Brighton & Hove

Brighton & Hove City Council



Air Quality
Detailed Assessment 2007

In association with
The Sussex Air Quality Partnership

SUSSEX AIR

Part IV of the Environment Act 1995 **September 2007**

CONTENTS

EXECUTIVE SUMMARY

The Environment Act 1995, introduced the system of Local Air Quality Management, requiring Local Authorities in the UK to review and assess air quality against 7 health based Air Quality Objectives (Objectives).

The first step of this process was to carry out an Updating and Screening Assessment (USA) of local air quality. This is intended to identify potential areas and pollutants of concern, focusing on changes and new information since the end of the previous round of review and assessment.

The Brighton & Hove City Council USA published in April 2006, identified a number of potential exceedences of the Nitrogen Dioxide (NO_2) annual objective within the city, as well as the need to further assess local particulate (PM_{10}) concentrations. These findings were in addition to the existing Air Quality Management Areas AQMA.(fig1).

The role of the Detailed Assessment is to look in more detailed at these areas to confirm the extent of any exceedences. Through both monitoring and dispersion modelling the following exceedences have been confirmed-

- St James's St
- Queens Road and Queens Road Quad
- Terminus Road
- Sackville Road
- Sackville Road/Old Shoreham Road junction
- The junction of Old Shoreham Road/Chatham Place
- The junction of Boundary Road/A259
- The junction of Kingsway(A259)/Hove Street
- The junction of Kings Road (259)/West Street
- Ditching Road (North of St Peters Church)
- Seven Dials (certain sections)
- Eastern Road
- Western Road
- North Street

A number of other areas identified in the USA were shown to meet the NO_2 objectives.

- Edward Street
- Portland Road
- Upper Lewes Road

In line with the Defra Technical Guidance all areas as identified as exceeding the NO_2 objective now need to be declared as AQMAs. The guidance states that provided all areas that exceed are included within AQMA's, it is the responsibility of the local authority to define the boundaries. In addition to this the report

concluded that in areas where the findings are inconclusive further monitoring is required.

Based on the findings of the USA the Detailed Assessment has also considered the likelihood that the PM_{10} objectives will be breached within the city. The elevated concentrations seen at the Partisol site suggested that sensitive receptors (such as residential areas) may exceed the short term 24hr PM_{10} objective. The findings of the Detailed Assessment monitoring survey in the Queens Road area, suggests there may be other possible short term Objective exceedences in other areas of Brighton and Hove. Further monitoring of PM_{10} as well as working with Defra to learn more about local particle sources in the city is therefore recommended.

In line with the updated Defra Policy Guidance 2006 the following areas have been identified as also exceeding the short term NO_2 objective.

- Western Road
- North Road
- Terminus Road
- Viaduct Road (within existing AQMA)
- London Road (within existing AQMA)

These areas will also need to be assessed when drawing up AQMA's.

In terms of consultation, comments are welcome on the report as well as the direction the council should be taking in terms of drawing up AQMA(s).

GLOSSARY

AADT	Annual Average Daily Traffic (vehicles per day)
AQMA	Air Quality Management Area
AQAP	Air Quality Action Plan
Objective (AQO)	Air Quality Objectives
AQ	Air Quality
AURN	Automatic Urban and Rural (air quality monitoring) Network
DA	Detailed Assessment
DETR	Department for Environment Transport and the Regions
Defra	Department for Environment Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges Screening Model
EPAQS	Expert Panel on Air Quality Standards
ERG-KCL	Environmental Research Group, Kings College London
EU	European Union
FR&A	Further Review and Assessment
GIS	Geographical Information System
HDV	Heavy Duty Vehicles
IZS	Internal Zero Span
LA	Local Authority
LAQM	Local Air Quality Management
$\mu g/m^3$	Micrograms of the pollutant per cubic metre of air
NAEI	National Atmospheric Emissions Inventory
NAQS	National Air Quality Strategy
NO	Nitric oxide
NO_2	Nitrogen dioxide
PM_{10}	Particles with diameter less than 10µm
QA/QC	Quality Assurance / Quality Control
R & A	Review and Assessment
TEOM	Tapered Element Oscillating Microbalance
USA	Updating and Screening Assessment
Vpd	Vehicles per day

1 INTRODUCTION

1.1 Local Air Quality Management

Through the Environment Act 1995, the National Air Quality Strategy[1] set out an air quality management framework for the 8 pollutants identified by the Expert Panel on Air Quality Standards (EPAQS). Subsequently, the Air Quality Regulations[2] set out health based Air Quality Objectives (Objectives) for seven of the eight pollutants. (see appendix I)

The Strategy also introduced the system of Local Air Quality Management (LAQM). This requires local authorities to periodically carry out a Review and Assessment (R&A) of the current and likely future air quality in their areas against seven of the eight Objectives. Ozone is not included within LAQM due to its transboundry nature, requiring national and international intervention. The 5 main steps in the R&A process are set out below

Updating and Screening Assessment (USA) - this identifies anything that has changed in terms of sources and emissions since the last round of R&A, including new air quality problems identified from monitoring.

Detailed Assessment (DA) – this looks in more detail at the areas identified in the USA to see if there are any exceedences of the Objectives.

Air Quality Management Area (AQMA) – once exceedences of the Objective's have been identified, Defra requires the local authority to declare an AQMA in order to identify geographically the areas of poor air quality.

Further Review and Assessment (FR&A) – submitted to Defra within 12 months of the AQMA declaration. The role of the FR&A is to confirm the original declaration, identify the different pollutant sources, and where possible quantify the reduction needed to meet the Objectives.

Air Quality Action Plan (AQAP) – within 18 months of an AQMA declaration the local authority needs to produce an action plan describing the measures it intends to take to improve local air quality.

1.2 Current situation

Based on the results of the Brighton and Hove City Council 2003 Detailed Assessment, a number of exceedences of the annual Nitrogen Dioxide (NO_2) Objective were predicted. In response to this Brighton and Hove City Council declared an AQMA on 8th December 2004.

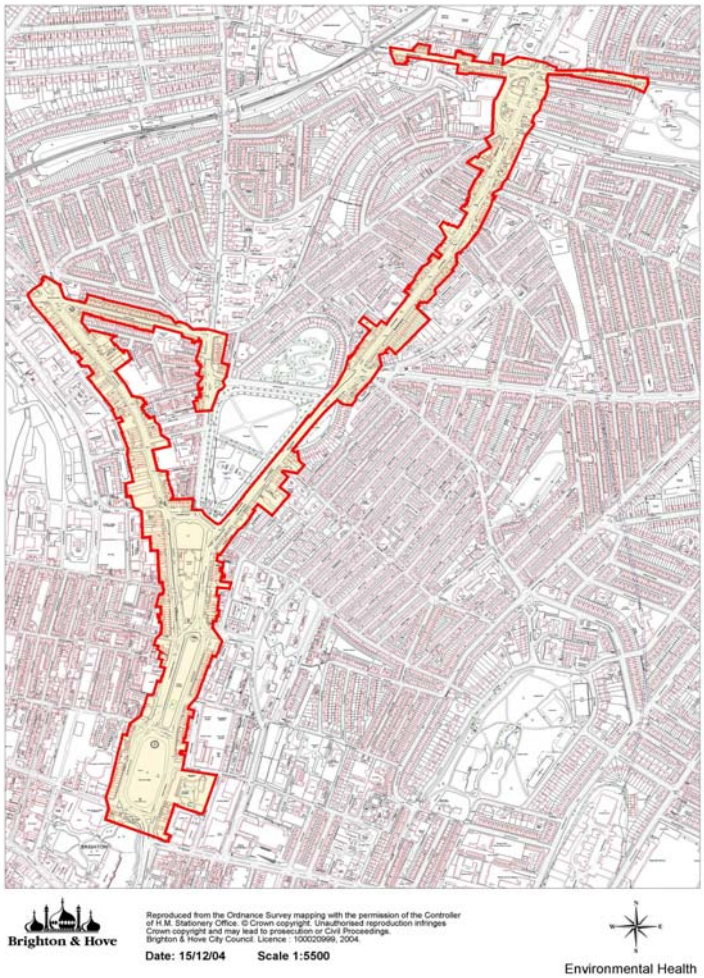
[1] National Air Quality Strategy for England, Scotland, Wales and Northern Ireland (DETR 2000) and addendum (Defra, 2003a)
[2] Air Quality (England) Regulations 2000 and the 2002 amendments

When drawing up an AQMA the relevant Defra guidance[3] states that provided all areas of predicted exceedence are covered by the AQMA, it is the responsibility of the local authority to define the exact boundaries. With this in mind the boundary was drawn up on the assumption that as the areas of exceedence were linked by major road networks with similar traffic flows, a similar pollution profile was likely to exist throughout. A map of the AQMA is shown in Figure 1.

Since the declaration of the AQMA Brighton and Hove City Council has published an Air Quality Action Plan (AQAP) which sets out the measures and policies that will be implemented in the City to improve local air quality. As with a number of other local authorities in the UK, Brighton and Hove City Council (in line with the relevant Defra guidance[4]) has incorporated the AQAP with the City's Second Local Transport Plan 2005/6 -2010/11. This is seen as a logical step given that the primary source of local man-made air pollution is from road traffic, and that it is only through transport planning that significant improvement in air quality can be achieved.

Progress on the AQAP is assessed through the statutory annual reporting process.

Figure 1 Air Quality Management Area



[3] LAQM Technical Guidance 2003.
[4] LAQM Policy Guidance: Addendum 2005

The Objectives referred to in this report are set out in Table 1.

Table 1 NO_2 and PM_{10} Air Quality Objectives

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40 µg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 µg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 µg/m^3	Annual mean	31.12.2004

1.3 Conclusions of the 2006 Updating & Screening Assessment

1.3.1 Nitrogen Dioxide

The 2006 USA, in line with the updated guidance[5], reassessed air quality in the city, and in doing so considered the following-

- matters that have changed since the second round of R&A was completed.
- build upon and utilise the information provided in the progress report submitted in 2005.
- any new monitoring data, new sources or significant changes to existing sources (either locally or within neighbouring authorities), or any other local changes that may be significant.
- any changes to public exposure e.g. new residential developments alongside busy roads etc, if these locations were not fully evaluated in previous R&A reports.

Authorities did not need to re-assess the issues that had been adequately considered in previous rounds, but did need to clearly show that due consideration had been given to all aspects. As a minimum they must have confirmed that the item was no longer relevant or had not changed.

In terms of areas located outside the existing AQMA, the USA identified the following further areas as potentially exceeding the annual NO_2 Objective.

- Sackville Road
- Old Shoreham Road/Nevil Road Junction

[5] LAQM Technical Guidance 2003 (Update 2006).

- St James St
- Eastern Road
- Upper Lewes Road
- North Road, Brighton
- Seven Dials
- Queens Road
- Ditchling Road (North of St Peters Church)
- Queens Road North
- North Street

Further to this, the USA also concluded that a number of other locations should be taken through to a DA. This was due to either their proximity to existing exceedences and/or locations where elevated levels had been identified and further monitoring had been set up to investigate. Further details on this are given in the 2006 USA report. These areas were:

- Western Road (East and West of Montpelier Road)
- Chatham Place/Old Shoreham Road(West of New England Road)
- Terminus Rd

Since the completion of the USA, monitoring data has identified a number of other locations close to the annual NO_2 Objective. Therefore, despite not having been identified in the USA these sites have been considered in this DA. These are-

- Boundary Road/A259 junction
- Hove Street A259 junction
- West Street A259 junction
- Portland Road.

1.3.2 Particulates (PM_{10}).

Given the elevated results seen for 2005 at the Brighton AURN Partisol site Brighton and Hove City Council committed to performing further monitoring of PM_{10} in the city as part of the DA.

2 DETAILED ASSESSMENT

2.1 Key objectives of the Detailed Assessment 2007

The main objective of the DA is to both supplement and build on the information, data and conclusions presented in the 2006 USA. The report is aimed at assessing more accurately the findings of the USA and establish the extent, both geographically, and quantitatively any additional exceedences of the annual NO_2 Objective. When assessing this, careful consideration has been given to relevant receptors, in terms of exposure. This has been done in line with the relevant Defra guidance[3].

2.2 General assessment methodology

In order to accurately assess these potential further exceedences significant data in addition to that presented in the USA has been collected.

Initially the proposal was to assess these areas by setting up new monitoring surveys using a combination of real time chemiluminescent analysers and bias adjusted diffusion tubes, and to carry out dispersion modelling in the remaining areas. This methodology was considered particularly relevant as certain areas under assessment were complex junctions, which do not lend themselves easily to dispersion modelling.

However, a number of the monitoring surveys contain less then 12 months data so period mean adjustments has been used to obtain annual results. Whilst such adjusted data sets are acceptable methods for screening assessments, it is not considered sufficiently robust for a DA. Therefore dispersion modelling has also been carried out in areas with less than 12 months diffusion tube data. This has not necessarily been done for locations where there is sufficient confidence in the monitoring data.

2.3 NO_2 Monitoring methodology

Brighton and Hove City Council has been monitoring Nitrogen Dioxide in the City since the early 1990's and now has over 70 diffusion tubes sites and four real time continuous sites. However, in order for this data to be used in the review and assessment process strict quality assurance/quality control (QA/QC) protocols need to be adhered to.

Three of the four continuous sites, Preston Park Urban Background, Brighton Roadside and Hove Roadside are part of the Automatic Urban and Rural Network. These sites are subject to the QA/QC objectives set out in the relevant guidance[6]. The fourth (the mobile site) is not, so to ensure accurate data, and to minimise uncertainty, the analyser is subject to the following QA/QC procedures:

- Overnight 24hr Internal Zero Span (IZS) calibration checks
- Fortnightly manual zero/span calibration using certified cylinders.
- Full data analyses and ratification through Environmental Research Group, Kings College London (ERG-KCL)
- Six monthly services visits.

(the mobile site is not part of the AURN so is not subject to six monthly audits).

Because of their low cost and low maintenance, diffusion tubes are widely used in the city to assess annual concentrations of NO_2. However, in order to assess the results against the Objectives both the tubes, and the data, are also subject to QA/QC protocols.

[6] Defra. AURN Site Operators Manual 2003

The tubes used by Brighton and Hove City Council are supplied and analysed by the Bristol Scientific Services Laboratory and provide monthly results which can easily be calculated to annual means. As part of its quality procedures, Bristol Scientific takes part in the network field comparison organised by Netcen. Details of both this and the laboratories internal QA/QC results are presented appendix VI.

2.3.1 Bias Adjustment and Period Means

In terms of the data itself local authorities using diffusion tubes are required to calculate a relevant bias adjustment factor. This is basically a test to show how accurate the results are when compared to more accurate and sophisticated analysers. The purpose of this is to minimise the potential inaccuracy of the results.

This is achieved by co-locating triplicate NO_2 tubes at the inlet of Hove Roadside AURN site. Throughout the year any discrepancy between that measured by the diffusion tubes and that by the continuous analyser can be quantified and a bias adjustment factor produced. Brighton and Hove City Council annually submits these results to The University of the West of England for inclusion in the national bias adjustment factors database. The database includes data from many such studies around the country, (including Brighton and Hove City Council) and from this calculates a single bas adjustment factor for all local authorities using that laboratory.

The bias adjustment factor for 2006 was **0.9**.

Since the completion of the 2006 USA a number of additional diffusion tube sites have been set up. Unfortunately there is less than 12 months data in many cases, meaning that a period mean adjustment was needed to obtain annual results. Period adjustment is a method by which short term monitoring can be calculated to annual averages by comparing the results to other local 12 month data sets. As a number of the surveys were set up at different times, three period mean adjustment factors have been calculated. Details of these are given in appendix IV.

Further to this, separate bias adjustment factors have been calculated for the periods in question. These factors are also given in appendix IV.

All period and bias adjustments have been calculated using the relevant Defra guidance[3].

2.3.2 New Monitoring Sites

In addition to the existing diffusion tube network the following sites were set up and re-sited in response to the conclusions of the 2006 USA.

Site No	Site Name
3	West St
6	Terminus Road
32	Lewes Road North
39	Old Steine
41	Edward Street

43	Eastern Road (2)
44	Eastern Road (3)
49	Sackville Road (Clarenden Villas)
52	Sackville Road (Frith Road)
54	Old Shoreham Road/Nevil Road (West)
55	Old Shoreham Road/Nevil Road (East)
65	Seven Dials (Dyke Road South)
66	Seven Dials (Dyke Road South-Powis Sq)
67	Seven Dials (Dyke Road North)
68	Seven Dials (Dyke Road Belmont)
69	Seven Dials (Buckingham Place)
70	Seven Dials (Goldsmid Road)
71	Seven Dials (Vernon Terrace)
72	Vernon Terrace
73	New England Road (Chatham Place)
74	Old Shoreham Road (New England Road)
75	Western Road (West)
76	Western Road (re-sited from Churchill Square to east of Montpelier Road, Brighton)
77	North Street

The mobile AQ unit has also been sited in Queens Road to assess for both PM_{10} and NO_2.

2.4 PM_{10} monitoring methodology

The council currently has two particulate monitors in the city, one static and one mobile. The static Partisol site was installed at the Brighton Pavilion in 2003 and being part of the national network is subject to the QA/QC requirements of the relevant guidence[6]. The mobile TEOM is not part of the AURN so is subject to the following procedures

- Full data analyses and ratification through Environmental Research Group, Kings College London (ERG-KCL)
- Six monthly services visits.
- Regular filter change and data diagnostics download.

The mobile site containing both the TEOM and an NO_2 chemiluminescent analyser is relocated every 6 to 12 months to different areas of the city for assessing air quality.

2.5 Dispersion modelling methodology

Detailed dispersion modelling of NO_x and NO_2 has been undertaken by using the Trinity Consultants, Breeze Roads model. Breeze Roads is designed to estimate carbon monoxide (CO), particulate matter (PM_{10}) and nitrogen dioxide (NO_2) and other pollutant concentrations from motor vehicles at roadside locations. The model includes the CALINE4, CAL3QHC and CAL3QHCR line source dispersion models and a traffic algorithm for estimating vehicular emissions.

The model has been used to identify the 2006 base year concentrations for all sites as well as a prediction to 2010 for comparison with the UK Objective (2005), and the European Limit Values (2010) respectively.

The following baseline data has been collected for inputting into the model-

Emission factors- In order to accurately estimate vehicle emissions the emission factors toolkit sourced from the Review and Assessment Helpdesk Website (run on behalf of Defra) has been used. The toolkit allows calculation of road traffic exhaust emissions for different vehicle categories, at various speeds, and on different road types. Two versions are available; Version 2e has been used in this assessment.

In addition to classified traffic data, information on average speed is also required. For the purpose of this assessment, in the absence of specific data, speed for the various runs has been estimated. This data is presented in appendix II. Speed is an important factor, in terms of the emissions profile; with emissions being greater at slower speeds. This is particularly the case with urban inner city roads that see very stop start, congested traffic. Therefore for the purpose of the model, traffic speeds have been considerably reduced at congested junctions to better reflect the likely emissions.

Traffic data – The traffic data required for this assessment has been sourced both from existing as well as from newly commissioned surveys. Where data from previous years has been collected factors have been used to estimate Annual Average Daily Traffic (AADTs) for the relevant years. A 2% annual traffic growth factor has been used for this purpose in line with national predictions. This is considered to represent a worst case scenario for Brighton and Hove given that the City's Local Transport Plan[7] is targeting a 1% reduction annually over the next 5 years.

The raw data is obtained from both continuous automatic counts and 12hr manual classified turning counts. This is insufficient for the purposes of dispersion modelling, which requires 24hr annual average daily counts (AADT). In the absence of continuous automatic traffic data, previous assessments have applied a general factor of 1.25 city wide to convert 12hr data to 24hr data. However, given the variation in traffic flow and composition across the city this is unlikely to represent AADT on all road networks in the city.

In recent years Brighton and Hove City Council has set up a network of automatic traffic site counts, so for the purpose of this assessment individual 24hr factors for a number of sites can be calculated. This will significantly reduce the error associated with this aspect of the modelling. Traffic count details are given in appendix II.

Specific receptors- In addition to the general receptors setup in the model to produce the contour plots (as shown in appendix VII) specific receptors are used to predict the pollutant level at a number of given locations, such as residential properties. These are used in the model to quantify the level of Objective

[7] Brighton & Hove City Council Local Transport Plan 2005/6-2010/2011

exceedence as well as compare and verify the modelled results to local monitoring data.

Metrological data- For the purpose o this assessment a full year's met data for the 2006 base year has been used. The data has been obtained from the Shoreham met station, as this best represents the meteorological environment of Brighton and Hove.

Background Pollution- Breeze Roads only predicts the contribution from the road traffic components and not the existing background pollution concentrations. In order to calculate the total ambient concentration national background maps, which are available from the Air Quality Archive[8], have been used.

It is important when selecting background maps that they are representative of the area, and therefore relevant to the modelling. To do this a number of 1km x 1km maps have been averaged over the two main modelling areas of Hove and Brighton. Details of these are given in the appendix III.

Road width – this has implications for dispersion rates in the model and is accurately measured using GIS. (Geographical Information System)

Base map file – DXF and Shape file maps have been used as the basis of the pollutant contours maps, as shown in appendix VII.

2.6 Verification and uncertainty

Despite the validation carried out by Trinity Consultants on the model it is often the case that the model will not necessarily accurately predict the concentrations as experienced locally. To take account of this unquantified uncertainty, local verification has been carried out. The theory is to compare the modelled results to local monitoring data and establish correction factors which are applied to the whole modelled data set. Once done the dispersion plots give a more accurate representation of ambient pollution concentrations in each given location. Details of the verification process are given in appendix III.

