Aether

Air Quality Assessment for the proposed development at Between Towns Road, Oxford

Report to Cantay Estates Ltd

September 2019

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1 Introduction

Aether has been commissioned by Cantay Estates Ltd to undertake an air quality assessment for the proposed development of student accommodation (223 student beds) at Between Towns Road, Oxford. There will be no centralised on-site energy generation, and parking provision will be for operational (student drop-off) and disabled bays only.

The development falls within Oxford City Council, which suffers from elevated levels of air pollution, primarily due to high levels of traffic. It is therefore important to assess whether there will be an exceedance of the air quality objectives for particulate matter (PM_{10}) or nitrogen dioxide (NO_2) at the proposed site and then advise whether any action is required to reduce the residents' exposure to air pollution. The assessment utilises ADMS-Roads, a comprehensive dispersion modelling tool for investigating air pollution problems due to small networks of roads and industrial sources. In addition, a demolition and construction dust risk assessment has been undertaken.

The expected completion date of the proposed development is 2021. The assessment has therefore been completed for 2022, the expected first full year of occupation.

The primary assessment (**Sections 1 – 3**) relates to long term post-development impacts. **Section 4** considers short-term impacts due to the development construction phase.

1.1 The Location of the Development

The proposed development is located at the junction of Between Towns Road and St Luke's Road, Oxford (**Figure 1**).

Figure 1: Location of the development site

Source: OpenStreetMap contributors

1.2 Assessment Criteria

A summary of the air quality objectives relevant to the Between Towns Road development, as set out in the UK Air Quality Strategy[1], is presented in **Table 1** below.

Table 1: UK Air Quality Objectives for NO_2 and PM_{10}

Pollutant	Concentration	Measured as
Nitrogen Dioxide (NO_2)	40 µg/m^3	Annual mean
	200 µg/m^3	Hourly mean not to be exceeded more than 18 times per year (99.8th percentile)
Particulate Matter (PM_{10})	40 µg/m^3	Annual mean
	50 µg/m^3	24 hour mean not to be exceeded more than 35 times a year (90.4th percentile)

The oxides of nitrogen (NO_X) comprise principally of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a reddish brown gas (at sufficiently high concentrations) and occurs as a result of the oxidation of NO, which in turn originates from the combination of atmospheric nitrogen and oxygen during combustion processes. NO_2 can also form in the atmosphere due to a chemical reaction between NO and ozone (O_3). Health based standards for NO_X generally relate to NO_2, where acute and long-term exposure may adversely affect the respiratory system.

Particulate matter is a term used to describe all suspended solid matter, sometimes referred to as Total Suspended Particulate matter (TSP). Sources of particles in the air include road transport, power stations, quarrying, mining and agriculture. Chemical processes in the atmosphere can also lead to the formation of particles. Particulate matter with an aerodynamic diameter of less than 10 µm is the subject of health concerns because of its ability to penetrate deep within the lungs and is known in its abbreviated form as PM_{10}.

Further information on the health effects of air pollution can be found in the reports produced by the Committee on the Medical Effects of Air Pollutants[2].

As defined by the regulations, the air quality objectives for the protection of human health are applicable:

- Outside of buildings or other natural or man-made structures above or below ground
- Where members of the public are regularly present.

Using these definitions, the annual mean objectives will apply at locations where members of the public might be regularly exposed such as building façades of residential properties, schools and hospitals and will not apply at the building façades of offices or other places of work, where members of the public do not have regular access. The 24 hour objective will apply at all locations where the annual mean objective would apply together with hotels. Therefore in this assessment the annual mean and 24 hour mean

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland
[2] https://www.gov.uk/government/collections/comeap-reports

objectives will apply at all floors of the residential development. The hourly objective will apply at all locations where members of the public could reasonably be expected to spend that amount of time. Therefore, in this assessment the hourly objective will also apply at all levels of the development.

1.3 Local Air Quality Management

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met, the authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan (AQAP).

Oxford City Council has declared one AQMA[3] covering the whole City. This AQMA was declared in 2010 due to exceedances of the annual mean NO_2 objective. An AQAP[4] was published in 2006, which has since been updated for the current period 2013-2020.

1.4 The ADMS-Roads Method

Local air quality has been assessed using ADMS-Roads, a comprehensive dispersion model that can be used to predict concentrations of pollutants in the vicinity of roads and small industrial sources. The model has been used for many years in support of planning applications for new residential/commercial developments.

ADMS-Roads is able to provide an estimate of air quality both before and after development, taking into account important input data such as background pollutant concentrations, meteorological data, traffic flows and on-site energy generation (if applicable). The model output can be verified against local monitoring data to increase the accuracy of the predicted pollutant concentrations and this approach has been followed in this assessment.

The use of dispersion modelling enables estimates of concentrations to be made at varying heights. As a result, suggestions for appropriate mitigation measures can be made where necessary, taking into consideration the identification of worst-case locations.

The most recent version of ADMS-Roads (v4.1.1) was issued in January 2018 and requires the following information to assess the impact at sensitive receptor locations:

- **Setup:** General site details and modelling options to be used
- **Source:** Source dimensions and locations, release conditions, emissions
- **Meteorology:** hourly meteorological data
- **Background:** Background concentration data
- **Grids:** Type and size of grid for output
- **Output:** Output required and sources/groups to include in the calculations.

