

Warwickshire County Council
**Stratford-on-Avon Strategic
Transport Assessment**
Options Analysis Report

232815-55.R001

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This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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SDC STA Queue Analysis Plots

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1 Executive Summary

1.1 Overview

Arup have been commissioned by Warwickshire County Council (WCC) and Stratford-on-Avon District Council (SDC) to undertake detailed testing of a number of potential Core Strategy (CS) allocations. This report builds upon the methodologies and analysis presented within previous Stratford-on-Avon Strategic Transport Assessment (STA) Reports.

1.2 Study Objectives

The objectives of this assessment are as follows:

- To undertake a detailed assessment of the likely impacts of five potential options for allocating housing and employment across the District area.
- To identify an outline mitigation strategy to accompany each of the proposed options for development and assess the mitigation levels thereof.

In line with the level of assessment that is being undertaken, this work is considered to provide a strategic overview of the progress to date.

1.3 Scenario Development

SDC have requested 5 options be assessed as part of this current round of testing. An overview of each option that has been assessed is provided as follows:

Option 1 – Further Dispersal - This option assumed a housing distribution encompassing existing settlements as well as a number of specific sites.

Option 2 – Gaydon/Lighthorne Heath - Option 2 assumes the delivery of 3,000 dwellings and 100 Ha of employment in an area of land between the M40 and the B4100 near Gaydon/Lighthorne Heath. It is assumed that 2,500 dwellings will be delivered by the end of the plan period.

Option 3 – Long Marston Airfield - Option 3 comprises 3,500 dwellings at the Long Marston Airfield Site and 13 Ha of employment. It is assumed that 2,100 dwellings at least would be built out by 2031 alongside all of the employment and tertiary elements of the site.

Option 4 – South East Stratford - Option 4 testing involved the allocation of 2,750 dwellings in an area of land to the South East of Stratford alongside 8 Ha of employment. It is assumed that 2,500 dwellings would be delivered within the Plan period.

Option 5 – Southam North and Stoneythorpe - Option 5 assumes the delivery of 2,800 dwellings across 2 separate sites. It has been anticipated that 800 dwellings will be delivered within the Stoneythorpe area whilst 2,000 dwellings will be delivered in an area to the North of Southam. The assumption is that 2,500 dwellings would be delivered within the 2031 plan period.

1.4 Mitigation Schedule

As part of the assessment process a series of mitigation measures have been identified and incorporated within the assessment. In some cases the mitigation measures have been applied to a number of scenarios whilst in others the mitigation has been derived in response to conditions observed within a specific scenario.

Stratford-upon-Avon Mitigation Measures

Within the Stratford-upon-Avon testing the following measures have been included within the majority of scenarios:

- The Stratford Transport Package (STP) – The STP comprises 8 proposed schemes within the area of Stratford-upon-Avon which have been identified through previous stages of assessments.
- Warwick Road Dynamic Signage Strategy - One of the measures proposed within the STP/SRZ work was the adoption of a dynamic signage strategy for the Warwick Road. At this stage, the change in signage strategy has been modelled through a consistent change in link classification along the Warwick Road. It is likely that a more refined scheme would be delivered in reality which directs vehicles to use the Warwick Road in response to congestion effects on the Birmingham Road.

As part of the Assessment of Option 3 Long Marston airfield and Option 4 South East Stratford, key mitigation measures have been identified as being essential to ensure an acceptable level of network operation can be maintained. These schemes were included as follows:

Option 3 Long Marston Airfield – Western Relief Road - The Do Minimum proposals within the Option 3 Long Marston Airfield comprise delivery of a Western Relief Road. This link is intended to connect the A3400 Shipston Road (south of Stratford-upon-Avon) with the B439 Evesham Road. It is anticipated that delivery of a new link road in this location would better link the areas to the Southwest, including the area of the LMA site, with the A46.

Option 4 South East of Stratford – Eastern Relief Road - The Do Minimum proposals within the Option 4 South East Stratford comprise delivery of an Eastern Relief Road. This link is intended to connect the A422 Banbury Road to the A439 Warwick Road via Tiddington Road and a new bridge across the River Avon. Delivery of a new link road in this area would undoubtedly relieve some of the issues which occur as a result of the constraints in the south east area of Stratford.

In addition to the revised signposting along Warwick Road and the Stratford Transport Package the following mitigation measures have been incorporated in one or more of the Stratford test scenarios:

- Shakespeare Street/Mulberry Street
- A46/A439 Marraway Roundabout
- A439/A3400 Junction
- WRR/Evesham Road
- A46/WRR Wildmoor Roundabout

M40 & South Warwick Mitigation Measures

The mitigation measures identified through the assessments undertaken within the M40 model have been defined separately for both the Option 2 Gaydon/Lighthorne Heath and Option 5 Southam North and Stoneythorpe scenarios.

The mitigation measures identified through the Option 2 Gaydon/Lighthorne Heath scenario assessment are as follows:

- M40 Junction 12 NB on-slip
- B4100 Widening
- M40 Capacity Enhancements
- M40 Junction 13 NB off-slip
- Fosse Way/Harbury Lane
- Fosse Way/Southam Road Roundabout
- A452/B4100 'Grey's Mallory' Roundabout
- A452 Corridor Dualling
- Europa Way/Harbury Lane Roundabout
- Banbury Road/Myton Road/Gallows Hill (various measures)

The mitigation measures identified through the Option 5 Southam North and Stoneythorpe scenario assessment are as follows:

- A423 / Daventry Road
- A423 / A425
- A425 / B4451
- A425 (Southam Road) / B4455
- A425 (Radford Road) / Willes Road

1.5 Methodology

Each of the options outlined previously have been tested within a series of model scenarios and the outcome of these tests has been recorded and described within this report.

In order for the testing to be undertaken in a consistent manner each of the scenarios were assessed using either the Stratford-upon-Avon or M40 PARAMICS model. The principles behind these assessments are outlined as follows:

- Each option has been assessed using a consistent Reference Case
- Testing has been split into two core areas of focus:
 - Stratford focussed testing
 - M40 focussed testing
- The sites are considered to be of a sufficient distance apart to negate the need for testing of any option to be undertaken within both study area models.
- Where possible, each option has been assessed using the following method of scenario derivation:
 - Do Nothing – demand associated with the option have been assigned to the network but no additional mitigation has been incorporated.

- Do Minimum – core mitigation measures have been incorporated based on a wider understanding of what is likely to be required to facilitate the delivery of the site
- Do Something – refined mitigation measures have been proposed which are intended to build additional capacity into the network and enable the demands associated with the sites to be better accommodated.

1.6 Results Analysis

The assessments pertaining to Options 1, 3 and 4 were undertaken within the Stratford-upon-Avon PARAMICS model whilst the M40 model was used to assess the outputs from the Option 2 and 5 scenarios.

1.7 Option 1 Dispersed Development Findings

The initial comparisons between the 2031 Reference Case and the 2031 Option 1 Dispersed Development scenario reveal the following conclusions:

- Inclusion of the Option 1 development sites will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy
- Adoption of the additional mitigation measures is not expected to lead to a significant improvement in network conditions beyond that expected should the major mitigation measures be implemented.
- Analysis of the trip completion ratios and network conditions within the Reference Case and Dispersed Development scenarios indicates that, in general, the major mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM period.
- Analysis of the impacts on queuing levels indicates that the PM network is likely to suffer from the greatest level of impact in spite of the inclusion of the proposed mitigation measures.
- Analysis of the impacts on journey times indicates that some improvements are deliverable but there are also some impacts likely to occur. The impacts appear to be largely focussed in and around the area of the gyratory where there is limited scope for further mitigation measures to be included within the network.

1.8 Option 3 Long Marston Airfield Findings

The initial comparisons between the 2031 Reference Case and the 2031 Option 3 Long Marston Airfield Development scenarios reveal the following conclusions:

- Inclusion of the LM development demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.

- Analysis of the trip completion ratio within both Reference Case and LM scenarios indicates that, in general, the mitigation measures associated with Option 3 DS + WRM are able to accommodate the additional demand levels assigned during both peak periods.
- The queuing analysis does not indicate any areas where a severe increase in queuing levels has been identified whilst, furthermore, a considerable number of reductions in queue lengths is achieved within the town centre during the PM period as a result of the additional mitigation measures.
- Increases in delay are likely to occur on routes which are peripheral to Stratford town centre, in particular routes into the town from the south west and the A46/A439 Warwick Road routes are affected which indicates further mitigation measures within these areas is likely to be desirable.

1.9 Option 4 South East Stratford Findings

The initial comparisons between the 2031 Reference Case and the 2031 Option 4 South East Stratford Development scenarios reveal the following conclusions:

- The analysis of the Do Nothing scenario outputs reveals that the network is unable to accommodate the proposed demands without the inclusion of the ERR; this is in spite of the presence of the STP proposals.
- Analysis of the trip completion rates indicates that the 2031 Option 4 DS + WRM network is able to accommodate a greater level of trips than the Reference Case.
- Overall, within the 2031 Option 4 DS + WRM scenario network the conditions are observed to improve in so far as journey speeds are likely to increase and delays reduce as a result of the inclusion of the allocated demands as well as the associated mitigation measures.
- Analysis of both queuing and delay outputs appears to indicate that there are a large number of instances where improvements are likely to occur as a result of the inclusion of the scheme proposals and associated mitigation measures.

1.10 Option 2 Gaydon/Lighthorne Heath Findings

The initial comparisons between the 2031 Reference Case and the 2031 Option 2 Gaydon/Lighthorne Heath Development scenarios reveal the following conclusions:

- Inclusion of the additional demands associated with Option 2 will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve should not mitigation measures be introduced.
- Inclusion of the schemes associated with Option 2 DS results in an improvement to network conditions in both peak periods.
- Analysis of the trip completion ratio within the Reference Case and Option 2 DS indicates that, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak periods.

- Adoption of Option 2 DS and the associated mitigation measures has the potential to deliver improved conditions for road users in the form of reduced queuing and, improved journey times.
- Any impacts in queuing and journey times are most likely to occur in close proximity to the site whereas, currently, improvements are identified in the network around south west Warwick/Leamington. These improvements occur as a result of the inclusion of the additional mitigation measures within these areas. These mitigation measures are intended to overcome existing and forecast network constraints which have the potential to occur irrespective of whether the site and associated demands are allocated or not.

1.11 Option 5 Southam North and Stoneythorpe Findings

The initial comparisons between the 2031 Reference Case and the 2031 Option 5 Southam North and Stoneythorpe development scenarios reveal the following conclusions:

- Inclusion of the Option 5 demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions.
- During the AM peak period, assuming the mitigation measures are implemented, the network conditions are expected to remain relatively constant compared to that which is achieved by the 2031 reference scenario. This occurs in spite of the additional demand on the network.
- During the PM peak period, assuming the mitigation measures are implemented, the network conditions are expected to improve slightly compared to that which is achieved by the 2031 reference scenario. This occurs in spite of the additional demand on the network.
- Analysis of the trip completion ratio within both Reference Case and Option 5 scenario indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak period
- The queuing analysis indicates that there are no instances of severe increases in queue lengths occurring across the network.
- The delay analysis indicates that within the AM there are issues along Chesterton Road westbound, southbound along A423 Southam Bypass, southbound on the B4451 at Deppers Bridge and at Bishop's Itchington and westbound along the A425 Leamington Road, Ufton Hill and Southam Road corridor which correspond with routes that would be expected to accommodate additional development traffic.

1.12 Summary of Key Conclusions

Based on the outline conclusions of each individual assessment, coupled with a review of the impacts identified within each option, the following conclusions have been drawn:

- Based on the outputs from the assessment thus far, there are no issues that have been identified that would be considered to be of sufficient magnitude to render an option undeliverable.
- Failures to deliver either the WRR or ERR proposals are likely to preclude the delivery of the full allocation of either Option 3 Long Marston Airfield or Option 4 South East Stratford sites.
- The impacts identified within the assessment of Option 1 Dispersed Development are of a similar magnitude to the impacts identified within the assessment of Option 3 Long Marston Airfield and Option 4 South East Stratford. It should be noted that there are substantially lower levels of housing tested within Option 1 around the area of Stratford-upon-Avon town, but a similar magnitude of impact identified. Arguably the quantum of development proposed through Option 1 Dispersed Development would not be of a sufficient magnitude to ensure that mitigation on a scale to the WRR and ERR could be include alongside the proposed developments.
- Comparatively, of the three Stratford focussed assessment scenarios Option 4 South East Stratford incurs a lower level of impact than Option 3 Long Marston Airfield, albeit the assumptions within Option 4 South East Stratford also contain 750 fewer houses and 5 Ha lower employment allocation, thus there are inherently lower demand levels within the Option 4 assessments than Option 3.
- When considering the outcomes from the M40 focussed assessment Option 2 Gaydon /Lighthorne Heath has the potential to deliver improvements in some areas of the study area but this is predicated on the delivery of mitigation measures along the A452 corridor which is linked to existing WDC CS proposals and has also been identified within the Coventry and Warwickshire Strategic Economic Plan (SEP).
- The initial assessments of both Option 2 Gaydon/Lighthorne Heath and Option 5 Southam and Stoneythorpe reveals that both Options can be accommodated, alongside the proposed mitigation measures but that residual impacts are still likely to occur as a result of both options which may require further mitigation (i.e. in close proximity to the Gaydon/Lighthorne Heath site in Option 2 and along the A423 Southam Bypass and B4451 within Option 5).

1.13 Further Considerations and Recommendations

Whilst the assessment undertaken thus far has been based on the most recently available assumptions, pertaining to each of the sites, consideration should be given to updating these at an appropriate stage following the identification of the CS Option for allocation. Elements that could be considered for review include, but are not limited to:

- The appropriateness of the development trip generation and distribution assumptions.
- Where applicable, the profiling and release of traffic generation within the modelling, particularly concerning the assessment of the employment element of the Option 2 Gaydon/Lighthorne Heath proposals.
- The assumptions pertaining to mode share and internalisation and, further refinement based on the adopted site proposals.

- The potential impacts of development trip types not included within the strategic level assessment (i.e. Education, Leisure, etc.).

There are a number of additional elements that should be considered during any future stages of the assessment but it is acknowledged that not all of these issues may be addressed prior to the site allocation and, furthermore, it may not be possible to address certain issues until the allocated site is being promoted through the planning process.

Considerations include:

- The impacts on areas not included within the modelling;
- The feasibility and deliverability of the scheme proposals identified within the work thus far, including a review against Highway requirements and current design and safety standards since, currently, scheme proposals are based wholly on model outputs.
- Specific risks pertaining to the delivery of one or more scheme on the network such as:
 - The physical risks to delivering the M40 capacity enhancements in the area required and the viability of the costs thereof;
 - The feasibility of the proposed network reconfiguration within Stratford-upon-Avon town.
 - The costs and feasibility of delivering either the ERR or the WRR proposals.

2 Introduction

2.1 Scope

Arup have been commissioned by Warwickshire County Council (WCC) and Stratford-on-Avon District Council (SDC) to undertake detailed testing of a number of potential Core Strategy (CS) allocations. This report builds upon the methodologies and analysis presented within previous Stratford-on-Avon Strategic Transport Assessment (STA) Reports.

2.2 Study Objectives

The objectives of this assessment are as follows:

- To undertake a detailed assessment of the likely impacts of five potential options for allocating housing and employment across the District area.
- To identify an outline mitigation strategy to accompany each of the proposed options for development and assess the mitigation levels thereof.

In line with the level of assessment that is being undertaken, this work is considered to provide a strategic overview of the progress to date.

The impact analysis that is presented within this report is intended to inform an assessment on the feasibility of each potential option alongside the proposed mitigation measures.

At this stage the level of assessment is not of a sufficient level of detail, nor has the mitigation strategy been reviewed comprehensively enough, to be considered as sufficient to fully mitigate the impacts and ensure the delivery of the proposed allocations. Rather it is intended to confirm what strategic elements of infrastructure are likely to be required to ensure that the allocated growth can be accommodated upon the existing network.

It is anticipated that the planning process associated with the individual options and sites will continue throughout the planning and adoption process and that each development will be supported by a separate planning application that will, in turn, be accompanied by a Transport Assessment (TA). The planning process associated with the individual sites will be expected to deal in more detail with issues such as the associated access strategies and the mitigation of localised impacts incurred.

At this stage it should also be recognised that the purpose of this assessment is to determine an appropriate mitigation strategy necessary to accommodate all of the growth that is envisaged to occur as a result of the site allocations. Thus the mitigation proposed through this work reflects that which will be anticipated across the entire 2011 to 2031 plan period. Furthermore, the mitigation strategies have been derived based on the full build out anticipated for each option, and it should be acknowledged that in some cases the dwelling numbers tested may overlap into the next plan period.

The delivery of the mitigation measures proposed through this work is most likely to be achieved through a phased approach which mirrors the phased approach to the development of sites across the District.

Whilst it is recognised that there may be a requirement to determine an appropriate phasing strategy to accompany the delivery of the allocated sites throughout the plan period it should also be recognised that such work cannot be completed until the allocation strategy is adopted and the accompanying full mitigation schedule determined.

2.3 Background

The objectives set out previously are intended to build upon the work that has previously been completed with regards the testing of the SDC housing and employment allocations.

It is intended that this report should be considered as building upon those previous stages of work which have been documented in independent, but complementary, STA reports¹.

An overview of the process that has been followed prior to the commencement of this phase of testing has been summarised as follows:

Stratford-on-Avon STA: S-PARAMICS Modelling Report

The initial testing of SDC allocations involved threshold testing of growth allocation within the Stratford-upon-Avon PARAMICS model whereby incremental growth levels were added to the model and the areas of network stress identified. Some initial mitigation proposals were tested, in the form of Town Centre Improvements and an Eastern and Western Relief Road as well as some initial specified growth options.

Stratford-on-Avon STA: Phase 2 Modelling Report

The second phase of testing looked in more detail at two potential options for allocating growth across the District. As part of this work, further refinements to the initially proposed 'Town Centre Improvement' schemes was also undertaken and the emergence of a town wide transport strategy, herein referred to as the Stratford Transport Package (STP), was recorded.

Stratford-on-Avon STA: Stratford (Canal Quarter) Regeneration Zone Scenario Analysis

The most recent phase of analysis looked in detail at the impacts of the Stratford Regeneration Zone (SRZ) and the potential impacts of delivering the SRZ alongside the proposed STP measures. The STP measures were further refined through the assessment process and an initial cost estimate for the schemes was produced. Further analysis also indicated a potential phasing strategy that may be adopted as part of the approach to delivering the overall STP mitigation strategy.

¹ <https://www.stratford.gov.uk/planning/ldf-evidence-base.cfm>

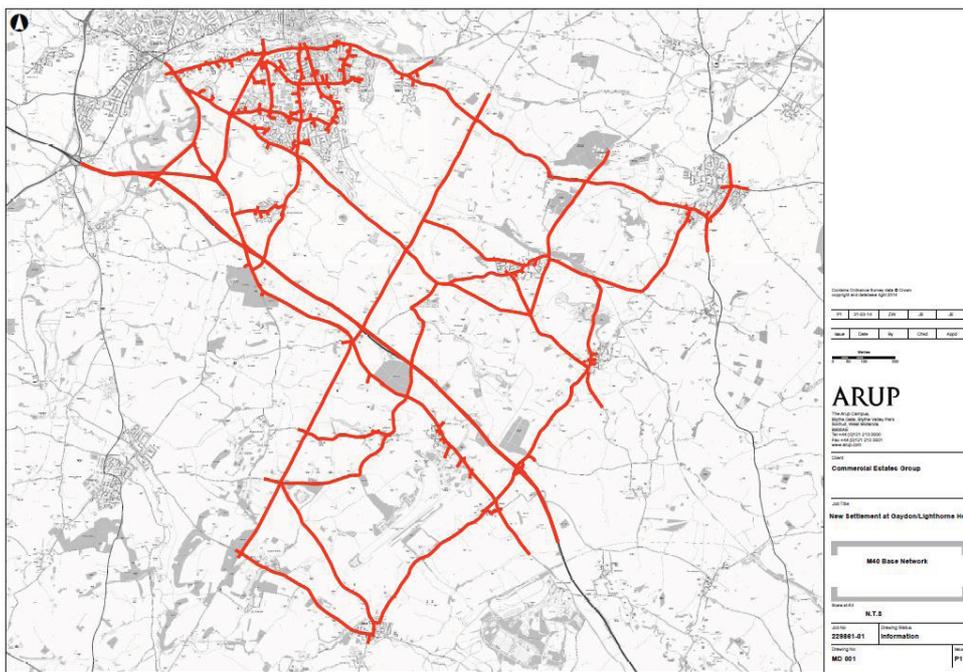
2.4 Study Area

The scope of the study area has been broadly defined by the availability of existing PARAMICS models. The two key models used for this assessment are the Stratford-upon-Avon PARAMICS model and the recently extended M40 PARAMICS model. The extent of these model networks is illustrated within the following **Figure 1** and **Figure 2**:

Figure 1 Stratford-upon-Avon PARAMICS Model



Figure 2 –Extended M40 PARAMICS model Coverage



2.5 Assessment Periods

It should be noted that the two models run for different time periods as a result the analysis presented within later sections of this report has been based on outputs from varying time periods. The AM and PM periods within the Stratford-upon-Avon PARAMICS model covers 07:00 to 09:00 and 16:00 to 18:00 whilst the corresponding periods within the extended M40 model cover 06:00 to 10:00 and 16:00 to 19:00 respectively.

2.6 Core Strategy Options

SDC have requested 5 options be assessed as part of this current round of testing. An overview of each option that has been assessed is provided as follows:

2.6.1 Stratford Regeneration Zone/Stratford Transport Package

For all options whereby the assessment was undertaken within the Stratford-upon-Avon PARAMICS model the reference conditions were assumed to be inclusive of the SRZ and the STP proposals.

2.6.2 Option 1 – Further Dispersal

This option assumed a housing distribution encompassing existing settlements as well as a number of specific sites. SDC advised that the option would contain the following housing allocations:

- Stratford = 650 dwellings
- Alcester = 175 dwellings
- Bidford = 125 dwellings
- Henley = 75 dwellings
- Kineton = 50 dwellings
- Shipston = 125 dwellings
- Southam = 150 dwellings
- Studley = 150 dwellings
- Wellesbourne = 150 dwellings
- Local Service Villages = 350 dwellings (in total)
- Long Marston Depot = 500 dwellings

Not all of these sites have been included explicitly within the modelling as some were too far outside of the areas covered by the models to be able to exert a material influence. Further details on this have been provided within the following section of this report.

2.6.3 Option 2 – Gaydon/Lighthorne Heath

Option 2 assumes the delivery of 3,000 dwellings and 100 Ha of employment in an area of land between the M40 and the B4100 near Gaydon/Lighthorne Heath. It is assumed that 2,500 dwellings will be delivered by the end of the plan period.

2.6.4 Option 3 – Long Marston Airfield

Option 3 comprises 3,500 dwellings at the Long Marston Airfield Site and 13 Ha of employment. It is assumed that 2,100 dwellings at least would be built out by 2031 alongside all of the employment and tertiary elements of the site.

2.6.5 Option 4 – South East Stratford

Option 4 testing involved the allocation of 2,750 dwellings in an area of land to the South East of Stratford alongside 8 Ha of employment. It is assumed that 2,500 dwellings would be delivered within the Plan period.

2.6.6 Option 5 – Southam North and Stoneythorpe

Option 5 assumes the delivery of 2,800 dwellings across 2 separate sites. It has been anticipated that 800 dwellings will be delivered within the Stoneythorpe area whilst 2,000 dwellings will be delivered in an area to the North of Southam. The assumption is that 2,500 dwellings would be delivered within the 2031 plan period.

2.7 Methodology

Each of the options outlined previously have been tested within a series of model scenarios and the outcome of these tests has been recorded and described within this report.

In order for the testing to be undertaken in a consistent manner each of the scenarios were assessed using either the Stratford-upon-Avon or M40 PARAMICS model. The principles behind these assessments are outlined as follows:

- Each option has been assessed using a consistent Reference Case
- Testing has been split into two core areas of focus:
 - Stratford focussed testing
 - M40 focussed testing
- The sites are considered to be of a sufficient distance apart to negate the need for testing of any option to be undertaken within both study area models.
- Where possible, each option has been assessed using the following method of scenario derivation:
 - Do Nothing – demand associated with the option have been assigned to the network but no additional mitigation has been incorporated.
 - Do Minimum – core mitigation measures have been incorporated based on a wider understanding of what is likely to be required to facilitate the delivery of the site
 - Do Something – refined mitigation measures have been proposed which are intended to build additional capacity into the network and enable the demands associated with the sites to be better accommodated.

2.8 Report Structure

The remainder of this report is set out as follows:

- **Section 3** – Details the development of the models used to inform the various assessments.
- **Section 4** – Identifies the mitigation assumptions adopted within the modelling
- **Section 5** – Documents the model outputs that have been used within the various stages of the assessment
- **Section 6** – Provides an overview of the test scenarios as well as detailing growth levels within the various scenarios.
- **Sections 7 to 9** – Documents the findings from the Stratford-upon-Avon focussed testing.
- **Sections 10 and 11** – Presents the findings from the M40 focussed assessment.
- **Section 12** – Outlines the Summary and Conclusions
- **Section 13** – Provides some recommendations for consideration during any future phase of assessment.

3 SDC Scenario Development

3.1 Overview

The following section of this report sets out the assumptions and development process which underpin the PARAMICS models used to inform the assessment.

3.2 2031 Stratford-upon-Avon Reference Conditions

The model adopted as the Reference Case for the Stratford-upon-Avon focussed element of the testing was produced as a result of the recent SRZ/STP testing as outlined within **Section 2.3** of this report.

This model scenario already included the demands associated with the Stratford Regeneration Zone as well as the refined Stratford Transport Package. A brief overview of these elements and the changes that they represent from the original Stratford-upon-Avon 2028 Reference Case, used to underpin the assessment of the SRZ/STP, is outlined within the following section:

3.2.1 Stratford Regeneration Zone & Stratford Transport Package

The SRZ policy looks to re-allocate land within Stratford-upon-Avon (SuA) for housing and relocate existing and proposed employment from that area to areas which are on the periphery of the existing SuA Road network.

The initial testing, undertaken previously, assumed that 700 dwellings will be delivered within the areas outlined within **Figure 3** on the following page.

In addition to the housing, two areas have been identified as being required to accommodate the re-allocated and proposed employment; these areas (Area 1 and Area 4) have been illustrated within **Figure 4**.

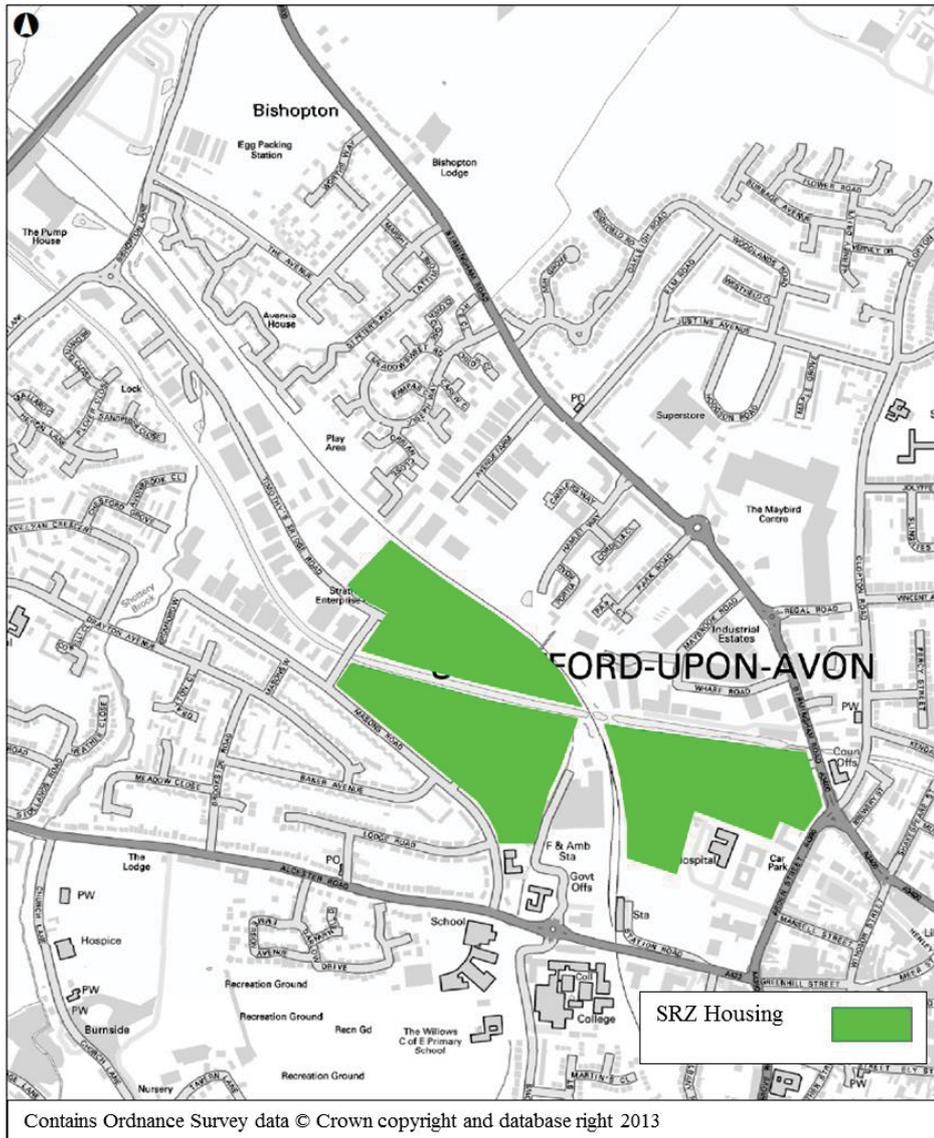
The proposed split of employment to be delivered within Area 1 (15 Ha gross) was assumed as follows:

- B1 = 30%
- B2 = 40%
- B8 = 30%

The proposed split of employment to be delivered within Area 4 (10 Ha gross) was assumed to be as follows:

- B1 = 50%
- B2 = 20%
- Sui generis, e.g. car showrooms = 30%

Figure 3- SRZ Housing Allocation Areas



3.2.2 SRZ Demand Summary

The trip generation figures assigned to the model as a result of the inclusion of the SRZ policy, as well as the net trip generation that these values represent, once the impact of the supplanted trips has been considered, are presented within **Table 1** and **Table 2** respectively:

Table 1 - SRZ Total Trip Generation

	In	Out	Total
0700 to 0800	417	278	695
0800 to 0900	815	396	1211
1600 to 1700	327	600	927
1700 to 1800	363	754	1117

Figure 4 - SRZ Employment Allocation Areas



Table 2 - SRZ Net Trip Generation

	In	Out	Total
0700 to 0800	73	201	274
0800 to 0900	118	294	412
1600 to 1700	215	104	319
1700 to 1800	292	111	403

3.2.3 SRZ Demand Allocation

3.2.4 Peak Spreading

Historically, demands allocated to the Stratford-upon-Avon model have been subject to peak spreading which is informed by the interpolation of existing growth rates by hour into forecast hourly growth rates. The existing growth rates

have been derived using observed annual cordon count data that is collected by WCC. A full overview of the process that underpins peak spreading within the modelling is provided within the 2021 Model Update Report².

