PARSONS BRINCKERHOFF

February 2015

CARLISLE TRANSPORT IMPROVEMENT STUDY

Cumbria County Council

3513699C-PTM

Final

Carlisle Transport Improvement Study

3513699C-PTM

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Report Title	**:**	**Carlisle Transport Improvement Study**
PIMS Number	**:**	
Report Status	**:**	**Final Draft**
Job No	**:**	**3513699C-PTM**
Date	**:**	**February 2015**

DOCUMENT HISTORY AND STATUS

Document control			
Prepared by	James Collins and Craig Waller	**Checked by** *(technical)*	Chris Appleton
Approved by	Sean Ford	**Checked by** *(quality assurance)*	Sean Ford

Revision details			
Version	**Date**	**Pages affected**	**Comments**
3.0	February 2015		

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EXECUTIVE SUMMARY

Introduction

Parsons Brinckerhoff has been commissioned by Cumbria County Council to undertake a transport improvements study for Carlisle to mitigate the impact of and support the proposed Carlisle District Local Plan for the period 2015–2030. This study consists of two key linked elements:

- Identification of a range of potential sustainable transport improvements that can be delivered in Carlisle with the aim of encouraging modal shift from the car to other means of transport and reduce the impact of vehicular traffic on the road network.
- Identification of potential highways improvements at 22 junctions as agreed with Cumbria County Council, in order to increase junction capacity or provide prioritisation to pedestrians and therefore improve facilities at key traffic pinch-points in Carlisle.

These two measures are complementary solutions which could help to mitigate the impact of growth required by the Local Plan.

Local Plan Context

The study report will form part of the Carlisle Local Plan evidence base and will specifically inform Carlisle City Council's Infrastructure Delivery Plan. It will be used by Carlisle City Council to support the Local Plan through the Examination in Public.

A key thrust of the vision underpinning the Local Plan is for Carlisle to develop as a highly accessible, sustainable and healthy city. Consequently there is a strong desire to identify and pursue sustainable transport improvements; both to help accommodate growth through reducing pressures on the highway network/securing modal shift and through recognition of the wider benefits sustainable modes of travel can entail for the population.

A range of sustainable transport measures have been included in this report, specifically related to improvements to walking, cycling and public transport infrastructure. Enhancements to Travel Planning within the district have also been recommended to maximise the benefits of the recommended infrastructure.

Sustainable Transport Improvements

The existing travel mode share in Carlisle was considered and sustainable transport improvements were identified which would be expected to increase sustainable transport modal share. Sustainable transport covers four key areas: environmental, health, deprivation, and congestion.

The following points form the basis of this review:

- Existing travel to work modal share across Carlisle has been reviewed and identified potential areas for improvement within Carlisle, both at city and ward level.
- Existing and future sustainable transport infrastructure provision for all modes has been reviewed; specifically walking, cycling, and public transport.
- Travel planning processes currently in place in Carlisle and Cumbria have been reviewed and recommendations made on how they can be improved to maximise the benefit of the proposed sustainable infrastructure.
- An analysis of the likely impact of the proposed improvements on traffic flows in Carlisle.

It is intended that delivering improved options for sustainable travel will reduce the proportion of trips made by car. Reviews of literature supplied by the Department for Transport, suggest that implementation of the measures suggested will assist in reducing car modal share. Workplace travel planning, accompanied by the implementation of hard infrastructure measures can reduce car trips amongst the target population of around 18%. Assuming a third of the workplace population is targeted, this would most likely equate to a 5% peak hour reduction in the number of car trips.

Corridor Assessments

The junctions selected for review and redesign were selected in consultation with Cumbria County Council, based on outputs from the strategic traffic model using criteria relating to junction operational performance. A total of 22 junctions were selected, with focus on Hardwicke Circus and the Scotland Road, Warwick Road, London Road, Durdar Road/Blackwell Road and Wigton Road/Dalston Road corridors.

Existing performance of the identified junctions has been undertaken using industry standard junction modelling software; specifically LinSig, PICADY and ARCADY. These models presented information on existing junction capacity, delay and queue lengths on each junction arm.

Traffic flow data for base and future years were obtained from the Carlisle strategic traffic model, which has been prepared and maintained by Cumbria County Council. These flows were used to create detailed models to forecast junction performance.

Where junctions were found to have capacity issues, potential junction improvements were identified with the intention of improving the operation of the junction. Suggested improvements range from amending traffic signals and existing delineation to improve traffic management, through to the creation of additional road space to increase capacity.

These potential improvements were then modelled to assess the impact of the capacity improvements.

Infrastructure Cost Summary

Highway improvement and sustainable infrastructure schemes have all been listed with supplied estimated costs based either on existing figures supplied by Cumbria County Council, previous schemes undertaken by Parsons Brinckerhoff or through review of other similar schemes in the UK.

It is intended that funding for the potential schemes would in the first instance come from developer funding from the Local Plan sites and other developments that come forward during the plan period. Developer funding mechanisms used may include Section 106 or 278 Agreements and the Community Infrastructure Levy if introduced.

Where there is a shortfall in developer funding, it may be sought from other external sources such as:

- Department for Transport
- Local Growth Fund
- European Regional Development Fund

The delivery of schemes will be dependent upon securing external funding, as they cannot be accommodated within existing budgets.

Conclusions

The following conclusions have been drawn from the study:

- There are a number of opportunities to deliver improved sustainable transport infrastructure in Carlisle, which is a compact city that (with further improvements) can be made highly accessible for pedestrians, cyclists and public transport users.
- A number of junctions in Carlisle are operating at or above capacity and, without action, traffic flows would be expected to worsen as Local Plan development is completed.
- There are a number of opportunities to enhance capacity at a number of pinch-point junctions through the strategic redesign of various arrangements.
- Detailed junction modelling supports that proposed highway improvements are capable of significantly enhancing capacity on the Carlisle road network and therefore enabling future development growth.

It is anticipated that delivery of the recommended sustainable transport schemes can realistically achieve a 5% reduction in traffic across Carlisle, contributing to improved traffic flows in Carlisle and creating a more accessible, healthier city.

1 INTRODUCTION

1.1 Overview

1.1.1 Parsons Brinckerhoff (PB) has been commissioned by Cumbria County Council (CCC) to undertake a transport improvements study for Carlisle to mitigate the impact of and support the proposed Carlisle District Local Plan for the period 2015–2030. This Local Plan is a high level plan which contains strategic policies, detailed development management policies and specific site allocations for development, together with a broad location for growth, which will commence delivery towards the end of the overall plan period. Whilst the area covered by the Local Plan extends to the whole district, which consists of over 1,000 square kilometres of land and includes a large rural area, the transport improvements study concentrates on the urban area of Carlisle.

1.1.2 This study consists of two key linked elements:

- Identification of a range of potential sustainable transport improvements that can be delivered in Carlisle with the aim of encouraging modal shift from the car to other means of transport and reduce the impact of vehicular traffic on the road network.
- Identification of potential highways improvements at 22 junctions as agreed with Cumbria County Council, in order to increase junction capacity or provide prioritisation to pedestrians and therefore improve facilities at key traffic pinch-points in Carlisle.

1.1.3 These two measures are complementary solutions intended to mitigate the impact of growth required by the Local Plan.

1.2 Purpose of Report

1.2.1 The Carlisle Transport Improvements Study report will form part of the Carlisle District Local Plan evidence base and will specifically inform Carlisle City Council's Infrastructure Delivery Plan.

1.2.2 It will be used by Cumbria County Council and Carlisle City Council to identify transport improvements that could help address the cumulative effects of development over the plan period. It does not seek to identify longer-term strategic improvements or the rerouting of traffic across the city centre.

1.3 Report Structure

1.3.1 The remainder of this report is structured as follows:

Section 2	*Local Plan Context – Placing the context of the project in terms of the Carlisle District Local Plan*
Section 3	*Assessment Methodology – Details on the sustainable transport review, the selection process for each junction improvement and how traffic data has been collected and utilised to review the junction improvements*
Section 4	*Sustainable Transport Infrastructure – A review of existing walking, cycling, public transport and travel planning provision in Carlisle, with supplied details of proposed improvements for each mode*
Section 5 - 10	*Details and assessment of junction improvements for all identified junctions*
Section 11	*Infrastructure Cost Summary – Costings for sustainable transport improvements and junction improvements*
Section 12	*Summary and Conclusion – Outline of the key findings of the study*

2 LOCAL PLAN CONTEXT

2.1 Carlisle Local Plan

2.1.1 The Carlisle District Local Plan will present the development aspirations for Carlisle up to 2030.

2.1.2 In the context of this study, understanding the quantum and location of development likely to occur in Carlisle will assist in the determination of the transport schemes that should be brought forward to unlock future proposed growth by mitigating their anticipated impact upon the local highway network.

2.1.3 The Carlisle District Local Plan identifies specific development sites to 2025. Further development from 2025 to 2030 is identified at the broad location of South Carlisle.

2.1.4 In total the Carlisle District Local Plan to 2025 includes the following scales of development:

- 2,043 urban residential dwellings (excluding those with planning permission or live planning applications);
- 1,260 rural residential dwellings (excluding those with planning permission or live planning applications);
- 8,175 sq.m A1 food retail development.
- 27,620 sq.m A1 non-food retail development.
- 1,929 sq.m A3 restaurant/café development.
- 37,415 sq.m B2 or B8 employment development.
- 8,000 sq.m D1 non-residential institution development.
- 6,800 sq.m D2 leisure development.

2.1.5 The Carlisle Local Plan also identifies a broad location for strategic growth at South Carlisle. The delivery of development at this area would commence in 2025 and potentially continue after the end of the plan period in 2030. Consideration has been given to the anticipated levels of development up to 2030 as follows:

- 2,825 residential dwellings in South Carlisle.
- 40,000 sq.m B1 / B2 / B8 employment development in South Carlisle.

2.1.6 A map of the Local Plan site and a full breakdown of development quanta are included in Appendix I of this report.

2.1.7 Sections 5 to 10 of this report address how these Local Plan developments are anticipated to impact on the local highway network in Carlisle.

3 ASSESSMENT METHODOLOGY

3.1 Sustainable Infrastructure

3.1.1 Baseline sustainable travel infrastructure has been reviewed as a part of this scheme with the aim of identifying possible areas of improvement. Having identified areas for potential improvement in the system and consulting with Cumbria County Council, a range of sustainable infrastructure measures have been recommended with the target of further improving traffic flow through the identified junctions by providing a viable alternative to car based trips.

3.2 Corridor Assessment Overview

3.2.1 This section describes the methodology of the junction appraisal and includes the assessment years, peak hours, traffic flow and forecasting assumptions including committed development, the software utilised and the process used to select specific junctions to be included within the study.

3.2.2 The assessment is based on the results of the Carlisle SATURN strategic traffic model, developed by Cumbria County Council to assess the transport implications of the Local Plan. The transport model consists of a morning peak period (08:00-09:00) and an evening peak period (17:00-18:00) which have been run for the following three future year design scenarios:

- **2025 Base**: includes developments which have planning permission and live applications with the potential to gain permission in the near future.
- **2025 Local Plan**: includes the Local Plan proposals for housing, employment, retail and leisure.
- **2030 Local Plan**: includes potential proposals for a strategic urban extension to South Carlisle to the end of the Plan period.

3.2.3 The transport model contains separate vehicle classes for cars, light goods vehicles (LGV) and heavy goods vehicles (HGV).

3.2.4 The outputs from the traffic model were analysed by Cumbria County Council for delay at junctions and an initial list of the worst performing junctions was provided to PB as a starting point for this assessment. The list contained 27 junctions on key radial routes into the city centre.

3.2.5 Further details on the transport modelling are provided in the Carlisle Local Plan Transport Modelling report.

3.3 Traffic Flow, Forecast Years, and Peak Hours of Assessment

3.3.1 All the traffic flow information used in this assessment was provided to PB by Cumbria County Council and originated from the Carlisle SATURN model. These flows have been used in the traffic modelling and each junction has been assessed for the following six future year design scenarios:

- 2025 Base AM.
- 2025 Base PM.
- 2025 Local Plan AM.

- 2025 Local Plan PM.
- 2030 Local Plan AM.
- 2030 Local Plan PM.

3.3.2 The forecast assumptions used within the traffic modelling undertaken by Cumbria County Council to produce the above six scenarios, follow the guidance set out in the Department for Transport's Transport Appraisal Guidance Unit M4: Forecasting and Uncertainty (May 2014).

3.3.3 For cars; growth factors were calculated from the National Trip End Model (NTEM) dataset using the Trip End Model Presentation programme (TEMPRO). There are a significant number of committed developments in and around Carlisle, so the 'Alternative Assumptions' facility within TEMPRO was used for the Carlisle urban area as follows:

- The Carlisle District Local Plan has an annual average housing target of 565 dwellings, 70% of which will be in the urban area. This was used as a baseline for the urban household numbers in 2025 and 2030 which gave 4,270 and 7,095 additional dwellings respectively.
- For the 2025 Base scenario, the baseline number of dwellings was reduced based upon the number of dwellings included in the committed developments (3,167 in the urban area).
- For the 2025 Local Plan scenario, the number of dwellings identified in the committed development and Local Plan sites was greater than the identified housing need, so the future year number of dwellings was set equal to the 2013 assumption in NTEM.
- For the 2030 Local Plan, the future year number of dwellings was set equal to the 2013 assumption in NTEM.

3.3.4 This process ensures the impact of new housing is not double-counted, but the growth factors represent other effects, such as changes in car ownership. The Carlisle (rural) and Brampton areas were adjusted as per the methodology for the 2025 base scenario. The forecast used a fixed demand approach so fuel and income factors were also applied to the NTEM factors.

3.3.5 For LGVs and HGVs; growth factors were calculated using the National Traffic Model (NTM) forecasts and adjusted using NTEM factors.

3.4 Junction Assessment Software

3.4.1 The junction assessment software used in this study is set out below:

- Junctions 8.0.2.316 ARCADY module: for roundabouts;
- Junctions 8.0.2.316 PICADY module: for priority T-junctions and priority crossroads; and
- LinSig 3.1.7.0 for signalised junctions and gyratories.

3.4.2 ARCADY and PICADY report the junction results as a Ratio of Flow to Capacity (RFC). The RFC is a measure of junction performance, as a ratio of traffic demand to available junction capacity. An RFC of less than 0.85 indicates that the junction is performing effectively, above 0.85 indicates that the junction is nearing capacity and greater than 1.00 confirms that the junction is operating over capacity.

3.4.3 LinSig reports the junction results as Degree of Saturation (DOS) which is identical to RFC but presented as a percentage. A DOS of less than 90% indicates that the junction is performing effectively, above 90% indicates that the junction is nearing capacity and greater than 100% confirms that the junction is operating over capacity.

3.4.4 The traffic flows have been entered in passenger car units (PCU) for a one hour period. All ARCADY and PICADY models have used the 'One Hour' flow profile to ensure robustness.

3.5 Junctions Included in Study

3.5.1 The initial list of 27 junctions identified by the strategic traffic model consisted of key locations on radial routes identified as experiencing high levels of delay or a high RFC in the strategic model within the forecast year scenarios. Of the initial 27 junctions identified by Cumbria County Council, a number have been removed from the detailed assessment undertaken in this study following further analysis.

3.5.2 Table 3-1 provides the list of junctions considered for assessment alongside the rationale for their inclusion or exclusion. In general, junctions with a forecast RFC greater than 0.95 have been included in the study as this demonstrates that they are experiencing capacity issues.

Table 3-1: Junctions Assessed Within Study

Radial Route	Junction	Assessed within Study	Reason for Inclusion / Exclusion
City Centre	Hardwicke Circus	✓	Key junction and operates with an RFC greater than 0.95 in the AM peak and RFC greater than 1.00 in the PM peak.
Scotland Road	Scotland Road / Briar Bank / Morrisons	✓	Operates with an RFC greater than 1.00 in both peaks.
	Scotland Road / Etterby Street	✓	Operates with an RFC greater than 1.00 in the PM peak.
	Stanwix Bank / Brampton Road	✓	Operates with an RFC of 1.00 in the PM peak.
Warwick Road	Warwick Road / Montgomery Way / Tesco	✓	Operates with an RFC greater than 1.00 in both peaks.
	Warwick Road / Eastern Way	✓	Operates with an RFC greater than 1.00 in both peaks.
	Warwick Road / Victoria Road	✗	Increasing capacity may increase the junction's attractiveness as a rat-run. Not desirable in a 20mph zone.
	Warwick Road / Greystone Road	✓	Operates with an RFC greater than 1.00 in the AM peak and greater than 0.95 in the PM peak.
	Georgian Way / Victoria Place	✓	Operates with an RFC greater than 1.00 in both peaks.

Radial Route	Junction	Assessed within Study	Reason for Inclusion / Exclusion
London Road	London Road / Eastern Way	✓	Operates with an RFC greater than 1.00 in the AM peak.
	London Road / B&Q	✓	Operates with an RFC greater than 0.95 in the AM peak.
	London Road / Brook Street / St Nicolas Retail Park	✓	Operates with an RFC greater than 1.00 in the PM peak. The junction has recently been converted to a signalised junction.
	Botchergate / St Nicholas Street	✓	Operates with an RFC greater than 0.95 in the AM peak and greater than 1.00 in the PM peak.
	Botchergate / Tait Street / Crown Street	✓	Operates with an RFC greater than 0.95 in the AM peak and greater than 1.00 in the PM peak.
	Botchergate / The Crescent	✓	Operates with an RFC of 0.95 in the PM peak.
Durdar Road / Blackwell Road	Durdar Road / Newbiggin Road	✓	Operates with an RFC in excess of 1.00 in both peaks.
	Upperby Road / St Ninian's Road	✓	Operates with an RFC greater than 1.00 in both peaks.
	Currock Road / Crown Street	✓	Operates with an RFC greater than 0.95 in the PM peak.
	James Street / Victoria Viaduct / Nelson Bridge	✓	Operates with an RFC greater than 1.00 in both peaks.
Wigton Road / Dalston Road	Wigton Road / Queensway	✗	The junction only has a capacity problem in the AM peak. The junction lies on a radial route but is not 'strategic'.
	Wigton Road / Orton Road	✓	Key junction on a radial route.
	Dalston Road / Nelson Street	✗	Increasing capacity may increase the junction's attractiveness as a rat-run. Not desirable in a traffic calmed area.
	Dalston Road / Stanhope Road	✗	Increasing capacity may increase the junction's attractiveness as a rat-run. Not desirable in a 20mph zone.

Radial Route	Junction	Assessed within Study	Reason for Inclusion / Exclusion
	Wigton Road / Stanhope Road	✗	Junction has been designed with a build-out to aid pedestrians and there is a nearby pedestrian crossing on Wigton Road.
	Shaddongate / Junction Street	✓	Junction operates with a V/C greater than 0.95 in both peaks.
	Wigton Road / Caldcoates	✓	Operates with a V/C greater than 1.00 in both peaks.
	Bridge Street / Shaddongate / Church Street / John Street / Sainsbury's	✓	Operates with a V/C greater than 1.00 in both peaks.

3.5.3 Following this initial filtering process, the remaining 22 junctions were progressed to the next stage of the assessment which analysed specific capacity issues associated with each junction. Potential mitigation measures were designed where appropriate and the junctions re-modelled to illustrate the potential impact of the mitigation.

4 SUSTAINABLE TRANSPORT IMPROVEMENTS

4.1 Introduction

4.1.1 This section considers the existing mode share in Carlisle and identifies sustainable transport improvements which would be expected to increase the sustainable transport modal share.

4.1.2 The following points explain in greater detail why it is considered important to increase the existing sustainable transport modal share in Carlisle:

- Environmental – A reduction in the number of car trips will result in improved air quality in Carlisle and a reduction in the carbon footprint of Carlisle's road traffic.
- Health – 61.9% of UK residents are overweight; a trend that has been rising over the past 20 years. Providing healthy choices to travel enables the residents of Carlisle to adopt a healthier lifestyle and in return deliver the associated economic benefits that this supplies.
- Deprivation – By providing alternative travel opportunities to the most deprived households who may not own a car, improved access to employment and other essential services is delivered.
- Congestion – It is important that improvements to road infrastructure and junction pinch-points are counterweighted by sustainable measures to ensure that junction improvements do not simply increase the number of drivers on the road, but instead deliver further capacity improvements through a reduction in the number of car trips.

4.1.3 The following points form the basis of this review of sustainable transport infrastructure provision in Carlisle.

- A review of existing travel to work modal share, including a review of trends across each of the wards within Carlisle's urban area. This will be used to identify potential areas for improvement, both at city and ward level.
- A review of existing and future sustainable transport infrastructure provision for all modes; specifically walking, cycling, and public transport. This review comprises four parts:
    - A review of the existing infrastructure provision for each mode and the associated issues.
    - A review of current aspirational infrastructure improvements for each mode, based on existing policy documents including the Carlisle Local Plan (2001–2016) and Cumbria LTP3 and with due consideration to information provided in consultation with Cumbria County Council and Carlisle City Council.
    - An analysis of potential further schemes that could realistically be introduced in Carlisle.
    - A description of all recommended schemes and associated costs, where available.
- A review of travel planning processes currently in place in Carlisle and Cumbria with recommendations on how this can be improved to maximise the benefit of the proposed sustainable infrastructure.

- An analysis of the likely impact of the proposed improvements on traffic flows in Carlisle.

4.2 Carlisle Transport Modal Share Profile

4.2.1 Table 4-1 shows the travel to work data from the 2011 Census for the working population, which clearly illustrates that compared to the North West and England, the district of Carlisle (including surrounding rural conurbations):

- Has public transport use of less than half the national average.
- Has a higher share of journeys to work on foot.
- Has a similar share of journeys to work by bicycle.
- Has a greater share of journeys to work by car compared to England, although this is in line with the North West region.

Table 4-1: Travel to Work Modal Share in Carlisle (Source: Census 2011)

	Carlisle	North West	England
Car / Van / Taxi / Motorcycle	65.7%	67.0%	60.2%
Public Transport	7.2%	11.4%	16.4%
Walk	14.6%	10.0%	9.8%
Bicycle	2.5%	2.1%	2.9%
Work from Home	9.6%	9.0%	10.3%
Other	0.3%	0.4%	0.4%

4.2.2 The census data, therefore, indicates that the areas with the most significant need for improvement are public transport and cycling, although opportunities to consolidate and improve walking modal shares should also be considered.

4.2.3 It is evident that the relative popularity of walking in Carlisle may be expected to impact the proportion of residents using buses or electing to cycle. The reasons for this will be considered further as part of the review of existing walking infrastructure.

4.2.4 2011 travel to work census data is also presently available at ward level in Carlisle, however, it has not been fully aggregated and can therefore not be directly compared against the figures provided in Table 4-1. Travel to work from each ward via the following modes and have been shown as a heat map below:

- Car or Van as driver (Figure 4-1).
- Public Transport (Figure 4-2).
- Working from Home (Figure 4-3).

