

4.0 Central Severn Vale (CSV) SATURN model

4.1 Introduction

- 4.1.1 The JCS authorities have been supported by Gloucestershire County Council and Highways England (formally known as the Highways Agency), as the Highway Authorities, in developing a transport evidence base which sets out likely future transport network needs and identifies the mitigation measures necessary to satisfy those needs.
- 4.1.2 The evidence base has been informed by forecast models derived from the 2013 Central Severn Vale (CSV) SATURN model. It was agreed by the Highways Authorities that the 2013 CSV model represented the best highways model available to undertake a strategic assessment of JCS.
- 4.1.3 It should be noted that reliance on SATURN highways model outputs on their own for individual sites would be insufficient to support a planning application without appropriate interpretation by the applicant's transport consultants, and without the requirement for further, more detailed, micro-simulation and/or individual junction-based traffic modelling.

4.2 The Central Severn Vale (CSV) SATURN model

- 4.2.1 Gloucestershire County Council in partnership with Highways England, as the Highways Authorities within Gloucestershire own the Central Severn Vale (CSV) SATURN highways traffic model. Although primarily a strategic model, the key urban centres of Gloucester, Cheltenham and the Tewkesbury/Ashchurch area are modelled in relative detail in simulation format, the outputs from which can be used to help inform and facilitate the development of third party micro-simulation and/or stand alone junction models for more localised assessment purposes.
- 4.2.2 The CSV SATURN highway model detailed (simulation) network coding extends from the M5 Junction 9 in the north to M5 Junction 13 in the south, from west of Tewkesbury eastwards to A46/A435 Teddington Hands junction, and from A40 west of Highnam roundabout eastwards as far as the A417 corridor between the Air Balloon roundabout at Crickley Hill and Cirencester. Geographically, the CSV modelled area therefore covers the whole of the Gloucester, Cheltenham and Tewkesbury urban areas and their surrounding environs.
- 4.2.3 The CSV SATURN model was been developed in order to:
- Assist in the development of Local Plans and site allocations
 - Inform the assessment of individual planning applications
 - Inform the development of Gloucestershire's Local Transport Plan
- 4.2.4 The CSV SATURN model has been developed in accordance with Department for Transport (DfT) guidelines and advice set out in the Design Manual for Roads and Bridges (DMRB) and WebTAG acceptability criteria, with the aim of achieving relevant validation standards, ensuring high levels of confidence associated with the development of the demand (trip

matrix) data. To ensure that all traffic models remain fit for purpose and accurate (in terms of calibration and validation requirements) it is standard practice that they be regularly updated – on a five yearly (six at most) cycle. At the time of writing this Protocol, the CSV SATURN highways model has been successfully validated to a 2013 base year and represents an average weekday during a neutral travel month. The model is currently available for the following two peak hour time periods:-

- The AM Peak Hour (08:00-09:00hrs), and
- The PM Peak Hour (17:00-18:00hrs).

4.2.5 The 2013 CSV SATURN Model base year Local Modal Validation Report (LMVR), dated March 2017, can be provided upon request, free of charge.

4.2.6 The CSV SATURN highways models are managed and maintained directly by GCC who, in association with Highways England, will retain ownership and intellectual rights of the models. Any third party will therefore be required to confirm that the output data from any associated traffic modelling work will not be used for any other purpose, other than assessing a specific site and/or planning application.

4.2.7 The expectations of the Highway Authorities regarding the use and appropriateness of the CSV SATURN highways model shall be confirmed during pre-application discussions, and will be determined on an individual development site basis. The size, nature and location of any development will be a prime determinant in deciding the use of the models, and early contact with the Highways Authorities should be made to 'scope' the extent of any modelling, if deemed required, in support of a proposal for planning application.

4.2.8 It should also be noted that the current CSV SATURN highways model is comprised of highways based models only.

4.2.9 To discuss the use of the CSV SATURN highways model, contact should be made with GCC's Highways Development Management Team as early as possible, initially via the following email address:-

devcoord@gloucestershire.gov.uk

5.0 Highways Modelling Outputs (Do something scenarios)

5.1 Introduction

- 5.1.1 This sections outline the iterative process followed to inform the JCS Transport Strategy as the JCS emerged through the different stages of plan development.
- 5.1.2 The modelling outputs provided in support of the JCS represent a robust assessment of the likely travel impacts of the growth proposals. The 2013 CSV SATURN model is a fixed trip matrix and not a variable demand matrix, this means there has been no account taken for peak spreading or modal shift other than where this has been manually adjusted. Details of this are outlined with the supporting JCS Modelling Technical Notes.

5.2 Draft for Consultation JCS (October 2013) Highways Modelling (Autumn 2013 to Spring 2014)

- 5.2.1 The transport modelling undertaken to assess the impacts of the development proposed within the Draft for Consultation JCS (October 2013) provided an understanding of its likely impacts on the highways network.
- 5.2.2 The transport schemes included in the highway infrastructure-focussed scenario did have a significant impact in reducing vehicle delay on the network. However, in the absence of further scenario testing the report failed to quantify impact if certain schemes were to be removed from the scenario. In terms of deliverability and affordability, greater refinement of the transport schemes was required before a preferred transport package could be identified within the JCS.

5.3 'Do Something' 1, 2, 3, 3a - Pre-Submission Joint Core Strategy (April 2014) Highways Modelling (Summer 2014 to Spring 2015)

- 5.3.1 During 2014/15 additional modelling was required to test the updated JCS land-use allocations identified in the Pre-Submission JCS. The scale of proposed developed was reduced from the Draft for Consultation stage and the transport scenario needed to reflect this.
- 5.3.2 The Highways Authorities helped scope and agree a project brief for this round of modelling. The process was managed by the JCS Team with GCC and Highways England officers actively participating in project meetings.
- 5.3.3 To identify potential mitigation measures GCC officers managed two workshops with local stakeholders to explore issues and possible mitigation schemes. The output from these sessions was a 'long list' of schemes. GCC then worked with ATKINS Highways and Transport to reduce this to a 'short-list' reflecting more 'realistic and potentially deliverable' schemes, taking viability into account as best as possible.
- 5.3.4 To enable the planned Pre-Submission JCS growth to take place, a number of transport schemes and sustainable measures were proposed, designed to relieve congestion on the

roads located within the JCS wider area including SRN. A long list of potential mitigation schemes was reduced to a short list using a multi-criteria assessment framework. This assisted in developing measures contained in three 'Do-Something' modelling strategies (DS1, DS2, DS3 and finally DS3a) which were tested against a 'Do-Minimum' (DM) option that contained all known planned and committed highway improvement schemes. The forecasts had been carried out for the AM and PM peak hours and a 2031 future year.

- 5.3.5 Strategy DS1 primarily focused on the promotion of sustainable transport measures, as featured in the Gloucestershire LTP.

Strategy DS2 included the mitigation measures identified in DS1, but added in physical highway junction improvements.

Strategy DS3 included the mitigation measures included in DS1 and DS2, in addition to a number of traffic management schemes on local roads and the introduction of a new access junction on the A40 to serve the proposed site in Longford. The traffic management measures were designed to limit the speed on local roads, thus moving longer distance traffic onto the Strategic Road Network (SRN) and other major roads, which are better able to accommodate the extra strategic traffic.

Strategy DS3a removed some of the traffic management measures in DS3 to achieve a better balance between traffic using the local network and that using the SRN.

- 5.3.6 The strategies (DS1 to DS3a) were tested sequentially. Relative to the 'Do Minimum' (DM) strategy, the DS1 strategy was not found to be successful due to the limited impacts of the behavioural change programme and further, major infrastructure interventions were considered necessary to mitigate the development impacts.

- 5.3.7 Similarly, Strategy DS2 reported minimal improvement to the transport network. However, in resolving a number of junction issues, the impact was over-compensated by encouraging too much traffic onto the local roads, which would be unacceptable. To address this, the impact of the Strategic Allocations was considered in isolation; this identified a number of local roads that were made less attractive through traffic management measure and subsequently tested in DS3.

- 5.3.8 The model outputs from DS3 indicated that the predicted impacts of the traffic management measures were too severe, reducing traffic flow on the relevant local roads to less than current levels and diverting too much traffic onto the SRN. As a result, Strategy DS3a was introduced to redress the balance between traffic on local roads and the SRN. The mitigation strategy DS3a was an improvement relative to the DM in the following ways:

- The network improvements implemented up to DS3a resulted in a significant reduction in average queued time compared to the DM, and a moderate drop compared to DS3. These improvements caused the over capacity queued time to decrease by 34% compared to the DM during both the AM and PM peak periods; and
- DS3a led to an improvement in the average network speed of around 2% during both peaks compared to the DM

5.3.9 Despite these improvements there continued to be a number of junctions located in the vicinity of the strategic allocations which reported capacity issues during either one or both periods of peak travel. Additional mitigation schemes will need to be identified for the following junctions:

- Junction of Cheltenham Road East and Pirton Lane, near Strategic Allocation Site A2 and A3
- A40 Longford Roundabout
- A46 Shurdington
- M5 Junction10 Southbound Off-slip
- A46 Aston Cross Junction, Tewkesbury

5.3.10 The JCS was submitted on 20th November 2014 before the Do Something 3a JCS Transport modelling had been completed. The evidence base provided to date identified the likely future impacts on the transport network in terms of network capacity of the JCS Strategic Allocations. The scheme identification and appraisal process has also identified a list of measures. However, further understanding of which package of these mitigation measures is required to enable the delivery of the JCS, while not impacting the viability of the plan was required.

5.4 Do Something 4 - Response to Inspector's Interim Report on Pre-Submission Joint Core Strategy (July 2016) Highways Modelling (Summer 2016)

5.4.1 In July 2016, following the Inspector's Interim Report, the JCS authorities requested an additional land use scenario to be tested using the 2008 CSV SATURN model. This scenario within the transport evidence base is referred to 'Do Something 4' (DS4).

5.4.2 DS4 includes a number of significant modifications to the land-use scenario tested in DS3a including the addition of five potential strategic sites (Fiddington, Mitton, Winneycroft Farm, Innsworth and West of Cheltenham) and the removal of one site (North Churchdown). This resulted in an increase of 3,970 dwellings and 45.8 ha of employment; the latter is focussed on a site to the West of Cheltenham.

5.4.3 Within DS4 the existing transport mitigation strategy outlined in DS3a (**Appendix I**) was included as the starting point to assess the impacts of the increased scale of development.

5.4.4 The impacts of DS4 was the significant deterioration in the performance of the highway network in terms of much longer queues, higher average travel times, and reduced average travel speeds.

5.4.5 The significant deterioration was principally highlighted with the increase of queuing time per vehicle at over capacity junctions, which increased from 52 seconds per vehicle in the AM peak under DS3a to 674 seconds in DS4. In DS4 this equates to 11 minutes spent not moving per vehicle in the AM peak (08:00 to 09:00). For the new employment site located to the West of Cheltenham it was modelled assuming to provide 10,000 new jobs. The

impact of this delay was so significant that only 24% of trips were able to arrive at the site during the AM peak.

5.4.6 In the PM peak (17:00 to 18:00) using the same data set, under DS3a each vehicle on average is delayed by 72 seconds, but under DS4 this increases to 785 seconds. This equates to 13 minute spent not moving for every vehicle representing 22% of the journey total trip per vehicle in the AM peak.

5.4.7 The scale of impact on the transport network reflects the significant increase in vehicles operating within each of the peak periods. The land use scenario tested under DS3a generated 16,688 vehicle movements during both peak periods compared to 28,036 vehicle movements under DS4.

5.4.8 The junctions operating over capacity in DS4 included:

- M5 Junction 9
- M5 Junction 11
- M5 Junction 10
- A40 Arle Court roundabout
- A40 Benhall roundabout
- A46 Ashchurch
- A46 Shurdington
- St. Barnabas roundabout
- A417 Air Balloon roundabout

5.5 Do Something 5a - Response to Inspector's Interim Report on Pre-Submission Joint Core Strategy (July 2016) Highways Modelling [Autumn 2016]

5.5.1 In response to the scale of journey time delay experienced by the development proposals outlined in DS4 a revised set of land use assumptions was tested. This scenario within the transport evidence base is referred to as 'Do Something 5a' (DS5a).

5.5.2 DS5a includes a number of modifications to the land-use scenario tested in DS4 including the removal of two strategic sites (Fiddington and Leckhampton) and changes in the development quantum's for North West Cheltenham, West Cheltenham, Twigworth and Mitton. This resulted in a decrease of 2,261 dwellings and 12.9 ha of employment.

5.5.3 Within DS5a the development at Fiddington site has been removed. Transport modelling outputs provided through the testing of scenarios DS3a and DS4 have consistently indicated significant delays on the A46 (part of the strategic corridor) between Aston Cross and M5 Junction 9. The situation was further compounded by the inclusion of the Fiddington site in scenario DS4.

5.5.4 To date, evidence of on-line highway improvements has proved inconclusive. To resolve this issue other options must now be considered including an off-line solution which would seek to separate local and through movements by providing an alternative route option for through traffic accessing the M5 at junction 9.

- 5.5.5 An off-line solution was previously considered in the 1990's and at the time the Department of Transport promoted a road alignment to the south of the existing A46. As no other scheme has been identified by the strategic highway authority at this stage, for the purposes of this work it has been assumed that this 1993 alignment should be tested within a future highways modelling scenario. This route alignment would bisect the proposed Fiddington site.
- 5.5.6 It is recognised that this route alignment has not been confirmed, but as work progresses to identify a preferred solution it was considered prudent to exclude the Fiddington site (as tested within DS4) until such time as a preferred solution for this corridor is known. It has therefore been removed in the DS5a scenario.
- 5.5.7 Within DS5a the transport mitigation strategy outlined in DS3a (**Appendix I**) was included as the starting point to assess the impacts of the increased scale of development. With the same mitigation package used for DS3a, DS4 and DS5a this aided the analysis of the modelling outputs.
- 5.5.8 The impact of DS5a was the significant improvement in the performance of the highway network in terms of over capacity queued time per vehicle when compared to DS4.
- 5.5.9 Despite the network improvements between DS4 and DS5a there are significant issues in the scale of delay when compared to the DS3a scenario.
- 5.5.10 The junctions operating over capacity in DS5a included:
- M5 Junction 9
 - M5 Junction 10
 - M5 Junction 11
 - A38 Longford
 - A40 Arle Court roundabout
 - A40 Benhall roundabout
 - A46 Ashchurch
 - A46 Shurdington
 - St. Barnabas roundabout
 - A417 Air Balloon roundabout

5.6 Do Something 5 - Response to Inspector's Interim Report on Pre-Submission Joint Core Strategy (July 2016) Highways Modelling [Autumn 2016]

- 5.6.1 The network delays experienced in DS5a remained unacceptable in terms of excessive vehicle delay and a revised mitigation package was required. This scenario within the transport evidence base is referred to 'Do Something 5' (DS5).
- 5.6.2 DS5 includes no changes in the land-use scenario tested in DS5a.
- 5.6.3 **Appendix J** outlines details of the revised mitigation package. It represents a radical departure from DS3a and focuses on road building (including major link roads) and the

upgrade of high frequency Public Transport bus corridors. It also includes a number of schemes which are not JCS dependant, but due to changes in their scheme status they have been included as it is assumed that the impact of the schemes will be significant on the transport network. They include:

- M5 J10 – Full Movements
- A417 Missing Link

5.6.4 DS5 had a significant impact on reducing the number of junction arms experiencing prolonged delay. These tend to be more local and are not strategically important.

5.6.5 The junctions operating over capacity in DS5 included:

- A40 Longford Roundabout
- St Barnabas Roundabout
- M5 Junction 11 Southbound
- A435 / Hayfield Way / Finlay Way
- A38 Barnwood Rd / Armscroft Park Rd

5.6.6 Some of the key impacts of the DS5 scenario compared to previous scenarios include:

- A46 through Ashchurch – significant reduction in delay, total time and flows as a result of the new link road
- M5 Flows – slight reduction in northbound flows, with an increase in southbound flows. Note that M5 J10 is all movements in DS5, and therefore more traffic is able to access the motorway and there are significantly improved link routes to the motorways
- A40 Golden Valley, M5 J11 to Princess Elizabeth Way – Eastbound this route shows a significant increase in traffic compared to DS4 and DS5a, with traffic now flowing better as a result of the West Cheltenham Link Road and access to the West Cheltenham Cyber Park. Note that for both DS4 and DS5a, the level of demand to West Cheltenham was unable to flow through the network, causing significant delay. There is also a reduction in both delay and total time (this appears contradictory). For the Westbound in the AM, delay is reduced and flows are reduced as there are now alternative routes and access to the M5 (for example, via the M5 J10 all movements junction);
- M5 J10 to A4019 - significant reduction in eastbound delay and total time (with traffic able to use the new link road to access West Cheltenham. The new Cheltenham Western Relief Road removes significant level of traffic from the congested local road network.

5.6.7 The Do Something 5 scenario mitigates much of the impacts of the JCS strategic allocations and complies with the JCS Transport Strategy Objectives. It should be noted that the Do Something 5 transport mitigation scenario has been devised on a cumulative basis i.e. with new schemes added to the Do Something 3a scenario.

5.6.8 Neither Highway Authority could agree the JCS Transport Strategy until this scenario had been re-assessed using the 2013 CSV SATURN model. This would also provide the opportunity to fully review the scheme included within the scenario.

5.7 Do Something 6 – JCS Proposed Main Modifications (February 2017) Highways Modelling [Spring 2017]

5.7.1 The Do Something 6 scenario was the first of the JCS model runs to use the updated 2013 CSV SATURN base year model. It also tested the revised land use scenario inline with the proposals included in the JCS Proposed Main Modifications document. Details of the land use scenario are included in **Figure 6**.

5.7.2 The schemes included within the scenario were identified in response to process outlined in **Paragraph 1.3** and the outputs from the 'Do Nothing' and 'Do Minimum' modelling scenarios.

5.7.3 The mitigation package differed from previous scenarios and included over 30 interventions. Critical to the scenario were the access arrangements into the West Cheltenham Strategic Site. Within this scenario these are provided via Junction 10 of the M5 and a new distributor road linking into the site from the motorway. The motorway junction improvement comprised a minimum upgrade to allow full movements, with additional capacity provided on the slip roads. (This was based on an earlier scheme proposal tested in the Do Something 5 scenario developed previously by the Highways Agency – now Highways England).

5.7.4 The results of this modelling exercise recorded excessive queuing on the M5 Southbound and Northbound off-slips in the AM peak hour at Junction 10, with major queuing on the A4019 Tewkesbury Road at the new junction with the West of Cheltenham distributor road. During the PM peak hour, there was significant queuing on the distributor road due to traffic exiting the site being delayed at the northern signalised junction with the A4019 Tewkesbury Road, adjacent the M5 J10.