Since growth in background demands and committed developments have been subjected to peak spreading it appears reasonable that the same assumptions should be applied to the demand allocated within the model as a result of the implementation of the SRZ policy.

However, the likelihood for peak spreading to occur is dependent upon the premise that vehicles will elect to retime their journeys in response to adverse network conditions present within the period that they would most like to depart.

Since the SuA PARAMICS model only covers 2 hours for both AM and PM time periods it is only possible to consider peak spreading over the same periods. Otherwise, retiming of trips into the 'post-peak' hour would simply mean the removal of demand from the model which is an approach which would be difficult to justify.

When reviewing the demand levels within the current 2028 Reference Case, it is difficult to see how further peak spreading could be justified within the PM period. There is very little difference in the magnitude of demand that is being assigned within the model during either the 16:00 to 17:00 or 17:00 to 18:00 hour. Thus, it is unrealistic to assume that trips assigned within the model during the PM Peak hour would choose to retime into the preceding hour when the levels of congestion are likely to be comparable between both hours. If that is the case, it is more likely that the trips will simply depart within the originally intended departure window.

The hourly demand levels, assigned within the 2028 Reference Case, are illustrated within **Table 3**:

Table 3 - 2028 Reference Case, Demands by Matrix Levels

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Background	9534	14730	13993	15404
HGV	792	813	825	527
Com Dev.	1241	769	2150	1259
Growth	522	575	531	528
Hourly Demand	12089	16887	17499	17718

The previous table illustrates the parity in demand levels between the PM pre-peak and peak hours. As a result no additional account of peak spreading has been incorporated when assigning the SRZ demand into the model.

When considering the AM, demands within the 07:00 to 08:00 hour are considerably lower than those within the 08:00 to 09:00 hour. As a result, some account of peak spreading has been incorporated within the assignment of SRZ demand into the model during the AM period

The historic peak spreading proportions that have previously been adopted, during the AM period, are presented within **Table 4**.

² MID3176.R001 Stratford-upon-Avon Model Update Report, 2015 & 2021 Scenario Years, JMP Consultants, August 2011

Table 4 – Stratford-upon-Avon Forecast Peak Spreading Proportions AM (07:00 to 09:00)

Period	Proportion
07:00 to 08:00	97%
08:00 to 09:00	7%

If the aforementioned proportions were adopted in entirety this would lead to a substantial reassignment of SRZ demand into the pre-peak hour. In order to reduce this propensity, the process has been applied to only 50% of the predicted growth in trips. The remaining 50% of the demand is assigned to the model in line with original SRZ trip generation totals.

The initial and adjusted SRZ demand totals that have been adopted within the modelling are summarised within **Table 5**:

Table 5 - SRZ Modelled Demand Totals

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Unadjusted*	693	1209	927	1116
Peak Spread*	1233	669	927	1116

*Demand totals vary from initial trip generation values as a result of the rounding process involved in translating trip generation figures into model demands.

3.2.5 Demand Summary

The resultant demand levels assigned within the 2028 Stratford-upon-Avon plus SRZ scenario are outlined within **Table 6**:

Table 6 - SRZ Model Demand Summary

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Background	9225	14176	13730	15093
HGV	757	780	797	507
Com Dev.	1758	1040	2751	1628
Growth	522	575	531	528
SRZ	1233	669	927	1116
Total	13495	17240	18736	18872
Periodic	30735		37607	
Growth	15.90%		15.54%	

3.2.6 TEMPRO Growth Forecasts

TEMPRO Growth predictions for the 2011 to 2031 period, across both Stratford District and Warwickshire County are between 7 and 12% respectively. Analysis of the above previous **Table 6** reveals that the growth levels forecast within the Stratford PARAMICS model, inclusive of the SRZ, are already in excess of these levels. As a result no additional internal growth needs to be applied to the Reference Case model before it can be used for the purposes of the CS testing.

The NTEM adjusted TEMPRO factor is in excess of 20% for both the District and County areas and, as a result, no consideration has been given to the application of redistribution or reassignment mechanisms in response to the allocated demand levels.

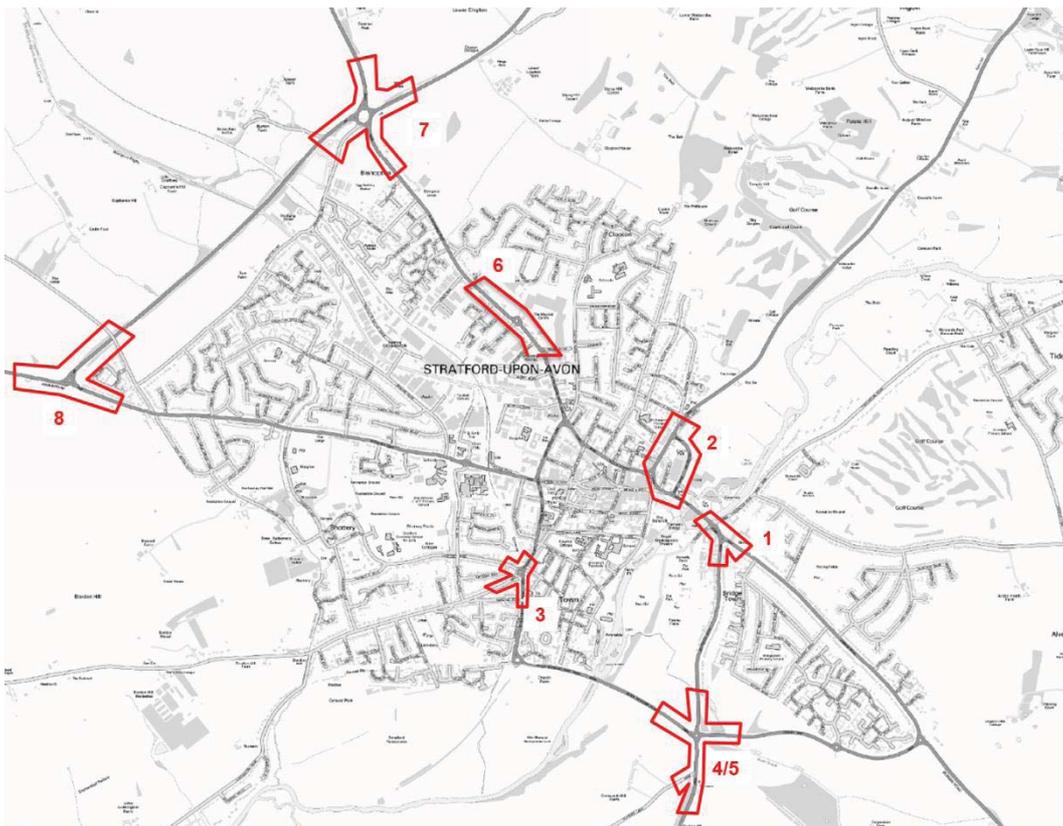
3.2.7 Stratford Transport Package (STP) Scheme Overview

During previous stages of the Stratford on Avon Strategic Transport Assessment (STA) ten schemes were identified as being likely to mitigate the impacts of Core Strategy and general growth as well as addressing issues which act to constrain the movement of traffic across the network.

During the refined analysis of these proposals the number of schemes was reduced as the review process identified two schemes which, for various reasons, were unlikely to be deliverable.

An overview of the extent of the final schemes proposed during the previous STP/SRZ assessment, and therefore carried forward into this stage of testing, is provided within the following **Figure 5**.

Figure 5 - Scheme Locations



Full details of the assumptions pertaining to each of the schemes outlined within the previous Figure, as well as any risks and issues, are available from the accompanying report³. A brief overview of these schemes is provided as follows:

³ 232815-07.R002, Stratford-on-Avon Strategic Transport Assessment: Stratford (Canal Quarter) Regeneration Zone Scenario Analysis, Arup, November 2013

- **Scheme 01 - Tiddington Road/Banbury Road ‘Alveston Manor’ Junction:** Proposals involve reconfiguration of the existing priority junction into a signalised junction with further enhancements to the geometry of the Shipston Road/Banbury Road roundabout.
- **Scheme 02 – Bridgefoot/Bridgeway Stratford Gyratory:** Proposals involve signalisation of the Bridgeway/Bridgefoot and Bridge Street/Bridgefoot entry arms onto the junction. These signals are synchronised with the Tiddington Road/ Bridgefoot proposals as well as the existing Guild Street/Bridgefoot/Warwick Road signals.
- **Scheme 03 – Evesham Place/Evesham Road Roundabout:** Potential capacity benefits of switching from a roundabout to traffic signal-controlled priority junction. Signalisation required due to the tidal nature of movements across the junction.
- **Scheme 04/05 – Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road Roundabouts:** Substantial widening has been assumed both within the junction footprints and on the roads between and leading up to the junctions inclusive of extended entry and exit flares.
- **Scheme 06 – Birmingham Road between Regal Road and Justin’s Avenue:** provision of two lanes NB along the Birmingham Road from just south of the junction with Regal Road to just north of the Junction with Hamlet Way.
- **Scheme 07 – Birmingham Road/A46 ‘Bishopton Roundabout’:** Currently the proposals for this scheme assume substantial widening of the circulating carriageway and entry and exit flares are proposed in order that the capacity of the junction can be increased. The scheme could potentially be adapted further to include signals but these have not been included at this stage.
- **Scheme 08 – Alcester Road/A46 ‘Wildmoor Roundabout’:** The potential to amend the current junction layout is limited due to the limited junction radius. Any scheme enhancements that are proposed will need to be delivered in a way which minimises the changes to the layout, the emerging scheme is likely to be an enlarged roundabout with a dedicated left slip lane from the A46 eastbound to Stratford Northern Bypass.

The last two schemes, scheme 07 and 08, have been amended within the model to reflect mitigation proposals but the scope and scale of those proposals is still to be determined. This is likely to be the subject of more detailed analysis work undertaken by both WCC and the Highways Agency.

3.3 M40 Reference Case Model

Prior to the commencement of this work the M40 PARAMICS model was extended and reforecast to a new 2031 Reference Year. The coverage of the extended M40 PARAMICS model was outlined previously within **Figure 2** of this report whilst an overview of the model development and forecasting process is documented within the accompanying Extended M40 Model Local Model Validation and Forecast Report⁴.

⁴ 219860-00 2013 M40 Model Extension – LMVR & Forecast Report, Arup, April 2014

The key elements that have been included within the M40 future year reference case model include the following:

- The committed A452 Europa Way works at the A452/Warwick Bypass and A452 Europa Way/Harbury Lane/Gallows Hill roundabout
- The dualling of the B4100 between M40 Junction 12 and the Heritage Motor Centre
- The new scheme proposals at M40 J12
- Increased demands to reflect the extant permissions in existence at the Jaguar Land Rover (JLR) and Aston Martin Lagonda (AML) employment sites. These are assumed to be equivalent to 2,600 additional jobs across the two sites.

The methodology for deriving the increase in demands associated with the existing extant permission has been included within the model in line with the methodology adopted during the recent modelling of the J12 proposals to support the planning application for the scheme. Full details of this process are provided within the model LMVR and forecast note.

The committed schemes have been included within the modelling in line with the designs produced by Warwickshire County Council. Further details of the scheme proposals are available on WCCs Highway Schemes & Projects website⁵.

3.3.1 Demands

The demand levels contained within the extended M40 PARAMICS model are outlined, by matrix level, within the following **Table 7**:

Table 7 - M40 2028 Demand Levels

	06:00 to 07:00	07:00 to 08:00	08:00 to 09:00	09:00 to 10:00	16:00 to 17:00	17:00 to 18:00	18:00 to 19:00
M1	4529	12274	17785	11306	15564	17395	13048
M2	1695	3361	5955	6135	5664	6597	6812
M3	277	551	795	952	519	414	376
M4	1330	3404	1724	768	2987	1522	610
M5	232	550	1748	1246	994	2132	1602
Total	8063	20139	28007	20406	25728	28061	22449
Growth from 2011	870	2098	3114	2415	2789	3126	2618
% Increase	12.10%	11.63%	12.51%	13.43%	12.16%	12.53%	13.20%

Overall growth within the M40 2031 Reference Case is around 12.5% higher in both AM and PM periods. Demands within the 06:00 to 07:00 hour are not included within the forecasting as this hour reflects a ‘warm-up’ period within the model.

⁵ <http://www.warwickshire.gov.uk/highwayprojects>

3.4 Core Strategy Demand Forecasting

As has been mentioned previously within this report, there are a number of options for the allocation of housing and employment across Stratford District.

The demands for each of these options have been forecast on an individual basis and then assigned within the Reference Case model networks.

The following section of this Report outlines the assumptions which have been adopted for each of these individual options.

3.4.1 Residential Trip Rates

Where possible, specific trip rates have been used to forecast the traffic generation associated with the sites which are being assessed. These site specific trip rates have been provided by WCC following consultation with SDC and, where possible, the site promoters. In other areas, in particular those sites tested as part of the Option 1 assessment, specific trip rates were not available. In those cases dwellings have been converted into trip generation figures through the application of the WCC standard residential trip rates. The hourly trip rates used for all residential trip generation assumptions are summarised within the following **Table 8**:

Table 8 - STA Residential Trip Rates

STA Trip Generation Rates	In	Out	Total
0700 to 0800	0.08	0.33	0.41
0800 to 0900	0.12	0.48	0.6
1600 to 1700	0.35	0.12	0.46
1700 to 1800	0.48	0.12	0.6

3.4.2 Option 1 Demand Forecasting

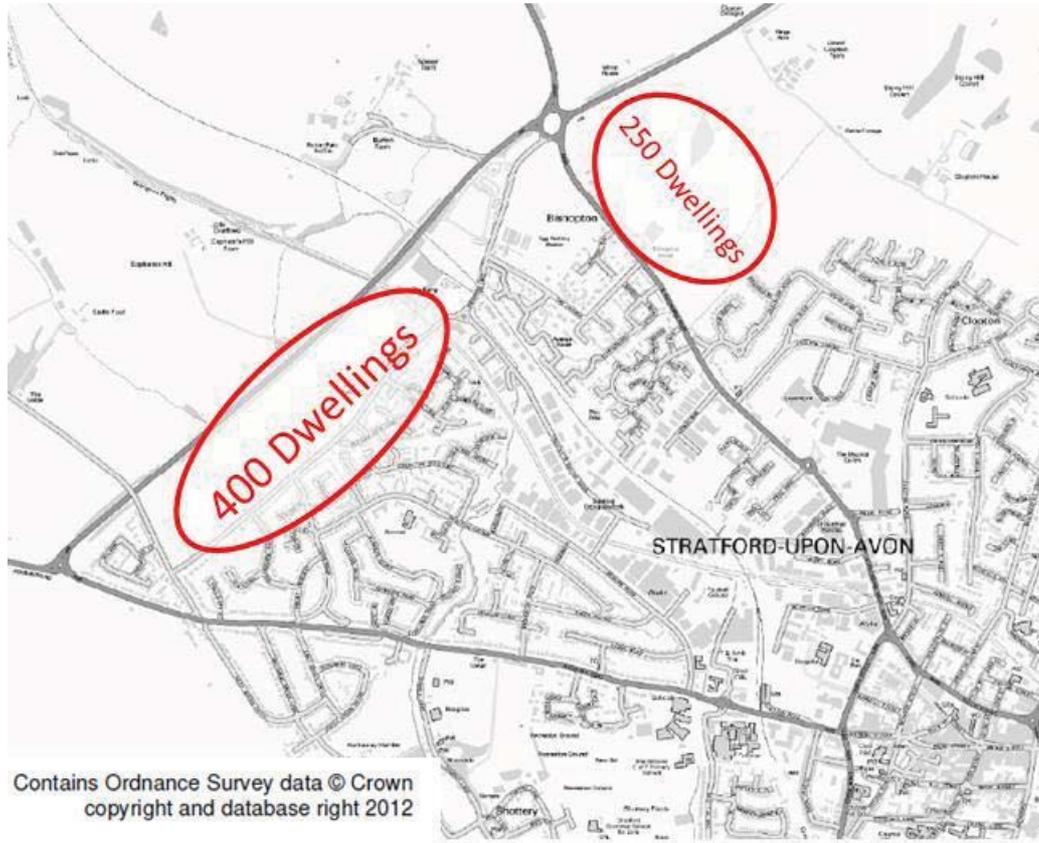
SDC indicated that Option 1 should assume a distribution of dwellings across the following locations:

- Stratford = 650 dwellings
- Alcester = 175 dwellings
- Bidford = 125 dwellings
- Henley = 75 dwellings
- Kineton = 50 dwellings
- Shipston = 125 dwellings
- Southam = 150 dwellings
- Studley = 150 dwellings
- Wellesbourne = 150 dwellings
- Local Service Villages = 350 dwellings (in total)
- Long Marston Depot = 500 dwellings

The 650 dwellings in Stratford-upon-Avon were allocated across land to the north of the town with 400 dwellings allocated in the area north of Bishopton Lane and 250 dwellings allocated in an area to the east of Birmingham Road.

An overview of these site locations is provided within **Figure 6**.

Figure 6 Stratford-upon-Avon Northern Sites



Trip generation associated with the allocation at Southam was not considered due to the distance from the study area.

Similarly trip generation associated with the Local Service Villages was not included as they cannot be accurately determined.

Trip generation figures for the development located in Studley were also omitted from the assessment. The impacts of the allocation within Studley have also been addressed in a separate report⁶.

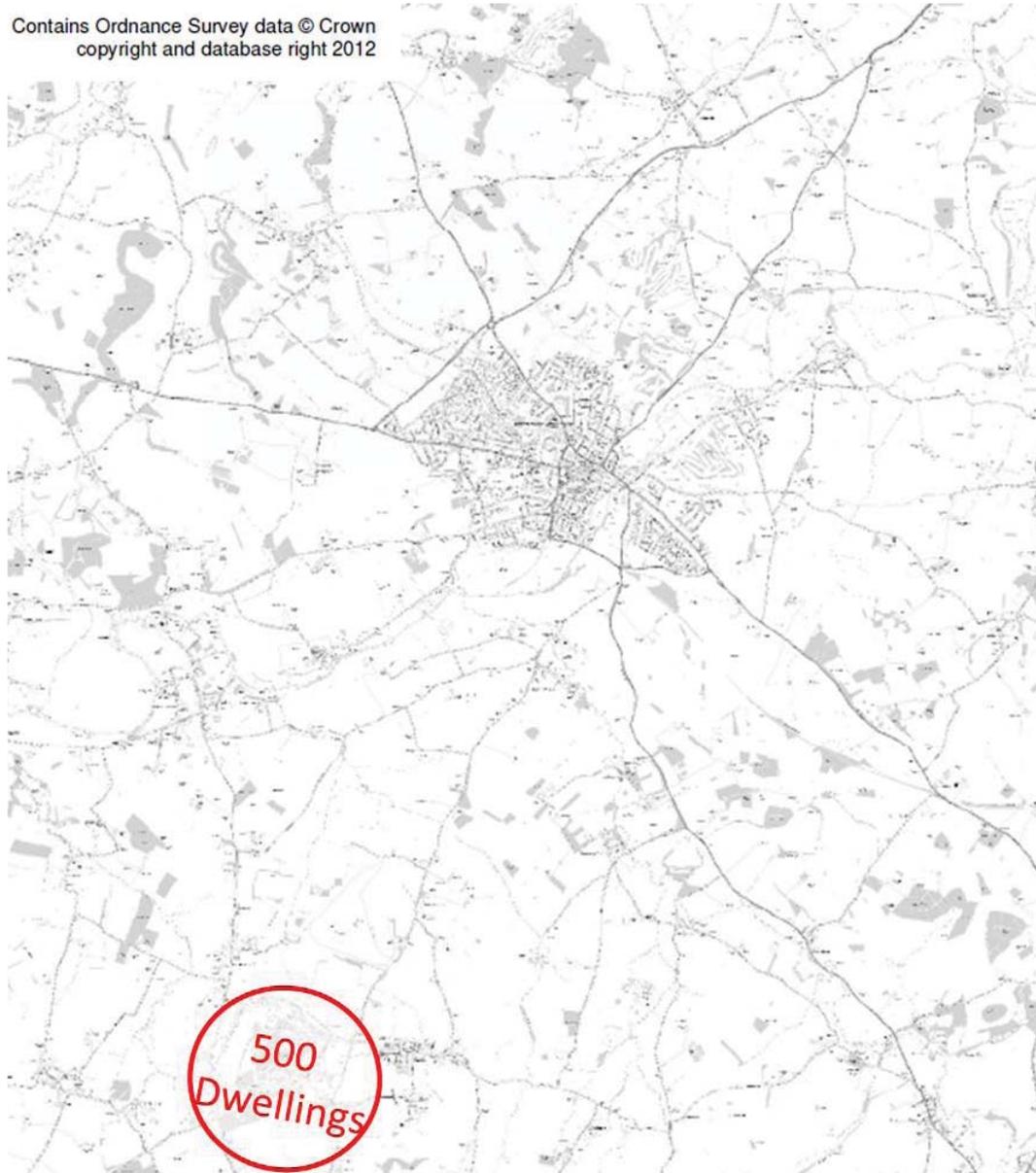
Trip generation associated with the Long Marston Depot was included within the modelling. **Figure 7** illustrates the assumption with regards the site location relative to the overall study area.

A review of the existing census distribution, associated with each of the remaining site locations, was undertaken to identify how many trips, generated from each of these sites, would be likely to generate a Stratford-upon-Avon trip end.

Following the review of the census data it was determined that less than 5% of the demands generated by these houses would produce a trip-end within the Stratford-upon-Avon town boundary. This value equates to less than 50 dwellings and, as a result, it was not felt necessary to include these demands as the majority of the trip generation has been dealt with through the application of TEMPRO growth factors to the external O-D movements within the Stratford-upon-Avon PARAMICS model.

⁶ 232815-07.R001, Studley STA Additional Analysis, Arup, November 2013

Figure 7 Long Marston Depot Site Location



Hourly trip generation figures were calculated for the remaining site allocations that were to be assigned within the model scenario. The distribution for the site in Long Marston identified a small proportion of trips which would be unlikely to enter into the PARAMICS model network, a small adjustment was made to reflect this which resulted in a reduction in the assigned demands when compared to the hourly trip generation totals calculated for the three sites.

A summary of the hourly totals, calculated using the standard residential trip rates, alongside the assigned demand totals, is provided within **Table 9**.

Table 9 - 2031 Option 1 Hourly Trip Generation

	Arrive	Depart	TOTAL	Assigned
0700 to 0800	90	378	468	449
0800 to 0900	138	552	690	662
1600 to 1700	401	133	534	512
1700 to 1800	552	138	690	662

3.4.3 Option 1 Demands

The demands produced and assigned to the Option 1 scenario model, as a result of the aforementioned forecasting process, are summarised within the following **Table 10**:

Table 10 - 2031 Option 1 Demand Forecasting

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Base Model Demand Net	10448	16083	15701	16849
Periodic	26531		32549	
2031 Reference Case	13495	17240	18736	18872
Periodic	30735		37607	
Option Demands	449	662	512	662
2031 Option Demands	13944	17902	19248	19534
SUE Demands:	31847		38782	
2011 to 2031 Option Growth	20.04%		19.15%	

3.4.4 Option 2 Demand Forecasting

SDC indicated that Option 2 should comprise 3,000 dwellings to be allocated in an area of land between the B4100 and the M40 alongside 100Ha employment.

The location of the site is illustrated within the **Figure 8**.

The residential trip rates associated with the Option 2 site were provided by WCC and have been outlined within the following **Table 11**:

Table 11 Option 2 Residential Trip Rates

Residential	Arrival	Departure	Total
0700 to 0800	0.073	0.303	0.376
0800 to 0900	0.103	0.432	0.535
0900 to 1000	0.111	0.216	0.327
1600 to 1700	0.252	0.135	0.387
1700 to 1800	0.345	0.147	0.492
1800 to 1900	0.253	0.127	0.380

Figure 8 Option 2 Site Location



The previous residential vehicle trip rates include an allowance for 35% affordable dwellings and trip internalisation of 17% in the AM period and 15% in the PM period. The resultant trip generation figures derived for the residential element of the site are detailed within the following **Table 12**:

Table 12 Option 2 Residential Trip Generation

Residential	Arrival	Departure	Total
0700 to 0800	220	910	1130
0800 to 0900	309	1297	1606
0900 to 1000	332	648	980
1600 to 1700	756	406	1162
1700 to 1800	1036	440	1476
1800 to 1900	759	382	1141

The trip generation figures for the employment element of the site as calculated by WSP on behalf of JLR were provided by WCC for use in the analysis and are outlined within the following **Table 13**:

Table 13 Option 2 Employment Trip Generation

WSP JLR Employment	Arrival	Departure	Total
0600 to 0700	860	31	891
0700 to 0800	1420	46	1466
0800 to 0900	472	70	542
0900 to 1000	307	34	341
1600 to 1700	119	1735	1854
1700 to 1800	80	1278	1358
1800 to 1900	0	0	0

3.4.5 Employment Trip Profiling

The rate release of vehicles onto the model network is controlled by a vehicle release profile. In most cases aggregate profiles (or suitable proxy profiles) already exist for residential sites and these profiles have been applied throughout the assessment of all of the CS options.

Arup were advised by SDC/WCC following consultation with the site promoters that, for the moment, the trip profiling associated with the employment element of the site should be consistent with the trip profiling of existing employment trips within the area.

It should be acknowledged that adopting the same profile for all employment trips within the area is robust for the following reasons:

- The demands within the forecast model associated with the extant permissions at the JLR/AML site (equivalent to an additional 2,600 jobs) have also been assigned within the model using a consistent release rate.
- With the existing employee numbers all following the same travel pattern, this approach has the potential to significantly exacerbate network congestion effects by assigning demands at a higher rate than the forecast link capacities can accommodate.
- The existing profiles are likely to have arisen due to the present-day unique conditions that occur in and around the M40 J12 area. Trip numbers are increasing within the pre-peak periods as they are departing earlier to avoid existing queues, the committed scheme proposals for the M40 J12 and adjacent B4100 will likely remove the presences of the queues through capacity enhancements. It is highly likely that this will instil a behavioural change in trips associated with the site as they will no longer exhibit queue avoidance behaviours. No account of this is included within the modelling at this stage.

3.4.6 Option 2 Demands

The resultant demands assigned within the M40 PARAMICS model following completion of the aforementioned forecasting process, are summarised within **Table 14**.

Table 14 - 2031 Option 2 Demand Forecasting

	06:00 to 07:00	07:00 to 08:00	08:00 to 09:00	09:00 to 10:00	16:00 to 17:00	17:00 to 18:00	18:00 to 19:00
M1	4529	12274	17785	11306	15564	17395	13048
M2	1695	3361	5955	6135	5664	6597	6812
M3	277	551	795	952	519	414	376
M4	1330	3404	1724	768	2987	2165	892
M5	218	506	625	422	593	636	483
Option 2	891	2594	2147	1322	3015	2834	1140
Total	8940	22690	29031	20904	28343	30041	22750
Growth from 2011	1747	4649	4139	2913	5404	5106	2920
% Increase	24.3%	25.8%	16.6%	16.2%	23.6%	20.5%	14.7%
Periodic	n/a	19.2%			19.8%		

3.4.7 Option 3 Demand Forecasting

SDC indicated that Option 3 should comprise 3,500 dwellings to be allocated in the area currently occupied by Long Marston Airfield as well as 13Ha Employment (100% B1).

