

**HERTSMERE BOROUGH COUNCIL**

**LAQM DETAILED ASSESSMENT 2010**

**BV/AQ/AGGX3765213/LJ/2695**

**MAY 2010**




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# 1 Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work.

Hertsmere Borough Council's (HBC) fourth round Updating and Screening Assessment 2009 concluded that there was a risk of exceedence of the annual mean nitrogen dioxide (NO<sub>2</sub>) objective at the following locations identified through 2008 monitoring results and DMRB assessment:

- Elstree Crossroads, Elstree (Barnet Lane and High Street)
- Potters Bar, including the junction of Barnet Road/Southgate Road/High Street and the High Street, near the bus station and junction of the High Street with Hatfield Road/The Causeway.
- Radlett, including the junctions of Watling Street/Aldenham Road and Watling Street/Park Road.
- M1 Bushey, at Hartspring Lane.

Bureau Veritas has been commissioned by Hertsmere Borough Council to provide a Detailed Assessment for nitrogen dioxide at these locations.

The Detailed Assessment has been undertaken in accordance with Defra LAQM.TG(09)<sup>1</sup> Guidance methodologies. The Detailed Assessment aims, through assessment of monitoring data and dispersion model predictions, to assess these four areas and determine whether the prescribed objectives are being met. Where exceedences are predicted to occur, the Detailed Assessment aims to define the area of exceedence to assist the Council in respect of subsequent Air Quality Management Area declaration.

The findings of the Detailed Assessment are the following:

High Street and High Street/Hatfield Road Junction, Potters Bar:

- The modelling predicted exceedences of the annual mean NO<sub>2</sub> objective in 2009 near the High Street/Hatfield Road junction and further down the High Street adjacent to the existing AQMA. It is therefore recommended that the Council amend the existing AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009;
- In addition, prior to undertaking Further Assessment work, it is recommended that monitoring be conducted at 169-183 High Street to assess compliance with the annual mean air quality objective for NO<sub>2</sub>;
- Investigation is required to determine if relevant exposure exists at the Hall and Police station near the High Street Road/Hatfield Road junction. If there is found to be no relevant exposure at these locations then no further action is required at this junction.

High Street/Southgate Road Junction, Potters Bar:

- The modelling predicted that there would be no exceedences in either 2009 or 2015 in the vicinity of the High Street/Southgate junction. Therefore, it will not be necessary to declare an AQMA for this junction. However, this junction should continue to be monitored as monitoring results in previous years have suggested higher levels than measured in 2009.

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<sup>1</sup> Defra (2009), Local Air Quality Management Technical Guidance LAQM.TG(09)

Elstree Crossroads:

- The modelling predicted widespread exceedences of the annual mean NO<sub>2</sub> objective outside of the AQMA in 2009. In 2015, only isolated exceedences are predicted in the immediate vicinity of the AQMA. It is therefore recommended that the Council consider expanding the existing AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009;
- In addition, prior to undertaking Further Assessment work, it is recommended that monitoring be undertaken at 1-3 Elstree Hill North to assess compliance with the annual mean objective for NO<sub>2</sub>.

Watling Street, Radlett:

- The modelling predicted exceedences of the annual mean NO<sub>2</sub> objective at the junction of Watling Street/Park Road and along Watling Street near the Aldenham Lane junction in 2009. No exceedences were predicted in 2015. It is therefore recommended that the Council consider declaring an AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009.

M1/Hartspring Lane:

- The modelling confirmed the need for the existing AQMA along the M1 and predicted an exceedence of the annual mean NO<sub>2</sub> objective outside of the AQMA in 2009. Exceedences are not predicted outside of the AQMA in 2015. It is therefore recommended that the Council consider expanding the existing AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009.

## 2 Introduction

### 2.1 Project Background

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work. This Detailed Assessment is a requirement of the fourth round of Review and Assessment following recommendations of the Council's Updating and Screening Assessment 2009. Bureau Veritas was commissioned by Hertsmere Borough Council (HBC) to undertake the Detailed Assessment of nitrogen dioxide (NO<sub>2</sub>) at the following locations.

- Elstree Crossroads, Elstree (Barnet Lane and High Street)
- Potters Bar, including the junction of Barnet Road/Southgate Road/High Street and the High Street, near the bus station and junction of the High Street with Hatfield Road/The Causeway.
- Radlett, including the junctions of Watling Street/Aldenham Road and Watling Street/Park Road.
- M1 Bushey, at Hartspring Lane.

### 2.2 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)<sup>2</sup> 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<sup>3</sup> introduces new obligatory standards for PM<sub>2.5</sub> for Government but places no statutory duty on local Government to work towards achievement.

The Air Quality Standards (England) Regulations 2007<sup>4</sup> came into force on 15<sup>th</sup> 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 (NO<sub>2</sub>), sulphur dioxide particulates - PM<sub>10</sub> and PM<sub>2.5</sub>, ozone and PAHs - Polycyclic Aromatic Hydrocarbons) have been prescribed within the Air Quality Strategy<sup>2</sup> based on The Air Quality Standards (England) Regulations 2007.

This assessment focuses on nitrogen dioxide, in respect of pollutant sources affecting air quality within the Council's administrative area. The objectives set out in the AQS for pollutants included in Air Quality Regulations for the purpose of Local Air Quality Management are presented in the table below.

The UK Government and the Devolved Administrations have also set new national air quality objectives for PM<sub>2.5</sub>. These objectives have not been incorporated into LAQM Regulations, and local authorities have no statutory obligation to review and assess air quality against them.

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<sup>2</sup> 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

<sup>3</sup> 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

<sup>4</sup> The Air Quality Standards Regulations 2007, Statutory Instrument No 64, The Stationary Office Limited



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 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 2.1 – 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
<b>Benzene</b> All authorities	16.25 µg/m <sup>3</sup>	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 µg/m <sup>3</sup>	annual mean	31.12.2010
Authorities in Scotland and Northern Ireland only	3.25 µg/m <sup>3</sup>	running annual mean	31.12.2010
<b>1,3 Butadiene</b> All authorities	2.25 µg/m <sup>3</sup>	running annual mean	31.12.2003
<b>Carbon monoxide</b> Authorities in England, Wales and Northern Ireland only	10.0 µg/m <sup>3</sup>	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 µg/m <sup>3</sup>	running 8-hour mean	31.12.2003
<b>Lead</b> All authorities	0.5 µg/m <sup>3</sup>	annual mean	31.12.2004
	0.25 µg/m <sup>3</sup>	annual mean	31.12.2008
<b>Nitrogen dioxide</b> <sup>a</sup> All authorities	200 µg/m <sup>3</sup> , not to be exceeded more than 18 times a year	hourly mean	31.12.2005
	40 µg/m <sup>3</sup>	annual mean	31.12.2005
<b>Particles (PM<sub>10</sub>) (gravimetric)</b> <sup>b</sup> All authorities	50 µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 µg/m <sup>3</sup>	annual mean	31.12.2004
Authorities in Scotland only <sup>c</sup>	50 µg/m <sup>3</sup> not to be exceeded more than 7 times a year	24 hour mean	31.12.2010
	18 µg/m <sup>3</sup>	annual mean	31.12.2010
<b>Sulphur dioxide</b> All authorities	350 µg/m <sup>3</sup> not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
	125 µg/m <sup>3</sup> not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 µg/m <sup>3</sup> not to be exceeded more than 35 times a year	15 minute mean	31.12.2005

<sup>a</sup> 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<sub>10</sub>, to be achieved by 2005, and benzene by 2010.

<sup>b</sup> Measured using the European gravimetric transfer sampler or equivalent.

<sup>c</sup> These 2010 air quality objectives for PM<sub>10</sub> apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.

## 2.3 Local Air Quality Management Review and Assessment

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)<sup>5</sup> 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))<sup>6</sup> and Technical Guidance (LAQM.TG (09))<sup>7</sup>. 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.

## 2.4 Summary of Review and Assessment in Hertsmere

Hertsmere Borough Council has declared six Air Quality Management Areas (AQMA) for nitrogen dioxide following the results of the first and second rounds of Review and Assessment. Descriptions and figures of the AQMA are shown below:

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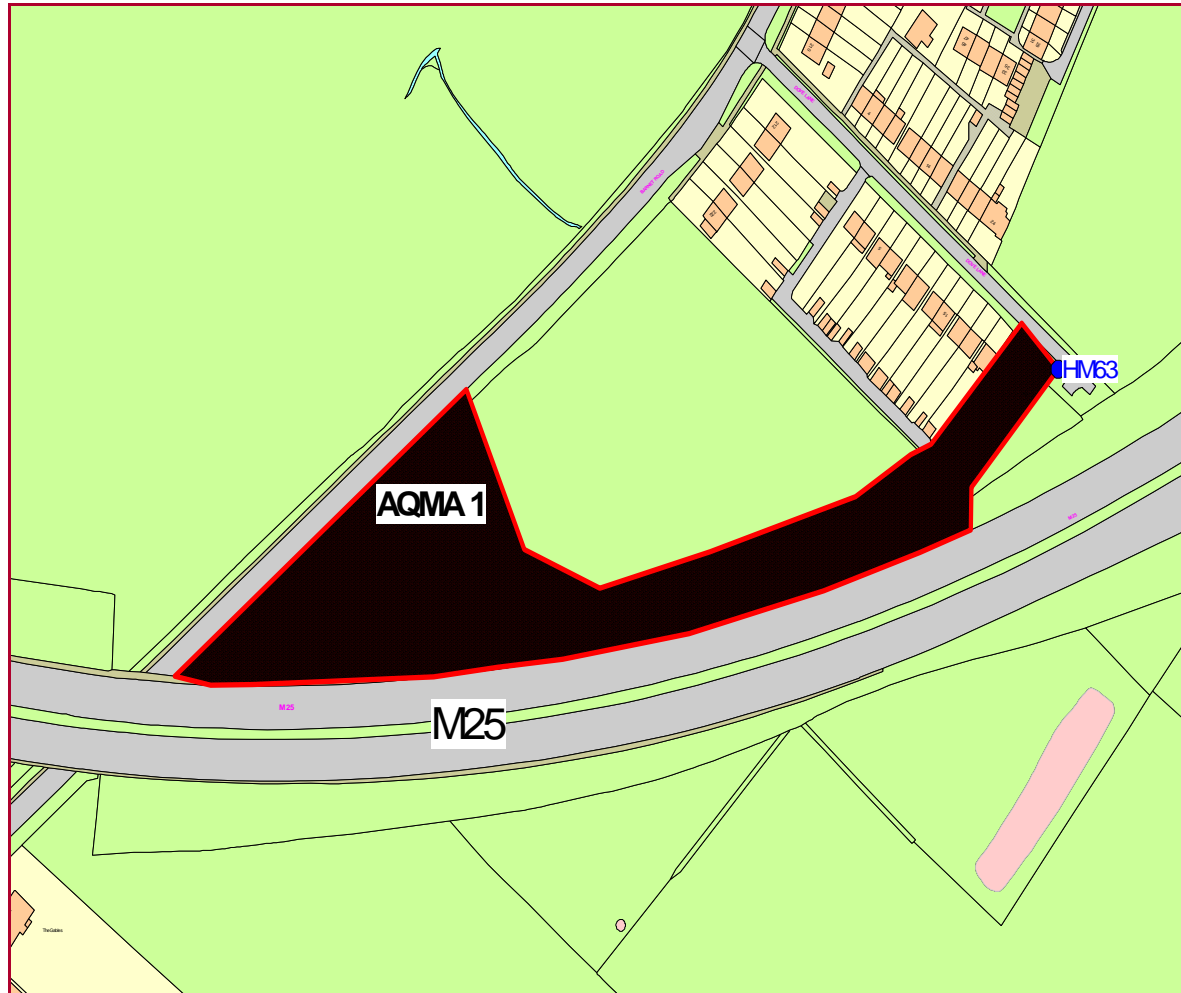
<sup>5</sup> DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationary Office

<sup>6</sup> 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

<sup>7</sup> 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

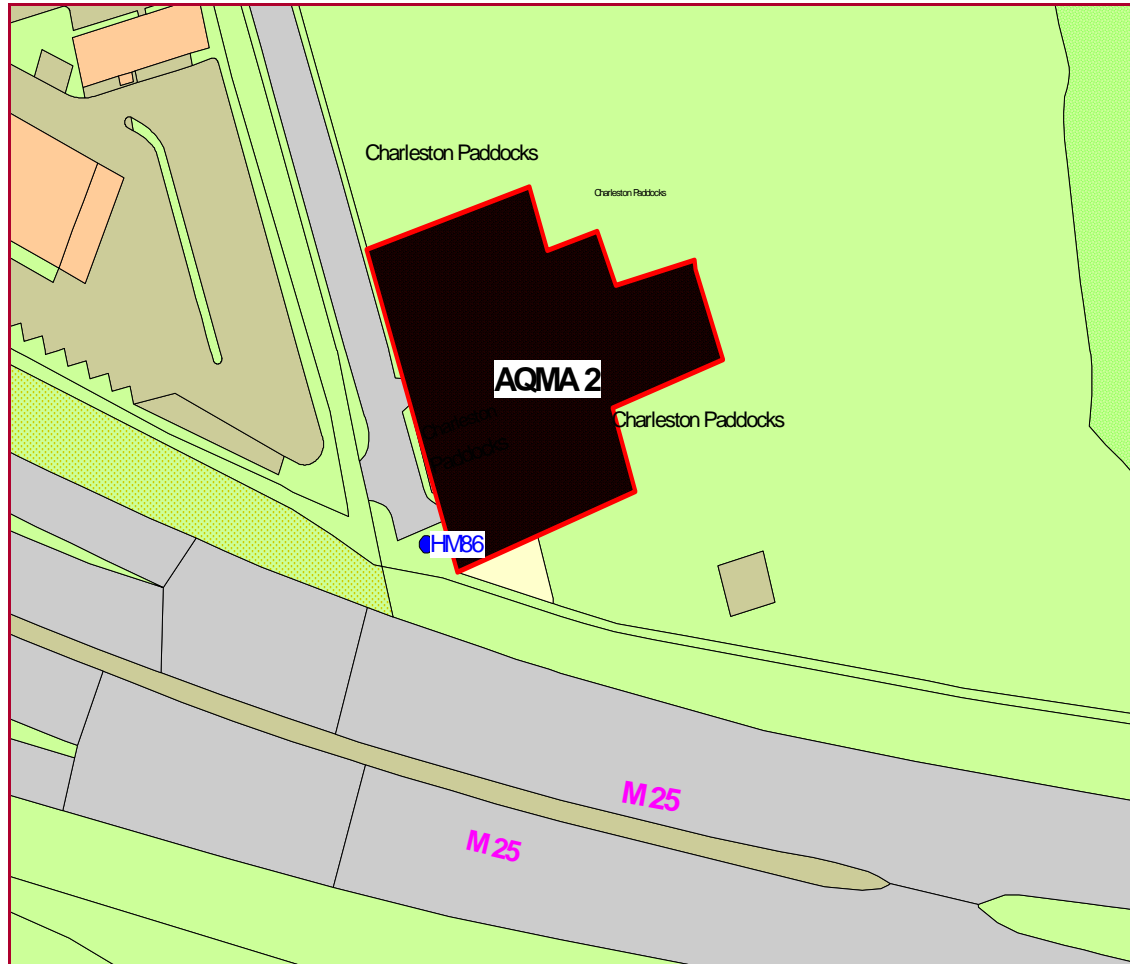
**Figure 2.1 – Hertsmere AQMA No. 1**

Hertsmere No. 1: An area comprising the domestic properties 23-27 Dove Lane and caravan site off A1000 Barnet Road, near the M25.



