



Air Quality Assessment



28-32

Northfield Rd
& 26-30

Swansea Rd,
RG1 8AH

November
2019

Ref: 19-6378

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<i>Revision</i>	-
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1. Introduction

Background

Syntegra Consulting was retained to conduct an Air Quality Assessment for the proposals at 28-32 Northfield Road and 26-30 Swansea Road, Reading. This report has been prepared to support the planning application for the development of the brownfield site to include 9 residential units.

Due to the site location, the proposed development has the potential to expose future occupants to elevated pollution levels and impact air quality conditions at exiting receptors. As such, this Air Quality Assessment has been prepared to consider its suitability for the proposed use.

Site Location and Context

The site is located at the currently vacant 28-32 Northfield Road and 26-30 Swansea Road, Reading at approximate National Grid Reference (NGR): 471180E, 174146N. The site is bound by Northfield Road to the south, residential units to the north and east and by Swansea Road to the west. Figure 1 shows the site location and surrounding area.



Figure 1: Site Location and Approximate Redline Boundary (Imagery from Google Earth, 2019)

The proposals comprise the demolition of the existing industrial units on the site and the construction of 9 dwellings with associated parking. As such pollutant concentrations at the site have been assessed in the following report to consider location suitability for the proposed use and define any requirement for mitigation. Potential impacts associated with the scheme have also been considered using standard screening methodologies.

2. Legislation and Policy

2.1. European Directives

European Union (EU) air quality legislation is provided within Directive 2008/50/EC¹, which came into force on 11th June 2008. This Directive consolidated previous legislation which was designed to deal with specific pollutants in a consistent manner and provided new Air Quality Limit Values (AQLVs) for particulate matter with an aerodynamic diameter of less than 2.5µm. The consolidated Directives include:

- Directive 1999/30/EC - the First Air Quality "Daughter" Directive - sets ambient AQLVs for NO₂, oxides of nitrogen (NO_x), sulphur dioxide, lead and particulate matter with an aerodynamic diameter greater than 10µm (PM₁₀);
- Directive 2000/69/EC - the Second Air Quality "Daughter" Directive - sets ambient AQLVs for benzene and carbon monoxide; and,
- Directive 2002/3/EC - the Third Air Quality "Daughter" Directive - seeks to establish long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air.

2.2. UK Legislation

The Air Quality Standards Regulations (2010) came into force on 11th June 2010 and transposed the EU Directive 2008/50/EC into UK law. AQLVs were published in these regulations for 7 pollutants, as well as Target Values for an additional 5 pollutants.

Part IV of the Environment Act (1995) requires UK government to produce a national Air Quality Strategy (AQS) which contains standards, objectives, and measures for improving ambient air quality. The most recent AQS was produced by the Department for Environment, Food and Rural Affairs (Defra) and published July 2007². The AQS sets out AQS objectives that are maximum ambient pollutant concentrations that are not to be exceeded either without exception or with a permitted number of exceedances over a specified timescale. These are generally in line with the AQLVs, although the requirements for the determination of compliance vary.

Table 1 presents the AQS objectives for pollutants considered within this assessment.

Table 1 - Air Quality Strategy Objectives

Pollutant	Air Quality Strategy Objective	
	Concentration (µg/m ³)	Averaging Period
NO ₂	40	Annual mean

¹ Directive 2008/50/EC on Ambient Air Quality for Cleaner Air for Europe, Council of European Committees, 2008.

² The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA, 2007.

Pollutant	Air Quality Strategy Objective	
	Concentration ($\mu\text{g}/\text{m}^3$)	Averaging Period
	200	1-hour mean, not to be exceeded on more than 18 occasions per annum (equivalent to the 99.8 th percentile)
PM ₁₀	40	Annual mean
	50	24-hour mean, not to be exceeded on more than 35 occasions per annum (equivalent to the 90.4 th percentile)

Table 2 summarises the advice provided in the Defra guidance³ on where the AQS objectives for pollutants considered within this report apply.

Table 2- Examples of Where the Air Quality Objectives Apply

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
Annual mean	All locations where members of the public might be regularly exposed Building façades of residential properties, schools, hospitals, care homes etc.	Building façades 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 locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean	All locations where the annual mean objective would apply, together with hotels Gardens of residential properties	Kerbside sites (as opposed to 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 sites (for example, pavements of busy shopping streets)	Kerbside sites where the public would not be expected to have regular access

³ Local Air Quality Management Technical Guidance 2016 (TG16), Defra, 2018.

Averaging Period	Objective Should Apply At	Objective Should Not Apply At
	Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer	

2.3. Local Air Quality Management

Under Section 82 of the Environment Act (1995) (Part IV) Local Authorities (LAs) are required to periodically review and assess air quality within their area of jurisdiction under the system of Local Air Quality Management (LAQM). This review and assessment of air quality involves comparing present and likely future pollutant concentrations against the AQS objectives. If it is predicted that levels at locations of relevant exposure, as summarised in Table 2, are likely to be exceeded, the LA is required to declare an AQMA. For each AQMA the LA is required to produce an Air Quality Action Plan, the objective of which is to reduce pollutant concentrations in pursuit of the AQS objectives.

2.4. National Planning Policy

The revised National Planning Policy Framework⁴ (NPPF) was published in February 2019 and sets out the Government's planning policies for England and how these are expected to be applied.

The purpose of the planning system is to contribute to the achievement of sustainable development. In order to ensure this, the NPPF recognises three overarching objectives (set out at paragraph 8 of the NPPF), including the following is of relevance to air quality:

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

Chapter 15 paragraph 170 of the NPPF details objectives in relation to conserving and enhancing the natural environment. It states that:

"Planning policies and decisions should contribute to and enhance the natural and local environment by:

[...]

e) preventing both new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever

⁴ NPPF, Ministry of Housing, Communities and Local Government, 2019.

possible, help to improve local environmental conditions such as air and water quality [...]"

The NPPF specifically recognises air quality as part of delivering sustainable development and at paragraph 181 states that:

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

The implications of the NPPF have been considered throughout this assessment.

2.1. National Planning Practice Guidance

The National Planning Practice Guidance⁵ (NPPG) web-based resource was launched by the Department for Communities and Local Government on 6th March 2014 to support the NPPF and is currently under the Ministry of Housing, Communities & Local Government. The guidance is aimed to make the NPPF more accessible. The air quality pages are summarised under the following headings:

1. Why should planning be concerned about air quality?
2. What is the role of Local Plans with regard to air quality?
3. Are air quality concerns relevant to neighbourhood planning?
4. What information is available about air quality?
5. When could air quality be relevant to a planning decision?
6. Where to start if bringing forward a proposal where air quality could be a concern?
7. How detailed does an air quality assessment need to be?
8. How can an impact on air quality be mitigated?
9. How do considerations about air quality fit into the development management process?

These were reviewed, and the relevant guidance considered as necessary throughout the undertaking of this assessment.

2.2. Development Plan Planning Policy

Local Planning Policy

The Reading Borough Council (RBC) New Local Plan⁶ is currently in draft form and under review includes the strategies and objectives for the borough until 2036. A review of the RBC Local Plan indicates the following policy in relation to air quality that is relevant to this assessment:

⁵ <http://planningguidance.planningportal.gov.uk>.

⁶ Draft Reading Local Plan, Reading Borough Council, May 2017.

Policy 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 significantly 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 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.”