Figure 4-1: Car or Van Travel to Work Mode Share (Source: Census 2011)

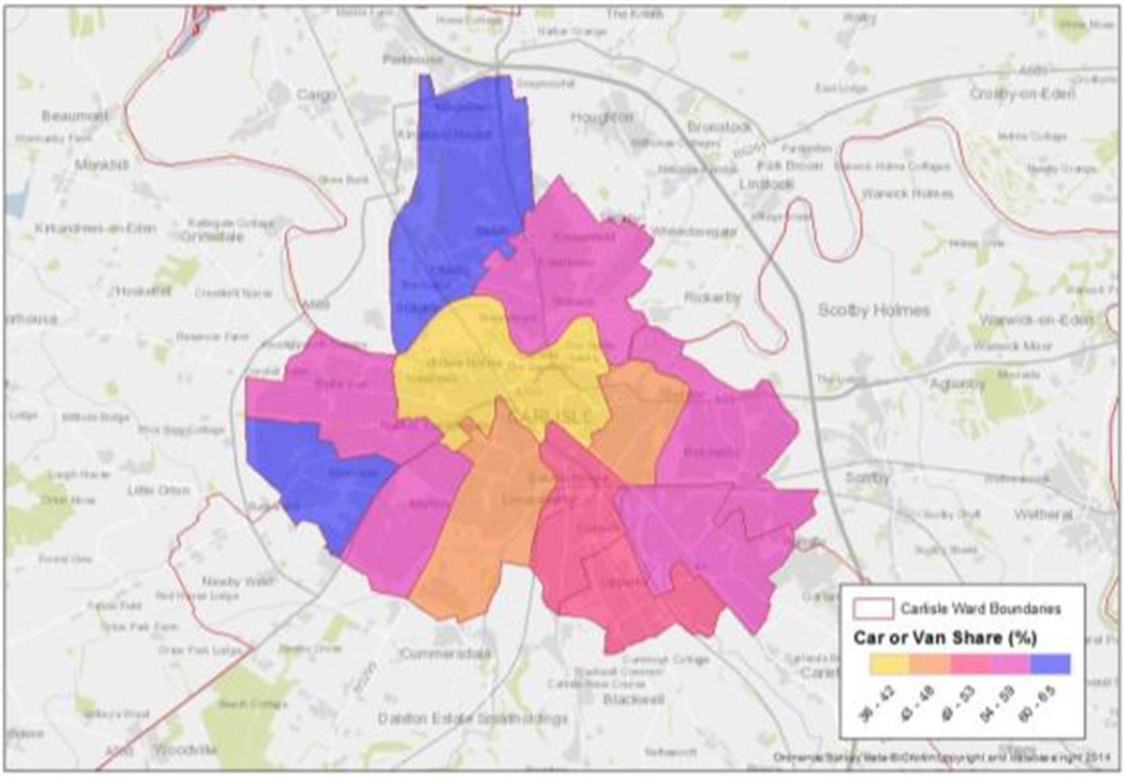


Figure 4-2: Public Transport Travel to Work Mode Share (Source: Census 2011)

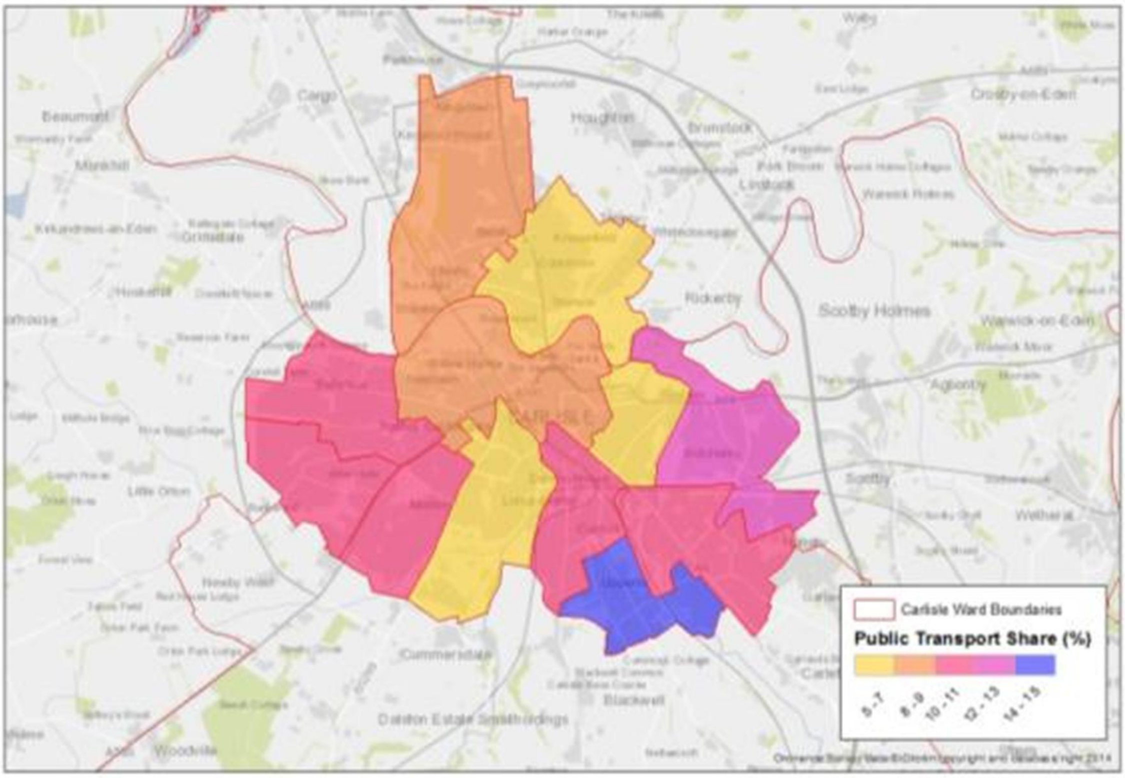
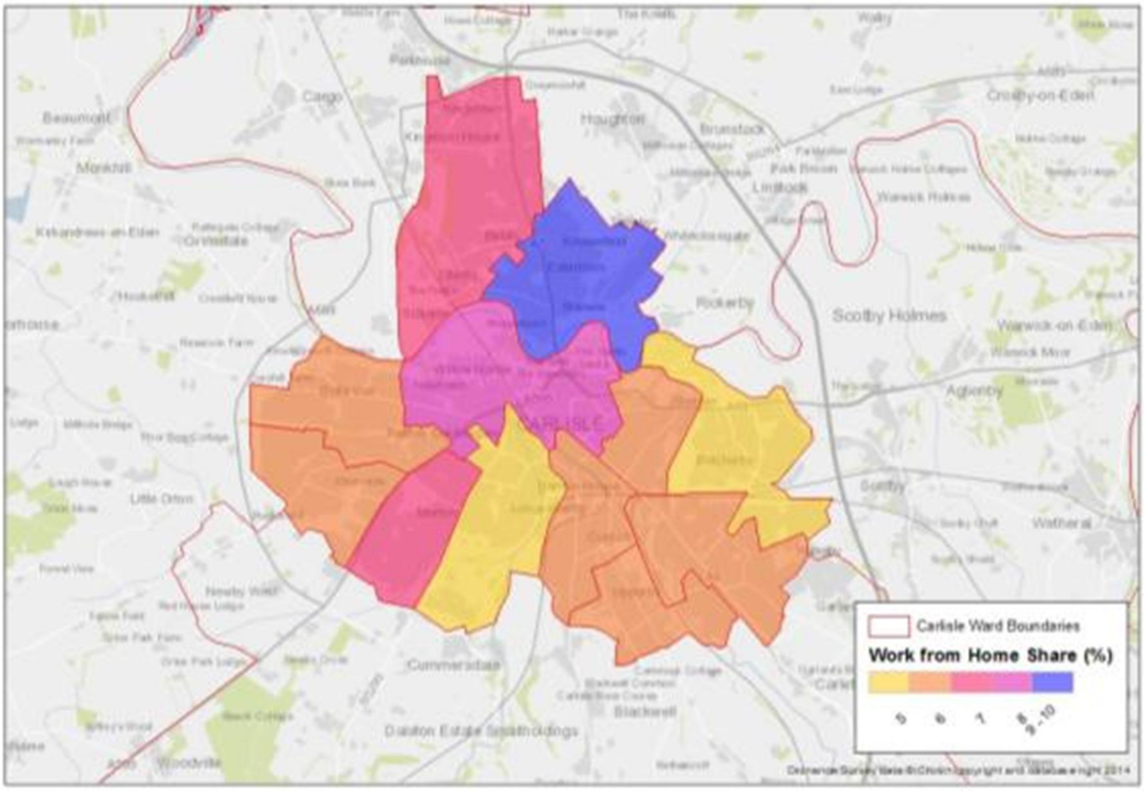


Figure 4-3: Work from Home Travel to Work Mode Share (Source: Census 2011)



4.2.5 The heat maps show disparity across the city in terms of modal share. Towards the centre of Carlisle (in the Castle ward) there are significant reductions in car trips, as is typical in any urban area where the distance between home and employment is relatively short and therefore residents are more inclined to walk or cycle.

4.2.6 The Belah and Yewdale wards of Carlisle presently have a high share of car drivers. In comparison Denton Holme and St. Aidans to the south and southeast of Carlisle's centre experience relatively low levels of car use.

4.2.7 A review of public transport use across the wards would suggest that the greatest proportion of public transport trips come from the south west and south east of the city, whereas south, central and north Carlisle have relatively low shares of public transport use.

4.2.8 The greatest proportion working from home occurs in north Carlisle, however, it is also combined with high car usage, which results in a reasonably low proportion of residents electing to travel by sustainable means to the north of Carlisle.

4.3 Walking

<u>Existing Infrastructure and Issues</u>

4.3.1 As described in Section 4.2, there is a relatively high proportion of walking trips to and from work in Carlisle, with the 2011 Census recording 14.6% which is significantly in excess of the national average of 9.8%.

4.3.2 This high proportion is demonstrative of a pre-existing urban environment in Carlisle that is particularly conducive to supporting an effective pedestrian environment. Key features of Carlisle that promote walking include:

- A compact city with relatively short distances between residential and employment locations, meaning that the option of walking to work is available to many residents.
- High quality pre-existing pedestrian facilities in Carlisle, including wide footways, and numerous pedestrian crossings, offering good connectivity to pedestrians.
- Narrow, single carriageway 30 mph radial routes in Carlisle do not promote the dominance of the car over other road users.
- Positive perceptions of Carlisle residents towards walking, as seen in Cumbria as a whole where walking remains a regular recreational activity.

4.3.3 It should also be noted that the above features promote walking not only instead of car use, but instead of other modes of transport, specifically the bus, where journey distances are compact and residents may prefer to walk for longer than have to wait for/pay for a bus.

4.3.4 A visit to the city centre has found the area to be highly accessible to pedestrians, with wide footways and good utilisation of green infrastructure, public realm and the local historical architecture to create a pleasant environment for pedestrians.

4.3.5 Nevertheless, in adopting the principles of Manual for Streets (MfS) consideration should be given to whether the local environment is convenient and attractive to walk within, thus reducing potential reliance on motorised vehicles. When considering pedestrians as the main priority within the MfS hierarchy of road users; there remain issues on the periphery of the city centre which currently prioritise motorists:

- Use of guard rails on a number of streets.
- Wide carriageways with 30 mph speed limits.
- Minimal road crossing opportunities for pedestrians.

4.3.6 These issues are particularly prevalent on Lowther Street and Botchergate in the area between the bus station and rail station, and on Bridge Street/Castle Way to the north, where a dual carriageway separates the city centre from adjoining areas, forcing pedestrians to make significant detours to cross this road.

4.3.7 Existing signage to key attractors is of low standard with poor visibility and with minimal detail.

<u>Current Aspirations</u>

4.3.8 To deliver the sustainable development aspired for in the Carlisle Local Plan it is essential that the individual sites provide good quality links to the existing pedestrian network.

4.3.9 Consultation with officers in Cumbria County Council has indicated the most recent pedestrian study undertaken in Carlisle was in October 2008 in the form of the Pedestrian Links to the City Centre report. Through consultation with Cumbria County Council, it has been established that the following issues remain aspirational for Carlisle:

- Improved pathfinding and accessibility between public transport interchanges and the city centre and its key attractors.
- Improved pathfinding and accessibility between car parks and the city centre and its key attractors.
- Improved signage for pedestrian routes to schools.

Recommended Improvements

4.3.10 The following infrastructure improvements are recommended in order to consolidate and improve the existing high quality pedestrian infrastructure in Carlisle:

1. Development of a signage strategy across Carlisle, aimed at pedestrians and cyclists. Signage should be designed to assist in linking pedestrians between key attractors in the city centre, the bus station and the rail station, in addition to providing information at local car parks.

   Signage should also provide directions between residential developments and schools. The signs should also be delivered on key radial routes and, where appropriate, associated with all Local Plan developments which are brought forward.

   Signage should be of a high quality, of an appropriate design for its surroundings and include cycle network information where relevant, in addition to promoting the relative distances between locations in Carlisle (potentially presented in terms of journey times).

   In the city centre, it is envisaged that the signage would upgrade existing provisions, rather than cluttering the streets with a range of new signage. However, on routes into the city signage would need to be introduced at key strategic locations.
2. A study should be undertaken with a focus on redesigning the urban realm around the city centre, specifically Lowther Street and Botchergate. Redesign should focus on generating a more accessible and permeable city centre, including the removal of unnecessary guard rails, where safe and appropriate to do so, and traffic calming measures that will focus on reclaiming the city centre periphery for pedestrians.
3. Utilising the planning process to ensure all Local Plan developments deliver high quality pedestrian connectivity to the existing pedestrian network. Pedestrian links should adhere to best practice guidance from Manual for Streets and avoid measures that give preference to the car such as guard rails, where safe and appropriate.
4. Utilisation of off-road cycle routes detailed in Section 4.4.

4.4 Cycling

Existing Infrastructure and Issues

4.4.1 2.5% of Carlisle residents travel to work by bicycle which is slightly below the national average of 2.9%.

4.4.2 Figure 4-3 shows the existing cycle network in Carlisle, which consists of a number of adopted and unadopted routes. The network shows relatively good coverage throughout the south of Carlisle with at least partial routes from the south west, south and south east of Carlisle towards the city centre. There is also significant cycle lane provision around the west of the city, which was delivered as part of the CNDR scheme.

4.4.3 North of the River Eden there is presently less cycle network coverage, although there are cycle lanes across the Eden Bridge, meaning that the River Eden is not in itself a barrier to cycle trips from the north.

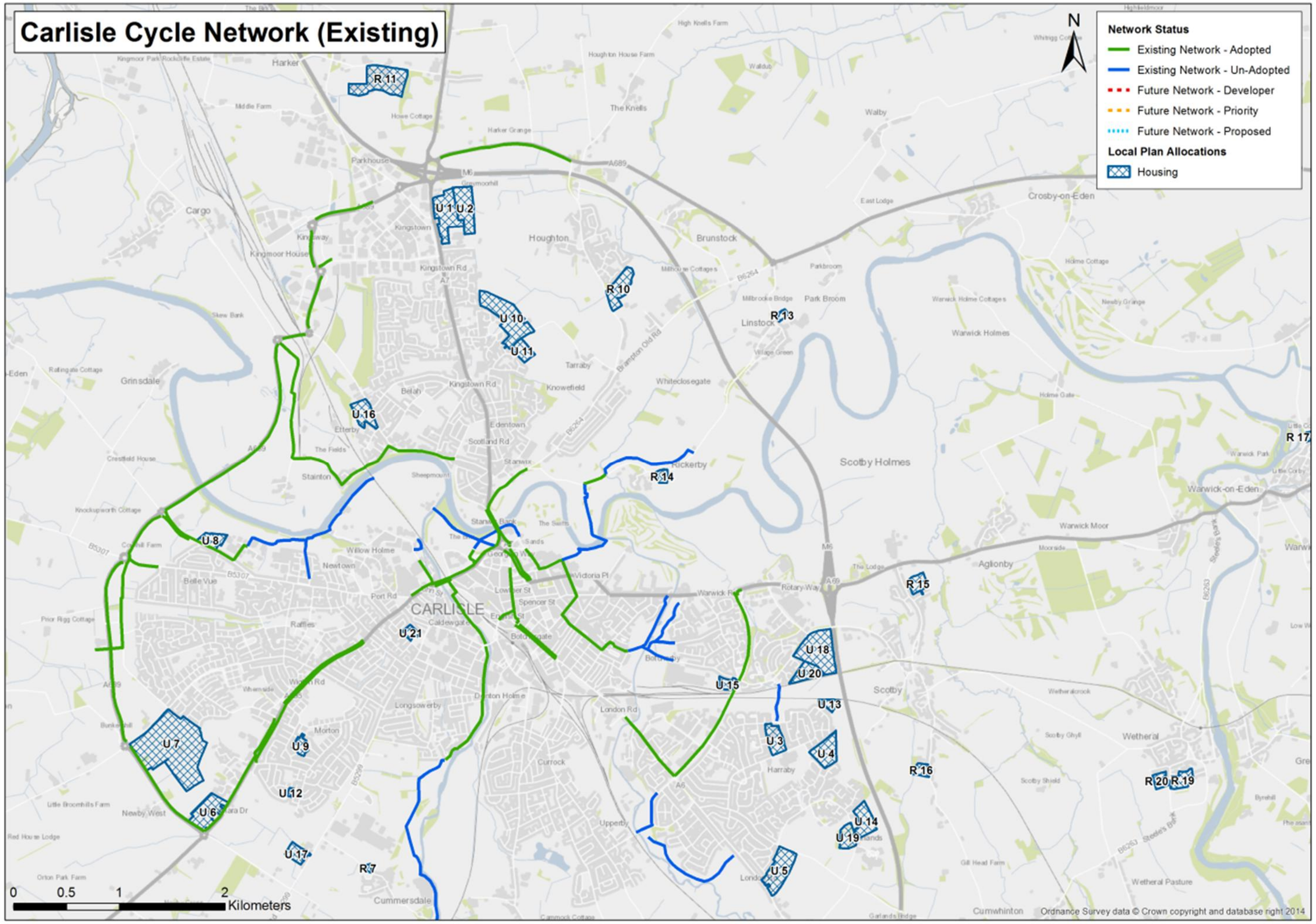


Figure 4-3: Existing Carlisle Cycle Network

4.4.4 When considering the existing cycle network in the context of travel to work modal shares, as shown in Figure 4-4, it demonstrates that in those wards where car trips to work are less prevalent, there is a direct near complete cycle route linking the ward to the city centre, whereas in the Belah and Yewdale wards where a complete cycle link is not available, the car is at its most prevalent.

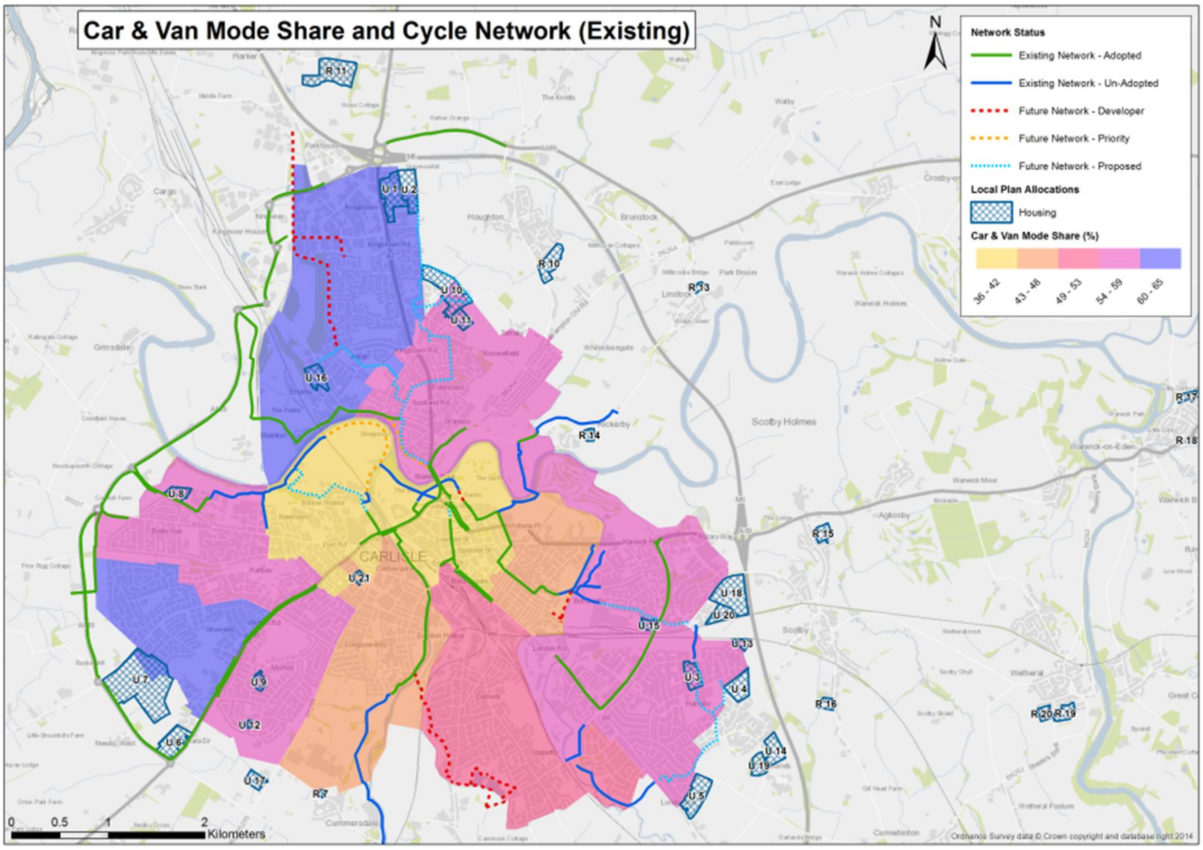


Figure 4-4: Cycle Network and Carlisle Car/Van Travel to Work Modal Share (Source: Census 2011)

4.4.5 On Bridge Street and Castle Way there is a cycle lane on the pavement on the north side of the dual carriageway, however, there are presently minimal methods of crossing Bridge Street and cyclists must either cycle westbound to the junction with Bridge Lane or eastbound to pass under Bridge Street at West Tower Street in order to find a safe place to cross.

4.4.6 Furthermore, there are two junctions along Bridge Street/Castle Way including Devonshire Walk and West Tower Street where visibility for eastbound cyclists of turning traffic is poor and many cyclists are forced to dismount to cross safely.

4.4.7 Figure 4-3 also places the existing cycle network in the context of Local Plan development. It shows that a number of development sites in the Local Plan are not presently served by a nearby cycle lane. Cycle infrastructure would need to be delivered to provide a coherent link between the city centre and these sites.

4.4.8 A review of the signage for cycle routes in Carlisle has demonstrated that across the city, signage is relatively small with poor presence in terms of visibility and the provision does very little to promote the availability of an extensive cycle network in Carlisle.

4.4.9 At present there are a number of unadopted cycle lanes. Whilst it would be advantageous to adopt these routes in the future in order to ensure that a coherent cycle network may be managed, especially as some of the unadopted routes are currently of high standard, this would result in incurred costs to the Local Authority with regards adoption/maintenance.

4.4.10 To summarise, the following specific issues identified as part of the review of cycle facilities include:

- Gaps in completeness of cycle lanes connecting the south-west and south-east of Carlisle to the city centre.
- The lack of a coherent cycle network to the north of the River Eden or any links to the crossing point at Eden Bridge.
- Severance between the north side of Bridge Street/Castle Way and trip attractors to the south of the dual carriageway and hazards in crossing the junctions along the north side of Bridge Street/Castle Way.
- A lack of cycle network connections to Local Plan sites.
- Low visibility of signage for cycle routes.

<u>Existing Aspirations</u>

4.4.11 Cumbria County Council and Carlisle City Council have developed a Carlisle Cycle Network Plan, which is used to identify the routes for a number of developer (or alternative) funded schemes, non-funded priority schemes and other proposed schemes.

4.4.12 The Cycle Network Plan is included in Appendix D. Through taking a mapped perspective it is possible to identify how the funded and priority schemes sit amongst the existing adopted/unadopted cycle paths and where additional funding becomes available from developer contributions, further proposed schemes can be developed using these developer contributions.