[3] https://uk-air.defra.gov.uk/aqma/details?aqma_ref=666
[4] https://www.oxford.gov.uk/downloads/download/133/air_quality_action_plan

2 Methodology

2.1 Local Pollutant Concentrations

It is good practice to include up-to-date local background pollutant concentrations in the assessment model, and also to verify modelled outputs against local monitoring data where available. This section provides an overview of the local data available for use in the assessment.

2.1.1 Local monitoring data

Oxford City Council has three automatic monitoring sites which monitor nitrogen dioxide (NO_2); particulate matter (PM_{10}) is also monitored at two of these sites. Unfortunately, none of these automatic monitoring sites lie within close proximity of the development. NO_2 concentrations are also measured passively at diffusion tube sites across the Borough. Three of these diffusion tube sites lie within 500 m of the development site. Details of these monitoring sites are given in **Table 2**.

Monitoring results have been taken from the Council's latest Annual Status Report (ASR)[5].

Table 2: Monitoring sites within 500 m of the Between Towns Road development

Site Name	Site Type	Pollutant(s)	Grid Reference	Distance to Kerb (m)	Approx. Distance to development site (m)
Templar Square	R	NO_2	454336, 203952	2	200
Oxford Rd / Between Towns Rd	R	NO_2	454472, 204246	2	140
Oxford Rd (Cowley) LP13	R	NO_2	454355, 204296	1	210

Note: R = roadside

The diffusion tubes were analysed by South Yorkshire Air Quality Samplers, who participate in the Proficiency scheme[6]. Whilst diffusion tubes provide an indicative estimate of pollutant concentrations, they tend to under or over read. The data is therefore corrected using a bias adjustment factor. There are two types of bias adjustment factor – local and national. The local factor is derived from co-locating diffusion tubes (usually in triplicate) with automatic monitors, whereas the national factor is obtained from the average bias from all local authorities using the same laboratory. Oxford City Council has applied a local bias adjustment factor (0.89) to their 2017 diffusion tube results.

Monitoring results are presented in **Table 3**. The data shows that the annual mean NO_2 objective was not exceeded at any of the monitoring sites between 2015 and 2017. Diffusion tubes do not provide information on hourly exceedances, but research[7] identified a relationship between the annual and 1 hour mean objective, such that

[5] https://www.oxford.gov.uk/downloads/20052/air_quality
[6] This is a national QA/QC scheme.
[7] As described in Box 5.2 of LAQM Technical Guidance (TG16).

exceedances of the latter were considered unlikely where the annual mean was below 60 µg/m³. Therefore, no exceedances of the hourly mean objectives are expected at the diffusion tube monitoring sites.

Table 3: Monitoring results for sites close to the proposed development site, 2015-2017

Objective	Site Name	2015	2016	2017
Annual mean NO_2 (µg/m³)	Templar Square	25	21	20
	Oxford Rd / Between Towns Rd	36	31	28
	Oxford Rd(Cowley) LP13	34	29	27

2.1.2 Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website[8] and data has been extracted for the Between Towns Road grid for this assessment. These 2017 baseline, 1 kilometre grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites.

The estimated mapped background NO_X, NO_2 and PM_{10} concentrations around the development site are 26.7 µg/m³, 18.1 µg/m³ and 16 µg/m³ respectively in 2017. For 2022 (the estimated first full year of occupation), the concentrations obtained for the same pollutants are 22.7 µg/m³, 15.8 µg/m³ and 15.2 µg/m³ respectively.

Due to the lack of a nearby urban background monitoring site, the 2017 mapped background concentrations have been used in this assessment. To provide a conservative estimate, the projected improvements in background air quality by 2022 have not been used in the dispersion modelling. This is in line with best practice to apply worst-case assumptions.

2.2 Model input data

Hourly meteorological data from Brize Norton for 2017 has been used in the model. The wind-rose diagram (**Figure 2**) presents this below.

[8] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Figure 2: Wind-rose diagram for Brize Norton meteorological data, 2017