**Figure 2.1 – Hertsmere AQMA No. 2**

Hertsmere No. 2: An area comprising the domestic property known as Charleston Paddocks, St Albans Road, South Mimms, Potters Bar, near the M25.



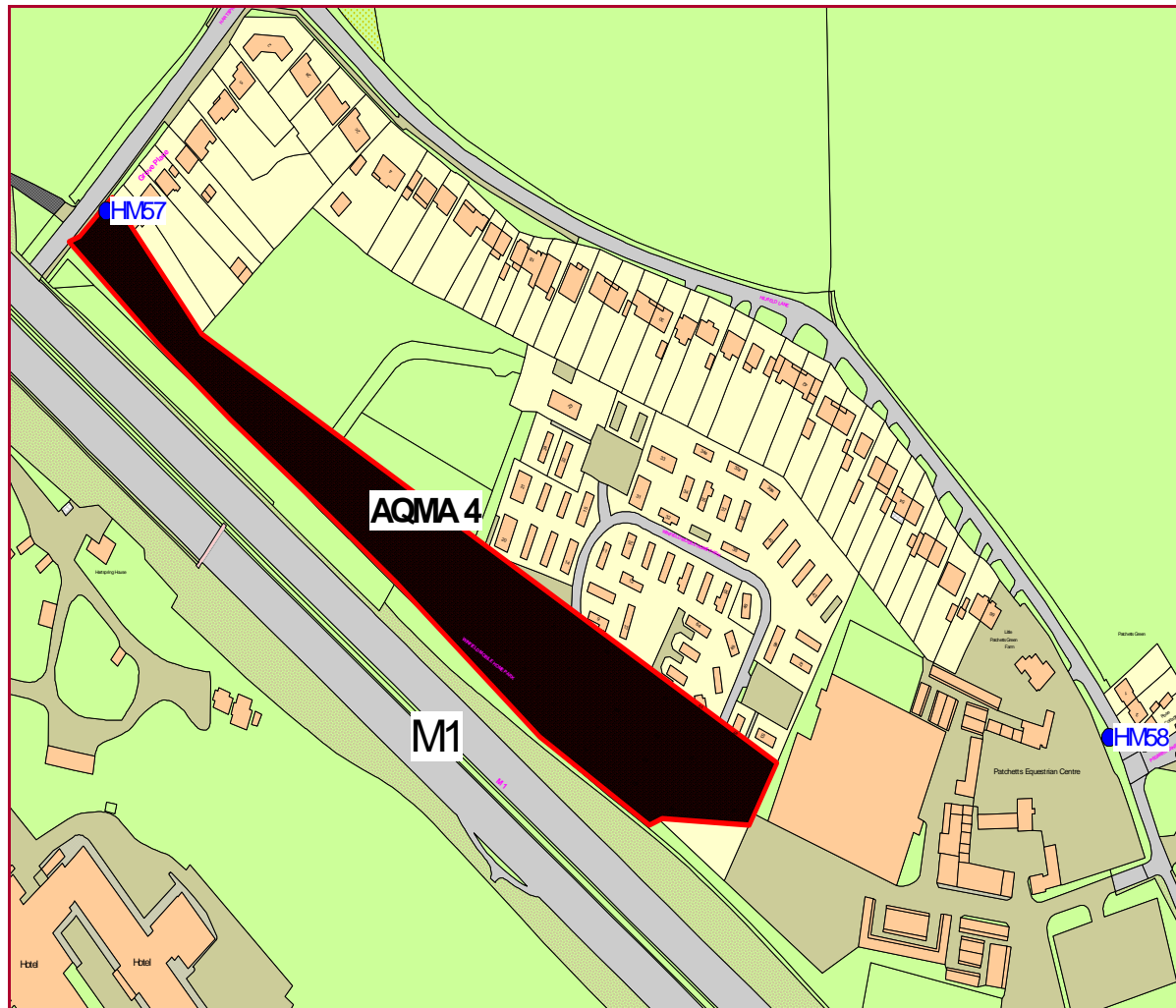
**Figure 2.3 – Hertsmere AQMA No. 3**

Hertsmere No. 3: An Area comprising the domestic properties 31-39 Blanche Lane, South Mimms, near the M25.



**Figure 2.4 – Hertsmere AQMA No. 4**

Hertsmere No. 4: An area comprising the domestic properties 12 Grove Place, Hartspring Lane, Aldenham and caravans numbered 1, 2, 3, 4, 7, 8, 55, 56, 57, 58, 59, 60 within Winfield Caravan site, Hartspring Lane, near the M1 at Bushey.



Hertsmeare No. 5: Comprising domestic dwellings within eight properties on the east side of the A5183 High Street Elstree either side of the junction with the A411.



# Hertsmere AQMA 6

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At present there are six designated AQMAs in Hertsmere, however, a new area is to be declared at The Broadway, Potters Bar in the near future.

The Annual Progress Report 2008 concluded that further investigation needs to be carried out at Southgate Road, Potters Bar and Park Road, Radlett following analysis of monitoring data and that these should be further assessed in the next review and assessment carried out by Hertsmere Borough Council.

The Updating and Screening Assessment 2009 further investigated the areas identified in the 2008 progress report and also identified other areas where the annual mean NO<sub>2</sub> objective are not likely to be met. The USA 2009 concluded that a detailed assessment of the following areas was required:

- Elstree Crossroads, Elstree (Barnet Lane and High Street)
- Potters Bar, including the junction of Barnet Road/Southgate Road/High Street and the High Street, near the bus station and junction of the High Street with The Causeway.
- Radlett, including the junctions of Watling Street/Aldenham Road and Watling Street/Park Road.
- M1 Bushey, at Hartspring Lane.

## 2.5 Scope and Methodology of the Detailed Assessment

The scope of this assessment is to predict NO<sub>2</sub> concentrations at relevant receptor locations along High Street, Potters Bar including junctions with Hatfield Road and Southgate Road, Watling Street, Radlett including junctions with Park Road and Aldenham Road, Elstree crossroads and M1/Hartspring Lane, Hertsmere. Hertsmere Borough Council identified these areas in the 2009 Updating and Screening Assessment as having potential exceedences of the annual mean NO<sub>2</sub> objective. The purpose of the Detailed Assessment is to provide the local authority with an opportunity to supplement the information they have gathered in their earlier Review and Assessment work and more accurately assess the impact of pollution sources on local receptors at identified hotspots through detailed dispersion modelling. Dispersion modelling can be used to predict concentrations over a wider area than can be monitored. It is important to ensure, as far as possible, that the results of modelling reflect the results from local monitoring sites across the assessment area and allow comparison of pollutant concentrations against the AQS objectives. This Detailed Assessment will identify with reasonable certainty whether or not pollutant concentrations are likely to exceed the AQS objectives and, if so, define the extent and magnitude of the exceedences.

Detailed dispersion modelling was carried out as part of the Detailed Assessment based on the ADMS-Roads (v2.3) atmospheric dispersion model. Monitoring results from nitrogen dioxide diffusion tubes installed in the assessment areas were used to verify the modelled results. NO<sub>x</sub>/ NO<sub>2</sub> concentrations were predicted for the baseline (verification) year 2009 and future year 2015. The dispersion modelling was undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM.TG(09)) for Detailed Assessments

## 3 Baseline Information

### 3.1 Traffic Data

Updated traffic counts for the roads in the assessment areas were provided by Hertsmere Borough Council, via Hertfordshire County Council Highways, where available. Data included the annual average daily traffic (AADT) and breakdown of traffic flows into vehicle categories.

Traffic data were projected to 2009 and 2015 using growth factors from Temprow<sup>8</sup> and NTM (National Traffic Model) adjusted for the Hertsmere area.

In the absence of speed data, free flowing vehicle speeds were assumed to be at the speed limit. Speed was reduced near junctions to 20kph and along congested sections of the road by 10kph to account for stop/ start emissions. The traffic data used in this assessment are summarised in Appendix 1.

### 3.2 Air Quality Monitoring Data

#### 3.2.1 Nitrogen Dioxide Diffusion Tube data

Hertsmere Borough Council undertook monitoring at 15 NO<sub>2</sub> diffusion tube sites relevant for model verification in this assessment in 2009. The diffusion tubes are supplied and analysed by Gradko utilising the 20% Triethanolamine (TEA) in water preparation method. Gradko participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO<sub>2</sub> diffusion tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO<sub>2</sub> concentrations reported are of a high calibre. The lab follows the procedures set out in the Harmonisation Practical Guidance.

With regard to the application of a bias adjustment factor for the diffusion tubes, the technical guidance LAQM.TG (09) and Review and Assessment Helpdesk recommends use of a local bias adjustment factor where available and relevant to diffusion tube sites. Hertsmere Borough Council has a (triplicate) diffusion tube co-location study at the Borehamwood background site. However, this site was not considered as relevant to the assessment areas considered in this report as all monitoring sites used for the purpose of model verification are located on busy roadsides. The bias adjustment factor for 2009 has therefore been taken from the Review and Assessment Helpdesk spreadsheet of national co-location sites for this laboratory methodology. This is calculated as 0.9 (update 31/03/10) based on 33 studies<sup>9</sup>. For 2006 and 2007 data, the bias adjustment factors were 0.89 for 2007 and 0.9 for 2008.

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<sup>8</sup> Temprow (Trip End Model Presentation Program) version 6.2 (dataset version 5.4 ), Department for Transport

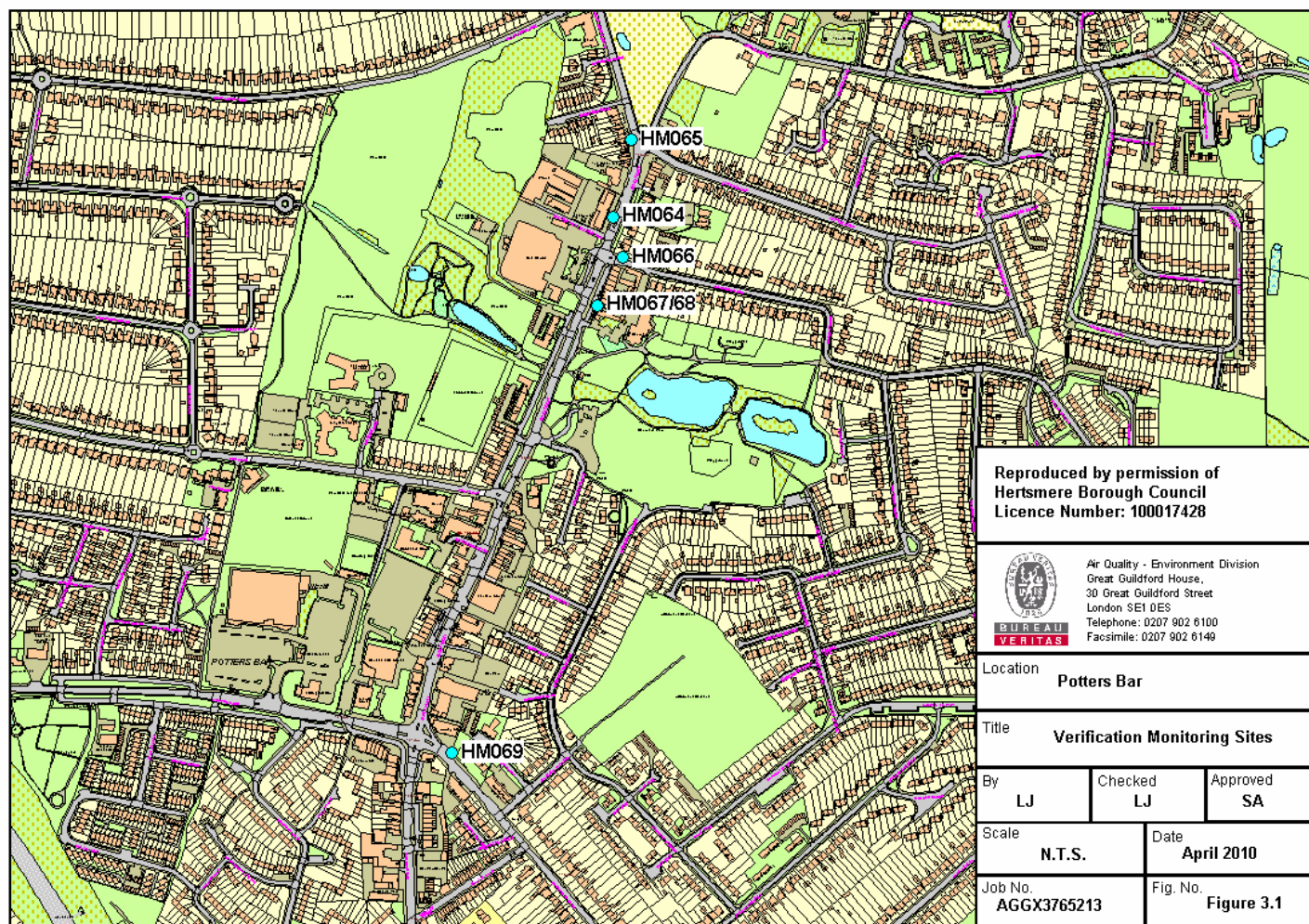
<sup>9</sup> <http://www.uwe.ac.uk/aqm/review/mR&Asupport09.html#Bias Adjustment>