5.7.5 The conclusion reached was that in this scenario, the proposed network mitigation for access to the West of Cheltenham via M5 J10 and a new distributor road linking into the site was insufficient in terms of reducing traffic impact on both the Strategic road network and local road network to a reasonable level. The results however indicated that further work on an improved layout arrangement could potentially allow sufficient distribution of traffic across the network as, apart from the impact on the all-movements arrangements at M5 J10, there are no significant impacts elsewhere along key corridor routes across the modelled network.

5.8 Do Something 6a – JCS Proposed Main Modifications (February 2017) Highways Modelling [Spring 2017]

5.8.1 To robustly assess the access arrangements into the West Cheltenham Strategic Allocation an alternative Do Something 6a scenario was tested. This included the same mitigation measures included in Do Something 6 with the exception of alternative access arrangements to the West of Cheltenham site. This would provide a direct comparison between the scenarios.

5.8.2 Within Do Something 6a access to the West of Cheltenham site would be via a new link road off the A40 Golden Valley bypass, east of M5 Junction 11. This was necessary as a

preliminary review of the site indicated that due to physical restrictions in terms of location of existing nearby development, together with necessary grade separation and turning radii land take requirements, it would prove difficult to upgrade the existing M5 Junction 11 arrangement in order to allow direct access from the M5 into the site.

- 5.8.3 The modelling assumptions for this DS6a iteration are therefore as follows:
- M5 J10 would remain as current arrangement i.e. not all movements
 - Access to the West of Cheltenham site to be from the direction of J11 of the M5, with direct slip roads assumed to the site on the A40 Golden Valley, east of M5 Junction 11
- 5.8.4 Inline with the Do Something 6a access strategy the arrangements for access to and from the Park and Ride facility at Arle Court have been changed to provide a direct access from the A40 via a new signalised junction, so that traffic does not have to travel through A40 / Arle Court Roundabout to access the Park and Ride.
- 5.8.5 The outputs from this model test showed that impacts on the M5 were even more significant than those recorded in Do Something 6, with queuing on the M5 mainline and off-slip roads, as well as on the A40 Golden Valley Bypass eastbound on-slip, east of M5. There were a greater number of junctions on the rest of the highway network experiencing delays.
- 5.8.6 Analysis of the impacts on the M5 indicated the measurable deterioration at the motorway junctions compared to the Do Something 6 scenario, 'Do Minimum' and 'Do Something' scenarios.
- 5.8.7 Based on the model outcomes and understanding of design constraints for the two access strategies, there is justification for discounting the primary access from the south (M5 Junction 11) in favour of the north (M5 Junction 10). The basis of this justification includes:
- Access to the West of Cheltenham site from the south in Do Something 6a scenario via M5 Junction 11 and A40 has significant implications on the motorway network operational performance
 - There are a number of constraints due to the physical restrictions at Junction 11 limiting potential improvements
 - The linkages between M5 J10 and access to the West of Cheltenham site could be further integrated and improved
 - A revised access improvement from M5 Junction 10 offers potential significant benefit over M5 Junction 11 in terms of
 - linkages to local roads as well as to the wider regional and national road network
 - a range of options for designing a technically feasible and deliverable access to the West Cheltenham site.
- 5.8.8 The updated scenario would revert back to providing access to the site from M5 Junction 10, based on further improved mitigation and refinement of the proposed junction design and layout.

6.0 The JCS transport strategy (Do something 7)

6.1 Introduction

- 6.1.1 The JCS Transport Strategy's Six Point Plan identified in **Figure 5** shows the desired approach to managing the transport network within the JCS area. It highlights the importance of minimising the impact of development to ensure an efficient, safe and resilient transport network. It recognises the importance of place and the removal of strategic or 'through' traffic from local environments. It also strongly supports the role of walking, cycling and public transport use underpinning its long-term aim of reducing reliance on the car for short and longer distance trips.
- 6.1.2 The transport mitigation strategy outlined within the 'Do Something 7' scenario is the preferred package of transport improvements. The schemes included within the scenario supports delivery of the JCS Transport Strategy Objectives identified in **Figure 4**, is consistent with the Six Point Plan identified in **Figure 5** and will help achieve the Transport Outcomes identified in **Figure 6**. A full list of mitigation measures included in the 'Do Something 7' scenario is outlined in **Appendix K**.
- 6.1.3 The schemes identified within the mitigation strategy were informed by the technical modelling outputs provided by the 2013 CSV SATURN highway base year model in line with the process identified in **Para 1.3**. To understand the impacts of the 'Do Something' 6 and 7 scenarios, modelling outputs from the 'Do nothing' scenario and 'Do minimum' scenarios were created and used as benchmarks against which to measure the impacts of the 'Do Something' scenarios.
- 6.1.4 It is important to note that this assessment has been undertaken based on the delivery of the full JCS plan. At this stage no assessment has been made regarding delivery phasing or the prioritisation of mitigation schemes.
- 6.1.5 The JCS plan period is to 2031. Regardless of the scale of growth identified in the plan, the transport network will be considerably busier than it is today as a result of planned growth outside the JCS area alongside existing committed growth already taking place within the JCS area. The JCS Transport Strategy is not required to resolve all of these issues, but only those attributed to the scale of growth outlined in the JCS plan.
- 6.1.6 The JCS transport strategy is therefore only required to mitigate those impacts on the highway network occurring between the 'Do Nothing' and 'Do Minimum' scenarios.
- 6.1.7 The assumptions used to create the 'Do Nothing' scenario include all JCS strategic allocation growth where planning permission has been granted at the time of the modelling assessment; and committed / delivered transport schemes since 2013. This includes:
- M5 J9 / A46 Improvement (2014)
 - A417 Walls & C&G roundabouts pinch-point schemes (2014)
 - A40 Longford & A40 Over roundabouts pinch-point schemes (2014)

- A40 Elmbridge roundabout improvement scheme (currently under construction – projected opening date – August 2017)
 - A40 Over roundabout improvement Phase 2 – Growth Fund Scheme
 - A40 Cheltenham Westbound Corridor Bus Priority scheme - Arle Court to Benhall section (part of the Elmbridge Transport scheme)
 - Gloucester Central Transport Hub (Bus Station); Abbeymead/Metz Way bus priority scheme
 - Cheltenham Transport Plan (CTP) phases 1 to 3 only (Boot's Corner Closure - Trial Scheme excluded)
- 6.1.8 The assumptions used to create the 'Do Minimum' scenario cover all JCS strategic allocation growth where planning permission has not been granted at the time of the modelling assessment, along with all other unallocated non strategic housing development, and transport schemes where funding has been allocated but not committed. This includes:
- A417 Missing Link (previously coded for DS5 Scenario);
 - St Barnabas Roundabout;
 - Gloucester South West Bypass, Llanthony Road Section Widening
- 6.1.9 The transport schemes identified within the 'Do Nothing' and 'Do Minimum' scenarios are therefore included as part of the 'Do Something' 7 scenario.
- 6.1.10 To assess the impact of the transport strategy, 11 strategic travel corridors were identified within the JCS area. Within those corridors, highway junctions considered to be critical to their function have been identified. The operation of these junctions will be used to assess journey time reliability as a proxy of how well the corridor is functioning. The 11 corridors are illustrated in **Appendix L**. They were identified on the basis of their importance to support national and local economic growth, and informed by the Link and Place Spectrum outlined within Gloucestershire's Local Transport Plan (2015-2031).
- 6.1.11 No definition of 'severe' shall be provided within this assessment as its application depends on local context. The severity of any impacts for individual sites will be assessed as part of the Transport Assessment accompanying the planning application.
- 6.1.12 As the CSV SATURN model is a strategic highways model, only those junctions identified where a 'significant' increase in delay or any safety issues occur for the M5 would be mitigated are taken forward as part of the strategy. The definition of 'significant' in the JCS strategic context is for any junction with a Ratio of Flow to Capacity (RFC) greater than 100% where a 10% increase is recorded between the 'Do Nothing' and 'Do Minimum' scenario for any part of the junction. Junctions are assumed to be operating within capacity if the RFC is less than 100%.
- 6.1.13 For the remainder of this section, the impacts of 'Do Something' 7 will be described for each of the strategic corridors.

6.2 Corridor 1 - M5 – between (and including) M5 Junction 9 and Junction 13

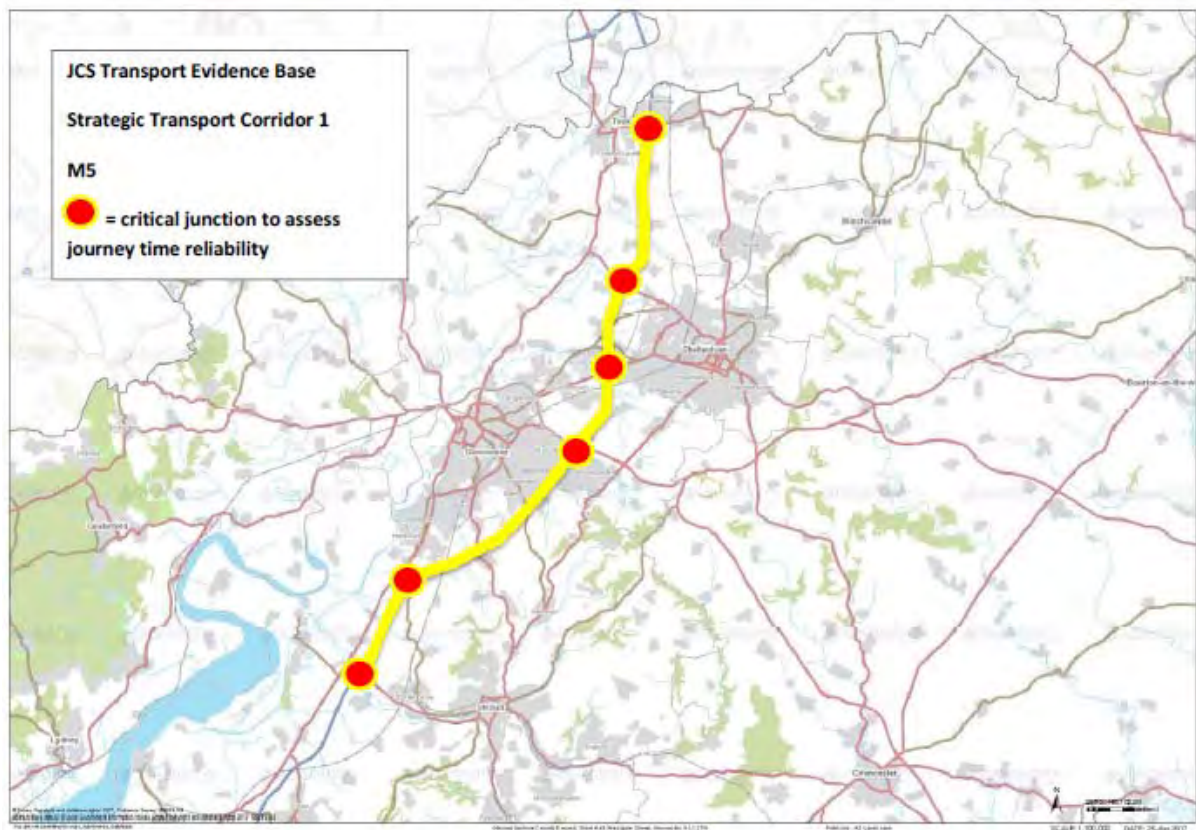
6.2.1 Corridor 1 includes the M5 mainline, from Junction 13 (Stroud), to Junction 9 (Tewkesbury). This forms part of the Strategic Road Network and is managed by Highways England. It is essential to maintain highway operation and safety by avoiding any queuing traffic on the motorway mainline caused by congestion at the motorway junctions impacting vehicles on the off-slips.

6.2.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a national link critical to the national economy. This section of highway has an average daily vehicle flow of over 50,000 vehicles (**Appendix C**).

6.2.3 **Figure 33** illustrates the location of those junctions considered critical to assess journey time reliability. Six junctions have been identified and they are:

- M5 Junction 13 – Stroud, Dursley A419
- M5 Junction 12 – Gloucester A38
- M5 Junction 11a – Gloucester, Cirencester, London A417
- M5 Junction 11 – Cheltenham, Gloucester A40
- M5 Junction 10 – Cheltenham A4019
- M5 Junction 9 – Tewkesbury A438 Evesham A46

Figure 33 - Corridor 1 – critical junctions



6.2.4 **Figure 34** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Despite operating over 100%, the JCS Transport Strategy will not consider mitigation for M5 Junction 13 as this is already operating over 100% in the ‘Do nothing’ scenario and therefore impact at the junction is not attributable to JCS growth. On the basis of change from the Do Nothing and the Do Minimum, mitigation will need to be considered for the following junctions:

- M5 Junction 12 – B4008 approach from the south towards Gloucester
- M5 Junction 11a – capacity issues on northbound off-slip
- M5 Junction 9 – westbound approach from A46 Ashchurch

Figure 34 – Corridor 1 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|-----------------|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| M5 Junction 13 | 87.6% | 88.0% | 105.0% | 105.1% |
| M5 Junction 12 | 99.3% | 102.5% | 95.5% | 95.4% |
| M5 Junction 11a | 88.2% | 102.9% | 84.1% | 91.4% |
| M5 Junction 11 | 89.2% | 93.7% | 75.4% | 92.0% |
| M5 Junction 10 | 89.5% | 91.0% | 76.9% | 84.2% |
| M5 Junction 9 | 96.9% | 111.9% | 101.8% | 101.3% |

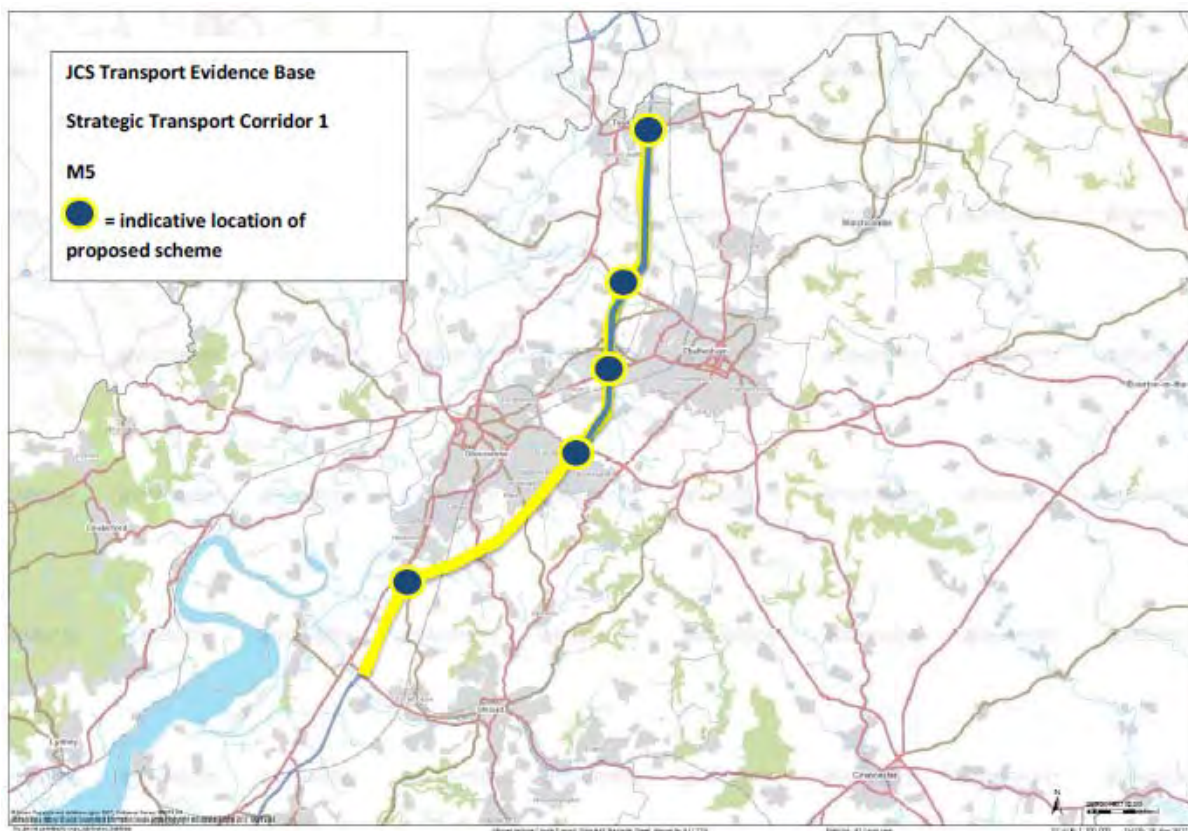
6.2.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 34** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- M5 J11a to M5 J9 - Upgrade motorway to a smart motorway increasing capacity during peak times and controlling vehicle flows
- M5 J12 -Upgrade to junction to include 2 lane wide off and on slips
- M5 J11a - Optimise junction operation with improved signing and lining and area wide reassignment
- M5 J11 - Signalise Southbound off-slip. Northbound off slip extra lane
- M5 J10 - ‘All Movements’ junction improvements including complementary measures to M5 mainline. This includes a high capacity upgrade of M5 J10 junction including three lane motorway off slips and a three circulatory lane grade separated roundabout with A4019, and a new signal controlled junction immediately west of the M5 to accommodate the associated West of Cheltenham development access road (see corridor 6 for more information). This will be a high capacity signal controlled junction, with a separate left turn slip road from M5J10 northbound off-slip onto Cyber Park link road (southbound). There would also be new signals on the A4019 westbound entry to the new grade separated motorway junction
- M5 J9 - Extended junction to accommodate new off-line route for the A46 (see corridor 2 for more information)

- As the corridor is related to the motorway there are no sustainable transport schemes

6.2.6 **Figure 35** illustrates the location of the mitigation measures outlined above.

Figure 35 - Corridor 1 – Location of mitigation measures



6.2.7 **Figure 36** summarises the impacts of the Do Something 7 Strategy.

Figure 36 – Corridor 1 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|-----------------|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| M5 Junction 13 | 88.0% | 94.2% | 105.1% | 109.2% |
| M5 Junction 12 | 102.5% | 102.1% | 95.4% | 105.0% |
| M5 Junction 11a | 102.9% | 93.9% | 91.4% | 89.0% |
| M5 Junction 11 | 93.7% | 99.6% | 92.0% | 93.8% |
| M5 Junction 10 | 91.0% | 96.8% | 84.2% | 93.9% |
| M5 Junction 9 | 111.9% | 87.2% | 101.3% | 97.8% |

6.2.8 The outcome of the Do Something 7 changes are that the M5 mainline and motorway off slips now operating within capacity. This is despite an increase in motorway traffic as a result of improvements to M5 Junction 10 and conversion to a full-movements junction.

