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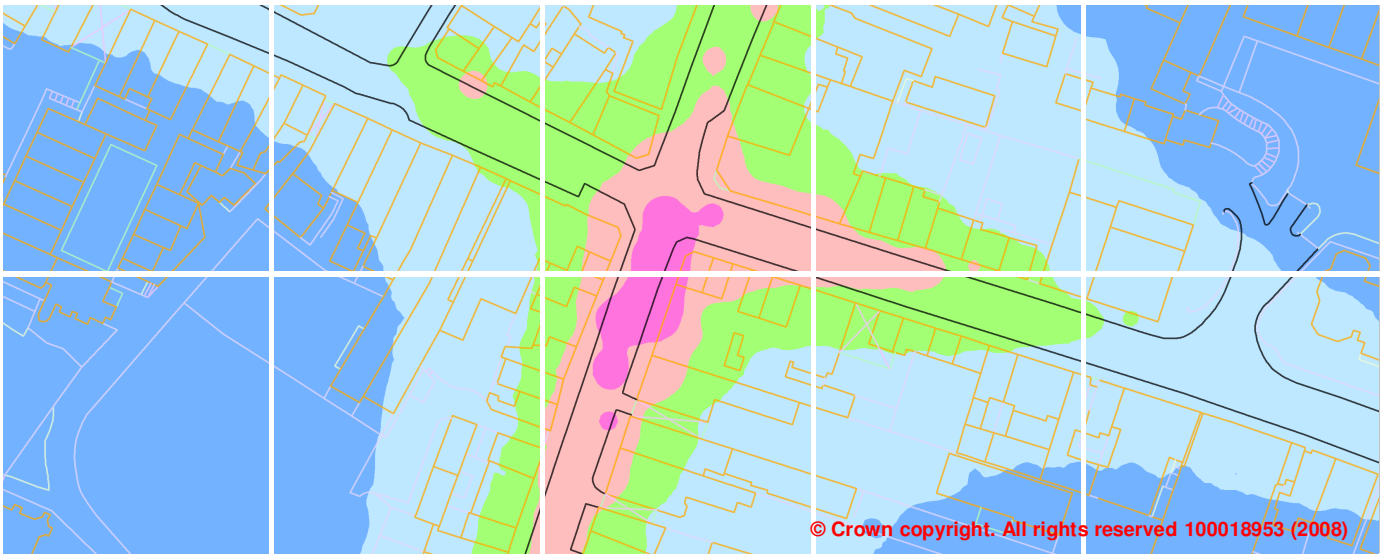

Air Quality Review & Assessment:
Detailed Assessment 2008

Report to St Albans City and District Council

AEA/ENV/R/2701
ED43569
Final
December 2008

St Albans City and District Council

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Executive summary

The Government prepared the Air Quality Strategy for England, Scotland, Wales and Northern Ireland for consultation in August 1999. It was published in January 2000 (DETR, 2000). A revised version was published in July 2007 (Defra, 2007).

At the centre of the Air Quality Strategy is the use of national air quality standards to enable air quality to be measured and assessed. These also provide the means by which objectives and timescales for the achievement of the objectives can be set.

Local Authorities are required to review and assess the air quality in their area from time to time to determine whether the air quality objectives are likely to be met. This report is a Detailed Assessment for St. Albans City and District Council as outlined in the Government's published guidance.

St Albans City and District Council have recently undertaken a Further Assessment for their existing three AQMAs (Dec 2007). This assessment identified an additional location exceeding the annual mean NO_2 objective. This location is Hollywell Hill, which is very close to the borders of the existing AQMA.

In light of the availability of new monitoring data and traffic counts, the Council wish to undertake a Detailed Modelling Assessment to be in a position to redefine their current AQMAs and designate any new areas of exceedences. This detailed modelling covers the following areas:

- Watsons Walk
- High Street
- St. Peters Street
- Hollywell Hill

In addition, a traffic scenario for Watsons Walk / London Road is included in this detailed modelling assessment, that took into consideration the change in traffic conditions that was expected to be caused by the proposed Tesco Store development located to the on the A1081 London Road.

The detailed assessment showed the following:

- Watsons Walk / London Road:
  - The measured NO_2 concentration at SA135 was 44 μg m^{-3} in 2006 and 51 μg m^{-3} in 2007.
  - The model predicted NO_2 concentrations of 40 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^3 was exceeded.
  - The model predicted that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide might occur in 2010 at properties located to the north side of London Road across from Watsons Walk.

- Peahen Junction
  - High Street:
    - The measured NO_2 concentration at SA137 was 44 μg m^{-3} in 2006 and 49 μg m^{-3} in 2007.
    - The model predicted NO_2 concentrations of 45 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^3 was exceeded.
  - Hollywell Hill:
    - The measured NO_2 concentration at SA138 was 48 μg m^3 in 2006 and 54 μg m^{-3} in 2007. The model predicted NO_2 concentrations of 48 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^{-3} was exceeded.
    - The measured NO_2 concentration at SA134 was 41 μg m^{-3} in 2007 and the model predicted NO_2 concentrations of 40 μg m^{-3} for the same year.

- The model predicted that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide might occur in 2010 at properties located to the south eastern and south western corners of the junction.

- St Peters Street:
  - The measured NO_2 concentration at SA136 was 53 μg m^{-3} in 2006 and 57 μg m^{-3} in 2007.
  - The model predicted NO_2 concentrations of 48 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^{-3} was exceeded.
  - The model predicted that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide might occur in 2010 at properties located to the east side of St Peters Street. It is unlikely that any exceedences will occur in 2010 at properties located to the west side of St Peters Street.

- Watsons Walk / London Road – Tesco Scenario:

  The comparison with the 2010 base case modelling results indicates that there will be a small increase of the annual mean of NO_2 concentrations at the junction of Watsons Walk / London Road, due to the additional traffic. The model predicts that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide might occur to properties located to both sites of London Road at the junction with Watsons Walk.

Based upon the results above, and taking into consideration model uncertainties and the fact that the model under-predicted the concentrations in the above locations, this Detailed Assessment suggests the following:

- St Albans City and District Council should consider extending the existing AQMA to the west to cover housing properties in High Street (SA137 location), and to the south to cover housing properties along Hollywell Hill (SA138 location).

- St Albans City and District Council should consider declaring the area covering the properties located to the east side of St Peters Street (near the location of SA136) as an AQMA.

- St Albans City and District Council should consider declaring the area covering the properties located to the north side of London Road across Watsons Walk (covering the location of SA135) as an AQMA.

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1 Introduction

1.1 National Air Quality Strategy

All local authorities (LA) are obliged to review and assess their air quality under the Environment Act 1995. As a result of this, the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland was published in January 2000 with a revised version published in July 2007.

Within the AQS, national air quality objectives are set out. LA's are therefore required to review and assess their air quality in order to assess whether they will meet the objectives. Table 1.1 lists the objectives included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purposes of Local Air Quality Management (LAQM) with dates to be achieved by.

Table 1.1 Objectives included in the Air Quality Regulations and subsequent Amendments for the purpose of Local Air Quality Management.

National Air Quality Objectives			
Pollutant	**Air Quality Objective**		**Date to be achieved by**
	Concentration	**Measured as**	
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	2.25 μg m^{-3}	running annual mean	31.12.2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 mg m^{-3}	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 mg m^{-3}	running 8-hour mean	31.12.2003
Lead	0.5 μg m^{-3} 0.25 μg m^{-3}	annual mean annual mean	31.12.2004 31.12.2008
Nitrogen dioxide[a]	200 μg m^{-3} not to be exceeded more than 18 times a year 40 μg m^{-3}	1 hour mean annual mean	31.12.2005 31.12.2005
Particles (PM_{10}) (gravimetric)[b] All authorities	50 μg m^{-3} not to be exceeded more than 35 times a year 40 μg m^{-3}	24 hour mean annual mean	31.12.2004 31.12.2004
Authorities in Scotland only[c]	50 μg m^{-3} not to be exceeded more than 7 times a year 18 μg m^{-3}	24 hour mean annual mean	31.12.2010 31.12.2010
Sulphur dioxide	350 μg m^{-3} not to be exceeded more than 24 times a year 125 μg m^{-3} not to be exceeded more than 3 times a year 266 μg m^{-3} not to be exceeded more than 35 times a year	1 hour mean 24 hour mean 15 minute mean	31.12.2004 31.12.2004 31.12.2005

a. These objectives are provisional.
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 Amendment Regulations 2002.

1.2 Purpose of the Detailed Assessment

The primary objective of undertaking a review of air quality is to identify any areas that are unlikely to meet national air quality objectives and ensure that air quality is considered in local authority decision-making processes. The first round of air quality review and assessments is now complete and all local authorities should have completed all necessary stages. Where the likelihood of exceedences of air quality objectives has been identified in areas of significant public exposure, an air quality management area should have been declared, followed by a further Stage 4 review and assessment, and the formulation of an action plan to eliminate exceedences. Local authorities were required to proceed to the second round of review and assessment in which sources of emissions to air are reassessed to identify whether the situation has changed since the first round of review and assessment, and if so, what impact this may have on predicted exceedences of the air quality objectives. Such changes might include significant traffic growth on a major road, which had not been foreseen, construction of a new industrial plant with emissions to air, or significant changes in the emissions of an existing plant.

The second round of review and assessment is undertaken in two steps. The first step is an Updating and Screening Assessment, which updates the Stage 1 and 2 review and assessments previously undertaken for all pollutants identified in the Air Quality Regulations. Where a significant risk of exceedence is identified for a pollutant it is necessary for the local authority to proceed to a Detailed Assessment, equivalent to the previous Stage 3 assessments. Where a local authority does not need to undertake a Detailed Assessment, a progress report is required instead. The different levels of assessments are briefly summarised in Table 1.2.

Table 1.2 The phased approach to review and assessment

Level of Assessment	Objective	Approach
Updating and Screening Assessment (USA)	To identify those matters that have changed since the last review and assessment, which might lead to a risk of the air quality objective being exceeded.	Use a check list to identify significant changes that require further consideration. Where such changes are identified, apply simple screening tools to decide whether there is sufficient risk of an exceedance of an objective to justify a Further Assessment
Detailed Assessment	To provide an accurate assessment of the likelihood of an air quality objective being exceeded at locations with relevant exposure. This should be sufficient to allow the designation or amendment or any necessary AQMAs.	Use quality-assured monitoring and validated modelling methods to determine current and future pollutant concentrations in areas where there is a significant risk of exceeding an air quality objective.
Further Assessment	To confirm boundaries of identified areas of exceedence using the latest and most detailed input information available. To provide source apportionment information to identify primary emissions sources contributing to exceedences so that action-planning measures can be targeted. To test out the likely impact of potential action planning scenarios if possible.	Use quality-assured monitoring and validated modelling methods to determine current and future pollutant concentrations in areas where there is a significant risk of exceeding an air quality objective.

The latest Detailed Assessment carried out for St Albans City and District Council in March 2004 predicted that the UK annual average and hourly average objectives for NO_2 in 2005 would be exceeded at relevant receptors in the following areas:

- Isolated property next to the A4147, between the M1 and M10 south of M1 junction 7
- Peahen crossroads, central St Albans.

As a result of the Detailed Assessment, St Albans City and District Council declared three air quality management areas for NO_2 in the district at:

- Peahen Junction / London Road, central St Albans
- Beechtree Cottages at the junction of the M1 and M10 motorways
- Smug Oak Lane and Frogmore / Colney Street adjacent to the M25

The Council was then required to carry out a Further Assessment to confirm the NO_2 exceedences, equivalent to a Stage 4 review and assessment. The Council was also required to formulate an action plan to eliminate the exceedences. The further assessment is intended to 'supplement such information as the Council has in relation to the designated area in question'. A further assessment has been undertaken and an action plan is already in place for the Smug Oak Lane area.

In 2006, St Albans City and District Council carried out an Updating and Screening Assessment and concluded that all the objectives in the Air Quality Regulations for England will be met by the relevant dates at most locations in St Albans City and District. The Updating and Screening Assessment also concluded that the EU annual average limit value (Stage 2) for PM_{10} might be exceeded at some locations within the District, close to busy roads and junctions in 2010.

The latest Progress Report in 2007 indicated, based on diffusion tube results, that six locations exhibited annual mean values above the AQS objective of 40 µg m^{-3} for NO_2. In addition to that, the Progress Report showed that monitored data from St Albans District Council indicates that both the AQS objectives for PM_{10} are being met: the annual mean objective was well below 40 µg m^{-3} and there were 9 days when the daily average objective value of 50 µg m^{-3} was exceeded.

