



Air Quality Assessment

Reading Community Church, Oxford Road, Reading

Client Name: The Trustees of the Gate

Project Number: P2894.2.1

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Site:	Reading Community Church, Oxford Road, Reading
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1 Introduction

The client, The Trustees of the Gate, is proposing to develop a plot at Reading Community Church, Oxford Road, Reading, hereafter referred to as 'the site'. The development proposals and purpose of investigation are detailed below.

1.1 Development Proposals

The proposals are for the demolition of existing buildings at the site and the construction of a new three storey building with community use on the ground floor and residential use above. The site is located at 553 Oxford Road, Reading RG30 1HJ (see **Figure 1**).

1.2 Purpose of Investigation

agb Environmental Ltd has been commissioned to undertake an air quality assessment for the proposed development. Reading Borough Council has declared an air quality management area (AQMA) for exceedences of the annual mean nitrogen dioxide (NO₂) objective, and the application site lies within this area.

The scale of the development is such that it will not significantly increase traffic on local roads; however, the new residential properties will be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to traffic emissions are NO₂ and fine particulate matter (PM₁₀ and PM_{2.5}).

The assessment has been prepared taking into account all relevant local and national guidance and regulations.

2 Air Quality Legislation and Policy

2.1 EU Limit Values

The European Union's Directive on ambient air quality and cleaner air for Europe (European Parliament, Council of the European Union, 2008) set legally binding limit values for NO₂, PM₁₀ and PM_{2.5}. The Air Quality Standards Regulations 2010 (The Stationary Office, 2010) implement the EU Directive limit values in English legislation. Achievement of the limit values is a national obligation rather than a local one.

The limit values are the same as the objective values (described below and shown in **Table 1**); however, the compliance dates differ, and the limit values apply at all locations (apart from where the public does not have access, where health and safety at work provisions apply and on the road carriageway). The PM₁₀ and NO₂ limit value applied from 2005 and 2010 respectively, whereas the PM_{2.5} limit value applied from 2015.

2.2 The Air Quality Strategy

Part IV of The Environment Act 1995 required the UK Government to prepare an Air Quality Strategy. The Air Quality Strategy (Defra, 2007), provides an overview and outline of ambient air quality policy in the UK and the devolved administrations. The strategy sets out air quality standards and objectives intended to protect human health and the environment.

Standards are the concentrations of pollutants in the atmosphere, below which there is a minimum risk of health effects or ecosystem damage; they are set with regard to scientific and medical evidence. Objectives are the policy targets set by the Government, taking account of economic efficiency, practicability, technical feasibility and timescale, where the standards are expected to be achieved by a certain date.

The Air Quality Strategy also describes the system of Local Air Quality Management (LAQM), introduced in Part IV of the Environment Act 1995, which requires every local authority to carry out regular review and assessments of air quality in its area. Where an objective has not been, or is unlikely to be achieved, the local authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which sets out appropriate measures to be introduced in pursuit of the objectives.

The objectives for NO₂ and PM₁₀, as prescribed by the Air Quality (England) Regulations 2000 and the Air Quality (England) (Amendment) Regulations 2002 (The Stationary Office, 2000; The Stationary Office, 2002), are shown in **Table 1**. The objectives for PM₁₀ and NO₂ were to have been achieved by 2004 and 2005 respectively, and continue to apply in all future years thereafter. The PM_{2.5} objective, also shown in **Table 1**, is to be achieved by 2020; however, there is no obligation for local authorities to try to meet the PM_{2.5} objective, and it is not included in the Regulations.

The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the objective. Examples of where the objectives should apply are provided in the Local Air Quality Management Technical Guidance (Defra, 2016) issued by the Department for Environment, Food and Rural Affairs (Defra). The annual mean NO₂ and PM₁₀ objectives should apply at the building façades of residential properties, schools, hospitals, care homes *etc.*; they should not apply at the building façades of places of work, hotels, gardens or

kerbside sites. The 24-hour mean PM₁₀ objective should apply at all locations where the annual mean objective applies, as well as the gardens of residential properties and hotels. The 1-hour mean NO₂ objective should apply at all locations where the annual and 24-hour mean objectives apply, as well as at kerbside sites where the public have regular access, e.g. the pavements of busy shopping streets.

Table 1: The Objectives for NO₂, PM₁₀ and PM_{2.5}

Pollutant	Concentration Measured As	Objective
NO ₂	1-hour Mean	200 µg/m ³ not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m ³
PM ₁₀	24-hour Mean	50 µg/m ³ not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m ³
PM _{2.5}	Annual Mean	25 µg/m ³

2.3 Planning Policy

2.3.1 National Policies

The National Planning Policy Framework (NPPF) (DCLG, 2012) sets out planning policy for England and acts as guidance for local planning authorities in drawing up plans and is a material consideration in determining applications. It places a general presumption in favour of sustainable development, stressing that the planning system should perform an environmental role to minimise pollution.

The NPPF states that:

“The planning system should contribute to conserving and enhancing the environment and reducing pollution by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.”

The NPPF goes on to state that:

“To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account.”

With specific reference to air quality, the NPPF states that:

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

The NPPF is supported by Planning Practice Guidance (PPG) (DCLG, 2014). The PPG states that:

“Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit.”

