Warwickshire County Council
Rugby Borough Council

Rugby Borough Local Plan

Strategic Transport Assessment
Modelling Analysis and Overview

September 2016

Cornwall Buildings, 45 Newhall Street, Birmingham B3 3QR www.vectos.co.uk
Registered address: Vectos Microsim Limited, 82 St John Street, London EC1M 4JN Company no. 9322829

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Primary Author	James Edwards
Contributor	Nick Dauncey (WCC)
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1 EXECUTIVE SUMMARY

Overview

1.1 Vectos Microsim (VM) has been assisting Rugby Borough Council (RBC) and Warwickshire County Council (WCC) in the assessment of options pertaining to the delivery of the Rugby Borough Local Plan through the use of the Rugby Wide Area (RWA) S-Paramics micro-simulation model.

1.2 This Strategic Transport Assessment (STA) report has been produced to document the methods adopted for the various stages of the assessment as well as the providing analysis of the outputs extracted therefrom.

Objectives

1.3 The modelling assessment work has been underway since early 2015 and the primary objectives of the work are summarised as follows:

- To assess the likely impacts, on the highway network, of the various emerging strategies concerning the delivery of housing and employment through the Rugby Borough Local Plan.
- To identify what, if any, interventions may be deliverable which will minimise the residual impacts likely to occur as a result of the Local Plan proposals.
- To assess the impacts of the allocation strategy identified by RBC for adoption and to determine an initial set of highway mitigation measures to inform the infrastructure requirements associated with the Local Plan.

Methodology

1.4 The assessment has been completed via three key stages:

- **Stage 1** – Assessed the likely impacts for allocating all development identified within the SHLAA across the entire Rugby Area which, including committed and already adopted developments.

- **Stage 2** – Assessed the implications of delivering development across three broad areas (North, Southeast and Southwest) each of which comprised a reduced number of dwellings in comparison to the number tested in stage 1.
- **Stage 3** – Reviewed, in more detail, the implications of delivering the development strategy identified as the Preferred Option which focussed significant development in the Southwest. Stage 3 also looked at the inclusion of an additional site (Lodge Farm) as well as potential trigger points for the delivery of the Southwest Link Road inclusive of an assessment of the design speeds thereof.

1.5 At each stage the TEMPRO factors have been adjusted to ensure that, proportionally, the growth in traffic volumes reflected within the modelling takes account of the housing numbers being assessed within each test scenario.

1.6 The methodology for the derivation of growth forecast was applied to the Reference Case and each of the growth scenarios tested during each stage of the assessment.

Mitigation Assumptions

1.7 Through the appraisal of each stage, mitigation measures were identified and assigned based on the distribution of development. It was also possible to grade the schemes based on the following criteria:

- Essential – Scheme delivery is considered to serve a role of strategic significance in accommodating the growth strategy and is essential to minimise development impacts.
- Recommended – A scheme considered likely to deliver local and strategic benefits but more work is required to determine precise composition and/or delivery requirements.
- Considered – A scheme likely to deliver benefits which may be necessary to mitigate specific development impacts but not necessarily considered to be strategically significant.

1.8 At this stage it should be recognised that the majority of schemes represent an initial set of concept proposals and have been identified through a review of the model operation. It is

envisaged that the scheme proposals would be subject to further refinement and optioneering throughout the Local Plan delivery period.

1.9 The criteria assigned to each scheme based on each option under consideration, alongside the schemes themselves, has been listed within **Table 1**.

Table 1: Option Mitigation Strategy

Scheme	North	Southwest	Southeast
Dunchurch Signposting		Essential	
Ashlawn Road signposting			Essential
Hillmorton Road Ped crossing	Recommended	Recommended	Recommended
Leisure Centre Access	Recommended	Recommended	Recommended
Potford Dam roundabout		Essential	
B4429/Onley Lane/Barby Road widening			Essential
Barby Lane/Ashlawn Road Roundabout			Essential
M6 to Coton House	Essential		
M6 J1	Essential	Recommended	Recommended
Rugby Gyratory	Essential	Essential	Essential
Clifton Road/Lower Hill Morton	Recommended	Recommended	Recommended
Whitehall Road Pedestrian crossing	Recommended	Recommended	Recommended
Butlers Leap/Clifton Road	Recommended	Considered	Considered
A426/Brownsover roundabout	Essential	Considered	Considered
A5/A428 'Half-way house' roundabout			Essential
Dunchurch Road/Sainsbury's Roundabout		Essential	
South-western link		Essential	
South-eastern link			Essential
Full signalisation of M6 J1	Essential	Recommended	Recommended
Full signalisation of M45/A45		Recommended	
A426/Central Park Drive	Essential	Recommended	Recommended
A426/Newton Manor Lane	Essential	Recommended	Recommended
Cawston Grange Drive/A4071		Essential	

1.10 The southwest mitigation strategy was adopted as the core mitigation strategy to support the Local Plan, although further work is still required to establish the form of the proposals on the A426 corridor in more detail, the principles of the proposals are unlikely to change significantly through further detailed assessment work.

Assessment Findings

1.11 The findings from each stage of the assessment are summarised as follows:

Stage 1 - Summary of Findings

1.12 Critically, the first stage of the assessment found that, in spite of the additional mitigation, there are a number of areas which appear to suffer from congestion and delays as a result of the inclusion of the housing numbers identified, these include:

- The Gyratory
- The A426 between Avon Mill and the M6
- Clifton Road and specifically the junction with Butlers Leap to the north and Whitehall Road to the south.

Stage 1 – Conclusions

1.13 Based on the analysis completed through Stage 1, the following conclusions were identified.

- To deliver the level of housing identified to the south of Rugby, provision of the southern distributor link (a link which connects between the A45/M45 to the southwest and the A5/A428 to the southeast) should be considered as critical and, furthermore, if housing is to be delivered to the southwest and southeast then the link must be provided in full.
- In spite of the mitigation proposed, there are still likely to be a number of residual impacts which occur on the network. Some of these impacts, such as the congestion levels around the Gyratory, along Clifton Road and along the A426 between Avon Mill and the M6 are likely to be considered severe.
- The performance of the Gyratory potentially represents one of the biggest constraints to growth on the network. Options for highway interventions in this area are limited and consideration should be given to options which either divert traffic away from this junction or reduce the number of car based trips to the Town Centre, from the new sites, altogether.

1.14 The analysis indicated that the level of housing that tested in stage 1 is likely to generate traffic levels which reach, and in some cases exceed, the network capacity even after mitigation measures have been assigned.

1.15 Based on the findings from the first stage of analysis, it was determined that the next stage of the assessment should focus specifically on the impacts of allocating less development than was identified in Stage 1, retaining the strategy of allocating development across the three broad locations identified previously albeit with a focus on each specific area rather than all areas.

Stage 2 – Summary of Findings

1.16 The assessment work completed through Stage 2 indicated that the Southwest allocation option returns the lowest levels of delay across both the AM and PM periods yet delivers over 1000 more houses than those assessed within the North allocation test.

1.17 All model scenarios have comparable stability levels but the Southwest option provides the greatest level of stability of any of the strategic options tested.

1.18 Both Southwest and Southeast options include the delivery of part of the distributor link whereas the North option does not include any additional link road which indicates that the northern mitigation strategy is likely to be the most easily deliverable but it will not unlock the same level of benefits as has been identified via the assessment of the Southwest allocation option.

Stage 2 - Conclusions

1.19 Based on the assessment work completed through Stage 2, the following conclusions were identified:

- To deliver the level of housing identified to the south of Rugby, provision of the Southern Link Road in part, within the development allocation area, is considered essential for the Southwest and Southeast options.
- In spite of the mitigation proposed, there are still likely to be a number of residual impacts which occur on the network requiring the identification of further mitigation measures. Some of these may be strategic but it is envisaged most of the

additional mitigation would be required to deal with localised impacts identified on a site by site basis.

- The early high level analysis indicates that the level and location of housing that has been tested for the Southeast allocation is likely to generate traffic levels which reach, and in some cases exceed, the network capacity even once mitigation measures associated with that option have been assigned. As such, it is considered likely that the Southern Distributor Link which connects the M45/A45 and the A5/A428 would be required in full if the developments in the Southeast come forward.
- The analysis of the Northern scenario impacts revealed that the network performs better than the Southeast option and worse than the Southwest option, particularly when considering journey times. Potentially the problems in the North allocation option relate to the conflict between traffic entering the study area to travel to work in Rugby Town Centre and traffic leaving Rugby along the A426 to travel via the M6. Further analysis of the potential implications of these conflicts is recommended if this option is to be taken forward.
- All options indicate that further work is required along the A426 to improve the network conditions in that area, especially since there are queuing increases along the A426 in all scenarios not just the North allocation. Unlike the Southwest and Southeast options the North option does not provide the opportunity, within the development land, to introduce new infrastructure to distribute traffic associated with the development sites (such as a new link road) meaning a large majority of trips wishing to travel between the sites and Rugby must traverse the M6 via Junction 1 which explains why this junction is identified as likely to come under pressure in all options.

1.20 Given that the Southwest option performs most favourably in terms of the overall network performance of all three scenarios, coupled with the option having the greatest potential to deliver mitigation measures such as the Southwest Link Road (SWLR), which will deliver strategic and local benefits, the Southwest option was considered to be the most favourable in terms of the operation of the highway network.

Stage 3

1.21 Stage 3 centred around more detailed assessment of the Local Plan Preferred Option and comprised 5 discrete assessments as follows:

Stage 3A

1.22 Stage 3A involved the update of the development demands to reflect the emerging Preferred Option as advised by RBC. This scenario was run and the outputs reviewed in line with the previous stages of the Local Plan Assessment work. A sensitivity test was also undertaken to assess the significance of the alignment of the SWLR which connected the SWLR and the A4071 versus one which connected the SWLR and the B4642.

Stage 3B

1.23 Within Stage 3B the scenario demands were fixed to the strategy advised by RBC and as per Stage 3A. A series of options were defined which assessed different layouts for the SWLR and were indented to determine the strategic and local significance of the alignment and proposals defined and adopted throughout Stage 1 and Stage 2 previously.

Stage 3C

1.24 Whilst Stage 3B looked at how different alignments would affect the operation and impact of the SWLR, Stage 3C set out to look at how the phasing of the developments would influence the network operation and identify what localised impacts were likely to occur whilst the SWLR and Southwest developments were being built out.

Stage 3D

1.25 Upon completion of the previous stages of the assessment, RBC advised that an additional site had come forward which they considered appropriate to include within the Local Plan allocation testing. It was not possible to rerun all of the assessments with this development in and so, as a result, the additional development was added in as a sensitivity test and the impacts on the network, specifically in the southwest area, were reviewed.

Stage 3E

1.26 Subsequent to the completion of the initial testing, a series of sensitivity tests were completed which assessed the impact of changing the design speed of the SWLR as well as

the signing strategy. The purpose of this test was to establish the impact that the design speed would have on the benefits that are perceived to occur as a result of the strategic role that the link serves in providing opportunities for general background traffic flows to reassign away from congested areas such as Dunchurch.

Stage 3A - Summary of Findings

1.27 The revised allocation approach testing in Stage 3A resulted in more additional impacts, in the form of junction queuing increases, than was observed in the Southwest testing completed in Stage 2, indicating a need for further refinement of the mitigation proposals identified at some stage.

1.28 The initial analysis focussed on the differences in average network wide journey times between the different scenarios. This revealed that there are some differences in delays between the original SWLR alignment which connected directly into the A4071, south of the Potford Dam junction, and the revised alignment which connected onto the B4642 Coventry Road with the original alignment producing marginally quicker journey times.

1.29 When considering Potford Dam roundabout, both options resulted in an increase in traffic flows at the junction but the flow increases were lower when the original alignment was adopted. This is because traffic wishing to access the M45/A45 no longer needs to travel through the junction. Furthermore, detailed analysis indicated that the original alignment also concentrated more of the traffic increases on the main A4071 links as opposed to the B4642 which is considered to be beneficial as this, straight on, movement, is easier to cater for since it is constrained by issues such as poor visibility due to the railway bridge.

Stage 3A - Conclusions

1.30 The analysis completed through the Stage 3A testing revealed the following conclusions:

- Any proposals to mitigate impacts at the Potford Dam roundabout will be difficult to deliver. Furthermore, the connection south of Potford Dam provides additional strategic infrastructure insofar as it will enable the issues around the Cawston Bends to be improved.
- There are a number of non-modelled issues which need to be considered when assessing the relative merits of the two SWLR alignment options including:

- The opportunity to re-align the 'Cawston Bends' and improve the operational and safety standards of that section of the A4071.
- Safety concerns around poor visibility due to the alignment and the disused railway bridge, especially as traffic volumes increase as a result of the development build out.
- Physical constraints preventing delivery of enhanced mitigation measures, particularly when considering the disused railway bridge.

- The connection south of Potford Dam provided by the original alignment resulted in marginally faster journey times than the alternative option indicating that it is the better performing option strategically.

1.31 Thus, it was concluded that the original alignment is preferred to the alternative alignment and was therefore adopted in all subsequent assessment stages.

Stage 3B - Summary of Findings

1.32 The testing completed within Stage 3B assessed the strategic impacts of a series of different phasing options associated with the delivery of the Southwest Link Road (SWLR).

1.33 The SWLR is required to enable the growth in housing and employment identified within the area to come forward with a reduced impact on the existing transport infrastructure network. The SWLR provides three key connections:

- A major connection between the A426 and the A45/M45 bypassing Dunchurch.
- A major connection between the A45/M45 and the A4071, via the SWLR and connecting through the development land which significantly improves the connectivity between the development sites and the A4071.
- A minor connection between the A426 and the B4642 which improves access to the southwest development sites and provides an opportunity to disperse traffic generated by the sites in the Southwest.

1.34 Specific analysis of the network performance in key areas of the model revealed the following:

Ashlawn Road

1.35 None of the alignment options produce large fluctuations in traffic flows around the Ashlawn Road junction. It is noted that modelled flows are largely consistent throughout all of the options and could, therefore, be indicative of the junction being close to capacity.

Rugby Gyratory

1.36 Scenario 02 (all connections) and 03 (all connections minus the A4071/M45/A45 connection) performed best in terms of options which induced the lowest increases in delays compared to the Reference Case. There is a notable increase in the demands at the gyratory between Scenario 02 and 03, indicating that the connection between the A45/M45 and the A4071 has the potential to deliver relief to the Gyratory area by providing better access to the A4071 Rugby Western Relief Road.

1.37 Thus it was concluded that, without the additional link between the SWLR and the A4071, conditions at the Gyratory will worsen as more traffic is likely to use the Gyratory since there is less opportunity to divert.

1.38 Similarly removing the link between the A426 and A45/M45, which bypasses Dunchurch was also observed to impact on the Gyratory and so its retention is also desirable as a means of attempting to alleviate the demand on the Gyratory.

Dunchurch Crossroads

1.39 It was concluded that improvement of the conditions at Dunchurch Crossroads represented the greatest single opportunity to deliver an improvement in the local area as a result of the SWLR.

1.40 Delivering the alignment in full is likely to be essential as, even before further investigation is given towards the restriction of movements across the Dunchurch Crossroads junction (such as potentially banning right turns), the SWLR appears to deliver a significant reduction in modelled and demand flows at the crossroads.

Stage 3B - Conclusions

1.41 Stage 3B analysis revealed the following conclusions:

- Dunchurch Crossroads benefits significantly from the additional north/south capacity that is provided by the link between the A426 and the A45/M45.

- There are benefits to the Dunchurch Crossroads observed to also occur from the east/west capacity provided by the links between the A45/M45 and A4071 as well as the A426 andB4642 Coventry Road.
- Delivery of an additional link between the A45/M45/SWLR and the A4071 is also important as it has been proven to deliver relief to the Rugby Gyratory as well as the Crossroads. Given the limited opportunities to mitigate these areas directly all schemes which are likely to provide relief through the diversion of traffic flows are considered to be a high priority.
- In terms of phasing it is likely that the delivery of the link between the A426 and the B4642 will be required at an early stage and will, potentially deliver additional benefits in the area of the Dunchurch crossroads so long as it can be delivered to a sufficiently high standard (either via a new link or upgrading Cawston Lane).
- Any alignment for the link road must be defined to deliver as direct a route as it is possible to do so between the A426 Rugby Road, just north of Dunchurch, and the M45/A45. If the nature of the route becomes more ambiguous/less direct or there is an increase in the amount of friction on the route (e.g. multiple junctions, narrow carriageways, etc.) then it is reasonable to conclude that the benefits associated with the SWLR will be diminished.

Stage 3D - Summary of Findings

1.42 The initial results analysis pertaining to the assessment of allocating an additional 1500 dwellings at Lodge Farm indicated that there will likely be some strategic impacts during the PM period that will require the determination of additional highway mitigation measures to ensure that they are minimised.

1.43 It is considered highly likely that junction enhancements could be identified both along the A4071 Rugby Western Relief Road and along the A426 north of Rugby which would further reduce the cumulative impact of the sites, including Lodge Farm, observed thus far.

1.44 The analysis of the impacts on the Dunchurch Crossroads and Potford Dam roundabout also revealed that there will be an increase in vehicle flows at both locations as a result of the allocation of the Lodge Farm development. It is likely that these additional development trips

will need to be considered during the assessment and design of any mitigation proposals put forward for the Potford Dam roundabout.

Stage 3D - Conclusions

1.45 Completion of the Lodge Farm sensitivity test detailed within the Stage 3D assessment revealed the following conclusions:

- That there are some strategic impacts within the PM period that indicate a need for further mitigation to be delivered to minimise the development induced impacts for all identified sites including Lodge Farm.
- The allocation of Lodge Farm will result in an increase in vehicle demands at both the Potford Dam and Dunchurch junctions indicating that the Lodge Farm development trips will need to be considered when defining any of the highway mitigation schemes in these areas.
- Whilst the impact on Dunchurch Crossroads does not exceed the demands and flows identified in the 2031 Reference Case (i.e. Pre-SWLR) there are still impacts and, since one of the primary aims of delivering development in the southwest is to enable a mitigation strategy to come forward which will alleviate the impacts at Dunchurch Crossroads, it is reasonable to conclude that the phasing of Lodge Farm will be reliant on the SWLR being in place to enable the site to be delivered.
- The increase in vehicle demands at Dunchurch Crossroads, which occurs as a result of the allocation of the Lodge Farm development, is likely to result in demands which are still lower at the crossroads than the levels likely to occur without the SWLR in place. This demonstrates the junction will still benefit from the delivery of development in line with the PO allocation strategy but consideration should be given to identifying additional measures that can be introduced to safeguard the capacity of the junction by encouraging Lodge Farm traffic to use alternative routes.

Stage 3E - Summary of Findings

1.46 The testing completed within Stage 3E was intended to determine the relative significance of the design speed and signage strategy applied to the three key elements of the SWLR. The testing was set out to ascertain the effects of any change to the layout assumed within the modelling both strategically and on key local junctions.

1.47 The strategic level analysis indicated that the was little difference between the proposals for the speed limit and signage of the link between the A426 Rugby Road and the B4642 Coventry Road, although there was a modest increase in delays when the link was reclassified to minor (i.e. not signed).

1.48 During the PM however the changes in speeds along the SWLR to 30 mph have a much more significant impact on the network with an increase in delays across the entire model network of as much as an additional 4%, compared to the Reference Case. This increase was directly attributable to the drop in speed limit and the impact was network-wide. This increase is an average of every journey across the entire model network and indicated that there are potentially widespread effects occurring as a result of the change in the speed limit.

1.49 Analysis of the impact on Dunchurch Crossroads revealed that the drop in speed along the SWLR from 40 mph to 30 mph would result in an increase in traffic flows and demands at the crossroads as the low speed along the SWLR means that less traffic is encouraged to switch to the SWLR and use it as an alternative route to travelling through the Dunchurch Crossroads since the slower speed reduces the cost/time savings that induce the switch in the first place.

Stage 3E - Conclusions

1.50 The final stage of testing looked at the impact of the design speeds on the operation of the SWLR and this work concluded:

- The principles of the link assume that the route between the A426 and the M45/45 minimises conflict and friction, as would be achieved through the 40 mph design speed. This needs to be considered in detail in any subsequent design work pertaining to the link (I.e. the route must provide a direct bypass opportunity for Dunchurch).

- That reducing the design speed on the main SWLR link between the A426 Rugby Road and the M45/A45 below 40 mph will induce additional delays within the network and also have a direct impact on the operation of Dunchurch Crossroads since the lower speed is predicted to induce a lower level of reassignment.
- That reducing the A45/M45 to A4071 Western Relief Road link from 40 mph to 30 mph will induce localised impacts which are undesirable and, as such, it is considered desirable to retain the connection through at 40mph.
- That reclassifying the route between the B4642 Coventry Road and A426 Ashlawn Road to a minor route is beneficial insofar as flows on the route through the housing site will reduce with only a relatively small impact on the strategic level performance or Dunchurch Crossroads. If the parallel route between the M45/A45 and A4071 is also reclassified to minor these flows begin to rise again and so, it is concluded that the best strategy is one which encourages the use of the M45/A45 to A4071 route through signage but retains the A426 to B4642 classification as a minor route which accommodates local traffic only.

1.51 The strategic nature of the link was identified through Stage 1 and Stage 2 also. Within Stage 2 it was highlighted that the link would most likely need to be delivered in full if the development within the Southeast is to come forward. As a result, delivering the major routes through the southwest area to as high a standard as possible is going to be essential in order that the network can continue to accommodate growth in housing beyond the current plan period.

2 INTRODUCTION

2.1 Vectos Microsim (VM) has been assisting Rugby Borough Council (RBC) and Warwickshire County Council (WCC) in the assessment of options pertaining to the delivery of the Rugby Borough Local Plan through the use of the Rugby Wide Area (RWA) S-Paramics micro-simulation model.

2.2 The purpose of this Strategic Transport Assessment (STA) Report is to provide an overview of the work that has been completed to date as well as documenting the assumptions adopted at each key stage of the study and the findings therefrom.

Objectives

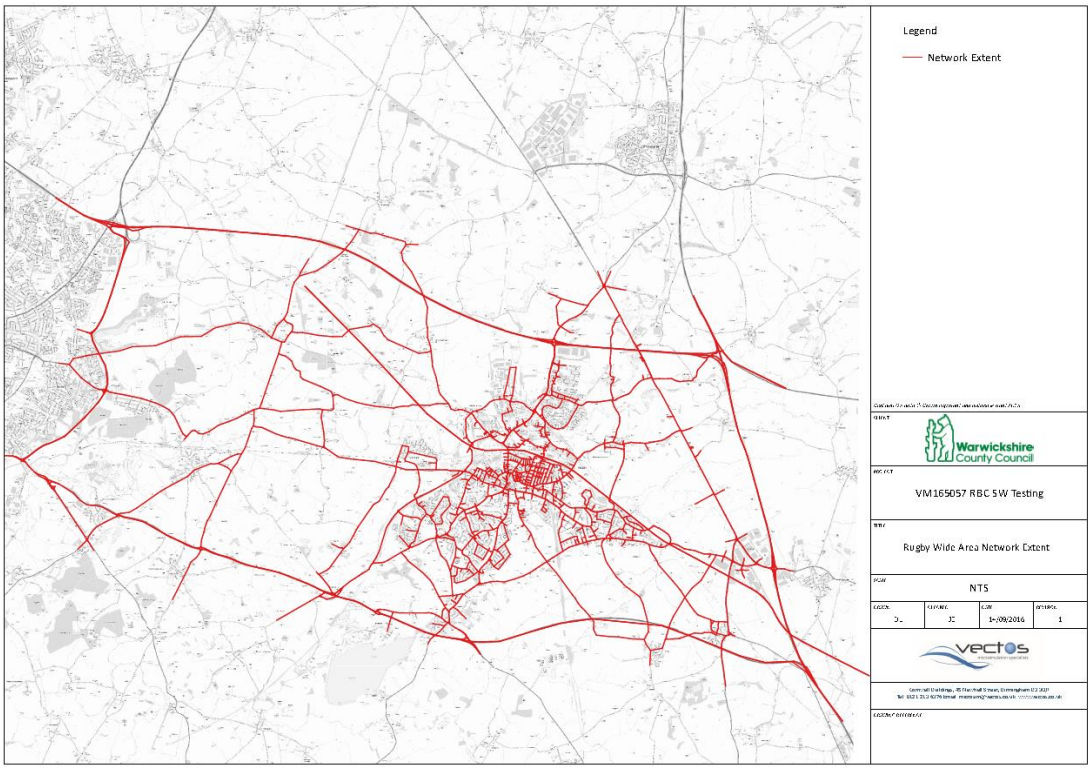
2.3 The modelling assessment work has been underway since May 2015 and the primary objectives of the work are summarised as follows:

- To assess the likely impacts, on the highway network, of the various emerging strategies concerning the delivery of housing and employment through the Rugby Borough Local Plan.
- To identify what, if any, interventions may be deliverable which will minimise the residual impacts likely to occur as a result of the Local Plan proposals.
- To assess the impacts of the allocation strategy identified by RBC for adoption and to determine an initial set of highway mitigation measures to inform the infrastructure requirements associated with the Local Plan.

Study Area

2.4 The modelling assessment has been completed using the existing RWA S-Paramics model. The extent of this model has been defined within **Figure 1.**

Figure 1: RWA Network Extent



Report Structure

2.5 The remainder of this report is set out as follows:

- **Chapter 3 –** Provides a summary of the key stages of the assessment as well as an overview of the emerging issues that exist on the highway network within Rugby.
- **Chapter 4 –** Details the methodology adopted including the reporting mechanisms, the updates applied to the Reference Case and an overview of how growth in traffic volumes has been calculated alongside any redistribution mechanisms adopted within the scenarios.
- **Chapter 5 –** Presents the findings from the first stage of the assessment which looked at the impacts of allocating all sites identified in the SHLAA.
- **Chapter 6 –** Documents the results and analysis extracted from the second stage of the assessment work which compared the relative impacts of allocating development across three broad areas (North, Southwest and Southeast).
- **Chapter 7 –** Presents the findings from the detailed assessment of the principles of allocating development in the southwest area including some initial commentary

around the phasing of development and key infrastructure, particularly the Southwest Link Road. At this stage, some more detailed analysis of key areas within the network is also included to begin to ascertain the development impacts to a more refined level.

- **Chapter 8 –** Presents the summary findings from the work alongside the initial conclusions.

3 BACKGROUND

Stages of Assessment

3.1 The objectives set out in para 2.3 previously have been addressed through a series of different assessments each of which was defined in response to the emergence of the Local Plan proposals. In total, there have been three key stages of assessment work completed prior to the production of this report. Each of the individual stages of assessment work that have been completed is described below:

Stage 1 – Full Development Allocation Assessment

3.2 The first stage of the assessment work assessed the implications of allocating all sites identified through the SHLAA in terms of both identifying an appropriate highway infrastructure strategy as well as identifying the residual impacts likely to occur as a result of the development strategy being tested.

3.3 An update to the 2031 RWA model was also completed to ensure that the model reflected the latest housing trajectory figures and also took account of the developments approved since the last model update including, DIRFT Phase III and the associated infrastructure.

Stage 2 – Broad Location Allocation Assessment

3.4 Following the completion of the first stage of the assessment, a subsequent assessment was undertaken to identify the likely impacts, on the highway network, of concentrating development across three key areas of Rugby (North, Southeast and Southwest). This work also began to look in more detail at the potential access and mitigation strategies that should be considered in conjunction with the three different areas for development.

Stage 3 – Detailed Southwest Allocation, Phasing and Infrastructure Assessment

3.5 The final stage of the assessment work focussed on reviewing the impacts emerging as a result of concentrating development in the southwest. This included a review of the proximate infrastructure identified to support growth in the area as well as the likely impact of the phasing of development, paying particular attention to the delivery of the southwest link road and the benefits, or otherwise, that arise from the delivery thereof.

Areas of Constraint

3.6 Throughout the assessment work there have been a number of areas which have been continuously highlighted as likely to constrain the delivery of development within the Rugby area. Most of these areas are ones which already suffer from issues around traffic congestion and are likely to experience further issues due to the growth in traffic volumes predicted to occur as a result development sites already identified and approved.

3.7 Further details on the current conditions in these areas has been provided within the following section of this report, however, it should be recognised that this is simply intended to highlight some key areas of concern and by no means represents a comprehensive list of the issues which will need to be considered in ensuring that the development strategy identified in the Local Plan can come forward with minimal additional impact.

3.8 The areas of constraint include:

- A428/A426 'Rugby Gyratory'
- A426/B4429 'Dunchurch Crossroads'
- A428 Hillmorton Road/Ashlawn Road
- A426 North (between Newbold Road and Central Park Drive)

3.9 The location of these areas is illustrated within **Figure 2** and detailed further as follows:

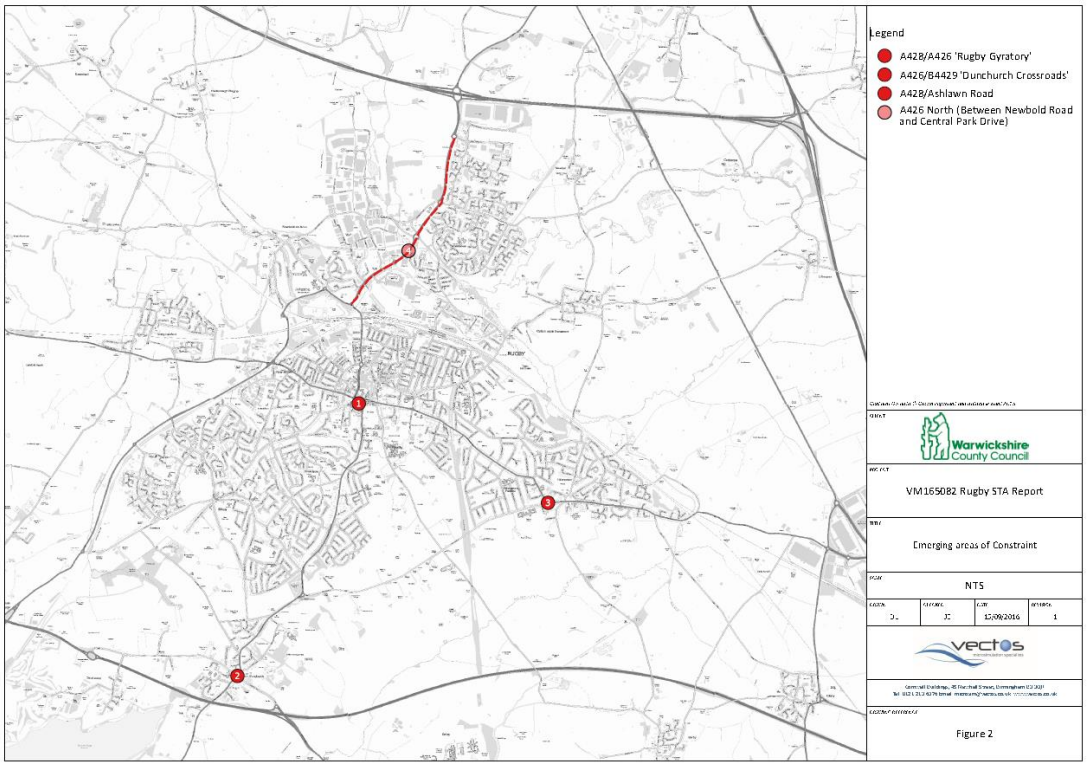
A428/A426 'Rugby Gyratory'

3.10 The Gyratory within Rugby Town Centre is a junction which is critical to the overall network operation and is the point of convergence for 5 key routes into Rugby town centre. The Gyratory was recently upgraded in response to queuing conditions observed in the area and also in preparation for forthcoming developments including the Rugby Radio Mast Sustainable Urban Extension.

3.11 It is considered that the scheme proposals that have been delivered represent the maximum capacity option for that area whilst ensuring non-motorised users are well provided for. As such, the likelihood of additional highway capacity enhancements being identified in this area is considered very low. The area also suffers from an issue with air quality that means

that it is considered favourable to promote options which limit the amount of additional traffic which needs to utilise the Gyratory.

Figure 2: Emerging Areas of Constraint



A426/B4429 'Dunchurch Crossroads

3.12 The Dunchurch Crossroads connects the A426 with the M45/A45 via the B4429 Coventry Road. The area is one which already suffers from severe queuing and experiences issues with air quality. At the time or writing this Report, VM understand that interim proposals may have been identified which could provide some additional capacity at the junction but that, after these proposals have been delivered, options for enhancing the capacity of the junction via direct intervention are likely to have been exhausted.

3.13 The situation at the crossroads is very similar to that which is observed at the Rugby Gyratory insofar as there are not likely to be any further, significant, measures identified for the junction which will improve the conditions both in terms of congestion and air quality. As with the Gyratory, it is therefore considered favourable to promote options which limit the amount of additional traffic which is likely to travel through the crossroads as the Local Plan is brought forward.

A428 Hillmorton Road/Ashlawn Road

3.14 The A428 Hillmorton Road/Ashlawn Road junction was highlighted as an area of constraint during previous stages of the Local Plan assessment, including the assessment of the impacts of delivering the SUE to the east of Rugby. As part of the planning approval for the SUE a scheme has been identified which involves signalisation of this junction. It is noted that the area around the junction is particularly constrained and, as such, there are unlikely to be many options for further improvements to the capacity in this area. This junction has been highlighted as experiencing and likely to continue to experience congestion issues especially if traffic volumes in the area continue to increase once the signal proposals have been delivered.

A426 North

3.15 The A426 between Rugby town centre and the M6 is considered to be a route of key local importance which also serves a strategic function. There are a number of schemes that are to be delivered by developments coming forward within Rugby that will, to some extent, support growth on this corridor. There have also been proposals identified through the Coventry and Warwickshire Local Enterprise Partnership (CWLEP) Local Growth Deal for a possible funding contribution towards the delivery of improvements to the A426/A4071 Avon Mill and A426 Newbold Road/Hunters Lane junctions.

3.16 Whilst there is likely to be some capacity for additional improvements in this area, particularly to the north of the corridor, it is still an area of concern as the scope for improvements is limited. The significant role the route plays in linking the town and the M6 mean that traffic volumes are likely to increase irrespective of the development approach adopted via the Local Plan.

3.17 It is considered likely that, at some point, traffic growth along the corridor will reach a point beyond which the capacity in the area will be exceeded. This means traffic impacts in this area throughout the assessment of options is considered to be a material concern. Additional work is also to be undertaken in the coming months which will provide further analysis of the impacts on this corridor of growth in traffic volumes coupled with the delivery of the scheme proposals identified thus far. This work will be completed via a separate study so as to ensure the Saturday period, which is one of the most congested periods, is included in the assessment. Since the RWA model has been developed to account for the traditional

peak periods only, the assessment of Saturday conditions is to be achieved via the development of a bespoke model covering a smaller area and inclusive of Saturday traffic data.

Local Plan Transport Strategy

3.18 The evidence presented within subsequent sections of this Report reveals some areas which are unlikely to experience benefits as a result of the developments and associated highway infrastructure coming forward through the Local Plan, whereas other areas will benefit substantially. In all cases the work completed thus far is intended to identify a set of proposals which will serve to minimise the additional impact predicted to occur as a result of delivering the additional development sites identified through this Local Plan review.

3.19 It is considered difficult to justify funding and delivery of measures which improve the network on the basis of alleviating existing congestion issues since these are not generated by the additional traffic volumes associated with the new developments. Therefore there must be an intrinsic link between the development proposals and schemes identified to ensure an appropriate case for funding can be made.

3.20 However, it is recommended that, subsequent to this work, more detailed analysis is completed which looks at options for improving the transport infrastructure network beyond simply seeking to mitigate the impacts associated with the Local Plan.

3.21 It is envisaged that work of this nature would continue throughout the Local Plan determination process and beyond. It would also be used to support funding bids and to inform the production of business cases to enable funds to be secured to aid the scheme delivery (i.e. via the CWLEP Strategic Economic Plan).

4 METHODOLOGY

S-Paramics Micro-simulation Modelling

4.1 The assessment has been completed using the RWA S-Paramics micro-simulation model. Paramics is a micro-simulation traffic model that simulates the behaviour of each individual vehicle and presents its output as a real time visual display for traffic management and road network design.

4.2 Paramics allows a detailed representation of the highway network in the form of modelling a high level of detail, such as individual lanes, traffic signals, junctions, pedestrian crossings and bus stops as well as the events which occur on it. Each individual vehicle is separately represented and therefore the program can take an account of each individual driver's behaviour.