St Albans City and District Council have recently undertaken a Further Assessment for their existing three AQMAs (Dec 2007). This assessment identified an additional location exceeding the annual mean NO_2 objective. This location is Hollywell Hill, which is very close to the borders of the existing AQMA.

In light of the availability of new monitoring data and traffic counts, the Council wish to undertake a Detailed Modelling Assessment to be in a position to redefine their current AQMAs and designate any new areas of exceedences. This detailed modelling will cover the following areas:

- Watsons Walk
- High Street
- St. Peters Street
- Hollywell Hill

In addition, a traffic scenario for Watsons Walk / London Road will be included in this detailed modelling assessment, that will take into consideration the change in traffic conditions that were expected to be caused by the proposed Tesco Store development located to the on the A1081 London Road.

This report is a Detailed Assessment for St Albans City and District Council as outlined in the Government's published guidance.

1.3 Overview of the Approach taken

The general approach taken to this Detailed Assessment was to:

- Collect and interpret additional data to that already used in previous assessments in order to support this Detailed Assessment, including detailed traffic flow data around the AQMAs;
- Consider recent continuous monitoring and diffusion tube measurements;
- Utilise the monitoring data from the Council's monitoring campaign to assess the ambient concentrations resulting from road traffic emissions, and to validate the output of the modelling studies;
- Model the concentrations of NO_2 around the AQMAs for the base case (2007) and for 2010, concentrating on the locations (receptors) where people might be exposed over the relevant averaging times of the air quality objectives;
- Present the concentrations as contour plots and assess the uncertainty in the predicted concentrations;
- Consider whether the authority should amend or revoke the Air Quality Management Areas and provide recommendations on the scope and extent of any revisions.

Technical Guidance LAQM.TG(03) was used throughout this Detailed Assessment.

1.4 Locations that the Review and Assessment must concentrate on

When carrying out the review and assessment of air quality it is only necessary to focus on areas in where the public are likely to be regularly present and are likely be exposed over the averaging period of the objective. Table 1.3 summarises examples of where air quality objectives (AQS) should and should not apply.

Table 13 Examples of where the Air Quality Objectives should and should not apply

Averaging Period	Pollutants	Objectives *should* apply at …	Objectives should *not* generally apply at …
Annual mean	1,3 Butadiene Benzene Lead Nitrogen dioxide Particulate Matter (PM_{10})	All background locations where members of the public might be regularly exposed.	Building facades of offices or other places of work where members of the public do not have regular access.
		Building facades of residential properties, schools, hospitals, libraries etc.	Gardens of residential properties.
			Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term
24 hour mean and 8-hour mean	Carbon monoxide Particulate Matter (PM_{10}) Sulphur dioxide	All locations where the annual mean objective would apply.	Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
		Gardens of residential properties.	
1 hour mean	Nitrogen dioxide Sulphur dioxide	All locations where the annual mean and 24 and 8-hour mean objectives apply.	Kerbside sites where the public would not be expected to have regular access.
		Kerbside sites (e.g. pavements of busy shopping streets).	
		Those parts of car parks and railway stations etc. which are not fully enclosed.	
		Any outdoor locations to which the public might reasonably be expected to have access.	
15 minute mean	Sulphur dioxide	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

2 Information used to support this Assessment

2.1 Review and Assessment reports

Information from the following review and assessment reports was used when producing this Detailed Assessment:

- Stage 1 Review and Assessment (December 1998)
- Stage 2 Review and Assessment (January 2000)
- Stage 3 Review and Assessment (June 2000)
- Stage 4 Review and Assessment (January 2003)
- Updating and Screening Assessment (July 2003)
- Air Quality Action Plan ` (December 2003)
- Detailed Assessment (March 2004)
- Progress report (August 2005)
- Updating and Screening Assessment (July 2006)
- Progress Report (May 2007)
- Further Assessment (December 2007)

The Stage 1 report identified that PM_{10} and NO_2 may exceed the air quality objectives due to road traffic in the district and neighbouring authorities. The Stage 2 report determined that a Stage 3 review and assessment study of PM_{10} and NO_2 in the district was necessary. This Stage 3 assessment concluded that only isolated properties in the vicinity of motorways were likely to be affected by NO_2 exceedences. As a result, St Albans City and District Council declared six Air Quality Management Areas for NO_2. The Stage 4 assessment recommended revoking most of the declared AQMAs, leaving only one area covering domestic properties in Frogmore. The report assessed several remedial measures, which could be applied locally, and it was concluded that the proposed remedial measures were unlikely to enable the area to attain the air quality objectives.

In March 2004, a Detailed Assessment for St Albans City and District Council predicted that the UK annual average and hourly average objectives for NO_2 in 2005 would be exceeded at relevant receptors in the following areas:

- Isolated property next to the A4147, between the M10 and M10 south of M1 junction 7.
- Peahen crossroads, central St Albans.

As a result of this detailed assessment, St Albans City and District Council had declared three AQMAs covering residential properties close to the Peahen Junction, Smug Oak Lane adjacent to the M25, and at the junction of M1 and M10 motorways.

The Updating and Screening Assessment carried out in 2006 concluded that all the objectives in the Air Quality Regulations for England will be met by the relevant dates at most locations in St Albans. The latest Progress Report in 2007, showed that monitored data from St Albans area showed that both the Air Quality Strategy objectives for PM_{10} are being met. However, diffusion tube results indicated that six locations exhibited annual mean values above the AQS objective of 40 $\mu g/m^3$.

The three AQMAs have been modelled explicitly in the latest Further Assessment (Dec 2007). This modelling suggested the following:

- Peahen Junction / London Road:

    - The existing AQMA should continue to cover the same areas because:
        - Modelled and measured concentrations have not changed much since the AQMA was declared;
        - Model predictions continue to show areas where members of the public will be exposed to NO_2 concentrations greater than the annual mean objectives at relevant receptor locations;
        - Diffusion tube measurements continue to show concentrations in excess of the objective;
        - It remains possible, within the uncertainty of the modelling that exceedence of the objective will occur throughout most or all of the area of the AQMA.

    - It is suggested that St Albans City and District Council could consider extending the existing AQMA to the west to cover housing properties in High Street (SA39/SA137 location), and to the south to cover housing properties along Hollywell Hill (SA15/SA138 location).

    - It is suggested that St Albans City and District Council should consider having a detailed assessment in St Peters Street area (SA03/SA136 location) and in Watsons Walk (SA40 / SA135 location).

- Beechtree Cottages / M1-M10

    - The existing AQMA should remain unchanged since both modelled and measured results show exceedences in year 2006.

- Smug Oak Lane and Frogmore / Colney Street

    - Measured and modelled results showed that the concentrations at the diffusion tube locations close to the AQMA at Frogmore Street are below the air quality objective. Housing properties inside the AQMA are no longer exposed to concentrations above 40 $\mu g\ m^3$. Therefore, it is suggested that St Albans City and District Council could consider revoking the AQMA at Frogmore Street.

The existing AQMA at Smug Oak Lane should remain unchanged since both measured and modeled results indicate exceedences over the air quality objective.

2.2 Maps

All maps within this report were provided by St Albans City and District Council for use in our Geographical Information System (GIS). The GIS was used to identify receptors and accurately measure distances from road centres to these receptors.

2.3 Road Traffic Data

Data were collated from a range of sources, including:

- Data provided by Hertfordshire County Council 2007/2008
- Additional traffic data was taken from the air quality assessment report prepared by Jacobs UK Limited for modeling the traffic scenario for the year 2010 for London Road / Watsons Walk taking into consideration the change in traffic conditions that is expected to be caused by the proposed Tesco Store development located to the on the A1081 London Road.

The base year for traffic flows was 2007. All traffic data was then projected to 2010 using growth factors provided by TEMPRO and NTM (The English regional traffic growth growth forecasts from the National Traffic Model). These growth factors are shown in Table 2.1.

Table 2.1 Traffic growth factors applied

Year	NTM	TEMPRO
2007 to 2008	1.0148	1.0187
2008 to 2009	1.0146	1.0185
2009 to 2010	1.0144	1.0183

2.4 Air Quality Monitoring

2.4.1 QA/QC

As outlined in Technical Guidance LAQM.TG(03), it is important to have QA/QC procedures in place in order to ensure that the air quality monitoring data are reliable and credible. The following list outlines basic data requirements:

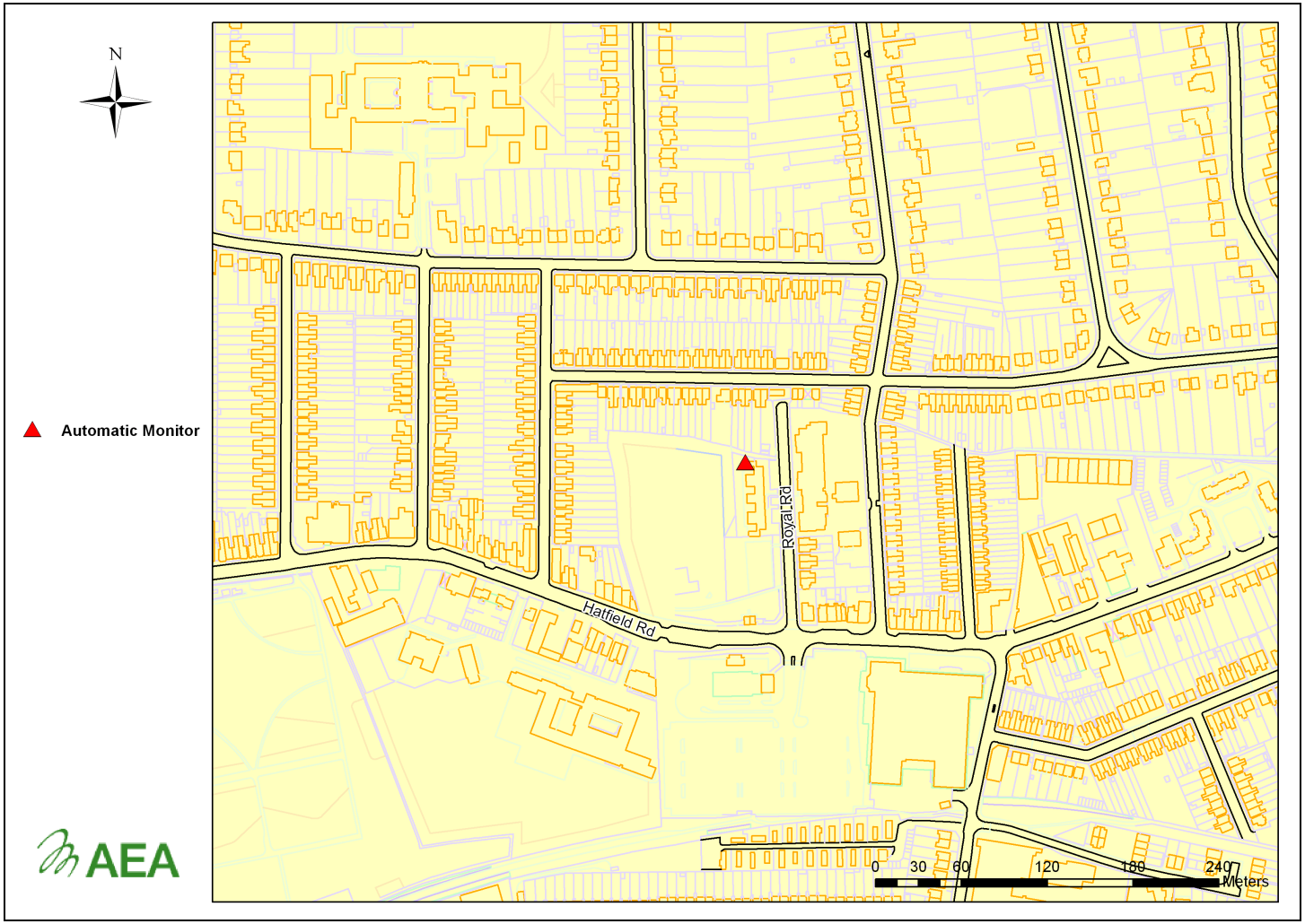
- Accuracy;
- Precision;
- Traceability to national/international metrology standards;
- Long-term consistency.

The following section outlines the QA/QC procedures employed by St Albans City and District Council.

2.4.2 Automatic Monitoring

In order to satisfy the requirement outlined above, nitrogen dioxide concentrations are monitored by continuous monitoring undertaken at a monitoring site located at Fleetville Community Centre, Royal Road, St Albans. This is an urban background site approximately 100m from the A1057 (OS coordinates 516549, 207391) and co-located with triplicate NO_2 tubes. The location of the monitoring site is shown in Figure 2.1

Figure 2.1 Automatic Monitoring Site in St Albans City and District



2.4.3 Diffusion Tubes

Diffusion tubes used by St Albans City and District Council are analysed by Gradko using 20% TEA in water methodology.

