Cambridge Environmental Research Consultants

Air Quality Modelling for the London Borough of Lewisham

Final Report

Prepared for
London Borough of Lewisham

25th January 2011

C E R C

Report Information

CERC Job Number:	FM877
Job Title:	Air Quality Modelling for the London Borough of Lewisham
Prepared for:	London Borough of Lewisham
Report Status:	Final
Report Reference:	FM877/M5/11
Issue Date:	25th January 2011
Author(s):	Chetan Lad
Reviewer(s):	Sarah Strickland

Issue	Date	Comments
1	18/11/10	Draft – model verification only
2	19/11/10	Added info re Part Bs
3	22/11/10	Minor changes re background
4	12/01/11	Full draft
5	25/01/11	Final

Main File(s):	FM877_M5_25Jan11.pdf

Contents

1. Summary

The London Borough of Lewisham has declared four large Air Quality Management Areas (AQMAs) and a fifth consisting of a series of ribbon roads, due to concentrations of nitrogen dioxide (NO_2) and fine particles (PM_{10}) exceeding the UK air quality standards. Lewisham's most recent Updating and Screening Assessment (USA), 2009, identified further roads as warranting further investigation by means of a Detailed Assessment.

Cambridge Environmental Research Consultants Ltd (CERC) was commissioned by the London Borough of Lewisham to carry out air quality modelling, taking into account the new London Atmospheric Emissions Inventory (LAEI) and Department for Transport (DfT) traffic emission factors, to create air quality maps for the whole of the London Borough of Lewisham.

Air quality modelling was carried out using the ADMS-Urban (version 2.3.3.1) air quality modelling software, using emissions and traffic data from the London Atmospheric Emissions Inventory (LAEI) 2008.

Traffic emissions were calculated using the latest set of DfT emission factors, taking into account the lack of expected reduction in NO_x emissions from new diesel vehicles. PM_{10} and $PM_{2.5}$ emissions included contributions from exhaust, brake and tyre-wear, and road-wear and resuspension, as applicable.

Model verification was carried out by comparing measured and modelled concentrations at Lewisham's continuous monitoring sites for 2008. The modelling shows generally good agreement between the measured and modelled concentrations, indicating that the emissions data and model set-up are appropriate for the area. There is some over-prediction of the 99.79^{th} percentiles of hourly average NO_2 concentrations at Lewisham 2 and Crystal Palace, and under-prediction of the annual average NO_2 concentrations at Lewisham 1 and Crystal Palace. PM_{10} concentrations show good agreement at both locations.

Air quality maps were created for ground level concentrations of NO_2, PM_{10} and $PM_{2.5}$, for the years 2011 and 2015, for comparison against air quality standards.

The air quality standard of 40 $\mu g/m^3$, for annual average NO_2 concentrations, is predicted to be exceeded around major roads in Lewisham for both 2011 and 2015. The air quality standard of 200 $\mu g/m^3$, for the 99.79^{th} percentile of hourly average NO_2 concentrations, is predicted to be exceeded around the busiest roads and junctions for both years.

There are no predicted exceedences of the air quality standards for PM_{10} and $PM_{2.5}$ concentrations for either 2011 or 2015.

Based on predicted concentrations for 2011, a 10% reduction in annual average $PM_{2.5}$ concentrations is required at urban background locations in Lewisham by 2020 in order to meet the national exposure reduction target. Concentrations are predicted to reduce by 4% to 6% at these locations between 2011 and 2015, indicating that a similar reduction is required between 2015 and 2020 to meet the target.

2. Introduction

The London Borough of Lewisham has declared four large Air Quality Management Areas (AQMAs) and a fifth consisting of a series of ribbon roads, due to concentrations of nitrogen dioxide (NO_2) and fine particles (PM_{10}) exceeding the UK air quality standards. Lewisham's most recent Updating and Screening Assessment (USA), 2009, identified further roads as warranting further investigation by means of a Detailed Assessment.

Cambridge Environmental Research Consultants Ltd (CERC) was commissioned by the London Borough of Lewisham to carry out air quality modelling, taking into account the new London Atmospheric Emissions Inventory (LAEI) and Department for Transport (DfT) traffic emission factors, to create air quality maps for the whole of the London Borough of Lewisham.

The air quality limit values and target values with which the calculated concentrations are compared are presented in Section 3. The emissions data and model set-up are described in Sections 4 and 5. The results of the modelling are then presented: model verification in Section 6; and the concentration maps in Section 7. A discussion of the results is presented in Section 8.

3. Air quality standards

The EU *ambient air quality directive* (2008/50/EC) sets binding limits for concentrations of air pollutants. The directive has been transposed into English legislation as the *Air Quality Standards Regulations 2010*[1], which also incorporates the provisions of the *4th air quality daughter directive* (2004/107/EC).

The Air Quality Standards Regulations 2010 include limit values and target values. The limit values are presented in Table 3.1.

Table 3.1: Air quality limit values

	Value (μg/m³)	Description of standard
NO_2	200	Hourly mean not to be exceeded more than 18 times a calendar year (modelled as 99.79th percentile)
	40	Annual average
PM_{10}	50	24-hour mean not to be exceeded more than 35 times a calendar year (modelled as 90.41st percentile)
	40	Annual average
$PM_{2.5}$	25	Annual average

Note that the limit value for $PM_{2.5}$ includes a margin of tolerance of 20% in June 2008, decreasing on the next 1st January and every 12 months thereafter by equal annual percentages to reach 0% by 1st January 2015. A target value of 25μg/m³ also exists for $PM_{2.5}$.

The regulations also include national exposure reduction targets for $PM_{2.5}$, as set out in Table 3.2. These are based on the Average Exposure Indicator (AEI) which is calculated as the three-year average of all measured $PM_{2.5}$ concentrations at urban background locations, e.g. the AEI for 2010 must be based on measurements for the years 2009, 2010 and 2011.

[1] http://www.legislation.gov.uk/uksi/2010/1001/contents/made

Table 3.2: Exposure reduction target for $PM_{2.5}$ relative to the AEI in 2010

Initial concentration (µg/m³)	Reduction target (%)	Year by which exposure reduction target should be met
Less than or equal to 8.5	0	2020
More than 8.5 but less than 13	10	
13 to less than 18	15	
18 to less than 22	20	
22 or more	All appropriate measures to reach 18 µg/m³	

The short-term standards considered are specified in terms of the number of times during a year that a concentration measured over a short period of time is permitted to exceed a specified value. For example, the concentration of NO_2 measured as the average value recorded over a one-hour period is permitted to exceed the concentration of 200 µg/m^3 up to 18 times per year. Any more exceedences than this during a one-year period would represent a breach of the objective.

It is convenient to model objectives of this form in terms of the equivalent percentile concentration value. A percentile is the concentration below which lie a specified percentage of concentration measurements. For example, consider the 98th percentile of one-hour concentrations over a year. Taking all of the 8760 one-hour concentration values that occur in a year, the 98th percentile value is the concentration below which 98% of those concentrations lie. Or, in other words, it is the concentration exceeded by 2% (100 – 98) of those hours, that is, 175 hours per year. Taking the NO_2 objective considered above, allowing 18 exceedences per year is equivalent to not exceeding for 8742 hours or for 99.79% of the year. This is therefore equivalent to the 99.79th percentile value.

4. Emissions data

The modelling for this study was based on emissions data taken from the London Atmospheric Emissions Inventory (LAEI 2008), released by the Greater London Authority (GLA) in 2010.

4.1. Traffic flow data

Traffic flows and speeds for all major roads in London were taken from the LAEI, where data are provided for the years 2008, 2011 and 2015.

For the model verification, all major roads within 1500 metres of the monitoring sites were modelled in detail, with all other roads in London modelled as part of a 1-kilometre resolution grid source. In order to generate pollution maps, all major roads inside and within a distance of 1500 metres of Lewisham were modelled in detail. Figure 4.1 shows the major roads in Lewisham.

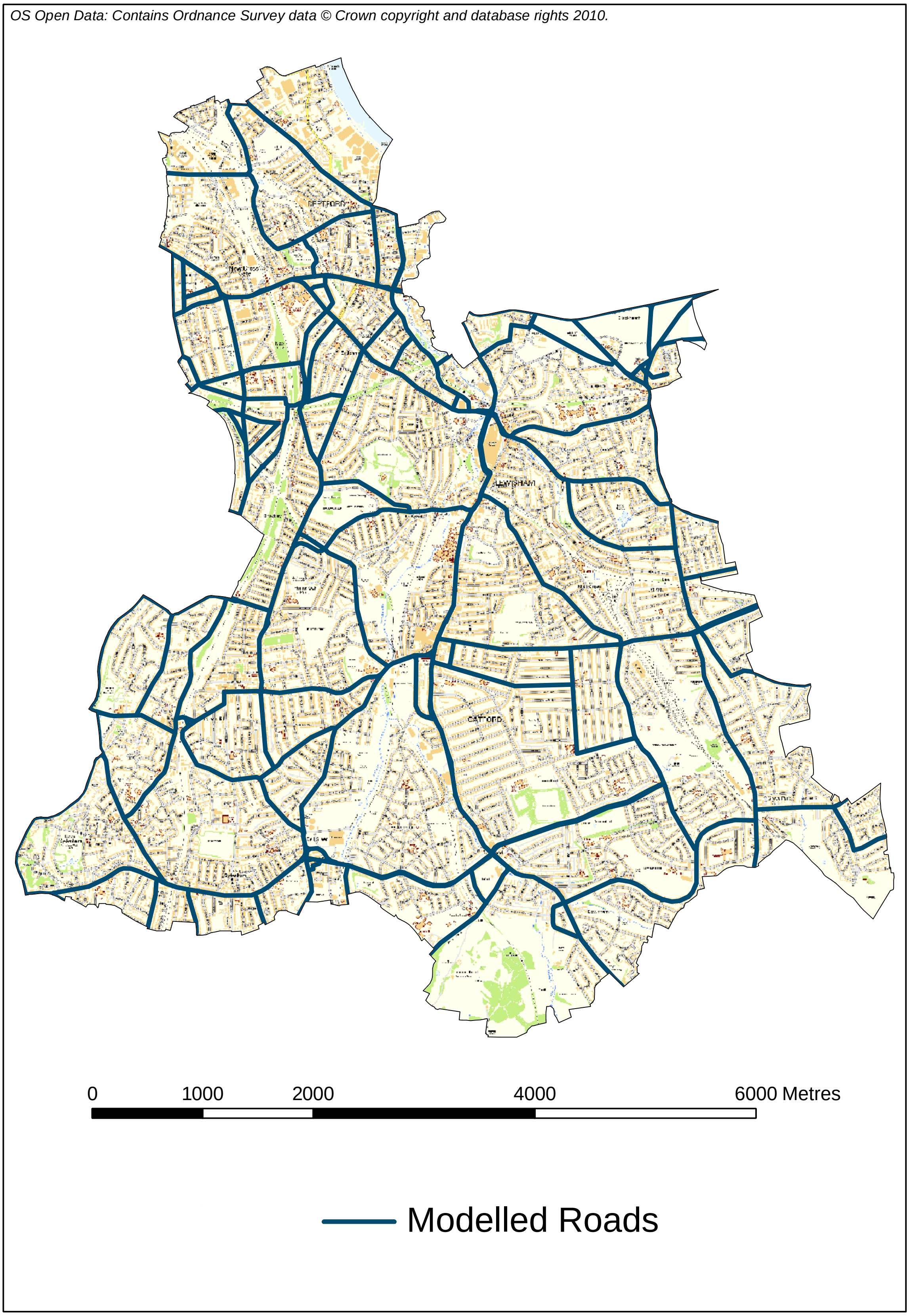

Figure 4.1: Major roads in the London Borough of Lewisham

4.2. Traffic emissions

Emission rates for each road were calculated using the LAEI traffic flows and speeds and the latest set of DfT emission factors[2] released in 2009. These include primary NO_2 emission factors for each vehicle type resulting in accurate road-by-road NO_x and NO_2 emission rates.