4.4.13 Table 4-2 shows the existing Funded and Priority Schemes:

Table 4-2: Funded and Non-Funded Priority Schemes

No.	Name	Type
1	Kingstown – Etterby	Funded Scheme
2	Hammonds Pond	Funded Scheme
3	Sheepmount	Priority Scheme
4	Petteril Valley Link	Funded Scheme
5	Caldew Cycleway	Funded Scheme
6	Newark Terrace	Funded Scheme
7	Currock Bridge	Funded Scheme
8	Willowholme – Sheepmount	Priority Scheme
9	Eden Bridge – Etterby Scaur	Priority Scheme
10	Castle Way Crossing Options	Priority Scheme
-	Signing	Priority Scheme
-	Adoption	Priority Scheme

4.4.14 As part of the delivery of the above cycle routes, it is vital that the developed cycle lanes are progressed in a manner that offers a connected approach. For example, schemes 2, 5 and 7 paid for by developer contributions and the Department for Transport will provide a continuous link from Hammonds Pond to the Caldew Cycleway providing a good connection to the city centre.

4.4.15 Existing signage on cycle routes is minimal and enhanced signage will provide benefits in demonstrating to residents the linkage opportunities between residential/employment areas and the city centre; in what is an already well-established cycle network.

Recommended Improvements

4.4.16 The following improvements are recommended in order to grow the mode share of cyclists in Carlisle:

1. Improved signage in line with the pedestrian signage recommendations detailed in Section 4.3.

2. Replacement of pelican crossings with toucan crossings between the Bridge Street and Bridge Lane junctions.

3. To mitigate the incomplete cycle route on Wigton Road, a quiet route should be signed connecting Wigton Road to the existing cycle lane along the River Caldew. This should utilise Dunmail Drive and Norfolk Road, and requires a toucan crossing on Dalston Road and opening up of Norfolk Road to cyclists from the western side.

4. Implementation of new cycle routes, to include those funded and priority schemes previously identified by Carlisle City Council/Cumbria County Council, the delivery of new routes designed to provide cycle access between the Local Plan sites/the city centre and improving cycle network links with Carlisle to the north of the River Eden. Developer contributions could be used to fund the delivery of these improvements.

   These new links are as follows:

   - U1/2/10/11 Link (Scheme 11)
   - U16 Link (Scheme 12)
   - Eden Bridge – Etterby Street (Scheme 13)
   - Willowholme Road Link (Scheme 14)
   - Lowther Street – Georgian Way Link (Scheme 15)
   - Borland Avenue (Scheme 16)
   - Harraby Link (Scheme 17)

   Full details of all schemes including larger maps and cost breakdowns are included in Appendix D.

   Figure 4-5 shows the proposed network in the context of 2011 car modal share. This network provides completeness to many pre-existing gaps in the network and provides significant expansion to provide a near complete connection between Local Plan sites in the north and south-east of Carlisle with the City Centre.

   Direct cycle links to the following sites have not been considered as quiet residential roads can be used to link these sites to either existing or proposed cycle network, without the need to invest in significant infrastructure. Signage would, however, be required to connect these sites to the cycle network and developer funding could be utilised from these sites to fund nearby future proposed cycle routes:

   - U9
   - U12
   - U13
   - U14

- U17
- U18
- U19
- U20

5. Installation of advance stop lines/boxes and toucan crossings as part of the Highway Improvements as detailed in sections 5 – 10 of this report. Installation of trixi mirrors could be considered to help vehicles see cyclists located in blind spots.

6. Complementary cycling facilities should be delivered at all new developments and secured through travel plans or through the planning process. Facilities should include cycle parking and maintaining suitable cycle links through the master-planning of sites. For employment sites, these should include secure cycle parking, changing and shower facilities.

4.4.17 A link to site R15 to the east of the M6 and the existing cycle network has been considered, however, due to the relative size of the site and the issues in delivering a safe crossing of the M6 (at its grade separated junction with the A69) this does not at present appear feasible. Future delivery of a safe crossing of the M6 would need to be part of a wider strategy to deliver a cycle link between Carlisle, Scotby and the districts to the east.

4.4.18 In addition to the routes discussed in this report, there are a number of other further aspirational schemes identified by Carlisle City Council and Cumbria County Council that are not considered essential to enabling Local Plan development and have, therefore, not been reviewed in great detail or costed. Nevertheless, these routes would provide added connectivity to the cycle network and could also be considered if funding from external non-developer sources was made available:

- Kingstown to Houghton.
- California Lane/Windsor Way, Kingstown (east of Scotland Road) to Rickerby Park.
- Beechwood Avenue to Larch Drive link, Stanwix.
- Knowefield Avenue to Brampton Road.
- Stoneyholme Golf Club car park to Warwick Road.
- Melbourne Park via London Road to Carliol Drive (west of Eastern Way).
- Melbourne Park via London Road to St Ninians Road , Upperby & links to Upperby Park.
- Currock Road east to Hammonds Pond route & west to Caldew Cycleway.
- Denton Holme links.
- Chance's Park links, Morton.
- Sandesfield Road to Bower Street via Raffles Estate.
- Riverside Lower Viaduct & links along Castle Way.

4.4.19 The following summarises the identified schemes and their estimated cost:

Developer or Other Funded Schemes					
Ref No	**Name**	**Fund**	**Amount**	**Full Costs**	**Gap**
1	Kingstown - Etterby	Developer - Story	£281k	£371k	£90k
2	Hammond Pond	Developer - Story	£185k but unlikely to be available till 2017/2018	£342k	£157k
4	Petteril Valley Link	Developer - Persimmon	£80k	£93k	£13k
5	Caldew Cycleway	Northern Developments Ltd	£25k	£34k	£9k
6	Newark Terrace	Developer – Carlisle College	£30k	£2k	£0
7	Currock Bridge	DfT – Local Growth Deal	£2m+	£2m+	£0

Priority Schemes					
3	Sheepmount	None	TBD	£204k	
8	Willowholme Rd - Sheepmount	None	-	£67k	-
9	Etterby Scaur – Eden Bridge	None	TBD	£142k	
10	Bridge Street Crossing	None	TBD	£140k-280k	
	Route Signing	None	TBD	£150 per sign	
	Route Adoption Business Case Study	None	TBD	£15k	

Proposed Schemes					
11	U1/2/10/11 Link	None		£624k	
12	U16 Link	None		£277k	
13	Etterby Street – Eden Bridge Cycle Route	None		£15k	
14	Willowholme Road Link	None		£181k	
15	Lowther Street - Georgian Way Link	None		£1.3k	
16	Borland Avenue Cycle Lane	None		£110k	
17	Harraby Link	None		£280k	

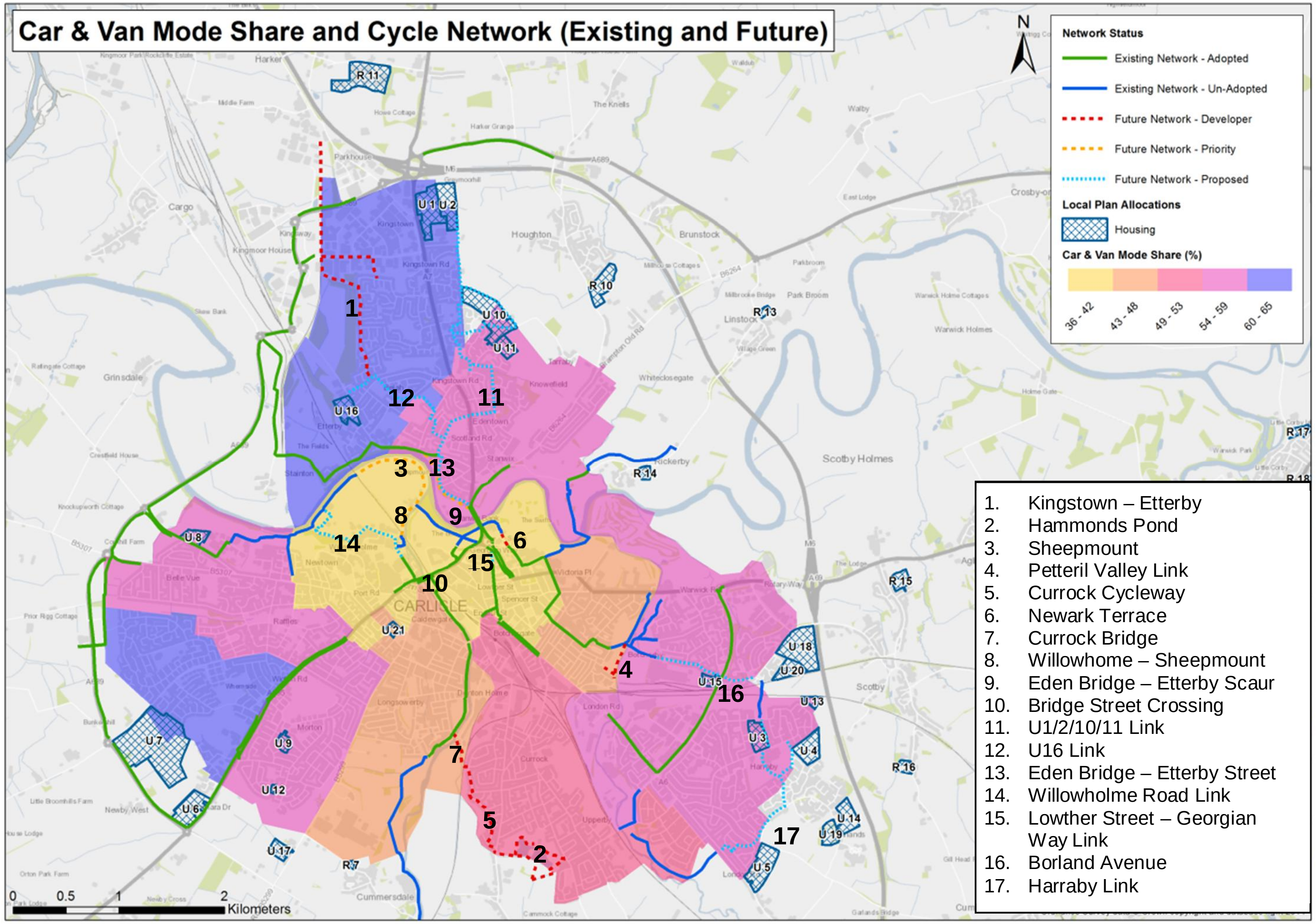


Figure 4-5: Proposed Cycle Network and Carlisle Car/Van Travel to Work Modal Share (Source: Census 2011)

4.5 Public Transport

Existing Infrastructure and Issues

4.5.1 The 2011 Census travel to work data demonstrates that only 7.2% of Carlisle residents travel to work via bus in comparison to the 16.4% national average.

4.5.2 Following a review of the walking infrastructure in Carlisle, it is evident that the low modal share is in part a consequence of walking being a strong alternative to catching the bus, once wait times and bus fares are taken into account.

4.5.3 Nevertheless, there is an opportunity to improve the bus offering in Carlisle and to present the bus as a viable alternative to the private motor vehicle.

4.5.4 Figure 4-6 shows the extent of the bus network in Carlisle for all regular services. Routes are typically radial; passing through the city centre.

4.5.5 Whilst Figure 4-6 demonstrates a bus service that broadly covers the Carlisle urban area, Figure 4-7 shows the bus services in the context of their frequency and the level of bus use in each ward. Larger maps are included in the Appendix F.

4.5.6 Figure 4-7 demonstrates some degree of linkage with public transport modal share, with the wards of Stanwix Urban, Denton Holme, and St Aidan's with the lowest public transport modal share, all have minimal bus coverage and limited frequency corridors.

4.5.7 With the Local Plan sites coming forward, the above frequency analysis demonstrates the importance of ensuring that these sites are served with a frequent service in order to maximise bus usage. The following Local Plan sites would benefit from improved frequencies and diverted services:

- U5
- U6
- U7
- U10
- U11
- U14
- U17
- U19

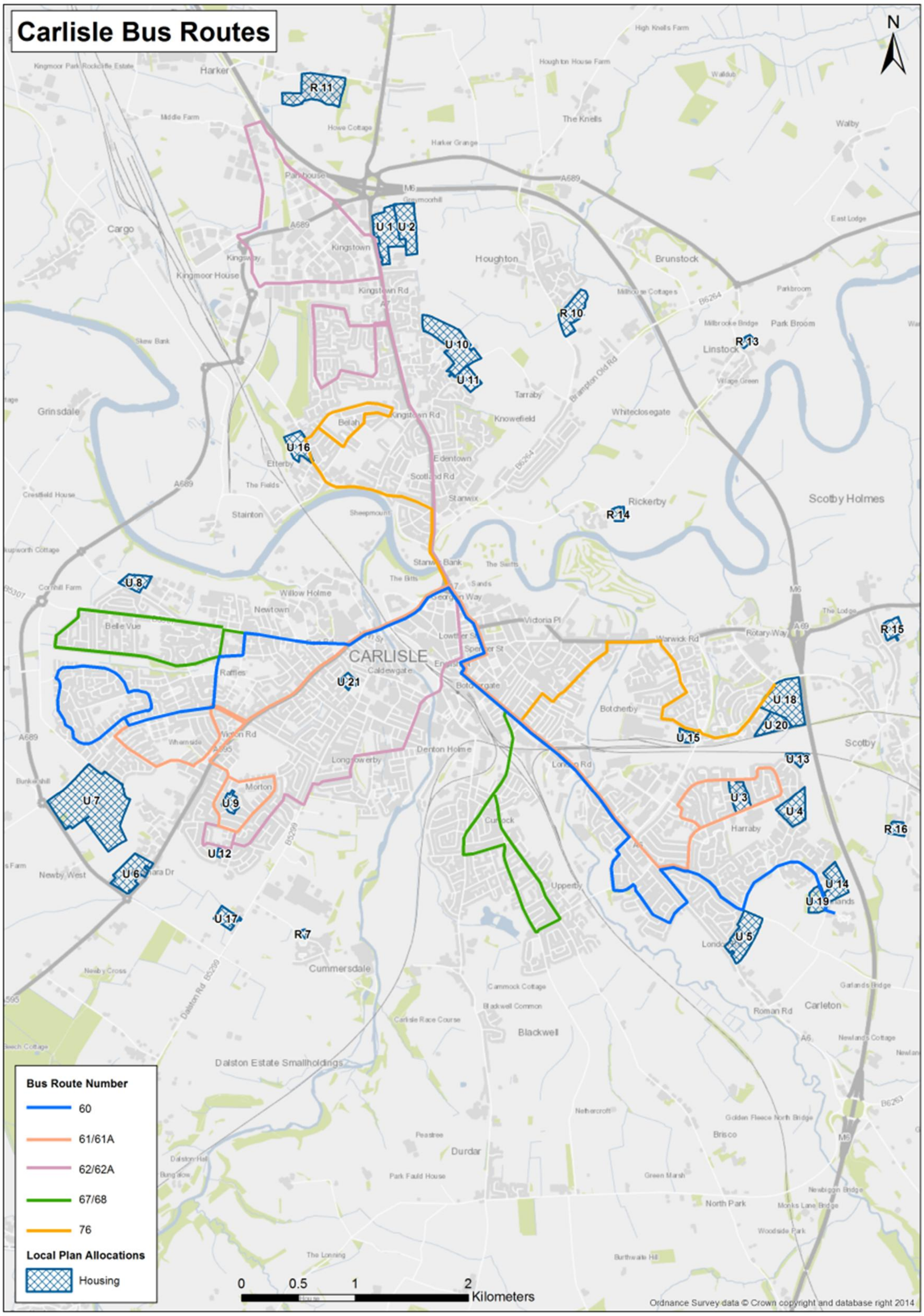


Figure 4-6: Carlisle Bus Network

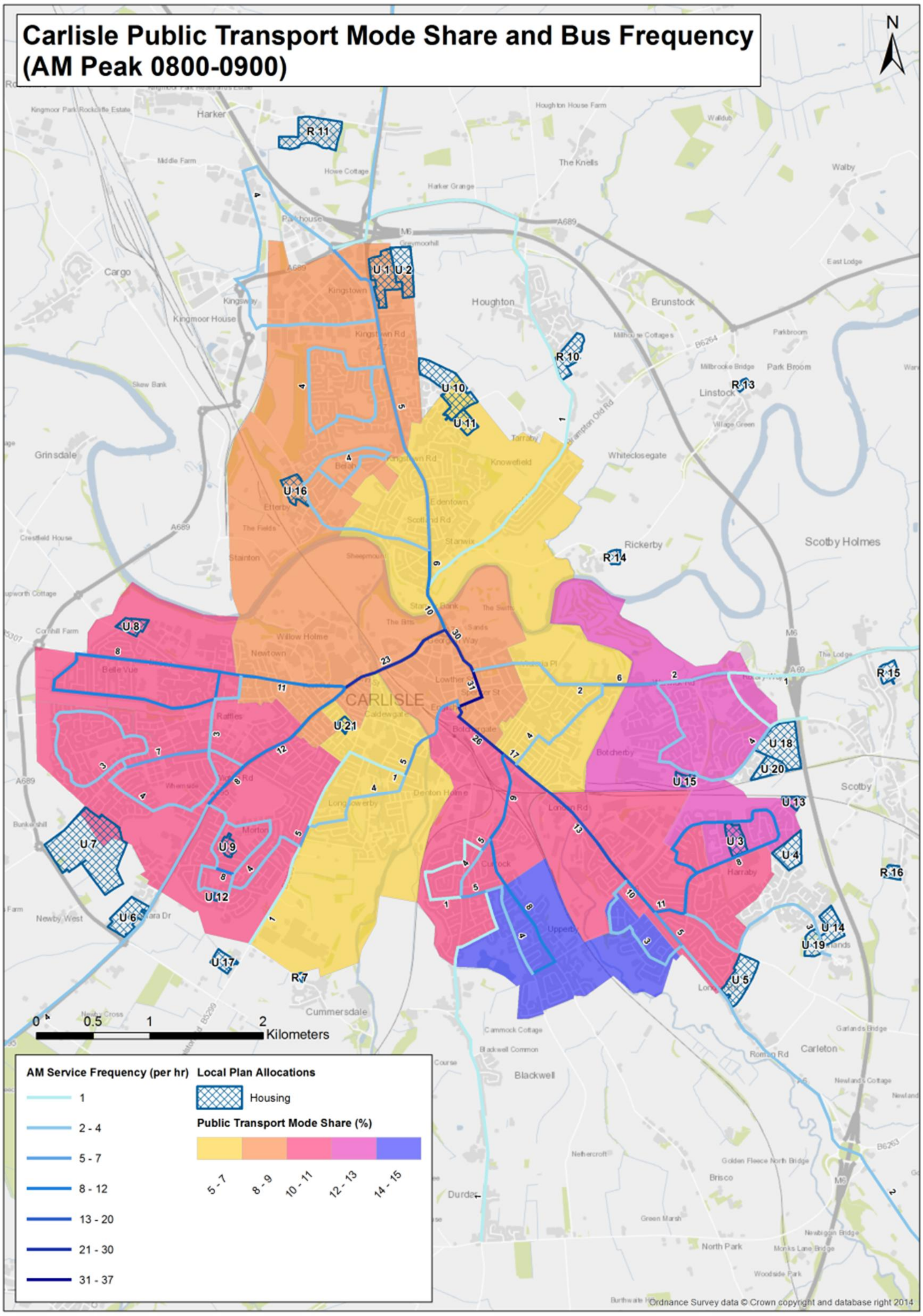


Figure 4-7: Bus Network Frequencies and Ward Public Transport Modal Share (Source: 2011 Census)

4.5.8 Presently a number of bus stops in Carlisle have very limited facilities, particularly outside of the city centre and on outbound routes in suburban areas (although it is acknowledged that inbound stops often result in a greater number of waiting passengers) often consisting of no more than a flag pole. Waiting for the bus in poor weather conditions is likely to be a key factor that discourages bus use across Carlisle. Bus stops (in particular) require improvement on the Wigton Road, Scotland Road, London Road/Botchergate radials and at locations adjacent to a number of the Local Plan sites.

4.5.9 Existing bus stops do not benefit from the installation of 'real time' passenger information systems.

4.5.10 Due to limited highway space, all available opportunities for bus priority in Carlisle have been taken advantage of. As a result, congestion on radial routes will affect buses as well as private motor vehicles, which presents a significant disadvantage in terms of promoting the bus as a preferable mode of travel instead of the car.

4.5.11 Bus fares in Carlisle are also considered expensive, with limited completion on all routes presenting an existing barrier to the potential for fare decreases.

Existing Aspirations

4.5.12 Cumbria's Local Transport Plan 3 for 2011-2026: Moving Cumbria Forward has the following targets for bus improvements over the next 5 years:

- Explore with bus operators the opportunities to replace older buses with high quality low floor vehicles more quickly.
- Investigate opportunities to further develop successful Rural Wheels service.
- Develop and extend the use of smartcard ticketing.
- Work with bus operators and local community groups to promote access by passenger transport to jobs, shops and healthcare facilities.
- Improve access to passenger transport information.

4.5.13 Consultation with Cumbria County Council officers has demonstrated that the majority of these above targets and policies remain aspirational, however, low floors are now present on all services.

4.5.14 The main operator in Carlisle (Stagecoach) is in the process of installing on-board sensors onto their fleet which will enable bus passengers to check on the whereabouts of their bus using the NextBus mobile phone service.

4.5.15 Cumbria County Council has supplied details on how future developments will be served by existing bus services. This information is included in Appendix E.

Recommended Improvements

4.5.16 The following infrastructure improvements are recommended, in order to grow bus patronage in Carlisle:

1. Engagement with major bus operators to promote initiatives such as smarter ticketing.

2. Diversion and increase of service frequency to allow improved bus accessibility to Local Plan sites. The following sites, accounting for as many as eight diverted routes should (through the planning process) be required to deliver funding for this and to ensure the sites are designed to allow buses to pass through:

   - U5
   - U6
   - U7
   - U10
   - U11
   - U14
   - U17
   - U19

3. Enhancement of bus stop infrastructure on the Wigton Road, Scotland Road, and London Road/Botchergate radials. Enhancements should include where appropriate:

   - Shelters.
   - Raised kerbs for wheelchair and pushchair access.
   - Seating.
   - Printed timetables.

   Where possible, enhancements should be linked to Local Plan sites utilising those transport corridors. This should include U1/U2/U10/U11 for stops on Scotland Road and U6/U9 for stops on Wigton Road.

4. Enhancement of bus stop infrastructure at locations expected to supply nearby bus services to Local Plan sites. These enhancements should be in line with those proposed for the key radial routes and funding should be secured through the planning process for these sites, which should also be used to ensure that sites must have a layout that accommodates easy access to bus stops. Table 4-3 shows the location and relevant Local Plan sites for these bus stop improvements:

Table 4-3: Location for Bus Stop enhancements

Location of Bus Stop	Linked sites
Wetheral	R19, R20
Durranhill Road	U14, U18
Pennine Way	U3
Cumwhinton Drive	U19
Carleton Road	U5
Dalston Road	U21, U17
Orton Road	U7
Moorhouse Road	U8
Hartley Avenue	U16
Harker	R11

4.5.17 Including the upgrade to the Wigton Road and Scotland Road corridors, it is anticipated that up to 20 pairs of bus stops could receive developer funded improvements. Based on cost estimates, this would require a total of £320k at a cost of £6k-8k per bus stop.

4.5.18 A new bus service operating at a 20 minute frequency would be expected to cost £240k per annum, however, a diverted service would be anticipated to cost around half of this sum.

4.6 Travel Planning

Existing Travel Planning Activities at Cumbria County Council

4.6.2 The present focus on Travel Planning at Cumbria County Council focuses around ensuring that new development is accompanied with a robust Travel Plan, secured through a Section 106 agreement.

4.6.3 Officers at Cumbria County Council work with Carlisle City Council to ensure that all delivered Travel Plans should cover the following aspects, as enshrined within Cumbria County Council's Planning Obligation Policy:

- Site Specific Measures (Action Plan) or Travel Plan Contribution.
- Travel Plan Coordinator Admin Fee.
- Bus Service Funding (where no existing services).
- Bus Stop Infrastructure.
- Target of 10% reduction in car trips.
- Monitoring during peak hours.

4.6.4 It is Cumbria County Council's preference to have site specific measures within a Travel Plan as opposed to a Travel Plan Contribution, which will only be sought if the measures are deemed insufficient. This contribution would then, therefore, be utilised if the developer is not achieving the agreed targets.