**Table 3.1 - Diffusion Tube Results in Assessment Areas**

Code	Location	X	Y	Site Type	AQMA?	Location used for verification	2007	2008	2009	% Data capture 2009
<b>Potters Bar</b>										
HM064	Bus Garage 1 Potters Bar	526229	201507	K	Yes	Yes	<b>62</b>	<b>62</b>	<b>50</b>	100
HM065	Hatfield Road Potters Bar	526252	201604	K	No	Yes	<b>52</b>	<b>48</b>	<b>47</b>	100
HM066	Bus Garage 2 Potters Bar	526241	201457	K	Yes	Yes	<b>45</b>	<b>45</b>	39	92
HM067/68	Bus Garage 3 Potters Bar	526209	201397	K	Yes	Yes	<b>43</b>	<b>42</b>	39	100
HM069	Southgate Road Potters Bar	526028	200838	K	No	Yes	<b>59</b>	<b>57</b>	<b>47</b>	100
<b>Elstree Crossroads</b>										
HM048	Elstree Crossroads 1	517846	195346	K	Yes	Yes	<b>42</b>	<b>41</b>	39	100
HM049	Elstree Crossroads 2	517861	195226	K	No	Yes	<b>43</b>	<b>45</b>	<b>42</b>	83
HM050/51	Elstree Crossroads 3	517802	195249	K	No	Yes	<b>54</b>	<b>56</b>	<b>55</b>	100
HM052	Elstree Crossroads 5	517745	195247	K	Yes	Yes	<b>59</b>	<b>58</b>	<b>55</b>	100
<b>Radlett</b>										
HM071/72/73	Park Road Junction Radlett	516291	200036	R	No	Yes	<b>47</b>	<b>50</b>	<b>47</b>	92
HM074/75/76	301 Watling Street Radlett 1	516458	199623	R	No	Yes	37	38	37	92
HM102/103/104	Aldenham Road 1 Radlett	516350	199762	R	No	Yes	-	-	33	33
<b>M1 Bushey ,Hartspring Lane</b>										
HM057	Hartspring Lane Aldenham Bushey	513516	197819	K	Yes	Yes	<b>43</b>	<b>46</b>	<b>43</b>	100
HM058	Pegmire Lane Aldenham	513963	197621	R	No	Yes	34	32	31	100
HM108/109/110	Hartspring Lane PH 1	513397	197677	K	No	Yes	-	-	30	17

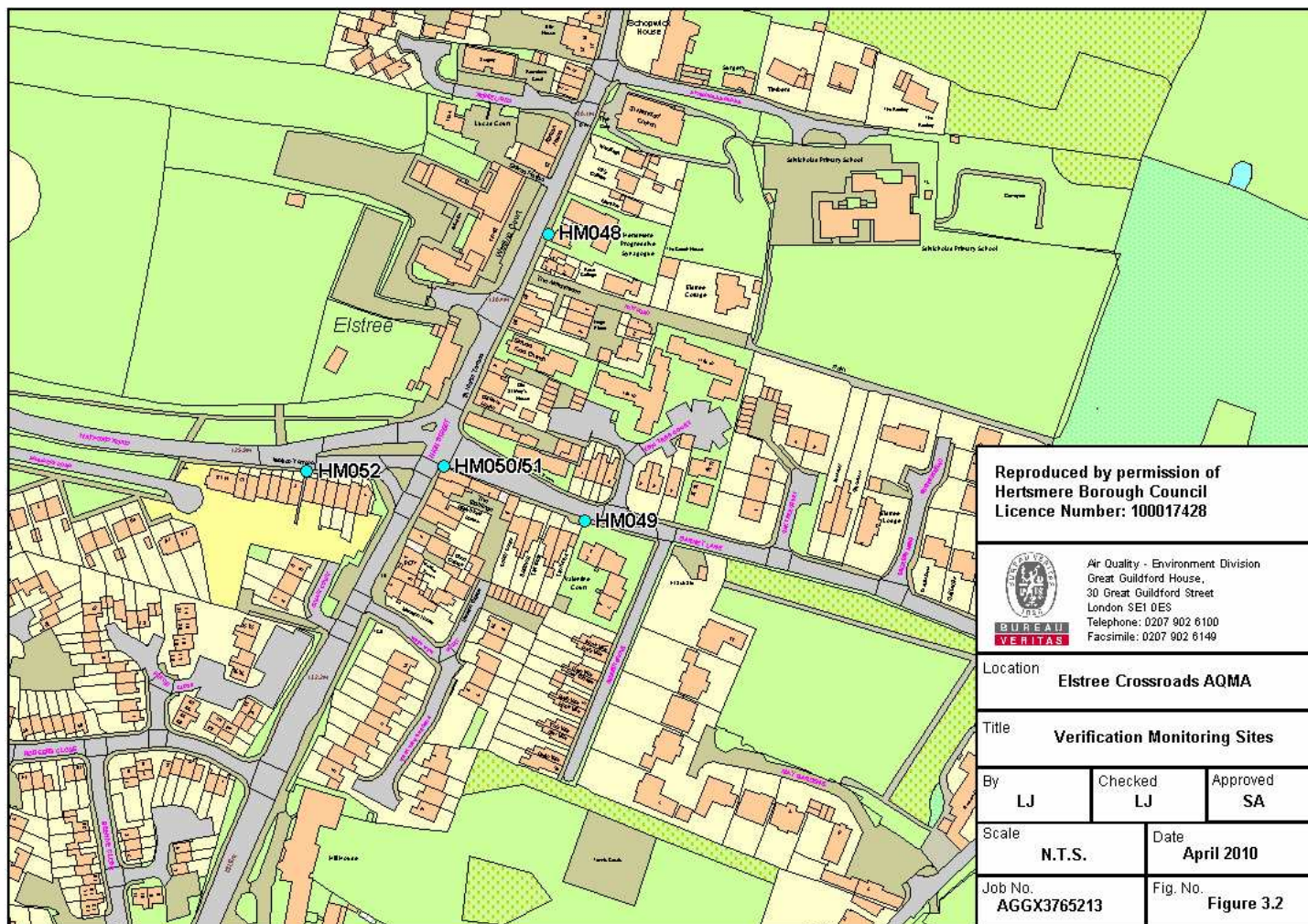
In bold, exceedence of the NO<sub>2</sub> annual mean AQS objective (40 µg/m<sup>3</sup>). B=Background, R= Roadside, k=Kerbside.

**Figure 3.1 –Monitoring Sites in Potters Bar**



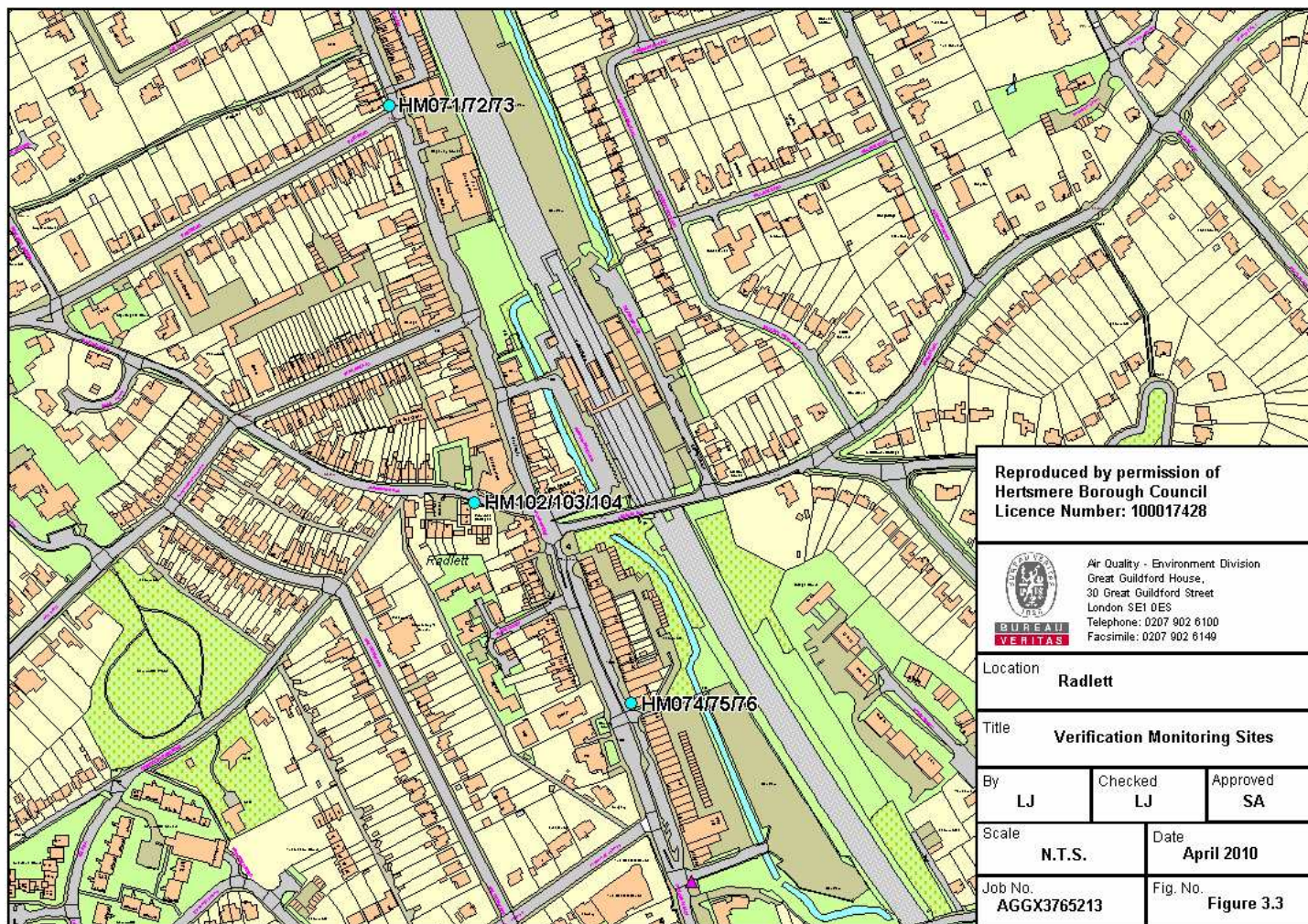


**Figure 3.2 –Monitoring Sites in Elstree**



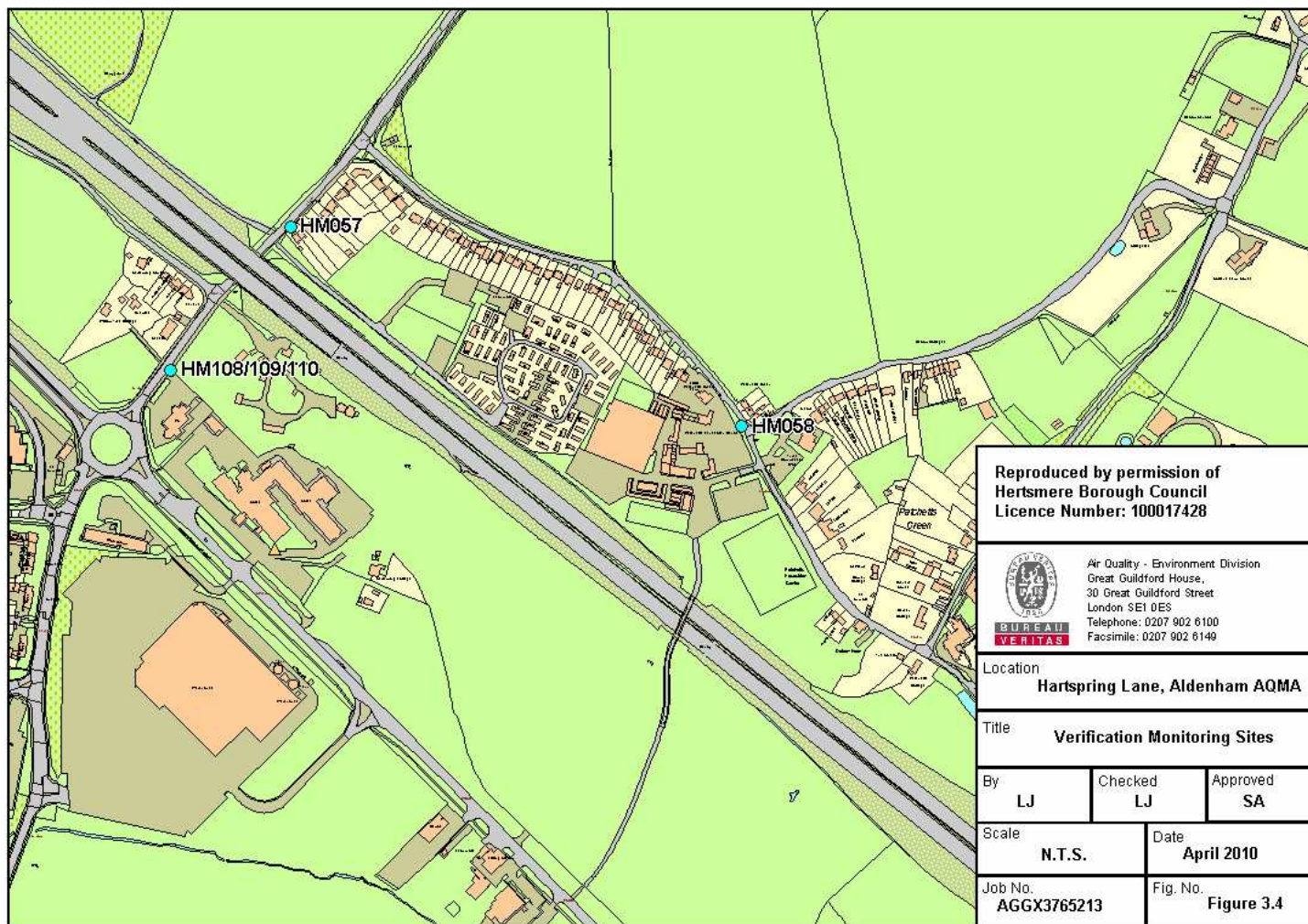


**Figure 3.3 –Monitoring Sites in Radlett**





**Figure 3.4 –Monitoring Sites in Hartspring Lane**



### 3.2.2 Background Concentrations

Local monitoring data and LAQM.TG (09) updated background maps were considered to determine appropriate background for this assessment. NO<sub>2</sub> concentrations from the Air Quality Archive background maps for year 2009 are approximately 18 - 21µg/m<sup>3</sup> within the Hertsmere assessment areas while the Borehamwood continuous urban background site measured concentrations of approximately 27µg/m<sup>3</sup> in 2009. The Borehamwood urban location was not considered representative of the areas assessed and therefore, the predicted background concentrations for the grid squares nearest to the assessment areas have been used. Background NO<sub>x</sub> and NO<sub>2</sub> concentrations for future years were derived from the background maps provided through the Air Quality Archive website<sup>10</sup>

**Table 3.2 – Comparison of Background Concentrations (Borehamwood) 2009 (µg/m<sup>3</sup>)**

Pollutant	Modelled Background Map (µg/m <sup>3</sup> ) (grid square x=520500, y=197500)	Borehamwood Urban Background Monitoring Site (µg/m <sup>3</sup> )
NO <sub>x</sub>	31.9	42.2
NO <sub>2</sub>	21.1	26.6