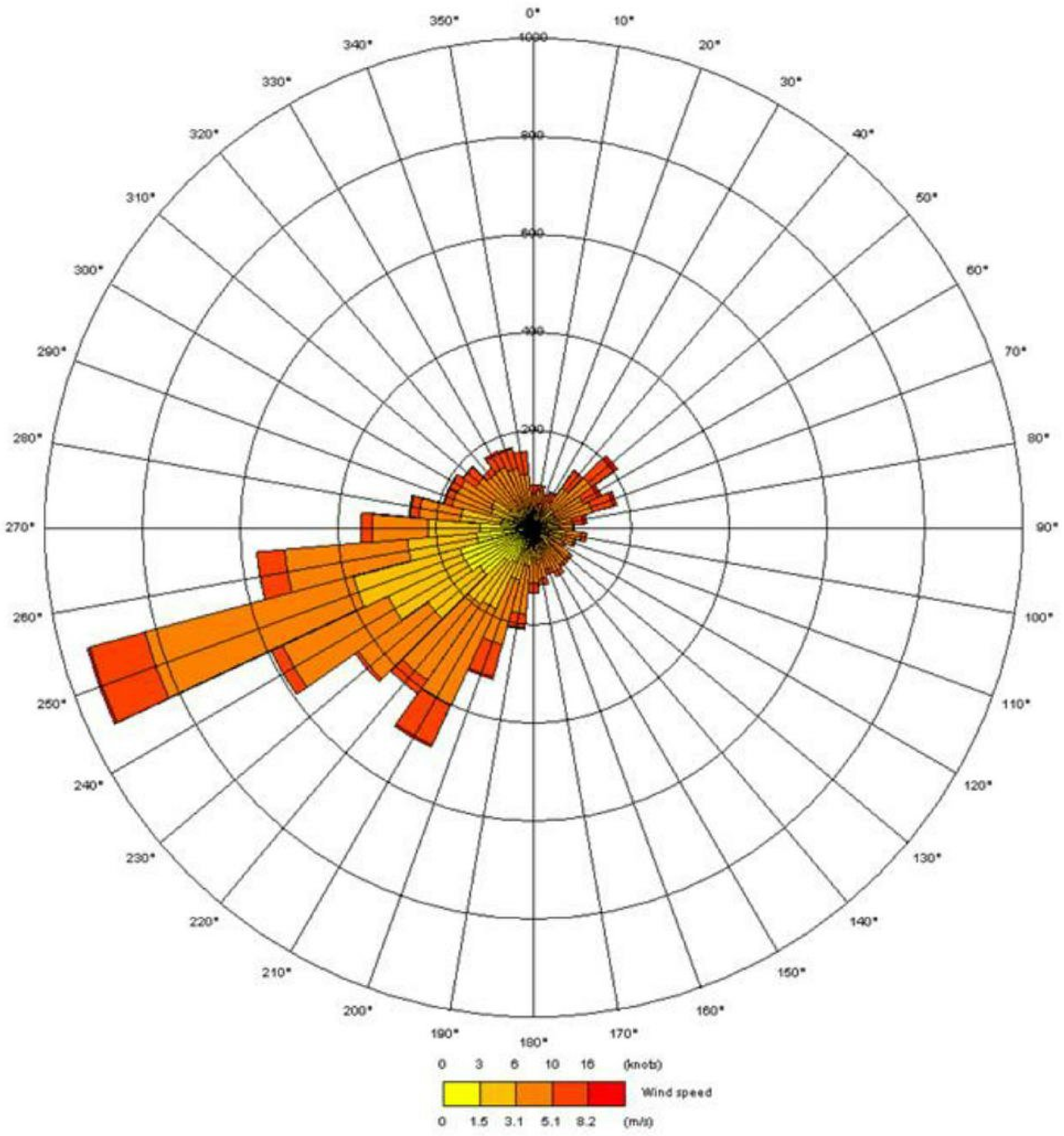
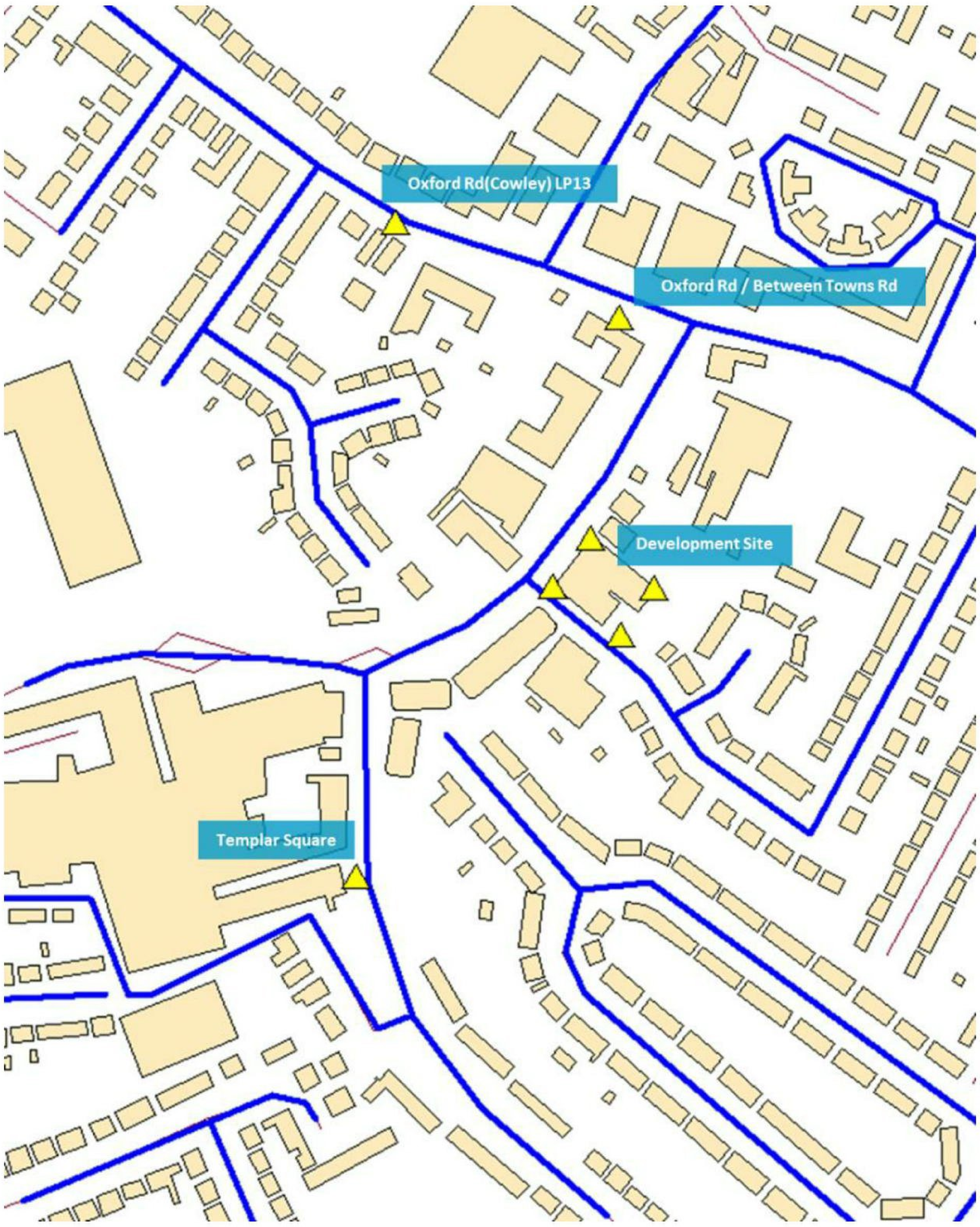