4.3 The output is a visual display which shows the changing position of individual vehicles and queues on the highway network in real time. The advantage of a visual display enables non-technical stakeholders to view the results of highway and development proposals in terms of traffic flows and congestion.

4.4 There are a number of advantages of using Paramics to inform the assessment as it allows a visual interrogation of the network to be completed alongside the empirical analysis. This, in turn, enables the identification of potential schemes to be completed within the same assessment and, unlike other approaches, does not require supplementary analysis to be completed using isolated junction modelling tools to support the overall analysis.

4.5 The RWA S-Paramics model also operates under conditions of dynamic assignment which means that the reassignment of vehicles in response to congestion as a result of traffic growth or, alternatively, in response to the alleviation of congestion through schemes, can be considered within the assessment work.

4.6 In line with the standard approach to the development of traffic models, the RWA model has been developed for the AM and PM peak periods of 07:00 to 10:00 and 16:00 to 19:00 respectively. WebTAG guidance states that traffic models should be developed for the period when traffic flows are 'markedly' highest within the fully modelled area which, in most towns and cities, is encompassed within the hours identified.

4.7 Whilst it is acknowledged that there are additional impacts which occur during hours outside of the core modelled periods these traffic peaks are often localised and do not represent a step change in the overall traffic volumes when considered in the context of the entire study area which, in this case, includes the whole of Rugby town as well as the M1 and M6.

4.8 Issues pertaining to localised impacts such as school pick up trips during the PM hour of 15:00 to 16:00 or factory shift change impacts can be assessed through micro simulation modelling but it is recommended that bespoke models are developed which encompass only the affected areas within the analysis since it would be very costly and resource intensive to develop a large scale microsimulation model of the study area for hours outside of those which have been modelled thus far.

RWA Model History

4.9 The development of the Rugby Wide Area (RWA) S-Paramics model was completed in 2010 and was used to inform the last round of Local Plan testing as well as subsequent planning applications submitted for Rugby Gateway, the Radio Mast SUE and all other key developments coming forward within the area.

4.10 The model was originally forecast to 2016 and 2026 and has since been updated to reflect 2026 and 2031 network conditions post-approval of the Gateway and SUE development sites as well as the DIRFT Phase III development.

4.11 Although the RWA model has been calibrated to the necessary DMRB standards it is recognised that the model would benefit from being updated to ensure that the traffic conditions identified within the model reflect those which are occurring on-street.

4.12 It is also necessary to update the model to ensure that the effects of infrastructure which has been delivered since the last update is accurately accounted for within the model. Similarly changes in travel patterns and/or traffic volumes that have occurred in the interim period are based on estimates within the current modelling and the update provides an opportunity to ensure these elements are accounted for accurately within the base model moving forward.

4.13 As such, it is considered pertinent to highlight that, once it is available, the updated wide area model would supersede the existing RWA model and all subsequent testing would need to be completed within that model. In the meantime, it has been possible to deal with any

perceived weaknesses within the existing RWA model through the development of bespoke, area specific, microsimulation models which have been and will continue to be used to bridge any gaps in the data that are perceived to exist within the RWA model. Bespoke models have been derived for the A426 corridor, Dunchurch Crossroads and the Rugby Gyratory and are available to supplement the strategic level analysis that has been completed thus far. Some of these models are also programmed to be used in detail during subsequent assessment stages to be completed following the release of this Report.

4.14 As has been mentioned previously, the model has been subject to a series of updates to ensure that the model forecast years take account of all known committed developments and that any assessment is robust. A series of reports have been produced to document the forecasting process which has been adopted. This process, which is governed by WCC's modelling protocol, ensures that the models are kept as up to date as possible.

4.15 Prior to commencing the assessment, VM reviewed the existing RWA forecast models and identified a series of additional changes that were required to ensure that the models were up to date. An overview of the updates applied to the forecast models is provided within the following section of this Report.

4.16 Once it is available, all subsequent stages of the assessment work should be completed using the updated Rugby Wide Area model. It is also expected that this version of the model should be used to inform any planning application work that is undertaken in relation to the sites identified through the Local Plan as well as any additional sites which come forward within the study area.

Forecast Model Update

4.17 WCC's Paramics models are subject to continuous review to ensure that they include all pertinent development considerations prior to being utilised for any assessment work. Whilst updating the Base model requires extensive input due to the data collection/collation and model calibration costs it is possible to update the forecast year models regularly by reviewing the development delivery schedule and identifying what, if any, additional developments have been approved since the last model update.

4.18 Prior to undertaking the updated Local Plan assessment work, the existing 2026 RWA Paramics model was reviewed and the following elements were revised and/or included as a result:

- The status of DIRFT III and associated mitigation measures.
- The revised housing trajectory estimates for the existing/allocated core strategy sites.
- Adjustments to the forecasting levels, as informed via the interrogation of the TEMPRO database, to reflect the latest assumptions on growth within the RBC housing trajectory.
- To update the forecast horizon from 2026 to 2031 whilst retaining a 2026 forecast year for Development Control purposes.

DIRFT III Proposals

4.19 Since the original RWA 2026 Reference Case was made available for testing, DIRFT III was granted permission through the IPC process and, as a result, the proposed mitigation measures and demands associated with DIRFT III needed to be incorporated within the model network.

4.20 All changes to the 2026 RWA model network, intended to reflect the revised status of the DIRFT III site, were derived specifically from the Paramics model utilised to evidence the DIRFT III development impacts and mitigation strategy as part of the IPC process.

4.21 The first stage involved the extraction of the DIRFT III network from the existing model. This was coded into the RWA Reference Case alongside an additional access point on the A5 in the form of a new roundabout access north of the northernmost Rugby Radio Mast development A5 access roundabout.

4.22 The mitigation measures for DIRFT III, that involved changes to the model network, comprised the following:

- **A5/A426 Gibbet Hill Roundabout** – widening and signalisation of A5/A426 roundabout.

- **M1 Junction 18** – part signalisation and widening of some entry/exit points to the roundabout.
- **A5/A428 (Parklands) Roundabout** – amendments to lane markings on some approaches.
- **A428/A5 (Halfway House) Roundabout** – widening of approaches to the junction and altered lane markings.

4.23 In addition to the network revisions, it was also necessary to include an account of the development demands. Again, the demand matrices were extracted directly from the original DIRFT III scenario model.

4.24 On the basis that the year of commencement is 2016 and the development is intended to be fully built out over a 20 year horizon, and in the absence of any more detailed information, it was assumed that the development completion would occur at a rate of 5% per annum.

4.25 Thus the proportion of the full demand matrices assigned to the 2026 and 2031 forecast period was 50% and 75% respectively.

4.26 The original and revised 2026 and 2031 demand totals assigned to the model network to account for DIRFT are summarised within the following **Table 2.**

Table 2: DIRFT Updated Demands 2026 & 2031

Year	Demand	0700 - 1000	1600 - 1900
2026 Original	Lights	2998	3648
	HGV	1291	1537
	Total	**4289**	**5185**
2031	Lights	2249	2736
	HGV	968	1152
	Total	**3217**	**3888**
2026	Lights	1499	1824
	HGV	646	769
	Total	**2145**	**2593**

Existing Housing Adjustments

4.27 Following the assignment of the DIRFT III mitigation measures, the next stage of the update involved the revision of the housing numbers assigned to the Rugby Radio Mast and Rugby Gateway allocated sites.

4.28 Within the original Rugby 2026 Reference Case it was assumed that 1300 dwellings would be delivered at the Rugby Gateway development site and 5,000 dwellings would be delivered at the Rugby Radio Mast site.

4.29 The revised trajectory information, provided by RBC, documented within the following **Table 3**, was to be assumed, within the model, to have been delivered within each site by 2026 and 2031 respectively.

Table 3: Revised Housing Numbers (RRM & RG)

	2026	2031	Original 2026
Gateway	860	1129	1300
Radio Mast	3050	4750	5000

4.30 As with the DIRFT III demand adjustments, the revised demand assignment totals were derived by factoring the original matrices, with the factors having been based on the revised housing numbers.

4.31 The factors were applied only to the zones associated with the assignment of trips associated with the housing element of both sites. Both sites comprise a relatively small proportion of employment trips which were retained in full based on the original assignment matrices. The original and revised cumulative demand totals, assumed within the modelling for both the Radio Mast and Gateway sites are summarised within **Table 4**.

Table 4: Revised Core Strategy Demand Totals

	Original 2026	Revised 2026	Revised 2031
AM	10977	6461	10295
PM	13456	7776	12592

TEMPRO Forecasting

4.32 Historically forecasting of the RWA S-Paramics model has been undertaken based on the NTEM adjusted TEMPRO factor for the 2009 to 2026 and 2031 forecast periods.

4.33 The latest version of TEMPRO is TEMPRO v7. However, the data sets for this version of TEMPRO were released 28 July 2016. This was after the majority of the modelling work had been completed and, as such, TEMPRO version 6.2 was adopted to inform the derivation of growth forecasts throughout the modelling appraisal for consistency purposes.

4.34 Since the primary objective of this exercise is to update the model with respect to the revised housing forecasts which it was considered appropriate to revisit these forecasting assumptions.

4.35 During previous stages of Local Plan work, completed on behalf of other Districts and Boroughs within Warwickshire, a comparison has been made of the level of housing intended to be delivered through the Local Plan and the level of housing accounted for within TEMPRO. Where appropriate, adjustments have been made to the factors to ensure any capping or redistribution procedures adopted are informed by the housing numbers identified for delivery rather than the housing numbers originally assumed within the TEMPRO database.

4.36 Analysis of the assumptions within the TEMPRO database reveals that TEMPRO assumes delivery of the housing numbers and associated growth forecasts, for the Rugby Authority area, documented within **Table 5**.

Table 5: TEMPRO 2009 to 2031 Forecast Assumptions (Rugby authority Level)

		2026	2031
TEMPRO DATA	Housing Numbers	9762	12589
	Growth Factor AM	1.14	1.17
	Growth Factor PM	1.15	1.19
	NTEM Adjusted AM	1.22	1.31
	NTEM Adjusted PM	1.24	1.33

4.37 Analysis of the above table reveals that the NTEM Adjusted TEMPRO factors result in a 50% increase in growth allocated within the model within the 2009 to 2031 forecast horizon (i.e. around 22,000 to 23,000 houses).

4.38 Given that the initial assumptions within TEMPRO identify the delivery of 12589 houses for the 2009 to 2031 period it was acknowledged that capping growth within the RWA Reference Case at the NTEM adjusted TEMPRO level could result in an overestimation of the

model demands which would, in turn, hinder the assessment of additional sites assigned to the same model network.

4.39 As a result, it was decided that the TEMPRO factors, used as a cap within the model, would be determined based on a moving target which took cognisance of the housing numbers identified within the housing trajectory. Further information pertaining to the principles behind these adjustments, alongside the relevant TAG guidance, is provided within the following section of this report.

4.40 The following numbers were identified as a result of the review of the latest housing trajectory:

- 2009 to 2010 = 412 dwellings[1]
- 2010 to 2026 = 3388 dwellings
- Core strategy housing numbers = 5879 (1129 Gateway & 4750 RRM)

4.41 Thus, the initial 2031 forecast model contained growth equivalent to 11754 houses which is slightly less than the TEMPRO predications for the same period. TEMPRO estimates are most likely above the actual delivery on account of the slippage in the build out rates for the currently adopted Local Plan sites.

4.42 Because of the difference in housing numbers contained within TEMPRO, when compared to the housing trajectory, it was decided that the TEMPRO factors would be adjusted for both the 2026 and 2031 RWA forecast reference case demands. The rationale behind this was to ensure that the model forecasting process conformed to the guidance set out within WebTAG guidance and that the initial growth estimates within the Reference Case were not overly robust as this would likely result in the model returning unrealistic results due to growth forecasts being too high which, in turn, could result in an option being ruled out or significant mitigation measures being identified which would not be realistic.

4.43 Further details on the rationale behind the TEMPRO adjustments are provided as follows:

[1] Source RBC 2013 Local Plan Housing Trajectory (Pre-2010 committed developments not accounted for due to the 2009 model base year.)

TEMPRO Adjustment Principles

4.44 The deterministic nature of S-Paramics models and the lack of an ability to apply the principles of variable demand or other demand elasticity response assumptions means that it is essential that any forecasting method adopted within the modelling seeks to account for the realism of the forecasts as part of the overall methodology.

4.45 Once the trip generation/distribution calculations have been completed, trip assignment totals will be available for all of the development sites identified for inclusion within the forecasting exercise. This applies to both committed developments and sites identified through the Local Plan.

4.46 The trip generation and distribution is combined to produce a series of Origin/Destination matrices which control the assignment of vehicle demands, associated with the development sites, onto the model network.

4.47 Assignment of the demands produces an overall level of traffic growth within the model network. It is important to establish that the growth levels which have been forecast are reasonable and, furthermore, that the model network can accommodate the growth, albeit acknowledging that additional mitigation measures are likely to be required to establish a position whereby the model can operate in a satisfactory manner.

4.48 It is recommended that the overall level of growth is controlled within the modelling by comparing the development quantum being assessed against the relevant TEMPRO projections for the same period. Manual adjustments can then be made to the TEMPRO factors to enable the growth forecasts within the model to better reflect the anticipated housing and employment levels being considered within the assessment.

4.49 Analysis of the assumptions within the TEMPRO data base, with regards the development quantum delivered within the forecast period(s) should be undertaken and should be compared to the numbers that are predicted to occur if all sites identified come forward.

4.50 A high level summary of the forecasting approach is provided as follows:

- Trip generation and distribution assumptions for the committed development sites, as well as Local Plan sites, are derived and combined to produce development specific demand matrices for assignment within the model network.

- A review of the housing assumptions accounted for within the forecasting is undertaken against the trajectory assumed within the TEMPRO database for the same forecast period.
- The TEMPRO factors are adjusted to reflect the overall housing numbers now assumed to be delivered within the forecast period.
- The adjusted growth forecasts will be used to inform the overall growth levels within the forecast models for each of the key stages.
- Internal growth, i.e. trips with at least one trip end within the core study area not related to an external zone, within the model will be capped to the levels predicted through the adjusted TEMPRO factors, ensuring that the internal growth levels within the model do not exceed the adjusted TEMPRO levels predicted.
- As housing levels increase between each of the model forecast scenarios the adjusted TEMPRO factors can also increase to ensure that the level of growth within the modelling reflects the housing and employment numbers at each stage.

4.51 TAG guidance indicates that, when developing a Reference forecast the impact of both national and local changes should be accounted for. Critically, TAG guidance states that:

"Overall demand in the forecast should be constrained to the Department's projections… In order to maintain consistency with national projections, the core scenario should be based on trip end growth factors from the NTEM Dataset… In most cases, some adjustments to the NTEM dataset will be required at the local level" (TAG M4, para 7.3.2 to 7.3.4)

4.52 In the absence of available variable demand modelling, any forecasting method proposed must take cognisance of this fact when setting the overall growth levels within the model network.

4.53 The forecast growth levels within the RWA model were then adjusted based on the TEMPRO growth factors which accounted for the 11754 houses delivered within the 2009 to 2031 period as identified earlier.

4.54 As highlighted previously, a number of principles were adopted to inform the capping and redistribution procedure namely:

- That HGVs were excluded from the capping and the growth in these vehicle types was retained at a level consistent with the original forecasting methodlogy (i.e. growth in HGV traffic is continuous).
- Due to its strategic nature, DIRFT III was excluded from the calculations, therefore the demands assigned to DIRFT III were assumed to occur 'in addition' to the growth associated with the housing.
- The reduction in forecast demand levels was applied proportionally across all internal trip matrices including Committed Developments and existing Local Plan demands.

Scenario Forecasting

4.55 The methodology for the derivation of growth forecast was applied to the derivation of the Reference Case and each of the growth scenarios tested during each key stage of the assessment.

4.56 At each stage the TEMPRO factors have been adjusted to ensure that, proportionally, the growth in traffic volumes reflected within the modelling takes account of the housing numbers being assessed within each discrete test scenario.

4.57 The development and growth assumptions assumed within each of the scenarios has been described in detail within the following section:

Reference Case Demand Forecasting

4.58 The previous section of this Chapter describes the adjustments that were included to account for committed developments within the RWA forecast models. Once these demands were assigned to the model the number of houses which were accounted for within that scenario were reviewed and compared to the levels contained within the TEMPRO database in order to determine an appropriate level of growth to be assigned within the model network.

4.59 The original 2009 to 2031 TEMPRO forecasts assumed that circa 12600 houses were to be delivered within that period. The housing levels that should be considered within the 2031 RWA Reference Case were identified as:

- **412** dwellings delivered between 2009 and 2010[2]
- **3388** dwellings delivered via commitments between 2010 and 2026
- **5879** dwellings delivered through adopted core strategy sites (1129 via Rugby Gateway and 4750 via Rugby SUE)

4.60 The developments outlined previously represent all those which were accounted for within the RWA 2031 Reference Case and represent a total delivery of 9679 dwellings committed between 2009 and 2031. This number is over 20% lower than the number assumed within the TEMPRO forecast housing assumptions and, as such, required the growth within the 2031 model to be adjusted to reflect the appropriate housing number.

4.61 The original and revised growth levels which were identified via interrogation of the TEMPRO database (v6.2) are summarised within the following **Table 6**:

Table 6: Original/Adjusted TEMPRO Assumptions

Housing Assumptions	Original		Revised	
	AM	PM	AM	PM
General	12589		-	
2009 to 2010	-		412	
2010 to 2026	-		3388	
CS Housing Numbers	-		5879	
Total	12589		9679	
Diff	-		-2910	
TEMPRO	**AM**	**PM**	**AM**	**PM**
Growth Factor	1.17355	1.19365	1.1421	1.15915
Diff (%)	-	-	-3.2%	-3.45%

4.62 The previous table illustrates that, as a result of the adjustments to TEMPRO to account for the projected housing numbers across the area, growth within the Reference Case was capped to between 14.2% and 15.9% across the AM and PM respectively which is around 3 to 3.5% lower than the level of growth forecast to occur through the unadjusted TEMPRO factors.

[2] Source RBC 2013 Local Plan Housing Trajectory

4.63 These demand levels were adopted within the RWA Reference Case which was subsequently used as a comparator for each successive stage of the assessment.

Local Plan Forecasting

4.64 Each Local Plan option was assessed using a consistent forecasting method and in line with the assumptions outlined previously. At each stage a discrete set of demands was determined for each of the development sites based on the site composition. A set of standardised trip rates were applied based on land use.

4.65 Whilst it is recognised that each site will likely produce trip generation figures which are subtly different and influenced by factors such as the site composition and location, the purpose of this stage of the assessment is to determine the strategic level impacts associated with the developments and, as such, it is considered acceptable that all sites are treated consistently.

4.66 The WCC standard residential trip rate was applied, on a per dwelling basis, to all new residential sites included within the assessment. These are confirmed within the following **Table 7:**

Table 7: WCC Residential Trip Rates

Period	In	Out	Total
07:00 to 08:00	0.08	0.33	0.41
08:00 to 09:00	0.12	0.48	0.6
09:00 to 10:00	0.12	0.22	0.34
16:00 to 17:00	0.35	0.11	0.46
17:00 to 18:00	0.48	0.12	0.6
18:00 to 19:00	0.36	0.11	0.48

4.67 Some of the options assessed through this study also contain an account of employment land being delivered within or adjacent to some of the development sites. Where it was considered necessary to include employment land within the assessment this was done using trip rates, based on land use, provided by Warwickshire County Council. These are summarised for B1, B2 and B8 in the following **Table 8** to **Table 10** respectively.

4.68 A modal shift allowance was made for all sites of 10% whilst sites which contained an element of Residential and Employment were subject to a further 10% reduction to allow for internalisation. At this stage the mode shift factor has been applied on the basis that it is in

line with what was adopted during the earlier STA work. These adjustments have been applied only to the new sites being promoted through the local plan.

4.69 No assumptions have been applied to account for the potential shift in background traffic in response to the delivery of enhancements to existing and provision of new sustainable transport services and, as a result, when assessed in the context of the overall demands assigned within the model, these adjustments affect less than 1% of the assigned demand totals within the model.

Table 8: B1 Edge of Town Trip Rates

Period	In	Out	Total
07:00 to 08:00	0.72	0.11	0.82
08:00 to 09:00	1.62	0.12	1.74
09:00 to 10:00	1.03	0.23	1.26
16:00 to 17:00	0.14	1.12	1.26
17:00 to 18:00	0.11	1.51	1.62
18:00 to 19:00	0.04	0.40	0.44

Table 9: B2 Edge of Town Trip Rates

Period	In	Out	Total
07:00 to 08:00	0.16	0.06	0.23
08:00 to 09:00	0.22	0.11	0.33
09:00 to 10:00	0.15	0.14	0.29
16:00 to 17:00	0.11	0.17	0.29
17:00 to 18:00	0.06	0.20	0.25
18:00 to 19:00	0.02	0.06	0.07

Table 10: B8 Edge of Town Trip Rates

Period	In	Out	Total
07:00 to 08:00	0.05	0.04	0.09
08:00 to 09:00	0.05	0.03	0.08
09:00 to 10:00	0.04	0.04	0.07
16:00 to 17:00	0.04	0.06	0.10
17:00 to 18:00	0.02	0.05	0.06
18:00 to 19:00	0.01	0.03	0.04

Results Analysis

Overview

4.70 As has been discussed previously, the assessment work comprised a number of discrete stages and, at each stage, the results analysis that was completed was tailored to ensure that it was proportionate and provided the level of detail necessary with regards the decisions which were to be informed via the modelling.

4.71 In response to the differing needs for each stage of the assessment, a tiered approach to the results analysis was adopted whereby stages 1 and 2 focussed largely on strategic level impacts whilst stage 3 included a more refined set of outputs which reflected the greater level of detail required of the modelling assessment at this stage. An overview of the results that have been extracted and reported is described within the following section:

Number of Runs

4.72 All analysis has been based, consistently, on a minimum of 10 and a maximum of 20 runs per scenario. In all cases 20 runs per period were undertaken and any 'failed' runs discounted.

Network Wide Statistics

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

- **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.

4.74 The first two 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.

Model Stability

4.75 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.

4.76 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 issue 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.

4.77 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 stability within the models frequently improves as development plans evolve and mitigation schemes are refined. This is also partly due to developments within the plan proceeding with applications which enables more localised impacts to be identified and mitigated through the development specific transport assessment work. This level of detail cannot be achieved within a high level strategic assessment. All mitigation proposals will be subject to further detailed assessments, refinements and optimisation through the planning process and it is expected that improved network performance and stability will be realised as a result.

4.78 As has been mentioned previously, 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.

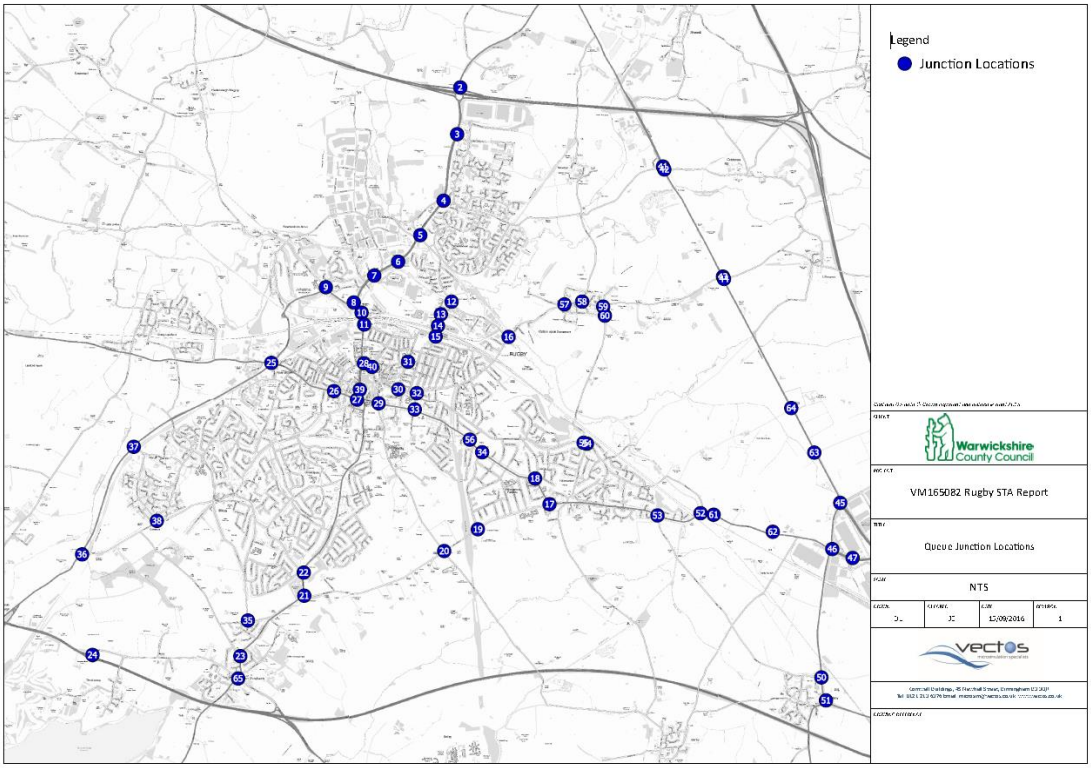
Queue Lengths

4.79 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 network wide analysis as it provides a more detailed picture of the impacts at specific junctions within the model network.

4.80 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. All queues are reported in numbers of vehicles.

4.81 The junctions for which average hourly maximum queue lengths have been calculated and compared are illustrated within **Figure 3.**

Figure 3: RWA Junction Queue Locations



4.82 Junctions where queue differences have not been presented on the maps simply represent junctions which did not trigger any of the assessment criteria across any one approach.

4.83 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, but 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.

4.84 The classifications for the queue length analysis are 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)

Journey Time Analysis

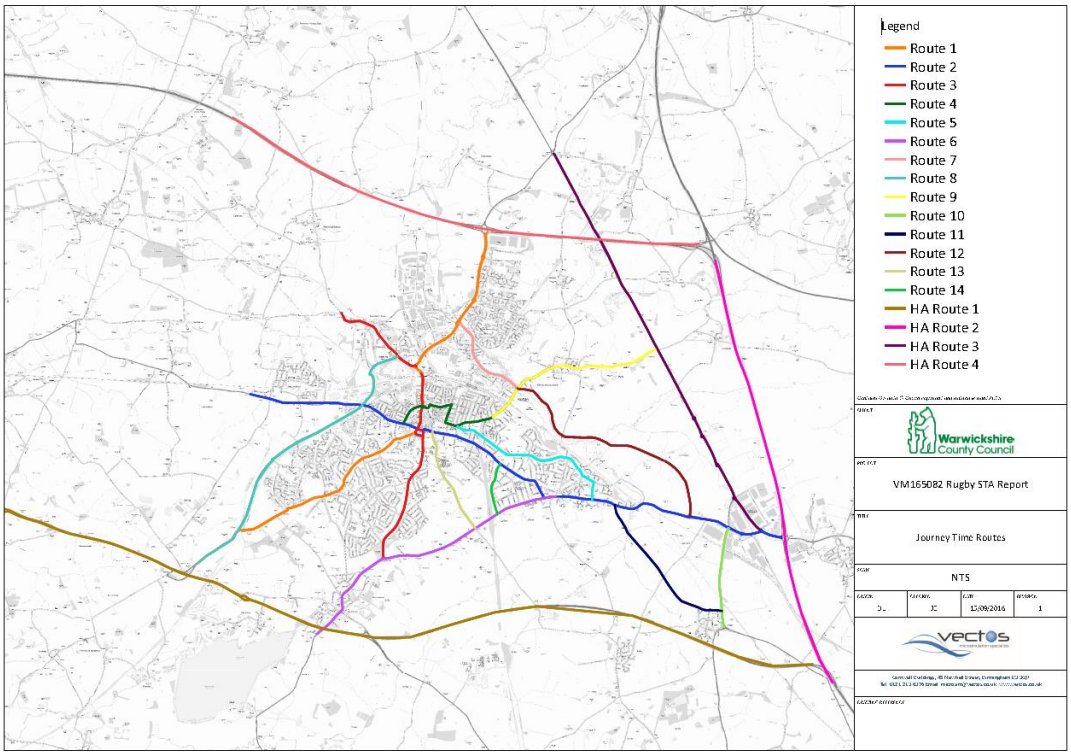
4.85 In addition to the analysis of queue lengths, journey time routes were defined within the modelling and the time it takes vehicles to traverse these routes was collected and presented within the analysis. At that stage the purpose of analysis was simply to ascertain which routes experienced the 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.

4.86 A series of key routes were defined within the model network and these routes have been illustrated within **Figure 4**.

4.87 In order that the impact on delay across various routes can be better understood the routes have been filtered by direction and have been split into sections. 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.

Figure 4: RWA Journey Time Analysis Paths



4.88 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%

4.89 At this stage it was decided to classify journey time differences of between -15% and +15% as not significant. 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 assessment of planning applications a lower threshold may be considered as it would be expected that the mitigation schemes are optimised in that regard.

4.90 The benefit of undertaking delay analysis on key routes, compared to simply reviewing the network wide average journey time and speed, is that it begins to allow a more detailed picture of where the additional delays or journey time improvements are likely to occur.

Detailed Junction Flow/Demand Analysis

4.91 At times within the testing it was determined that the strategic measures used within the standard reporting should be supplemented with detailed analysis of the changes in traffic volumes and demands at key locations within the model network.

4.92 The measures identified previously within this report are those which are considered necessary to support the strategic level assessment of options. They do not, however, provide an indication of the localised impacts associated with the various options.

4.93 Whilst it is not considered necessary, at this stage, to undertake detailed analysis of every location that has been included within the modelled area, there are some areas which have been identified as critical to the overall network operation and, in these cases, a detailed assessment of changes in traffic flows was considered appropriate as an aid to the decision making process.

4.94 In order that the impacts in these areas could be fully understood the average throughput that occurs within the model scenario was compared to the predicted demands for the junction during the same period.

4.95 Junction demands were extracted by running the models with limited congestion effects to obtain a clear picture of the desired routing of traffic through the study area when congestion effects are alleviated.

4.96 To some extent it is hoped that this alleviation will occur, in part, as a result of the localised mitigation strategies, associated with each of the sites that would accompany the delivery of the strategic infrastructure.

4.97 The findings from each of the assessment stages described previously have been presented within the remainder of this Report.

5 STAGE 1 ASSESSMENT

Overview

5.1 The first stage of the assessment work was intended to assess the implications of allocating all sites identified through the SHLAA in terms of both identifying an appropriate highway infrastructure strategy and identifying the residual impacts likely to occur as a result of the development strategy being tested.

Objectives

5.2 The objectives of the first stage of the assessment have been summarised as follows:

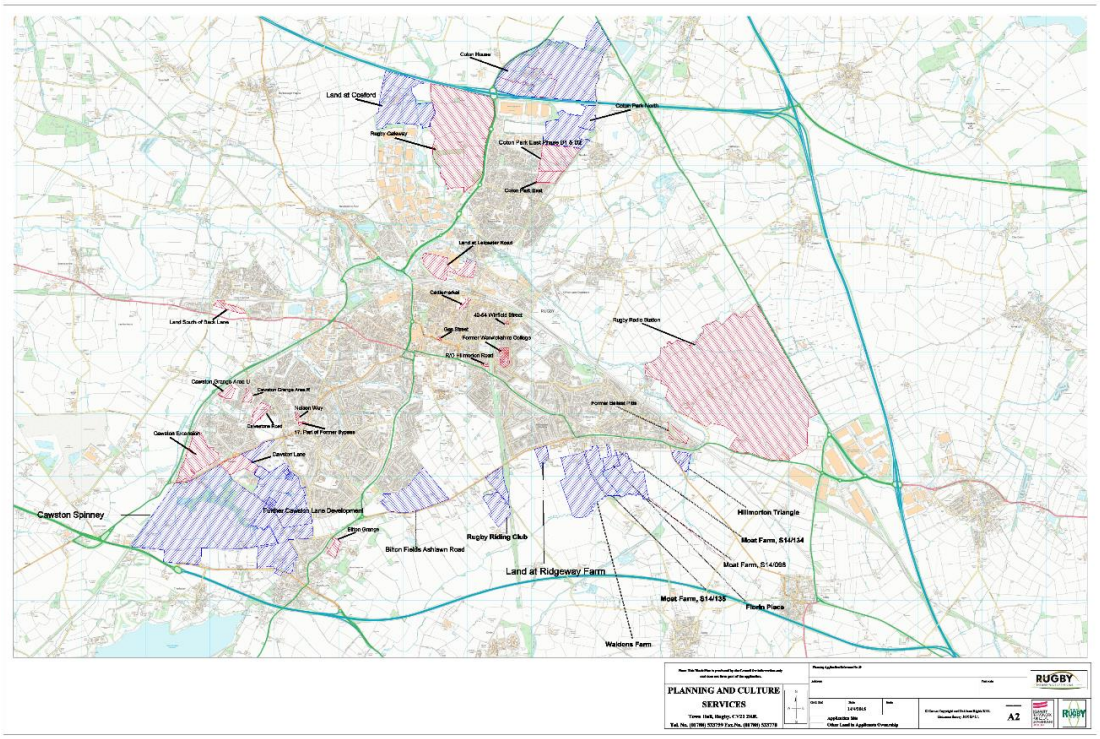
- To assess the impacts of allocating the additional pre-application and SHLAA sites identified in the updated RBC housing trajectory.
- To determine a potential mitigation strategy in response to the emerging impacts identified as a result of the inclusion of the SHLAA housing sites.
- To assess the overall level of network performance predicted to occur once the housing and mitigation strategy has been included within the modelling.

Stage 1 - Demand Forecasting

5.3 The first stage of the assessment involved a review of the impacts of an extensive amount of housing which comprised the full development list identified within the SHLAA.

5.4 An overview of the site locations included within the assessment is provided within **Figure 5** on the following page.

Figure 5: Stage 1 Assessment Site Locations



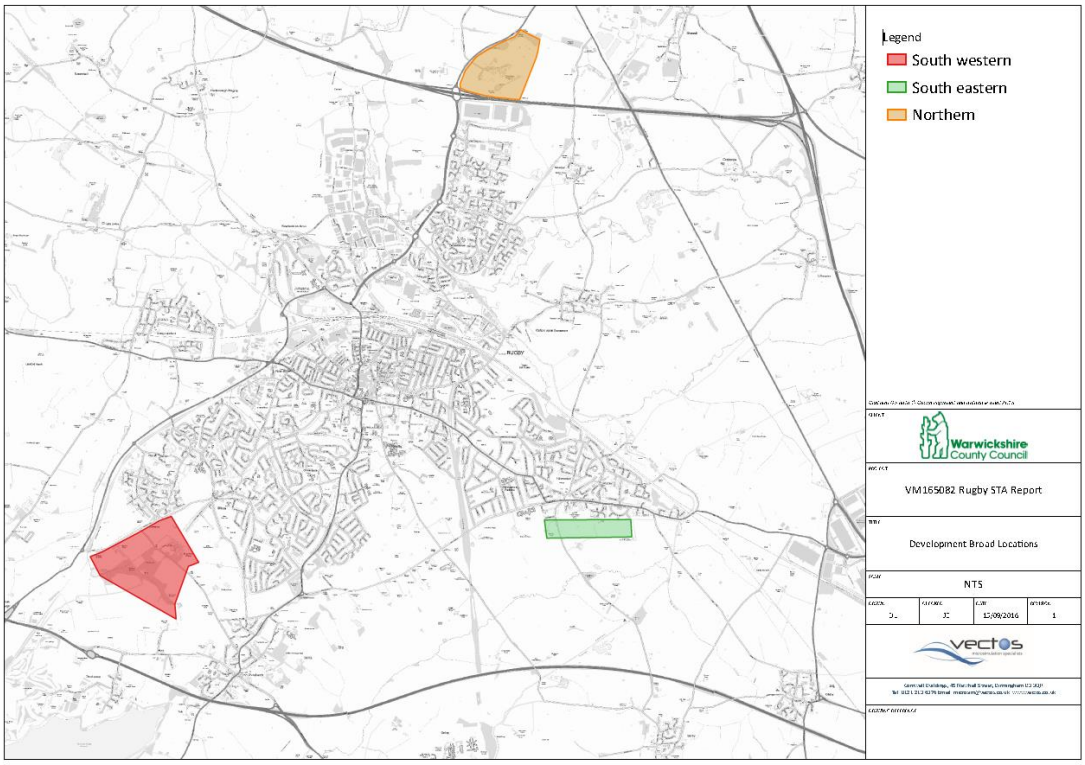
5.5 The previous Figure reveals that the sites covered a significant amount of the study area and, when considered alongside the already allocated/committed sites (outlined in red) represent an extensive spread of development.

