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Stratford-upon-Avon – Third River Crossing High Level Option Appraisal

January 2016

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1 INTRODUCTION

1.1 Vectos Microsim (VM) has been commissioned by Warwickshire County Council (WCC) to undertake a study to evaluate the impact of delivering additional road capacity provision within Stratford-upon-Avon in the form of a third river crossing.

1.2 This work is being produced in response to a number of transport issues both observed and forecast to occur within the area of Stratford-upon-Avon. The work is also intended to take account of the likely impact of Stratford on Avon District Council's proposals for allocating housing and employment through the Core Strategy up to 2031.

Objectives

1.3 The analysis set out within this report provides an initial overview of the potential benefits that may be unlocked via the delivery of additional road capacity, most likely in the form of an additional crossing across the River Avon which bisects Stratford-upon-Avon town.

Background

1.4 The SuAWA model was recently recalibrated and validated using more up to date counts, ranging from 2013 to 2015, as well as additional routing information such as the 2011 Census journey to work (JtW) data base and routing information collected in key areas of the network through Automatic Number Plate (ANPR) surveys.

1.5 Upon completion of the 2013 SuAWA Base model, VM updated the SuAWA 2031 Reference and 2031 Core Strategy models, to ensure that all relevant developments within the Stratford area, which have been granted planning permission since the last model update, were included within the model.

1.6 A further 'Core Strategy' model reflecting the Core Strategy proposals, has also been developed, this included the proposed development demands and infrastructure improvements relating to the Core Strategy sites. Detail on the 2031 Reference and Core Strategy models are provided in the Stratford upon Avon Wide Area Forecasting Report[1].

[1] VM155042.R001 – Model Forecasting Report - Stratford upon Avon Wide Area Model

Report Structure

1.7 The remainder of the report is set out as follows:

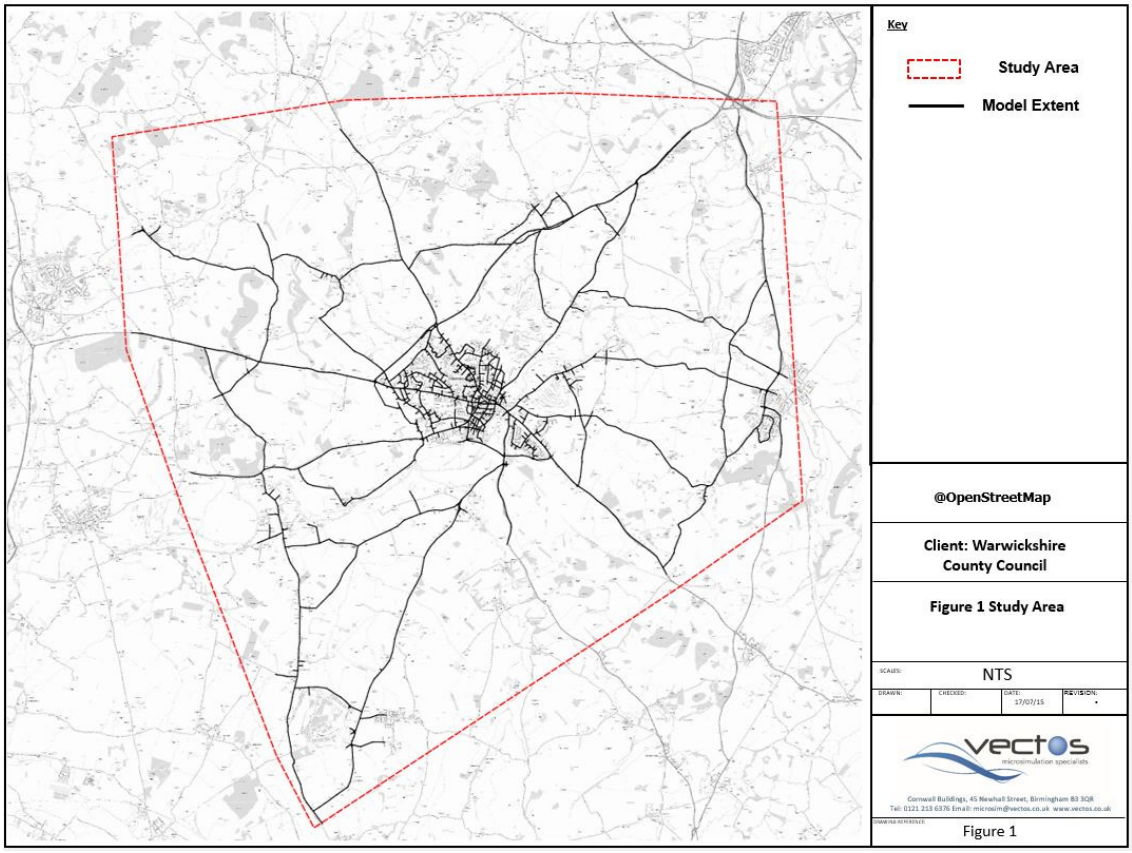
- **Chapter 2** – Provides an overview of the project scope, study area and scenarios to be assessed;
- **Chapter 3** – Summarises the development of the Reference Case and Core Strategy models
- **Chapter 4** – Summarises the details of the Relief Road options to be included within the models;
- **Chapter 5** – Provides a summary of the network performance of each of the scenarios assessed;
- **Chapter 6** – Presents statistical results obtained from the model runs of the scenarios tests, including analysis of Key Performance Indicators and Queue Lengths across the modelled network;
- **Chapter 7** – Presents an overview of impacts of additional road capacity on the town centre traffic conditions;
- **Chapter 8** – Summarises the findings of the study undertaken and presents the conclusions identified thus far.

2 STUDY SCOPE AND SCENARIO ASSESSMENT

Study Area

2.1 The area covered by the SuAWA model is shown in Figure 1. The model includes Stratford-upon-Avon town centre, and extends to include rural areas stretching towards the M40 to the north, and Wellesbourne to the east.

Figure 1 Study Area



2.2 Throughout the process of compiling evidence for both planning applications and the assessment of the Core Strategy proposals put forward by SDC, the number of existing river crossings has been highlighted as something which will likely constrain the delivery of housing and employment within the area, particularly in areas to the southwest of the town.

2.3 When approaching from the south and southwest there are two primary opportunities for crossing the river Avon on route into the town. The historic Clopton Bridge provides one of the main routes into the town and is frequently observed to suffer from severe traffic congestion during peak periods. The second crossing is provided by Trinity Way, this was

opened in the 1980's and enables traffic to cross the river Avon via a bridge which connects Shipston road and Evesham Road passing via the back of Stratford Race course. .

2.4 Similar to the issues surrounding the traffic conditions around Clopton Bridge, the Evesham Road/Evesham Place roundabout is frequently observed to suffer from severe traffic congestion during the peak periods. Although less regular in occurrence than the traffic conditions around Clopton Bridge, extensive queues into the town centre can be observed to form, during the AM and PM along both Evesham Road and Seven Meadows Road. At times the queuing along Seven Meadows can be seen to extend back behind the Racecourse and, on occasion, as far as Shipston Road. As traffic conditions around Clopton Bridge worsen over time the queuing in this area will also be exacerbated as more traffic will seek to find alternative routes to Clopton Bridge.

2.5 Analysis of mitigation options at both Clopton Bridge and Evesham place has been undertaken throughout the course of providing evidence in support of the SDC Core Strategy. This has revealed that opportunities for mitigation measures to be delivered are limited, primarily due to highway capacity, and will likely comprise some form of signal control.

2.6 The availability of highway land is perceived to be a significant constraint to the delivery of mitigation measures in and around the area of the Evesham Road/Evesham Place junction and the opportunities' for capacity enhancements to be delivered in this area are significantly restricted as a result.

2.7 As a result of the existing and emerging traffic congestion around Stratford-upon-Avon, and specifically around the areas highlighted previously, specifically the limited opportunities' for further enhancements of the network in the areas of Clopton Bridge and Evesham Road/Evesham Place, it is considered appropriate that alternative methods of enhancing the network capacity and providing further resilience are investigated and, in this instance, it is considered that the provision of a third river crossing, which will serve as a means to bypass these existing congestion hot-spots, represents the optimum solution to safeguard the network performance throughout the life of the plan.

Scenario Assessment

2.8 A number of options have been identified for the provision of a third river crossing, intended to provide additional road capacity within the Stratford-upon-Avon network. In total, as part of this study, six scenarios have been assessed and are listed as follows:

- **Scenario 1** – Reference Case - inclusive of the Shottery Western Relief Road (WRR)
- **Scenario 2** – Western Alignment – extending the relief road which is present in the Reference Case, to form a complete Western Relief Road (S-WRR) between the A3400 Shipston Road and the A46/A422 at the Wildmoor junction.
- **Scenario 3** – Eastern Alignment – full Eastern bypass alignment (ERR) to be included within the model network, extending from Banbury Road at its southern extent to Warwick Road at its northern extent.
- **Scenario 4** – Eastern Alignment Partial – As per Scenario 3, but ending where the ERR meets Tiddington Road. This scenario also includes the upgrade and straightening of the alignment of Wellesbourne Road to the A429, which then provides a route through to the M40 via Longbridge Island.
- **Scenario 5** – Comprising Scenarios 2 and 3 – full western and eastern routes
- **Scenario 6** – Comprising Scenarios 2 and 4 – full western and partial eastern routes

2.9 Following the testing of the above scenarios within the Reference Case network, the scenarios have then been tested within the Core Strategy network.

Western Relief Road (S-WRR) Option

2.10 The proposed Western Relief Road alignment connects the A3400 Shipston Road with the B439 Evesham Road. The link itself routes to the south of the Stratford-upon-Avon Racecourse and joins Luddington Road across the River Avon.

2.11 The proposed alignment of the S-WRR is shown in Figure 2.

Eastern Relief Road (ERR) Option

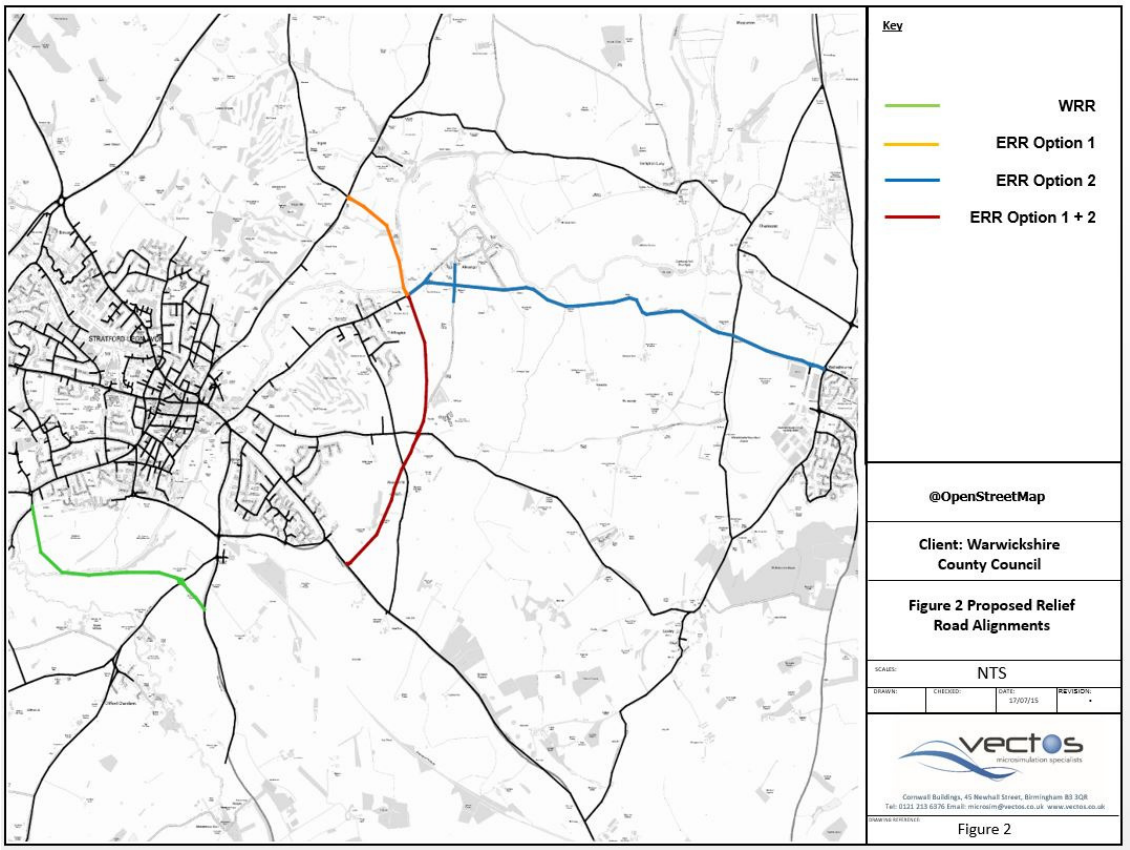
2.12 The proposed Eastern Relief Road alignment connects the A422 Banbury Road with the A439 Warwick Road via Tiddington Road, and a third River Bridge across the River Avon. The proposed alignment also connects Wellesbourne and the adjacent M40 which would

undoubtedly relieve some of the traffic issues in the area. As such, two options of ERR are to be tested, as follows (Figure 2):

i) **ERR Option 1 (Full Eastern Bypass)** – Adjoining the A422 Banbury Road connecting with the B4086 Main Street, Tiddington and subsequently the A439 Warwick Road/Ingon Lane. Delivery of such a programme would require the construction of an elevated bridge section above the River Avon and the local floodplain area.

ii) **ERR Option 2 (Partial ERR)** – Improving the alternative ERR route via the B4086 linking with the A429 at Wellesbourne. As part of this option, the B4086 has been upgraded to a 'major' routing network. The assignment of this route as 'major' is necessary as the link becomes equally as attractive to both familiar and unfamiliar drivers thus encouraging a higher volume of traffic use depending on the conditions along the local transport network.

Figure 2 Proposed Relief Road Alignments



2.13 Although the partial option does not necessarily provide an additional river crossing point, it is considered that the alternative route should be investigated as a means of providing a

more attractive 'bypass' both of the river and SuA town centre and the option has therefore been assessed on this basis.

2.14 The above have been included within the 2031 Reference and Core Strategy models, to create the following scenarios:

Reference Models

- M001A - 2031 Reference Model
- M001B - 2031 Reference Model + S-WRR
- M001C - 2031 Reference Model + ERR
- M001D - 2031 Reference Model + Partial ERR
- M001E - 2031 Reference Model + S-WRR + ERR
- M001F - 2031 Reference Model + S-WRR + Partial ERR

Core Strategy Models

- M002A - 2031 Core Strategy Model
- M002B - 2031 Core Strategy Model + S-WRR
- M002C - 2031 Core Strategy Model + ERR
- M002D - 2031 Core Strategy Model + Partial ERR
- M002E - 2031 Core Strategy Model + S-WRR + ERR
- M002F - 2031 Core Strategy Model + S-WRR + Partial ERR

3 SCENARIO DEVELOPMENT

3.1 This assessment has made use of the 2031 Reference Case model and 2031 Core Strategy model for Stratford-upon-Avon. These models have been created from the recently updated 2013 Base model for Stratford-upon Avon. The model development process that has been undertaken to create both the Reference Case and Core Strategy models is summarised in the following section of the report, along with a summary of the network changes applied in each of the subsequent assessment scenarios.

2031 Reference Case

Committed Development

3.2 The 2031 Reference Case update required the inclusion of all relevant committed development trips within the model. All developments that have been approved since the 2013 Base year, irrespective of development magnitude, have been included within the 2031 Reference Model.

3.3 Table 1 details the developments that have been documented by WCC as having been recently permitted within the Stratford-upon-Avon area, which are to be accounted for within the Reference Case models.

Table 1 Committed Development Details

Name	Details
A. Land east of Birmingham Road	60 dwellings
B. Land between 256 And 346, Birmingham Rd	85 dwellings
C. Stratford Cattle Market	214 dwellings
D. Tesco Extension	2,916 sqm extension to existing store
E. McDonalds Western Road	Two storey restaurant
F. Meon Vale, Long Marston	550 dwellings
G. Land west of Birmingham Road, Bishopton	160 dwellings
H. Land to the West of Shottery	800 dwellings
I. Warwick House, Birmingham Road	82 dwellings
J. Home Guard Club, Main Street, Tiddington	32 dwellings
K. Land off Oak Road, Tiddington	60 dwellings
L. Codex Sims Metal	380 dwellings + 5,000 sqm employment
M. Long Marston Airfield (400)	400 dwellings
N. Arden Heath Farm	270 dwellings

3.4 The committed development trip demands were assigned to the model using either new zones specifically for the development or using existing zones if applicable.

3.5 The assessment then made use of available 2011 Census Journey to Work data to provide a trip distribution for the committed developments included within the model extent. The trip distribution was derived by combining the Journey to Work data at MSOA level for three areas that represent Stratford-upon-Avon. This combined data has then been used to predict the distribution of trips across the modelled network and beyond for each committed development.

3.6 The analysis demonstrated that 42.2% of trips will travel to/from the committed developments from zones within the model extent, whilst 57.8% of trips will travel to/from areas outside of the model extent.

Model Forecasting

3.7 The 2031 Reference model created through this exercise has been forecast via the inclusion of all known committed developments, as noted above, but also through the interrogation of the TEMPRO database.

3.8 The level of growth contained within the model has been capped at NTEM adjusted TEMPRO forecast levels of growth. Where TEMPRO factors have been used to inform growth, it was deemed necessary to adjust by NTEM for the purposes of this forecast, as it is considered that application of these factors would result a more realistic representation of growth when considering the number of dwellings to be delivered across the study area.

Model Review and Network Refinement

3.9 Following the inclusion of the forecast demands a review of the model operation was undertaken. It was observed that significant congestion issues were occurring, most notably in the 2031 Reference model's AM period. At this point two committed schemes were included within the model network. These schemes, detailed below, are to be delivered as part of the planning application relating to the Meon Vale site.

- Tiddington Road/Banbury Road; and
- Bridge Foot/Bridgeway Stratford Gyratory

Tiddington Road/Banbury Road

3.10 This scheme involves the reconfiguration of the existing priority junction into a signalised junction.

Bridge Foot/Bridgeway Stratford Gyratory

3.11 This scheme involves signalisation of the Bridgeway/Bridge Foot and Bridge Street/Bridge Foot entry arms to the Stratford Gyratory. These signals were synchronised with the Tiddington Road/Bridge Foot proposals.

Model Summary

3.12 Upon review of the model operation it was clear that the schemes around Tiddington Road/Banbury Road and Bridge Foot/Stratford Gyratory were necessary in order to reduce the significant levels of queuing that were being observed. The delivery of these two committed schemes resulted in a network with a predictable pattern of congestion, without the model resulting in 'locking up'.