4.6.5 Whilst all of the key requirements for Travel Plans are addressed within Cumbria County Council's Planning Obligation Policy, a bespoke Travel Plan Strategy document produced to support the Local Plan could be utilised to deliver an analysis of the site specific measures that should be included in Travel Plans for Local Plan sites. These measures should draw from the findings in this report and ensure that other measures are secured which complement the proposed infrastructure (such as cycle parking) are delivered in order to maximise the benefit.

4.6.6 A limitation of the focus on Travel Planning on future development is that it will not impact upon pre-existing travel to work or travel to school patterns. It is recommended that a programme of business engagement is utilised in Carlisle to secure voluntary Travel Plans and tackle the number of car travel to work trips.

Business Engagement Voluntary Travel Planning

4.6.7 It is recommended that Cumbria County Council develop a programme of engagement with local businesses in Carlisle to encourage the implementation of voluntary travel plans and to support their staff in engaging in sustainable means of travel.

4.6.8 The below describes examples of measures that could be implemented in terms of business engagement:

- Identification of businesses to be contacted via letter, telephone and email to raise awareness/encourage uptake.
- Once a business has bought in to the scheme, delivery of a toolkit of measures specifically tailored towards the company and its staff should be delivered. This could include:
  - Cycle Smart - Cycle Training, Dr Bike, Fix it Yourself.
  - Drive Smart - Car Share Website, Driver Training.
  - Ticket Smart - Public Transport Taster Tickets.
  - Travel Smart - Personalised Travel Planning (PTP).
  - Walk Smart - Walking Challenges.
  - Work Smart - Smarter Working Seminars.
  - Matched Funding for infrastructure; e.g. cycle parking.
- The impact of the scheme at each participating business should be monitored through staff travel surveys, which will be undertaken at the beginning of the programme and 12 months later.

4.7 Outcome of Measures

4.7.1 The measures detailed in this section provide a mixture of transport improvements for all sustainable modes utilised within Carlisle and supported by travel planning initiatives.

4.7.2 By delivering improved options for sustainable travel in Carlisle, it is intended that this will have an impact in terms of reducing the proportion of trips made by car.

4.7.3 Reviews of literature supplied by the Department for Transport, suggest that the implementation of the measures supplied will assist in reducing car modal share. Most recently, TAG Unit M5.2 – Modelling Smarter Choices (January 2014) demonstrates that workplace travel planning, accompanied by the implementation of hard infrastructure measures can reduce car trips amongst the target population of around 18%. Assuming a third of the workplace population is targeted, this would most likely equate to a 5% peak hour reduction in the number of car trips.

4.7.4 This is additionally supported by more historical documents such as the Department for Transport's Smarter Choices: Changing the Way We Travel (2005) which suggests that a mixture of soft and hard measures can achieve a peak hour reduction in traffic of 5%.

4.7.5 Therefore, supported by the above evidence, it is assumed that the implementation of the majority of the described sustainable measures could reduce peak hour traffic by 5% in Carlisle. In order to ensure that a robust assessment is presented in the following sections, the effect of this potential reduction has not been modelled within the Carlisle Transport Improvements Study. This will provide greater assurances that the predicted capacity improvements are achievable, without relying upon the successful delivery of sustainable transport infrastructure measures.

5 HARDWICKE CIRCUS

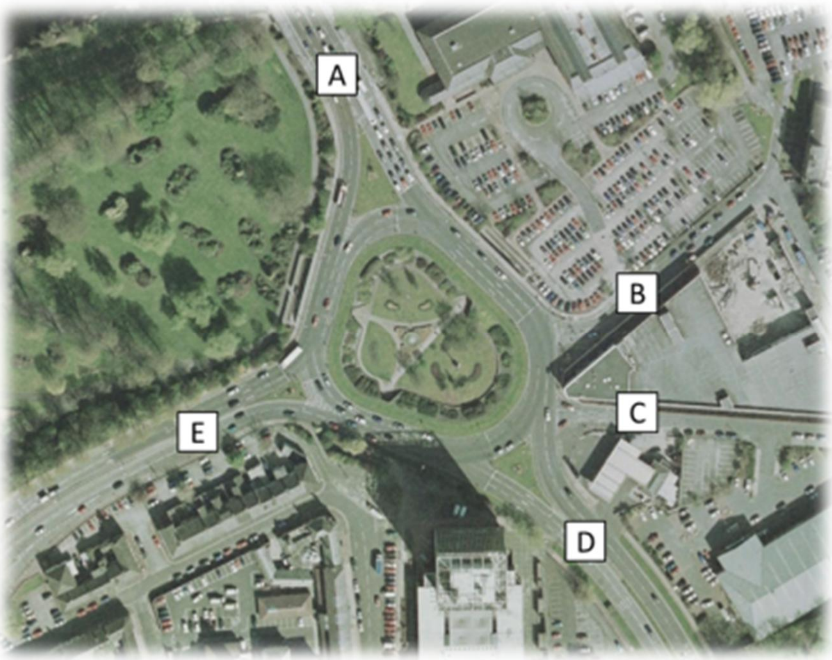
5.1 Junction 1 – Hardwicke Circus

5.1.1 Hardwicke Circus lies immediately adjacent to the northern edge of Carlisle city centre and currently forms a four arm roundabout arrangement between A7 Eden Bridge, Newmarket Road, A7 Georgian Way and A595 Castle Way. In between the Newmarket Road and Georgian Way arms of the roundabout, Duke's Road connects with the circulatory carriageway by means of a simple priority junction arrangement.

5.1.2 The junction forms an at-grade roundabout with part-time signal control operational during the peak periods on the surrounding highway network. Pedestrians use three subways to access all directions and the centre of the roundabout is an important part of public realm with seating and landscaping. An uncontrolled pedestrian crossing facility (with associated refuge island) is available on Newmarket Road.

5.1.3 The Eden Bridge, Georgian Way and Castle Way arms feature three approach lanes, with between three and four lanes available for circulatory traffic streams. The existing junction layout is presented in the diagram at Figure 5-1 below.

Figure 5-1: Hardwicke Circus



5.1.4 The overall junction arrangement tested within this report comprises five arms labelled A to E as follows:

- A – A7 Eden Bridge
- B – Newmarket Road
- C – Dukes Road
- D – A7 Georgian Way
- E – A595 Castle Way

5.2 2025-2030 Base Results (Do Nothing)

5.2.1 The predicted operational performance of the existing Hardwicke Circus junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

5.2.2 The operational peak hours assessed within this study (i.e. 08:00-09:00 and 17:00-18:00) have been established through stakeholder engagement with Cumbria County Council (as Local Highway Authority) and the resulting traffic flows extracted from the strategic city wide Saturn model, which was established in order to inform the Local Plan evidence base.

5.2.3 The results tabulated at Table 5-1, illustrate the predicted performance of the worst performing arm in the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ). Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 5-1: Hardwicke Circus Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/2+1/3 Eden Bridge Ah (2025 Base)	97.3%	28.4	96.1%	23.2
1/2+1/3 Eden Bridge Ah (2025 LP)	102.7%	53.5	115.3%	130.2
1/2+1/3 Eden Bridge Ah (2030 LP)	110.4%	104.2	116.0%	135.5

5.2.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Eden Bridge (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 110.4% in the morning and 116.0% in the evening respectively.

5.3 Proposed Junction Improvements

5.3.1 In order to improve the operation of certain constrained links at the junction arrangement, outline mitigation measures have been considered which test the effect of:

- Increasing the number of approach lanes on the Eden Bridge arm and Georgian Way arm from three to four to provide an additional right turn lane on Eden Bridge and an additional ahead lane on Georgian Way.
- Increasing the number of circulatory lanes between the Eden Bridge and Georgian Way arms, from three to four.

5.3.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

5.4 2025-2030 Predicted Results (Do Something)

5.4.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 5-2, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

5.4.2 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 5-2: Hardwicke Circus Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/2+1/3 Eden Bridge Ah (2025 Base)	39.6%	4.6	33.5%	3.7
1/2+1/3 Eden Bridge Ah (2025 LP)	50.0%	6.4	29.7%	3.1
1/2+1/3 Eden Bridge Ah (2030 LP)	53.8%	7.1	28.3%	3.0

5.5 Summary

5.5.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction continues to be Eden Bridge (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 99.5% in the morning (compared with 110.4% previously) and 97.4% in the evening (compared with 116.0% previously).

5.5.2 It can be concluded that the improvement would provide capacity benefits for vehicles and the potential improvement is therefore recommended.

6 SCOTLAND ROAD CORRIDOR

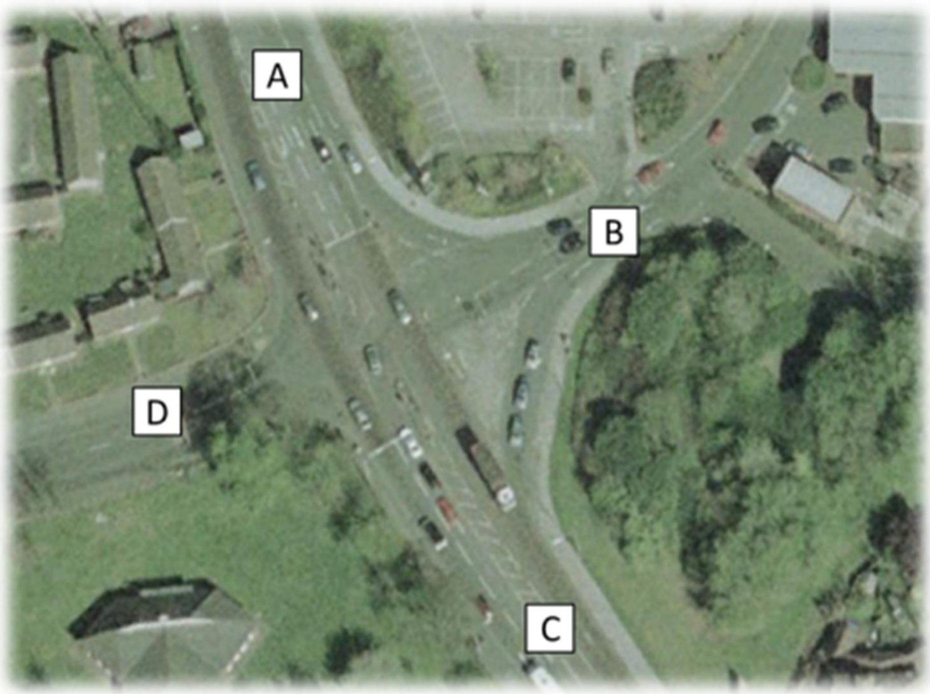
6.1 Junction 2 – Scotland Road/Briar Bank/Morrisons

6.1.1 The junction is located approximately 2.40 kilometres north of Carlisle city centre and currently forms a four arm signal controlled crossroads arrangement between A7 Scotland Road, Briar Bank and Morrisons store access. Signalised pedestrian crossing facilities are available across the A7 (to both sides of the junction) and uncontrolled crossings are available on the Briar Bank and Morrisons arms.

6.1.2 The northern arm of the A7 features two approach lanes, which flare to offer dedicated right and left (priority controlled) turn lanes. The southern arm of the A7 features a single approach lane, which flares to provide a dedicated right turn lane into Morrisons.

6.1.3 The store access provides a single lane approach, which flares to offer a dedicated left turn lane (priority controlled) and Briar Bank and offers a single lane approach with all moves permitted. The existing junction layout is presented in the diagram at Figure 6-1.

Figure 6-1: Scotland Road/Briar Bank/Morrisons



6.1.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – A7 Scotland Road (North)
- B – Morrisons
- C – A7 Scotland Road (South)
- D – Briar Bank

6.2 2025-2030 Base Results (Do Nothing)

6.2.1 The predicted operational performance of the existing Scotland Road/Briar Bank/Morrisons junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

6.2.2 The results tabulated at Table 6-1, illustrate the worst performing arm when reviewing predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ). Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 6-1: Scotland Road/Briar Bank/Morrisons Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
4/1 Morrisons Rt/Ah (2025 Base)	71.6%	4.0	92.4%	9.5
4/1 Morrisons Rt/Ah (2025 LP)	70.2%	3.3	89.9%	7.2
4/1 Morrisons Rt/Ah (2030 LP)	67.4%	3.3	93.3%	8.5

6.2.3 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity and just over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Scotland Road North and Morrisons (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 76.0% in the morning and 93.3% in the evening respectively.

6.3 Proposed Junction Improvements

6.3.1 Following completion of detailed junction modelling using LinSig3 software, the predicted operational performance of the Scotland Road/Briar Bank/Morrisons junction is forecast to be acceptable following delivery of the Local Plan. The development of potential mitigation measures associated with this junction arrangement will, therefore, not be considered as part of the Carlisle Transport Improvements Study.

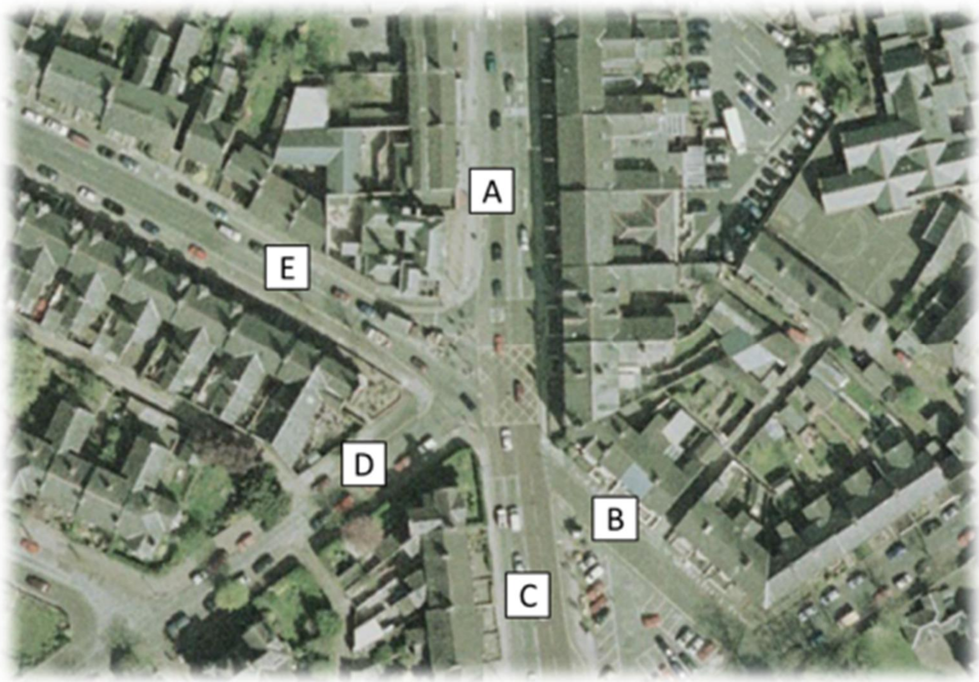
6.4 Junction 3 – Scotland Road/Etterby Street

6.4.1 The junction is located approximately 1.50 kilometres north of Carlisle city centre and currently forms a three arm signal controlled arrangement between A7 Scotland Road and Etterby Street. Signalised pedestrian crossing facilities are available on the Etterby Street arm of the junction.

6.4.2 The northern arm of the A7 features two approach lanes for southbound traffic, with the right turn into Etterby Street also permitted from the offside lane. The southern arm of the A7 features two approach lanes, with the nearside lane dedicated to left turning traffic and the offside lane assigned to northbound traffic.

6.4.3 Etterby Street features a single lane approach, which flares to provide a short dedicated left turn lane with storage capacity for a single vehicle. The existing junction layout is presented in the diagram at Figure 6-2.

Figure 6-2: Scotland Road/Etterby Street



6.4.4 The overall junction arrangement tested within this report comprises five arms (including two one-way priority junction arrangement located within close proximity to the junction) labelled A to E as follows:

- A – A7 Scotland Road (North)
- B – Church Terrace
- C – A7 Scotland Road (South)
- D – Marlborough Gardens
- E – Etterby Street

6.5 2025-2030 Base Results (Do Nothing)

6.5.1 The predicted operational performance of the existing Scotland Road/Etterby Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

6.5.2 The results tabulated at Table 6-2 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

6.5.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 6-2: Scotland Road/Etterby Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1 Scotland Road (N) Ah (2025 Base)	86.9%	25.0	83.6%	22.8
1/1 Scotland Road (N) Ah Lt (2025 LP)	92.7%	30.6	81.4%	21.4
1/1 Scotland Road (N) Ah/Lt (2030 LP)	95.4%	34.6	86.3%	24.6

6.5.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Scotland Road North (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 95.4% in the morning and 86.3% in the evening respectively.

6.6 Proposed Junction Improvements

6.6.1 Given that the junction is forecast to operate with a maximum degree of saturation greater than 90%, in order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Removing the right turn manoeuvre from Scotland Road (North) to Etterby Street, in order to eliminate stationary traffic from the offside lane, which currently impede the progress of southbound traffic during certain stages within the overall cycle. It is assumed that the right turn traffic will use one of the alternative routes available and so this traffic has been removed from the junction assessment.

6.6.2 Detailed design plans of the scheme tested are attached at Appendix A and B to the rear of this report.

6.7 2025-2030 Predicted Results (Do Something)

6.7.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 6-3 which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ). Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 6-3: Scotland Road/Etterby Street Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1 Scotland Road (N) Ah (2025 Base)	49.2%	8.8	43.0%	7.4
1/1 Scotland Road (N) Ah Lt (2025 LP)	51.6%	9.4	41.1%	7.0
1/1 Scotland Road (N) Ah/Lt (2030 LP)	52.9%	9.8	43.5%	7.5

6.8 Summary

6.8.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Etterby Street and Scotland Road South (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 77.4% in the morning (compared with 95.4% previously) and 84.7% in the evening (compared with 86.3% previously).

6.8.2 It can be concluded that the improvement would provide capacity benefits for vehicles and the potential improvement is therefore recommended. However, if this option were to be progressed further, additional work would be required to assess the suitability of the necessary diversion route for vehicles currently turning right onto Etterby Street.

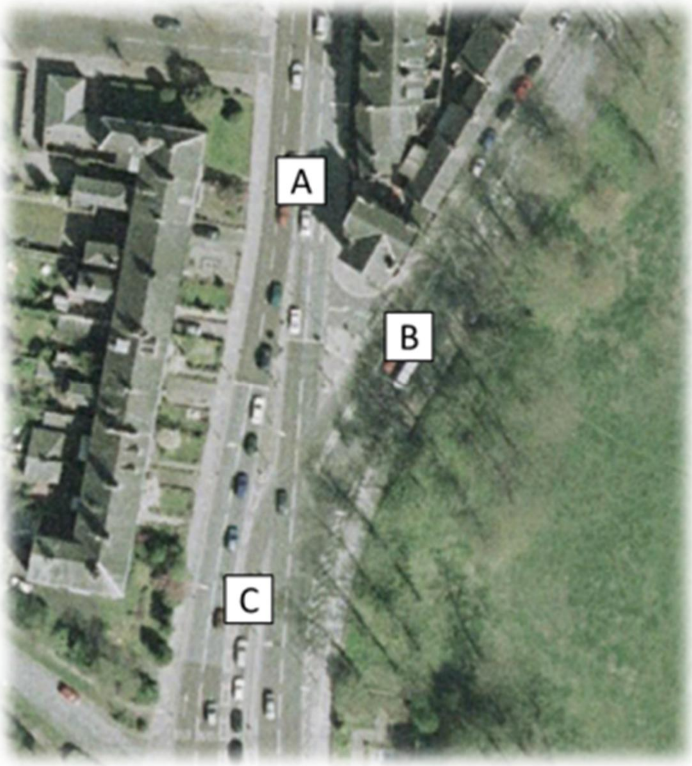
6.9 Junction 4 – Stanwix Bank/Brampton Road

6.9.1 The junction is located approximately 1.20 kilometres north of Carlisle city centre and currently forms a three arm signal controlled arrangement between A7 Stanwix Bank and B6264 Brampton Road. Signalised pedestrian crossing facilities are available on both the Stanwix Bank and Brampton Road arms of the junction.

6.9.2 The northern arm of the A7 features two approach lanes for southbound traffic, with the left turn into Brampton Road also permitted from the nearside lane, by means of a dedicated slip (with storage capacity for approximately two vehicles) leading to a priority controlled give way arrangement. The southern arm of the A7 features two approach lanes for northbound traffic, featuring a third lane in the form of a dedicated right turn flare for traffic turning from Stanwix Bank on to Brampton Road.

6.9.3 Brampton Road features a two lane approach, with both the nearside and offside lanes assigned to left turning traffic onto Stanwix Bank, with the right turn forming a banned manoeuvre. The existing junction layout is presented in the diagram at Figure 6-3.

Figure 6-3: Stanwix Bank/Brampton Road



6.9.4 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – A7 Stanwix Bank (North)
- B – Brampton Road
- C – A7 Stanwix Bank (South)

6.10 2025-2030 Base Results (Do Nothing)

6.10.1 The predicted operational performance of the existing Stanwix Bank/Brampton Road junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

6.10.2 The results tabulated at Table 6-4 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

6.10.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 6-4: Stanwix Bank/Brampton Road Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/3 Stanwix Bank (N) Ah (2025 Base)	76.5%	18.0	90.2%	21.2
1/3 Stanwix Bank (N) Ah (2025 LP)	81.8%	20.4	93.7%	23.0
1/3 Stanwix Bank (N) Ah (2030 LP)	84.0%	21.7	98.5%	29.4

6.10.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods (but over the 90% DOS threshold during the PM peak) in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Stanwix Bank North (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 84.0% in the morning and 98.5% in the evening respectively.

6.11 Proposed Junction Improvements

6.11.1 Given that the junction is forecast to operate with a maximum degree of saturation greater than 90%, in order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Altering the existing white lining arrangement in order to dedicate the offside lane to right turning traffic from Stanwix Bank (South) onto Brampton Road, along the entire length of the approach from Hardwicke Circus.

6.11.2 Detailed design plans of the scheme tested are attached at Appendix A and B to the rear of this report.

6.12 2025-2030 Predicted Results (Do Something)

6.12.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 6-5, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

6.12.2 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 6-5: Stanwix Bank/Brampton Road Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/3 Stanwix Bank (N) Ah (2025 Base)	70.9%	15.8	87.6%	19.7
1/3 Stanwix Bank (N) Ah (2025 LP)	76.2%	17.9	90.2%	21.2
1/3 Stanwix Bank (N) Ah (2030 LP)	78.3%	18.7	91.0%	21.9

6.13 Summary

6.13.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Stanwix Bank North and South (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 78.3% in the morning (compared with 84.0% previously) and 92.3% in the evening (compared with 98.5% previously).

6.13.2 It can be concluded that the improvement would provide capacity benefits for vehicles and the potential improvement is therefore recommended.