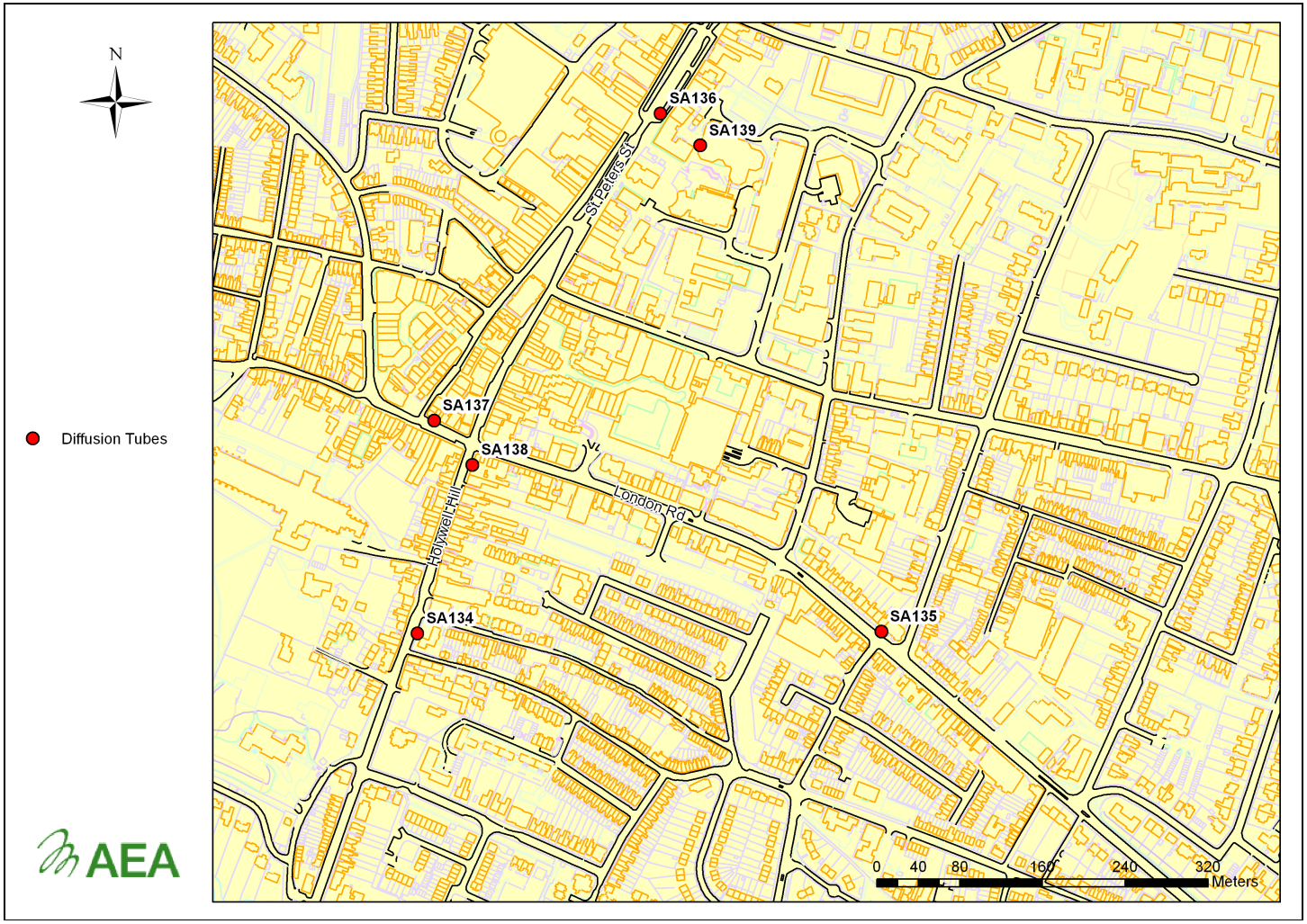
St Albans City and District Council carry out monitoring of nitrogen dioxide by diffusion tubes at 39 sites. The location of the diffusion tubes is shown on Table 2.2.

Table 2.2 Diffusion tube locations

Code	Location	Easting	Northing	Classification
SA101	Museum Hatfield Rd	515105	207476	Kerbside
SA102	Folly Lane	514160	207694	Kerbside
SA103	Links View, Batchwood	513988	208188	Intermediate
SA104	Ben Austin, Redbourn	509002	211731	Background
SA105	St. Agnell's, Lybury Lane, Redbourn	509012	213678	Background
SA106	Lybury Lane, Redbourn	509432	212778	Background
SA107	Redbourn Junior school, Long Cutt, Redbourn	510194	212526	Background
SA108	Redding Lane, Redbourn	509099	214068	Background
SA109	High Street, Harpenden	513345	214409	Kerbside
SA110	Crabtree Junior School, Crabtree Lane, Harpenden	514498	214382	Background
SA111	Butterfield Road, Wheathampstead	517393	213424	Background
SA112	High Street, Wheathampstead	517732	214117	Kerbside
SA113	Pondfield Crescent. Marshalswick	516634	209085	Background
SA114	Fleetville (1) Community Centre, Royal Road	516549	207391	Background
SA115	Fleetville (2) Community Centre, Royal Road	516549	207391	Background
SA116	Fleetville (3) Community Centre, Royal Road	516549	207391	Background
SA117	Five Acres, London Colney	517666	204828	Intermediate
SA118	Ridgeview Hostel, Barnet Road, London Colney	518706	203475	Intermediate
SA119	Telford Road, London Colney	517482	203881	Background
SA120	Sleapcross Gardens, Smallford	520053	206618	Background
SA121	Mount Drive, Park Street	514654	204546	Background
SA122	Sycamore Drive, Park Street	514899	203857	Background
SA123	Radlett Road, Colney Street	515295	202765	Background
SA124	Smug Oak Lane, Colney Street	515383	202528	Background
SA125	Lye Lane, Bricket Wood	513308	202655	Background
SA126	Five Acres Avenue, Bricket Wood	512689	202700	Background
SA127	Oakwood Road, Bricket Wood	512570	202716	Background
SA128	Waterdale Court, Old Watford Road, Bricket Wood	512004	202105	Intermediate
SA129	Ashridge Drive, Bricket Wood	512876	202246	Intermediate
SA130	Tippendell Lane, Chiswell Green	513569	204537	Intermediate
SA131	Searchers Lane, Bedmond	511351	203740	Background
SA132	Westminster Lodge, Holywell Hill	514317	206453	Background (u4)
SA133	Belmont Hill	514606	206801	Kerbside
SA134	Albert Street	514648	206919	Kerbside
SA135	Watsons Walk	515096	206921	Roadside
SA136	St. Peter's Street	514883	207422	Background
SA137	High Street	514664	207125	Roadside
SA138	Holywell Hill	514701	207082	Kerbside
SA139	Civic Centre	514921	207391	Background (u4)

Figure 2.2 indicates the location of the Diffusion Tubes that were used for this assessment.

Figure 2.2 Diffusion Tube Sites in St Albans City and District



2.5 Emission Factors

The vehicle emission factors used for national mapping were revised in 2001by Defra and the devolved administrations[1]. The most recent emission factors have been used in this detailed assessment.

Emissions from stationary traffic in queues and at bus stops were estimated using the emission factor for vehicles moving at 5 km h^{-1} and taking account of the proportion of time stationary vehicles are present and the length of road over which emissions take place. The average length of a queuing vehicle was assumed to be 5 m.

[1] The new set of emission factors on the NAEI website (www.naei.org.uk/emissions/index.php) approved by DEFRA and DTLR for use in emissions and air quality modelling, following consultation of the TRL Report "Exhaust Emission Factors 2001: Database and Emission Factors" by TJ Barlow, AJ Hickman and P Boulter, TRL, September 2001

3 Detailed Assessment for Nitrogen Dioxide

3.1 The National Perspective

Nitrogen dioxide (NO_2) and nitric oxide (NO) are collectively known as NO_x. NO_x is produced during all combustion processes in air, usually in the form of NO and subsequently reacts with ozone (O_3) to form NO_2. The predominant source of NO_x in Britain is road transport, where it is thought that half of emissions in Europe originate from. The highest concentrations of NO_2 are therefore generally found close to busy roads in urban areas. Other significant sources of NO_x are power stations, heating plants and industrial processes.

There are a number of potential effects on health and the environment caused by NO_x. At high levels, NO_2 can cause inflammation of the airways aggravating conditions such as asthma. Long-term exposure may affect lung function possibly increasing people's susceptibility to infection. High levels of NO_x may lead to acidification and/or eutrophication of sensitive habitats. Oxides of nitrogen also contribute to the formation of secondary particles and ground level ozone, both of which are associated with ill health effects.

Modelling studies suggest that, in general, achieving the annual mean objective is more demanding than achieving the hourly objective. If the annual mean is achieved, the modeling suggests the hourly objectives will also be achieved.

3.2 Standards and Objectives for NO_2

The Government and the Devolved Administrations have adopted two Air Quality Objectives for nitrogen dioxide, as an annual mean concentration of 40 μgm^{-3}, and a 1-hour mean concentration of 200 μgm^{-3} not to be exceeded more than 18 times per year. The objectives are to be achieved by the end of 2005 and in subsequent years.

3.3 Conclusions of Previous Report for NO_2 on the study area

The following conclusions were given for nitrogen dioxide in the earlier Further Assessment for St Albans City and District Council:

There were a total of 4 diffusion tubes where measurements showed exceedences of the air quality objective for nitrogen dioxide in 2006. These were:

- SA39 / SA137 – High Street
- SA15 / SA138 – Hollywell Hill
- SA03 / SA136 – St. Peters Street
- SA40 / SA135 – Watsons Walk

The AQMA on Peahen Junction / London Road has been modelled explicitly for this Further Assessment. This modelling suggests the following:

- The existing AQMA should continue to cover the same areas because:
    - Modelled and measured concentrations have not changed much since the AQMA was declared;
    - Model predictions continue to show areas where members of the public will be exposed to NO_2 concentrations greater than the annual mean objectives at relevant receptor locations;
    - Diffusion tube measurements continue to show concentrations in excess of the objective;
    - It remains possible, within the uncertainty of the modelling that exceedence of the objective will occur throughout most or all of the area of the AQMA.

- It was suggested that St Albans City and District Council could consider extending the existing AQMA to the west to cover housing properties in High Street (SA137 location), and to the south to cover housing properties along Hollywell Hill (SA138 location).

- It was suggested that St Albans City and District Council should consider having a detailed assessment in St Peters Street area (SA136 location) and in Watsons Walk (SA135 location).

3.4 Background Concentrations for NO_2

The estimated annual average background nitrogen dioxide (NO_2) concentration provided by the UK background maps for 2007 was 5.3 μg m^{-3}, averaged across St Albans City and District. The estimated annual average background NO_2 concentration in 2010 is 4.9 μg m^{-3}.

3.5 Assessment of Monitoring Data

3.5.1 Automatic Monitoring Data

Table 3.1 summarises the measurements of nitrogen dioxide concentrations at the continuous monitoring station at Fleetville in St Albans City and District Council for 2007

Table 3.1 Continuous monitoring data

Months (2007)	Fleetville NO_2 Concentration (μg m^{-3})		
	Average	Minimum	Maximum
January	22.2	4.0	73.9
February	34.6	4.0	122.2
March	24.2	3.2	93.2
April	20.7	0.6	98.0
May	15.8	-0.8	65.5
June	16.2	1.0	63.2
July	12.7	0.6	69.3
August	16.5	1.0	72.8
September	15.6	-1.3	121.5
October	30.4	3.1	77.0
November	31.8	0.0	135.4
December	33.8	0.8	179.7
Annual Average	**22.9**	n/a	n/a

The annual average NO_2 objective is generally the most stringent of the NO_2 objectives. The 2007 annual mean nitrogen dioxide concentration at the Fleetville site was markedly less than the objective of 40 μg m^{-3}. There were zero occurrences exceeding the hourly mean objective of 200 μg m^{-3}.

3.5.2 Diffusion Tubes Data

The diffusion tubes were exposed for one-month periods, and the average monthly NO_2 level, from the January 2007 until the December 2007, is determined.

