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Chelmsford Local Plan

Transport Impact of Local Plan Spatial Options

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Essex County Council

Document Control Sheet

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Contents

Tables

Figures

Executive Summary

- We have been commissioned by Essex County Council (ECC) to assist Chelmsford City Council (CCC) with understanding the transport impact of their Local Plan Spatial Options and mitigation proposals as outlined in the 'Issues and Options Consultation Document – November 2015'.

- For this stage of the study, analysis has focused on the relative transport impact of each Spatial Option based on changes in vehicle flow and levels of network congestion over a 2036 forecast-year 'Do-minimum' scenario without Local Plan development. Mitigation infrastructure has then been assessed based on its relative effect on vehicle flows and network congestion for each Spatial Option.

- The VISUM software used specifically for the modelling in this study applies a fixed demand highway assignment which does not consider behavioural responses to congestion. Behavioural responses would include changes to the volume of car journeys made, changes to journey destinations, switches to other travel modes such as bus or rail, and/or changes made to the time of travel. The model does however allow for rerouting of traffic based on journey times and congestion.

- As such, the results for this stage of the study, although comparable with each other, will likely represent an overestimate of traffic levels. It is the intention to undertake later stages of the study using the fully completed Chelmsford Strategic Model, which will include a variable demand element to account for travel behaviour responses.

- Based on modelled outputs, by 2036 all main corridor routes into or out of Chelmsford city centre would be expected to experience high levels of congestion in the AM and PM peak hours without any Local Plan development specifically modelled in the Chelmsford Administrative Area.

- The highway impact of three Spatial Options set out by CCC in their document, Chelmsford Local Plan – Issues and Options Consultation, November 2015 has been assessed in this study. The three Options are as follows:
    - Option 1 – Urban Focus
    - Option 2 – Urban Focus and Growth on Key Transport Corridors
    - Option 3 – Urban Focus and Growth in Key Villages

- With the addition of Local Plan development flows, Spatial Option 2 is shown in the modelling to result in the highest increases in traffic flow concentrated on key routes across Chelmsford, with lowest overall flow increases shown with Spatial Option 1.

- However, congestion due to background growth and subsequent wide-scale route reassignment away from strategic links and corridor routes to/from the city centre, appears to neutralise any variability between Options in the impact on network congestion across the wider area.

- At a more local level, modelling generally reflects the impact of development traffic on congestion in the immediate vicinity of larger Local Plan developments – such as those to the west of Chelmsford.

- It should be noted that a focus on urban development associated with Spatial Option 1 would likely have the greatest potential to encourage mode shift to sustainable travel alternatives.

- High levels of congestion forecast along the A12 are shown in the model to result in a considerable flow of traffic routing through the city centre along the A1114/A138. In this respect, conditions along the A12 play a significant role in levels of congestion experienced in the city centre – particularly along the A138 Chelmer Road and at the Army and Navy Roundabout.

- The impact of the three Spatial Options has also been considered with the addition of infrastructure aimed at mitigating growth in future traffic levels. Specific infrastructure modelled is as follows: an Eastern Gateway Access Road (EGAR), a Western Relief Road, A132 dualling, and new Park and Ride sites at Boreham and Widford. The demand for Park and Ride has been incorporated into the model manually to represent journey mode switch.

- With the modelling of additional infrastructure, flows are shown to reduce along the A138 and at the Army and Navy Roundabout in particular. Whilst additional Park and Ride facilities contribute to this reduction, there is also a reduction in city centre through-routing of strategic trips as a result of the provision of an alternative north-south route via the proposed Western Relief Road.

- At the same time, the addition of mitigating infrastructure is shown to have little beneficial impact on traffic flows in the city centre itself. This is likely due to the part alleviation (but not removal) of city centre bottlenecks, with suppressed traffic flows replacing Park and Ride transfer trips.

- The proposed Western Relief Road would help to address potential congestion along main routes through Melbourne and Broomfield. However, by attracting strategic traffic away from the A12, additional pressure is placed on routes through Writtle, increasing the case for a Writtle bypass, should the A12 not be widened in the future.

- As such, the impact of infrastructure improvements will be influenced heavily by the levels of future congestion experienced along the A12. Should the route be widened in the future, it might be reasonable to expect the impact of these mitigation measures to change – potentially to a significant extent.

- Regardless, it is apparent from the network congestion analysis, that the proposed infrastructure alone will be unlikely to mitigate the high levels of congestion modelled across the city.

- The impact of each Spatial Option on the local road network around Great Leighs and South Woodham Ferrers is expected to be consistent with the quantum of housing proposed for each. However, as the VISUM model is less refined in these areas, without further local junction modelling it is not possible to draw accurate conclusions regarding the likely extent of congestion on the road network in the future, or the specific impact of the Spatial Option development flows in these areas.

1 Introduction

1.1 Background

We have been commissioned by Essex County Council (ECC) to assist Chelmsford City Council (CCC) with understanding the transport impact of their Local Plan Spatial Options and mitigation proposals as outlined in the 'Issues and Options Consultation Document – November 2015'. The appraisal will provide evidence to support a Preferred Spatial Option and package of mitigation measures to include in the Local Plan Pre-Submission in Summer 2017.

The current Chelmsford Local Development Framework (LDF) covers the period from 2001 to 2021. The Government requires Local Authorities to put in place Local Plans which provide certainty for the supply of housing land for a period of up to 10 years and ideally for up to 15 years. It is therefore now necessary for Chelmsford City Council (CCC) to prepare the next Chelmsford Local Plan for 2021 to 2036.

The Chelmsford Strategic Model is being developed using VISUM modelling software as part of a separate commission for ECC. VISUM is an area-wide assignment modelling package used in this study to assess the impact of development traffic on the wider 'strategic' road network in and around Chelmsford.

On behalf of CCC, this project places focus on using the Chelmsford Strategic Model to demonstrate a sound and robust highways evidence base by testing CCC's emerging growth proposals and identifying transport mitigation measures to as far as possible accommodate planned growth to support the emerging Chelmsford Local Plan.

The appraisal of the Local Plan Spatial Options, as documented in this report, was originally carried out in Summer 2016 and has now been finalised ahead of the consultation on CCC's Preferred Option.

1.2 Approach

This project will be divided into four stages:

- Local Plan Spatial Option Testing;
- Local Plan Sensitivity Testing;
- Preferred Spatial Option Modelling; and
- Additional Forecast Year Assessments.

This document summarises the work undertaken during the first stage, Local Plan Spatial Option Testing. The remaining stages will be the subject of future technical notes.

The work undertaken in the first three stages will be undertaken using an interim model as a fixed-demand highway assignment only version of the Chelmsford Strategic Model. This means that there will be no modelling of travel behaviour responses to congestion outside of route choice, i.e. no changes to the numbers of car trips people make, no changes to the destinations of car trips, no switching to other modes such as bus or rail and no changes in time of travel. As such the results from these stages, although consistent with each other, will likely represent an overestimate of traffic levels. It is the intention to undertake the later stages using the fully completed Chelmsford Strategic Model, which will include a variable demand model and therefore be able to model these travel behaviour responses.

The first stage will be restricted to the Spatial Options and Infrastructure Proposals contained within the November 2015 Issues and Options Consultation Document. The second stage will consider sensitivity testing of spatial options/locations, additional/revised transport interventions and sustainable transport infrastructure as a mitigation measure. The technical notes from these stages, of which this is the first, will provide evidence to feed into the process of agreeing a preferred Spatial Option.

1.3 Document layout

This document consists of five chapters, as follows:

- Chapter 1: **Introduction**
- Chapter 2: **Do-minimum model** – this describes a reference model, built to compare against the various Local Plan Options, and its results;
- Chapter 3: **Modelling the Spatial Options** – this describes modelling of the Local Plan Options contained within the Issues and Options Consultation Document, i.e. the housing and employment/retail, but without any additional Infrastructure Proposals; and covers the results from this modelling including comparison with the Do-minimum model;

- Chapter 4: **Modelling the Spatial Options with Infrastructure Improvements** – this describes modelling of the Local Plan Options with the Infrastructure Proposals contained within the Issues and Options Consultation Document; and

- Chapter 5: **Conclusions** – this draws together the conclusions from the work described in the earlier chapters.

1.4 Glossary of Modelling Terms

Actual (Link) Flow	The modelled vehicle flow on a road accounting for both the reassignment of traffic as a result of network capacity constraint and through congestion caused by the presence of conflicting vehicle movements on the road network.
Do Minimum / Do Min	Referred to in this study as a reference case against which to compare the various Local Plan Spatial Option scenarios. The 2036 Do-Minimum scenario does not contain housing or job growth in Chelmsford covering the Local Plan period 2021-2036.
Fixed Demand	Demand for peak hour travel that does not change to take account of congestion on the road network.
Matrix Furness	Process of creating a matrix of vehicle journeys based on known trip ends for both origins and destinations.
NTEM	National Trip End Model – produced by the Department for Transport, it uses a number of forecasts for population, employment and households by car ownership to forecast changes in trip ends (trips by origin and by destination). The results are viewed in software called TEMPro (Trip End Model Presentation Program).
Tidal Flow	A flow of traffic that is representative of typical peak hour patterns – i.e. city centre inbound flows are higher in the morning and outbound flows are higher in the evening.

Variable Demand	Demand for peak hour travel that is adjusted to take account of congestion on the road network.
VISUM	An area-wide assignment modelling package used in this study to assess the impact of development traffic on the wider 'strategic' road network in and around Chelmsford.
Volume/Capacity Ratio	The volume of traffic calculated as a percentage of the capacity of the road. 100% equates to the road being at full capacity – often characterised by large queue extents and delays.

2 Do-minimum model

2.1 Assumptions

The Do-minimum model is a version of the Chelmsford Strategic Model built to compare with the various Local Plan Options. It is different from the Do-minimum model built as part of the project to build the Chelmsford Strategic Model.

The Do-minimum model developed for this project is for 2036. It builds on the 2021 Do-minimum model developed as part of the project to build the Chelmsford Strategic Model[1], but also includes committed development proposals contained within the current plan period with construction now expected to extend beyond 2021, as shown below in Table 2-1[2].

Zone number	Zone Name	Housing units
3	Bond Street	60
4	Duke Street	188
5	Wharf Road	172
8	Riverside	85
9	Hoffmans Way	111
55	Widford Industrial Estate	34
89	Greater Beaulieu Park	2541
90	Greater Beaulieu Park	15
91	Essex Regiment Way East	24

Table 2-1: 2036 Do-minimum model housing assumptions

Figure 2.1 and Figure 2.2 on the following page illustrate the area coverage of the model zones containing committed development proposals as shown in Table 2-1 above.

[1] Chelmsford Traffic and Access Strategy, Traffic Forecast Report V2, August 2016.
[2] These were taken from the 5 Year Rolling Supply April 2016 document provided by CCC and agreed with CCC on 18/07/16.

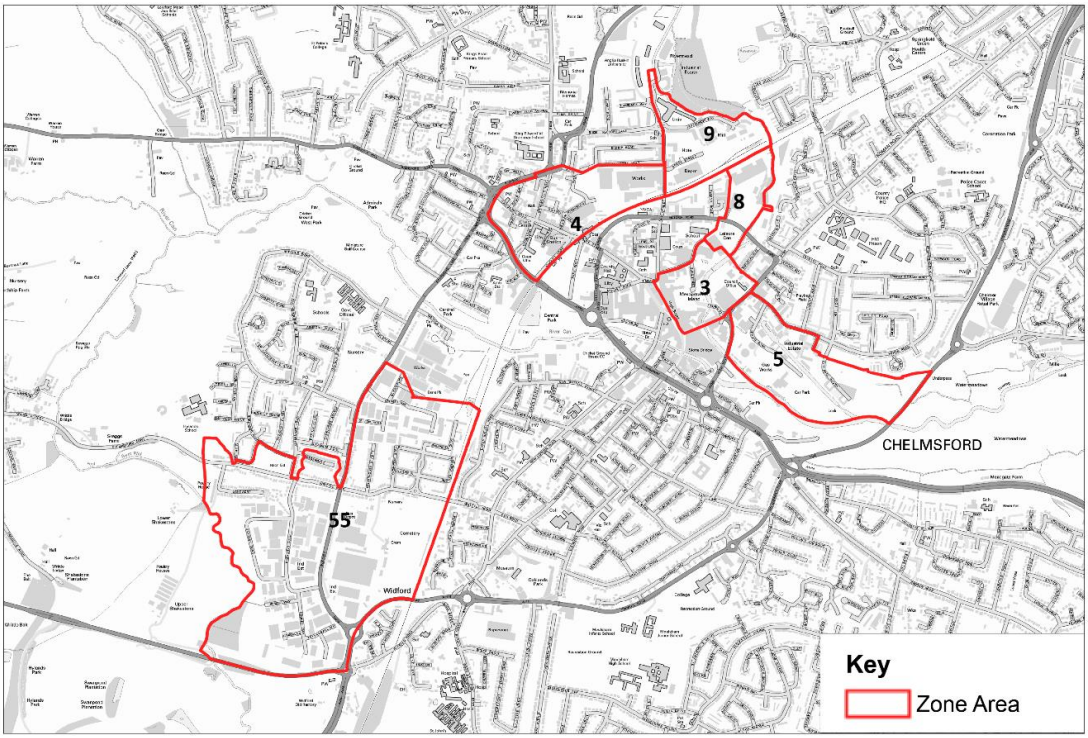


Figure 2.1: Area coverage of zones containing committed development proposals – City Centre

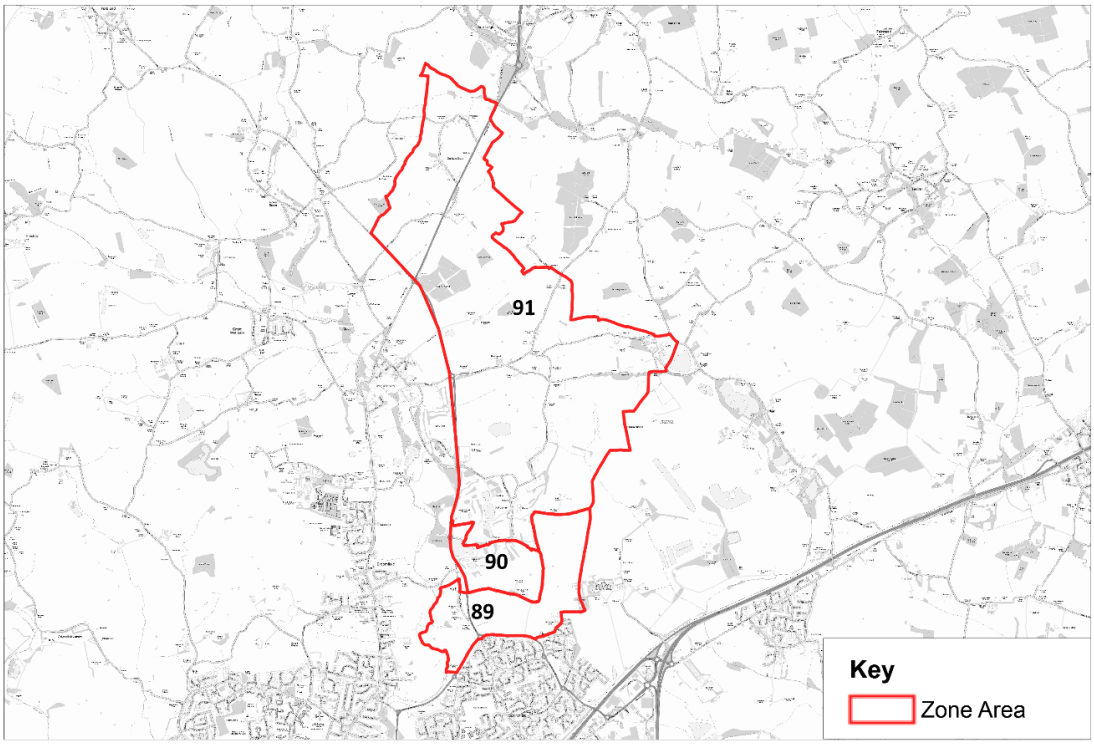


Figure 2.2: Area coverage of zones containing committed development proposals – North Chelmsford

No further growth in trips has been modelled for trips starting or ending in the Chelmsford Administrative Area apart from growth due to changes in fuel and income. No additional infrastructure has been included beyond 2021. Trips starting or ending outside of the Chelmsford Administrative Area have been controlled to forecasts from the National Trip End Model (NTEM V6.2) as per the Department for Transport's guidance and in the absence of more up-to-date information at the time of undertaking this work.

2.2 2036 Do-Minimum forecast traffic flows

- 2036 Do-minimum traffic flow plots serve predominantly as verification of the distribution of traffic flow across the road network in Chelmsford.
- The distribution of traffic in the AM, Inter and PM peak hour 2036 Do-minimum modelled scenarios appears to be reasonable.
- Tidal traffic flow on arterial routes to/from the city centre is apparent on routes such as the A130 Essex Regiment Way, A1016 Chelmer Valley Road, B1008 Main Road (Broomfield), B1007 Galleywood Road and the A414 (East).
- Flows are notably high across all modelled scenarios along the A12, A130 (south) and along the A1114 Baddow Bypass towards Chelmsford. While flows are consistently high along Parkway in the city centre, the central corridor route also demonstrates flow tidality in the AM and PM peak hours.
- As would be expected, traffic flows in the inter peak hour are lower in comparison with the AM and PM peaks. However, the distribution of traffic across the road network in Chelmsford is largely maintained across the three modelled hours, with main arterial routes carrying the largest volume of vehicles.

The following pages illustrate the patterns of vehicle flow in the 2036 Do-minimum scenario using screenshots taken from the VISUM model. 'Actual' flows have been shown – representing the modelled flows assigned across the road network.

It should be noted that minor residential and rural roads are not shown in the VISUM outputs in order to enhance the clarity of the screenshots produced.

Figure 2.3: 2036 AM Peak 'actual' link-flows – Chelmsford urban area

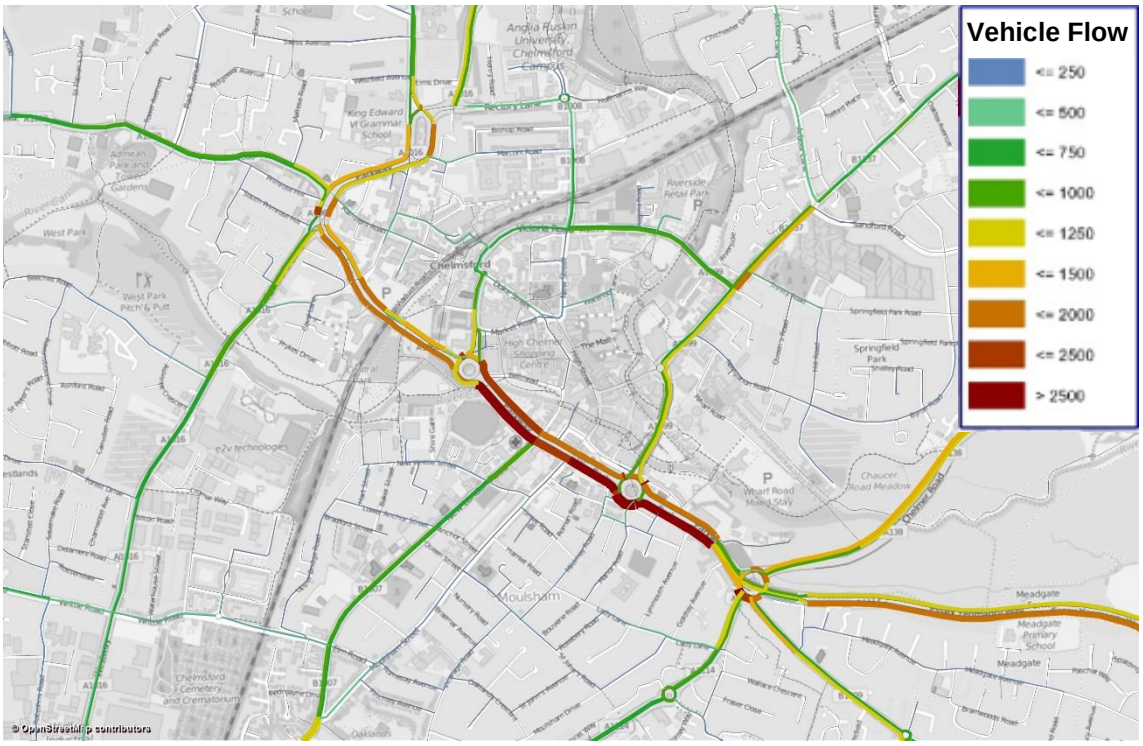


Figure 2.4: 2036 AM Peak 'actual' link-flows – Chelmsford city centre

Figure 2.5: 2036 Inter Peak 'actual' link-flows – Chelmsford urban area

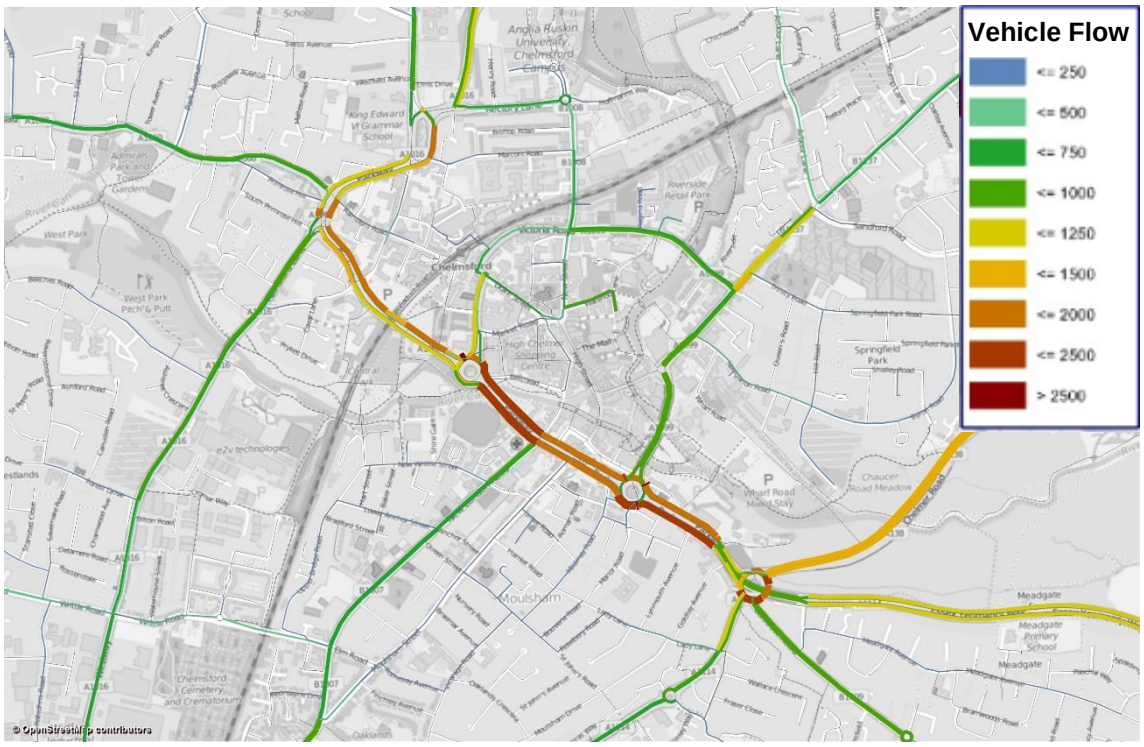


Figure 2.6: 2036 Inter Peak 'actual' link-flows – Chelmsford city centre

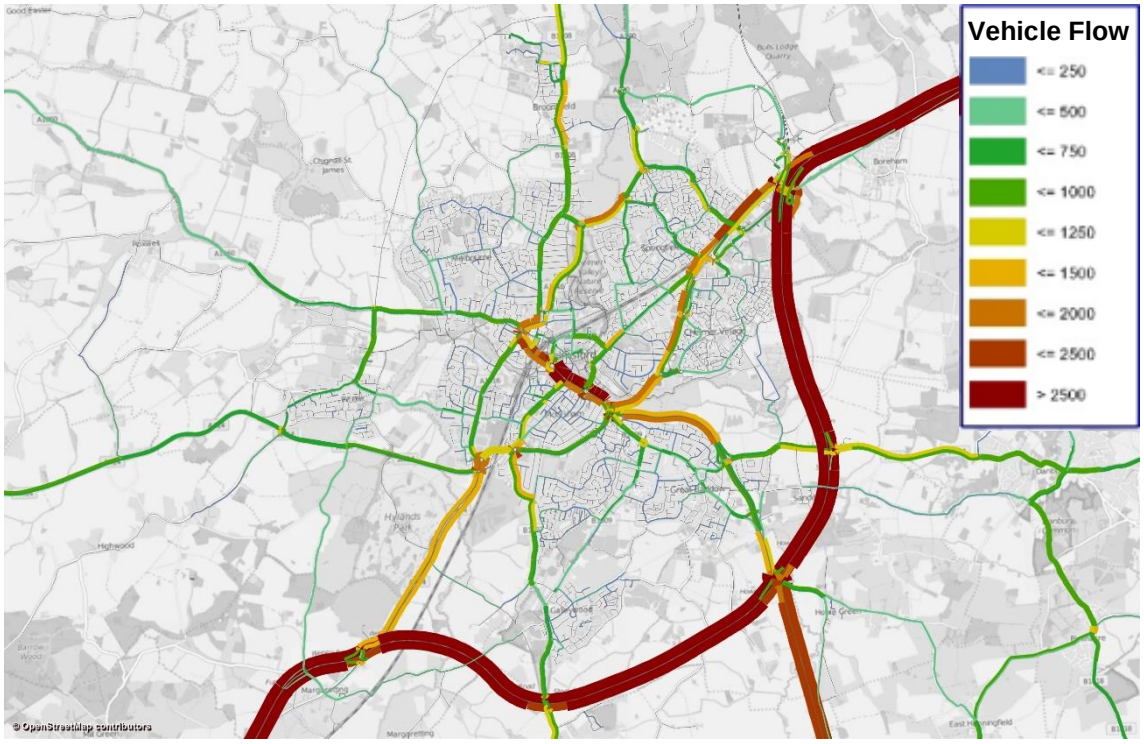


Figure 2.7: 2021 PM Peak 'actual' link-flows – Chelmsford urban area

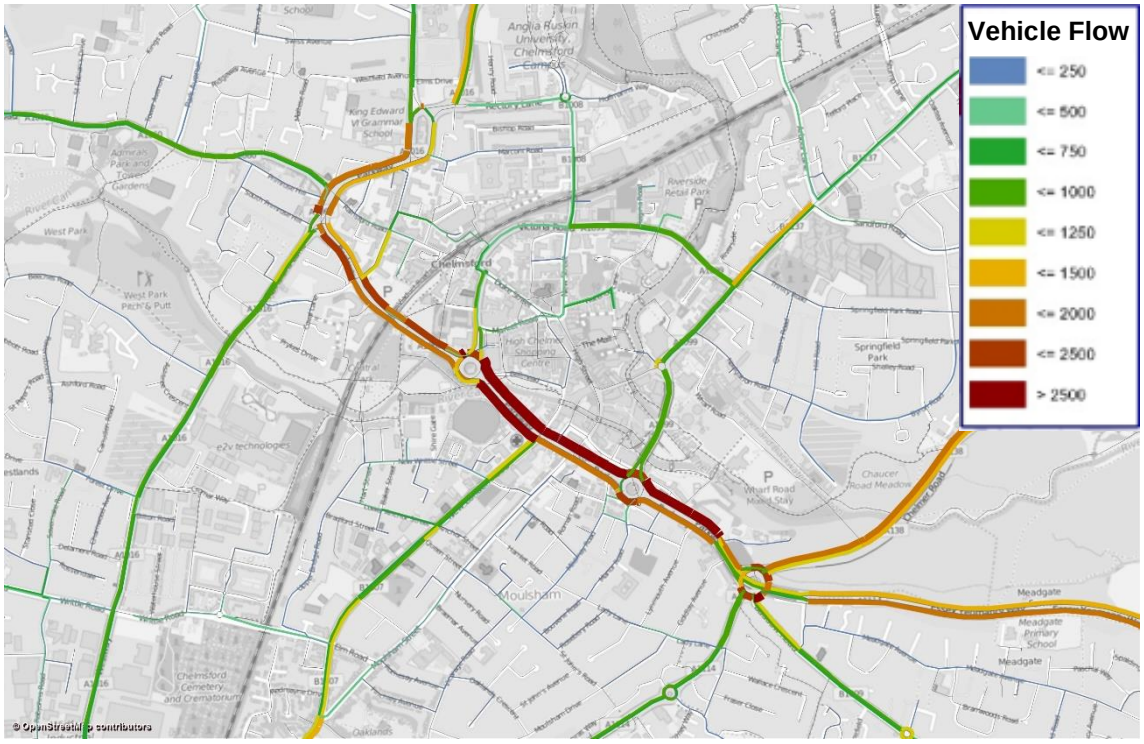


Figure 2.8: 2036 PM Peak 'actual' link-flows – Chelmsford city centre

2.3 Forecast network congestion

- 2036 Do-minimum volume/capacity (v/c) ratio plots demonstrate that the Chelmsford modelled road network is most congested in the PM peak. However, a number of arterial routes into and out of Chelmsford are shown to exceed capacity across all modelled hours.

- Links with a v/c ratio of 85% or more can be considered to be approaching capacity. It is likely that these links will be affected by rising levels of congestion as the ratio increases. Those shown in the v/c plots as having a ratio exceeding 90% have been highlighted as likely to experience moderate levels of congestion.

- Links that are shown to exceed capacity with a v/c ratio of 100% or more would be expected to experience high levels of congestion and journey-time delay.

- The following routes are shown to exceed capacity in 2036 in the AM, PM and inter peak hours:

    - B1008 Main Road in the vicinity of the junction with Parkway
    - A1060 Rainsford Road in the vicinity of the junction with Parkway
    - A1016 Waterhouse Lane in the vicinity of the junction with Parkway
    - Springfield Road (southern section) & High Bridge Road
    - Victoria Road (eastern section) in the vicinity of Springfield Road
    - Parkway westbound carriageway between New London Road and Market Roundabout
    - Baddow Road in the vicinity of the Army and Navy Roundabout
    - A138 Chelmer Road northbound on the approach to the junction with New Dukes Way (single carriageway section)
    - A12 between junction 17: Howe Green (A130) and junction 19: Boreham Interchange
    - At Wood Street Roundabout (Princes Road Tesco Store)

- The following additional routes are shown to exceed capacity in 2036 in the AM and PM peak hour:

    - B1008 Main Road in Broomfield

- A414 westbound on approach to A12 junction 18
- Pump Lane (North Springfield)

- The following additional routes are shown to exceed capacity in 2036 in the most congested PM peak hour:
  - London Road (Widford Viaduct) approach to Wood Street Roundabout
  - B1007 New London Road southbound between Parkway and Wood Street Roundabout
  - Parkway eastbound between Market Roundabout and the Army and Navy Roundabout
  - Victoria Road between junctions with New Street and Springfield Road
- Based on modelled v/c ratios, by 2036 all main corridor routes into or out of Chelmsford city centre would be expected to experience high levels of congestion in the AM and PM peak hours even without any development specifically modelled in the Chelmsford Administrative Area.

The following pages illustrate the patterns of congestion in the 2036 Do-minimum scenario using screenshots taken from the VISUM model.

When interpreting the VISUM outputs, it should be noted that the length of links in the model defines the length of the colour bars shown on the maps. The length of the bars are not necessarily representative of the extents of network congestion.