7 WARWICK ROAD CORRIDOR

7.1 Junction 5 – Warwick Road/Montgomery Way/Tesco

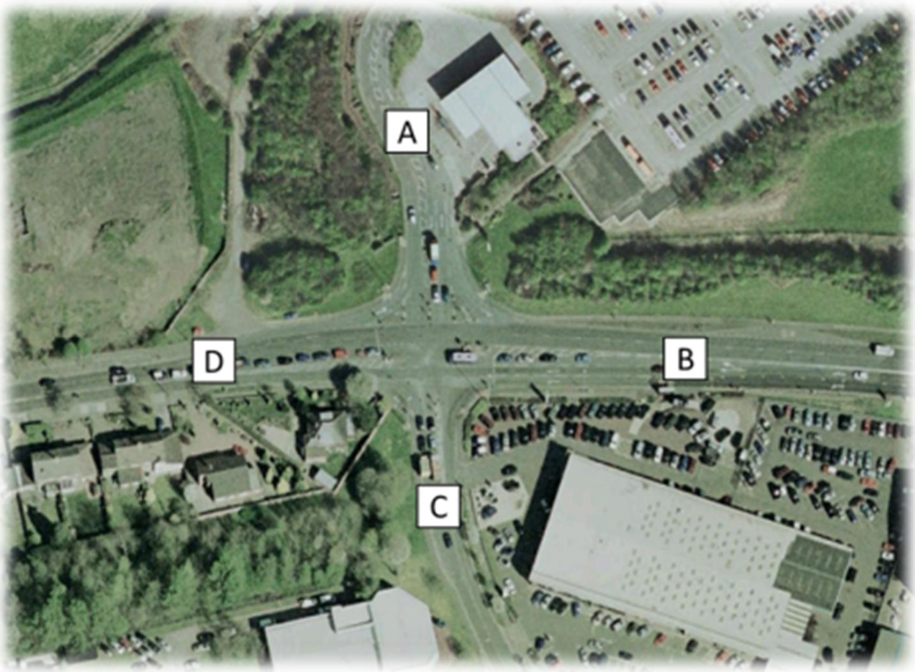
7.1.1 The junction is located approximately 2.40 kilometres east of Carlisle city centre and currently forms a four arm signal controlled crossroads arrangement between A69 Warwick Road, Montgomery Way and Tesco store access. It is a significant junction as it lies less than 500 metres from the M6 Junction 43. Signalised pedestrian crossing facilities are available across the A69 (on the eastern side of the junction) and uncontrolled crossings are available on the Montgomery Way and Tesco arms.

7.1.2 The eastern arm of the A69 features two approach lanes, with the nearside lane dedicated to left turning traffic onto Montgomery Way and the offside lane being assigned to westbound traffic (with a flare being provided for right turners into Tesco). The western arm of the A69 features two approach lanes for eastbound traffic, which flare to provide a dedicated right turn lane into Montgomery Way and left turn lane into Tesco (with storage capacity for approximately nine vehicles) by means of a priority controlled arrangement.

7.1.3 The store access provides a two lane approach, with the nearside lane dedicated to southbound traffic on Montgomery Way (with a flare being provided for left turners onto the A69) by means of a priority controlled arrangement and the offside lane assigned to right turning traffic onto the A69.

7.1.4 Montgomery Way features a single lane approach, with a flare providing a dedicated left turn lane for traffic accessing the A69 westbound. Right turning eastbound manoeuvres and traffic entering Tesco are required to do so by means of the offside lane. The existing junction layout is presented in the diagram at Figure 7-1.

Figure 7-1: Warwick Road/Montgomery Way/Tesco



7.1.5 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – Tesco
- B – A69 Rotary Way (East)
- C – Montgomery Way
- D – A69 Warwick Road (West)

7.2 2025-2030 Base Results (Do Nothing)

7.2.1 The predicted operational performance of the existing Warwick Road/Montgomery Way/Tesco junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

7.2.2 The results tabulated at Table 7-1, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ). Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-1: Warwick Road/Montgomery Way/Tesco Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/2+3/1 Montgomery Way (S) Ah/Rt/Lt (2025 Base)	104.3%	23.1	134.3%	89.2
3/2+3/1 Montgomery Way (S) Ah/Rt/Lt (2025 LP)	99.7%	18.3	158.3%	130.5
3/2+3/1 Montgomery Way (S) Ah/Rt/Lt (2030 LP)	104.4%	25.0	149.4%	117.1

7.2.3 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Montgomery Way South (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 104.4% in the morning and 149.4% in the evening respectively.

7.3 Proposed Junction Improvements

7.3.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Increasing the number of approach lanes on the A69 Rotary Way arm (for westbound traffic) from two to three.
- Increasing the number of exit lanes on the A69 Warwick Road (connecting with Eastern Way for westbound traffic) from one to two.
- Increase the flare length of the left turn lane on Montgomery Way by approximately 20 metres.

7.3.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

7.4 2025-2030 Predicted Results (Do Something)

7.4.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 7-2, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

7.4.2 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-2: Warwick Road/Montgomery Way/Tesco Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/2+3/1 Montgomery Way (S) Ah/Rt/Lt (2025 Base)	82.1%	9.9	101.3%	24.3
3/2+3/1 Montgomery Way (S) Ah/Rt/Lt (2025 LP)	92.1%	12.6	114.5%	57.0
3/2+3/1 Montgomery Way (S) Ah/Rt/Lt (2030 LP)	89.4%	11.8	111.2%	49.5

7.5 Summary

7.5.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during the morning peak period and above it in the evening peak period in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Warwick Road West (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 95.4% in the morning (compared with 104.4% previously) and 113.6% in the evening (compared with 149.4% previously).

7.5.2 It can be concluded that the improvement would provide capacity benefits for vehicles and the potential improvement is therefore recommended.

7.6 Junction 6 – Warwick Road/Eastern Way

7.6.1 The junction is located approximately 2.10 kilometres east of Carlisle city centre and currently forms a three arm signal controlled arrangement between A69 Warwick Road and Eastern Way. Uncontrolled pedestrian crossing facilities are available on the Warwick Road (East) and Eastern Way arms of the junction.

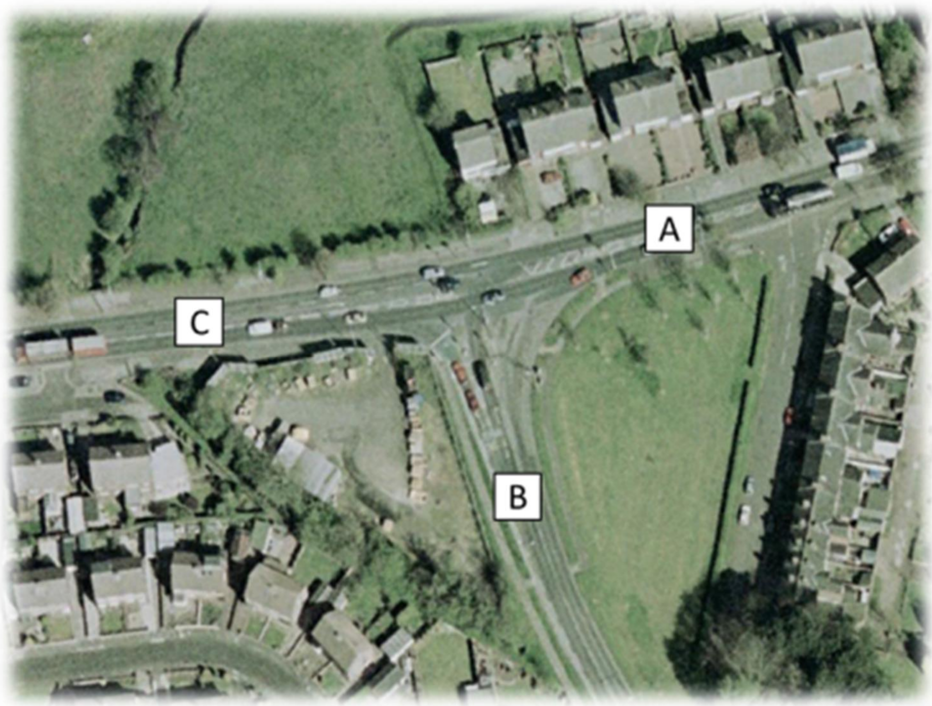
7.6.2 The eastern arm of the A69 features single approach lane for westbound traffic (with all manoeuvres permitted). The western arm of the A69 features a single approach lane, which flares to provide a dedicated right turn lane for traffic entering Eastern Way.

7.6.3 Eastern Way features a single lane approach, which flares to provide dedicated left and right turn lanes for vehicles accessing the A69. The existing junction layout is presented in the diagram at Figure 7-2.

7.6.4 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – A69 Warwick Road (East)
- B – Eastern Way
- C – A69 Warwick Road (West)

Figure 7-2: Warwick Road/Eastern Way



7.7 2025-2030 Base Results (Do Nothing)

7.7.1 The predicted operational performance of the existing Warwick Road/Eastern Way junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

7.7.2 The results tabulated at Table 7-3 below, illustrate the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

7.7.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-3: Warwick Road/Eastern Way Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1 Warwick Road (E) Lt/Ah (2025 Base)	93.0%	36.9	90.2%	36.9
1/1 Warwick Road (E) Lt/Ah (2025 LP)	96.3%	42.5	90.4%	37.0
1/1 Warwick Road (E) Lt/Ah (2030 LP)	99.1%	50.2	92.0%	39.0

7.7.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Warwick Road East and Eastern Way (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 99.1% in the morning and 92.8% in the evening respectively.

7.8 Proposed Junction Improvements

7.8.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Increasing the number of approach lanes on the A69 Warwick Road arm from one to two (providing a dedicated left turn lane for traffic entering Eastern Way, which extends back to the junction with Montgomery Way).
- Increase the flare length of the left turn lane on Eastern Way by approximately 50 metres.

7.8.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

7.9 2025-2030 Predicted Results (Do Something)

7.9.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 7-4, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

7.9.2 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-4: Warwick Road/Eastern Way Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1 Warwick Road (E) Lt/Ah (2025 Base)	86.0%	28.5	83.1%	28.3
1/1 Warwick Road (E) Lt/Ah (2025 LP)	93.2%	36.5	85.4%	30.5
1/1 Warwick Road (E) Lt/Ah (2030 LP)	97.2%	44.2	87.5%	32.8

7.10 Summary

7.10.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Warwick Road East and Warwick Road West (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 97.2% in the morning (compared with 99.1% previously) and 89.5% in the evening (compared with 92.8% previously).

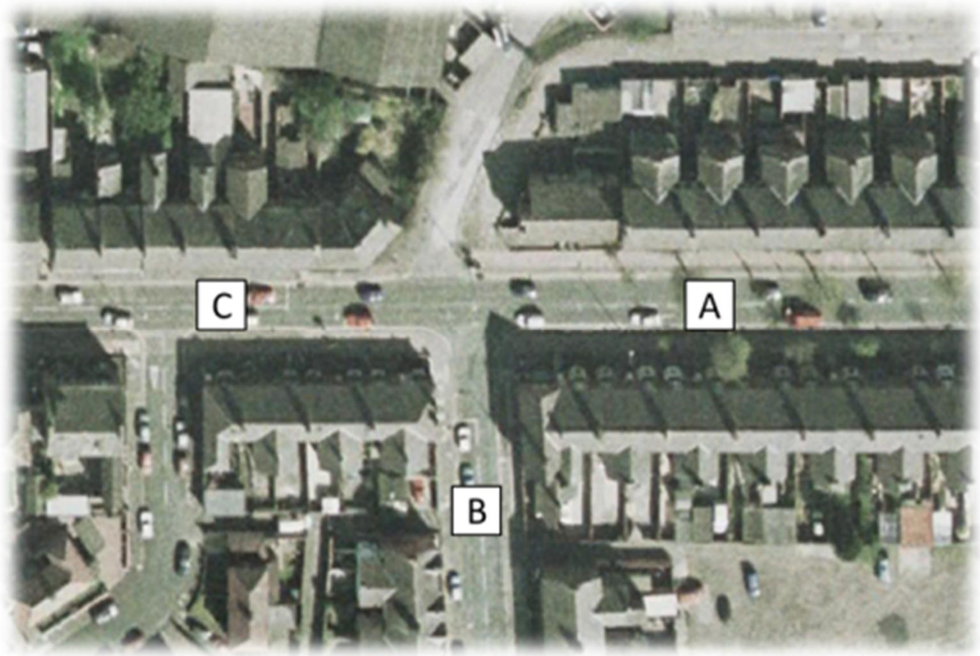
7.10.2 It can be concluded that the improvement would provide modest capacity benefits for vehicles and the potential improvement is therefore recommended.

7.11 Junction 7 – Warwick Road/Greystone Road

7.11.1 The junction is located approximately 1.30 kilometres east of Carlisle city centre and currently forms a three arm signal controlled arrangement between A69 Warwick Road and Greystone Road. A signalised pedestrian crossing facility is available on the Warwick Road (west) arm of the junction. A short northern access road serves the Carlisle United football stadium.

7.11.2 Both the eastern/western arms of the A69 and Greystone Road feature single approach lanes for traffic (with all manoeuvres permitted). The existing junction layout is presented in the diagram at Figure 7-3.

Figure 7-3: Warwick Road/Greystone Road



7.11.3 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – A69 Warwick Road (East)
- B – Greystone Road
- C – A69 Warwick Road (West)

7.12 2025-2030 Base Results (Do Nothing)

7.12.1 The predicted operational performance of the existing Warwick Road/Greystone Road junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

7.12.2 The results tabulated at Table 7-5 below, illustrate the worst performing arm when considering th predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

7.12.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-5: Warwick Road/Greystone Road Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/2+1/1 Warwick Road (E) Lt/Ah (2025 Base)	80.7%	23.3	71.4%	18.8
1/2+1/1 Warwick Road (E) Lt/Ah (2025 LP)	84.8%	27.7	76.6%	22.4
1/2+1/1 Warwick Road (E) Lt/Ah (2030 LP)	87.5%	31.5	80.6%	25.9

7.12.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Greystone Road (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 87.5% in the morning and 81.4% in the evening respectively.

7.13 Proposed Junction Improvements

7.13.1 Following completion of detailed junction modelling using LinSig3 software, the predicted operational performance of the Warwick Road/Greystone Road junction is forecast to be acceptable following delivery of the Local Plan. The development of potential mitigation measures associated with this junction arrangement will, therefore, not be considered as part of the Carlisle Transport Improvements Study.

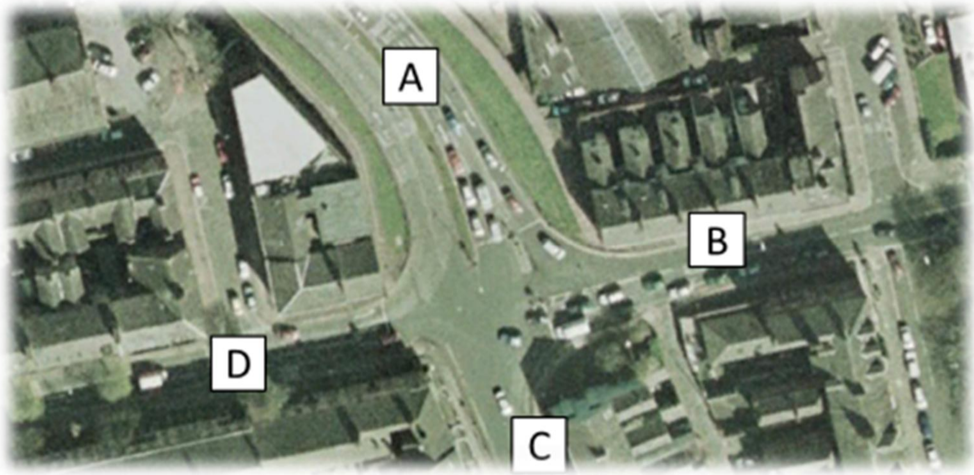
7.14 Junction 8 – Georgian Way/Victoria Place

7.14.1 The junction is located approximately 0.40 kilometres east of Carlisle city centre and currently forms a four arm signal controlled crossroads arrangement between A7 Georgian Way, A69 Victoria Place and Spencer Street. Signalised pedestrian crossing facilities are available across A7 Spencer Street and on the A69 Victoria Place (west) arm of the junction.

7.14.2 The northern arm of the A7 features two approach lanes, with the nearside lane providing a dedicated left turn facility and the offside lane flaring to offer two ahead lanes at the stop-line. Spencer Street is one-way in nature and provides two exit lanes for southbound traffic.

7.14.3 The A69 Victoria Place (east) provides a two lane approach, with the nearside lane assigned to both left/right turning traffic and the offside lane dedicated to right turning traffic only. The Victoria Place (west) arm is one-way in nature and provides three arms each dedicated to left/ahead/right turning traffic respectively. The existing junction layout is presented in the diagram at Figure 7-4.

Figure 7-4: Georgian Way/Victoria Place



7.14.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – A7 Georgian Way
- B – A69 Victoria Place (East)
- C – Spencer Street
- D – A7 Victoria Place (West)

7.15 2025-2030 Base Results (Do Nothing)

7.15.1 The predicted operational performance of the existing Georgian Way/Victoria Place junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

7.15.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

7.15.3 Table 7-6, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

7.15.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-6: Georgian Way/Victoria Place Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/2+1/3 Georgian Way Ah (2025 Base)	64.6%	7.2	58.0%	6.4
1/2+1/3 Georgian Way Ah (2025 LP)	77.9%	8.6	63.0%	6.7
1/2+1/3 Georgian Way Ah (2030 LP)	108.9%	43.7	101.5%	24.9

7.15.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Georgian Way (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 108.9% in the morning and 101.5% in the evening respectively.

7.16 Proposed Junction Improvements

7.16.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Increase the length of the three lane approach on the A7 Georgian Way arm by approximately 25 metres.

7.16.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

7.17 2025-2030 Predicted Results (Do Something)

7.17.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 7-7, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ). Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 7-7: Georgian Way/Victoria Place Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/2+1/3 Georgian Way Ah (2025 Base)	63.9%	7.0	57.4%	6.3
1/2+1/3 Georgian Way Ah (2025 LP)	69.1%	7.6	59.2%	6.3
1/2+1/3 Georgian Way Ah (2030 LP)	76.8%	10.5	72.0%	10.3

7.18 Summary

7.18.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction remains Georgian Way (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 80.0% in the morning (compared with 108.9% previously) and 76.9% in the evening (compared with 101.5% previously).

7.18.2 It can be concluded that the improvement would provide capacity benefits for vehicles and the potential improvement is therefore recommended.

8 LONDON ROAD CORRIDOR

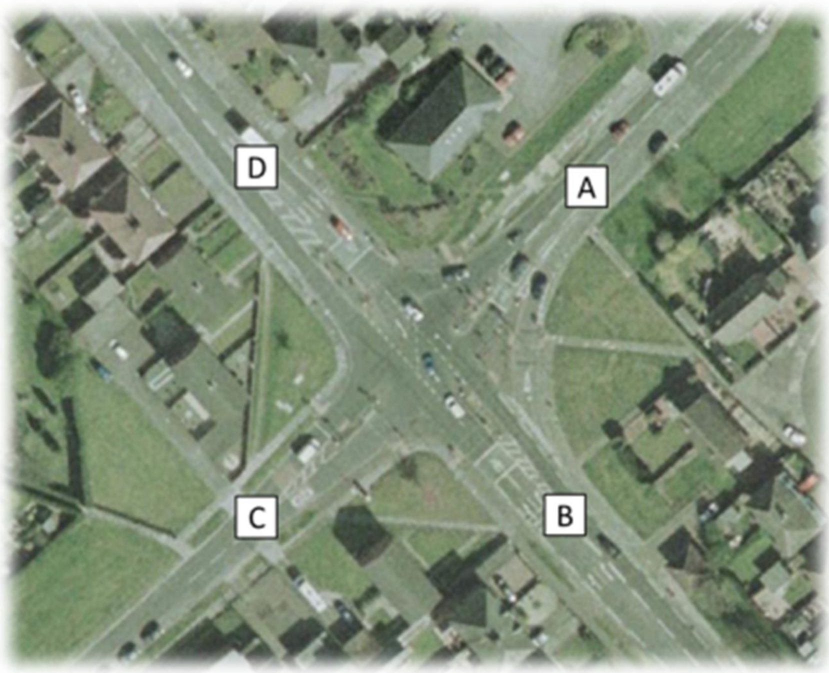
8.1 Junction 9 – London Road/Eastern Way

8.1.1 The junction is located approximately 2.10 kilometres southeast of Carlisle city centre and currently forms a four arm signal controlled crossroads arrangement between A6 London Road and Eastern Way. Signalised pedestrian crossing facilities are available across A6 London Road (northwest) and on both of the Eastern Way arms. There are advanced cycle stop lines on the London Road and Eastern Way approaches.

8.1.2 The north-western arm of the A6 features two approach lanes to provide dedicated ahead/left and ahead/right lanes at the stop-line. The south-eastern arm features a single approach lane, which flares to provide dedicated ahead/left and right turn lanes at the stop-line.

8.1.3 The north-eastern arm of Eastern Way features a single approach lane, which flares to provide dedicated ahead/right and left turn lanes at the stop-line. The south-western arm features a single approach lane (with all moves permitted). The existing junction layout is presented in the diagram at Figure 8-1.

Figure 8-1: London Road/Eastern Way



8.1.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – Eastern Way (Northeast)
- B – A6 London Road (Southeast)
- C – Eastern Way (Southwest)
- D – A6 London Road (Northwest)

8.2 2025-2030 Base Results (Do Nothing)

8.2.1 The predicted operational performance of the existing London Road/Eastern Way junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

8.2.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.2.3 Table 8-1 below, illustrate the worst performing arm when considering predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.2.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-1: London Road/Eastern Way Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/1 London Rd (N) Ah/Lt (2025 Base)	68.4%	13.7	89.7%	24.1
3/1 London Rd (N) Ah/Lt (2025 LP)	67.7%	14.9	90.9%	30.3
3/1 London Rd (N) Ah/Lt (2030 LP)	71.7%	17.6	94.1%	34.4

8.2.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Eastern Way and London Road North (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 88.9% in the morning and 94.1% in the evening respectively.

8.3 Proposed Junction Improvements

8.3.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Increase the length of the two lane approach on the A6 London Road (Southeast) arm by approximately 35 metres.
- Increase the length of the two lane approach on the Eastern Way (Northeast) arm by approximately 35 metres.

8.3.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

8.4 2025-2030 Predicted Results (Do Something)

8.4.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at

8.4.2 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.4.3 Table 8-2 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.4.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.4.5 Table 8-2: London Road/Eastern Way Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/1 London Rd (N) Ah/Lt (2025 Base)	68.4%	13.7	89.7%	24.1
3/1 London Rd (N) Ah/Lt (2025 LP)	67.7%	14.9	90.9%	30.3
3/1 London Rd (N) Ah/Lt (2030 LP)	71.7%	17.6	92.6%	32.9

8.5 Summary

8.5.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now London Road South and Eastern Way (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 87.6% in the morning (compared with 88.9% previously) and 92.7% in the evening (compared with 94.1% previously).

8.5.2 It can be concluded that the improvement would provide modest capacity benefits for vehicles and the potential improvement is therefore recommended.

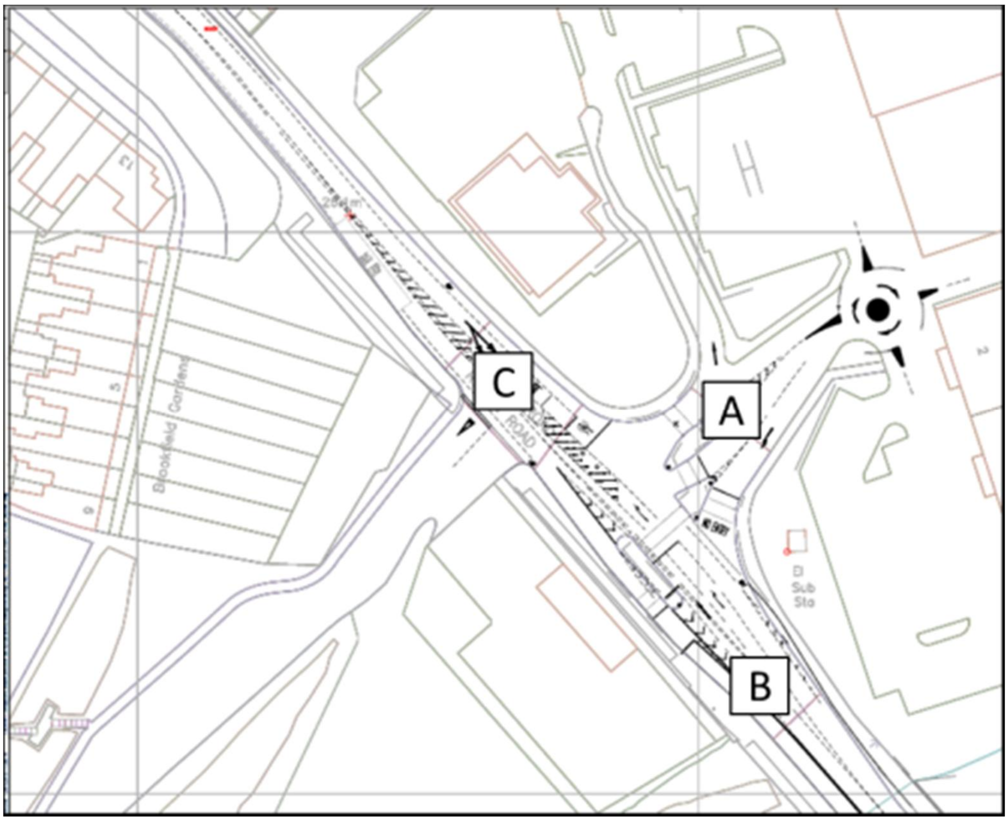
8.6 Junction 10 – London Road/B&Q/London Road Retail Park

8.6.1 The junction is located approximately 1.35 kilometres southeast of Carlisle city centre and currently forms a three arm signal controlled arrangement between A6 London Road and B&Q. Signalised pedestrian crossing facilities are available on the London Road (southeast) and B&Q arms of the junction. Just north of the junction a western access road serves Hilltop Heights.

