Warwickshire County Council

Strategic Transport Assessment

Cumulative Assessment

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1 Executive Summary

1.1 Overview

Arup have been commissioned by Warwickshire County Council (WCC), Stratford-on-Avon District Council (SDC) and Warwick District Council (WDC) to undertake additional cumulative analysis of the proposed Warwick District and Stratford District Core Strategy (CS) allocations. This report builds upon the evidence presented within the recently completed Warwick STA Phase 4 Assessment report[1] and the Stratford STA Options Analysis Report[2].

The objective of this study is to assess the cumulative impacts of allocating both WDC and SDC Core Strategies, alongside the proposed mitigation measures, within the Warwick and Leamington transport network.

The impact analysis that is presented within this report is intended to inform an assessment on the traffic impacts of the two SDC CS options alongside the proposed mitigation measures against both the WLWA Reference and WLWA RDA network conditions.

At this stage, the level of assessment does not include detailed information and analysis of each of the proposed schemes in detail, nor does it comprehensively identify the full scope of the impacts and benefits that occur as a result of the proposed allocation strategies. Rather it is intended to confirm what strategic elements of infrastructure are likely to be required to ensure that the allocated growth can be accommodated upon the existing network.

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

It should also be recognised that the purpose of this assessment is to determine an appropriate mitigation strategy necessary to accommodate all of the growth that is envisaged to occur across the duration of the plan period. Thus the mitigation proposed through this work reflects that which will be anticipated across the entire 2011 to 2029/2031 plan period.

1.1.1 SDC Scenario Overview

An overview of the SDC options to be incorporated within the cumulative assessment is as follows:

- SDC CS Option 2 - assumes the delivery of 3,000 dwellings and 100 Ha of employment in an area of land between the M40 and the B4100

[1] 232815-53.R001 Warwick STA - Phase 4 Assessment, Arup, April 2014
[2] 232815-55.R001 Stratford-on-Avon STA – Options Assessment Report, Arup, April 2014

near Gaydon/Lighthorne Heath. It is assumed that 2,500 dwellings will be delivered by the end of the plan period.

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

It should be noted that, although both sites assume delivery of 2,500 residential units within the plan period, the assessments have been undertaken with consideration to the full potential site build out. This means Option 2 (Gaydon/Lighthorne Heath) assumes 3,000 dwellings whilst Option 5 (Southam and Stoneythorpe) assumes 2,800 dwellings.

1.2 Mitigation

In addition to the mitigation measures identified through the assessment of the WDC RDA strategy, the following mitigation measures have been identified to accompany the proposed SDC CS Options:

Option 2 Gaydon/Lighthorne Heath Mitigation

A full summary of the entire mitigation strategy identified, thus far, as being necessary to accommodate the level of demand created by the proposals for the Gaydon/Lighthorne Heath area is provided within the SDC STA Options Assessment Report. The mitigation measures, proposed through the initial development assessment, that are proposed for delivery within the study area are outlined as follows:

- M40 Capacity Enhancements
- M40 J13 NB Off-slip
- Fosse Way/Harbury Lane
- Fosse Way/Southam Road Roundabout
- Banbury Rd/Europa Way ‘Greys Mallory’ Roundabout

Option 5 SS Mitigation Measures

As with the Option 2 G/LH mitigation measures, a full summary of the entire mitigation strategy identified, thus far, as being necessary to accommodate the level of demand created by the proposals for the Southam and Stoneythorpe areas is provided within the SDC STA Options Assessment Report. The only mitigation measure identified for inclusion within the WLWA study area involved substantial amendments to the Southam Road/Fosse Way roundabout. The proposals for this junction include the introduction of extended 2 lane approach flares on most approaches, widening of the circulating carriageway and the introduction of two lane extended exit flares.

WDC RDA Mitigation measures

The individual option assessment pertaining to the Option 2 G/LH proposals identified that the potential impacts associated with the site would benefit from

the implementation of the following schemes already identified through the WDC STA process:

- Dualling of the A452 between M40 J14 to the Shires Retail Park junction
- Extended two lane entry and exit flares at the Banbury Road/Gallows Hill junction.
- Introduction of a new roundabout to serve Warwick Technology Park, currently this is assumed to be delivered at the location of the Western entrance to enable an extended two lane EB section of Gallows Hill to be delivered between the existing Banbury Road/Gallows Hill junction and the new roundabout.
- Proposed signalisation of the Myton Road/Banbury Road junction.

1.3 Methodology

The assessment was completed through the following steps:

- The M40 scenarios models, inclusive of mitigation measures, were interrogated to provide information on the likely vehicle numbers which would be generated by the respective options and enter into the WLWA study area.
- A model screen line was defined to identify the point where trips left the M40 model area and entered into the WLWA area. The screen line was defined to run parallel to the Fosse Way, to the East, and vehicles crossing this screen line were enumerated and the numbers allocated into the WLWA model via the various loading points.
- Any newly proposed mitigation measures, identified within the SDC STA work, which were required within the area encompassed by the WLWA model, were included within the WLWA model. These schemes were included in addition to the WLWA proposed CS mitigation measures.
- The models were run and strategic level outputs were assessed to provide an overview of the potential implications of each option.

1.4 Conclusion

The initial comparisons between the 2028 Reference Case and the 2031 SDC scenarios reveal the following conclusions:

- Inclusion of the SDC strategy demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategies.
- Analysis of the network statistics reveals that whilst relatively similar levels of delay and speed are expected during the AM peak period for the SDC scenarios, Option 2 results in improved conditions during the PM peak period compared to the 2028 WLWA RDA network performance.
- The location of the Gaydon/Lighthorne Heath development, near the M40 J12, is such that additional capacity along the M40 has been included within the localised modelling assessment, transferring this

additional capacity, alongside the inclusion of capacity enhancements to the northwest of M40 J15, within the WLWA model area is likely to contribute to the mitigation of the impacts associated with the demands generated by the Gaydon/Lighthorne Heath development.

- The queuing analysis revealed a number of instances where the level of queuing experienced at key locations increases in both Cumulative Assessment Options when compared to both the 2028 Reference Case and the 2028 WLWA RDA scenario networks.
- Within the AM queuing levels tend to increase in areas to the east and south of the model area in both 2031 WLWA CA SDC options. There are impacts observed along the A452 and Tachbrook Road corridors as well as around M40 J15. Within the PM there is a general worsening of queuing levels to the south and east of the model area as the additional demands associated with the two SDC options are assigned to the model network.
- The analysis of the difference in journey times across the three scenarios, when compared to the reference case, reveals that the majority of journey time increases are consistent across all three scenarios. The 2031 WLWA CA SDC Op 2 scenario demonstrates a greater level of journey time increases to the south east of the model area when compared to either the 2028 WLWA RDA or 2031 WLWA CA SDC Op 5 journey times.
- Overall the queuing and journey time analysis indicates that further attention should be afforded to the performance of the junctions along the A452 and Tachbrook Road corridors as well as the Fosse Way within both 2031 WLWA CA SDC scenarios.

1.5 Further Considerations and Recommendations

Mitigation Scheme Proposals

The assessment of the proposed mitigation measures associated with the delivery of the SDC Options has, at this stage, only been undertaken at a high level. The modelling analysis appears to indicate that that further attention should be afforded to the performance of the junctions along the A452 and Tachbrook Road corridors as well as the Fosse Way within both 2031 WLWA CA SDC scenarios.

Recommendations

The following outlines a series of recommendations that should be considered during any additional stages of the Strategic Transport Assessment.

- Once a Preferred Option for allocation has been identified by SDC, a further review of the assumptions that have been used within the modelling should be undertaken and, in particular, the following elements should be reviewed:
    - Trip rates and distribution assumptions
    - Trip profiling, particular with regards the delivery of the employment element of the G/LH site.
- More detailed work is undertaken on sustainable transport requirements and the assumptions on mode share and mode shift are based on the outcome of these studies. Once the preferred allocation

strategy has been identified, a sensitivity test should be undertaken to determine the importance of achieving the targets for mode share/shift and internalisation and to establish areas where further mitigation may be required should the targets, associated with the proposed sites not be realised.

- As more certainty emerges on the provision of Education facilities alongside the allocation strategy, further testing should be undertaken which includes more detailed assumptions regarding the access strategy including any additional pedestrian facilities, trip generation and the distribution thereof.
- Testing of a phased approach to the implementation of the mitigation strategy should be undertaken to determine which schemes are likely to be required at an early stage of the plan period and, conversely, which can be delivered towards the end of the plan period.

2 Introduction

2.1 Scope

Arup have been commissioned by Warwickshire County Council (WCC), Stratford-on-Avon District Council (SDC) and Warwick District Council (WDC) to undertake additional cumulative analysis of the proposed Warwick District and Stratford District Core Strategy (CS) allocations. This report builds upon the evidence presented within the recently completed Warwick STA Phase 4 Assessment report[3] and the Stratford STA Options Analysis Report[4].

2.2 Study Objectives

The objective of this study is to assess the cumulative impacts of allocating both WDC and SDC Core Strategies, alongside the proposed mitigation measures, within the Warwick and Leamington transport network.

2.3 Background

This work builds upon two previously completed studies which have looked at the implications of the Stratford-on-Avon options for Core Strategy allocation and the Warwick Core Strategy allocations in isolation. An overview of these two assessments is provided as follows:

WDC STA Phase 4

The fourth phase of the WDC STA sought to ascertain the potential impacts of assigning a revised allocation strategy, referred to as the Revised Development Approach (RDA) within the areas of Warwick, Leamington, Kenilworth and Stoneleigh areas within Warwick District. This assessment was undertaken using the existing Warwick and Leamington Wide Area (WLWA) and Kenilworth and Stoneleigh Wide Area (KSWA) PARAMICS models.

The work undertook to refine and revise the proposed mitigation measures in response to the RDA and document the impacts thereof. Within the accompanying report a mitigation strategy has been identified which serves to accommodate the additional demands associated with the RDA.

SDC STA Options Assessment Report

The most recent phase of the SDC STA was undertaken to assess the potential impacts of five different options for the allocation of housing and employment across Stratford-on-Avon District. The options tested within this process were identified as follows:

- Option 1 – Dispersed Development
- Option 2 – Development at Gaydon/Lighthorne Heath
- Option 3 – Development at Long Marston Airfield
- Option 4 – Development in South East Stratford-upon-Avon
- Option 5 – Development at Southam and Stoneythorpe

[3] 232815-53.R001 Warwick STA - Phase 4 Assessment, Arup, April 2014
[4] 232815-55.R001 Stratford-on-Avon STA – Options Assessment Report, Arup, April 2014

Testing was undertaken using both the Stratford-upon-Avon PARAMICS model and the recently extended M40 PARAMICS model. The developments were tested in either the Stratford-upon-Avon PARAMICS model or the M40 model subject to their proposed location.

It recommended that this report is read in conjunction with the aforementioned studies.

2.4 Study Area

The purpose of this work is to understand the implications of the cumulative impacts of delivering both SDC and WDC Local plans in conjunction as well as identifying any additional changes that may be required to the mitigation measures that have been proposed to accompany either of the Districts respective CS allocations.

The location of the site options within the SDC CS recent allocation assessment are such that it is not considered that the cumulative impacts of Options 1, 3 and 4 are likely to be of a sufficient magnitude to merit further, more detailed analysis.

Options 2 and 5 involve the allocation of strategic housing sites in areas which are most likely to generate a number of trips which will interact with the Warwick and Leamington areas. Considering all of the Options it was not felt that any would be likely to impact significantly on the area outlined within the KSWA model.

Similarly, the impact on the Stratford-upon-Avon road network, incurred through the allocation of the WDC RDA sites was not anticipated to be significant. In both cases it was felt that the methodology for applying growth factors to the external movements across the study area, along with the allocation of specific Committed and Allocated demands was sufficiently robust to conclude that the additional demands likely to occur through the WDC RDA or SDC CS allocated sites did not merit further testing within the KSWA or Stratford-upon-Avon PARAMICS models.

As a result, the focus of this study was on the extent defined within the WLWA model. Additional information was also extracted from the M40 PARAMICS model to identify the level of development demand interaction across the two study areas.

The area of Coverage of the WLWA and extended M40 models has been outlined within the following **Figure 1** and **Figure 2** respectively.

2.5 Methodology

As has been mentioned previously, this assessment builds upon the previous analysis work undertaken to assess the impacts of the WDC and SDC local plan allocations in isolation.

The assessment focussed largely on the area outlined within the WLWA model and specifically the interaction between the sites allocated through the SDC allocation Options 2 and 5 as these sites were perceived as being likely to exert a greater level of impact on the WLWA road transport network than options 1, 3 and 4.

Figure 1 - Warwick and Leamington Model Coverage

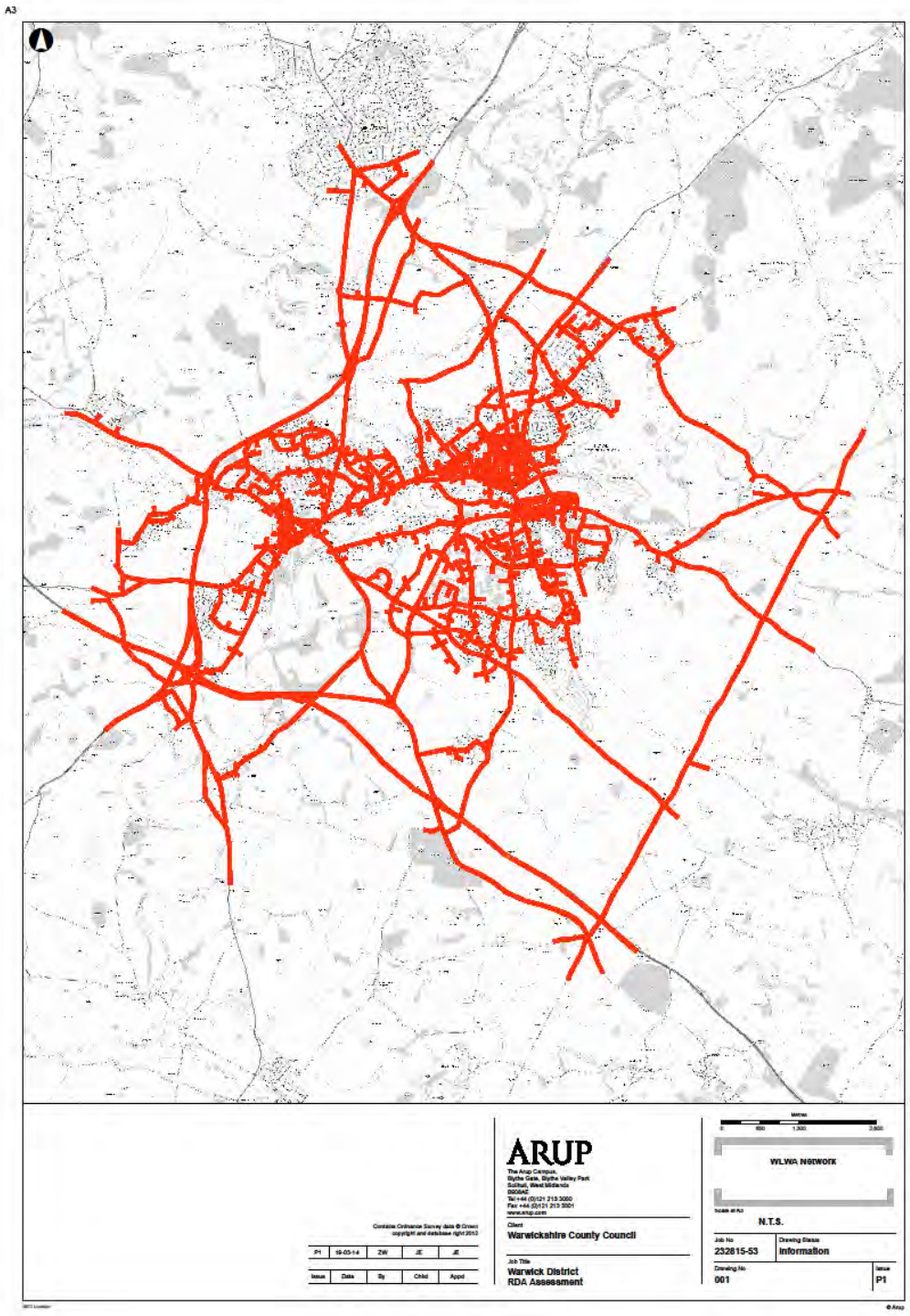
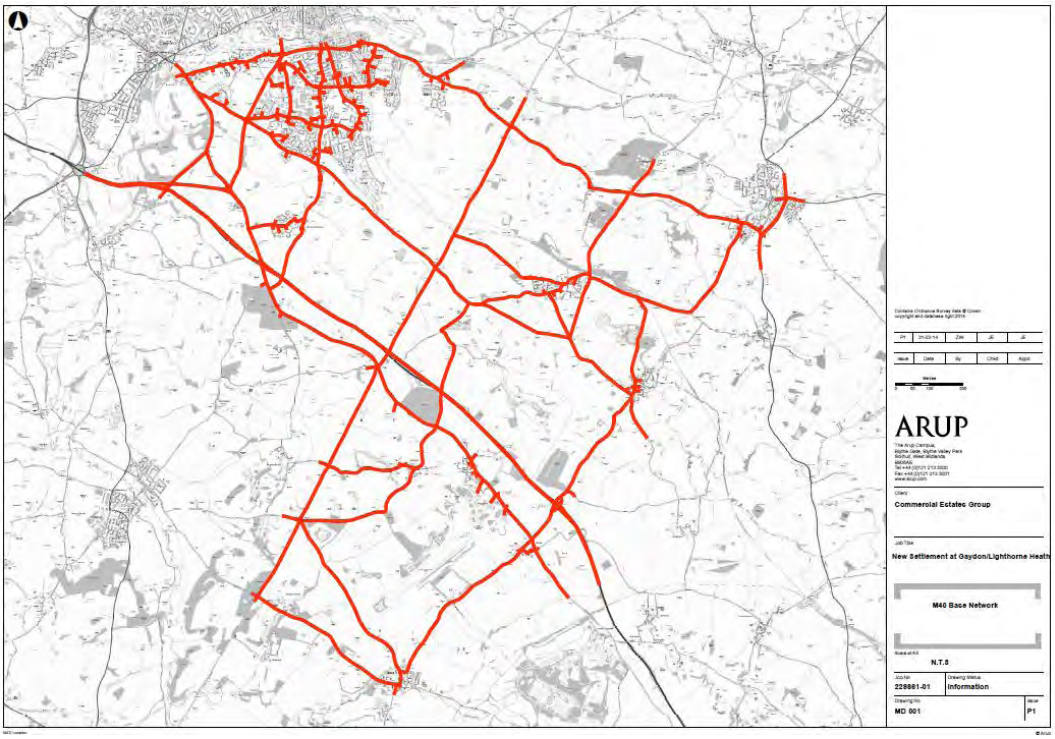