4.2.1. Diesel NO_x emissions

Recent evidence from NO_x and NO_2 monitoring data in urban areas has shown that diesel NO_x emissions are not decreasing at the expected rate, as discussed in a Defra Frequently Asked Question[3] in September 2010. In this modelling study, in line with Defra guidance, NO_x emissions from all EURO 2 to EURO 5 diesel vehicles were set to be the same as the equivalent EURO 1 vehicles. Primary NO_2 emissions were calculated by applying the primary NO_2 fraction for each vehicle type to the EURO 1-equivalent NO_x emissions. It is expected that emissions from EURO 6 vehicles will meet the expected emission reductions so these emission factors are unchanged. These changes have the effect of increasing NO_x and NO_2 road traffic emission rates for all years; PM_{10} and $PM_{2.5}$ emissions are unaffected.

4.2.2. Brake and tyre-wear

Brake and tyre-wear emissions data were taken directly from the LAEI and added to the exhaust emissions for each road.

4.2.3. Road-wear and resuspension

Concentrations of PM_{10} and $PM_{2.5}$ at roadside locations are affected by road-wear, and concentrations of PM_{10} are affected by resuspension. These are not quantified in the LAEI but a recent study prepared for Defra[4] presented combined road-wear and resuspension emission factors for light and heavy vehicles. These were used to calculate road-by-road road-wear and resuspension emission rates and were added to the exhaust and brake and tyre-wear emission rates.

[2] http://www.dft.gov.uk/pgr/roads/environment/emissions/

[3] *Measured nitrogen oxides (NOx) and/or nitrogen dioxide (NO2) concentrations in my local authority area do not appear to be declining in line with national forecasts. Should I take this into account in my Review and Assessment work?* http://laqm2.defra.gov.uk/FAQs/General/Measured nitrogen oxides (NOx) and-or nitrogen dioxide (NO_2) concentrations do not appear to be declining in line with national forecasts.pdf

[4] *Road vehicle non-exhaust particulate matter: initial air quality model development and application, model uncertainty analysis and further model improvements*, prepared by TRL for DEFRA 2007 http://www.airquality.co.uk/archive/reports/cat15/0706061626_Report3__Modelling_Development.pdf

4.2.4. Daily traffic variation

The variation of traffic flow during the day has been taken into account by applying a set of diurnal profiles to the road emissions. These profiles were taken from the report *Air pollution and emissions trends in London*[5] used in the compilation of the LAEI, and are shown in Figure 4.2.

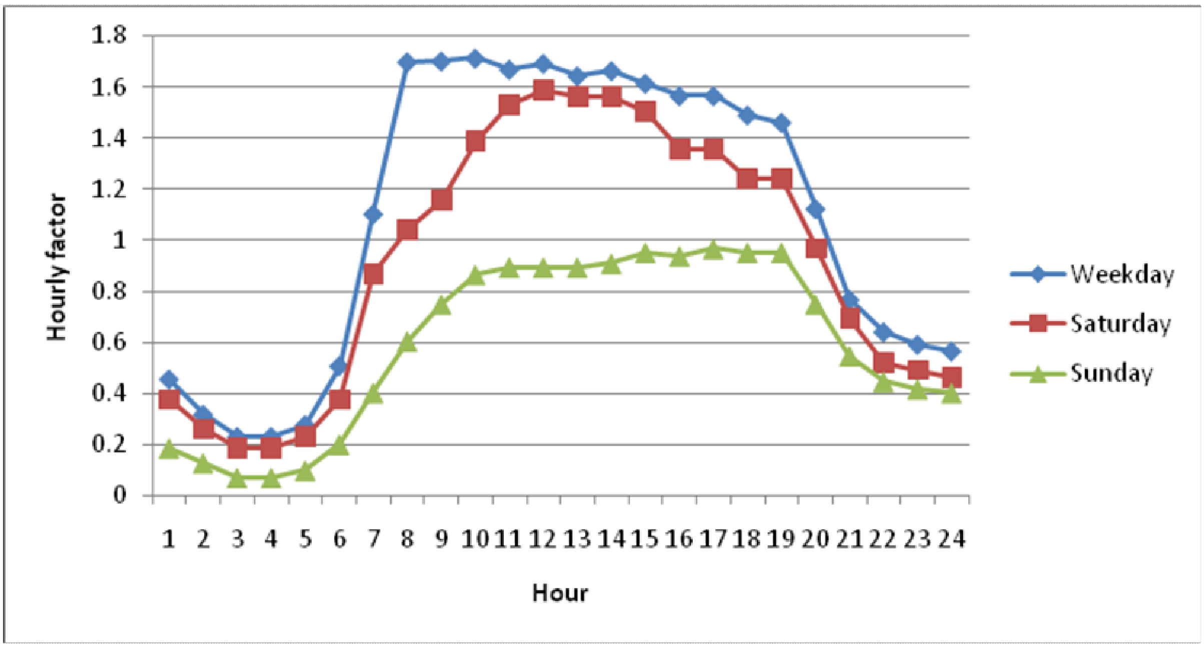

Figure 4.2: Diurnal profiles for Central London

4.3. Industrial sources

Four industrial sources were included explicitly as point sources in the modelling:

1. The South East London Combined Heat and Power Plant (SELCHP), located within Lewisham, which has a relatively high NO_x emission rate of 12g/s;
2. Croydon Energy power station, 6km to the south west of Lewisham, which has a relatively high NO_x emission rate of 17g/s;
3. Part B process 'Mobile Plant'[6], located 400m west of Lewisham; and
4. Part B process 'Bardon Aggregates Aggregate Industries Ltd'[7], located within Lewisham.

4.4. Other emissions

Emission rates for all other sources were taken from the LAEI and modelled as aggregated 1-kilometre resolution grid sources covering the whole of London.

[5] *Air pollution and emissions trends in London*, King's College London, Environmental Research Group and Leeds University, Institute for Transport studies http://www.airquality.co.uk/reports/cat05/1004010934_MeasurementvsEmissionsTrends.pdf
[6] Quarry processes, 38 Stanbury Road, Peckham, London SE15 2DB
[7] Quarry processes, 3 Copperas Street, Deptford, London SE8 3DA

5. Model set-up

Modelling was carried out using the ADMS-Urban[8] model (version 2.3.3.1). The model uses the detailed emissions data described in Section 4 together with a range of other input data to calculate the dispersion of pollutants. This section summarises the data and assumptions used in the modelling.

5.1. Surface roughness

A length scale parameter called the surface roughness length is used in the model to characterise the study area in terms of the effects it will have on wind speed and turbulence, which are key factors in the modelling. A value of 1 metre was used in the modelling.

The difference in land use at Heathrow compared to the study area was taken into account by entering a different surface roughness for the meteorological site. See Section 5.3 for further details.

5.2. Monin-Obukhov Length

In urban and suburban areas a significant amount of heat is emitted by buildings and traffic, which warms the air within and above a city. This is known as the urban heat island and its effect is to prevent the atmosphere from becoming very stable. In general, the larger the urban area the more heat is generated and the stronger the effect becomes.

In the ADMS-Urban model, the stability of the atmosphere is represented by the Monin-Obukhov parameter, which has the dimension of length. In very stable conditions it has a positive value of between 2 metres and 20 metres. In near neutral conditions its magnitude is very large, and it has either a positive or negative value depending on whether the surface is being heated or cooled by the air above it. In very convective conditions it is negative with a magnitude of typically less than 20 metres.

The effect of the urban heat island is that, in stable conditions, the Monin-Obukhov length will never fall below some minimum value; the larger the city, the larger the minimum value. A value of 75 metres was used in the modelling.

[8] http://www.cerc.co.uk/environmental-software/ADMS-Urban-model.html

5.3. Meteorological data

Meteorological data from Heathrow for the year 2008 were used in the modelling. A summary of the data is given in Table 5.1. Figure 5.1 shows a wind rose giving the frequency of occurrence of wind from different directions for a number of wind speed ranges.

The difference in land use at Heathrow compared to the study area was taken into account by entering a different surface roughness for the meteorological site. The surface roughness for Heathrow was set to 0.1 metre, compared to 1 metre for Central London.