8.6.2 The north-western arm of the A6 features single approach lane for south-eastbound traffic (with all manoeuvres permitted) and an advanced cycle stop line. The south-eastern arm features a single approach lane, which flares to provide a dedicated right turn lane for traffic entering B&Q. A bus prioritisation scheme is also present at this location, with a dedicated lane available for passenger transport services. Cyclists are also permitted to use the bus lane.

8.6.3 The B&Q store access features a two lane approach, with dedicated right and left turn lanes available to store customers accessing the A6 in both directions. The existing junction layout is presented in the diagram at Figure 8-2.

Figure 8-2: London Road/B&Q



8.6.4 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – B&Q
- B – A6 London Road (South-east)
- C – A6 London Road (North-west)

8.7 2025-2030 Base Results (Do Nothing)

8.7.1 The predicted operational performance of the existing London Road/B&Q junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

8.7.2 The results tabulated at Table 8-3 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.7.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-3: London Road/B&Q Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1+1/2 London Rd (S) Ah/Rt (2025 Base)	72.1%	15.7	45.4%	6.9
1/1+1/2 London Rd (S) Ah/Rt (2025 LP)	84.2%	22.9	51.6%	8.2
1/1+1/2 London Rd (S) Ah/Rt (2030 LP)	84.8%	25.7	55.5%	9.4

8.7.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is London Road South and London Road North (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 84.8% in the morning and 79.5% in the evening respectively.

8.8 Proposed Junction Improvements

8.8.1 Following completion of detailed junction modelling using LinSig3 software, the predicted operational performance of the London Road/B&Q junction is acceptable following delivery of the Local Plan. The development of potential mitigation measures associated with this junction arrangement will, therefore, not be considered as part of the Carlisle Transport Improvements Study.

8.8.2 The Botchergate/London Road corridor signals are currently operated using the Urban Traffic Control (UTC) system. This system coordinates the signals by detecting traffic and optimising the signal timings to minimise vehicular delay through the network. The UTC system does not currently extend to the London Road/B&Q junction. The potential to extend the existing coverage of the UTC network to include the London Road/B&Q junction will be investigated by the Local Highway Authority in due course, as part of an independent programme of study.

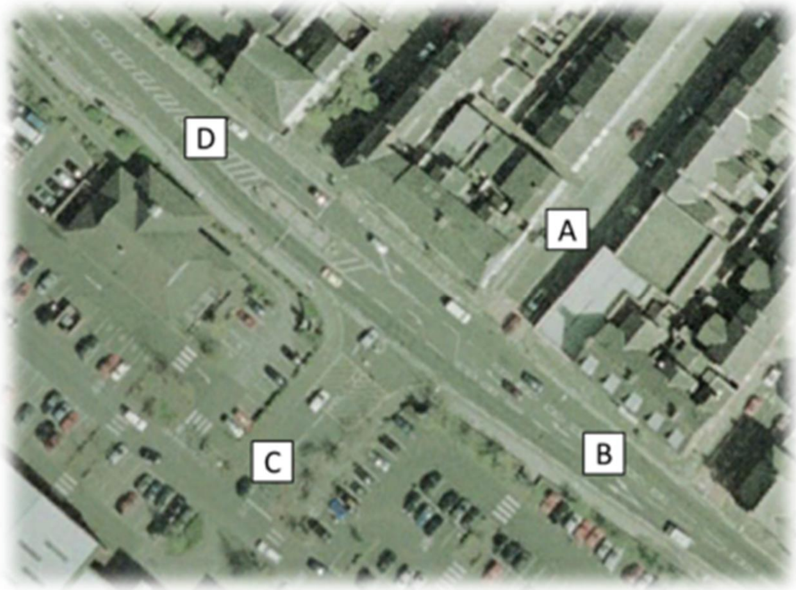
8.9 Junction 11 – London Road/St Nicholas Retail Park

8.9.1 The junction is located approximately 0.80 kilometres southeast of Carlisle city centre and currently forms a four arm signal controlled arrangement between A6 London Road, Brook Street and St Nicholas Retail Park. Signalised pedestrian crossing facilities are available on the London Road (north-west) and St Nicholas Retail Park arms of the junction.

8.9.2 The north-western arm of the A6 features single approach lane for south-eastbound traffic, which flares to provide dedicated left/ahead and right turn lanes at the stop-line. The south-eastern arm features a two lane approach, with the nearside lane dedicated to left turning traffic and the offside lane assigned to north-westbound traffic and a flare to provide a dedicated right turn lane at the stop-line. Advanced cycle stop lines are also present on both London Road approaches.

8.9.3 The St Nicholas Retail Park access features a two lane approach, with dedicated left turn and right/ahead lanes provided at the stop-line. Brook Street features a single lane approach (with all manoeuvres permitted). The existing junction layout is unavailable, however, the footprint is presented in the diagram at Figure 8-3.

Figure 8-3: London Road/St Nicholas Retail Park



8.9.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – Brook Street
- B – A6 London Road (South-east)
- C – St Nicholas Retail Park
- D – A6 London Road (North-west)

8.10 2025-2030 Base Results (Do Nothing)

8.10.1 The predicted operational performance of the existing London Road/St Nicholas Retail Park junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

8.10.2 The results tabulated at Table 8-4 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.10.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-4: London Road/St Nicholas Retail Park Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
2/2+2/3 London Road (S) Ah/Rt (2025 Base)	78.3%	23.9	78.0%	14.1
2/2+2/3 London Road (S) Ah/Rt (2025 LP)	80.9%	25.9	92.0%	18.5
2/2+2/3 London Road (S) Ah/Rt (2030 LP)	81.9%	26.9	105.6%	44.6

8.10.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity during the morning peak period and above it during the evening peak period in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is London Road South (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 81.9% in the morning and 105.6% in the evening respectively.

8.11 Proposed Junction Improvements

8.11.1 Following a review of the existing junction arrangement and extent of the limits of adoptable highway within the area, it has been established that there is very little scope for delivery of a meaningful improvement scheme, which would significantly benefit the operational performance of this junction. The development of potential mitigation measures associated with this junction arrangement will, therefore, not be considered as part of the Carlisle Transport Improvements Study.

8.11.2 However, the benefits of extending the UTC network to the neighbouring London Road/B&Q junction may provide limited improvements in the co-ordination of the signals, potentially reducing delays.

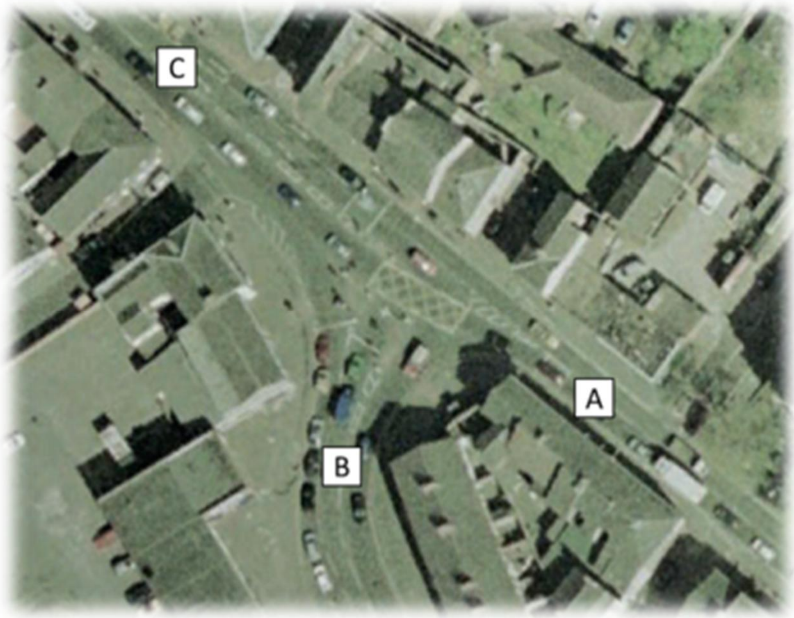
8.12 Junction 12 – Botchergate/St Nicholas Street

8.12.1 The junction is located approximately 0.50 kilometres south-east of Carlisle city centre and currently forms a three arm signal controlled arrangement between A6 Botchergate and St Nicholas Street. Signalised pedestrian crossing facilities are available on the Bothchergate (North-west) and St Nicholas Street arms of the junction. Advance cycle stop lines are present on all approaches.

8.12.2 The south-eastern arm of the A6 features single approach lane for north-westbound traffic (with all manoeuvres permitted). The north-western arm features a single approach lane, which flares to provide a dedicated right turn lane for traffic entering St Nicholas Street.

8.12.3 St Nicholas Street features a two lane approach, with dedicated left and right turn lanes for vehicles accessing the A6 in both directions. The existing junction layout is presented in the diagram at Figure 8-4.

Figure 8-4: Botchergate/St Nicholas Street



8.12.4 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – A6 London Road (South-east)
- B – St Nicholas Street
- C – A6 Botchergate (North-west)

8.13 2025-2030 Base Results (Do Nothing)

8.13.1 The predicted operational performance of the existing Botchergate/St Nicholas Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

8.13.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.13.3 Table 8-5 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.13.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-5: Botchergate/St Nicholas Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1 London Road Lt/Ah (2025 Base)	88.5%	22.3	84.4%	18.2
1/1 London Road Lt/Ah (2025 LP)	87.4%	21.6	87.9%	20.1
1/1 London Road Lt/Ah (2030 LP)	93.5%	25.9	91.6%	22.8

8.13.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity and just over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is London Road (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 93.5% in the morning and 91.6% in the evening respectively.

8.14 Proposed Junction Improvements

8.14.1 Following a review of the existing junction arrangement and extent of the limits of adoptable highway within the area, it has been established that there is very little scope for delivery of a meaningful improvement scheme, which would significantly benefit the operational performance of this junction. The development of potential mitigation measures associated with this junction arrangement will, therefore, not be considered as part of the Carlisle Transport Improvements Study.

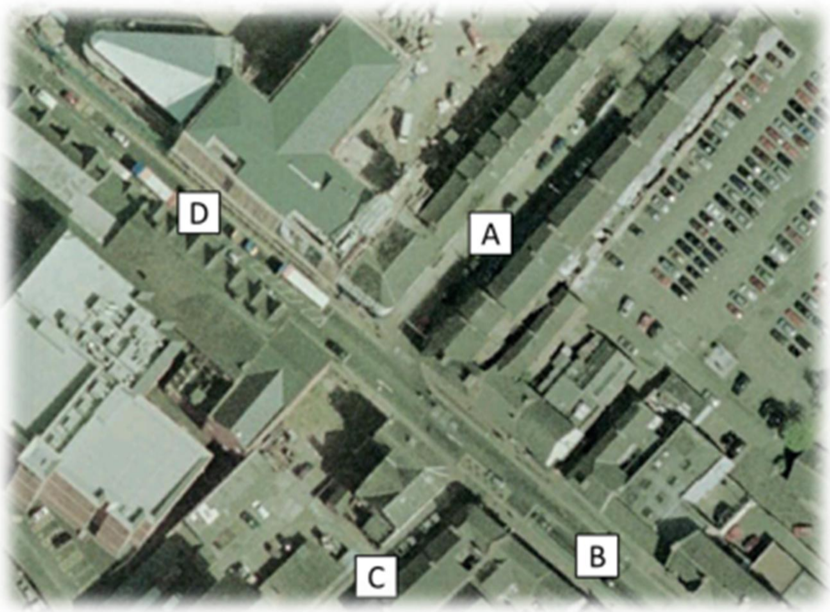
8.15 Junction 13 – Botchergate/Crown Street/Tait Street

8.15.1 The junction is located approximately 0.30 kilometres south-east of Carlisle city centre and currently forms a four arm signal controlled staggered crossroads arrangement between A6 Botchergate, Tait Street and Crown Street. Signalised pedestrian crossing facilities are available on the A6 Botchergate (North-west), Tait Street and Crown Street arms of the junction.

8.15.2 The south-eastern arm of the A6 features a single approach lane (with all manoeuvres permitted) and the north-western arm provides a single approach lane for south-eastbound traffic only (with the left and right turns forming banned manoeuvres).

8.15.3 Tait Street is one-way in nature and provides a single lane approach for left turning traffic onto Botchergate (with the right turn forming a banned manoeuvre). Crown Street has a single lane approach for both left and right turning traffic onto Botchergate. The existing junction layout is presented in the diagram at Figure 8-5.

Figure 8-5: Botchergate/Crown Street/Tait Street



8.15.4 The overall junction arrangement tested within this report comprises five arms labelled A to E as follows:

- A – Tait Street
- B – A6 Botchergate (South-east)
- C – Crown Street
- D – A6 Botchergate (North-west)

8.16 2025-2030 Base Results (Do Nothing)

8.16.1 The predicted operational performance of the existing Botchergate/Tait Street/Crown Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

8.16.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.16.3 Table 8-6 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ). Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-6: Botchergate/Tait Street/Crown Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
6/1 Botchergate (NW) Ah (2025 Base)	119.6%	24.6	155.7%	52.0
6/1 Botchergate (NW) Ah (2025 LP)	117.8%	23.1	157.8%	53.7
6/1 Botchergate (NW) Ah (2030 LP)	132.5%	44.3	106.4%	20.4

8.16.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Botchergate (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 132.5% in the morning and 106.4% in the evening respectively.

8.17 Proposed Junction Improvements

8.17.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Making Crown Street a one-way road with a two lane approach at the stop-line (providing dedicated right and left turn facilities for traffic entering Botchergate).

8.17.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

8.18 2025-2030 Predicted Results (Do Something)

8.18.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.18.2 Table 8-7 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.18.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-7: Botchergate/Tait Street/Crown Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
6/1 Botchergate (NW) Ah (2025 Base)	50.4%	5.0	69.2%	7.3
6/1 Botchergate (NW) Ah (2025 LP)	47.1%	4.8	70.1%	7.4
6/1 Botchergate (NW) Ah (2030 LP)	51.0%	6.4	72.8%	8.2

8.19 Summary

8.19.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Botchergate Southeast and Botchergate Northwest (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 64.5% in the morning (compared with 132.5% previously) and 72.8% in the evening (compared with 106.4% previously).

8.19.2 It can be concluded that the improvement would provide capacity benefits for vehicles and the potential improvement is therefore recommended. However, if this option is progressed further, additional work would be required to assess suitability of the necessary diversion route for vehicles currently turning onto Crown Street. It is anticipated that further improvement work would be required to provide a suitable diversion route.

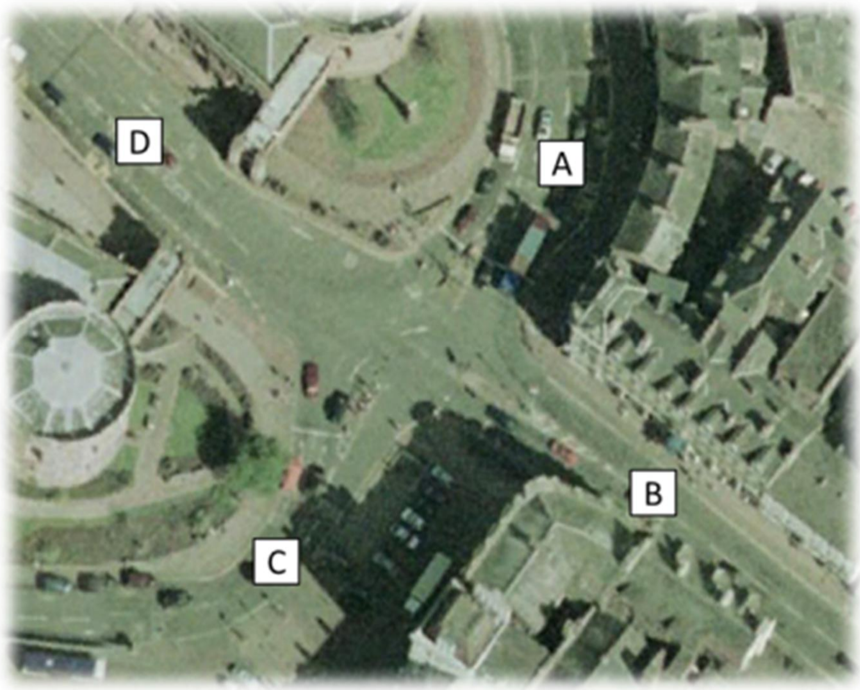
8.20 Junction 14 – Botchergate/The Crescent

8.20.1 The junction is located within Carlisle city centre and currently forms a four arm signal controlled arrangement between A7 The Crescent, A6 Botchergate, Court Square Brow and English Street. Signalised pedestrian crossing facilities are available on The Crescent, Botchergate and Court Square Brow arms of the junction.

8.20.2 The Crescent features a two lane approach, with the nearside lane forming a dedicated left turn facility and the offside lane assigned to the ahead/right turn manoeuvres. Botchergate has a single approach lane, which flares to provide a dedicated right turn lane for traffic entering The Crescent.

8.20.3 Court Square Brow features a single lane approach (with all manoeuvres permitted). English Street is one-way in nature and provides a single exit lane for westbound traffic. The existing junction layout is presented in the diagram at Figure 8-6.

Figure 8-6: Botchergate/The Crescent



8.20.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – A7 The Crescent
- B – A6 Botchergate
- C – Court Square Brow
- D – English Street

8.21 2025-2030 Base Results (Do Nothing)

8.21.1 The predicted operational performance of the existing Botchergate/The Crescent junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

8.21.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

8.21.3 Table 8-8 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.21.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-8: Botchergate/The Crescent Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/1 Court Square Brow Ah/Rt/Lt (2025 Base)	78.0%	5.6	53.4%	4.9
3/1 Court Square Brow Ah/Rt/Lt (2025 LP)	84.1%	6.5	57.8%	5.4
3/1 Court Square Brow Ah/Rt/Lt (2030 LP)	95.2%	9.6	60.5%	5.8

8.21.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Court Square Brow and The Crescent (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 95.2% in the morning and 78.6% in the evening respectively.

8.22 Proposed Junction Improvements

8.22.1 Due to the location of the junction in the city centre, it is not appropriate to consider significant vehicular capacity improvement works. However, there exists potential to reduce pedestrian delay by reconfiguring the staging of the junction. In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Re-staging the existing junction layout, introducing an all-round red stage at the end of the cycle to aid crossing opportunities for pedestrians in the city centre.

8.23 2025-2030 Predicted Results (Do Something)

8.23.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Table 8-9 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

8.23.2 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 8-9: Botchergate/The Crescent Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/1 Court Square Brow Ah/Rt/Lt (2025 Base)	85.8%	6.5	84.5%	7.0
3/1 Court Square Brow Ah/Rt/Lt (2025 LP)	92.5%	8.1	84.4%	7.4
3/1 Court Square Brow Ah/Rt/Lt (2030 LP)	95.2%	9.6	76.6%	6.9

8.24 Summary

8.24.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate above its theoretical capacity during the morning peak period and within during the evening peak period in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Botchergate (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 100.1% in the morning (compared with 95.2% previously) and 77.8% in the evening (compared with 78.6% previously).

8.24.2 This option served to improve the public realm by increasing crossing opportunities for pedestrians. However, it has a detrimental impact on vehicular capacity and traffic flow. It is, therefore, not recommended as part of this study.

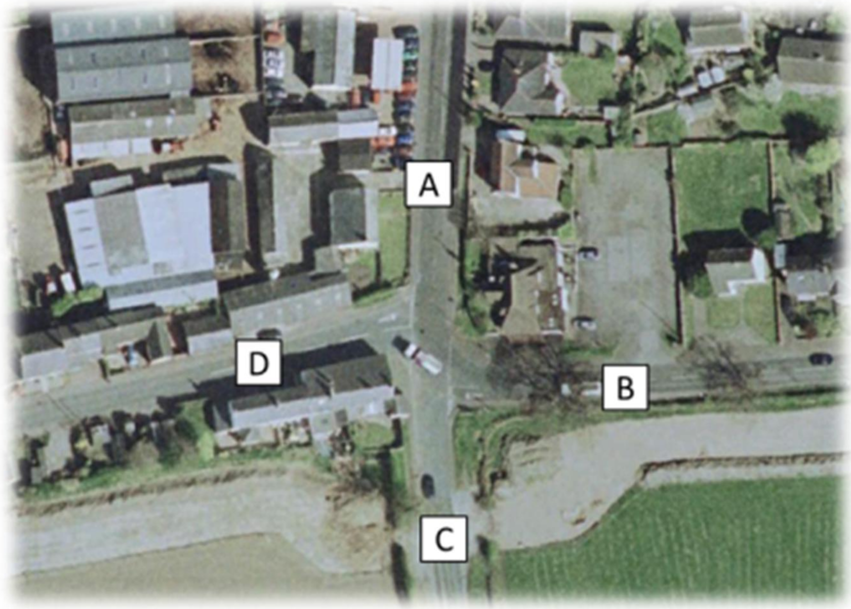
9 DURDAR ROAD/BLACKWELL ROAD CORRIDOR

9.1 Junction 15 – Durdar Road/Newbiggin Road

9.1.1 The junction is located approximately 4.65 kilometres south of Carlisle city centre and currently forms a four arm priority controlled 'Right/Left' staggered crossroads arrangement between Durdar Road and Newbiggin Road. No pedestrian crossing facilities are available within the vicinity of the junction.

9.1.2 Durdar Road forms the main-line approach and takes priority over traffic approaching on Newbiggin Road from the east and west respectively. All approaches to the junction are single lane in nature and provisions for the storage of right turning traffic are not currently available. The existing junction layout is presented in the diagram at Figure 9-1.

Figure 9-1: Durdar Road/Newbiggin Road



9.1.3 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – Durdar Road (North)
- B – Newbiggin Road (East)
- C – Durdar Road (South)
- D – Newbiggin Road (West)

9.2 2025-2030 Base Results (Do Nothing)

9.2.1 The predicted operational performance of the existing Durdar Road/Newbiggin Road junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

9.2.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

9.2.3 Table 9-1 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Ratio of Flow to Capacity (RFC) as defined in Section 3 and the average vehicular Queue.

9.2.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-1: Durdar Road/Newbiggin Road Model Results – Worst Performing Arm

Turn and Scenario	AM Peak		PM Peak	
	RFC	Queue (PCU)	RFC	Queue (PCU)
Newbiggin Road (East) to Durdar Road North and Newbiggin Road (West) (2025 Base)	0.751	2.76	0.833	4.20
Newbiggin Road (East) to Durdar Road North and Newbiggin Road (West) (2025 LP)	1.015	16.70	1.115	26.51
Newbiggin Road (East) to Durdar Road North and Newbiggin Road (West) (2030 LP)	1.216	33.75	1.283	46.36

9.2.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Newbiggin Road (East) (during both the AM and PM peaks), with the model forecasting an operational maximum ratio of flow to capacity of 1.216 (i.e. 121.6%) in the morning and 1.283 (i.e. 128.3%) in the evening respectively.