Figure 2 –Extended M40 PARAMICS model Coverage



The assessment was completed through the following steps:

- The M40 scenarios models, inclusive of mitigation measures, were interrogated to provide information on the likely vehicle numbers which would be generated by the respective options and enter into the WLWA study area.
- A model screen line was defined to identify the point where trips left the M40 model area and entered into the WLWA area. The screen line was defined to run parallel to the Fosse Way, to the east, and vehicles crossing this screen line where enumerated and the numbers allocated into the WLWA model via the various loading points.
- Any newly proposed mitigation measures, identified within the SDC STA work, which were required within the area encompassed by the WLWA model, were included within the WLWA model. These schemes were included in addition to the WLWA proposed CS mitigation measures.
- The models were run and strategic level outputs were assessed to provide an overview of the potential implications of each option.

2.6 Report Structure

The remainder of this report is set out as follows:

- **Section 3** – Outlines the development of the respective model scenarios
- **Section 4** – Presents an overview of the mitigation assumptions and amendments thereto.
- **Section 5** – Describes the measures used to inform the assessment and analysis of impacts.

- **Section 6** – Presents the outcome of the testing completed within the WLWA model.
- **Section 7** – Outlines the Summary and Conclusions
- **Section 8** – Details a series of recommendations and considerations for any future stages of the assessment.

3 Scenario Development

3.1 Overview

Prior to the commencement of the assessment it is important to ascertain that the Reference Case that has been adopted to inform the assessment is appropriate and fit for purpose.

The term Reference Case refers to the scenario against which all other scenarios are compared. In assessing the implications of any development allocation strategy it is important to ensure all variables are kept to a minimum, thus the Reference Case is used to identify the likely network conditions prior to the application of any of the core strategy assumptions.

In this case the differences between scenarios should relate specifically to the development strategy (i.e. growth & mitigation thereof), other considerations, such as committed developments and network interventions, should be consistent throughout the assessment.

3.2 WLWA 2028 Reference Case

WCC have already developed a PARAMICS model Warwick and Leamington area which was considered to be reflective of likely 2028 conditions. This model was adopted during the previous Phase 4 STA work and it was not considered necessary to amend this model for the purposes of this assessment.

3.3 WLWA + RDA Scenario

Full details of the scenario development process adopted to create the 2028/29 WLWA + RDA model scenario are available within the associated WDC Phase 4 STA Report.

The growth levels represented by the allocation of the aforementioned RDA demands, within the WLWA model are documented within the following

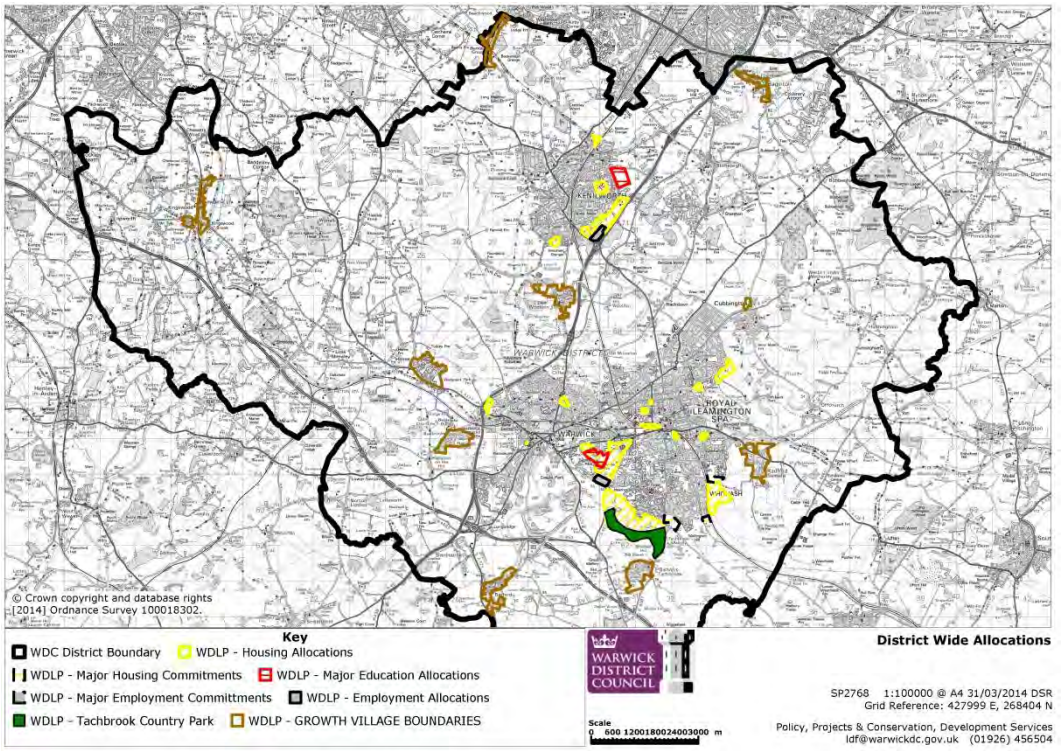
The resultant Hourly demands assigned within the two key modelling scenarios are summarised within the following **Table 1**:

Table 1 – WDC RDA Scenario Demand Summary

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 RDA + SDC Op2 Demands	44645	50662	39078	50391	50328	45119
Growth from Ref Case	5.61%			6.71%		

The site locations included within the WLWA RDA assessment are illustrated within the following **Figure 3**.

Figure 3 - WDC RDA Site Locations



3.4 WLWA + SDC CS Scenario Development

As has been mentioned previously, it was intended that the Cumulative Assessment would focus on assessing the combined impacts of the SDC CS Options 2 and 5 alongside the WDC RDA allocations.

3.4.1 SDC Scenario Overview

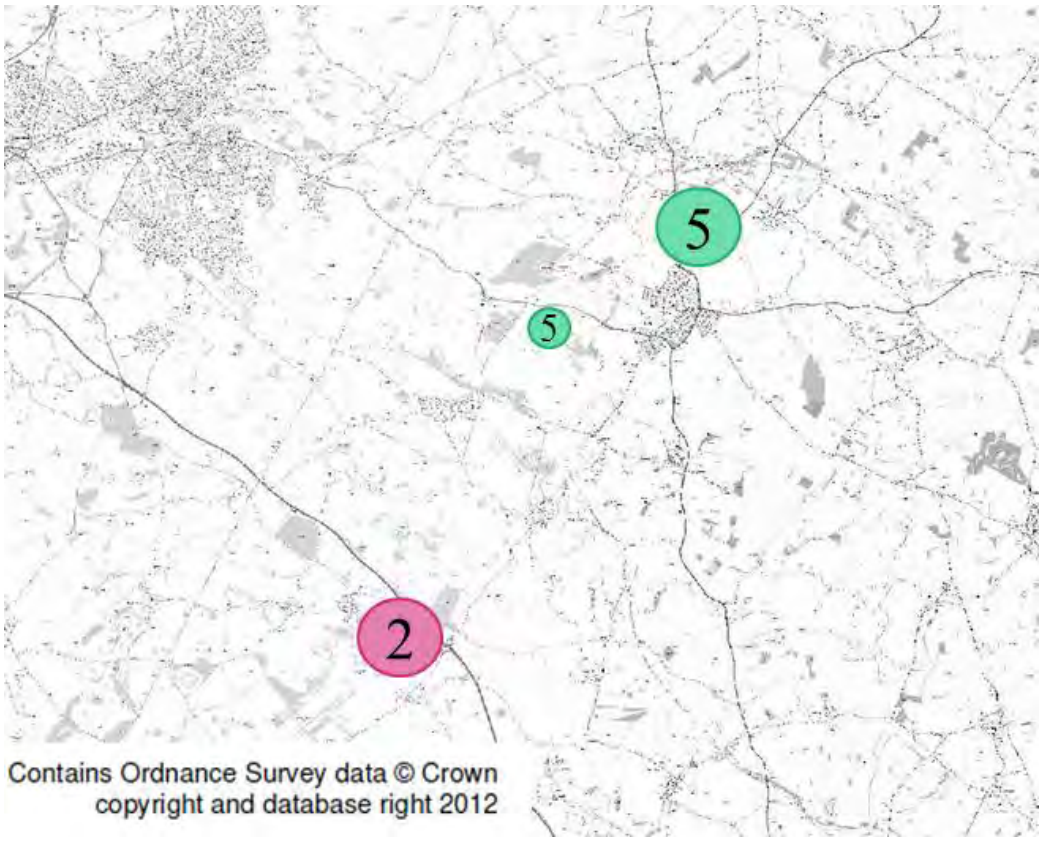
An overview of the SDC options to be incorporated within the cumulative assessment is as follows:

- SDC CS Option 2 - assumes the delivery of 3,000 dwellings and 100 Ha of employment in an area of land between the M40 and the B4100 near Gaydon/Lighthorne Heath. It is assumed that 2,500 dwellings will be delivered by the end of the plan period.
- SDC Option 5 - assumes the delivery of 2,800 dwellings across 2 separate sites. It has been anticipated that 800 dwellings will be delivered within the Stoneythorpe area whilst 2,000 dwellings will be delivered in an area to the North of Southam. The assumption is that 2,500 dwellings would be delivered within the 2031 plan period.

It should be noted that, although both sites assume delivery of 2,500 residential units within the plan period, the assessments have been undertaken with consideration to the full potential site build out. This means Option 2 (Gaydon/Lighthorne Heath) assumes 3,000 dwellings whilst Option 5 (Southam and Stoneythorpe) assumes 2,800 dwellings.

An overview of the SDC site locations considered within the testing is provided within **Figure 4**.

Figure 4 - SDC Option 2 & 5 Site Locations



3.4.2 Demand Forecasting

In order that the WLWA RDA model could be amended to include the trips associated with the two SDC sites it was first necessary to identify the level of trips, generated by each development option, that were likely to enter into the WLWA model.

The first stage of this process involved the definition of a model screen-line which ran north to south along the eastern extent of the Fosse Way. Adopting this approach enabled links within the M40 model to be assigned to external zones within the WLWA model network. The screen line used in the assessment has been illustrated within the following **Figure 5**.

Once the screen line was defined, each of the links along the screen line, within the M40 model, was assigned to WLWA external zones. The purpose of this is to define the origin and destination points for the demands associated with the allocated sites as well as the volumes.

The link locations and corresponding zones are highlighted within the following **Table 2** and **Figure 6**

Figure 5 – M40 to WLWA Screen-line

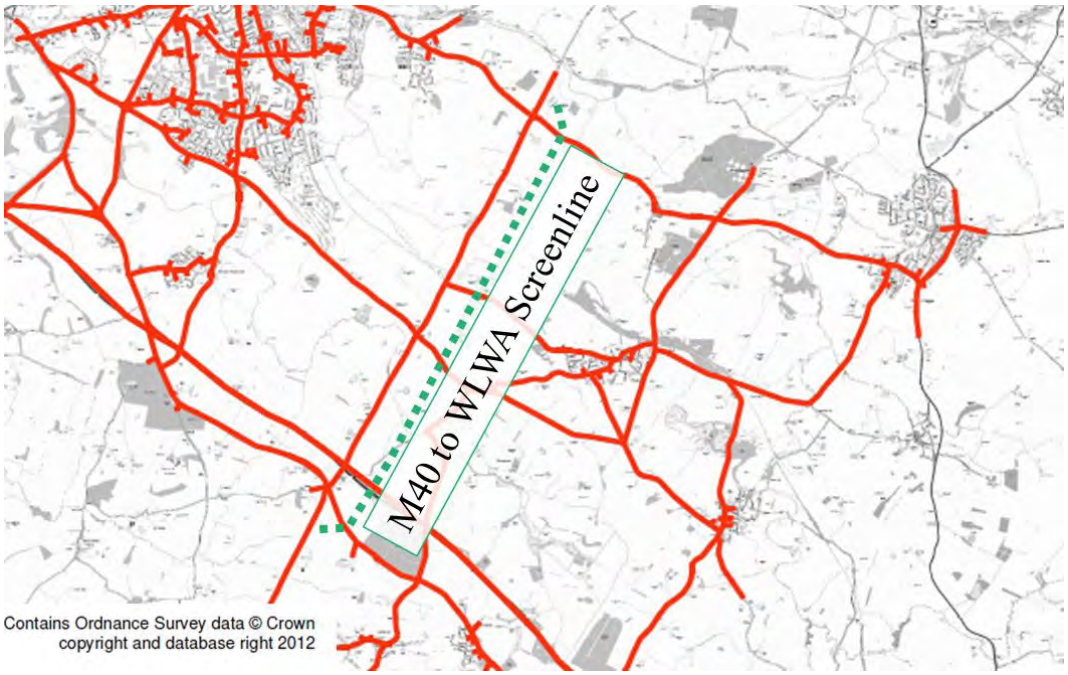
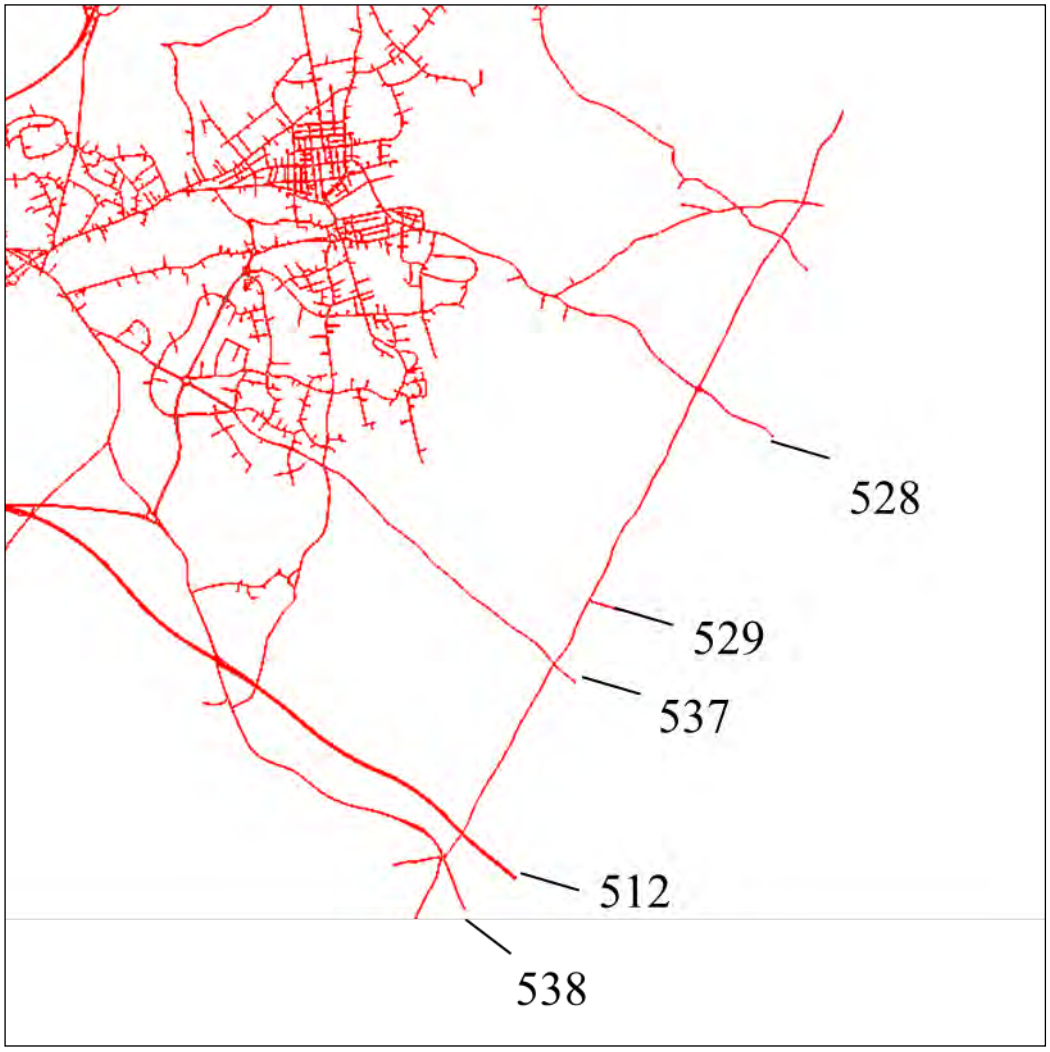


Table 2- M40 Links to WLWA Zones

WLWA Zone	Road	Direction		M40 Link
538	B4100	Into WLWA	From Dev.	189:188
		Out WLWA	To Dev.	188:189
512	M40	Into WLWA	From Dev.	121:122
		Out WLWA	To Dev.	107:108
537	Chesterton Rd	Into WLWA	From Dev.	487:486
		Out WLWA	To Dev.	486:487
529	Middle Road	Into WLWA	From Dev.	874:875
		Out WLWA	To Dev.	875:874
528	Southam Road	Into WLWA	From Dev.	848:849
		Out WLWA	To Dev.	849:848

Figure 6 - WLWA External Zone Locations



This information was used to calculate hourly development specific WLWA trip generation figures for both SDC Option 2 and Options 5. The outcome of these calculations is presented for Option 2 and Option 5 within the following **Table 3** and **Table 4** respectively.