**Table 3.3 - Background Mapped Concentrations for Hertsmere (µg/m<sup>3</sup>)**

Location	Pollutant	2009 Background (µg/m <sup>3</sup> )	2015 Background (µg/m <sup>3</sup> )
Potters Bar (Grid square x= 525500, y= 201500)	NO <sub>x</sub>	35.0	24.2
	NO <sub>2</sub>	21.8	16.1
Elstree Crossroads (Grid square x= 517500, y= 195500)	NO <sub>x</sub>	30.3	21.5
	NO <sub>2</sub>	20.2	15.2
Radlett (Grid square x= 516500, y= 199500)	NO <sub>x</sub>	27.8	20.3
	NO <sub>2</sub>	20.0	14.8
Hartspring Lane (Grid square x= 514500, y= 197500)	NO <sub>x</sub>	29.7	20.7
	NO <sub>2</sub>	18.9	14.5

<sup>10</sup> <http://www.airquality.co.uk/archive/index.php>



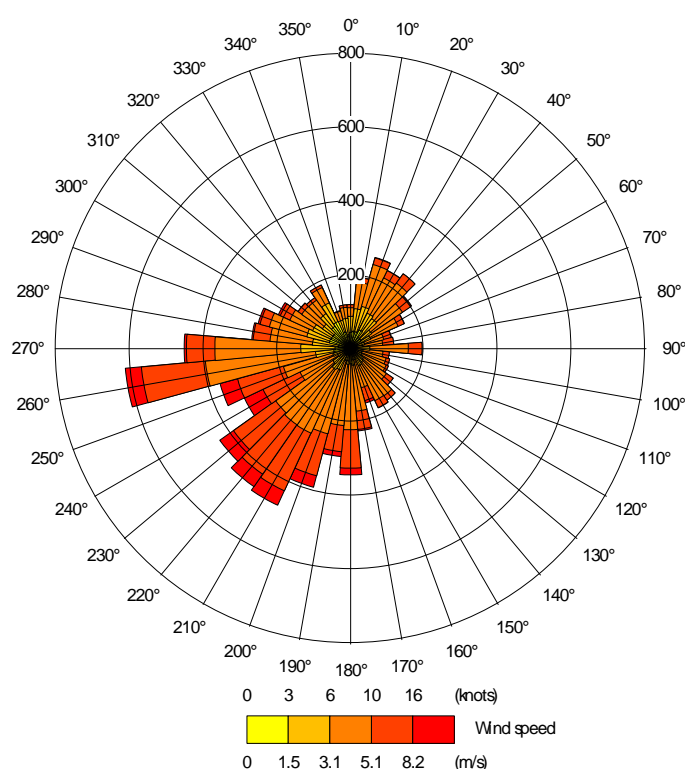
## 4 Dispersion Modelling Methodology

Detailed dispersion modelling of  $\text{NO}_x$  was undertaken based on ADMS-Roads (version 2.3) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Conversion to  $\text{NO}_2$  was based on the updated  $\text{NO}_x/\text{NO}_2$  conversion model released by Defra in February 2009 as part of LAQM.TG(09) tools.

ADMS-Roads is an advanced Gaussian dispersion model, which has been extensively used in local air quality management and has formed the basis for many AQMA declarations. A number of validation studies have been completed, showing overall good agreement between model outputs and observations at continuous monitoring sites.

Dispersal of pollutant emissions is dependent (amongst other factors like topography and street canyon effects) upon the prevailing meteorological conditions at the time of emissions release. Hourly sequential meteorological data from the nearest, representative meteorological station (Heathrow) was used in this assessment, based on the year 2009. The wind rose showing the predominant southwesterly wind direction is shown in Figure 4.2.

**Figure 4.2 – Heathrow 2009 Hourly Sequential Meteorological Data**



## 5 Results

### 5.1 Model Verification and adjustment

Model verification at specific locations was carried out prior to predicting concentrations within the assessment areas at sensitive receptor locations. The objectives of the model verification are:

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

Comparison of the modelled and monitored results was carried out based on local NO<sub>2</sub> monitoring data from diffusion tubes in the assessment areas. Predicted NO<sub>2</sub> was derived based on the latest NO<sub>x</sub>/NO<sub>2</sub> conversion model released by Defra in January 2010<sup>11</sup>.

During the verification process, Bureau Veritas aim to ascertain whether all final modelled NO<sub>2</sub> concentrations are within 25% of the monitored NO<sub>2</sub> concentrations. Modelled results may not compare as well at some locations for a number of reasons including:

- Errors in traffic flow and speed data estimates;
- Model setup (including street canyons, road widths, receptor locations);
- Model limitations (treatment of roughness and meteorological data);
- Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data).

The model verification process minimises the above uncertainties as far as practicable. The model verification results are provided in Table 5.1.

Overall, predicted concentrations are in good agreement with monitoring data, as all adjusted modelled NO<sub>2</sub> results are within  $\pm 25\%$  of monitored concentrations, with thirteen out of 15 agreeing within  $\pm 10\%$ . The highest percentage difference was calculated for Site HM052 Watford Road, Elstree with 20%. This is due to uncertainties in turning traffic movements to and from Watford Road. The full verification methodology is shown in Appendix 2.

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<sup>11</sup> <http://www.airquality.co.uk/archive/laqm/tools.php>

**Table 5.1 – Model verification results at monitoring sites in the assessment areas**

Site	Within AQMA (yes/no)	Monitored NO <sub>2</sub> 2008 (µg/m <sup>3</sup> )	Predicted Total NO <sub>2</sub> 2008(µg/m <sup>3</sup> )	Difference predicted / monitored 2008 (µg/m <sup>3</sup> )	Difference predicted / monitored 2008 (%)
Potters Bar - High Street/Hatfield Road Junction					
HM069	No	47.1	47.1	0	0
Potters Bar - High Street/Southgate Road Junction					
HM064	No	50.3	51.6	1.3	3
HM065	No	46.7	44.3	-2.4	-5
HM066	No	38.8	38.5	-0.3	-1
HM067/68	Yes	39.2	40.0	0.8	2
Elstree Crossroads					
HM048	No	39.2	42.7	3.5	9
HM049	No	41.6	42.9	1.3	3
HM050/51	Yes	54.6	58.1	3.5	6
HM052	No	55.2	44.0	-11.2	-20
Radlett					
HM071/72/73	No	47.6	47.2	-0.4	1
HM074/75/76	No	36.5	36.1	-0.4	-2
HM102/103/104	No	30.3	30.1	-0.2	-8
M1/Hartspring Lane					
HM057	Yes	42.7	42.6	-0.1	0
HM058	No	31.1	26.3	-4.8	-15
HM108/109/110	No	29.8	32.4	2.6	9
Summary					
Number of sites	Within ±10%			13	
	Between ± 10-25%			2	
	Exceeds ±25%			-	
	Total			15	
In bold: exceedence of NO <sub>2</sub> annual mean AQS objective					

## 5.2 Modelled NO<sub>2</sub> Concentrations

Annual average NO<sub>2</sub> concentrations were predicted for the baseline year 2009 and 2015 at a number of specific receptors representing relevant public exposure, located at the facade of properties. Additionally, predictions were made to a 5m-grid spacing across the assessment areas to produce NO<sub>2</sub> concentration contour maps for year 2009. Contour results were predicted at 1.5m from the ground, while specific receptors were adjusted to location of relevant exposure.

Appendix 3 summarises predicted NO<sub>2</sub> results for years 2009 and 2015 at specific receptor locations in the assessment areas. NO<sub>2</sub> concentration contours for the year 2009 are also illustrated in Appendix 4.

### Potters Bar

The model predicted exceedences of the AQS objective in 2009 at a small number of receptors relevant of public exposure (facade of properties), within the assessment area: High Street and High Street/Hatfield Road junction. There were no predicted exceedences of the objective within the AQMA due to receptors being located on the 1<sup>st</sup> floor level. Exceedences outside the AQMA occurred at properties adjacent to the AQMA, 169-183 High Street, and at the Hall and Police Station at the High Street/Hatfield Road junction. It is recommended that further investigation be conducted to confirm the presence of residential accommodation within the Hall and Police Station buildings as these may not constitute relevant exposure. It is also recommended that monitoring be undertaken at 169-183 High Street to assess compliance with the annual mean NO<sub>2</sub> objective. The maximum predicted annual mean concentration in 2009 is 44.5µg/m<sup>3</sup> at the Hall.

There are no predicted exceedences of the AQS objective in 2009 at receptors relevant of public exposure (facade of properties), within the High Street/Southgate Road junction assessment area.. The maximum predicted annual mean concentration in 2009 is 39.2µg/m<sup>3</sup>.

Predicted results for year 2015 show a decrease at modelled receptors along the High Street and at Hatfield Road and Southgate junctions due to predicted decrease in background pollution concentrations and vehicle emissions that compensate for expected traffic growth. The maximum predicted annual mean concentration in 2015 is 32.4µg/m<sup>3</sup>. The annual mean objective of 40µg/m<sup>3</sup> is not predicted to be exceeded at any location in the Potters Bar assessment area in 2015.

### Elstree Crossroads

The model predicted exceedences of the AQS objective in 2009 at many receptors relevant of public exposure (facade of properties) outside of the existing AQMA, including the commercial/residential length of Elstree Hill North and areas close to the High Street Junction on Barnet Lane, Watford Road and Elstree Hill South. Two exceedences were also predicted outside of the commercial town centre at 1 and 3 Elstree Hill North near the junction of Allum Lane. Elstree Hill North is subject to slower moving traffic and queuing quite some distance from the town centre and these properties are close to the roads. It is therefore recommended that monitoring be undertaken at this location to assess compliance with the annual mean objective. The maximum predicted annual mean concentration in 2009 is 55.4µg/m<sup>3</sup> and is within the existing AQMA.

Predicted results for year 2015 show a decrease at modelled receptors in Elstree due to predicted decrease in background pollution concentrations and vehicle emissions that compensate for expected traffic growth. Nevertheless, the objective is still likely to be exceeded by this date within the existing AQMA and at one receptor, 6 Elstree Hill North, adjacent to the AQMA. The maximum predicted annual mean concentration in 2015 of 43.0µg/m<sup>3</sup>.

### Watling Street, Radlett

The model predicted exceedences of the AQS objective in 2009 at receptors relevant of public exposure (facade of properties), within the assessment area in the vicinity of the Watling Street/Park Road junction and along a small section of Watling Street near the Aldenham Road junction. Exceedences have been confirmed at the Watling Street/Park Road junction by diffusion tube

monitoring and additional monitoring is recommended between 223 and 255 Watling Street to assess compliance with the annual mean objective there. The maximum predicted annual mean concentration in 2009 is  $43.8\mu\text{g}/\text{m}^3$ .

Predicted results for year 2015 show a decrease at modelled receptors along Watling Street due to predicted decrease in background pollution concentrations and vehicle emissions that compensate for expected traffic growth. The maximum predicted annual mean concentration in 2015 is  $33.1\mu\text{g}/\text{m}^3$  i.e. the annual mean objective of  $40\mu\text{g}/\text{m}^3$  is not predicted to be exceeded at any location in the Watling Street area in 2015.

### Hartspring Lane

The model confirmed exceedences of the AQS objective in 2009 at receptors relevant of public exposure (facade of properties), within the AQMA. An exceedence was also predicted at one receptor outside the AQMA at 19 Hartspring Road and concentrations within 10% of the annual mean objective were predicted at two neighbouring properties, 15 and 17 Hartspring Lane. The maximum predicted annual mean concentration in 2009 is  $45.9\mu\text{g}/\text{m}^3$ . The exceedence and near exceedence concentrations are limited to a small number of properties closest to the M1 and Hartspring Lane, just outside of the AQMA boundary.

Predicted results for year 2015 show a decrease at modelled receptors due to predicted decrease in background pollution concentrations and vehicle emissions that compensate for expected traffic growth. The maximum predicted annual mean concentration in 2010 is  $45.2\mu\text{g}/\text{m}^3$ . The exceedences are limited to within the AQMA in 2010.

## 6 Conclusions and Recommendations

As part of the Local Air Quality Management (LAQM) regime, a Detailed Assessment for nitrogen dioxide (NO<sub>2</sub>) was carried out for the following locations based on detailed dispersion modelling:

- Elstree Crossroads, Elstree (Barnet Lane and High Street)
- Potters Bar, including the junction of Barnet Road/Southgate Road/High Street and the High Street, near the bus station and junction of the High Street with Hatfield Road/The Causeway.
- Radlett, including the junctions of Watling Street/Aldenham Road and Watling Street/Park Road.
- M1 Bushey, at Hartspring Lane.

The Detailed Assessment was required following recommendations within the Council's Updating and Screening Assessment 2009, which indicated a risk of exceedence of the annual mean NO<sub>2</sub> objective as identified through 2008 monitoring results and DMRB assessment.

This assessment was based on advanced atmospheric dispersion modelling of NO<sub>2</sub> traffic emissions, relying on updated background pollutant concentrations, monitoring, traffic and meteorological data for the year 2009.

The findings of this report are the following:

### High Street and High Street/Hatfield Road Junction, Potters Bar:

- The modelling predicted exceedences of the annual mean NO<sub>2</sub> objective in 2009 only near the High Street Road/Hatfield Road junction and further down the High Street adjacent to the existing AQMA. No exceedences were predicted inside the existing AQMA in either 2009 or 2015. It is therefore recommended that the Council amend the existing AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009;
- In addition, prior to undertaking Further Assessment work, it is recommended that monitoring be conducted at 169-183 High Street to assess compliance with the annual mean air quality objective for NO<sub>2</sub>;
- Investigation is required to determine if relevant exposure exists at the Hall and Police station near the High Street Road/Hatfield Road junction. If there is found to be no relevant exposure at this location then no further action is required.

### High Street/Southgate Road Junction, Potters Bar:

- The modelling predicted that there would be no exceedences in either 2009 or 2015 in the vicinity of the High Street/Southgate junction. Therefore, it will not be necessary to declare an AQMA for this junction. However, this junction should continue to be monitored as monitoring results in previous years have suggested higher levels than measured in 2009.

### Elstree Crossroads:

- The modelling predicted widespread exceedences of the annual mean NO<sub>2</sub> objective outside of the AQMA in 2009, with exceedences isolated to the immediate vicinity of the AQMA only in 2015. It is therefore recommended that the Council consider expanding the existing AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009;
- In addition, prior to undertaking Further Assessment work, it is recommended that monitoring be undertaken at 1-3 Elstree Hill North to assess compliance with the annual mean objective for NO<sub>2</sub>.

### Watling Street, Radlett:

- The modelling predicted exceedences of the annual mean NO<sub>2</sub> objective the junction of Watling Street/Park Road and along Watling Street near the Aldenham Lane junction in 2009. No exceedences were predicted in 2015. It is therefore recommended that the Council consider declaring an AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009.