The PPG goes on to state that:

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

The PPG also sets out the information that may be required in an air quality assessment, stating that:

“Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality.”

It also provides guidance on options for mitigating air quality impacts, and makes clear that:

“Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact.”

2.3.2 Local Policies

The Reading Core Strategy (Reading Borough Council, 2008) includes Policy CS34: Pollution and Water Resources, which states that:

“Development will only be permitted where it would not be damaging to the environment through air, land, noise or light pollution; where it would preserve or ideally enhance ground and surface water quality; and where existing water resources, sewerage and wastewater treatment infrastructure are adequate to support the proposed development.

Proposals for development that are sensitive to the effects of air, noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution. ...”

The Reading Sites and Detailed Policy Document (Reading Borough Council, 2012) includes Policy DM19: Air Quality, which states that:

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 reduce air quality;*
- *Whether the development is within, or accessed via, an Air Quality Management Area; and*
- *Whether it can be demonstrated that a local reduction 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.

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

2.3.3 Air Quality Action Plan

The Reading Air Quality Action Plan (Reading Borough Council, 2015; Reading Borough Council, 2016) includes a number of measures and actions that the council intends to implement in order to help meet the air quality objectives within its AQMA.

3 Methodology

3.1 Baseline Conditions

Information on existing air quality within the study area has been collated from the following sources:

- The results of monitoring and the LAQM review and assessment reports undertaken by Reading Borough Council;
- Maps of roadside concentrations published by Defra (Defra, 2017a) have been used to identify current exceedences of the NO₂ EU limit value ¹;
- Background pollutant concentration maps published by Defra (Defra, 2017b); and
- Defra's Pollutant Release and Transfer Register (Defra, 2017c) and the Environment Agency's 'What's in your backyard' website (Environment Agency, 2017) have been used to screen for local industrial and waste management sources.

3.2 Road Traffic Impacts

Receptors have been located at the façade of the proposed development, where the impact from existing sources of pollution is likely to be greatest. The receptor locations are described in **Table 2** and are shown in **Figure 1**.

Table 2: Description of Receptors

Receptor	OS Grid Reference		Height (m)	
	x	y	Ground Floor	First Floor
R1	469455	173702	1.5	4.5
R2	469444	173705	1.5	4.5
R3	469435	173708	1.5	4.5
R4	469432	173705	1.5	4.5
R5	469431	173701	1.5	4.5
R6	469428	173693	1.5	4.5

3.2.1 Assessment Scenarios

Concentrations of NO₂, PM₁₀ and PM_{2.5} have been predicted at the receptors assuming an opening year of 2019.

In addition to predictions using emissions data published by Defra, a sensitivity analysis has been undertaken that assumes higher NO_x emissions from diesel vehicles. This sensitivity analysis provides a worst-case assessment of future impacts (see section on uncertainty below).

3.2.2 Modelling Methodology

Concentrations have been predicted using the ADMS Roads (v4.1.1.0) dispersion model. The model requires the input of a range of data, details of which are provided in **Appendix A1**, along with details of the model verification calculations.

¹ There are no exceedences of the PM₁₀ limit values.