[8] http://www.airquality.co.uk/

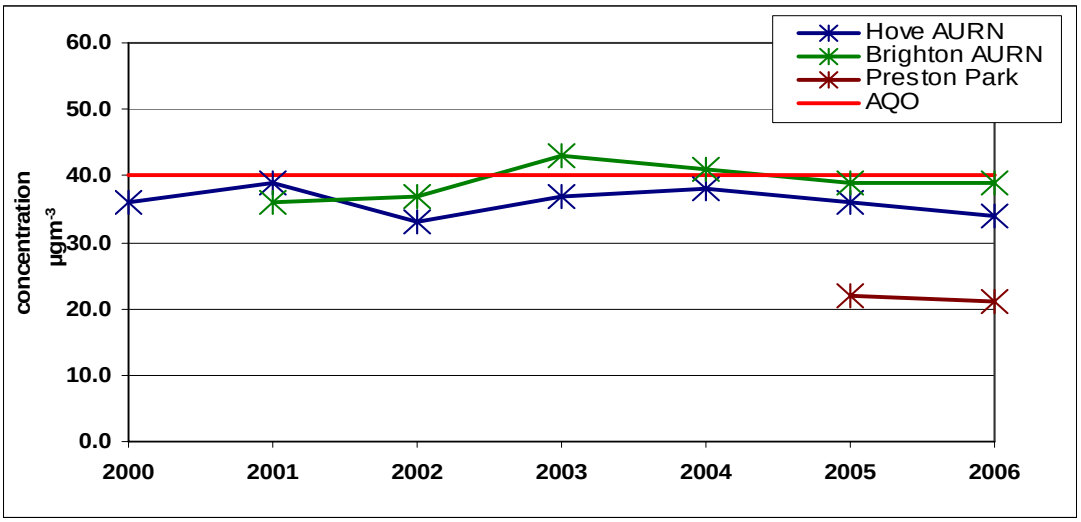
3 RESULTS

3.1 Monitoring Results.

3.1.1 Nitrogen Dioxide

The annual average concentrations in recent years for the three AURN sites are show in Figure 2.

Figure 2 AURN Concentrations 2000-2006



It can be seen from the data that two exceedences of the annual mean NO_2 objective have occurred at the Brighton Roadside site in 2003 and 2004. However, this is not of concern for the purposes of this assessment as the site is within the boundaries of the existing AQMA. Neither of the other sites has shown exceedences since 2000.

Since the declaration of the AQMA the mobile AQ unit has monitored at three locations (Table 2). However, as it has not been possible to assess each location for a full 12 month period, the relevant Defra guidance[3] was used to calculate the annual results from period mean calculations. Details of these calculations are given in appendix IV.

Table 2 Mobile AQ annual NO_2 results (Chemiluminescent analyser)

Site	Grid Ref	Annual Mean	Year
Preston Circus	531204-105433	50µgm_3*	2005
Lewes Road	532118-105778	44 µgm^{-3}	2005/06
Queens Road	530975-104726	48 µgm^{-3}	2007/07

** this figure was incorrectly presented in the 2006 USA as 48 µgm_3*

The full data set for the bias and period adjusted NO_2 diffusion tube results are shown in appendix V. The 2006 annual results presented in Table 3 show those exceedences identified outside the AQMA from 2006 data.

Table 3 2006 diffusion tube exceedences (outside the AQMA)

Site No.	All NO2 Tube Sites	Bias adjusted annual mean	
		2006	over the EU Limit Value
	AQO	40	40
2	Kings road - outside Grand hotel	41.1	
3	West St	51.5	
4	Queens road - corner of Brighthelm park	45.7	
5	Queens Road North	57.7	49.9
6	Terminus Rd	59.1	51.2
19	Preston Road	45.5	
22	Beaconsfield Road	46.2	40.0
28	Ditchling Road - St Peters church end	41.0	
40	St James Street - outside camping shop	42.3	
50	Sackville Rd (façade)	41.0	
51	Sackville Road - outside no.151	46.1	
64	Seven dials - nth side in Dyke rd	46.5	40.3
69	Site 69 - Seven Dials - Buckingham Place	47.0	40.7
73	New England Road (Chatham Place)	46.9	40.6
74	Old Shoreham Rd - New England Rd	52.9	45.8
75	Western Road (west)	44.3	
76	Western road - Churchill Square	64.5	55.9
77	North St	73.4	

Note annual results show in red have been calculated from period means

A number of other sites set up to assess potential exceedences identified in the USA show levels below the Objective. However, as these results are calculated from period means, which have inherit uncertainty, they have also been assessed by dispersion modelling. Further to this, many of the sites in question (table 4) are in the vicinity of roads with similar traffic flows currently showing exceedences, therefore have been assessed in this DA.

Table 4 2006 period mean diffusion tube results close to NO_2 Objective or near to areas of known exceedence (outside the AQMA)

Site No.	All NO2 Tube Sites	Period and bias adjusted means
		2006
	AQO	40
32	Lewes road North	33.4
41	Edward Street	32.0
43	Eastern Rd (2)	39.1
44	Eastern Rd (3)	35.0
49	Sackville Rd (Clarenden Villas)	33.2
52	Sackville Road (Frith Road)	32.2
54	Old Shoreham Rd/Nevill Rd (West)	23.9
55	Old Shoreham Rd/Nevill Rd (East)	24.1
65	Site 65 - Seven Dials - Dyke Road South	36.7
66	Site 66 - Seven Dials - Dyke Road South Powis Grove	31.0
67	Site 67 - Seven Dials - Dyke Road North	35.6
70	Site 70 - Seven Dials - Goldsmid Road	30.5
71	Site 71 - Seven Dials - Vernon Terrace	26.0
72	Site 72 - Vernon Terrace	25.2

Despite using a bias adjustment factor to reduce the uncertainty of the diffusion tube results it is possible that an element of error will remain. In order to be robust all sites that have shown annual means of above 38 have also been assessed by dispersion modelling. These sites are shown in table 5.

Table 5 2006 diffusion tube results close to NO_2 Objective (outside the AQMA)

Site No.	All NO2 Tube Sites	Bias adjusted annual mean
		2006
	AQO	40
42	Eastern Road - next to zebra crossing	38.1
53	Old Shoreham Rd/Nevill Rd	39.2
59	Wellington rd - north side	39.2
61	Portland rd - outside no.274	39.2

3.1.2 PM_{10}

The data from the Partisol at Brighton AURN shows that the 24hr objective of no more the 35 exceedences a year has been breached, with 38 exceedences in 2005 and 51 exceedences in 2006. The annual mean has been met in both years. However, as stated in the USA 2006 the site does not represent relevant exposure.

Unfortunately, due to both equipment malfunction and power supply problems with the mobile AQ unit which houses the TEOM, it has only been possible to obtain approximately four months data from one location in Queens Rd. The calculated annual result in Table 6 shows that the 24hr PM_{10} objective will not be met at this location.

The results from both the static Partisol and the mobile AQ unit are given below

Table 6 2006 PM_{10} results for the Static Partisol and Mobile TEOM (Queens Road)

Annual AQO		40			
		2003	2004	2005	2006
	Partisol	36.2	32	35	38
	Mobile AQ unit*	n/a	n/a	n/a	37.1
24hr AQO		50 (max of 35 times a year)			
	Partisol	37	31	37	51
	Mobile AQ unit*	n/a	n/a	n/a	61

* the annual result for Queens Road is for 21/02/06 - 21/02/06 and is calculated from period adjustment

3.2 Site Assessment Results

The relevant Defra guidance[3] defines the locations that need to be considered for the purposes of LAQM, as areas where members of the public are likely to be exposed over the relevant time period stated in the objective. To ensure that this is accurately assessed in the modelling, careful consideration has been given to these locations.

3.2.1 Road sections as identified in the USA

Eastern Road (and Edward Street)- Given there is less than 12 months data from the new Eastern Road and Edward St tubes the model run has only been verified locally against a single tube. However, in order to test the accuracy of this, the model has been run to predict the concentration at one of the new sites on each road section. The model has predicted to within 1% and 9% for Edward Street and Eastern Road respectively, which gives high confidence in the results.

Despite not being identified in the USA Edward Street was also assessed as it is the link road between Eastern Road and the existing AQMA, and therefore sees similar traffic flows.

The resulting dispersion plot, receptor data, and diffusion tube result shows a minor exceedence of the Objective in Eastern Road. Edward Street is shown to meet the Objective and all sites are predicted to meet the Objective and EU limit value by 2010.

St James's Street – The monitoring data suggested that concentrations were significantly above the Objective in 2005 and only marginally above in 2006, showing a reduction. The model result verified against the 2006 data also shows that ambient concentrations to be in excess of the Objective.

There are no residential properties on the ground floor. However given that St James St is a classic street canyon, dispersion and dilution is likely to be minimal between 1.8m and 3m. As the model is unlikely to reflect this, the plot for 1.8m is most likely to represent ambient concentrations.

The model run has only been locally verified against a single tube. However, given the simple nature of this road section this is considered reasonable. The Objective and EU limit value is predicted to be met at all relevant receptors by 2010.

Queens Road and Queens Road Quadrant – The 2004 DA identified Queens Road as a hotspot area in that it was close to the Objective at the time. Given this Brighton and Hove City Council commissioned ERG-KCL to also model this area when undertaking the Further Assessment of the AQMA[9] in 2005/6. The results of this assessment confirm the local diffusion tube and continuous monitoring results in showing the area to be exceeding the Objective.

The limited PM_{10} monitoring from this area also suggests an exceedence of the short term PM_{10} AQO's.

Terminus Road – Given the results of the Queens Road assessment and that Seven Dials was being taken through to DA it was concluded that Terminus Road should also be assessed. Terminus Road is the link road between these two areas and is often congested at the Queens Road end. Further to this, terraced housing fronts the pavement next to Terminus Road.

[9] Brighton & Hove City Council Further Review and Assessment 2006

The results of both the monitoring and modelling show a significant breach of the NO_2 objective. The objective is also predicted to be exceeded at most receptors by 2010. The modelling result also suggests an exceedence of the short term 24 hr 1-hour NO_2 objective. (It should be noted however that the verification for Terminus Road is based on short term diffusion tube monitoring).

Sackville Road – Based on the tube results from the north of Sackville Road it was concluded to take the road through to DA. Subsequent results from the new diffusion tube sites suggest that a number of sections of Sackville Road are likely to meet the Objective. However, the existing tube sites show results remaining in excess of the Objective. The model run which has been verified using both the factors of Sackville Road and the Sackville Road/Old Shoreham Road junction has been run at 0m as many residential properties in the road have basement flats. This confirms the tube results in showing exceedences at various sections along the road.

The Objective is predicted to be met at most relevant receptors by 2010, however some slight exceedences of 40μgm^{-3} NO_2 Objective remain.

Sackville Road/Old Shoreham Road junction – At the time of the USA there was only one diffusion tube site at this location so as part of the DA three further sites were set up. As these new sites contain less than 12 months data only the existing Old Shoreham Road/Sackville Road tube has been used for the purposes of model verification. However for the purpose of checking accuracy the model has been run to predict the concentrations at the remaining diffusion tube locations. The results of this show the model to be slightly over predicting. Site inspection showed that that residential properties in the area is a mix of ground and first floor locations, therefore model input reflects this.

The results show that there are some minor exceedences of 40μgm^{-3} NO_2 Objective at ground and first floor residential receptors immediately at the junction in Sackville Road and Old Shoreham Road West. Further away from the junction along Old Shoreham Road the Objective is predicted to be met. Sackville Road is dealt with in more detail in a separate model run.

The Objective is predicted to be met at all relevant receptors by 2010.

Old Shoreham Road/Chatham Place – the existing AQMA covers the area of Preston Circus and stops east of the New England Road railway bridge. The 2006 USA concluded that potential exceedences also exist west of the railway bridge on both Old Shoreham Road and Chatham place, so diffusion tubes were sited in both locations. For verification purposes local correction factors from both tubes have been used in the model run. The model shows that the Objective will be exceeded at the congested ends of the two road sections (near the railway bridge) where terraced houses front the pavement. In reality traffic emissions from Chatham Place are unlikely to impact on receptors in Old Shoreham Road (and visa versa), as shown in the plot, due to the buildings restricting dispersion. Given that this will not be accurately represented in the model the results plot can be considered to be a worse case.

The results plot suggests that the Objective is likely to be exceeded at a number of receptors in 2010.

Western Road – In addition to the existing diffusion tube east of Montpelier Road (relocated from Church Hill square for 2006) a second tube was set up west of the junction in light of the USA findings. Western Road is primarily a shopping area with no residential properties at the ground floor level. However, given that it is considered street canyon-like, the model has been run at the default height of 1.8m. This therefore represents a worst case.

The model plot shows that the Objective is exceeded on both the east and west road sections of Western Road for both 2006 and 2010. The results from both monitoring and modelling also suggest an exceedence of the short term 1-hour NO_2 objective.

3.2.2 Road sections identified since in the 2006 USA

Portland Road – Given the monitoring data for 2005 as presented in the 2006 USA showed the concentration in this area to be only 0.8μgm^{-3} below the Objective, it was taken through to DA for further analysis. The model was initial run at 1.8m, which is the default height in Breeze Roads with the result suggesting the façade of either side of the Road was exceeding the Objective. However, close inspection of the area showed that there are no residential properties at the ground floor level so the model was run again at 3m. The resulting plot suggests that at this height Portland Road is unlikely to breach the Objective. Portland Road is not considered to be a street canyon.

The model run has only been locally verified against a single tube. However, given the simple nature of this road section this is considered reasonable.

Boundary Road/A259 Junction – The nearest diffusion tube to the junction is approximately 100m to the west on Wellington Road and shows results very close to the Objective. With this mind it was considered likely that terraced housing at the junction may exceed the Objective. The verified model result confirms this, showing exceedence at both at the junction and the residential properties to the east. To a lesser extent the 2010 plot also shows exceedences.

The model in this case has only been verified locally to the single diffusion tube which is not ideal for a junction. Hoverer given the tube results over recent years and the close proximity of terraced housing to the junction, it is probable that there is an exceedence.

Kingsway (A259)/Hove Street Junction- The junction has been included in the DA as it leads directly to Sackville Rd which was highlighted as potential exceeding the Objective in the 2006 USA. For verification purposes the model run has been assessed using factors from both the Sackville Road and Old Shoreham Road/Sackville junction diffusion tubes.

The model results show there to be slight exceedences on both the east and west sides of the junction. The objective is predicted to be met at all relevant receptors by 2010.

Kings Road (259)/West Street Junction- Since the 2006 USA a diffusion tube has been sited in West Street to assess against the NO_2 Objective. Despite not having 12 months data, the initial results suggest levels in excess of the Objective. It was therefore concluded that given the diffusion tube result from the existing Kings Road tube showed levels very close to the Objective that this area should be assessed in the DA.

Due to major works being undertaken in 2007 in the City as part of the pipe replacement work being carried out by Southern Water, the traffic flows in this area have been hugely disrupted. For example, in order to gain access to the city centre a number of buses have been redirected up West St. With this in mind it is unlikely that the traffic count for 2006 when modelled will bare any resemblance to the concentrations shown by the diffusion tube. Therefore it has only been possible to verify the model run for this junction against the existing tube in Kings Road.

The model results show exceedences immediately at the junction and to the east. The plot also shows marginal exceedences to the west of the junction at relevant receptors but no exceedences in West Street. The Objective is predicted to be marginally exceeded at some relevant receptors by 2010.

Kings Road - In light of the results of the Kings Road/West Street model runs a further run was performed to investigate the Kings Road west of the junction as there are a number or residential receptors along the road.

The model plot for 2006 suggests there are marginal exceedences on residential receptors between the junction and Embassy Court to the west. The Objective is predicted to be met at all relevant receptors by 2010.

The verification based on a single tube at this location and the Kings Road/West Street junction is not considered very robust so is discussed in the 'further work' section of the conclusions.

North Street – The Southern Water pipe replacement works taking place in the City have also had a significant impact on the traffic flow and composition in North Street. Therefore it has not been possible to verify the model result against the local North Street diffusion tube. However, the high diffusion tube result coupled with the fact that the road is canyon like and carries a high volume of bus traffic suggests an annual NO_2 objective exceedence is likely.

The monitoring result also suggests an exceedence of the short term 1-hour NO_2 objective.

Upper Lewes Road – The diffusion tube results since the 2006 USA have shown ambient concentrations to be below the Objective

Ditchling Road (North of St Peters Church) – When the 2004 AQMA was drawn up a section of Ditchling Road north of St Peters Church was not included, as it showed ambient NO_2 concentrations below the objective. The results present in the 2006 USA, as well as the 2006 data presented in this report, show that this area is now exceeding.

Seven Dials – Since the USA a total of 10 diffusion tube sites have been set up around this major junction to give a detailed picture of annual NO_2 levels. Although not based on a full calendar year, all tubes now have a total of 12 months data for all arms of the junction. In order to thoroughly investigate the site tubes have been located both at the junction end of each arm as well as at receptors further away. This approach has been taken to establish the extent of any exceedences. Due to the complexity of the junction it was decided to set up an extensive monitoring survey as apposed to using a dispersion model.

The results show only three of the seven arms to be exceeding the Objective and of those only two are showing exceedences away from the junction.

3.2.3 The existing AQMA

In addition to investigating the potential exceedences identified in the 2006 USA, the measured concentrations within the existing AQMA have also been assessed. The annual results for 2006 show most sites to still be exceeding.

4 DISCUSSION AND CONCLUSIONS

4.1 Nitrogen Dioxide

When assessing the modelling and monitoring results, all appropriate steps have been taken to minimise uncertainty. In terms of monitoring, all continuous sites have adhered to strict QA/QC protocols in line with the relevant guidenace[6]. The mobile AQ unit is not part of the AURN so is instead subject to the QA/QC procedures detailed in the relevant section of this report. Audits are considered an important part of the data ratification process however given the QA/QC specific to the mobile site, Brighton and Hove City Council is still confident with the results.

All diffusion tubes are supplied and analysed by Bristol Scientific Services who follow their own strict QA/QC protocols, details of which are given in appendix VI. In addition, Brighton and Hove City Council also conducts a triplicate co-location study in order to quantify a bias adjustment factor for the tube results, which is then submitted to the national triplicate data base to further improve accuracy.

All modelling results have been verified against both the Hove Roadside AURN Chemiluminescent analyser as well as against bias adjusted diffusion tube results. This gives a high level of confidence in the model results.

Despite this it is likely that a element of uncertainty remains and local authorities often declare areas that are just below the 40μgm^{-3} to allow for this. However given that every step has been taken to minimise uncertainty Brighton and Hove City Council proposes to instead only highlight areas below the objective as hot spots and where necessary under take further monitoring. Clearly through on-going

assessment, should any of these areas show future exceedences then they will be declared as AQMA's accordingly. These areas will be specially reported on in future progress reports to ensure continuing close scrutiny.

Based on the findings in this report the following has been concluded:
Road sections to be declared within AQMA's:

- St James's St
- Queens Road and Queens Road Quad
- Terminus Road
- Sackville Road
- Sackville Road/Old Shoreham Road junction
- The junction of Old Shoreham Road/Chatham Place
- The junction of Boundary Road/A259
- The junction of Kingsway(A259)/Hove Street
- The junction of Kings Road (259)/West Street
- Ditchling Road (North of St Peters Church)
- Seven Dials (certain sections)
- Eastern Road
- Western Road
- North Street

Road section shown to meet the Objective's-

- Edward Street
- Portland Road
- Upper Lewes Road

The relevant Defra guidance[5] states that areas of relevant exposure where the annual NO_2 concentration is above 60µgm^{-3} may also exceed the 1-hour NO_2 objective. From the results the following locations have been identified as such-

- Western Road
- North Street
- Terminus Road
- Viaduct Road (within existing AQMA)
- London Road (within existing AQMA)

When drawing up AQMA's for all identified exceedences, areas shown to exceed the 1-hour NO_2 objective will be considered in terms of relevant exposure.

4.2 PM_{10}

The results from both the Partisol at Grand Parade and the TEOM in Queens Road show exceedences of the 24hr short term AQO.

Given there are only two PM_{10} analysers the City, the initial proposal was to use dispersion modelling to assess against the relevant PM_{10} Objective's. As with the

NO_2, the model was verified against the Brighton AURN Partisol site. The result showed a factor of 41 was needed to correct the modelled road contribution to the measured concentration, demonstrating that the model was hugely under predicting the PM_{10} road component. In terms of the modelling it was therefore considered inappropriate to verify all results against the Partisol as this may significantly over predict PM_{10} concentrations at other sites around the City.

The high verification result suggests there are factors which the model is unable to account for. Problems with the site itself are unlikely given the strict QA/QC procedures, therefore suggesting other fugitive PM_{10} sources are to blame. As the model only takes account of tail pipe emissions, any additional PM_{10} loading from road re-suspension, sea salt, local construction and/or road work projects or other sources unknown could explain this large discrepancy.

The ratified data from Queens Road shows concentrations comparable with those from the Partisol. Despite the fact that the Partisol sees higher traffic volumes, similar concentrations were expected in the Queens Road area given the congested and canyon-like setting.

To support this, the two local diffusion tubes (Sites 4,5) closest to the Queens Road TEOM also show comparable results with the tubes (Sites 8,9) adjacent to the Partisol.

4.3 Future Work

The further model run undertaken on Kings Road suggests that NO_2 levels at residential receptors along the sea front are very close to the Objective. The model run at this site has been based on a single NO_2 located on the kerbside which has been calculated to the façade based on the factors given on the Defra Review and Assessment Helpdesk Website. This is not considered sufficiently robust to make an accurate assessment against the Objective. Therefore further monitoring will be set up to gain a better understanding of NO_2 levels along this road section.

The limited PM_{10} results suggest that areas of Brighton and Hove may be exceeding the short-term PM_{10} AQO. Therefore, Brighton and Hove City Council will need to monitor in several other key locations around the city to clarify this. Unfortunately PM_{10} monitoring will be extremely difficult in the foreseeable future given that EDF, (the local energy supplier for Brighton and Hove) no longer allow the council to use temporary power supply boxes from street lights. Presently this is the only viable source of electricity in the city for powering the mobile AQ unit.