The implications of these policies were taken into consideration throughout the undertaking of the assessment.

3. Baseline

Existing air quality conditions in the vicinity of the proposed development site were identified in order to provide a baseline for assessment. These are discussed in the following Sections.

3.1. Local Air Quality Management

Annual mean concentrations of NO₂, are above the relevant AQS objectives within the borough. As such, an AQMA described as “An area covering Reading Town Centre, areas along the major radical road routes into Reading (including J11 of the M4) and along the railway lines where they pass through built-up areas.” has been declared by the Reading Borough Council (RBC). The proposed development is located within the AQMA; therefore, there is the potential for the site to be affected by elevated pollutant concentrations and any emissions from the proposals to impact on this sensitive area. These issues have been considered throughout the assessment.

Air Quality Monitoring

RBC undertakes monitoring for NO₂ throughout the borough at a number of monitoring sites. Historical NO₂ monitoring results from the sites in closest proximity to the development are shown below in Table 3.

Table 3 - Measured Annual Mean NO₂ Concentrations within 300m of Development Site

Site ID	X	Y	Classification	Distance (m)*	2016 (µg/m ³)	2017 (µg/m ³)	2018 (µg/m ³)
RD1-Caversham Rd	471153	174429	Roadside	260	39	37	40
DT48-50-Caversham Rd Co-location	471156	174424	Roadside	260	37	37	36
DT47-197 Caversham Rd	471161	174379	Roadside	215	35	36	34
DT53-131 Caversham Rd	471261	174236	Roadside	110	36	36	35
DT51-108 Caversham Rd	471293	174236	Roadside	140	41	40	42
DT52-31a Vastern Rd	471420	174129	Roadside	220	37	38	33
DT43-59a Caversham Rd	471169	173869	Roadside	220	41	43	41
DT45-125 Cardiff Rd	470866	174059	Roadside	290	28	28	23
DT46-Railway Depot	470899	174017	Roadside	270	35	34	27

*Distance from Development Site; DT=Diffusion Tube; Bold indicates exceedance of AQS objective; results have been annualised and bias adjusted by RBC where required.

As seen in Table 3, the closest monitoring sites to the development, located roadside at Caversham Road have exceeded or been close to exceeding the AQS objective for annual mean NO₂ in recent years. The site is located approximately 100m from Caversham Road and would not experience concentrations as high as those recorded at the roadside monitors.

The Borough also undertakes monitoring of PM₁₀ at the automatic monitor RD1. Measured concentrations from recent years are shown in Table 4.

Table 4 - Measured Annual Mean PM₁₀ Concentrations within Vicinity of the Site

Site ID	X	Y	Classification	Distance (m)	2016* (µg/m ³)	2017* (µg/m ³)	2018* (µg/m ³)
RD1-Caversham Rd	471153	174429	Roadside	260	20 (5)	23 (7)	24 (3)

*Number of exceedances of the daily mean of 50µg/m³ is shown in brackets

PM₁₀ concentrations are well below the AQS objectives for long and short-term concentrations in recent years at Caversham Road monitoring station.

There is one station which monitors PM_{2.5} in the borough (AURN). The monitor is located over 2km from the site and would not be representative of site conditions.

3.2. Background Pollutant Concentrations

Predictions of background pollutant concentrations on a 1km by 1km grid basis have been produced by Defra for the entire of the UK to assist LAs in their Review and Assessment of air quality. The proposed development site is located in grid square NGR: 471500, 174500. Data for this location was obtained from the Defra website and is summarised in Table 5.

Table 5 – Defra Background Pollutant Concentrations

Pollutant	Defra Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)	
	2017 (Base Year)	2021 (Earliest Operating Year)
NO ₂	24.2	21.0
PM ₁₀	17.1	16.2
PM _{2.5}	12.0	11.3

The predicted Defra background concentrations are below the relevant AQS objectives at the development site for the base year (2017) and the future earliest year of operation (2021).

4. Methodology

4.1. Construction Phase Assessment

The proposed development has the potential to expose existing residents to poor air quality during construction phases of the works. To determine appropriate mitigation measures a dust risk assessment was undertaken in accordance with the methodology outlined within the Institute of Air Quality Management's (IAQM) 'Guidance on the Assessment of Dust from Demolition and Construction'⁷.

Activities on the proposed construction site have been divided into four types to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

The potential for dust emissions was assessed for each activity that is likely to take place and considered three separate dust effects:

- Annoyance due to dust soiling;
- Harm to ecological receptors; and
- The risk of health effects due to a significant increase in exposure to PM₁₀.

⁷ Guidance on the Assessment of Dust from Demolition and Construction version 1.1, IAQM, 2014.

The assessment steps are detailed below.

Step 1

Step 1 screens the requirement for a more detailed assessment. Should human receptors be identified within 350m of the boundary or 50m from the construction vehicle route (up to 500m from the site entrance for large sites, 200m from medium sites and 50m from small sites), then the assessment proceeds to Step 2. Additionally, should ecological receptors be identified within 50m of the site or 50m from the construction vehicle route (up to 500m from the site entrance for large sites, 200m from medium sites and 50m from small sites), then the assessment also proceeds to Step 2.

Should sensitive receptors not be present within the relevant distances then negligible impacts would be expected and further assessment is not necessary.

Step 2

Step 2 assesses the risk of potential dust impacts. A site is allocated a risk category based on two factors:

- The scale and nature of the works, which determines the magnitude of dust arising as: small, medium or large (Step 2A); and
- The sensitivity of the area to dust impacts, which can be defined as low, medium or high sensitivity (Step 2B).

The two factors are combined in Step 2C to determine the risk of dust impacts without mitigation applied.

Step 2A defines the potential magnitude of dust emission through the construction phase. The relevant criteria are summarised in Table 6.

Table 6 – Construction Dust - Magnitude of Emission

Magnitude	Activity	Criteria
Large	Demolition	Total building volume greater than 50,000m ³ Potentially dusty construction material (e.g. concrete) On-site crushing and screening Demolition activities greater than 20m above ground level
	Earthworks	Total site area greater than 10,000m ² Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) More than 10 heavy earth moving vehicles active at any one time Formation of bunds greater than 8m in height More than 100,000 tonnes of material moved
	Construction	Total building volume greater than 100,000m ³ On site concrete batching Sandblasting
	Trackout	More than 50 Heavy Duty Vehicle (HDV) trips per day

Magnitude	Activity	Criteria
		Potentially dusty surface material (e.g. high clay content) Unpaved road length greater than 100m
Medium	Demolition	Total building volume 20,000m ³ to 50,000m ³ Potentially dusty construction material Demolition activities 10m to 20m above ground level
	Earthworks	Total site area 2,500m ² to 10,000m ² Moderately dusty soil type (e.g. silt) 5 to 10 heavy earth moving vehicles active at any one time Formation of bunds 4m to 8m in height Total material moved 20,000 tonnes to 100,000 tonnes
	Construction	Total building volume 25,000m ³ to 100,000m ³ Potentially dusty construction material (e.g. concrete) On site concrete batching
	Trackout	10 to 50 HDV trips per day Moderately dusty surface material (e.g. high clay content) Unpaved road length 50m to 100m
Small	Demolition	Total building volume under 20,000m ³ Construction material with low potential for dust release (e.g. metal cladding or timber) Demolition activities less than 10m above ground level. Demolition activities during wetter months
	Earthworks	Total site area less than 2,500m ² Soil type with large grain size (e.g. sand) Less than 5 heavy earth moving vehicles active at any one time Formation of bunds less than 4m in height Total material moved less than 20,000 tonnes Earthworks during wetter months
	Construction	Total building volume less than 25,000m ³ Construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout	Less than 10 HDV trips per day Surface material with low potential for dust release Unpaved road length less than 50m

Step 2B defines the sensitivity of the area around the development to potential dust impacts. The influencing factors are shown in Table 7.