#### **M1/Hartspring Lane:**

- The modelling confirmed the need for the existing AQMA along the M1 and predicted an exceedence of the annual mean NO<sub>2</sub> objective outside of the AQMA in 2009. Exceedences are not predicted outside of the AQMA in 2015. It is therefore recommended that the Council consider expanding the existing AQMA based on predicted exceedences of the annual mean air quality objective for NO<sub>2</sub> in 2009.

## Appendix 1 – Traffic Data

Table A1-1 – Hertsmere traffic data

Site Ref	Data source	Road No.	Location	X	Y	%HDV	AADT 2009	Speed (mph)	AADT 2015
115	DFT	A1000	Barnet Road	525980	200700	3.0	13572	-	15109
110	DFT	A1000	Barnet Road	525800	200000	3.0	12228	-	13613
120	DFT	A1000	High Street	526023	200992	6.5	19497	-	21706
130	DFT	A1000	Hatfield Road	526125	202000	6.3	11203	-	12472
60	DFT	A111	Southgate Road	526200	200620	7.4	16024	-	17840
200	HCC	A111	Southgate Road	-	-	-	22462	28.4	25007
245	HCC	A1000	Barnet Road, Great North Road, Hatfield Road Kitts End, Potters Bar	-	-	-	9390	36.2	10454
327	HCC	B556	Cecil Road	-	-	16.4	10454	-	11638
	HCC	A111	Southgate Road	-	-	-	17446	-	19423
S82	HCC	A1000	Barnet Road	-	-	-	30700	28.5	34178
89	LAEI		Baker Street	524258	200208	3.0	8639	-	8748
10	DFT	A5183	Elstree Hill South	517685	195000	3.7	12785	-	14240
120	HCC	A5183	Elstree Hill North, Elstree	-	-	3.7	14431	-	16073
M72	HCC	A5183	Elstree Hill North, Elstree	-	-	3.7	14586	-	16245
S82	HCC	A5183	Elstree Hill South	-	-	3.7	13650	-	15204
140	DFT	A411	Barnet Lane	520000	195487	2.4	16082	-	17913
130	DFT	A411	Watford Road	517000	195150	3.8	12122	-	13502
212	HCC	A411	Barnet Lane, Borehamwood	-	-	-	23042	38.8	25665
1900	DFT	A5183	Watling Street	516300	200000	4.9	11361	20.2	12616
20	DFT	A5183	Watling Street	514660	204500	5.4	11113	20.2	12341
04-090	HCC		Aldenham Road, Radlett	-	-	-	3923	32.1	4347
5032	HCC	C84	Radlett Lane, Shenley	-	-	-	6605	38.4	7334
315	HCC	B462	Hartspring Lane, Bushey	-	-	4.1	17032	28.8	19019
60	DFT	M1	N/A	514700	196100	5.4	85749	-	95215



## Appendix 2 – Model Verification

Table A3-1 – Model verification – High Street/Southgate Road Junction, Potters Bar

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
HM069	21.8	35.0	100.1	65.1	34.0	1.91	1.91	65.1	100.1	47.1	47.1	0

Table A3-2 – Model verification – High Street/Hatfield Road Junction, Potters Bar

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
HM064	21.8	35.0	110.4	75.4	20.2	3.73	3.95	79.9	114.9	51.6	50.3	3
HM065			98.9	63.9	14.2	4.49		56.3	91.3	44.3	46.7	-5
HM066			75.5	40.5	10.0	4.04		39.6	74.6	38.5	38.8	-1
HM067			76.6	41.6	11.1	3.75		43.8	78.8	40.0	39.2	2

Table A3-3 – Model verification – Elstree Crossroads

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
HM048	20.2	30.3	75.5	45.2	14.6	3.10	3.81	55.5	85.8	42.7	39.2	9
HM049			82.4	52.1	14.8	3.53		56.3	86.6	42.9	41.6	3
HM050			125.3	95.0	28.5	3.34		108.3	138.6	58.1	54.6	6
HM052			127.6	97.3	15.7	6.21		59.6	89.9	44.0	55.2	-20

Table A3-4 – Model verification – Radlett

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
HM071	18.9	27.8	99.5	71.7	19.7	3.63	3.77	74.5	102.4	47.2	46.8	1
HM074			70.5	42.7	10.9	3.92		41.1	69.0	36.1	37.1	-2
HM102			59.1	31.3	6.7	4.67		25.3	53.1	30.1	32.7	-8

Table A3-5 – Model verification – M1/Hartspring Lane

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
HM057	20.0	29.7	85.7	56.0	53.4	1.05	1.04	55.7	85.4	42.6	42.7	0
HM058			54.6	24.9	13.1	1.91		13.6	43.3	26.3	31.1	-15
HM108			51.4	21.7	26.8	0.81		28.0	57.7	32.4	29.8	9

