NORTH LONDON CLUSTER GROUP AIR QUALITY MODELLING

HARINGEY COUNCIL

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BUREAU VERITAS

Move Forward with Confidence

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Executive Summary

As established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives set down by Government for a number of pollutants.

Haringey Council as part of this statutory duty has undertaken air quality assessments of their borough, which has resulted in the declaration of a borough wide Air Quality Management Area (AQMA) for nitrogen dioxide (NO_2) and particles (PM_{10}). In order to update on areas where air quality objectives may be exceeded Bureau Veritas have been commissioned to provide an air quality assessment report in relation to road traffic emissions for seven boroughs in the North London Cluster Group. This includes a borough-wide air quality assessment of PM_{10} and NO_2, as well as a detailed scenario at one specific area within the borough.

The scope of the borough-wide assessment is to predict NO_2 and PM_{10} concentrations based on detailed dispersion modelling of road traffic emissions for the baseline year 2007. The modelling will provide information on areas that are likely to exceed the AQS objectives. Modelling areas as large as a whole borough requires extensive traffic data input. In order to create the model the data within the London Atmospheric Emissions Inventory (LAEI) has been used as well as up to date traffic counts and speed survey data from the boroughs and Department for Transport (DfT). This data was then used in conjunction with the latest speed related emission factors. The modelling was carried out using ADMS Roads Extra 2.3 part of Cambridge Environmental Research Consultants (CERC) Ltd Atmospheric Dispersion Modelling System. This system has been extensively validated by the model supplier and is frequently used in Local Air Quality Management.

The assessment was carried out in accordance with Defra Guidance LAQM.TG(09) Guidance methodologies and aims.

From the borough-wide modelling, the following 'hotspot' areas were picked out that were predicted to exceed the air quality objectives. These areas have been predicted to exceed 60µg/m^3 annual mean NO_2 and therefore presents a potential risk for the hourly NO_2 objective.

- Area 1 - The junction of Colney Hatch Lane B550 with Alexander Park Road B106;
- Area 2 - The junction of the A1 Archway Road into Aylmer Road where it meets the A1000 Cherry Tree Hill;
- Area 3 - The junction of the A1 Archway Road with the B550 Southwood Lane;
- Area 4 - The junction of the A103 Tottenham Lane with the A1201 Middle Lane and The Broadway;
- Area 5 - The junction of the A504 where Turnpike Lane and High Street meet Hornsey Park Road and Wightman Road B138;
- Area 6 - Along Alfoxton Avenue between West Green Road A504 and Green Lane A105;
- Area 7 - Along the A105 Green Lanes between Salisbury Road and the B152 St Ann's Road;
- Area 8 - The receptors adjacent to the junction of White Hart Lane and the A10 Great Cambridge Road;
- Area 9 - The junction of the A1080 The Roundway with A109 Lordship Lane and B155 Downhills Way;
- Area 10 - The section of road where the A10 Bruce Grove/The Roundway and the A109 Lordship Lane converge.
- Area 11 - The junction of the A1010 High Road with White Hart Lane;
- Area 12 - The junction of the A10 High Road with the B153 Philip Lane;
- Area 13 - The junction of Seven Sisters Road A503 with the A10/A503 High Road at the receptors at the corner of the A10 and Earlsmead Road;
- Area 14 - The receptors south of the railway tracks along Seven Sisters Road A503 to the south of the junction of the A503 and St Ann's Road B152.

The only areas where concentrations are predicted to be above the annual mean PM_{10} AQS objective of 40µg/m^3 have already been identified above for the NO_2 results. These are areas 2, 12 and 13. However, for each of these areas, there are no properties that fall within the 40µg/m^3 PM_{10} annual mean concentration contour. The areas where the daily mean PM_{10} AQS objective is exceeded (more 35 daily means above 50µg/m^3) include all the areas identified previously in the NO_2 section, apart from Area 11.

The results of the scenario are:

The model results for the scenario with respect to proposed traffic management changes for the A10 at Tottenham Hale predict that the baseline level of air quality exceeds the NO_2 AQS objectives at the majority of the receptors modelled. When the proposed traffic management changes were modelled, a significant improvement in air quality is predicted. The concentrations of nitrogen dioxide at the majority of receptors fall below the AQS objectives. It is recommended that the monitoring around the area be increased, particularly around the A10 circular. This will provide more information on the levels that are currently being experienced and assess the reduction in the NO_2 levels when the traffic management changes are implemented. The monitoring will provide more robust data for future LAQM work and will support the changes being made which should improve air quality in the area.

1 Introduction

Bureau Veritas has been commissioned to provide air quality assessment reports in relation to road traffic emissions for seven boroughs in the North London Cluster Group. This includes a borough-wide air quality assessment of PM_{10} and NO_2 for Haringey Council, as well as a detailed scenario at one specific area within the borough.

This report focuses on local air quality management in regards to road traffic source emissions of nitrogen dioxide (NO_2) and particulate mater less than 10 micrometers (µm) (PM_{10}).

1.1 Legislative Background

The significance of existing and future pollutant levels are assessed in relation to the national air quality standards and objectives, established by Government. The revised Air Quality Strategy (AQS)[1] for the UK (released in July 2007) provides the over-arching strategic framework for air quality in the UK and contains national air quality standards and objectives established by the UK Government and devolved administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from the Limit Values prescribed in the EU Directives transposed into national legislation by member states.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The Directive 2008/50/EC[2] introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local Government to work towards achievement.

The Air Quality Standards (England) Regulations 2007[3] came into force on 15th February 2007 in order to align and bring together in one statutory instrument the Governments obligations to fulfil the requirements of the CAFE Directive.

The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide particulates - PM_{10} and $PM_{2.5}$, ozone and PAHs - Polycyclic Aromatic Hydrocarbons) have been prescribed within the Air Quality Strategy based on The Air Quality Standards (England) Regulations 2007.

Part IV of the Environment Act 1995 places a statutory duty on local authorities to periodically review and assess the current and the future air quality within their area – a process known a Local Air Quality Management (LAQM). The air quality objectives that apply to LAQM are defined in Air Quality Regulations 2000[4] and Air Quality (England) (Amendment) Regulations 2002[5] for seven pollutants benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide, particulates - PM_{10}..

This assessment focuses on the two pollutants that are most commonly associated with road traffic emissions (Nitrogen Dioxide and PM_{10}). The objectives set out in the AQS for all the pollutants are presented in the table below.

The UK Government and the Devolved Administrations have also set new national air quality objectives for $PM_{2.5}$. These objectives have not been incorporated into LAQM Regulations, and authorities have no statutory obligation to review and assess air quality against them.

The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed [to pollutant concentrations] over

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[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

[2] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[3] The Air Quality Standards Regulations 2007, Statutory Instrument No 64, The Stationary Office Limited

[4] The Air Quality (England) Regulations 2000 (Statutory Instrument 928)

[5] The Air Quality (England) (Amendments) Regulations 2000 (Statutory Instrument 3043)

the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

Table 1 - Air Quality Objectives Included in the Air Quality Regulations for the Purpose of Local Air Quality Management

Pollutant	Objective	Concentration Measured As	Date to Be Achieved By and Maintained Thereafter
Benzene All authorities	16.25 µg/m^3	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 µg/m^3	annual mean	31.12.2010
Authorities in Scotland and Northern Ireland only	3.25 µg/m^3	running annual mean	31.12.2010
1,3 Butadiene All authorities	2.25 µg/m^3	running annual mean	31.12.2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 µg/m^3	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 µg/m^3	running 8-hour mean	31.12.2003
Lead	0.5 µg/m^3	annual mean	31.12.2004
All authorities	0.25 µg/m^3	annual mean	31.12.2008
Nitrogen dioxide [a]	200 µg/m^3, not to be exceeded more than 18 times a year	hourly mean	31.12.2005
All authorities	40 µg/m^3	annual mean	31.12.2005
Particles (PM_{10}) (gravimetric) [b]	50 µg/m^3, not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
All authorities	40 µg/m^3	annual mean	31.12.2004
Authorities in Scotland only [c]	50 µg/m^3 not to be exceeded more than 7 times a year	24 hour mean	31.12.2010
	18 µg/m^3	annual mean	31.12.2010
Sulphur dioxide	350 µg/m^3 not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
All authorities	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

a EU Limit values in respect of nitrogen dioxide to be achieved by 1st January 2010. There are, in addition, separate EU limit values for carbon monoxide, sulphur dioxide, lead and PM_{10}, to be achieved by 2005, and benzene by 2010.
b Measured using the European gravimetric transfer sampler or equivalent.
c These 2010 air quality objectives for PM_{10} apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.
*Rows shaded grey highlight the pollutants to be studied in this report.

1.2 Local Air Quality Management (LAQM)

As established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives set down by Government for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the Local Air Quality Management (LAQM) regime and involves a phased three yearly assessment of local air quality. Where the results of the review and assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high levels of pollution and exceedences of AQS objectives.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS)[6] and introduced the idea of local authority 'Review and Assessment'. The Government subsequently published policy and technical guidance related to the review and assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PG (09))[7] and Technical Guidance (LAQM.TG (09))[8]. The guidance lays down a progressive, but continuous, framework for the local authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to meet the air quality objectives.

Defra and the Devolved Administrations released the latest Policy and Technical Guidance in February 2009, in anticipation of the fourth round of review and assessment.

1.3 Summary of the Review and Assessment by Haringey Council

Haringey is located in North London and is mainly urban in character. The population density is highest in the south and east of the borough. Despite being a densely populated urban area, 25% of the borough is made up of parks and recreational areas.

Haringey Council has been monitoring air quality within the authority in accordance with the requirements set out in Part IV of the Environment Act 1995 since the first round of review and assessment.

During the first stage of review and assessment Haringey Council determined that for all of the seven health based pollutants there would be no exceedences of the air quality objectives except for NO_2 and PM_{10}. These two pollutants were predicted to be in exceedence of air quality objectives across the whole borough along the major transport routes. Some of these transport routes were in areas where there are relevant receptors and as such the council took the decision to declare the whole borough as an AQMA in 2001.

Since the declaration of an AQMA, the Council has carried out the necessary review and assessments of air quality within the borough. No major changes have occurred and there is still an AQMA in place for NO_2 and PM_{10}.

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[6] DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationary Office

[7] Policy Guidance LAQM.PG(09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

[8] Technical Guidance LAQM.TG (09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

2 Baseline Information for the Borough-wide Modelling

The scope of this assessment is to predict NO_2 and PM_{10} concentrations based on detailed dispersion modelling of road traffic emissions for the baseline year 2007. The modelling will provide information on areas that are likely to exceed the AQS objectives. Modelling areas as large as a whole borough requires extensive traffic data input. In order to create the model, data within the London Atmospheric Emissions Inventory (LAEI) has been used as well as up to date traffic counts and speed survey data from the boroughs and Department for Transport (DfT). This data was then used in conjunction with the latest average speed related emission factors.

