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Energy & Environment

# Oxford Traffic Filters Scheme Air Quality Modelling Report

Report for Oxfordshire County Council and Oxford City Council

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**Contact:**

Thomas Adams

Ricardo Energy & Environment

Gemini Building, Harwell, Didcot, OX11 0QR, United Kingdom

t: +44 (0) 1235 75 3517

e: Thomas.Adams@ricardo.com

Ricardo-AEA Ltd is certificated to ISO9001 and ISO14001

Authors:

Katherine Pugsley, Thomas Adams

Approved By:

Guy Hitchcock

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# Summary

The following report describes an atmospheric dispersion modelling study for nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$ and $PM_{2.5}$) in the area in and around the City of Oxford. The study uses annual model outputs to determine the current air quality situation in Oxford and assess the impact of the implementation of traffic filter scheme proposals which formed part of a pre-Experimental Traffic Regulation Order consultation (5th September to 13th October 2022).

The City of Oxford, like many other urban areas in the UK, has some locations where $NO_2$ concentrations are identified as at risk of exceeding (within 10% of) national and European air quality standards, particularly where there are high levels of road traffic. The current City of Oxford Air Quality Management Area (AQMA) covers a citywide area and was declared for $NO_2$ in 2010. The study area also includes Botley AQMA which covers an area encompassing a number of properties in Westminster Way, Coles Court, Stanley Close and along the Southern Bypass and was declared for $NO_2$ in 2008. In the city, $NO_2$ continues to be the pollutant of most concern, and transport is the most significant source of emissions of oxides of nitrogen (NOx). The most recent Air Quality Annual Status Report (ASR) reports that the transport sector accounts for 68% of NOx emissions in the city.

Oxford City Council has set its own voluntary target for a 30 µg/m$^3$ $NO_2$ annual mean to be achieved by 2025 at the latest going beyond the current 40 µg/m$^3$ legal target set out by the UK Government. This report has assessed the modelled concentrations against both the national and Oxford specific $NO_2$ limit values.

Oxfordshire County Council and Oxford City Council have committed to implementing a number of Transport Core Schemes which include the introduction of traffic filters, a Workplace Parking Levy (WPL) and an expanded Zero Emission Zone (ZEZ), together with improvements to bus services and cycle routes. The air quality modelling assessment presented in this report focuses on the impact of the implementation of the Traffic Filters Scheme using a 2024 implementation year as the date when the scheme is assumed to have been implemented by. Pollutant concentrations were assessed at roadside and other specified locations across the city that were determined to be relevant for the protection of human health.

The study shows that $NO_2$ concentrations are predicted to decrease along 76% of the assessed road links and at 91% of existing monitoring locations as a result of the Traffic Filters Scheme.

The maximum predicted decrease in $NO_2$ concentration at monitoring locations (8.17 µg/m$^3$) was observed at St Clement's. The location is no longer predicted to exceed the Oxford limit value as a result of implementation of the traffic filters.

A significant decrease (7.43 µg/m$^3$) in $NO_2$ concentration as a result of the scheme was also observed along the A420 (High Street / Headington Road). This location also showed the maximum decrease in $PM_{10}$ and $PM_{2.5}$ concentrations at roadside receptors as a result of scheme implementation.

All road links which show a predicted increase in $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations as a result of the scheme are located on road links outside of the city centre. These include the A34 Southern By-Pass Road / Botley Interchange, A4144 Woodstock Road / Wolvercote Roundabout, A4142 Eastern By-Pass Road and the A4142 Eastern By-Pass Road / Heyford Hill Roundabout. The scheme does not result in any exceedances of the national air quality objectives.

The scheme also provides a 6% decrease in annual $CO_2$ emissions associated with road transport in the city.

# 1 Introduction and outline modelling scope

The following report describes an atmospheric dispersion modelling study for nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$ and $PM_{2.5}$) in the area in and around the City of Oxford. The study uses annual model outputs to determine the current air quality situation in Oxford and assess of the impact of the implementation of traffic filter schemes.

## 1.1 Air quality in Oxford and background

The City of Oxford, like many other urban areas in the UK, has some locations where $NO_2$ concentrations are identified as at risk of exceeding (within 10% of) national and European air quality standards, particularly where there are high levels of road traffic. The current City of Oxford Air Quality Management Area (AQMA) covers a citywide area and was declared for $NO_2$ in 2010. The study area also includes Botley AQMA which covers an area encompassing a number of properties in Westminster Way, Coles Court, Stanley Close and along the Southern Bypass and was declared for $NO_2$ in 2008. In the city, $NO_2$ continues to be the pollutant of most concern, and transport is the most significant source of emissions of oxides of nitrogen (NOx). The most recent Air Quality Annual Status Report (ASR) reports that the transport sector accounts for 68% of NOx emissions in the city followed by domestic combustion (19%), combustion from industry and services (12%) and others: waste, agriculture, solvents, nature (<1%).

Oxfordshire County Council and Oxford City Council have committed to implementing a number of Transport Core Schemes which include the introduction of traffic filters, a Workplace Parking Levy (WPL) and an expanded Zero Emission Zone (ZEZ), together with improvements to bus services and cycle routes

The air quality modelling assessment presented in this report focuses on the impact of the implementation of the Traffic Filters Scheme which was subject to a pre-Experimental Traffic Regulation Order consultation from 5$^{th}$ September to 13$^{th}$ October 2022. The purpose of the traffic filters is to reduce traffic levels across the city, making cycling and walking more attractive and bus journeys faster and more reliable. When they are operating, private cars will not be allowed through the traffic filters without a permit. All other vehicles including buses, coaches, taxis, vans, mopeds, motorbikes and HGVs will be allowed at all times. Residents in Oxford and some areas just outside the city will be able to apply for a permit allowing them to drive through the traffic filters for up to 100 days per year. Automatic number plate recognition (ANPR) cameras will monitor the traffic filters.

Currently there are plans to implement six trial traffic filters across the city, three of these will be located in the city centre on St Cross Road, Thames Street and Hythe Bridge Street, and the remaining three filters will be located on St Clements, Marston Ferry Road and Hollow Way as shown in Figure 1-1. For more information see the Council's website.

**Figure 1-1 Location of Oxford traffic filters (shown as red circles)**

## 1.2 $NO_2$ sources and health impacts

Combustion of fossil fuels in power generation, industrial processes, domestic heating and vehicles, give rise to air pollutants including nitrogen oxides (NOx). The most recent Air Quality ASR reports that the transport sector accounts for 68% of NOx emissions in Oxford. NOx emissions include both primary emissions of $NO_2$ and NO, and secondary $NO_2$ which is produced from primary NO by chemical reactions in the atmosphere.

Air pollution is recognised as a contributing factor in the onset of heart disease and cancer. It particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often the less affluent areas[1,2]. In 2018, the Committee on the Medical Effects of Air Pollutants (COMEAP) provided an updated report on the association between long-term exposure to increased levels of $NO_2$ and mortality, which estimated that between 28,000 and 36,000 premature deaths in the UK could be linked to air pollution every year[3].

## 1.3 Particulate matter sources and health impacts

Emissions from power stations, industrial facilities and vehicles also contain particulate matter, PM. Particle pollution, also known as particulate matter or PM, is a general term for a mixture of solid and liquid droplets suspended in the air. Coarse particles with diameters generally larger than 2.5 µm and smaller than, or equal to, 10 µm in diameter are known as $PM_{10}$. $PM_{10}$ can irritate throat, nose and eyes. Fine particles (also known as $PM_{2.5}$) are particles generally 2.5 µm in diameter or smaller are more dangerous because they get to deeper parts of the lungs and into the blood system. The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[4]. The most recent Air Quality ASR reports that road transport accounts for 10% of $PM_{10}$ and $PM_{2.5}$ emissions in Oxford.

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010

[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

[3] Nitrogen dioxide: effects on mortality, https://www.gov.uk/government/publications/nitrogen-dioxide-effects-on-mortality

[4] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

# 2 Policy context

## 2.1 National and local policy background

The UK Clean Air Strategy[5] was updated in 2019. This sets out the national policy approach to air quality across the UK. The strategy sets out a series of air quality objectives which Local Authorities must work towards achieving. The UK air quality objectives have been derived from legally binding limit values set in EU legislation. An air quality objective is a date by which the relevant Standard should not be exceeded, these dates have now passed for all pollutants.

Council obligations in this regard are laid out in the Environment Act 1995 which set out a system called Local Air Quality Management (LAQM). Local authorities have a central role in achieving improvements in air quality. Their local knowledge and interaction with the communities that they serve mean that they are better able to know the issues on the ground in detail and the solutions that may be necessary or appropriate to the locality.

It should be noted that although the objectives are policy targets, all the UK objectives are at least as stringent as the European Limit Values for the various pollutants. The Limit Values carry legal standing and have been written into UK law through the various Air Quality Standards Regulations.

## 2.2 Air quality and planning policy

The UK Government's air quality policy guidance (PG16)[6] sets out the relationship between air quality management and planning for local authorities in England, excluding those in London who are provided guidance separately by the Mayor of London. Government advice is that air quality should be a consideration for large scale proposals, proposals in areas likely to be occupied by sensitive groups such as the elderly or young children, or areas likely to have cumulative effects. A study of air quality may be warranted, particularly for proposals which are likely to have a significant impact on air quality.

All impacts and their quantification should be included in an Impact Assessment, covering any wider economic, social and environmental implications. The Government has provided guidance for carrying out impact assessments, including specific advice in relation to air quality valuation.

## 2.3 National Planning Policy Framework

The National Planning Policy Framework was first published in March 2012 before being updated in July 2018 and most recently in February 2019[7]. It sets out the Government's planning policies for England and how these are expected to be applied.

Planning policies and decisions should aim to contribute towards compliance with the relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas 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.

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[5] Clean Air Strategy 2019, https://www.gov.uk/government/publications/clean-air-strategy-2019, Accessed 12-02-2020

[6] LAQM PG16, https://laqm.defra.gov.uk/documents/LAQM-PG16-April-16-v1.pdf, Accessed 12-02-2020

[7] National Planning Policy Framework, https://www.gov.uk/government/publications/national-planning-policy-framework--2, Accessed 12-02-2020

## 2.4 Environment Act 2021

The Environment Act 2021 establishes a legally binding duty on government to bring forward at least two new air quality targets in secondary legislation by 31 October 2022. This duty sits within the environmental target's framework outlined in the Environment Act (Part 1).

The proposed air quality targets for $PM_{2.5}$ are:

- Annual Mean Concentration Target ('concentration target') - a maximum concentration of 10 µg/$m^3$ to be met across England by 2040
- Population Exposure Reduction Target ('exposure target') - a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

# 3 Air Quality Standards and Guidelines

The objectives specified in the Clean Air Strategy mirror limit values required by EU Framework and Daughter Directives on Air Quality and have been transposed into UK law through the Air Quality Standards Regulations 2007. A more recent EU Directive 2008/50/EC consolidates the Framework and first three Daughter Directives, and this has been transposed into English law via the Air Quality (Standards) Regulations 2010.

Table 3.1 summarises the air quality objectives relevant to this study. For LAQM purposes, and for the assessment of air quality against the air quality objectives, personal exposure is also important. Therefore, predicted concentrations greater than the values listed at a given location do not necessarily indicate an exceedance of the Air Quality Objective. Rather, the predicted concentrations should be considered in the context of personal exposure, with consideration given to the types of locations where the Air Quality Objectives should apply (Table 3.2).

UK Local Authorities are required under the Environment Act 1995 to assess air quality in their areas on an annual basis against the air quality objectives; and are required to declare an Air Quality Management Area (AQMA) where they have identified that the air quality objectives are not being achieved.

Oxford City Council has set its own voluntary target for a 30 µg/m$^3$ $NO_2$ annual mean to be achieved by 2025 at the latest going beyond the current legal target set out by the UK Government. This report has assessed the modelled concentrations against both the National and Oxford specific $NO_2$ limit values (Table 3.1).

$PM_{2.5}$ concentrations have been assessed in terms of the National annual air quality objective (20 µg/m$^3$) and the maximum concentration of 10 µg/m$^3$ to be met across England by 2040 according to the Environment Act 2021 (Table 3.1).

$PM_{10}$ concentrations have been assessed in terms of the National annual air quality objective (40 µg/m$^3$).

**Table 3.1: UK National Air Quality Objectives and additional limit values and concentration targets**

| Pollutant | Concentration | Measured as |
|---|---|---|
| Nitrogen dioxide ($NO_2$) | 200 µg/m$^3$ not to be exceeded more than 18 times a year; equivalent to a 99.8$^{th}$ percentile of hourly means not exceeding 200 µg/m$^3$ | 1-hour mean |
| | 40 µg/m$^3$ | Annual mean |
| | 30 µg/m$^3$ (Oxford specific $NO_2$ limit value) | Annual mean |
| Particles ($PM_{10}$) | 50 µg/m$^3$ not to be exceeded more than 35 times a year | 24-hour mean |
| | 40 µg/m$^3$ | Annual mean |
| Particles ($PM_{2.5}$) | 20 µg/m$^3$ | Annual mean |
| | 10 µg/m$^3$ (Environment Act 2021 concentration target) | Annual mean |

**Table 3.2: Relevant receptors for Air Quality Objectives**

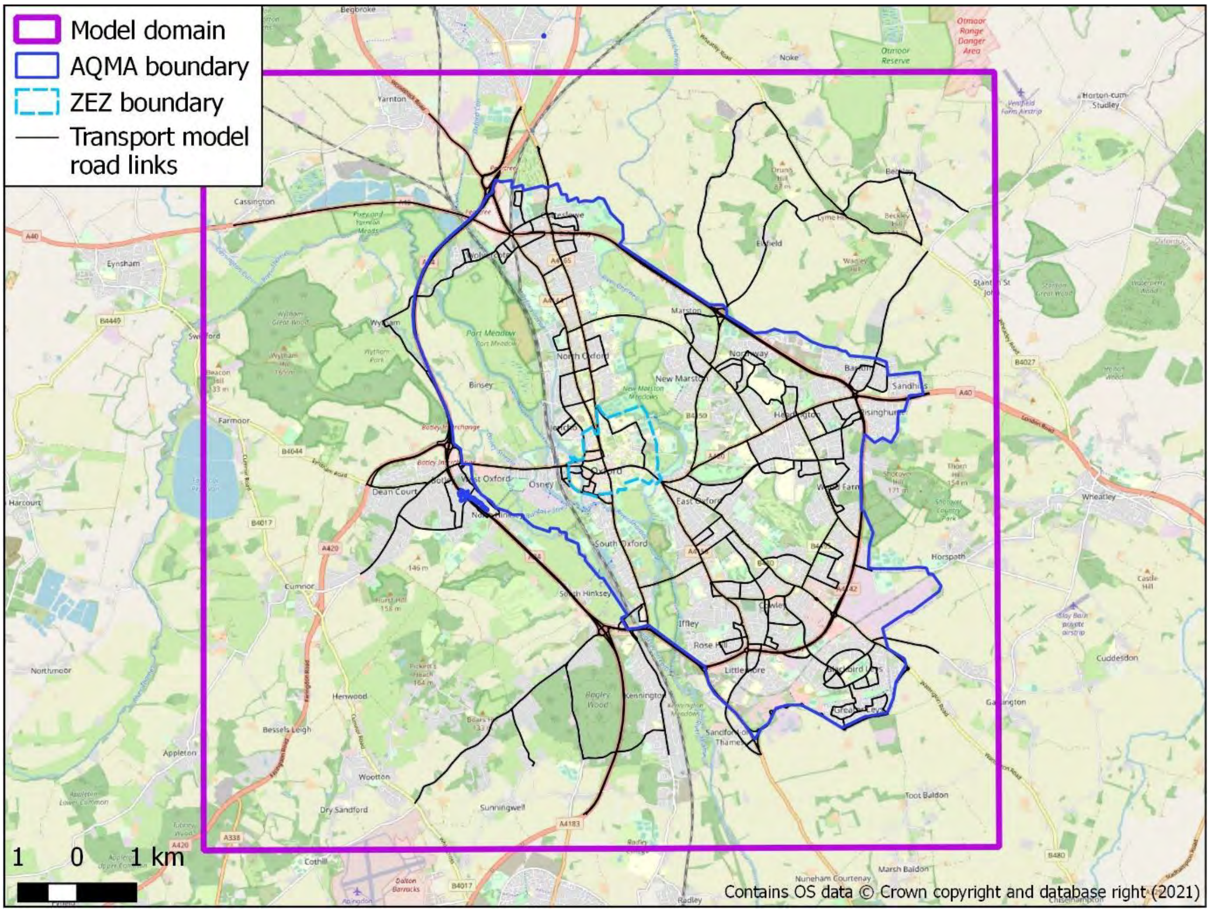
| Averaging period | Objectives should apply at: | Objectives should not generally apply at: |
|---|---|---|
| Annual mean | All locations where members of the public might be regularly exposed.<br>Building façades of residential properties, schools, hospitals, care homes etc. | Building facades of offices or other places of work where members of the public do not have regular access.<br>Hotels, unless people live there as their permanent residence.<br>Gardens of residential properties.<br>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 objectives apply, together with hotels and gardens of residential properties, and:<br>Kerbside sites (for example, pavements of busy shopping streets).<br>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.<br>Any outdoor locations where members of the public might reasonably be expected to spend one hour or longer. | Kerbside sites where the public would not be expected to have regular access. |

# 4 Method statement

## 4.1 Study area

To assess the transport and air quality impacts of the Traffic Filter Scheme, a model domain (Figure 4-1) was selected that incorporated the traffic filter locations, the City of Oxford AQMA and Botley AQMA including the main areas of concern identified in the national modelling assessment within the city-centre and possible diversion routes as a result of scheme implementation.

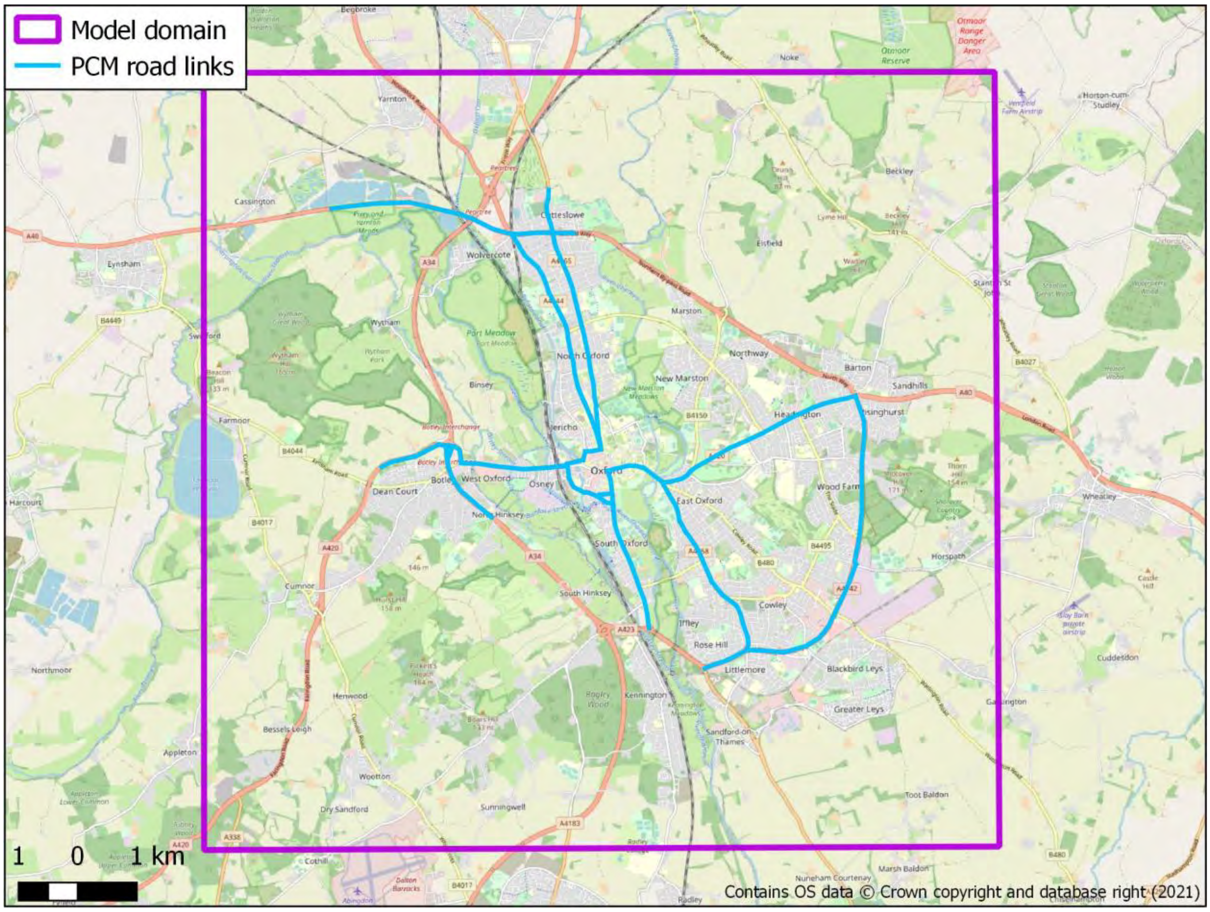
**Figure 4-1 The model domain (area within purple rectangle)**




The core air quality model domain includes the City of Oxford AQMA and extends beyond the city boundary to include feeder roads to the outer ring road.

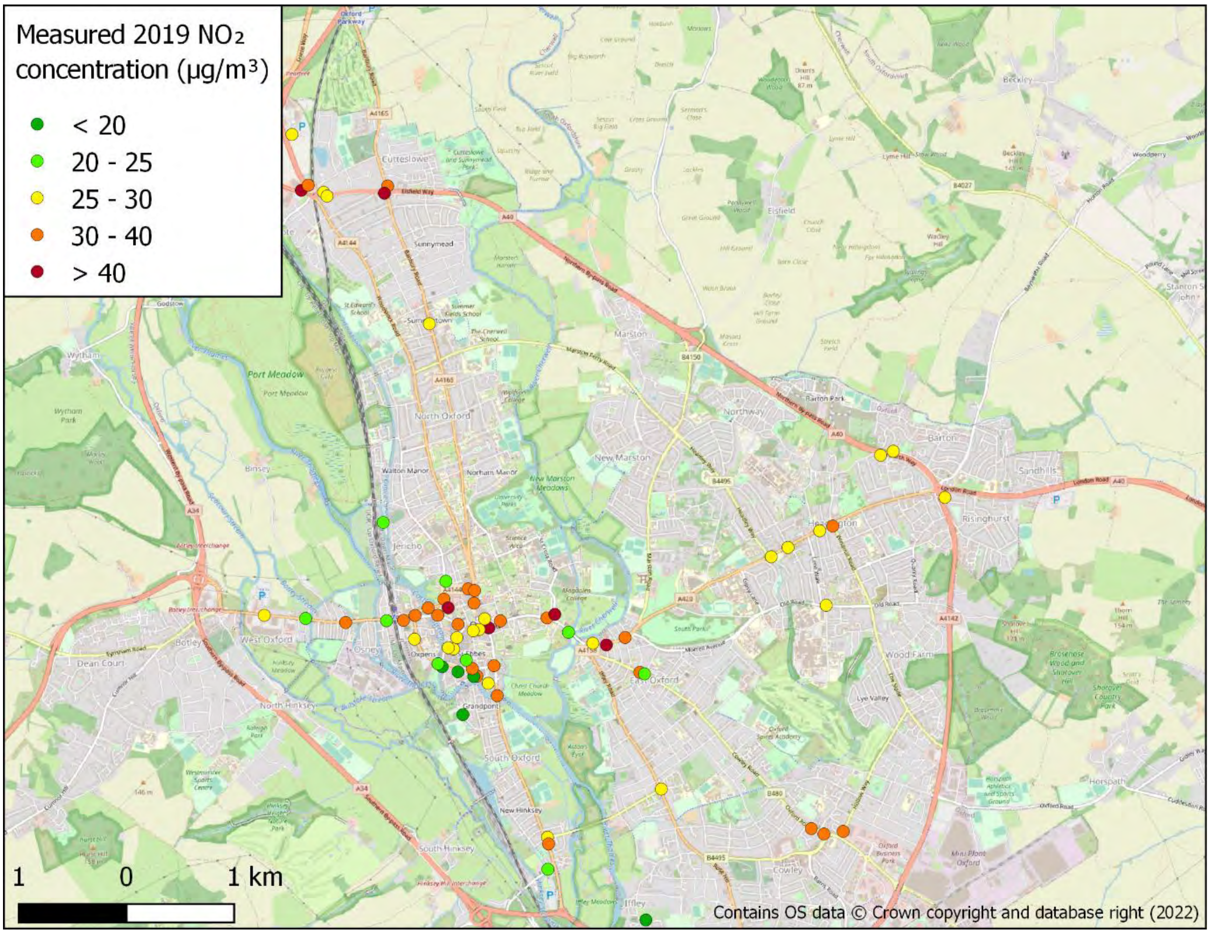
A map showing the model domain relative to roads included in the Government's national Pollution Climate Mapping (PCM) model is presented in Figure 4-2. All road links in the PCM model within the Oxford City boundary were included in the model domain specification. The PCM model is used by the Government as part of its evidence base when reporting compliance against the EU air quality standards and it is therefore useful to consider results specific to these road links as part of the assessment.