Table 5.1: Summary of meteorological data

	Minimum	Maximum	Mean
Temperature (°C)	-3.7	29.1	11.3
Wind speed (m/s)	0	14.4	4.4
Cloud cover (oktas)	0	8	4.9

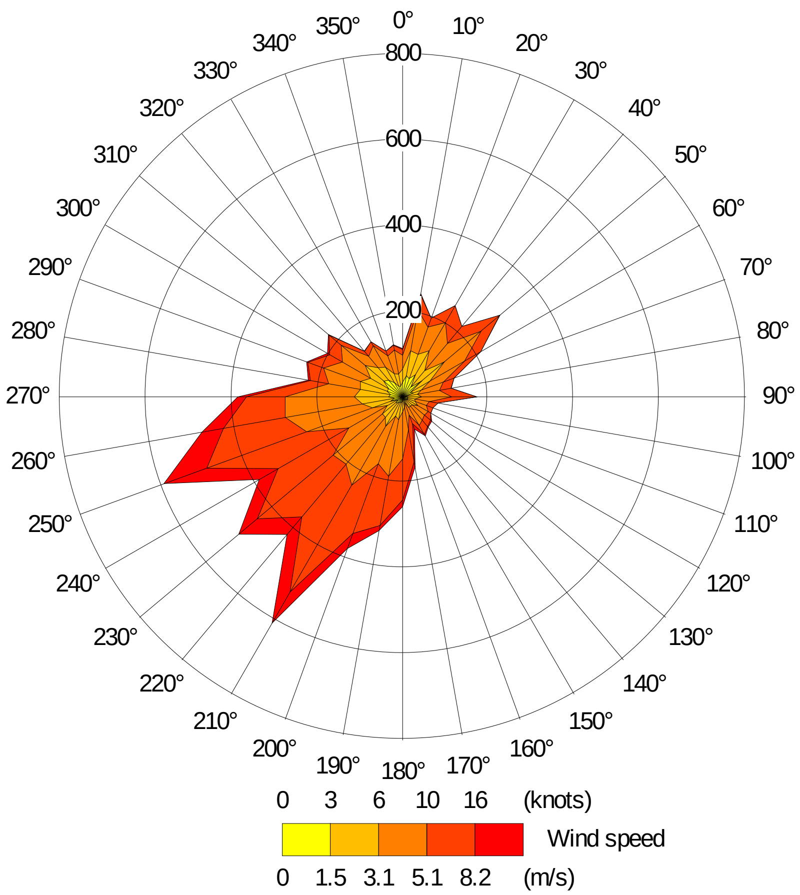

Figure 5.1: Wind rose for Heathrow, 2008

5.4. NO_x chemistry and background data

Nitrogen dioxide (NO_2) results from direct emissions from combustion sources together with chemical reactions in the atmosphere involving NO_2, nitric oxide (NO) and ozone (O_3). The combination of NO and NO_2 is referred to as nitrogen oxides (NO_x).

The chemical reactions taking place in the atmosphere were taken into account in the modelling using the Generic Reaction Set (GRS) of equations. These use hourly average background concentrations of NO_x, NO_2 and O_3, together with meteorological and modelled emissions data to calculate the NO_2 concentration at a given point.

All emissions of NO_x and NO_2 from within the city are included in the modelling. Hourly background data for these pollutants and ozone were input to the model to represent the concentrations in the air being blown into the city. These data were obtained from rural monitoring sites around the city as described in Section 5.4.1.

PM_{10} concentrations at any location can be thought of as being made up of a primary component (directly emitted), a secondary component (formed from primary particulates by subsequent reactions) and a coarse component (such as re-suspended dust). Only primary particulates are included in the emissions inventory, with secondary PM_{10} concentrations calculated by the model using SO_2 background and emissions data.

5.4.1. Background data for 2008

NO_x, NO_2 and O_3 concentrations from Rochester, Harwell, Lullington Heath and Wicken Fen were input to the model, the monitored concentration used for each hour depending upon the wind direction for that hour, as shown in Figure 5.2.

Two sources of PM_{10} and $PM_{2.5}$ background data were used for the 2008 validation modelling. For hours for which the wind direction was from the west, rural PM_{10} and $PM_{2.5}$ data from Harwell were used and for hours for which the wind direction was from the east, rural PM_{10} and $PM_{2.5}$ measurements from Rochester were used.

The PM_{10} and $PM_{2.5}$ background concentrations were calculated using data from Harwell and Rochester only, as these are the only rural sites which monitor hourly average PM_{10} and $PM_{2.5}$ in the south of England. A coarse component of $2 \mu g/m^3$ was added to the monitored PM_{10} concentrations.

Table 5.2 summarises the annual statistics of the resulting background concentrations used in the modelling for 2008.

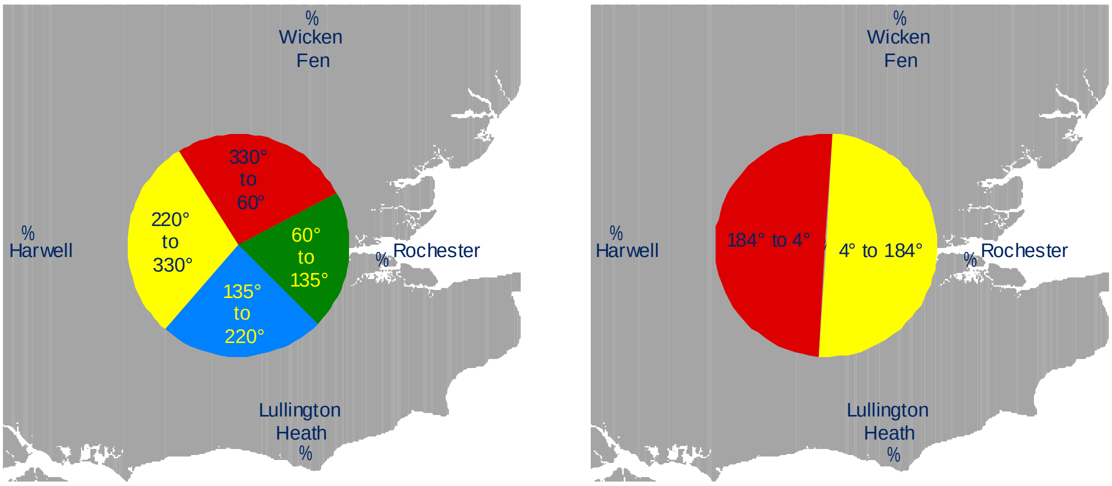

Figure 5.2 Wind direction segments used to calculate background concentrations for NO_x, NO_2 and O_3 (left) and PM_{10} and $PM_{2.5}$ (right)

Table 5.2: Background concentrations for 2008 ($\mu g/m^3$)

	NO_x	NO_2	O_3	PM_{10}	$PM_{2.5}$
Annual average	13.0	9.4	54.5	19.5	9.4
99.79th percentile of hourly average	147.9	60.3	127.1	-	-
90.41st percentile of 24-hour average	-	-	-	36.0	16.0

5.4.2. Background data for 2011 and 2015

Background concentrations of NO_x, NO_2 and O_3 for 2008 were used for 2011 and 2015. Defra guidance[3], discussed in Section 4.2.1, suggests that forecast reductions in background NO_x and NO_2 concentrations in future year projections are likely to be optimistic. In line with this guidance, background concentrations of NO_x, NO_2 and O_3 are assumed to remain constant between 2008 and 2015 in this modelling study.

Background concentrations of PM_{10} and $PM_{2.5}$ for 2011 and 2015 were obtained by projecting forward hourly measured data from 2008. Factors for the projection were calculated by comparing 2008 concentrations against 2011 and 2015 concentrations in the LAQM 2008 base year background maps[9], for the locations of the Harwell and Rochester stations.

Table 5.3 summarises the annual statistics of the resulting background PM_{10} and $PM_{2.5}$ concentrations used in the modelling for 2011 and 2015.

[9] http://laqm1.defra.gov.uk/review/tools/background-maps-info.php?year=2008

Table 5.3: PM_{10} and $PM_{2.5}$ background concentrations for 2011 and 2015 ($\mu g/m^3$)

	2011		**2015**	
	PM_{10}	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Annual average	18.7	8.9	18.2	8.5
90.41st percentile of 24-hour average	34.5	15.0	33.6	14.4

6. Model verification

The first stage of a modelling study is to model a current case in order to verify that the input data and model set-up are representative for the area. This was carried out by calculating hourly average concentrations of NO_x, NO_2 and PM_{10} at the sites of the continuous monitors in Lewisham and comparing the measured and modelled concentrations. Note that the meteorological data used in the modelling and the measured pollutant concentrations contain some missing values; the statistics compared in this exercise therefore only include hours for which both measured and modelled concentrations are available.

The London Borough of Lewisham had three continuous monitors in operation in 2008; three measuring NO_x and NO_2 and two measuring PM_{10}. Figure 6.1 shows the locations of the monitoring sites and Table 6.1 summarises their locations.

Table 6.1: Monitoring site details

	Grid reference	Height (m)	Distance from modelled road (m)	Street canyon height (m)
Lewisham 1 (Catford)	537675 173689	5	-	-
Lewisham 2 (New Cross)	536240 176934	3	6	10
Crystal Palace	533906 171285	3		-

The Crystal Palace monitoring site is jointly owned between four London boroughs.

A new automatic monitoring site for PM_{10}, Lewisham 3 started operation in February 2010 and is located close to industrial premises.