5.6 RBC advised that the sites identified through the SHLAA could potentially deliver up to 11754 dwellings. Analysis of the concentration of development across the key sites revealed that, of the 11754 dwellings being tested, 9300 or 80% of the sites could be classified as lying within one of three broad locations:

- Northern Growth – 2024 Dwellings
- South-eastern Growth - 3145 Dwellings
- South-western Growth - 4133 Dwellings & 27.9 Ha employment

5.7 These broad locations are illustrated within **Figure 6** on the following page.

Figure 6: Development Broad Locations



5.8 The growth levels identified for assignment within the model, following adjustments to the TEMPRO database to account for the additional housing, have been summarised within the following **Table 11**:

Table 11 – Stage 1 Adjusted TEMPRO Assumptions

Housing Assumptions	2031 Reference Case		2031 RC + SHLAA Sites	
	AM	PM	AM	PM
2009 to 2010	412		412	
2010 to 2026	3388		3388	
CS Housing Numbers	5879		5879	
SHLAA Sites	-		11754	
Total	9679		21433	
Diff	-		11754	
TEMPRO	**AM**	**PM**	**AM**	**PM**
Growth Factor	1.14	1.16	1.27	1.299
Diff (%)	-	-	13.00%	13.90%

5.9 **Table 11** reveals that the additional houses identified within Stage 1 are predicted to result in an additional increase in traffic volumes of between 13 and 14%. This is on top of the traffic growth already predicted to occur within the Reference case meaning that, overall,

growth within these scenarios is predicted to be close to 30% from 2009 levels once all identified sites are included. This is considered to be a significant increase in traffic volumes, particularly when considering the extent of the study area being considered.

Test Scenarios

5.10 Inclusion of the infrastructure identified previously, alongside the development sites and associated traffic growth, resulted in the following model scenarios being assessed as part of Stage 1:

- **Scenario 01: 2031 RWA Reference Case –** The Rugby Wide Area model forecast to 2031 with growth aligned to the TEMPRO predictions post-adjustment for the revised housing numbers.
- **Scenario 02: 2031 Stage 1 Do Nothing –** The 2031 Reference Case with the sites identified by RBC comprising an additional 11745 dwellings without any additional mitigation.
- **Scenario 03: 2031 Stage 1 Do Something** - The 2031 Reference Case with the sites identified by RBC comprising an additional 11745 dwellings with mitigation.

Stage 1 Mitigation Proposals

5.11 As part of the assessment work, a series of mitigation proposals were included within the model network in an attempt to achieve an acceptable level of operation. The starting point for this work was the 2031 Do Nothing network which was subject to a series of reviews on the new demands had been assigned.

5.12 The process of identifying the infrastructure for inclusion within the model network was iterative with measures being included in response to issues observed of the network and then subject to further optimisation as the network operation began to stabilise.

5.13 It should be acknowledged that the schemes proposed within the modelling have not been subject to any detailed design or safety review at this stage. Furthermore, it should not be assumed that the schemes recommended through this study are fixed and will be delivered in the form described within this report. Rather it is intended that the schemes proposed are outline schemes which may change through further optimisation and detailed design that

will precede the final delivery. Thus the concept and location of the schemes are considered fundamental rather than the precise form at this stage.

5.14 Throughout the modelling exercise, signals times have been refined and optimised, in some cases through the use of signal plans. It is expected that specific requirements to optimise signalised junctions will be identified during the detailed planning phase associated with one or more of the proposed site allocations.

5.15 The infrastructure proposals largely comprise individual junction enhancements and network amendments included in response to issues identified in the model network. Additionally however it was identified at an early stage that, to accommodate the level of housing identified within the southeast and southwest of the study area, a new distributor link would be required to ensure that the development trips could access the highway network as well as improving the dispersion of traffic in an attempt to mitigate some of the impacts identified.

5.16 Further details on the assumptions incorporated within the Do Something scenario network are provided as follows:

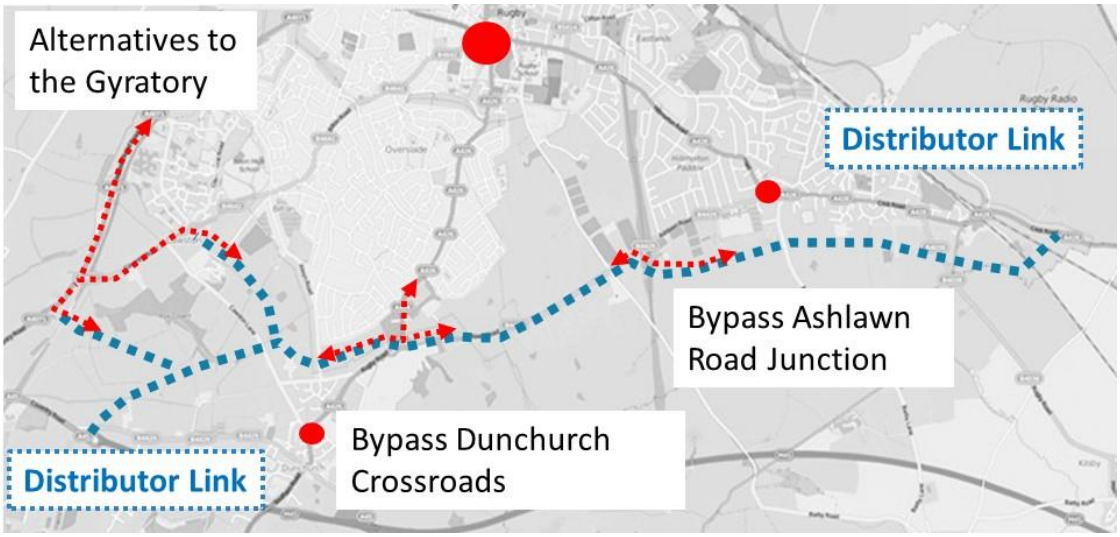
Southern Distributor Link

5.17 As has already been mentioned, the large quantum of development to the southeast and southwest of Rugby was identified as likely to induce severe impacts on the transport network at an early stage.

5.18 As a result, a distributor link was included within the assessment which was intended to minimise some of the impacts identified as a result of the traffic growth via the provision of additional highway capacity coupled with improved dispersion of traffic to/from the sites to the south.

5.19 The alignment of the distributor road was also considered beneficial insofar as it enabled some key existing congestion hot-spots to be bypassed. An overview of the link alignment and the potential hot-spots that the link road could relive, by providing alternative routes for new and existing traffic, is illustrated within **Figure 7** on the following page.

Figure 7: Southern Distributor Link Initial Alignment and Benefits



Additional Mitigation Measures

5.20 Testing in Stage 1 revealed that the southern distributor link alone was not likely to be sufficient in providing an acceptable level of network operation and, as a result, additional measures were identified and included within the modelling to create the final Do Something model scenario.

5.21 An overview of the location of these measures, alongside a description of what has been assumed in each scenario, has been provided within the following **Figure 8** and **Table 12** respectively:

Figure 8: Mitigation Scheme Locations

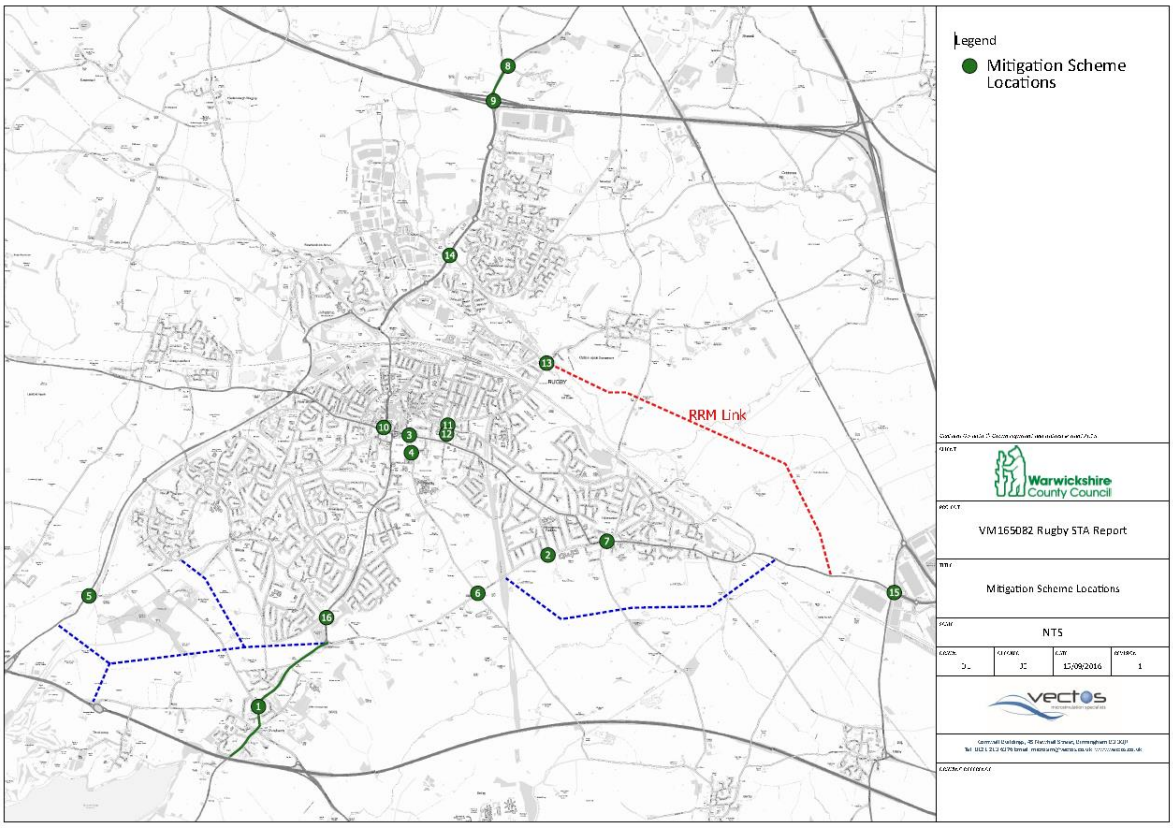


Table 12: Stage 1 Mitigation Summary

Ref	Scheme	Description
1	Dunchurch Signposting	Sign posting of traffic away from Dunchurch via the southern distributor link
2	Ashlawn Road	Signposting of traffic away from Ashlawn Road/Hillmorton Road via southern distributor link
3	Hillmorton Road Ped crossing	Pedestrian crossing on Hillmorton road (w of Barby Road) set to sync with new Gyratory crossing to the west of existing crossing
4	Leisure Centre Access	Opening up of southern link into Leisure Centre
5	Potford Dam roundabout	Widening of roundabout approaches and between the existing roundabout and southern distributor link
6	B4429/Onley Lane/Barby Road widening	Junction widening and introduction of right turn bays on all approaches
7	Barby Lane/Ashlawn Road Roundabout	Reconfiguration of junction to roundabout configuration
8	M6 to Coton House	Dualling between M6 J2 and new development access
9	M6 J1	Signal optimisation and re-lining to enable vehicles to travel NB using two lanes
10	Rugby Gyratory	De-activation of queue detector on Corporation street
11	Clifton Road/Lower Hillmorton Road	Part signalisation of roundabout
12	Whitehall Road Pedestrian crossing	Introduction of pedestrian crossing on Whitehall Road to 'gate' traffic in response to queuing on Hillmorton Road WB
13	Butlers Leap/Clifton Road	Optimisation of signal proposals
14	A426/Brownsover roundabout	Widening to three lanes south and north of roundabout to increase NB vehicle throughput
15	A5/A428 'Half-way house' roundabout	Part-signalisation of the roundabout
16	Dunchurch Road/Sainsbury's Roundabout	Widening of all approaches to roundabout to increase throughput

Sustainable Transport

5.22 The exercise currently being undertaken assumes that a standard 10% mode shift target will be applied to the new sites. This affects new Local Plan demands only and, in reality, accounts for less than 1% of the assigned model demands in any option (i.e. is not likely to be significant).

5.23 This document has focussed on the highway network mitigation required in order to achieve an acceptable level of network performance when considering RBC's Local Plan allocation. The exercise has been based around modelling outcomes which primarily focus on car based

trips. However, there are wider ranging sustainable transport issues which need to be considered in conjunction with this report

5.24 It is critical that sustainable transport improvements form part of the mitigation package to support the housing and employment growth proposals within Rugby Borough. Such improvements will:

- Contribute towards the delivery of sustainable development within the District;
- Maximise the number of journeys made by sustainable transport modes from trips generated as a result of new development;
- Reduce the impact of car based travel on the local and strategic highway network;
- Deliver an integrated approach to transport provision to serve new development; and
- Contribute towards the aims and objectives of the Borough Council's Garden Towns, Villages and Suburbs Prospectus.

5.25 A 'Do Minimum' infrastructure strategy is presented for the town concerning highway infrastructure which means that the Local Plan can be adopted with confidence regarding infrastructure proposals, but it should be recognised that there would be significant value attributable to the determination of an overall Borough-wide transport strategy which would ideally be identified during the initial years of the plan period post-adoption. It is not considered that the lack of a transport strategy, at this stage, should preclude the plan progressing as it is anticipated that any strategy that is promoted would, ultimately, seek to reduce traffic levels compared to those reported within the following sections of this report and, therefore, these impacts should be seen as a 'worst case'.

5.26 There will be sufficient time post Local Plan adoption, to enable a more thorough strategy to be determined which maximises opportunities for sustainable transport measures and reduced car based trips across the town centre.

5.27 It is recommended some funding should be secured through the delivery of the housing sites allocated through the Local Plan to ensure that the operation of the network can be safeguarded against any unforeseen transport impacts. This money should also be targeted to ensure that the opportunities for encouraging a greater adoption of sustainable modes, and therefore discouraging car trips within the same areas, are maximised.

Scenario 02: Do Minimum Assessment

5.28 As has been mentioned previously, the first phase of the assessment involved the assignment of the development demands onto the model network without any additional infrastructure. This scenario represented the Do Minimum scenario and was used as the starting point for the determination of the infrastructure requirements necessary to support the growth levels associated with the development strategy.

5.29 It should be noted that the assignment of the development demands onto the model network without any additional infrastructure resulted in a significant level of growth in traffic volumes which, in turn, resulted in the network becoming over-capacity. The capacity issues occurred primarily within the PM period where traffic volumes are higher and the peak of traffic levels is more prolonged within the model period.

Model Stability

5.30 An assessment of the model stability levels exhibited in each scenario clearly demonstrated the issue highlighted within the Do Minimum scenario. The stability levels recorded in each scenario, for both AM and PM time periods, is presented within the following **Table 13**:

Table 13: Stage 1 Model Stability Assessment 2031 Reference vs. Do Min/Do Some

	2031 Ref Case	2031 S1 Do Min	2031 S1 Do Some
AM	100%	100%	100%
PM	100%	0%	100%

5.31 The analysis of the model stability reveals that, without the mitigation measures, the PM model will not operate at a satisfactory level meaning congestion levels continue to build and delays increase exponentially. On that basis it was not considered appropriate to undertake any further, more detailed, analysis of the Do Minimum Scenario since delays and congestion are likely to be too high to yield realistic comparisons between these scenarios and the Reference Case.

5.32 Thus the remainder of the analysis focuses on the comparisons between the Reference Case and the Development Do Something scenarios only.

Network Wide Statistics

5.33 The network wide statistics were assessed for both the 2031 RWA Reference Case and the 2031 Stage 1 Do Something scenario. A summary of these values is presented within the following **Table 14** and **Table 15** for the AM and PM respectively.

Table 14: Network Stats 2031 Ref Case vs. 2031 Stage 1 Do Something AM (07:00 to 10:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	117083	60	673
Do Something	122127	50	790
Diff	4.3%	-16.7%	17.4%

Table 15: Network Stats 2031 Ref Case vs. 2031 Stage 1 Do Something PM (16:00 to 19:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	131622	61	626
Do Something	141339	53	716
Diff	7.4%	-13.1%	14.4%

5.34 Analysis of the results presented within the previous tables reveals that the inclusion of the developments results in an increase in journey times of around 14 to 17% whilst speeds on the network reduce by a similar magnitude. Whilst some reductions are inevitable as a result of the inclusion of additional traffic on the network, the impacts identified here are likely to be symptomatic of residual issues on the network which occur in spite of the mitigation measures identified thus far.

5.35 The tables also reveal that the number of trips which complete within the model periods increases by 4.3% and 7.4% in the AM and PM periods respectively. Because of the inclusion of the additional sites, traffic volumes within the Do Something scenarios are around 13% higher than the Reference Case. When considering the AM results in particular, this indicates that only around 1/3 of the additional trips assigned to the network complete within the model period meaning that the mitigation strategy is not likely to accommodate the additional traffic on the network.

Maximum Queue Length Analysis

5.36 The following sets out some initial observations based on the differences in queue lengths between the Reference Case and the Do Something scenario. The comparison between

queuing levels in the Reference Case and Do Something scenario have been illustrated for the AM and PM time periods within **Figure 9** and **Figure 10** respectively.

Figure 9: AM Period Maximum Queue Length Comparisons (Ref Case vs. Do Some)

Figure 10: PM Period Maximum Queue Length Comparisons (Ref Case vs. Do Some)

5.37 Analysis of the difference in queuing levels recorded within the two scenarios reveals the following:

- Despite the mitigation measures there is only one instance of queues reducing (Dunchurch Road/Sainsburys roundabout).
- The AM network experiences increases in queuing on the route to the west of Rugby, most likely as a result of developments in the southwest using this route to the M6.
- There is a cluster of queuing increases within the town centre during both the AM and PM model periods.
- During the AM there are very severe increases in queuing experienced at Barby Road/Ashlawn Road and the Newton Manor Lane/A426 roundabout.
- During the PM there is a very severe increase in queuing at the Ashlawn Road/Hillmorton Road junction despite the relief provided by the southern distributor link.

Journey Time Analysis

5.38 The following sets out some initial observations of journey time impacts identified when comparing the time it takes, between scenarios, to traverse a series of pre-defined routes within the model network. The comparison between queuing levels in the Reference Case and Do Something scenario have been illustrated for the AM and PM time periods within **Figure 11** and **Figure 12** respectively.

Figure 11: AM Peak Average Journey Time Analysis (Ref Case vs. Do Some)

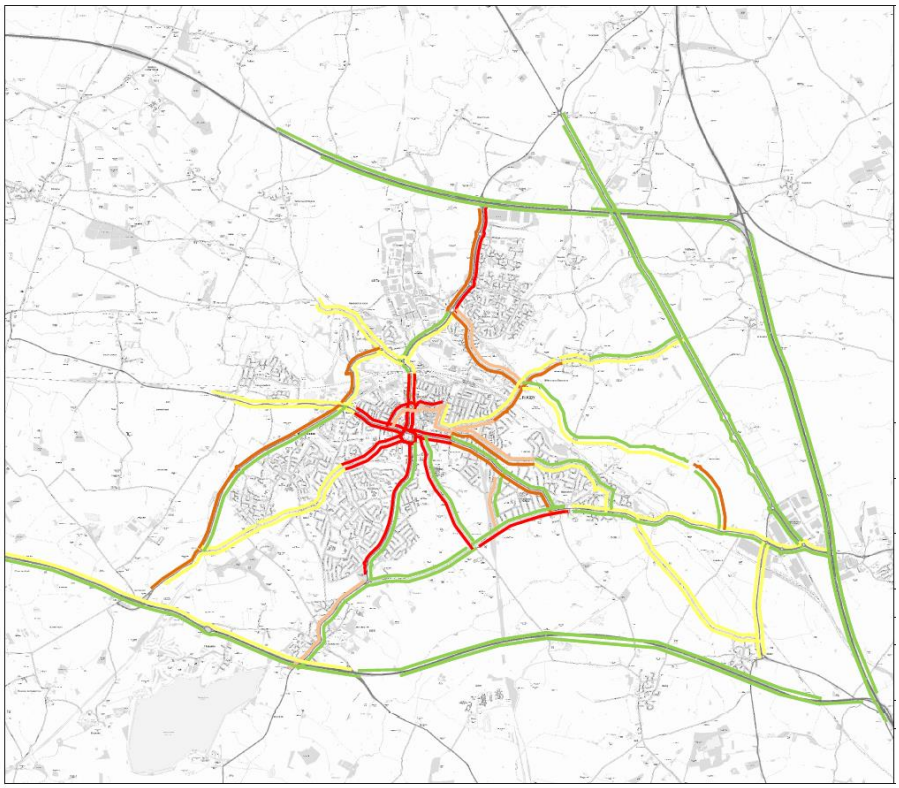
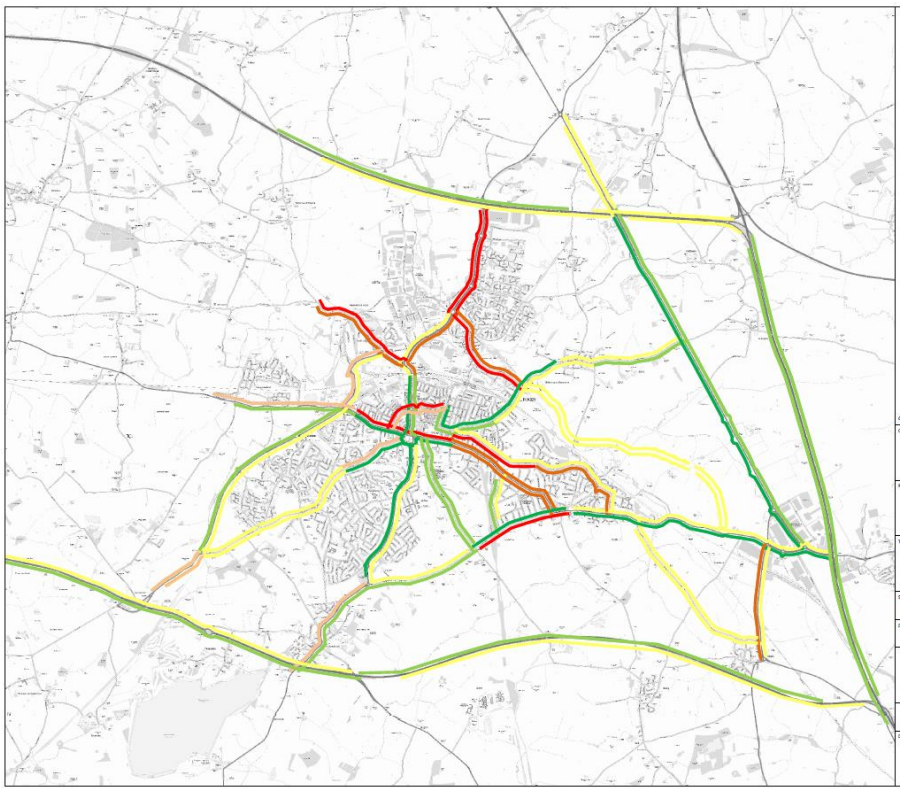


Figure 12: PM Peak Average Journey Time Analysis (Ref Case vs. Do Some)



5.39 Analysis of **Figure 11** presented previously reveals the following:

- During the AM there are clearly significant issues arising from the convergence of flows at the Gyratory within central Rugby. Previous analysis of this junction has indicated that there is little else that can be done in this location to provide additional capacity.
- This indicates that the distributor link does not provide sufficient relief to the Gyratory from traffic approaching the junction from either the north or the south.
- During the AM, journey times to the West of Rugby increase, most likely due to AN increase in traffic travelling towards the M6 from the housing located in the Southwest.
- During the AM there are also issues north of Rugby along the A426, potentially some of these impacts could be alleviated by signalisation of the roundabouts in this section of the corridor.
- There are also issues at the Butler's Leap/Rugby Road junction, similar to the Gyratory, it is unclear whether there are any other options for mitigation in this area that could be delivered due to the physical constraints in the area as well as land availability.

5.40 Analysis of **Figure 12** presented previously reveals the following:

- During the PM the Gyratory does not appear to induce the same level of constraint. There are, however, severe impacts occurring just east of the Gyratory, which is directly attributable to the performance of the Clifton Road/Whitehall Road roundabout as well as the Hillmorton Road/Whitehall Road roundabout.
- Journey times are also adversely affected on the approaches, from the north, to Avon Mill roundabout, as well as further north on the A426 corridor.
- Journey times suffer on this section of the A426 because it represents the primary route between Rugby and the M6. Prior to this section of the A426 there are a number of routes that vehicles can choose (via A426, via Clifton Road/Butlers Leap,

via the new RRM link road and via the RWRR and Brownsover Road) which means the effects are dissipated south of this section.

Stage 1 - Summary of Findings

5.41 The following findings have been determined as a result of the completion of the Stage 1 testing.

5.42 When reviewing network stability it is apparent that the mitigation measures identified are essential to accommodate the level of development identified and, even then, there is likely to be a significant level of residual impact retained on the network.

5.43 It is likely that the PM network performance is worse because of the constant loading pattern with regards trip profiling. During the AM there is a noticeable peak of traffic within the peak hour which then dissipates, during the PM the trip loading pattern is more constant between the 16:30 to 18:30 period meaning the network is under stress for a much longer period.

5.44 When mitigated, the PM network performance improves substantially and the mitigation ensures the PM network is stable but the journey time and queuing analysis have indicated that, in spite of the apparent stability, severe increases in both queuing and delay are prevalent across the network.

5.45 In spite of the additional mitigation, there are a number of areas which appear to suffer from congestion and delays as a result of the inclusion of the additional housing, these include:

- The Gyratory
- The A426 between Avon Mill and the M6
- Clifton Road and specifically the junction with Butlers Leap to the north and Whitehall Road to the south.

Stage 1 – Conclusions

5.46 Based on the analysis completed through stage 1, the following conclusions were identified.

- To deliver the level of housing identified to the south of Rugby, provision of the Southern Distributor Link should be considered as critical and, furthermore, if

housing is to be delivered to the southwest and southeast then the link should be provided in full.

- In spite of the mitigation that has been proposed, there are still likely to be a number of residual impacts which occur on the network. Some of these impacts, such as the congestion levels around the Gyratory, along Clifton Road and along the A426 between Avon Mill and the M6 are likely to be considered severe.
- The performance of the Gyratory potentially represents one of the biggest constraints to growth on the network. Options for highway interventions in this area are limited and consideration should be given to options which either divert traffic away from this junction or reduce the number of car based trips to the town centre, from the new sites, altogether.

5.47 The analysis indicates that the level of housing that has been tested in stage 1 is likely to generate traffic levels which reach and in some cases exceed, the network capacity even once mitigation measures have been assigned.

5.48 The location of the developments in the broad locations identified (southeast, southwest and north) appear to elicit a limited level of localised impacts, rather the majority of impacts occur away from the developments in areas where congestion problems either already exist or have been forecast as likely to occur in the future anyway. Thus it can be concluded that the development locations are potentially favourable in terms of transport impacts, so long as they are delivered alongside the associated mitigation measures identified, but the quantum of development may be too high to be accommodated without some severe residual impacts.

5.49 Based on the findings from this stage of analysis, it was determined that the next stage of the assessment should focus specifically on the impacts of allocating less development than was identified in Stage 1 but retaining the strategy of allocating development across the three broad locations identified previously. This work comprised the stage 2 assessment and is presented within the subsequent chapter of this report.

6 STAGE 2 ASSESSMENT

Overview

6.1 Since one of the key findings from Stage 1 was that allocation of all of the housing numbers identified would result in a high number of residual impacts, the second stage of the assessment work was intended to identify the likely impacts, on the highway network, of concentrating development across three key areas of Rugby (North, Southeast and Southwest). This work also began to look in more detail at the potential access strategies for some of the sites identified and also reviewed the mitigation measures assumed in the work thus far as well as any additional measures also identified.

Objectives

6.2 The objectives of the second stage of the assessment have been summarised as follows:

- To assess the impacts of allocating additional housing sites based on a principle of broad locations.
- To identify a potential mitigation strategy in response to the emerging impacts associated with each of the housing options.
- To assess the overall level of network performance predicted once the housing and mitigation strategy has been included within the network.

Stage 2 - Demand Forecasting

6.3 As with Stage 1, a critical element of the second stage of the assessment was the derivation of forecast demands for assignment onto the model network.

6.4 The housing allocation strategies that were to be tested were split into the following:

- Key and upcoming developments – development sites considered by RBC to be highly likely to come forward in the short term and therefore likely to be a material consideration in any forthcoming housing allocation strategy.
- Area specific housing sites – development sites considered based on discrete areas (North, Southwest and Southeast).

6.5 As a result of the perceived status of the key and upcoming sites, these were included in all of the assessment options and then the area specific housing sites were added on top.

6.6 As a result of this approach the following housing numbers were assumed in each strategy:

- Key and upcoming developments – approximately 2200 dwellings including around 1300 houses in the southwest area and 900 houses to the North of Rugby and south of the M6.
- North Allocation – approximately an additional 2000 dwellings allocated to the north of Rugby and North of the M6.
- Southwest Allocation – approximately an additional 3400 dwellings allocated to the southwest of Rugby.
- Southeast Allocation – approximately an additional 3900 dwellings allocated to the southeast of Rugby.

6.7 The resultant housing projections assumed within each option, alongside the corresponding growth facts assigned to the model network, are summarised within the following **Table 16**

Table 16 – Stage 2 Housing and Adjusted TEMPRO Assumptions

Housing Assumptions	2031 Reference Case		2031 North Allocation		2031 Southwest Allocation		2031 Southeast Allocation	
	AM	PM	AM	PM	AM	PM	AM	PM
2009 to 2010	412		412		412		412	
2010 to 2026	3388		3388		3388		3388	
CS Housing Numbers	5879		5879		5879		5879	
Key Sites	-		2204		2204		2204	
Area Specific	-		2024		3383		3861	
Total	9679		13907		15266		15744	
Diff	-		4228		5587		6065	
TEMPRO	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Growth Factor	1.14	1.16	1.186	1.207	1.201	1.223	1.206	1.229
Diff (%)	-	-	4.38%	4.80%	5.86%	6.42%	6.37%	6.99%

6.8 The previous table reveals that the increase in growth levels, over and above the reference case, ranges from around 4.3% to 7% across the various scenarios/time periods. Unsurprisingly growth levels are highest within the Southeast option since this scenario

contains the highest housing levels whilst the additional increase in traffic growth is lowest in the Northern option since this contains the lowest housing numbers.

6.8.1 The distribution of housing that has been assumed in each option is illustrated within the following **Figure 13** to **Figure 15** respectively.

Figure 13: North Option – Housing Distribution

Figure 14: Southwest Option – Housing Distribution

Figure 15: Southeast Option – Housing Distribution

D

Test Scenarios

6.9 Inclusion of the infrastructure identified previously, alongside the development sites and associated traffic growth, resulted in the following model scenarios being created and tested:

- **Scenario 1: 2031 RWA Reference Case –** The Rugby Wide Area model forecast to 2031 with growth aligned to the TEMPRO predictions post-adjustment for the revised housing numbers.
- **Scenario 02: 2031 RWA North Allocation–** The 2031 Reference Case with the additional key sites and development sites to the North included.
- **Scenario 03: 2031 RWA Southwest Allocation–** The 2031 Reference Case with the additional key sites and development sites to the Southwest included.
- **Scenario 04: 2031 RWA Southeast Allocation–** The 2031 Reference Case with the additional key sites and development sites to the Southeast included.

Stage 2 Mitigation Proposals

Overview

6.10 As with Stage 1, part of the assessment process involved the identification of mitigation measures for inclusion within the model network. Through Stage 1, sixteen potential mitigation schemes were identified for inclusion within the assessment, these have been summarised previously within **Table 12** of this Report.

6.11 During the network review process completed through Stage 2, a number of additional schemes were also identified.

6.12 Additionally, it was not considered necessary for the Southern Distributor Link to be included within all of the model scenarios. Sections of the link were identified as necessary dependent upon the distribution option being assessed. Details on the assumptions around the link road as well as the new mitigation measures identified are provided within the following sections of this Report.

Southern Distributor Link Amendments

6.13 The status and role of the link road was reviewed within each individual option, this subsequently revealed the following for each housing distribution option tested.

North Allocation

6.14 Since the distributor link is predominantly required to distribute traffic associated with the sites in the south it was not considered necessary to include the link in the option which allocated the majority of the housing to the North.

6.15 It was clear that the link would deliver some benefits when considering that there are around 1300 houses located in the southwest in every option but the land requirements are such that the link alignment runs through the areas of land allocated for development specifically within the southwest option. If these areas are not promoted for housing then it is likely to be very difficult to deliver a link through the land and, furthermore, the cost would be out of scale with of the developments being considered.

6.16 As such, whilst the link does benefit the sites in the north simply through the provision of additional network capacity, land and cost issues mean that, without a significant concentration of development in the area, it is unlikely that the link could be brought forward.

Southwest Allocation

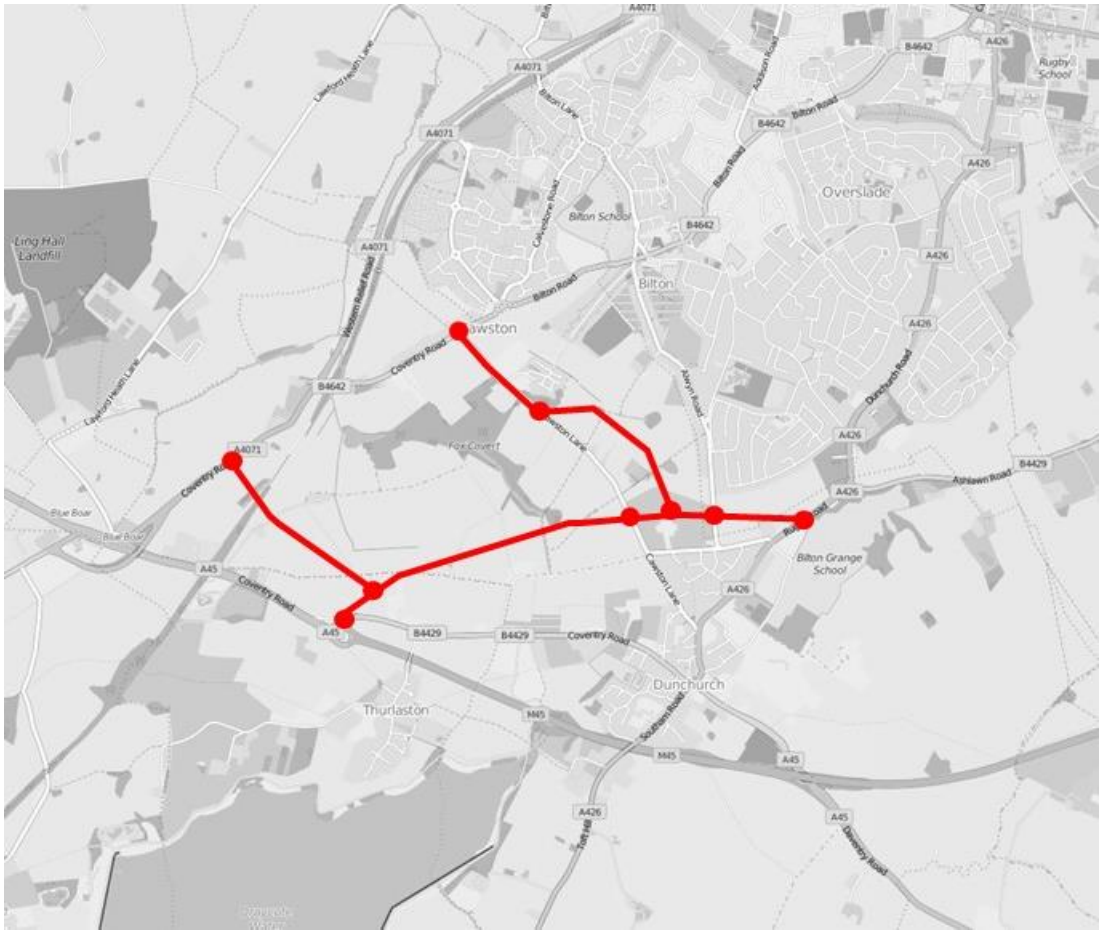
6.17 The southwest option includes delivery of almost 3800 dwellings in between the A426 Rugby Road and the A4071 Western Relief Road as well as a further 1000 approx. dwellings located off the B4429 Ashlawn Road to the West.

6.18 Within this land it is possible to deliver the southwest section of the distributor link which connected the A426 Rugby Road, the A4071 Western Relief Road and Cawston Lane and Alwyn Road together.