The decision for declaring an AQMA for PM_{10} in the city will depend on the results of this further monitoring. Progress will be reported through the annual reporting process

Further work is also required to establish local particulate sources. In pursuit of this the Council will liaise with Defra to discuss possible chemical analyses of the Partisol filters.

5 RECOMMENDATIONS

- Brighton and Hove City Council needs to retain the areas currently within the existing AQMA

- Consider proposals and options for including the further exceedences highlighted in this report within AQMA's.

- Further monitoring should be conducted on the A259 Kings Road and Kings Way, to identify NO_2 concentrations at relevant receptors in terms of the Objective's.

- Investigate options for future temporary power supplies for the mobile unit, or locate both the NO_2 and PM_{10} analysers to a static permanent site.

- Investigate options for further monitoring PM_{10}.

- Liaise with Defra over particulate analysis of the Partisol filters.

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Local Authority Air Quality Support Website http://www.laqmsupport.org.uk

Appendix 1: Air Quality Objectives

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.5 μg/m^3	Running annual mean	31.12.2003
	5 μg/m^3	Annual mean	31.12.2010
1,3 Butadiene	2.25 μg/m^3	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Maximum daily 8-hour running mean	31.12.2003
Lead	0.5 μg/m^3	Annual mean	31.12.2004
	0.25 μg/m^3	Annual mean	31.12.2008
Nitrogen dioxide	200 μg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40 μg/m^3	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 μg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 μg/m^3	Annual mean	31.12.2004
Sulphur dioxide	350 μg/m^3 not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
	125 μg/m^3 not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 μg/m^3 not to be exceeded more than 35 times a year	15 minute mean	31.12.2005

*since writing this report the New National Air Quality Strategy has been published by Defra which sets out the updated AQO's for the UK. This has no implications for this report as the AQO's for PM_{10} and NO_2 have been retained.

Appendix II: Model Input Data

Appendix II(a) - Input data summary Single Roads

Terminus Road (30/31-04/05)	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	454	91.9	8.1	32	20	0.9214	1.0837	23.1	34.1	2007
2010	492					0.6706	0.7863	21	29.2	

Eastern Road (3203/04)	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	702	93.2	6.8	32	N/A	0.8411	N/A	23.1	34.1	2003
2010	759					0.6133	N/A	21	29.2	

Edward Street (3104)	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	631	94.3	5.7	40	24	0.7319	0.8427	23.1	34.1	2003
2010	683					0.5343	0.6146	21	29.2	

North Street (30/31-04))	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	532	67.8	32.2	24	10	2.7302	4.2315	23.1	34.1	2004
2010	575					1.9638	3.0397	21	29.2	

St James St (3104)	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	108	82.8	17.2	24	N/A	1.6618	N/A	23.1	34.1	2007
2010	117					1.2001	N/A	21	29.2	

Portland Road (2705)	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	494	96.0	4.0	48	N/A	0.6202	N/A	18.4	24	2006
2010	535					0.4532	N/A	16.8	20.3	

Church Road (verification)	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	700	90.9	9.1	32	N/A	0.9832	N/A	18.4	24	2006

Sackville Rd	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow Split	Emiss F ($g.vehKM^{-1}$) NOx	Emiss F ($g.vehKM^{-1}$) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	749	94.8	5.2	24	n/a	0.8071	N/A	18.4	24	2007
2010	811					0.5891	N/A	16.8	20.3	

Appendix II(b) - Input data summary Junctions

Western Road/Montpelier

Western Road West	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	455	82.9	17.1	32	10	1.4775	2.4833	23.1	34.1	2007
2010	492					1.0675	1.7832	21	29.2	

Western Road East	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	351	85.9	14.1	32	10	1.2921	2.1359	23.1	34.1	2007
2010	381					0.9352	1.5336	21	29.2	

Montpelier Road North	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	350	96.2	3.8	32	10	0.6557	0.9434	23.1	34.1	2004
2010	379					0.4810	0.6765	21	29.2	

Montpelier Road South	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	161	96.1	3.9	32	n/a	0.6619	n/a	23.1	34.1	2004
2010	175					0.4854	n/a	21	29.2	

Sackville Road/OSR

OSR Road West	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	1099	96.0	4.0	48	10	0.6202	0.9666	18.4	24	2004
2010	1190					0.4532	0.6931	16.8	20.3	

OSR Road East	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	989	96.4	3.6	48	10	0.5992	0.9202	18.4	24	2004
2010	1070					0.4383	0.6598	16.8	20.3	

Nevil Road	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	863	95.2	4.8	32	10	0.7175	1.0592	18.4	24	2004
2010	934					0.5251	0.7597	16.8	20.3	

Sackville Road	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	985	95.0	5.0	32	10	0.7299	1.0823	18.4	24	2004
2010	1067					0.5339	0.7763	16.8	20.3	

A259/Boundary Road

A259 West	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	963	92.5	7.5	48	10	0.8033	1.3718	18.4	24	2004
2010	1042					0.5839	0.9844	16.8	20.3	

A259 East	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	964	92.8	7.2	48	10	0.7876	1.3371	18.4	24	2004
2010	1043					0.5727	0.9534	16.8	20.3	

Boundary Road	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	238	91.2	8.8	32	10	0.9647	1.5223	18.4	24	2004
2010	257					0.7015	1.0925	16.8	20.3	

Docks Road	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	33	93.6	6.4	32	10		1.2444	18.4	24	2004
2010	35						0.8928	16.8	20.3	

Kings Road/West Street

Kings Road West	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	1608	97.7	2.3	24	10	0.6005	0.7697	23.1	34.1	2003
2010	1740					0.4415	0.5516	21	29.2	

Kings Road East	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	1652	97.7	2.3	24	10	0.6005	0.7697	23.1	34.1	2003
2010	1788					0.4415	0.5516	21	29.2	

West Street	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	434	97.9	2.1	24	10	0.5862	0.7466	23.1	34.1	2003
2010	470					0.4313	0.5350	21	29.2	

OSR/Chatham Place

OSR East of Dyke Road	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	401	96.4	3.6	32	10	0.6434	0.9202	23.1	34.1	2006
2010	434					0.4722	0.6598	21	29.2	

Chathan Place	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehK M^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	431	96.3	3.7	32	10	0.6496	0.9318	23.1	34.1	2006
2010	467					0.4766	0.6681	21	29.2	

A259/Hove St

A259 West	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehKM^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	1214	94.9	5.1	48	10	0.6777	1.0939	18.4	24	2003
2010	1314					0.4943	0.7846	16.8	20.3	

A259 East	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehKM^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	1257	95.5	4.5	48	10	0.6463	1.0244	18.4	24	2003
2010	1361					0.4719	0.7347	16.8	20.3	

Hove St	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehKM^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	306	94.8	5.2	24	10	0.7422	1.1055	18.4	24	2003
2010	331					0.5428	0.7930	16.8	20.3	

Kings Esp	Traf Flows (veh hr^{-1})	%LDV	%HDV	Av Speed (kph)	Av Speed (kph) Slow	Emiss F (g.vehKM^{-1}) NOx	Emiss F (g.vehKM^{-1}) Slow Split NOx	NO2 Bgd Conc (μgm^{-3})	NOx Bgd Conc (μgm^{-3})	Traffic data base year
2006	71	98.3	1.7	10	10		0.7003	18.4	24	2003
2010	77						0.5017	16.8	20.3	

Appendix II(c) - Traffic data

	Site	Road	Traffic Count year	2006	2010	1 hour ave (2006)	1 hour ave (2010)	OGV +BUS %	24 hr factor based on ATC
Montpellier	M4412	Monpelier North of Western	2004	8400	9092	350	379	3.6	1.45
Road/Western	M4411	Monpelier South of Western	2004	3876	4195	161	175	3.7	1.45
Road	M4872	Western Road (W of Montpelier)	2007	10910	11815	455	492	17.1	1.45
	802	Western Road (op sillwood st) auto count	2007	8435	9134	351	381	14.1	N/A
Terminus	M4873	Terminus Road	2007	10906	11810	454	492	8.1	1.34
Sackville	M4874	Sackville Rd (nr clarendon)	2007	17983	19473	749	811	5.2	1.21
Road	77B	Nevill Road	2004	20704	22410	863	934	4.8	1.21
Area		A27 (E)		23734	25690	989	1070	3.6	1.21
		Sackville Road		23652	25602	985	1067	5.0	1.21
		A27 (W)		26387	28563	1099	1190	4.0	1.21
	78B	Hove Street	2003	7343	7948	306	331	5.2	1.24
		A259 (E)		30176	32664	1257	1361	4.5	1.24
		Kings Esplanade		1704	1845	71	77	1.7	1.24
		A259 (W)		29143	31546	1214	1314	5.1	1.24
A259 and	22B	Boundary Road	2004	5701	6170	238	257	8.8	1.2
Boundary		A259 (E)		23136	25043	964	1043	7.2	1.2
Road		Docks Road		787	851	33	35	6.4	1.2
Area		A259 (W)		23108	25013	963	1042	7.5	1.2
Eastern Road	M4178	Eastern Road (Sudley Place)	2003	16840	18228	702	759	6.8	1.29
Edwards St	75D	Edward Street		15143	16392	631	683	5.7	1.29
North Street	M4406	North Street (W)	2004	12758	13810	532	575	32.2	1.5
		North Street (E)		12642	13685	527	570	32.4	1.5
		Ship Street		1960	2122	82	88	5.3	1.5
Kings Road and	76B	Kings Road (W)	2003	38584	41764	1608	1740	2.3	1.3
West Street		Kings Road (E)		39638	42905	1652	1788	2.3	1.3
		West Street		10424	11283	434	470	2.1	1.3
Seven Dials to	M4256	Chatham Pl	2006	**10353**	11206	431	467	3.7	1.34
Preston Circus	M4670	Old Shoreham Road East		**9628**	10422	401	434	3.6	1.35
		Automatic Counts							
St James St	824	St Jamess Street A824	2007	2590	2805	108	117	17.2	N/A
Portland Road	502	Portland Road A502	2006	**11860**	12838	494	535	4.0	N/A
		Verification Counts							
Church Road	M4795	Grand Ave (N)	2006	**11699**	12663	487	528	0.0	1.25
Hove TH		Church Road (E)		**15294**	16554	637	690	0.0	1.25
		Grand Ave (S)		**8004**	8664	333	361	0.0	1.25
		Church Road (W)		**16794**	18178	700	757	9.1	1.25

Note: the default factor of 1.25 has been used for sites where no local data is available from automatic counts.

Appendix II(d) - Background map data

For the purpose of assessing the background pollution concentrations the Netcen nation background maps have been used. Two factors have been calculated for Hove and Brighton respectively by averaging the concentrations of all mapped values for each of the two modelling areas.

Hove Background

Grid Ref		Background Data for Hove Model Runs				
X	Y	NOx 2006*	NOx 2010	NO2 2006*	NO2 2010	PM10 2006*
526500	104500	20.78	17.7	16.69	15.6	21.07
527500	105500	25.69	21.5	19.13	17.4	22.64
528500	105500	25.01	21.5	19.13	17.4	22.94
528500	106500	24.53	20.4	18.55	16.9	22.74
average		**24.0**	**20.3**	**18.4**	**16.8**	**22.3**

Brighton Background

Grid Ref		Background Data for Brighton Model Runs				
X	Y	NOx 2006*	NOx 2010	NO2 2006*	NO2 2010	PM10 2006*
530500	104500	35.02	30	23.53	21.4	23.73
530500	105500	38	32.3	24.8	22.5	24.71
531500	104500	35.11	30	23.53	21.4	23.82
531500	105500	37.71	32	24.7	22.3	24.61
532500	103500	27.23	23.7	19.82	18.4	21.46
532500	104500	31.75	27.2	21.97	20.1	23.04
average		**34.1**	**29.2**	**23.1**	**21.0**	**23.6**

* calculated from 2005 dat using the NETCEN year adjustement calculator v2.2a

Appendix III: Model Verification

Appendix III(a) - Verification methodology

Most NO_2 in the atmosphere is produced by complex photochemical reactions with ozone and not directly emitted from motor vehicles, so the initial results from the model are presented in terms of the primary pollutant NO_x (NO_2 and NO). The ambient NO_2 concentration is then calculated.

Verification has been carried out in the following steps:

1) As described in the relevant defra guidance[3] the first step was to model the NO_x road contribution at Hove Roadside AURN for 2006. The total monitored NO_x was then subtracted from the background NO_x as shown in the NETCEN background maps. A road NO_x correction factor was then calculated by dividing the road monitored NO_x by the road modelled NO_x.

2) The next step was to calculate the proportion of NO_x converted to NO_2. In doing so the updated factors (given on the LAQM Support Website) which reflects recent monitoring changes to the NO_x:NO_2 relationship was used. The total NO_2 concentration was then calculated by adding the corrected modelled NO_2 to the NETCEN background NO_2.

3) Given the total modelled concentration was still slightly under reading the monitored concentration, a second correction factor for NO_2 was calculated. This was obtained by dividing the monitored road NO_2 by the corrected modelled NO_2. These two factors were then applied to all modelled data sets.

For the purpose of stages 1-3, factors were calculated for both 2005 and 2006 using the relevant input and met data for each year. The final correction factors are an average of these results.

Despite the verification, further inaccuracies were identified when individual model runs were compared to local monitoring data at other sites. The likely explanation for this is the model not being able to accurately predict varying urban dispersion patterns. Therefore a further local correction factor has been calculated at each site.

4) This third and final correction factor is obtained by dividing the local monitored road contribution (the diffusion tube result minus the Netcen background NO_2 for that given area) by the modelled road contribution (including the factors obtained from steps 1-3). The resultant figures then correct for the model either under or over reading at individual model sites. To avoid over reliance on the accuracy of individual tubes, more than one diffusion tube site has been used to calculate this local factor where possible.

An example of step 4, (verifying against local diffusion tubes) is not presented in this appendix as it is principally the same as step 3)

Appendix III(b) - Hove AURN verification (stages 1-3)

Step 1&2 2006

Steps 1 & 2 Breeze Roads verification Hove AURN (2006)					
Step 1	Calc mon roadside contribution for Nox and NO2				
	[Nox] Tot Mon	-	[Nox] Bkgd	=	[Nox] RoadsMon
	61	-	24	=	37
	[No2] Tot Mon	-	[No2] Bkgd	=	[No2] RoadsMon
	34	-	18.4	=	15.6
Step 2	Dertermine adjustment factor for mod roadside cont				
	[Nox] Roads Mon	/	[Nox] RoadsMod	=	[Nox] Adjustment Roads Mod
	37	/	5	=	7.4
	[Nox] CorrRoadsMod	=	[Nox] RoadsMod	x	[Nox] Adjustment Roads Mod
	37	=	5	x	7.4
Step 3	Calc F (Nox converted to NO2)				
			F= -0.0719xLn([Nox]TotMon)+0.6248		
	f=	0.33			
Step 4	Calc mod roadside NO2 contribution				
	[No2] Roads Mod	=	[Nox] CorrRoadsMod	x	Factor F
	12.2	=	37	x	0.33
Step 5	Calc Final NO2 conc.				
	[No2] Tot Mod	=	[No2] RoadsMod	+	[No2] Bkgd
	30.6	=	12.2	+	18.4

Step 3 2006

Step 3 Breeze Roads verification Hove AURN (2006)					
[No2] RoadsMod (from corr Nox)	[No2] Bkgd (NC)	NO2 Total (NC Bg +NO2 Rds Mod)	Total NO2 monitored	Rds NO2 monitored	NO2 Verification correction factor (F)
12.2	18.4	30.6	34	15.6	15.6/12.2 =1.28

Step 1&2 2005

Steps 1 & 2 Breeze Roads verification Hove AURN (2005)					
Step 1	Calc mon roadside contribution for Nox and NO2				
	[Nox] Tot Mon	-	[Nox] Bkgd	=	[Nox] RoadsMon
	65	-	25.1	=	39.9
	[No2] Tot Mon	-	[No2] Bkgd	=	[No2] RoadsMon
	36	-	18.9	=	17.1
Step 2	Dertermine adjustment factor for mod roadside cont				
	[Nox] Roads Mon	/	[Nox] RoadsMod	=	[Nox] Adjustment Roads Mod
	39.9	/	5.55	=	7.19
	[Nox] CorrRoadsMod	=	[Nox] RoadsMod	x	[Nox] Adjustment Roads Mod
	39.9	=	5.55	x	7.19
Step 3	Calc F (Nox converted to NO2)				
			F= -0.0719xLn([Nox]TotMon)+0.6248		
	f=	0.32			
Step 4	Calc mod roadside NO2 contribution				
	[No2] Roads Mod	=	[Nox] CorrRoadsMod	x	Factor F
	13.0	=	39.9	x	0.32
Step 5	Calc Final NO2 conc.				
	[No2] Tot Mod	=	[No2] RoadsMod	+	[No2] Bkgd
	31.9	=	13.0	+	18.9

Step 3 2005

Step 3 Breeze Roads verification Hove AURN (2005)					
[No2] RoadsMod (from corr Nox)	[No2] Bkgd (NC)	NO2 Total (NC Bg +NO2 Rds Mod)	Total NO2 monitored	Rds NO2 monitored	NO2 Verification correction factor (F)
13	18.9	31.9	36	17.1	17.1/13 =1.32

Verification Summary Table 2005/2006			
	Receptor Height	NOx Corr F	NO2 Verification correction factor (F)
2006	3.5m	7.40	1.28
2005	3.5m	7.19	1.32
All Years	1.5m	7.30	1.30

Appendix IV: Period and Bias adjustment

All period and bias adjustment means have been calculated using the relevant Defra guidance[3]. (All results are presented as μgm^{-3})

Period and Bias adjustment summary table for NO_2 Tubes

Site No.	Site Name	Sample Period	Raw period Data	Bias Adjustment Factor	Period Adjustment Facor	Final Concentration
	AQO					40
3	West St	feb -June 2007	74.9	0.72	1.02	55.0
6	Terminus Rd	April-Dec 2006	69.7	0.78	1.09	59.3
32	Lewes road North	feb -June 2007	52	0.72	1.02	38.2
39	Old Steine	feb -June 2007	61.8	0.72	1.02	45.4
41	Edward Street	feb -June 2007	47.8	0.72	1.02	35.1
43	Eastern Rd (2)	feb -June 2007	55.4	0.72	1.02	40.7
44	Eastern Rd (3)	feb -June 2007	52.1	0.72	1.02	38.3
49	Sackville Rd (Clarenden Villas)	feb -June 2007	47.1	0.72	1.02	34.6
52	Sackville Road (Frith Road)	feb -June 2007	46.5	0.72	1.02	34.1
54	Old Shoreham Rd/Nevill Rd (West)	feb -June 2007	35.2	0.72	1.02	25.9
55	Old Shoreham Rd/Nevill Rd (East)	feb -June 2007	34.5	0.72	1.02	25.3
65	Seven Dials - Dyke Road South	July-Dec 2006	46.2	0.73	1.09	36.8
66	Seven Dials - Dyke Road South Powis Grove	feb -June 2007	44.9	0.72	1.02	33.0
67	Seven Dials - Dyke Road North	July-Dec 2006	44.8	0.73	1.09	35.6
68	Seven Dials - Dyke Road Belmont	feb -June 2007	37	0.72	1.02	27.2
69	Seven Dials - Buckingham Place	July-Dec 2006	59.1	0.73	1.09	47.0
70	Seven Dials - Goldsmid Road	July-Dec 2006	38	0.73	1.09	30.2
71	Seven Dials - Vernon Terrace	July-Dec 2006	32.7	0.73	1.09	26.0
72	Site 72 - Vernon Terrace	feb -June 2007	36.7	0.72	1.02	27.0
73	New England Road (Chatham Place)	April-Dec 2006	55.3	0.78	1.09	47.0
74	Old Shoreham Rd - New England Rd	April-Dec 2006	62.4	0.78	1.09	53.1
75	Western Road (west)	July-Dec 2006	55.7	0.73	1.09	44.3
77	North St	July-Dec 2006	92.3	0.73	1.09	73.4

Period mean factors for 2006 short term NO_2 tube data

		Period means			Ratios		
AURN Site	Annual Mean 2006	*Jan to Sept*	*April to Dec*	*July to Dec*	*Jan to Sept*	*April to Dec*	*July to Dec*
Preston Park	20.7	20.3	19.4	18.5	1.02	1.06	1.12
Portsmouth	22.1	21.2	20.0	20.9	1.04	1.11	1.06
				Average	**1.03**	**1.09**	**1.09**

		Period means	Ratios
AURN	Annual Mean 2006	feb to June 2007	
Preston Park	20.7	23.1	0.896
Portsmouth	22.1	19.3	1.145
		Average=	**1.02**

Period means for the mobile AQ unit

Queens Rd Annual PM_{10}			
long term site	**annual mean**	**period mean**	
	Feb 06 -Feb 07	**Oct 06 -Feb 07**	**ratio**
Portsmouth	24.2	26.1	0.929
Eastbourne	18.8	18.8	0.999
		ave ratio	**0.964**
Queens Rd NO_2			
long term site	**annual mean**	**period mean**	
	June 06 -June 07	**Sept 06 -June 07**	**ratio**
Portsmouth	21.0	22.7	0.925
Preston Park	21.1	22.9	0.921
		ave ratio	**0.923**
Preston Circus NO_2			
long term site	**annual mean**	**period mean**	
	2005	**Jan 05- August 2005**	**ratio**
Portsmouth	23.1	21.2	1.090
Preston Park	22.1	20.4	1.083
		ave ratio	**1.086**
Lewes Road NO_2			
long term site	**annual mean**	**period mean**	
	Sept 05 -Sept 06	**Sept 05 -August 06**	**ratio**
Portsmouth	23.5	24.5	0.959
Preston Park	22.7	23.9	0.950
		ave ratio	**0.954**