Table 3.2 shows the measurements made at nitrogen dioxide diffusion tube sites in the study area during 2007. Diffusion tubes frequently exhibit bias (over – or under-read) relative to the chemiluminescence analyser (the Reference technique for NO_2), and the Guidance states that it is necessary to correct for any such bias when using diffusion tube results for review and assessment purposes. Three diffusion tubes were co-located with the Fleetville continuous monitor between January and December 2007 inclusively. On the basis of the local co-location study in St Albans, the 2007 diffusion tube bias adjustment factor of 0.92 was calculated using the AEA Energy and

Environment's diffusion tube precision and accuracy bias adjusting spreadsheet. UWE publish the results of UK-wide collocation studies on their website (http://www.uwe.ac.uk/aqm/review/mguidance.html#Bias%20Adjustment). According to their website, results using the Gradko 20% TEA in water methodology provided a bias diffusion tube factor of 0.90 for 2007.

Table 3.2 also shows the projected concentrations for 2010 calculated using year adjustment factors taken from the LAQM internet site http://www.airquality.co.uk/archive/laqm/tools.php?tool=year. These forward projections do not take into account the possible effect of local traffic growth or for any local action planning measures. A factor of 0.92 was used for the sites at background locations, while a factor of 0.89 was used for the sites at roadside and kerbside locations.

Table 3.2 NO_2 annual average concentrations at diffusion tube sites (µg m^{-3})

Code	Location	Class	Raw Mean 2007	Adjusted Mean 2007	Prediction 2010
SA114	Fleetville (1) Community Centre, Royal Road	Background	25	23	22
SA115	Fleetville (2) Community Centre, Royal Road	Background	25	23	21
SA116	Fleetville (3) Community Centre, Royal Road	Background	26	24	22
SA101	Museum Hatfield Rd	Kerbside	39	36	32
SA133	Belmont Hill	Kerbside	**45**	**41**	37
SA134	Albert Street	Kerbside	**45**	**41**	37
SA135	Watsons Walk	Roadside	**55**	**51**	**45**
SA136	St. Peter's Street	Background	**62**	**57**	**52**
SA137	High Street	Roadside	**53**	**49**	**43**
SA138	Holywell Hill	Kerbside	**59**	**54**	**49**
SA139	Civic Centre	Background (u4)	32	29	27

3.6 Overview of Modelling

3.6.1 Summary of the Models used

The air quality impact from roads has been assessed using our proprietary urban model (LADS Urban). There are two parts to this model:

- The *Local Area Dispersion System (LADS) model*. This model calculates background concentrations of oxides of nitrogen on a 1 km x 1 km grid. The estimates of emissions of oxides of nitrogen for each 1 km x 1 km area grid square were obtained from the 2006 National Atmospheric Emissions Inventory.
- The *DISP model*. This model is a tool for calculating atmospheric dispersion using a 10 m x 10 m x 3 m volume-source kernel derived from ADMS4 to represent elements of the road. The volume source depth takes account of the initial mixing caused by the turbulence induced by the vehicles. Estimates of emissions from vehicles have been calculated using the latest (and finalised for this round of Review and Assessment) vehicle emission factors.

Concentrations of NO_2 from road traffic emissions were modelled with a resolution of 10 m close to the roads as recommended in the Technical Guidance LAQM.TG (03).

Particular attention was paid to the avoidance of "double counting" of the contribution from major roads in the modelled areas. Thus the emissions from sections of roads modelled using the DISP model were removed from the LADS inventory.

Hourly sequential meteorological data was obtained from Heathrow station, approximately 20 km south-west of St Albans. A surface roughness of 1 m was used in the modelling to represent the urban conditions corresponding to the most exposed sites. The modelling took into account the urban heat island effect in St Albans by limiting the Monin Obukhov length to a minimum of 30 m. An intelligent

gridding system was used with receptors at 10 m intervals on a rectangular grid within 150 m of the modelled roads and more widely spaced receptors elsewhere.

The AQEG 2004 model was used to calculate nitrogen dioxide concentrations from the oxides of nitrogen concentrations predicted by LADS Urban. This is an empirical model that converts the predicted background and road NO_X concentrations to NO_2 concentrations using the polynomial fits given by AQEG (2004). The model takes into account the background ozone, nitrogen dioxide and nitric oxide concentrations, the proportion of the oxides of nitrogen released from vehicles as nitrogen dioxide, and the exposure of the site to sunlight.

All the models used in the assessment make a number of assumptions during the calculations. These include no consideration of terrain relief over the surface being modelled. Modelling of pollutant concentrations on roads can sometimes provide misleading information on produced contour maps. For example, polygons and circles on certain areas of the contour maps, e.g. roundabouts or the centres of roads, can be generated. This is not a deficiency of the model; it is an artefact of the data and the use of discreet receptor points. As such, these additional features should be ignored and the wider context and implications of the contour maps be considered.

3.6.2 Validation and Verification of the Model

In simple terms, validation of the model is the process by which the model outputs are tested against monitoring results at a range of locations and the model is judged to be suitable for use in specific applications. The modelling approach used in this assessment has been validated and the LADS-Urban model has been used in numerous AEA Review and Assessments.

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations. Table 3.3 compares modelled predictions using LADS Urban of nitrogen dioxide concentrations with measured values at the St Albans monitoring sites.

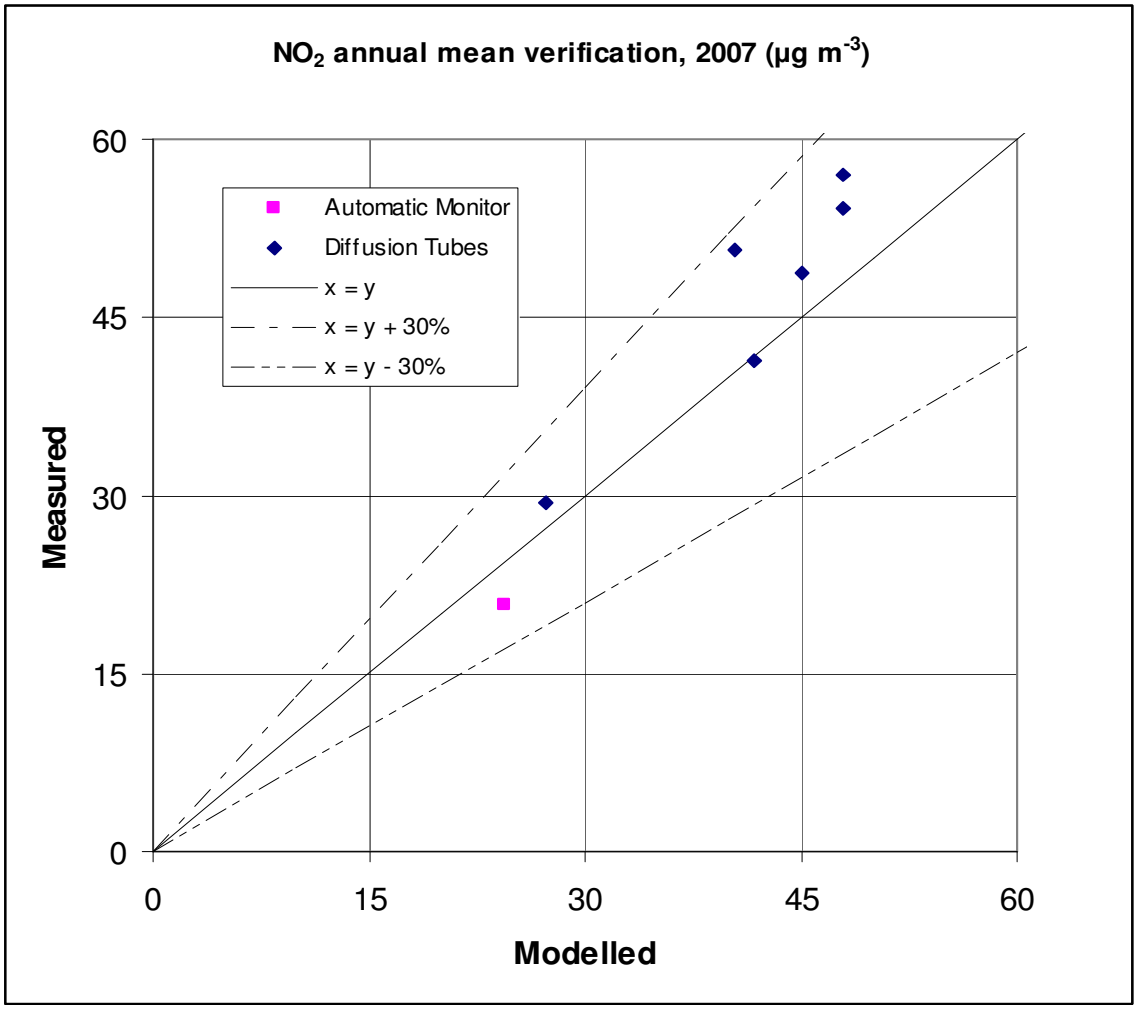
Table 3.3 Comparison of modelled and measured concentrations, 2007

Code	Location	NO_2 Concentration, µg m^{-3}		%Difference
		Measured Mean 2007	Modelled Mean 2007	
	Fleetville Automatic	21	24	114%
SA134	Albert Street	41	42	102%
SA135	Watsons Walk	51	40	78%
SA136	St. Peter's Street	57	48	84%
SA137	High Street	49	45	92%
SA138	Holywell Hill	54	48	89%
SA139	Civic Centre	29	27	93%

The model has provided satisfactory predictions of the measured nitrogen dioxide concentrations without adjustment and so no adjustment has been made.

Figure 3.1 shows that in 2007, the model did not exhibit any systematic under or over prediction of NO_2 concentrations. The 1:1 line is an ideal representation of modelled concentrations. The Figure 3.1 illustrates that the model output was encouraging with all sites at background and roadside locations lying on or about the 1:1 line and all within the +/- 30% DQO range.

Figure 3.1 Verification of NO_2 model



3.6.3 Model Uncertainty

The results of dispersion modelling of pollutant concentrations are necessarily uncertain because of the uncertainties in the estimation of rates of emission, meteorological data and dispersion conditions. Table 3.4 shows confidence levels for modelled nitrogen dioxide concentrations based on a statistical analysis of a comparison of modelled and measured concentrations in London (LAQM.TG(03)). In this report, we present predicted concentrations as isopleths (lines of constant concentration) superimposed on a map of the local area. The concentration values are shown in Table 3.4. Predicted concentrations in excess of 40 µg m^{-3} indicate that there is more than 95% chance of exceeding the annual average objective for NO_2. Public exposure in these areas should be considered in order to assess whether it will be necessary to declare an Air Quality Management Area for NO_2.

Table 3.4 Confidence levels for modelled concentrations for future years

Description	Chance of exceeding objective	Annual average objective
Very unlikely	Less than 5%	< 28
Unlikely	5 to 20%	28 to 34
Possible	20 to 50%	34 to 40
Probable	50 to 80%	40 to 46
Likely	80 to 95%	46 to 52
Very likely	More than 95%	> 52

3.7 Modelling Results

In this section, nitrogen dioxide concentrations predicted for 2007 and 2010 are presented as a series of contour plots and described based on the indication from Table 3.4. Additional modelling results are reported from a traffic scenario for the year 2010 for London Road / Watsons Walk. This scenario is taking into consideration the change in traffic conditions that was expected to be caused by the proposed Tesco Store.

3.7.1 Predicted nitrogen dioxide concentrations 2007

Figure 3.2 shows the modelled nitrogen dioxide concentrations for 2007 in the Peahen Junction area in St Albans. The contour plot shows that exceedences of the objective for nitrogen dioxide are likely to have occurred in 2007 to the Peahen Junction (Figure 3.3), to St Peters Street (Figure 3.4) and to London Road / Watsons Walk (Figure 3.5), where the predicted concentration exceeds 40 μg m^{-3}.

Figure 3.3 indicates that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide are **Likely** to have occurred at properties situated close to Peahen Junction. To be more specific, the model predicted 46 to 52 μg m^{-3} NO_2 annual mean concentrations in 2007 at the properties located to the south eastern corner of the junction, and 40 to 46 μg m^{-3} NO_2 annual mean concentrations in 2007 for the rest of the properties in the area.

Figure 3.4 shows that exceedences of the objective for nitrogen dioxide may **Possibly** have occurred at properties found near St Peter Street. Furthermore, the model predicted 34 to 40 μg m^{-3} NO_2 annual mean concentrations in 2007 at the properties located on both sides of St Peters Street. It is important to mention that it is **Probable** that a property to the east side of the street had exceedences in 2007, since the model predicts 40.5 μg m^{-3} NO_2 annual mean concentration in the façade of the building.

