



# **Air Quality Assessment: Cumulative Impact of Developments in Stratford-on-Avon – Stage 1**

---

December 2014



Experts in air quality  
management & assessment

## Document Control

<b>Client</b>	Stratford-on-Avon	<b>Principal Contact</b>	Nick Ellison
---------------	-------------------	--------------------------	--------------

<b>Job Number</b>	J2083
-------------------	-------

<b>Report Prepared By:</b>	Penny Wilson
----------------------------	--------------

### Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
2083/1/F1	5 December 2014	Final Report	Prof. Duncan Laxen

This report has been prepared by Air Quality Consultants Ltd on behalf of the Client, taking into account the agreed scope of works. Unless otherwise agreed, this document and all other Intellectual Property Rights remain the property of Air Quality Consultants Ltd.

In preparing this report, Air Quality Consultants Ltd has exercised all reasonable skill and care, taking into account the objectives and the agreed scope of works. Air Quality Consultants Ltd does not accept any liability in negligence for any matters arising outside of the agreed scope of works. The Company operates a formal Quality Management System, which is certified to ISO 9001:2008, and a formal Environmental Management System, certified to ISO 14001:2004. QMF 08.

When issued in electronic format, Air Quality Consultants Ltd does not accept any responsibility for any unauthorised changes made by others.

When printed by Air Quality Consultants Ltd, this report will be on Evolve Office, 100% Recycled paper.

**Air Quality Consultants Ltd**  
**23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086**  
**12 Airedale Road, London SW12 8SF Tel: 0208 673 4313**  
**aqc@aqconsultants.co.uk**

Registered Office: 12 St Oswalds Road, Bristol, BS6 7HT  
 Companies House Registration No: 2814570

## 1 Introduction

- 1.1 This report sets out the first stage the consideration of the potential cumulative air quality impacts associated with proposed development set out within the Stratford-on-Avon Core Strategy. It has been prepared by Air Quality Consultants Ltd on behalf of Stratford-on-Avon District Council (SDC).
- 1.2 The Stratford-on-Avon urban area has been designated an Air Quality Management Area (AQMA) as a result of historically measured exceedences of the annual mean nitrogen dioxide objectives. No exceedences of the objective have been measured in recent years and therefore SDC is considering whether to revoke the AQMA. Prior to this decision SDC wishes to determine whether there is a risk that the cumulative impacts of developments in the area could lead to exceedences of the air quality objectives, and thus a requirement for an AQMA, in the future.
- 1.3 The consideration of the cumulative air quality impacts of the proposed developments is being carried out following a two stage process. This report sets out the first stage, which is to identify whether the Core Strategy developments could cumulatively increase traffic by a significant amount in areas where there is a risk that the air quality objectives may be exceeded. Where such areas are identified, the assessment will move on to a second stage involving air quality modelling to determine whether the combined influence of these developments would be sufficient to lead to an exceedence of the air quality objectives.