Table 7– Construction Dust - Examples of Factors Defining Sensitivity of an Area for Human Receptors

Receptor Sensitivity	Examples
	Human Receptors
High	Users expect of high levels of amenity High aesthetic or value property People expected to be present continuously for extended periods of time Locations where members of the public are exposed over a time period relevant to the objective for PM₁₀. e.g. residential properties, hospitals, schools and residential care homes
Medium	Users would expect to enjoy a reasonable level of amenity Aesthetics or value of their property could be diminished by soiling People or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land e.g. parks and places of work
Low	Enjoyment of amenity would not reasonably be expected Property would not be expected to be diminished in appearance Transient exposure, where people would only be expected to be present for limited periods. e.g. public footpaths, playing fields, shopping streets, playing fields, farmland, footpaths, short term car park and roads

The guidance also provides the following factors to consider when determining the sensitivity of an area to potential dust impacts:

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

These factors were considered during the undertaking of the assessment. The criteria for determining the sensitivity of the area to dust soiling effects on people and property is summarised in Table 8. Only the highest level of sensitivity needs to be considered.

Table 8 – Construction Dust - Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		Less than 20	Less than 50	Less than 100	Less than 350
High	More than 100	High	High	Medium	Low
	10 - 100	High	Medium	Low	Low
	1 - 10	Medium	Low	Low	Low
Medium	More than 1	Medium	Low	Low	Low
Low	More than 1	Low	Low	Low	Low

Table 9 outlines the criteria for determining the sensitivity of the area to human health impacts. Only the highest level of sensitivity needs to be considered.

Table 9 – Construction Dust - Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM ₁₀ Conc.	Number of Receptors	Distance from the Source (m)				
			Less than 20	Less than 50	Less than 100	Less than 200	Less than 350
High	Greater than 32µg/m ³	More than 100	High	High	High	Medium	Low
		10 - 100	High	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	28 - 32µg/m ³	More than 100	High	High	Medium	Low	Low
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	High	Medium	Low	Low	Low
	24 - 28µg/m ³	More than 100	High	Medium	Low	Low	Low
		10 - 100	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	Less than 24µg/m ³	More than 100	Medium	Low	Low	Low	Low
		10 - 100	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low

Receptor Sensitivity	Annual Mean PM ₁₀ Conc.	Number of Receptors	Distance from the Source (m)				
			Less than 20	Less than 50	Less than 100	Less than 200	Less than 350
Medium	Greater than 32µg/m ³	More than 10	High	Medium	Low	Low	Low
		1 - 10	Medium	Low	Low	Low	Low
	28 - 32µg/m ³	More than 10	Medium	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	24 - 28µg/m ³	More than 10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
	Less than 24µg/m ³	More than 10	Low	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low	Low
Low	-	1 or more	Low	Low	Low	Low	Low

Step 2C combines the dust emission magnitude with the sensitivity of the area to determine the risk of unmitigated impacts. Table 10 outlines the risk category from demolition activities.

Table 10 – Construction Dust - Dust Risk Category from Demolition Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Medium
Medium	High	Medium	Low
Low	Medium	Low	Negligible

Table 11 outlines the risk category from earthworks and construction activities.

Table 11 – Construction Dust - Dust Risk Category from Earthworks and Construction Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Medium	Low
Low	Low	Low	Negligible

Table 12 outlines the risk category from trackout activities.

Table 12 – Construction Dust - Dust Risk Category from Trackout Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Low	Negligible
Low	Low	Low	Negligible

Step 3

Step 3 requires the identification of site-specific mitigation measures within the guidance to reduce potential dust impacts based upon the relevant risk categories identified in Step 2. For sites with negligible risk, mitigation measures beyond those required by legislation are not required. Additional controls may be applied as part of good practice.

Step 4

Once the risk of dust impacts has been determined and the appropriate mitigation measures identified, the final step is to determine the significance of any residual impacts. For almost all construction activity, the aim should be to control effects through the use of effective mitigation. Experience shows this is normally possible and the residual effect will normally be **'not significant'**.

4.2. Operational Phase Assessment

NO₂ and PM₁₀ concentrations were assessed across the site using detailed dispersion modelling. Modelling was undertaken for 2017 for verification purposes and 2021 to represent the earliest development opening year. The assessment was conducted in accordance with the methodology discussed below.

Dispersion Model

Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 4.1.1.0). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and Defra.

The model requires input data that details the following parameters:

- Assessment area;
- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;
- Roughness length (z_0); and,
- Monin-Obukhov length.

These are detailed in the following Sections.

Assessment Area

Ambient concentrations were predicted over the area NGR: 470980 173946 to 471380 174346. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

Where applicable, roads located outside of the model extent were included in the dispersion model to ensure the impact of all relevant vehicle emissions in the vicinity of the development were considered.

Traffic Flow Data

Traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition, was obtained from the Department for Transport (DfT) traffic count website. This is deemed as being a suitable source of data for air quality assessments and is therefore considered to provide a reasonable estimate of traffic flow in the vicinity of the site.

The baseline traffic data was converted to the appropriate assessment years utilising factors obtained from TEMPro (version 7.2). This software package has been developed by the Department for Transport (DfT) to calculate future traffic growth within the UK.

Road widths were estimated from aerial photography. A summary of the traffic data used in the assessment is provided in Appendix A.

Emission Factors

Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 9.0). This has been produced by Defra and incorporates updated vehicle emission factors and fleet information.

Meteorological Data

Meteorological data used in the assessment was taken from Heathrow Airport meteorological station over the period 1st January 2017 to 31st December 2017 (inclusive). Heathrow Airport is located approximately 30km east of the proposed development. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for use in the dispersion model. Figure 2 shows the wind rose of the meteorological data used in the assessment.

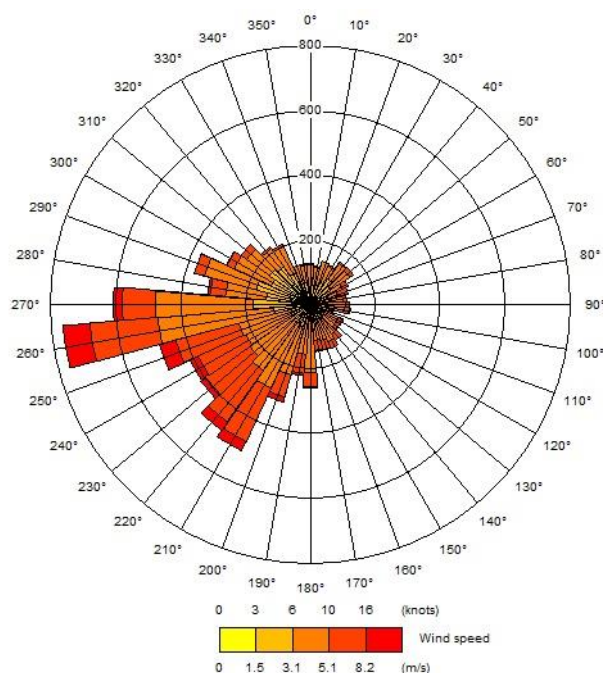


Figure 2: Wind Rose from Heathrow Airport Meteorological Station for 2017

Roughness Length

A z_0 of 1.0m was used to describe the modelling extents. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'Cities, woodlands'.