Figure 3: Road sources and receptors



Contains Ordnance Survey data © Crown copyright and database right [2019]

ArcMap software has been used to model the road source locations (blue lines) that are within 200 metres of the receptor locations (yellow triangles). This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in terms of the length of roads and distances between sources and receptors. This is shown in **Figure 3** above. It is assumed that the contribution of other sources to NO_2 and PM_{10} is included in the background concentrations.

Four sensitive receptor locations have been selected for the assessment:

- A: W corner of the development, located at the corner of Between Towns Road and St Luke's Road.
- B: N corner of the development, adjacent to Between Towns Road.
- C: E corner of the development, representing the drop off in pollutant concentrations with distance from the road(s).
- D: S corner of the development, adjacent to St Luke's Road.

These sites have been chosen to reflect the extremities of the site and their proximity to road traffic sources. The architect's plans (**Figure 4**) show the development site in more detail with receptor locations highlighted (blue circles). An assessment is made for the receptors at varying heights to assess likely concentrations across floor levels. It has been assumed that background concentrations remain constant at all heights of the development based on the 2017 City Air Quality at Height report[9]. Exposure has been assumed to be represented at the mid-point of each floor.

Figure 4: The location of the receptors used in the modelling

[9] http://www.wsp-pb.com/PageFilesn/80156/WSPPB%20City%20Air%20Quality%20at%20Height.pdf

2.3 Traffic data

Average annual daily traffic (AADT) count data for 2017 (the selected baseline year) has been obtained for Barns Road and Oxford Road (B480) from Oxford Traffic Counts[10]. AADT data for Between Towns Road (B4495) was only available for 2009 from Department for Transport (DfT) Traffic Counts[11], which provides data for major roads. Analysis of traffic data across central Oxford shows no obvious trend after 2009, so it was decided to maintain this value for use in the model, whilst acknowledging the introduction of additional uncertainty.

In the absence of any other data being available for the minor roads, estimates are based upon average values for an 'urban minor road, South East' from the DfT National Road Traffic Survey, 2017[12]. Therefore there will be uncertainty in the model input. All roads within 200 metres of the modelled receptors have been included in the assessment. The values are shown in Appendix B.

For the purpose of this assessment, the RTF[13] model has been utilised to project traffic growth. It has been assumed that traffic on local roads will increase by 5.2 % between 2017 and 2022.

The proposed development will include operational (student drop-off) and disabled parking bays only. The transport consultants have confirmed[14] that there will be negligible contribution to traffic generation as a result of the development. Results (**Section 3** of this report) therefore refer to concentrations modelled in 2022 regardless of whether the development takes place or not. As a result, the assessment and its conclusions are focused on the exposure of residents to currently elevated levels of pollutant concentrations, rather than assessing the impacts of the development per se.

An average speed of 16 kph has been assumed on all surrounding roads, based on morning peak journey time data in Oxford[15]. This provides a worst-case scenario, as it is the slowest time period reported, resulting in highest exhaust emissions.

2.4 Energy Statement

An energy statement[16] has been provided for this development, outlining that a combination of high efficient (ultra-low NO_X) gas fired boilers to provide space heating and domestic hot water (DHW) in conjunction with 40KWp of PV solar panels will be utilised in the scheme. The scheme has been completed in accordance with Oxford City Council policies. The scheme will have negligible impact on local air pollutant concentrations, and is not considered further in this report.

2.5 Conversion of NO_X to NO_2

Evidence shows that the proportion of primary NO_2 in vehicle exhaust has increased[17]. This means that the relationship between NO_X and NO_2 at the roadside has changed from that currently used in the ADMS model. A NO_X to NO_2 calculator (Published in April

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[10] https://www.oxfordshire.gov.uk/residents/roads-and-transport/traffic/transport-monitoring
[11] http://www.dft.gov.uk/traffic-counts
[12] http://www.dft.gov.uk/statistics/series/traffic/
[13] http://laqm.defra.gov.uk/documents/RTF-Automated-Traffic-Growth-Calculator-v3-1.xls
[14] Email communication, JD Highways, 2nd September 2019
[15] https://www.oxfordshire.gov.uk/residents/roads-and-transport/traffic/transport-monitoring
[16] Energy & Sustainability Statement, ERS Consultants, August 2019
[17] http://uk-air.defra.gov.uk/assets/documents/reports/aqeg/primary-no-trends.pdf

2019)[18] has therefore been developed and has been used in conjunction with the ADMS model to obtain a more accurate picture of NO_2 concentrations.

