Durham Transport Model

Durham County Council

County Durham Plan Appraisal Report

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Contents

1. Introduction

1.1 Overview

Jacobs was commissioned by Durham County Council (DCC) to undertake a study to analyse the transport implications of the emerging local plan, known as the County Durham Plan (CDP). This work forms part of the initial plan preparation, in the lead up to the submission of the CDP for examination in 2019.

1.2 Background

Jacobs has recently carried out an update of the Durham Transport Model, using traffic count and roadside interview data undertaken in 2015, to produce a fit for purpose modelling tool to examine the traffic and transport implications of the CDP. This latest model update was completed in October 2018, and this updated Durham Transport Model has been used to model several scenarios associated with DCC's preferred future housing and employment allocation options. This spatial strategy has also been assessed in combination with a proposed Western Relief Road (WRR) and the sustainable transport measures detailed within the draft Durham Sustainable Transport Strategy 2019-2035 including a Northern Relief Road (NRR). This report presents the results of the modelling of these scenarios and analyses their impact on the Durham highway network in the years 2022 and 2037.

In total, four scenarios have been modelled and presented within this report. These include:

- **Scenario 1** – Western Relief Road External Transport Funding – Committed sites and background growth (inclusive of Aykley Heads) with Western Relief Road;
- **Scenario 2** – Western Relief Road S106 Funding – Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations with Western Relief Road;
- **Scenario 3** – Northern Relief Road – Committed sites and background growth (inclusive of Aykley Heads) with Northern Relief Road; and
- **Scenario 4** – Western Relief Road and Northern Relief Road – Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations with Western and Northern Relief Roads.

Each of the modelled scenarios is compared to a 'Do Nothing' scenario which indicates the growth in traffic due to the development allocations, but without the improvements to the highway network. The composition of each of the modelled scenarios is described in more detail later in this report.

1.3 Report Structure

Following this introduction, the remainder of this report is structured as follows:

- **Section 2: Methodology** – provides an overview of the updates made to the Durham Transport Model, and details the methodology to produce the forecast year models;
- **Section 3: Analysis methodology** – describes the types of analysis undertaken to assess the impacts of each scenario;
- **Section 4: Current Traffic Conditions** – presents the existing issues and constraints on the Durham highways network;
- **Section 5: Do Nothing Analysis** – presents the results of the modelling of the Do Nothing Scenarios;
- **Section 6: Scenario 1 Analysis** – presents the results of the modelling of Scenario 1;
- **Section 7: Scenario 2 Analysis** – presents the results of the modelling of Scenario 2.
- **Section 8: Scenario 3 Analysis** – presents the results of the modelling of Scenario 3;
- **Section 9: Scenario 4 Analysis** – presents the results of the modelling of Scenario 4; and
- **Section 10: Summary** – presents conclusions of the scenario testing.

2. Methodology

2.1 Base Model Summary

The existing Durham Transport Model (DTM), which has been developed using the SATURN suite of modelling software, has been used to inform the traffic and transport assessments required to support the CDP. The model represents a typical weekday in 2015, for a morning peak and evening peak period. The SATURN model replaced an older CUBE TRIPS model which dates back to 2006. Due to the age of the model, it was not considered suitable to support the CDP submission and Examination in Public, and so the model was comprehensively updated in 2015 in relation to the following:

- Inclusion of new observed traffic data including roadside interviews (RSIs), Automatic Traffic Counts (ATCs) and Manual Classified Counts (MCCs);
- Restructure of model zoning to capture updated 2011 Census data;
- Revisions to network coding;
- Updated WebTAG values of time and vehicle operating costs; and
- Speed-flow curves.

The above updates and refinements have been undertaken to ensure the model better represents the characteristics and reflects the current performance of the road network in Durham, representative of a 2015 base year. The DTM has also undergone further refinements to the network, demand and assignment matrices to ensure that the journey times and junction delays accurately reflect the existing pattern observed on the network.

The base model is considered an up-to-date, fit for purpose tool for local planning in Durham, suitable for testing the impacts of the various options included within the scenarios presented in this report.

2.2 Development Quantum

Two development scenarios have been considered for the CDP testing, each one developed for two forecast years, 2022 and 2037:

- Committed sites and background growth (inclusive of Aykley Heads); and
- Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations

The composition of the developments within the scenarios is outlined below.

2.2.1 Committed Sites

The committed sites consist of housing and employment. Table 2.1 lists the committed residential developments, with all sites larger than 50 dwellings listed specially and all sites smaller than 50 dwellings grouped as ‘Remaining Sites’. In total there are 2,873 dwellings, of which 1,337 are forecast to come forward by 2022 and the remainder by 2037.

Table 2.2 lists the committed employment sites, consisting of Aykley Heads and Milburngate House. As part of the Aykley Heads project, County Hall will relocate to The Sands in the city centre.

Table 2.1: Committed Residential Developments

Development Name	Total Dwellings	Built out by 2022	Built out by 2037
Milburngate House	441	75	441
Land To The South Of Wallnook Lane And East Of Recreation Ground	400	30	400
Integra 61 Land South Of Bowburn & West Of The A688	270	120	270
Land On The North East Side Of Cross Lane	200	75	200
Mount Oswald	173	160	173
Land to the South West of Station Road	150	70	150
Former Police Headquarters	149	140	149
Land West of Browney Lane	140	140	140
Land East of Mill Lane	120	25	120
Finchale Training College	100	30	100
Durham Johnston Comprehensive School Whinney Hill	75	75	75
Former Cape Asbestos Works Durham Road (The Grange)	74	74	74
Land To The West Of Fulforth Way	73	60	73
Land To The North East Of Hycroft Benridge Bank	65	44	65
Total of Remaining Sites	443	219	443
Grand Total	**2,873**	**1,337**	**2,873**

Table 2.2: Committed Employment Sites

Development Name	Total Jobs	Built out by 2022	Built out by 2037
Aykley Heads Phase 1 – Northern Zone Site D and E	679	0	679
Aykley Heads Phase 1 – Northern Zone Site C	300	300	300
Aykely Heads Phase 2 – Park Gateway Sites A and B	1,137	0	1,137
Total Aykely Heads	**2,116***	**300**	**2,116**
Development Name	**Site Area (sqm)**	**Built out by 2022**	**Built out by 2037**
Milburngate House – Offices	13,285	100%	100%
Milburngate House – Cinema	977	100%	100%
Total Milburngate House	**14,262**	**100%**	**100%**

** The total number of jobs at the Aykley Heads site is additional to those already available at County Hall, currently located on the site. As part of Aykley Heads Phase 2, County Hall will relocate to The Sands in Durham city centre.*

2.2.2 County Durham Plan Allocations

The County Durham Plan (CDP) allocations consist of residential sites that, with the exception of Sherburn Road, are located to the north and west of the city centre; Sherburn Road is located to the east of Durham city centre. Table 2.3 details the sites that make up the CDP allocations; in total there are 3,714 proposed dwellings, all of which are forecast to come forward after 2022. As highlighted in green below, 3 out of the 8 sites are green belt releases.

Table 2.3: County Durham Plan Allocations

Ref	Development Name	Total Dwellings	Built out by 2022	Built out by 2037
H/1	Gilesgate School	60	0	60
H/2	Land at Hawthorn House	20	0	20
H/3	South of Potterhouse Terrace	10	0	10
H/4	Former Skid Pan	50	0	50
H/5	Sniperley Park	1,700	0	1,700
H/6	Sherburn Road	420	0	420
H/7	Cook Avenue	200	0	200
H/8	Cook Avenue North	50	0	50
	Grand Total	**2,510**	**0**	**2,510**

When including the Sniperley Park site in the traffic model, improvements to the access point with the existing highways network were included to facilitate the additional traffic loading onto the network.

2.2.3 Background Growth

Any background growth not attributable to the developments listed above has been input to the model using NTEM data calculated from TEMPRO v7.2. Further detail on the forecasting process and inclusion of background growth is contained in Section 2.5.

2.3 Network Improvements

2.3.1 Existing Network Improvements

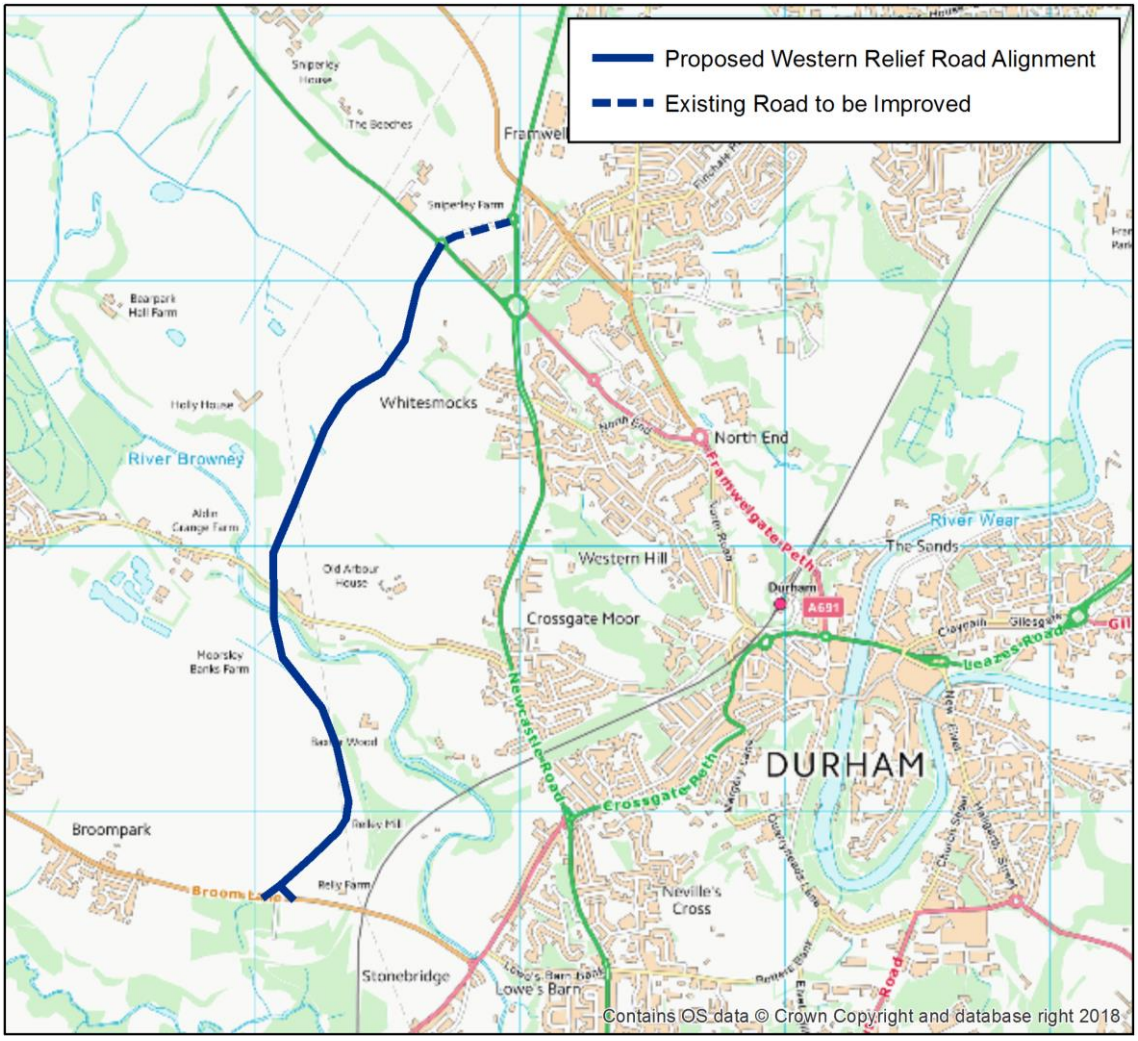
Between 2015 (the date of the base year model) and 2018, there have been a number of changes to the highway network in Durham. The following changes have been included in the forecast models as 'Do Minimum' schemes.

- Gilesgate roundabout improvements;
- Leazes Bowl junction improvements; and
- A177 Mount Oswald signals.

2.3.2 Western Relief Road

The proposed Western Relief Road connects the A691 and A167 with the A690, to the west of Durham city centre, to provide an alternative route to the congested A167 for north-south traffic. As well as relieving traffic volumes on the A167, the WRR would also help to alleviate congestion at the A167/A690 junction at Neville's Cross, which currently experiences substantial delay at peak periods. The proposed alignment of the WRR is illustrated in Figure 2.1. In addition to the new route, existing roads and junctions linking into the WRR will also be improved.

Figure 2.1: Western Relief Road Proposed Alignment



2.3.3 Northern Relief Road

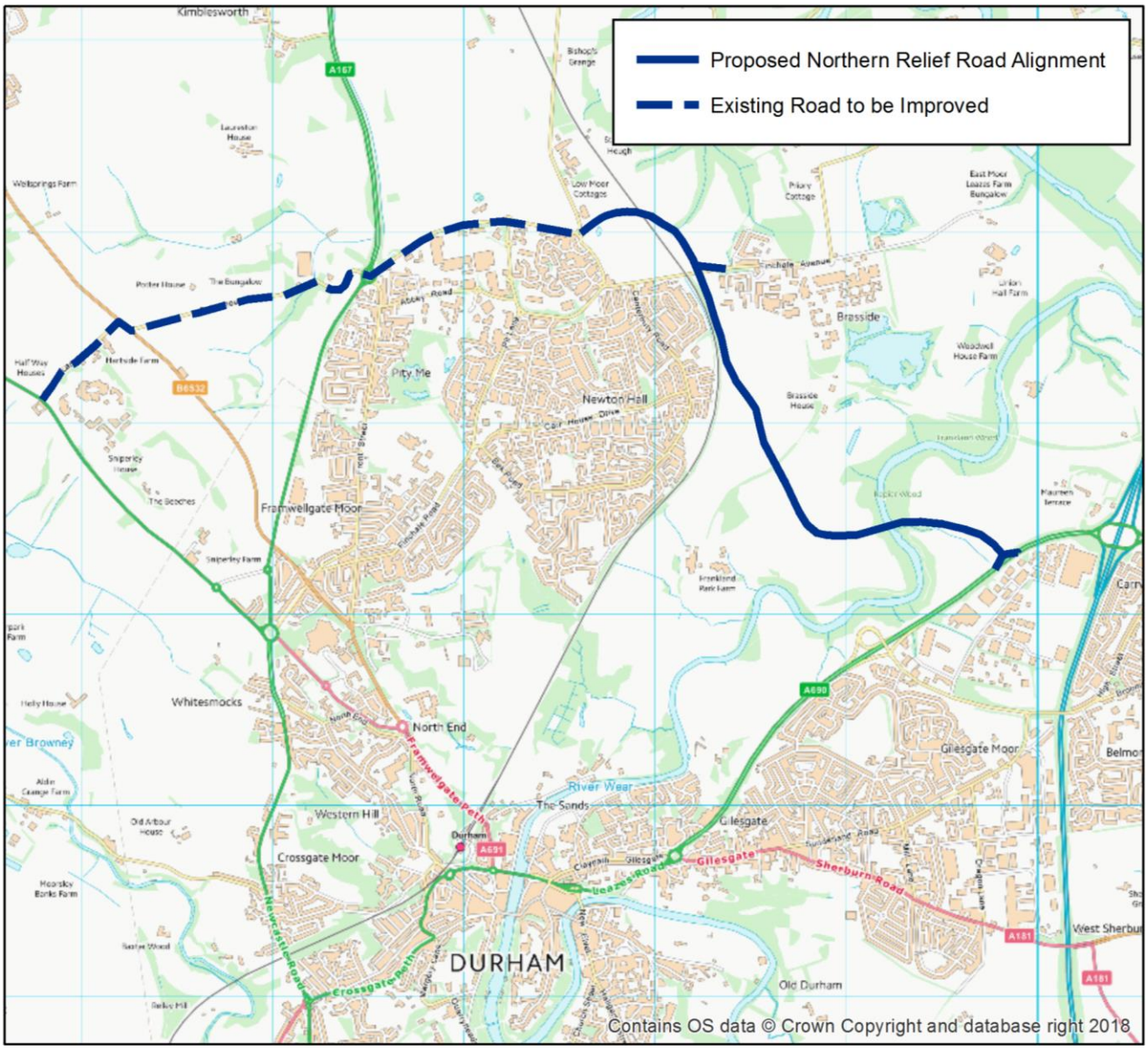
A Northern Relief Road is proposed towards the north east of the city centre, between the A167 at Pity Me and the A690 at Carrville, with the aim of removing some cross-city traffic movements from the city centre. The NRR provides an additional crossing of the River Wear and serve as an alternative route for east-west traffic movements across Durham, particularly between the A1(M) the A167 and the A691. There are two proposed alignments for the Northern Relief Road however, to provide clarity in this technical note, the results are based on the alignment illustrated in Figure 2.2. In addition to the new route, existing routes and junctions linking into the NRR will also be improved, such as Potterhouse Lane, Trout Lane and Pity Me roundabout to connect the NRR with the A691.

The NRR would help to alleviate congestion and environmental problems in Durham city centre and provide the potential to reallocate city centre road space for sustainable modes. Therefore, to complement the introduction of the NRR and the resulting removal of some of the east/west 'through traffic' from the city centre, it is proposed to reallocate road space on Milburngate Bridge to sustainable modes by reducing the number of lanes from four to two in both directions. This will enable improved facilities for pedestrians, cyclists and buses to be introduced, contributing to the prioritisation of sustainable travel in the city centre.

The infrastructure proposals and sustainable travel mode shift objectives relating to the NRR are contained within the draft Durham City Sustainable Transport Strategy (STS) 2019-35. This document aims to address the

sustainable transport needs of the city to help tackle congestion, air quality, safety and improve public health, by providing the framework to deliver future sustainable transport provision.

Figure 2.2: Northern Relief Road Proposed Alignment



2.4 Modelled Scenarios

This section describes the composition of each of the modelled scenarios in terms of the various developments, infrastructure proposals and sustainable transport measures included.

2.4.1 Do Nothing

This scenario is used to assess the effect on the network of the committed development and anticipated background traffic growth only, without any transport interventions included. Two scenarios were undertaken as follows:

- Scenario A – Committed sites and background growth (inclusive of Aykley Heads); and
- Scenario B – Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations.

2.4.2 Scenario 1 – External Transport Funding

This scenario tests the impacts of the Western Relief Road with the committed development sites only:

- Committed sites and background growth (inclusive of Aykley Heads) with Western Relief Road.

2.4.3 Scenario 2 – S106 Funding

This scenario tests the impacts of the Western Relief Road with the committed development sites and County Durham Plan allocations:

- Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations with Western Relief Road.

2.4.4 Scenario 3 – Northern Relief Road

This scenario tests the impacts of the Northern Relief Road with the committed development sites only. Two runs have been undertaken to analyse the impacts of the capacity restrictions on Milburngate Bridge:

- Committed sites and background growth (inclusive of Aykley Heads) with Northern Relief Road; and
- Committed sites and background growth (inclusive of Aykley Heads) with Northern Relief Road with one lane in each direction over Millburngate Bridge.

2.4.5 Scenario 4 – Western Relief Road and Northern Relief Road

This scenario tests the impacts of both relief roads and the full range of developments. Two runs have been undertaken to analyse the impacts of the capacity restrictions on Milburngate Bridge:

- Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations with Western Relief Road and Northern Relief Road; and
- Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations with Western Relief Road and Northern Relief Road with one lane in each direction over Millburngate Bridge.

2.5 Model Forecasting

2.5.1 Trip Generation and Trip Distribution

The forecasting consists of traffic generated from the committed housing and employment sites, plus the CDP allocations. Trip rates have been used to calculate the number of trips generated by each site. The trip rates used have been sourced from TRICS and summarised by development type in Table 2.4.

It has been assumed for the purposes of this study, that all the trips are car based. Due to the make-up of the land use types, it is likely that HGV trip generation would be very small, and so they have not been considered at this stage.

The trip distribution was undertaken using a ‘parent zones’ approach, where the distributions of similar zones in the base model are used to represent the distributions of the development zones.

Table 2.4: Trip Rates

Land Use	TRICS Category	Units	Trip Rates					
			AM Dep	AM Arr	IP Dep	IP Arr	PM Dep	PM Arr
Residential	Edge of Town Centre	HH	0.296	0.143	0.128	0.121	0.180	0.228
	Edge of Town	HH	0.390	0.097	0.158	0.158	0.149	0.319
Office	Edge of Town Centre	Jobs	0.021	0.171	0.044	0.044	0.127	0.027
Residential	From Milburngate Transport Assessment	GFA (100m^2)	0.350	0.088	0.184	0.180	0.187	0.408
Office		GFA (100m^2)	0.194	2.191	1.063	1.019	1.927	0.183
Cinema		GFA (100m^2)	0.000	0.000	0.000	0.000	1.092	1.662

2.5.2 Forecast Levels of Growth

The total traffic growth for each of the forecast years was constrained to the total growth calculated from NTEM. TEMPRO v7.2 was used to extract the NTEM data for County Durham and the growth factors are shown in Table 2.5. This growth includes the developments discussed in Section 2.2 and so the total growth was capped to these figures to avoid 'double counting'.

The overall growth is capped to NTEM in both the demand scenarios modelled. The assumption is that if the total NTEM growth is not fulfilled by sites in Durham city, it will be fulfilled elsewhere in the county. This ensures that baseline network conditions in the forecast years of 2022 and 2037 are as accurate as possible and in line with Central Government projections.

Table 2.5: Forecast NTEM Growth from TEMPRO

Forecast Year	Time-Period	Origin	Destination	Average
2015 to 2022	AM	1.0524 (5.2%)	1.0578 (5.8%)	1.0551 (5.5%)
	IP	1.0546 (5.5%)	1.0545 (5.5%)	1.0545 (5.5%)
	PM	1.0525 (5.3%)	1.0495 (4.9%)	1.0510 (5.1%)
2015 to 2037	AM	1.1549 (15.5%)	1.1645 (16.5%)	1.1597 (15.9%)
	IP	1.1599 (15.9%)	1.1598 (15.9%)	1.1599 (15.9%)
	PM	1.1534 (15.3%)	1.1474 (14.7%)	1.1504 (15.0%)

3. Analysis Methodology

3.1 Overview

This section outlines the analysis that has been undertaken for each of scenarios described in Section 2.4. A consistent approach has been used to analyse the performance of the Durham highway network in 2022 and 2037, for a typical AM and PM peak hour representing 08:00-09:00 and 17:00-18:00 respectively.

For the purpose of providing useful comparisons, the Do Nothing outputs have been analysed relative to 2015 base metrics. Scenario 1 and 3 have been compared to the to the Do Nothing Scenario A to assess the impacts of committed development sites and background growth (inclusive of Aykley Heads), while Scenario 2 and 4 have been compared to the Do Nothing Scenario B to assess the committed development sites and background growth (inclusive of Aykley Heads) and County Durham Plan allocations.

3.2 Network Capacity Analysis

Detailed network capacity analysis has captured a number of the key links and junctions on the network, which together, provide a comprehensive assessment of network performance and identifies the pinch points on the network and the changes between scenarios.

3.2.1 Link Based Capacity Analysis

The key metric used to determine overall network capacity is a Volume over Capacity (VoC) ratio. This provides a measure of traffic demand (by volume) in a given period of time expressed as a ratio of the total design capacity (or volume) of the road or junction. In general, a VoC of less than 85% indicates that a road is likely to operate within capacity, a road with a VoC of between 85% and 100% is likely to be approaching capacity, and a road with a VoC greater than 100% will be over capacity.

This metric can be applied to both road links and junctions as a measure of capacity. Once a road or junction is approaching capacity, or is over capacity, it is very likely that road users will experience increasing delays. As well as additional delay to journeys, road links or junctions which operate over capacity result in a less reliable and resilient network.

VoC provides a good measure of overall network performance at key locations. The analysis of the VoC results focuses on those links on the network that experience a VoC output of greater than 50%. The links affected are provided in a number of visual plots in remaining sections of this report, clearly highlighting those links that are identified to be operating at or approaching capacity on the network.