Figure 3.5 indicates that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide may **Possibly** have occurred at properties located on both sides of the London Road close to junction with the Watsons Walk, since the model predicted 34 to 40 μg m^{-3} NO_2 annual mean concentrations in 2007 at these properties.

Figure 3.2 Predicted nitrogen dioxide concentrations in Peahen junction area, 2007

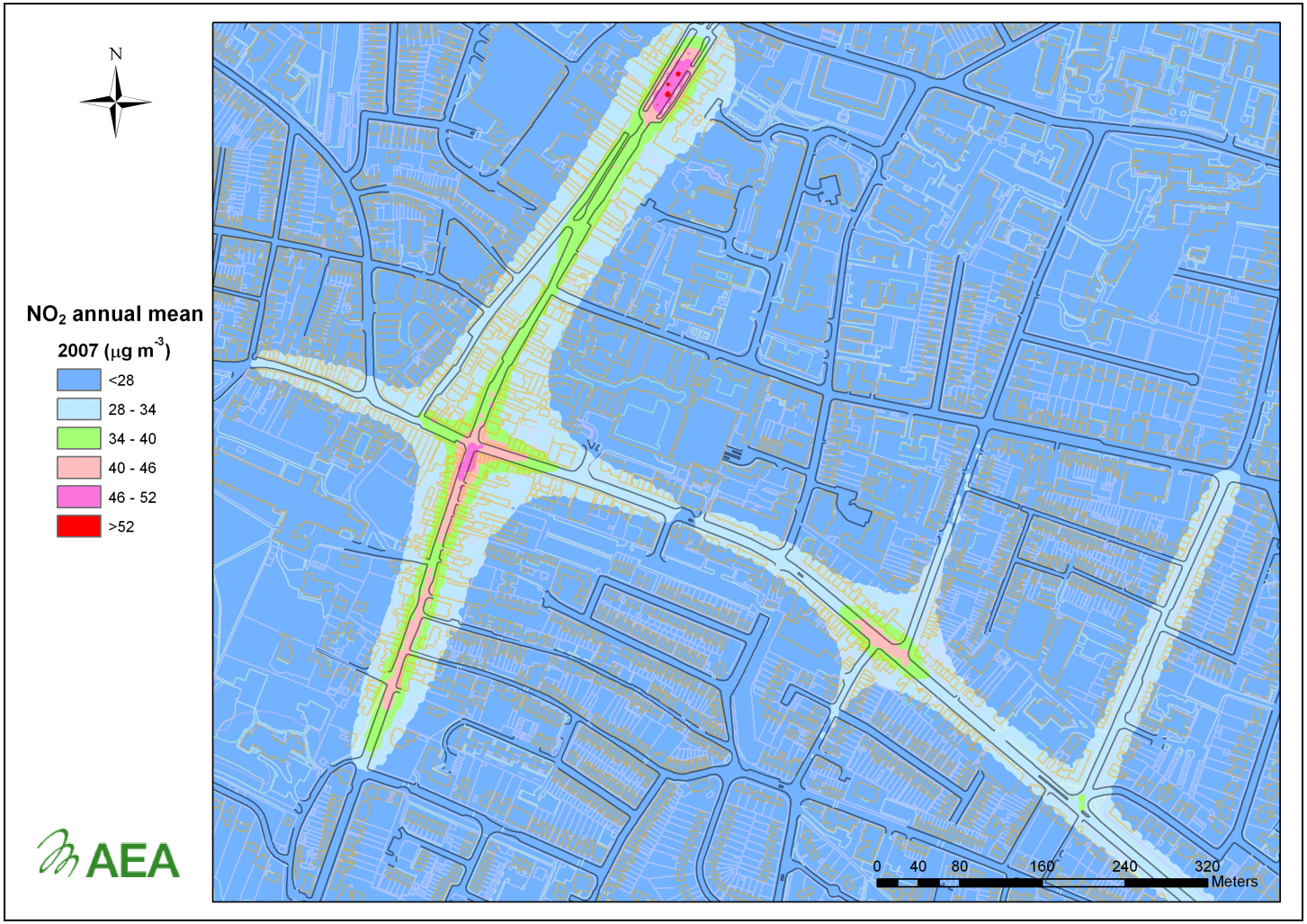


Figure 3.3 Predicted nitrogen dioxide concentrations in Peahen junction, 2007

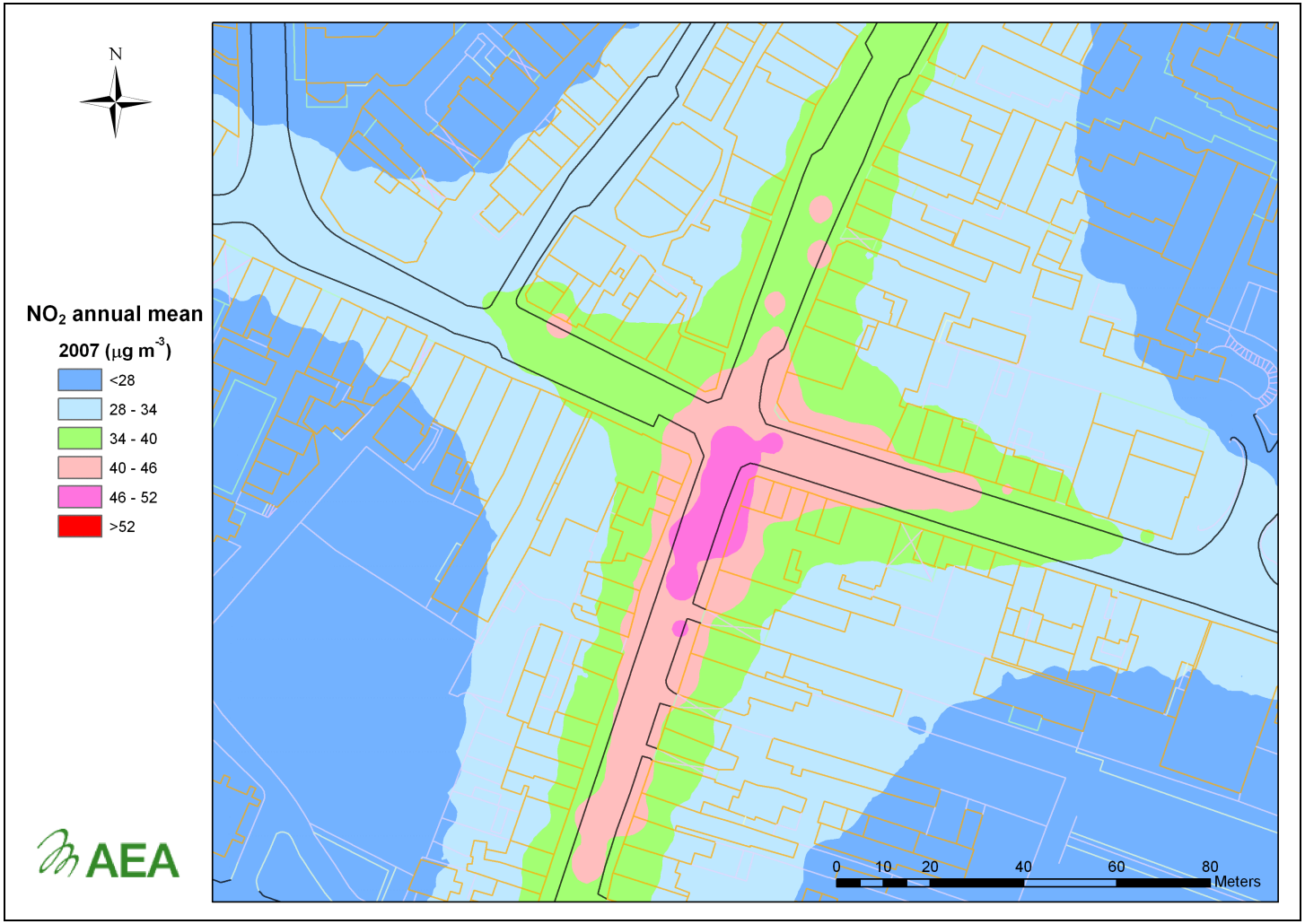


Figure 3.4 Predicted nitrogen dioxide concentrations in St Peters Street, 2007

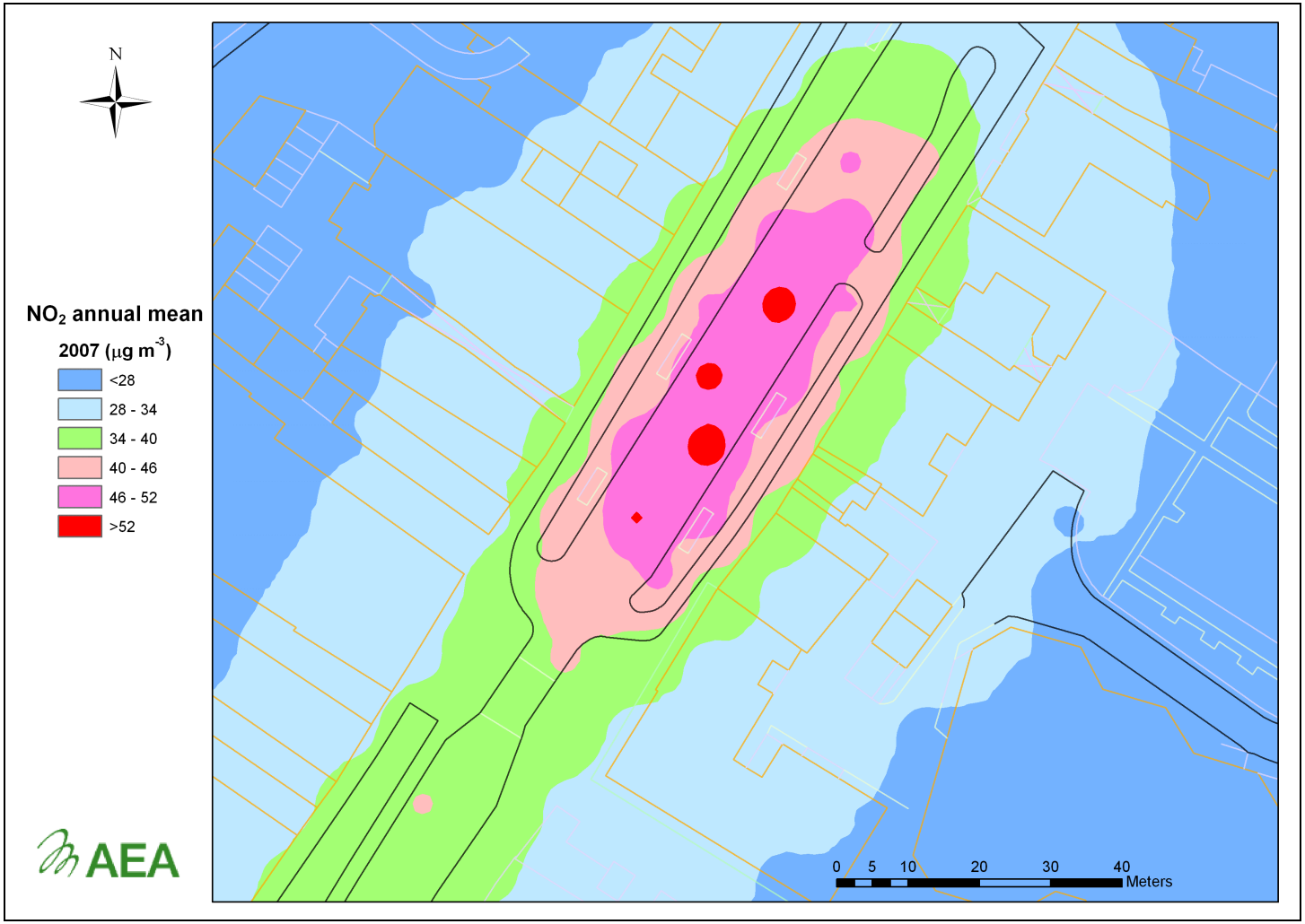
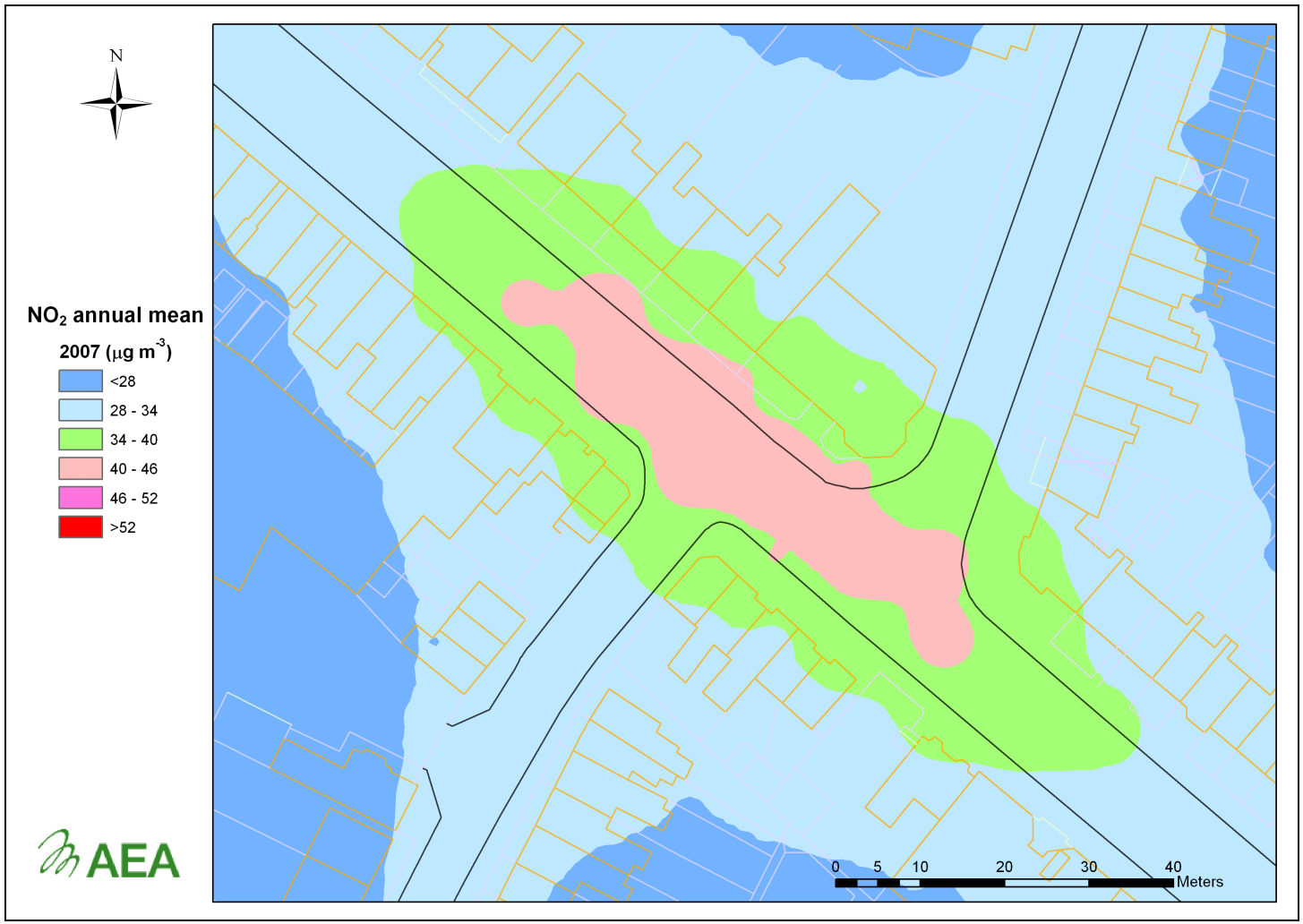