The London Atmospheric Emissions Inventory (LAEI) 2004 is the latest comprehensive version of the annual LAEI series at the time of assessment. It uses the most up to date activity datasets and emission factors to provide a database of geographically referenced datasets of emissions sources and information about the location, rates of emissions and estimates of the quantity of specific pollutants emitted into the air within and around the Greater London area (i.e. within the M25 motorway ring). As the majority of the boroughs in the North London Cluster Group are within the LAEI this provides an excellent data source for the baseline modelling.

The detailed dispersion modelling has been undertaken using ADMS Roads Extra 2.3 part of Cambridge Environmental Research Consultants (CERC) Ltd Atmospheric Dispersion Modelling System. This system has been extensively validated by the model supplier and is frequently used in Local Air Quality Management.

Local verification of the modelling has been taken using data from continuous roadside monitoring sites in the London Air Quality Monitoring Network (LAQN), which has been validated and ratified. Where there were gaps in the continuous monitoring data, roadside diffusion tubes have been used to supplement the continuous monitoring in the verification process. All the diffusion tubes were bias adjusted using either a factor determined locally, through the collation (in triplicate) of diffusion tubes with a continuous monitor, or where the data was not available, a default bias adjustment factor has been derived from available co-location studies provided by the Air Quality Review and Assessment Helpdesk on behalf of Defra.

2.1 Traffic Data

The data from the LAEI was used as the baseline traffic data set as it provided a good coverage of major roads in the boroughs within the M25. Roads within the LAEI were digitised within Map Info GIS and incorporated within the model ADMS Roads.

Haringey Council provided traffic counts for the roads that they had data for. These roads were also digitised using MapInfo to create road source links in the model. Department for Transport road traffic data were also used to build up the road network. The links were then combined with the LAEI data to create an overall road network for each borough. This road structure was the basis for the modelling.

The next stage was to input the traffic data for the road network, so that each link had the most accurate traffic flows possible. The LAEI data had a number of discrepancies in terms of accuracy of data and also more recent traffic counts had been undertaken in the area, so local or DFT counts were used in preference to the LAEI counts on some road links. The Annual Average Daily Traffic (AADT) data was projected to the baseline year 2007, where required, using growth factors from the Tempro[9] and NRTF[10] (National Road Traffic Forecasts) adjusted for the local authority.

Speed data was taken from locally provided traffic data and LAEI data for free flowing links. Separate road links were created at junctions where speeds are generally reduced due to queuing and slower moving traffic. The final traffic data for Haringey is presented in Appendix 1.

[9] Tempro (Trip End Model Presentation Program) version 6.0, Department for Transport

[10] DETR, National Road Traffic Forecasts (Great Britain) 1997

2.2 Air Quality Monitoring

Haringey Council use both diffusion tubes and automatic analysers to monitor the air quality within the borough. The diffusion tubes are analysed by Lambeth Scientific Services using the 50% TEA in acetone method. The bias adjustment factor has been calculated using the Review and Assessment website bias adjustment spreadsheet based on 13 co-location studies for this laboratory method. The bias adjustment factor for 2007 is 1.07. All sites have greater than 9 months data capture and therefore no annualisation has been undertaken. The corrected results for 2007 have been presented below.

Table 2 - Monitoring Diffusion Tube Results in Haringey

Site Ref	Site	X	Y	Type	Bias Adjusted Annual Mean NO_2 (2007, $\mu g/m^3$)
HR06	ARCHWAY RD	528940	187660	R	**67.2**
HR07	ASHLEY RD	534400	190160	UB	35.8
HR08	MYDDELTON RD	530440	189450	UB	29.2
HR10	HIGH RD	530860	190690	R	36.5
HR13	TURNPIKE LANE	531460	189670	R	**74.9**
HR14	HIGH RD	533890	190710	R	36.5
HR15	MUSWELL HILL BDY	528810	189690	R	**54.2**
HR16	FERRY LANE	534370	189460	R	**58.4**
HR17	HIGH RD	531060	190270	R	**91.8**
HR18	HIGH RD	530990	190420	R	**59.2**

R= Roadside, UB= Urban background

Table 3 - Continuous Monitoring Results in Haringey

Site	X	Y	Type	Pollutants	Ratified Results (2007, $\mu g/m^3$)
Town Hall (High road)	533890	190710	R	NO_2	**42**
				PM_{10}	26
Priory Park	529850	189150	UB	NO_2	32
				PM_{10}	26

R= Roadside, UB= Urban background

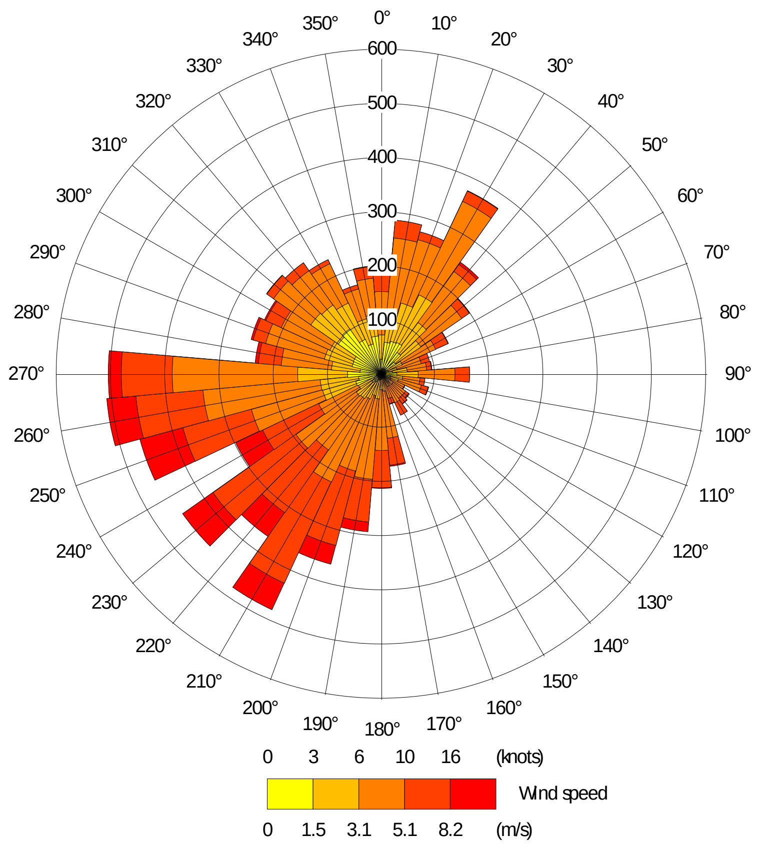
3 Dispersion Modelling Methodology for the Borough-wide Modelling

Detailed dispersion modelling of NO_2 was undertaken using the Cambridge Environmental Research Consultants (CERC) Ltd ADMS-Roads advanced Gaussian air dispersion model. ADMS-Roads Extra 2.3 can model up to 600 road sources at any one time. The model is used extensively in local air quality management, and has formed the basis for many AQMA declarations. A considerable number of validation studies have been completed, showing overall excellent agreement between model outputs and observations at continuous monitoring sites. ADMS-Roads has integrated modules to take into the account the effects of street canyons and plume chemistry. Details of the model inputs are provided below.

3.1 Meteorological Data

The meteorological data for 2007 is taken from the nearest representative weather station. For Haringey Council the weather station at Heathrow was used. The wind rose for Heathrow is shown below. This shows the dominant wind direction is from the south west.

Figure 1 - Wind Rose from Heathrow Meteorological Data 2007



3.2 Emissions Factors

The emissions factors incorporated into ADMS-Roads Extra 2.3 were used to calculate the NO_x and PM_{10} emissions for each road link in the assessment. These emission factors are the most up-to-date emission factors available from the Department for Transport (D*f*T), and are the same as those calculated with the Emission Factors Toolkit[11] and the DMRB[12] widely used throughout the UK. The emissions factors are available for three different road types which act as a proxy for the differences in fleet composition of traffic in different conditions; urban, rural and motorway.

For the primary NO_2 emissions, the default value in the model is 10%. However, many recent studies have pointed that the proportion of primary NO_2 might be significantly higher[13]. The AQEG (Air Quality Expert Group) report[14] analyses why the recent decreases in annual mean NO_x concentrations have not translated in the similar reduction of NO_2 concentrations. The report concludes that monitoring and modelling results suggest that the proportion of primary NO_2 is higher than 10%, currently used in the model. For this assessment, rather than using predicted modelled NO_2 concentrations, NO_X model output has been converted to NO_2 using the latest LAQM.TG(09) NO_X:NO_2 conversion calculator provided by Defra which takes account of the higher proportion of primary NO_2.

3.3 Background Concentrations

For the assessment of NOx/NO_2 and PM_{10} the relevant background concentration maps were downloaded from the Air Quality Archive for the years 2007. The maps used were the latest maps available from LAQM.TG (09). As using one background level for the whole of the borough would cause some areas to over read and some to under read, a system was devised so the receptors would use the background to the nearest 1 x 1 kilometre grid point. This provides a more accurate picture of air quality as regional variations in the background levels can be incorporated and this improves the overall accuracy of the modelled results.

3.4 Model Input Parameters

A minimum Monin-Obukhov length of 30m was selected to represent the stability of the atmosphere due to the characteristics of the local area. This Monin-Obukhov length was chosen as north London is a mainly suburban in character. As the area to be modelled was so large it was not possible to use specific Monin-Obukhov lengths for different areas within the borough. Therefore a length that was most representative for the borough was chosen. Also a worst case scenario approach was taken to avoid under representation in urban areas where the most receptors are likely to be. The model considers this the minimum height above ground level above which vertical turbulence is inhibited. A surface roughness length of 0.5 was assigned in the model for the borough-wide assessment.

3.5 Model Outputs

The ADMS-Roads dispersion model produces modelled concentrations of NO_X and PM_{10} at specific receptor points identified for the prediction of air quality impacts. To be able to create contours across the whole borough, receptors were required at 5m grid spacing adjacent to emissions sources to enable good resolution within the modelled predictions.

The link to a geographic information system (GIS) for mapping purposes provides the best method of analysing the pollution output. Maps have been produced illustrating NO_2 and PM_{10} concentrations predicted at the receptor points spread across the borough as shown in Appendix 2.

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[11] Emission Factor Toolkit developed by Casella Stanger for Defra. http://www.casellastanger.com/JointProjects/default.asp
[12] Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 Air Quality. The Highways Agency, February 2003.
[13] Carslaw DC *et al*. Atmospheric Environment, 39 (2005) 167-177.
[14] Defra (2007). AQEG Report 'Trends in Primary Nitrogen Dioxide in the UK'

3.6 Model Verification

The model has been used to predict concentrations of NO_2 and PM_{10} at roadside continuous and diffusion tube monitoring locations in the area assessed, in order to verify the model against monitored concentrations. The following are the main objectives of the model verification:

- to evaluate model performance;
- to show that the baseline is well established;
- to provide confidence in the assessment results.