The location of the site is illustrated within **Figure 9**.

The residential element of the trip generation was factored using the WCC standard residential trip rate with a 15% adjustment for mode share. No adjustments were made for internalisation at this stage.

The employment trips rates for use in the assessment were provided by WCC and are documented within the following **Table 15**:

Table 15 – Long Marston Airfield Employment Trip Rates

	Arrive	Depart
0700 to 0800	0.72	0.11
0800 to 0900	1.62	0.12
1600 to 1700	0.14	1.12
1700 to 1800	0.11	1.51

3.4.8 Option 3 Demands

The demands produced and assigned to the Option 1 scenario model, as a result of the aforementioned forecasting process, are summarised within **Table 16**.

Figure 9 Option 3 Site Location

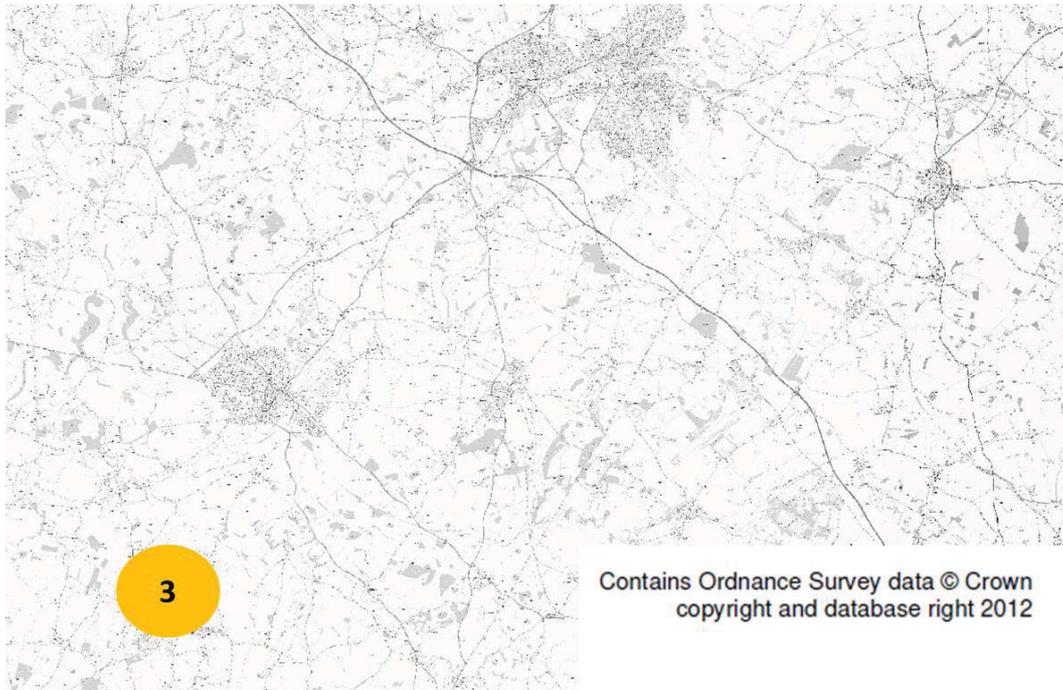


Table 16 - 2031 Option 3 Demand Forecasting

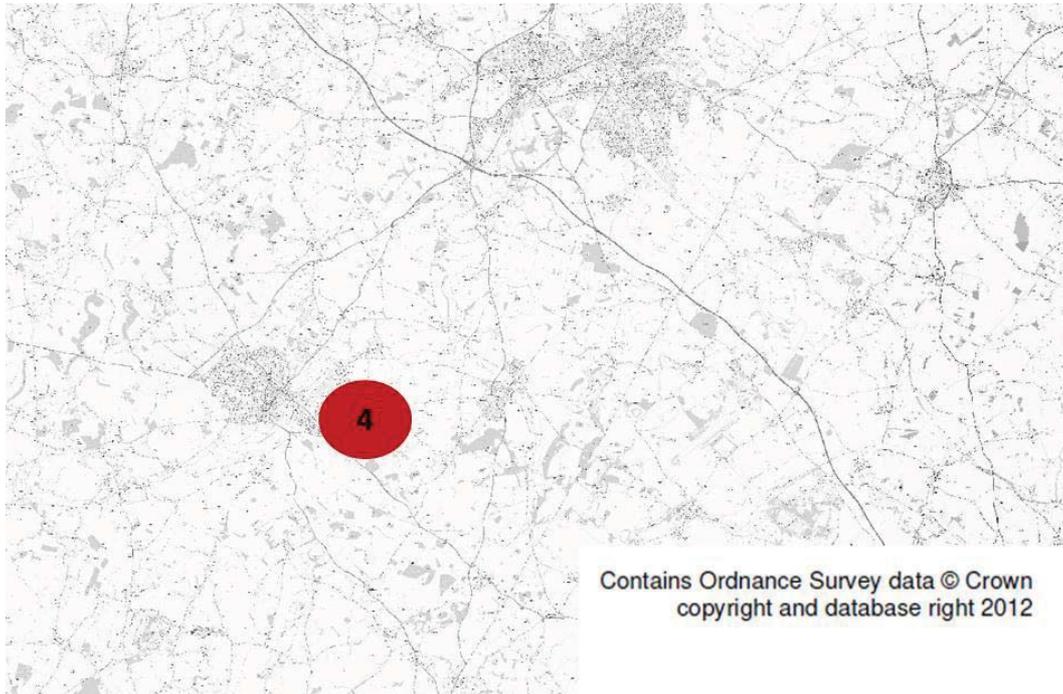
	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Base Model Demand Net	10448	16083	15701	16849
Periodic	26531		32549	
2031 Reference Case	13495	17240	18736	18872
Periodic	30735		37607	
Option Demands	1770	2824	2149	2774
2031 Option Demands	15265	20064	20884	21645
SUE Demands:	35329		42530	
2011 to 2031 Option Growth	33.16%		30.66%	

3.4.9 Option 4 Demand Forecasting

SDC indicated that Option 3 should assume delivery of 2,750 dwellings to be allocated in an area to the south east of Stratford alongside 8Ha Employment (100% B1). The location of the site is illustrated within the **Figure 10**.

The residential element of the trip generation was factored using the WCC standard residential trip rate with a 15% adjustment for mode share. No adjustments were made for internalisation at this stage.

Figure 10 Option 4 Site Location



The employment trips rates for use in the assessment were provided by WCC and are documented within the following **Table 17**:

Table 17 – East of Stratford Employment Trip Rates

	Arrive	Depart
0700 to 0800	0.59	0.09
0800 to 0900	1.68	0.24
1600 to 1700	0.31	1.16
1700 to 1800	0.18	1.44

3.4.10 Option 4 Demands

The demands produced and assigned to the Option 1 scenario model, as a result of the aforementioned forecasting process, are summarised within the following **Table 18**:

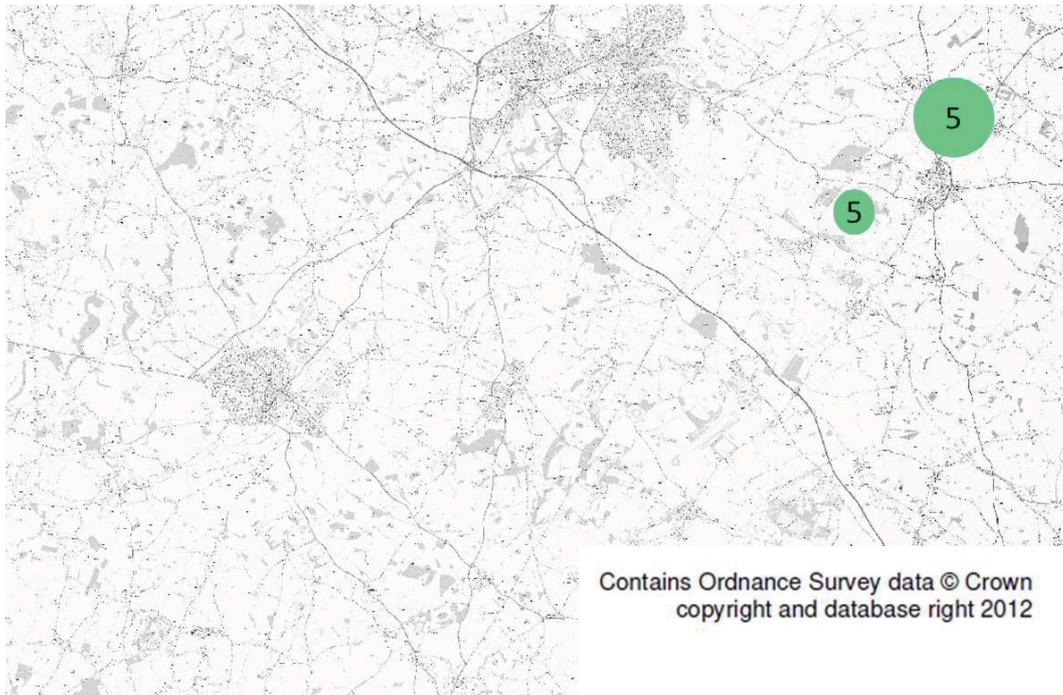
Table 18 - 2031 Option 4 Demand Forecasting

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Base Model Demand Net	10448	16083	15701	16849
Periodic	26531		32549	
2031 Reference Case	13495	17240	18736	18872
Periodic	30735		37607	
Option Demands	1293	2142	1653	2065
2031 Option Demands	14788	19382	20388	20936
SUE Demands:	34170		41325	
2011 to 2031 Option Growth	28.79%		26.96%	

3.4.11 Option 5 Demand Forecasting

SDC indicated that Option 5 should assume the delivery of 2,800 dwellings split across two sites near Southam/Stoneythorpe. A total of 800 dwellings were allocated to the area of land at Stoneythorpe whilst the remaining 2,000 dwellings have been allocated in an area of land to the North of Southam. The location of the site is illustrated within **Figure 11**.

Figure 11 Option 5 Site Locations



Analysis of the census travel to work area distribution for Southam revealed that around 25% of trips generated by the development in Southam would be likely to travel northwards. Because of the location of the development relative to the model extent, these trips were unlikely to enter into the model area and, as such, the matrices were adjusted to reflect this assumption.

The residential trip rates as provided by WCC are as follows and these allow for 35% affordable dwellings (NB a further adjustment of 15% was applied to residential and employment trip totals to allow for internalisation). These trip rates are summarised within **Table 19**.

Table 19 - Option 3 Residential Trip Rates

	Arrive	Depart
0700 to 0800	0.100	0.352
0800 to 0900	0.141	0.502
1600 to 1700	0.297	0.161
1700 to 1800	0.407	0.175

The net trip generation, alongside the adjusted assignment demands, associated with Option 5 are summarised within **Table 20**.

Table 20 - 2031 Option 5 Trip Generation

	Arrive	Depart	TOTAL	Assigned
0700 to 0800	280	987	1267	942
0800 to 0900	393	1406	1800	1338
0900 to 1000	423	702	1125	836
1600 to 1700	832	452	1284	954
1700 to 1800	1140	489	1629	1211
1800 to 1900	835	425	1260	937

3.4.12 Option 5 Demands

The resultant demands assigned within the M40 PARAMICS model following completion of the aforementioned forecasting process, are summarised within the following **Table 21**:

Table 21 - 2031 Option 5 Demand Forecasting

	06:00 to 07:00	07:00 to 08:00	08:00 to 09:00	09:00 to 10:00	16:00 to 17:00	17:00 to 18:00	18:00 to 19:00
M1	4529	12274	17785	11306	15564	17395	13048
M2	1695	3361	5955	6135	5664	6597	6812
M3	277	551	795	952	519	414	376
M4	1330	3404	1724	768	2987	2165	892
M5	218	506	625	422	593	636	483
	0	942	1338	836	954	1211	937
Total	8049	21038	28222	20419	26282	28419	22547
Growth from 2011	856	2997	3329	2428	3343	3483	2717
% Increase	11.9%	16.6%	13.4%	13.5%	14.6%	14.0%	13.7%
Periodic	n/a	14.4%			14.1%		

3.5 CS Redistribution

During previous stages of the STA work the forecasting process has referred to the growth levels with the TEMPRO database in order that some account of the potential redistribution effects that may occur, as a result of the inclusion of the additional demand levels, can be included.

However, this phase of the assessment is intended to assess the impacts of each of the individual options when the entire site is delivered as opposed to the dwellings within the plan period. As a result, any application of redistribution or re-assignment would act to balance the demands at 2031 levels.

In scenarios when the growth is forecast to be substantially higher than the initial forecast this would act to dampen the effects of the additional demand. This would put the scenarios in which the growth levels are lower at a disadvantage as the overall difference in demand levels between the two scenarios would be smaller than is likely to occur in reality.

This is considered appropriate since the sites that are being assessed are being tested on the basis of the full site allocation rather than the allocation likely to be delivered within the plan period.

It is reasonable that this assumption should be revisited during the detailed assessment of one or more sites during the planning application phase.

4 Mitigation Overview

4.1 Introduction

As part of the assessment process a series of mitigation measures have been identified and incorporated within the assessment. In some cases the mitigation measures have been applied to a number of scenarios whilst in others the mitigation has been derived in response to conditions observed within a specific scenario.

A brief overview of the mitigation measures identified throughout the course of this assessment has been provided within the following section of this report. The mitigation has been classified firstly by area. The mitigation measures proposed within the Stratford focused modelling are presented first with the M40 measures detailed subsequently.

4.1 Stratford-upon-Avon Mitigation Measures

The following provides a summary of all of the mitigation measures adopted within the Stratford-upon-Avon testing.

4.1.1 Constant Mitigation Measures

The following Measures have been included within all test scenarios either from the onset of testing or, in the case of dynamic signing, the first iteration of the review. It should be noted that these schemes are also included within the Reference Case network.

Stratford Transport Package

The measures proposed through the ‘Stratford Transport Package’ (STP) have been included within all scenarios including the Stratford Reference Case. The schemes have been incorporated alongside the demands associated with the Stratford Regeneration Zone (SRZ).

A brief overview of these proposals has been provided within **Section 3** of this report whilst full details of the scheme proposals are contained within the accompanying STP/SRZ Analysis Report⁷.

Warwick Road Dynamic Signage Strategy

One of the measures proposed within the STP/SRZ work was the adoption of a dynamic signage strategy for the Warwick Road.

Initially the assessment of this strategy was included within the STP/SRZ analysis work as a sensitivity test included in addition to the proposed STP measures rather than the proposals being included directly within the STP proposals.

⁷ 232815-07.R002, Stratford-on-Avon Strategic Transport Assessment: Stratford (Canal Quarter) Regeneration Zone Scenario Analysis, Arup, November 2013

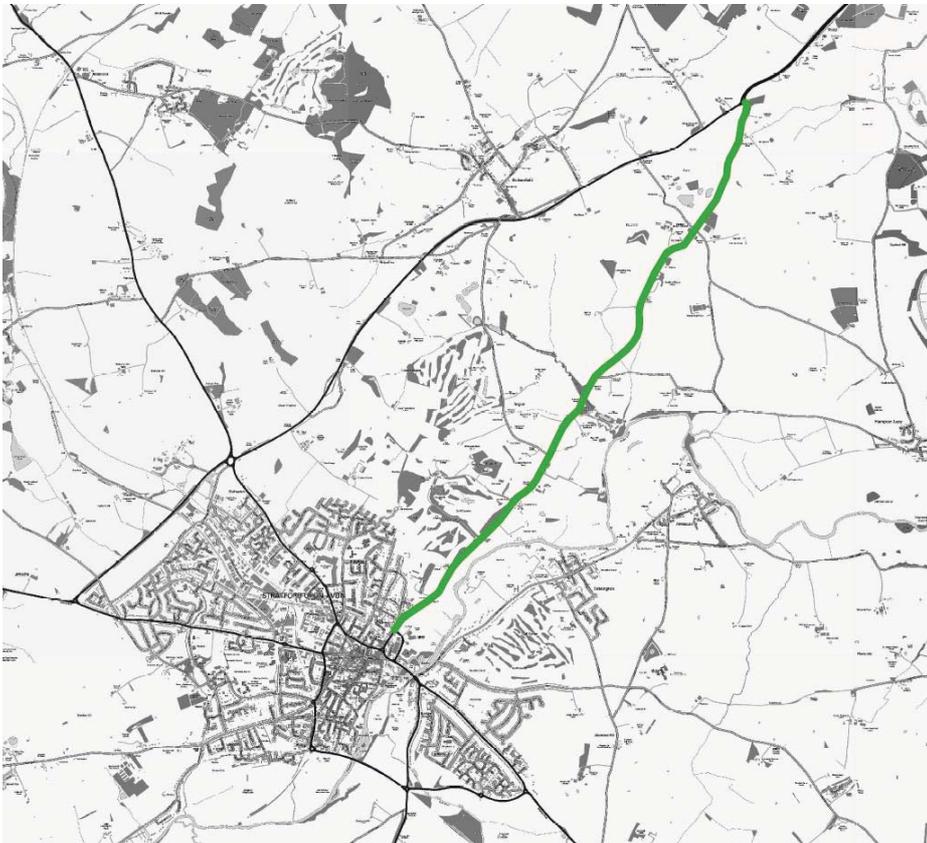
The intention of the dynamic signage strategy is to better control routing within the area to encourage traffic to use Warwick Road during times when Birmingham Road is busy and vice versa. Ultimately this would be achieved by a signage strategy that would encourage users to use Birmingham Road/ Warwick Road depending on the conditions recorded on the network and, specifically, in response to the detection of low speeds along the Birmingham Road.

Detailed assessment of such proposals would involve extensive and complex modelling to ensure that the signage strategy is reactive to the congested conditions within the model network which, coupled with the need to ensure that the trigger for the change in signposting and the behavioural response that this elicits is accurately calibrated, could be both time consuming and expensive. Such a detailed stage of analysis is not considered proportionate to the overall strategic nature of the testing undertaken thus far.

At this stage, the change in signage strategy has been included within the modelling by revising the current signposting levels associated with the Warwick road from 'minor' to 'major'.

By signing a route as major it becomes equally attractive to both familiar and unfamiliar drivers and is also afforded a more equal precedence to the Birmingham Road. Although this is a relatively simplistic approach to the modelling it was felt it was sufficiently detailed for the overall stage of the assessment. An overview of the area of the Warwick Road amended within the modelling is provided within the following **Figure 12**:

Figure 12 - Extent of Warwick Road subject to changes



As has been mentioned previously, since the proposals for the Warwick Road could come forward as part of the broader STP measures the scheme has also been included within the Reference Case network.

4.1.2 Do Minimum Proposals

During the initial phases of testing it became apparent that, in order that an acceptable level of network operation can be maintained, delivery of the full allocation of development identified in Option 3 Long Marston Airfield and Option 4 South East Stratford would require significant infrastructure measures to be delivered alongside the developments.

These infrastructure requirements, in addition to the constant mitigation measures, are considered the minimum measures necessary to maintain an acceptable level of network operation in so far as the introduction of these measures are necessary to maintain the movement of vehicles across the network. Without these measures included on the network there is a significant propensity for the network to ‘lock-up’ in one or more scenarios which is indicative of significant network failure, most likely induced by insufficient capacity.

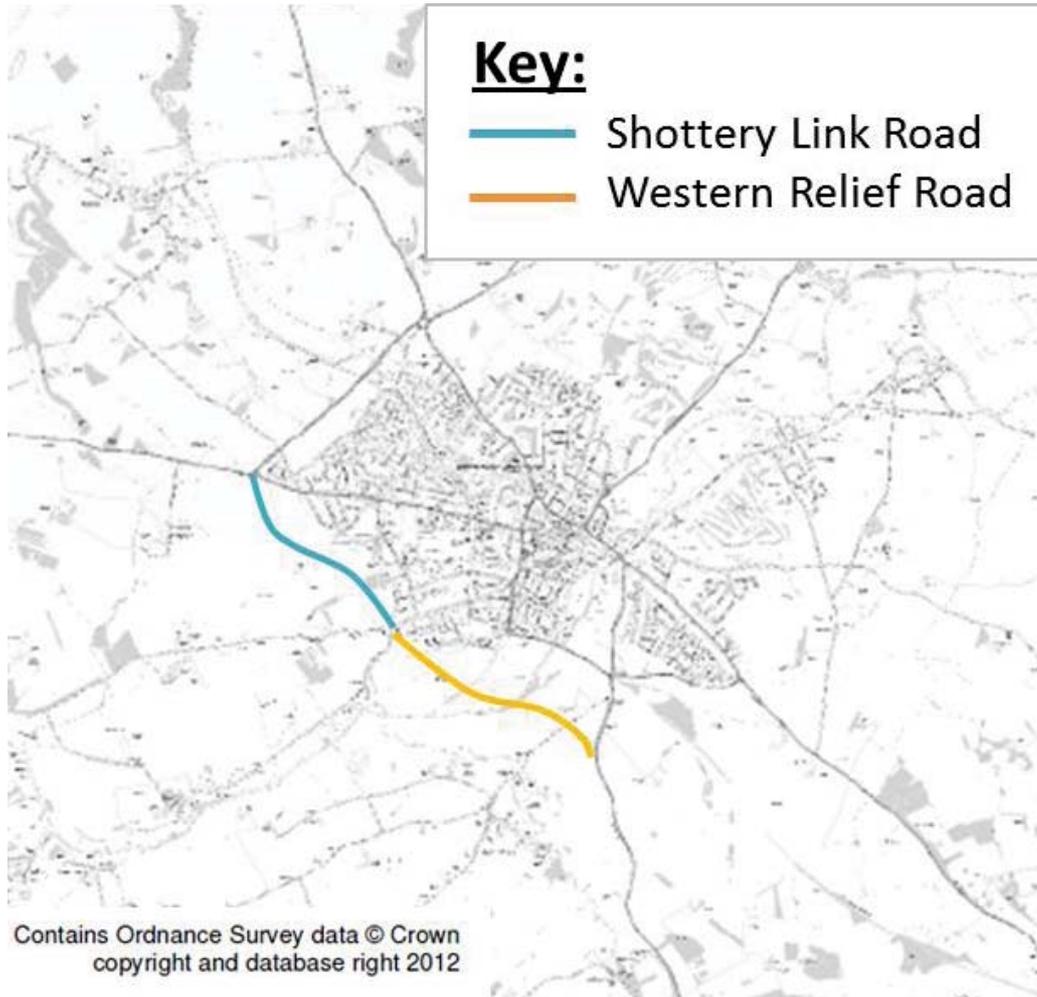
The Do Minimum measures have been derived specifically for the Option 3 Long Marston Airfield and Option 4 South East Stratford scenarios and comprise the following.

Option 3 LMA – Western Relief Road

The Do Minimum proposals within the Option 3 Long Masrton airfield comprise delivery of a Western Relief Road. This link is intended to connect the A3400 Shipston Road (south of Stratford-upon-Avon) with the B439 Evesham Road. The connection follows a route to the southwest of Stratford-upon-Avon and has been assumed to tie into the B439 via a new junction with Luddington Road. By connecting the route via this point it enables traffic to travel along the new link road, onto Luddington Road and then north/south to the A46 by the proposed link West of Shottery. It is anticipated that delivery of a new link road in this location would better link the areas to the Southwest, including the area of the LMA site, with the A46. Vehicles travelling from the southeast of Stratford towards the A46 with the intention of travelling towards Alcester may also be drawn along this route rather than travelling through the town centre.

Essentially the Western Relief Road proposals identified through this stage of the assessment would serve as an extension to the proposed link west of Shottery. An indicative alignment for the new Western Relief Road (WRR) is presented within **Figure 13**.

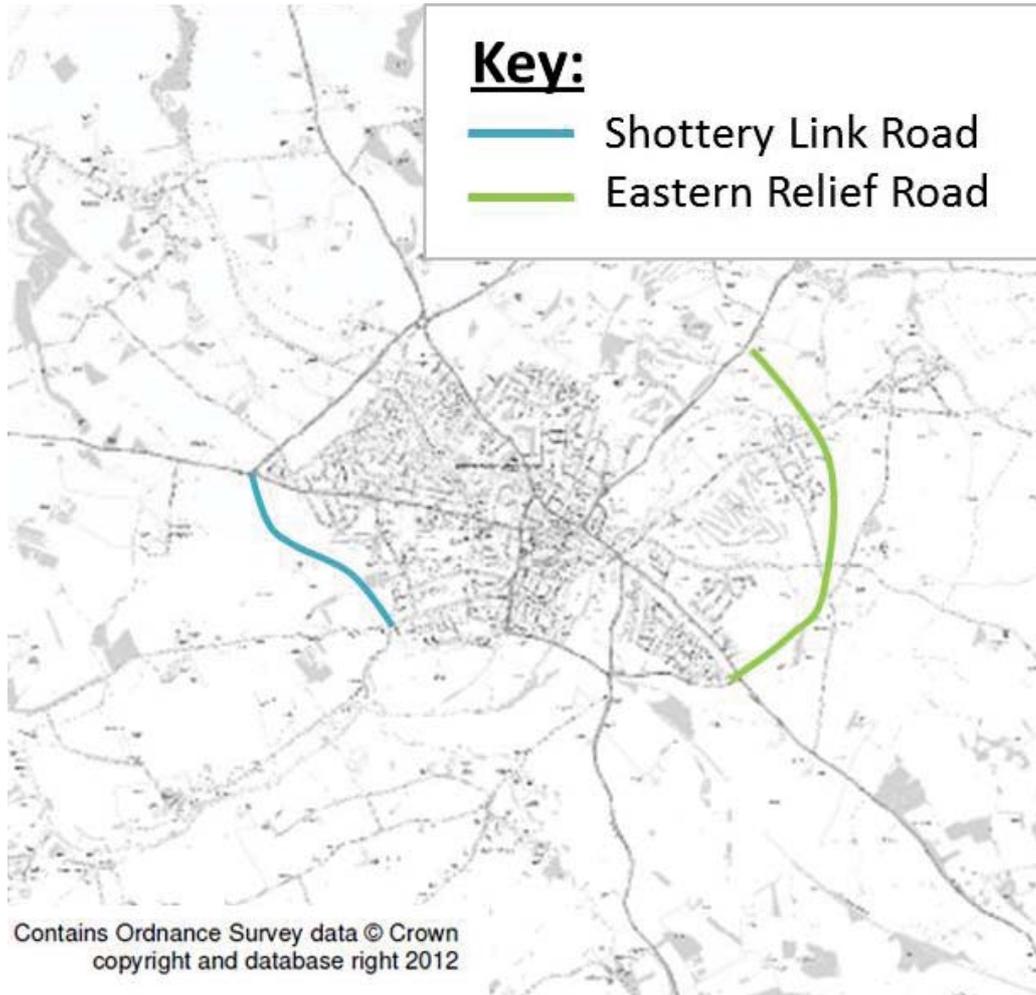
Figure 13 - Indicative Western Relief Road Alignment



Option 4 South East of Stratford – Eastern Relief Road

The Do Minimum proposals within the Option 4 South East Stratford comprise delivery of an Eastern Relief Road. This link is intended to connect the A422 Banbury Road to the A439 Warwick Road via Tiddington Road and a new bridge across the River Avon. Historic assessments undertaken within the Stratford-upon-Avon PARAMICS model have consistently identified congestion within the southeast of Stratford as being the most constrained area of network. Delivery of a new link road in this area, of the form previously described, would undoubtedly relieve some of the issues which occur as a result of the constraints in this area. Delivery of a new link in this location would also improve the connectivity between the area of South East Stratford, inclusive of the area covered by the proposed development site in South East Stratford. An indicative alignment for the new Eastern Relief Road (ERR) is presented within **Figure 14**.