Table 3 - Option 2 G/LH Hourly Demand Totals

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
From Dev.	578	910	556	1200	1391	383
To Dev.	1063	672	532	520	725	579
Total	**1641**	**1581**	**1088**	**1721**	**2115**	**962**
% of Total Dev. Demand	63.26%	73.65%	82.33%	57.07%	74.64%	84.39%

Table 4 - Option 5 SS Hourly Demand Totals

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
From Dev.	415	638	469	218	261	237
To Dev.	123	190	213	345	496	472
Total	**538**	**829**	**681**	**563**	**757**	**709**
% of Total Dev. Demand	42.48%	46.04%	60.57%	43.81%	46.49%	56.28%

Analysis of the information presented within the previous tables reveals that between 60 to 80% of the total trip generation associated with the sites contained within the two options is likely to enter into the WLWA model area. It should be noted that a large number of these trips load on to the M40 motorway and travel through the study area either along the M40 or along the A46 via the M40. Therefore not all of the trips identified within the above table are bound for the Warwick and Leamington towns.

In order that these demands could be assigned within the WLWA, the WDC and SDC CS demands were combined into a single matrix level and the redistribution analysis undertaken in line with previous stages of the WDC CS assessment. This is particularly pertinent when considering the limitations, identified within the previous SDC STA report, associated with the forecasting of the demands associated with Option 2 G/LH. These have been summarised as follows:

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

By treating the SDC demands in a consistent manner to the approach to dealing with the WDC RDA demands some of the issues identified above will be minimised.

It is recommended that these assumptions are revisited during any detailed assessment pertaining to the delivery of any of the sites identified within Option 2 or 5. However, given the strategic nature of the testing to date the current approach, involving the amalgamation of all CS demands within a single model O-D assignment matrix was considered appropriate.

3.5 CS Redistribution and Peak Spreading

Because of the limitations associated with the demand development that have been outlined above it was decided that the SDC CS demands would be subject to the same redistribution and peak spreading processes as have been applied to the WDC RDA demands. An overview of the principle behind this methodology and the approach adopted is provided as follows:

3.5.1 Guidance

Latest guidance on forecasting within transport models indicates that growth rates should be corrected to avoid double counting and that this 'correction' should be based on a view as to the plausible overall likely growth within an area, informed by TEMPRO, rather than whether a development, or set of developments, is interpreted as being 'additional'.

The purpose of this approach is to minimise the potential for over estimation of forecasts which could, in turn, lead to over-engineered solutions to problems that may not necessarily be realistic. Furthermore, if growth within the scenario models is allowed to remain too high there is a chance that one or more scenarios may be discounted on the basis that the demand impacts cannot be satisfactorily accommodated on the network irrespective of the proposed mitigation measures.

The relevant extracts from the WebTAG guidance (3.15.2) are outlined as follows:

> ***"Where a particular development proposal is likely to have a significant impact on demand for transport on one of the roads or rail services where transport measures are being considered, this should be allowed for by explicit modelling of trips associated with that development. Methods adopted for doing this need where possible to be consistent with those set out in the Transport Assessment for the development. It is important to ensure that modal split assumptions are realistic in the context of current planning policy guidance. The growth factors applied to non-development trips may then have to be adjusted downwards, to avoid double-counting of trips within the model."***
>
> ***"Similarly, the correction of growth rates to avoid double-counting should be informed by a view as to the plausible overall population, household or employment growth in the zone, not by a local argument as to whether or not the development can be seen as "additional" in terms of the derivation of the TEMPRO figures."***

It is recommended that a sensitivity test be undertaken during the next stage of testing whereby unadjusted growth is assigned to the model network in order to identify further areas that may require additional mitigation. Such schemes would be difficult to secure in the short term as the growth levels required to trigger the need for these schemes is hard to justify. The purpose of any sensitivity test would be to provide an indication of any further mitigation that may be required over and above that which can be attributed, and delivered, by the respective CS growth options.

The need to apply a capping procedure is further demonstrated by the fact that, during the initial modelling exercise, it was not possible to undertake an assessment of the impacts of each option within the PM model period on account of the inherent model instability. By applying a cap the impacts of model instability are minimised.

3.5.2 Redistribution Methodology

Previously, the application of the cap to the levels of growth within the model was based on NTEM Adjusted TEMPRO factor for Warwickshire County. The AM

and PM NTEM adjusted factors for the 2011 to 2028 forecast period were 19.19% and 19.92% respectively.

However, since the SDC plan period is understood to run until 2031, it was considered appropriate that the NTEM adjusted TEMPRO factors that have been used to inform the redistribution process were amended to reflect the 2011 to 2031 forecast levels. The AM and PM NTEM adjusted factors for the 2011 to 2031 forecast period were identified as **23.4%** and **24.4%** for the AM and PM respectively.

The methodology for applying the capping procedure was as follows:

- Education and HGV trips were excluded from the capping calculations as these trips are less likely to be prone to redistribution effects, nor will they be subject to peak spreading. On that basis, the Education and HGV growth within the model is unconstrained and, thus, subject to larger growth forecasts than the remaining trip types.
- External growth was retained at the original WDC RDA forecast levels, since the SDC Options generate external trips as well as internal trips, no further forecasting of the external trip generation figures was deemed necessary at this stage. This was partially informed by the need to reduce the number of variables between the WDC RDA and the WDC RDC + SDC CS scenarios, applying varying levels of growth between the two scenarios would lead to the introduction of an unnecessary variable.
- The level of internal demand within the 2011 model, less education and HGV, was calculated.
- The level of internal demand likely to be assigned as a result of the interrogation of the TEMPRO database was calculated.
- The resultant level of demand assigned to the model as a result of the RDA + SDC sites was calculated.
- If the level of demand assigned within the model as a result of the RDA + SDC sites was in excess of the TEMPRO predicted level then the net difference is assumed to be the volume of trips that redistribute as a result of the inclusion of the CS developments.
- The redistribution of trips in response to the inclusion of the RDA + SDC developments was calculated by subtracting the growth levels forecast within the RDA + SDC matrices from the TEMPRO/NTEM predicted forecasts and the applying the aforementioned reduction proportionally across the background matrices. This was done by comparing the demand within the revised allocation matrices to the background matrices. This process meant that the reduction in trips was targeted to those zones which had the highest level of interaction with revised allocation sites.
- The reduction was calculated firstly by O-D (Origin – Destination) movements, secondly by O-D totals and finally proportionally across the entire matrix. The purpose of this approach is to ensure that the reductions that are applied are as focussed as possible. Simply reducing the entire matrix, proportionally, by the required level would result in a reduction in background trips in areas where there is little or no interaction with RDA or SDC CS sites.

Redistributing trips means that background trips are diverted based on the level of interaction between existing zones and sites within the RDA or SDC CS allocations. This means that zones which had a high level of trip interaction with RDA and SDC CS zones were likely to experience greater reductions in the background traffic generation totals than those with limited or no interaction with RDA and SDC CS zones. This limits the potential for reductions in background trips to materialise in areas where there is little or no interaction with RDA or SDC CS sites.

The impact of the redistribution procedure is outlined for both RDA plus SDC Option 2 G/LH and SDC Option 5 SS within **Table 5** and **Table 6**.

Table 5- TEMPRO Capping Overview RDA + SDC Op 2 G/LH

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
Base Model Demand (excluding HGV & Education)	32174	38778	29127	38790	44134	32609
Periodic	100078			115532		
2028 Reference Demands (Less HGV& Education & External Growth)	38731	39905	33468	43222	46833	39306
Periodic	112104			129360		
2009 to 2028 Ref	***12.02%***			***11.97%***		
RDA Demands:	4422	5789	3524	4959	6204	4009
2028 + RDA + Op 2	42306	45695	36539	48140	53023	43231
Periodic	124539			144394		
2009 to 2028 + RDA + SDC Op 2	***24.44%***			***24.98%***		
TEMPRO NTEM Target	123538	23.44%		143696	24.38%	
Reduction	-1001			-698		
Proportion of CD Demand	-322	-422	-257	-228	-285	-184
RDA + SDC Op 2 Revised Demand Totals	41983	45273	36282	47912	52738	43047
Periodic	123538			143696		
2009 to 2031 + RDA + SDC Op 2 Adjusted	***23.44%***			***24.38%***		
Total Demand (Including HGV & Growth)	44303	54717	39665	51413	54783	44807
Periodic	138684			151003		
Net Growth	**21.70%**			**23.60%**		

Table 6- TEMPRO Capping Overview RDA + SDC Op 5 S&S

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
Base Model Demand (excluding HGV & Education)	32174	38778	29127	38790	44134	32609
Periodic	100078			115532		
2028 Reference Demands (Less HGV& Education & External Growth)	38731	39905	33468	43222	46833	39306
Periodic	112104			129360		
2009 to 2028 Ref	***12.02%***			***11.97%***		
RDA Demands:	3323	5040	3120	3805	4851	3759
2028 + RDA + Op 5	41207	44946	36135	46986	51670	42982
Periodic	122288			141638		
2009 to 2028 + RDA + SDC Op 5	***22.19%***			***22.60%***		
TEMPRO NTEM Target	123538	23.44%		143696	24.38%	
Reduction	1251			2059		
Proportion of CD Demand	0	0	0	0	0	0
RDA + SDC Op 5 Revised Demand Totals	41207	44946	36135	46986	51670	42982
Periodic	122288			141638		
2009 to 2031 + RDA + SDC Op 5 Adjusted	***22.19%***			***22.60%***		
Total Demand (Including HGV & Growth)	43526	54390	39518	50488	53715	44743
Periodic	137434			148945		
Net Growth	**20.61%**			**21.91%**		

Analysis of the previous tables reveals that the need for redistribution, based on NTEM adjusted TEMPRO growth forecasts, was not triggered through the assignment of the SDC Option 5 SS demands, only the Option 2 G/LH internal growth levels exceeded the NTEM adjusted TEMPRO forecasts.

Furthermore, the previous tables also demonstrate that the growth levels forecast through the assignment of the demands associated with the Option 2 G/LH allocated site is between 1 and 1.75% higher, overall, than the growth levels forecast through the assignment of the SDC Option 5 SS demands via the same methodology.

3.6 Peak Spreading Methodology

As with earlier stages of the STA, peak spreading assumptions were applied after the redistribution since redistribution deals with demand across the entire period whilst peak spreading deals with hourly changes.

Once the revised CS demand totals had been derived peak spreading assumptions were applied. Since peak spreading assumptions had already been applied to the 2028 Reference Demands[5] then the application of further peak spreading

[5] Warwick District Council Strategic Transport Assessment Modelling, - PARAMICS Testing and Results, JMP Consultants, 17 April 2012

assumptions has been applied only to the growth that could be considered as occurring in addition to the original 2028 Reference Case.

The peak spreading assumptions applied were initially consistent with those outlined within the 2028 Future Year model development report and are summarised, for the AM and PM model periods, within **Table 7** and **Table 8**.

Table 7 – AM Peak Spreading Proportions

0700 to 0800	0800 to 0900	0900 to 1000
68%	6%	26%

Table 8 – PM Peak Spreading Proportions

1600 to 1700	1700 to 1800	1800 to 1900
54%	26%	20%

Peak spreading evidence and the derived trend data was based on observed Automatic Traffic Count (ATC) data collected annually at WCC cordon monitoring locations around the modelled area. After application of the above proportions it was apparent that there was a substantial shift in demand within the PM model period. The shift occurred to such an extent that the 16:00 to 17:00 demand levels exceeded those within the 17:00 to 18:00 peak hour. Whilst there is potential for this situation to occur, the principle of peak spreading is such that vehicles are redistributed away from the most congested peak hour in response to congestion.

As a result the PM peak spreading proportions were readjusted within the PM period to ensure that demand in the 1600 to 1700 hour did not substantially exceed the level of demand within the 17:00 to 18:00 peak hour. It should be noted that, due to the warm up nature of the pre-peak hour, i.e. network starts from an empty state and then is populated with traffic, the assigned demands can be marginally higher within the 16:00 to 17:00 hour but the peak of congestion will still occur within the 17:00 to 18:00 hour as the network at the beginning of the 17:00 hour is already full of traffic and, thus, the additional demands increase the congestion levels and raise the peak of congestion further despite slightly lower demand levels having been assigned.

Whilst testing without any application of peak spreading assumptions is not likely to yield acceptable results due to the general bias towards the peak hour, it is recommended that, once the final option for the allocation of growth is determined, testing is undertaken both with and without the revised PM spreading assumptions attributed to the model demands.

In order that this principle could be achieved 30% of the 16:00 to 17:00 increase was redistributed, proportionally, back across the 17:00 to 18:00 and 18:00 to 19:00 hours. By redistributing 30% the goal of ensuring that demand within the 16:00 to 17:00 and 17:00 to 18:00 hours was retained at comparable levels.

The resultant peak spreading proportions assigned to the PM period are summarised within the following **Table 9**:

Table 9 – Revised PM Peak Spreading Proportions

1600 to 1700	1700 to 1800	1800 to 1900
24%	43%	33%

The peak spreading proportions were applied to only those levels of growth that occur in excess of the levels contained within the 2028 Reference Case since the Reference Case had already been subject to some element of peak spreading.

The specific differences between the two scenarios relates primarily to the inclusion of the demand associated with the RDA + SDC CS sites. If, however, peak spreading assumptions were applied only to those demands then it would result in a disproportionate shift in CS demand away from the traditional peak hour.

As a result, a more refined methodology was adopted whereby the assumption was that only 50% of the total traffic growth would be subjected to peak spreading. Furthermore 50% of the growth that was subjected to peak spreading would be associated with the RDA and SDC CS demands whilst the remaining 50% would be associated with the background matrices. This approach is reasonable given that Committed Developments and Forecast growth have already been subjected to peak spreading during the development of the Reference Case whilst the Education and HGV trips are unlikely to be affected by peak spreading.

An overview of changes resulting from the application of the peak spreading procedure to is illustrated within the following **Table 10** and **Table 11** for the two scenarios:

Table 10- Peak Spreading Overview WDC RDA + SDC Op 2 G/LH

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 SF Demands	44303	54717	39665	51413	54783	44807
Growth from 2028 Ref	3253	5368	2814	4690	5905	3741
Periodic Growth	11435			14336		
50% Peak Spread Total	5717			7168		
Peak Spreading Proportions	68%	6%	26%	24%	43%	33%
LDF Adjustments	1944	172	743	860	1540	1184
Background Adjustments	2068	-2859	791	1508	-3584	2076
Assigned Hourly Demands	47351	50837	40452	52603	51274	47103
Difference	3048	-3880	788	1189	-3509	2296

Table 11- Peak Spreading Overview WDC RDA + SDC Op 5 SS

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 SF Demands	43526	54390	39518	50488	53715	44743
Growth from 2028 Ref	2476	5040	2667	3765	4837	3676
Periodic Growth	10184			12278		
50% Peak Spread Total	5092			6139		
Peak Spreading Proportions	68%	6%	26%	24%	43%	33%
LDF Adjustments	1731	153	662	737	1319	1014
Background Adjustments	1842	-2546	704	1291	-3069	1778
Assigned Hourly Demands	46316	50890	40185	51566	50769	46582
Difference	2790	-3500	667	1078	-2946	1840

3.7 WDC RDA + SDC CS Demand Summary

The resultant hourly demands assigned across the model scenarios are summarised within the following **Table 12** and **Table 13** for SDC Options 2 and 5 respectively.