**Figure 4-2 PCM model road links within the model domain (area within purple rectangle)**




Oxford City Council's 2019 $NO_2$ measurements were applied to the air quality modelling assessment in order to verify the model outputs. Measurements were applied from 74 monitoring sites which were confirmed as having sufficient data capture for the 2019 base year. A map showing the sites at which $NO_2$ concentrations were measured during 2019 is presented in Figure 4-3, with a majority of these being located in and around the city centre and on the main radial routes in the city.

**Figure 4-3 Oxford City Council's $NO_2$ monitoring sites 2019. The site marker colours correspond to the $NO_2$ concentrations measured at the site in 2019.**




## 4.2 Modelling years

This report presents air quality modelling results for the historic base year and future implementation modelling year scenarios, as set out in Table 4.1 below. A 2019 base year was applied as this allows the use of the most up to date pre-COVID air quality and transport data.

**Table 4.1: Model years**

| Year | Description |
|---|---|
| 2019 | **Base year** – using latest available data on air quality and traffic |
| 2024 | **Implementation year** – date when the scheme is assumed to have been implemented by |

## 4.3 Background concentrations

The primary cause of the localised air pollution problems in Oxford are related to emissions from vehicle traffic and as such the focus of the modelling study is road traffic emissions. Emissions from sources not included in the model were provided by the most recent 2018-based LAQM background maps[8] used to provide background concentrations for this study.

## 4.4 Air dispersion modelling methodology

### 4.4.1 Model selection

The RapidAIR© Urban Air Quality Modelling Platform was used to predict air pollutant concentrations for this study. This is Ricardo Energy & Environment's proprietary modelling system developed for urban air pollution assessment.

RapidAIR has been developed to provide graphic and numerical outputs which are comparable with other models used widely in the United Kingdom. The model approach is based on loose coupling of three elements:

- Road traffic emissions model conducted using fleet specific COPERT 5 (via the Defra EfT) algorithms to prepare grams/kilometre/second (g/km/s) emission rates of air pollutants originating from traffic sources.
- Convolution of an emissions grid with dispersion kernels derived from the USEPA AERMOD[9] model, at resolutions ranging from 1 m to 20 m. AERMOD provides the algorithms which govern the dispersion of the emissions and is an accepted international model for road traffic studies.
- The kernel based RapidAIR model running in GIS software to prepare dispersion fields of concentration for further analysis with a set of decision support tools coded in Python/arcpy.

RapidAIR includes an automated meteorological processor based on AERMET which obtains and processes meteorological data of a format suitable for use in AERMOD. Surface meteorological data is obtained from the NOAA online repository[10] and upper air data is downloaded from the NOAA Radiosonde database[11].

The model produces high resolution concentration fields at the city scale (down to a 1 m scale) so is ideal for spatially detailed compliance modelling. The combination of an internationally recognised model code and careful parameterisation matching international best practice makes RapidAIR ideal for this study. A validation study has been conducted in London using the same datasets as the 2011 Defra air quality model inter-comparison study[12]. Using the LAEI (London Atmospheric Emissions Inventory) 2008 data and the measurements for the same time period the model performance is consistent (and across some metrics performs better) than other modelling solutions currently in use in

[8] Background Mapping data for local authorities - 2018, https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

[9] https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod

[10] ftp://ftp.ncdc.noaa.gov/pub/data/noaa

[11] https://www.esrl.noaa.gov/roabs/

[12] https://uk-air.defra.gov.uk/research/air-quality-modelling?view=intercomparison

the UK.[13] This validation study has been published in *Environmental Modelling and Software*, in partnership with the University of Strathclyde[14].

### 4.4.2 Meteorology

RapidAIR includes an automated meteorological processor based on AERMET which obtains and processes meteorological data of a format suitable for use in AERMOD. Surface meteorological data is obtained from the NOAA online repository[15] and upper air data is downloaded from the NOAA Radiosonde database[16].

For this study, 2019 surface meteorological data was obtained from three stations (High Wycombe, Little Rissington and Benson) and upper air meteorological data was obtained from two stations (Cambourne and Herstmonceux). RapidMet was used to carry out data filling where necessary according to the methodology provided by the USEPA in their “Meteorological Monitoring Guidance for Regulatory Modelling Applications” guidance document[17]. Data gaps from the primary meteorological stations (High Wycombe and Cambourne) are first filled using data from the other nearby stations (Little Rissington and Benson for surface stations, and Herstmonceux for the upper air station). Remaining data gaps were filled based on the persistence method, where a missing value is replaced by the use of data from the previous hour(s), for data gaps up to and including three hours.

### 4.4.3 Canyon modelling

The presence of buildings either side of a road can introduce ‘street canyon’ effects which result in pollutants becoming trapped, leading to increased pollutant concentrations. There are canyon effects present in Oxford, highlighted in Figure 4-4, which may be contributing to air quality issues in the study area.

Street canyon impacts were modelled using the RapidAIR canyon module. Building heights were obtained from Ordnance Survey MasterMap Topography Layer data.

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[13] The 2008 LAEI dataset was used in this context as a benchmarking study, to compare the performance of RapidAIR to other modelling systems. The 2008 LAEI dataset was not used as an input in the current modelling study.

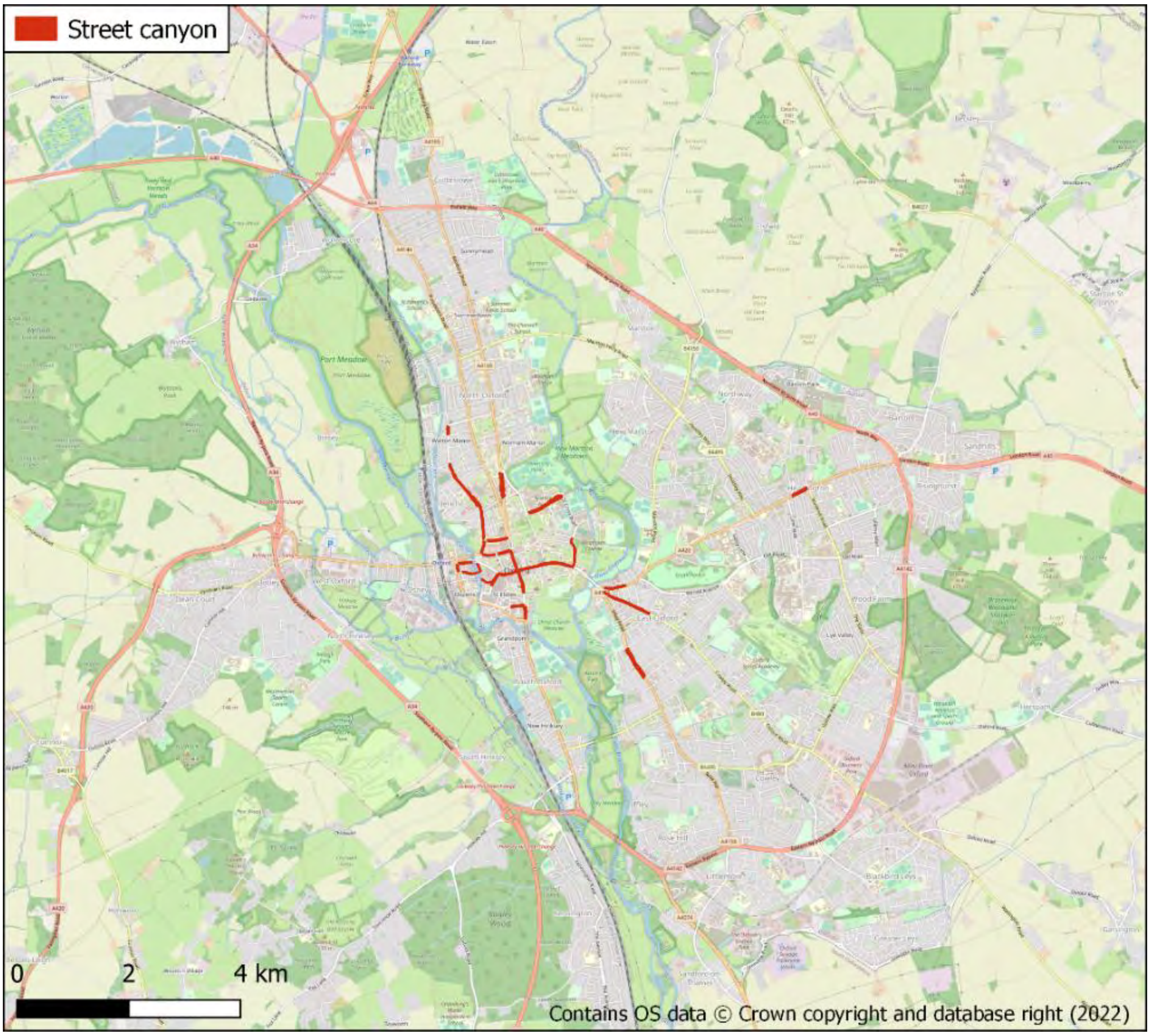
[14] Masey, Nicola, Scott Hamilton, and Iain J. Beverland. "Development and evaluation of the RapidAIR® dispersion model, including the use of geospatial surrogates to represent street canyon effects." *Environmental Modelling & Software* (2018). DOI: https://doi.org/10.1016/j.envsoft.2018.05.014

[15] ftp://ftp.ncdc.noaa.gov/pub/data/noaa

[16] https://www.esrl.noaa.gov/roabs/

[17] United States Environmental Protection Agency, “Meteorological Monitoring Guidance for Regulatory Modelling Applications” available via https://www3.epa.gov/scram001/guidance/met/mmgrma.pdf, accessed June 2017.

**Figure 4-4 Modelled street canyons in Oxford**




### 4.4.4 Road gradients

Gradient effects were included in the modelling, based on elevation data from the Environment Agency's open data Light Detection and Ranging (LIDAR) Digital Terrain Model (DTM)[18] and Digital Surface Model (DSM)[19] and where this was unavailable, Google Earth.[20]

Gradients were included in the model for all modelled road links. All road links were modelled at ground level in order to provide a conservative estimate of ground level concentrations; roads above ground will have a reduced impact on ground level concentrations due to elevation of the plume centreline.

[18] LIDAR Composite DTM 2020 - 1m, https://data.gov.uk/dataset/b1ff0a9c-74d3-4b97-a3fb-c8ab39ef6152/lidar-composite-dtm-2020-1m

[19] LIDAR Composite DSM 2017 - 1m, https://data.gov.uk/dataset/80c522cc-e0bf-4466-8409-57a04c456197/lidar-composite-dsm-2017-1m

[20] Google Earth, https://earth.google.com/web/

### 4.4.5 Air quality model receptor locations

Oxford has a wide network of monitoring locations comprised of passive diffusion tube samplers and automatic analysers (Figure 4-3). All available $NO_2$ measurements conducted in 2019 have been specified as receptors in the model; and where relevant, used for model verification and calculating model performance statistics. The monitoring locations in Oxford are located at a height of 3 m. Therefore, the model validation was undertaken at a height of 3 m to provide an accurate comparison and evaluation of model performance at the measurement stations. A set of gridded results with a resolution 1 m × 1 m was provided across the entire domain.

### 4.4.6 Traffic activity and speed data

Annual average daily traffic (AADT) flows and 24-hour average speeds for each modelled road link were sourced from the local traffic model data provided by Atkins. A typical UK weekday traffic flow diurnal profile[21] from the Department for Transport statistics was assumed and applied as time varying emissions in AERMOD when creating the RapidAIR dispersion kernel.

### 4.4.7 Vehicle fleet composition

Vehicle emission factors for NOx were obtained from COPERT v5 emission functions. Link specific emission factors were calculated with Ricardo's in-house emission calculation tool RapidEMS, which links directly to our RapidAIR dispersion modelling system. The input for RapidEMS consists of a basic fleet split based on vehicle categories (diesel cars, petrol cars, LGVs, articulated HGVs, rigid HGVs, and buses) according to the traffic activity information described in Section 4.4.6. RapidEMS is used to provide a more detailed parameterization of vehicle fleets in 2019, including all vehicles up to and including Euro 6/VI. PM and $CO_2$ emissions were calculated using the latest version (v11.0) of the Defra Emissions Factors Toolkit (EFT).[22]

The traffic model data provided vehicle flows for cars, HGVs, LGVs and buses. A further breakdown of the HGVs into rigid and articulated categories was conducted using local ANPR data to create a percentage of each for the whole study domain.

Ricardo were provided with 24 Excel files containing ANPR data recorded at 12 sites in Oxford city centre on the 24th and 25th April 2019. The data were processed to inform the fleet split and average number of unique daily vehicles visiting the city centre for each of the ZEZ charging bands. The data were also used to provide the fuel type and Euro standard split for each vehicle type.

The ANPR data were also used to identify the number of taxis (passenger cars and black cabs) present in the fleet and subsequently separate out the proportion of cars included in the traffic model that were attributed to taxis.

Emission calculations for each vehicle category were based on vehicle age split by Euro classification. Information on the baseline Euro standard mix (traffic composition & age) was collected during the ANPR surveys. An average distribution of Euro classifications calculated from the complete ANPR dataset was applied across the entire model domain. An assessment of the ANPR data suggested that for both light and heavy-duty vehicles, the Euro class distribution was reasonably consistent across the survey locations. Based on this, a common distribution of fuel types and Euro classifications was used across the whole model domain for each vehicle type.

[21] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801205/tra0307.ods

[22] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

### 4.4.8 NOx/$NO_2$ emissions assumptions

NOx to $NO_2$ chemistry was modelled using the Defra NOx to $NO_2$ calculator (v8.1)[23]. Modelled annual mean road NOx concentrations were combined with background NOx concentrations at each discrete receptor to calculate $NO_2$ annual mean concentrations.

Where $NO_2$ concentration maps were required, total $NO_2$ was derived from background and road NOx concentrations using a specific polynomial equation.

[23] NOx to NO2 Calculator. https://laqm.defra.gov.uk/air-quality/air-quality-assessment/nox-to-no2-calculator/

# 5 Projected future year scenario modelling

There were three projected future year scenarios modelled, these were:

- 2024 Do Minimum (without Traffic Filters)
- 2024 Do Something (Traffic Filters)
- 2024 Do Nothing – only used to inform the Habitats Regulations Assessment see Section 6.3.

The setup of each of these scenarios is detailed in Section 5.1 and 5.2.

## 5.1 Road transport future year baseline

As discussed in Section 4.2, all future year scenarios were modelled for 2024. Table 5.1 includes a description of the differences relative to the 2019 base year model.

**Table 5.1 Description of changes to future year scenarios**

| Change | Description |
|---|---|
| **AADT for future years** | Total AADT flows for the four vehicle classes were provided for each future scenario by Atkins from the Oxfordshire Strategic Transport Model (OSM). The same methodology for separating the car and taxi traffic flows was applied as for the 2019 base year (Section 4.4.6). |
| **Projected fleet split (vehicle type)** | All future year scenarios have scenario specific vehicle fleet splits for each traffic model link, using the same categories as provided in the 2019 base year traffic model. The NAEI[24] was again used to separate HGV flows into articulated and rigid and cars by their fuel type. The disaggregation of flows among more detailed vehicle categories is explained in Section 4.4.7 for the base year. The number of electric cars and LGVs were informed by future battery electric vehicle (BEV) projections published by the Committee on Climate Change (CCC)[25]. The number of zero emission buses in the Do Something scenario (69% of the bus fleet) were informed by projections from the OCC Zero Emission Bus Regional Areas (ZEBRA) scheme. |
| **Projected fleet age composition (Euro class)** | The 2019 fleet age compositions informed by ANPR data were projected forward to 2024 in line with national NAEI and CCC data. The conventional bus fleets were predicted to be 100% Euro VI in line with expectations for the OCC ZEBRA scheme. |
| **Future year scenarios average vehicle speed data** | Average link speeds for all future year scenarios were provided by the Atkins traffic model. |

[24] https://naei.beis.gov.uk/data/ef-transport

[25] https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Surface-transport.pdf

| Change | Description |
|---|---|
| **Projected vehicle emission rates** | NOx emission rates were calculated by applying the latest COPERT v5 emission functions to the projected average flows, average speeds, fleet, and vehicle age composition for the future year being modelled.<br><br>PM and $CO_2$ emissions were calculated using the latest version (v11.0) of the Defra Emissions Factors Toolkit (EFT).[26] |

## 5.2 Non-road transport projections

Background concentrations were provided for the 2024 model scenarios using the relevant future year LAQM background maps. The relevant road traffic sector contributions were again discounted to avoid double counting of emissions, as for the 2019 base year.

[26] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/

# 6 Assessment of air quality related to human health

## 6.1 Model verification and adjustment

Ratified $NO_2$ measurements from 74 monitoring locations were used for the model verification.

RapidAIR was used to generate a map of NOx concentrations arising from road traffic sources across the study area at a 1 m x 1 m resolution, based on the traffic activity data from the 2019 base year scenario (Section 4.4.6) and 2019 meteorological data (Section 4.4.2). Background NOx values for 2019 were obtained from the background maps available on the LAQM website (Section 4.3). The most up to date background maps used a 2018 base year[27].

It was appropriate to verify the RapidAIR model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + $NO_2$). The model output of Road NOx (the total NOx originating from road traffic) was compared to the measured Road NOx, where the measured Road NOx contribution is calculated as the difference between the total NOx and the background NOx value. Total measured NOx for each diffusion tube was calculated from the measured $NO_2$ concentration using the latest version of the Defra NOx to $NO_2$ calculator.

This initial comparison indicated that the model was under-predicting the NOx arising from road emissions at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible, and a linear adjustment factor of **2.56** was calculated for the road emissions component of the NOx model.

Total NOx was calculated as the sum of the adjusted Road NOx contribution from RapidAIR and the Defra 2019 background maps (with main road sources removed from the background map). Total $NO_2$ concentrations at specified receptors were subsequently obtained from background and adjusted Road NOx concentrations using the NOx to $NO_2$ calculator provided by Defra (Section 4.4.8).

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted $NO_2$ annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that for an annual model, an RMSE of up to 4 µg/m$^3$ is ideal, and an RMSE of up to 10 µg/m$^3$ is acceptable. In this case the RMSE value was **6.14** µg/m$^3$, which shows good agreement between modelled and measured concentrations.

In the absence of a sufficient number of PM monitoring sites, the NOx adjustment factor of **2.56** was also applied to adjust the modelled Road $PM_{10}$ and $PM_{2.5}$ concentrations. This is in line with LAQM.TG(16) Section 7.541.

## 6.2 Model uncertainty

Some clear outliers were apparent during the model verification process, whereby the model inputs could not be refined sufficiently to achieve good model performance at these locations. There are a number of reasons why this could be the case, including:

- A site located next to a large car park, bus stop or other emission source that has not been explicitly modelled due to unknown activity data.

[27] Background Mapping data for local authorities - 2018, https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

- Sites located in unsuitable locations for diffusion tubes to measure $NO_2$ concentrations effectively.
- Uncertainties in the traffic model outputs (please refer to the transport model reports for further information).
- Uncertainties introduced by modelling background concentrations at 1 km resolution over a large model domain. We have attempted to address this by interpolating the 1 km background maps to a finer 1 m resolution and therefore smooth out the sudden changes in background concentrations at the edges of the 1 km square background maps.

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted $NO_2$ annual mean concentrations was calculated, as detailed in LAQM.TG(16). In this case the RMSE was calculated at **6.14** µg/m$^3$.

More information on model performance and uncertainty is presented in Appendix 1.

## 6.3 Habitats Regulations Assessment

In addition to the human health assessment, a separate Habitats Regulations Assessment (HRA) is being performed for the Traffic Filters Scheme – see standalone reports by Atkins. Ammonia ($NH_3$) concentrations were modelled for each 2024 scenario for application to the HRA.

Vehicle emission factors for ammonia ($NH_3$) were obtained from the EMEP/EEA air pollutant emission inventory guidebook.[28] Link specific emission factors were calculated with our in-house emission calculation tool RapidEMS, which links directly to our RapidAIR dispersion modelling system.

In absence of measured ammonia concentrations and in line with LAQM.TG(16) Section 7.541, the NOx adjustment factor of **2.56** was applied to the road emissions component of the $NH_3$ model.

## 6.4 Concentration maps

### 6.4.1 $NO_2$ annual mean

Figure 6-1, Figure 6-2 and Figure 6-3 show the modelled $NO_2$ annual mean concentrations across the full model domain for the 2019 base year, 2024 Do Minimum and 2024 Do Something (Traffic Filters) scenarios respectively. Areas in red have concentrations in exceedance of the national $NO_2$ annual limit value of 40 µg/m$^3$ and areas in orange are above the Oxford specific target value of 30 µg/m$^3$. Figure 6-4, Figure 6-5 and Figure 6-6 show the same modelled $NO_2$ annual mean concentration maps focussed in on the city centre.