2.6 Model Verification

Model verification refers to checks that are carried out on model performance at a local level. This involves the comparison of predicted versus measured concentrations. Where there is a disparity, the first step is to check the input data and the model parameters in order to minimise the errors. If required, the second step will be to determine an appropriate adjustment factor that can be applied.

In the case of NO_2, the model should be verified for NO_X as the initial step and should be carried out separately for the background contribution and the source (i.e. road traffic). Once the NO_X has been verified and adjusted as necessary, a final check should be made against the measured NO_2 concentration.

For this project, modelled annual mean road-NO_X estimates were initially verified against the concentrations measured at the three diffusion tube sites (see **Appendix A**). These sites were selected because they represent the monitoring sites closest to the proposed development. After the first model run, the Templar Square site was removed from the verification site as an outlier. Further detail is provided on the reason for this in Appendix A.

The adjustment factor determined for annual mean NO_X concentrations was also applied to the modelled annual mean PM_{10} concentrations. This was done as no PM_{10} monitoring data that is representative of the development site is available, and this approach was considered more appropriate than not applying any adjustment[19].

[18] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc
[19] Paragraph 7.529 of LAQM TG(16)

3 Results

3.1 Results of the Dispersion Modelling

Table 4 below provides the estimated pollutant concentrations in the base year (2017) and the development year (2022). Given the inherent uncertainties in the modelling, background pollutant concentrations and vehicle fleet emission factors have been maintained at 2017 levels in the development year scenarios to provide a conservative estimate. Traffic growth has been predicted using the RTF calculator.

Table 4: Estimated pollutant concentrations in 2017 and 2022 (µg/m³)

Floor level	Receptor	Annual mean NO_2 concentration (µg /m³)		Annual mean PM_{10} concentration (µg /m³)		NO_2 Change	PM_{10} change
		2017	2022	2017	2022		
g	A	30.0	30.5	17.5	17.6	0.6	<0.1
	B	28.6	29.1	17.3	17.4	0.5	<0.1
	C	22.0	22.2	16.5	16.5	0.2	<0.1
	D	23.3	23.6	16.7	16.7	0.3	<0.1
1	A	25.8	26.2	17.0	17.0	0.4	<0.1
	B	25.6	25.9	16.9	17.0	0.4	<0.1
	C	21.7	21.9	16.5	16.5	0.2	<0.1
	D	22.1	22.3	16.5	16.5	0.2	<0.1
2	A	22.7	22.9	16.6	16.6	0.2	<0.1
	B	22.8	23.1	16.6	16.6	0.2	<0.1
	C	21.3	21.4	16.4	16.4	0.2	<0.1
	D	21.2	21.3	16.4	16.4	0.2	<0.1
3	A	21.1	21.3	16.4	16.4	0.1	<0.1
	B	21.2	21.4	16.4	16.4	0.2	<0.1
	C	20.7	20.8	16.3	16.3	0.1	<0.1
	D	20.5	20.7	16.3	16.3	0.1	<0.1
4	A	20.3	20.4	16.3	16.3	0.1	<0.1
	B	20.4	20.5	16.3	16.3	0.1	<0.1
	C	20.2	20.3	16.3	16.3	0.1	<0.1
	D	20.1	20.2	16.3	16.3	0.1	<0.1

Note: The changes in NO_2 and PM_{10} presented may not exactly equal the difference in the constituent parts shown due to rounding.

In the base year scenario, the model predicts annual mean NO_2 concentrations to be below (by 25 %) the annual mean objective at all locations. The worst-case location is identified as receptor A, at the corner of Between Towns Road and St Luke's Road, where roadside concentrations will be maximised.

The estimated annual mean NO_2 concentrations at the development site are reasonable when compared to the data collected at the two Oxford Road monitoring sites (Table 3). Although the traffic flows along Between Towns Road are expected to be just below those found at Cowley Road / Oxford Road, the proposed development is located close to the kerbside, where elevated concentrations can be expected.

The Guidance states that authorities may assume exceedances of the hourly mean objective are only likely to occur where annual mean concentrations are 60 $\mu g/m^3$ or above. Therefore, it is considered highly unlikely that this objective will be exceeded at any of the receptors.

The model has also been run for a future year scenario taking into account predicted general increases to traffic levels on local roads. The results indicate that annual mean NO_2 concentrations would increase by 0.6 $\mu g/m^3$ at worst-case locations.

The model estimates no exceedance against the annual mean PM_{10} objective. Potential exceedances of the daily mean PM_{10} objective can be estimated based on the annual mean[20], such that:

$$No. 24 - hour\ mean\ exceedances = -18.5 + 0.00145 \times Annual\ Mean^3 + \left(\frac{206}{Annual\ Mean}\right)$$

On this basis, it is estimated that in 2022 there will be one exceedance of the daily mean PM_{10} limit value, regardless of whether the development takes place or not. Therefore, the daily mean PM_{10} objective would be met as 35 exceedances of limit value are allowed per year.

3.2 Mitigation Measures

Based on the ADMS results, there is no specific requirement for mitigation, as concentrations are estimated to meet all of the objective levels.