- 6.2.9 There remains an issue at M5 Junction 12 despite the improvements outlined in Do Something 7. The junction is marginally over 100% capacity in both peak hours and this is specifically linked to the B4008 internal roundabout approach arms. Through further detailed junction modelling and iterative design it is considered probable that increased efficiencies would be achievable at this junction.

6.3 Corridor 2 - A46 – M5 Junction 9 to county boundary (east of Teddington Hands)

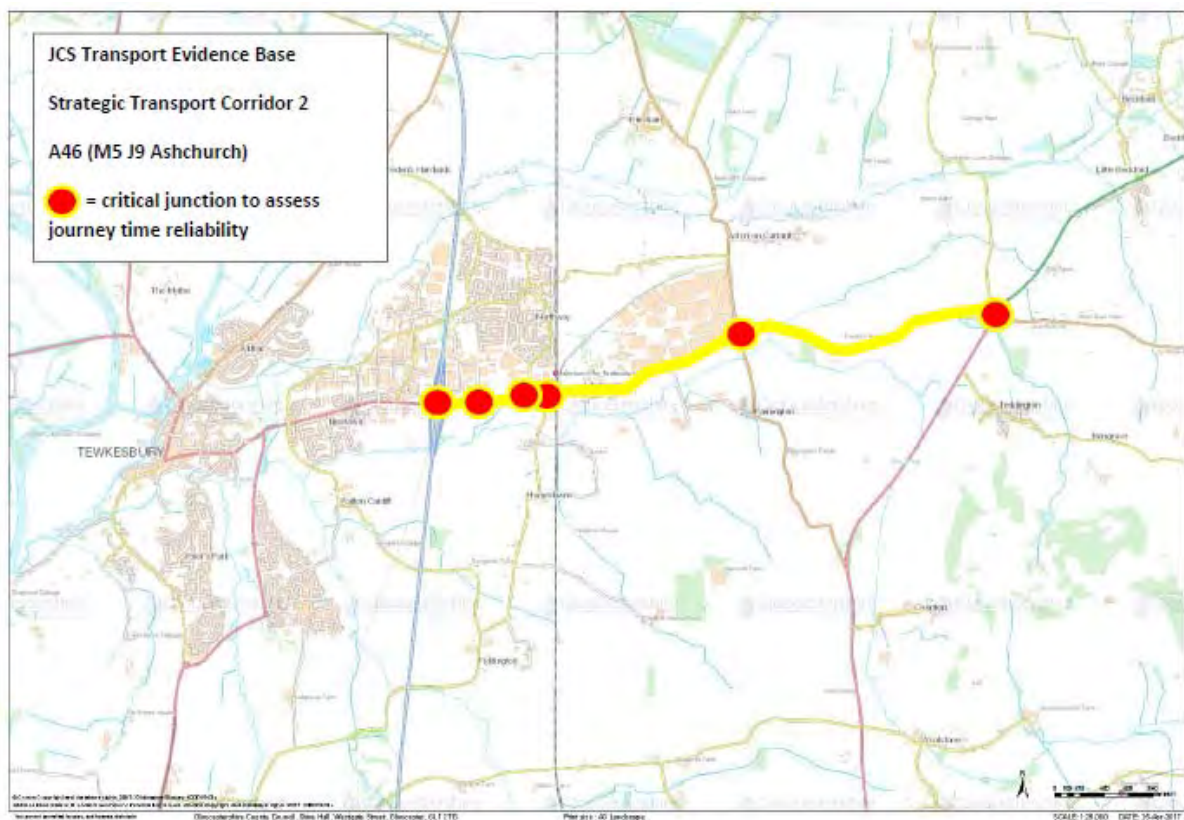
6.3.1 Corridor 2 includes the A46 from M5 Junction 9 Tewkesbury, up to the county boundary. This forms part of the Strategic Road Network and is managed by Highways England. The A46 provides a link between the M40 Junction 15 and the M5. The route is identified as being of regional importance and Midland Connects are prioritising investment within the strategic corridor. The section of the route within Gloucestershire is not typical of the wider route as it is highly constrained with numerous side roads, direct accesses, existing development up to the highway boundary

6.3.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a national link critical to the national economy. This section of highway has an average daily vehicle flow of over 15,000 to 20,000 vehicles (**Appendix C**).

6.3.3 **Figure 37** illustrates the location of those junctions considered critical to assess journey time reliability. Six junctions have been identified and they include:

- A438 / A46 Rbt (M5 J9)
- A46 Ashchurch Rd / Alexandra Way
- A46 Ashchurch Rd / Northway Lane
- A46 Ashchurch Rd / Fiddington Lane
- A46 Ashchurch Rd / B4079 Aston Cross
- A46 Ashchurch Rd / A46 / A435 Teddington Hands Roundabout

Figure 37 - Corridor 2 – critical junctions



6.3.4 **Figure 38** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. With the exception of Teddington Hands and Northway Lane there are capacity issues at each of the junctions identified. However the issues at Aston Cross exist in the Do Nothing scenario, and are therefore not attributed to JCS growth. On the basis of change from the Do Nothing and the Do Minimum mitigation will need to be considered for the following junctions:

- M5 Junction 9 - A46 westbound approach to junction
- Alexandra Way – side road approach from Business Park
- Fiddington Lane – side road approach from Fiddington

Figure 38 – Corridor 2 Ratios of Flow to Capacity – DN and DM

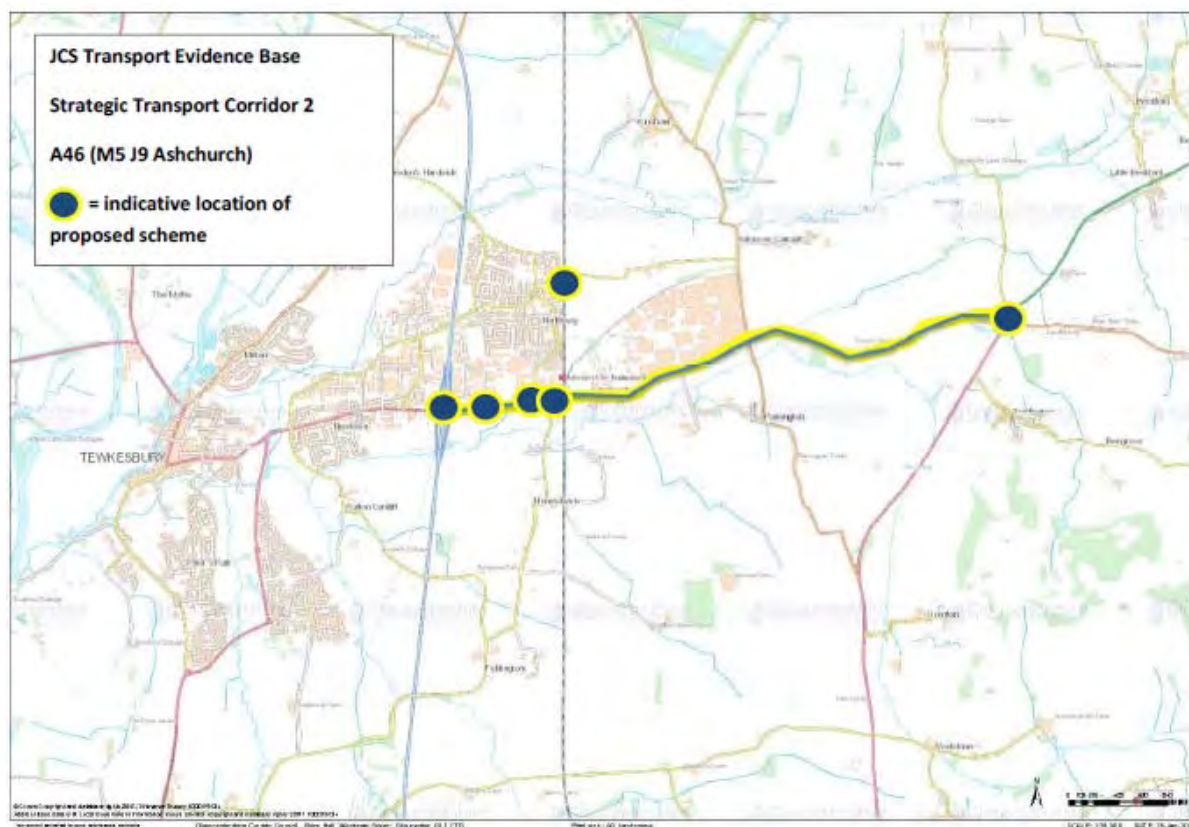
| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A438 / A46 Rbt (M5 J9) | 96.9% | 111.9% | 101.8% | 101.3% |
| A46 Ashchurch Rd / Alexandra Way | 104.0% | 129.5% | 469.7% | 497.3% |
| A46 Ashchurch Rd / Northway Ln | 99.9% | 87.7% | 78.9% | 84.8% |
| A46 Ashchurch Rd / Fiddington Lane | 78.5% | 115.1% | 102.7% | 114.5% |
| A46 Ashchurch Rd / B4079 Aston Cross | 101.3% | 105.4% | 103.9% | 106.9% |
| A46 Ashchurch Rd / A46 / A435 Teddington Hands Rbt | 60.1% | 69.0% | 56.3% | 59.3% |

6.3.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 38** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) include:

- A46 through Ashchurch – New dual carriageway bypass linking Teddington Hands roundabout with M5 Junction 9 and associated changes to junctions. Based on the Department for Transport’s 1993 alignment to provide an alternative to the south of the existing A46 alignment;
- Upgrade signals to MOVA or SCOOT operation to optimise signal timings along existing alignment;
- Close Railway Level Crossing, and replace with new bridge linking Grange Road with Hardwicke Bank Road to improve alternative access to the north of A46.

6.3.6 **Figure 39** illustrates the location of the mitigation measures outlined above.

Figure 39 - Corridor 2 – Location of mitigation measures



6.3.7 **Figure 40** summarises the impacts of the Do Something 7 Strategy.

Figure 40 – Corridor 2 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A438 / A46 Rbt (M5 J9) | 111.9% | 87.2% | 101.3% | 92.5% |
| A46 Ashchurch Rd / Alexandra Way | 129.5% | 67.9% | 497.3% | 95.4% |
| A46 Ashchurch Rd / Northway Ln | 87.7% | 91.8% | 84.8% | 49.6% |
| A46 Ashchurch Rd / Fiddington Lane | 115.1% | 39.2% | 114.5% | 42.3% |
| A46 Ashchurch Rd / B4079 Aston Cross | 105.4% | 100.4% | 106.9% | 97.3% |
| A46 Ashchurch Rd / A46 / A435 Teddington Hands Rbt | 69.0% | 50.7% | 59.3% | 59.1% |

6.3.8 The outcome of the Do Something 7 changes result in a significant improvement to the operation of the A46, with all junctions along this corridor now operating within acceptable levels. The advantages of the offline improvement and new bridge over the railway crossing will bring about significant improvements to the existing A46 route encouraging walking, cycling and public transport use.

6.4 Corridor 3 - A40 –M5 Junction 11 to county boundary (east of Ross on Wye)

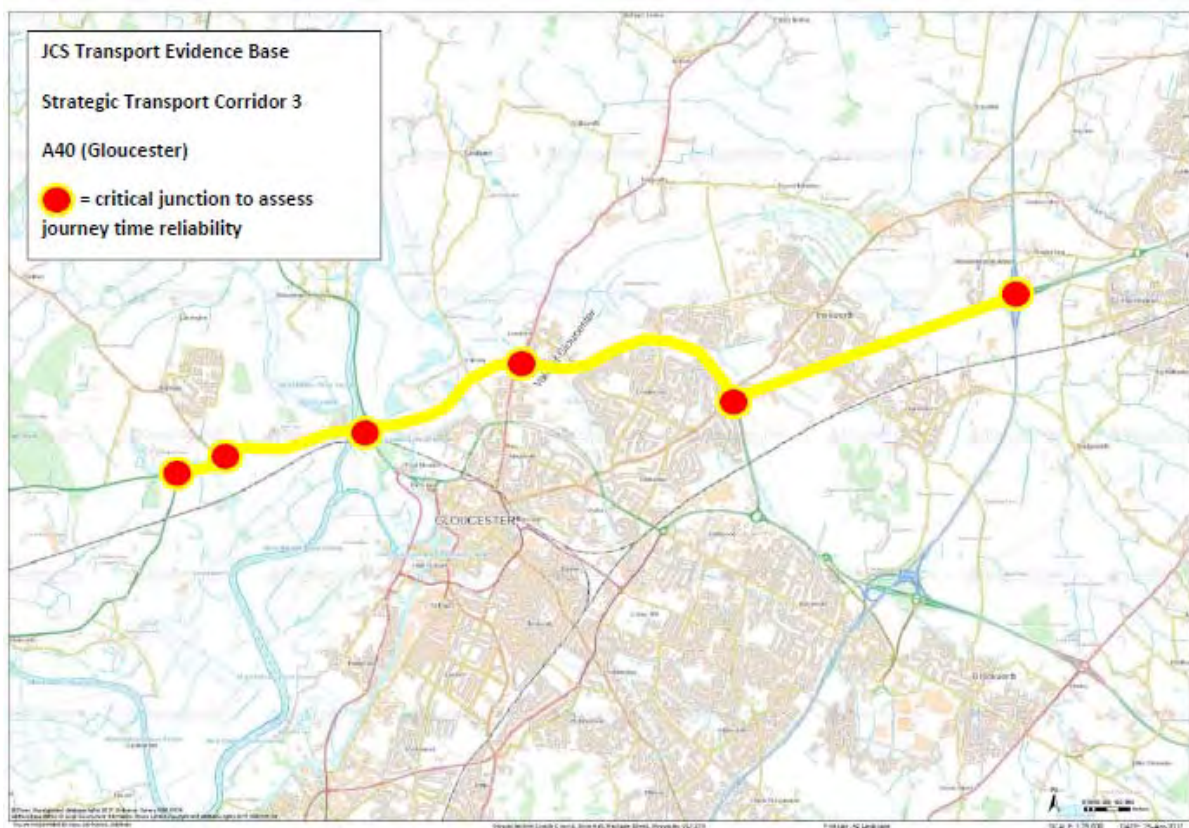
6.4.1 Corridor 3 includes the A40 from M5 Junction 11 to the county boundary. This forms part of the Strategic Road Network and is managed by Highways England. The A40 provides Gloucester’s northern bypass and interacts with a number of locally important routes. It also provides the primary access linking the Forest of Dean with the JSC area.

6.4.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a national link critical to the national economy. This section of highway has an average daily vehicle flow of over 20,000 to 50,000 vehicles (**Appendix C**).

6.4.2 **Figure 41** illustrates the location of those junctions considered critical to assess journey time reliability. Six junctions have been identified:

- A40/ A48 Roundabout Highnam Roundabout
- A40/ B4215 Newent Junction
- A40/ A417 Over Roundabout
- A40/ A38 Longford Roundabout
- A40 Elmbridge Court Roundabout
- M5/ A40 (Junction 11)

Figure 41 - Corridor 3 – critical junctions



6.4.3 **Figure 42** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Please note that within this route

analysis it does not include the proposed new junction on the A40 Northern Bypass between Longford and Elmbridge Court that may be added as a result of access to the A1 Innsworth and A1a Twigworth Strategic Allocations. With the exception of M5 Junction 11 there are capacity issues at each of the junctions identified. Despite operating over 100% the JCS Transport Strategy will consider some high level mitigation for the A40 /A48 Highnam and A40/B4215 Newent junctions despite the capacity issues not being directly caused by the JCS allocation. On the basis of change from the Do Nothing and the Do Minimum mitigation will need to be considered for the following junctions:

- A40 / A48 Highnam – due to demand from the West of Severn towards Gloucester
- A40 / B4215 Newent Junction – due to demand from the West of Severn towards Gloucester
- A40 / A417 / Over – due to demand from the A417 northern approach (Maisemore)
- A40 / A38 Longford – due to demand from the A38 northern approach and A40 western approaches
- A40 Elmbridge Court – due to demand from B4063 (Churchdown) and adjacent junction circulatory queuing

Figure 42 – Corridor 3 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|--------------------------------|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A40/ A48 Rbt Highnam Rbt | 134.7% | 139.6% | 102.9% | 115.7% |
| A40/ B4215 Newent Junction | 115.1% | 118.1% | 104.4% | 104.4% |
| A40/ A417 Over Roundabout | 115.3% | 117.0% | 124.6% | 118.6% |
| A40/ A38 Longford Roundabout | 105.3% | 139.7% | 99.1% | 95.4% |
| A40 Elmbridge Court Roundabout | 120.6% | 173.1% | 107.9% | 110.2% |
| M5/ A40 (Junction 11) | 89.2% | 93.7% | 75.4% | 92.0% |

6.4.4 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 42** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- A40/A48 Highnam Roundabout - Signalise roundabout – MOVA signals
- A40 Over Roundabout - Add a dedicated left slip from A40 east to the south towards Gloucester
- A40 Longford Roundabout and new Innsworth site access
- New junction on A40 - New signalised junction on A40 between Longford and Elmbridge Court roundabouts
- New junction on A38 - New priority junction on A38 giving priority to new highway link and accessing the new junction on A40

- New section of highway - New 50 mph highway link, joining upgraded junctions on A40 and A38 through / adjacent to Twigworth / Innsworth development sites
- A40 Longford Roundabout - Existing A40 / A38 Longford junction changed from a roundabout to a signalised crossroads. Junction arrangement designed to complement the introduction of Longford Bypass. Turn from A40 east to A38 north not allowed. Bus priority – traffic signals will be used to facilitate north / south movements
- A40 Longford Roundabout - Removal of existing A40 pedestrian crossing and replacement with new pedestrian and cycle over bridge
- A38 Tewkesbury Road - A38 Tewkesbury Rd to be downgraded between A40/A38 Longford signalised crossroads and new A38/Twigworth junction to 20mph, and encourage as a sustainable travel corridor. Access from A38 north is restricted to one lane entry to crossroads, A40 west to A38 north - right hand turn banned with alternative route via A40 / A38 Link Road
- A38 Tewkesbury Road – Downgrading of junction with Longford Lane, to remove right turn holding lane into Longford Lane
- A38 Tewkesbury Road - Upgrade A38 Tewkesbury Rd / Down Hatherley Lane junction, to include a dedicated right turn from A38 south
- A40 Elmbridge Court Roundabout - Remove B4063 Cheltenham Rd East approach arm from the junction and also the Elmbridge Court access road to / from existing Business Park; New free flow left turn link from A40 East to A40 Barnwood Link, and similar free flow left turn link from A40 Northern Bypass to A40 East
- New A40 junction east of Elmbridge – four way signals with turning restrictions. New link road from B4063 Cheltenham Rd East and access to existing Business Park and South Churchdown strategic employment site. Both roads would access the new junction