Table 12 – WDC RDA + SDC Option 2 G/LH Scenario Demand Summary

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 RDA + SDC Op2 Demands	47351	50837	40452	52603	51274	47103
Growth from Ref Case	8.95%			10.47%		

Table 13 – WDC RDA + SDC Option 5 S&S Scenario Demand Summary

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 RDA + SDC Op2 Demands	46316	50890	40185	51566	50769	46582
Growth from Ref Case	7.97%			8.96%		

3.8 Summary

The following sections of the report are intended to present the results obtained from the detailed testing undertaken within the WLWA model involving the following 4 scenarios:

2028 Reference Case – The WLWA Reference Case as presented within the recent WDC STA Phase 4 assessment.

2028 WLWA RDA – The 2028 WLWA Reference Case inclusive of the CS mitigation measures and RDA demands.

2028 WLWA CA SDC OP2 – The 2028 WLWA RDA inclusive of the demands associated with the allocation of development in the Gaydon/Lighthorne Heath areas as well as the specific mitigation measures outlined within the following section of this report.

2028 WLWA CA SDC OP5 – The 2028 WLWA RDA inclusive of the demands associated with the allocation of development at Southam and Stoneythorpe as well as the specific mitigation measures outlined within the following section of this report.

4 Mitigation Schedule

4.1 Overview

As has been mentioned previously the initial WDC RDA scenario was used as the starting point for the derivation of the cumulative assessment scenarios. As a result the starting point for the network configuration was one which was inclusive of all of the mitigation measures identified during the previous WDC RDA STA assessment.

A summary of these measures is provided within the following **Table 14:**

Table 14 - WDC RDA Mitigation Schedule

Scheme	Grade
Thickthorn Roundabout	Grade 1
Kenilworth Gyratory	Grade 1
A452/Bericote Roundabout	Grade 1
A452/Blackdown Roundabout	Grade 1
A452 Spinney Hill Roundabout	Grade 2
Emscote Road/Greville Road	Grade 1
Princes Drive/Warwick New Road	Grade 1
Bath Street/High Street	Grade 1
Adelaide Road/Avenue Road	Grade 2
Dormer Place/Adelaide Road	Grade 2
Myton Road Roundabout	Grade 1
Priory Road/Smith Street/St Nicholas	Grade 1
Castle Hill Gyratory Signals	Grade 1
Europa Way/Myton Road Roundabout	Grade 1
Shires Retail Park Roundabout	Grade 1
Europa Way Roundabout	Grade 1
Grey's Mallory Roundabout	Grade 2
A46/Birmingham Road 'Stanks Island'	Grade 1
Bericote Road Stoneleigh Road	Grade 3
Kenilworth Road/Westhill Road	Grade 3
Europa Way Corridor – Part 1	Grade 1
Europa Way Corridor – Part 2	Grade 1
Tech Park Roundabout	Grade 2
Banbury Road – 2 Lanes	Grade 2
M40 Capacity Enhancements	Grade 1
Sustainable Travel Infrastructure	Grade 1
Virtual P&Rs	Grade 1

The following provides an overview of the grading system applied to the current mitigation measures.

- **GRADE 1 - Strategically Essential –** A scheme identified at an early stage of the assessment that has been included within the modelling and is likely to be essential in maintaining network operation and conditions. Delivery of these schemes will serve a role of strategic importance in the context of maintaining overall network operation levels.
- **GRADE 2 - Strategically Desirable -** A scheme identified during the assessment that has been included within the modelling, implementation of the scheme is desirable to ensure maintenance of network operation and conditions. Further investigation may be required to determine whether the scheme is essential. Delivery of these schemes is likely serve a role of strategic importance in the context of maintaining overall network operation levels.
- **GRADE 3 –Locally Desirable -** A scheme identified during the assessment that has been included within the modelling, implementation of the scheme is desirable to ensure maintenance of network operation and conditions. Further investigation may be required to determine whether the scheme is essential. Delivery of these schemes is will serve a role of local importance in the context of maintaining the operational levels in the areas of close proximity to the scheme.

Further mitigation measures where then incorporated within the model networks depending upon the scenario that was being assessed.

At this stage it is proposed that all of the mitigation measures identified through the SDC Options assessment would be considered **Grade 1** status schemes. In some cases the schemes identified through the SDC assessment correspond to schemes identified within the WDC RDA testing, it is envisaged that the mechanism for funding these schemes would most likely involve contributions for the sites allocated within both WDC and SDC Core Strategies.

It is recommended that once a preferred allocation option is identified by SDC further, more detailed, work should be undertaken to identify an appropriate level of contribution that should be made from the relevant sites, allocated through the SDC CS, towards the WDA CS mitigation measures, specifically where the measures have been identified as alleviating impacts which may occur as a result of the SDC allocations.

4.2 Option 2 G/LH Mitigation Measures

A full summary of the entire mitigation strategy identified, thus far, as being necessary to accommodate the level of demand created by the proposals for the Gaydon Lighthorne Heath area is provided within the SDC STA Options Assessment Report. The mitigation measures, proposed through the initial development assessment, that are proposed for delivery within the study area are outlined as follows:

M40 Capacity Enhancements

Lane gains/lane drops have been included on sections of the M40 between J13 and J12 in both directions. The original WDC RDA Assessment assumed delivery

of enhanced capacity measures between M40 J15 and J14 whilst the SDC STA work has identified capacity enhancements between J13 and J12. For the purposes of the cumulative assessment additional capacity enhancements have been added from north of M40 J15 to the south of J13 within the WLWA model. In reality it is envisaged that these measures would extend to just south of J12 and would potentially be delivered in the form of Smart Motorways (SM).

M40 J13 NB Off-slip

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

Fosse Way/Harbury Lane

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

Fosse Way/Southam Road Roundabout

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

Banbury Road/Europa Way 'Greys Mallory' Roundabout

The existing proposals for this roundabout have been amended to include widening on the northwest of the roundabout. The widening enables a 3 lane flare to be accommodated on the Warwick Bypass NB approach to the junction as well as enabling vehicles to turn right from the Banbury Road onto the A452 NB via two lanes. These proposals are in addition to the amendments identified during the WDC STA work. It should be acknowledged that further review of the proposals in this area is necessary to ensure that the optimum junction configuration is proposed to accommodate the CS growth levels.

WDC RDA Mitigation measures

The individual option assessment pertaining to the Option 2 G/LH proposals identified that the potential impacts associated with the site would benefit from the implementation of the following schemes already identified through the WDC STA process:

- Dualling of the A452 between M40 J14 to the Shires Retail Park junction.
- Extended two lane entry and exit flares at the Banbury Road/Gallows Hill junction.
- Introduction of a new roundabout to serve Warwick Technology Park, currently this is assumed to be delivered at the location of the Western entrance to enable an extended two lane EB section of Gallows Hill to be delivered between the existing Banbury Road/Gallows Hill junction and the new roundabout.
- Proposed signalisation of the Myton Road/Banbury Road junction.

4.3 Option 5 SS Mitigation Measures

As with the Option 2 G/LH mitigation measures, a full summary of the entire mitigation strategy identified, thus far, as being necessary to accommodate the level of demand created by the proposals for the Southam and Stoneythorpe areas is provided within the SDC STA Options Assessment Report. The only mitigation measure identified for inclusion within the WLWA study area involved substantial amendments to the Southam Road/Fosse Way roundabout. The proposals for this junction include the introduction of extended 2 lane approach flares on most approaches. Widening of the circulating carriageway and the introduction of two lane extended exit flares.

4.3.1 M40 Motorway Enhancements

The previously outlined costs attributed to the WDC CS infrastructure allocated almost 25% of the required revenue to the delivery of capacity enhancements on the section of the M40 between Junction 15 and Junction 13. Thus far the assessment has included an additional lane on the M40 between J15 and J14, one of these lanes has been segregated so that traffic travelling to Warwick via the A46 and M40 does not need to enter into the M40 mainline.

The work undertaken in assessing the impacts for the allocation of growth according to SDC CS options has also identified a potential need for the delivery of additional capacity enhancements on the M40 between J13 and J12.

There has been recent dialogue with the Highways Agency regarding Managed Motorways. This form of mitigation is now termed ‘Smart Motorways’. Whilst the assessment work has indicated that Smart Motorways may not be required until towards the end of the plan period, the Agency has indicated that due to technology advances other interventions may be more appropriate at that time. Therefore at this stage we refer to Motorway Enhancements rather than Smart Motorways.

The final form of the capacity enhancements on the M40 will be dependent upon the level of demand and requirements at the time. It is not possible at this early stage to precisely define proposals for the M40 due to the high level of detailed design work likely to be required. As such an appropriate level of funding contribution is only likely to be fully determinable once the complete costs for delivering the scheme have been ascertained.

It should be acknowledged that, in certain SDC scenarios at least, the allocation of additional housing through the SDC CS process may exert additional stress on the M40. This is particularly pertinent when considered the proposals at Gaydon/Lighthorne Heath (Option 2) which involves the allocation of a significant amount of employment land, plus 3,000 houses, on land adjacent to the M40.

Thus SDC sites may be expected to contribute to the delivery of capacity enhancements on the M40. The level and proportionality of the contribution requires further work as there are likely to be a number of contributing factors which trigger the need for additional capacity in this area, the most significant of which is likely to constitute existing demand alongside forecast growth in strategic trips. Thus, any cost apportionment should be undertaken in

consideration of the complexion of the demand which will benefit from the implementation of the scheme with and without WDC/SDC allocations being included within the assessment.

5 Results Analysis

5.1 Overview

The following section of this report is intended to present the results obtained from the detailed testing undertaken within the WLWA PARAMICS model.

A tiered assessment has been adopted; results analysis is focussed on a strategic level assessment at this stage which is similar to the approach adopted during earlier stages of the assessment.

All of the measures used to inform the assessment are outlined as follows:

5.2 Model Stability

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

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

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

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

5.3 Number of Runs

Network statistics analysis has been based, consistently, on 20 runs per scenario with runs that are classified as unstable or 'failed' being removed prior to detailed analysis.

5.4 Network Wide Statistics

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

- **Average Distance (Km)** – The average distance travelled by a vehicle that completed their journey during the model simulation period.
- **Average Time (seconds)** – The average travel time of a completed trip during the model simulation period.
- **Average Speed (Km/h)** – The average speed travelled by all vehicles that completed a journey during the model simulation period.
- **Completed Trips (vehicles)** – The number of completed trips recorded during the model simulation.

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

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

5.5 Queue Lengths

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

At this stage the analysis of queue lengths has been based on the average hourly maximum queue length. Results presented for each junction are based on the worst performing single approach. The hourly maximum for each individual model run has been calculated and then the average of all runs has been calculated for each hour. The maximum of these values, across all hours, is reported as the maximum periodic average maximum queue length and is reported in vehicles.

The junctions for which average hourly maximum queue lengths have been calculated and compared are illustrated within **Figure 7**.

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

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

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

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

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

The locations of the junctions that have been included within the assessment are outlined within **Figure 7** on the following page.

5.6 Journey Time Analysis

During the first phase of STA analysis some journey time routes were defined within the modelling and the time it takes vehicles to traverse these routes was collected and presented within the analysis. At that stage the purpose of analysis was simply to ascertain which routes experienced the lowest and greatest levels of delay across a number of different allocation options. Building upon that analysis, the purpose of the comparisons during this stage of work is to identify which areas of the network, when compared to the Reference Conditions, are likely to suffer the greatest changes in levels of delay when the allocated demand is assigned to the network.

In total 9 key routes were defined within the model network and these routes have been illustrated within **Figure 8**.

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

Figure 7 - Queue Assessment, Junction Locations

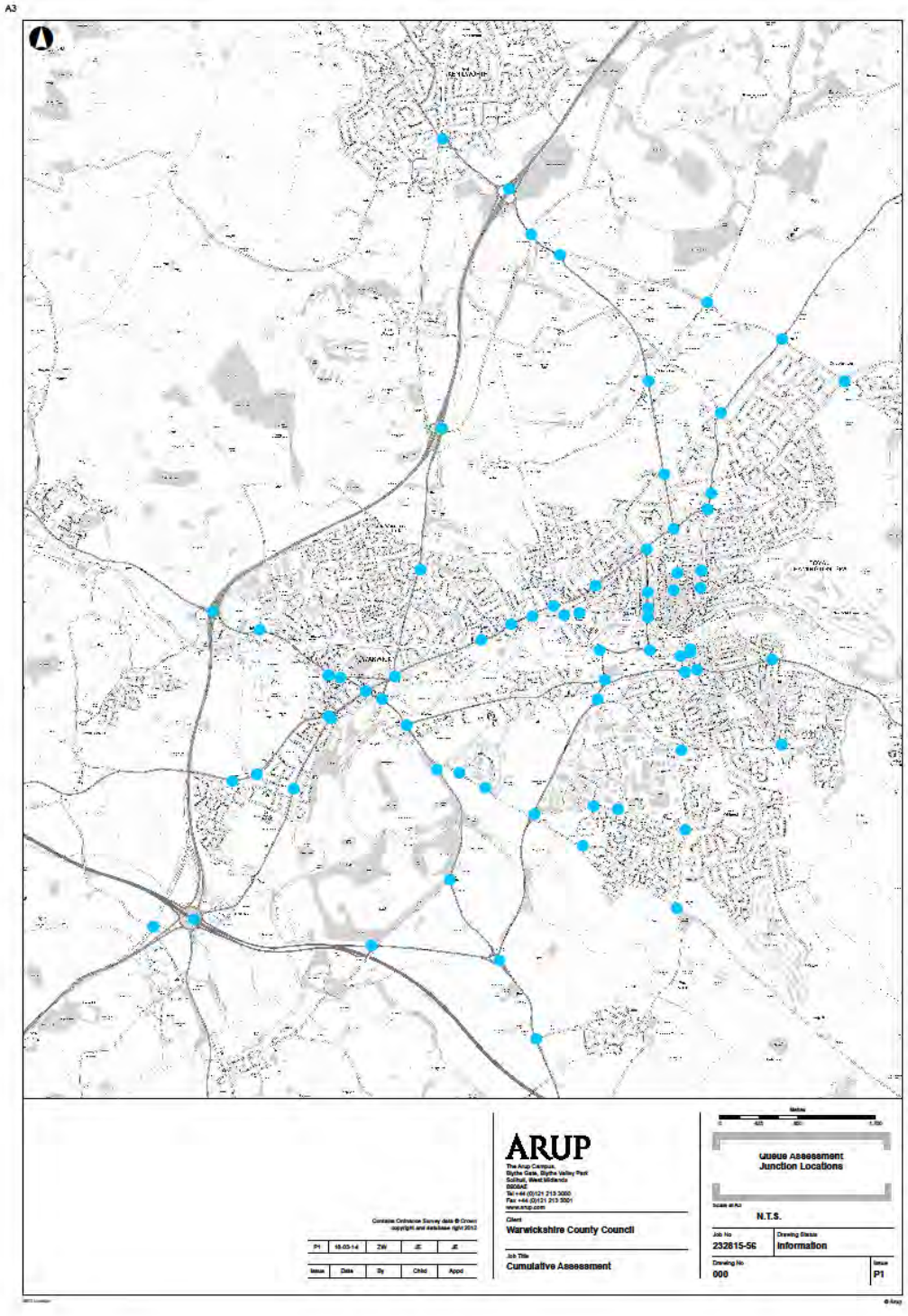
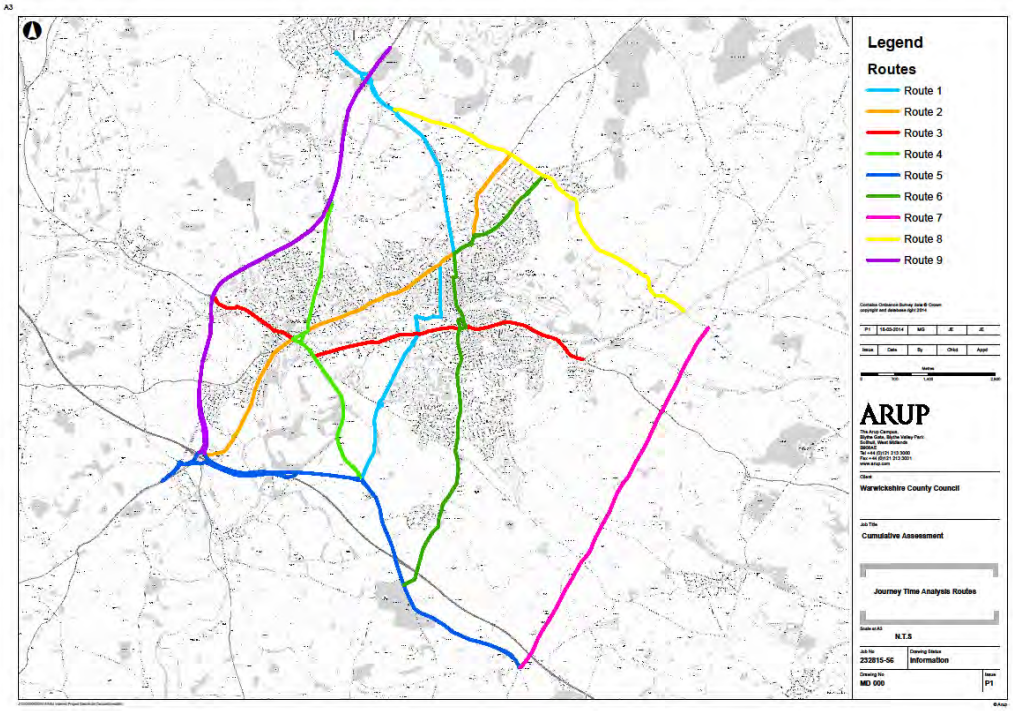


Figure 8 - Journey Time Analysis Routes



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

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

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

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

6 Results Analysis – Warwick Focus

6.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken for the following four scenarios within the Warwick and Leamington Areas:

- 2028 Reference Demands
- 2028 WLWA RDA
- 2031 WLWA CA SDC OP 2
- 2031 WLWA CA SDC OP 5

6.2 Model Stability

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

The apparent network stability exhibited within the AM and PM simulation runs across the two scenarios is illustrated within the following **Table 15**

Table 15 - Model Stability Assessment 2028 Reference vs. 2028 WLWA RDA vs. 2031 WLWA CA SDC Options 2 and 5

	2028 Reference Demands	WLWA RDA	2031 WLWA CA SDC OP 2	2031 WLWA CA SDC OP 5
AM	75%	75%	65%	50%
PM	80%	80%	80%	80%

Given the size of 20 runs it is reasonable to conclude, from the previous table, that the inclusion of the revised development allocation and the SDC Option measures appears to result in a notable reduction in model stability levels in the AM period. Within the PM period the network stability remains relatively consistent across all scenarios. As has been noted previously, the level of instability within the models is frequently improves as the options are looked at in more detail. Partly this is because of the fact that, as developments are progressed in isolation, more localised impacts are identified and mitigated than can be achieved during such a high level assessment and partly this is because the existing mitigation that has been proposed will be subject to further refinement and improvement beyond this stage of the assessment.