However, it is widely acknowledged that there is no safe level of exposure to air pollution[21], and as such, the developer is encouraged to consider mitigation measures to reduce emissions arising from the site. The National Planning Policy Framework[22], requires new developments to support sustainable travel and air quality improvements. A key theme of the NPPF is that developments "should ensure that appropriate opportunities to promote sustainable transport can be – or have been taken up". It states that developments should be located and designed where practical to:

- Give priority to pedestrian and cycle movements and have access to high quality public transport facilities. *The site is served by good bus links and a high*

[20] Paragraph 7.92 of LAQM TG(16)
[21] https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution
[22] https://www.gov.uk/government/publications/national-planning-policy-framework--2 Published in July 2018

amount of cycling is expected due to the accommodation being provided for students.

- Incorporate facilities for charging plug-in and other ultra-low emission vehicles. *Limited car parking spaces will be provided and therefore this measure may not be appropriate.*
- A key tool to facilitate the above will be a Travel Plan. All developments which generate a significant amount of movement should be required to provide a Travel Plan. *This is not applicable to this development as the increase in traffic is thought to be negligible.*

Building on the NPPF, the Institute of Air Quality Management (IAQM) has provided guidance on the principles of good practice[23] which should be applied to all major development[24]. Examples of good practice include:

- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floor space. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made.
- Where the development generates significant additional traffic, a detailed travel plan should be implemented. *Not applicable*
- All gas-fired boilers to meet a minimum standard of < 40 mg NO_X/kWh. *The developer has confirmed adoption of highly efficient ultra-low NOx boilers.*
- *Not applicable:* All gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mg NO_X/Nm^3
  - Compression ignition engine: 400 mg NO_X/Nm^3
  - Gas turbine: 50 mg NO_X/Nm^3
- *Not applicable:* A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of:
  - Solid biomass boiler: 275 mg NO_X/Nm^3 and 25 mg PM/Nm^3

3.3 Mitigating the Impacts of the Construction Phase

Emissions and dust from the construction phase of a development can have a significant impact on local air quality. The IAQM has produced a document titled 'Guidance on the assessment of dust from demolition and construction'[25] published in May 2015. This guidance contains a methodology for determining the significance of construction developments on local air quality using a simple four step process:

- STEP 1: Screen the requirement for a more detailed assessment
- STEP 2: Assess the risk of dust impacts
- STEP 3: Determine any required site-specific mitigation
- STEP 4: Define post mitigation effects and their significance.

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[23] http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

[24] Major developments can be defined as developments where:
(1) The number of dwellings is 10 or above, (2) The residential development is carried out on a site of more than 0.5ha where the number of dwellings is unknown, (3) The provision of more than 1000 m^2 commercial floor space, (4) Development carried out on land of 1ha or more, (5) Developments which introduce new exposure into an area of existing poor air quality (e.g. an AQMA) should also be considered in this context.

[25] http://iaqm.co.uk/guidance/

A Dust Risk Assessment for the proposed development at Between Towns Road is presented in **Section 4**.

4 Demolition & Construction Dust Risk Assessment

Emissions and dust from the construction phase of a development can have a significant impact on local air quality. The Institute of Air Quality Management's (IAQM) Guidance on the Assessment of Dust from Demolition and Construction[26] contains a methodology for determining the significance of construction developments on local air quality. The assessment presented below has been produced in accordance with these guidelines.

The main air quality impacts that may arise during demolition and construction activities are:

- Dust deposition, resulting in the soiling of surfaces
- Visible dust plumes, which are evidence of dust emissions
- Elevated PM_{10} concentrations, as a result of dust generating activities on site
- An increase in concentrations of airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery) and vehicles accessing the site.

The risk of dust emissions from a demolition/construction site causing loss of amenity and/or ecological impacts is related to a number of factors, including: the activities being undertaken; the duration of these activities; the size of the site; the mitigation measures implemented and meteorological conditions. In addition, the proximity of receptors to the site and the sensitivity of these receptors to dust, impacts the level of risk from dust emissions. Receptors include both 'human receptors' and 'ecological receptors'. The former refers to a location where a person or property may experience adverse effects for airborne dust or dust soiling, or exposure to PM_{10}, over a time period relevant to the air quality objectives (see **Table 1**). Ecological receptors are defined as any sensitive habitat affected by dust soiling, through both direct and indirect effects. Details of the assessment procedure in accordance with the IAQM guidance, and the results of the demolition and construction management plan are detailed below.

STEP 1: Screen the requirement for a more detailed assessment

Due to the location of the development there is a large number of human receptors in the immediate surrounding area (see **Figure 5**). Therefore, an assessment is required to determine potential dust impacts. No ecological receptors are identified within 350 m of the development.

[26] http://iaqm.co.uk/guidance/

Figure 5: The location of the proposed development site and potential receptors within 350 m

STEP 2: Assess the risk of dust impacts

The risk of dusk arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts has been determined using the following risk factors: negligible, low, medium and high risk. The allocated risk category is based upon two factors, the scale and nature of the works (**Table 6**) and the sensitivity of the area to dust impacts (**Table 7**). These two factors are then combined to determine the risk of dust impacts with no mitigation applied, the results are summarised in **Table 8**.