Appendix V: NO_2 Tube annual results

Site No.	All NO2 Tube Sites	Bias adjusted annual mean						over the EU Limit Value
		2001	2002	2003	2004	2005	2006	
	AQO	40	40	40	40	40	40	40
2	Kings road - outside Grand hotel	46.1	34.3	47.7	45.2	43.1	41.1	
3	West St						55.0	
4	Queens road - corner of Brighthelm park	47.0	37.7	46.2	43.0	47.5	45.7	
5	Queens Road North					54.0	57.7	49.9
6	Terminus Rd						59.1	51.2
7	North road, Brighton - outside old Argus office	34.7	32.9	40.1	44.1	42.1	37.2	
8	Grand Parade - façade			56.9	50.0	50.1	52.0	45.0
9	Marlborough Place					57.0	52.2	45.2
10	Gloucester Place					60.0	*48.3	41.8
11	York Place					58.0	*55.4	48.0
12	St Peters Place					41.9	43.8	
13	Oxford Place (London Rd)					68.8	48.0	41.5
14	London Road - outside co-op	43.4	44.5	49.7	55.9	50.8	**43.6	
15	St Bartholomew school / New England st	34.0	29.9	36.3	36.3	36.3	29.3	
16	New England Rd					47.6	52.2	45.2
17	London Rd West					61.2	*60.9	52.8
18	London Rd East					44.3	44.3	
19	Preston Road					48.7	45.5	
20	Southdown Avenue - Background	24.1	20.9	22.2	24.0	24.1	23.9	
22	Beaconsfield Road					49.3	46.2	40.0
23	Viaduct Road - façade			45.3	47.1	45.5	44.4	
24	Viaduct Road East					48.7	**61.5	53.2
25	Ditchling Road North					51.0	49.1	42.5
26	Kingsbury Street - Background	29.9	27.4	29.0	31.3	28.2	29.7	
27	Francis St (Ditchling Road)					44.0	43.4	
28	Ditchling Road - St Peters church end	40.5	35.8	38.6	44.7	43.6	41.0	
29	Lewes Rd South					61.2	*43.2	
30	Lewes road - façade			55.5	55.6	62.3	56.9	49.2
31	Hollingdean Road		42.9	51.4	53.1	52.9	*53.6	46.4
32	Lewes road North						38.2	
33	Bear Road		33.6	42.6	38.9	38.2	39.5	
34	Upper Lewes Rd		31.4	39.3	39.1	40.3	*37.8	
35	Elm Grove - outside school	31.8	27.2	32.9	34.0	31.2	29.6	
36	Richmond Terrance		38.8	47.4	52.2	49.1	*35.8	
37	Richmond Place					46.9	41.1	
38	Upper Grand Parade					55.8	*52.5	45.5
39	Old Steine						45.4	
40	St James Street - outside camping shop	37.1	35.3	40.6	43.3	45.8	**42.3	
41	Edward Street						35.1	
42	Eastern Road - next to zebra crossing	40.6	38.1	47.0	56.9	47.6	38.1	
43	Eastern Rd (2)						40.7	
44	Eastern Rd (3)						38.3	
49	Sackville Rd (Clarenden Villas)						34.6	
50	Sackville Rd (façade)						41.0	
51	Sackville Road - outside no.151	36.6	33.7	45.3	46.0	42.9	46.1	
52	Sackville Road (Frith Road)						34.2	
53	Old Shoreham Rd/Nevill Rd	34.1	31.8	38.2	41.1	40.2	**39.2	
54	Old Shoreham Rd/Nevill Rd (West)						25.8	
55	Old Shoreham Rd/Nevill Rd (East)						25.3	
56	Ashlings Way - Background	22.9	18.3	21.3	21.0	22.1	23.3	
58	Trafalgar rd - east side near no.15	37.1	29.9	36.4	35.9	36.3	36.1	
59	Wellington rd - north side	38.1	34.6	35.8	43.9	38.4	39.2	
60	Boundary Road - outside no.78	38.0	34.9	37.6	41.1	38.8	36.9	
61	Portland rd - outside no.274	38.1	33.3	41.5	40.8	37.7	39.2	
62	Raphael Road - Background	21.2	19.7	22.0	24.5	23.4	22.5	
63	Davigdor Road - outside no.55	31.2	28.4	32.6	33.8	34.1	33.5	
64	Seven dials - nth side in Dyke rd	38.6	31.8	43.0	45.5	49.2	46.5	40.3
65	Seven Dials - Dyke Rd South						36.7	
66	Seven Dials - Dyke Rd South Powis Grove						33.0	
67	Seven Dials - Dyke Rd North						35.6	
68	Seven Dials - Dyke Rd Belmont						27.1	
69	Seven Dials - Buckingham Place						47.0	40.7
70	Seven Dials - Goldsmid Road						30.5	
71	Seven Dials - Vernon Terrace						26.0	
72	Site 72 - Vernon Terrace						26.9	
73	New England Road (Chatham Place)						46.9	40.6
74	Old Shoreham Rd - New England Rd						52.9	45.8
75	Western Road (west)						44.3	
76	Western road - Churchill Square	41.2	44.7	52.4	51.3	52.1	**64.5	55.9
77	North St						73.4	

Note

Prior to 2006 annaul averages from tubes that where located at kerdside have been have been calculated u where this was not been possible façade calculations have been used in the data set.

* **tubes have been relocated at the façade of the same site for 2006**

** **tubes have been resited within the same road section to better reflect exposure.**

Over the annual Air Quality Objective (31/12/05)

Over the annual EU Limit Value (1/1/2010)

Provisional figures. Annual averages calculated from short term monitoring in 2007

Appendix VI: Diffusion tube laboratory certification

Appendix VI(a) WASP – Annual Performance Criteria for NO_2 Diffusion Tubes used in Local Air Quality Management (LAQM).

The Workplace Analysis Scheme for Proficiency is an independent analytical performance testing scheme, operated by the Health and Safety Laboratory.

WASP formed a key part of the former UK NO_2 Network's QA/QC, and remains an important QA/QC exercise for laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM).

For this purpose, laboratory performance in WASP is currently assessed by AEA Energy & Environment according to the following criteria, which have been agreed with Defra and HSL. (This forms part of AEA Energy & Environment's work for Defra under their contract "Support to Local Authorities for LAQM" - please note these criteria only apply within the context of LAQM).

1. Apart from laboratories joining or leaving WASP during the year, participating laboratories must complete at least 10 of the 12 monthly WASP rounds.
2. The year's **single** worst result for the laboratory is discarded. This makes some limited allowance for one-off problems with analytical equipment etc.
3. Each laboratory's monthly results is then combined to give a standard uncertainty for the full year, expressed as a relative standard deviation (%RSD) using the following formula:

$$\%RSD = \left(\sqrt{\frac{\sum_{i=1}^{n} \left(\frac{x_i}{\bar{x}} - 1 \right)^2}{n-1}} \right) \times 100$$

- where x_i are the monthly results obtained by the laboratory, $\bar{x}$ is the assigned value and n is the number of results.

4. If the relative standard deviation is greater than 15%, the laboratory's performance for the year in the WASP scheme is deemed unsatisfactory.

The agreed performance criteria require the RSD of the standardised result to be within 15%; however, the Health and Safety Laboratory (HSL) say that a competent analyst should be able to consistently obtain results within $\pm$10% of the assigned value, and the majority of laboratories meet this standard.

If you have any questions about these performance criteria, or the context in which they apply, please contact Alison Loader at AEA Energy & Environment, on 0870 190 6518, or e-mail alison.loader@aeat.co.uk . For more general enquiries about the WASP scheme, please contact Lucy Rix at HSL, lucy.rix@hsl.gov.uk .

Appendix VI(b)

Workplace Analysis Scheme for Proficiency (WASP): Summary of Results for 2006

Nitrogen Dioxide Diffusion Tube Analysis

Laboratory: Bristol City Council

The WASP scheme is an independent proficiency testing scheme operated by the Health and Safety Laboratory (HSL). Each month a diffusion tube doped with nitrite is distributed to each participating laboratory; participants then analyse the tube and report the results to HSL. The nominal mass of nitrite on the doped tubes is different each month, and is intended to reflect the range encountered in actual monitoring.

For the purpose of diffusion tube QA/QC in the context of Local Air Quality Management, AEA Energy & Environment carry out an assessment of laboratory performance for each full calendar year. This was based on the following criteria, which were agreed with Defra and HSL:

1. Participating laboratories must complete at least 10 of the 12 monthly WASP rounds.
2. The year's single worst result is ignored: this makes some limited allowance for one-off problems with analytical equipment etc.
3. Each laboratory's monthly standardised results are then combined to give a standard uncertainty for the full year, expressed as a relative standard deviation (%RSD)
4. The RSD must be within 15%.

Month	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Mean
WASP Round	*81*	*82*	*83*	*84*	*85*	*86*	*87*	*88*	*89*	*90*	*91*	*92*	
Nominal Value, ug nitrite	*2.15*	*1.54*	*1.32*	*0.99*	*2.34*	*1.21*	*1.29*	*0.74*	*2.60*	*1.86*	*1.47*	*0.86*	
Lab Result, ug nitrite	2.01	1.44	1.30	1.00	2.30	1.16	1.38	0.78	2.42	1.86	1.41	0.87	
Standardised Result	0.93	0.94	0.98	1.01	0.98	0.96	1.07	1.05	0.93	1.00	0.96	1.01	**0.98**

Mean Standardised result (actual result / nominal value) 0.98
Mean percentage under/over-estimation of analysis: -1.5%

Comparison with AEA performance criteria for Local Authority Support:
RSD of Standardised Results, ignoring worst value: 4.0 % **This is within the performance target of 15%.**

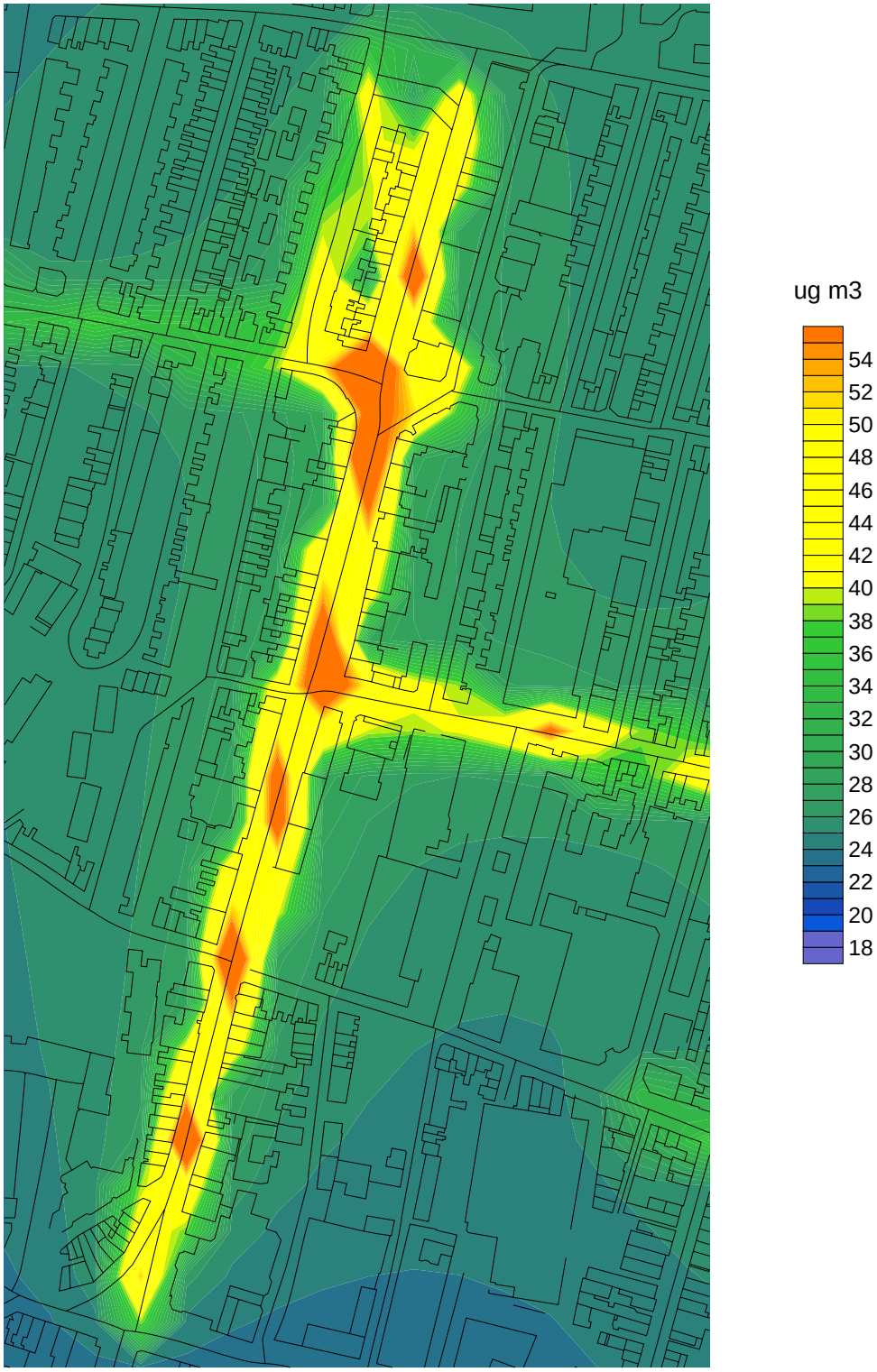
Comments: This laboratory's WASP results met AEA Energy & Environment's performance criteria in 2006.

Produced by AEA under Defra contract RMP 2877 "Support to Local Authorities for LAQM". WASP results supplied by HSL.

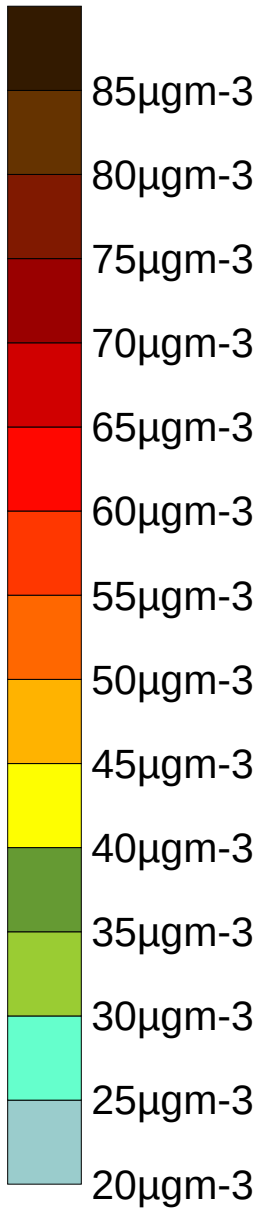
Appendix VII: NO_2 Model Surfer Plots

Appendix VII(a) Single Roads 2006 NO_2 (Queens Road 2005)

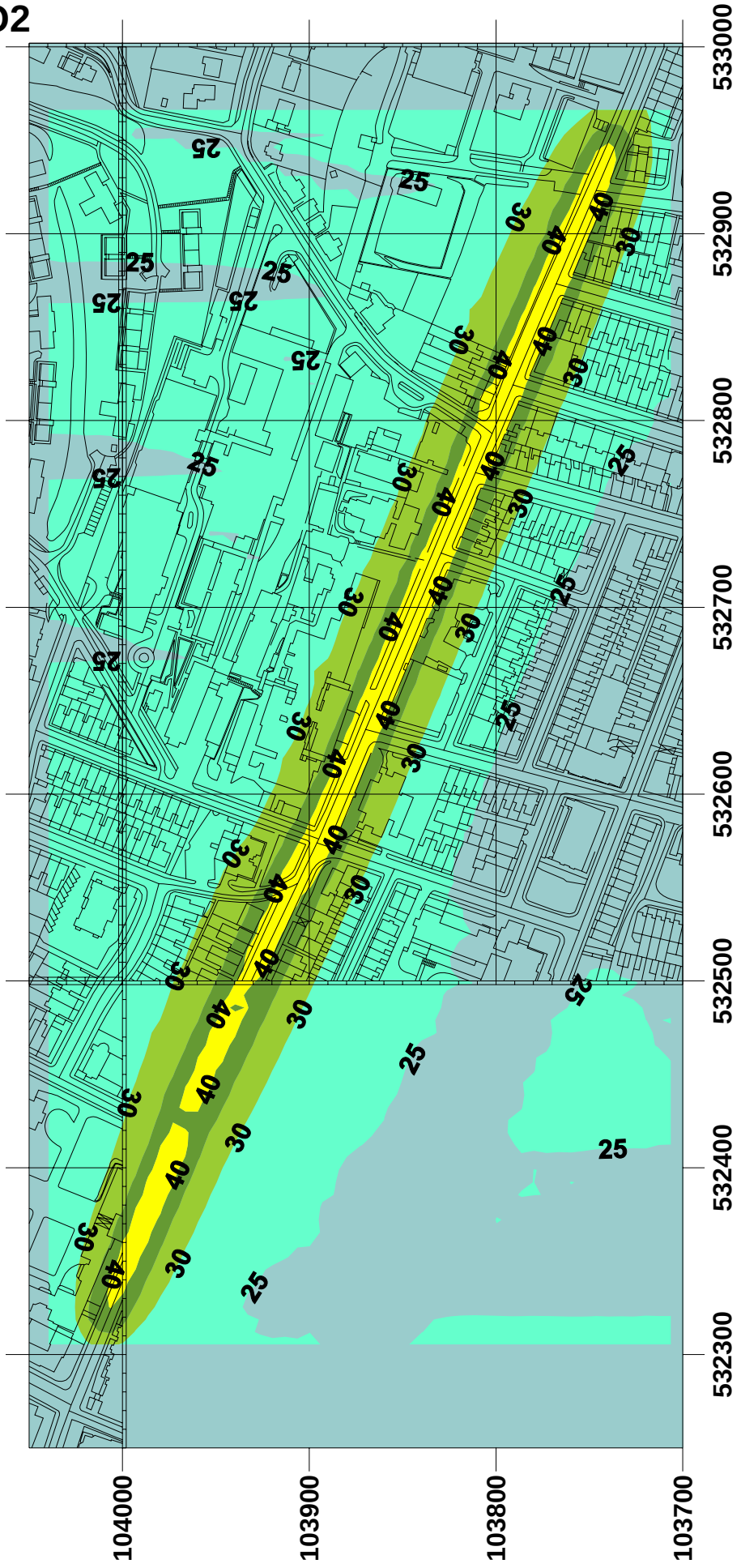
QUEENS ROAD NO_2 2005 (FROM 2006 FURTHER REVIEW AND ASSESSMENT)



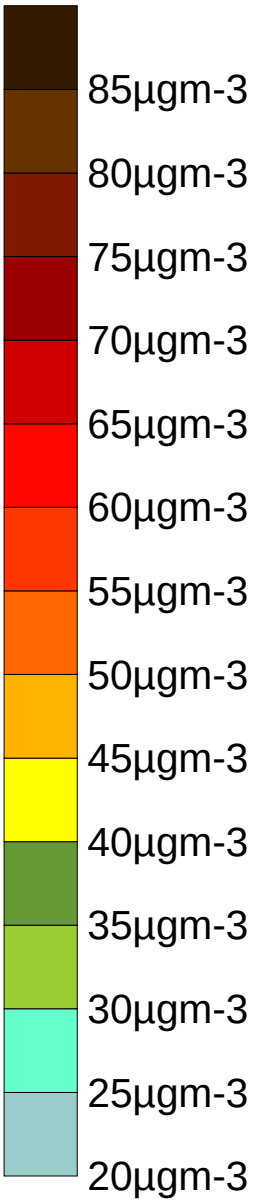
EASTERN ROAD 2006 NO2



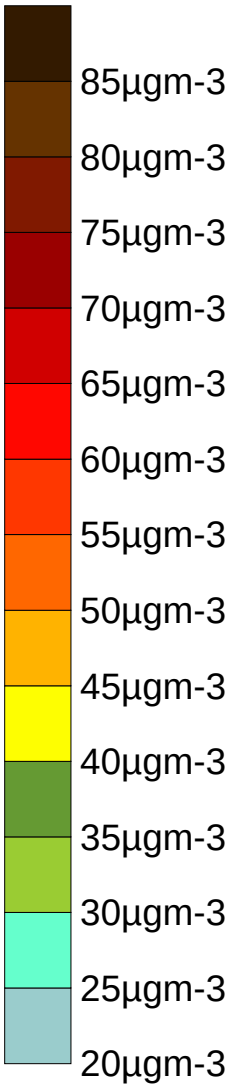
NOTE: Due to a fault with the mapping software a section of the background map is missing from the model plot.