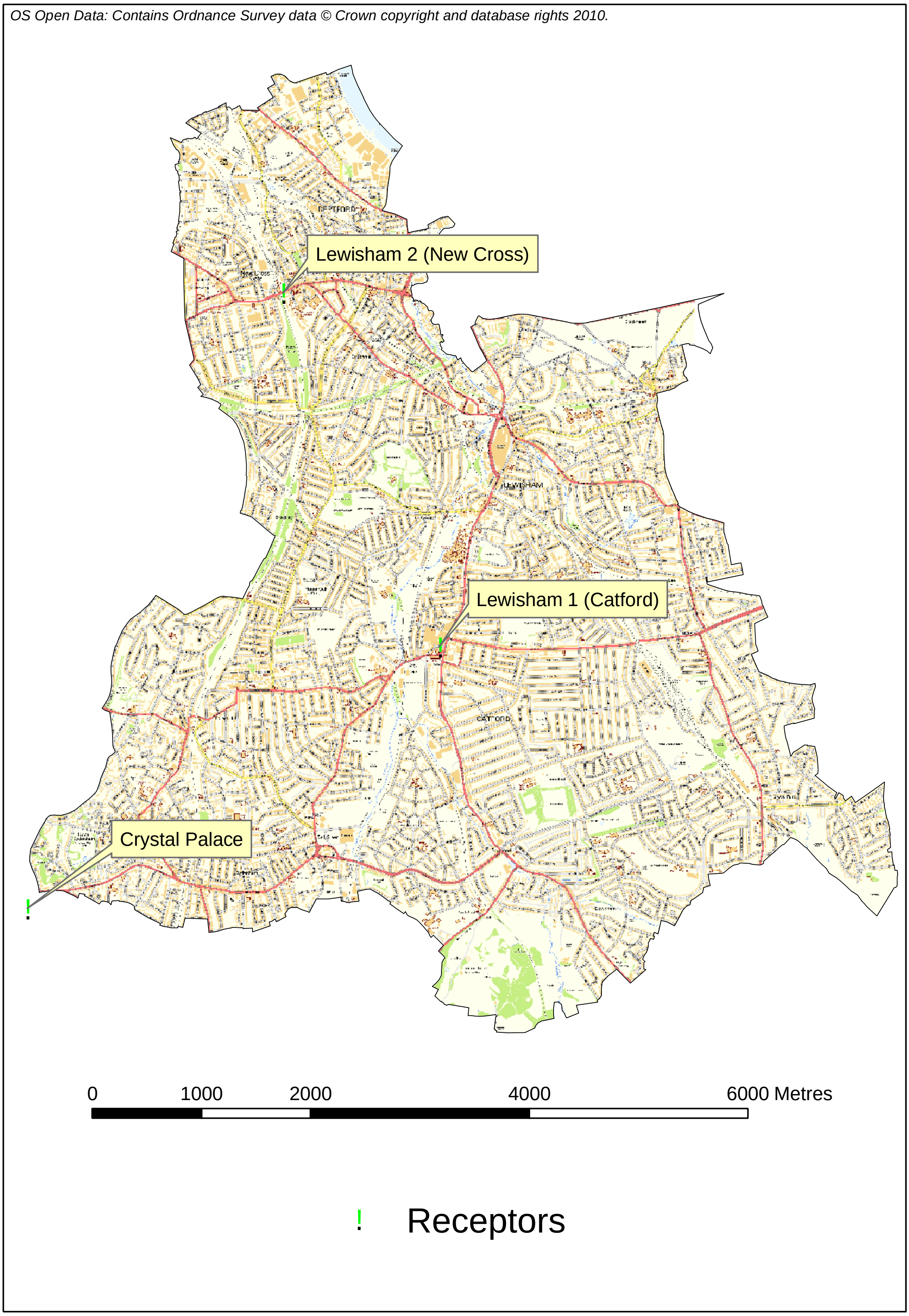

Figure 6.1: London Borough of Lewisham continuous monitoring sites

Tables 6.2 to 6.4 show the measured and modelled concentrations of NO_x, NO_2 and PM_{10} for 2008 at the three continuous monitoring sites, together with the modelled concentrations expressed as a percentage of the measured concentrations. A value of 100% indicates perfect agreement between measured and modelled data, with values greater than 100% indicating that the model is over-predicting concentrations and values less than 100% showing model under-prediction.

Table 6.2: Measured and modelled concentrations of NO_x for 2008

Site	Annual average (µg/m³)			99.79^{th} percentile (µg/m³)		
	Measured	Modelled	%	Measured	Modelled	%
Lewisham 1 (Catford)	98.6	74.9	76	620.6	522.4	84
Lewisham 2 (New Cross)	145.2	187.7	129	690.8	975.6	141
Crystal Palace	111.9	87.6	78	523.7	672.7	128

Table 6.3: Measured and modelled concentrations of NO_2 for 2008

Site	Annual average (µg/m³)			99.79^{th} percentile (µg/m³)		
	Measured	Modelled	%	Measured	Modelled	%
Lewisham 1 (Catford)	52.1	40.4	78	149.9	154.5	103
Lewisham 2 (New Cross)	63.4	71.0	112	183.2	259.3	142
Crystal Palace	49.0	42.7	87	152.7	192.3	126

Table 6.4: Measured and modelled concentrations of PM_{10} for 2008

Site	Annual average (µg/m³)			90.41^{st} percentile (µg/m³)		
	Measured	Modelled	%	Measured	Modelled	%
Lewisham 2 (New Cross)	25.0	27.5	110	41.7	45.0	108
Crystal Palace	23.6	23.9	101	37.2	38.9	105

The modelling shows generally good agreement between the measured and modelled concentrations, indicating that the emissions data and model set-up are appropriate for the area. There is some over-prediction of the 99.79^{th} percentiles of hourly average NO_2 concentrations at Lewisham 2 and Crystal Palace, and under-prediction of the annual average NO_2 concentrations at Lewisham 1 and Crystal Palace. PM_{10} concentrations show good agreement at both relevant locations.

7. Air quality maps

Ground level concentrations of NO_2, PM_{10} and $PM_{2.5}$, for the years 2011 and 2015, were calculated on a grid of receptor points across the whole borough, with a grid resolution of 50m. Extra receptor points were added close to the modelled roads, where concentration gradients are highest. Concentrations were predicted to allow comparison against the air quality standards presented in Section 3 and presented in the form of colour contour maps.

7.1. NO_2 air quality maps

Figure 7.1 and Figure 7.2 show predicted annual average NO_2 concentrations across Lewisham for 2011 and 2015 respectively. Predicted 99.79^{th} percentiles of hourly average NO_2 concentrations are shown in Figure 7.3 and Figure 7.4, for 2011 and 2015 respectively.

The air quality standard of 40 $\mu g/m^3$ for annual average NO_2 concentrations is predicted to be exceeded around major roads in Lewisham for both 2011 and 2015. The area of exceedence is predicted to be smaller for 2015 than for 2011.

The air quality standard of 200 $\mu g/m^3$ for the 99.79^{th} percentile of hourly average NO_2 concentrations is predicted to be exceeded around the busiest roads and junctions in the borough for both 2011 and 2015. The predicted areas of exceedence are similar for 2011 and 2015.