Table 6: Dust Emission Magnitude

Activity	Dust Emission Magnitude	Justification
Demolition	Small	Total building volume < 20,000 m³ (10,483 m^3), construction material with low potential for dust release
Earthworks	Medium	Total site area 2,500 - 10,000 m² (3,144 m^2) moderately dusty soil type expected
Construction	Small	Total building volume < 25,000 m³ (10,483 m^3), construction material with low potential for dust release

Trackout	Medium	10 - 50 HDV outward movements in any one day, moderately dusty surface material, unpaved road length 50 -100 m length

Table 7: Defining the sensitivity of the area

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

Note: NA = not applicable

Table 8: Summary of the dust risk impacts for the proposed development

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

Note: NA = not applicable

STEP 3: Determine any required site-specific mitigation

Stage 2 identifies that the development is a **"Low Risk Site"** with respect to human health impacts for the earthworks and trackout phases. This is due to the low annual mean PM_{10} concentrations across the development site and the surrounding area.

Regarding the impacts from dust soiling, the development is a **"medium risk"** in terms of the earthworks phase. This is due to the development being in a residential area, with a nearby school. Following best practice measures will help to reduce the impact of the construction activities to an acceptable level. The development is considered **"low risk"** for dust soiling impacts from the demolition, construction and trackout phases.

Although the maximum construction-phase HDV movements are identified in the 10 – 50 AADT bracket, the more realistic daily impact of HDV movements will be < 30. This will also be short-term and therefore not worthy of further mitigation as part of the post-development AQA (**Section 3**)[27].

If an activity at the site results in unacceptable levels of dust being generated, then that activity should cease until sufficient measures have been adapted which prevent or minimise the dust emission. The implementation of such measures will be the responsibility of the site manager. In addition, the likelihood of concurrent dust generating activities on nearby sites should also be considered.

STEP 4: Define post mitigation effects and their significance

[27] The IAQM Land-Use Planning & Development Control: Planning For Air Quality identifies >25 AADT long-term impact for HDVs as criteria for further assessment.

Based upon consideration of the sensitivity and impact risk assessment completed for this development, the construction of the proposed development is not expected to cause a significant increase in pollution concentrations. Therefore, compliance with the mitigation measures outlined in the IAQM guidance for 'low risk' developments is considered sufficient to mitigate the potential impacts of construction on local air quality.

The mitigation measures specific to this development, that are designated as 'highly recommended' as outlined in the IAQM guidance, include:

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
- Ensure all vehicles switch off engines when stationary – no idling vehicles
- Avoid the use of diesel and petrol powered generators and use mains electricity or battery powered equipment where practicable
- Ensure an adequate water supply on the site. Water suppression should be used to damp down dust and other debris that could generate dust, and, where practical, manual or mechanical demolition techniques should be used.
- Ensure all loads entering and leaving the site to be covered.

5 Summary and Conclusions

An air quality assessment has been undertaken for a proposed residential development at Between Towns Road. Oxford City Council has declared one Air Quality Management Area (AQMA) due to the exceedance of the annual mean nitrogen dioxide (NO_2) objective. The proposed development falls within the AQMA.

A conservative approach with regards to expected improvements to air quality has been taken in that no improvement in the pollutant background concentrations or road transport emission factors has been assumed between the base year (2017) and the first year of occupation (2022). With expected improvements to the traffic fleet, improvements in pollutant concentrations may however materialise. This is in line with best practice to apply worst-case assumptions.

The ADMS-Roads dispersion model has been used to determine the impact of emissions from road traffic on sensitive receptors. Predicted concentrations have been compared with the air quality objectives. The results of the assessment indicate that annual mean NO_2 concentrations are below the objective in the base year scenario. Concentrations of particulate matter (PM_{10}) are also predicted to be below the annual mean objective in the base year scenario. Based on the evidence it is estimated that there will be no exceedances of either short term objective for NO_2 or PM_{10}. The future year scenario predicts NO_2 and PM_{10} concentrations to change by a maximum of 0.6 and < 0.1 µg/m^3, respectively. However, this is due to assumptions on future general traffic growth, as the development itself is expected to have a negligible impact on local traffic generation.

Therefore, no mitigation is required as the air quality objectives are predicted to be met. Instead, other measures such as providing secure and covered cycle storage and installing an electric charging points, should be considered to reduce the emissions arising from the development.

The energy scheme for the development consists of high efficiency boilers, domestic hot water and solar PV. The impacts of the scheme do not warrant inclusion in the assessment model.

In addition, assessment of the impact of the development during the construction phase has been undertaken and is presented in **Section 4**. The potential dust risk impacts for the development is classed as ‘low risk’. However, it is recommended that the developer consults the relevant IAQM guidance and develops a Dust Management Plan in order to mitigate the potential impacts of construction dust on local air quality.