Figure 14 - Indicative Western Relief Road Alignment



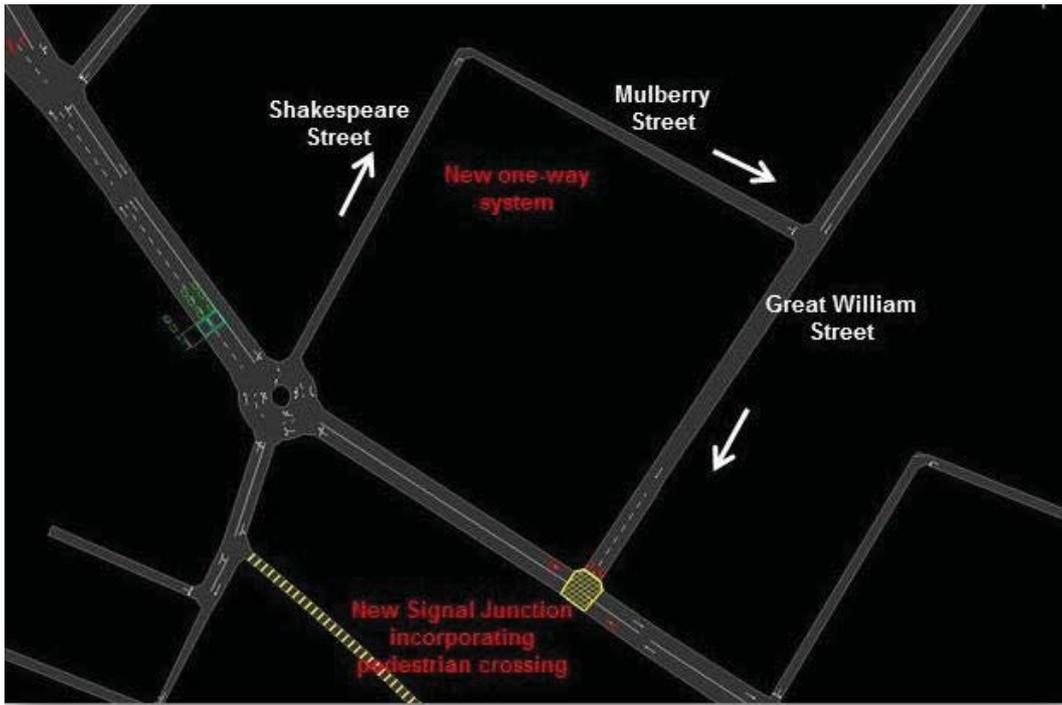
4.1.3 Additional Mitigation

In addition to the revised signposting along Warwick Road and the Stratford Transport Package the following mitigation measures have been incorporated in one or more of the Stratford test scenarios:

Shakespeare Street/Mulberry Street

Shakespeare Street and Mulberry Street converted to a one-way system north and eastbound respectively. Great William Street remains one-way southbound. Signals introduced at Great William Street / Birmingham Road junction replacing pedestrian crossing to the east

Figure 15 : Shakespeare Street and Mulberry Street



A46/A439 Marraway Roundabout

Proposals for this junction have incorporated either of the following:

- Signals added to the A46 / A439 Warwick Road roundabout on the Warwick Road approach arm and circulatory
- Provision of a through-route bypassing the roundabout on the A46 eastbound at the A46 / A439 Warwick Road roundabout. Provision of signals on the A46 (N) approach and circulatory. Creation of a two-lane exit on the A46 (W)

A439/A3400 Junction

Signals added to the junction between the A439 Warwick Road and A3400 Bridgeway at the northern entry point to the Gyrratory to control merging traffic

WRR/Evesham Road

Increased size of roundabout at Western Relief Road / B439 Evesham Road – 35m diameter central island

A46/WRR Wildmoor Roundabout

Further work to the original STP proposals has included:

- Increased two lane approach to the A46 / Alcester Road / WRR roundabout on the A46 (N) approach.

- New signals also to be provided on the A46 (N) approach and circulatory.
- New two lane exit on A46 Alcester Road

4.1.4 Stratford-upon-Avon Mitigation Summary

A summary of the options in which the aforementioned mitigation measures have been assigned is provided within the following **Table 22**:

Table 22 Stratford Mitigation Assignment

Mitigation	Option 1	Option 3	Option 4
STP	✓	✓	✓
Warwick Road signing	✓	✓	✓
Eastern Relief Road			✓
Western Relief Road		✓	
Shakespeare Street/Mulberry Street	✓	✓	✓
A46/A439 Marraway Roundabout	✓	✓	✓
A439/A3400 Junction		✓	
WRR/Evesham Road		✓	
A46/WRR Wildmoor Roundabout		✓	

4.2 M40 & South Warwick Mitigation Measures

The following sets out the mitigation proposals included within the modelling assessment that has been undertaken. The mitigation has been presented based on the option in which it has been included:

4.2.1 Option 2 Mitigation Measures

The following mitigation measures have been included within the analysis of the impacts associated with the delivery of Option 2:

M40 Junction 12 NB on-slip

A northbound on-slip has been included within the modelling which allows vehicles to diverge away from the B4100 and enter onto the M40 NB without the need to enter into the signalised junction which is to be delivered at the top of the J12 M40 NB off-slip.

B4100 Widening

The B4100 has been widened to 3 lanes in sections between the junctions which have been proposed as part of the wider, committed M40 J12 works.

M40 Capacity Enhancements

Lane gains/lane drops have been included on sections of the M40 between J13 and J12 in both directions.

M40 Junction 13 NB off-slip

Signals have been added to the top of the M40 J13 NB off-slip to ensure that vehicles exiting the M40 have priority during heavily congested periods and that the increase in demands along the B4100 does not affect the queuing in this area and the propensity for queuing to propagate back onto the mainline.

Fosse Way/Harbury Lane

The modelling assessment currently assumes provision of signals at this junction location. Following a review of the corridor wide strategy for this area it is likely that a roundabout would represent a more appropriate mitigation strategy.

Fosse Way/Southam Road Roundabout

Proposals include widening of the NB and SB Fosse Way entry arms to include extended two lane flares. Two lane exit flares have also been included within the modelling NB and SB along the Fosse Way.

A452/B4100 'Grey's Mallory' Roundabout

The scheme proposals for this junction include part widening and part signalisation. Delivery of the proposals in this area would be complementary to the proposals identified to accommodate WDC local plan aspirations.

A452 Corridor

Dualling of the A452 between M40 J14 and Leamington Retail Park has already been identified through the analysis of WDC local Plan impacts. These measures have also been identified within the Coventry & Warwickshire LEP's Strategic Economic Plan (SEP) as a result they have been included within this assessment. Funding for these proposals would likely be secured through contributions rather than a single developer delivery mechanism.

Europa Way/Harbury Lane Roundabout

Proposals to widen and signalise this roundabout were identified within the WDC Local Plan assessments, the widening element of these proposals was also included within the Option 2 scenario network.

Banbury Road/Myton Road/Gallows Hill

Proposals for this area include the following:

- Widening of the entry and exit flares around the Banbury Road/Gallows Hill junction

- Introduction of a new roundabout configuration at the western entrance to Warwick Technology Park to better accommodate trips entering the Technology Park
- Introduction of signal proposals at the Warwick Road/Myton Road junction

All of the measures outlined above are considered within the WDC Local Plan mitigation plan and could therefore, potentially, be funded through contributions to the infrastructure rather than through a single developer funding mechanism,

4.2.2 Option 5 Mitigation Measures

The following mitigations have been included within the analysis of the impacts associated with the delivery of Option 5:

A423 / Daventry Road

Reconfigured roundabout / increased size + 2-lane approach & dedicated left-turn slip from eastern arm (solid white line) + revised white lining.

A423 / A425

Reconfigured roundabout / increased size + dedicated left-turn slip from west arm (solid white line) + revised white lining.

A425 / B4451

Lengthened 2-lane flare on east arm and inclusion of part signalisation.

A425 (Southam Road) / B4455

2-lane approach on east arm + 2-lane circulatory carriageway + 2-lane exit on west arm + revised white lining.

A425 (Radford Road) / Willes Road

Flare on minor arm (1 PCU in length) + revised white lining.

5 Results Analysis

5.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken with both the Stratford-upon-Avon and M40 models.

The results analysis, pertaining to the follow stages of assessment, is still focussed on a strategic level at this stage. As a result, the majority of results analysis that has been undertaken corresponds to the analysis undertaken during earlier stages of the assessment.

5.2 Model Stability

Due to the deterministic nature of assignment within PARAMICS it is possible for vehicles to continue to attempt to enter a network even when congestion has reached such an extent that the network is effectively 'grid-locked'. In some cases the grid-lock can occur due to problems that will require mitigation, in other cases it can be something as simple as vehicles entering a mini-roundabout from all three approaches at exactly the same time.

When a model becomes grid-locked vehicles still continue to be assigned to the network and so delay begins to increase exponentially. It should be acknowledged that these issues may be occurring due to a need for mitigation in one or more areas of the model but, if the models do not lock up every time it can be concluded that the problem is not severe enough to cause the network to cease to function. Furthermore, the fact that some model runs are completed without mitigation indicates that a mitigation strategy can only provide additional improvements and should be deliverable. If it is model error causing the issues then these results should also be discounted due to the fact that they cannot be considered realistic.

It should also be acknowledged that experience gained elsewhere in the application of PARAMICS micro simulation modelling, in projects of a similar size, has highlighted that the level of instability within the models is frequently improves as the options are looked at in more detail. Partly this is because of the fact that, as developments are progressed in isolation, more localised impacts are identified and mitigated than can be achieved during such a high level assessment and partly because the existing mitigation that has been proposed will be subject to further refinement and improvement beyond this stage of the assessment.

5.3 Number of Runs

Twenty model runs were initially undertaken, and where model stability has been particularly poor, the propensity for a model to lock up (and thus to be considered to have failed), is assessed to allow the reliability of the model network across the various scenarios to be better understood. A minimum of fourteen successful runs were achieved for each scenario.

5.4 Network Wide Statistics

A number of statistics used in the analysis have been obtained from analysing each individual trip that has occurred within the network. This information is collected within PARAMICS through the Trips-all file and contains information specific to each individual trip that has been completed within the model period. This information is then aggregated and processed to provide the following comparative statistics:

- **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.
- **Completed Trips (vehicles)** – The number of completed trips recorded during the model simulation.

The first three measurements are averages so can be used to compare between the various scenarios. The final measurement is an absolute and is dependent on congestion on the network (as this will prevent trips from completing) and the demand within the model (i.e. the number of trips actually trying to complete). As demand differs between scenarios, as well as small variations between runs of the same scenario, we cannot expect the number of completed trips to be the same. However, as the demands do not differ significantly it can still provide an indication of the relative congestion on each network.

The use of these statistics is in line with the methodology adopted during the previous Strategic Transport Assessment work.

5.5 Queue Lengths

A second, more detailed, level of analysis has been undertaken in the form of queue length analysis. Queue length analysis is intended to accompany the mean speed analysis as it provides a more detailed picture of the impacts at specific junctions within the model network.

At this stage the analysis of queue lengths has been based on the average hourly maximum queue length. 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 each hour. The maximum of these values, across all hours, is reported as the maximum periodic average maximum queue length and is reported in vehicles.

The junctions for which average hourly maximum queue lengths have been calculated and compared are illustrated within Figure 14 on the following page. Junctions where queue differences have not been plotted on the maps simply represent junctions which did not trigger any of the assessment criteria across any one approach.

Queue difference plots have been produced for all model scenarios and have been presented within **Appendix A** of this report.

At this stage these results simply identify areas where further attention is required. A queue length increase of 50 vehicles does not necessarily mean that a scheme will not work, it may indicate that further optimisation of the layout or any signal times are required. Furthermore it may not account for improvements on other arms of the same junction which, when investigated further, may contain additional capacity which could be unlocked to reduce the queue length on the offending approach.

The classification of differences used within the queue length analysis is outlined as follows:

- **Queue Reduction** (a reduction in queue lengths of greater than 5 vehicles)
- **Moderate Increase** (an increase in queue lengths of between 15 and 30 vehicles)
- **Severe Increase** (an increase in queue lengths of between 30 and 50 vehicles)
- **Very Severe Increase** (an increase in queue length of over 50 vehicles)

The locations of the junctions that have been included within the assessment are outlined within **Figure 16** on the following page.

5.6 Detailed Junction Analysis

At certain times additional specific analysis of the performance of certain junctions has been included which may outline the impacts on queuing at one or more approach of a junction. This has been calculated using the 10 minute average maximum queue length, in vehicles calculated across the entire model period, and this information has been presented with confidence intervals to outline the degree of stability contained within the model runs from which the results are being reported. These results have been based on as many successful runs as are available for each scenario.

The junction locations selected for the analysis within both the Stratford-upon-Avon and M40 PARAMICS model are outlined within the following **Figure 16** and **Figure 17** respectively.

Figure 16 - Queue Assessment, Junction Locations SuA Model



Figure 17 - Queue Assessment, Junction Locations M40 Model



5.7 Journey Time Analysis

During the first phase of STA analysis some journey time routes were defined within the modelling and the time it takes vehicles to traverse these routes was collected and presented within the analysis. At that stage the purpose of analysis

was simply to ascertain which routes experienced the lowest and greatest levels of delay across a number of different allocation options. Building upon that analysis, the purpose of the comparisons during this stage of work is to identify which areas of the network, when compared to the Reference Conditions, are likely to suffer the greatest changes in levels of delay when the allocated demand is assigned to the network.

A number of key routes were defined within the Stratford-upon-Avon and M40 PARMICS models

In total 10 key routes were defined within the model network and these routes have been illustrated on the following page.

In order that the impact on delay across various routes can be better understood the routes have been dissected both by direction and into smaller sections thereof. The purpose of this disaggregation is to ensure that a sufficient sample size is collected from the analysis as the number of vehicles travelling across the entire length of a number of the routes is likely to be substantially smaller than the number of vehicles travelling along each of the component parts of the route.

The average time it takes for vehicles to travel across each section of the route has been collected and aggregated for each scenario and then the level of deviation from the Reference Case conditions has been summarised using the following classification bands:

- **Delay Reduction** - A reduction in overall delay levels of -15% or more
- **No Significant Change** - A difference in journey times of between -15% and +15% falls within this category
- **Moderate Increase** - An increase in journey times of more than 15% but less than 25%
- **Severe Increase** – An increase in journey times of more than 25% but less than 50%
- **Very Severe Increase** – An increase in journey times, when compared to the Reference Case, of more than 50%

At this stage it was decided to classify journey time differences of between -15% and +15% as not significant as the intention is to highlight those areas which suffer the greatest impacts as these impacts are more pertinent to this stage of the assessment. The classifications adopted are in line with those that have been recommended by WCC and are such that they reflect the DMRB acceptability standards for comparisons between observed and modelled journey times. It should be noted that although the current methodology does not consider an increase in delay of less than 15%, on a single section of a route, as significant, during more detailed assessment stages, the potential for any increase in delay to be considered as being significant should not be discounted.

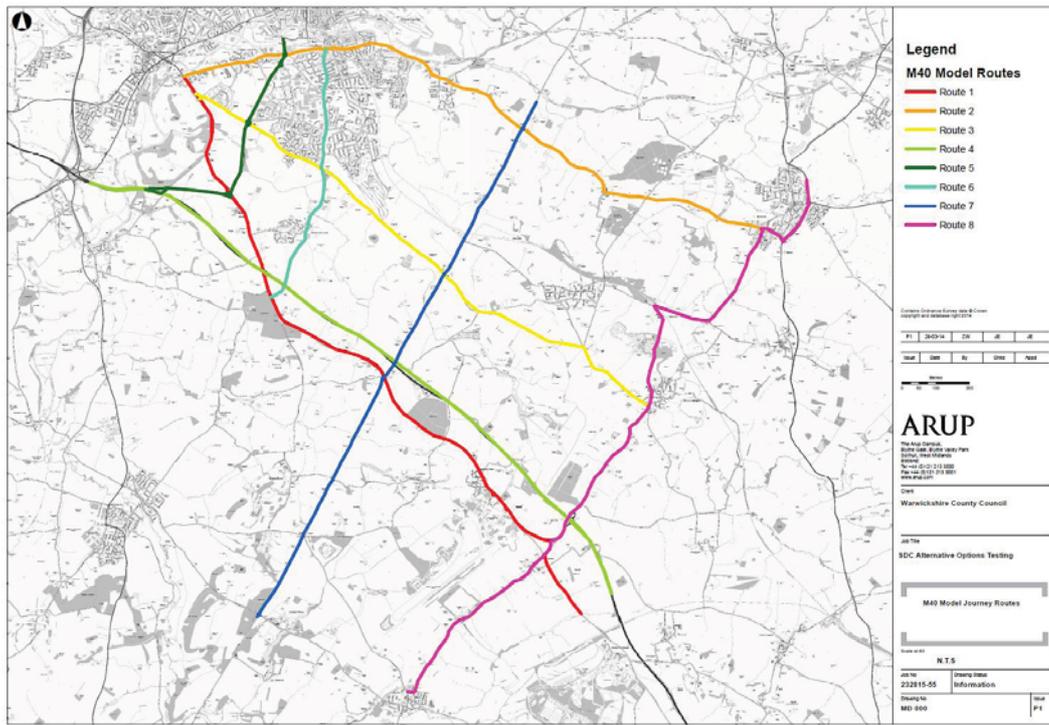
The benefit of undertaking analysis of delay on key routes, compared to simply reviewing the network wide average journey time alongside the mean speed outputs, is that it begins to allow a more detailed picture of where the additional delays are likely to be incurred as well as highlight, in more detail, any areas which appear to benefit from the introduction of the allocated demand and associated mitigation measures.

The routes that have been defined for this assessment, within both the Stratford-upon-Avon and M40 PARAMICS models are illustrated within the following figures:

Figure 18 – Journey Time Analysis Routes SuA Model



Figure 19 - Journey Time Analysis Routes M40 Model



6 Core Strategy Results Analysis

6.1 Stratford Focus: Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken using the Stratford-upon-Avon PARAMICS models.

Options 1, 3 and 4 are considered as having a direct impact on the study area which is encompassed by the SuA PARAMICS model.

6.2 Stratford-upon-Avon Scenario Summary

In total 13 different scenarios have been derived and tested as a result of this assessment process and these are described as follows:

- **2031 SRZ+STP Reference Case** – Reference Case, with Warwick Road coded as Minor, no mitigation
- **2031 SuA Ref Case + WRM** – Reference Case, with Warwick Road coded as Major, no mitigation
- **2031 SuA Option 1 DN** – Dispersed Development, with Warwick Road coded as Minor, no mitigation
- **2031 SuA Option 1 DN + WRM** – Dispersed Development, with Warwick Road coded as Major, no mitigation
- **2031 SuA Option 1 DS + WRM** – Dispersed Development, with Warwick Road coded as Major, with mitigation
- **2031 SuA Option 3 DN** – Long Marston Development, with Warwick Road coded as Minor, no mitigation
- **2031 SuA Option 3 DM** – Long Marston Development, WRR with Warwick Road coded as Minor, no further mitigation
- **2031 SuA Option 3 DM + WRM** – Long Marston Development, WRR with Warwick Road coded as Major, no further mitigation
- **2031 SuA Option 3 DS + WRM** – Long Marston Development, WRR with Warwick Road coded as Major, with further mitigation
- **2031 SuA Option 4 DN** – East of Stratford Development, with Warwick Road coded as Minor, no mitigation
- **2031 SuA Option 4 DM** – East of Stratford Development, ERR with Warwick Road coded as Minor, no further mitigation
- **2031 SuA Option 4 DM + WRM** – East of Stratford Development, ERR with Warwick Road coded as Major, no further mitigation
- **2031 SuA Option 4 DS + WRM** – East of Stratford Development, ERR with Warwick Road coded as Major, with further mitigation

The following outlines the referencing that has been adopted during the course of the scenario derivation:

WRM: Scenario is inclusive of Warwick Road dynamic signage strategy (Warwick Road has been coded as major)

DN: ‘Do Nothing’ – Aside from the development access strategy no further network amendments have been proposed within the assessment.

DM: ‘Do Minimum’ – A single, significant, intervention has been included within the assessment, i.e. the ERR or WRR depending upon the option being assessed.

DS: ‘Do Something’ – Additional mitigation has been included to either the DN or DM model network as outlined within **Section 4** of this report.

Further details on the demand assumptions adopted within each of these model scenarios are provided within **Section 3** of this report.

6.3 M40 Focus Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken for the M40 model for the following options:

- Option 2: Gaydon and Lighthorne
- Option 5: Southam North and Stoneythorpe

The following Scenarios were therefore tested as part of this exercise:

- **2031 M40 Extended Reference Case** – Reference Case, inclusive of 2,400 jobs (extant) at AML/JLR and committed highway schemes at M40 J12/B4100 and A452 Europa Way Corridor.
- **2031 Option 2 DN** – Option 2 demands, no mitigation.
- **2031 Option 2 DS** – Option 2 demands with enhanced mitigation strategy.
- **2031 Option 5 DN** – Option 5 demands, no mitigation.
- **2031 Option 5 DS** – Option 5 demands with enhanced mitigation.

The models are developed from the newly developed M40 2031 Reference Case Reference Case model with the Options defined as follows where:

- DN = Do Nothing – Development demand but no mitigation
- DM = Do Minimum – Enhanced Access Strategy
- DS = Do Something – Full mitigation strategy

6.4 Results Analysis

The outputs from the analysis undertaken within the Stratford-upon-Avon PARAMICS model have been presented, by Option, within the following **Section 7 to 9** of this report whilst the outputs from the M40 focussed analysis has been presented within **Sections 10 and 11**.

7 Option 1: Dispersed Development Approach Results

7.1 Overview

The first stage of this assessment was to review the performance of the model network following the allocation of the revised demand levels and network optimisation. Option 1 involves three scenarios as follows:

- **2031 Option 1 DN** – with Warwick Road coded as Minor, no mitigation
- **2031 Option 1 DN + WRM** – with Warwick Road coded as Major, no mitigation
- **2031 Option 1 DS + WRM** – with Warwick Road coded as Major, with mitigation

7.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within section 5.1 of this report.

The apparent network stability exhibited within the AM and PM simulation runs across the four scenarios is illustrated within the following **Table 23**:

Table 23 - Model Stability Assessment 2031 Reference vs. 2031 Revised Allocation

	Reference Case	Option 1 DN	Option 1 DN + WRM	Option 1 DS + WRM
AM	95%	100%	100%	90%
PM	85%	55%	70%	70%

Given the relatively limited sample size of 20 runs it is reasonable to conclude, from the previous table, that there are no notable differences during the AM peak period between the scenarios when considering network stability. Therefore the scenarios effectively demonstrate the same level of stability to within one run. However, there is a notable drop in model stability for the Option 1 DN scenario in the PM peak period, some improvement in stability is achieved by the various mitigation options but the level of stability is still worse than the Reference Case and indicates that further optimisation of the proposals assumed within the modelling is desirable.

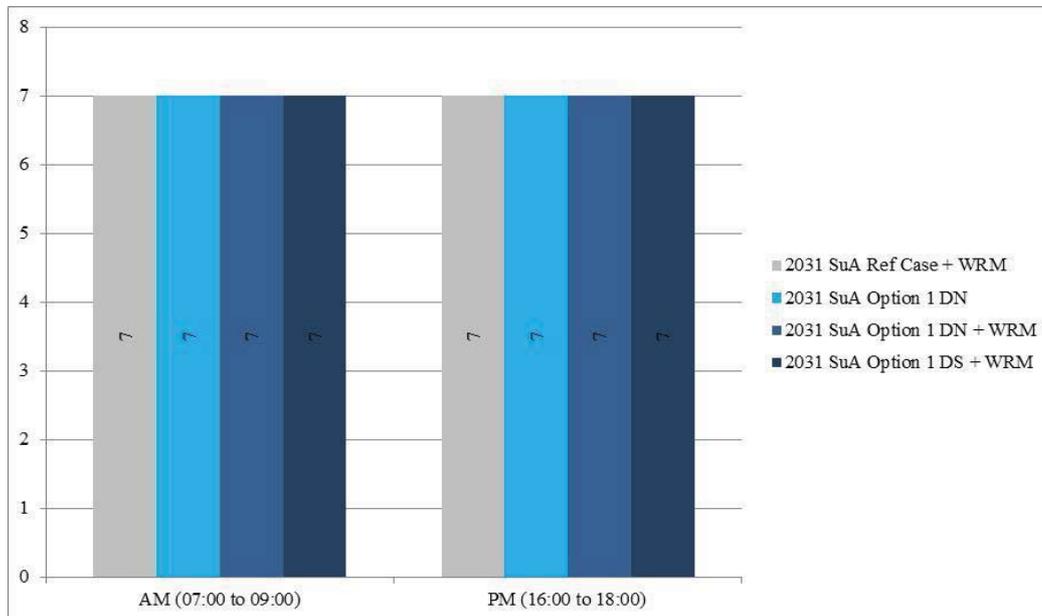
7.3 Network Wide Statistics

The following sets out the changes in network wide statistics between the 2031 Reference Case and the Option 1 scenarios.

7.3.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within the **Figure 20**.

Figure 20 - Average Journey Distance (2031 Ref A2 vs Op1 DN, Op1 DN + WRM, Op1 DS + WRM), Km



Analysis of **Figure 20** indicates very little difference between the three scenarios (they have been rounded to the nearest significant figure). An increase in the distance travelled may indicate an increase in the number of longer distance trips occurring within an option, or it may indicate an increased propensity for vehicles to reassign along longer routes in response to congestion.

A small increase in the distance travelled is always going to be likely due to the need to locate development on the periphery of the existing town network since that is where the available land is located.

7.3.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within **Figure 21**.

Figure 21 demonstrates that the reference scenario results in the highest levels of average speeds across the two periods. However, with the introduction of the Dispersed development, the mitigation measures seem to improve conditions beyond that of the scenario with no mitigation measures introduced (Option 1 DN).

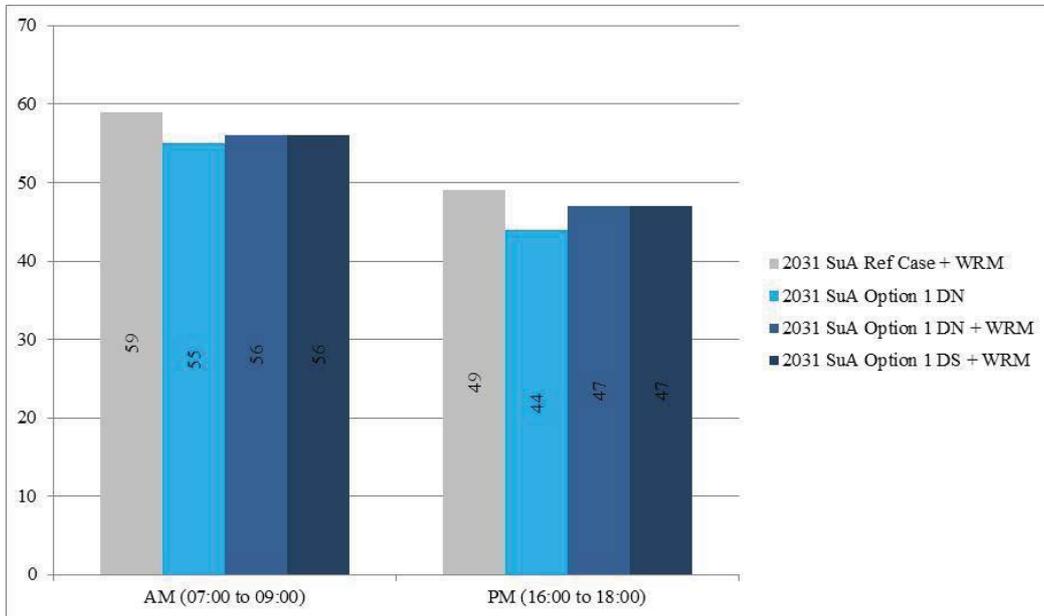
During the AM peak period, assuming the dispersed development is adopted with no mitigation measures, a drop in average journey speed of approximately 7% is expected. Assuming the major mitigation measures are introduced this reduces to a 5% decrease in average journey speed.

Analysis of the Option 1 DS + WRM results, indicates that the implementation of the additional mitigation measures does not improve average journey speeds across the network compared to the introduction of the major mitigation measures alone.

During the PM peak period, a similar pattern is observed with a 10% decrease in average journey speed expected assuming no mitigation measures are introduced

compared to the 2031 reference scenario. Should the major mitigation measures be introduced this reduces to a 4% decrease. Again, introduction of the additional mitigation measures has no bearing on the average journey speeds across the network.

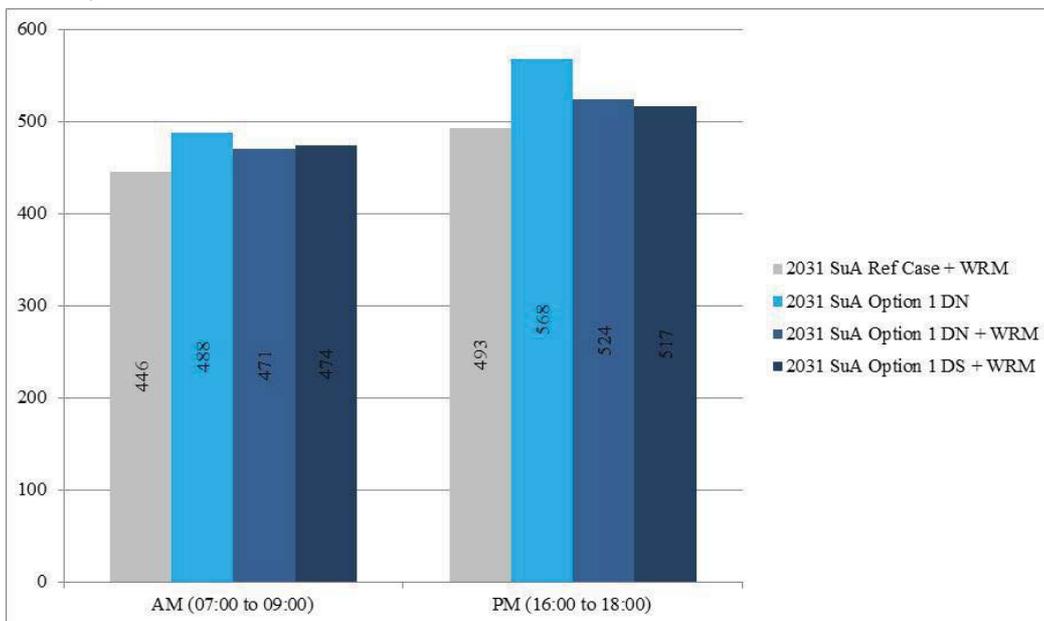
Figure 21 - Average Journey Speed (2031 Ref A2 vs Op1 DN, Op1 DN + WRM, Op1 DS + WRM), Km/h



7.3.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within **Figure 22**.