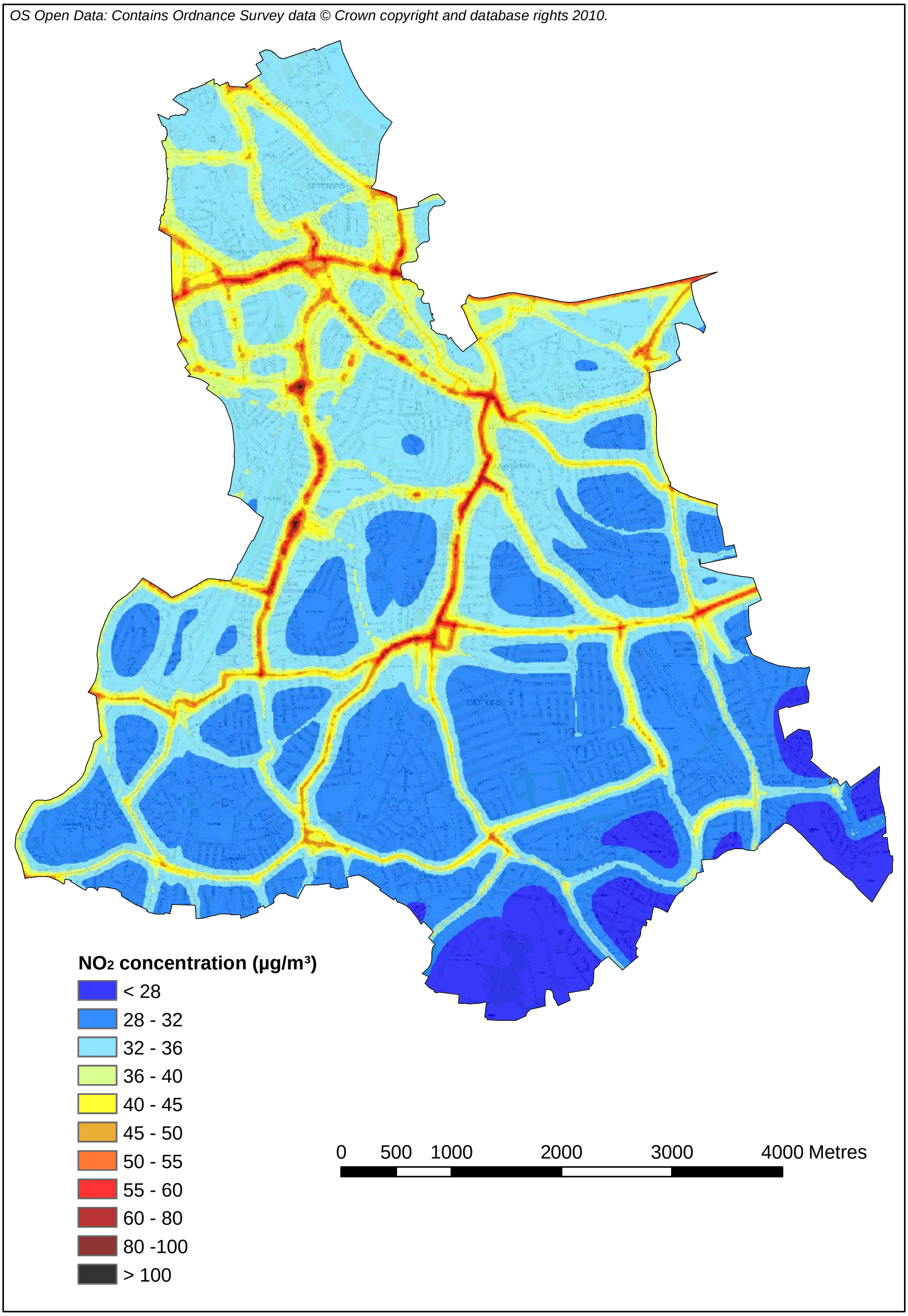

Figure 7.1: Predicted annual average NO_2 concentrations ($\mu g/m^3$), 2011

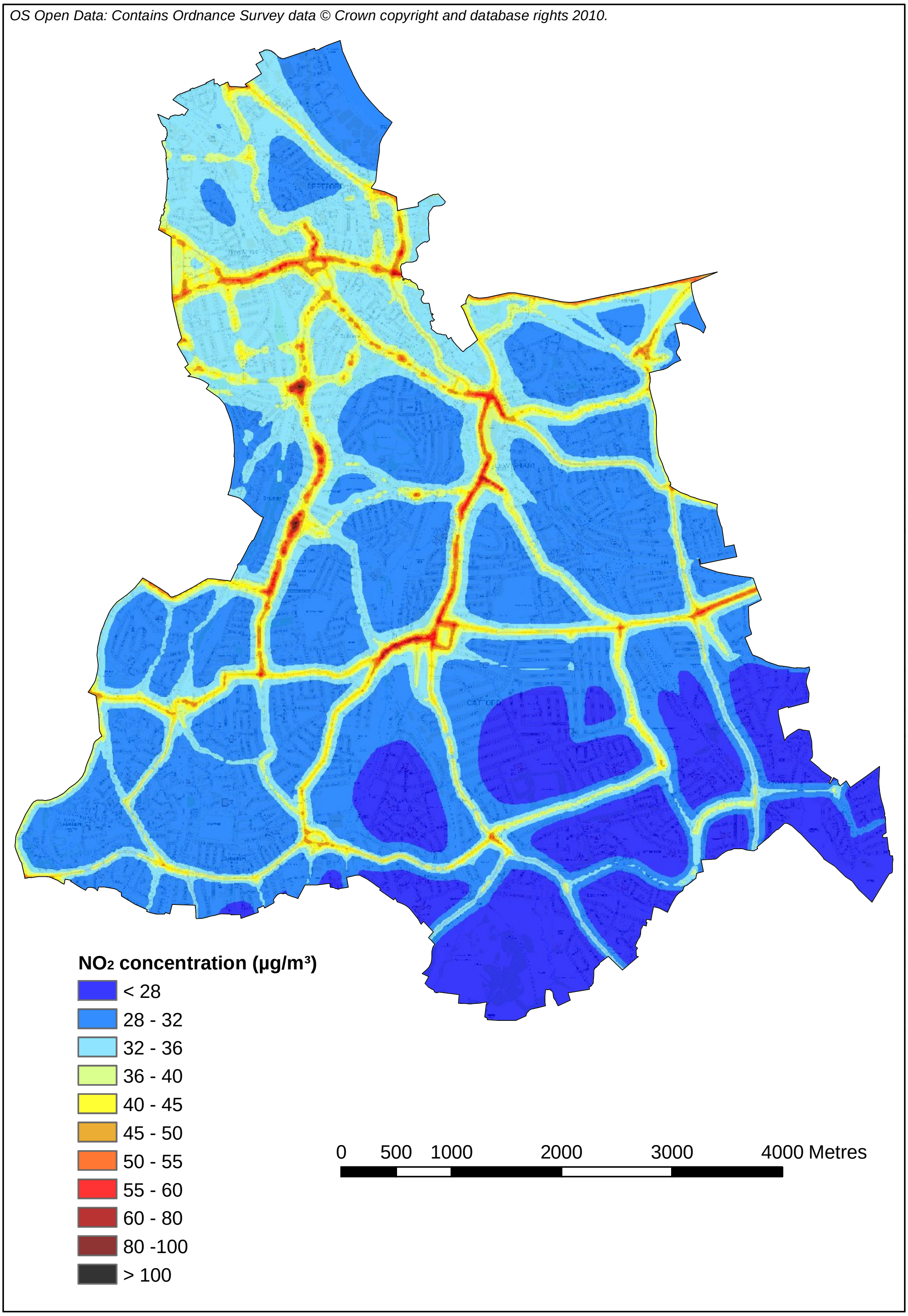

Figure 7.2: Predicted annual average NO_2 concentrations ($\mu g/m^3$), 2015

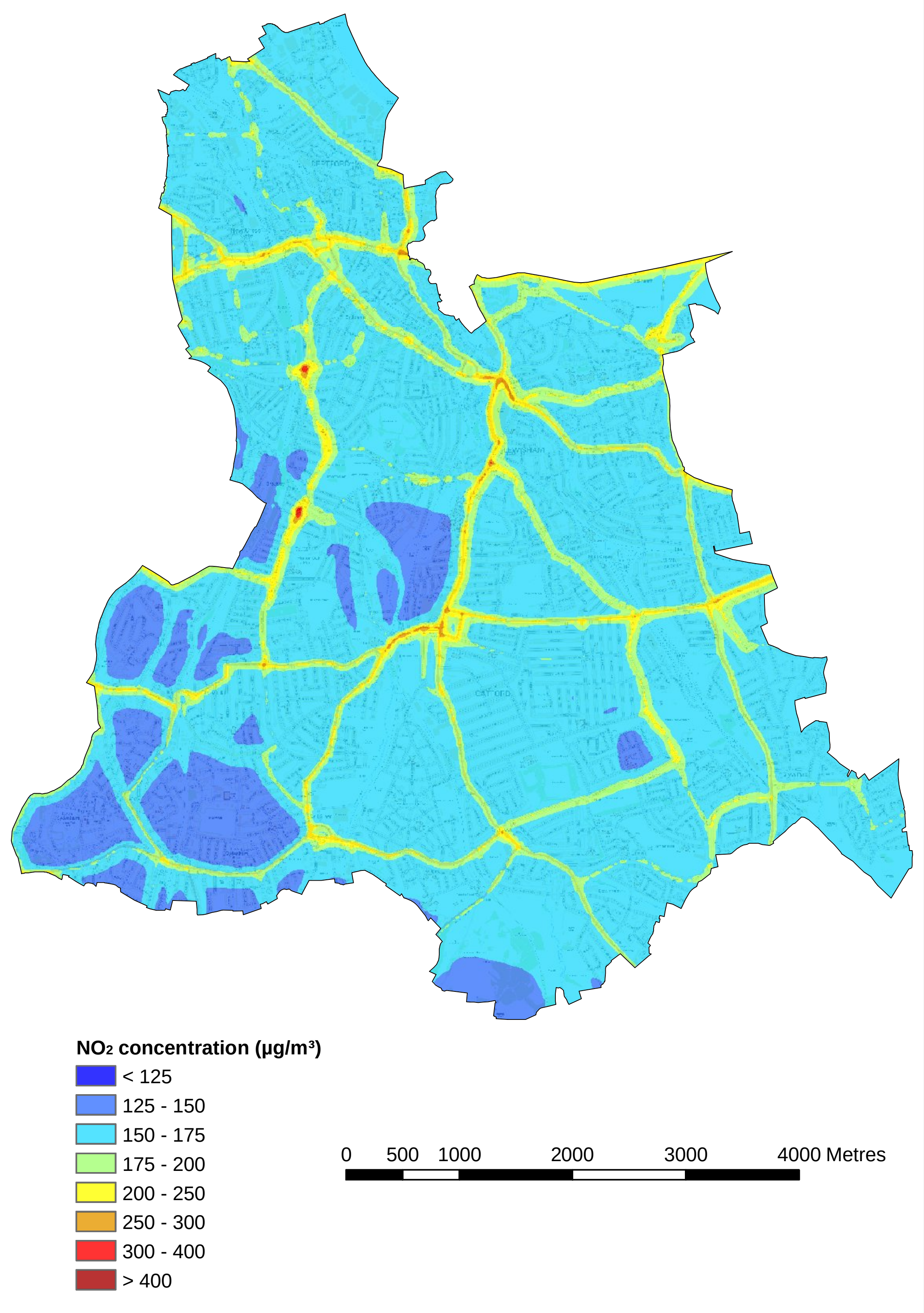

Figure 7.3: Predicted 99.79th percentile of hourly average NO_2 concentrations ($\mu g/m^3$), 2011

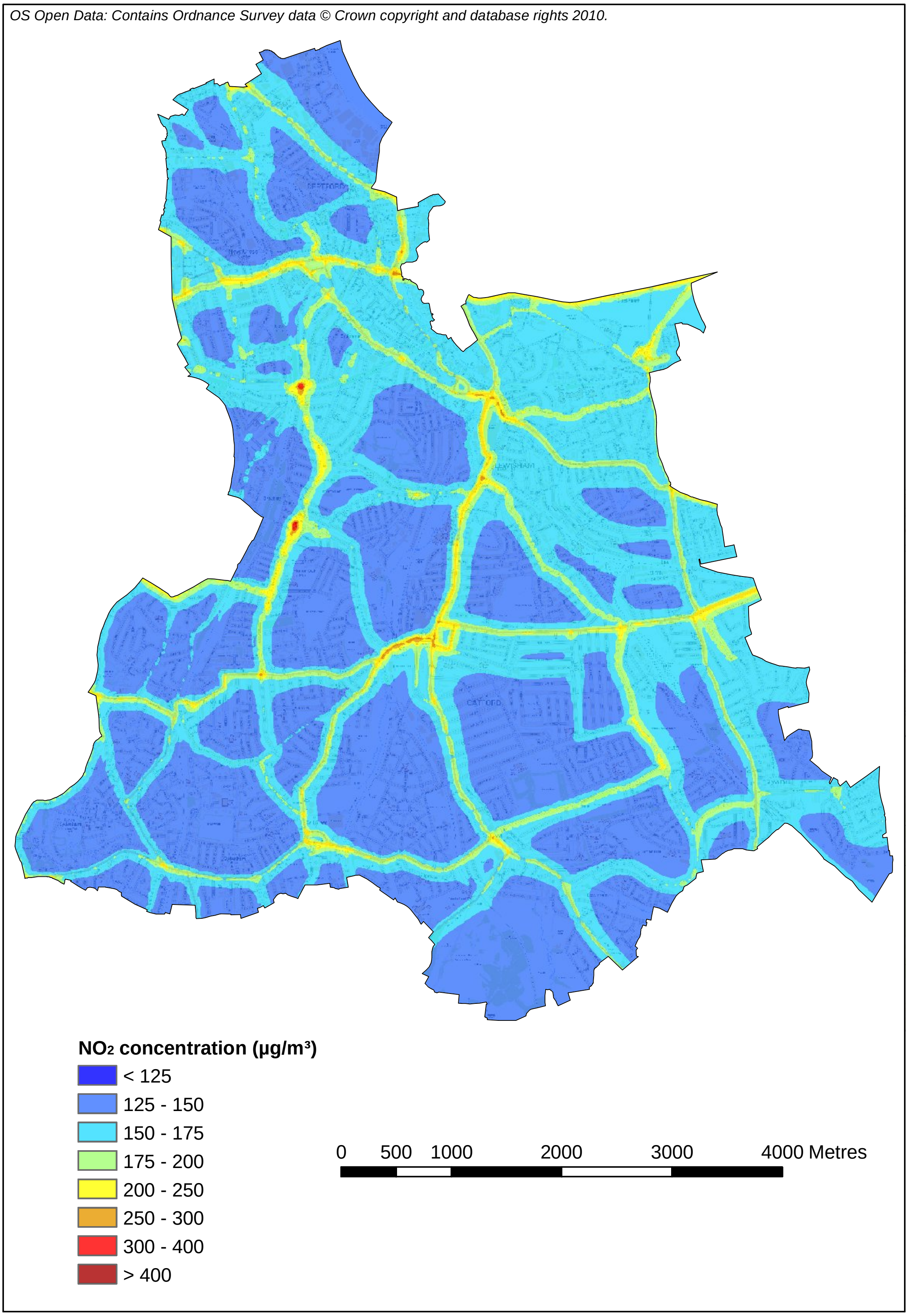

Figure 7.4: Predicted 99.79th percentile of hourly average NO_2 concentrations (µg/m^3), 2015

7.2. PM_{10} air quality maps

Figure 7.5 and Figure 7.6 show predicted annual average PM_{10} concentrations across Lewisham, for 2011 and 2015 respectively. Predicted 90.41^{st} percentiles of 24-hour average PM_{10} concentrations are shown in Figure 7.7 and Figure 7.8, for 2011 and 2015 respectively.