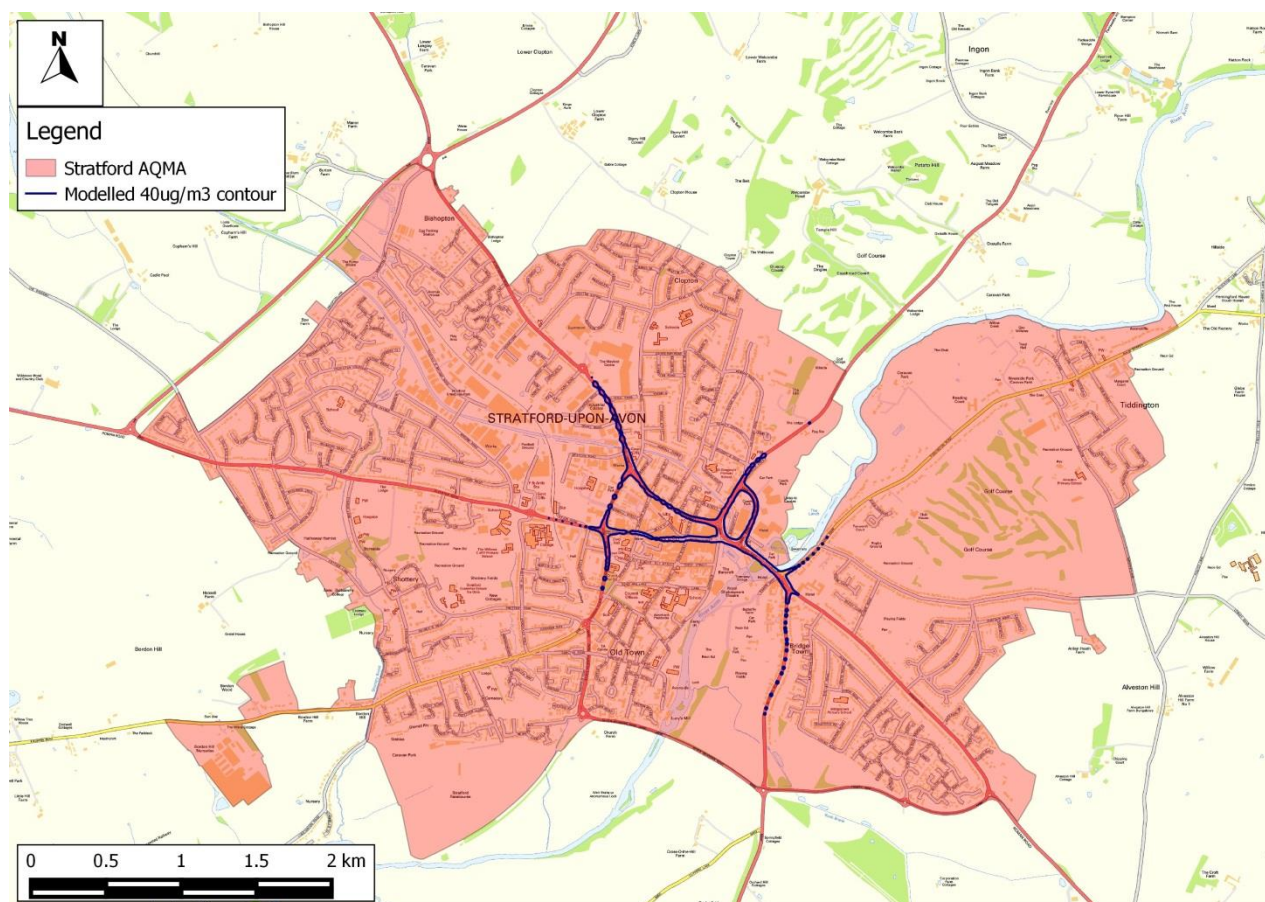
## 2 Approach

- 2.1 The assessment is based on the Stratford-on-Avon traffic model, developed by Arup on behalf of Warwickshire County Council. Arup has supplied modelled am and pm peak 4-hour traffic data (0700 – 0900 and 1600 – 1800) for Stratford-on-Avon for the following scenarios<sup>1</sup>:
- 2015 reference case – includes Kipling Road, Shipston Road (Waitrose), NC Joseph developments and network amendments
  - 2028 reference case – includes the Stratford Transport Package (STP), Warwick Road Dynamic Signage Strategy and a number of other proposed junction improvements
  - 2028 Core Strategy Option 1 – dispersed development
  - 2028 Core Strategy Option 3 – Long Marston Airfield (includes Western Relief Road)
  - 2028 Core Strategy Option 4 – South East of Stratford (includes Eastern Relief Road)
- 2.2 The traffic data were supplied as 1-way flows for all the roads in each of the networks. These 1-way flows have been paired to determine total 2-way peak traffic flows. The 2-way traffic flows for each option have then been compared with the 2028 reference case to identify locations where flows are predicted to increase by more than 5% as a result of cumulative developments. The 2028 reference case has also been compared with the 2015 reference case, to determine the expected changes over this period.
- 2.3 The assessment is confined to the Stratford-on-Avon AQMA, which covers the whole town area, as shown in Figure 1. Within this area, the primary focus is on the area where exceedences of the annual mean nitrogen dioxide objective of  $40\mu\text{g}/\text{m}^3$  were modelled in the Further Assessment, which was completed in 2010<sup>2</sup>.

---

<sup>1</sup> Warwickshire County Council (2014) Stratford-on-Avon Strategic Transport Assessment Options Analysis Report, April 2014.

<sup>2</sup> Air Quality Consultants Ltd (2010). Further Assessment of Air Quality in the Stratford-on-Avon AQMA, September 2010.

**Figure 1: Stratford-on-Avon AQMA**

Contains Ordnance Survey data © Crown copyright and database right 2014

- 2.4 Locations where the 2-way peak 4-hour flows are less than 1,000 have not been considered further, as it is highly unlikely that the air quality objectives would be exceeded alongside these roads. For comparative purposes, the 4-hour 2-way flow at Guild St, where exceedences of the objective have previously been monitored, is expected to be 3,483 in 2028.
- 2.5 The locations where a greater than 5% change in 4-hour peak traffic flow (where the flow is greater than 1,000) have been considered in relation to the factors below, to determine the risk of the annual mean nitrogen dioxide objective being exceeded:
- Current and historic measured nitrogen dioxide concentrations<sup>3</sup>;
  - Modelled nitrogen dioxide concentrations<sup>2</sup>; and
  - Narrow and congested streets.

<sup>3</sup> Stratford-on-Avon District Council (2014). 2014 Air Quality Progress Report for Stratford-on-Avon District Council, May 2014.

## Limitations

- 2.6 It is not straightforward to take into consideration the direct impact of changes in congestion on air quality. This screening assessment is therefore based solely on changes in peak traffic numbers. The impact of changes in average speed will be considered where detailed modelling is carried out at stage 2 of this project.
- 2.7 The impact of changes in vehicle emissions in the future is not taken into account at this stage. Again this will be taken into account where detailed modelling is carried out at stage 2.
- 2.8 The traffic impacts of the Kipling Road residential development, Shipston Road neighbourhood centre (Waitrose) and redevelopment of the NC Joseph site on Birmingham Road are included in the 2015 and 2028 reference case models. These developments have only recently been completed and therefore the full impact of these developments may not have been apparent in the 2013 air quality monitoring data used as the basis for this assessment. They will however, influence monitoring data from 2014 and beyond.