Figure 22 - Average Journey Time (2031 Ref A2 vs Op1 DN, Op1 DN + WRM, Op1 DS + WRM), Seconds



Analysis of **Figure 22** reveals an increase in the time it takes to complete a journey when compared to the 2031 Reference Case conditions of around 9% and 15% during both AM and PM periods for Option 1 DN scenario.

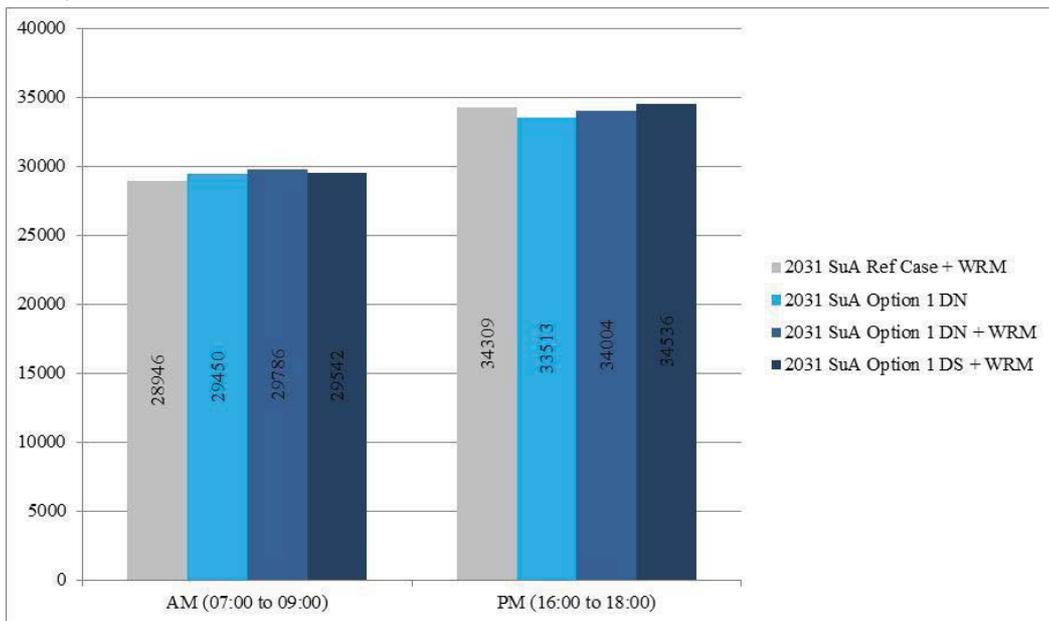
Should the WRM proposals be introduced, the increase in average journey time above the reference scenario is reduced to approximately 6% in both the AM and PM peak period. Should the additional mitigation measures be implemented, the average journey time is actually expected to increase further in the AM peak period by 0.6% beyond that for option 1 DN + WRM.

During the PM peak period, the additional mitigation measures improve conditions slightly from option 1 DN + WRM by 1%. Overall, the WRM proposals lead to the network being better able to accommodate the additional demand however, the additional mitigation measures seem to have little effect on the average journey times.

7.4 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 23**.

Figure 23 - Completed Trips (2031 Ref A2 vs Op1 DN, Op1 DN + WRM, Op1 DS + WRM), Vehicles



Analysis of the figure demonstrates that during the AM peak period, the additional demand on the network is best handled by Option 1 DN + WRM. The completed trips are approximately 3% higher during this period than for the reference case. In fact the additional mitigation measures seem to have a slight negative effect on the level of completed trips during this period. The total trips completed are 1% lower with the additional mitigation measures implemented compared to if the major mitigation measures were implemented alone.

During the PM peak period, Option 1 DS + WRM results in the highest level of completed trips but is only 1% higher than that in the reference scenario and 1.5% higher than that of Option 1 DN + WRM should the major mitigation measures be implemented alone.

Notably, the level of demand assigned within the Option 1 scenario is around 3.6% higher in the AM and 3.1% higher in the PM. It is worth noting that the increase in completed trips is approximately equal to the increase in assigned demand between the two scenarios.

Because of the need for a cut off period it is never possible that 100% of the demand assigned within the model network will complete the entire journey by the end of the model period. Some trips will have only just started when the model ends whilst some may be released onto the network later due to congestion effects.

To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following **Table 24**:

Table 24 Completed Trips Analysis (2031 Ref vs WLWA RDA and WLWA RDA +RTC)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
2031 SuA Ref Case + WRM	30735	28946	94.18%	37606	34309	91.23%
2031 SuA Option 1 DN	31846	29450	92.48%	38781	33513	86.42%
2031 SuA Option 1 DN + WRM	31846	29786	93.53%	38781	34004	87.68%
2031 SuA Option 1 DS + WRM	31846	29542	92.77%	38781	34536	89.05%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the AM model period, is comparable between both scenarios whilst, in the PM, there is a reduction in the rate of trip completion within the Option scenarios.

This indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during the AM period but that additional work may be required during the PM period to achieve similar levels of success. The Option 1 DS network facilitates the greatest levels of completed trips.

7.5 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2031 Reference Case and 2031 DS + WRM scenario.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report. The queue length plots for the other scenarios are also contained within this Appendix.

7.5.1 AM Analysis (MQ001)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 1 DS +WRM scenario, during the AM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network

- There is one instance where a queue length reduction is expected at the junction of Birmingham Road and Arden Street
- There are two instances of a queue length increase of between 15 and 30 vehicles
- Over the AM peak period, the majority of junctions assessed do not trigger one of the assessment criteria indicating that there a large number of junctions where a negligible effect change in the queuing is expected to occur.

7.5.2 PM Analysis (MQ002)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 1 DS +WRM scenario, during the PM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network
- There are two instances of queue lengths between 30 and 50 vehicles
- The majority of junctions assessed that trigger the criteria experience a queue length increase of 15 to 30 vehicles
- There is one further instance of queue length decrease across the network when compared to the AM peak hour (MQ001).

7.5.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2031 Reference Case and 2031 DS+ WRM scenario is provided as follows:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network in either the AM or PM peak period
- There are a number of instances where a queue length reduction is expected across both peak hours
- The majority of junctions across the scenarios and periods assessed that trigger the criteria experience a queue length increase of 15 to 30 vehicles and these impacts tend to occur within the PM period.

7.6 Delay Analysis

The following section sets out some initial observations of the mean delay plots for the three key model scenarios; 2031 Reference Case and 2031 Option DS + WRM scenario.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

7.6.1 AM Analysis (MD001)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option DS + WRM scenario, during the AM period, reveals the following:

- There are a number of links particularly surrounding Stratford upon Avon town area that are expected to have an increase in delay of greater than 25% when compared to the reference scenario
- Notably, there are a number of impacts which appear to converge upon the area of the gyratory, significant enhancements have already been proposed for this area and there is limited scope for further measures to be incorporated within the assessment.

7.6.2 PM Analysis (MD002)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option DS + WRM scenario, during the PM period, reveals the following:

- As has been observed within the AM peak hour, in the PM there are a number of links which are expected to experience a reduction in mean delay assuming option 1 DS + WRM is implemented
- Again, there are a number of links where an improvement in delay conditions is expected, however an increase of greater than 50% is expected along A4300 Shipston Road NB and B4086 Tiddington Road SB.

7.6.3 Delay Analysis Summary

In general, the results appear to indicate that changes in delay levels, between scenarios are likely to be variable with some areas suffering increases in delay levels whilst reductions may be achievable in other areas. In general, the focus of impacts appears to be within the town centre area where, currently, there is limited scope for further improvements over and above those which have been included within the assessment thus far.

7.7 Conclusion

The initial comparisons between the 2031 Reference Case and the 2031 Option 1 Dispersed Development scenario reveal the following conclusions:

- Inclusion of the Option 1 development sites will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy
- Adoption of the additional mitigation measures is not expected to lead to a significant improvement in network conditions beyond that expected should the major mitigation measures be implemented.
- Analysis of the trip completion ratios and network conditions within the Reference Case and Dispersed Development scenarios indicates that, in general, the major mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM period.
- Analysis of the impacts on queuing levels indicates that the PM network is likely to suffer from the greatest level of impact in spite of the inclusion of the proposed mitigation measures.

- Analysis of the impacts on journey times indicates that some improvements are deliverable but there are also some impacts likely to occur. The impacts appear to be largely focussed in and around the area of the gyratory where there is limited scope for further mitigation measures to be included within the network.

8 Option 3: Long Marston Development Results

8.1 Overview

The first stage of this assessment was to review the performance of the model network following the allocation of the revised demand levels and network optimisation. Option 3 involves five scenarios as follows:

- **2031 Option 3 DN** – with Warwick Road coded as Minor, no mitigation
- **2031 Option 3 DN + WRM** – with Warwick Road coded as Major, no mitigation
- **2031 Option 3 DM** – with Warwick Road coded as Minor, plus WRR, no further mitigation
- **2031 Option 3 DM + WRM** – with Warwick Road coded as Major, plus WRR, no further mitigation
- **2031 Option 3 DS + WRM** – with Warwick Road coded as Major, plus WRR, with further mitigation

8.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within section 5.1 of this report.

The apparent network stability exhibited within the AM and PM simulation runs across the four scenarios is illustrated within the following **Table 25**:

Table 25 - Model Stability Assessment 2031 Reference vs. 2031 LM development scenarios

	2031 SuA Ref Case + WRM	2031 Sua Option 3 DN	2031 Sua Option 3 DM	2031 Sua Option3 DM + WRM	2031 Sua Option3 DS + WRM
AM	95%	55%	100%	95%	95%
PM	85%	0%	0%	60%	85%

Analysis of the previous Table reveals that the performance of the Reference scenario demonstrates a relatively high level of stability in both peak periods. When the LM development demand allocations are included the model stability drops to unacceptable levels for the PM peak periods but then improves substantially once the dynamic signage strategy is implemented along Warwick Road within the model network.

8.3 2031 SuA Option 3 DN scenario

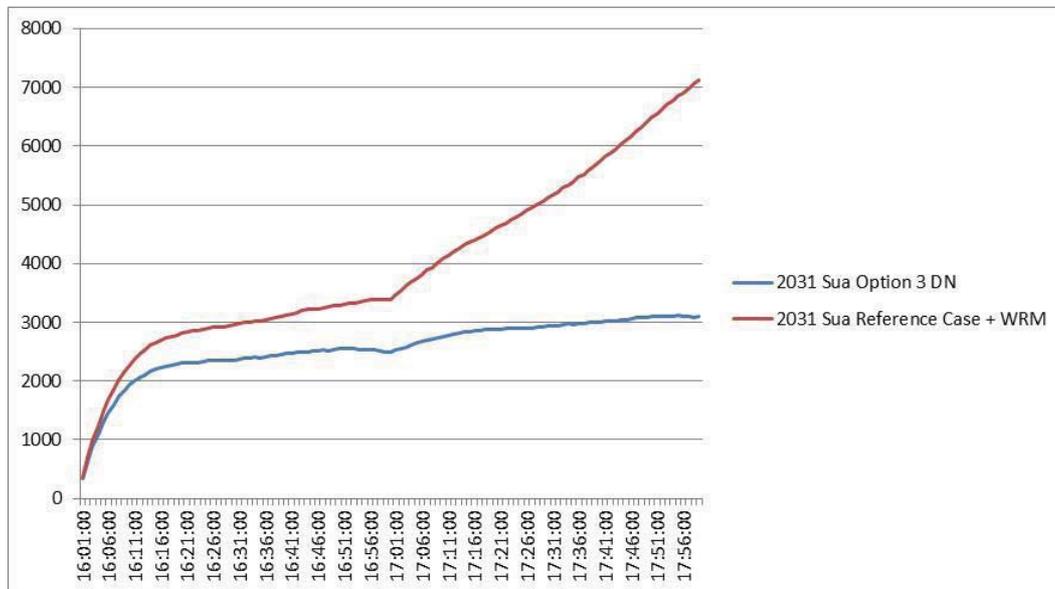
The initial analysis of the model stability demonstrates that the results extracted from the 2031 Option 3 DN (do nothing) scenario and Option 3 DM (major mitigation measures but no dynamic signage strategy) are not considered suitable

for any further, more detailed stages of assessment. This is because the high levels of instability will inevitably lead to unrealistic levels of delay and congestion which will, in turn, result in high levels of reassignment and thus, render the outputs both unreliable and unrealistic.

A key symptom of a model lock up is continuously increasing numbers of vehicles on the network. This indicates that the model network fails to accommodate the levels of demand that have been assigned, as it fails to clear the assigned demand levels the number of vehicles on the network simply continues to build and consequently delay and queuing levels also increase substantially.

The following **Figure 24** illustrates the average number of vehicles on the network during the AM and PM time periods of both the 2031 Reference Case and the Option 3 DM model network, during the PM period. Analysis of the number of vehicles on the network during the PM period reveals that traffic levels can be seen to increase exponentially as the network is unable to accommodate the assigned demand levels.

Figure 24 - PM (16:00 to 18:00) Vehicles on the network, 2031 Reference Case vs. 2031 Option 3 DN



On this basis no further analysis has been undertaken using either the Option 3 DN or Option 3 DM scenario outputs. Furthermore it is reasonable to conclude that both the Warwick Road Signage strategy and the accompanying mitigation measures are key to ensuring the development can be accommodated.

Therefore the remaining section of this report focusses only on the outputs from the following scenarios:

- **2031 Option 3 DM + WRM** – with Warwick Road coded as Major, plus WRR, no further mitigation
- **2031 Option 3 DS + WRM** – with Warwick Road coded as Major, plus WRR, with further mitigation

8.4 Network Wide Statistics

The following sets out the changes in network wide statistics between the 2031 Reference Case and the Long Marston (LM) Development scenarios.

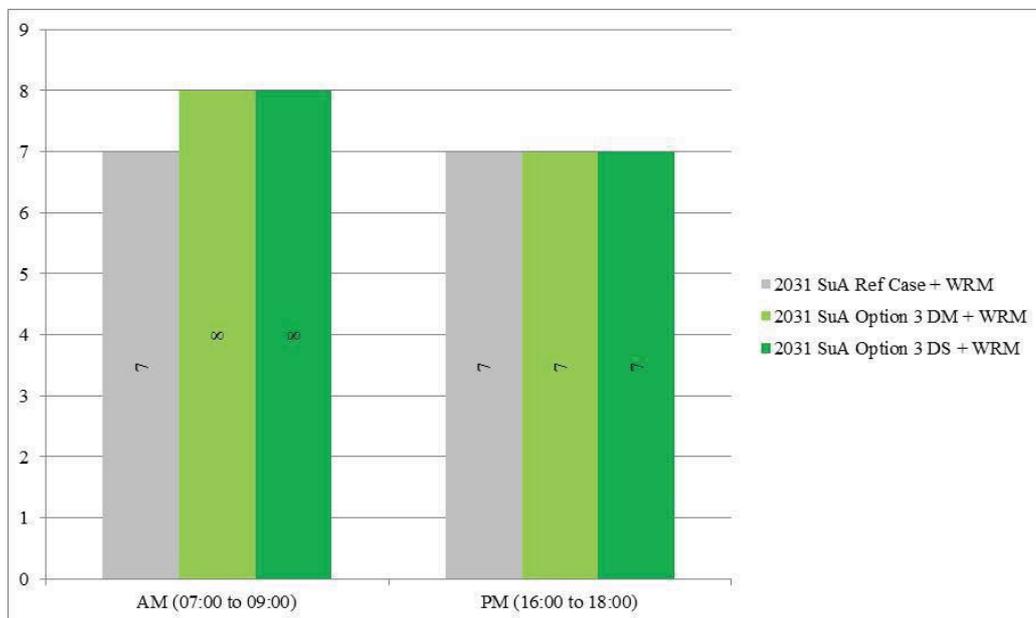
8.4.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within **Figure 25**.

Analysis of **Figure 25** reveals that the journey distances vary by a maximum of \pm 1km.

A small increase in the average distance travelled is always going to be likely due to the location of the Option 3 Long Marston airfield site which lies approximately 5km to the south west of the existing SuA town network.

Figure 25 - Average Journey Distance (2031 Ref vs LM development scenarios), Km



8.4.2 Average Journey Speed

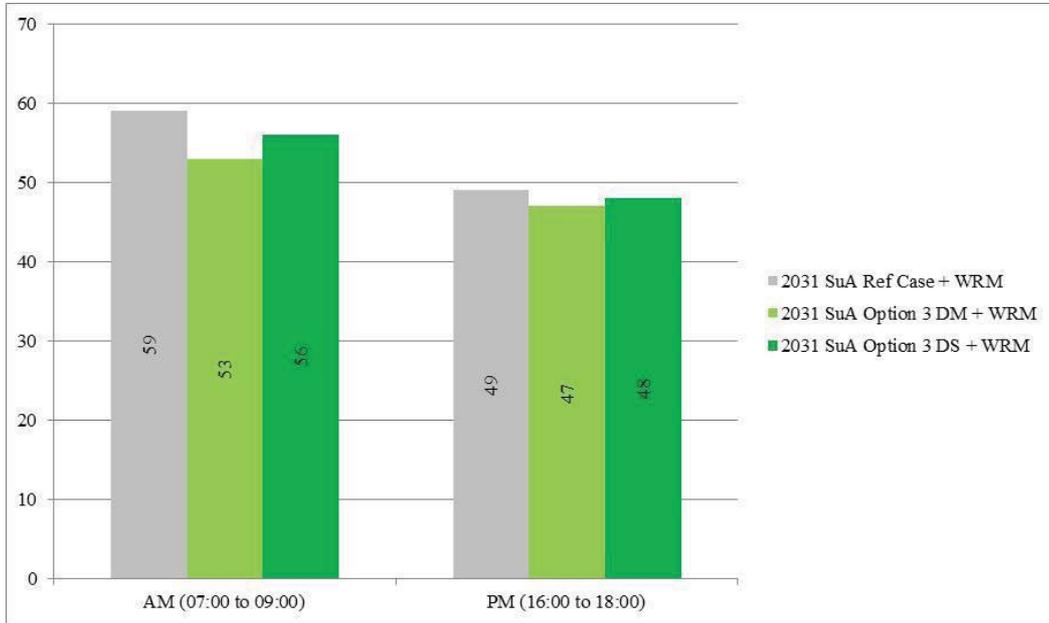
Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within **Figure 26**.

Figure 26 demonstrates that the allocation of the demands associated with Long Marston alongside the WRR results in a drop in the average speed of vehicles, on the network, of approximately 10% and 4% compared to the reference scenario during the AM and PM peak period respectively. The inclusion of the additional mitigation measures results in an increase in journey speeds when compared to the DM scenario but these are still lower than Reference Case speeds. The biggest difference between the Reference Case and Option 3 DS scenario speeds occurs within the AM period.

The drop in average speeds in both peak periods is likely to be indicative of the general effects of the assignment of the additional demand. Allocating additional demand is inevitably going to result in a drop in the overall average speed that

vehicles are able to travel at within the network due to increased friction incurred as a result of the additional movements within the network and the and resultant increase in congestion.

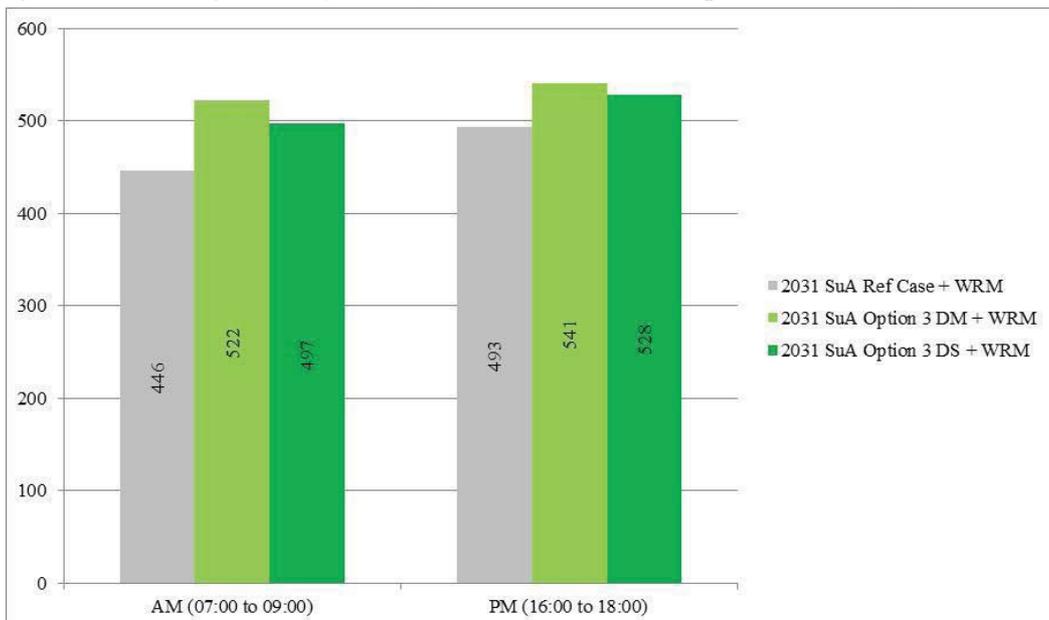
Figure 26 - Average Journey Speed (2031 Ref vs LM development scenarios), Km/h



8.4.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within the following **Figure 27**:

Figure 27 - Average Journey Time (2031 Ref vs LM development scenarios), Seconds



Analysis of the difference in average journey time across the scenarios indicates that of the LM development scenarios option 3 DS + WRM results in the smallest

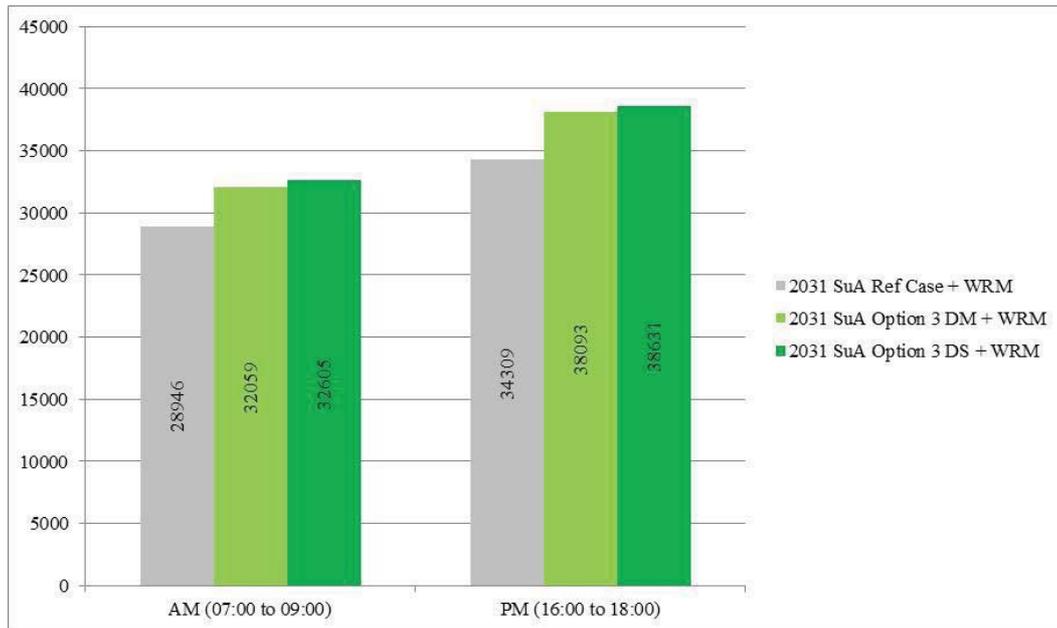
increase above that of the reference case in both peak periods. This represents an increase in journey time across the network of approximately 11% and 7% during the AM and PM periods respectively. This compares to the 17% and 10% increase expected for option 3 DN above the reference scenario in the AM and PM peak period respectively. A significant amount of this will be as a result of the additional demand that has been assigned across the network.

An incremental increase in delay is likely to be experienced as a result of these vehicles being added onto an already congested network. In some areas mitigation has been introduced to minimise these impacts and it is entirely possible that conditions in some areas will improve as a result of the schemes which accompany the allocated growth. However, overall, it can be assumed that there will be a general increase in the average time spent travelling on the network once the allocated demand has been assigned to the network.

8.5 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 28** on the following page.

Figure 28 - Completed Trips (2031 Ref vs LM development scenarios), Vehicles



Analysis of the figure indicates that as the mitigation measures increase the level of completed trips does so to during both peak periods. Given Option 3 DS + WRM, there is an increase in completed trips of around 13%, in both the AM and PM periods respectively, when compared to the 2031 Reference Case.

Notably, the level of demand assigned within the Revised Allocation option is around 15% higher in the AM and 13% higher in the PM. It is worth noting that the increase in completed trips is less than the increase in assigned demand between the two scenarios.

Because of the need for a cut off period it is never possible that 100% of the demand assigned within the model network will complete the entire journey by the end of the model period. Some trips will have only just started when the model

ends whilst some may be released onto the network later due to congestion effects.

To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following **Table 26**.

Table 26 Completed Trips Analysis (2031 Ref vs WLWA RDA and WLWA RDA +RTC)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
Ref Case A2	30735	28946	94.18%	37606	34309	91.23%
2031 Sua Option 3 DM + WRM	35328	32059	90.75%	42529	38093	89.57%
2031 Sua Option 3 DS + WRM	35328	32605	92.29%	42529	38631	90.83%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the both AM and PM model periods reduces within the Option 3 scenario networks. The overall rate of trip completion is higher within the 2031 Option 3 DS network than the Option 3 DM network which indicates the additional mitigation measures are likely to increase the levels of demand that the network is able to accommodate.

This indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during both model periods, particularly when considering that the number of completed trips is over 12% higher within the Option 3 scenarios.

8.6 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2031 Reference Case and 2031 Option 3 DS + WRM scenario.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

8.6.1 AM Analysis (MQ003)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 3 DS + WRM scenario, during the AM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network
- There are two instances of a queue length reduction along the A4390 within the town centre
- The majority of junctions assessed that trigger the criteria experience an increase of between 15 and 50 vehicles.

8.6.2 PM Analysis (MQ004)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 3 DS + WRM scenario, during the PM peak hour, reveals the following:

- There are no instances of queue lengths exceeding 50 vehicles on the network
- There are a number of instances where a queue length reduction is expected to occur (10) which is far more than is experienced within the AM peak period.
- There are a larger number of junctions which trigger the assessment criteria indicating the option has a larger impact on the network conditions during the PM peak period than it does during the AM peak period.

8.6.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2031 Reference Case and 2031 Option 3 DS + WRM scenario is provided as follows:

- There are no instances where a severe queue length increase (> 50 vehicles) is expected in either peak period
- There are a large number of instances where a reduction in queue length is expected around the town centre in the PM peak period
- There are a larger number of junctions which trigger the assessment criteria indicating the option has a larger impact on the network conditions during the PM peak period than it does during the AM peak period.

8.7 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the two key model scenarios; 2031 Reference Case and 2031 Option 3 DS + WRM. The comments in the remainder of this section are based on observations of the predicted changes journey times across key routes within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

8.7.1 AM Analysis (MD003)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 3 DS + WRM scenario, during the AM peak hour, reveals the following:

- Analysis of MD003 reveals that there are a large number of links where a reduction in the mean delay is expected when compared to the reference scenario
- There are a number of links where an improvement in delay conditions is expected, however an increase of greater than 50% is expected along A439

Warwick Road SB, B4632 Campden Road/Clifford Lane NB, A4390
Trinity Way EB and A3400 Guild Street/Birmingham Road WB

8.7.2 PM Analysis (MD004)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 3 DS + WRM scenario, during the PM peak hour, reveals the following:

- Analysis of MD006 indicates the improvements on network delay are mainly focused in and around the town centre whilst the negative effects are felt on the wider network
- Again, there are a number of areas where an improvement in delay conditions is expected, however an increase of greater than 50% is expected along A4300 Birmingham Road WB, Clopton Road SB, B4632 Clifford Lane SB and A4390 Trinity Way WB.

8.7.3 Delay Analysis Summary

In general, the results appear to indicate that changes in delay levels are likely to be variable with some areas suffering increases in delay levels whilst reductions may be achievable in other areas. It should be remembered that any reduction in delay is achieved in spite of the general increase in demand levels across the entire network.

8.8 Conclusion

The initial comparisons between the 2031 Reference Case and the 2031 Option 3 Long Marston Airfield Development scenarios reveal the following conclusions:

- Inclusion of the LM development demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- Analysis of the trip completion ratio within both Reference Case and LM scenarios indicates that, in general, the mitigation measures associated with Option 3 DS + WRM are able to accommodate the additional demand levels assigned during both peak periods.
- The queuing analysis does not indicate any areas where a severe increase in queuing levels has been identified whilst, furthermore, a considerable number of reductions in queue lengths is achieved within the town centre during the PM period as a result of the additional mitigation measures.
- Increases in delay are likely to occur on routes which are peripheral to Stratford town centre, in particular routes into the town from the south west and the A46/A439 Warwick Road routes are affected which indicates further mitigation measures within these areas is likely to be desirable.