During the verification process, Bureau Veritas aim for all final modelled NO_2 concentrations to be within 25% of the monitored NO_2 concentrations. The comparison of the monitored and modelled data shows reasonable agreement between the datasets. Where discrepancies do exist, these could be due to a variety of reasons, for example:

- Uncertainty in traffic data (flows, speeds or fleet composition);
- Model set up (road widths, elevations and receptor locations);
- Model limitations (treatment of roughness and meteorological data);
- Uncertainty in monitoring data, such as use of diffusion tubes (notably where singly located) and application of bias adjustment factor for diffusion tubes;
- Uncertainty in background concentrations.

3.6.1 NO_2 Model Verification

Table 4 shows the modelled and monitored annual mean NO_2 concentrations for 2007 for all suitable roadside monitoring sites identified. The full verification procedure is shown in Appendix 3.

Table 4 - Comparison between Modelled and Monitored Annual Mean NO_2

Site	Within AQMA (yes/no)	Monitored NO_2 2007 ($\mu g/m^3$)	Predicted Total NO_2 2007($\mu g/m^3$)	Difference Predicted / Monitored 2007 ($\mu g/m^3$)	Difference Predicted / Monitored 2007 (%)
HG1 Continuous	Yes	**41.7**	**45.2**	-3.6	9
HG2 Continuous	Yes	32.2	38.7	-6.5	20
HR06 DT	Yes	**67.2**	**62.8**	4.5	-7
HR10 DT	Yes	36.5	**44.0**	-7.5	21
HR13 DT	Yes	**74.9**	**60.4**	14.5	-19
HR14 DT	Yes	36.5	**46.9**	-10.4	29
HR15 DT	Yes	**54.2**	**48.6**	5.6	-10
HR16 DT	Yes	**58.4**	**69.1**	-10.7	18
HR18 DT	Yes	**59.2**	**62.2**	-2.9	5
Summary					
Number of sites	Within ±10%			3	
	Between ± 10-25%			5	
	Exceeds ±25%			1	
	Total			9	
In bold: exceedence of NO_2 annual mean AQS objective					

The sites selected were all within Haringey borough and only roadside sites with over 9 months of data were selected. Seven diffusion tubes and two continuous monitoring analysers installed across the borough were used to carry out the model verification. Based on these sites, the model adjustment factor for the Road-NO_x contribution was 3.20. All predicted NO_x results have been adjusted using this factor prior to deriving the NO_2 annual mean, using the NO_x:NO_2 conversion calculator.

The model verification results show that there is a reasonable agreement between the modelled and monitored concentrations, as all but one site are within the 25% target. Especially, the model successfully predicts all monitored exceedences of the NO_2 annual mean (>40µg/m^3).

3.6.2 PM_{10} Model Verification

As PM_{10} monitoring data is generally scarce compared to NO_2 monitoring, PM_{10} model verification can be more difficult due to the lack of suitable sites. Therefore, the model verification for PM_{10} has been based on all available roadside sites located in the seven districts that are part of the North London Cluster Group. Seven suitable sites have been identified, including the two continuous analysers (HG1 and HG2) monitoring PM_{10} in Haringey.

Table 5 shows the modelled and monitored annual mean PM_{10} concentrations for 2007, using these sites. The full verification procedure is shown in Appendix 3. The model verification was based on the results of roadside PM_{10} monitoring sites within urban areas with over 9 months of data capture. A verification factor of 5.99 was determined to adjust all PM_{10} modelled results.

The model verification results show that there is a reasonable agreement between the modelled and monitored concentrations, as they are all within the 25% target, and even within 10% for 5 sites out of 7. The model did not predict any exceedences of the PM_{10} annual mean AQS objective of 40µg/m^3, which is consistent with monitoring results.

Table 5 - Comparison between Modelled and Monitored Annual Mean PM_{10}

Site	Local Authority	Within AQMA (yes/no)	Monitored PM_{10} 2007 (µg/m^3)	Predicted Total PM_{10} 2007 (µg/m^3)	Difference Predicted / Monitored 2007 (µg/m^3)	Difference Predicted / Monitored 2007 (%)
BN1 - Tally Ho Continuous Monitoring Station	Barnet	No	23.4	26.2	2.8	12%
EN4 - Derby Road	Enfield	No	30.8	29.0	-1.8	-6%
EN5 - Bowes Road A406	Enfield	No	30.0	26.7	-3.3	-11%
HG1 - High Road, N17	Haringey	No	25.8	26.0	0.2	1%
HG2 - Priory Park, N8	Haringey	No	26.0	23.8	-2.2	-8%
WL4 - Crooked Billet	Waltham Forest	No	34.0	35.3	1.4	4%
HR2 - Pinner Road, North Harrow	Harrow	No	26.0	25.5	-0.4	-2%
Summary						
Number of sites		Within ±10%			5	
		Between ± 10-25%			2	
		Exceeds ±25%			0	
		Total			7	

4 Results of the Borough-wide Modelling

The results of the borough-wide modelling are shown in Appendix 2. Predicted results for NO_2 and PM_{10} are discussed separately below.

The whole of the borough has already been declared as an AQMA for the annual mean objective for nitrogen dioxide and 24-hour mean objective for particulates (PM_{10}). The results have therefore been used to identify pollutant 'hot spots' to inform decisions to be made regarding the placement of future air quality monitoring sites in the borough. Areas where the annual mean has been predicted to be over 60µg/m^3 at sensitive receptors have been highlighted as this will indicate where there could be a risk of exceeding the hourly NO_2 objective. The selection has been based on sensitive receptors being located within these 'hot spots'.

4.1 NO_2 Concentrations

4.1.1 Annual Mean Results

As seen in Figure 3, the NO_2 annual mean is predicted to exceed 40µg/m^3 along most of the main road axes in Haringey. As the whole borough is already declared as an AQMA with respect to the NO_2 annual mean, the focus has been to identify the areas most likely to exceed the hourly mean AQS objective for NO_2, which is discussed in Section 4.1.2 below.

4.1.2 Hourly Mean Results

Analysis of UK continuous NO_2 monitoring data[15] has shown that the hourly mean NO_2 objective (of 18 hourly means over 200µg/m^3) is likely to be exceeded if the annual mean concentration is over 60µg/m^3. The areas identified below have been predicted to exceed the 60µg/m^3 annual mean NO_2 and therefore present a potential risk with respect to the NO_2 hourly mean AQS objective. All the areas can be seen in Figure 6 Appendix 2.

- Area 1 - The junction of Colney Hatch Lane B550 with Alexander Park Road B106;
- Area 2 - The junction of the A1 Archway Road into Aylmer Road where it meets the A1000 Cherry Tree Hill;
- Area 3 - The junction of the A1 Archway Road with the B550 Southwood Lane;
- Area 4 - The junction of the A103 Tottenham Lane with the A1201 Middle Lane and The Broadway;
- Area 5 - The junction of the A504 where Turnpike Lane and High Street meet Hornsey Park Road and Wightman Road B138;
- Area 6 - Along Alfoxton Avenue between West Green Road A504 and Green Lane A105;
- Area 7 - Along the A105 Green Lanes between Salisbury Road and the B152 St Ann's Road;
- Area 8 - The receptors adjacent to the junction of White Hart Lane and the A10 Great Cambridge Road;
- Area 9 - The junction of the A1080 The Roundway with A109 Lordship Lane and B155 Downhills Way;
- Area 10 - The section of road where the A10 Bruce Grove/The Rounway and the A109 Lordship Lane converge.
- Area 11 - The junction of the A1010 High Road with White Hart Lane;

[15] Laxen, D. & Marner, B., July 2003. Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites. www.uwe.ac.uk/aqm/review/hourlyNO2report.pdf - Section 4.2

- Area 12 - The junction of the A10 High Road with the B153 Philip Lane;
- Area 13 - The junction of Seven Sisters Road A503 with the A10/A503 High Road at the receptors at the corner of the A10 and Earlsmead Road;
- Area 14 - The receptors south of the railway tracks along Seven Sisters Road A503 to the south of the junction of the A503 and St Ann's Road B152;

4.2 PM_{10} Concentrations

4.2.1 Annual Mean Results

Figure 4 in Appendix 2 illustrates the PM_{10} annual mean concentrations for year 2007. The map highlights the potential areas that are predicted to exceed the annual mean PM_{10} AQS objective of 40µg/m^3.

The only areas where concentrations are predicted to be above 40µg/m^3 have already been identified above for the NO_2 results. These are:

- Area 2 - The junction of the A1 Archway Road into Aylmer Road where it meets the A1000 Cherry Tree Hill, and
- Area 12 - The junction of the A10 High Road with the B153 Philip Lane;
- Area 13 - The junction of Seven Sisters Road A503 with the A10/A503 High Road at the receptors at the corner of the A10 and Earlsmead Road;

However, for each of these areas, there are no properties that fall within the 40µg/m^3 PM_{10} annual mean concentration contour.

4.2.2 Daily Mean Results

Figure 5 in Appendix 2 shows the number of PM_{10} daily means above 50µg/m^3 for year 2007. PM_{10} daily means were derived from the PM_{10} annual means based on the relationship described in Technical Guidance LAQM.TG(09)[16]. The map highlights the potential areas that are predicted to exceed the 24-hour PM_{10} AQS objective of 35 exceedences allowed per year.

The areas where the daily mean PM_{10} AQS objective is exceeded (more 35 daily means above 50µg/m^3) include all the areas identified previously in the NO_2 section, apart from Area 11.

[16] "Relationship between the annual mean and 24-hour mean PM_{10} concentrations" – LAQM.TG(09) – page 2-9

5 Scenario

As part of the scope of work it was agreed that a detailed scenario of one area within each borough would be carried out. The area was agreed with Haringey Council and a site visit was undertaken. This allowed a detailed picture to be built up of the area in question and parameters to be input into the dispersion model were noted from a site visit and details observed on MapInfo.

5.1 Scenario Details

The area chosen for the scenario is at Tottenham Hale, including the A10 High Road, Hale Road, Ferry Lane and Broad Lane. The modelled area has the same coverage as the traffic assessment provided by TfL. The scenario includes a baseline assessment of air quality and a 'do-something' scenario of the proposed traffic management changes. The AADT traffic data for the area has been taken from the TfL traffic assessment.

The same legislative background and air quality objectives apply for the scenario as detailed previously.

5.2 Baseline Information

The baseline information for the scenario is similar to the main study, in terms of traffic data inputs and use of the ADMS Roads 2.3 model. The links have been reduced to cover the specific area to be modelled and greater refinement of the modelling has been undertaken to take account of stop/start movements and queuing at junctions.

The model verification was undertaken using the same method as used in the main study, but focuses on those monitoring sites in the vicinity of the specific scenario area.