### 3 Analysis

#### 2015 Reference Case compared with 2028 Reference Case

- 3.1 The locations where a greater than 5% increase in 4-hour peak traffic flow when the 2028 reference case is compared with the 2015 reference case (and flows >1,000) are shown in Figure 2. Analysis of these locations in relation to the factors contributing to a risk of an exceedence of the air quality objectives is set out in Table 1.
- 3.2 Generally decreases are predicted by 2028 in areas where exceedences have previously been modelled. This is as a result of a combination of factors, including the Stratford Transport Package. However, increases are expected at the Arden Street/Birmingham Road junction, near to receptors.
- 3.3 Some very large increases in traffic are predicted on wide roads with receptors set back from the road, outside the previously modelled exceedence area. Some of these large increases are due to increased capacity as a result of specific transport schemes, for example the increase on Banbury Road is a result of the Tiddington Road scheme proposals.

#### Option 1

- 3.4 The locations where a greater than 5% increase in 4-hour peak traffic flow is predicted with Option 1 (and flows >1,000) are shown in Figure 3. Analysis of these locations, and all locations in the previously modelled area, in relation to the factors which contribute to a risk of an exceedence of the air quality objectives is set out in Table 2.
- 3.5 The traffic model indicates that there would be a greater than 5% increase in traffic around the Warwick Road/Bridgeway gyratory with Core Strategy Option 1 (dispersed development). Potential exceedences of the objective were previously modelled at this location and there are sensitive receptors present. There has not been any previous monitoring carried out near to receptors in this area. It is therefore recommended that both monitoring of existing levels and modelling of future concentrations is carried out.
- 3.6 A greater than 5% increase in traffic is also predicted at the northern end of Windsor Street. There are some houses fairly close to the road and possibly some flats above shops, and the street is congested and narrow in places, however, traffic flows are relatively low and it was not in the previously modelled exceedence area. On this basis consideration should be given to monitoring and possibly modelling at relevant receptors.
- 3.7 In the rest of the previously modelled exceedence area, including locations where historic exceedences of the objective have been measured, Option 1 is expected to lead to reductions in traffic flow.

3.8 At most other locations in the AQMA, where Option 1 is expected to increase traffic by more than 5%, houses are set well back from the road and there are unlikely to be exceedences of the objective. The exception is Shottery, where sections of road are very narrow and there are some houses at the back of narrow pavements. Whilst exceedences of the objective are unlikely with current traffic flows, it is suggested that a short period of monitoring is carried out, to confirm this is the case.

### Option 3

3.9 The locations where a greater than 5% increase in 4-hour peak traffic flow is predicted with Option 3 (and flows >1,000) are shown in Figure 4. Analysis of these locations in relation to the factors which contribute to a risk of an exceedence of the air quality objectives is set out in Table 3.

3.10 The traffic model indicates that there would be a greater than 5% increase in traffic in much of the previously modelled area with Core Strategy Option 3 (Long Marston). This includes the Warwick Road/Bridgeway gyratory, the Banbury Road/Shipston Road junction, and Guild Street and Grove Road. On this basis, it is recommended that detailed dispersion modelling of this area is carried out.

3.11 At most other locations in the AQMA, where Option 3 is expected to increase traffic by more than 5%, houses are set well back from the road and there are unlikely to be exceedences of the objective. Again, the exception is Shottery, where sections of road are very narrow and there are some houses at the back of narrow pavements. Whilst exceedences of the objective are unlikely with current traffic flows, it is suggested that a short period of monitoring is carried out, to confirm this is the case.

### Option 4

3.12 The locations where a greater than 5% increase in 4-hour peak traffic flow is predicted with Option 4 (and flows >1,000) are shown in Figure 5. Analysis of these locations in relation to the factors which contribute to a risk of an exceedence of the air quality objectives is set out in Table 4.

