439	3%
Road011	Caversham Road before underpass	48	35,770	3%	37,439	3%
Road012	After underpass	20	35,770	3%	37,439	3%
Road013	Located on the eastern end of Napier Road	20	35,770	3%	37,439	3%
Road014	Located on the eastern end of Napier Road	20	20,934	3%	6,542	1%

Appendix B Windrose

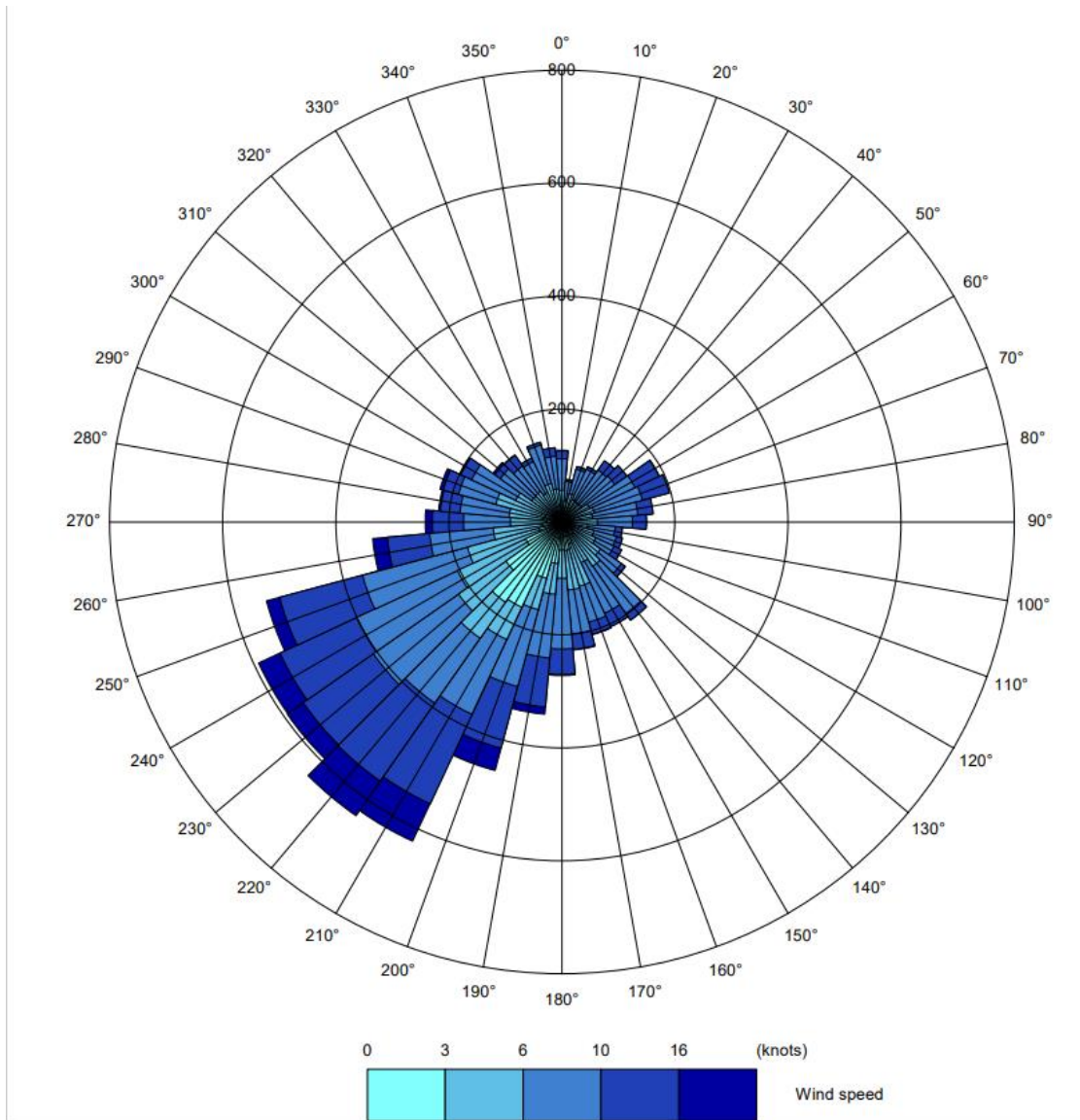


Figure 10: Wind rose Farnborough Airport (2019)

Data Capture is as follows:

- » Wind speed: 99.9 %;
- » Wind direction: 99.1 %;
- » Data capture for temperature: 99.9 %; and
- » Cloud cover: 96. %.