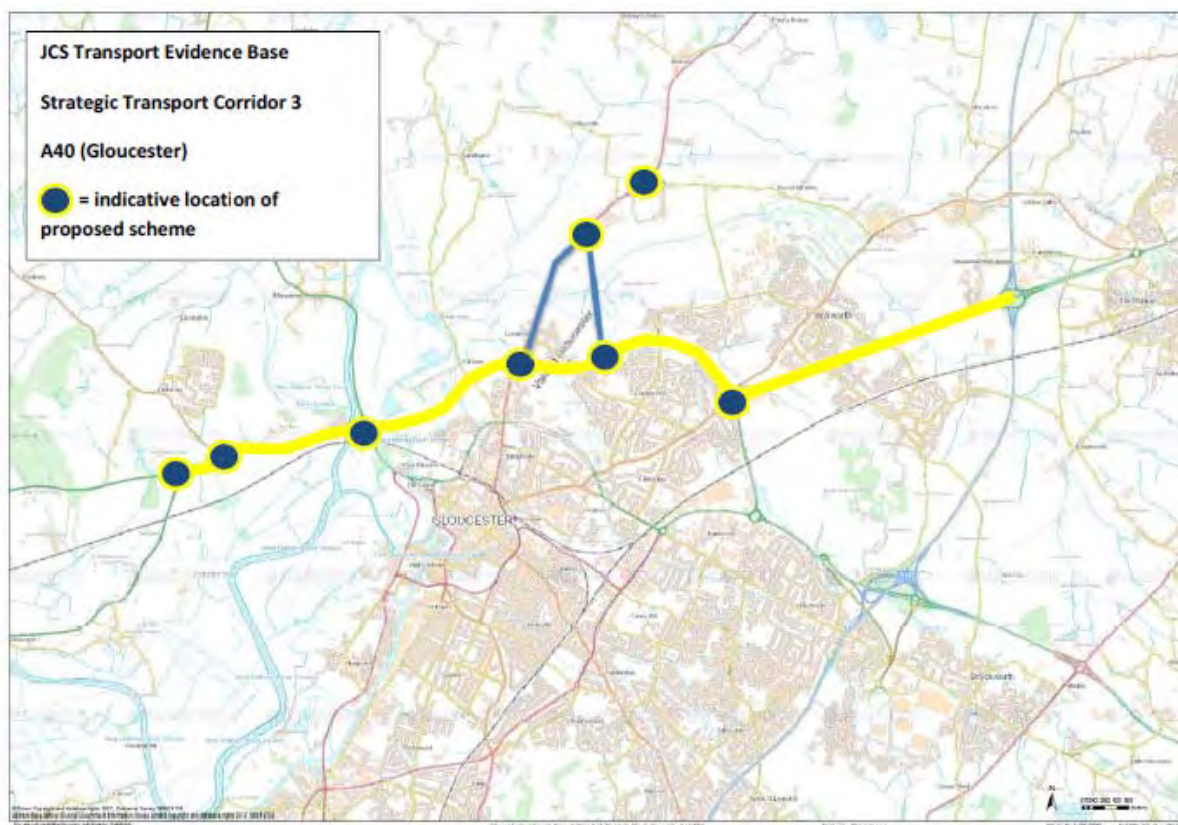
6.4.5 **Figure 43** illustrates the location of the mitigation measures outlined above.

6.4.6 **Figure 44** summarises the impacts of the Do Something 7 Strategy.

Figure 43 – Corridor 2 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|--------------------------------|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A40/ A48 Rbt Highnam Rbt | 139.6% | 153.6% | 115.7% | 131.7% |
| A40/ B4215 Newent Junction | 118.1% | 128.4% | 104.4% | 104.4% |
| A40/ A417 Over Roundabout | 117.0% | 117.8% | 118.6% | 120.7% |
| A40/ A38 Longford Roundabout | 139.7% | 100.6% | 95.4% | 100.5% |
| A40 Elmbridge Court Roundabout | 173.1% | 103.8% | 110.2% | 103.0% |
| M5/ A40 (Junction 11) | 93.7% | 99.6% | 92.0% | 93.8% |

Figure 44 - Corridor 4 – Location of mitigation measures



6.4.7 The outcome of the Do Something 7 scenario improves the operation of critical junctions and the corridor can continue to operate, but there are several junctions where capacity concerns remain. These are principally as a result from travel demand originating from the West of Severn and are related to accessing employment opportunities within the JCS area.

6.4.8 The remaining issues for corridor 3 include:

- Highnam Roundabout (both peaks); A40/B4215 Newent Junction (AM peak) and Over Roundabout (both peaks). Through further detailed junction modelling and iterative design it is considered probable that increased efficiencies would be achievable at these junctions
- Longford Roundabout (PM peak); the Longford changes are part of the wider scheme to provide an acceptable network to access both Innsworth and Twigworth. Note that the operation of the junction is significantly improved for the AM peak compared to the Do Minimum, and the PM is only just over 100% (100.5%). Therefore, this is considered acceptable given expected network efficiencies gained as the planning process proceeds and more details of the scheme become known
- Elmbridge Roundabout (both peaks); Despite major improvements when compared to the 'Do Nothing' there remains operational capacity concerns with the new four arm signalised junction on the A40 to the east of Elmbridge Roundabout. A potential variation to a staggered junction arrangement could improve the operational efficiency of this new junction.

- 6.4.9 For most of the corridor the A40 acts as a barrier to walking and cycling. Much of the A40 does not have a footway and walking along this corridor is not to be encouraged and only the most experienced cyclist should consider using this route. However, as the route does interact with a number of local highway links where walking and cycling are to be encouraged. The existing grade separated crossings at Over, Longford, Innsworth and Elmbridge provide a environment to cross the route in safety. The proposed replacement of the at grade crossing at Longford roundabout with a grade separated facility and downgrade of the existing A38 should enhance the attractiveness for people wanting to Gloucester from the JCS strategic allocations in Innsworth and Twigworth.
- 6.4.10 The bus priority improvements incorporated into the Longford scheme will also assist in maintaining journey times for routes 71 and 97 / 98, this is essential for maximising public transport desirability and ridership.

6.5 Corridor 4 - A417 – M5 Junction 11a to Nettleton roundabout

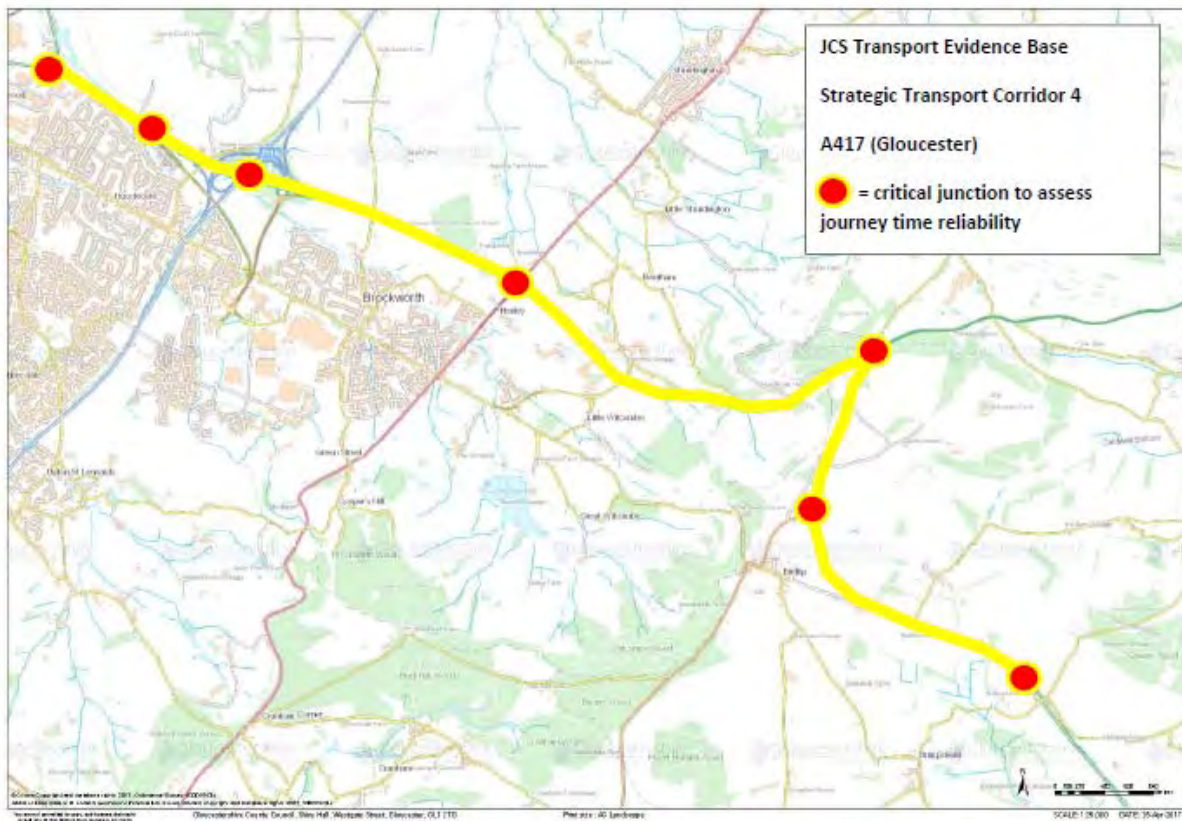
6.5.1 Corridor 4 includes the A417 M5 Junction 11a to Nettleton roundabout covering Birdlip and the Air Balloon junctions to the east up to the Corinium Avenue junction on the edge of Gloucester. This forms part of the Strategic Road Network and is managed by Highways England.

6.5.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a national link critical to the national economy. This section of highway has an average daily vehicle flow of over 30,000 to 50,000 vehicles (**Appendix C**).

6.5.3 **Figure 45** illustrates the location of those junctions considered critical to assess journey time reliability. Seven junctions have been identified and they include:

- A417/ Stockwell Junction
- A417/ Birdlip Junction
- A417/ Air Balloon Roundabout
- A417/ A46 Junction
- A417/ B4641 M5 J11a Intersection
- A417/ Delta Way Roundabout
- A417/ Barnett Way/ Corinium Avenue Roundabout

Figure 45 - Corridor 4 – critical junctions



6.5.4 **Figure 46** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Please note that the Do Minimum scenario includes the proposed major scheme at Birdlip and the Air Balloon, known as the “Missing Link”, resulting in the significant improvements at these junctions within the Do Minimum scenario. On the basis of change from the Do Nothing and the Do Minimum mitigation will need to be considered for the following junctions:

- A417/A46 junction – A46 southbound (Shurdington) and A417 eastbound off slip
- A417 / Delta Way ‘Zoons’ Roundabout – Delta Way northbound approach and A417 westbound approach

Figure 46 – Corridor 4 Ratios of Flow to Capacity – DN and DM

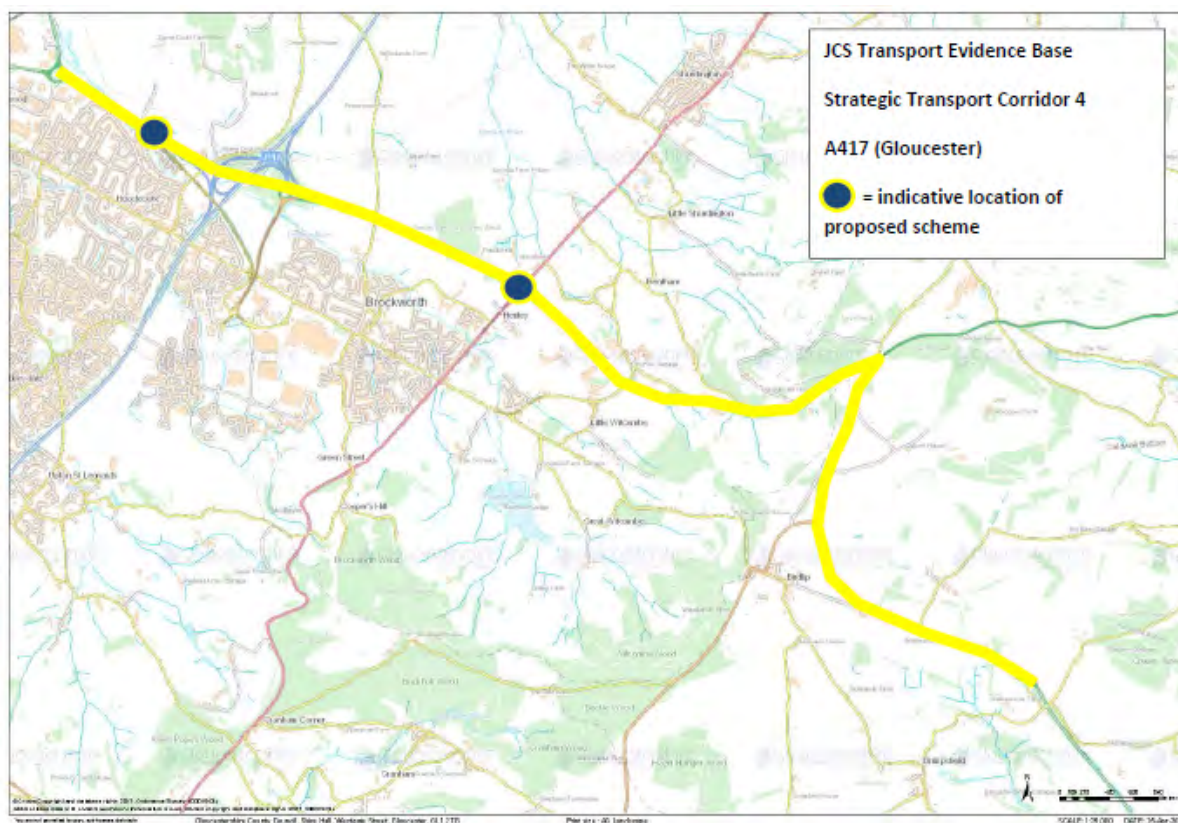
| Junction Name | Ratios of Flow to Capacity | | | |
|---|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A417/ Stockwell Junction | 100.5% | 63.6% | 114.3% | 60.1% |
| A417/ Birdlip Junction | 122.9% | 105.3% | 112.7% | 47.5% |
| A417/ Air Balloon Roundabout | 129.7% | 69.9% | 120.6% | 50.1% |
| A417/ A46 Junction | 100.5% | 107.7% | 88.9% | 101.2% |
| A417/ B4641 M5 J11a Intersection | 71.3% | 95.1% | 82.5% | 86.4% |
| A417/ Delta Way Roundabout | 94.5% | 107.9% | 82.8% | 101.7% |
| A417/ Barnett Way/ Corinium Avenue Roundabout | 83.0% | 97.0% | 109.0% | 110.1% |

6.5.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 46** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- A417 / Delta Way ‘Zoons’ Roundabout - Junction Improvement: Removing the existing left turn slip from Delta Way (Brockworth) to C&G Roundabout, and signalling the A417 approach (from Cirencester) and the opposing roundabout circulatory movement
- A417 Brockworth Bypass - Signalling the westbound and eastbound ‘Off-slips’

6.5.6 **Figure 47** illustrates the location of the mitigation measures outlined above.

Figure 47 - Corridor 4 – Location of mitigation measures



6.5.7 **Figure 48** summarises the impacts of the Do Something 7 Strategy.

Figure 48 – Corridor 4 Ratios of Flow to Capacity – DM and DS7

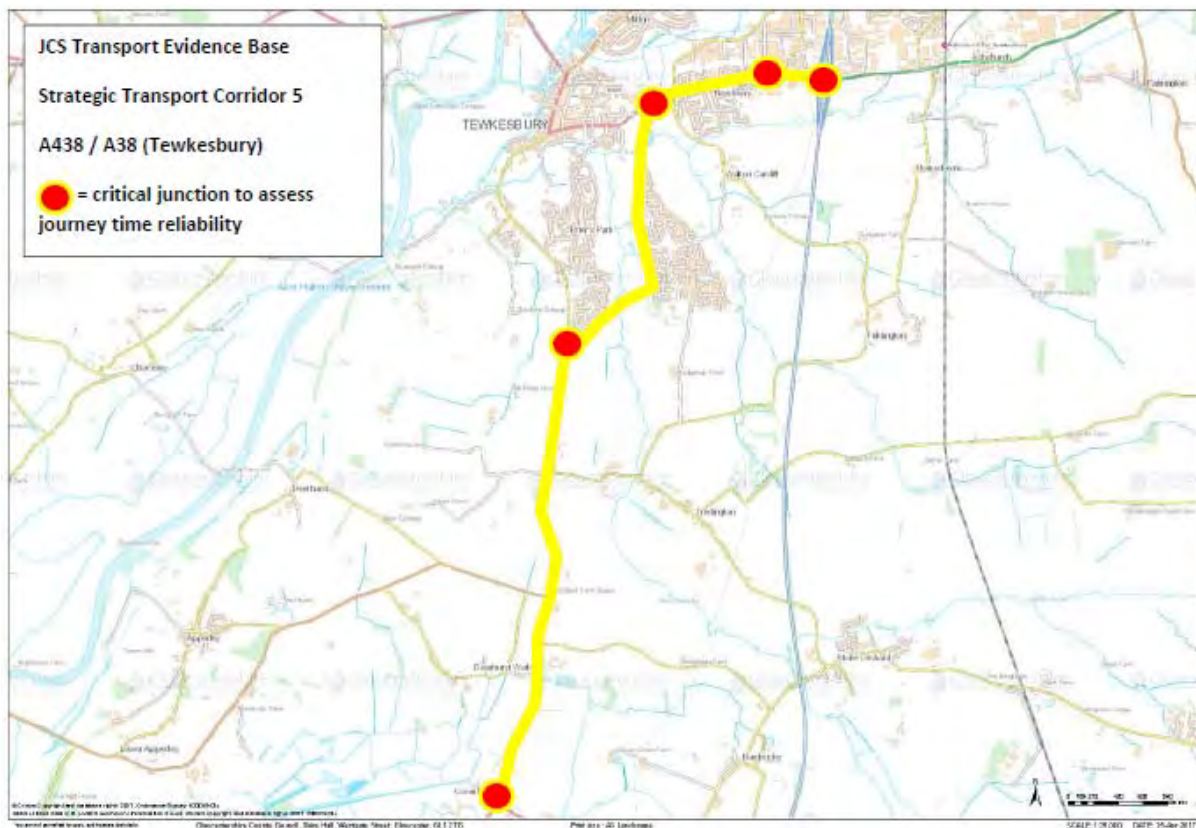
| Junction Name | Ratios of Flow to Capacity | | | |
|---|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A417/ Stockwell Junction | 63.6% | 58.4% | 60.1% | 60.6% |
| A417/ Birdlip Junction | 105.3% | 97.9% | 47.5% | 56.5% |
| A417/ Air Balloon Roundabout | 69.9% | 64.6% | 50.1% | 51.7% |
| A417/ A46 Junction | 107.7% | 104.0% | 101.2% | 102.9% |
| A417/ B4641 M5 J11a Intersection | 95.1% | 103.4% | 86.4% | 84.1% |
| A417/ Delta Way Roundabout | 107.9% | 100.0% | 101.7% | 90.1% |
| A417/ Barnett Way/ Corinium Avenue Roundabout | 97.0% | 88.1% | 110.1% | 103.4% |

6.5.8 The outcome of these changes results in significant improvements when compared to the ‘Do Minimum’ operating conditions, with the majority of junctions operating within or at capacity during both peak hour periods. There remain minor issues during both peak for the A417 / A46 junction with both A46 approaches. Possible signalisation of these approaches may mitigate the scale of delay experienced.