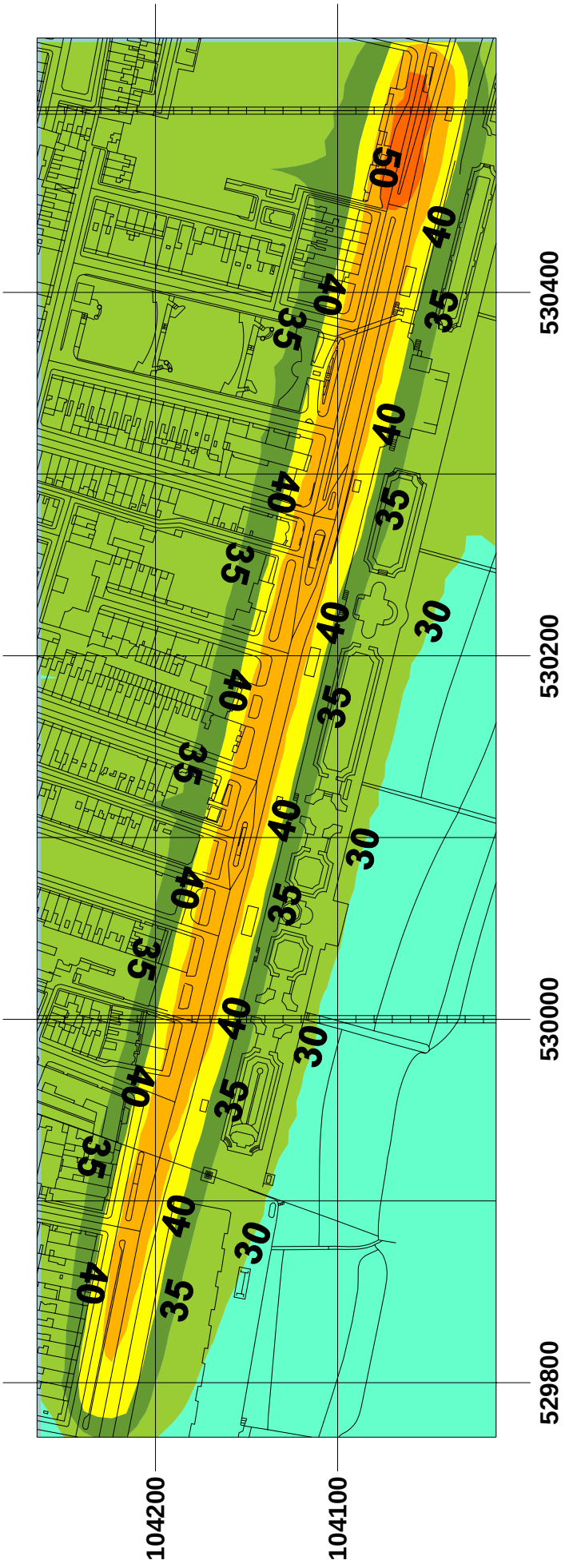


EDWARD STREET 2006 NO2

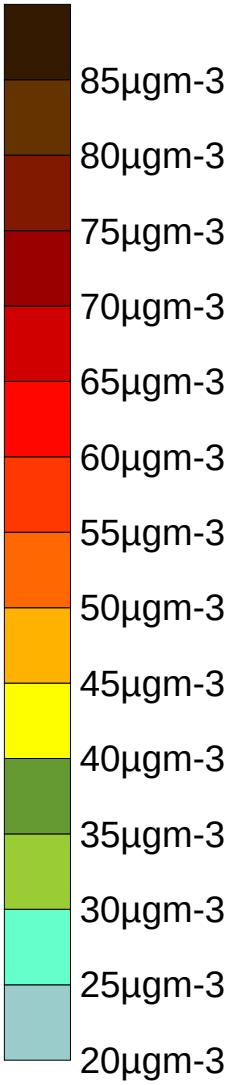


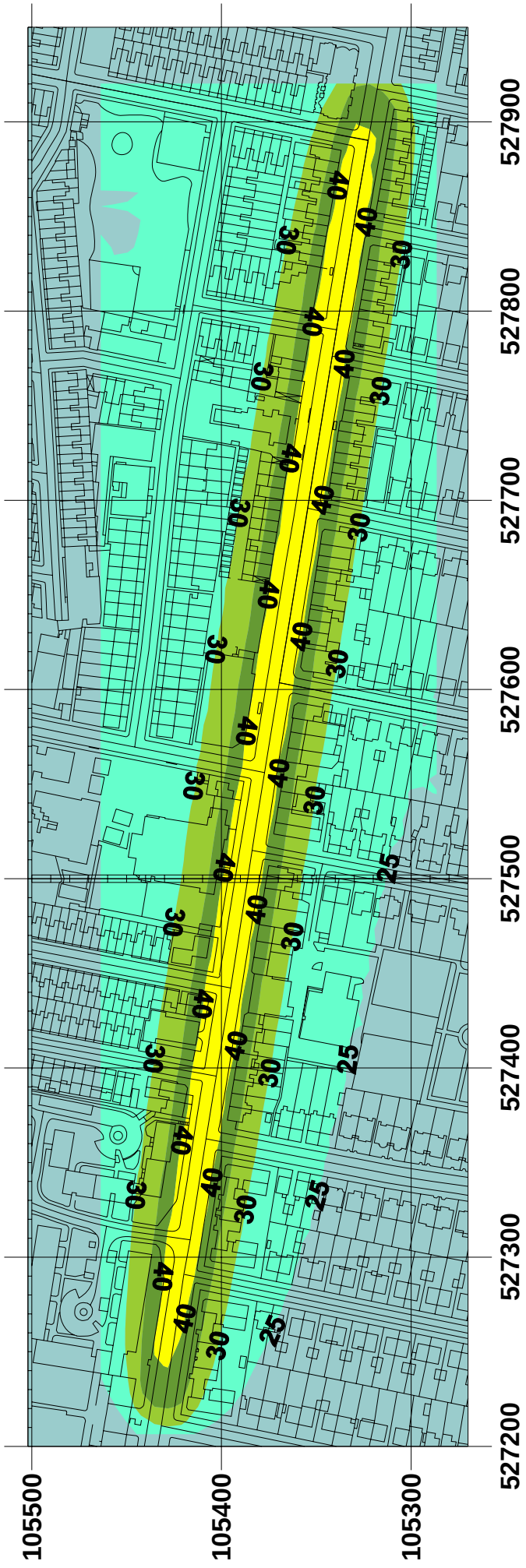
KINGS ROAD 2006 NO2



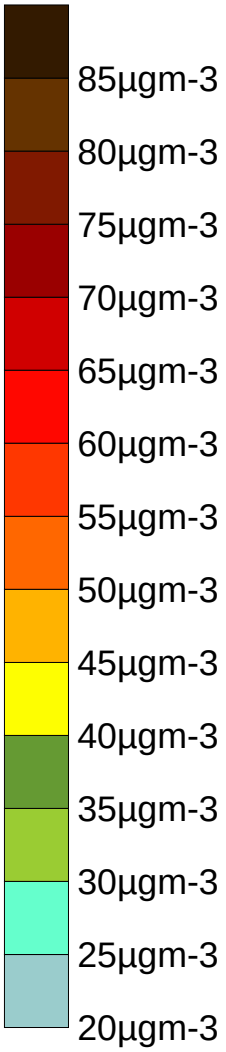


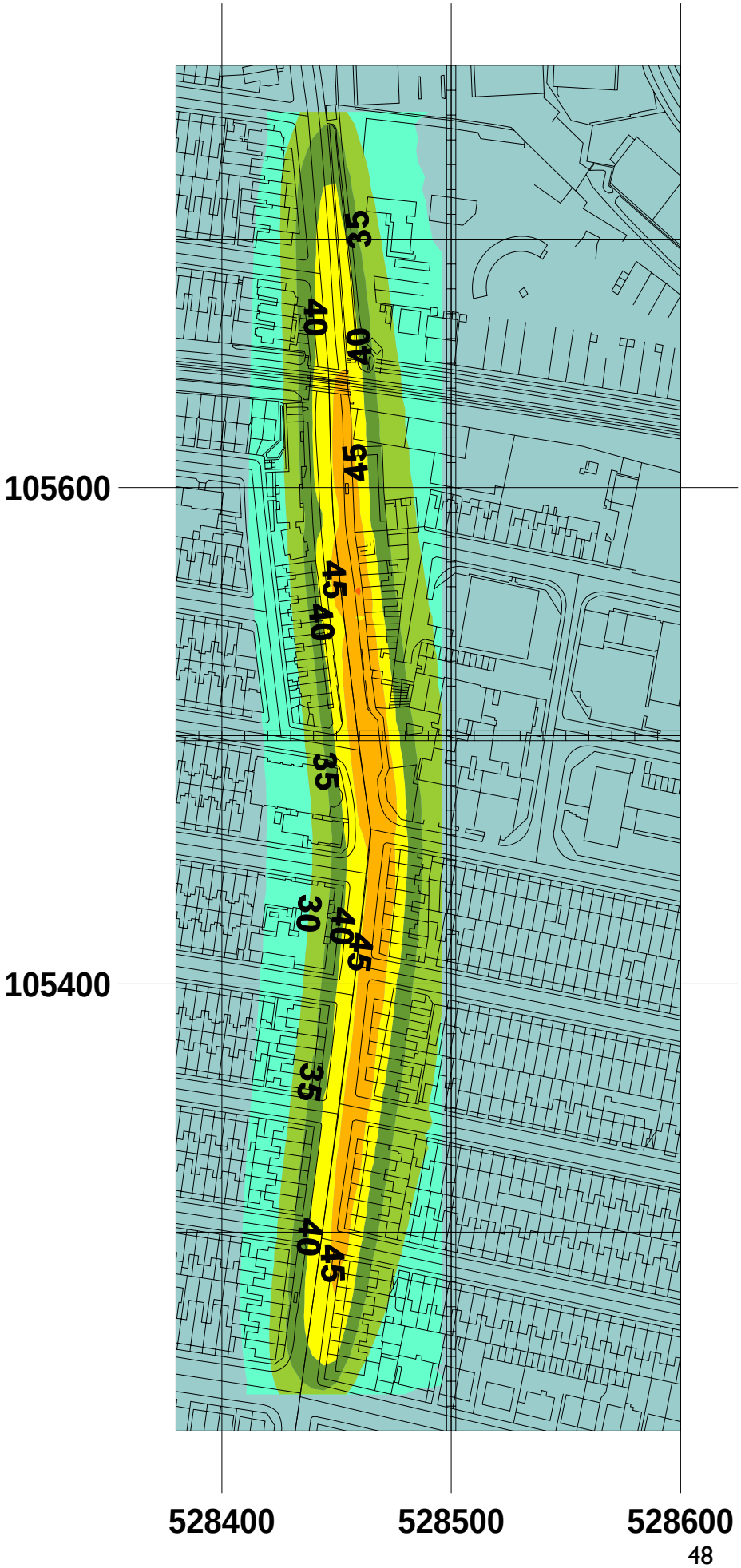
PORTLAND ROAD NO2 2006 (3M)