6.19 Analysis of the network conditions within the Do Minimum scenario (i.e. development trips but no additional mitigation) revealed that connecting these routes up via a link road had significant benefits in terms of the alleviation of congestion impacts as well as enabling better distribution of development traffic.

6.20 As a result a partial link road arrangement was adopted within the Southwest option assessment which followed the indicative alignment illustrated within the following **Figure 16**:

Figure 16: Southwest Link Road – Indicative Alignment



Southeast Allocation

6.21 Similar to the Southwest allocation scenario, when reviewing the network operation with the sites in the southeast included it was apparent that delivery of a section of the link between the B4429 Ashlawn Road and the A428 Crick Road was essential in order that traffic could distribute to/from the sites included within the assessment.

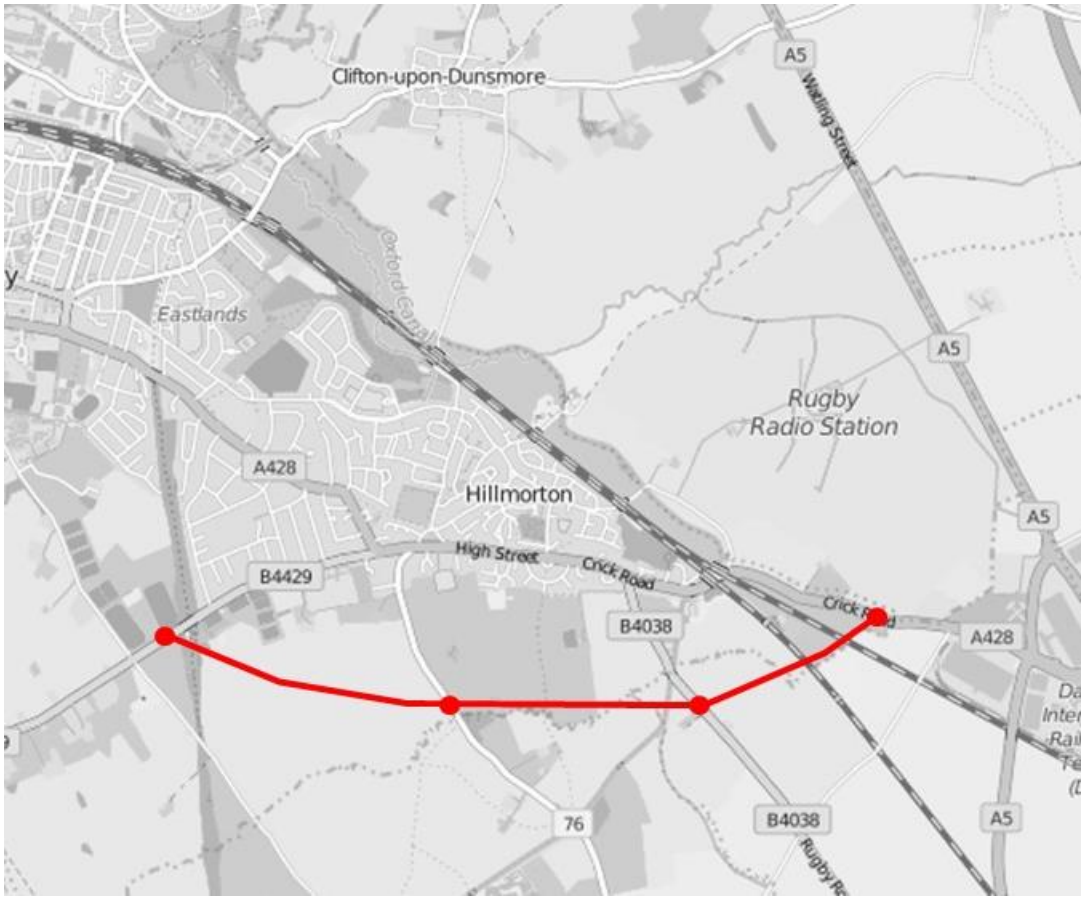
6.22 Again, due to the coverage of the sites identified, it is also possible to deliver a significant amount of the link road within the boundaries of the proposed development sites.

6.23 However, when compared to the southwest option, the link road alignment assumed within the southeast testing has a greater proportion of the route outside of the area of land

allocated for development meaning it is likely to be harder to deliver than the southwest element tested in the previous option.

6.24 As a result a partial link road arrangement was adopted within the Southeast option assessment which followed the indicative alignment illustrated within the following **Figure 17**:

Figure 17: Southeast Link Road – Indicative Alignment



6.25 It should also be recognised that land constraints and upcoming developments may mean that the link would need to connect on to the A5 rather than the A428, as illustrated previously, although this would not substantially change the nature of the route being proposed.

Additional Mitigation Measures

6.26 As has been mentioned previously, the original assessment work identified an initial 16 mitigation proposals as being necessary to mitigate the impacts associated with the delivery

of the local plan sites. Subsequently, through the testing completed in Stage 2, the following mitigation measures/refinements were identified:

- Full Signalisation of M6 Junction 1
- Signalisation of M45/A45 Junction
- A426/Central Park Drive roundabout widening and potential signalisation
- A426/Newton Manor Lane roundabout widening and potential signalisation
- A4071 RWRR/Cawston Grange Drive roundabout widening

Mitigation Assumptions

6.27 Originally the testing had assumed that all mitigation measures were included, however, through the appraisal of each option, the measures were assigned based on the distribution of development. It was also possible to grade the schemes based on the following criteria:

- Essential – Scheme delivery is considered to serve a role of strategic significance in accommodating the growth strategy and is essential to minimise development impacts.
- Recommended – A scheme considered likely to deliver local and strategic benefits but more work is required to determine precise composition and/or delivery requirements.
- Considered – A scheme likely to deliver local benefits which may be necessary to mitigate specific development impacts but not considered to be strategically significant.

6.28 The criteria assigned to each scheme based on each option under consideration, has been summarised within **Table 17** on the following page.

6.29 At this stage it should be recognised that the majority of schemes represent an initial set of concept proposals and have been identified through a review of the model operation. It is envisaged that the scheme proposals would be subject to further refinement and optioneering throughout the local plan delivery period.

Table 17: Option Mitigation Strategy

Scheme	North	Southwest	Southeast
Dunchurch Signposting		Essential	
Ashlawn Road signposting			Essential
Hillmorton Road Ped crossing	Recommended	Recommended	Recommended
Leisure Centre Access	Recommended	Recommended	Recommended
Potford Dam roundabout		Essential	
B4429/Onley Lane/Barby Road widening			Essential
Barby Lane/Ashlawn Road Roundabout			Essential
M6 to Coton House	Essential		
M6 J1	Essential	Recommended	Recommended
Rugby gyratory	Essential	Essential	Essential
Clifton Road/Lower Hill Morton	Recommended	Recommended	Recommended
Whitehall Road Pedestrian crossing	Recommended	Recommended	Recommended
Butlers Leap/Clifton Road	Recommended	Considered	Considered
A426/Brownsover roundabout	Essential	Considered	Considered
A5/A428 'Half-way house' roundabout			Essential
Dunchurch Road/Sainsbury's Roundabout		Essential	
South-western link		Essential	
South-eastern link			Essential
Full signalisation of M6 J1	Essential	Recommended	Recommended
Full signalisation of M45/A45		Recommended	
A426/Central Park Drive	Essential	Recommended	Recommended
A426/Newton Manor Lane	Essential	Recommended	Recommended
Cawston Grange Drive/A4071		Essential	

Avon Mill/Hunters Lane

6.30 All scenarios which have been tested assume the delivery of some development to the North and, as a result, it is pertinent to highlight that the delivery of the Avon Mill/Hunters Lane improvement scheme proposals which are included in all modelled scenarios should be considered a pre-requisite of delivering development to the north along the A426 corridor.

6.31 At the time of writing this Report, WCC has advised that funding is still being sought to aid delivery of the scheme proposals and, as such, it should be highlighted that contribution towards the scheme in this area will also be required to ensure the developments identified, and particularly those to the north, can come forward.

Mitigation Scenarios

6.32 As with Stage 1, two infrastructure scenario have been tested for each option:

- **Do Minimum -** with just the sites and access strategies included
- **Do Something –** inclusive of the aforementioned mitigation strategy

Stage 2 Results Analysis

6.33 The following section of this report sets out the findings from the analysis of the results extracted from each of the scenarios derived through the Stage 2 assessment. The impacts and analysis of each option has been set out separately.

North Allocation Assessment

Model Stability

6.34 An assessment of the model stability levels exhibited in the North allocation scenarios, for both AM and PM time periods, is presented within the following **Table 18**:

Table 18: Stage 1 Model Stability Assessment 2031 Reference vs. North Do Min/Do Some

	2031 Ref Case	2031 North Do Min	2031 North Do Some
AM	100%	90%	80%
PM	100%	55%	100%

6.35 The analysis of the model stability reveals that the performance of the Do Minimum network was particularly poor with high levels of instability. Whilst the AM stability is considered acceptable within a range of 80% to 100% the 55% recorded within the PM period is indicative of inherent problems within the Do Minimum PM network.

6.36 As with the analysis undertaken in Stage 2, it was not considered appropriate to provide further detail on the performance of the Do Minimum network since the high instability would yield unrealistic/unreliable results from which no firm conclusions could be drawn.

Network Wide Statistics

6.37 The network wide statistics were assessed for both the 2031 RWA Reference Case and the 2031 Stage 1 Do Something scenario. A summary of these values is presented within the following **Table 19** and **Table 20** for the AM and PM respectively.

Table 19: Network Stats 2031 Ref Case vs. 2031 North Do Something AM (07:00 to 10:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	117083	60	673
Do Something	116466	51	770
Diff	-0.53%	-15.00%	14.41%

Table 20: Network Stats 2031 Ref Case vs. 2031 North Do Something PM (16:00 to 19:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	131622	61	626
Do Something	135499	56	684
Diff	2.95%	-8.20%	9.27%

6.38 Analysis of the results presented within the previous tables reveals that the inclusion of the developments results in an increase in journey times of between 15% and 10% in the AM and PM respectively. Similarly the average speeds reduce by a comparable magnitude across the two periods.

6.39 Notably, when considering the completed trips, the number reduced in the AM even with the additional mitigation on the network, this indicates that significantly more mitigation measures will be required to enable the demands identified to be accommodated within the highway network.

6.40 Similarly, within PM the magnitude of increase is far lower than the total growth in traffic volumes between the two options indicating that additional mitigation measures are required to limit the impact of traffic generated by this option.

Maximum Queue Length Analysis

6.41 The following sets out some initial observations based on the differences in queue lengths between the Reference Case and the North Do Something scenario.

6.42 The comparison between queuing levels has been illustrated for the AM and PM time periods within **Figure 18** and **Figure 19** respectively.

Figure 18: AM Period Maximum Queue Length Comparisons (Ref Case vs. North Do Some)

Figure 19: PM Period Maximum Queue Length Comparisons (Ref Case vs. North Do Some)

6.43 Analysis of the previous figures reveals:

- The majority of impacts appear concentrated to the North and along the A426
- The scheme proposals at the A426/Brownsover Lane junction appear to have reduced the scale of impact at this junction but the remaining two junctions on the A426 clearly require further mitigation:
    - A426/Central Park Drive/Gateway Northern Access
    - A426/Newton Manor Lane/Gateway Southern Access
- In addition to the A426 junctions, the development option appears to elicit an impact at M6 Junction 1 and this is in spite of the introduction of further signal optimisation. It is reasonable to conclude that full signalisation of the M6 Junction 1 will be essential.
- In both the AM and PM periods, queue increases are observed in the area of Rugby Gyratory. It is unlikely that these can be mitigated due to the constraints on options for delivering further transport mitigation measures in this area beyond the proposals delivered in 2015.

Stage 2 North Assessment Conclusions

6.44 Based on the initial assessment of the North allocation option, the following conclusions have been identified:

- The allocations tested in the North option compound the concentration of the majority of the impacts along the A426 to the north of Rugby.
- The modelling analysis indicates that the scheme proposals at the A426/Brownsover Lane junction will likely mitigate the development impacts but there is a need for further mitigation measures to be delivered at a number of other junctions along the A426.
- It is reasonable to conclude that full signalisation of the M6 J1 will be required if the housing is allocated to the north of the motorway, as has been proposed within this option.

- Some impacts within the Town Centre have limited opportunity for mitigation and consideration will therefore need to be given to identifying options which reduce the number of car based trips between the allocated sites to the north and Rugby town centre in order that these impacts can be minimised.

Southwest Allocation Assessment

Model Stability

6.45 An assessment of the model stability levels exhibited in the Southwest option, for both AM and PM time periods, is presented within the following **Table 21**:

Table 21: Stage 1 Model Stability Assessment 2031 Reference vs. Southwest Do Min/Do Some

	2031 Ref Case	2031 Southwest Do Min	2031 Southwest Do Some
AM	100%	70%	100%
PM	100%	70%	95%

6.46 Similar to the analysis of the impacts of the North allocation approach, the Southwest Allocation stability analysis also reveals that the performance of the Do Minimum network was particularly poor with high levels of instability. Both the AM or PM stability levels are below 80% and, as a result, it is considered that this demonstrates that the mitigation measures are essential in delivering the development strategy being tested.

6.47 Subsequently it was not considered appropriate to provide further detail on the performance of the Do Minimum network on the basis that the high instability would yield unrealistic/unreliable results from which no firm conclusions could be drawn.

Network Wide Statistics

6.48 The network wide statistics were assessed for both the 2031 RWA Reference Case and the 2031 Southwest Do Something scenario. A summary of these values is presented within the following **Table 22** and **Table 23** for the AM and PM respectively.

Table 22: Network Stats 2031 Ref Case vs. 2031 Southwest Do Something AM (07:00 to 10:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	117083	60	673

Do Something	120857	57	704
Diff	3.22%	-5.00%	4.61%

Table 23: Network Stats 2031 Ref Case vs. 2031 Southwest Do Something PM (16:00 to 19:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	131622	61	626
Do Something	137154	58	658
Diff	4.20%	-4.92%	5.11%

6.49 Analysis of the results presented within the previous tables reveals that the inclusion of the developments results in an increase in journey times of around 5% in both the AM and PM time periods. Similarly the average speeds reduce by a comparable magnitude across the periods assessed.

6.50 There is also an increase in the number of completed trips within the model period which indicates that the mitigation measures serve to facilitate at least some of the development trips. The number is highest in the PM indicating that it is that period in which the mitigation is most successful at alleviating impacts and accommodating the additional development trips.

6.51 Although there is still likely to be some residual impact associated with an increase in journey times of around 5% the increase should be considered in the context of the additional development that has been included within the model network and is more favourable than the circa 10% to 15% increases observed in the testing of the North allocation option. At this stage the level of increase observed would not be considered severe.

Maximum Queue Length Analysis

6.52 The following sets out some initial observations based on the differences in queue lengths between the Reference Case and the Southwest Do Something scenario. The comparisons have been illustrated for the AM and PM time periods within **Figure 20** and **Figure 21** respectively.

Figure 20: AM Period Maximum Queue Length Comparisons (Ref Case vs. Southwest Do Some)

Figure 21: PM Period Maximum Queue Length Comparisons (Ref Case vs. Southwest Do Some)

6.53 Analysis of the queuing impacts identified within the previous Figures reveals the following:

- Queuing impacts in the southwest appear to be largely mitigated in the Do Something scenario which indicates that the southern distributor road will likely alleviate a significant number of impacts in the area.
- Overall, the impacts on queuing appear minimal, the queue impacts identified to the north of the study area will be attributable to the allocation of some housing in this area, albeit the impacts are reduced in comparison to the North allocation network performance.
- There are only 5 instances of queuing impacts having been identified within the AM analysis and 7 within the PM, 3 of which are attributable to the delivery of the housing sites to the north of the study area.
- There is an impact on queuing levels identified at the M45/A45 junction which may indicate that the signalisation scheme may be necessary for this junction in order that the impacts on the Strategic Road Network (SRN) can be managed and further mitigated.
- There are far fewer instances of queuing increases within the town centre area within the Do Something analysis, when compared to the Northern site assessment. This indicates that, in general, delivery of the southwest allocation will elicit a lower level of impact, overall, than the northern allocation.
- Impacts at the Cawston Grange Drive/A4071 junction indicates that further mitigation in this area is likely to be required to accompany this allocation option.

Stage 2 Southwest Assessment Conclusions

6.54 Based on the initial assessment of the southwest allocation option, the following conclusions have been identified:

- The allocations tested in the Southwest appear to induce lower levels of impacts, once the mitigation strategy has been incorporated within the assessment, than the Northern allocation. Furthermore, early analysis indicates that the mitigation

strategy and the South West Link Road are successful in mitigating a number of developmental impacts at least at the strategic level.

- The queuing analysis reveals that the delivery of the road to the southwest will mitigate a significant number of the anticipated queuing impacts. Thus the link may also serve to relieve other congested routes into the town centre (such as the A426 via Dunchurch Crossroads) by improving connectivity to the A4071 Western Relief Road.
- The Southwest option elicits a lower level of overall impact than the North allocation at this stage. The Southwest Do Something model network, when compared to the North allocation network, experiences lower journey times and higher average speeds, thus, it can be concluded that a mitigation strategy is likely to be more easily discernible for the Southwest strategy due to the availability of land and proximate infrastructure (such as the A4071 Western Relief Road) than is the case with the Northern Allocation.

Southeast Allocation Assessment

Model Stability

6.55 An assessment of the model stability levels exhibited in the Southwest allocation scenarios, for both AM and PM time periods, is presented within the following **Table 24**:

Table 24: Stage 1 Model Stability Assessment 2031 Reference vs. Southeast Do Min/Do Some

	2031 Ref Case	2031 Southeast Do Min	2031 Southeast Do Some
AM	100%	95%	90%
PM	100%	0%	80%

6.56 The model stability analysis again reveals that the network is too unstable without the mitigation measures included. This is particularly true of the PM network without a single successful run having been completed.

6.57 As with previous stages, it was therefore not considered appropriate to undertake any further analysis of the development Do Minimum scenario due to the reliability issues.

Network Wide Statistics

6.58 The network wide statistics were assessed for both the 2031 RWA Reference Case and the 2031 Southeast Do Something scenario. A summary of these values is presented within the following **Table 25** and **Table 26** for the AM and PM respectively.

Table 25: Network Stats 2031 Ref Case vs. 2031 Southeast Do Something AM (07:00 to 10:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	117083	60	673
Do Something	121418	56	723
Diff	3.70%	-6.67%	7.43%

Table 26: Network Stats 2031 Ref Case vs. 2031 Southeast Do Something PM (16:00 to 19:00)

Scenario	Completed Trips (veh.)	Average Speed (KpH)	Average Delay (s)
Reference	131622	61	626
Do Something	133315	51	754
Diff	1.29%	-16.39%	20.45%

6.59 Analysis of the results presented within the previous tables reveals that the inclusion of the developments results in an increase in journey times in both periods. During the AM the increase in journey times is around 7.5% whereas within the PM the increase is far more severe and in excess of 20%.

6.60 Journey speeds can also be seen to reduce with AM speeds falling by almost 7% and PM speeds by 16% the latter of which is again considered to be quite severe.

6.61 Analysis of the completed trips also reveals that the PM network struggles to accommodate the extra traffic, in spite of the inclusion of additional mitigation measures which includes the link to the southeast, with an increase of less than 1.5% between the two scenarios.

Maximum Queue Length Analysis

6.62 The following sets out some initial observations based on the differences in queue lengths between the Reference Case and the Southeast Do Something scenario. The comparisons between queuing levels in the Reference Case and Do Something scenario have been illustrated for the AM and PM time periods within **Figure 22** and **Figure 23** respectively

Figure 22: AM Period Maximum Queue Length Comparisons (Ref Case vs. Southeast Do Some)

Figure 23: PM Period Maximum Queue Length Comparisons (Ref Case vs. Southeast Do Some)

6.63 Analysis of the queuing impacts identified within the previous Figures reveals the following:

- The Southeast Do Something network experiences the greatest number of queuing impacts of any of the mitigated options that have been tested.
- Within the PM period there are a large number of instances of severe and very severe increases in queuing levels, indicating that a significant amount of additional mitigation is likely to be required to enable this development option to be delivered.
- There are a considerable number of queuing impacts experienced within the town centre area and, also across the wider study area indicating that the impacts associated with the Southeast Do Something option are severe and widespread.

Stage 2 Southeast Assessment Conclusions

6.64 Based on the initial assessment of the Southeast allocation option, the following conclusions have been identified:

- The level of model instability present within the PM model network indicates that the mitigation measures proposed thus far should be considered essential.
- The network performance is still considered very poor and, on that basis, the identification of further mitigation measures is essential.
- The allocations tested in the Southeast induce the highest levels of delay, within the PM period, of any of the options which indicates a substantial amount of further mitigation is required.
- The modelling analysis indicates that, particularly within the PM period, there will be a substantial number of instances where queuing levels increase at junctions across the study area even with the southeast link road in place.

Stage 2 – Summary of Findings

6.65 The assessment work completed thus far through stage 2 indicates that the Southwest allocation option returns the lowest levels of delay across both the AM and PM periods yet delivers over 1000 more houses than those assessed within the North Allocation test.

6.66 All model scenarios have comparable stability levels but the Southwest option provides the greatest level of stability of any of the strategic options tested.

6.67 Both Southwest and Southeast options include the delivery of part of the distributor link whereas the North option does not include any additional link road which indicates that the northern mitigation strategy is likely to be the most easily deliverable but it will not unlock the same level of benefits as has been identified via the assessment of the Southwest allocation option.

Stage 2 - Conclusions

6.68 Based on the assessment work completed through Stage 2, the following conclusions have been identified:

6.69 To deliver the level of housing identified to the south of Rugby, provision of the Southern link in part, within the development allocation area, is considered essential for the Southwest and Southeast options.

6.70 In spite of the mitigation that has been proposed, there are still likely to be a number of residual impacts which occur on the network requiring the identification of further mitigation measures. Some of these may be strategic but it is envisaged most of the additional mitigation would be required to deal with localised impacts identified on a site by site basis.

6.71 It is clear that, when mitigated, the Southwest scenario performs best and the Southeast scenario performs worst. It is therefore reasonable to conclude a preference for delivery in transport impact terms of the Southwest option, then the Northern option, and lastly the Southeast option on account of the fact that this option returns the highest increases in delay and the greatest number of increases in queues at key junctions.

6.72 Although further work is recommended before a conclusion can be fully determined, the early high level analysis indicates that the level and location of housing that has been tested for the Southeast allocation is likely to generate traffic levels which reach, and in some cases exceed, the network capacity even once mitigation measures associated with that option have been assigned. This option is only likely to be feasible once the Southwest allocation is built out, inclusive of the link road, as the link through the southwest sites will provide relief to the transport network around the Southeast allocations by encouraging reassignment

along the full link and thus maximising the benefits of the additional capacity that the link delivers. Without the southwest section in place the link through the Southeast serves only a limited role strategically.

6.73 The analysis of the Northern scenario impacts reveals that the network performs better than the Southeast option and worse than the Southwest option, particularly when considering journey times. Potentially the problems in the North allocation option may relate to the conflict between traffic entering the study area to travel to work in Rugby Town Centre and traffic leaving Rugby along the A426 to travel to work via the M6. Further analysis of the potential implications of these conflicts is recommended if this option is to be taken forward.

6.74 All options indicate that further work is required along the A426 to improve the network conditions in that area since there are queuing increases along the A426 in all scenarios not just the North allocation. Unlike the Southwest and Southeast options the North option does not provide the opportunity, within the development land, to introduce new infrastructure to distribute traffic associated with the development sites meaning a large majority of trips wishing to travel between the sites and Rugby must traverse the M6 via Junction 1 which is identified as likely to come under pressure in all options.

6.75 Given that the Southwest option performs most favourable in terms of the overall network performance of all three scenarios, coupled with the option having the greatest potential to deliver mitigation measures, including some such as the southwest link road which will deliver strategic benefits, the Southwest option is considered to be the most favourable in terms of the operation of the highway network.

7 STAGE 3 ASSESSMENT

Overview

7.1 Since one of the key findings from Stage 2 was that allocation of housing to the southwest was preferable, in terms of impacts on the highway network across Rugby, then a third stage of assessment work was defined to look in detail at the performance of the sites in the southwest, alongside those identified across the remainder of Rugby Borough.

7.2 RBC also indicated that the Preferred Option for delivery of housing across the Borough would include delivery of up to 5000 dwellings in the southwest area plus additional sites to the south and north of Rugby.

7.3 It was considered necessary to review the impact of the Preferred Option within the 2031 RWA model network, inclusive of the mitigation measures identified thus far, to establish what the potential level of residual impact was likely to be as well as identifying key considerations with regards phasing of the sites to the southwest and the Southwest Link Road.

Objectives

7.4 The objectives of the second stage of the assessment have been summarised as follows:

- To assess the impact of the emerging Option for allocation development through the Local Plan as provided by RBC.
- To assess, in detail, the potential relief to the network that is afforded by the delivery of the Southwest Link Road (SWLR) including the impact of severing key linkages between the different areas that are assumed in the overall SWLR alignment testing.
- To assess the impacts of phasing in the area to determine the localised impacts that may occur as a result of the development being brought forward.

7.5 In addition to the initial objectives, as the findings from the initial study work emerged, a number of additional objectives to the assessment were defined:

- To assess the impact of revising the allocation strategy and including an additional site in the southwest area.
- To assess the impact, within the current model, of changing the design speed of the SWLR, paying particular attention to the impacts on Dunchurch Crossroads.

Stage 3 Methodology

7.6 A series of discrete assessments were defined in response to the study objectives. For all stages, the scenario demands were forecast in a manner which was consistent with previous stages of the assessment.

Stage 3A

7.7 Stage 3A involved the update of the development demands to reflect the emerging Preferred Option as advised by RBC. This scenario was run and the outputs reviewed in line with the previous stages of the Local Plan Assessment work. A sensitivity test was also undertaken to assess the significance of the alignment of the SWLR which connected the SWLR and the A4071 versus one which connected the SWLR and the B4642.

Stage 3B

7.8 Within Stage 3B the scenario demands were fixed to the strategy advised by RBC and as per Stage 3A. A series of options were defined which assessed different layouts for the SWLR and were indented to determine the strategic and local significance of the alignment and proposals defined and adopted throughout Stage 1 and Stage 2 previously.

Stage 3C

7.9 Whilst Stage 3B looked at how different alignments would affect the operation and impact of the SWLR, Stage 3C set out to look at how the phasing of the developments would influence the network operation and identify what localised impacts were likely to occur whilst the SWLR and Southwest developments were being built out.

Stage 3D

7.10 Upon completion of the previous stages of the assessment, RBC advised that an additional site had come forward which they considered appropriate to include within the Local Plan allocation testing. It was not possible to rerun all of the assessments with this development

in and so, as a result, the additional development was added in as a sensitivity test and the impacts on the network, specifically in the southwest area, were reviewed.

Stage 3E

7.11 Subsequent to the completion of the initial testing, a series of sensitivity tests were completed which assessed the impact of changing the design speed of the SWLR as well as the signing strategy. The purpose of this test was to establish the impact that the design speed would have on the benefits that are perceived to occur as a result of the strategic role that the link serves in providing opportunities for general background traffic flows to reassign away from congested areas such as Dunchurch.

7.12 The remainder of this chapter sets out the key assumptions within each of the assessments alongside the findings derived therefrom.

Stage 3A Analysis

3A Scenario Forecasting

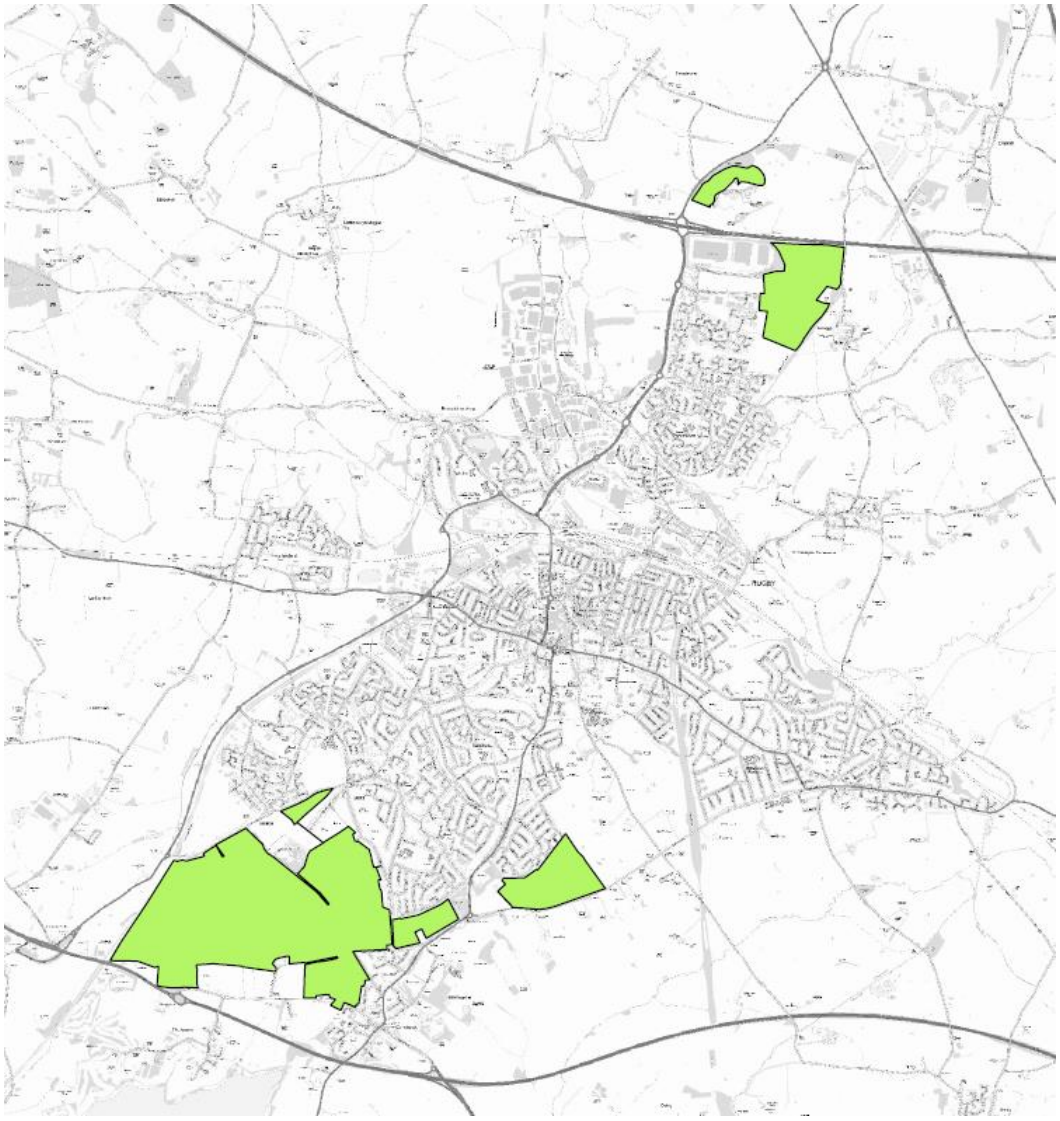
7.13 Demand forecasting for Stage 3A was completed in line with the approach to forecasting adopted during previous stages of the assessment. RBC advised that the following, strategic, sites should be tested:

- Coton House – Up to 150 Dwellings
- Coton Park East – 855 Dwellings
- Southwest Rugby – Up to 5000 dwellings

7.14 Additionally it was advised that 2200 dwellings would be delivered through the Main Rural Centres (MRC) (700 dwellings) and sites outside of the model network (1500 dwellings).

7.15 The location of the strategic sites is illustrated within the following **Figure 24**.

Figure 24: Stage 3A PO Site Locations



7.16 The MRCs have not been tested explicitly since each site will be unlikely to trigger the need for any of the strategic infrastructure measures to be included.

7.17 Whilst the sites will have some cumulative impact, this is accounted for in part by retaining the housing numbers within the TEMPRO adjustments. It is not anticipated that any localised impacts would be severe enough to trigger the need for strategic infrastructure. As such, the growth associated with these sites is inherent within the general traffic growth.

7.18 It is envisaged that any localised mitigation requirements would be identified through the development specific planning application work and, most likely, funded by S106.

7.19 These housing numbers were combined to inform the update of the TEMPRO factors and the resultant housing projections assumed within each option, alongside the corresponding growth facts assigned to the model network, are summarised within the following **Table 27:**

Table 27: Stage 3A Housing and Adjusted TEMPRO Assumptions

Housing Assumptions	2031 Reference Case		2031 Stage 3A Allocation	
	AM	PM	AM	PM
2009 to 2010	412		412	
2010 to 2026	3388		3388	
CS Housing Numbers	5879		5879	
MRC's	-		700	
Outside Model	-		1500	
Coton Park East	-		855	
Coton House	-		150	
Southwest	-		5000	
Total	9679		17884	
Diff	-		8205	
TEMPRO	**AM**	**PM**	**AM**	**PM**
Growth Factor	1.14	1.16	1.231	1.257
Diff (%)	-	-	9.1%%	9.7%

3A Mitigation Assumptions

7.20 The mitigation assumptions applied within the model network are in line with the mitigation assumed for the Southwest testing in Stage 2. Albeit the network has been subject to minor review and refinement exercise which includes small modifications to schemes (widening, signal optimisation, etc.)

7.21 However, it was also considered beneficial to undertake some sensitivity testing pertaining to the alignment of the SWLR and, specifically, the connection between the SWLR and the A4071 which could link in to either the A4071 Western Relief Road or the B4642 Coventry Road.

7.22 The two different alignments that were tested have been illustrated within **Figure 25** and **Figure 26** on the following page.