5.2.1 Air Quality Monitoring

The air quality monitoring for the detailed scenario assessment is the same as provided for the main study. The monitoring site that is of particular relevance for the scenario model verification is the Ferry Lane nitrogen dioxide diffusion tube.

5.2.2 Background Concentrations for the Scenario

The background concentrations used for the scenario are taken from the urban background continuous analyser located in Haringey at Priory Park. This was chosen as it was considered as representative of the area when compared with the Defra modelled background maps of the borough.

Table 6 - Background Concentrations Used for the Scenario

Site	Pollutant	Concentration at Monitoring Site (μg/m^3)
Priory Park	NO_2	32
	NO_X	58

5.3 Dispersion Modelling Methodology for the Scenario

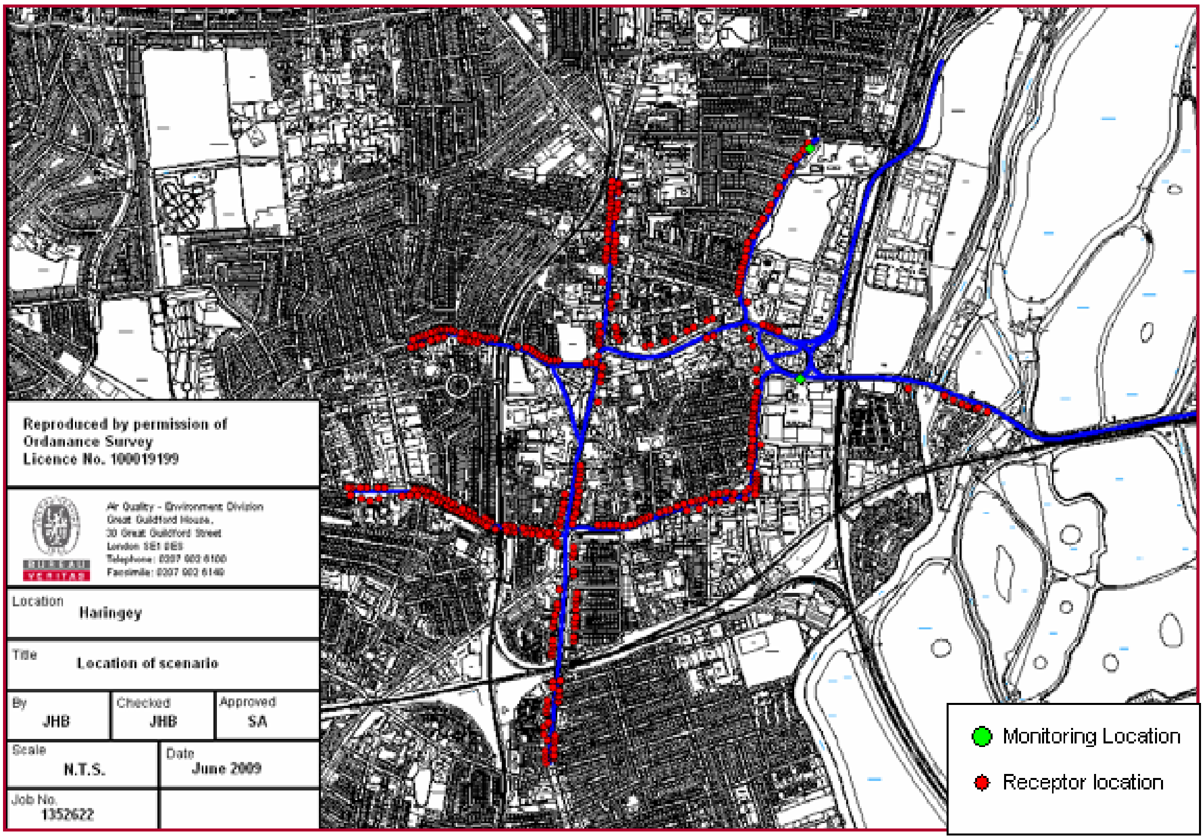
Detailed dispersion modelling of NO_2 was undertaken using the ADMS-Roads Extra 2.3 model, as was also used for the borough-wide modelling.

5.3.1 Meteorological Data

The meteorological data for 2007 is taken from the nearest representative weather station. For Haringey Council the weather station at Heathrow used. The wind rose for Heathrow as shown previously shows the dominant wind direction is from the south west.

5.3.2 Model Set Up

Figure 2 - Location of Modelled Roads, Monitoring Sites and Receptors



5.3.3 Emission Factors

The emission factors used were the same as used in the main study. See section 3.2 for details.

5.3.4 Model Input Parameters

A minimum Monin-Obukhov length of 30m was selected to represent the stability of the atmosphere due to the characteristics of the local area. This length was chosen as the scenario area is in an urban area of North London. The model considers this the minimum height above ground level above which vertical turbulence is inhibited. A surface roughness length of 0.5 was assigned in the model for the area.

The level of detail for the scenario also allowed canyon effects to be added to the model. Where canyons were observed they were input into the scenario model.

5.3.5 Model Outputs

The ADMS-Roads dispersion model predictions was used to produce modelled concentrations of NO_2 at specific receptor points of relevant exposure e.g. residential property facades.

The link to a geographic information system (GIS) for mapping purposes provides the best method of analysing the pollution output. Maps have been produced illustrating NO_2 concentration contours predicted at properties in the vicinity of the roads modelled, as shown in Appendix 4.

5.4 Model Verification

The model verification methodology for the scenario is similar to that carried out for the main study described in 3.6, although the monitoring sites chosen focus on the scenario area to increase accuracy. Only one roadside DT was available in the area of study

Table 7 - Comparison between Modelled and Monitored Annual Mean NO_2

Site	Within AQMA (yes/no)	Monitored NO_2 2007 (µg/m^3)	Predicted Total NO_2 2007 (µg/m^3)	Difference Predicted / Monitored 2007 (µg/m^3)	Difference Predicted / Monitored 2007 (%)
Ferry Lane	Yes	**58.4**	**58.4**	0.0	0
In bold: exceedence of NO_2 annual mean AQS objective					

During the verification process, Bureau Veritas aim for all final modelled NO_2 concentrations to be within 25% of the monitored NO_2 concentrations. The comparison of the monitored and modelled data shows reasonable agreement between the datasets. Where discrepancies do exist, these could be due to a variety of reasons, for example:

- Uncertainty in traffic data (flows, speeds or fleet composition)
- Model set up (road widths, elevations and receptor locations)
- Model limitations (treatment of roughness and meteorological data)
- Uncertainty in monitoring data, such as use of diffusion tubes (notably where singly located) and application of bias adjustment factor for diffusion tubes
- Uncertainty in background concentrations.

5.5 Results of the Scenario

The model results for the scenario in the baseline year, without the traffic management scheme in place, show that concentrations of NO_2 in the area modelled generally exceed the annual objective for NO_2 of 40µg/m^3. There are also identified areas where there is the potential for exceedences of the hourly NO_2 objective i.e. annual mean NO_2 is above 60µg/m^3. The modelled results show that there is potential for exceedence of the hourly objective along the loop of the A10 which includes High Road, Monument Way, Fountayne Road, and Broad Lane. Elevated concentrations of NO_2 are also predicted further away from these main roads, such as on West Green Road A504 and Ferry Lane A503.

The proposed traffic management changes as provided by TfL show that if the scheme were implemented, air quality along the A10 would improve. The concentrations of NO_2 in the area would fall. The results of the predicted scenario show that air quality along the roads would reduce to around 36-40µg/m^3 i.e. the AQS objectives would be marginally met. This is a significant improvement in air quality in this area.

6 Conclusions and Recommendations

The borough wide air quality modelling has provided a representation of the levels of air pollution for NO_2 and PM_{10}. The results of the borough-wide assessment are shown in Appendix 2. The main borough maps show pollutant concentrations across the borough. The main sources are identified as major roads bisecting the borough and busy junctions in urban areas. Although the whole borough has already been declared as an AQMA for the NO_2 annual mean objective and the PM_{10} 24-hour mean objective, these maps have been used to identify 'hot spots' where exceedences of the NO_2 and PM_{10} AQS objectives are most likely and where future monitoring programmes can be focused. In addition, it can assist with identifying areas where there is a potential risk for the NO_2 hourly mean objective to be exceeded.

The Haringey scenario at Tottenham Hale provided a detailed picture of air quality in the area. It has shown that the air quality across the area modelled is generally above the annual mean NO_2 air quality objective of 40µg/m^3. Also, there is a potential risk of exceedence of the hourly objective. The scenario included the A10 at High Road, Monument Way, Fountayne Road, and Broad Lane. Based on these modelled results recommendations can be made about how to proceed in the future.

6.1 Recommendations

Recommendations for the borough-wide assessment include consideration to highlighting the worst case 'hotspot' areas where additional monitoring would be useful. The map of locations where further monitoring is recommended is shown in Appendix 2. Haringey Council already operates an air quality monitoring network including both diffusion tubes and continuous monitors. However the areas suggested for further monitoring would allow a more comprehensive picture of air quality in the borough to be built up. This would help inform future policy decision making and help focus the borough-wide action plan on the worst affected areas. The list of areas where further monitoring at hot spots is recommended is shown below. These areas has been predicted to exceed 60µg/m^3 annual mean NO_2 and therefore present a potential risk for the hourly NO_2 objective.

- Area 1 - The junction of Colney Hatch Lane B550 with Alexander Park Road B106;
- Area 2 - The junction of the A1 Archway Road into Aylmer Road where it meets the A1000 Cherry Tree Hill;
- Area 3 - The junction of the A1 Archway Road with the B550 Southwood Lane;
- Area 4 - The junction of the A103 Tottenham Lane with the A1201 Middle Lane and The Broadway;
- Area 5 - The junction of the A504 where Turnpike Lane and High Street meet Hornsey Park Road and Wightman Road B138;
- Area 6 - Along Alfoxton Avenue between West Green Road A504 and Green Lane A105;
- Area 7 - Along the A105 Green Lanes between Salisbury Road and the B152 St Ann's Road;
- Area 8 - The receptors adjacent to the junction of White Hart Lane and the A10 Great Cambridge Road;
- Area 9 - The junction of the A1080 The Roundway with A109 Lordship Lane and B155 Downhills Way;
- Area 10 - The section of road where the A10 Bruce Grove/The Rounway and the A109 Lordship Lane converge.
- Area 11 - The junction of the A1010 High Road with White Hart Lane;
- Area 12 - The junction of the A10 High Road with the B153 Philip Lane;
- Area 13 - The junction of Seven Sisters Road A503 with the A10/A503 High Road at the receptors at the corner of the A10 and Earlsmead Road;
- Area 14 - The receptors south of the railway tracks along Seven Sisters Road A503 to the south of the junction of the A503 and St Ann's Road B152.

The areas that have been identified as being at risk of exceeding the hourly mean NO_2 air quality objective should be assessed with respect to relevant exposure and additional monitoring. This will help to determine the necessity to declare an AQMA for the NO_2 hourly objective.