Figure 3.5 Predicted nitrogen dioxide concentrations in London Road / Watsons Walk, 2007



3.7.2 Predicted nitrogen dioxide concentrations 2010

Figure 3.6 shows the predicted concentrations for 2010. These contour plots show that the area with concentrations greater than 40 μg m^{-3} is predicted to have decreased in size compared with the 2007 exceedences.

Figure 3.7 indicates that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide will **Probably** occur in 2010 at properties situated close the Peahen Junction. To be more specific, the model predicts 40 to 46 μg m^{-3} NO_2 annual mean concentrations at the properties located to the south eastern and south western corners of the junction.

Figure 3.8 shows that exceedences of the objective for nitrogen dioxide will **Possibly** occur in 2010 at properties to the east side of St Peter Street, since the model predicts 34 to 40 μg m^{-3} NO_2 annual mean concentrations there. For the properties located to the east side of St Peters Street, the model predicts that it is **Unlikely** for exceedences to occur in 2010.

Figure 3.9 indicates that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide will **Possibly** occur at properties located to the north side of London Road across Watsons Walk. This is mainly because the model predicts 34 to 40 μg m^{-3} NO_2 annual mean concentrations for these properties in 2010. In addition, the contour plot of 34 to 40 μg m^{-3} NO_2 annual mean is marginally reaching the façades of the buildings at the end of the Watsons Walk.

Figure 3.6 Predicted nitrogen dioxide concentrations in Peahen junction area, 2010