Figure 25: SWLR Alignment Option 01 (Potford Dam Connection)

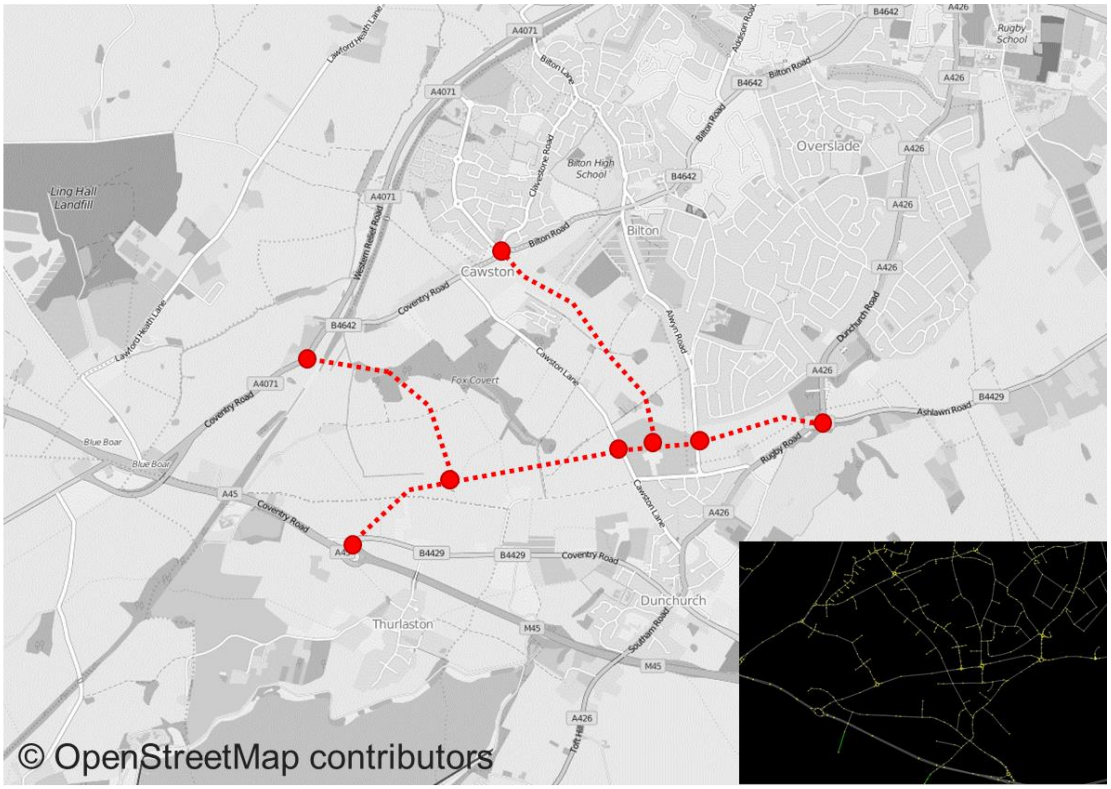
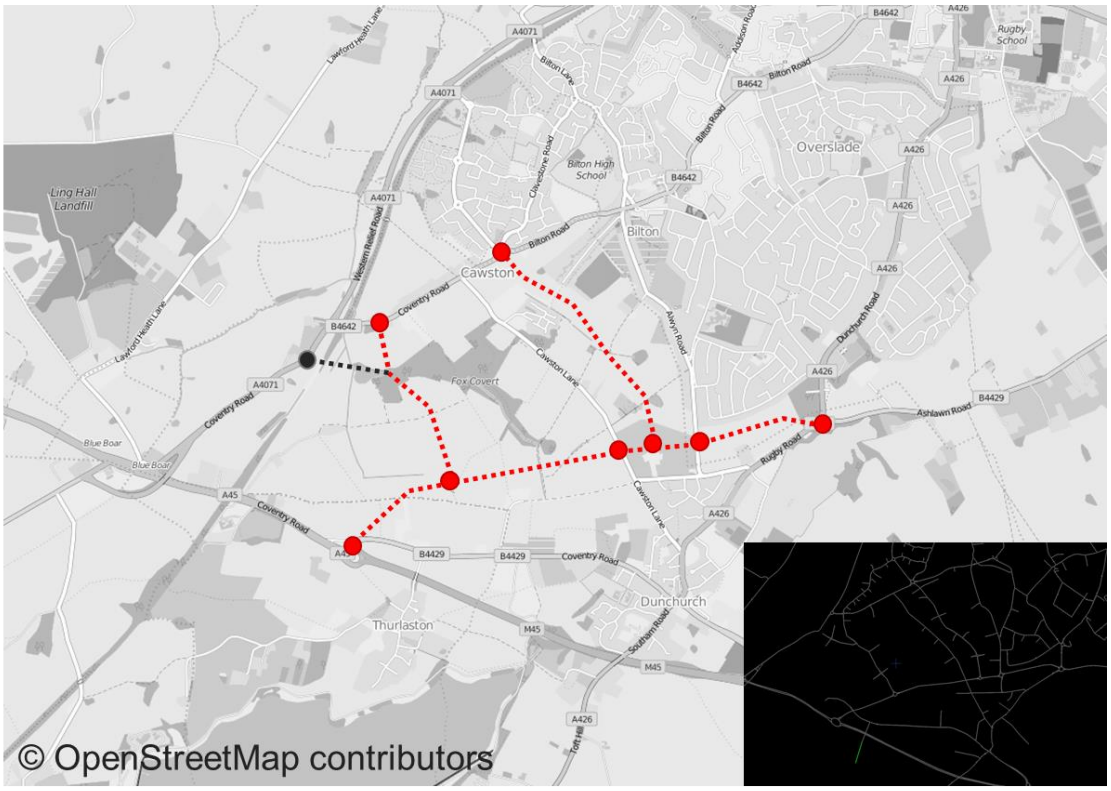


Figure 26: SWLR Alignment Option 02 (Coventry Road Connection)



3A Test Scenarios

7.23 The analysis presented within Stage 2 demonstrated that the Southwest Scenario, without mitigation, was too unstable to yield reliable outputs. Since the option now being tested contains a higher quantum of development that situation remains unchanged. As a result, only development Do Something (i.e. with mitigation measures) scenarios have been assessed.

7.24 Two development scenarios have been assessed through Stage 3A and these are:

- 2031 Stage 3A SWLR Alignment Option 01 (2031 3A Op1)
- 2031 Stage 3A SWLR Alignment Option 02 (2031 3A Op2)

Stage 3A Results Analysis

7.25 The results extracted from the Stage 3A scenarios outline previously are summarised as follows:

Model Stability

7.26 Analysis presented previously revealed that the inclusion of the mitigation proposals serves to stabilise the model network and is essential in order that the allocation strategy can be adopted. This conclusion is unchanged and, as such, no additional analysis of model stability was necessary at this stage.

Network wide Statistics

7.27 The network wide statistics were assessed for both the 2031 RWA Reference Case and the 2031 Stage 3A Do Something scenarios. A summary of these values is presented within the following **Table 28** and **Table 29** for the AM and PM respectively.

Table 28: Network Stats 2031 Ref Case vs. 2031 Southwest Do Something AM (07:00 to 10:00)

Scenario	Average Speed (KpH)	Average Delay (s)
Reference	60	673
2031 3A Op1	58.5	690
Diff from Ref	-2.50%	2.53%
2031 3A Op2	58.1	693
Diff from Ref	-3.17%	2.97%

Table 29: Network Stats 2031 Ref Case vs. 2031 Southwest Do Something PM (16:00 to 19:00)

Scenario	Average Speed (KpH)	Average Delay (s)
Reference	61	626
2031 3A Op1	56.4	669
Diff from Ref	-7.54%	6.87%
2031 3A Op2	56.3	670
Diff from Ref	-7.70%	7.03%

7.28 Analysis of the previous Tables reveals that the development scenarios perform comparably when compared to the Reference Case. The delays in the model increase by around 3% in the AM and 7% in the PM with the 2031 Stage 3A SWLR Alignment Option 01 performing marginally better of the two development scenarios.

Maximum Queue Length Analysis

7.29 The following sets out some initial observations based on the differences in queue lengths between the Reference Case and the two Development Do Something scenarios.

7.30 The comparisons between queuing levels in the Reference Case and 2031 Stage 3A SWLR Alignment Option 01 have been illustrated for the AM and PM time periods within **Figure 27** and **Figure 28** respectively.

7.31 Similarly the comparisons between the queuing levels within the Reference Case and 2031 Stage 3A SWLR Alignment Option 02 have been illustrated for the AM and PM time periods within **Figure 29** and **Figure 30** respectively.

Figure 27: AM Period Maximum Queue Length Comparisons (Ref Case vs. 2031 Stage 3A SWLR Alignment Option 01)

Figure 28: PM Period Maximum Queue Length Comparisons (Ref Case vs. 2031 Stage 3A SWLR Alignment Option 01)

Figure 29: AM Period Maximum Queue Length Comparisons (Ref Case vs. 2031 Stage 3A SWLR Alignment Option 02)

Figure 30: PM Period Maximum Queue Length Comparisons (Ref Case vs. 2031 Stage 3A SWLR Alignment Option 02)

7.32 Analysis of the impacts on queuing levels between the Development Scenarios and the 2031 RWA Reference Case reveals the following:

- Both alignments trigger impacts on the A426 in the vicinity of the B4429. However, these impacts are consistent across the scenarios and are therefore considered indicative of a need for further mitigation to be delivered at both junctions in this area rather than reflective of the SWLR alignments.
- The revised alignment triggers higher queuing levels in the AM at the existing A4071/B4642 roundabout and this will occur as more vehicles try to access the A4071 via the B4642 as a result of the connection with the SWLR.
- When the connection is provided directly south of the A4071/B4642 roundabout then traffic travelling towards the M45/A45 and beyond does not need to travel through the junction and therefore conflicts are reduced.
- The analysis of the impacts on queuing levels indicates that there are differences between the two options insofar as the revised alignment triggers greater impacts at the A4071/B4642 roundabout due to increased loading via the B4642. This, in turn constrains traffic volumes along the A4071 meaning, further away from the site, impacts are lessened.

7.33 It is likely that a strategy could be identified which at least reduces these impacts and, on that basis the differences in queuing levels beyond the Potford Dam roundabout, between the two scenarios is not considered significant.

3A - Detailed Junction Analysis

7.34 Whilst the analysis set out previously presents an indication of the strategic significance of delivering the differing SWLR alignments, it does not provide an indication of the localised impacts associated with the various options. So that the localised impacts of the two options could be better understood, the impact at two locations was reviewed in detail namely:

- A426/B4429 'Dunchurch Crossroads'
- A4071/B4642 'Potford Dam Roundabout'

7.35 In order that the impacts in these areas could be fully understood the average throughput that occurs within the model scenario was compared to the predicted demands for the junction. Junction demands were extracted by running the models with limited congestion

effects to obtain a clear picture of the desired routing of traffic through the study area when congestion effects are alleviated.

7.36 To some extent it is hoped that this alleviation will occur, in part, as a result of the localised mitigation strategies associated with each of the sites that will accompany the delivery of the strategic infrastructure.

7.37 It should be noted that the Preferred Option demands account for the assignment of housing across multiple areas and not just to the southwest. Thus impacts and changes in traffic volumes and demands at each of the areas identified will not be entirely related to the growth in the southwest.

Dunchurch Crossroads

7.38 The Dunchurch crossroads area represents one of the most constrained areas of the network. It is acknowledged that there is limited capacity in this area to provide additional improvements and there are also issues with air quality that make it highly undesirable any traffic volume increase in this area.

7.39 At the moment Dunchurch crossroads comes under a lot of pressure as the A426 is one of the main arterial routes into and out of Rugby. The current linkages between the B4642 and A426 are poor standard and unattractive to drivers which makes avoiding the crossroads very difficult. Therefore, many drivers wishing to travel to/from the south of Rugby towards Coventry, south Warwickshire and even the M45 EB, will travel via the Dunchurch crossroads.

7.40 Furthermore, this junction is in close proximity to the SW development area and, therefore, represents the area of the network most likely to benefit from the various alignment options for the SWLR being delivered.

7.41 A summary of the AM and PM period modelled and demand flows, across all of the model scenarios has been provided, for the Dunchurch Crossroads, within **Table 30** and **Table 31** respectively which are presented on the following page.

Table 30: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	2031 Ref Case	2031 3A Op1	2031 3A Op2
Demand	4302	2865	2945
Modelled	4212	2949	2992
Diff	97.9%	102.9%	101.6%

Table 31: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	2031 Ref Case	2031 3A Op1	2031 3A Op2
Demand	4507	3056	3048
Modelled	4198	2900	2899
Diff	93.1%	94.9%	95.1%

7.42 Analysis of the information within the previous tables reveals that the two SWLR alignments appear to offer a significant opportunity to alleviate congestion at the Dunchurch Crossroads.

7.43 Both alignments appear to offer similar levels of relief in terms of the actual volume of trips travelling through the junction as well as the vehicular demands across both AM and PM modelled periods.

Potford Dam Roundabout

7.44 When assessing the impact of various network and SWLR configuration during previous stages of the assessment the A4071/B4642 Potford Dam roundabout has also been highlighted to cause issue. As a result, detailed analysis of the changes in traffic volumes at this location has also been undertaken for both AM and PM modelled periods and the outcome from these comparisons has been presented within the following **Table 32** and **Table 33** respectively.

Table 32: Potford Dam Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	2031 Ref Case	2031 3A Op1	2031 3A Op2
Demand	4069	5690	6001
Modelled	4108	5232	5435
Diff	101.0%	92.0%	90.6%

Table 33: Potford Dam Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	2031 Ref Case	2031 3A Op1	2031 3A Op2
Demand	3790	5737	5983
Modelled	3900	5511	5606
Diff	102.9%	96.1%	93.7%

7.45 Analysis of the information presented within the previous tables reveals that traffic volumes are predicted to increase in both options but the magnitude of increase is likely to be less when the connection occurs south of Potford Dam rather than when the connection is provided to the east of the junction along the B4642.

7.46 The difference in the flows between the two scenarios relates to the ability for the alignment which connects below Potford Dam to enable traffic which is generated by the housing sites in the southwest, particularly those placed along the B4642, to access the A45/M45 without travelling through the Potford Dam junction.

7.47 Having reviewed the tables above, it is clear that there are differences between options and that a benefit of the original alignment option (2031 Stage 3A SWLR Alignment Option 01) exists insofar as it induces lower levels of vehicular demand than the revised option (2031 Stage 3A SWLR Alignment Option 02).

7.48 Both options suffer significant increases in traffic volumes when compared to the Reference Case but the second alignment increases are higher than the original alignment.

7.49 To supplement this analysis, a review was undertaken to determine how the traffic volumes change on each arm. This focussed on the actual flows extracted from the modelling and the flows by arm across the AM and PM periods have been presented within **Table 34** and **Table 35** for the AM and PM respectively.

Table 34: Potford Dam Traffic Volumes by Link AM Period (07:00 to 10:00)

Road	2031 Ref Case	2031 3A Op1	2031 3A Op2
A4071 NB	1675	2168	1522
A4071 SB	815	957	1043
B4642 WB	1618	2107	2869
Total	4108	5232	5435

Table 35: Potford Dam Traffic Volumes by Link PM Period (16:00 to 19:00)

Road	2031 Ref Case	2031 3A Op1	2031 3A Op2
A4071 NB	2221	3067	2740
A4071 SB	868	1258	1243
B4642 WB	811	1187	1623
Total	3900	5511	5606

7.50 Analysis of these flow differences reveals that the flows in the original option are higher on the A4071 whereas the revised alignment option, which connects into the B4642, experiences larger traffic volumes on the B4642, again this is understandable as more traffic assigns onto this route as a result of the alignment.

7.51 It is considered particularly undesirable to load traffic onto the B4642 due to the nature of the road whereas traffic loading on to the A4071 is likely to have less of an impact on the junction operation since this is already the predominant flow and, furthermore, the A4071 north of Potford Dam appears to have some spare capacity. However, there is still a requirement for junction improvements to be delivered along the A4071 to improve vehicular flows west of Rugby. These improvements are, as a minimum, likely to be required at the A4071/Cawston Grange Drive and the A4071/Bilton Road junctions.

3A Non-Modelled Benefits

7.52 It is considered pertinent to highlight that there are also a number of non-modelled benefits that are predicted to occur as a result of the adoption of the original alignment tested within the 2031 Stage 3A SWLR Alignment Option 01 scenario. These have been identified through consultation with WCC and include:

- Delivery of the access to the south of Potford Dam provides an opportunity to re-align the 'Cawston Bends' and improve the operational and safety standards of that section of the A4071
- The introduction of the traffic signals to the east of the Potford Dam roundabout occurs in an area of poor visibility due to alignment issues. Visibility is further impacted upon by the obstruction caused by the disused railway crossing bridge, increasing traffic in this area will introduce more risks in terms of safety.

- Traffic flows will increase at a faster rate if the SWLR is connected directly onto the B4642 instead of the A4071 as traffic wishing to travel north and south along the A4071 must travel through the junction. If the connection is delivered south of the Potford Dam roundabout then only northbound traffic will need to use the junction.
- The disused railway crossing presents a significant constraint to the delivery of mitigation proposals in this area, making any scheme which diverts traffic away from the Potford Dam roundabout more attractive.
- The Potford Dam roundabout is considered to be a poor standard junction with existing issues with levels and alignment that make delivery of enhanced mitigation proposals particularly difficult in this area.

3A Summary of Findings

7.53 The testing completed through Stage 3A reviewed the impact of the revised allocation approach, put forward through Stage 3A on the model network in conjunction with various options for the alignment of the SWLR around the Potford Dam area based on two potential alignment options.

7.54 The revised allocation approach testing in Stage 3A results in more additional impacts, in the form of junction queuing increases, than was observed in the Southwest testing completed in Stage 2, indicating a need for further refinement of the mitigation proposals.

7.55 Whilst some very severe queuing impacts where observed in the area to the southwest of Rugby the majority of instances where queuing levels have increased fall within the moderate increase band. Whilst it is recommended that some of the residual impacts are subject to further, more detailed analysis to identify an appropriate mitigation strategy the location of the impacts are such that it is anticipated that they could be overcome through the planning and design process associated with the sites identified in the southwest.

7.56 The initial analysis has focussed on the differences in average network wide journey times between the different scenarios. This analysis reveals that there are some differences in delays between the original alignment which connected south of the Potford Dam junction

and the revised alignment which connected onto the B4642 Coventry Road with the original alignment producing marginally quicker journey times.

7.57 Detailed analysis has been undertaken to review the impacts on traffic volumes at Dunchurch Crossroads as well as the A4071/B4642 'Potford Dam Roundabout'.

7.58 This detailed flow analysis has revealed that neither option will elicit a significant impact on Dunchurch Crossroads but that it is likely that traffic flows/demands will be lower at Dunchurch Crossroads as a result of the original alignment which is desirable although both options appear to demonstrate the potential to deliver significant benefits at the Dunchurch Crossroads in the form of reduced traffic volumes.

7.59 When considering Potford Dam roundabout, both options result in an increase in traffic flows at this junction but the flows are lower when the original alignment is adopted and this is because traffic wishing to access the M45/A45 no longer needs to travel through the junction. Furthermore, detailed analysis indicates that the original alignment also concentrates more of the traffic volume increase on the main A4071 links as opposed to the B4642 which is also considered to be beneficial.

Stage 3A Conclusions

7.60 The analysis set out previously, in relation to the Stage 3A testing reveals the following conclusions:

- Residual queuing impacts are observed in the immediate area of the sites in the Southwest. These will need further consideration and identification of an appropriate mitigation strategy as the sites in the southwest come forward.
- As well as the queuing within the southwest area, the queuing in the north, along the A426 continues to occur and, as a result, demonstrates a need for further mitigation proposals to come forward in this area to ensure that impacts can be minimised.
- It is apparent that any proposals to mitigate impacts at the Potford Dam roundabout will be difficult to deliver. Furthermore, the connection south of Potford Dam actually provides strategic infrastructure insofar as it will enable the issues around the Cawston Bends to be improved. It is therefore considered that

the original alignment, with the connection south of Potford Dam is the preferred alignment option at this stage.

- There are a number of non-modelled issues which need to be considered when assessing the relative merits of the two SWLR alignment options including:
    - The opportunity to re-align the 'Cawston Bends' and improve the operational and safety standards of that section of the A4071.
    - Poor visibility due to the alignment and the disused railway bridge represent a safety concern, especially as traffic volumes increase as a result of the development build out.
    - Physical constraints preventing delivery of enhanced mitigation measures, particularly when considering the disused railway bridge.
- The connection south of Potford Dam provided by the original alignment results in marginally faster journey times than the alternative option indicating that it is the better performing option strategically.
- The detailed analysis of changes in flows indicates little difference between the two options when considering the implications on Dunchurch Crossroads although the traffic volumes may potentially be lower at the crossroads as a result of the original alignment, indicating that option is marginally better for Dunchurch Crossroads. It should be noted that both options deliver significant benefits when the SWLR is provided in full.

7.61 The original alignment results in the lowest traffic level increase at the Potford Dam roundabout. Furthermore, the traffic flow increases that occur relative to the Reference Case are focussed on the A4071 whereas the revised alignment results in a marked increase along the B4642 which is considered undesirable due to the delays that are likely to be induced by these increases and the relatively restricted nature of the link capacity on the B4642 compared to the A4071.

7.62 Thus it is concluded that the original alignment is preferred to the alternative alignment and should be adopted in all assessments going forward.

Stage 3B Analysis

7.63 A key outcome of Stage 3A was the confirmation that the general level of network performance was likely to be considered acceptable. Albeit the conclusions also acknowledge a need for further review of impacts and additional mitigation in the areas of the southwest as well as north along the A426.

7.64 The purpose of Stage 3B was to look in more detail at the effect of changing the alignments of the Southwest Link Road (SWLR) further but with the demands constant between the scenarios. The objective of this stage is to determine both the strategic significance and local implications associated with the delivery of the SWLR. Initially in consideration of the full allocation identified in the Preferred Option (PO) and based on up to 5 different options for alignment and connectivity.

3B Test Scenarios

7.65 In total, 5 new scenarios were created and run, using the RWA model, inclusive of the full PO allocation demands.

7.66 The scenarios which have been tested are summarised as follows:

- **Scenario 01 –** 2031 RWA Reference Case
- **Scenario 02 –** 2031 RWA PO plus additional schemes and SWLR full alignment.
- **Scenario 03 –** 2031 RWA PO plus SWLR alignment option 03 (as full but without the link between the SWLR and B4642).
- **Scenario 04 –** 2031 RWA PO plus SWLR alignment option 02 (as full but without the link to Alwyn Road and the A426).
- **Scenario 05 –** 2031 RWA PO plus SWLR alignment option 01 (as full but without the connection between Cawston Lane and the M45 or the link between the SWLR and B4642.
- **Scenario 06 –** 2031 RWA PO plus SWLR alignment for access only. Connection provided between Alwyn Road and Cawston Lane only.

3B Mitigation Assumptions

7.67 In response to the issues identified in Stage 3A, additional junction widening and revised lane markings was adopted within Scenario 02 onwards at the following locations:

- Dunchurch Road/Sainsbury's Roundabout
- A426/Ashlawn Road roundabout
- Cawston Grange Drive/A4071
- A45/M45 Roundabout

7.68 Each of the alignment options, including the full alignment assumed within Scenario 02, have been illustrated within **Figure 31** to **Figure 35** as follows:

Figure 31: SWLR Full Alignment [Scenario 02]

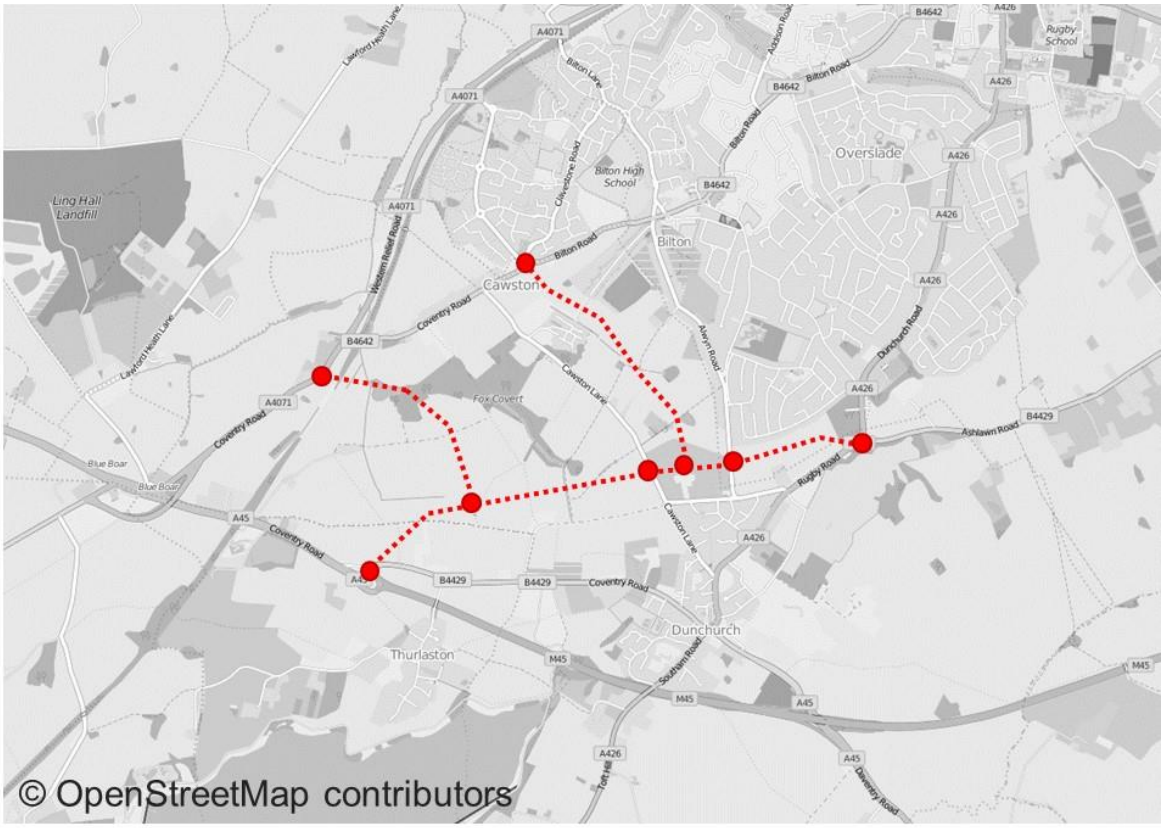


Figure 32: SWLR Alignment Option 03 (No connection to A4071) [Scenario 03]

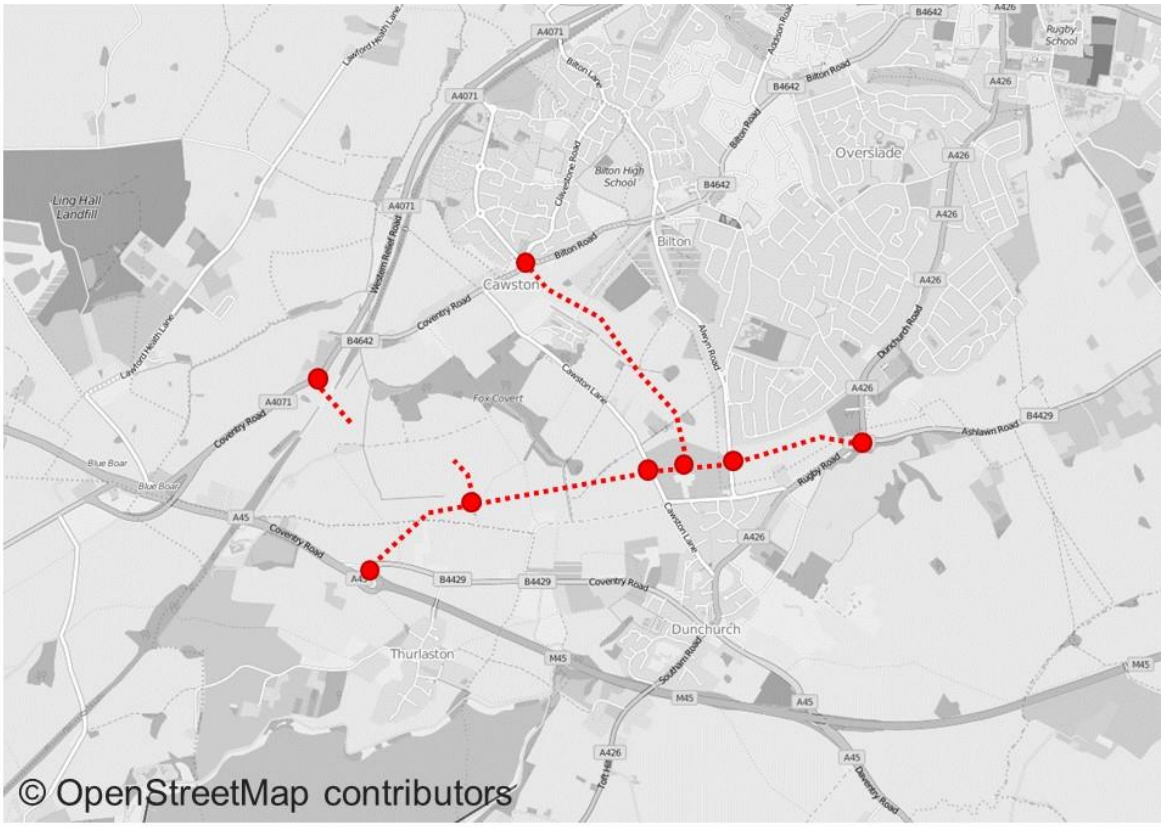


Figure 33: SWLR Alignment Option 02 (No connection across Alwyn Road to the B4642) [Scenario 04]

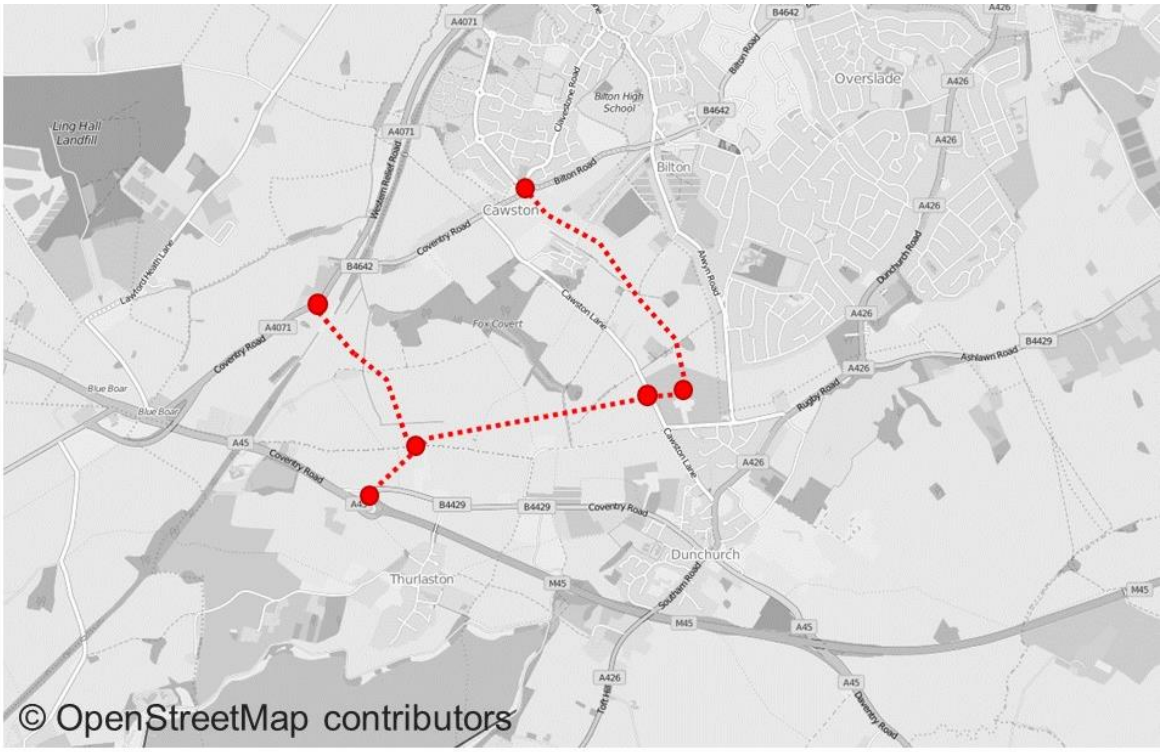


Figure 34: SWLR Alignment Option 01 (No connection between Cawston Lane and M45 or between SWLR and B4642) [Scenario 05]

Figure 35: SW Access only strategy (link between Alwyn Road and Cawston Lane) [Scenario 06]

3B Results Analysis

7.69 As the scenarios have not changed dramatically between Stage 3B and Stage 3A it was considered acceptable to reduce the level of strategic impacts reported to enable a greater focus on localised impacts to be afforded within the analysis.

7.70 As a result, the strategic analysis focussed only on average delay in the model and the queuing impacts. This has then been supplemented with detailed analysis of the impacts at key junctions within the study area.

Network wide Statistics – Average Delay

7.71 The network wide average delay was assessed for the 2031 RWA Reference Case and all Stage 3B test scenarios. A summary of these values is presented within the following **Table 36** and **Table 37** for the AM and PM respectively.

Table 36: Network Stats 2031 Ref Case vs. 2031 Stage 3B Scenarios AM (07:00 to 10:00)

Scenario:	Ref Case	Scenario 02	Scenario 03	Scenario 04	Scenario 05	Scenario 06
Delay	673	695	688	713	693	697
Diff from Ref	-	22	15	40	20	24
%	-	3.27%	2.23%	5.94%	2.97%	3.57%

Table 37: Network Stats 2031 Ref Case vs. 2031 Stage 3B Scenarios PM (16:00 to 19:00)

Scenario:	Ref Case	Scenario 02	Scenario 03	Scenario 04	Scenario 05	Scenario 06
Delay	626	663	670	698	677	688
Diff from Ref	-	37	44	72	51	62
%	-	5.91%	7.03%	11.50%	8.15%	9.90%

7.72 Analysis of the results set out within **Table 36** and **Table 37** indicates that there are very few differences in the strategic level impacts when comparing the Scenario 02 and Scenario 03 networks. The only difference between these two options concerns the connection between the SWLR and the A4071. Differences in the average journey times between these two scenarios is less than ± 2%.

7.73 Similarly, the difference between Scenario 02 and Scenario 05 is less than ± 2.5%. The difference between these two options is that Alwyn Road and the A426 are linked to B4642 via a partial upgrade of Cawston Lane. There is also a link which connects the B4642 with the B4429 to further distribute traffic.

7.74 Within the AM delays are highest in Scenario 04 and Scenario 06. Particularly during the PM. These delays are across the network and so, considering the relatively local nature of the various changes, the increases indicate that the elements omitted from Scenario 06 and particularly Scenario 04 are more critical.

7.75 Scenario 04 and 06 are the only scenarios without a connection between the A426/Alwyn Road and the new site links. Surprisingly, scenario 06 performs worse than Scenario 06. Initial investigations indicate that this is because the various alignments in Scenario 06 encourage more development to access the A4071 to the West of Rugby. This increases the impacts along the A4071 and increases the overall delay experienced within the model as the effects are more widespread. Within Scenario 06 the increases in delays are focussed around the southwest area.

3B Detailed Junction Analysis

7.76 Whilst the analysis set out previously presents an indication of the strategic significance of delivering the differing SWLR alignments, it does not provide an indication of the localised impacts associated with the various options. In order this could be better understood, the impact at three key locations was reviewed in detail namely:

- A426/B4429 'Dunchurch Crossroads'
- A426/A428/Bilton Road 'Rugby Gyratory'
- A428/B4429 'Ashlawn Junction'

7.77 As with the analysis presented within Stage 3A, the average throughput that occurs within the model scenario was compared to the predicted demands for the junction, extracted by running the models with limited congestion effects, to obtain a clear picture of the desired routing of traffic through the study area when congestion effects are alleviated.

Ashlawn Road Junction

7.78 The Ashlawn Road junction (A428/B4429) is likely to be the junction least affected by the proposals because it is remote from the site. Most of the traffic which travels through this junction and is associated with the new housing to the southwest will be travelling towards the employment to the east of Rugby (DIRFT, etc.) and the M1.

7.79 Some impacts could be reduced however by providing better access to the M45 which connects to the M1 SB only. Traffic wishing to travel NB will still have to travel along the A428 and access via M1 J18.

7.80 A summary of the AM and PM period modelled and demand flows, across all of the model scenarios has been provided, for the Ashlawn Road junction, within the following **Table 38** and **Table 39** respectively:

Table 38: Ashlawn Road Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	Ref Case	Scenario02	Scenario03	Scenario04	Scenario05	Scenario06
Demand	5533	5916	5966	5790	5899	5889
Modelled	5328	5703	5730	5615	5686	5654
Diff	96.3%	96.4%	96.0%	97.0%	96.4%	96.0%

Table 39: Ashlawn Road Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	Ref Case	Scenario02	Scenario03	Scenario04	Scenario05	Scenario06
Demand	6917	7440	7413	7253	7357	7403
Modelled	6406	6803	6812	6720	6799	6795
Diff	92.6%	91.4%	91.9%	92.7%	92.4%	91.8%

7.81 Analysis of the information presented within the two previous tables reveals that the likely demand at the junction will increase across all scenarios. This is to be expected as there is more traffic in the area as a result of the additional housing.

7.82 Within both the AM and PM period the traffic demands around the Ashlawn Road junction are stable and range within 150 vehicles across all options. Scenarios 02 and 03 do produce higher demands than the other scenarios which could be indicative of an increased draw as a result of connecting the A426 to the M45 via a connection through Alwyn Road. However, there is not a significant increase in demands which occur as a result. Furthermore, scenario 06 also produces quite high demand levels which could also indicate that a connection between the B4642 and A426, either by a new link and/or an upgrade of Cawston Lane, may draw some additional traffic along the A426.

7.83 Further review and refinement of the scheme proposals for the A428/B4429 Ashlawn Road junction may be necessary irrespective of the approach to alignment of the SWLR but none of the alignments elicit a significant change when compared to the option with the full link

road in (Scenario 02) and all options indicate traffic volumes at this junction will increase as a consequence of the additional housing.

Rugby Gyratory

7.84 The Rugby Gyratory is located in the centre of Rugby and, depending upon the link alignments, traffic may access the gyratory directly via the A428 and B4642 as both links lead into the gyratory and in some options are connected via the SWLR.

7.85 Additional access into the gyratory is provided indirectly via improving access to the A4071 which provides a route into Rugby town centre and the gyratory via Lawford Road.

7.86 A summary of the AM and PM period modelled and demand flows, across all of the model scenarios has been provided, for the Rugby Gyratory, within the following **Table 40** and **Table 41** respectively:

Table 40: Rugby Gyratory Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	Ref Case	Scenario02	Scenario03	Scenario04	Scenario05	Scenario06
Demand	10676	11446	11811	12138	11791	12054
Modelled	10052	10519	10506	10499	10563	10636
Diff	94.2%	91.9%	88.9%	86.5%	89.6%	88.2%

Table 41: Rugby Gyratory Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	Ref Case	Scenario02	Scenario03	Scenario04	Scenario05	Scenario06
Demand	12585	13464	13737	14105	13919	14172
Modelled	11369	11988	11999	11582	11868	11805
Diff	90.3%	89.0%	87.4%	82.1%	85.3%	83.3%

7.87 Analysis of the information presented within the previous tables indicates that there are larger fluctuations in vehicle demands at the gyratory than was observed via the analysis of the Ashlawn Road junction. Thus it is possible to conclude that this area of the network will be affected more significantly by the link road configuration.