A z_0 of 0.3m was used to describe the meteorological site. This value of z_0 is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'agricultural areas (max)'.

Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used for the development site and a value of 100m was used to describe the meteorological site. These values are considered appropriate for the nature of both areas and is suggested within ADMS-Roads as being suitable for 'Cities and large towns' and 'Large conurbations > 1 million' respectively.

Background Concentrations

Background concentrations obtained from Defra for the grid square containing the site were used in the assessment to represent pollutant levels across the modelling extents.

To avoid 'double-counting' of road vehicle exhaust emissions, the proportion of the relevant background concentrations from Primary A roads and Minor roads within the grid square were removed in accordance with the methodology outlined in the Defra's LAQM (TG16) guidance⁸. These sectors were considered most representative of those being modelled. Background concentrations before and after adjustment are shown in Table 13.

⁸ Local Air Quality Management Technical Guidance 2016 (TG16), Defra, 2018.

Table 13 - Background Pollutant Concentrations - Sector Removal

Pollutant	Predicted Background Concentration ($\mu\text{g}/\text{m}^3$)			
	Total 2017 Background	2017 Background with Sectors Removed	Total 2021 Background	2021 Background with Sectors Removed
NO ₂	24.2	21.8	21.0	19.0
PM ₁₀	17.1	17.0	16.2	16.2
PM _{2.5}	12.0	11.9	11.3	11.3

NO_x to NO₂ Conversion

Predicted annual mean NO_x concentrations were converted to NO₂ concentrations using the spreadsheet (version 7.1) provided by Defra, which is the method detailed within the Defra's LAQM (TG16) guidance document.

Uncertainty with Future Emissions

A report produced on behalf of Defra⁹, considered NO₂ monitoring data from across the UK and suggests that reductions in concentrations have slowed in recent years; therefore, it is now agreed among many air quality professionals that future predictions of NO₂ concentrations may be underestimated. Defra updated the air quality tools in 2019 (including the new emission factor toolkit, background maps and NO_x / NO₂ converter) which aimed to close this "gap" between forecast and monitored NO₂ trends. However, it is considered that future NO₂ levels based on these updated tools are still likely to be underestimated. To address the uncertainty in future emissions the 2017 emission factors and background concentrations were applied to the future assessment year (2021) as a conservative estimate.

Verification

The predicted results from a dispersion model may differ from measured concentrations for a number of reasons, including:

- Estimates of background concentrations;
- Uncertainties in source activity data such as traffic flows and emission factors;
- Variations in meteorological conditions;
- Overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

⁹ Trend in NO_x and NO₂ emissions and ambient measurements in the UK, DEFRA, 2011.

Model verification was undertaken as per the methodology outlined in Defra's LAQM (TG16)¹⁰. For the purpose of this assessment model verification was undertaken for 2017 using traffic data, meteorological data and monitoring results from this year. The model verification methodology is described in detail in Appendix C.

The overall verification factor for NO_x was 1.774, which was applied to the dispersion model results. A factor for particulate matter was determined by comparing modelled and measured concentrations. A factor of 2.634 was applied to the PM₁₀ and PM_{2.5} results as per guidance outlined in Defra's LAQM (TG16).

Determination of Impacts

Operational Phase Road Traffic Assessment

A development has the potential to impact on existing air quality due to road traffic exhaust emissions associated with vehicles travelling to and from the site. A screening assessment was therefore undertaken using the criteria contained within Institute of Air Quality Management (IAQM) 'Land-Use Planning & Development Control: Planning for Air Quality'¹¹ guidance documents to determine the potential for trips generated by the development to affect local air quality.

The IAQM guidance document provides the following criteria to help establish when an assessment of potential impacts on the local area is likely to be considered necessary:

- A change of Light Duty Vehicle (LDV) flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- A change of HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- Realignment of roads where the change is 5m or more and the road is within an AQMA; or,
- Introduction of a new junction or removal of an existing junction near to relevant receptors.

Should screening of the relevant data indicate that any of the above criteria are met, then potential impacts at sensitive receptor locations can be assessed by calculating the change in pollutant concentrations from the proposed development. The significance of predicted impacts can then be determined in accordance with the methodology outlined in the IAQM guidance. Should the IAQM criteria not be met, then the IAQM guidance documents consider air quality impacts associated with a scheme to be negligible and no further assessment is required.

Exposure of Future Occupants

The proposed development has the potential to introduce new receptors into an area of existing poor quality. The results of the dispersion modelling assessment were therefore compared against the Air Quality Standard Objectives for each pollutant to determine the extent of exposure to future receptors.

¹⁰ Local Air Quality Management Technical Guidance (TG16), Defra, 2018.

¹¹ Land-Use Planning & Development Control: Planning for Air Quality. IAQM//EPUK, 2017.

5. Assessment

5.1. Construction Phase Assessment

The proposed development construction phase has the ability to impact an area with existing poor air quality. The construction assessment is detailed below.

Step 1

The undertaking of demolition, excavation, ground works, cutting, construction and storage of materials has the potential to result in fugitive dust emissions throughout the construction phase. Vehicle movements both on-site and on the local road network also have the potential to result in the re-suspension of dust from highway surfaces. The potential for impacts at sensitive locations depends on local meteorology during the undertaking of dust generating activities, with the most significant effects likely to occur during dry and windy conditions.

As there are a number of sensitive receptors located within 350m of the proposed site, a detailed assessment of potential dust impacts was required. There are no ecological receptors sensitive to dust within proximity of the site or trackout boundary. As such, ecological impacts have not been assessed further.

Step 2A

Demolition

The demolition activities planned for the proposals are for a building volume less than 20,000m³. In accordance with the criteria outlined in the IAQM's construction dust guidance document, the magnitude of potential dust emissions from demolition is classified as **small**.

Earthworks

The site is less than 2,500m² and there will not be more than 5 heavy earth moving vehicles active at any one time; therefore, in accordance with the guidance document, the magnitude of potential dust emissions from earthworks is classified as **small**.

Construction

The total building volume is predicted to be less than 25,000m³. Construction materials would most likely be comprised of low potential for dust release. In accordance with the criteria outlined in the guidance document, the magnitude of potential dust emissions from construction is classified as **small**.

Trackout

The proposed site would most likely be accessed from Swansea Road. From the information presently available, it is considered that there would not be more than 10 HDV movements per day and unpaved haul road lengths are unlikely to be greater than 50m. As such, in accordance with the guidance criteria, the magnitude of potential dust emissions from trackout is classified as **small**.

The dust emission magnitude for the project is summarised in Table 14.

Table 14 – Dust Emission Magnitude Summary

Activity	Dust emission magnitude
Demolition	Small
Earthworks	Small
Construction	Small
Trackout	Small

Step 2B

Receptors sensitive to potential dust impacts during demolition, earthworks and construction were approximated and are summarised in Table 15.