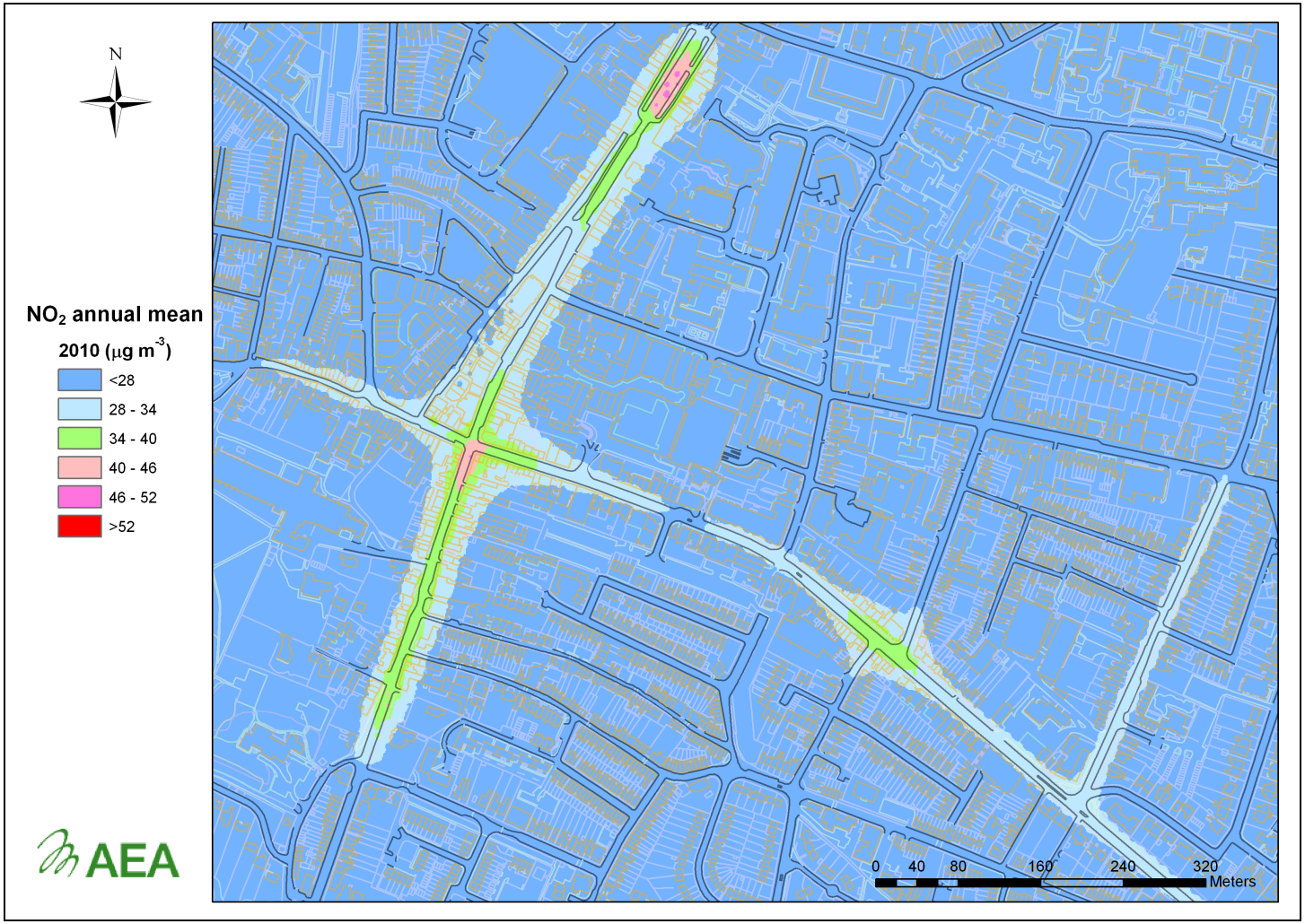


Figure 3.7 Predicted nitrogen dioxide concentrations in Peahen junction, 2010

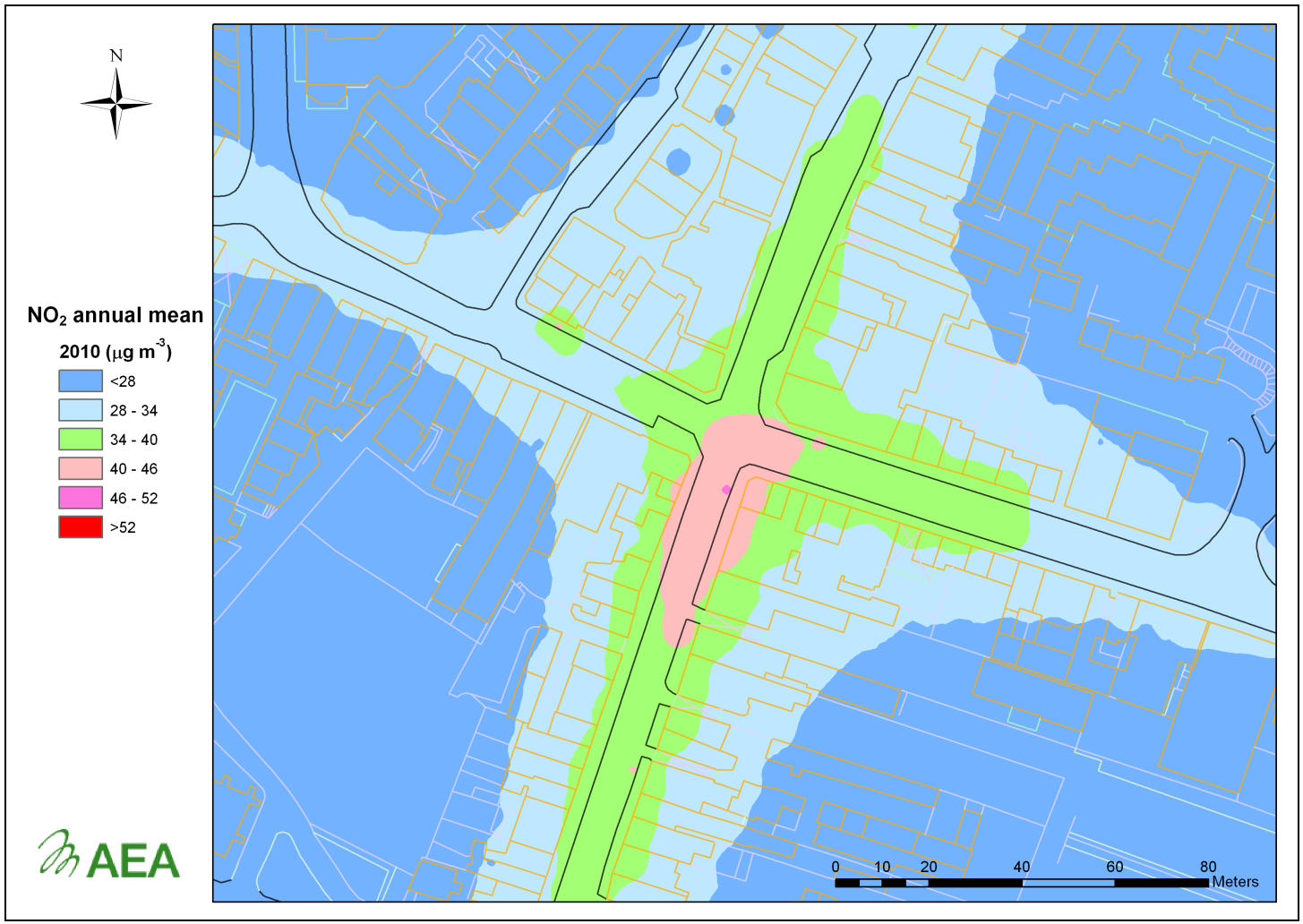


Figure 3.8 Predicted nitrogen dioxide concentrations in St Peters Street, 2010

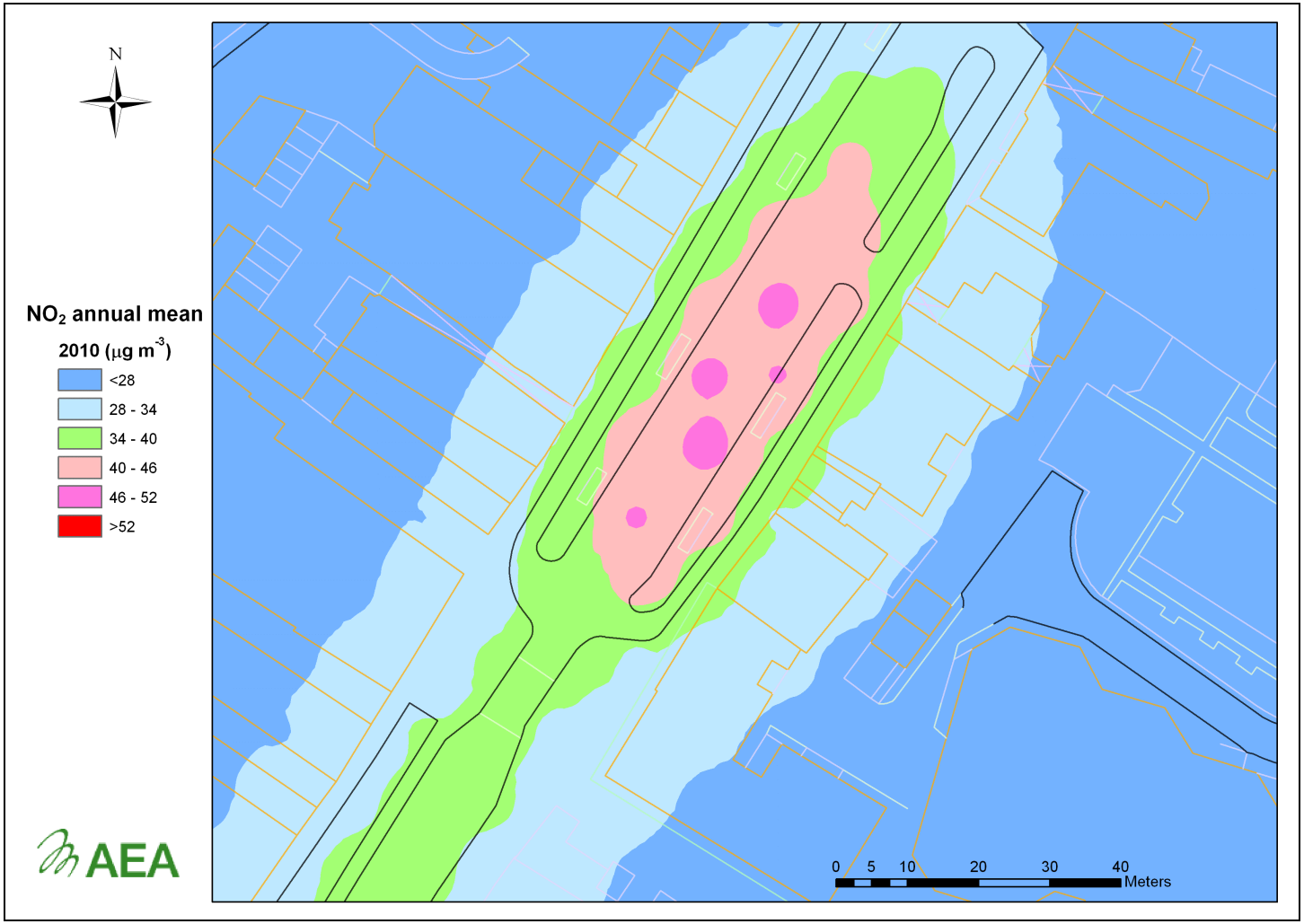
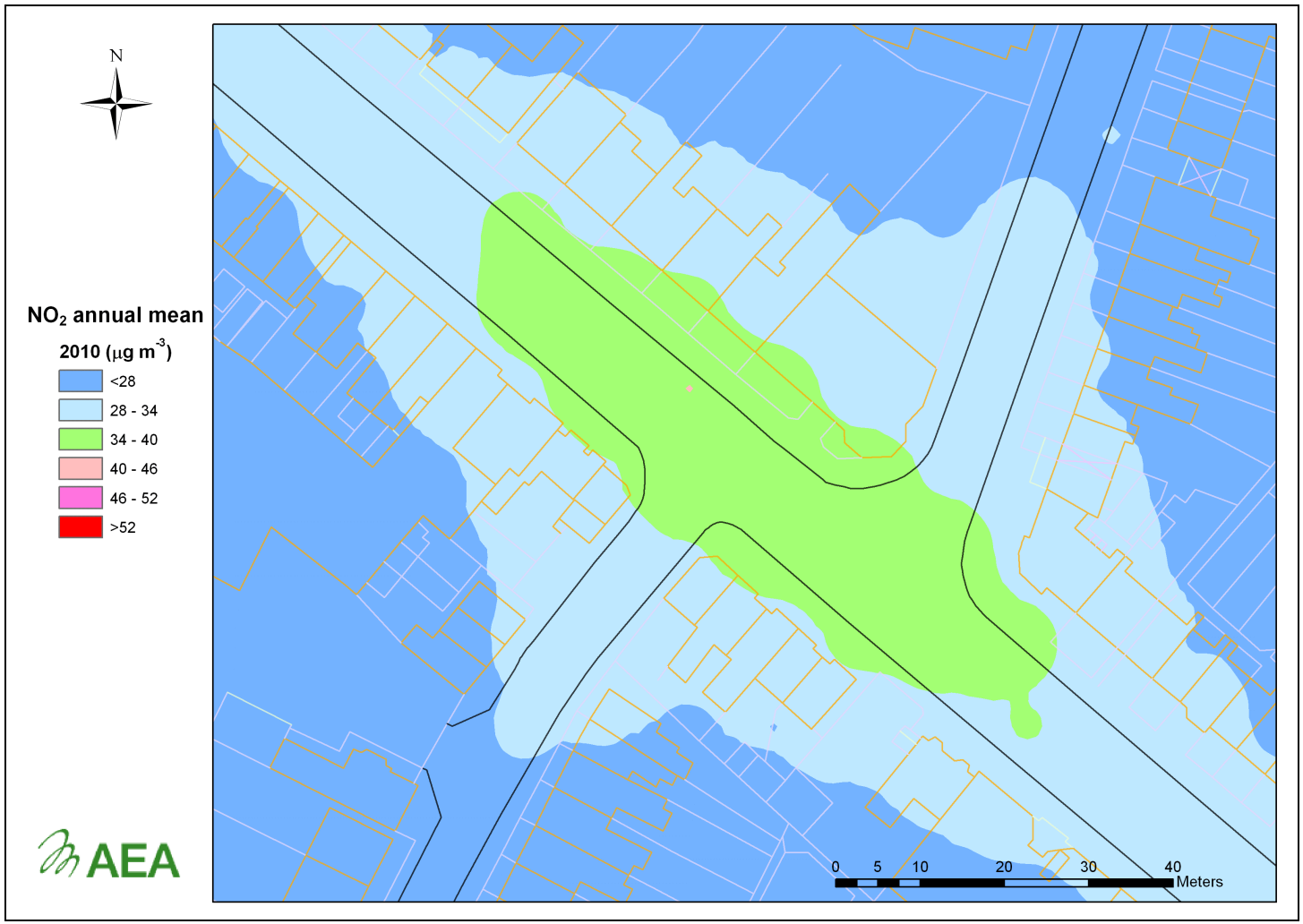


Figure 3.9 Predicted nitrogen dioxide concentrations in London Road / Watsons Walk, 2010



3.7.3 Predicted nitrogen dioxide concentrations 2010 with TESCO scenario

Tesco Stores Ltd proposed to build a store on London Road, St Albans, at the site of Eversheds Printing Works. Although the Council has informed us that this planning application has been rejected, a modelling work was carried out to assess the effect of the proposed Tesco on the air quality. It was expected that this proposed store will generate additional traffic at the London Road / Watsons Walk junction. Data for the expected additional traffic was taken from the air quality assessment report prepared by Jacobs UK Limited and was used for modeling the traffic scenario for the year 2010.

Figure 3.10 shows the predicted concentrations from a traffic scenario for the year 2010. This scenario is taking into consideration the change in traffic that is expected to be caused by the proposed Tesco Store. The comparison against Figure 3.6 (predicted nitrogen dioxide concentrations 2010 without Tesco Scenario) indicates that there will be an increase of the annual mean NO_2 concentration on the London Road / Watsons Walk junction due to the additional traffic. However, the Peahen junction and St Peters Street will not be affected.

Figure 3.11 indicates that the exceedences of the 40 μg m^{-3} objective for nitrogen dioxide are **Possible** to occur at properties located on both sides of London Road at the junction with Watsons Walk. More specifically the model predicts 34 to 40 μg m^{-3} NO_2 annual mean concentrations for these properties in 2010 with the Tesco scenario.

Figure 3.10 Predicted nitrogen dioxide concentrations in Peahen junction area, 2010 with TESCO scenario