An initial analysis of the concentration maps shows a city-wide improvement in $NO_2$ concentrations across the full domain between the 2019 (Figure 6-1) and 2024 Do Minimum (Figure 6-2) scenarios as a result of improvements in the national vehicle fleet. A comparison of the 2024 Do Minimum and 2024 Do Something scenario concentration maps shows the impact of the Traffic Filters Scheme in reducing $NO_2$ concentrations in the city centre (Figure 6-5 and Figure 6-6) owing to the reduction in private cars on central links in the city. **A detailed analysis of the impacts of the Traffic Filters Scheme on pollutant concentrations on the main road links in the city is presented in Section 6.5.**

[28] European Environment Agency, "EMEP/EEA air pollution emission inventory guidebook 2016", https://www.eea.europa.eu/publications/emep-eea-guidebook-2016

**Figure 6-1 Modelled annual mean $NO_2$ concentrations in Oxford in the 2019 base year for the full domain**

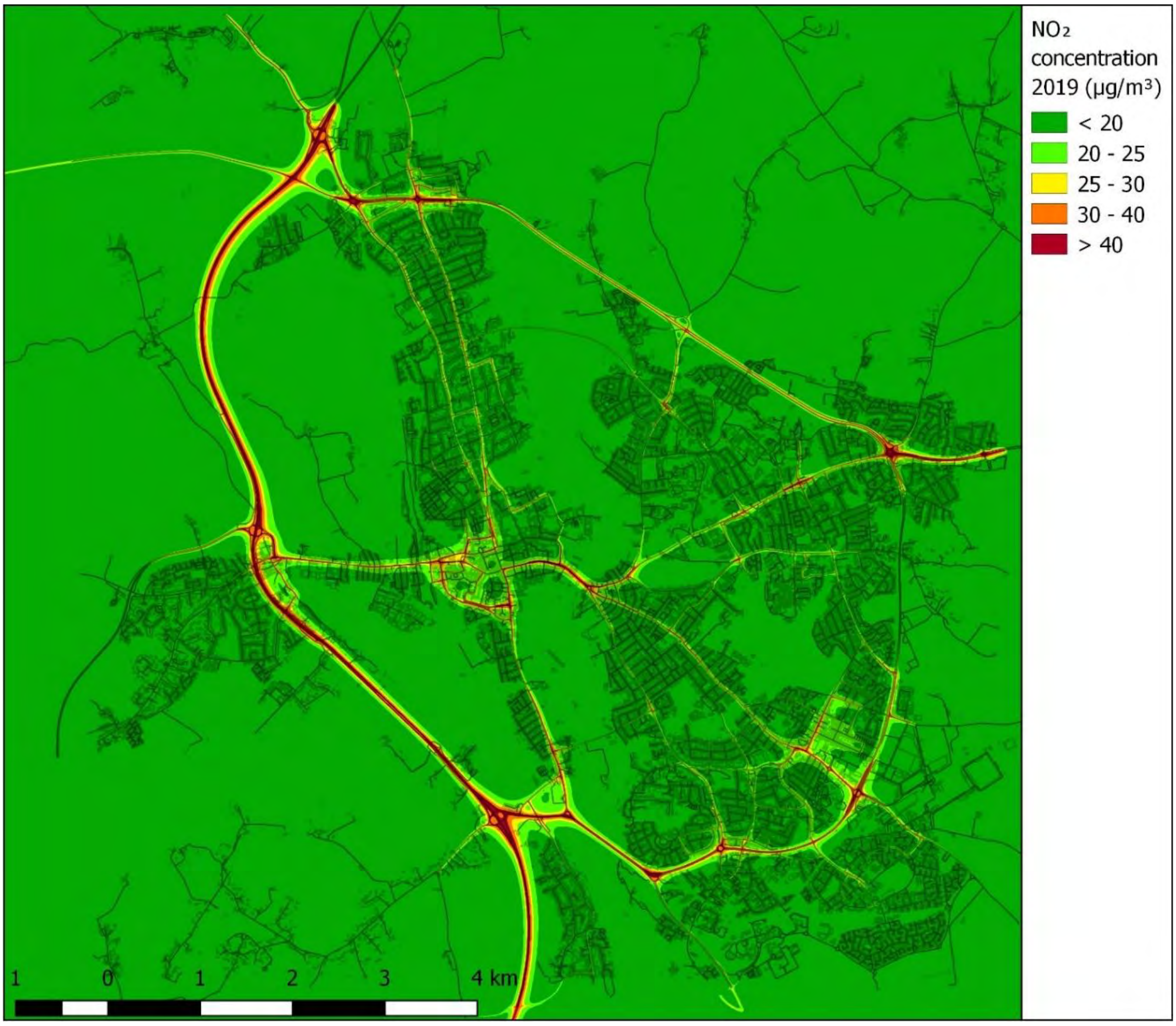


**Figure 6-2 Modelled annual mean $NO_2$ concentrations in Oxford in the 2024 Do Minimum scenario (without Traffic Filters) for the full domain**

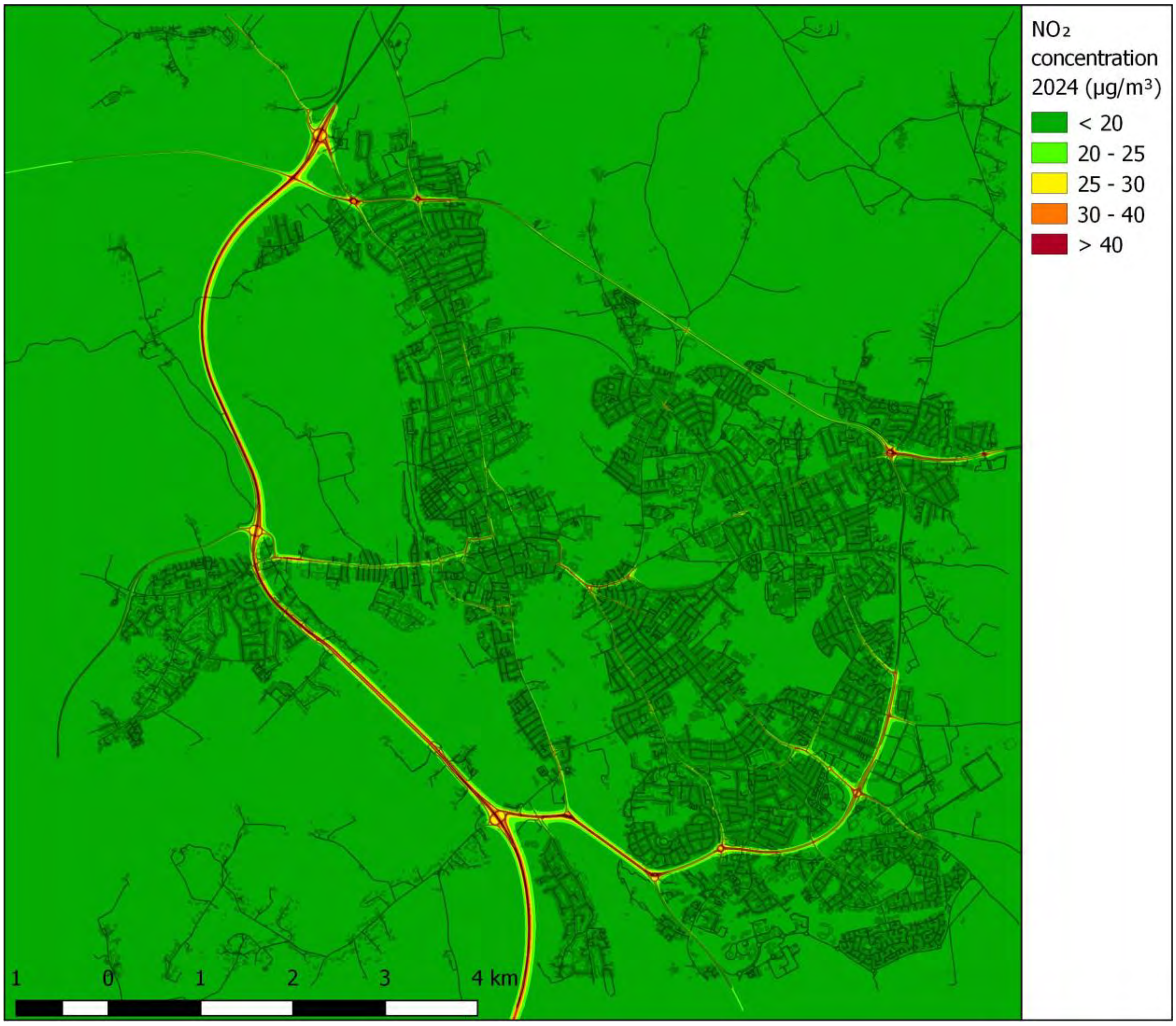


**Figure 6-3 Modelled annual mean $NO_2$ concentrations in Oxford in the 2024 Do Something (Traffic Filters) scenario for the full domain**

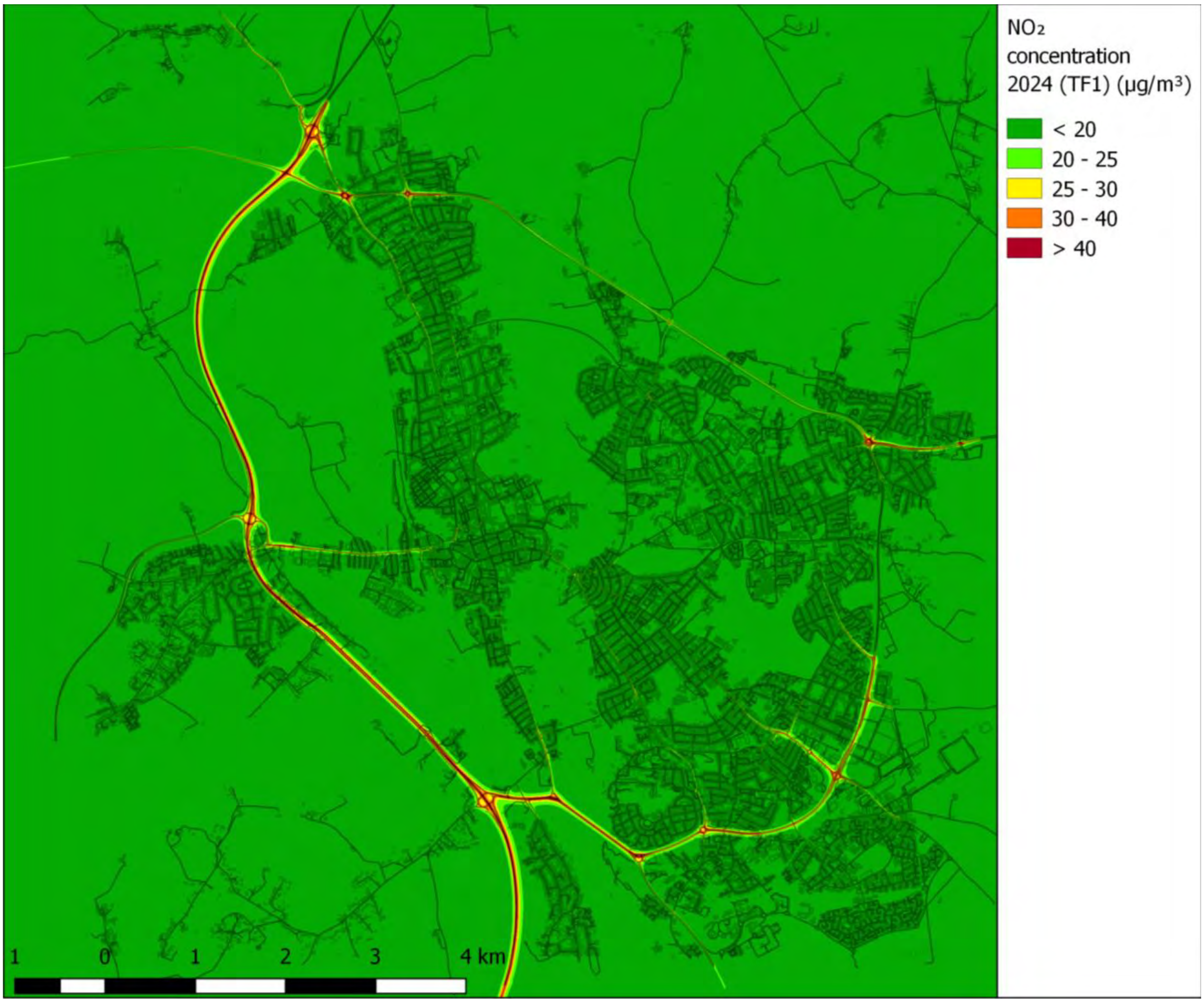


**Figure 6-4 Modelled annual mean $NO_2$ concentrations in Oxford in the 2019 base year for Oxford City Centre**

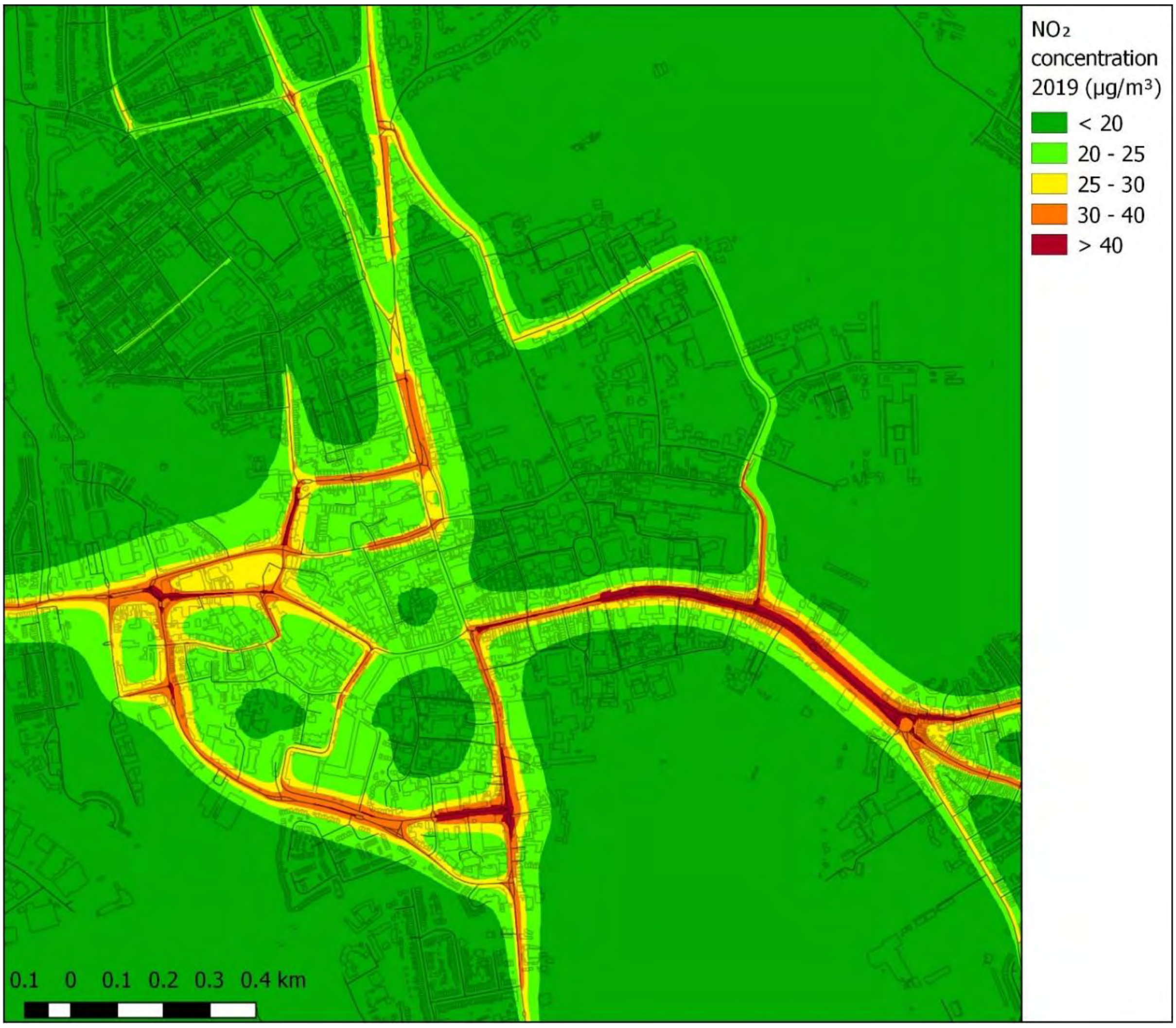


**Figure 6-5 Modelled annual mean $NO_2$ concentrations in Oxford in the 2024 Do Minimum scenario (without Traffic Filters) for Oxford City Centre**

**Figure 6-6 Modelled annual mean $NO_2$ concentrations in Oxford in the 2024 Do Something (Traffic Filters) scenario for Oxford City Centre**

### 6.4.2 $PM_{10}$ annual mean

Figure 6-7, Figure 6-8 and Figure 6-9 show the modelled $PM_{10}$ annual mean concentrations across the full model domain for the 2019 base year, 2024 Do Minimum and 2024 Do Something (Traffic Filters) scenarios respectively. Figure 6-10, Figure 6-11 and Figure 6-12 show the same modelled $PM_{10}$ annual mean concentration maps focussed in on the city centre. $PM_{10}$ annual mean concentrations are well below the national objective (40 µg/m$^3$) for each scenario. **A detailed analysis of the impacts of the Traffic Filters Scheme on pollutant concentrations on the main road links in the city is presented in Section 6.5.**

**Figure 6-7 Modelled annual mean $PM_{10}$ concentrations in Oxford in the 2019 base year for the full domain**

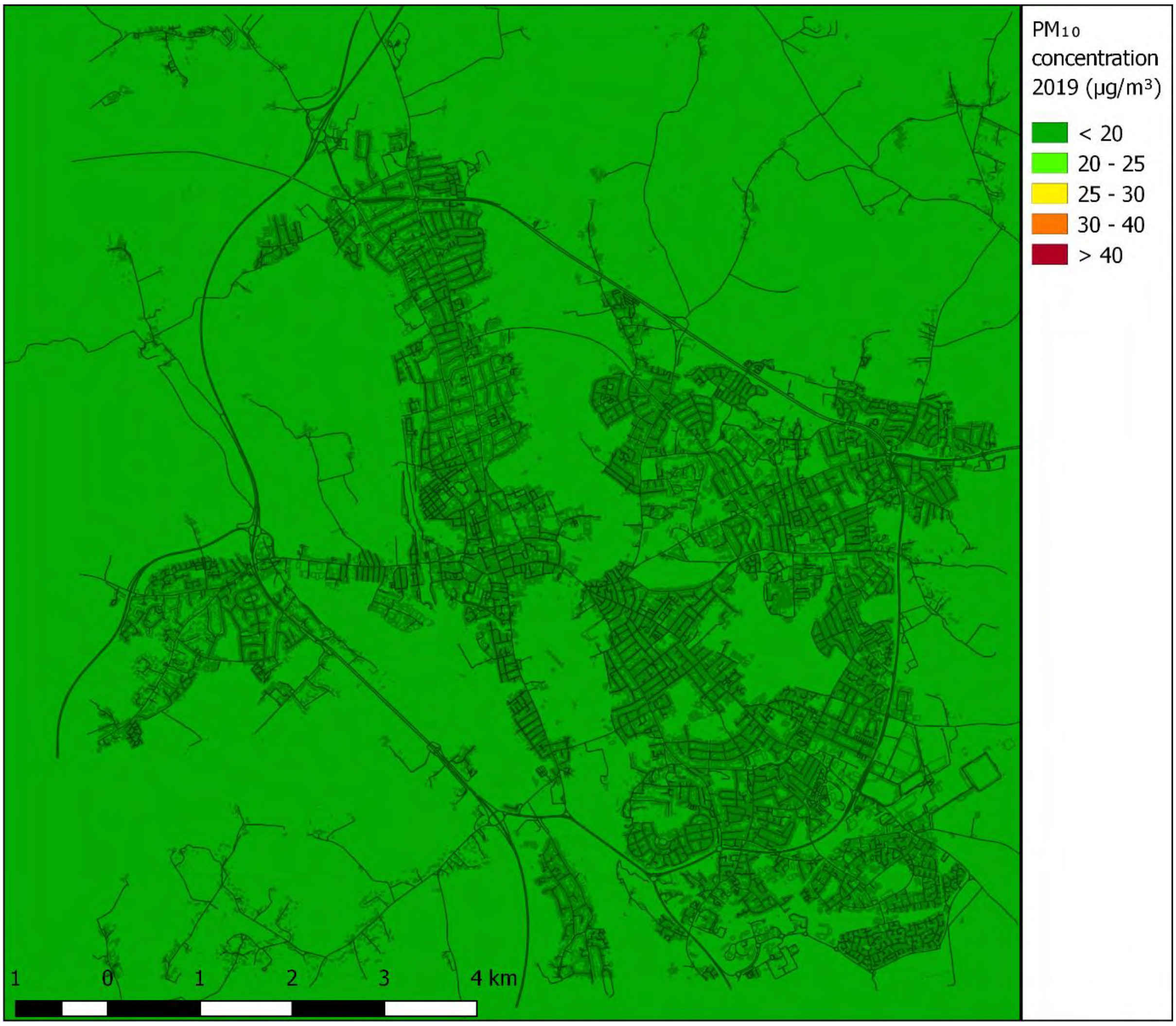


**Figure 6-8 Modelled annual mean $PM_{10}$ concentrations in Oxford in the 2024 Do Minimum (without Traffic Filters) for the full domain**

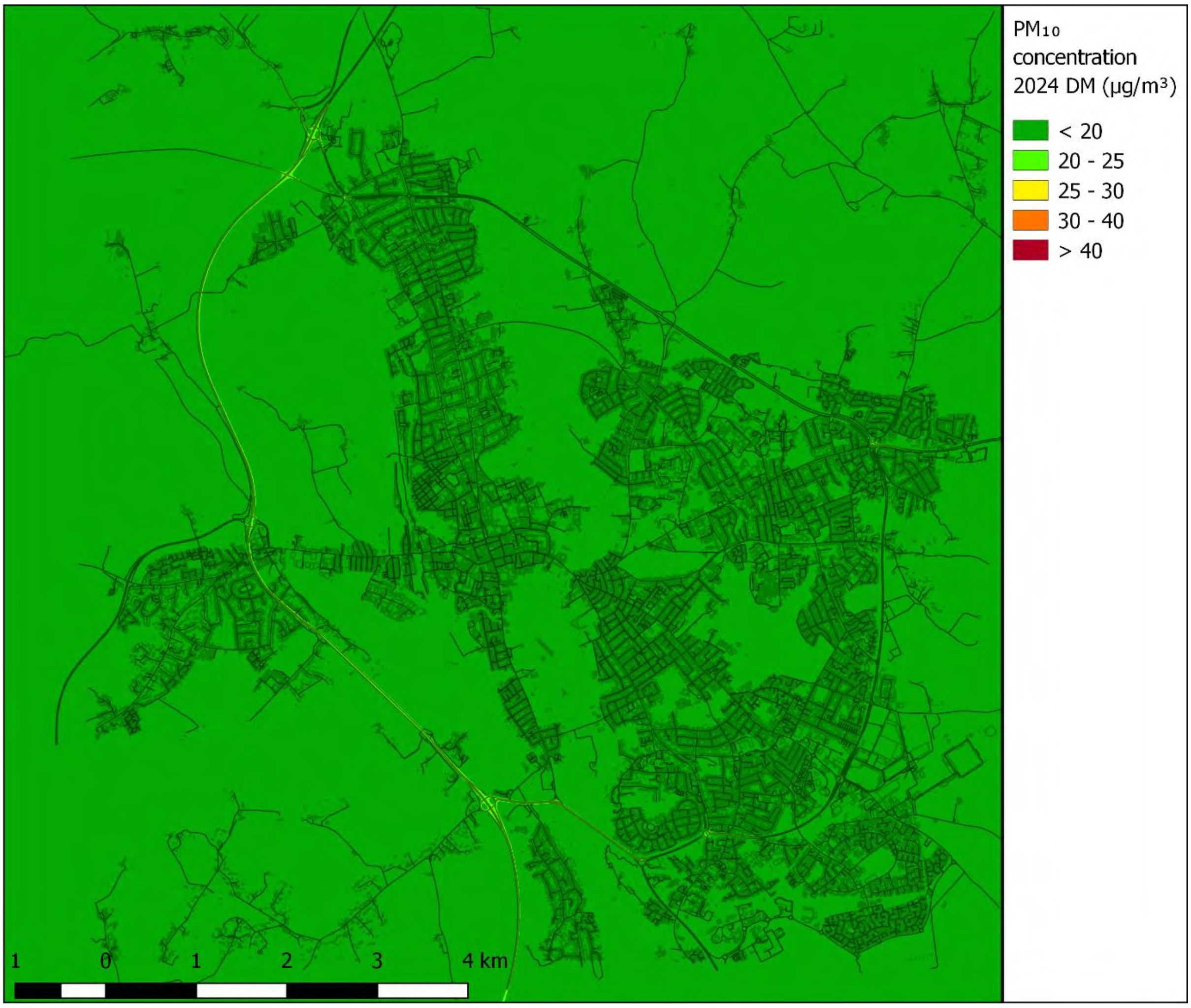


**Figure 6-9 Modelled annual mean $PM_{10}$ concentrations in Oxford in the 2024 Do Something (Traffic Filters) for the full domain**