Table 15 – Demolition, Earthworks and Construction Dust Sensitive Receptors

Distance from Site (m)	Approximate Number of Human Receptors*
Less than 20	10-100
20 – 50	>100
50 - 100	>100
100 – 200	>100
200 - 350	>100
*Number of residential and commercial properties approximated using professional judgement	

Receptors sensitive to potential dust impacts during trackout were approximated from a desktop study of the area up to 50m from the road network within 50m of the Site access based on the magnitude of potential dust release. These are summarised in Table 16.

Table 16 – Trackout Dust Sensitive Receptors

Distance from Trackout Study Area (m)	Approximate Number of Human Receptors*
Less than 20	10-100
20 – 50	>100
*Number of residential properties approximated using professional judgement	

In order to determine the sensitivity of the receiving environment, the background concentration for PM₁₀ was obtained from the Defra website and identified as being 16.6µg/m³ for 2019 (the earliest year of construction). Therefore, health impacts were determined based on the criteria within the less than 24µg/m³ category.

The sensitivity of the receiving environment to potential dust impacts is considered to be high in terms of human receptors as users would expect to enjoy a reasonable level of amenity, aesthetics or value or their property could be diminished by soiling and people would be expected to be present for

extended periods of time e.g. residential properties. It should be noted that in accordance with the IAQM guidance⁷, the highest level of sensitivity should be recorded. The sensitivity of the receiving environment to specific dust impacts is summarised in Table 17.

Table 17 – Summary of the Sensitivity of the Area

Potential Effect	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust soiling	High	High	High	High
Human health	Low	Low	Low	Low

Step 2C

The risk of effects in the absence of environmental measures was then defined based on the interaction between the magnitude of emission and the highest level of area sensitivity (as determined in Steps 2A and 2B) for each construction activity. The risk of dust effects is shown below in Table 18.

Table 18 – Summary of the Risk of Dust Effects

Potential Effect	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust soiling	Medium	Low	Low	Low
Human health	Negligible	Negligible	Negligible	Negligible

The maximum risk of dust effects was determined to be **medium**. It should be noted that the potential for impacts depends significantly on the distance between the dust generating activity and receptor location. Mitigation recommended to minimise sensitive receptor exposure to construction dust is included in the IAQM's construction dust guidance document. Should the appropriate mitigation suggested in this document and summarised in Appendix B be adhered too, the construction dust impacts on surrounding sensitive receptors are predicted to be negligible.

5.2. Operational Phase Assessment

Impacts on Existing Air Quality

Dispersion modelling was undertaken with the inputs described in Section 4 to quantify concentrations at the site. As none of the IAQM criteria listed in section 4 were triggered, the significance of impacts on air quality from increased road traffic sources associated with the proposals were deemed to be **negligible** as per the IAQM guidance¹².

¹² Land-Use planning & Development Control: Planning for Air Quality, IAQM, 2017.

Impacts on Future Receptors

Nitrogen Dioxide

Predicted annual mean NO₂ concentrations across the development site are shown in Figure 3. Contours display the worst-case level (ground floor) of the proposals. As seen in Figure 3, annual mean NO₂ concentrations were predicted to be well below the relevant AQS objective of 40µg/m³ across the entire development site.

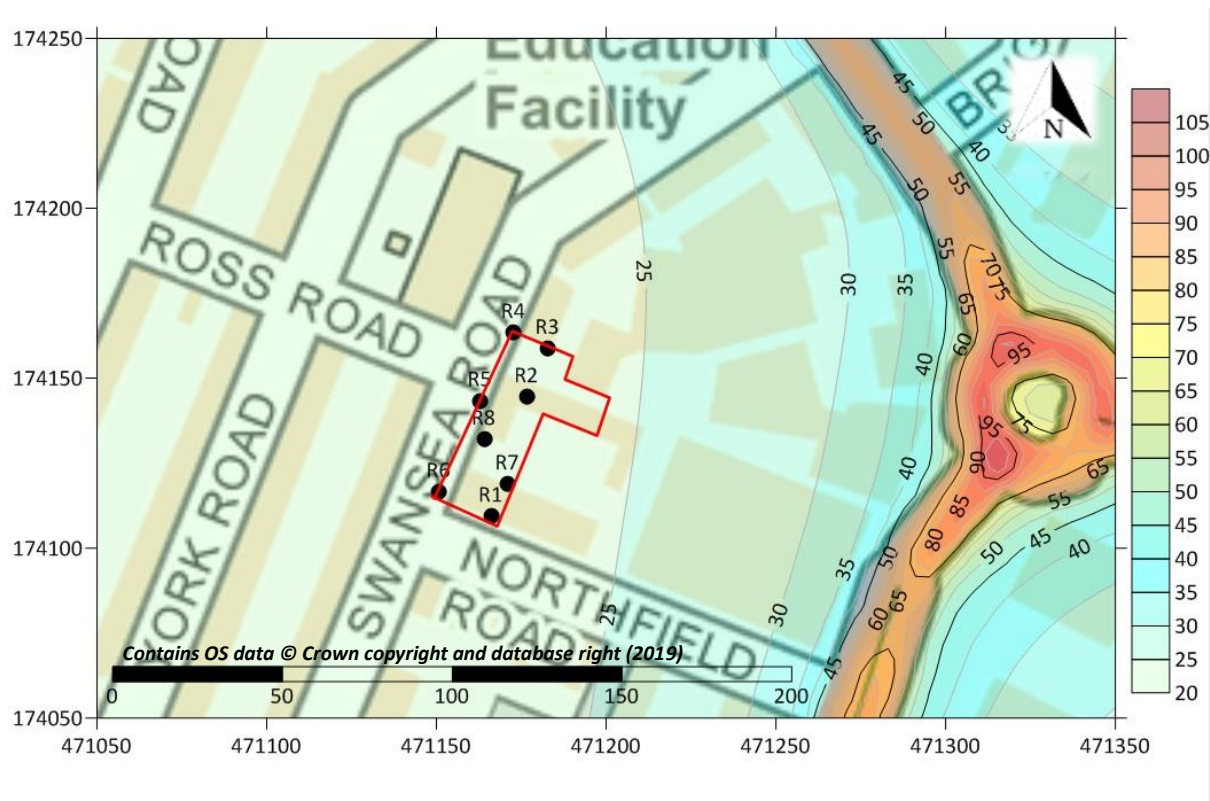


Figure 3 – Predicted Annual Mean NO₂ Concentrations (µg/m³)

Discrete receptors were modelled at the worst-case facades of the proposals. Results can be seen in Table 19.

Table 19 – Annual Mean NO₂ Concentrations Predicted at Discrete Receptor Locations

Future Receptor	Predicted Annual Mean NO ₂ Concentration (µg/m ³)	% of AQS objective
R1	23.9	60%
R2	24.0	60%
R3	23.9	60%
R4	24.1	60%
R5	23.8	60%
R6	23.6	59%
R7	23.9	60%
R8	23.8	60%

The maximum annual mean NO₂ concentration predicted at worst-case facades of the proposals was 24.1µg/m³, which is equivalent to 60% of the applicable AQS objective and is considered background level.

As per Defra's TG16, concentrations above 60µg/m³ indicate the potential for the exceedance of the short term hourly NO₂ AQS objective. As concentrations across the site are predicted to be well below 60µg/m³, it can be assumed the short-term objective for NO₂ would not be exceeded at the site.

Based on the assessment results, exposure of future receptors to exceedances of the annual mean AQS objective for NO₂ is considered unlikely as a result of the proposed development.