The only areas where concentrations are predicted to be above the annual mean PM_{10} AQS objective of 40µg/m^3 have already been identified above for the NO_2 results. These are areas 2, 12 and 13. However, for each of these areas, there are no properties that fall within the 40µg/m^3 PM_{10} annual mean concentration contour. The areas where the daily mean PM_{10} AQS objective is exceeded (more 35 daily means above 50µg/m^3) include all the areas identified previously in the NO_2 section, apart from Area 11.

The model results for the scenario with respect to proposed traffic management changes for the A10 at Tottenham Hale predict that the baseline level of air quality exceeds the NO_2 AQS objectives at the majority of the receptors modelled. When the proposed traffic management changes were modelled, a significant improvement in air quality is predicted. The concentrations of nitrogen dioxide at the majority of receptors fall below the AQS objectives. It is recommended that the monitoring around the area be increased, particularly around the A10 circular. This will provide more information on the levels that are currently being experienced and assess the reduction in the NO_2 levels when the traffic management changes are implemented. The monitoring will provide more robust data for future LAQM work and will support the changes being made which should improve air quality in the area.

Appendices

Appendix 1 - Traffic Data

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
1 A12	540001	187841	51991	6	20
2 A12	539987	187796	51991	6	20
3 A12	539929	187825	41948	11	20
4 WHIPPS CROSS ROAD	539787	187941	29700	3	20
5 A12	539654	187920	51991	6	20
6 A12	539643	187881	51991	6	20
7 CHURCH HILL ROAD	538000	189432	165	85	30
8 EAST CROSS ROUTE	537220	185384	44432	6	47
9 EASTWAY A106	537189	185403	88865	6	20
10 EASTWAY A106	537120	185266	8483	6	25
11 EAST CROSS ROUTE	537000	185188	44432	6	47
12 EAST CROSS ROUTE	537000	185211	44432	6	47
13 SOUTH GROVE	536543	188648	6816	7	20
14 MARKHOUSE ROAD	536535	188622	19161	6	20
15 ST JAMES'S STREET	536515	188635	19161	6	20
16	537662	186161	1763	3	17
17 CHURCH ROAD A100	536998	187562	14888	8	20
18 HIGH ROAD	539944	191709	48165	2	44
19 FRIDAY HILL B146	539156	193072	18048	6	20
20 SOUTHEND ROAD	539239	190489	66819	5	20
21 CHINGFORD LANE	539198	192992	18670	3	20
22 CHURCH ROAD A100	537939	186954	14888	8	20
23 SOUTHEND ROAD	539532	190437	165719	5	70
24 WOODFORD NEW RD	539433	190541	14718	3	20
25 FOREST ROAD A503	539305	190272	24891	4	20
26 SOUTHEND ROAD	539269	190521	66819	5	20
27 HARROW GREEN	539249	186288	6641	9	20
28 HARROW GREEN B16	539244	186248	3967	7	20
29 SOUTHEND ROAD	539514	190394	82860	5	20
30 WOODFORD NEW RD	539406	190549	14718	3	20
31 WOOD STREET B160	538674	188887	9561	7	20
32 HALL LANE A1009	536698	192780	9633	5	20
33 NORTH CIRCULAR	537660	190949	66819	5	20
34 NEW ROAD A1009	538577	193035	18670	3	20
35 LARKSHALL ROAD	538570	192998	13849	6	20
36 LARKSHALL ROAD	538562	191762	7072	5	20
37 HATCH LANE A1009	539126	193014	18670	3	20
38 CHINGFORD ROAD	537459	191070	21679	4	20
39 LARKSHALL ROAD	538550	193060	16125	5	20
40 ALEXANDRA ROAD	538147	186186	3438	5	20
41 ALEXANDRA ROAD	538137	186178	3438	5	20
42 NEW ROAD A1009	538518	193011	18670	3	20
43 HALE END RD	538417	190990	1079	10	26
44 ALEXANDRA ROAD	538178	186141	4736	13	34
45 RUCKHOLT ROAD	538151	186203	5422	8	29

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
46 OLIVER ROAD	538015	186130	7184	11	20
47 OLIVER ROAD	538006	186126	7184	11	20
48 THE RIDGEWAY B16	537844	193893	6619	8	20
49 OLIVER ROAD	537593	186781	14368	11	20
50 CHINGFORD ROAD	537495	190897	15914	6	20
51 BILLET ROAD B179	537398	190954	23435	6	20
52	536128	193281	5113	9	43
53 LEE PARK WAY	535945	192395	5113	9	21
54 WALTHAMSTOW AVE	536134	192271	48611	10	20
55	535976	192218	857	8	20
56	535968	192221	857	8	20
57 ANGEL ROAD NORTH	535847	192269	56447	7	20
58 ANGEL ROAD NORTH	535808	192291	56447	7	20
59 A12	540528	188160	40959	6	46
60	536530	191691	57483	13	30
61 LEA BRIDGE ROAD	538716	188851	10364	7	20
62 LEYTON ROAD A112	538696	185000	14027	5	26
63 CHOBHAM ROAD A11	538971	185320	7337	5	34
64 FOREST LANE A11	539122	184924	22783	4	27
65 WATER LANE B164	539296	184903	15739	19	17
66 LEYTONSTONE ROAD	539205	184992	11392	4	20
67 LEYTONSTONE ROAD	539222	184993	11392	4	20
68 LEYTONSTONE ROAD	539131	185240	22783	4	27
69 FOREST LANE	539831	185154	18986	16	31
70 ALDERSBROOK ROAD	540620	186838	18254	3	47
71 DAMES ROAD B161	540276	185910	2070	29	24
72 LEYTONSTONE ROAD	539159	185477	15820	4	31
73 CANN HALL ROAD	539520	185967	8565	2	30
74 CROWNFIELD ROAD	538714	185566	6688	11	25
75 MAJOR ROAD A112	538494	185424	7411	2	30
76 TEMPLE MILLS	538121	185534	10447	6	30
77 WATERDEN ROAD	537429	185042	5579	13	29
78 HIGH ROAD LEYTON	538370	186000	14878	10	35
79 HIGH ROAD LEYTON	539135	185967	12370	6	31
80 HIGH ROAD LEYTON	538274	186250	20805	11	35
81 GROVE GREEN ROAD	538516	186381	6305	9	34
82 WARREN ROAD A106	538404	186383	5422	8	29
83 CATHALL ROAD B16	538927	186501	6969	7	20
84 HIGH ROAD LEYTON	539224	186296	12370	6	20
85 CHINGFORD LANE	539659	192502	15353	8	48
86 CHINGFORD LANE	539164	193000	18670	3	20
87 OLIVER ROAD	537804	186411	14368	11	24
88 HARROW ROAD B161	539473	186390	6049	1	34
89 HIGH ROAD LEYTON	539392	186838	12338	3	31
90 HIGH ROAD LEYTON	539554	187520	17426	10	21
91 BUSH ROAD A114	539928	187670	14895	6	25
92 LAKE HOUSE ROAD	540171	186659	12289	11	26
93 WOODGRANGE ROAD	540505	185939	16130	2	30

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
94 BLAKE HALL ROAD	540440	187196	32412	3	42
95 FRANCIS ROAD A10	538602	186490	11419	5	29
96 FRANCIS ROAD B16	538268	186929	5194	1	24
97 GRANGE PARK ROAD	537936	186792	11109	7	26
98 HIGH ROAD LEYTON	538126	187617	19771	4	31
99 ESSEX ROAD SOUTH	538718	187874	1330	18	16
100 JAMES LANE	539017	188238	11826	1	29
101 WHIPPS CROSS	539446	188410	27254	5	41
102 HAINAULT ROAD	538767	187752	4837	8	9
103 COLWORTH ROAD	539269	188275	1042	5	31
104 BLAKE HALL ROAD	540332	187861	14329	6	24
105 GORDON ROAD	540157	188209	444	1	27
106 HIGH STREET	540496	188500	3668	18	32
107 HIGH STREET	540161	188865	3360	6	18
108 HERMON HILL A11	540420	189197	25273	3	43
109 NEW WANSTEAD	539861	187978	13706	4	20
110 NEW WANSTEAD	539889	188054	13706	4	20
111 NEW WANSTEAD	540100	188436	12066	3	46
112 HOLLYBUSH HILL	539909	188608	30465	2	39
113 HIGH ROAD	540115	189393	21659	3	42
114 SNARESBROOK	539363	189088	9738	2	32
115 LEA BRIDGE ROAD	538837	188871	20728	7	20
118 EASTERN AVENUE	540507	188155	40959	6	46
119 CAMBRIDGE PARK	540158	187955	77937	7	23
120 CAMBRIDGE PARK	540421	188124	3796	30	18
121 A114	539894	187804	103983	6	20
122 CATHALL ROAD B1	538852	186518	14688	1	22
123 CATHALL ROAD B1	539059	186434	7035	6	22
124 GROVE GREEN ROAD	538962	186904	13302	3	26
125 GAINSBOROUGH ROAD	539346	187575	51991	6	28
126 BULWER ROAD	538870	187401	9125	11	17
127 FAIRLOP ROAD	538844	187622	9125	11	17
128 LEYTON GREEN	538157	188178	16525	5	22
129 HOE STREET A112	537394	188946	11709	6	20
130 HOE STREET A112	537379	188914	11709	6	20
131 HOE STREET A112	537397	188979	23418	6	30
132 HOE STREET A112	537367	189032	11709	6	20
133 HOE STREET A112	537357	189018	11709	6	20
134 CHINGFORD ROAD	537465	190936	23435	6	20
135	537561	191000	6871	3	20
136 BILLET ROAD B17	536762	190814	162886	3	41
137 CHINGFORD ROAD	537328	192146	18846	7	35
138 OLD CHURCH ROAD	537395	193405	11581	8	37
139 INKS GREEN	538022	192241	6477	1	28
140 WINCHESTER ROAD	538405	191268	78573	2	29
141 THE BROADWAY	538530	191758	26673	5	20
142 HALE END ROAD	538544	190576	2458	6	36
143 HALE END ROAD	538793	191337	87642	2	22