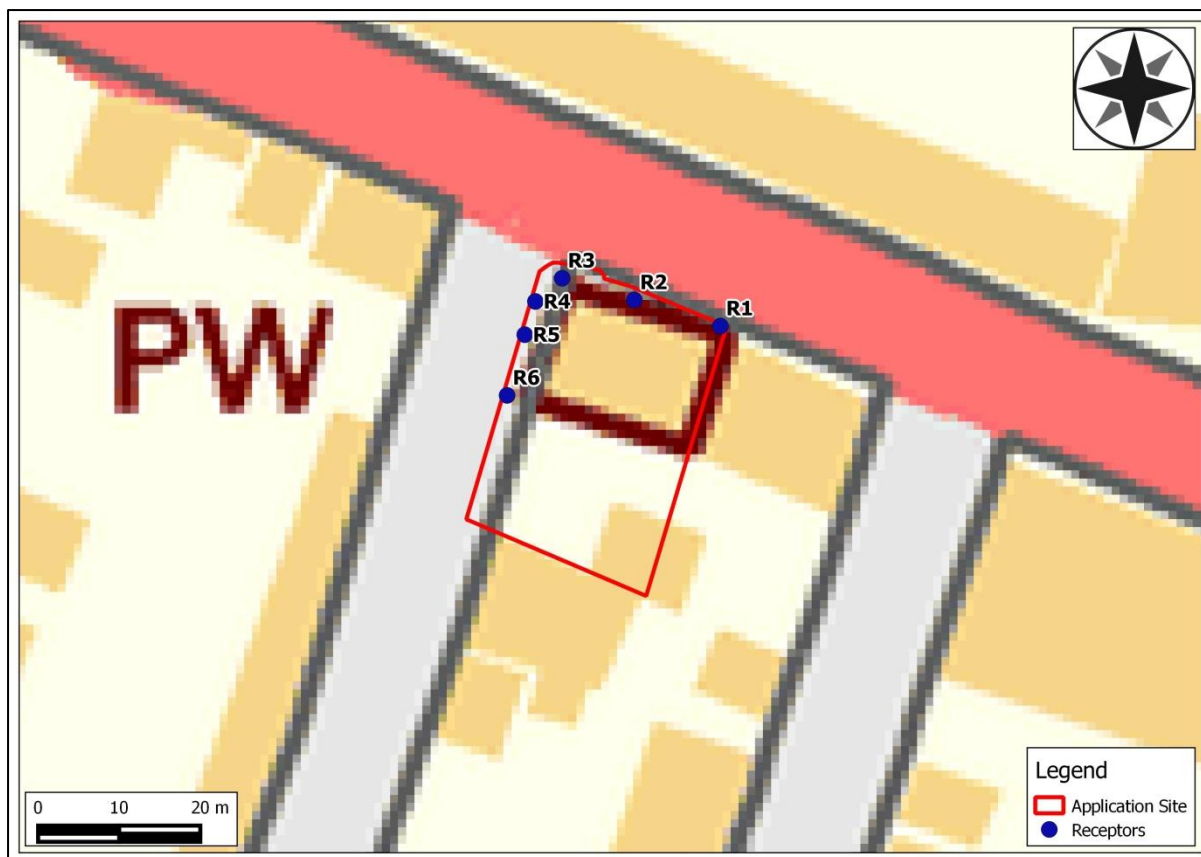


Figure 1: Location of Receptors

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3.3 Uncertainty

There are many factors that contribute to uncertainty when predicting pollutant concentrations. The emission factors utilised in the air quality model are dependent on traffic data, which have inherent uncertainties associated with them. There are also uncertainties associated with the model itself, which simplifies real world conditions into a series of algorithms. The model verification process, as described in **Appendix A1**, minimises the uncertainties; however, future year predictions use projected traffic data, emissions data, and background concentrations. The most recent emission factors and background data have been used in this assessment; however, there are still uncertainties associated with this data.

Analysis has shown a disparity between historical monitoring data and the projected background concentrations published by Defra (Carslaw et al., 2011). Overall, there is little evidence of the consistent downward trend in NO₂ and NO_x concentrations suggested by the emission inventory estimates.

This disparity is believed to be due to the actual on-road performance of diesel vehicles when compared with emissions calculations based on the Euro standards and published in the Emissions Factor Toolkit (EFT) used for modelling. Therefore, forecast reductions in the road traffic component of background concentrations are also likely to be over optimistic in the near-term. There is no evidence that the contribution to background concentrations from non-traffic sources should not behave as forecast.

Recent evidence indicates that future emissions from petrol vehicles are likely to reduce as expected, but that emissions from Euro 6, Euro IV, Euro V and Euro VI diesel vehicles should be uplifted to provide a worst-case assessment.

Transport for London (TfL) has published a report that compares the on-road emissions performance of vehicles with the emissions factors in COPERT 4 (as used in the EFT) (TfL, 2015). The report shows that on-road emissions from Euro 6 petrol vehicles are consistently less than those in COPERT 4, using a London drive cycle. In addition, diesel emissions from Euro 6 cars show a significant improvement on those at Euro 5; however, these emissions are higher than the emissions in COPERT 4. Euro VI emissions from buses and heavy duty vehicles (HDVs) have also been found to be significantly reduced from Euro V.

An analysis of recent reports that compare the on-road NO_x emissions performance of diesel vehicles with vehicle type-approval standards has been published by Air Quality Consultants Ltd (AQC) (AQC, 2016a). The report concludes that Euro 6 vehicles perform significantly better than earlier vehicles; with a reduction in NO_x emissions of 50-70% when compared with Euro 5 vehicles. However, Euro 6 vehicles have been found to emit significantly more NO_x than the Euro 6 standard. For HDVs there is good evidence that Euro VI NO_x emissions are consistently better than those of Euro V and earlier standards.

The COPERT emissions factors used in the EFT have been updated to reflect recent evidence on the real-world emission performance; however, the AQC report compares on-road NO_x emissions with the COPERT emissions factors and concludes that:

- there is no evidence that COPERT emissions factors are incorrect for Euro 5 or earlier diesel cars;
- there is a small under-prediction in the COPERT emissions factors when compared with Euro 6ab diesel cars;
- COPERT emissions factors for Euro IV and Euro V under-predict emissions; and
- It is likely that COPERT emissions factors for Euro VI under-predict emissions.

The AQC report recommends that future year modelling should be based on the unadjusted EFT emissions factors, and that a sensitivity analysis that uplifts emissions from Euro 6, Euro IV, Euro V and Euro VI diesel vehicles should be undertaken. AQC have produced the Calculator Using Realistic Emissions for Diesels (CURED) tool (V2A) that applies the relevant adjustments to diesel emission factors from the EFT for use by consultants when undertaking sensitivity analysis of future air quality impacts (AQC, 2016b).

The COPERT/EFT emissions do not include Euro 6c, which is likely to reduce emissions when compared with Euro 6ab; therefore, the CURED emissions are likely to be higher than actual emissions from future diesel vehicles, and thus the use of CURED emissions provides a worst-case assessment.

The road traffic components of NO_x and NO₂ in the Defra background maps have also been adjusted to produce background concentrations for the sensitivity test following the methodology recommended by AQC (AQC, 2016c).