Particulate Matter-PM₁₀

Predicted annual mean PM₁₀ concentrations across the development site are shown in Figure 4. Contours display the ground floor level of the proposals. As seen in Figure 4, annual mean PM₁₀ concentrations were predicted to be below the relevant AQS objective of 40µg/m³ at all locations across the development site.

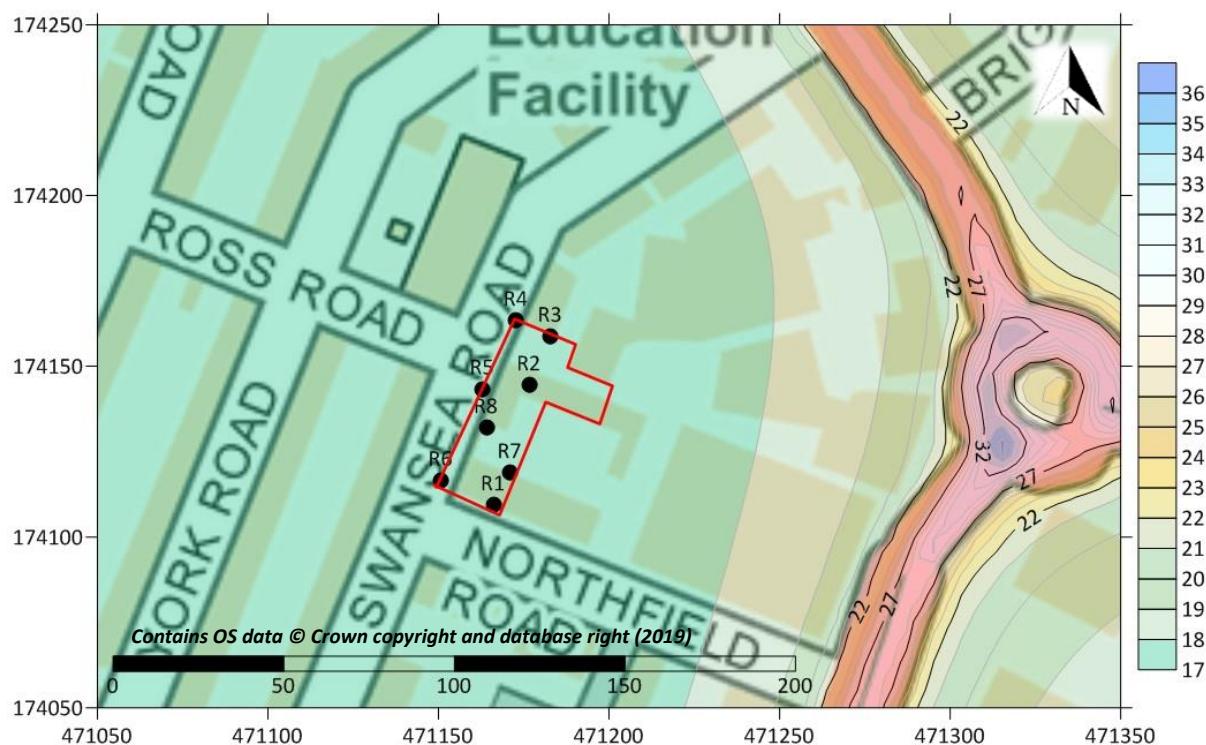


Figure 4 - Contour Plot of Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)

Results at discrete receptors locations are presented in Table 20. The greatest concentration predicted at any future receptor was $17.4 \mu g/m^3$, which is equivalent to 44% of the applicable AQS objective for annual mean PM_{10} and would be considered background level.

Table 20 - Annual Mean PM_{10} Concentrations Predicted at Discrete Receptor Locations

Future Receptor*	Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)**	% of AQS objective
R1	17.4	44%
R2	17.4	44%
R3	17.4	44%
R4	17.5	44%
R5	17.4	44%
R6	17.4	44%
R7	17.4	44%
R8	17.4	44%

Short term impacts were assessed by determining the mean 24-hour concentrations of PM₁₀. The AQS objective allows for the short-term objective of 50µg/m³ to be exceeded up to 35 times per year (equivalent to the 90.4th percentile). The results of the dispersion modelling assessment indicate the AQS objective short-term objective for PM₁₀ was met as the maximum number of days exceeding the short-term objective was predicted to be less than one.

Based on the assessment results, exposure of future receptors to exceedances of the annual mean AQS objective for PM₁₀ is considered unlikely as a result of the proposed development.

Particulate Matter-PM_{2.5}

Predicted annual mean PM_{2.5} concentrations across the development site are shown in Figure 4. Contours display the ground floor level of the proposals. As seen in Figure 5, annual mean PM_{2.5} concentrations were predicted to be below the relevant AQS objective of 25µg/m³ at all locations across the development site.

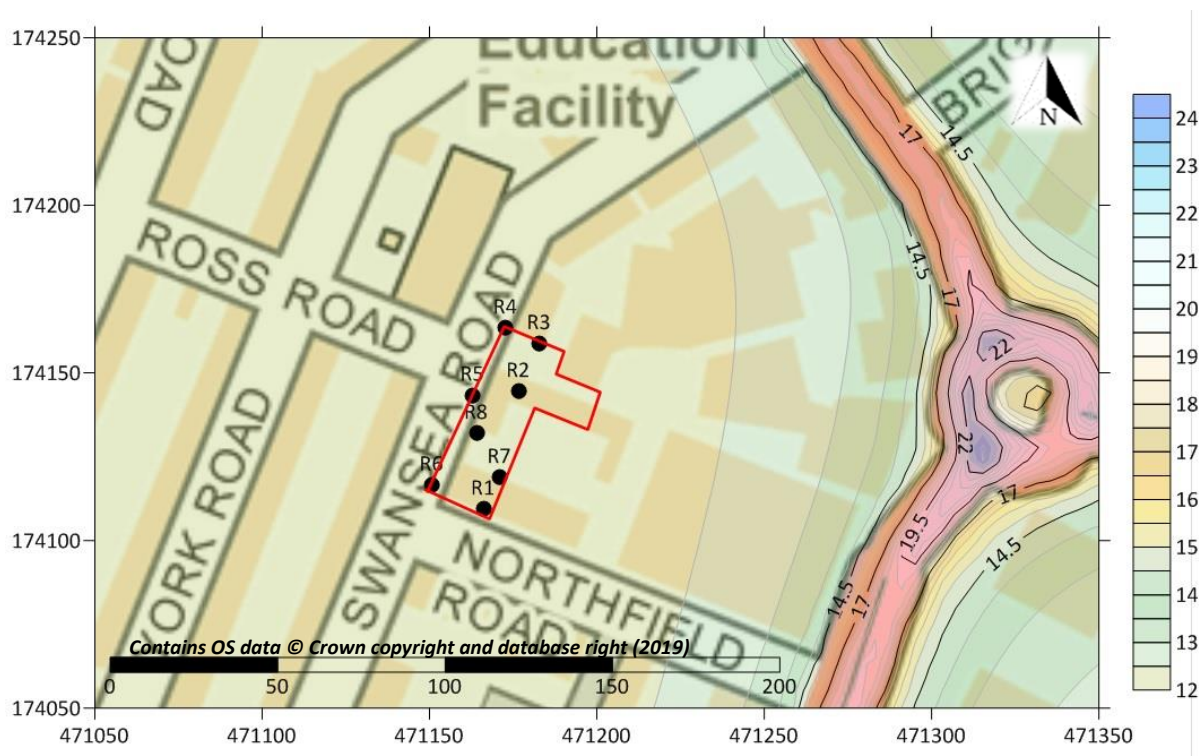


Figure 5 - Contour Plot of Predicted Annual Mean PM_{2.5} Concentration (µg/m³)

Results at discrete receptors locations are presented in Table 21. The greatest concentration predicted at any future receptor was 12.2µg/m³, which is equivalent to 49% of the applicable AQS objective for annual mean PM_{2.5} and would be considered background level.