7.88 It is notable that, across all scenarios, the volume of trips able to travel through the junction is relatively stable between the various test scenarios and which indicates that the current arrangement is operating close to capacity.

7.89 When compared to the Reference Case (Scenario 01) the full alignment option (Scenario 02) elicits the smallest increase in vehicle demands at the junction. This in turn must indicate that provision of the full link road, provides the best option, of those which have been tested, to provide relief to the Rugby Gyratory area by diverting traffic volumes, and particularly those associated with the new developments, away from the area.

7.90 In both the AM and PM periods Scenario 02 demands are around 7.5% higher than the reference case. In all other scenarios demands are 10% or higher than the Reference Case. Thus, the full alignment demonstrates potential for traffic to reassign away from the gyratory by providing better linkages between key routes and, most specifically, the A4071 which can be used to access the A426 bypassing Rugby centre.

7.91 Other than Scenario 02, Scenario 03 induces lower increases in demands than the alternative alignments that have been tested. Scenario 03 severs the assumed link between the A45 and the B4642 at the southern extent of the development area. Removing this link adds some pressure on to the gyratory and then the demands then continue a pattern of increase when reviewing the other scenarios, they continue to go up as different elements of the SWLR are removed. Scenario 04 and 06 suffer the greatest increases in demands, neither of these connects the B4642 to the A426 via link which crosses Alwyn Road.

7.92 Thus, improving connectivity between B4642 and the A426 can be assumed to be most likely to provide relief to the Rugby Gyratory in the form of reducing the overall demand for traffic to travel through the junction than would otherwise occur without the link in place.

Dunchurch Crossroads

7.93 The Dunchurch crossroads area represents one of the most constrained areas of the network. It is acknowledged that there is limited capacity in this area to provide additional improvements and there are also issues with air quality that make it highly undesirable for traffic volumes to increase.

7.94 At the moment Dunchurch crossroads comes under a lot of pressure as one of the main arterial routes out of Rugby. The current linkages between the B4642 and A426 are poor standard and unattractive to drivers and therefore, many drivers wishing to travel to/from the south of Rugby towards Coventry, south Warwickshire and even the M45 EB, will travel via the Dunchurch crossroads.

7.95 Furthermore, this junction is in close proximity to the southwest development area and, therefore, represents the area of the network most likely to benefit from the various alignment options for the SWLR being delivered.

7.96 A summary of the AM and PM period modelled and demand flows, across all of the model scenarios has been provided, for the Dunchurch Crossroad, within the following **Table 42** and **Table 43** respectively:

Table 42: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	Ref Case	Scenario02	Scenario03	Scenario04	Scenario05	Scenario06
Demand	4302	2865	2945	3414	4506	4761
Modelled	4212	2949	2992	3432	4346	4508
Diff	97.9%	102.9%	101.6%	100.5%	96.5%	94.7%

Table 43: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	Ref Case	Scenario02	Scenario03	Scenario04	Scenario05	Scenario06
Demand	4507	2937	3011	3625	4829	4994
Modelled	4198	2889	2910	3610	4436	4540
Diff	93.1%	98.3%	96.6%	99.6%	91.9%	90.9%

7.97 Analysis of the information presented within the previous tables reveals that there are significant benefits which occur at Dunchurch Crossroads as a result of the introduction of the SWLR.

7.98 Unlike the other areas of the model, significant reductions in both the demand and modelled flows are lower in Scenarios 02 to 04 than is observed within the Reference Case. Furthermore Scenarios 02 and 04, and to some extent Scenario 03, demonstrate that the modelled flows are a close match to the demands which means that the junction itself must be less of a constraint to the movement of traffic across the study area. This is inevitable given the large reductions in the volumes due to the diversion of traffic on to the SWLR.

7.99 When the difference between demand and modelled exceeds 100% this indicates that the area has become attractive to people using it as a rat run/alternative route to get between two points, this has occurred across scenario 02 to 05 within the AM period for all scenarios.

7.100 Traffic flows and demands are observed to be lowest within Scenario 02 and gradually increase across scenario 03 and 04. Within Scenario 05 and 06 the flows are higher than the

Reference Case which indicates that neither of these alignment options will benefit the crossroads and, in all likelihood, conditions will worsen as a result of the combination of housing and infrastructure being tested in these options.

7.101 Neither Scenario 05 nor 06 improve connectivity between the A426 and M45/A45 and the results outlined previously demonstrate that this link plays a critical role in enabling traffic to bypass the Dunchurch area and accessing the SRN for journeys onwards.

3B Summary of Findings

7.102 The testing completed within Stage 3B assessed the strategic impacts of a series of different phasing options associated with the delivery of the Southwest Link Road (SWLR).

7.103 The SWLR is required to enable the growth in housing and employment identified within the area to come forward with a reduced impact on the existing transport infrastructure network.

7.104 The analysis presented previously has focussed on both high level strategic impacts and more focussed junction impacts informed via a review of changes in traffic flows both demand and actual.

7.105 The demand flows are considered to be a very useful indicator of the relative performance of each option, with regards the specific area being assessed, since they indicate what the latent demand for the area may be. Junctions operating at or close to capacity will experience congestion impacts that may require mitigation. If the latent demand for these areas is high then improving the junction performance via mitigation may not necessarily improve conditions at the junction as it may draw more traffic, that otherwise was choosing alternative routes, to travel through the study area in response to the improved conditions.

7.106 Based on the assessment of the strategic level network wide journey times it is clear that the scenario 06 and 04 perform worst overall as they return the highest journey times. Neither of these alignments contain a link connecting the B4642 and the A426, either via a new link or Cawston Lane. Scenario 02 and 03 both perform better than Scenario 05 and both, in addition to linking the B4642 and A426, provide a direct link between the A426 and the M45/A45 that bypasses Dunchurch.

7.107 Whilst the connection between the M45/A45 and A4071 does provide some benefits when comparing Scenarios 04 and 05, the magnitude of change is relatively limited and, therefore, it is clear that link serves a more locally significant role, particularly when considering the operation of the Potford Dam roundabout which was analysed in detail earlier within Stage 3A. It also has potential to provide traffic relief at Rugby Gyratory (see paragraphs 7.112 to 7.115 below) where there are limited options for further capacity enhancements beyond those implemented in 2015 by WCC.

7.108 Conclusions drawn from the localised assessments are summarised as follows:

Ashlawn Road

7.109 It has been concluded that none of the alignment options produce large fluctuations in traffic flows around the Ashlawn Road junction. It is noted that modelled flows are largely consistent throughout all of the PO options and could, therefore, be indicative of the junction being close to capacity.

7.110 Improving linkages with the A426, as is proposed in Scenarios 02 and 03, will potentially draw traffic along the A426 and, as a result, some increases in traffic flows are likely to occur along Ashlawn Road. Additional sites are also allocated along Ashlawn Road. Thus it can be concluded that further, more detailed, analysis will be required to determine whether or not the additional impacts can be mitigated.

7.111 Irrespective of the options, the Ashlawn Road junction will likely require further mitigation and will almost inevitably experience an increase in traffic flows.

Rugby Gyratory

7.112 It has been concluded that the Rugby Gyratory, compared to the Ashlawn Road junction, is more likely to be affected by the housing allocation, particularly in the form of increased vehicular demands.

7.113 As with the strategic level results Scenario 02 and 03 perform best in terms of options which induced the lowest increases in traffic levels relative to the Reference Case. There is a notable increase in the demands at the gyratory between Scenario 02 and 03 which indicate that the connection to the A4071, which connects into the SWLR via some of the housing

and employment sites has the potential to deliver additional relief to the gyratory area by providing better access to the A4071.

7.114 Thus it can be concluded that, without the additional link between the SWLR and the A4071, conditions at the gyratory will worsen as more traffic is likely to use the gyratory since there is one less opportunity to divert. The main connection between the A4071 and the A426 is likely to deliver a reduction in vehicle demands at the gyratory by improving access to the A4071. Thus delivery of this element of the link road is considered very beneficial to the gyratory.

7.115 Similarly removing the link between the A426 and A45/M45, which bypasses Dunchurch can also be seen, through the analysis of Scenario 05 traffic flows, to impact on the gyratory and so its retention should also be seen as a means of attempting to alleviate the demand on the Gyratory.

Dunchurch Crossroads

7.116 It has been concluded that improvement of the conditions at Dunchurch Crossroads represent the greatest single opportunity to deliver an improvement in the local area as a result of the SWLR.

7.117 Delivering the alignment in full is likely to be essential as, even before further investigation is given towards the restriction of movements across the junction (such as potentially banning right turns), the SWLR appears to deliver a significant reduction in modelled and demand flows at the Dunchurch crossroads.

7.118 Removing the A45/M45/A4071 connection, as is modelled in Scenario 03, reduces the benefits. Although it still delivers significant reductions in traffic flows these are not achieved to the same magnitude as the full SWLR (Scenario 02). Scenario 03 also delivers some benefits and these are achieved without the full connection to the M45/A45 and A426 via the section which crosses Alwyn Road. This demonstrates that although Scenario 03 does not perform well when assessed against strategic level outputs (specifically network wide journey times) there are some benefits locally to the partial link down to the A45/M45.

Stage 3B Conclusions

7.119 The analysis set out within Stage 3B demonstrates that there are further opportunities to mitigate the impacts identified in the initial Stage 3A testing via the inclusion of additional mitigation measures in the area around the Southwest, namely the Dunchurch Road/Sainsburys and Ashlawn Road/A426 Rugby Road roundabouts.

7.120 The average delay analysis reveals that there are still residual impacts identified elsewhere on the network which will require additional mitigation measures to be identified.

7.121 The strategic level analysis reveals that improving the connection between the A426 and the B4642 is likely to deliver the greatest overall benefits whilst the link between the A426 and the A45/M45 is also beneficial.

7.122 All options where the link between the A426 Ashlawn Road and B4642 Coventry Road is omitted return the highest levels of modelled delay and also result in the worst conditions around the Dunchurch Crossroads area in terms of induced traffic volumes.

7.123 Dunchurch Crossroads benefits significantly from the additional north/south capacity that is provided by the link between the A426 and the A45/M45 meaning that locally, if there is a desire to deliver growth in the area with minimum impacts on Dunchurch crossroads both the link between the A426 and A45/M45 across Alwyn Road and the upgraded connection between the A426 and B4642 Coventry Road are essential.

7.124 Delivery of an additional link between the SWLR and the A4071 is also considered important as it has been proven to deliver relief to both the Dunchurch Crossroads and the Rugby Gyratory, given the limited opportunities to mitigate these areas directly all schemes which are likely to provide relief through the diversion of traffic flows are considered to be a high priority.

7.125 In terms of phasing it is likely that the delivery of the link between the A426 and the B4642 will be required at an early stage and will, potentially deliver additional benefits in the area of the Dunchurch crossroads so long as it can be delivered to a sufficiently high standard (either via a new link or upgrading Cawston Lane).

7.126 Following on from that, delivery of the additional link between the A426 and the A45/M45 is going to be essential and will further reduce the developmental impacts and will also improve conditions both at the Gyratory and Dunchurch crossroads.

7.127 Finally, delivery of the link between the M45/A45 and A4071 is considered to be important as the additional capacity has been demonstrated to benefit Dunchurch Crossroads and the Rugby Gyratory. Some of the benefits may come simply from the ability of this link to provide more routing options to development traffic in the southwest area and improving connectivity between the sites and the A4071. Furthermore, if connected south of Potford Dam, the link has been demonstrated to reduce the demand on the B4642 Coventry Road which, given the nature of this area, is also considered to be beneficial.

7.128 Any alignment for the link road must be defined to deliver as direct a route as it is possible to do so between the A426 Rugby Road, just north of Dunchurch, and the M45/A45. If the nature of the route becomes more ambiguous/less direct or there is an increase in the amount of friction on the route (multiple junctions, narrow carriageways, etc.) then it is reasonable to conclude that the benefits associated with the SWLR will be diminished.

7.129 Consideration should also be given to the findings presented within Stage 2 which highlighted that the Southern Distributor link (as illustrated within Figure 7) would likely need to be delivered in full if the development area to the southeast is to come forward. Whilst this is not being considered within this Local Plan period, it is considered pertinent to raise the prospect that a failure to deliver the SWLR road to the high standards identified may not only fail to deliver benefits to the Dunchurch area but may also preclude the delivery of additional development in the area south of Rugby due to the under provision of capacity.

Stage 3C Analysis

7.130 The analysis undertaken through Stage 3B demonstrated that all elements of the SWLR, as have been defined, are likely to deliver benefits both strategically and, more importantly, locally in the form of alleviating impacts on the Dunchurch Crossroads as well as the Gyratory.

7.131 It is recognised, however, that the link road cannot be delivered in full, prior to some housing sites coming forward as they will be required to fund the delivery of the road.

7.132 The next stage of the assessment, Stage 3C, set out to establish the impact of development and link road phasing on the local road network. To do this, the area to the Southwest was segregated into a number of different areas and then RBC provided a suggested breakdown of development phases.

7.133 It is important to highlight that the phasing strategy for development was, at this stage, purely conceptual and so it is acceptable for the phasing strategy for the link road to also be conceptual at this stage. It is envisaged that this work will enable some key principles of delivery to be defined and also highlight any areas that need to be given due consideration as the link road comes forward alongside the developments. It is not intended to represent the final phasing strategy for either the link road or the southwest development sites at this stage.

3C Scenario Development

7.134 Originally two different options for phasing were identified and tested, one was put forward by RBC and the second was suggested by the site promoters representing the southwest area. The two different phasing projections were broadly consistent albeit the site promoters' phasing strategy assumed that more houses would be delivered in each phase and some areas would come forward sooner than others. The site promoters' phasing strategy assumed almost 2000 houses would come forward in the first phase whereas the RBC strategy assumed increments of between 1000 houses and 1600 houses for each stage. Employment was assumed to come forward at a similar rate for both phasing strategies.

7.135 Both phasing strategies are, at this stage, estimates and the assessment work is indicative and almost certainly likely to change as the delivery schedule for the southwest area becomes more certain. On that basis, since the RBC phasing assumed a more gradual phasing strategy it was considered that this was more beneficial to report on at this stage.

7.136 The areas identified for development, alongside the housing and employment delivery rate therein, has been illustrated within **Figure 36** and **Table 44** respectively:

Figure 36: Core Housing and Employment Areas (Southwest)

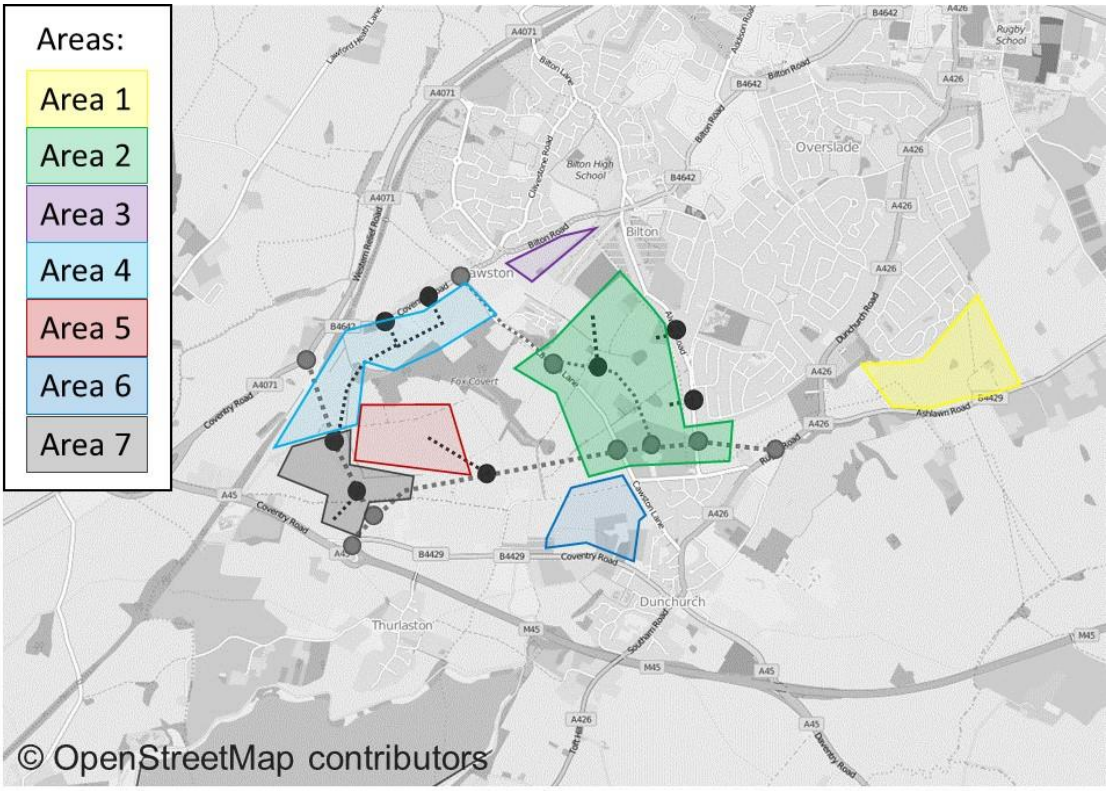


Table 44: RBC Southwest Development Phasing Trajectory by Area

Area	Allocation	Phase 1	Phase 2	Phase 3	Phase 4	Total
Area 1	Housing			430	430	860
Area 2	Housing	150	370	460	790	1770
Area 3	Housing	150				150
Area 4	Housing	300	500	290		1090
Area 5	Housing			250	460	710
Area 6	Housing	420				420
Area 7	Employment (m^2)		335000	1365000		1700000
Housing delivery:		*1020*	*870*	*1430*	*1680*	
Rolling total:		*1020*	*1890*	*3320*	*5000*	

7.137 The housing numbers were subject to the same TEMPRO forecast adjustments as has been reported upon earlier within this report to ensure that the overall growth within the model was reflective of the developments being considered.

Link Road Phasing

7.138 In conjunction with the development phasing, it was also considered necessary to identify a concept phasing strategy for the Link Road to accommodate the developments in the southwest.

7.139 The link road phases was determined based in part on the location of the developments coming forward in each phase as well as in response to any congestion issues observed within the model network.

7.140 As a result of the review a series of phases of delivery of the SWLR were identified as follows:

- Phase 01 – Access only assumed in this strategy (**SWLR Stage A**)
- Phase 02 – initially access only followed by inclusion of the connection between the A426 and the B4642 (**SWLR Stage B**)
- Phase 03 – initially as per the mitigated Phase 02 network with extensions into some of the land further away from the highway network (**SWLR Stage C**) followed by an initial connection between the M45/A45 junction and the A4071, primarily serving to connect the housing an employment sites. (**SWLR Stage D**)
- Phase 04 - The final phase of infrastructure was also included within Phase 03 which included the east/west connection of the SWLR which enables Dunchurch Crossroads to be bypassed. (**SWLR Stage E**)

7.141 An overview of the resultant SWLR staged delivery strategy is provided, across all of the development phases within **Figure 37** to **Figure 41** inclusive.

Figure 37: SWLR Stage A (Access Only)

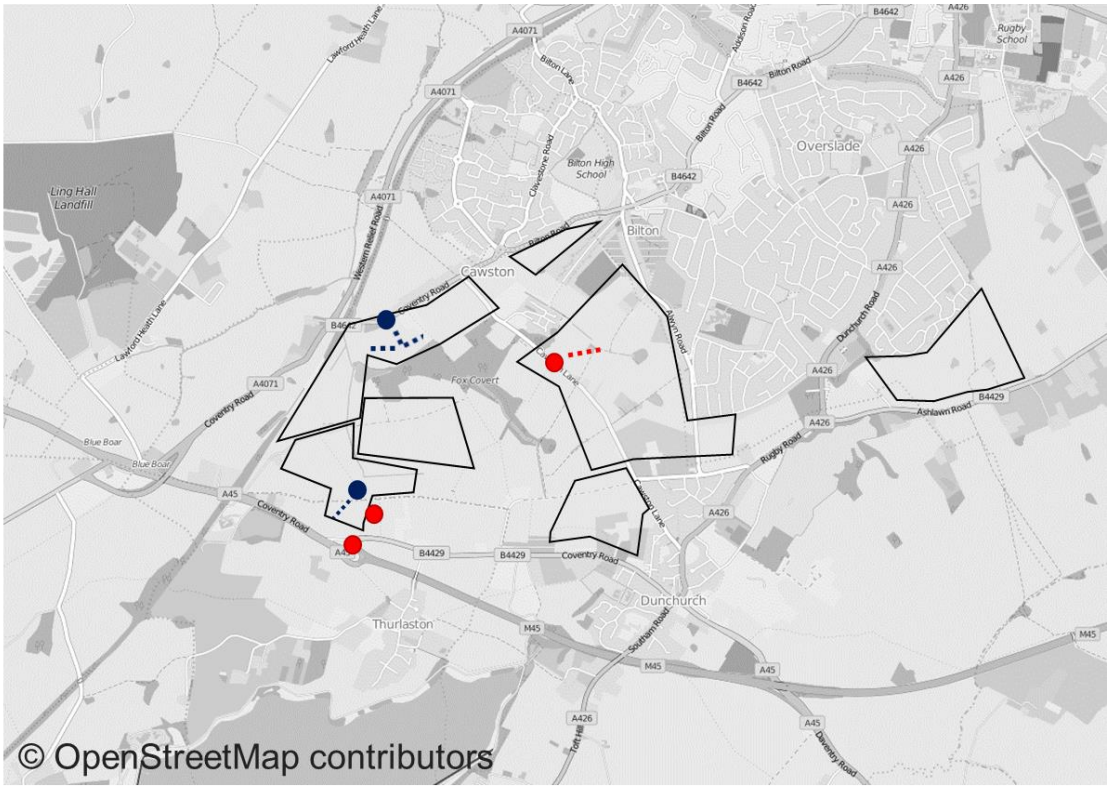


Figure 38: SWLR Stage B

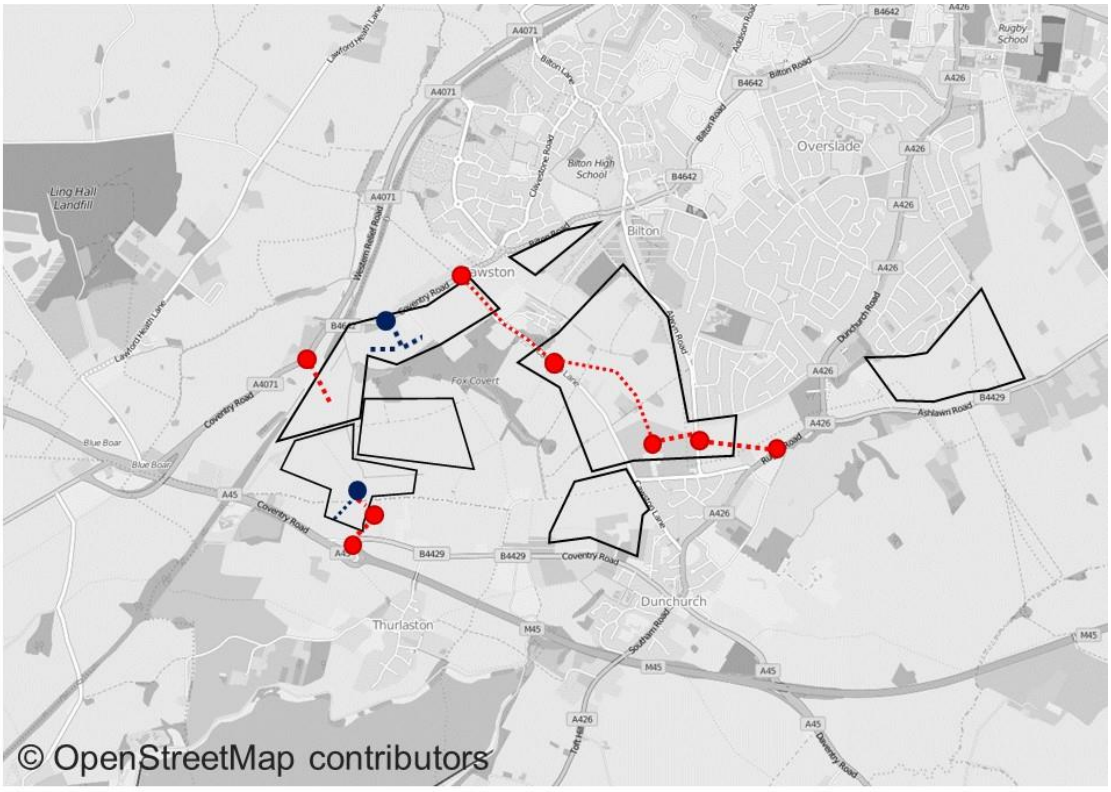


Figure 39: SWLR Stage C

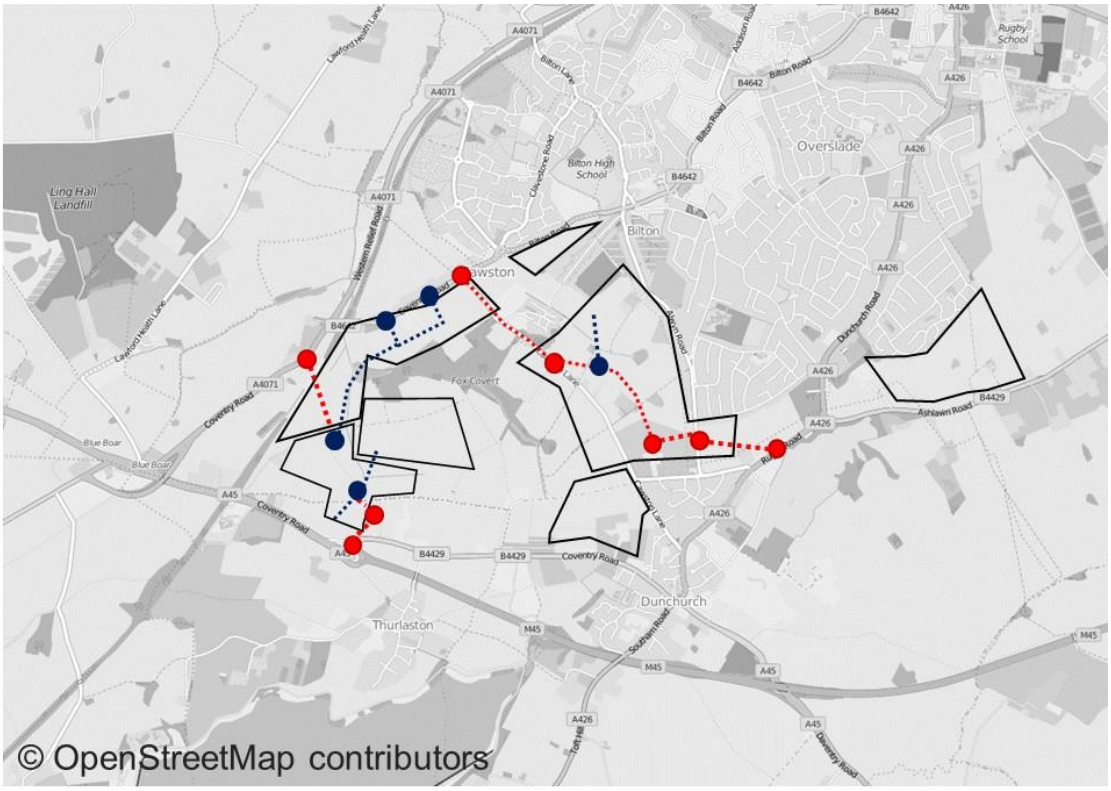


Figure 40: SWLR Stage D

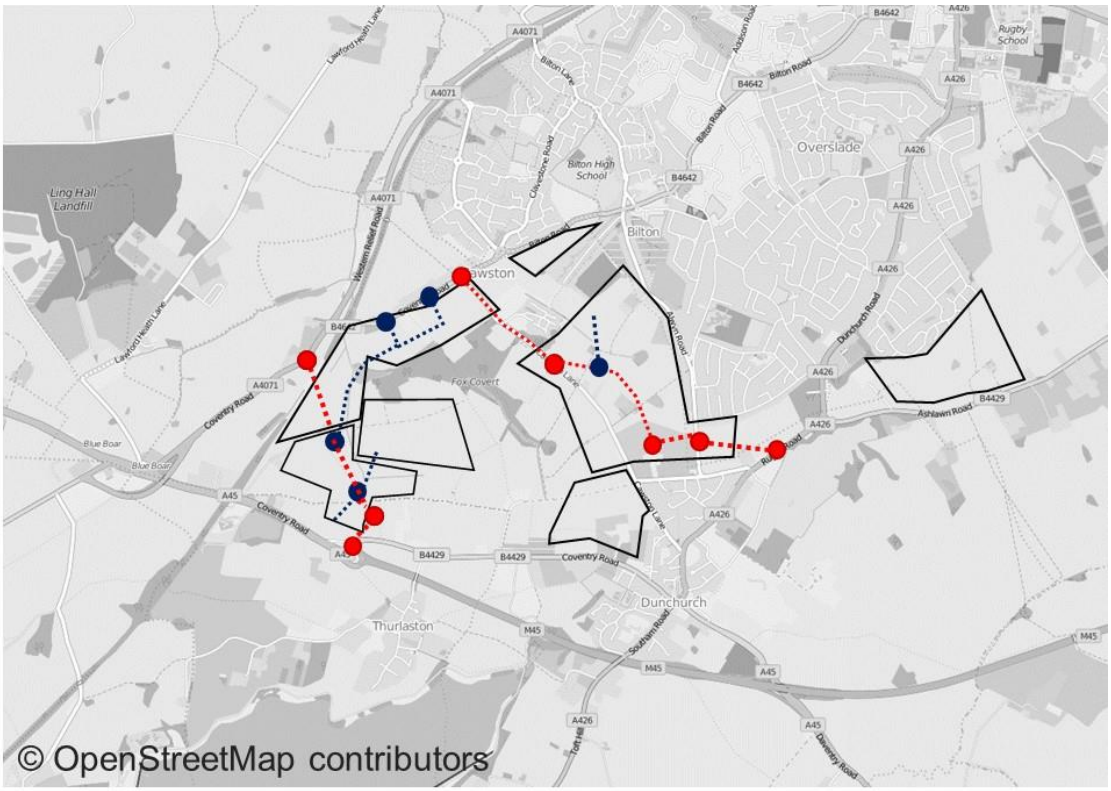
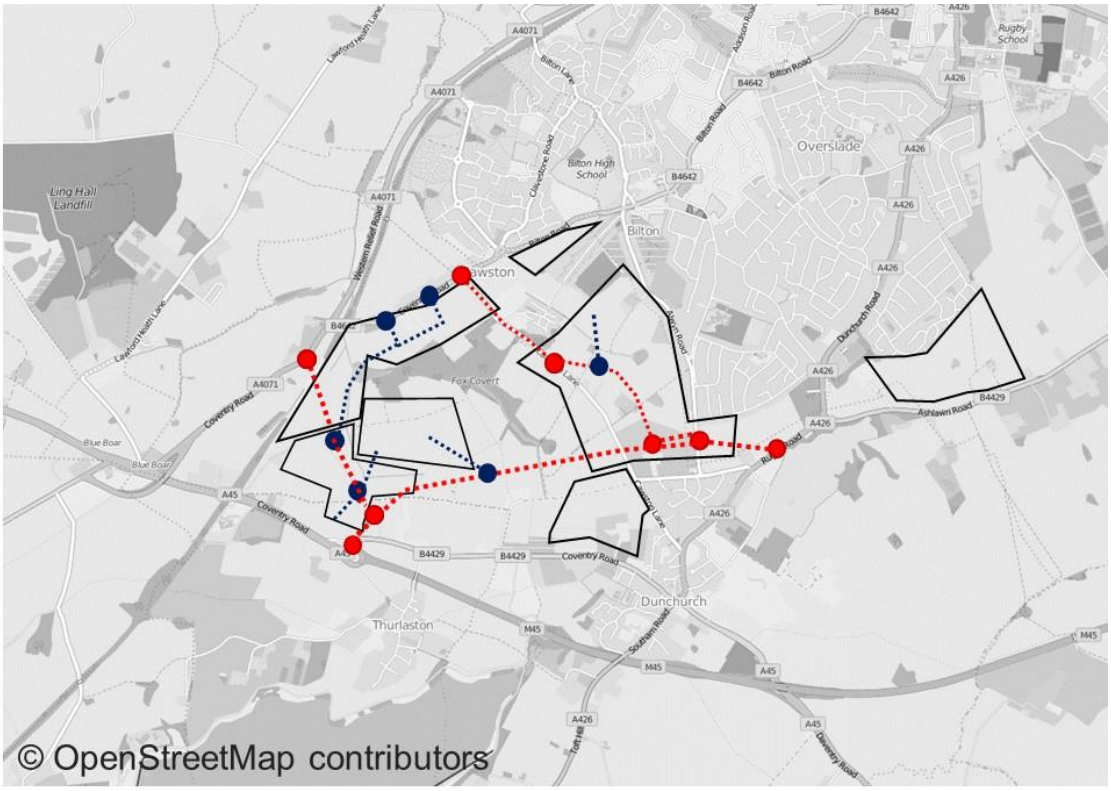


Figure 41: SWLR Stage E



Stage 3C Test Scenarios

7.142 The staged approach to the derivation of the model outputs resulted in the creation of a series of model scenarios which contained different assumptions both in terms of the development and highway interventions.

7.143 The comparisons of scenario outputs presented within the subsequent section of this note have split the scenarios based on the development phasing. There are two core scenarios which provide the basis for the initial comparisons, these are:

- **Scenario 01 –** 2031 RWA Reference Case: The RWA model forecast to 2031 with no additional housing sites included. This scenario provides an indication of likely network conditions before the additional housing sites are delivered.
- **Scenario 02 –** 2031 RWA + Development Phase 0: The RWA model inclusive of all proposed mitigation measures, except the SWLR, and inclusive of all sites located outside of the SW study area. This scenario provides an indication of the likely

network conditions inclusive of the general sites and mitigation but specifically excluding the SW growth.

7.144 Scenario 02 provides an indication of the residual impacts on the network which will occur as a result of the remaining site allocations. The purpose of running this scenario and presenting the outcomes is it will provide an indication of traffic growth levels, across the southwest that will occur irrespective of the delivery of growth specifically within the southwest area. It is considered beneficial to gain an understanding of the likely traffic growth in the area which will be outside of the control of the sites being promoted within the SW area as, although it is desirable, it would be unreasonable to expect the sites within the SW to mitigate for these impacts fully through the area specific mitigation strategy.

7.145 An overview of the phasing scenarios that have been tested are provided as follows:

- **Scenario 03** – Phase 01: phase 1 developments only
- **Scenario 04** – Phase 01a: phase 1 developments minus the housing identified in Area 6.
- **Scenario 05** – Phase 2: phase 1 & 2 developments only
- **Scenario 06** – Phase 2 + Stage B: Scenario 05 plus Stage B connection between A426 and the B4642.
- **Scenario 07** – Phase 3 + Stage C: Scenario 06 plus phase 3 housing and increases connectivity between the sites to the north.
- **Scenario 08** – Phase 3 + Stage D: Scenario 07 plus a direct north/south connected between the M45/A45 and the new junction south of Potford Dam.
- **Scenario 09** – Phase 3 + Stage E: Scenario 08 plus the connection between the A426 and the M45/A45 junction.
- **Scenario 10** – Phase 4 + Stage E: The full development and SWLR alignment.

7.146 Scenario 04 was identified in response to the perception that the allocation of housing in area 4 could have an adverse effect on the Dunchurch Crossroads area and may trigger the need for the SWLR to be brought forward sooner. As a result it was removed from one test to enable the likely impact of the development on the Dunchurch Crossroads to be determined.