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
144 THE AVENUE	538951	192404	34566	4	28
145 RUCKHOLT ROAD	537823	186128	33399	8	28
146 EASTWAY A106	537559	185836	28695	5	28
147 EASTWAY A106	537395	185589	28905	10	27
148 TEMPLE MILLS	537520	185506	51991	6	28
149 EASTWAY A106	537326	185462	4708	12	11
150 EASTWAY A106	537313	185450	4708	12	11
151 A12	537500	185459	51991	6	28
152	536910	186651	14111	4	39
153 LEA BRIDGE ROAD	536032	186959	30548	6	35
154 EASTERN ROAD	538435	188836	447	36	20
155 BROOKE ROAD	538400	189269	141	100	22
156 WOODFORD NEW	539462	190420	45966	4	47
157 WOODFORD NEW	539682	191212	27766	7	47
158 BROADMEAD ROAD	540377	191614	19662	3	37
159 HIGH ROAD	540012	191844	51075	3	28
160 HIGH ROAD	540130	192129	27459	4	45
161 EPPING NEW ROAD	540654	194370	18176	2	35
162 WHITEHALL ROAD	540089	193623	10490	3	45
163 WHITEHALL ROAD	539458	193995	14799	10	35
164 RANGERS ROAD	539312	194732	8313	7	44
165 A1006	536539	188637	9285	7	28
166 SOUTH GROVE	536709	188761	6816	7	28
167 SELBORNE ROAD	537225	188986	9391	9	32
168 PALMERSTON ROAD	536677	189090	79543	3	30
169 CHURCH HILL	538166	189016	65662	1	30
170 SHERNHALL STREET	538086	189650	467	30	25
171 HIGHAM HILL	536289	190061	51038	1	44
172 BILLET ROAD B17	535881	190703	18574	6	39
173 BROAD LANE A503	534234	189274	45171	5	28
174 HALE ROAD A1055	534408	189549	18495	6	20
175 WATERMEAD WAY	534933	190562	36990	6	39
176 WALTHAMSTOW AVE	535587	192154	56447	7	60
177 WALTHAMSTOW AVE	536356	192155	48611	10	60
178 A406	535966	192283	112894	7	60
179	535936	192163	57483	13	30
180 FOLLY LANE	536475	191695	57483	13	30
181 SOUTHEND ROAD	537382	191031	68221	10	83
182 SOUTHEND ROAD	537405	191030	68221	10	83
183	536480	191756	57483	13	20
184 HARBET ROAD	536107	191877	57483	13	30
185 WALTHAMSTOW AVE	536222	192280	56447	7	60
186 WALTHAMSTOW AVE	536462	192024	51282	7	60
187 SOUTHEND ROAD	540116	190507	82860	5	70
188 SOUTHEND ROAD	540463	190547	82860	5	70
189 LOWER HALL LANE	536275	192476	3580	5	36
190 HALL LANE A1009	536557	192442	19296	8	43
191 HALL LANE A1009	536659	192795	21366	4	43

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
192 LARKSHALL ROAD	538436	192037	20155	5	22
193 LARKSHALL ROAD	538564	192634	13849	6	27
194 NEW ROAD A1009	538568	193025	13849	6	20
195 NEW ROAD A1009	537936	192875	91572	3	48
196 HATCH LANE A100	538909	193013	18670	3	48
197 FRIDAY HILL B14	539111	193492	101065	3	33
198 LARKSHALL ROAD	538580	193272	102394	2	32
199 LARKSHALL ROAD	538739	193828	12531	4	27
200 ENDLEBURY ROAD	538311	193729	52682	1	38
201 HALL LANE A1009	537134	192746	9314	9	33
202 THE RIDGEWAY	538116	194075	3689	8	31
203 BURY ROAD	539218	195855	28603	0	45
204 HIGH ROAD	539780	187732	10750	6	20
205 HIGH ROAD	539780	187714	12436	9	20
206 LEA BRIDGE ROAD	538973	189051	19277	5	20
207 LEA BRIDGE ROAD	538938	189000	19661	4	20
208 A406	538670	190878	66819	5	20
209 WADHAM ROAD	537702	190959	94452	1	40
210 LEA BRIDGE ROAD	538719	188872	18620	6	20
211 WOODFORD NEW	539348	190305	24819	10	20
212 WOODFORD NEW	539192	189765	34252	8	48
213 WHIPPS CROSS	538834	188785	14850	3	20
214 WHIPPS CROSS	538818	188776	14850	3	20
215 WOODFORD NEW	539341	190316	24819	10	20
216 HOMERTON ROAD	537000	185508	16313	8	20
217 LEA VALLEY ROAD	537000	195196	19718	8	45
218 LEA VALLEY ROAD	537599	194903	19718	8	20
219 SEWARDSTONE	537612	194867	21051	10	20
220 KINGS HEAD HILL	537646	194881	15425	8	20
221 KINGS HEAD HILL	538196	194465	15425	8	32
222 SEWARDSTONE	537731	196000	15304	10	35
223 SEWARDSTONE	537622	194930	15304	10	20
224 SEWARDSTONE	537574	194528	21051	10	20
225 SEWARDSTONE	537594	194684	21051	10	29
226 WALTHAM WAY A10	537550	194482	21264	4	20
227 WALTHAM WAY A10	537155	193981	21264	4	55
228 MANSFIELD HILL	537669	194107	12437	5	37
229 MANSFIELD HILL	537580	194468	12437	5	20
230 WALTHAM WAY A10	536876	193294	10526	5	55
231 WALTHAM WAY A10	536669	192810	10526	5	20
232 WALTHAM WAY A10	536659	192821	10526	5	20
233 WALTHAM WAY A10	536861	193282	10526	5	55
234 NORTH CIRCULAR	537699	190916	66819	5	20
235 FULBOURNE ROAD	538295	190001	81229	3	20
236 FULBOURNE ROAD	538106	190927	81229	3	33
237 FOREST ROAD A50	538328	189987	19512	7	20
238 FOREST ROAD A50	538723	190103	19512	7	40
239 WOOD STREET B16	538479	189389	94441	3	29

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
240 WOOD STREET B16	538308	189947	94441	3	20
241 FOREST ROAD A50	538274	189965	24891	4	20
242 FOREST ROAD A50	537472	189778	24891	4	20
243 FOREST ROAD A50	537832	189786	24891	4	40
244 CHINGFORD ROAD	537493	190232	14663	10	35
245 CHINGFORD ROAD	537446	189808	14663	10	20
246 FOREST ROAD A50	537414	189795	12892	8	20
247 HOE STREET A112	537422	189763	15975	14	20
248 HOE STREET A112	537215	189476	15975	14	30
249 BLACKHORSE LANE	535865	190124	84844	3	40
250 BLACKHORSE LANE	535848	189444	84844	3	20
251 FOREST ROAD A50	535878	189420	12892	8	20
252 FOREST ROAD A50	536513	189612	12892	8	38
253 ST JAMES'S STREET	535851	189390	15033	14	20
255 FOREST ROAD A50	535030	189318	22932	10	30
256 FOREST ROAD A50	535816	189408	22932	10	20
257 MARKHOUSE ROAD	536640	188091	22616	3	20
258 MARKHOUSE ROAD	536640	188091	22616	3	31
259 LEA BRIDGE ROAD	537488	187847	20866	12	20
260 LEA BRIDGE ROAD	536671	187385	23720	14	35
261 LEA BRIDGE ROAD	536671	187385	23720	14	20
262 LEA BRIDGE ROAD	537932	188317	13581	11	20
263 LEA BRIDGE ROAD	538338	188610	28943	5	32
264 LEA BRIDGE ROAD	538338	188610	28943	5	20
265 LEA BRIDGE ROAD	537932	188317	13581	11	32
266 LEA BRIDGE ROAD	537932	188317	13581	11	20
267 HIGH ROAD LEYTON	537998	187998	13288	11	31
268 HIGH ROAD LEYTON	537998	187998	13288	11	20
269 LEA BRIDGE ROAD	537488	187847	20866	12	30
270 LEA BRIDGE ROAD	537488	187847	20866	12	20
271 HOE STREET A112	537501	188451	118264	7	20
272 HOE STREET A112	537501	188451	118264	7	30
273 HIGH ROAD LEYTON	538046	186549	20809	11	34
274 HIGH ROAD LEYTON	537994	187113	13547	9	20
275 HIGH ROAD LEYTON	537994	187113	13547	9	31
276 HIGH ROAD LEYTON	538046	186549	10405	11	34
277 HIGH ROAD LEYTON	538046	186549	10405	11	20
278 CHURCH ROAD A10	537846	186902	14888	8	35
279 CHURCH ROAD A10	537846	186902	14888	8	20
280 CHURCH ROAD A10	537281	187070	13723	10	35
281 CHURCH ROAD A10	537281	187070	13723	10	20
282 A12	539396	187678	51991	6	28
283 A12	539396	187678	51991	6	28
284 A12	539396	187678	51991	6	28
285 A12	539396	187678	51991	6	28
286 A12	539001	186869	42799	10	28
287 A12	539001	186869	42799	10	28
288 A12	539001	186869	42799	10	28

Road Name	X	Y	AADT 2007	% HGV	Average Speed (Kph)
289 A12	539001	186869	42799	10	28
290 ST JAMES'S STREET	536169	188970	15033	14	31
291 ST JAMES'S STREET	536169	188970	15033	14	31