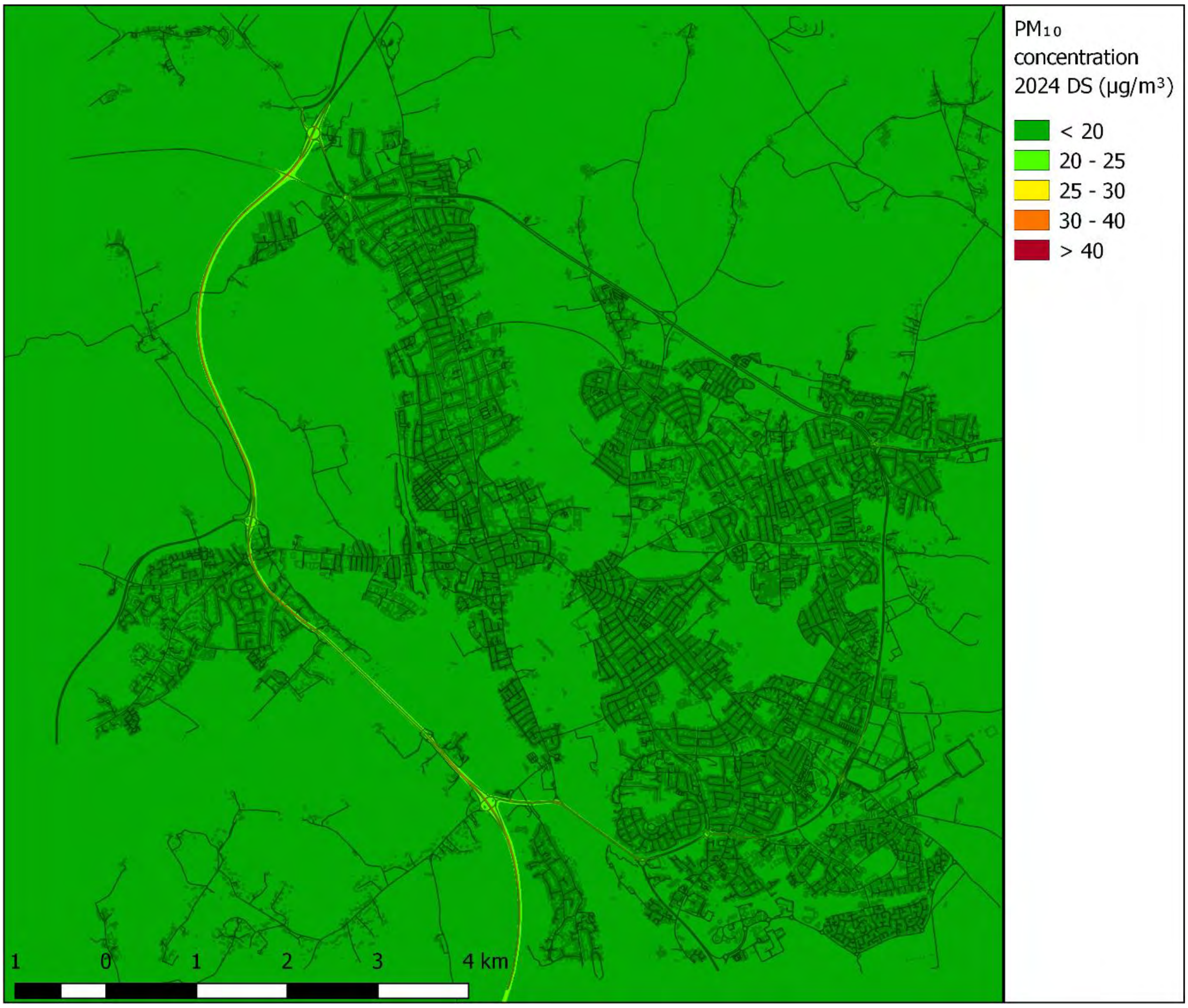


**Figure 6-10 Modelled annual mean $PM_{10}$ concentrations in Oxford in the 2019 base year scenario for the City Centre area**

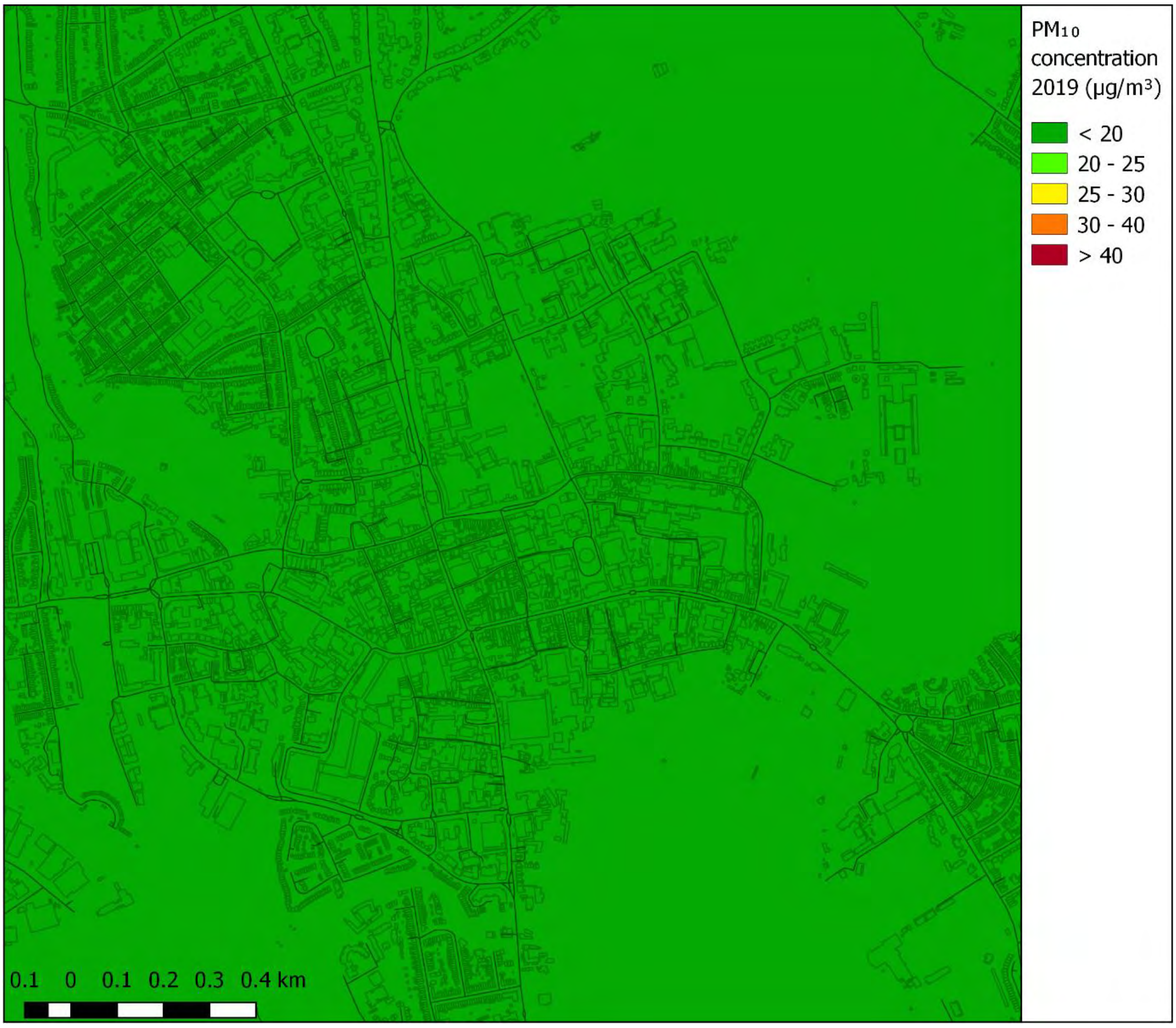


**Figure 6-11 Modelled annual mean $PM_{10}$ concentrations in Oxford in the 2024 Do Minimum scenario for the City Centre area**

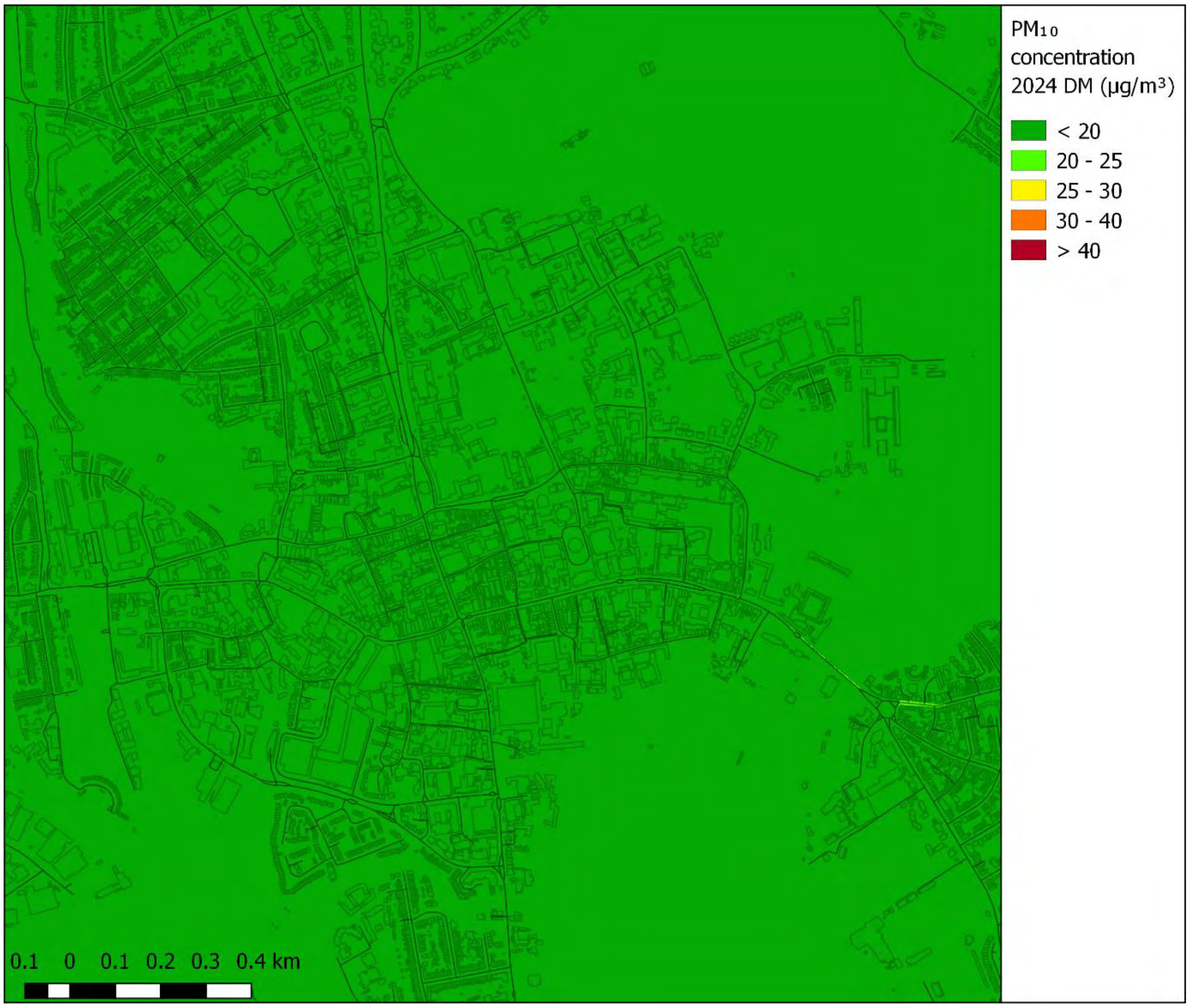
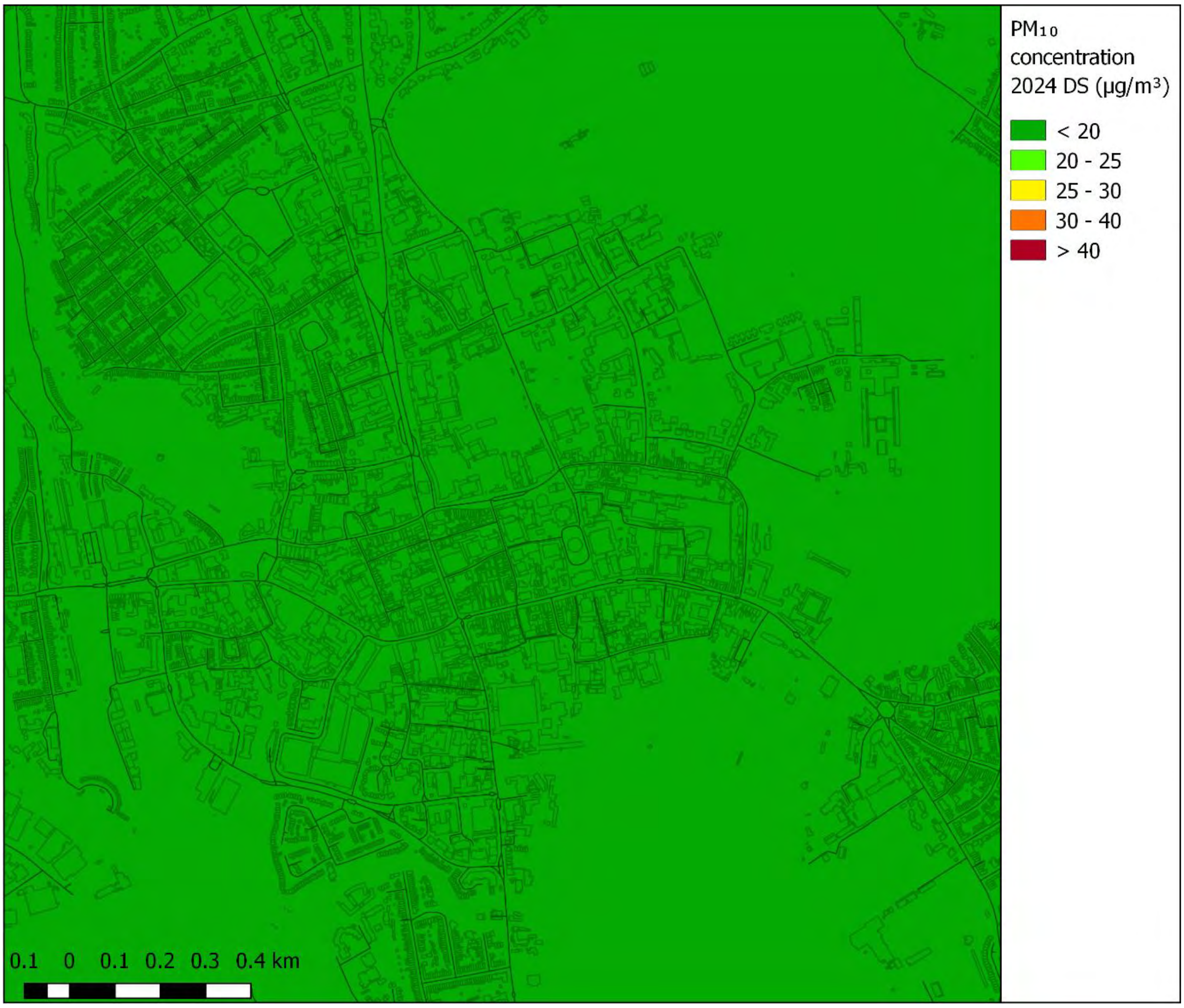


**Figure 6-12 Modelled annual mean $PM_{10}$ concentrations in Oxford in the 2024 Do Something (Traffic Filters) scenario for the City Centre area**



### 6.4.3 $PM_{2.5}$ annual mean

Figure 6-13, Figure 6-14 and Figure 6-15 show the modelled $PM_{2.5}$ annual mean concentrations across the full model domain for the 2019 base year, 2024 Do Minimum and 2024 Do Something (Traffic Filters) scenarios respectively. Figure 6-16, Figure 6-17 and Figure 6-18 show the same modelled $PM_{2.5}$ annual mean concentration maps focussed in on the proposed ZEZ area in the city centre. Similar to the $NO_2$ results, an initial analysis of the concentration maps shows a city-wide improvement in $PM_{2.5}$ concentrations across the full domain between the 2019 (Figure 6-13) and 2024 Do Minimum (Figure 6-14) scenarios as a result of improvements in the national vehicle fleet. A comparison of the 2024 Do Minimum and 2024 Do Something scenario concentration maps shows the impact of the Traffic Filters Scheme in reducing $PM_{2.5}$ concentrations in the city centre (Figure 6-17 and Figure 6-18) owing to the reduction in private cars on central links in the city. **A detailed analysis of the impacts of the Traffic Filters Scheme on pollutant concentrations on the main road links in the city is presented in Section 6.5.**

**Figure 6-13 Modelled annual mean $PM_{2.5}$ concentrations in Oxford in the 2019 base year for the full domain**

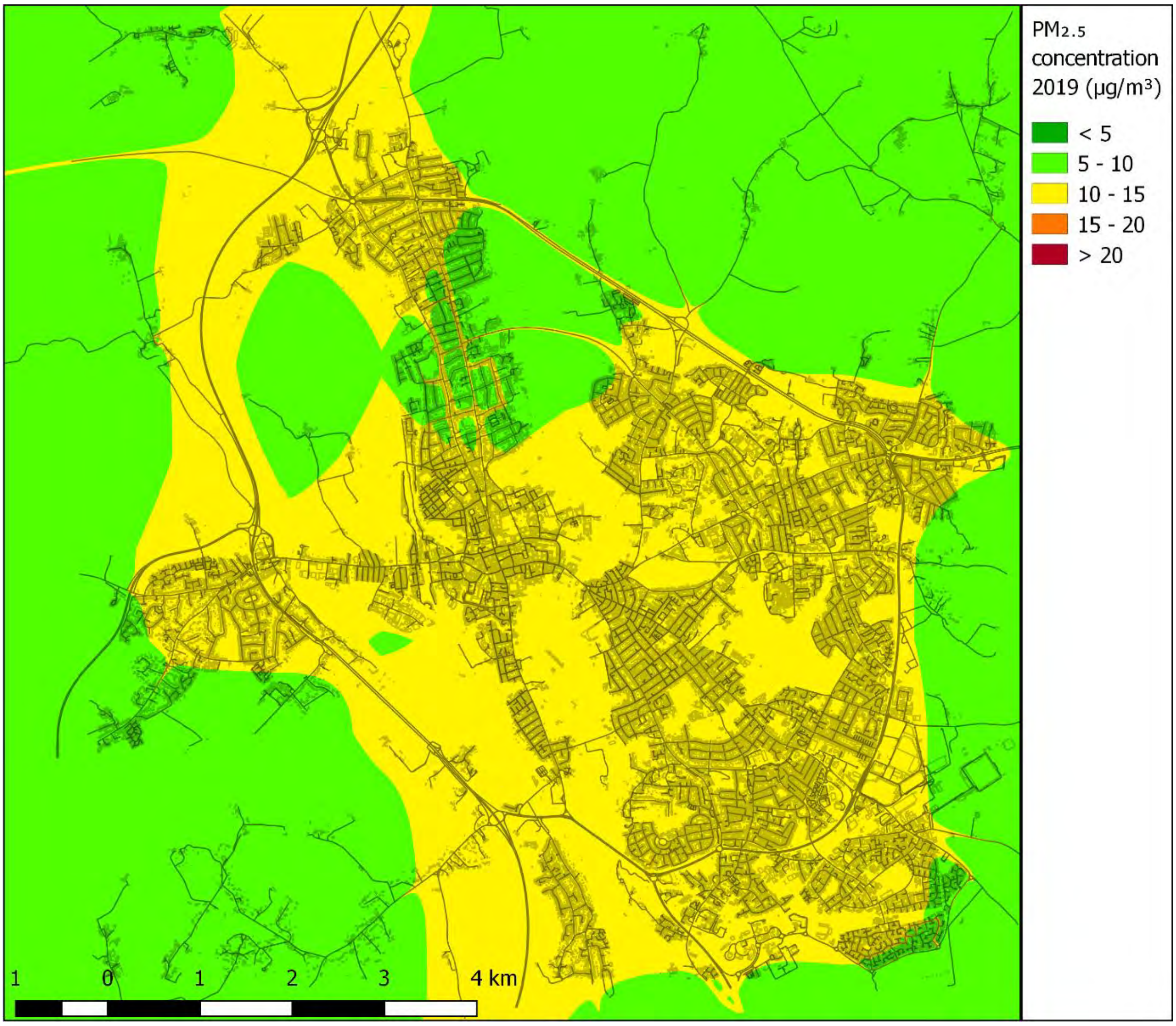


**Figure 6-14 Modelled annual mean $PM_{2.5}$ concentrations in Oxford in the 2024 Do Minimum (without Traffic Filters) for the full domain**

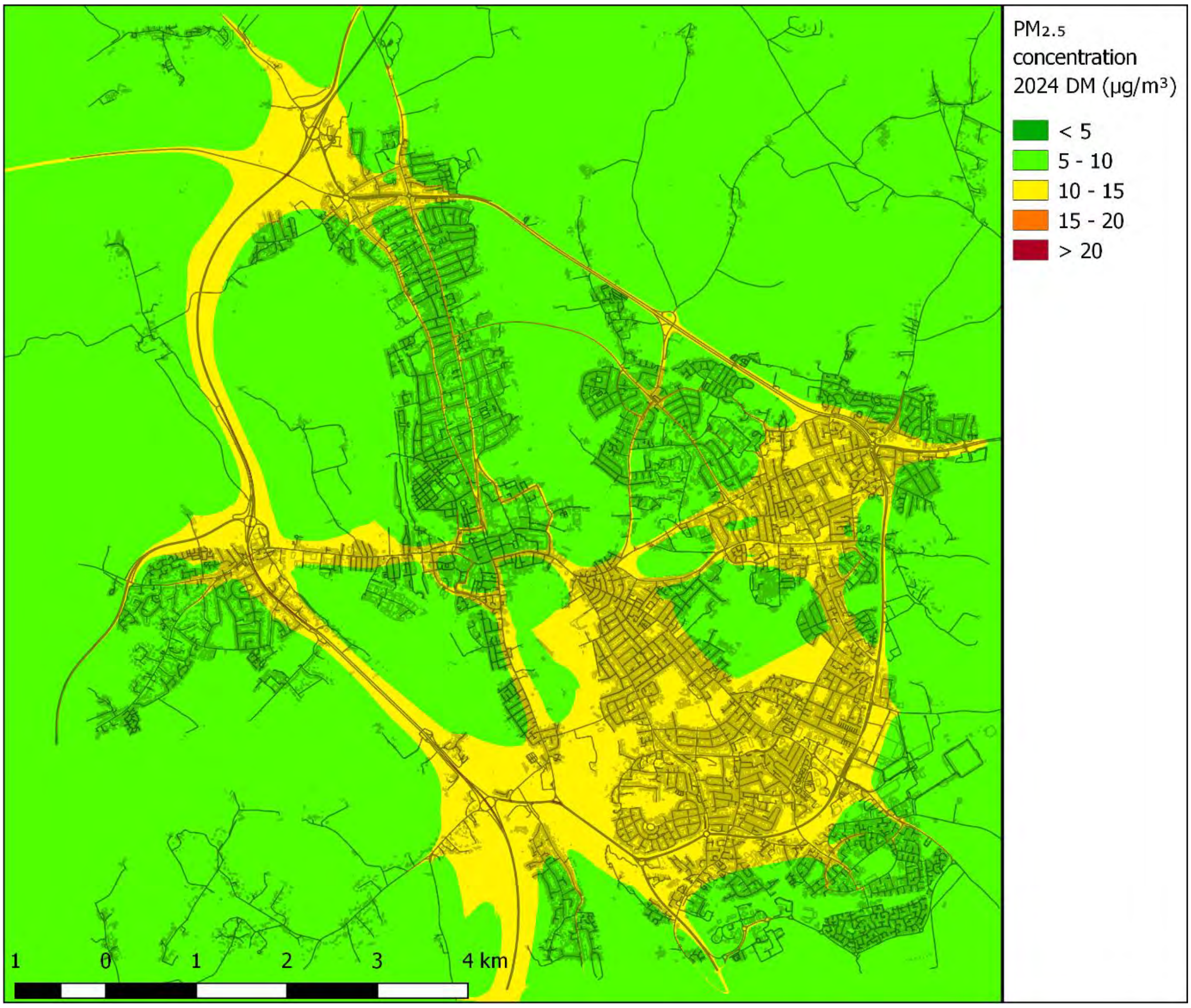


**Figure 6-15 Modelled annual mean $PM_{2.5}$ concentrations in Oxford in the 2024 Do Something (Traffic Filters) for the full domain**