Table 21 - Annual Mean PM_{2.5} Concentrations Predicted at Discrete Receptor Locations

Future Receptor*	Predicted Annual Mean PM ₁₀ Concentration (µg/m ³)**	% of AQS objective
R1	12.2	49%
R2	12.2	49%
R3	12.2	49%
R4	12.2	49%
R5	12.2	49%
R6	12.2	49%
R7	12.2	49%
R8	12.2	49%

Based on the assessment results, exposure of future receptors to exceedances of the annual mean AQS objective for PM_{2.5} is considered unlikely as a result of the proposed development.

6. Conclusion

Syntegra Consulting was retained to conduct an air quality assessment for the proposals at 28-32 Northfield Rd & 26-30 Swansea Rd, Reading. This report has been prepared to support the planning application for the redevelopment of a brownfield site to contain 9 residential units.

The proposed development has the potential to expose existing receptors to elevated pollution levels. As such, an Air Quality Assessment was required to determine baseline conditions at the site, consider its suitability for the proposed end-use, and assess potential effects associated with the scheme.

Construction phase impacts were deemed to be not significant as per the guidance in the IAQM's "Guidance on the assessment of dust from demolition and construction"¹³, providing the mitigation measures suggested in the guidance (included in Appendix B) are adhered to.

The significance of air quality impacts from additional traffic generated from the proposed development are anticipated to be negligible as the development did not trigger any of the IAQM criteria for developments which may cause significant impacts.

Dispersion modelling was undertaken using ADMS-Roads version 4.1.1.0 to predict pollutant concentrations at the development location and immediate vicinity associated with emissions from the local highway network. Results were subsequently verified using monitoring data obtained from RBC.

The results of the dispersion modelling assessment indicate concentrations of NO₂, PM₁₀ and PM_{2.5} are anticipated to be below all applicable AQS objectives across the development site. As such, the proposals are considered acceptable from an air quality perspective.

¹³ Guidance on the assessment of dust from demolition and construction, IAQM, 2014.

7. Appendix A

Table A1 – Traffic Data Used in Dispersion Modelling Assessment

Link	Description	24-hour AADT Flow		Mean Vehicle Speed (km/h)	%HDV
		2017	2021		
Link 1	Richfield Avenue to Randolph Road	27872	29419	20	4.1
Link 2	Randolph Road to Swansea Road	27872	29419	32.2	4.1
Link 3	Swansea Road to A329N	27872	29419	32.2	4.1
Link 4	A329N Roundabout to	27872	29419	10	4.1
Link 5	A329N Roundabout to	35714	37697	10	3.2
Link 6	A329N Jnc to Northfield Road Jnc	35714	37697	32.2	3.2
Link 7	Northfield Road Jnc	35714	37697	10	3.2
Link 8	Northfield Road Jnc to Tudor Road	35714	37697	32.2	3.2
Link 9	Vastern Road Jnc to De Montfort Road	20924	22086	10	2.9
Link 10	De Montfort Road to B3345 Junction	20924	22086	32.2	2.9
Link 11	A4074 to Richfield Avenue	27872	29419	32.2	4.1

8. Appendix B

Mitigation Measures for Construction Phase

The IAQM's guidance provides potential mitigation measures to reduce impacts as a result of fugitive dust emissions during the construction phase. These have been adapted for the development site as summarised in Table B1. These may be reviewed prior to the commencement of construction works.

Table B1– Fugitive Dust Emission Mitigation Measures for Medium Risk Sites¹⁴

Mitigation Measure		Highly Recommended (XX) / Desirable (X)
Site Management	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	XX
	Develop a Dust Management Plan	XX
	Display the name and contact details of a person(s) accountable for air quality pollutant emissions and dust issues on the site boundary.	XX
	Display the head or regional office contact information.	XX
	Record and respond to all dust and air quality pollutant emissions complaints.	XX
	Make a complaint log available to the local authority when asked.	XX
	Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked.	XX
	Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions and dust are being carried out, and during prolonged dry or windy conditions.	XX
	Record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and the action taken to resolve the situation is recorded in the log book.	XX

¹⁴ The Control of Dust and Emissions During Construction and Demolition Supplementary Planning Guidance, The Mayor of London, 2014.

Mitigation Measure		Highly Recommended (XX) / Desirable (X)
Preparing and maintaining the site	Plan site layout: machinery and dust causing activities should be located away from receptors.	XX
	Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site.	XX
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for extensive period.	XX
	Install green walls, screens or other green infrastructure to minimise the impact of dust and pollution.	X
	Avoid site runoff of water or mud.	XX
	Keep site fencing, barriers and scaffolding clean using wet methods.	XX
	Remove materials from site as soon as possible.	XX
	Cover, seed or fence stockpiles to prevent wind whipping.	XX
	Carry out regular dust soiling checks of buildings within 100m of site boundary and cleaning to be provided if necessary.	X
	Agree monitoring locations with the Local Authority	XX
	Where possible, commence baseline monitoring at least three months before phase begins.	XX
	Put in place real-time dust and air quality pollutant monitors across the site and ensure they are checked regularly	XX
Operating vehicle/ machinery and sustainable travel	Ensure all on-road vehicles comply with the requirements of Low Emission Zones.	XX
	Ensure all non-road mobile machinery (NRMM) comply with the standards set within this guidance.	XX
	Ensure all vehicles switch off engines when stationary – no idling vehicles.	XX

Mitigation Measure		Highly Recommended (XX) / Desirable (X)
	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where possible.	XX
	Impose and signpost a maximum-speed-limit of 10mph on surfaced haul routes and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).	X
	Produce a Construction Logistics Plan to manage the sustainable delivery of good and materials	XX
	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).	XX
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.	XX
	Ensure an adequate water supply on the site for effective dust/ particulate matter mitigation (using recycled water where possible).	XX
	Use enclosed chutes, conveyors and covered skips.	XX
	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	XX
	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.	XX
Waste Management	Reuse and recycle waste to reduce dust from waste materials.	XX
	Avoid bonfires and burning of waste materials.	XX
Measures Specific to Demolition	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	X

Mitigation Measure		Highly Recommended (XX) / Desirable (X)
	Ensure water suppression is used during demolition operations	XX
	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	XX
	Bag and removed any biological debris or damp down such material before demolition.	XX
Measures specific to Construction	Avoid scabbing (roughening of concrete surfaces) if possible	X
	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.	X
Measures specific to Trackout	Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site.	X
	Avoid dry sweeping of large areas.	X
	Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport.	X
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	X

Assuming the relevant mitigation measures outlined in Table B1 are implemented, the residual effect from all dust generating activities is predicted to be negligible, in accordance with the guidance.