## Appendix 3 – Modelled Specific Receptor Results

Figure A3-1 –Potters Bar Southgate Road/High Street Junction 2009

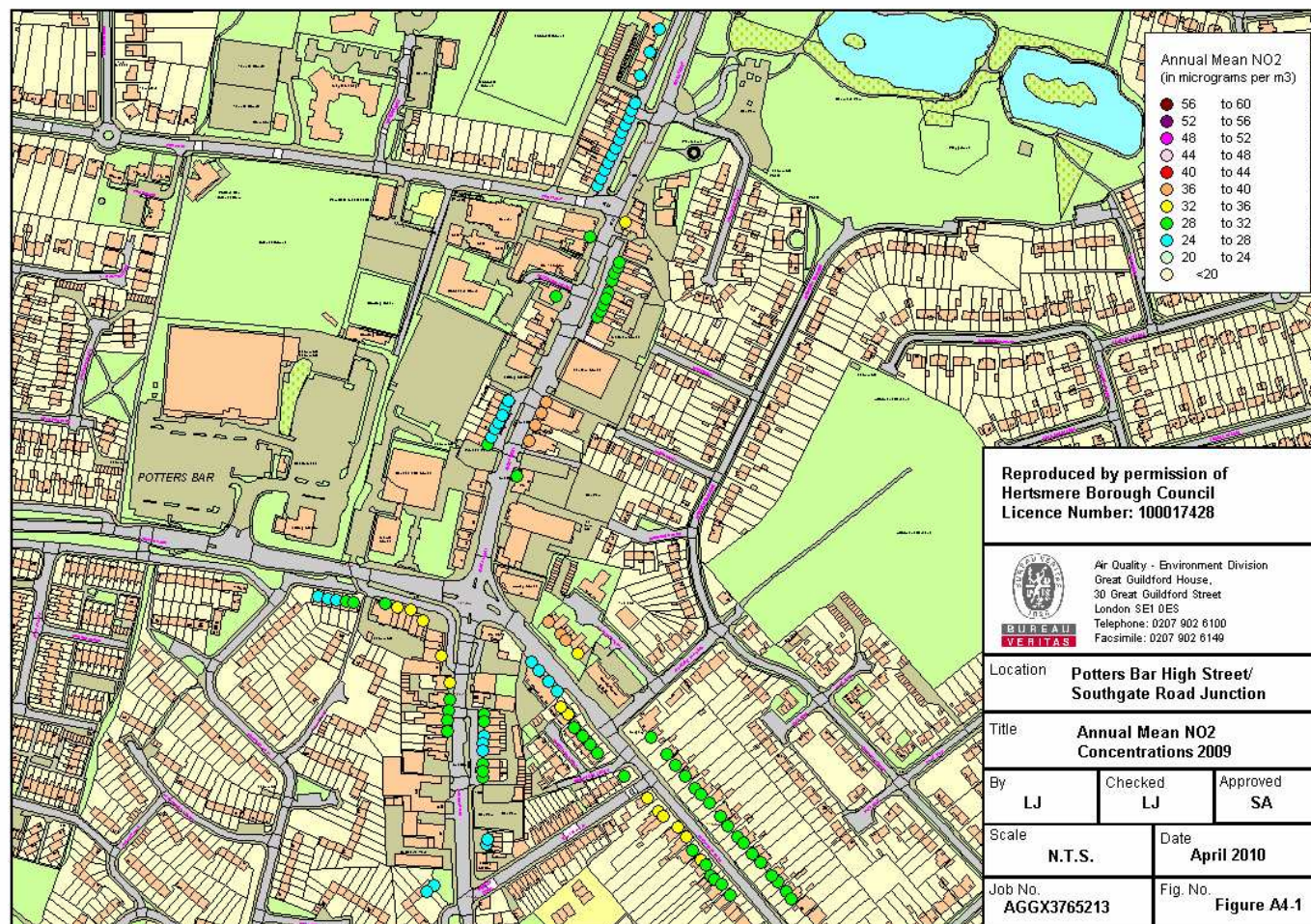




Figure A3-2 – Potters Bar Southgate Road/High Street Junction 2015

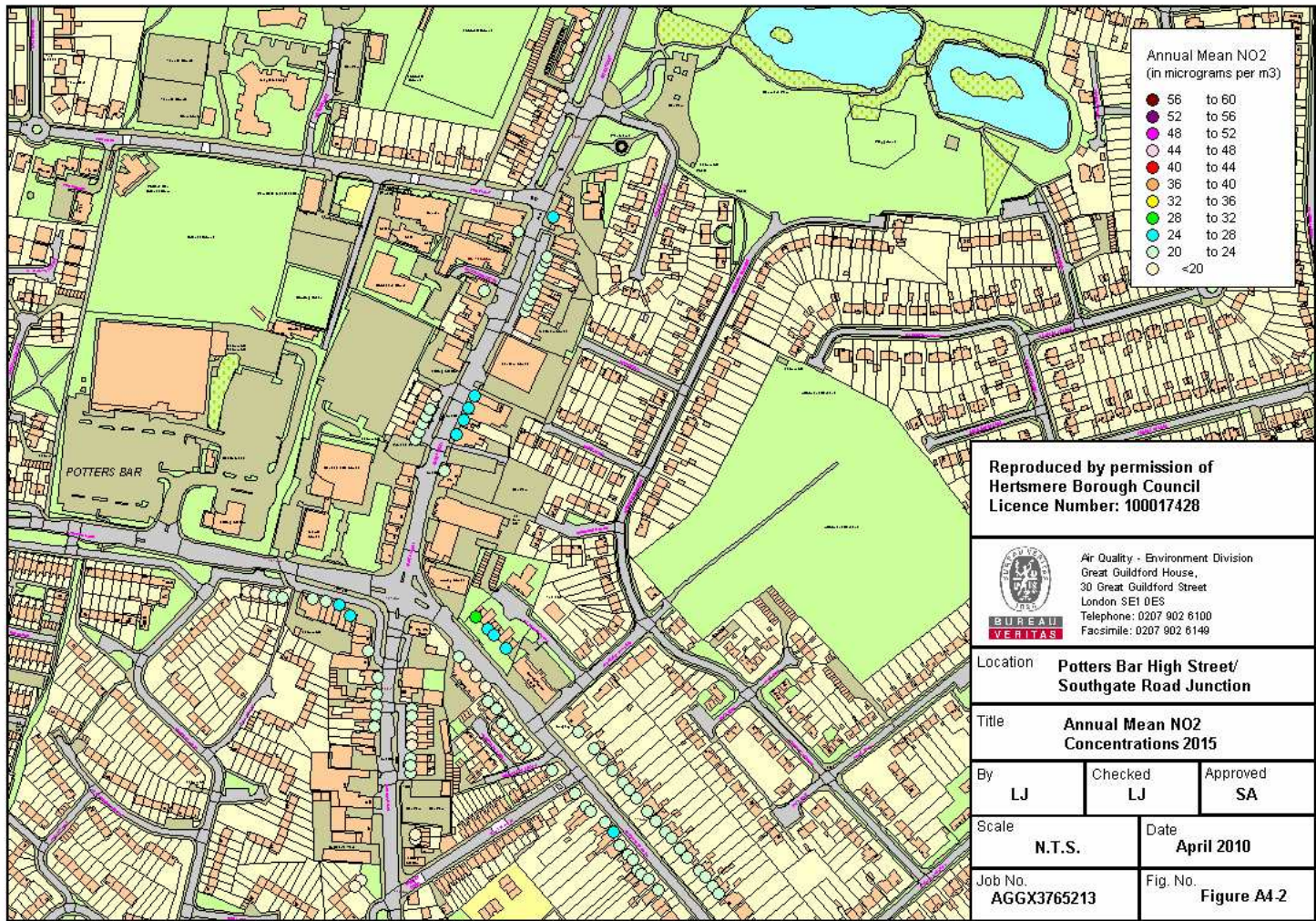




Figure A3-3 – High Street/Hatfield Road Junction, Potters Bar 2009

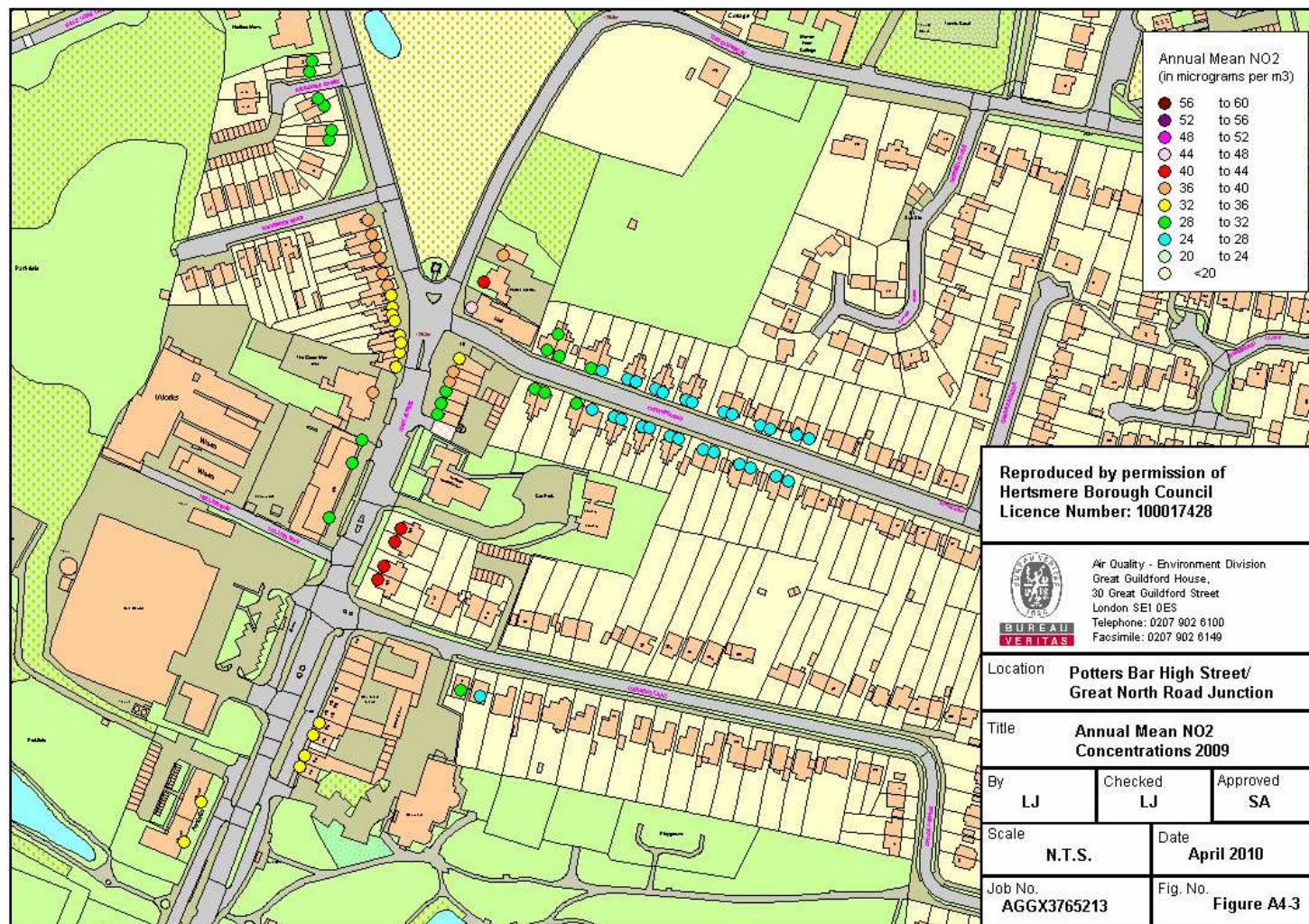




Figure A3-4 – High Street/Hatfield Road Junction, Potters Bar 2015

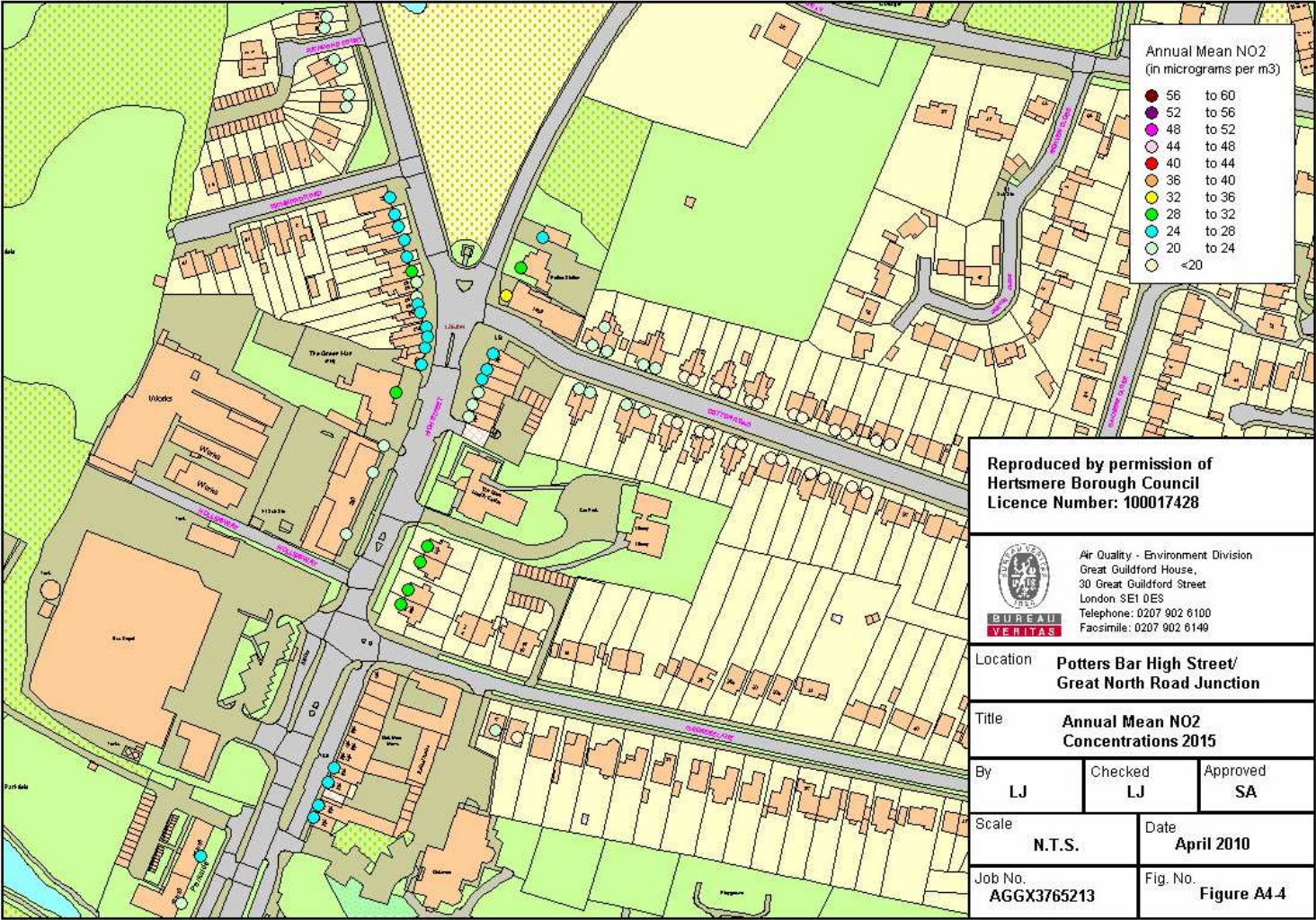