6.6 Corridor 5 - A438 / A38 – M5 Junction 9 to A38 Coombe Hill

- 6.6.1 Corridor 5 starts at M5 Junction 9 Tewkesbury and includes the A438, and the A38 through Walton Cardiff to Coombe Hill. The route forms part of the local highway network and is managed by Gloucestershire County Council.
- 6.6.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 10,000 to 15,000 vehicles (**Appendix C**). It also forms part of the 41/42 public transport corridor.
- 6.6.3 **Figure 49** illustrates the location of those junctions considered critical to assess journey time reliability. Five junctions have been identified and they include:
- A438 / M5 Junction 9
 - A438 / Shannon Way
 - A438 / A38 Tewkesbury Bypass
 - A38 / Gupshill Close Rbt
 - A38/Coombe Hill

Figure 49 - Corridor 5 – critical junctions



- 6.6.4 **Figure 50** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Within the corridors there are two sections which require mitigation - the A438 approach to M5 Junction 9 from Shannon Way,

and the A38 Coombe Hill junction. Both highway links experiencing congestion are related to accessing the M5. On the basis of change from the Do Nothing and the Do Minimum mitigation will need to be considered for the following junctions:

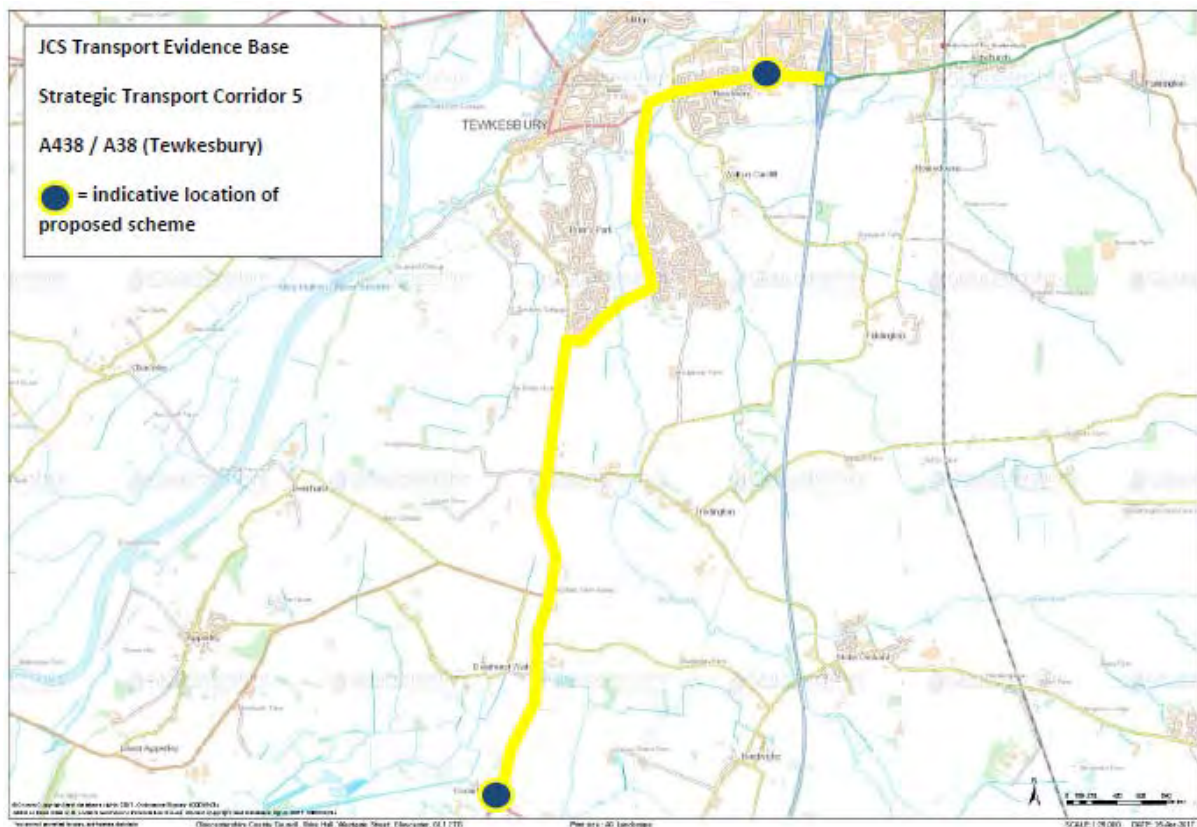
- M5 Junction 9 – approach from A438 Shannon Way
- A38 / A419 – Coombe Hill – approach from A38 towards M5 Junction 10

Figure 50 – Corridor 5 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|---------------------------------|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A438 / M5 Junction 9 | 96.9% | 111.9% | 101.8% | 101.3% |
| A438 / Shannon Way | 116.4% | 117.1% | 101.3% | 104.4% |
| A438 / A38 Tewkesbury Bypass | 96.9% | 98.5% | 91.1% | 98.2% |
| A38 / Gupshill Close Rbt | 40.6% | 51.2% | 52.2% | 52.5% |
| A38/Coombe Hill | 101.6% | 115.0% | 103.7% | 108.3% |

6.6.5 **Figure 51** illustrates the location of the mitigation measures outlined above.

Figure 51 - Corridor 5 – Location of mitigation measures



6.6.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 50** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- Shannon Way – Improvement to the A438/Shannon Way traffic signal junction to provide an additional eastbound exit lane from the junction to M5J9; separate left turn lane from A438 (west) to Shannon Way, with two straight ahead lanes eastbound
- A38 / A419 – Coombe Hill – signals optimisation

6.6.6 **Figure 51** summarises the impacts of the Do Something 7 Strategy.

Figure 51 – Corridor 5 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|---------------------------------|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A438 / M5 Junction 9 | 111.9% | 87.2% | 101.3% | 92.5% |
| A438 / Shannon Way | 117.1% | 103.9% | 104.4% | 103.5% |
| A438 / A38 Tewkesbury Bypass | 98.5% | 83.4% | 98.2% | 94.4% |
| A38 / Gupshill Close Rbt | 51.2% | 59.6% | 52.5% | 43.8% |
| A38/Coombe Hill | 115.0% | 91.9% | 108.3% | 106.8% |

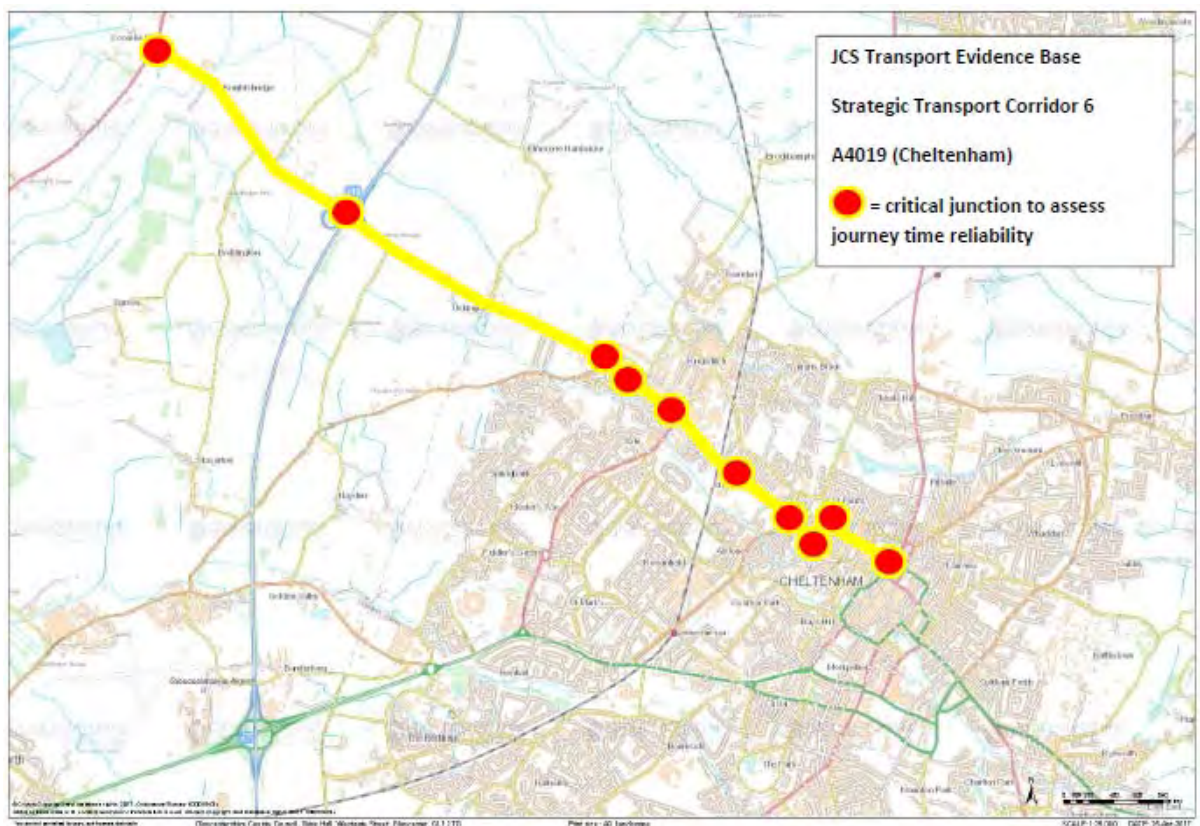
6.6.7 The outcome of these changes results in no significant delays within this corridor resulting from JCS allocations. Delays do remain, but additional signal optimisation at these junctions may result in further efficiencies at these junctions reducing the scale of delay experienced.

6.6.8 The expected impact on the 41/42 public transport corridor is expected to be minimal. If delays do persist then as part of the signal optimisation bus priority measures could be incorporated into the final scheme.

6.7 Corridor 6 - A4019 – Coombe Hill to A46 Albion Street / St Johns Avenue

6.7.1 Corridor 6 starts within Cheltenham Town Centre and continues to the A38 Coombe Hill junction to the west of M5 Junction 10. The largest of the JCS Strategic housing allocations at North West Cheltenham will have direct access onto this corridor. It also forms part of the strategic public transport corridor served by the 41/42 linking Tewkesbury with Cheltenham. The route forms part of the local highway network and is managed by Gloucestershire County Council.

6.7.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 10,000 to 30,000 vehicles (**Appendix C**). **Figure 52 - Corridor 6 – Critical Junctions**



6.7.3 **Figure 52** illustrates the location of those junctions considered critical to assess journey time reliability. Ten junctions have been identified:

- A4019 / North Place
- A4019 Swindon Rd / Poole Way Jct
- A4019 High St / Poole Way
- A4019 Tewkesbury Rd / B4633 Gloucester Road
- A4019 Tewkesbury Rd / Elm St
- A4019 Tewkesbury Rd / Princess Elizabeth Way
- A4019 Tewkesbury Rd / Hayden Rd
- A4019 Tewkesbury Rd / B4634 Old Gloucester Road

- M5/ A4019 (Junction 10)
- A4019 Tewkesbury Rd / A38 Coombe Hill

6.7.4 **Figure 53** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Within the corridors there are two junctions that operate over capacity including Coombe Hill which was discussed in **Section 6.6** and the A4019 Hayden Road/Manor Road Junction where capacity issues are linked to accessing Cheltenham Town Centre.

Figure 53 – Corridor 6 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|---|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A4019 / North Place | 81.5% | 86.3% | 68.8% | 65.6% |
| A4019 Swindon Rd / Poole Way Jct | 79.5% | 80.8% | 26.3% | 24.8% |
| A4019 High St / Poole Way | 55.5% | 72.1% | 60.7% | 64.0% |
| A4019 Tewkesbury Rd / B4633 Gloucester Road | 93.4% | 94.3% | 88.9% | 98.7% |
| A4019 Tewkesbury Rd / Elm St | 90.0% | 96.0% | 56.1% | 83.8% |
| A4019 Tewkesbury Rd / Princess Elizabeth Way | 81.3% | 86.3% | 77.6% | 88.2% |
| A4019 Tewkesbury Rd / Hayden Rd | 98.8% | 116.6% | 95.8% | 93.7% |
| A4019 Tewkesbury Rd / B4634 Old Gloucester Road | 73.6% | 84.4% | 77.1% | 94.1% |
| M5/ A4019 (Junction 10) | 89.5% | 91.0% | 76.9% | 84.2% |
| A4019 Tewkesbury Rd / A38 Coombe Hill | 101.6% | 115.0% | 103.7% | 108.3% |

6.7.5 A significant change to this corridor is required to provide access to the West of Cheltenham Strategic Allocation. The Do Something 6a scenario considered access to the south of the site via M5 Junction 11 and the A40 resulting in significant delays including issues with the M5 mainline. Converting junction 10 to an ‘All movements’ junction and providing access from the A4019 to the West of Cheltenham via a new distributor link road significantly reduces the impact of the site on the local network.

6.7.6 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 53** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- M5 J10 - ‘All Movements’ junction improvements (see corridor 1)
- New 50 mph dual carriageway two-lane link road, providing free-flow access from A4019 / M5 J10 to West of Cheltenham site only

- West of M5 J10 - Major/Minor Priority Junction on new 50 mph dual carriageway two-lane link road, with Minor junction arm for West of Cheltenham residential site access only
- West of M5 J10 - Change to highway priorities west of M5 J10, with a new Major/Minor Priority Junction, with A4019 (West) as Minor junction arm
- Withybridge Lane - Close access onto A4019
- A4019 / A4013 Kingsditch (Centrum Park) Roundabout – replacing existing roundabout with traffic signals
- New A4019 traffic signals site access junction, west of B4634 Old Gloucester Rd
- Revised A4019 traffic signals site access junction at B4634 Old Gloucester Rd / Gallagher Retail Park
- A4019 Tewkesbury Road corridor - Upgrade signals to SCOOT operation to optimise signal timings with bus priority along A4019 corridor junctions including
 - B4634 Old Gloucester Rd/A4019 Junction
 - Hayden Road/A4019/Manor Road Junction
 - A4019 / Elm Street Junction
 - B4633 Gloucester Rd / A4019 /Townsend Street

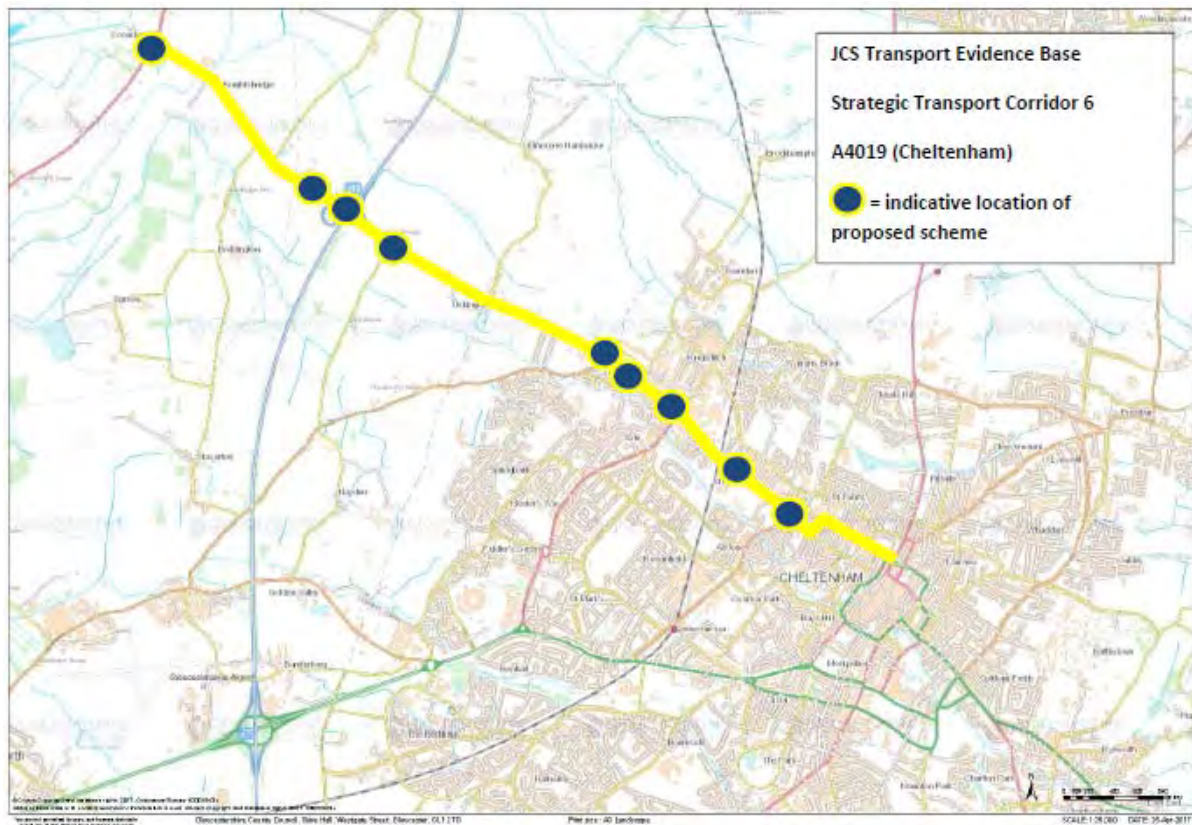
6.7.7 **Figure 54** illustrates the location of the mitigation measures outlined above.

6.7.8 **Figure 55** summarises the impacts of the Do Something 7 Strategy.