3.4 Assessment Criteria and Significance

3.4.1 Health Criteria

There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach suggested by Environmental Protection UK (EPUK) and the IAQM in Guidance on Land-Use Planning & Development Control: Planning for Air Quality (EPUK and IAQM, 2015) has been used for this assessment.

The predicted concentrations at each receptor have been compared with air quality assessment levels (AQALs) based on the annual mean objectives shown in **Table 1**. Measurements of PM₁₀ have shown that exceedences of the 24-hour mean PM₁₀ objective may occur above an annual mean PM₁₀ concentration of 32 µg/m³; therefore, 32 µg/m³ has been used as the AQAL for PM₁₀ (Defra, 2016). The AQALs for NO₂ and PM_{2.5} are the same as the objectives. Where an exceedence of the AQAL occurs, the effect is judged as significant, unless provision is met to reduce exposure by some means. Predicted concentrations below the AQALs will be considered as insignificant.

The determination of the significance of the effects includes elements of professional judgement and the professional experience of the consultant preparing the report set out in **Appendix A2**.

4 Baseline Conditions

4.1 Industrial Sources

The search of the UK Pollutant Release and Transfer Register, and Environment Agency's 'What's in your backyard?' websites did not identify any significant industrial or waste management sources that are likely to affect air quality at the application site.

4.2 EU Limit Values

There are no AURN monitoring sites within the study area. Oxford Road (A329) is included in the modelling undertaken by Defra and the annual mean NO₂ limit value is predicted to be achieved in 2015 adjacent to the application site, with concentrations of between 30-40 µg/m³.

4.3 LAQM Review and Assessment

Reading Borough Council has declared an AQMA for exceedences of the annual mean NO₂ objective across Reading town centre and along the major radial road routes into Reading, including along Oxford Road (A329). The application site lies within this area.

In terms of PM₁₀, Reading Borough Council has concluded that there are no exceedences of the objectives; therefore, it is highly unlikely concentrations in the vicinity of the application site exceed the objectives (Reading Borough Council, 2016).

4.4 Local Air Quality Monitoring

Reading Borough Council operates four automatic monitoring sites, one of which is located on Oxford Road, approximately 830m northwest of the application site. The council also operates a number of diffusion tube monitoring sites, and data from sites located within 1km of the application site are shown in **Table 3**. Exceedence statistics for the 1-hour mean NO₂ objective from the Oxford Road automatic monitor are shown in **Table 4**. The monitoring site locations are shown in **Figure 2**.

Exceedences of the annual mean NO₂ objective have been measured at four of the diffusion tube monitoring sites (D2, D3, D8 and D9) and at the Oxford Road automatic monitoring site in 2013. Roadside annual mean NO₂ concentrations along Oxford Road ranged from 31 to 52 µg/m³ between 2011 and 2015. However, no exceedences of the objective have been measured at diffusion tube monitoring site D6, which is located on the north side of Oxford Road almost opposite the application site. Annual mean NO₂ concentrations at the D6 monitoring site ranged from 33 to 38 µg/m³ between 2011 and 2015 and air quality at the façade of the proposed development facing onto Oxford Road is likely to be similar.

No exceedences of the 1-hour mean NO₂ objective have been measured at the Oxford Road automatic monitoring site.

There are no clear trends in monitoring results for the past five years. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards. The implications of this have been discussed in **Section 3.3** of this report.

Concentrations of PM₁₀ are also measured at the Oxford Road automatic monitor. Results from the years 2011 to 2015 are shown in **Table 5**. There have been no exceedences of the PM₁₀ objectives.

Table 3: Measured Annual Mean NO₂ Concentrations (2011 to 2015) ^a

Site ID	Location	Site Type	Annual Mean (µg/m³)				
			2011	2012	2013	2014	2015
Automatic Monitor							
RD3	Oxford Road	Roadside	37	38	43	35	31
Diffusion Tubes							
D1	Tilehurst Rd/Water Rd	Roadside	31	37	-	-	32
D2	689 Oxford Road	Roadside	41	45	-	-	38
D3	744 Oxford Road	Roadside	43	52	-	-	45
D4	762 Oxford Road	Roadside	31	34	-	-	-
D5	606 Oxford Road	Roadside	31	34	-	-	-
D6	494 Oxford Road	Roadside	34	38	-	-	33
D7	Cow Lane Bridges	Roadside	33	35	-	-	29
D8	327 Oxford Road	Roadside	46	50	-	-	41
D9	281 Oxford Road	Roadside	45	47	-	-	43
Objective			40				

^a Exceedences are shown in bold. LAQM reports containing diffusion tube data for 2013 and 2014 are not available on the Reading Borough Council website.