The instability levels presented within **Table 15** indicate that further refinement of the proposed mitigation measures is desirable, particularly with regards the AM network performance levels.

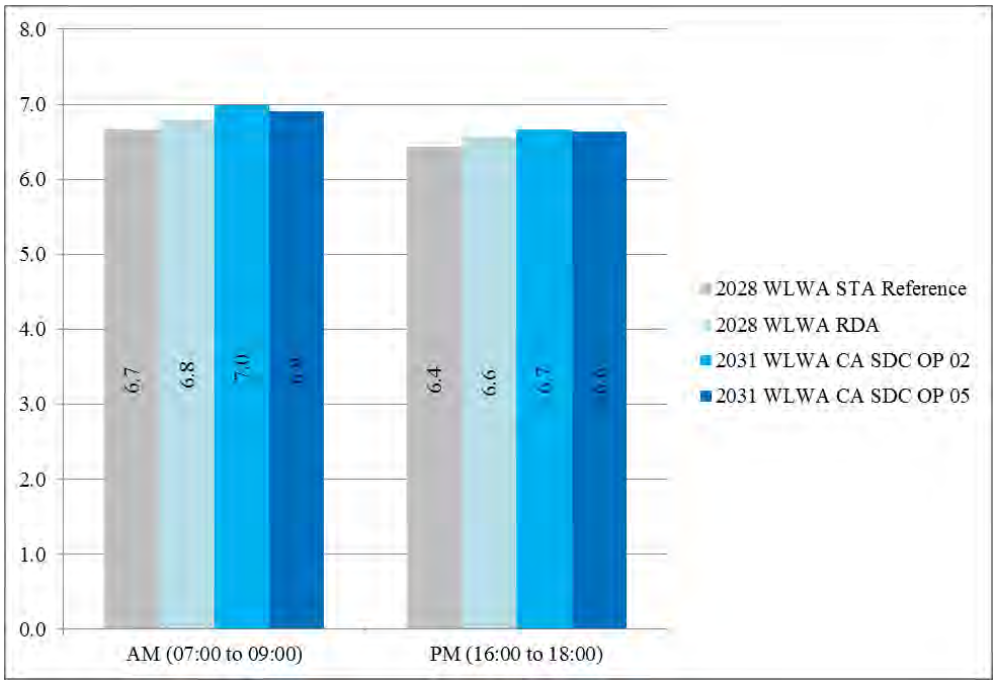
6.3 Network Wide Statistics

The following sets out the changes in network wide statistics between the 2028 Reference Case and the 2028 CA SDC scenarios.

6.3.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within **Figure 9**.

Figure 9 - Average Journey Distance (2028 Ref vs. 2028 WLWA RDA vs. 2031 WLWA CA SDC Options 2 and 5), Km

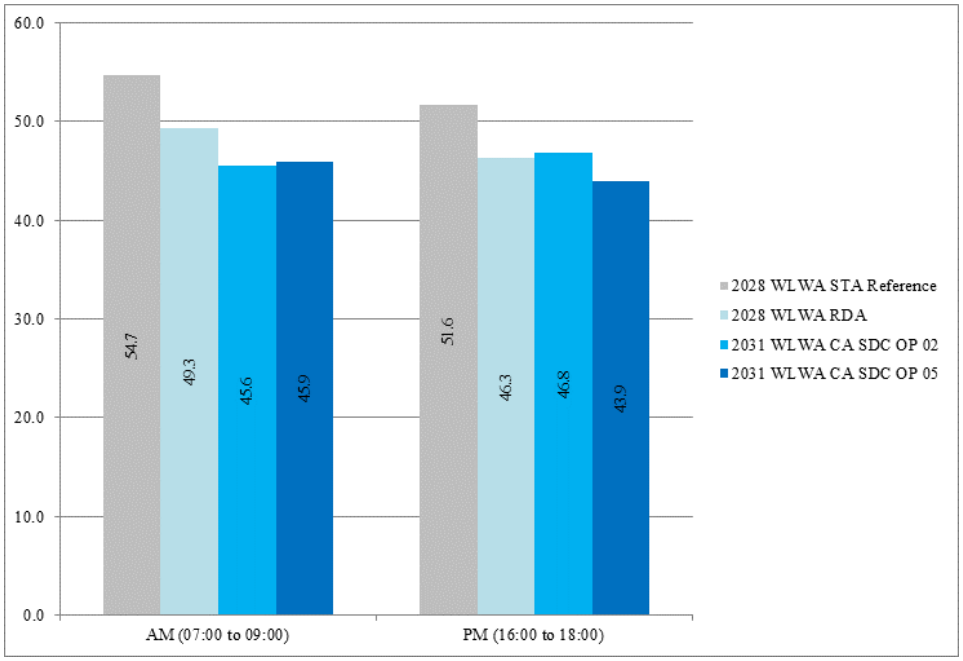


Analysis of **Figure 9** indicates very little difference between the four scenarios. An increase in the average journey distances is to be expected when comparing the WLWA RDA and the WLWA CA SDC options as both options involve the allocation of development in areas which are outside of the WLWA study area. As a result it is inevitable that the average journey distances will experience a marginal increase as the additional SDC CS demands are entering the model via the external model loading zones.

6.3.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within **Figure 10**.

Figure 10 - Average Journey Speed (2028 Ref vs. 2028 WLWA RDA vs. 2031 WLWA CA SDC Options 2 and 5), Km/h



The previous figure demonstrates that the RDA + SDC option 2 scenario results in a drop in the average speeds of approximately 16% and 10% when compared to the Reference Case. The implementation of Option 5 results in a 15% drop in average speeds in both the AM and PM peak periods. Previously, assignment of the RDA strategy has resulted in a drop in the average speed of vehicles, on the network, of approximately 10% and 11% in the AM and PM peak periods respectively.

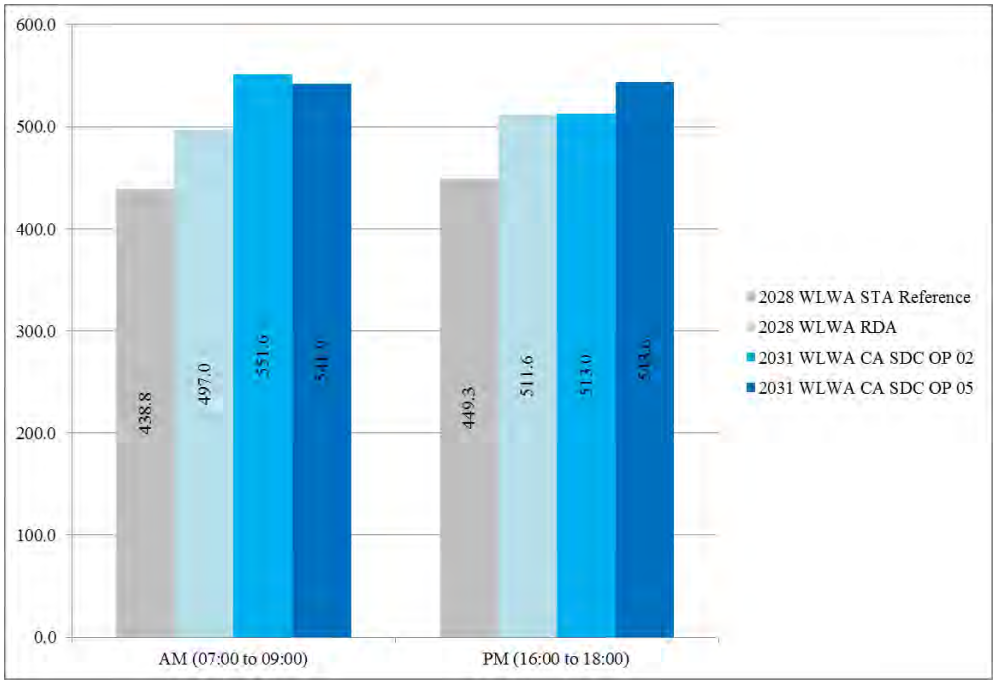
The magnitude of reduction in speeds between the respective CS scenarios reveals that there is almost no difference in the average speeds, during the PM period, between the 2028 WLWA RDA and 2031 WLWA CA SDC Op 02 model network. This is in spite of the additional demand having been assigned to the model network. Similarly within the AM the average speeds within the 2031 WLWA CA SDC Op 02 and 2031 WLWA CA SDC Op 05 networks are comparable.

Figure 10 reveals that the allocation of the two SDC options are likely to result in a drop in the average speeds that vehicles achieve when compared to the 2028 Reference Case and 2028 WLWA RDA networks during the AM, but the magnitude of reduction is similar across both options. Within the PM the 2031 WLWA CA SDC Op 02 network speeds are close to those achieved within the 228 WLWA RDA network and are, in fact, slightly higher whilst the speeds within the 2031 WLWA SDC Op 05, during the PM, are the lowest of any of the scenarios.

6.3.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within the **Figure 11.**

Figure 11 - Average Journey Time (2028 Ref vs. 2028 WLWA RDA vs. 2031 WLWA CA SDC Options 2 and 5), Seconds



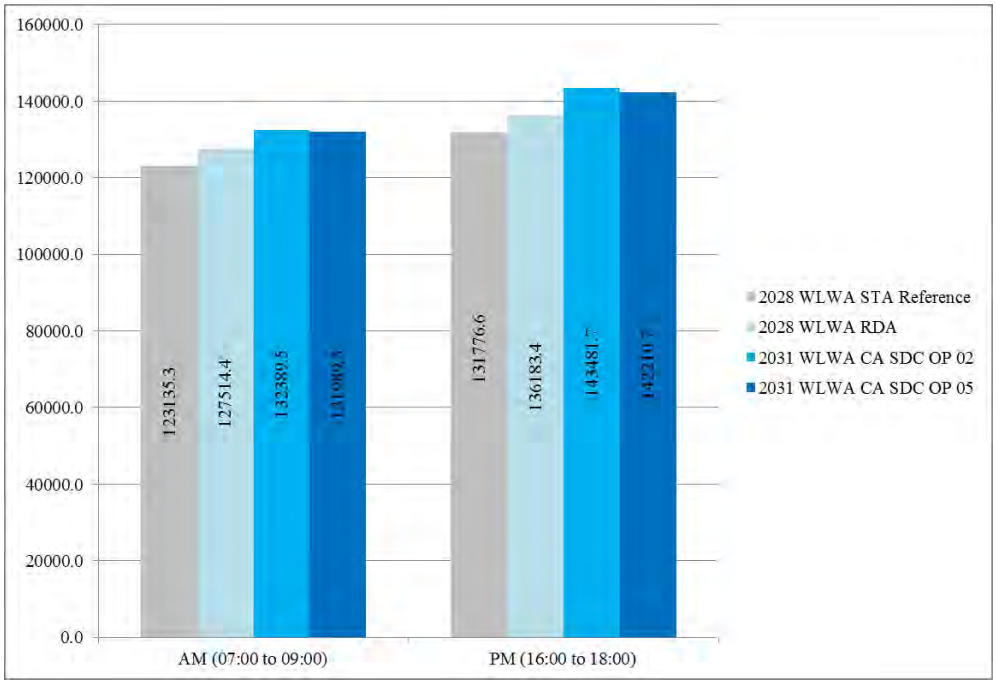
Analysis of the difference in average journey time across the scenarios indicates an increase in the time it takes to complete a journey when compared to the 2028 Reference Case conditions of around 26% and 14% during the AM and PM periods respectively for the Option 2 scenario. When comparing the Reference Case to the Option 5 scenario, an increase of 22% and 21% is expected during the AM and PM periods respectively. Analysis of the difference in average journey times indicates an increase in the time it takes to complete a journey when compared to the 2028 Reference Case conditions of around 15% during both AM and PM periods for the WLWA RDA scenario.

The difference in journey times across the four scenarios is broadly consistent with the difference identified earlier with regards the assessment of average journey speeds. Within the AM there is an increase in journey times between the 2028 WLWA RDA scenario and both 2031 WLWA CA SDC scenarios, albeit journey times are longer within the 2031 WLWA SDC Op 02 scenario than the 2031 WLWA SDC Op 5 scenario. Within the PM the journey times within the 2028 WLWA RDA and the 2031 WLWA CA SDC Op 02 are consistent but, when compared to the journey times in these scenarios, the journey times within the 2031 WLWA SDC Op 5 scenario are longer. Notably the journey times across both the AM and PM model periods, within the 2031 WLWA SDC Op 5 scenario, are comparable for both periods.

6.4 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 12** on the following page.

Figure 12 - Completed Trips (2028 Ref vs. 2028 WLWA RDA vs. 2031 WLWA CA SDC Options 2 and 5), Vehicles



Analysis of **Figure 12** indicates that there is an increase in completed trips of around 8%, for Option 2 and 5 in both the AM and PM periods respectively, when compared to the 2028 Reference Case.

Notably, the level of demand assigned within the Option 2 scenario network is around **9%** higher in the AM and **10%** higher in the PM. The increase in assigned demand for Option 5 is approximately 8% and 9% during the AM and PM peak periods respectively. It is worth noting that the increase in completed trips is slightly lower than the increase in assigned demand between the two scenarios.

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

6.5 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2028 Reference Case, 2028 WLWA RDA and 2031 SDC scenarios for the AM and PM peak periods.

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

6.5.1 AM Analysis (MQ001, MQ003 and MQ005)

Analysis of the difference in queuing between the 2028 Reference and 2028 WLWA RDA scenario, during the AM peak period, reveals the following:

- There are no instances of very severe increases in queue lengths.
- The majority of junctions assessed that trigger the criteria experience a level between a reduction in queuing levels and a maximum increase of 30 vehicles.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 2 scenario, during the AM peak hour, reveals the following:

- There is one instance of a very severe increase in queue lengths (exceeding 50 vehicles) on the network at Longbridge Island (M40 J15). Further optimisation of the signals in this location may further mitigate these impacts. This has been demonstrated through previous work undertaken by the Highways Agency Consultants[6] in 2013 albeit with slightly different demand assumptions included for the LDF sites.
- A number of junctions surrounding the town centre experience an increase in queue length of between 15 and 30 vehicles
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 30 vehicles.
- There appears to be a number of instances of severe increases to the west of the study area. In particular impacts are noted along the Tachbrook Road and A452 Corridors.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 5 scenario, during the AM peak hour, reveals the following:

- There are two instances of very severe increases in queue lengths on the network; Longrbidge Island is again affected as are the Shires Retail Park junction proposals.
- As has been identified within the analysis of the 2031 WLWA CA SDC Op2 AM analysis, there appears to be a number of instances of severe increases to the west of the study area. In particular impacts are noted along the Tachbrook Road and A452 Corridors.
- Compared to the 2031 WLWA CA SDC Op2 AM analysis, there appears to be an increase in the number of junctions that experience

[6] MID3543.R001 – M40 J15 MOVA Study 220413, JMP Consultants, April 2013.

a worsening in queuing conditions in areas to the East of Warwick and Leamington Spa.
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 30 vehicles.