Stage 3C Results Analysis

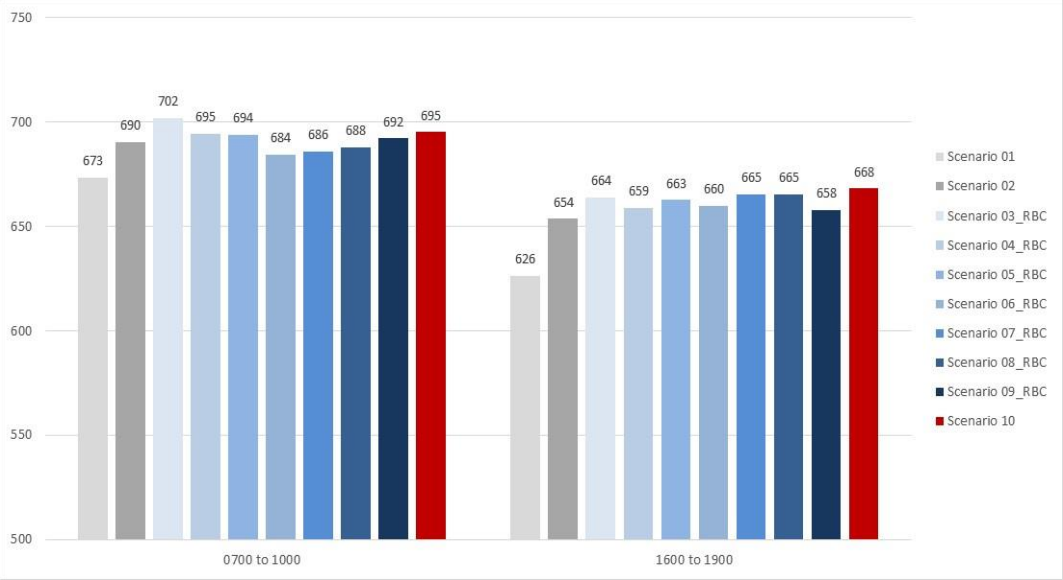
7.147 The previous analysis set out earlier within this report, has established the overall level of network operation that is predicted to occur when all of the sites RBC have identified, including 5000 dwellings in the Southwest, come forward alongside the infrastructure identified thus far.

7.148 Thus it was considered acceptable to undertake on high level analysis in the form of the average delay statistic extracted at a network wide level and then focus on the detailed impacts observed at the Dunchurch Crossroads since minimising the impacts in this area is considered to be a determining factor in the overall delivery of development in the southwest area.

Network wide Statistics – Average Delay

7.149 The network wide average delay was assessed for the 2031 RWA Reference Case and all Stage 3C test scenarios. A summary of these values is illustrated within the following **Figure 42** for both AM and PM model periods.

Figure 42: Network Stats 2031 Ref Case vs. 2031 Stage 3C Scenarios AM



7.150 Analysis of the previous figure reveals that, at the strategic level, some variation in journey times is observed across the options.

7.151 It is Scenario 06 that produces some of the lowest overall delays which is indicative of the benefit of delivering the Stage B connection, albeit Scenario 06 also has the second lowest

level of housing of the scenarios and would therefore be expected to produce lower delays than some of the subsequent scenarios. The subsequent increase in delays in Scenario 07 is also relatively small which indicates that the Stage B connection (A426 to B4642) delivers continued benefits throughout the delivery of phases 1 to 3 of the RBC development phasing strategy.

7.152 Analysis of the results also reveals a reduction in delay when Stage E is delivered in Scenario 09. This indicates the benefit of connecting the link road between the A426 and the A45/M45 and that this delivers benefits between Phase 03 and Phase 04 (full build out).

3C Detailed junction Analysis

7.153 The following section documents the findings from the analysis of detailed junction impacts.

7.154 As has been mentioned previously, the current mitigation strategy has been identified as having the potential to deliver benefits at Dunchurch Crossroads by providing an alternative route to enable traffic traveling North/South and also between Rugby and the M45/A45 and Coventry, to bypass Dunchurch. On that basis it was considered appropriate, particularly given the conceptual status of the proposals, to focus the analysis specifically on the Dunchurch Crossroads.

7.155 The modelled flows and demand flows have been extracted for all model scenarios and presented for the AM and PM period respectively. Alongside the modelled and demand flows, an additional series is presented on the figures which illustrates the level of demand present within the Scenario 02 as this is the level of junction demand which the model predicts will occur irrespective of the development strategy in the southwest.

7.156 It is considered that assessment of the demand flows is particularly pertinent when considering the operation of Dunchurch Crossroads. It is widely accepted that the junction currently operates beyond capacity and whilst it is likely that some additional mitigation may be able to come forward to introduce some additional capacity in the area it is unlikely to be sufficient to accommodate the growth in traffic volumes which are likely to have occurred by 2031. Thus, in the majority of the model scenarios the junction will be operating beyond capacity and vehicles will not choose to assign through the area (demonstrated by a relatively stable modelled flow value), the demands however provide an indication of what will happen to the junction even if it is mitigated.

7.157 A higher demand in the area means that more traffic will choose to assign via the junction in response to an improvement in conditions. Therefore it is plausible for any benefits that could be delivered through unlocking additional capacity to be entirely eroded by the reassignment of supressed demand through the junction. The explains why options to improve the junction should only be seen as an interim solution as it is likely that improvements in traffic conditions could be short-lived and the improvements draw more traffic into the area, re-instating the current status quo.

7.158 The modelled and demand flows predicted to occur at the Dunchurch Crossroads, as a resulted of the RBC phasing strategy have been presented for the AM and PM time periods within **Figure 43** and **Figure 44** respectively.

Figure 43: Dunchurch Crossroads, Modelled Versus Demand Flows, RBC Phasing Strategy, AM period (07:00 to 10:00)

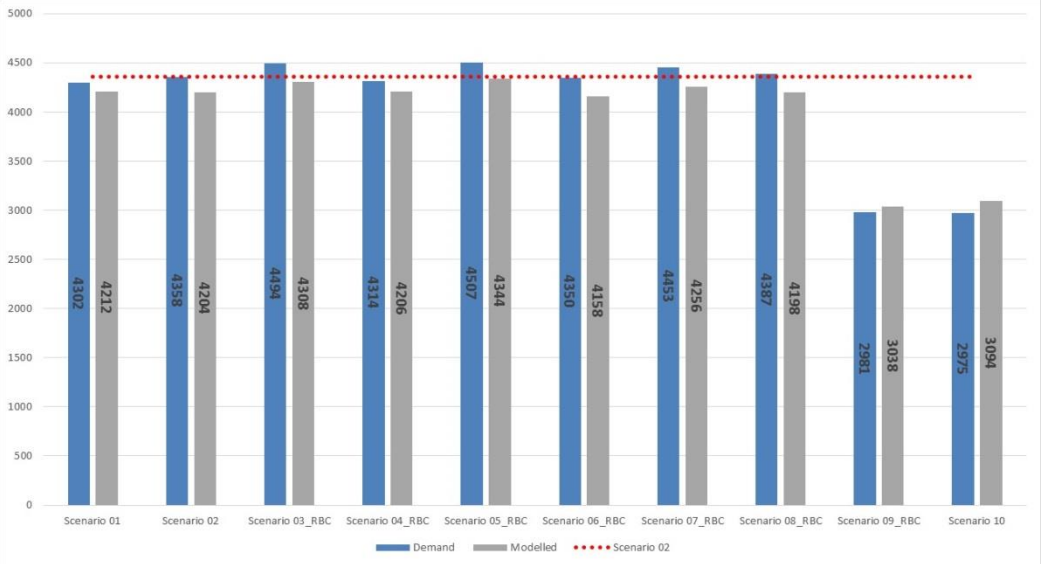
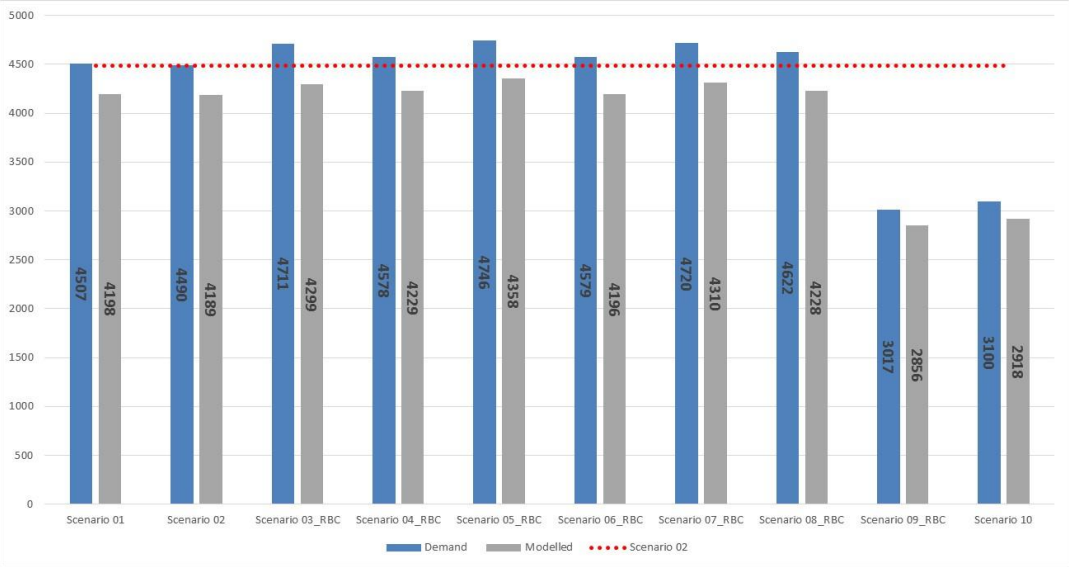


Figure 44: Dunchurch Crossroads, Modelled Versus Demand Flows, RBC Phasing Strategy, PM period (16:00 to 19:00)



7.159 Analysis of the information presented within these figures reveals that there is a significant drop in vehicular demand at the junction as a result of the completion of the SWLR.

7.160 There are a number of scenarios where the demands increase at this junction. It is in these scenarios that it can be concluded that there will likely be a negative impact in the area of Dunchurch Crossroads.

7.161 The demand impacts and pattern of change between scenarios, at the junction, are broadly consistent between AM and PM time periods with the exception of Scenario 04 which experiences demand which are comparable to Scenario 02 in the AM but these are higher within the PM.

7.162 The analysis shows a notable increase in demands occurs in Scenario 03 which drop slightly in Scenario 04 as a result of the removal of housing assumed in Area 6. Demands increase again in Scenario 05 which is to be expected as a result of the additional phase 2 housing levels.

7.163 Within the AM the demands in Scenario 06 drop to a level which is comparable to scenario 02, in the PM the levels are still slightly higher in Scenario 06 than Scenario 02. This indicates that the connection assumed between the A426 and the B4642 has the potential to deliver some relief to the Dunchurch Crossroads, although it does not reduce traffic levels to below the levels predicted within Scenario 02 it does indicate that the link will deliver some relief from the additional traffic volumes generated by the developments in the southwest.

7.164 Demands increase in Scenario 07 as a result of the additional housing assumed as a result of phase 03. Again, within the next scenario, Scenario 08, there is a drop in the demands at the junction which indicates that connecting the route between the M45/A45 junction and the A4071, provides additional potential for traffic to be diverted away from the Dunchurch crossroads.

7.165 It is not until the full SWLR is connected that the model predicts conditions at the junction will improve and, furthermore, within Scenarios 03, 05 and 07 it is likely that traffic demands will result in a worsening of conditions due to higher traffic demands for the area. Detailed threshold testing would likely be required to determine whether the level of impact is unacceptable.

3C Summary of Findings

7.166 The testing completed through stage 3C has focussed on establishing the relative impacts of bringing forward both housing and the SWLR across a number of key phases. The development phasing was advised by RBC and then VM determined an initial SWLR phasing strategy in response to the development phasing coupled with a series of network reviews.

7.167 The phasing strategy that was assessed was a concept strategy provided by RBC and should be treated as such. The same is true of the SWLR phasing strategy proposed through the assessment. Both phasing strategies are, at this stage, estimates and the assessment work is indicative and almost certainly likely to change as the delivery schedule for the southwest area becomes more certain.

7.168 Analysis of the impact on network delay, of the various options reveals that Scenario 06 produced some of the lowest overall delays which is indicative of the benefit of delivering the Stage B connection, albeit Scenario 06 also has the second lowest level of housing of the scenarios.

7.169 As the housing levels increase the delays also increase even when the SWLR connections are included. Thus there are no ‘quick wins’ strategically when the link is delivered, rather the SWLR serves to minimise the incremental impact of the development build out within the southwest area.

7.170 Analysis of the detailed junction impacts in the Dunchurch area revealed that bringing forward the housing identified in Phase 1 but without Area 6 will have a lower impact on

Dunchurch Crossroads than if the phase 1 housing comes forward in full. However, regardless of the option promoted, both are predicted to have an impact on the crossroads and will likely increase vehicle demands in the area.

7.171 The connection included within the SWLR Stage B (connection between A426 Rugby Road and B4642 Coventry Road) delivers some benefits but these are not sufficient to induce a reduction in vehicle demands at Dunchurch crossroads. This could indicate that the benefits to the crossroads of this section are likely to be minimal or, alternatively, that the housing numbers would need to be lower for this particular element of the SWLR to deliver a benefit at the crossroads.

7.172 A similar picture emerges when the Stage C and Stage D connections are delivered (connecting the A4071 and the M45/A45 through the employment land) insofar as the extra housing is accommodated with relatively modest traffic demand increases at the crossroads. This indicates that these connections serve to provide some benefit to the crossroads but this is eroded by the additional housing that comes forward through Phase 3.

7.173 It is only when Stage E is connected (i.e. the link between the A426 Rugby Road and the M45/A45 which bypasses Dunchurch) that there is a truly discernible benefit at the junction.

Stage 3C Conclusions

7.174 The analysis set out within Stage 3C demonstrates that, strategically, bringing the link forward in phases, alongside the housing schedule, does not deliver a significant amount of benefit across the study area. Rather, judging by the changes in the average delay, the SWLR appears to deliver the necessary capacity to ensure that the average delays across the study area do not increase significantly.

7.175 The detailed analysis of the impacts on Dunchurch Crossroads revels that there are opportunities for the SWLR to be phased alongside the housing and that this will potentially reduce some of the impacts in the area of Dunchurch but it is not until the full link is delivered that a benefit to the crossroads is experienced.

7.176 This is not surprising since the benefits of the SWLR emerge from the ability for traffic to bypass the crossroads. Without this link then, for some developments, the link between the A426 and the B4642 Coventry Road will not provide a viable alternative to routing through the crossroads.

7.177 It is clear from the analysis that delivery of the links between the A426 Rugby Road and the B4642 Coventry Road and between the M45/A45 and A4071 can potentially reduce impacts on Dunchurch by ensuring more alternative routes are available for the development sites but for benefits to occur at the crossroads then the direct link between the A426 Rugby Road and the M45/A45 is required at the earliest possible opportunity.

7.178 In the meantime, if a development strategy is to come forward which minimises the impacts of the development in the southwest on the crossroads then it would be beneficial if it comes forward in the area of the B4642 Coventry Road/A426 link as well as facing the B4642/A4071 to the north of the development area, albeit issues at the Potford Dam roundabout will likely mean that this area would benefit from a link directly on to the A4071 at an early stage to ensure those localised impacts can be mitigated.

Stage 3D Analysis

7.179 Once the testing outlined previously had been completed, RBC advised that a sensitivity test was required which was intended to assess the effects of allocating 1,500 dwellings in the Lodge Farm area.

7.180 This assessment was undertaken once the previous stages had been completed and the objectives of the assessment were to determine the strategic impacts associated with the allocation alongside the likely impacts on key junctions in the area, in this case Dunchurch Crossroads.

3D Test Scenarios

7.181 The 1,500 houses at Lodge Farm represented a shift away from a site outside of the core study area and into the southwest area. Rather than adjust the development growth assumptions at this stage, it was decided that, for the initial assessment, it would be acceptable to simply assign the additional development site within the model and assess the outputs.

7.182 This approach can be considered to be robust as no redistribution effects will be included, at this stage, in response to the inclusion of the development.

7.183 It is acknowledged that this assumption may need to be revisited during any subsequent stages of analysis.

7.184 The site is anticipated to comprise 1,500 dwellings and the location is illustrated within the following **Figure 45**:

Figure 45: Lodge Farm Site Location

7.185 The site itself lies just outside of the model area and, as a result, the network was extended along the A45 to ensure that the site could be accounted for within the modelling. Census Journey to Work data was reviewed for the site using the MSOA in which the site is contained (Rugby 012). This information was used to create a distribution for the site which then assigned development trips into the model as appropriate.

7.186 Because of the location of the site on the periphery of the network, not all trips will enter into the study area, this was accounted for within the distribution analysis. The distribution derived from the Census data and the resultant distribution assigned within the model is illustrated within **Figure 46** and **Figure 47** respectively.

Figure 46: Lodge Farm Census Distribution

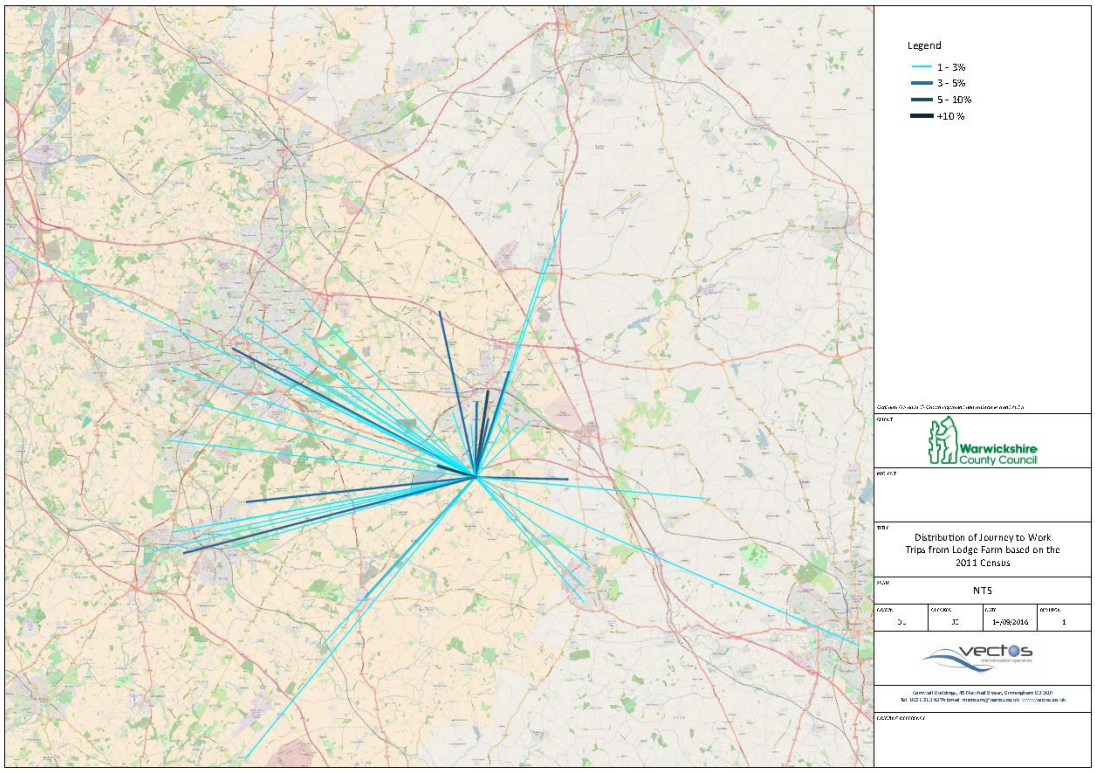


Figure 47: Lodge Farm Assigned Distribution

7.187 In order that the impacts of allocating the Lodge Farm development can be understood in the context of the broader approach to allocating development through the RBC Local Plan, the following scenarios have been run and assessed:

- **2031 RWA Reference case** – The RWA model forecast to 2031 but excluding sites identified in the Local Plan.
- **2031 Preferred Option (2031 PO)**– the previous scenario inclusive of all Local Plan sites including all sites identified within the SW area as well as the SWLR.
- **2031 Preferred Option plus SW & Lodge Farm (2031 PO + LF)** - The previous scenario inclusive of the additional development trips associated with Lodge Farm.

Stage 3D Results Analysis

7.188 The results extracted from the aforementioned scenarios and accompanying analysis has been documented within the following section:

Network wide Statistics – Average Delay

7.189 The network wide average delay was assessed for the 2031 RWA Reference Case and all Stage 3B test scenarios. A summary of these values is presented within the following **Table 45** and **Table 46** for the AM and PM respectively.

Table 45: Network Stats 2031 Ref Case vs. 2031 Stage 3D Scenarios AM (07:00 to 10:00)

Scenario:	Ref Case	2031 PO No SW	2031 PO	2031 PO + LF
Delay	673	690	688	696
Diff from Ref	-	17	15	23
%	-	2.53%	2.23%	3.42%

Table 46: Network Stats 2031 Ref Case vs. 2031 Stage 3B Scenarios PM (16:00 to 19:00)

Scenario:	Ref Case	2031 PO No SW	2031 PO	2031 PO + LF
Delay	623	654	670	689
Diff from Ref	-	28	44	63
%	-	4.47%	7.03%	10.06%

7.190 Analysis of the information presented within the previous Tables reveals that, at the strategic level, within the AM there are very few impacts associated with the delivery of Lodge Farm. Whilst there is a minor increase in delay within the PM there is a more notable

increase in journey times. As such it is likely that, within the AM, there are very few amendments to the strategic infrastructure likely to be required within the network. Some variation in journey times is to be expected as the remote location for the site will naturally induce longer journey times.

7.191 Within the PM there is a more substantial increase in journey times, this is likely to be indicative of a need for additional infrastructure to be delivered within the study area. This is not surprising as the housing site will increase the pressure on the network in the southwest, some additional analysis has been undertaken, in the way of maximum queue length analysis, which has been documented within the following section to aid the identification of the areas where potential mitigation measures may be required:

Maximum Queue Length Analysis

7.192 The following sets out some initial observations based on the differences in queue lengths between the Reference Case and the 2031 Preferred Option + Lodge Farm scenarios. The comparison between queuing levels in the Reference Case and Do Something scenario have been illustrated for the AM and PM time periods within **Figure 48** and **Figure 49** respectively.

Figure 48: AM Period Maximum Queue Length Comparisons (Ref Case vs. Do Some)

Figure 49: PM Period Maximum Queue Length Comparisons (Ref Case vs. Do Some)

7.193 Analysis of the previous figures reveals that, when compared to the earlier analysis of queuing undertaken within Stage 3A (Figure 27 to Figure 30), there are now no instances of very severe queuing increases but the number of severe (30 to 50 vehicles) queue increases has increased in both the AM and the PM.

7.194 The PM network appears to have a larger number of queuing increases than both the AM and the original PO PM network. A concentration of impacts along the Western Relief Road has occurred within the PM which may be indicative of a need for additional mitigation measures to be delivered within this area and/or optimisation and refinement of existing proposals may also be required.

7.195 The impacts that have been identified are the cumulative impacts of all sites included in the assessment, not just Lodge Farm and the analysis indicates that further work on junction capacity along the A4071 may be required in addition to further measures along the A426 to the North of Rugby. It is likely that further review of scheme proposals in these areas will be required but, based on the current outputs extracted, this does not necessarily need to be fully resolved prior to the adoption of the Local Plan.

3D Detailed Junction Analysis

7.196 Whilst the analysis set out previously presents an indication of the strategic significance of delivering the differing SWLR alignments, it does not provide an indication of the localised impacts associated with the various options. In order this could be better understood, the impact at two key locations was reviewed in detail namely:

- A426/B4429 'Dunchurch Crossroads'
- A4071/B4642 'Potford Dam Roundabout'

7.197 As with the analysis presented within earlier Stage 3 tests, the average throughput that occurs within the model scenario was compared to the predicted demands for both of the junctions.

7.198 The analysis of the impacts at these junctions has been undertaken in line with the previous stages of the threshold assessment and has been detailed as follows:

Dunchurch Crossroads

7.199 Early analysis of the impacts in this location, in the form of changes to the vehicular demands, has indicated that the junction will benefit significantly from the inclusion of the SWLR which enables traffic to bypass Dunchurch altogether.

7.200 A summary of the AM and PM period modelled and demand flows, across all of the model scenarios has been provided, for the Dunchurch Crossroads, within the following **Table 47** and **Table 48** and has also been illustrated within **Figure 50** and **Figure 51** respectively.

Table 47: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	2031 Ref Case	2031 PO No SW Dev.	2031 PO plus SW	2031 PO plus SW & LF
Demand	4302	4358	2975	3644
Modelled	4212	4204	3094	3645
Diff	97.90%	96.46%	104.01%	100.04%

Table 48: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (16:00 to 19:00)

Scenario:	2031 Ref Case	2031 PO No SW Dev.	2031 PO plus SW	2031 PO plus SW & LF
Demand	4507	4490	3100	3794
Modelled	4198	4189	2918	3589
Diff	93.15%	93.29%	94.12%	94.62%

Figure 50: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

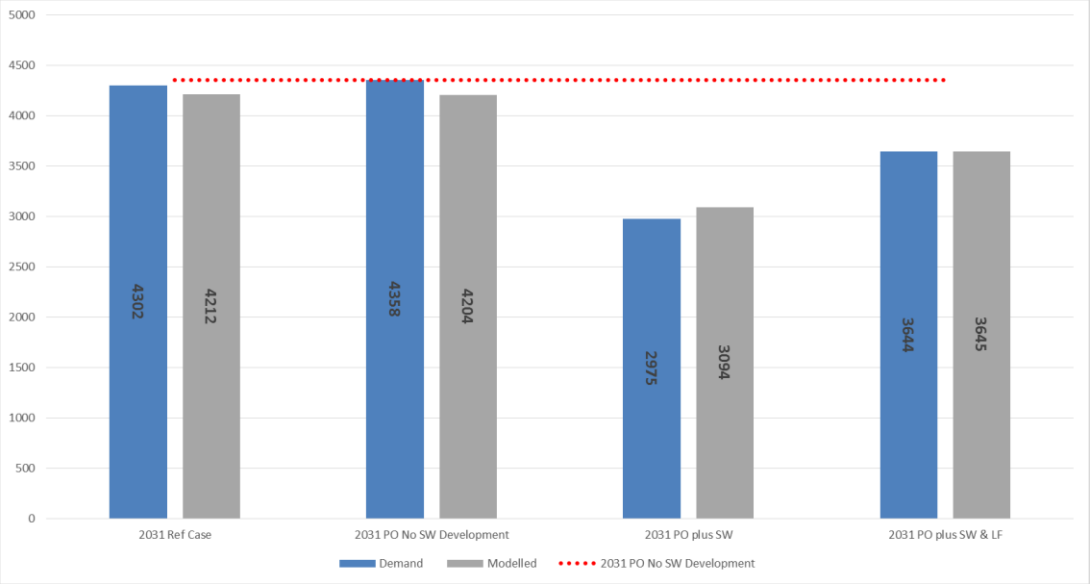
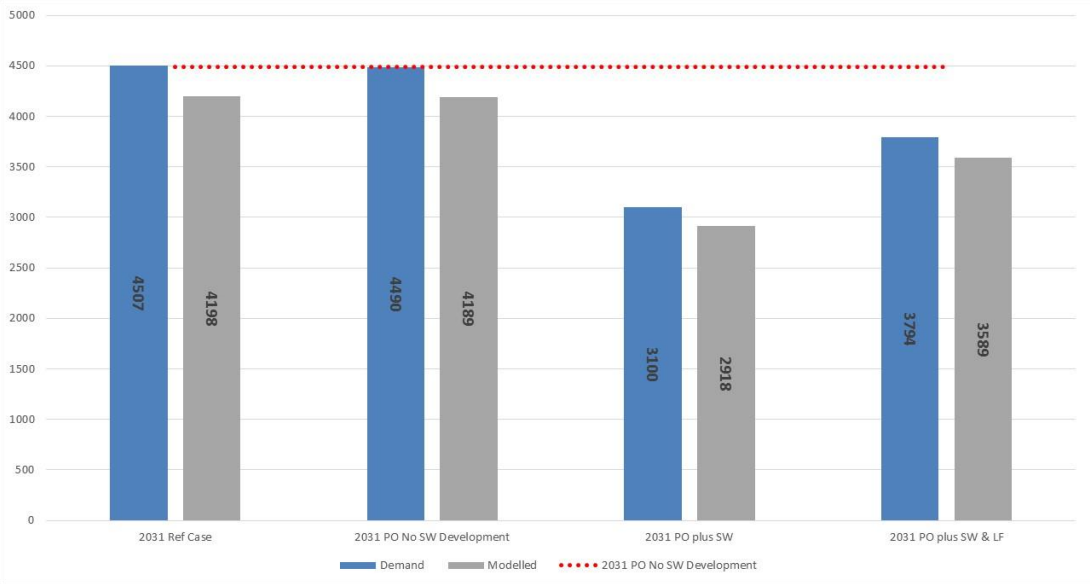


Figure 51: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)



7.201 The information presented within the previous tables and figures also contains the values for the 2031 PO no SW scenario since this is considered to reflect the inherent demands at the junction, post adoption of the Local Plan, that the sites in the southwest cannot influence (i.e. the allocation strategy will trigger these conditions before any of the sites in the southwest come forward).

7.202 Analysis of the information presented within the previous tables and figures reveals that the drop in traffic levels achieved within the PO scenario is likely to be, in part, eroded by the inclusion of the Lodge Farm development but the conditions will still represent an improvement compared to the 2031 Reference Case model. This means that it is likely that the Lodge Farm development can be accommodated without additional impacts provided the SWLR is in place at the time.

7.203 The red dotted line represents the 2031 situation prior to the developments within the Southwest being included. Although the line provides a useful marker it is pertinent to note that the traffic conditions currently observed at the junction are already considered to be unacceptable and, therefore, the red line should not be assumed to indicate an acceptable level of junction performance. Vehicular flows and demands which exceed that line however, can be concluded to be likely to adversely affect the network performance in this area and so the target of reducing flows in the area is considered to be a minimum measure of success for the overall southwest mitigation strategy.

Potford Dam Roundabout

7.204 When assessing the impact of various network and SWLR configurations during previous stages of the assessment, the A4071/B4642 Potford Dam was highlighted as an area of concern. As a result, detailed analysis of the changes in traffic volumes at this location has also been undertaken for both AM and PM modelled periods and the outcome from these comparisons has been presented within the following **Table 49** and **Table 50:**

Table 49: Potford Dam Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	2031 Ref Case	2031 PO No SW Dev.	2031 PO plus SW	2031 PO plus SW & LF
Demand	4069	4227	5483	5996
Modelled	4108	4300	5046	5454
Diff	100.97%	101.74%	92.04%	90.96%

Table 50: Potford Dam Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	2031 Ref Case	2031 PO No SW Dev.	2031 PO plus SW	2031 PO plus SW & LF
Demand	3790	4028	5388	6016
Modelled	3900	4190	5251	5655
Diff	102.89%	104.02%	97.45%	94.01%

7.205 Analysis of the information presented within the previous tables reveals that traffic volumes are predicted to increase as a result of the inclusion of the Lodge Farm development. This is because traffic from the development which is heading north towards the M6, as well as some trips destined for the north of the town centre, will travel via A4071 along a route which involves travelling through the Potford Dam roundabout.

7.206 Thus, if the Lodge Farm development site is allocated it is considered pertinent to highlight that the potential impacts form this development should be considered when determining the solution for the Potford Dam junction improvements. These measures will be necessary to mitigate impacts predicted to occur as a result of the allocation of the Local Plan sites and specifically those to the southwest of Rugby.

3D Summary of Findings

7.207 The initial results analysis pertaining to the impact assessment of allocating an additional 1500 dwellings at Lodge Farm indicates that there will likely be some strategic impacts during the PM that will require the determination of additional highway mitigation measures to ensure that the impacts are minimised and that at this stage, the level of impact across the study area is likely to increase as a result of the inclusion of this site.

7.208 It is however considered highly likely that junction enhancements could be identified both along the A4071 Rugby Western Relief Road and along the A426 north of Rugby which would further reduce the cumulative impact of the sites, including Lodge Farm, that have been observed thus far.

7.209 The analysis of the impacts on the Dunchurch Crossroads and Potford Dam roundabout also reveals that there will be an increase in vehicle flows at both locations as a result of the allocation of the Lodge Farm development. It is likely that these additional development trips will need to be considered during the assessment and design of any mitigation proposals put forward for the Potford Dam roundabout.

7.210 It is not possible to consider the mitigation proposals at the Potford Dam roundabout in any more detail at this stage as the alignment of the SWLR and the means of improving the connectivity towards the A4071 is still to be determined.

7.211 However, VM understand that one of the primary benefits of the delivery of the SWLR is the ability to deliver an improvement in conditions at the Dunchurch Crossroads and the work completed thus far indicates that, although still notable, the benefits that have been identified as a result of the delivery of the SWLR are likely to be partially eroded via the allocation of development at Lodge Farm.

7.212 It should be acknowledged that delivery of the SWLR provides a number of opportunities for the reconfiguration of the Dunchurch Crossroads to further reduce the vehicular demand at the junction. For example it is highly likely that delivery of the SWLR may improve opportunities for the right turn from the A426 north to the B4429 to also be banned as this movement is well served by the SWLR. Introducing restrictions such as this would serve to deter certain movements away from the junction which may ultimately serve to reduce the vehicle demands in the area further and improve congestion and air quality issues as a result.

7.213 Additionally, other opportunities should be considered such as restricted movements from the B4429 south to minimise the amount of traffic coming from the new development which uses the junction to access the wider Rugby network as, at the moment, the modelling predicts that the B4429 would be the preferred route for most vehicles rather than 'hopping' between the junctions on the M45. This could be further reinforced by the provision of a high standard link between the M45/A45 and A4071 to encourage traffic to utilise that route to the A4071 which would complement the restrictions put in place at the crossroads.

7.214 There may also be an opportunity to reconfigure the M45/Daventry Road junction to accommodate all movements but consideration should be given as to whether this would draw more traffic through the Dunchurch junction by improving accessibility to the east of Rugby.

Stage 3D Conclusions

7.215 Completion of the Lodge Farm sensitivity test detailed previously within this Report has revealed the following conclusions:

- That there are some strategic impacts within the PM period that indicate a need for further mitigation to be delivered to minimise the development induced impacts.
- That the allocation of Lodge Farm will result in an increase in vehicle demands at both the Potford Dam and Dunchurch junctions indicating that the Lodge Farm development trips will need to be considered when defining any of the highway mitigation schemes in the area.
- Whilst the impact on Dunchurch Crossroads does not exceed the demands and flows identified in the 2031 Reference Case (i.e. Pre-SWLR) there are still impacts and since one of the primary aims of delivering development in the southwest is to enable a mitigation strategy to come forward which will alleviate the impacts at Dunchurch Crossroads then it is reasonable to conclude that the phasing of Lodge Farm will be reliant on the SWLR being in place to enable the site to be delivered.
- The increase in vehicle demands at Dunchurch Crossroads, which occurs as a result of the allocation of the Lodge Farm development, is likely to result in demands which are still lower at the crossroads than the levels likely to occur without the SWLR in place. This demonstrates the junction will still benefit from the delivery of development in line with the PO allocation strategy but consideration should be given to any additional measures that can be introduced to safeguard the capacity of the junction by encouraging traffic to use alternative routes.

Recommendations

7.216 Following completion of this initial study, VM have identified the following recommendations which it is considered pertinent to raise for consideration in future stages of the Local Plan assessment. Whilst addressing these recommendations would be beneficial, VM do not believe that it is essential that the following recommendations are considered in advance of the adoption of the Local Plan:

- That the distribution associated with the Lodge Farm development is reviewed in more detail in subsequent stages since this has a direct impact on the traffic flows predicted to occur around the Dunchurch Crossroads.

- That further consideration is given to the identification of additional mitigation measures to ensure that any impacts arising as a result of the allocation of the Lodge Farm development can be minimised and furthermore;
- That further analysis is undertaken with regards the potential reconfiguration of the Dunchurch crossroads and/or reconfiguration of the M45/A45 Daventry Road junction to further reduce the vehicular demands at the Dunchurch crossroads as a result of the sites allocated through the Local Plan.

Stage 3E Analysis

7.217 Following the completion of the Lodge Farm Sensitivity Testing a second sensitivity test was identified by RBC and WCC as being necessary. The purpose of this test was to determine the relative importance of the design speeds for each of the key sections of the SWLR.

7.218 The original layout for the SWLR assumed that the link between the A426 Rugby Road and the M45/A45 junction was to be a major signposted routed delivered with a 40mph design speed, the link between the M45/A45 and the A4071 Western Relief Road was delivered to the same standard whilst the link between the A426 Rugby Road and the B4642 Coventry Road was a signed route set to a 30mph speed limit.