Table 4: Exceedence Statistics for the 1-hour Mean NO₂ Objective (2011 to 2015)

Site ID	Location	Site Type	Number of Hours > 200 µg/m³				
			2011	2012	2013	2014	2015
Automatic Monitor							
RD3	Oxford Road	Roadside	0	0	3	0	0
Objective			18				

Table 5: Summary of PM₁₀ Monitoring Data (2011 to 2015)

Site ID	Location	Site Type	2011	2012	2013	2014	2015
Annual Mean (µg/m³)							
RD3	Oxford Road	Roadside	25	24	20	20	23
Objective			40				
Number of Days > 50 µg/m³							
RD3	Oxford Road	Roadside	16	13	4	3	7
Objective			35				

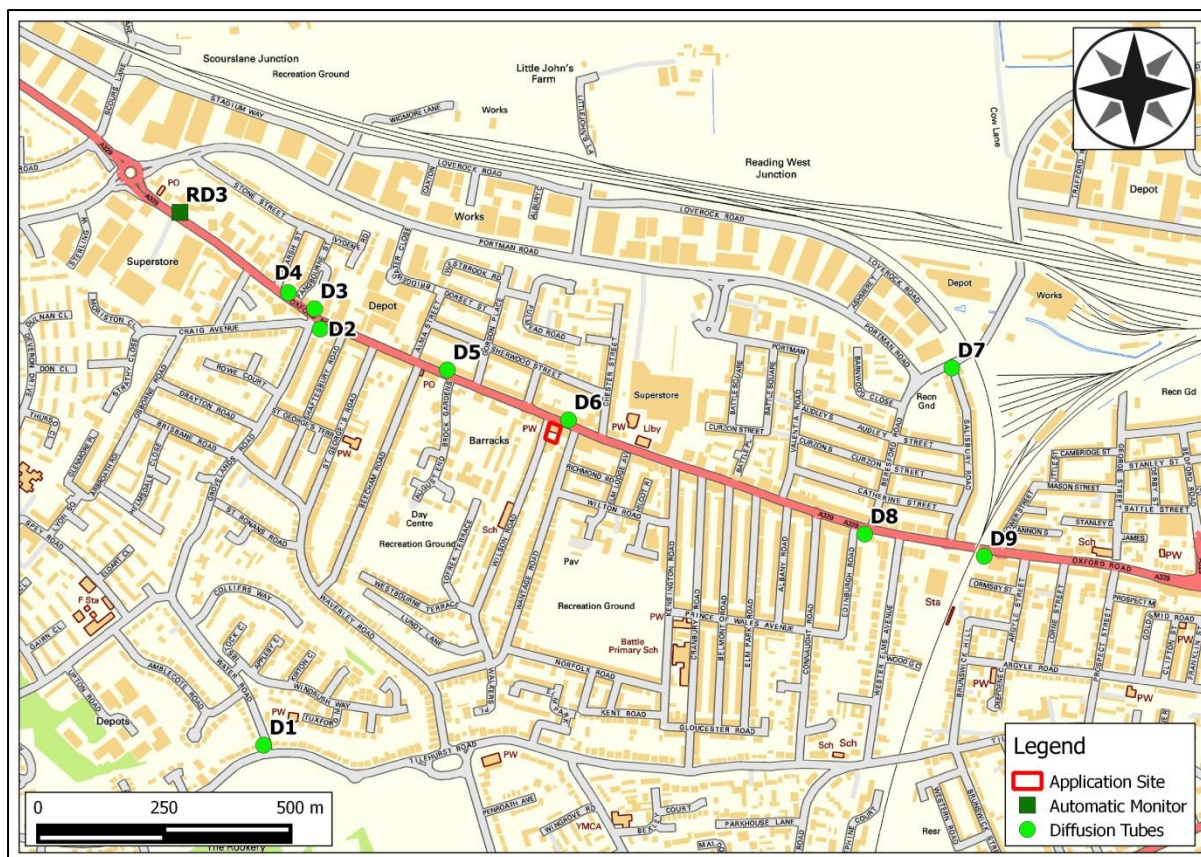


Figure 2: Air Quality Monitoring Sites

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4.5 Background Concentrations

Estimated background concentrations at the application site are shown in **Table 6**. The background concentrations have been derived from data in the national maps published by Defra. The background concentrations are all well below the objectives.

Table 6: Estimated Annual Mean Background Concentrations in 2015 and 2019 ($\mu\text{g}/\text{m}^3$)

Year	NO _x	NO ₂	PM ₁₀	PM _{2.5}
2015	29.2	19.9	15.9	11.6
2019 EFT	24.9	17.3	15.2	11.0
2019 CURED	25.8	17.9	-	-
Objective	-	40	40	25

5 Road Traffic Impacts

Predicted concentrations at the proposed development are shown in **Table 7**. Annual mean concentrations are predicted to be well below the AQALs at all receptors; therefore, air quality for future residents at the proposed development will be acceptable.

Table 7: Predicted Impacts on the Development in 2019

Receptor	Annual Mean ($\mu\text{g}/\text{m}^3$)							
	NO ₂				PM ₁₀		PM _{2.5}	
	EFT		CURED					
	Ground Floor	1 st Floor	Ground Floor	1 st Floor	Ground Floor	1 st Floor	Ground Floor	1 st Floor
R1	27.9	21.8	32.4	24.2	21.8	18.1	14.7	12.6
R2	26.9	21.7	31.2	24.1	21.2	18.0	14.4	12.6
R3	26.2	21.6	30.2	24.0	20.8	18.0	14.1	12.6
R4	24.4	21.3	27.8	23.6	19.6	17.8	13.5	12.5
R5	23.1	21.0	25.9	23.1	18.8	17.6	13.0	12.3
R6	21.6	20.4	23.9	22.3	17.9	17.2	12.5	12.1
AQAL	40				32		25	

6 Mitigation

The assessment has demonstrated that the scheme will not introduce receptors into an area where the air quality objectives are exceeded. Mitigation measures to reduce pollutant emissions from road traffic are also being delivered in the longer term by the introduction of more stringent emissions standards, largely via European legislation. It is not considered appropriate to propose further mitigation measures for this scheme.