6.5.2 PM Analysis (MQ002, MQ004 and MQ006)

Analysis of the difference in queuing between the 2028 Reference and 2028 WLWA RDA scenario, during the PM peak period, reveals the following:

- The majority of junctions assessed that trigger the criteria experience a queue length increase of 15 to 30 vehicles
- There are fewer instances of queue length decreases across the network when compared to the AM period (MQ001)

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 2 scenario, during the PM peak hour, reveals the following:

- There are no instances of queue lengths increases exceeding 50 vehicles on the network
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 15 vehicles
- There are more instances of queue length decreases than are experienced across the network when compared to the AM period (MQ003)
- There is a small increase in the number of junctions which experience an increase in queue lengths around the town centres when compared to the 2028 WLWA RDA network performance.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 5 scenario, during the PM peak hour, reveals the following:

- There are no instances of queue lengths increases exceeding 50 vehicles on the network
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 15 vehicles
- There are fewer instances of queue length decreases than are experienced across the network when compared to the AM period (MQ005).
- There are more instances where increases in queue lengths are observed within this scenario, when compared to the 2028 Reference Case, than either of the two alternative scenarios.

6.5.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference Case and 2031 SDC Scenarios is provided as follows:

- There are a number of instances where the level of queuing experienced at key locations increases in both Cumulative

Assessment Options when compared to both the 2028 Reference Case and the 2028 WLWA RDA scenario networks.

- Within the AM queuing levels tend to increase in areas to the East and South of the model area in both 2031 WLWA CA SDC options. There are impacts observed along the A452 and Tachbrook Road corridors as well as around M40 J15.
- Within the PM the is a general worsening of queuing levels to the south and east of the model area as the additional demands associated with the two SDC options are assigned to the model network.

6.6 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the three key model scenarios; 2028 Reference Case and 2031 Option 2 and 2031 Option 5. The comments in the remainder of this section are based on observations of the predicted journey times across pre-defined routes within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

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

6.6.1 AM Analysis (MD001, MD003 and MID005)

Analysis of the difference in queuing between the 2028 Reference and 2028 WDC RDA scenario, during the AM peak hour, reveals the following:

- The routes into Warwick experience limited changes in journey times compared to the Reference Case, notably the Banbury Road, Birmingham Road and Coventry Road all experience reductions.
- Increases in journey times are evident on three of the four approaches to Grey's Mallory. This indicates that further optimisation of the scheme proposed in this area is desirable.
- There are still increases in delay along the A452 in both directions which indicates that further optimisation of the schemes in this area may also be desirable, particularly when considering the substantial increases experienced on the approach from the south.
- There are two other instances of very severe increases in journey times. One occurs on the approach to the Emscote Road Greville Road junction which is likely to be as a result of the introduction of signals at the junction where previously traffic flowing from this direction was unopposed. The second instance is the Myton Road approach to the Princes Drive/Europa Way roundabout which indicates that further optimisation of the signal scheme in this area is also desirable.
- Notably, there are no negative impacts accrued on the approaches to the Banbury Road/Myton Road junction proposals which indicate that the reduced scheme for this area is effective.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 2 scenario, during the AM peak hour, reveals the following:

- There are a large number of links where an increase in journey times is experienced when compared to the reference scenario. These increases in peak hour journey times correspond to the routes which are anticipated to suffer from increases in traffic volumes as a direct result of the inclusion of the development at Gaydon/Lighthorne Heath.
- Compared to the increase in journey times observed between the 2028 Reference Case and the 2028 WLWA RDA scenarios, there inclusion of the SDC Op 2 demands results in an increase in peak hour journey times along the southern sections of the A452 and Tachbrook Road corridors.
- Other areas were journey times are observed to increase include all routes leading to both the M40 J15 and B4100/A452 'Grey's Mallory roundabouts as well as the B4087 which runs perpendicular to the B4100, sections of the Fosse Way the A452 and the Stratford Road approach to/from Warwick town centre.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 5 scenario, during the AM peak hour, reveals the following:

- There are a large number of links where an increase in journey times is experienced when compared to the reference scenario. These increases occur along the A452 as well as along Tachbrook Road.
- In line with the analysis of the previous scenarios it is also apparent that journey times have increased on all approaches to the B4100/A452 'Grey's Mallory roundabout, the A452 between Leamington Spa and Thickthorn roundabout and the Stratford Rd approach to Long Bridge Island.

6.6.2 PM Analysis (MD002, MD004 and MID006)

Analysis of the difference in queuing between the 2028 Reference and 2028 WDC RDA scenario, during the PM peak hour, reveals the following:

- There are a large number of instances where journey times have reduced around the Myton Road/Europa Way area which indicates that the mitigation in these areas is operating effectively.
- There are still increases in delay on the approaches to Grey's Mallory which would likely benefit from further optimisation of the Grey's Mallory Scheme proposals.
- There is an increase in delay along the A452 which indicates further optimisation of the proposed measures during the PM period is also desirable. There is an historic issue associated with vehicles wishing to turn right from the A452 into Northumberland Road which will also contribute to the increases in delay, there may be scope to extend the right turn bay to minimise these impacts but it is also undesirable to increase the levels of demand along Northumberland Road and so further investigation would be required before such proposals were adopted.
- Delays on the Stratford Road approach to Longbridge Island have also increased but further optimisation of the signals in this location may further mitigate these impacts. This has been demonstrated through

previous work undertaken by Highways Agency Consultants[7] in 2013 albeit with slightly different demand assumptions included for the LDF sites.
- Further increases in delay occur on the Birmingham Road and Coventry Road routes into Warwick which may require attention.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 2 scenario, during the PM peak hour, reveals the following:

- The majority of increases in journey times are consistent with those that have been observed within the 2028 WLWA RDA scenario.
- There are a few areas where the increase in journey times is greater within the 2031 WLWA CS SDC Op 2 scenario, namely:
  - The NB and SB approaches to the Tachbrook Road/Oakley Wood Drive/Harbury Lane junction.
  - The B4100 EB/WB between Fosse Way and the A452
  - The Fosse Way immediately north of the B4100
- The routes that suffer further increases in journey times are those which provide distribution routes away from the G/LH development towards Warwick and Leamington Spa towns.

Analysis of the difference in queuing between the 2028 Reference and 2031 Option 5 scenario, during the PM peak hour, reveals the following:

- The majority of increases in journey times are consistent with those that have been observed within the 2028 WLWA RDA scenario. There are additional increases in journey times along the following routes:
  - Leicester Lane SB towards Leamington
  - Warwick bypass towards the B4100/A452 ‘Grey’s Mallory roundabout

6.6.3 Delay Analysis Summary

Analysis of the difference in journey times between the two 2028 WLWA RDA scenarios and the Reference Case reveals that within the AM period the 2028 WDC + RDA network performs well with a limited number of instances of severe increases in delay. These instances all occur on the approach to proposed signalised junctions and, coupled with the fact that there are either reductions in delay on other approaches to the same junctions, or scope to further enhance the junction proposals, these impacts would likely be further mitigated through additional scheme optimisation.

When reviewing the PM impacts it is apparent that further review of proposals along the A452 and consideration towards further optimisation of Longbridge Island (M40 J15) are desirable.

The analysis of the 2031 WLWA CA SDC Op2 journey times reveals that there appears to be an increase in stress on North/South corridors across the model area which manifests in increased journey times, particularly along the A452 and Tachbrook Road corridors.

[7] MID3543.R001 – M40 J15 MOVA Study 220413, JMP Consultants, April 2013.

Both the 2031 WLWA CA SDC Op2 and the 2031 WLWA CA SDC Op5 journey time analysis reveals increases in journey times on approaches to the B4100/A452 'Grey's Mallory roundabout within the AM period.

Within the PM the increases in journey times are broadly consistent across all three scenarios, however the increase in journey times to the south east of the model area are greater within the 2031 WLWA CD SDC Op 2 scenario which is likely to be reflective of the increased demands within this area on account of the location of the proposed development in Gaydon/Lighthorne Heath.

6.7 Conclusion

The initial comparisons between the 2028 Reference Case and the 2031 SDC scenarios reveal the following conclusions:

- Inclusion of the SDC strategy demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategies.
- Analysis of the network statistics reveals that whilst relatively similar levels of delay and speed are expected during the AM peak period for the SDC scenarios, Option 2 results in improved conditions during the PM peak period compared to the 2028 WLWA RDA network performance.
- The location of the Gaydon/Lighthorne Heath development, near the M40 J12, is such that additional capacity along the M40 has been included within the localised modelling assessment, transferring this additional capacity, alongside the inclusion of capacity enhancements to the northwest of M40 J15, within the WLWA model area is likely to contribute to the mitigation of the impacts associated with the demands generated by the Gaydon/Lighthorne Heath development.
- The queuing analysis revealed a number of instances where the level of queuing experienced at key locations increases in both Cumulative Assessment Options when compared to both the 2028 Reference Case and the 2028 WLWA RDA scenario networks.
- Within the AM queuing levels tend to increase in areas to the East and South of the model area in both 2031 WLWA CA SDC options. There are impacts observed along the A452 and Tachbrook Road corridors as well as around M40 J15. Within the PM there is a general worsening of queuing levels to the south and east of the model area as the additional demands associated with the two SDC options are assigned to the model network.
- The analysis of the difference in journey times across the three scenarios, when compared to the reference case, reveals that the majority of journey time increases are consistent across all three scenarios. The 2031 WLWA CA SDC Op 2 scenario demonstrates a greater level of journey time increases to the south east of the model area when compared to either the 2028 WLWA RDA or 2031 WLWA CA SDC Op 5 journey times.

Overall the queuing and journey time analysis indicates that further attention should be afforded to the performance of the junctions along the A452 and

Tachbrook Road corridors as well as the Fosse Way within both 2031 WLWA CA SDC scenarios.

7 Summary & Conclusions

Arup have been commissioned by Warwickshire County Council (WCC), Stratford on Avon District Council (SDC) and Warwick District Council (WDC) to undertake additional cumulative analysis of the proposed Warwick District and Stratford District Core Strategy (CS) allocations. This report builds upon the evidence presented within the recently completed Warwick STA Phase 4 Assessment report[8] and the Stratford STA Options Analysis Report[9].

The objective of this study is to assess the cumulative impacts of allocating both WDC and SDC Core Strategies, alongside the proposed mitigation measures, within the Warwick and Leamington transport network.

The assessment was completed through the following steps:

- The M40 scenarios models, inclusive of mitigation measures, were interrogated to provide information on the likely vehicle numbers which would be generated by the respective options and enter into the WLWA study area.
- A model screen line was defined to identify the point where trips left the M40 model area and entered into the WLWA area. The screen line was defined to run parallel to the Fosse Way, to the east, and vehicles crossing this screen line where enumerated and the numbers allocated into the WLWA model via the various loading points.
- Any newly proposed mitigation measures, identified within the SDC STA work, which were required within the area encompassed by the WLWA model, were included within the WLWA model. These schemes were included in addition to the WLWA proposed CS mitigation measures.
- The models were run and strategic level outputs were assessed to provide an overview of the potential implications of each option.

The impact analysis that is presented within this report is intended to inform an assessment on the traffic impacts of the two SDC CS options alongside the proposed mitigation measures against both the WLWA Reference and WLWA RDA network conditions.

At this stage, the level of assessment does not include information and analysis of each of the proposed schemes in detail, nor does it comprehensively identify the full scope of the impacts and benefits that occur as a result of the proposed allocation strategies. Rather it is intended to confirm what strategic elements of infrastructure are likely to be required to ensure that the allocated growth can be accommodated upon the existing network.

It is anticipated that the planning process associated with the individual sites will continue throughout the development of the Core Strategy and that each development will be supported by a separate planning application that will, in turn, be accompanied by a Transport Assessment (TA). The planning process associated with the individual sites will be expected to deal in more detail with

[8] 232815-53.R001 Warwick STA - Phase 4 Assessment, Arup, April 2014
[9] 232815-55.R001 Stratford-on-Avon STA – Options Assessment Report, Arup, April 2014

issues such as the associated access strategies and the mitigation of localised impacts.

At this stage it should also be recognised that the purpose of this assessment is to determine an appropriate mitigation strategy necessary to accommodate all of the growth that is envisaged to occur across the duration of the plan period. Thus the mitigation proposed through this work reflects that which will be anticipated across the entire 2011 to 2029/2031 plan period.

7.1 Conclusion

The initial comparisons between the 2028 Reference Case and the 2031 SDC scenarios reveal the following conclusions:

- Inclusion of the SDC strategy demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategies.
- Analysis of the network statistics reveals that whilst relatively similar levels of delay and speed are expected during the AM peak period for the SDC scenarios, Option 2 results in improved conditions during the PM peak period compared to the 2028 WLWA RDA network performance.
- The location of the Gaydon/Lighthorne Heath development, near the M40 J12, is such that additional capacity along the M40 has been included within the localised modelling assessment, transferring this additional capacity, alongside the inclusion of capacity enhancements to the northwest of M40 J15, within the WLWA model area is likely to contribute to the mitigation of the impacts associated with the demands generated by the Gaydon/Lighthorne Heath development.
- The queuing analysis revealed a number of instances where the level of queuing experienced at key locations increases in both Cumulative Assessment Options when compared to both the 2028 Reference Case and the 2028 WLWA RDA scenario networks.
- Within the AM queuing levels tend to increase in areas to the east and south of the model area in both 2031 WLWA CA SDC options. There are impacts observed along the A452 and Tachbrook Road corridors as well as around M40 J15. Within the PM there is a general worsening of queuing levels to the south and east of the model area as the additional demands associated with the two SDC options are assigned to the model network.
- The analysis of the difference in journey times across the three scenarios, when compared to the reference case, reveals that the majority of journey time increases are consistent across all three scenarios. The 2031 WLWA CA SDC Op 2 scenario demonstrates a greater level of journey time increases to the south east of the model area when compared to either the 2028 WLWA RDA or 2031 WLWA CA SDC Op 5 journey times.
- Overall the queuing and journey time analysis indicates that further attention should be afforded to the performance of the junctions along the A452 and Tachbrook Road corridors as well as the Fosse Way within both 2031 WLWA CA SDC scenarios.

8 Further Considerations and Recommendations

8.1 Overview

The following section of this report outlines some additional points for consideration during any future stages of assessment. Further work is only recommended once the certainty regarding the proposed sites for allocation has been established for both SDC and WDC Core Strategies

8.2 Mitigation Scheme Proposals

The assessment of the proposed mitigation measures associated with the delivery of the SDC Options has, at this stage, only been undertaken at a high level. The modelling analysis appears to indicate that that further attention should be afforded to the performance of the junctions along the A452 and Tachbrook Road corridors as well as the Fosse Way within both 2031 WLWA CA SDC scenarios.

8.3 Recommendations

The following outlines a series of recommendations that should be considered during any additional stages of the Strategic Transport Assessment.

- Once a Preferred Option for allocation has been identified by SDC, a further review of the assumptions that have been used within the modelling should be undertaken and in particular the following elements should be reviewed:
    - Trip rates and distribution assumptions
    - Trip profiling, particular with regards the delivery of the employment element of the G/LH site.
- Further work on determining the feasibility, timing and costs of delivering motorway enhancements, together with an acceptable level of apportionment, is recommended to be undertaken at the earliest opportunity as this represents a significant factor in the determination of the costs of delivering the associated mitigation infrastructure to facilitate development in both districts, whether related to a specific option / site or the cumulative impact of plan proposals.
- Whilst it is acknowledged that Option 2 G/LH appears to have an impact on M40 J15 the potential for this to occur should either of the 3 alternate options be adopted, i.e. those not included within this stage of the cumulative assessment (options 1, 3 and 4), is recommended for assessment at a later stage if necessary.
- More detailed work is undertaken on sustainable transport requirements and the assumptions on mode share and mode shift are based on the outcome of these studies. Once the preferred allocation strategy has been identified, a sensitivity test should be undertaken to determine the importance of achieving the targets for mode share/shift and internalisation and to establish areas where further mitigation may be required should the targets, associated with the proposed sites not be realised.

- As more certainty emerges on the provision of Education facilities alongside the allocation strategy, further testing should be undertaken which includes more detailed assumptions regarding the access strategy including any additional pedestrian facilities, trip generation and the distribution thereof.
- Testing of a phased approach to the implementation of the mitigation strategy should be undertaken to determine which schemes are likely to be required at an early stage of the plan period and, conversely, which can be delivered towards the end of the plan period.