Appendix 2 - Maps for Borough wide Modelling

Figure 3 - Modelled NO_2 Annual Mean 2007 for Haringey

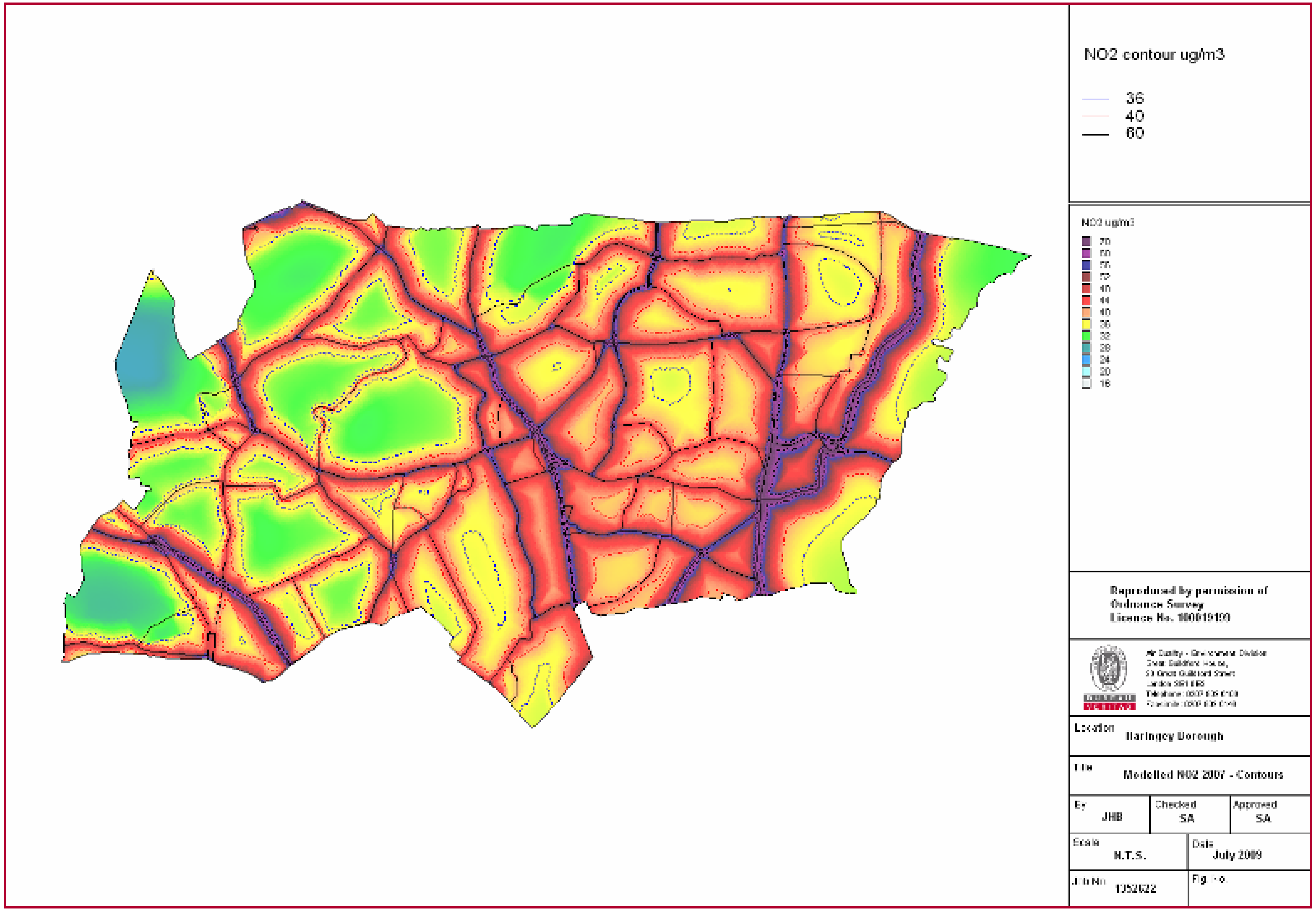


Figure 4 - Modelled PM_{10} Annual Mean 2007 for Haringey

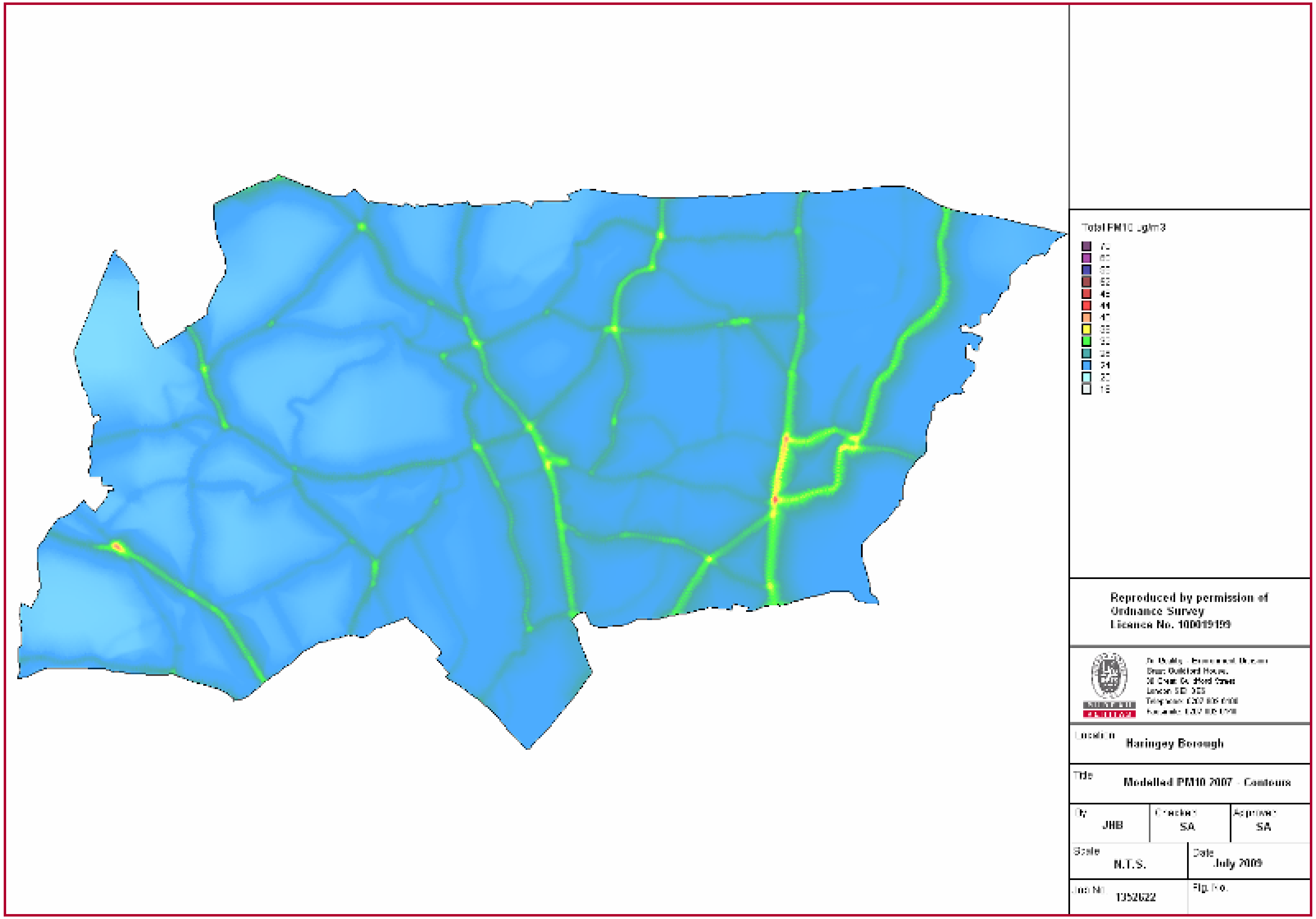
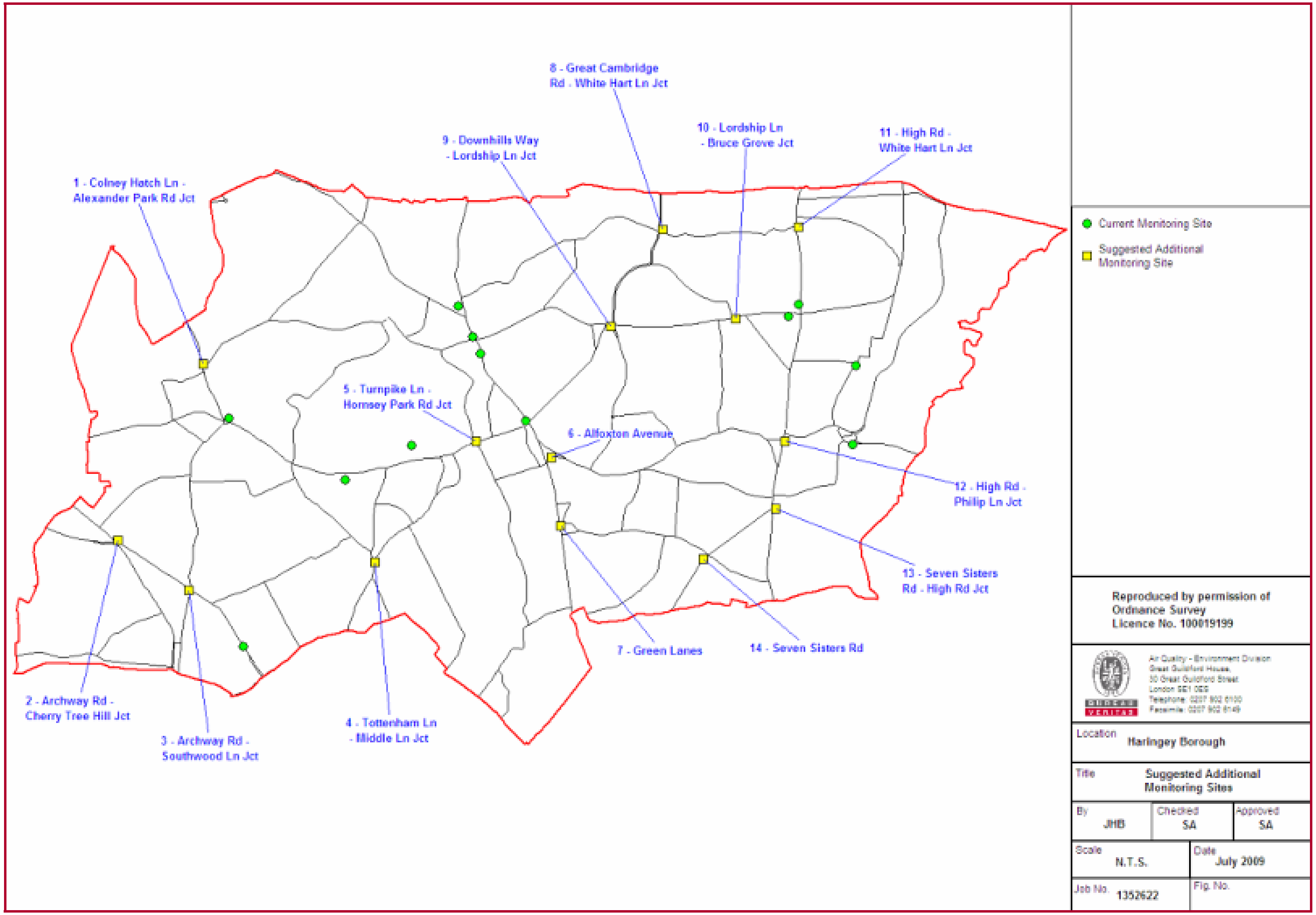


Figure 5 - Modelled PM_{10} Daily Mean 2007 for Haringey

Figure 6 - Identified ‘Hotspots’ Where Additional Monitoring Recommendations Have Been Made



Appendix 3 - Model Verification for Borough-wide Modelling

Table 8 - Details of the NO_2 Model Verification – Borough-wide Modelling

Site	Background NO_2 (µg/m^3)	Background NO_x (µg/m^3)	Monitored Total NO_x (µg/m^3)	Monitored Road Contribution NO_x (µg/m^3)	Modelled Road Contribution NO_x (µg/m^3)	Ratio of Monitored Road NO_x / Modelled Road NO_x	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_x (µg/m^3)	Adjusted Modelled Total NO_x (µg/m^3)	Modelled Total NO_2 (µg/m^3)	Monitored Total NO_2 (µg/m^3)	% Difference NO_2 [(Modelled - Monitored)/ Monitored]
HG1 Continuous	31.3	42.2	88.4	10.4	12.4	3.7	3.2	39.8	82.0	45.2	41.7	9.0
HG2 Continuous	27.8	36.4	57.5	4.4	8.9	2.4	3.2	28.6	65.0	38.7	32.2	20.0
HR06 DT	29.5	39.1	189.3	37.7	38.8	3.9	3.2	124.4	163.4	62.8	67.2	-7.0
HR10 DT	29.3	38.8	57.2	7.2	12.9	1.4	3.2	41.4	80.2	44.0	36.5	21.0
HR13 DT	31.6	42.6	231.8	43.3	32.3	5.9	3.2	103.7	146.3	60.4	74.9	-19.0
HR14 DT	31.3	42.2	55.4	5.2	14.2	0.9	3.2	45.7	87.8	46.9	36.5	29.0
HR15 DT	28.1	36.8	122.5	26.1	19.3	4.4	3.2	61.9	98.7	48.6	54.2	-10.0
HR16 DT	30.9	41.5	137.6	27.5	48.5	2.0	3.2	155.5	197.1	69.1	58.4	18.0
HR18 DT	29.3	38.8	144.7	29.9	37.9	2.8	3.2	121.7	160.5	62.2	59.2	5.0