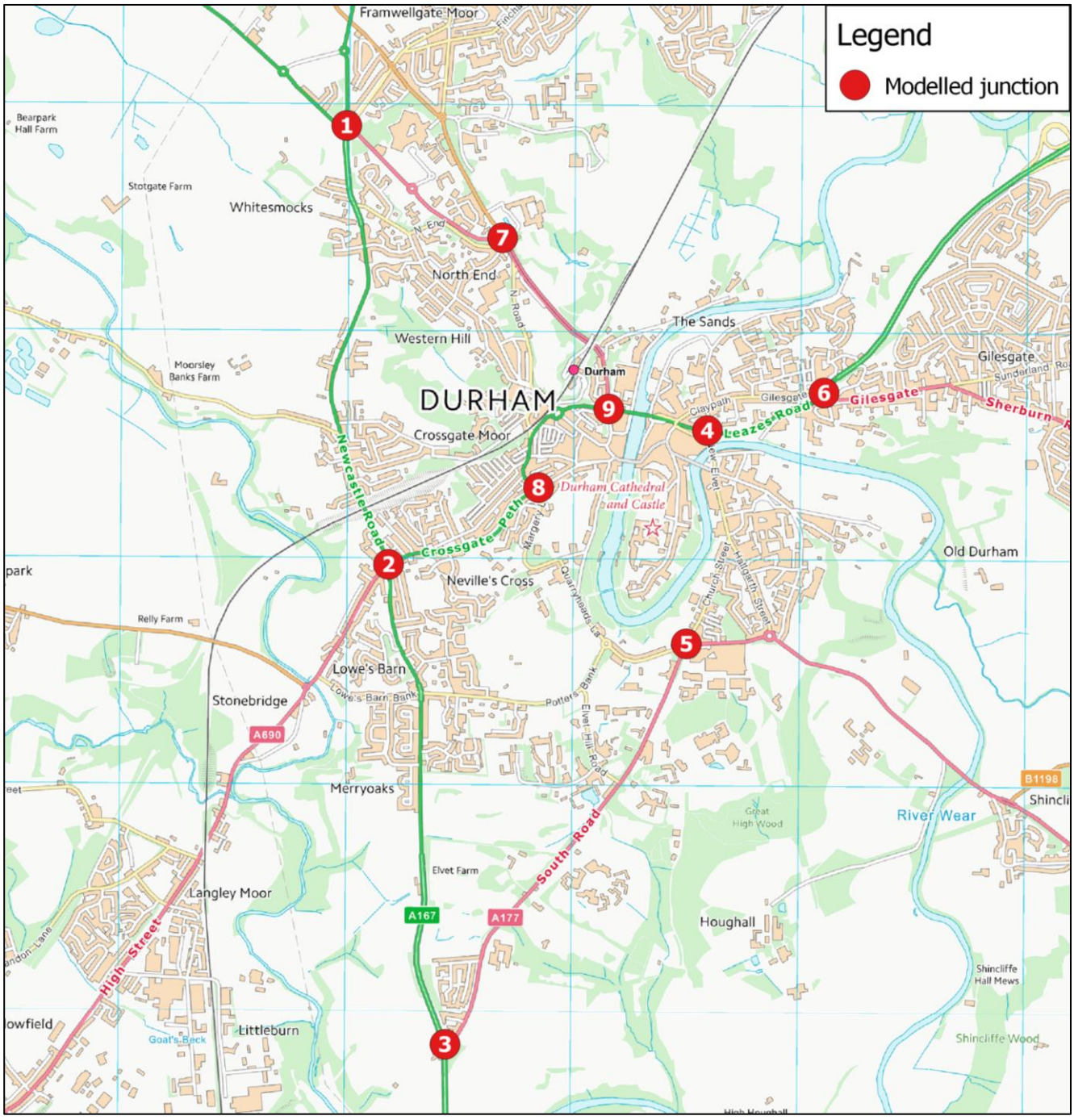
3.2.2 Junction Capacity Analysis

It is recognised that a number of the residual delays and issues relating to the road network in Durham result from capacity issues at specific junctions, which cause blocking back and congestion issues on a number of adjoining links. Therefore, in addition to VoC analysis on strategic road links, VoC analysis has also been analysed at nine key junctions on the A167, A177, A690 and A691 corridors within Durham, as shown in Figure 3.1. The junctions identified are considered to represent the majority of the strategic junctions in and around Durham City, which will provide a comprehensive understanding of future development and intervention options across the network. The junctions analysed are:

- Junction 1 – A167 / A691 Sniperley Park roundabout;
- Junction 2 – A167 / A690 Neville's Cross signal controlled junction;
- Junction 3 – A167 / A177 South Road roundabout;
- Junction 4 – A690 / New Elvet (Leazes Bowl) roundabout;
- Junction 5 – A177 South Road / Stockton Road / Quarryheads Lane signal controlled junction;
- Junction 6 – A690 / A181 Gilesgate roundabout;

- Junction 7 – A691 / B6532 (County Hall) roundabout;
- Junction 8 – A690 / Crossgate / Margery Lane signal controlled junction; and
- Junction 9 – A690 / A691 / Milburngate signalised roundabout.

Figure 3.1: Key Junctions Analysed



The analysis of each junction focusses on all movements that occur at each location, to enable the overall impact of each scenario to be considered strategically.

The results of the junction capacity analysis are presented using the following metrics:

- **Total Delay** – the demand weighted average delay experienced per simulation for all movements;

- **Total vehicles through junction** – the combined total number of vehicles which travel through the junction on each key movement; and
- **Movement VoC** – identification of demand Weighted VoC for all movements, as well as the poorest performing movement. The results of this analysis are expressed as a percentage, based on the same capacity thresholds used to determine the corridor VoC analysis described earlier, i.e:

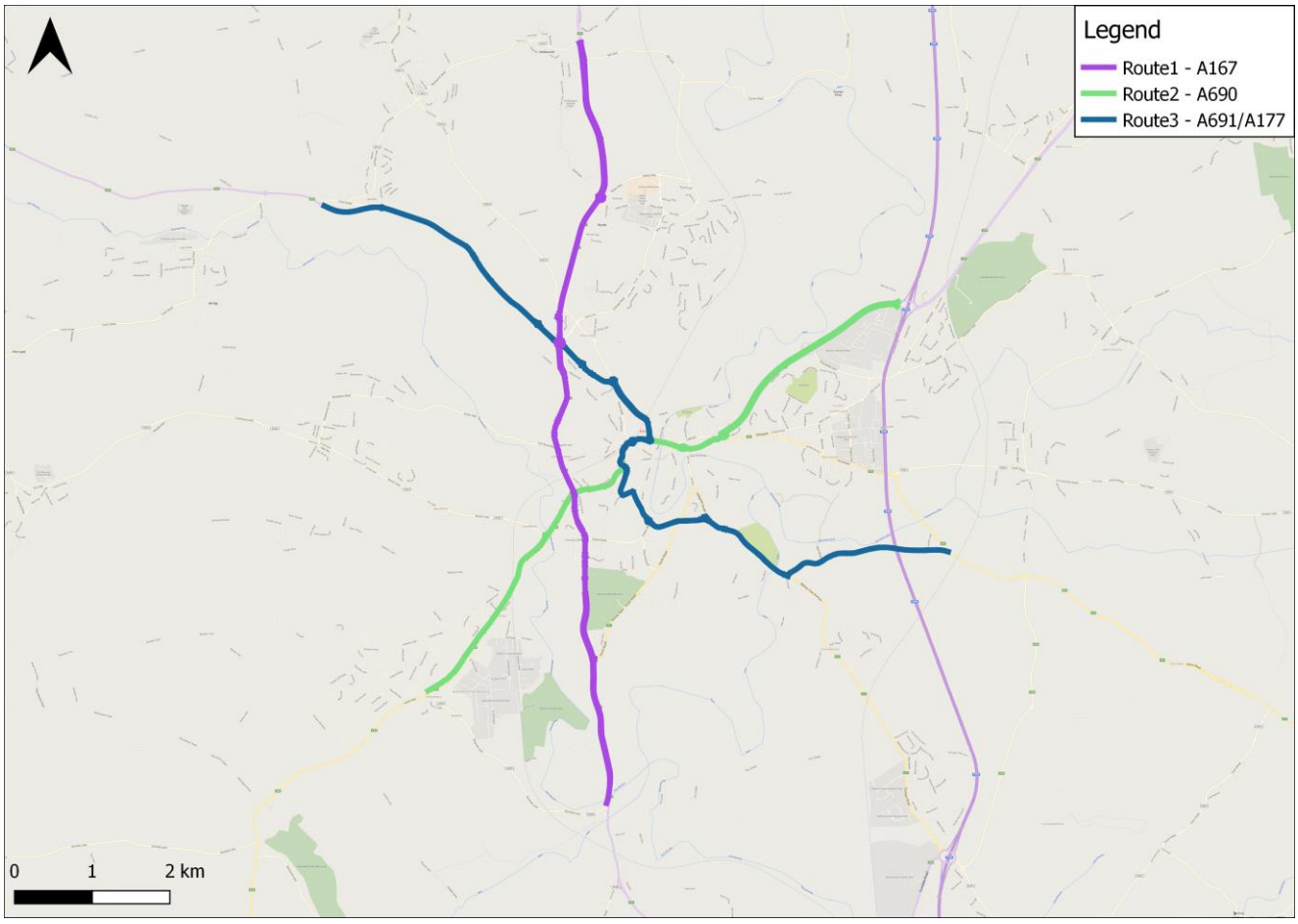
- A VoC of less than 85% indicates that a junction is likely to operate within capacity;
- A VoC of between 85% and 100% indicates a junction is likely to be approaching capacity; and
- A VoC greater than 100% indicates that the junction will be over capacity.

These metrics are considered to accurately capture the likely impact at the key junctions, which in turn provide information relating to traffic flows on key corridors such as the A167 and A690.

3.3 Journey Time Analysis

As part of the scenario analysis, the journey times along three key road corridors have also been extracted from the DTM for the 2015, 2022 and 2037 scenarios. The extents of the corridors that have been assessed are shown in Figure 3.2. These routes are considered to accurately capture strategic north-south and east-west traffic movements through Durham City.

Figure 3.2: Journey Time Routes



4. Current Traffic Conditions

4.1 Base Year Model Analysis

4.1.1 Wider Trends

The Durham road network currently experiences a number of problems which restrict its ability to operate efficiently and reliably. These problems have been borne out in the 2015 traffic surveys and baseline modelling undertaken as part of this study, which shows that while the majority of links are within capacity, key city centre links and junctions experience significant delays during peak periods. Strategic routes such as the A167 and A690, which provide north-south and east-west connectivity across the city respectively, are particularly affected.

Durham's existing traffic issues can be summarised as follows:

- Traffic which passes through Durham city, but which has neither an origin nor destination (OD) within the city account for approximately 30% of all trips. If classifying Framwelgate Moor and Pity Me as sites outside of the city centre, this value rises to 35%. These represents journeys for which alternative routes avoiding the centre are either not realistically available or are less direct;
- Non-commuting or non-business trips, such as leisure and shopping etc account for the largest proportion of trips likely to cross through the centre of Durham City;
- Traffic peaks are focused on the morning and evening peak periods although traffic builds up through the afternoon;
- The main east-west route through the city is congested throughout the day, particularly at Milburngate Bridge and along Gilesgate bank to the east;
- Key city centre junctions experience significant delays; and
- Congestion occurs on most cross-city routes particularly in the morning and evening peak periods.

4.1.2 2015 Volume Over Capacity Network Analysis

Volume over Capacity (VoC) has been plotted for the base year links and junctions in Figure 4.1 and Figure 4.2. The plots highlight a number of key routes within Durham that are already constrained in 2015 during peak periods.

The A690 corridor consists of a number of constrained links through the city centre during the AM and PM peak. Whilst they do operate within capacity, this route can be seen to be operating towards 85% capacity in large stretches. The plots also highlight that the network in the immediate vicinity of the Leazes Bowl junction is constrained in both peak periods. In addition the A690 at Crossgate Peth and the A691 Framwellgate link approaching Milburngate Bridge are constrained in both time periods, with section approaching capacity or exceeding capacity in the AM peak, representing a key pinch point on the network.

Beyond the A690 corridor, the road network to the west of the city centre generally has a larger number of links that are operating towards 85% capacity in both the AM and PM peak. This is evident on the A167, which is identified to be nearing the 85% VoC threshold along a number of sections between Neville's Cross (Junction 2) and the A691 Sniperley roundabout (Junction 1).

Overall, the network shows a number of constrained links in the current baseline conditions, representing less than ideal conditions for strategic external to external and external to city centre traffic.

Regarding junction performance, the plots highlight similar trends in both the AM and PM peak periods, with the same junctions generally being constrained in both peak periods. It should be noted that due to the analysis above being an average across the junction, it doesn't represent readily some key movements which are perhaps over capacity. However, this is the best presentational mechanism to show relative change in forecast scenarios. More detailed information on each junction is provided in the next section.

Figure 4.1: Network VoC Summary, 2015 AM Peak

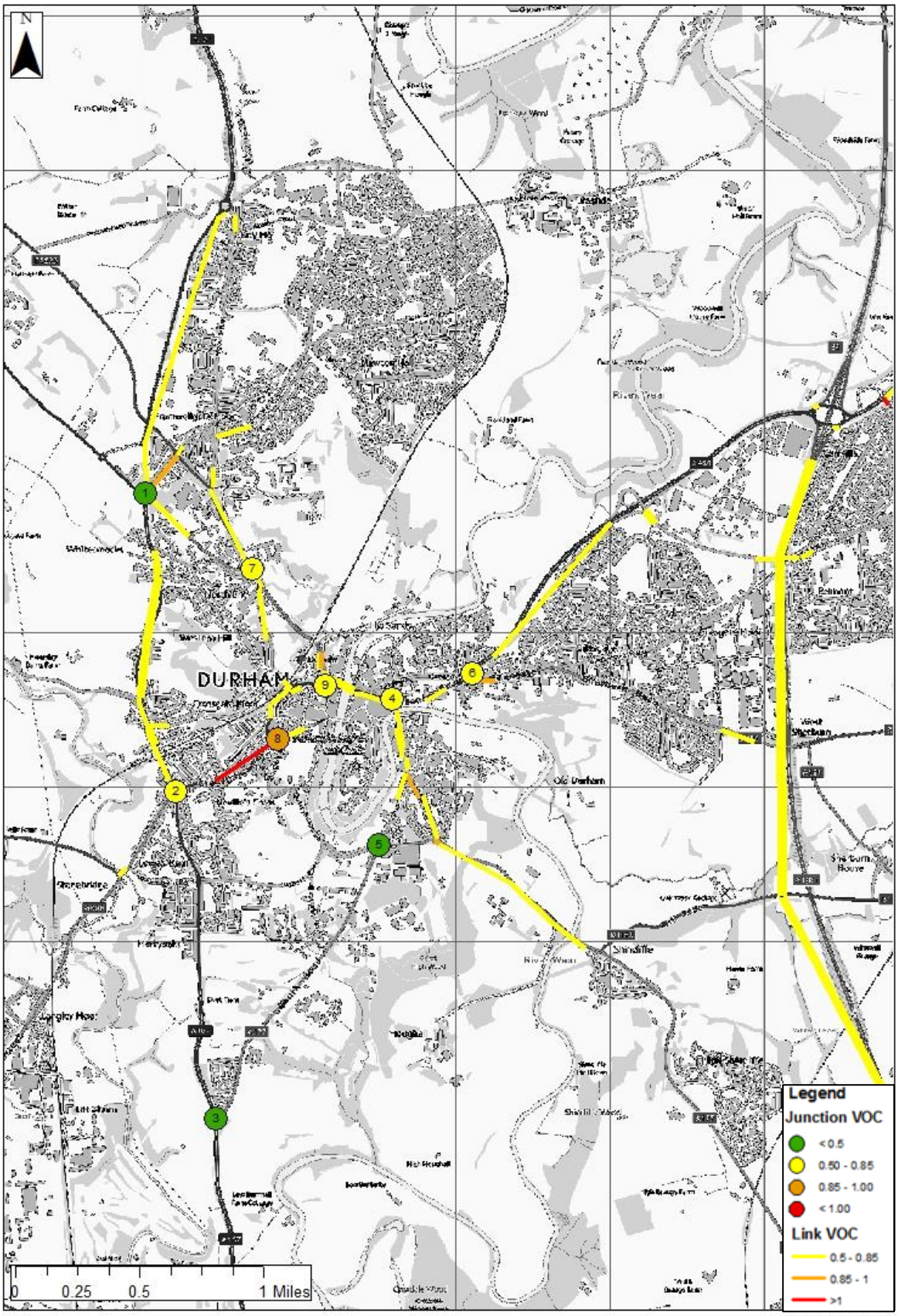
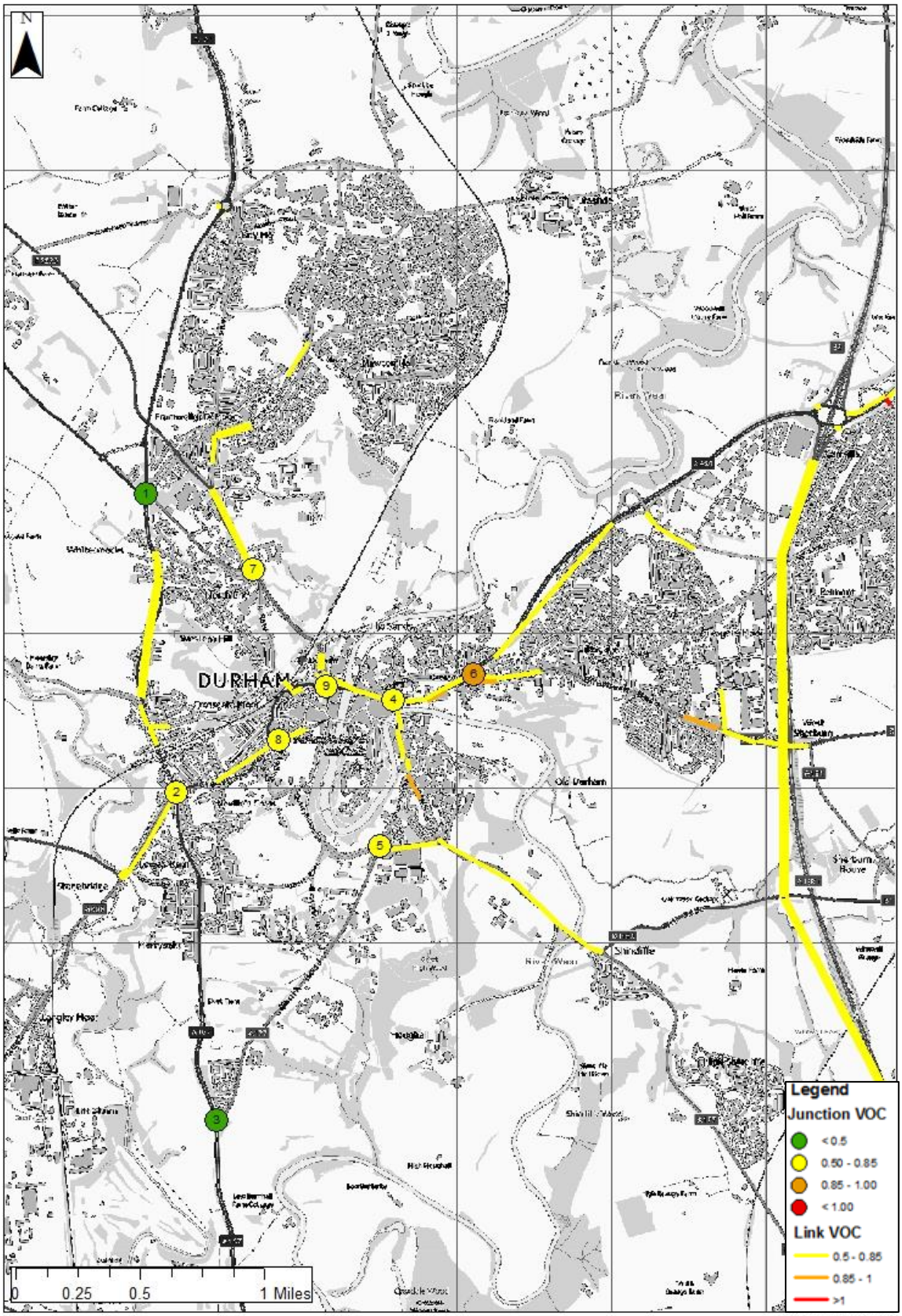


Figure 4.2: Network VoC Summary, 2015 PM Peak



4.1.3 Junction Analysis

Table 4.1 summarises the total movements through the junction, the poorest performing movement VoC and average delay per vehicle for all movements at the junctions. Although the majority of the junctions show a VoC demand weighted average of less than 85% in Figure 4.1 and Figure 4.2, many of the junction have an arm that experiences a capacity constraint that is approaching or over capacity. Table 4.1 shows this in more detail.

Table 4.1: 2015 Reference Case Junction Summary

Junction	Total Movements (vehicles)		Poorest performing movement (VoC)		Total Delay per Vehicle (mm:ss)	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Junction 1	4,102	3,516	93%	39%	00:17	00:14
Junction 2	2,904	2,801	87%	97%	00:49	01:13
Junction 3	2,214	1,987	47%	57%	00:13	00:12
Junction 4	3,354	3,260	95%	99%	00:16	00:17
Junction 5	1,301	1,325	74%	74%	00:51	00:57
Junction 6	3,140	3,802	95%	103%	00:13	00:27
Junction 7	3,289	3,278	103%	89%	00:39	00:20
Junction 8	1,621	1,593	101%	94%	01:43	01:02
Junction 9	4,089	3,871	101%	96%	00:51	00:38
Total	**26,014**	**25,433**			**05:52**	**05:18**

At Junction 1 (A691/Sniperley Park roundabout), the Dryburn Park to A167 southbound has a movement VoC of 93% in the AM period. It should also be noted that the Junction 1 is located on the A167 corridor, which is highlighted to be approaching capacity in this locality. Therefore, it is possible that constraint/delay from links upstream or downstream contribute to delay and congestion at Sniperley, as queues or congestion blocks back from other locations.

Junction 2 (Neville's Cross junction) represents one of the more constrained junctions, particularly in the PM peak with a total of 1m 13s delay per vehicle. The key strategic movements approaching capacity are the A690 eastbound movement with a VoC of 87% in the AM peak, and the A167 to A690 westbound movement with a VoC of 97% in the PM peak.

Junction 4 (A690 / New Elvet (Leazes Bowl) junction) poorest performing movement is the A690 to Claypath at 99%. It should also be noted that the A690 corridor and New Elvet has large sections which are constrained.

The results highlight that Junction 6 (A690 / A181 Gilesgate roundabout) shows the A690 to Claypath arm is the poorest performing movement at 103%. This junction only operates over capacity during the PM peak.

Junction 7 (A691 / B6532 County Hall roundabout), shows that the B6532 to A691 SB and B6532 to County Hall are both operating over capacity at 103% in the AM peak, while the B6532 to A691 SB arm approaches capacity at 89% in the PM peak.

Junction 8 (A690 Crossgate/Margery Lane junction) to the south-west of the city centre represents one of the more constrained junctions, with a total of 1m 43s delay per vehicle in the AM peak and 1m 2s delay in the PM peak. The poorest performing movement is the A690 Crossgate Peth to A690 NB and A690 to Margery Lane

SB, which both operate over capacity in the AM peak at 101%, while Crossgate to Margery Lane southbound approaches capacity at 94% in the PM peak.

Junction 9 (A690/A691/Milburngate Bridge junction), shows that the A690 to Milburngate southbound is approaching capacity in both the AM and PM peak at 91% and 92%, respectively.

Junction 3 (A167 / A177 South Road junction) and Junction 5(A177 South Road / Stockton Road / Quarryheads Lane junction) do not highlight any capacity issues in the junction analysis for both the AM and PM peak

In summary, it can be highlighted that a number of strategic junctions are operating at or approaching capacity in both peak periods, contributing to increasing journey times and delay at these locations. In terms of the total delay per simulation, Junction 8 provides the highest level of delay in both peaks, with Junction 2 also experiencing high levels of delay in the PM peak.

4.1.4 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3.

Table 4.2 highlights that journey times are broadly comparable between the two peak periods across the three routes, with the AM peak showing slightly longer journey times for each route than the PM peak. Route 2 and 3, which both pass directly through Durham city centre both have journey times of over 30 minutes; highlighting the constraint and delay associated with through-city trips.

Table 4.2: Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2015	15:09	15:41	30:51	17:19	17:11	34:30	21:59	19:24	41:23
PM Peak	2015	15:09	14:06	29:15	17:10	16:29	33:39	20:13	19:22	39:35

4.2 Current Traffic Conditions Summary

- The highway network is currently operating with stretches of constraint at various locations. This is focused at a number of key junctions on strategic corridors.
- The A167 to the west of the city centre is particularly affected, as is the A690 corridor to the east. This is consistent across both AM and PM peak periods.
- The AM peak represents a more constrained period than the PM peak, reflected in the junction performance metrics and journey times through the network.

5. Do Nothing

5.1 Overview

This section presents the results of the modelling of the Do Nothing Scenarios. Two Do Nothing Scenarios have been created to reflect each of the demand scenarios as follows:

- Scenario A – Committed sites and background growth (inclusive of Aykley Heads); and
- Scenario B – Committed sites, background growth (inclusive of Aykley Heads) and County Durham Plan allocations.

The analysis has been undertaken separately for each scenario within this section.

5.2 Do Nothing Scenario A

This section presents the results of the modelling of the Do Nothing Scenario A, which focuses only on the effects of committed developments and background traffic growth on the highway network, without any transport interventions. The analysis has been undertaken to provide an indication of future network operation based on anticipated background traffic growth and committed developments from a 2015 base to 2022 and 2037.

5.2.1 2022 Volume Over Capacity Network Analysis

The impacts of traffic growth between the base year and 2022 are shown in Figure 5.1 and Figure 5.2. They highlight that the growth is anticipated to have a negative impact on Durham's road network in both peak periods.

Figure 5.1 shows the conditions in the 2022 AM peak and highlights that the A690 to the west of the A167 and through the city centre is shown to deteriorate, with a link between Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout) and Junction 6 (A690 / A181 Gilesgate roundabout) operating at approaching capacity. With regards to the junctions, Junction 1 (A167 / A691 Sniperley Park roundabout) and Junction 5 (A177 South Road / Stockton Road / Quarryheads junction), both operating towards a VoC of 85%.

Figure 5.2 shows the impacts in the 2022 PM peak are also forecast to worsen in comparison to the base year. The A1(M) and A167 north of Durham highlight that these links operate with a VoC above 50% due to the increase in demand. With regards to junctions, Junction 8 (A690 / Crossgate / Margery Lane junction) is shown to be approaching capacity.

Figure 5.1: Network VoC Summary, Do Nothing Scenario A 2022 AM Peak

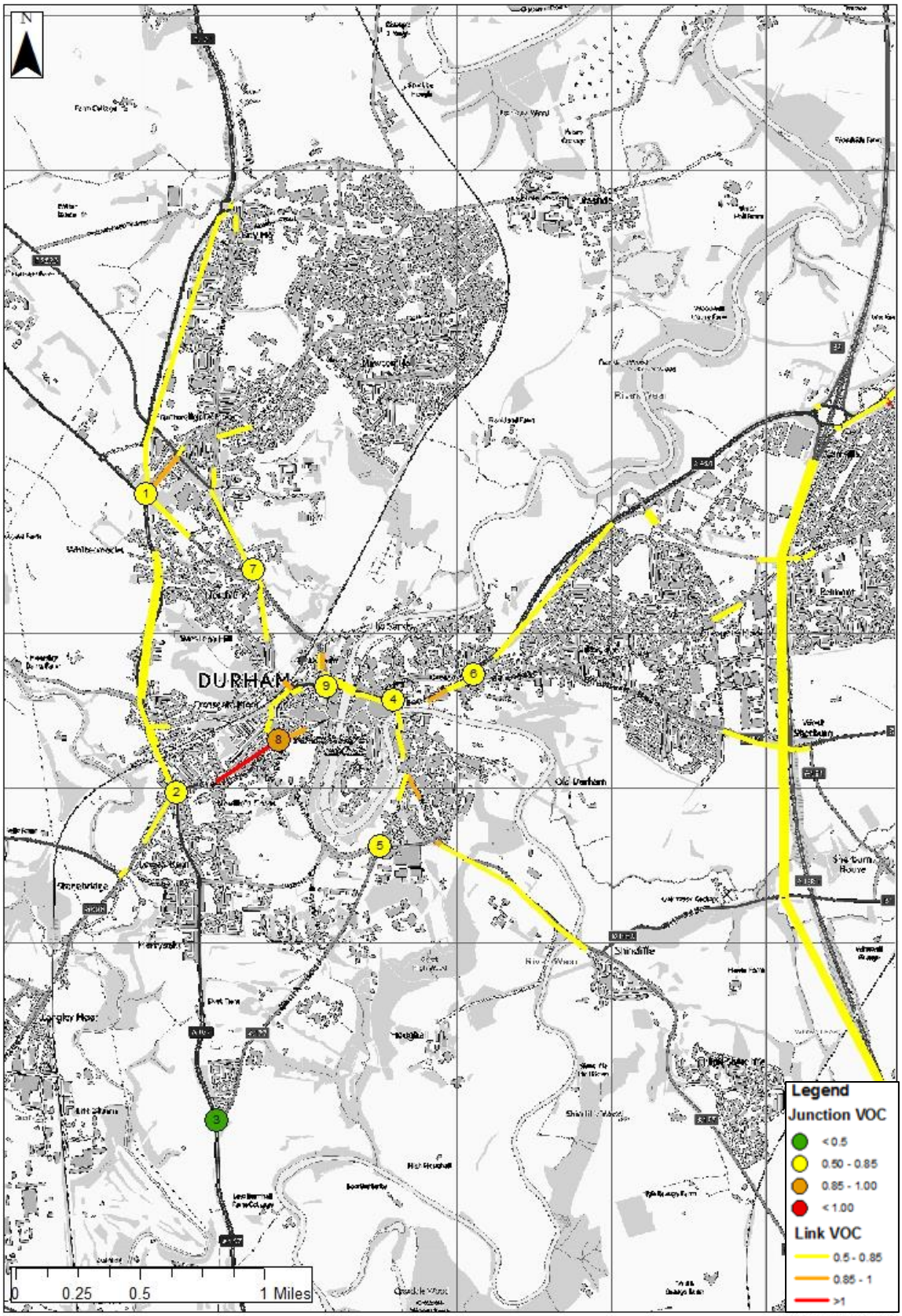
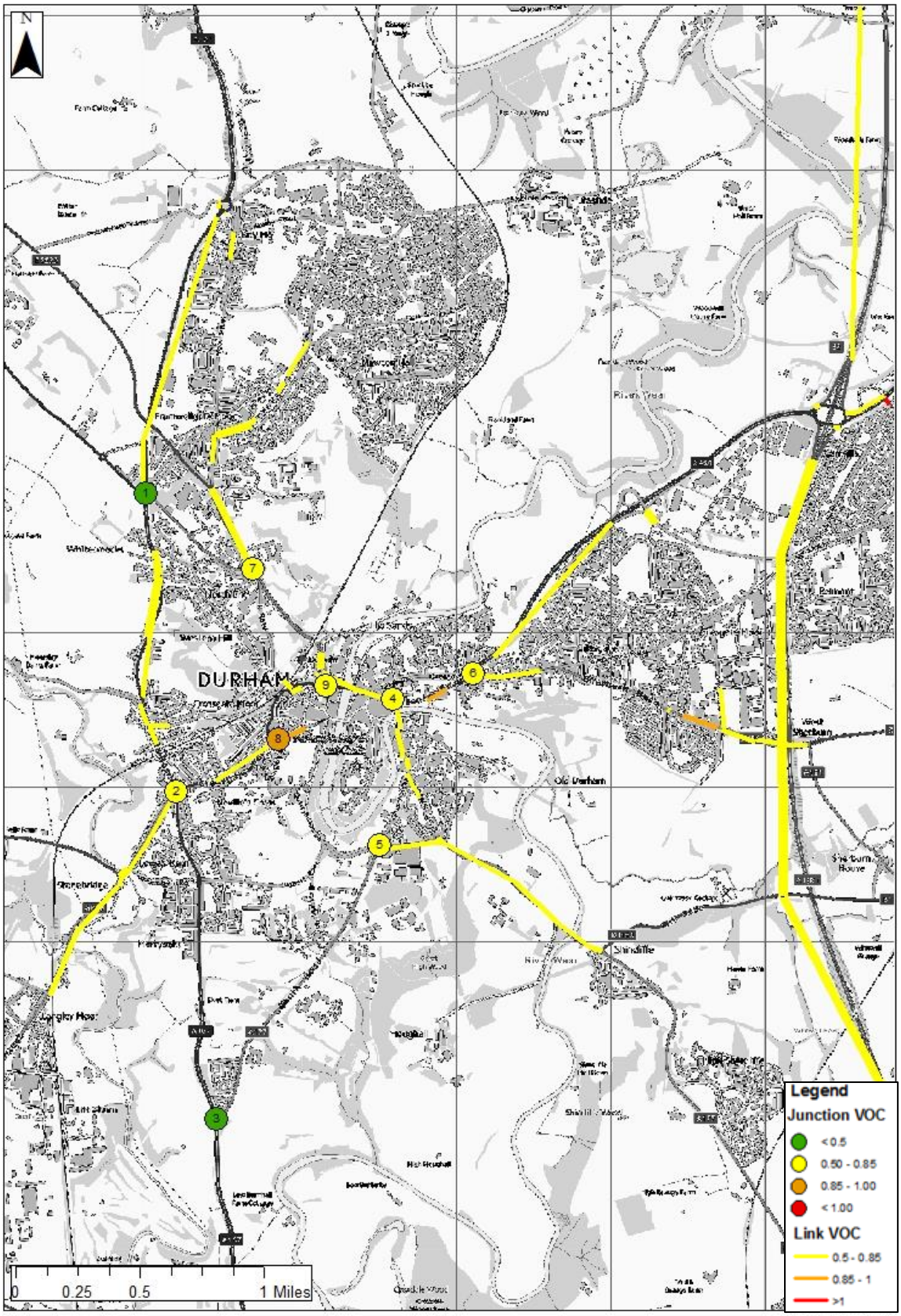


Figure 5.2: Network VoC Summary, Do Nothing Scenario A 2022 PM Peak



5.2.2 2022 Junction Analysis

Table 5.1 shows the summary of junction performance for 2022; this includes the total movements through the junction, the poorest performing VoC, and average delay per vehicle across all movements. The general trend is a further deterioration in performance of those junctions already identified in the base year as approaching capacity or operating at capacity.

Table 5.1: Do Nothing Scenario A 2022 Junction Summary

Junction	Total Movements (vehicles)		Poorest performing movement (VoC)		Total Delay per Vehicle (mm:ss)	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Junction 1	4,294	3,756	100%	44%	00:20	00:14
Junction 2	2,990	2,869	94%	98%	00:49	01:16
Junction 3	2,290	2,101	48%	63%	00:13	00:12
Junction 4	4,273	4,500	80%	73%	00:22	00:21
Junction 5	1,416	1,429	90%	75%	00:55	00:58
Junction 6	3,231	3,949	70%	96%	00:22	00:32
Junction 7	3,305	3,433	105%	92%	00:50	00:21
Junction 8	1,687	1,669	101%	100%	01:54	01:18
Junction 9	4,193	4,044	103%	96%	01:07	00:43
Total	**27,679**	**27,749**			**06:51**	**05:55**

The largest increases in traffic are shown at Junction 1 (A167 / A691 Sniperley Park roundabout) and Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout), which is a result of the additional development. Despite the increases in flow, there is an improvement in the poorest performing movement at Junction 4 by 15% in the AM peak and 26% in the PM peak. This is a results of the junction upgrade included in the Do Nothing network. There was also a junction improvement at Gilesgate, with a reduction in VoC of 25% in the AM and 7% in the PM peak. Although reductions in VoC can be seen, this is not reflected in the delay, which shows a marginal increase most likely due to the implementation of signals.

The unmodified junctions show an increase to the poorest performing movement VoC, with Junction 5 (A177 South Road / Stockton Road / Quarryheads junction) now being classified as approaching capacity in the AM peak.

Overall, across the wider network, there is expected to be an increase of 17% and 11% in total delay at junctions across the network in the AM and PM peak respectively. This is due to the total movements through each junction increasing from 2015 to 2022.

5.2.3 2037 Volume Over Capacity Network Analysis

The impacts of traffic growth between the base year and 2037 are shown in Figure 5.3 and Figure 5.4. They highlight the forecast network link and junction performance in 2037 for the Do Nothing Scenario A.

Figure 5.3 highlights that an additional two links are forecast to operate over capacity in 2037 in the AM peak. This includes the Dryburn Park approach to Junction 1 (A167 / A691 Sniperley Park roundabout) and the North Road approach to the A690 / North Road roundabout. The A1(M) north of Durham also indicates an increase in traffic, and the A690 east of the A167 has become constrained. Figure 5.4 highlights little change from 2022 to 2037, but does indicate that the A690 is shown to worsen either side of the A167.

Figure 5.3: Network VoC Summary, Do Nothing Scenario A 2037 AM Peak

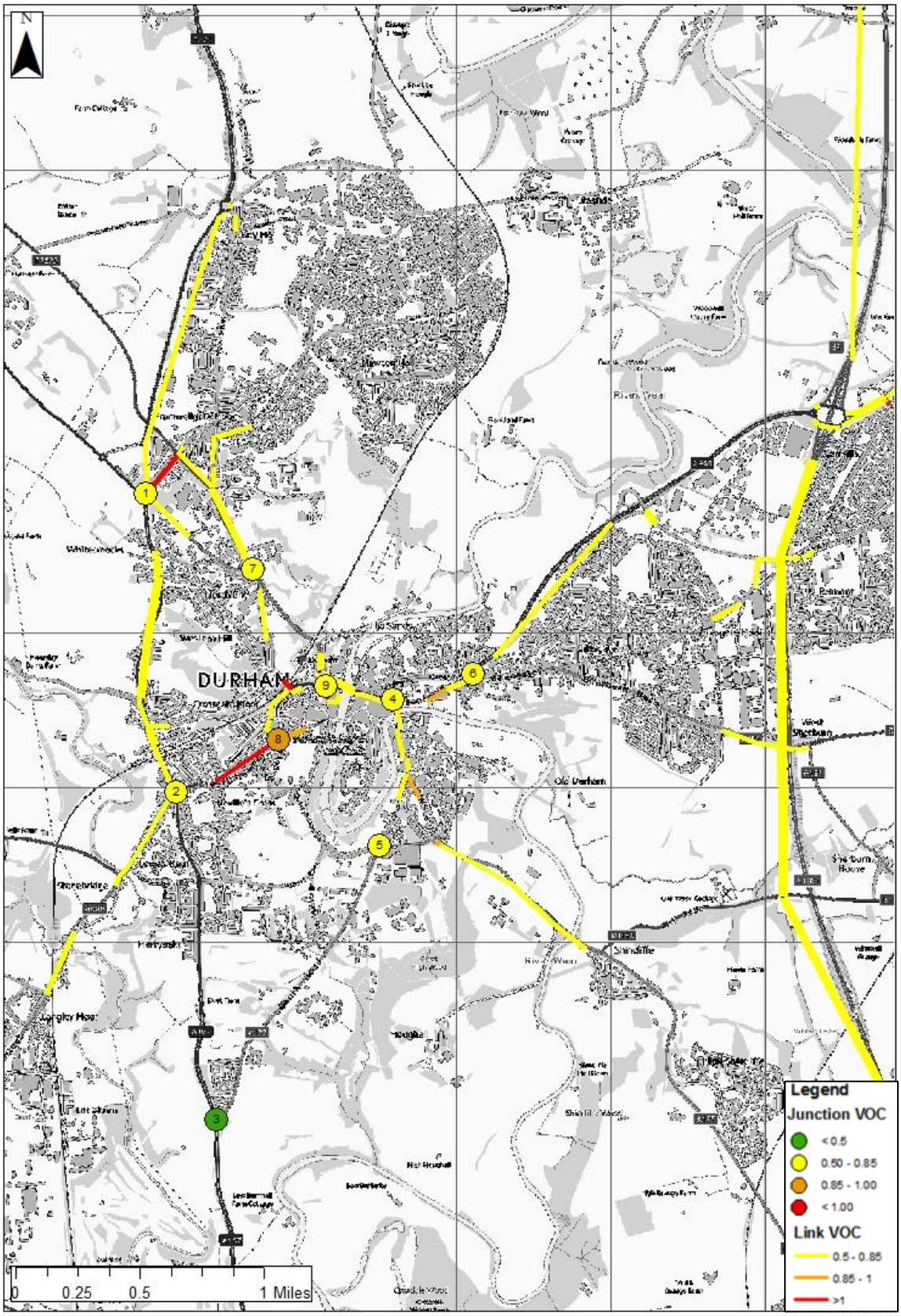
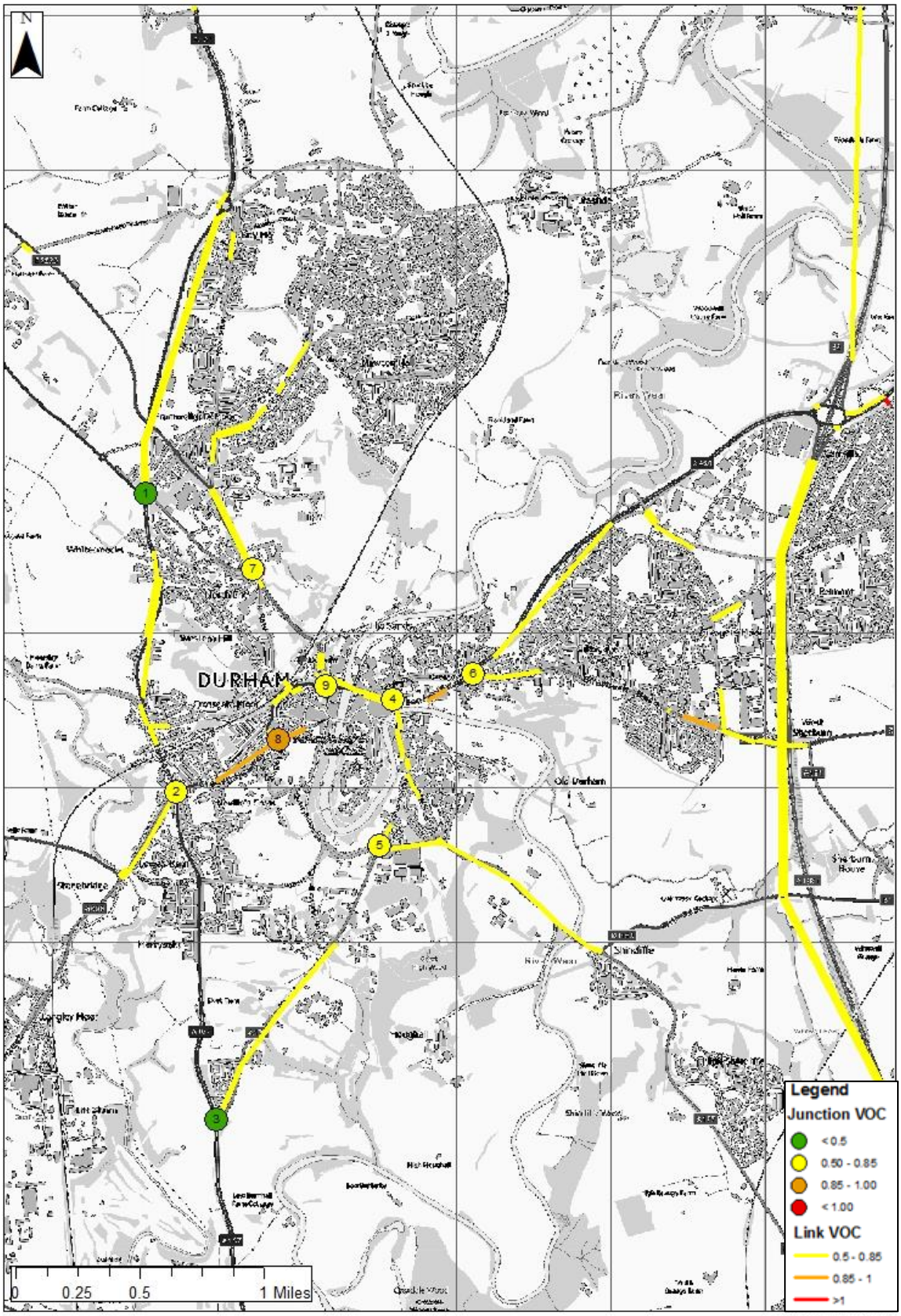


Figure 5.4: Network VoC Summary, Do Nothing Scenario A 2037 PM Peak



5.2.4 2037 Junction Analysis

Table 5.2 shows the summary of junction performance for 2037 Do Nothing Scenario A. The general trend is a further deterioration in performance of those junctions already identified to approaching or operating at capacity as extra demand is placed on the network.

The largest increases in traffic can be identified at A167 / A691 Sniperley Park roundabout (Junction 1), especially in the AM peak. This results in a 11% increase in the VoC. In the AM peak, this junction operates over capacity, with the poorest performing movement showing a VoC of 101%. Junction 7 (A691 / B6532 (County Hall) roundabout) is also exceeding capacity in the PM peak, with a VoC of 149% from County Hall to B6532 NB. While Junction 5 (A177 South Road / Stockton Road / Quarryheads junction) is now classified as approaching capacity from Quarryheads Ln to A177 EB in the AM peak.

The signals at Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout) results in an improvement in the poorest performing movement VoC by 7% in the AM peak and 23% in the PM peak which is due to the improvement scheme. Junction 6 (A690 / A181 Gilesgate roundabout) also shows an improvement, with a reduction of 28% in the AM and an 6% in the PM peak. Although reductions in VoC can be seen, this is not reflected in the delay, which is still set to increase most likely due to the implementation of signals.

Overall, across the wider network, there is expected to be a large increase of 37% and 52% in total delay at junctions across the network in the AM and PM peak respectively.

Table 5.2: Do Nothing Scenario A 2037 Junction Summary

Junction	Total Movements (vehicles)		Poorest performing movement (VoC)		Total Delay per Vehicle (mm:ss)	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Junction 1	4,540	4,081	101%	50%	00:24	00:14
Junction 2	3,096	2,797	95%	97%	00:49	01:13
Junction 3	2,408	2,226	48%	70%	00:13	00:12
Junction 4	4,343	4,719	88%	76%	00:24	00:22
Junction 5	1,539	1,587	93%	84%	00:57	01:02
Junction 6	3,358	4,145	67%	97%	00:22	00:34
Junction 7	3,427	3,737	109%	149%	01:21	01:54
Junction 8	1,704	1,780	102%	104%	02:07	01:35
Junction 9	4,201	4,179	104%	100%	01:26	00:59
Total	**28,615**	**29,251**			**08:04**	**08:04**

5.2.5 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3 for the two forecast years of 2022 and 2037 compared to the 2015 base year.

The analysis highlights that despite localised improvements at Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout) and Junction 6 (A690 / A181 Gilesgate roundabout), background traffic increases across the network are likely to result in a deterioration in overall network performance as the number of constrained links and junctions increases.

The result of this is visible in the strategic journey time analysis, summarised in Table 5.3 above. The largest increases in journey times are observed on the A690 W/B in the AM peak and on the A177 W/B in the PM peak in 2037.

Average increases of 3% and 8% in journey times (two-way) across all three routes are anticipated in the AM peak for 2022 and 2037 respectively. By comparison, average increases in two-way journey times of 4% and 10% are anticipated by 2022 and 2037 in the PM peak.

Table 5.3: Do Nothing Scenario A Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2015	15:09	15:41	30:50	17:19	17:11	34:30	21:59	19:24	41:23
	2022	15:29	16:08	31:37	18:38	17:37	36:15	22:35	20:00	42:35
	2037	16:30	16:17	32:47	19:22	18:04	37:26	23:09	21:22	44:31
PM Peak	2015	15:09	14:06	29:15	17:10	16:29	33:39	20:13	19:22	39:35
	2022	15:37	14:25	30:02	18:03	16:59	35:02	22:10	19:35	41:45
	2037	16:51	14:57	31:48	18:52	17:43	36:35	23:43	20:17	44:00

5.3 Do Nothing Scenario A Summary

- Traffic growth places additional pressure on key routes through Durham, particularly the A690 through the city centre and the A167 around Pity Me.
- This results in key strategic junctions operating over capacity on at least one arm by 2037. This includes A167 / A691 Sniperley Park roundabout (Junction 1), A690 / Crossgate / Margery Lane signal controlled junction (Junction 8), and A690 / A691 / Milburngate signalised roundabout (Junction 9).
- Traffic from the proposed development at Aykley Heads puts pressure on the A691 / B6532 (County Hall) roundabout.
- Deterioration in network performance results in increased journey time and delays across the network.

5.4 Do Nothing Scenario B

This section presents the results of the modelling of the Do Nothing Scenario B, which focuses on the effects of committed developments, background traffic growth and County Durham Plan allocations on the highway network, without any transport interventions. The analysis has been undertaken to provide an indication of future network operation based on anticipated background traffic growth and committed developments from a 2015 base to 2022 and 2037.

5.4.1 2022 Volume Over Capacity Network Analysis

Due to the County Durham Plan allocations being implemented in 2037, the analysis for 2022 is the same as Do Nothing Scenario A. Please refer to Section 5.2.1 for further information on this scenario.

5.4.2 2022 Junction Analysis

Due to the County Durham Plan allocations being implemented in 2037, the analysis for 2022 is the same as Do Nothing Scenario A. Please refer to Section 5.2.2 for further information on this scenario.

5.4.3 2037 Volume Over Capacity Network Analysis

The impacts of traffic growth between the base year and 2037 are shown in Figure 5.5 and Figure 5.6 for the Do Nothing Scenario B.

Figure 5.5 shows the AM peak and highlights that the A690 to the west of the A167 is shown to deteriorate due to the growth in traffic, operating towards 85% capacity. This is also shown on the A1(M) and A691 north of Durham. Areas around the A690 / North Road junction and Dryburn Park are now shown to exceed capacity, as well as vehicles connecting onto the A181 at Gilesgate.

Strategic junctions are also shown to worsen. Junction 1 (A167 / A691 Sniperley Park roundabout) and the Junction 5 (A177 South Road / Stockton Road / Quarryheads junction) are both increasingly constrained, moving towards a capacity of 85%. Whilst the rest of the network mirrors the congested links in the 2015 base, Junction 6 (A690 / A181 Gilesgate roundabout) improves due to upgrades discussed previously.

Figure 5.6 shows the impacts on the 2037 PM peak are also forecast to worsen. Both the A1(M) and A167 north of Durham become constrained towards 85% capacity, while A690 towards Crossgate is now approaching capacity. This is also shown on the A181 as vehicles join the A690 from Gilesgate. Junction 8 (A690 / Crossgate / Margery Lane junction) and Junction 7 (A691 / B6532 (County Hall) roundabout) have also deteriorated, with both approaching capacity.

Figure 5.5: Network VoC Summary, Do Nothing Scenario B 2037 AM Peak

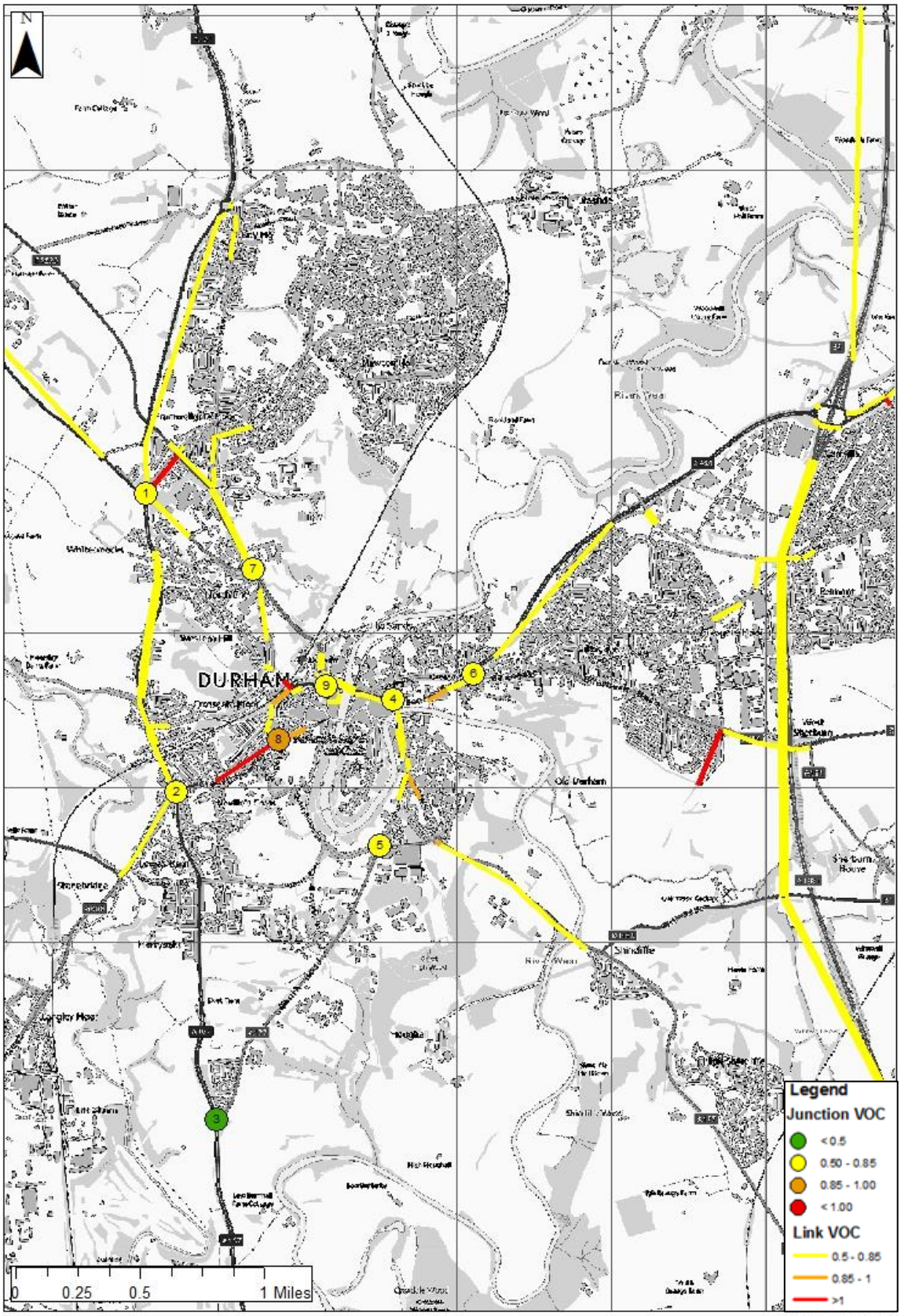
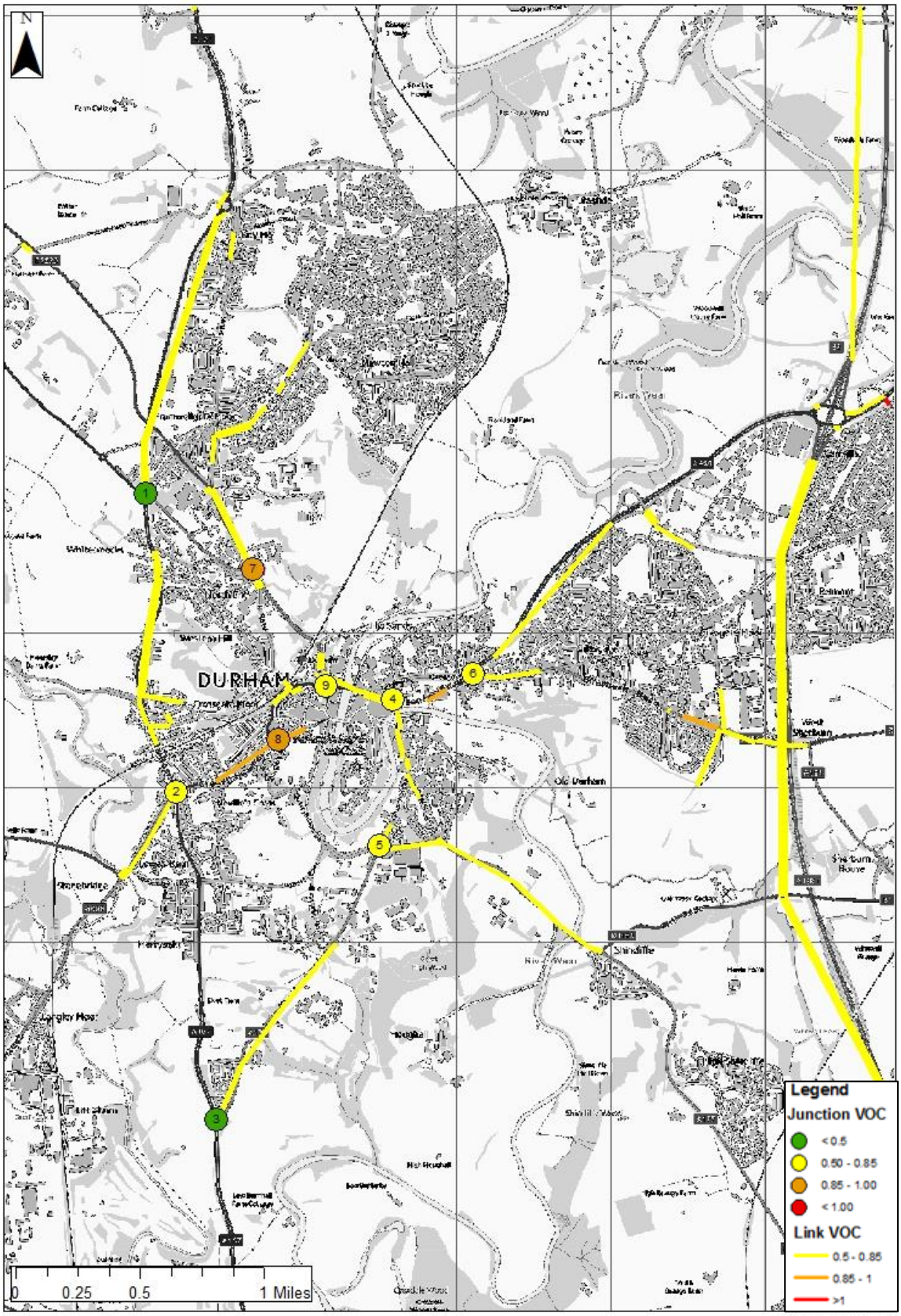


Figure 5.6: Network VoC Summary, Do Nothing Scenario B 2037 PM Peak



5.4.4 2037 Junction Analysis

Table 5.4 shows the summary of junction performance for 2037; this includes the total movements through the junction, the poorest performing VoC and average delay per vehicle across movements. The general trend is a further deterioration in performance of those junctions already identified to approaching or operating at capacity as extra demand is placed on the network.

The largest increases in traffic are shown at Junction 1 (A167 / A691 Sniperley Park roundabout) and Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout). Junction 1 in particular handles more traffic in this scenario due to the County Durham Plan allocations around the A167 to the north and west of the city centre. As a result, the VoC poorest performing arm at Junction 1 increases by 13% in the AM peak and PM peak.

Other junctions also show an increase to the poorest performing movement VoC. These include Junction 5 (A177 South Road / Stockton Road / Quarryheads Lane junction) with increases of 18% and 9% in the AM and PM peak respectively, and Junction 7 (A691 / B6532 (County Hall) roundabout) with increases of 10% and 56% in the AM and PM peak respectively. Each movement at Junction 7 operates over capacity in the PM peak.

Overall, across the wider network, there is expected to be an increase of 50% and 53% in total delay at junctions across the network in the AM and PM peak respectively.

Table 5.4: Do Nothing Scenario B 2037 Junction Summary

Junction	Total Movements (vehicles)		Poorest performing movement (VoC)		Total Delay per Vehicle (mm:ss)	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Junction 1	4,608	4,310	106%	52%	00:33	00:15
Junction 2	3,104	2,984	95%	99%	00:48	01:14
Junction 3	2,394	2,278	48%	70%	00:13	00:13
Junction 4	4,347	4,727	89%	74%	00:24	00:22
Junction 5	1,556	1,604	92%	83%	00:57	01:02
Junction 6	3,368	4,129	67%	97%	00:22	00:33
Junction 7	3,506	3,811	113%	145%	01:58	01:45
Junction 8	1,709	1,747	102%	102%	02:05	01:27
Junction 9	4,198	4,197	104%	102%	01:27	01:13
Total	**28,789**	**29,786**			**08:48**	**08:05**

5.4.5 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3 for the two forecast years of 2022 and 2037 compared to the 2015 base year.

The analysis highlights that despite localised improvements at Leazes Bowl and Gilesgate, the growth in demand for the Do Nothing Scenario B are likely to result in a deterioration in overall network performance as the number of constrained links and junctions increases.

The result of this is visible in the strategic journey time analysis, summarised in Table 5.5. The largest increases in journey times are observed on the A177 E/B in the AM and A177 W/B in the PM peak, in 2037.

Average increases of 3% and 9% in journey times (two-way) across all three routes are anticipated in the AM peak for 2022 and 2037 respectively. By comparison, average increases in two-way journey times of 4% and 7% are anticipated by 2022 and 2037 in the PM peak.

Table 5.5: Do Nothing Scenario B Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2015	15:09	15:41	30:50	17:19	17:11	34:30	21:59	19:24	41:23
	2022	15:29	16:08	31:37	18:38	17:37	36:15	22:35	20:00	42:35
	2037	17:33	16:29	34:02	19:25	17:55	37:20	23:15	22:31	45:46
PM Peak	2015	15:09	14:06	29:15	17:10	16:29	33:39	20:13	19:22	39:35
	2022	15:37	14:25	30:02	18:03	16:59	35:02	22:10	19:35	41:45
	2037	16:10	15:16	31:26	18:54	17:40	36:34	22:38	20:09	42:47

5.5 Do Nothing Scenario B Summary

In addition to the outcomes identified in Do Nothing Scenario A, the following can be noted:

- Traffic from the County Durham Plan allocations place additional pressures on the A691 north of Sniperley junction, as well as the A167 between Pity Me and Neville's Cross.
- This suggests supporting transport infrastructure is required to effectively mitigate the impacts of the additional traffic generated by the County Durham Plan allocations.

6. Scenario 1 Analysis

6.1 Western Relief Road (External Transport Funding)

This section presents the results of the modelling of Scenario 1, which includes background traffic growth and the committed developments (inclusive of Aykley Heads), with the addition of the Western Relief Road (WRR) in the modelled highway network.

The aim of this scenario is to test the impact of a significant additional link to the Durham road network to determine how this infrastructure is likely to impact on key city centre routes and junctions. This scenario has been compared to the Do Nothing Scenario A, as this provides a direct like-for-like comparison in terms of the developments modelled.

6.1.1 2022 Volume Over Capacity Network Analysis

Figure 6.1 and Figure 6.2 show the network analysis for this scenario. The greatest benefit of the WRR is highlighted by the improved performance of the A167 corridor. In both the AM and PM periods, the WRR provides an alternative route, which reduces the VoC outputs on the A167 between Neville's Cross and Sniperley to little or no capacity constraints compared to the Do Nothing Scenario A.

With the introduction of the WRR there is little impact or improvement in the operation of the key city centre routes. Both the A690 at Framwellgate Peth and the A690 at the Leazes Bowl continue to show large stretches of capacity constraints with the WRR in place during the AM and PM peak.

Figure 6.1 highlights that in the AM peak, both Junction 5 (A177 South Road / Stockton Road / Quarryheads Lane) and Junction 1 (A167 / A691 Sniperley Park roundabout) drop to a VoC below 50% suggesting a well operating junction. While, the Junction 8 (A690 / Crossgate / Margery Lane junction) is no longer approaching capacity in both the AM and PM peak, improving the A690 corridor into the city centre from the south-west (via Crossgate Peth) when compared to the Do Nothing Scenario A.

It's important to note that links operating under 50% VoC are not plotted on the image to improve clarity. As the WRR is less than 50%, it cannot be seen on the plot.

Figure 6.1: Network VC Summary, Scenario 1 2022 AM Peak

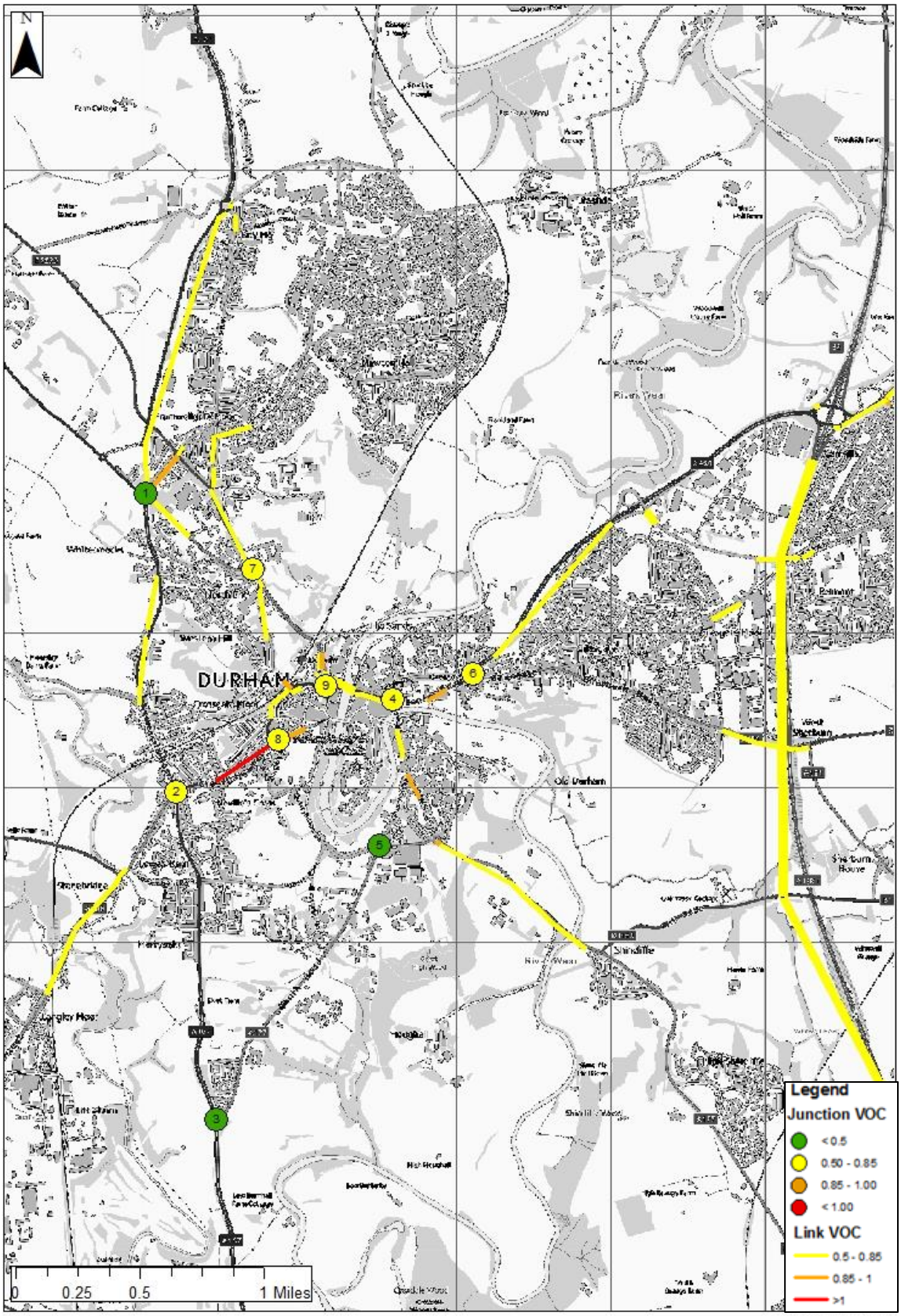
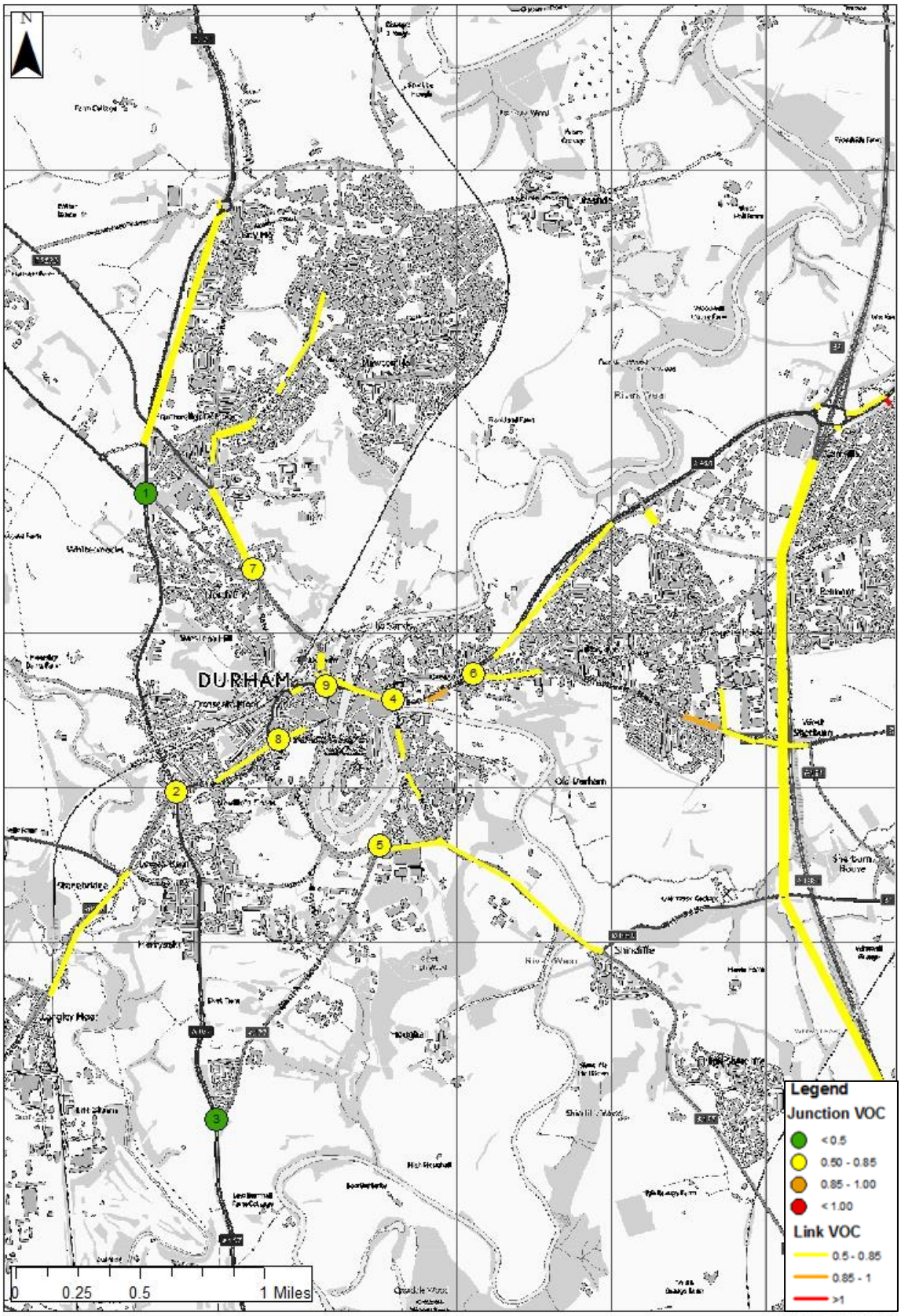


Figure 6.2: Network VoC Summary, Scenario 1 2022 PM Peak



6.1.2 2022 Junction Analysis

Table 6.1 and Table 6.2 shows the total movements through the junction, the poorest performing VoC and average delay per vehicle for all movements at the nine junctions for 2022. The data highlights that on average, the WRR has a positive impact on both traffic flows and journey times across the network at the nine junctions identified in both the AM and PM peak.

The WRR has the most positive impact in the immediate vicinity of the scheme, principally along the A167 to the west of the city, including at Junction 1 (A167 / A691 Sniperley Park roundabout) and Junction 2 (A167 / A690 Neville's Cross signal controlled junction). Both junctions see a significant decrease in vehicles over the Do Nothing scenario.

However, it is also noteworthy that benefits, albeit not as significant, are observed elsewhere in the city centre as traffic is drawn away from the city centre. On average, a reduction in traffic of 5% and 6% is expected to occur across the nine junctions for the AM and PM peak respectively, as traffic is reassigned onto the WRR in comparison to the Do Nothing Scenario A. In particular, Junction 5 (A177 South Road / Stockton Road / Quarryheads Lane signal controlled junction) in the AM peak shows a 14% improvement in the poorest performing movement VoC.

Table 6.1: Scenario 1 2022 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN1	Diff	DN-A	SCN1	Diff	DN-A	SCN1	Diff
Junction 1	4,294	4,066	-228	100%	100%	0%	00:20	00:21	00:01
Junction 2	2,990	2,332	-657	94%	90%	-4%	00:49	00:47	-00:02
Junction 3	2,290	2,284	-5	48%	51%	3%	00:13	00:13	00:00
Junction 4	4,273	4,129	-145	80%	79%	-1%	00:22	00:21	-00:01
Junction 5	1,416	1,285	-131	90%	76%	-14%	00:55	00:51	-00:04
Junction 6	3,231	3,151	-80	70%	68%	-2%	00:22	00:22	00:00
Junction 7	3,305	3,313	8	105%	104%	-1%	00:50	00:44	-00:06
Junction 8	1,687	1,559	-127	101%	101%	0%	01:54	01:43	-00:11
Junction 9	4,193	4,175	-18	103%	103%	0%	01:07	01:04	-00:03
Total	**27,679**	**26,295**	**-1,385**				**06:51**	**06:27**	**-00:28**

Table 6.2: Scenario 1 2022 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN1	Diff	DN-A	SCN1	Diff	DN-A	SCN1	Diff
Junction 1	3,756	3,381	-375	44%	37%	-7%	00:14	00:14	00:00
Junction 2	2,869	2,264	-605	98%	88%	-10%	01:16	01:03	-00:13
Junction 3	2,101	2,085	-16	63%	55%	-8%	00:12	00:12	00:00
Junction 4	4,500	4,443	-56	73%	73%	0%	00:21	00:20	-00:01
Junction 5	1,429	1,337	-92	75%	77%	2%	00:58	00:58	00:00
Junction 6	3,949	3,894	-55	96%	96%	0%	00:32	00:31	-00:01
Junction 7	3,433	3,332	-100	92%	89%	-3%	00:21	00:20	-00:01
Junction 8	1,669	1,435	-234	100%	96%	-4%	01:18	01:02	-00:16
Junction 9	4,044	4,054	10	96%	97%	1%	00:43	00:42	-00:01
Total	**27,749**	**26,225**	**-1,525**				**05:55**	**05:22**	**-00:33**

6.1.3 2037 Volume Over Capacity Network Analysis

Although there are some improvements observed compared to the Do Nothing Scenario A, a number of links in the wider road network continues to experience congestion as a result of the increases in traffic resulting from committed development and background traffic growth in Durham City, which ultimately is likely to result in continued congestion and delay across the wider network.

The plots suggest that the WRR will still provide benefit to the A167 corridor; however the traffic growth in 2037 results in the road filling back up and therefore the VoC constraints can still be seen.

Significant improvements can be seen along the A690 to Crossgate Peth in the PM peak, as traffic is drawn out of the centre, no longer approaching capacity on this link.

Figure 6.3 and Figure 6.4 highlight the anticipated network link and junction performance by 2037 for Scenario 1.

Figure 6.3: Network VoC Summary, Scenario 1 2037 AM Peak

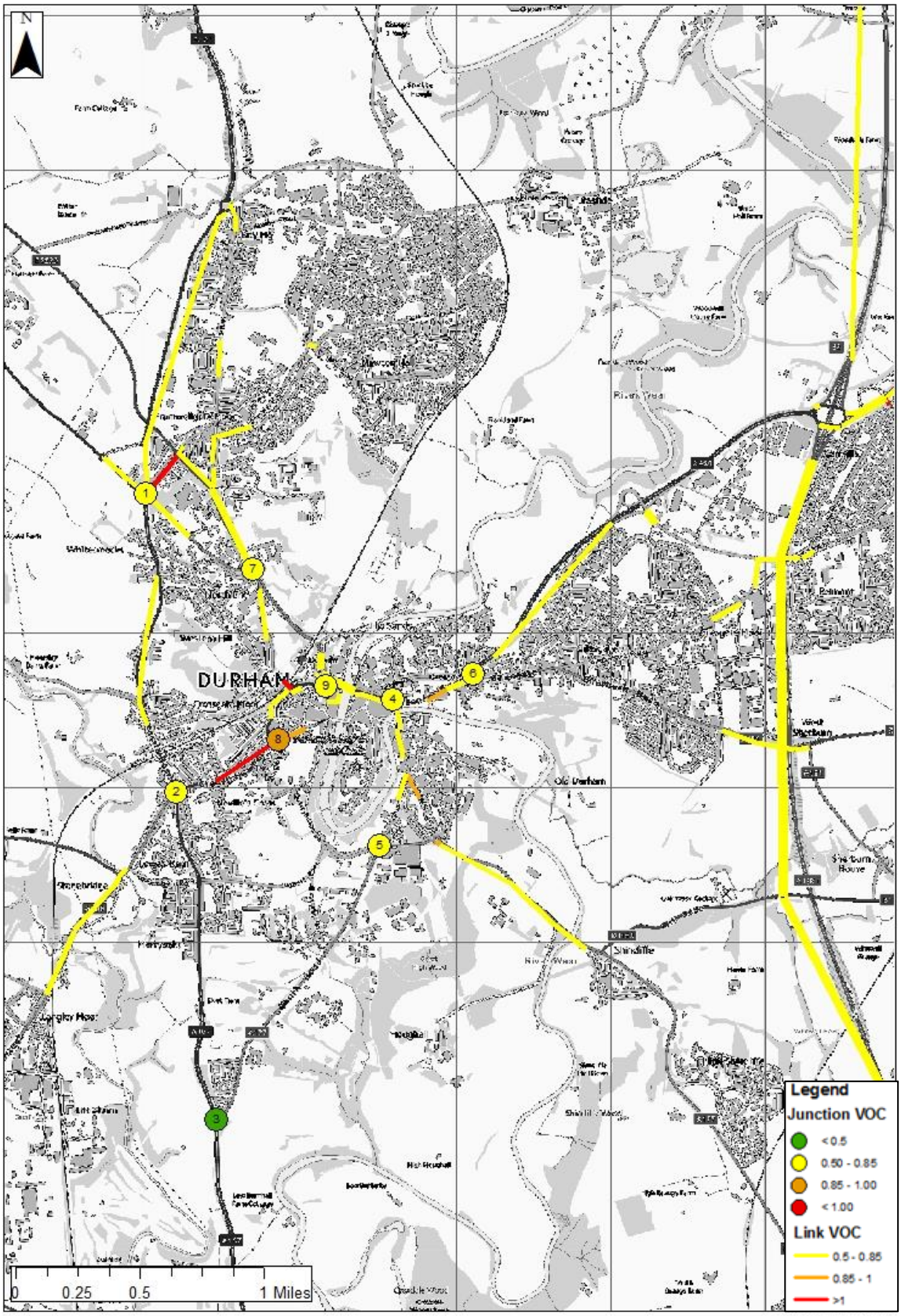
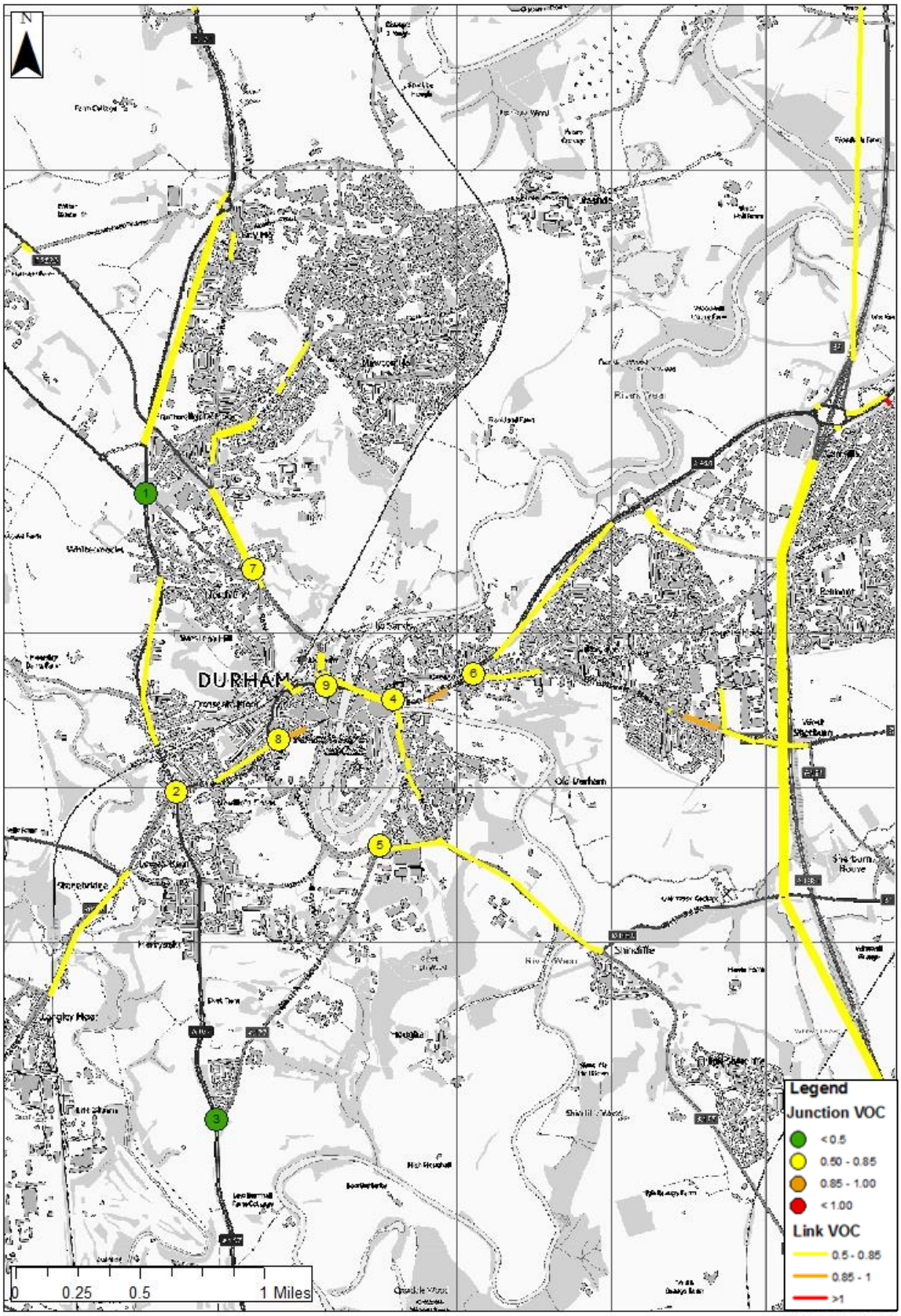


Figure 6.4: Network VoC Summary, Scenario 1 2037 PM Peak



6.1.4 2037 Junction Analysis

Table 6.3 and Table 6.4 shows the total movements through the junction, the poorest performing VoC and average delay per vehicle for Scenario 1 in 2037 compared to the equivalent 2037 Do Nothing Scenario A outputs.

The data highlights that on average, the WRR has a positive impact on both traffic flows and journey times across the network. Only one junction is impacted in comparison to the Do Nothing Scenario A. This is Junction 3, which shows a very minor increase in VoC by 3% in the AM peak, and a small increase in average delay in the PM peak.

Similar to the 2022 forecast year, the WRR in 2037 has the most positive impact in the immediate vicinity of the scheme, principally along the A167 to the west of the city. Benefits are observed elsewhere in the city centre as traffic is drawn away from this city centre through route.

On average, a reduction in traffic of 5% and 6% is expected to occur across the nine junctions, as traffic is reassigned onto the WRR in comparison to the Do Nothing Scenario A.

Table 6.3: Scenario 1 2037 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN1	Diff	DN-A	SCN1	Diff	DN-A	SCN1	Diff
Junction 1	4,540	4,359	-181	101%	102%	0%	00:24	00:27	00:00
Junction 2	3,096	2,494	-601	95%	89%	-7%	00:49	00:47	-00:02
Junction 3	2,408	2,391	-17	48%	51%	3%	00:13	00:13	00:00
Junction 4	4,343	4,250	-93	88%	83%	-5%	00:24	00:23	-00:01
Junction 5	1,539	1,425	-114	93%	89%	-4%	00:57	00:54	-00:03
Junction 6	3,358	3,309	-49	67%	67%	0%	00:22	00:22	00:00
Junction 7	3,427	3,430	3	109%	107%	-2%	01:21	01:09	-00:12
Junction 8	1,704	1,581	-123	102%	102%	0%	02:07	01:58	-00:09
Junction 9	4,201	4,180	-21	104%	104%	0%	01:26	01:23	-00:03
Total	**28,615**	**27,420**	**-1,195**				**08:04**	**07:36**	**-00:30**

Table 6.4: Scenario 1 2037 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN1	Diff	DN-A	SCN1	Diff	DN-A	SCN1	Diff
Junction 1	4,081	3,685	-396	50%	46%	-4%	00:14	00:14	00:00
Junction 2	2,797	2,351	-446	97%	87%	-10%	01:13	01:04	-00:09
Junction 3	2,226	2,241	15	70%	62%	-8%	00:12	00:13	00:01
Junction 4	4,719	4,642	-77	76%	73%	-3%	00:22	00:21	-00:01
Junction 5	1,587	1,464	-123	84%	80%	-4%	01:02	01:00	-00:02
Junction 6	4,145	4,054	-91	97%	98%	0%	00:34	00:34	00:00
Junction 7	3,737	3,612	-125	149%	141%	-8%	01:54	01:40	-00:14
Junction 8	1,780	1,494	-285	104%	100%	-3%	01:35	01:05	-00:30
Junction 9	4,179	4,140	-39	100%	100%	0%	00:59	00:54	-00:05
Total	**29,251**	**27,684**	**-1,567**				**08:04**	**07:04**	**-01:00**

6.1.5 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3 for the two forecast years of 2022 and 2037 compared to the 2015 base year.

Table 6.5 shows that the WRR has a positive impact on most the strategic journey times, when comparing to the Do Nothing Scenario A. As expected the A167 is shown to have the largest journey time benefits, with the WRR expected to reduce journey times (two-way) by 8% in the AM peak and 13% in the PM peak, compared to the Do Nothing Scenario A in 2037. One route shows an increase in journey time, Route 3 W/B in 2037, which is a result of additional traffic around the A691 at the norther tie-in point of the WRR.

The results highlight that a WRR provides on average, two-way journey time savings of 3% across the 3 routes in the AM peak and 8% in the PM peak compared to the Do Nothing Scenario A in 2037.

Table 6.5: Scenario 1 Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2022 DN-A	15:29	16:08	31:37	18:38	17:37	36:15	22:35	20:00	42:35
	2022 SCN1	14:14	14:55	29:08	18:15	17:36	35:51	22:32	19:41	42:13
	Diff	-01:15	-01:13	-02:28	-00:23	-00:01	-00:24	-00:03	-00:19	-00:22
	2037 DN-A	16:30	16:17	32:47	19:22	18:04	37:26	23:09	21:22	44:31
	2037 SCN1	15:25	15:01	30:26	19:04	18:04	37:07	23:25	20:44	44:09
	Diff	-01:05	-01:16	-02:21	-00:18	00:00	-00:18	00:16	-00:38	-00:22

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
PM Peak	2022 DN-A	15:37	14:25	30:02	18:03	16:59	35:02	22:10	19:35	41:45
	2022 SCN1	13:40	13:31	27:11	17:22	16:48	34:10	21:12	19:30	40:41
	Diff	-01:57	-00:54	-02:51	-00:41	-00:11	-00:52	-00:58	-00:05	-01:03
	2037 DN-A	16:51	14:57	31:48	18:52	17:43	36:35	23:43	20:17	44:00
	2037 SCN1	14:11	13:58	28:09	17:54	17:24	35:18	21:20	20:13	41:34
	Diff	-02:40	-00:59	-03:39	-00:58	-00:19	-01:17	-02:23	-00:04	-02:27

6.2 Scenario 1 Summary

- The Western Relief Road provides considerable benefit to strategic routes to the west of the city, principally the A167.
- Capacity constraints at key junctions on these routes are reduced, namely Neville's Cross and Sniperley as traffic is redirected onto the Western Relief Road. Improvements can also be observed elsewhere in the city centre as traffic is drawn away from the city centre, most notably the A690 via Crossgate Peth.
- Re-distribution of traffic across the constrained road network to the west of the city centre generates journey time savings on the wider network, for all three strategic routes and the majority of junctions.

7. Scenario 2 Analysis

7.1 Western Relief Road (S106 Funding)

This section presents the results of the modelling of Scenario 2, which includes background traffic growth, committed developments (inclusive of Aykley Heads) and County Durham Plan allocations, with the addition of the Western Relief Road (WRR) in the modelled highway network.

The aim of this scenario is to test the impact of a significant potential additional link to the Durham road network to determine how this infrastructure is likely to impact on key city centre routes and junctions. This scenario has been compared to the Do Nothing Scenario B, as this provides a direct like-for-like comparison in terms of the developments modelled.

7.1.1 2022 Volume Over Capacity Network Analysis

Due to the County Durham Plan allocations being implemented in 2037, the analysis for 2022 is the same as the Scenario 1 analysis. Please refer to Section 6.1.1 for further information on this scenario.

7.1.2 2022 Junction Analysis

Due to the County Durham Plan allocations being implemented in 2037, the analysis for 2022 is the same as the Scenario 1 analysis. Please refer to Section 6.1.2 for further information on this scenario.

7.1.3 2037 Volume Over Capacity Network Analysis

The greatest benefit of the WRR is highlighted by the improved performance of the A167 corridor. In both the AM and PM periods, the WRR provides an alternative route, which reduces the VoC outputs on the A167 between Neville's Cross and Sniperley to little or no capacity constraints, performing better than Scenario 1.

For Scenario 2 there is little or no improvement in the operation of the key city centre routes or junctions when compared to the Do Nothing Scenario B, whereas improvements can be seen in Scenario 1. Both the A690 at Framwellgate Peth and the A690 at the Leazes Bowl continue to show large stretches of capacity constraints with the WRR in place during the AM and PM peak. Areas to the west of the model have also worsened, due to the addition of County Durham Plan allocations in this area and the more vehicles being attracted to the west of Durham via the WRR. This can be seen on Broom Lane and the A691 north of Sniperley. Consequently, this has caused the Junction 7 (A691 / B6532 (County Hall) to worsen in the PM peak.

It's important to note that links operating under 50% VoC are not plotted on the image to improve clarity. As the WRR is less than 50%, it cannot be seen on the plot.

Figure 7.1 Network VoC Summary, Scenario 2 2037 AM Peak

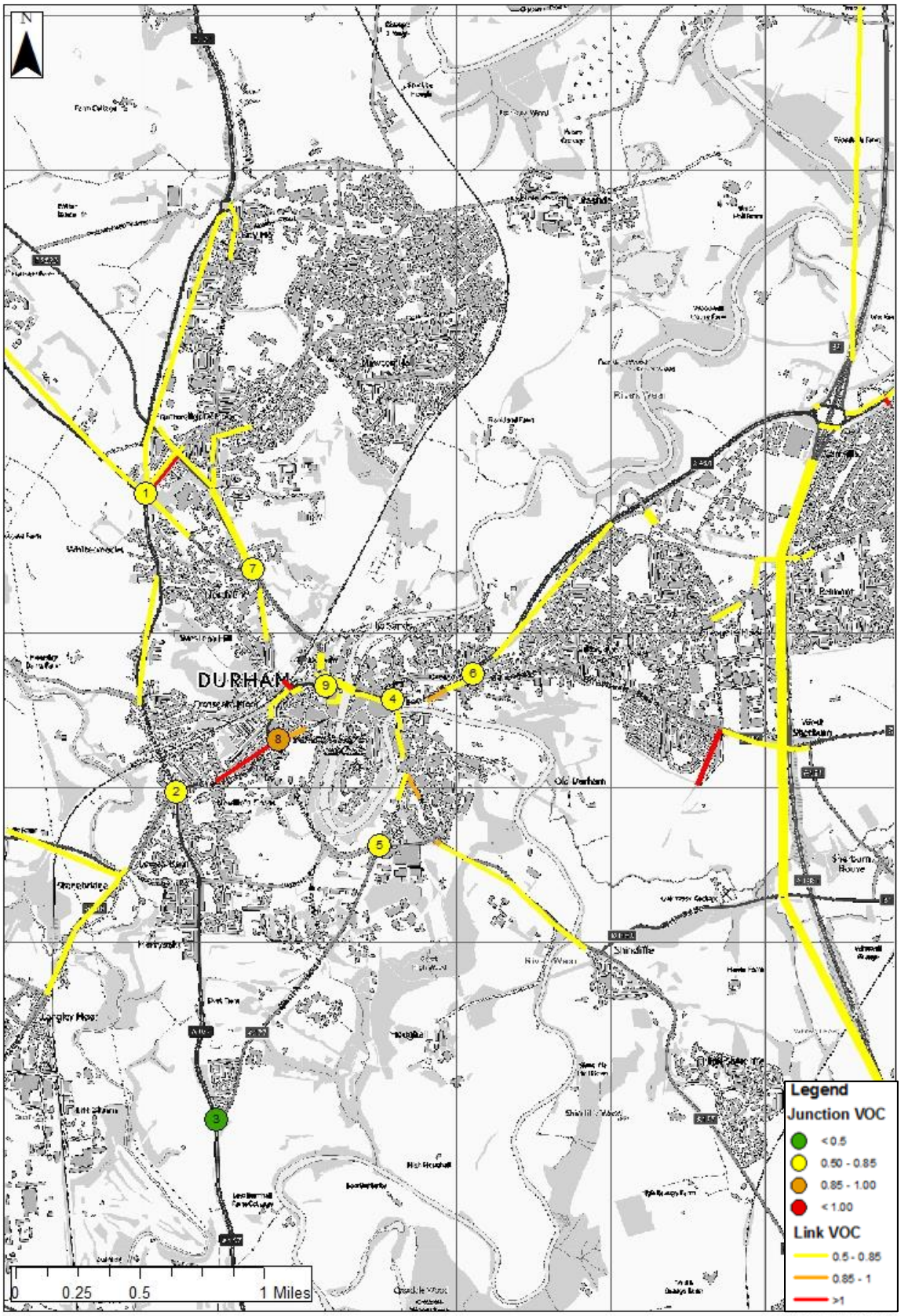
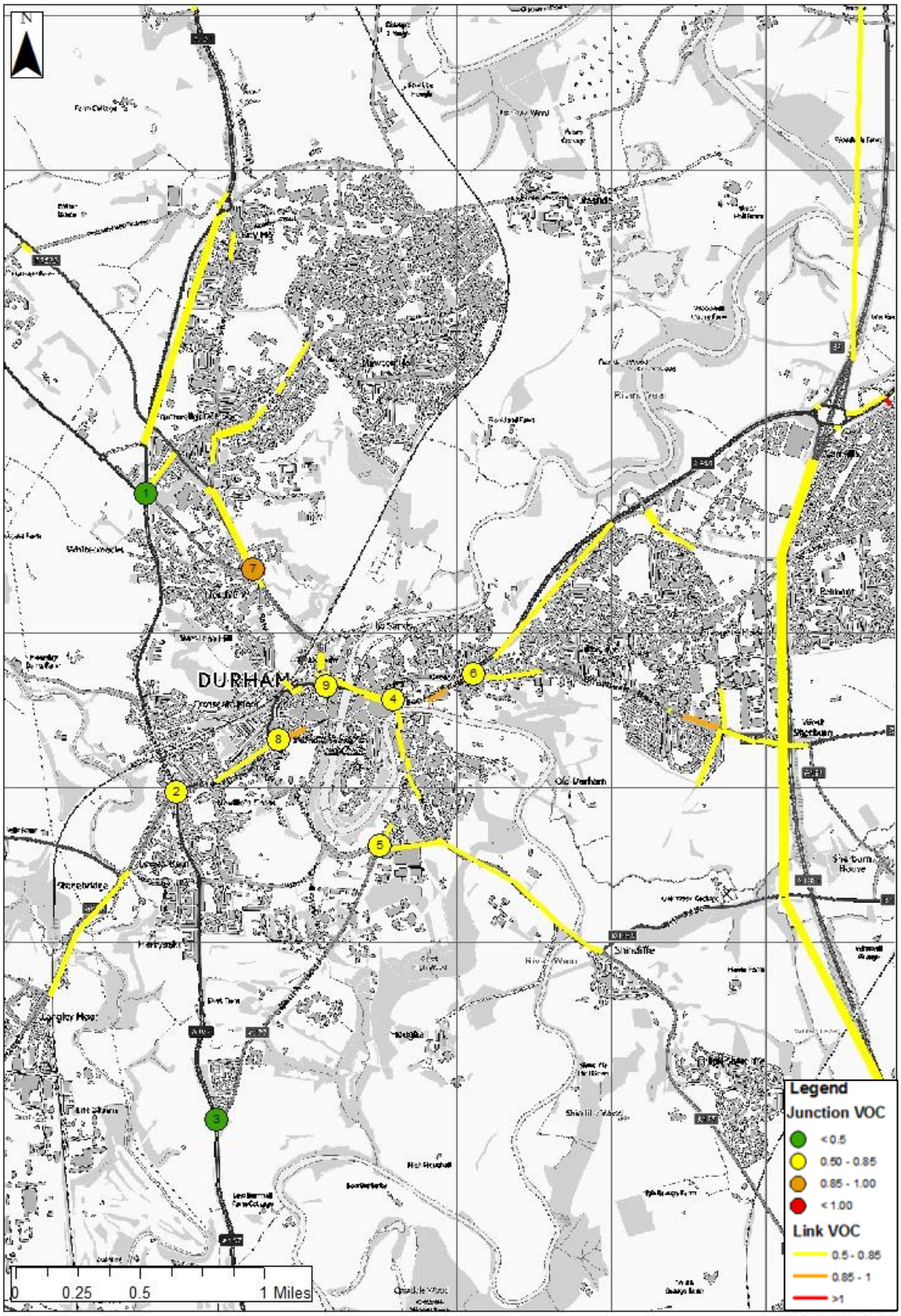


Figure 7.2 Network VoC Summary, Scenario 2 2037 PM Peak



7.1.4 2037 Junction Analysis

Table 7.1 and Table 7.2 shows the total movements through the junction, the poorest performing VoC and average delay per vehicle for Scenario 2 in 2037 compared to the equivalent 2037 Do Nothing Scenario B outputs.

The data highlights that on average, the WRR generally has a positive impact on both traffic flows and journey times across the network in both the AM and PM peak. This is with the exception of Junction 1 (A167 / A691 Sniperley Park junction), which has an increase in delay of 18% in the AM peak when compared to the Do Nothing Scenario B. As previous mentioned, this is due to the addition of County Durham Plan allocations in the surrounding area and the more vehicles being attracted to the west of Durham via the WRR

The WRR has the most positive impact in the immediate vicinity of the scheme, principally along the A167 to the west of the city, However, it is also noteworthy that benefits, albeit not as significant, are observed elsewhere. On average, a reduction in traffic of 4% and 6% is expected to occur across the nine junctions for the AM and PM peak respectively, as traffic is reassigned onto the WRR in comparison to the Do Nothing Scenario B.

The most extensive reductions in delay at junctions and therefore journey time savings are shown to be Junction 7 (A691 / B6532 (County Hall) roundabout) in the AM with a saving of 21% and Junction 2 (A167 / A690 Neville's Cross junction) with a saving of 14% in the PM, as traffic is drawn out of the city centre.

Table 7.1: Scenario 2 2037 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-B	SCN2	Diff	DN-B	SCN2	Diff	DN-B	SCN2	Diff
Junction 1	4,608	4,483	-125	106%	106%	0%	00:33	00:39	00:06
Junction 2	3,104	2,512	-591	95%	93%	-2%	00:48	00:47	-00:01
Junction 3	2,394	2,385	-8	48%	50%	2%	00:13	00:13	00:00
Junction 4	4,347	4,248	-99	89%	84%	-5%	00:24	00:23	-00:01
Junction 5	1,556	1,449	-107	92%	92%	-1%	00:57	00:56	-00:01
Junction 6	3,368	3,296	-71	67%	68%	1%	00:22	00:22	00:00
Junction 7	3,506	3,491	-14	113%	113%	-1%	01:58	01:33	-00:25
Junction 8	1,709	1,595	-114	102%	102%	0%	02:05	01:59	-00:06
Junction 9	4,198	4,185	-14	104%	104%	0%	01:27	01:24	-00:03
Total	**28,789**	**27,644**	**-1,144**				**08:48**	**08:16**	**-00:31**

Table 7.2: Scenario 2 2037 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-B	SCN2	Diff	DN-B	SCN2	Diff	DN-B	SCN2	Diff
Junction 1	4,310	3,777	-533	52%	47%	-5%	00:15	00:14	-00:01
Junction 2	2,984	2,364	-620	99%	88%	-11%	01:14	01:04	-00:10
Junction 3	2,278	2,257	-21	70%	63%	-8%	00:13	00:13	00:00
Junction 4	4,727	4,685	-42	74%	74%	-1%	00:22	00:21	-00:01
Junction 5	1,604	1,519	-85	83%	83%	-1%	01:02	01:01	-00:01
Junction 6	4,129	4,076	-53	97%	97%	0%	00:33	00:33	00:00
Junction 7	3,811	3,721	-90	145%	146%	1%	01:45	01:49	00:04
Junction 8	1,747	1,516	-231	102%	101%	-1%	01:27	01:20	-00:07
Junction 9	4,197	4,180	-17	102%	101%	-1%	01:13	01:06	-00:07
Total	**29,786**	**28,093**	**-1,693**				**08:05**	**07:41**	**-00:23**

7.1.5 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3 for the two forecast years of 2022 and 2037 compared to the 2015 base year. The analysis shows that the WRR has a positive impact on all the strategic journey times, when comparing to the Do Nothing Scenario B.

In the AM peak, the impacts are broadly similar to those shown in Scenario 1, with the exception of Route 2 E/B and Route 3 W/B – which shows an increase of 7s and 9s respectively.

In the PM peak, the WRR is shown to provide a benefit to journey times along all routes, with the exception of Route 3 W/B which shows an increase of 21s.

As expected the A167 is shown to have the largest journey time benefits, with the WRR expected to reduce journey times (two-way) by 10% in the AM peak and 9% in the PM peak, compared to the Do Nothing Scenario B in 2037. The results highlight that a WRR provides on average, two-way journey time savings of 3% across the 3 routes in the AM peak and 3% in the PM peak compared to the Do Nothing Scenario B in 2037.

The benefits for Scenario 2 are generally less than that shown in Scenario 1, due to the additional traffic generated by the County Durham Plan allocations.

Table 7.3: – Scenario 2 Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2022 DN-B	15:29	16:08	31:37	18:38	17:37	36:15	22:35	20:00	42:35
	2022 SCN2	14:14	14:55	29:08	18:15	17:36	35:51	22:32	19:41	42:13
	Diff	-01:15	-01:13	-02:28	-00:23	-00:01	-00:24	-00:03	-00:19	-00:22
	2037 DN-B	17:33	16:29	34:02	19:25	17:55	37:20	23:15	22:31	45:46
	2037 SCN2	15:46	15:05	30:51	19:00	18:02	37:02	23:24	22:04	45:28
	Diff	-01:47	-01:24	-03:11	-00:25	00:07	-00:18	00:09	-00:27	-00:18
PM Peak	2022 DN-B	15:37	14:25	30:02	18:03	16:59	35:02	22:10	19:35	41:45
	2022 SCN2	13:40	13:31	27:11	17:22	16:48	34:10	21:12	19:30	40:41
	Diff	-01:57	-00:54	-02:51	-00:41	-00:11	-00:52	-00:58	-00:05	-01:03
	2037 DN-B	16:10	15:16	31:26	18:54	17:40	36:34	22:38	20:09	42:47
	2037 SCN2	14:33	14:13	28:45	18:12	17:23	35:35	22:59	20:04	43:03
	Diff	-00:37	-01:03	-02:41	-00:42	-00:17	-00:59	00:21	-00:05	00:16

7.2 Scenario 2 Summary

- The Western Relief Road provides considerable benefit to strategic routes to the west of the city, principally the A167.
- Traffic and journey times at key junctions on these routes are reduced, namely Neville's Cross and Sniperley, as traffic is redirected onto the Western Relief Road. Improvements can also be observed elsewhere in the city centre as traffic is drawn away from the city centre, most notably the A690 via Crossgate Peth. Constraints and delay can be seen around County Hall and Sniperley, as the County Durham Plan allocations generate traffic that is attracted towards the Western Relief Road.
- Re-distribution of traffic across the road network to the west of the city centre generates journey time savings on the wider network, for all three strategic routes and the majority of junctions.
- The Western Relief Road provides adequate mitigation for the additional traffic generated by the County Durham Plan allocations to the north and west of the city centre.

8. Scenario 3 Analysis

8.1 Overview

This section presents the results of the modelling for Scenario 3. Two scenarios have been created to reflect the potential impact of a reduction in lanes at Milburngate with the Northern Relief Road.

- 3A: Milburngate with 1 lane per direction; and
- 3B: Milburngate in its current condition, with 2 lanes per direction.

The analysis has been undertaken separately for each scenario within this section.

8.2 3A: Northern Relief Road with 1 Lane per Direction over Milburngate Bridge

This section presents the results of the modelling of Scenario 3A, which includes background traffic growth and committed developments (inclusive of Aykley Heads), with the addition of the Northern Relief Road (NRR) and a reduction in lanes on Milburngate Bridge.

The aim of this scenario is to test the impact of a significant potential additional link to the Durham road network to determine how this infrastructure is likely to impact on key city centre routes and junctions. This scenario has been compared to the Do Nothing Scenario A, as this provides a direct like-for-like comparison in terms of the developments modelled.

8.2.1 2022 Volume Over Capacity Network Analysis

Figure 8.1 and Figure 8.2 show the VoC network analysis for links and junctions forecast to occur in 2022 for the AM and PM peaks for Scenario 3A. These plots are best compared against the equivalent outputs for the Do Nothing Scenario A, which identifies the impact of the sustainable transport measures and NRR with the same quantum of future development.

The NRR has a significant impact on network performance in combination with the Milburngate lane reduction, particularly for links through the city centre. The A690 corridor from the A1(M) approaching the city centre from the east is expected to benefit notably, as the NRR provides a secondary crossing of the River Wear and east-west route, diverting traffic away from the city centre. This is evident, as the capacity constraints on this route lessen, with the Leazes Bowl junction reducing to less than 85% VoC in both the AM and PM peak. The A690 / Crossgate / Margery Lane junction also shows improvement, now operating at less than 85% capacity in the PM peak.

The A691 Framwelgate Peth link and B6232 west of Milburngate Bridge is shown to benefit in terms of reductions in VoC compared to the 2022 Do Nothing Scenario A. This is reflected at Junction 1 (A167 / A691 Sniperley Park roundabout) in the AM peak and Junction 7 (A691 / B6532 (County Hall) roundabout) in the PM peak, both dropping to a VoC below 50%. This highlights that two city centre pinch points either side of Milburngate Bridge, which are consistently congested in Scenario 1 and 2, are expected to operate with improved VoC as a result of a NRR.

It should be noted, that as a result of reducing Milburngate Bridge lane capacity by 50%, this link is expected to increase in VoC terms compared to the Do Nothing Scenario A. The reallocation of road space to sustainable modes has a significant impact on the capacity, with the Bridge now approaching capacity on some links. Typically, such a link capacity constraint would be a negative outcome; however in this instance, it should be identified in the positive context of reduced traffic utilising the bridge as a result of the NRR and the reallocation of road space to sustainable modes, creating a more pleasant environment in this area of the city and encouraging the uptake of active travel in, around and across the city centre. Therefore, the increase in VoC is resulting from the reduction in capacity of the bridge itself, rather than an increase in traffic at this location.

Figure 8.1: Network VoC Summary, Scenario 3A 2022 AM Peak

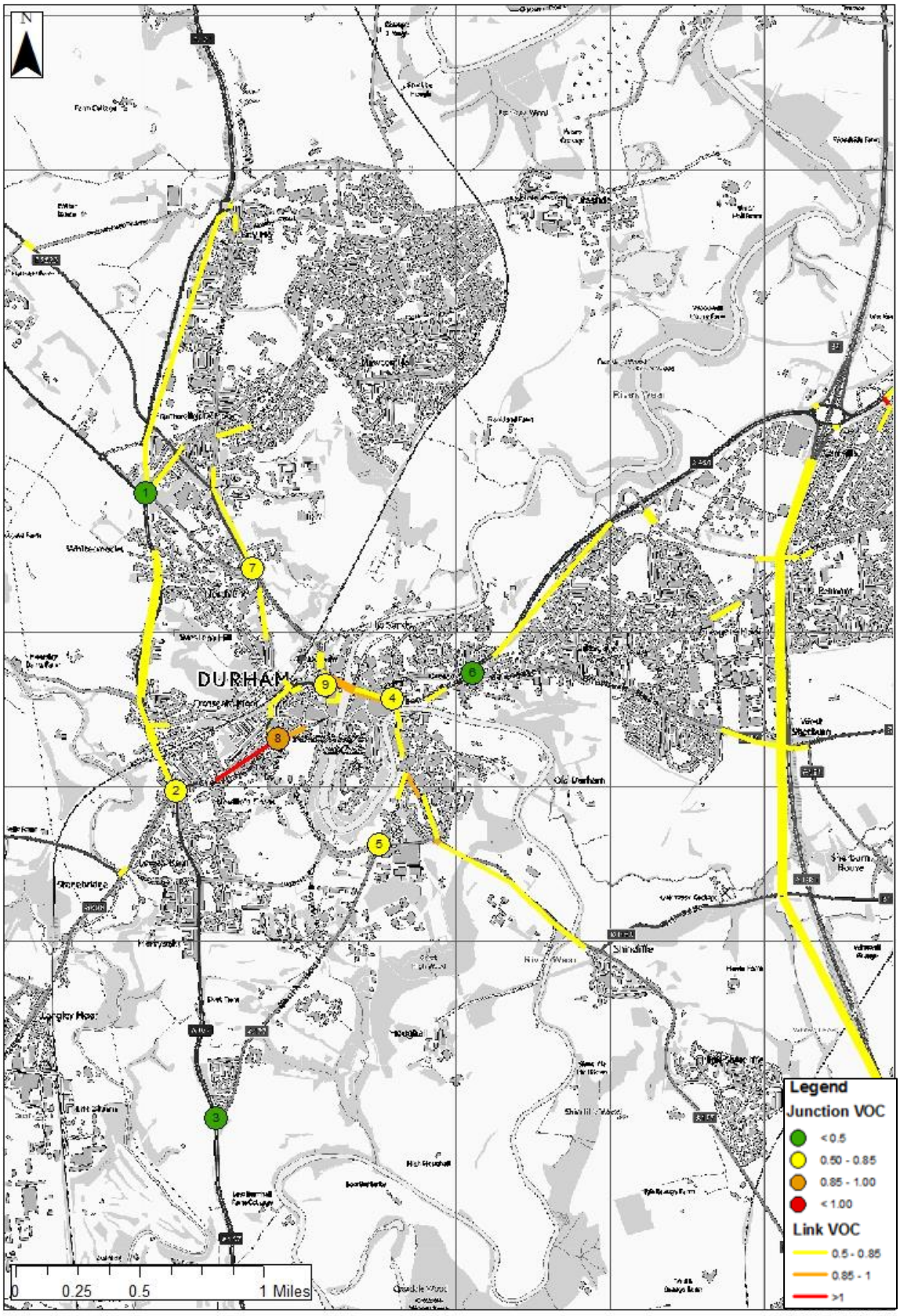
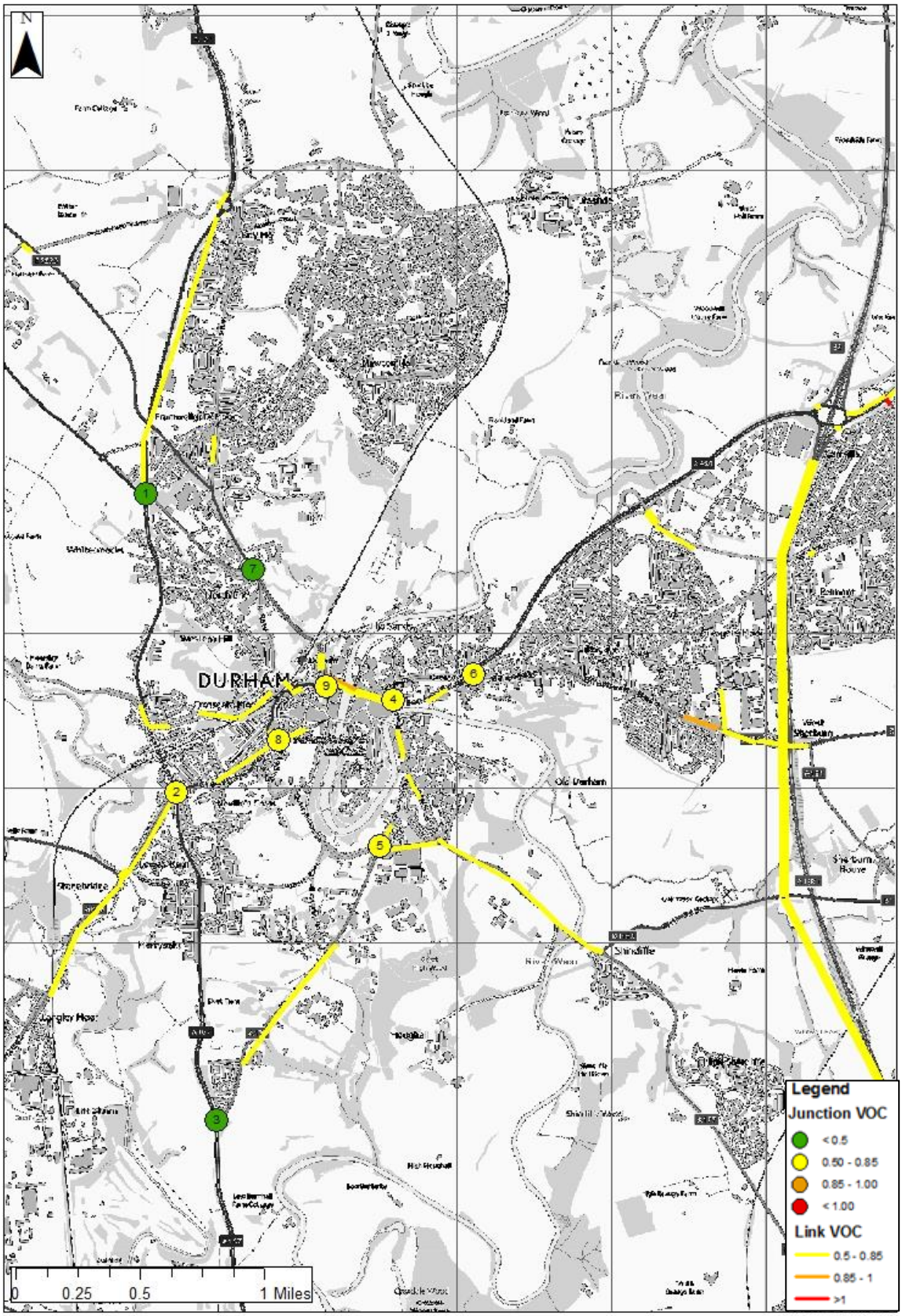


Figure 8.2: Network VoC Summary, Scenario 3A 2022 PM Peak



8.2.2 2022 Junction Analysis

Table 8.1 summarises the total movements and journey time to undertake all movements at the junctions for Scenario 3AA in 2022 compared to the equivalent 2022 Do Nothing Scenario A.

The data highlights that the implementation of the NRR and the Milburngate Bridge lane reductions has a positive impact on traffic flow and VoC across the nine junctions in both the AM and PM peak. Slight delay of 3% and 1% can be seen at Junction 2 (A167 / A690 (Neville's Cross)) and Junction 3 (A167 / A177 South Road junction) respectively in the AM peak, most likely due to an increase in traffic accessing the NRR via the A167.

The NRR provides a secondary east-west route for traffic. The effect is a considerable re-assignment of traffic from the solitary main east-west route that is currently provided via Milburngate Bridge through the city centre. In the AM peak, it can be seen that the worst performing movement VoC for Junction 1 (A167 / A691 (Sniperley Park) roundabout), Junction 7 (A691 / B6532 (County Hall) roundabout) and Junction 9 (A690 / A691 / Milburngate junction) have reduced by at least one category or more. This can also be seen in the PM peak for the Junction 6 (A690 / A181 (Gilesgate) roundabout), Junction 7 (A691 / B6532 (County Hall) roundabout) and Junction 9 (A690 / A691 / Milburngate roundabout).

As a result of the re-distributional impacts associated with the NRR, traffic movements across the nine junctions are expected to reduce by around 10% and 11% in the AM and PM respectively, compared to the Do Nothing Scenario A. This highlights that the NRR is expected to result in a more comprehensive re-distribution of traffic across the network compared to both Scenario 1 and 2. This is reflected in the delay, with a total of 19% time savings in the AM peak and 10% in the PM peak.

Table 8.1: Scenario 3A 2022 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN3	Diff	DN-A	SCN3	Diff	DN-A	SCN3	Diff
Junction 1	4,294	3,772	-522	100%	62%	-38%	00:20	00:15	-00:05
Junction 2	2,990	2,871	-119	94%	86%	-8%	00:49	00:50	00:01
Junction 3	2,290	2,157	-132	48%	43%	-5%	00:13	00:13	00:00
Junction 4	4,273	3,769	-504	80%	74%	-6%	00:22	00:20	-00:02
Junction 5	1,416	1,393	-23	90%	87%	-3%	00:55	00:54	-00:01
Junction 6	3,231	2,714	-518	70%	53%	-17%	00:22	00:21	-00:01
Junction 7	3,305	2,899	-407	105%	91%	-14%	00:50	00:17	-00:33
Junction 8	1,687	1,679	-8	101%	101%	0%	01:54	01:43	-00:11
Junction 9	4,193	3,698	-496	103%	91%	-12%	01:07	00:29	-00:38
Total	**27,679**	**24,951**	**-2,728**				**06:51**	**05:22**	**-01:30**

Table 8.2: Scenario 3A 2022 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN3	Diff	DN-A	SCN3	Diff	DN-A	SCN3	Diff
Junction 1	3,756	3,427	-329	44%	41%	-3%	00:14	00:14	00:00
Junction 2	2,869	2,576	-293	98%	98%	0%	01:16	01:09	-00:07
Junction 3	2,101	2,000	-101	63%	63%	0%	00:12	00:12	00:00
Junction 4	4,500	3,867	-633	73%	71%	-2%	00:21	00:21	00:00
Junction 5	1,429	1,464	35	75%	78%	3%	00:58	00:59	00:01
Junction 6	3,949	3,374	-574	96%	78%	-18%	00:32	00:23	-00:09
Junction 7	3,433	2,888	-544	92%	65%	-27%	00:21	00:16	-00:05
Junction 8	1,669	1,658	-11	100%	100%	0%	01:18	01:10	-00:08
Junction 9	4,044	3,427	-617	96%	93%	-3%	00:43	00:34	-00:10
Total	**27,749**	**24,682**	**-3,067**				**05:55**	**05:17**	**-00:38**

8.2.3 2037 Volume Over Capacity Network Analysis

Figure 8.3 and Figure 8.4 show the 2037 VoC analysis for Scenario 3A.

The AM peak does not show any improvement to capacity along the A690 and shows the NRR has a high volume of traffic with a VoC between 50% and 85% in 2037. However, Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout) does show signs of improvement, reducing to less than 50% VoC. In the PM peak, the A690 corridor from the A1(M) approaching the city centre from the east is shown to benefit from implementation of the NRR, similarly to the pattern found in 2022. This is evident, as the capacity constraints on these links reduce, while Junction 4 (A690 / New Elvet (Leazes Bowl) roundabout) reduces to less than 50% VoC.

The B6232 west of Milburngate Bridge is also shown to benefit in terms of reductions in VoC compared to the 2037 Do Nothing Scenario A. This is reflected at Junction 1 (A167 / A691 Sniperley Park roundabout) in the AM peak, dropping to a VoC below 50%. This highlights that two city centre pinch points either side of Milburngate Bridge, which are consistently congested in Scenario 1 and 2. However, Framwelgate Peth still shows signs of constrains in both time periods, suggesting the traffic growth in 2037 is still putting pressure on the network. particularly in the AM peak.

Similar to the 2022 forecast year, reducing Milburngate Bridge lane capacity by 50%, increases the VoC compared to the Do Nothing Scenario A. This is more apparent in 2037 as the growth in traffic resulting from the committed developments and background growth in Durham City results in continued congestion and delay.

Figure 8.3: Network VoC Summary, Scenario 3 2037 AM Peak

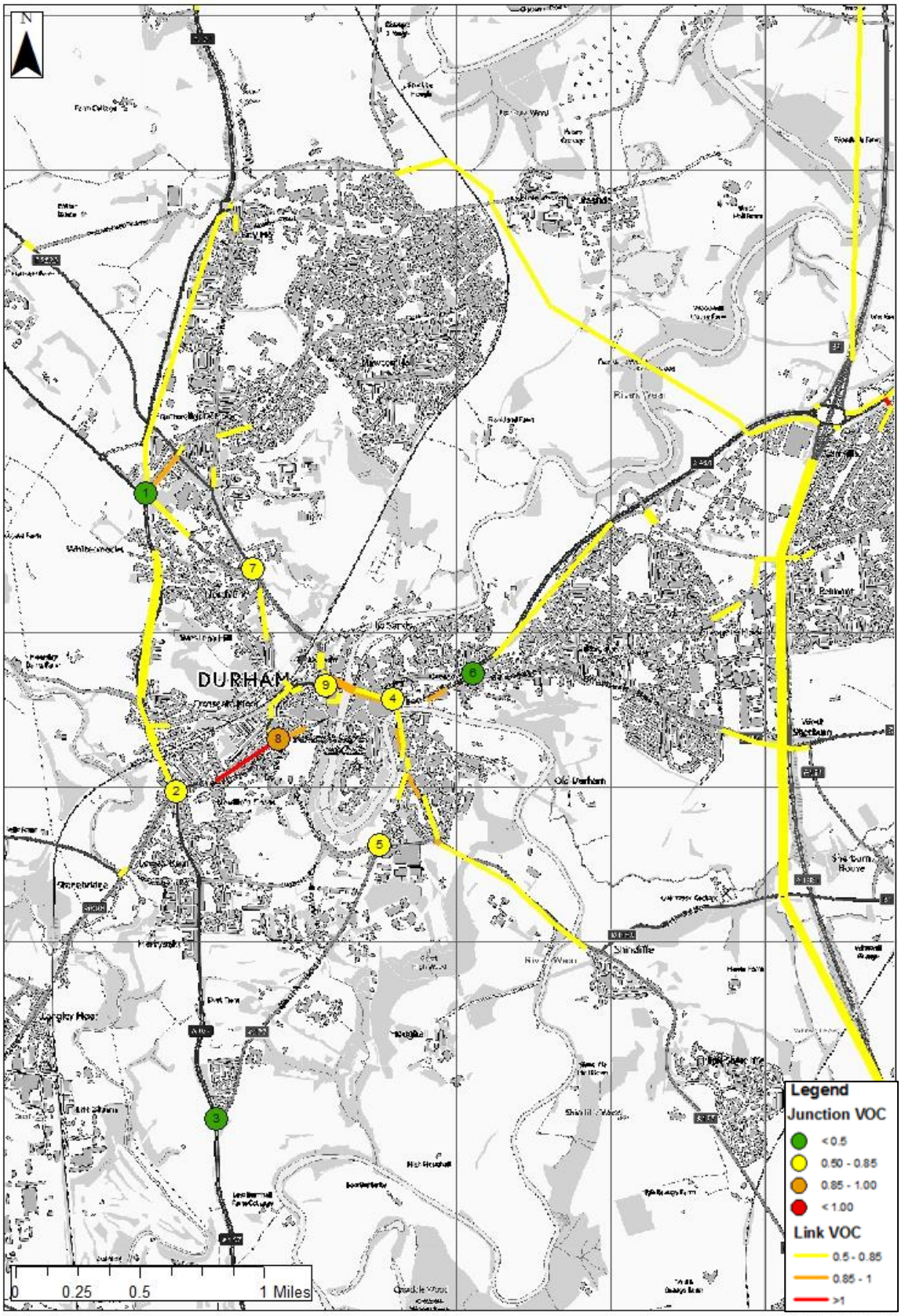
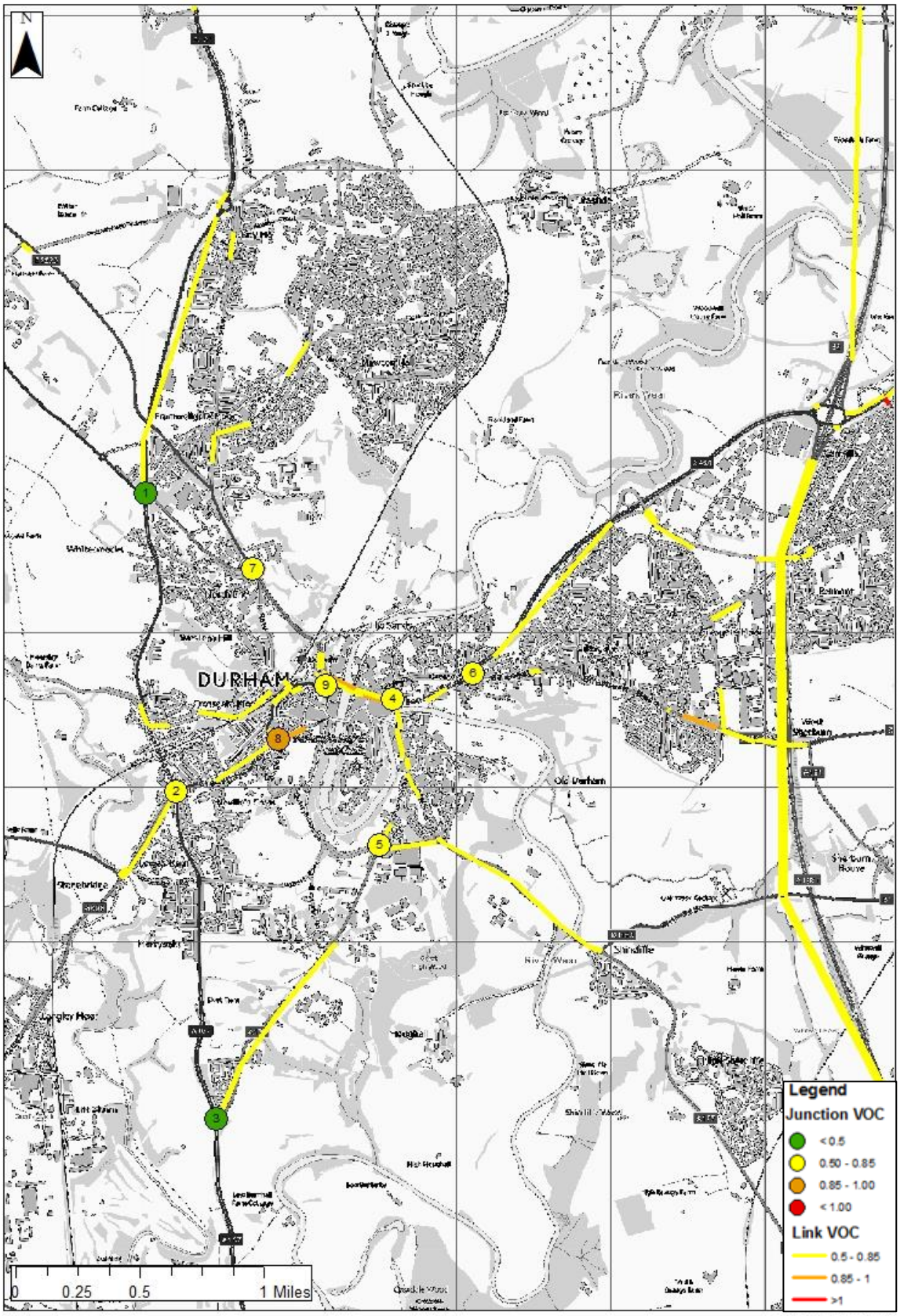


Figure 8.4: Network VoC Summary, Scenario 3 2037 PM Peak



8.2.4 2037 Junction Analysis

Table 8.3 summarises the total movements and journey time to undertake all movements at the junctions for Scenario 3A in 2037 compared to the equivalent 2037 Do Nothing Scenario A.

Following the same trend as 2022, the data highlights that the implementation of a NRR and the Milburngate Bridge lane reductions has a positive impact on traffic flow and VoC across the nine junctions in both the AM and PM peak. Slight delay of 6% and 1% can be seen at Junction 2 (A167 / A690 (Neville's Cross) junction) and A167 / A177 South Road respectively in the AM peak, most likely due to an increase in traffic accessing the NRR via the A167.

As the NRR provides a secondary east-west route for traffic, the junctions through the centre of Durham show the largest benefits. In the AM peak, it can be seen that the worst performing movement VoC at Junction 1 (A167 / A691 (Sniperley Park) roundabout), Junction 7 (A691 / B6532 (County Hall) roundabout) and Junction 9 (A690 / A691 / Milburngate junction) have reduced by at least one category or more. This can also be seen in the PM peak for Junction 6 (A690 / A181 (Gilesgate) roundabout), Junction 7 (A691 / B6532 (County Hall) roundabout) and Junction 9 (A690 / A691 / Milburngate roundabout).

As a result of the re-distributional impacts associated with the NRR, traffic movements across the nine junctions are expected to reduce by around 8% and 10% in the AM and PM respectively compared to the Do Nothing Scenario A. This highlights that the NRR is expected to result in a more comprehensive re-distribution of traffic across the network compared to both Scenario 1 and 2. This is reflected in the delay, with a total of 21% time savings in the AM peak and 10% in the PM peak. However, it is important to note that in 2037 the roads start to fill back up due to the growth in traffic, resulting in continued congestion and delay in some areas.

Table 8.3: Scenario 3A 2037 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN3	Diff	DN-A	SCN3	Diff	DN-A	SCN3	Diff
Junction 1	4,540	4,245	-295	101%	92%	-10%	00:24	00:17	-00:07
Junction 2	3,096	2,957	-138	95%	93%	-3%	00:49	00:52	00:03
Junction 3	2,408	2,293	-115	48%	45%	-3%	00:13	00:13	00:00
Junction 4	4,343	3,907	-437	88%	78%	-10%	00:24	00:21	-00:03
Junction 5	1,539	1,471	-68	93%	92%	0%	00:57	00:57	00:00
Junction 6	3,358	2,863	-495	67%	56%	-11%	00:22	00:21	-00:01
Junction 7	3,427	3,150	-278	109%	101%	-8%	01:21	00:29	-00:52
Junction 8	1,704	1,722	18	102%	102%	-1%	02:07	02:00	-00:07
Junction 9	4,201	3,841	-359	104%	98%	-6%	01:26	00:38	-00:48
Total	**28,615**	**26,448**	**-2,167**				**08:04**	**06:09**	**-01:55**

Table 8.4: Scenario 3A 2037 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-A	SCN1	Diff	DN-A	SCN1	Diff	DN-A	SCN1	Diff
Junction 1	4,081	3,704	-377	50%	47%	-3%	00:14	00:14	-00:00
Junction 2	2,797	2,626	-171	97%	98%	1%	01:13	01:10	-00:03
Junction 3	2,226	2,132	-94	70%	68%	-2%	00:12	00:12	00:00
Junction 4	4,719	4,089	-630	76%	80%	4%	00:22	00:21	-00:01
Junction 5	1,587	1,561	-26	84%	85%	0%	01:02	01:00	-00:02
Junction 6	4,145	3,619	-526	97%	80%	-18%	00:34	00:23	-00:11
Junction 7	3,737	3,147	-591	149%	79%	-70%	01:54	00:19	-01:34
Junction 8	1,780	1,748	-31	104%	101%	-2%	01:35	01:32	-00:03
Junction 9	4,179	3,597	-582	100%	96%	-4%	00:59	00:37	-00:22
Total	**29,251**	**26,224**	**-3,027**				**08:04**	**05:50**	**-02:16**

8.2.5 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3 for the two forecast years of 2022 and 2037 compared to the 2015 base year.

The NRR improves journey times on the A167 and A177 in the AM peak (2022 and 2037), but results in additional delay on the A690. This is due to the capacity reduction on Milburngate Bridge, which increases journey times through the city centre. This is advantageous as it encourages use of the NRR for through traffic.

The PM peak shows that the NRR results in additional delay on the A167 in 2022 and 2037, and on the A177 in 2037. This is a result of increased traffic on the A167 and A177 possibly as a result of the more strategic movements being influenced by the NRR encouraging more traffic along the most north eastern and south western extents of the journey time route.

Table 8.5: Scenario 3A Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2022 DN-A	15:29	16:08	31:37	18:38	17:37	36:15	22:35	20:00	42:35
	2022 SCN3	15:14	15:22	30:35	18:12	18:30	36:42	21:19	19:20	40:39
	Diff	-00:15	-00:46	-01:01	-00:26	00:53	00:27	-01:16	-00:40	-01:56
	2037 DN-A	16:30	16:17	32:47	19:22	18:04	37:26	23:09	21:22	44:31
	2037 SCN3	15:47	15:45	31:31	18:48	19:00	37:48	22:19	20:07	42:26
	Diff	-00:43	-00:32	-01:15	-00:34	00:56	00:22	-00:50	-01:15	-02:05

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
PM Peak	2022 DN-A	15:37	14:25	30:02	18:03	16:59	35:02	22:10	19:35	41:45
	2022 SCN3	16:33	14:14	30:47	18:27	17:43	36:10	20:01	19:32	39:33
	Diff	00:56	-00:11	00:45	00:24	00:44	01:08	-02:09	-00:03	-02:12
	2037 DN-A	16:51	14:57	31:48	18:52	17:43	36:35	23:43	20:17	44:00
	2037 SCN3	17:03	14:56	31:59	19:07	18:34	37:41	22:16	20:18	42:35
	Diff	00:12	-00:01	00:11	00:15	00:51	01:06	-01:27	00:01	-01:26

8.3 3B: Northern Relief Road with 2 Lanes per Direction over Milburngate Bridge

This section summarises the results of the modelling of Scenario 3B, which includes background traffic growth and committed developments (inclusive of Aykley Heads), with the addition of the Northern Relief Road (NRR) and no lane reduction at Milburngate Bridge in the modelled highway network. This scenario was modelled to measure the benefits of reducing Milburngate Bridge to 1 lane in each direction.

In 2022, both peak periods mirror that of Scenario 3A, with the exception of an improvement to the link based VoC across Milburngate bridge. This is due to the fact there has been no reduction in capacity here. As this route is more attractive than Scenario 3 A, the VoC for junctions along this route show less improvement. This is a similar story for 2037.

As a result of the re-distributional impacts associated with the NRR and no reduction at Milburngate, traffic movements across the nine junctions are expected to reduce by around 7% and 9% in the AM and PM respectively, compared to the Do Nothing Scenario A in 2022 and 6% and 8% in 2037. This highlights that the NRR is expected to result in a more comprehensive re-distribution of traffic across the network compared to both Scenario 1 and 2 however, more improvements can be seen in Scenario 3 A. This is reflected in the delay, with a total of 15% time savings in the AM peak and 9% in the PM peak in 2022, while 2037 shows an improvement of 165 in the AM and 28% in the PM.

8.4 Scenario 3 Summary

- The Northern Relief Road provides a secondary east-west route for traffic.
- The lane reduction on Milburngate Bridge increases VoC on the A690 through the centre of Durham, but in turn makes the relief road a more attractive route.
- The Northern Relief Road has a clear positive effect, in terms of reductions in traffic flows and journey times at strategic junctions as traffic re-distributes across the network.
- Some strategic journey routes see a slight increase in journey times due to the Northern Relief Road encouraging more traffic along the most north eastern and south western extents of the journey time route. This is particularly true for the A167 and indicates that additional relief may be required.
- In 2037, the Northern Relief Road will still provide benefit however, the increase in traffic associated with the committed developments and background growth, results in continued congestion and delay in Durham city centre.

9. Scenario 4 Analysis

9.1 Overview

This section presents the results of the modelling for Scenario 4. Two scenarios have been created to reflect the potential impact of a reduction in lanes at Milburngate with the Northern and Western Relief Road.

- 4A: Milburngate with 1 lane per direction; and
- 4B: Milburngate in its current condition, with 2 lanes per direction.

The analysis has been undertaken separately for each scenario within this section.

9.2 4A: Northern and Western Relief Road with 1 Lane per Direction over Milburngate Bridge

This scenario focuses on the effects of background growth, committed developments (inclusive of Aykley Heads) and County Durham Plan allocations with the addition of the Northern and West Relief Roads, as well as a reduction in lanes on Milburngate Bridge. The analysis has been undertaken to provide an indication of future network operation from a 2015 base to 2022 and 2037.

9.2.1 2022 Volume Over Capacity Network Analysis

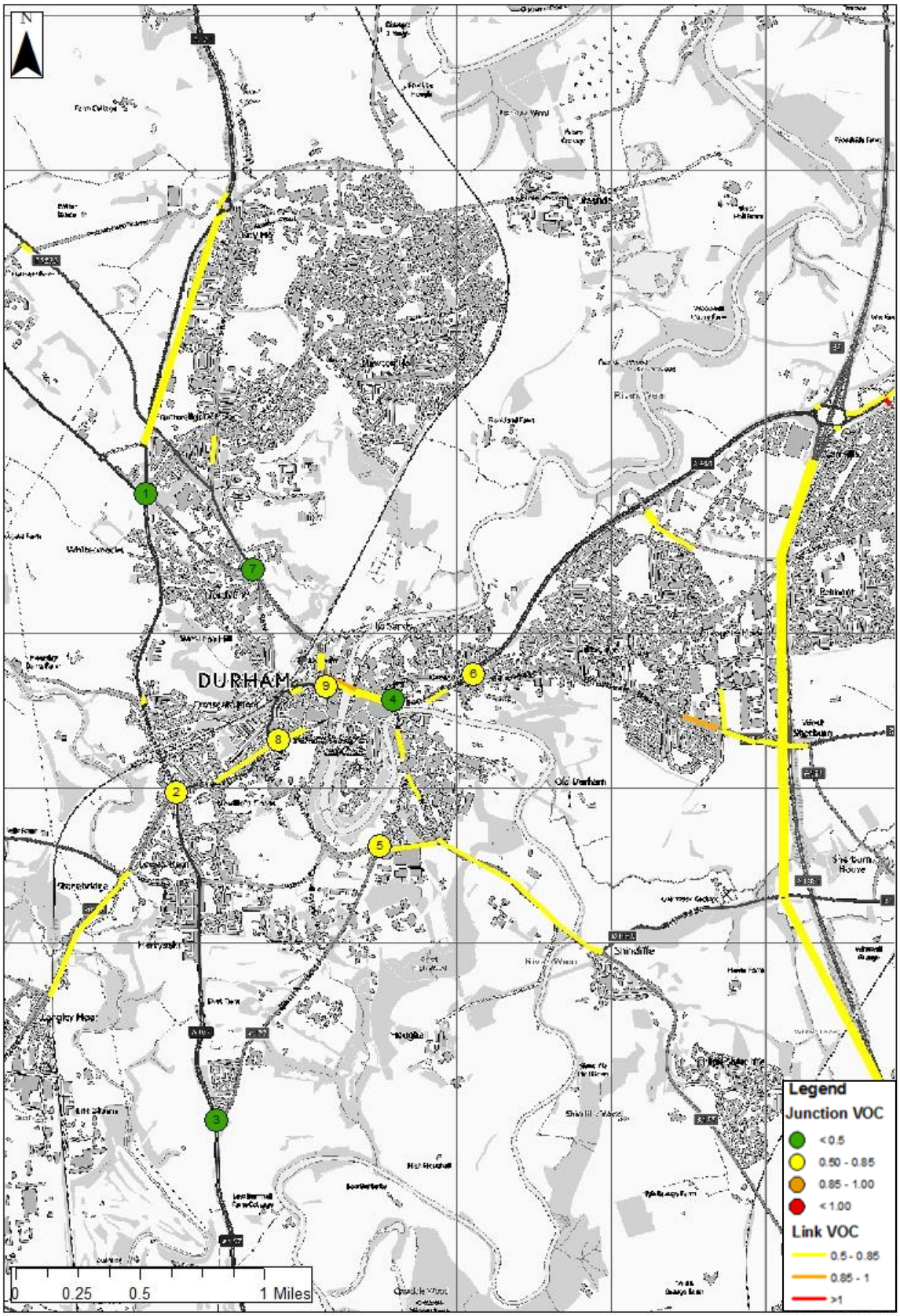
The VoC analysis is shown in Figure 9.1 and Figure 9.2. It highlights that introducing all proposed interventions facilitates an improvement in all the key routes across the city, including the A691, B6532, A181, A690 and A167 in the AM and PM peaks, to have no or little constraints. This is with the exception of the link VoC at Milburngate bridge. As found in Scenario 3, the result of reducing Milburngate Bridge lane capacity by 50%, increases in VoC compared to the Do Nothing Scenario B. The reallocation of road space to sustainable modes has a significant impact on the capacity, with the bridge now approaching capacity on some links. This is not a negative outcome in this instance, as the reallocation of road space to sustainable modes and encouraging the uptake of active travel in, around and across the city centre. Therefore, the increase in VoC is resulting from the reduction in capacity of the bridge itself, rather than an increase in traffic at this location.

The performance of the A167 corridor is benefitted by the WRR in this scenario, with this route operating within capacity along its full extent between Sniperley roundabout and Neville's Cross junction, with sections towards Pity Me also showing areas of improvement.

This highlights that the key city pinch points across Durham city, which are consistently congested without intervention, are expected to operate with improved capacity as a results of the relief roads.

Figure 9.1: Network VoC Summary, Scenario 4A 2022 AM Peak

Figure 9.2: Network VoC Summary, Scenario 4A 2022 PM Peak



9.2.2 2022 Junction Analysis

Table 9.1 and Table 9.2 summarise the total movements through the junction, the poorest performing VoC and average delay per vehicle junctions for Scenario 4A in 2022 compared to the equivalent 2022 Do Nothing Scenario B.

The data highlights that the implementation of the NRR and WRR, with the Milburngate Bridge lane reductions has a positive impact on traffic flow and VoC across the nine junctions in both the AM and PM peak. The greatest improvements to the poorest performing VoC can be seen at Junction 1 (A167 / A691 Sniperley Park roundabout) in the AM peak, going from 100% to 54% from the Dryburn Park to A167 NB. Likewise, in the PM peak Junction 7 (A691 / B6532 (County Hall) roundabout) reduces from 92% to 52% from B6532 to A691 SB.

As a result of the re-distributional impacts associated with the highway intervention, traffic movements across the nine junctions are shown to reduce by 13% and 17% in the AM and PM respectively, compared to the Do Nothing Scenario B. This highlights that the combined relief roads and reduction in lanes at Milburngate Bridge results in a more comprehensive re-distribution of traffic across the network compared to both Scenario 1, 2 and 3. This is reflected in the delay, with the largest time saving out of all the scenarios being 28% in the AM peak and 17% in the PM peak.

Table 9.1: Scenario 4A 2022 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-B	SCN4	Diff	DN-B	SCN4	Diff	DN-B	SCN4	Diff
Junction 1	4,294	3,531	-763	100%	54%	-47%	00:20	00:15	-00:05
Junction 2	2,990	2,324	-666	94%	85%	-8%	00:49	00:47	-00:02
Junction 3	2,290	2,211	-79	48%	46%	-1%	00:13	00:13	00:00
Junction 4	4,273	3,569	-704	80%	72%	-9%	00:22	00:20	-00:02
Junction 5	1,416	1,263	-153	90%	72%	-18%	00:55	00:50	-00:05
Junction 6	3,231	2,607	-625	70%	51%	-19%	00:22	00:21	-00:01
Junction 7	3,305	2,919	-386	105%	90%	-14%	00:50	00:16	-00:34
Junction 8	1,687	1,533	-153	101%	100%	-2%	01:54	01:27	-00:27
Junction 9	4,193	3,652	-541	103%	89%	-14%	01:07	00:28	-00:39
Total	**27,679**	**23,609**	**-4,070**				**06:51**	**04:56**	**-01:55**

Table 9.2: Scenario 4A 2022 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-B	SCN4	Diff	DN-B	SCN4	Diff	DN-B	SCN4	Diff
Junction 1	3,756	3,246	-510	44%	40%	-4%	00:14	00:14	00:00
Junction 2	2,869	2,170	-699	98%	87%	-11%	01:16	01:02	-00:14
Junction 3	2,101	1,994	-107	63%	53%	-10%	00:12	00:12	00:00
Junction 4	4,500	3,743	-757	73%	60%	-13%	00:21	00:19	-00:02
Junction 5	1,429	1,302	-126	75%	74%	0%	00:58	00:57	-00:01
Junction 6	3,949	3,279	-669	96%	77%	-19%	00:32	00:23	-00:09
Junction 7	3,433	2,678	-755	92%	52%	-40%	00:21	00:15	-00:06
Junction 8	1,669	1,397	-272	100%	94%	-6%	01:18	00:59	-00:19
Junction 9	4,044	3,353	-691	96%	93%	-3%	00:43	00:33	-00:10
Total	**27,749**	**23,162**	**-4,587**				**05:55**	**04:55**	**-01:01**

9.2.3 2037 Volume Over Capacity Network Analysis

The 2037 forecast years shows a similar trend to 2022, with improvements shown to all the key routes across the city in comparison to the Do Nothing Scenario B. Including the A691, B6532, A181, A690 and A167, highlighting improvements to the city centre pinch points, which are consistently congested without intervention.

However, as shown in previous scenarios, the pressure of growth in 2037 is shown to put pressure back on the network, with the relief road not showing as great an improvement as they did in 2022. This can be seen on the A690 corridor from the A1(M) approaching the city centre from the east in the AM peak, with the capacity staying at 50-85%. Likewise in the PM peak, the A167 still shows areas of constraints between Sniperley and Neville's Cross junction.

It can also be seen that the NRR becomes constrained in 2037 in the AM peak at 50-85% VoC. Similarly, in the 2022 forecast year, reducing Milburngate Bridge lane capacity by 50%, increases the VoC compared to the Do Nothing Scenario B.

Figure 9.3: Network VoC Summary, Scenario 4A 2037 AM Peak

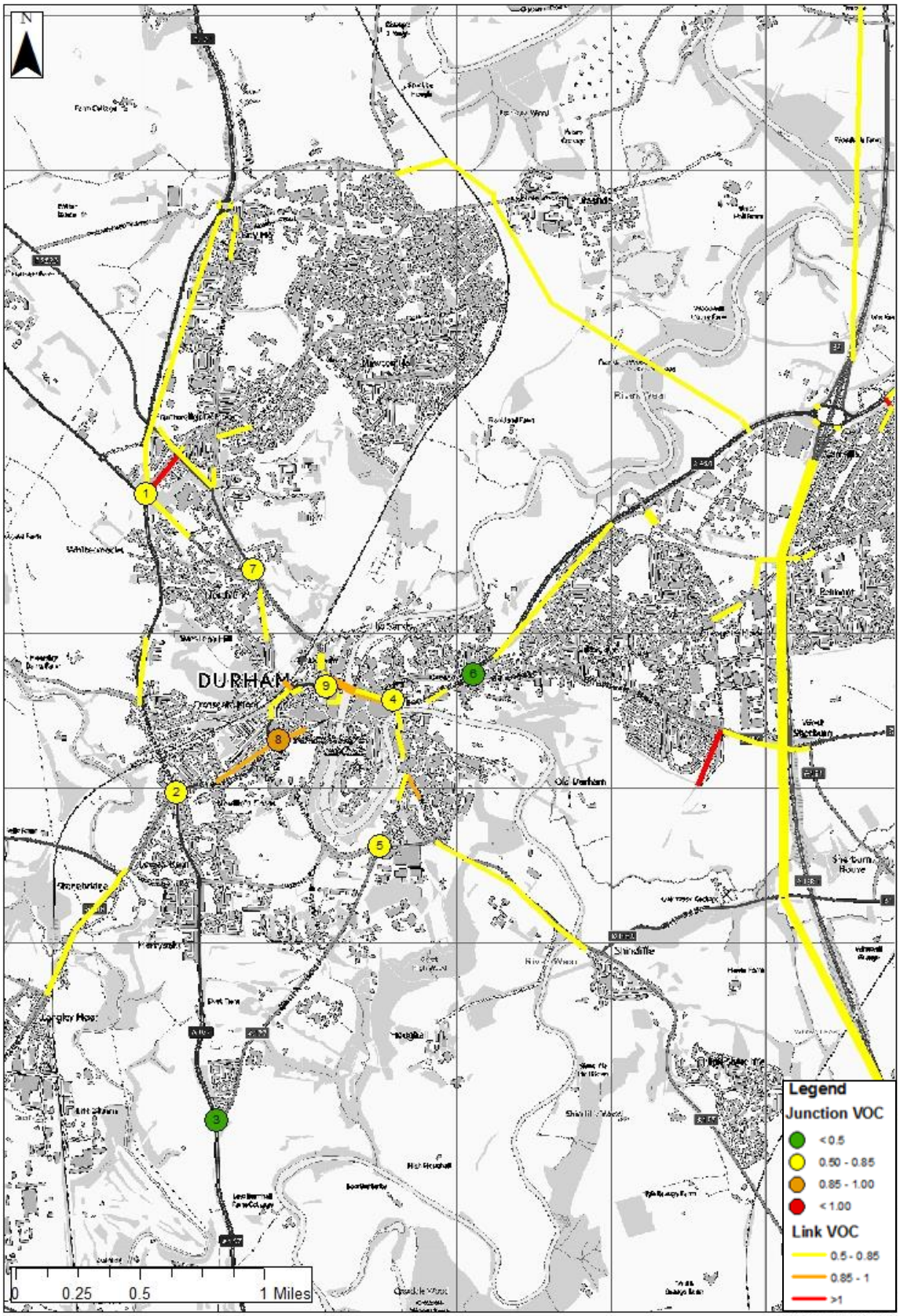
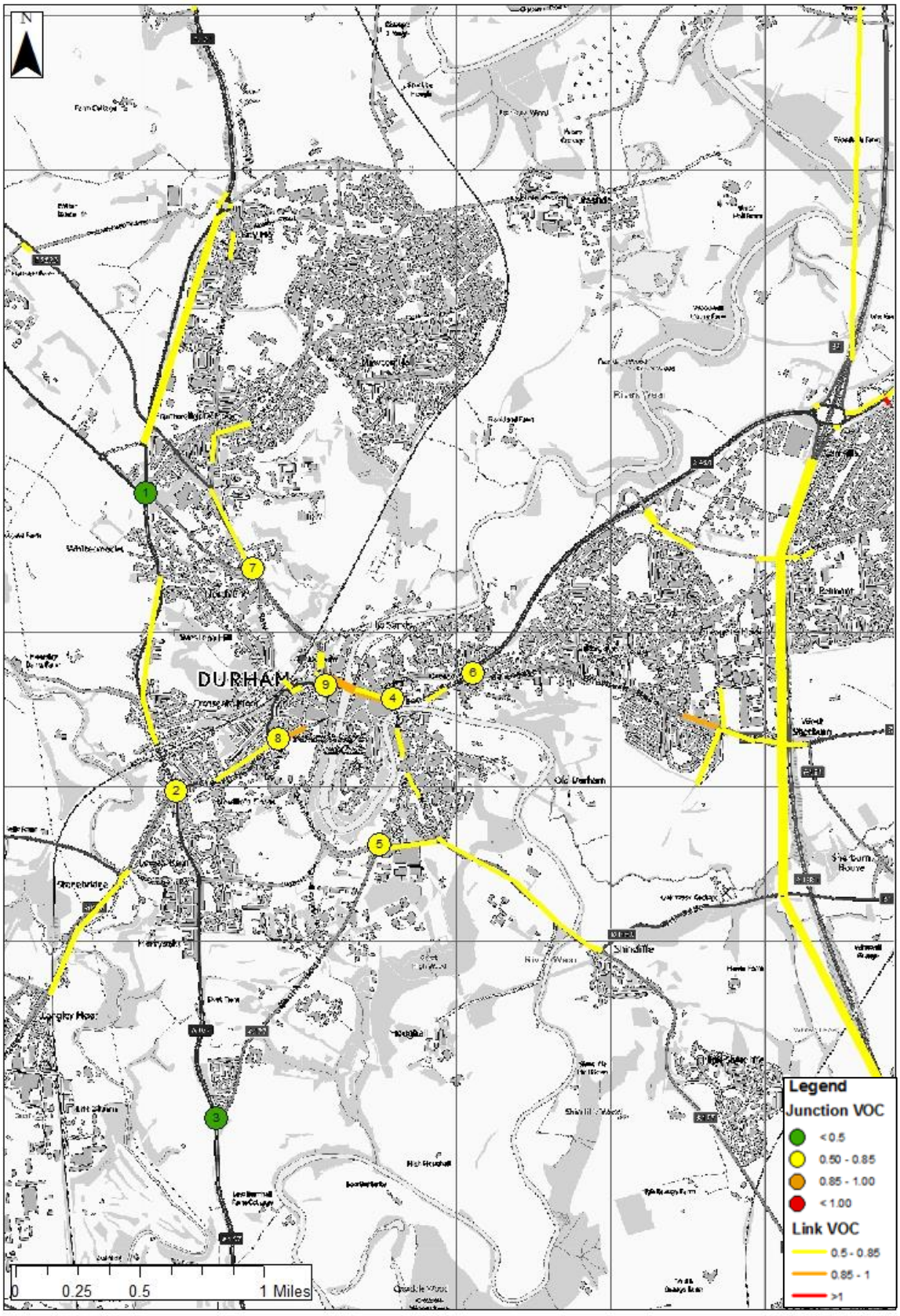


Figure 9.4: Network VoC Summary, Scenario 4A 2037 PM Peak



9.2.4 2037 Junction Analysis

Table 9.3 and Table 9.4 summarise the total movements through the junction, the poorest performing VoC and average delay per vehicle junctions for Scenario 4A in 2037 compared to the equivalent 2022 Do Nothing Scenario B.

The data highlights that the implementation of the NRR and WRR, with the Milburngate Bridge lane reductions has a positive impact on traffic flow and VoC across the nine junctions in both the AM and PM peak. The greatest improvements to the poorest performing VoC can be seen at Junction 6 (A690 / A181 Gilesgate roundabout) in the AM peak and Junction 7 (A691 / B6532 (County Hall) roundabout) in the PM peak, going from 145% to 62% from the A691 to B6532 NB.

As a result of the highway intervention, traffic movements across the nine junctions are shown to reduce by 11% and 16% in the AM and PM respectively, compared to the Do Nothing Scenario B. This highlights that the combined relief roads and reduction in lanes at Milburngate Bridge results in significantly more comprehensive re-distribution of traffic across the network compared to both Scenario 1, 2 and 3 in 2037. This is reflected in the delay, with a total of 30% time savings in the AM peak and 35% in the PM peak.

Both relief roads in combination provide improvements in both the AM and PM peak in 2037, whereas just one relief road in isolation, whilst mostly providing improvements to junctions, some junctions saw increases in delay due to reassignment of traffic.

Table 9.3: Scenario 4A 2037 Junction Summary (AM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-B	SCN4	Diff	DN-B	SCN4	Diff	DN-B	SCN4	Diff
Junction 1	4,608	4,156	-452	106%	103%	-3%	00:33	00:30	-00:03
Junction 2	3,104	2,437	-667	95%	89%	-6%	00:48	00:47	-00:01
Junction 3	2,394	2,293	-101	48%	46%	-2%	00:13	00:13	00:00
Junction 4	4,347	3,723	-624	89%	78%	-11%	00:24	00:21	-00:03
Junction 5	1,556	1,408	-148	92%	90%	-2%	00:57	00:54	-00:03
Junction 6	3,368	2,807	-560	67%	55%	-12%	00:22	00:21	-00:01
Junction 7	3,506	3,258	-248	113%	105%	-8%	01:58	00:45	-01:13
Junction 8	1,709	1,666	-44	102%	99%	-3%	02:05	01:41	-00.24
Junction 9	4,198	3,847	-351	104%	97%	-7%	01:27	00:36	-00:51
Total	**28,789**	**25,594**	**-3,195**				**08:48**	**06:08**	**-02:39**

Table 9.4: Scenario 4A 2037 Junction Summary (PM Peak)

Junction	Total Movements (vehicles)			Poorest Performing Movement (VoC)			Total Delay per Vehicle (mm:ss)		
	DN-B	SCN4	Diff	DN-B	SCN4	Diff	DN-B	SCN4	Diff
Junction 1	4,310	3,642	-668	52%	48%	-4%	00:15	00:14	-00:01
Junction 2	2,984	2,272	-711	99%	87%	-11%	01:14	01:03	-00:11
Junction 3	2,278	2,134	-145	70%	59%	-12%	00:13	00:13	00:00
Junction 4	4,727	4,031	-696	74%	64%	-10%	00:22	00:20	-00:02
Junction 5	1,604	1,433	-171	83%	76%	-7%	01:02	00:58	-00:04
Junction 6	4,129	3,510	-618	97%	78%	-19%	00:33	00:23	-00:10
Junction 7	3,811	3,099	-712	145%	62%	-82%	01:45	00:18	-01:27
Junction 8	1,747	1,474	-273	102%	99%	-3%	01:27	01:04	-00:23
Junction 9	4,197	3,550	-648	102%	97%	-5%	01:13	00:39	-00:34
Total	**29,786**	**25,145**	**-4,641**				**08:05**	**05:11**	**-02:52**

9.2.5 Journey Time Analysis

This section presents the journey time analysis for the three strategic routes identified in Section 3.3 for the two forecast years of 2022 and 2037 compared to the 2015 base year.

The results show that the combination of relief roads results in journey time improvements on the A167 and A177, in both directions. On the A690, there is an increase in journey time in the E/B direction across all time periods. This is due to the capacity restraints on Milburngate Bridge.

In summary, the combined interventions of a WRR, NRR and lane reductions on Milburngate Bridge allows the additional development traffic to be accommodated on the road network. This highlights that the combination of measures included in the Scenario 4A assessment essentially mitigate the impact of traffic growth across the network compared to the current network operation.

Table 9.5: Scenario 4A Strategic Journey Time Summary (mm:ss)

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
AM Peak	2022 DN-B	15:29	16:08	31:37	18:38	17:37	36:15	22:35	20:00	42:35
	2022 SCN2	13:46	14:11	27:57	17:29	18:25	35:55	20:57	19:01	39:57
	Diff	-01:43	-01:57	-03:40	-01:09	00:48	-00:21	-01:38	-00:59	-02:37
	2037 DN-B	17:33	16:29	34:02	19:25	17:55	37:20	23:15	22:31	45:46
	2037 SCN2	14:51	14:34	29:25	18:21	18:36	36:57	22:22	20:10	42:32
	Diff	-02:42	-01:55	-04:37	-01:04	00:41	-00:23	-00:53	-02:21	-03:14

Time Period	Year	Route 1 – A167			Route 2 – A690			Route 3 – A177		
		S/B	N/B	Total	W/B	E/B	Total	W/B	E/B	Total
PM Peak	2022 DN-B	15:37	14:25	30:02	18:03	16:59	35:02	22:10	19:35	41:45
	2022 SCN2	13:39	13:25	27:04	17:28	17:35	35:03	20:28	19:02	39:30
	Diff	-01:58	-01:00	-02:58	-00:35	00:36	00:01	-01:42	-00:33	-02:15
	2037 DN-B	16:10	15:16	31:26	18:54	17:40	36:34	22:38	20:09	42:47
	2037 SCN2	14:12	14:03	28:15	18:00	18:15	36:15	21:03	19:40	40:43
	Diff	-01:58	-00:13	-03:11	-00:54	00:35	-00:19	-01:35	-00:29	-02:04

9.3 4B: Northern and Western Relief Road with 2 Lanes per Direction over Milburngate Bridge

This section summarises the results of the modelling of Scenario 4B, which includes background traffic growth and committed developments (inclusive of Aykley Heads), with the addition of the Northern and Western Relief Roads and no lane reduction at Milburngate Bridge in the modelled highway network. This scenario was modelled to measure the benefits of reducing Milburngate Birdge to 1 lane in each direction.

In 2022, both peak periods mirror that of Scenario 4A, with the exception of an improvement to the link based VoC across Milburngate bridge. This is due to the fact there has been no reduction in capacity here. As this route is more attractive than Scenario 4A, the VoC for junctions along this route show less improvement. This is a similar story for 2037.

As a result of the re-distributional impacts associated with the NRR, WRR and no reduction at Milburngate, traffic movements across the nine junctions are expected to reduce by around 12% and 15% in the AM and PM respectively, compared to the Do Nothing Scenario B in 2022 and 10% and 13% in 2037. This highlights that this intervention is expected to result in a more comprehensive re-distribution of traffic across the network compared to all other scenarios however, more improvements can be seen in Scenario 4A. This is reflected in the delay, with a total of 25% time savings in the AM peak and 17% in the PM peak in 2022, while 2037 shows an improvement of 27% in the AM and 34% in the PM.

9.4 Scenario 4 Summary

- The relief roads in combination provide benefits across the whole network, and work together to mitigate any negative impacts of the individual relief roads working in isolation.
- Limiting the capacity on Milburngate Bridge increases journey times through the centre of the city but encourages strategic trips to circumvent the centre of Durham.
- Traffic levels and delay at junctions are reduced considerably compared to the Do Nothing Scenario B, with journey time savings across the two of the strategic routes (A167 and A691/A177).
- Pinch points inevitably still exist within the city centre, especially around Milburngate Bridge, albeit at a much reduced level when compared with other scenarios.

10. Summary

This report presents and summarises four scenario tests associated with the aspirations for future development within Durham, known as the County Durham Plan (CDP). The scenario tests quantify and comment upon key metrics relating to the traffic associated with the future development aspirations. Alongside these different development scenarios, various mitigations are included to assess how successful each is in providing Durham a serviceable road network in the future.

The existing Durham Transport Model (DTM), which has been developed using the SATURN suite of modelling software, has been used to inform the traffic and transport assessments required to support the CDP. The assessment also utilises latest DfT economic parameters for Value of Time and Vehicle Operating Costs, as well as the latest TEMPRO v7.2 release.

A number of key metrics have been chosen to best compare the impacts on the road network in the future. These are:

- **Link Based Capacity Analysis** – The number of vehicles using a road divided by the design capacity of vehicles for that road. This metric can be applied to both road links and junctions as a measure of capacity;
  - A VoC of less than 85% indicates that a road is likely to operate within capacity;
  - A VoC of between 85% and 100% indicates a road is likely to be approaching capacity; and
  - A VoC greater than 100% indicates that a road will be over capacity.
- **Junction Capacity Analysis** – the analysis of each junction focusses on all movements that occur at each location, to enable the overall impact of each scenario to be considered strategically.
  - **Total Delay** – the demand weighted average delay experienced per simulation for all movements;
  - **Total Vehicles Through Junction** – the combined total number of vehicles which travel through the junction on each key movement; and
  - **Movement VoC** – identification of demand Weighted VoC for all movements, as well as the poorest performing movement. The results of this analysis are expressed as a percentage, based on the same capacity thresholds used to determine the corridor VoC analysis described earlier.
- **Journey Time Analysis** – The total time taken in minutes to travel from one end of an identified key route to the other, in one direction.

Analysing the above for each scenario has allowed for the following key conclusions to be drawn following analysis of each scenario:

Current Traffic Conditions Summary

- The highway network is currently operating with stretches of constraint at various locations. This is focused at a number of key junctions on strategic corridors.
- The A167 to the west of the city centre is particularly affected, as is the A690 corridor to the east. This is consistent across both AM and PM peak periods.
- The AM peak represents a more constrained period than the PM peak, reflected in the junction performance metrics and journey times through the network.

Do Nothing Scenario A Summary

- Traffic growth places additional pressure on key routes through Durham, particularly the A690 through the city centre and the A167 around Pity Me.
- This results in key strategic junctions operating over capacity on at least one arm by 2037. This includes the A167 / A691 Sniperley Park roundabout, A690 / Crossgate / Margery Lane signal controlled junction, and A690 / A691 / Milburngate signalised roundabout.
- Traffic from the proposed development at Aykley Heads puts pressure on the A691 / B6532 (County Hall) roundabout.
- Deterioration in network performance results in increased journey time and delays across the network.

Do Nothing Scenario B Summary

In addition to the outcomes identified in Do Nothing Scenario A, the following can be noted:

- Traffic from the County Durham Plan allocations place additional pressures on the A691 north of Sniperley junction, as well as the A167 between Pity Me and Neville's Cross.
- This suggests supporting transport infrastructure is required to effectively mitigate the impacts of the additional traffic generated by the County Durham Plan allocations.

Scenario 1 – Western Relief Road (External Transport Funding) – Summary

- The Western Relief Road provides considerable benefit to strategic routes to the west of the city, principally the A167.
- Capacity constraints at key junctions on these routes are reduced, namely Neville's Cross and Sniperley as traffic is redirected onto the Western Relief Road. Improvements can also be observed elsewhere in the city centre as traffic is drawn away from the city centre, most notably the A690 via Crossgate Peth.
- Re-distribution of traffic across the constrained road network to the west of the city centre generates journey time savings on the wider network, for all three strategic routes and the majority of junctions.

Scenario 2 – Western Relief Road (S106 Funding) – Summary

- The Western Relief Road provides considerable benefit to strategic routes to the west of the city, principally the A167.
- Traffic and journey times at key junctions on these routes are reduced, namely Neville's Cross and Sniperley, as traffic is redirected onto the Western Relief Road. Improvements can also be observed elsewhere in the city centre as traffic is drawn away from the city centre, most notably the A690 via Crossgate Peth. Constraints and delay can be seen around County Hall and Sniperley, as the County Durham Plan allocations generate traffic that is attracted towards the Western Relief Road.
- Re-distribution of traffic across the road network to the west of the city centre generates journey time savings on the wider network, for all three strategic routes and the majority of junctions.
- The Western Relief Road provides adequate mitigation for the additional traffic generated by the County Durham Plan allocations to the north and west of the city centre.

Scenario 3 – Northern Relief Road – Summary

- The Northern Relief Road provides a secondary east-west route for traffic.
- The lane reduction on Milburngate Bridge increases VoC on the A690 through the centre of Durham, but in turn makes the relief road a more attractive route.
- The Northern Relief Road has a clear positive effect, in terms of reductions in traffic flows and journey times at strategic junctions as traffic re-distributes across the network.
- Some strategic journey routes see a slight increase in journey times due to the Northern Relief Road encouraging more traffic along the most north eastern and south western extents of the journey time route. This is particularly true for the A167 and indicates that additional relief may be required.
- In 2037, the Northern Relief Road will still provide benefit however, the increase in traffic associated with the committed developments and background growth, results in continued congestion and delay in Durham city centre.

Scenario 4 – Northern and Western Relief Road –Summary

- The relief roads in combination provide benefits across the whole network, and work together to mitigate any negative impacts of the individual relief roads working in isolation.
- Limiting the capacity on Milburngate Bridge increases journey times through the centre of the city but encourages strategic trips to circumvent the centre of Durham.
- Traffic levels and delay at junctions are reduced considerably compared to the Do Nothing Scenario B, with journey time savings across the two of the strategic routes (A167 and A691/A177).
- Pinch points inevitably still exist within the city centre, especially around Milburngate Bridge, albeit at a much reduced level when compared with other scenarios.

The existing road network is incapable of suitably accommodating forecast future traffic growth. This is evidenced in both the Committed sites and background growth (inclusive of Aykley Heads); and with the addition of the County Durham Plan allocations.

The inclusion of a Western Relief Road facilitates north/south movements which would have previously used the A167. The A167 still exhibits a high volume of traffic in 2037, but the inclusion of the Western Relief Road is necessary to ensure that forecast growth can occur.

The inclusion of a Northern Relief Road facilitates traffic that would have previously used the A690. The impact is a reduction in traffic in the City Centre. When combined with a reduction in the number of lanes on Milburngate Bridge, the Northern Relief Road further reduces traffic in the centre of Durham.

When the relief roads are combined alongside a reduction in the number of lanes on Milburngate Bridge, the performance of the road network is at its best in the forecast future years when analysing the key metrics.