There are no predicted exceedences of the air quality standard of 40 $\mu g/m^3$ for annual average PM_{10} concentrations for either 2011 or 2015.

There are no predicted exceedences of the air quality standard of 50 $\mu g/m^3$ for the 90.41^{st} percentile of 24-hour average PM_{10} concentrations for either 2011 or 2015.

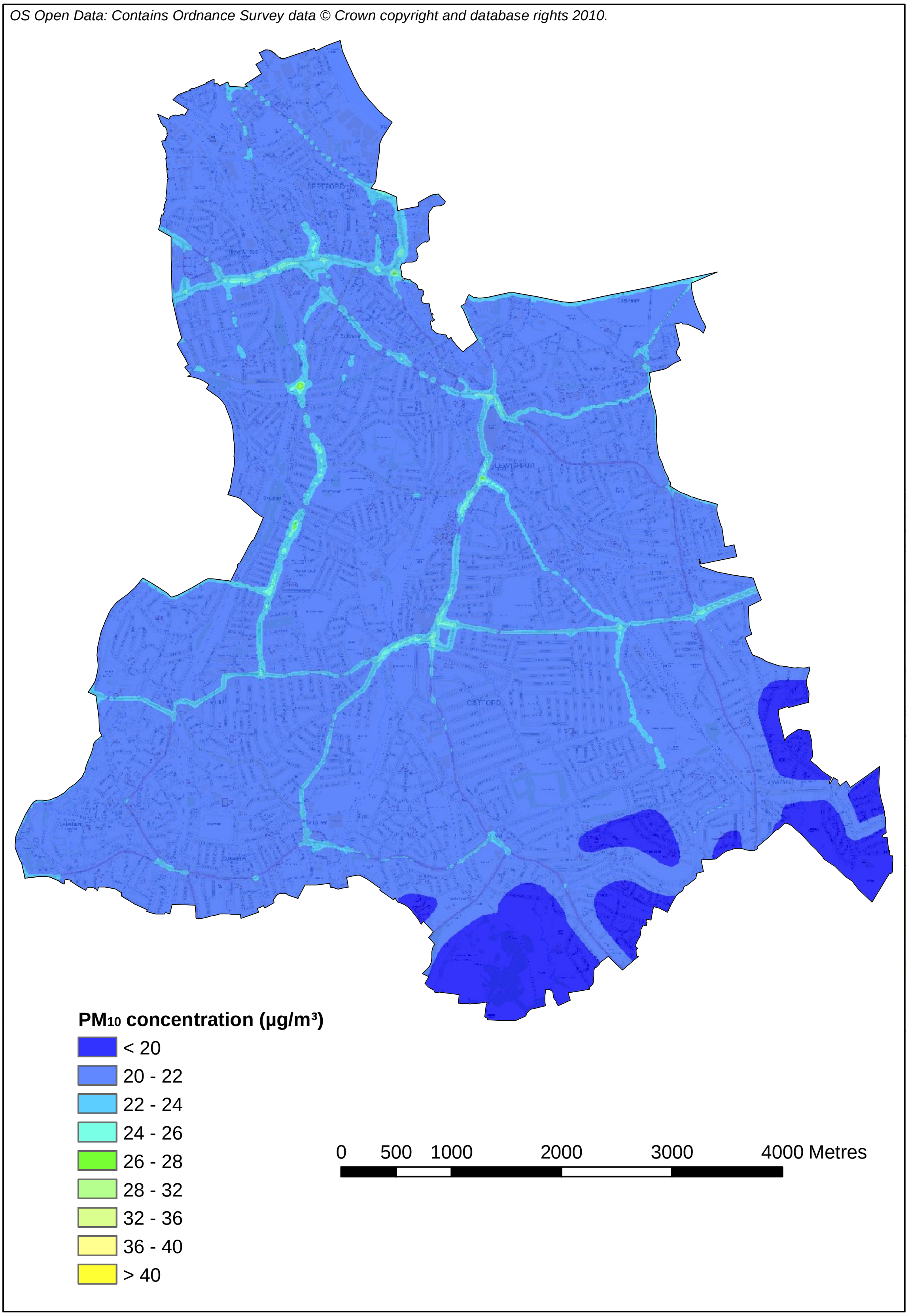

Figure 7.5: Predicted annual average PM_{10} concentrations (µg/m^3), 2011

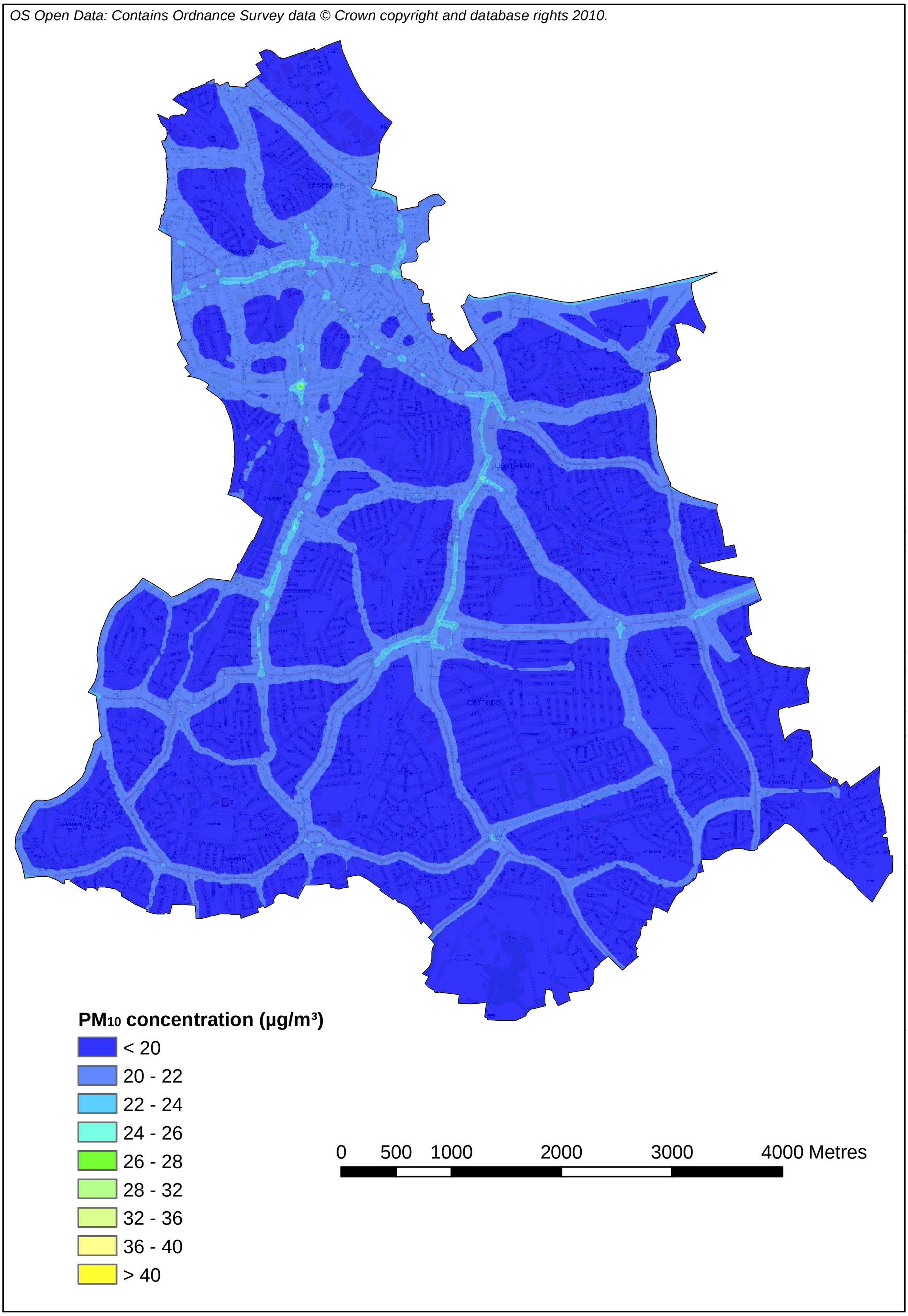

Figure 7.6: Predicted annual average PM_{10} concentrations ($\mu g/m^3$), 2015

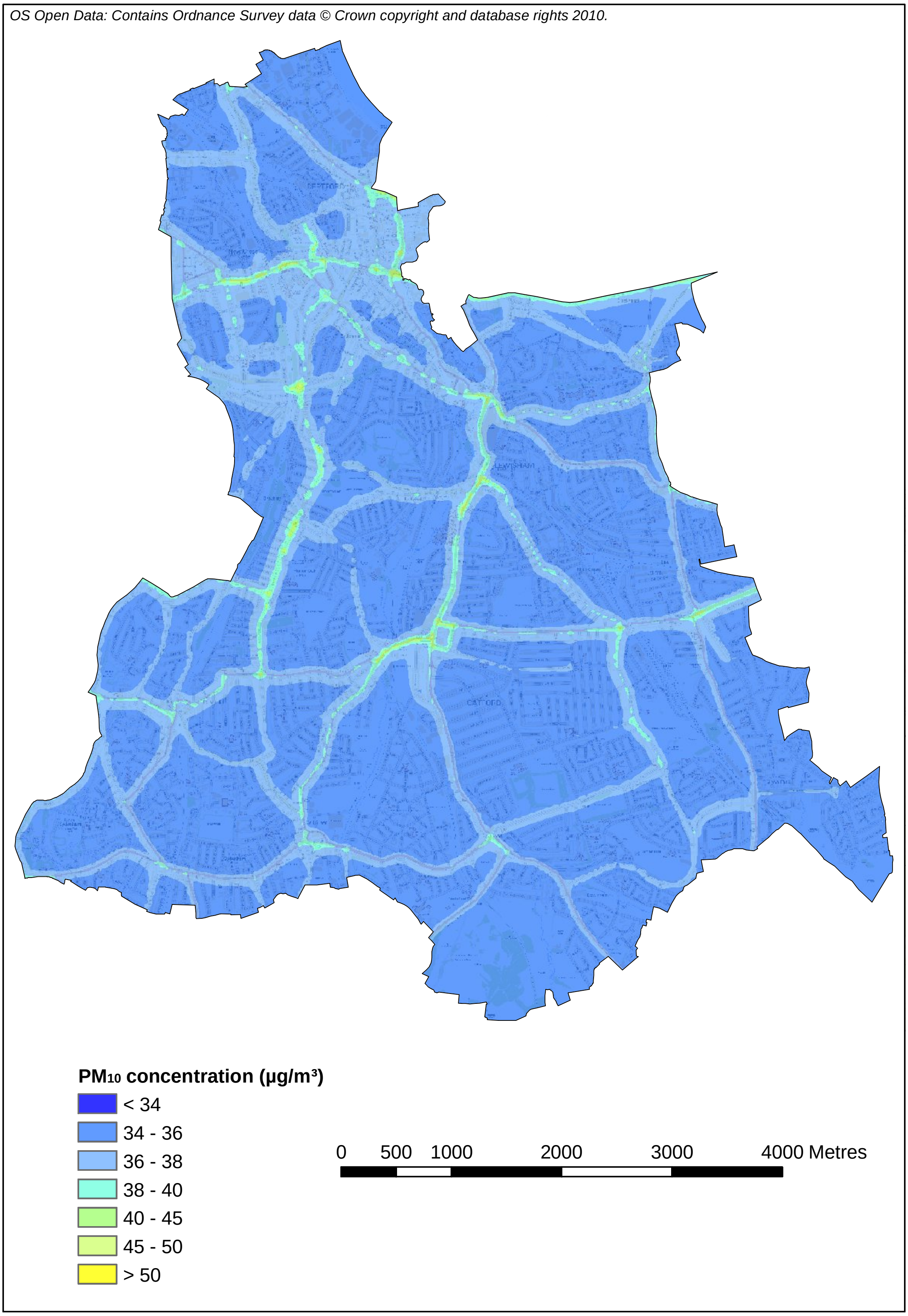

Figure 7.7: Predicted 90.41st percentile of 24-hour average PM_{10} concentrations (µg/m^3), 2011

