



APRIL 2019

Hearing Statement

Epping Forest Local Plan: Examination in Public

Matter 13

Iceni Projects Limited on behalf of
Tele Lands Improvement Limited

April 2019

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ON BEHALF OF TELE LANDS
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HEARING STATEMENT
EPPING FOREST LOCAL PLAN: EXAMINATION IN
PUBLIC

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1. MATTER 13: TRANSPORT

Issue 1: Has regard been had to the Mayor of London's draft Transport Strategy and London Plan in proposing Policy T1; and are its provisions clear and effective?

- 1.1 With respect to whether the provisions of Policy T1 are clear and effective, we consider the objectives are clear – to manage congestion, to reduce journey times, to minimise the need to travel, to promote opportunities for sustainable transport, and not to result in unacceptable increases in traffic generation or compromise highway safety. However, the SVLP itself lacks the detail of coordinated sustainable transport measures or major strategic interventions to support these objectives.
- 1.2 The 2019 Transport Assessment (**EB503**), produced to support the SVLP, identifies the following reductions in vehicle trip rates that are expected at new developments as a result of the following assumptions:
 - Sustainable transport measures, which have not yet been defined in any detail in the SVLP or Transport Assessment, but are predicted to reduce vehicle trips by 15% to 22%. We note that the car trip rates for some residential land uses have been reduced by up to 88% and we cannot find any justification or evidence to support this reduction. In addition we further understand from correspondence with Essex County Council that measures to achieve the very ambitious reduction in car use will be identified on a site by site basis, indicating there is, at present, no intention from the Council to identify comprehensive area wide solutions that would be required to achieve their target and make the development proposed in the SVLP acceptable.
 - A package of highway improvements for Epping that require Epping Forest SAC or Common Land (eg. improvements to the Wake Arms Roundabout and Theydon Road/High junction). However, these improvements have not been included in the Habitat Regulations Assessment (**EB209**) and therefore the impact of these proposed upgrades have not been tested under the Habitats Regulations. Furthermore, the Corporation of London who own this land advise that these projects aren't deliverable without likely significant effects on Epping Forest SAC.
 - Peak Spreading factors that have been assumed to reduce peak hour trip rates by up to 32%. In practice, peak spreading means that the congestion and extensive queuing predicted in Epping will occur for a greater part of the day.
 - "Reduced Parking" development that is expected to provide parking at around 50% of parking standards, reducing trip rates for these developments by around 60% in the AM peak. It should be noted however that many Local Planning Authorities have moved away from reduced car parking standards because of the adverse impacts they have on the local environment with spill over parking in neighbouring streets, on verges and pavements.

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- 1.3 The 2019 Transport Assessment (**EB503**) shows that many of the junctions in Epping will be over capacity with the SVLP development. This is even after the Council have made reductions in the car trip rates for:
- The sustainable transport measures that have not yet been identified;
 - A package of highway measures which probably cannot be delivered;
 - Peak spreading which will extend congestion over the day; and
 - Reduced parking development.
- 1.4 Whilst the Transport Assessment (**EB503**) does not provide queue lengths, a review of the existing situation (based on site visits and recent TPP surveys) and the Council's analysis in Transport Assessment which predicts extensive congestion in Epping, it is our view that queue lengths could extend through the entire town centre and beyond, and exceed the existing queues of up to 1km that currently occur at the Wakes Arms Roundabout.
- 1.5 A review of the updated 2019 Transport Assessment (**EB503**) for the SVLP is attached as **Appendix A1**. This provides a more detailed response to the analysis and conclusions in the revised Transport Assessment.
- 1.6 Therefore, we do not consider that the transport effects of the plan as a whole have been properly tested and sufficient mitigation has still not been properly identified. This is clear from the latest Transport Assessment (**EB503**) which identifies that there will be a significant increase in congestion in Epping town and the Epping Forest SAC as a result of the SVLP development.
- 1.7 It can therefore be concluded that the LPA does not currently have a spatial strategy that delivers the objectives in Policy T1. The LPA should consider measures that would allow the SVLP to meet these objectives, including the provision of a Western Relief Road around Epping. In August 2015, Essex County Council undertook a review of a relief road option to alleviate congestion on Epping High Street in 'Epping Town Strategy, Western Relief Road and High Street Feasibility Study' (**Appendix A2**), and includes indicative plans for the relief road route. This demonstrated that a relief road would remove through traffic and significantly improve traffic conditions in the town centre.
- 1.8 A Western Relief Road could allow for extensive improvements for pedestrians and cyclists, transforming Epping Town Centre and the way people travel in Epping. This could also reduce car trips by existing and future residents, offsetting the impact of Local Plan Development, and enabling the Council to achieve the ambitious targets for car trip reduction.

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- 1.9 Having undertaken extensive traffic survey work in Epping town ourselves, we believe the relief road could be a single carriageway road creating a green corridor in the manner of a country lane. Areas of SANGs could be provided in this corridor to reduce the impact on Epping Forest SAC.
- 1.10 We recommend that significant work on transport issues still need to be undertaken for the Local Plan to proceed. In relation to Policies T1 and T2 (discussed below), this includes:
- Detailed work on sustainable transport measures demonstrating how vehicle trip rates will be reduced by 15% to 22%. We would request examples of where this level of change has been achieved. We would also appreciate an explanation and justification of how an 88% reduction has been derived for some residential car trip rates.
 - Confirmation that the highway improvements referred to can be delivered, given that they take up Epping Forest SAC land, have not been tested through a Habitat Regulations Assessment and have received objection from the Corporation of London.
 - Confirmation of the level of queuing that would be expected as result of the SVLP development in Epping town centre and Epping Forest SAC.
 - Further work on peak hour spreading to confirm for how much of the day junctions in Epping town centre and Epping Forest SAC will be congested with the proposed SVLP development.
 - An assessment of the air quality and other environmental impacts of the expected congestion and queuing in Epping town centre, including the Air Quality Management Area (AQMA) at Bell Common, as well as the air quality impacts on Epping Forest SAC.
 - A study of the impacts of proposals for reduced car parking standards.
 - To identify the transport mitigation that is required to mitigate the impacts of the SVLP, that can be delivered and therefore identify land that needs to be safeguarded
- Q1: Does this policy take account of the strategic transport objectives in the Mayor of London's draft Transport Strategy and London Plan? Would the policy support the objectives of these documents in respect of transportation and have any specific conflicts been identified? (Reps TfL).
- 1.11 The SVLP "*Policy T1 Sustainable Transport choices*" broadly reflects the strategic objectives of the Mayor's draft Transport Strategy with regard to Healthy Streets, a comfortable and convenient public transport experience, and the provision of new homes and jobs. Policy T1 states that the Council will promote a safe, efficient and convenient transport system which will promote transport choice. This is to be achieved through improvements to public transport services and providing coherent and direct cycling and walking networks to provide a genuine alternative to the car and facilitate a modal shift. This reflects the objectives of the Mayor's draft Transport Strategy. However, as identified

above the SVLP itself lacks the detail of coordinated transport measures or major strategic interventions to support these objectives.

Q2: Should Part A, perhaps A(ii) make reference to the desirability of promoting safer routes to school and to establishing an attractive pedestrian environment around schools to encourage travel by non-car modes?

- 1.12 We agree that Policy T1 should make reference to the desirability of promoting safer routes and promoting walking and cycling to schools.

Q3: Is it clear what scale/type of development will be required to submit a Transport Statement or Assessment in accordance with Part D?

- 1.13 It is not clear from Policy T1 what scale and type of development will be required to submit a Transport Statement or Assessment.

A1. TPP TRANSPORT NOTE

Epping District Forest Local Plan

EFDC Revised Transport Assessment January 2019

Tele Lands Comments

Introduction

1. EFDC issued a revised "Transport Assessment Report" (EB503) at the end of January 2019 for the Local Plan. The analysis in this report indicates that there will be significant increases in congestion in Epping as a result of the Local Plan development. In particular these increases will occur on the B1393 High Road, around the town centre and in the Forest where there will be extensive queues of vehicles. This can be expected to lead to poorer air quality and other environmental and economic impacts on the town centre and the Forest.

Results of Traffic Analysis

2. The results of the traffic analysis from the Epping Forest District Council (EFDC) revised Local Plan Transport Assessment (EB503) are summarised in Table 1 below. This compares the existing situation with the Council's predictions for the Local Plan Scenario 3 (which assumes significant reductions in vehicle trips as a result of improvements for walking, cycling and public transport) and Scenario 4 which in addition to the sustainable transport measures in Scenario 3 assumes a package of highway improvements.
3. The definitions for Local Plan Scenarios 1 to 4 in the revised Transport Assessment (EB503) are as follows.
 - **Scenario 1 '2017 Base Year'** - an assessment of network performance for the current situation;
 - **Scenario 2 '2033 Do-Minimum'** - includes all residential development sites that have received planning permission within EFDC to October 2016, other TEMPro planning assumptions across the Plan period along with full background traffic growth. This scenario assumes no new highway schemes or sustainable modal shift to rail, bus or active modes; Note Scenario 2 is not summarised in the table 1.
 - **Scenario 3 '2033 Do-Something Existing Network'** - continuation of Scenario 2 with the addition of LPSV development with adjusted TEMPro background traffic growth. This scenario assumes the inclusion of reasonable sustainable transport improvements with no new highway schemes; Note reasonable is the term used by the Council for the still to be defined sustainable transport measures.

- **Scenario 4 '2033 Do-Something Mitigated Network'** – continuation of Scenario 3 with the inclusion of a package of highway improvement schemes;
4. When reviewing table 1 it is worth noting that a Degree of Saturation (DoS) above 85% or 90% is usually considered to be over capacity and above 100% extensive queues can develop. Therefore from the Council's Transport Assessment it is apparent that many of the junctions in the town centre and Forest will be significantly congested with the Local Plan development.

Table 1 Congestion in Epping AM/PM Peak Degree of Saturation (DoS)

Junction	Local Plan Scenario 1		Local Plan Scenario 3		Local Plan Scenario 4	
	Existing 2017 traffic		Local Plan + sustainable transport measures		As Scenario 3 + highway improvements	
	AM	PM	AM	PM	AM	PM
A121/B1393 Wakes Arms roundabout	119%	113%	186%	173%	130%	135%
B1393 Thornwood Rd	89%	118%	129%	164%	124%	147%
B1393 / St Johns Rd	76%	62%	148%	135%	106%	101%
Bury Lane/ High Rd	94%	92%	160%	131%	109%	82%
Theydon Rd/ High Rd	95%	82%	173%	162%	98%	106%

Scenario 1, Existing 2017 traffic

5. It is apparent from the EFDC revised Transport Assessment that the highway network in Epping is already close to or at capacity. Indeed there are often queues in Epping throughout the day even at some of the junctions that currently have a DoS below the 85% to 90% threshold in the Council's analysis.

Scenario 3, Local Plan + sustainable transport measures

6. When the Local Plan development is added traffic conditions in Epping become much worse than they are at present. Even after allowing for the as yet to be defined sustainable transport measures, which the Council hope will significantly reduce car trips, all of the junctions are significantly overcapacity as demonstrated by the Councils Scenario 3.

7. Unfortunately the EFDC analysis does not provide queue lengths. However a review of the existing situation suggests that these could be very extensive and certainly much longer than the existing queues, particularly in Epping High Street and Epping Forest. In our view based on the Council's analysis, these queues could at times extend the whole length of the town centre and beyond and at the Wakes Arms roundabout be considerably longer than the existing queues of around 1km that currently occur at peak times.
8. In practice conditions could be even worse than predicted in the Council's Scenario 3. This is because the council have still not identified to any level of detail what sustainable transport measures will be put in place to reduce vehicle trips by the 15% to 22% they are claiming or the 23% to 88% reduction they appear to have applied to vehicle trip rates for private houses and flats for example. The difference in the stated reduction of trip rates in the Transport Assessment (EB503) and the reduction that appears to have been applied to the trip rates for private houses and flats also needs to be explained.
9. Towns that have achieved significantly reduced car trip rates have usually achieved this as a result of major strategic interventions by the authorities. This might include creating town centres with very low traffic flows, major cycle networks, creating an environment where walking and cycling are more attractive than car use and major public transport investment such as tram networks. No such measures are currently set out in the Local Plan for Epping. Also ECC have informed us that the mitigation will be identified on a site by site basis with the developers of each site. Therefore it seems that there is no intention to identify the comprehensive area wide solutions that would be required to achieve the reductions in car trips that the Council are relying on to make the Local Plan acceptable.

Scenario 4 Local Plan + sustainable transport + highway improvements

10. The council have identified a package of highway improvements for Epping which are included in Scenario 4. However with the exception of the St John's Road junction the highway measures require Forest or Common Land. The Corporation of London has said that the improvements are not deliverable without likely significant effects on Epping Forest SAC and the HRA report does not assess the impact of these highway measures. Therefore it would appear unlikely that the highway improvements can be delivered.
11. Even with the package of highway measures, which probably cannot be delivered, and the sustainable transport measures that have not yet been identified, all of the junctions in table 1 would still be still over capacity in the AM peak. In the PM peak all of the junctions, except Bury Lane, would also be over capacity.

Peak Spreading factors, Scenario 5 and 6

12. The revised Local Plan Transport Assessment considers two further Scenarios, 5 and 6. These are a continuation of Scenario 3 and 4 but with the application of Peak Spreading factors. In practice this means that the Council have assumed that the congestion and queuing they have predicted in Epping will occur for a greater part of the day.
13. The actual time for which congestion and queuing in Epping will occur has not been specified although the peak hour trip rates have been reduced by around 32% in the AM peak. No results are provided in the revised Transport Assessment for Scenario 5. However the Scenario 6 results, which should show less congestion than Scenario 5 because as well as the sustainable transport trip rate reductions and peak spreading they also include the highway mitigation, show that most of the junctions in Table 1 are still

over capacity. This is even after the Council have made reductions in the car trip rates for.

- The package of highway measures which probably cannot be delivered.
- The sustainable transport measures that have not yet been identified.
- Peak spreading which will extend congestion over the day and
- Reduced parking development which is considered below.

Reduced and car free parking development

14. The Transport Assessment also relies on an element of reduced parking development. Reduced parking development is expected to provide parking at around 50% of parking standards. However the reduction in trip rates for these developments appears to be around 60% in the AM peak for example.
15. The Council is also proposing elements of car free development. In Epping where car ownership is important for many day to day journeys this could cause a range of issues. Many Councils have moved away from reduced car parking standards because of the adverse impacts they have on the environment with overspill residents parking in neighbouring streets, on verges and pavements etc.

Conclusion

16. In summary the future situation for Epping with the Local Plan development looks very challenging. The Transport Assessment is predicting extensive congestion and queuing in the town centre and the Forest which could lead to worsening air quality, difficult conditions for residents and possibly a decline in the town centre.

Is there an alternative future for Epping?

17. The question that arises therefore is whether or not there is an alternative Local Plan future for Epping that has not been assessed in developing the Local Plan. We believe that there is and that this is the provision of a Western Relief Road. The County Council has already demonstrated that such a relief road would remove through traffic and significantly improve traffic conditions in the town centre. This work was reported in the Epping Town Strategy, Western Relief Road and High Street Feasibility Study, of August 2015 that was commissioned by EFDC.
18. As a result of removing through traffic a Western Relief Road could allow for extensive improvements for pedestrians and cyclists in Epping. These improvements could transform the town centre and the way people travel in Epping which in turn could reduce car trips by existing and future residents and offset the impact of Local Plan Development. The relief road could allow the Council to achieve the ambitious targets for reducing car trips that they are relying on to make the Local Plan acceptable.
19. We have undertaken extensive traffic survey work in Epping and based on this we believe that such a relief road could be a single carriageway road. This could perhaps create a green corridor in the manner of a country lane. Areas of SANGs could be provided in this corridor reducing the impact on the Forest.

20. The provision of a Western Relief Road and green corridor in Epping could also impact on the spatial strategy for where development should be located. This is in particular the case because the Relief Road would change existing traffic patterns.

What should happen next?

21. We believe that a significant amount of work on transport issues still needs to be undertaken in order for the Local Plan to be able to proceed and that this includes.
 - Detailed work on sustainable transport measures. This is to demonstrate how vehicle trip rates will be reduced by the 15% to 22% referred to in the Council's revised Local Plan Transport Assessment (EB503). This work should set out how each of the proposed measures is expected to reduce car trips and evidence from other locations of where this has been achieved.
 - Confirmation as to why the actual reduction in trips rates (23% to 88%) applied to the trip rates for private houses and flats appears to exceed the reduction the Council have referred to in the text of 15% to 22%. Which numbers are correct?
 - Confirmation that the highway improvements being referred to can be delivered, particularly given the views expressed by the Corporation of London that they are not deliverable and that they have not been assessed in the HRA report.
 - Further work on peak hour spreading to confirm for how much of the day junctions in Epping town centre and Epping Forest will be congested with the proposed Local Plan development.
 - Confirmation of the level of queuing that would be expected as result of the Local Plan development in Epping town centre and Epping Forest.
 - A review of the air quality and other environmental impacts of the expected congestion and queuing in Epping town centre and Epping Forest.
 - A study of the consequences of proposals for reduced car parking standards.
22. In addition so that third parties can properly understand the Transport Assessment work that has been undertaken by the Council the following information should be released.
 - Base traffic data including turning flows and link counts.
 - The results of the junction modelling assessments.
 - Details of the predicted queue lengths at congested junctions.
 - VISUM model outputs.
 - Details of the trip generation assessments.
 - Details of the traffic growth estimates.

Summary

23. In summary we are concerned that most of the junctions in Epping are over capacity with the Local Plan development, see Table 1. This is even after the Council have made reductions in the car trip rates for.
 - The package of highway measures which probably cannot be delivered.
 - The sustainable transport measures that have not yet been identified.
 - Peak spreading which will extend congestion over the day and
 - Reduced parking development.
24. Therefore significant further work is required to support the Local Plan and identify the transport mitigation that is needed to allow the Local Plan to proceed.

A2. ESSEX COUNTY COUNCIL EPPING RELIEF ROAD REPORT 2015

Epping Town Centre Strategy

Western Relief Road and High Street Feasibility Study

August 2015



Document Control Sheet

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Report Title	Epping Town Centre Strategy
Project Number	B3553R0E
Status	Final
Revision	0
Control Date	20 th August 2015

Record of Issue

Issue	Status	Author	Date	Check	Date	Review	Date
1	Draft	J. O'Regan	May 2014	J. Howell	May 2014	R. Mason	May 2014
2	Draft	J. O'Regan	May 2014	J. Howell	May 2014	R. Mason	May 2014
3	Final	K. Valsamis Warren	Aug 2015	J. Howell	Aug 2015	R. Mason	Aug 2015
TP	Final	J. Wiffen	July 2015	T. Kruger	July 2015	T. Kruger	July 2015

Distribution

Organisation	Contact	Number of Copies
Essex County Council	D. Sprunt	Electronic

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1 Introduction

1.1 Scheme Background

Epping Forest District Council (EFDC) have commissioned Essex Highways (EH) to undertake a transport-led appraisal of their Local Development Plan containing a quantum of new residential developments in Epping Town Centre. As of June 2014, the location and quantity of proposed residential units is undecided, with plans underway to appraise the impact of low, medium and high volumes of development in the District.

1.2 Scheme Brief

As part of this process, EH have been tasked with investigating measures that would increase and improve highway capacity in order to reduce the existing congestion problems in Epping Town Centre and, in particular, along Epping High Street (B1393). Dependent on the scale of the future housing development, EH have been advised that two particular areas should be explored:

- For the large scale projection the feasibility of introducing a western relief road around Epping High Street should be explored. The alignment of this road should be such to connect with the existing highway network bypassing the High Street from the north. The designer is to explore an option that will minimise negative impacts upon the highway network and local environment whilst providing maximising benefits to the residents and road users.
- For the small scale projection the feasibility of improving capacity along the High Street should be explored. In particular the feasibility of increasing capacity at the existing double mini roundabout junction of Epping High Street, Station Road and St John's Road will be investigated. Furthermore, the feasibility of rationalising and possibly relocating the existing pedestrian crossings along Epping High Street should be reviewed. Alteration of the parking provision along the High Street should also be explored to enhance efficiency, although the loss of any parking spaces and any measures that would result in the loss of passing trade should be minimised.

EH have been commissioned to identify options for both a western relief road and improvements along Epping High Street as outlined above. This will involve a high level overview study. The alignment of the western relief road will be informed by a desktop study and Ordnance Survey (OS) base mapping at this stage. OS mapping will also be used along the High Street with existing relevant site features noted on this.

The Transport Planning element of this study will look at existing congestion along the B1393 route through Epping and consider the impact of future traffic flows associated with the Local Plan developments proposed. It will then pay specific attention to the traffic impact of a western relief road, using the Epping Spreadsheet Model to determine the in-scope demand for the relief road and appraise its potential to reduce congestion through the town centre.

1.3 Scope of the Study

This study will:

- Establish current and potential future levels of congestion along Epping High Street – looking at junction capacities and journey times along the B1393.
- Identify existing High Street site features and details.
- Study reported Personal Injury Collisions along Epping High Street (B1393) for the most recent 36 month period available. Provide an analysis of all recorded collisions and identify any patterns which may have a bearing upon the measures proposed as part of the scheme.
- Conduct a desktop study to inform proposals for a western relief road element of the scheme. Propose two options for a western (bypass) relief road.
- Propose appropriate measures to alleviate congestion and improve highway capacity along Epping High Street.
- Produce concept design drawings of all proposals and options.
- Detail options within this Feasibility Study for both the western relief road and Epping High Street including discussion of benefits and dis-benefits, design decisions, issues and outline the nature of any investigations that have led to proposed measures.
- Provide a cost estimate for the recommended works.
- Appraise feasibility of a western relief road in terms of congestion relief and in-scope demand.

2 Preliminary Investigation

2.1 Study Area

Located within Epping Forest District Council, Epping Town lies in the western area of Essex. Both the M25 and M11 motorways are situated within close proximity to Epping. Also known as the B1393, Epping High Street is a distributor road carrying traffic from the Loughton and Theydon Bois area in the south to the Harlow area in the north. The B1393 also provides access from Epping to both the M25 and M11 motorways.

The area of Epping expected to be impacted by a western relief road lies between the junctions of B182 Bury Lane to the south-west and B181 The Plain to the north-east. This provides the extent of the wider study area as shown in Figure 2.1 below.

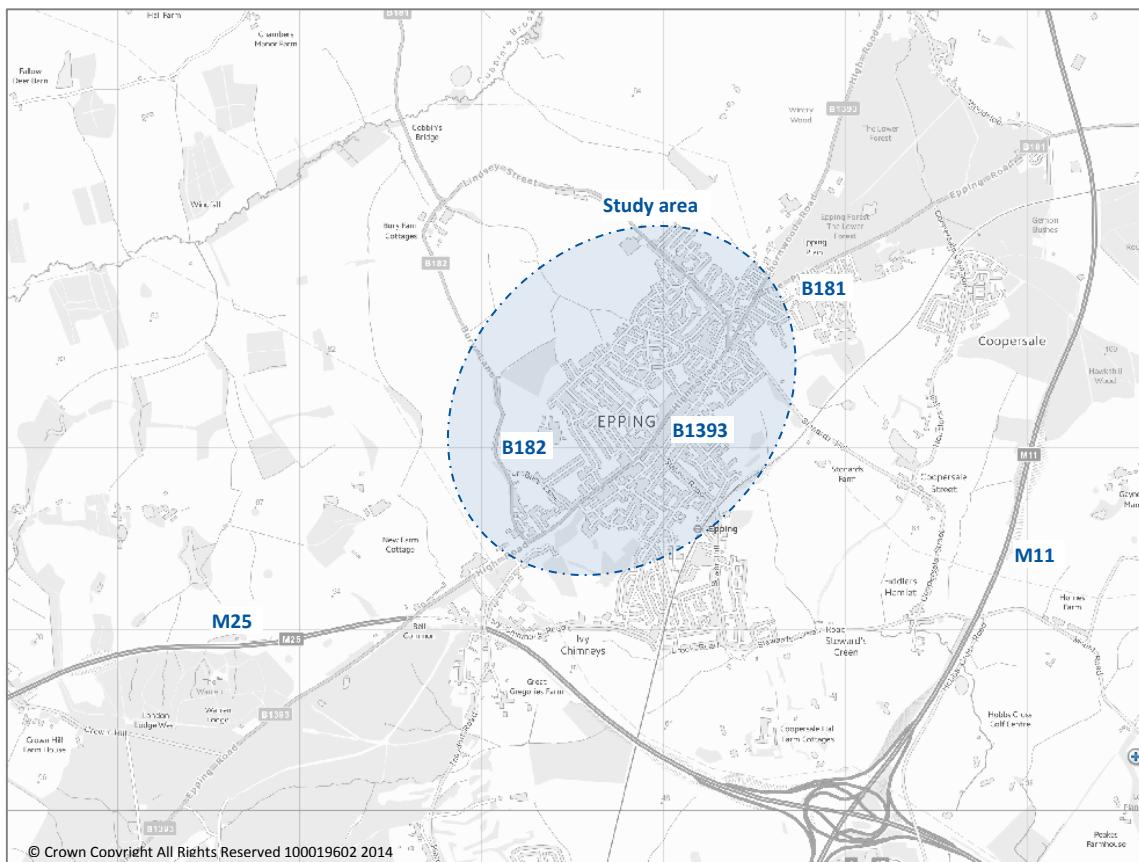


Figure 2.1: Epping study area

2.2 2013 Traffic Conditions

Trafficmaster journey time data has been used to establish patterns of congestion in around Epping town centre. Specifically, 2013/14 link data has been used to determine the peak hour speed compared to the free flow speed along the strategic routes in the area. Peak hour plots are shown in Figure 2.2 and Figure 2.3 below.



Figure 2.2: Peak hour speed as a percentage of free flow speed – AM Peak

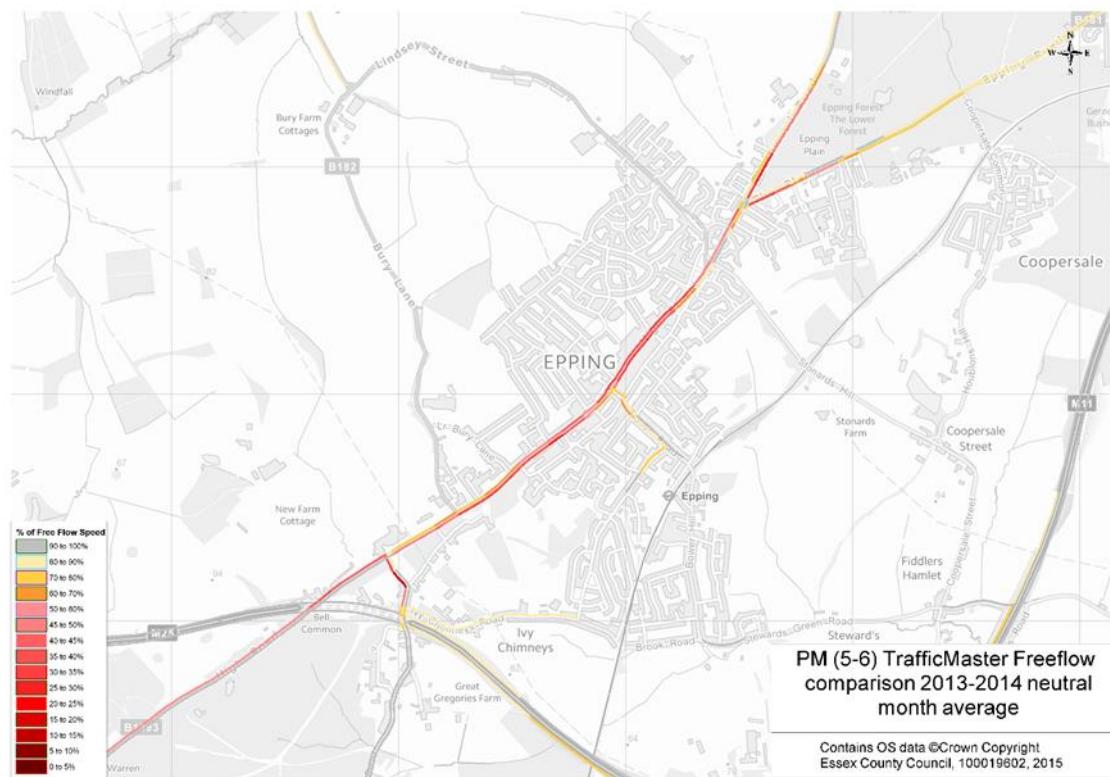


Figure 2.3: Peak hour speed as a percentage of free flow speed – PM Peak

AM peak hour (0800-0900) congestion – as represented by a low percentage of vehicles achieving free flow speed – is apparent through Epping, between and including both the Thornwood Road signalised junction to the north-east, and the B181 Bury Lane roundabout to the south-west of Epping. This congestion is replicated in the PM peak hour (1700-1800) but with more pronounced delays occurring along the B1393 High Street through the town centre.

Four main junctions along the B1393 in Epping have been identified as in-scope for modelling appraisal as part of the town centre review, having previously been assessed as part of the wider LDP study. Using the numbering convention adopted for the Epping Local Plan Appraisal study, these junctions are as follows:

- Junction 8 – Traffic signals at junction of B1393 Thornwood Road and B181 The Plain
- Junction 9a – Mini-roundabout junction of B1393 High Street with Station Road
- Junction 9b – Mini-roundabout junction of B1393 High Street with St. John's Road
- Junction 11 – Mini-roundabout junction of B1393 High Road with B182 Bury Lane



Figure 2.4: Junctions in scope of the Epping Town Centre Review

As part of the Local Plan appraisal, capacity assessments were undertaken using observed 2013 traffic flows at the four main junctions along the B1393 High Street. Results of the modelling are shown in Table 2.1 below.

The tables below document the Ratio of Flow to Capacity (RFC) values and Passenger Car Unit (PCU) queue lengths on each junction approach arm. A glossary of terms can be found in Appendix D of this report.

Table 2.1: 2013 base year junction capacity assessments

Junction 8 (Thornwood Road) - Epping			2013 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	DOS	LOS	Queue Length	DOS
B1393 Thornwood Road - Left/Ahead	-	24	90	-	113	111
B181 The Plain - Left/Ahead	-	22	77	-	22	101
B1393 Palmers Hill - Right/Ahead	-	20	89	-	161	119

Junction 9a (Station Rd) - Epping			2013 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	RFC	LOS	Queue Length	RFC
B1393 High Street RAB Link	C	4	0.80	E	9	0.92
Station Road	D	3	0.77	C	2	0.69
B1393 High Street	E	9	0.92	D	6	0.87

Junction 9b (St. John's Rd) - Epping			2013 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	RFC	LOS	Queue Length	RFC
St. John's Road	B	1	0.37	E	4	0.82
B1393 High Street	B	2	0.69	E	9	0.93
B1393 High Street RAB Link	D	7	0.89	B	3	0.72

Junction 11 (Bury Ln) - Epping			2013 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	RFC	LOS	Queue Length	RFC
B182 Bury Lane	C	2	0.68	A	1	0.43
B1393 High Road (East)	F	26	1.02	F	21	1.00
B1393 High Road (West)	C	4	0.82	C	6	0.86

Supporting the findings of the Trafficmaster analysis, the 2013 junction capacity analysis highlights similar patterns of congestion currently experienced at the Thornwood Road signals and Bury Lane junction in both peak hours. The capacities of the High Street approach arms at the double mini-roundabout (junction 9a/b) are also shown to be stretched, if not exceeded in the peak hours. Further base year analysis can be found in the 'Epping Local Plan Highway Impact Assessment Technical Note 1' – October 2013.

2.3 2026 Forecast Year Traffic Conditions

As part of EFDC's Local Plan proposals, a maximum total of 2,750 houses are proposed across a number of sites in Epping by 2036. This is expected to place additional pressures on the main B1393 junctions in Epping. Figure 2.5 below illustrates the location and size of the proposed development sites in Epping.

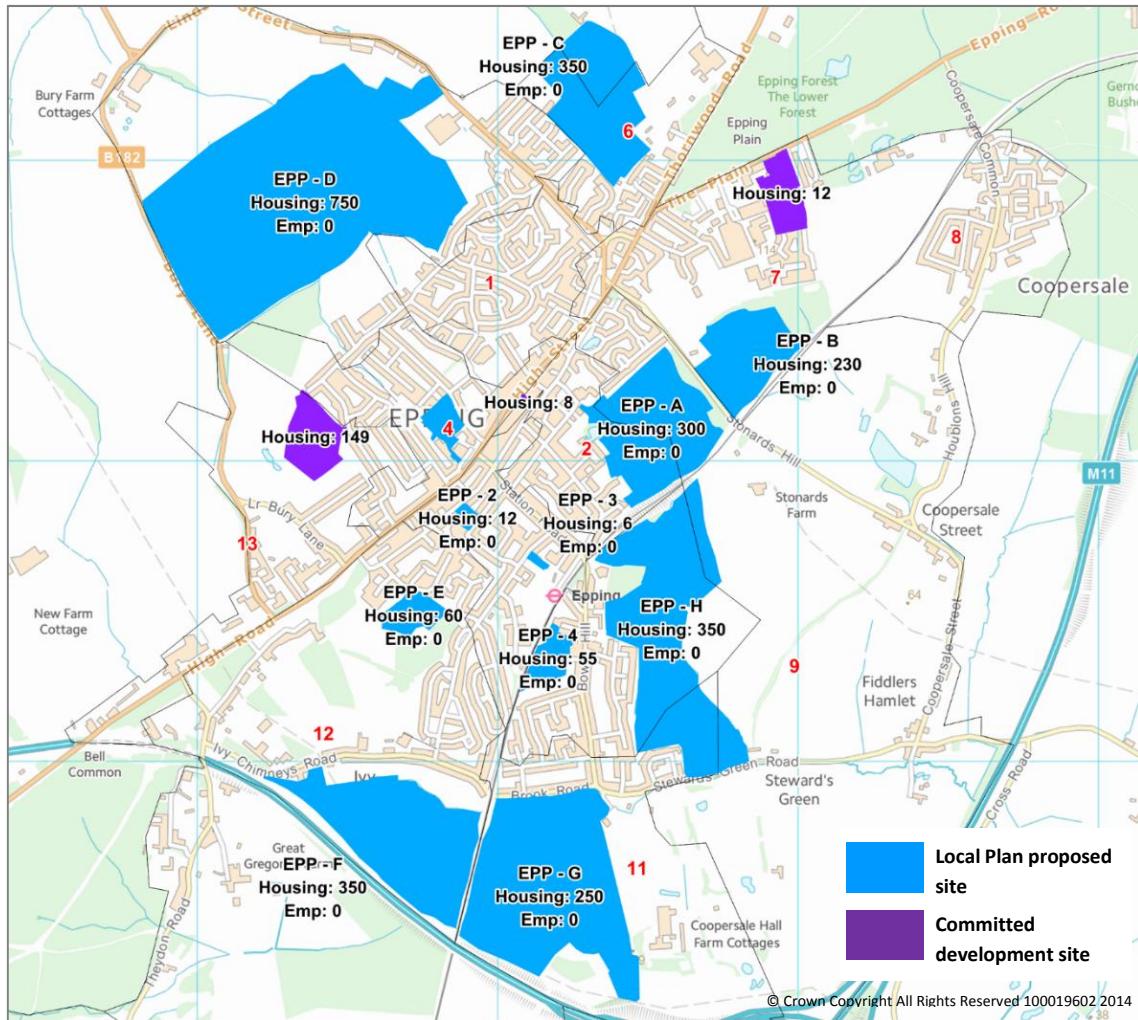


Figure 2.5: Total proposed Local Plan development sites in Epping (as of June 2014)

It is anticipated that the final allocation of LDP housing for Epping will be lower than the maximum proposed. For initial Local Plan forecast modelling (see ‘Epping Local Plan Highway Impact Assessment Technical Note 3’ – May 2014) EFDC suggested a quota of 2,000 houses in Epping as part of an overall development scenario for the district, termed ‘Scenario One’. The quota was maintained for this town centre review and includes the following sites in Epping:

- Epp-B 230 houses
 - Epp-C 350 houses
 - Epp-D 750 houses
 - Epp-F 350 houses
 - Epp-H 350 houses

The housing allocation for each site is proposed up to the year 2036. For the 2026 interim assessment year, it was assumed that half of the planned housing total for each site would be built and occupied.

A spreadsheet model of Epping, developed for the Local Plan appraisal, was used to determine the impact of traffic flows associated with the Local Plan developments by modelling the volume and distribution of trips through the local road network. Details of the modelling are discussed further in the 'Epping Local Plan Highway Impact Assessment Technical Note 2' – January 2014.

Using 2026 flow outputs from the spreadsheet model, further capacity assessments were undertaken at the four main junctions along the B1393 High Street. The results are shown in Table 2.2 below.

Table 2.2: 2026 forecast year junction capacity assessments

Junction 8 (Thornwood Road) - Epping			2026 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	DOS	LOS	Queue Length	DOS
B1393 Thornwood Road - Left/Ahead	-	243	131	-	143	115
B181 The Plain - Left/Ahead	-	46	98	-	77	115
B1393 Palmers Hill - Right/Ahead	-	66	103	-	574	192

Junction 9a (Station Rd) - Epping			2026 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	RFC	LOS	Queue Length	RFC
B1393 High Street RAB Link	F	77	1.12	F	99	1.17
Station Road	F	33	1.11	F	7	0.91
B1393 High Street	F	95	1.17	F	148	1.26

Junction 9b (St. John's Rd) - Epping			2026 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	RFC	LOS	Queue Length	RFC
St. John's Road	F	11	1.05	F	49	1.31
B1393 High Street	F	188	1.35	F	155	1.34
B1393 High Street RAB Link	F	84	1.13	F	44	1.05

Junction 11 (Bury Ln) - Epping			2026 - existing network			
Arm	AM PEAK			PM PEAK		
	LOS	Queue Length	RFC	LOS	Queue Length	RFC
B182 Bury Lane	F	30	1.07	B	1	0.59
B1393 High Road (East)	F	297	1.52	F	154	1.30
B1393 High Road (West)	F	23	0.99	F	200	1.26

The results of the capacity modelling suggest that the junctions along the B1393 will all exceed capacity in both peak periods. It should however, be noted that queue length outputs are best viewed as indicative of the levels of congestion possible. Furthermore, as flow outputs have been taken from a fixed assignment spreadsheet model, junction capacity results should be deemed 'worse case'. In reality, it might be expected that

vehicles will attempt to avoid the worst incidences of congestion by changing route, mode of travel or time of travel.

Nevertheless, it can be concluded from the modelling that a combination of infrastructure improvements and sustainable travel initiatives will likely be required across the road network in Epping in order for future traffic flows to be accommodated in the peak hours.

Given the extent of congestion modelled in Epping in 2026 with half the quota of development traffic proposed, it was considered superfluous to model conditions at the junctions in 2036 with the full traffic quota. This future year scenario would be reserved for the appraisal of mitigation measures.

2.4 Town Centre Site Detail

The central area of Epping High Street under investigation as part of the High Street improvement study, lies between the junctions of Tower Road to the south-west and Grove Lane to the north-east. Within this area the land use immediately adjacent to Epping High Street is distinctly commercial in nature. Beyond both of these junctions the land use takes on a more noticeably rural feel.

The town centre route can further be categorised into two sections which are effectively separated by a double mini roundabout junction located approximately mid-way along the study route. To the north-east of the double mini roundabout a market is present (operational on Mondays) and the retail units are more of a ‘town centre’ nature. Site observations show that there appears to be more vehicle and pedestrian activity along this section. To the south-west of the double mini roundabout retail units are more ‘local shopping parade’ in character.

The south-eastern arm of the double mini roundabout provides access to Epping Underground Station via Station Road. In addition to the double mini roundabout, Epping High Street also has a number of other priority junctions with the High Street designated as the main road. It should be noted that some of the minor roads, particularly adjacent to the market area, appear to be quiet access roads with low traffic flows where give way road markings have been omitted.

Epping High Street (B1393) is a single carriageway road with one traffic lane in each direction along most of the study route. The carriageway does flare out to incorporate two traffic lanes on the south-western and north-eastern approach arms at the double mini roundabout. Central hatch road markings are present from the double mini roundabout, south-west to Tower Road. Right turning lanes and gaps have also been

incorporated along this section of the High Street. A small length of hatch road markings are present to the north-east of the double mini roundabout although traffic lanes are generally separated by a central demarcation line to the north-east of the double mini roundabout. Epping High Street has a speed limit of 30mph. Thirteen bus routes serve Epping High Street with three bus stops located along the study route for each direction (six in total).

A total of eight pedestrian crossings are present along the study route. These consist of three signalised crossings, two zebra crossings (that both incorporate refuge islands) and three further pedestrian refuge islands. The signalised crossings have been implemented at the north-eastern and south-western extremities of the High Street and the zebra crossings to either side of the double mini roundabout.

Two of the pedestrian refuge islands on the High Street are adjacent to the market area with the remaining refuge island close to the Crows Road junction. The refuge islands adjacent to the market have narrow dropped kerb crossing and no tactile paving provision. Accessibility of the north-easternmost of these refuge islands is further hampered as it is flanked by parking bays to the east and market stalls to the west (when the market is in operation). Tactile paving and dropped kerb crossings are present at all other pedestrian crossings along the High Street.

There are a number of on-street parking bays on the High Street. To the south-west of the double mini roundabout lengths of parking bays are intermittent with restrictions between Mondays and Saturdays, 8am to 6pm, allowing parking for one hour. To the north-east of the double mini roundabout lengths of parking bays are more continuous. Restrictions along the eastern side of the highway are between Mondays and Saturdays, 9am to 5.30pm, allowing parking for one hour. On the western side of the highway a further restriction has been imposed for Monday from midnight to 6pm, prohibiting parking whilst the market is in operation.

In addition to these parking bays there are also a number of bays situated towards the north-eastern end of the study route for loading, blue badge holders, police vehicles and taxis. In addition to parking bays, bus stops and controlled crossing areas, road markings of single and double yellow lining are present long the remainder of the study route.

The carriageway generally has a bituminous surface along the length of the study route although some parking bays and a bus stop are modular block paved at the north-eastern end. The footway is surfaced with a variety of surfaces including concrete slab paving, modular block paving and bituminous surfacing along the study route. Site observations have highlighted that the condition of the footway and carriageway is moderate along much of the route.

2.5 Collision Data and Analysis

Personal Injury Collision data (PICs) for the 50-month period from 31 December 2008 to 31 December 2013 recorded by Essex Police has been obtained and analysed along Epping High Street between the junction with Tower Road to the junction with Grove Lane. Collision stick diagrams, collision plot and interpreted listings have been used in order to provide an analysis of the collision history. These are located in Appendix A of this report.

Table 2.3 gives a summary of the collision data (to 31 December 2013) for Epping High Street. During this period there were a total of 30 PICs resulting in 1 fatal, 1 serious and 28 slight collisions with a total of 33 casualties being recorded.

Annually, trends indicate that there is a fluctuation of the number of collisions taking place each year, with 4 collisions occurring in the first and third years, 10 collisions in the second year, 7 in the fourth year and 5 in the final year. A Poisson statistical test has been carried out to measure whether or not the fluctuations are statistically significant or not.

The results show that there is a fair to high chance that the fluctuation in the second year of data is statistically significant and that there is also some statistical significance that the fluctuations in the first and third year may not be random as well. This implies that these fluctuations, particularly the data observed in the second year may not be due to random fluctuation and that there may have been an external influence in this area that contributed towards these variations.

Table 2.3: Collisions by severity and time period

Collisions in the 12 month period ending	Slight	Serious	Fatal	Total
December 2009	2	1	1	4
December 2010	10	0	0	10
December 2011	4	0	0	4
December 2012	7	0	0	7
December 2013	5	0	0	5
TOTAL COLLISIONS	28	1	1	30

The main contributory factor, which is subjective, has been interpreted for each of the collisions. Ten (33.3%) of the collisions involved vehicles making a poor turn or manoeuvre and a further eight (26.7%) of the collisions involved road users failing to look properly. Four collisions (13.3%) involved drivers disobeying give way controls and a further two collisions (6.7%) could be attributed to aggressive driving. The remaining collisions were all attributed to isolated causation factors.

Further analysis of the collision data has highlighted certain trends. A sizeable proportion of collisions involved pedal cyclists (6 collisions or 20%) and motorcyclists (8 collisions or 26.7%). A further 7 collisions (23.3%) directly involved vehicles pulling into or out of parking bays. These collisions may suggest a potential issue with the manner in which carriageway space and traffic lane widths are distributed along the High Street. Table 2.4 outlines these collision patterns that have been observed.

Table 2.4: Collision patterns

Pattern of Collision	Total	Percentage
Pedal Cyclist involvement	6	20.0%
Motorcyclist involvement	8	26.7%
Vehicles manoeuvring into/from parking bays	7	23.3%

Additionally, a substantial proportion of collisions involved vehicles entering the double mini roundabout. Seven collisions (23.3% of collisions) involved vehicles either circulating or approaching the junction. The four collisions involving vehicles disobeying give way controls all relate to this junction. Furthermore, two collisions were recorded which involved pedestrians crossing the road to the south-west of Crows Road, at the site of one of the pedestrian refuge islands. It should be noted that one of these collisions was fatal.

With the exception of the patterns noted above, collisions appear to be reasonably evenly distributed geographically along the study route. Table 2.5 provides a breakdown of collisions occurring by road condition and speed related factors. The data shows that 12 (40%) of the collisions occurred during the hours of darkness. Collisions occurring whilst the road surface was not dry were recorded at 23.2% (7 collisions). Analysis of the data has also highlighted that a relatively high number of collisions (30% or 9 collisions) involved pedestrians. This would suggest a need for additional or improved pedestrian crossing facilities along the High Street.

Table 2.5: Collisions by road conditions and speed related factors

Cause	Number	Percentage
Dark	12	40.0%
Non dry	7	23.3%
Pedestrian	9	30.0%

3 Town Centre Proposed Measures

3.1 Town Centre Existing Problems and Site Observations

During a site visit, conducted on Monday 24 February 2014, a number of observations were made which identified where obstructions were evident along Epping High Street. These obstructions appear to have a negative impact upon traffic flows and, in some instances, safety along the High Street. All of these obstructions were observed between St John's Road and Grove Lane – the area of the High Street with the greatest pedestrian activity, shops that are more 'town centre' in nature and where a market operates on Mondays.

The existing configuration of the highway appears to contribute towards these obstructions. Firstly it was noted that some vehicles attempting to park in the tight on street parallel parking bays on the south eastern side of the carriageway resulted in an obstruction to traffic flows downstream. Site measurements show that the existing parking bays are narrow, 1.8 metres wide, and are not delineated by length. Therefore, some vehicles were observed trying to park in a space that was not of an adequate length to manoeuvre into and accommodate their vehicle.



Figure 3.1: Pedestrian Refuge Island and adjacent parking outside 188 High Street

Site observations showed that the existing pedestrian refuge islands along this section of the High Street also contributed towards obstructing free flowing traffic. In particular, the position of the pedestrian refuge island outside of 190 High Street results in a pinch point to the adjacent southbound traffic lane of 2.8metres. During the site visit a vehicle

was poorly parked in the area of parking bays adjacent to the island (shown in Figure 3.1). Consequently larger vehicles had difficulty navigating between the vehicle and the island. As demonstrated by a bus which was seen mounting the kerbs of the island. Furthermore, the islands afford poor accessibility. Neither accommodate tactile paving and the island outside of 188 High Street guides pedestrians directly into parking bays and the market area. The islands, therefore, fall outside of current design standards with regards to accessibility.

Finally, the arrangement of the market area on the north-western side of the carriageway also appeared to contribute towards an obstruction for the passage of traffic travelling northbound. The market operates within the existing carriageway area currently occupied by parking bays on the north-western side of the carriageway. As the market is not bound by any physical demarcation a number of market stalls, vehicles and even objects associated with the market have spilled out into the live carriageway. Figure 3.2, an image produced from Google Earth, provides evidence of this.



Figure 3.2: Vehicle associated with market area causing obstruction to live carriageway.
Image produced from Google Earth: ©2014 Google

The observations noted during February 2014 site visit, therefore, suggest that the carriageway is poorly aligned along the northern stretch of the High Street. The collision analysis findings identified in Section 2.5 also suggest that there are safety concerns which may be as a result of the existing carriageway alignment. Furthermore, a sizable number of collisions have occurred on the approach to the double mini roundabout and have involved pedestrians.

3.2 Proposed Measures along Epping High Street

In order to facilitate more efficient traffic flows along the High Street it is proposed to redistribute the carriageway in order to reduce and remove obstructions. Firstly, it is proposed to alter the arrangement of the existing parking bays along the High Street in order to allow vehicles to park more easily and therefore contribute towards a reduction in waiting times for travelling vehicles. It is proposed to widen all parking bays along the south-eastern side of the carriageway from the existing 1.8metres to 2.0metres.

It is proposed to demarcate each of the parking bays by length in order to promote more effective parking discipline. This would result in the parking bay road marking being changed to a marking to TSRGD diagram number 1032. In order to allow vehicles to park as easily as possible proposed lengths are as near to the maximum permissible length of 6.6metres. Although this alteration to parking bay lengths may result in a reduction to overall parking capacity along the south-eastern side of the High Street the overall length of area designated for parking bays will be the same as the existing configuration.

To the north-west of the parking bay areas it is proposed to implement two traffic lanes at 4.0 metres in width (this is wider than the standard 3.65m, see Section 3.3 for further explanation). This would mean that the existing traffic islands outside of 180 and 190 High Street would need to be removed. This is considered to represent more benefits than dis-benefits. However, as the existing islands not only result in pinch points for traffic movement they are also not designed to current standards and represent safety concerns in relation to visibility and accessibility.

Traffic lane widths of 4.0 metre have been chosen so to allow HGVs and PSVs to safely pass pedal and motor cyclists without obstruction. The collision analysis data shows a significant number involve pedal and motor cyclists along the High Street. A large number of bus routes also serve the High Street and HGV numbers would also be high given the large number of commercial premises.

On the north-western side of the High Street it is proposed to formalise the existing area where the market takes place. In its present form the Monday market takes place largely within an area of carriageway designated with parallel and echelon parking. It is proposed to convert this area from carriageway to a paved area which could be physically differentiated from the carriageway by being implemented at footway level and bounded by kerbing. The exact configuration and form would be detailed further into the design process. It is considered that these new areas would complement the existing paved area at the north-eastern end of the High Street which currently

accommodates road markings for market stalls as well as parking bays. However, a consultation with the market stall holders will be required.

As well as accommodating areas for the Monday market, market stalls and activities the proposed paved areas could also allow for on street parking at other times in the week. Indicative dropped kerbs have been shown on the proposed measures plans to indicate where these facilities may be introduced. As it is considered that this new arrangement may result in the loss of on street parking spaces a number of additional parallel parking bays have been incorporated as part of the proposals adjacent to the main market area. As with the parking bays on the opposite side of the High Street it is proposed to implement 2.0metres by 6.6metres bays. It is considered that the existing build out area to the south of the market area could be adjusted to complement the proposed paved market area and act as an extension of this facility.

Finally, it is proposed to relocate the existing bus stop clearway near to St John's Road on the south-eastern side of the carriageway further to the north-east so that it is adjacent to the existing disabled parking bays. It is proposed to alter the alignment of the kerb line adjacent to the existing relocated bus stop clearway in order to facilitate for smoother bus stopping movements and allow for additional carriageway space. The new kerb alignment would result in a number of telephone call boxes having to be relocated. A tree may also need to be removed and utility service apparatus may also need to be diverted as part of the proposed kerb re-alignment. It is also proposed to relocate the bus shelter to be closer to the new bus stop area.

3.3 Proposed Measures at the Existing Double-Mini Roundabout

Further to the design brief for the project, measures have been proposed that would increase capacity at the existing double mini roundabout junction on the High Street. Additionally the collision analysis has highlighted safety concerns at this junction, in particular with regards to vehicles disobeying the give way controls at the junction. The most obvious measure to control traffic streams in order to increase capacity and reduce collision risk would be to signalise the junction. A geometric design has therefore been formulated presenting a design for the signalisation of the site. The proposals have been formulated using design guidance from TD 50 of the Design Manual for Roads and Bridges and Chapter 5 of the Traffic Signs Manual (TSM).

TD 50 provides a number of permutations for signalised junction arrangements and types. As the existing junction operates with a stagger between St Johns Road and Station Road it appears that the most suitable type of signal controlled junction would be a right/left stagger. TD 50 states that for a junction to be considered as a single signal controlled staggered junction the maximum stagger distance, i.e. the distance along the major road between the two centre lines of the minor roads, is 75metres. The stagger

distance in this case is 50metres and therefore satisfies this criteria. Furthermore, TD 50 also places a requirement on the reservoir length, i.e. the distance between the inner stop lines, to be a minimum of 15metres. In this case the proposals would result in a reservoir length of 29 metres.

The next factor to consider was capacity at the junction. Although the analysis of traffic flows and the production of traffic modelling is beyond the scope of this particular part of the study it was considered necessary to produce a layout which introduces as many traffic lanes as possible and that could operate under as many stages as possible. Therefore, two lanes are proposed in both directions along the High Street in all cases except for the exit on the north-eastern arm. The existing highway configuration does not allow for two lanes to be accommodated here that could be safely merged into one lane further north the High Street.

On the south-western approach arm it is proposed to introduce two approach lanes for a distance of approximately 70metres from the junction. On the exit it is proposed to introduce two segregated lanes for a distance of approximately 40metres. The proposed configuration then allows for vehicles to merge over a further 50 to 60metres. It is considered that this could be refined further pending the results of modelling requirements and from further discussions to ascertain whether or not it would be acceptable to remove, relocate or reduce the existing parking bays on the south-eastern side of the carriageway. Due to constricted highway space only one approach and exit lane could be provided along both St John's Road and Station Road.

Traffic lane and traffic island widths have been proposed considering existing highway space, safety and capacity issues. TD 50 proposes lane widths at junctions between 3.0 and 3.65 metres. Considering the significant numbers of cyclists and larger vehicles that would be using the junction it is considered that 3.0metres will be narrow. A 3.25 metres width is considered to represent a safe width which would allow larger vehicles to pass cyclists as recommended in Local Transport Note 1/07, Traffic Calming. Additionally, island widths of 3.0 metres have been selected to allow for staggered pedestrian movements.

The above proposals would allow for more permutations of signal staging and therefore should allow for the junction to operate with increased capacity. It was also considered that standard pedestrian refuge islands without staggers may not be suitable when taking into account the significant crossing lengths of at least 14.5metres (pedestrians would have to navigate as part of a pedestrian phase). A reduction in crossing widths and spaces would allow for green phases to operate for a longer time. The pedestrian staggers have been designed to the preferred left/right orientation. Crossing widths have been provided at 2.4metres, as recommended in Chapter 5 of the TSM, and tactile

paving has been designed to the specification set out in the DETR guidance on Tactile Paving. No crossing facilities have been provided within the junction reservoir as there is considered to be no pedestrian desire line present here.

It is proposed to retain the pedestrian crossing point along St John's Road in order to serve the existing pedestrian desire line. It is proposed to relocate the pedestrian crossing point and stop line on Station Road slightly to the north-west as this would allow for a reduction in the associated inter-green period for traffic exiting Station Road. The existing pedestrian crossing point here does not appear to be located on any desire line. It is also proposed to realign kerbs on both sides of the carriageway along Station Road to allow for increased footway capacity on the north-eastern footway. The effective carriageway width would stay similar here but the increased capacity would mean that the south-western footway width would need to be reduced in width from 4.0metres to 2.5 metres.

Road markings and the locations of signal posts have been determined using the guidance set out in Chapter 5 of the TSM. Primary, secondary and pedestrian phase aspects are shown indicatively on the proposed measures drawing, although this can be revised pending the results of modelling work. Destination arrows have been omitted from the proposed measures drawing as will be subject to modelling work and should be advised pending the results of this exercise. Swept path movements have been conducted which shows that small articulated and rigid pantechnicon vehicles can manoeuvre the junction in all directions. It appears that any vehicles larger than these would have difficulty negotiating the junction in its present form and therefore these have not been catered for in the proposal.

It is proposed to effectively set out the geometry of the junction from the building line on the south-eastern side of the junction along the High Street. It is proposed to provide a 3.0metre footway here before introducing four traffic lanes of 3.25metres in width and the traffic island of 3.0metres in width. It is proposed to alter the kerb line on the south-eastern side of the highway to the north-east to complement this arrangement. This would allow for two approach lanes of approximately 50metres on the north-eastern approach arm. To allow for the proposed carriageway and island capacity the existing grass verge on the north-western side of the highway along the High Street would need to be reduced from the St John's Road junction to the Crows Road junction. There are a number of problems associated with this however. Preliminary investigations have shown that this may have some bearing upon services utility apparatus here although detailed analysis to determine this is beyond the scope of this study. Furthermore, a number of mature trees will need to be removed on the south-western approach arm to the junction in order to allow for the new carriageway alignment.

A significant risk is to the proposed measures the ownership of land. Plans outlining the public maintainable highway have been procured to determine whether or not the proposals fall within the existing highway boundary. The results from this search show that the grass verge and footpath on the north-western side of the highway between St John's Road and Crows Road is not highway land. Further investigations have shown that this area is likely to be common land which would have significant protected rights. Its adoption to highway may require State approval. This is likely to represent a major risk towards the development of these proposals.

Consequently, alternative geometric arrangements have been considered that would fit within the existing highway boundary. Further land ownership and site constraints would prevent the creation of additional carriageway space on the south-eastern side of the highway. It is considered that any alternative design for a signal controlled junction within the existing carriageway footprint would not have a positive effect upon reducing capacity as only one lane would realistically be achievable in each direction. Therefore, it is recommended to retain the original proposals as this was considered most appropriate towards improving capacity at the junction.

3.4 Benefits and Dis-Benefits

Table 3.1 outlines the benefits and the dis-benefits associated with the proposals. Proposals have been segregated along the High Street but grouped together at the junction as it was considered unsuitable to segregate the benefits and dis-benefits for the individual proposals here.

Table 3.1: Benefits and dis-benefits of proposed measures

Proposal	Benefits	Dis-benefits
Conversion of the existing double mini roundabout to a staggered signal controlled junction	<ul style="list-style-type: none"> Potential for increased capacity – Note: modelling needs to be undertaken to confirm this. Reduced risk of collision 	<ul style="list-style-type: none"> Costs – Construction design and project management. Some utility apparatus may require diversions Removal of trees. The conversion of common land to highway may not be achievable and even if it is may require state approvals process.
Alteration of parking bays to maximise lengths and widths	<ul style="list-style-type: none"> Potential for reduced congestion downstream. Reduced risk of low impact collisions from vehicles manoeuvring into tight spaces. 	<ul style="list-style-type: none"> Actual reduction in overall number of vehicles able to park although no loss in overall space.

Removal of pedestrian refuges outside of 180 and 188 Epping High Street	<ul style="list-style-type: none"> • Removal of pinch point which can cause difficulty for large vehicles passing. • Removal of facility which has safety and accessibility concerns. 	<ul style="list-style-type: none"> • Removal of feature that can provide refuge for pedestrians crossing. • Costs – Construction, design and project management.
Formalisation of market area	<ul style="list-style-type: none"> • Containment of market area and associated activities will reduce objects ‘spilling out’ onto the live carriageway. • Potential for area with more aesthetic appeal. 	<ul style="list-style-type: none"> • Costs – Construction, design and project management. • Potential reduction in parking spaces (although mitigated by adjacent parallel bays and potential for parking within area outside of market day)
Relocation of bus stop near to St John's Road north-eastwards	<ul style="list-style-type: none"> • Creation of smoother kerb line allowing more effective alignment for buses. • Creation of additional capacity on the approach to the St John's Road / Station Road junction 	<ul style="list-style-type: none"> • Costs – Construction, design and project management. • Telephone call boxes would require relocation • A tree and service apparatus may require removal and diverting.

4 Western Relief Road

4.1 General

Epping has one main road that runs through the town centre, specifically the B1393, High Road, High Street and Palmers Hills. The road is heavily trafficked as it provides access to the commercial high street and residential estates; a link between Loughton, Epping, Harlow and Ongar; access to the M11 and M25 motorways as well as the A414 to Chelmsford. Due to its proximity to the junction of the M11 and M25 motorways, it is known to be an alternative route when there are congestion problems on the motorways. Should the town further expand the traffic through the high street will significantly increase from the demand of the local residents alone. Therefore, Essex Highways have been commissioned to investigate the possibility of introducing a western relief road to reduce the congestion on the High Street.

It must be noted that the recommendations in this feasibility study are based on a desktop study and Ordnance Survey base mapping.

The outline design is based on the horizontal alignment only. No investigation work has been carried out on the vertical alignment. Further investigation work is required to confirm its feasibility; discussed further in Section 4.3.

4.2 Site Observations and Desktop Study

A general site visit was carried out on Monday 24 February 2014. All site observations were carried out via the road side as the ownership of the land within the area of the proposed road is unknown and therefore assumed to be privately owned.

The land proposed to be used is mainly agricultural land used for farming and grazing. Farms, and accesses to them, are scattered throughout the area.

Ground levels varied significantly along the proposed route. From site observation, the ground level difference were significant when compare with the rest of the site at the locations of land drainage watercourse.

Observations were carried out to the B182 Bury Lane to review if this road could be used as access to the bypass. The road is a single lane carriageway with a footway along the eastern side; the western side has a narrow verge and ditches. Road lighting columns are situated along the narrow western verge. The southern section of the lane is mainly surrounded by residential properties and a school along the eastern side. The western side has a couple of residential properties at the approach with the B1393 High Road. Epping's cemetery is also located on the western side of the lane about 590metres north

of the junction. The lane is not straight; it has a number of bends along its length and is surrounded by trees, hedgerows and vegetation.

An internet based search indicated that within the proposed area of works there are a number of specific environmental interests that may restrict the works. Based on the MAGIC website, which is a website that provides authoritative geographic information about the natural environment from several government departments, indicated that the location of the proposed relief road is an area with sensitive environmental agreements such as woodlands, common land and allotment gardens. These areas of interest have been highlighted on the drawings attached to this study.

Essex County Council's website indicated that there are a number of public rights of ways (footpaths and a bridleway) in the vicinity. These too have been indicated on the drawings.

The Environment Agency's website indicated that there is a Main River watercourse adjacent to Wintry Wood, which flows northwest to join Cobbins Brook.

OS mapping information indicates that there are a number of watercourses and drainage streams located within the area of interest

During the site visit it was noted that a number of electricity pylons were situated in the land; the desktop study confirmed these as well as the existence of electricity substations.

4.3 Proposed Options

Following the desktop study various options for the relief road have been developed to determine suitable horizontal line. It must be noted that the options are based on the constrictions identified. This does not take into consideration any level differences along the land. They are possible horizontal alignments which will require further investigation work and feasibility studies will be required to confirm their buildability.

It is anticipated that the relief road will have a medium to high usage by the motorists who require driving through Epping as part of their journey and wish to avoid the High Street and by those driving through Epping when the M11 and M25 motorways are congested.

It must be noted that the desktop study indicated that nearly the whole of the northern section of Bury Lane is common land and consequently this will impose risks to the development of this proposal. Further land ownership investigation works will be required to confirm the status of the all land required for the proposed routes.

The first option to be reviewed was to determine if the Bury Lane could be used as a main access point to the new relief road. An initial review indicated that there are limited alterations that could be carried out to this lane to improve the alignment based on the findings in Section 4.2. It is possibly surrounded by common land and may have environmental constraints. This lane also provides an access to a school and has limited space to possibly enable widening of the junction with the High Road. Modelling information will be required during the feasibility stage to confirm if this lane could be utilised.

In the case where it was established that Bury Lane could not be used the only other possible location for a junction to the relief road is approximately 210metres south of Bury Lane utilising the land next to a hotel. The desktop study did not indicate any environmental constraints within this land. Possible risks with this option could be the objections from the residents and business adjacent to the proposed junction, the additional cost for land purchase and cost to construct the road up to Bury Lane. However, this option will allow for the design of an option without restriction to road widths.

The second design option was to find a suitable line for the bypass between the B181 and B182. Problems arose along the B182 side as there are a number of residential properties, farms and business estate along the road. The option of possibly utilising Bolt Cellar Lane was disregarded as the road appears to terminate as you approach Shaftesbury Farm and there isn't sufficient land available to extend the road and provide a junction to the B182 at that location. (refer to Drawing Number DC20053-00-009)

There is a possibility that a junction could be provided through the land north of Shaftesbury Farm, but the desktop study revealed that that parcel of land is dedicated to allotment gardens. Further investigation work is required to confirm this. If this is definitely the case the land maybe protected by the Allotment Act 1908 to 1950. It may be possible to use this land if an alternative location is provided. As there is a strong case that this land cannot be used a further alternative route needs to be investigated. (Refer to Drawing Number DC20053-00-009)

The final alternative for this section would be to provide a road north of all residential properties along the B182. The environmental desktop study indicated the road may cut through an area where tree felling licenses are in place. An environmental desktop study is required to confirm this and its implications. However it is believed that this option would have fewer constraints to develop. (refer to Drawing Number DC20053-00-010)

The third and final stage of the review was to find a suitable location to tie in the new relief road with the B1393 Thornwood Road. Ideally, the tie in would need to be situated close to the junction of Thornwood Road with Palmers Hill and The Plain (B181).

The desktop study indicated that there are two locations of Deciduous Woodland Biodiversity Action Plan (BAP) Protected Habitats; specifically Wintry Wood and the woodland areas along Thornwood Road. Internet searches indicated that BAP protected habitats were those that were identified as being the most threatened and requiring conservation action under the UK Biodiversity Action Plan and therefore were bypassed during the outline design process.

It was investigated if the access road to the electricity substation area could be utilised but there is very limited land available to provide a wider road as well as to provide a suitable horizontal alignment due to adjacent residential properties, their accesses, another allotment garden and electricity pylons.

Following the raising of these issues, the only suitable location to tie in the proposed relief road with the B1393 Thornwood Road is north of the small woodland area located on the western verge, as illustrated on Drawings Numbers DC20053-00-009 and 010.

At this stage of the study the options for connecting the bypass to any of the existing roads has not been finalised. Modelling work with predicted vehicle movement will be necessary to determine the type of junction required; whether it is a signalised junction, simple T junction or roundabout.

High level estimates have been prepared for the main proposed options indicated on Drawings DC20053-00-009 Epping Western Relief Road Option One and DC20053-00-010 Epping Western Relief Road Option Two. The cost estimates are provided in Appendix B.

At this moment in time it is difficult to recommend a preferred option for the western relief road as the land to be used appears to have environmentally sensitive designation. An environmental constraints, land ownership and topographical survey will be required to enable the Essex Highways recommend a suitable option.

4.4 Transport Appraisal of a Proposed Western Relief Road

4.4.1 Spreadsheet Model Reconfiguration

The proposed western relief road was incorporated into the Epping Spreadsheet Model through a manual reassignment of traffic away from the B1393 route, and onto the proposed bypass link.

As base traffic flows had been taken from junction turning counts rather than origin-destination matrices, it was not possible to differentiate between through-traffic and town centre flows in the model. Consequently, it was not possible to ascertain with certainty, the proportion of background vehicle trips in-scope to relocate to the relief road.

To overcome this, the maximum volume of in-scope background traffic was estimated by determining the point at which the reassignment of traffic to the relief road left turning movements at junctions along the existing B1393 route with negative values in the spreadsheet.

As part of this process, assumptions were made in determining the traffic movements that would reassign to the relief road.

The modelling assumed use of the B182 Bury Lane and the existing mini-roundabout junction with the B1393 as part of the western relief road alignment. As documented in Section 4.3, the Major Projects desktop study also considered a new-build link extension connecting into a new junction on the B1393 between Bury Lane and Theydon Road. Regardless of the choice of connectivity into the B1393, the analysis presented in this report can largely be applied to either alignment, with there being no anticipated effect on the route reassignment calculations.

For north-eastbound journeys along the B1393 at the junction with the B182 Bury Lane, those with onward destinations via the B1393 Thornwood Road and B181 The Plain were assumed to be in-scope to divert to the relief road. The split in through traffic movements was derived from the proportions recorded for all traffic flows approaching the junction from Epping town centre.

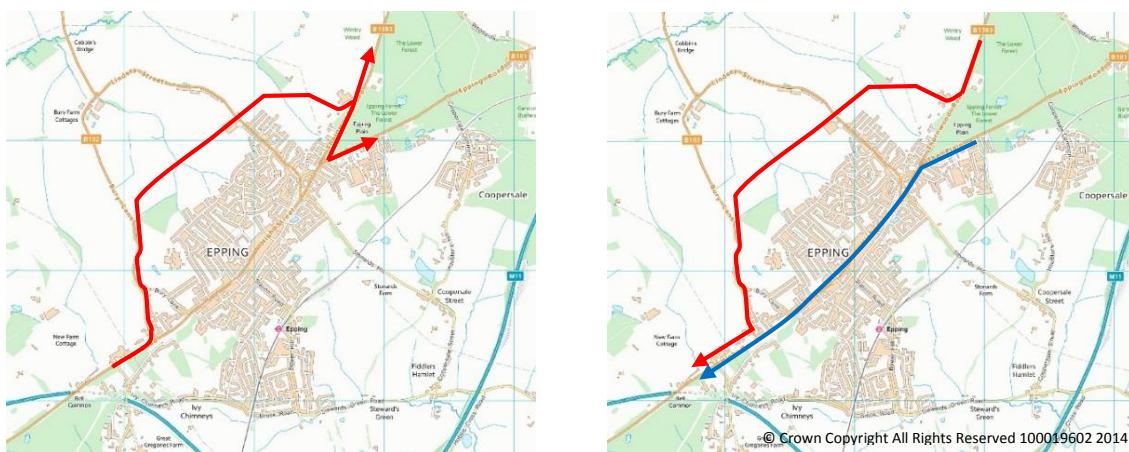


Figure 4.1: Assumed NEB and SWB reassigned trip movements to the relief road

For journeys heading south-west from the signals on the B1393 Thornwood Road, it was assumed that those from the B1393 Thornwood Road were in-scope to divert to the relief road. In contrast, through movements from the B181 The Plain were assumed to route through the town centre rather than head north-east to access the relief road. These routing assumptions are illustrated in Figure 4.1 above.

It was recognised that a route via the relief road would not be as direct as the existing B1393 route through Epping town centre. Under free-flow conditions, the town centre route would likely offer a faster journey time than the relief road – without stringent traffic management measures in place. For this reason, it was assumed that vehicles travelling through the town centre would continue to use the existing route so long as the junctions along it remained within capacity. In this regard, an iterative approach to the junction capacity modelling would determine whether a proportion of background traffic flows, below the maximum amount estimated, should be assigned to the relief road.

Development trips associated with the ‘Scenario One’ quota were reassigned to the relief road where the link offered a reasonable alternative to the congested B1393 route without significant diversion. In this respect, only development trips with origins and destinations on the periphery of the town centre, either from an internal or external model zone, were considered for reassignment to the relief road.

The reassignment was undertaken by adjusting the assigned routes manually between model zones in the spreadsheet. For each affected zone OD pair, this involved adding the relevant junction turning movements along each route via the relief road, and then removing the relevant turning movements along the old route.

4.4.2 Assignment of Traffic to the Relief Road

Initial junction capacity tests using the ‘Scenario One’ development quota showed that that a number of junctions along the B1393 would likely remain over capacity with the maximum allocation of background traffic flows assigned to the relief road.

For this reason, the maximum allocation was taken forward for inclusion in the future year relief road appraisal, as shown in Figure 4.2 below:

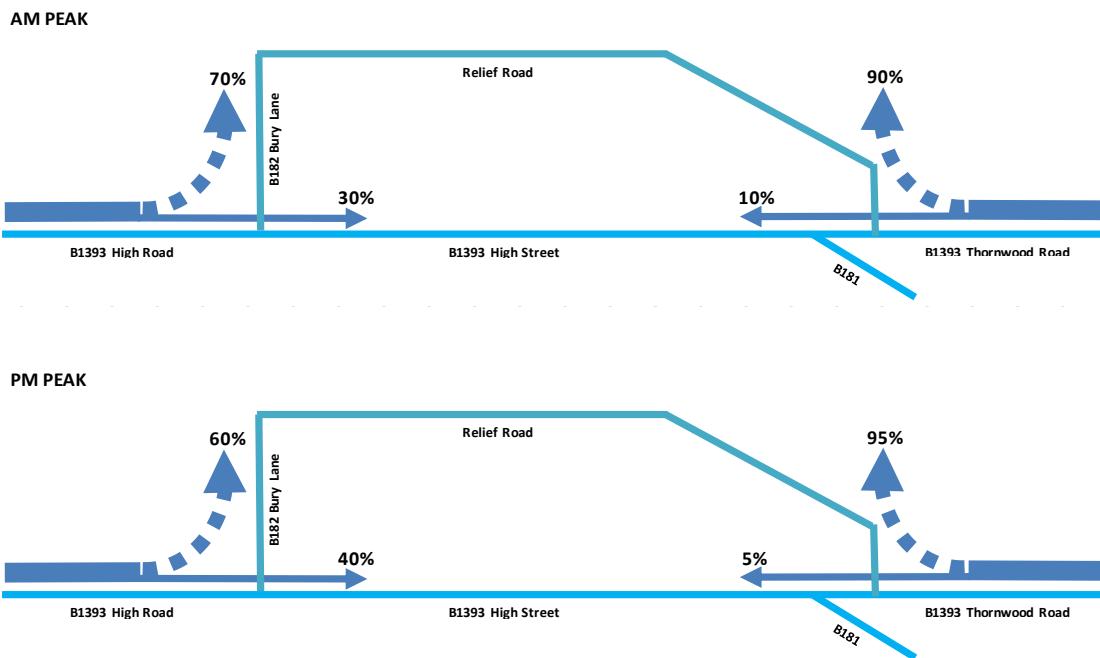


Figure 4.2: Max percentage of peak hour background traffic to western relief road

Adopting a broad assumption that half of Local Plan development would be built by 2026 across all proposed sites, with the remaining half built by 2036, turning proportions thus remained consistent across the assessment years 2026 and 2036.



Figure 4.3 below illustrates the difference in flows along the B1393 between the existing network and the modelled network incorporating a western relief road. This effectively represents the total diverted traffic flow (background flow and development traffic)

from the B1393 to the relief road as shown in the spreadsheet model for the three assessment years.

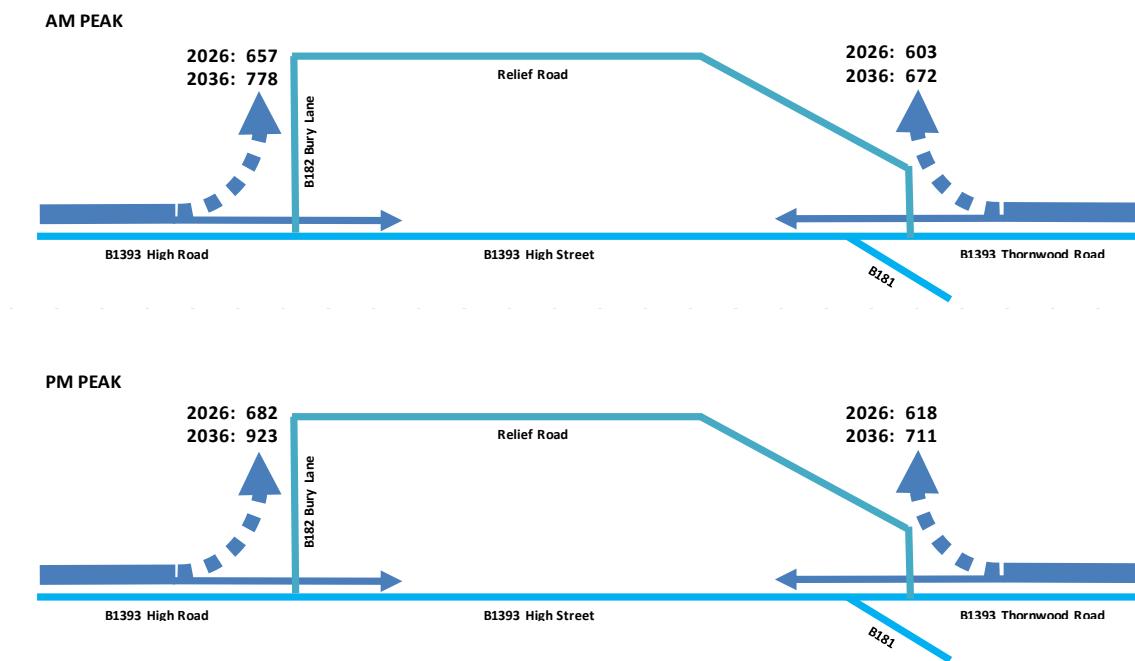


Figure 4.3: Peak hour modelled diverted flows to the western relief road

The final set of diagrams below show the directional flows modelled at the extremities of the relief road – incorporating a section of the B182 Bury Lane at its western end. In addition to diverted B1393 traffic, the directional flows also include B181/B182 traffic flows and all development traffic associated with the EPP-D development site to the north of the town centre.

These flows are likely to represent the maximum traffic volumes along the relief road incorporating the ‘Scenario One’ development quota in 2026 and 2036.

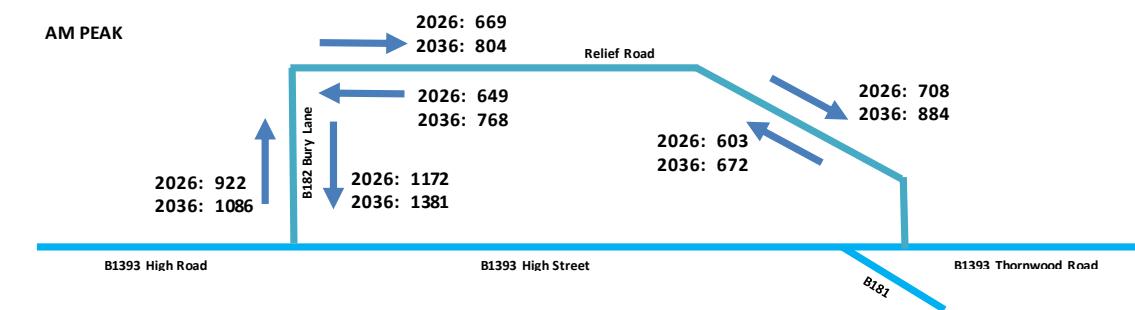




Figure 4.4: Peak hour modelled directional flows along the western relief road

4.4.3 Junction Capacity Assessments

Capacity assessments have been undertaken using reassigned traffic flows in the 2026 and 2036 forecast years at the four junctions along the B1393 High Street that are impacted by the development of a western relief road. Using the numbering convention adopted for the Epping LDP study, these are as follows.

- Junction 8 – Traffic signals at junction of B1393 Thornwood Road and B181 The Plain
- Junction 9a – Mini-roundabout junction of B1393 High Street with Station Road
- Junction 9b – Mini-roundabout junction of B1393 High Street with St. John's Road
- Junction 11 – Mini-roundabout junction of B1393 High Road with B182 Bury Lane

Original proposals were to include the signalised junction of B1393 High Road with Theydon Road. However, following a manual redistribution of traffic in the spreadsheet model to accommodate a western relief road, flows at the junction remained unaffected.

It is proposed that the relief road would connect into the B1393 at its eastern end via a new junction located north-east of the traffic signals at the B1393/B181. An assumption has been made that any new junction will be designed with sufficient capacity to accommodate future traffic flows.

At the relief road's western end, it is anticipated that the junction of Bury Lane with the B1393 will be redesigned to cater for the shift in traffic flow to the (current) minor approach arm. Capacity assessments have been undertaken using the existing junction geometries in order to identify the future areas of constraint associated with an altered distribution of trips through the junction.

The tables below document the Ratio of Flow to Capacity (RFC) / Degree of Saturation (DoS) values and Passenger Car Unit (PCU) queue lengths on each junction approach arm. A glossary of terms can be found in Appendix D of this report.

It should be acknowledged that modelled queue lengths in Junctions 8 (ARCADY) are considered to become less reliable as RFC/DoS values increase beyond capacity limits. Where approach arms are modelled to operate over capacity, associated queue lengths should therefore be seen as indicative rather than representative of future conditions.

Furthermore, it is important to state that the modelling undertaken in this appraisal utilises a fixed model assignment with a fixed demand. The outputs are therefore likely to demonstrate a worst-case scenario of future congestion on the existing network. In reality, there would likely be greater variability in peak hour route choice and traffic volumes due to the effects of peak spreading. This would subsequently limit the extent of congestion at junctions during the AM and PM peak hours.

Table 4.1: LINSIG tables for junction of B1393 Thornwood Road and B181 The Plain

Junction 8 (Thornwood Road) - Epping		2026 - existing network					
Arm		AM PEAK			PM PEAK		
		LOS	Queue Length	DOS	LOS	Queue Length	DOS
B1393 Thornwood Road - Left/Ahead	-	243		131	-	143	115
B181 The Plain - Left/Ahead	-	46		98	-	77	115
B1393 Palmers Hill - Right/Ahead	-	66		103	-	574	192

Junction 8 (Thornwood Road) - Epping		2026 - with relief road					
Arm		AM PEAK			PM PEAK		
		LOS	Queue Length	DOS	LOS	Queue Length	DOS
B1393 Thornwood Road - Left/Ahead	-	26		100	-	22	97
B181 The Plain - Left/Ahead	-	46		97	-	19	93
B1393 Palmers Hill - Right/Ahead	-	7		47	-	23	95

Junction 8 (Thornwood Road) - Epping		2036 - with relief road					
Arm		AM PEAK			PM PEAK		
		LOS	Queue Length	DOS	LOS	Queue Length	DOS
B1393 Thornwood Road - Left/Ahead	-	294		171	-	335	172
B181 The Plain - Left/Ahead	-	71		100	-	41	100
B1393 Palmers Hill - Right/Ahead	-	7		49	-	49	101

Using development Scenario One, and assuming a maximum transferral of trips to a relief road, Thornwood Road junction sees a significant reduction in congestion along the B1393 approach arms in both peak periods in 2026. However, the Thornwood Road approach arm is shown to operate at capacity, largely as a result of the increased volume of left-turners to the B181 from the relief road. By 2036, it is likely that the junction would require capacity improvements to the left-turn filter from the Thornwood Road approach arm in order to tackle heavy congestion along the link.

Table 4.2: Junctions 8 tables for junction of B1393 High Street with Station Road

Junction 9a (Station Rd) - Epping				2026 - existing network			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
B1393 High Street RAB Link	F	77	1.12	F	99	1.17	
Station Road	F	33	1.11	F	7	0.91	
B1393 High Street	F	95	1.17	F	148	1.26	

Junction 9a (Station Rd) - Epping				2026 - with relief road			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
B1393 High Street RAB Link	A	1	0.52	A	1	0.56	
Station Road	C	3	0.75	C	2	0.64	
B1393 High Street	A	1	0.45	A	1	0.52	

Junction 9a (Station Rd) - Epping				2036 - with relief road			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
B1393 High Street RAB Link	C	4	0.79	C	3	0.78	
Station Road	F	22	1.03	D	4	0.82	
B1393 High Street	A	1	0.53	A	2	0.61	

Under the same development and assignment assumptions, the mini-roundabout on the High Street at Station Road is shown to be congestion free in 2026. The diversion of through traffic to the relief road also leaves the High Street approach arms comfortably within capacity in 2036, although by this time, the Station Road arm approach arm might be expected to exceed capacity.

Table 4.3: Junctions 8 tables for junction of B1393 High Street with St. John's Road

Junction 9b (St. John's Rd) - Epping				2026 - existing network			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
St. John's Road	F	11	1.05	F	49	1.31	
B1393 High Street	F	188	1.35	F	155	1.34	
B1393 High Street RAB Link	F	84	1.13	F	44	1.05	

Junction 9b (St. John's Rd) - Epping				2026 - with relief road			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
St. John's Road	A	0	0.29	B	1	0.52	
B1393 High Street	A	1	0.45	A	0	0.31	
B1393 High Street RAB Link	A	1	0.50	A	1	0.41	

Junction 9b (St. John's Rd) - Epping				2036 - with relief road			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
St. John's Road	A	0	0.33	C	2	0.66	
B1393 High Street	B	2	0.70	A	1	0.47	
B1393 High Street RAB Link	A	2	0.61	A	1	0.49	

Under the same development and assignment assumptions, the mini-roundabout on the High Street at St. John's Road is shown to operate well within capacity in 2026 and 2036.

Table 4.4: Junctions 8 tables for junction of B1393 High Road with B182 Bury Lane

Junction 11 (Bury Ln) - Epping				2026 - existing network			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
B182 Bury Lane	F	30	1.07	B	1	0.59	
B1393 High Road (East)	F	297	1.52	F	154	1.30	
B1393 High Road (West)	F	23	0.99	F	200	1.26	

Junction 11 (Bury Ln) - Epping				2026 - with relief road			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
B182 Bury Lane	F	182	1.30	F	36	1.04	
B1393 High Road (East)	F	12	0.96	F	6	0.88	
B1393 High Road (West)	F	25	1.00	F	207	1.28	

Junction 11 (Bury Ln) - Epping				2036 - with relief road			
Arm	AM PEAK			PM PEAK			RFC
	LOS	Queue Length	RFC	LOS	Queue Length	RFC	
B182 Bury Lane	F	414	1.53	F	82	1.14	
B1393 High Road (East)	F	151	1.38	F	60	1.20	
B1393 High Road (West)	F	118	1.16	F	715	1.66	

It is envisaged that the junction of the B1393 with Bury Lane will require upgrading to accommodate development of a relief road. Based on the latest capacity assessments in this study, it should be expected that all arms of the roundabout would require capacity improvement in order for the junction to operate within capacity by 2036.

There would be a likely requirement for approach arm widening along Bury Lane to accommodate the significant increase in traffic flow along the link. At the same time, the left-turn movement from the B1393 into Bury Lane would require attention in order to accommodate the heavy turning flow predicted. This might best be addressed through the provision of a dedicated left-turn filter lane.

With traffic flows along the B1393 eastern approach arm giving way to a significantly higher volume of right-turning traffic from Bury Lane, there is the potential for heavy

congestion along the link by 2036 – despite there being a significant reduction in B1393 traffic flow. A straight-ahead filter lane may have the potential to tackle this turning movement conflict.

It should be noted that any new junction built further west of the B182 to provide access to the western relief road from the B1393, would likely require similar filter lanes to be incorporated into its design in order for it to function within capacity.

5 Summary of findings

The purpose of this study has been to investigate the existing factors that contribute towards congestion along the High Street and propose measures that would have a positive impact upon increasing capacity and traffic flows. In particular the existing pedestrian crossings, parking bays and measures that would increase capacity at the High Street junction with Station Road and St John's Road. The study also required the investigation to provide a relief road on the western side of Epping town, to reduce congestion along the High Street and to divert motorists who use the High Street as a diversion route.

The results of the forecast-year capacity modelling suggest that the junctions along the B1393 will all significantly exceed capacity in both peak periods by 2026. A combination of infrastructure improvements and sustainable travel initiatives will likely be required across the road network in Epping in order for future traffic flows to be accommodated in the peak hours.

The collision analysis has determined that a high proportion of collisions have been recorded for vehicles approaching the double mini roundabout. Furthermore, high proportions of collisions appear to be as a result of the carriageway alignment. A high number of collisions have involved cyclists and powered two wheelers and a high number of collisions have involved vehicles parking or pulling out of parking bays along the High Street. Site observations have re-enforced the sentiment that the carriageway alignment is not effective between the St John's Road and Grove Lane junctions. The parking bays, market area and pedestrian refuge islands all appear to negatively contribute towards increased localised congestion along the High Street by creating obstructions to free flowing traffic.

In order to remedy the above issues a series of proposals have been made, shown on Drawing Numbers DC20053-00-006 and DC20053-00-007. The proposals seek to improve congestion along the High Street by redistributing the carriageway to facilitate wider parking bays that are demarcated by length, removing the pedestrian refuge islands, rationalising carriageway widths and relocating the market so that it does not overspill onto the carriageway. It is also recommended that the existing double mini roundabout be changed to a staggered traffic signal controlled junction in order to increase capacity. A geometric arrangement has been proposed for the junction that should maximise capacity although modelling assessments will need to be carried out to inform if this would deliver increased capacity and if any of the geometric features need to be revised to facilitate this. Furthermore, the incidence of common land on the north-

western side of the junction may require State approval and may be a major risk towards the further development of this proposal.

A Level 1 Cost Estimate has been produced for the proposals outlined as part of the study. The cost for the scheme is estimated to total £3.2 million. This is comprised from costs totalling to £1.35 million for the junction elements, £665k for the High Street elements with the remaining costs prescribed to risk, scheme preparation and contract management. The cost breakdown is provided in Appendix B.

With regards to the western relief road the desktop study identified a number of constraints which could affect the alignment of the western relief road which in turn could raise the cost. Two options were developed taking into account the findings from the desktop study. As the area may have a number of environmental constraints it is recommend that an environmental constraints investigation is carried out to confirm the findings of this report. Following that the horizontal alignment can be better determined. However, if a more realistic alignment and cost is required a topographical survey will necessary. This will enable the Essex Highways to carry out a more detailed preliminary design.

Using the specific Local Plan development quota used for this study, and assuming a maximum possible transferral of trips to the relief road, the junctions along the B1393 might be expected to demonstrate considerable reductions in congestion with a relief road in place. However, minor capacity improvements at junctions may still be required to accommodate certain movements in the town centre. Should the relief road connect into the B1393 via the B182 Bury Lane at its south-western end, the mini-roundabout junction will likely require significant capacity upgrades.

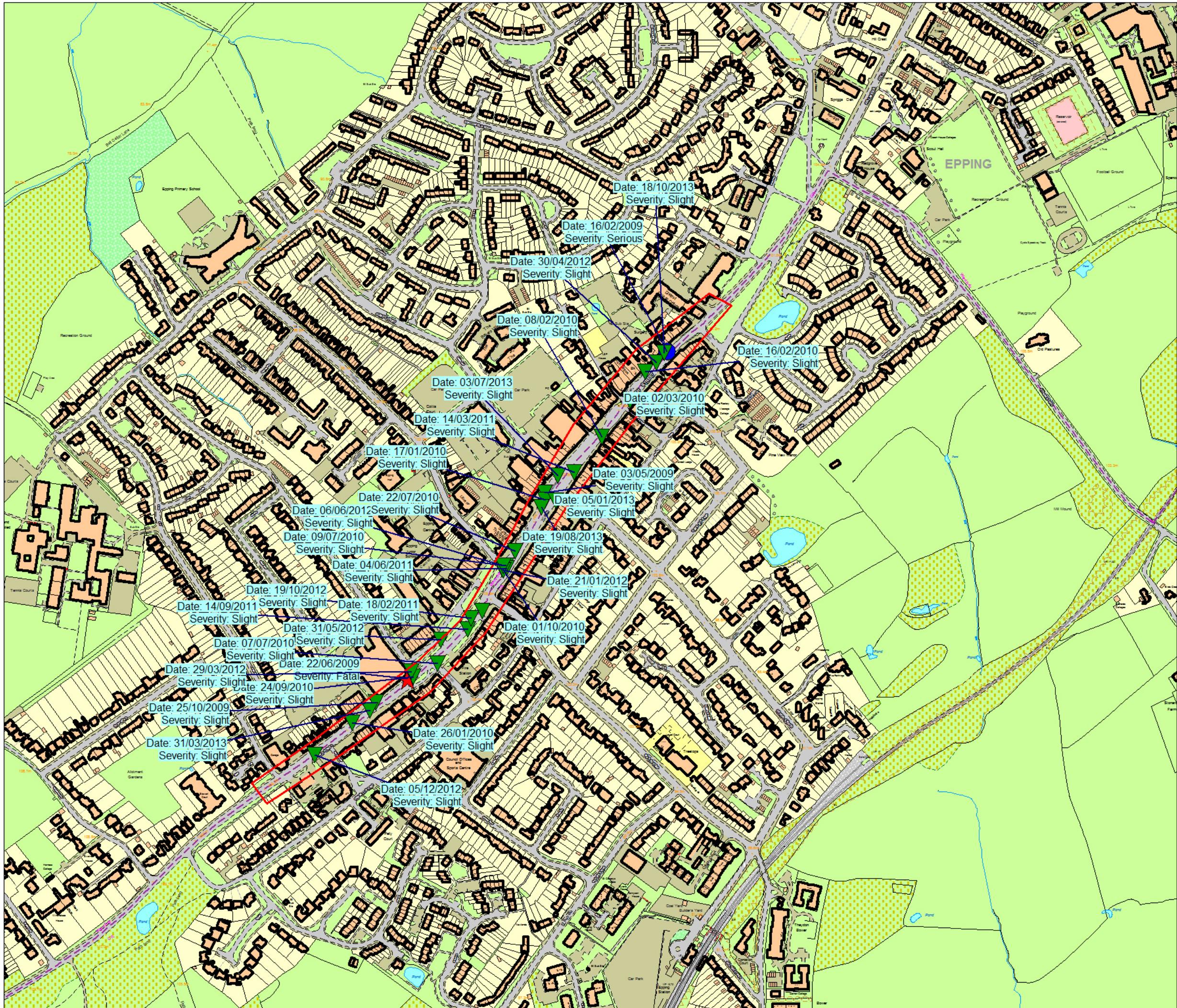
It should be acknowledged that the maximum transferal of trips to the western relief road was incorporated into the modelling on the understanding that the existing B1393 route through Epping town centre would remain sufficiently congested for the less-direct relief road route to continue to offer up journey time savings once all in-scope trips were transferred. To this effect, the relief road might not be expected to remove congestion from the B1393, but rather help to reduce it in the peak periods.

Should the feasibility of a western relief road be investigated further, it is recommended that ANPR surveys are undertaken or mobile phone data obtained and analysed in order to better determine the proportion of through-traffic on the B1393 in Epping. It is also recommended that a micro-simulation model of the scheme is built in order to better understand the extent of route reassignment. This would in turn, provide a more robust assessment of the mitigation impact on junction capacities along the B1393.

Appendices

Appendix A:

Collision Stick Diagrams, Collision Data and Collision Plot



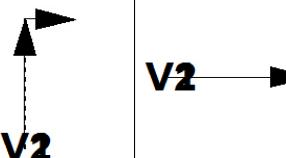
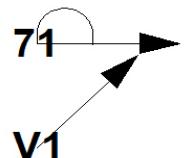
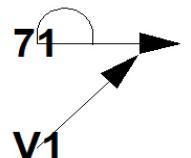
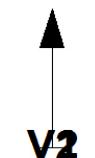
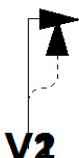
AccsMap - Accident Analysis System

Accidents between dates 31/12/2008 and 31/12/2013

Selection:

Selected using Manual Selection

Notes:
Epping Town Centre

	1	2	3	4	5
Police Ref:	I04920209	I13620509	I18860609	I35631009	I01500110
Day:	Monday	Sunday	Monday	Sunday	Sunday
Date:	16/02/2009	03/05/2009	22/06/2009	25/10/2009	17/01/2010
Time:	18:50	22:10	11:00	22:20	14:00
Visibility:	Dark	Dark	Light	Dark	Light
Road Condition:	Dry	Dry	Dry	Dry	Dry
Severity:	Serious	Slight	Fatal	Slight	Slight
Conflict:					
Pedestrians:	0	0	1	0	0
Manoeuvres:	Right	Right	None	None	Right
Easting:	546166	546006	545825	545784	546007
Northing:	202345	202160	201915	201884	202150
Weather:	Fine-no wind	Fine-no wind	Fine-no wind	Fine-no wind	Fine-no wind
CFs:	302V1B 403V1B 405V1A 701V1B	403V1A 306V2B	406V1A	405V1B	403V1A 405V1A 605V1A

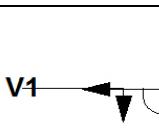
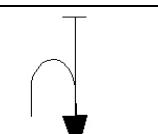
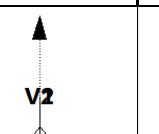
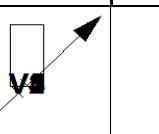
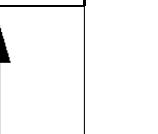
AccesMap - Accident Analysis System

Accidents between dates 31/12/2008 and 31/12/2013

Selection:

Selected using Manual Selection

Notes:
Epping Town Centre

	6	7	8	9	10
Police Ref:	I01900110	I06750210	I04570210	I06120310	I22100710
Day:	Tuesday	Monday	Tuesday	Tuesday	Wednesday
Date:	26/01/2010	08/02/2010	16/02/2010	02/03/2010	07/07/2010
Time:	19:30	07:40	11:15	08:40	19:45
Visibility:	Dark	Light	Dark	Light	Light
Road Condition:	Dry	Dry	Wet/Damp	Dry	Dry
Severity:	Slight	Slight	Slight	Slight	Slight
Conflict:					
Pedestrians:	1	0	0	0	0
Manoeuvres:	Right	Right	None	None	Left
Easting:	545753	546081	546138	546118	545865
Northing:	201858	202233	202318	202280	201935
Weather:	Fine-no wind	Fine-no wind	Rain-no wind	Fine-no wind	Fine-no wind
CFs:	405V1B 602V1B	509V1A 405V1A 709V1B	103C1B 601V1A	410V1A 603V1A 505V1A	602V1A

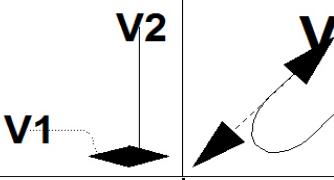
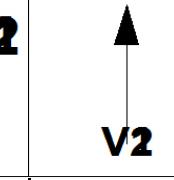
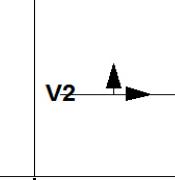
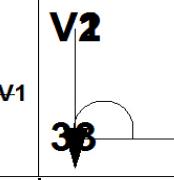
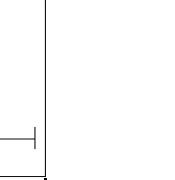
AccesMap - Accident Analysis System

Accidents between dates 31/12/2008 and 31/12/2013

Selection:

Selected using Manual Selection

Notes:
Epping Town Centre

	11	12	13	14	15
Police Ref:	I22600710	I23300710	I31060910	I31841010	I10220211
Day:	Friday	Thursday	Friday	Friday	Friday
Date:	09/07/2010	22/07/2010	24/09/2010	01/10/2010	18/02/2011
Time:	10:45	20:55	10:30	21:17	11:30
Visibility:	Light	Dark	Light	Dark	Light
Road Condition:	Dry	Wet/Damp	Dry	Wet/Damp	Wet/Damp
Severity:	Slight	Slight	Slight	Slight	Slight
Conflict:					
Pedestrians:	0	0	0	0	1
Manoeuvres:	Right	Right	None	Right	None
Easting:	545955	545967	545833	545950	545924
Northing:	202064	202083	201918	202060	202004
Weather:	Fine-no wind	Other	Fine-no wind	Rain-no wind	Other
CFs:	405C1B 602C1B	103V2A 410V2A 403V1B	402V1B 509V1B	707V2A 406V2B 103V2A	601V1A

AccesMap - Accident Analysis System

Accidents between dates 31/12/2008 and 31/12/2013

Selection:

Selected using Manual Selection

Notes:
Epping Town Centre

	16	17	18	19	20
Police Ref:	I07400311	I16570611	I28990911	I01650112	I10530312
Day:	Monday	Saturday	Wednesday	Saturday	Thursday
Date:	14/03/2011	04/06/2011	14/09/2011	21/01/2012	29/03/2012
Time:	17:22	21:30	19:25	22:39	16:40
Visibility:	Light	Light	Light	Dark	Light
Road Condition:	Dry	Dry	Dry	Dry	Dry
Severity:	Slight	Slight	Slight	Slight	Slight
Conflict:					
Pedestrians:	1	0	0	0	0
Manoeuvres:	None	None	None	Right	Left
Easting:	546045	545956	545905	545951	545831
Northing:	202186	202060	201980	202058	201925
Weather:	Fine-no wind	Fine-no wind	Fine-no wind	Fine-no wind	Fine-no wind
CFs:	305V1B 405V1A 403V1B		405V1A	405V2A 406V2B	404V1B 405V1A 710V1B

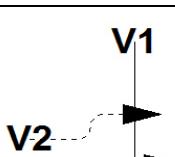
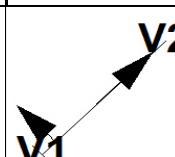
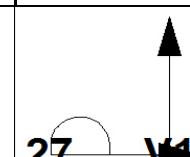
AccesMap - Accident Analysis System

Accidents between dates 31/12/2008 and 31/12/2013

Selection:

Selected using Manual Selection

Notes:
Epping Town Centre

	21	22	23	24	25
Police Ref:	I14090412	I15950512	I20480612	I34191012	I39631212
Day:	Monday	Thursday	Wednesday	Friday	Wednesday
Date:	30/04/2012	31/05/2012	06/06/2012	19/10/2012	05/12/2012
Time:	21:07	09:45	08:44	20:00	18:45
Visibility:	Dark	Light	Light	Dark	Dark
Road Condition:	Wet/Damp	Dry	Dry	Wet/Damp	Wet/Damp
Severity:	Slight	Slight	Slight	Slight	Slight
Conflict:					
Pedestrians:	0	1	0	0	1
Manoeuvres:	Left	None	Right	None	None
Easting:	546152	545869	545951	545909	545704
Northing:	202330	201966	202064	201995	201815
Weather:	Rain-no wind	Fine-no wind	Fine-no wind	Other	Fine-no wind
CFs:	103V002B 510V002B		402V1B 403V2B 404V2B	103V1B 403V1A 404V1A	304V001A 509V001A

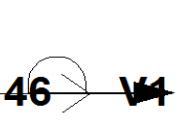
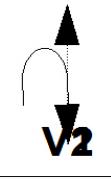
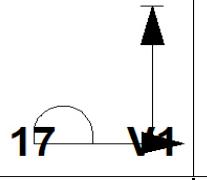
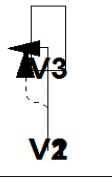
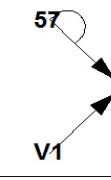
AccesMap - Accident Analysis System

Accidents between dates 31/12/2008 and 31/12/2013

Selection:

Selected using Manual Selection

Notes:
Epping Town Centre

	26	27	28	29	30
Police Ref:	I01800113	I08520313	I26780713	I24140813	I32951013
Day:	Saturday	Sunday	Wednesday	Monday	Friday
Date:	05/01/2013	31/03/2013	03/07/2013	19/08/2013	18/10/2013
Time:	10:50	11:00	16:00	19:13	23:00
Visibility:	Light	Light	Light	Light	Dark
Road Condition:	Dry	Dry	Dry	Dry	Dry
Severity:	Slight	Slight	Slight	Slight	Slight
Conflict:					
Pedestrians:	1	0	1	0	1
Manoeuvres:	None	Right	None	Left	None
Easting:	546020	545776	546023	546001	546163
Northing:	202149	201874	202182	202141	202343
Weather:	Fine-no wind	Fine-no wind	Fine-no wind	Fine-no wind	Fine-no wind
CFs:	405V001B 602V001B 710V001A 800V001A	602V1A 405V1A 406V1A 801V001A	802C001A 801C001A 808C001A 800V001A	308V1B 403V1A 605V1A 808C001A	806C001A 802C001A 808C001A 800V001A

AccsMap - Accident Analysis System**Accidents between dates 31/12/2008 and 31/12/2013****Selection:****Selected using Manual Selection****Notes:**
Epping Town Centre**Percentages**

Pedestrian: 30
Wet: 23
Dark: 40

Accident Figures

Fatal	Serious	Slight	Total
1	1	28	30

Site Diagram

Appendix B:

Level 1 Cost Estimate

PRELIMINARY COSTINGS

Epping Western relief road option one

Epping western relief road option one as per drawing DC20053-00-009

Reference: DC20053-00-009
 Version: 001
 Prepared By Koula Valsamis-Warren 28/05/2014

Checked By

Authorised

Item	Description	Unit	Quantity	Rate	Amount £
	Highway Works Total Cost of Highway Works	sum	1	8,354,630	8,354,630
	Structures Works Culvert, footbridge	sum	3	250,000	750,000
	Bridge	sum	1	350000	350,000
	Landscaping and Ecology Landscaping and Ecology	sum	1	500,000	500,000
	Estimated Construction Costs			£	9,954,630
	Statutory Undertaker Diversions Statutory Undertaker Diversions - Nominal Sum [Assumes no pylon affected]	sum	1.00	1,000,000	1,000,000
	Estimated Construction Costs			£	10,954,630
	Scheme Preparation Design - Civils (includes project management etc.) Design - Structures Surveys (includes topographical survey, trial holes, drainage) Environmental Surveys, mitigation and design	%		12.0 15.0 10.0 4.0	1,002,556 112,500 995,463 398,185
	Contract Administration NEC Project Manager and Supervisor	%		10.0	1,095,463
	Risk Sum from Quantified Risk Assessment - [assumed 40%]	%	40.00	4,381,852	4,381,852
	Total			£	18,940,649

Notes

Costs do not include:

Land Acquisition

Part 1 Claims

TRO Processing, advertising and legal fees

Consultation and publicity

Essex CC Commissioning and administrative costs

Drainage attenuation structures

The following assumptions have been made:

There are no special geotechnical requirements

No quantified risk assessment has been made therefore an assumption has been made.

The pylon will remain in-situ

There are no special environmental issues/requirements

The price base used is:

2013 Prices

PRELIMINARY COSTINGS

Western relief road option two

Western relief road option two as per drawing DC20053-00-010

Reference: DC20053-00-010
 Version: 001
 Prepared By Koula Valsamis-Warren 28/05/2014

Checked By

Authorised

Item	Description	Unit	Quantity	Rate	Amount £
	Highway Works Total Cost of Highway Works	sum	1	8,998,454	8,998,454
	Structures Works Culvert, footbridge	sum	3	250,000	750,000
	Landscaping and Ecology Landscaping and Ecology	sum	1	500,000	500,000
Estimated Construction Costs				£	10,248,454
	Statutory Undertaker Diversions Statutory Undertaker Diversions - Nominal Sum [Assumes no pylon affected]	sum	1.00	1,000,000	1,000,000
Estimated Construction Costs				£	11,248,454
	Scheme Preparation Design - Civils (includes project management etc.) Design - Structures Surveys (includes topographical survey, trial holes, drainage) Environmental Surveys, mitigation and design	%		12.0 15.0 10.0 4.0	1,079,814 112,500 1,024,845 409,938
	Contract Administration NEC Project Manager and Supervisor	%		10.0	1,124,845
	Risk Sum from Quantified Risk Assessment - [assumed 40%]	%	40.00	4,499,382	4,499,382
Total				£	19,499,779

Notes

Costs do not include:

Land Acquisition

Part 1 Claims

TRO Processing, advertising and legal fees

Consultation and publicity

Essex CC Commissioning and administrative costs

Drainage attenuation structures

The following assumptions have been made:

There are no special geotechnical requirements

No quantified risk assessment has been made therefore an assumption has been made.

The pylon will remain in-situ

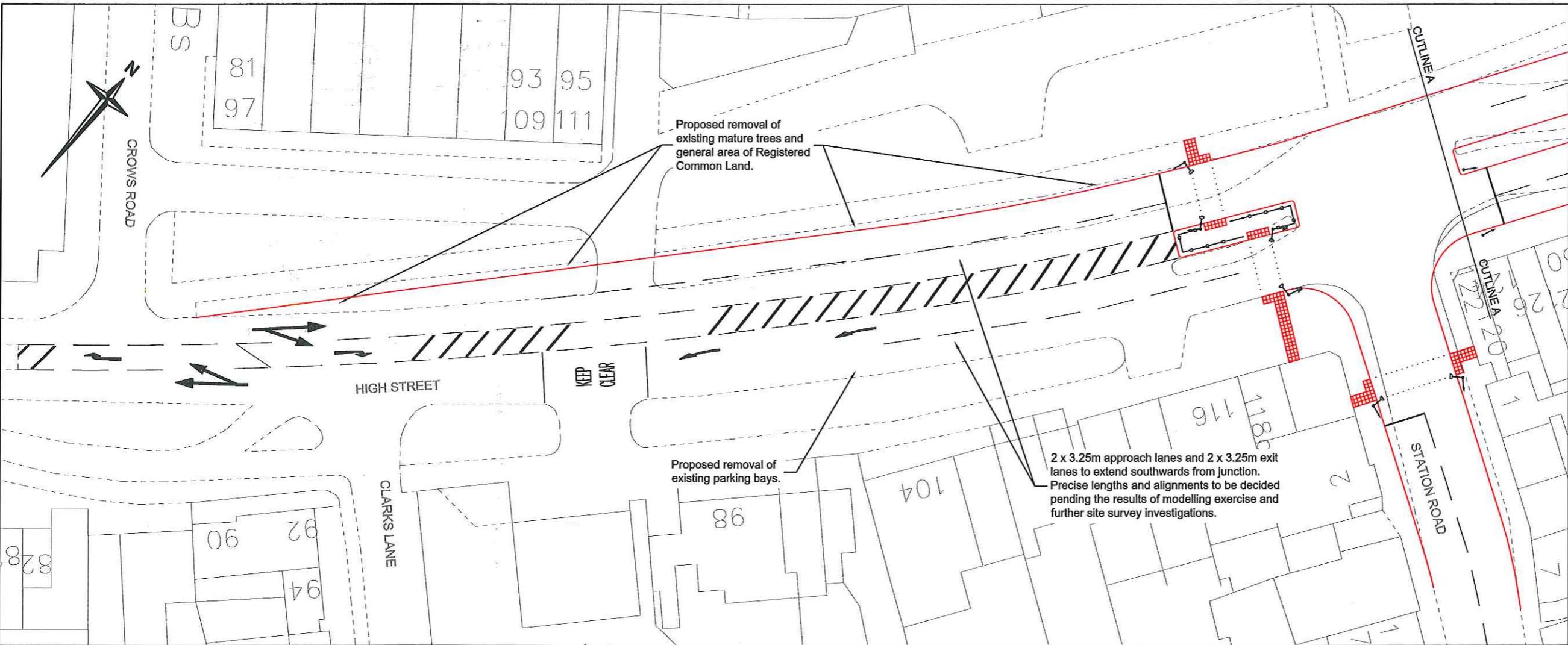
There are no special environmental issues/requirements

The price base used is:

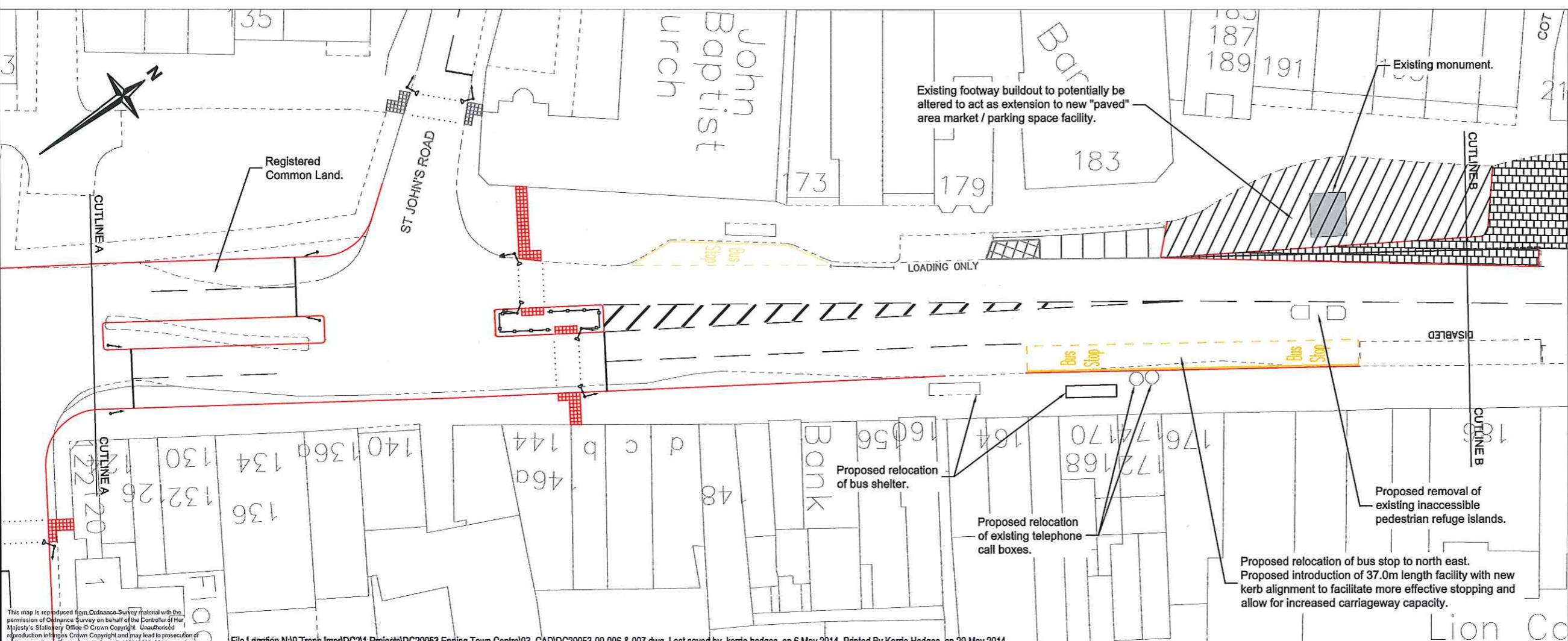
2013 Prices

Appendix C:

Drawings

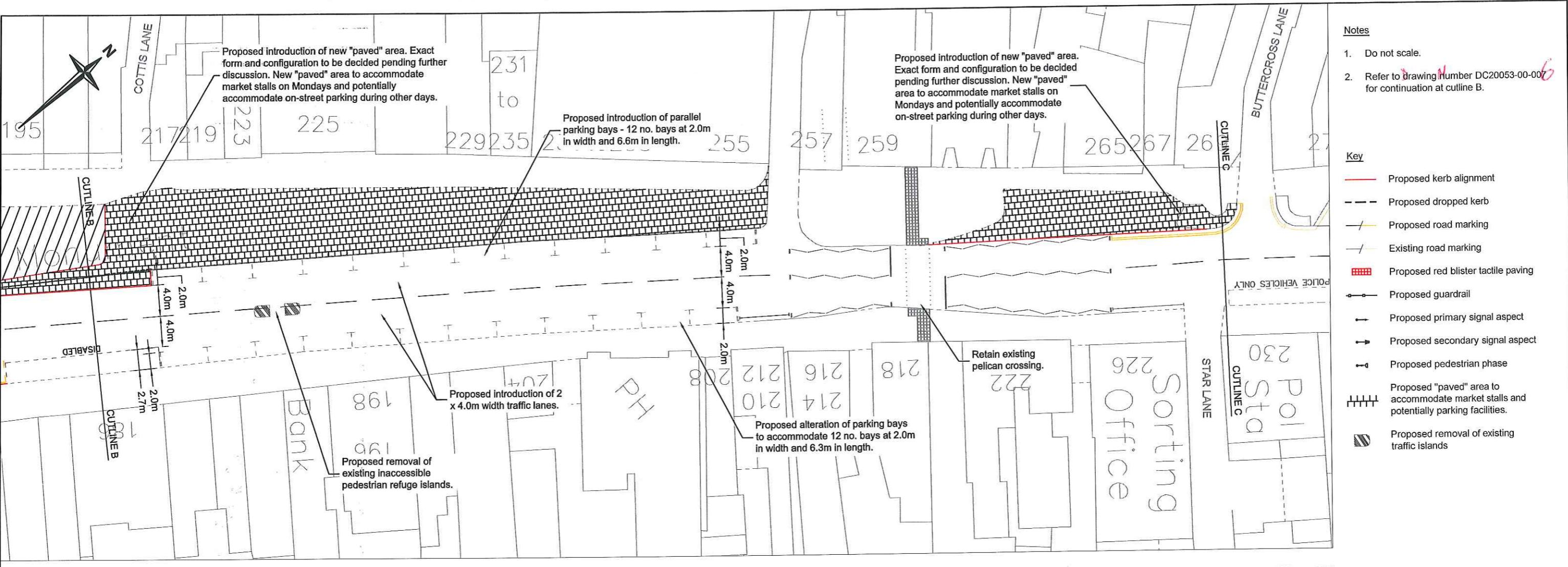


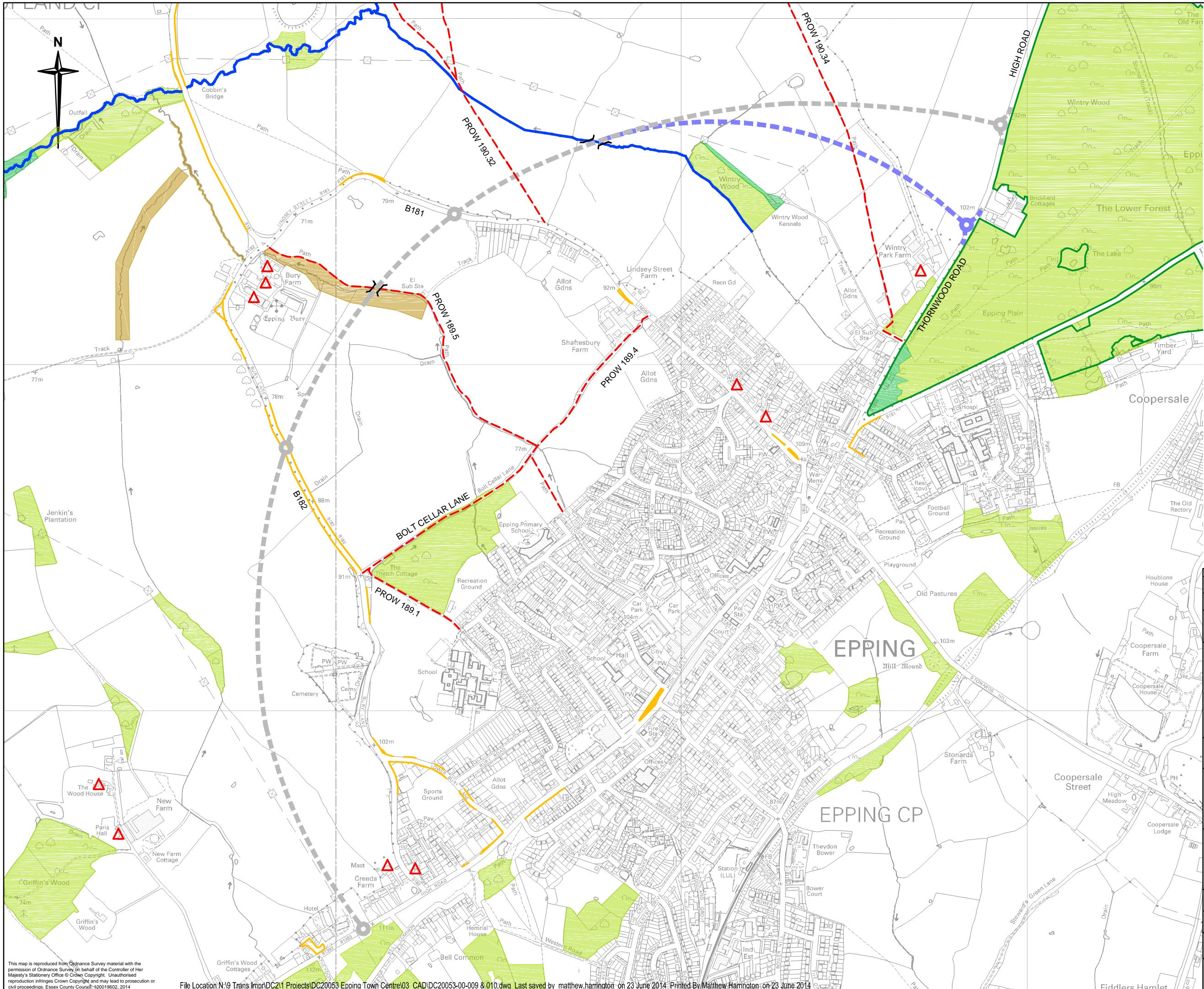
- Notes**
1. Do not scale.
 2. Refer to drawing number DC20053-00-007 for continuation at cutline B.
- Key**
- Proposed kerb alignment
 - Proposed dropped kerb
 - Proposed road marking
 - Existing road marking
 - Proposed red blister tactile paving
 - Proposed guardrail
 - Proposed primary signal aspect
 - Proposed secondary signal aspect
 - Proposed pedestrian phase
 - Proposed "paved" area to accommodate market stalls and potentially parking facilities.
 - Proposed removal of existing traffic islands



Rev.	Date	Description of revision	Drawn	Checked	Revised	Approved
DRAWING STATUS						
FEASIBILITY						
Essex Highways 						
Ringway Jacobs working in partnership with 						
Mark Rowe, Service Director, Essex Highways County Hall, Chelmsford, CM1 1QH Tel: 0845 6037631 © Essex County Council						
SCHEME TITLE						
EPPING TOWN CENTRE STRATEGY						
DRAWING TITLE						
HIGH STREET PROPOSALS SHEET 1 OF 2						
DESIGNED BY JO DRAWN BY KIH CHECKED BY JH REVIEWED BY RDW APPROVED BY DR DATE APR 14 DRAWN DATE APR 14 CHECKED DATE MAY 14 REVIEWED DATE MAY 14 APPROVED DATE MAY 14						
DRAWING UNITS IN MM						
DIMENSIONS IN MILLIMETRES						
LEVELS IN METRES						
SCALE AT A3 (297x420mm)						
1:500						
DRAWING NO. DC20053-00-006						
REV. -						

CHECK PRINT





Notes

1. Do not scale.
2. Public Right of Way (PROW) information taken from Essex County Council website.
3. MAGIC website used to identify location of Registered Common Land, Woodland and Listed Buildings. (www.magic.gov.uk)
4. Environment Agency website used to identify Main Rivers.

Key

- Indicative Route Option One
- Alternative northern junction
- Public Right of Way (PROW)
- Registered Common Land
- Deciduous Woodland BAP Priority Habitat
- National Inventory of Woodland and Trees
- Ancient and Semi-Natural Woodland
- Tree Felling Licence Agreements
- Main River
- Listed Building

Rev	Date	Description of revision	Drawn	Checked	Reviewed	Approved

FEASIBILITY



Ringway Jacobs working in partnership with Essex County Council

Mark Rowe, Service Director, Essex Highways
County Hall, Chelmsford, CM1 1QH
Tel: 0845 6037631 © Essex County Council

SCHEME TITLE

EPPING TOWN CENTRE

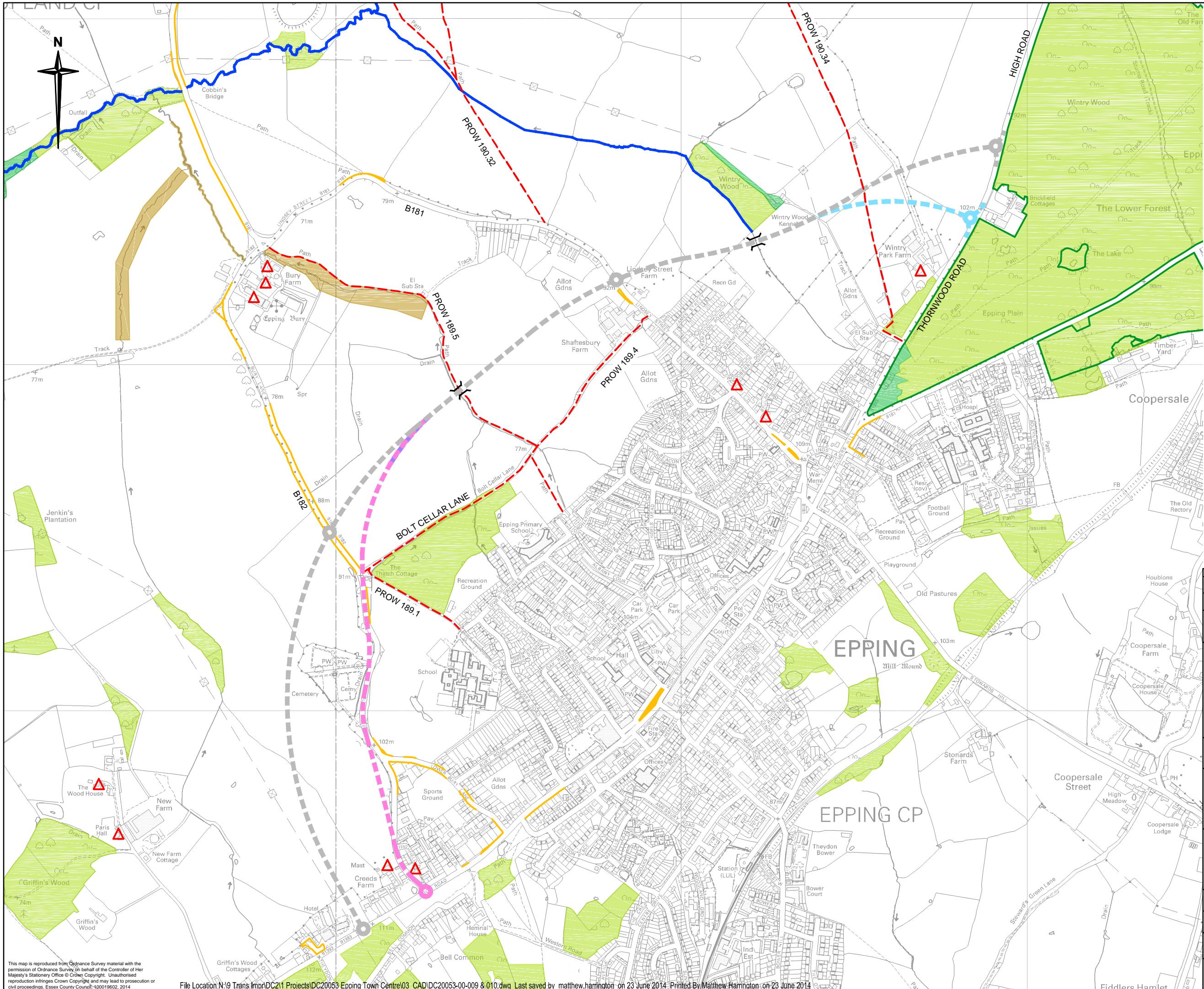
DRAWING TITLE

WESTERN RELIEF ROAD INDICATIVE ROUTE OPTION ONE

DESIGNED	KVW	DRAWN	MH	CHECKED	JH	REVIEWED	RDM	APPROVED	TK
DATE	MAY 14	DATE	MAY 14	DATE	JUN 14	DATE	JUN 14	DATE	JUN 14

DRAWING UNITS UNO. DIMENSIONS IN MILLIMETRES LEVELS IN METRES SCALE AT A3 (420x297mm)
1:10,000

DRAWING NO. DC20053-00-009 REV. -



Rev	Date	Description of revision	Drawn	Checked	Reviewed	Approved

FEASIBILITY



Ringway Jacobs working in partnership with

Mark Rowe, Service Director, Essex Highways
County Hall, Chelmsford, CM1 1QH
Tel: 0845 6037631 © Essex County Council

SCHEME TITLE

EPPING TOWN CENTRE

DRAWING TITLE

WESTERN RELIEF ROAD INDICATIVE ROUTE OPTION TWO

DESIGNED	KVW	DRAWN	KJH	CHECKED	JH	REVIEWED	RDM	APPROVED	TK
DATE	MAY 14	DATE	MAY 14	DATE	JUN 14	DATE	JUN 14	DATE	JUN 14

DRAWING UNITS UNO. DIMENSIONS IN MILLIMETRES LEVELS IN METRES SCALE AT A3 (420x297mm)
1:10,000

DRAWING NO. DC20053-00-010 REV. -

Appendix D:

Junction Capacity Descriptions & Application

RFC = Ratio of Flow to Capacity

The ratio of flow to capacity provides a measure of the utilised capacity of a junction approach arm. Arms exceeding a ratio of 0.85 (i.e. 85% capacity utilised) are considered to be approaching capacity and characteristically have light-to-moderate levels of queued traffic flow. Arms exceeding a ratio of 1.00 (i.e. 100% capacity utilised) are considered to be over capacity and are characterised as having heavy volumes of queued traffic.

ARCADY results that exceed RFCs of 1.00 generate queue lengths that are subject to exponential growth. However, the instability of flows through over-capacity approach arms, results in an inherent difficulty in calibrating modelled outputs to observed conditions. For this reason, queue lengths attributed to over capacity approach arms should be seen as indicative rather than representative.

The capacity assessment tables at the end of this technical note use a colour-coding system to assist in appraisal:

- Arms with an RFC of less than 0.85 are coloured green
- Arms with an RFC between 0.85 and 0.99 are coloured amber
- Arms with an RFC of 1.00 or more are coloured red

DOS = Degree of Saturation

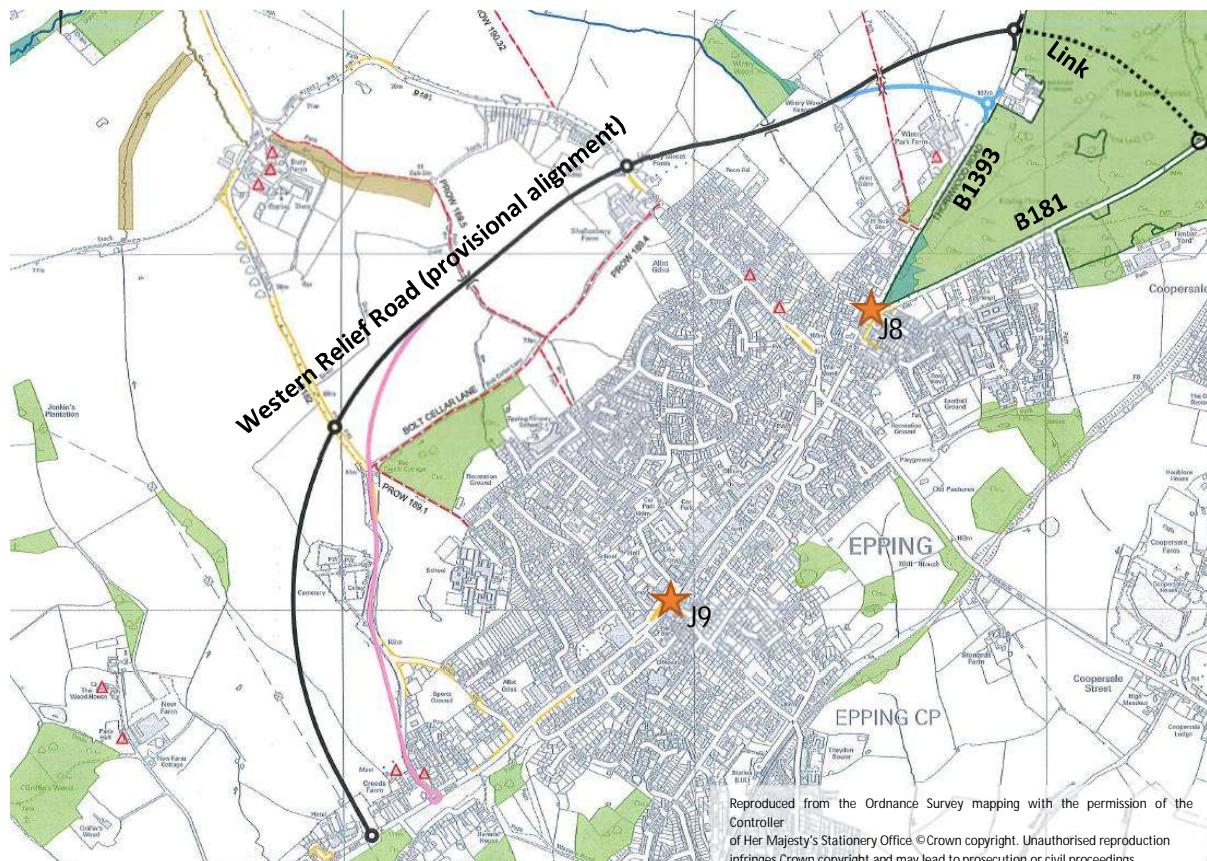
The degree of saturation is an output from LINSIG which provides a measure of the utilised capacity of a signalised junction approach lane. It is directly comparable to the RFC outputs obtained from ARCADY assessments (see above).

The colour-coding system used to categorise DOS in the model results tables is as follows:

- Lanes with a DOS of less than 85% are coloured green
- Lanes with a DOS between 85% and 99% are coloured amber
- Lanes with a DOS of 100% or more are coloured red

Junction 8 – Thornwood Road Signals, Epping

From discussions with EFDC, it is understood that an extension to existing proposals for a western relief road in Epping – providing a cut-through between the B181 and B1393 (illustrated below) - should be given due consideration despite the land-take required through Epping Forest.



With the relief road and extension in place, there is *potential* for the signalised junction along Thornwood Road to operate largely within capacity in 2036 with no alterations to the junction (other than signal optimisation) required. Although the junction is modelled to exceed capacity under the 'Ambitious Growth A' scenario, PM peak period congestion at the junction is shown to be less than that modelled with 2013 traffic flows.

Given the lack of space around the junction in which to expand, removal of peak hour traffic from the junction (via a scheme such as a relief road) would appear to be the best means of mitigating the forecast growth in congestion at the junction.

It should, however, be noted that broad assumptions were made in modelling trip assignment to the relief road, in the absence of origin/destination data.

Using turning count data available at junctions along the B1393, the maximum volume of in-scope background traffic to divert to the relief road was estimated by determining the point at which reassignment left turning movements at junctions along the existing B1393 route

with negative values in the Epping spreadsheet model. Development trips associated with were reassigned to the relief road where the link offered a reasonable alternative to the congested town centre route without significant diversion. The diverted flows were then split between the B1393 and B181 based on existing turning movement proportions at the Thornwood Road signalised junction.

Junction 9 – Station Road / St. John’s Road Double-Mini Roundabout, Epping

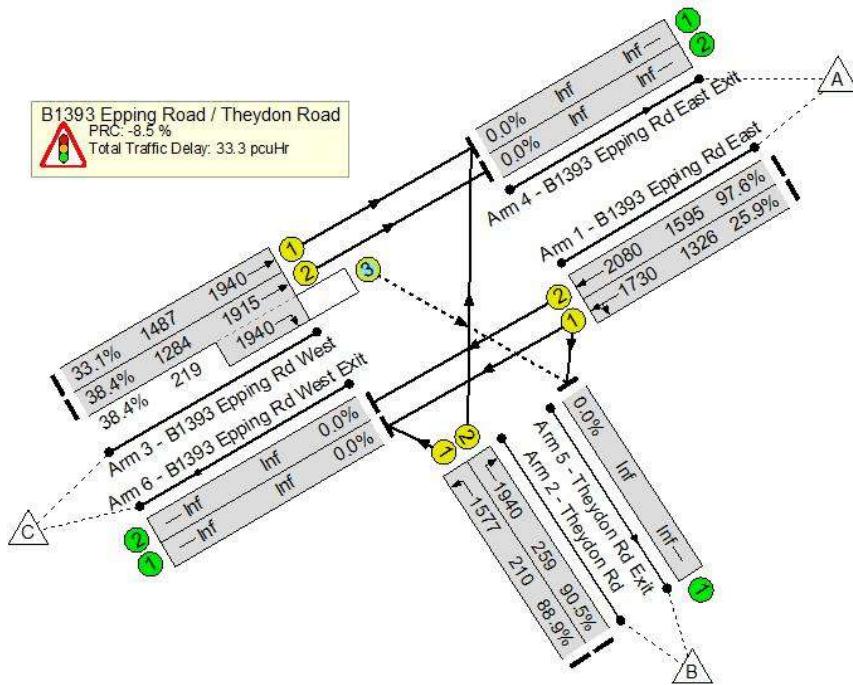
With a relief road in place, effectively bypassing the junction, modelling suggests that there is potential for the double-mini roundabout to accommodate 2036 traffic volumes - without the junction exceeding capacity and without the need for local infrastructure improvements. Model tests using ambitious growth scenarios indicate that all approach arms would operate within capacity.

These model results are however, caveated with an acknowledgement of the methodology and assumptions used in determining usage of the relief road.

Junction 10 – Theydon Road Signals, Epping

Option Test:

- Widened the B1393 eastbound approach arm to three lanes to accommodate two lanes for straight-ahead movements and a dedicated right-turn lane (approximately five vehicles in length) for access to Theydon Road.
- Widened the B1393 westbound approach arm to two lanes to accommodate straight-ahead movements in both.
- Widened the Theydon Road approach to two lanes for dedicated left and right-turn movements.
- Two-lane exits were modelled for both B1393 arms, whilst the length of road widening required along each approach arm was unspecified in the model, but presumed to be in excess of 60 metres.



Evaluation: The capacity enhancements detailed above allow the Theydon Road signalised junction to operate within capacity under the 'Ambitious Growth C' scenario with a high quota of development in and around Epping. Modelling of the other scenarios suggests that with lower volumes of traffic through the junction, the extent of road widening required along the B1393 approaches could be reduced, although the provision of additional lanes would still likely be required.

It is possible that for the junction concept to be realised, the B1393 carriageway could require realignment to make use of land to the south of the junction, given the lack of land available on the northern side.

Junction 11 – Bury Lane Mini-Roundabout, Epping

This junction was not considered as part of the mitigation study. Should the Epping Western Relief Road feed into the roundabout as a means of connecting to the B1393, the junction would necessarily require redesigning as part of the overall relief road scheme. Should the relief road connect into the B1393 further to the south, the Bury Lane mini-roundabout would then be bypassed, leaving a significantly reduced flow of traffic passing through. It is also possible that the relief road could connect to the B182 at a point north-west of the junction with the B1393. If this was to occur, the southern section of Bury Lane would effectively become a local access link.

As seen with the Station Road/ St. John's Road double-mini roundabout, under these circumstances, a reduction in flow along the B1393 would likely leave the junction operating within capacity in 2036.

Appendices

1) Junction Capacity Descriptions & Application

RFC = Ratio of Flow to Capacity

The ratio of flow to capacity provides a measure of the utilised capacity of a junction approach arm. Arms exceeding a ratio of 0.85 (i.e. 85% capacity utilised) are considered to be approaching capacity and characteristically have light-to-moderate levels of queued traffic flow. Arms exceeding a ratio of 1.00 (i.e. 100% capacity utilised) are considered to be over capacity and are characterised as having heavy volumes of queued traffic.

ARCADY results that exceed RFCs of 1.00 generate queue lengths that are subject to exponential growth. However, the instability of flows through over-capacity approach arms, results in an inherent difficulty in calibrating modelled outputs to observed conditions. For this reason, queue lengths attributed to over capacity approach arms should be seen as indicative rather than representative.

The capacity assessment tables at the end of this technical note use a colour-coding system to assist in appraisal:

- Arms with an RFC of less than 0.85 are coloured green
- Arms with an RFC between 0.85 and 0.99 are coloured amber
- Arms with an RFC of 1.00 or more are coloured red

DOS = Degree of Saturation

The degree of saturation is an output from LINSIG which provides a measure of the utilised capacity of a signalised junction approach lane. It is directly comparable to the RFC outputs obtained from ARCADY assessments (see above).

The colour-coding system used to categorise DOS in the model results tables is as follows:

- Lanes with a DOS of less than 85% are coloured green
- Lanes with a DOS between 85% and 99% are coloured amber
- Lanes with a DOS of 100% or more are coloured red

Junction 8: Thornwood Road Signals, Epping - No Mitigation (2026)

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A	90	107	108	116	112	128	119	143	110.5	112	111	111	111	111	110	137
B181 The Plain - L/A	77	95	95	99	96	103	98	93	101	118	118	119	118	119	115	116
B1393 Palmers Hill - R/A	89	102	103	101	103	97	101	111	119.4	161	161	176	165	191	179	194

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A	24	143	172	190	183	220	206	290	112.8	135	134	117	136	115	119	270
B181 The Plain - L/A	22	42	37	47	37	69	45	39	22	80	80	84	81	89	73	80
B1393 Palmers Hill - R/A	20	64	58	47	61	40	52	141	161	413	418	494	437	573	507	614

Junction 8: Thornwood Road Signals, Epping - Mitigation Option Test (2026 and 2036)

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		65	66	69	66	73	69	67		75	75	78	78	81	79	79
B181 The Plain - L/A		51	50	57	52	64	58	56		25	25	27	27	28	28	30
B1393 Palmers Hill - R/A		44	43	45	44	46	46	45		84	83	86	86	88	87	85

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		14	14	16	14	17	16	15		9	9	9	9	9	9	10
B181 The Plain - L/A		12	11	13	12	16	13	13		4	4	5	5	5	5	5
B1393 Palmers Hill - R/A		7	7	7	7	7	7	7		15	15	17	17	19	17	16

Junction 8 (Thornwood Road) - Epping								2036 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		74	72	81	73	91	82	80		87	87	94	94	103	99	96
B181 The Plain - L/A		63	63	76	65	91	79	75		30	30	32	32	34	35	41
B1393 Palmers Hill - R/A		50	50	52	51	54	54	53		93	93	98	98	102	99	97

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		17	17	21	18	28	22	21		11	11	15	15	33	20	17
B181 The Plain - L/A		15	15	20	16	30	21	20		6	6	6	6	6	7	8
B1393 Palmers Hill - R/A		8	8	8	8	8	8	8		27	26	36	36	57	42	33

Junction 9: Station Road/ St John's Road Double Mini-Roundabout, Epping - No Mitigation (2026)

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link	0.80	1.01	1.02	1.08	1.04	1.17	1.14	1.04	0.92	1.10	1.10	1.12	1.12	1.13	1.13	1.16
Station Road	0.77	0.99	0.99	1.04	1.02	1.05	1.02	1.01	0.69	0.85	0.85	0.87	0.87	0.88	0.88	0.86
B1393 High Street	0.92	1.11	1.11	1.13	1.13	1.14	1.14	1.16	0.87	1.12	1.13	1.20	1.15	1.29	1.26	1.15

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link	4	26	29	56	36	99	87	35	9	59	63	70	70	76	77	91
Station Road	3	14	14	20	18	22	18	15	2	5	5	6	6	6	6	5
B1393 High Street	9	64	63	73	72	78	80	92	6	72	79	115	89	175	155	87

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road	0.37	1.01	1.01	1.03	1.02	1.07	1.06	1.01	0.82	1.20	1.21	1.24	1.23	1.28	1.27	1.30
B1393 High Street	0.69	1.19	1.20	1.29	1.23	1.41	1.38	1.23	0.93	1.22	1.23	1.26	1.25	1.28	1.28	1.30
B1393 High Street RAB Link	0.89	1.05	1.05	1.07	1.07	1.08	1.08	1.10	0.72	0.92	0.93	1.00	0.95	1.07	1.05	0.95

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road	1	10	10	11	10	13	13	10	4	31	32	38	35	45	42	50
B1393 High Street	2	82	86	140	99	230	206	100	9	85	90	106	103	119	121	126
B1393 High Street RAB Link	7	43	42	54	53	58	56	67	3	10	11	23	14	54	44	13

Junction 9: Station Road/ St John's Road Double Mini-Roundabout, Epping - Mitigation Option Test (2026 and 2036)

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						0.56	0.52	0.43				0.52	0.52	0.54		
Station Road						0.73	0.70	0.66				0.61	0.60	0.60		
B1393 High Street						0.43	0.45	0.49				0.50	0.56	0.55		

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						1	1	1				1	1	1		
Station Road						3	2	2				2	2	2		
B1393 High Street						6	1	1				1	1	1		

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						0.30	0.30	0.30				0.51	0.52	0.57		
B1393 High Street						0.49	0.45	0.36				0.29	0.28	0.26		
B1393 High Street RAB Link						0.46	0.47	0.51				0.38	0.44	0.43		

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						0	0	0				1	1	1		
B1393 High Street						1	1	1				0	0	0		
B1393 High Street RAB Link						1	1	1				1	1	1		

Junction 9a (Station Rd) - Epping								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						0.86	0.79	0.60				0.69	0.68	0.72		
Station Road						0.98	0.90	0.80				0.74	0.73	0.74		
B1393 High Street						0.49	0.53	0.61				0.56	0.69	0.68		

Junction 9a (Station Rd) - Epping								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						6	4	2				2	2	3		
Station Road						14	7	4				3	3	3		
B1393 High Street						1	1	2				1	2	2		

Junction 9b (St. John's Rd) - Epping								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						0.34	0.35	0.35				0.64	0.67	0.78		
B1393 High Street						0.78	0.71	0.52				0.40	0.40	0.36		
B1393 High Street RAB Link						0.54	0.55	0.63				0.44	0.55	0.54		

Junction 9b (St. John's Rd) - Epping								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						1	1	1				2	2	3		
B1393 High Street						4	2	1				1	1	1		
B1393 High Street RAB Link						1	1	2				1	1	1		

Junction 10: Theydon Road Signals, Epping - No Mitigation (2026)

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Rd (E) L/A	82	115	116	120	119	126	105	149	65	74	74	115	113	127	121	126
Theydon Road	92	340	343	347	346	348	163	344	84	120	126	337	335	341	351	551
B1393 Epping Rd (W) R/A	87	115	115	120	117	126	203	120	75	98	98	111	111	111	110	112

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Rd (East) L/A	28	140	151	174	168	216	95	358	17	21	21	108	97	154	135	162
Theydon Road	15	160	162	165	164	165	96	163	12	48	57	160	158	162	169	302
B1393 Epping Rd (West) R/A	17	98	96	115	105	137	290	126	22	47	47	106	105	113	108	117

Junction 10: Theydon Road Signals, Epping - Mitigation Option Test (2026 and 2036)

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		55	56	58	57	61	62	78		45	46	46	46	47	48	61
B1393 Epping Rd (E) A		38	39	40	40	43	43	42		27	28	28	28	29	29	39
Theydon Road (L)		61	61	63	63	66	61	67		29	29	31	31	31	28	18
Theydon Road (R)		65	66	65	65	69	67	74		73	74	74	73	75	76	84
B1393 Epping Rd (W) A		29	29	29	29	30	30	31		37	38	40	39	43	43	51
B1393 Epping Rd (W) R/A		33	33	34	34	34	34	36		43	44	46	45	50	49	58

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		12	12	13	12	14	14	23		9	9	9	9	9	10	15
B1393 Epping Rd (E) A		8	8	8	8	9	9	8		5	5	5	5	5	6	9
Theydon Road (L)		6	6	6	6	6	6	6		3	3	3	3	3	3	2
Theydon Road (R)		7	8	8	7	8	8	8		10	10	10	10	10	11	19
B1393 Epping Rd (W) A		5	5	5	5	5	5	5		7	7	8	7	9	9	12
B1393 Epping Rd (W) R/A		5	5	5	5	5	5	5		7	8	8	8	10	9	13

Junction 10 (Theydon Road) - Epping								2036 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		64	65	69	67	76	78	86		52	53	53	53	55	59	72
B1393 Epping Rd (E) A		45	46	49	48	55	54	78		32	32	33	32	34	36	82
Theydon Road (L)		66	66	71	68	75	70	73		31	31	35	35	35	28	14
Theydon Road (R)		71	73	72	68	76	80	83		77	78	79	77	80	82	97
B1393 Epping Rd (W) A		33	32	34	34	34	35	76		45	47	50	48	58	59	93
B1393 Epping Rd (W) R/A		38	37	39	39	46	47	57		51	53	57	55	65	65	80

Junction 10 (Theydon Road) - Epping								2036 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		15	16	18	17	22	24	28		11	11	11	11	12	14	18
B1393 Epping Rd (E) A		9	10	11	11	13	12	26		6	6	6	6	7	7	25
Theydon Road (L)		6	6	7	7	7	7	7		3	3	3	3	3	3	2
Theydon Road (R)		9	9	9	8	9	10	10		11	11	11	11	12	13	36
B1393 Epping Rd (W) A		6	6	6	6	6	6	23		9	10	11	10	14	14	33
B1393 Epping Rd (W) R/A		6	6	6	6	6	6	1		10	11	12	12	16	16	22

Technical Note 5 – Preliminary Mitigation Measures Modelling

31st July 2014

Introduction

This technical note has been produced as an interim document to provide Epping Forest District Council (EFDC) and Essex County Council (ECC) with an early view of model outputs. It is envisaged that the contents of this note, will form part of a final report to be produced at the conclusion of the overall LDP study.

Technical Note 5 documents an initial investigation into possible junction infrastructure improvements to help mitigate the impact of Local Plan developments and the growth in background traffic across Epping Forest District up to 2036.

At this stage, infrastructure ‘concepts’ have been formulated through use of junction modelling packages (Junctions 8 and LINSIG) to appraise the *extent* of capacity upgrades potentially required for junctions to fully (or at least better) accommodate worst-case peak period future traffic flows. Concepts presented in this report are intended to illustrate the scale of possible capacity requirements, and are not intended to be definitive or exhaustive. No in-depth consideration has been given to the practical design, land take and cost implications of the junction concepts, and no junction drawings have been produced for this study.

Without junction drawings, geometric specifics such as entry radii and conflict angles have been estimated. The numbers of lanes per approach arm, lane allocation, entry lane widths, flare lengths and roundabout diameters have then been adjusted through an iterative modelling process to determine junction geometries broadly deemed necessary for a junction to function within or as close to capacity as practically possible.

It is therefore envisaged that this investigation should be the first part of a three stage process. The second stage would consider outline designs of junction proposals with which to more accurately determine design, land and cost constraints. The third stage would then consider designs in more detail, determining accurate junction geometries, statutory undertakers equipment and land ownership considerations.

Whilst it was planned to provide cost estimates for the junction proposals, it was subsequently recognised that large-scale works proposed outside of the existing highway boundaries would be difficult to cost with any degree of accuracy, and could prove misleading, without the provision of technical drawings. For this reason, it was deemed appropriate for outline costs to be considered at a latter point in the mitigation process.

Scheme concepts and capacity appraisal analysis are presented for each junction in turn, based on the sequencing established in the base-year modelling study (Technical Note 1 -

Oct 2013). The seven LDP scenarios established in the forecast-year appraisal documented in Technical Note 4 (June 2014) have been taken forward for the mitigation modelling.

Where earlier forecast model outputs at particular junctions were shown to vary little between development scenarios, certain scenarios were subsequently dropped from the mitigation modelling. This prevented repetition in the presentation of data, and provided time to appraise additional scheme concepts along with those initially envisaged. Similarly, junctions that were shown to function well within capacity in earlier forecast modelling work, were modelled using a single, appropriate growth scenario in 2036 to confirm that they remained within capacity.

For the development of mitigation measures at roundabouts, the Junctions 8 'Entry Lane Analysis' tool was used as a more robust measure of capacity requirements. This tool simulates lane usage more accurately, and was deemed appropriate for the purpose of testing proposals as opposed to replicating an existing layout. It should, however, be noted that queue length outputs from the Entry Lane Analysis method and those from the standard/basic method are not directly comparable.

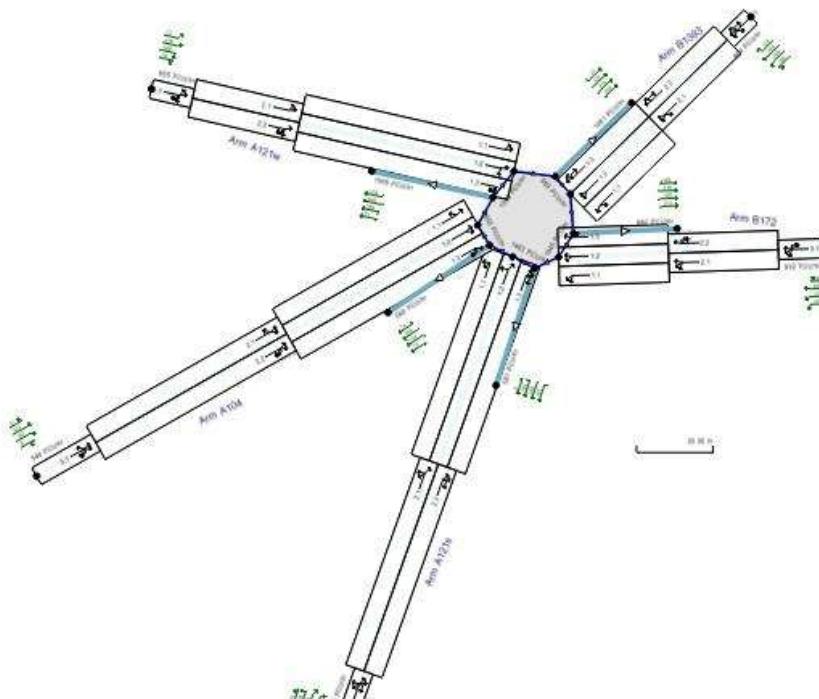
Model outputs can be found in the appendices of the report, whilst junction schematics - as presented in the Junctions 8 and LINSIG models - have been used to illustrate the scheme concepts in the report.

Mitigation Testing

Junction 1 – Wake Arms Roundabout, Epping Forest

Option Test:

- Increased the diameter of the roundabout to 85m and widened the circulatory carriageway to three lanes.
 - Increased entry widths along all approach arms to three lanes with 5-10 vehicles storage in each.
 - Widened junction approaches up to 120 metres back along the A121 south and A104 arms, 90 metres along the A121 west arm and 60 metres along the remaining arms.
 - Assumed two-lane exits on all approach arms.



Evaluation: With significant carriageway widening and enlargement of the roundabout, it may be possible for the junction to accommodate a 54% growth in peak period traffic flow (averaged across all junction arms) associated with the 2036 'Ambitious Growth A' scenario. Nevertheless, under the junction geometries modelled, a number of approach arms are shown to have reached capacity, suggesting that further roundabout enlargement and/or additional mitigation intervention may be required for the junction to fully accommodate peak period traffic flows further into the future.

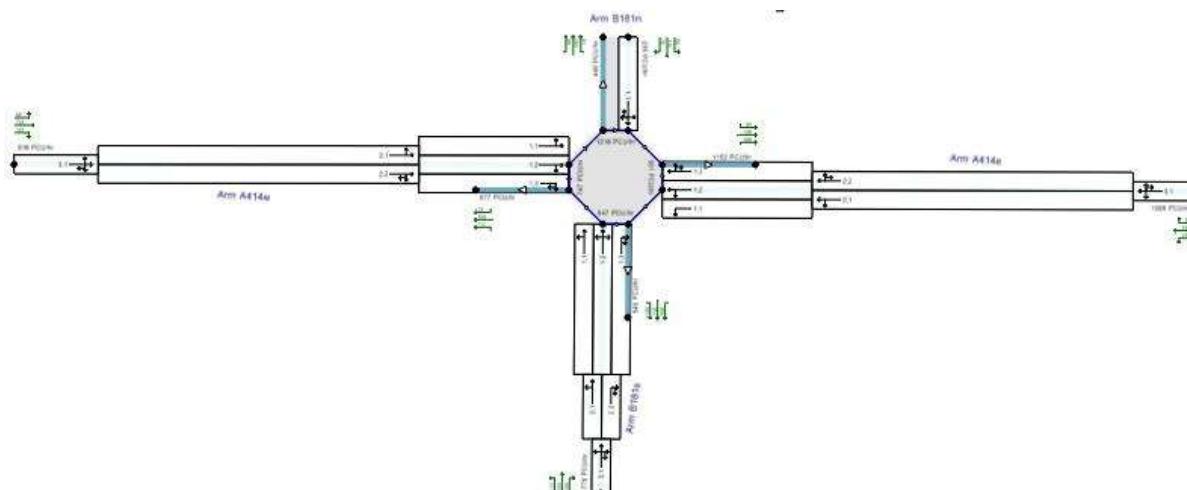
With the additional traffic associated with 'Ambitious Growth C' in 2036, both the A104 and A121 approach arms are shown with significant queuing in the PM peak.

The proposals for capacity enhancement would likely require a large quantity of land-take within Epping Forest. Potential issues surrounding access to the restaurant, petrol station and timber yard in the vicinity of the junction would need to be overcome at a design stage, or risk compromising the extent of carriageway widening that could be realised.

Junction 2 – Talbot Roundabout, North Weald

Option Test:

- Widened the two A414 approach arms to three lanes at the entry to the roundabout, with two lanes assigned for straight-ahead movements. Although not modelled as such, a left-turn lane from the A414 eastern approach into the B181 High Road could be designed as a filter lane.
- A three lane entry was also modelled on the B181 High Road approach arm.
- Junction approaches were widened up to 130 metres back along both A414 arms and 60 metres back along the B181 High Road.
- Assumed a three-lane circulatory carriageway and two-lane exits on all approach arms which will likely necessitate an enlargement of the roundabout, although this was not specifically modelled.



Evaluation: Provision of an additional entry lane on both the A414 approaches would help to accommodate the predicted 60-70% growth in traffic flow on the A414 under ambitious growth scenarios with high levels of development in Ongar. With the increased volume of east-west traffic channelled through the junction and the growth in traffic brought about by development in North Weald, it is likely that an additional lane on the B181 High Road would also be required in order for the junction to operate within capacity.

Land-take would likely be required to take forward the mitigation measures proposed. The nearby Talbot pub/restaurant and residential properties along the approach arms are likely to present challenges to the implementation of the road widening proposals.

Junction 3 – Crooked Mile Roundabout, Waltham Abbey

No mitigation measures are proposed at this junction. A test of the capacity of the junction under the 2036 ‘Ambitious Growth B’ scenario revealed there to be sufficient capacity remaining on all approach arms in the future.

Junction 4 – Highbridge Street Roundabout, Waltham Abbey

The existing junction layout leaves the B194 Highbridge Street approach arm exceeding capacity in the PM peak under most 2026 development scenarios. However, it is noted that the full capacity of the roundabout is currently constrained by the use of road hatching which narrows the entry width of the junction approach. By removing the road markings and utilising the full width of carriageway, modelling suggests that the junction would likely operate within capacity in 2036 under an ambitious development scenario, on the assumption that a two-lane approach along the B194 Highbridge Street arm could be accommodated.



However, any such removal would be subject to a review by highways designers in the event that the road markings are currently in place as a road safety measure.

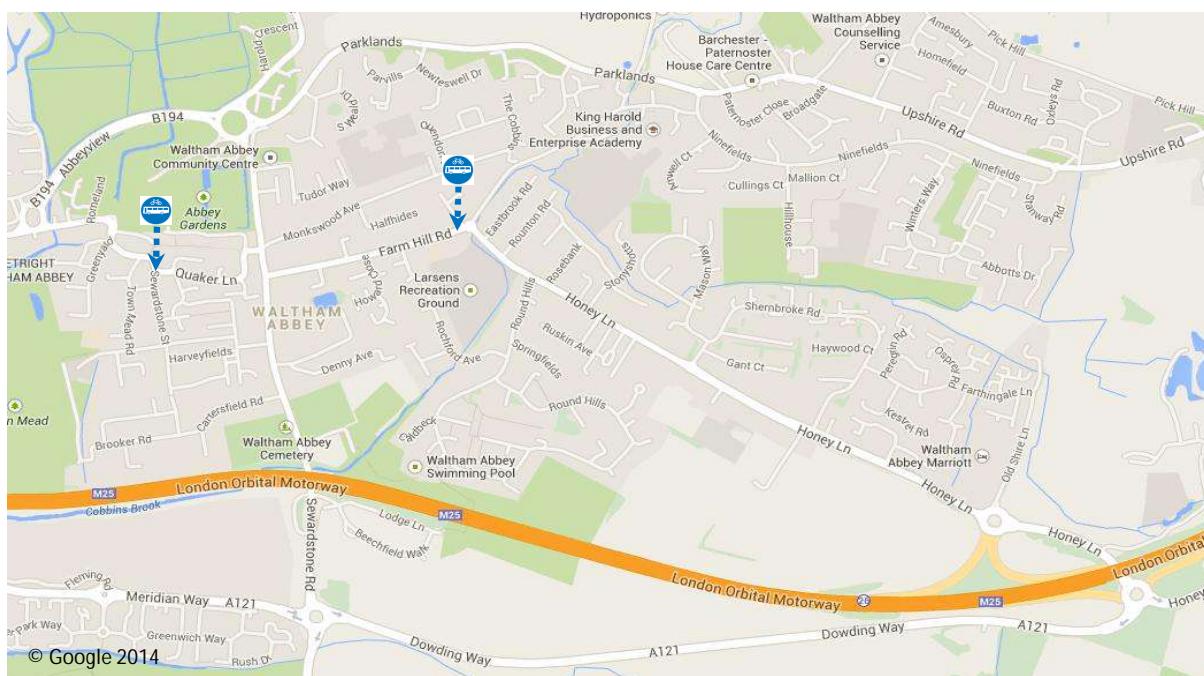
Junction 5 – Sewardstone Road Roundabout, Waltham Abbey

No mitigation measures are proposed at this junction. A test of the capacity of the junction under the 2036 'Ambitious Growth C' scenario revealed there to be sufficient capacity remaining on all approach arms in the future.

Junction 6 – Sewardstone Road / Sun Street Signals, Waltham Abbey

Option Test:

- Modelled the provision of a bus gate at the junction of Leverton Way and Quaker Lane to remove through-traffic along Sun Street, and a bus gate on Farm Hill Road at the roundabout junction of Honey Lane and Broomstick Hall Road.
- Also facilitated a right-turn movement in both lanes from Sun Street to Sewardstone Road at the signalised junction.



Evaluation: The central area of Waltham Abbey along Sun Street and Sewardstone Road is heavily built-up, providing little scope for capacity enhancement through road widening. As a result, mitigation measures for the two signalised junctions looked instead at redistributing traffic away from the centre of Waltham Abbey. The use of bus gates located on Quaker Lane and Farm Hill Road for example, would help to reduce the volume of through-traffic from the town centre and also directly alleviate congestion identified at the junction of Farm Hill Road and Sewardstone Road.

Modelled under the 2036 'Medium Growth B' scenario (which was shown to have the greatest impact on the junctions in the 2026 testing), the proposals would likely leave the

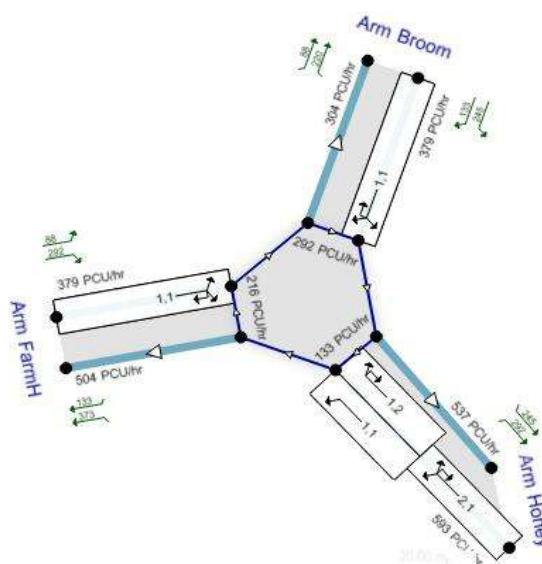
Sewardstone Road signals operating largely within capacity, with only a small amount of congestion left on the Sun Street approach arm. The results are based on an assumption that a third of peak hour trips on Sun Street / Quaker Lane would function as through-trips that could subsequently be diverted away from the route.

Whilst no further capacity upgrades would be required at the junction, the impact of the diverted traffic on the Crooked Mile Roundabout (J3) at the northern end of Sewardstone Road and the Sewardstone Road Roundabout (J5) at the southern end, would likely need to be reviewed. Furthermore, the priority junction of Broomstick Hall Rd with Ninefields and the mini roundabout at the junction of Ninefields and Paternoster Hill would also be impacted by diverted traffic and would likely require separate capacity appraisals.

Junction 7 – Honey Lane Mini-Roundabout, Waltham Abbey

Option Test:

- Widened the Honey Lane approach arm to two-lanes at the entry stop line, extending the two-lane approach 10 metres back along Honey Lane.

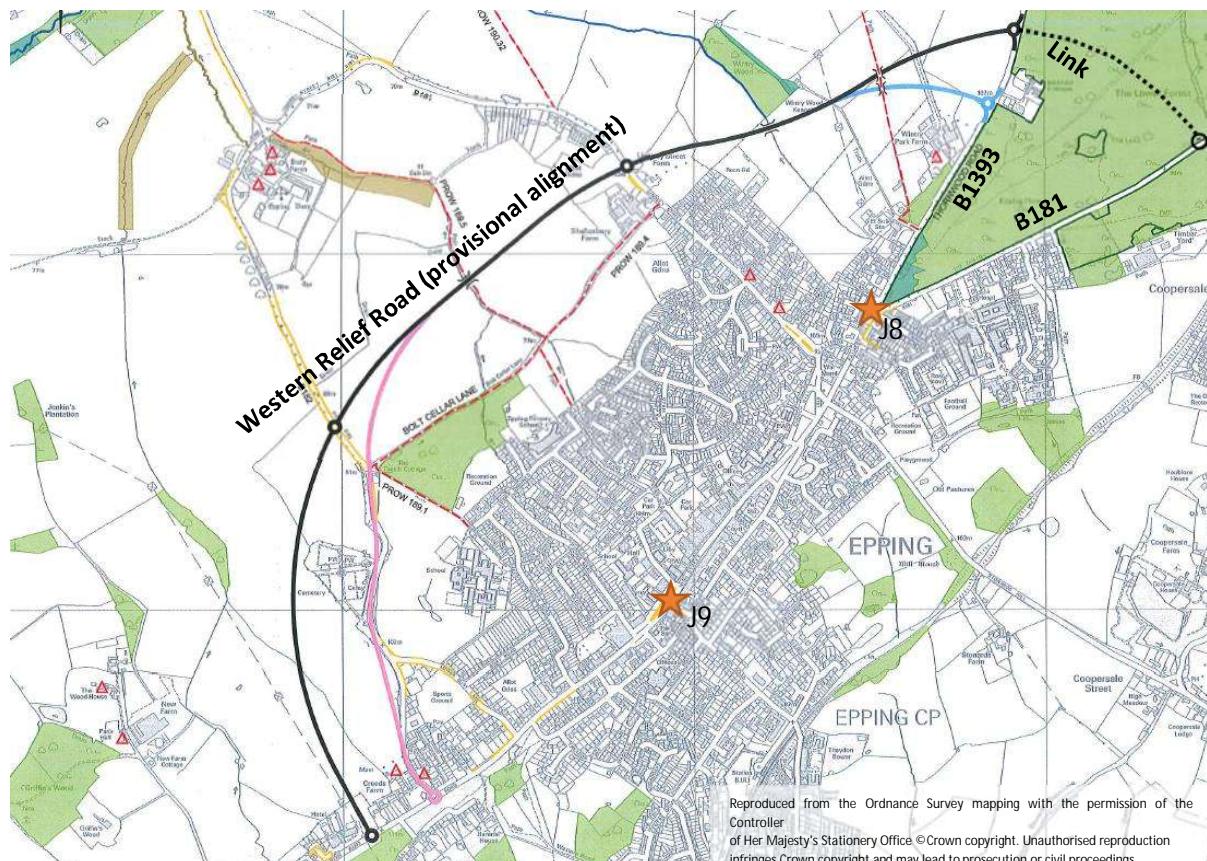


Evaluation: Widening of the Honey Lane approach would appear sufficient to accommodate traffic associated with all 2036 LDP development scenarios modelled. However, implementation of the concept would be subject to a number of considerations including possible bridge widening on the Honey Lane approach and the possible relocation of a nearby war memorial.

It should be noted that the implementation of a bus gate on Farm Hill Road, would remove turning conflicts at the Honey Lane junction and subsequently negate the need to improve its capacity.

Junction 8 – Thornwood Road Signals, Epping

From discussions with EFDC, it is understood that an extension to existing proposals for a western relief road in Epping – providing a cut-through between the B181 and B1393 (illustrated below) - should be given due consideration despite the land-take required through Epping Forest.



With the relief road and extension in place, there is *potential* for the signalised junction along Thornwood Road to operate largely within capacity in 2036 with no alterations to the junction (other than signal optimisation) required. Although the junction is modelled to exceed capacity under the 'Ambitious Growth A' scenario, PM peak period congestion at the junction is shown to be less than that modelled with 2013 traffic flows.

Given the lack of space around the junction in which to expand, removal of peak hour traffic from the junction (via a scheme such as a relief road) would appear to be the best means of mitigating the forecast growth in congestion at the junction.

It should, however, be noted that broad assumptions were made in modelling trip assignment to the relief road, in the absence of origin/destination data.

Using turning count data available at junctions along the B1393, the maximum volume of in-scope background traffic to divert to the relief road was estimated by determining the point at which reassignment left turning movements at junctions along the existing B1393 route

with negative values in the Epping spreadsheet model. Development trips associated with were reassigned to the relief road where the link offered a reasonable alternative to the congested town centre route without significant diversion. The diverted flows were then split between the B1393 and B181 based on existing turning movement proportions at the Thornwood Road signalised junction.

Junction 9 – Station Road / St. John’s Road Double-Mini Roundabout, Epping

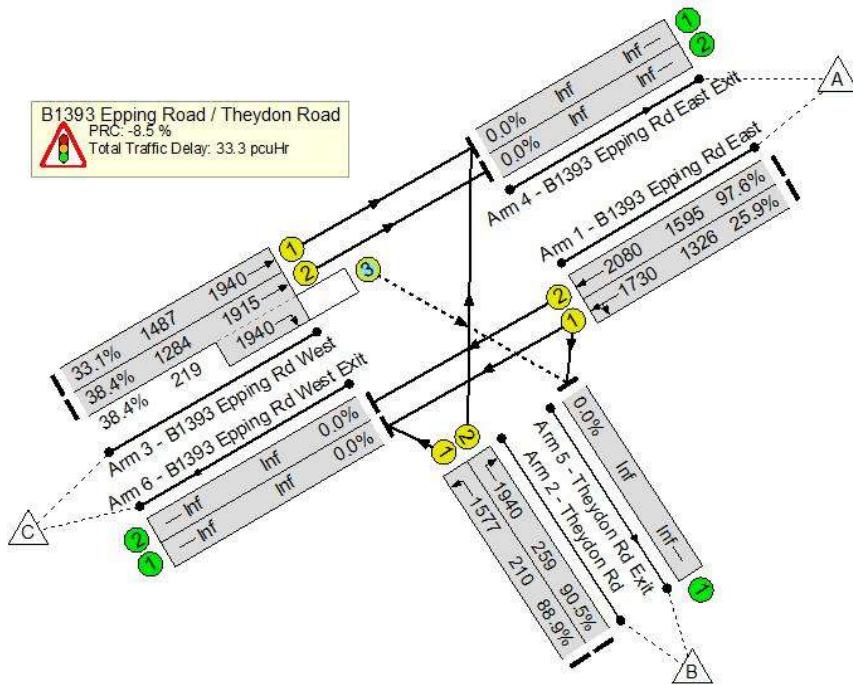
With a relief road in place, effectively bypassing the junction, modelling suggests that there is potential for the double-mini roundabout to accommodate 2036 traffic volumes - without the junction exceeding capacity and without the need for local infrastructure improvements. Model tests using ambitious growth scenarios indicate that all approach arms would operate within capacity.

These model results are however, caveated with an acknowledgement of the methodology and assumptions used in determining usage of the relief road.

Junction 10 – Theydon Road Signals, Epping

Option Test:

- Widened the B1393 eastbound approach arm to three lanes to accommodate two lanes for straight-ahead movements and a dedicated right-turn lane (approximately five vehicles in length) for access to Theydon Road.
- Widened the B1393 westbound approach arm to two lanes to accommodate straight-ahead movements in both.
- Widened the Theydon Road approach to two lanes for dedicated left and right-turn movements.
- Two-lane exits were modelled for both B1393 arms, whilst the length of road widening required along each approach arm was unspecified in the model, but presumed to be in excess of 60 metres.



Evaluation: The capacity enhancements detailed above allow the Theydon Road signalised junction to operate within capacity under the 'Ambitious Growth C' scenario with a high quota of development in and around Epping. Modelling of the other scenarios suggests that with lower volumes of traffic through the junction, the extent of road widening required along the B1393 approaches could be reduced, although the provision of additional lanes would still likely be required.

It is possible that for the junction concept to be realised, the B1393 carriageway could require realignment to make use of land to the south of the junction, given the lack of land available on the northern side.

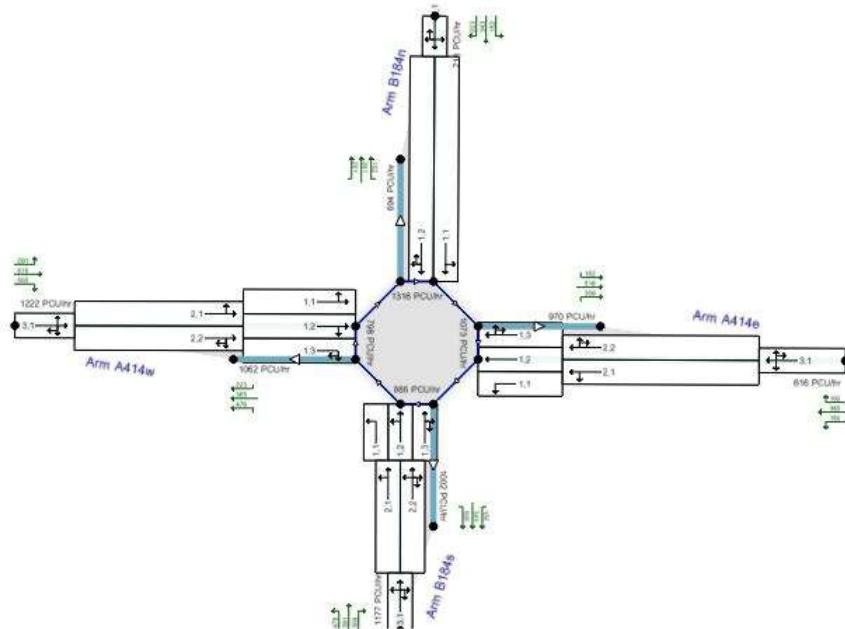
Junction 11 – Bury Lane Mini-Roundabout, Epping

This junction was not considered as part of the mitigation study. Should the Epping Western Relief Road feed into the roundabout as a means of connecting to the B1393, the junction would necessarily require redesigning as part of the overall relief road scheme. Should the relief road connect into the B1393 further to the south, the Bury Lane mini-roundabout would then be bypassed, leaving a significantly reduced flow of traffic passing through. It is also possible that the relief road could connect to the B182 at a point north-west of the junction with the B1393. If this was to occur, the southern section of Bury Lane would effectively become a local access link.

As seen with the Station Road/ St. John's Road double-mini roundabout, under these circumstances, a reduction in flow along the B1393 would likely leave the junction operating within capacity in 2036.

Junction 12 – Four Wantz Roundabout, Ongar
Option Test:

- Widened both A414 approaches to three lanes, with two lanes to accommodate straight-ahead movements.
- Overall carriageway widening extended back approximately 50 metres along both A414 arms.
- Modelled a three lane entry at the roundabout from the B184 southern approach arm and a two lane entry from the B184 northern approach.
- Road widening on these approaches extended back 30 metres and 50 metres respectively.
- Also modelled two-lane exits on all approach arms.



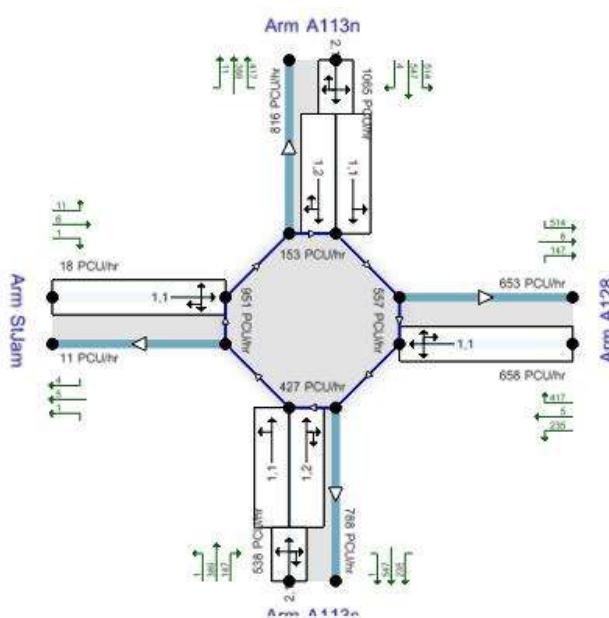
Evaluation: The extent of the carriageway widening described above, takes into consideration the land constraints present at the junction. These include the location of a petrol station, businesses and housing close to the roundabout itself. The concept design also assumes the likely loss or narrowing of footpaths in the vicinity and the relocation of the pedestrian crossing further away from the junction along the A414 western arm.

In light of the capacity constraints, the limited scale of the capacity improvements modelled are shown to leave most junction arms close to, or at capacity in the 2036 assessed scenarios.

Junction 13 – Coopers Hill Roundabout, Ongar

Option Test:

- Modelled the existing mini-roundabout junction as a standard roundabout with a 20 metre diameter.
- Widened both A113 approach arms to two lanes, extending back 20 metres.
- Assumed two-lane exits to both A113 approach arms.



Evaluation: Located in a built-up residential area, there is little land available around the junction within which to expand the junction. Consequently, the proposed length of the approach arm widening, and the size of the proposed roundabout itself, would appear to be sufficient only to keep the junction operating within capacity in 2036 with the low growth scenarios modelled.

Modelling suggests that further road widening along the A113 northern approach arm would likely be required for the junction to fully accommodate peak hour traffic flows associated with the Medium and Ambitious Growth scenarios. This however, would likely require land-take from private residences fronting onto the northern approach arm.

Junction 19 – Piercing Hill / Coppice Road Priority Junction, Theydon Bois

Option Test:

- Widened Piercing Hill and The Green approaches to accommodate two lanes.

- In the event that land constraints might prove prohibitive, there is a possibility to consider a one-way system along The Green approach arm and the link through Theydon Green (although this has not been modelled).

Evaluation: Widening of the Piercing Hill approach was shown in the modelling to accommodate traffic flows in all assessed 2026 development scenarios. However the arm was subsequently shown to exceed capacity in all 2036 scenario tests.

Should the widening proposals be considered as a short-term measure, it is likely that implementation would require a small amount of land-take, removal of surrounding trees and shrubs to improve visibility, and a possible realignment of the minor approach arms.

Alternative Test:

- Converted the priority junction into a small roundabout with a 12 metre long two-lane approach on the B172 to accommodate westbound traffic flows.

Evaluation: The roundabout option was modelled using the same LDP scenarios to appraise its performance alongside that of the road-widening scheme, and was shown to accommodate 2036 traffic flows across all scenarios.

The roundabout scheme would likely prove more costly to implement, and require more land-take than a widened priority junction. The optimum size of the roundabout would need to be determined following more detailed design work, although a small junction of between 15-20 metres diameter was sufficient in the modelling.

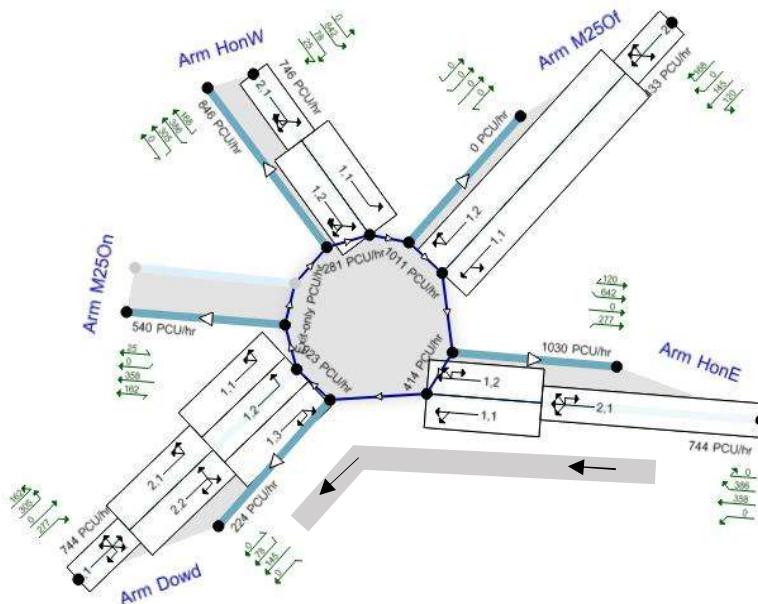
Junction 21 – M25 Junction 26 Northern Roundabout, Waltham Abbey

No mitigation measures are proposed at this junction. A test of the capacity of the junction under the 2036 'Medium Growth B' scenario (which was shown to have the greatest impact on the junction in the 2026 testing), revealed there to be sufficient capacity remaining on all approach arms in the future.

Junction 22 – M25 Junction 26 Southern Roundabout, Waltham Abbey

Option Test:

- Modelled a left-turn slip lane from the A121 Honey Lane to A121 Dowding Way.
- Widened the A121 Dowding Way arm to three lanes at the stop line, with overall carriageway widening extending back 30 metres along the approach.



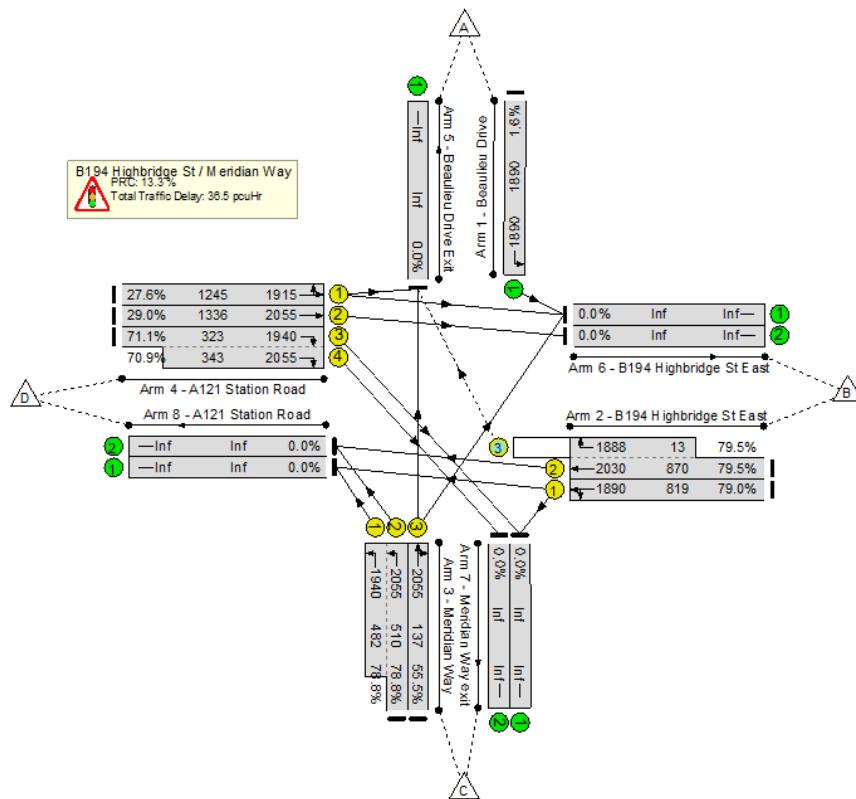
Evaluation: Provision of a filter lane is shown in the modelling to reduce the flow of traffic entering the roundabout from the Honey Lane approach, sufficient to enable the arm to operate within capacity in the 2036 scenarios tested. Channelling more traffic through the junction from the Honey Lane approach, is however, shown to place more constraint on the Dowding Way arm. An additional lane would therefore likely be required to mitigate an increase in congestion on this approach – particularly in the PM peak. Modelling nevertheless shows that with the specific carriageway improvements stated, congestion may still be experienced along Dowding Way in the 'Ambitious Growth C' scenario.

Junction 24 – Meridian Way Signals, Waltham Abbey

Option Test:

- Modelled a three-lane approach along the A121 Meridian Way, with two lanes assigned specifically for left-turn movements and extending back approximately 90 metres along the carriageway.
- Widened the B194 Highbridge Street approach to three lanes, accommodating two lanes for straight-ahead movements and a dedicated right-turn lane.
- A four-lane approach was modelled on the A121 Station Road consisting of two lanes for right-turn movements and two lanes for straight-ahead movements.
- Two-lane exits were assumed on all but the Beaulieu Drive junction arm.
- The length of the three/four lane approach along Station Road matched the length of its existing two lane approach.
- A right-turn lane was modelled along Highbridge Street with stacking capacity for around 9 -10 vehicles.

- Finally, the signal stage for the Beaulieu Drive approach arm was removed and a left-turn only restriction imposed, with access onto the B194 Highbridge Street via a merge after the junction.



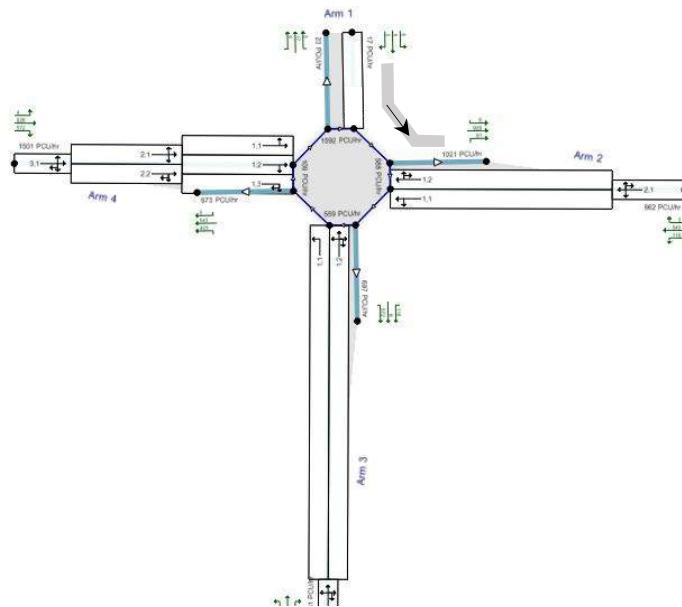
Evaluation: With extensive approach arm widening, access restrictions and possible carriageway realignment, modelling suggests that the signalised junction could operate within capacity under the 2036 scenarios tested.

A comparatively large quantity of land-take would be required to realise this scheme, made more problematic by the close proximity of the McDonalds restaurant and private residences to the junction. Widening of the A121 Station Road could also impact on the existing bridge over the River Lee.

In order to reduce dwell time at the signals for flows on other approach arms (and to subsequently keep the junction operating within capacity), the scheme also restricts access from the housing estate off Beaulieu Drive. Under proposals, local residents leaving the estate would be directed onto the B194 Highbridge Street eastbound, and would be required to route around the Highbridge Street roundabout and back along the A121 for destinations west of Waltham Abbey.

Alternative Test: Converted the signalised junction into a 30 metre diameter roundabout (which may require further enlargement following more detailed design work, in order to accommodate a three-lane section of circulatory carriageway). Widened the A121 westbound approach to three lanes, accommodating five vehicles per lane, and

assumed two-lane exits on all but the Beaulieu Drive access arm. Maintained a left-turn exit-only restriction from Beaulieu Drive with access via a merge with B194 Highbridge Street.



Evaluation: The alternative roundabout scheme concept operates within capacity under the same 2036 LDP scenario tests used for the enlarged signalised arrangement. Although land-take and some carriageway realignment would likely be required to develop the reimagined junction, the extent of road widening required along the junction approaches would appear reduced. This could prove particularly beneficial given potential land constraint on the B194 Highbridge Street and issues around possible bridge engineering on the A121 Station Road.

Access restrictions on the Beaulieu Drive approach arm have been maintained across both options tested. Under a roundabout layout with full access from Beaulieu Drive, modelling suggests that the northern approach arm would exceed capacity – despite a very small approach flow - due to the heavy flow of traffic from the A121 Station Road circulating the roundabout.

Modelling of a left-turn filter merging with the B184 Highbridge Street has been assumed to offer a better means of accessing the wider road network from Beaulieu Drive. However, the feasibility of such access arrangements would require further appraisal at a more detailed design stage. As part of a roundabout redesign, the proposed left-turn filter would benefit only a small quantity of vehicle trips from the nearby housing estate during the peak hours.

Smarter Choices

The promotion and implementation of Smarter Choices initiatives would be expected to have an impact on the number of development trips generated by the LDP. However, for the purposes of this study, any reduction in trip generation brought about through the uptake of alternative modes of travel, has not been represented in the modelling exercise through a given reduction in development trips. Such an approach is open to criticism given the inherent difficulty in establishing an accurate and representative trip reduction factor. There is a recognised spatial variation in the uptake of Smarter Choices, based on the availability of alternative modes of travel, and the quality of infrastructure. The level of Smarter Choices uptake will also vary over time, with an expectation that reductions in private travel achieved from the outset, would be difficult to sustain over a period of time.

With this in mind, the study aims to treat Smarter Choices as a separate, but complementary mitigation measure to work alongside the infrastructure proposals presented in this report.

Potential reductions in trips achievable across the various towns in Epping Forest District are considered below, based on data from case studies in other areas.

The IHT published document; "Making Smarter Travel Choices", states that personal travel planning initiatives reported typical reductions in car use of 7%-15% in urban areas and 2%-6% in rural and smaller urban areas.

Towns in Epping Forest District such as Epping and Waltham Abbey would, along with Harlow, be more likely to achieve reductions in car use of between 7%-15%. These towns are served by both bus and rail networks, providing good, accessible alternatives to private car use. Harlow in particular, has in recent years invested in upgrading bus corridors and cycle networks. To provide a more specific example, personal travel planning undertaken in 2011 in the Great Parndon, Kingsmoor, Stewards and Sumners Farm areas of Harlow recorded a 5.5% reduction in journeys made by car amongst the residents surveyed¹.

Towns such as North Weald and Ongar are more rural in nature, with limited public transport access, and would be more likely to achieve reductions in car use of between 2%-6%.

Given the reduction in car trips achieved in Harlow as a result of personal travel planning, it might be reasonable to expect similar Smarter Choices initiatives in West Essex to achieve car reduction levels closer to the lower estimates stated in the "Making Smarter Travel Choices document.

¹ "Harlow Personal Travel Planning 3", Mouchel, Dec 2011)

Under current LDP proposals, The Four Wantz Roundabout (J12) is an example of a junction modelled to be directly impacted by traffic from nearby proposed developments in Ongar. Assuming that the adoption of Smarter Choices travel alternatives could lead to a 2% reduction in rural-based development trips, this would equate to a 0.6% reduction in overall traffic flow passing through the junction in 2036 under an ambitious LDP growth scenario. At the Wake Arms Roundabout (J1) a 5% overall reduction in development trips is calculated (using the Epping Spreadsheet Model) to equate to a 1% reduction in total traffic flow through the junction in 2036.

Relocation of LDP developments

The results of the forecast year appraisal and subsequent mitigation testing provide insight into the levels of congestion that could be experienced across the Epping Forest road network under the various LDP scenarios tested. They also provide indicators as to the scale of infrastructure potentially required to mitigate the impact of background growth and development traffic to 2036.

By identifying areas of the road network with spare capacity, and/or areas where junction mitigation may be better implemented (based on presumed cost and land-take), there may be scope to relocate or adjust the scale of LDP housing and employment sites so as to help mitigate the impact of development traffic.

Observations from the modelling are bulleted below:

- Land constraint at the Four Wantz Roundabout (J12) on the A414 and the mini-roundabout on Coopers Hill (J13) would appear to restrict the extent of capacity improvements possible at both junctions to accommodate development traffic in Ongar.
- A relocation of development from sites in Ongar to sites west of the Talbot Roundabout would likely reduce the flow of development traffic along the A414 through the junction, and thus reduce the extent of carriageway widening required along its approach arms.
- In the absence of long-term scheme alternatives aimed at reducing congestion along the B1393 in Epping, a western relief road scheme could arguably be deemed an important consideration to help mitigate the impact of background traffic growth alone. Should such a scheme be built, the revised road network would be better positioned to accommodate the levels of LDP development currently proposed in Epping (and likely required to fund development of the relief road).
- However, focussing development in Epping would be expected to place additional pressure on the capacity of the Wake Arms roundabout (J1), which would likely

require extensive capacity upgrades and land-take in a sensitive area to accommodate 2036 traffic flows associated with the current LDP scenario tests.

- Waltham Abbey would appear best placed to accommodate relocated LDP sites to the south, east and (to a lesser extent) the north of the town. Junctions on the periphery are largely modelled to operate within capacity in 2036 under current development proposals, whilst the lack of any obvious land constraint could help reduce the cost of providing any necessary mitigation measures. The proximity of the M25 would also help to distribute traffic away from the local road network, thus reducing the wider impact of development traffic on junctions such as the Wake Arms Roundabout.

Appendices

1) Junction Capacity Descriptions & Application

RFC = Ratio of Flow to Capacity

The ratio of flow to capacity provides a measure of the utilised capacity of a junction approach arm. Arms exceeding a ratio of 0.85 (i.e. 85% capacity utilised) are considered to be approaching capacity and characteristically have light-to-moderate levels of queued traffic flow. Arms exceeding a ratio of 1.00 (i.e. 100% capacity utilised) are considered to be over capacity and are characterised as having heavy volumes of queued traffic.

ARCADY results that exceed RFCs of 1.00 generate queue lengths that are subject to exponential growth. However, the instability of flows through over-capacity approach arms, results in an inherent difficulty in calibrating modelled outputs to observed conditions. For this reason, queue lengths attributed to over capacity approach arms should be seen as indicative rather than representative.

The capacity assessment tables at the end of this technical note use a colour-coding system to assist in appraisal:

- Arms with an RFC of less than 0.85 are coloured green
- Arms with an RFC between 0.85 and 0.99 are coloured amber
- Arms with an RFC of 1.00 or more are coloured red

DOS = Degree of Saturation

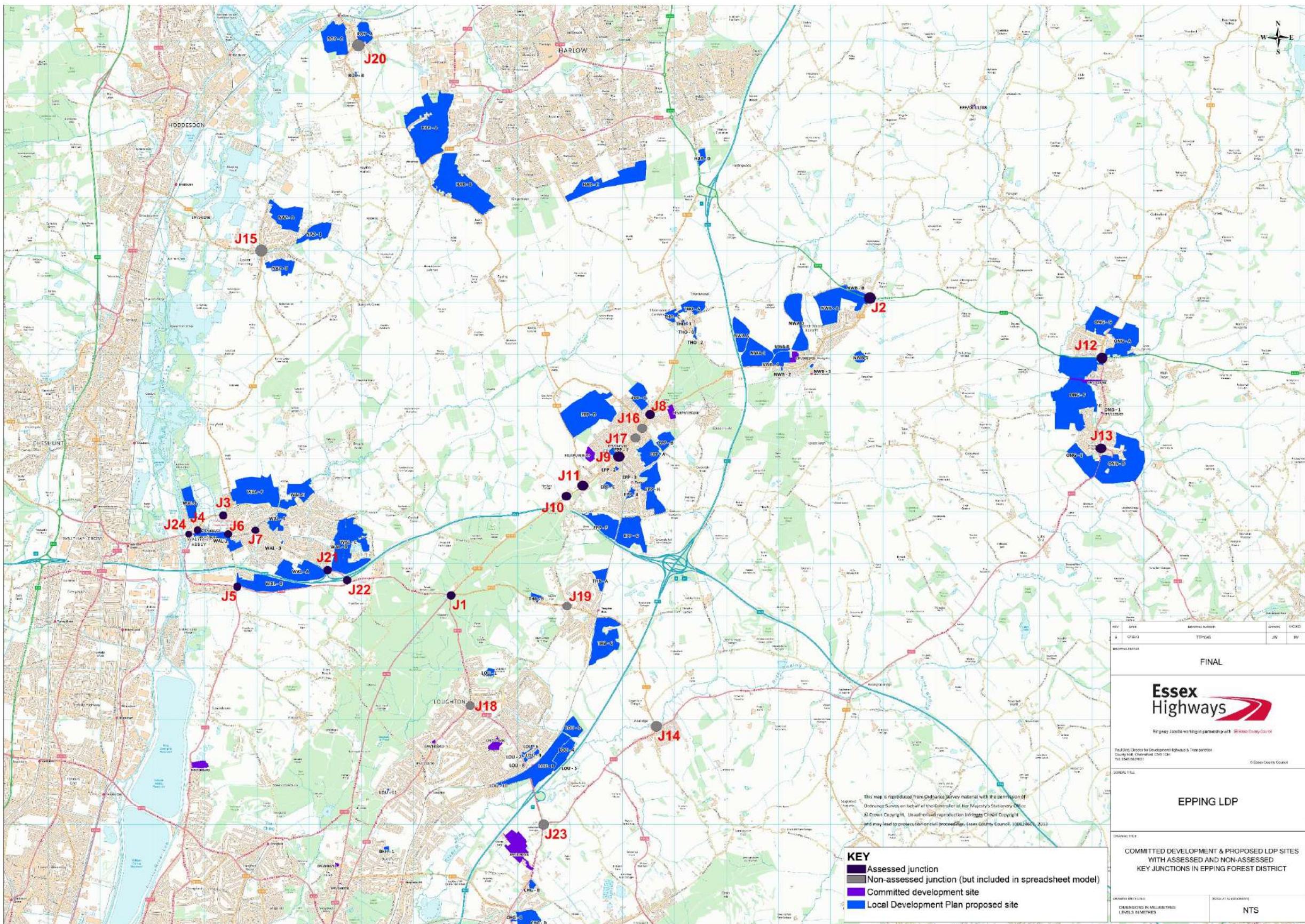
The degree of saturation is an output from LINSIG which provides a measure of the utilised capacity of a signalised junction approach lane. It is directly comparable to the RFC outputs obtained from ARCADY assessments (see above).

The colour-coding system used to categorise DOS in the model results tables is as follows:

- Lanes with a DOS of less than 85% are coloured green
- Lanes with a DOS between 85% and 99% are coloured amber
- Lanes with a DOS of 100% or more are coloured red

2) Epping Forest Local Plan – reasonable alternatives for housing provision

3) Location Map of Assessed Junctions, LDP Sites and Committed Developments in Epping Forest District



4) Mitigation Model Output Tables

Junction 1: Wake Arms Roundabout, Epping Forest - No Mitigation (2026)

Junction 1 (Wake Arms PH) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Road	0.59	0.82	0.85	0.91	0.88	1.01	1.00	1.29	0.73	0.85	0.85	0.87	0.86	0.87	0.88	0.99
B172	0.89	1.15	1.17	1.22	1.20	1.28	1.28	1.33	0.96	1.16	1.17	1.18	1.18	1.20	1.20	1.29
A121 Golding's Hill	1.33	1.68	1.68	1.75	1.73	1.80	1.79	1.91	1.02	1.25	1.27	1.30	1.29	1.34	1.33	1.42
A104 Epping New Road	0.94	1.05	1.03	1.03	1.03	1.01	1.02	1.07	1.14	1.45	1.50	1.55	1.52	1.63	1.63	1.80
A121 Woodridden Hill	0.86	1.08	1.04	1.12	1.12	1.09	1.09	1.12	1.21	1.46	1.48	1.51	1.49	1.53	1.54	1.74

Junction 1 (Wake Arms PH) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Road	1	4	5	8	7	25	21	184	3	5	5	6	6	6	7	21
B172	7	83	94	113	104	142	143	192	14	86	90	96	94	102	103	138
A121 Golding's Hill	160	437	452	506	493	542	535	629	26	125	135	157	150	186	179	234
A104 Epping New Road	11	29	26	25	26	22	22	38	55	234	269	316	293	389	384	529
A121 Woodridden Hill	6	39	27	51	52	41	41	52	79	239	251	277	266	294	300	493

Junction 1: Wake Arms Roundabout, Epping Forest - Mitigation Option Test (2026 and 2036)

Junction 1 (Wake Arms PH) - Epping									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Road		0.58		0.66		0.62		0.72		0.62		0.63		0.65		0.67
B172		0.76		0.76		0.80		0.87		0.73		0.74		0.74		0.77
A121 Golding's Hill		0.79		0.60		0.85		0.90		0.60		0.62		0.65		0.68
A104 Epping New Road		0.54		0.71		0.56		0.63		0.67		0.72		0.75		0.86
A121 Woodridden Hill		0.52		0.74		0.55		0.62		0.71		0.76		0.78		0.95

Junction 1 (Wake Arms PH) - Epping									2026 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Road		1		2		2		4		2		2		2		3
B172		3		3		4		6		3		3		3		3
A121 Golding's Hill		4		2		5		9		2		2		2		2
A104 Epping New Road		1		3		2		2		2		3		4		7
A121 Woodridden Hill		1		4		1		2		3		3		4		18

Junction 1 (Wake Arms PH) - Epping									2036 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Road		0.67		0.72		0.77		1.01		0.71		0.76		0.74		0.79
B172		0.87		0.94		0.98		0.99		0.82		0.84		0.84		0.89
A121 Golding's Hill		0.90		0.97		1.00		0.99		0.69		0.76		0.80		0.89
A104 Epping New Road		0.66		0.68		0.72		0.77		0.84		0.96		1.01		1.01
A121 Woodridden Hill		0.64		0.69		0.67		0.83		0.88		0.98		1.00		1.01

Junction 1 (Wake Arms PH) - Epping									2036 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Road		2		3		5		160		3		3		3		5
B172		6		11		20		61		4		6		6		9
A121 Golding's Hill		9		18		35		107		3		4		5		8
A104 Epping New Road		2		3		3		4		5		17		66		256
A121 Woodridden Hill		2		3		3		4		8		20		37		334

Junction 2: Talbot Roundabout, North Weald - No Mitigation (2026)

Junction 2 (Talbot PH) - North Weald									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B181 Weald Bridge Road	0.19	0.30	0.29	0.38	0.30	0.51	0.40	0.31	0.18	0.28	0.28	0.33	0.28	0.40	0.35	0.28
A414 High Road	0.81	1.03	1.01	1.07	1.03	1.15	1.09	1.02	0.53	0.75	0.74	0.77	0.75	0.83	0.80	0.74
B181 High Road	0.43	0.60	0.59	0.63	0.60	0.66	0.63	0.63	0.47	0.70	0.69	0.78	0.71	0.90	0.81	0.74
A414	0.45	0.59	0.58	0.59	0.59	0.64	0.63	0.57	0.70	0.93	0.90	0.97	0.92	1.09	1.02	0.90

Junction 2 (Talbot PH) - North Weald									2026 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B181 Weald Bridge Road	0	0	0	1	0	1	1	0	0	0	0	1	0	1	1	0
A414 High Road	4	43	32	60	41	109	75	34	1	3	3	3	3	5	4	3
B181 High Road	1	2	2	2	2	2	2	2	1	2	2	3	2	7	4	3
A414	1	2	1	2	2	2	2	1	2	10	8	16	9	55	28	8

Junction 2: Talbot Roundabout, North Weald - Mitigation Option Test (2026 and 2036)

Junction 2 (Talbot PH) - North Weald								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B181 Weald Bridge Road		0.29		0.39	0.30	0.49	0.39	0.31		0.28		0.34	0.29	0.45	0.36	0.28
A414 High Road		0.71		0.73	0.71	0.77	0.73	0.70		0.54		0.56	0.55	0.60	0.59	0.53
B181 High Road		0.42		0.46	0.44	0.48	0.46	0.46		0.49		0.54	0.50	0.61	0.56	0.52
A414		0.42		0.42	0.42	0.45	0.44	0.41		0.64		0.67	0.63	0.74	0.69	0.61

Junction 2 (Talbot PH) - North Weald								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B181 Weald Bridge Road		0		0	0	1	1	0		0		0	0	1	0	0
A414 High Road		2		3	2	3	3	2		1		1	1	2	1	1
B181 High Road		1		1	1	1	1	1		1		1	1	2	1	1
A414		1		1	1	1	1	1		2		2	2	3	2	2

Junction 2 (Talbot PH) - North Weald								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B181 Weald Bridge Road		0.42		0.64	0.44	0.95	0.70	0.46		0.42		0.59	0.46	0.90	0.72	0.45
A414 High Road		0.85		0.88	0.83	0.96	0.91	0.81		0.69		0.71	0.68	0.80	0.76	0.66
B181 High Road		0.55		0.60	0.56	0.67	0.62	0.60		0.64		0.74	0.66	0.89	0.78	0.71
A414		0.51		0.51	0.51	0.60	0.58	0.49		0.79		0.83	0.78	0.98	0.93	0.74

Junction 2 (Talbot PH) - North Weald								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B181 Weald Bridge Road		1		2	1	18	3	1		1		2	1	10	3	1
A414 High Road		5		6	5	16	8	4		2		2	2	4	3	2
B181 High Road		1		2	2	2	2	2		2		3	2	7	4	2
A414		1		1	1	2	1	1		4		5	4	33	11	3

Junction 3: Crooked Mile Roundabout, Waltham Abbey - No Mitigation (2026 and 2036)

Junction 3 (Crooked Mile) - Waltham Abbey								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Crooked Mile	0.52	0.61	0.66	0.64	0.67	0.67	0.68	0.59	0.44	0.51	0.53	0.53	0.54	0.54	0.54	0.50
Parklands	0.48	0.59	0.59	0.60	0.62	0.61	0.62	0.56	0.39	0.47	0.48	0.48	0.48	0.48	0.48	0.46
Crooked Mile	0.32	0.37	0.38	0.38	0.39	0.39	0.39	0.37	0.46	0.52	0.53	0.53	0.53	0.53	0.53	0.52
Car park	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
B194 Abbeyview	0.23	0.26	0.27	0.27	0.28	0.28	0.28	0.26	0.53	0.63	0.68	0.67	0.69	0.69	0.71	0.61

Junction 3 (Crooked Mile) - Waltham Abbey								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Crooked Mile	1	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
Parklands	1	1	1	2	2	2	2	1	1	1	1	1	1	1	1	1
Crooked Mile	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Car park	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B194 Abbeyview	0	0	0	0	0	0	0	0	1	2	2	2	2	2	2	2

Junction 3 (Crooked Mile) - Waltham Abbey								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Crooked Mile							0.84							0.64		
Parklands							0.79							0.57		
Crooked Mile							0.46							0.60		
Car park							0.03							0.03		
B194 Abbeyview							0.32							0.89		

Junction 3 (Crooked Mile) - Waltham Abbey								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Crooked Mile							5							2		
Parklands							4							1		
Crooked Mile							1							2		
Car park							0							0		
B194 Abbeyview							1							8		

Junction 4: Highbridge Street Roundabout, Waltham Abbey - No Mitigation (2026)

Junction 4 (Highbridge St) - Waltham Abbey									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Abbeyview	0.34	0.41	0.44	0.44	0.46	0.46	0.48	0.39	0.27	0.31	0.32	0.32	0.33	0.33	0.33	0.30
Highbridge Street	0.33	0.39	0.40	0.40	0.41	0.41	0.41	0.38	0.25	0.29	0.29	0.29	0.30	0.30	0.30	0.29
B194 Highbridge Street	0.46	0.52	0.53	0.53	0.54	0.54	0.54	0.51	0.85	0.99	1.06	1.04	1.07	1.07	1.09	0.96
Powdermill Lane	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.15	0.18	0.17	0.18	0.17	0.17	0.17	0.18

Junction 4: Highbridge Street Roundabout, Waltham Abbey - Mitigation Option Test (2026 and 2036)

Junction 4 (Highbridge St) - Waltham Abbey								2026 Roundabout Maximum RFC Values							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Abbeyview							0.48							0.33	
Highbridge Street							0.41							0.30	
B194 Highbridge Street							0.35							0.71	
Powdermill Lane							0.05							0.18	

Junction 4 (Highbridge St) - Waltham Abbey								2026 Roundabout Maximum Queue Lengths							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Abbeyview							1						1		
Highbridge Street							1						0		
B194 Highbridge Street							1						3		
Powdermill Lane							0						0		

Junction 4 (Highbridge St) - Waltham Abbey								2036 Roundabout Maximum RFC Values							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Abbeyview							0.61						0.39		
Highbridge Street							0.51						0.34		
B194 Highbridge Street							0.40						0.87		
Powdermill Lane							0.06						0.21		

Junction 4 (Highbridge St) - Waltham Abbey								2036 Roundabout Maximum Queue Lengths							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B194 Abbeyview							2						1		
Highbridge Street							1						1		
B194 Highbridge Street							1						6		
Powdermill Lane							0						0		

Junction 5: Sewardstone Road Roundabout, Waltham Abbey - No Mitigation (2026 and 2036)

Junction 5 (Sewardstone Rd) - Waltham Abbey									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Sewardstone Road	0.36	0.43	0.42	0.43	0.43	0.43	0.43	0.42	0.36	0.44	0.44	0.45	0.45	0.45	0.45	0.45
A121 Dowding Way	0.52	0.63	0.63	0.67	0.66	0.66	0.66	0.69	0.37	0.44	0.44	0.45	0.45	0.44	0.44	0.46
A112 Sewardstone Road	0.42	0.49	0.49	0.50	0.50	0.50	0.50	0.51	0.65	0.76	0.76	0.78	0.78	0.77	0.77	0.76
A121 Meridian Way	0.34	0.39	0.39	0.40	0.40	0.40	0.40	0.41	0.46	0.58	0.58	0.61	0.60	0.62	0.61	0.64

Junction 5 (Sewardstone Rd) - Waltham Abbey									2026 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Sewardstone Road	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
A121 Dowding Way	1	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
A112 Sewardstone Road	1	1	1	1	1	1	1	1	2	3	3	3	3	3	3	3
A121 Meridian Way	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2

Junction 6: Sewardstone Road / Sun Street Signals, Waltham Abbey - No Mitigation (2026)

Junction 6 (Sun St) - Waltham Abbey								2026 Signals Maximum DoS Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A121 Crooked Mile	62	74	68	90	69	67	69	69	81	88	81	83	84	87	82	78
Monkswood Avenue	76	76	84	80	72	84	84	87	59	66	70	72	70	69	69	70
Sun Street - Left/Ahead	35	37	33	42	35	36	36	37	29	43	40	40	44	42	41	42
Sun Street - Right	71	78	70	89	73	75	75	77	88	133	124	127	139	131	126	131
Sewardstone Rd NB - L/A	71	76	77	73	83	79	79	78	66	76	70	70	73	72	72	65
Sewardstone Rd NB - R/A	54	72	58	29	57	48	48	47	65	63	63	62	62	65	66	59
Sewardstone Rd SB - L/A	59	65	66	68	68	70	67	67	82	82	83	82	82	81	82	78
Sewardstone Rd SB - Ahead	31	37	33	35	30	30	34	35	42	48	48	47	48	48	47	44
Farm Hill Road	116	142	142	134	155	152	147	144	107	136	130	131	125	127	130	117
Sewardstone Rd NB	69	73	79	91	74	78	79	74	105	114	120	121	121	120	120	130

Junction 6 (Sun St) - Waltham Abbey								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A121 Crooked Mile	10	13	10	24	12	12	10	12	10	13	12	12	12	13	14	10
Monkswood Avenue	6	7	7	8	6	8	8	8	4	4	4	5	4	4	4	4
Sun Street - Left/Ahead	4	4	4	5	4	4	4	4	3	3	3	3	3	3	3	3
Sun Street - Right	9	12	11	14	11	10	12	10	13	71	59	67	82	69	62	70
Sewardstone Rd NB - L/A	7	7	7	9	7	7	7	7	7	6	7	7	7	7	7	7
Sewardstone Rd NB - R/A	4	5	3	2	2	2	2	2	7	7	7	7	7	6	7	7
Sewardstone Rd SB - L/A	7	7	7	8	7	7	7	7	7	7	8	7	7	7	7	7
Sewardstone Rd SB - Ahead	3	5	3	7	6	4	4	3	5	6	6	6	7	6	7	7
Farm Hill Road	76	158	160	138	192	185	170	164	45	135	120	124	110	115	119	84
Sewardstone Rd NB	6	7	7	15	7	8	8	7	68	133	165	174	174	170	164	212

Junction 6: Sewardstone Road / Sun Street Signals, Waltham Abbey - Mitigation Option Test (2026 and 2036)

Junction 6 (Sun St) - Waltham Abbey								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A121 Crooked Mile					62							58				
Monkswood Avenue					80							73				
Sun Street - Left/Ahead					81							77				
Sun Street - Right					62							61				
Sewardstone Rd NB - L/A					57							50				
Sewardstone Rd NB - R/A					67							67				
Sewardstone Rd SB - L/A					31							30				
Sewardstone Rd SB - Ahead					34							31				
Farm Hill Road					10							17				
Sewardstone Rd NB					44							67				

Junction 6 (Sun St) - Waltham Abbey								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A121 Crooked Mile					11							8				
Monkswood Avenue					7							4				
Sun Street - Left/Ahead					7							7				
Sun Street - Right					5							5				
Sewardstone Rd NB - L/A					5							5				
Sewardstone Rd NB - R/A					7							7				
Sewardstone Rd SB - L/A					3							5				
Sewardstone Rd SB - Ahead					5							7				
Farm Hill Road					0							1				
Sewardstone Rd NB					5							19				

Junction 6 (Sun St) - Waltham Abbey								2036 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A121 Crooked Mile					75							70				
Monkswood Avenue					94							83				
Sun Street - Left/Ahead					89							102				
Sun Street - Right					72							94				
Sewardstone Rd NB - L/A					54							59				
Sewardstone Rd NB - R/A					74							71				
Sewardstone Rd SB - L/A					38							34				
Sewardstone Rd SB - Ahead					35							35				
Farm Hill Road					9							17				
Sewardstone Rd NB					49							76				

Junction 6 (Sun St) - Waltham Abbey								2036 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A121 Crooked Mile					16							10				
Monkswood Avenue					12							6				
Sun Street - Left/Ahead					9							15				
Sun Street - Right					5							10				
Sewardstone Rd NB - L/A					4							6				
Sewardstone Rd NB - R/A					7							8				
Sewardstone Rd SB - L/A					5							5				
Sewardstone Rd SB - Ahead					7							7				
Farm Hill Road					0							1				
Sewardstone Rd NB					7							30				

Junction 7: Honey Lane Mini-Roundabout, Waltham Abbey - No Mitigation (2026)

Junction 7 (Honey Ln) - Waltham Abbey									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Broomstick Hall Road	0.32	0.48	0.41	0.49	0.49	0.49	0.49	0.43	0.32	0.45	0.45	0.46	0.46	0.45	0.45	0.42
Honey Lane	0.92	1.12	1.07	1.13	1.14	1.13	1.13	1.09	0.85	1.15	1.16	1.18	1.18	1.16	1.16	1.07
Farm Hill Road	0.46	0.54	0.53	0.54	0.55	0.54	0.54	0.53	0.74	0.89	0.89	0.91	0.91	0.90	0.89	0.88

Junction 7 (Honey Ln) - Waltham Abbey									2026 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Broomstick Hall Road	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Honey Lane	9	51	34	54	55	54	53	39	5	61	63	70	73	66	65	34
Farm Hill Road	1	1	1	1	1	1	1	1	3	7	7	8	8	7	7	6

Junction 7: Honey Lane Mini-Roundabout, Waltham Abbey - Mitigation Option Test (2026 and 2036)

Junction 7 (Honey Ln) - Waltham Abbey								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Broomstick Hall Road		0.33	0.28		0.34			0.29		0.30	0.30		0.30			0.29
Honey Lane		0.68	0.68		0.69			0.68		0.62	0.61		0.63			0.60
Farm Hill Road		0.42	0.41		0.43			0.41		0.70	0.70		0.71			0.68

Junction 7 (Honey Ln) - Waltham Abbey								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Broomstick Hall Road		0	0		0			0		0	0		0			0
Honey Lane		2	2		2			2		2	2		2			2
Farm Hill Road		0	0		0			0		2	2		2			2

Junction 7 (Honey Ln) - Waltham Abbey								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Broomstick Hall Road		0.44	0.33		0.45			0.36		0.39	0.40		0.41			0.34
Honey Lane		0.74	0.75		0.75			0.74		0.69	0.70		0.73			0.70
Farm Hill Road		0.47	0.47		0.49			0.46		0.82	0.83		0.87			0.79

Junction 7 (Honey Ln) - Waltham Abbey								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Broomstick Hall Road		0	0		0			0		0	0		0			0
Honey Lane		4	3		4			3		4	5		6			3
Farm Hill Road		1	1		1			1		4	5		6			3

Junction 8: Thornwood Road Signals, Epping - No Mitigation (2026)

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A	90	107	108	116	112	128	119	143	110.5	112	111	111	111	111	110	137
B181 The Plain - L/A	77	95	95	99	96	103	98	93	101	118	118	119	118	119	115	116
B1393 Palmers Hill - R/A	89	102	103	101	103	97	101	111	119.4	161	161	176	165	191	179	194

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A	24	143	172	190	183	220	206	290	112.8	135	134	117	136	115	119	270
B181 The Plain - L/A	22	42	37	47	37	69	45	39	22	80	80	84	81	89	73	80
B1393 Palmers Hill - R/A	20	64	58	47	61	40	52	141	161	413	418	494	437	573	507	614

Junction 8: Thornwood Road Signals, Epping - Mitigation Option Test (2026 and 2036)

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		65	66	69	66	73	69	67		75	75	78	78	81	79	79
B181 The Plain - L/A		51	50	57	52	64	58	56		25	25	27	27	28	28	30
B1393 Palmers Hill - R/A		44	43	45	44	46	46	45		84	83	86	86	88	87	85

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		14	14	16	14	17	16	15		9	9	9	9	9	9	10
B181 The Plain - L/A		12	11	13	12	16	13	13		4	4	5	5	5	5	5
B1393 Palmers Hill - R/A		7	7	7	7	7	7	7		15	15	17	17	19	17	16

Junction 8 (Thornwood Road) - Epping								2036 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		74	72	81	73	91	82	80		87	87	94	94	103	99	96
B181 The Plain - L/A		63	63	76	65	91	79	75		30	30	32	32	34	35	41
B1393 Palmers Hill - R/A		50	50	52	51	54	54	53		93	93	98	98	102	99	97

Junction 8 (Thornwood Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Thornwood Rd - L/A		17	17	21	18	28	22	21		11	11	15	15	33	20	17
B181 The Plain - L/A		15	15	20	16	30	21	20		6	6	6	6	6	7	8
B1393 Palmers Hill - R/A		8	8	8	8	8	8	8		27	26	36	36	57	42	33

Junction 9: Station Road/ St John's Road Double Mini-Roundabout, Epping - No Mitigation (2026)

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link	0.80	1.01	1.02	1.08	1.04	1.17	1.14	1.04	0.92	1.10	1.10	1.12	1.12	1.13	1.13	1.16
Station Road	0.77	0.99	0.99	1.04	1.02	1.05	1.02	1.01	0.69	0.85	0.85	0.87	0.87	0.88	0.88	0.86
B1393 High Street	0.92	1.11	1.11	1.13	1.13	1.14	1.14	1.16	0.87	1.12	1.13	1.20	1.15	1.29	1.26	1.15

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link	4	26	29	56	36	99	87	35	9	59	63	70	70	76	77	91
Station Road	3	14	14	20	18	22	18	15	2	5	5	6	6	6	6	5
B1393 High Street	9	64	63	73	72	78	80	92	6	72	79	115	89	175	155	87

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road	0.37	1.01	1.01	1.03	1.02	1.07	1.06	1.01	0.82	1.20	1.21	1.24	1.23	1.28	1.27	1.30
B1393 High Street	0.69	1.19	1.20	1.29	1.23	1.41	1.38	1.23	0.93	1.22	1.23	1.26	1.25	1.28	1.28	1.30
B1393 High Street RAB Link	0.89	1.05	1.05	1.07	1.07	1.08	1.08	1.10	0.72	0.92	0.93	1.00	0.95	1.07	1.05	0.95

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road	1	10	10	11	10	13	13	10	4	31	32	38	35	45	42	50
B1393 High Street	2	82	86	140	99	230	206	100	9	85	90	106	103	119	121	126
B1393 High Street RAB Link	7	43	42	54	53	58	56	67	3	10	11	23	14	54	44	13

Junction 9: Station Road/ St John's Road Double Mini-Roundabout, Epping - Mitigation Option Test (2026 and 2036)

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						0.56	0.52	0.43				0.52	0.52	0.54		
Station Road						0.73	0.70	0.66				0.61	0.60	0.60		
B1393 High Street						0.43	0.45	0.49				0.50	0.56	0.55		

Junction 9a (Station Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						1	1	1				1	1	1		
Station Road						3	2	2				2	2	2		
B1393 High Street						6	1	1				1	1	1		

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						0.30	0.30	0.30				0.51	0.52	0.57		
B1393 High Street						0.49	0.45	0.36				0.29	0.28	0.26		
B1393 High Street RAB Link						0.46	0.47	0.51				0.38	0.44	0.43		

Junction 9b (St. John's Rd) - Epping								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						0	0	0				1	1	1		
B1393 High Street						1	1	1				0	0	0		
B1393 High Street RAB Link						1	1	1				1	1	1		

Junction 9a (Station Rd) - Epping								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						0.86	0.79	0.60				0.69	0.68	0.72		
Station Road						0.98	0.90	0.80				0.74	0.73	0.74		
B1393 High Street						0.49	0.53	0.61				0.56	0.69	0.68		

Junction 9a (Station Rd) - Epping								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 High Street RAB Link						6	4	2				2	2	3		
Station Road						14	7	4				3	3	3		
B1393 High Street						1	1	2				1	2	2		

Junction 9b (St. John's Rd) - Epping								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						0.34	0.35	0.35				0.64	0.67	0.78		
B1393 High Street						0.78	0.71	0.52				0.40	0.40	0.36		
B1393 High Street RAB Link						0.54	0.55	0.63				0.44	0.55	0.54		

Junction 9b (St. John's Rd) - Epping								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
St. John's Road						1	1	1				2	2	3		
B1393 High Street						4	2	1				1	1	1		
B1393 High Street RAB Link						1	1	2				1	1	1		

Junction 10: Theydon Road Signals, Epping - No Mitigation (2026)

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Rd (E) L/A	82	115	116	120	119	126	105	149	65	74	74	115	113	127	121	126
Theydon Road	92	340	343	347	346	348	163	344	84	120	126	337	335	341	351	551
B1393 Epping Rd (W) R/A	87	115	115	120	117	126	203	120	75	98	98	111	111	111	110	112

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B1393 Epping Rd (East) L/A	28	140	151	174	168	216	95	358	17	21	21	108	97	154	135	162
Theydon Road	15	160	162	165	164	165	96	163	12	48	57	160	158	162	169	302
B1393 Epping Rd (West) R/A	17	98	96	115	105	137	290	126	22	47	47	106	105	113	108	117

Junction 10: Theydon Road Signals, Epping - Mitigation Option Test (2026 and 2036)

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		55	56	58	57	61	62	78		45	46	46	46	47	48	61
B1393 Epping Rd (E) A		38	39	40	40	43	43	42		27	28	28	28	29	29	39
Theydon Road (L)		61	61	63	63	66	61	67		29	29	31	31	31	28	18
Theydon Road (R)		65	66	65	65	69	67	74		73	74	74	73	75	76	84
B1393 Epping Rd (W) A		29	29	29	29	30	30	31		37	38	40	39	43	43	51
B1393 Epping Rd (W) R/A		33	33	34	34	34	34	36		43	44	46	45	50	49	58

Junction 10 (Theydon Road) - Epping								2026 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		12	12	13	12	14	14	23		9	9	9	9	9	10	15
B1393 Epping Rd (E) A		8	8	8	8	9	9	8		5	5	5	5	5	6	9
Theydon Road (L)		6	6	6	6	6	6	6		3	3	3	3	3	3	2
Theydon Road (R)		7	8	8	7	8	8	8		10	10	10	10	10	11	19
B1393 Epping Rd (W) A		5	5	5	5	5	5	5		7	7	8	7	9	9	12
B1393 Epping Rd (W) R/A		5	5	5	5	5	5	5		7	8	8	8	10	9	13

Junction 10 (Theydon Road) - Epping								2036 Signals Maximum DoS Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		64	65	69	67	76	78	86		52	53	53	53	55	59	72
B1393 Epping Rd (E) A		45	46	49	48	55	54	78		32	32	33	32	34	36	82
Theydon Road (L)		66	66	71	68	75	70	73		31	31	35	35	35	28	14
Theydon Road (R)		71	73	72	68	76	80	83		77	78	79	77	80	82	97
B1393 Epping Rd (W) A		33	32	34	34	34	35	76		45	47	50	48	58	59	93
B1393 Epping Rd (W) R/A		38	37	39	39	46	47	57		51	53	57	55	65	65	80

Junction 10 (Theydon Road) - Epping								2036 Signals Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
B1393 Epping Rd (E) L/A		15	16	18	17	22	24	28		11	11	11	11	12	14	18
B1393 Epping Rd (E) A		9	10	11	11	13	12	26		6	6	6	6	7	7	25
Theydon Road (L)		6	6	7	7	7	7	7		3	3	3	3	3	3	2
Theydon Road (R)		9	9	9	8	9	10	10		11	11	11	11	12	13	36
B1393 Epping Rd (W) A		6	6	6	6	6	6	23		9	10	11	10	14	14	33
B1393 Epping Rd (W) R/A		6	6	6	6	6	6	1		10	11	12	12	16	16	22

Junction 12: Four Wantz Roundabout, Ongar - No Mitigation (2026)

Junction 12 (Wantz Service Stn) - Ongar								2012 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B184 Fyfield Road	0.67	0.95	0.93	0.96	0.95	0.99	0.99	0.94	0.57	1.02	0.99	1.02	1.00	1.06	1.05	0.98
A414 Chelmsford Road	0.86	1.14	1.13	1.15	1.15	1.18	1.17	1.15	0.52	0.69	0.68	0.69	0.69	0.71	0.70	0.68
B184 High Street	0.71	1.00	0.97	1.00	0.99	1.03	1.01	0.95	0.75	1.08	1.06	1.08	1.07	1.13	1.11	1.03
A414 Epping Road	0.54	0.91	0.90	0.91	0.91	0.96	0.94	0.89	0.76	1.07	1.04	1.07	1.08	1.12	1.10	1.04

Junction 12 (Wantz Service Stn) - Ongar								2012 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B184 Fyfield Road	2	12	10	13	12	18	17	11	1	22	17	23	19	34	29	15
A414 Chelmsford Road	6	81	77	84	85	98	95	86	1	2	2	2	2	2	2	2
B184 High Street	3	23	16	23	20	33	26	13	3	57	47	60	56	84	74	35
A414 Epping Road	1	9	8	10	10	15	13	8	3	53	41	55	56	85	72	40

Junction 12: Four Wantz Roundabout, Ongar - Mitigation Option Test (2026 and 2036)

Junction 12 (Wantz Service Stn) - Ongar								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B184 Fyfield Road		0.66	0.65			0.69	0.68	0.65		0.70	0.67			0.77	0.78	0.67
A414 Chelmsford Road		0.84	0.85			0.86	0.86	0.85		0.54	0.53			0.55	0.55	0.53
B184 High Street		0.74	0.72			0.76	0.74	0.71		0.83	0.80			0.84	0.85	0.80
A414 Epping Road		0.68	0.67			0.72	0.72	0.69		0.76	0.75			0.80	0.80	0.77

Junction 12 (Wantz Service Stn) - Ongar								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B184 Fyfield Road		2	2			2	2	2		3	3			4	4	3
A414 Chelmsford Road		6	6			7	7	7		1	1			1	1	1
B184 High Street		4	3			4	4	3		5	4			6	5	4
A414 Epping Road		2	2			3	3	2		3	3			4	4	3

Junction 12 (Wantz Service Stn) - Ongar								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B184 Fyfield Road		0.88	0.83			0.94	0.94	0.86		0.97	0.99			1.00	1.00	0.98
A414 Chelmsford Road		1.00	0.97			0.99	1.01	0.99		0.64	0.66			0.70	0.66	0.65
B184 High Street		0.92	0.89			0.96	0.93	0.87		0.97	0.97			0.97	1.00	0.94
A414 Epping Road		0.93	0.89			0.97	0.98	0.95		0.92	0.91			0.98	0.97	0.92

Junction 12 (Wantz Service Stn) - Ongar								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
B184 Fyfield Road		9	6			17	14	7		78	50			139	114	39
A414 Chelmsford Road		51	40			78	76	60		2	2			3	2	2
B184 High Street		17	11			28	21	8		42	31			75	61	19
A414 Epping Road		13	10			31	24	13		12	9			32	24	12

Junction 13: Coopers Hill Roundabout, Ongar - No Mitigation (2026)

Junction 13 (Coopers Hill) - Marden Ash (Ongar)								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A113 Coopers Hill	0.96	1.40	1.37	1.41	1.39	1.45	1.43	1.34	0.73	1.09	1.08	1.10	1.13	1.17	1.11	0.98
A128 Brentwood Road	0.66	0.83	0.83	0.83	0.89	0.90	0.84	0.84	0.53	0.72	0.73	0.73	0.74	0.75	0.74	0.71
A113 Stanford Rivers Road	0.37	0.68	0.68	0.68	0.69	0.71	0.69	0.55	0.77	1.14	1.12	1.15	1.16	1.20	1.16	1.03
St. James Avenue	0.04	0.10	0.10	0.10	0.10	0.11	0.10	0.08	0.09	0.34	0.35	0.35	0.39	0.42	0.38	0.35

Junction 13 (Coopers Hill) - Marden Ash (Ongar)								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A113 Coopers Hill	14	231	203	240	224	269	252	187	3	49	44	52	64	78	57	17
A128 Brentwood Road	2	5	5	5	7	8	5	5	1	3	3	3	3	3	3	2
A113 Stanford Rivers Road	1	2	2	2	2	2	2	1	3	62	54	64	69	83	68	25
St. James Avenue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0

Junction 13: Coopers Hill Roundabout, Ongar - Mitigation Option Test (2026 and 2036)

Junction 13 (Coopers Hill) - Marden Ash (Ongar)								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A113 Coopers Hill		0.81	0.80		0.81	0.84	0.82	0.79		0.69	0.68		0.72	0.74	0.71	0.67
A128 Brentwood Road		0.66	0.66		0.71	0.72	0.67	0.66		0.53	0.54		0.55	0.56	0.54	0.51
A113 Stanford Rivers Road		0.45	0.46		0.45	0.48	0.46	0.37		0.73	0.72		0.75	0.75	0.73	0.66
St. James Avenue		0.04	0.04		0.04	0.04	0.04	0.03		0.06	0.07		0.06	0.07	0.06	0.05

Junction 13 (Coopers Hill) - Marden Ash (Ongar)								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A113 Coopers Hill		4	3		4	5	4	3		2	2		2	2	2	1
A128 Brentwood Road		2	2		2	2	2	1		1	1		1	1	1	1
A113 Stanford Rivers Road		1	1		1	1	1	0		3	2		3	3	3	2
St. James Avenue		0	0		0	0	0	0		0	0		0	0	0	0

Junction 13 (Coopers Hill) - Marden Ash (Ongar)								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A113 Coopers Hill		0.99	0.98		1.01	1.01	1.01	0.99		0.87	0.85		0.93	0.96	0.90	0.83
A128 Brentwood Road		0.86	0.84		0.96	0.99	0.88	0.85		0.70	0.71		0.75	0.76	0.74	0.65
A113 Stanford Rivers Road		0.67	0.68		0.70	0.71	0.69	0.50		0.94	0.92		0.97	0.99	0.95	0.81
St. James Avenue		0.06	0.06		0.06	0.06	0.06	0.05		0.10	0.10		0.12	0.12	0.11	0.07

Junction 13 (Coopers Hill) - Marden Ash (Ongar)								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
A113 Coopers Hill		48	30		51	88	72	33		7	5		12	21	9	4
A128 Brentwood Road		7	6		17	23	8	5		2	2		2	3	3	1
A113 Stanford Rivers Road		2	2		2	2	2	1		14	11		23	38	20	4
St. James Avenue		0	0		0	0	0	0		0	0		0	0	0	0

Junction 19: Piercing Hill / Coppice Row Priority Junction, Theydon Bois - No Mitigation (2026)

Junction 19 (Piercing Hill) - Theydon Bois								2026 Priority Junction Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Piercing Hill	0.89	1.11	1.13	1.12	1.12	1.13	1.15	1.17	0.66	0.82	0.85	0.83	0.82	0.84	0.86	0.87
B172 Coppice Road (E) R-T	0.32	0.36	0.37	0.37	0.36	0.37	0.37	0.38	0.40	0.47	0.48	0.48	0.47	0.49	0.49	0.51
The Green	0.76	0.96	0.98	0.97	0.97	0.98	0.99	0.98	0.80	1.00	1.02	1.01	1.00	1.01	1.03	1.02
B172 Coppice Road (W) R-T	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.08	0.08	0.08	0.08	0.08	0.08	0.08

Junction 19 (Piercing Hill) - Theydon Bois								2026 Priority Junction Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Piercing Hill	6	27	30	29	28	30	33	37	2	4	5	4	4	5	5	6
B172 Coppice Road (E) R-T	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
The Green	3	9	10	10	9	10	11	10	4	12	14	13	13	14	14	14
B172 Coppice Road (W) R-T	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Results for Piercing Hill and The Green approach arms were incorrectly entered in the reporting tables contained in Technical Note 4.

Junction 19: Piercing Hill / Coppice Row Priority Junction, Theydon Bois - Mitigation Option Test (2026 and 2036)

Junction 19 (Piercing Hill) - Theydon Bois								2026 Priority Junction Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill L A		0.81	0.83	0.82			0.84	0.87		0.63	0.65	0.64			0.66	0.67
Piercing Hill R A		0.55	0.55	0.55			0.56	0.56		0.35	0.35	0.35			0.36	0.36
B172 Coppice Road (E) R-T		0.36	0.37	0.37			0.37	0.38		0.47	0.48	0.48			0.49	0.51
The Green L A		0.62	0.63	0.63			0.64	0.63		0.63	0.64	0.64			0.65	0.65
The Green R A		0.45	0.46	0.45			0.46	0.46		0.49	0.49	0.49			0.50	0.50
B172 Coppice Road (W) R-T		0.06	0.06	0.06			0.06	0.06		0.08	0.08	0.08			0.08	0.08

Junction 19 (Piercing Hill) - Theydon Bois								2026 Priority Junction Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill L A		4	4	4			4	5		2	2	2			2	2
Piercing Hill R A		1	1	1			1	1		1	1	1			1	1
B172 Coppice Road (E) R-T		1	1	1			1	1		1	1	1			1	1
The Green L A		2	2	2			2	2		2	2	2			2	2
The Green R A		1	1	1			1	1		1	1	1			1	1
B172 Coppice Road (W) R-T		0	0	0			0	0		0	0	0			0	0

Junction 19 (Piercing Hill) - Theydon Bois								2036 Priority Junction Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill L A		1.06	1.12	1.09			1.17	1.21		0.78	0.85	0.81			0.89	0.92
Piercing Hill R A		0.66	0.68	0.67			0.69	0.69		0.44	0.46	0.45			0.49	0.49
B172 Coppice Road (E) R-T		0.40	0.42	0.41			0.43	0.45		0.53	0.56	0.55			0.58	0.62
The Green L A		0.80	0.84	0.82			0.87	0.84		0.79	0.83	0.82			0.86	0.85
The Green R A		0.56	0.59	0.57			0.61	0.59		0.58	0.61	0.6			0.62	0.61
B172 Coppice Road (W) R-T		0.07	0.07	0.07			0.07	0.07		0.08	0.09	0.09			0.09	0.09

Junction 19 (Piercing Hill) - Theydon Bois								2036 Priority Junction Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill L A		16	22	19			27	34		3	5	4			6	7
Piercing Hill R A		2	2	2			2	2		1	1	1			1	1
B172 Coppice Road (E) R-T		1	1	1			1	1		1	1	1			1	2
The Green L A		3	4	4			5	4		3	4	4			5	4
The Green R A		1	1	1			1	1		1	1	1			2	2
B172 Coppice Road (W) R-T		0	0	0			0	0		0	0	0			0	0

Junction 19: Piercing Hill / Coppice Row Priority Junction, Theydon Bois - Mitigation Alternative Test (2026 and 2036)

Junction 19 (Piercing Hill) - Theydon Bois								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill		0.73	0.75	0.74			0.75	0.75		0.51	0.51	0.51			0.52	0.52
B172 Coppice Road (E) R-T		0.51	0.52	0.52			0.53	0.53		0.46	0.47	0.47			0.47	0.47
The Green		0.42	0.42	0.42			0.42	0.42		0.62	0.64	0.63			0.65	0.63
B172 Coppice Road (W) R-T		0.45	0.45	0.45			0.45	0.47		0.40	0.41	0.40			0.42	0.42

Junction 19 (Piercing Hill) - Theydon Bois								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill		3	3	3			3	3		1	1	1			1	1
B172 Coppice Road (E) R-T		1	1	1			1	1		1	1	1			1	1
The Green		1	1	1			1	1		2	2	2			2	2
B172 Coppice Road (W) R-T		1	1	1			1	1		1	1	1			1	1

Junction 19 (Piercing Hill) - Theydon Bois								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill		0.83	0.86	0.84			0.87	0.86		0.57	0.59	0.58			0.60	0.61
B172 Coppice Road (E) R-T		0.63	0.65	0.63			0.67	0.65		0.54	0.55	0.54			0.55	0.56
The Green		0.49	0.50	0.50			0.51	0.50		0.73	0.78	0.76			0.81	0.77
B172 Coppice Road (W) R-T		0.50	0.51	0.50			0.51	0.55		0.46	0.48	0.47			0.49	0.51

Junction 19 (Piercing Hill) - Theydon Bois								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	
Piercing Hill		5	6	5			6	6		1	1	1			2	1.55
B172 Coppice Road (E) R-T		2	2	2			2	2		1	1	1			1	1.24
The Green		1	1	1			1	1		3	3	3			4	3.19
B172 Coppice Road (W) R-T		1	1	1			1	1		1	1	1			1	1.03

Junction 21: M25 Junction 26 Northern Roundabout, Waltham Abbey - No Mitigation (2026 and 2036)

Junction 21 (M25 J26 Northern RAB) - Waltham Abbey								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Old Shire Lane	0.17	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.13	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Honey Lane RAB Link	0.38	0.43	0.41	0.44	0.44	0.43	0.43	0.43	0.52	0.62	0.63	0.64	0.64	0.63	0.63	0.61
M25 Off Slip	0.24	0.27	0.27	0.27	0.28	0.27	0.27	0.27	0.40	0.47	0.48	0.49	0.49	0.48	0.48	0.46
Honey Lane	0.33	0.46	0.41	0.47	0.47	0.47	0.46	0.42	0.20	0.28	0.28	0.31	0.31	0.29	0.29	0.26

Junction 21 (M25 J26 Northern RAB) - Waltham Abbey								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Old Shire Lane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Honey Lane RAB Link	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
M25 Off Slip	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Honey Lane	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0

Junction 21 (M25 J26 Northern RAB) - Waltham Abbey								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Old Shire Lane					0.25								0.19			
Honey Lane RAB Link					0.51								0.77			
M25 Off Slip					0.31								0.59			
Honey Lane					0.63								0.43			

Junction 21 (M25 J26 Northern RAB) - Waltham Abbey								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Old Shire Lane					0								0			
Honey Lane RAB Link					1								4			
M25 Off Slip					0								2			
Honey Lane					2								1			

Junction 22: M25 Junction 26 Southern Roundabout, Waltham Abbey - No Mitigation (2026)

Junction 22 (M25 J26 Southern RAB) - Waltham Abbey									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
M25 Off Slip	0.34	0.42	0.41	0.44	0.44	0.42	0.42	0.42	0.26	0.33	0.33	0.34	0.34	0.34	0.33	0.33
A121 Honey Lane	0.97	1.24	1.20	1.33	1.32	1.30	1.29	1.37	0.75	0.94	0.94	0.98	0.97	0.96	0.96	1.00
A121 Dowding Way	0.38	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.49	0.67	0.68	0.73	0.72	0.72	0.71	0.77
Honey Lane RAB Link	0.46	0.56	0.53	0.60	0.61	0.57	0.57	0.55	0.48	0.55	0.55	0.57	0.57	0.56	0.56	0.57

Junction 22: M25 Junction 26 Southern Roundabout, Waltham Abbey - Mitigation Option Test (2026 and 2036)

Junction 22 (M25 J26 Southern RAB) - Waltham Abbey								2026 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
M25 Off Slip		0.62	0.61	0.63		0.63		0.62		0.44	0.43	0.45		0.45		0.45
A121 Honey Lane		0.73	0.71	0.77		0.75		0.76		0.70	0.69	0.72		0.70		0.69
A121 Dowding Way		0.47	0.47	0.50		0.49		0.49		0.63	0.62	0.64		0.62		0.66
Honey Lane RAB Link		0.61	0.59	0.66		0.62		0.59		0.59	0.58	0.61		0.59		0.60

Junction 22 (M25 J26 Southern RAB) - Waltham Abbey								2026 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
M25 Off Slip		2	1	2		2		2		1	1	1		1		1
A121 Honey Lane		3	2	3		3		3		2	2	2		2		2
A121 Dowding Way		1	1	2		1		2		2	2	2		3		3
Honey Lane RAB Link		1	1	2		1		1		1	1	1		1		1

Junction 22 (M25 J26 Southern RAB) - Waltham Abbey								2036 Roundabout Maximum RFC Values								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
M25 Off Slip		0.73	0.70	0.78		0.74		0.73		0.51	0.51	0.53		0.53		0.54
A121 Honey Lane		0.87	0.79	0.94		0.88		0.90		0.83	0.82	0.89		0.85		0.81
A121 Dowding Way		0.59	0.56	0.63		0.60		0.64		0.77	0.77	0.85		0.84		0.98
Honey Lane RAB Link		0.73	0.64	0.83		0.74		0.69		0.65	0.66	0.70		0.68		0.70

Junction 22 (M25 J26 Southern RAB) - Waltham Abbey								2036 Roundabout Maximum Queue Lengths								
Arm	AM PEAK							PM PEAK								
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
M25 Off Slip		3	2	4		3		3		1	1	1		1		1
A121 Honey Lane		6	4	15		7		10		4	4	7		5		4
A121 Dowding Way		2	2	3		3		4		5	5	10		12		72
Honey Lane RAB Link		2	2	5		3		2		1	2	2		2		2

Junction 24: Meridian Way Signals, Waltham Abbey - No Mitigation (2026)

Junction 24 (Station Road) - Waltham Abbey									2026 Signals Maximum DoS Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive	22	24	24	24	24	24	24	24	34	36	36	36	36	36	36	36
B194 Highbridge St (E)	111	143	150	153	154	157	161	143	89	105	109	113	110	115	111	112
Meridian Way	95	103	104	107	107	108	107	113	61	68	69	68	70	67	70	67
A121 Station Road	98	93	93	91	94	92	91	92	89	103	106	106	107	110	111	113

Junction 24 (Station Road) - Waltham Abbey									2026 Signals Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
B194 Highbridge St (E)	73	195	226	230	243	249	264	185	19	49	65	78	70	89	73	71
Meridian Way	24	41	44	54	54	60	54	78	12	16	16	16	16	15	16	16
A121 Station Road	23	20	21	19	21	20	20	20	35	88	108	113	121	144	154	165

Junction 24: Meridian Way Signals, Waltham Abbey - Mitigation Option Test (2026 and 2036)

Junction 24 (Station Road) - Waltham Abbey								2026 Signals Maximum DoS Values							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			2		2		2			1		1		1	
B194 Highbridge St E (L A)			65		67		68			57		59		60	
B194 Highbridge St E (R)			66		68		69			59		61		62	
Meridian Way (L)			60		62		63			35		35		35	
Meridian Way (R)			50		50		50			64		64		64	
A121 Station Road (L A)			24		24		25			36		37		38	
A121 Station Road (A)			26		26		26			38		38		39	
A121 Station Road (R)			60		60		60			56		56		58	

Junction 24 (Station Road) - Waltham Abbey								2026 Signals Maximum Queue Lengths							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			0		0		0			0		0		0	
B194 Highbridge St E (L A)			15		15		16			10		10		10	
B194 Highbridge St E (R)			16		17		17			11		11		11	
Meridian Way (L)			9		10		10			5		5		5	
Meridian Way (R)			3		3		3			4		4		4	
A121 Station Road (L A)			4		4		4			8		8		8	
A121 Station Road (A)			5		5		5			9		9		9	
A121 Station Road (R)			7		7		7			8		8		8	

Junction 24 (Station Road) - Waltham Abbey								2036 Signals Maximum DoS Values							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			2		2		2			1		1		1	
B194 Highbridge St E (L A)			76		78		80			64		65		67	
B194 Highbridge St E (R)			77		79		81			66		67		69	
Meridian Way (L)			70		76		78			39		41		40	
Meridian Way (R)			55		55		56			68		71		73	
A121 Station Road (L A)			27		28		28			44		44		46	
A121 Station Road (A)			29		29		29			45		46		48	
A121 Station Road (R)			69		74		75			65		66		69	

Junction 24 (Station Road) - Waltham Abbey								2036 Signals Maximum Queue Lengths							
Arm	AM PEAK							PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			0		0		0			0		0		0	
B194 Highbridge St E (L A)			19		20		21			12		12		13	
B194 Highbridge St E (R)			20		22		23			13		14		14	
Meridian Way (L)			12		13		14			5		6		6	
Meridian Way (R)			3		3		3			5		5		5	
A121 Station Road (L A)			5		5		5			10		10		11	
A121 Station Road (A)			6		6		6			11		11		12	
A121 Station Road (R)			9		9		9			10		10		11	

Junction 24: Meridian Way Signals, Waltham Abbey - Mitigation Alternative (2026 and 2036)

Junction 24 (Station Road) - Waltham Abbey									2026 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			-		-		-				-		-		-	
B194 Highbridge St E			0.73		0.76		0.77				0.62		0.64		0.64	
Meridian Way			0.63		0.65		0.70				0.48		0.48		0.48	
A121 Station Road			0.57		0.56		0.57				0.83		0.84		0.84	

Junction 24 (Station Road) - Waltham Abbey									2026 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			-		-		-				-		-		-	
B194 Highbridge St E			2		3		3				1		1		1	
Meridian Way			2		2		2				1		1		1	
A121 Station Road			1		1		1				4		5		5	

Junction 24 (Station Road) - Waltham Abbey									2036 Roundabout Maximum RFC Values							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			-		-		-				-		-		-	
B194 Highbridge St E			0.87		0.92		0.94				0.73		0.76		0.76	
Meridian Way			0.84		0.92		0.96				0.56		0.58		0.57	
A121 Station Road			0.62		0.63		0.63				0.96		0.97		0.99	

Junction 24 (Station Road) - Waltham Abbey									2036 Roundabout Maximum Queue Lengths							
Arm	AM PEAK								PM PEAK							
	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C	Base	Low A	Low B	Med A	Med B	Amb A	Amb B	Amb C
Beaulieu Drive			-		-		-				-		-		-	
B194 Highbridge St E			7		12		17				2		3		3	
Meridian Way			6		11		19				1		1		1	
A121 Station Road			1		1		1				15		19		38	