3.13 Although some queues are observed within the models they do not cause severe impacts upon the model operation.

2031 Core Strategy Model

3.14 Following the completion of the 2031 Reference model, development of a further model was required to reflect the current understanding of the proposed Core Strategy. Accordingly, a 2031 Core Strategy model has been created, based upon the newly created Reference Case model.

3.15 The Core Strategy model contains the Core Strategy aspirations and commitments in terms of developments and infrastructure, and provides a suitable model in which transport infrastructure studies and Core Strategy sensitivity tests can be undertaken.

Development Assumptions

3.16 The following development assumptions have been included within the Core Strategy model:

- Allocation of 650 dwellings to the north of Stratford;
- Allocation of 650 dwellings in the Stratford Regeneration Zone (SRZ);

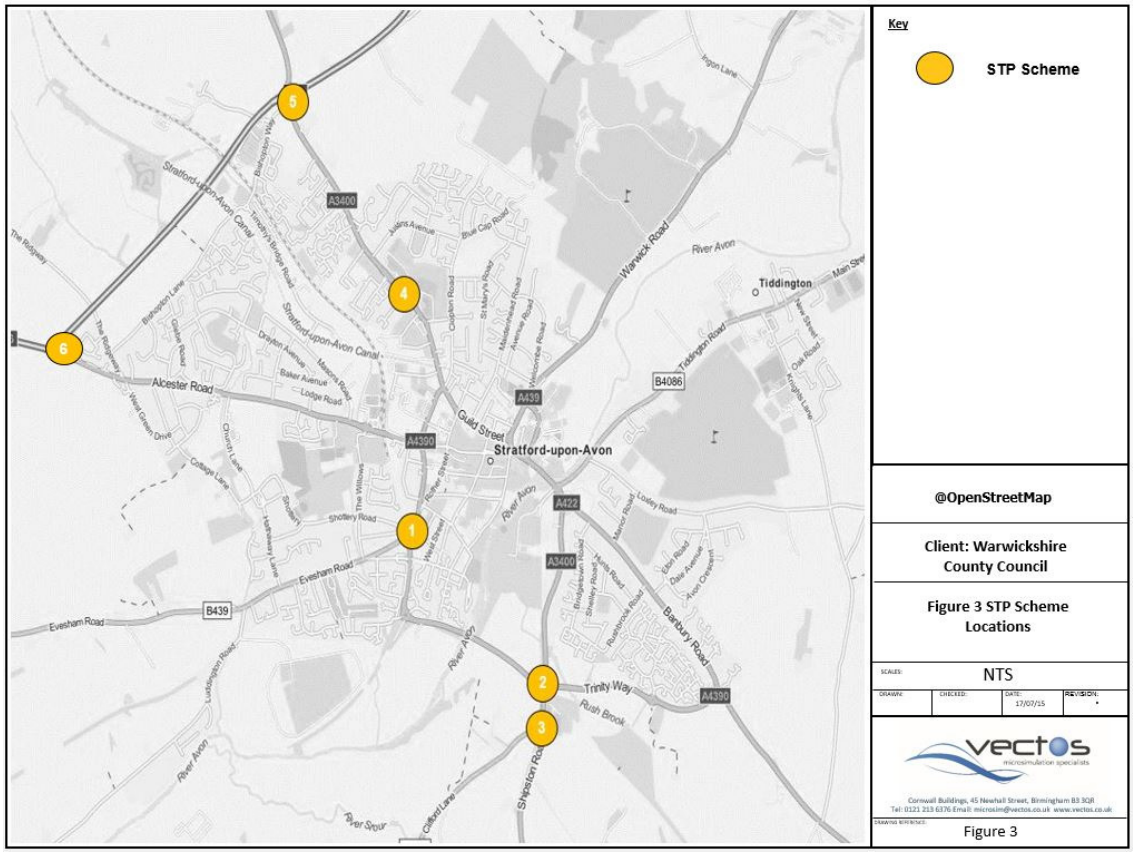
- Re-location of the employment land which currently lies within the SRZ area and the delivery of 20 hectares of employment land off Alcester Road; and
- Allocation of 3,500 dwellings at Long Marston Airfield.

Infrastructure Assumptions

3.17 During the Stratford-upon-Avon Strategic Transport Assessment process, schemes were identified that were intended to mitigate the impact of the Core Strategy developments, along with addressing issues which act to constrain the movement of traffic across the network. These schemes form the proposed Stratford Transport Package (STP).

3.18 It was deemed appropriate to include these schemes within the Core Strategy model in this instance. An overview of the schemes proposed, and therefore included within the Core Strategy model, is provided below.

Figure 3 STP Scheme Locations



Scheme 1 – Evesham Place/Evesham Road Roundabout

3.19 It is proposed that the roundabout is reconfigured to become a traffic signal controlled priority junction. During the AM heavy traffic flows are present northbound, into Stratford

whilst the opposite occurs in the PM. The use of signals allows the junction to be better tailored to the differing AM and PM conditions. Queue detectors have been used to minimise the queuing on approach to the signals. Two lane entry widths have been retained on all approaches whilst the existing highway area is used to provide stacking space for right turning traffic.

Scheme 2 & 3 – Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road Roundabouts

3.20 The proposals include widening the approaches to the roundabouts as well as, where necessary, the circulating carriageway. Two lane exit sections are provided on the Trinity Way WB, Shipston Road NB and Shipston Road SB exit arms which allow certain movements across the junction to be made from two lanes. Furthermore, the two lane exit on the Shipston Road SB has been extended to a dual section between the two junctions which provides additional capacity. There is also a segregated left turn lane for Clifford Lane NB to Shipston Road left turning traffic.

Scheme 4 - Birmingham Road between Regal Road and Justins Avenue

3.21 The proposals involve provision of two lanes northbound along the Birmingham Road from south of the junction with Regal Road to north of the junction with Hamlet Way. Further work on the schemes assumed in the Birmingham Road area is ongoing and will be revisited once an appropriate set of schemes has been identified.

Scheme 5 – Birmingham Road/A46 'Bishopton Island' Roundabout

3.22 The proposals include substantial widening of the circulating carriageway and entry and exit flares in order to increase the capacity of the junction. The scheme could potentially be adapted further to include signals but these have not been included at this stage.

Scheme 6 – Wildmoor Roundabout

3.23 The proposals include widening of the circulating carriageway and entry and exit flares in order to increase the capacity of the junction. The scheme also includes a segregated left turn for the A46 West to North movement.

Core Strategy Model Summary

3.24 The developments identified within the Core Strategy, detailed in this section, along with the schemes outlined in the Stratford Transport Package, have been included within the 2031 Reference model to create the 2031 Core Strategy model.

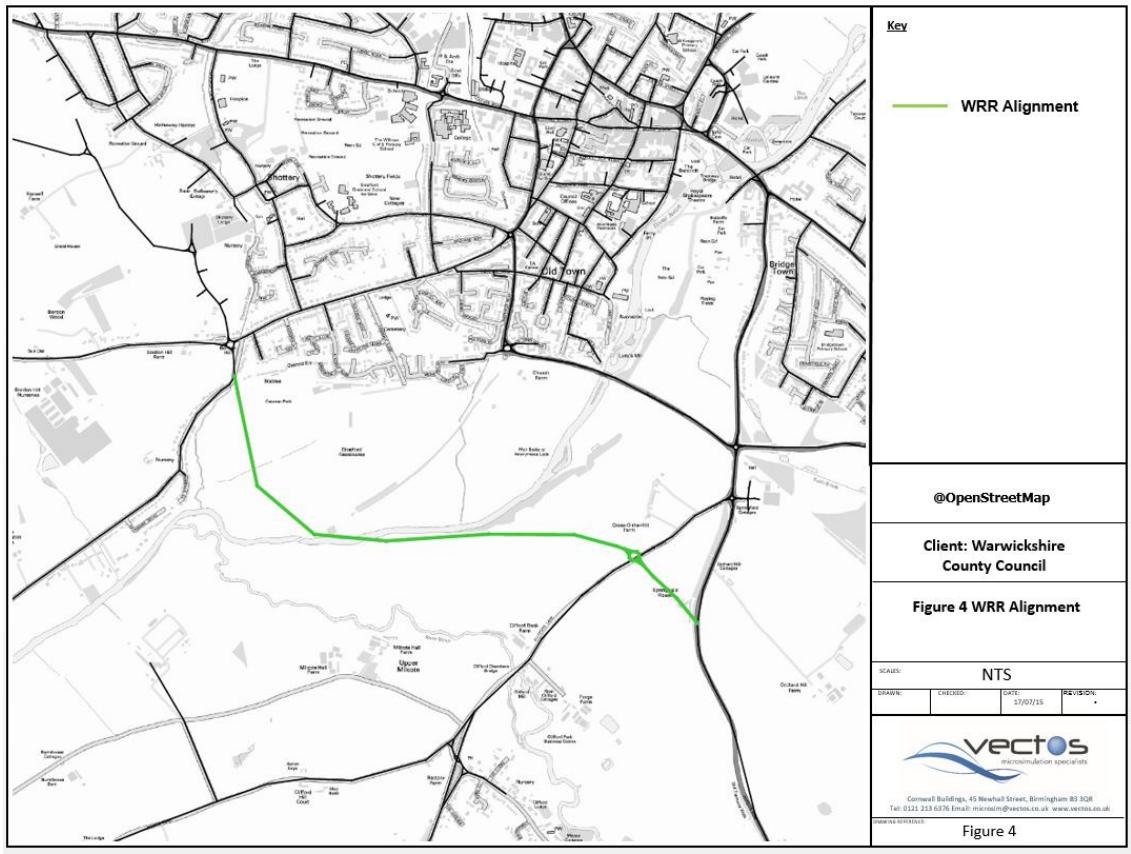
4 RELIEF ROAD ALIGNMENT

4.1 The following section details how the Western Relief Road (S-WRR), and Eastern Relief Road (ERR) have been coded into both the Reference Case and Core Strategy models, as part of the scenario testing being undertaken in this assessment.

Western Relief Road

4.2 The alignment of the Western Relief Road incorporated within the model is shown in Figure 4 below.

Figure 4 S-WRR Proposed Alignment



4.3 The southern extent of the S-WRR begins at a junction with Shipston Road. Travelling in a northbound direction, the S-WRR crosses Clifford Lane, forming of a new four arm roundabout, before routing to the south of Stratford Racecourse and meeting Evesham Road via Luddington Lane. The S-WRR meets the roundabout on Evesham Road which forms part of the relief road between Evesham Road and Alcester Road, delivered as part of the Shottery development to the west of Stratford. The provision of the S-WRR provides a continuous link from Alcester Road to Shipston Road.

4.4 The S-WRR has been coded as a 40mph, single carriageway, and major link classification along its full route.

4.5 The following calibration parameters have been applied at junctions along the ERR:

Junction 1 - Shipston Road/S-WRR Junction

4.6 The Shipston Road/S-WRR junction forms the southern extent of the S-WRR. The junction is a three arm priority junction, with the S-WRR and Shipston Road NB the major priority movements and the Shipston Road SB the minor approach. The right turn from Shipston Road SB onto the S-WRR has been barred. The approaches to the junction have been calibrated as follows:

- Shipston Road SB - Visibility set to 20m and Gap Acceptance set at default
- Shipston Road NB - Visibility set to 20m and Gap Acceptance set at default
- S-WRR SB - Visibility set to 20m and Gap Acceptance set at default

Junction 2 - Clifford Lane/S-WRR Junction

4.7 The Clifford Lane/S-WRR junction is a four arm roundabout when the S-WRR crosses Clifford Lane. The approaches to the junction have been calibrated as follows:

- Clifford Lane SB - Visibility set to 20m and Gap Acceptance set at default
- Clifford Lane NB - Visibility set to 20m and Gap Acceptance set at default
- S-WRR SB - Visibility set to 20m and Gap Acceptance set at default
- S-WRR NB - Visibility set to 20m and Gap Acceptance set at default

Junction 3 - Luddington Lane/S-WRR Junction

4.8 The Luddington Lane/S-WRR junction is a three arm priority junction, with the S-WRR and Luddington Lane SB the major priority movements and the Luddington Lane NB the minor give-way approach. The approaches to the junction have been calibrated as follows:

- Luddington Lane/S-WRR SB - Visibility set to 0m and Gap Acceptance set at default
- Luddington Lane NB - Visibility set to 0m and Gap Acceptance set at default
- S-WRR SB - Visibility set to 0m and Gap Acceptance set at default

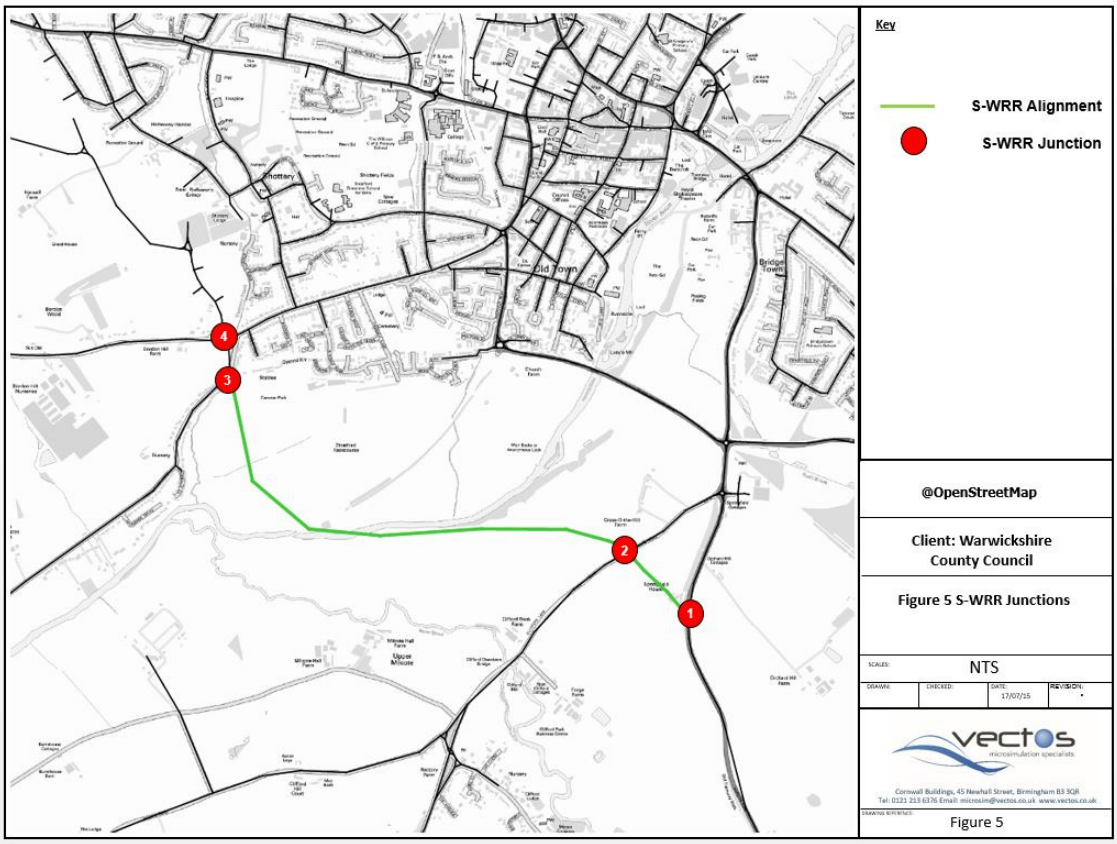
Junction 4 -Evesham Road/S-WRR Junction

4.9 The Evesham Road/S-WRR junction is a four arm roundabout at the northern extent of the S-WRR, where the S-WRR meets Evesham Road, opposite the Shottery Relief Road. The approaches to the junction have been calibrated as follows:

- Evesham Road EB - Visibility set to 17m and Gap Acceptance set at 0.20 seconds
- Evesham Road WB - Visibility set to 15m and Gap Acceptance set at 0.50 seconds
- S-WRR NB - Visibility set to 15m and Gap Acceptance set at 2.0 seconds
- Shottery Relief Road SB - Visibility set to 16m and Gap Acceptance set at 2.0 seconds

4.10 The location of the junctions listed above along the S-WRR is shown in Figure 5 below.

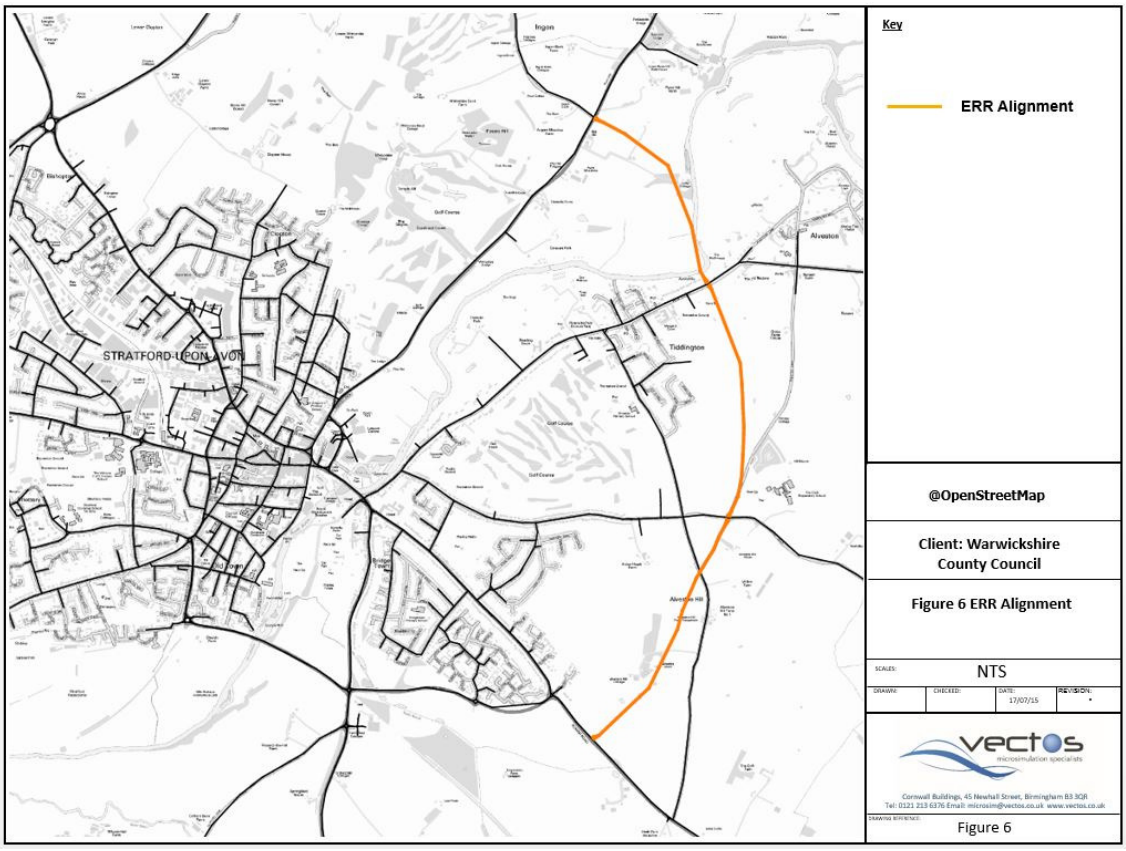
Figure 5 S-WRR Junction Locations



Eastern Relief Road

4.11 The following section details how the Eastern Relief Road (ERR) has been coded into both the Reference Case and Core Strategy models. The alignment of the Eastern Relief Road incorporated within the model is shown in Figure 6.

Figure 6 ERR Alignment



4.12 The southern extent of the ERR begins at a junction with Banbury Road, to the south of the existing A4390/Banbury Road junction. Travelling in a northbound direction, the ERR crosses Boundary Lane, forming a new four arm priority junction, before crossing Loxley Road in the form of a four arm roundabout. The ERR then crosses Tiddington Road, again in the form of a four arm roundabout, before meeting Warwick Road opposite the existing junction with Ingon Lane. At this northern extent of the ERR a further four arm roundabout is provided. The provision of the ERR provides a continuous link from Warwick Road to Banbury Road.

4.13 The ERR has been coded as a 40mph, single carriageway, major link classification along its full route.

4.14 The following calibration parameters have been applied at junctions along the ERR:

Junction 1 - Banbury Road/ERR Junction

4.15 The Banbury Road/ ERR junction forms the southern extent of the ERR. The junction is a three arm roundabout. The approaches to the junction have been calibrated as follows:

- Banbury Road SB - Visibility set to 20m and Gap Acceptance set at default
- Banbury Road NB - Visibility set to 20m and Gap Acceptance set at default
- ERR SB - Visibility set to 20m and Gap Acceptance set at default

Junction 2 - Boundary Lane/ERR Junction

4.16 The Boundary Lane/ERR junction is a four arm crossroads, where the ERR crosses Boundary Lane. The ERR forms the main arms and the Boundary Lane approaches the minor, give way arms. The approaches to the junction have been calibrated as follows:

- Boundary Lane SB - Visibility set to 0m and Gap Acceptance set at default
- Boundary Lane NB - Visibility set to 0m and Gap Acceptance set at default
- ERR SB - Visibility set to 20m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default

Junction 3 - Loxley Road/ERR Junction

4.17 The Loxley Road/ ERR junction is a four arm roundabout where the ERR crosses Loxley Road. The approaches to the junction have been calibrated as follows:

- Loxley Road EB - Visibility set to 20m and Gap Acceptance set at default
- Loxley Road WB - Visibility set to 20m and Gap Acceptance set at default
- ERR SB - Visibility set to 19.3m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default

Junction 4 - Tiddington Road/ERR Junction

4.18 The Tiddington Road/ERR junction is a four arm roundabout where the ERR crosses Tiddington Road. The approaches to the junction have been calibrated as follows:

- Tiddington Road EB - Visibility set to 20m and Gap Acceptance set at default

- Tiddington Road WB - Visibility set to 20m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default
- ERR SB - Visibility set to 20m and Gap Acceptance set at default

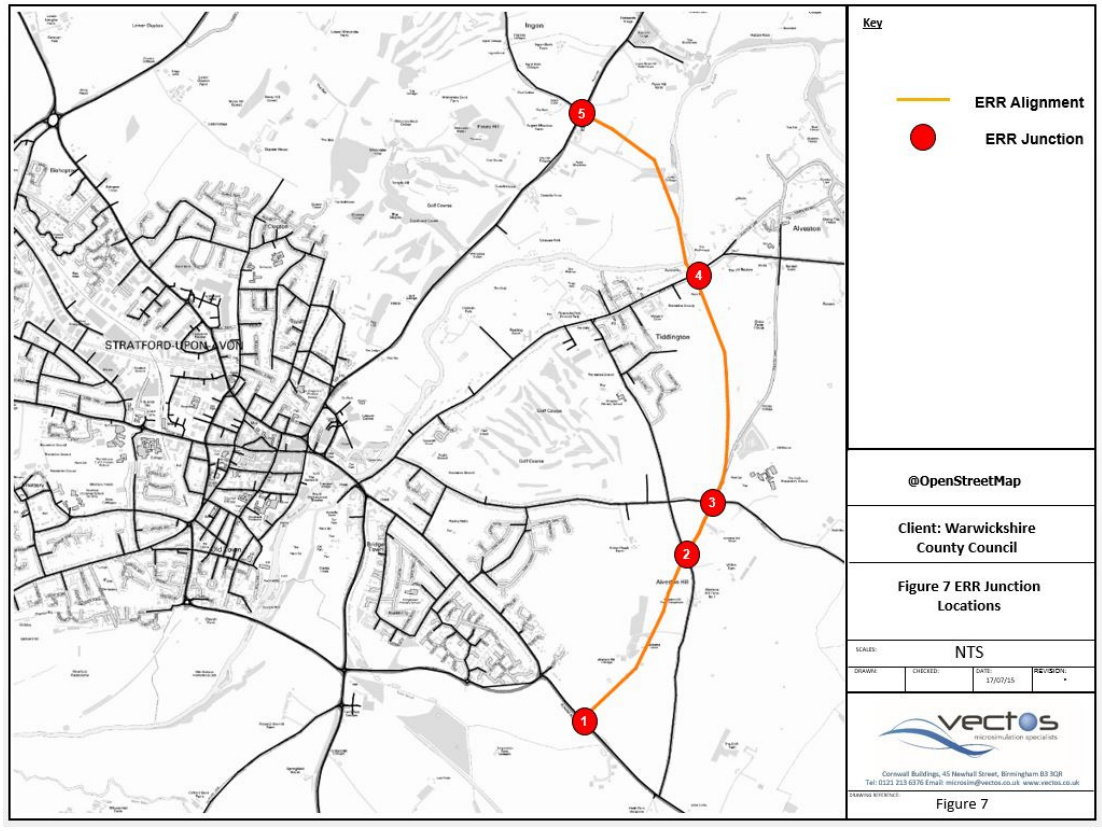
Junction 5 - Warwick Road/ERR Junction

4.19 The Warwick Road/ERR junction is a four arm roundabout at the northern extent of the ERR, where the ERR meets Warwick Road, opposite Ingon Lane. The approaches to the junction have been calibrated as follows:

- Warwick Road EB - Visibility set to 20m and Gap Acceptance set at default
- Warwick Road WB - Visibility set to 20m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default
- Ingon Lane SB - Visibility set to 20m and Gap Acceptance set at default

4.20 The location of these junctions listed above is demonstrated in Figure 7.

Figure 7 ERR Junction Locations

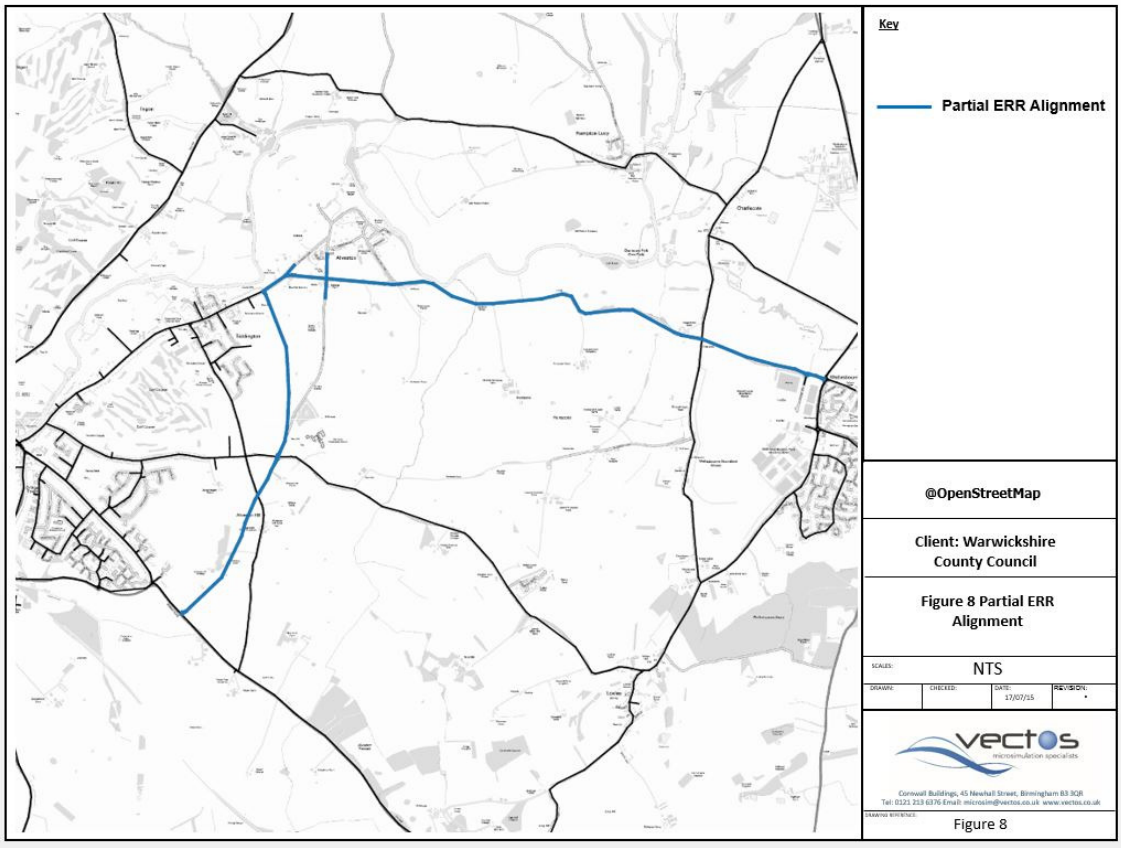


Partial Eastern Relief Road

4.21 The following section details how the Partial Eastern Relief Road (Partial ERR) has been coded into both the Reference Case and Core Strategy models.

4.22 The alignment of the Partial Eastern Relief Road incorporated within the model is shown in Figure 8.

Figure 8 Partial ERR Proposed Alignment



4.23 The southern extent of the Partial ERR begins at a junction with Banbury Road, to the south of the existing A4390/Banbury Road junction, as per the full ERR. Travelling in a northbound direction, the ERR crosses Boundary Lane, forming a new four arm priority junction, before crossing Loxley Road in the form of a four arm roundabout. The ERR then ends at the junction with Tiddington Road and forms a three arm roundabout.

4.24 From this point the western approach to the newly created roundabout at the northern extent of the partial ERR is upgraded, between this junction and Wellesbourne. The route is upgraded to a 'major' classification, making it a more attractive route for vehicles to use.

4.25 The following calibration parameters have been applied along the Partial ERR when coding it into the model:

- The Partial ERR has been coded as a 40mph, single carriageway, with major link classification along its full route.
- Wellesbourne Road has been upgraded to major classification between Wellesbourne and the junction of the Partial ERR and Tiddington Road. This route has also been 'straightened out' between Tiddington and Wellesbourne, within the model, in a further attempt to increase the attractiveness of this route.

4.26 The following calibration parameters have been applied at junctions along the Partial ERR:

Junction 1 - Banbury Road/Partial ERR Junction

4.27 The Banbury Road/Partial ERR junction forms the southern extent of the Partial ERR. The junction is a three arm roundabout. The approaches to the junction have been calibrated as follows:

- Banbury Road SB - Visibility set to 20m and Gap Acceptance set at default
- Banbury Road NB - Visibility set to 20m and Gap Acceptance set at default
- ERR SB - Visibility set to 20m and Gap Acceptance set at default

Junction 2 - Boundary Lane/Partial ERR Junction

4.28 The Boundary Lane/Partial ERR junction is a four arm crossroads, where the Partial ERR crosses Boundary Lane. The Partial ERR forms the main arms and the Boundary Lane approaches the minor, give way arms. The approaches to the junction have been calibrated as follows:

- Boundary Lane SB - Visibility set to 0m and Gap Acceptance set at default
- Boundary Lane NB - Visibility set to 0m and Gap Acceptance set at default
- ERR SB - Visibility set to 20m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default

Junction 3 - Loxley Road/Partial ERR Junction

4.29 The Loxley Road/Partial ERR junction is a four arm roundabout where the ERR crosses Loxley Road. The approaches to the junction have been calibrated as follows:

- Loxley Road EB - Visibility set to 20m and Gap Acceptance set at default
- Loxley Road WB - Visibility set to 20m and Gap Acceptance set at default
- ERR SB - Visibility set to 19.3m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default

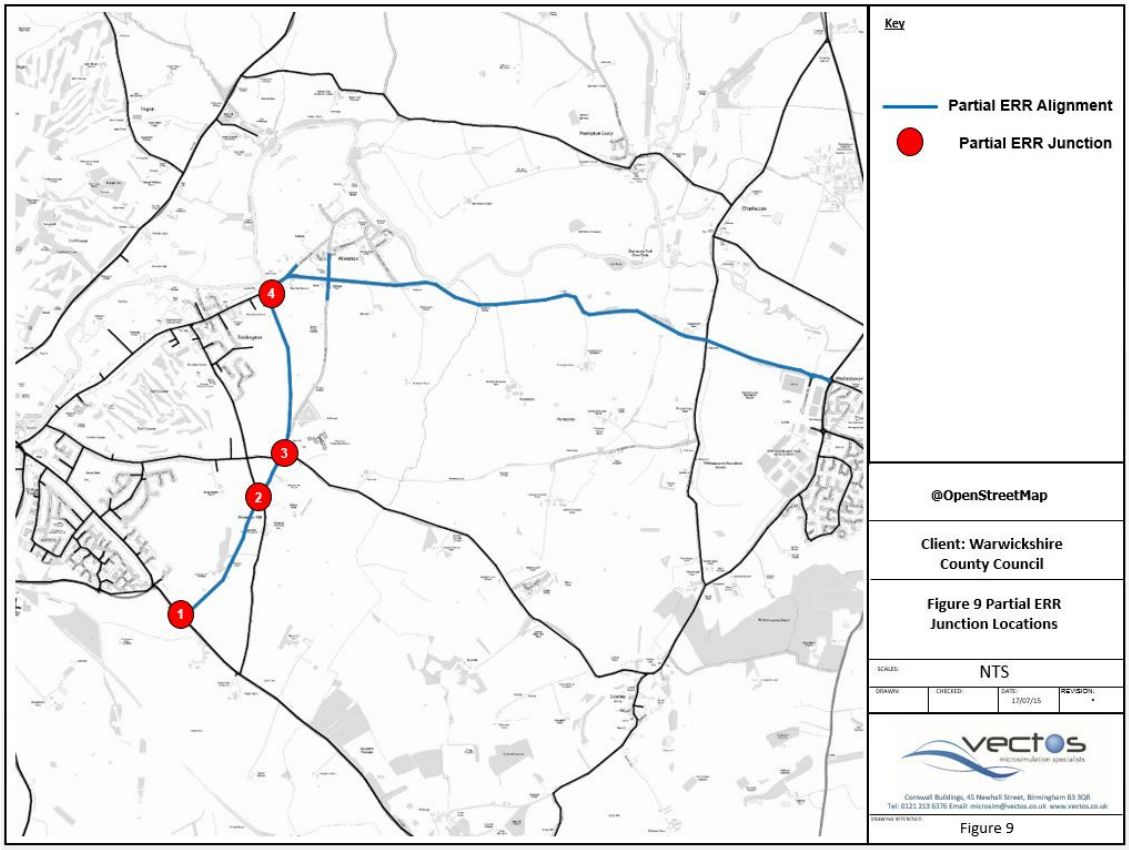
Junction 4 - Tiddington Road/Partial ERR Junction

4.30 The Tiddington Road/Partial ERR junction forms the northern extent of the Partial ERR. The junction is a three arm roundabout. The approaches to the junction have been calibrated as follows:

- Tiddington Road EB - Visibility set to 20m and Gap Acceptance set at default
- Tiddington Road WB - Visibility set to 20m and Gap Acceptance set at default
- ERR NB - Visibility set to 20m and Gap Acceptance set at default

4.31 The location of these junctions listed above is demonstrated in Figure 9.

Figure 9 Partial ERR Junction Locations



5 NETWORK PERFORMANCE SUMMARY

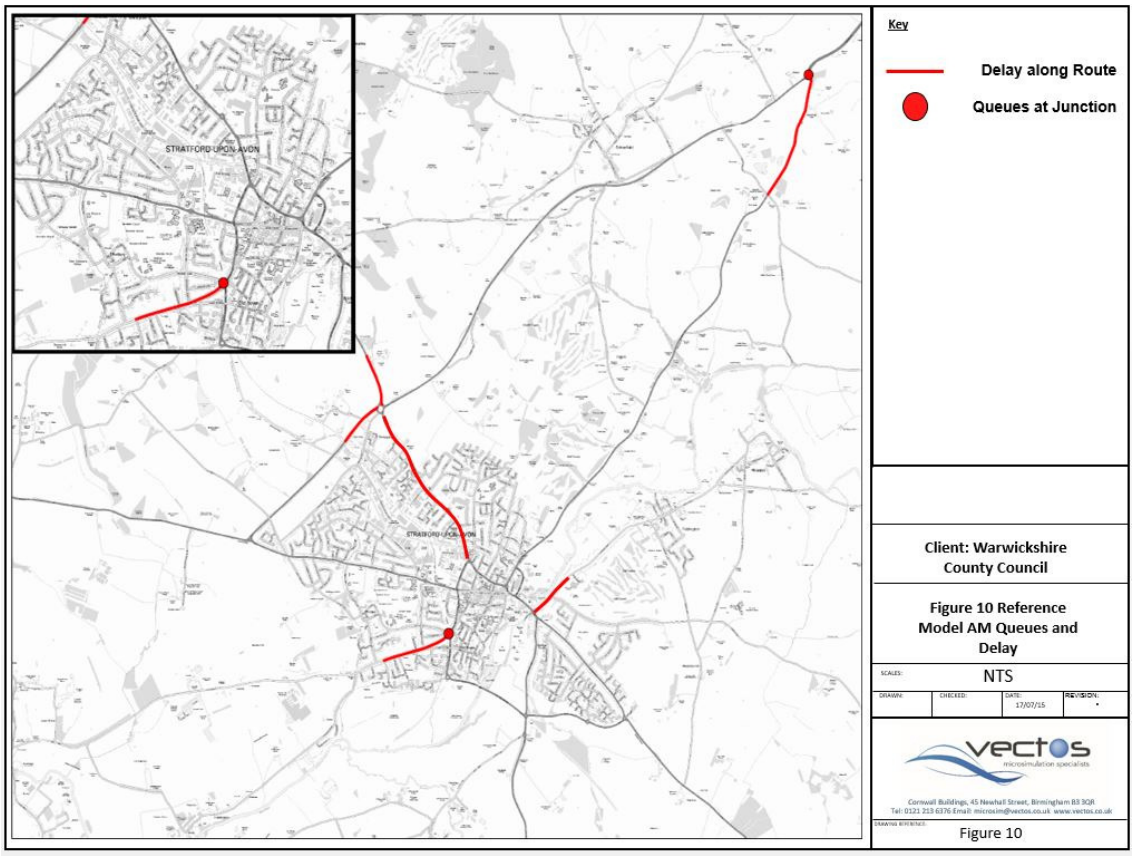
5.1 The options highlighted in Section 4 have been included within the respective Reference Case or Core Strategy models and the model performance observed. A summary of the network performance of each scenario created, is provided within this section of the report.

Reference Model Scenarios

2031 Reference Model (M001A)

5.2 The AM model performance in the Reference Case reveals some queuing at key junctions across the model network. These are outlined in Figure 10 and summarised below.

Figure 10 Reference Model – AM Queues and Delay Locations

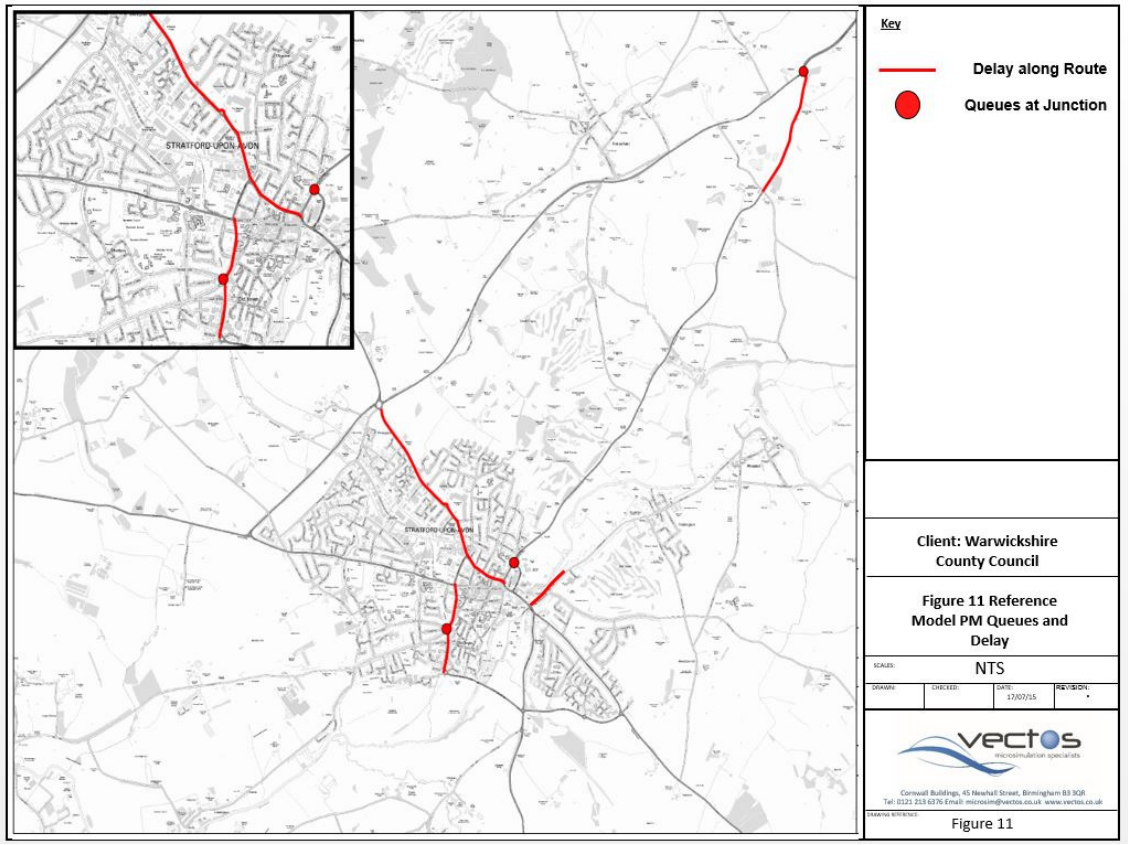


- Queues begin to form along the Evesham Road approach to the Evesham Road/Shottery Road/Seven Meadows Road roundabout
- Queues also develop and at the Bishopton Island junction most notably on the A46 eastbound approach and the A3400 southbound approach

- Significant queues also form on the Warwick Road northbound approach to the A46/Warwick Road roundabout. There is also some queuing modelled on the A46 northbound and southbound approaches to this junction.
- Additionally delay is also observed along Birmingham Road in the AM period, along with Tiddington Road on the inbound approach to Stratford town centre.

5.3 During the PM, queues and congestion are again observed, the location of which is highlighted in Figure 11 and summarised below.

Figure 11 Reference Model – PM Queues and Delay Locations



- Queues form on the Warwick Road northbound approach to the A46/Warwick Road roundabout.
- High levels of congestion are also observed along the Birmingham Road corridor and in Stratford town centre, particularly around the Stratford Gyratory.
- Significant queues also build on the A4390 and Seven Meadows Road approaches to the Evesham Road/Shottery Road/Seven Meadows Road roundabout.

- Additionally some delay is observed on the Tiddington Road approach to the town centre during the PM peak.

2031 Reference Model + S-WRR (M001B)

5.4 When comparing this scenario to the Reference Case (M001A), the following observations were made:

- Queuing between the two scenarios is during the AM peak is similar, with queues continuing to form at the Bishopton Island junction and A46/Warwick Road junction.
- Traffic is also observed to build along the A3400 Birmingham Road corridor in this scenario during the AM.
- During PM period, queues significantly reduce at the Evesham Road/Shottery Road/Seven Meadows Road roundabout in this scenario.
- With the inclusion of the S-WRR, general congestion levels in this area of the network are much reduced.

2031 Reference Model + ERR (M001C)

5.5 When comparing this scenario to the Reference Case (M001A), the following observations were made:

- The addition of the ERR results in a reduction of traffic travelling through Stratford town centre. This is particularly noticeable for traffic travelling south-westbound along Warwick Road, in the AM peak, where traffic volumes reduce significantly
- This in turn reduces the amount of traffic merging onto the A3400 Bridge Foot and arriving at the Stratford Gyratory. As such, there is less upstream queuing along the A3400 Guild Street and Birmingham Road aiding traffic flow throughout the whole of Stratford-upon-Avon town centre.
- During the PM a similar pattern emerges, and as in the AM period, the volume of traffic travelling on Warwick Road to and from the town centre appears to be reduced when compared to the Reference Case.

2031 Reference Model + Partial ERR (M001D)

5.6 When comparing this scenario to the Reference Case (M001A), the following observations were made:

- Due to the upgraded status of the B4086 Wellesbourne Road, traffic flow along this link increases when compared to the Reference Case.
- As a result the volume of traffic traveling through the Tiddington Road/Banbury Road junction, and also the Stratford Gyratory is increased. This is most noticeable during the PM period.
- Despite this there appears to be reduced delay and congestion within the town centre in both the AM and PM periods.

2031 Reference Model + S-WRR + ERR (M001E)

5.7 When comparing this scenario to the Reference Case (M001A), the following observations were made:

- During the AM period in this scenario, a significant increase in trips between Alcester Road and Evesham Road (along the Shottery Relief Road) is observed when compared with Reference Case.
- This has the effect of reducing trips travelling along Alcester Road, and through Stratford-upon-Avon town centre when travelling to and from the south of the town.
- The S-WRR shows a clear benefit in terms of providing an alternative route to large volumes of traffic travelling north to south and vice versa, that does not involve travelling through the town centre.
- The inclusion of the ERR also delivers benefits in terms of a reduction of traffic arriving and exiting the town centre during the AM period via Warwick Road, and the Stratford Gyratory, where the volume of traffic has notably decreased.
- Throughout the PM period, traffic and queuing has greatly subsided to west of Stratford-upon Avon, as vehicles now use the S-WRR rather than travelling through

the town centre, which demonstrates noticeable benefits when compared to the Reference Case.

- Additionally the ERR appears to result in less traffic arriving and exiting the town centre via Warwick Road.

2031 Reference Model +S-WRR + Partial ERR (M001F)

5.8 When comparing this scenario to the Reference Case (M001A), the following observations were made:

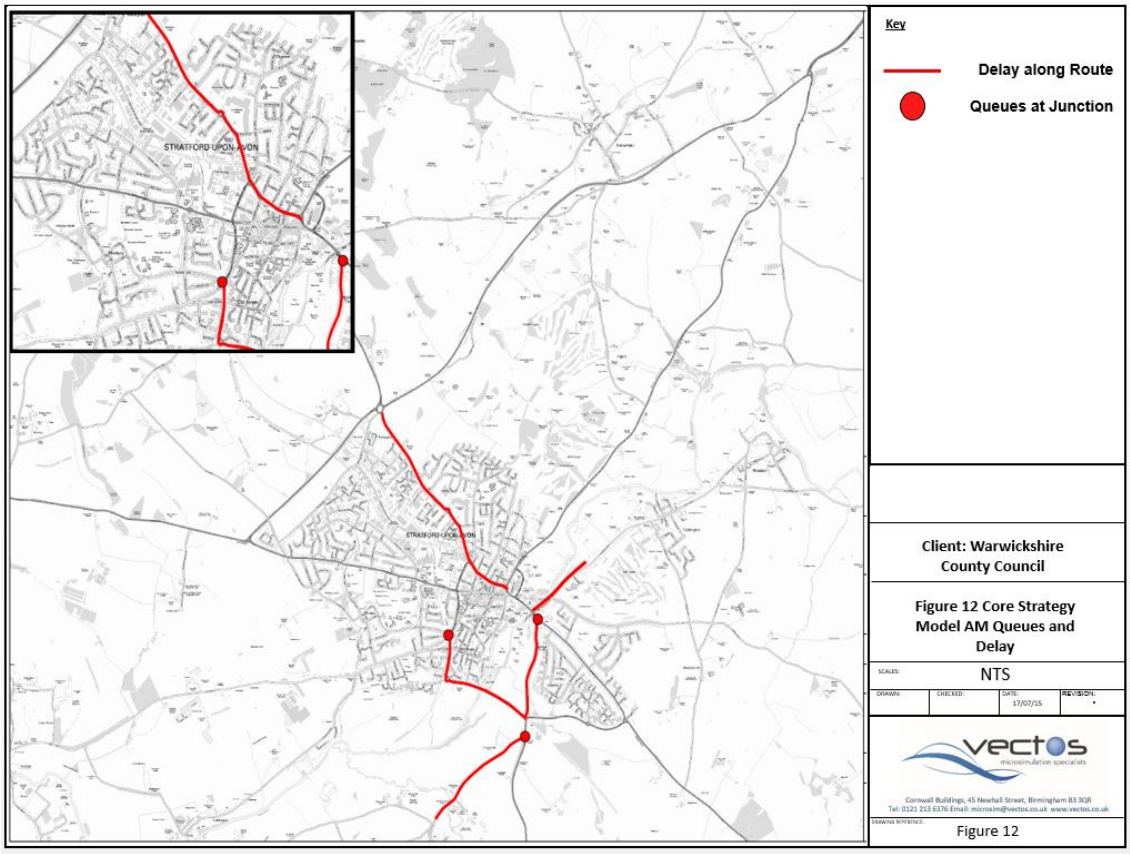
- This scenario appears to shows similar impacts to scenario M001E. The level of congestion within Stratford town centre has reduced in both the AM and PM periods.
- It appears that the inclusion of the Partial ERR as opposed to the full ERR in M001E does not significantly change the pattern of queuing or delay, and that the Partial ERR continues to deliver reduced delay and a reduction in traffic travelling to and from Stratford town centre via Warwick Road, particularly during the AM period.

Core Strategy Model Networks

2031 Core Strategy Model (M002A)

5.9 The AM period model performance of the Core Strategy model reveals some queuing at key junctions across the model network. These are outlined in Figure 12 and summarised below.

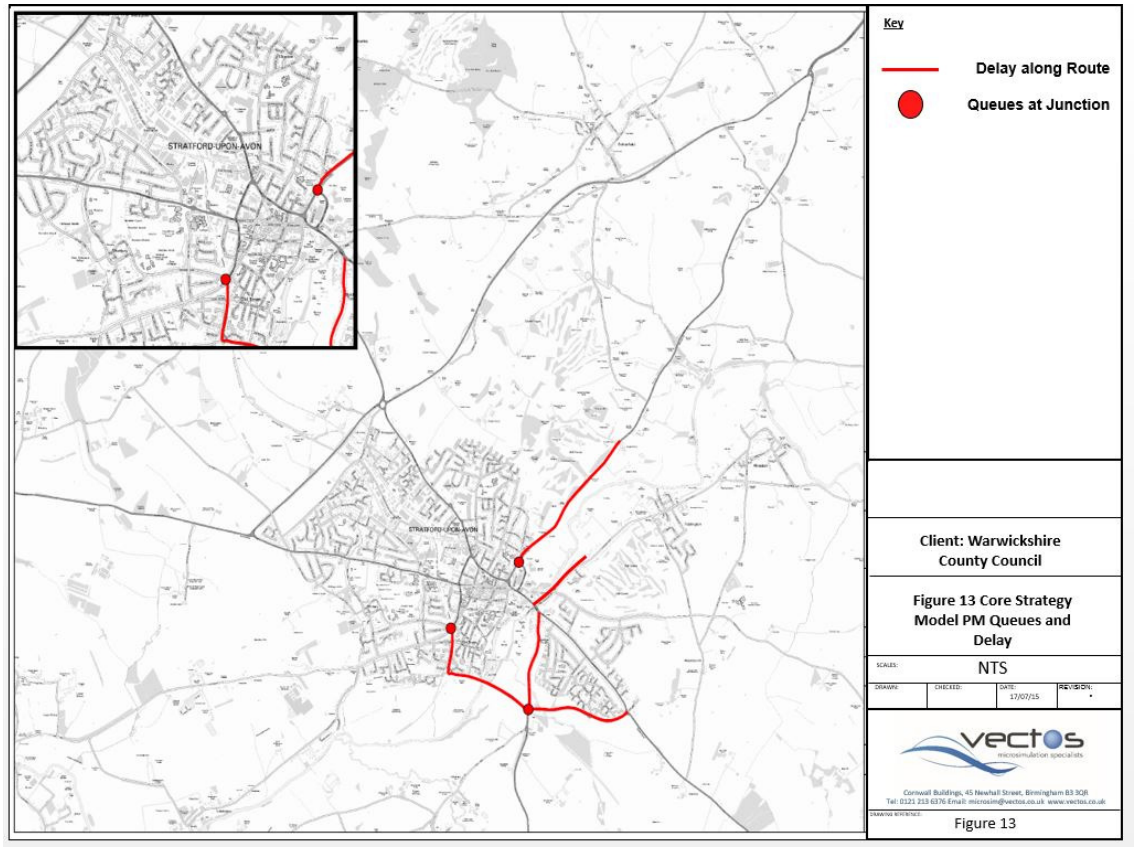
Figure 12 Core Strategy Model – AM Queues and Delay Locations



- A major build-up of traffic is observed in and around Stratford town centre. Most notably queuing occurs on Seven Meadows road which causes significant delay at the Evesham Road/Shottery Road/Seven Meadows Road roundabout.
- At the busiest point during the period queuing from the Evesham Road/Shottery Road/Seven Meadows Road roundabout extends across the Shipston Road/Seven Meadows Road roundabout as far as Trinity Way.
- Congestion is also noticeable within Stratford town centre, with heavy traffic in both directions along the A3400 Birmingham Road corridor.
- The traffic build-up throughout the town centre creates large delays along Tiddington Road, Bridge Foot and Bridge Street, whilst Shipston Road incurs significant queuing, on the northbound approach to the Banbury Road/Shipston Road junction.
- Significant queues also form on the Clifford Lane approach to the Shipston Road/Clifford Lane roundabout.

5.10 During the PM period, extensive delay is again observed within the model. The location of this delay is highlighted within Figure 13 and summarised below.

Figure 13 Core Strategy Model – PM Queues and Delay Locations



- The most noticeable congestion occurs around the Bridge Foot and the Stratford Gyratory, with delay along the Bridge Street in both directions, and significant queues building on the Warwick Road southbound approach to the gyratory.
- There is also significant delay at the Evesham Road/Shottery Road/Seven Meadows Road roundabout, with the most extensive queues forming on the Seven Meadows Road approach to the junction.
- The Shipston Road/Seven Meadows Road roundabout also experiences significant delay during the PM peak, most noticeably on the Seven Meadows Way and Trinity Way approaches to the junction.

5.11 It should be noted that, in order that the relative merits of each relief road can be assessed on a comparable basis (i.e. against network conditions which do not include a relief road at all) the S-WRR has not been included whilst the Core Strategy forecast demands have.

5.12 This does not reflect a realistic scenario and the adverse traffic conditions, which would otherwise be considered unacceptable, will be unlikely to be realised as the allocation of the 3,500 houses at Long Marston Airfield (LMA) is predicated on the delivery of the S-WRR beyond a certain number of houses.

5.13 The removal of the S-WRR does, however, amplify the congestion conditions that are forecast to occur as a result of the delivery of the housing numbers identified through the Core Strategy and, thus, the benefits of delivering any of the options for an additional river crossing will be more clearly discernible as a result.

2031 Core Strategy + S-WRR (M002B)

5.14 When comparing this scenario to the Core Strategy model (M002A), the following observations were made:

- This scenario shows significant reductions in queuing along Clifford Lane, on approach to the Shipston Road/Clifford Lane junction.
- Significant reductions in queues on the Seven Meadows Road approach to the Evesham Road/Shottery Road/Seven Meadows Road roundabout are also observed.
- During the PM period the reduction in congestion is greater than observed in the AM period.
- Queues are significantly reduced around the Shipston Road/Clifford Lane junction, the Shipston Road/Seven Meadows Road/Trinity Way roundabout, and Evesham Road/Shottery Road/Seven Meadows Road roundabout.
- There is also a general reduction in queuing and delay around the Stratford Gyratory and the Bridge Foot area of the town centre.

2031 Core Strategy + ERR (M002C)

5.15 When comparing this scenario to the Core Strategy model (M002A), the following observations were made:

- There are significant reductions in traffic along the Warwick Road, on approach to the Stratford Gyratory, in both the AM and the PM periods. In turn this reduces the

levels of congestion along Bridge Foot and around the gyratory that was observed in the Core Strategy model. This is most noticeable during the PM peak.

- This scenario does however continue to result in queues forming around the Shipston Road/Clifford Lane junction, the Shipston Road/Seven Meadows Road/Trinity Way roundabout, and Evesham Road/Shottery Road/Seven Meadows Road roundabout.
- It is noticeable that this scenario does not deliver the same reductions in queuing and general congestion as the M002B scenario.

2031 Core Strategy + Partial ERR (M002D)

5.16 When comparing this scenario to the Core Strategy model (M002A), the following observations were made:

- During the AM period in this scenario there appears to be some reductions in traffic in the town centre when compared to the Core Strategy model,
- Despite this a significant amount of queuing on the Shipston Road approach to the Banbury Road/Shipston Road junction is observed, and queues continue to form on Clifford Lane and Seven Meadows Road.
- During the PM this scenario begins to show significant delay on the Warwick Road approach to the Stratford Gyratory, with an increase in traffic routing along Warwick Road.
- This in turn increases delay around this area of the town centre, and causes significant queuing at a number of junctions within close proximity to the gyratory.
- This frequently results in the model gridlocking, as the gyratory and Bridge Foot are unable to cope with the additional traffic routing through this area of the model.

2031 Core Strategy + S-WRR + ERR (M002E)

5.17 When comparing this scenario to the Core Strategy model (M002A), the following observations were made:

- The incorporation of both the S-WRR and ERR in this scenario reduces the level of queuing and delay observed within the Core Strategy model during the AM period significantly.
- The amount of traffic travelling through the town centre is reduced and as a result the Stratford Gyratory along with the Shipston Road/Clifford Lane junction, the Shipston Road/Seven Meadows Road/Trinity Way roundabout, and Evesham Road/Shottery Road/Seven Meadows Road roundabout all appear to operate with much lower levels of delay.
- During the PM, some queuing occurs along the Warwick Road and Bridge Foot, and as per scenario M002C, congestion is significantly lower than that of the base Core Strategy model.
- The level of queuing around Shipston Road, Trinity Way and Seven Meadows Road is much reduced, as per scenario M002B.
- It is clear that this scenario delivers the most significant reductions in congestion across the model.

2031 Core Strategy + S-WRR + Partial ERR (M002F)

5.18 When comparing this scenario to the Core Strategy model (M002A), the following observations were made:

- This scenario is not as effective at reducing congestion as the scenarios with the full ERR included. This is most noticeable on the Warwick Road approach to town centre during the PM period, where large queues continue to form.
- As per scenarios M002B and M002E, the presence of the S-WRR reduces congestion and queuing along Seven Meadows Road, Shipston Road and Clifford Lane, whilst delay along Alcester Road is also reduced.
- This scenario demonstrates that despite the Partial ERR not delivering noticeable benefits, the presence of the S-WRR continues to result in reduced delay and queuing.

Summary

5.19 The observations of the model operation for both the Reference Case and Core Strategy scenarios has revealed the following:

Reference Scenarios

- In the Reference Case model queuing forms at the A46/Bishopton Island Junction, the A46/Warwick Road junction, the Evesham Road/Shottery Road/Seven Meadows Road roundabout and around Stratford Gyratory.
- The inclusion of the S-WRR reduces general congestion levels across the network, and most significantly at the Evesham Road/Shottery Road/Seven Meadows Road roundabout
- The inclusion of the ERR reduces traffic within the town centre, and most notably around the Stratford Gyratory and the Bridge Foot area of the town centre. This scenario also reduces delay along Birmingham Road.
- The inclusion of the Partial ERR appears to reduce general congestion across the town centre. However there is an increase in traffic on Tiddington Road and Warwick Road with worsening of conditions observed at the Tiddington Road/Banbury Road junction.

Core Strategy Scenarios

- In the Core Strategy model queues form around the Evesham Road/Shottery Road/Seven Meadows Road roundabout and Stratford Gyratory, along with at the Shipston Road/Clifford Lane, Shipston Lane/Banbury Road and Shipston Lane/Seven Meadows Road/Trinity Way roundabout. The most significant delay is focused along Shipston Road.
- The inclusion of the S-WRR reduces general congestion levels across the network, and most significantly on the Clifford Lane approach to the Shipston Road/Clifford Lane junction. Significant reductions in queues are also observed on the Seven Meadows Road approach to the Evesham Road/Shottery Road/Seven Meadows Road roundabout are also observed.

- Queues are significantly reduced in the PM period around the Shipston Road/Clifford Lane junction, the Shipston Road/Seven Meadows Road/Trinity Way roundabout, along with around Stratford Gyratory.
- The inclusion of the ERR reduces traffic along the Warwick Road, on approach to the Stratford Gyratory, in both the AM and the PM periods. In turn this reduces the levels of congestion along Bridge Foot and around the gyratory
- This scenario does however continue to result in queues forming around the Shipston Road/Clifford Lane junction, the Shipston Road/Seven Meadows Road/Trinity Way roundabout, and Evesham Road/Shottery Road/Seven Meadows Road roundabout.
- The inclusion of the Partial ERR results in reductions in traffic in the town centre when compared to the Core Strategy model. Despite this a significant amount of queuing occurs at the Banbury Road/Shipston Road junction and queues continue to form on Clifford Lane and Seven Meadows Road. During the PM this scenario begins to show significant delay on the Warwick Road approach to the Stratford Gyratory, with an increase in traffic routing along Warwick Road.

6 RESULTS ANALYSIS

6.1 Each of the scenarios, outlined previously, were assessed using a series of key performance indicator measures, including model stability, average journey time and average speed.

6.2 This high level analysis was then supplemented with more refined and detailed analysis which focusses on the impact that are predicted to occur, relative to the Reference Case, or Core Strategy Model, as a result of the scenario assumptions. The detailed analysis has focussed on the changes in queuing levels at key junctions between the original 2031 Reference Case and each of the development scenarios assessed.

Key Network Performance Indicators

6.3 The following section presents the analysis of the key network performance indicators (KPI) across all modelled scenarios. The measures used to inform the assessment are summarised as follows:

- Model Stability - Due to the assignment of Paramics it is possible for vehicles to enter a network even when congestion is to such an extent it is considered 'grid-locked'. When 'grid-locked', vehicles continue to be assignment to the network and delay increases exponentially. As such, runs that follow such characteristics can be discarded as they cannot be considered realistic. A review of the model stability provides an indication of how regularly a model reaches this unrealistic 'grid-locked' position and therefore highlights where a scenario is unlikely to operate sufficiently. The model stability analysis has been based upon 20 AM and 20 PM model runs.
- Average Distance (Km) - The average distance travelled by a vehicle that completed their journey during the model simulation period.
- Average Time (Seconds) – The average travel time of a completed trip during the model simulation period.
- Average Speed (Km/h) – The average speed travelled by all vehicles that completed a journey during the model simulation period.

6.4 These results are presented for the AM and PM time periods within the following section.

Key Performance Indicators - Reference Case

6.5 The KPI outputs extracted for the Reference Case scenarios have been presented, for the AM and PM time periods, within the following Tables 2 and 3 respectively:

Table 2 Key Network Performance Statistics – Reference Case Model: AM Period

	M001A	M001B	M001C	M001D	M001E	M001F
Model Stability	100%	100%	95%	100%	90%	100%
Average Distance (km)	8.1	8.1	8.1	8.2	8.1	8.2
Average Delay (s)	516	511	509	503	505	496
Average Speed (km/h)	56.6	57.1	57.1	58.7	57.5	59.6

Table 3 Key Network Performance Statistics – Reference Case Model: PM Period

	M001A	M001B	M001C	M001D	M001E	M001F
Model Stability	100%	100%	100%	100%	100%	100%
Average Distance (km)	7.7	7.7	7.7	7.8	7.7	7.8
Average Delay (s)	508	490	482	494	471	478
Average Speed (km/h)	54.6	56.5	57.2	57.1	58.5	59.0

6.6 Analysis of the above KPIs reveals that the model stability of all scenarios is high, which indicates little instances of the network grid-locking.

6.7 The results also indicate that average delay reduces in all scenarios with link road options included. It is also notable that the average speed of trips increases in all scenarios when compared to the Reference Case.

6.8 The results suggest that scenarios M001E and M001F demonstrates the most significant reductions in delay and increase in speed when compared to the Reference Case, across both the AM and PM periods. This is unsurprising given that these scenarios contain the most additional infrastructure, in terms of the S-WRR and ERR/Partial ERR.

6.9 The KPIs also indicate that the inclusion of the full ERR (M001C) results in greater reductions in delay than the scenario which contains only the S-WRR (M001B). These results would suggest that the ERR delivers greater benefits than the S-WRR, whilst the partial ERR (M001D) results in similar levels of delay and average speeds as the S-WRR scenario (M001B)

Reference Case KPI - Results Summary

6.10 The initial analysis of the key network performance indicators for the Reference Case scenarios presented above reveals the following:

- The scenarios containing the ERR (M001C, M001E, M001F) results in the most significant reductions in delay, with M001E delivering the greatest benefits during the PM period, whilst M001F performs slightly better than M001F during the AM.
- The initial analysis appears to indicate that, in the context of natural traffic growth on the network, which occurs through the assignment of the committed developments alongside an account of generalised growth via the application of TEMPRO factors, that the inclusion of the ERR as far as Tiddington Road (Partial ERR), is the most critical factor in terms of reducing delay and increasing speeds across the model network.

Key Performance Indicators – Core Strategy

6.11 The KPI outputs extracted for the Core Strategy scenarios have been presented, for the AM and PM time periods, within the following Tables 4 and 5 respectively:

Table 4 Key Network Performance Statistics – Core Strategy Model – AM Period

	M002A	M002B	M002C	M002D	M002E	M002F
Model Stability	100%	95%	90%	100%	95%	100%
Average Distance (km)	8.4	8.4	8.4	8.5	8.3	8.4
Average Delay (s)	580	509	555	597	499	512
Average Speed (km/h)	52.4	59.3	54.3	51.4	60.0	59.2

Table 5 Key Network Performance Statistics – Core Strategy Model – PM Period

	M002A	M002B	M002C	M002D	M002E	M002F
Model Stability	60%	100%	100%	55%	100%	95%
Average Distance (km)	8.2	8.2	8.1	8.3	8.1	8.2
Average Delay (s)	631	520	533	631	489	520
Average Speed (km/h)	47.0	56.6	54.8	47.4	59.6	57.1

6.12 Analysis of the model stability, in the Core Strategy model results, shows some variation during the AM period between scenarios, with M002B, M002D and M002E resulting in the highest level of stability throughout. During the PM period, the level of stability in M002B,

M002C, M002E and M002F is high. M002B and M002E stand out as the most stable during both the AM and PM.

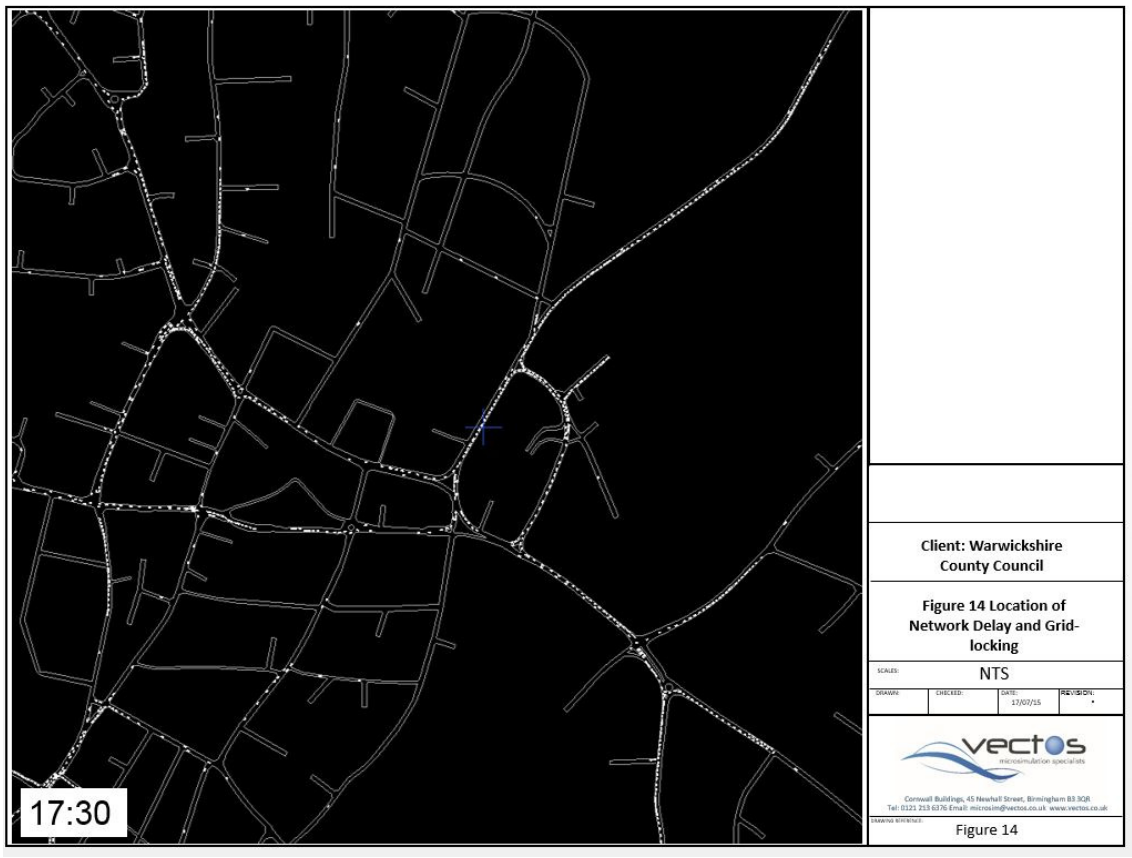
6.13 During the PM, there is a considerable reduction in model stability in M002A and M002D, suggesting that the network coded is unable cope with the additional demands arising from the Core Strategy.

6.14 Upon review of the M002A scenario it was observed that during the PM period, queues around the Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road roundabout are significant, which frequently causes the model to grid lock. The level of congestion around Stratford town centre is also high in this scenario, as a result of traffic blocking back from the Shipston Road/Seven Meadows Road roundabout. This demonstrates that the delivery of a relief road alongside the Core Strategy demands is essential. It would appear that the inclusion of the S-WRR, and the full ERR reduces these impacts by providing sufficient alternative options to enable traffic to 'bypass' the congestion hot-spots. Without provision of the relief road traffic will continue to seek to enter the study area from the south via the two existing river crossings which will inevitably lead to areas of the network becoming over-saturated and a pattern of failure will likely ensue.

6.15 A review of the M002D scenario again revealed that during the PM period, queues build to such an extent that the network frequently gridlocks. This is most noticeable within the town centre, and around the Stratford Gyratory, specifically on the Warwick Road SB approach to the gyratory. This is demonstrated by Figure 14 below, which demonstrates the extent of the queues modelled on the Warwick Road SB approach, along with the generally high levels of congestion around the gyratory.

6.16 This is considered symptomatic of the issue highlighted previously insofar as the Core Strategy demands will seek to continue to enter into the study area via the existing river crossing points. There is limited attraction likely to be associated with the partial route that is proposed in this option when considering the route that traffic has taken from the Core Strategy sites, and particularly LMA, into the study area. It is unlikely that traffic will continue to route into the town only to double back on itself to join the partial route provided by the ERR to the M40.

Figure 14 Location of Network Delay and Gridlocking – Scenario M002D – PM Peak



6.17 Further review of the model reveals that with the Partial ERR included in the Core Strategy network, a significant number of trips chose to route through the town centre, which is already congested, and there is a resulting gridlock around the gyratory. Notably the inclusion of the S-WRR alongside the partial ERR (M002F) appears to alleviate this issue.

6.18 The average delay results demonstrate a reduction in delay in all scenarios when compared to the Core Strategy model (M002A), with the exception of the Partial ERR scenario (M002D), which shows an increase in delay during the AM and the same level of delay during the PM. This is supported by the average speed results which demonstrate an increase in average speeds across the scenarios, again with the exception of M002D.

6.19 The M002E scenario, with the S-WRR and ERR included, results in the most notable reduction in delay and increase in speed across the AM and PM periods. This is followed by M002B and M002F which show little difference in terms of average delay and average speeds. It is clear that M002C does not deliver the scale of reduced delays or increased speeds that are modelled in scenarios M002B, M002E and M002F.

6.20 The results therefore suggest that the most significant reductions in delay come in the scenarios which contain the S-WRR.

Core Strategy KPI - Results Summary

6.21 The initial analysis of the key network performance indicators for the Core Strategy scenarios presented above reveals the following:

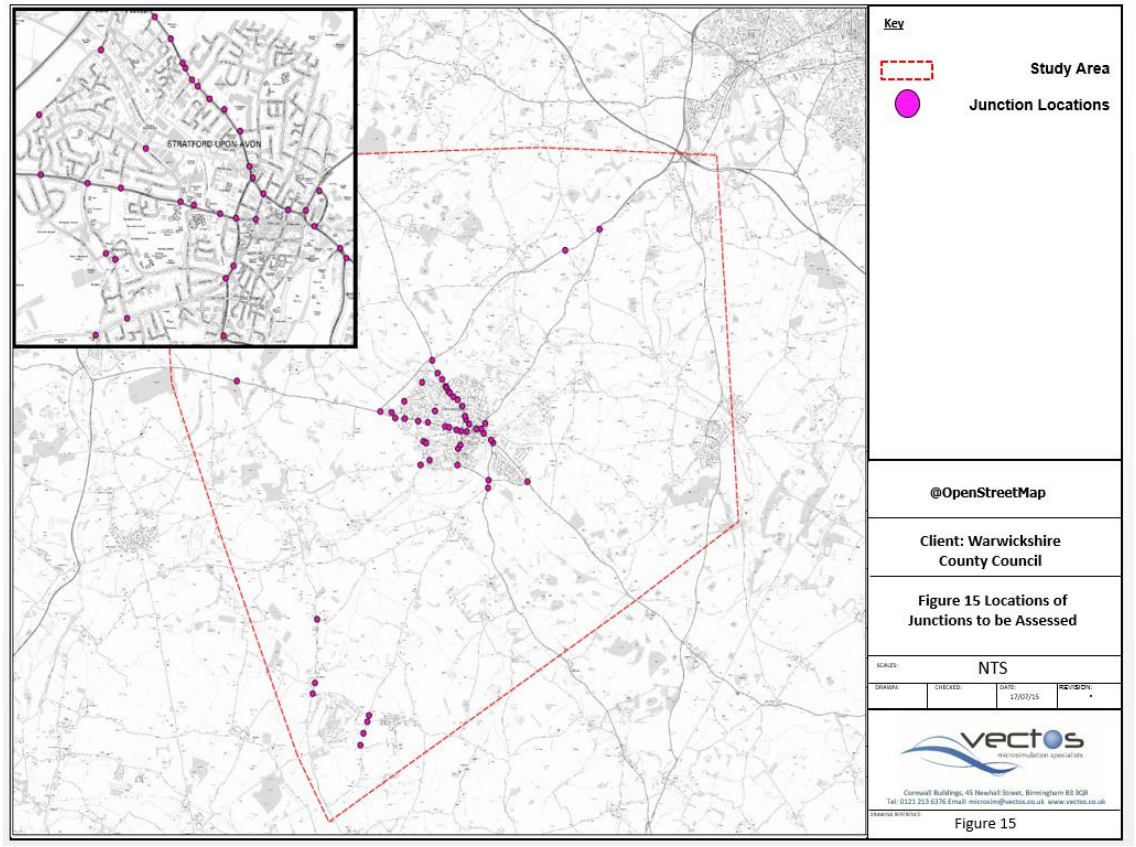
- Scenario M002D (Partial ERR) results in significant delays and frequently results in the network gridlocking, with particularly high levels of congestion within Stratford town centre during the PM peak.
- The scenarios containing the S-WRR (M002B, M002E, M002F) result in the most significant reductions in delay, with M002E delivering the greatest benefits, whilst M002B performs very similarly to M002F.
- The early indications regarding the network performance is that the inclusion of the S-WRR is critical within the Core Strategy scenario, in order to deliver significant reductions in delay and increases in average speed across the model network.

Queuing Analysis

6.22 In addition to the analysis of the key network performance indicators, analysis has also been undertaken to ascertain the impacts on queuing levels that are predicted to occur, relative to the Reference Case and Core Strategy model, for each of the scenarios.

6.23 The queue length analysis is intended to accompany the KPI analysis as it provides a more detailed picture of the impacts at specific junctions within the model network. The location of junctions on the network that have been assessed is presented in Figure 15.

Figure 15 Junction Locations for Queue Analysis



6.24 At this stage the analysis of queue lengths has been based on the peak hour maximum queue lengths in vehicles. Results presented for each junction are based on the worst performing single approach. The hourly maximum for each individual model run has been calculated and then the average of all runs has been calculated for the traditional peak hours (0800-0900 and 1700-1800).

6.25 The outcome from the queuing assessments has been presented in queuing plots MQ-001 to MQ-020, provided within **Appendix A** of this report. An overview of the findings from this analysis has been provided, per scenario, within the following section.

2031 Reference vs. 2031 Reference + S-WRR

6.26 The analysis of the difference in queuing levels between the Reference + S-WRR scenario and the 2031 Reference Case reveals the following:

AM Analysis (MQ001)

6.27 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are some notable reductions in queue lengths with the S-WRR included. There are two

instances where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles at both locations, firstly at the Bishopton Island junction, and secondly at the Evesham Road/Shottery Road/Seven Meadows Road roundabout.

PM Analysis (MQ006)

6.28 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are a significant number of locations across the network at which reductions in queue lengths are modelled in the scenario including the S-WRR. There are 8 instances where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles at each location, including along the A46 and at a number of junctions around the town centre, including Stratford Gyratory.

2031 Reference vs. 2031 Reference + ERR

6.29 The analysis of the difference in queuing levels between the Reference + ERR scenario and the 2031 Reference Case reveals the following:

AM Analysis (MQ002)

6.30 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are some reductions in queue lengths with the ERR included. There are 3 instances where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles, within the town centre. These reductions are modelled around Bridge Foot, the Tiddington Road/Banbury Road junction and Banbury Road/Shipston Road junction.

6.31 This scenario reveals an increase in queues by 15-30 vehicles on the Sand Barn Lane approach to the junction of the A46/Sand Barn Lane, as some vehicles chose this route to join the A46 rather than queuing on the Warwick Road approach to the A46 further north.

PM Analysis (MQ007)

The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are a significant number of locations across the network at which reductions in queue lengths are modelled in the scenario including the ERR. There are 6 instances within the town centre where reductions in queue lengths have been highlighted, including around Stratford Gyratory, Bridge Foot, the Tiddington Road/Banbury Road junction and Banbury Road/Shipston Road junction. Additionally, reductions in queues are modelled at the A46/Warwick Road junction.

2031 Reference vs. 2031 Reference + Partial ERR

6.32 The analysis of the difference in queuing levels between the Reference + Partial ERR scenario and the 2031 Reference Case reveals the following:

AM Analysis (MQ003)

6.33 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are some reductions in queue lengths with the Partial ERR included. There are 3 instances where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles, each along the A46.

6.34 This scenario reveals an increase in queue lengths of 15-30 vehicles at the Shipston Road/Clifford Lane junction.

PM Analysis (MQ008)

6.35 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are some locations across the network at which reductions in queue lengths are modelled in the scenario including the Partial ERR. These are mainly located along the A46, but also at 4 locations within the town centre, including around the Stratford Gyratory.

6.36 There are two instances on the network at which increases in queue lengths have been observed. This occurs at the Banbury Road/Shipston Road junction and at the Evesham Road/Shottery Road/Seven Meadows Road roundabout. In both instances the increases in queuing are between 15-30 vehicles.

2031 Reference vs. 2031 Reference + S-WRR + ERR

6.37 The analysis of the difference in queuing levels between the Reference + S-WRR + ERR scenario and the 2031 Reference Case reveals the following:

AM Analysis (MQ004)

6.38 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are a number of reductions in queue lengths with both the S-WRR and ERR included on the network. Reductions in queue lengths have been highlighted at 4 locations within the town centre, along with at the A46/Sandy Barn Lane junction on the A46.

PM Analysis (MQ009)

6.39 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are multiple locations across the network at which reductions in queue lengths are modelled in the scenario including the S-WRR and ERR. These are mainly located within the town centre, with 9 instances of reduced queue lengths here. These reductions are observed along Birmingham Road, around Stratford Gyratory and Bridge Foot along with along Seven Meadows Road. A reduction in queue lengths is also modelled at the A46/Warwick Road roundabout.

2031 Reference vs. 2031 Reference + S-WRR + Partial ERR

6.40 The analysis of the difference in queuing levels between the Reference + S-WRR + Partial ERR scenario and the 2031 Reference Case reveals the following:

AM Analysis (MQ005)

6.41 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are a number of reductions in queue lengths with both the S-WRR and Partial ERR included on the network. Reductions in queue lengths have been modelled at 2 locations within the town centre, along with 4 locations along the A46, including the Bishopton Island junction and A46/Warwick Road junction.

PM Analysis (MQ010)

6.42 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are multiple locations across the network at which reductions in queue lengths are modelled in the scenario including the S-WRR and Partial ERR. There are 6 instances of reduced queue lengths within the town centre, around Bridge Foot, Stratford Gyratory, and along Seven Meadows Road.

6.43 This scenario also results in reduced queuing at the A46/Warwick Road and Bishopton Island junctions.

Reference Scenarios - Queuing Summary

6.44 The analysis of differences in queue lengths between the Reference Case and all scenarios modelled has revealed the following:

- The majority of scenarios deliver reductions in queue lengths, most significantly within Stratford town centre or along the A46
- It appears that the scenarios containing the ERR result in the most notable reduction in queue lengths, focused around the Stratford Gyratory and Bridge Foot areas
- The ERR appears to reduce queues along the A46 at both the Bishopton Island and A46/Warwick Road junctions, and along the Birmingham Road corridor
- The scenarios containing the S-WRR also deliver reductions in queue lengths, however, these reductions in queues appear to be more focused around the Seven Meadows Road and A4390 area of the town centre
- The analysis has shown that the inclusion of the Partial ERR has resulted in the worst performing of all the scenarios tested, with increases in queues modelled in both the AM and PM periods
- The best performing scenario modelled is the Reference + S-WRR + ERR, however it would appear that scenarios including the ERR deliver the greatest reductions in queue lengths within the town centre, and across the wider network.

2031 Core Strategy vs. 2031 Core Strategy + S-WRR

6.45 The analysis of the difference in queuing levels between the 2031 Core Strategy + S-WRR scenario and the 2031 Core Strategy model reveals the following:

AM Analysis (MQ011)

6.46 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are a large number of reductions in queue lengths with the S-WRR included. There are 12 instances within the town centre where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles at each location. This includes reductions in queues around the Bridge Foot and Stratford Gyratory area, the Tiddington Road/Banbury Road, and Banbury Road/Shipston Road junction, along with a number of junctions along Seven Meadows Road and Alcester Road.

6.47 This scenario does however show an increase in queue lengths of between 15-30 vehicles at the Evesham Road/Luddington Road junction, where the S-WRR joins Evesham Road.

PM Analysis (MQ016)

6.48 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are a significant number of locations across the network at which reductions in queue lengths are modelled in the scenario including the S-WRR.

6.49 There are 13 instances of reductions in queue lengths within the town centre, with reductions in queues of greater than 5 vehicles around Stratford Gyratory, at the Tiddington Road/Banbury Road, and Banbury Road/Shipston Road junctions, along with a number of junctions along Seven Meadows Road and Alcester Road. This scenario also results in reduced queuing at the Bishopton Island and A46/Warwick Road junction and the Shipston Road/Clifford Road junction

6.50 This scenario reveals a high level of queue reductions across the network, particularly in the PM peak.

2031 Core Strategy vs. 2031 Core Strategy + ERR

6.51 The analysis of the difference in queuing levels between the 2031 Core Strategy + ERR scenario and the 2031 Core Strategy model reveals the following:

AM Analysis (MQ012)

6.52 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are some reductions in queue lengths with the ERR included, most notably in 5 town centre locations, where queues have reduced by greater than 5 vehicles. This includes reductions in queues around the Bridge Foot and Stratford Gyratory area, the Tiddington Road/Banbury Road, and Banbury Road/Shipston Road junction.

PM Analysis (MQ017)

6.53 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are a significant number of locations across the network at which reductions in queue lengths are modelled in the scenario including the ERR.

6.54 There are 14 instances of reductions in queue lengths within the town centre and along the Birmingham Road corridor, with reductions in queues of greater than 5 vehicles around Stratford Gyratory, along with at a number of junctions on Seven Meadows Road and Birmingham Road. This scenario also results in reduced queuing at the Bishopton Island and A46/Warwick Road junction and the Shipston Road/Clifford Road junction.

6.55 This scenario reveals three instances of increased queuing when compared to the Core Strategy model. Two of these instances result in increases in queue lengths of 15-30 vehicles, at the Tiddington Road/Banbury Road junction and Shipston Road/Seven Meadows Road/Trinity Way junction, whilst the third instance, at the Shipston Road/Clifford Lane junction results in an increase in queuing of 50+ vehicles.

6.56 This scenario reveals a high level of reduced queuing along Birmingham Road and within the town centre, particularly in the PM peak, however there are also three instances of significant increases in queue lengths across the network.

2031 Core Strategy vs. 2031 Core Strategy + Partial ERR

6.57 The analysis of the difference in queuing levels between the 2031 Core Strategy + Partial ERR scenario and the 2031 Core Strategy model reveals the following:

AM Analysis (MQ013)

6.58 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are some reductions in queue lengths with the Partial ERR included. There are two instances of reduced queue lengths within the town centre, at the Stratford Gyratory and the Banbury Road/Shipston Road junction. This scenario also results in reduced queue lengths at the A46/Warwick Road junction.

PM Analysis (MQ018)

6.59 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there 5 instances of reduced queue lengths with the Partial ERR included within the network, mainly occurring along the A46, notably at the Bishopton Island and A46/Warwick Road junctions.

6.60 This scenario however reveals 4 instances of increased queuing when compared to the Core Strategy model. 3 of these instances result in increases in queue lengths of 15-30 vehicles, at the Tiddington Road/Banbury Road junction, Banbury Road/Shipston Road junction, and at the Evesham Road/Seven Meadows Road/Shottery Road junction. The final instance of increased queuing is modelled at the Shipston Road/Clifford Lane junction, where an increase in queuing of 50+ vehicles is modelled.

6.61 Despite some reductions in queue lengths being modelled, this scenario reveals a number of instances where significant increases in queue lengths occur, in both the AM and PM periods.

2031 Core Strategy vs. 2031 Core Strategy + S-WRR + ERR

6.62 The analysis of the difference in queuing levels between the 2031 Core Strategy + S-WRR + ERR scenario and the 2031 Core Strategy model reveals the following:

AM Analysis (MQ014)

6.63 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are a large number of reductions in queue lengths with the S-WRR and ERR included. There are 14 instances within the town centre where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles each location. This includes reductions in queues around the Bridge Foot and Stratford Gyratory area, the Tiddington Road/Banbury Road, and Banbury Road/Shipston Road junction, along with a number of junctions along Seven Meadows Road and Alcester Road.

6.64 This scenario also shows reduced queue lengths along the A46, most notably at the A46/Warwick Road junction.

PM Analysis (MQ019)

6.65 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are a significant number of locations across the network at which reductions in queue lengths are modelled in the scenario including the S-WRR and ERR.

6.66 There are 18 instances of reductions in queue lengths within the town centre, with reductions in queues of greater than 5 vehicles around Stratford Gyratory, at the Tiddington Road/Banbury Road, and Banbury Road/Shipston Road junctions, along with a number of junctions along Seven Meadows Road, Birmingham Road and Alcester Road. This scenario also results in reduced queuing at the Bishopton Island and A46/Warwick Road junction and the Shipston Road/Clifford Road junction

6.67 This scenario reveals a significant amount of queue reduction across the network, particularly during the PM peak.

2031 Core Strategy vs. 2031 Core Strategy + S-WRR + Partial ERR

6.68 The analysis of the difference in queuing levels between the 2031 Core Strategy + S-WRR + Partial ERR scenario and the 2031 Core Strategy model reveals the following:

AM Analysis (MQ015)

6.69 The analysis of the queuing impacts within the AM period, between scenarios, reveals that there are a large number of reductions in queue lengths with the S-WRR and Partial ERR included. There are 11 instances within the town centre where changes in queue lengths have been highlighted, with reductions in queues of greater than 5 vehicles each location. This includes reductions in queues around the Bridge Foot and Stratford Gyratory area, the Tiddington Road/Banbury Road, and Banbury Road/Shipston Road junction, along with a number of junctions along Seven Meadows Road.

6.70 This scenario does however show an increase in queue lengths at the Evesham Road/Luddington Road junction, where the S-WRR meets Evesham Road.

PM Analysis (MQ020)

6.71 The analysis of the queuing impacts within the PM period, between scenarios, reveals that there are a significant number of locations across the network at which reductions in queue lengths are modelled in the scenario including the S-WRR and Partial ERR.

6.72 There are 12 instances of reductions in queue lengths within the town centre, with reductions in queues of greater than 5 vehicles around Stratford Gyratory, at the Banbury Road/Shipston Road junctions, along with a number of junctions along Seven Meadows Road, Birmingham Road and Alcester Road. This scenario also results in reduced queuing at the Bishopton Island and A46/Warwick Road junction and the Shipston Road/Clifford Road junction.

6.73 This scenario does however show an increase in queue lengths at the Tiddington Road/Banbury Road and Shipston Road/Seven Meadows Road/Trinity Way junctions.

Core Strategy Scenarios - Queuing Summary

6.74 The analysis of differences in queue lengths between the Core Strategy models and all scenarios tested has revealed the following:

- The majority of scenarios deliver reductions in queue lengths, most notably within Stratford town centre, along the Birmingham Road corridor or along the A46
- It appears that the scenarios containing the S-WRR result in the most notable reduction in queue lengths, focused around the Stratford Gyratory and Bridge Foot areas. Additionally the S-WRR appears to reduce queues along the A46, and along Alcester Road and Shipston Road
- The scenarios containing the ERR also deliver reductions in queue lengths, with these reductions in queues appearing to be more focused along the Birmingham Road corridor. This scenario does however result in a worsening of queuing conditions on Shipston Road, at both the Shipston Road/Seven Meadows Road/Trinity Way and Shipston Road/Clifford Lane junctions
- The analysis has shown that the inclusion of the Partial ERR has resulted in the worst performing of all the scenarios tested, with increases in queues modelled in both the AM and PM periods
- The best performing scenario modelled is the Core Strategy + S-WRR + ERR, however it would appear that any scenario which includes the S-WRR delivers significant reductions in queue lengths within the town centre, and across the wider network.

Queuing Analysis Summary

6.75 The analysis presented in this chapter reveals that in the Reference Case assessments, the majority of scenarios deliver reductions in queue lengths, most significantly within Stratford town centre or along the A46. It is clear that scenarios containing the ERR result in the most notable reduction in queue lengths, which are largely focused around the Stratford Gyratory and Bridge Foot areas of the town centre, along with reducing queues along the A46 at both the Bishopton Island and A46/Warwick Road junctions, and along the Birmingham Road corridor

6.76 The analysis of the Core Strategy scenarios has revealed that the scenarios containing the S-WRR result in the most notable reduction in queue lengths, which are focused around the Stratford Gyratory and Bridge Foot areas. Additionally the S-WRR appears to reduce queues along the A46, and along Alcester Road and Shipston Road. It is clear that the S-WRR

alleviates the queuing and delay created by the inclusion of the Core Strategy demands within the model.

6.77 The Core Strategy scenarios containing the ERR also deliver reductions in queue lengths along the Birmingham Road corridor. This scenario does however result in a worsening of queuing conditions on Shipston Road, at both the Shipston Road/Seven Meadows Road/Trinity Way and Shipston Road/Clifford Lane junctions

6.78 The findings thus far can therefore be summarised as follow:

- The ERR delivers the greatest benefits in the Reference Case scenarios
- The S-WRR delivers the greatest benefit in the Core Strategy scenarios
- The delivery of both the ERR and S-WRR in the Reference and Core Strategy scenarios results in the most significant benefits
- In the Core Strategy scenarios the inclusion of the Partial ERR does not deliver benefits.
- The inclusion of the ERR, in the Reference Case, reduces traffic within the town centre, and most notably around the Stratford Gyratory and the Bridge Foot area of the town centre. The ERR also reduces delay along Birmingham Road.
- The inclusion of the S-WRR, in the Core Strategy scenario, reduces general congestion levels across the network, and most significantly on the Clifford Lane approach to the Shipston Road/Clifford Lane junction. Significant reductions in queues are also observed on the Seven Meadows Road approach to the Evesham Road/Shottery Road/Seven Meadows Road roundabout, around the Shipston Road/Clifford Lane junction, the Shipston Road/Seven Meadows Road/Trinity Way roundabout, along with around Stratford Gyratory.

7 TOWN CENTRE ANALYSIS

7.1 The previous section of analysis has focussed on the network-wide benefits of the delivery of the options that have been assessed. However, it should be recognised that one of the primary benefits associated with the delivery of a third river crossing will be the alleviation of congestion within the town centre via the provision of one or more alternative route to enable traffic to 'bypass' the existing and forecast congestion hot-spots. As a result, it was considered pertinent to undertake an additional assessment of the impacts, of each option, within the town centre area.

7.2 This section of the report quantifies the changes in traffic travelling through Stratford town centre in each of the scenarios tested. It is anticipated that the inclusion of a relief road will enable a number of existing through trips across the town centre to be removed, as these trips can now be made on the less congested relief roads.

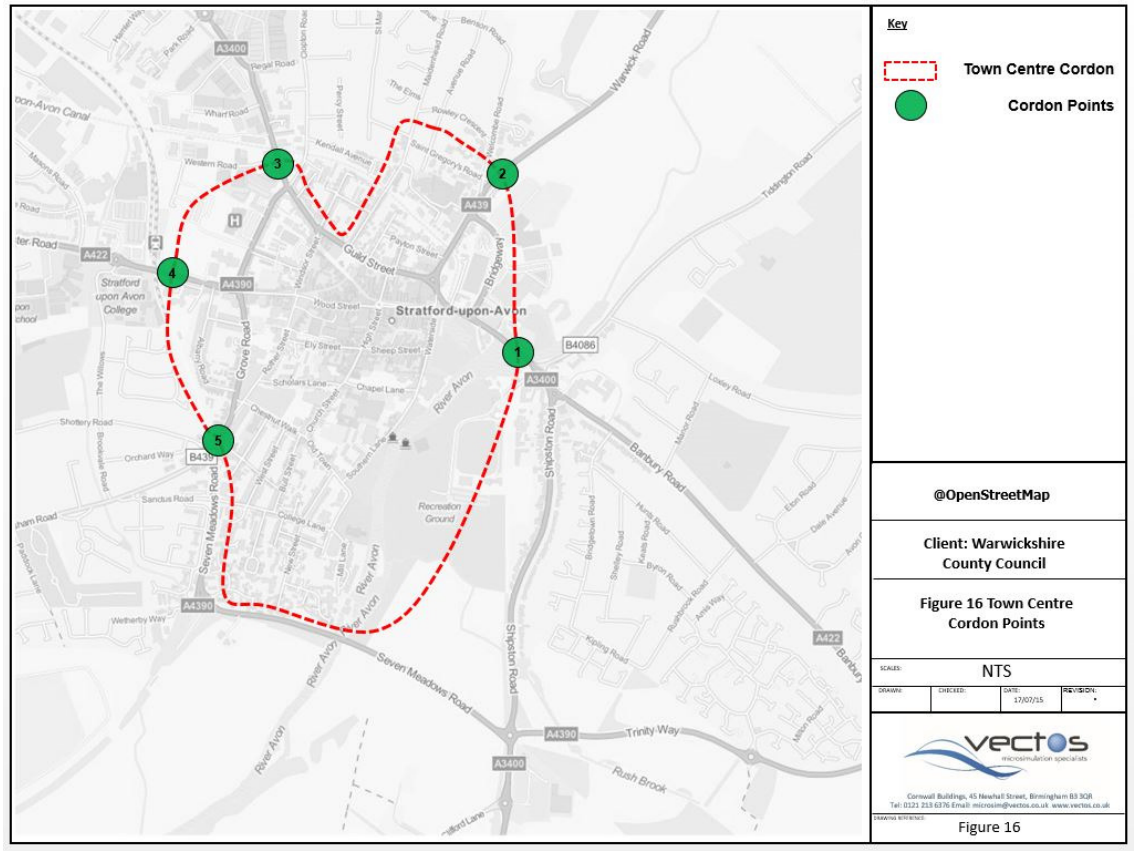
7.3 Through trips have been focused on in this part of the assessment as opposed to all town centre trips, as trips which currently have an origin or destination within the town centre are unlikely to change as a result of the inclusion of a relief road. The shifting of through trips onto the relief roads has the potential to alleviate congestion issues within the town centre.

7.4 This section outlines the methodology for assessing changes in town centre through trips, and provides a direct comparison of the levels of traffic in each of the scenarios assessed.

Assessment Methodology

7.5 In order to determine the volume of through trips in the town centre, it was firstly necessary to create a cordon in which results would be extracted from Paramics. This cordon represents the town centre study area, and the number of vehicles arriving and exiting the town centre, via major routes crossing the cordon would be analysed. The cordon applied is demonstrated in Figure 16.

Figure 16 Town Centre Cordon



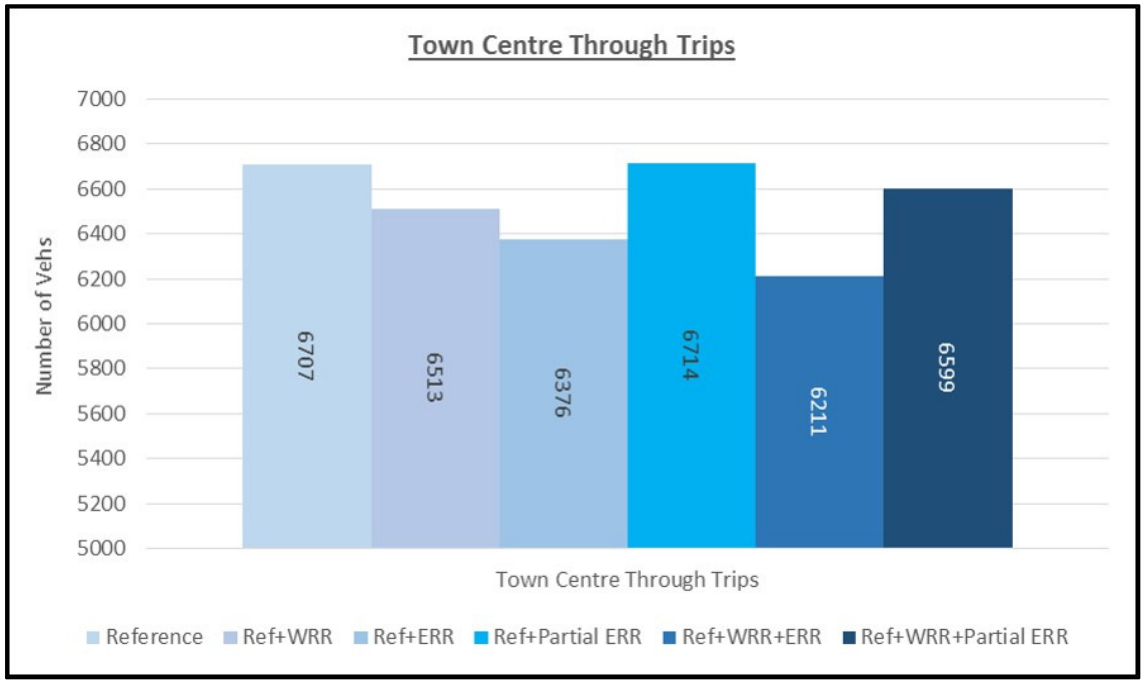
7.6 It was possible to simply extract the number of vehicles traversing links into and out of the cordon, however, this would capture all vehicles, including those that started or ended within the town centre, which would be consistent across all scenarios, and would not reflect through trips. As such all trips with an origin or destination zone within the cordon were discounted from the results extracted for the cordon.

Reference Case Analysis

7.7 The analysis of through trips in each of the Reference Case scenarios is presented in the following figures. These provide an analysis of overall level of through trips within the town centre, followed by analysis of the two-way trips crossing the selected cordon points (with trips beginning or ending in the town centre discounted), in the AM and PM peak hours (0800-0900 and 1700-1800).

AM Peak Hour Analysis (0800-0900)

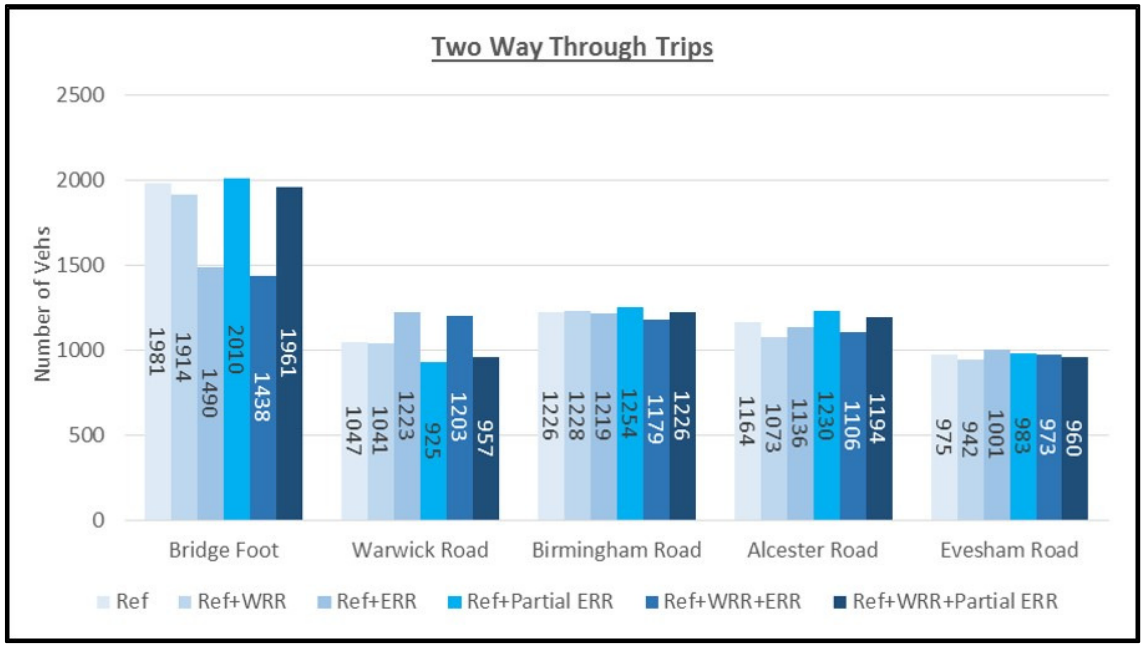
Figure 17 Town Centre Through Trips– AM Peak Hour (0800-0900)



7.8 Analysis of through trips during the AM peak hour reveals the scenarios with the full ERR included result in the most significant reductions in through trips across the town centre, with around 400 less through trips when compared to the Reference Case model. The full S-WRR scenario also shows a reduction in through trips, with around 200 less trips than the Reference Case. The Partial ERR scenario shows negligible differences in through trips when compared to the Reference Case.

7.9 Further analysis of the difference in through trips by cordon points is shown below.

Figure 18 Town Centre Through Trips by Cordon Point – AM Peak Hour (0800-0900)



7.10 Analysis of through trips during the AM peak hour reveals the scenarios with the full ERR included result in significant reductions in through trips at the Bridge Foot cordon point. The full ERR however appears to show an increase in trips crossing the cordon at Warwick Road, and only marginal difference in through trips at all other cordon points when compared to the Reference Case.

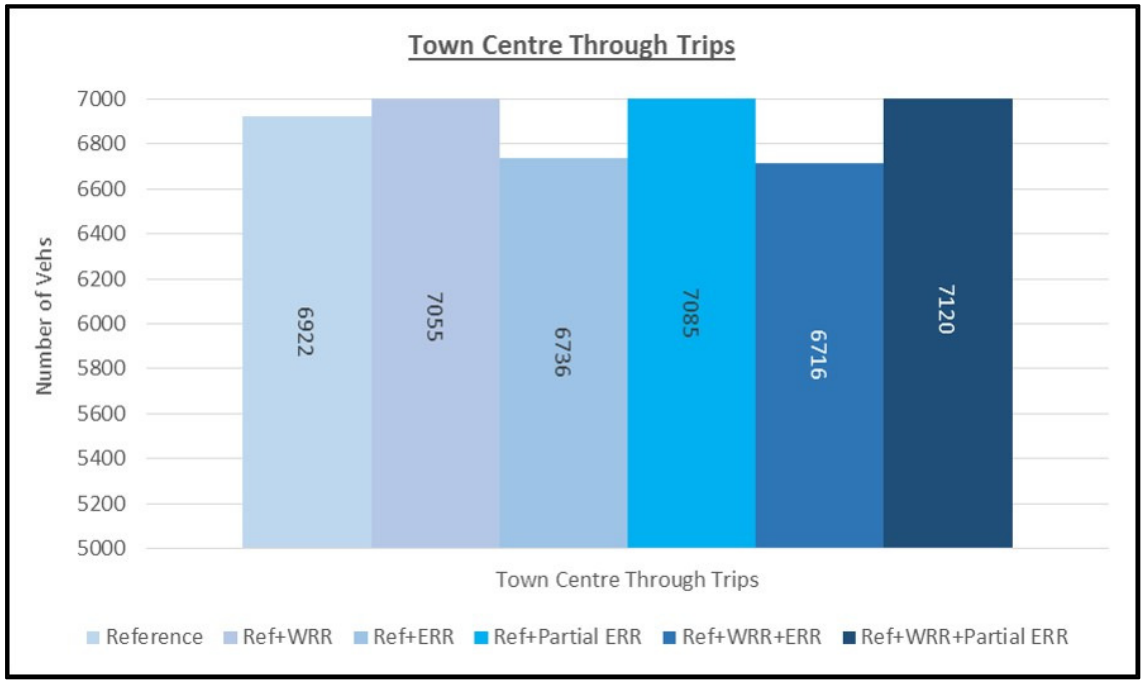
7.11 The scenario containing only the S-WRR appears to show minor decreases in through trips at the Alcester Road cordon, along with the Bridge Foot. However, at all other cordon points the number of through trips remains similar to the levels observed in the Reference Case.

7.12 The scenarios containing only the partial ERR appears to show a shift in through trips from the Warwick Road to the Bridge Foot cordon point when compared to the Reference Case. This is also noticeable in the S-WRR + Partial ERR scenario.

7.13 In summary, the results extracted from the Reference Case testing reveal that the greatest reduction in town centre through traffic is observed in the scenarios which contain the ERR.

PM Peak Hour Analysis (1700-1800)

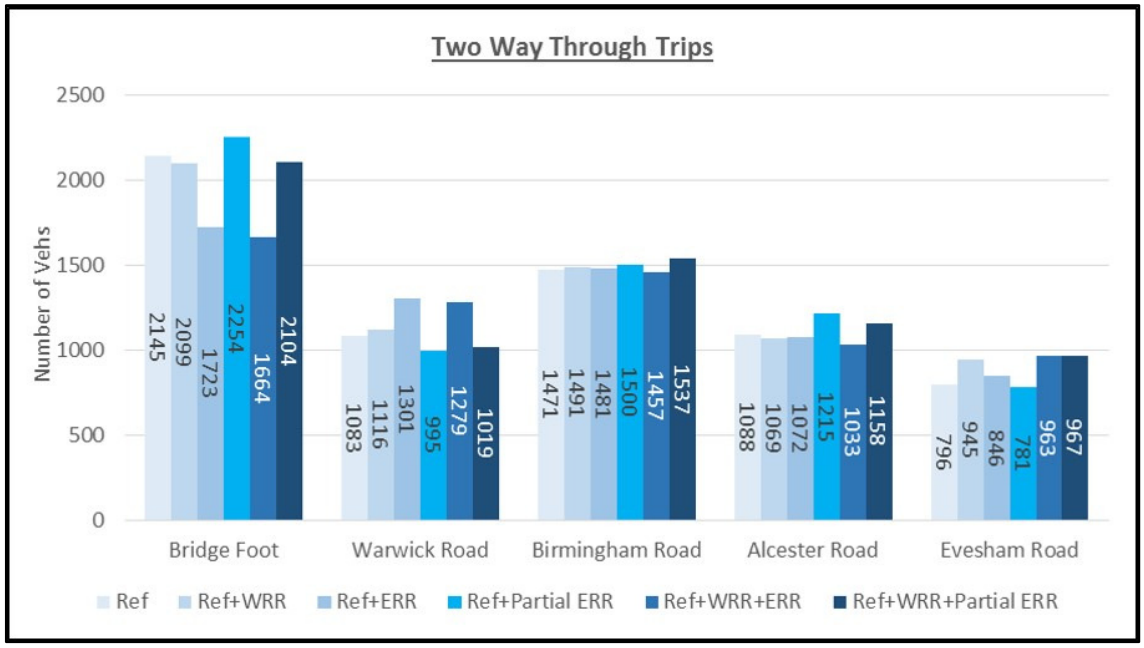
Figure 19 Town Centre Through Trips – PM Peak Hour (1700-1800)



7.14 Analysis of through trips during the PM peak hour reveals the scenarios with the ERR included result in the most significant reductions in through trips across the town centre, with around 200 less through trips when compared to the Reference Case model. The full S-WRR scenario appears to show an increase in through trips, when compared to the Reference Case, as does the Partial ERR scenario.

7.15 Further analysis of the difference in through trips by cordon points is shown below.

Figure 20 Town Centre Through Trips by Cordon Point – PM Peak Hour (1700-1800)



7.16 Analysis of through trips during the PM peak hour reveals a similar pattern to the through trips in each scenarios observed in the AM.

7.17 Again, with the full ERR included, a significant reduction in through trips at the Bridge Foot cordon point occurs, whilst the scenarios containing only the partial ERR appears to show an increase in through trips at the Bridge Foot cordon point when compared to the Reference Case. This is also noticeable in the S-WRR + Partial ERR scenario.

7.18 The scenario containing only the S-WRR appears to show minor differences in through trips at all cordon points, and it appears that the inclusion of the S-WRR does little to impact upon the levels of through traffic in the town centre.

Summary

7.19 In summary, The following has been established from the Reference Case town centre through trip assessment:

- The results suggest that the greatest reduction in town centre through traffic is achieved in the scenarios which contain the ERR, with around 400 fewer trips in the AM peak and 200 fewer in the PM peak. These reductions are most noticeable around the Bridge Foot area of the town centre.

- The inclusion of the S-WRR does result in some reductions in town centre through trips, most notably at in the AM peak around Alcester Road and Evesham Road. The differences in traffic between the scenarios containing the S-WRR and the Reference Case in the PM is negligible.
- The scenario containing the Partial ERR appears to increase the amount of through trips in the town centre, particularly around the Bridge Foot area. It would appear that due to the way that the Partial ERR scenario has been coded into the model that more trips are attracted through the town centre, perhaps as they chose to route along the A429 and upgraded Wellesbourne Road when travelling across the model network, as opposed to previously routing along Warwick Road.

Core Strategy Analysis

7.20 The analysis of through trips in each of the Core Strategy scenarios is presented in the following figures.

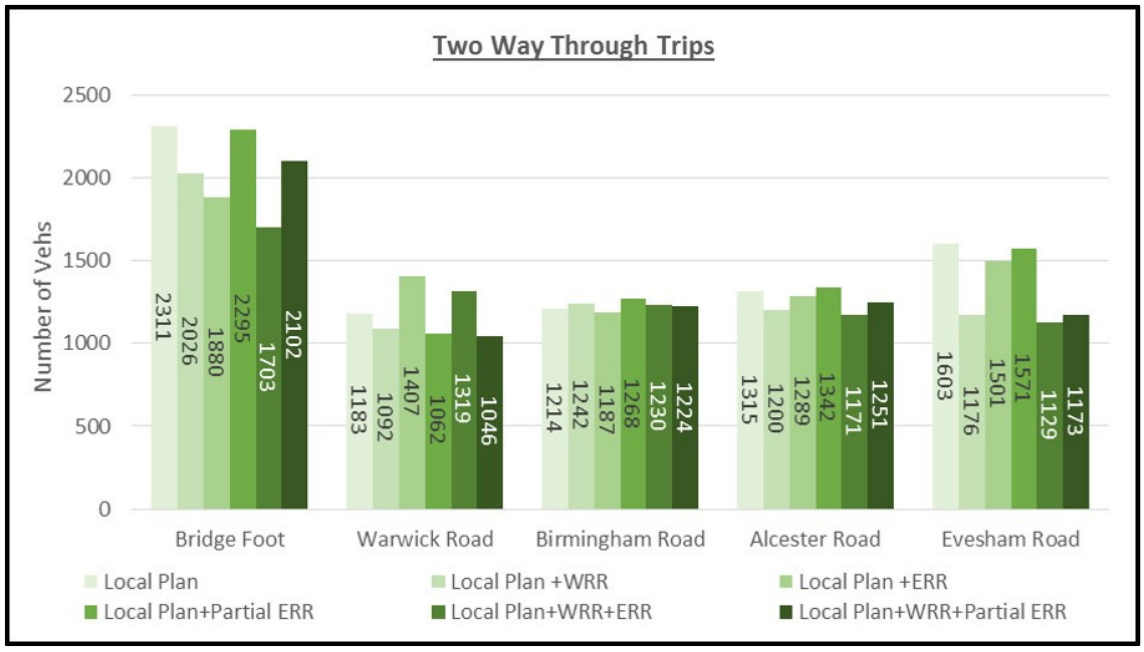
AM Peak Hour Analysis (0800-0900)

Figure 21 Town Centre Through Trips – AM Peak Hour (0800-0900)

7.21 Analysis of through trips during the AM peak hour reveals the scenarios with the S-WRR included result in significant reductions in through trips across the town centre, with around 900 less through trips when compared to the Core Strategy model. The full ERR scenario appears to show a reduction in trips, with around 400 fewer trips, however this is not to the same extent as the S-WRR scenarios. The Partial ERR alone scenario shows minor reductions in through trips of around 100 trips. The scenario containing the S-WRR and Partial ERR appears to show more through trips than the S-WRR alone scenario. This indicates that in the S-WRR and Partial ERR scenario, the inclusion of the Partial ERR undermines some of the benefits that the S-WRR is delivering, by increasing town centre through trips, as the route from Wellesbourne becomes more attractive.

7.22 Further analysis of the difference in through trips by cordon points is shown in the following figure.

Figure 22 Town Centre Through Trips by Cordon Point – AM Peak Hour (0800-0900)



7.23 Analysis of through trips during the AM peak hour reveals the scenarios with the full ERR included result in significant reductions in through trips at the Bridge Foot cordon point. The full ERR however appears to show an increase in trips crossing the cordon at Warwick Road, and only marginal difference in through trips at all other cordon points when compared to the Core Strategy model.

7.24 The scenario containing only the S-WRR appears to show a decrease in through trips at the Bridge Foot, Warwick Road, Alcester Road and Evesham Road cordon points. These decreases are most significant at Bridge Foot and Evesham Road, which is indicative of the role the S-WRR plays relative to the largest quantum of development in the Core Strategy scenario (Long Marston Airfield). Without the S-WRR trips from this site will route through the town centre to access the M40 and areas to the north of the model network. The inclusion of the S-WRR negates these impacts.

7.25 In general the inclusion of the S-WRR appears to have decreased through traffic at each of the cordon points when compared to the levels of through traffic observed in the Core Strategy model.

7.26 The scenarios containing only the Partial ERR appears to show an increase in through trips at the Bridge Foot cordon point when compared to the Core Strategy model. At all other cordon points the amount of through trips appears to remain similar to the levels observed in the Core Strategy model.

7.27 In summary, the results suggest that the greatest reduction in town centre through traffic is observed in the scenarios which contain the S-WRR. The ERR only appears to reduce through traffic significantly at the Bridge Foot cordon point.

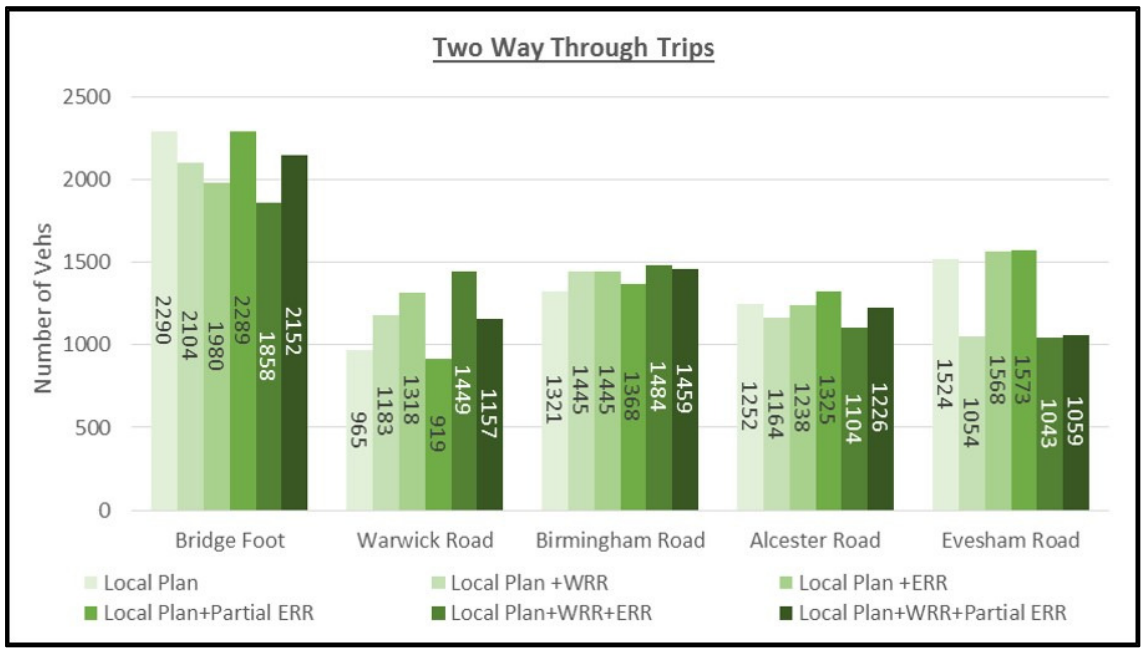
PM Peak Hour Analysis (1700-1800)

Figure 23 Town Centre Through Trips – PM Peak Hour (1700-1800)

7.28 Analysis of through trips during the PM peak hour reveals that the scenarios with the S-WRR included result in the most significant reduction in through trips across the town centre, with around 450 fewer through trips. The scenarios including the ERR and Partial ERR results in a similar level of through trips to the Core Strategy model.

7.29 Further analysis of the difference in through trips by cordon points is shown below.

Figure 24 Town Centre Through Trips by Cordon Point – AM Peak Hour (0800-0900



7.30 Analysis of through trips during the PM peak hour reveals that the scenarios with the full ERR included result in reductions in through trips at the Bridge Foot cordon point, however these reductions are not as noticeable as those observed in the AM peak. The full ERR again appears to show an increase in trips crossing the cordon at Warwick Road, and only marginal difference in through trips at all other cordon points when compared to the Core Strategy model.

7.31 The scenario containing only the S-WRR appears to show a slight decrease of around 180 through trips at the Bridge Foot, with more noticeable reductions at the Evesham Road cordon points, of around 500 trips. In general the inclusion of the S-WRR appears to have decreased through traffic at each of the cordon points when compared to the levels of through traffic observed in the Core Strategy model, with the exception of the Warwick Road cordon point where through traffic has slightly increased.

7.32 The scenarios containing only the Partial ERR appears to show a notable increase in through trips at the Bridge Foot cordon point when compared to the Core Strategy model. At all other cordon points the amount of through trips appears to remain similar to the levels observed in the Core Strategy model.

Core Strategy Summary

7.33 In summary, The following has been established from the Core Strategy scenarios town centre through trip assessment:

- The results suggest that the greatest reduction in town centre through traffic is achieved in the scenarios which contain the S-WRR, with around 900 fewer trips in the AM peak and 450 fewer in the PM peak. These reductions are most noticeable around the Bridge Foot and Alcester Road areas of the town centre.
- A large proportion of the Core Strategy demands within the Core Strategy scenario route to/from south-west Stratford to the rest of the model network. These trips travel through the town centre, along either Alcester Road or Evesham Road. With the inclusion of the S-WRR, these trips bypass both of these routes when travelling between south west Stratford and the A46, which results in the reduction of town centre through trips observed in the scenarios containing the S-WRR
- The inclusion of the ERR does result in some reductions in town centre through trips, most notably in the AM peak around the Bridge Foot area. The differences in traffic between the scenarios containing the ERR and the Core Strategy model in the PM is negligible.
- The scenario containing the Partial ERR appears to increase the amount of through trips in the town centre, particularly around the Bridge Foot area. It would appear that, as in the Reference Case, due to the way that the Partial ERR scenario has been coded into the model, that more trips are attracted through the town centre, as they chose to route along the A429 and upgraded Wellesbourne Road when travelling across the model network, as opposed to previously routing along the A46.

Town Centre Through Trip Summary

7.34 The initial town centre through trip analysis shows different results between the Reference scenario testing and Core Strategy scenario testing.

7.35 The Reference scenario testing suggests that the greatest benefit in terms of reducing town centre through trips is realised through the inclusion of the ERR,

7.36 The results for the Core Strategy scenario assessment suggest that the greatest benefit in terms of through traffic is realised through the inclusion of the S-WRR.

7.37 In the Reference Scenario the predominant flows of traffic into the town centre is via one of the existing river crossing points from the south east of the town.

7.38 With the Core Strategy demands included, there is a shift in traffic levels travelling into the town via Shipston Road, which is accessible to both existing river crossing points.

7.39 It is therefore reasonable to assume that without an additional river crossing the inclusion of the Core Strategy demands will put increased pressure on Evesham Place and Bridge Foot.

7.40 As such the inclusion of the S-WRR reduces pressure on the two existing river crossings by diverting traffic onto the new relief road, as the S-WRR becomes a bypass for the significant volume of Core Strategy demands based to the south west of Stratford.

8 SUMMARY AND CONCLUSIONS

Summary

8.1 Vectos Microsim (VM) has been commissioned by Warwickshire County Council (WCC) to undertake a high level option appraisal for an additional river crossing within Stratford-upon-Avon, in the form of either a Western Relief Road or Eastern Relief Road.

8.2 The testing has been undertaken in the recently created 2031 Reference Case and 2031 Core Strategy Stratford-upon-Avon Wide Area model. The 2031 Reference Case model contains all developments within the Stratford area, which have been granted planning permission since the last model update are included within the model. VM have produced a 2031 Reference Case model using known committed infrastructure and development assumptions, enabling development control testing to be undertaken.

8.3 A further 'Core Strategy' model reflecting the Core Strategy proposals, has also been developed using the completed Reference Case.

8.4 The following scenarios have then been created within the Reference Case and Core Strategy models:

- **Scenario 1** – Reference case - inclusive of a relief road as part of the Land to the West of Shottery committed development.
- **Scenario 2** – Western Alignment – extending the relief road which is present in the Reference Case, to form a complete Western Relief Road (S-WRR) between the A3400 Shipston Road and the A46/A422 at the Wildmoor junction.
- **Scenario 3** – Eastern Alignment Partial – As per Scenario 3, but ending where the ERR meets Tiddington Road. This scenario also includes the upgrade and straightening of the alignment of Tiddington Road to the A429, which then provides a route through to the M40 via Longbridge Island.
- **Scenario 4** – Eastern Alignment Partial – As per Scenario 3, but ending where the ERR meets Tiddington Road
- **Scenario 5** – Comprising Scenarios 2 and 3 – full western and eastern routes
- **Scenario 6** – Comprising Scenarios 2 and 4 – full western and partial eastern routes

8.5 The scenarios listed above have been assessed, with a focus on Key Performance Indicators, Queuing and Town Centre through trips. A summary of the results for each of these is provided below.

Key Performance Indicators

8.6 The KPI outputs extracted from the Reference Case scenarios are presented, for the AM and PM time periods, within the following Tables 6 and 7 respectively, and summarised below:

Table 6 Key Network Performance Statistics – Reference Case Model: AM Period

	M001A	M001B	M001C	M001D	M001E	M001F
Model Stability	100%	100%	95%	100%	90%	100%
Average Distance (km)	8.1	8.1	8.1	8.2	8.1	8.2
Average Delay (s)	516	511	509	503	505	496
Average Speed (km/h)	56.6	57.1	57.1	58.7	57.5	59.6

Table 7 Key Network Performance Statistics – Reference Case Model: PM Period

	M001A	M001B	M001C	M001D	M001E	M001F
Model Stability	100%	100%	100%	100%	100%	100%
Average Distance (km)	7.7	7.7	7.7	7.8	7.7	7.8
Average Delay (s)	508	490	482	494	471	478
Average Speed (km/h)	54.6	56.5	57.2	57.1	58.5	59.0

- The scenarios containing the ERR (M001C, M001E, M001F) result in the most significant reductions in delay, with M001E delivering the greatest benefits during the PM period, whilst M001F performs slightly better than M001F during the AM.
- The indications regarding the network performance here is that the inclusion of the ERR as far as Tiddington Road (Partial ERR), is the most critical factor in terms of reducing delay and increasing speeds across the model network.

8.7 The KPI outputs extracted for the Core Strategy scenarios are presented, for the AM and PM time periods, within the following Tables 8 and 9 respectively and summarised below:

Table 8 Key Network Performance Statistics – Core Strategy Model – AM Period

	M002A	M002B	M002C	M002D	M002E	M002F
Model Stability	100%	95%	90%	100%	95%	100%
Average Distance (km)	8.4	8.4	8.4	8.5	8.3	8.4
Average Delay (s)	580	509	555	597	499	512
Average Speed (km/h)	52.4	59.3	54.3	51.4	60.0	59.2

Table 9 Key Network Performance Statistics – Core Strategy Model – PM Period

	M002A	M002B	M002C	M002D	M002E	M002F
Model Stability	60%	100%	100%	55%	100%	95%
Average Distance (km)	8.2	8.2	8.1	8.3	8.1	8.2
Average Delay (s)	631	520	533	631	489	520
Average Speed (km/h)	47.0	56.6	54.8	47.4	59.6	57.1

- Scenario M002D (Partial ERR) results in significant delays and frequently results in the network gridlocking, with particularly high levels of congestion within Stratford town centre during the PM peak.
- The scenarios containing the S-WRR (M002B, M002E, M002F) result in the most significant reductions in delay, with M002E delivering the greatest benefits, whilst M002B performs very similarly to M002F.
- The indications regarding the network performance of the Core Strategy scenarios is that the inclusion of the S-WRR is critical within the Core Strategy scenario, in order to deliver significant reductions in delay and increases in average speed across the model network.

Queuing Analysis

8.8 An analysis of differences in queue lengths between firstly the Reference Case scenarios and following this, the Core Strategy scenario has been undertaken within this study. This has revealed the following:

Reference Scenarios - Queuing Summary

- The majority of scenarios deliver reductions in queue lengths, most significantly within Stratford town centre or along the A46
- It appears that the scenarios containing the ERR result in the most notable reduction in queue lengths, focused around the Stratford Gyratory and Bridge Foot areas

- The ERR appears to reduce queues along the A46 at both the Bishopton Island and A46/Warwick Road junctions, and along the Birmingham Road corridor
- The scenarios containing the S-WRR also deliver reductions in queue lengths, however, these reductions in queues appear to be more focused around the Seven Meadows Road and A4390 area of the town centre
- The best performing scenario modelled is the Reference + S-WRR + ERR, however it would appear that scenarios including the ERR deliver the greatest reductions in queue lengths within the town centre, and across the wider network.

Core Strategy Scenario Queuing Summary

- The majority of scenarios deliver reductions in queue lengths, most notably within Stratford town centre, along the Birmingham Road corridor or along the A46
- It appears that the scenarios containing the S-WRR result in the most notable reduction in queue lengths, focused around the Stratford Gyratory and Bridge Foot areas. Additionally the S-WRR appears to reduce queues along the A46, and along Alcester Road and Shipston Road
- The scenarios containing the ERR also deliver reductions in queue lengths, with these reductions in queues appearing to be more focused along the Birmingham Road corridor. This scenario does however result in a worsening of queuing conditions on Shipston Road, at both the Shipston Road/Seven Meadows Road/Trinity Way and Shipston Road/Clifford Lane junctions
- The best performing scenario modelled is the Core Strategy + S-WRR + ERR, however it would appear that any scenario which includes the S-WRR delivers significant reductions in queue lengths within the town centre, and across the wider network.

Town Centre Through Trip Analysis

8.9 An analysis of differences in town centre through trips between all of the scenarios tested has also been undertaken within this study. This has revealed the following:

- The Reference scenario testing suggests that the greatest benefit in terms of reducing town centre through trips is realised through the inclusion of the ERR.
- The most significant reduction in through trips are modelled at the Bridge Foot cordon point in both the AM and PM peak.
- The results for the Core Strategy scenario assessment suggest that the greatest benefit in terms of through traffic is realised through the inclusion of the S-WRR.
- The S-WRR reduces traffic at all cordon points, but most significantly Alcester Road and Evesham Road, as the S-WRR becomes a bypass for the significant volume of Core Strategy demands based to the south west of Stratford, which travel from the south of the town centre to the A46 and across the wider network.

Conclusions

8.10 Analysis of the scenarios developed within this study reveals differing conclusions between the Reference Case testing and Core Strategy testing.

8.11 The Reference testing results in a clear indication that the ERR delivers the most significant benefits, with reduced queuing across the network, particularly within the town centre and along Birmingham Road. This scenario also delivers the most significant reduction in through trips within Stratford-upon-Avon town centre.

8.12 The Core Strategy scenario testing reveals that the inclusion of the S-WRR delivers the greatest benefits in terms of queue and congestion reduction across the network. Significant reductions in queues are delivered to the west of Stratford, within the town centre and along the A46. The inclusion of the S-WRR also results in the most noticeable reduction in through traffic within the town centre.

8.13 Again, the scenario containing both the S-WRR and ERR results in the most significant reduction in queues, but it is clear that the S-WRR is the most critical factor in this.

8.14 It would appear in the scenario whereby growth is applied across the model network (Reference Case) then the ERR is most effective at reducing congestion, whilst in the scenario whereby growth is focused on specific locations (Core Strategy) then the S-WRR delivers the greatest benefits.

8.15 The modelling results suggest that the S-WRR is critical in terms of mitigating the large residential development at Long Marston Airfield, to the south of Stratford town centre, which is included within the Core Strategy model.

APPENDIX A

Queue Plots