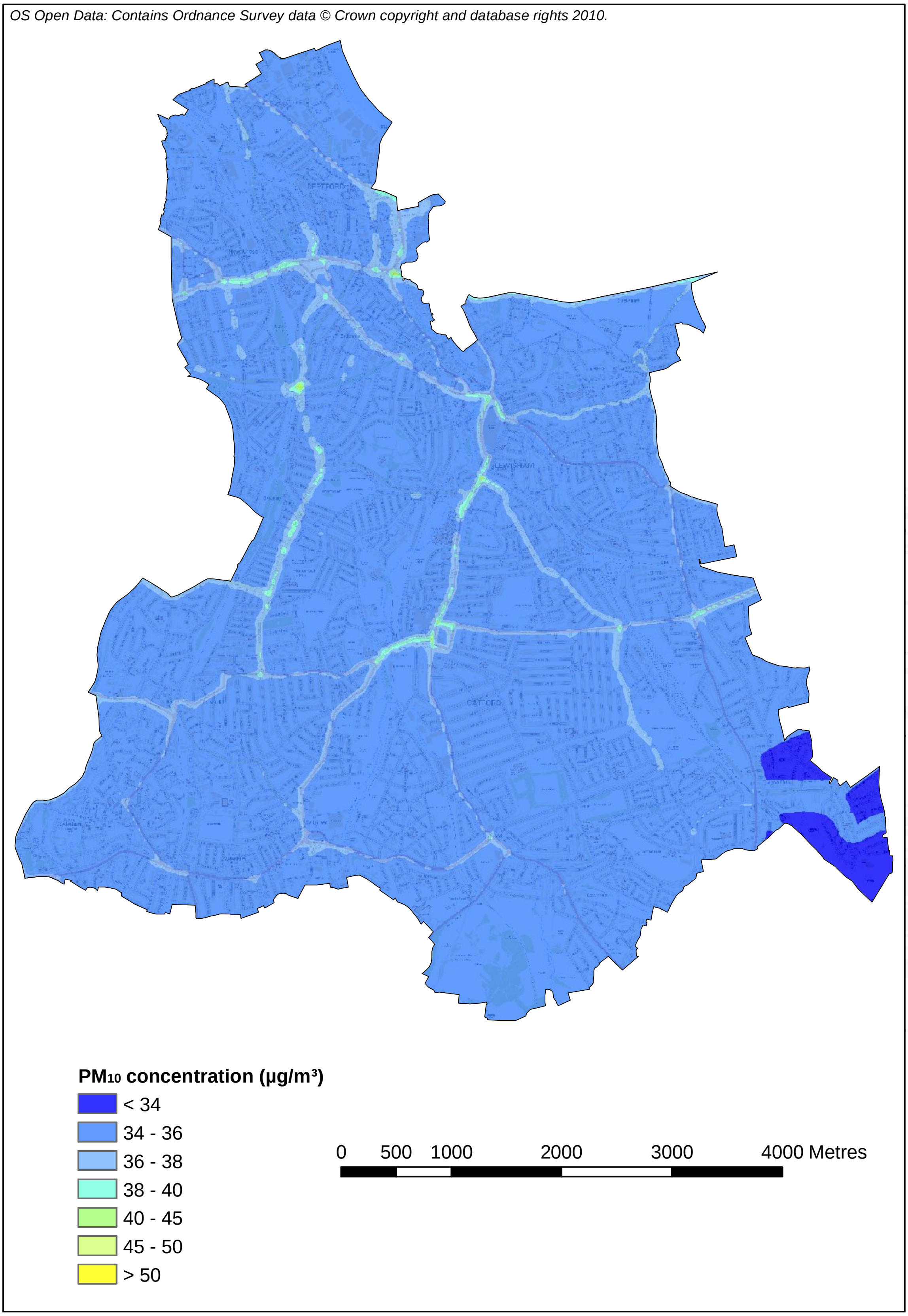

Figure 7.8: Predicted 90.41st percentile of 24-hour average PM_{10} concentrations (µg/m^3), 2015

7.3. $PM_{2.5}$ air quality maps

Figure 7.9 and Figure 7.10 show predicted annual average $PM_{2.5}$ concentrations across Lewisham, for 2011 and 2015 respectively.

There are no predicted exceedences of the air quality standard of 25 $\mu g/m^3$ for annual average $PM_{2.5}$ concentrations for either 2011 or 2015.

Across the borough, annual average $PM_{2.5}$ concentrations at urban background locations are predicted to be between 9 $\mu g/m^3$ and 11 $\mu g/m^3$ for 2011. For 2015, urban background concentrations are predicted to be between 9 $\mu g/m^3$ and 10 $\mu g/m^3$.

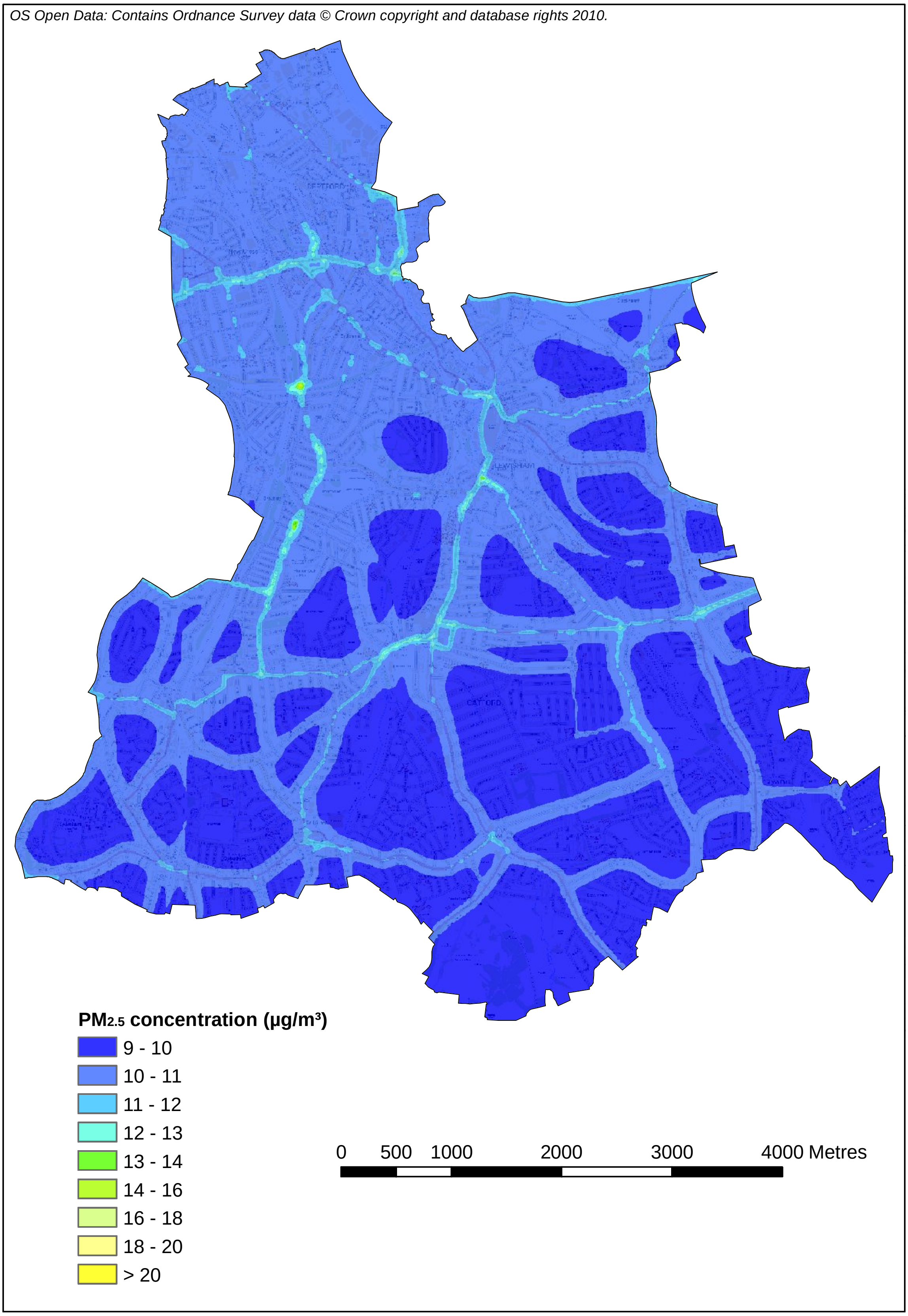

Figure 7.9: Predicted annual average $PM_{2.5}$ concentrations ($\mu g/m^3$), 2011