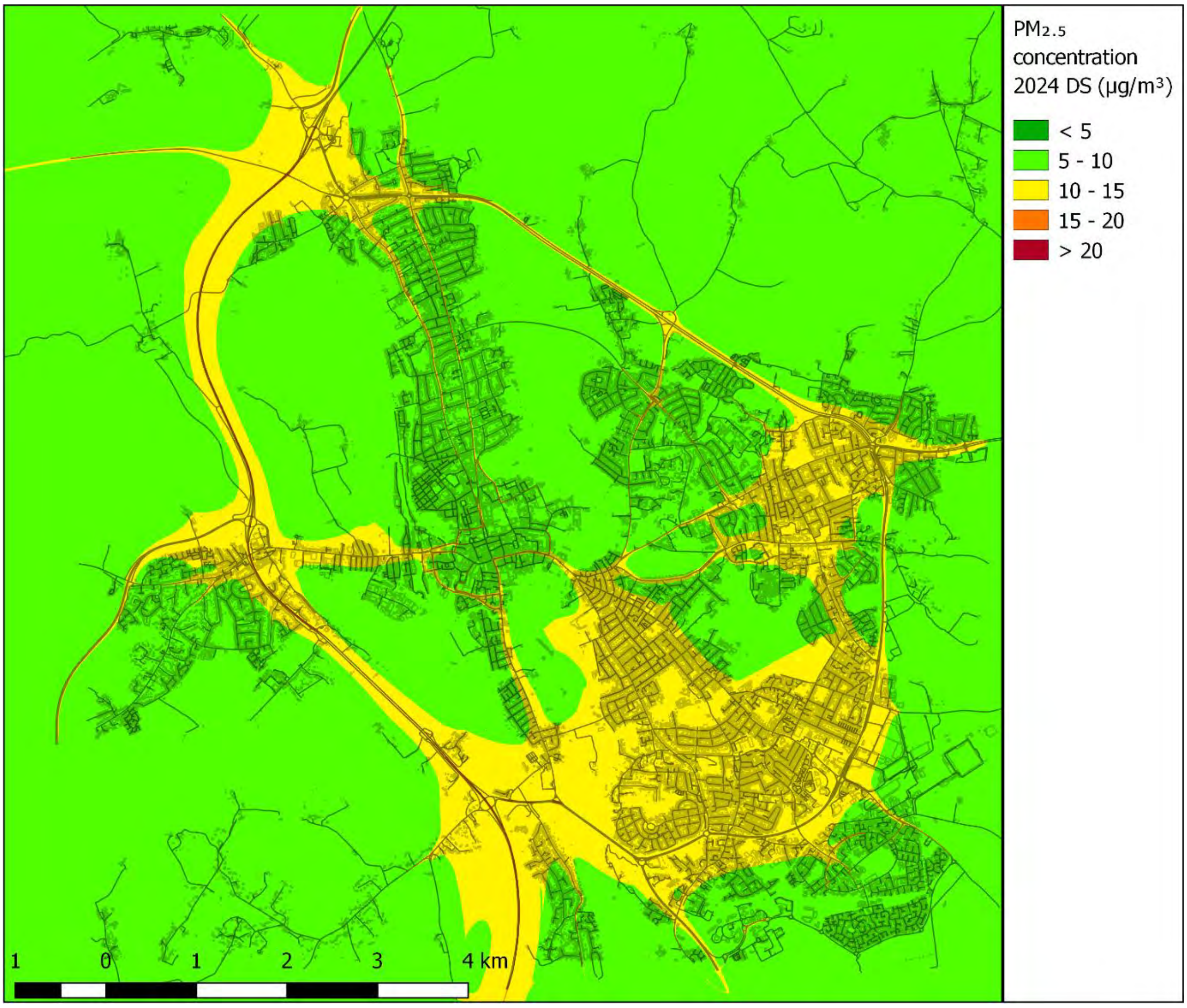


**Figure 6-16 Modelled annual mean $PM_{2.5}$ concentrations in Oxford in the 2019 base year scenario for Oxford City Centre**

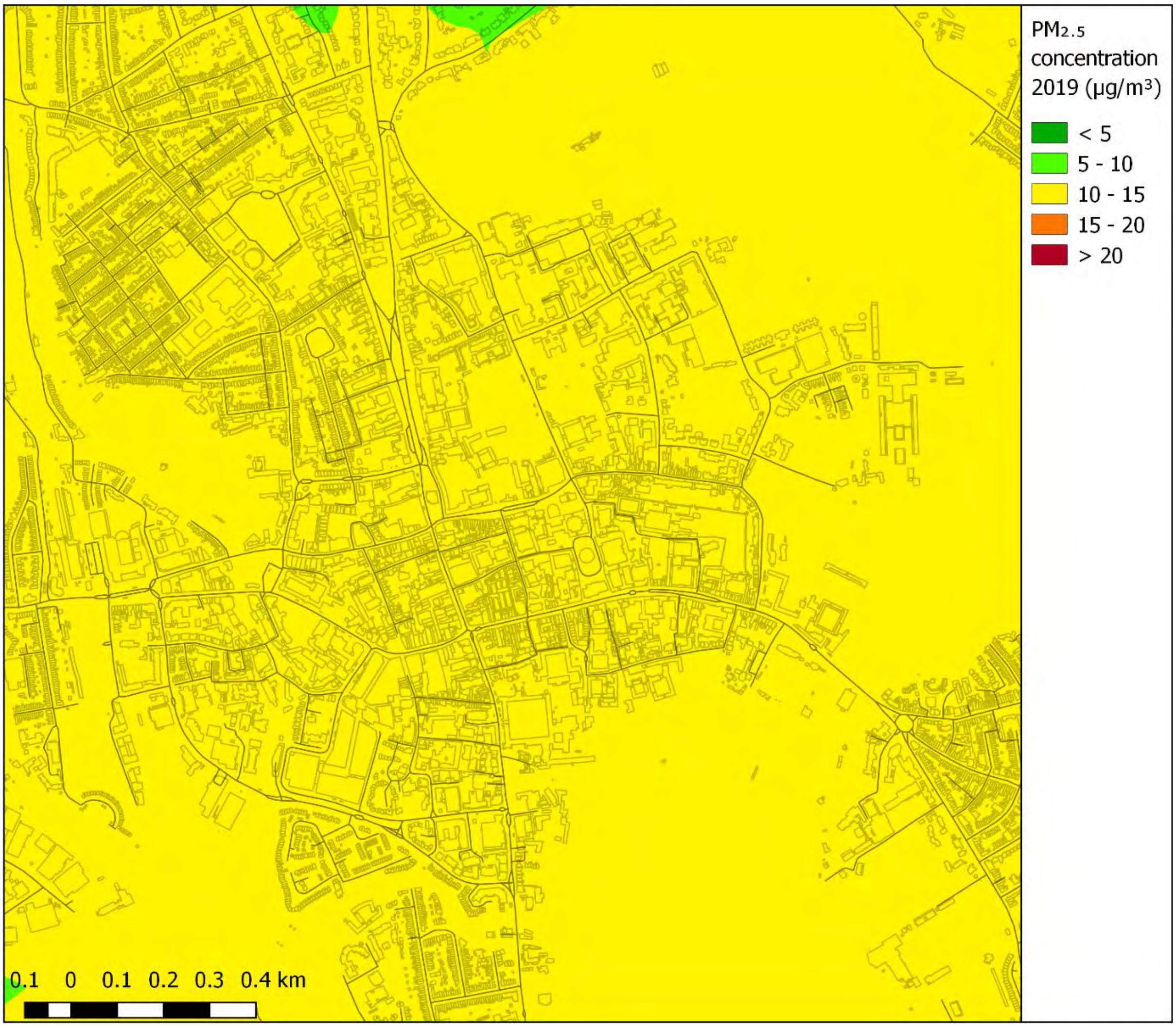


**Figure 6-17 Modelled annual mean $PM_{2.5}$ concentrations in Oxford in the 2024 Do Minimum (without Traffic Filters) scenario for Oxford City Centre**

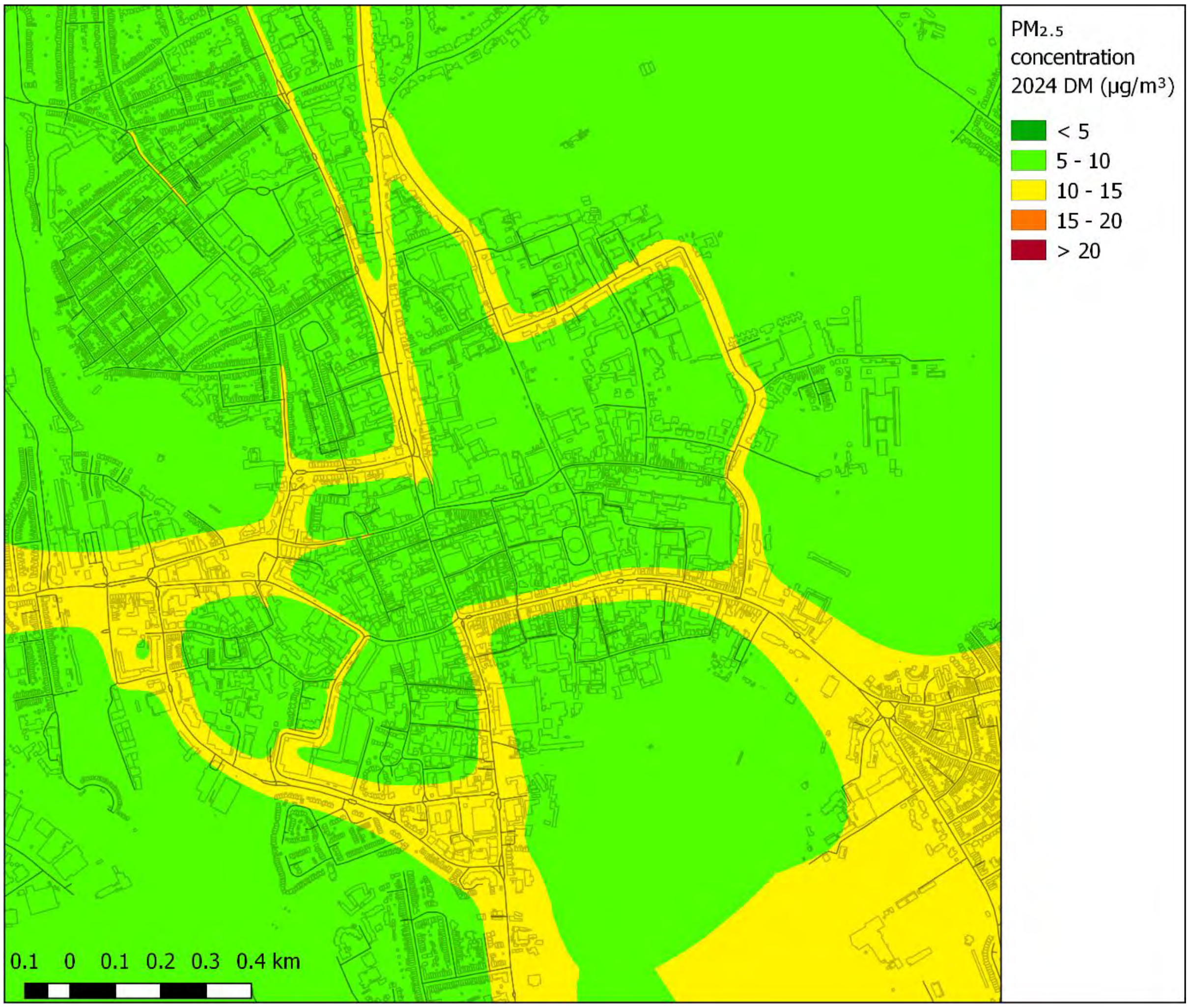
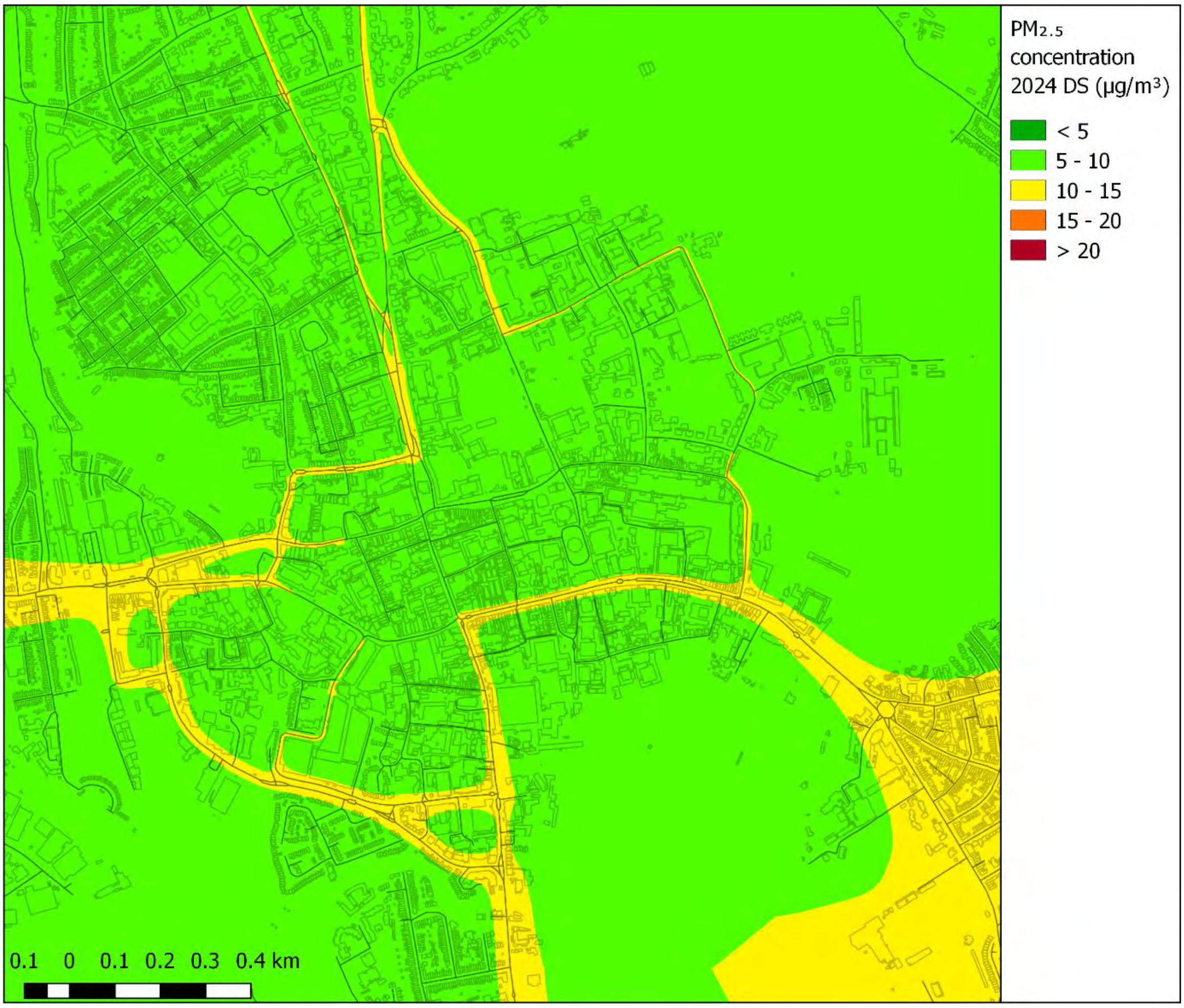


**Figure 6-18 Modelled annual mean $PM_{2.5}$ concentrations in Oxford in the 2024 Do Something (Traffic Filters) scenario for Oxford City Centre**



## 6.5 Results on PCM links

### 6.5.1 Road links and receptor points

Modelled annual mean $NO_2$ and PM concentrations were extracted at roadside receptor points along all PCM road links in Oxford (Figure 4-2). As RapidAIR produces concentration grids (in raster format), modelled $NO_2$ concentrations can be extracted at receptor locations anywhere on the 1 m resolution model output grid. For comparison with the PCM model results, annual mean concentrations at a distance of 4 m from the kerb and at a height of 2 m were extracted from the model outputs. This provides an assessment of compliance at relevant roadside locations where there may be public access, as specified in the Air Quality Directive (AQD) requirements Annex III A, B, and C3.

Results were extracted at receptor points positioned every 50 m along the roadside. Annex III of the AQD also specifies that microscale sampling should be at least 25 m from the edge of major junctions. Therefore, when reporting model results relevant to compliance with the AQD, locations up to 25 m from the edge of major junctions in the model domain have been excluded. The results are presented in the tables and maps on the following pages.

The roadside receptor locations in the PCM model were located 4 m from the kerb and at a height of 2 m. To represent this in the city-scale modelling, a subset of the OS Mastermap GIS dataset provided spatially accurate polygons representing the road carriageway; receptor locations were then placed at 50 m intervals along relevant road links using a 4 m buffer around the carriageway polygons.

Each PCM link is assigned a unique Census ID (Figure 6-19 and Figure 6-20) and a grid reference (Table 6.1), which typically describes the location of the Department for Transport (DfT) traffic count points on each link. The reported concentrations for each Census ID represent the highest modelled concentration recorded at an associated receptor.

**Figure 6-19 Oxford PCM links labelled by Census ID for the full domain**

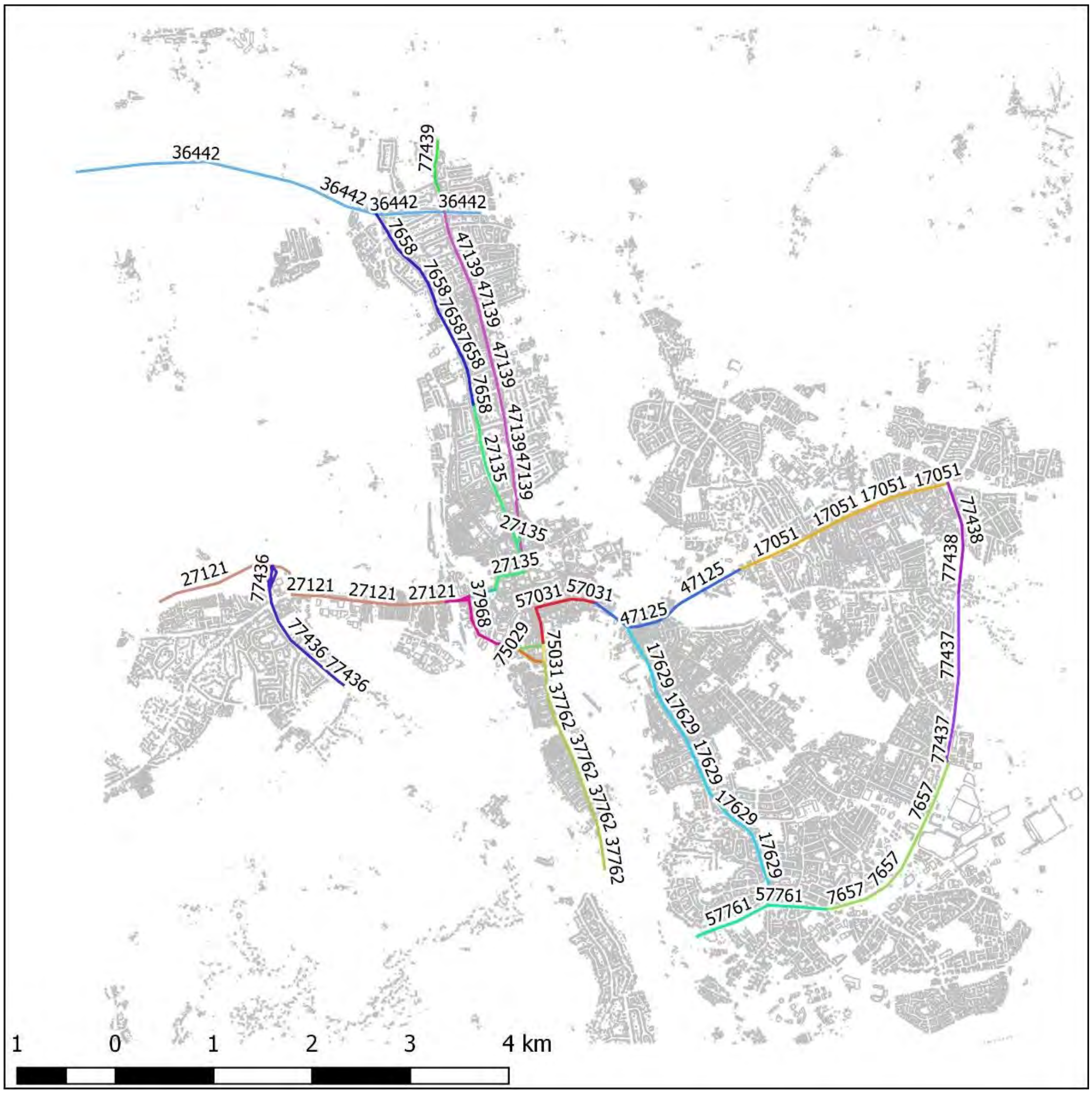


**Figure 6-20 Oxford PCM links labelled by Census ID for Oxford City Centre**


**Table 6.1 Location coordinates of Oxford PCM links**

| Census ID | Local Authority | Road | Easting X (m) | Northing Y (m) |
|---|---|---|---|---|
| 47139 | Oxford City Council | A4165 | 450460 | 210000 |
| 27135 | Oxford City Council | A4144 | 451010 | 206510 |
| 77436 | Vale of White Horse District Council | A34 | 449000 | 205710 |
| 37762 | Oxford City Council | A4144 | 451600 | 204950 |
| 17051 | Oxford City Council | A420 | 455000 | 207310 |
| 7658 | Oxford City Council | A4144 | 450000 | 209775 |
| 17629 | Oxford City Council | A4158 | 452770 | 205000 |
| 27121 | Oxford City Council | A420 | 449950 | 206200 |
| 77437 | Oxford City Council | A4142 | 455630 | 206000 |
| 77438 | Oxford City Council | A4142 | 455620 | 207200 |
| 75032 | Oxford City Council | A4144 | 450850 | 206350 |
| 37968 | Oxford City Council | A420 | 450800 | 205902 |

| Census ID | Local Authority | Road | Easting X (m) | Northing Y (m) |
|---|---|---|---|---|
| 57031 | Oxford City Council | A420 | 451400 | 206000 |
| 47125 | Oxford City Council | A420 | 452000 | 206200 |
| 7657 | Oxford City Council | A4142 | 455000 | 203440 |
| 77439 | Oxford City Council | A4165 | 450330 | 210500 |
| 36442 | Oxford City Council | A40 | 450100 | 210200 |
| 75029 | Oxford City Council | A420 | 451300 | 205790 |
| 57761 | Oxford City Council | A4142 | 453410 | 203000 |
| 75030 | Oxford City Council | A420 | 451300 | 205650 |
| 75031 | Oxford City Council | A420 | 451430 | 205720 |

### 6.5.2 $NO_2$

Table 6.2 and Table 6.3 compare the maximum modelled $NO_2$ concentrations recorded at receptors alongside each of the PCM links for the 2019 base year and 2024 Do Minimum scenarios and 2019 base year and 2024 Do Something scenarios, respectively. In each case, representative concentrations for 2020 to 2023 have been calculated through linear interpolation between the two modelled years.

The modelled data shows seven PCM links where exceedance of the national $NO_2$ annual mean limit value of 40 µg/m$^3$ is predicted in 2019:

- Census ID 77436 corresponds to the A34 (Southern By-Pass Road / Botley Interchange)
- Census ID 27121 corresponds to the A420 (Botley Road / Botley Interchange)
- Census ID 57031 corresponds to the A420 (St Aldate's / High Street)
- Census ID 47125 corresponds to the A420 (High Street / Headington Road)
- Census ID 7657 corresponds to the A4142 (Eastern By-Pass Road)
- Census ID 36442 corresponds to the A40 (Northern By-Pass Road)
- Census ID 75029 corresponds to the A420 (Thames Street / Speedwell Street)

All PCM links above are in exceedance of the Oxford $NO_2$ annual mean limit value of 30 µg/m$^3$ in 2019 except Census ID 77437 and 75030 corresponding to the A4142 (Eastern By-Pass Road) and A420 (Thames Street) respectively.