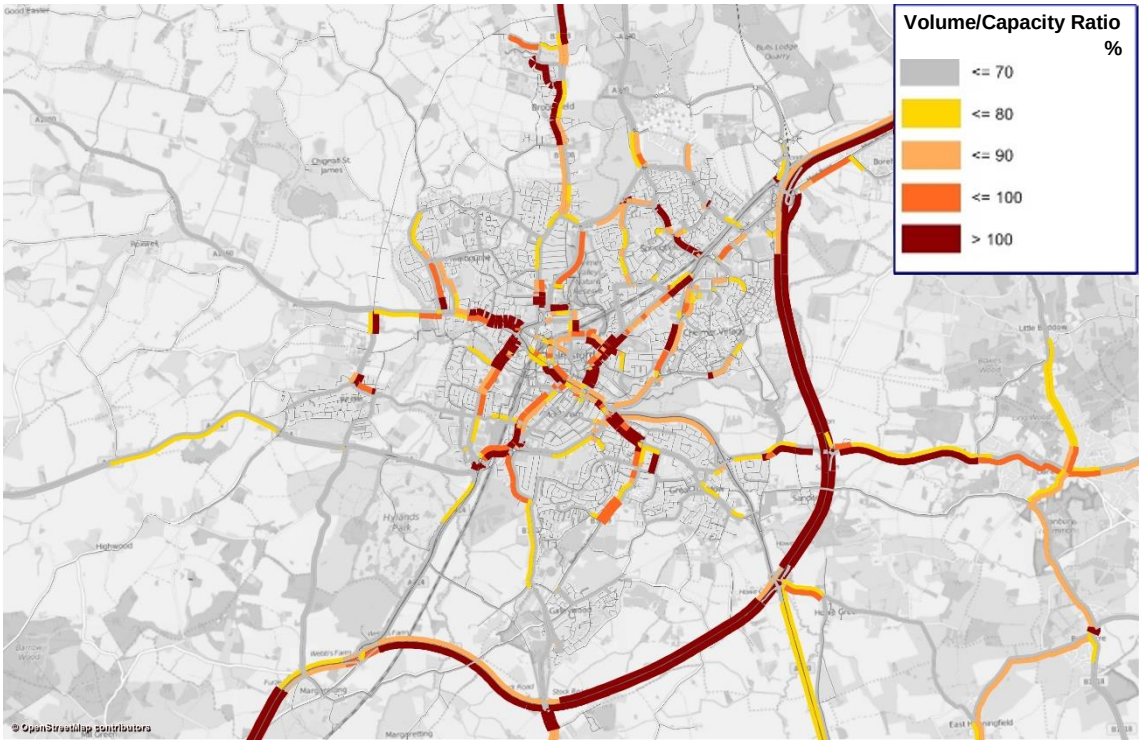


Figure 2.9: 2036 AM Peak 'volume / capacity ratios' – Chelmsford urban area

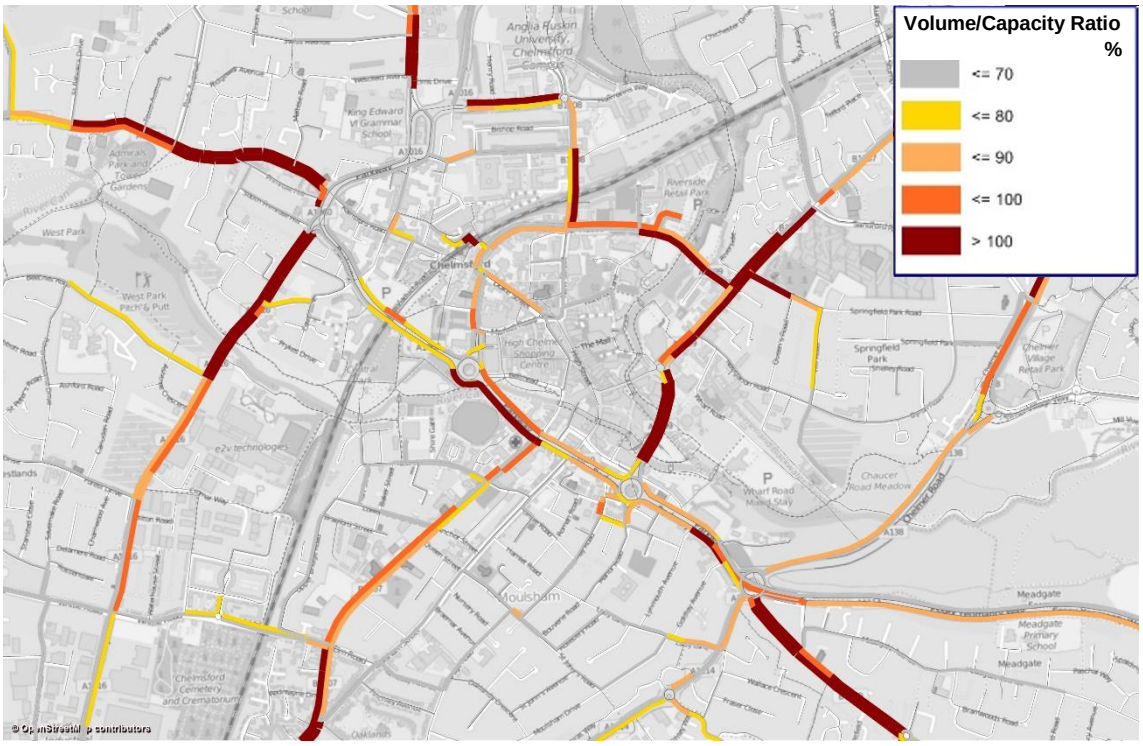


Figure 2.10: 2036 AM Peak 'volume / capacity ratios' – Chelmsford city centre

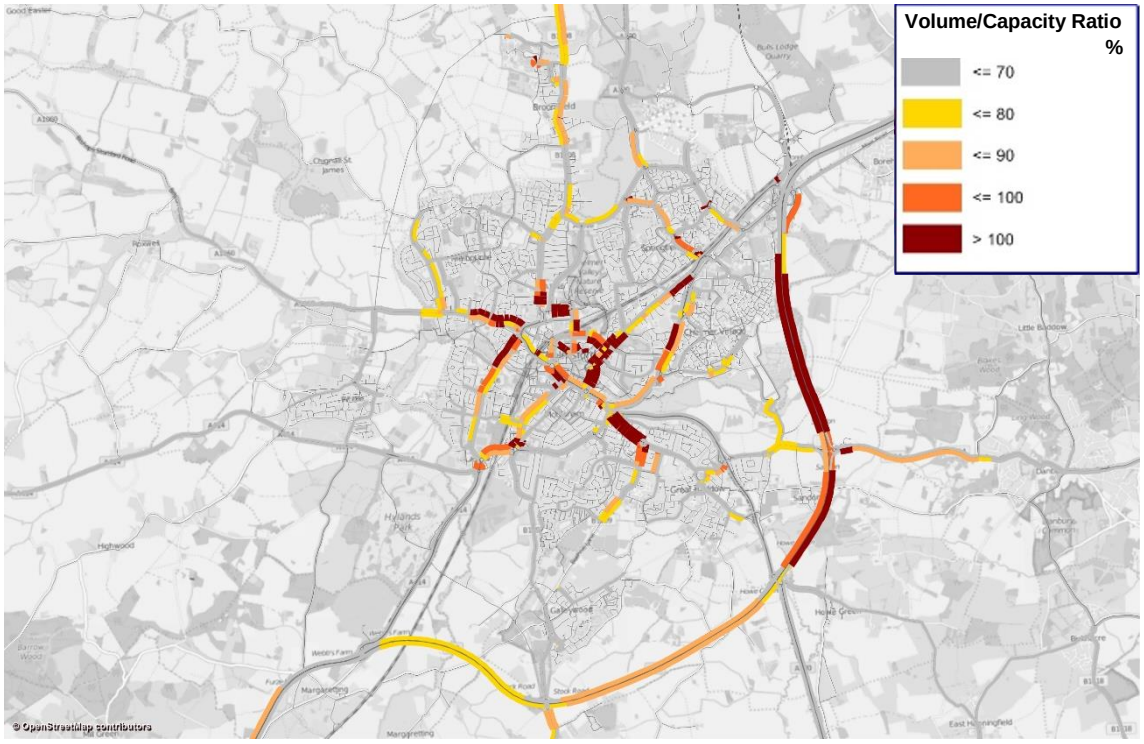


Figure 2.11: 2036 Inter Peak 'volume / capacity ratios' – Chelmsford urban area

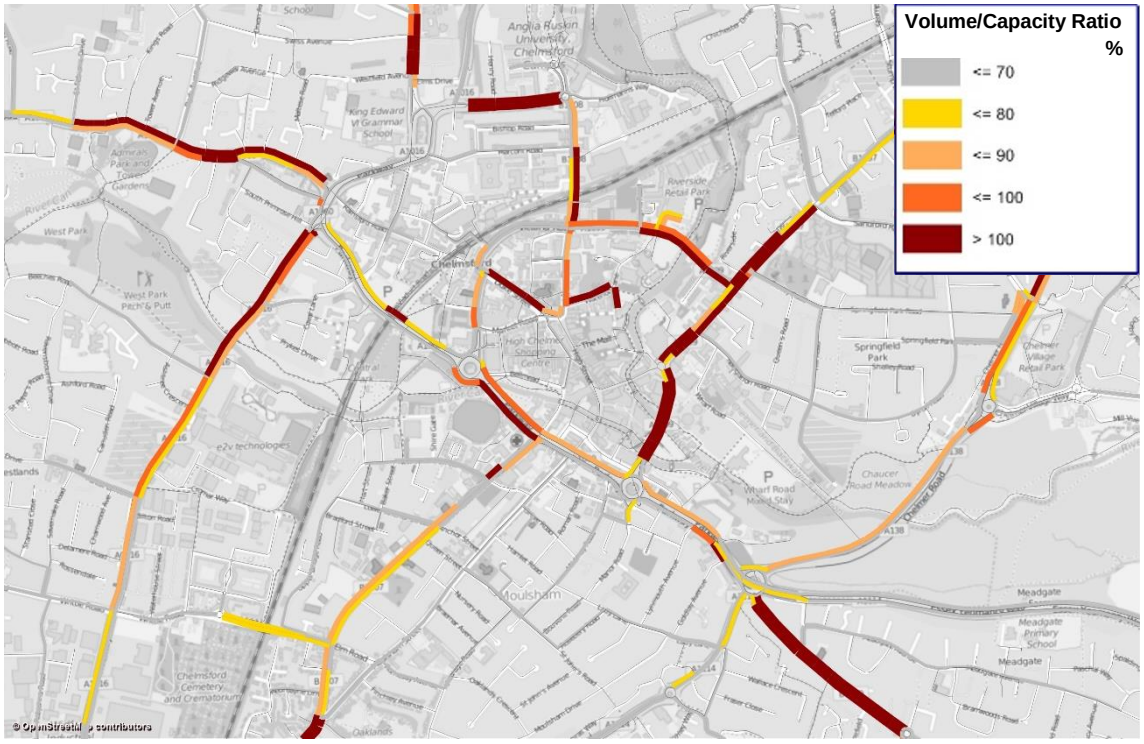


Figure 2.12: 2036 Inter Peak 'volume / capacity ratios' – Chelmsford city centre

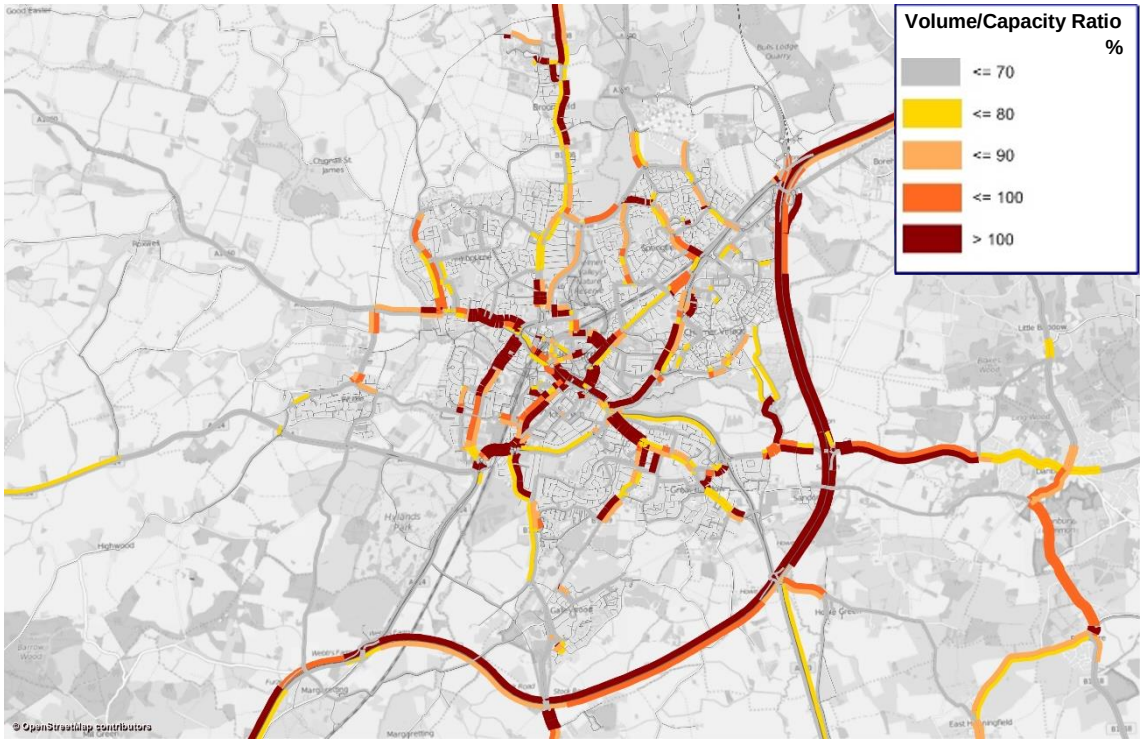


Figure 2.13: 2036 PM Peak 'volume / capacity ratios' – Chelmsford urban area

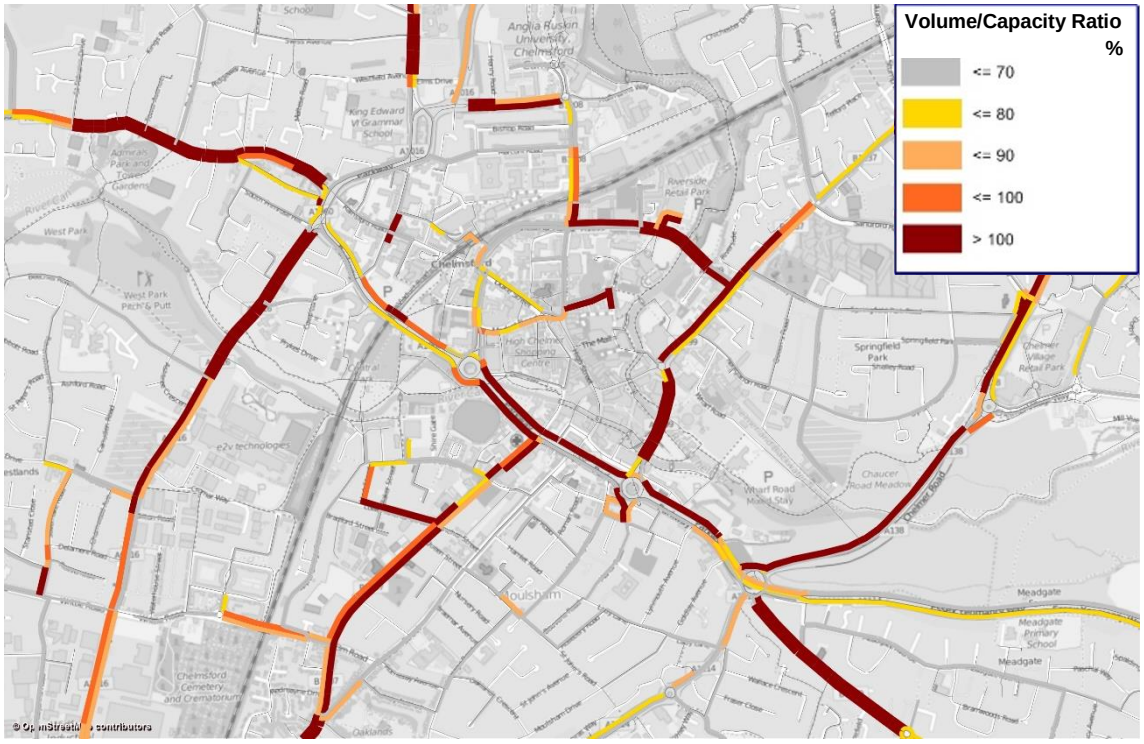


Figure 2.14: 2036 PM Peak 'volume / capacity ratios' – Chelmsford city centre

3 Modelling the Spatial Options

3.1 Spatial Options

The Spatial Options were set out by CCC in their document, Chelmsford Local Plan – Issues and Options Consultation, November 2015[3]. There are three options:

- Option 1 – Urban Focus
- Option 2 – Urban Focus and Growth on Key Transport Corridors
- Option 3 – Urban Focus and Growth in Key Villages

More information about these options can be found in the aforementioned document, whilst copies of the maps produced can be found in Appendix B of this report. The remainder of this section summarises these options in terms of the assumptions used to model their strategic impact on the transport network.

3.1.1 Development location and access

All three options have been modelled using a 2036 forecast year (the end of the Local Plan period) and use the 2036 Do-minimum as the starting point, i.e. they also include the same committed development proposals contained within the current plan period with construction now expected to extend beyond 2021.

Table 3-1 below summarises the additional housing development assumptions used for each option:

Development Locations	Spatial Option Development Allocations		
	1	2	3
Location 1 Chelmsford Urban Area	2,500	2,500	2,500
Location 2 West Chelmsford	3,000	2,500	2,250
Location 3 North Chelmsford (Broomfield)	1,500	1,250	750
Location 4 North East Chelmsford	3,000	2,500	2,250
Location 5 East Chelmsford (East of Great Baddow)		750	500
Location 6 North of South Woodham Ferrers	2,000	1,750	1,250

[3] http://www.chelmsford.gov.uk/sites/chelmsford.gov.uk/files/files/files/documents/files/ISSUES%20AND%20OPTIONS%20CONSULTATION%20DOCUMENT%20NOV%202015.pdf

Development Locations	Spatial Option Development Allocations		
	1	2	3
Location 7 Great Leighs	2,000	1,500	1,000
Location 8 Howe Green			800
Location 9 Rettendon Place		1,250	283 *(=1,700/6)*
Location 10 Boreham			800
Location 11 Danbury			100
Location 12 Bicknacre			100
Location 13 Ford End			283 *(=1,700/6)*
Location 14 Great Waltham			283 *(=1,700/6)*
Location 15 Little Waltham			283 *(=1,700/6)*
Location 16 East Hanningfield			283 *(=1,700/6)*
Location 17 Woodham Ferrers			283 *(=1,700/6)*

Table 3-1: Housing assumptions for Options 1-3

Appendix A shows how these developments have been incorporated into the model zones and where these developments have been assumed to access the road network in terms of the shares between connector nodes used.

Table 3-2 below summarises the additional employment and retail assumptions used for each option:

Development Proposals	Description	Zone System
Greater Beaulieu Business Park	Business Park B1 40,000sqm	Zone 128, Connector Node 1070003953
Location 1 Chelmsford Urban Area	Food Retail 11,500sqm	Split across Zones 1 / 2 / 3 / 4 / 8 / 9 / 10 / 76 using existing distribution
Location 4 North East Chelmsford	Office/Business Park 45,000sqm	Zone 97, Connector Node 1070004286
Location 5 East Chelmsford (East of Great Baddow)	Office/Business Park 5,000sqm in Options 2 and 3 only	Zone 136, Connector Node 574819

Table 3-2: Employment and retail assumptions for Options 1-3

Trips starting or ending outside of the Chelmsford Administrative Area have been controlled to forecasts from the National Trip End Model (NTEM V6.2) as per the Department for Transport's guidance and in the absence of any more up-to-date information at the time of undertaking this work.

3.1.2 Development trip generation and distribution

Vehicle trips to and from the developments by model zone have been calculated based on the assumptions listed above and using the same method as that employed for the Chelmsford Strategic Model initial forecasting as reported in the *Traffic Forecasting Report, Version 2, August 2016*. Zone connector shares have been updated to load the quantities of traffic associated with the development on the assumed connector nodes in the proportions detailed, whilst leaving the quantity of base traffic assigned as per the base model.

The total forecast year trips (base year trips and development trips for each option) have been distributed between start and end points (origins and destination zones) through a Furness process to create the demand matrices for the model. This method is also the same as that employed for the Chelmsford Strategic Model initial forecasting as reported in the *Traffic Forecasting Report, Version 2, August 2016* and uses the distribution from the base model as a starting point.

Fuel and income factors as reported in the *Traffic Forecasting Report, Version 2, August 2016* have been used to grow the vehicle matrices further to account for changes in those variables.

3.1.3 Infrastructure

For these initial runs, no additional changes have been included to the highways network above those included in the 2036 Do-minimum model.

3.1.4 Comparison to Do-minimum 2036

The vehicle matrices for each Spatial Option were run through the 2036 Do-minimum highways network. Models were then reviewed and results analysed. The remainder of this chapter summarises the results for each time period (AM peak hour, IP hour, PM peak hour) focussing on:

- Impact on traffic flows – analysis of vehicle flow differences between each Option and the Do-minimum development scenario

- Impact on network congestion – analysis of volume over capacity ratios for each Spatial Option – including a review of the relative impact of the three Options on levels of congestion in Chelmsford

Analysis has been supported through the use of VISUM model screenshots. More detailed volume over capacity plots have been placed in Appendix C of this report.

3.2 Spatial Option 1

3.2.1 Impact on forecast traffic flows: Summary Analysis

With the addition of Local Plan development, the most significant increases in modelled traffic flow are shown on key links in Chelmsford that are common across all Spatial Options. The routes are listed below for Option 1, with flow comparisons between the Options highlighted in grey:

- An increase in eastbound traffic flow along **A1060 Roxwell Road** and Rainsford Road, with the biggest increase modelled in the inter peak.
    - *Flow increase is shown to be highest in Option 2 and lowest in Option 3.*

- An increase in traffic flow along **Lordship Road** through **Writtle**, with the biggest increase modelled northbound in the PM peak.
    - *Flow increase is shown to be highest in Option 1 and lowest in Option 3.*

- An increase in traffic flow northbound on the **A138 Chelmer Road** in the vicinity of the Boreham Interchange in inter peak and PM peak.
    - *IP flow increase is higher in Option 1 than in Options 2 & 3.*
    - *PM flow increase is highest in Options 2 & 3.*

- A notable increase in inter peak traffic flows along **Parkway**, the **A12, A138 Chelmer Road** and **B1008 Main Road (Broomfield)**. These are higher than in the AM and PM peak hours due to greater availability of capacity on the road network.
    - *Flow increases along Parkway, A12 and A138 are highest in Options 2 & 3.*
    - *Flow increases along B1008 Main Road shown to be highest in Option 2 and lowest in Option 3.*

- An increase in traffic flow along **Valley Bridge** in the PM peak in both directions.
    - *WB flow increase is comparable across Options 1, 2 & 3.*
    - *EB flow increase is higher in Option 1 than in Options 2 & 3.*

- An increase in traffic flow along the **A1114 Baddow Bypass**, most notably in the PM peak in both directions.
    - *PM flow increase is highest in Option 2 – which also has a high flow increase in the AM peak.*
    - *Flow increase in Option 3 differs across the peak hours but overall is closer in comparison to Option 1.*

- A significant increase in traffic flow routing along **Lawn Lane** – particularly northbound in the PM peak.
    - *PM flow increase in highest in Option 1 and lowest in Option 3.*
    - *AM flow increase is highest Option 2 and lowest in Option 3.*
    - *Option 3 shows a wider spread of traffic flow through N. Springfield.*

At the same time, the addition of Local Plan development is shown to lead to a reduction in vehicle flow on some key routes in the modelled area of Chelmsford. This reduction is understood to be the result of 'upstream' congestion on the network resulting in the re-routing of vehicle trips away from certain links.

We would, however, advise caution when considering flow reductions associated with development growth. Use of a fixed demand model arguably presents a 'worst-case' scenario of high traffic flows and network congestion. This provides the conditions in the model to facilitate downstream reductions in vehicle numbers. It is likely that variable demand modelling will reduce the quantity of traffic in congested areas of the network, thus reducing in turn the impact of upstream bottlenecks and associated traffic flow reduction. While traffic reassignment may still occur as a consequence of congestion, it might be expected that any improvement in traffic conditions would be negated by surrounding supressed traffic flow returning.

Nevertheless, analysis of larger flow reductions can help to identify the causes of traffic reassignment in the model which can be attributed to an increase in development traffic. Notable examples of modelled traffic flow reductions shown with Spatial Option 1 and which are common across all Options are as follows:

- Along the **A1016 Chelmer Valley Road** in the PM peak. This appears to be the result of an increase in flow and subsequent congestion along the A1060 Rainsford Road and (to a lesser extent) the A1016 Waterhouse Lane approaches to Parkway.
    - The increase in flow along the A1060 Rainsford Road is likely to be impacted by development trips associated with proposed housing to the West of Chelmsford.

- As a result, vehicles travelling between the west/south-west of Chelmsford and the north of the city are shown in the model to use alternative routes through Melbourne and Broomfield – particularly utilising Valley Bridge Road.

  Flow reductions are greatest in Option 2 and similar between Options 1 and 3.

- Westbound along the **A1060 Roxwell Road**, west of the junction with Lordship Road in the AM and PM peaks. This reduction appears to be the result of a wider re-routing of longer-distance trips away from the A1060 due to an increase in local trips associated with proposed housing developments in the west of Chelmsford.

  Flow reductions are greatest in Option 1 and similar between Options 2 and 3.

- Northbound from the A12 to the **Radial Distributor Road** around the Beaulieu Park development in the AM and (to a greater extent) PM peak. Modelling suggests that congestion along the A12 is resulting in Beaulieu Park development trips accessing the site via routes through Springfield to Essex Regiment Way as an alternative.

  Flow reductions are greatest in Option 1 and similar between Options 2 and 3.

3.2.2 Impact on forecast traffic flows – Flow change from Do-Minimum to Option 1

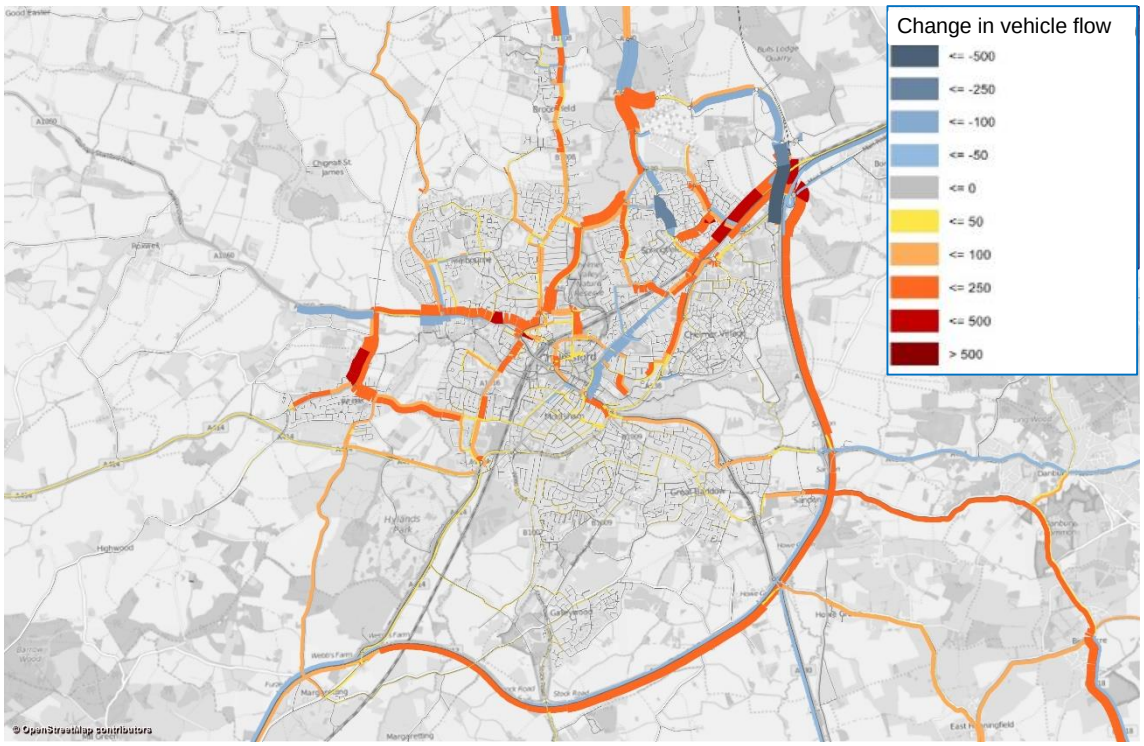


Figure 3.1: 2036 AM Peak 'actual' link-flow change from Do Min to Option 1 – Chelmsford urban area

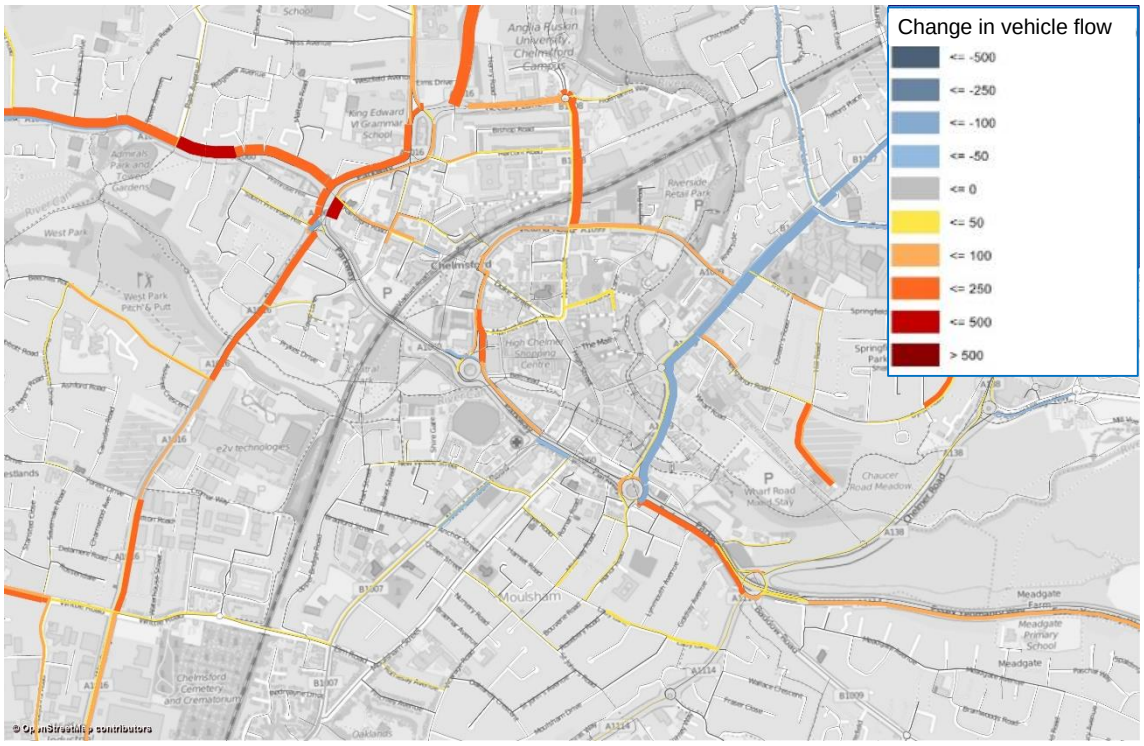


Figure 3.2: 2036 AM Peak 'actual' link-flow change from Do Min to Option 1 – Chelmsford city centre

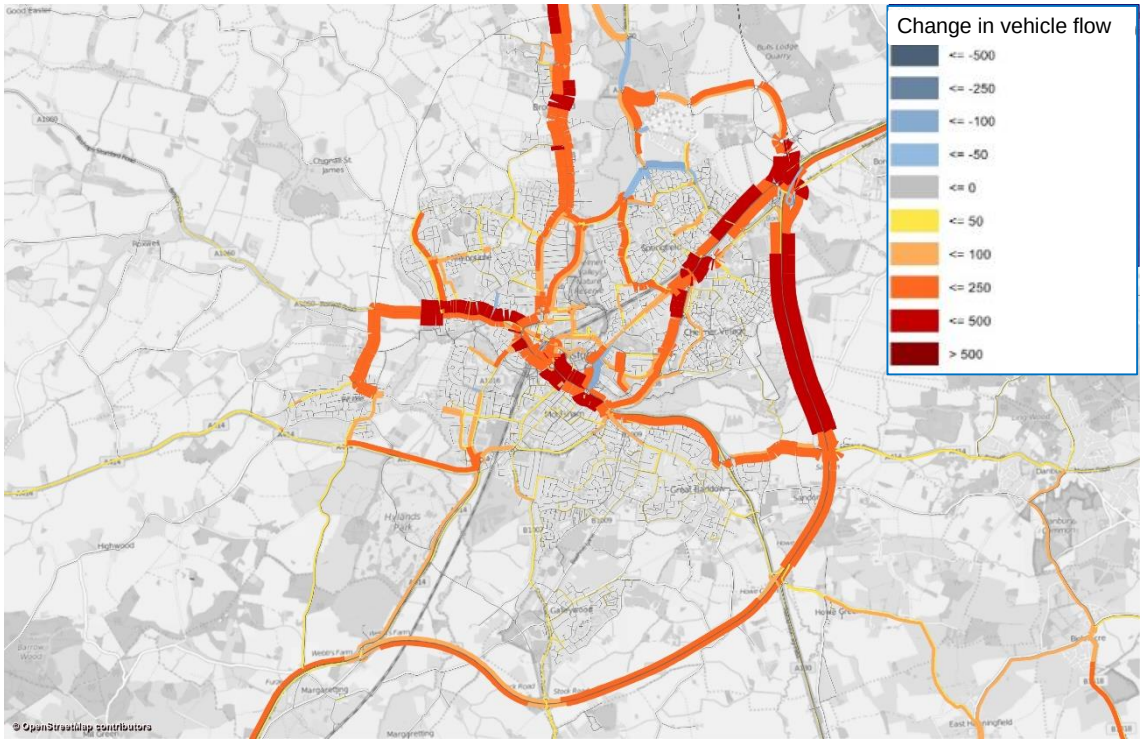


Figure 3.3: 2036 Inter Peak 'actual' link-flow change from Do Min to Option 1 – Chelmsford urban area

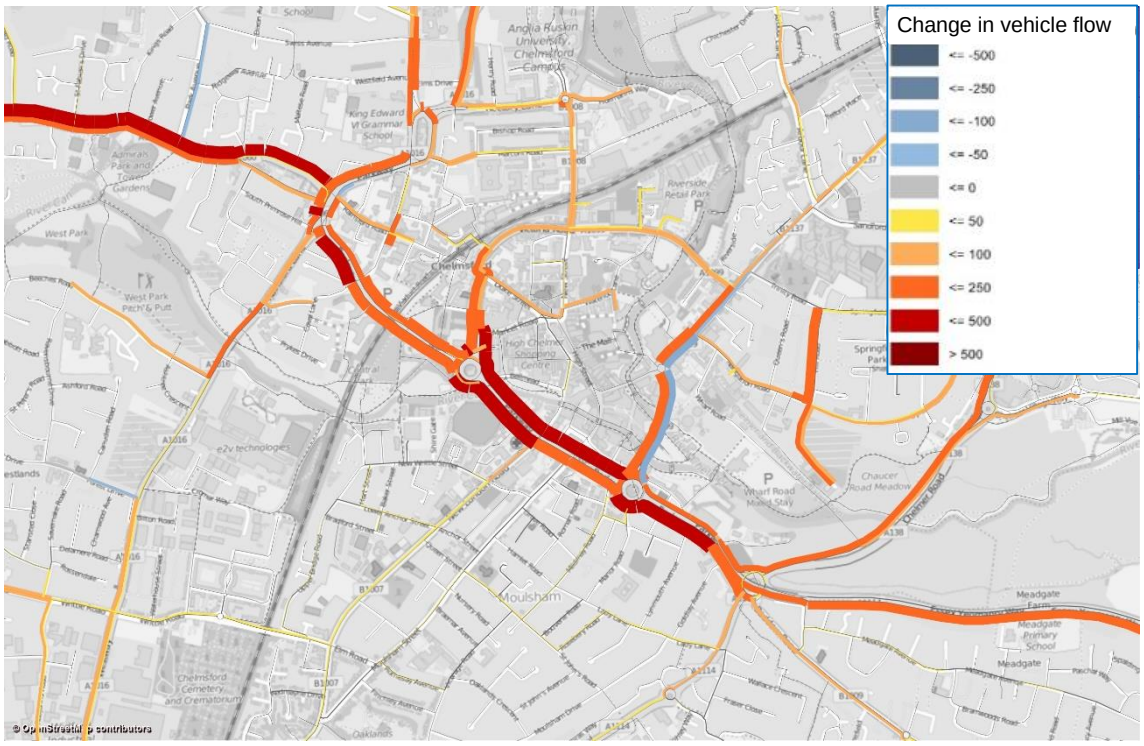


Figure 3.4: 2036 Inter Peak 'actual' link-flow change from Do Min to Option 1 – Chelmsford city centre

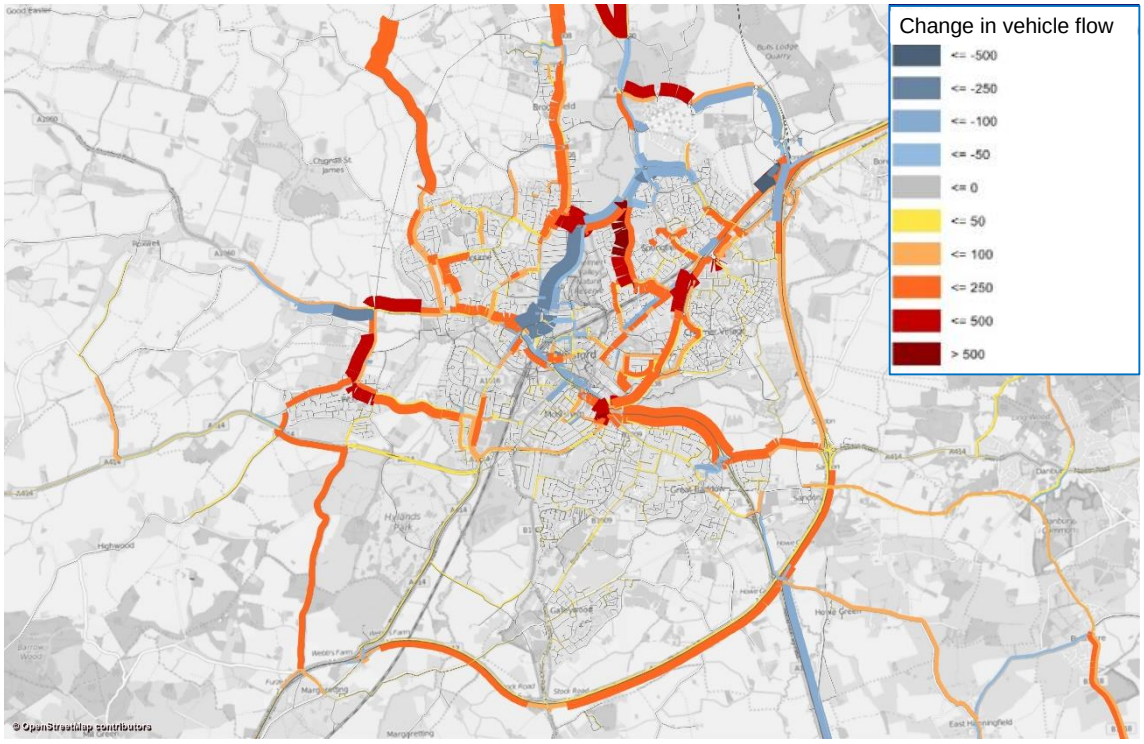


Figure 3.5: 2036 PM Peak 'actual' link-flow change from Do Min to Option 1 – Chelmsford urban area

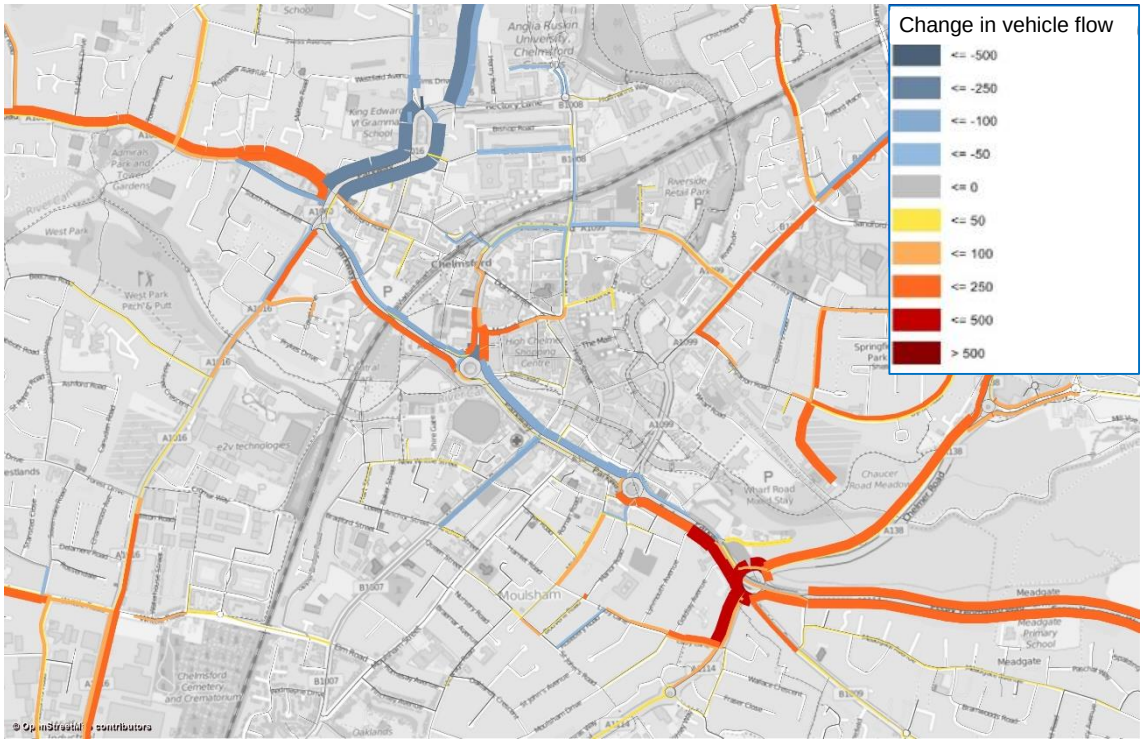


Figure 3.6: 2036 PM Peak 'actual' link-flow change from Do Min to Option 1 – Chelmsford city centre

3.3 Spatial Option 2

3.3.1 Impact on forecast traffic flows: Summary Analysis

With the addition of Spatial Option 2 Local Plan development, the most significant increases in modelled traffic flow are shown on the same key links in Chelmsford as identified in Options 1 and 3. On these links, traffic flow increases are, on the whole, shown to be the greatest in Option 2.