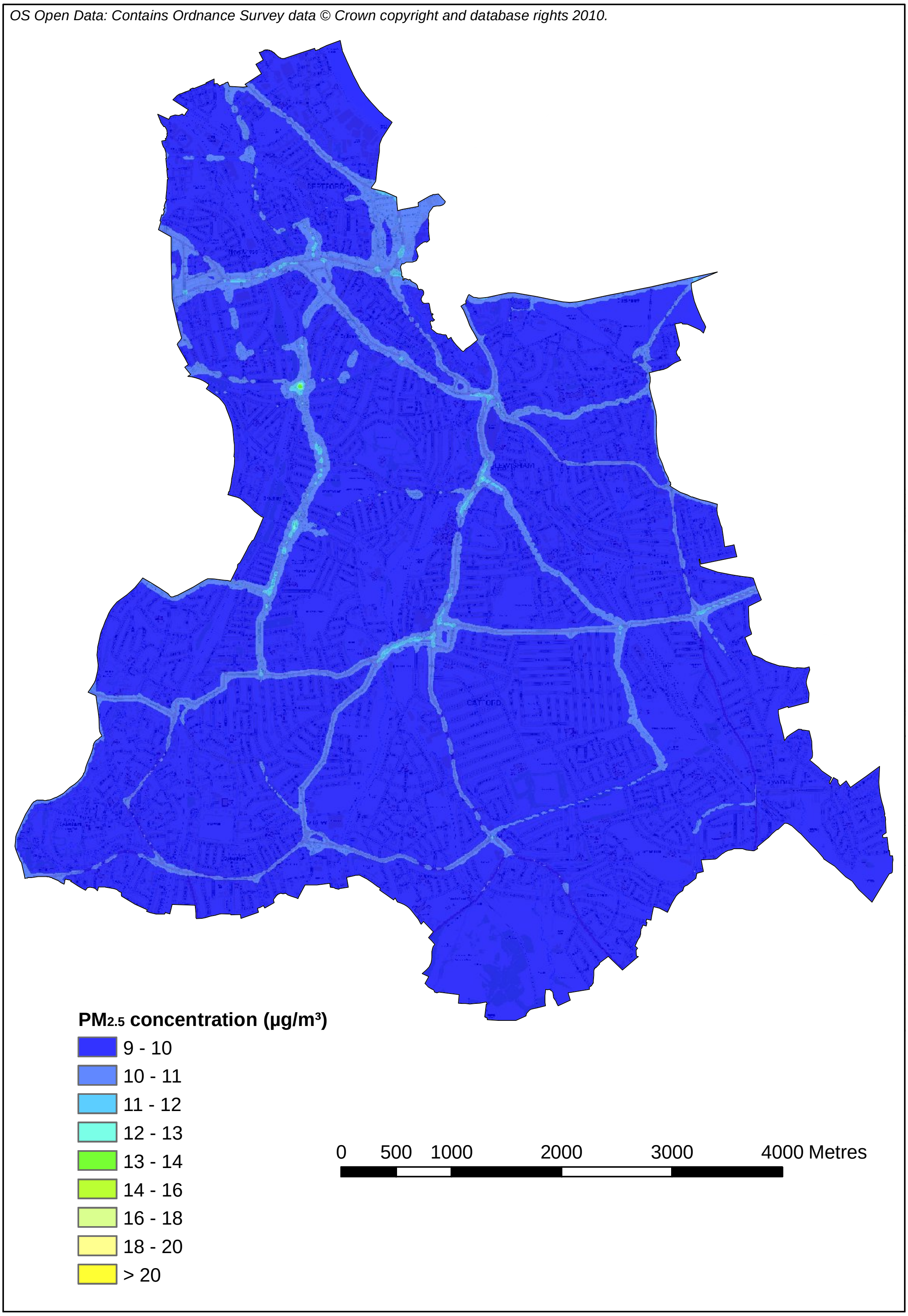

Figure 7.10: Predicted annual average $PM_{2.5}$ concentrations (µg/m^3), 2015

8. Discussion

The London Borough of Lewisham has declared four large Air Quality Management Areas (AQMAs) and a fifth consisting of a series of ribbon roads, due to concentrations of nitrogen dioxide (NO_2) and fine particles (PM_{10}) exceeding the UK air quality standards. Lewisham's most recent Updating and Screening Assessment (USA), 2009, identified further roads as warranting further investigation by means of a Detailed Assessment.

Cambridge Environmental Research Consultants Ltd (CERC) was commissioned by the London Borough of Lewisham to carry out air quality modelling, taking into account the new London Atmospheric Emissions Inventory (LAEI) and Department for Transport (DfT) traffic emission factors, to create air quality maps for the whole of the London Borough of Lewisham.

Air quality modelling was carried out using ADMS-Urban (version 2.3.3.1) air quality modelling software using emissions and traffic data from the London Atmospheric Emissions Inventory (LAEI) 2008.

Traffic emissions were calculated using the latest set of DfT emission factors, taking into account the lack of expected reduction in NO_x emissions from new diesel vehicles. PM_{10} and $PM_{2.5}$ emissions included contributions from exhaust, brake and tyre-wear, and road-wear and resuspension, as applicable.

Model verification was carried out by comparing measured and modelled concentrations at Lewisham's continuous monitoring sites for 2008. The modelling shows generally good agreement between the measured and modelled concentrations, indicating that the emissions data and model set-up are appropriate for the area. There is some over-prediction of the 99.79^{th} percentiles of hourly average NO_2 concentrations at Lewisham 2 and Crystal Palace, and under-prediction of the annual average NO_2 concentrations at Lewisham 1 and Crystal Palace. PM_{10} concentrations show good agreement at both locations.

Air quality maps were created for ground level concentrations of NO_2, PM_{10} and $PM_{2.5}$, for the years 2011 and 2015. Concentrations were predicted to allow comparison against the air quality standards.

The air quality standard of 40 $\mu g/m^3$ for annual average NO_2 concentrations is predicted to be exceeded around major roads in Lewisham for both 2011 and 2015. The air quality standard of 200 $\mu g/m^3$ for the 99.79^{th} percentile of hourly average NO_2 concentrations is predicted to be exceeded around the busiest roads and junctions for both years.

There are no predicted exceedences of the air quality standard of 40 $\mu g/m^3$ for annual average PM_{10} concentrations or the air quality standard of 50 $\mu g/m^3$ for the 90.41^{st} percentile of 24-hour average PM_{10} concentrations, for either 2011 or 2015.

There are no predicted exceedences of the air quality standard of 25 $\mu g/m^3$ for annual average $PM_{2.5}$ concentrations for either 2011 or 2015.

Across the borough, annual average $PM_{2.5}$ concentrations at urban background locations are predicted to be between 9 µg/m^3 and 11 µg/m^3 for 2011. Therefore a 10% reduction in annual average $PM_{2.5}$ concentrations is required at these locations by 2020, to meet the national exposure reduction target.

Figure 8.1 shows the percentage reduction in annual average $PM_{2.5}$ concentrations between 2011 and 2015. At urban background locations in Lewisham, concentrations are predicted to reduce by 4% to 6% between these years, indicating that a similar reduction is required between 2015 and 2020 to meet the national exposure reduction target.

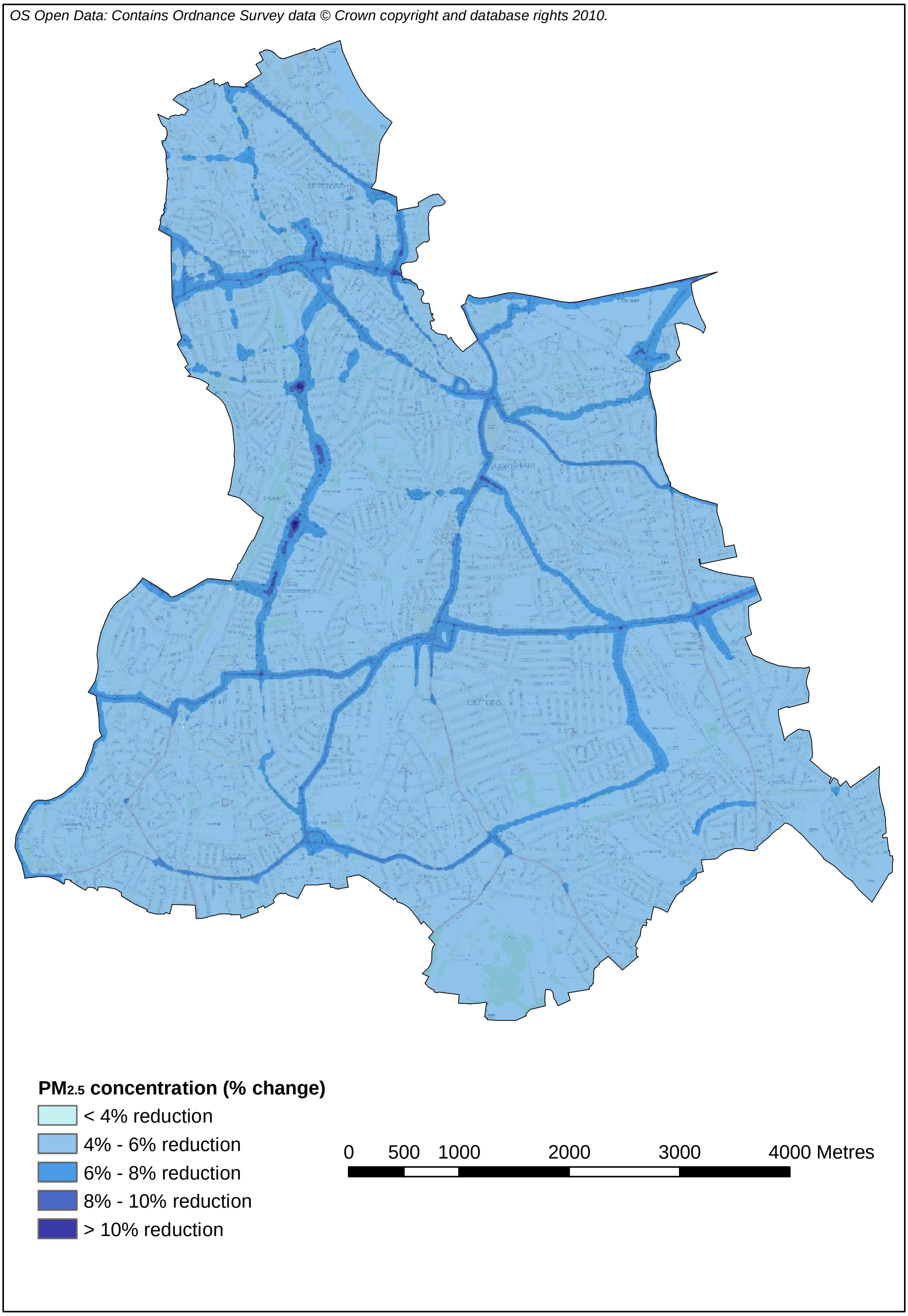

Figure 8.1: Percentage change in predicted annual average $PM_{2.5}$ concentrations between 2011 and 2015