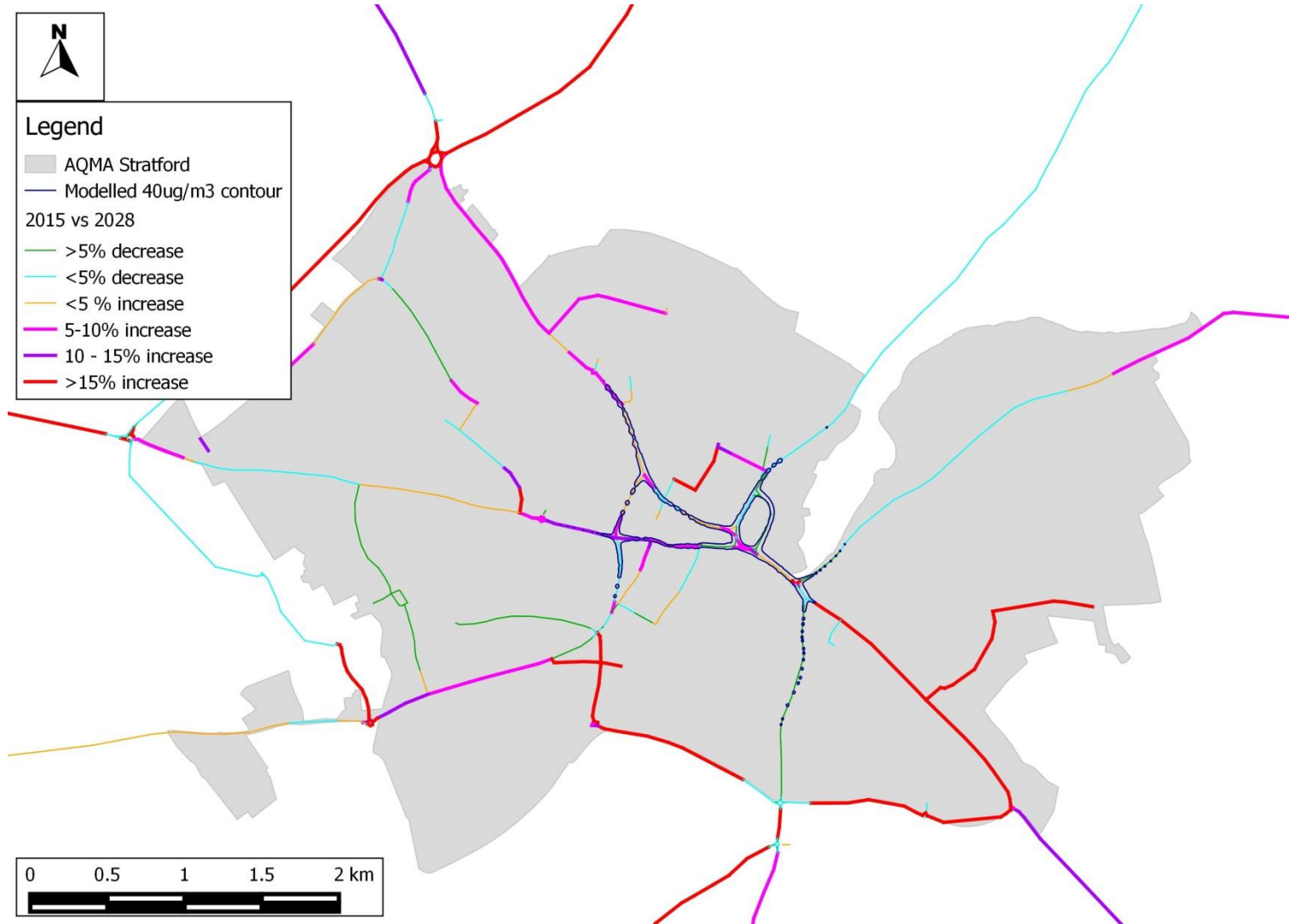
3.13 The traffic model indicates that there would be a greater than 5% increase in traffic in much of the previously modelled area with Core Strategy Option 4 (East of Stratford). This includes Warwick Road near to the Warwick Road/Bridgeway gyratory, the Banbury Road/Shipston Road junction, and Guild Street and Rother Street. On this basis, it is recommended that detailed dispersion modelling of this area is carried out. Increases are also predicted on Bridge Street and High Street. The buildings in these streets have predominantly retail uses, however, if there are flats above the shops in this area, modelling should be carried out.

3.14 At most other locations in the AQMA, where Option 4 is expected to increase traffic by more than 5%, houses are set well back from the road and there are unlikely to be exceedences of the objective. An exception is Sanctus Road, where sections of road are very narrow and there are



some houses at the back of narrow pavements. Whilst exceedences of the objective are unlikely with current traffic flows, it is suggested that a short period of monitoring is carried out, to confirm this is the case.

**Figure 2: 2015 to 2028 Changes in 4-hour peak flow (where total >1,000)**



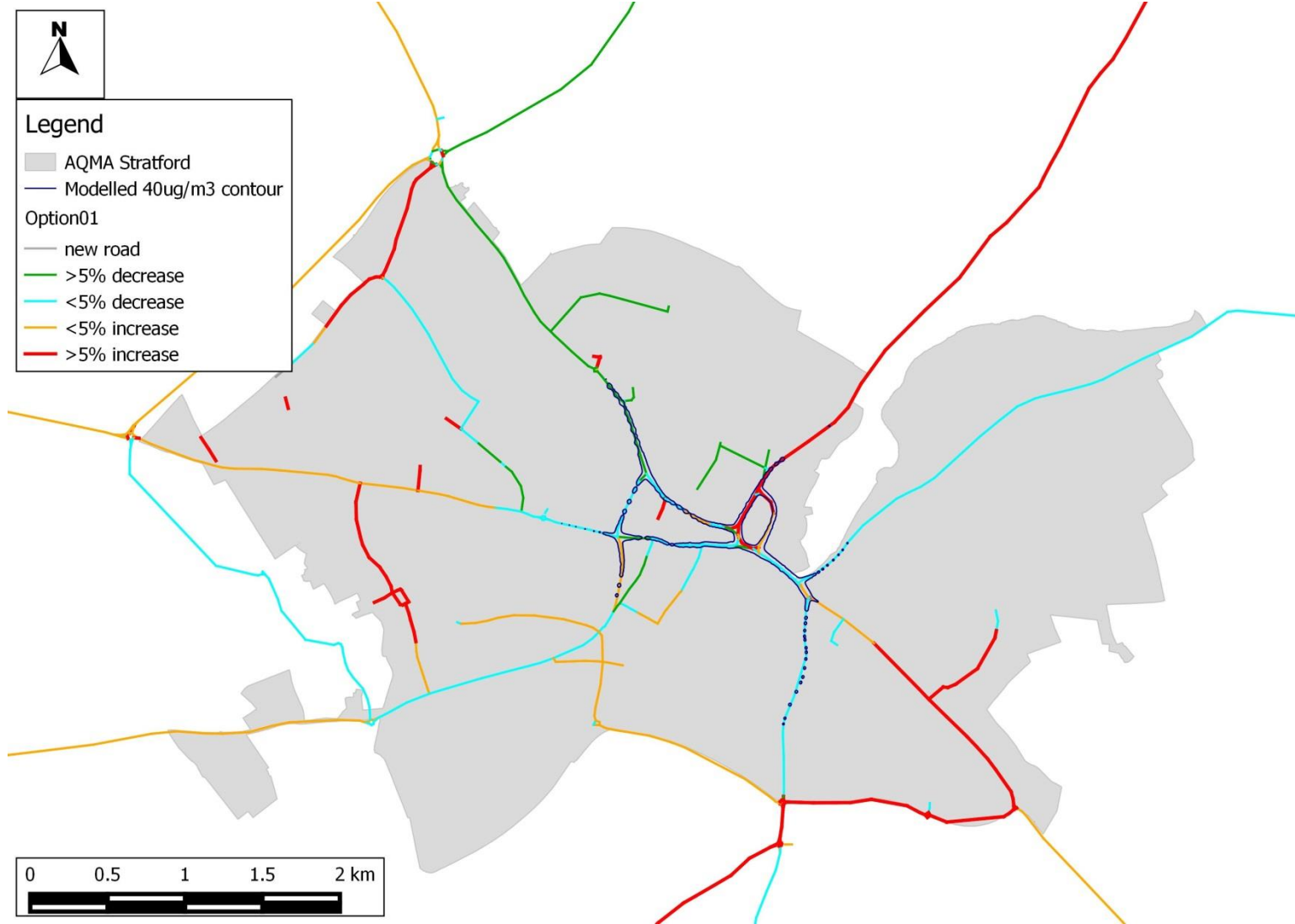
Contains Ordnance Survey data © Crown copyright and database right 2014