In the 2024 Do Minimum scenario, the modelled data shows that no PCM links were in exceedance of the national $NO_2$ annual mean limit value, however, there are four PCM links where exceedance of the Oxford $NO_2$ annual mean limit value is predicted:

- Census ID 77436 corresponds to the A34 (Southern By-Pass Road / Botley Interchange)
- Census ID 27121 corresponds to the A420 (Botley Road / Botley Interchange)
- Census ID 36442 corresponds to the A40 (Northern By-Pass Road)
- Census ID 57761 corresponds to the A4142 (Eastern By-Pass Road / Heyford Hill Roundabout)

For the 2024 Do Something Scenario, the modelled data shows no PCM links were in exceedance of the national $NO_2$ annual mean limit value but five PCM links where exceedance of the Oxford $NO_2$ annual mean limit value of 30 µg/m$^3$ is predicted:

- Census ID 77436 corresponds to the A34 (Southern By-Pass Road / Botley Interchange)
- Census ID 7658 corresponds to the A4144 (Woodstock Road / Wolvercote Roundabout). This road link was not showing an exceedance of the Oxford $NO_2$ annual mean limit value for the 2024 Do Minimum scenario.
- Census ID 27121 corresponds to the A420 (Botley Road / Botley Interchange)
- Census ID 36442 corresponds to the A40 (Northern By-Pass Road)
- Census ID 57761 corresponds to the A4142 (Eastern By-Pass Road / Heyford Hill Roundabout)

The locations which are predicted to be in exceedance of 30 µg/m$^3$ are all located on the outer road links of the city. No exceedances are predicted in Oxford City Centre.

Table 6.4 shows the difference in maximum modelled $NO_2$ concentrations at PCM receptors between the 2024 Do Minimum and 2024 Do Something scenarios caused as a result of the implementation of the Traffic Filters Scheme. 16 out of 21 road links show a decrease in $NO_2$ concentration as a result of the Traffic Filters Scheme. The maximum decrease in $NO_2$ concentration as a result of the Traffic Filters Scheme was 7.43 µg/m$^3$ on Census ID 47125, corresponding to the A420 (High Street / Headington Road). This location also has the maximum decrease in $PM_{10}$ and $PM_{2.5}$ concentrations.

The following five road links show an increase in $NO_2$ concentration as a result of the scheme are all located on road links outside of the city centre, this is consistent with the other assessed pollutants:

- Census ID 77436 corresponds to the A34 (Southern By-Pass Road / Botley Interchange)
- Census ID 7658 corresponds to the A4144 (Woodstock Road / Wolvercote Roundabout)
- Census ID 77437 corresponds to the A4142 (Eastern By-Pass Road)
- Census ID 7657 corresponds to the A4142 (Eastern By-Pass Road)
- Census ID 57761 corresponds to the A4142 (Eastern By-Pass Road / Heyford Hill Roundabout)

The maximum increase in $NO_2$ concentration as a result of the Traffic Filters Scheme was 4.62 µg/m$^3$ on Census ID 7658, corresponding to the A4144 (Woodstock Road / Wolvercote Roundabout). This location also has the maximum increase in $PM_{10}$ and $PM_{2.5}$ concentrations.

**Table 6.2 Modelled $NO_2$ concentrations at PCM receptors for the 2019 base year and 2024 Do Minimum scenarios (Red = >40 μg/m³, Orange = 30 – 40 μg/m³, Yellow = 25 – 30 μg/m³, Green = <25 μg/m³). Concentrations for 2020 to 2023 have been calculated through linear interpolation**

| Census_ID | Local Authority | Road | Maximum $NO_2$ concentration (μg/m³) at receptors adjacent to PCM links | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Modelled | Interpolated | | | | Modelled |
| | | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 DM |
| 47139 | Oxford City Council | A4165 | 35.23 | 32.93 | 30.63 | 28.34 | 26.04 | 23.74 |
| 27135 | Oxford City Council | A4144 | 36.39 | 34.67 | 32.94 | 31.22 | 29.49 | 27.77 |
| 77436 | Vale of White Horse District Council | A34 | 59.02 | 54.91 | 50.80 | 46.70 | 42.59 | 38.48 |
| 37762 | Oxford City Council | A4144 | 39.37 | 36.80 | 34.23 | 31.65 | 29.08 | 26.51 |
| 17051 | Oxford City Council | A420 | 39.28 | 36.22 | 33.16 | 30.11 | 27.05 | 23.99 |
| 7658 | Oxford City Council | A4144 | 37.81 | 35.77 | 33.72 | 31.68 | 29.63 | 27.59 |
| 17629 | Oxford City Council | A4158 | 31.98 | 30.68 | 29.38 | 28.08 | 26.78 | 25.48 |
| 27121 | Oxford City Council | A420 | 40.96 | 39.40 | 37.84 | 36.29 | 34.73 | 33.17 |
| 77437 | Oxford City Council | A4142 | 29.30 | 29.00 | 28.70 | 28.40 | 28.10 | 27.80 |
| 77438 | Oxford City Council | A4142 | 33.29 | 31.38 | 29.46 | 27.55 | 25.63 | 23.72 |
| 75032 | Oxford City Council | A4144 | 31.24 | 29.75 | 28.26 | 26.78 | 25.29 | 23.80 |
| 37968 | Oxford City Council | A420 | 36.96 | 34.58 | 32.19 | 29.81 | 27.42 | 25.04 |
| 57031 | Oxford City Council | A420 | 44.91 | 40.21 | 35.51 | 30.80 | 26.10 | 21.40 |
| 47125 | Oxford City Council | A420 | 47.59 | 44.03 | 40.46 | 36.90 | 33.33 | 29.77 |
| 7657 | Oxford City Council | A4142 | 41.24 | 38.61 | 35.98 | 33.35 | 30.72 | 28.09 |
| 77439 | Oxford City Council | A4165 | 34.65 | 32.43 | 30.21 | 27.98 | 25.76 | 23.54 |
| 36442 | Oxford City Council | A40 | 43.64 | 41.66 | 39.68 | 37.70 | 35.72 | 33.74 |
| 75029 | Oxford City Council | A420 | 52.89 | 47.38 | 41.86 | 36.35 | 30.83 | 25.32 |
| 57761 | Oxford City Council | A4142 | 34.74 | 33.87 | 33.00 | 32.12 | 31.25 | 30.38 |
| 75030 | Oxford City Council | A420 | 27.78 | 26.40 | 25.03 | 23.65 | 22.28 | 20.90 |
| 75031 | Oxford City Council | A420 | 37.61 | 34.03 | 30.45 | 26.86 | 23.28 | 19.70 |

**Table 6.3 Modelled $NO_2$ concentrations at PCM receptors for the 2019 base year and 2024 Do Something scenarios (Red = >40 μg/m³, Orange = 30 – 40 μg/m³, Yellow = 25 – 30 μg/m³, Green = <25 μg/m³). Concentrations for 2020 to 2023 have been calculated through linear interpolation**

| Census_ID | Local Authority | Road | Maximum $NO_2$ concentration (μg/m³) at receptors adjacent to PCM links | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Modelled | Interpolated | | | | Modelled |
| | | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 DS |
| 47139 | Oxford City Council | A4165 | 35.23 | 32.89 | 30.54 | 28.20 | 25.85 | 23.51 |
| 27135 | Oxford City Council | A4144 | 36.39 | 33.89 | 31.38 | 28.88 | 26.37 | 23.87 |
| 77436 | Vale of White Horse District Council | A34 | 59.02 | 55.18 | 51.34 | 47.51 | 43.67 | 39.83 |
| 37762 | Oxford City Council | A4144 | 39.37 | 36.69 | 34.00 | 31.32 | 28.63 | 25.95 |
| 17051 | Oxford City Council | A420 | 39.28 | 35.28 | 31.28 | 27.28 | 23.28 | 19.28 |
| 7658 | Oxford City Council | A4144 | 37.81 | 36.69 | 35.57 | 34.45 | 33.33 | 32.21 |
| 17629 | Oxford City Council | A4158 | 31.98 | 30.18 | 28.38 | 26.58 | 24.78 | 22.98 |
| 27121 | Oxford City Council | A420 | 40.96 | 39.19 | 37.42 | 35.65 | 33.88 | 32.11 |
| 77437 | Oxford City Council | A4142 | 29.30 | 29.27 | 29.25 | 29.22 | 29.20 | 29.17 |
| 77438 | Oxford City Council | A4142 | 33.29 | 31.27 | 29.24 | 27.22 | 25.19 | 23.17 |
| 75032 | Oxford City Council | A4144 | 31.24 | 29.06 | 26.87 | 24.69 | 22.50 | 20.32 |
| 37968 | Oxford City Council | A420 | 36.96 | 34.45 | 31.94 | 29.44 | 26.93 | 24.42 |
| 57031 | Oxford City Council | A420 | 44.91 | 39.55 | 34.19 | 28.84 | 23.48 | 18.12 |
| 47125 | Oxford City Council | A420 | 47.59 | 42.54 | 37.49 | 32.44 | 27.39 | 22.34 |
| 7657 | Oxford City Council | A4142 | 41.24 | 38.78 | 36.31 | 33.85 | 31.38 | 28.92 |
| 77439 | Oxford City Council | A4165 | 34.65 | 32.26 | 29.87 | 27.48 | 25.09 | 22.70 |
| 36442 | Oxford City Council | A40 | 43.64 | 41.65 | 39.67 | 37.68 | 35.70 | 33.71 |
| 75029 | Oxford City Council | A420 | 52.89 | 46.09 | 39.28 | 32.48 | 25.67 | 18.87 |
| 57761 | Oxford City Council | A4142 | 34.74 | 33.93 | 33.12 | 32.31 | 31.50 | 30.69 |
| 75030 | Oxford City Council | A420 | 27.78 | 25.95 | 24.13 | 22.30 | 20.48 | 18.65 |
| 75031 | Oxford City Council | A420 | 37.61 | 33.40 | 29.19 | 24.98 | 20.77 | 16.56 |

**Table 6.4 Difference in modelled $NO_2$ concentrations at PCM receptors between the 2024 Do Minimum and 2024 Do Something scenarios (Red = >40 µg/m$^3$, Orange = 30 – 40 µg/m$^3$, Yellow = 25 – 30 µg/m$^3$, Green = <25 µg/m$^3$)**

| Census_ID | Local Authority | Road | $NO_2$ concentration (µg/m3) | | |
|---|---|---|---|---|---|
| | | | Modelled 2024 DM | Modelled 2024 DS | Modelled DS - DM |
| 47139 | Oxford City Council | A4165 | 23.74 | 23.51 | -0.23 |
| 27135 | Oxford City Council | A4144 | 27.77 | 23.87 | -3.90 |
| 77436 | Vale of White Horse District Council | A34 | 38.48 | 39.83 | 1.35 |
| 37762 | Oxford City Council | A4144 | 26.51 | 25.95 | -0.56 |
| 17051 | Oxford City Council | A420 | 23.99 | 19.28 | -4.71 |
| 7658 | Oxford City Council | A4144 | 27.59 | 32.21 | 4.62 |
| 17629 | Oxford City Council | A4158 | 25.48 | 22.98 | -2.50 |
| 27121 | Oxford City Council | A420 | 33.17 | 32.11 | -1.06 |
| 77437 | Oxford City Council | A4142 | 27.80 | 29.17 | 1.37 |
| 77438 | Oxford City Council | A4142 | 23.72 | 23.17 | -0.55 |
| 75032 | Oxford City Council | A4144 | 23.80 | 20.32 | -3.48 |
| 37968 | Oxford City Council | A420 | 25.04 | 24.42 | -0.62 |
| 57031 | Oxford City Council | A420 | 21.40 | 18.12 | -3.28 |
| 47125 | Oxford City Council | A420 | 29.77 | 22.34 | -7.43 |
| 7657 | Oxford City Council | A4142 | 28.09 | 28.92 | 0.83 |
| 77439 | Oxford City Council | A4165 | 23.54 | 22.70 | -0.84 |
| 36442 | Oxford City Council | A40 | 33.74 | 33.71 | -0.03 |
| 75029 | Oxford City Council | A420 | 25.32 | 18.87 | -6.45 |
| 57761 | Oxford City Council | A4142 | 30.38 | 30.69 | 0.31 |
| 75030 | Oxford City Council | A420 | 20.90 | 18.65 | -2.25 |
| 75031 | Oxford City Council | A420 | 19.70 | 16.56 | -3.14 |

### 6.5.3 $PM_{10}$

Table 6.5 and Table 6.6 compare the maximum modelled $PM_{10}$ concentrations recorded at receptors alongside each of the PCM links for the 2019 base year and 2024 Do Minimum scenarios and 2019 base year and 2024 Do Something scenarios, respectively. In each case, representative concentrations for 2020 to 2023 have been calculated through linear interpolation between the two modelled years.

The modelled data shows no PCM links were in exceedance of the national $PM_{10}$ annual mean limit value of 40 µg/m$^3$ in 2019 or in the 2024 Do Minimum and 2024 Do Something scenarios.

**Table 6.5 $PM_{10}$ concentrations at PCM receptors for the 2019 base year and 2024 Do Minimum scenarios (Red = >40 µg/m$^3$, Orange = 30 – 40 µg/m$^3$, Yellow = 25 – 30 µg/m$^3$, Green = <25 µg/m$^3$). Concentrations for 2020 to 2023 have been calculated through linear interpolation**

| Census ID | Local Authority | Road | Maximum $PM_{10}$ concentration (µg/m$^3$) at receptors adjacent to PCM links | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Modelled | Interpolated | | | | Modelled |
| | | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 DM |
| 47139 | Oxford City Council | A4165 | **18.61** | 18.41 | 18.20 | 18.00 | 17.80 | **17.59** |
| 27135 | Oxford City Council | A4144 | **18.56** | 18.28 | 17.99 | 17.70 | 17.41 | **17.12** |
| 77436 | Vale of White Horse District Council | A34 | **26.36** | 25.97 | 25.58 | 25.18 | 24.79 | **24.40** |
| 37762 | Oxford City Council | A4144 | **19.38** | 19.10 | 18.83 | 18.55 | 18.28 | **18.01** |
| 17051 | Oxford City Council | A420 | **18.40** | 18.18 | 17.97 | 17.76 | 17.54 | **17.33** |
| 7658 | Oxford City Council | A4144 | **20.11** | 19.79 | 19.47 | 19.15 | 18.83 | **18.51** |
| 17629 | Oxford City Council | A4158 | **18.58** | 18.46 | 18.34 | 18.22 | 18.10 | **17.98** |
| 27121 | Oxford City Council | A420 | **21.05** | 20.75 | 20.44 | 20.14 | 19.84 | **19.53** |
| 77437 | Oxford City Council | A4142 | **19.19** | 19.00 | 18.81 | 18.63 | 18.44 | **18.25** |
| 77438 | Oxford City Council | A4142 | **19.55** | 19.27 | 18.99 | 18.71 | 18.43 | **18.15** |
| 75032 | Oxford City Council | A4144 | **17.62** | 17.36 | 17.11 | 16.85 | 16.60 | **16.34** |
| 37968 | Oxford City Council | A420 | **18.56** | 18.26 | 17.95 | 17.64 | 17.34 | **17.03** |
| 57031 | Oxford City Council | A420 | **18.28** | 18.03 | 17.78 | 17.54 | 17.29 | **17.05** |
| 47125 | Oxford City Council | A420 | **19.54** | 19.42 | 19.30 | 19.18 | 19.06 | **18.94** |
| 7657 | Oxford City Council | A4142 | **20.48** | 20.28 | 20.08 | 19.89 | 19.69 | **19.49** |
| 77439 | Oxford City Council | A4165 | **19.07** | 18.84 | 18.61 | 18.38 | 18.15 | **17.92** |
| 36442 | Oxford City Council | A40 | **24.88** | 24.62 | 24.35 | 24.09 | 23.82 | **23.56** |
| 75029 | Oxford City Council | A420 | **18.35** | 18.06 | 17.77 | 17.49 | 17.20 | **16.91** |
| 57761 | Oxford City Council | A4142 | **20.74** | 20.59 | 20.44 | 20.29 | 20.13 | **19.98** |
| 75030 | Oxford City Council | A420 | **17.48** | 17.22 | 16.96 | 16.69 | 16.43 | **16.16** |
| 75031 | Oxford City Council | A420 | **16.92** | 16.72 | 16.51 | 16.31 | 16.11 | **15.91** |

**Table 6.6 $PM_{10}$ concentrations at PCM receptors for the 2019 base year and 2024 Do Something scenarios (Red = >40 µg/m$^3$, Orange = 30 – 40 µg/m$^3$, Yellow = 25 – 30 µg/m$^3$, Green = <25 µg/m$^3$). Concentrations for 2020 to 2023 have been calculated through linear interpolation**

| Census ID | Local Authority | Road | Maximum $PM_{10}$ concentration (µg/m$^3$) at receptors adjacent to PCM links | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Modelled | Interpolated | | | | Modelled |
| | | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 DS |
| 47139 | Oxford City Council | A4165 | **18.61** | 18.43 | 18.24 | 18.06 | 17.88 | **17.69** |
| 27135 | Oxford City Council | A4144 | **18.56** | 18.04 | 17.53 | 17.01 | 16.49 | **15.97** |
| 77436 | Vale of White Horse District Council | A34 | **26.36** | 26.09 | 25.82 | 25.55 | 25.28 | **25.01** |
| 37762 | Oxford City Council | A4144 | **19.38** | 19.14 | 18.90 | 18.66 | 18.42 | **18.18** |
| 17051 | Oxford City Council | A420 | **18.40** | 18.15 | 17.90 | 17.64 | 17.39 | **17.14** |
| 7658 | Oxford City Council | A4144 | **20.11** | 19.92 | 19.72 | 19.52 | 19.33 | **19.13** |
| 17629 | Oxford City Council | A4158 | **18.58** | 18.45 | 18.31 | 18.18 | 18.05 | **17.91** |
| 27121 | Oxford City Council | A420 | **21.05** | 20.77 | 20.48 | 20.20 | 19.92 | **19.63** |
| 77437 | Oxford City Council | A4142 | **19.19** | 19.07 | 18.95 | 18.83 | 18.71 | **18.59** |
| 77438 | Oxford City Council | A4142 | **19.55** | 19.26 | 18.98 | 18.69 | 18.40 | **18.11** |
| 75032 | Oxford City Council | A4144 | **17.62** | 17.22 | 16.82 | 16.43 | 16.03 | **15.63** |
| 37968 | Oxford City Council | A420 | **18.56** | 18.23 | 17.90 | 17.57 | 17.24 | **16.91** |
| 57031 | Oxford City Council | A420 | **18.28** | 17.95 | 17.63 | 17.30 | 16.98 | **16.65** |
| 47125 | Oxford City Council | A420 | **19.54** | 19.12 | 18.69 | 18.27 | 17.85 | **17.42** |
| 7657 | Oxford City Council | A4142 | **20.48** | 20.35 | 20.22 | 20.09 | 19.97 | **19.84** |
| 77439 | Oxford City Council | A4165 | **19.07** | 18.82 | 18.57 | 18.32 | 18.06 | **17.81** |
| 36442 | Oxford City Council | A40 | **24.88** | 24.64 | 24.39 | 24.14 | 23.89 | **23.64** |
| 75029 | Oxford City Council | A420 | **18.35** | 17.94 | 17.54 | 17.14 | 16.74 | **16.34** |
| 57761 | Oxford City Council | A4142 | **20.74** | 20.62 | 20.49 | 20.37 | 20.25 | **20.12** |
| 75030 | Oxford City Council | A420 | **17.48** | 17.12 | 16.75 | 16.38 | 16.01 | **15.65** |
| 75031 | Oxford City Council | A420 | **16.92** | 16.69 | 16.46 | 16.24 | 16.01 | **15.79** |

Table 6.7 shows the difference in maximum modelled $PM_{10}$ concentrations at PCM receptors between the 2024 Do Minimum and 2024 Do Something scenarios caused as a result of the implementation of the Traffic Filters Scheme. 12 out of 21 road links show a decrease in $PM_{10}$ concentration as a result of the Traffic Filters Scheme. The maximum decrease in $PM_{10}$ concentration as a result of the Traffic Filters Scheme was 1.51 µg/m$^3$ on Census ID 47125, corresponding to the A420 (High Street / Headington Road). This location also has the maximum decrease in $NO_2$ and $PM_{2.5}$ concentrations.

The road links which show an increase in $PM_{10}$ concentration as a result of the scheme are all located on road links outside of the city centre: This is consistent with the other assessed pollutants. The maximum increase in $PM_{10}$ concentration as a result of the Traffic Filters Scheme was 0.62 µg/m$^3$ on Census ID 7658, corresponding to the A4144 (Woodstock Road / Wolvercote Roundabout). This location also has the maximum increase in $NO_2$ and $PM_{2.5}$ concentrations.

**Table 6.7 Difference in modelled $PM_{10}$ concentrations at PCM receptors between the 2024 Do Minimum and 2024 Do Something scenarios (Red = >40 µg/m$^3$, Orange = 30 – 40 µg/m$^3$, Yellow = 25 – 30 µg/m$^3$, Green = <25 µg/m$^3$)**

| Census_ID | Local Authority | Road | $PM_{10}$ concentration (µg/m$^3$) | | |
|---|---|---|---|---|---|
| | | | Modelled 2024 DM | Modelled 2024 DS | Modelled DS - DM |
| 47139 | Oxford City Council | A4165 | 17.59 | 17.69 | 0.10 |
| 27135 | Oxford City Council | A4144 | 17.12 | 15.97 | -1.15 |
| 77436 | Vale of White Horse District Council | A34 | 24.40 | 25.01 | 0.61 |
| 37762 | Oxford City Council | A4144 | 18.01 | 18.18 | 0.18 |
| 17051 | Oxford City Council | A420 | 17.33 | 17.14 | -0.19 |
| 7658 | Oxford City Council | A4144 | 18.51 | 19.13 | 0.62 |
| 17629 | Oxford City Council | A4158 | 17.98 | 17.91 | -0.07 |
| 27121 | Oxford City Council | A420 | 19.53 | 19.63 | 0.10 |
| 77437 | Oxford City Council | A4142 | 18.25 | 18.59 | 0.34 |
| 77438 | Oxford City Council | A4142 | 18.15 | 18.11 | -0.04 |
| 75032 | Oxford City Council | A4144 | 16.34 | 15.63 | -0.71 |
| 37968 | Oxford City Council | A420 | 17.03 | 16.91 | -0.12 |
| 57031 | Oxford City Council | A420 | 17.05 | 16.65 | -0.40 |
| 47125 | Oxford City Council | A420 | 18.94 | 17.42 | -1.51 |
| 7657 | Oxford City Council | A4142 | 19.49 | 19.84 | 0.35 |
| 77439 | Oxford City Council | A4165 | 17.92 | 17.81 | -0.11 |
| 36442 | Oxford City Council | A40 | 23.56 | 23.64 | 0.09 |
| 75029 | Oxford City Council | A420 | 16.91 | 16.34 | -0.58 |
| 57761 | Oxford City Council | A4142 | 19.98 | 20.12 | 0.14 |
| 75030 | Oxford City Council | A420 | 16.16 | 15.65 | -0.52 |
| 75031 | Oxford City Council | A420 | 15.91 | 15.79 | -0.12 |

### 6.5.4 $PM_{2.5}$

Table 6.8 and Table 6.9 compare the maximum modelled $PM_{2.5}$ concentrations recorded at receptors alongside each of the PCM links for the 2019 base year and 2024 Do Minimum scenarios and 2019 base year and 2024 Do Something scenarios, respectively. In each case, representative concentrations for 2020 to 2023 have been calculated through linear interpolation between the two modelled years.

The modelled data shows no PCM links were in exceedance of the national $PM_{2.5}$ annual mean limit value of 20 µg/$m^3$ in 2019 or in the 2024 Do Minimum and 2024 Do Something scenarios.

All PCM links had receptors in 2019 and in the 2024 Do Minimum and 2024 Do Something scenarios with concentrations above the annual mean concentration target of 10 µg/$m^3$ to be met across England by 2040.