Further flow increases are noted in Option 2 which are not identified in Option 1 (comparisons with Option 3 are highlighted in grey):

- An increase in traffic flow southbound along **Beeleigh Link** in the PM peak and along **Springfield Park Lane** in the AM and PM peaks.
  - *PM flow increase along Beeleigh Link is comparable with Option 3.*
  - *PM flow increase along Springfield Park Lane is highest in Option 3.*

- An increase in traffic flow southbound along **Springfield Road, High Bridge Road** and eastbound along **Parkway** in the AM peak.
  - *Not observed to the same extent in Option 3.*

The addition of Spatial Option 2 Local Plan development is also shown to lead to a reduction in vehicle flow on some key routes in the modelled area of Chelmsford. Again, this reduction is understood to be the result of 'upstream' congestion on the network resulting in the re-routing of vehicle trips away from certain links.

Notable examples of modelled traffic flow reductions specifically identified in Option 2 - but which are apparent to a lesser extent in Option 3 - are as follows:

- Along the **A138 Chelmer Road** southbound on the approach to the junction with Chelmer Village Way in the PM peak, with traffic switching to an alternative route via Beeleigh Link.

- Along **Springfield Road** northbound after the signalised junction with Victoria Road in the PM peak, with traffic switching to alternative routes via Byron Road and Springfield Park Lane to avoid congestion.

3.3.2 Impact on forecast traffic flows – Flow change from Do-Minimum to Option 2

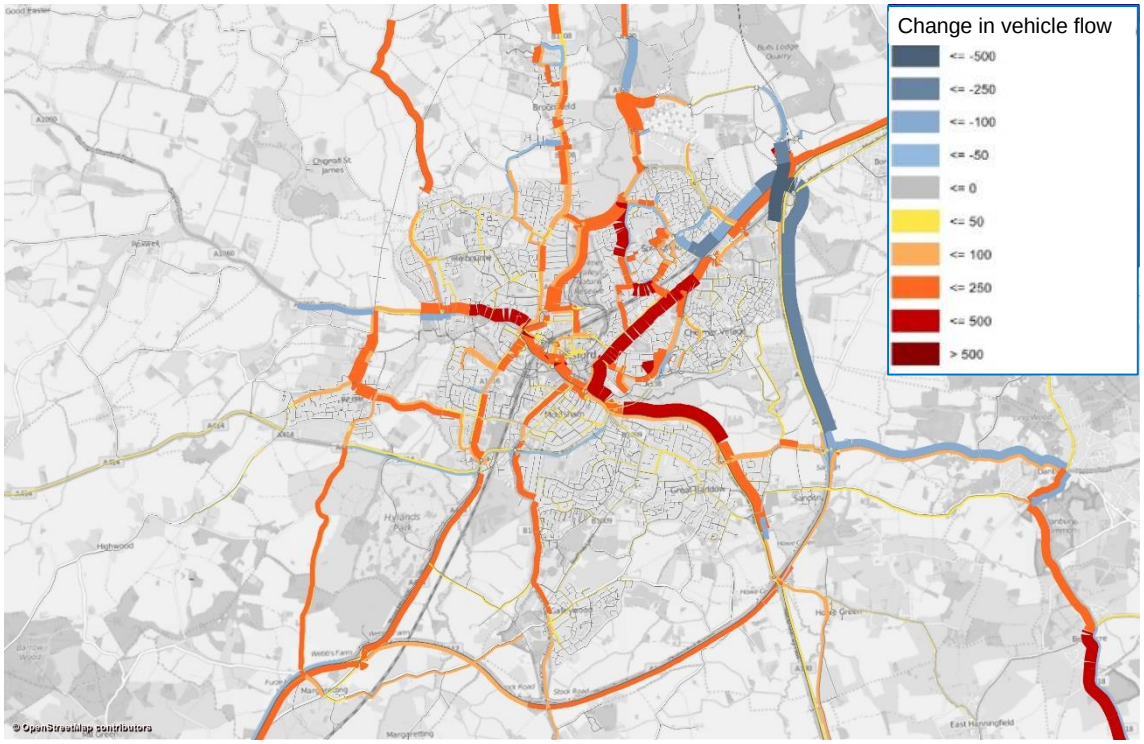


Figure 3.7: 2036 AM Peak 'actual' link-flow change from Do Min to Option 2 – Chelmsford urban area

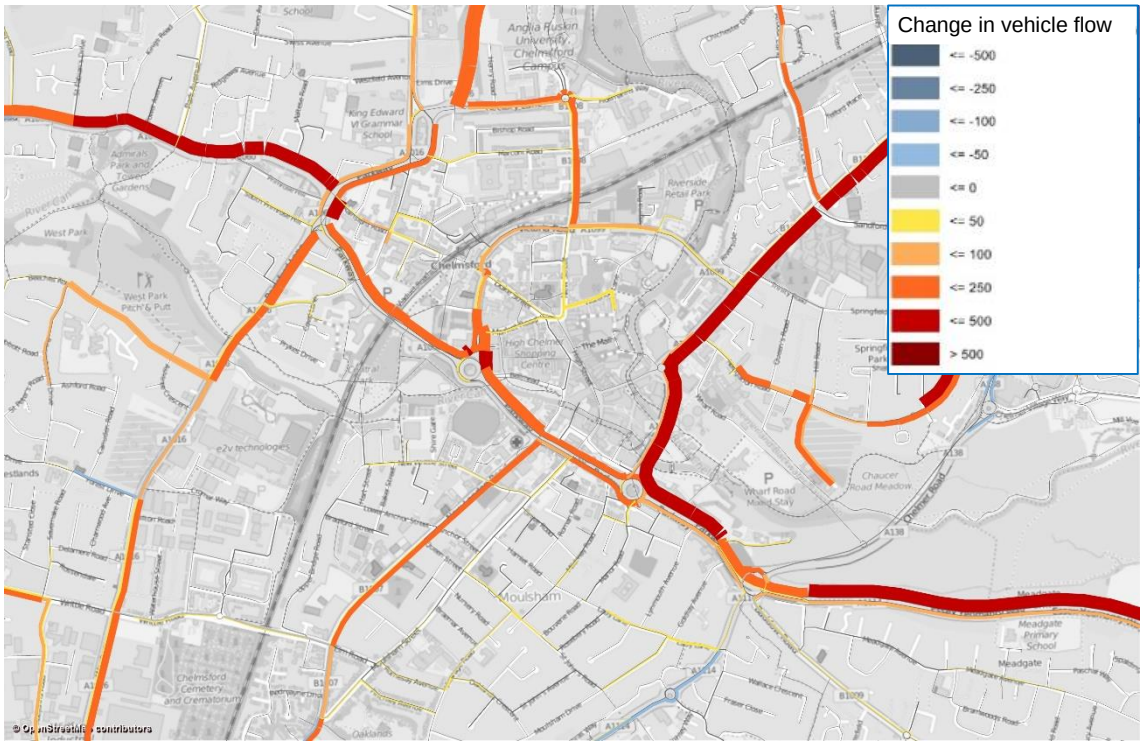


Figure 3.8: 2036 AM Peak 'actual' link-flow change from Do Min to Option 2 – Chelmsford city centre

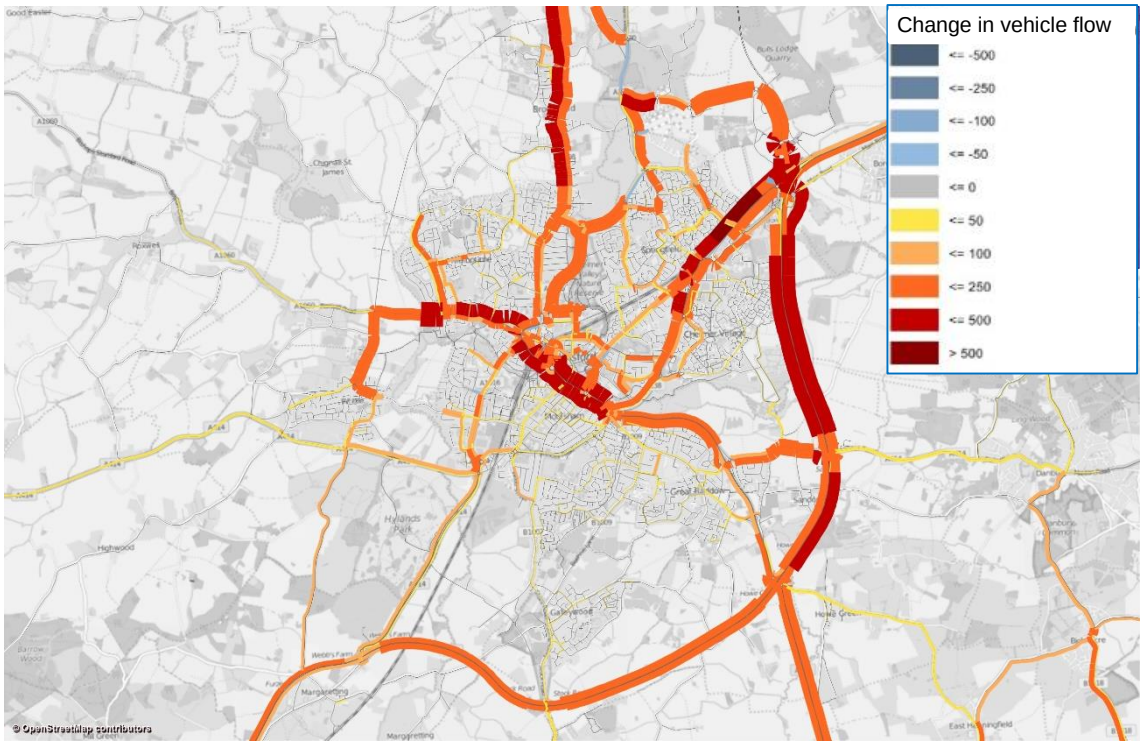


Figure 3.9: 2036 Inter Peak 'actual' link-flow change from Do Min to Option 2 – Chelmsford urban area

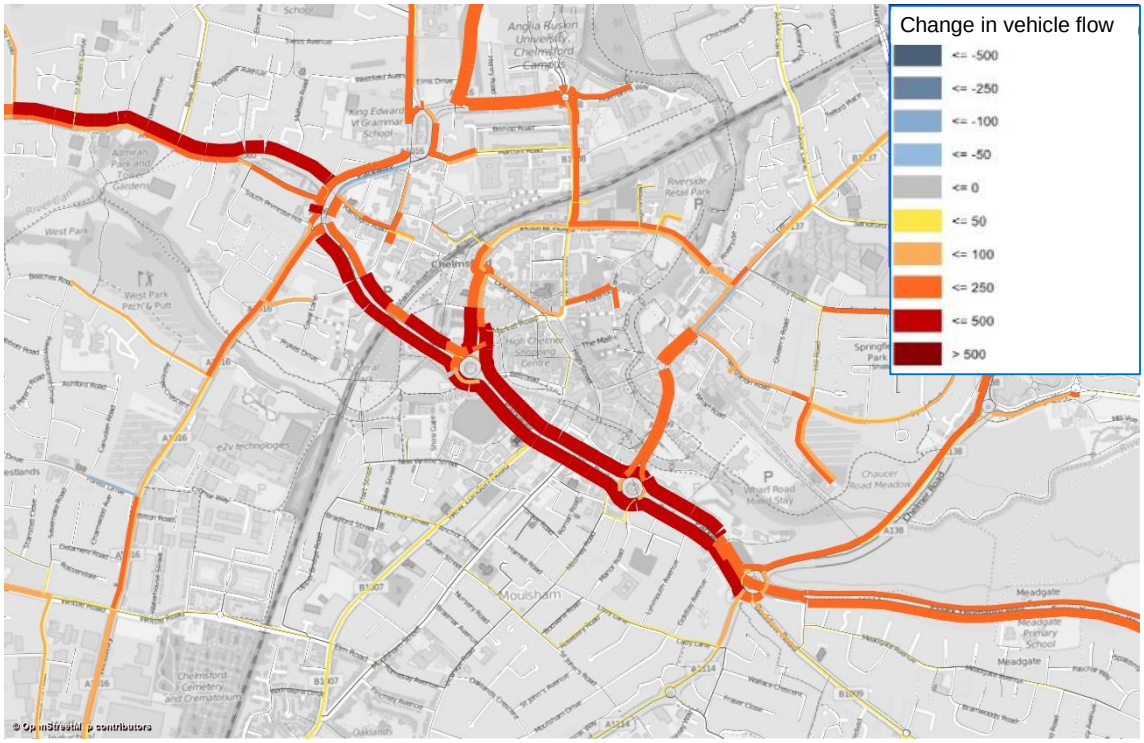


Figure 3.10: 2036 Inter Peak 'actual' link-flow change from Do Min to Option 2 – Chelmsford city centre

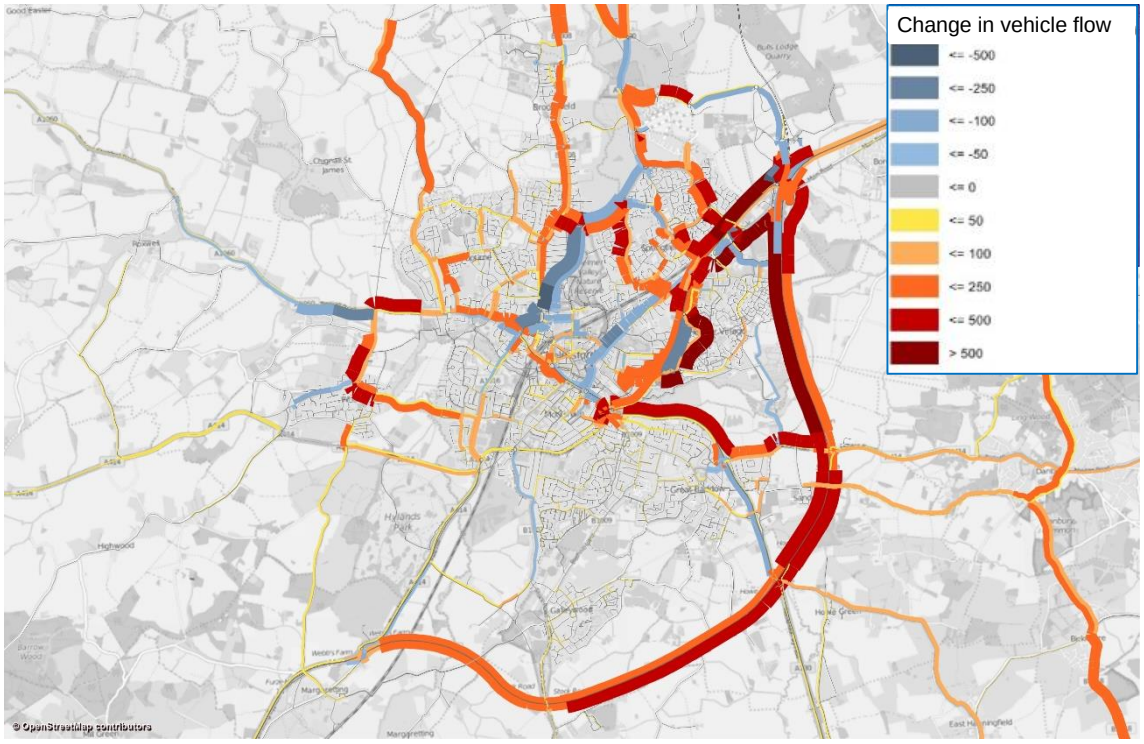


Figure 3.11: 2036 PM Peak 'actual' link-flow change from Do Min to Option 2 – Chelmsford urban area

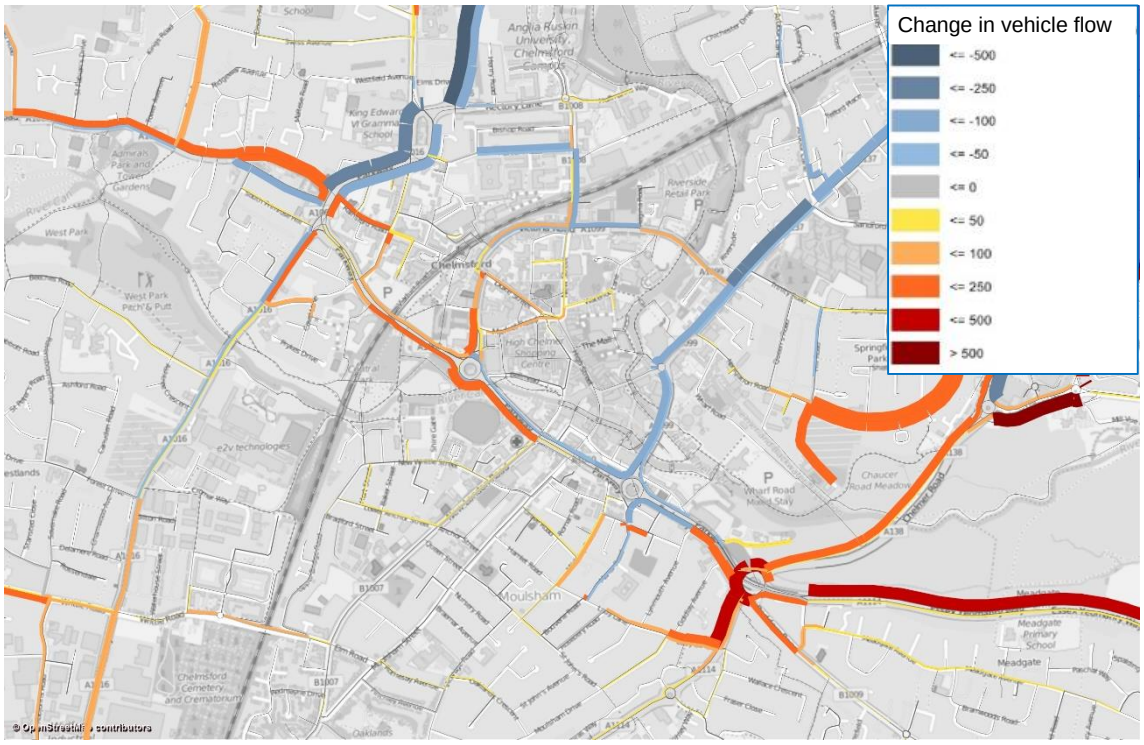


Figure 3.12: 2036 PM Peak 'actual' link-flow change from Do Min to Option 2 – Chelmsford city centre

3.4 Spatial Option 3

3.4.1 Impact on forecast traffic flows: Summary Analysis

With the addition of Spatial Option 3 Local Plan development, the most significant increases in modelled traffic flow are shown on the same key links in Chelmsford as identified in Options 1 and 2.

The patterns of change in forecast traffic flows in Option 3 are comparable to those in Option 2, but occur to a lesser extent.

A review of the Option 3 flow difference plots suggests that no additional routes in Chelmsford experience a significant increase or decrease in traffic flow attributable to Option 3 development.

Despite the spread of development across outer villages associated with Option 3, the distribution of trips suggests that there will still be an impact on city centre traffic flows commensurate with the other Spatial Options – either directly along corridor routes into town, or indirectly by adding to A12 traffic flows and diverting other vehicle trips towards city centre routes.

3.4.2 Impact on forecast traffic flows – Flow change from Do-Minimum to Option 3

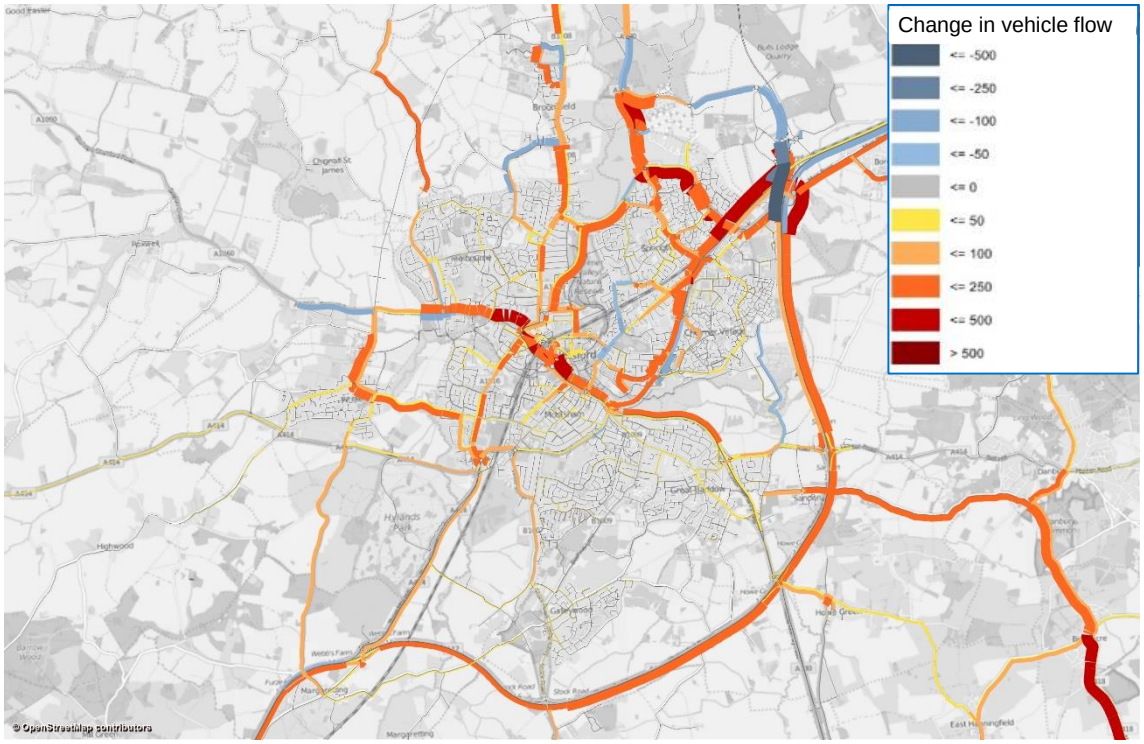


Figure 3.13: 2036 AM Peak 'actual' link-flow change from Do Min to Option 3 – Chelmsford urban area

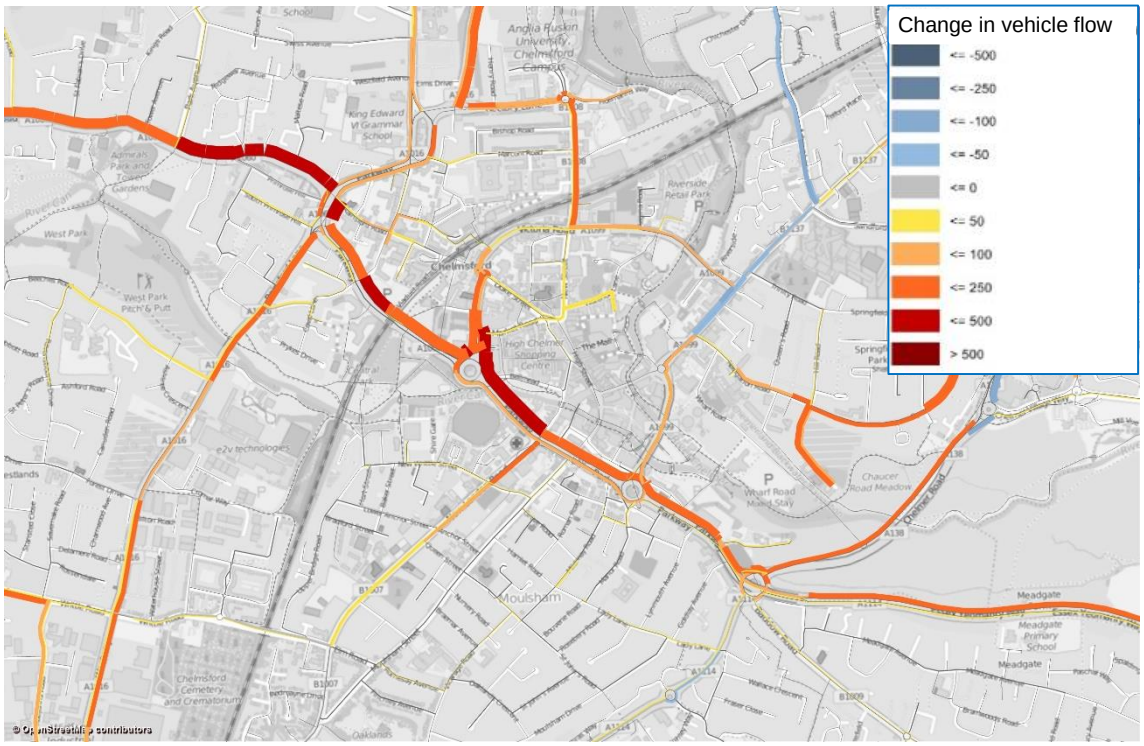


Figure 3.14: 2036 AM Peak 'actual' link-flow change from Do Min to Option 3 – Chelmsford city centre

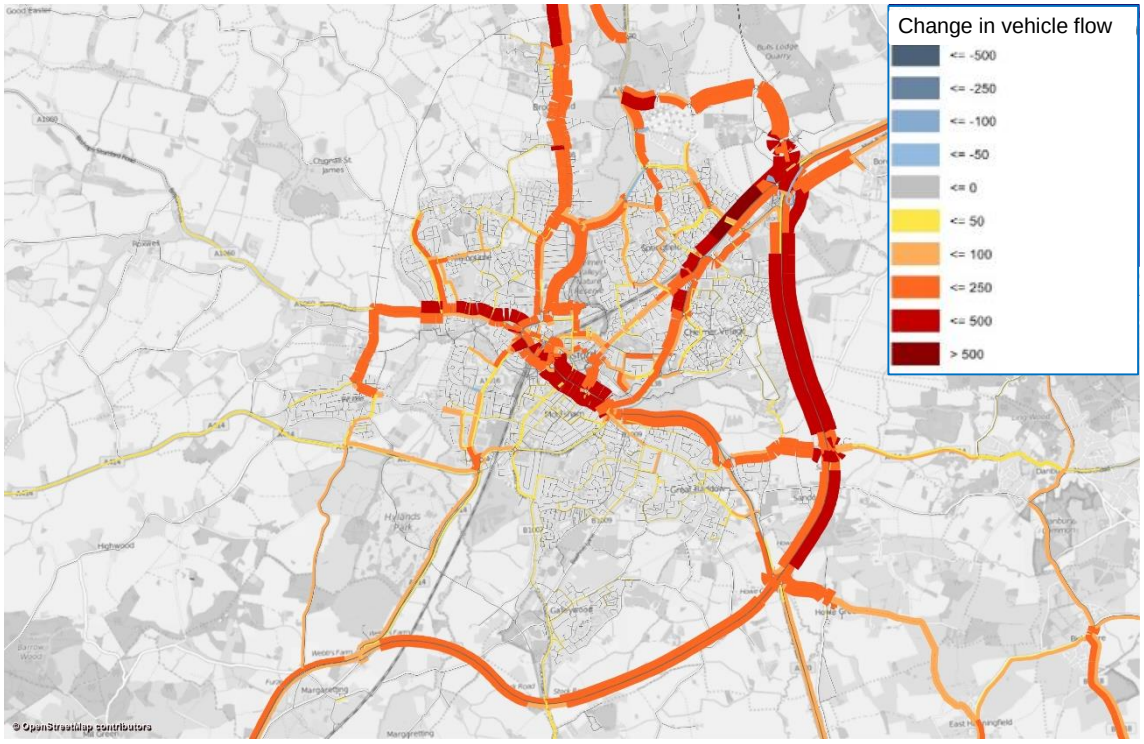


Figure 3.15: 2036 Inter Peak 'actual' link-flow change from Do Min to Option 3 – Chelmsford urban area

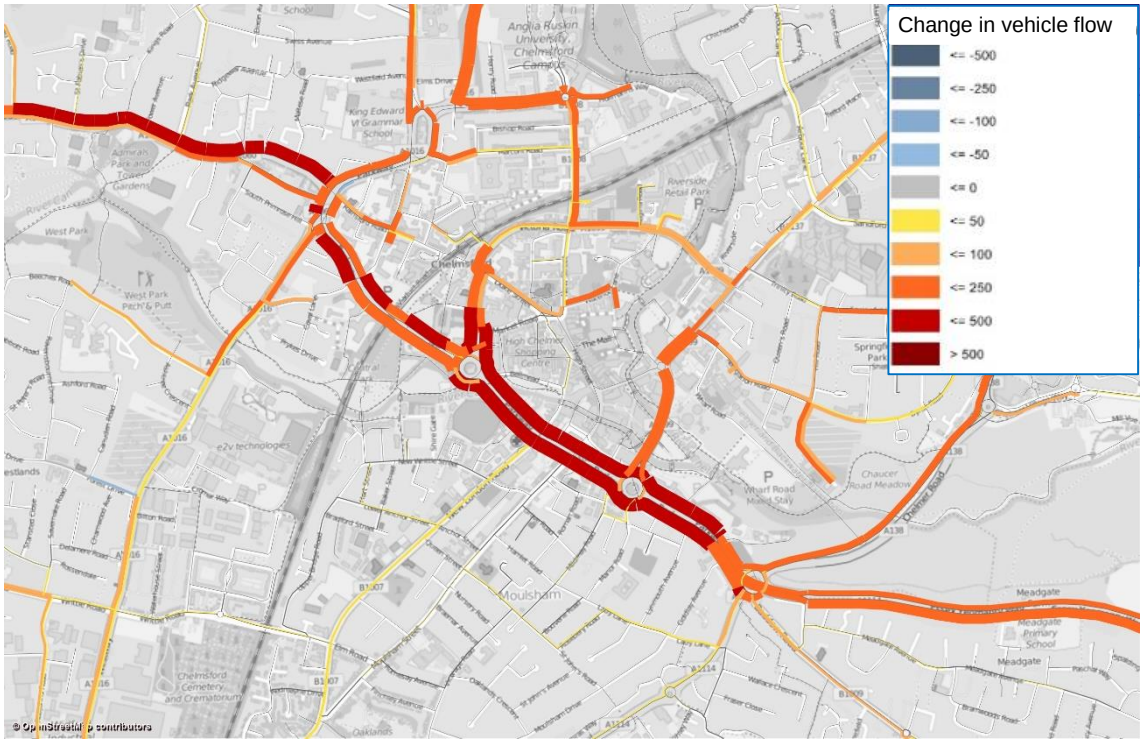


Figure 3.16: 2036 Inter Peak 'actual' link-flow change from Do Min to Option 3 – Chelmsford city centre

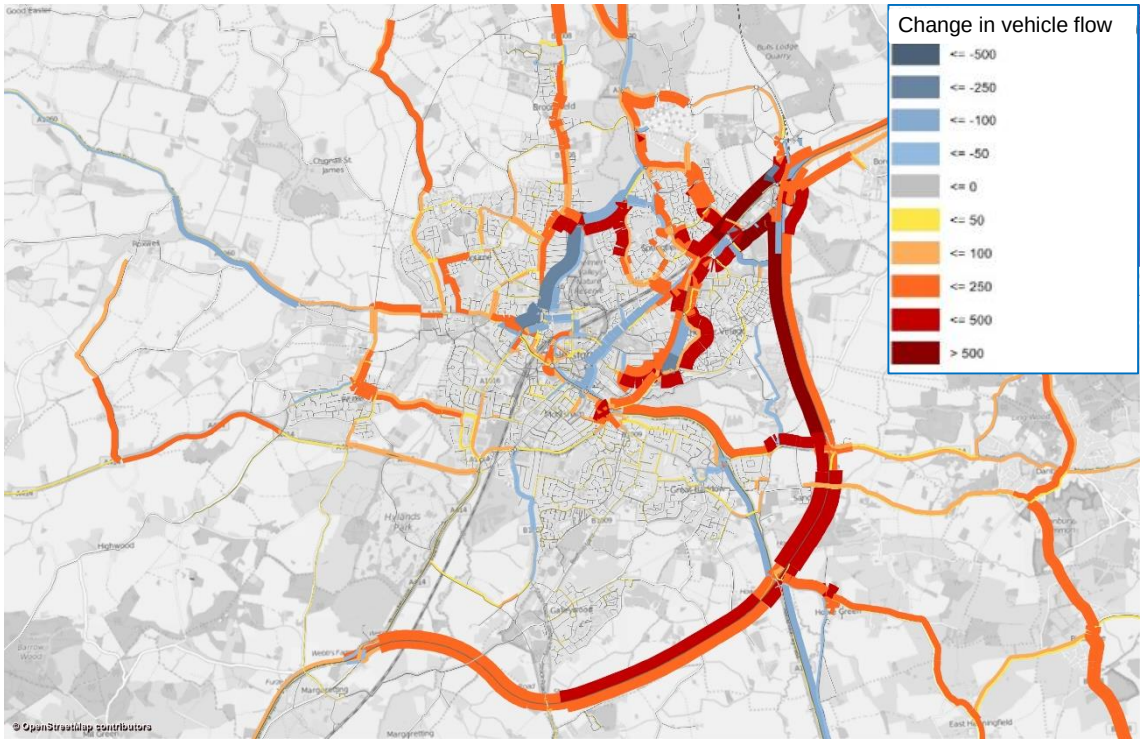


Figure 3.17: 2036 PM Peak 'actual' link-flow change from Do Min to Option 3 – Chelmsford urban area

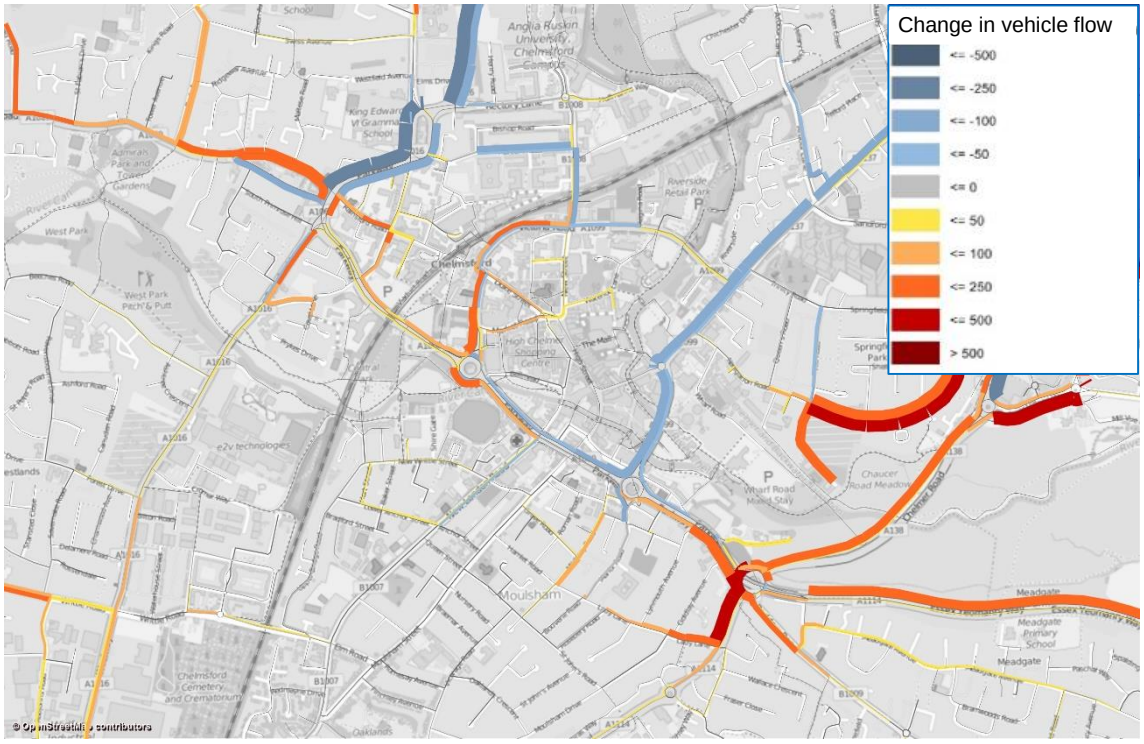


Figure 3.18: 2036 PM Peak 'actual' link-flow change from Do Min to Option 3 – Chelmsford city centre

3.5 Impact on network congestion: Summary Analysis

Table 3-3 and Table 3-4 on the following pages summarise the comparative impact of the three Spatial Options on congestion in Chelmsford. Analysis is focussed on the ranking of Options based on their highway impact on:

- Sectors of Chelmsford – covering local routes in the city centre and agglomerated settlements within the surrounding urban area
- Key urban corridors and strategic routes in and around the urban area of Chelmsford

Analysis has been based on a high-level review of the peak hour volume over capacity plots that can be found in Appendix C of this report.