9.3 Proposed Junction Improvements

9.3.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Constructing a new signal controlled junction arrangement to provide safety benefits and improved control over the timing of manoeuvres into/out of Newbiggin Road.

9.3.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

9.4 2025-2030 Predicted Results (Do Something)

9.4.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

9.4.2 Table 9-2 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

9.4.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-2: Durdar Road/Newbiggin Road Model Results – Worst Performing Arm after Improvements

Turn and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
2/1 Newbiggin Road (E) Rt/Lt/Ah (2025 Base)	77.2%	12.5	72.4%	11.9
2/1 Newbiggin Road (E) Rt/Lt/Ah (2025 LP)	84.6%	16.5	82.8%	15.9
2/1 Newbiggin Road (E) Rt/Lt/Ah (2030 LP)	105.7%	33.2	100.4%	27.2

9.5 Summary

9.5.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Durdar Road (South) and Newbiggin Road (East) (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 106.6% in the morning (compared with 121.6% previously) and 100.4% in the evening (compared with 128.3% previously).

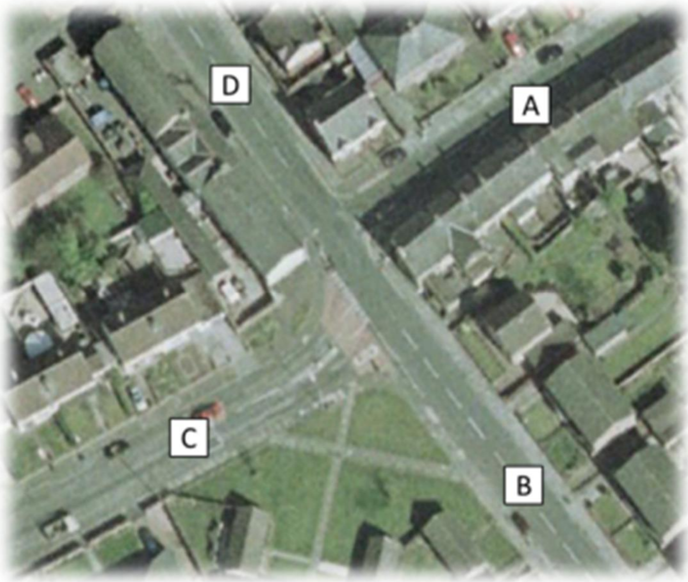
9.5.2 It can be concluded that the improvement would initially provide capacity benefits for vehicles, although the junction is forecast to still operate over capacity in 2030. However, given that this junction is significantly affected by development at the broad South Carlisle location, it may be appropriate to consider more strategic improvements to provide lasting capacity benefits. It is recommended that these modifications are developed in line with the future master-plan for this area.

9.6 Junction 16 – Upperby Road/St Ninian's Road/Lamb Street

9.6.1 The junction is located approximately 2.30 kilometres south of Carlisle city centre and currently forms a four arm priority controlled 'Left/Right' staggered crossroads arrangement between Upperby Road, St Ninian's Road and Lamb Street. No pedestrian crossing facilities are available within the vicinity of the junction.

9.6.2 Upperby Road forms the main-line approach and takes priority over traffic approaching on St Ninian's Road/Lamb Street from the east/west respectively. All approaches to the junction are single lane in nature and provisions for the storage of right turning traffic are not currently available. The existing junction layout is presented in the diagram at Figure 9-2.

Figure 9-2: Upperby Road/St Ninian's Road/Lamb Street



9.6.3 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – St Ninian's Road
- B – Upperby Road (South)
- C – Lamb Street
- D – Upperby Road (North)

9.7 2025-2030 Base Results (Do Nothing)

9.7.1 The predicted operational performance of the existing Upperby Road/St Ninian's Road/Lamb Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

9.7.2 The results tabulated at Table 9-3 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Ratio of Flow to Capacity (RFC) as defined in Section 3 and the average vehicular Queue.

9.7.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-3: Upperby Road/St Ninian's Road/Lamb Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
St Ninian's Road to all movements (2025 Base)	0.695	2.17	0.890	6.16
St Ninian's Road to all movements (2025 LP)	0.803	3.66	0.965	10.56
St Ninian's Road to all movements (2030 LP)	1.022	15.94	1.189	38.63

9.7.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is St Ninian's Road (during both the AM and PM peaks), with the model forecasting an operational maximum ratio of flow to capacity of 1.022 (i.e. 102.2%) in the morning and 1.189 (i.e. 118.9%) in the evening respectively.

9.8 Proposed Junction Improvements

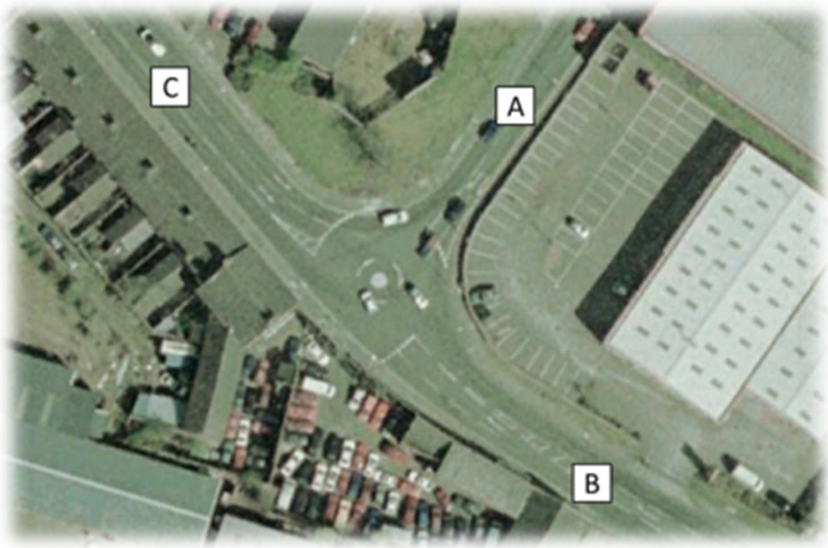
9.8.1 Following a review of the existing junction arrangement and extent of the limits of adoptable highway within the area, it has been established that there is very little scope for delivery of a meaningful improvement scheme, which would significantly benefit the operational performance of this junction. The development of potential mitigation measures associated with this junction arrangement will, therefore, not be considered as part of the Carlisle Transport Improvements Study.

9.9 Junction 17 – Currock Road/Crown Street

9.9.1 The junction is located approximately 0.45 kilometres south of Carlisle city centre and currently forms a three arm mini-roundabout arrangement between Currock Road, Currock Street and Crown Street. No pedestrian crossing facilities are available within the vicinity of the junction.

9.9.2 The Crown Street and Currock Road arms of the roundabout currently benefit from a single approach lane, which flare to provide two dedicated lanes at the give-way line for different traffic streams. The Currock Street approach has two approach lanes. The existing junction layout is presented in the diagram at Figure 9-3.

Figure 9-3: Currock Road/Crown Street



9.9.3 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – Crown Street
- B – Currock Road
- C – Currock Street

9.10 2025-2030 Base Results (Do Nothing)

9.10.1 The predicted operational performance of the existing Currock Road/Crown Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

9.10.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

9.10.3 Table 9-4 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Ratio of Flow to Capacity (RFC) as defined in Section 3 and the average vehicular Queue.

9.10.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-4: Currock Road/Crown Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
Currock Street (2025 Base)	0.789	3.66	0.962	17.59
Currock Street (2025 LP)	0.826	4.60	1.007	37.36
Currock Street (2030 LP)	0.859	5.82	1.092	114.25

9.10.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity during the morning peak period and above during the evening peak period in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Crown Street and Currock Street (during the AM and PM peaks), with the model forecasting an operational maximum ratio of flow to capacity of 0.995 (i.e. 99.5%) in the morning and 1.092 (i.e.109.2%) in the evening respectively.

9.11 Proposed Junction Improvements

9.11.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Construction of a new roundabout arrangement with an increased Inscribed Circle Diameter.

9.11.2 A further potential improvement option has also been considered and tested which would require the construction of a new signal controlled junction to provide greater control over the priority of traffic movement. Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

9.12 2025-2030 Predicted Results (Do Something)

9.12.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

9.12.2 Table 9-5 (roundabout option) and Table 9-6 (signalised option) below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS)/Ratio of Flow to Capacity (RFC) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ)/average vehicular queue. Results are given for the as defined in Section 3 and the average vehicular Queue.

9.12.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-5: Currock Road/Crown Street Roundabout Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	RFC	Queue	RFC	Queue
Currock Street (2025 Base)	0.486	0.94	0.603	1.51
Currock Street (2025 LP)	0.506	1.02	0.631	1.69
Currock Street (2030 LP)	0.521	1.08	0.684	2.14

Table 9-6: Currock Road/Crown Street Signalised Junction Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
Currock Street (2025 Base)	65.3%	6.0	78.4%	16.0
Currock Street (2025 LP)	66.1%	6.2	78.6%	16.0
Currock Street (2030 LP)	71.5%	9.8	86.8%	23.7

9.13 Summary

9.13.1 The revised results clearly demonstrate that the upgraded junction arrangement (roundabout option) is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Currock Road and Currock Street (during the AM and PM peaks), with the model forecasting an operational maximum ratio of flow to capacity of 0.560 (i.e. 56.0%) in the morning (compared with 99.5% previously) and 0.684 (i.e. 68.4%) in the evening (compared with 109.2% previously).

9.13.2 With regards the signal controlled option tested, the results demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Crown Street and Currock Street (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 75.7% in the morning (compared with 99.5% previously) and 86.8% in the evening (compared with 109.2% previously).

9.13.3 It can be concluded that both improvements would provide capacity benefits for vehicles (particularly the roundabout option) and are therefore recommended. It would be beneficial to form a strategic opinion on the degree of improvement considered desirable when performing future detailed design of this roundabout option, as this will affect the amount of land-take required to deliver the scheme.

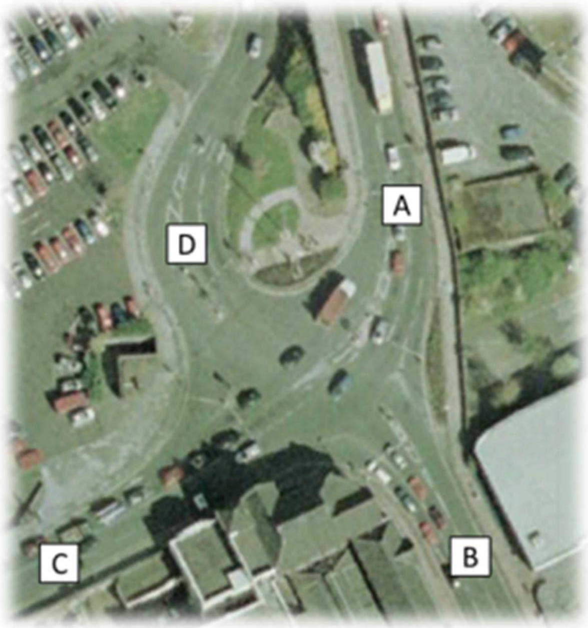
9.14 Junction 18 – Victoria Viaduct/James Street/Nelson Bridge/Viaduct Estate Road

9.14.1 The junction is located approximately 0.25 kilometres south of Carlisle city centre and currently forms a four arm signal controlled arrangement between Victoria Viaduct, James Street, Nelson Bridge and Viaduct Estate Road. Signalised pedestrian crossing facilities are available on the Victoria Viaduct and Viaduct Estate Road arms of the junction. There is also a pedestrian underpass. Advance cycle stop lines are present on all approach arms.

9.14.2 Victoria Viaduct features a single lane approach, which flares to provide three lanes at the stop-line, with the nearside lane forming a dedicated left turn facility, the central lane for westbound traffic and the off-side lane for westbound traffic and right turn manoeuvres into Viaduct Estate Road. James Street has a two lane approach, with the nearside lane dedicated to left turning traffic and the offside lane assigned to the ahead/right turn manoeuvres.

9.14.3 Nelson Bridge also benefits from a two lane approach, which flares to provide three lanes at the stop-line, with the nearside lane dedicated to the left turn, the central lane to eastbound traffic and the offside lane to the right turn. Viaduct Estate Road features a single lane approach, which flares to provide two lanes at the stop-line, with the nearside lane assigned to the ahead/left turn manoeuvres and the offside lane dedicated to right turning traffic. The existing junction layout is presented in the diagram at Figure 9-4.

Figure 9-4: James Street/Victoria Viaduct/Viaduct Estate Road/Nelson Bridge



9.14.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – Victoria Viaduct
- B – James Street
- C – Nelson Bridge
- D – Viaduct Estate Road

9.15 2025-2030 Base Results (Do Nothing)

9.15.1 This junction was modelled in conjunction with the adjacent Charlotte Street/Denton Street/Nelson Bridge signals, due to the close proximity of the two arrangements, to accurately reflect the linked operation of the junctions.

9.15.2 The predicted operational performance of the existing Victoria Viaduct/James Street/Nelson Bridge/Viaduct Estate Road junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

9.15.3 The results tabulated at Table 9-7 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

9.15.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-7: Victoria Viaduct/James Street/Nelson Bridge/Viaduct Estate Road Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/2+1/1 Victoria Viaduct Ah/Rt (2025 Base)	57.7%	3.1	75.5%	9.3
1/2+1/1 Victoria Viaduct Ah/Rt (2025 LP)	57.7%	3.1	110.7%	33.5
1/2+1/1 Victoria Viaduct Ah/Rt (2030 LP)	62.5%	4.0	128.5%	81.2

9.15.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over the 90% DOS threshold during the morning peak period and above during the evening peak period in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Viaduct Estate Road and Victoria Viaduct (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 94.8% in the morning and 128.5% in the evening respectively.

9.16 Proposed Junction Improvements

9.16.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Construction of a new four arm mini-roundabout.

9.16.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

9.17 2025-2030 Predicted Results (Do Something)

9.17.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

9.17.2 Table 9-8 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Ratio of Flow to Capacity (RFC) as defined in Section 3 and the average vehicular Queue.

9.17.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 9-8: Victoria Viaduct/James Street/Nelson Bridge/Viaduct Estate Road Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	RFC	Queue	RFC	Queue
Victoria Viaduct (2025 Base)	0.224	0.29	0.818	4.02
Victoria Viaduct (2025 LP)	0.268	0.36	1.088	30.42
Victoria Viaduct (2030 LP)	0.522	1.07	1.730	224.77

9.18 Summary

9.18.1 The revised results demonstrate that the tested junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Nelson Bridge and Victoria Viaduct (during the AM and PM peaks), with the model forecasting an operational maximum ratio of flow to capacity of 1.119 (i.e. 111.9%) in the morning (compared with 94.8% previously) and 1.730 (i.e. 173.0%) in the evening (compared with 128.5% previously).

9.18.2 The assessment has revealed that introducing a mini-roundabout would not provide capacity benefits. It is, therefore, not recommended that this option is progressed as part of the Carlisle Transport Improvements Study.

9.18.3 Further capacity improvements would only be possible at this location by the restriction of some traffic movements. For example, it would be possible to significantly improve capacity by closing the Viaduct Estate Road approach. However, to accommodate the rerouting of traffic currently using this arm would potentially require significant engineering works.

9.18.4 This junction is also heavily influenced by adjacent potential development sites, including Caldew Riverside and future possible uses on the site of The Pools. It is therefore recommended that improvements such as these are investigated further once more detail is available on potential developments around this area.

10 WIGTON ROAD/DALSTON ROAD CORRIDOR

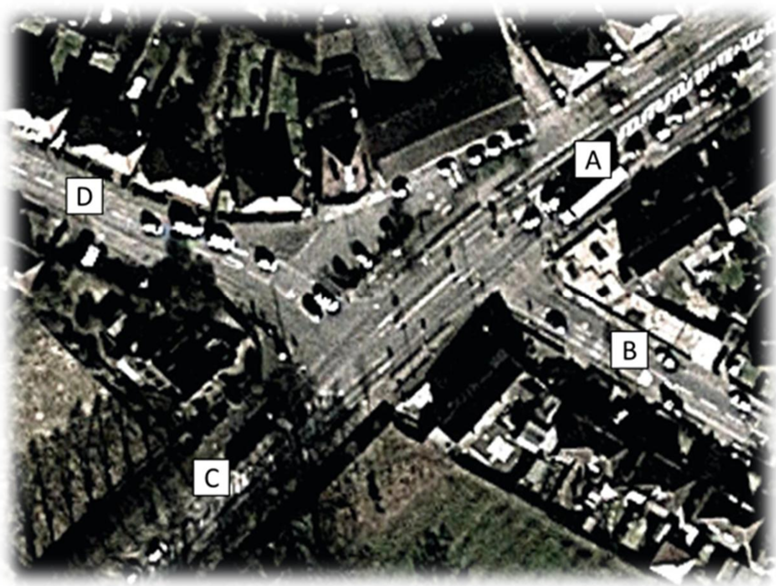
10.1 Junction 19 – Wigton Road/Orton Road/Dunmail Drive

10.1.1 The junction is located approximately 1.95 kilometres west of Carlisle city centre and currently forms a four arm signal controlled arrangement between A595 Wigton Road, Orton Road and Dunmail Drive. Signalised pedestrian crossing facilities are available on all arms of the junction.

10.1.2 The southern arm of the A595 features single approach lane (with all manoeuvres permitted). The northern arm features a single approach lane, which flares to provide two lanes at the stop-line, including a dedicated right turn lane for traffic entering Orton Road.

10.1.3 Dunmail Drive features a single approach lane with the right-turn banned. Orton Road benefits from a single approach lane, which flares to provide two lanes at the stop-line, with the nearside lane assigned to the ahead/left turn manoeuvres and the offside lane dedicated to right turning traffic entering Wigton Road in a southbound direction. The existing junction layout is presented in the diagram at Figure 10-1.

Figure 10-1: Wigton Road/Orton Road



10.1.4 The overall junction arrangement tested within this report comprises four arms labelled A to D as follows:

- A – Wigton Road (North)
- B – Dunmail Drive
- C – Wigton Road (South)
- D – Orton Road

10.2 2025-2030 Base Results (Do Nothing)

10.2.1 The predicted operational performance of the existing Wigton Road/Orton Road/Dunmail Drive junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

10.2.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

10.2.3 Table 10-1 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.2.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-1: Wigton Road/Orton Road/Dunmail Drive Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1+1/2 Wigton Road (N) Ah/Lt (2025 Base)	76.7%	15.1	88.1%	24.2
1/1+1/2 Wigton Road (N) Ah/Lt (2025 LP)	82.1%	19.8	88.7%	28.0
1/1+1/2 Wigton Road (N) Ah/Lt (2030 LP)	82.5%	20.0	92.3%	31.3

10.2.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Orton Road and Wigton Road North (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 88.8% in the morning and 92.3% in the evening respectively.

10.3 Proposed Junction Improvements

10.3.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Installing MOVA signal control to the junction in order to optimise cycle timings in real-time.
- Increase the length of the two lane approach on the Wigton Road (North) arm by approximately 25 metres.

10.4 2025-2030 Predicted Results (Do Something)

10.4.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

10.4.2 Table 10-2 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.4.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-2: Wigton Road/Orton Road/Dunmail Drive Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
1/1+1/2 Wigton Road (N) Ah/Lt (2025 Base)	74.6%	14.5	84.8%	21.8
1/1+1/2 Wigton Road (N) Ah/Lt (2025 LP)	81.2%	19.2	85.1%	24.7
1/1+1/2 Wigton Road (N) Ah/Lt (2030 LP)	80.1%	19.0	88.7%	27.7

10.5 Summary

10.5.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is now Orton Road (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 87.1% in the morning (compared with 88.8% previously) and 89.3% in the evening (compared with 92.3% previously).

10.5.2 It should also be noted that the above results take into account a 3% increase in junction capacity due to the benefits of MOVA being installed. This is in line with research on modelling MOVA control[1].

10.5.3 It can be concluded that the improvement would provide modest capacity benefits for vehicles and is therefore recommended.

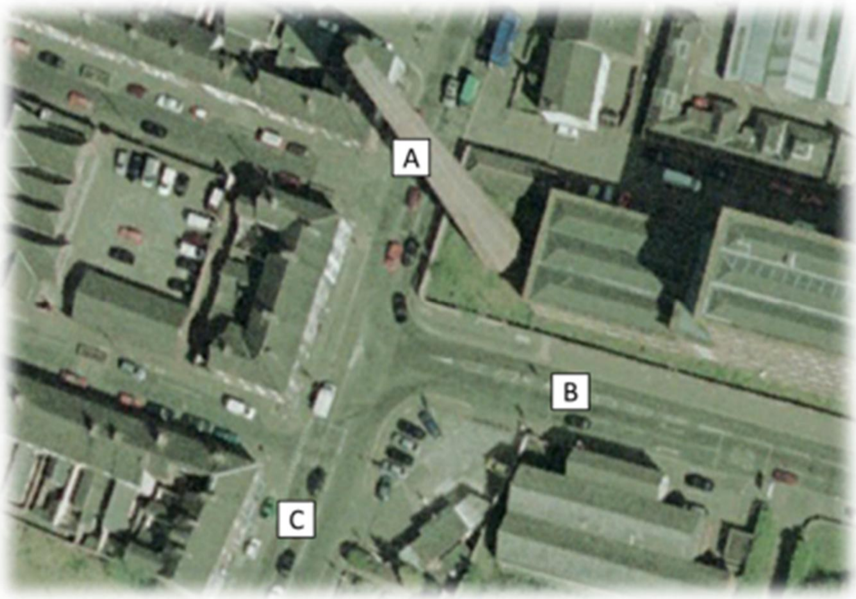
10.6 Junction 20 – Shaddongate/Junction Street

10.6.1 The junction is located approximately 0.85 kilometres west of Carlisle city centre and currently forms a three arm signal controlled arrangement between B5299 Shaddongate and Junction Street. Signalised pedestrian crossing facilities are available on the Shaddongate (North) arm of the junction.

[1] MEEHAN, D. (2003), Modelling MOVA Control. *TEC.* (September). P.295-298.

10.6.2 All arms of the junction feature two lane approaches, with dedicated lanes for each individual manoeuvre provided. The existing junction layout is presented in the diagram at Figure 10-2.

Figure 10-2: Shaddongate/Junction Street



10.6.3 The overall junction arrangement tested within this report comprises three arms labelled A to C as follows:

- A – B5299 Shaddongate (North)
- B – Junction Street
- C – B5299 Shaddongate (South)

10.7 2025-2030 Base Results (Do Nothing)

10.7.1 The predicted operational performance of the existing Shaddongate/Junction Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

The results tabulated at

10.7.2 Table 10-3 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.7.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-3: Shaddongate/Junction Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/2 Shaddongate (S) Rt (2025 Base)	67.4%	11.6	72.2%	13.9
3/2 Shaddongate (S) Rt (2025 LP)	90.4%	19.4	81.4%	16.2
3/2 Shaddongate (S) Rt (2030 LP)	95.7%	23.9	92.1%	21.1

10.7.4 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity but over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Shaddongate South (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 95.7% in the morning and 92.1% in the evening respectively.

10.8 Proposed Junction Improvements

10.8.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Relocating the stop-lines in order to reduce inter-green requirements of the signal set-up and the restriction of heavy good vehicle movements.