**Table 6.8 $PM_{2.5}$ concentrations at PCM receptors for the 2019 base year and 2024 Do Minimum scenarios (Red = >20 µg/m$^3$, Orange = 15 – 20 µg/m$^3$, Yellow = 10 – 15 µg/m$^3$, Green = <10 µg/m$^3$). Concentrations for 2020 to 2023 have been calculated through linear interpolation**

| Census ID | Local Authority | Road | Maximum $PM_{2.5}$ concentration (µg/m$^3$) at PCM receptors | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Modelled | Interpolated | | | | Modelled |
| | | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 DM |
| 47139 | Oxford City Council | A4165 | 12.20 | 12.02 | 11.83 | 11.65 | 11.46 | 11.27 |
| 27135 | Oxford City Council | A4144 | 12.30 | 12.07 | 11.83 | 11.60 | 11.36 | 11.12 |
| 77436 | Vale of White Horse District Council | A34 | 16.70 | 16.37 | 16.03 | 15.70 | 15.37 | 15.04 |
| 37762 | Oxford City Council | A4144 | 12.84 | 12.61 | 12.38 | 12.15 | 11.92 | 11.69 |
| 17051 | Oxford City Council | A420 | 12.48 | 12.30 | 12.12 | 11.95 | 11.77 | 11.59 |
| 7658 | Oxford City Council | A4144 | 13.22 | 12.95 | 12.69 | 12.43 | 12.16 | 11.90 |
| 17629 | Oxford City Council | A4158 | 12.78 | 12.62 | 12.46 | 12.30 | 12.14 | 11.98 |
| 27121 | Oxford City Council | A420 | 13.50 | 13.24 | 12.98 | 12.73 | 12.47 | 12.22 |
| 77437 | Oxford City Council | A4142 | 12.72 | 12.55 | 12.38 | 12.20 | 12.03 | 11.86 |
| 77438 | Oxford City Council | A4142 | 13.07 | 12.84 | 12.61 | 12.38 | 12.15 | 11.92 |
| 75032 | Oxford City Council | A4144 | 11.78 | 11.57 | 11.36 | 11.15 | 10.94 | 10.74 |
| 37968 | Oxford City Council | A420 | 12.41 | 12.16 | 11.91 | 11.67 | 11.42 | 11.17 |
| 57031 | Oxford City Council | A420 | 12.12 | 11.91 | 11.69 | 11.48 | 11.26 | 11.05 |
| 47125 | Oxford City Council | A420 | 13.08 | 12.93 | 12.79 | 12.64 | 12.50 | 12.35 |
| 7657 | Oxford City Council | A4142 | 13.65 | 13.46 | 13.27 | 13.08 | 12.88 | 12.69 |
| 77439 | Oxford City Council | A4165 | 12.43 | 12.23 | 12.03 | 11.82 | 11.62 | 11.42 |
| 36442 | Oxford City Council | A40 | 15.60 | 15.35 | 15.10 | 14.85 | 14.60 | 14.35 |
| 75029 | Oxford City Council | A420 | 12.26 | 12.02 | 11.77 | 11.52 | 11.27 | 11.02 |
| 57761 | Oxford City Council | A4142 | 13.85 | 13.70 | 13.55 | 13.39 | 13.24 | 13.08 |
| 75030 | Oxford City Council | A420 | 11.73 | 11.52 | 11.31 | 11.09 | 10.88 | 10.67 |
| 75031 | Oxford City Council | A420 | 11.41 | 11.24 | 11.06 | 10.88 | 10.71 | 10.53 |

**Table 6.9 $PM_{2.5}$ concentrations at PCM receptors for the 2019 base year and 2024 Do Something (Red = >20 µg/m$^3$, Orange = 15 – 20 µg/m$^3$, Yellow = 10 – 15 µg/m$^3$, Green = <10 µg/m$^3$). Concentrations for 2020 to 2023 have been calculated through linear interpolation**

| Census ID | Local Authority | Road | Maximum $PM_{2.5}$ concentration (µg/m$^3$) at PCM receptors | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Modelled | Interpolated | | | | Modelled |
| | | | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 DS |
| 47139 | Oxford City Council | A4165 | 12.20 | 12.03 | 11.85 | 11.68 | 11.50 | 11.33 |
| 27135 | Oxford City Council | A4144 | 12.30 | 11.93 | 11.55 | 11.18 | 10.80 | 10.43 |
| 77436 | Vale of White Horse District Council | A34 | 16.70 | 16.44 | 16.17 | 15.91 | 15.65 | 15.39 |
| 37762 | Oxford City Council | A4144 | 12.84 | 12.63 | 12.42 | 12.21 | 12.00 | 11.79 |
| 17051 | Oxford City Council | A420 | 12.48 | 12.27 | 12.07 | 11.86 | 11.66 | 11.45 |
| 7658 | Oxford City Council | A4144 | 13.22 | 13.03 | 12.84 | 12.64 | 12.45 | 12.26 |
| 17629 | Oxford City Council | A4158 | 12.78 | 12.61 | 12.44 | 12.27 | 12.10 | 11.93 |
| 27121 | Oxford City Council | A420 | 13.50 | 13.25 | 13.01 | 12.76 | 12.52 | 12.27 |
| 77437 | Oxford City Council | A4142 | 12.72 | 12.59 | 12.46 | 12.33 | 12.20 | 12.07 |
| 77438 | Oxford City Council | A4142 | 13.07 | 12.84 | 12.60 | 12.37 | 12.13 | 11.90 |
| 75032 | Oxford City Council | A4144 | 11.78 | 11.48 | 11.19 | 10.90 | 10.60 | 10.31 |
| 37968 | Oxford City Council | A420 | 12.41 | 12.15 | 11.88 | 11.62 | 11.36 | 11.10 |
| 57031 | Oxford City Council | A420 | 12.12 | 11.86 | 11.59 | 11.33 | 11.06 | 10.80 |
| 47125 | Oxford City Council | A420 | 13.08 | 12.75 | 12.42 | 12.09 | 11.76 | 11.43 |
| 7657 | Oxford City Council | A4142 | 13.65 | 13.48 | 13.31 | 13.14 | 12.97 | 12.80 |
| 77439 | Oxford City Council | A4165 | 12.43 | 12.22 | 12.00 | 11.78 | 11.57 | 11.35 |
| 36442 | Oxford City Council | A40 | 15.60 | 15.36 | 15.12 | 14.88 | 14.64 | 14.40 |
| 75029 | Oxford City Council | A420 | 12.26 | 11.95 | 11.64 | 11.32 | 11.01 | 10.69 |
| 57761 | Oxford City Council | A4142 | 13.85 | 13.72 | 13.58 | 13.44 | 13.30 | 13.17 |
| 75030 | Oxford City Council | A420 | 11.73 | 11.46 | 11.18 | 10.91 | 10.63 | 10.36 |
| 75031 | Oxford City Council | A420 | 11.41 | 11.22 | 11.02 | 10.83 | 10.63 | 10.44 |

Table 6.10 shows the difference in maximum modelled $PM_{2.5}$ concentrations at PCM receptors between the 2024 Do Minimum and 2024 Do Something scenarios caused as a result of the implementation of the Traffic Filters Scheme. 12 out of 21 road links show a decrease in $PM_{2.5}$ concentration as a result of the Traffic Filters Scheme. The maximum decrease in $PM_{2.5}$ concentration as a result of the Traffic Filters Scheme was 0.92 µg/m$^3$ on Census ID 47125, corresponding to the A420 (High Street / Headington Road). This location also has the maximum decrease in $NO_2$ and $PM_{10}$ concentrations.

The road links which show an increase in $PM_{2.5}$ concentration as a result of the scheme are all located on road links outside of the city centre: This is consistent with the other assessed pollutants. The maximum increase in $PM_{2.5}$ concentration as a result of the Traffic Filters Scheme was 0.36 µg/m$^3$ on Census ID 7658, corresponding to the A4144 (Woodstock Road / Wolvercote Roundabout). This location also has the maximum increase in $NO_2$ and $PM_{10}$ concentrations.

**Table 6.10 Difference in modelled $PM_{2.5}$ concentrations at PCM receptors between the 2024 Do Minimum and 2024 Do Something scenarios (Red = >20 µg/m$^3$, Orange = 15 – 20 µg/m$^3$, Yellow = 10 – 15 µg/m$^3$, Green = <10 µg/m$^3$)**

| Census_ID | Local Authority | Road | $PM_{2.5}$ concentration (µg/m$^3$) | | |
|---|---|---|---|---|---|
| | | | Modelled 2024 DM | Modelled 2024 DS | Modelled DS - DM |
| 47139 | Oxford City Council | A4165 | 11.27 | 11.33 | 0.06 |
| 27135 | Oxford City Council | A4144 | 11.12 | 10.43 | -0.70 |
| 77436 | Vale of White Horse District Council | A34 | 15.04 | 15.39 | 0.35 |
| 37762 | Oxford City Council | A4144 | 11.69 | 11.79 | 0.10 |
| 17051 | Oxford City Council | A420 | 11.59 | 11.45 | -0.14 |
| 7658 | Oxford City Council | A4144 | 11.90 | 12.26 | 0.36 |
| 17629 | Oxford City Council | A4158 | 11.98 | 11.93 | -0.06 |
| 27121 | Oxford City Council | A420 | 12.22 | 12.27 | 0.06 |
| 77437 | Oxford City Council | A4142 | 11.86 | 12.07 | 0.21 |
| 77438 | Oxford City Council | A4142 | 11.92 | 11.90 | -0.03 |
| 75032 | Oxford City Council | A4144 | 10.74 | 10.31 | -0.43 |
| 37968 | Oxford City Council | A420 | 11.17 | 11.10 | -0.08 |
| 57031 | Oxford City Council | A420 | 11.05 | 10.80 | -0.25 |
| 47125 | Oxford City Council | A420 | 12.35 | 11.43 | -0.92 |
| 7657 | Oxford City Council | A4142 | 12.69 | 12.80 | 0.11 |
| 77439 | Oxford City Council | A4165 | 11.42 | 11.35 | -0.07 |
| 36442 | Oxford City Council | A40 | 14.35 | 14.40 | 0.05 |
| 75029 | Oxford City Council | A420 | 11.02 | 10.69 | -0.33 |
| 57761 | Oxford City Council | A4142 | 13.08 | 13.17 | 0.08 |
| 75030 | Oxford City Council | A420 | 10.67 | 10.36 | -0.31 |
| 75031 | Oxford City Council | A420 | 10.53 | 10.44 | -0.09 |

## 6.6 Results for local monitoring sites

### 6.6.1 $NO_2$

Automatic monitoring stations (CM) and diffusion tubes (DT) have been sited to capture the worst-case exceedance locations on road links within the City of Oxford AQMA. Pollutant concentrations at these locations therefore provide a good indication of local air quality and potential exceedances in relation to the local air quality management regime.

Table 6.11 shows the measured and modelled annual mean $NO_2$ concentrations at specified monitoring site locations in 2019 and the modelled concentrations for the two scenarios, with and without Traffic Filters, in 2024. Mapped diffusion tube locations showing modelled concentrations for the 2024 Do Minimum and Do Something scenarios are shown in Figure 6.21 and Figure 6.22, respectively.

Measured concentrations from 2019 showed exceedance of the national 40 $\mu g/m^3$ $NO_2$ annual mean objective at 10 locations and 25 locations with concentrations above the Oxford limit value (30 $\mu g/m^3$).

The 2024 Do Minimum scenario shows no modelled $NO_2$ concentrations above the national objective at the monitoring locations and one exceedance of the Oxford objective at DT_55 (St Clements). There are five additional monitoring sites with modelled concentrations within 10% of the Oxford objective (27 – 30 $\mu g/m^3$).

The 2024 Do Something scenario shows no modelled $NO_2$ concentrations above the national or Oxford objectives at the monitoring locations and there are two additional monitoring sites with modelled concentrations within 10% of the Oxford objective (27 – 30 $\mu g/m^3$).

Implementation of the Traffic Filters Scheme shows a decrease in $NO_2$ concentrations at all monitoring locations except seven (DT 26 at Cuttleslowe Roundabout 3 Summers Place, DT 29 at Pear Tree Park & Ride North Gateway, DT 30 at Osney Lane/Hollybush Row, DT 35 at Botley Rd /Hillview Rd, DT 36 at Botley Road North (Prestwich Place), DT 83 at A44 Woodstock Road, DT 84 at 226 Botley Rd.). The largest decrease in concentration as a result of the scheme was 8.17 $\mu g/m^3$ observed at DT_55 (St Clements). The location no longer exceeds the Oxford limit value as a result of implementation of the traffic filters. The largest increase in concentration as a result of the scheme was 0.65 $\mu g/m^3$ observed at DT 36 at Botley Road North (Prestwich Place).

**Table 6.11 Measured and modelled $NO_2$ annual mean concentrations at monitoring site locations (2019, 2024 Do Minimum and 2024 Do Something (Traffic Filters)) (Red = >40 µg/m$^3$, Orange = 30 – 40 µg/m$^3$, Yellow = 25 – 30 µg/m$^3$, Green = <25 µg/m$^3$)**

| Location | Site ID | $NO_2$ concentration (µg/m$^3$) | | | | Location | Site ID | $NO_2$ concentration (µg/m$^3$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Measured 2019 | Modelled 2019 | Modelled 2024 DM | Modelled 2024 DS | | | Measured 2019 | Modelled 2019 | Modelled 2024 DM | Modelled 2024 DS |
| St Ebbe's | DT_1 | 15.75 | 15.11 | 12.63 | 12.48 | High St. / Turl St. | DT_50 | 31.98 | 36.03 | 18.72 | 16.90 |
| Weirs Lne./Abingdon Rd. LP1 | DT_2 | 28.84 | 33.53 | 24.03 | 23.08 | 50 High St. | DT_51 | 36.60 | 45.27 | 21.81 | 17.91 |
| LP 52 Abingdon Rd. | DT_3 | 33.93 | 33.79 | 23.56 | 23.41 | Longwall St. | DT_52 | 41.44 | 28.62 | 20.80 | 16.77 |
| Boundary Brook Rd/ Iffley Rd | DT_4 | 28.07 | 30.84 | 24.96 | 23.40 | Magdalen Bridge | DT_53 | 23.29 | 37.52 | 23.38 | 17.85 |
| Lenthall Rd Allotments | DT_5 | 14.15 | 14.64 | 12.61 | 12.53 | York Place | DT_54 | 25.75 | 27.38 | 20.39 | 16.74 |
| Oxford Rd/ Between Towns Rd | DT_7 | 31.57 | 28.14 | 23.16 | 22.74 | St Clements | DT_55 | 53.01 | 42.86 | 32.24 | 24.07 |
| Oxford Rd(Cowley) LP13 | DT_8 | 31.14 | 27.96 | 23.72 | 23.35 | High St. | DT_56 | 49.61 | 37.01 | 18.83 | 16.89 |
| Churchill Drive/Old Rd | DT_12 | 28.37 | 25.15 | 18.82 | 18.53 | Speedwell St. / St. Aldate's | DT_57 | 38.58 | 52.50 | 24.66 | 17.93 |
| Windmill Rd. W | DT_14 | 35.45 | 30.24 | 18.02 | 16.36 | Folly Bridge | DT_58 | 34.09 | 28.10 | 20.40 | 18.57 |
| London Rd./BHF | DT_15 | 27.28 | 37.75 | 21.56 | 18.44 | Thames St. | DT_59 | 25.90 | 26.53 | 20.19 | 18.18 |
| Headley Way/London Rd. LP2 | DT_16 | 26.97 | 30.73 | 20.92 | 18.12 | New Butterwyke Place/ Thames St. | DT_60 | 32.56 | 26.88 | 20.06 | 17.96 |
| 49 London Rd. /Latimer/Sandfield Rds | DT_17 | 25.48 | 27.87 | 18.78 | 16.76 | Friars Wharf | DT_61 | 19.84 | 26.16 | 19.66 | 17.60 |
| The Roundway | DT_18 | 28.37 | 27.83 | 19.79 | 19.24 | 1 Blackfriars Rd. | DT_62 | 19.89 | 23.45 | 16.76 | 15.27 |
| Barton Lane LP2 | DT_20 | 27.64 | 22.94 | 17.49 | 17.30 | Thames St. / Trinity St. | DT_63 | 19.32 | 24.57 | 17.79 | 16.43 |
| North Way /Barton Village Rd LP20 | DT_21 | 26.75 | 20.03 | 15.80 | 15.59 | Thames St. / Oxpens Rd. | DT_64 | 22.53 | 29.60 | 20.92 | 19.42 |
| Cuttleslowe Rbout 3 Elsfield Rd. | DT_25 | 35.03 | 38.35 | 28.19 | 26.43 | Speedwell St. / Littlegate | DT_65 | 30.87 | 30.52 | 19.07 | 16.87 |
| Cuttleslowe Rbout 3 Summers Place | DT_26 | 40.43 | 39.53 | 28.23 | 28.43 | 36 Faulkner St. | DT_66 | 24.74 | 21.56 | 15.01 | 14.12 |
| Wolvercote Rbout 78 Sunderland Ave. | DT_27 | 29.32 | 31.22 | 21.65 | 21.34 | Old Greyfriars St | DT_67 | 20.04 | 21.65 | 14.55 | 13.92 |
| Wolvercote Rbout 51 Sunderland Ave | DT_28 | 25.91 | 30.77 | 21.17 | 20.88 | Norfolk St. | DT_68 | 26.84 | 23.02 | 15.39 | 14.43 |
| Pear Tree P&R N Gateway | DT_29 | 26.36 | 23.72 | 18.54 | 18.67 | Paradise Square | DT_69 | 25.88 | 20.60 | 14.99 | 14.36 |
| Osney Lne/Hollybush Row | DT_30 | 27.35 | 33.38 | 19.43 | 19.54 | Castle St. | DT_70 | 28.90 | 27.61 | 16.01 | 14.70 |
| Beckett St. | DT_31 | 31.54 | 32.07 | 22.79 | 22.70 | BP City Motors | DT_71 | 40.10 | 38.61 | 26.91 | 26.57 |
| Royal Oxford Hotel | DT_32 | 32.47 | 36.57 | 23.61 | 20.78 | Cowley Rd./ James Street | DT_72 | 30.59 | 30.51 | 23.37 | 21.12 |
| Botley RD/ Mill St | DT_33 | 24.47 | 26.35 | 21.02 | 20.63 | Walton Street LP18 | DT_73 | 23.98 | 24.30 | 18.28 | 16.14 |
| Botley Rd /Hillview Rd | DT_35 | 34.10 | 32.08 | 24.03 | 24.56 | St Gilles | DT_76 | 35.09 | 26.02 | 18.79 | 16.65 |
| Botley Rd N (Prestwich Place) | DT_36 | 24.64 | 25.72 | 21.36 | 22.01 | St Clements 2 | DT_77 | 42.39 | 29.65 | 23.20 | 18.33 |
| St Aldate's | DT_39 | 42.54 | 30.42 | 17.63 | 16.21 | William Lucy Way | DT_78 | 22.79 | 14.93 | 12.63 | 12.55 |
| Queen St. | DT_40 | 28.48 | 22.82 | 14.80 | 14.10 | Old Abingdon Rd. | DT_79 | 24.40 | 25.68 | 16.60 | 16.53 |
| Bonn Square | DT_41 | 25.79 | 23.01 | 14.89 | 14.16 | Holloway Road | DT_80 | 36.91 | 30.80 | 22.70 | 22.38 |
| New Rd. | DT_42 | 33.17 | 28.55 | 16.90 | 15.29 | Cowley Rd/ Union Street | DT_81 | 21.96 | 28.09 | 20.75 | 18.97 |
| Park End St. | DT_43 | 34.59 | 34.00 | 22.24 | 18.42 | Summertown Parade | DT_82 | 27.36 | 20.10 | 14.64 | 14.27 |
| Hythe Bridge St. | DT_44 | 30.08 | 28.52 | 22.37 | 19.48 | A44 Woodstock Rd. | DT_83 | 39.85 | 34.42 | 23.42 | 24.00 |
| Worcester St. | DT_45 | 39.84 | 37.43 | 28.51 | 24.41 | 226 Botley Rd. | DT_84 | 26.79 | 35.34 | 29.52 | 29.72 |
| Beaumont St. | DT_46 | 31.35 | 33.24 | 27.00 | 22.59 | St Clements 3 | DT_85 | 36.46 | 29.21 | 25.29 | 18.45 |
| George St. / Magdalen St. | DT_47 | 39.97 | 34.33 | 16.87 | 15.30 | AURN Oxford Centre | CM1 | 42.00 | 30.42 | 17.63 | 16.21 |
| George St. | DT_48 | 43.60 | 29.63 | 20.66 | 19.25 | Oxford High Street | CM2 | 40.00 | 46.11 | 21.81 | 18.39 |
| Cornmarket St. | DT_49 | 26.31 | 22.69 | 14.81 | 14.17 | AURN St Ebbes | CM3 | 16.00 | 15.11 | 12.63 | 12.48 |

**Figure 6-21 Modelled 2024 Do Minimum (without Traffic Filters) $NO_2$ concentrations at monitoring locations**

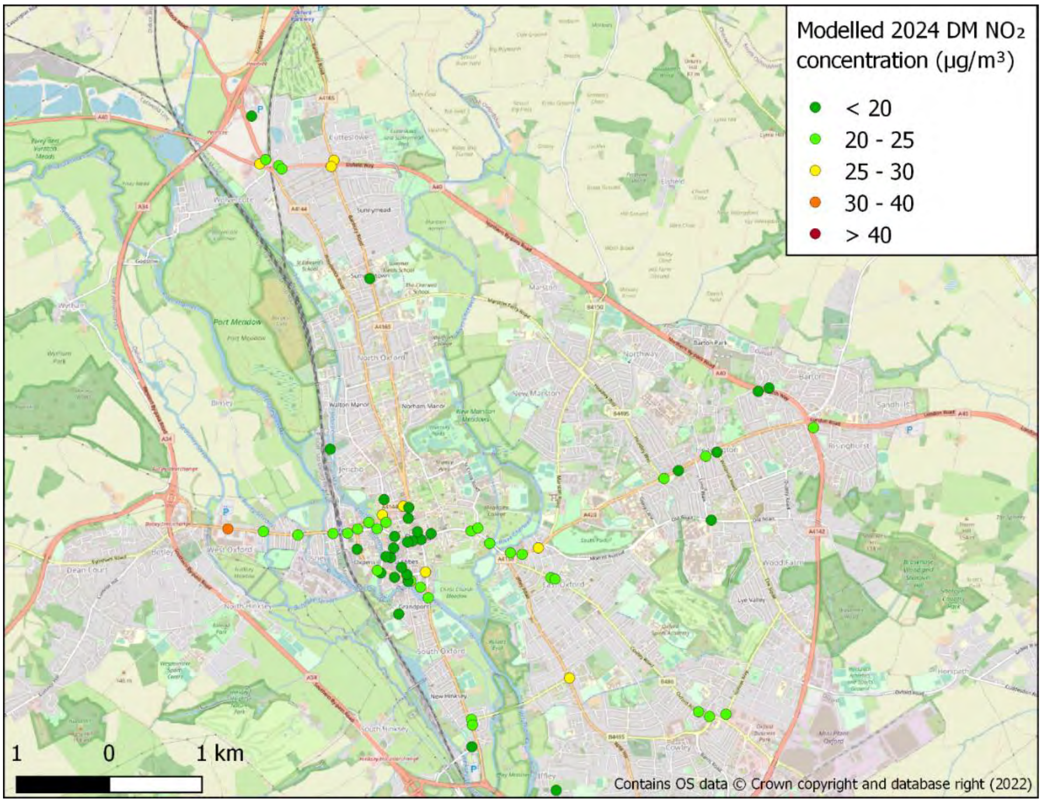
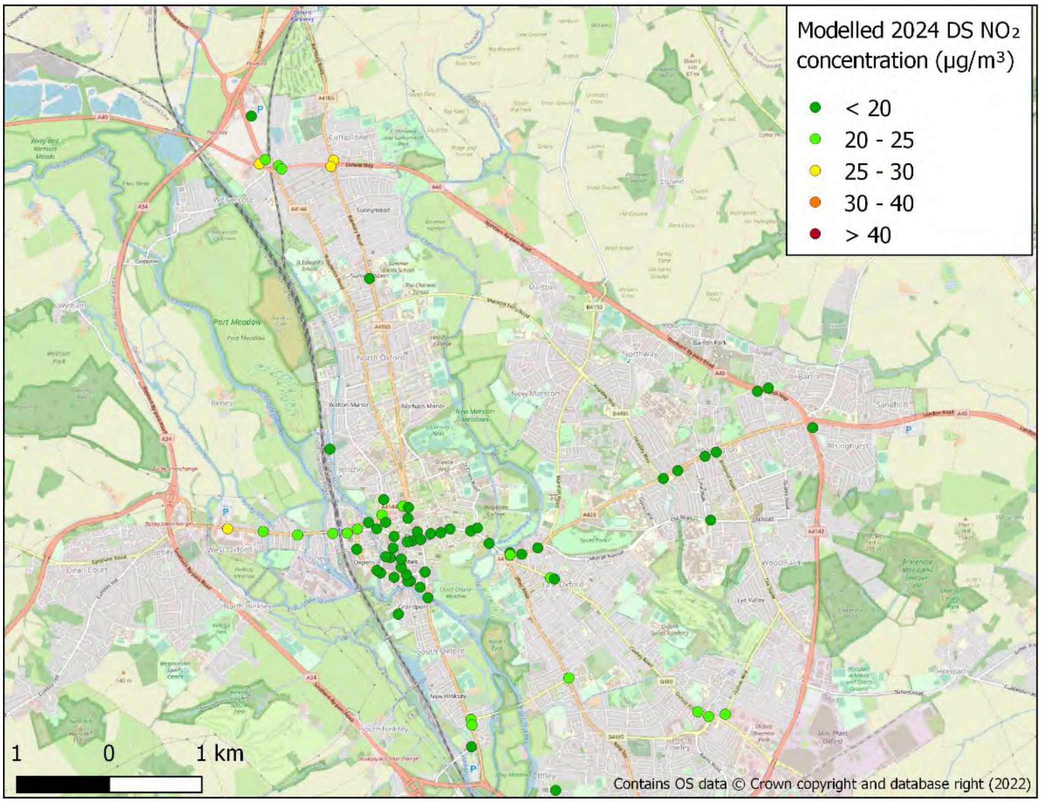


**Figure 6-22 Modelled 2024 Do Something (Traffic Filter) $NO_2$ concentrations at monitoring locations**




## 6.6.2 $PM_{10}$ and $PM_{2.5}$

Table 6.12 and Table 6.13 show the measured and modelled annual mean $PM_{10}$ and $PM_{2.5}$ concentrations at specified monitoring site locations in 2019 and for the 2024 Do Minimum and 2024 Do Something scenarios.