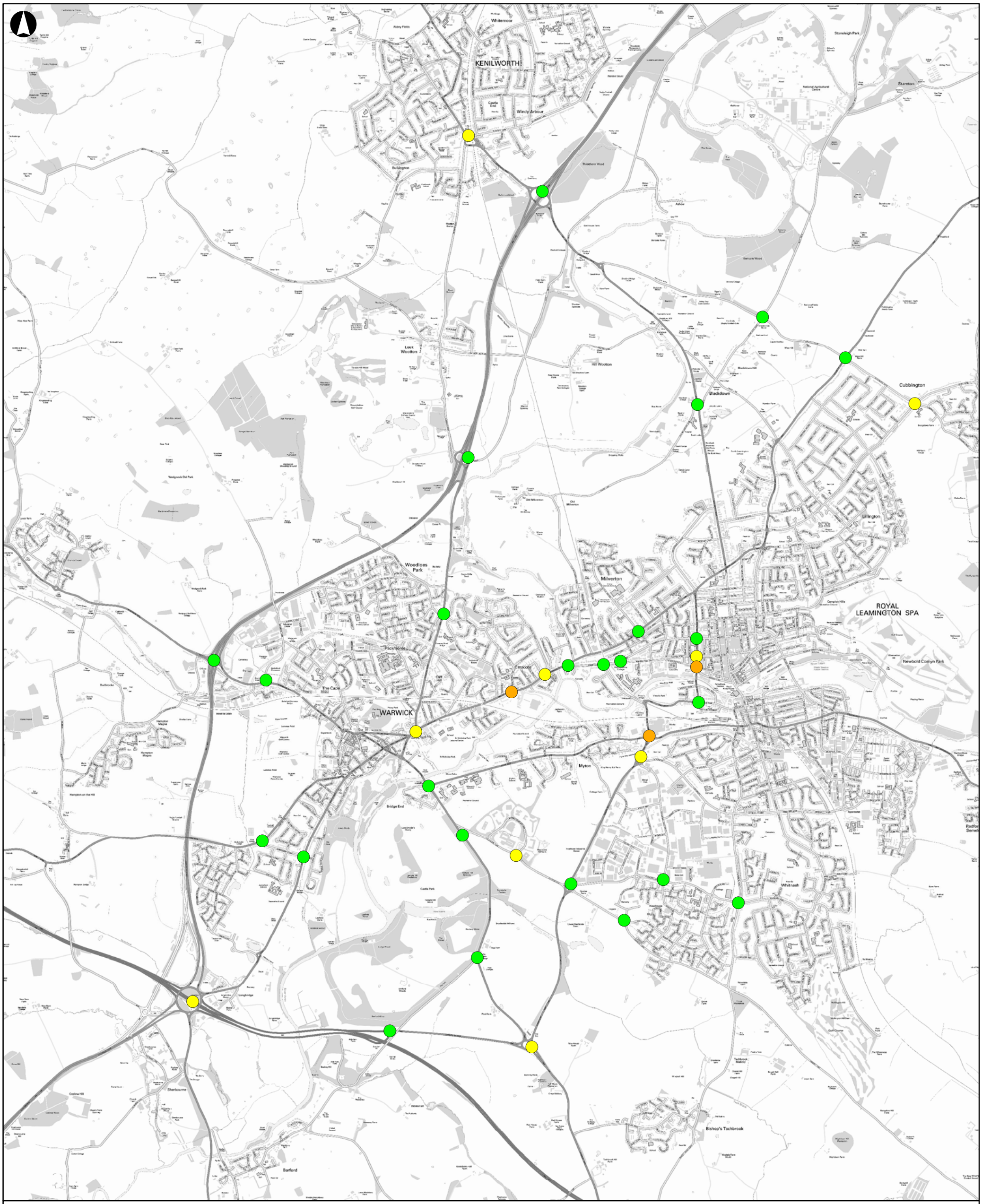
Appendix A

WDC/SDC CA - Queue Analysis Plots

A1

- **MQ001** – 2028 WLWA RDA AM (07:00 to 10:00)
- **MQ002** – 2028 WLWA RDA PM (16:00 to 19:00)
- **MQ003** – 2031 WLWA CA SDC OP 2 AM (07:00 to 10:00)
- **MQ004** – 2031 WLWA CA SDC OP 2 PM (16:00 to 19:00)
- **MQ005** – 2031 WLWA CA SDC OP 5 AM (07:00 to 10:00)
- **MQ006** - 2031 WLWA CA SDC OP 5 PM (16:00 to 19:00)

A3



Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

ARUP
The Arup Campus,
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Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Cumulative Assessment

Metres
0 425 850 1,700

WLWA RDA
AM Peak Period
Average Maximum Queue

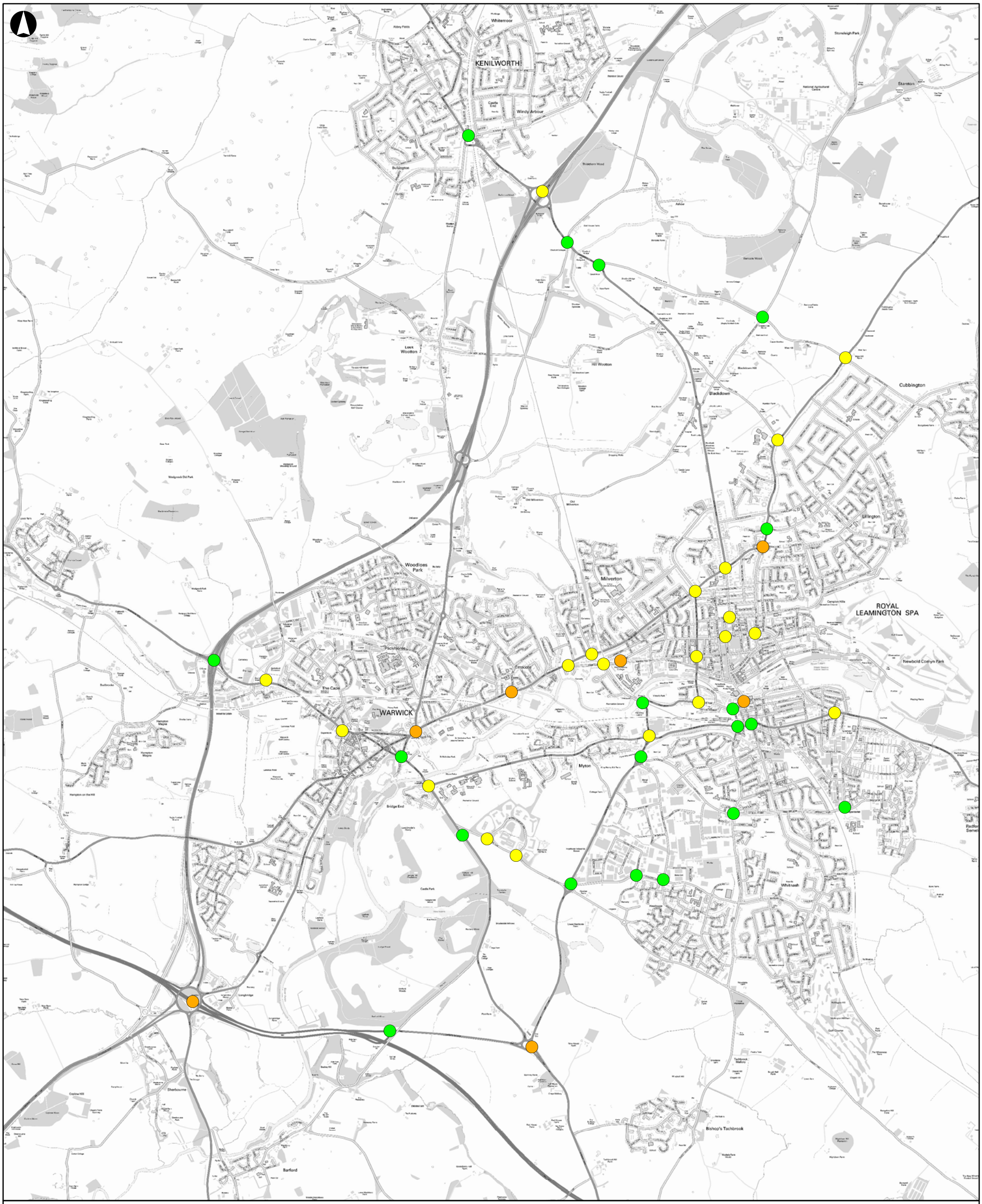
Scale at A3
N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MQ 001	**P1**

MXD Location

A3



Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

ARUP
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Client
Warwickshire County Council

Job Title
Cumulative Assessment

Metres
0 425 850 1,700

WLWA RDA
PM Peak Period
Average Maximum Queue

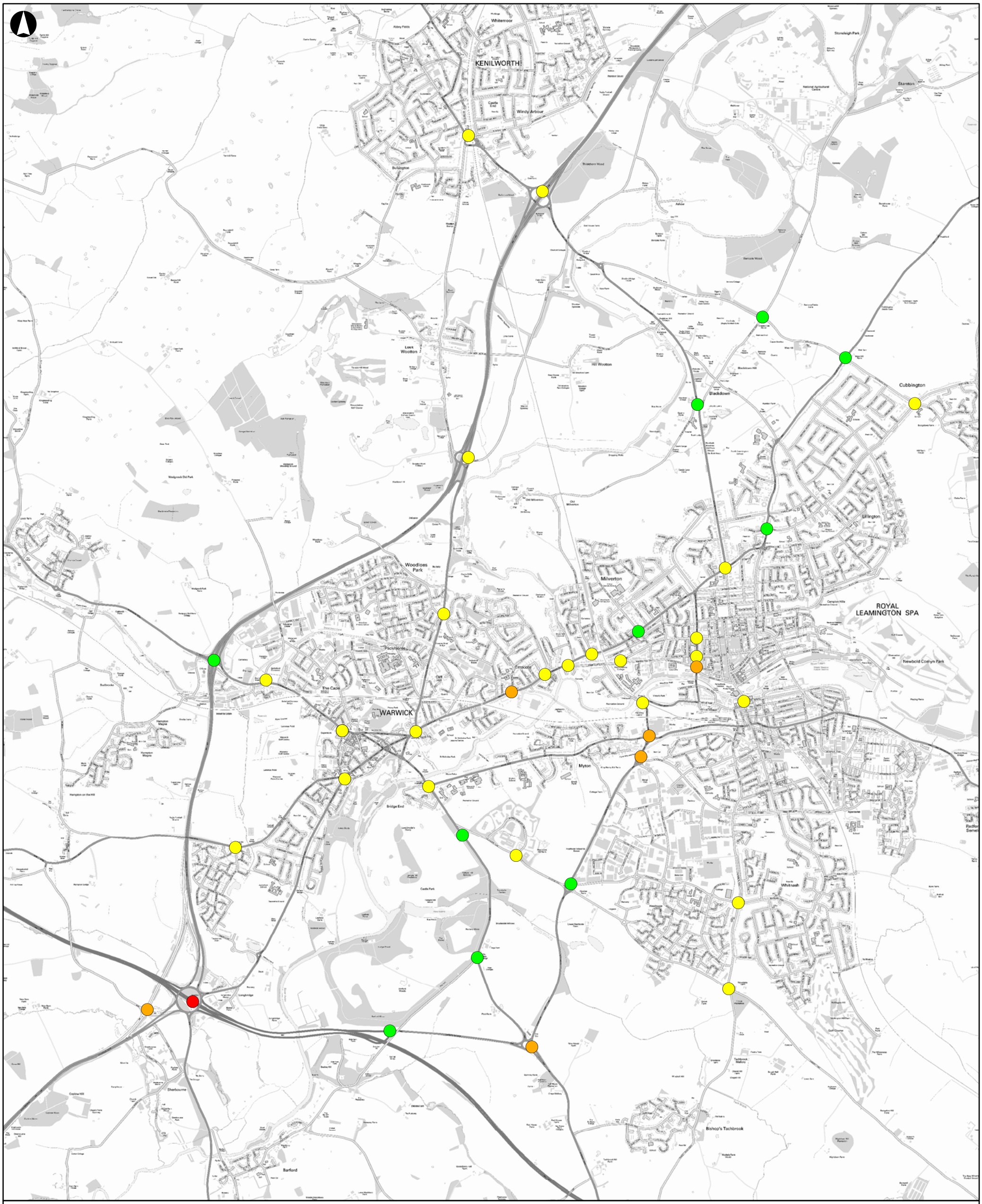
Scale at A3
N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MQ 002	**P1**

MXD Location

A3



Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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Client
Warwickshire County Council

Job Title
Cumulative Assessment

Metres
0 425 850 1,700

WLWA 2031 CA SDC Op 2
AM Peak Period
Average Maximum Queue

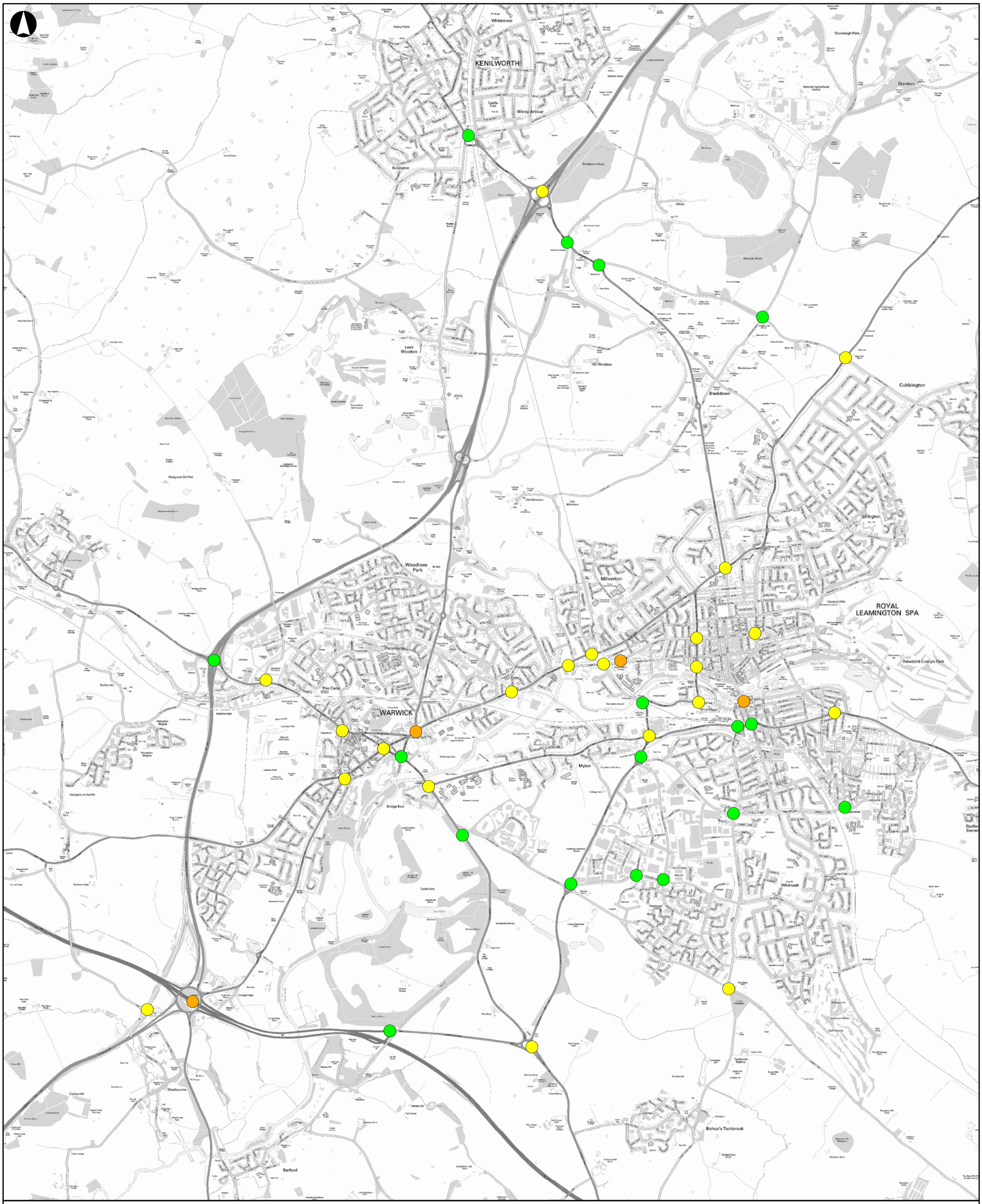
Scale at A3
N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MQ 003	**P1**

MXD Location

A3



Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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Client
Warwickshire County Council