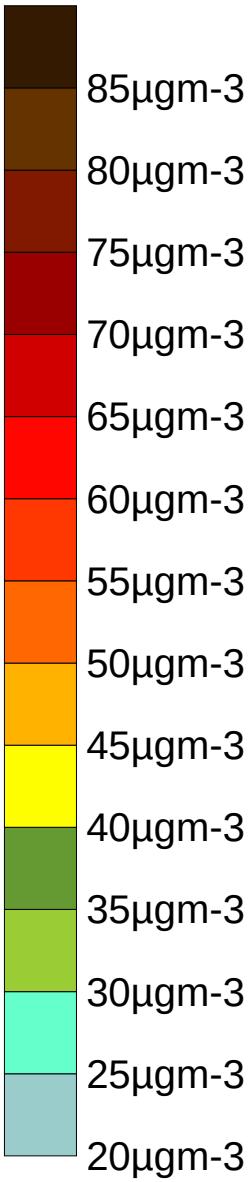


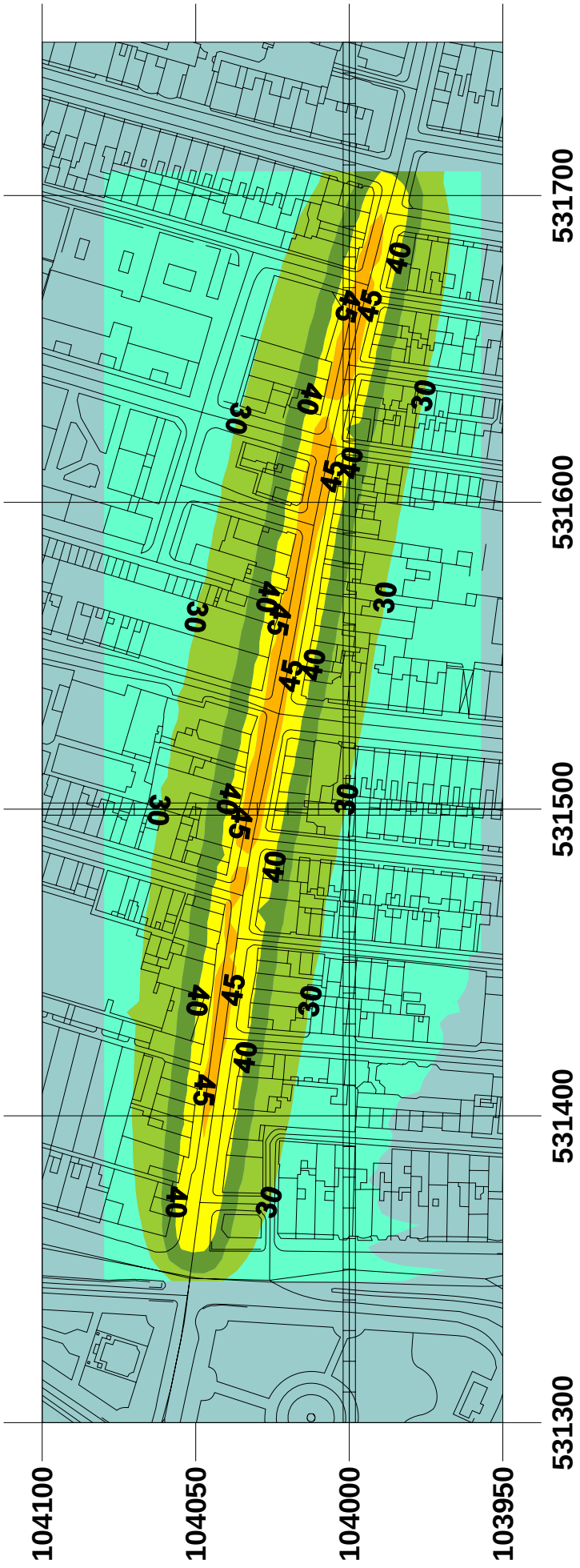
SACKVILLE RD 2006 NO2



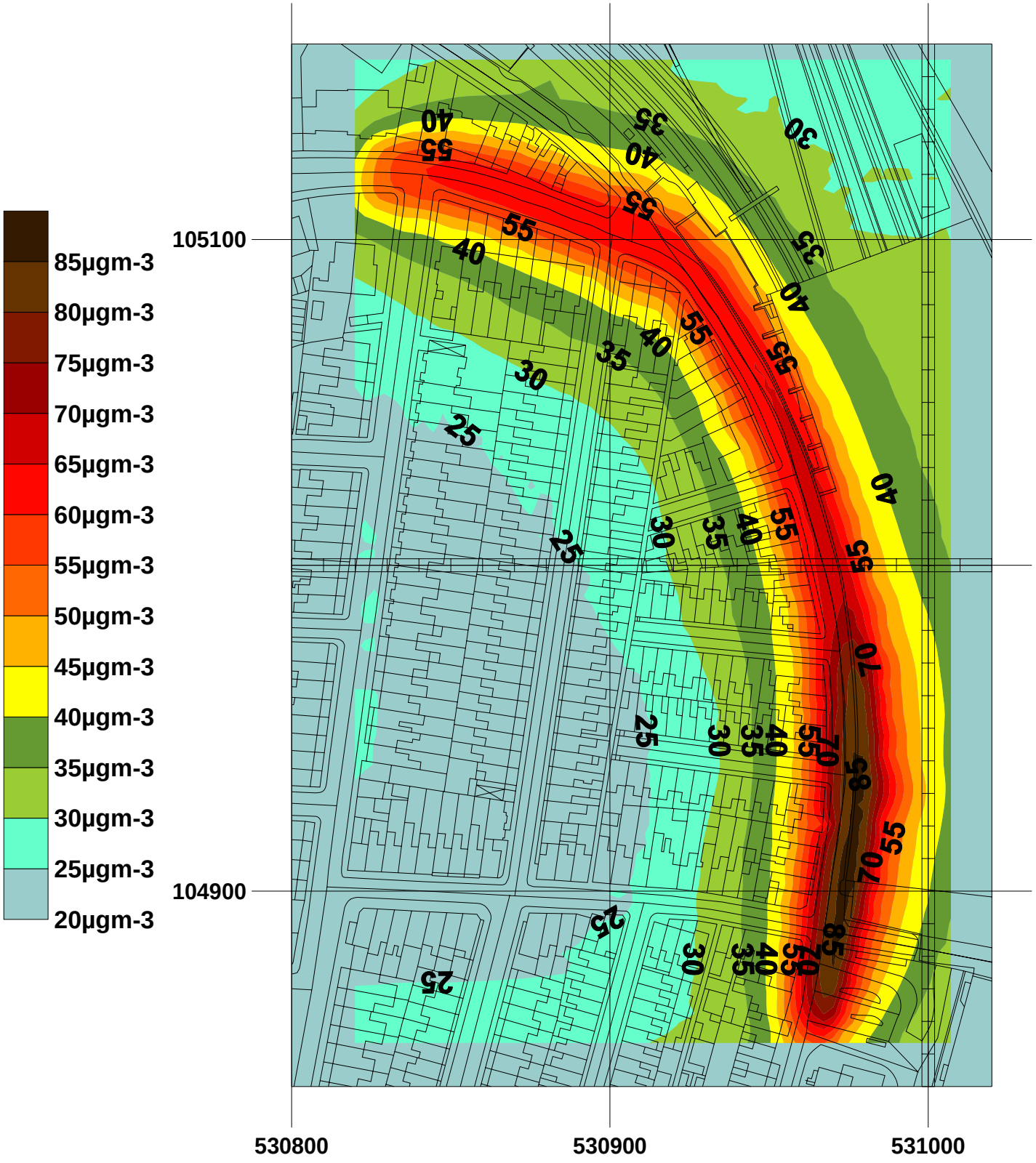


ST JAMES ST 2006 NO2

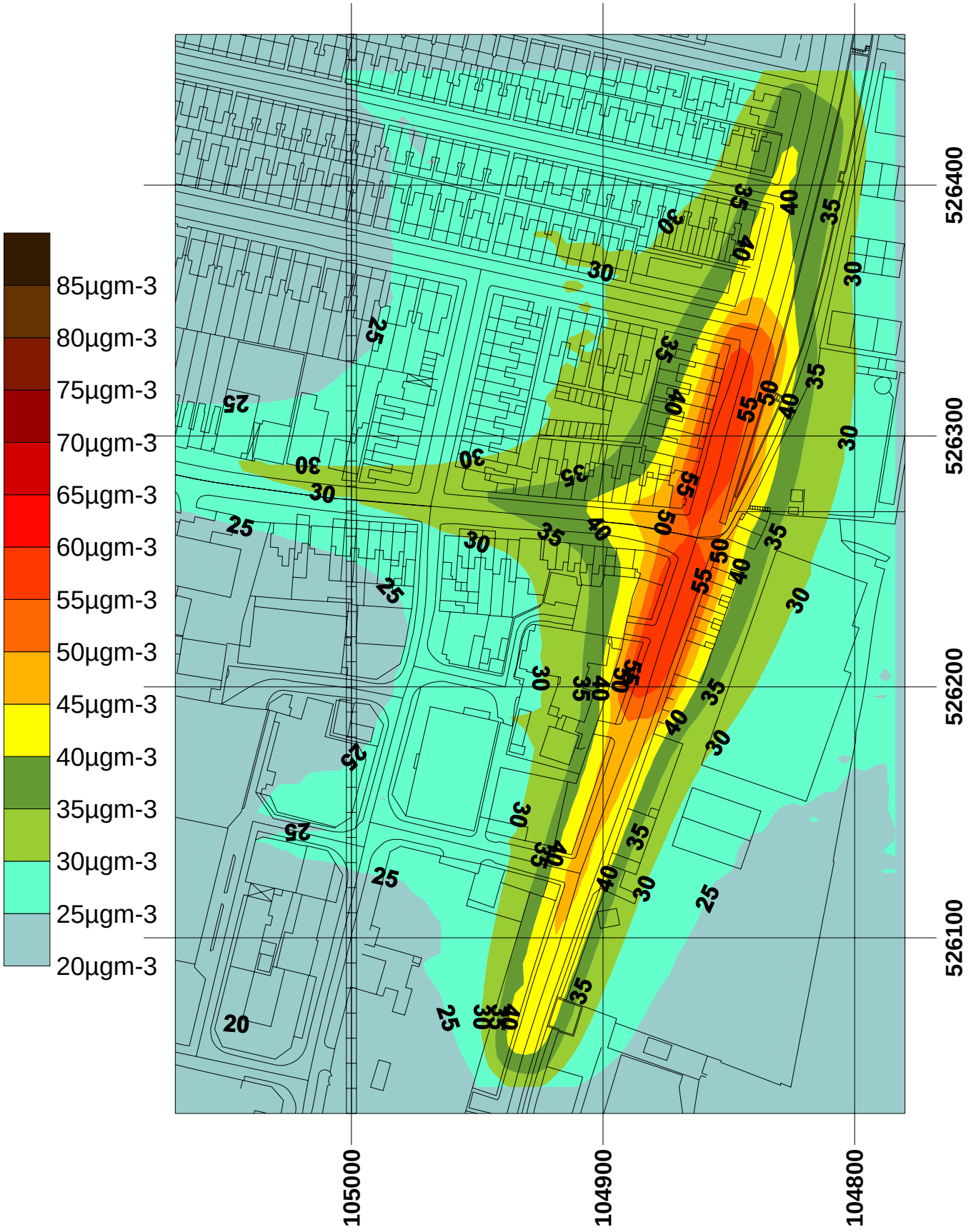




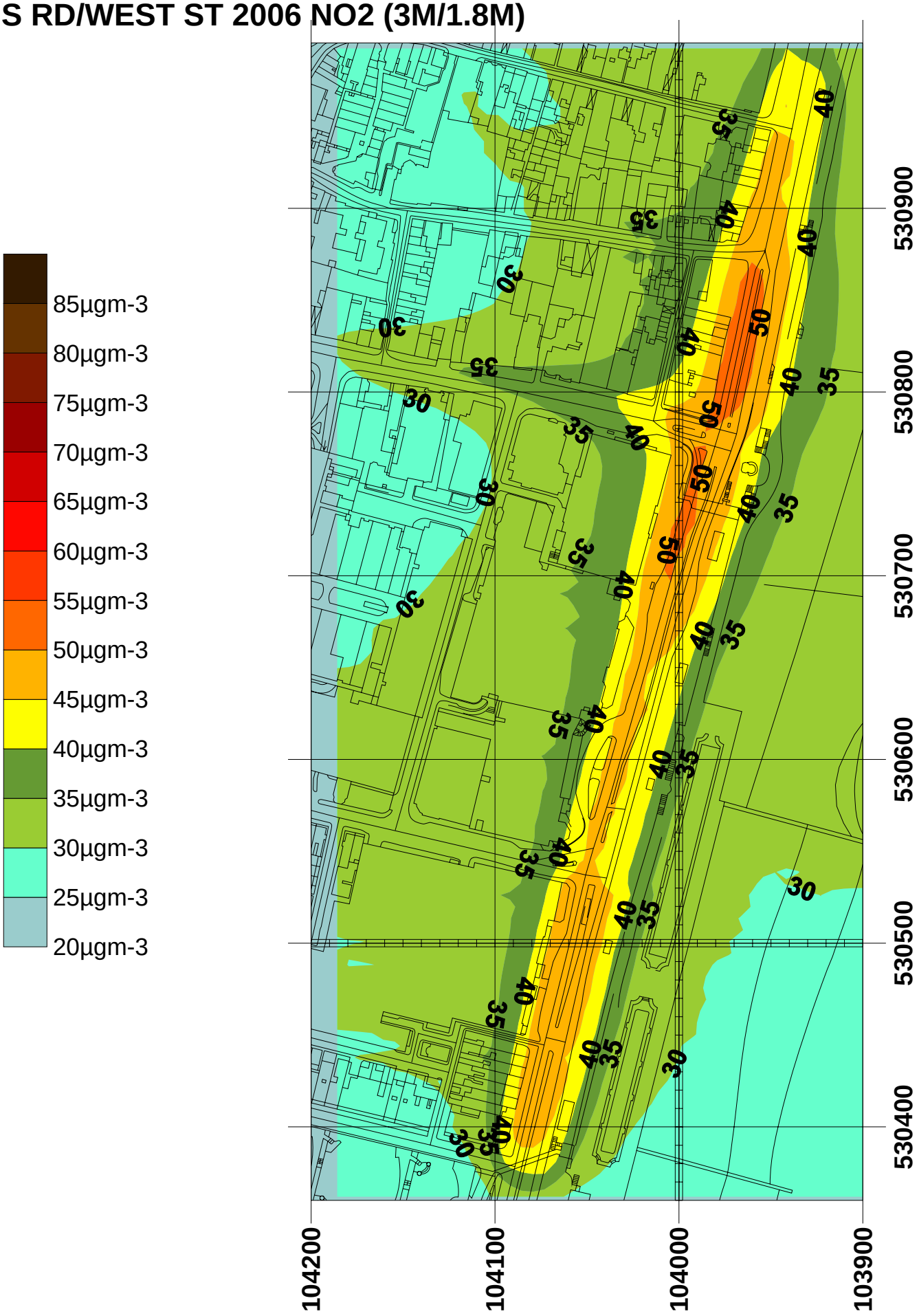
TERMINUS ROAD 2006 NO2



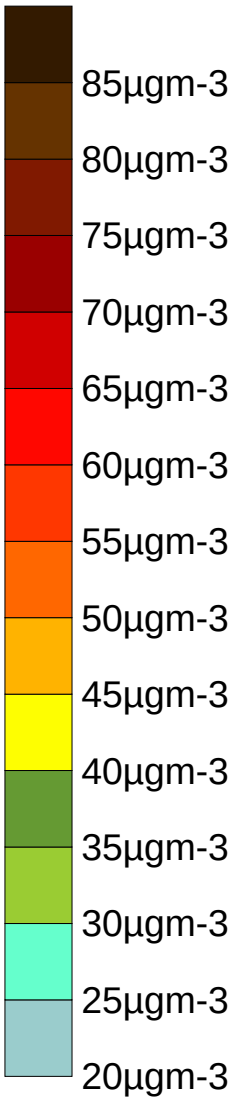
BOUNDARY-A259 2006 NO2

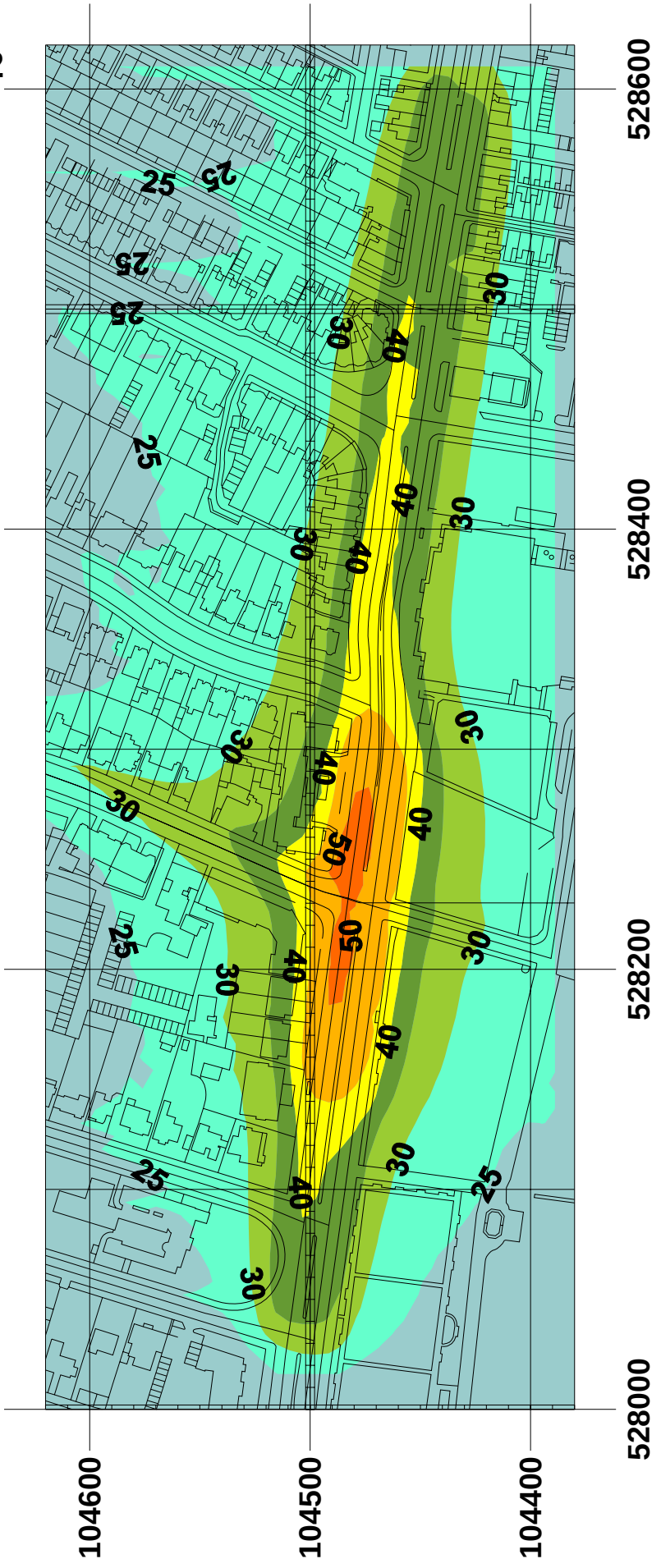


KINGS RD/WEST ST 2006 NO2 (3M/1.8M)

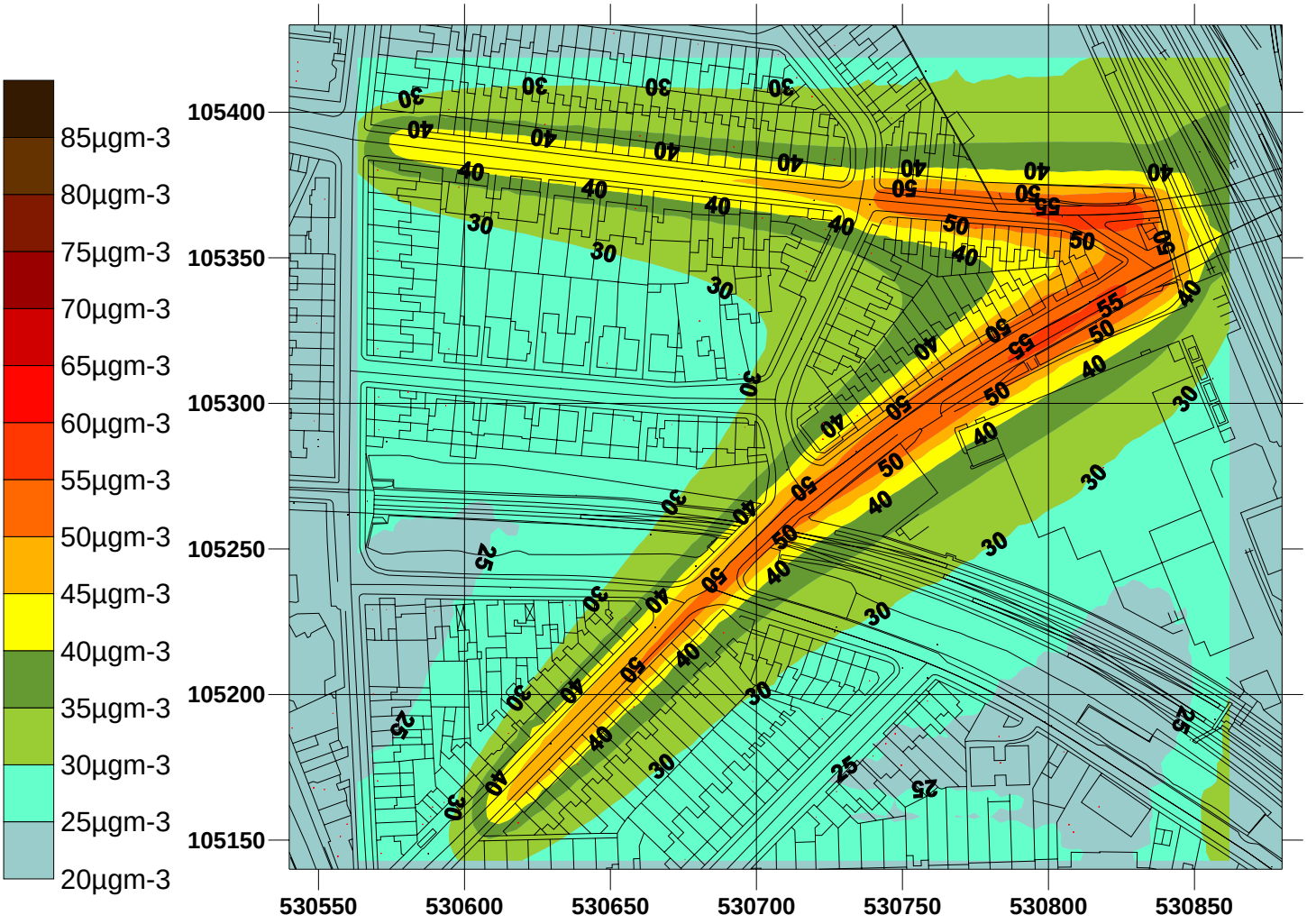


Kingsway/Hove St 2006 NO2

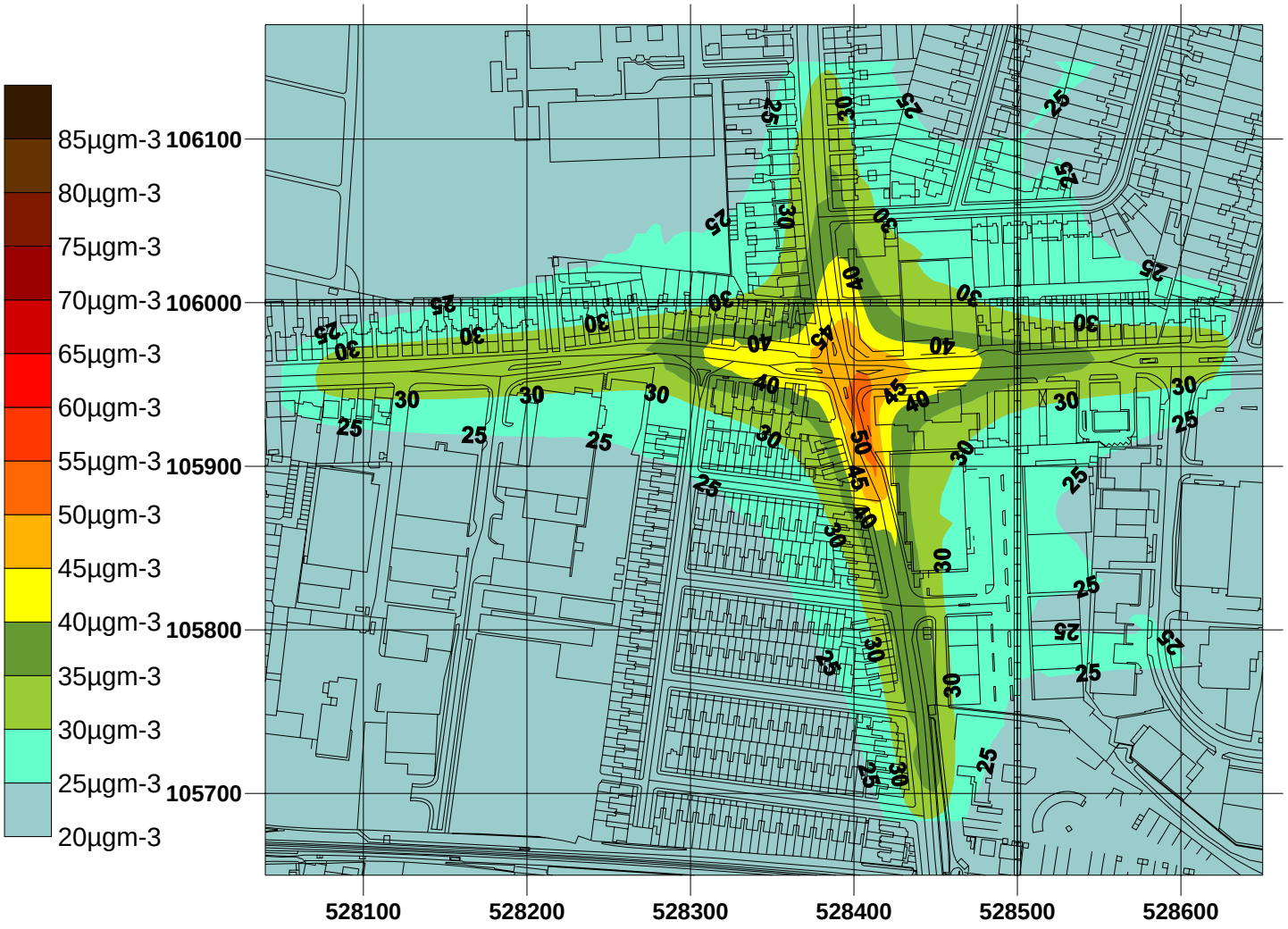




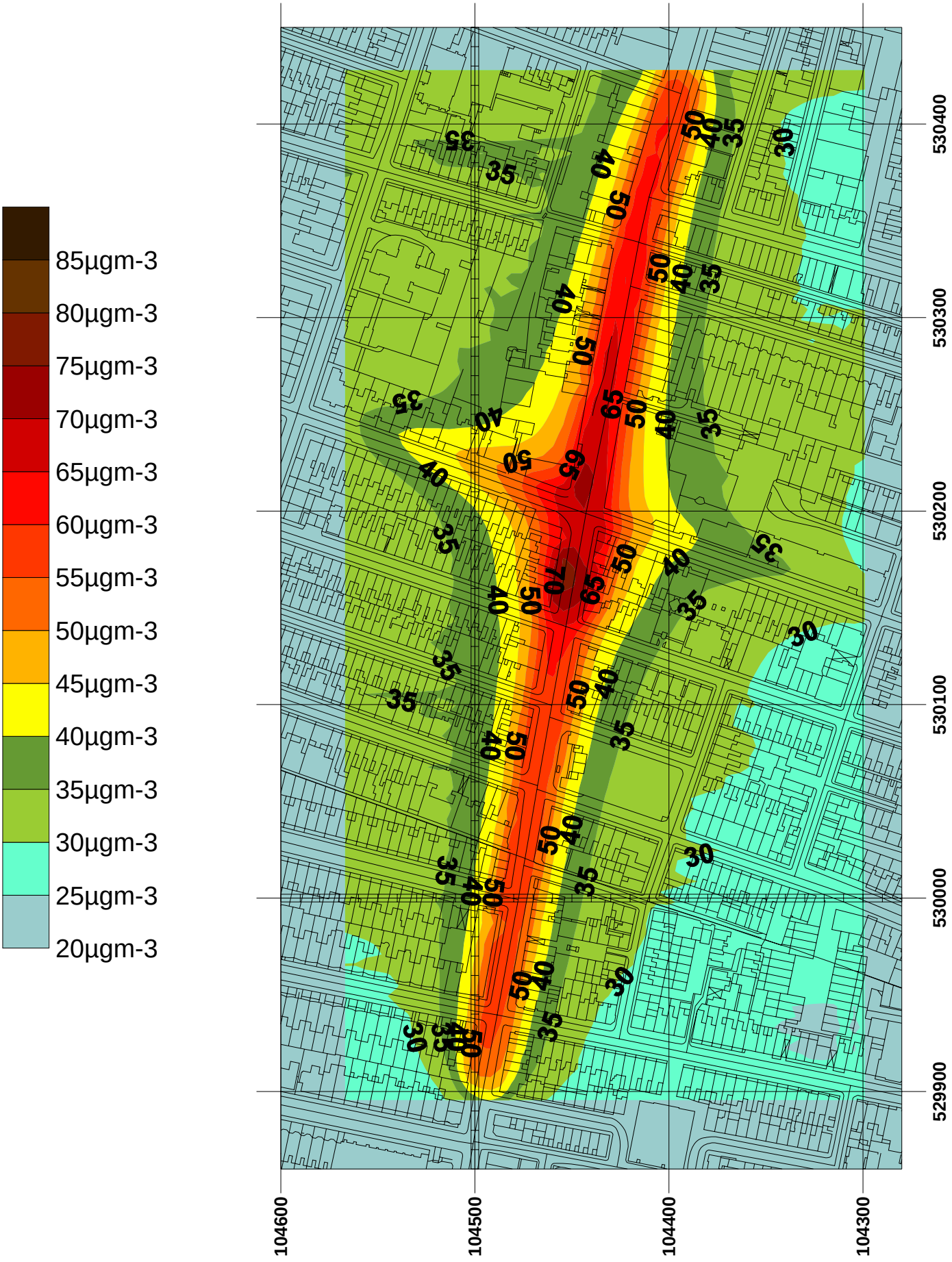
Old Shoreham Road/Chatham Place NO2 2006



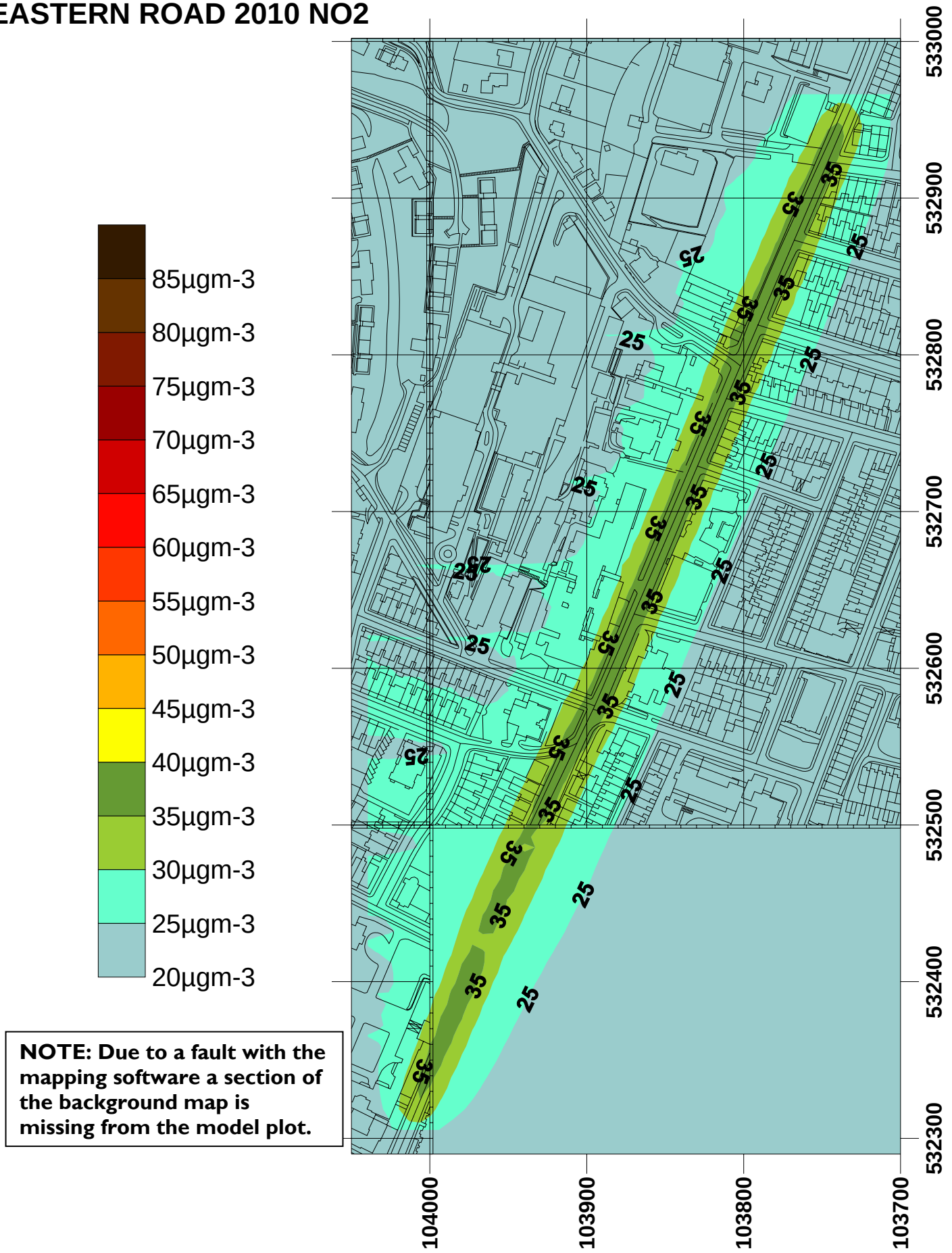
SACKVILLE/OLD SHOREHAM NO2 2006 (3m/1.8m)