Measured concentrations from 2019 show no exceedance of the national 40 µg/m³ $PM_{10}$ annual mean objective or 20 µg/m³ $PM_{2.5}$ annual mean objective.

The modelled concentrations at the monitoring locations in the 2024 Do Minimum and Do Something scenarios also show no exceedance of the national objectives. Implementation of the Traffic Filters Scheme shows a decrease in both $PM_{10}$ and $PM_{2.5}$ concentrations at all monitoring locations. The largest decreases in $PM_{10}$ and $PM_{2.5}$ concentrations as a result of the scheme were 0.37 µg/m³ and 0.24 µg/m³ observed at CM2 (Oxford High Street) for $PM_{10}$ and $PM_{2.5}$ respectively.

**Table 6.12 Measured and modelled $PM_{10}$ annual mean concentrations at monitoring site locations (2019, 2024 Do Minimum and 2024 Do Something (Traffic Filters)) (Red = >40 µg/m³, Orange = 30 – 40 µg/m³, Yellow = 25 – 30 µg/m³, Green = <25 µg/m³).**

| Location | Site ID | Latitude | Longitude | $PM_{10}$ concentration (µg/m³) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Measured 2019 | Modelled 2019 | Modelled 2024 DM | Modelled 2024 DS |
| AURN Oxford Centre | CM1 | 51.752 | -1.257 | - | 17.02 | 15.87 | 15.77 |
| Oxford High Street | CM2 | 51.753 | -1.253 | 19.00 | 18.29 | 17.06 | 16.69 |
| AURN St Ebbes | CM3 | 51.745 | -1.261 | 14.00 | 15.31 | 14.29 | 14.27 |

**Table 6.13 Measured and modelled $PM_{2.5}$ annual mean concentrations at monitoring site locations (2019, 2024 Do Minimum and 2024 Do Something (Traffic Filters)) (Red = >20 µg/m$^3$, Orange = 15 – 20 µg/m$^3$, Yellow = 10 – 15 µg/m$^3$, Green = <10 µg/m$^3$)**

| Location | Site ID | Latitude | Longitude | $PM_{2.5}$ concentration (µg/m$^3$) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Measured 2019 | Modelled 2019 | Modelled 2024 DM | Modelled 2024 DS |
| AURN Oxford Centre | CM1 | 51.752 | -1.257 | - | 11.33 | 10.37 | 10.31 |
| Oxford High Street | CM2 | 51.753 | -1.253 | - | 12.12 | 11.04 | 10.81 |
| AURN St Ebbes | CM3 | 51.745 | -1.261 | 9.00 | 10.39 | 9.60 | 9.59 |

# 7 $CO_2$ total emissions

The table below summarises the total modelled emissions of $CO_2$ (in tonnes per year) across the entirety of the modelling domain, for each modelling scenario. The $CO_2$ emissions have been separated into emissions from direct ($CO_2$ Emissions from Tailpipe) and indirect ($CO_2$e Emissions from Electric Charging) sources for each scenario. A 11909 tonnes/annum reduction in $CO_2$ emissions as a result of implementation of the Traffic Filters Scheme is shown for the model domain.

**Table 7.1 Total modelled emissions of $CO_2$ for all modelling scenarios (tonnes/yr) across the modelling domain**

| Scenario | Total $CO_2$ Emissions (tonnes/annum) | Direct $CO_2$ Emissions from Tailpipe (tonnes/annum) | Indirect $CO_2$e Emissions from Electric Charging (tonnes/annum) |
|---|---|---|---|
| 2019 | 203692 | 203332 | 360 |
| 2024 DM | 193564 | 191533 | 2031 |
| 2024 DS | 181655 | 179643 | 2012 |
| DS – DM | –11909 | –11890 | –19 |

# 8 Conclusions

This report detailed the air quality $NO_2$, $PM_{10}$ and $PM_{2.5}$ modelling results for Oxford for different scenarios in 2019 and 2024 and provided an assessment of the impact of the proposed Traffic Filters Scheme. Modelled concentrations were reported at receptors relevant to the national air quality objective for the protection of human health including roadside PCM receptors and existing air quality monitoring site locations. Concentrations are also provided as contour plots across the whole city.

The modelled results for the 2024 Do Minimum and 2024 Do Something (Traffic Filters) scenarios showed that:

**$NO_2$**

- No PCM links were in exceedance of the national $NO_2$ annual mean limit value in the 2024 Do Minimum or 2024 Do Something scenarios
- Four PCM links were exceedance of the Oxford $NO_2$ annual mean limit value the 2024 Do Minimum scenario
- Five PCM links were exceedance of the Oxford $NO_2$ annual mean limit value in the 2024 Do Something scenario
- 16 out of 21 road links show a decrease in $NO_2$ concentration as a result of the Traffic Filters Scheme
- The maximum decrease in $NO_2$ concentration as a result of the scheme was 7.43 $\mu g/m^3$ on Census ID 47125, corresponding to the A420 (High Street / Headington Road). This location also has the maximum decrease in $PM_{10}$ and $PM_{2.5}$ concentrations
- The maximum increase in $NO_2$ concentration as a result of the Traffic Filters Scheme was 4.62 $\mu g/m^3$ on Census ID 7658, corresponding to the A4144 (Woodstock Road / Wolvercote Roundabout). This location also has the maximum increase in $PM_{10}$ and $PM_{2.5}$ concentrations
- The 2024 Do Minimum scenario shows no modelled $NO_2$ concentrations above the national objective at the monitoring locations and one exceedance of the Oxford objective at DT_55 (St Clements). There are five additional monitoring sites with modelled concentrations within 10% of the Oxford objective (27 – 30 $\mu g/m^3$)
- The 2024 Do Something scenario shows no modelled $NO_2$ concentrations above the national or Oxford objectives at the monitoring locations and there are two additional monitoring sites with modelled concentrations within 10% of the Oxford objective (27 – 30 $\mu g/m^3$)
- Implementation of the Traffic Filters Scheme shows a decrease in $NO_2$ concentrations at 67 out of 74 monitoring locations.
- The largest decrease in $NO_2$ concentration at monitoring locations as a result of the scheme was 8.17 $\mu g/m^3$ observed at DT_55 (St Clements). The location no longer exceeds the Oxford limit value as a result of implementation of the traffic filters.
- The largest increase in $NO_2$ concentration at monitoring locations as a result of the scheme was 0.65 $\mu g/m^3$ observed at DT_36 (Botely Rd N, Prestwich Place)

**$PM_{10}$**

- No PCM links were in exceedance of the national $PM_{10}$ annual mean limit value of 40 $\mu g/m^3$

- 12 out of 21 road links show a decrease in $PM_{10}$ concentration as a result of the Traffic Filters Scheme.
- The maximum decrease in $PM_{10}$ concentration as a result of the scheme was 1.51 µg/$m^3$ on Census ID 47125, corresponding to the A420 (High Street / Headington Road). This location also has the maximum decrease in $NO_2$ and $PM_{2.5}$ concentrations
- The road links which show an increase in $PM_{10}$ concentration as a result of the scheme are all located on road links outside of the city centre: This is consistent with the other assessed pollutants
- The maximum increase in $PM_{10}$ concentration as a result of the scheme was 0.62 µg/$m^3$ on Census ID 7658, corresponding to the A4144 (Woodstock Road / Wolvercote Roundabout). This location also has the maximum increase in $NO_2$ and $PM_{2.5}$ concentrations
- The 2024 Do Minimum and Do Something scenarios also show no exceedance of the $PM_{10}$ national objective at current automatic monitoring site locations
- Implementation of the scheme shows a decrease in $PM_{10}$ concentrations at all monitoring locations
- The largest decrease in $PM_{10}$ concentration as a result of the scheme was 0.37 µg/$m^3$ observed at CM2 (Oxford High Street)

**$PM_{2.5}$**

- No PCM links were in exceedance of the national $PM_{2.5}$ annual mean limit value of 20 µg/$m^3$ in the 2024 Do Minimum and 2024 Do Something scenarios.
- All PCM links had receptors in the 2024 Do Minimum and 2024 Do Something scenarios with concentrations above the annual mean concentration target of 10 µg/$m^3$ to be met across England by 2040
- 12 out of 21 road links show a decrease in $PM_{2.5}$ concentration as a result of the Traffic Filters Scheme
- The maximum decrease in $PM_{2.5}$ concentration as a result of the scheme was 0.92 µg/$m^3$ on Census ID 47125, corresponding to the A420 (High Street / Headington Road). This location also has the maximum decrease in $NO_2$ and $PM_{10}$ concentrations
- The road links which show an increase in $PM_{2.5}$ concentration as a result of the scheme are all located on road links outside of the city centre: This is consistent with the other assessed pollutants
- The maximum increase in $PM_{2.5}$ concentration as a result of the scheme was 0.36 µg/$m^3$ on Census ID 7658, corresponding to the A4144 (Woodstock Road / Wolvercote Roundabout). This location also has the maximum increase in $NO_2$ and $PM_{10}$ concentrations
- The 2024 Do Minimum and Do Something scenarios also show no exceedance of the $PM_{10}$ national objective at current automatic monitoring site locations
- Implementation of the scheme shows a decrease in $PM_{2.5}$ concentrations at all monitoring locations

- The largest decrease in $PM_{2.5}$ concentration as a result of the scheme was 0.24 μg/m$^3$ observed at CM2 (Oxford High Street)

# A Air quality model verification and adjustment

## A.1 NOx and $NO_2$

Ratified $NO_2$ measurements from 74 monitoring locations were used for the model verification.

RapidAIR was used to generate a map of NOx concentrations arising from road traffic sources across the study area at a 1 m x 1 m resolution, based on the traffic activity data from the 2019 base year scenario (Section 4.4.6) and 2019 meteorological data (Section 4.4.2). Background NOx values for 2019 were obtained from the background maps available on the LAQM website (Section 4.3). The most up to date background maps used a 2018 base year.

It was appropriate to verify the RapidAIR model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + $NO_2$). The model output of Road NOx (the total NOx originating from road traffic) was compared to the measured Road NOx, where the measured Road NOx contribution is calculated as the difference between the total NOx and the background NOx value. Total measured NOx for each diffusion tube was calculated from the measured $NO_2$ concentration using the latest version of the Defra NOx/$NO_2$ calculator.

This initial comparison indicated that the model was under-predicting the NOx arising from road emissions at most locations. Refinements were subsequently made to the model inputs to improve model performance where possible, and a linear adjustment factor of **2.56** was calculated for the road emissions component of the NOx model.

Total NOx was calculated as the sum of the adjusted Road NOx contribution from RapidAIR and the Defra 2019 background maps (with main road sources removed from the background map). Total $NO_2$ concentrations at specified receptors were subsequently obtained from background and adjusted road NOx concentrations using the NOx to $NO_2$ calculator provided by Defra (Section 4.4.8).

To evaluate model performance and uncertainty, the Root Mean Square Error (RMSE) for the observed vs predicted $NO_2$ annual mean concentrations was calculated, as detailed in Technical Guidance LAQM.TG(16). This guidance indicates that for an annual model, a RMSE of up to 4 µg/m$^3$ is ideal, and an RMSE of up to 10 µg/m$^3$ is acceptable. In this case the RMSE value was **6.14** µg/m$^3$, which shows good agreement between modelled and measured concentrations

Total $NO_2$ concentrations at specified receptors were obtained from background and adjusted road NOx concentrations using the NOx to $NO_2$ calculator provided by Defra[29].

Where annual $NO_2$ concentration maps were required, total $NO_2$ was derived using the following equation:

$$(\mathbf{NO_2 \text{ in } \mu g/m^3}) = \mathbf{-0.000929\,(NOx \text{ in } \mu g/m^3)^2 + 0.571(NOx \text{ in } \mu g/m^3) + 3.38}$$

In the absence of a sufficient number of PM monitoring sites, the NOx adjustment factor of **2.56** was also applied to adjust the modelled Road $PM_{10}$ and $PM_{2.5}$ concentrations. This is in line with LAQM.TG(16) Section 7.541.

[29] Department for Environment, Food & Rural Affairs, Background maps, https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html, accessed December 2019.

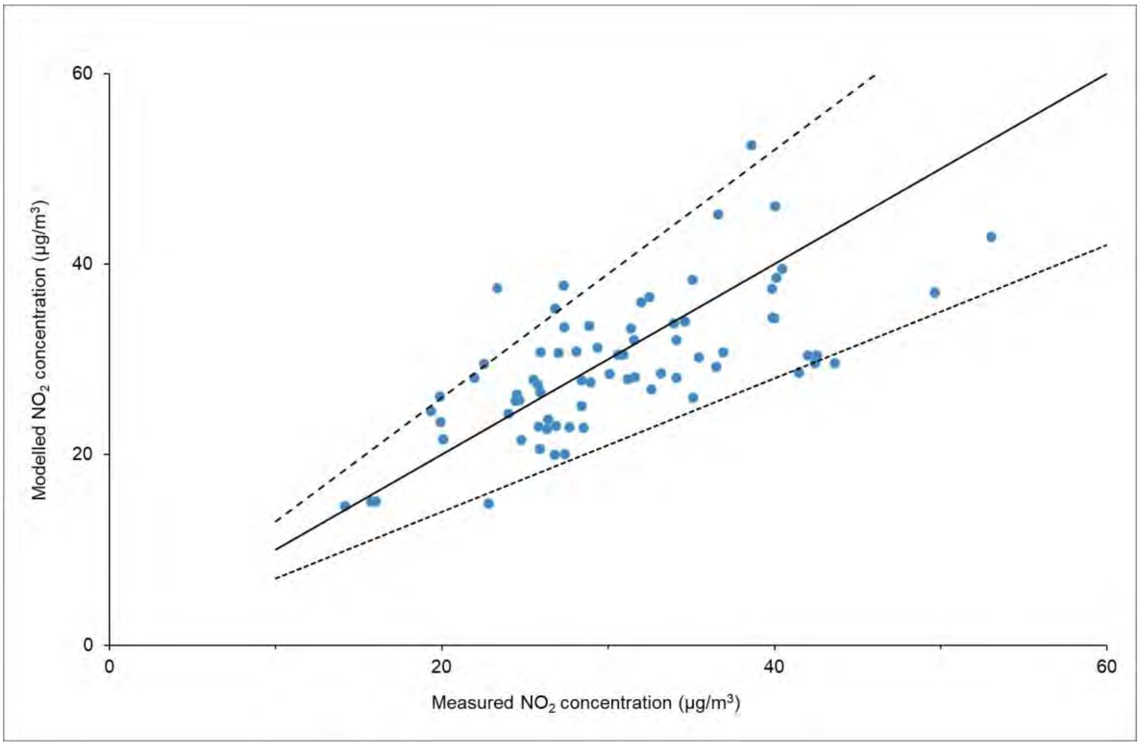
**Table A.1 Model verification points and $NO_2$ concentrations**

| Monitoring site ID | Monitoring type | Measured $NO_2$ annual mean concentration in 2019 (µg/m-3) | Modelled $NO_2$ annual mean concentration for 2019 base year (µg/m-3) | Difference between measured and modelled concentration (µg/m-3) |
|---|---|---|---|---|
| DT_1 | Diffusion tube | 15.75 | 15.11 | 0.6 |
| DT_2 | Diffusion tube | 28.84 | 33.53 | -4.7 |
| DT_3 | Diffusion tube | 33.93 | 33.79 | 0.1 |
| DT_4 | Diffusion tube | 28.07 | 30.84 | -2.8 |
| DT_5 | Diffusion tube | 14.15 | 14.64 | -0.5 |
| DT_7 | Diffusion tube | 31.57 | 28.14 | 3.4 |
| DT_8 | Diffusion tube | 31.14 | 27.96 | 3.2 |
| DT_12 | Diffusion tube | 28.37 | 25.15 | 3.2 |
| DT_14 | Diffusion tube | 35.45 | 30.24 | 5.2 |
| DT_15 | Diffusion tube | 27.28 | 37.75 | -10.5 |
| DT_16 | Diffusion tube | 26.97 | 30.73 | -3.8 |
| DT_17 | Diffusion tube | 25.48 | 27.87 | -2.4 |
| DT_18 | Diffusion tube | 28.37 | 27.83 | 0.5 |
| DT_20 | Diffusion tube | 27.64 | 22.94 | 4.7 |
| DT_21 | Diffusion tube | 26.75 | 20.03 | 6.7 |
| DT_25 | Diffusion tube | 35.03 | 38.35 | -3.3 |
| DT_26 | Diffusion tube | 40.43 | 39.53 | 0.9 |
| DT_27 | Diffusion tube | 29.32 | 31.22 | -1.9 |
| DT_28 | Diffusion tube | 25.91 | 30.77 | -4.9 |
| DT_29 | Diffusion tube | 26.36 | 23.72 | 2.6 |
| DT_30 | Diffusion tube | 27.35 | 33.38 | -6.0 |
| DT_31 | Diffusion tube | 31.54 | 32.07 | -0.5 |
| DT_32 | Diffusion tube | 32.47 | 36.57 | -4.1 |
| DT_33 | Diffusion tube | 24.47 | 26.35 | -1.9 |
| DT_35 | Diffusion tube | 34.10 | 32.08 | 2.0 |
| DT_36 | Diffusion tube | 24.64 | 25.72 | -1.1 |
| DT_39 | Diffusion tube | 42.54 | 30.42 | 12.1 |
| DT_40 | Diffusion tube | 28.48 | 22.82 | 5.7 |
| DT_41 | Diffusion tube | 25.79 | 23.01 | 2.8 |
| DT_42 | Diffusion tube | 33.17 | 28.55 | 4.6 |

| Monitoring site ID | Monitoring type | Measured $NO_2$ annual mean concentration in 2019 (µg/m$^{-3}$) | Modelled $NO_2$ annual mean concentration for 2019 base year (µg/m$^{-3}$) | Difference between measured and modelled concentration (µg/m$^{-3}$) |
|---|---|---|---|---|
| DT_43 | Diffusion tube | 34.59 | 34.00 | 0.6 |
| DT_44 | Diffusion tube | 30.08 | 28.52 | 1.6 |
| DT_45 | Diffusion tube | 39.84 | 37.43 | 2.4 |
| DT_46 | Diffusion tube | 31.35 | 33.24 | -1.9 |
| DT_47 | Diffusion tube | 39.97 | 34.33 | 5.6 |
| DT_48 | Diffusion tube | 43.60 | 29.63 | 14.0 |
| DT_49 | Diffusion tube | 26.31 | 22.69 | 3.6 |
| DT_50 | Diffusion tube | 31.98 | 36.03 | -4.1 |
| DT_51 | Diffusion tube | 36.60 | 45.27 | -8.7 |
| DT_52 | Diffusion tube | 41.44 | 28.62 | 12.8 |
| DT_53 | Diffusion tube | 23.29 | 37.52 | -14.2 |
| DT_54 | Diffusion tube | 25.75 | 27.38 | -1.6 |
| DT_55 | Diffusion tube | 53.01 | 42.86 | 10.1 |
| DT_56 | Diffusion tube | 49.61 | 37.01 | 12.6 |
| DT_57 | Diffusion tube | 38.58 | 52.50 | -13.9 |
| DT_58 | Diffusion tube | 34.09 | 28.10 | 6.0 |
| DT_59 | Diffusion tube | 25.90 | 26.53 | -0.6 |
| DT_60 | Diffusion tube | 32.56 | 26.88 | 5.7 |
| DT_61 | Diffusion tube | 19.84 | 26.16 | -6.3 |
| DT_62 | Diffusion tube | 19.89 | 23.45 | -3.6 |
| DT_63 | Diffusion tube | 19.32 | 24.57 | -5.3 |
| DT_64 | Diffusion tube | 22.53 | 29.60 | -7.1 |
| DT_65 | Diffusion tube | 30.87 | 30.52 | 0.3 |
| DT_66 | Diffusion tube | 24.74 | 21.56 | 3.2 |
| DT_67 | Diffusion tube | 20.04 | 21.65 | -1.6 |
| DT_68 | Diffusion tube | 26.84 | 23.02 | 3.8 |
| DT_69 | Diffusion tube | 25.88 | 20.60 | 5.3 |
| DT_70 | Diffusion tube | 28.90 | 27.61 | 1.3 |
| DT_71 | Diffusion tube | 40.10 | 38.61 | 1.5 |
| DT_72 | Diffusion tube | 30.59 | 30.51 | 0.1 |

| Monitoring site ID | Monitoring type | Measured $NO_2$ annual mean concentration in 2019 (μg/m$^{-3}$) | Modelled $NO_2$ annual mean concentration for 2019 base year (μg/m$^{-3}$) | Difference between measured and modelled concentration (μg/m$^{-3}$) |
|---|---|---|---|---|
| DT_73 | Diffusion tube | 23.98 | 24.30 | -0.3 |
| DT_76 | Diffusion tube | 35.09 | 26.02 | 9.1 |
| DT_77 | Diffusion tube | 42.39 | 29.65 | 12.7 |
| DT_78 | Diffusion tube | 22.79 | 14.93 | 7.9 |
| DT_79 | Diffusion tube | 24.40 | 25.68 | -1.3 |
| DT_80 | Diffusion tube | 36.91 | 30.80 | 6.1 |
| DT_81 | Diffusion tube | 21.96 | 28.09 | -6.1 |
| DT_82 | Diffusion tube | 27.36 | 20.10 | 7.3 |
| DT_83 | Diffusion tube | 39.85 | 34.42 | 5.4 |
| DT_84 | Diffusion tube | 26.79 | 35.34 | -8.5 |
| DT_85 | Diffusion tube | 36.46 | 29.21 | 7.2 |
| CM1 | Automatic | 42.00 | 30.42 | 11.6 |
| CM2 | Automatic | 40.00 | 46.11 | -6.1 |
| CM3 | Automatic | 16.00 | 15.11 | 0.9 |
| | | | **RMSE** | **6.14** |

**Figure A.1 Modelled (post adjustment) vs measured $NO_2$ annual mean concentrations at specified receptors. The dashed lines represent 30% difference between the measured and modelled concentrations**



Ricardo
Energy & Environment

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR
United Kingdom

t: +44 (0)1235 753000
e: enquiry@ricardo.com

ee.ricardo.com