Figure 54 – Corridor 6 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|---|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A4019 / North Place | 86.3% | 74.7% | 65.6% | 62.2% |
| A4019 Swindon Rd / Poole Way Jct | 80.8% | 73.7% | 24.8% | 21.7% |
| A4019 High St / Poole Way | 72.1% | 51.9% | 64.0% | 62.4% |
| A4019 Tewkesbury Rd / B4633 Gloucester Road | 94.3% | 92.7% | 98.7% | 97.1% |
| A4019 Tewkesbury Rd / Elm St | 96.0% | 95.9% | 83.8% | 82.5% |
| A4019 Tewkesbury Rd / Princess Elizabeth Way | 86.3% | 93.9% | 88.2% | 95.6% |
| A4019 Tewkesbury Rd / Hayden Rd | 116.6% | 103.9% | 93.7% | 100.7% |
| A4019 Tewkesbury Rd / B4634 Old Gloucester Road | 84.4% | 100.8% | 94.1% | 95.2% |
| M5/ A4019 (Junction 10) | 91.0% | 96.8% | 84.2% | 93.9% |
| A4019 Tewkesbury Rd / A38 Coombe Hill | 115.0% | 91.9% | 108.3% | 106.8% |

Figure 55 - Corridor 6 – Location of mitigation measures

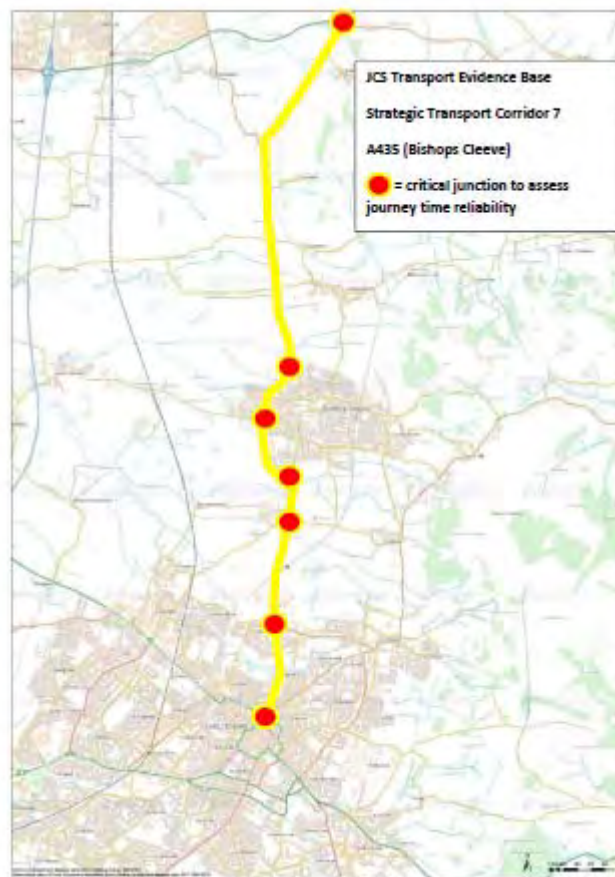


6.7.9 The outcome of changes to M5 Junction 10 results in increased travel demand within the corridor. On the majority of the junctions in this corridor journey time delays have been minimised, however further efficiencies could be achieved through additional iterations of the layout designs for the following junctions: B4634 Old Gloucester Rd/A4019 Junction and Hayden.

6.8 Corridor 7 - A435 – Teddington Hands (A46) to A46 St. Margaret's Road / Fairview Road

- 6.8.1 Corridor 7 starts within Cheltenham Town Centre and continues north to the A46 / A435 Teddington Hands roundabout. The corridor includes the link around Bishops Cleeve and along the A435 passing the racecourse. The route forms part of the local highway network and is managed by Gloucestershire County Council.
- 6.8.2 Within Gloucestershire Local Transport Plan's Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 6,000 to 15,000 vehicles (**Appendix C**).
- 6.8.3 **Figure 56** illustrates the location of those junctions considered critical to assess journey time reliability. Seven junctions have been identified:
- A435 St Margarets Rd / Fairview Rd Jct
 - A435 Swindon Ln / B4075 Racecourse Rbt
 - A435 / Hyde Ln / Southam Ln
 - A435 / Cheltenham Rd Rbt (GE Aviation)
 - A435 / Stoke Orchard Rd / Voxwell Ln Rbt
 - A435 / Finlay Way Rbt
 - A435 Teddington Hands Roundabout

Figure 56 - Corridor 7 – critical junctions



6.8.5 **Figure 57** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. There are issues caused by the volume of vehicles using the A435 corridor and almost of all of the junctions require some form of mitigation to increase capacity. On the basis of change from the Do Nothing and the Do Minimum, improvements will need to be considered for the following junctions:

- A435 / Finlay Way Roundabouts – demand from A435 corridor
- A435/ Stoke Road - demand from Stoke Road
- A435/GE Aviation Roundabout – demand from A435 corridor
- A435 / Hyde Lane / Southam Lane Signalised Junction - demand from A435 northbound and Hyde Lane eastbound approaches
- A435 / Racecourse Roundabout – demand from A435 southbound and Swindon Lane eastbound approaches

Figure 57 – Corridor 7 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A435 St Margaret's Rd / Fairview Rd Jct | 86.2% | 91.0% | 93.2% | 93.8% |
| A435 Swindon Ln / B4075 Racecourse Rbt | 91.5% | 100.7% | 81.7% | 90.9% |
| A435 / Hyde Ln / Southam Ln | 64.2% | 82.0% | 82.7% | 90.7% |
| A435 / Cheltenham Rd Rbt (GE Aviation) | 68.6% | 101.4% | 94.8% | 104.4% |
| A435 / Stoke Orchard Rd / Voxwell Ln Rbt | 84.6% | 102.9% | 94.3% | 103.1% |
| A435 / Finlay Way Rbt | 76.0% | 102.2% | 88.0% | 101.0% |
| A435 Teddington Hands Roundabout | 60.1% | 69.0% | 56.3% | 59.3% |

6.8.6 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 57** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- A435/ Stoke Road and A435 / Finlay Way Roundabouts - Capacity Improvements by approach arm widening;
- A435/GE Aviation Roundabout - Capacity Improvements by increasing the number of circulatory lanes to 2, and the A435 south bound exit to two lanes;
- A435 / Hyde Lane / Southam Lane Signalised Junction - Signalised Junction -Upgraded to provide additional straight ahead lanes on all junction approaches;
- A435 / Racecourse Roundabout - Capacity Improvements by approach arm widening.

6.8.7 **Figure 58** illustrates the location of the mitigation measures outlined above.

6.8.8 **Figure 59** summarises the impacts of the Do Something 7 Strategy.

Figure 58 - Corridor 7 – Location of mitigation measures

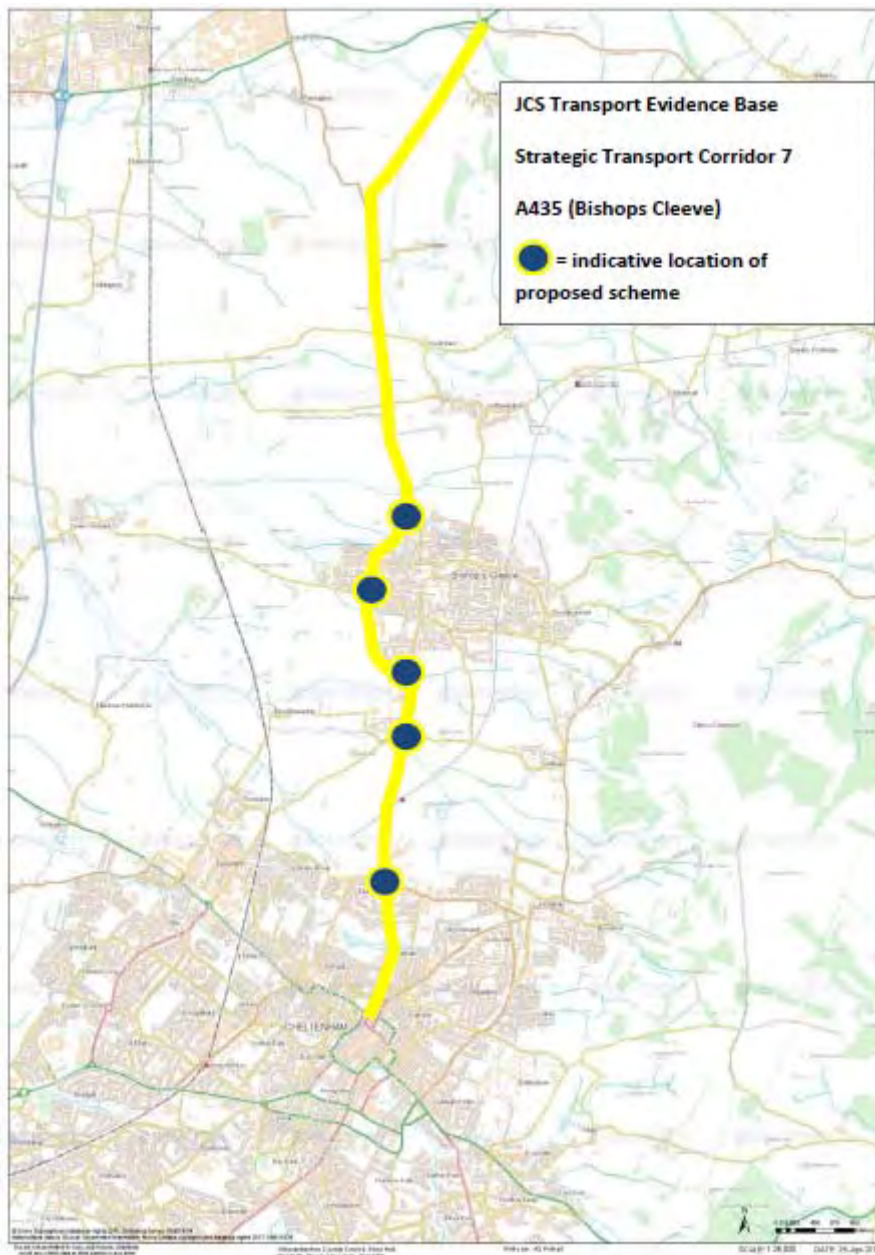


Figure 59 – Corridor 7 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A435 St Margaret's Rd / Fairview Rd Jct | 91.0% | 85.5% | 93.8% | 94.2% |
| A435 Swindon Ln / B4075 Racecourse Rbt | 100.7% | 77.0% | 90.9% | 94.5% |
| A435 / Hyde Ln / Southam Ln | 82.0% | 64.3% | 90.7% | 83.4% |
| A435 / Cheltenham Rd Rbt (GE Aviation) | 101.4% | 61.5% | 104.4% | 83.5% |
| A435 / Stoke Orchard Rd / Voxwell Ln Rbt | 102.9% | 70.7% | 103.1% | 89.2% |
| A435 / Finlay Way Rbt | 102.2% | 69.3% | 101.0% | 79.4% |
| A435 Teddington Hands Roundabout | 69.0% | 50.7% | 59.3% | 59.1% |

6.8.9 The outcome of these changes, and the wider area impact of the new A46 Ashchurch off-line bypass, has resulted in no delays reported within this corridor (from the JCS allocations). The new A46 off-line improvement reduces non-local vehicle flows from the corridor demand which will have positive impact on bus service time reliability and improve the quality of the environment for cycling along this important local corridor.

6.9 Corridor 8 - A40 – M5 Junction 11 to A435 London Road

6.9.1 Corridor 8 starts at M5 Junction 11 and flows eastwards via the A40 through Cheltenham Town Centre. The corridor has the highest vehicle flows on the local highway network and accesses several major employers in the JCS area. It also forms part of the main public transport corridor linking Cheltenham and Gloucester and provides access to Arle Court Park and Ride. The route is managed by Gloucestershire County Council.

6.9.2 Within Gloucestershire Local Transport Plan's Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 10,000 to 50,000 vehicles (**Appendix C**). .

6.9.3 **Figure 60** illustrates the location of those junctions considered critical to assess journey time reliability. Nine junctions have been identified and they include:

- M5/ A40 (Junction 11)
- A40/ B4063 Roundabout Arle Court
- A40/ Princess Elizabeth Way Roundabout
- A40 Lansdown Rd / B4633 Gloucester Rd
- A40 / Hatherley Rd
- A40 / Queen's Rd
- A40 Suffolk Rd / Bath Road
- A40 Thirlestaine Rd / Old Bath Rd Mini Rbt
- A40 London Rd / Hales Road

6.9.4 **Figure 61** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Within the Do Something 7 scenario it should be noted that the primary access to the West of Cheltenham site is provided via M5 Junction 10 with an expanded Park and Walk facility provided at the Arle Court Park and Ride site. Providing access via Junction 10 does have a significant impact on vehicle flows using this corridor resulting in fewer junctions reporting vehicle delay issues. On the basis of change from the Do Nothing and the Do Minimum mitigation will need to be considered for the following junctions:

- A40 Arle Court – demand from A40 eastbound and B4063 eastbound with traffic being blocked due to increased demand when accessing the West of Cheltenham site
- A40/ B4633 Gloucester Road – demand from B4633 Gloucester Road southbound approach

Figure 60 - Corridor 8 – critical junctions

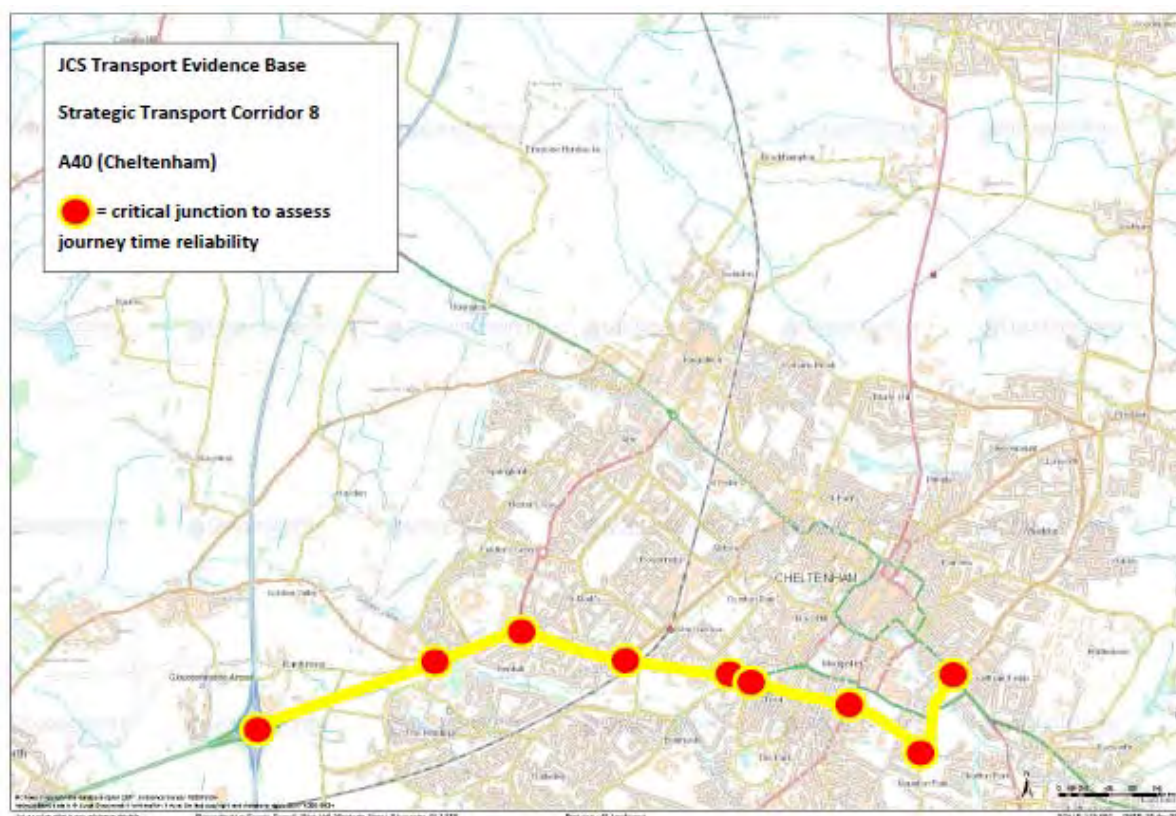


Figure 61 – Corridor 8 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| M5/ A40 (Junction 11) | 89.2% | 93.7% | 75.4% | 92.0% |
| A40/ B4063 Roundabout Arle Court | 112.1% | 184.7% | 98.6% | 111.3% |
| A40/ Princess Elizabeth Way Roundabout | 64.5% | 99.1% | 83.6% | 92.6% |
| A40 Lansdown Rd / B4633 Gloucester Rd | 95.9% | 100.0% | 99.1% | 100.9% |
| A40 / Hatherley Rd | 73.6% | 92.6% | 81.1% | 84.1% |
| A40 / Queen's Rd | 34.4% | 32.5% | 41.0% | 43.0% |
| A40 Suffolk Rd / Bath Road | 64.8% | 95.4% | 66.2% | 70.2% |
| A40 Thirlestaine Rd / Old Bath Rd Mini Rbt | 40.8% | 53.4% | 31.1% | 35.6% |
| A40 London Rd / Hales Road | 97.7% | 97.4% | 102.2% | 102.1% |

6.9.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 61** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- Arle Court Park and Ride - Expansion of existing Arle Court P&R parking facilities (100% Increase in Capacity), and new walking and cycling improvements to link P&R site with the new West of Cheltenham Employment site;
- A40 Arle Court Roundabout - New signalised junction on the A40 to the west of Arle Court roundabout to provide access into Park and Ride site only. With left turn out and right turn in only. This will not allow through traffic into Hatherley Lane.