Key findings from this review are as follows:

- Overall differences in network congestion across the three Spatial Options is shown in the modelling to be relatively small.
- Existing network congestion in 2036 and subsequent wide-scale route reassignment appears to neutralise the variability in the impact of each Spatial Option across the wider road network.
- The comparative impact of each Option is shown to be influenced by the extent of congestion along strategic links and corridor routes into the city centre – with increases in delay shown to result in a reassignment of traffic to local routes.
- Consequently, it is difficult to establish firm conclusions regarding the relative impact of each Spatial Option tested. Nevertheless, analysis of results indicates that:
    - Option 1 appears to have the lowest overall impact on the levels of congestion on local routes across Chelmsford, despite having the highest overall impact in areas to the west of the city centre.
    - Although there are differences between peak hours, there is little overall variation in network impact between Options 2 and 3.
    - However, Option 3 is shown to have the highest overall impact on local routes in the city centre.

- There is little variability across the Spatial Options in the levels of congestion modelled along strategic routes and corridors in Chelmsford. Again, this is likely due to the extent of congestion modelled along these routes in the Do-minimum scenario.

- Direct analysis of Table 3-4 provides a degree of insight into the impact of the Spatial Options on levels of congestion modelled along individual strategic and corridor routes. However, these results should be considered alongside the sector-based results in order to build a better picture of network congestion and local route-reassignment.

	AM peak			Inter peak			PM peak		
Sector	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3
North East (Springfield, Boreham)	1	3	2	2	1	3	1	3	2
North West (Broomfield, Melbourne)	1	3	2	3	2	1	3	2	1
City Centre	1	2	3	1	=2	=2	1	2	3
South East (Great Baddow)	1	3	2	1	=2	=2	1	2	3
South West (Widford)	3	1	2	=1	=1	2	1	3	2
West (Writtle)	=1	=1	=1	2	=1	=1	3	1	2

Table 3-3: Ranking of Spatial Options based on comparative extent of network congestion impact in sectors of Chelmsford

1 (Green) = Least overall impact on road network 3 (Red) = Most overall impact on road network

		AM peak			Inter peak			PM peak		
Corridor	**Direction**	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3
B1008 - Main Road (Broomfield)	Inbound	1	=2	=2	=1	=1	=1	=1	2	=1
	Outbound	=1	=1	=1	=2	=2	1	=2	=2	1
A1016 - Chelmer Valley Road	Inbound	1	3	2	2	=1	=1	=1	=1	=1
	Outbound	=2	=2	1	=1	=1	=1	=1	=1	=1
A138 - Chelmer Road	Inbound	2	=1	=1	=1	2	=1	=2	=2	1
	Outbound	=2	1	=2	=1	=1	=1	3	2	1
A12	Clockwise	=1	=1	=1	=1	=1	=1	=1	=1	=1
	Anticlockwise	=1	2	=1	=1	=1	=1	=1	=1	=1
A1114 - Essex Yeomanry Way (Baddow Bypass)	Inbound	2	=1	=1	=1	=1	=1	=1	=1	2
	Outbound	=1	2	=1	=1	=1	=1	=1	=1	2
A1060 - Parkway	Westbound	3	2	1	1	=2	=2	1	=2	=2
	Eastbound	2	3	1	2	=1	=1	1	2	3
B1009 - Baddow Road	Inbound	=1	=1	=1	1	=2	=2	=1	=1	=1
	Outbound	1	3	2	1	=2	=2	1	=2	=2
B1007 - New London Road	Inbound	3	=2	=2	3	1	2	1	=2	=2
	Outbound	=1	2	=1	2	=1	=1	1	2	3
A1016 - Waterhouse Lane	Inbound	=1	=1	=1	2	=1	=1	=1	=1	=1
	Outbound	=1	=1	=1	=2	=2	1	3	2	1
A1060 - Rainsford Road	Inbound	=1	=1	=1	1	=2	=2	=2	1	=2
	Outbound	1	=2	=2	=1	=1	=1	2	=1	=1

Table 3-4: Ranking of Spatial Options based on comparative extent of network congestion impact along key urban corridors and strategic routes in Chelmsford

1 (Green) = Least overall impact on road network 3 (Red) = Most overall impact on road network

4 Modelling the Spatial Options with Infrastructure Provision

4.1 Modelling infrastructure provision

Each of the spatial options identified in the *Chelmsford Local Plan – Issues and Options Consultation, November 2015* has then been modelled with the addition of the infrastructure outlined in Table 4-1 below:

Infrastructure	Description
Eastern Gateway Access Road	Road linking Navigation Road or High Bridge Road to Chelmer Viaduct via Chelmer Waterside providing an eastern gateway route into City Centre
Potential Western Relief Road	Testing of a new single carriageway relief road link between the A414 west of Writtle to junction of B1008/A130 and A131 (Sheepcotes Junction)
A132 dualling	Dualling of A132 between junction with B1418 and A130
Additional Park and Ride in NE Chelmsford	Potential location to be tested at J19 A12 Boreham Interchange
Additional Park and Ride in West Chelmsford	Potential location to be tested on A414 between Widford Roundabout and Margaretting Road.

Table 4-1: Additional infrastructure modelled

Modelling also includes the proposed Chelmsford North East Bypass connecting the A130 at Great Leighs with the A12 at the Boreham Interchange[4].

For these model runs, the same development assumptions (matrices) have been used as those described in the previous chapter with the adjustments applied for the proposed new Park and Ride sites as described below. Additional access points (connector nodes) have, however, been added to link into the additional infrastructure (i.e. proposed Western Relief Road). These are as follows:

Development Location	Model Zones and Connector Nodes
Location 2 West Chelmsford	Zone 146, Connector Nodes 1070104628, 1070104585, 1070104581

[4] Based on the Design Freeze A scheme design documented in 'Chelmsford North East Bypass – Scheme Review Report: Volume 1' Jacobs, 12th November 2015

Location 3 North Chelmsford (Broomfield)	Zone 87, Connector Node 1070104592

Table 4-2: Additional access points used for modelling infrastructure provision

The following map shows these zones and additional access points along with the indicative location of the Western Relief Road that has been used in the modelling.

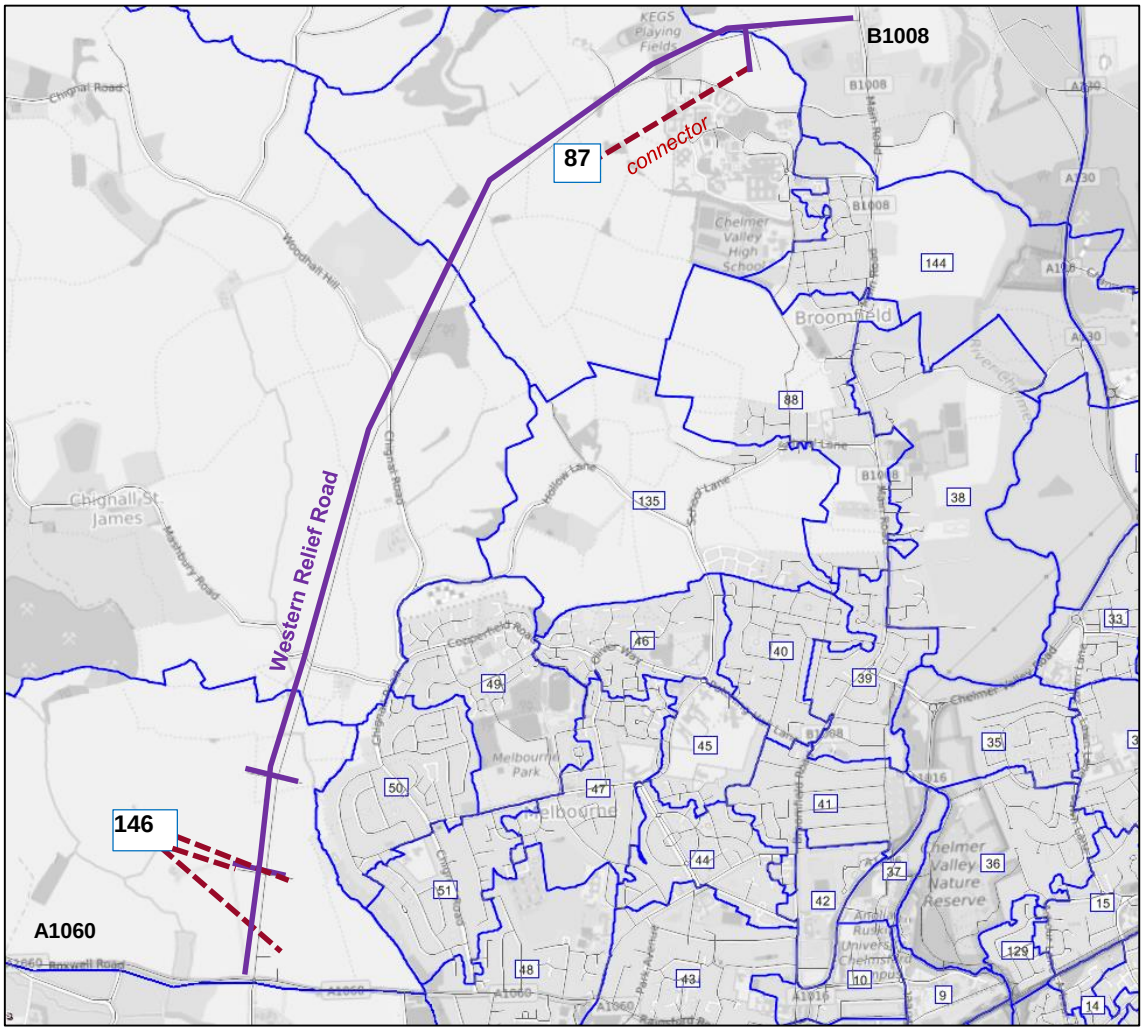


Figure 4.1: Indicative location of Western Relief Road and associated access points added to the forecast model

4.1.1 Park and Ride

The demand for Park and Ride has been taken from the Park and Ride Demand Spreadsheet model as used with the Chelmsford SATURN Model for modelling the proposed Chelmsford North East Bypass. The following trips have been assumed to be attracted in the AM and PM peak hours. Inter peak use of the Park and Ride has not been modelled. These assumptions can be considered to be an underestimate, since demand for Park and Ride has increased since the model was calibrated in 2011.

Park and Ride Location			AM		PM	
	Zone	Connector Node	Trips In	Trips Out	Trips In	Trips Out
Boreham	128	1070003953	149	0	0	150
Widford	79	557928	179	0	0	179

Table 4-3: Park and Ride demand

Figure 4.2: Indicative location of proposed Park and Ride sites at Widford and Boreham

These origins and destinations of these trips have been translated from the Chelmsford SATURN Model zone system to the Chelmsford VISUM model zone system. This process resulted in matrices which, when applied to the option matrices, removed some trips from city centre car parks and moved them to the new Park and Ride sites. Since these Park and Ride matrices were built from a different dataset to the Chelmsford VISUM model, the combined Park and Ride and option matrices contained some small negative numbers between certain origin zones and car parks in the AM peak and between certain car parks and destination zones in the PM peak. These were all set to zero. Again this will overestimate the number of trips to city centre car parks and therefore result in a robust assessment.

4.1.2 Comparison of models with and without infrastructure provision

The vehicle matrices for each option with infrastructure provision were run through the highways networks with infrastructure provision. Each of the models were reviewed and results analysed. The remainder of this chapter summarises the results for each time period (AM peak hour, IP hour, PM peak hour) and link of the highway network in terms of:

- Impact on traffic flows – analysis of vehicle flow differences in each Option with and without infrastructure

- Impact on network congestion – analysis of volume over capacity ratios for each Option with infrastructure

4.2 Impact of infrastructure on forecast traffic flows: Summary Analysis

4.2.1 Spatial Option 1

The modelled impact of infrastructure mitigation measures on vehicle flows in Chelmsford with Spatial Option 1 can be summarised as follows:

- Flows along the A1060 Roxwell/Rainsford Road, Chignal Road, School Lane and the B1008 Main Road are shown to reduce, with local and strategic vehicle trips expected to divert to the proposed Western Relief Road.

- Flows along Lordship Road through Writtle are shown to increase, as the Western Relief Road attracts further strategic movements from alternative routes such as the A12 and the A1114/A138 (city centre route).

  Congestion along Lordship Road in the PM peak results in wider modelled trip reassignment via rural routes to the west. This is symptomatic of the increase in modelled flow predicted through Writtle, but it is not expected that such a reassignment would occur in reality.

- Northbound flows along the A138 Chelmer Road are shown to decrease significantly whilst flows along Parkway and Springfield Road increase moderately. Flows through the Army and Navy Roundabout are also shown to reduce significantly across the peak hours.

  The apparent reduction in flows entering the city centre along a number of main routes can be partly explained by the impact of Park and Ride facilities at Boreham and Widford, as well as a reduction in the city centre through-routing of strategic trips following the opening of an alternative north-south route via the Western Relief Road. Reductions in flow might be expected to alleviate city centre bottlenecks resulting in overall increases in flow along certain city centre routes.

- The Park and Ride at Boreham might also be expected to influence a modelled increase in flow along routes such as the A130 White Hart Lane, Colchester Road and A138 Chelmer Road in the vicinity of the sites in North East Chelmsford.

It should be noted that as the fixed demand model presents a ‘worst-case scenario’ of high traffic flows and journey time delays in Chelmsford, so it has the

potential to overstate the impact of mitigation measures and possible reductions in traffic flow.

The proposed Western Relief Road is shown in the modelling to open up an alternative route between the north and south of Chelmsford to the west of the city centre. Should this road be built, it is likely to become an increasingly desirable route as the A12 becomes more congested and trips routing via the east of the city and the Chelmsford North East Bypass suffer from increased journey time delays.

Modelling suggests that a Western Relief Road would place additional pressure on routes through Writtle – which could increase the justification for a Writtle bypass to complete a full strategic bypass route. However, subsequent improvements made to the capacity of the A12 would likely leave the eastern and western bypasses as competing strategic routes, potentially accommodating low volumes of traffic.

4.2.2 Impact on forecast traffic flows of additional infrastructure – Option 1

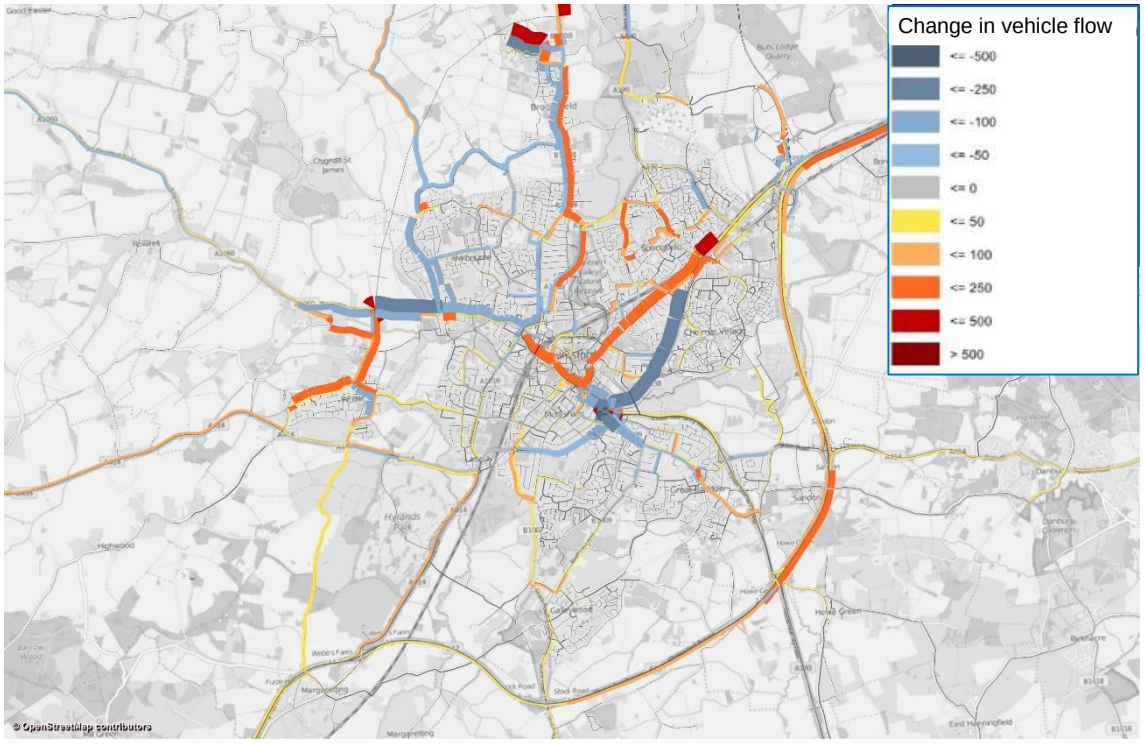


Figure 4.3: 2036 AM Peak Option 1: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

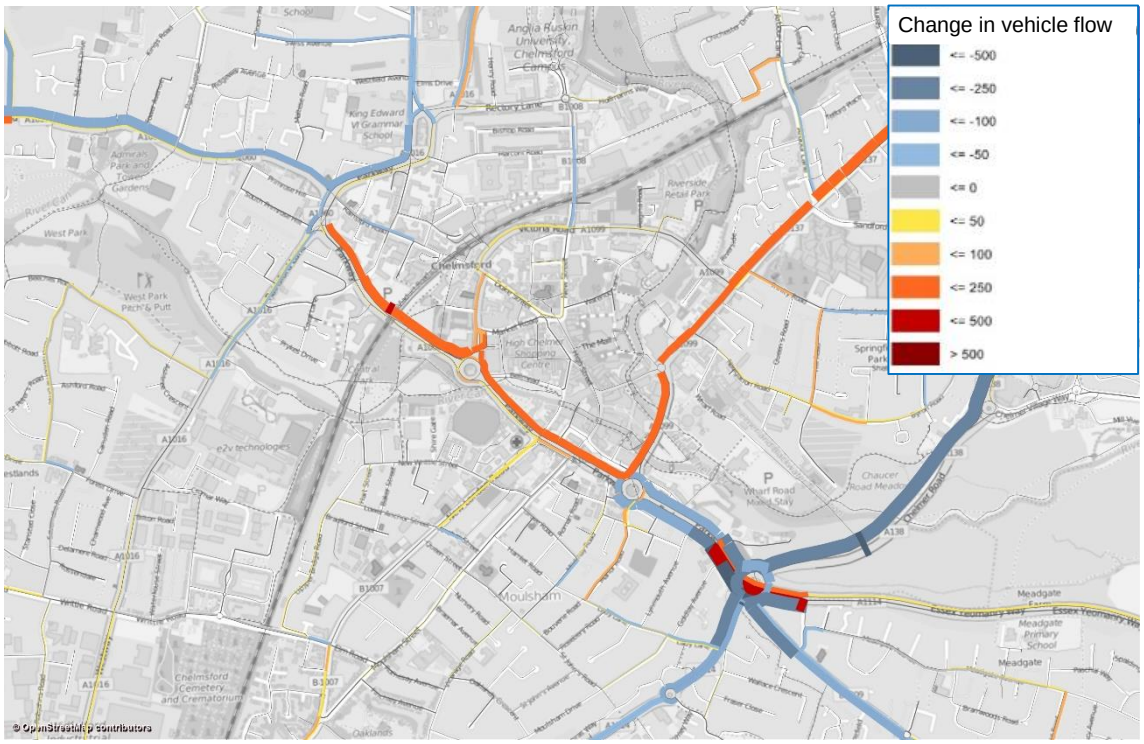


Figure 4.4: 2036 AM Peak Option 1: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

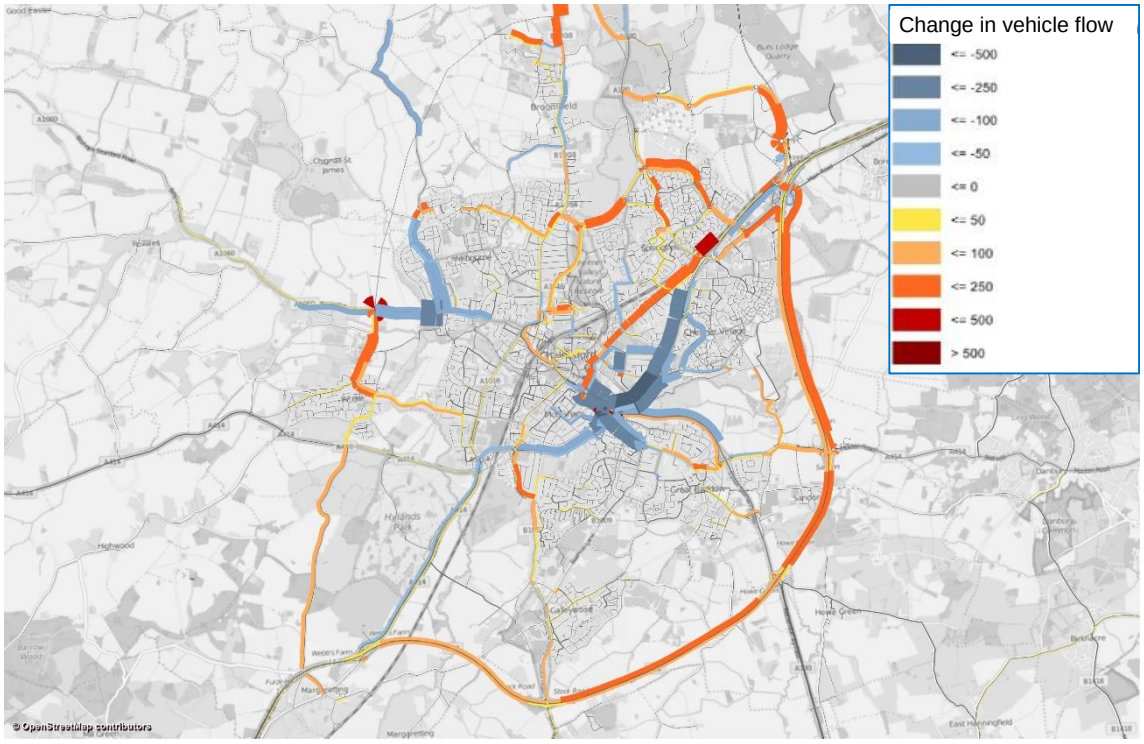


Figure 4.5: 2036 Inter Peak Option 1: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

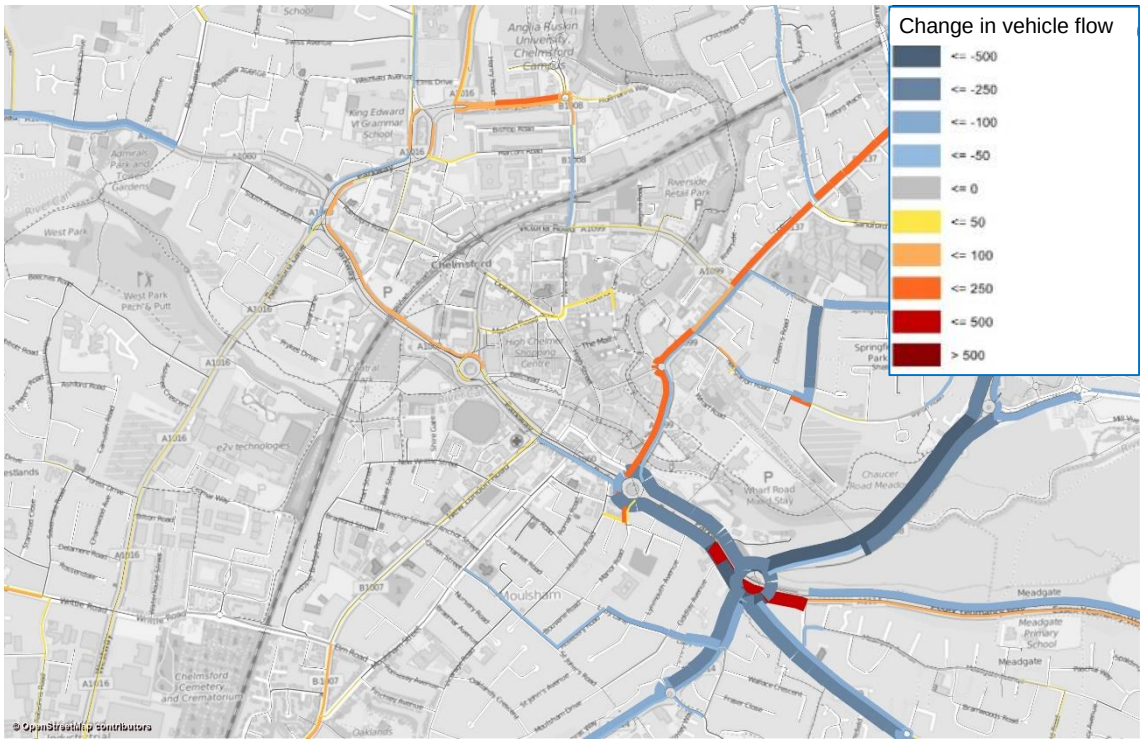


Figure 4.6: 2036 Inter Peak Option 1: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

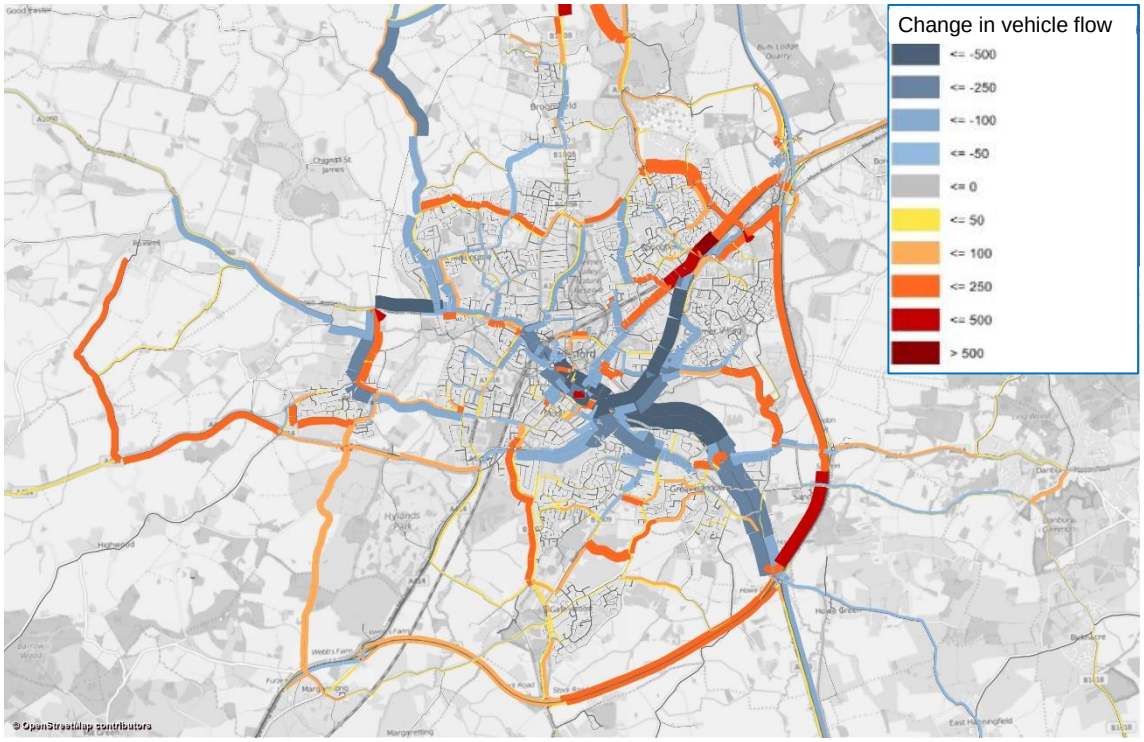


Figure 4.7: 2036 PM Peak Option 1: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

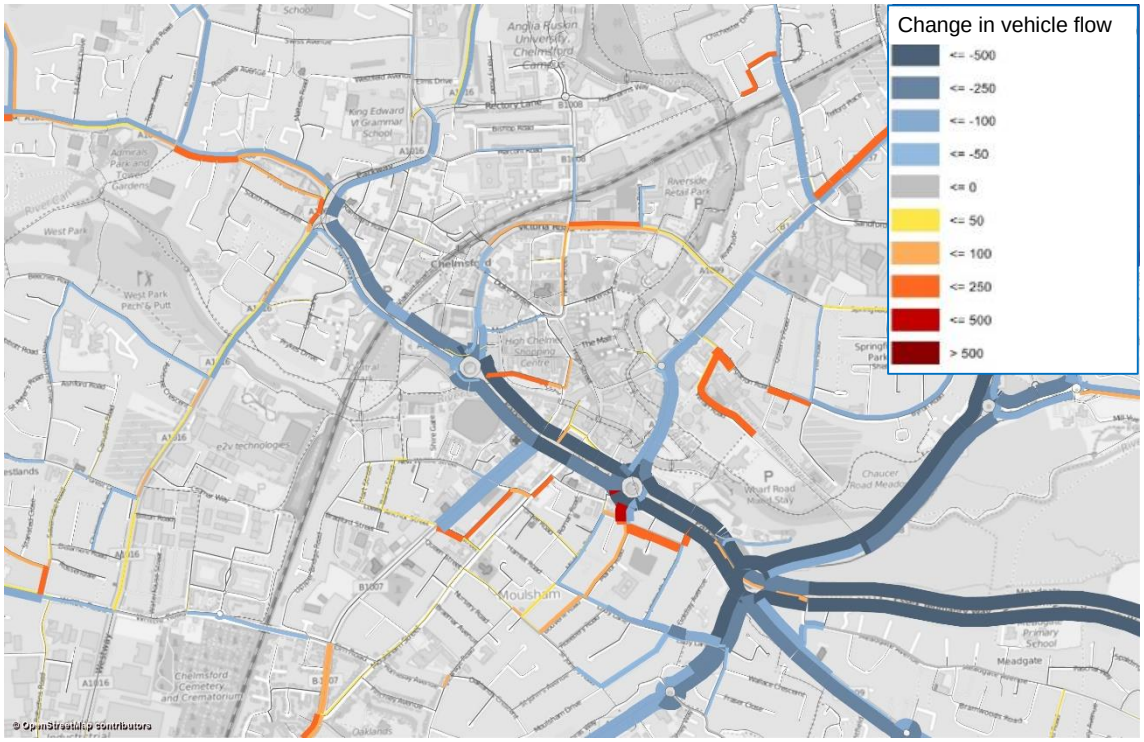


Figure 4.8: 2036 PM Peak Option 1: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

4.2.3 Spatial Option 2

The impact of infrastructure mitigation measures on vehicle flows in Chelmsford with Spatial Option 2 are similar to those modelled with Options 1 and 3.

Nevertheless, the following differences have been identified:

- AM peak flow increases westbound along White Hart Lane are higher than in Option 1.
- There is a more pronounced increase in northbound flows in the modelled peak hours along Springfield Road – but no increase along Parkway.
- Overall flow reductions follow the same patterns across the peak hours but to a smaller extent. In the inter peak in particular, both flow reductions and flow increases are less pronounced.
- Northbound flow increases along the A12 appear higher across the modelled peak hours.

Given the similarities in flow patterns displayed, the flow difference screenshots produced for Option 2 have been placed towards the end of Appendix C in this report.

4.2.4 Spatial Option 3

The following differences in vehicle flow patterns have been identified with Spatial Option 3 – compared with Options 1 and 2.

- AM peak flow increases are significantly higher in the vicinity of the Boreham Interchange and along the North East Bypass.
- AM peak flow increases are also significantly higher eastbound along the A1114 Baddow Bypass and in both directions along Springfield Road.
- AM peak flow reductions in southbound vehicle flow are also modelled along the A12 south of the Boreham Interchange.
- Inter-peak flow differences are largely the same as with Option 2 (i.e. less pronounced than Option 1) except for a slightly larger increase in flow over High Bridge Road.

- PM peak flow differences are largely the same as with Spatial Option 2 but to a lesser extent overall. However, Springfield Road shows a higher increase in flow northbound.

Flow difference screenshots produced for Spatial Option 3 can be located in Appendix C of this report alongside those produced for Option 2.

4.3 Impact on network congestion: Summary Analysis

Volume over capacity ratio network screenshots for Spatial Options 1, 2 and 3 - including infrastructure mitigation, can be found at the end of Appendix C of this report. A summary of model observations for the three Spatial Options can be found below.

For all three Spatial Options, the proposed infrastructure modelled is shown to result in broadly the same improvements to network congestion – predominantly, but not exclusively, along routes in the nearby vicinity of the schemes.

The capacity improvements generally coincide with the identified reductions in traffic flow reported earlier in the report.

Notable network improvements where congested links have been shown in the model to be brought within capacity are as follows:

- Along Chignal Road and B1008 Main Road (south of Broomfield) in the AM and inter peak.
- Along A138 Chelmer Road northbound across all modelled peak hours.
- Along Baddow Road westbound in the inter peak and PM peak (PM only in Options 2 & 3)
- Along the A1060 Roxwell Road eastbound on the approach to the junction with Chignal Road in the PM peak.
- Along the A1114 London Road (Widford Viaduct) westbound in the PM peak (in inter peak in Options 2 & 3).

The infrastructure measures modelled afford little improvement to network congestion in the city centre.

In line with the analysis of the impact on vehicle flows, it can be considered likely that the Western Relief Road would help to address potential congestion along main routes through Melbourne and Broomfield. The availability of an alternative strategic route to the west of Chelmsford, combined with the effect of the Park and Ride in Boreham and Widford might also be expected to alleviate congestion along the A414 – A1114 – A138 city centre through-route and at the Army and Navy Roundabout.

However, the impact of the infrastructure improvements in this instance, will be influenced heavily by the levels of future congestion experienced along the A12. Should the route be widened, it might be reasonable to expect the city centre network impact of additional Park and Rides and/or a Western Relief Road to change – potentially significantly.

Regardless, it is apparent from analysis of the modelled outputs, that the proposed infrastructure alone will be unlikely to mitigate the high levels of congestion modelled across the city.

5 Impact of Spatial Options on Chelmsford Local Authority Area

The wider highways impact of the Local Plan Spatial Options has been reviewed at a high level as part of this study. It is important to acknowledge however, that outputs from the VISUM model that are extracted from peripheral areas of the Chelmsford Local Authority area should be considered less robust, with network validation focussed on the urban area of Chelmsford. Flows along the A132 in the vicinity of South Woodham Ferrers and the A130 close to Great Leighs for example, will likely be sensitive to the reassignment of strategic traffic, such that the impact of changes in local traffic flows could be under or overstated.

Summary analysis provided in this report should therefore be considered in this context and viewed as indicative – subject to replacing it with more detailed junction analysis in the local areas.

5.1 South Woodham Ferrers

General observations of network congestion suggests development associated with Spatial Option 2 results in the greatest increase in the ratio of flow to capacity on the A132 and northbound on the B1418. Spatial Option 3 is modelled to have the smallest impact on congestion along the A132 and at the junction of the A132 with the B1418. This correlates with the lower quantum of housing proposed in Option 3 for the development area to the north of South Woodham Ferrers.