WESTERN ROAD/MONPELIER ROAD 2006 NO2

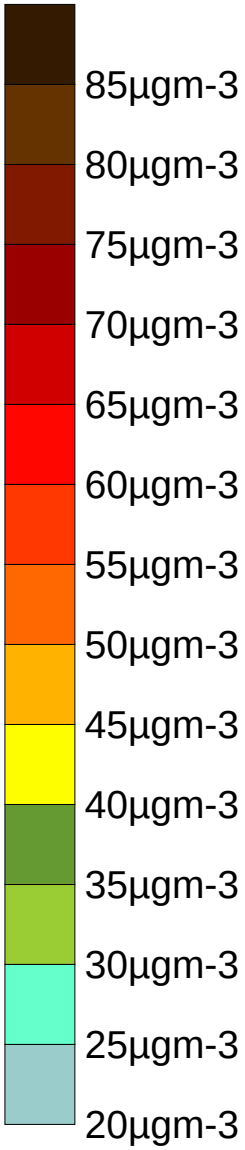


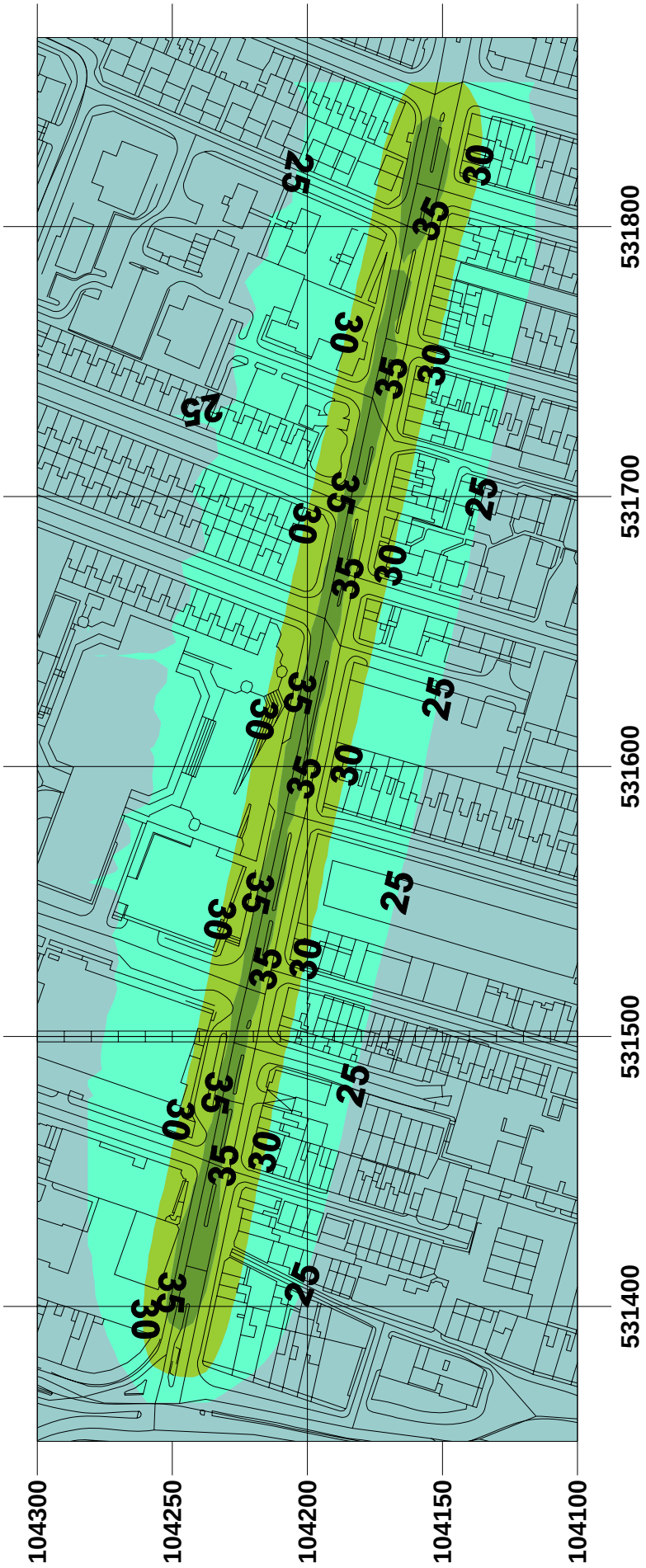
EASTERN ROAD 2010 NO2



NOTE: Due to a fault with the mapping software a section of the background map is missing from the model plot.

EDWARD STREET 2010 NO2





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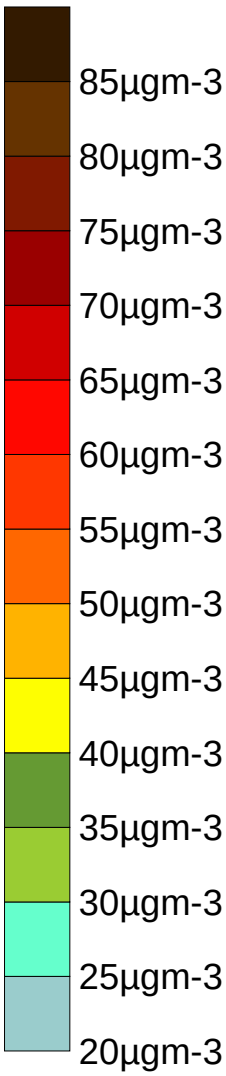
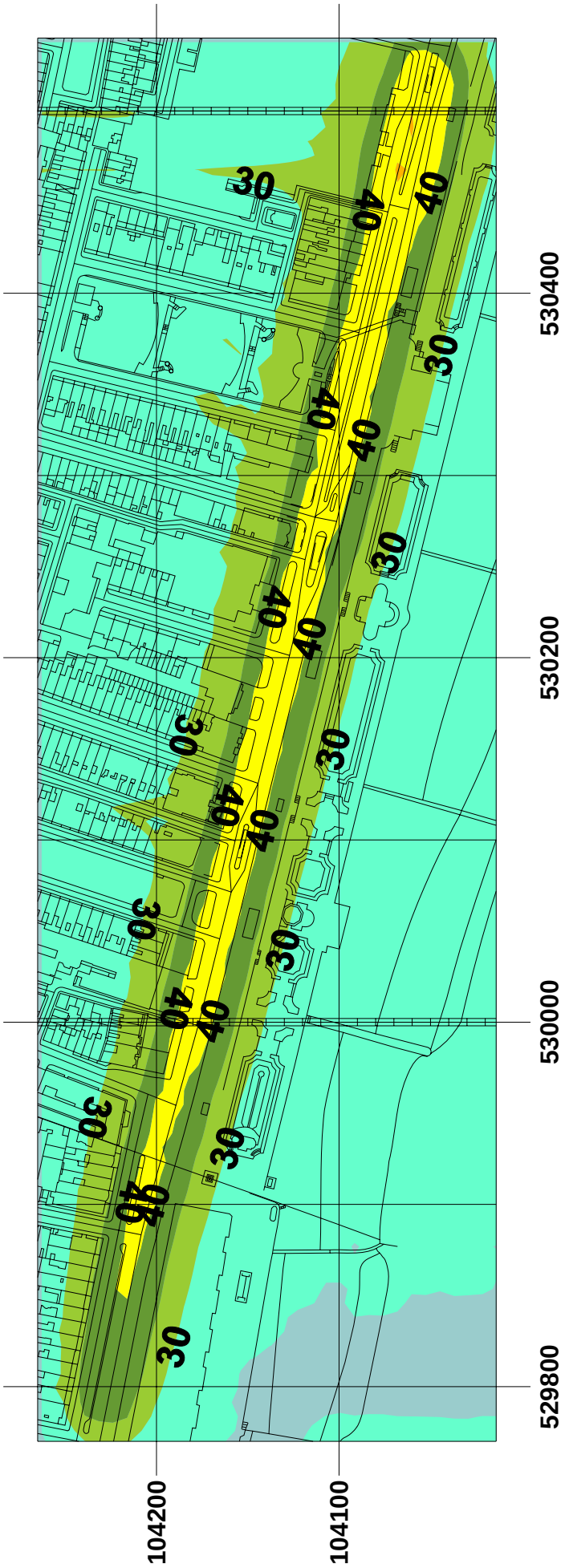
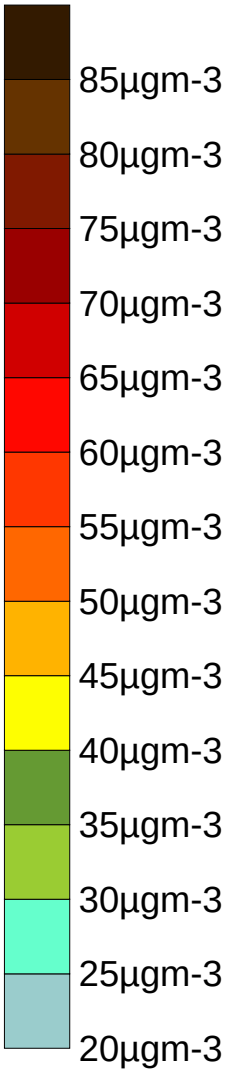
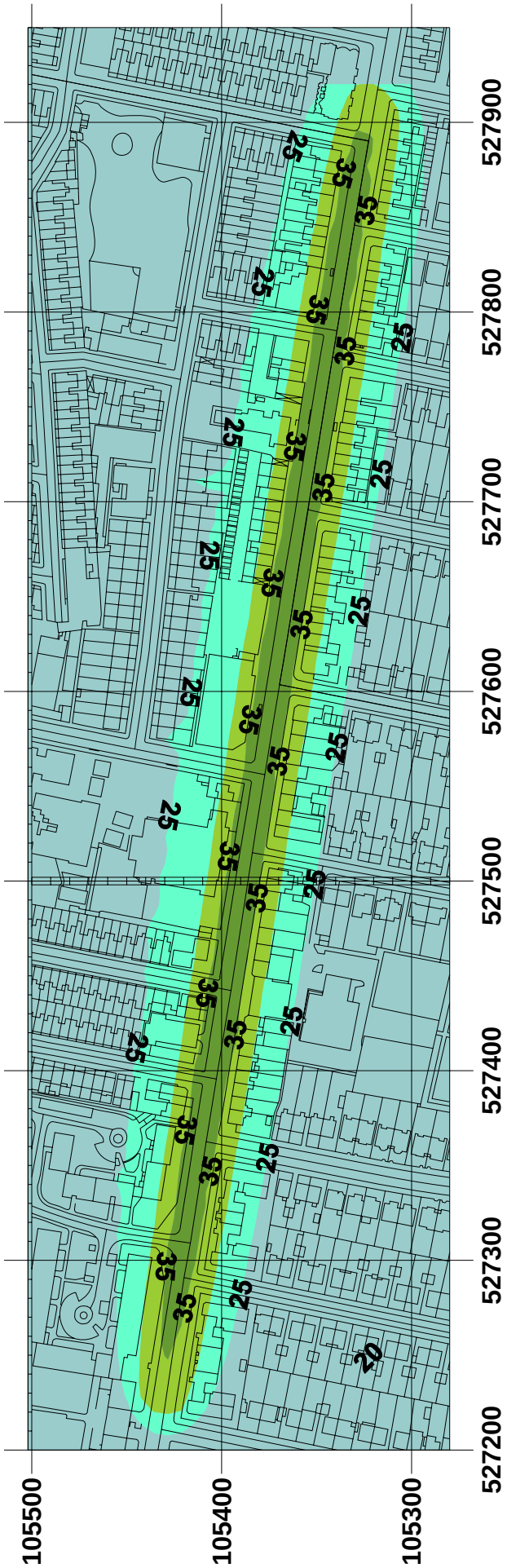


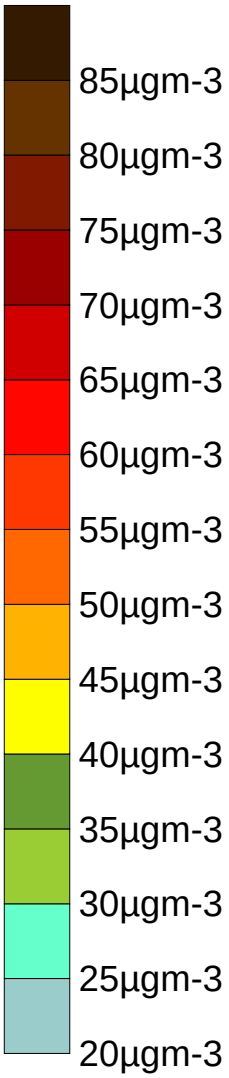


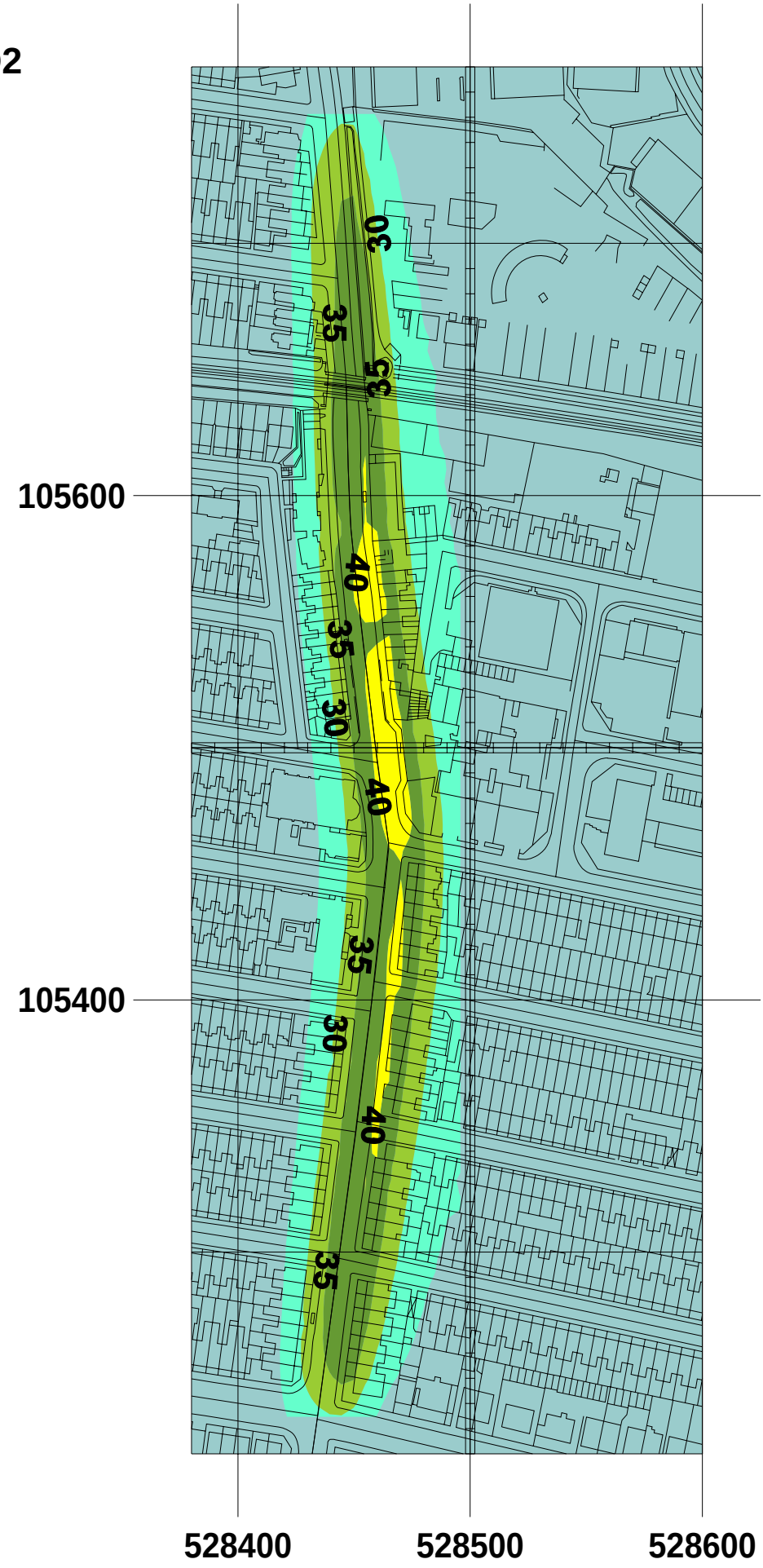
PORTLAND ROAD NO2 2010 (3M)