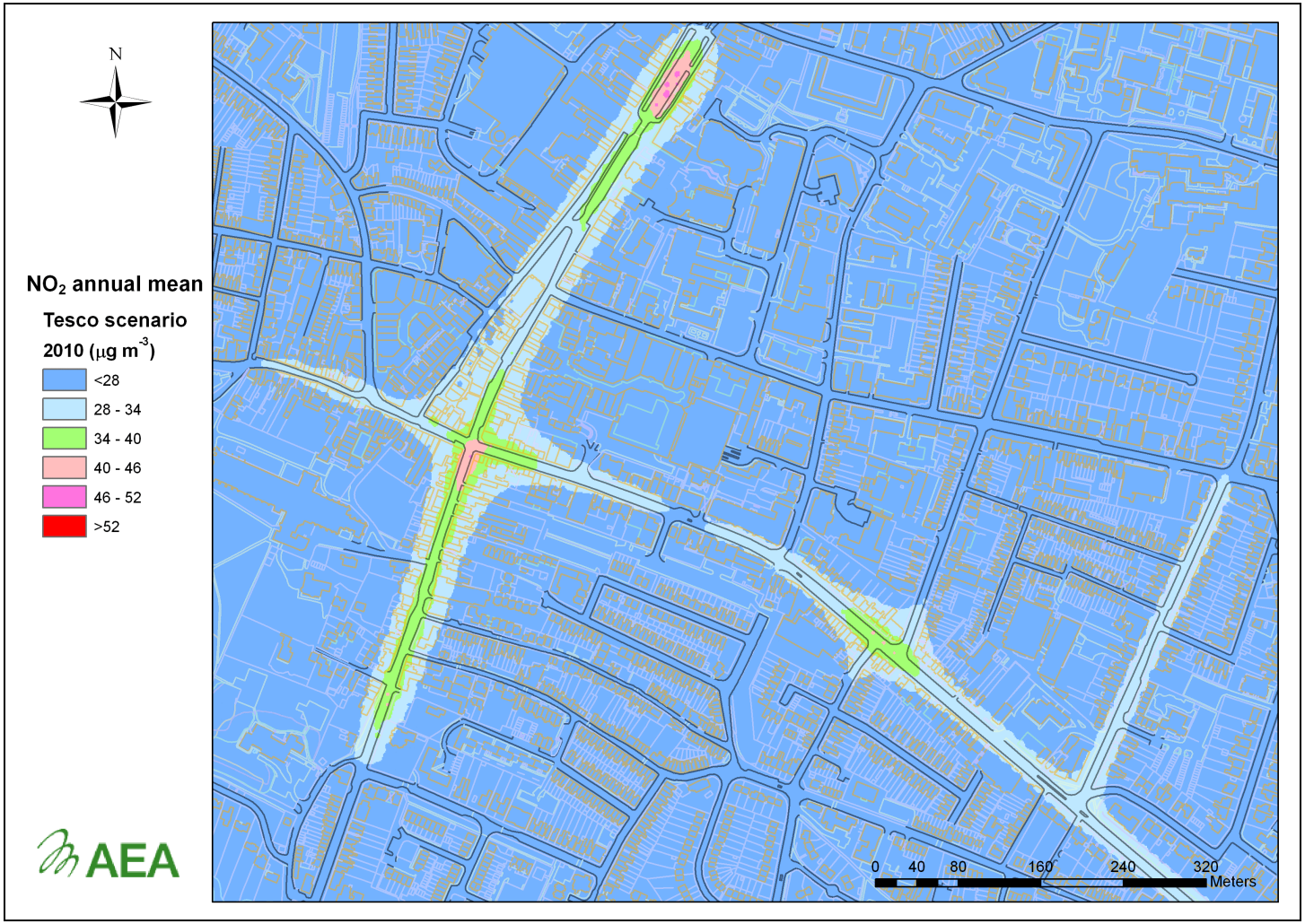
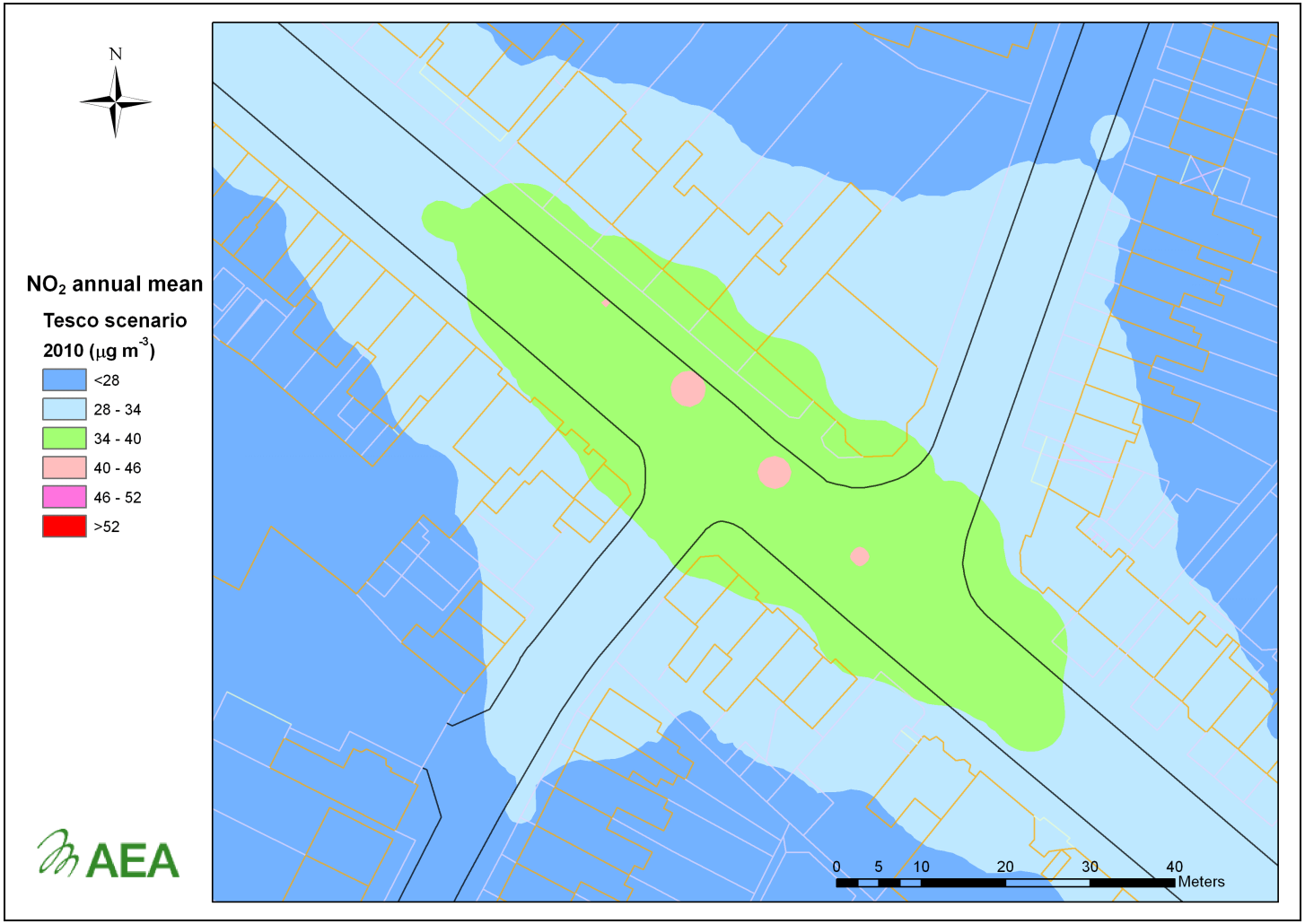


Figure 3.11 Predicted nitrogen dioxide concentrations in London Road / Watsons Walk, 2010 with TESCO scenario



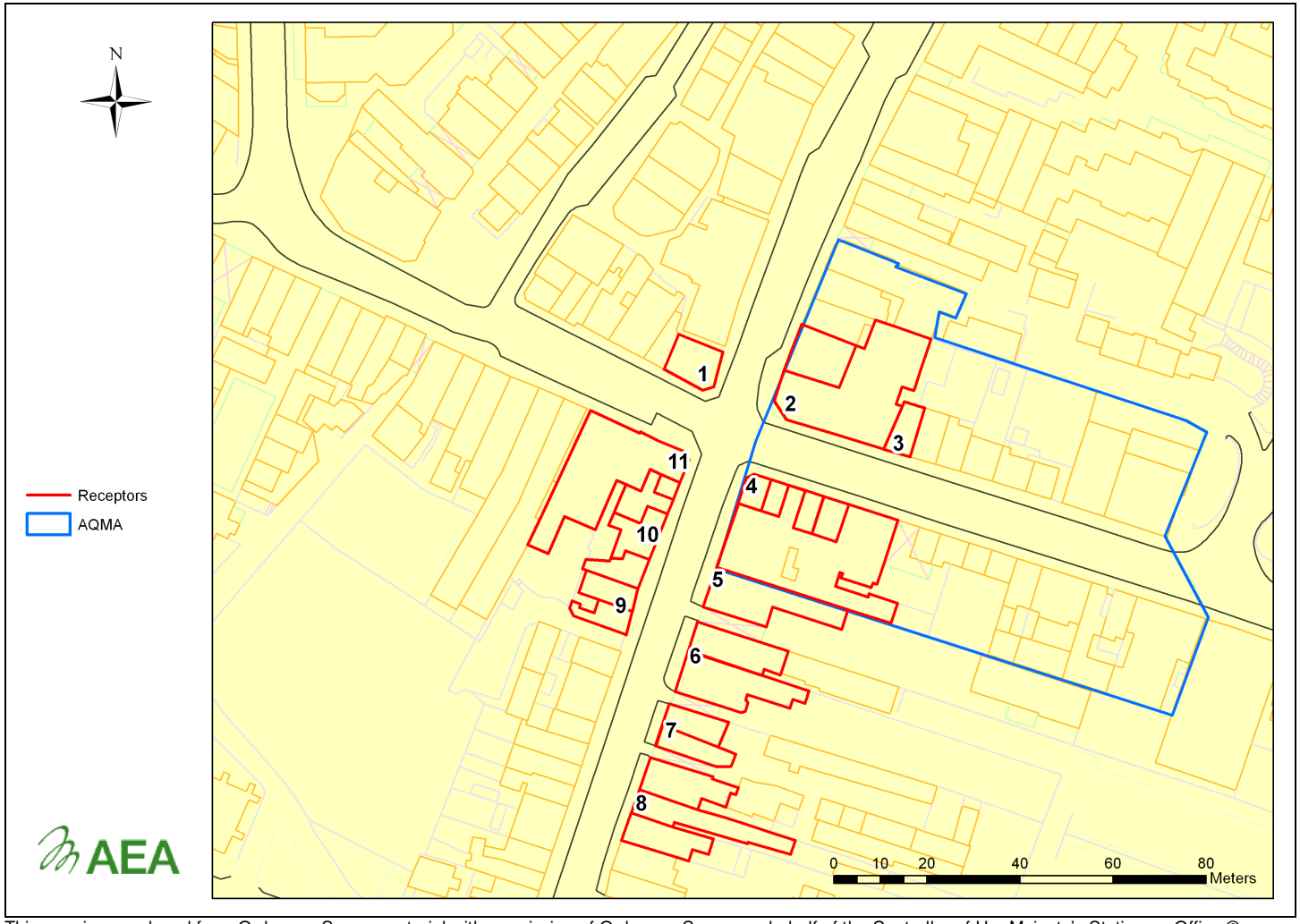
3.8 Receptors

The receptors of relevant exposure considered within this Detailed Assessment were taken at the locations on the corners or on the façade of buildings. These receptors are chosen in locations where the public are likely to be regularly present and are likely be exposed over the averaging period of the objective. The locations of these receptors are highlighted in Figure 3.12. Due to limitation of the GIS data, it is not possible to highlight the real size of the buildings. Table 3.5 indicates the predicted concentrations in 2007.

Table 3.5 Predicted NO_2 annual mean concentrations in 2007

Receptors	NO_2 Concentrations
1	41.92
2	43.14
3	40.49
4	46.66
5	43.88
6	42.23
7	40.15
8	40.64
9	40.70
10	43.79
11	43.75

Figure 3.12 Receptors at Peahen junction



4 Conclusions

This Detailed Modelling Assessment covered the following areas:

- Watsons Walk
- High Street
- Hollywell Hill
- St Peters Street

The concentrations of nitrogen dioxide in the area of modelling have changed since the last Further Assessment. The concentrations at the four diffusion tube monitoring sites located in the above areas were higher than the concentrations in 2006, and all of them showed concentrations above the annual mean objective of 40 μg m^3.

The assessment showed the following:

- Watsons Walk / London Road:
  - The measured NO_2 concentration at SA135 was 44 μg m^{-3} in 2006 and 51 μg m^{-3} in 2007.
  - The model predicted NO_2 concentrations of 40 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^{-3} was exceeded.
  - The model predicted that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide might occur in 2010 at properties located to the north side of London Road across Watsons Walk.

- Peahen Junction
  - High Street:
    - The measured NO_2 concentration at SA137 was 44 μg m^{-3} in 2006 and 49 μg m^{-3} in 2007.
    - The model predicted NO_2 concentrations of 45 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^{-3} was exceeded.
  - Hollywell Hill:
    - The measured NO_2 concentration at SA138 was 48 μg m^{-3} in 2006 and 54 μg m^{-3} in 2007. The model predicted NO_2 concentrations of 48 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^{-3} was exceeded.
    - The measured NO_2 concentration at SA134 was 41 μg m^{-3} in 2007 and the model predicted NO_2 concentrations of 40 μg m^{-3} for the same year.
  - The model predicted that exceedences of the 40 μg m^{-3}.objective for nitrogen dioxide might occur in 2010 at properties located in the south eastern and south western corners of the junction.

- St Peters Street:
  - The measured NO_2 concentration at SA136 was 53 μg m^{-3} in 2006 and 57 μg m^{-3} in 2007.
  - The model predicted NO_2 concentrations of 48 μg m^{-3} in the same location for 2007, indicating that the annual mean objective of 40 μg m^{-3} was exceeded.
  - The model predicted that exceedences of the 40 μg m^{-3} objective for nitrogen dioxide are possible to occur in 2010 at properties located in the east side of St Peters Street. It is unlikely that any exceedences will occur in 2010 at properties located in the east side of St Peters Street.

- Watsons Walk / London Road – Tesco Scenario:

  The comparison with the 2010 base case modelling results indicates that there will be a small increase of the annual mean of NO2 concentrations at the junction of Watsons Walk / London Road, due to the additional traffic. The model predicts that exceedences of the 40 μg m^{-3}

objective for nitrogen dioxide are possible to occur to properties located to both sites of London Road at the junction with Watsons Walk.

Based upon the results above, and taking into consideration model uncertainties and the fact that the model under-predicted the concentrations in the above locations, this Detailed Assessment suggests the following:

- St Albans City and District Council should consider extending the existing AQMA to the west to cover housing properties in High Street (SA137 location), and to the south to cover housing properties along Hollywell Hill (SA138 location).

- St Albans City and District Council should consider declaring the area covering the properties located to the east side of St Peters Street (near the location of SA136) as an AQMA.

- St Albans City and District Council should consider declaring the area covering the properties located to the north side of London Road across Watsons Walk (including the location of SA135) as an AQMA.

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Acknowledgements

The author would like to acknowledge the help of Stephen Hide from St Albans City and District Council.

Appendices

Appendix 1: Traffic Data

Appendix 1

Traffic Data

Road Name	AADT	%HDVs	Tesco - added
Chequer Street	15478	6.3	
Holywell Hill	16987	5	
High Street	11567	3.6	
Watsons Walk	7301	1.7	600
French Row	3629	8	
George Street	15720	3	
St Peters Street	11947	9.2	
Romeland Hill	15720	3	
Lattimore Road	6538	1.7	
Alma Road	14148	2.6	1104
London Road	14237	3.9	3000

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