Job Title
Cumulative Assessment

Metres
0 425 850 1,700

WLWA 2031 CA SDC Op 2
PM Peak Period
Average Maximum Queue

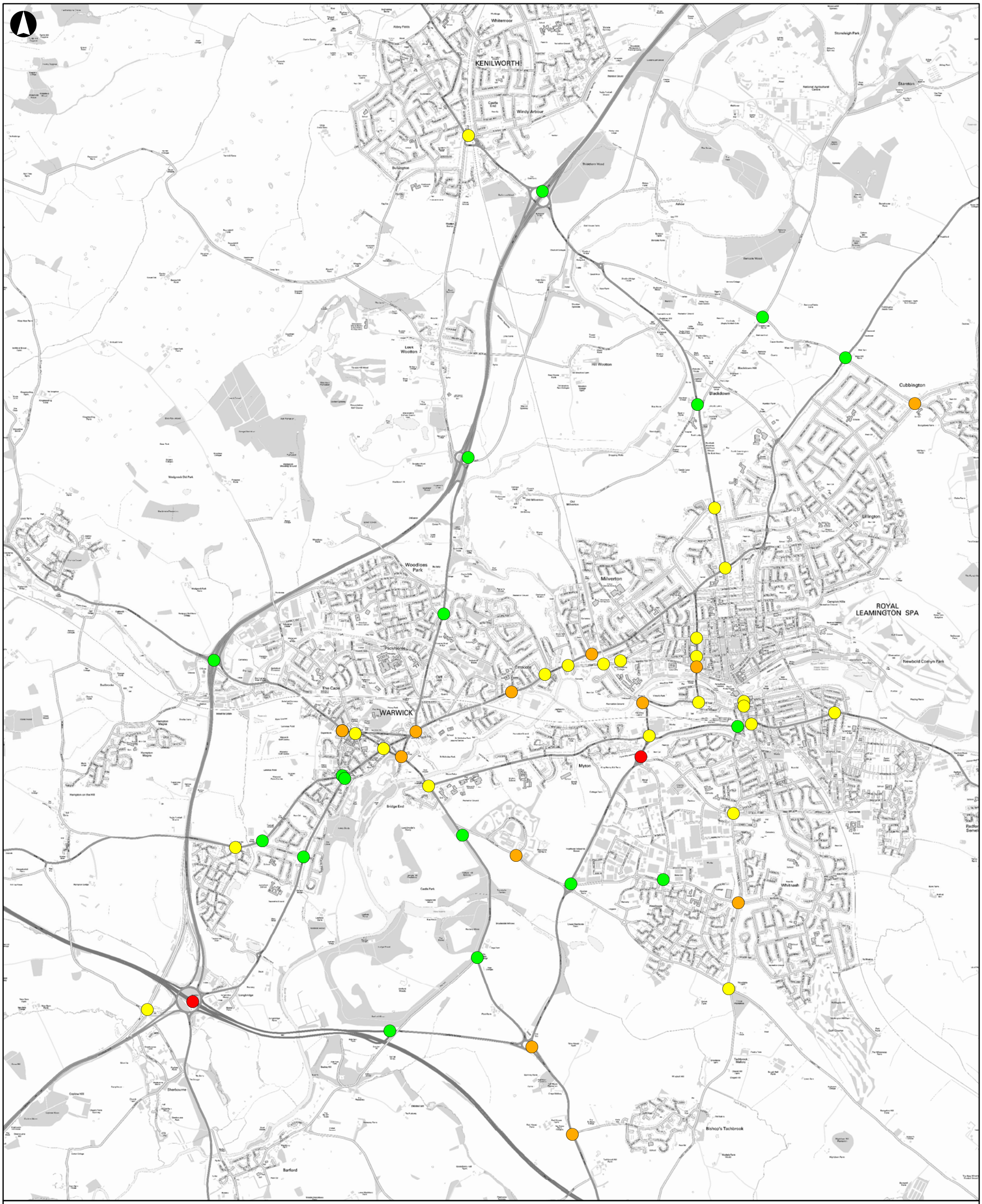
Scale at A3
N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MQ 004	**P1**

MXD Location

A3



Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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Client
Warwickshire County Council

Job Title
Cumulative Assessment

Metres
0 425 850 1,700

WLWA 2031 CA SDC Op 5
AM Peak Period
Average Maximum Queue

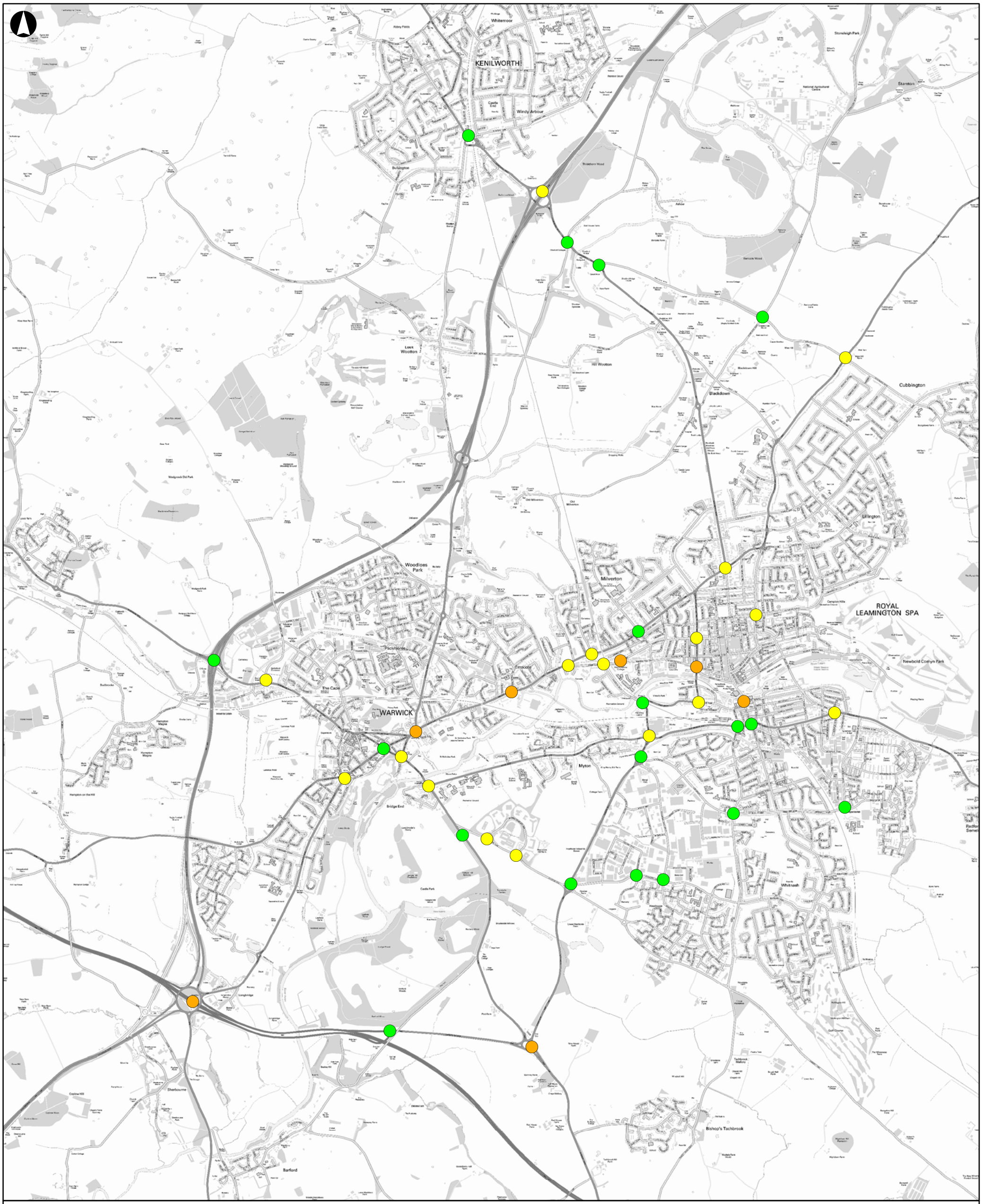
Scale at A3
N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MQ 005	**P1**

MXD Location

A3



Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 425 850 1,700

WLWA RDA + RTC
2028 PM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MQ 006	**P1**

MXD Location

Appendix B

WDC/SDC CA - Journey Time Analysis Plots

B1 Contents

- **MD001** – 2028 WLWA RDA AM (07:00 to 10:00)
- **MD002** – 2028 WLWA RDA PM (16:00 to 19:00)
- **MD003** – 2031 WLWA CA SDC OP 2 AM (07:00 to 10:00)
- **MD004** – 2031 WLWA CA SDC OP 2 PM (16:00 to 19:00)
- **MD005** – 2031 WLWA CA SDC OP 5 AM (07:00 to 10:00)
- **MD006** - 2031 WLWA CA SDC OP 5 PM (16:00 to 19:00)

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-2014	MG	JE	JE

Metres

0 700 1,400 2,800

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Warwickshire County Council

Job Title

Cumulative Assessment

WLWA RDA
AM 0800-0900
Percentage Difference Mean Delay

Scale at A3

N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MD 001	**P1**

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A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-2014	MG	JE	JE

Metres

0 700 1,400 2,800

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Client

Warwickshire County Council

Job Title

Cumulative Assessment

WLWA RDA
PM 1700-1800
Percentage Difference Mean Delay

Scale at A3

N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MD 002	**P1**

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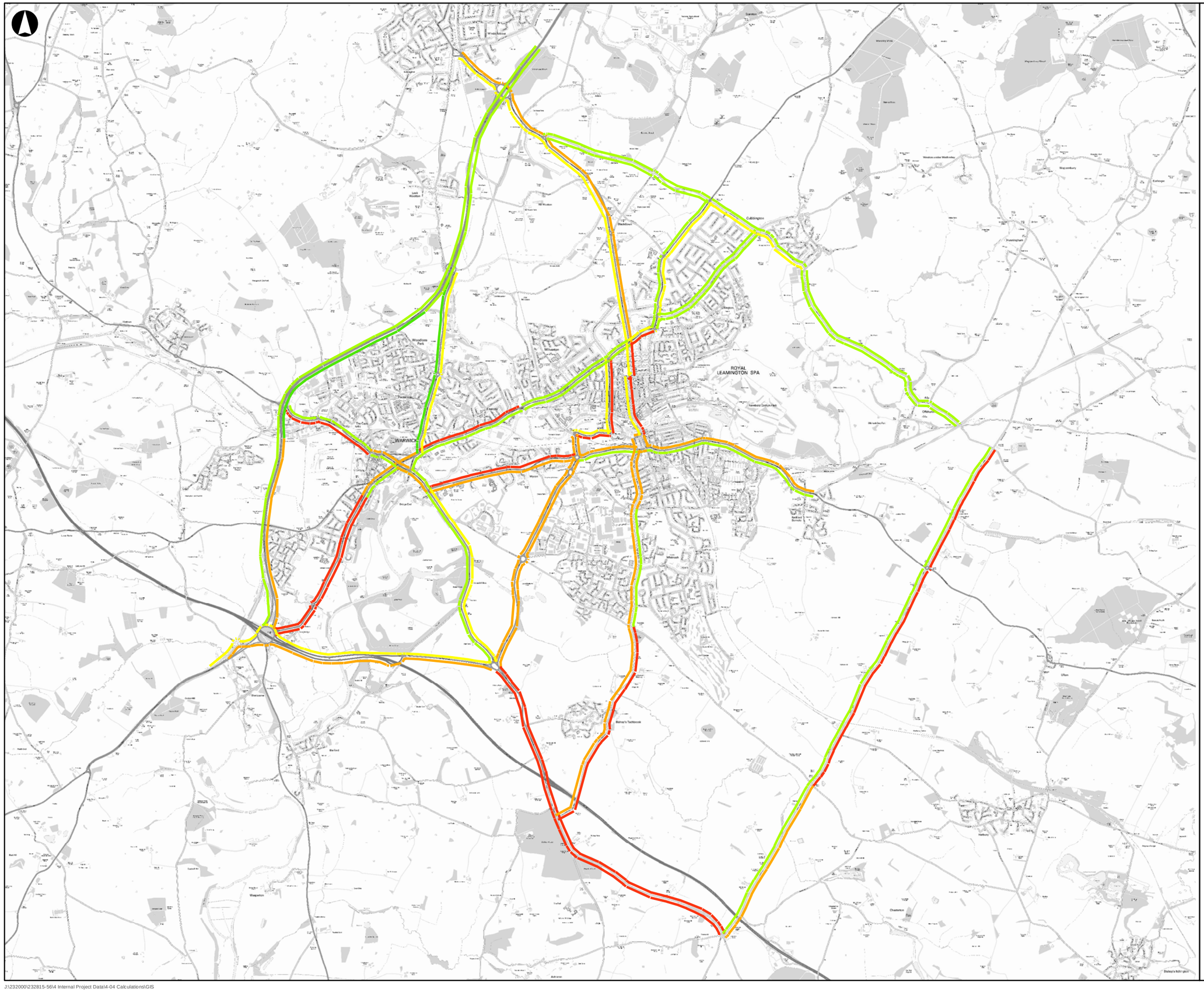
A3



Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-2014	MG	JE	JE

Metres

0 700 1,400 2,800

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Client

Warwickshire County Council

Job Title

Cumulative Assessment

WLWA 2031 CA WLWA SDC Op 2
AM 0800-0900
Percentage Difference Mean Delay

Scale at A3

N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MD 003	**P1**

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A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-2014	MG	JE	JE

Metres

0 700 1,400 2,800

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Client

Warwickshire County Council

Job Title

Cumulative Assessment

WLWA 2031 CA WLWA SDC Op 2
PM 1700-1800
Percentage Difference Mean Delay

Scale at A3

N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MD 004	**P1**

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A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-2014	MG	JE	JE

Metres

0 700 1,400 2,800

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Job Title

Cumulative Assessment

WLWA 2031 CA WLWA SDC Op 5
AM 0800-0900
Percentage Difference Mean Delay

Scale at A3

N.T.S.

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MD 005	**P1**

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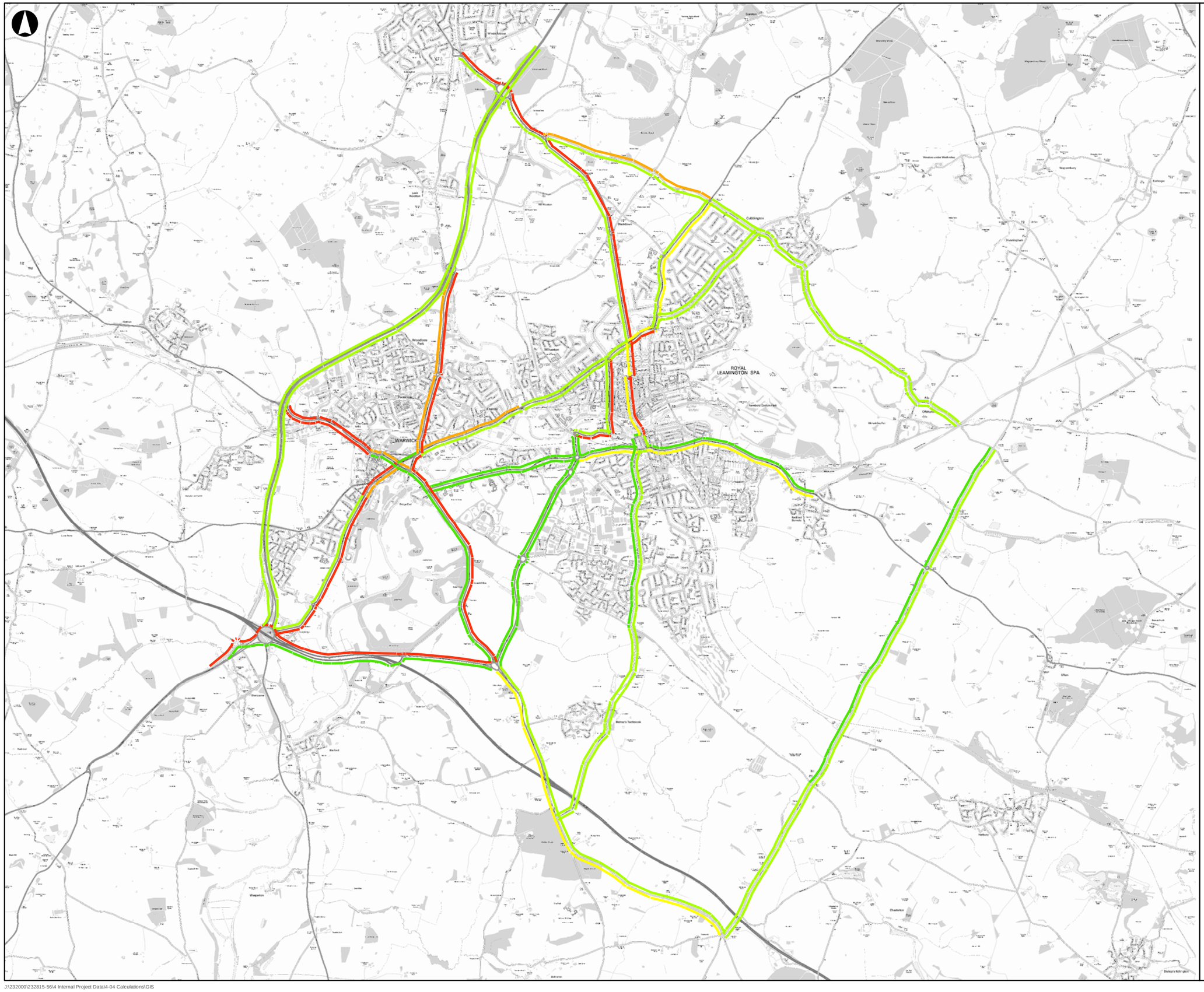
A3



Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-2014	MG	JE	JE

Metres

0 700 1,400 2,800

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Warwickshire County Council

Job Title

Cumulative Assessment

WLWA 2031 CA WLWA SDC Op 5
PM 1700-1800
Percentage Difference Mean Delay

Scale at A3

1:52,080

Job No	Drawing Status
232815-56	**Information**

Drawing No	Issue
MD 006	**P1**

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