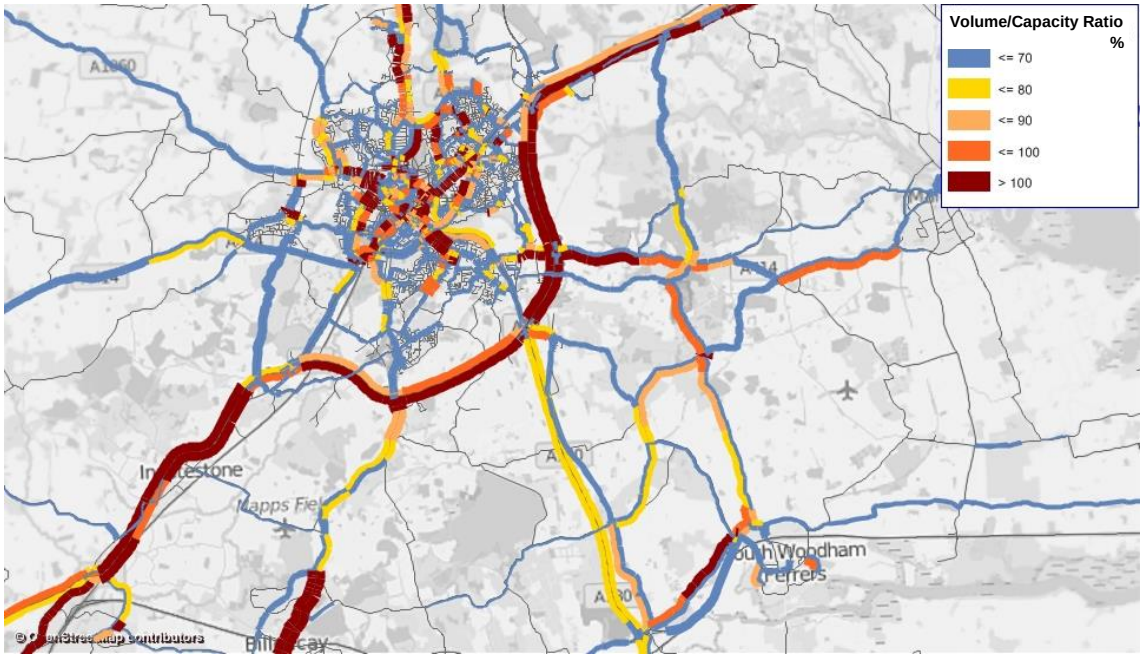


Figure 5.1: 2036 AM Peak Option 2 (Example): 'volume / capacity ratios' – South of Chelmsford

However, from this, it is not possible to draw accurate conclusions regarding the extent of congestion possible on the road network in the future, and the specific impact of the Spatial Option development flows in the area. More detailed junction modelling will be required to understand the likely impact in detail.

5.2 Great Leighs

Analysis of the wider impact of the Local Plan Spatial Options to the north of Chelmsford (specifically Great Leighs), is limited to an assessment of the modelled A130 link between Sheepcotes Roundabout and Deres Bridge Roundabout. Here, the main difference between the Spatial Options is shown in the PM peak, with the greatest overall increase in congestion shown in Option 1 and the least overall impact shown in Option 3. This correlates with the flow differences modelled in the area, and the quantum of housing proposed in Great Leighs across the various Spatial Options.

Figure 5.2: 2036 AM Peak Option 1 (Example): 'volume / capacity ratios' – North of Chelmsford

However, as with South Woodham Ferrers, without more detailed modelling, it is not possible to draw accurate conclusions regarding the extent of congestion on the road network in the future, and the specific impact of the Spatial Option development flows in the area.

6 Conclusion

Overall results from the evaluation of Local Plan Spatial Options do not indicate significant differences between each of the three Spatial Options. Option 2 is shown in the modelling to result in the highest increases in traffic flow concentrated on key routes across Chelmsford, whilst Option 1 has the lowest. However, levels of congestion in the city centre and along strategic and corridor routes show little variation across all Spatial Options. It is therefore not possible to establish a direct link between increases in Local Plan development flow associated with each Spatial Option and increases in the level of congestion on key routes in and around Chelmsford.

Existing network congestion in 2036 and subsequent wide-scale route reassignment away from strategic links and corridor routes to/from the city centre, appears to neutralise any variability in the impact of each Spatial Option across the wider road network. However, modelling does reflect the local impact of development traffic on levels of congestion in the immediate vicinity of larger Local Plan developments – such as those to the west of Chelmsford.

It should be noted that a focus on urban development associated with Spatial Option 1 would likely have the greatest potential to encourage mode shift to sustainable travel alternatives.

High levels of congestion modelled along the A12 is shown in the model to result in a considerable flow of traffic routing through the city centre along the A1114/A138. In this respect, conditions along the A12 play a significant role in levels of congestion experienced in the city centre – particularly along the A138 Chelmer Road and at the Army and Navy Roundabout.

With the modelling of additional infrastructure, flows are shown to reduce along the A138 and at the Army and Navy Roundabout in particular. While additional Park and Ride facilities contribute to this reduction, there is also a reduction in city centre through-routing of strategic trips as a result of the provision of an alternative north-south route via the proposed Western Relief Road.

At the same time, the addition of mitigating infrastructure is shown to have little beneficial impact on traffic flows in the city centre itself. This is likely due to the part alleviation (but not removal) of city centre bottlenecks, with suppressed traffic flows replacing Park and Ride transfer trips.

The proposed Western Relief Road would help to address potential congestion along main routes through Melbourne and Broomfield. However, by attracting

strategic traffic away from the A12, additional pressure is placed on routes through Writtle, increasing the case for a Writtle bypass – should the A12 not be widened in the future.

Indeed, the impact of infrastructure improvements will be influenced heavily by the levels of future congestion experienced along the A12. Should the route be widened in the future, it might be reasonable to expect the impact of these mitigation measures to change – potentially to a significant extent.

Regardless, it is apparent from analysis of the modelled outputs that the current scope of highway infrastructure provision will require expanding across Chelmsford, with a focus on a greater provision of sustainable measures in the city centre, in order to mitigate the high levels of congestion expected in the future.

Appendix A:

Housing Development Access Assumptions

Development Locations	Options (Development Capacity)		
	1	**2**	**3**
Location 1 Chelmsford Urban Area	Split across Zones 1 / 2 / 3 / 4 / 8 / 9 / 10 / 76 using existing distribution		
Location 2 West Chelmsford	Zone 146, Connector Node 558921	Zone 146, Connector Node 558921	Zone 146, Connector Node 558921
Location 3 North Chelmsford (Broomfield)	50% Zone 145, Connector Node 100007400; 50% Zone 87, Connector Node 100007400	60% Zone 145, Connector Node 100007400; 40% Zone 87, Connector Node 100007400	70% Zone 145, Connector Node 100007400; 30% Zone 87, Connector Node 100007400
Location 4 North East Chelmsford	25% Zone 89, Connector Nodes 1070003287, 1070004541, 1070004535, 1070014574; 25% Zone 91, Connector Node 569024; 30% Zone 97 (500 dwellings in Zone 97 will be north of the bypass), Connector Nodes 573514, 1070004517; 20% Zone 128, Connector Node 577328	30% Zone 89, Connector Nodes 1070003287, 1070004541, 1070004535, 1070014574; 30% Zone 91, Connector Node 569024; 40% Zone 97), Connector Nodes 573514, 1070004517	30% Zone 89, Connector Nodes 1070003287, 1070004541, 1070004535, 1070014574; 30% Zone 91, Connector Node 569024; 40% Zone 97, Connector Nodes 573514, 1070004517
Location 5 East Chelmsford (East of Great Baddow)		80% Zone 136, Connector Node 574819; 20% Zone 21, Connector Node 571888	100% Zone 136, Connector Node 574819
Location 6 North of South Woodham Ferrers	Zone 111, Connector Nodes 107000331, 591757	Zone 111, Connector Nodes 107000331, 591757	Zone 111, Connector Nodes 107000331, 591757
Location 7 Great Leighs	80% Zone 95, Connector Node 50383; 20% Zone 96, Connector Node 268860239	70% Zone 95, Connector Node 50383; 30% Zone 96, Connector Node 268860239	60% Zone 95, Connector Node 50383; 40% Zone 96, Connector Node 268860239
Location 8 Howe Green			100% Zone 101, Connector Node 575958
Location 9 Rettendon Place		100% Zone 112, Connector Node 10007707	100% Zone 112, Connector Node 10007707

Development Locations	Options (Development Capacity)		
	1	**2**	**3**
Location 10 Boreham			50% Zone 98, Connector Node 10013275; 50% Zone 99, Connector Node 10007360
Location 11 Danbury			100% Zone 105, Connector Node 10007786
Location 12 Bicknacre			50% Zone 105, Connector Node 10013861; 50% Zone 126, Connector Node 588214
Location 13 Ford End			50% Zone 93, Connector Node 10007454; 50% Zone 94, Connector Node 10007458
Location 14 Great Waltham			100% Zone 92, Connector Node 10011918
Location 15 Little Waltham			100% Zone 145, Connector Node 10013257
Location 16 East Hanningfield			50% Zone 113, Connector Node 1070003323; 50% Zone 114, Connector Node 583166
Location 17 Woodham Ferrers			100% Zone 108, Connector Node 10013863

Table 6-1 Housing zone and connector node assumptions for Options 1-3[5]

[5] The zoning system for the Chelmsford Strategic Model is detailed in the *Local Model Validation Report, Revision 4, August 2016*.

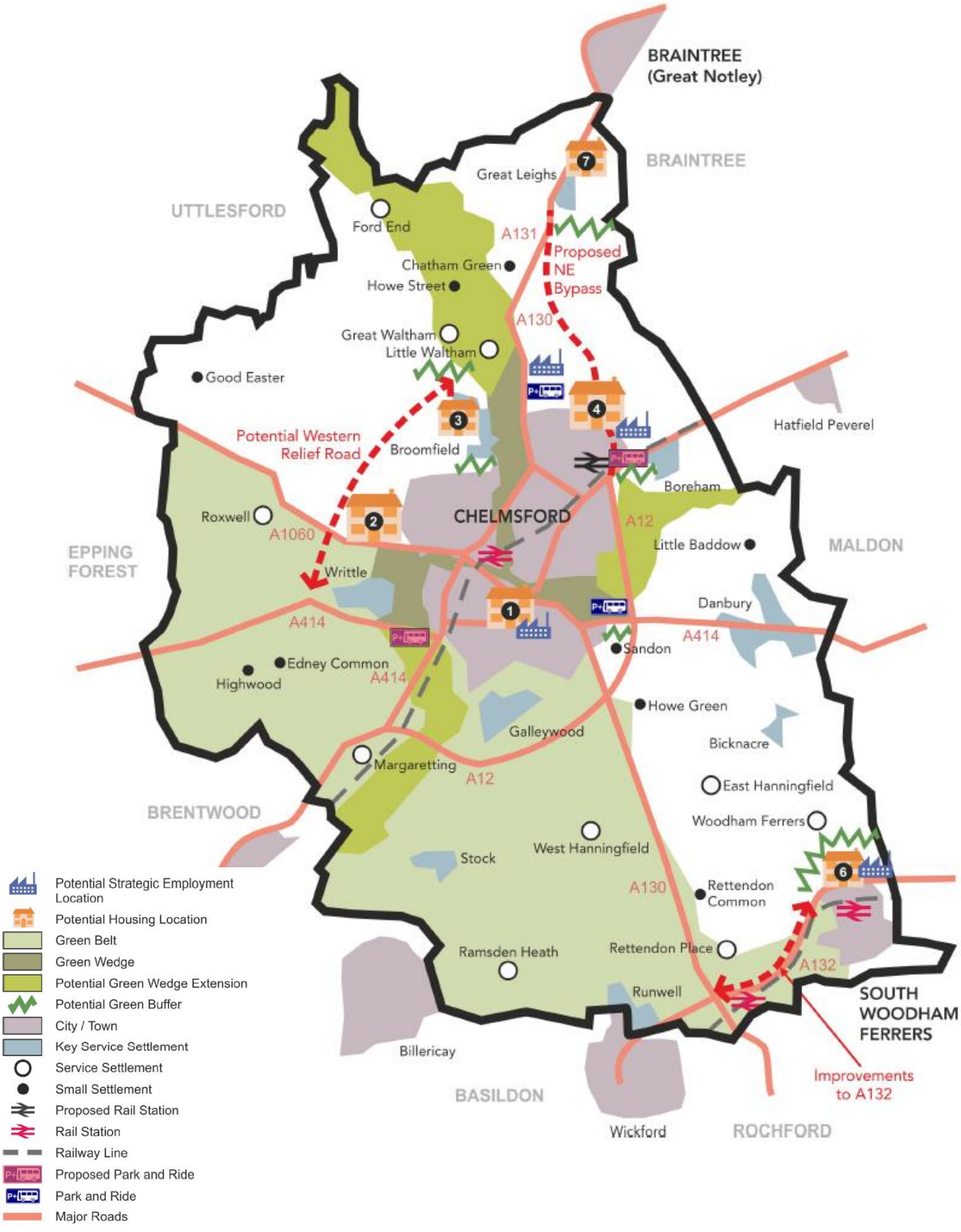
Appendix B:

Spatial Option Maps

(from: Chelmsford Local Plan Issues and Options Consultation Document – November 2015)

- **Option 1 – Urban Focus**
- **Option 2 – Urban Focus and Growth on Key Transport Corridors**
- **Option 3 – Urban Focus and Growth in Key Villages**

Map 1 - Option 1 Urban Focus



Map 2 - Option 2 Urban Focus and growth on Transport Corridors

Map 3 - Option 3 Urban Focus and growth in Key Villages

Appendix C:

VISUM Model Screenshots

C.1 Impact on forecast network congestion – Option 1

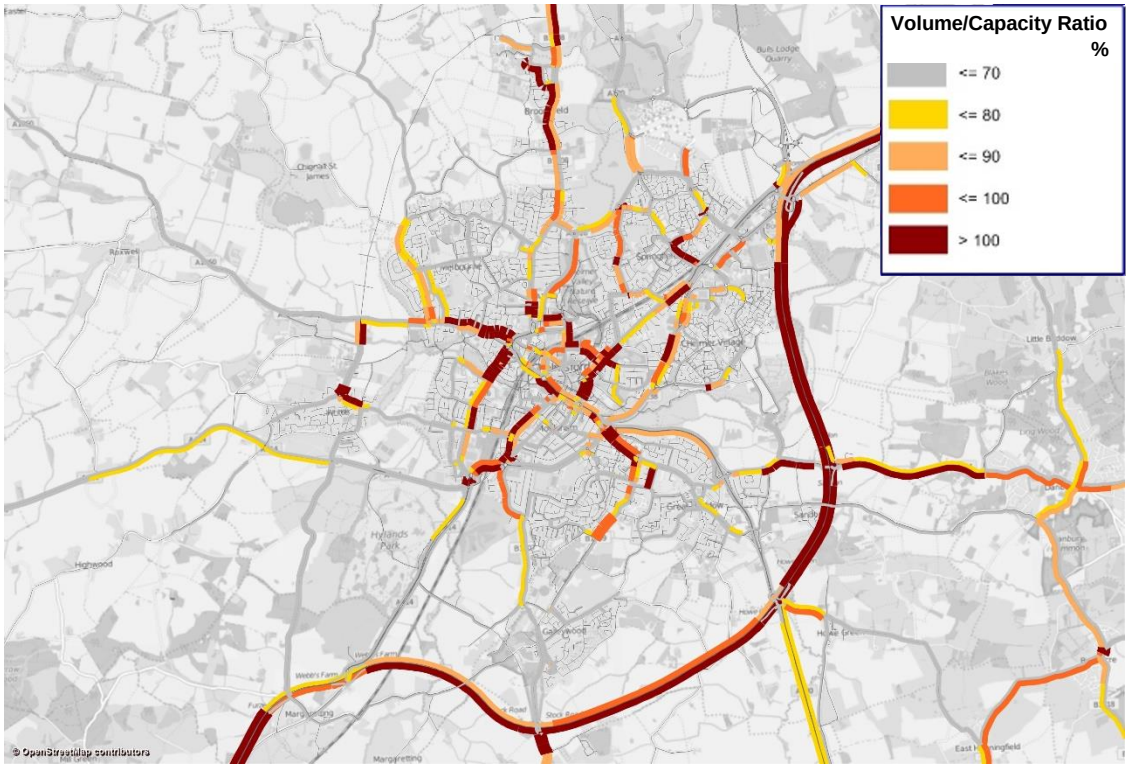


Figure C.1: 2036 Option 1 AM Peak 'volume / capacity ratios' – Chelmsford urban area

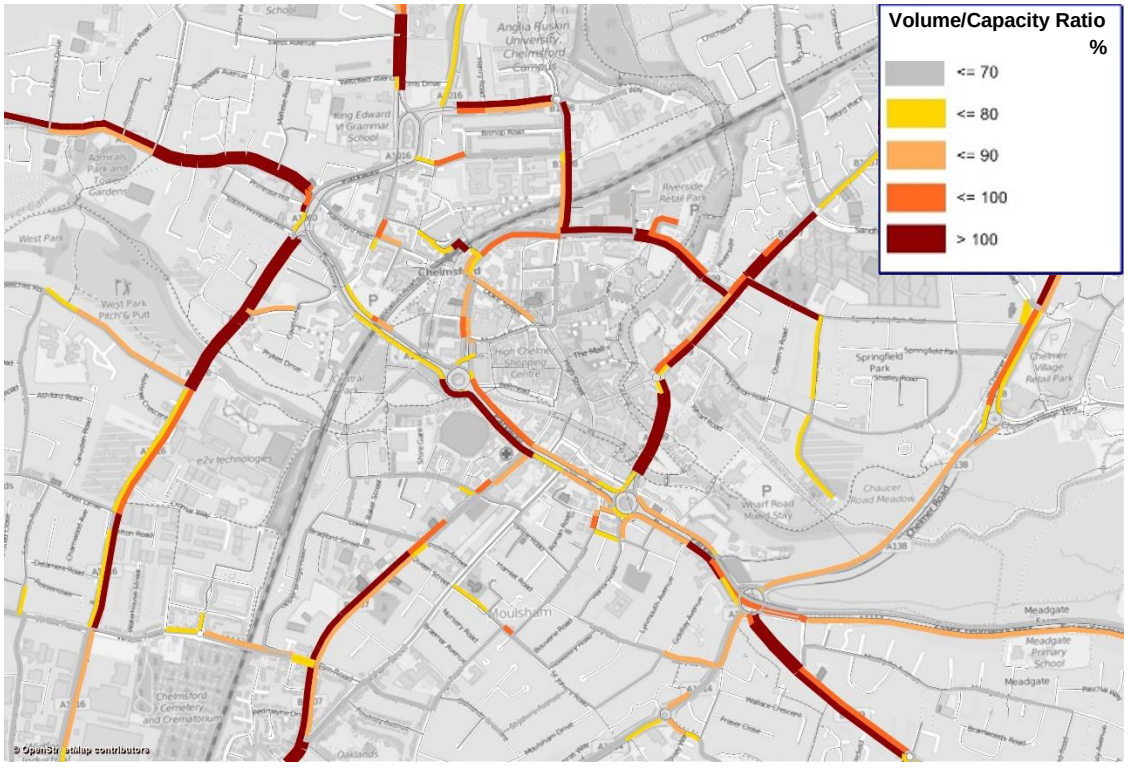


Figure C.2: 2036 Option 1 AM Peak 'volume / capacity ratios' – Chelmsford city centre

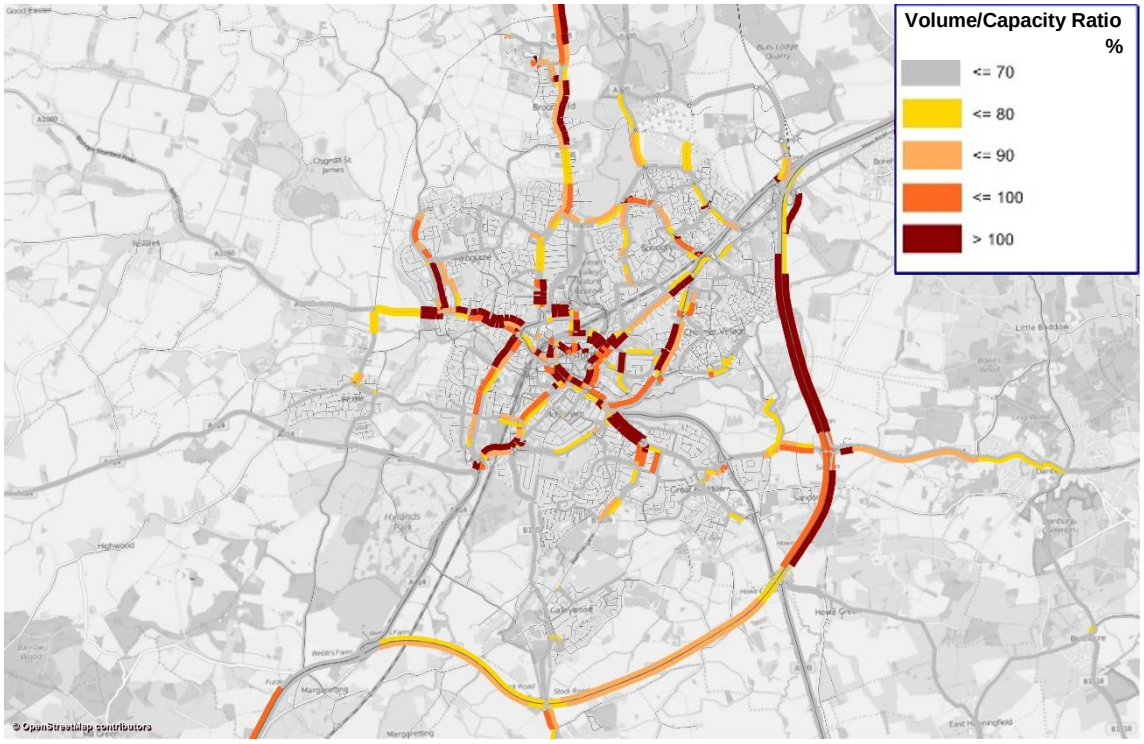


Figure C.3: 2036 Option 1 Inter Peak 'volume / capacity ratios' – Chelmsford urban area

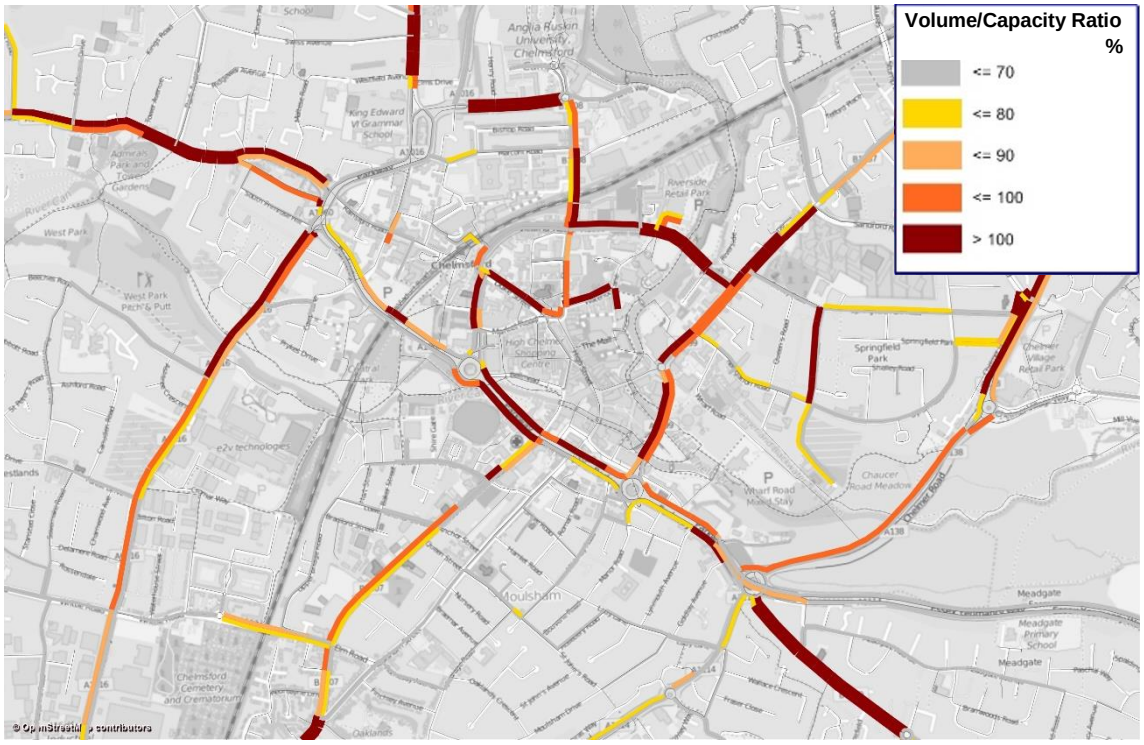


Figure C.4: 2036 Option 1 Inter Peak 'volume / capacity ratios' – Chelmsford city centre

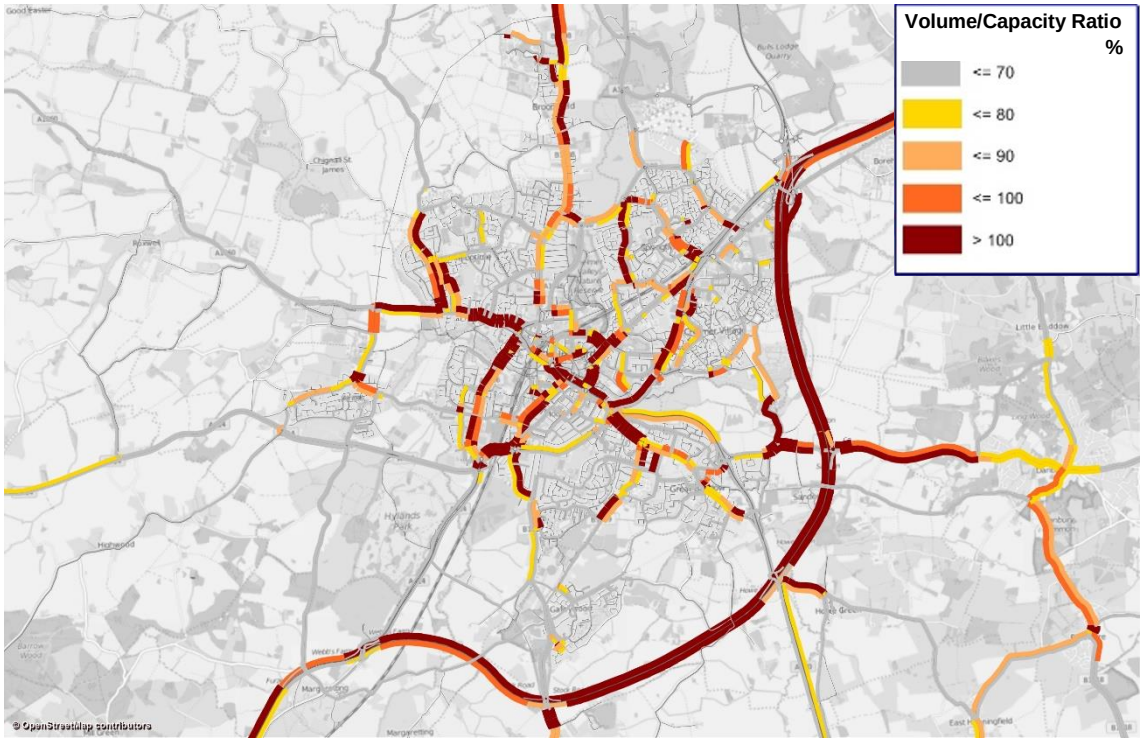


Figure C.5: 2036 Option 1 PM Peak 'volume / capacity ratios' – Chelmsford urban area

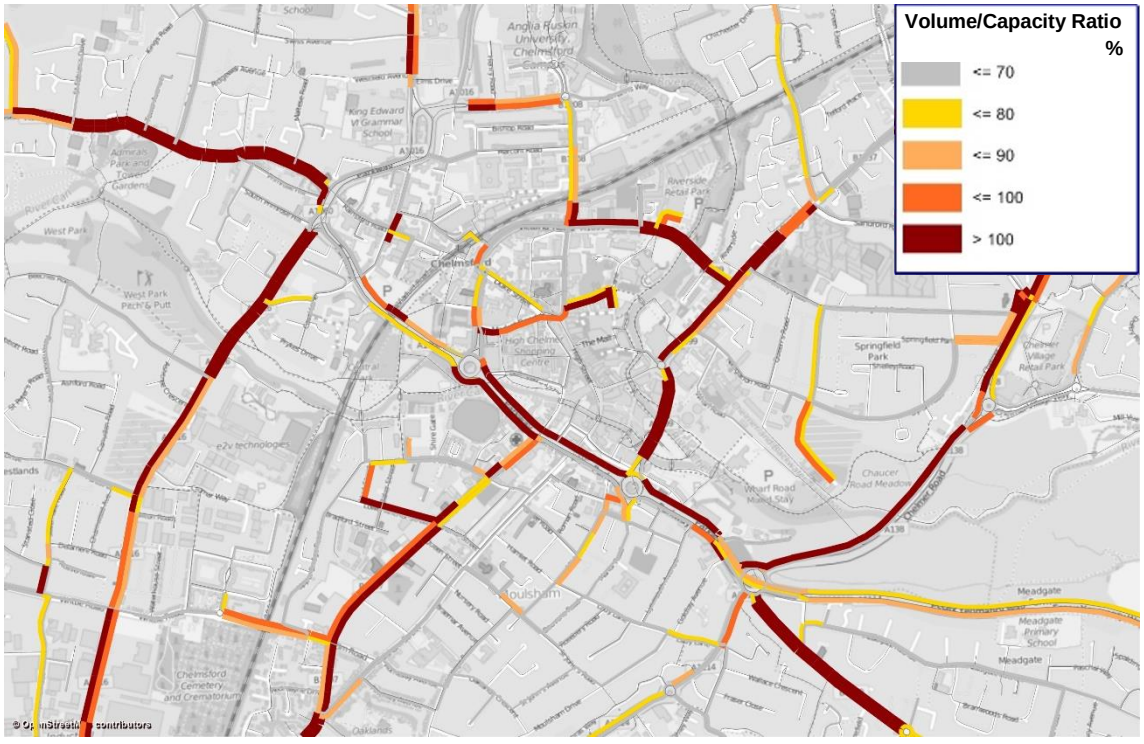


Figure C.6: 2036 Option 1 PM Peak 'volume / capacity ratios' – Chelmsford city centre

C.2 Impact on forecast network congestion – Option 2

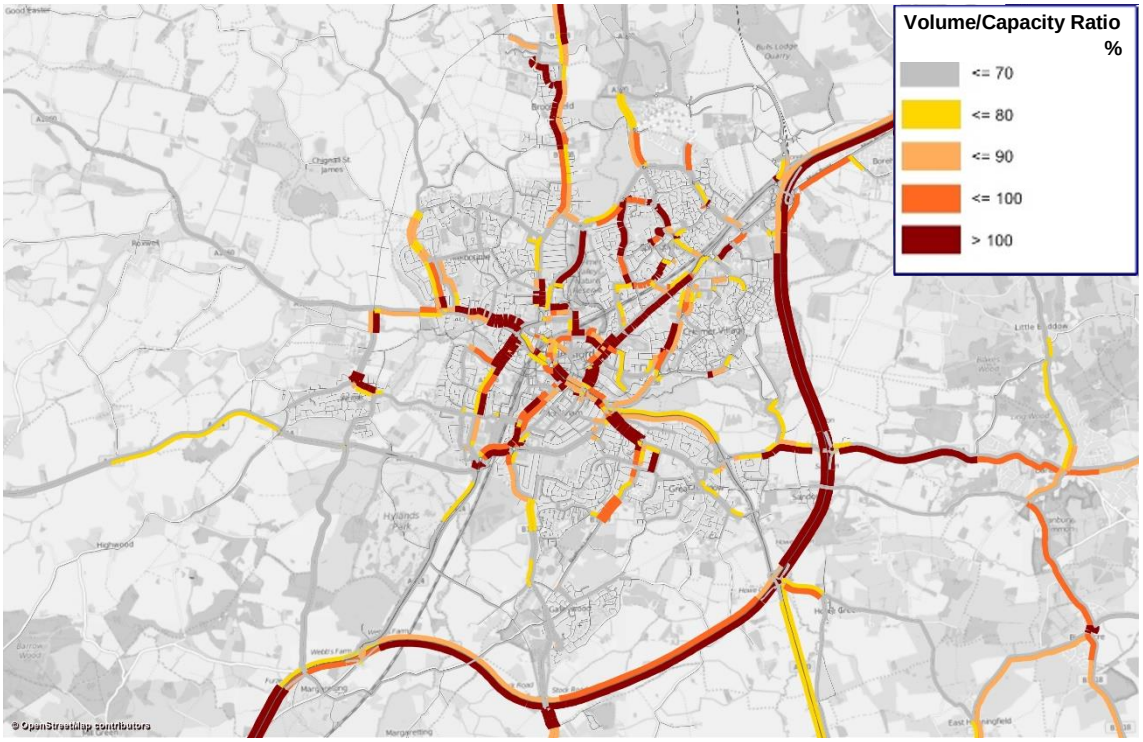


Figure C.7: 2036 Option 2 AM Peak 'volume / capacity ratios' – Chelmsford urban area

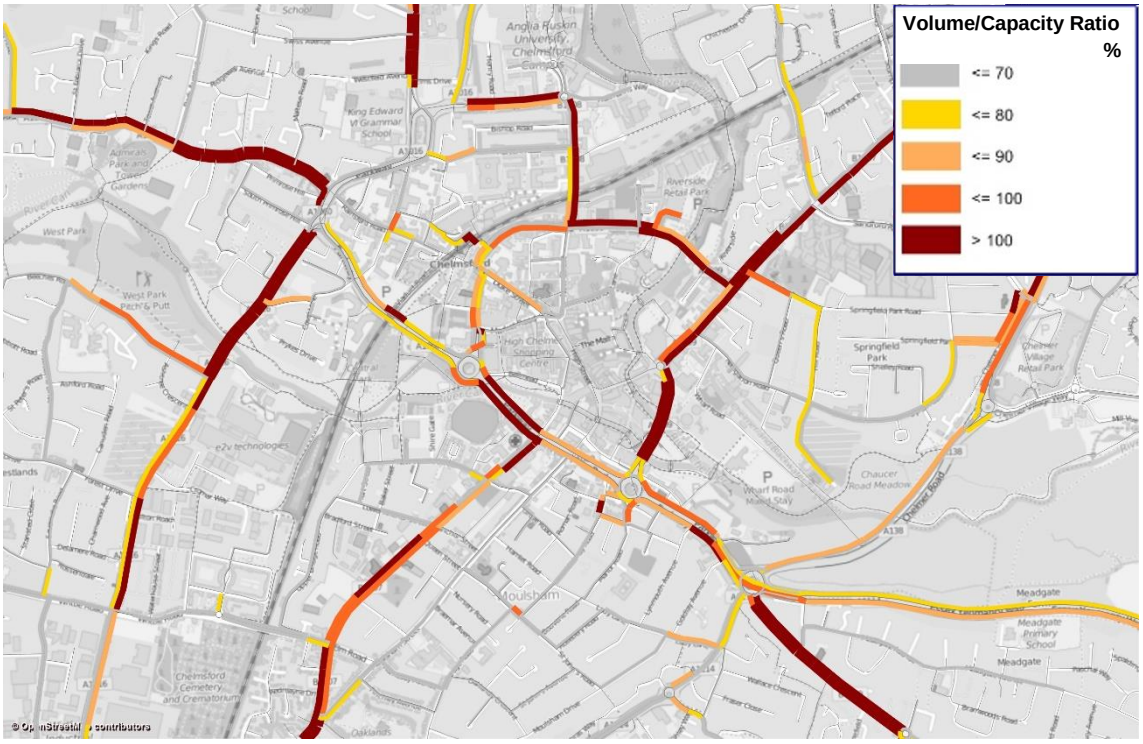


Figure C.8: 2036 Option 2 AM Peak 'volume / capacity ratios' – Chelmsford city centre