Table 9 - Details of the PM_{10} Model Verification – District-wide Modelling

Site	Background PM_{10} (µg/m^3)	Monitored Road Contribution PM_{10} (µg/m^3)	Modelled Road Contribution PM_{10} (µg/m^3)	Ratio of Monitored Road PM_{10}/Modelled Road PM_{10}	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution PM_{10} (µg/m^3)	Adjusted Modelled Total PM_{10} (µg/m^3)	Monitored Total PM_{10} (µg/m^3)	% Difference PM_{10} [(Modelled - Monitored)/ Monitored]
BN1 - Tally Ho Continuous Monitoring Station	22.0	1.4	0.7	2.0	5.99	4.2	26.2	23.4	12.1%
EN4 - Derby Road	24.1	6.7	0.8	8.2		4.9	29.0	30.8	-5.8%
EN5 - Bowes Road A406	22.5	7.5	0.7	10.8		4.2	26.7	30.0	-11.1%
HG1 - High Road, N17	23.4	2.4	0.4	5.6		2.6	26.0	25.8	0.7%
HG2 - Priory Park, N8	21.9	4.1	0.3	12.7		1.9	23.8	26.0	-8.3%
WL4 - Crooked Billet	23.4	10.6	2.0	5.3		11.9	35.3	34.0	3.9%
HR2 - Pinner Road, North Harrow	21.9	4.1	0.6	6.7		3.6	25.5	26.0	-1.7%

Appendix 4 - ADMS Modelled Results for the Scenario

Figure 7 - Results of Tottenham Hale Scenario – Baseline NO_2 Annual Mean Concentrations 2007 in $\mu g/m^3$

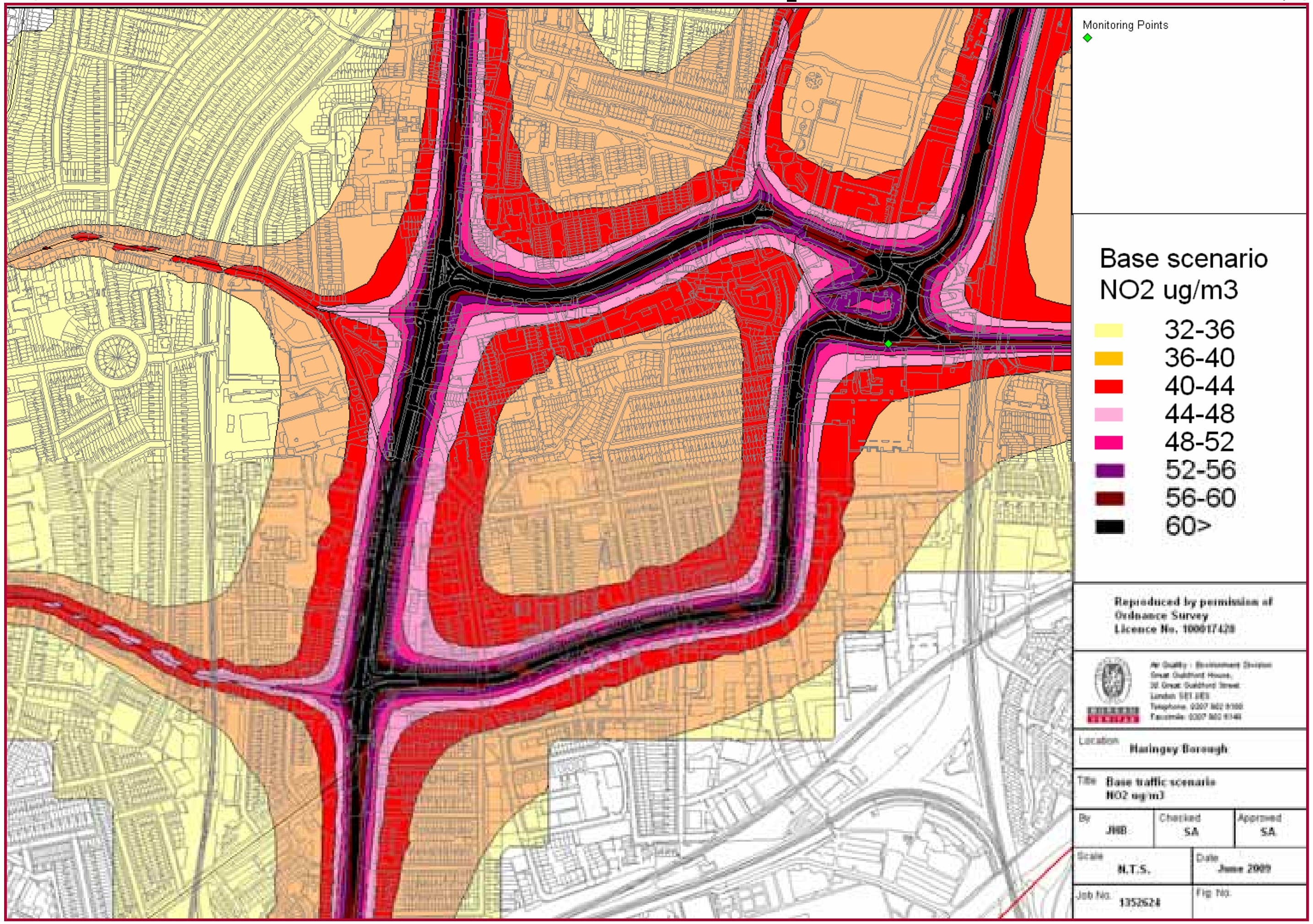
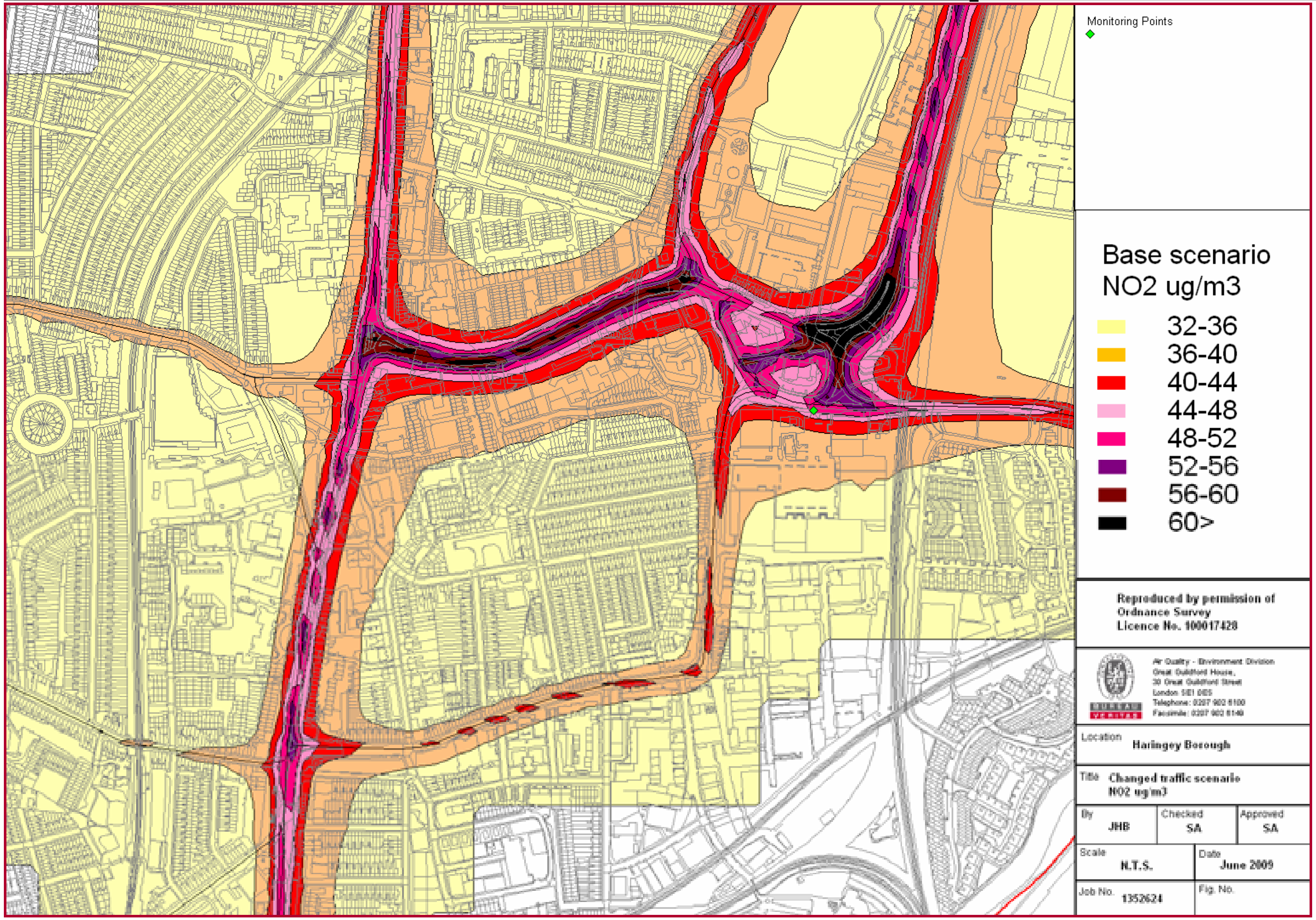


Figure 8 - Results of Tottenham Hale Scenario Traffic Management Changes– NO_2 Annual Mean Concentrations 2007 in $\mu g/m^3$



Appendix 5 - Model Verification for Modelled Scenario

Table 10 - NO_2 Model Verification – Tottenham Hale Scenario

Site	Background NO_2 (µg/m^3)	Background NO_x (µg/m^3)	Monitored Total NO_x (µg/m^3)	Monitored Road Contribution NO_x (µg/m^3)	Modelled Road Contribution NO_x (µg/m^3)	Ratio of Monitored Road NO_x/Modelled Road NO_x	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_x (µg/m^3)	Adjusted Modelled Total NO_x (µg/m^3)	Modelled Total NO_2 (µg/m^3)	Monitored Total NO_2 (µg/m^3)	% Difference NO_2 [(Modelled - Monitored)/ Monitored]
Ferry Lane	32	57.5	149.4	91.9	47.9	1.9	1.9	91.9	149.4	58.4	58.4	0