7 Residual Impacts

The residual impacts will be the same as those identified in **Section 5**.

8 Conclusions and Recommendations

The impacts due to emissions from local road traffic on the air quality for residents living in the proposed development have been shown to be acceptable at the worst-case locations assessed, with concentrations being below the air quality objectives at all receptors.

The overall operational air quality impacts on the development are judged to be insignificant. This conclusion, which takes account of the uncertainties in future projections, in particular for NO₂, is based on the predicted concentrations being below the objectives at all of the receptors.

The proposed development is consistent with:

- The NPPF;
- Policy CS34 of the Reading Core Strategy and Policy DM19 of the Reading Sites and Detailed Policy Document.

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10 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emissions Factor Toolkit
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
µg/m³	Microgrammes per cubic metre
NAEI	National Atmospheric Emissions Inventory
NO₂	Nitrogen dioxide
NO_x	Nitrogen oxides (taken to be NO ₂ + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM_{2.5}	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

11 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the research carried out. The results of the research should be viewed in the context of the work that has been carried out and no liability can be accepted for matters outside the stated scope of the research. Any comments made on the basis of information obtained from third parties are given in good faith on the assumption that the information is accurate. No independent validation of third party information has been made by agb Environmental Ltd.

Advice provided within this report is based on current guidelines available at the time of writing. This report is subject to amendment in light of additional information becoming available or statutory consultee review.

This report is written in the context of an agreed scope of work between agb Environmental Ltd and the Client and should only be used in this specific context. Re-interpretation of this report in whole or part may become necessary if additional information becomes available or practices or legislation changes.

agb Environmental Ltd does not provide legal advice; the advice of the Client's legal advisors may also be required. agb Environmental Ltd Terms and Conditions apply.

Appendices

A1 Modelling Methodology

Model Inputs

Traffic Data

The AADT flows and the vehicle fleet composition data for Oxford Road (A329) have been determined using data from the interactive web-based map provided by the Department for Transport (DfT) (DfT, 2016a). The traffic flows have been factored forward to the assessment year (2019) using the TEMPRO System v6.2 (DfT, 2013). Traffic speeds on sections of open road have been estimated based on the speed limits. Speeds have been reduced to 20km/h within 25m of a junction stop line. The traffic data are shown in **Table A1**. The modelled road network is shown in **Figure 3**.

Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by the DfT (DfT, 2016b).

Table A1: Summary of Traffic Data used in the Assessment

DfT CP	Road	AADT		Fleet Composition (%)						Speed Limit (km/h)
		2015	2019	Car	LGV	Rigid HGV	Artic HGV	Bus and Coach	MC	
6924	A329	13,426	14,382	79.0	13.0	2.9	0.9	3.0	1.1	48

Emissions

Emissions have been calculated using the most recent version of the Emissions Factor Toolkit (EFT) v7.0 (Defra, 2017b). The traffic data were entered into the EFT in order to calculate a combined emission rate for each of the road links in the modelled network.

The road traffic emissions for the sensitivity analysis were calculated using the Calculator Using Realistic Emissions for Diesels (CURED) tool (V2A) (AQC, 2016b).

Meteorological Data

The model has been run using the full year of meteorological data that corresponds with the most recent set of available NO₂ monitoring data (2015). The meteorological data has been taken from the monitoring station located at Heathrow Airport, which is considered suitable for the area.

Background Concentrations

Background concentrations have been based on those published by Defra (Defra, 2017b). These cover the whole country on a 1 km by 1 km grid and are published for each year from 2013 to 2030. The current maps have been verified against measurements undertaken during 2013. The Defra NO_x and NO₂ maps have been adjusted based on a comparison

between the mapped data and measured data from background AURN monitoring sites (AQC, 2016c).



Figure 3: Modelled Road Network

Contains Ordnance Survey Data © Crown copyright and database right 2017

Verification

The verification process seeks to minimise uncertainties associated with the air quality model by comparing the model output with locally measured concentrations. Data from the Oxford Road automatic monitoring site and diffusion tube monitoring sites D2, D3 and D6 have been used. The verification methodology is described below.

Nitrogen Dioxide

Most NO_2 is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$). The model has been run to predict the 2015 annual mean NO_x concentrations at the monitoring sites.

The model output of road- NO_x has been compared with the 'measured' road- NO_x , calculated from the measured annual mean NO_2 concentration and the background concentration using the NO_x from NO_2 calculator v5.1 published by Defra.