Figure A3-5 – Elstree Crossroads 2009

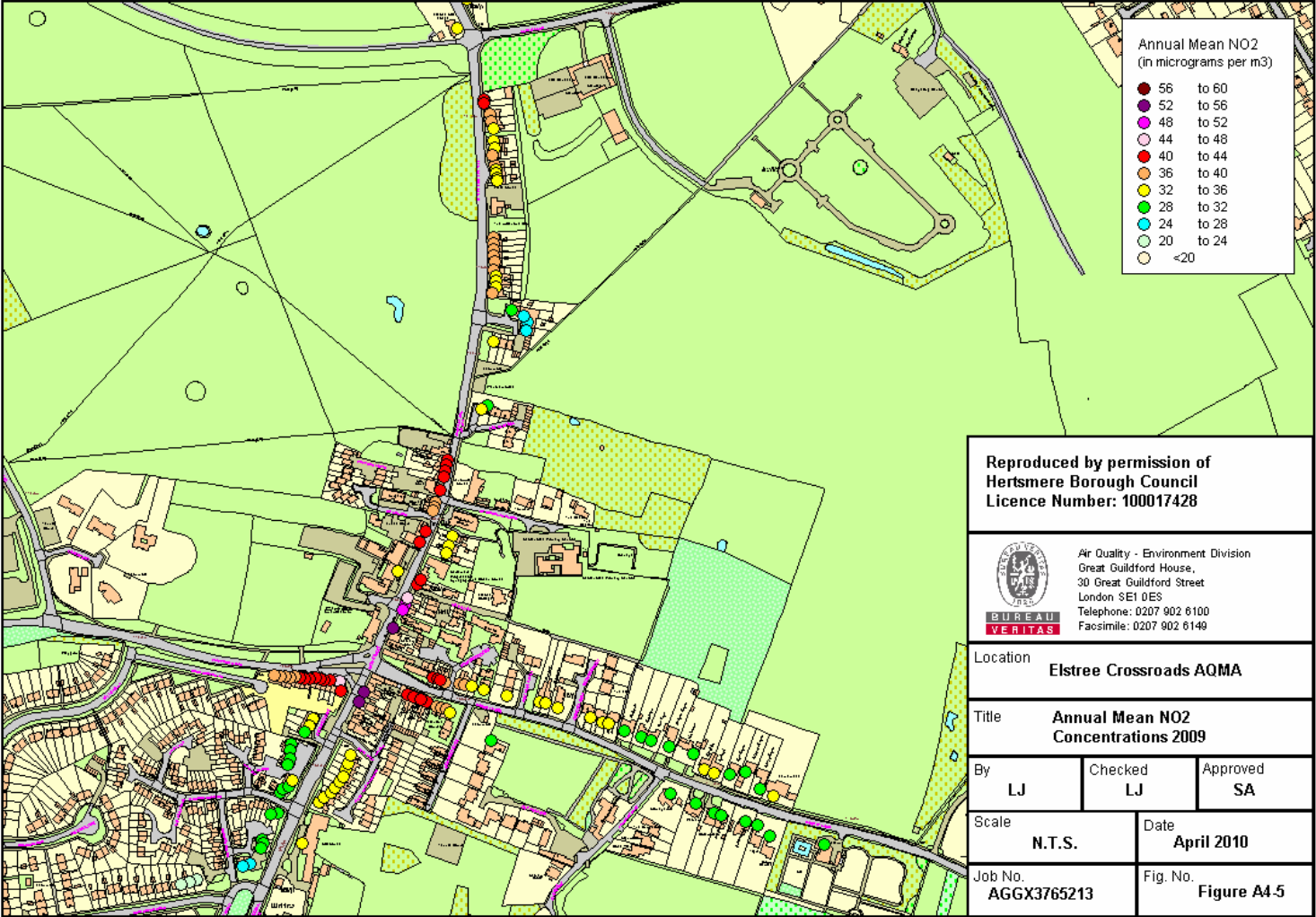




Figure A3-6 – Elstree Crossroads 2015

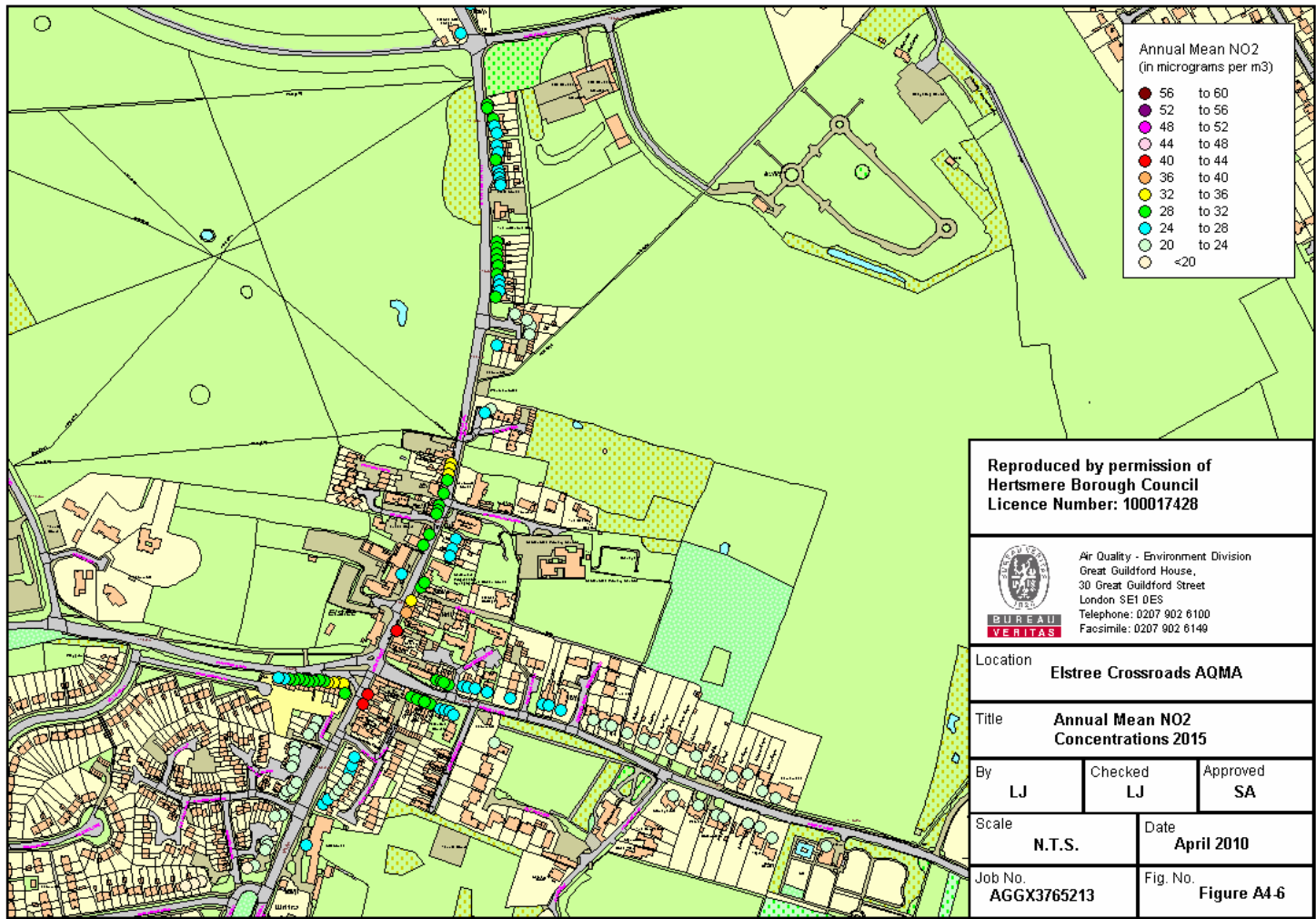




Figure A3-7 – Watling Street, Radlett 2009

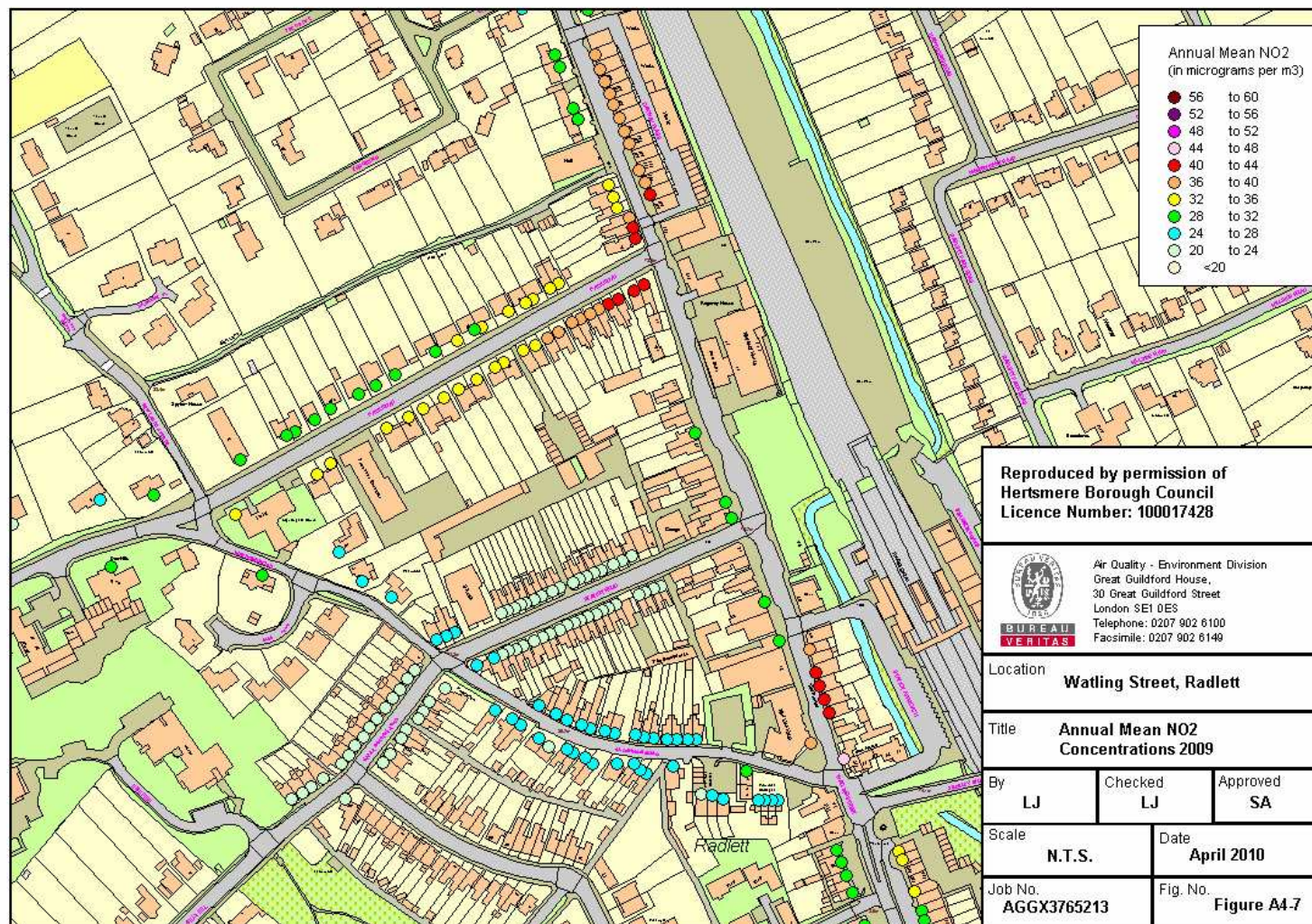




Figure A3-8 – Watling Street, Radlett 2015

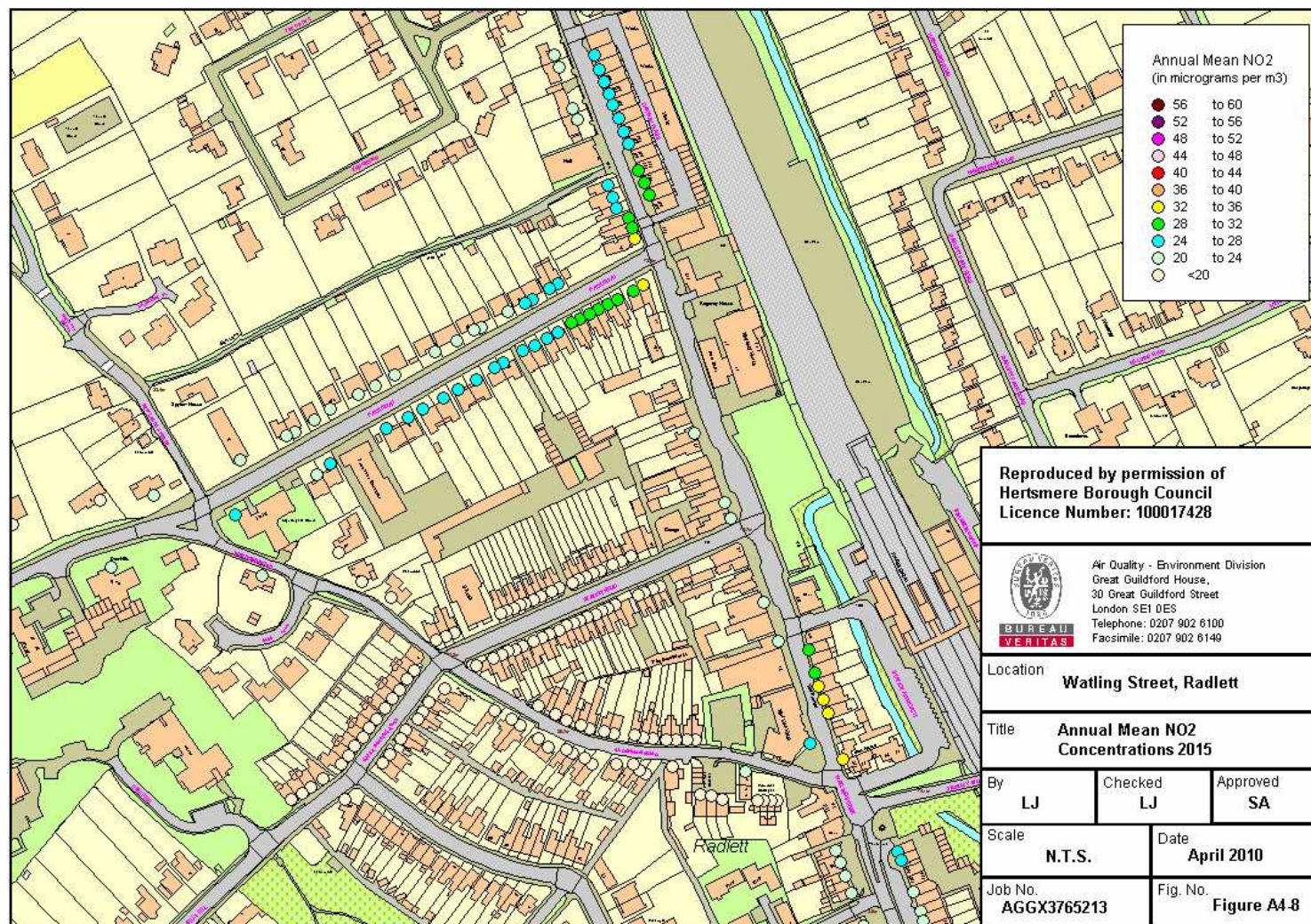




Figure A3-9 – Hartspring Lane 2009

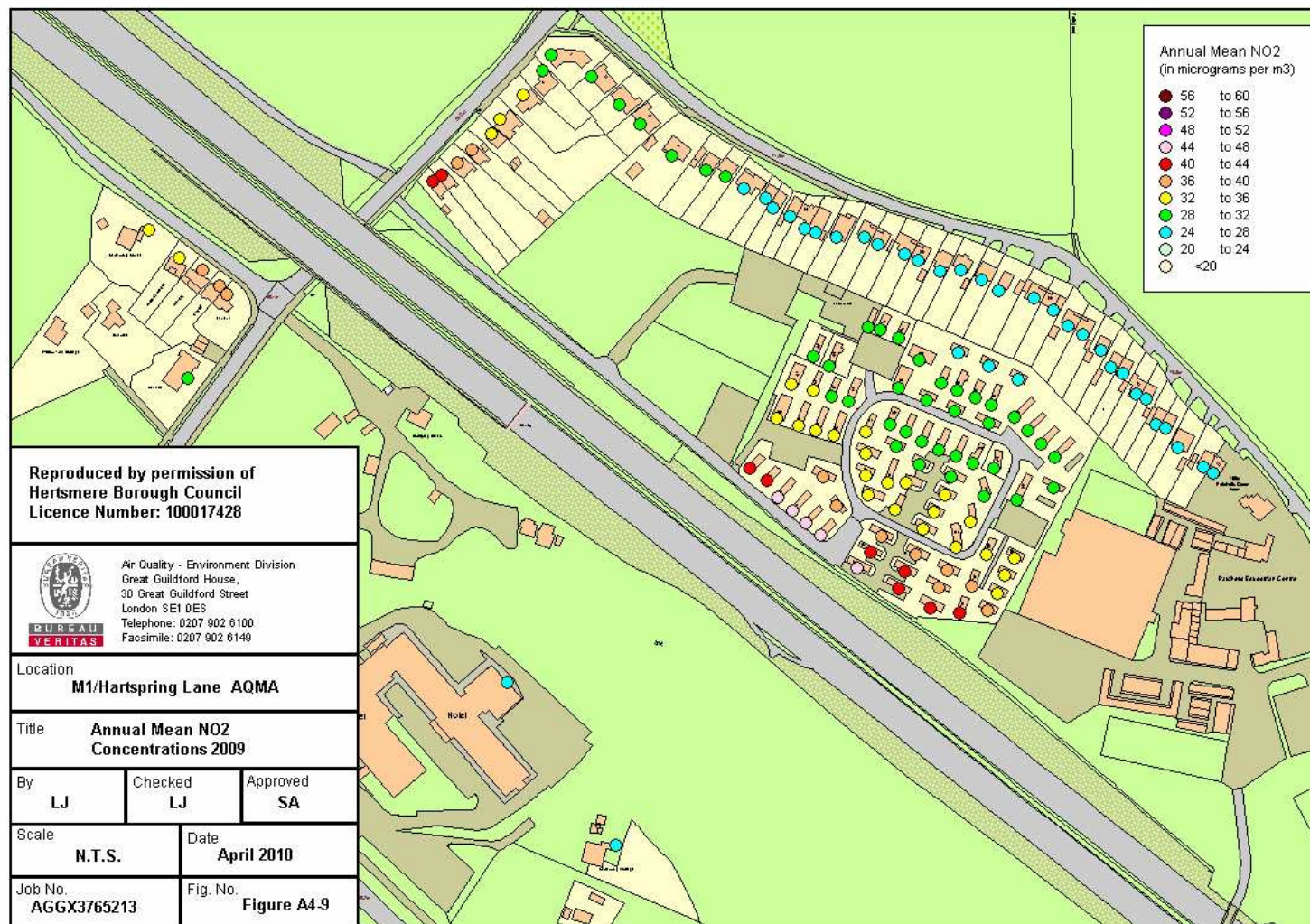
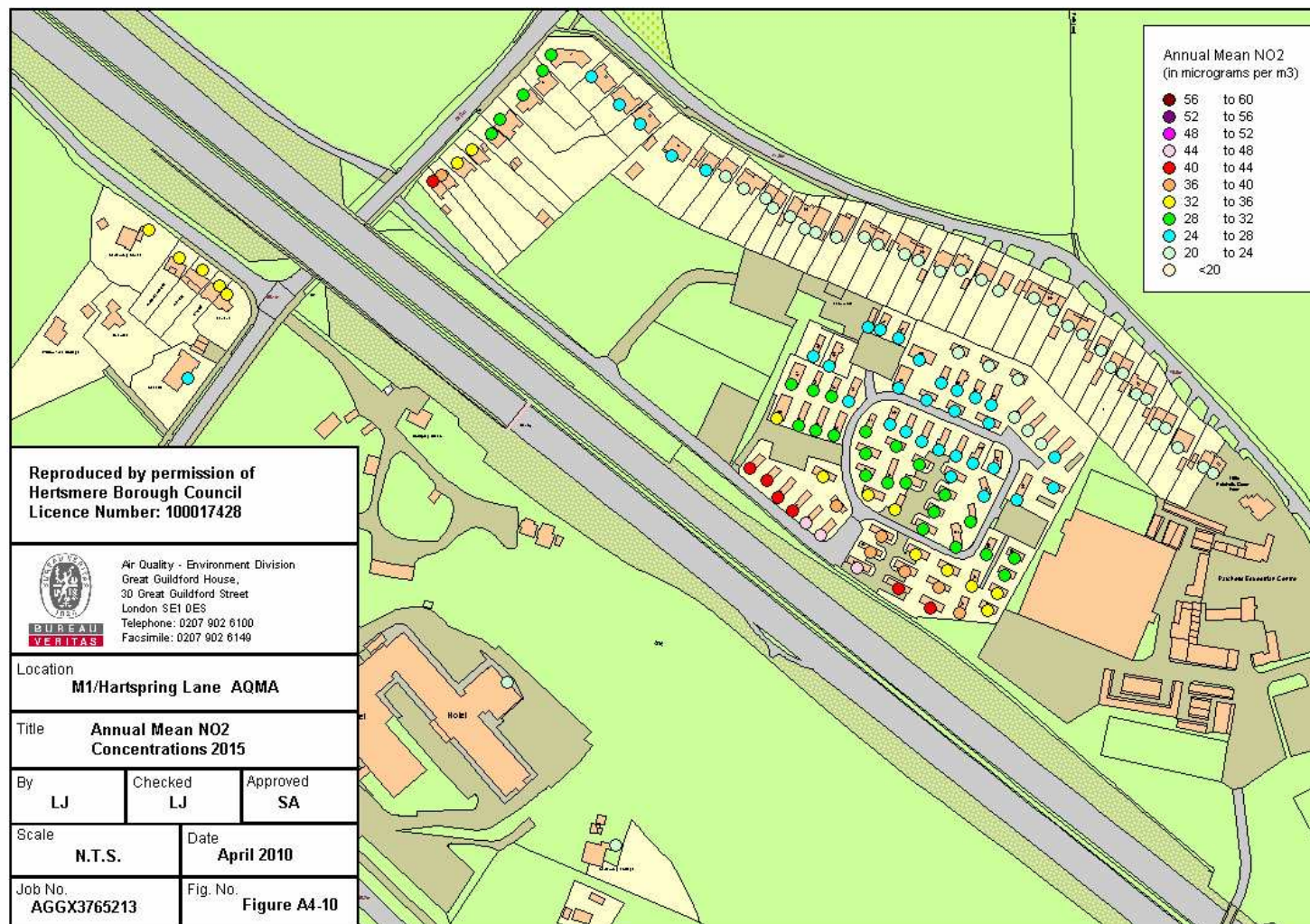