9. Appendix C

Model Verification

Model Performance

An evaluation of model performance has been undertaken to establish confidence in model results. Defra's LAQM (TG16) identifies several statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. The statistical parameters used in this assessment are:

- root mean square error (RMSE);
- fractional bias (FB); and
- correlation coefficient (CC).

A brief for explanation of each statistic is provided in Table C1, and further details can be found in LAQM (TG16) Box 7.17.

Table C1 – Statistical Parameters used to Estimate Model Performance¹⁵

Statistical Parameter	Comments	Ideal Value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO₂ objective of 40 µg/m³, if an RMSE of 10 mg/m³ or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4µg/m³ for the annual mean NO₂ objective.	0.01
FB	It is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.00
CC	It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

These parameters estimate how the model results agree or diverge from the observations. These calculations have been carried out prior to, and after, adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

¹⁵ Local Air Quality Management Technical Guidance (TG16), Defra, 2018.

Air Quality Monitoring Data

The air quality monitoring data collected as part of this assessment and detailed in the baseline section was reviewed to determine the suitability of each of the monitoring locations for inclusion into the model verification process. The criteria used to determine the suitability of the monitoring for inclusion into the verification exercise is outlined below:

- monitoring was discounted where there was less than 75% data capture in 2017 and poor data capture in other years;
- monitoring sites classified as roadside were used;
- monitoring was excluded from verification if major sources were missing from the traffic model that may influence monitored concentrations and therefore could not be included in the air quality modelling (such as large car parks, industrial stacks in close proximity etc.); and
- sites where the location of the monitoring could not be confirmed to a satisfactory standard were omitted from the verification.

A comparison of modelled versus monitored road NO_x and NO₂ concentrations are shown in Table C2.

Table C2 – Unadjusted Modelled versus Monitoring Concentrations

Site ID	X	Y	Monitored Total NO ₂ (µg/m ³)	Modelled Total NO ₂ (µg/m ³)	Total NO ₂ Monitored vs. Modelled % Difference	Monitored Road NO _x (µg/m ³)	Modelled Road NO _x (µg/m ³)	Road NO _x Monitored vs. Modelled % Difference
RD1	471153	174429	37	35.18	-4.9%	51.5	28.0	-45.5%
DT48-50*	471156	174424	38	35.32	-7.1%	34.5	28.3	-17.7%
DT47	471161	174379	36	27.08	-24.8%	29.9	10.6	-64.5%
DT53	471261	174236	36	27.74	-22.9%	29.9	12.0	-59.9%
DT51	471293	174236	40	31.06	-22.4%	39.1	19.0	-51.5%
DT52	471420	174129	38	30.09	-20.8%	34.5	16.9	-50.9%

*Triplicate Co-located with RD1

Verification Methodology

The verification method used for this assessment follows the process detailed in LAQM (TG16). The verification was undertaken by comparing the monitored versus modelled road NO_x. A total of six monitoring sites were used in the verification.

For each monitoring site, the relevant 1x1km 2017 background concentrations for NO_x and NO₂ were acquired. The NO₂ to NO_x tool was used to calculate the total road NO_x at each monitoring site. The

monitored versus modelled total NO₂ concentrations for unadjusted and adjusted results were plotted on a scatter graph as presented on Figure C1.

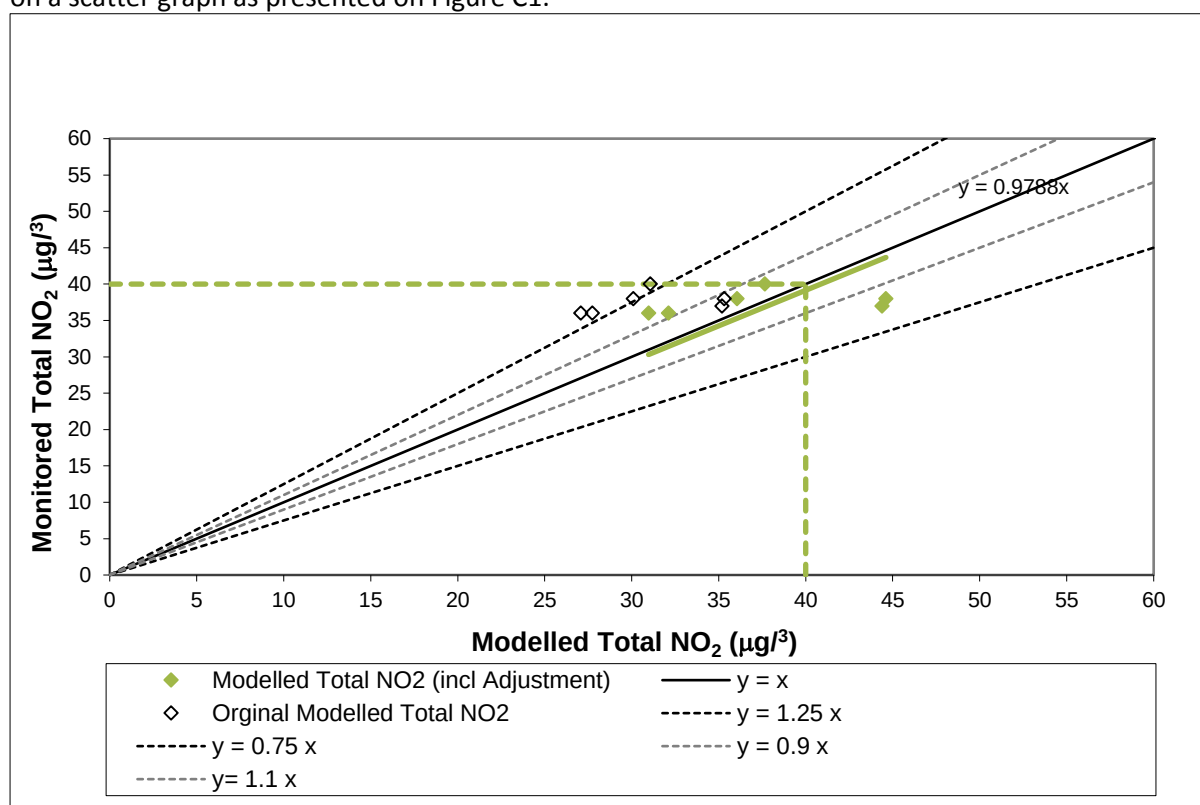


Figure C1-Unadjusted and Adjusted Monitored versus Modelled NO₂

Figure C1 demonstrates once adjusted for road NO_x, total modelled NO₂ concentrations are closer to monitored total NO₂ concentrations, than the unadjusted total modelled NO₂. Table C3 summarises the model performance before and after adjustment.

Table C3 – Summary of Total Modelled NO₂ Performance Statistics before and after Adjustment of Modelled Road NO_x

Summary Table	Results without Adjustment	Results with Adjustment
Within +10%	0	0
Within -10%	2	2
Within +-10%	2	2
Within +10 to 25%	0	2
Within -10 to 25%	4	2
Within +-10 to 25%	4	4
Over +25%	0	0
Under -25%	0	0
Greater +-25%	0	0

Summary Table	Results without Adjustment	Results with Adjustment
Within +/-25%	6	6
Total	6	6
Uncertainties Assessment		
Correlation	0.392	0.397
RMSE ($\mu\text{g}/\text{m}^3$)	7.080	4.967
Fractional Bias	0.187	-0.004

As can be seen from Table C3, the model is under-predicting concentrations in comparison to the measured values at all verification sites. Following adjustment, the statistics are improved.