**Table 1: 2015 to 2028 Changes in 4-hour peak flow (where total >1,000)**

Area	Receptors?	Narrow and congested?	Current Risk of Exceedence?	Growth	Further Action?
<b>Previously modelled area</b>					
<b>Warwick Road/Bridgeway gyratory</b>	Back of pavement on Warwick Road and northern section of Bridgeway	Slight canyon near receptors, possible congestion	Modelled >40 µg/m <sup>3</sup>	5-10% on sections where no receptors. Decreases on sections with receptors	<b>Monitoring suggested near to receptors</b>
<b>Wood Street</b>	Possibly above shops, at back of pavement	Congested, some sections narrow	Modelled >40 µg/m <sup>3</sup>	5-10%	<b>Model if receptors present</b>
<b>Greenhill Street</b>	Possibly above shops, at back of pavement	Congested, some sections narrow	Modelled >40 µg/m <sup>3</sup>	10-15%	<b>Model if receptors present</b>
<b>Grove Road</b>	Sheltered accommodation at junction with Alcester Road	Congested, slight canyon	Modelled >40 µg/m <sup>3</sup>	Reductions	None
<b>Alcester Road</b>	Houses set fairly well back	Congested nr junction with Grove Road	Modelled >40 µg/m <sup>3</sup> nr Grove Road junction	10-15%	None
<b>Arden Street/Birmingham Road (east of Arden St)</b>	Flats near junction, houses on Birmingham Road	Potential for congestion, not particularly narrow	Modelled >40 µg/m <sup>3</sup>	5-10%	<b>Model</b>
<b>Warwick Road (north of Stratford)</b>	Few isolated, well back from road	No	Unlikely	Reductions	None
<b>Other areas in AQMA where &gt;5% increase predicted (4-hour peak flow &gt;1,000)</b>					
<b>Banbury Road</b>	Houses set well back	Wide, possible congestion at peak hours	Unlikely at sensitive receptors	>15%	None

Area	Receptors?	Narrow and congested?	Current Risk of Exceedence?	Growth	Further Action?
<b>Dale Avenue/Loxley Road</b>	Houses set well back	No	Unlikely	>15%	None
<b>Shottery</b>	Some houses at back of narrow pavement	Narrow	Unlikely with current traffic flows	Reductions	None
<b>Birmingham Road</b>	Houses set well back	Wide	Unlikely	5-10%	None
<b>Masons Road</b>	Houses set back	No	Unlikely	>10%	None
<b>Campden Road/Trinity Way</b>	No sensitive receptors	No	Unlikely	>15%	None
<b>Seven Meadows Road</b>	Houses set well back	No	Unlikely	>15%	None
<b>Sanctus Road</b>	Some back of pavement in narrow section nr junction	Only small section narrow	Unlikely with current traffic flows	>15%	<b>Monitoring suggested to confirm exceedence unlikely</b>
<b>Evesham Road</b>	Houses set well back	No	Unlikely	5-15%	None
<b>Shakespeare St/Mulberry St/Maidenhead Road/St Gregory's Rd</b>	Houses at back of pavement	Narrow roads, many one-way with parking either side	Unlikely, flows relatively low	5-15%	None