10.8.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

10.9 2025-2030 Predicted Results (Do Something)

10.9.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

10.9.2 Table 10-4 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.9.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-4: Shaddongate/Junction Street Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
3/2 Shaddongate (S) Rt (2025 Base)	65.2%	11.3	70.9%	13.7
3/2 Shaddongate (S) Rt (2025 LP)	75.4%	14.9	76.8%	15.3
3/2 Shaddongate (S) Rt (2030 LP)	79.9%	16.6	87.5%	19.2

10.10 Summary

10.10.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction remains Shaddongate South (during both the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 79.9% in the morning (compared with 95.7% previously) and 87.5% in the evening (compared with 92.1% previously).

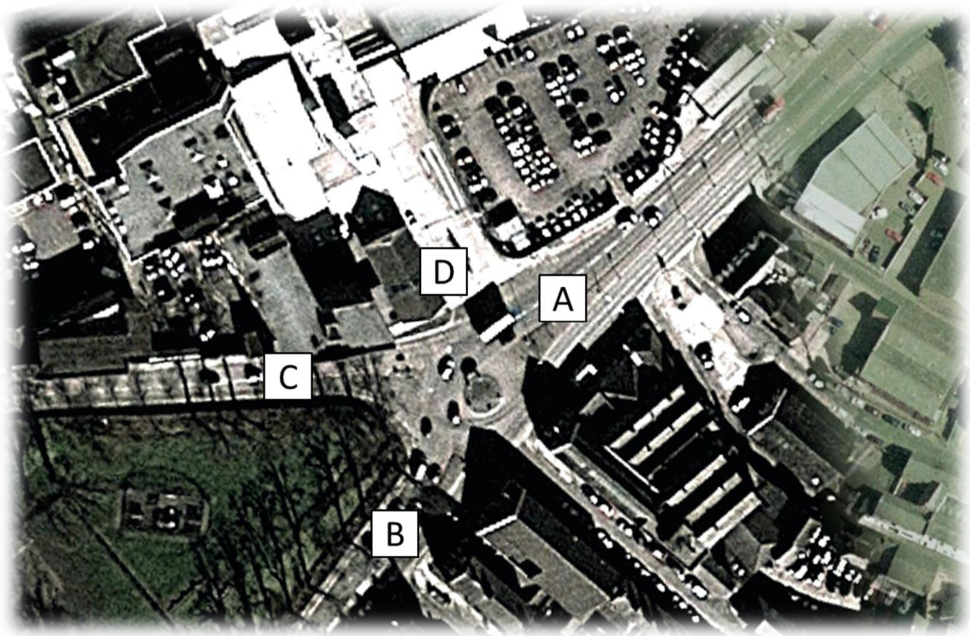
10.10.2 Thus the improvement would provide capacity benefits for vehicles and is therefore recommended subject to an assessment of the suitability of available diversion routes for heavy goods vehicles currently using the B5299 to access Junction Street.

10.11 Junction 21 – Wigton Road/Port Road/Church Street

10.11.1 The junction is located approximately 1.00 kilometre west of Carlisle city centre and currently forms a five arm roundabout between A595 Wigton Road, B5307 Port Road, A595 Church Street, Morton Street and McVities. A signalised pedestrian crossing is available on the Wigton Road arm of the junction and a zebra crossing on the Port Road arm of the junction.

10.11.2 The Wigton Road and Port Road arms of the roundabout both currently benefit from a single approach lane, which flare to provide two dedicated lanes at the give-way line for different traffic streams. The Church Street arm, however, features two full length approach lanes which provided two lanes at the give-way line for westbound traffic. The existing junction layout is presented in the diagram at Figure 10-3.

Figure 10-3: Wigton Road/Port Road/Church Street



10.11.3 The overall junction arrangement tested within this report comprises four arms (including a private access into the McVities facility) labelled A to D as follows:

- A – Church Street
- B –Wigton Road
- C – Port Road
- D – McVities Access

10.12 2025-2030 Base Results (Do Nothing)

10.12.1 The predicted operational performance of the existing Wigton Road / Port Road / Church Street junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

10.12.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

10.12.3 Table 10-5 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.12.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-5: Wigton Road/Port Road/Church Street Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
10/2 Church St Ah	54.1%	10.2	68.1%	12.4
10/2 Church St Ah	69.5%	13.2	85.6%	21.5
10/2 Church St Ah	73.0%	15.5	91.8%	25.0

10.12.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate within its theoretical capacity and just over the 90% DOS threshold during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Wigton Road and Church Street (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 97.2% in the morning and 91.8% in the evening respectively.

10.13 Proposed Junction Improvements

10.13.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Relocating the stop lines to provide increased visibility for vehicles entering the junction from all three major arms.

10.13.2 Detailed design plans of the schemes considered are attached at Appendix A and B to the rear of this report.

10.13.3 Following a review of the upgraded junction arrangement, whilst the proposals will likely offer a benefit to drivers accessing the roundabout, modelling software is unlikely to predict an improvement in operational performance due to the limits of the software (with regards visibility considerations). The testing of mitigation measures associated with this junction arrangement has, therefore, not been conducted as part of the Carlisle Transport Improvements Study.

10.13.4 It is, however, anticipated that the improvement will provide capacity and safety benefits for vehicles and is therefore recommended as part of this study.

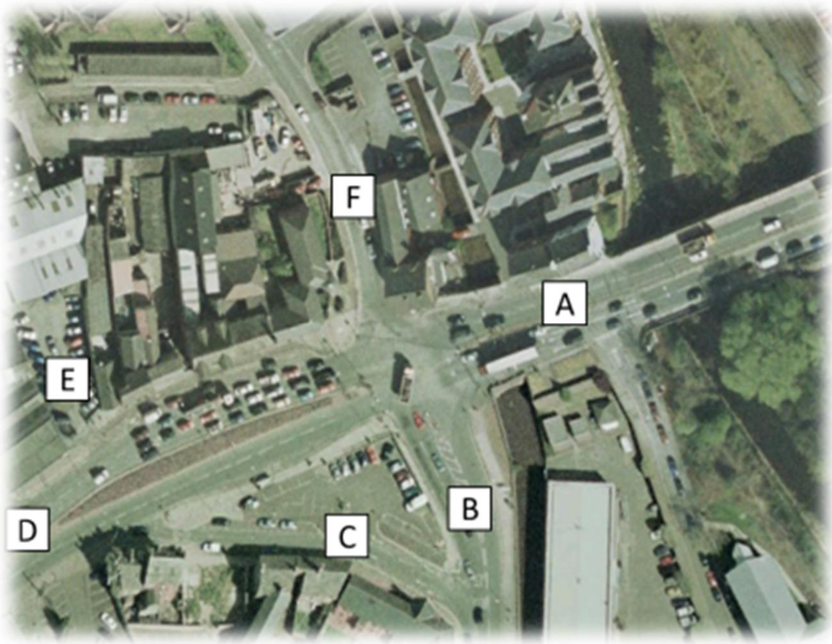
10.14 Junction 22 – Bridge Street/Shaddongate/Church Street/Sainsbury's

10.14.1 The junction is located approximately 0.85 kilometres west of Carlisle city centre and currently forms a six arm signal controlled arrangement between A595 Church Street, Bridge Lane, A595 Bridge Street and B5299 Shaddongate/John Street (with an access spur into Sainsbury's located approximately 115 metres to the west). Signalised pedestrian crossing facilities are available on all arms of the junction.

10.14.2 The western arm of the A595 has two approach lanes, which flare to provide four lanes at the internal stop-line (with dedicated left and right turn lanes and two assigned to eastbound traffic entering Bridge Street). The eastern arm has two approach lanes, which flare to provide three lanes at the stop-line (a dedicated left turn lane for traffic entering Shaddongate, two offside lanes assigned to westbound traffic accessing Church Street and the right turn into Bridge Lane forming a banned manoeuvre).

10.14.3 Bridge Lane has a single approach lane, which flares to provide two lanes at the stop-line (the nearside lane assigned to left turning/southbound traffic and the offside lane dedicated to right turn). Shaddongate benefits from a two lane approach, which flares to provide two left turn lanes (John Street) adjacent to the Sainsbury's access and two lanes for right turning/northbound traffic, which are separated by Paddy's Market Car Park). The existing junction layout is unavailable, thus the footprint is presented in the diagram at Figure 10-4.

Figure 10-4: Bridge Street/Shaddongate/Church Street/Sainsbury's



10.14.4 The overall junction arrangement tested within this report comprises six arms labelled A to F as follows:

- A – A595 Bridge Street
- B – B5299 Shaddongate
- C – B5299 John Street

- D – A595 Church Street
- E – Sainsbury's
- F – Bridge Lane

10.15 2025-2030 Base Results (Do Nothing)

10.15.1 The predicted operational performance of the existing Bridge Street / Shaddongate / Church Street / Sainsbury's junction arrangement has been assessed during the three local plan allocation scenarios described previously (i.e. 2025 Base, 2025 Local Plan and 2030 Local Plan) using the industry standard LinSig 3 modelling package for the agreed peak hours of 08:00-09:00 and 17:00-18:00.

10.15.2 The results tabulated at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

10.15.3 Table 10-6 below, illustrate the worst performing arm when considering the predicted performance of the existing junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.15.4 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-6: Bridge Street/Shaddongate/Church Street/Sainsbury's Model Results – Worst Performing Arm

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
Bridge St/Church St/Shaddongate/Bridge Ln				
3/4 Bridge St (internal) WB Right (2025 Base)	92.2%	3.2	92.1%	4.5
3/4 Bridge St (internal) WB Right (2025 LP)	95.9%	3.9	108.2%	13.0
3/4 Bridge St (internal) WB Right (2030 LP)	97.1%	4.5	105.5%	11.0
Church St/John St/Sainsbury's				
3/1 Church St EB Ahead Left (2025 Base)	98.5%	38.4	87.5%	24.9
3/1 Church St EB Ahead Left (2025 LP)	110.7%	84.8	93.4%	30.4
3/1 Church St EB Ahead Left (2030 LP)	118.4%	120.4	107.5%	67.8

10.15.5 The results clearly demonstrate that the existing junction arrangement is predicted to operate above its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Church Street and Shaddongate (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 118.4% in the morning and 109.2% in the evening respectively.

10.16 Proposed Junction Improvements

10.16.1 In order to improve the operation of certain constrained links at the junction arrangement, mitigation measures have been considered which test the effect of:

- Constructing a spiral roundabout arrangement to improve traffic flow and reduce lost time associated with signal control.

10.16.2 Detailed design plans of the schemes tested are attached at Appendix A and B to the rear of this report.

10.17 2025-2030 Predicted Results (Do Something)

10.17.1 The mitigation measures discussed above have been assessed and the resulting operational performance is presented at Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

10.17.2 Table 10-7 below, which illustrates the predicted performance of the upgraded junction arrangement under the three test scenarios. Results are given for the Degree of Saturation (DOS) as defined in Section 3 and the Mean Maximum vehicular Queue (MMQ).

10.17.3 Full summary tables for each of the three scenarios are contained at Appendix G and model outputs are contained at Appendix H to the rear of this report.

Table 10-7: Bridge Street/Shaddongate/Church Street/Sainsbury's Model Results – Worst Performing Arm after Improvements

Link and Scenario	AM Peak		PM Peak	
	DOS	MMQ	DOS	MMQ
Bridge St/Church St/Shaddongate				
2/3 Shaddongate Ah (2025 Base)	35.2%	2.8	40.3%	2.0
2/3 Shaddongate Ah (2025 LP)	43.3%	2.5	43.3%	2.6
2/3 Shaddongate Ah (2030 LP)	43.3%	2.5	43.3%	2.6
Church St/John St/Sainsbury's				
2/1 Church St (E) Ah/Lt (2025 Base)	61.0%	7.8	72.3%	12.7
2/1 Church St (E) Ah/Lt (2025 LP)	65.9%	11.1	73.8%	14.6
2/1 Church St (E) Ah/Lt (2030 LP)	65.9%	11.1	73.8%	14.6

10.18 Summary

10.18.1 The revised results clearly demonstrate that the upgraded junction arrangement is predicted to operate within its theoretical capacity during both the morning and evening peak periods in 2030 following delivery of the Local Plan development sites. The most significant arm of the junction is Bridge Street West and East (during the AM and PM peaks), with the model forecasting an operational maximum degree of saturation of 88.8% in the morning (compared with 118.4% previously) and 86.4% in the evening (compared with 109.2% previously).

10.18.2 It can, therefore, be concluded that the improvement would provide capacity benefits for vehicles. However, the proposals would remove crossing opportunities and introduce significant diversion routes for pedestrians. A roundabout of this nature would also potentially introduce a safety concerns for cyclists. These concerns may have a detrimental effect on sustainable travel in the area. In addition, the junction has recently been upgraded as part of an adjacent development.

10.18.3 Due to the location of key pedestrian and cycle routes in this area and the fact that a large roundabout would introduce significant barriers to pedestrians and cyclists at this location, it is not recommended this option is progressed in the short-term.

11 INFRASTRUCTURE COST SUMMARY

11.1 Highway Infrastructure Costs

11.1.1 The estimated highway infrastructure costs (calculated in accordance with 2014 pricing information) for all of the proposed highway improvement schemes are shown in Table 11-1 overleaf.

11.1.2 The costs provided include for all construction works and associated design, consultation and TRO processes. Estimates have primarily been based on rates from Cumbria County Council's Section 38 rates for 2014 and previous similar projects worked on (with an allowance for inflationary rises). Where comparable rates were unavailable, SPONS calculated rates have been used. The estimate date is December 2014.

11.1.3 Elements included in the cost estimate are as follows:

- Carriageway surfacing.
- Traffic signals.
- Kerbing.
- Footways.
- Signs and road markings.
- Drainage.
- Street lighting.

11.1.4 Risks such as public utilities and land acquisition (CPO process, etc) have been identified, however, they have not been directly priced. It has not been possible to determine an accurate estimate for these items, without the benefit of land prices, utility layouts, etc.

11.1.5 Elements not included within the cost estimate are as follows:

- Public utility diversions and major protection.
- Land acquisition.
- Further survey work required to determine suitability of scheme.
- Major excavation.
- Major fill material.

11.1.6 Design and consultation have been allowed for, along with construction and supervision costs. A 30% preliminaries and 25% contingency allowance has been factored into the calculations, in addition to an optimism bias (of 15% - 44%) in line with the Department for Transport's 'Transport Appraisal Guidance' documentation.

11.1.7 A detailed breakdown of the construction costs (provided overleaf) can be found in Appendix J.

Table 11-1: Highway Infrastructure Costs

Junction Name	Outline Design Drawing No.	Design, Preparation, Consultation, etc. (27.5%)	Construction + 25% Contingency	Total Budget Estimate	OB %	OB Justification for >15%	Scheme Total (with OB)	Significant Risks to Delivery
Hardwicke Circus	3513699C-PTM-000-02	£45,524	£165,540.00	£211,064.00	20%	Possible impact on underpass structure, extensive T/M	£253,277	
Georgian Way / Victoria Place	3513699C-PTM-000-03	£15,516	£56,420.00	£71,936.00	15%		£82,726	
Currock Rd / Crown St (Option 1 - Traffic Signals)	3513699C-PTM-000-05a	£85,506	£310,930.00	£396,436	25%	Land required, delay and compensation unknowns, BT diversion possibly	£495,545	Acquisition of land (CPO's etc.)
Currock Rd / Crown St (Option 2 - Roundabout)	3513699C-PTM-000-05b	£245,946	£894,350	£1,140,296	30%	Land required, delay and compensation unknowns, BT diversion possibly	£1,482,385	Acquisition of land (CPO's etc.)
Brampton Rd / Stanwix Bank	3513699C-PTM-000-06	£7,332	£26,660	£33,992	15%		£39,091	
Warwick Rd / Eastern Way	3513699C-PTM-000-11	£47,356	£172,205	£219,561	40%	Consultation and impact mitigation of creating additional westbound lane, effect on residents and ped crossings, trees etc	£307,385	
Warwick Rd / Montgomery Way / Tesco	3513699C-PTM-000-12	£51,576	£187,550	£239,126	40%	Consultation and impact mitigation of creating additional westbound lane, effect on residents and ped crossings, trees etc	£334,776	
Botchergate / Tait St / Crown St	3513699C-PTM-000-13	£134,695	£489,800	£624,495	35%	Consultation, TROs required, impact on businesses, HGV route, possible extensive remedial work to alternative route	£843,068	
London Rd / Eastern Way	3513699C-PTM-000-17	£33,887	£123,225	£157,112	30%	Known Gas main problems, extents of surfacing could increase	£204,246	Existing public utility apparatus
Wigton Rd / Caldotes	3513699C-PTM-000-19	£51,427	£187,008	£238,435	15%		£274,200	

Junction Name	Outline Design Drawing No.	Design, Preparation, Consultation, etc. (27.5%)	Construction + 25% Contingency	Total Budget Estimate	OB %	OB Justification for >15%	Scheme Total (with OB)	Significant Risks to Delivery
Shaddongate / Junction St	3513699C-PTM-000-22	£19,096	£69,440	£88,536	15%		£101,816	
Wigton Rd / Orton Road	3513699C-PTM-000-27	£24,893	£90,520	£115,413	15%		£132,725	
	Total	**£516,808 - £677,248**	**£1,897,298 - £2,462,718**	**£2,396,106 - £3,139,966**			**£3,068,854– £4,055,695**	

11.2 Sustainable Transport Infrastructure Costs

11.2.1 Table 11-2 provides a list of the proposed sustainable transport measures and their estimated costs, which have been calculated based upon a combination of:

- Figures supplied by Cumbria County Council.
- PB's experience of designing similar schemes elsewhere within the country.
- A desk-based review of similar projects throughout the United Kingdom.

Table 11-2: Sustainable Infrastructure Scheme Costs

Measure	Estimated Cost
Revamp and redesign of pedestrian and cycle signage in Carlisle in accordance with signage strategy findings	£20k signage strategy (assumed 130 signs at £150 per sign).
Revamp of city centre urban design (review of barriers, pedestrian crossing and road width)	Initial £50k study, plus implementation of identified measures.
Kingstown - Etterby Cycle Route (Scheme 1)	£90k
Hammonds Pond Cycle Route (Scheme 2)	£157k
Sheepmount Cycle Route (Scheme 3)	£204k
Petteril Valley Link (Scheme 4)	£13k
Caldew Cycleway (Scheme 5)	£5k
Newark Terrace Cycle Lane (Scheme 6)	£0
Willowholme - Sheepmount Cycle Route (Scheme 8)	£67k
Eden Bridge - Etterby Scaur Cycle Route (Scheme 9)	£142k
Castle Way Crossing Option – Bridge Street Toucan Crossings (Scheme 10)	£140k
Wigton Road to River Caldew Quiet Route	£25k
U1/2/10/11 Link (Scheme 11)	£624k
U16 Link (Scheme 12)	£277k
Eden Bridge - Etterby Street Cycle Route (Scheme 13)	£15k
Willowholme Road Link (Scheme 14)	£181k
Lowther Street - Georgian Way Link (Scheme 15)	£1.3k
Borland Avenue Cycle Lane (Scheme 16)	£110k
Harraby Link (Scheme 17)	£280k
Additional/Diverted bus services for Local Plan sites	Up to £1,920k per annum (assumed £240k per annum for a 20 minute frequency service and up to 8 new or diverted services).
Upgraded Bus Stop Infrastructure	Up to £320k (assumed £6,000 - £8,000 per stop. And up to 40 new bus stops).

Measure	Estimated Cost
Travel Planning / Business Engagement Programme	£200k
Total	**£4,641k**

11.3 Scheme Funding

11.3.1 It is intended that funding for these schemes should be primarily be secured through developer funding mechanisms such as the Community Infrastructure Levy (if introduced) and Section 106 or 278 agreements.

11.3.2 Where there is a shortfall in developer funding, Cumbria County Council and Carlisle City Council will work jointly to secure funding through other external sources. Examples of external funding sources include:

- Department for Transport
- Local Growth Fund
- European Regional Development Fund

11.3.3 The delivery of schemes is dependent on securing external funding as they cannot be accommodated within existing budgets.

12 SUMMARY AND CONCLUSION

12.1 Summary

12.1.1 Parsons Brinckerhoff has been commissioned by Cumbria County Council and Carlisle City Council to undertake a transport improvements study for Carlisle.

12.1.2 The study report will form part of the Carlisle Local Plan evidence base and will specifically inform Carlisle City Council's Infrastructure Delivery Plan. It will be used by Carlisle City Council to support the Local Plan through the Examination in Public.

12.1.3 This study consists of two key elements:

- Identification of potential sustainable transport improvements, with the target to increase modal share of walking, cycling and public transport trips in Carlisle.
- Identification of potential highway/junction improvements to improve traffic network capacity

12.1.4 The above key elements are deliverables that are integral to unlocking future growth in Carlisle through the delivery of the specific development sites identified in the Carlisle Local Plan (2015–2030).

12.1.5 A key driver of the vision underpinning the Local Plan is to develop Carlisle as a highly accessible, sustainable and healthy city. Consequently there is a strong desire to identify and pursue sustainable transport improvements to help accommodate growth through reducing pressures on the highway network (by securing modal shift) and realising the wider benefits that sustainable modes of travel can provide for the population.

12.1.6 A range of sustainable transport measures have been included in this report, specifically related to improvements to walking, cycling and public transport infrastructure. Enhancement to Travel Planning has also been recommended to maximise the benefits of the recommended infrastructure improvements.

12.1.7 The junctions identified for review and redesign were selected through consultation with Cumbria County Council, based on outputs from the strategic traffic model using criteria relating to forecast operational performance.

12.1.8 A total of 22 junctions were selected, with focus on Hardwicke Circus and the Scotland Road, Warwick Road, London Road, Durdar Road/Blackwell Road and Wigton Road/Dalston Road corridors.

12.1.9 Traffic flow data for base and future years was extracted from the Carlisle strategic traffic model, which has been prepared and maintained by Cumbria County Council.

12.1.10 The performance of the identified junctions was undertaken using industry standard junction modelling software; specifically LinSig, PICADY and ARCADY, presenting information on existing junction capacity, delay and average queue lengths.

12.1.11 Where junctions were forecast to have capacity issues, potential junction improvements have been identified with the intention of improving the operation of the existing arrangement. Suggested improvements range from amending traffic signals and existing delineation to improve traffic management, through to the creation of additional road space to increase capacity. These potential improvements were then remodelled to assess the capacity improvements associated with the upgrades.

12.1.12 Highway improvement and sustainable infrastructure schemes have all been listed with supplied estimated costs, based either on existing figures supplied by Cumbria County Council, previous schemes undertaken by Parsons Brinckerhoff or through review of other similar schemes in the United Kingdom.

12.1.13 It is intended that financing of the potential schemes would primarily come from developer funding from the Local Plan sites and other developments progressed during the plan period. Developer funding mechanisms may include Section 106 or 278 agreements and the Community Infrastructure Levy if introduced.

12.1.14 Where there is a shortfall in developer contributions, the funding could be sought from other external sources such as:

- Department for Transport.
- Local Growth Fund.
- European Regional Development Fund.

12.1.15 The delivery of schemes is dependent on securing external funding as they cannot be accommodated within existing budgets.

12.2 Conclusions

12.2.1 The following conclusions have been drawn from the study as summarised above:

- A number of junctions in Carlisle are operating at or above capacity and without action, traffic flows would be expected to worsen as Local Plan development is completed.
- There are a number of opportunities to enhance capacity at a number of pinch-point junctions, through the redesign of existing arrangements.
- Detailed junction modelling supports that the proposed highway improvements are capable of significantly enhancing capacity on the local highway network and enabling future development growth.
- There are various opportunities to deliver improved sustainable transport infrastructure in Carlisle, which is a compact city that can be made highly accessible for pedestrians, cyclists and public transport users.

12.2.2 It is anticipated that delivery of the recommended sustainable transport schemes can realistically achieve a 5% reduction in traffic across Carlisle, contributing to improved traffic flows and creating a more accessible, healthier city. In order to ensure that a robust assessment is presented, the effect of this potential reduction has not been modelled within the Carlisle Transport Improvements Study.