9 Option 4: South East Stratford Development

9.1 Overview

The first stage of this assessment was to review the performance of the model network following the allocation of the revised demand levels and network optimisation. Option 4 involves five scenarios as follows:

- **2031 Option 4 DN** – with Warwick Road coded as Minor, no mitigation
- **2031 Option 4 DN + WRM** – with Warwick Road coded as Major, no mitigation
- **2031 Option 4 DM** – with Warwick Road coded as Minor, plus ERR, no further mitigation
- **2031 Option 4 DM + WRM** – with Warwick Road coded as Major, plus ERR, no further mitigation
- **2031 Option 4 DS + WRM** – with Warwick Road coded as Major, plus ERR, with further mitigation

9.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within section 5.1 of this report.

The apparent network stability exhibited within the AM and PM simulation runs across the four scenarios is illustrated within the following **Table 27**:

Table 27 - Model Stability Assessment 2031 Reference vs. 2031 Revised Allocation

	Reference Case	Option 4 DN	Option 4 DM	Option 4 DM + WRM	Option 4 DS + WRM
AM	95%	85%	100%	100%	100%
PM	85%	0%	85%	100%	95%

Analysis of the previous Table reveals that the performance of the Reference Case scenario demonstrates a relatively high level of stability in both peak periods. When the East of Stratford development demand allocations are included the model stability drops to unacceptable levels for the PM peak periods but then improves substantially once the mitigation measures and dynamic signage strategy are introduced within the model network.

9.3 2031 Option 4 DN scenario

The initial analysis of the model stability demonstrates that the results extracted from the 2031 Option 34 DN (do nothing) scenario is unlikely to yield reliable comparisons. Primarily this is because the reduction in stability will lead to unrealistic levels of delay and high levels of reassignment which will produce unreliable model outputs.

This replicates the findings presented within Section 8.3 for Option 3. A key symptom of a model lock up is continuously increasing numbers of vehicles on the network. This indicates that the model network fails to accommodate the levels of demand that have been assigned, as it fails to clear the assigned demand levels the number of vehicles on the network simply continues to build and consequently delay and queuing levels also increase substantially.

Analysis of the previous figures reveals that at some point during both AM and PM peak hours the number of vehicles on the 2031 Option 4 DN reaches a sufficiently high level to trigger the failure of the model network at which point the numbers of vehicles begins to increase continuously and, thus the levels of delay and queuing contained within the simulation network are unlikely to be considered reliable. As a result of this, aside from the analysis of the impact on journey times, the results obtained from the 2031 Option 4 DN scenario have been discounted from the further stages of analysis.

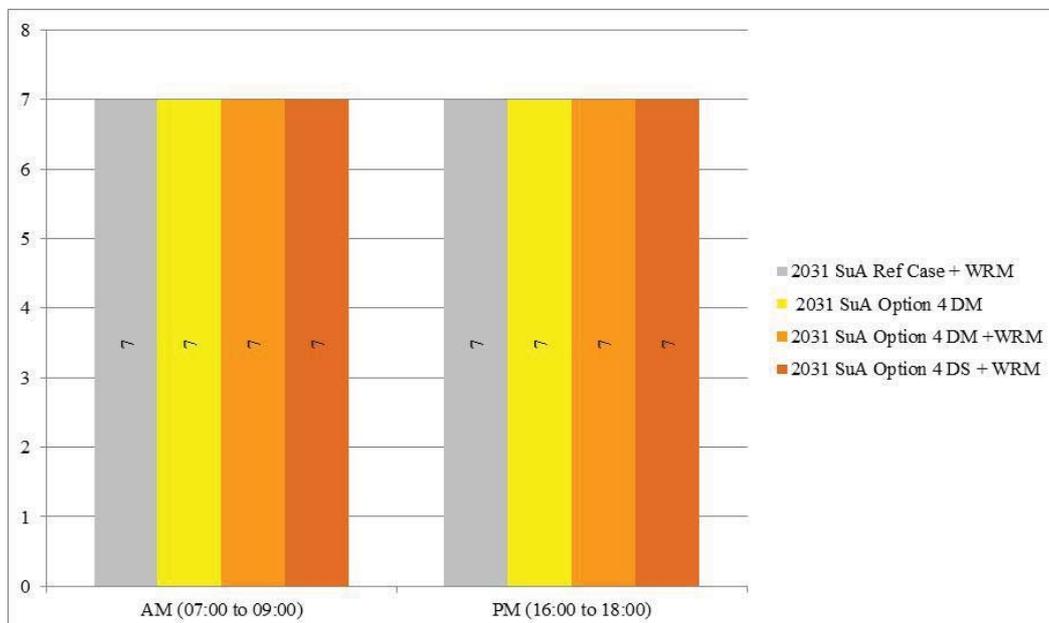
9.4 Network Wide Statistics

The following sets out the changes in network wide statistics between the 2031 Reference Case and the East of Stratford Development scenarios.

9.4.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within **Figure 29**.

Figure 29 - Average Journey Distance (2031 Ref vs South East Stratford Development options), Km



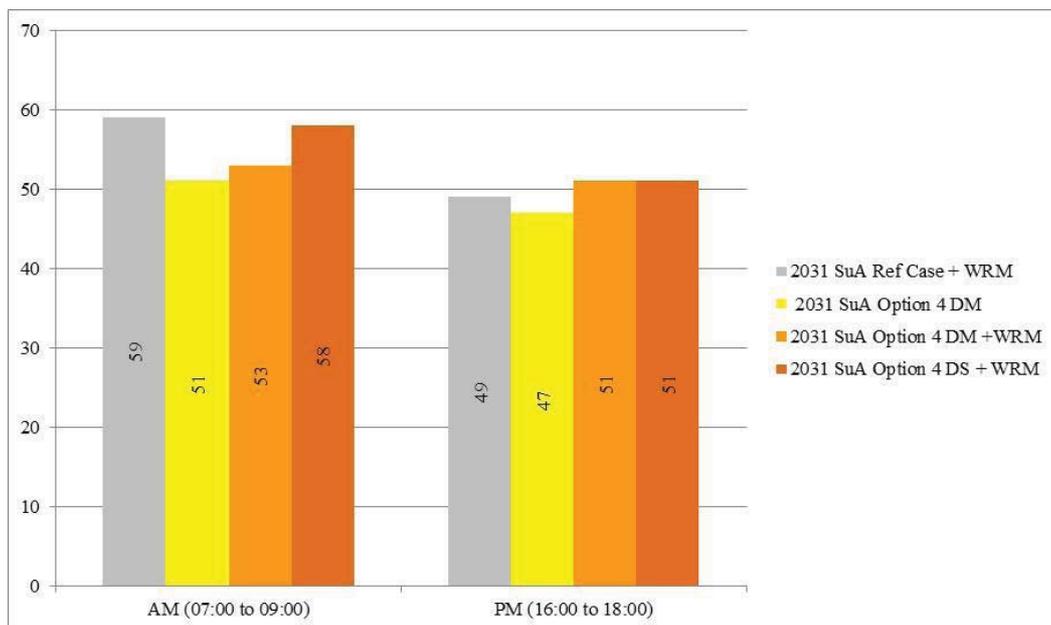
Analysis of the rounded values within **Figure 29** indicates very little difference between the three scenarios. An increase in the distance travelled may indicate an increase in the number of longer distance trips occurring within an option, or it may indicate an increased propensity for vehicles to reassign along longer routes in response to congestion.

A small increase in the distance travelled is always going to be likely due to the need to locate development on the periphery of the existing town network since that is where the available land is located.

9.4.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within the following **Figure 30**:

Figure 30 - Average Journey Speed (2031 Ref vs East of Stratford Development options), Km/h



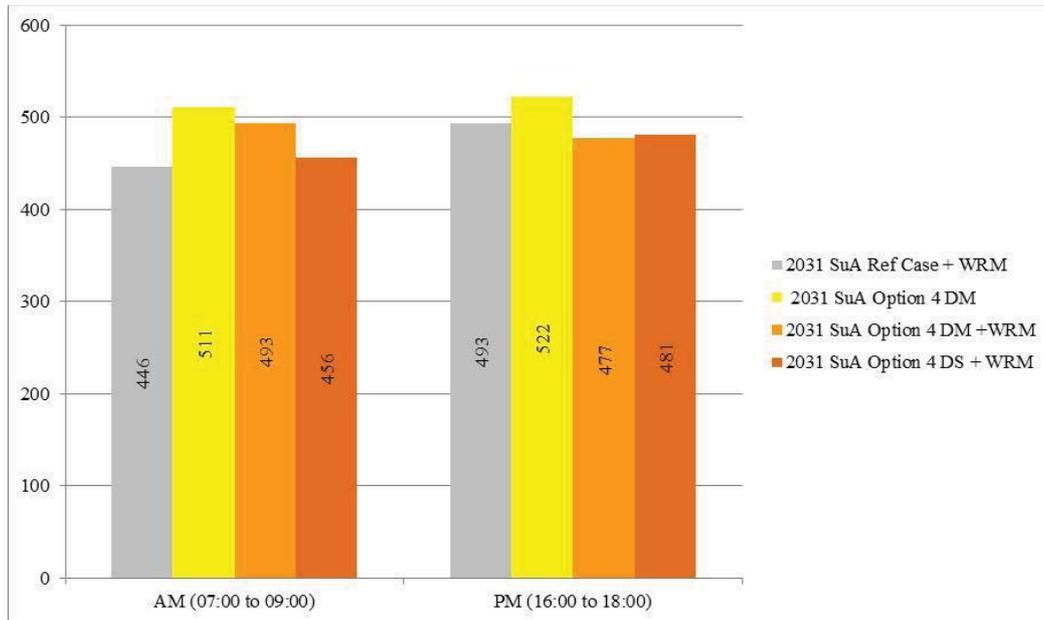
The previous figure demonstrates that the allocation of development to the East of Stratford results in a reduction in average speeds across both AM and PM model periods. The inclusion of the revised signage strategy along the Warwick Road appears to mitigate some of these impacts to some extent but speeds are still lower than the Reference Case within the AM, within the PM the average speeds are higher.

When the additional mitigation is included within the network the average speeds increase significantly within the AM period whilst there is little difference between the DM + WRM and the DS + WRM network speeds within the PM.

9.4.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within the **Figure 31**.

Figure 31 - Average Journey Time (2031 Ref vs East of Stratford Development options), Seconds



Analysis of **Figure 31** reveals that, across the East of Stratford development (ES) scenarios, as the mitigation measures increase the average journey time generally decreases. During the AM peak period implementation of the Option 4 DS + WRM, results in an increase in the average journey time of around 2% compared to the Reference Case journey times. During the PM peak period however, a reduction (improvement) in average journey time of approximately 2% is observed in both DM and DS scenario networks. This is indicative of an improvement in the network conditions compared to those that have been observed within the Reference Case.

9.5 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 32** on the following page.

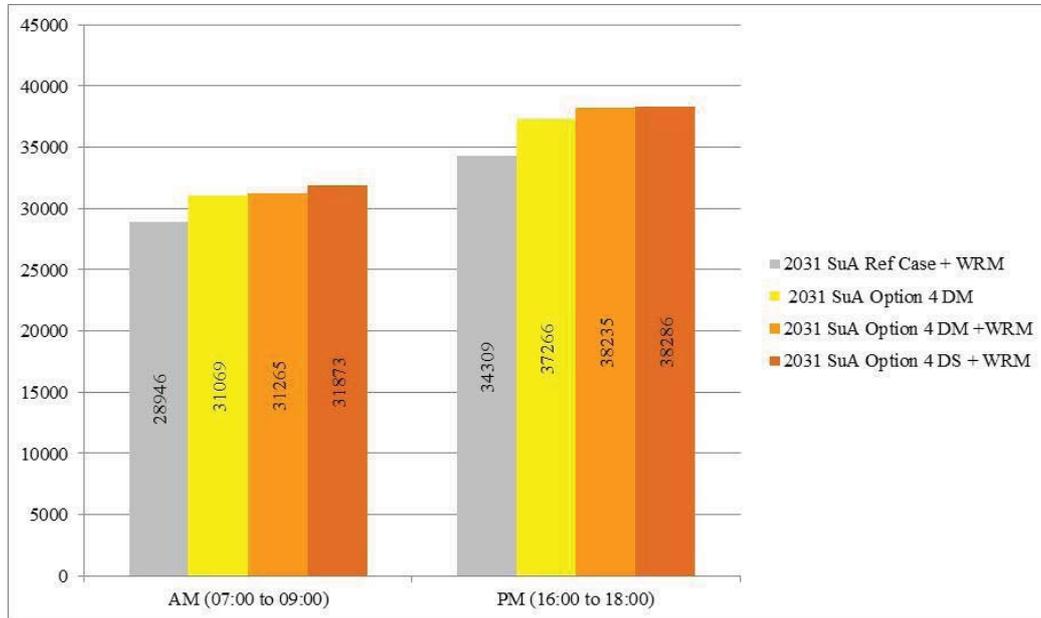
Analysis of **Figure 32** indicates that with increasing mitigation measures, the number of completed trips increases. Implementation of Option 4 DS + WRM results in the highest level of completed trips across the scenarios. Furthermore, the data presented within **Figure 32** demonstrates that as each incremental change is included within the scenario network the number of completed trips achieves a corresponding increase.

Notably, the level of demand assigned within the Option 4 network is up to 14% higher in the AM and 12% higher in the PM. It is worth noting that the increase in completed trips is higher than the increase in assigned demand in the AM peak period but less in the PM peak period.

Because of the need for a cut off period it is never possible that 100% of the demand assigned within the model network will complete the entire journey by the end of the model period. Some trips will have only just started when the model

ends whilst some may be released onto the network later due to congestion effects.

Figure 32 - Completed Trips (2031 Ref vs East of Stratford Development options), Vehicles



To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following **Table 28**:

Table 28 - Completed Trips Analysis (2031 Ref vs East of Stratford Development options)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
2031 SuA Ref Case + WRM	30735	28946	94.18%	37606	34309	91.23%
2031 SuA Option 4 DM	34169	31069	90.93%	41324	37266	90.18%
2031 SuA Option 4 DM + WRM	34169	31265	91.50%	41324	38235	92.52%
2031 SuA Option 4 DS + WRM	34169	31873	93.28%	41324	38286	92.65%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during both AM and PM model periods initially reduces but then begins to increase as the mitigation measures are incorporated within the model network. During the PM period the trip completion rate is actually higher within the DM and DS networks than it is within the Reference Case.

This indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during the AM, especially within the DS network. Within the PM the measures improve the trip completion rate and more

trips are accommodated as a result of the allocation of the development and the accompanying mitigation measures.

9.6 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2031 Reference Case and 2031 Option 4 DS + WRM scenarios.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

9.6.1 AM Analysis (MQ005)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 4 DS + WRM scenario, during the AM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network
- There are four instances where a queue length reduction is expected in the town centre at the junction of Birmingham Road/ Arden Street, Warwick Road/ Bridgeway, Bridgeway/ Bridgefoot and Bridgefoot/ Tiddington Road
- There are three instances where a queue length increase between 15 and 30 vehicles is expected.

9.6.2 PM Analysis (MQ006)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 4 DS + WRM scenario, during the PM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network
- The majority of junctions assessed that trigger the criteria experience a queue reduction
- There are more instances of queue length decreases that are expected across the network when compared to the AM period (MQ005).

9.6.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2031 Reference Case and 2031 Option 4 DS + WRM scenario is provided as follows:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network during both the AM and PM peak period
- There are a large number of instances where a reduction in queue length is expected surrounding the town centre in the PM peak period

9.7 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the two key model scenarios; 2031 Reference Case and 2031 Option 4 DS + WRM. The comments in the remainder of this section are based on observations of the predicted changes journey times across key routes within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

9.7.1 AM Analysis (MD005)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 4 DS + WRM scenarios, during the AM period, reveals the following:

- That there are a large number of links where a reduction in the mean delay is expected when compared to the reference scenario
- Notably, there are improvements to mean delay expected along links in the Stratford-upon-Avon town centre area
- There are no links which are expected to experience a greater than 50% increase in delay during the AM peak period when compared to the reference scenario

9.7.2 PM Analysis (MD006)

Analysis of the difference in queuing between the 2031 Reference and 2031 Revised Allocation scenarios, during the PM period, reveals the following:

- Again there are a large number of links where a reduction in the mean delay is expected when compared to the reference scenario
- Again, there are no links which are expected to experience a greater than 50% increase in delay during the PM peak period compared to the reference scenario

9.7.3 Delay Analysis Summary

In general, the results appear to indicate that changes in delay levels, between scenarios are likely to be variable with some areas suffering increases in delay levels whilst reductions may be achievable in other areas. However, the implementation of Option 4 DS + WRM will result in a reduction in the delay along a large number of links in and around the town centre. These improvements in the town centre are expected to be more pronounced in the PM peak period than they are in the AM peak period. It should be remembered that any reduction in delay is achieved in spite of the general increase in demand levels across the entire network.

9.8 Conclusion

The initial comparisons between the 2031 Reference Case and the 2031 Option 4 South East Stratford Development scenarios reveal the following conclusions:

- The analysis of the Do Nothing scenario outputs reveals that the network is unable to accommodate the proposed demands without the inclusion of the ERR; this is in spite of the presence of the STP proposals.
- Analysis of the trip completion rates indicates that the 2031 Option 4 DS + WRM network is able to accommodate a greater level of trips than the Reference Case.
- Overall, within the 2031 Option 4 DS + WRM scenario network the conditions are observed to improve in so far as journey speeds are likely to increase and delays reduce as a result of the inclusion of the allocated demands as well as the associated mitigation measures.
- Analysis of both queuing and delay outputs appears to indicate that there are a large number of instances where improvements are likely to occur as a result of the inclusion of the scheme proposals and associated mitigation measures.

10 Option 2: Gaydon/Lighthorne Heath Development

10.1 Overview

The first stage of this assessment was to review the performance of the model network following the allocation of the revised demand levels and network optimisation. Option 2 involves three scenarios as follows:

- **2031 Option 2 DN** – Option 2 demands, no mitigation.
- **2031 Option 2 DM** – Option 2 demands with enhanced access strategy.
- **2031 Option 2 DS** – Option 2 demands with enhanced mitigation strategy.

10.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within section 5.1 of this report.

The apparent network stability exhibited within the AM and PM simulation runs across the four scenarios is illustrated within the following **Table 29**:

Table 29 - Model Stability Assessment 2031 Reference vs. 2031 Revised Allocation

	Reference Case	Option 2 DN	Option 2 DM	Option 2 DS
AM	70%	70%	75%	75%
PM	75%	75%	75%	75%

Analysis of the previous Table reveals that the level of model stability is relatively constant across the scenarios during both peak periods

10.3 Network Wide Statistics

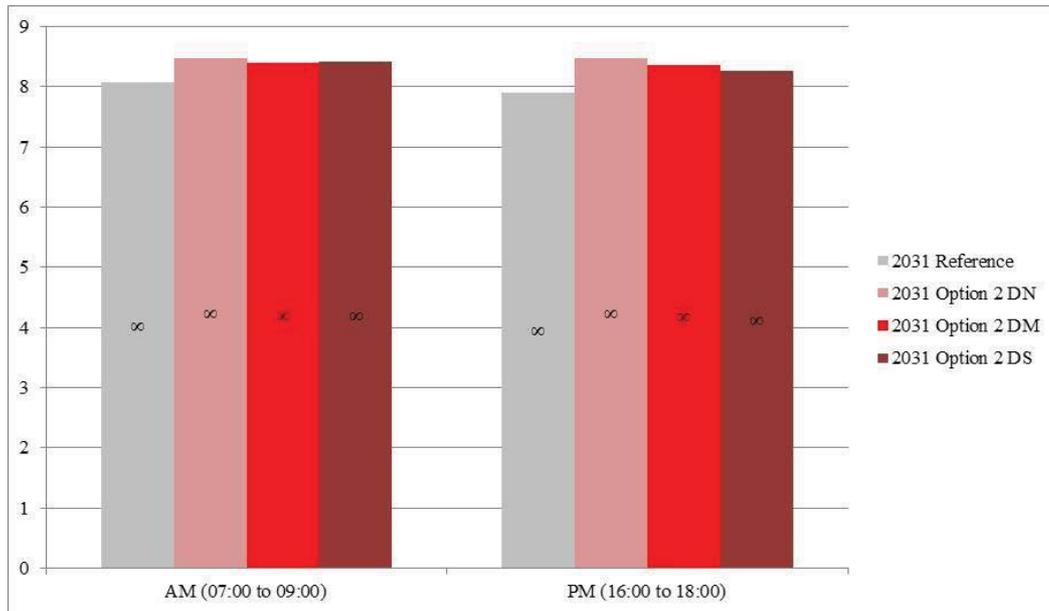
The following sets out the changes in network wide statistics between the 2031 Reference Case and the Option 2 scenarios.

10.3.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within the **Figure 33** on the following page.

Analysis of **Figure 33** indicates very little difference in average journey distance between the three scenarios. An increase in the distance travelled may indicate an increase in the number of longer distance trips occurring within an option, or it may indicate an increased propensity for vehicles to reassign along longer routes in response to congestion.

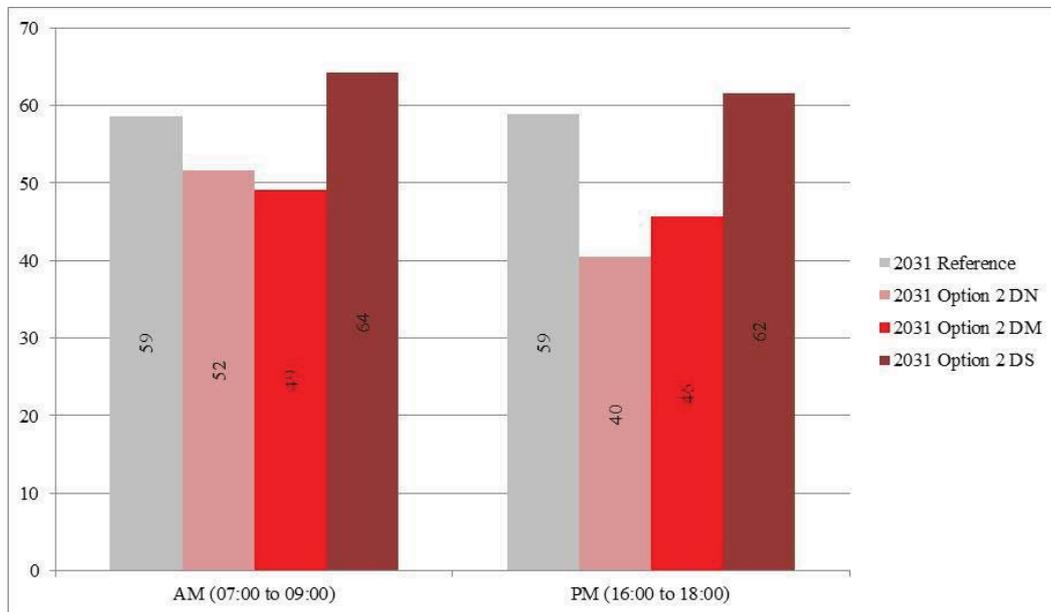
Figure 33 - Average Journey Distance (2031 Ref vs Option 2 development options), Km



10.3.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within the following **Figure 34**:

Figure 34 - Average Journey Speed (2031 Ref vs Option 2 development options), Km/h



The previous figure demonstrates that the implementation of Option 2 results in a drop in the average speed of vehicles, on the network, of approximately 12% and 31% for the Do Nothing scenario. The drop in average speeds is likely to be indicative of the general effects of the assignment of the additional demand.

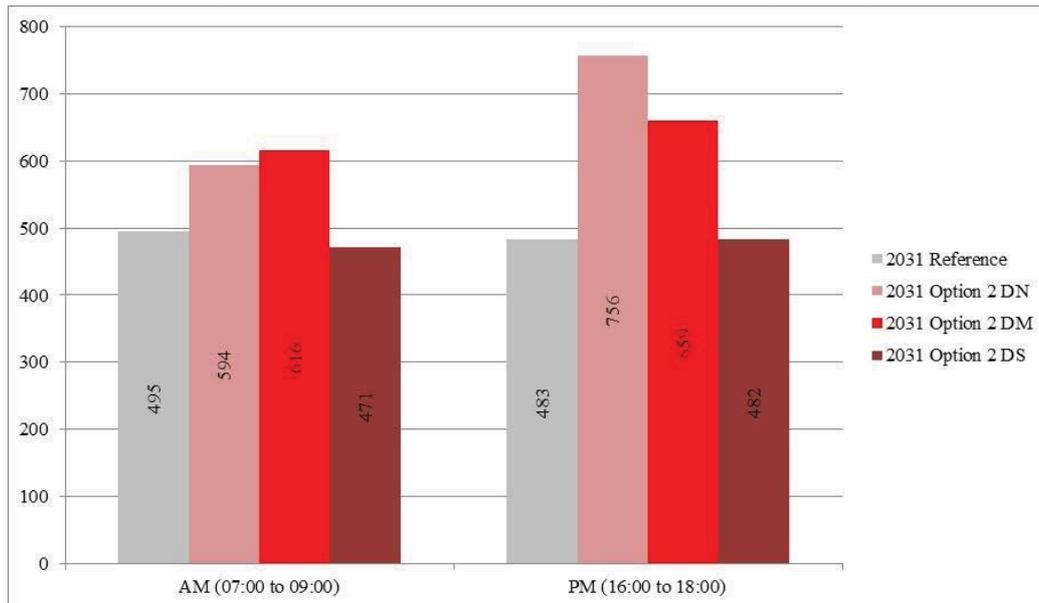
However, once the mitigation measures associated with the do something option are implemented, the average journey speed is expected to be 9% and 5% higher

than for the reference case in the AM and PM peak period respectively. This indicates that the mitigation measures enable the network to cope with the additional demand.

10.3.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within the following **Figure 35**:

Figure 35 - Average Journey Time (2031 Ref vs Option 2 development options), Seconds



The previous figure demonstrates that the implementation of Option 2 results in a substantial increase in the average journey time for vehicles on the network of approximately 20% and 56% for the Do Nothing scenario.

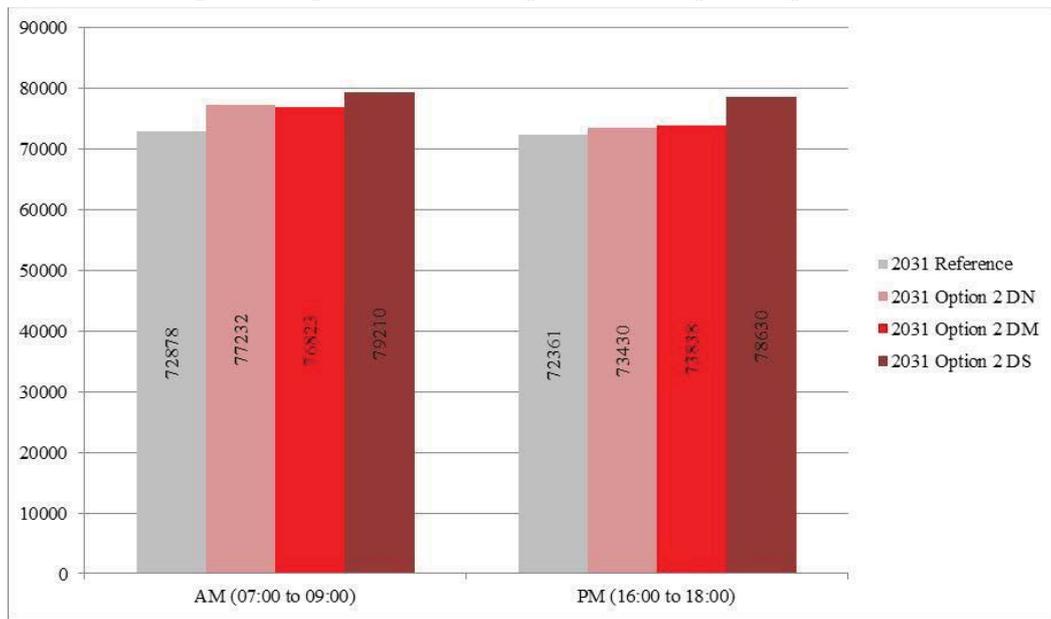
An incremental increase in delay is likely to be experienced as a result of these vehicles being added on to an already congested network. The introduction of the schemes associated with the Do Something scenario reduces the impacts on journey times to such an extent that the average journey times, during the AM period, are quicker within the 2031 Option 2 DS scenario network than the Reference Case journey times and are of a similar magnitude within the PM period.

10.4 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 36** on the following page.

Analysis of the figure indicates that generally with increasing mitigation measures, the number of completed trips increases. Implementation of Option 2 DS results in an increase in completed trips of around 8% during both the AM and PM periods respectively, when compared to the 2031 Reference Case.