SWLR Options

7.219 Three options for the design of the SWLR were tested as follows:

7.220 SWLR Option 1 comprised all routes as major with the A426 Rugby Road to M45/A45 and M45/A45 to A4071 Western Relief Road links set to 40 mph and the A426 Rugby Road to B4642 Coventry link set to 30 mph.

7.221 SWLR Option 2 comprised both A426 Rugby Road to M45/A45 and M45/A45 to A4071 Western Relief Road routes as major with the links set to 30 mph and the A426 Rugby Road to B4642 Coventry link was minor (i.e. not signed) and set to 30 mph.

7.222 SWLR Option 3 comprised the A426 Rugby Road to M45/A45 route set to 30 mph and signed and the M45/A45 to A4071 Western Relief Road and A426 Rugby Road to B4642 Coventry routes set to 30 mph and minor (i.e. not signed).

7.223 The assumptions in each of these scenarios has been illustrated within **Figure 52** to **Figure 54** respectively.

Figure 52: SWLR Option 01

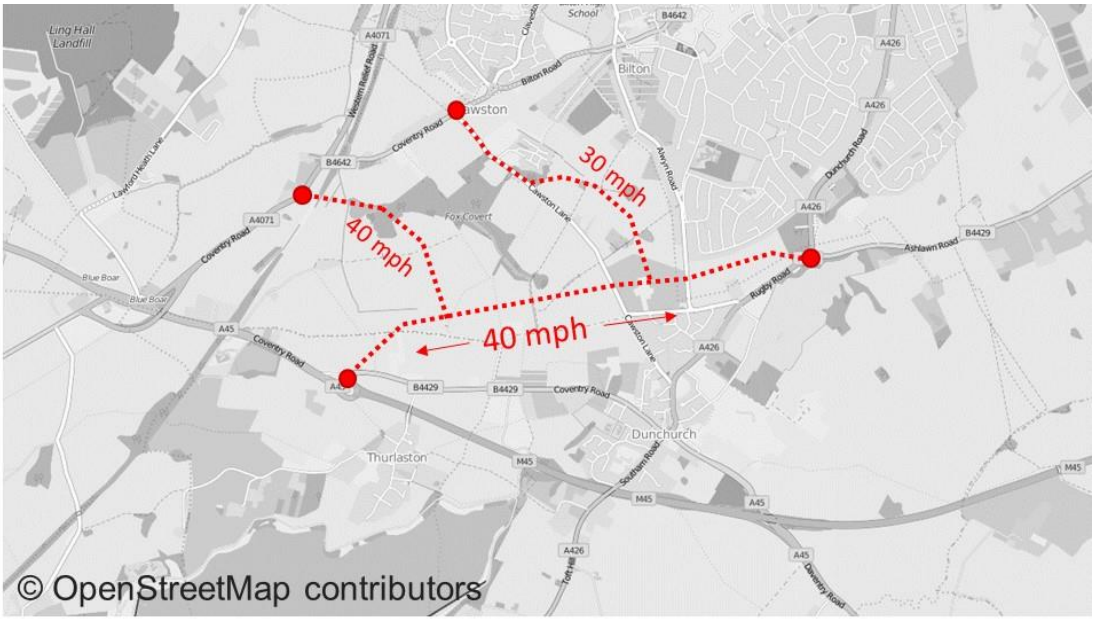


Figure 53: SWLR Option 02

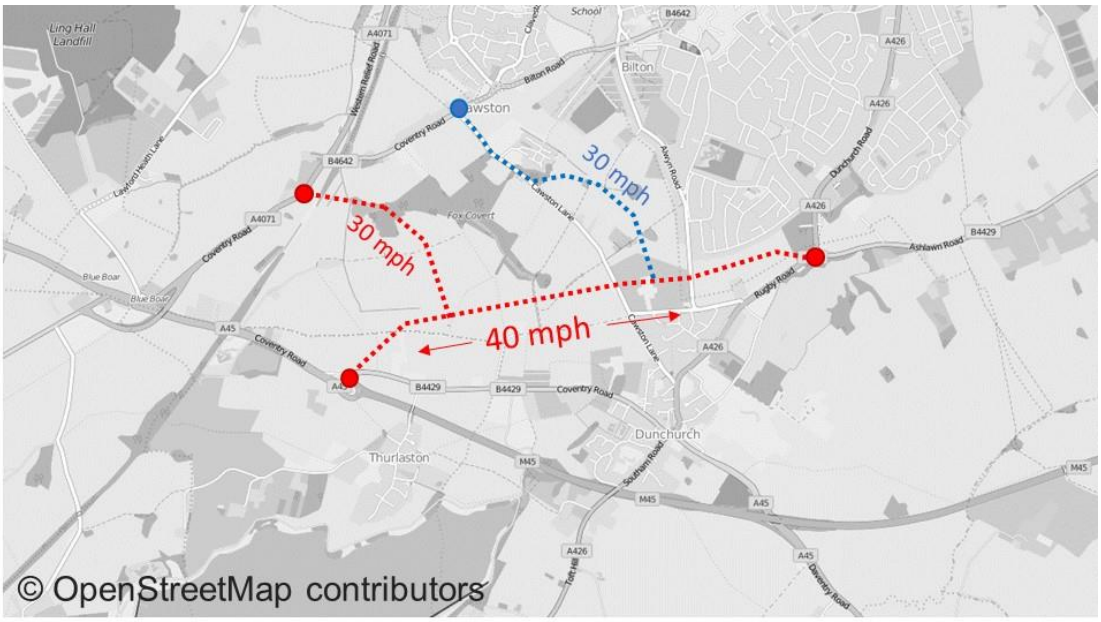
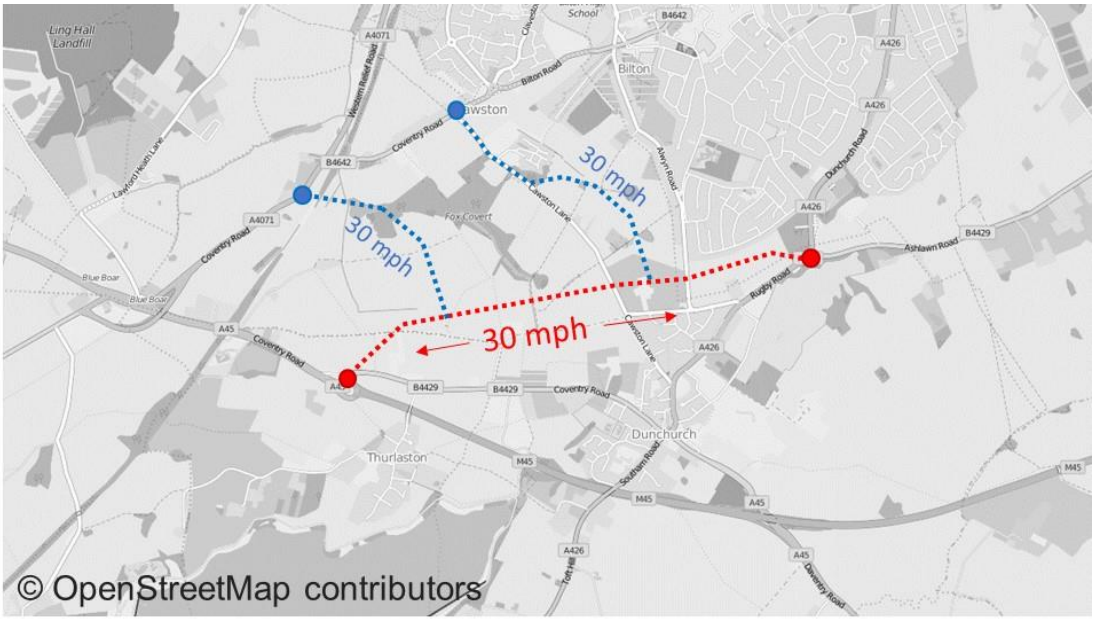


Figure 54: SWLR Option 03



3E Test Scenarios

7.224 The objective of this sensitivity test was to establish the relative importance of the SWLR speed and signage strategy. As a result, it was not considered necessary to alter any of the demand assumptions within the scenarios. All scenarios are inclusive of Lodge Farm also.

7.225 In order that the impact of the changes could be established, three options were defined for assessment:

- **2031 RWA PO + SWLR Option 01 –** The 2031 RWA Reference Case inclusive of all sites identified within the Preferred Option and SWLR Design Option 01.
- **2031 RWA PO + SWLR Option 02 –** The 2031 RWA Reference Case inclusive of all sites identified within the Preferred Option and SWLR Design Option 02
- **2031 RWA PO + SWLR Option 03 –** The 2031 RWA Reference Case inclusive of all sites identified within the Preferred Option and SWLR Design Option 03

Stage 3E Results Analysis

7.226 The results extracted from the aforementioned scenarios and accompanying analysis has been documented within the following section:

Network wide Statistics – Average Delay

7.227 The network wide average delay was assessed for the 2031 RWA Reference Case and all Stage 3E test scenarios. A summary of these values is presented within the following **Table 51** and **Table 52** for the AM and PM respectively.

Table 51: Network Stats 2031 Ref Case vs. 2031 Stage 3E Scenarios AM (07:00 to 10:00)

Scenario:	Ref Case	2031 PO SWLR Op1	2031 PO SWLR Op2	2031 PO SWLR Op3
Delay	673	696	694	697
Diff from Ref	-	23	21	24
%	-	3.42%	3.12%	3.57%

Table 52: Network Stats 2031 Ref Case vs. 2031 Stage 3E Scenarios PM (16:00 to 19:00)

Scenario:	Ref Case	2031 PO No SW	2031 PO SWLR Op2	2031 PO SWLR Op3
Delay	623	689	699	712
Diff from Ref	-	63	73	86
%	-	10.06%	11.66%	13.74%

7.228 Analysis of the results presented previously reveals that there are impacts associated with the changes that are particularly prominent within the PM period. The PM period is predicted to be the most congested of the two time periods and so this is not surprising.

7.229 Within the PM the difference in delay between Option 01 and Option 02 is relatively modest indicating that the reclassification of the A426 Rugby Road to B4642 Coventry Road is not likely to induce a significant impact. The increase is higher when the SWLR is reduced down to 30 mph however and the change appears to induce an additional 4% increase in the journey times which, considering that analysis of the previous sensitivity test has already indicated further work on the mitigation strategy is already required, is considered an undesirable increase.

3E Detailed Junction Analysis

7.230 Whilst the analysis set out previously presents an indication of the strategic significance of delivering the differing SWLR options, it does not provide an indication of the localised impacts associated with the various options. In order this could be better understood, the impact at two key locations was reviewed in detail namely:

- A426/B4429 'Dunchurch Crossroads'

- A4071/B4642 'Potford Dam Roundabout'

7.231 As with the analysis presented within earlier Stage 3 tests, the average throughput that occurs within the model scenario was compared to the predicted demands for both of the junctions.

7.232 The analysis of the impacts at these junctions has been undertaken in line with the previous stages of the assessment and has been detailed as follows:

Dunchurch Crossroads

7.233 Early analysis of the impacts in this location, in the form of changes to the vehicular demands, has indicated that the junction will benefit significantly from the inclusion of the SWLR which enables traffic to bypass Dunchurch altogether.

7.234 A summary of the AM and PM period modelled and demand flows, across all of the model scenarios has been provided, for the Dunchurch Crossroad, within the following **Table 53** and **Table 54** and has also been illustrated within **Figure 55** and **Figure 56** respectively.

Table 53: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	2031 Ref Case	2031 PO SWLR Op 1	2031 PO SWLR Op 2	2031 PO SWLR Op 3
Demand	4302	3608	3670	4100
Modelled	4212	3672	3699	3936
Diff	97.90%	101.78%	100.79%	96.01%

Table 54: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (16:00 to 19:00)

Scenario:	2031 Ref Case	2031 PO No SW Dev.	2031 PO plus SW	2031 PO plus SW & LF
Demand	4507	3740	3850	4106
Modelled	4198	3524	3594	3918
Diff	93.15%	94.22%	93.35%	95.43%

Figure 55: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

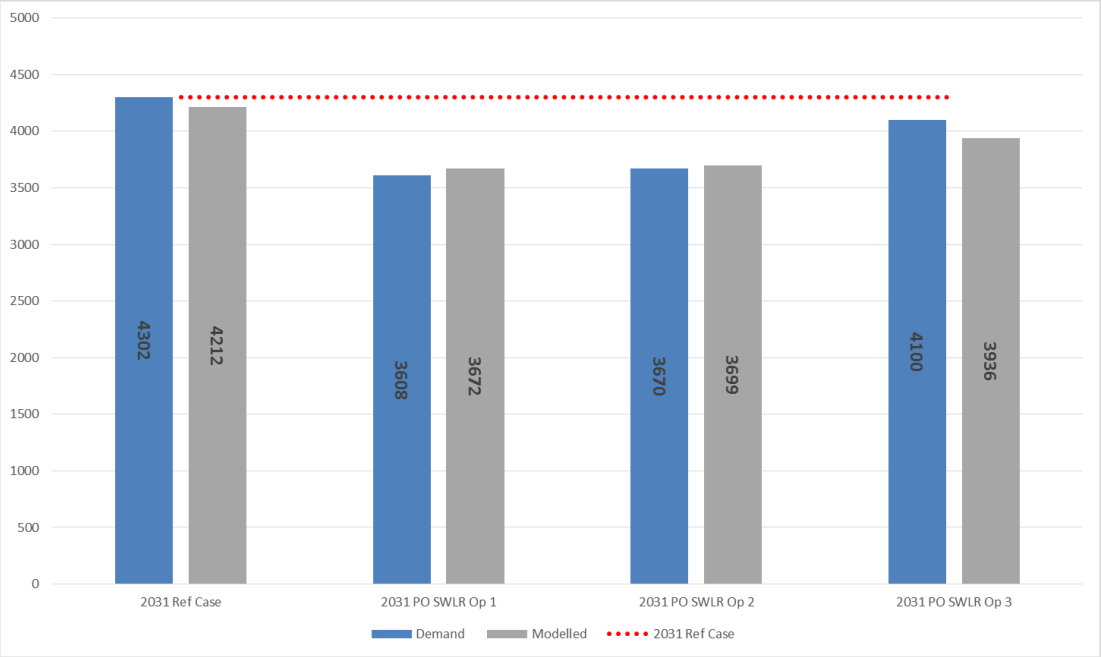
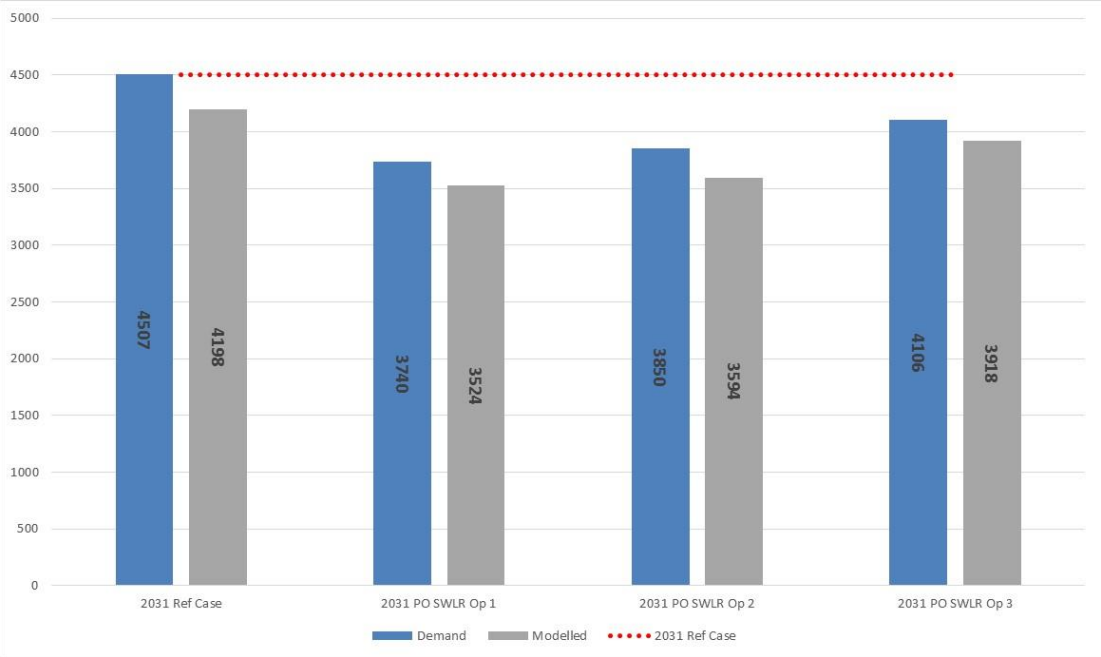


Figure 56: Dunchurch Crossroads Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)



7.235 Analysis of the information presented within the previous tables and figures reveals that the drop in traffic levels achieved within the PO scenario benefits from the 40 mph speed limit on the SWLR in both scenarios.

7.236 The analysis of the difference in vehicle flows and demands at the crossroads between Option 01 and Option 02 is minimal. Whilst Option 02 does result in a small increase in demand at the Crossroads, Option 03 appears to have a significant impact on the Demand for the crossroads.

7.237 Within Option 01 and Option 02, even with Lodge Farm included in the analysis, the demand at the junction is predicted to be around 15% lower as a result of the inclusion of the SWLR at 40 mph indicating that vehicles are using this route as an alternative to the cross roads.

7.238 When the speed is lowered to 30mph in Option 03 then the demand is a little as 5% lower indicating that the reduced speed will deter some vehicles from reassigning onto the new SWLR and, instead, they will remain on routes which utilise the Crossroads. Notably, within the AM Option 01 and Option 02 networks the demand/flow ratio is over 100% meaning that the junction is catering for the demand and no additional traffic is being drawn through the area. Within Option 03 the ratio has dropped back down to around 96% indicating that not all traffic can get through the junction now which indicates that the junction is approaching capacity again and traffic is diverting away from the area in response to these issues.

Potford Dam Roundabout

7.239 When assessing the impact of various network and SWLR configurations during previous stages of the assessment, the A4071/B4642 Potford Dam was highlighted as an area of concern. As a result, detailed analysis of the changes in traffic volumes at this location has also been undertaken for both AM and PM modelled periods and the outcome from these comparisons has been presented within the following **Table 55** and **Table 56.**

Table 55: Potford Dam Traffic Volumes (Demand vs. Modelled) AM Period (07:00 to 10:00)

Scenario:	2031 Ref Case	2031 PO SWLR Op 1	2031 PO SWLR Op 2	2031 PO SWLR Op 3
Demand	4069	5724	5594	5544
Modelled	4108	5284	5218	5217
Diff	100.97%	92.31%	93.28%	94.10%

Table 56: Potford Dam Traffic Volumes (Demand vs. Modelled) PM Period (16:00 to 19:00)

Scenario:	2031 Ref Case	2031 PO SWLR Op 1	2031 PO SWLR Op 2	2031 PO SWLR Op 3
Demand	3790	5704	5532	5780
Modelled	3900	5484	5392	5463
Diff	102.89%	96.14%	97.47%	94.51%

7.240 The analysis reveals that, within the PM, the greatest demand on the Potford roundabout occurs in Option 01. This is not surprising as the 40mph speed draws more traffic along the SWLR and some of this will travel towards the A4071 Western Relief Road.

7.241 When the link between the A45/M45 and A4071 is reduced to 30 mph traffic volumes drop as the route to the Western Relief Road becomes less attractive as a result. When the route between the M45/A45 and A4071 is then downgraded further there appears to be very little impact during the AM but within the PM the flows at the Potford roundabout increase again, in this instance it is because traffic now travels through the junction from the south and onto the B4542, returning to the residential areas that way whereas previously, when the route was signed, they would elect to travel along the new link to the SWLR and then on to the housing in the southwest of Rugby.

3E Summary of Findings

7.242 The testing completed within Stage 3E was intended to determine the relative significance of the design speed and signage strategy applied to the three key elements of the SLWR in order to ascertain the effects of any change to the layout assumed within the modelling both strategically and on key local junctions.

7.243 The strategic level analysis indicated that the was little difference between the proposals set out in Option 01 and Option 02, although there is a modest increase in delays. During the PM however the changes assumed in Option 03 have a much more significant impact on the network with an increase in delays of as much as an additional 4% from the Reference Case values occurring as a result of the drop in speed limit.

7.244 This is further demonstrated when the flows on the various links are analysed. Looking purely at the mid-point of each section the modelling predicts a substantial drop in flow along the SWLR if the speeds are dropped to 30 mph. A 40 mph design speed will also ensure that the link delivered is direct with reduced opportunities for conflict/friction which is considered likely to be a key design principle at this stage.

7.245 Analysis of the impact on Dunchurch Crossroads has also been undertaken in light of the perceived significance of the operation of this junction and this also revealed that the drop in speed along the SWLR from 40 mph to 30 mph would likely result in an increase in traffic

flows and demands at the crossroads as the low speed along the SWLR means that less traffic is encouraged to switch to the SWLR as an alternative route to travelling through the Dunchurch Crossroads as the slower speed reduces the cost/time savings that induce the switch in the first place.

Stage 3E Conclusions

7.246 Based on the analysis set out within Stage 3E, the following conclusions have been identified:

- The principles of the link assume that the route between the A426 and the M45/45 minimises conflict and friction, as would be achieved through the 40 mph design speed. This needs to be considered in detail in any subsequent design work pertaining to the link (I.e. the route must provide a direct bypass opportunity for Dunchurch).
- That reducing the design speed on the main SWLR link between the A426 Rugby Road and the M45/A45 below 40 mph will induce additional delays within the network and also have a direct impact on the operation of Dunchurch Crossroads since the lower speed is predicted to induce a lower level of reassignment.
- That reducing the A45/M45 to A4071 Western Relief Road link from 40 mph to 30 mph will also induce localised impacts which are undesirable and, as such, it is considered desirable to retain the connection through at 40mph.
- That reclassifying the route between the B4642 Coventry Road and A426 Ashlawn Road to a minor route is beneficial insofar as flows on the route through the housing site will reduce with only a relatively small impact on the strategic level performance or Dunchurch Crossroads. If the parallel route between the M45/A45 and A4071 is also reclassified to minor these flows begin to rise again and so, it is concluded that the best strategy is one which encourages the use of the M45/A45 to A4071 route through signage but the A426 to B4642 should be defined as a minor route to accommodate local traffic only.

7.247 The strategic nature of the link was identified through Stage 1 and Stage 2 also. Within Stage 2 it was highlighted that the link would most likely need to be delivered in full if the development within the Southeast is to come forward. As a result, delivering the major

routes through the southwest area to as high a standard as possible is likely to be essential in order that the network can continue to accommodate growth in housing beyond the current plan period.

Recommendations

7.248 It is pertinent to highlight that assessing the impacts of changes such as the impacts of design speeds and the impact that they have is very much reliant upon the routing assumptions which underpin the model. This, in turn is affected by the congestion in the area which is determined within the model based on the count data that has been used to inform the model development.

7.249 Once available, the updated RWA model, will be based on more recent information to underpin the routing calculations within the model area, as well as being based on 2016 survey data. At that stage it is recommended that the conclusions set out previously are rechecked by testing in a model which takes account, as far as it is practicable to do so, of current routing and assignment patterns within the study area.

7.250 At this stage the strategic nature of the testing is such that the current RWA model can be relied upon to determine broad principles but the detailed update to 2016 data will need to be completed in advance of the detailed design work pertaining to the delivery of the SWLR being completed. As such, it is recommended that the link is designed to the configuration set out within this report but it is recognised that this may change post adoption of the Local Plan as a result of more refined/detailed assessment work.

8 SUMMARY AND CONCLUSIONS

Summary

8.1 Vectos Microsim (VM) has been assisting Rugby Borough Council (RBC) and Warwickshire County Council (WCC) in the assessment of options pertaining to the delivery of the Rugby Borough Local Plan through the use of the Rugby Wide Area (RWA) S-Paramics micro-simulation model.

8.2 The modelling assessment work has been underway since May 2015 and the primary objectives of the work are summarised as follows:

- To assess the likely impacts, on the highway network, of the various emerging strategies concerning the delivery of housing and employment through the Rugby Borough Local Plan.
- To identify what, if any, interventions may be deliverable which will minimise the residual impacts likely to occur as a result of the Local Plan proposals.
- To assess the impacts of the allocation strategy identified by RBC for adoption and to determine an initial set of highway mitigation measures to inform the infrastructure requirements associated with the Local Plan.

8.3 A series of key stages of the assessment were defined to address these objectives as follows:

Stage 1 – Full Development Allocation Assessment

8.4 The first stage of the assessment work assessed the implications of allocating all sites identified through the SHLAA in terms of both identifying an appropriate highway infrastructure strategy as well as identifying the residual impacts likely to occur as a result of the development strategy being tested.

Stage 2 – Broad Location Allocation Assessment

8.5 Following the completion of the first stage of the assessment, a subsequent assessment was undertaken to identify the likely impacts, on the highway network, of concentrating development across three key areas of Rugby (North, Southeast and Southwest). This work

also began to look in more detail at the potential access and mitigation strategies that should be considered in conjunction with the three different allocation areas.

Stage 3 – Detailed Southwest Allocation, Phasing and Infrastructure Assessment

8.6 The final stage of the assessment work looked in detail at the impacts of concentrating development in the southwest. This included a review of the proximate infrastructure identified to support growth in the southwest as well as the likely impact of the phasing of development in the area paying particular attention to the delivery of the southwest link road and the benefits, or otherwise, that arise from the delivery thereof.

8.7 The third stage of the assessment was intended to address a number of competing objectives and, as such, the work was split into 5 core tests as follows:

- Stage 3A – Reviewed the impact of changing the SWLR alignment around the Potford Dam roundabout as well as the impact of introducing additional highway mitigation measures.
- Stage 3B – Tested the impact of changing the alignment and connectivity principles of the SWLR across a number of iterations to determine the significance of the measures identified and the role played by each linkage served by the SWLR.
- Stage 3C – Assess the impact of a concept phasing strategy for the developments in the southwest area and proposed a phasing strategy for the SWLR which best served the development build out albeit without delivering significant benefits in the area until the SWLR was completed in full.
- Stage 3D – Assessed the cumulative impact of the PO allocation inclusive of the introduction of the Lodge Farm site into the assessment.
- Stage 3E – Assessed the implications of the SWLR design speed and how it affects the assignment of traffic across the study area paying particular attention to the potential impacts on Dunchurch Crossroads.

Conclusions

8.8 At the end of each stages, or in the case of Stage 3, at the end of each discrete testing phase, a series of conclusions have been identified and are summarised as follows:

Stage 1 Conclusions

8.9 The main conclusion drawn from the Stage 1 assessment was that significant additional infrastructure would be required to ensure the development strategy identified can be accommodated within the highway network.

8.10 Stage 1 identified that deliver of a southern distributor link would be essential if the approach to allocating development was taken forward and the principles of the southwest distributor link were adopted in subsequent stages of the assessment, dependent upon the locations being assessed.

8.11 Given the high level of impacts observed and the large housing delivery number assumed, it was concluded that, in some areas, there was unlikely to be any option for additional infrastructure meaning that the development strategy tested in Stage 1 would likely push the network over capacity. Instead it was considered appropriate to reduce the development quantum and focus the approach across broad locations (North, Southwest and Southeast).

Stage 2 Conclusions

8.12 The main conclusion drawn from Stage 2 was that an element of the southern distributor link would be essential if either the southwest or southeast allocation is brought forward for development.

8.13 The analysis of the results also revealed that, overall, allocating development in the southwest was likely to be most favourable in traffic impact terms provided the strategy is accompanied by the Southwest link road (SWLR).

Stage 3

8.14 Stage 3 comprised 5 discrete stages of assessment, the conclusions from each of these stages have been summarised as follows:

Stage 3A

8.15 The conclusions from Stage 3A revealed that it was preferable for the link between the A4071 and M45/A45 to connect directly into the SWLR south of the A4071/B4642 Coventry Road 'Potford Dam' roundabout. Whilst the strategic level impacts of either option were considered to be comparable the connection south of the Potford Dam roundabout was considered beneficial for the following reasons:

- There are a number of non-modelled issues which need to be considered when assessing the relative merits of the two SWLR alignment options including:
    - The opportunity to re-align the 'Cawston Bends' and improve the operational and safety standards of that section of the A4071.
    - Poor visibility due to the alignment and the disused railway bridge represent a safety concern, especially as traffic volumes increase as a result of the development build out.
    - Physical constraints preventing delivery of enhanced mitigation measures, particularly when considering the disused railway bridge.
- The traffic flow increases that occur relative to the Reference Case are focussed on the A4071 when the connection is provided south of Potford Dam. When the connection is provided into the B4642 it, unsurprisingly, results in a marked increase along the B4642 which is considered undesirable due to the delays that are likely to be induced by these increases and the relatively restricted nature of the link capacity on the B4642 compared to the A4071.

8.16 Thus it was concluded that the link directly into the A4071 was preferable to the link into the B4642 Coventry Road when considering the overall strategy for linking the M45/A45 to the A4071/B4642 through the SWLR.

Stage 3B

8.17 Discrete analysis of the relative importance of the 3 key links that are provided by the SWLR revealed the following:

- Dunchurch Crossroads benefits significantly from the additional north/south capacity that is provided by the link between the A426 and the A45/M45 meaning that locally, if there is a desire to deliver growth in the area with minimum impacts on Dunchurch crossroads both the link between the A426 and A45/M45 across Alwyn Road and the upgraded connection between the A426 and B4642 Coventry Road are essential.
- Delivery of an additional link between the SWLR and the A4071 is also important as it has been proven to deliver relief to both the Dunchurch Cross Roads and the

Rugby Gyratory, given the limited opportunities to mitigate these areas directly all schemes which are likely to provide relief through the diversion of traffic flows are considered to be a high priority.

- In terms of phasing it is likely that the delivery of the link between the A426 and the B4642 will be required at an early stage and will, potentially deliver additional benefits in the area of the Dunchurch crossroads so long as it can be delivered to a sufficiently high standard (either via a new link or upgrading Cawston Lane).
- Any alignment for the link road must be defined to deliver as direct a route as it is possible to do so between the A426 Rugby Road, just north of Dunchurch, and the M45/A45. If the nature of the route becomes more ambiguous/less direct or there is an increase in the amount of friction on the route (multiple junctions, narrow carriageways, etc.) then it is reasonable to conclude that the benefits associated with the SWLR will be diminished.

Stage 3C

8.18 The analysis of the impacts of phasing both developments in the southwest and the SWLR, based on a concept development phasing strategy, revealed the following conclusions:

- Bringing the link forward in phases, alongside the housing schedule, does not deliver a significant amount of benefit across the study area. Rather, judging by the changes in the average delay, the SWLR appears to deliver the necessary capacity to ensure that the average delays across the study area do not increase significantly.
- The detailed analysis of the impacts on Dunchurch Crossroads reveals that there are opportunities for the SWLR to be phased alongside the housing and that this will potentially reduce some of the impacts in the area of Dunchurch but it is not until the full link is delivered that a benefit to the crossroads is experienced.
- The benefits of the SWLR emerge from the ability for traffic to bypass the crossroads. Without this link then, for some developments, the link between the A426 and the B4642 Coventry Road will not provide a viable alternative to routing through the crossroads.

8.19 The work also concluded that, if a development strategy is to come forward which minimises the impacts of the development in the southwest on the crossroads, it would be beneficial if it comes forward in the area of the B4642 Coventry Road/A426 link as well as facing the B4642/A4071 to the north of the development area, albeit issues at the Potford Dam roundabout will likely mean that this area would benefit from a link directly on to the A4071 at an early stage to ensure those localised impacts can be mitigated.

Stage 3D

8.20 Completion of the Lodge Farm sensitivity test detailed within the Stage 3D testing revealed the following conclusions:

- That there are some strategic impacts within the PM period that indicate a need for further mitigation to be delivered to minimise the development induced impacts.
- The allocation of Lodge Farm will result in an increase in vehicle demands at both the Potford Dam and Dunchurch junctions indicating that the Lodge Farm development trips will need to be considered when defining any of the highway mitigation schemes in the area.
- Whilst the impact on Dunchurch Crossroads does not exceed the demands and flows identified in the 2031 Reference Case (i.e. Pre-SWLR) there are still impacts and since one of the primary aims of delivering development in the southwest is to enable a mitigation strategy to come forward which will alleviate the impacts at Dunchurch Crossroads then it is reasonable to conclude that the phasing of Lodge Farm will be reliant on the SWLR being in place to enable the site to be delivered.
- The increase in vehicle demands at Dunchurch Crossroads, which occurs as a result of the allocation of the Lodge Farm development, is likely to result in demands which are still lower at the crossroads than the levels likely to occur without the SWLR in place. This demonstrates the junction will still benefit from the delivery of development in line with the PO allocation strategy but consideration should be given to any additional measures that can be introduced to safeguard the capacity of the junction by encouraging traffic to use alternative routes.

Stage 3E

8.21 The final stage of testing looked at the impact of the design speeds on the operation of the SWLR as the impacts elsewhere on the network and this work concluded:

- The principles of the link assume that the route between the A426 and the M45/45 minimises conflict and friction, as would be achieved through the 40 mph design speed. This needs to be considered in detail in any subsequent design work pertaining to the link (I.e. the route must provide a direct bypass opportunity for Dunchurch).
- That reducing the design speed on the main SWLR link between the A426 Rugby Road and the M45/A45 below 40 mph will induce additional delays within the network and also have a direct impact on the operation of Dunchurch Crossroads since the lower speed is predicted to induce a lower level of reassignment.
- That reducing the A45/M45 to A4071 Western Relief Road link from 40 mph to 30 mph will also induce localised impacts which are undesirable and, as such, it is considered desirable to retain the connection through at 40mph.
- That reclassifying the route between the B4642 Coventry Road and A426 Ashlawn Road to a minor route is beneficial insofar as flows on the route through the housing site will reduce with only a relatively small impact on the strategic level performance or Dunchurch Crossroads. If the parallel route between the M45/A45 and A4071 is also reclassified to minor these flows begin to rise again and so, it is concluded that the best strategy is one which encourages the use of the M45/A45 to A4071 route through signage but the A426 to B4642 should be defined as a minor route to accommodate local traffic only.

Recommendations for Future Stages of Assessment

8.22 The following recommendations have been identified and should be given consideration during subsequent stages of assessment work pertaining to the delivery of the Local Plan housing and employment sites identified by Rugby Borough Council.

8.23 The recommendations identified are provided for information purposes but it is not considered that these would have to be addressed pre-adoption of the Local Plan, rather they should be considered throughout the Local Plan determination process as well as the post-adoption planning and appraisal work which will be undertaken for each of the individual sites.

RWA Model Update

8.24 In light of the findings from the work completed thus far, and also giving due consideration to the ongoing update to the Rugby Wide Area model which is due to be completed in the coming months, it is recommended that the impacts of delivering the Preferred Option are retested within the updated model to enable more detailed work to be undertaken, particularly concerning any detail design requirements, with regards the infrastructure measures that have been identified thus far. Schemes do not necessarily need to be fully defined at this stage however as this work will continue throughout the Local Plan delivery period.

Highway Infrastructure and SWLR Design Considerations

8.25 At this stage the infrastructure requirements have been identified to a relatively high level of detail and the principles of the schemes are considered to be sufficiently detailed to support the conclusion that the Local Plan allocation strategy can be accommodated within the highway network subject to the delivery of the infrastructure measures identified.

8.26 As sites come forward and the Local Plan is adopted it is recommended that further work will be required to ensure that the schemes identified thus far represent the optimum set of proposals and, if necessary, any changes necessary should be identified at that stage.

8.27 This subsequent testing will also serve to reconfirm the design principles of the SWLR although it is not expected that they would differ substantially from those assumed within the work to date.

A426 Infrastructure Requirements

8.28 The work to date has also highlighted that it is expected there will be residual impacts on the A426 North of Rugby and, at this stage, a comprehensive mitigation strategy has not yet been determined for this part of the network. It is therefore recommended that this should

be given further consideration during any subsequent stages of the assessment work and that the A426 Leicester Road model should be used to inform any assessment work in this area in advance of the updated RWA being available, particularly as that model also accounts for the Saturday period.

8.29 Given that the impacts in that area are likely to be largely attributable to the delivery of the development sites identified to the North of Rugby, it is likely that this work will largely be completed through the site specific assessment work that will be undertaken to support the planning applications for those sites.

8.30 Notwithstanding the above, it is recommended that additional assessment work is completed to determine the optimal set of proposals for the highway infrastructure in this area and that the approach considers a strategy which will deliver benefits for the corridor beyond simply trying to mitigate the impact of the sites coming forward through the Local Plan.