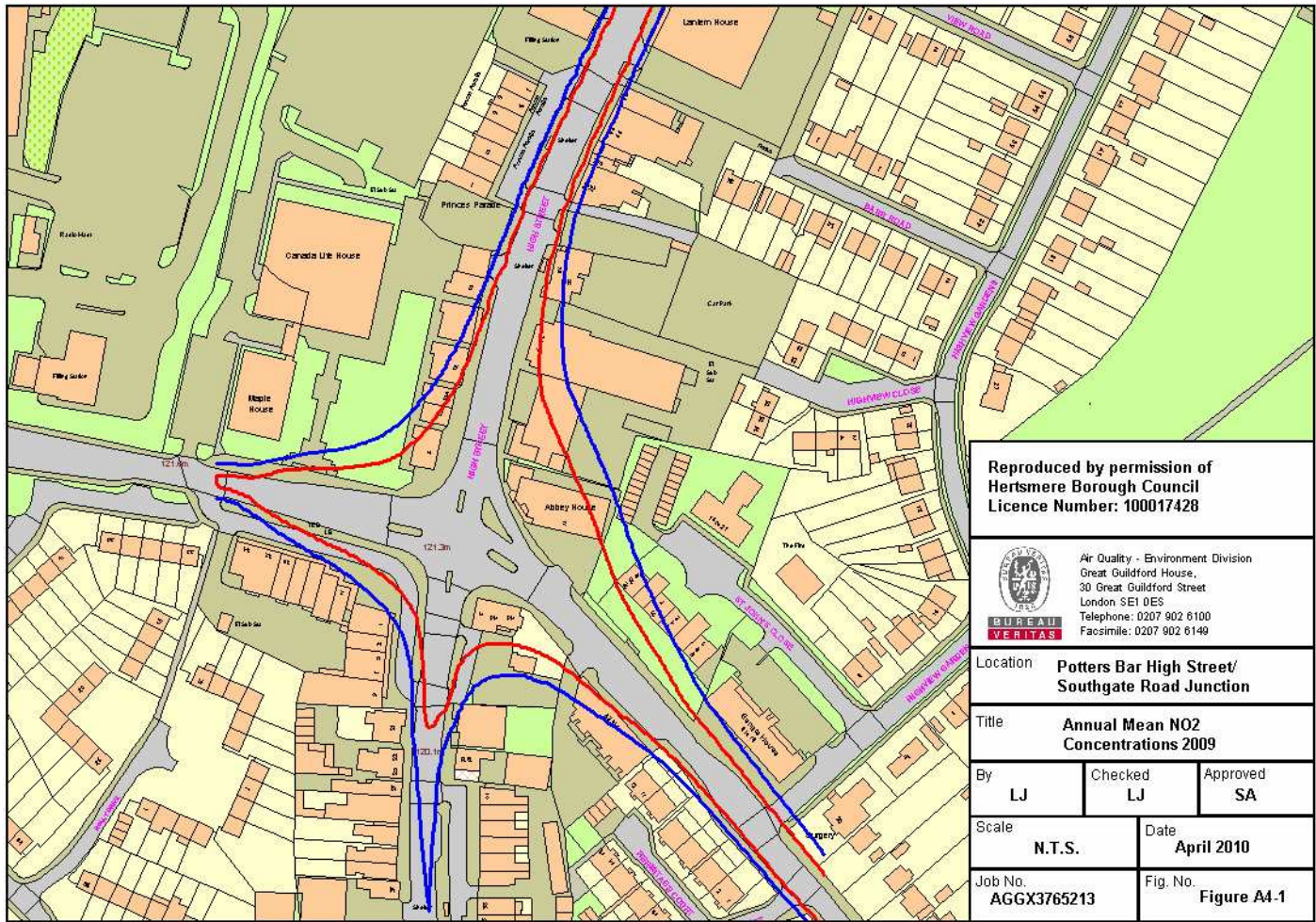
Figure A3-10 – Hartspring Lane 2015





Appendix 4 – Modelled Contour Results

Figure A4-1 – Potters Bar Southgate Road/High Street Junction 2009



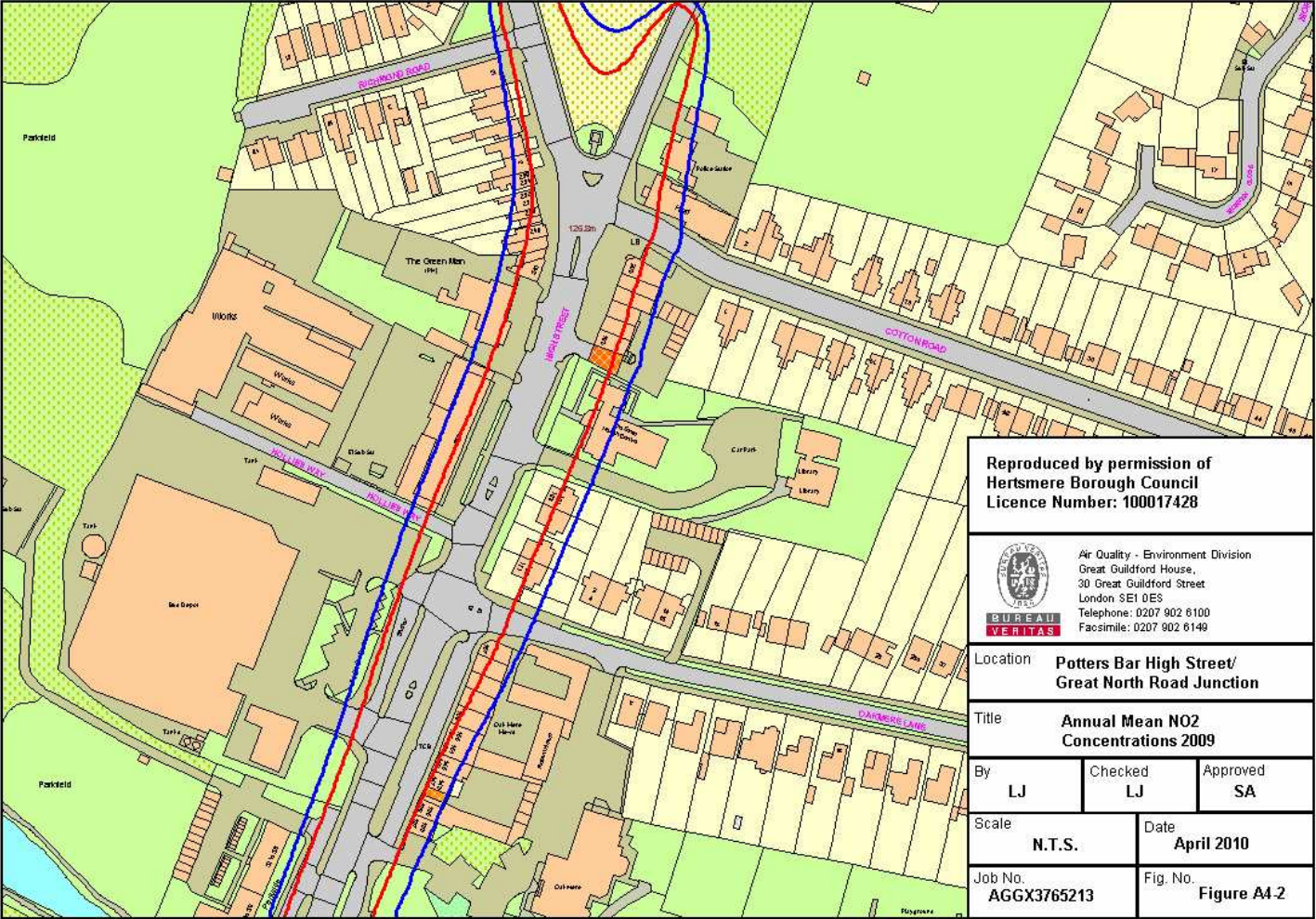
NO2 Annual Mean

— 36 micrograms per m3

— 40 micrograms per m3



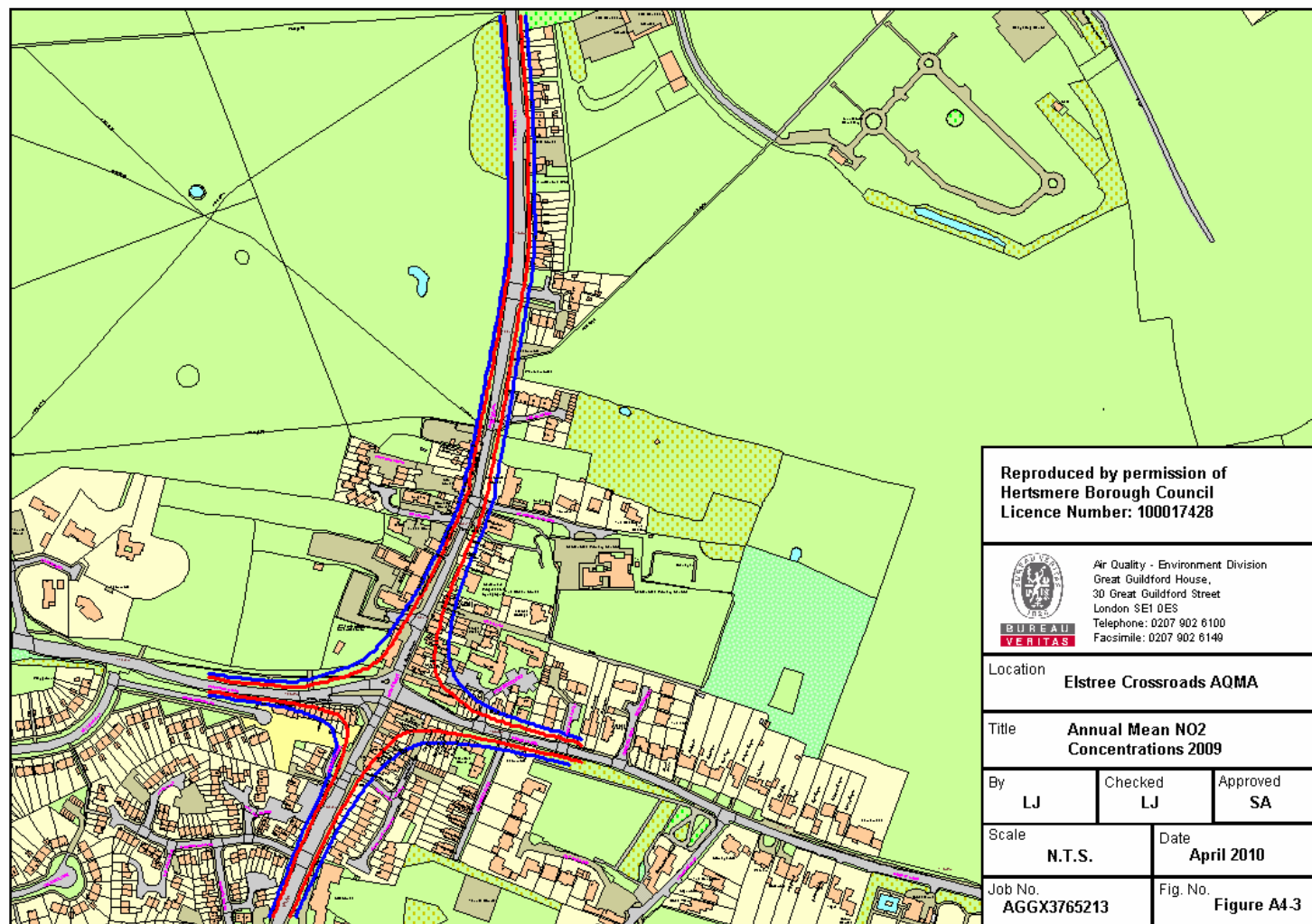
Figure A4-2 – High Street/Hatfield Road Junction, Potters Bar 2009



NO2 Annual Mean

— 36 micrograms per m3  
— 40 micrograms per m3

Figure A4-3 – Elstree Crossroads 2009



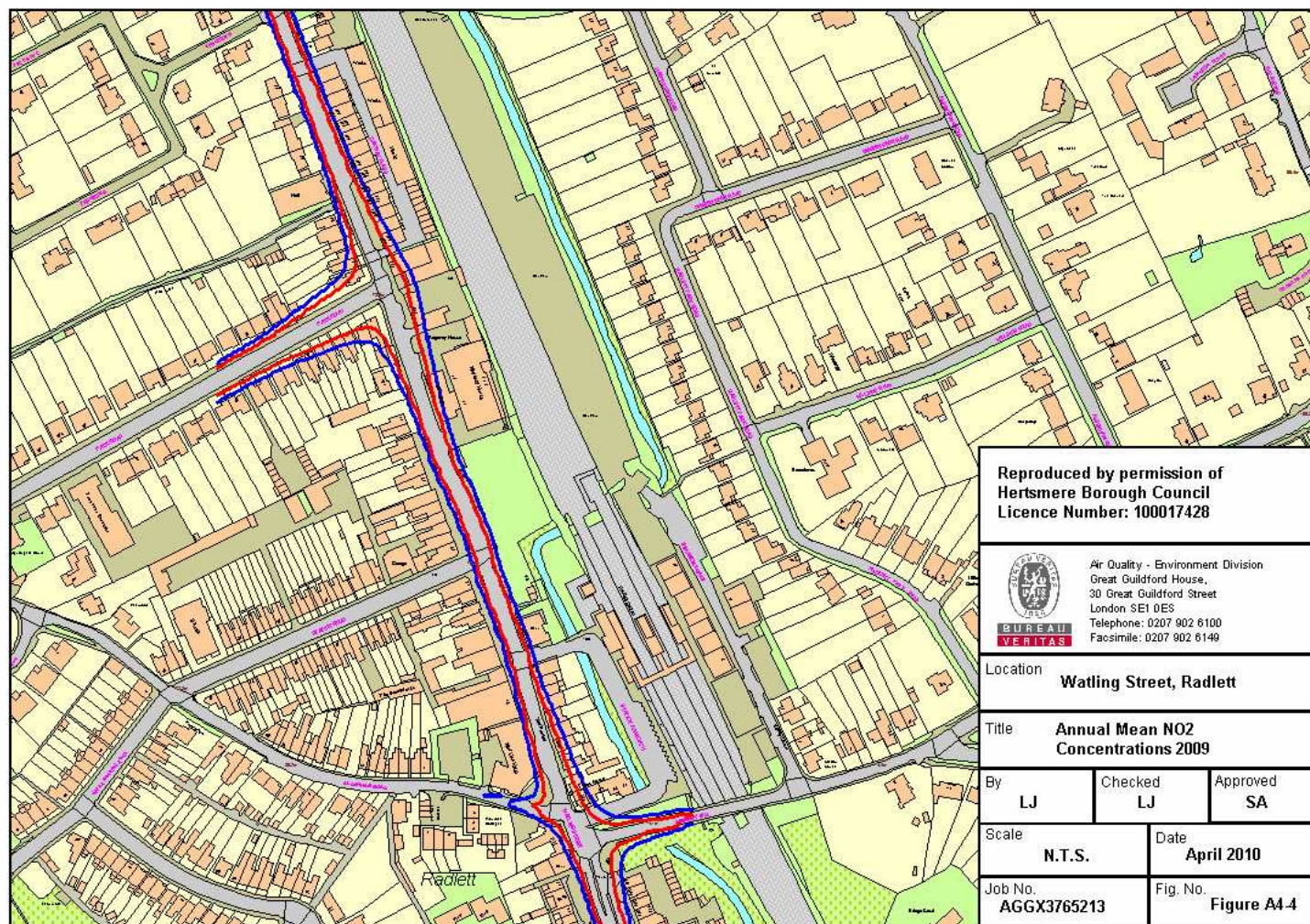
**NO2 Annual Mean**

**— 36 micrograms per m3**

**— 40 micrograms per m3**



Figure A4-4 – Radlett 2009



NO2 Annual Mean

— 36 micrograms per m3

— 40 micrograms per m3



Figure A4-5 – Hartspring Lane 2009