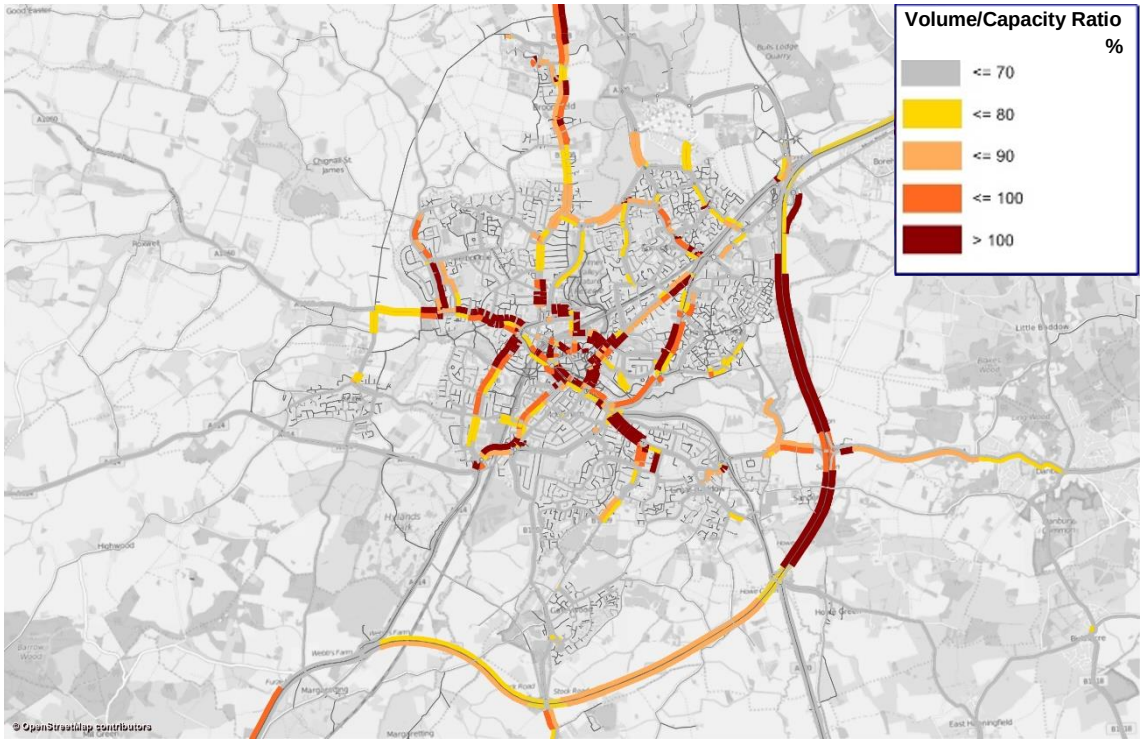


Figure C.9: 2036 Option 2 Inter Peak 'volume / capacity ratios' – Chelmsford urban area

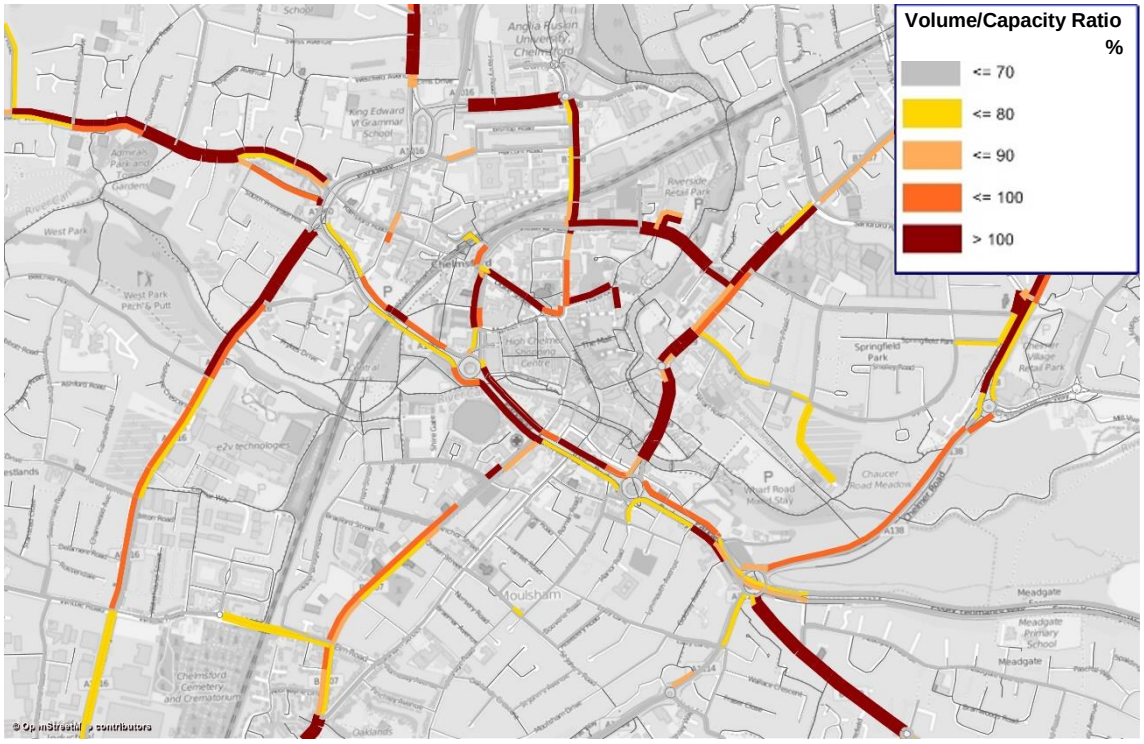


Figure C.10: 2036 Option 2 Inter Peak 'volume / capacity ratios' – Chelmsford city centre

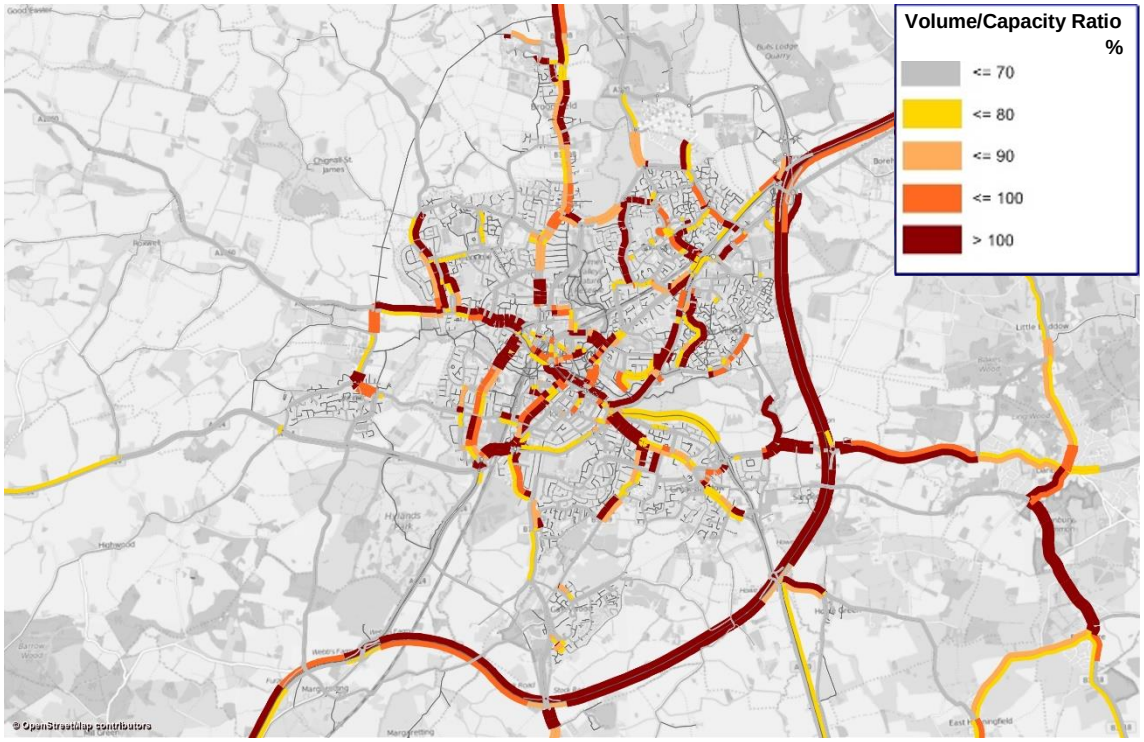


Figure C.11: 2036 Option 2 PM Peak 'volume / capacity ratios' – Chelmsford urban area

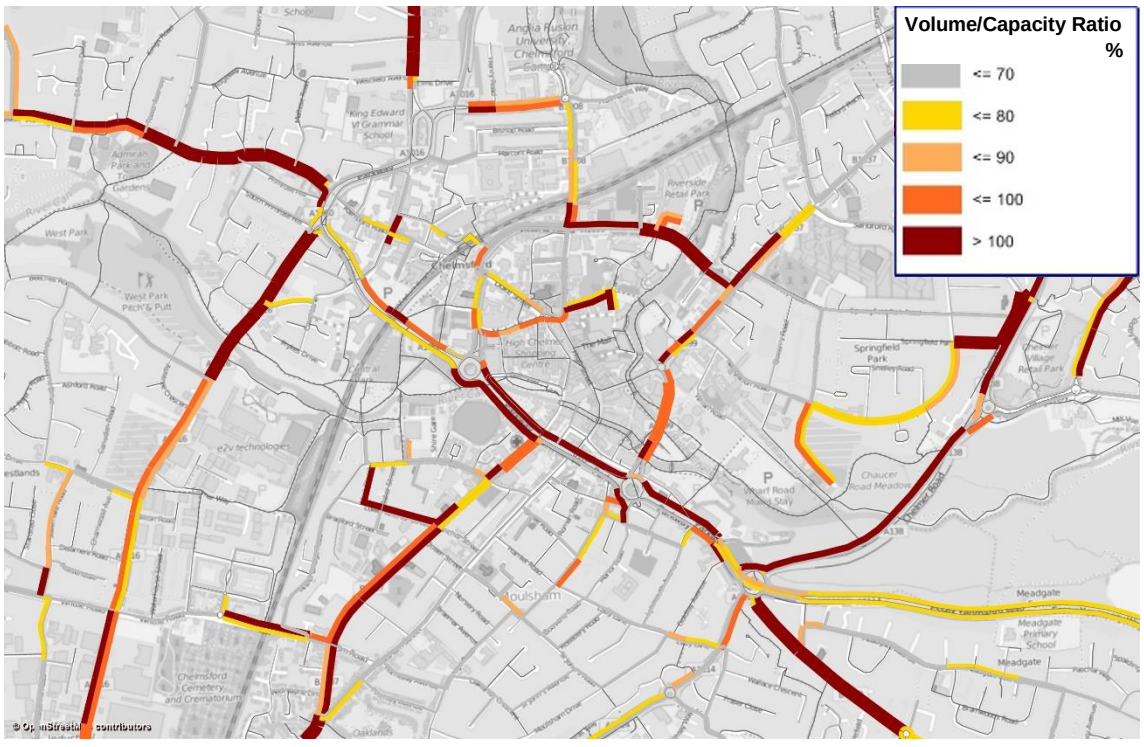


Figure C.12: 2036 Option 2 PM Peak 'volume / capacity ratios' – Chelmsford city centre

C.3 Impact on forecast network congestion – Option 3

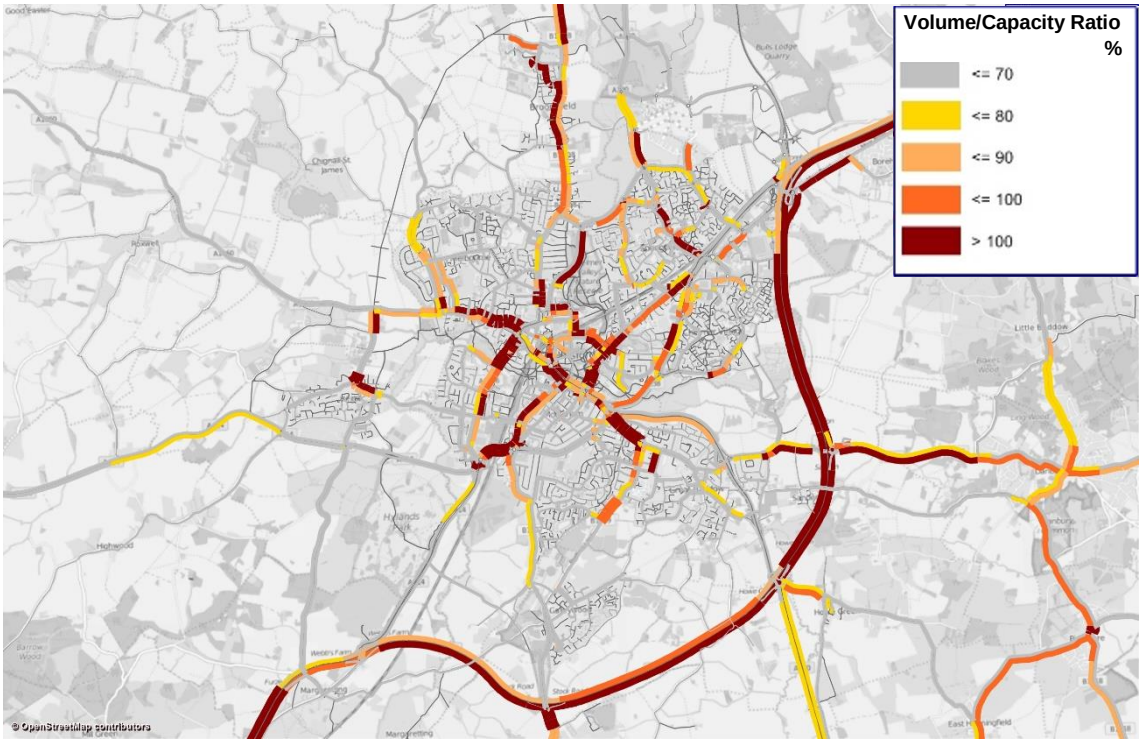


Figure C.13: 2036 Option 3 AM Peak 'volume / capacity ratios' – Chelmsford urban area

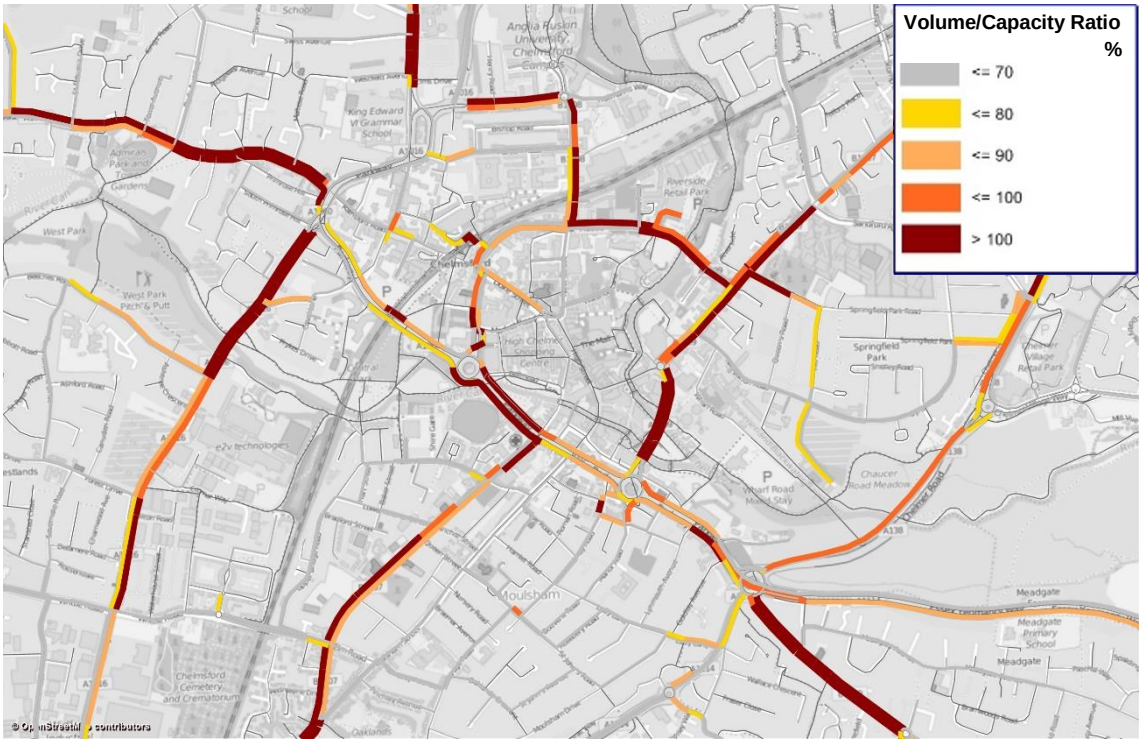


Figure C.14: 2036 Option 3 AM Peak 'volume / capacity ratios' – Chelmsford city centre

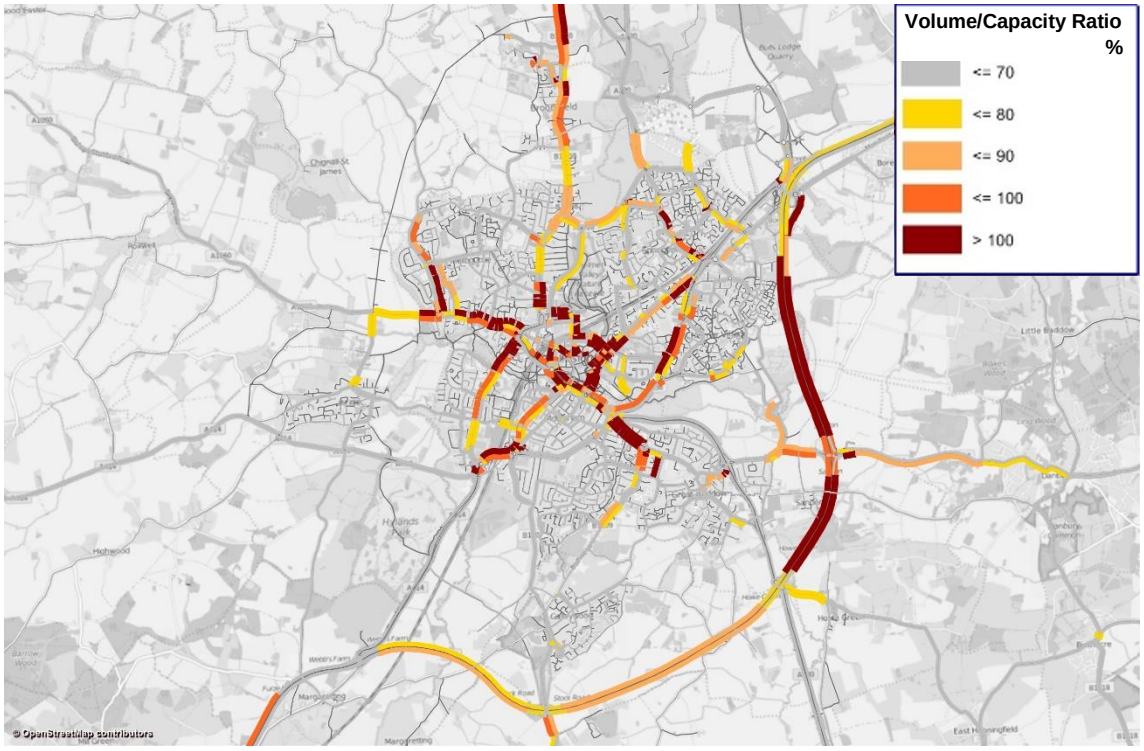


Figure C.15: 2036 Option 3 Inter Peak 'volume / capacity ratios' – Chelmsford urban area

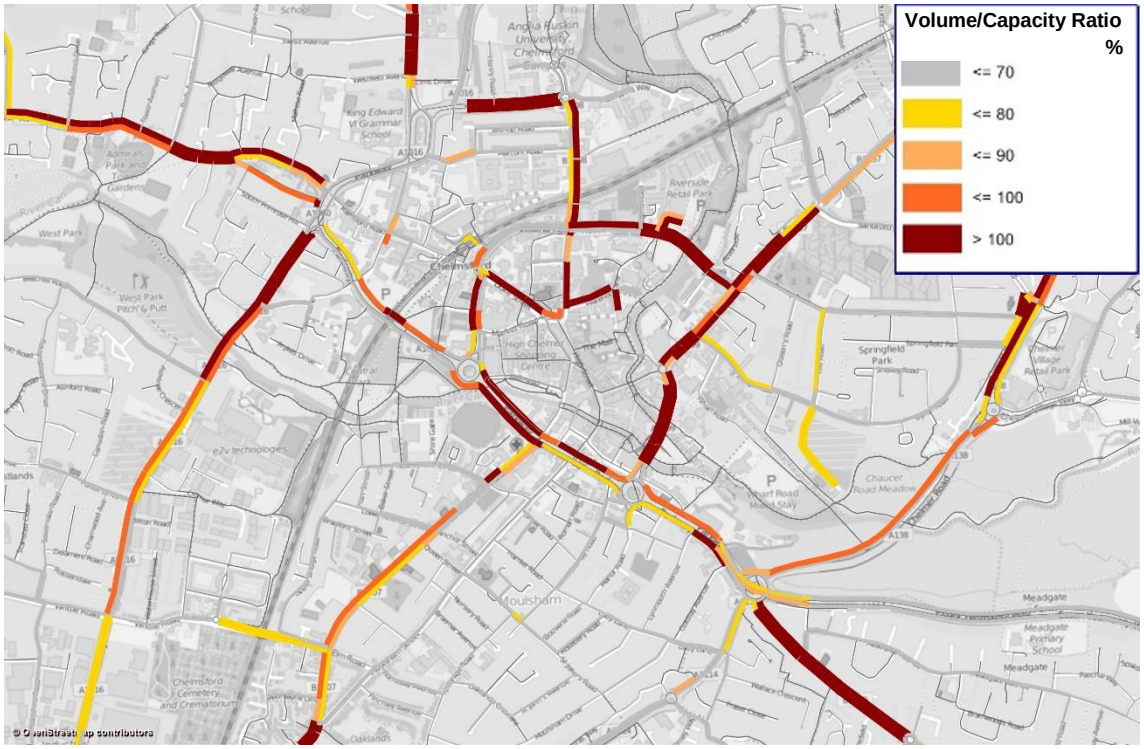


Figure C.16: 2036 Option 3 Inter Peak 'volume / capacity ratios' – Chelmsford city centre

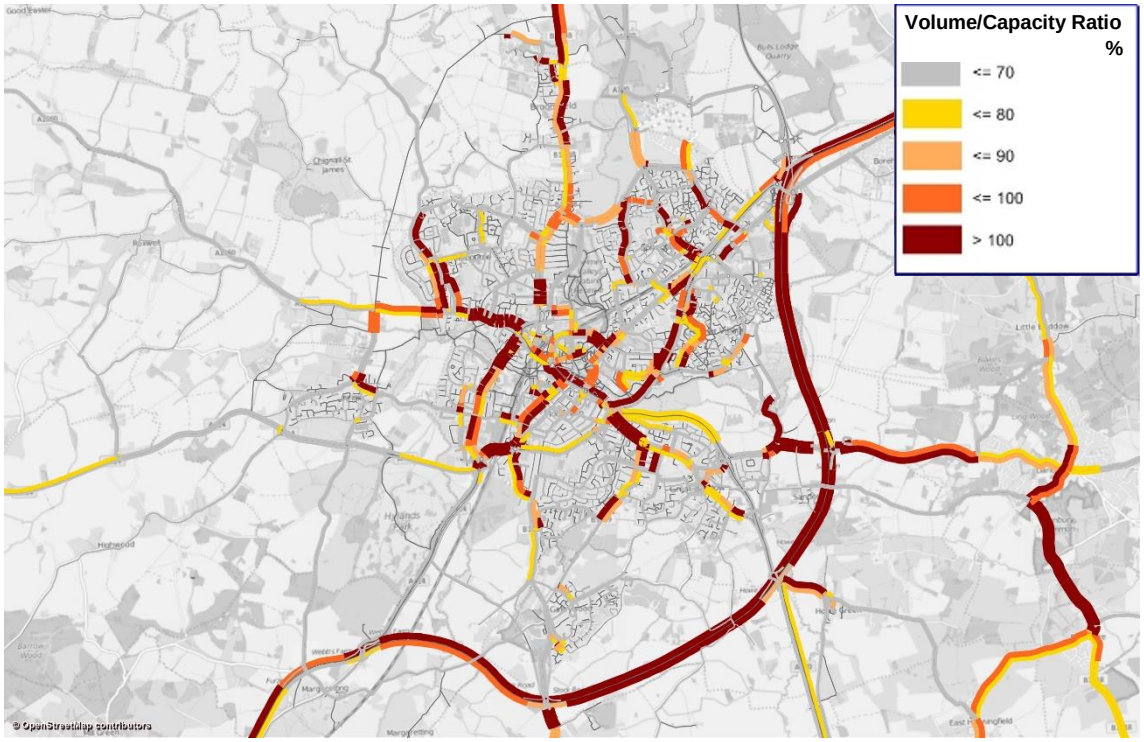


Figure C.17: 2036 Option 3 PM Peak 'volume / capacity ratios' – Chelmsford urban area

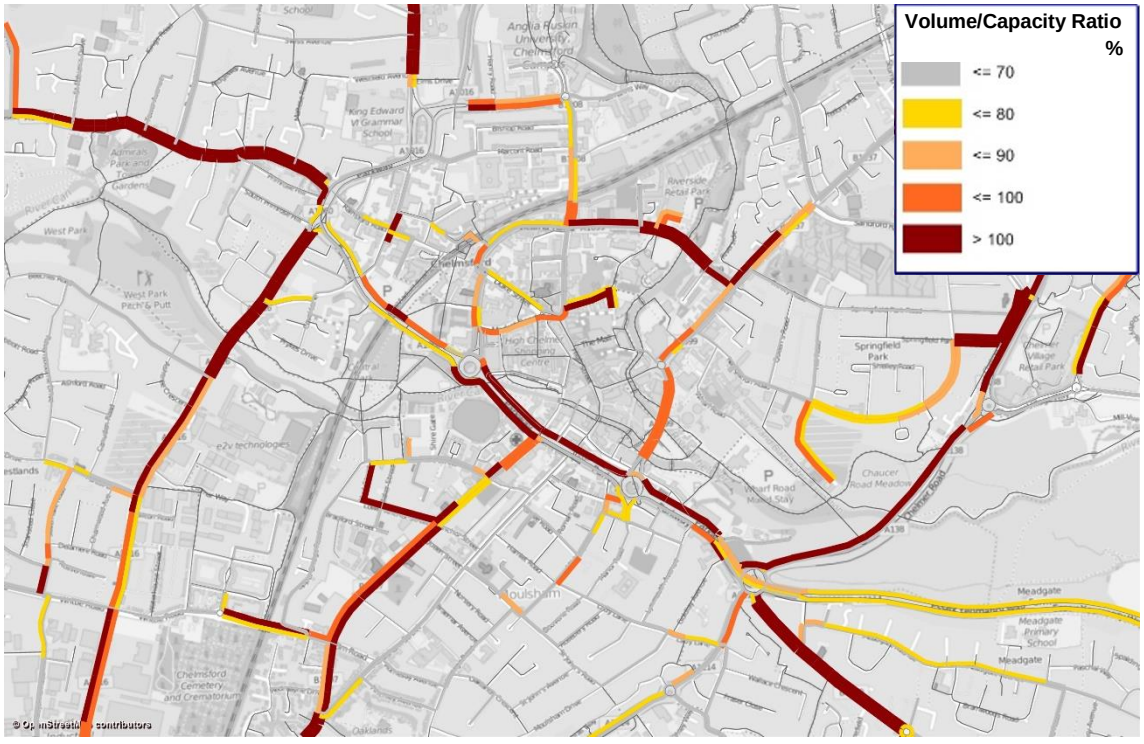


Figure C.18: 2036 Option 3 PM Peak 'volume / capacity ratios' – Chelmsford city centre

C.4 Impact of infrastructure on forecast traffic flows – Option 2

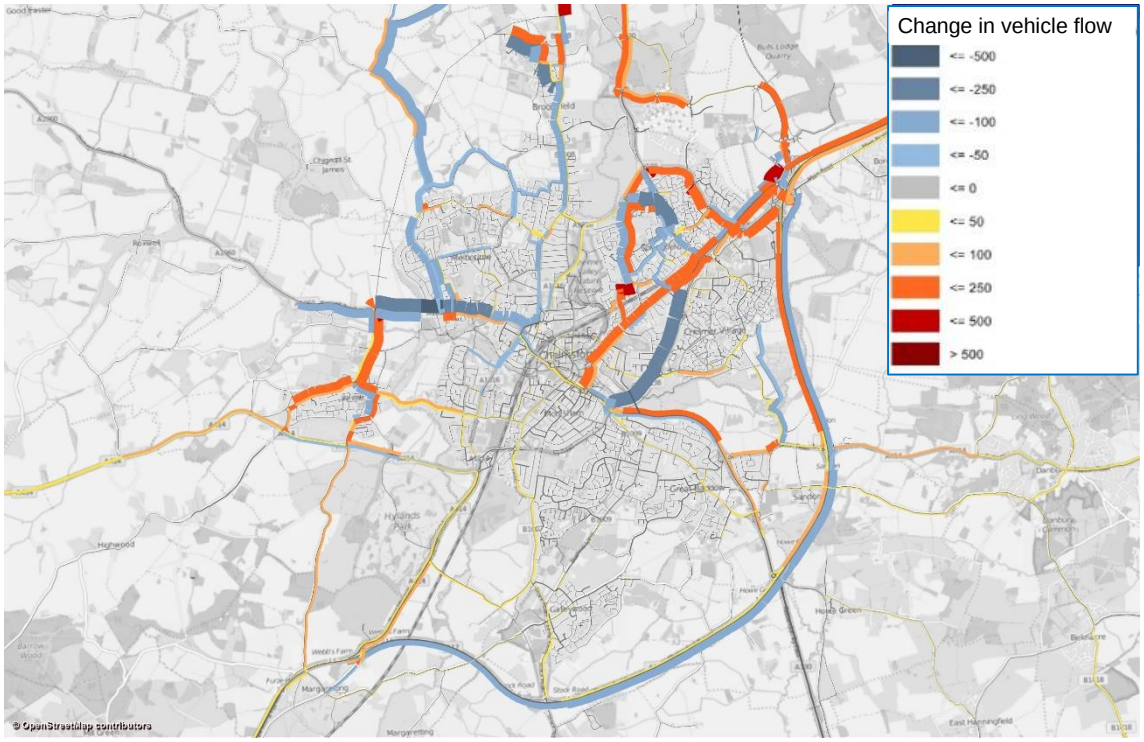


Figure C.19: 2036 AM Peak Option 2: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

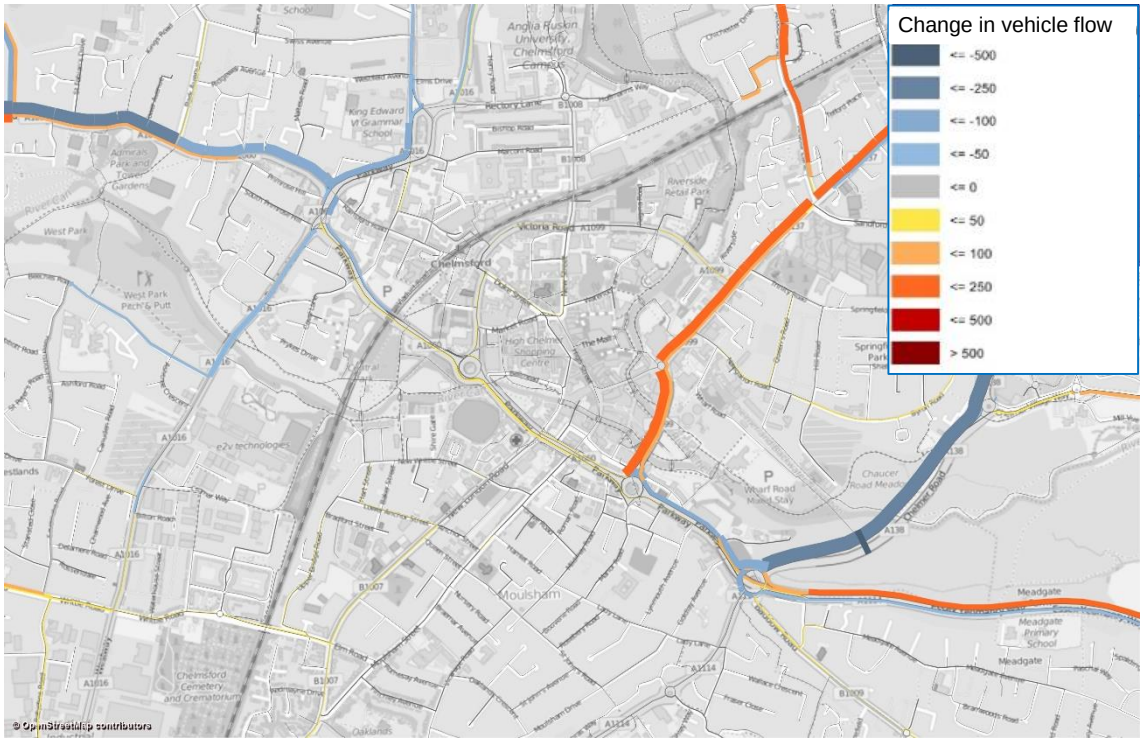


Figure C.20: 2036 AM Peak Option 2: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

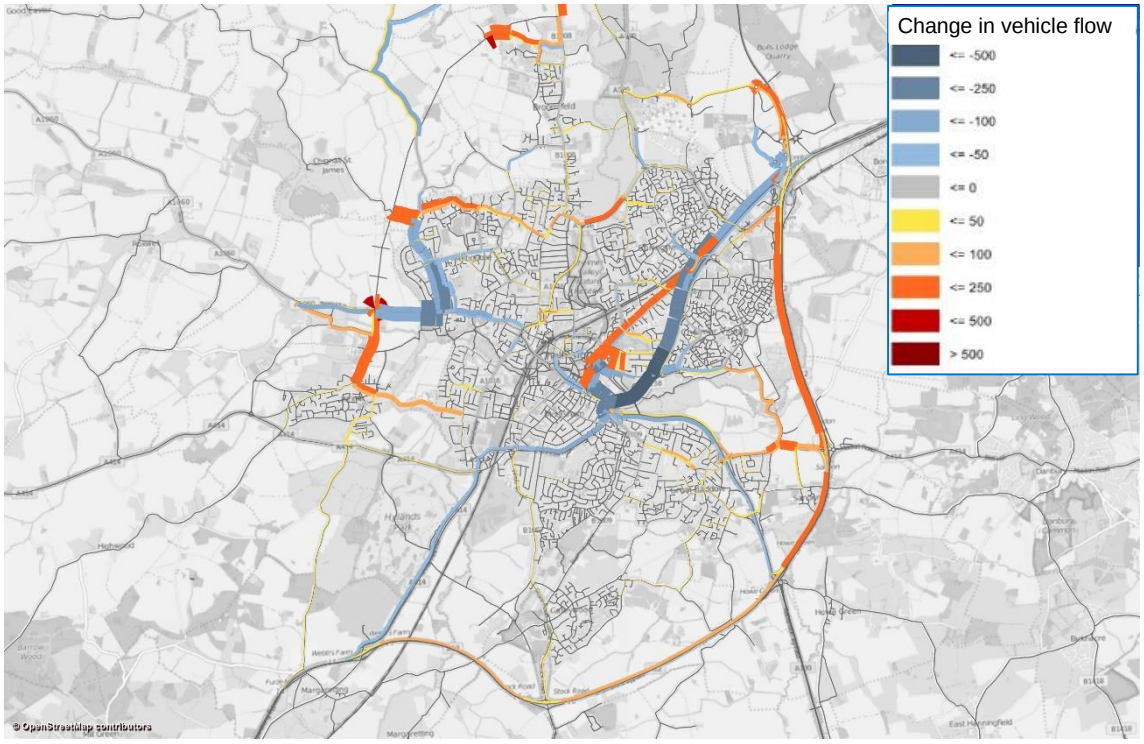


Figure C.21: 2036 Inter Peak Option 2: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

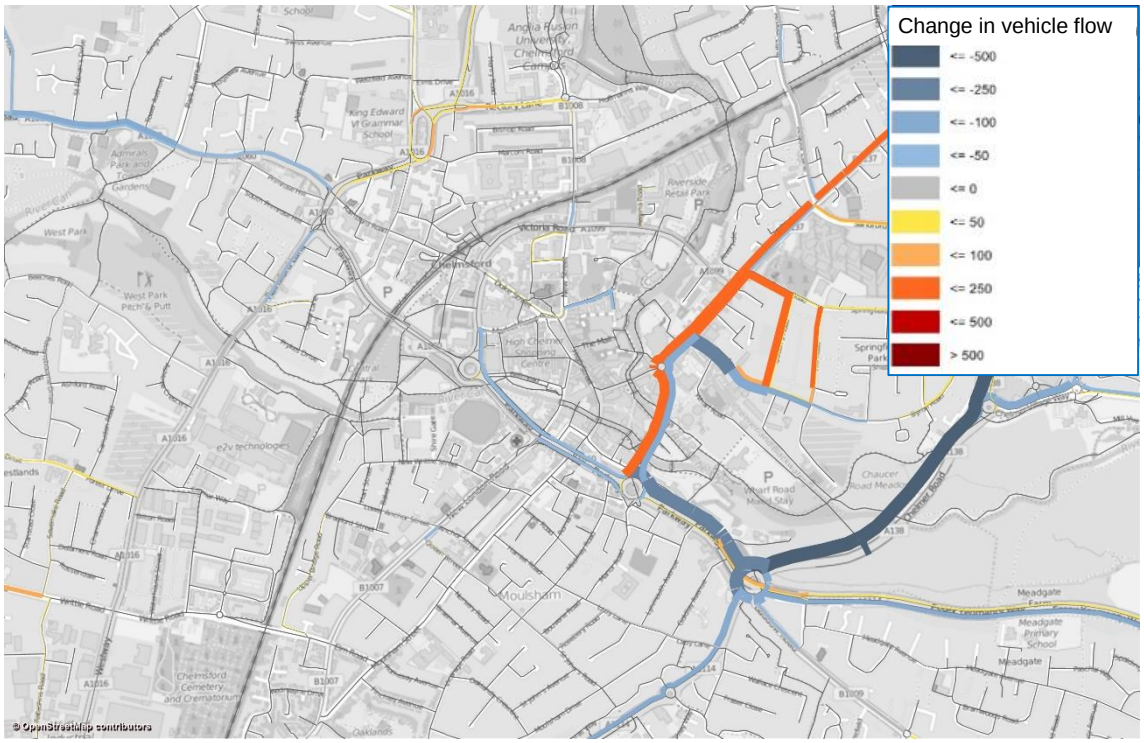


Figure C.22: 2036 Inter Peak Option 2: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

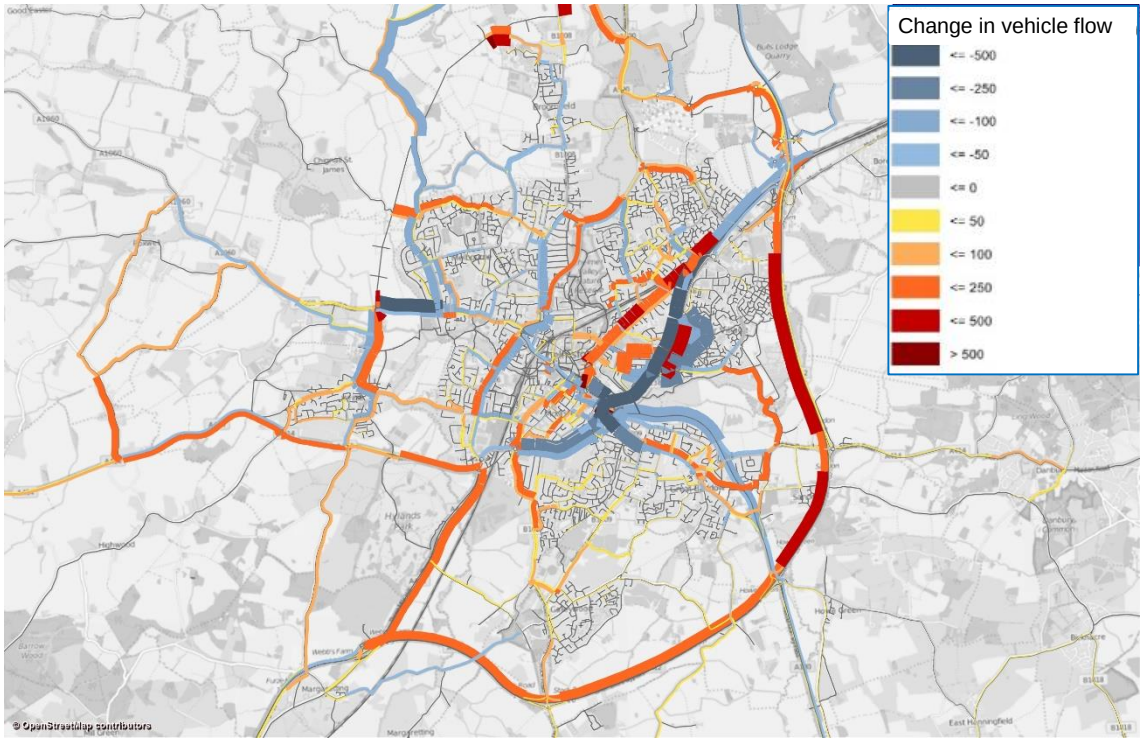


Figure C.23: 2036 PM Peak Option 2: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

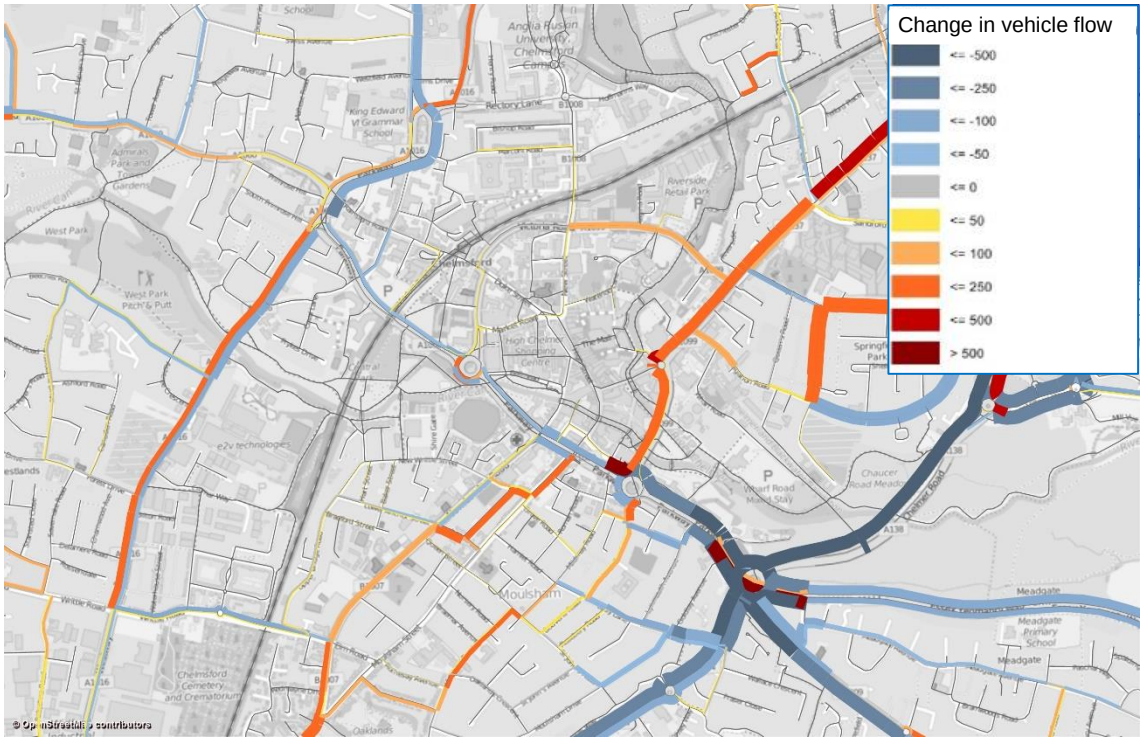


Figure C.24: 2036 PM Peak Option 2: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

C.5 Impact of infrastructure on forecast traffic flows – Option 3

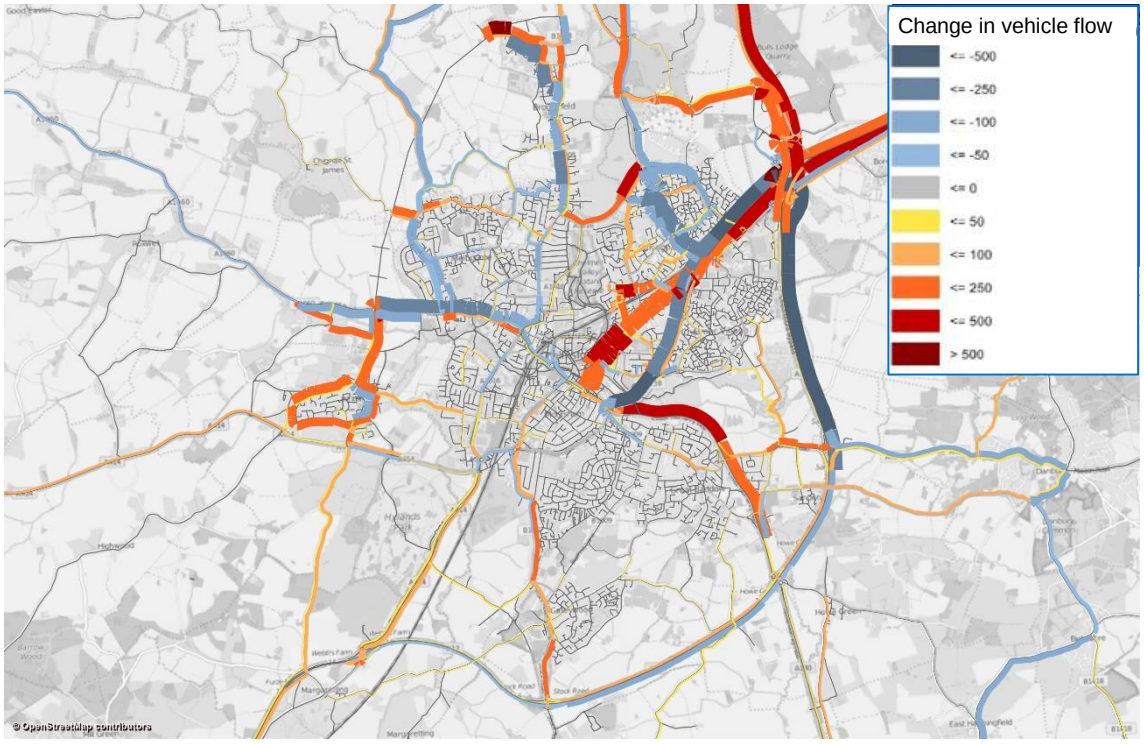


Figure C.25: 2036 AM Peak Option 3: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

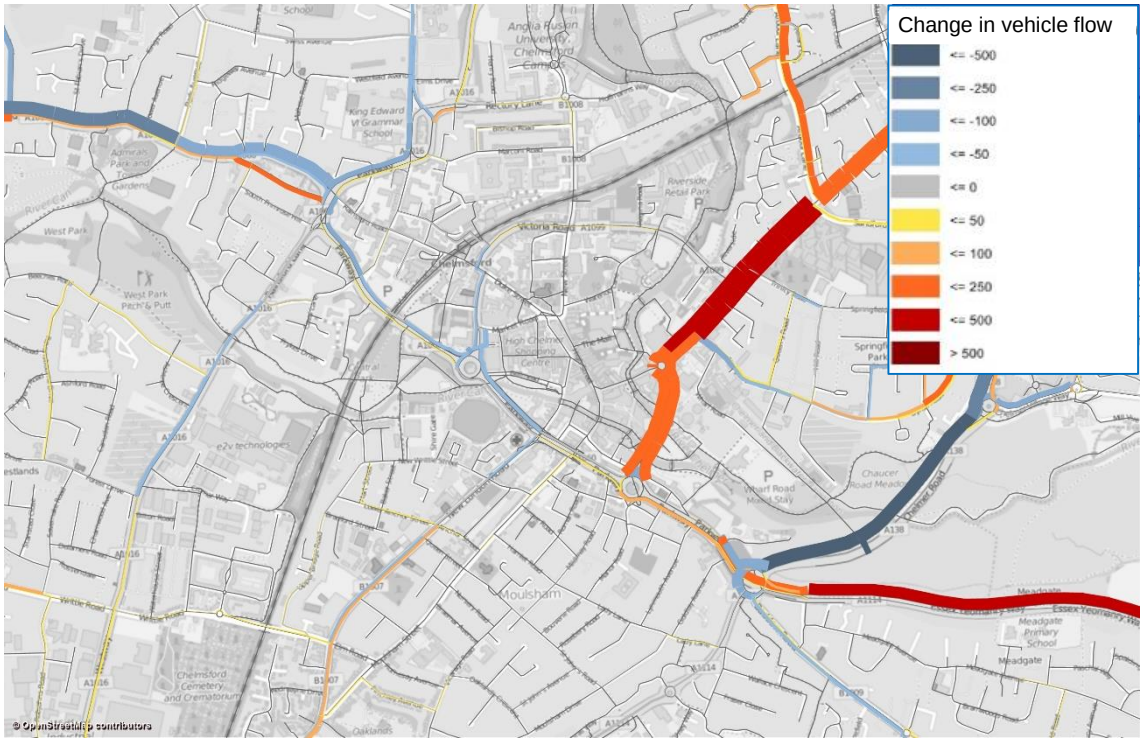


Figure C.26: 2036 AM Peak Option 3: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

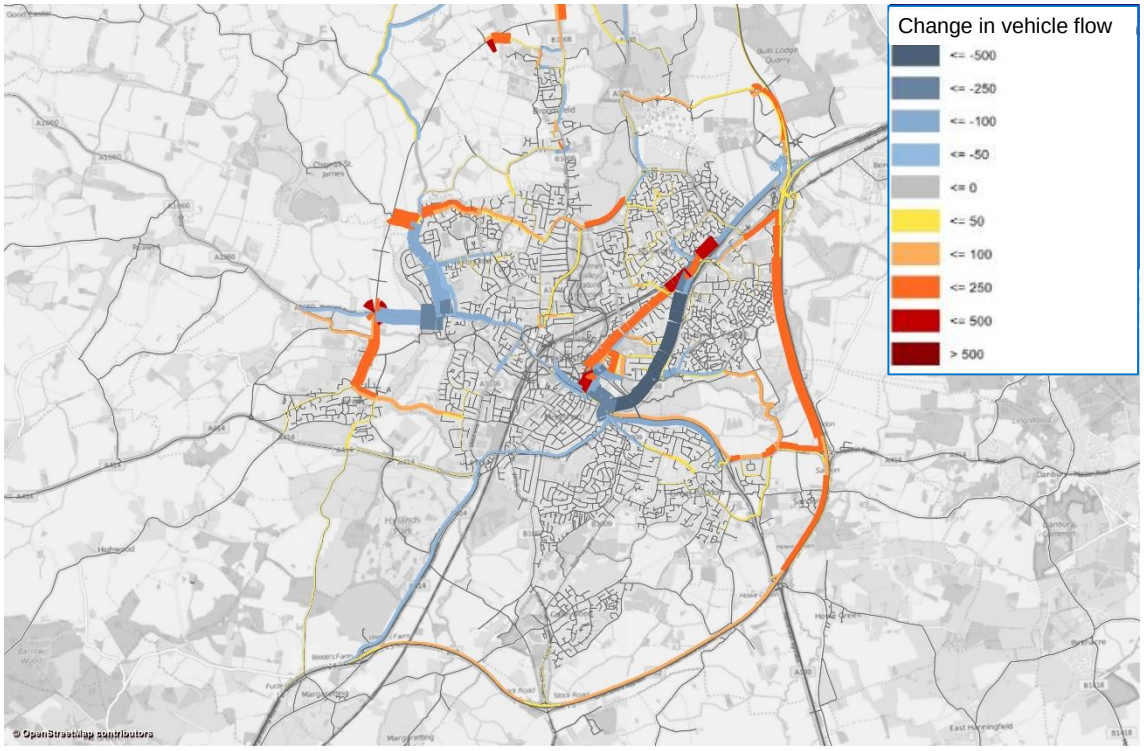


Figure C.27: 2036 Inter Peak Option 3: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

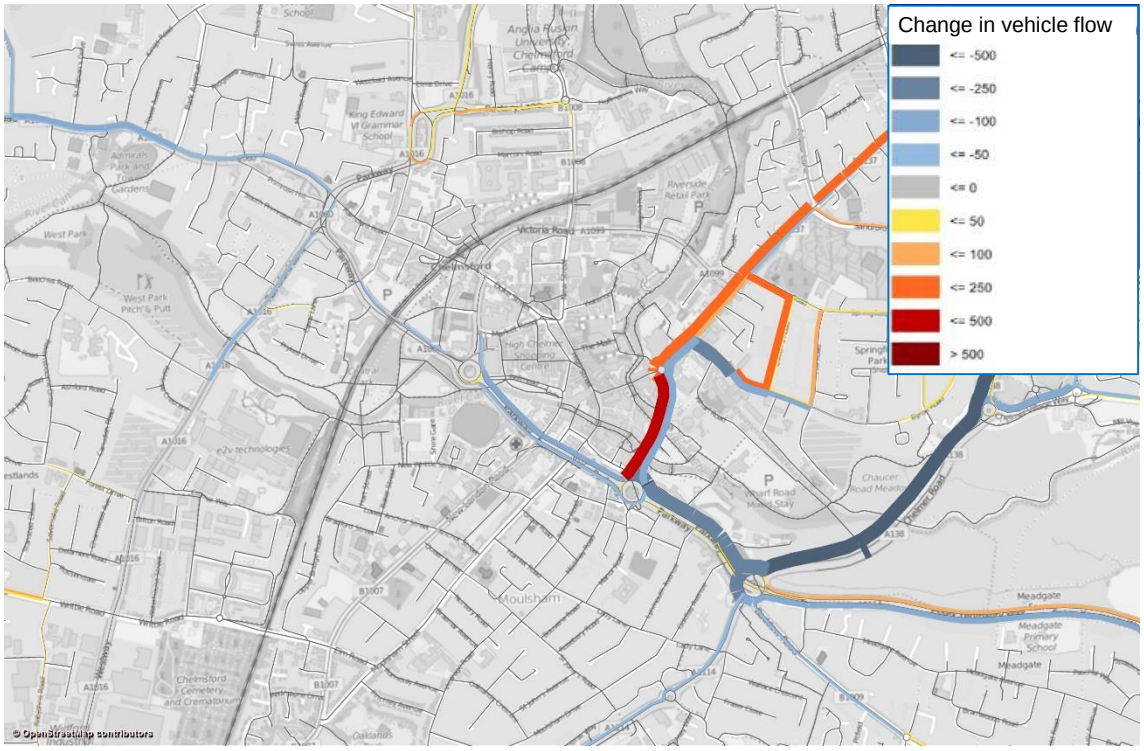


Figure C.28: 2036 Inter Peak Option 3: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

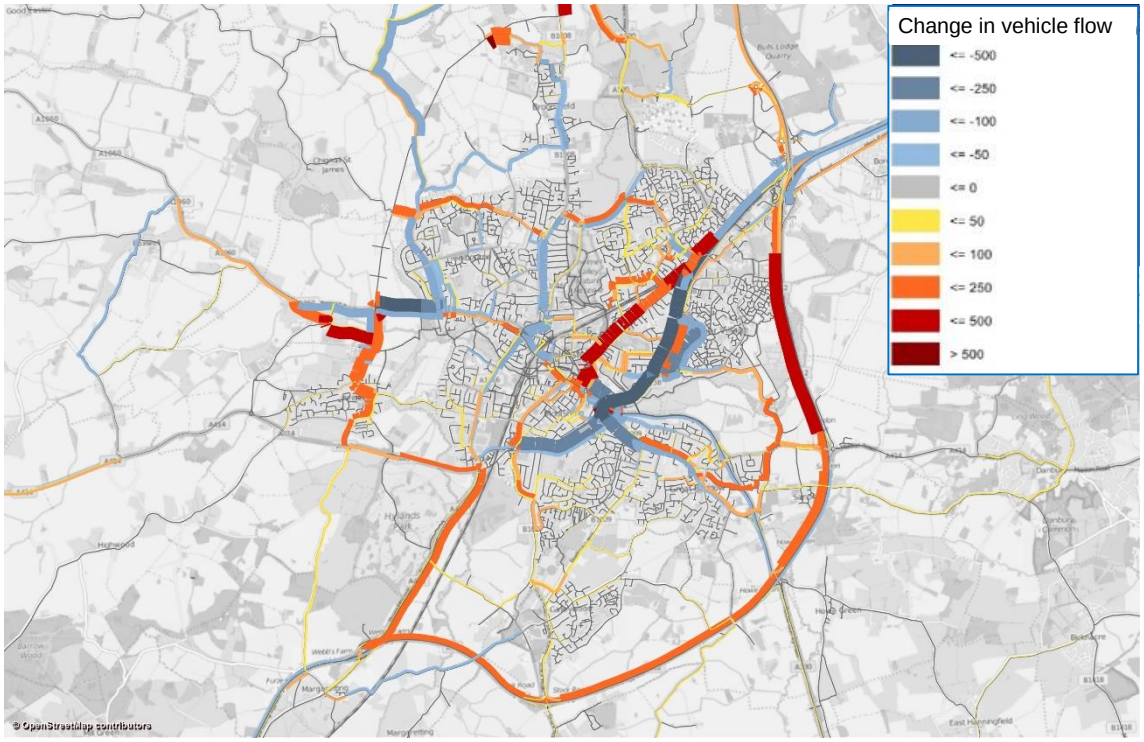


Figure C.29: 2036 PM Peak Option 3: Change in 'actual' flow following addition of infrastructure – Chelmsford urban area

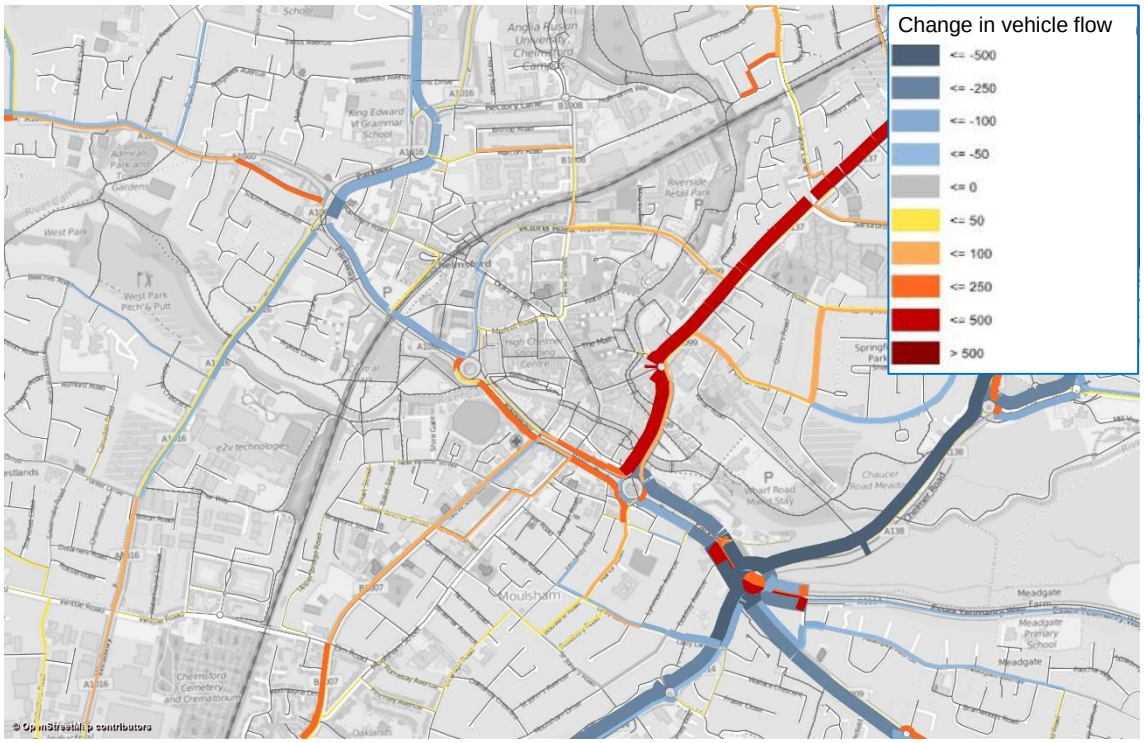


Figure C.30: 2036 PM Peak Option 3: Change in 'actual' flow following addition of infrastructure – Chelmsford city centre

C.6 Impact on forecast network congestion – Option 1 with (w/) infrastructure

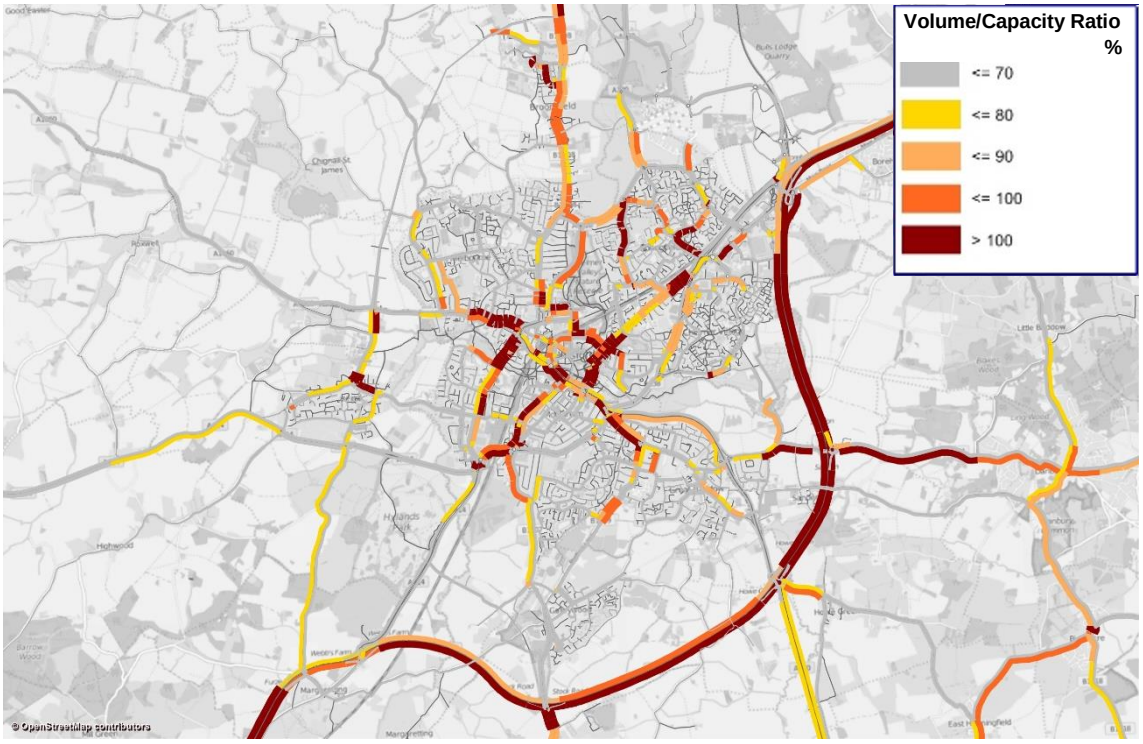


Figure C.31: 2036 Option 1 AM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford urban area

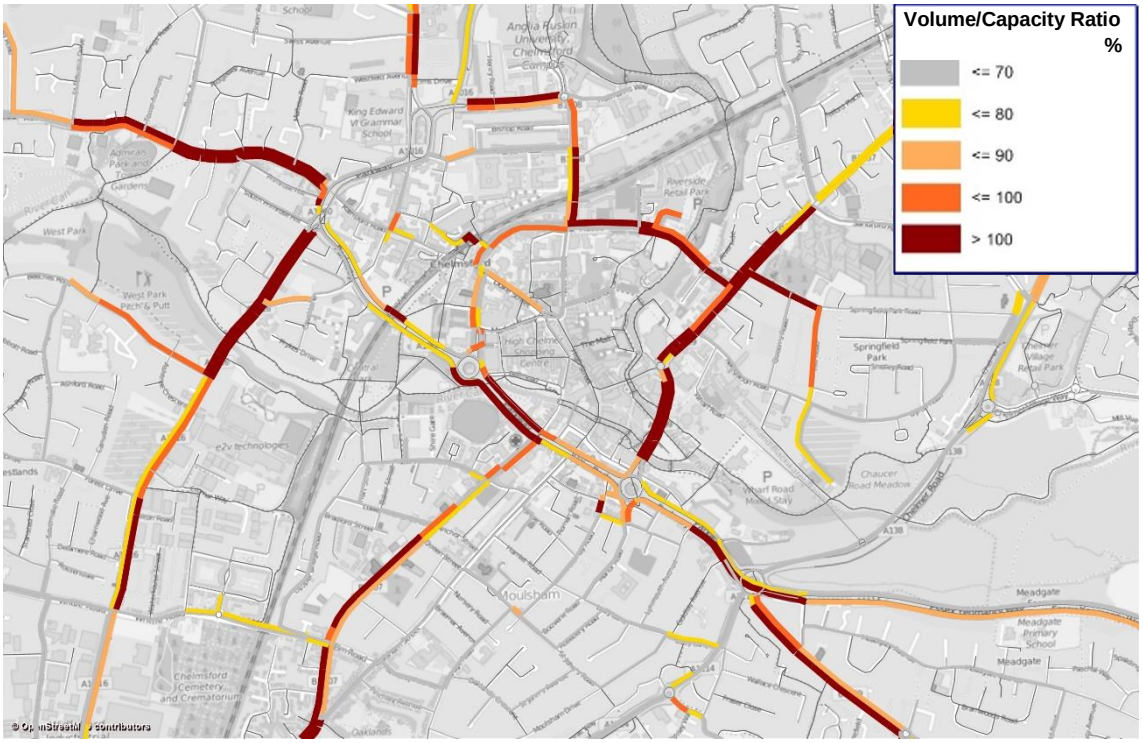


Figure C.32: 2036 Option 1 AM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford city centre

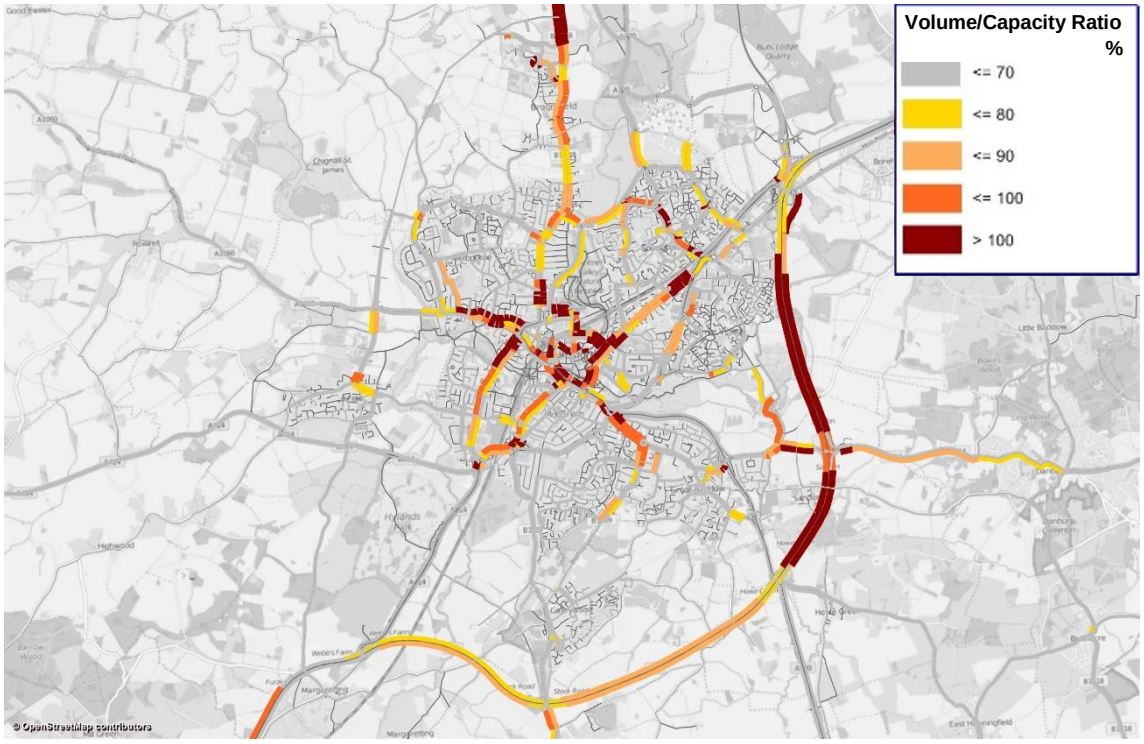


Figure C.33: 2036 Option 1 Inter Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford urban area

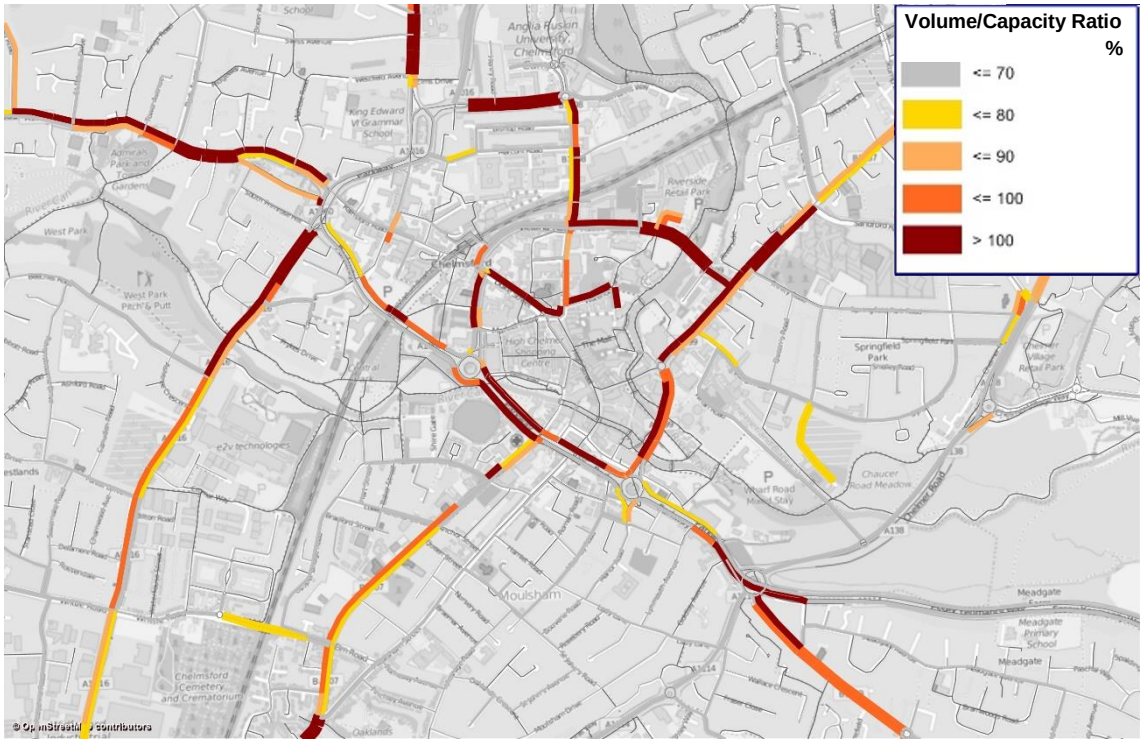


Figure C.34: 2036 Option 1 Inter Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford city centre

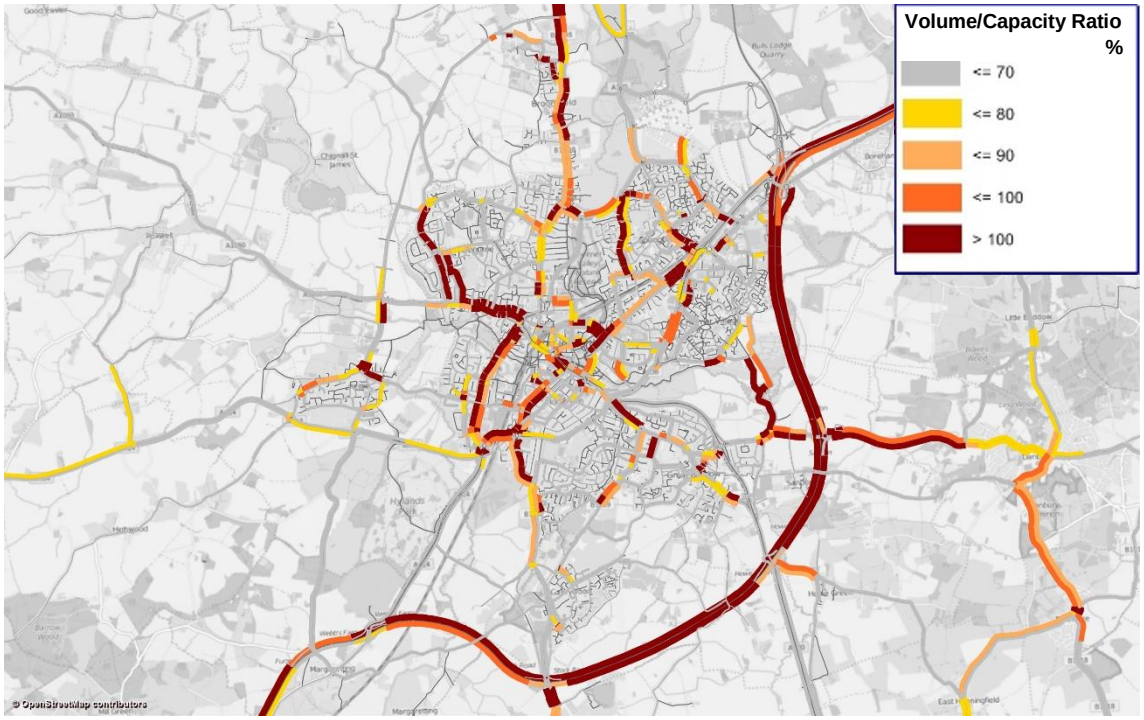


Figure C35: 2036 Option 1 PM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford urban area

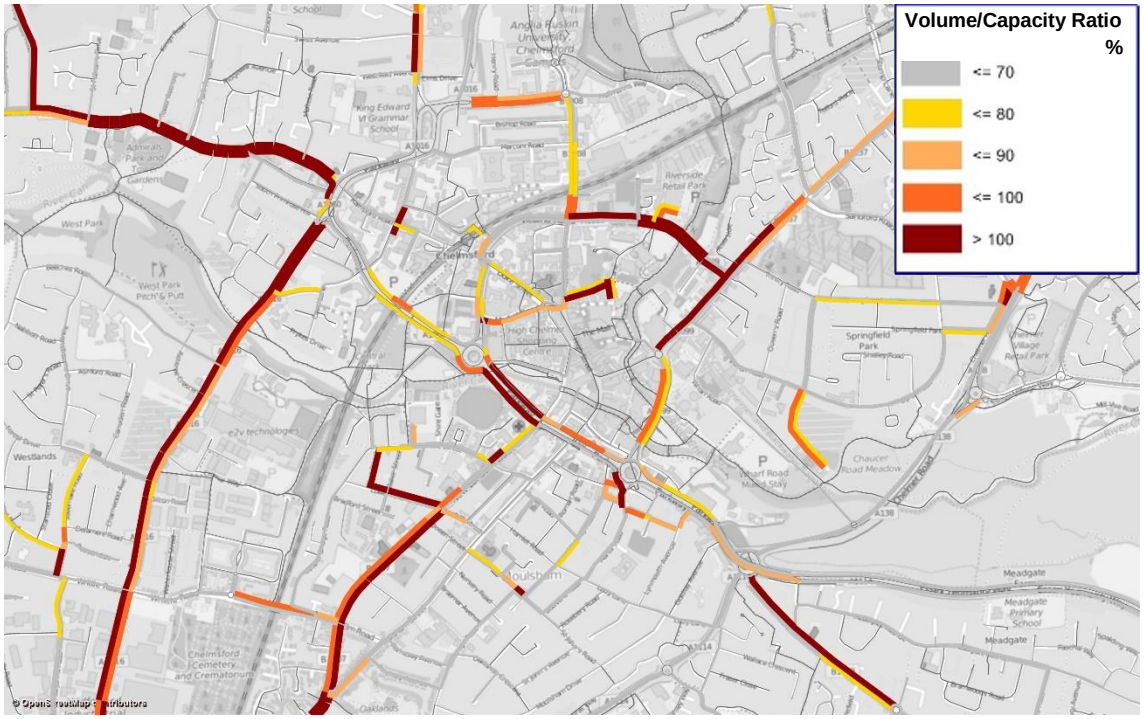


Figure C.36: 2036 Option 1 PM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford city centre

C.7 Impact on forecast network congestion – Option 2 w/infrastructure

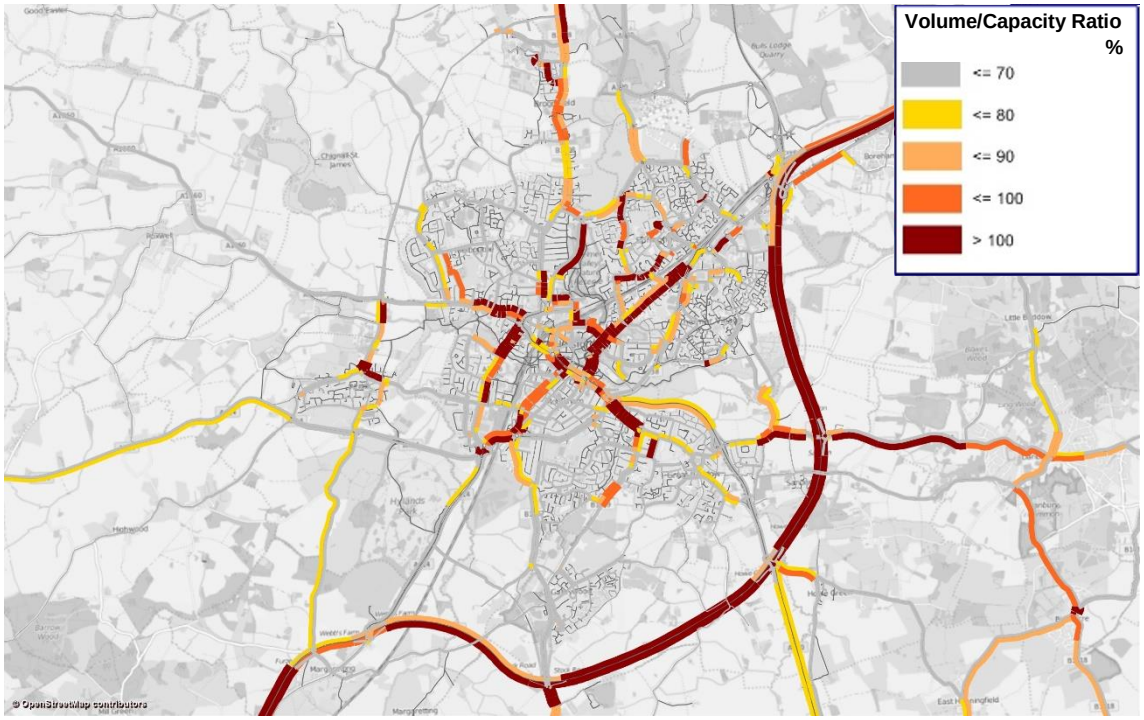


Figure C.37: 2036 Option 2 AM Peak 'volume / capacity ratios': w/ infrastructure – Chelmsford urban area

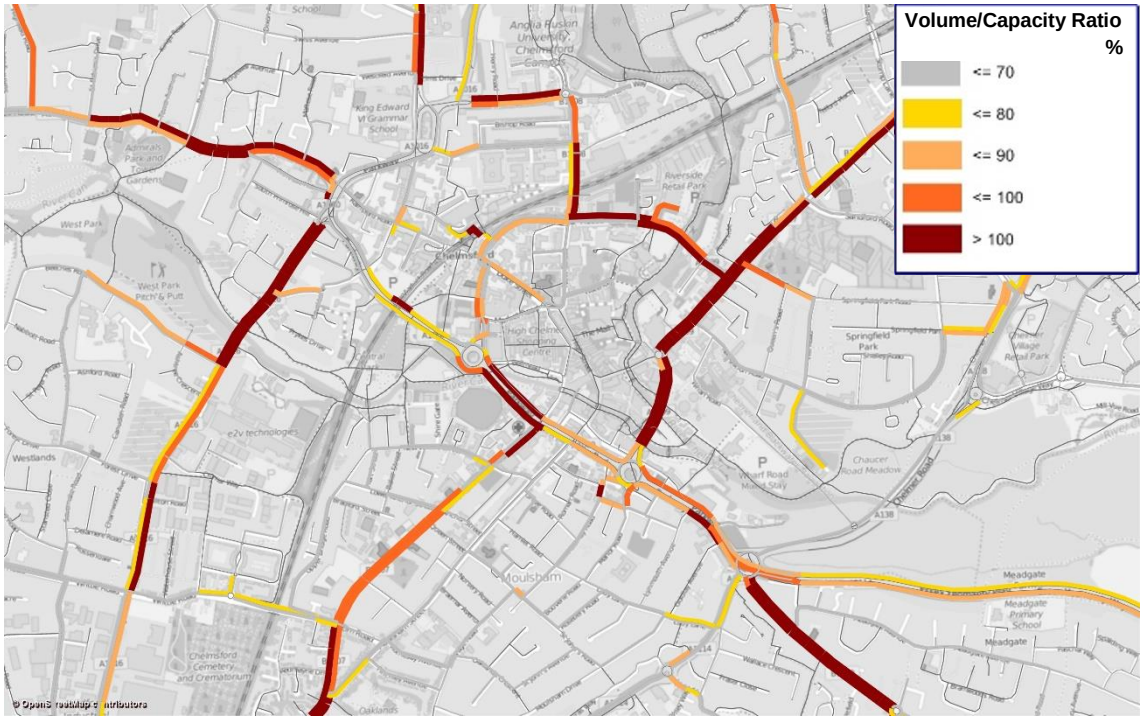


Figure C.38: 2036 Option 2 AM Peak 'volume / capacity ratios': w/ infrastructure – Chelmsford city centre

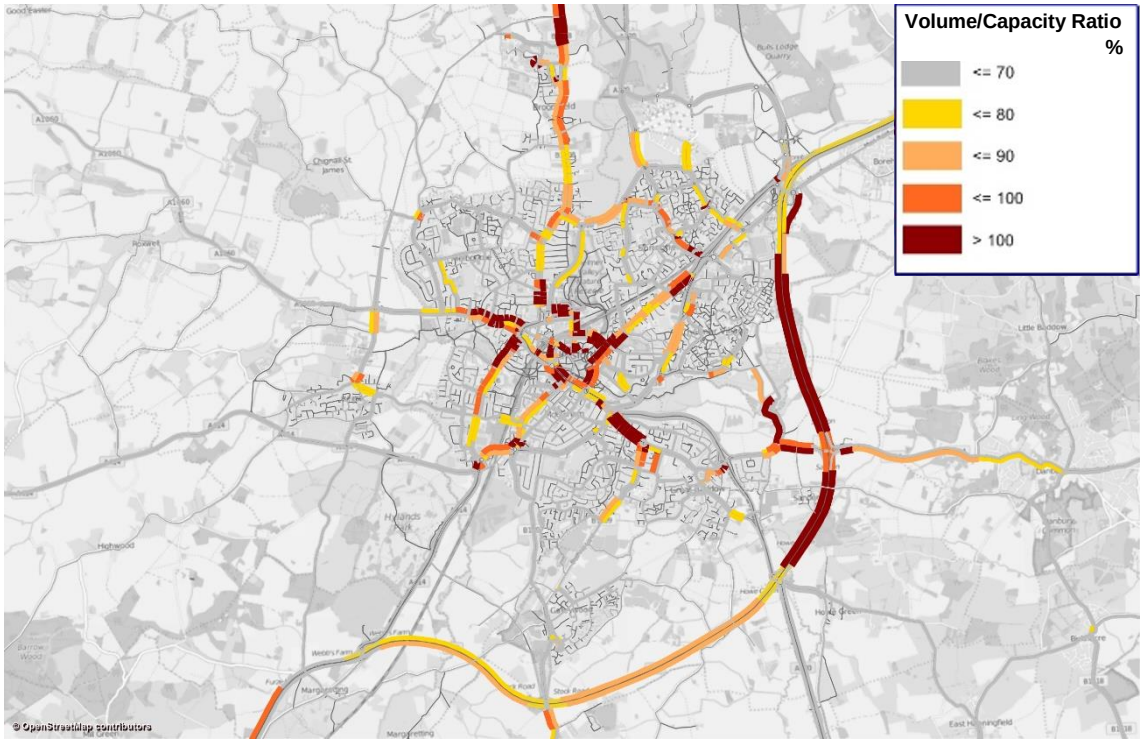


Figure C.39: 2036 Option 2 Inter Peak 'volume / capacity ratios': w/ infrastructure – Chelmsford urban area

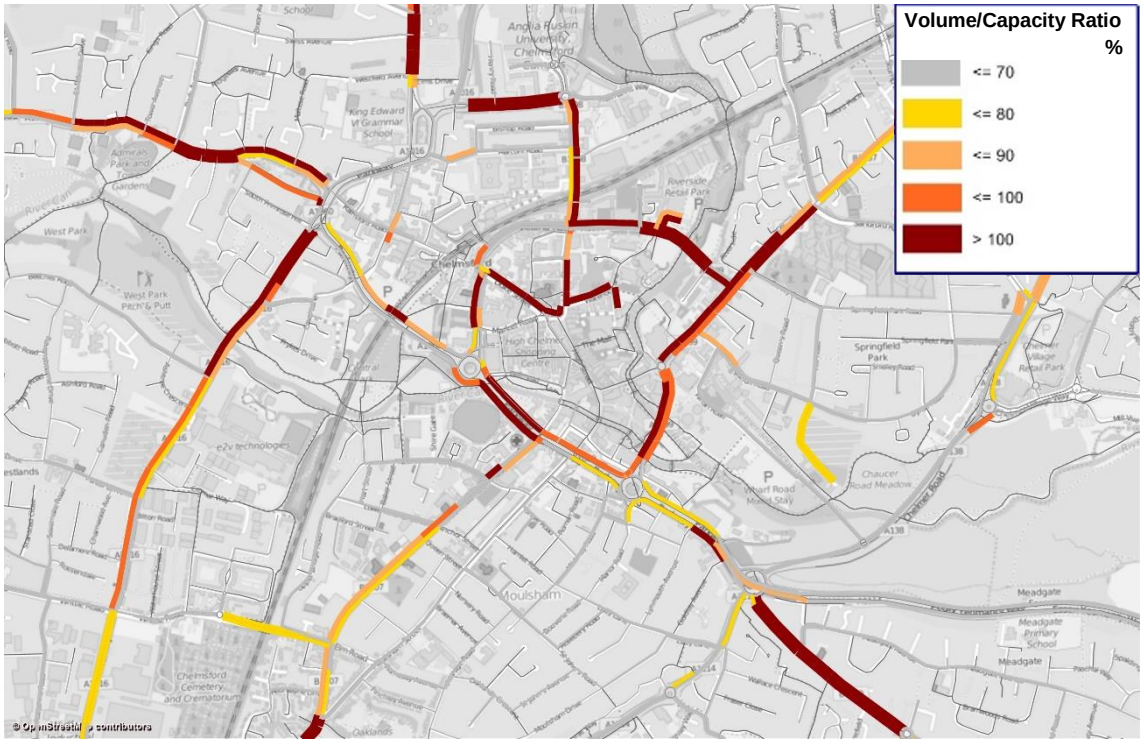


Figure C.40: 2036 Option 2 Inter Peak 'volume / capacity ratios': w/ infrastructure – Chelmsford city centre

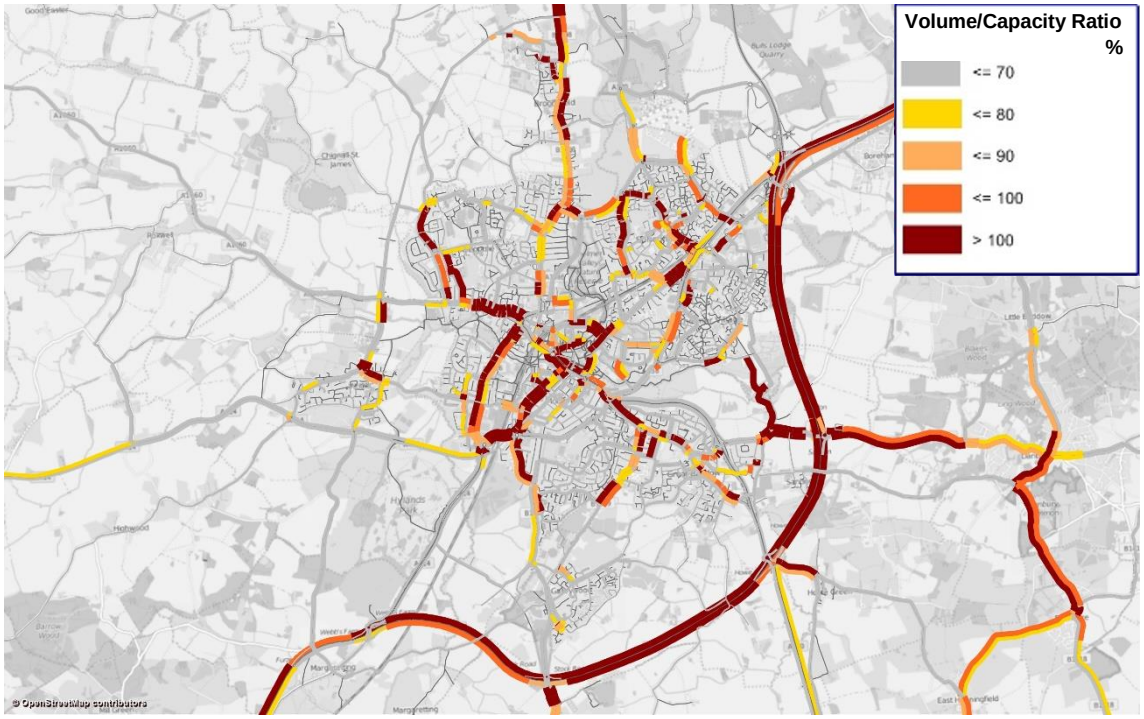


Figure C.41: 2036 Option 2 PM Peak 'volume / capacity ratios': w/ infrastructure – Chelmsford urban area

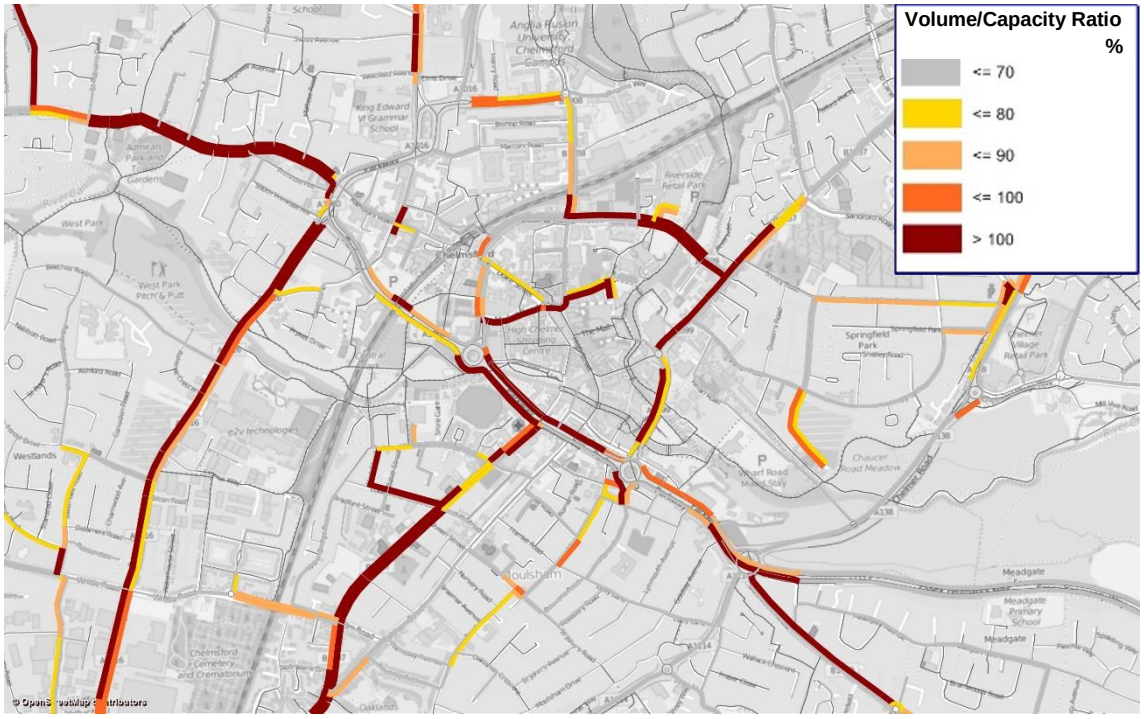


Figure C.42: 2036 Option 2 PM Peak 'volume / capacity ratios': w/ infrastructure – Chelmsford city centre

C.8 Impact on forecast network congestion – Option 3 w/infrastructure

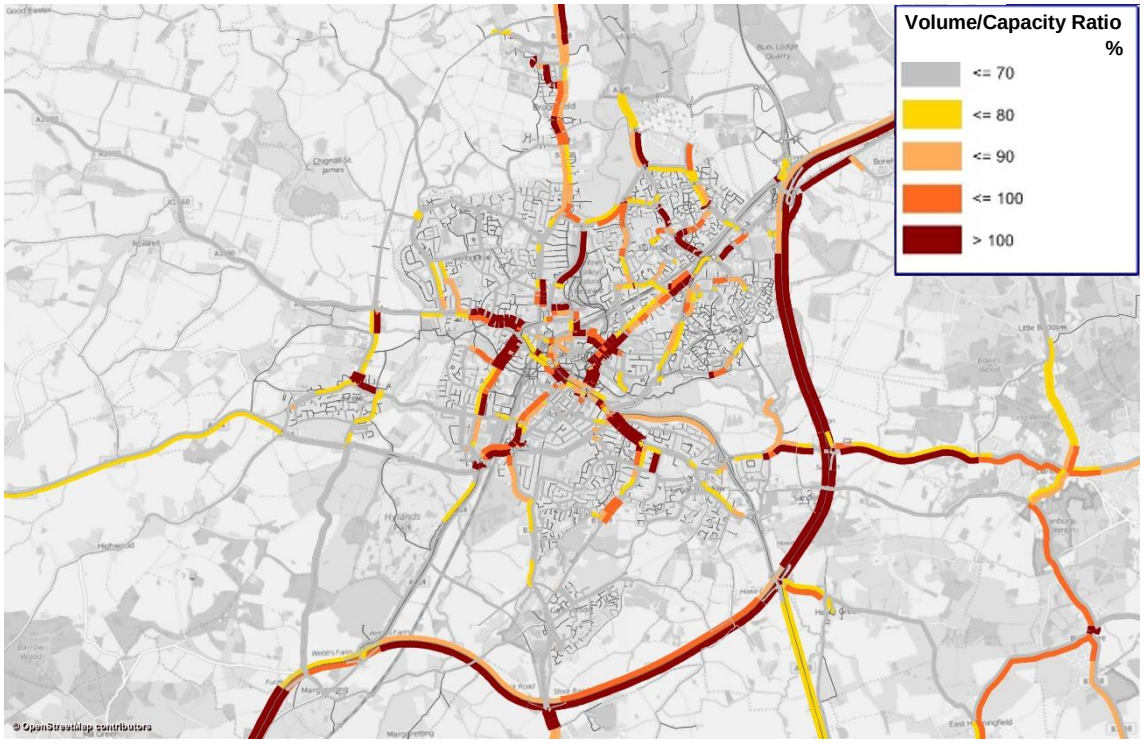


Figure C.43: 2036 Option 3 AM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford urban area

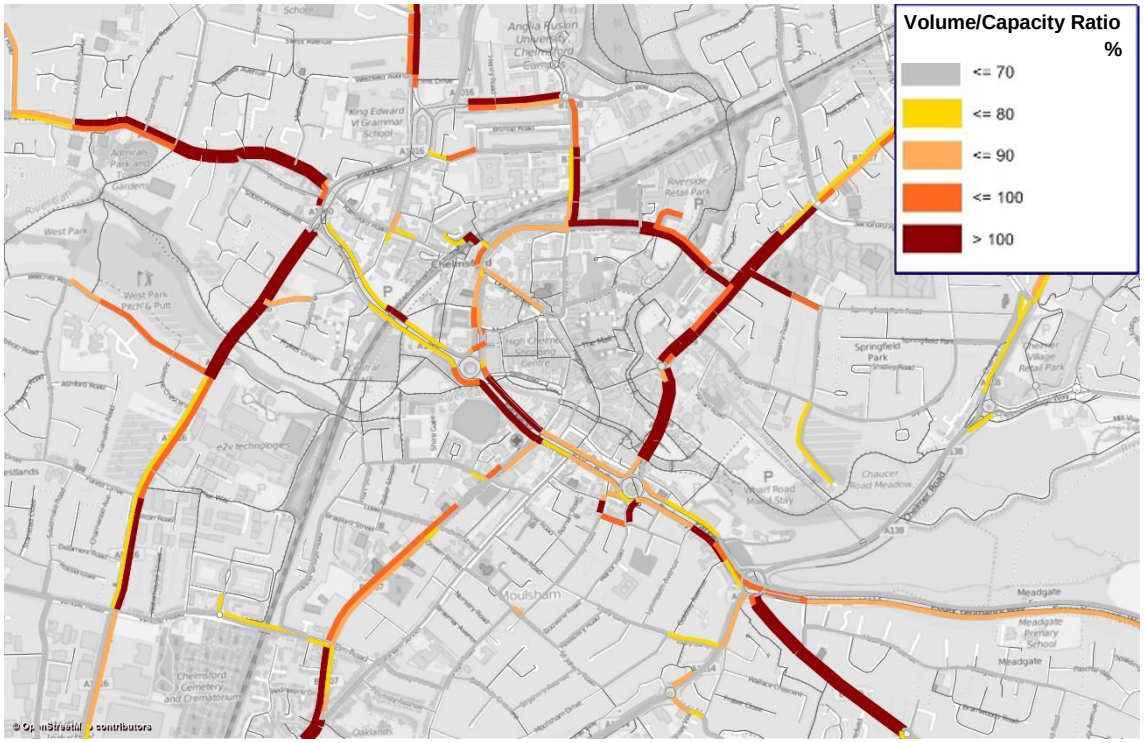


Figure C.44: 2036 Option 3 AM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford city centre

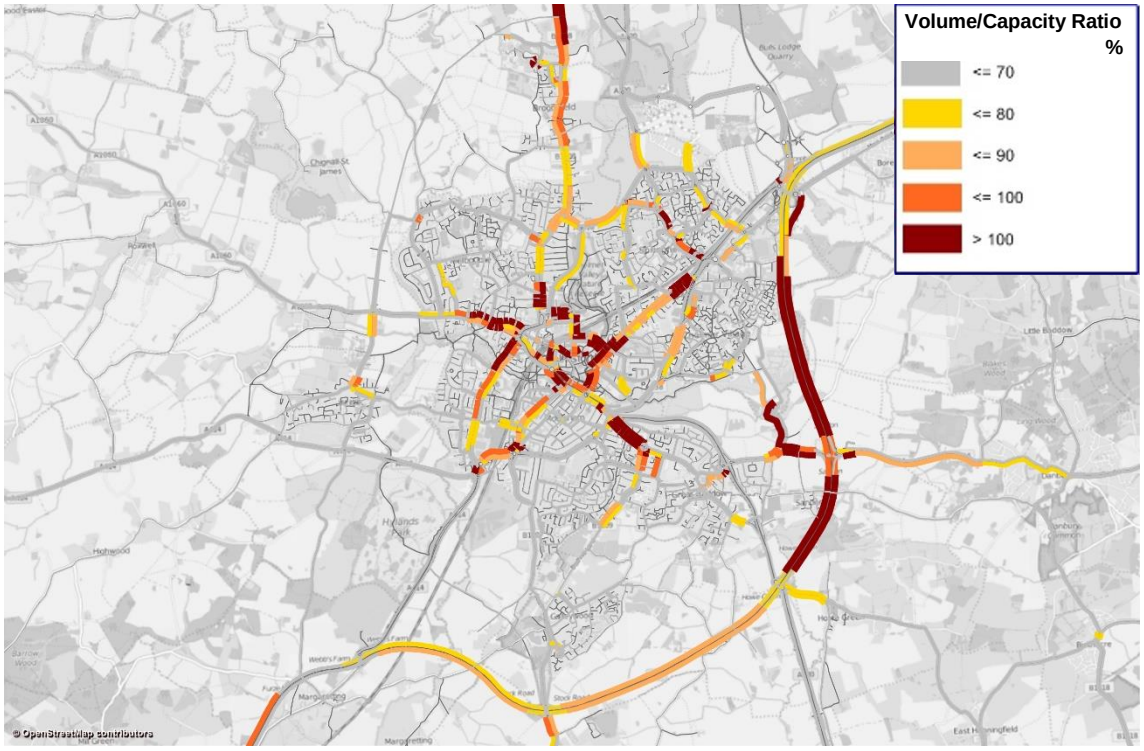


Figure C.45: 2036 Option 3 Inter Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford urban area

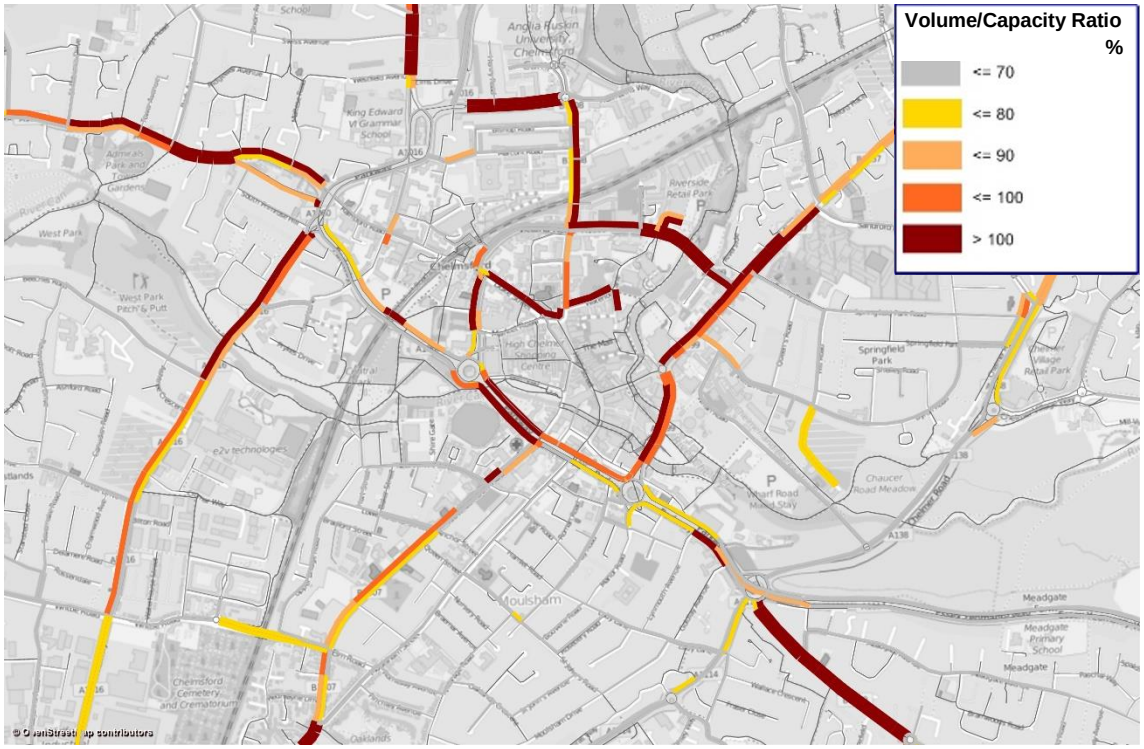


Figure C.46: 2036 Option 3 Inter Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford city centre

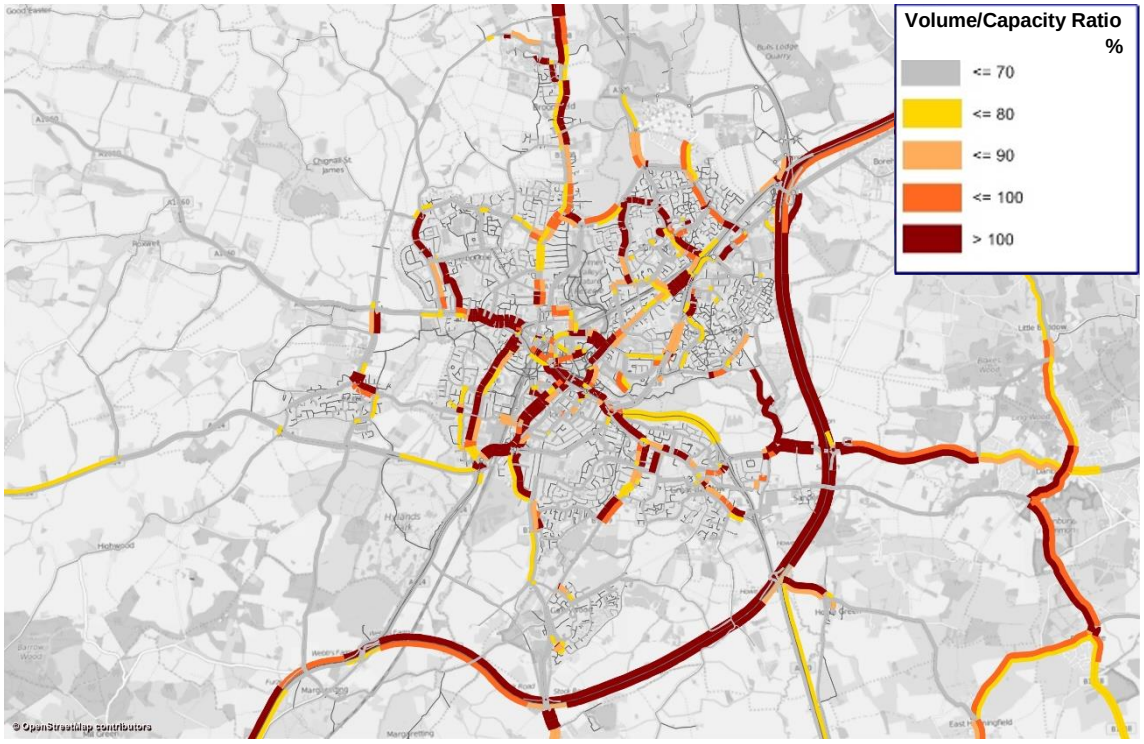


Figure C.47: 2036 Option 3 PM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford urban area

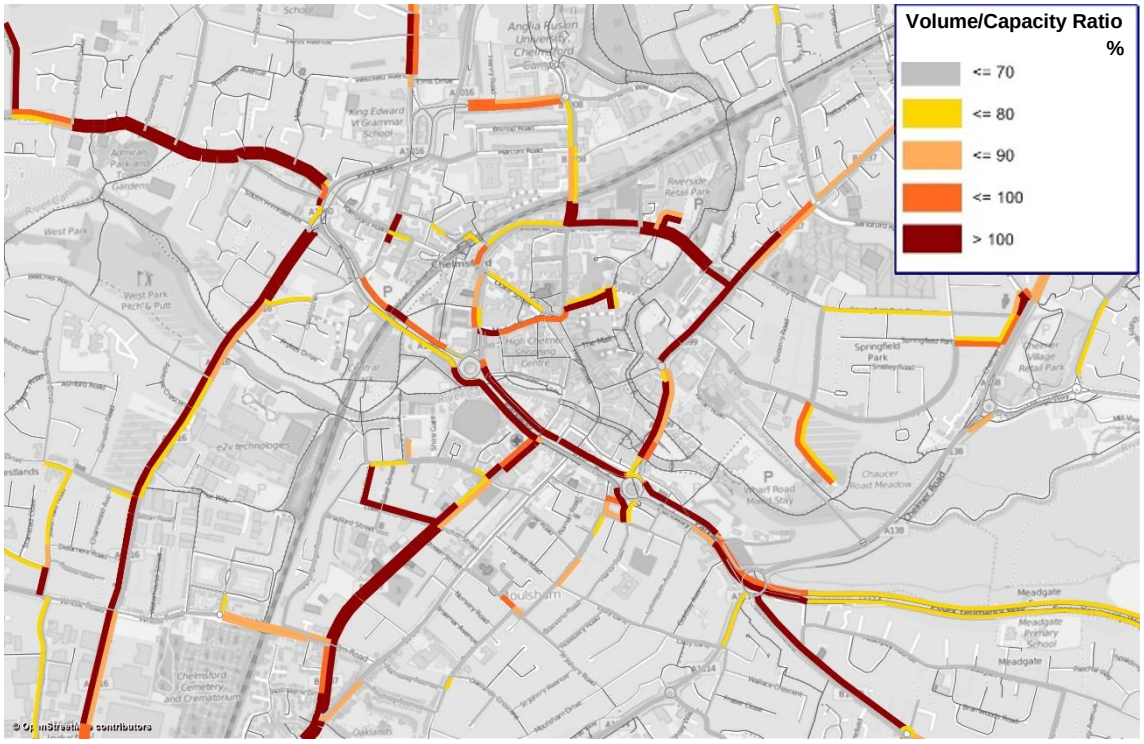


Figure C.48: 2036 Option 3 PM Peak 'volume / capacity ratios' w/ infrastructure – Chelmsford city centre

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