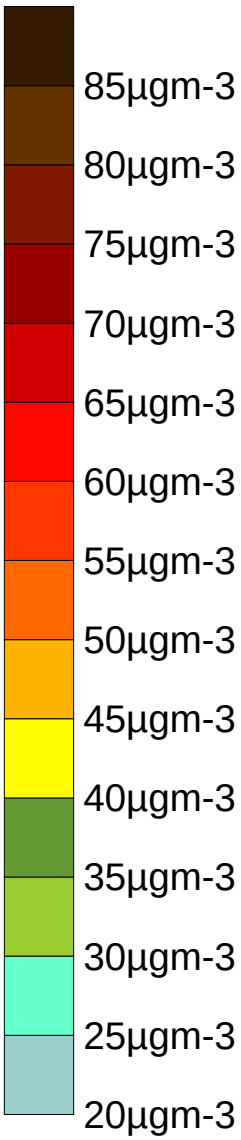


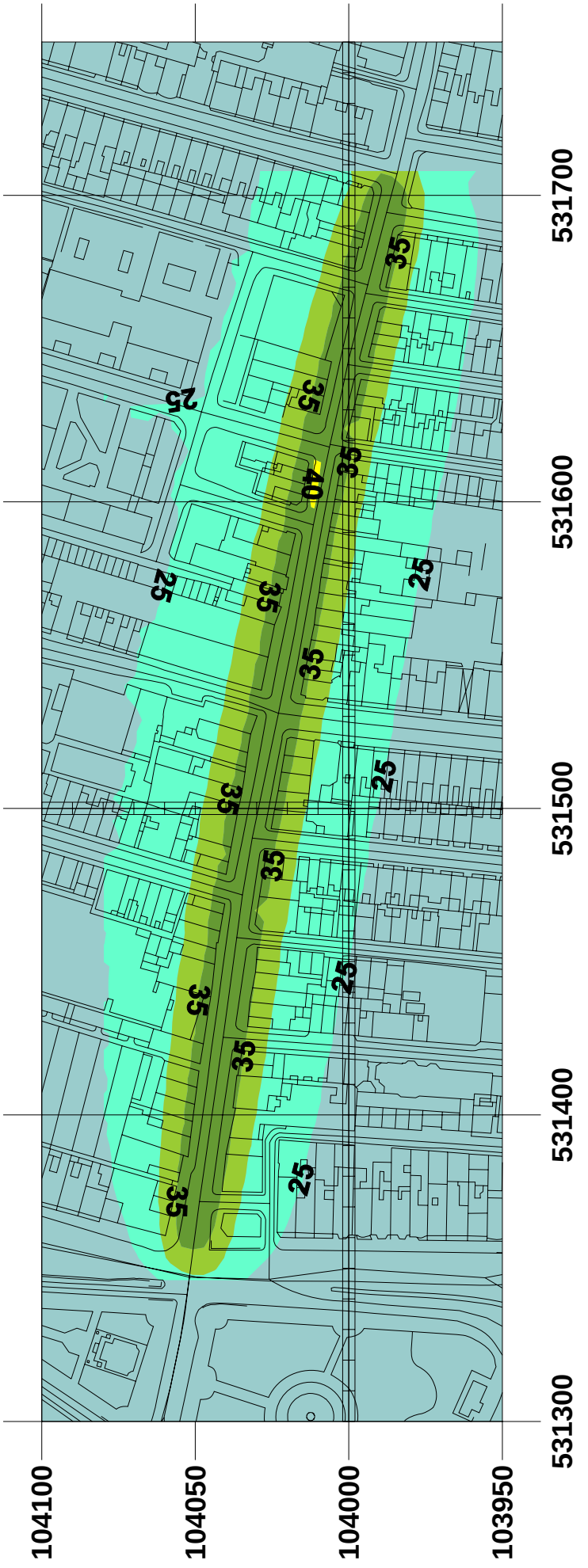
SACKVILLE RD 2010 NO2





ST JAMES ST 2010 NO2





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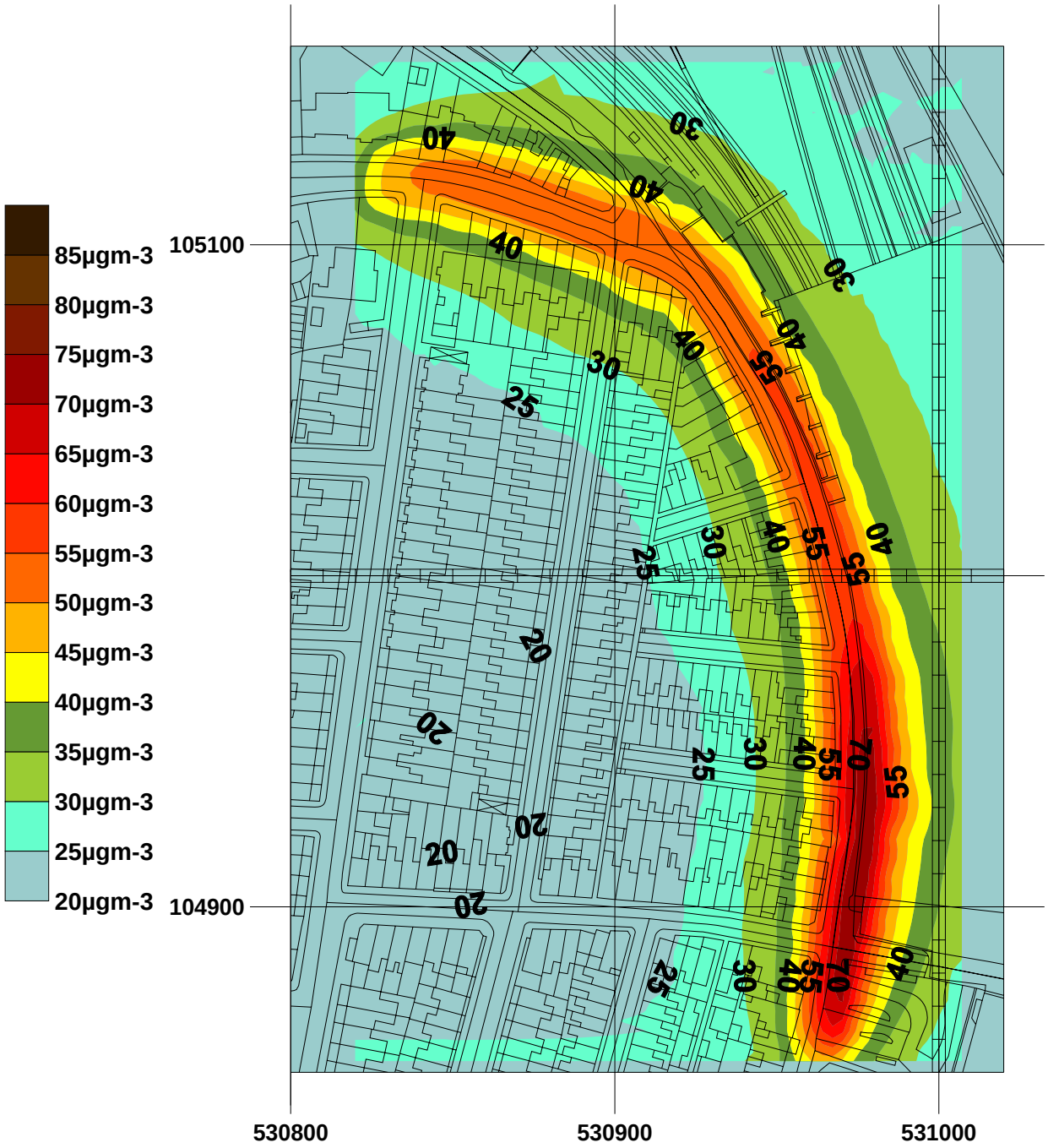
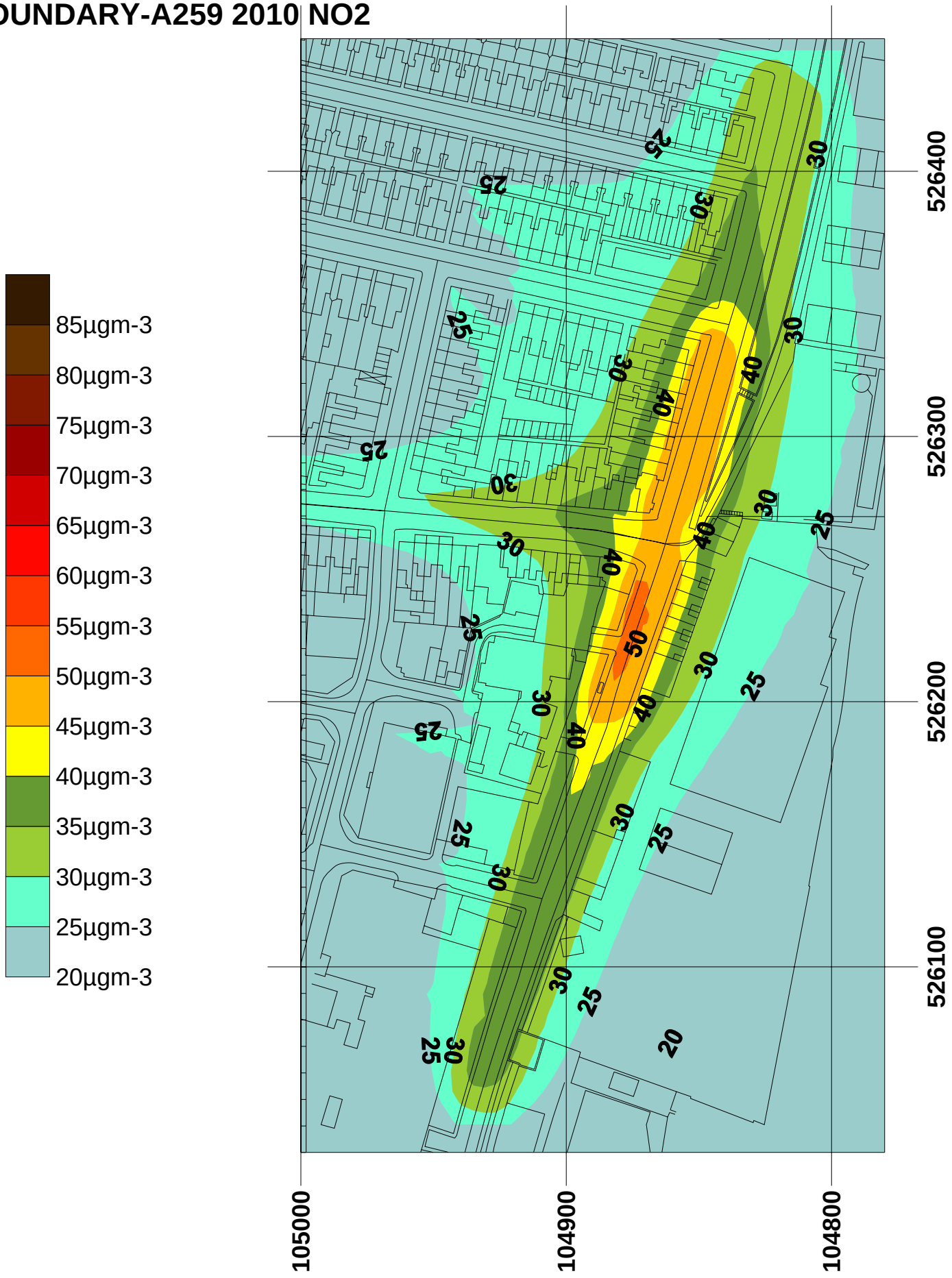
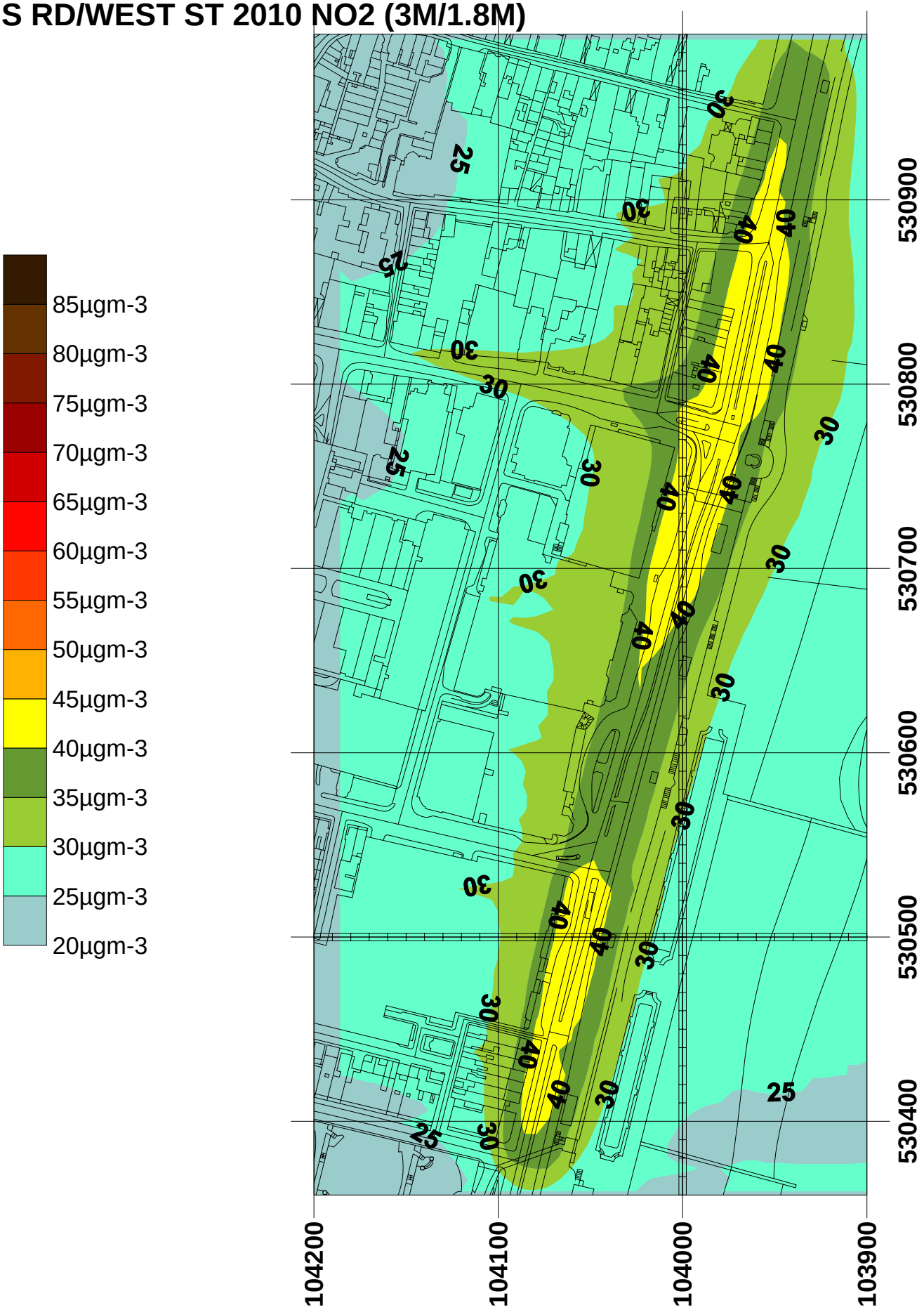


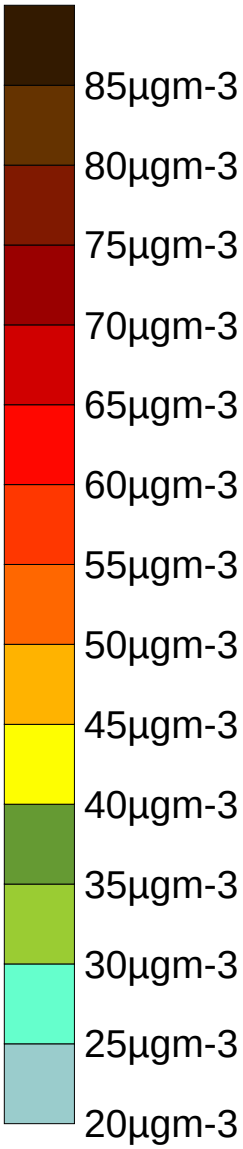
BOUNDARY-A259 2010 NO2

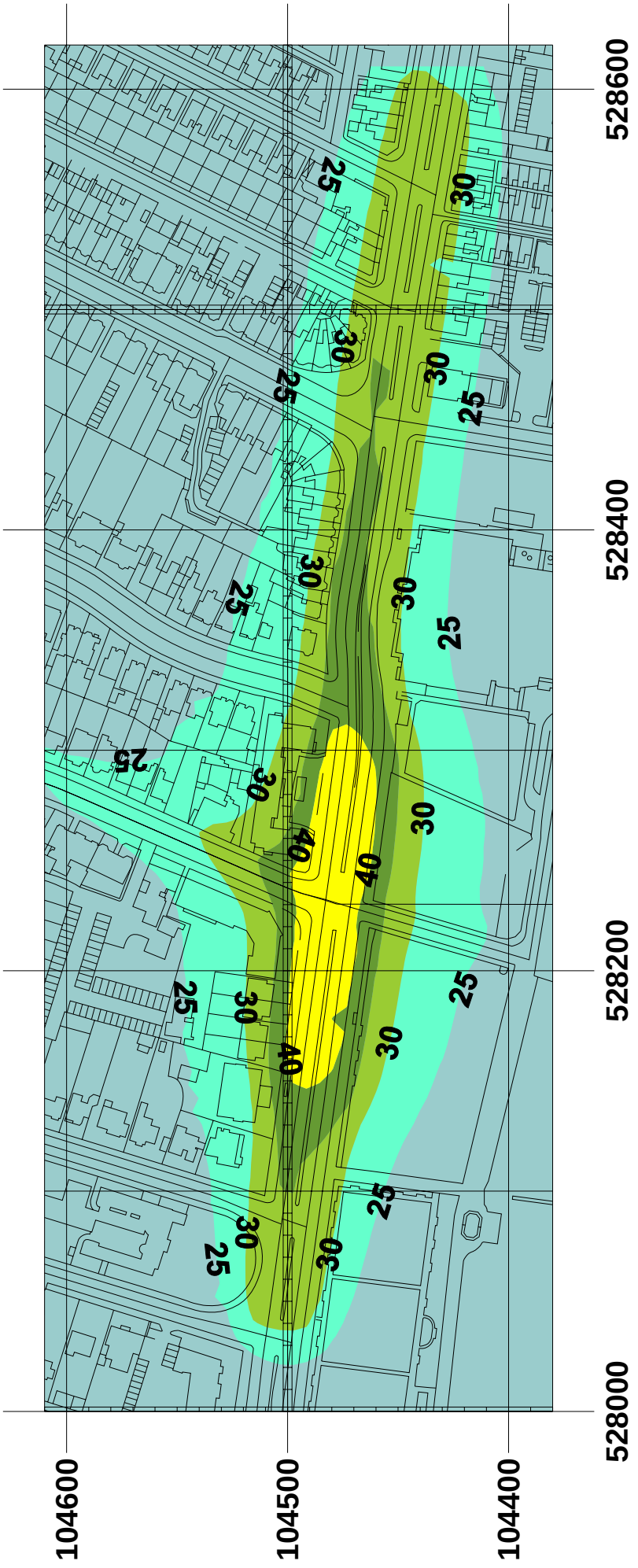


KINGS RD/WEST ST 2010 NO2 (3M/1.8M)

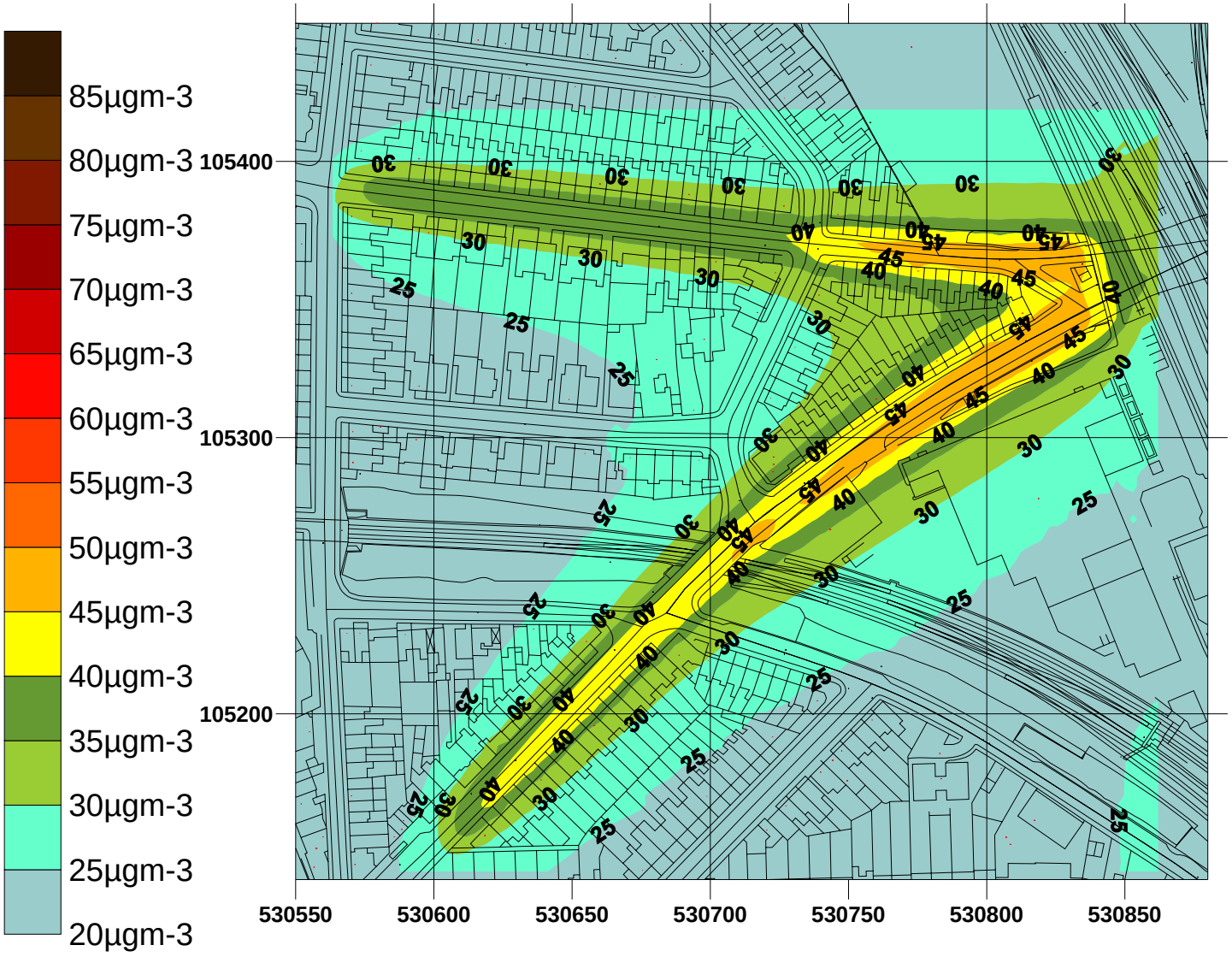


Kingsway/Hove St 2010 NO2

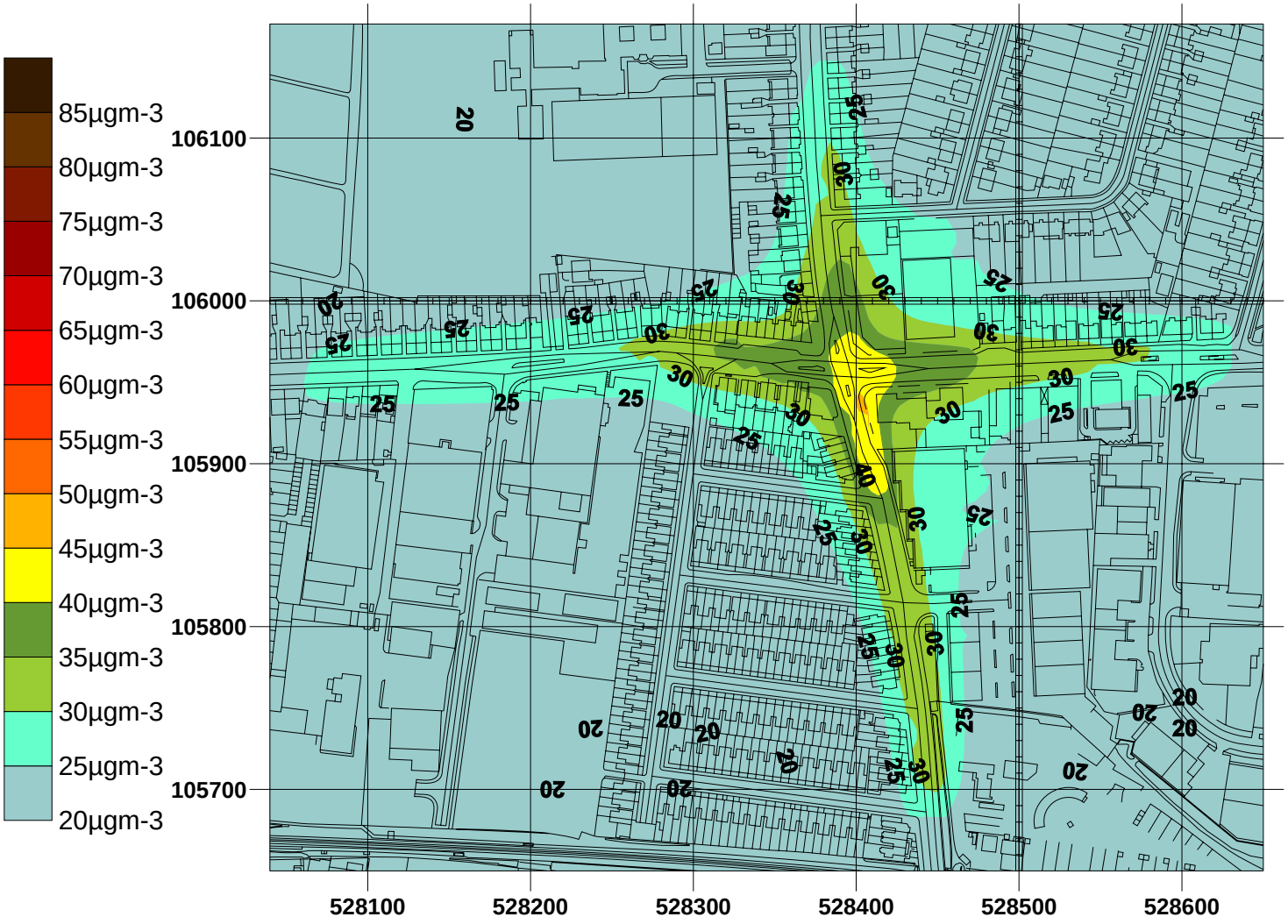




Old Shorham Road/Chatham Place NO2 2010



SACKVILLE/OLD SHOREHAM NO2 2010 (3m/1.8m)



WESTERN ROAD/MONPELIER ROAD 2010 NO2