Figure 62 – Corridor 8 – Location of mitigation measures

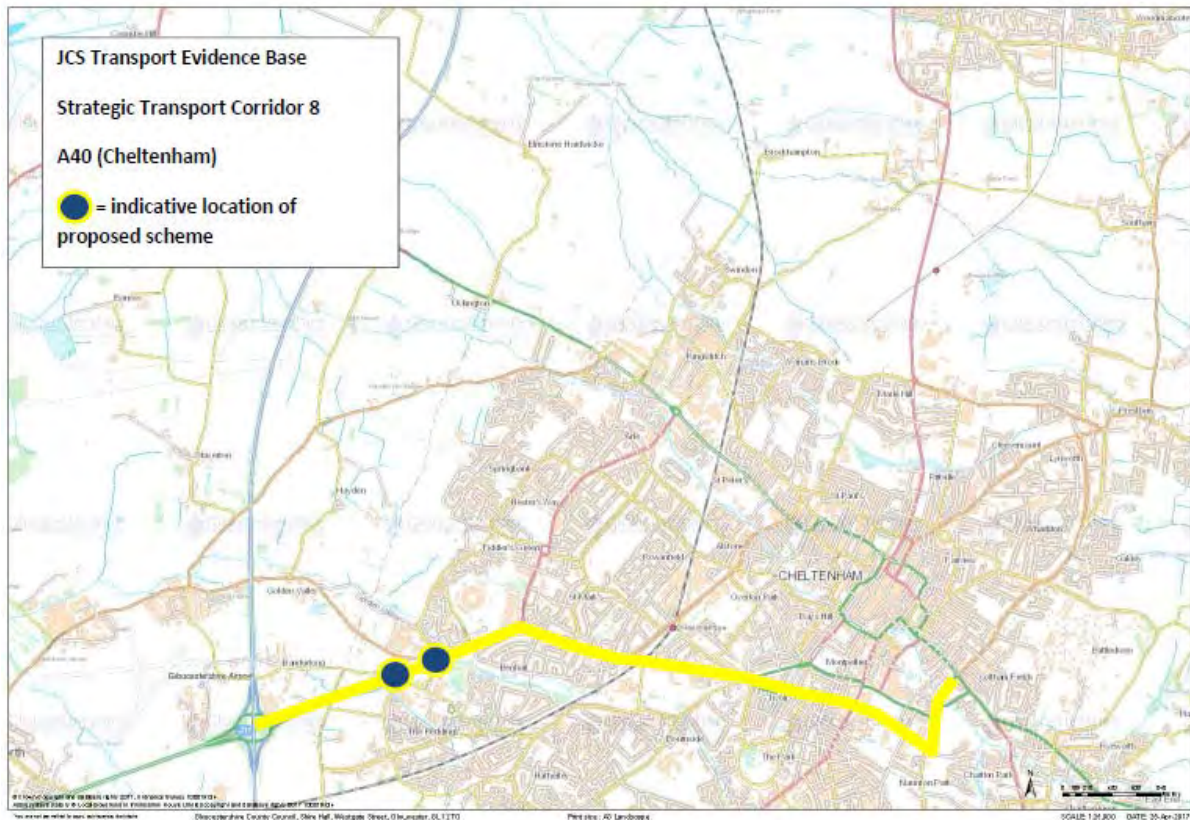


Figure 63 – Corridor 8 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|--------------|------------|--------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something | Do Minimum | Do Something |
| M5/ A40 (Junction 11) | 93.7% | 99.6% | 92.0% | 93.8% |
| A40/ B4063 Roundabout Arle Court | 184.7% | 105.4% | 111.3% | 102.2% |
| A40/ Princess Elizabeth Way Roundabout | 99.1% | 66.5% | 92.6% | 79.2% |
| A40 Lansdown Rd / B4633 Gloucester Rd | 100.0% | 89.1% | 100.9% | 98.1% |
| A40 / Hatherley Rd | 92.6% | 75.0% | 84.1% | 80.4% |
| A40 / Queen's Rd | 32.5% | 35.3% | 43.0% | 39.5% |
| A40 Suffolk Rd / Bath Road | 95.4% | 68.2% | 70.2% | 59.6% |
| A40 Thirlestaine Rd / Old Bath Rd Mini Rbt | 53.4% | 44.3% | 35.6% | 31.7% |
| A40 London Rd / Hales Road | 97.4% | 97.9% | 102.1% | 100.2% |

- 6.9.6 **Figure 62** illustrates the location of the mitigation measures outlined above.
- 6.9.7 **Figure 63** summarises the impacts of the Do Something 7 Strategy.
- 6.9.8 The outcome of these changes has minimised the sizeable increase in demand using this route when compared to the Do Minimum scenario. This has been achieved by altering the access arrangements into the west of Cheltenham site from M5 Junction 10, and the expansion of Park and Ride primarily for employees working at the West of Cheltenham site.
- 6.9.9 These changes will benefit all modes of travel within the corridor. Some further bus priority measures may be required at pinch points along the route to ensure service time reliability, but this will require more detailed modelling and design work to finalise the scale and type of improvements required.

6.10 Corridor 9 - A46 – Bath Road (central Cheltenham) to A417 junction

6.10.1 Corridor 9 starts at A46 junction with the A417 at Brockworth and heads northwards along the A46 through Shurdington to the Bath Road/Oriel Road junction in Cheltenham Town Centre. The route is a strategic public transport corridor serving Cheltenham and Gloucester with the high frequency 10 service. The route forms part of the local highway network and is managed by Gloucestershire County Council.

6.10.2 Within Gloucestershire Local Transport Plan's Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 15,000 to 20,000 vehicles (**Appendix C**). .

6.10.3 **Figure 64** illustrates the location of those junctions considered critical to assess journey time reliability. Nine junctions have been identified and they include:

- A46 / A417 Shurdington Rd Rbt
- A46 / Badgeworth Lane
- A46 Shurdington Rd / Leckhampton Lane
- A46 Shurdington / Up Hatherley Way
- A46 Shurdington Rd / Moorend Park Rd
- A46 Shurdington Rd / Bath Rd Rbt
- A46 Bath Rd / Thirlestaine Rd
- A46 Bath Rd / Sandford Rd
- A46 Bath Rd /Oriel Road

6.10.4 **Figure 65** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. There are issues with the A417 Brockworth Bypass and the Badgeworth Lane junction caused by vehicles rerouting to avoid delays elsewhere on the network. On the basis of change from the Do Nothing and the Do Minimum mitigation will need to be considered for the following junctions:

- A46 Badgeworth Lane junction – demand from Badgeworth Lane;
- A417 Brockworth Bypass – A46 southbound (Shurdington) and A417 eastbound off slip.

Figure 64 - Corridor 9 – critical junctions

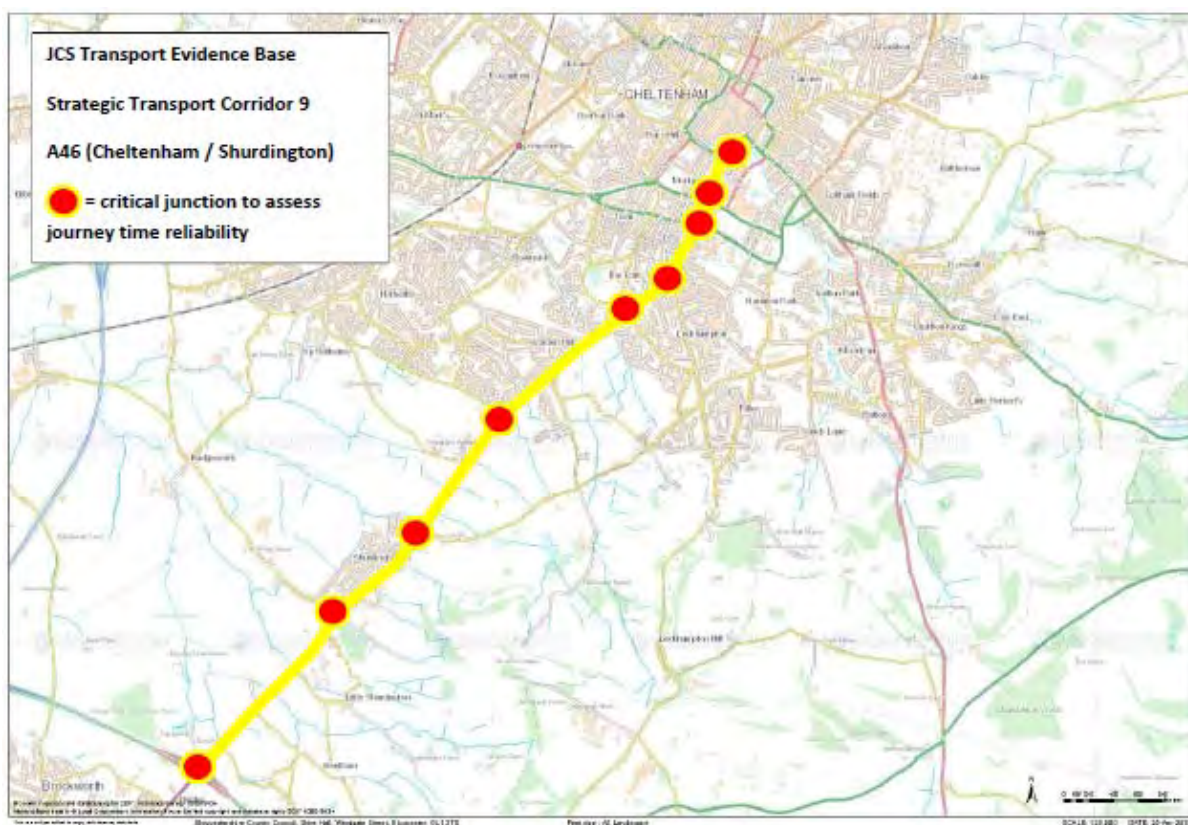


Figure 65 – Corridor 9 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|---------------------------------------|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A46 / A417 Shurdington Rd Rbt | 100.5% | 107.7% | 88.9% | 101.2% |
| A46 / Badgeworth Lane | 120.5% | 120.8% | 71.5% | 93.4% |
| A46 Shurdington Rd / Leckhampton Lane | 100.3% | 87.6% | 99.3% | 99.8% |
| A46 Shurdington / Up Hatherley Way | 74.3% | 93.9% | 60.3% | 72.8% |
| A46 Shurdington Rd / Moorend Park Rd | 94.8% | 97.4% | 64.9% | 79.6% |
| A46 Shurdington Rd / Bath Rd Rbt | 45.6% | 41.0% | 52.5% | 57.3% |
| A46 Bath Rd / Thirstaine Rd | 80.0% | 95.5% | 78.4% | 84.8% |
| A46 Bath Rd / Sandford Rd | 87.2% | 89.5% | 83.3% | 87.3% |
| A46 Bath Rd / Oriol Road | 46.6% | 53.8% | 36.9% | 35.3% |

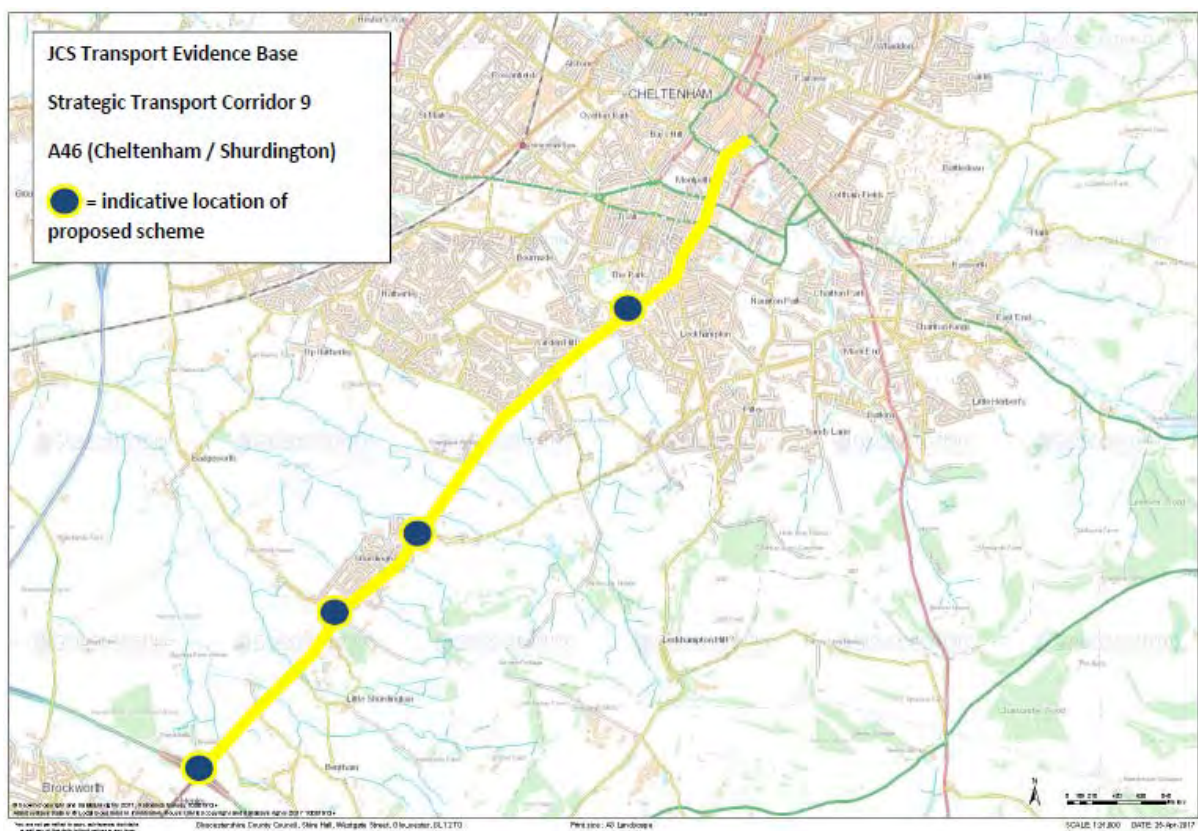
6.10.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 65** and other trip reassignment resulting from the JCS growth

strategy and other network changes which impact travel demand within the corridor) includes:

- Leckhampton Lane - upgrade A46 / Leckhampton Lane priority junction, to include a dedicated right turn from A46 south into Leckhampton Lane;
- Moorend Park Road - A46 Shurdington Road northbound approach to Moorend Park Road – additional highway space for right turning traffic by providing a longer stacking lane;
- Badgeworth Lane - A46 / Badgeworth Lane priority Junction – Signalisation of junction to provide improved access to/from Badgeworth.

6.10.6 **Figure 66** illustrates the location of the mitigation measures outlined above.

Figure 66 - Corridor 9 – Location of mitigation measures



6.10.7 **Figure 67** summarises the impacts of the Do Something 7 Strategy.

Figure 67 – Corridor 9 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A46 / A417 Shurdington Rd Rbt | 107.7% | 104.0% | 101.2% | 102.9% |
| A46 / Badgeworth Lane | 120.8% | 102.0% | 93.4% | 99.2% |
| A46 Shurdington Rd / Leckhampton Lane | 87.6% | 76.2% | 99.8% | 100.7% |
| A46 Shurdington / Up Hatherley Way | 93.9% | 70.0% | 72.8% | 68.9% |
| A46 Shurdington Rd / Moorend Park Rd | 97.4% | 91.5% | 79.6% | 88.8% |
| A46 Shurdington Rd / Bath Rd Rbt | 41.0% | 39.5% | 57.3% | 56.9% |
| A46 Bath Rd / Thirlestaine Rd | 95.5% | 77.2% | 84.8% | 78.1% |
| A46 Bath Rd / Sandford Rd | 89.5% | 82.2% | 87.3% | 83.4% |
| A46 Bath Rd /Oriel Road | 53.8% | 43.6% | 35.3% | 31.4% |

6.10.8 The outcome of these changes resolves delays along the Shurdington Road corridor. There remain minor issues during both peaks for the A417 / A46 junction at both A46 approaches. Possible signalisation of these approaches may mitigate the scale of delay predicted by the model.

6.10.9 The improvements will significantly benefit public transport specifically the operation of the 10 service within the A46 corridor by reducing the risk of journey time uncertainty.

6.11 Corridor 10 - A40 / A417 / A38 – Elmbridge Court Rbt to A430 Cole Avenue junction

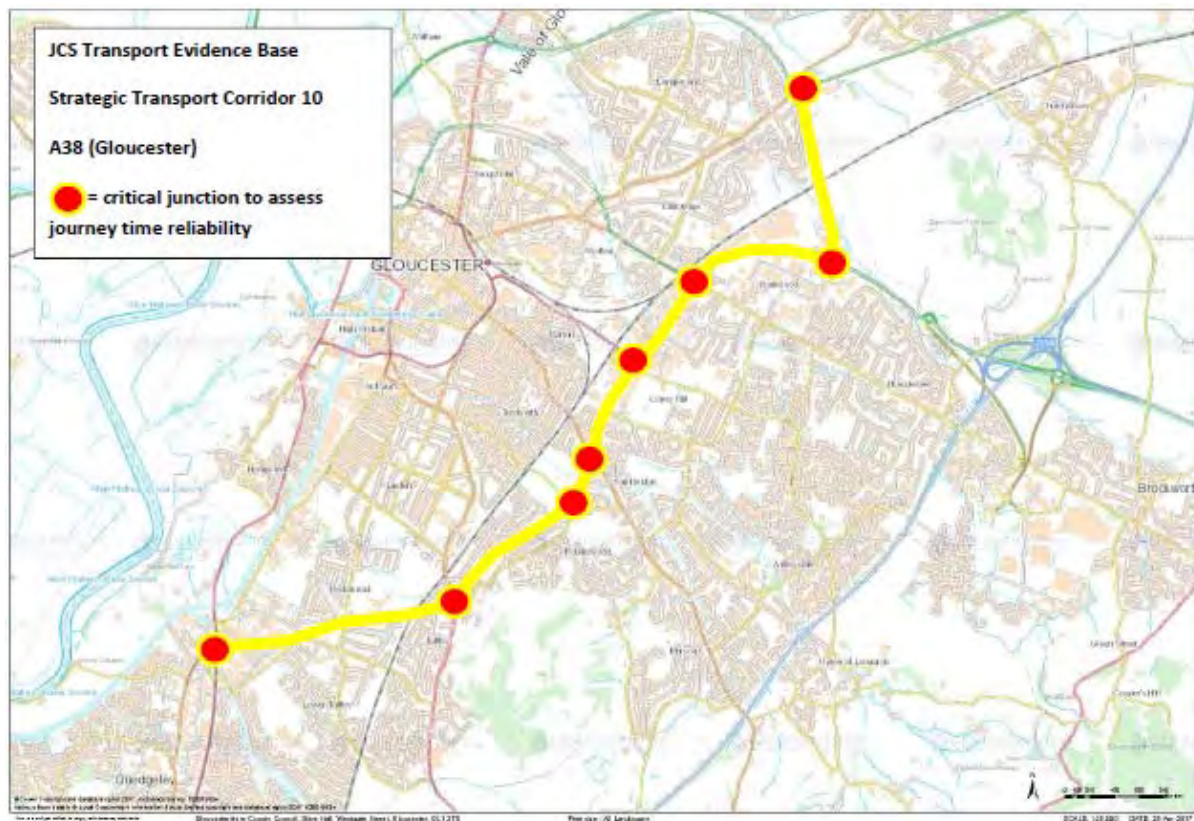
6.11.1 Corridor 10 starts at A38/A430 junction at Cole Avenue it then follows Gloucester’s southern and eastern bypass before linking into the Elmbridge Court Roundabout on the A40 and access to M5 Junction 11. The route records some of the highest non-strategic vehicle flows in the county and forms part of the local highway network. It is managed by Gloucestershire County Council and suffers from heavy peak hour vehicle flows resulting in congestion.

6.11.2 Within Gloucestershire Local Transport Plan’s Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 20,000 to 50,000 vehicles (**Appendix C**). .