Appendix A – Model Verification

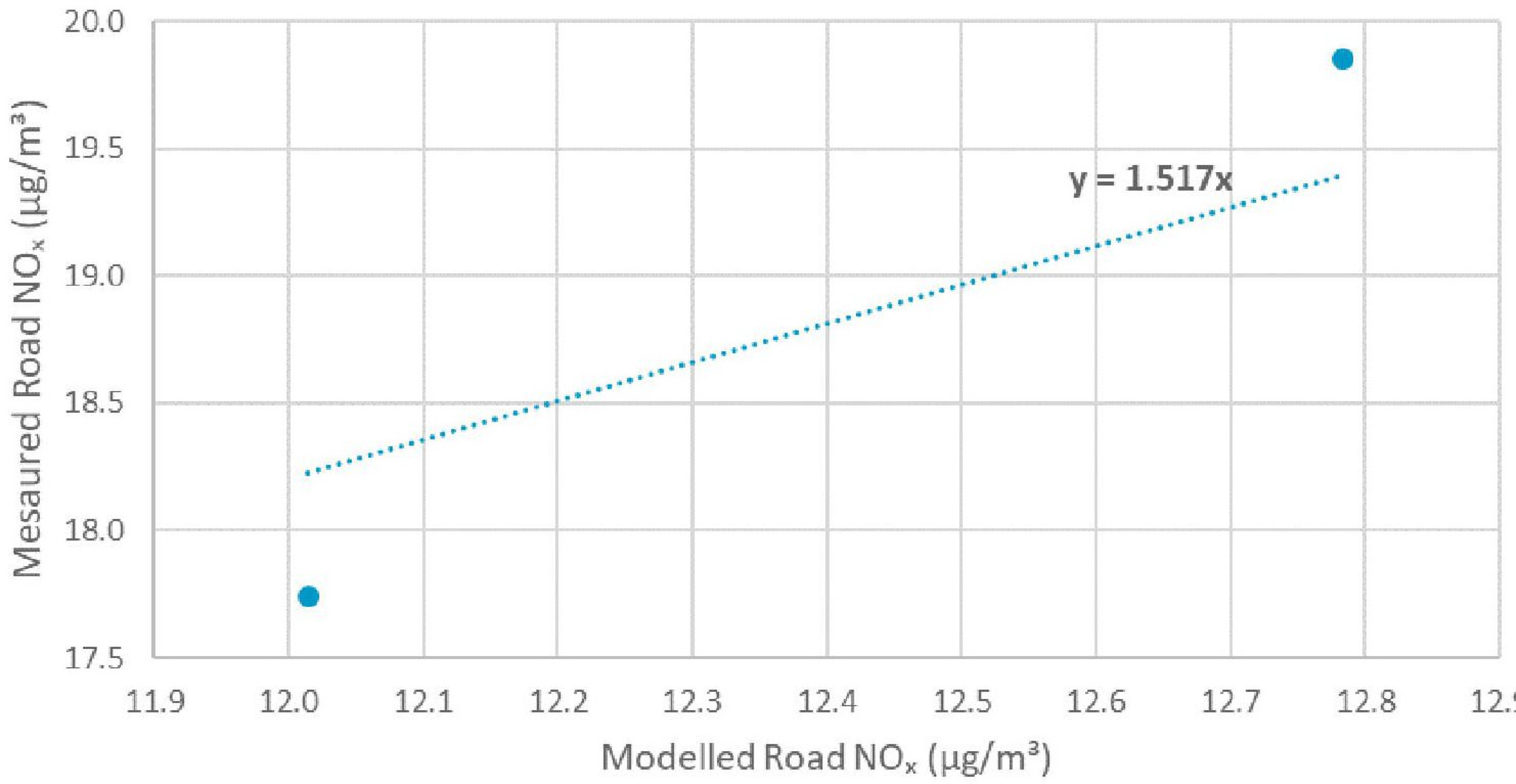
In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_X concentration during 2017 at the three diffusion tube sites described in **Table 2**. After the first model run, the Templar Square site was removed from the verification site as an outlier. This site gave a particularly low road-NO_X contribution in 2017, which is difficult to replicate in the model given the adjacent traffic flows. It is possible that specific characteristics at this site influence the pollutant concentrations, and it was deemed more reliable to remove this site from the model verification.

The model output of road-NO_X has been compared with the 'measured' road-NO_X. Measured NO_X for the monitoring sites was calculated using the NO_X to NO_2 calculator[18].

A primary adjustment factor was determined to convert between the 'measured' road contribution and the model derived road contribution (**Figure A.1**). This factor was then applied to the modelled road-NO_X concentration for each receptor to provide adjusted modelled road-NO_X concentrations. Total NO_2 concentrations were then determined by combining the adjusted modelled road-NO_X concentrations with the 2017 background NO_2 concentration.

The results imply that the model was under-predicting the road-NO_X contribution. This is a common experience with ADMS and most other models.

Figure A.1: Comparison of Measured road-NO_X to unadjusted modelled road-NO_X concentrations



RMSE

The root mean square error (RMSE) is used to define the average error or uncertainty of the model. The following RMSE value has been calculated:

NO_2: 3.1

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. In this case the model is being assessed against the annual mean objective, which is 40 µg/m^3 for NO_2. An RMSE value of less than 10 µg/m^3 is obtained and therefore the model behaviour is acceptable.

Appendix B – Traffic Data

Table B.1: Traffic data for 2017 (and prediction for 2022 without development)

Development/ verification site	Road links	Annual Average Daily Traffic (AADT)	% Heavy Duty Vehicles (HDV)	Speed (kph)
Development site	Between Towns Road B4495	14,392 (15,136)	2.8	16
	Minor roads	2,300 (2,419)	2.0	16
	Barns Rd	10,400 (10,938)	3.5	16
	Oxford Rd B480	18,700 (19,667)	3.5	16

Note: The development is not expected to result in any additional daily traffic

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