Appendix C Model Verification

An important stage in the modelling process is model verification, which involves comparing the model output with measured concentrations in order to increase confidence in modelled predictions.

According to LAQM.TG (22), the difference between modelled results and monitored concentrations is acceptable where it is within 25%.

Monitoring Locations used for Verification

The following monitoring locations were utilised for model verification due to being representative of the study area and having suitable traffic data available:

- » 131 Caversham Rd;
- » 31a Vastern Rd;
- » 108 Caversham Rd; and
- » 197 Caversham Rd.

The diffusion tube located at Malcolm Place was excluded from model verification due to its kerbside classification. LAQM.TG(22) states:

"Kerbside sites are generally not recommended for the adjustment of road traffic modelling results as the inclusion of these sites may lead to an over-adjustment of modelling at roadside sites."

Model Verification

It is most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$). The model output of road- NO_x (i.e., the component of total NO_x coming from road traffic) has been compared with the 'measured' road- NO_x . Measured road- NO_x has been calculated from the measured NO_2 concentrations using the NO_x from NO_2 calculator (Version 8.1) available on the Defra LAQM Support website³¹.

A comparison of modelled and monitored concentrations prior to adjustment are given in Table 14.

Table 14: 2019 Modelled and Monitored Concentrations Before Adjustment

Monitoring ID	Modelled Road NO_x ($\mu\text{g}/\text{m}^3$)	Monitored Road NO_x ($\mu\text{g}/\text{m}^3$)	Ratio Monitored/Modelled	Modelled Total NO_2 ($\mu\text{g}/\text{m}^3$)	Monitored Total NO_2 ($\mu\text{g}/\text{m}^3$)	Difference (%)
131 Caversham Rd	7.6	18.4	2.4	26.6	32.0	-16.8
31a Vastern Rd	16.6	10.1	0.6	31.1	27.9	11.5
108 Caversham Rd	14.2	25.4	1.8	29.9	35.3	-15.2
197 Caversham Rd	7.0	15.3	2.2	26.3	30.5	-13.8

As shown, the model was underpredicting at all diffusion tubes. As such, an adjustment factor of **1.327** has been determined, as the equation of the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution of NO_x, as shown below:

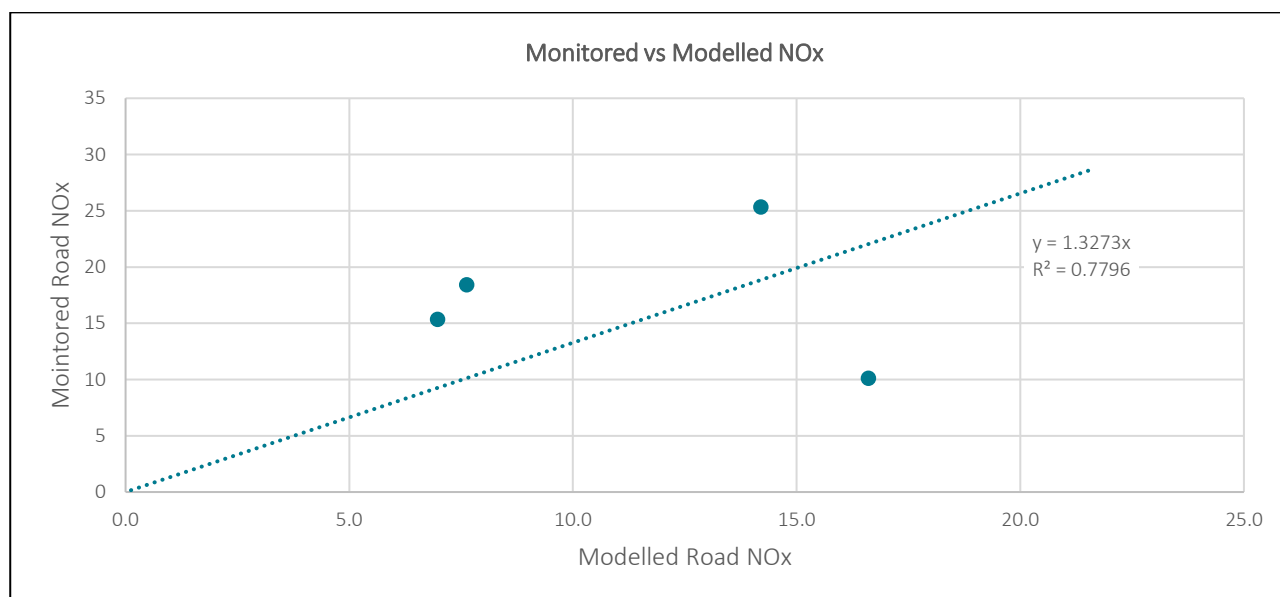


Figure 11: Model Adjustment Factor

Table 15 shows total monitored versus modelled NO₂ following the adjustment of the road contribution of NO_x by this factor. The total NO₂ concentration was determined by adding the calculated background NO₂ concentration to the modelled road contribution.

Table 15: Post-adjusted 2019 Modelled and monitored results

Monitoring ID	Adjusted Modelled NO ₂ (µg/m³)	Monitored NO ₂ (µg/m³)	Difference (%)
131 Caversham Rd	27.89	32	-12.8%
31a Vastern Rd	33.72	27.9	20.9%
108 Caversham Rd	32.19	35.3	-8.8%
197 Caversham Rd	27.46	30.5	-10.0%

Following adjustment of NO_x by a factor of **1.327**, modelled concentrations of NO₂ were within the accepted +/-25% range of monitored concentrations:

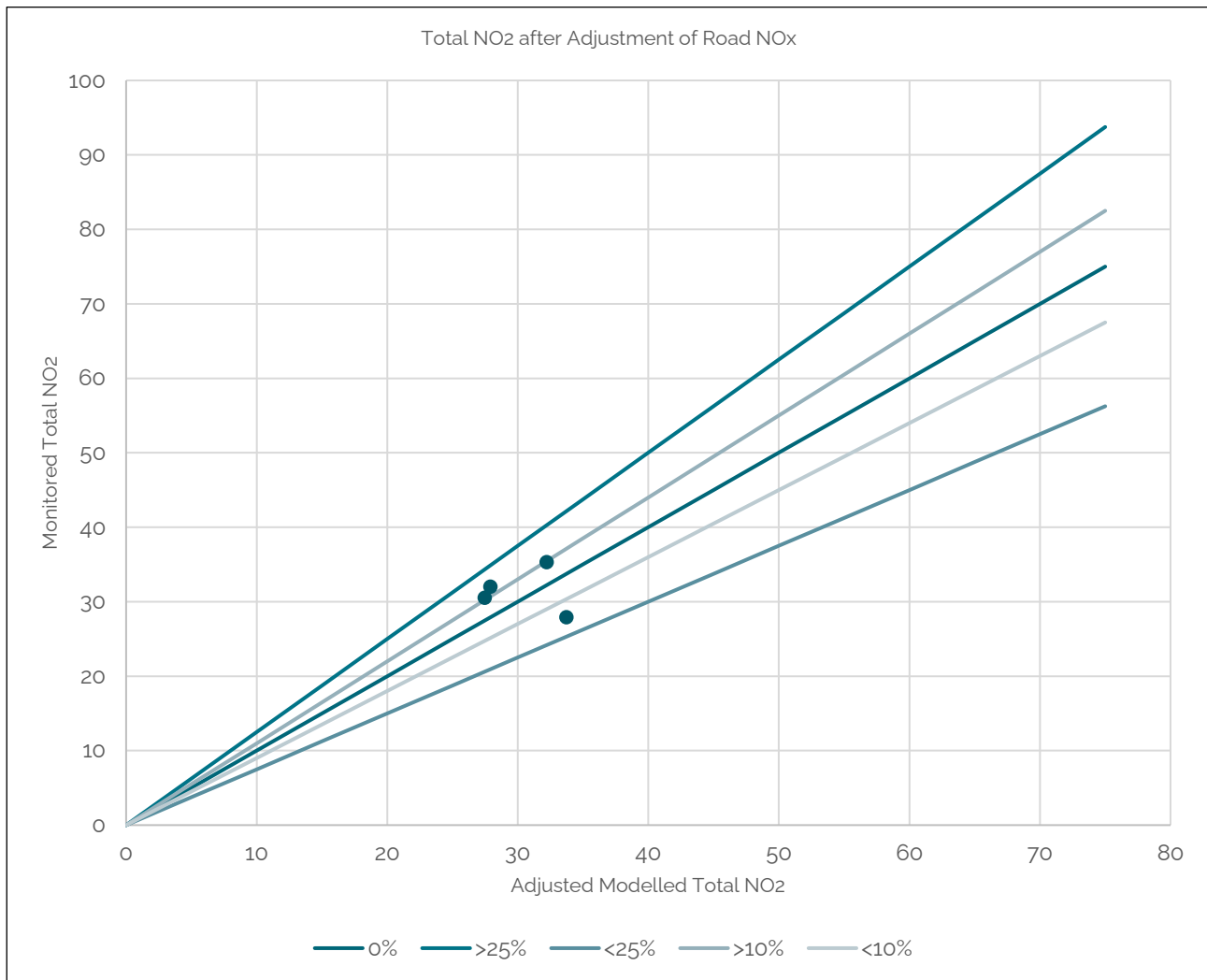


Figure 12: Post-adjusted Monitored vs Modelled NO₂

In addition, the overall post-adjusted uncertainty (RMSE) for annual mean NO₂ was 10.4%, which is within acceptable 25% range of uncertainty. As such, the factor was considered to be acceptable.

As there is insufficient PM₁₀ or PM_{2.5} monitoring data in the study area, it was not possible to perform model verification for these pollutants. As such, the NO₂ adjustment factor has also been applied to PM₁₀ and PM_{2.5} model results, in accordance with LAQM.TG(22).

Adjusted Background Concentrations

The adjusted background concentrations used in the modelling assessment are shown below. For future years as a conservative assumption 2019 concentrations were applied.

Table 16: 2019 Adjusted Background Concentrations

Receptor	Year	X	Y	NO ₂ (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
All Receptors (SITE)	2019	471500	174500	19.10	11.80	7.95

Appendix D Modelling Results

Table 17: Model Predicted Annual Mean Concentrations

Receptors	NO ₂ (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
First Floor			
R1a	24.6	12.9	8.5
R2a	24.6	12.9	8.5
R3a	24.5	12.8	8.5
R4a	24.4	12.8	8.5
R5a	24.5	12.9	8.5
R6a	24.5	12.9	8.5
R7a	23.9	12.7	8.5
R8a	23.5	12.7	8.4
R9a	23.2	12.6	8.4
R10a	24.5	12.8	8.5
R11a	23.6	12.7	8.4
R12a	23.6	12.7	8.4
R13a	24.1	12.8	8.5
R14a	23.7	12.7	8.4
Second Floor			
R1b	22.0	12.4	8.3
R2b	22.0	12.4	8.3
R3b	22.1	12.4	8.3
R4b	22.1	12.4	8.3
R5b	22.0	12.4	8.3
R6b	22.1	12.4	8.3
R7b	22.2	12.4	8.3
R8b	22.2	12.4	8.3
R9b	22.1	12.4	8.3
R10b	22.1	12.4	8.3
R11b	22.2	12.4	8.3
R12b	22.2	12.4	8.3

Receptors	NO ₂ (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)
R13b	22.2	12.4	8.3
R14b	22.2	12.4	8.3

Appendix E Construction Dust Mitigation

In order to mitigate the worst-case dust impacts the following general mitigation measures are highly recommended by the IAQM for **Medium Risk** construction sites. Highly recommended mitigation measures applicable specifically to Demolition, Earthworks, Construction and Trackout are provided based on the respective risk of adverse impact.

Communications

- » Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- » Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- » Display the head or regional office contact information
- » Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. In London additional measures may be required to ensure compliance with the Mayor of London's guidance. The DMP may include monitoring of dust deposition, dust flux, real-time PM₁₀ continuous monitoring and/or visual inspections.

Site Management

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

Monitoring

- » Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.
- » Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- » Agree dust deposition, dust flux, or real-time PM₁₀ continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.

Preparing and Maintaining the Site

- » 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 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.

Operating Vehicle / Machinery and Sustainable Travel

- » Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London NRMM standards, where applicable
- » 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.

Operations

- » Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- » Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- » Use enclosed chutes 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.
- » Ensure equipment is readily available on site to clean any dry spillages, and clean up

Waste Management

- » No bonfires and burning of waste materials.

Measures Specific to Demolition

- » Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
- » Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- » Bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Earthworks

There are no specific highly recommended measures for medium risk sites.

Measures Specific to Construction

- » 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

- » Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- » Avoid dry sweeping of large areas.
- » Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- » Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- » Record all inspections of haul routes and any subsequent action in a site log book.

- » Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- » Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- » Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- » Access gates to be located at least 10 m from receptors where possible.