6.11.3 **Figure 68** illustrates the location of those junctions considered critical to assess journey time reliability. Eight junctions have been identified and they include:

- A38 / A430 Cole Avenue
- St Barnabas Roundabout
- A38 Finlay Rd / Tredworth Roundabout
- A38 Eastern Ave / B4073 Painswick Roundabout
- A38 Eastern Ave / Metz Way Signals
- A38 Walls Roundabout
- A38 / A417 C&G Roundabout
- A417 / A40 Elmbridge Ct Roundabout

Figure 68 - Corridor 10 – critical junctions



6.11.4 **Figure 69** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Due to the number of interactions with other routes accessing parts of the city there are a number of congestion issues which due to the close proximity of junctions cause wide spread delays due to vehicles backing up from one junction impacting another. On the basis of change from the Do Nothing and the Do Minimum, mitigation will need to be considered for the following junctions:

- A40 / A417 C&G roundabout – demand from Barnett Way (Barnwood Business Park)
- A38 / Walls roundabout – demand northbound from Eastern Avenue;
- A38 / A4173 St. Barnabas roundabout – demand from all approaches;
- A38 / A430 / B4008 –Cole Avenue – demand from Quedgeley.

Figure 69 – Corridor 10 Ratios of Flow to Capacity – DN and DM

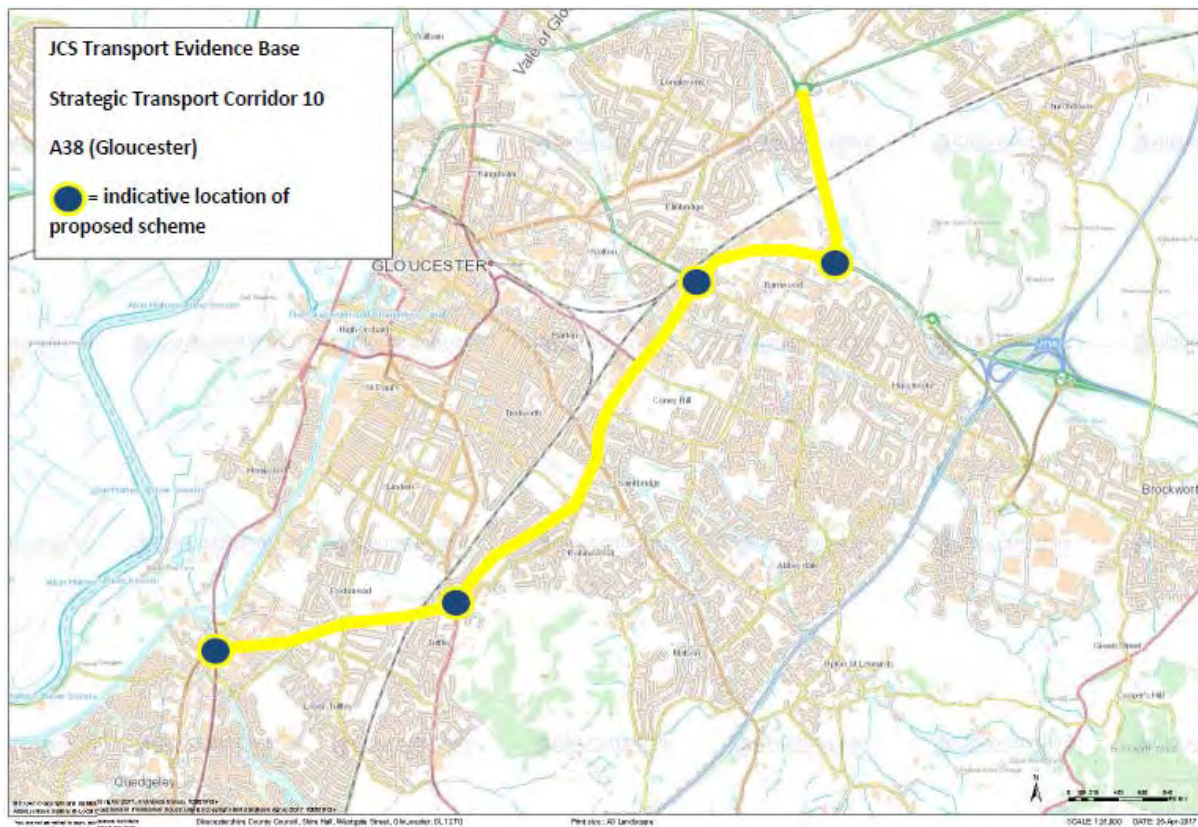
| Junction Name | Ratios of Flow to Capacity | | | |
|---------------------------------------|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| A38 / A430 Cole Avenue | 123.3% | 123.9% | 114.3% | 111.5% |
| St Barnabas Roundabout | 65.1% | 65.3% | 96.0% | 100.3% |
| A38 Finlay Rd / Tredworth Rbt | 88.5% | 103.4% | 92.0% | 94.9% |
| A38 Eastern Ave / B4073 Painswick Rbt | 80.8% | 104.8% | 82.6% | 82.5% |
| A38 Eastern Ave / Metz Way Signals | 96.8% | 102.3% | 102.3% | 103.4% |
| A38 Walls Rbt | 112.8% | 126.3% | 104.8% | 109.3% |
| A38 / A417 C&G Rbt | 83.0% | 97.0% | 109.0% | 110.1% |
| A417 / A40 Elmbridge Ct Rbt | 120.6% | 173.1% | 107.9% | 110.2% |

6.11.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 69** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- A40 / A417 C&G roundabout - A40 / A417 C&G roundabout –provision of a ‘free left turn lane’ from the A40 Barnwood Link approach arm to A417 Barnwood Bypass, and from A417 Corinium Avenue approach arm to A40 Barnwood Link;
- A38 / Walls roundabout - Capacity Improvement on 2014 Pinch Point Scheme, by providing 3 lane circulatory on the roundabout between Barnwood Rd / A38 Eastern Avenue approaches;
- A38 / A4173 St. Barnabas roundabout - Remove roundabout and signalising junction (with removal of Reservoir Rd approach arm);
- A38 / A430 / B4008 Cole Avenue Junction - Grade separation to allow straight through movement of north / south traffic on A38 Southern Connector/A430 corridor.

6.11.6 **Figure 70** illustrates the location of the mitigation measures outlined above.

Figure 70 - Corridor 10 – Location of mitigation measures



6.11.7 **Figure 71** summarises the impacts of the Do Something 7 Strategy.

Figure 71 – Corridor 10 Ratios of Flow to Capacity – DM and DS7

| Junction Name | Ratios of Flow to Capacity | | | |
|---------------------------------------|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| A38 / A430 Cole Avenue | 123.9% | 106.6% | 111.5% | 112.9% |
| St Barnabas Roundabout | 65.3% | 103.7% | 100.3% | 101.6% |
| A38 Finlay Rd / Tredworth Rbt | 103.4% | 98.9% | 94.9% | 101.1% |
| A38 Eastern Ave / B4073 Painswick Rbt | 104.8% | 79.5% | 82.5% | 96.3% |
| A38 Eastern Ave / Metz Way Signals | 102.3% | 88.4% | 103.4% | 101.9% |
| A38 Walls Rbt | 126.3% | 107.9% | 109.3% | 103.7% |
| A38 / A417 C&G Rbt | 97.0% | 88.1% | 110.1% | 103.4% |
| A417 / A40 Elmbridge Ct Rbt | 173.1% | 100.0% | 110.2% | 102.1% |

6.11.8 The outcome of these changes reduces the extent of many of the delays, but the route remains highly trafficked and as a result will be prone to congestion during peak times. There remain issues with St. Barnabas roundabout due to the volume of traffic and the

limited scope for physical infrastructure improvements. Issues also remain at Cole Avenue junction which would be resolved with through more detailed signal redesign.

6.12 Corridor 11 - A40 / A430 / A38 – Over Roundabout to Cross Keys Roundabout

6.12.1 Corridor 11 starts at A38/A430 junction at Cole Avenue. It then follows Gloucester's South West bypass before linking into the Over Roundabout on the A40 and access to the Forest of Dean. The route records high levels of strategic vehicle flows as it provides one of the primary links into the Forest of Dean from the M5 and Gloucester. The corridor forms part of the local highway network and is managed by Gloucestershire County Council. It should be noted that the scheme to widen the South West Bypass at Llanthony Priory was included within the Do Minimum scenario and removal of this pinch point has impacted vehicle flows through the route.

6.12.2 Within Gloucestershire Local Transport Plan's Link and Place Spectrum (**Appendix B**) the route is classified as a primary link critical to the local economy. This section of highway has an average daily vehicle flow of over 20,000 to 50,000 vehicles (**Appendix C**). .

6.12.3 **Figure 72** illustrates the location of those junctions considered critical to assess journey time reliability. Seven junctions have been identified and they include:

- Cross Keys Roundabout
- A38 Waterwells Roundabout
- A38 Kingsway
- A38 / A430 Cole Avenue
- A430 Hempsted Ln / St Ann Way Jct
- A430 Castle Meads Way / A417 Over Causeway Jct
- Over Roundabout

6.12.4 **Figure 73** documents the network performance during the AM and PM peak scenarios in terms of Ratios of Flow to Capacity for each junction. Due to the high levels of vehicles flows there are a number of congestion issues throughout the corridor but these are not directly related to the impacts of JCS growth, with several of the junctions recording Ratios of Flow to Capacity greater than 100% in the 'Do Nothing' scenario. On the basis of change from the Do Nothing and the Do Minimum, mitigation will need to be considered for the following junctions:

- A38 Crosskeys Roundabouts
- A38 / A430 / B4008 – Cole Avenue – demand from Quedgeley
- A430/A417 Castlemeads
- A40 / A417 Over Roundabout -demand from the A417 northern approach (Maisemore)

Figure 72 - Corridor 11 – critical junctions

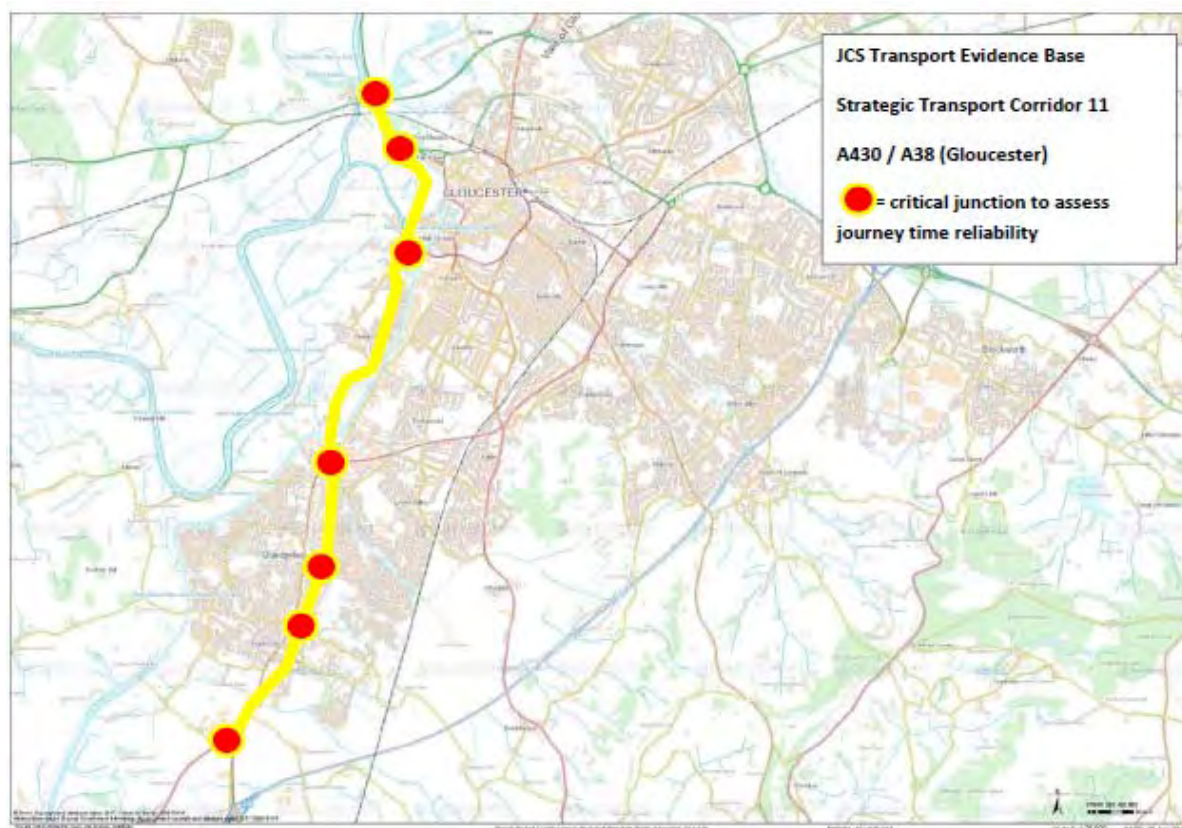


Figure 73 – Corridor 11 Ratios of Flow to Capacity – DN and DM

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|------------|------------|------------|
| | AM Peak | | PM Peak | |
| | Do Nothing | Do Minimum | Do Nothing | Do Minimum |
| Cross Keys Roundabout | 123.3% | 123.3% | 123.3% | 123.3% |
| A38 Waterwells Roundabout | 73.0% | 70.7% | 74.5% | 69.2% |
| A38 Kingsway | 115.8% | 115.0% | 128.2% | 124.6% |
| A38 / A430 Cole Avenue | 123.3% | 123.9% | 114.3% | 111.5% |
| A430 Hempsted Ln / St Ann Way Jct | 110.7% | 106.1% | 101.3% | 87.2% |
| A430 Castle Meads Way / A417 Over Causeway Jct | 109.1% | 108.5% | 130.8% | 127.5% |
| Over Roundabout | 115.3% | 117.0% | 124.6% | 118.6% |

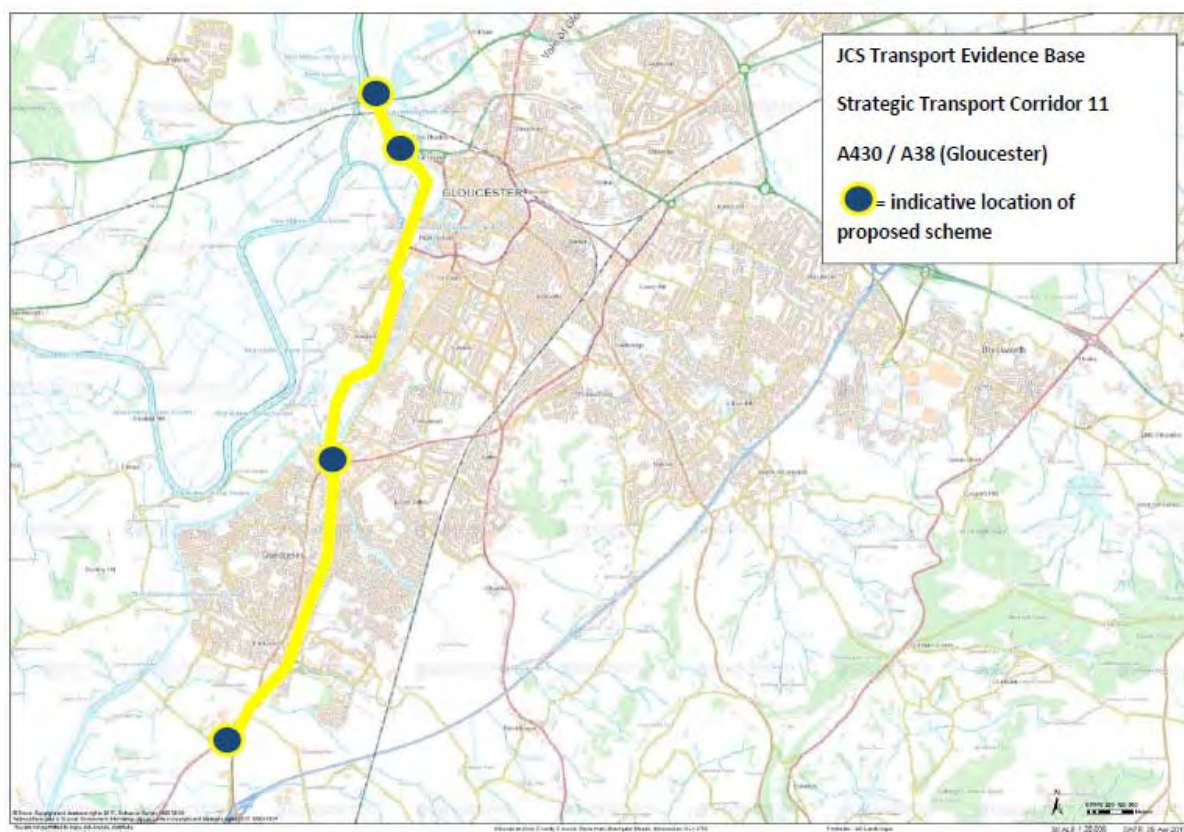
6.12.5 The preferred mitigation package for this corridor (intended to account for the capacity issues identified in **Figure 73** and other trip reassignment resulting from the JCS growth strategy and other network changes which impact travel demand within the corridor) includes:

- A38 / A430 / B4008 Cole Avenue Junction - Grade separation to allow straight through movement of north / south traffic on A38 Southern Connector/A430 corridor;

- A40 Over Roundabout - Add a dedicated left slip from A40 east to the south towards Gloucester;
- A40 / A417 Over Roundabout, A430/A417 Castlemeads, A38 Crosskeys Roundabouts - upgrade signals to MOVA or SCOOT operation to optimise signal timings.

6.12.6 **Figure 74** illustrates the location of the mitigation measures outlined above.

Figure 74 - Corridor 11 – Location of mitigation measures



6.12.7 **Figure 75** summarises the impacts of the Do Something 7 Strategy.

- **Figure 75 – Corridor 11 Ratios of Flow to Capacity – DM and DS7**

| Junction Name | Ratios of Flow to Capacity | | | |
|--|----------------------------|----------------|------------|----------------|
| | AM Peak | | PM Peak | |
| | Do Minimum | Do Something 7 | Do Minimum | Do Something 7 |
| Cross Keys Roundabout | 123.3% | 117.5% | 123.3% | 113.4% |
| A38 Waterwells Roundabout | 70.7% | 69.1% | 69.2% | 71.3% |
| A38 Kingsway | 115.0% | 106.9% | 124.6% | 117.5% |
| A38 / A430 Cole Avenue | 123.9% | 106.6% | 111.5% | 112.9% |
| A430 Hempsted Ln / St Ann Way Jct | 106.1% | 103.7% | 87.2% | 90.0% |
| A430 Castle Meads Way / A417 Over Causeway Jct | 108.5% | 104.2% | 127.5% | 125.7% |
| Over Roundabout | 117.0% | 117.8% | 118.6% | 120.7% |

6.12.8 The outcome of these changes reduces the scale of delays, but it does not remove it from occurring during peak times. The routes remains highly trafficked and as a result will be prone to congestion during peak times. There remain issues with several of the junctions and through further detailed junction modelling and iterative signal plan redesign it is considered probable that increased efficiencies would be achievable within this corridor.