**Figure 3: Option 1 – Changes in 4-hour peak flow (where total >1,000)**

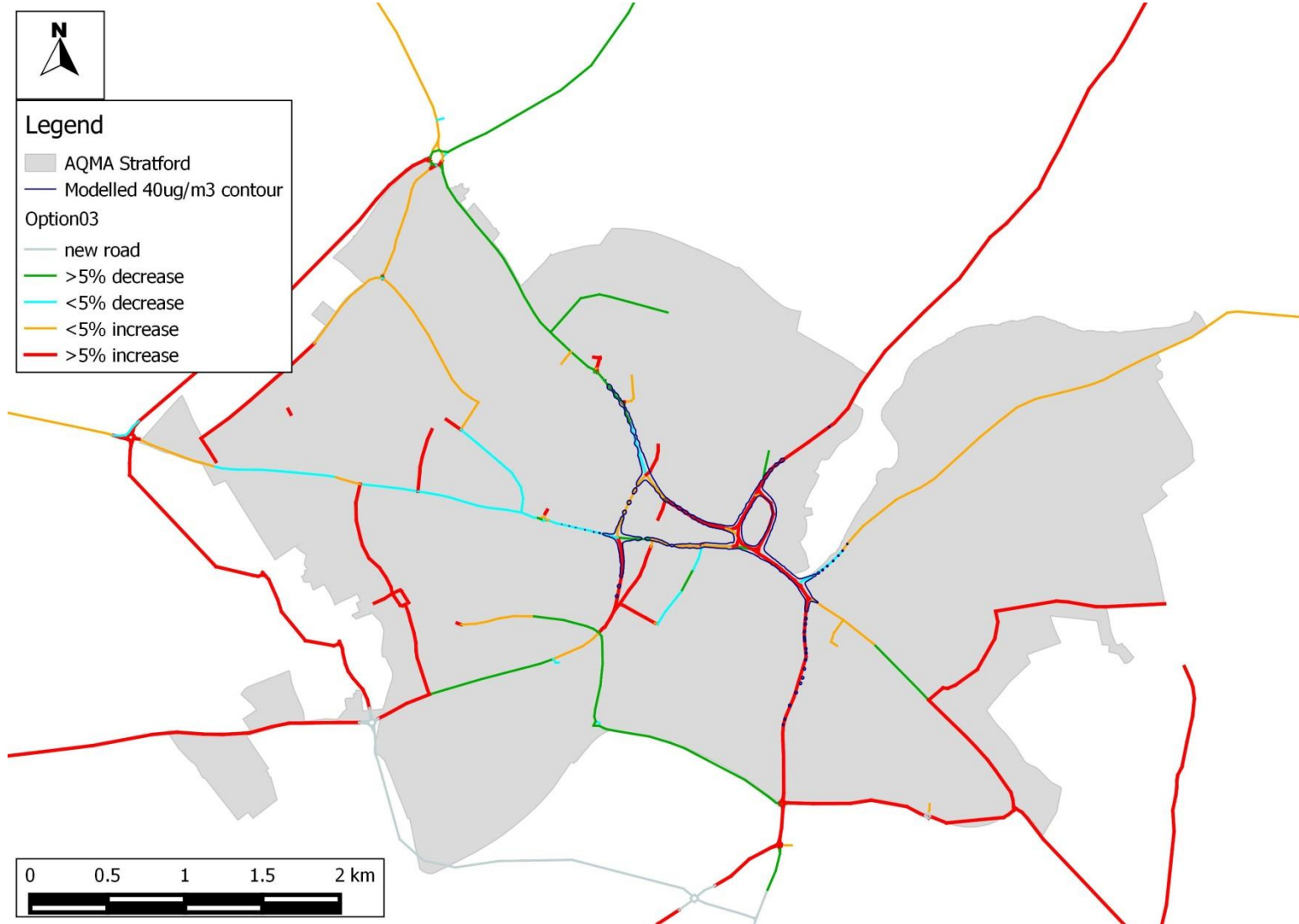


Contains Ordnance Survey data © Crown copyright and database right 2014

**Table 2: Option 1 – Analysis of locations where >5% increase predicted (4-hour peak flow >1,000)**

Area	Receptors?	Narrow and congested?	Risk of Exceedence?	Further Action?
<b>Previously modelled area</b>				
<b>Warwick Road/Bridgeway gyratory</b>	Back of pavement	Slight canyon, possible congestion	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model and monitor</b>
<b>Warwick Road (north of Stratford)</b>	Few isolated, well back from road	No	Unlikely	None
<b>Windsor Street</b>	Some houses fairly close and possibly flats above shops at back of pavement	Yes	Possible, although not in modelled exceedence area	<b>Consider monitoring and modelling</b>
<b>Other areas in AQMA</b>				
<b>Banbury Road</b>	Houses set well back	Wide, possible congestion at peak hours	Unlikely at sensitive receptors	None
<b>Dale Avenue</b>	Houses set well back	No	Unlikely	None
<b>Shottery</b>	Some houses at back of narrow pavement	Narrow	Unlikely with current traffic flows	<b>Monitoring suggested to confirm exceedence unlikely</b>
<b>Bishopston Lane</b>	Houses set well back	Wide	Unlikely	None
<b>Brookside Road/Masons Road</b>	Houses set back	No	Unlikely	None
<b>Campden Road/Trinity Way</b>	No sensitive receptors	No	Unlikely	None