The slope of the best-fit line between the 'measured' road- NO_x contribution and the model derived road- NO_x contribution, forced through zero, has been used to determine a primary adjustment factor (**Figure 4**). This factor has then been applied to the modelled road- NO_x

concentration for each receptor to provide adjusted modelled road-NO_x concentrations. The NO_x to NO₂ calculator has then been used to determine total NO₂ concentrations from the adjusted modelled road-NO_x concentrations and the background NO₂ concentrations. A secondary adjustment factor has then been calculated as the slope of the best-fit line between the measured NO₂ concentrations and the primary adjusted total NO₂ concentrations, forced through zero (**Figure 5**).

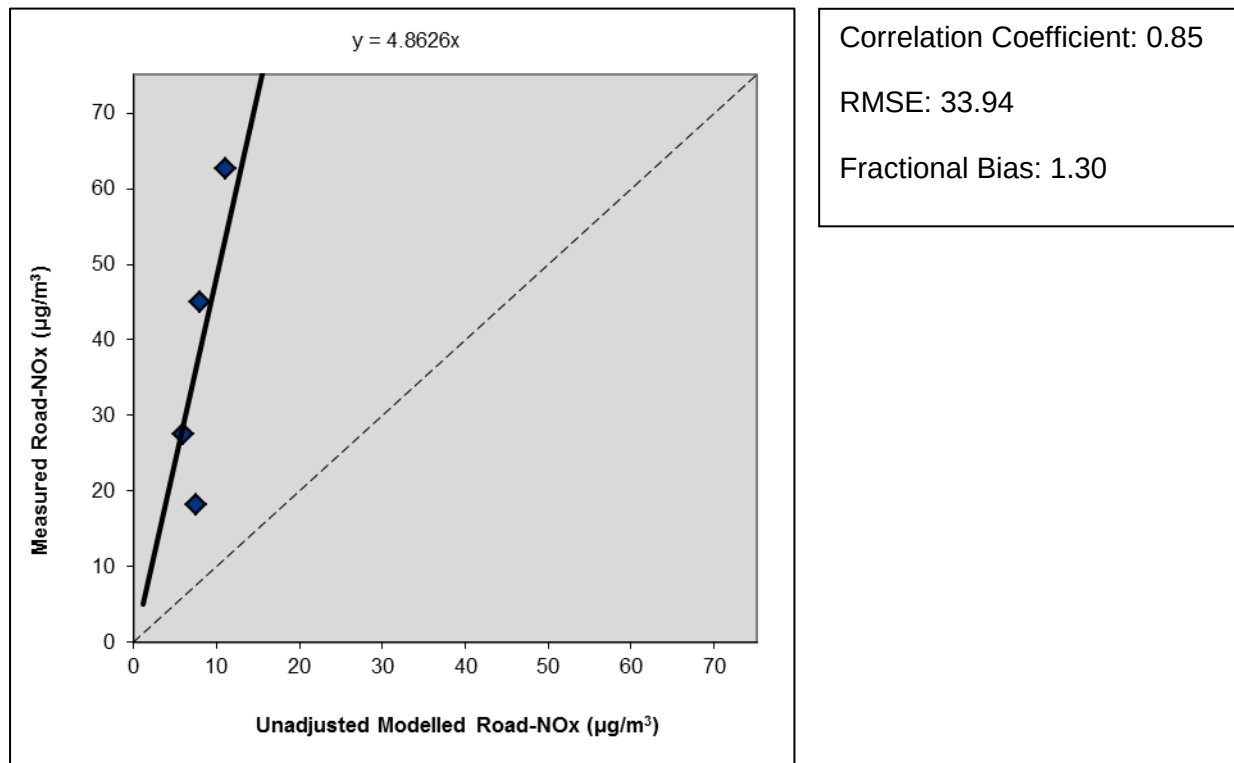
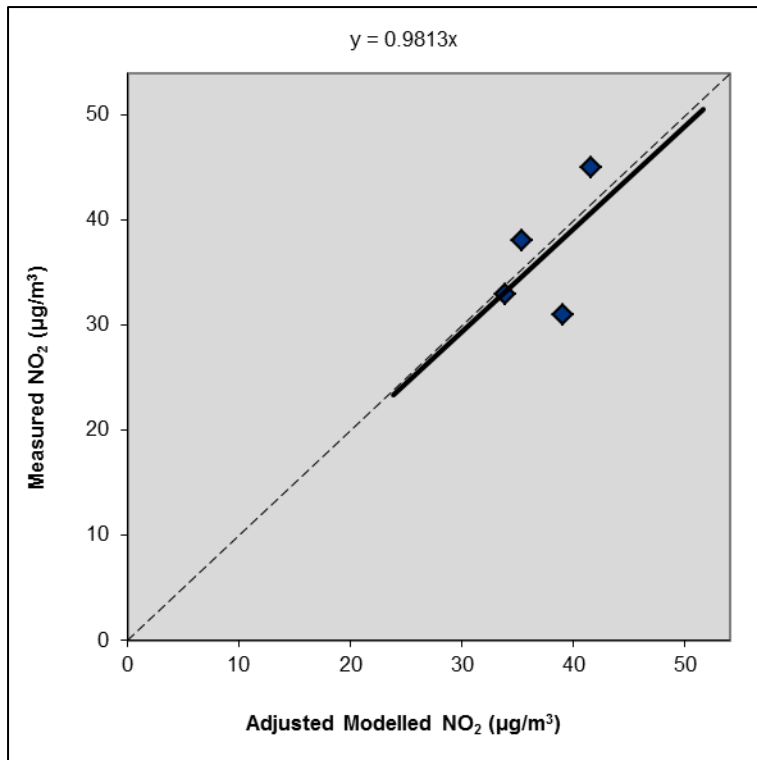


Figure 4: Comparison of Measured Road NO_x to Unadjusted Modelled Road NO_x Concentrations.