Figure 36 - Completed Trips (2031 Ref vs Option 2 development options), Vehicles



To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following **Table 30**:

Table 30 - Completed Trips Analysis (2031 Ref vs M40 Option 2 Scenarios)

	AM (06:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
Reference	76606	72878	95.13%	76226	72361	94.93%
Option 2 DN	81566	77232	94.69%	81134	73430	90.50%
Option 2 DM	81566	76823	94.19%	81134	73838	91.01%
Option 2 DS	81566	79210	97.11%	81134	78630	96.91%

The previous table illustrates for Option 2 DS, as a proportion of the demand assigned, the number of trips that are completed during the AM model period, is improves in both peak periods when compared to the reference scenario.

This indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during both peak periods.

10.5 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2031 Reference Case and 2031 Option 2 DS scenario.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

10.5.1 AM Analysis (MQ007)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 2 DS scenario, during the AM peak period, reveals the following:

- There is one instance of an increase in queue lengths exceeding 50 vehicles on the network which occurs at the J12 SB off-slip. This increase is caused by the inclusion of signals which introduces delay on movements that would, otherwise be opposed. As the number of vehicles exiting the M40 increases, traffic travelling SB along the B4451 is held up to ensure that queuing does not propagate back onto the M40 mainline which, in turn, causes the apparent severe increase in queuing.
- There are large number of junctions where a queue length reduction is experienced around the southwest Warwick/Leamington area.

10.5.2 PM Analysis (MQ008)

Analysis of the difference in queuing between the 2031 Reference and 2031 RDA WTC scenario, during the PM peak period, reveals the following:

- There are no instances of queue lengths increases exceeding 50 vehicles on the network
- There are large number of junctions where a queue length reductions is experienced around the southwest Warwick/Leamington area.

10.5.3 Queue Analysis Summary

Analysis of the impacts on queuing indicates a few increases may occur in and around the area immediately adjacent to the proposed site whilst reductions in queuing levels are experienced in and around the areas to the southwest of Warwick/Leamington.

10.6 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the two key model scenarios; 2031 Reference Case and 2031 Option 2 DS. The comments in the remainder of this section are based on observations of the predicted changes journey times across key routes within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

10.6.1 AM Analysis (MD007)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 2 DS scenario, during the AM peak hour, reveals the following:

- Notably, there are improvements to journey times along the M40 and the A452
- There are two links which are expected to experience a greater than 50% increase in delay during the AM peak period compared to the reference scenario. This occurs along the B4100 (SEB) and B4451 (both directions).

10.6.2 PM Analysis (MD008)

Analysis of the difference in queuing between the 2031 Reference and 2031 Revised Allocation scenarios, during the PM period, reveals the following:

- There are a large number of links where a reduction in journey times is expected when compared to the reference scenario
- There are three areas which are expected to experience a greater than 50% increase in delay during the PM peak period compared to the reference scenario. This occurs along the B4100 (both directions) and Europa Way (NB).

10.6.3 Delay Analysis Summary

In general, the results appear to indicate that changes in delay levels, between scenarios are mostly positive with a relatively small number of areas suffering increases in delay levels. The main increases in journey times occur along the B4100 immediately adjacent to the proposed Option 2 site.

10.7 Conclusion

The initial comparisons between the 2031 Reference Case and the 2031 Option 2 Gaydon/Lighthorne Heath Development scenarios reveal the following conclusions:

- Inclusion of the additional demands associated with Option 2 will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve should not mitigation measures be introduced.
- Inclusion of the schemes associated with Option 2 DS results in an improvement to network conditions in both peak periods.
- Analysis of the trip completion ratio within the Reference Case and Option 2 DS indicates that, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak periods.
- Adoption of Option 2 DS and the associated mitigation measures has the potential to deliver improved conditions for road users in the form of reduced queuing and, improved journey times.
- Any impacts in queuing and journey times are most likely to occur in close proximity to the site whereas, currently, improvements are identified in the network around south west Warwick/Leamington. These improvements occur as a result of the inclusion of the additional mitigation measures within these areas. These mitigation measures are intended to overcome existing and forecast network constraints which

have the potential to occur irrespective of whether the site and associated demands are allocated or not.

11 Option 5: Southam North and Stonythorpe Development

11.1 Overview

The first stage of this assessment was to review the performance of the model network following the allocation of the revised demand levels and network optimisation. Option 5 involves two scenarios as follows:

- **2031 Option 5 DN**– Option 5 demands, no mitigation.
- **2031 Option 5 DS** – Option 5 demands with enhanced mitigation strategy.

11.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within section 5.1 of this report.

The apparent network stability exhibited within the AM and PM simulation runs across the four scenarios is illustrated within the following **Table 31**:

Table 31 - Model Stability Assessment 2031 Reference vs. 2031 Option 5 scenarios

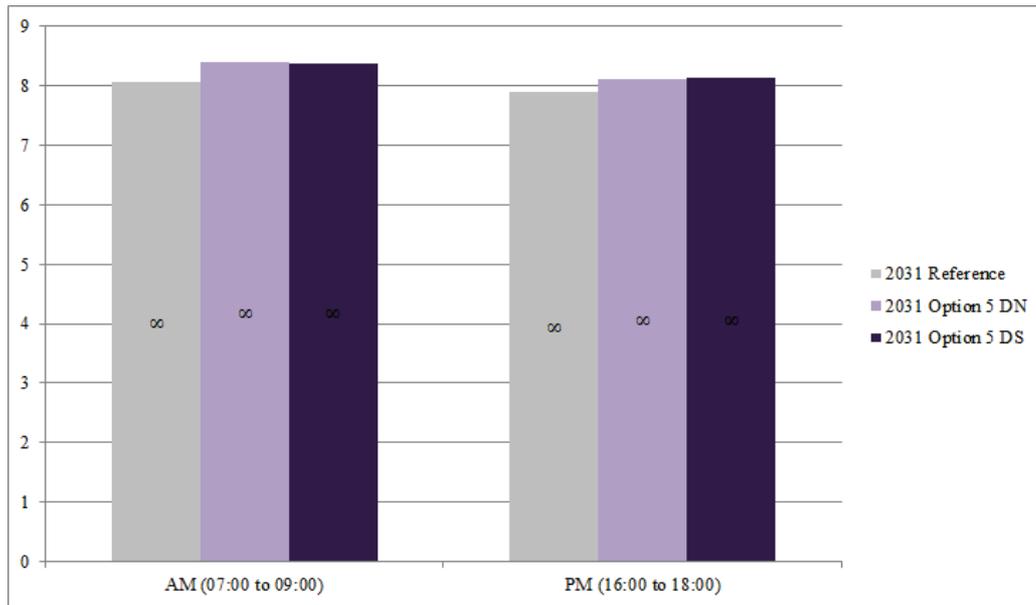
	Reference Case	Option 5 DN	Option 5 DS
AM	70%	70%	75%
PM	75%	75%	75%

Analysis of the previous Table reveals that the level of model stability is relatively constant across the scenarios during both peak periods

11.2.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within the **Figure 37**. Analysis of **Figure 37** indicates very little difference between the three scenarios.

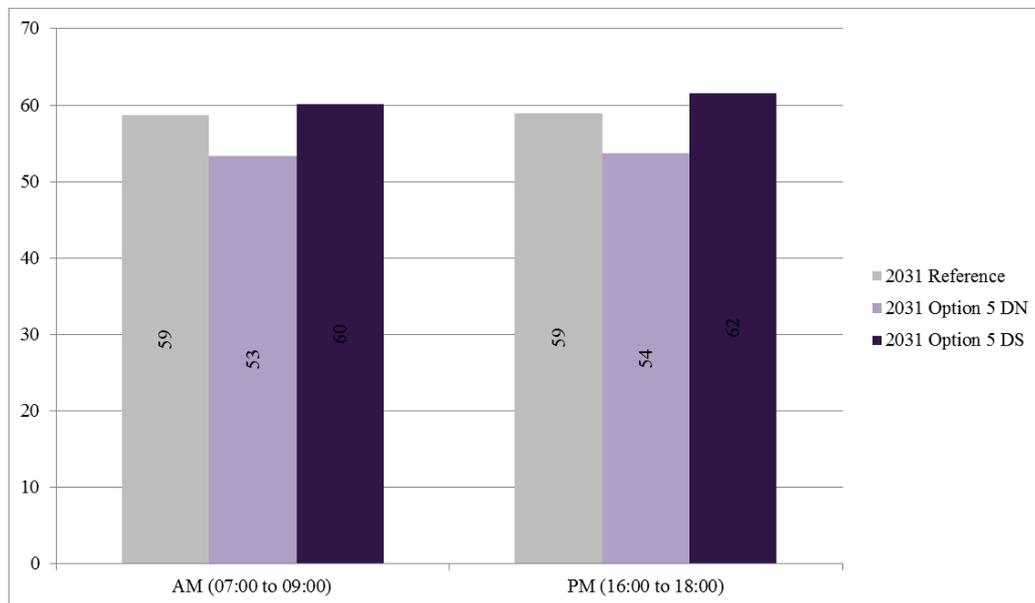
Figure 37 - Average Journey Distance (2031 Reference vs. 2031 Option 5 scenarios), Km



11.2.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within the following **Figure 38**

Figure 38 - Average Journey Speed (2031 Reference vs. 2031 Option 5 scenarios), Km/h



The previous figure demonstrates that allocation of the additional demands associated with Option 5 results in a drop in the average speed of vehicles, on the network, of approximately 9% during the AM and PM peak periods when no mitigation is assigned to the model network.

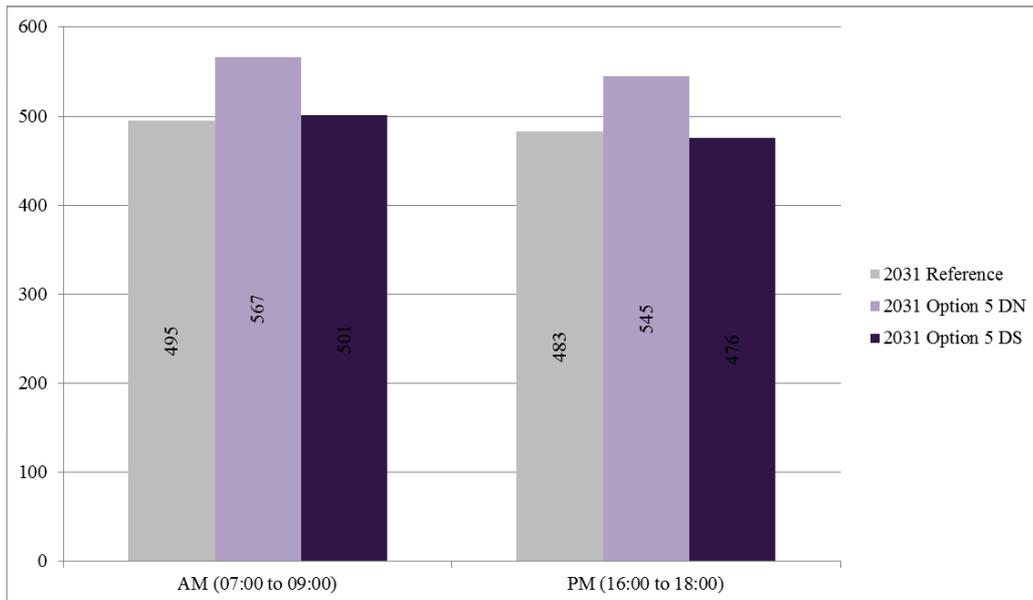
When the mitigation measures are introduced, the average speed increases by 2% and 4% in the AM and PM peak period respectively. This indicates that the

mitigation measures are able to accommodate the additional demand on the network.

11.2.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within the following **Figure 39**:

Figure 39 - Average Journey Time (2031 Reference vs. 2031 Option 5 scenarios), Seconds



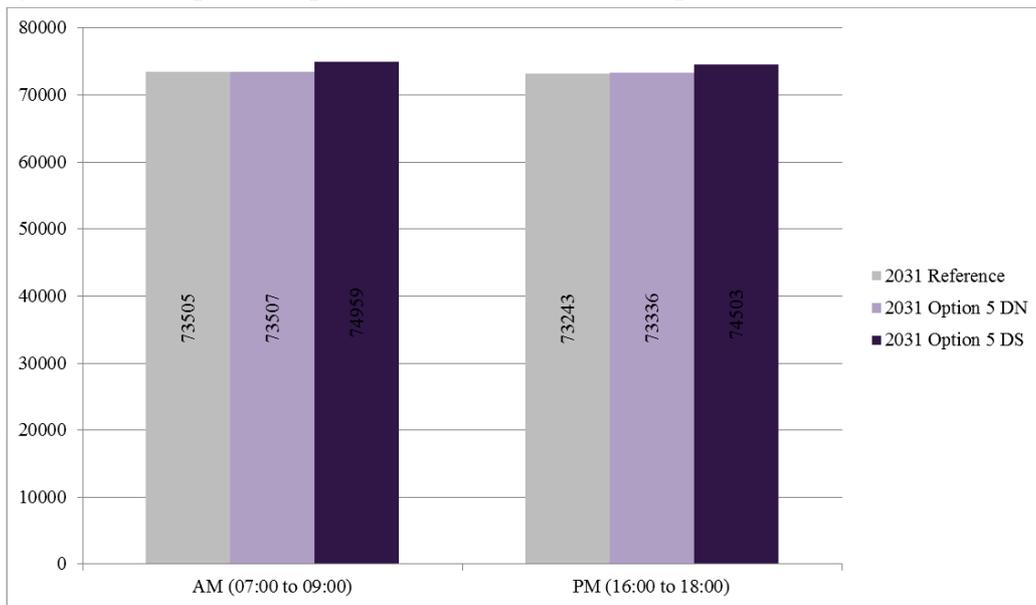
Analysis of **Figure 39** indicates that as a result of the additional demand on the network the average journey time increases by approximately 14% and 13% during the AM and PM peak periods respectively. Implementation of the mitigation measures results in a reduction of these impacts. Within the PM period this reduction is achieved to such an extent that journey times are quicker within the Option 5 DS scenario network than the Reference Case which indicates that the mitigation measures are likely to ensure that the additional demand levels can be accommodated within the modelled network with reduced impacts.

11.3 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 40** on the following page.

Analysis of **Figure 40** there is little effect on the number of trips completed between the Reference Case and Option 5 DN network. This is likely due to the additional journey time and delays expected for this scenario. Implementation of the proposed mitigation measures increases the number of trips that are completed within the model period. Compared to the reference scenario, an increase in the number of completed trips of approximately 2% in both the AM and PM periods is expected.

Figure 40 - Completed Trips (2031 Reference vs. 2031 Option 5 scenarios), Vehicles



To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following **Table 32**:

Table 32 - Completed Trips Analysis (2031 Reference vs. 2031 Option 5 scenarios)

	AM (06:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
2031 Reference	76606	72878	95.13%	76226	72361	94.93%
Option 5 DN	77728	72883	93.77%	77248	72529	93.89%
Option 5 DS	77728	74278	95.56%	77248	73947	95.73%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during both peak periods reduces for the do nothing scenario but increases above the level of the reference case once the mitigation measures are introduced.

This indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak periods.

11.4 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2031 Reference Case and 2031 Option 5 scenarios.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

11.4.1 AM Analysis (MQ009)

Analysis of the difference in queuing between the 2031 Reference and Option 5 Do Something scenario, during the AM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network
- There are a number of instances where a queue length reduction is expected in Heathcote (east of Warwick town centre)
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 30 vehicles.
- Four junctions assessed experience an increase in queuing levels of between 30 and 50 vehicles.

11.4.2 PM Analysis (MQ010)

Analysis of the difference in queuing between the 2031 Reference and Option 5 Do something, during the PM peak hour, reveals the following:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 30 vehicles

11.4.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2031 Reference Case and Option 5 Do something is provided as follows:

- There are no instances of increases in queue lengths exceeding 50 vehicles on the network in the AM and PM peak periods
- Four junctions experience increases of between 30 and 50 vehicles in the AM Peak Period.
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 30 vehicles

Detailed analysis of the queue reductions that have been presented within these plots has been undertaken to ascertain why the improvements appear to be triggered in the areas to the southwest of Warwick and Leamington without the inclusion of the focussed mitigation in this area. This analysis revealed that in almost all of the cases the margin of difference was between -9 and -5 which is unlikely to be identified through detailed analysis as being, statistically significant. Therefore it should be considered that the allocation of the Option 5 demands within the model network has little or no impact on these areas but it is unlikely to yield benefits as would be construed from analysis of the queue plots in isolation.

11.5 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the two key model scenarios; 2031 Reference Case and 2031 Option 5 Do Something scenario. The comments in the remainder of this section are based on observations of the predicted changes in peak hour mean speed across links within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

11.5.1 AM Analysis (MD009)

Analysis of the difference in queuing between the 2031 Reference and 2031 Option 5 Do Something scenario, during the AM period, reveals the following:

- Analysis of MD009 network conditions reveals that there are a large number of links where there is no significant change in journey times recorded between the two scenarios.
- There is one link which is expected to experience a greater than 50% increase in delay during the AM peak period compared to the reference scenario which is Chesterton Road (westbound). There are also impacts southbound along A423 Southam Bypass the B4451 at Deppers Bridge and at Bishop's Itchington and westbound along the A425 Leamington Road, Ufton Hill and Southam Road corridor. This indicates that the additional demands are likely to have cumulative impacts in these areas which increases delay and may benefit from further, more focussed, mitigation measures.
- There is an increase in delay along the A425 Banbury Road NB into Warwick which corresponds to an increase in queue lengths at the Banbury Road/Gallows Hill junction, most likely this could be overcome through further signal optimisation of the Banbury Road/Gallows Hill signalised junction.

11.5.2 PM Analysis (MD010)

Analysis of the difference in queuing between the 2031 Reference and Option 5 Do something scenarios, during the PM period, reveals the following:

- Analysis of MD012 network conditions reveals that again there are a large number of links where a reduction in the mean delay is expected when compared to the reference scenario
- There is one link which is expected to experience a greater than 50% increase in delay during the AM peak period compared to the reference scenario which is A425 Banbury Road (both directions)

11.5.3 Delay Analysis Summary

In general, the results appear to indicate that changes in delay levels, between scenarios are likely to be variable with some areas suffering increases in delay

levels whilst reductions may be achievable in other areas. It should be remembered that any reduction in delay is achieved in spite of the general increase in demand levels across the entire network.

The impact on the journey time routes identified through the analysis of the AM and PM conditions focusses on the peak hour impacts whilst the queuing analysis looks at the impacts across the model period as there are multiple peaks within the model which can be considered with this approach. Delay is extracted hourly and so not strictly comparable. Analysis of the impacts on peak hour journey times reveals that the impacts are incurred as a result of the constraint on the network which occurs as a result of the Myton Road/Banbury Road junction performance.

11.6 Conclusion

The initial comparisons between the 2031 Reference Case and the 2031 Option 5 Southam North and Stoneythorpe Development scenarios reveal the following conclusions:

- Inclusion of the Option 5 demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions.
- During the AM peak period, assuming the mitigation measures are implemented, the network conditions are expected to remain relatively constant compared to that which is achieved by the 2031 reference scenario. This occurs in spite of the additional demand on the network.
- During the PM peak period, assuming the mitigation measures are implemented, the network conditions are expected to improve slightly compared to that which is achieved by the 2031 reference scenario. This occurs in spite of the additional demand on the network.
- Analysis of the trip completion ratio within both Reference Case and Option 5 scenario indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak period
- The queuing analysis indicates that there are no instances of severe increases in queue lengths occurring across the network.
- The delay analysis indicates that within the AM there are issues Chesterton Road westbound, southbound along A423 Southam Bypass, southbound on the B4451 at Deppers Bridge and at Bishop's Itchington and westbound along the A425 Leamington Road, Ufton Hill and Southam Road corridor which correspond with routes that would be expected to accommodate additional development traffic.

12 Summary and Conclusions

12.1 Summary

12.1.1 Scope

Arup have been commissioned by Warwickshire County Council (WCC) and Stratford-on-Avon District Council (SDC) to undertake detailed testing of a number of potential Core Strategy (CS) allocations. This report builds upon the methodologies and analysis presented within previous Stratford-on-Avon Strategic Transport Assessment (STA) Reports.

12.1.2 Study Objectives

The objectives of this assessment are as follows:

- To undertake a detailed assessment of the likely impacts of five potential options for allocating housing and employment across the District area.
- To identify an outline mitigation strategy to accompany each of the proposed options for development and assess the mitigation levels thereof.

12.1.3 Methodology

Each of the options referred to above have been tested within a series of model scenarios and the outcome of these tests has been recorded and described within this report.

In order for the testing to be undertaken in a consistent manner each of the scenarios were assessed using either the Stratford-upon-Avon or M40 PARAMICS model. The principles behind these assessments are outlined as follows:

- Each option has been assessed using a consistent Reference Case
- Testing has been split into two core areas of focus:
 - Stratford focussed testing
 - M40 focussed testing
- The sites are considered to be of a sufficient distance apart to negate the need for testing of any option to be undertaken within both study area models.
- Where possible, each option has been assessed using the following method of scenario derivation:
 - Do Nothing – demand associated with the option have been assigned to the network but no additional mitigation has been incorporated.
 - Do Minimum – core mitigation measures have been incorporated based on a wider understanding of what is likely to be required to facilitate the delivery of the site
 - Do Something – refined mitigation measures have been proposed which are intended to build additional capacity into

the network and enable the demands associated with the sites to be better accommodated.

The results have been presented based on the relative site location rather than the order of Options. Therefore Option 1 Dispersed Development, Option 3 Long Marston Airfield and Option 4 South East Stratford, have all been assessed first whilst Option 2 Gaydon/Lighthorne Heath and Option 5 Southam North and Stoneymarston have been assessed within the M40 PARAMICS model.

12.1.4 Mitigation

Throughout this and previous stages of STA work, pertaining to the delivery of SDC CS allocations, a picture of the likely mitigation measures that may be required has been emerging. The assumptions regarding the mitigation measures included thus far have been summarised separately for Stratford-upon-Avon and the M40 corridor as follows:

12.1.5 Stratford Focussed Mitigation

Stratford Transport Package

Testing has assumed the delivery of the emergent Stratford Transport Package (STP) in all options. Work is on-going in determining the optimum proposals for each element within this package and so the measures that have been included have been based on the most recent proposals for each of the following schemes:

- Tiddington Road/Banbury Road 'Alveston Manor' Junction
- Bridgefoot/Bridgeway Stratford Gyratory
- Evesham Place/Evesham Road Roundabout
- Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road Roundabouts
- Birmingham Road between Regal Road and Justin's Avenue
- Birmingham Road/A46 'Bishopton Roundabout'
- Alcester Road/A46 'Wildmoor Roundabout'

Warwick Road Dynamic Signing

Some initial work has also been completed which assesses the potential level of additional capacity on the network that may be delivered by adopting a dynamic signage strategy for the two routes between Stratford-upon-Avon and the A46, via either Birmingham Road or Warwick Road. This would involve re-directing vehicles travelling towards Stratford via either of the two routes in response to the detection of adverse conditions on either of the routes. Testing such proposals at a detailed level would require an extensive amount of assessment work which is not in scale with the strategic level review of the on-going STA work. As a result a reflection of these proposals has been achieved by assigning the Warwick Road major route status within the modelling.

12.1.6 Constant Mitigation Measures

Both this and previous stages of the assessment have identified the STP and Warwick Road signage strategy as being mitigation measures with the potential to

unlock additional capacity within the Stratford-upon-Avon transport network. As a result these measures have been included within the majority of the assessments and, although still emerging, it is assumed that delivery of the majority of these measures is required to accommodate any option for the allocation of growth within the immediate area of the town of Stratford-upon-Avon.

12.1.7 Do Minimum Mitigation

The ‘Do Minimum’ mitigation refers to the delivery of major infrastructure proposals that have been identified as being essential to the delivery of some of the Options tested within the Stratford-upon-Avon model. They are considered as the minimum infrastructure requirements, in addition to those outlined previously, required to facilitate the delivery of the relevant allocation in full.

The ‘Do Minimum’ measures that have been adopted within the assessment are as follows:

Option 3 Long Marston Airfield – Western Relief Road - The Do Minimum proposals within the Option 3 Long Marston Airfield (LMA) comprise delivery of a Western Relief Road. This link is intended to connect the A3400 Shipston Road (south of Stratford-upon-Avon) with the B439 Evesham Road. It is anticipated that delivery of a new link road in this location would better link the areas to the Southwest, including the area of the LMA site, with the A46.

Option 4 South East of Stratford – Eastern Relief Road - The Do Minimum proposals within the Option 4 South East Stratford comprise delivery of an Eastern Relief Road. This link is intended to connect the A422 Banbury Road to the A439 Warwick Road via Tiddington Road and a new bridge across the River Avon. Delivery of a new link road in this area would undoubtedly relieve some of the issues which occur as a result of the constraints in the south east area of Stratford.

Both of the proposed interventions are considered to be significant infrastructure requirements and are also considered as to be essential measures required to accompany the full allocation of either Option 3 Long Marston Airfield or Option 4 South East Stratford.

12.1.8 Do Something Mitigation Measures

Some additional mitigation measures have been included within the Stratford-upon-Avon model network, in addition to those outlined previously; including proposals for interventions at the following locations:

- Shakespeare Street/Mulberry Street
- A46/A439 Marraway Roundabout
- A439/A3400 Junction
- WRR/Evesham Road
- A46/WRR Wildmoor Roundabout

12.1.9 Stratford Mitigation Summary

A summary of the options in which the aforementioned mitigation measures have been assigned is provided within **Table 33**.

Table 33 Stratford Mitigation Assignment

Mitigation	Option 1	Option 3	Option 4
STP	✓	✓	✓
Warwick Road signing	✓	✓	✓
Eastern Relief Road			✓
Western Relief Road		✓	
Shakespeare Street/Mulberry Street	✓	✓	✓
A46/A439 Marroway Roundabout	✓	✓	✓
A439/A3400 Junction		✓	
WRR/Evesham Road		✓	
A46/WRR Wildmoor Roundabout		✓	

12.1.10 M40 Focussed Mitigation Measures

The following sets out the mitigation proposals included within the modelling assessment that has been undertaken. The mitigation has been presented based on the option in which it has been included:

Option 2 Gaydon/Lighthorne Heath Mitigation Measures

The following mitigations have been included within the analysis of the impacts associated with the delivery of Option 2:

- M40 NB on-slip
- B4100 Widening
- M40 Capacity Enhancements
- M40 J13 NB Off-slip
- Fosse Way/Harbury Lane
- Fosse Way/Southam Road Roundabout
- A452/B4100 'Grey's Mallory' Roundabout

It is envisaged that the proposals concerning Grey's Mallory would either be delivered as a stand-alone intervention or could be delivered alongside existing proposals for the area which have been identified through the WDC Local Plan testing process.

Similarly, the assessment of Option 2 Gaydon/Lighthorne Heath also involved the inclusion of a series of transport interventions which have also been identified through the assessment of WDC CS allocations. Furthermore, some of these have also been identified within the Strategic Economic Plan (SEP) for the regions and it is therefore anticipated that funding for these schemes would be secured through a number of different sources rather than being specifically 'developer funded' schemes. These schemes are outlined as follows:

- A452 Corridor
- Europa Way/Harbury Lane Roundabout
- Banbury Road/Myton Road/Gallows Hill

Option 5 Southam North and Stoneythorpe Mitigation Measures

Mitigation measures associated with Option 5 Southam North and Stoneythorpe have been proposed for the following locations:

- A423 / Daventry Road
- A423 / A425
- A425 / B4451
- A425 (Southam Road) / B4455
- A425 (Radford Road) / Willes Road

The assessment of impacts associated with Option 5 Southam and Stoneythorpe has been confined based on the coverage of the M40 model. Since around 25% of the total demands generated by the site are envisaged to travel northwards and, thus, do not enter into the model area, it is envisaged that further mitigation measures would be required along the A426 and A423, neither of these routes, north of Southam, have been considered within this current phase of assessment.

12.2 Conclusions

The implication of each option has been assessed within the relevant modelling environment. These assessments have been completed in a manner which is consistent with previous stages of STA work. The conclusions that have been drawn from each of these individual assessments have been summarised as follows:

Option 1 Dispersed Development Conclusions

The initial comparisons between the 2031 Reference Case and the 2031 Option 1 Dispersed Development scenario reveal the following conclusions:

- Inclusion of the Option 1 development sites will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy
- Adoption of the additional mitigation measures is not expected to lead to a significant improvement in network conditions beyond that expected should the major mitigation measures be implemented.
- Analysis of the trip completion ratios and network conditions within the Reference Case and Dispersed Development scenarios indicates that, in general, the major mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM period.
- Analysis of the impacts on queuing levels indicates that the PM network is likely to suffer from the greatest level of impact in spite of the inclusion of the proposed mitigation measures.
- Analysis of the impacts on journey times indicates that some improvements are deliverable but there are also some impacts likely to occur. The impacts appear to be largely focussed in and around the area of the gyratory where there is limited scope for further mitigation measures to be included within the network.