**Figure 4: Option 3 - Changes in 4-hour peak flow (where total >1,000)**



Contains Ordnance Survey data © Crown copyright and database right 2014

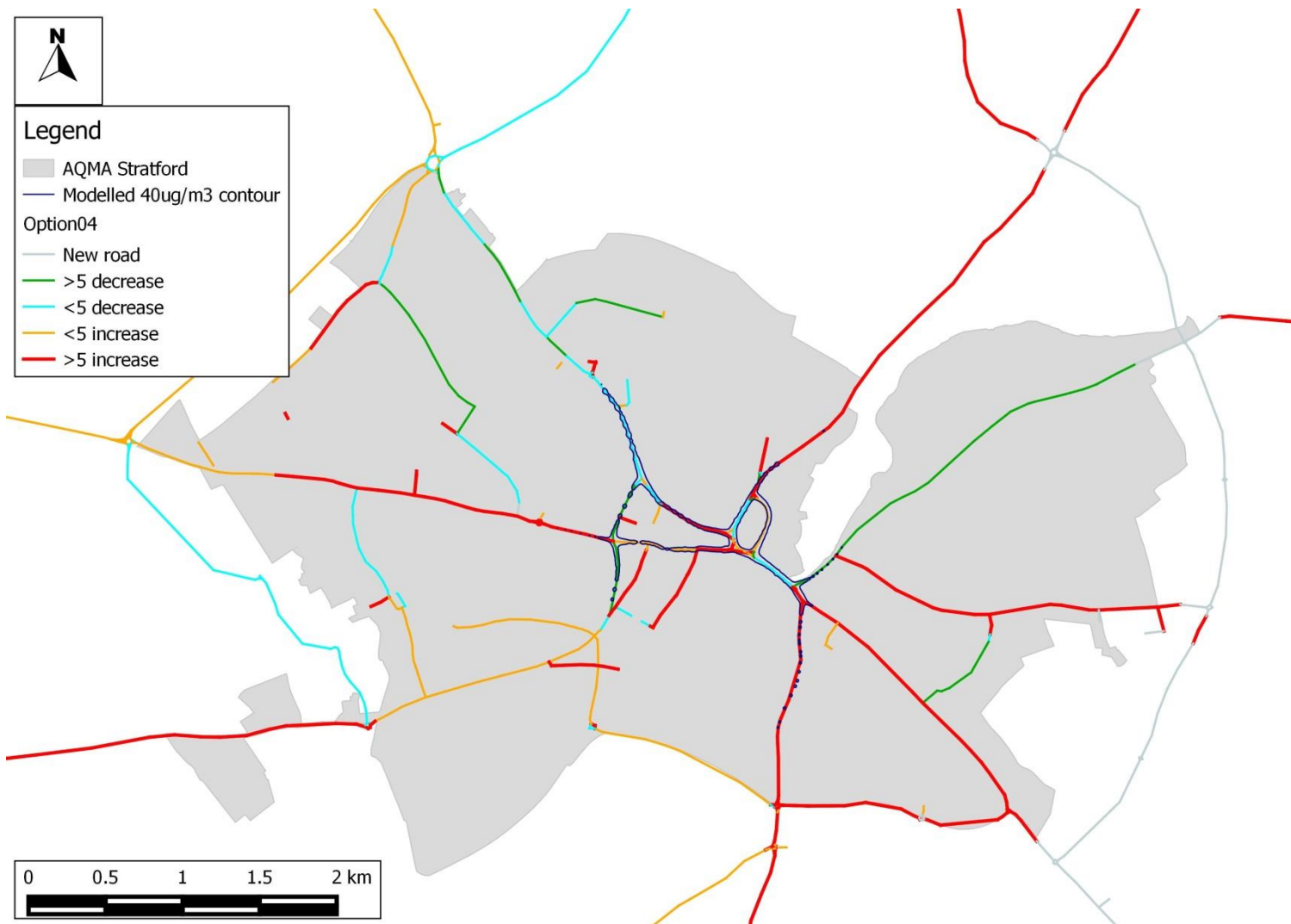
**Table 3: Option 3 – Analysis of locations where >5% increase predicted (4-hour peak flow >1,000)**

Area	Receptors?	Narrow and congested?	Risk of Exceedence?	Further Action?
<b>Previously modelled area</b>				
<b>Warwick Road/Bridgeway gyratory</b>	Back of pavement	Slight canyon, possible congestion	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model and monitor</b>
<b>Warwick Road (north of Stratford)</b>	Few isolated, well back from road	No	Unlikely	None
<b>Banbury Road/Shipston Road near junction</b>	Some near to junction on Shipston Road and Banbury Road	Congested but not narrow	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model</b>
<b>Windsor Street</b>	Some houses fairly close and possibly flats above shops at back of pavement	Yes	Possible, although not in modelled exceedence area	<b>Yes – model</b>
<b>Guild Street</b>	Yes	Congested, slight canyon	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model</b>
<b>Rother Street (north)</b>	Houses at back of pavement and possible flats above shops	Congested, slight canyon	Possible, although not in modelled exceedence area	<b>Yes - model</b>
<b>Grove Road</b>	Sheltered accommodation at junction with Alcester Road	Congested, slight canyon	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model, monitoring already being carried out</b>
<b>Other areas in AQMA</b>				
<b>Shipston Road</b>	Houses set well back	Wide, possible congestion at peak hours	Unlikely at sensitive receptors	None