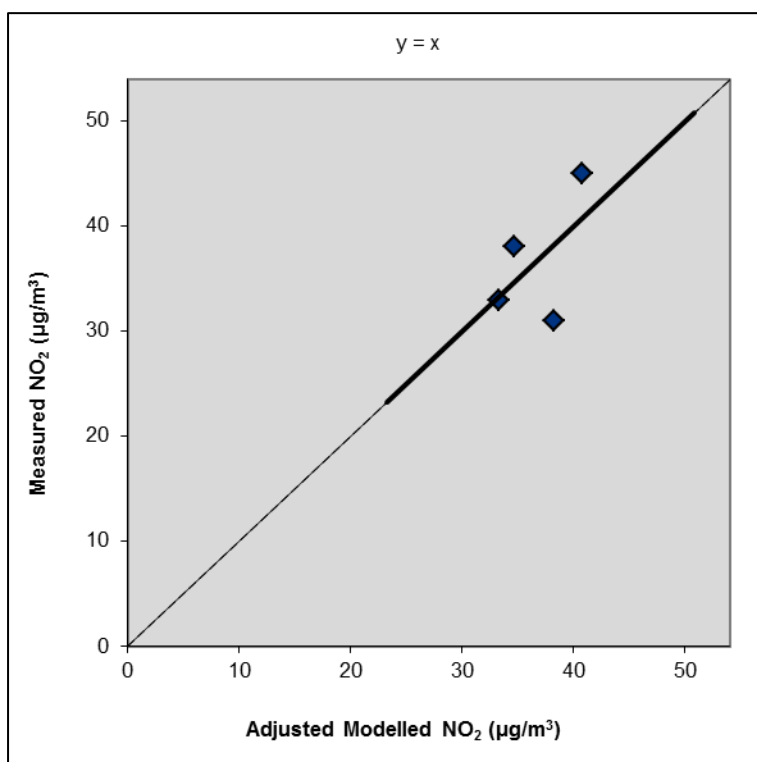


Correlation Coefficient: 0.55

RMSE: 4.56

Fractional Bias: -0.02

Figure 5: Comparison of Measured Total NO₂ to Primary Adjusted Modelled Total NO₂ Concentrations.



Correlation Coefficient: 0.55

RMSE: 4.51

Fractional Bias: 0.00

Figure 6: Comparison of Measured Total NO₂ to Final Adjusted Modelled Total NO₂ Concentrations.

The following primary and secondary adjustment factors have been applied to all modelled NO₂ data:

- Primary adjustment factor : 4.8626
- Secondary adjustment factor: 0.9813

The results imply that the model has under-predicted the road-NO_x contribution. This is a common experience with this and most other models. The final NO₂ adjustment is minor. **Figure 6** compares secondary adjusted total NO₂ at each of the monitoring sites, to measured NO₂, and shows a 1:1 relationship.

PM₁₀ and PM_{2.5}

PM₁₀ is measured at the Oxford Road automatic monitoring site and an adjustment factor for PM has been calculated as follows:

- Measured PM₁₀: 23 µg/m³
- 'Measured' road-PM₁₀ (measured – background at monitor): 23 – 16.0 = 7.0 µg/m³
- Modelled road-PM₁₀ = 0.6 µg/m³
- Road-PM adjustment factor: 7.0/0.6 = 11.4

Model Post-processing

Nitrogen Dioxide

The NO_x to NO₂ calculator v5.1 published by Defra (Defra, 2017b) has been used to convert the modelled, verified road-NO_x output for each receptor to road-NO₂. The background NO₂ concentrations have then been added to the predicted road-NO₂ concentrations to give the final predicted concentrations.

PM₁₀ and PM_{2.5}

The verified road-PM outputs need no further processing, and have been added to the background concentrations to give the final predicted concentrations.

A2 Professional Experience

Bob Thomas, BSc (Hons) PgDip MSc MEnvSc MIAQM CSci

Bob Thomas is a Director at AQA, with over nine years' experience in the field of air quality management and assessment. He has carried out air quality assessments for a wide range of developments, including residential, commercial, industrial, minerals and waste developments. He has been responsible for air quality projects that include ambient air quality monitoring of nitrogen dioxide, dust and PM₁₀, the assessment of nuisance odours and dust, and the preparation of Review and Assessment reports for local authorities. He has extensive dispersion modelling experience for road traffic, energy centre and industrial sources, and has completed many stand-alone reports and chapters for inclusion within an Environmental Statement. Bob has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers, architects and process operators, and has provided expert witness services at public inquiry. He is a Chartered Scientist, a Member of the Institute of Air Quality Management and a Member of the Institution of Environmental Sciences.

A full CV for Bob Thomas is available at <http://aqassessments.co.uk/about>