Option 3 Long Marston Airfield Conclusions

The initial comparisons between the 2031 Reference Case and the 2031 Option 3 Long Marston Airfield Development scenarios reveal the following conclusions:

- Inclusion of the LM development demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- Analysis of the trip completion ratio within both Reference Case and LM scenarios indicates that, in general, the mitigation measures associated with Option 3 DS + WRM are able to accommodate the additional demand levels assigned during both peak periods.
- The queuing analysis does not indicate any areas where a severe increase in queuing levels has been identified whilst, furthermore, a considerable number of reductions in queue lengths is achieved within the town centre during the PM period as a result of the additional mitigation measures.
- Increases in delay are likely to occur on routes which are peripheral to Stratford town centre, in particular routes into the town from the south west and the A46/A439 Warwick Road routes are affected which indicates further mitigation measures within these areas is likely to be desirable.

Option 4 South East Stratford Conclusions

The initial comparisons between the 2031 Reference Case and the 2031 Option 4 South East Stratford Development scenarios reveal the following conclusions:

- The analysis of the Do Nothing scenario outputs reveals that the network is unlikely to be able to accommodate the proposed demands without the inclusion of the ERR; this is in spite of the presence of the STP proposals.
- Analysis of the trip completion rates indicates that the 2031 Option 4 DS + WRM network is able to accommodate a greater level of trips than the Reference Case.
- Overall, within the 2031 Option 4 DS + WRM scenario network the conditions are observed to improve in so far as journey speeds are likely to increase and delays reduce as a result of the inclusion of the allocated demands as well as the associated mitigation measures.
- Analysis of both queuing and delay outputs appears to indicate that there are a large number of instances where improvements are likely to occur as a result of the inclusion of the scheme proposals and associated mitigation measures.

Option 2 Gaydon/Lighthorne Heath Conclusions

The initial comparisons between the 2031 Reference Case and the 2031 Option 2 Gaydon/Lighthorne Heath Development scenarios reveal the following conclusions:

- Inclusion of the additional demands associated with Option 2 will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve should not mitigation measures be introduced.
- Inclusion of the schemes associated with Option 2 DS results in an improvement to network conditions in both peak periods.
- Analysis of the trip completion ratio within the Reference Case and Option 2 DS indicates that, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak periods.
- Adoption of Option 2 DS and the associated mitigation measures has the potential to deliver improved conditions for road users in the form of reduced queuing and, improved journey times.
- Any impacts in queuing and journey times are most likely to occur in close proximity to the site whereas, currently, improvements are identified in the network around south west Warwick/Leamington. These improvements occur as a result of the inclusion of the additional mitigation measures within these areas. These mitigation measures are intended to overcome existing and forecast network constraints which have the potential to occur irrespective of whether the site and associated demands are allocated or not.

Option 5 Southam North and Stoneythorpe Conclusions

The initial comparisons between the 2031 Reference Case and the 2031 Option 5 Southam North and Stoneythorpe development scenarios reveal the following conclusions:

- Inclusion of the Option 5 demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2031 Reference Case conditions.
- During the AM peak period, assuming the mitigation measures are implemented, the network conditions are expected to remain relatively constant compared to that which is achieved by the 2031 reference scenario. This occurs in spite of the additional demand on the network.
- During the PM peak period, assuming the mitigation measures are implemented, the network conditions are expected to improve slightly compared to that which is achieved by the 2031 reference scenario. This occurs in spite of the additional demand on the network.
- Analysis of the trip completion ratio within both Reference Case and Option 5 scenario indicates that, in general, the mitigation measures are able to accommodate the additional demand levels assigned during the AM and PM peak period
- The queuing analysis indicates that there are no instances of severe increases in queue lengths occurring across the network.
- The delay analysis indicates that within the AM there are issues along Chesterton Road westbound, southbound along A423 Southam Bypass, southbound on the B4451 at Deppers Bridge and at Bishop's Itchington and westbound along the A425 Leamington Road, Ufton Hill and Southam Road corridor which correspond with routes that would be expected to accommodate additional development traffic.

12.2.1 Summary of Key Conclusions

Based on the outline conclusions of each individual assessment, coupled with a review of the impacts identified within each option, the following conclusions have been drawn:

- Based on the outputs from the assessment thus far, there are no issues that have been identified that would be considered to be of sufficient magnitude to render an option undeliverable.
- Failures to deliver either the WRR or ERR proposals are likely to preclude the delivery of the full allocation of either Option 3 Long Marston Airfield or Option 4 South East Stratford sites.
- The impacts identified within the assessment of Option 1 Dispersed Development are of a similar magnitude to the impacts identified within the assessment of Option 3 Long Marston Airfield and Option 4 South East Stratford. It should be noted that there are substantially lower levels of housing tested within Option 1 around the area of Stratford-upon-Avon town, but a similar magnitude of impact identified. Arguably the quantum of development proposed through Option 1 Dispersed Development would not be of a sufficient magnitude to ensure that mitigation on a scale to the WRR and ERR could be include alongside the proposed developments.
- Comparatively, of the three Stratford focussed assessment scenarios Option 4 South East Stratford incurs a lower level of impact than Option 3 Long Marston Airfield, albeit the assumptions within Option 4 South East Stratford also contain 750 fewer houses and 5 Ha lower employment allocation, thus there are inherently lower demand levels within the Option 4 assessments than Option 3.
- When considering the outcomes from the M40 focussed assessment Option 2 Gaydon /Lighthorne Heath has the potential to deliver improvements in some areas of the study area but this is predicated on the delivery of mitigation measures along the A452 corridor which is linked to existing WDC CS proposals and has also been identified within the Coventry and Warwickshire Strategic Economic Plan (SEP).
- The initial assessments of both Option 2 Gaydon/Lighthorne Heath and Option 5 Southam and Stoneythorpe reveals that both Options can be accommodated, alongside the proposed mitigation measures but that residual impacts are still likely to occur as a result of both options which may require further mitigation (i.e. in close proximity to the Gaydon/Lighthorne Heath site in Option 2 and along the A423 Southam Bypass and B4451 within Option 5).

13 Further Considerations and Recommendations

Whilst the assessment undertaken thus far has been based on the most recently available assumptions, pertaining to each of the sites, consideration should be given to updating these at an appropriate stage following the identification of the CS Option for allocation. Elements that could be considered for review include, but are not limited to:

- The appropriateness of the development trip generation and distribution assumptions.
- Where applicable, the profiling and release of traffic generation within the modelling, particularly concerning the assessment of the employment element of the Option 2 Gaydon/Lighthorne Heath proposals.
- The assumptions pertaining to mode share and internalisation and, further refinement based on the adopted site proposals.
- The potential impacts of development trip types not included within the strategic level assessment (i.e. Education, Leisure, etc.).

There are a number of additional elements that should be considered during any future stages of the assessment but it is acknowledged that not all of these issues may be addressed prior to the site allocation and, furthermore, it may not be possible to address certain issues until the allocated site is being promoted through the planning process.

Considerations include:

- The impacts on areas not included within the modelling;
- The feasibility and deliverability of the scheme proposals identified within the work thus far, including a review against Highway requirements and current design and safety standards since, currently, scheme proposals are based wholly on model outputs.
- Specific risks pertaining to the delivery of one or more scheme on the network such as:
 - The physical risks to delivering the M40 capacity enhancements in the area required and the viability of the costs thereof;
 - The feasibility of the proposed network reconfiguration within Stratford-upon-Avon town.
 - The costs and feasibility of delivering either the ERR or the WRR proposals.

Appendix A

SDC STA Queue Analysis Plots

A1 Contents

- **MQ001** – 2031 Option 1 DS AM (07:00 to 10:00)
- **MQ002** – 2031 Option 1 DS PM (16:00 to 19:00)
- **MQ003** – 2031 Option 3 DS AM (07:00 to 10:00)
- **MQ004** – 2031 Option 3 DS PM (16:00 to 19:00)
- **MQ005** – 2031 Option 4 DS AM (07:00 to 10:00)
- **MQ006** - 2031 Option 4 DS PM (16:00 to 19:00)
- **MQ007** – 2031 Option 2 DS AM (07:00 to 10:00)
- **MQ008** – 2031 Option 2 DS PM (16:00 to 19:00)
- **MQ009** – 2031 Option 5 DS AM (07:00 to 10:00)
- **MQ010** – 2031 Option 5 DS PM (16:00 to 19:00)

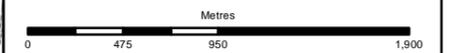


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Job Title
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**2031 Option 1 DS + WRM
 AM Peak Period
 Average Maximum Queue**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
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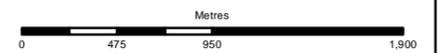


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**2031 Option 1 DS + WRM
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Scale at A3
N.T.S.

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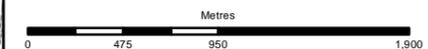


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**2031 Option 3 DS + WRM
AM Peak Period
Average Maximum Queue**

Scale at A3
N.T.S.

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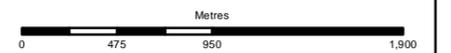


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**2031 Option 3 DS + WRM
PM Peak Period
Average Maximum Queue**

Scale at A3
N.T.S.

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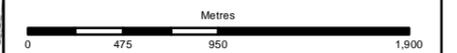


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**2031 Option 4 DS + WRM
 AM Peak Period
 Average Maximum Queue**

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N.T.S.

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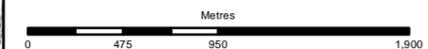


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**2031 Option 4 DS + WRM
PM Peak Period
Average Maximum Queue**

Scale at A3
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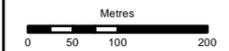
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**2031 Option 2 DS
 AM Peak Period
 Average Maximum Queue**

Scale at A3
N.T.S

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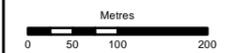


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**2031 Option 2 DS
 PM Peak Period
 Average Maximum Queue**

Scale at A3
N.T.S

Job No
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Final

Drawing No
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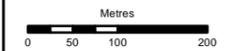


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**2031 Option 5 DS
 AM Peak Period
 Average Maximum Queue**

Scale at A3
N.T.S

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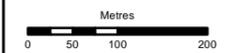


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**2031 Option 5 DS
 PM Peak Period
 Average Maximum Queue**

Scale at A3

N.T.S

Job No 232815-55	Drawing Status Final
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Drawing No MQ 010	Issue P1
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Appendix B

STD STA Journey Time Analysis Plots

B1 Contents

- **MD001** – 2031 Option 1 DS AM (07:00 to 10:00)
- **MD002** – 2031 Option 1 DS PM (16:00 to 19:00)
- **MD003** – 2031 Option 3 DS AM (07:00 to 10:00)
- **MD004** – 2031 Option 3 DS PM (16:00 to 19:00)
- **MD005** – 2031 Option 4 DS AM (07:00 to 10:00)
- **MD006** - 2031 Option 4 DS PM (16:00 to 19:00)
- **MD007** – 2031 Option 2 DS AM (07:00 to 10:00)
- **MD008** – 2031 Option 2 DS PM (16:00 to 19:00)
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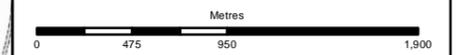


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Job Title
SDC Alternative Options Testing

**2028 Option 1 DS + WRM
 AM Peak Hour 0800-0900
 Percentage Difference Mean Delay**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
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Drawing No MD 001	Issue P1
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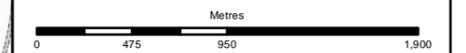


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Job Title
SDC Alternative Options Testing

**2028 Option 1 DS + WRM
 PM Peak Hour 1700-1800
 Percentage Difference Mean Delay**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
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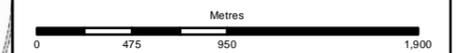


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Client
Warwickshire County Council

Job Title
SDC Alternative Options Testing

**2028 Option 3 DS + WRM
 AM Peak Hour 0800-0900
 Percentage Difference Mean Delay**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
Drawing No MD 003	Issue P1

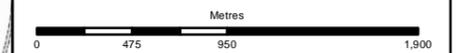


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P1	21-02-14	ZW	JE	JE
Issue	Date	By	Chkd	Appd



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Client
Warwickshire County Council

Job Title
SDC Alternative Options Testing

**2028 Option 3 DS + WRM
 PM Peak Hour 1700-1800
 Percentage Difference Mean Delay**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
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Drawing No MD 004	Issue P1
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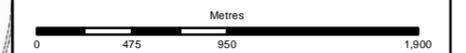


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Issue	Date	By	Chkd	Appd



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Job Title
SDC Alternative Options Testing

**2028 Option 4 DS + WRM
 AM Peak Hour 0800-0900
 Percentage Difference Mean Delay**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
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Drawing No MD 005	Issue P1
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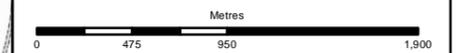


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Issue	Date	By	Chkd	Appd



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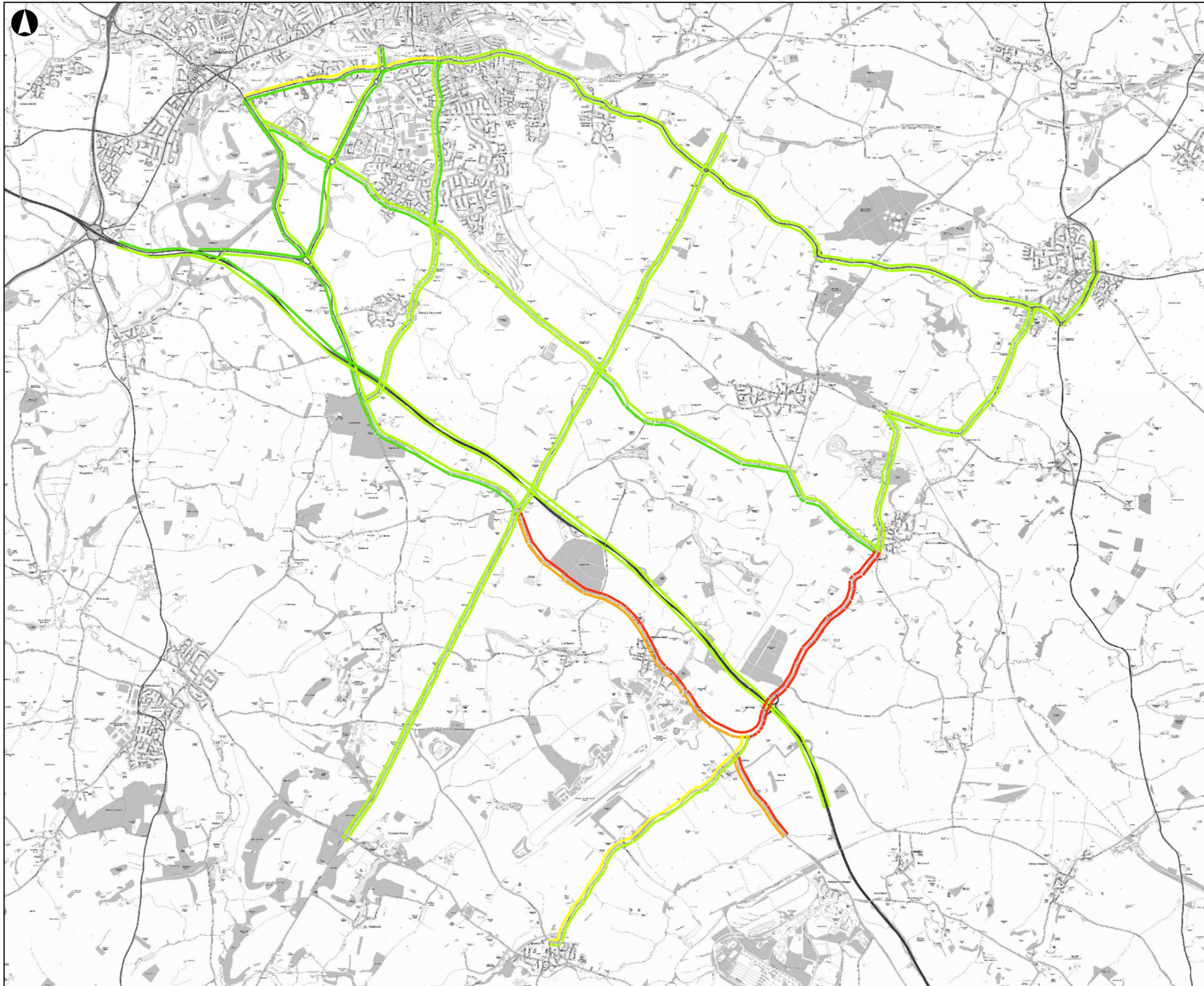
Job Title
SDC Alternative Options Testing

**2028 Option 4 DS + WRM
 PM Peak Hour 1700-1800
 Percentage Difference Mean Delay**

Scale at A3
N.T.S.

Job No 232815-55	Drawing Status Information
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Drawing No MD 006	Issue P1
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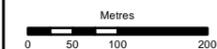
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P1	26-03-14	ZW	JE	JE
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Issue	Date	By	Chkd	Appd



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Job Title

SDC Alternative Options Testing

**2031 Option 2 DS
 AM Peak Hour 0800-0900
 Percentage Difference Mean Delay**

Scale at A3

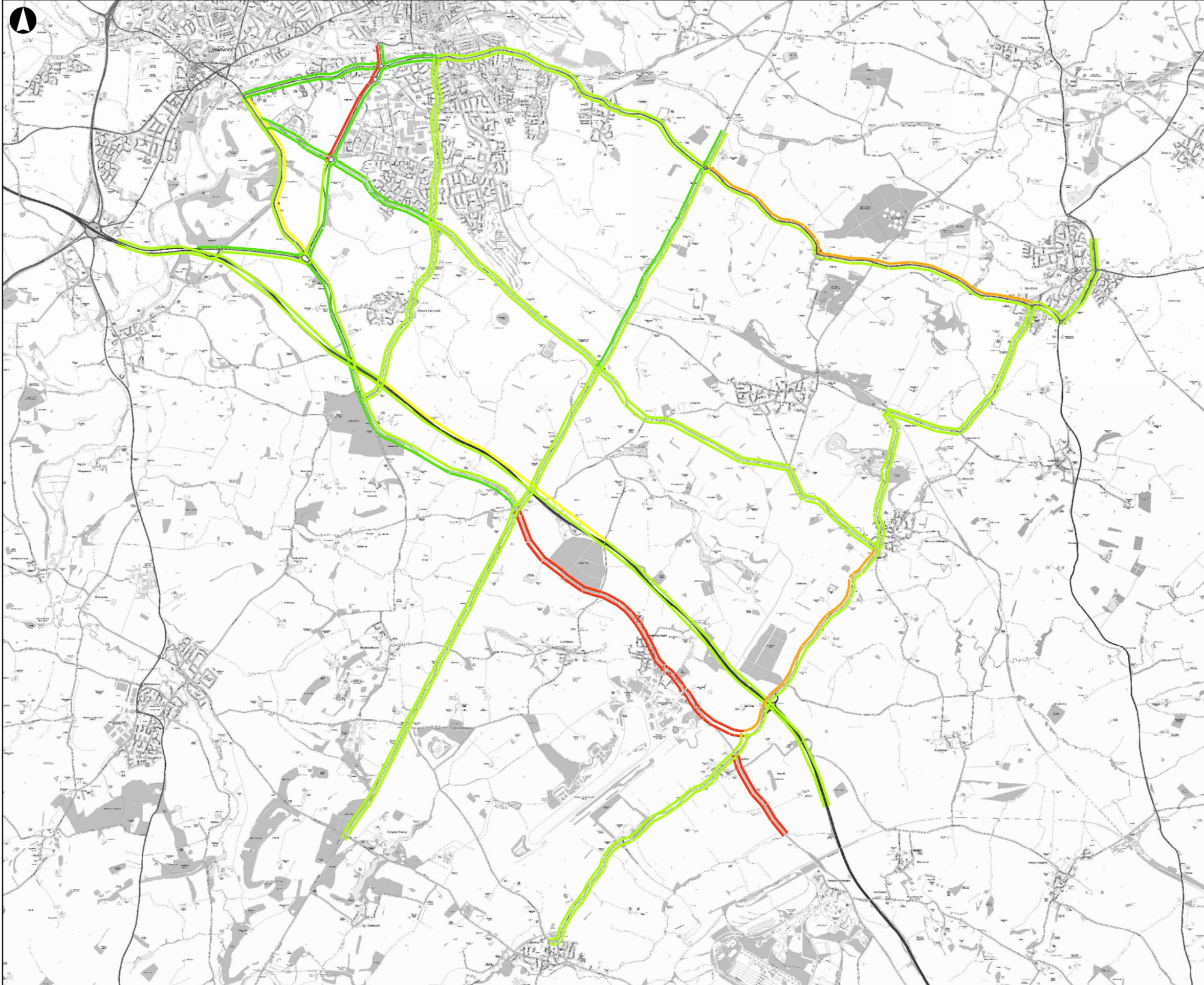
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Job No
232815-55

Drawing Status
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Drawing No
MD 007

Issue
P1



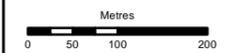
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Issue	Date	By	Chkd	Appd



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Job Title
SDC Alternative Options Testing

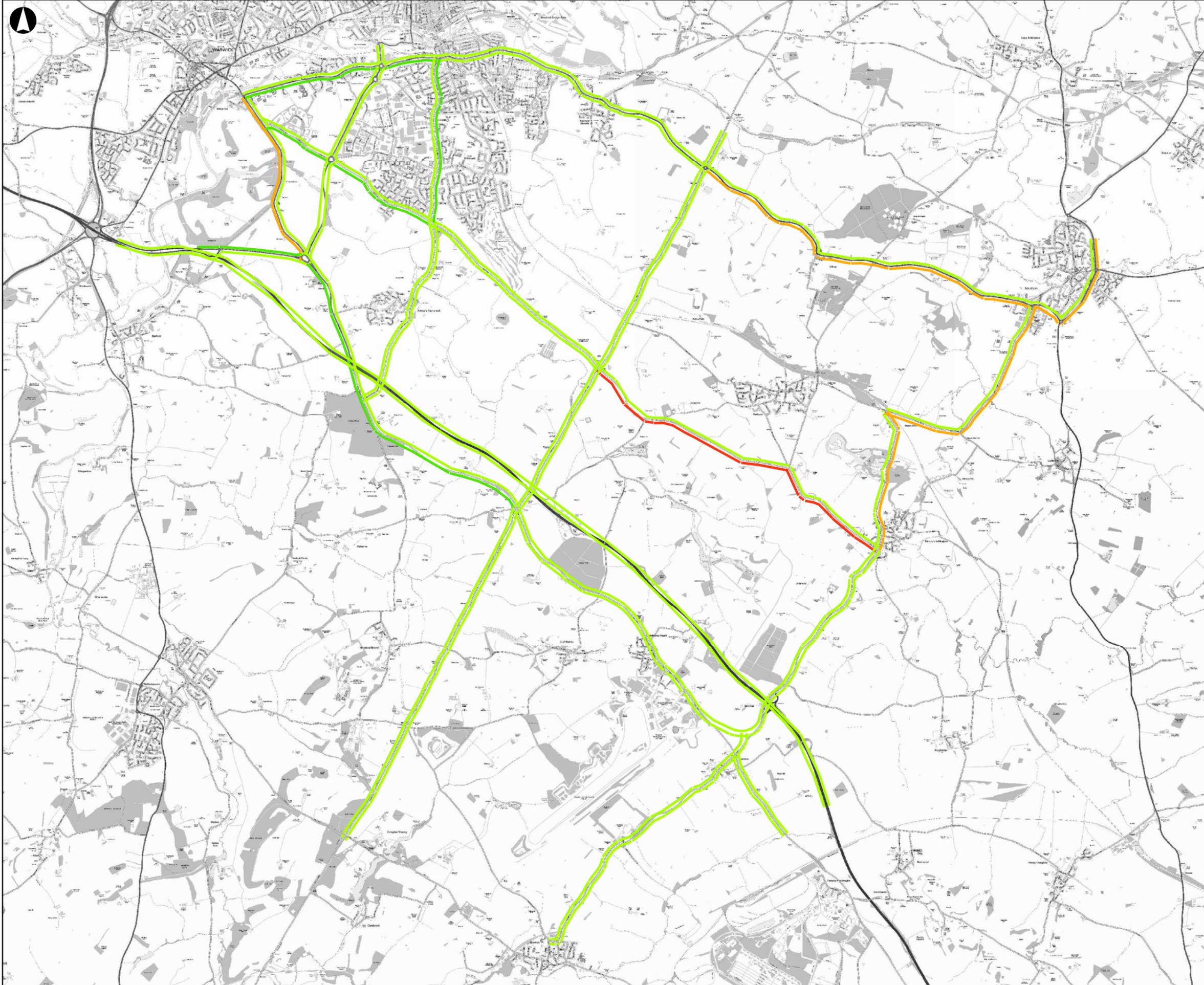
**2031 Option 2 DS
 PM Peak Hour 1700-1800
 Percentage Difference Mean Delay**

Scale at A3

N.T.S

Job No 232815-55	Drawing Status Information
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Drawing No MD 008	Issue P1
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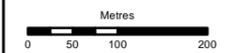


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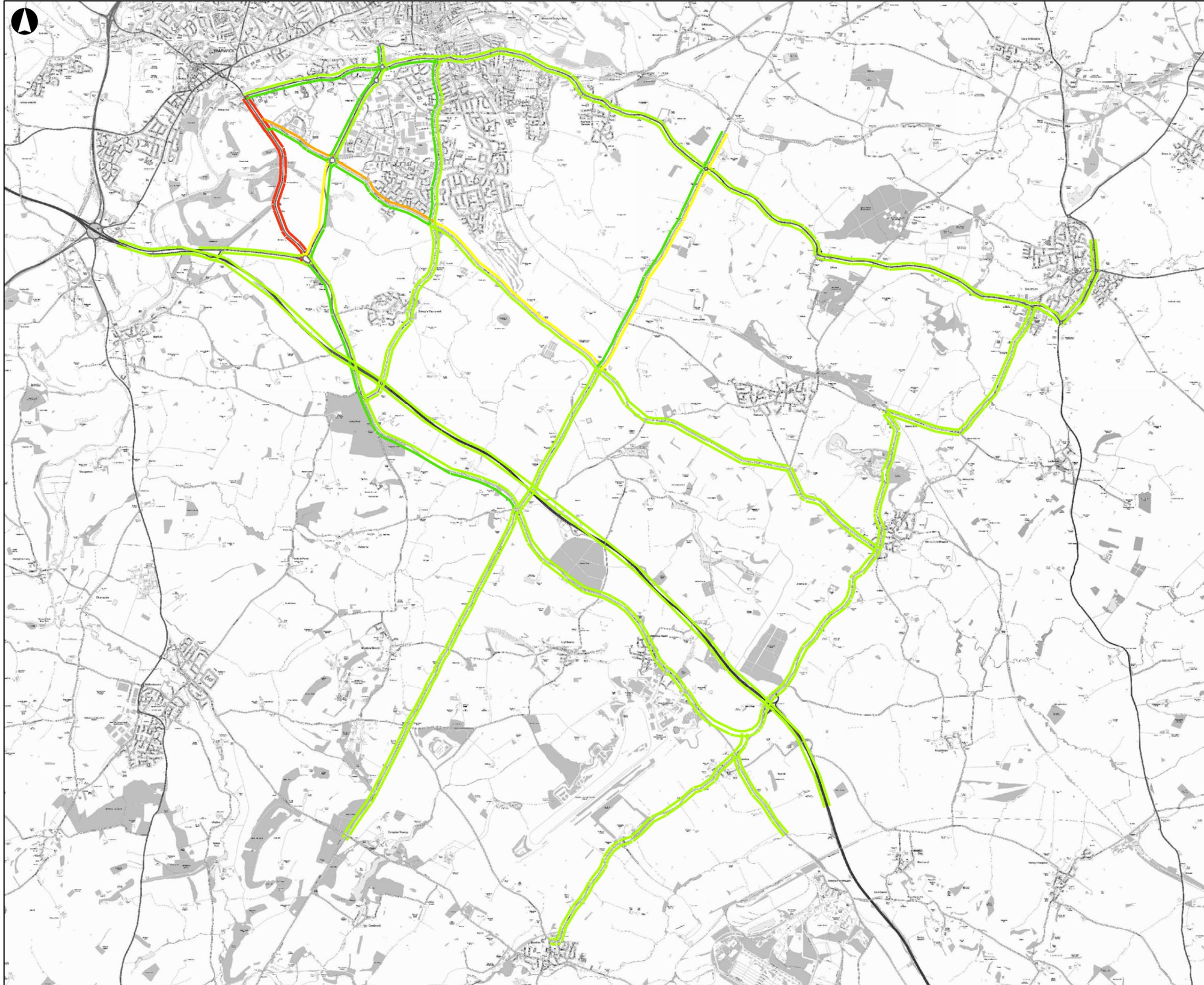
Job Title
SDC Alternative Options Testing

**2031 Option 5 DS
 AM Peak Hour 0800-0900
 Percentage Difference Mean Delay**

Scale at A3

N.T.S

Job No 232815-55	Drawing Status Information
Drawing No MD 009	Issue P1



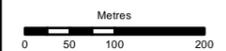
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P1	26-03-14	ZW	JE	JE
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Issue	Date	By	Chkd	Appd



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Job Title
SDC Alternative Options Testing

**2031 Option 5 DS
 PM Peak Hour 1700-1800
 Percentage Difference Mean Delay**

Scale at A3
N.T.S

Job No 232815-55	Drawing Status Information
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Drawing No MD 010	Issue P1
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