Area	Receptors?	Narrow and congested?	Risk of Exceedence?	Further Action?
<b>Banbury Road</b>	Houses set well back	Wide, possible congestion at peak hours	Unlikely at sensitive receptors	None
<b>Chesnut Walk</b>	Approx. 2m from back of pavement	Narrow in places	Unlikely with current traffic flows	None
<b>Dale Avenue/Loxley Road</b>	Houses set well back	No	Unlikely	None
<b>Shottery</b>	Some houses at back of narrow pavement	Narrow	Unlikely with current traffic flows	<b>Monitoring suggested to confirm exceedence unlikely</b>
<b>Bishopston Lane</b>	Houses set well back	Wide	Unlikely	None
<b>Brookside Road/Masons Road</b>	Houses set back	No	Unlikely	None
<b>Campden Road/Trinity Way</b>	No sensitive receptors	No	Unlikely	None
<b>Evesham Road</b>	Houses set well back	No	Unlikely	None

**Figure 5: Option 4 - Changes in 4-hour peak flow (where total >1,000)**



Contains Ordnance Survey data © Crown copyright and database right 2014

**Table 4: Option 4 – Analysis of locations where >5% increase predicted (4-hour peak flow >1,000)**

Area	Receptors?	Narrow and congested?	Risk of Exceedence?	Further Action?
<b>Previously modelled area</b>				
<b>Warwick Road/Bridgeway gyratory</b>	Back of pavement, near Warwick Road, where increases expected	Slight canyon, possible congestion	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model and monitor</b>
<b>Warwick Road (north of Stratford)</b>	Few isolated, well back from road	No	Unlikely	None
<b>Banbury Road/Shipston Road near junction</b>	Some near to junction on Shipston Road and Banbury Road	Congested but not narrow	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model and monitor</b>
<b>Guild Street</b>	Yes	Congested, slight canyon	Modelled >40 µg/m <sup>3</sup>	<b>Yes – model</b>
<b>Rother Street (north)</b>	Houses at back of pavement and possible flats above shops	Congested, slight canyon	Possible, although not in modelled exceedence area	<b>Yes - model</b>
<b>Bridge Street</b>	Possibly flats above shops	Congested, wide	Modelled >40 µg/m <sup>3</sup>	<b>Model if receptors present</b>
<b>High Street</b>	Possibly flats above shops	Congested, slight canyon	Possible, although not in modelled exceedence area	<b>Model if receptors present</b>
<b>Alcester Road</b>	Houses set fairly well back	Congested nr junction with Grove Road	Modelled >40 µg/m <sup>3</sup> nr Grove Road junction	None
<b>Other areas in AQMA</b>				
<b>Shipston Road</b>	Houses set well back	Wide, possible congestion at peak hours	Unlikely at sensitive receptors	None

Area	Receptors?	Narrow and congested?	Risk of Exceedence?	Further Action?
<b>Banbury Road</b>	Houses set well back	Wide, possible congestion at peak hours	Unlikely at sensitive receptors	None
<b>Loxley Road</b>	Houses set well back	No	Unlikely	None
<b>Bishopston Lane</b>	Houses set well back	Wide	Unlikely	None
<b>Brookside Road/Masons Road</b>	Houses set back	No	Unlikely	None
<b>Campden Road/Trinity Way</b>	No sensitive receptors	No	Unlikely	None
<b>Alcester Road</b>	Houses set well back	No	Unlikely	None
<b>Sanctus Road</b>	Some back of pavement in narrow section nr junction	Only small section narrow	Unlikely with current traffic flows	<b>Monitoring suggested to confirm exceedence unlikely</b>

## 4 Recommendations

4.1 It is recommended that detailed modelling is carried out for most of the previously modelled area in the centre of Stratford, to include:

- Warwick Road/Bridgeway gyratory;
- Banbury Road/Shipston Road junction;
- Greenhill Street/Grove Street junction;
- Greenhill Street/Rother Street junction;
- Arden Street/Birmingham Road junction;
- Windsor Street/Guild Street junction; and
- Bridge Street/High Street junction (if receptors present).

4.2 It is suggested that monitoring is carried out to determine whether there is a risk of exceedence of the annual mean nitrogen dioxide objective in the following locations:

- Warwick Road/Bridgeway gyratory;
- Windsor Street;
- Sanctus Road; and
- Shottery.

## 5 References

Air Quality Consultants Ltd (2010). Further Assessment of Air Quality in the Stratford-on-Avon AQMA, September 2010

Stratford-on-Avon District Council (2014). 2014 Air Quality Progress Report for Stratford-on-Avon District Council, May 2014

Warwickshire County Council (2014) Stratford-on-Avon Strategic Transport Assessment Options Analysis Report, April 2014

## 6 Glossary

**AADT** Annual Average Daily Traffic

**AQMA** Air Quality Management Area

**Exceedence** A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure

**µg/m<sup>3</sup>** Microgrammes per cubic metre

**NO** Nitric oxide

**NO<sub>2</sub>** Nitrogen dioxide

**NO<sub>x</sub>** Nitrogen oxides (taken to be NO<sub>2</sub> + NO)

**Objectives** A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides

**Standards** A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal