Local Plan Technical Report

2018/2019 Infrastructure Delivery Plan Appendices

Part 11: Transport – Hertfordshire County Council

Appendices 39 to 42

St Albans City & District Council

Appendix 39: Draft Hertfordshire County Council COMET: South West Herts Area Interpretation of COMET Model Results (July 2018)

South West Herts Area

Interpretation of COMET Model Results

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1 Introduction

Hertfordshire County Council have developed a Countywide model COMET. This consists of a suite of models including a Variable Demand Model, Highways Model and Public Transport Model and has been used to test the cumulative impacts of Local Plan growth across the county.

A new 2031 Forecast Model run was undertaken in early 2018 with districts Local Plan development assumptions as of Autumn 2017. Local Plan growth plus transport mitigation measures as identified by the districts and boroughs has been tested.

Countywide results of the latest Local Plan Run 3 have been documented in Forecasting Report.

This note provides a more detailed assessment of the model results within the South West Herts area (encompassing Dacorum, Hertsmere, St Albans, Three Rivers and Watford) taking into account the cumulative impact of growth and potential transport schemes across this area and in other Hertfordshire districts.

The highway assignment component of the COMET model suite is in SATURN. SATURN is a tool that suits the strategic geographical scale of COMET, however, does not enable investigation of detailed sections of the highway network (e.g. detailed junction or corridor assessment). At this stage, therefore, the results presented here should be interpreted as high level indications of likely traffic conditions.

The COMET model enables an interpretation of potential impacts across the whole area taking into account the influence of growth and schemes in other areas.

In addition to the results presented in the main body of this note, detailed, district based results, are presented in the Appendices:

- Appendix A – Dacorum
- Appendix B – Hertsmere
- Appendix C – St Albans
- Appendix D – Three Rivers
- Appendix E – Watford

2 Model Assumptions

2.1 Planning Assumptions

Planning assumptions are as per the COMET Local Plan Run 3 and are listed in Table 2-1 below. This is based on Tables 5.1 and 5.2 of the COMET Forecasting Report.

Table 2-1 COMET Model Local Plan Run 3 Planning Assumptions

	Dwellings 2014-2031[1]	Jobs 2014-2031
Dacorum	10,783	11,609
Hertsmere	4,718	3,270
St Albans	8,822	4,527
Three Rivers	2,613	4,114
Watford	8,223	7,683
SWH total	35,159	31203
County Overall	97,430	68,494

[1]Includes as built in addition to local plan allocations and windfall allowance

2.2 Infrastructure Assumptions

A number of schemes which were deemed as committed or highly likely along with appropriate access points from the key developments were already coded into model. In addition, there are general schemes identified in Local Plan Infrastructure Delivery Plans and other studies to accommodate growth. Those relevant to the South West Herts area are listed in Table 2-2. This table also indicates those schemes which were included in the model previously.

It should be noted that schemes have been included in the test regardless of their certainty level. Therefore, the model run includes a number of hypothetical conceptual schemes where no designs are yet available.

As all the schemes have been modelled together it is not possible to isolate the impacts of individual schemes in this forecast run.

Given the strategic nature of the COMET model it was not possible to include some of the more minor changes to the highway network. Where scheme elements were not coded this is indicated in the table.

Table 2-2 Schemes relevant to South West Herts included in the Model

Original Scheme ID	District	Location	Scheme	LP Run 2 DS
	Dacorum	Swallowdale Lane / Three Cherry Trees Lane, Hemel	Junction signalisation (Spencers Park scheme)	Yes
	Dacorum	A414 Breakspear Way / Maylands Lane, Hemel	Lane Reallocation (Maylands Gateway scheme)	Yes
	Dacorum	The Avenue, Hemel	West Hemel development site secondary site access onto The Avenue (extension of existing spur)	Yes
	Dacorum	A4147 Link Road, Hemel	New roundabout access onto A4147 Link Road (Location between Piccotts End Road and Aycliffe Drive (Marchmont Farm)	Yes
	Dacorum	Fletcher Way, Hemel	T junction onto Fletcher Way (new development access)	Yes
	Dacorum	A5 Dunstable	M1 A5 Link Road (now implemented)	Yes
	Dacorum	A4146 Water End	A4146 HGV Van at Waterend (now implemented)	Yes
T/8	Dacorum	Junction of Bedmond Road / Leverstock	Junction upgrade	Yes
T/9	Dacorum	Leighton Buzzard Road / Combe Street, Hemel	Signalisation	Yes
T/17	Dacorum	Kingshill / Shootersway, Berkhamsted	Signalisation (now implemented)	Yes
T/18	Dacorum	Berkamsted High Street	Traffic calming;	Yes
T/19	Dacorum	Lower Kings Road, Berkhamsted	Lower Kings Road, Berkhamsted, Public car park improvements*	No
T/21	Dacorum	Icknield Way, Tring	LA5-New access junctions	Yes
T/23	Dacorum	Chesham Road /Molyneaux Avenue, Bovingdon	LA6- New access Junctions	Yes
D/24	Dacorum	Leighton Buzzard Road / Queensway r/bout	Signalisation	Yes
D/25	Dacorum	Boundary Lane, Hemel	New link between Boundary Way and Wood Lane End (single carriageway with 30mph speed limit). Buncefield Lane north of Boundary Way (between Boundary Way and Cherry Tree Lane and between the A414 and Green Lane will become a quietway so does not need to be added).	Yes
D/26	Dacorum	Link Road / Redbourn Road r/bout, Hemel	Junction improvements	Yes
D/27	Dacorum	Redbourn Road / Shenley Road, Hemel	Changes to junction configuration	Yes
D/28	Dacorum	Station Road / St Johns Road /Heath Lane, Hemel	Junction reconfiguration	Yes

Original Scheme ID	District	Location	Scheme	LP Run 2 DS
D/29	Dacorum	London Road / Nash Mills Road / Red Lion Lane, Hemel	Signal optimisation	Yes
D/30	Dacorum	Fishery Road / Northridge Way, Hemel	Junction reconfiguration	Yes
D/31	Dacorum	Maylands Avenue / Wood Lane End, Hemel	Signal optimisation	Yes
D/32	Dacorum	Two Waters Road / London Road, Hemel	Signal optimisation	Yes
D/34	Dacorum	Fishery Road / London Road, Hemel	Signalisation of junction	Yes
D/35	Dacorum	Leighton Buzzard Road (north of Plough Roundabout)	Optimise signals	Yes
MG S1	Dacorum	M1 junction 8, Hemel	Major junction reconfiguration to provide direct access into Maylands (scheme also in St Albans scheme list)	Yes
MG SC1h	Dacorum	A414 /Green Lanes	A414 / Green Lane interim at grade signalisation scheme	No - previously modelled as existing signals with current roundabout layout
MG S2	Dacorum	Maylands Area, Hemel	New spine road from A414 to B487 Redbourn Road	No
MGS3	Dacorum	Maylands Area, Hemel	Cherry Trees Lane & Buncefield Lane quietways	No
MG S4	Dacorum	Maylands Area, Hemel	Wood Lane End – Boundary Way Link	Yes
MG S5	Dacorum	Maylands Area, Hemel	Nickey Line Access Improvements*	No
MG S6	Dacorum	Maylands Area, Hemel	New pedestrian / cycle crossings in Maylands area	No
MG S7	Dacorum	Redbourn area	HGV restrictions on B487 & A5183	No
MG S8	Dacorum	Maylands Area, Hemel	Bus service enhancements in Maylands	No
ITP12056	Hertsmere	Station Road/Theobald St/Allum Lane junction, Borehamwood	Junction improvements	Yes
	Hertsmere	Elstree Way, Borehamwood	Elstree Way Corridor improvements	Yes
	Hertsmere	Elstree and Borehamwood station	Elstree and Borehamwood station changes*	Yes
	Hertsmere	M25 junction 18-25	M25 j18-25 hard shoulder running	Yes
HMERE1	Hertsmere	A1 / A411 Barnet Lane (Stirling Corner) - Borehamwood	Changes to signal staging and timings (now implemented)	Yes

Original Scheme ID	District	Location	Scheme	LP Run 2 DS
	St Albans	A414 North Orbital Road	Radlett Railfreight, new access junction onto A414 and new spine road connecting to A5183 Radlett Road (south of Frogmore)	Yes
	St Albans	M25 junction 21a	M25 junction 21a capacity improvements (Radlett Railfreight mitigation)	Yes
	St Albans	M25 junction 22	M25 junction 22 capacity improvements (Radlett Railfreight mitigation)	Yes
	St Albans	A414 / A405 (Park Street)	A414 / A405 (Park Street) roundabout signalisation	Yes
	St Albans	A414 / Colney Heath Lane / High Street	A414 Colney Heath longabout safety scheme	Yes
	St Albans	A405 / B4630 Watford Road, Chiswell Green	New Arm to roundabout to serve new hotel development	Yes
10338-HL-07	St Albans	A1081 Luton Road, Harpenden	NW Harpenden Development access	Yes
10338-HL-08	St Albans	A1081 Luton Rd / Redbourn Lane, Harpenden	Minor capacity enhancements (NW Harpenden mitigation measure)	Yes
10338-HL-09	St Albans	A1081 Luton Rd /Station Road, Harpenden	Minor capacity enhancements(NW Harpenden mitigation measure)	Yes
10337_HL_09	St Albans	A1081 Luton Road / The Common, Harpenden	Minor capacity enhancements (NW Harpenden mitigation measure)	Yes
SL 1	St Albans	Sandpit Lane, St Albans	Oaklands development new access onto Sandpit Lane	Yes
SL 2	St Albans	Sandpit Lane / House Lane, St Albans	Enlargement of existing roundabout (Oaklands mitigation measure)	Yes
SL 3	St Albans	Sandpit Lane / Marshalswick Lane, St Albans	Junction improvements (Oaklands mitigation measure)	Yes
SL 4	St Albans	Sandpit Lane / Coopers Green Lane, St Albans	Junction improvements (Oaklands mitigation measure)	Yes
SL 5	St Albans	Sandpit Lane / Barnfield Road, St Albans	Junction improvement (Oaklands mitigation measure)	Yes
SL 6	St Albans	Sandpit Lane / Damson Way, St Albans	Junction improvements (Oaklands mitigation measure)*	No
60534762-SADC-2	St Albans	A414-A1081-London Colney Roundabout	Junction improvement (Hamburger Layout)	No
60534762-SADC-DWG_SITE6	St Albans	St Albans Road/Sandridge Road/Marshalswick Lane/Beech Road	Junction improvement	No
60534762-SADC-DWG_SITE8	St Albans	A5183 Redbourn Road/A4147 Bluehouse Hill/Batchwood Drive Roundabout, St Albans	Junction improvement	No
60534762-SADC-10	St Albans	B653 Cory Wright Way/Marford Road, Wheathampstead	Junction improvement	No

Original Scheme ID	District	Location	Scheme	LP Run 2 DS
60534762-SADC-A	St Albans	A4147 Hemel Hempstead Road / King Harry Lane	Junction improvement	No
60534762-SADC-B	St Albans	A1081 Luton Road/ Park Hill Junction, Harpenden	Signal optimisation	No
60534762-SADC-E	St Albans	Hatfield Road/Station Road, Smallford Roundabout	Junction improvement	No
SL7	St Albans	St Albans	SC1 Abbey Line shuttle bus service (implemented)	No
33	Three Rivers	Woodside Road, Abbots Langley	New development access	Yes
34	Three Rivers	Uxbridge Road, Mile End, Rickmansworth	New access for new 4fe secondary school	Yes
TR_1	Three Rivers	A412 / A402 Rickmansworth	Capacity improvement	Yes
TR_2	Three Rivers	M25 spur,Hunton Bridge	M25 spur approach to Hunton Bridge roundabout – widening approach/circulation or signalisation (Hunton Bridge)	Yes
TR_3	Three Rivers	Hempstead Road, Watford	Right turn lanes into/out of Glen Way and Grove Mill Lane at junctions with Hempstead Road (Watford)	Yes
TR_4	Three Rivers	Eastbury Road / Deacons Hill, Watford	Junction improvement	Yes
RFS	Three Rivers	Woodside Road, Abbots Langley	New roundabouts serving Reach Free School / Woodside Road.	Yes
	Watford	Thomas Sawyer Way, Watford	Watford Health Campus link (now implemented)	Yes
WH_H	Watford	Watford	Reduce travel demand / trip generation from key development zones	Yes
20mph	Watford	Watford	Implement 20mph zone	Yes
CR	Watford	Watford	Cycle Measures	No
T1	Watford	Abbey Line, Watford	Improvements to Abbey Line: Abbey Flyer proposal (new passing loop to enable a 30 minute frequency on the Abbey Line in each direction (but keep as heavy rail)	No
Wat New_2	Watford	A411 Hempstead Road / The Avenue (Town Hall) junction, Watford	Junction modification	No
Wat New_3	Watford	High Street, Watford	Improvements to restrict vehicular access	No
Wat New_4	Watford	Clarendon Road South, Watford	Clarendon Road S converted to one way	No
Wat New_5	Watford	Watford junction	Watford junction station forecourt improvements*	No

*Not possible to include scheme due to strategic nature of the model

3 Model Results

3.1 Flow Differences

Figures 3.1 and 3.2 show the difference in flows between 2031 Local Plan Run 3 and 2014 base models in the AM and PM peaks in the South West Herts area with green illustrating where flows increase and blue indicating where there are decreases in flow. This provides an indication of the impact of the planning data and growth information, alongside the impact of proposed schemes and mitigation schemes. As COMET also includes a Variable Demand and Public Transport model behavioural responses to congestion such as peak spreading and switching to other modes (especially rail) are also taken into account.

Figures 3.3 and 3.4 show the difference in flows between 2031 Local Plan Run 3 (2018) and 2031 Local Plan Run 2 DS. Local Plan Run 2 was based on local plan growth and schemes by districts in Autumn 2016. Key differences between the runs include the inclusion of full local plan growth in Buckinghamshire and Luton (in LP2 DS NTEM (TEMPro was used for all external areas)), additional highway schemes in St Albans district (in line with their Local Plan Design Study – Task S) and the alignment of schemes in Hemel Hempstead with the Maylands Growth Corridor Preferred Strategy. Another key difference between runs is that the LP run 2 included the Metropolitan Line Extension scheme in Waford whereas LP run 3 does not.

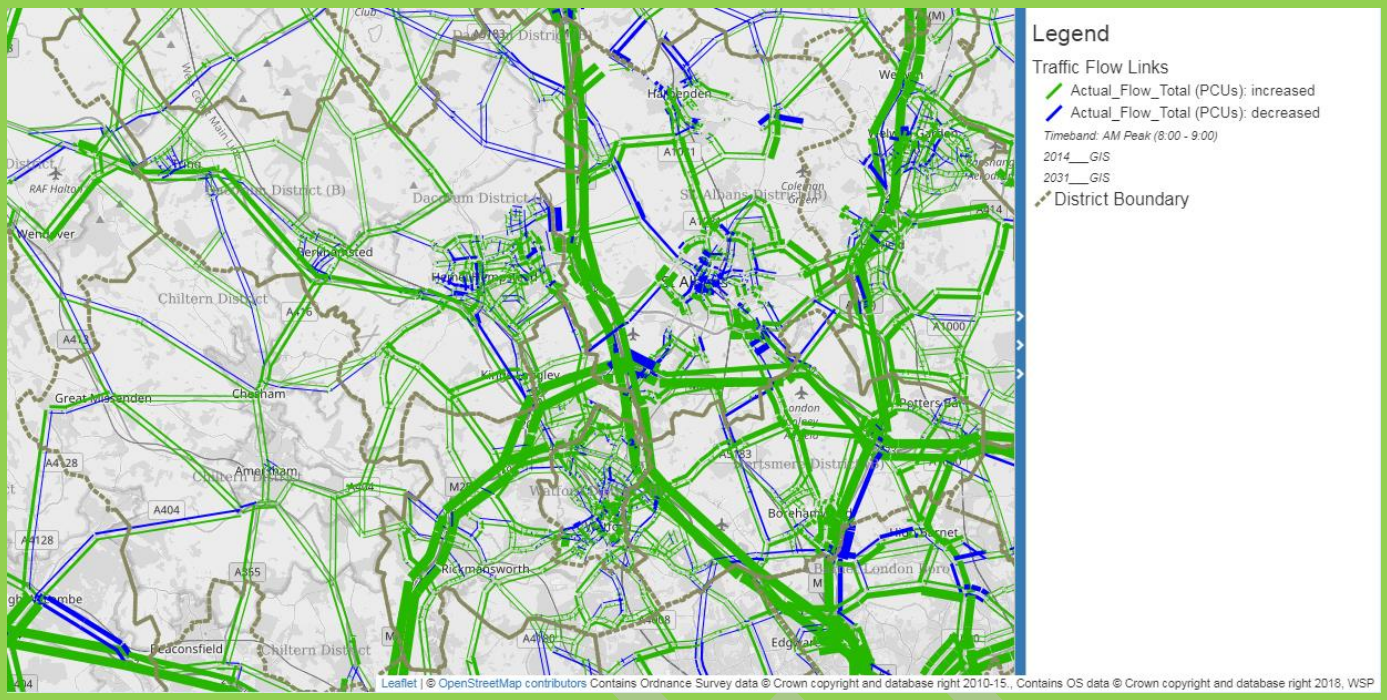

Figure 3-1 2031 – 2014 Change in Actual Flow in South West Herts Area AM (08:00 – 09:00)

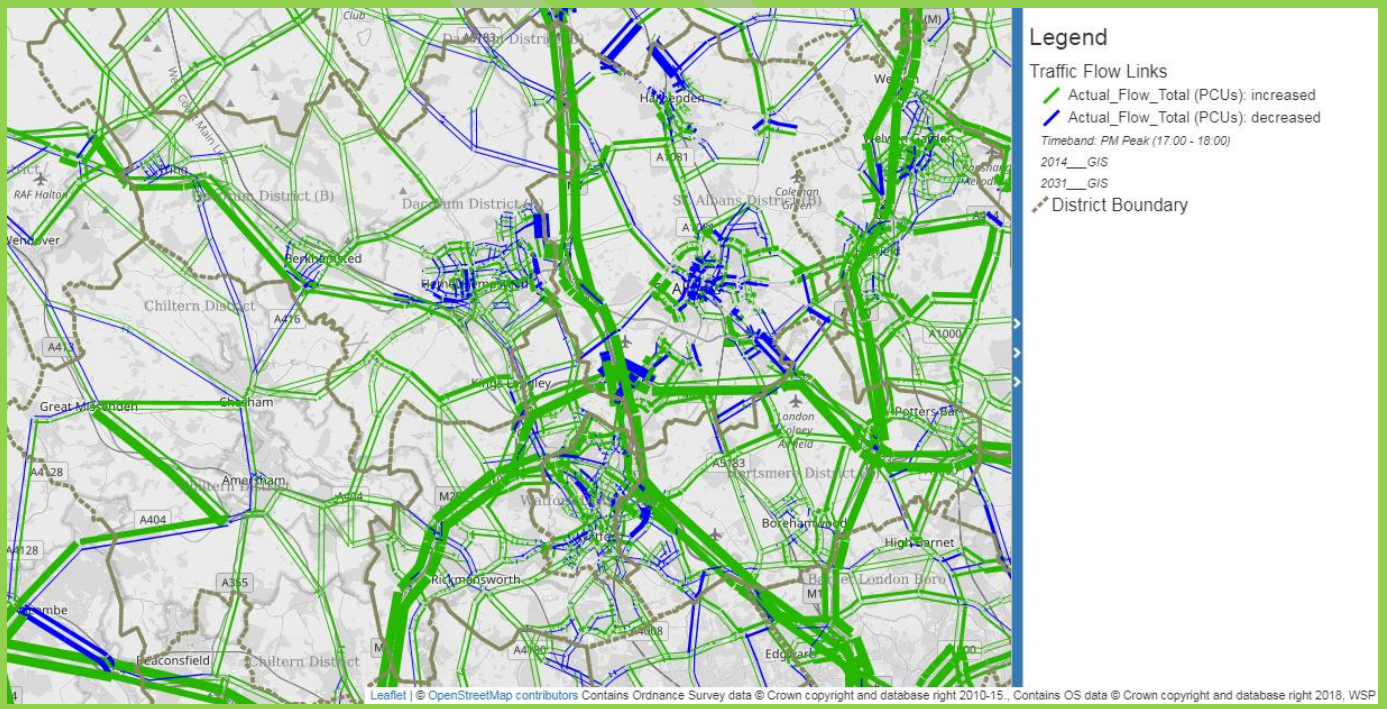

Figure 3-2 2031 - 2014 Actual Flow in South West Herts Area PM (17:00 – 18:00)

Figure 3-3 Change between 2031 Local Plan Run 3 and 2031 Local Plan Run 2 DS Actual Flow in South West Herts Area AM (08:00 – 09:00)

Figure 3-4 Change between 2031 Local Plan Run 3 and 2031 Run 2 DS Actual Flow in South West Herts Area PM (17:00 – 18:00)

Key changes in flow are outlined by district below. More detailed plans are included in the appendices.

3.1.1 **Dacorum** (Detailed plans in Appendix A)

There are decreases in flow between the base year and 2031 LP Run 3 forecast on the A5183. This is likely to be due to the M1-A5 link and downgrading of this corridor. The M1 corridor experiences large increases in flow as does the A41 north of Hemel Hempstead.

There are decreases in flow between the base year and Local Plan run 3 on the southern part of the A41 (in the southbound direction) due to difficulties entering the M25 Junction 20 on the clockwise merge.

Hemel Hempstead – There are significant changes in flow patterns from the base year in eastern Hemel, with some smaller shifts to the west of the town. Revising the layout at M1 junction 8 to provide direct access into Maylands relieves pressure at the current A414 / Green Lanes junction and results in localised rerouting. The flow differences in western Hemel are likely to be due to rerouteing due to the impacts of new development in the area.

In comparison to the LP Run 2 DS there are traffic increases on the A414 which are likely to be a result of the additional signalisation scheme at the Green Lane / A414 junction which increases capacity at this junction. There are switches in traffic flow in the Maylands / East Hemel area in general (LP run 3 includes the final set of Maylands Growth corridor schemes including the new spine road connecting the A414 and B487) and there are increases in traffic on the A4147, M1 and in the southern part of Hemel.

Berkhamstead – Compared to the base year, signalising the Shootersway / Kingshill Way junction and delays at the Kings Road / Chesham Road junction discourage local traffic from using this route to access the A41 resulting in minor flow decreases on the A4146 and increases on the High Street / London Road route towards the A41.

Compared with Local Plan run 2 there are increases in traffic flow on routes towards Buckinghamshire which are likely to be due to the increased planning growth assumed here in Local Plan run 3. This appears to have led to some rerouteing within Berkhamstead itself. In the PM peak there is a significant increase in flow on the A41 compared to LP run 2.

Tring – A new development (LA5) and associated access point is coded into Local Plan run 3 but there are no other proposed infrastructure schemes. This results in some minor flow changes in Tring itself. There are however some significant increases in traffic flow on the A41 which is likely to be due to the planning growth assumed in Buckinghamshire. A greater level of growth is assumed in Local Plan run 3 which results in even greater flows (compared with Local Plan run 2).

3.1.2 **Hertsmere** (see Appendix B for detailed plans)

Increases in flows from the 2014 Base Year are evident northbound on the A1M in the AM, and in both directions in the PM. This continues the pattern seen along the A1M. In the AM there is a reduction in flow in the southbound direction and this appears to be attributed to changes to the junction layout and signal timings at the Stirling Corner roundabout which

cause blocking back around the junction. In reality, further optimisation of the signal timings should reduce the level of delay and queuing at this location.

Compared to the base year increases in flow are evident in the AM peak on Elstree Way, Studio Way and Manor Way in Borehamwood which may be related to the changes to the Shenley Road/ Elstree Way junction.

Flow increases are also evident on the A1000 through Potters Bar into Barnet and on Hawkshead Road.

Relatively large increases in traffic are also evident on local routes in the Shenley area in the AM peak

Flow changes in the Bushey area are more limited and in the PM peak flow changes on local roads in the wider area are more limited.

Compared to Local Plan Run 2, Local Plan Run 3 predicts increased flow on the roads between Radlett and South Mimms. A reduction in flow is evident on the M25 and on the A1 southbound (probably due to the greater level of delay at key junctions).

In the AM peak an increase in flow is evident on the A5183 (Watling Street) in the northbound direction.

Given there is little change in planning data in Hertsmere and no difference in the scheme data between the model runs these differences are likely to be due to some rerouteing of traffic to avoid delays on the key road network.

3.1.3 **St Albans** (see Appendix C for detailed plans)

There are increases in flow from the base year between St. Albans and Harpenden, St Albans and Wheathampstead, and Harpenden and Wheathampstead.

St Albans –Compared to the base year there are reductions in flow in the city centre, with flow increases on the orbital roads around the town (including the A414 and northern Marshalswick Lane / Beechwood Avenue route). This is likely to be due to the various highway improvement schemes coded in Local Plan 3 freeing up capacity on these routes. These changes are greater in the Local Plan Run 3 model which has the additional highway schemes coded.

The proposed scheme at the A414 / A1081 London Colney junction results in an increase in A414 traffic able to get through the junction (particularly to the west) at the expense of traffic from the A1081 London Colney bypass to the south.

Increases in traffic are evident on the key routes towards Hatfield (due to the proposed developments in this area).

Harpenden – Compared to the base year there is a reduction in flow on the north-eastern roads into Harpenden (Bower Heath Lane, and B653) in both time periods, with the PM peak seeing a significant reduction northbound on the B653. This appears to be due to wider area

reassignment. There is an increase in two-way flows on the A1081 toward St Albans in both time periods and on the B487 Redbourn Lane.

Compared to Local Plan run 2 greater levels of traffic are forecast on the A1081 towards St Albans. This is likely to be due to additional traffic being attracted to the northern route around St Albans as a result of the proposed junction improvements.

Levels of flow are reduced on the B653 Lower Luton Road and on West Hyde Road and B652 towards Kimpton. This is likely to be due to wider traffic rerouteing.

Wheathampstead – There are changes in flow around the Cory Wright Way Junction with traffic reallocating due to the operation of the junction improvement scheme here. It should be noted that this scheme was not included in Local Plan run 2.

3.1.4 Three Rivers (See Appendix D for detailed plans)

Three Rivers area – There is a large increase in flow from the base year on the M25 in both time periods and on the M25 spur to Hunton Bridge.

Chorleywood, Rickmansworth, and Abbots Langley see small increases in flow. Some decrease in flow is evident on the A404 leading to junction 18.

Flow increases are evident through the Chipperfield and Sarratt areas. This is likely to be a result of traffic diverting away from the southern part of the A41 to avoid delays at M25 junction 20, particularly in the AM peak.

The key difference in schemes in the Three Rivers area between Local Plan Run 3 and 2 is the exclusion of the Metropolitan Line Extension. This is likely to be the cause of the increases in flow on the A412 Rickmansworth Road, Tolpits Lane and Baldwins Lane, particularly during the PM peak.

There is also a large increase in flow on the M25 which may be associated with the greater level of planning growth assumed in Buckinghamshire. In the north of the district, there are decreases in flow on the A41 Watford Road and changes in flow around the Abbotts Langley area. This appears to be due to wider re rerouteing to avoid M25 junction 20.

Watford (see Appendix E for detailed plans)

Watford – Compared to the base year there is an increase in traffic on the M1 in both directions on the A405 North Orbital Road in the Kingswood area and on Stephenson Way leading to M1 junction 5.

Elsewhere there are flow increases in the Watford junction and Ascots Lane area associated with development in these locations and additional traffic on both the town centre ring road and on the A411 Hempstead Road and parallel routes.

In west Watford there appears to be local rerouteing of traffic (most likely to avoid delays on particular routes).

The main difference between Local Plan Run 3 and Local Plan Run 2 is the exclusion of the Metropolitan Line extension. The impact of this appears to be evident with increased flows on Baldwins Lane, the A412 and Tolpits Lane corridors as well as additional traffic from the Ascot Road area.

Additional flows are also evident in the central Watford area in the AM peak although flows around the town centre ring road decrease in the PM peak (this may be due to wider rerouteing away from this area)

There also appears to be some rerouteing away from Stephenson Way and M1 junction 5 in the AM peak.

3.2 Volume Capacity Ratios

Figures 3.3 to 3.6 show the Volume to Capacity Ratios on highway links in the South West Herts area. Those links with a Volume / Capacity (VC) Ratio of over 80% (shown in Orange) and 90% (shown in Red) are operating close to or at capacity. Links with a VC ratio below 80% are not shown.

It should be noted that the length of the lines is determined by the length of the highway link in the model and does not indicate the extent of queuing.

More detailed plans by district are included in the appendices.

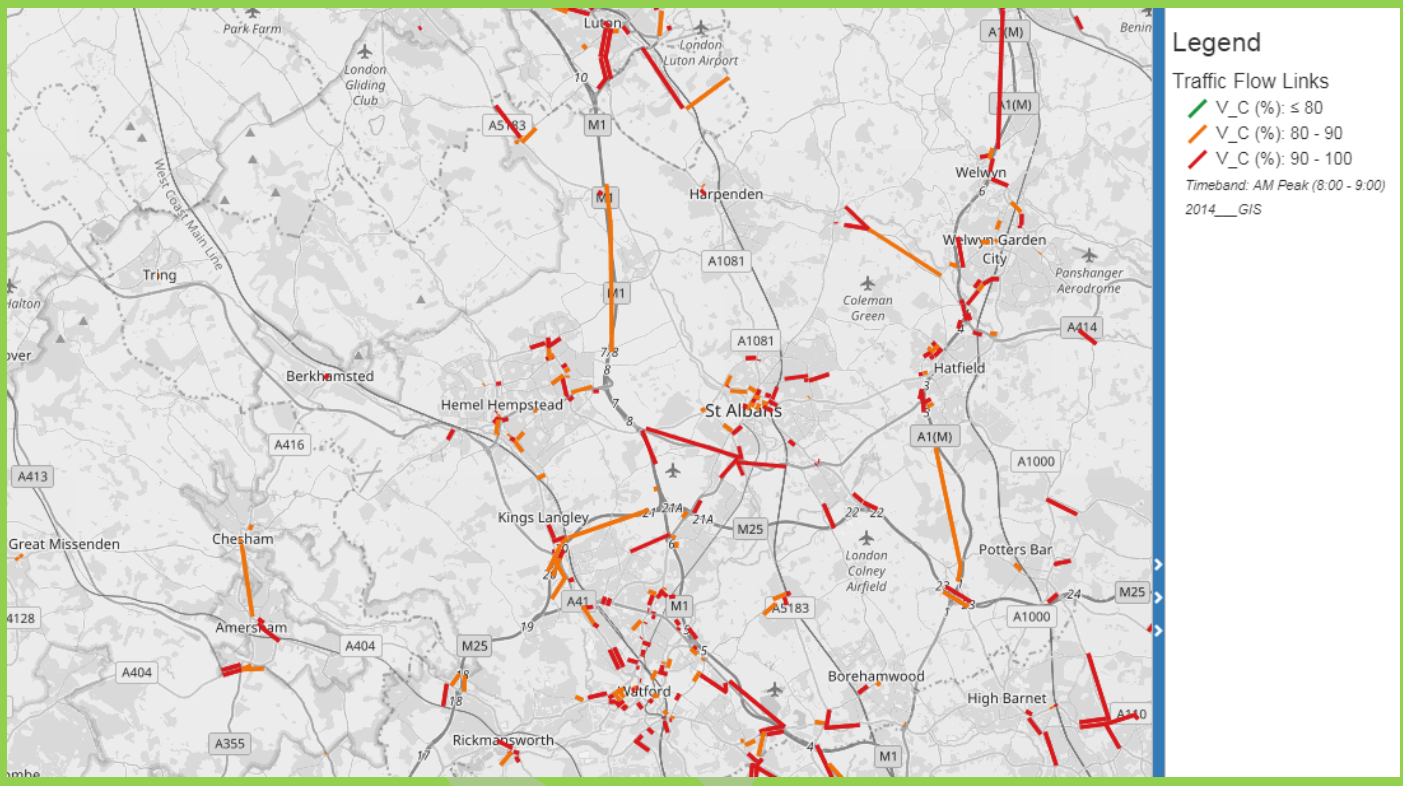

Figure 3-5 2014 Volume to Capacity Ratios in South West Herts Area – AM Peak (08:00 – 09:00)

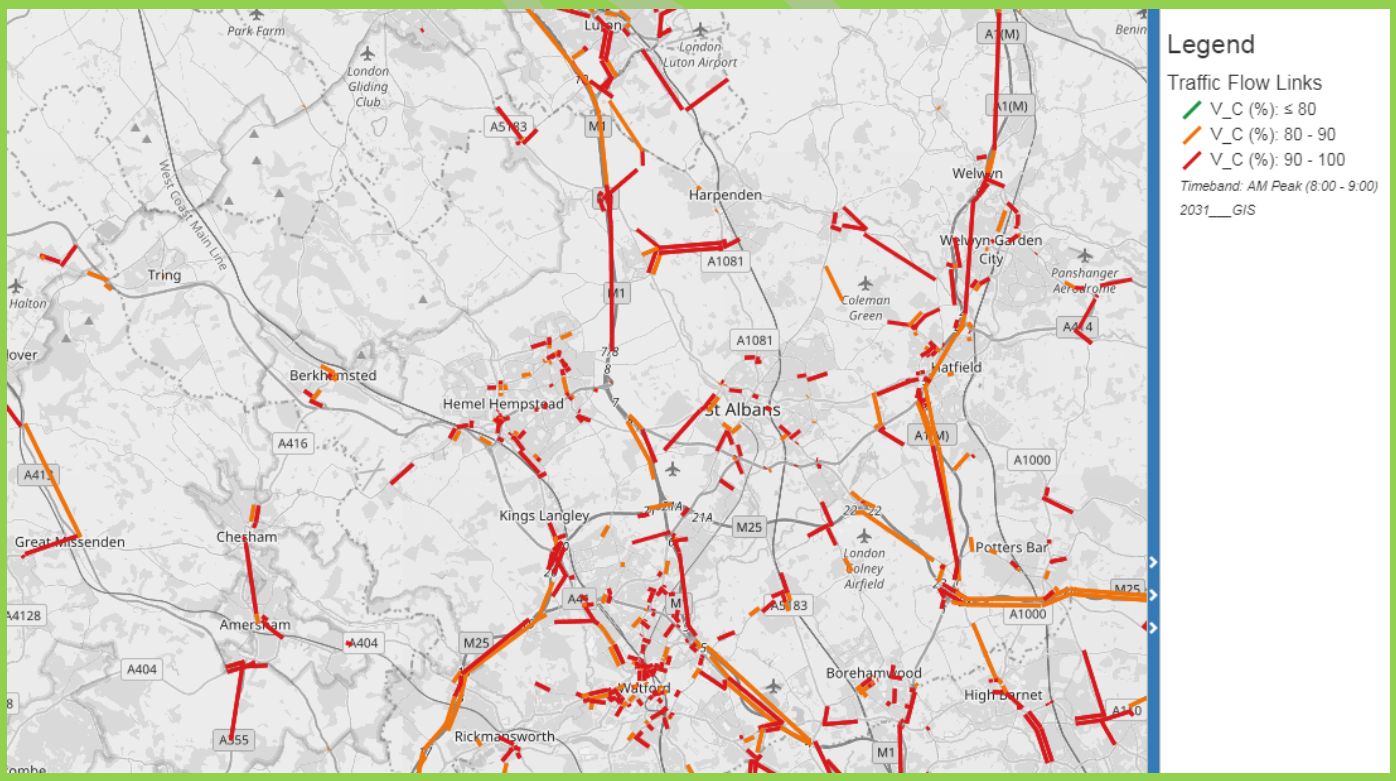

Figure 3-6 – 2031 Volume to Capacity Ratios in South West Herts Area – AM Peak (08:00 – 09:00)

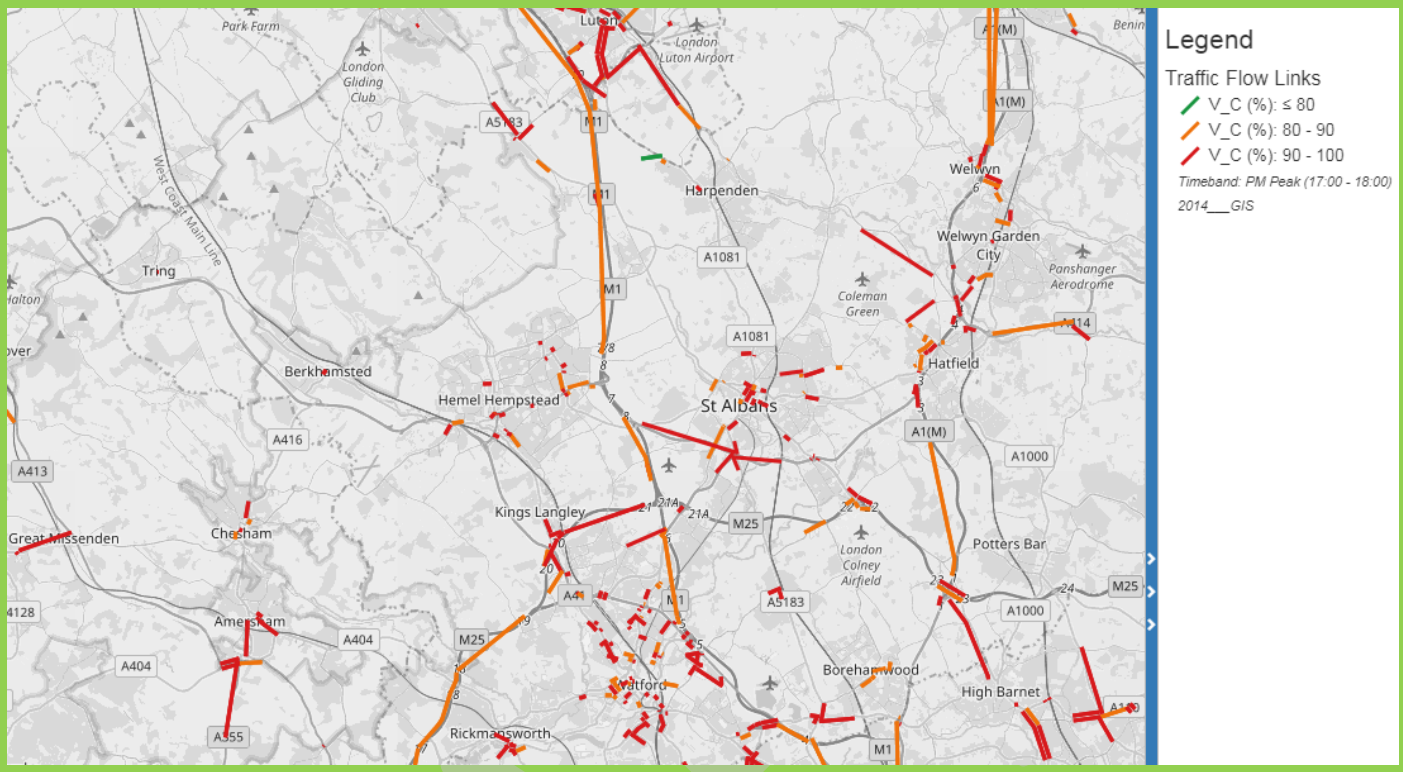

Figure 3-7 – 2014 Volume to Capacity Ratios in the South West Herts Area – PM Peak (17:00 – 18:00)

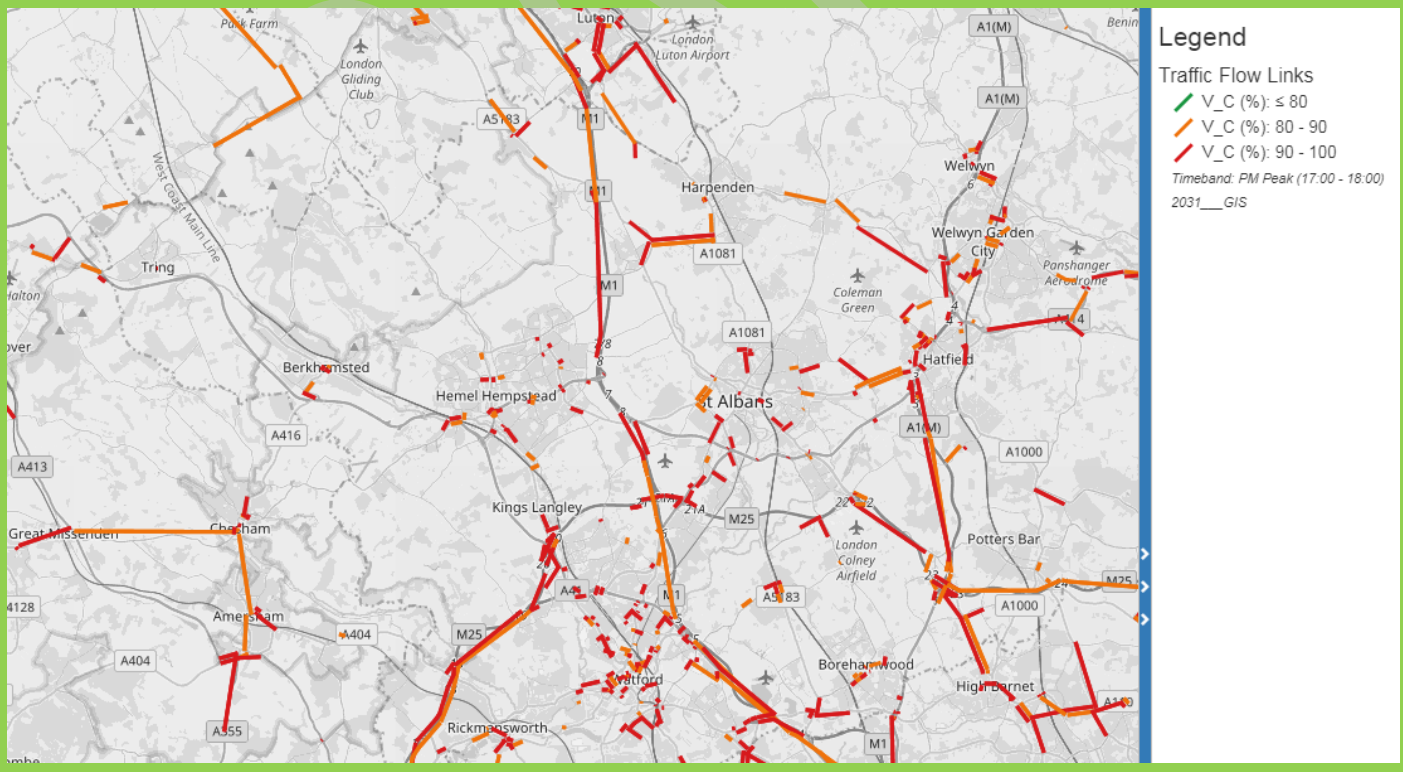

Figure 3-8 – 2031 Volume to Capacity Ratios in the South West Herts Area – PM Peak (17:00 – 18:00)

3.2.1 Dacorum

In Dacorum the main areas of stress in 2031 are as follows:

Hemel Hempstead:

- The A4147 St Agnells Lane Roundabout,
- Around the Maylands area (Swallowdale Lane – Maylands Avenue),
- Leverstock Green Road – Bedmond Road Junction,
- Queensway – A4146 area,
- The Plough Roundabout,
- B4505 Box Lane approach
- Belswains Lane – St Albans Hill area, and
- Along the A4251 London Road in Apsley.

Many of these are existing areas of stress in the base year. In the future year additional stress is evident around the Station and Apsley areas. The level of stress reduces however on the A414 in east Hemel and in the Maylands area as a result of the schemes being implemented here.

Berkhamsted: The High Street / Kings Road experiences stress in both the base year and 2031. In the future year the Shootersway / Kingshill Way junction experiences stress. There are new signals at the Shootersway / Kingshill Way junction which could be further optimised to reflect future flow patterns and reduce stress.

Markyate: Approaches to the A5183 / B4540 junction are at capacity in both the base and future year. The level of stress could be reduced with further signal optimisation.

M1 Junction 9: multiple approaches experience stress in both the base and future year.

M25 Junction 20: Multiple approaches experience significant stress, particularly in the future year.

3.2.2 Hertsmere

In Hertsmere the main areas of stress in 2031 are as follows:

- M1 southbound between junctions 5 and 4
- A411 Elstree Road approach to North Western Avenue
- Approaches to the Elstree Crossroads
- The Allum Lane / Shenley Lane /Elstree Way corridor in Borehamwood
- A1m approaches to Stirling Corner
- Watling Street, Radlett & B462 Radlett Road / Watford Road
- M25 approaches to junction 22 and junction 23.
- Mutton Lane and The Causeway in Potters Bar

Compared with the base year, the level of stress worsens on a number of key corridors.

3.2.3 St Albans

In St Albans the main areas of stress in 2031 are as follows:

- M1 between junctions 7-6a and around junction 6. In the AM the issues are southbound, whilst in the PM in the northbound direction.
- A405 approaches to M25 junction 21a
- Approaches to the A414 Park Street Roundabout
- Approaches to the Bell Lane / Shenley Lane / Harper Lane, North of Shenley
- Within St Albans City the approaches to the Ancient Briton Junction (Harpenden Road / Beech Road / Batchwood Drive), Sandpit Lane / Beechwood Avenue junction, King Harry Junction (King Harry Lane / Watford Road), London Road / St Vincent Drive, the Redbourn Road / Bluehouse Hill junction, A1081 /Drakes Drive junction, Victoria Street /Grimston Road and the Peahen junction.
- B487 Redbourn Lane and Approaches to junctions on A1081 Luton Road in Harpenden, and approaches to B487 / A5183 Junction in Redbourn
- A1081 Luton Road in the centre of Harpenden
- Approaches to the Marford Road / Cory-Wright Way roundabout and High Street in Wheathampstead

Compared with the base year, the level of stress is greater on B487 Redbourn Lane, around Wheathampstead and on roads between Hatfield and St Albans. Conditions however improve on the A414 south of St Albans (where a number of junction improvements are proposed) and within St Albans city centre.

3.2.4 Three Rivers

In Three Rivers the main areas of stress in 2031 are as follows:

- A404 London Road / A4145 Moor Lane and A404 Riverside Drive roundabout in Rickmansworth
- M25 Junctions 19 and 20 (and mainline)
- Brookdene Avenue / Hampermill Lane, South Oxhey
- Approaches to the Hunton Bridge Interchange and approaches to Watford Road / Langleybury Lane Junction in Hunton Bridge
- Tibbs Hill Road / High Street, Abbots Langley

Many of these locations also experience stress in the base year model, although there is an increase in stress on the M25 and on Baldwins Lane.

3.2.5 Watford

In Watford the main areas of stress in 2031 are as follows:

- Rickmansworth Road / Hagden Lane junction
- Vicarage Road / Hagden Lane

- Whippendell Road / Queens Avenue Junction and Whippendell Road / Ascot Road Junction
- Area around Watford junction (Station Road, Clarendon Road and Orphanage Road)
- Bushey Arches Roundabout
- Hempstead Road / Grove Mill Lane & Hempstead Road approach to Stratford Way
- Lower High Street approaches to Dalton Way and Exchange Road gyratory
- M1 junction 5 approaches
- Dome Roundabout approaches
- Woodmere Avenue & Meriden Way approaches to A41 Colne Way
- St Albans Road junctions with Garston Lane, Sheepcot Lane, Bushey Mill Lane, Balmoral Road, Leavesden Road, Langley Road / Station Road
- Courtlands Drive / Ashfields junction, and Ashfields / Aerodrome Way, Leavesden

A number of these locations are already at link capacity in the base year model. The 2031 Local Plan run 3 model shows a worsening in stress in west Watford and on the M1 / A41 corridor.

3.3 Junction Delays

Figures 3.9 to 3.12 show the junction delays in the local area and indicate those junctions with an overall average delay of over 30 seconds. Orange dots represent delays of between 90 seconds and 150 seconds (1 minute and 2.5 minutes), red dots represent delays between 150 seconds and 300 seconds (2.5 and 5 minutes) and dark red dots represent delays of over 5 minutes.

The results presented in the following sections are overall average junction delays for each district.

Note that the numbers presented in this chapter are modelled times only. Whilst the model has been validated to journey time data there has been no comparison of modelled junction delays against observed data. The numbers presented in this section should therefore be viewed as indicative only.

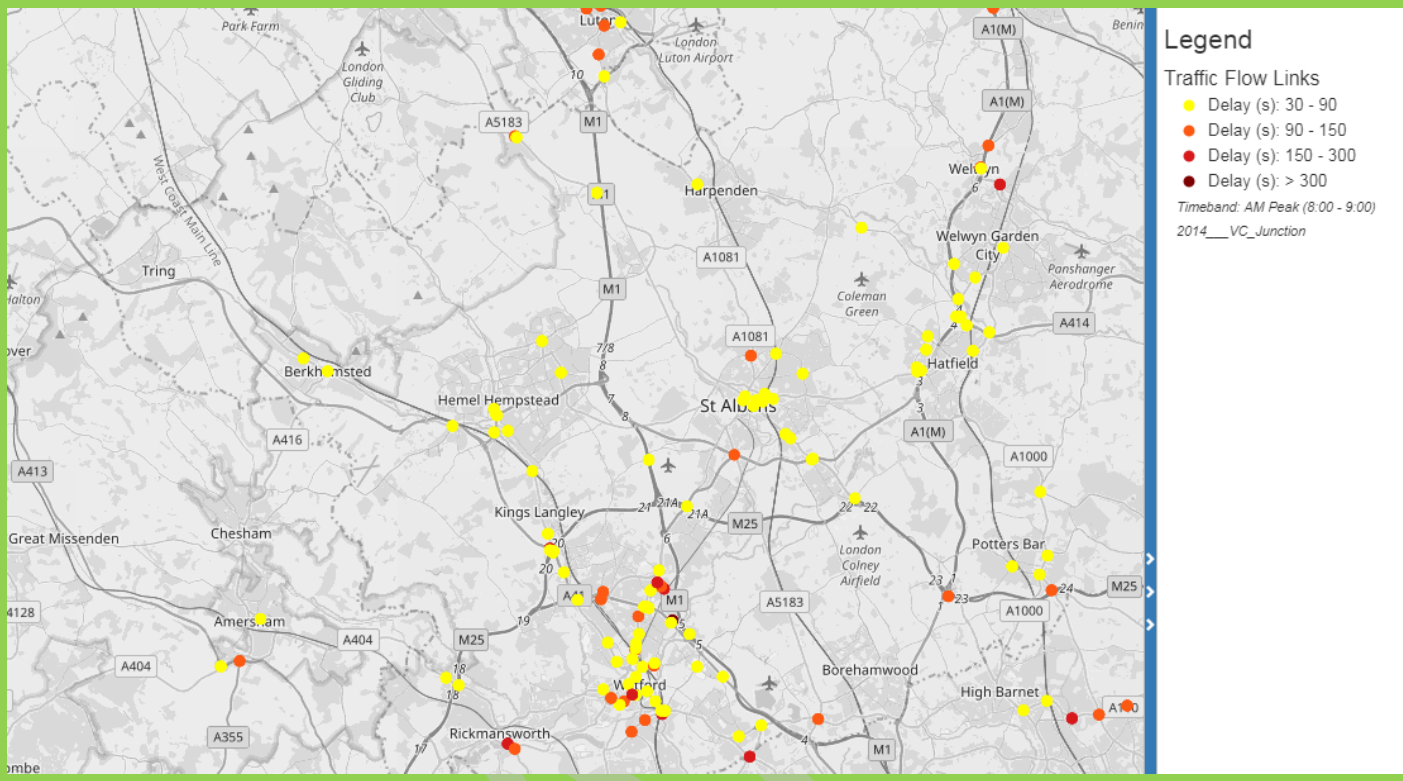

Figure 3-9 2014 Junction Delays in South West Herts Area – AM (08:00 – 09:00)

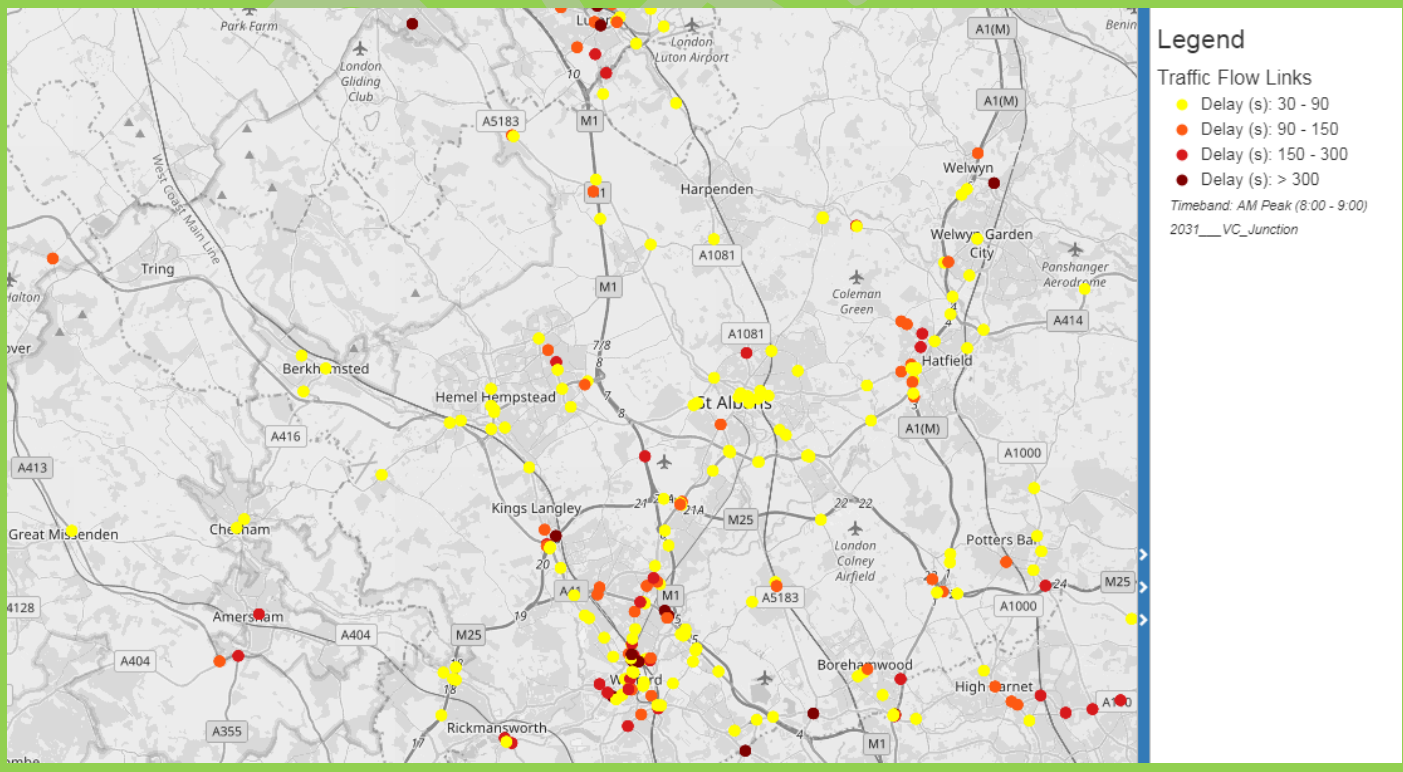

Figure 3-10 – 2031 Junction Delays in South West Herts Area – AM Peak (08:00 – 09:00)

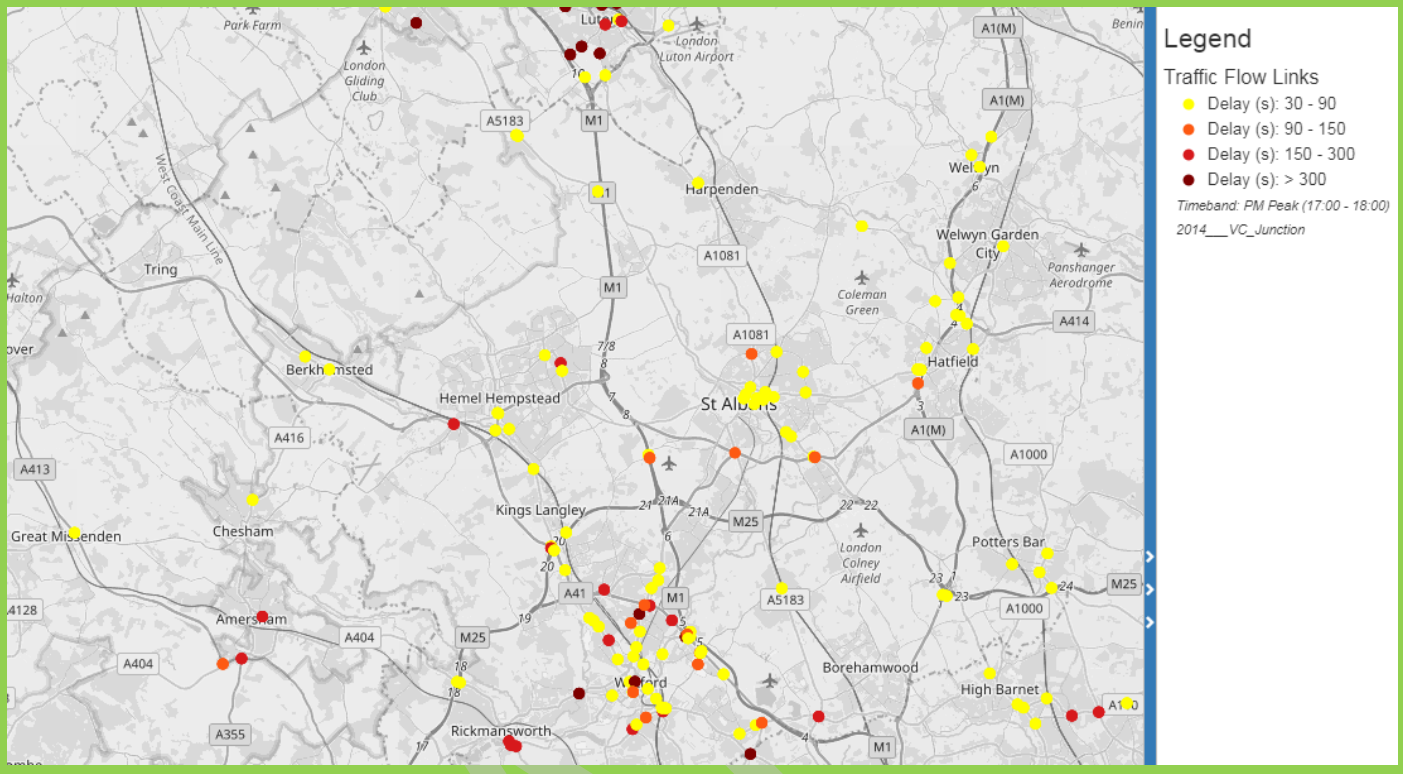

Figure 3-11 – 2014 Junction Delays in South West Herts Area – PM Peak (17:00 – 18:00)

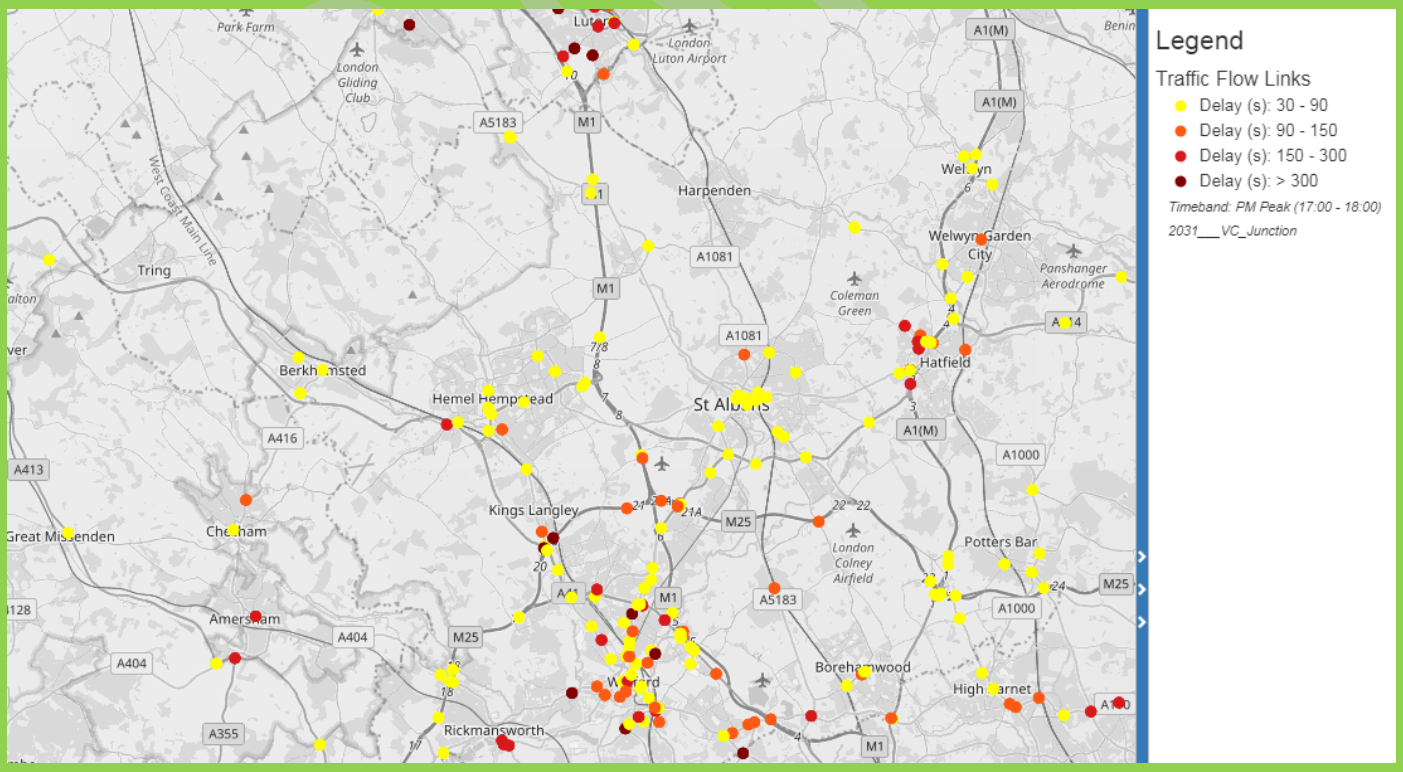

Figure 3-12 – 2031 Junction Delays in South West Herts Area – PM Peak (17:00 – 18:00)

3.3.1 Dacorum

Table 3-1 presents a combined list of the Top 20 worst overall average junction delay for the AM and PM in Dacorum district. Please note that the delays are indicative as the model has not been calibrated against junction delay.

Table 3-1 The Top 20 Peak hour Overall Average Delay in Dacorum District (2031)

COMET Node	Junction	AM (s)	Change from 2014	PM (s)	Change from 2014
2483	M25 Junction 20 A41 Approach	282	126 (80%)	73	15 (25%)
2158	Maylands Avenue / Maxted Road	198	189 (>100%)	9	-182 (-95%)
2160	Maylands Avenue / Swallowdale	130	116 (>100%)	17	1 (5%)
2485	M25 Junction 20 Northbound Offslip	110	33 (44%)	351	60 (21%)
2463	M1 Junction 9 / A5183 Western Roundabout	103	57 (>100%)	66	7 (12%)
2405	A5183 / High Street, Markyate	99	4 (5%)	57	-8 (-12%)
2448	Watford Road / Home Park Mill Link Road	92	43 (89%)	90	69 (>100%)
2339	Shootersway / Kingshill Way / Kings Road, Berkhamsted	88	85 (>100%)	75	72 (>100%)
2388	Leighton Buzzard Road / Waterhouse Street, Hemel Hempstead	87	-2 (-2%)	33	8 (34%)
2210	A4251 London Road / Rucklers Lane	86	31 (56%)	54	8 (17%)
2456	Leverstock Green Road / Bedmond Road, Leverstock Green	69	65 (>100%)	24	20 (>100%)
2347	Two Waters Junction, Hemel Hempstead	68	9 (16%)	72	10 (16%)
2389	High Street / Kings Road, Berkhamsted	68	13 (24%)	89	25 (39%)
2363	London Road / Box Lane, Hemel Hempstead	66	25 (61%)	255	64 (34%)
2394	Plough Roundabout - A414 Two Waters Road	53	15 (41%)	47	3 (7%)
2372	London Road / Fishery Road, Hemel Hempstead	52	40 (>100%)	47	34 (>100%)
2507	Lawn Lane / St Albans Hill, Hemel Hempstead	49	12 (31%)	90	37 (70%)
2357	Hempstead Road / High Street / Chesham Road / Newhouse Road, Bovingdon	48	37 (>100%)	11	1 (15%)
2406	A5183 / Luton Road, Markyate	41	3 (9%)	38	-4 (-10%)
2451	A414 Breakspear Way / Leverstock Green Way	39	11 (40%)	20	2 (8%)
2387	A4146 Leighton Buzzard Road / Combe Street, Hemel Hempstead	39	29 (>100%)	38	29 (>100%)
2450	Maylands Avenue / Wood Lane End, Hemel Hempstead	34	-26 (-44%)	44	-26 (-37%)
2338	Gossoms End / Billet Lane, Berkhamstead	31	0 (0%)	35	2 (5%)
2441	Queensway / Redbourn Road / Swallowdale Lane / High Street Green, Hemel Hempstead	20	4 (28%)	35	-16 (-32%)
2393	Plough Roundabout - Station Road, Hemel Hempstead	18	-18 (-51%)	38	-5 (-11%)

The longest delays are forecast at M25 Junction 20 (A41 approach, and Northbound offslip). The A41 approach experiences particularly high delay in the AM and is the highest delay in the AM, whilst the Northbound offslip experiences particularly high delay in the PM.

The highest percentage change in delay, in both the AM and the PM, is forecast to be Shooters Hill / Kingshill Way junction in Berkhamsted. This junction is signalised in 2031 and this will be a factor in the increased delay. Optimisation of these signals could help reduce the delay.

Maylands Avenue (including Maxted Road, Swallowdale Lane, Queensway and Redbourn Road) experiences particularly high delay in the AM, and with significant change from the 2014. Additional delay in this area is not surprising given the approximate 1500 jobs in the area.

Plough Roundabout sees increases in delay on the A414 Two Waters Road approach, with decreases on the Station Road approach.

The Box Lane / London Road junction in Hemel Hempstead sees increases in delay in both time periods, but the delay experienced in the PM is particularly long, and the second longest in the district.

3.3.1.1 Local Plan Run 3 vs Local Plan Run 2 DS

Most of the junctions within the Dacorum district see only small changes to delay, positive or negative when comparing Local Plan Run 3 with Local Plan Run 2 DS.

No junctions see an increase in delay of over 30 seconds in either the AM or PM.

A4147 Swallowdale Lane (node 2502) sees a reduction in delay of nearly 1 minute in the AM. This is likely to be due to the additional schemes in the Maylands area.

3.3.2 Hertsmere

Table 3-2 presents a combined list of the Top 20 worst overall average delay for the AM and PM in the Hertsmere district. Please note that the delays are indicative as the model has not been calibrated against junction delay.

Table 3-2 The Top 20 Peak hour Overall Average Delay in Hertsmere District

COMET Node	Junction	AM (s)	Change from 2014	PM (s)	Change from 2014
4213	Barnet Lane / Watford Road / High Street, Elstree	399	308 (>100%)	229	62 (37%)
4268	A1535 / Newark Green Junction, Borehamwood	153	152 (>100%)	2	0 (-4%)
4279	Potters Bar Interchange – M25 Eastbound Offslip / A111	153	45 (42%)	86	32 (58%)
4208	Park Road / Watling Street, Radlett	139	110 (>100%)	136	51 (60%)
4257	Bignell's Corner M25 Junction 23 – M25 Westbound Offslip / St Albans Road	130	39 (42%)	40	26 (>100%)
4250	Mutton Lane / Darkes Lane / Baker Street, Potters Bar	123	80 (>100%)	46	0 (1%)
4238	Bignell's Corner M25 Junction 23 – A1 to M25 onslip	114	110 (>100%)	62	58 (>100%)
4354	A5135 / Shenley Road / Brook Road, Borehamwood	93	-	54	-
4204	A411 Elstree Road / Heathbourne Road, Bushey	87	6 (8%)	98	-7 (-7%)
4152	Berrygrove Interchange – Stephenson Way Approach	77	59 (>100%)	23	-362 (-94%)
4198	A41 North Western Avenue / Sandy Lane, Bushey	75	28 (58%)	121	54 (79%)
4207	A41 / A411 Elstree Road, Elstree	75	45 (>100%)	101	73 (>100%)
4202	Berrygrove Interchange - A41 Northbound Offslip (Otterspool Way) / Interchange Circulatory	74	51 (>100%)	40	5 (15%)
4159	A1000 Hatfield Road / The Causeway / Cotton Road, Potters Bar	69	8 (14%)	37	5 (17%)
4056	The Drive / Watling Street, Radlett	68	66 (>100%)	3	0 (1%)
4203	Little Bushey Lane / Elstree Road / The Rutts, Bushey Heath	63	4 (7%)	92	3 (4%)
4255	High Street / Southgate Road / Barnet Road / Mutton Lane, Potters Bar	53	13 (32%)	57	9 (19%)
4124	Berrrygrove Interchange Circulatory - M1 Northbound Offslip / A41 Southbound Onslip	53	35 (>100%)	94	48 (>100%)
4139	Berrrygrove Interchange M1 Southbound Offslip	52	17 (46%)	128	82 (>100%)
4193	Hartspring Lane / Park Avenue, Watford	52	48 (>100%)	3	-68 (-96%)
4194	A41 / B462 Roundabout Watford	47	35 (>100%)	64	6 (10%)
4191	Hartspring Lane / Bushey Mill Lane, Watford	46	5 (11%)	82	-65 (-44%)
4105	Shenley Road, Eldon Avenue, Borehamwood	44	27 (>100%)	127	111 (>100%)
4263	Bignell's Corner - A1M Northbound Offslip / Circulatory	30	10 (51%)	86	30 (53%)
4262	Bignell's Corner - St Albans Road / Circulatory / A1M Onslip	22	-3 (-11%)	52	-1 (-2%)

COMET Node	Junction	AM (s)	Change from 2014	PM (s)	Change from 2014
9321	Stephenson Way / Colonial Way Roundabout, Watford	19	4 (29%)	353	321 (>100%)
4188	Berrygrove Interchange - A41 Southbound Offslip / Circulatory	12	1 (6%)	81	-24 (-23%)
4248	A1081 / Dancers Hill Road, Barnet	11	0 (3%)	82	65 (>100%)
4033	Elstree Road / Montacue Road, Bushey Heath	3	1 (56%)	105	60 (>100%)

In the Hertsmere area the worst junction in the AM is Elstree Crossroads (Barnet Lane / Watford Road / High Street) whilst in the PM Stephenson Way / Colonial Way Roundabout, Watford is the worst junction. The junction of Barnet Lane / Watford Road / High Street, Elstree crossroads is a signalised junction and it is likely that further optimisation at this junction would reduce delay.

The A5135 / Shenley Road / Brook Road Roundabout in Borehamwood, sees coding changes in 2031, although the equivalent junction node in 2014 does not experience overall average junction delay above 30 seconds. The Elstree Way Improvements schemes are likely to be contributing to this delay, with the node (4354) presented here being signalised in 2031. There is potential scope to optimise the signal timings and reduce delay at these junctions.

The largest proportional change in flow in the AM is forecast at one of the nodes that form the A5135 / Newark Green junction in Borehamwood where there is over 100% increase on flow in traffic from the A1 Southbound, with consequent doubling in traffic at the western end of the gyratory. This is despite a 300 PCU decrease in flow on the A1 southbound north of this junction, with a shift in the destination of traffic using this road, which may warrant further investigation. There is a doubling of inbound trips into the zone in the area reflecting the development growth in the Elstree Way corridor area.

The third largest delay in the AM, the M25 Eastbound Offslip / A111 part of Potters Bar Interchange (Junction 24), is a signalised junction and delay could potentially be reduced at this node through signal optimisation.

The largest proportional change in delay in the PM, which also sees considerable increase in the AM, is forecast at Bignell's Corner M25 Junction 23 – A1 to M25 Onslip (node 4238). This delay occurs at the merge, with increased queuing forecast on both the onslip and the mainline. This appears to be caused by an almost three fold increase in flow on the onslip, which stems from an apparent imbalance in signal timings (at node 4257) within the junction itself which causes traffic to route off the mainline, through the junction and back onto the mainline. Further investigation and optimisation of the signal timings around these junctions is warranted.

In the PM there is a significant reduction in delay at Berrygrove Interchange – Stephenson Way Approach. This appears to be due to reassignment and delay shift on the northern side of the junction, with blocking back impacting the operation of the junctions. The A41 southbound offslip sees a reduction of traffic flow. There is a need for further consideration of the junction's operation and potential for signal optimisation.

3.3.2.1 Local Plan Run 3 vs Local Plan Run 2 DS

Most of the junctions within Hertsmere see small changes in delay, positive or negative when comparing Local Plan Run 3 with Local Plan Run 2 DS.

The following junctions see reductions in delay of greater than 30 seconds in the AM Peak:

- Elstree Road / Montacute Road, Bushey
- Elstree Road / North Western Avenue, Elstree
- Watford Road / Barnet Lane, Elstree
- Watling Street / Allum Lane, Elstree
- Berrygrove Interchange – A4008 Stephenson Way Approach / Circulatory
- Berrygrove Interchange – M1 Northbound Offslip / Circulatory / A41 Southbound Onslip

The following junctions see increases in delay of greater than 30 seconds in the AM Peak:

- High Road / Magpie Hall Road, Bushey Heath
- Bushey Hall Road / The Avenue / Aldenham Road, Bushey
- Park Avenue / Hartspring Lane, Bushey
- Bell Lane / B5378 / Harper Lane / Shenley Lane, Shenley

The following junctions see reductions in delay of greater than 30 seconds in the PM Peak:

- Watford Road / Barnet Lane, Elstree
- M1 junction 5 Berrygrove Interchange– A4008 Stephenson Way Approach / Circulatory
- Berrygrove Interchange – M1 Northbound Offslip / Circulatory / A41 Southbound
- Berrygrove Interchange – A41 Northbound Offslip / Circulatory
- Berrygrove Interchange – Circulatory / A41 Northbound Onslip

The following junctions see increases in delay of greater than 30 seconds in the PM Peak:

- Elstree Road / North Western Avenue, Elstree
- Berrygrove Interchange – M1 Northbound Offslip / Circulatory / A41 Southbound Onslip
- Bell Lane / B5378 / Harper Lane / Shenley Lane, Shenley
- Eldon Avenue / B5378 Shenley Road, Borehamwood

It should be noted that there is little change in planning data or transport scheme data within Hertsmere itself and therefore these changes are likely to be a reflection of wider traffic redistribution

3.3.3 St Albans

Table 3-3 presents a combined list of the Top 20 worst overall average delay for the AM and PM in St Albans district. A number of the junctions within the St Albans are expected to be improved, or form part of improvement schemes. As such the nodes are not directly comparable. It should also be noted that the delays are indicative as the model has not been calibrated against junction delay.

Table 3-3 The Top 20 Peak hour overall Average Delay in St Albans District

COMET Node	Junction	AM (s)	Change from 2014	PM (s)	Change from 2014
6348	Ancient Briton Junction (Beech Road / Harpenden Road / Batchwood Drive), St Albans	208	87 (72%)	142	35 (32%)
6454	M1 Mainline Southbound - Offslip Approach	158	85 (>100%)	98	7 (7%)
6423	B653 Marford Road / Cory Wright Way Roundabout, Wheathampstead	131	88 (>100%)	13	-26 (-67%)
6169	M25 Junction 21 - Eastbound Offslip / North Orbital Road	125	123 (>100%)	124	122 (>100%)
6322	King Harry Lane / Watford Road, St Albans	123	109 (>100%)	80	68 (>100%)
2525	Green Lane / Breakspear Park Hemel Hempstead	100	N/A*	62	N/A*
6292	M25 Junction 21 - Westbound Onslip / North Orbital Road	98	94 (>100%)	145	127 (>100%)
6473	A414 London Colney Roundabout - Circulatory / North Orbital Road	90	49 (>100%)	65	28 (75%)
6500/ 6501	M25 Junction 22 (Radlett)	87	N/A*	60	N/A*
6519	London Road / St Vincent Drive / Mill House Lane, St Albans	78	75 (>100%)	68	65 (>100%)
6414	Shenley Lane / Harper Lane, Shenley	75	57 (>100%)	111	96 (>100%)
6428	A414 / High Street, Colney Heath	73	69 (>100%)	70	66 (>100%)
6386	A1081 London Road / Drakes Drive, St Albans	63	29 (83%)	40	4 (11%)
6426	A1057 Hatfield Road / Station Road / Oaklands Lane, Smallford	63	50 (>100%)	21	6 (35%)
6514	Park Street Roundabout, St Albans	58	N/A*	22	N/A*
6310	A1081 St Albans Road / Walkers Road / Redbourn Lane, Harpenden	58	44 (>100%)	19	6 (49%)
6340	Chequer Street / London Road / Holywell Road / High Street, St Albans	56	-12 (-17%)	61	-2 (-3%)
6365	Beaconsfield Road / Victoria Street / Alma Road, St Albans City	53	-22 (-30%)	46	-18 (-28%)
6395	Sandpit Lane / Beechwood Avenue, St Albans	50	-15 (-23%)	44	-40 (-48%)
6155	M25 Junction 21A Eastbound Offslip Diverge	50	48 (>100%)	103	101 (>100%)
6355	Lattimore Road / A1081 London Road / Watson's Walk, St Albans	45	3 (6%)	45	3 (7%)
2465	A414 Breakspear Way / Green Lane	35	N/A*	44	N/A*
6096	M25 Westbound Junction 21 Onslip Merge	26	24 (>100%)	116	(>100%)
6170	M25 Junction 21 North Orbital Road Southbound / Circulatory	16	-42 (-72%)	69	64 (>100%)
6468	M1 Mainline Northbound Merge	9	+9	45	**16 52%)**

‘*Direct comparison not possible given the change in junction configuration.

In the AM the largest delay is forecast at the Ancient Britton junction. It should be noted however that there is a considerable increase in traffic forecast through this junction in 2031.

B653 Marford Road / Cory Wright Way Roundabout, Wheathampstead experiences long delays in the 2031 forecast year. This junction has a proposed signalisation improvement in 2031 (which although an improvement on the operation of the current layout) does show . blocking back and delay. Further local junction modelling is recommended to ensure this design operates efficiently.

The largest delay in the PM is the M25 Junction 21 – Westbound Offslip. This junction also has proposed signalisation improvements in 2031, which could be optimised.

Nodes 6500 and 6501 represents the new coding for the new Junction 22 Improvements (Radlett). In the AM there is some blocking back within this new junction causing delay. There may be a need to optimise the new signals at node 6503.

The new junction A414 Breakspear Way / Green Lane junction has relatively long delays but the signalisation improvement Scheme does result in additional traffic travelling through the junction. . There may be opportunity to further optimise the signals as part of the detailed design of these junctions.

The largest proportional increase in delay in the AM is forecast at M25 Junction 21 - Eastbound Offslip / North Orbital Road. This junction sees new signals in 2031, and it may be necessary to review the performance of the new signals added at Junction 21 to minimise delay. The largest proportional increase in delay in the PM is the M25 Junction 21 Westbound Onslip Merge. M25 junction 21a also sees considerable increases in delay.

3.3.3.1 Local Plan Run 3 vs Local Plan Run 2 DS

Most of the junctions within St Albans see small changes in delay, positive or negative when comparing Local Plan Run 3 with Local Plan Run 2 DS. It should be noted that although the planning data has not changed much, a number of new highway infrastructure schemes have been coded into Local Plan run 3.

The following junctions see reductions in delay greater than 30 seconds in the AM Peak:

- Luton Road / Park Hill, Harpenden
- B653 Cory Wright Way / Marford Road, Wheathampstead
- St Albans Road / Marshalswick Drive / Beech Road, St Albans
- Beaumont Avenue / Beechwood Avenue / Hatfield Road Roundabout, St Albans
- Breakspear Way Westbound Approach to Breakspear Way / Green Lane Roundabout

Most of these junctions have additional improvements coded as part of Local Plan run 3.

The following junctions see increases in delay greater than 30 seconds in the AM Peak:

- Park Street Roundabout (A5183 Watling Street / A414 North Orbital Road)
- A414 North Orbital Road - Junction 22 Improvement (Radlett) Schemes
- Hatfield Road / Oaklands Lane, Smallford

The following junctions see reductions in delay greater than 30 seconds in the PM Peak:

- B653 Cory Wright Way / Marford Road, Wheathampstead

At the A414 / A1081 (London Colney roundabout) the A414 approaches experience a decrease in delay of over 30 seconds but the A1081 (south) approach and some of the circulatory links experience an increase in delay.

At M25 junction 21a there are increases in delay on the off slips and the A405 south approach associated with increases in traffic flow here. There is however a decrease in flow and delay on the A405 north approach as some traffic diverts onto the new Radlett Spine Road.

At M25 junction 21 the main increase in delay is on the M25 mainline clockwise.

3.4.1 Three Rivers

Table 16-1 presents a combined list of the Top 20 worst overall average delay for the AM and PM in St Albans district. It should be noted that the delays are indicative as the model has not been calibrated against junction delay.

Table 16-1 The Top 20 AM Overall Average Delay and Top 20 PM Overall Average Delay in Three Rivers District

COMET Node	Junction	AM (s)	Change from 2014	PM (s)	Change from 2014
8254	M25 Clockwise Northbound Junction 20 Merge	340	337 (>100%)	346	339 (>100%)
8116	Batchworth Roundabout (A404 Riverside Drive / A404 Church Street), Rickmansworth	279	78 (39%)	170	18 (11%)
8178	London Road / Moor Lane Roundabout, Rickmansworth	272	123 (82%)	207	49 (31%)
8213	A4125 Hampermill Lane / Brookdene Avenue, Watford Heath	177	36 (26%)	314	89 (39%)
8193	Bridge Road / Watford Road / Langleybury Lane, Kings Langley	84	21 (33%)	69	11 (19%)
8166	A404 Chorleywood Road / M25 Northbound On/Offslips	71	42 (>100%)	45	-4 (-9%)
8257	A404 London Road / Harefield Road, Rickmansworth	65	51 (>100%)	265	-3 (-1%)
8219	Hunton Bridge Interchange, A41 Westbound / Circulatory	52	6 (14%)	84	64 (>100%)
8188	M25 Junction 20 – A41 Northbound / Circulatory	50	4 (9%)	66	5 (8%)
8253	M25 Junction 20 – Circulatory /A41 Southbound	48	5 (12%)	19	1 (7%)
8246	M25 Mainline Clockwise	46	(>100%)	49	19 (65%)
8247	M25 Southbound On/Offslips / A404 Chorleywood Road	38	-10 (-20%)	55	0 (0%)
8229	M1 Mainline Southbound	37	29 (>100%)	0	(0%)
8163	A404 Rickmansworth Road / Dog Kennel Lane, Rickmansworth	34	-2 (-4%)	36	11 (42%)
8223	A4008 Oxhey Lane / B4542 Little Oxhey Lane, Carpenders Park	33	10 (44%)	155	107 (>100%)
8239	M25 Mainline Northbound	31	(>100%)	42	23 (>100%)
8249	M25 Mainline Westbound / Junction 19 Westbound Onslip	24	(>100%)	33	(>100%)
8199	A412 Watford Road / Baldwins Lane, Croxley Green	23	9 (65%)	587	49 (9%)
8064	A412 Uxbridge Road / Long Lane	9	8 (>100%)	34	32 (>100%)

In Three Rivers district in the 2031 AM the largest absolute delays and the greatest proportional increase is forecast at the M25 Mainline Clockwise Junction 20 Merge, whilst in the PM the largest delays are forecast at the A412 Watford Road / Baldwins Lane, Croxley Green. In the PM the largest proportional increase in delay is forecast at the M25

Northbound Junction 20 Merge. The merge onto the M25 clockwise causes blocking back into Junction 20 itself and and causes a knock-on impact to the A41. This is likely to be due to the difficulty in merging with much larger flows on the M25. The specific design, and thus coding, of the merge could be reviewed to mitigate this impact.

The A412 Watford Road / Baldwins Lane, Croxley Green junction sees a modest increase in westbound traffic but is already under significant stress in 2014 PM peak suggesting that the area should be considered for additional mitigation measures.

The Batchworth Roundabout (A404 Riverside Drive / A404 Church Street), Rickmansworth sees increased delay on the A404 northbound, with blocking back on this approach. The junction to the south, A404 / Harefield Road junction also experiences blocking back and delays at the signalised junction, and following London Road / Moor Lane Roundabout which experience over 200 seconds of delay in both peaks. The London Road / Harefield Road junction is the fourth worst in the PM, although there is a small reduction in delay since 2014. Signal optimisation and other mitigation may be able to improve the delays in this area.

3.4.1.1 Local Plan Run 3 vs Local Plan Run 2 DS

Most of the junctions within Three Rivers see small changes in delay, positive or negative when comparing Local Plan Run 3 with Local Plan Run 2 DS.

The following junctions see reductions in delay of greater than 30 seconds in the AM Peak:

- M25 Clockwise beyond Junction 20 (probably due to traffic not getting through the previous junction)

The following junctions see increases in delay of greater than 30 seconds in the AM Peak:

- A404 Church Street / Harefield Road, Rickmansworth
- M25 Clockwise Onslip Merge at Junction 20

The following junctions see reductions in delay of greater than 30 seconds in the PM Peak:

- M25 Clockwise beyond Junction 20

The following junctions see increases in delay of greater than 30 seconds in the PM Peak:

- A404 Church Street / Harefield Road, Rickmansworth
- M25 Clockwise Onslip Merge at Junction 20
- Hampermill Lane / Brookdene Avenue, Watford

16.1.1 Watford

Table 16-2 presents a combined list of the Top 20 worst overall average delay for the AM and PM in Watford district. It should be noted that the delays are indicative as the model has not been calibrated against junction delay.

Table 16-2 The Top 20 AM Overall Average Delay and Top 20 PM Overall Average Delay in Watford District

COMET Node	Junction	AM (s)	Change from 2014	PM (s)	Change from 2014
9215	Clarendon Road / St John's Road, Watford*	>500	(>100%)	14	1 (7%)
9063	Westland Road / Shady Lane*	>500	(>100%)	5	0 (2%)
9345	Westland Road / Station Road, Watford*	>500	(>100%)	137	134 (>100%)
9157	Meriden Way / Garsmouth Way, Watford	418	416 (>100%)	2	0 (8%)
9024	Hagden Lane / Brightwell Road, West Watford	398	396 (>100%)	3	0 (5%)
9220	St John's Road / Woodford Road / Orphanage Road / Queens Road, Watford	356	293 (>100%)	75	26 (52%)
9117	Westlea Avenue / Meriden Way, Watford	306	-55 (-15%)	3	0 (6%)
9052	Rickmansworth Road / Metropolitan Station Approach, Watford	294	208 (>100%)	125	97 (>100%)
9214	Station Road / Woodford Road, Watford	275	271 (>100%)	4	0 (6%)
9355	Farraline Road, Watford	256	45 (21%)	141	12 (9%)
9206	A412 St Albans Road / Leavesden Road, Watford	219	135 (>100%)	1	0 (-19%)
9243	A4008 Pinner Road / A4008 Aldenham Road, Bushey	199	-9 (-4%)	268	-27 (-9%)
9064	Clarendon Road / Shady Lane, Watford	198	195 (>100%)	3	0 (9%)
9230	Radlett Road / Orphanage Road Roundabout, Watford	195	104 (>100%)	92	75 (>100%)
9035	A411 Exchange Road / Marlborough Road	179	171 (>100%)	199	-255 (-56%)
9180	Whippendell Road / Queens Avenue, Watford	177	46 (35%)	101	51 (>100%)
9233	St Albans Road / Garston Lane, Watford	176	18 (11%)	43	-11 (-20%)
9260	The Dome Roundabout, Circulatory / A41 Eastbound	155	80 (>100%)	23	0 (-1%)
9197	A412 St Albans Road / Station Road / Langley Road, Watford	145	73 (>100%)	68	-5 (-7%)
9225	A4125 Eastbury Road / A4178 Deacons Hill / Oxhey Road, Watford	141	27 (23%)	175	34 (24%)
9212	A412 St Albans Road / Bushey Mill Lane	125	31 (34%)	307	-59 (-16%)
9174	Aerodrome Way / Ashfields	122	7 (6%)	201	-51 (-20%)
9245	A41 Colne Way / Westlea Avenue	91	5 (6%)	180	-36 (-17%)
9235	A405 / Horseshoe Lane	87	38 (78%)	78	29 (59%)
9217	A412 St Albans Road / Gammons Lane / Balmoral Lane	75	16 (27%)	125	43 (52%)
9291	Vicarage Road – Watford General Hospital Zone Loading	72	66 (>100%)	96	86 (>100%)

9094	A41 Colne Way / Asda	56	3 (6%)	166	-84 (-34%)
9177	A411 Hempstead Road / Langley Road	48	-2 (-5%)	204	-63 (-24%)
9269	Pinner Road / Chalk Hill scheme??	41	-13 (-24%)	117	58 (98%)
9198	A4145 Vicarage Road / Fearnley Street	31	3 (12%)	94	21 (28%)
9259	The Dome Roundabout, St Albans Road / A41 Westbound	26	3 (14%)	81	-14 (-15%)
9008	A4008 Pinner Road / Bucks Avenue	2	0 (4%)	100	85 (>100%)

* Considered unrealistic level of delay, likely to be due to zone loading issues.

The largest delays in the AM peak are in the area south of Watford junction station (eg around Clarendon Road, St Johns Road, Westland Road and Shady Lane) These junctions also have the largest increases in delay compared to the base year model. These results should however be treated with caution as the Watford junction development traffic is loading in this area. The COMET model is representing this fairly crudely and it is recommended that more detailed microsimulation modelling is undertaken in this area to identify the true impact on the network.

Away from the station area of the model that should be reviewed, there are several other junctions with delays over 300 seconds in the AM peak. Meriden Way / Garsmouth Way experiences significant delay due to blocking back from the A41 Colne Way / Westlea Avenue. Whilst this junction does experience some reduction in delay in 2031, there is potential for signal optimisation at this the A41 Colne Way / Westlea junction to alleviate some of these delays.

The Hagden Lane / Brightwell Road, West Watford experiences delays in part due to blocking back from the Vicarage Road signalised junctions.

The St John's Road / Woodford Road / Orphanage Road / Queens Road junction causes blocking back along St John's Road and consequent excessive delays at preceding junctions. Signal optimisation may relieve the stress at this junction.

There is a significant absolute decrease in the PM at A411 Exchange Road / Marlborough Road, caused by a small decrease in the trips from zone 5013. There is potentially a case to model this link in full, with a new or additional zone loading locations to ensure better junction performance at both ends of Marlborough Road, and along Exchange Road.

16.1.1.1 Local Plan Run 3 vs Local Plan Run 2 DS

One of the main scheme differences between Local Plan Run 3 and Local Plan Run 2 DS is the removal of the Metropolitan Line extension. This causes increased traffic in and around the centre of Watford, between Croxley and Watford Junction.

Most of the junctions within Watford see small changes in delay, positive or negative when comparing Local Plan Run 3 with Local Plan Run 2 DS.

The following junctions see reductions in delay of greater than 30 seconds in the AM Peak:

- St Alban's Road / Garston Lane, Watford
- Garston Lane / Fourth Avenue, Watford
- The Dome – Node of St Albans Road / Circulatory / Colne Way, Watford

- St Alban's Road / Lowestoft Road, Watford
- Number of junctions along Station Road and Clarendon Road
- Vicarage Road / General Hospital Zone Loading
- Pinner Road / Eastbury Roundabout

The following junctions see increases in delay of greater than 30 seconds in the AM Peak:

- St Alban's Road / Leavesden Road, Watford
- St Alban's Road / Station Road / Langley Road, Watford
- Shady Lane / Westland Road / Albert North Road, Watford
- Exchange Road / Marlborough Road, Watford
- Hagden Lane / Metropolitan Station Approach, Watford
- Hagden Lane / Brightwell Road, Watford
- Vicarage Road / General Hospital Zone Loading
- Whippendell Road / Queens Avenue, Watford

The following junctions see reductions in delay of greater than 30 seconds in the PM Peak:

- Aerodrome Way / Ashfields, Watford
- Colne Way / ASDA junction, Watford
- Colne Way / Woodmere Avenue, Watford
- St Alban's Road / Sheepcot Lane, Watford
- St Alban's Road / Garston Lane, Watford

The following junctions see increases in delay of greater than 30 seconds in the PM Peak:

- Pinner Road / Eastbury Roundabout, Watford
- Deacons Hill / Eastbury Road, Watford
- Vicarage Road / General Hospital Zone Loading, Watford
- Station Road / Westland Road, Watford

4. Conclusions

The COMET modelling work has tested the impact of implementing local plan growth and a variety of schemes identified by the South West Hertfordshire authorities in 2031, compared to the Base Year 2014. This enables the identification of the high-level impact of the schemes and whether there is a need to mitigate the additional pressure from development growth.

It should be noted that due to the strategic nature of the model this comparison provides an indication of potential scheme impacts and scheme design and development should be underpinned by more detailed operational models as necessary.

The mitigations already in the model will undoubtedly be making conditions better, but there is still stress on the network which may need to be mitigated. As developments are brought forward it may be necessary for more detailed local or micro simulation models to be prepared to assess the impact of a given development. There is also a need to review the schemes to ensure they are operating as expected, particularly where signalisation schemes have been put forward.

It should be noted that the work to date has concentrated on highway mitigation measures. Other than some localised development flow reductions tested in Watford, there are impacts of modal shift which could be achieved through the implementation of sustainable transport measures. Whilst the interventions do appear to offer some localised capacity improvements in some instances, the consequence is that there is increased traffic. It is therefore important that they form part of a balanced transport strategy which includes improvements to sustainable transport.

5. Appendices

5.1 Appendix A – Detailed Results Dacorum

5.2 Appendix B – Detailed Results Hertsmere

5.3 Appendix C – Detailed Results St. Albans

5.4 Appendix D – Detailed Results Three Rivers

5.5 Appendix E – Detailed Results Watford

Appendix 40: Draft Hertfordshire County Council COMET: South West Herts Area Interpretation of COMET Model Results, Appendix C – Detailed Results St Albans (July 2018)

Appendix C – St Albans

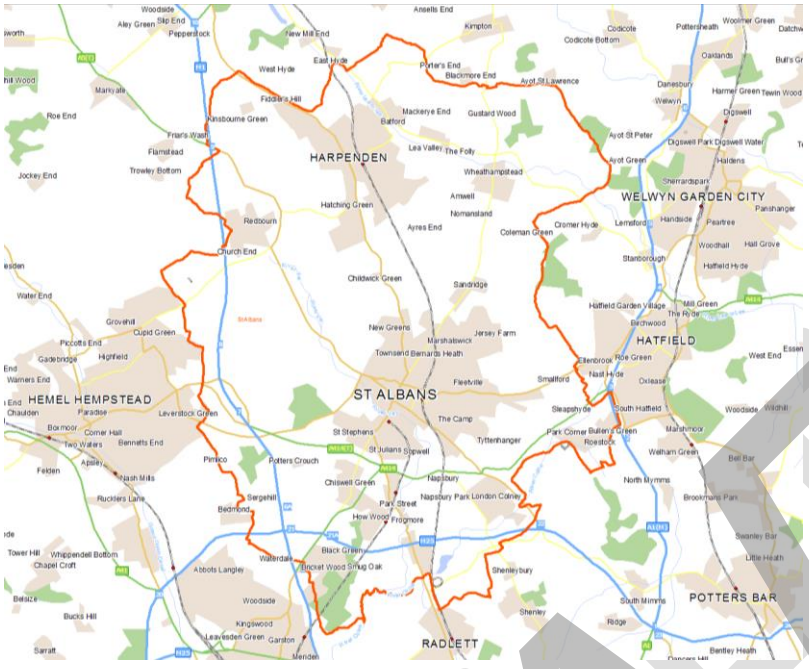

Figure 1 – Map showing St Albans District Boundary

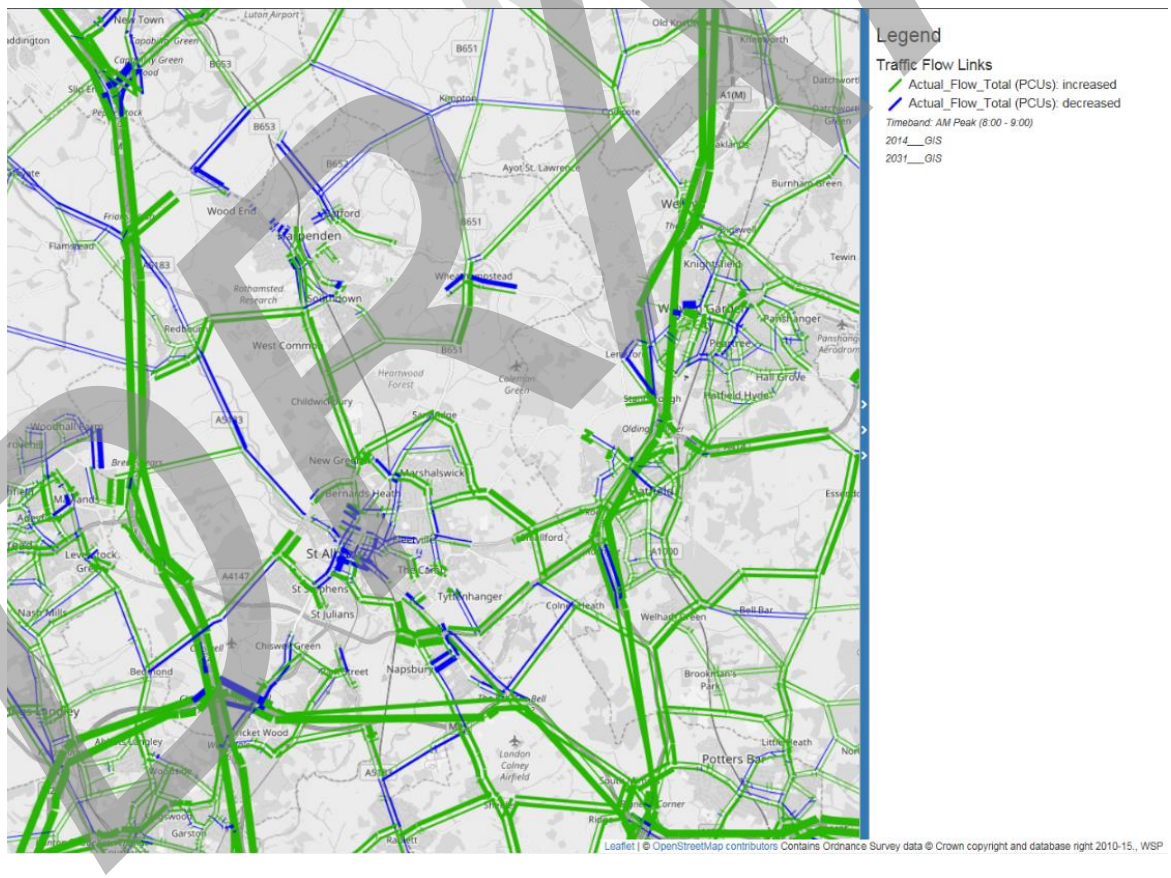

Figure 2 - 2031 – 2014 Actual Flow Difference (PCUs) AM Peak (08:00 – 09:00)

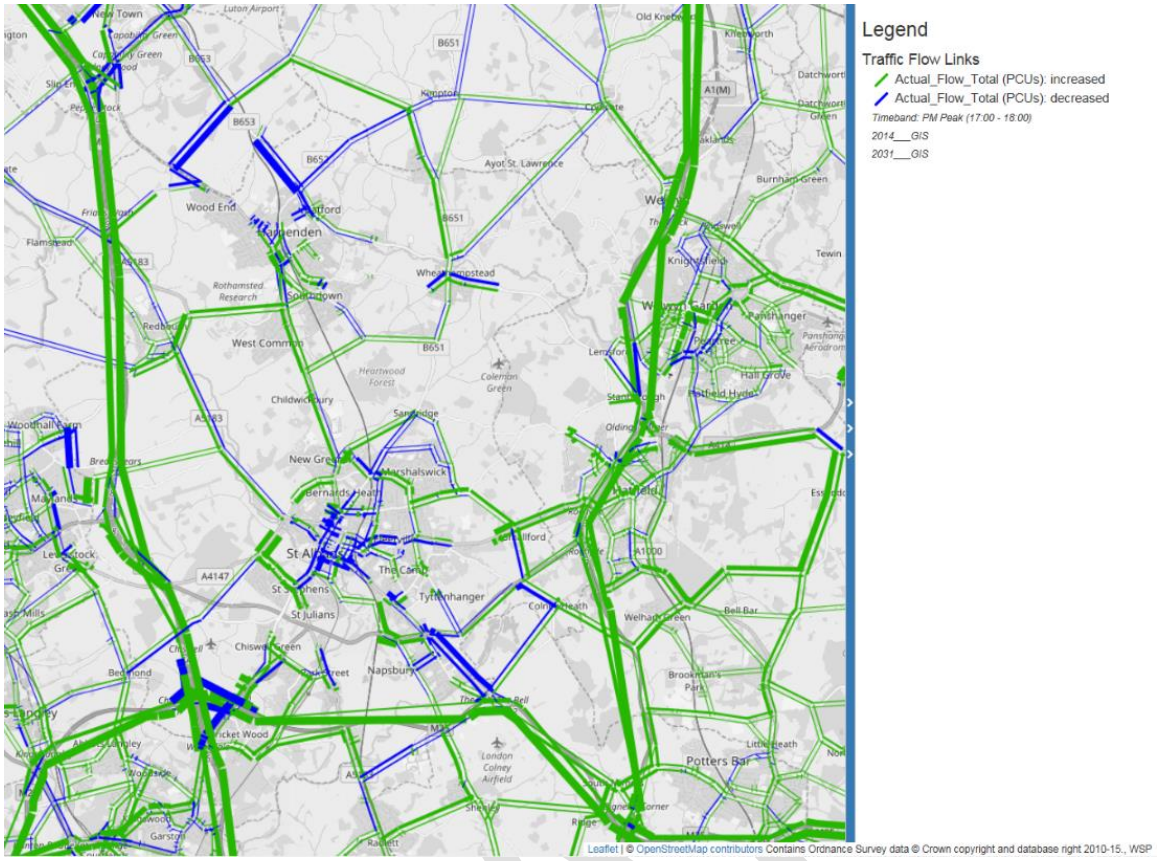

Figure 3 - 2031 – 2014 Actual Flow Difference (PCUs) PM Peak (17:00 – 18:00)

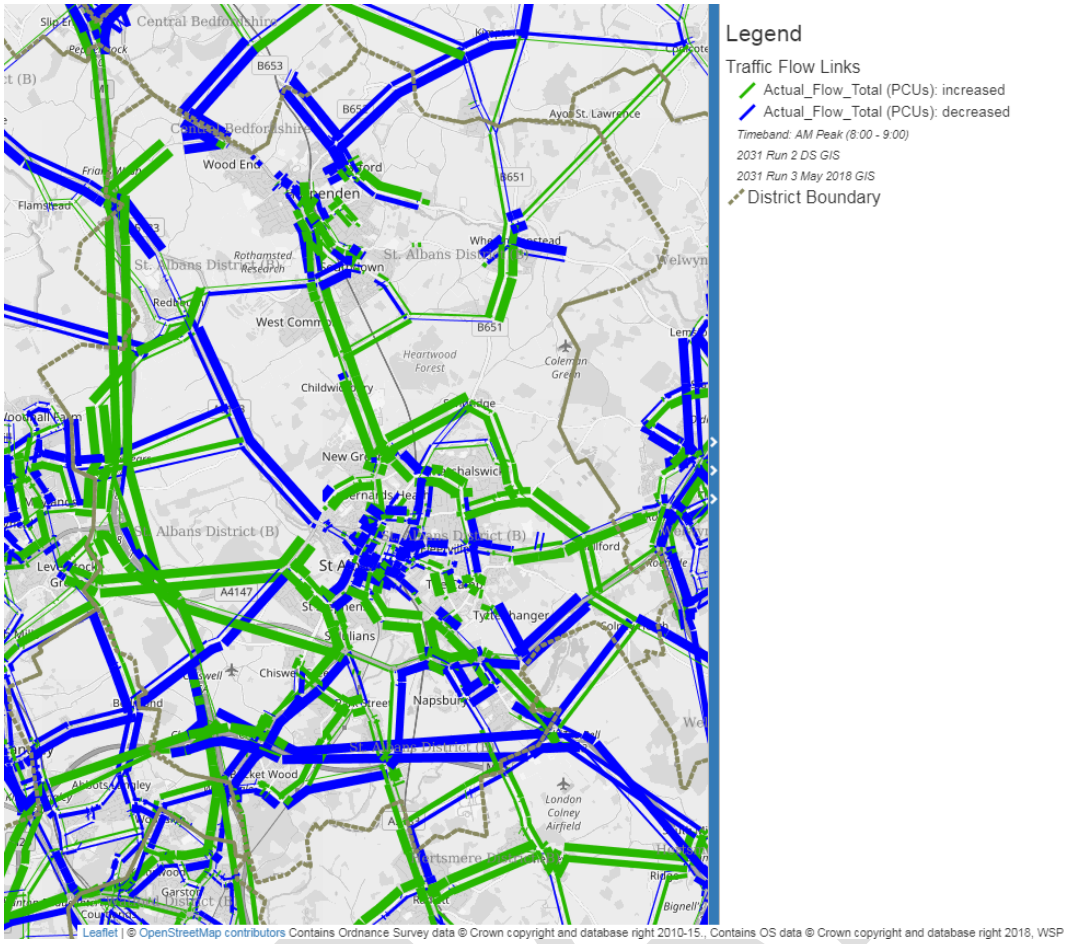

Figure 4 Actual Flow difference Local Plan run 3 – Local Plan run 2 AM peak (08:00-09:00)

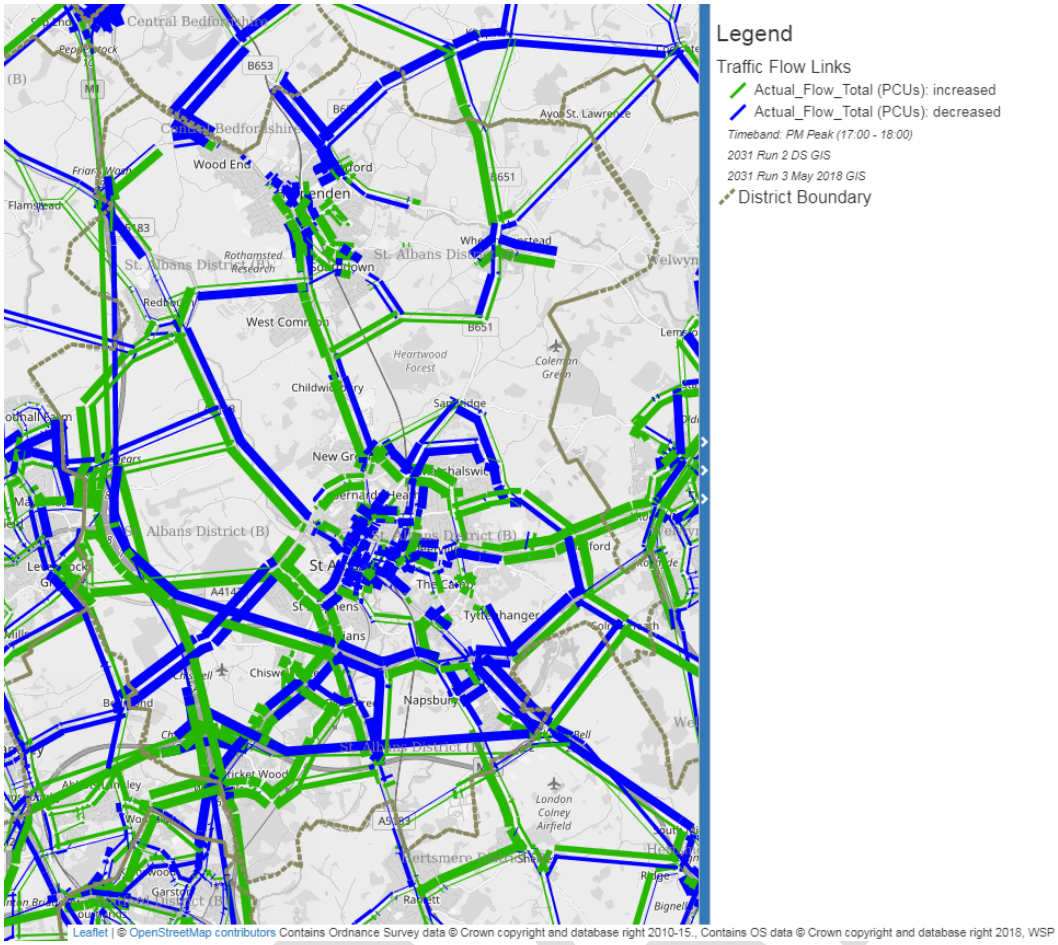

Figure 5 Actual Flow Change Local Plan Run 3 – Local Plan Run 2 PM peak (17:00-18:00)

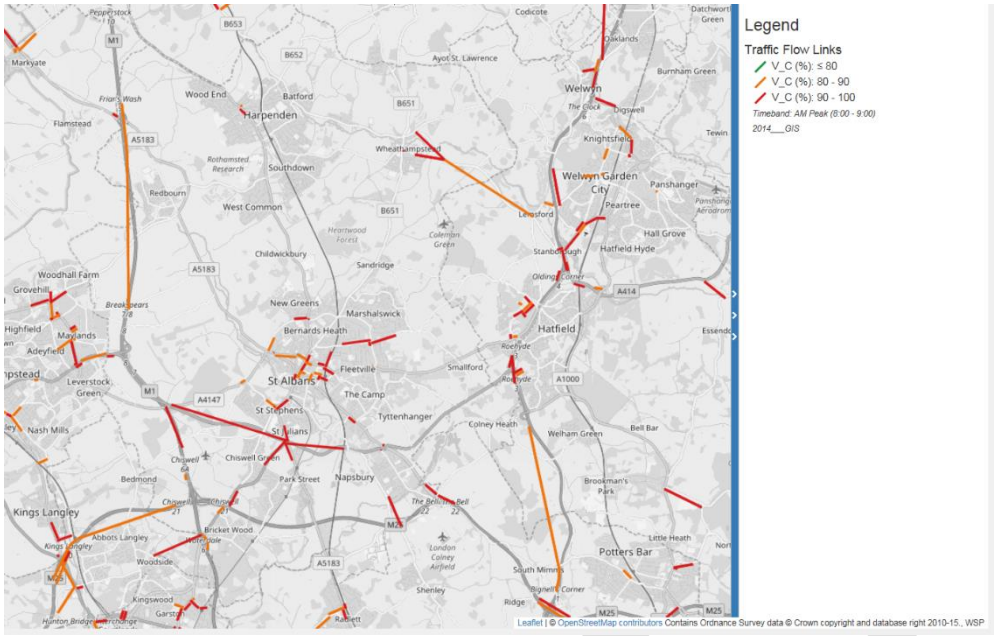

Figure 6 – 2014 Volume to Capacity Ratios in St Albans AM Peak (08:00 – 09:00)

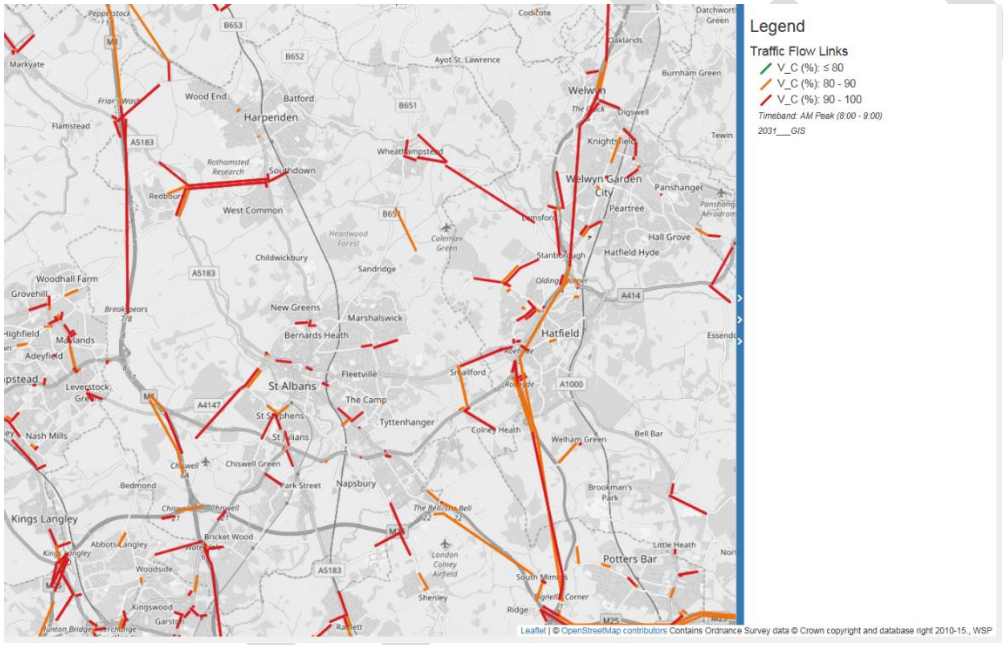

Figure 7 – 2031 Volume to Capacity Ratios in St Albans AM Peak (08:00 – 09:00)

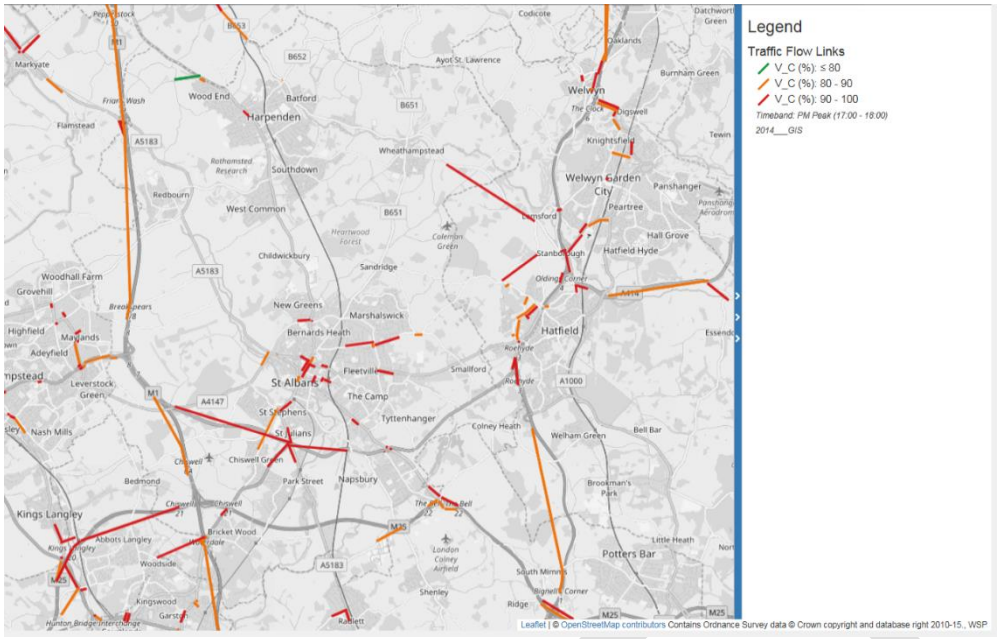

Figure 8 – 2014 Volume to Capacity Ratios in St Albans PM Peak (17:00 – 18:00)

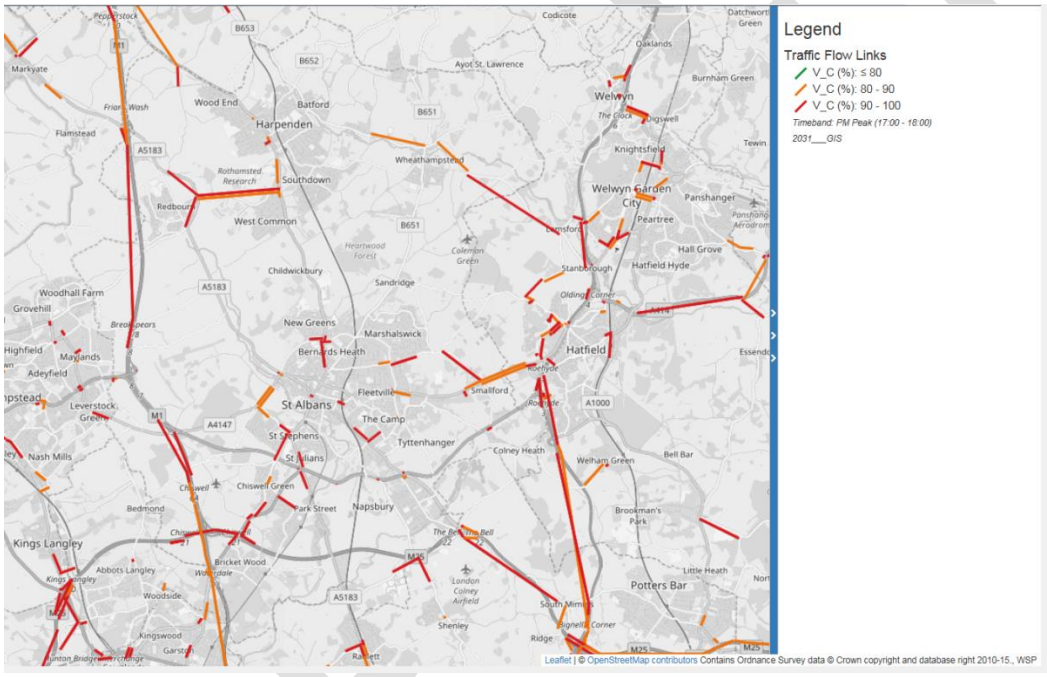

Figure 9 – 2031 Volume to Capacity Ratios in St Albans PM Peak (17:00 – 18:00)

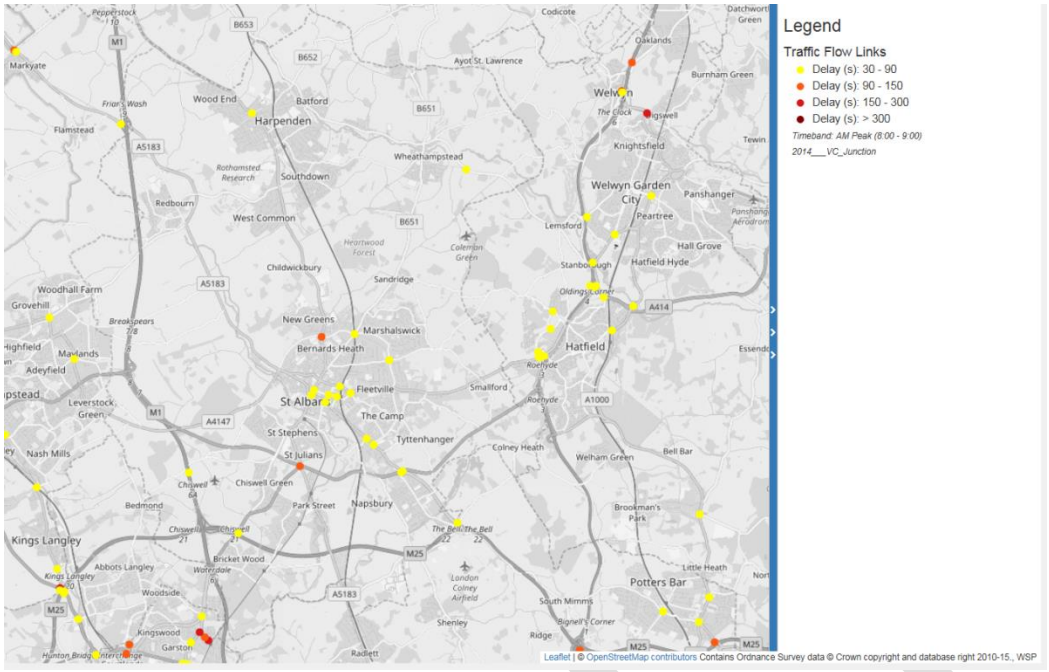

Figure 10 - 2014 Junction Delays in St Albans AM Peak (08:00 – 09:00)

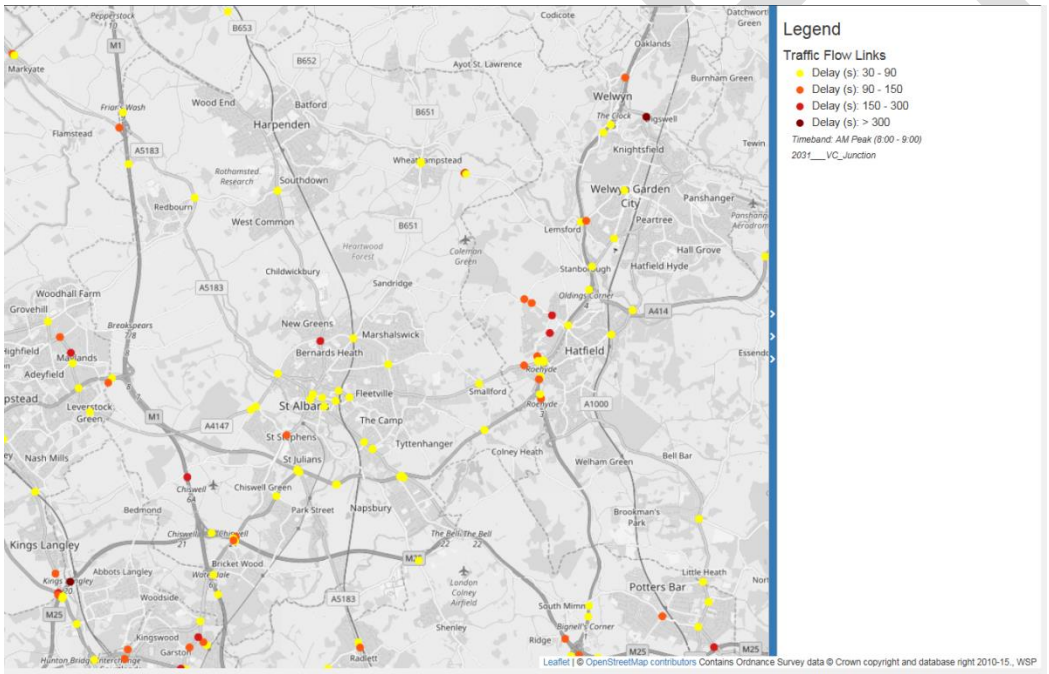

Figure 11 – 2031 Junction Delays in St Albans AM Peak (08:00 – 09:00)

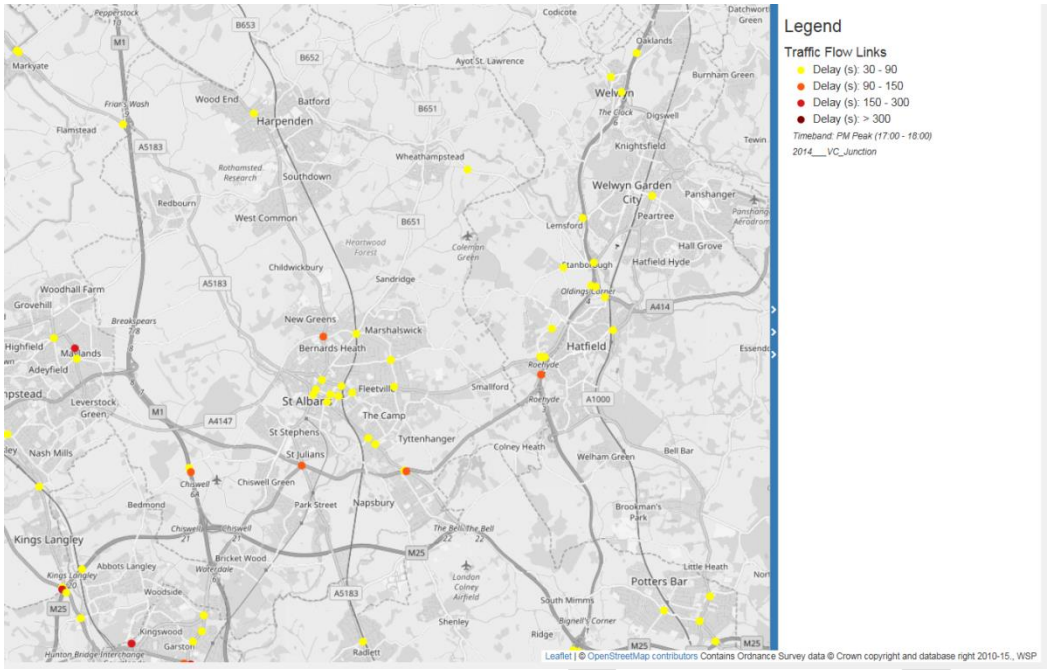

Figure 12– 2014 Junction Delays in St Albans PM Peak (17:00 – 18:00)

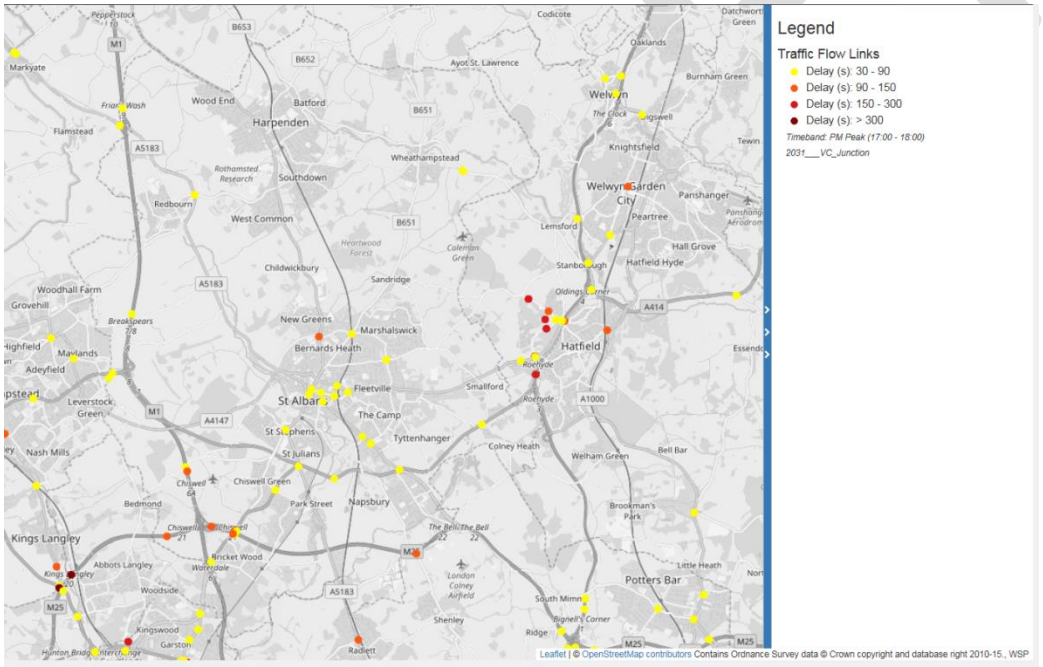

Figure 4 – 2031 Junction Delays in St Albans PM Peak (17:00 – 18:00)

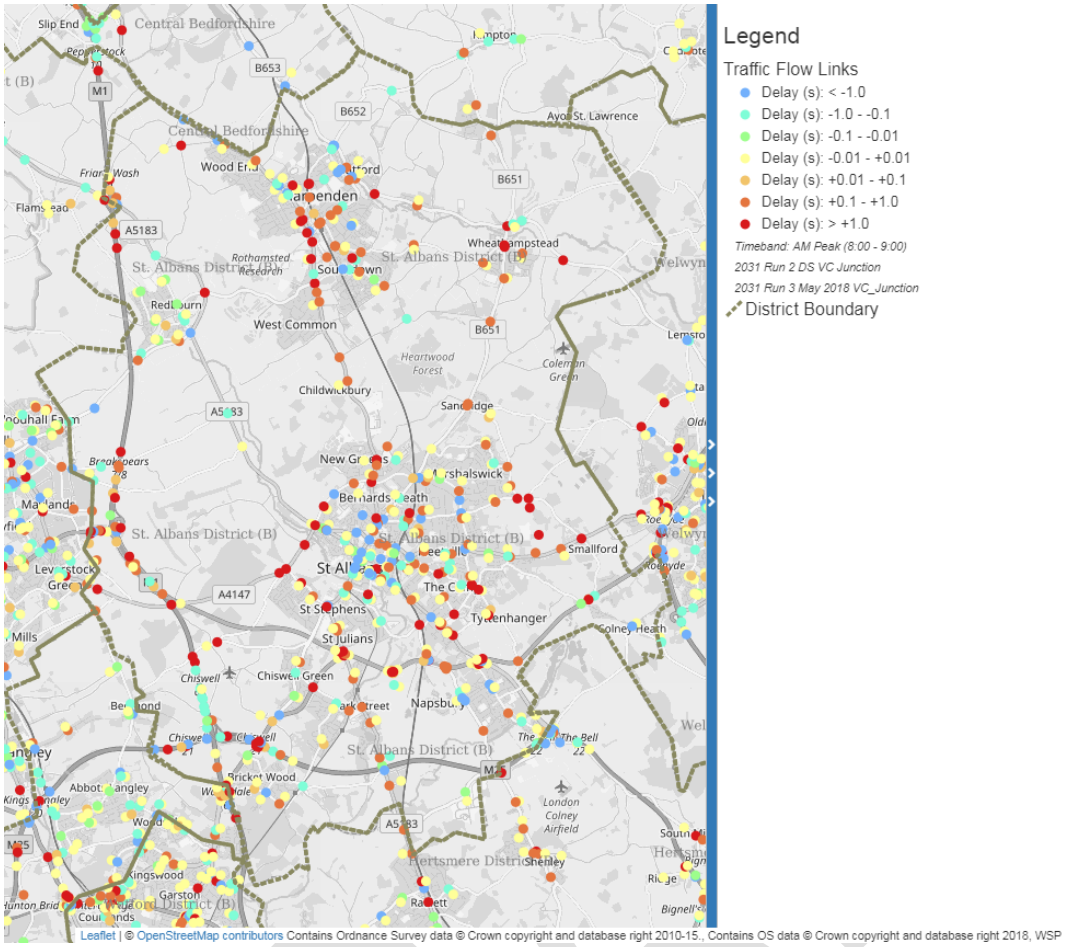

Figure 5 – Change in Delay Local Plan Run 3 to Local Plan Run 2 AM Peak (8:00 – 9:00)

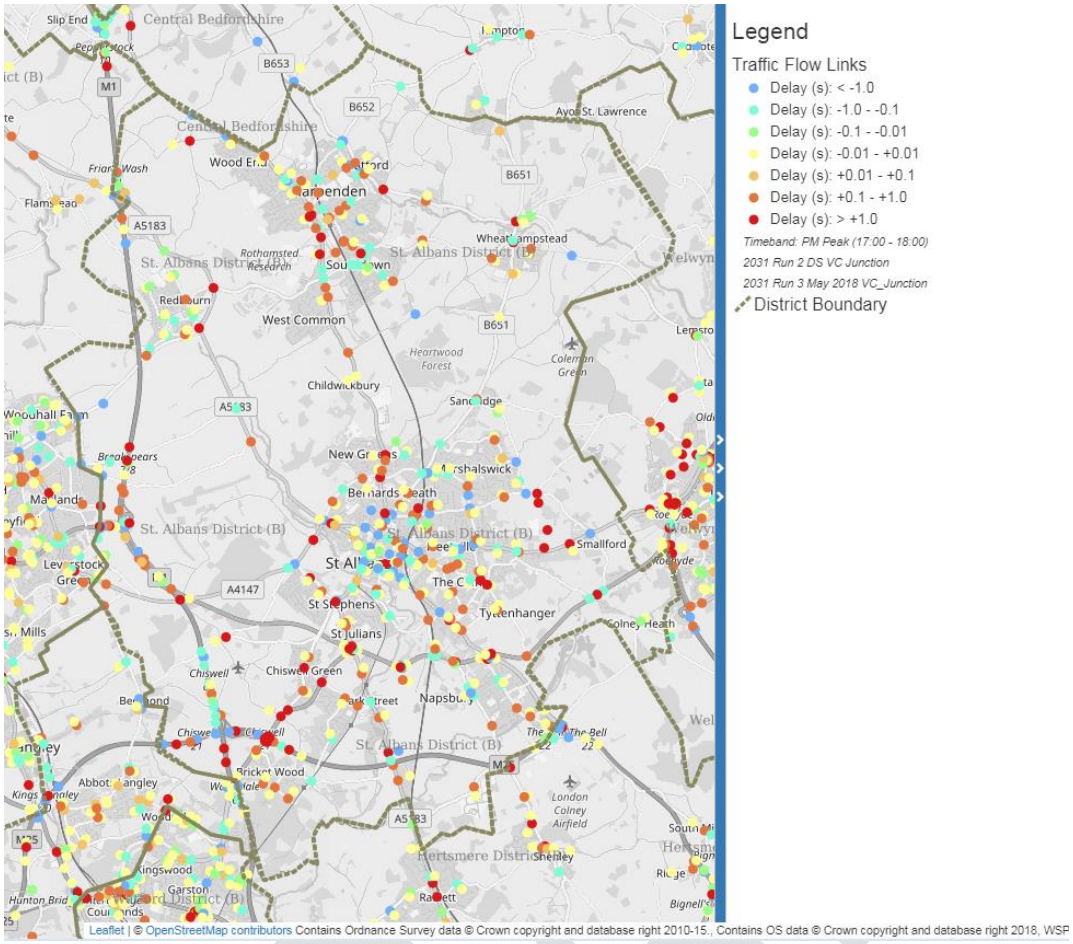

Figure 6 – Change in Delay Local Plan Run 3 to Local Plan Run 2 PM Peak (17:00 – 18:00)

Appendix 41: Draft Hertfordshire County Council COMET: AECOM Hertfordshire COMET Local Plan Forecasting Report (June 2018)

Hertfordshire COMET: Local Plan Forecasting Report

Project number: 60555331

June 2018

Quality information

Prepared by	Checked by	Approved by
AA, JW	JL	SK

Revision History

Revision	Revision date	Approved by
v1 – Draft for client comment	11th May 2018	In draft
v2 – Final version following client comment	22nd June 2018	SK

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Figures

Tables

1. Executive Summary

1.1 Background to the Forecast

1.1.1 Hertfordshire County Council (HCC) has commissioned AECOM to produce a 2031 forecast using the COMET multi-modal transport model. The forecast scenario includes the Local Plan aspirations (all employment and dwelling growth, regardless of certainty) of the 10 Hertfordshire districts, as well as the growth aspirations in the following neighbouring areas: Luton, Buckinghamshire (all districts), part of Essex (i.e. Epping Forest, Harlow, and Uttlesford), and part of Cambridgeshire (i.e. South Cambs and Cambridge)[1].

1.1.2 The scenario also includes the proposed transport schemes agreed with Hertfordshire districts in Autumn 2017, and aligns with the Infrastructure Delivery Plans and Transport Strategies at that time.

1.1.3 The forecast is a reflection of the total cumulative growth within the county rather than a test of any specific (set of) developments and/or schemes.

1.1.4 The forecast year has been defined by HCC as 2031. This year was chosen as it is the end point of Hertfordshire districts' Local Plans, and is the furthest year into the future for which reasonable planning data projections are available. The forecast is based on growth assumptions in Hertfordshire (shown in Table 1.1) between 2014 and 2031 (as COMET has a Base Year of 2014).

[1] For the rest of Great Britain, the growth in employment and population in the COMET forecast is based on NTEM 7.2 projections.

Table 1.1: Growth Assumptions in Hertfordshire and selected neighbouring areas (2014-2031)

District	Dwellings		Employment	
	Number of Dwellings	Percentage growth in dwellings	Number of Jobs	Percentage growth in jobs
Broxbourne	8,259	21%	9,861	23%
Dacorum	10,783	17%	11,609	16%
East Herts	18,008	31%	2,714	4%
Hertsmere	4,718	11%	3,270	7%
North Herts	16,070	29%	8,542	15%
St Albans	8,822	15%	4,527	7%
Stevenage	7,933	22%	4,323	9%
Three Rivers	2,613	7%	4,114	11%
Watford	8,223	22%	7,683	13%
Welwyn Hatfield	12,001	27%	11,851	16%
Essex (Epping Forest, Harlow & Uttlesford)	31,903	26%	30,768	22%
Luton	5,917	8%	19,103	19%
Buckinghamshire	57,327	21%	63,240	16%
Cambridgeshire (South Cambs and Cambridge)	38,084	34%	15,508	9%
Hertfordshire sub-total	**97,430**	**21%**	**68,494**	**12%**
Total	**230,661**	**22%**	**197,112**	**14%**

1.1.5 COMET is a multi-modal transport model suite that includes a Highway Assignment Model, Public Transport Model, and Variable Demand Model.

1.1.6 It should be noted that the reliability of the forecast results is dependent on the performance of the Base Year model, and that there are currently areas identified as not meeting WebTAG performance criteria. The performance of the model relative to WebTAG guidelines was set out in a presentation to Hertfordshire on 9th March 2017. No Local Model Validation Report was prepared for the version of the Base Model used for this forecast.

1.2 Highway Network Results

1.2.1 In terms of highway trips originating in Hertfordshire, an increase of approximately 19% (at a 24 hour level) is forecast between 2014 and 2031. This increase is accompanied by a rise in travel distance of between 19% - 27% (depending on time period), but an increase travel time of up to 39% (AM Peak). The relatively sharp rise in travel time compared to travel distance is indicative of increasing congestion, and corroborates the fall in average network speed of approximately 13% in the AM Peak.

Vehicle Flows and Congestion

1.2.2 Model results show significant congestion on key urban and inter-urban roads in 2031 – see figures in section 7.3 for further details:

- Modelling shows the highest levels of congestion in the urban areas of Watford, St Albans, Hemel Hempstead, Hatfield, Hertford and Broxbourne towns.
- Modelling also shows congestion (although to a lower level) in the urban areas of Welwyn Garden City, Stevenage, Hitchin, Letchworth Garden City, Baldock and Bishop's Stortford.
- A414 through Hemel Hempstead and between the M1 and A10.
- Various sections of the M25, A1(M) and M1
- A120 around Bishop's Stortford
- A505 near Letchworth Garden City and around Royston
- A602 near Ware

1.2.3 Figure 1.1 to Figure 1.3 provide a selection of forecast highway model results. Note that "BY" refers to "Base Year", whilst "FY Run 3" refers to the "Forecast Run 3" (i.e. the current forecast).

Figure 1.1: Flow Difference on Key Corridors (2031 AM Peak minus 2014 AM Peak)

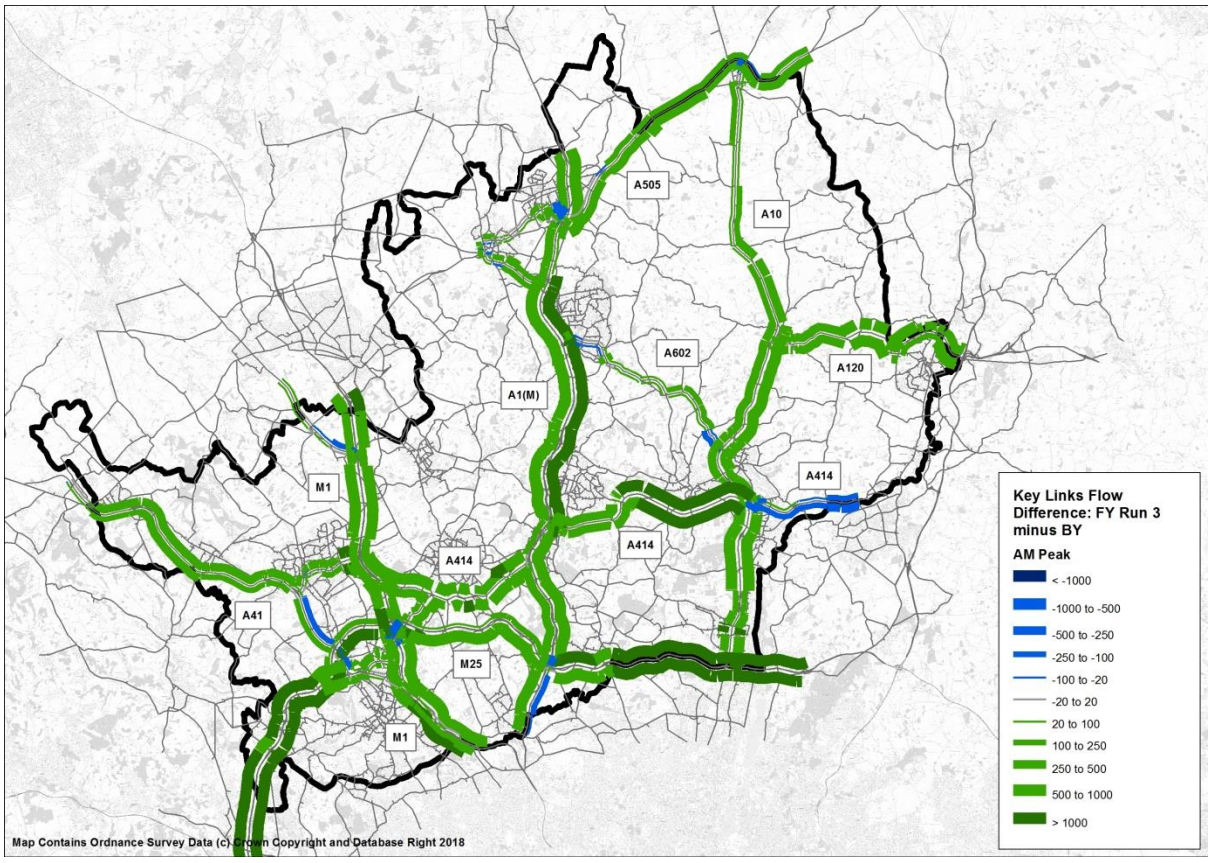


Figure 1.2: Volume over Capacity on Key Links (2031 AM Peak)

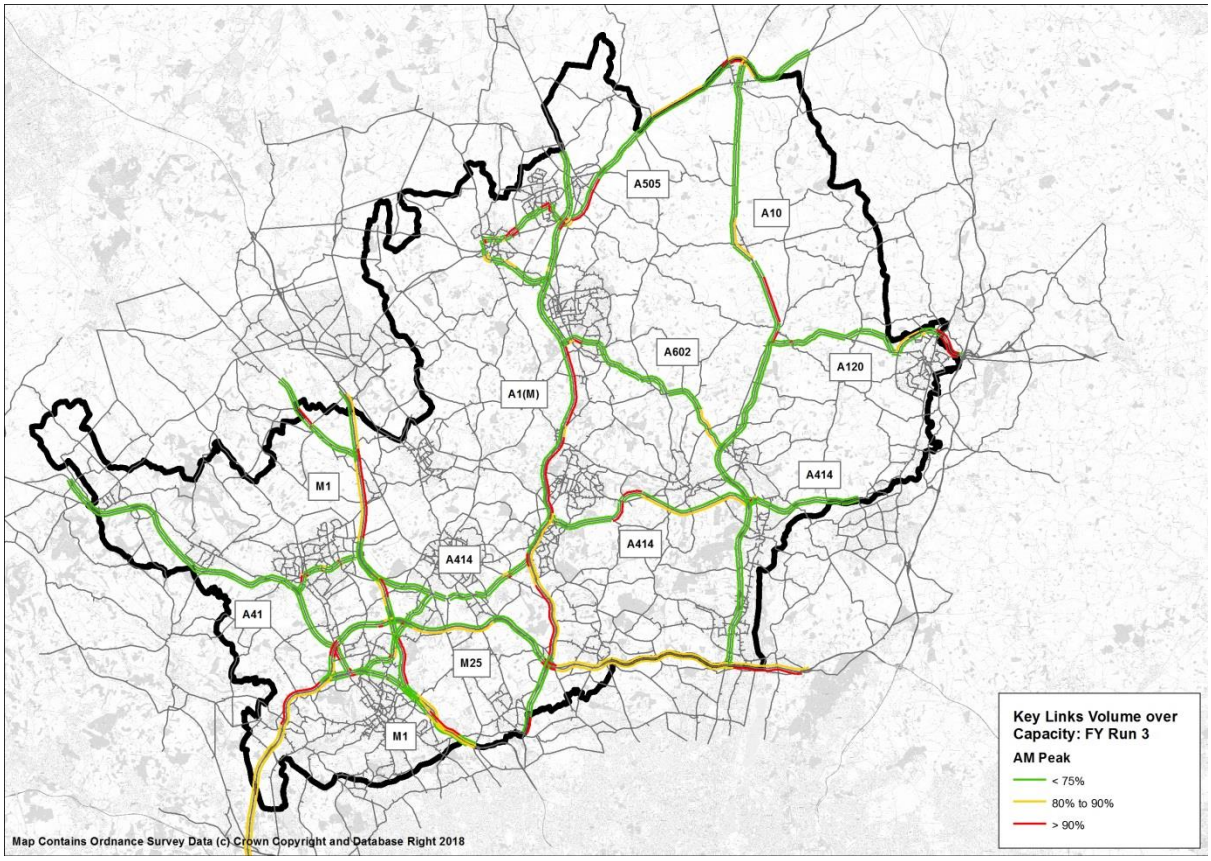
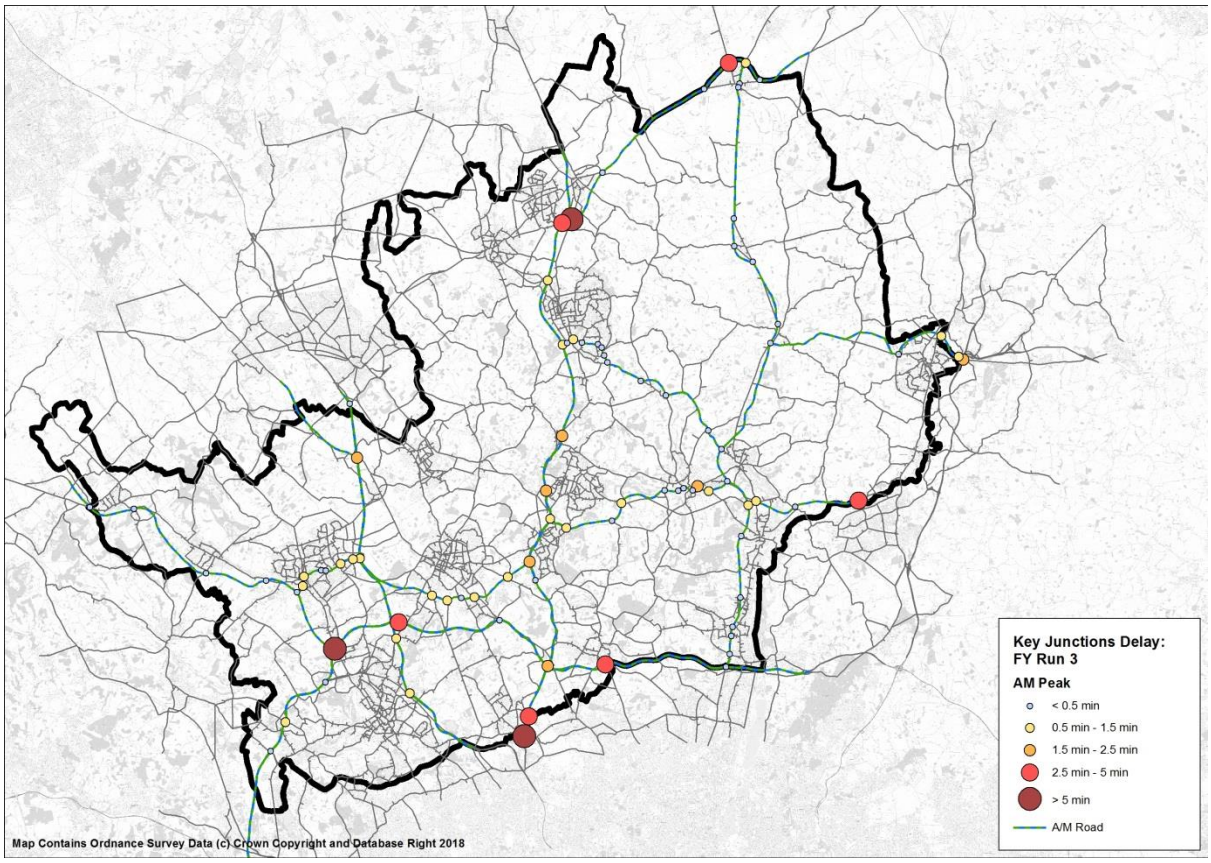


Figure 1.3: Delay at Key Junctions (2031 AM Peak)



Inter-urban Highway Journey Times

1.2.4 Increased vehicle flow and congestion in the Forecast Year cause a rise in the average journey time between urban areas in Hertfordshire. Changes in journey times between a sample of towns in the county are illustrated below (a full set is provided in *Appendix I: Inter-urban Journey Times*). This sample reflects towns where increases in journey times are likely to be most significant.

1.2.5 It should be noted that the diagrams show journey times for the "average route"; therefore, some journeys will be considerably slower than the indicated values.

Figure 1.4: Changes in Journey Times from Hemel Hempstead (AM Peak)

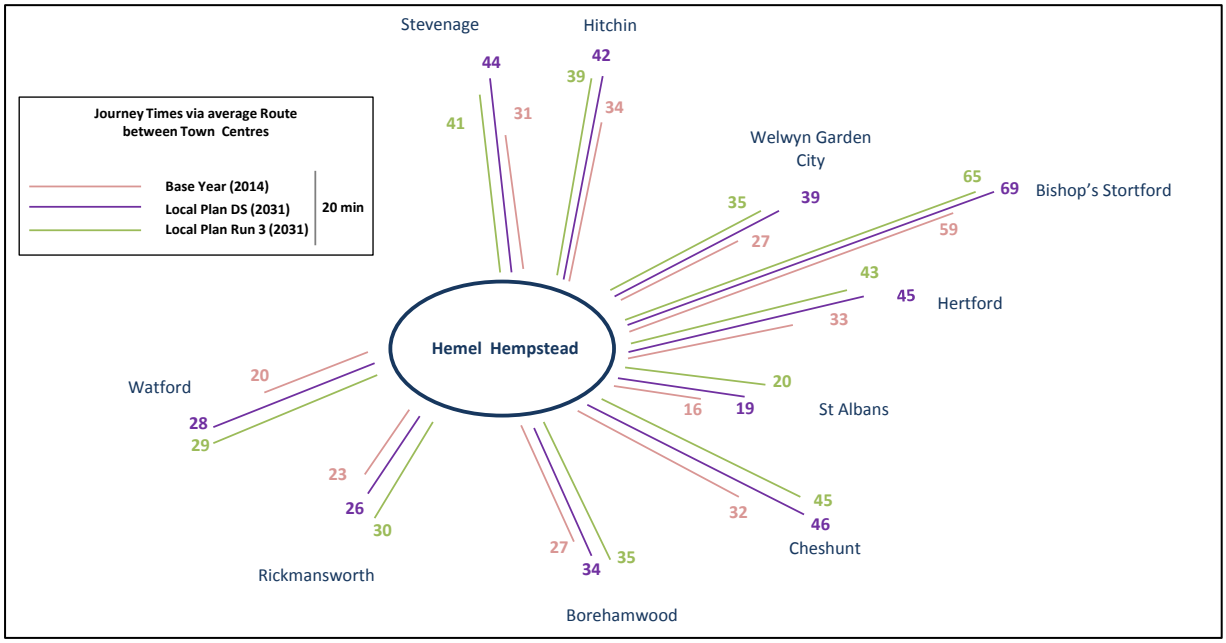


Figure 1.5: Changes in Journey Times from Watford (PM Peak)

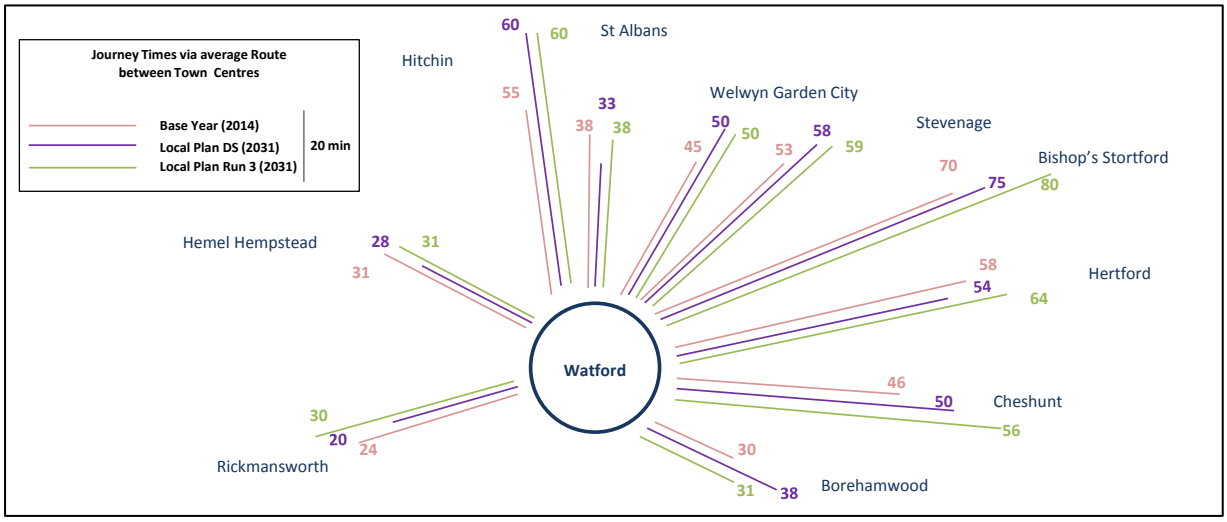


Figure 1.6: Changes in Journey Times from Welwyn Garden City (PM Peak)

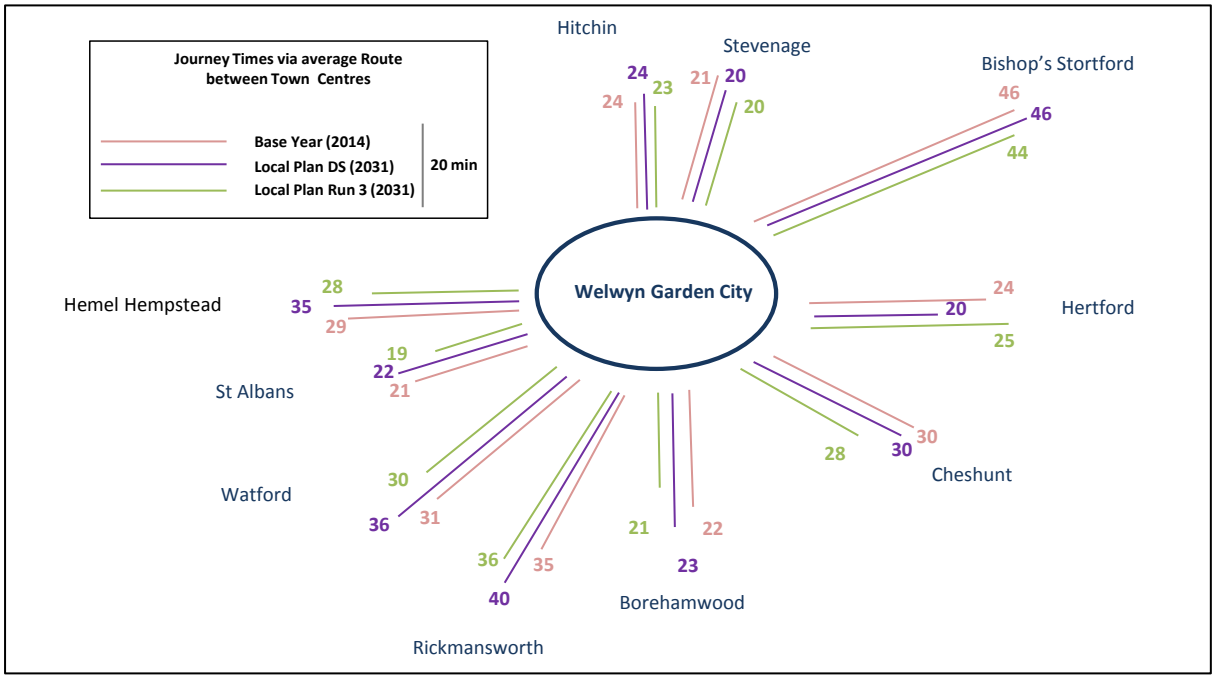
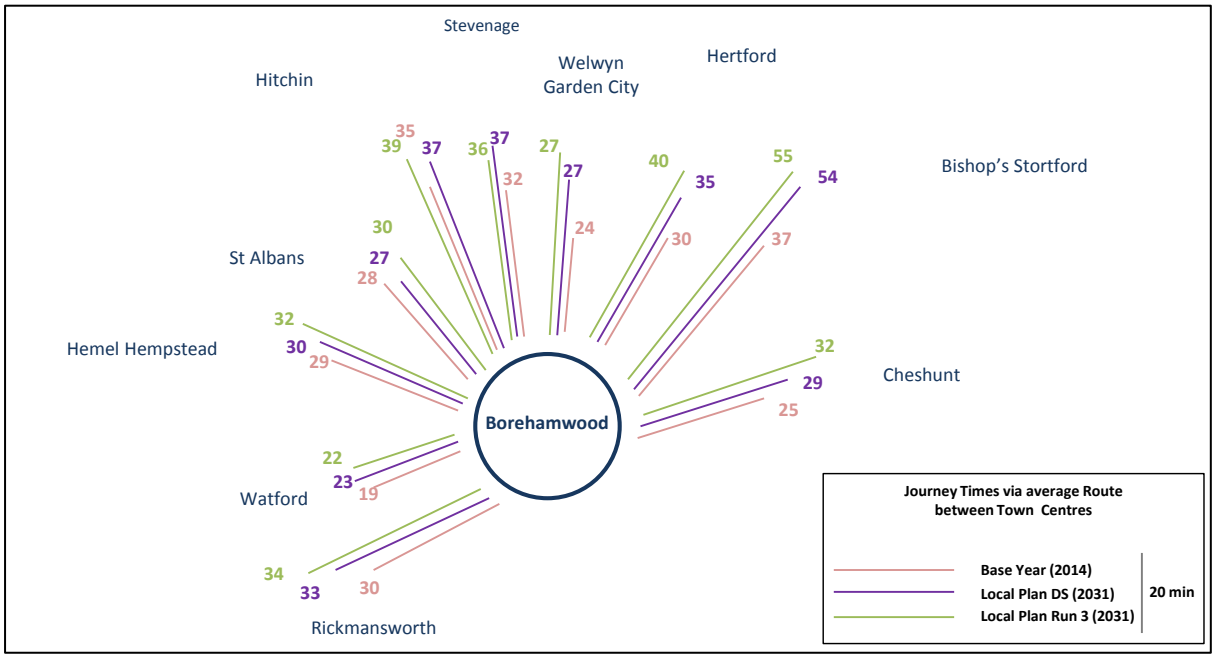


Figure 1.7: Changes in Journey Times from Borehamwood (PM Peak)



1.3 Public Transport Network Results

1.3.1 Forecast results also indicate that the rail network in Hertfordshire will experience an increase in passenger usage by approximately 25% in the AM and PM Peaks between 2014 and 2031. Bus travel, by comparison is likely to remain stable or decline (~-15%) as a result of rising personal incomes that make rail's higher fares relatively more affordable.

2. Introduction

2.1 Background

2.1.1 The development of the COMET model suite was commissioned by Hertfordshire County Council (HCC) in February 2015 in order to provide a structured evidence base for assessing transport policies and strategies on a consistent basis across the county. COMET is a multi-modal model with variable demand modelling capability.

2.1.2 Following the work to date on developing the COMET Base Year (2014) model, HCC has commissioned AECOM to produce a 2031 forecast including the Local Plan aspirations (all employment and dwelling growth, regardless of certainty) of the 10 Hertfordshire districts as well as the growth aspirations in the following neighbouring areas: Luton, Buckinghamshire (all districts), part of Essex (i.e. Epping Forest, Harlow, and Uttlesford), and part of Cambridgeshire (i.e. South Cambs and Cambridge)[2].

2.1.3 The scenario also includes the proposed transport schemes agreed with Hertfordshire districts in Autumn 2017, and aligns with the Infrastructure Delivery Plans and Transport Strategies at that time.

2.1.4 The forecast is a reflection of the total cumulative growth within the county rather than a test of any specific (set of) developments and/or schemes.

2.2 Purpose of this Document

2.2.1 This document presents the steps taken to produce the forecast scenario and a summary of high level results across Hertfordshire's highway and public transport networks.

[2] For the rest of Great Britain, the growth in employment and population in the COMET forecast is based on NTEM 7.2 projections.

2.3 Previous Local Plan COMET Forecasting

2.3.1 Table 2.1 presents a summary of the previously prepared Local Plan forecasts prepared in COMET for HCC.

Table 2.1: Previous Local Plan COMET Forecasting

Base Year Version	Local Model Development and Validation Report	Summary of COMET Base Year Version	Relevant Previous 2031 Forecast Scenarios
COMET v1	May 2016 (v1)	Initial version of COMET	Hertfordshire COMET: **Local Plan** Forecasting Report: June 2016
COMET v2	November 2016 (v2)	Version of COMET based on v1 enhanced in the Watford area: Refinements to the highway matrix build process New intra-urban highway screenlines/cordons Additional highway data collection Enhancement of network detail in the town New bus passenger cordon around Watford Additional bus passenger data collection	Hertfordshire COMET: **Local Plan Do Minimum** Forecasting Report: January 2017 **Local Plan Do Something** Scenario – developed in early 2017. Outputs presented to HCC in February 2017, however, no forecasting report was produced.
COMET v3	No LMVR produced	Version of COMET based on v2 enhanced in St Albans district: New intra-urban highway screenlines/cordons Additional highway data collection Enhancement of highway network detail in the town, including coding of speeds on urban links in St Albans and Harpenden. New bus passenger cordon around St Albans Additional bus passenger data collection in St Albans and Harpenden	**St Albans Local Plan Do Minimum** scenario. Outputs presented to HCC in June 2017, however, no forecasting report was produced. **Current forecast** documented in this report – referred to as Local Plan Run 3 and FY Run 3.

2.4 Report Structure

2.4.1 This report covers the following areas:

- Forecast Approach
- Forecast Network Development
- Forecast Trip Matrix Development
- Forecast Assignments
- Highway Forecast Results
- Public Transport Forecast Results
- Summary and Discussion

3. Forecast Approach

3.1 Forecast Objectives

3.1.1 The objective of this forecasting exercise is to understand the cumulative effect of all Local Plan growth in Hertfordshire, whilst also considering the impact of growth in selected neighbouring authorities (see Table 1.1).

3.1.2 This document does not draw any conclusions on any particular development or scheme regarding its effect on the local or wider transport network, nor does it present a comparison of the modelled forecast relative to any other forecast with alternative assumptions.

3.1.3 This forecast takes into consideration changes between 2014 and 2031 including increases in population, number of jobs and dwellings, rising costs of travel, and proposed transport infrastructure schemes. However, there is currently no allowance for factors that may fundamentally alter the nature of travel in Hertfordshire or elsewhere in Great Britain. These factors may include the introduction of new technologies (e.g. autonomous vehicles) or a significant shift in travel patterns relative to the Base Year model as a result of behavioural change.

3.2 Model Years

3.2.1 The forecast year has been defined by HCC as 2031. This year was chosen as it the end point of the majority of Hertfordshire districts' Local Plans, and is therefore the furthest year into the future for which reasonable planning data projections are available. No other forecasts with alternative model years have been created.

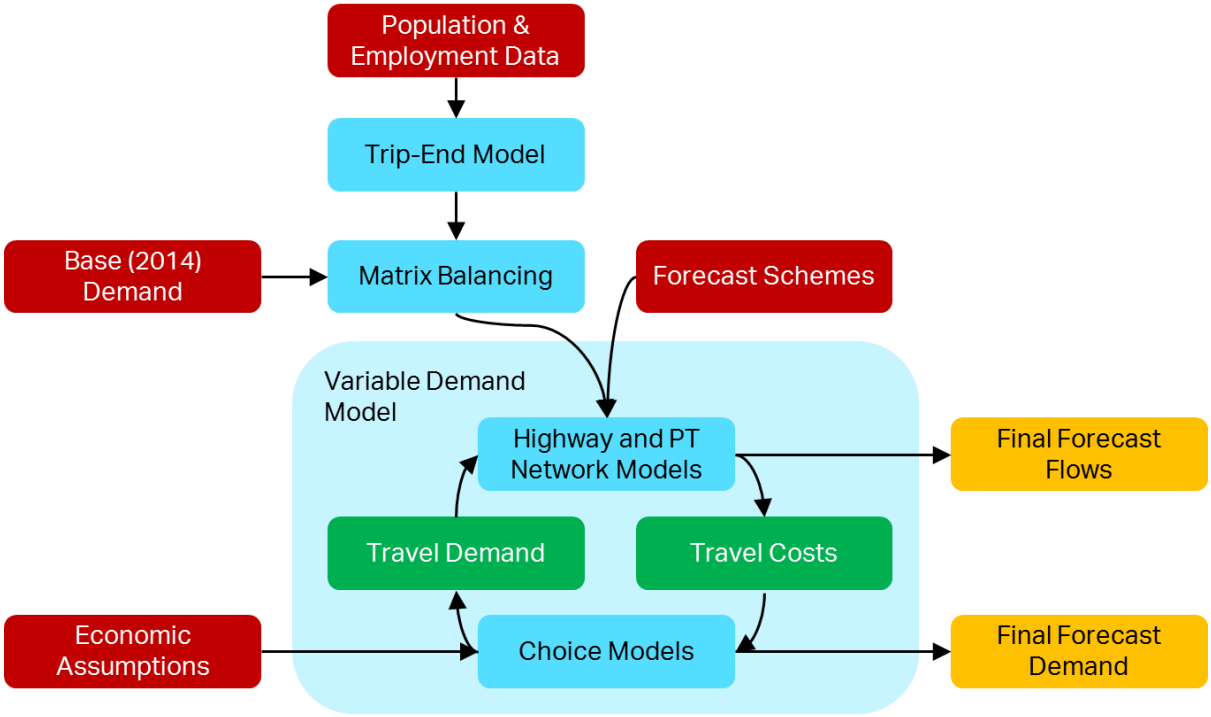
3.3 Treatment of Variable Demand

3.3.1 COMET includes a variable demand model which has been used in the preparation of forecast scenarios. The variable demand model is designed to estimate the effect of changes in transport infrastructure and travel cost upon patterns of demand. This considers changes in overall travel movements which is separate to modelling the way in which travellers respond to changes by choosing different routes (which is forecast by the highway and public transport assignment models). Further details of the treatment of variable demand can be found in chapter 5.

3.4 Model Structure

3.4.1 COMET is a multi-modal model with a Highway Assignment Model developed in SATURN, a Public Transport Model in Emme and Variable Demand Model in Emme. The structure of the forecasting process, including the interaction between the demand models and assignment models is shown in Figure 3.1.

Figure 3.1: Model Structure



4. Forecast Network Development

4.1 Public Transport Network

Forecast Public Transport Schemes

4.1.1 The new public transport schemes and services in Hertfordshire added during the creation of the forecast network are shown in Table 4.1 and Table 4.2.

Table 4.1: Modelled Public Transport Schemes in Hertfordshire

Scheme	District
Public transport enhancements identified through the Broxbourne Transport Strategy (see *FINAL Broxbourne Transport Strategy 2017-08-10.pdf – August 2017*) for further details.	Broxbourne
New rail stations at Park Plaza and Turnford	Broxbourne
Bus service enhancements in Maylands	Dacorum
Bus service between Gilston and Harlow town centre	East Hertfordshire/Harlow
North and East of Ware bus service	East Hertfordshire
Hertford East to/from Liverpool St (frequency increase)	East Hertfordshire/Broxbourne
Bus frequency improvements Hitchin - Letchworth	North Hertfordshire
Bus frequency improvements Hitchin - Luton	North Hertfordshire
Bus frequency improvements Letchworth - Stevenage	North Hertfordshire
SC1 Abbey Line shuttle bus service	St Albans
Abbey Line frequency increase (service every 30 minutes)	Watford/St Albans
Thameslink/Great Northern (timetable changes)	Various

Table 4.2: Modelled Public Transport Schemes outside Hertfordshire

Scheme	District
East West Rail	Various
Light Rail scheme linking Luton Airport Parkway station to Luton airport	Luton

Bus Services

4.1.2 It is acknowledged that our ability to predict changes in the bus network over a 10-20 year period is very limited. As bus routes tend to change on a commercial basis, it is generally not possible to make specific forecasts about details of bus routes over the next 10-20 years. Accordingly, the model assumes no changes from the model Base Year other than the schemes identified in Table 4.1.

4.2 Highway Network

4.2.1 The forecast highway network has been coded using the $INCLUDE file facility in SATURN, which allows for greater flexibility in coding and developing the supply network. The facility makes it simpler to update scheme files in the future year, providing greater capability for the model in assessing different infrastructure and development options that may have associated network improvements.

Forecast Highway Schemes

4.2.2 The forecast highway network schemes included in the forecasts are shown in Table 4.3 (Hertfordshire) and Table 4.4 (outside Hertfordshire).

4.2.3 The proposed transport schemes were agreed with districts in Autumn 2017, and align with the Infrastructure Delivery Plans and Transport Strategies at that time. A selection of the SATURN network diagrams associated with these schemes have been included for reference in *Appendix II: Forecast Highway Network Schemes*.

Table 4.3: Modelled Highway Schemes in Hertfordshire

Scheme	District
A10 / Lieutenant Ellis Way – Hamburger roundabout	Broxbourne
Park Plaza Access – 4 arm junction on A10	Broxbourne
Park Plaza Access – 3 arm junction on Lieutenant Ellis Way	Broxbourne
A10 / College Road – junction improvements	Broxbourne
A10 / Church Lane – turn bans	Broxbourne
Turnford Link Road (linking Brookfield Area and A10 Turnford interchange)	Broxbourne
Hells Wood Link Road (located between Turnford Link Road and A10)	Broxbourne
A10 Turnford Interchange (improvements to allow access to proposed Brookfield development site)	Broxbourne
Church Lane/High Street – signalisation	Broxbourne
Church Lane/Flamstead End Road – signalisation	Broxbourne
Fishpools junction – signalisation	Broxbourne
Goffs Lane/ Newgatestreet Road/Cuffley Hill – signalisation	Broxbourne
Dinant Link /A1170 Amwell Street – roundabout improvements	Broxbourne
Marriott Roundabout (Halfhide Lane/A1170) – additional capacity	Broxbourne
Hertford Road / Ware Road – roundabout improvements	Broxbourne
Old A10 (A1170 Ware Road / Charlton Way/ High Road/ B176 Cheshunt Wash / High Street / Turners Hill/ Crossbrook Street) – traffic calming	Broxbourne
M25 junction 25 RIS 2 capacity improvements - Option 2	Broxbourne
West Hoddesdon (High Leigh) development access onto A10 link	Broxbourne
Bedmond Road / Leverstock – junction improvements	Dacorum
Leighton Buzzard Road / Combe Street - signalisation	Dacorum
Shootersway/Kingshill Way – junction improvements	Dacorum
Berkhampstead Traffic Calming	Dacorum
LA5 (Tring) development access onto Icknield Way	Dacorum

Scheme	District
St john Buzzard Road / Queensway roundabout – partial signalisation and addition of separate left turn lane from Leighton Buzzard Rd north	Dacorum
Redbourn Road / Shenley Road roundabout – removal of flare on eastern arm	Dacorum
Station Road / St Johns Road junction – conversion to mini-roundabout	Dacorum
London Road / Red Lion Lane – signal optimisation	Dacorum
Fishery Road / Northridge Way – signalisation	Dacorum
Maylands Avenue / Wood Lane End – signal optimisation	Dacorum
Two Waters Road / London Road – signal optimisation	Dacorum
Fishery Road / London Road – signalisation	Dacorum
Leighton Buzzard Road / St Albans Road (Plough r/bout) – signal optimisation	Dacorum
A414 / Green Lane – junction signalisation	Dacorum
HGV restrictions on B487 & A5183	Dacorum
Shooters Way / Kingshill junction – signalisation	Dacorum
Swallowdale Lane/ Three Cherry Trees Lane Junction Signalisation	Dacorum
Western Hemel Hempstead – Development site access onto Long Chaulden (priority junction with dedicated RT lane in)	Dacorum
Western Hemel Hempstead – Development site Secondary site access onto The Avenue (extension of existing spur)	Dacorum
New roundabout access onto A4147 Link Road (Location between Piccotts End Road and Aycliffe Drive) – Marchmont Farm Access	Dacorum
Water End HGV ban	Dacorum
M1 Junction 8 – reconfigurarion of junction – see Figure 10.31	Dacorum
Maylands Area reconfiguration – see Figure 10.32	Dacorum
A10 south of Buntingford – dualling of southbound carriageway	East Hertfordshire
A10 / London Road (Buntingford) – junction capacity improvements	East Hertfordshire
A414 through Hertford – conversion of 1 lane in each direction to bus-only	East Hertfordshire
Old Cross junction, Hertford – signal optimisation	East Hertfordshire
A1184 / West Road/Station Rd junction – signalisation	East Hertfordshire
A1184 / High Wych Road junction – signalisation	East Hertfordshire
Rush Green Roundabout improvements (addition of flare on southbound A10 offlslip)	East Hertfordshire
A414/B195 Birchall Lane/Cole Green Lane – roundabout improvements	East Hertfordshire
A1(M) Junction 3 – signal optimisation	East Hertfordshire
A1(M) Junction 4 – short term capacity improvments	East Hertfordshire
Second River Stort crossing	East Hertfordshire
A414 Hertford Bypass – southern alignment (tying into A10 near Great Amwell)	East Hertfordshire
Widening of Fifth Avenue over River Stort	East Hertfordshire
Bishop’s Stortford south development accesses	East Hertfordshire
Goods Yard Link – Bishops Stortford	East Hertfordshire

Scheme	District
Amwell Roundabout capacity upgrade / signalisation	East Hertfordshire
Gresley Way/A602 Roundabout Upgrades	East Hertfordshire
A120 Little Hadham Bypass	East Hertfordshire
A602 Ware to Stevenage Corridor Strategy Stage 1	East Hertfordshire
Bishop's Stortford North Development, Access onto Hadham Road	East Hertfordshire
Bishop's Stortford North Development, new access onto A120 and Spine Road connecting with Rye Street	East Hertfordshire
A120 / B1383 capacity improvements (Bishop's Stortford North mitigation measure)	East Hertfordshire
A120 / A1250 Tesco roundabout capacity improvements (Bishop's Stortford North mitigation measure)	East Hertfordshire
Gilston development access	East Hertfordshire
Land North and East of Ware Spine Road	East Hertfordshire
M25 J18-25 – smart motorway (implemented)	Hertsmere
Stirling Corner – signal improvements	Hertsmere
Borehamwood - Station Road/Theobald St/Allum Lane junction signalisation	Hertsmere
Borehamwood - Elstree Way Corridor	Hertsmere
A1(M) junction 6 - 8 Smart motorway	North Hertfordshire
New link road connecting North Baldock development to North Road and Royston Road	North Hertfordshire
Woolgrove Road/ Cambridge Rd/ Willian Road Hitchin - signalisation	North Hertfordshire
Pirton Road / A505 / Upper Tilehouse St/ Wratten Rd, Hitchin – signalisation	North Hertfordshire
Upper tilehouse St / A602/ Paynes Park, Hitchin – signalisation	North Hertfordshire
A602 / B656 / Gosmore Rd/ St John's Road, Hitchin – junction improvements and signalisation	North Hertfordshire
Bancroft / Hermitage Road – signal optimisation	North Hertfordshire
Queen Street / Hermitage Road – signal optimsation	North Hertfordshire
A1 (M) J9 Letchworth Gate / A505 Letchworth – roundabout signalisation	North Hertfordshire
A1(M) J8 / A602 Letchworth – roundabout signalisation	North Hertfordshire
Station Road / Royston Rd/Clothall Rd, Baldock – signal optimisation	North Hertfordshire
Southern link road broadly from junction of A507 Clothall Road / Wallington Road / South Road to B656 Royston Road	North Hertfordshire
A505 / Norton Way – signal optimisation	North Hertfordshire
B197 Gravely Rd / North road – conversion to roundabout	North Hertfordshire
20mph zones in Hitchin	North Hertfordshire
20mph zones in Letchworth	North Hertfordshire
20mph zones in Royston	North Hertfordshire
A505 / A1198 Roundabout Royston – junction improvements	North Hertfordshire
A10/Newmarket Road / Melbourn Street Roundabout – junction improvements	North Hertfordshire

Scheme	District
Willian Road, Arch Road, Hitchin Road & Graveley Road, Great Wymondley – 20mph area	North Hertfordshire
Stevenage Road & Priory Lane – Little Wymondley – 20mph area	North Hertfordshire
B197 High Street, Graveley – 20mph area	North Hertfordshire
B656 High Street, Bury Lane, Heath Lane and St Albans Road – Codicote – 20mph area	North Hertfordshire
B197 Stevenage Road, London Road, Watton Road, Station Road & Gun Road, Knebworth – 20mph area	North Hertfordshire
Stevenage Road & Fishers Green Road, Todd's Green – 20mph area	North Hertfordshire
New left in left out access from York Way onto A505	North Hertfordshire
Northwest Harpenden development access	St Albans
A1081 Luton Rd / Station Road – junction improvements	St Albans
A1081 Luton Road / The Common – junction improvements	St Albans
Oaklands development site access – see Figure 10.30	St Albans
Sandpit Lane / House Lane enlargement of existing roundabout	St Albans
Sandpit Lane / Marshalswick Lane – widening and right turn	St Albans
Sandpit Lane / Coopers Green Lane – roundabout enlargement	St Albans
A414 / A1081 – London Colney Roundabout – conversion to Hamburger layout	St Albans
A5183 Redbourn Road/A4147 Bluehouse Hill/Batchwood Drive Roundabout – junction improvements	St Albans
B653 Cory Wright Way/Marford Road, Wheathampstead – junction improvement	St Albans
A4147 Hemel Hempstead Road/King Harry Road – junction improvements	St Albans
A1081 Luton Road/ Park Hill Junction – signal optimisation	St Albans
Hatfield Road/Station Road, Smallford Roundabout – junction improvements	St Albans
A414 Colney Heath Longabout signalisation	St Albans
Radlett Railfreight (spine road and associated junction improvements)	St Albans
A1(M) Junction 7 off slip widening	Stevenage
A1(M) Junction 8 off slip widening	Stevenage
Bragbury end development access onto A602 (south of Chequers pub)	Stevenage
A602 Corridor (Phase 1) A602 / Hertford Road signalisation	Stevenage
Lytton Way – bus only scheme	Stevenage
Hertford Road Speed reduction measures & bus gate	Stevenage
A404/A412 – junction improvements	Three Rivers
M25 spur approach to Hunton Bridge roundabout – widening approach/circulation or signalisation (Hunton Bridge)	Three Rivers
Grove Mill Lane / Hempstead Rd – flare on Grove Mill Lane	Three Rivers
Woodside Road Roundabout – new development access	Three Rivers
Uxbridge Road/Long Ln – new roundabout	Three Rivers

Scheme	District
Watford 20mph zone	Watford
Watford Health Campus Link (Thomas Sawyer Way)	Watford
Hospital access road (Willow Lane)	Watford
A1(M) junction 6 including Clock roundabout improvements	Welwyn Hatfield
Mundells Gyratory improvements	Welwyn Hatfield
A414 section between Mill Green & Tesco – signalisation and addition of segregated left turn lane	Welwyn Hatfield
Jack Oldings Roundabout – junction improvements	Welwyn Hatfield
A1(M) Junction 4 Satellite junction – increase in the number of lanes on bridge between dumbells	Welwyn Hatfield
A1(M) Junction 3 – signal optimisation	Welwyn Hatfield
Stanborough roundabout – junction improvements	Welwyn Hatfield
A414/A1000 – junction improvements	Welwyn Hatfield
A414/Holwell Lane Roundabout – additional of development access arm and flare on Holwell Ln approach	Welwyn Hatfield
Comet Way/Wellfield Way roundabout – junction improvements	Welwyn Hatfield
Coopers Green Lane/Green Lanes Roundabout – junction improvements	Welwyn Hatfield
Ellenbrook Lane/St Albans Road Roundabout – signalisation	Welwyn Hatfield
A1000 and South Way over-pass – southbound on-slip extension	Welwyn Hatfield
A1000 Chequers/ Broadwater Road – junction improvements	Welwyn Hatfield
Red Lion Junction A1000 Great North Road / B6426 St Albans Road East – signal optimisation	Welwyn Hatfield
A1000/Swanley Bar Lane – junction widening	Welwyn Hatfield
Plough Hill / Station Road Cuffley – priority changes	Welwyn Hatfield
A1000/Hawshead Road – localised widening	Welwyn Hatfield
Broadwater Road/Bridge Road – conversion to octobout form	Welwyn Hatfield
A1000 / Shepherds Way – signal optimisation	Welwyn Hatfield
A1000 / Dixons Hill Road – widening and addition of new arm	Welwyn Hatfield
West of Hatfield (Stanborough - HAT1) development access	Welwyn Hatfield
Symondshyde development access	Welwyn Hatfield
Birchall development access	Welwyn Hatfield
A1(M) junction 6 - 8 Smart motorway	Welwyn Hatfield / Stevenage / North Hertfordshire

Table 4.4: Modelled Highway Schemes outside Hertfordshire

Scheme	Area
A5 – M1 Link	Central Bedfordshire
M1 – A6 Link	Central Bedfordshire
M11 J7 short term capacity improvements	Harlow (Essex)
M11 J8 short term capacity improvements	Uttlesford (Essex)
M25 J23-25 Permanent use of Hard Shoulder	Hertfordshire / London Borough of Enfield
Widening of M25 J25-27	Essex / London Borough of Enfield
M25 Junction 25 Enhancement (Highways England RIS scheme)	London Borough of Enfield
M11 Junction 7 improvements	Harlow (Essex)
A414 / London Road Enterprise Zone New Access & Link Road	Harlow (Essex)
A414 / A1025 (Clocktower) Junction Capacity Upgrade	Harlow (Essex)
A414 First Avenue / Gilden Way Junction Upgrade	Harlow (Essex)
A414 Cambridge Road (Gates) Upgrade - including widening to 4 lanes of Edinburgh Way;	Harlow (Essex)
A414 Edinburgh Way / East Road Signal Junction Improvement	Harlow (Essex)
Cambridge Road - new access into River Way	Harlow (Essex)
M11 Junction 7 short term capacity improvements	Epping Forest (Essex)
New junction on M11 (J7a) with associated link to & roundabout on B183 Gilden Way; localised widening of Gilden Way	Epping Forest (Essex)
A1 Biggleswade Junction improvements – capacity improvements and dedicated left turn	Biggleswade (Central Bedfordshire)
Luton Town Centre Bypass	Luton
Luton London Road Grade Separated Junction	Luton

Additional Adjustments

Highway Buffer Speed

4.2.4 The speed of the forecast buffer network has been reduced relative to the Base Year to in order to simulate the effect of rising congestion outside the simulation area. This speed reduction is based on Scenario 1 of the 2015 Road Traffic Forecasts for England, and has been increased three-fold to achieve the expected forecast traffic growth in the buffer network. This approach was applied homogenously across the buffer network and represents a preference for correct representation of flows over speed.

Modal Shift

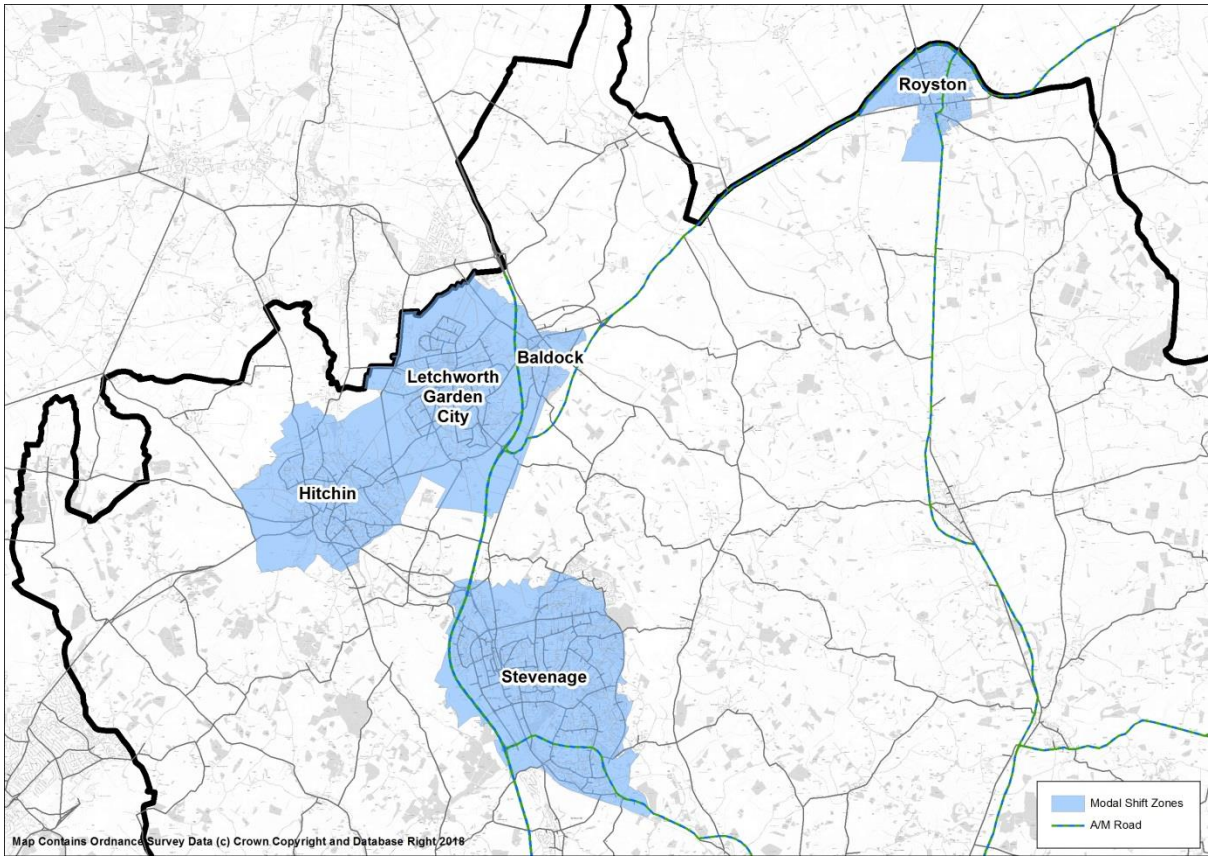
4.2.5 In addition to the schemes listed in Table 4.1 to Table 4.4, HCC requested that the forecast scenario should include an element of modal shift (from highway to other modes) in selected areas in order to represent districts' proposals to encourage sustainable travel. The areas where this modal shift has been simulated are as follows (also illustrated in Figure 4.1):

- Hitchin
- Letchworth Garden City
- Baldock
- Royston
- Stevenage

4.2.6 The modal shift in the forecast scenario has been achieved by applying a factor (in COMET's Variable Demand Model) to the cost of highway trips originating in the selected zones. By raising the cost of undertaking a journey by car, this factor encourages trips to be made by alternative means (i.e. public transport or sustainable travel). The level of modal shift specified by HCC and achieved for these zones is approximately 5%.

4.2.7 It should be noted that this is not a recommended approach to modelling modal shift in a multi-modal model (such as COMET) as no infrastructure to facilitate such behaviour change has been included in the forecast year network. This modelled modal shift is therefore not a result of COMET's Variable Demand Model representing behavioural change; rather, it is the result of a parameter adjustments that are currently not based on any specific interventions to the transport network. Once more specific scheme assumptions regarding the proposed sustainable travel initiatives are known, these should be coded into COMET as other forecast schemes already are.

Figure 4.1: Modal Shift Zones



Watford and Stevenage Developments – Car Parking Assumptions

4.2.8 There are several proposed residential developments in Watford and Stevenage that have been represented with lower levels of car ownership compared to the standard forecast assumptions. This has been implemented in response to developer plans to provide a lower level of car parking at these locations. The sites where this adjustment has been implemented are as follows:

- Heath Campus, Watford – 470 dwellings
- Ascot Road (Western Gateway), Watford – 1,000 dwellings
- Watford Junction, Watford – 2,777 dwellings
- North of Stevenage – 800 dwellings
- Stevenage West – 1,350 dwellings
- South East of Stevenage 1 + South East of Stevenage 2 – 550 dwellings
- Combined town centre sites, Stevenage – 2,000 dwellings

4.2.9 The lower level of car ownership has been simulated by shifting 20% of residents in new developments from a “car-owning” category to a “non car-owning” category. This change is made in the IXICarOwn table (this is one of several inputs to the COMET TripEnd model).

Signalised Junctions and Network Checking

4.2.10 Signalised junctions associated with transport schemes have been checked to compare the levels of delay with the base year model. Signal timings have been optimized in cases where significant delays were forecast.

4.2.11 Furthermore, a check has been made of the forecast highway assignment to ensure that the implementation of the schemes has not led to implausible levels of delay, or any unrealistic re-routeing of traffic.

5. Forecast Trip Matrix Development

5.1 Overview

5.1.1 The forecast trip matrix is an estimation of future trips in COMET based on the available planning data (i.e. for Hertfordshire and selected neighbouring authorities – see Table 1.1) and growth assumptions for the rest of Great Britain (NTEM v7.2).

5.1.2 The COMET Trip End model is used to forecast future trip ends (total productions and attractions for each model zone). These trip ends are used to build a reference matrix for the forecast year (2031). This reference matrix is then adjusted based on the forecast Highway and Public Transport assignments through the Variable Demand Model (VDM), which further adjusts demand to take into account changes in transport infrastructure, travel times and costs. The resulting matrices constitute the forecast trip matrices.

5.2 COMET Trip End Model

5.2.1 A Trip End model has been built specifically for COMET as part of the COMET Base Year (2014) development. The COMET Trip End model is based on version 7.2 of the National Trip-End Model (NTEM) and its associated CTripEnd software. As part of the COMET Trip End development, NTEM has been re-zoned for COMET zones, and demographic data has been uplifted to 2014 based on TEMPRO projections. NTEM v7.2 trip rates remain unchanged. NTEM v7.2 is available at 5 year intervals from 2011 to 2051.

5.2.2 NTEM uses its own zoning system (7,700 zones covering England and Scotland, based on 2011 Census MSOAs) which is inconsistent with the COMET zone system. As a preliminary step, the original NTEM zones are converted to COMET zones using aggregation or disaggregation as appropriate.

5.2.3 The COMET Trip End model takes in estimates of planning data (population, households and employment) for each COMET zone, and produces “trip ends”, that is, estimates of the number of trips produced by and attracted to each zone in an average weekday, by demand segment and by year.

5.2.4 The model has also been streamlined to enable the software to be run from a command prompt without user intervention, and to export results in Emme format for the variable demand model, but its functionality is otherwise unchanged.

5.2.5 There are three key data tables in the Trip End model:

- Car Ownership: population segmented by household types and children. Households are distinguished based on the number of adults and car availability;
- Employment: Total number of jobs and households. Employment is segmented by industry.
- Population: Population segmented by traveller types. These are defined as a combination of person type (age, gender and employment status) and household type.

5.2.6 Specifically, these tables are segmented in the following categories (See NTEM specification):

- Car Ownership (classification of Households by car ownership):
  - HHT1 persons in 1 adult households with no car
  - HHT2 persons in 1 adult households with one or more cars

  - HHT3 persons in 2 adult households with no car
  - HHT4 persons in 2 adult households with one car
  - HHT5 persons in 2 adult households with two or more cars
  - HHT6 persons in 3+ adult households with no car
  - HHT7 persons in 3+ adult households with one car
  - HHT8 persons in 3+ adult households with two or more cars
  - S1 Children (0 to 15), in 1 adult household with no car
  - S2 Children (0 to 15),in 1 adult household with one or more cars
  - S3 Children (0 to 15), in 2 adult household with no car
  - S4 Children (0 to 15), in 2 adult household with one car
  - S5 Children (0 to 15), in 2 adult household with two or more cars
  - S6 Children (0 to 15), in 3+ adult household with no car
  - S7 Children (0 to 15), in 3+ adult household with one car
  - S8 Children (0 to 15), in 3+ adult household with two or more cars
- Employment:
  - E01 All Jobs
  - E02 Households
  - E03 Primary & Secondary schools
  - E04 Higher Education
  - E05 Adult education
  - E06 Hotels, camp sites etc
  - E07 Retail trade
  - E08 Health / Medical
  - E09 Services (business, other, postal/courier) & equipment rental
  - E10 Industry, construction and transport
  - E11 Restaurants and bars
  - E12 Recreation and sport
  - E13 Agriculture and fishing
  - E14 Business
  - E15 Holiday accommodation and second residences
- Population:
  - PT01 Children (0 to 15)
  - PT02 males in full time employment (16 to 64)
  - PT03 males in part time employment (16 to 64)
  - PT04 male students (16 to 64)
  - PT05 male not employed / students (16 to 64) - Unemployed plus other Inactive
  - PT06 male 65+
  - PT07 females in full time employment (16 to 64)
  - PT08 females in part time employment (16 to 64)
  - PT09 female students (16 to 64)

- PT10 female not employed / students (16 to 64) - Unemployed plus other Inactive
- PT11 female 65+
- HHT1 persons in 1 adult households with no car
- HHT2 persons in 1 adult households with one or more cars
- HHT3 persons in 2 adult households with no car
- HHT4 persons in 2 adult households with one car
- HHT5 persons in 2 adult households with two or more cars
- HHT6 persons in 3+ adult households with no car
- HHT7 persons in 3+ adult households with one car
- HHT8 persons in 3+ adult households with two or more cars

5.2.7 COMET Trip End model outputs trip end estimates for the following demand segments:

- HBW Home-Based Work;
- HBEB Home-Based Employer's Business;
- HBO Home-Based Other;
- NHBEB Non-Home-Based Employer's Business;
- NHBO Non-Home-Based Other;
- LGV Light Goods Vehicles; and
- HGV Heavy Goods Vehicles.

COMET Trip End Model Forecast Update

5.2.8 The COMET Trip End model has been updated to 2031 as part of the COMET Forecast Year (2031) development.

5.2.9 Detailed planning data (provided from districts via HCC) is available in Hertfordshire and in selected adjoining areas (see Table 5.1 for a list of seleceted districts) has been implemented in the COMET forecast. NTEM v7.2 growth is used for the rest of the Great Britain. Growth assumptions can be found in the Forecast Planning Data section.

5.2.10 The COMET Trip End model forecast update is done by updating the three following tables (described in further detail above):

- Car Ownership (classification of Households by car ownership)
- Employment
- Population

5.2.11 HCC planning data provides estimates of dwellings and employment for the forecast year. In the absence of available population projections, it is derived by applying a population per dwelling assumption by NTEM zone from NTEM v7.2. These growth projections are split into the segments defined above for each table using NTEM original forecasts for each year.

5.2.12 In those areas outside Hertfordshire where no detailed planning data is available, NTEM v7.2 growth is used. Growth is calculated for each table, segment and zone and between NTEM 2014 (this year has been interpolated using 2011 and 2016 data) and the Forecast Year (2031). Since each segment is taken into consideration separately, the process accounts for ageing trend in UK demography just as NTEM does.

5.2.13 For “model development zones” (see Figure 5.6), population and household segmentation have been applied based on the NTEM zone where it is located geographically. Employment data segmentation is based on the land use provided by HCC for each site.

5.2.14 NTEM v7.2 is based on the 2011 Census, the same as COMET’s Trip End Model. Growth between the forecast year and base year is applied to the Trip End model using the formula below:

$$IXI_{FY} = IXI_{BY} * \frac{IXI\_NTEM_{FY}}{IXI\_NTEM_{2014}}$$

5.2.15 For zones and demand segments with no data for NTEM v7.2 in 2014 (value of zero), absolute growth is used following the formula below:

$$IXI_{FY} = IXI_{BY} + (IXI\_NTEM_{FY} - IXI\_NTEM_{2014})$$

Where:

- IXIFY refers to each of the Car Ownership / Employment / Population tables mentioned above for the Forecast Year (2031) in the COMET Forecast Year Trip End model
- IXIBY refers to each of the Car Ownership / Employment / Population tables mentioned above for the Base Year (2014) in the COMET Base Year Trip End model
- IXI_NTEMFY refers to each of the Car Ownership / Employment / Population tables mentioned above for the Forecast Year (2031) in the original NTEM v7.2
- IXI_NTEMBY refers to each of the Car Ownership / Employment / Population tables mentioned above for the interpolated Year (2014) from the original NTEM v7.2

NTEM Interpolated 2014 Year

5.2.16 NTEM v7.2 does not explicitly include 2014, however, this year is needed for the calculations described above. The Car Ownership / Employment / Population tables mentioned above have been estimated for 2014 by interpolating the same tables from NTEM between 2011 and 2016 years.

Additional Note on Conversions and Demolitions

5.2.17 The employment projections received from HCC contain a number of planned conversions to residential or other uses/demolitions, which involve the change or loss of certain types of employment land in some zones.

5.2.18 In most zones, the conversions/demolitions are directly accounted for in their COMET zone. For some zones, however, deducting the number of units to be demolished leads to negative values. This is due to discrepancies between the planning data and NTEM v7.2 employment allocations. To address this, where reduction of employment exceeds existing employment in a zone, the remaining reduction of employment has been subtracted from neighbouring zones proportionally, to reconcile the data. This addresses planning data and NTEM v7.2 employment allocation discrepancies, respecting the total reduction in employment forecast for each area.

5.3 Forecast Planning Data

5.3.1 The forecast planning data for the following areas was collated and provided by HCC in terms of employment and dwelling growth by COMET zone:

- All 10 Hertfordshire districts
- Luton
- Buckinghamshire
- Selected districts in Essex (Epping Forest, Harlow, and Uttlesford)
- Selected districts in Cambridgeshire (South Cambs and Cambridge)

5.3.2 Within these areas, all sites (employment and dwellings) have been incorporated into the forecast scenario regardless of certainty level. This includes growth categorised according to WebTAG definitions as “near certain”, “more than likely”, “reasonably foreseeable”, and “hypothetical”.

5.3.3 Outside of Hertfordshire and the selected neighbouring authorities, growth assumptions are based on NTEM v7.2 projections.

Dwelling Data within Hertfordshire and Selected Neighbouring Districts

5.3.4 Dwelling data provided by HCC is presented in Table 5.1, and is accompanied by a comparison with NTEM v7.2 projections. The data is provided spatially by model zone in Figure 5.1 (bespoke planning data area) and Figure 5.2 (Hertfordshire). The comparison with NTEM is provided for information only and does not inform the development assumptions within Hertfordshire and the selected neighbouring districts used in this forecast.

5.3.5 Dwelling growth includes: completions since 2014, those currently in the planning system, plus an allowance for windfall sites, as well as Local Plan Allocations.

5.3.6 In some instances, sites have not been allocated by HCC to a specific COMET zone (e.g. where assumptions are made for windfall development). In these cases, the dwellings have been split proportionately throughout the district according to the HCC dwelling growth assumptions in other zones in the district up to 2031. This applies to a relatively small number of dwellings.

5.3.7 Overall, there is assumed to be a net increase of approximately 97,000 dwellings between 2014 and 2031 in Hertfordshire. This total is significantly higher (~26,000 dwellings) than the NTEM projection, and is likely to be as such because all developments in the HCC data have been included (regardless of certainty), and because Local Planning Authorities own projections of housing need have increased in recent years.

Table 5.1: Dwelling Growth Assumptions in Hertfordshire and selected neighbouring districts (2014-2031)

District	2031 HCC Dwellings	2031 NTEM v7.2 Dwellings	2031 Difference
Broxbourne	8,259	5,042	3,217
Dacorum	10,783	8,764	2,019
East Hertfordshire	18,008	10,984	7,024
Hertsmere	4,718	4,587	131
North Hertfordshire	16,070	14,039	2,031
St Albans	8,822	4,453	4,369
Stevenage	7,933	8,178	-245
Three Rivers	2,613	2,997	-384
Watford	8,223	4,504	3,719
Welwyn Hatfield	12,001	7,793	4,208
Essex (Epping Forest, Harlow & Uttlesford)	31,903	16,065	15,838
Luton	5,917	5,258	659
Buckinghamshire	57,327	41,841	15,486
Cambridgeshire (South Cambs and Cambridge)	38,084	33,720	4,364
Hertfordshire sub-total	**97,430**	**71,342**	**26,088**
Total	**230,661**	**168,225**	**62,436**

Figure 5.1: Change in numbers of dwellings 2014-2031 by COMET model zone (wider zoom)

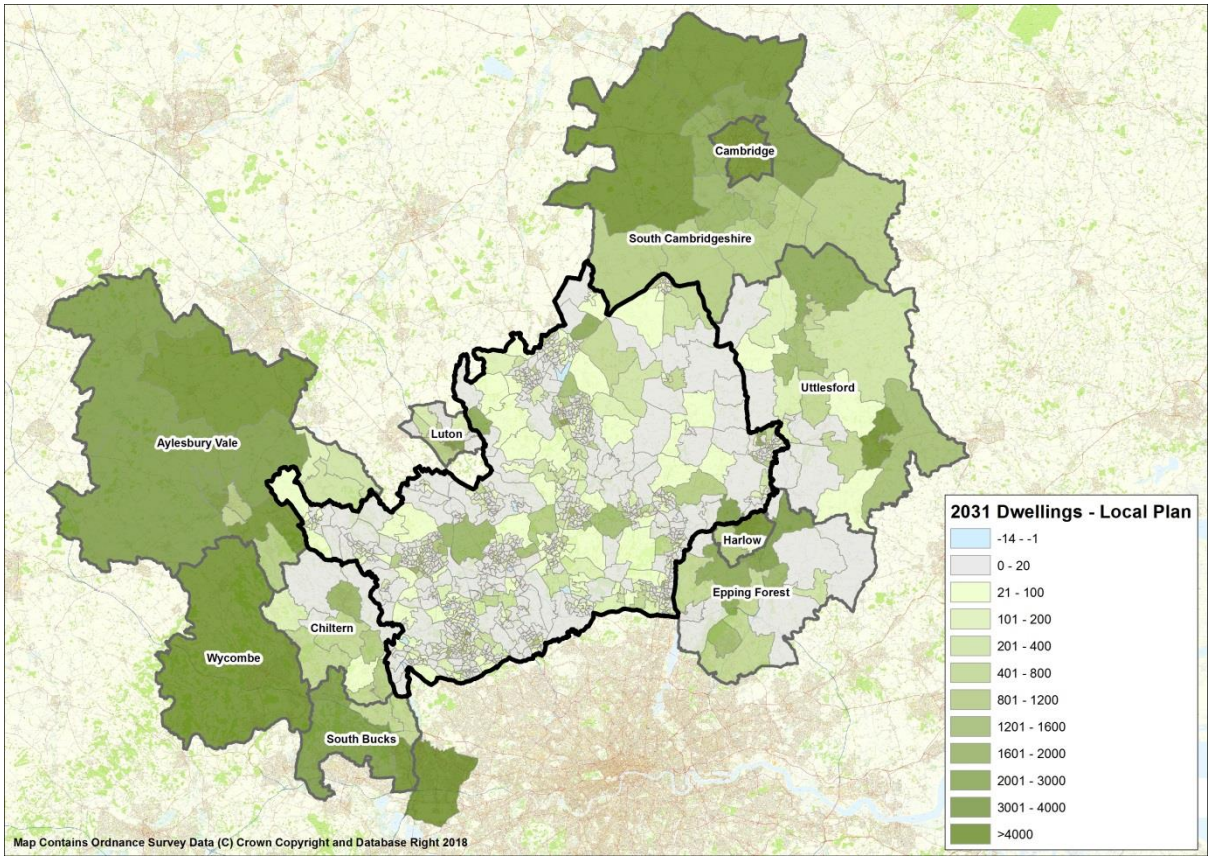
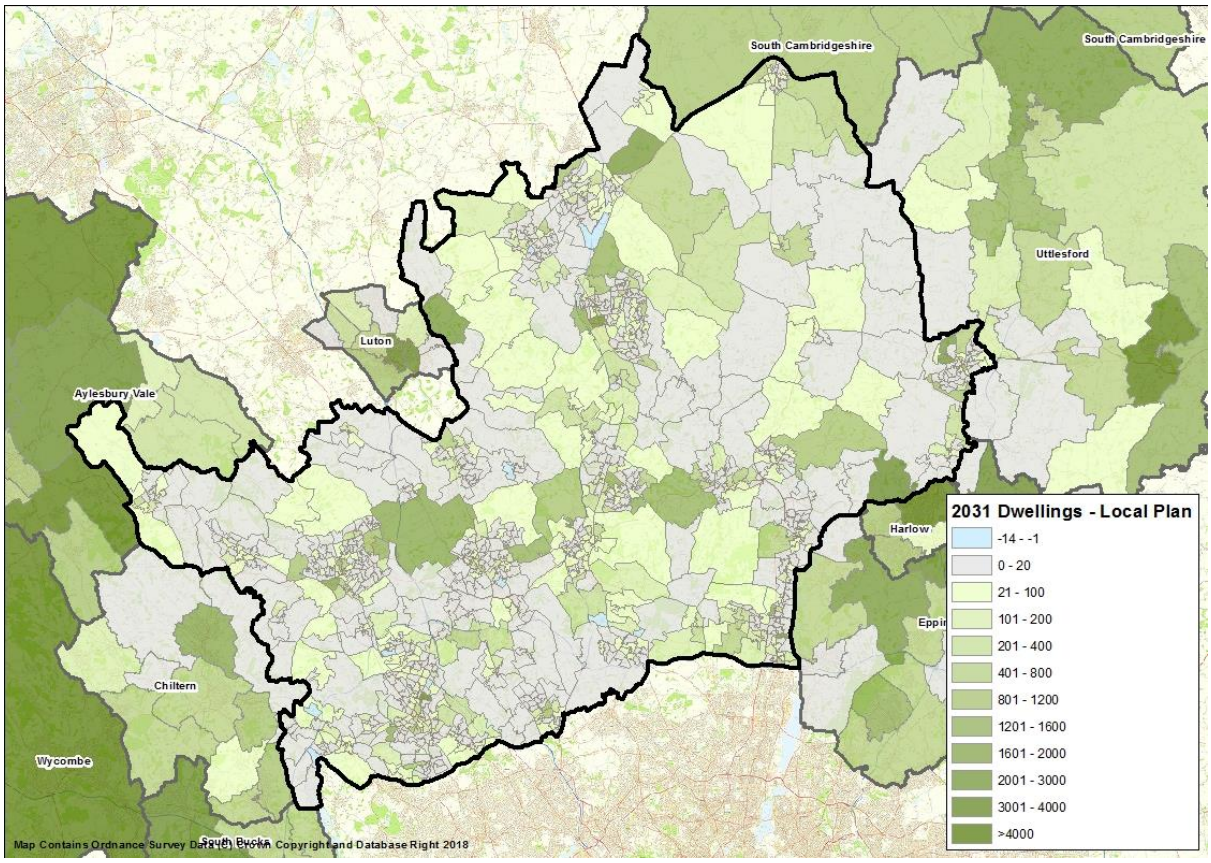


Figure 5.2 Change in numbers of dwellings 2014-2031 by COMET model zone (HCC zoom)



Employment Data within Hertfordshire and Selected Neighbouring Districts

5.3.8 Employment data provided by HCC is presented in Table 5.2, and is accompanied by a comparison with NTEM v7.2 projections. The data is provided spatially by model zone in Figure 5.3 (bespoke planning data) and Figure 5.4 (Hertfordshire). As with the dwelling data, the comparison with NTEM is provided for information only and does not inform the development assumptions within Hertfordshire used in this forecast.

5.3.9 Local planning authorities have less control over employment growth, and therefore less information on likely growth by location. Much of the employment data provided for the Hertfordshire districts was in terms of employment floor space rather than jobs, and has therefore been converted to an estimated number of jobs by AECOM. This conversion process is based on employment densities as defined in the Employment Densities Guide (November 2015 – Homes and Communities Agency). For land use types not included in this guide, site data from TRICS has been used to generate an employment density value. Whilst the employment data used represents the most complete available projection of job growth in Hertfordshire, efforts should be made by HCC and the Local Planning Authorities in the future to minimise the need for the assumptions defined above.

5.3.10 The employment projections include the Local Enterprise zone covering the Maylands area of Hemel Hempstead, Rothamsted Research institute in Harpenden and the Buildings Research Establishment in Bricket Wood with a combined target of 9,500 jobs. It should be noted that for the purposes of this forecast, the job growth in Maylands has been assigned to a zone located in Dacorum rather than St Albans.

5.3.11 Projected conversions/demolitions which involve the change or loss of a certain land use type have been taken into consideration during the employment data collation process. This reduces the risk of double counting job sites.

5.3.12 Overall, there is assumed to be a net increase of approximately 68,000 jobs between 2014 and 2031 in Hertfordshire. This total is significantly higher (~21,000 jobs) than the NTEM projection. As applies to the dwelling data, the reason for this difference is at least partly due to the inclusion of all employment sites in the HCC data regardless of certainty.

Table 5.2: Employment Growth Assumptions in Hertfordshire (2014-2031)

District	2031 HCC Jobs	2031 NTEM v7.2 Jobs	2031 Difference
Broxbourne	9,861	3,489	6,372
Dacorum	11,609	5,816	5,793
East Hertfordshire	2,714	5,215	-2,501
Hertsmere	3,270	4,009	-739
North Hertfordshire	8,542	5,173	3,369
St Albans	4,527	5,697	-1,170
Stevenage	4,323	4,194	129
Three Rivers	4,114	3,057	1,057
Watford	7,683	5,296	2,387
Welwyn Hatfield	11,851	5,988	5,863
Essex (Epping Forest, Harlow & Uttlesford)	30,768	11,594	19,174
Luton	19,103	8,787	10,316
Buckinghamshire	63,240	22,402	40,838
Cambridgeshire (South Cambs and Cambridge)	15,508	15,510	-2 (rounding error from intended value of 0)
Hertfordshire sub-total	68,494	47,934	20,560
Total	**197,113**	**106,227**	**90,886**

Figure 5.3: Change in numbers of jobs 2014-2031 by COMET model zone (wider zoom)

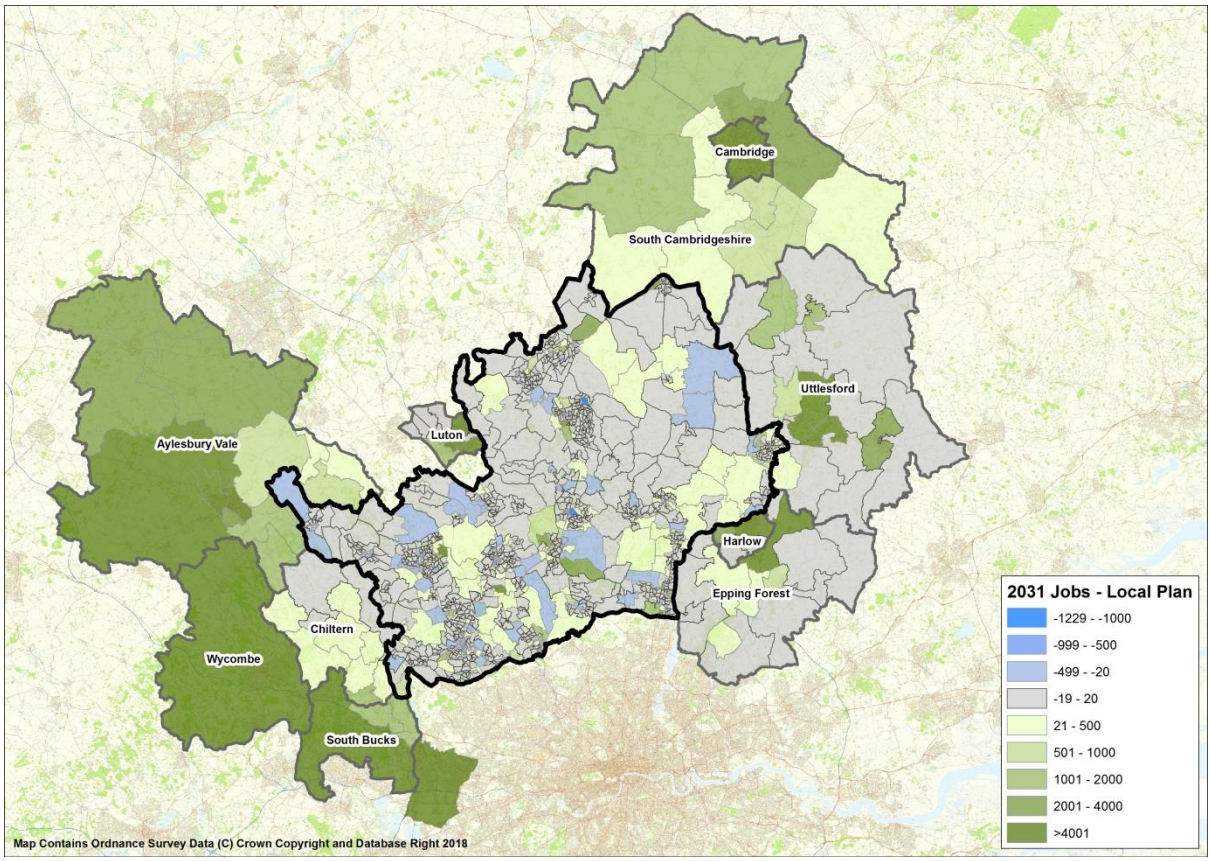
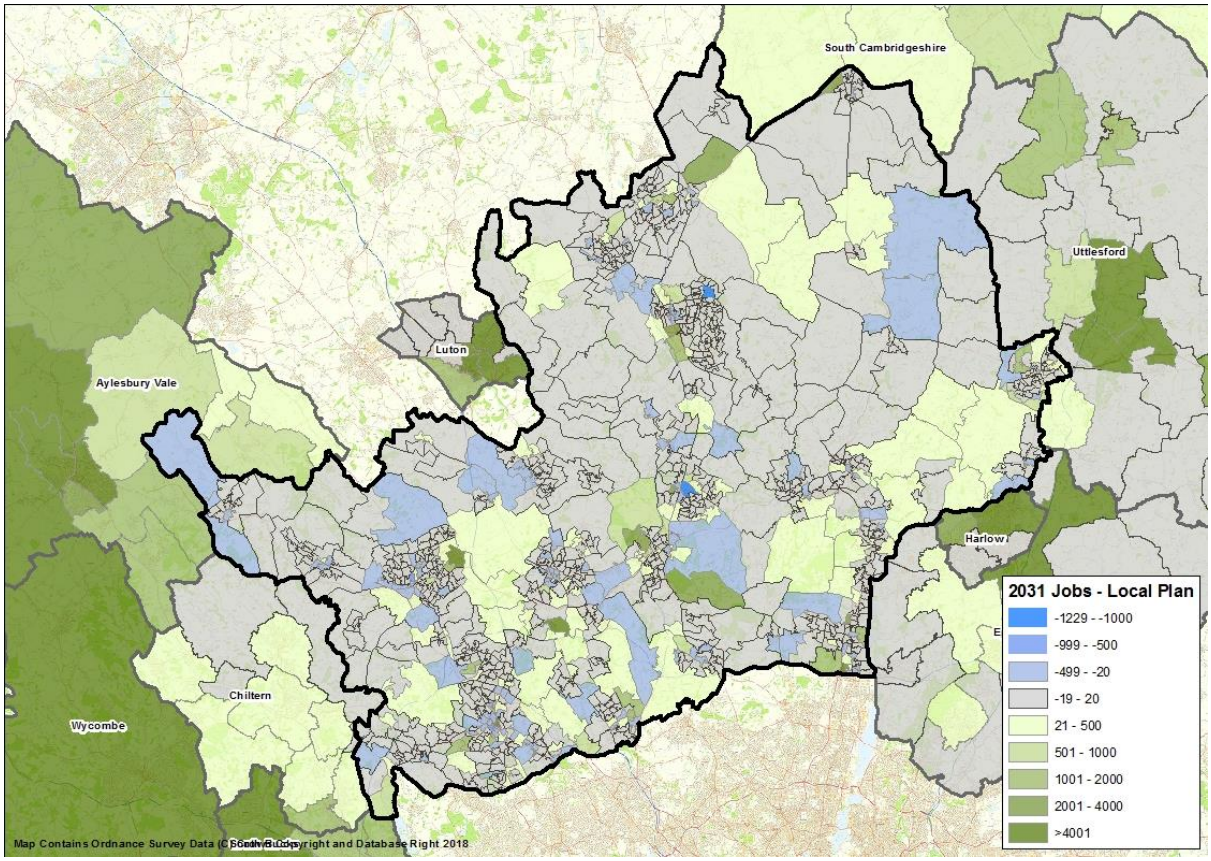


Figure 5.4 Change in numbers of jobs 2014-2031 by COMET model zone (HCC zoom)



Employment Data in Selected Neighbouring Districts

5.3.13 The same assumptions and caveats explained for planning data within Hertfordshire also apply to the additional planning data provided for the 9 districts outside Hertfordshire.

5.3.14 HCC were unable to provide employment data at a zone level for Buckinghamshire and Cambridgeshire. The following assumptions were made in order to prepare zone level growth assumptions for these two counties:

- For Buckinghamshire, HCC provided a value for total jobs in 2031.This value was then distributed between COMET zones according to NTEM v7.2 proportions.
- For Cambridgeshire (South Cambs and Cambridge), HCC requested that the NTEM v7.2 projections be used as totals and distribution of job growth.

Planning Data outside Hertfordshire and Selected Neighbouring Districts

5.3.15 The availability of planning data outside Hertfordshire and the selected neighbouring districts is limited. Consequently, growth in terms of housing, employment and population in the rest of Great Britain is derived directly from NTEM v7.2.The 2014-2031 growth rates are in Table 5.3. It is worth noting that these growth figures are likely to be lower than growth being proposed through the Local Plan processes in these areas.

Table 5.3: NTEM 7.2 Growth Rates (for areas without bespoke planning data)

	2014-2031
Dwellings	14.69%
Employment	7.58%
Population	10.26%

5.4 Model Development Zones

Background

5.4.1 There are a number of locations in Hertfordshire where significant levels of growth (in terms of housing and/or employment) are anticipated to come forward in previously undeveloped areas. The trip patterns of these developments are likely to be materially different to those of the existing land use, and as such require special consideration in terms of forecast demand estimation and loading point(s) onto the network.

5.4.2 Given the limited number of development zones available in the model (50), care has been taken to minimise the number used at this stage (thereby leaving more available for later applications). To this end, developments are allocated to model development zones according to the selection process in Figure 5.5. The developments that meet the requirements are set out in Figure 5.6.

5.4.3 Note that there are some developments that do not meet the minimum threshold of 2,000 jobs or dwellings, however, have been allocated to a model development zone:

- East Hemel Hempstead North: allocated to a model development zone because of its sensitive location and proximity to significant levels of other growth (i.e. East Hemel Hempstead South)
- Land North and East of Ware: allocated to a model development zone due to relatively large quantum and location in a zone that may otherwise produce an unrealistic trip distribution.
- Bishop's Stortford South: allocated to a model development zone due to relatively large quantum and location in a zone that may otherwise produce an unrealistic trip distribution.

Figure 5.5: Model Development Zone Selection Process

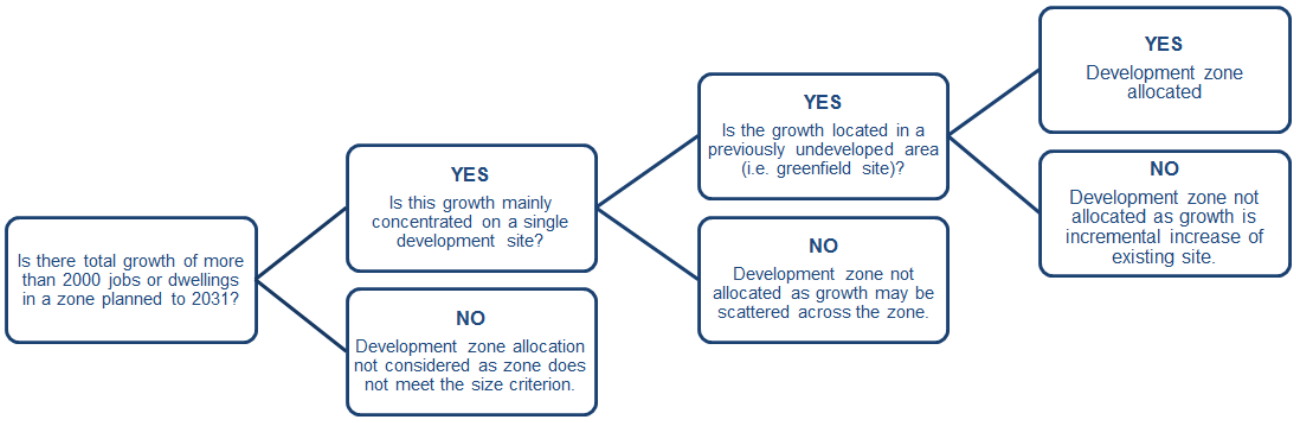
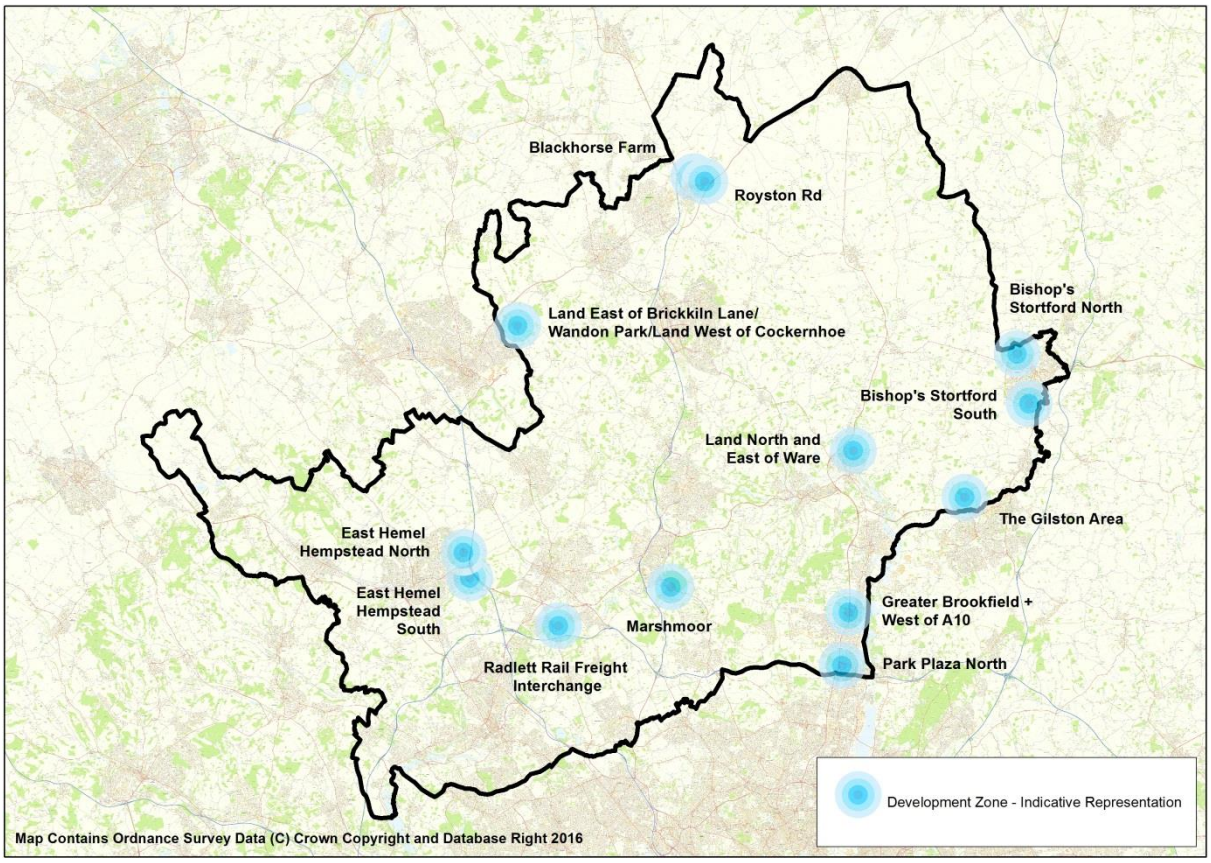


Figure 5.6: Model Development Zones



Derivation of Development Zone Demand

5.4.4 Zones which are empty in the Base Model require special consideration in the demand model. The trip-end model generates estimates of trips from them as described in the section entitled COMET Trip End Model Forecast Update. However, it is not possible to apply proportional growth to the base matrix for these zones as the Base matrix has no associated demand.

5.4.5 A set of gravity models, calibrated by mode and purpose based on the distribution of the base matrices, have been created for the purpose of estimating distribution to and from development zones. Because the incremental variable demand model will be applied to these zones as well as all others, the gravity models are based on base year generalised cost of travel, along with the trip-ends for the forecast year.

5.4.6 Having estimated the distribution of travel using a gravity model, the total level of trip-making for the development zones is then set to the trip ends from the trip-end model.

5.5 Variable Demand Modelling

Process

5.5.1 As a result of the updates described above, the COMET Trip End model for the Forecast Year outputs estimates of trip end growth between the Base Year (2014) and the Forecast Year (2031). The proportional growth implied by the trip-end model from Base Year 2014 to forecast year is applied to the Base Year matrix to create an estimate of forecast demand, a "reference" forecast matrix (see WebTAG Unit M2 Variable Demand Modelling – section 2.5.5). For example, if the trip-end model has 100 trips for a zone in the base year, and 130 in 2031, and the base matrix has 60 trips, the forecast matrix will have 60*130/100=78 trips. A "matrix balancing" approach is used, where the reference matrices are controlled first to matrix rows (productions), and then to the matrix columns (attractions). This approach is repeated iteratively until the matrix "balances" both productions and attractions.

5.5.2 These are not the final forecast matrices. Final forecast matrices are developed from reference matrices by application of the variable demand model to take account of the effect of changes in transport cost over time on traveller behaviour.

5.5.3 The forecasted matrices are then adjusted iteratively by the VDM taking into account the forecast changes in generalised cost based on the Highway model and Public Transport model assignments. In effect, trips will be decreased between areas with increases in generalised cost (e.g. increase in congestion), and vice versa. The VDM includes components that adjust mode shares based on relative changes in cost between modes, adjust time period splits based on relative changes in cost between periods, and adjust attraction sites based on relative change in cost for travel to various attractions.

5.5.4 A bespoke add-on to the VDM has been created for the purpose of this forecast in order to simulate modal shift from highway to PT/sustainable modes. This add-on is described in more detail in paragraph 4.2.6.

Convergence

5.5.5 The convergence of the variable demand model is measured through %GAP[3] between iterations set out in Figure 3.1. The convergence of a variable demand model is closely linked to the convergence of the assignment models, however, in the case of the COMET, the lack of modelled congestion in the public transport model means there is no convergence to measure. Therefore, the convergence of the COMET variable demand model is strongly related to that of the highway assignment model, discussed further in Chapter 6.

5.5.6 The 2031 forecast is currently capped to 14 variable demand model iterations, and reaches an aggregate %GAP convergence of 0.13% (Hertfordshire productions). According to WebTAG M2 section 6.3.8: "Tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%". The value achieved for COMET therefore within the upper limit indicated by WebTAG and may be improved as COMET is enhanced in future work.

[3] %GAP is the difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as a percentage of the minimum costs. %GAP provides a measure of the proximity to equilibrium of the assignment.

5.6 Economic Parameters

5.6.1 The variable demand model uses economic parameters including values of time, fuel prices, etc. to calculate the generalised costs of travel. These vary over time, and forecast projections for the majority of these parameters are provided in WebTAG. The forecast values for these parameters are summarised in alongside the base values and growth factors. Bus and rail fare change assumptions are not provided in WebTAG but are assumed to be a 1% year growth above inflation, based on recent trends.

Table 5.4: Economic Parameter Changes over Time, Fixed 2010 Prices[4]

Values	2014	2031	Change
Value of Time, Commuting (p/min)	17.41	23.297	+34%
Value of Time, Business (p/min)	26.001	34.793	+34%
Value of Time, Other (p/min)	7.946	10.633	+34%
Value of Time, LGV (p/min)	16.877	22.584	+34%
Value of Time, HGV (p/min)	42.19	56.456	+34%
Petrol Price – Non work (p/litre)	120.07	133.13	+11%
Diesel Price – Non work (p/litre)	125.34	140.18	+12%
Petrol Car Fuel Consumption Factor	0.929	0.603	-35%
Diesel Car Fuel Consumption Factor	0.914	0.676	-26%
Car Fleet Proportion, Diesel	0.496	0.502	+1%
Car Fleet Proportion, Electric	0.001	0.053	+5200%
Rail Fares	Varied	Varied	+18%
Bus Fares	Varied	Varied	+18%
Car Passenger Occupancy	Varied	Varied	None

5.7 Forecast Growth Rates

5.7.1 The overall growth in highway trips from the demand model is summarised in Table 5.5.

5.7.2 “2014 Base” below refers to COMET Base Year. “2031 Local Plan” refers to COMET Forecast Year being reported in this document. “2031 Reference” is the demand as produced from the trip-end model before the variable demand model adjusts the matrices to take account of generalised cost changes.

5.7.3 The “2031 Reference” totals are thus based on the output of the trip-end model applied to the Base Year matrix before the variable demand model is run. It can be seen that the effect of the variable demand model on highway trips is quite small; almost all of trip growth results from increases in population and employment, not changes to transport infrastructure.

5.7.4 For commuting trips (most of which occur in the peak hours with more highway congestion), the reduction between “2031 Reference” and “2031 Local Plan” can be attributed to congestion and consequent modal shift.

[4] Source: WebTAG Databook March 2017 v1.7 (except Rail Fares and Bus Fares which both rise at 1% per annum above inflation – this is in line with government policy for rail, and in line with recent historical trends for bus).

5.7.5 The relatively high growth in Light Goods Vehicle trips (vans) relative to Heavy Goods Vehicle trips is consistent with current trends.

5.7.6 There is no change in the number of freight trips (LGV and HGV) between the 2031 Reference forecast and the 2031 Local Plan forecast (i.e. the variable demand model process does not have any impact). This is due to the way in which COMET has been set up, and is in line with standard practice for freight forecasting.

Table 5.5: Highway Trip Growth over Time, 24 Hour Person Trips, Hertfordshire Productions Only

User Class	2014 Base	2031 Reference	2031 Local Plan	Change (2014 Base to 2031 Local Plan)
Commuting	436,391	477,603	468,886	**7.45%**
Business	130,504	148,321	148,137	**13.51%**
Other	2,069,063	2,499,585	2,507,831	**21.21%**
LGV	266,683	343,284	343,284	**28.72%**
HGV	66,272	70,479	70,479	**6.35%**
All	**2,968,913**	**3,539,272**	**3,538,617**	**19.19%**

5.7.7 A directly comparable table for public transport results is shown in Table 5.6. Although population and employment changes still have a significant effect, here the impact of the demand model is proportionally much larger. The demand model increases travel, largely because while fares are modelled as increasing, income levels (values of time) are modelled as increasing more, so perception of fare falls.

5.7.8 It is also highlighted that there is no modelling of crowding within the public transport model (the increase in public transport trips is therefore unconstrained by congestion). Consequently, while the highway assignment model experiences increased congestion and thus an increase in generalised cost for car travel, this increase is not reflected in public transport, resulting in a mode shift.

Table 5.6: Public Transport Trip Growth over Time, 24 Hour Person Trips, Hertfordshire Productions Only

User Class	2014 Base	2031 Reference	2031 Local Plan	Change (2014 Base to 2031 Local Plan)
Commuting	111,505	112,630	123,399	**10.67%**
Business	9,710	10,696	11,571	**19.16%**
Other	138,192	159,438	179,596	**29.96%**
All	**259,407**	**282,764**	**314,565**	**21.26%**

5.7.9 For both modes (public transport and highway), “other” trips rise significantly, while commuting trips rise much less. This is due primarily to an ageing population, with a smaller proportion of people in employment. Forecast assumptions relating to the ageing profile of the population are derived from the National Trip-End Model (NTEM), version 7.2.

6. Forecast Assignments

6.1 Highway Assignment

Assignment Parameters

6.1.1 No changes have been made in terms of SATURN assignment options or parameters relative to the base year. For reference, a full list is provided in *Appendix III: SATURN Highway Assignment Parameters.*

Assignment Convergence

6.1.2 The convergence of the highway assignment has been measured according to standards set out in Table 6.1 (as stated in WebTAG M3.1 section 3.3.5). When a model does not achieve convergence criteria, it may produce large variations between iterations, "noise", leading to unreliable results.

6.1.3 In SATURN terms, "percentage of links with flow change (P) <1%" is referred to as %FLOWS.

Table 6.1: Convergence Measures and Base Model Acceptable Values

Measure of Convergence	Base Model Acceptable Values
Delta and %GAP[5]	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%[6] (%FLOWS)	Four consecutive iterations greater than 98% (measured as 97.5% plus in SATURN)

6.1.4 For reference, the 2014 base year highway assignment convergence values are given in Table 6.2. Previous experience suggests that a base year model should converge in approximately 30 iterations or fewer, however, the AM peak requires somewhat more than expected.

Table 6.2: Base Year Convergence Values

Time Period	Iterations	%FLOWS	%GAP
AM	44	98.1	0.010
IP	25	98.1	0.008
PM	30	98.7	0.022

6.1.5 The 2031 convergence values in terms of %FLOWS and %GAP are presented in Table 6.3, and show that both indicators meet WebTAG criteria in all time periods.

[5] %GAP is the difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as a percentage of the minimum costs. %GAP provides a measure of the proximity to equilibrium of the assignment.
[6] The percentage of links on which flows change by less than 1% between iterations.

Table 6.3: 2031 Convergence Values

Time Period	Iterations	%FLOWS	%GAP
AM	62	97.9	0.018
IP	62	98.6	0.010
PM	57	98.1	0.021

6.2 Public Transport Assignment

Assignment Parameters

6.2.1 Other than the modelled schemes, the forecast 2031 public transport assignment is identical to the Base Year, except for the previously noted 1% increase per year in public transport fare and an increase in the passenger value of time in line with the demand model. The increases in fare and values of time above inflation are applied for both bus and rail travel.

Assignment Convergence

6.2.2 The public transport model does not model congestion, and as such there is no convergence to measure.

7. Highway Forecast Results

7.1 Simulation Area Statistics

7.1.1 This section provides a summary of simulation area statistics concerning the highway assignment. For reference, the 2014 Base Year model values are also given. All values only include travel within the time period simulated, and do not consider extra time and distance in later periods due to vehicles queued at over-capacity junctions.

7.1.2 Table 7.1 and the following figures show assignment statistics for all user classes combined. Other than *Total Trips Loaded,* all statistics refer to the simulation area only. For the equivalent assignment statistics by user class, see *Appendix IV: Highway Simulation Area Statistics by User Class.*

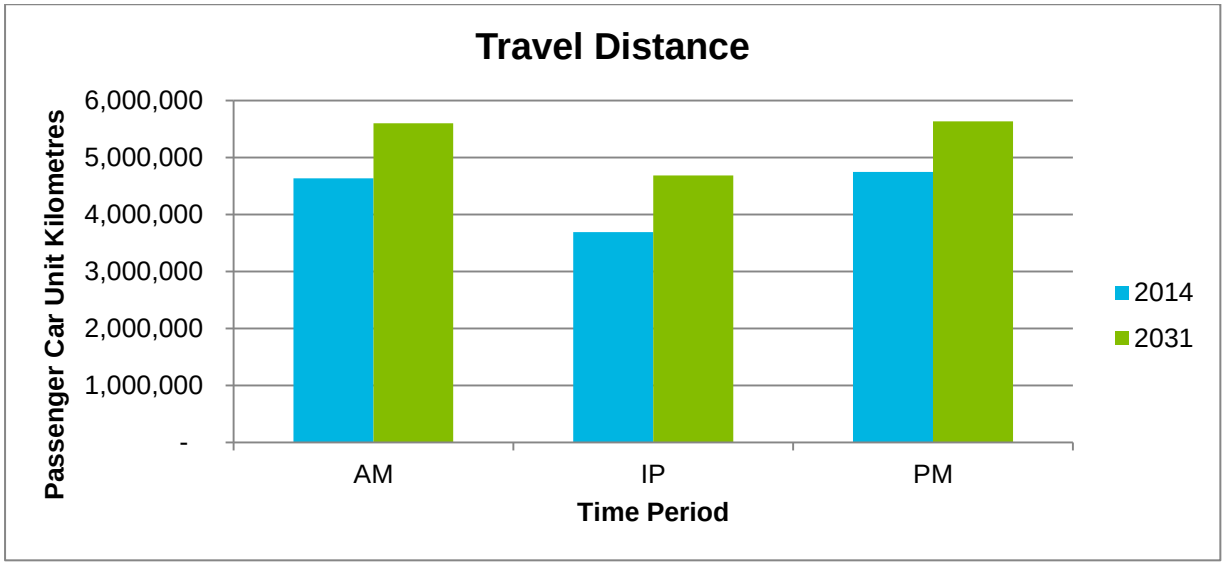
7.1.3 In terms of Total Trips Loaded, the increase between the 2014 Base Year and 2031 Forecast Year is 20% in the AM Peak, 19% in the PM Peak, and 25% in the Inter-peak (reflecting the relatively uncongested network in the Inter-peak). The increase in travel distance is higher than or equal to the increase in trips, suggesting that highway trips are longer in the forecast relative to the Base Year. The total travel time increases at a faster rate than the total trips loaded and travel distance, suggesting the forecast network has higher levels of delay and congestion.

7.1.4 Over-capacity queueing[8] increases most significantly in absolute terms in the AM peak and Inter peak, however, a smaller percentage increase also occurs in the PM Peak. The smaller increase in over-capacity queueing in the PM Peak is likely to be a result of the already more congested Base Year starting point from which the forecast pivots. It is likely that the level of over-capacity queueing reaches a “ceiling” beyond which people choose to take alternative routes/modes to reach their destination. Transient queues[8] increase more evenly across the different time periods.

Table 7.1: Simulation Area Assignment Statistics – All User Classes including fixed flows

	AM Peak			Inter-peak			PM Peak		
	2014	2031	Δ	2014	2031	Δ	2014	2031	Δ
Total Trips Loaded	809,707	968,829	+20%	590,845	739,774	+25%	837,645	998,148	+19%
Travel Distance (PCU km)[7]	4,631,257	5,599,981	+21%	3,689,202	4,681,716	+27%	4,743,326	5,634,455	+19%
Total Travel Time (PCU hours)	91,858	127,848	+39%	63,325	86,341	+36%	106,499	134,041	+26%
Average Speed (Kph)	50	44	-13%	58	54	-7%	45	42	-6%
Over-Capacity Queues (PCU hours)[8]	10,362	23,596	+128%	2,630	5,818	+121%	22,354	29,796	+33%
Transient Queues (PCU hours)[8]	13,954	20,298	+45%	9,234	13,728	+49%	14,452	19,888	+38%

Figure 7.1: Travel Distance (Simulation Area only)



[7] PCU = Passenger Car Unit

[8] From SATURN manual section 8.4.1: "Delays (and queues) may be subdivided into two main components:

- "transient" or "under capacity" delays and
- "queuing" or "over capacity" delays

where, for example at traffic signals, the transient delays correspond to the time spent queuing during the red phase by vehicles which then depart during the green phase, whereas the queuing delays only occur for turning movements in excess of capacity where a permanent queue builds up which is unable to clear in a single cycle."

Figure 7.2: Total Travel Time (Simulation Area only)

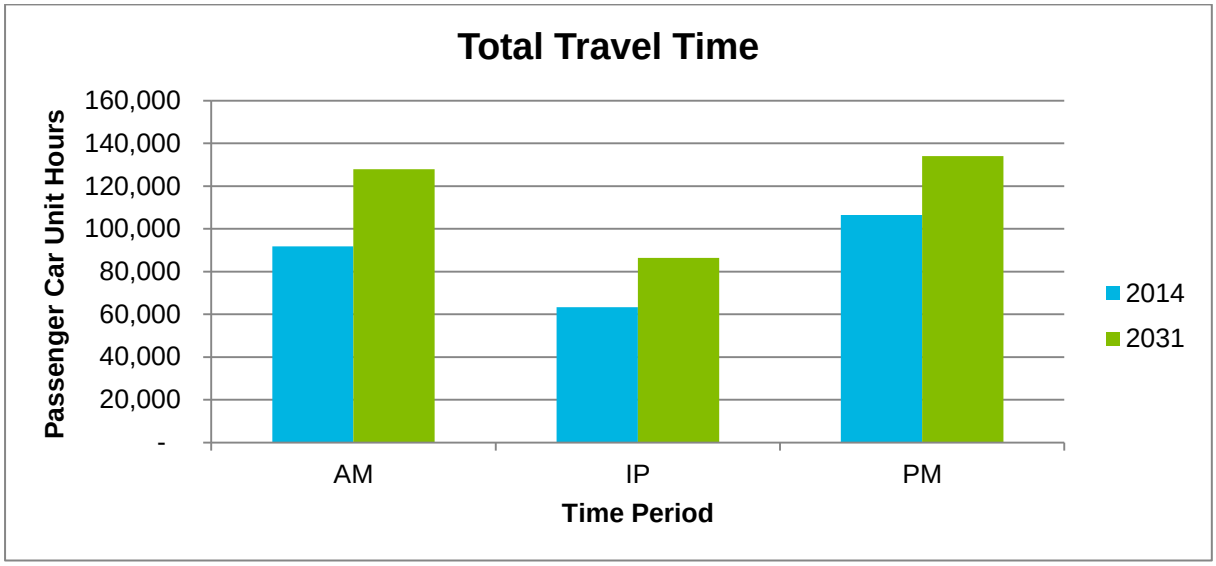


Figure 7.3: Average Speed (Simulation Area only)

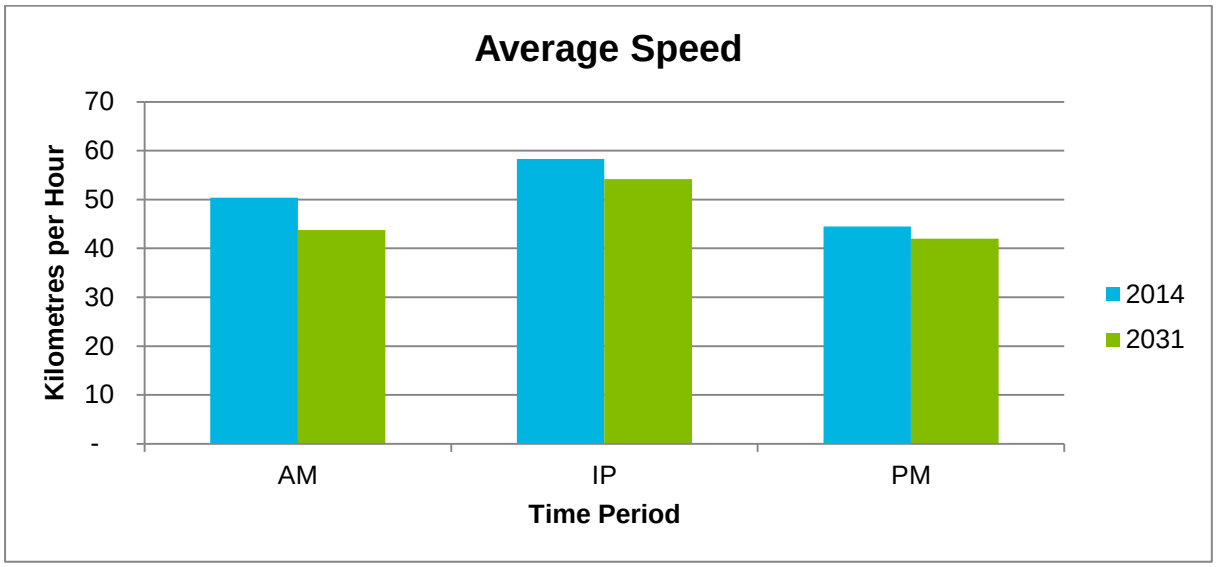
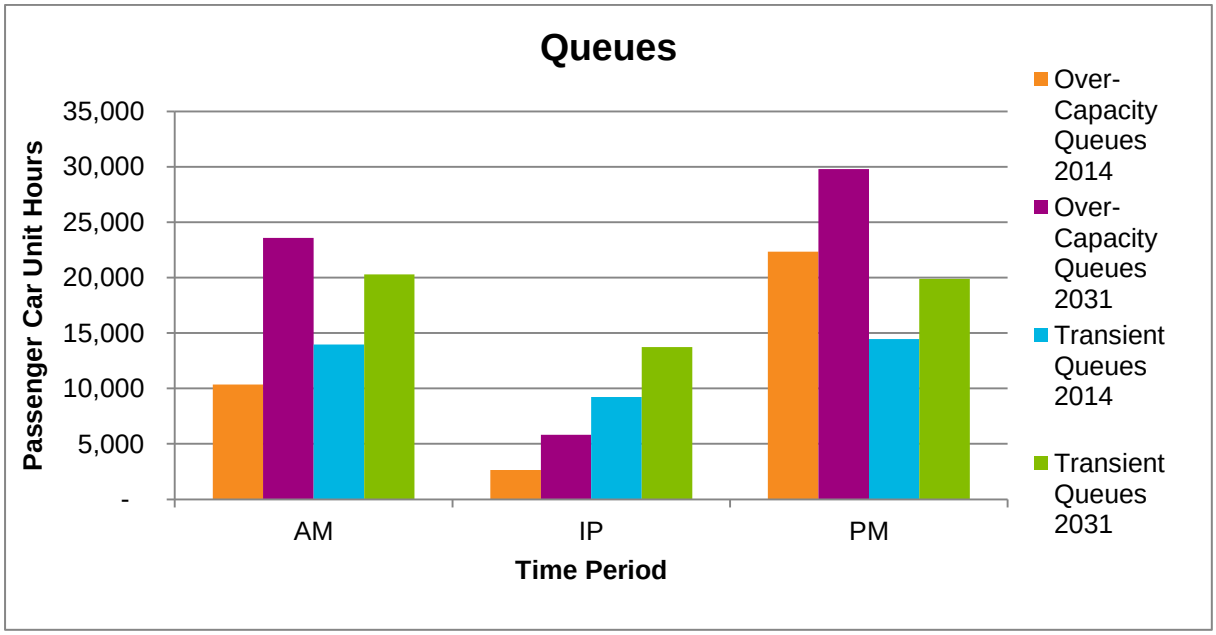


Figure 7.4: Queues (Simulation Area only)



7.2 Traffic Flows

7.2.1 The flow difference plots presented below display the change (in passenger car units) between the base year and forecast year in Hertfordshire.

7.2.2 Green bands indicate flow increase in the forecast, whilst blue indicates flow decrease. As expected, the greatest increases in absolute terms in vehicle flow occur on the strategic road network, however, most of the more minor links also experience traffic growth.

7.2.3 Notwithstanding some local re-routeing in town centres leading to flow reductions on some links, there are a number of key links where modelled flow decreases between the Base Year and Forecast Year. These are discussed in more detail in Table 7.2.

Table 7.2: Flow Reductions on Key Links relative to the Base Year

Area of flow reduction	Comment
A120 through village of Little Hadham	This is a result of local re-routing onto the A120 Little Hadham Bypass.
A414 between A10 and Eastwick roundabout	Likely to be related to the increase in delay at Eastwick roundabout and the removal of 1 lane for general traffic on Fifth Avenue. Modelling suggests re-routing onto B181 through Stanstead Abbots and Roydon.
A602 between A10 and Anchor Ln	This is a result of traffic re-routing onto the Hertford bypass. Modelling suggests that east/west traffic between the A10 and the A414 west of Hertford via the A602 and Wadesmill Rd shifts onto the bypass.
A602 through part of Stevenage	There is evidence of re-routing of some east/west traffic through Stevenage from the A062 onto the less congested Broadwater Crescent and Roebuck Gate.
A10 through part of Broxbourne (PM Peak Only)	The new direct linkage between the Brookfield Retail Park and the A10 provides an attractive route for northbound traffic to join the A10. This is more attractive when compared with the next available junction to the south from which a northbound turn can be made onto the A10 from the west (College Rd). This flow reduction is therefore a result of traffic re-routing to join the A10 at this junction instead of further south.
A1 southbound south of M25 (AM Peak Only)	This appears to be a result of increased delay at the Stirling corner roundabout. The high level of delay encourages re-routing onto parallel roads.
A405 between Park Street and M1	Likely to be associated with re-routing onto the new Radlett Railfreight Link road, Smug Oak Ln and Mount Pleasant Ln.
A41 southbound towards M25 and Watford	The increased delay at M25 Junction 20 leads to this flow reduction (modelling suggests that delay on the clockwise on-slip blocks back to the roundabout). Consequently, there are signs of re-routing visible on parallel local roads to the east (e.g. Primrose Hill).
A5183 between M1 and Markyate	Modelling suggests that this is a result of increased congestion at M1 junction 9 and re-routing onto the parallel Lybury Ln through Redbourn.
A10 in Royston (PM Peak Only)	In addition to flow reduction on the A10 through Royston, a similar result is modelled on the parallel Kneesworth St in the town. This appears to be a result of higher delays relative to the Base Year at the A505 roundabouts on both of these roads. At a strategic level, this may be a result of re-routing on Ashwell Rd and the B1368.
A505 Letchworth Gate in Letchworth Garden City	Associated with increase in delay at A1(M) junction 9. Modelling suggests alternative route choice to Stevenage via Wymondley Rd and B197.

Figure 7.5: 2031 AM Peak Flow minus 2014 AM Peak (Key Links)

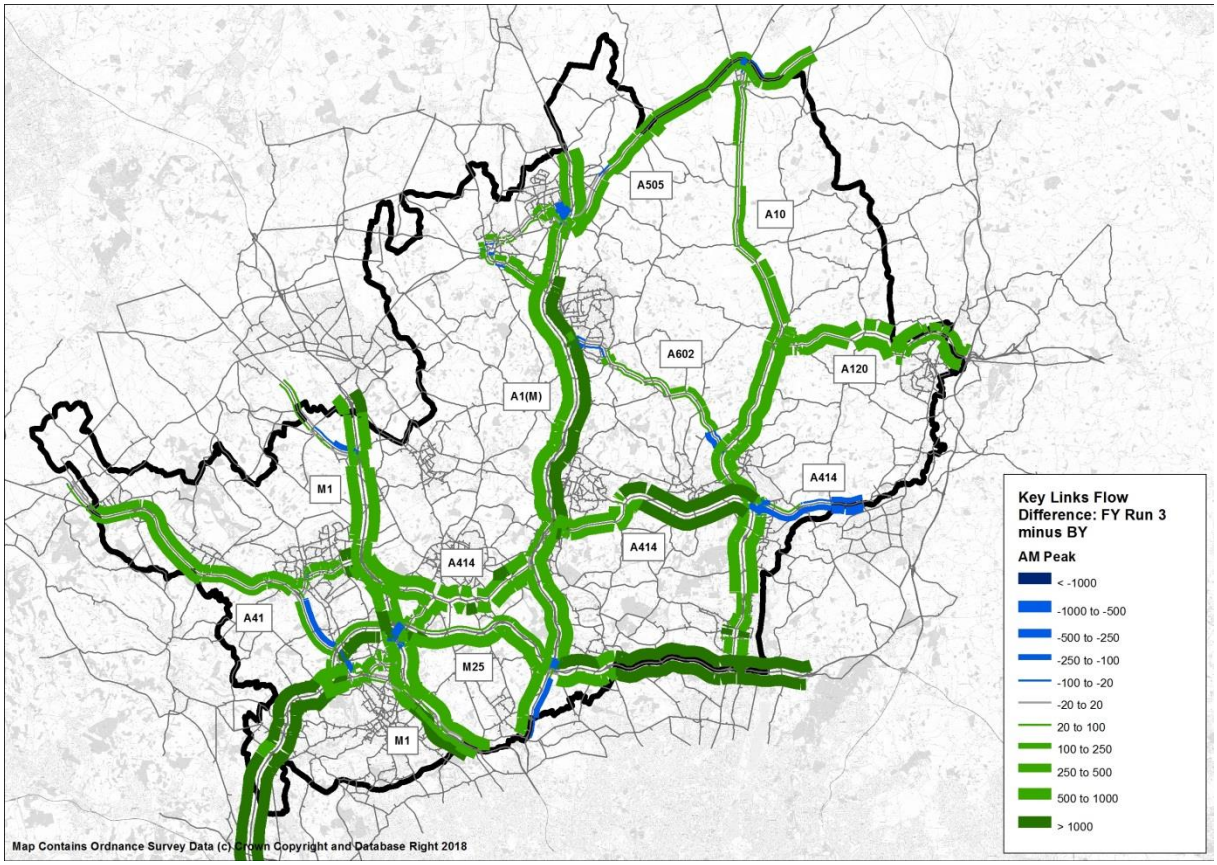


Figure 7.6: 2031 AM Peak Flow minus 2014 AM Peak (All Links)

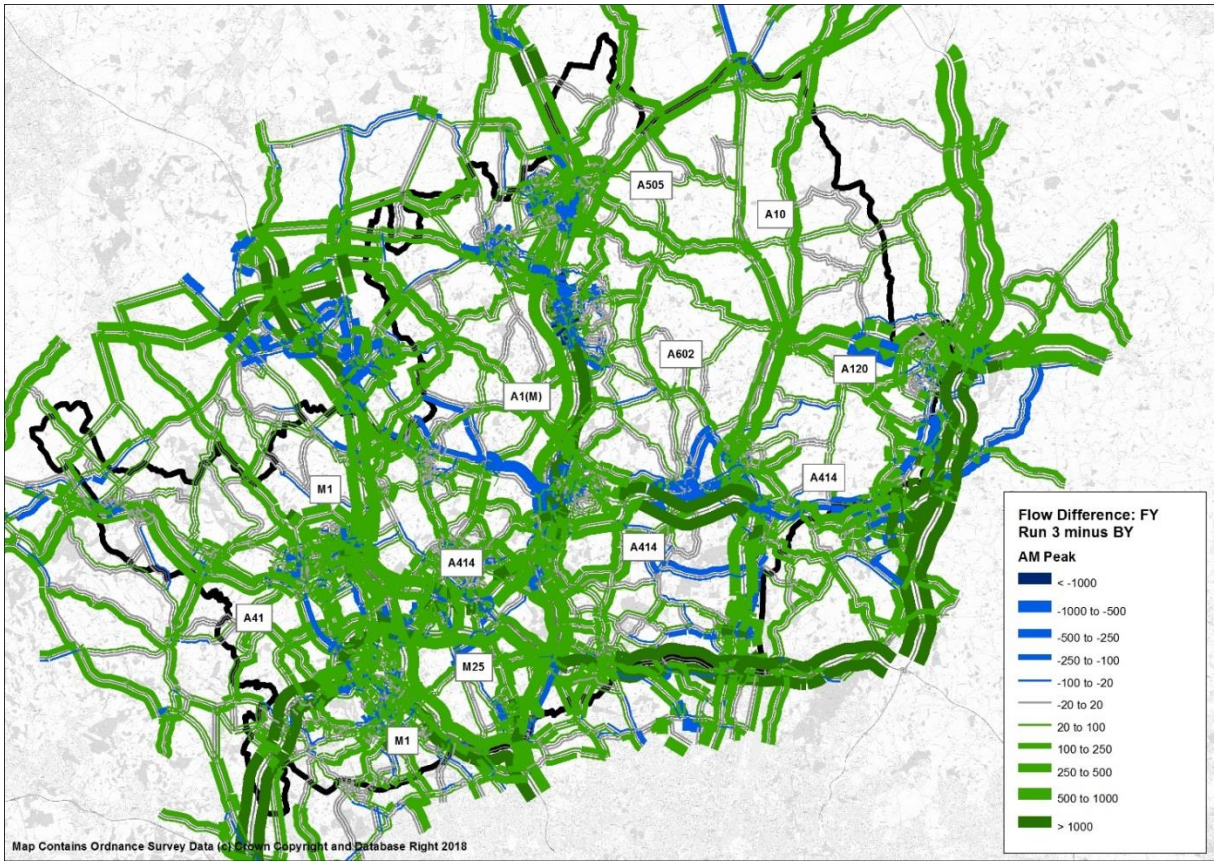


Figure 7.7: 2031 Inter-peak Flow minus 2014 Inter-peak (Key Links)

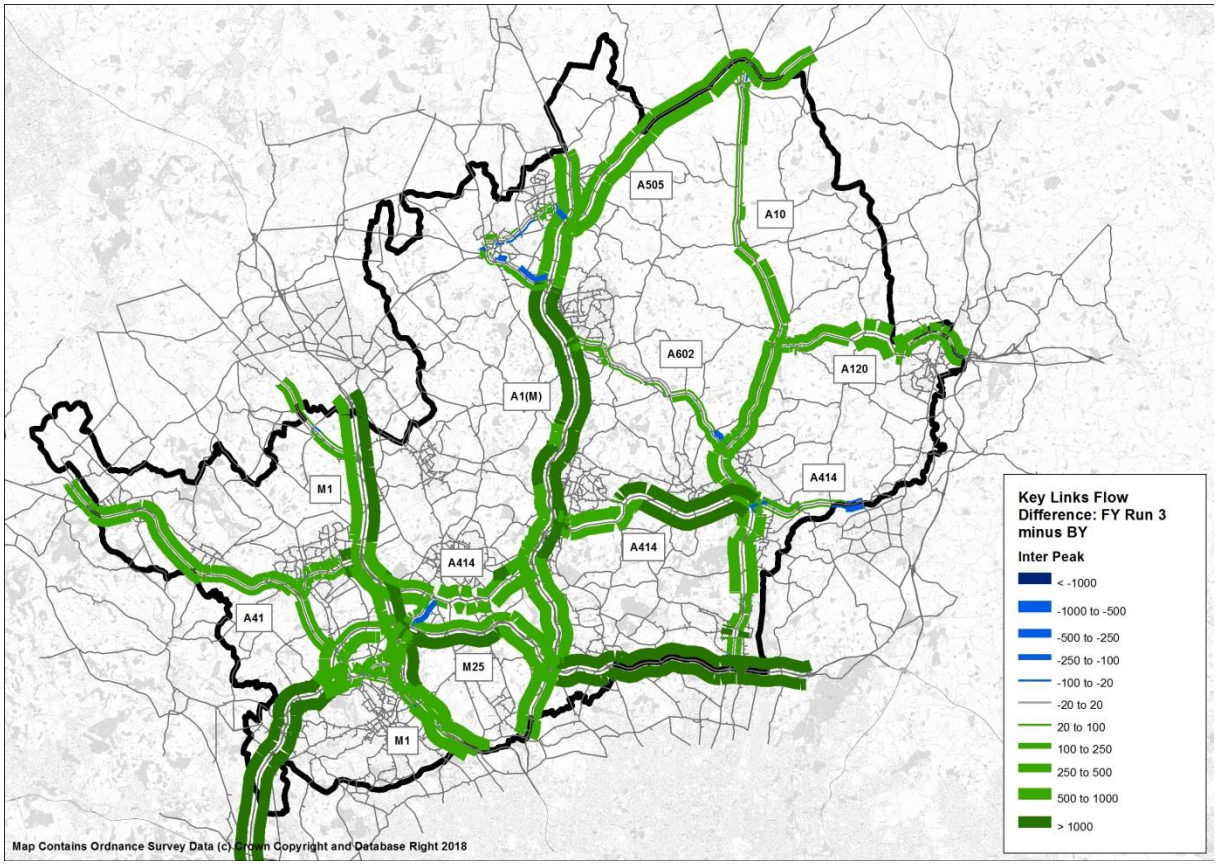


Figure 7.8: 2031 Inter-peak Flow minus 2014 Inter-peak (All Links)

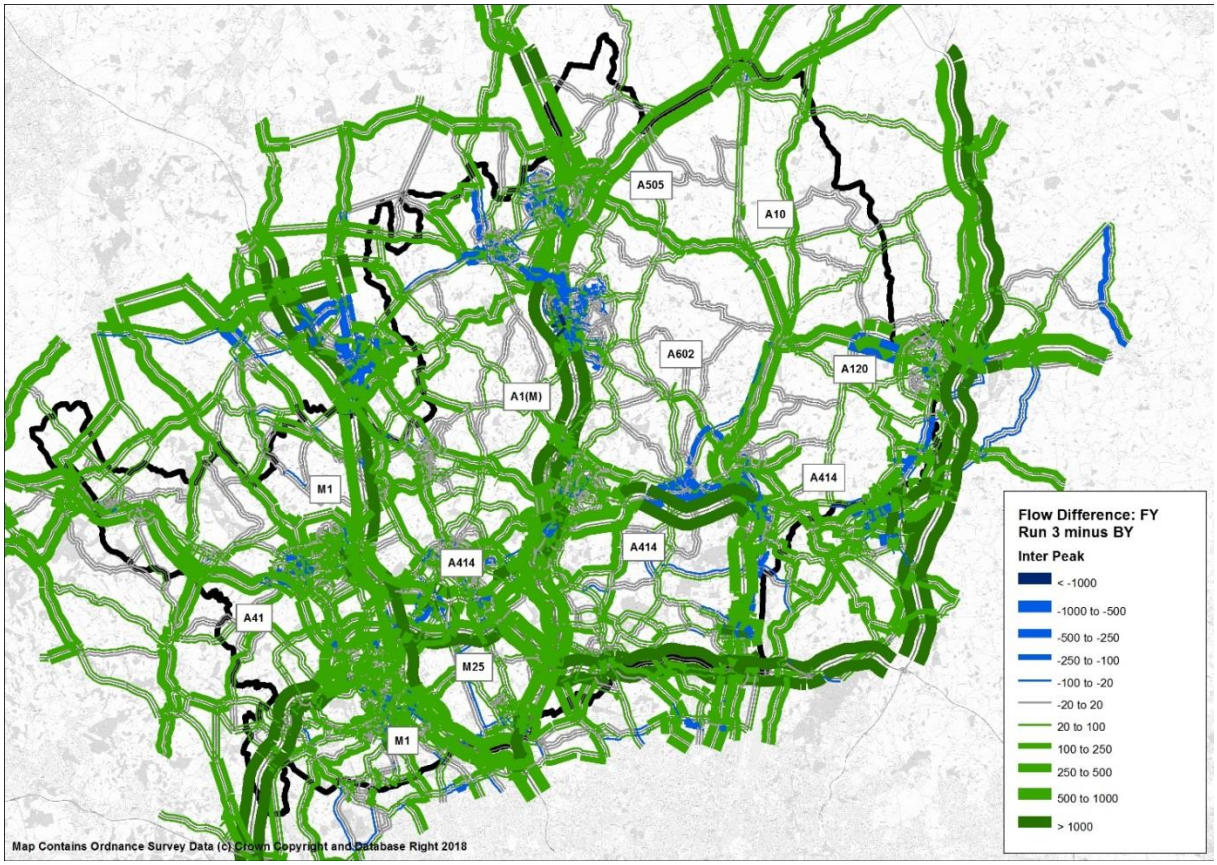


Figure 7.9: 2031 PM Peak Flow minus 2014 PM Peak (Key Links)

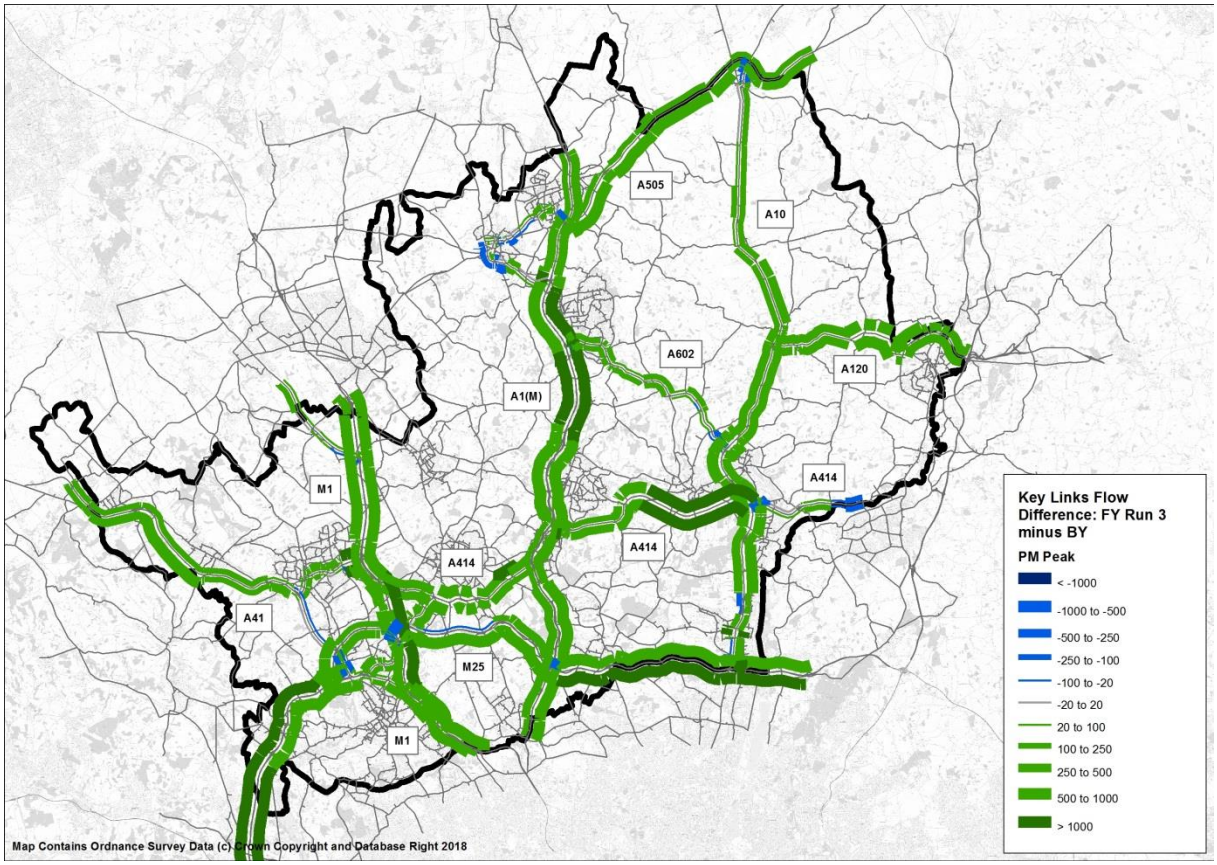
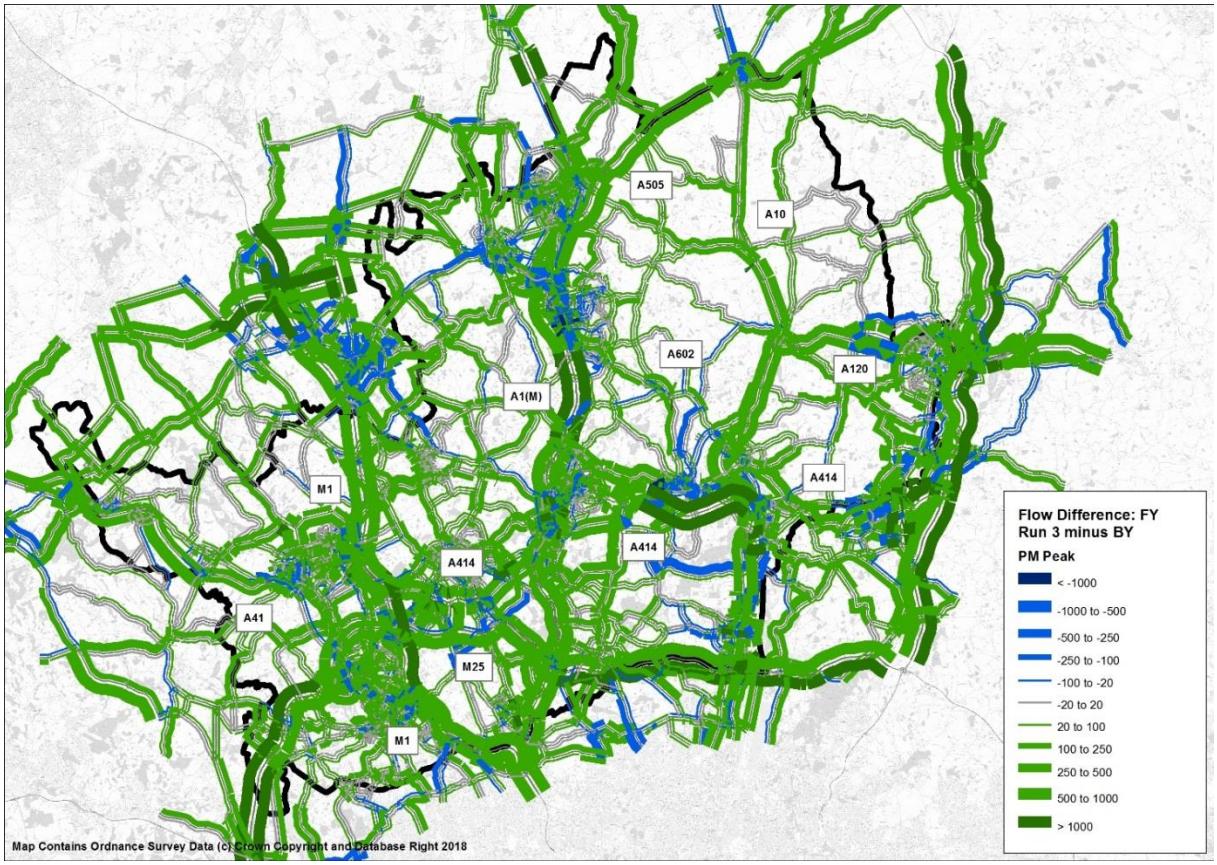


Figure 7.10: 2031 PM Peak Flow minus 2014 PM Peak (All Links)



7.3 Network Stress and Delays

7.3.1 Delays modelled in the highway assignment model are presented in the following sections in terms of link stress (volume over capacity – V/C) and junction (node) delay in minutes. The commentary given in the following sections is not intended as a comprehensive statement of network functionality, rather, points out where the main areas of congestion and delay are expected to occur on a corridor/strategic level given the assumptions inherent in these tests.

7.3.2 It should be noted that the reliability of the forecast results is dependent on the performance of the Base Year model, and that there are currently areas identified as not meeting WebTAG criteria.

7.3.3 Modelling shows the highest levels of congestion in the urban areas of Watford, St Albans, Hemel Hempstead, Hatfield, Hertford and Broxbourne towns. Modelling is also showing congestion (although to a lower level) in the urban areas of Welwyn Garden City, Stevenage, Hitchin, Letchworth Garden City, Baldock and Bishop's Stortford.

7.3.4 The following inter-urban links in Hertfordshire also show evidence of congestion in the 2031 model forecast:

- A414 through Hemel Hempstead and between the M1 and A10.
- Various sections of the M25, A1(M) and M1
- A120 around Bishop's Stortford
- A505 near Letchworth Garden City and around Royston
- A602 near Ware

Link Stress

7.3.5 The figures in this section show the 2031 modelled link stress in terms of volume over capacity (V/C) for the three modelled time periods.

Figure 7.11: COMET 2031 AM Peak Link V/C (Key Links)

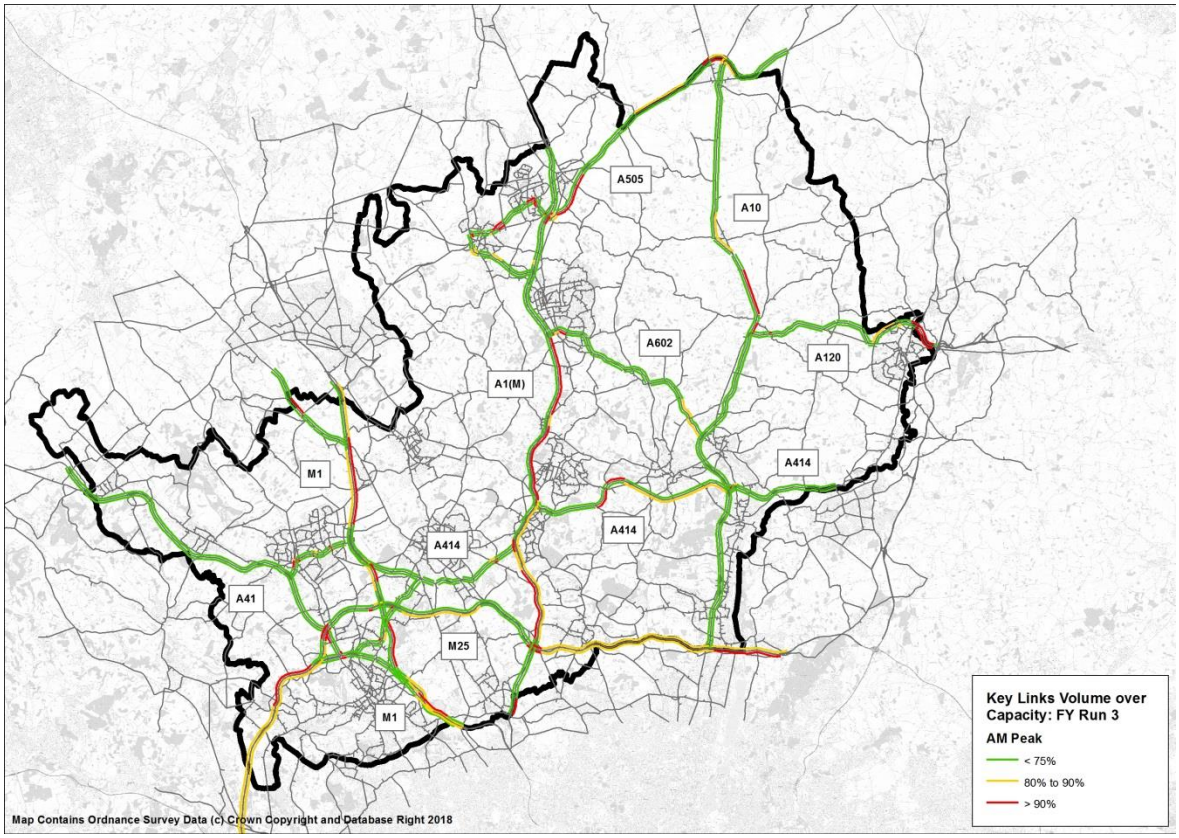


Figure 7.12: COMET 2031 AM Peak Link V/C (All Links)

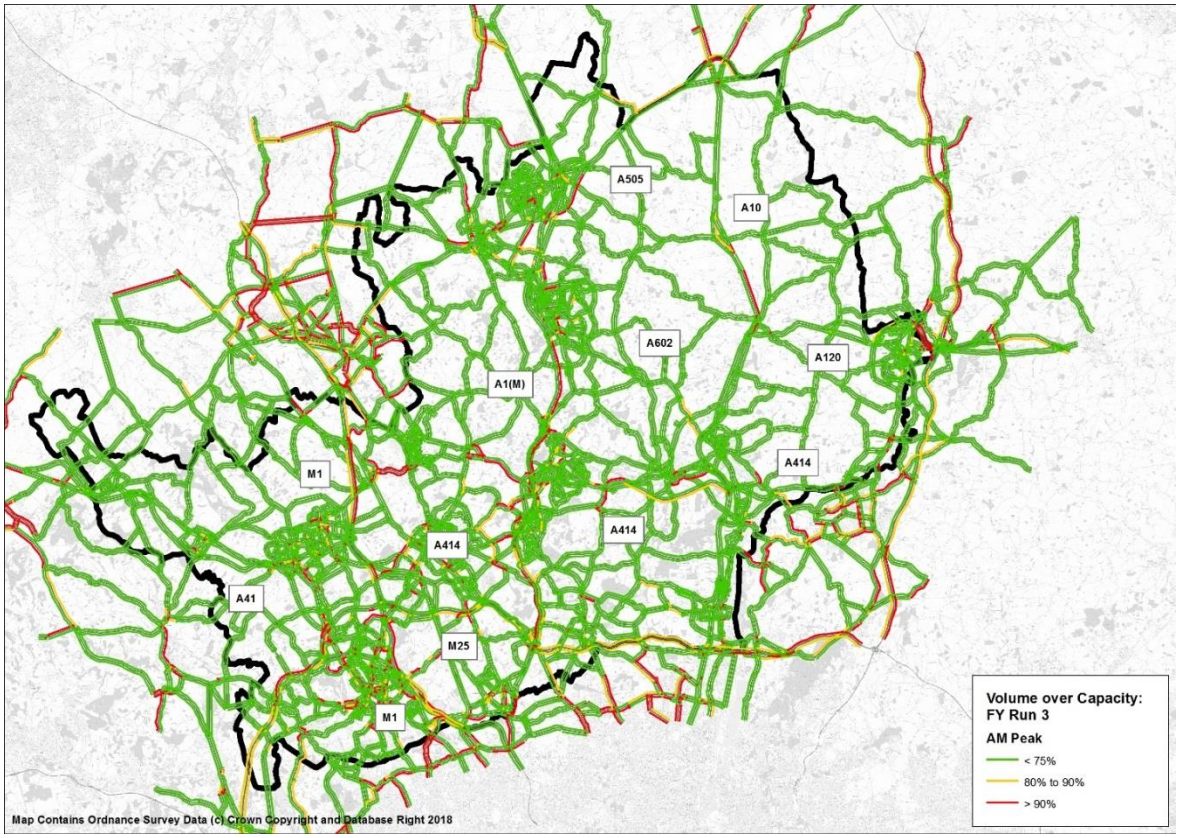


Figure 7.13: COMET 2031 Inter-peak Link V/C (Key Links)

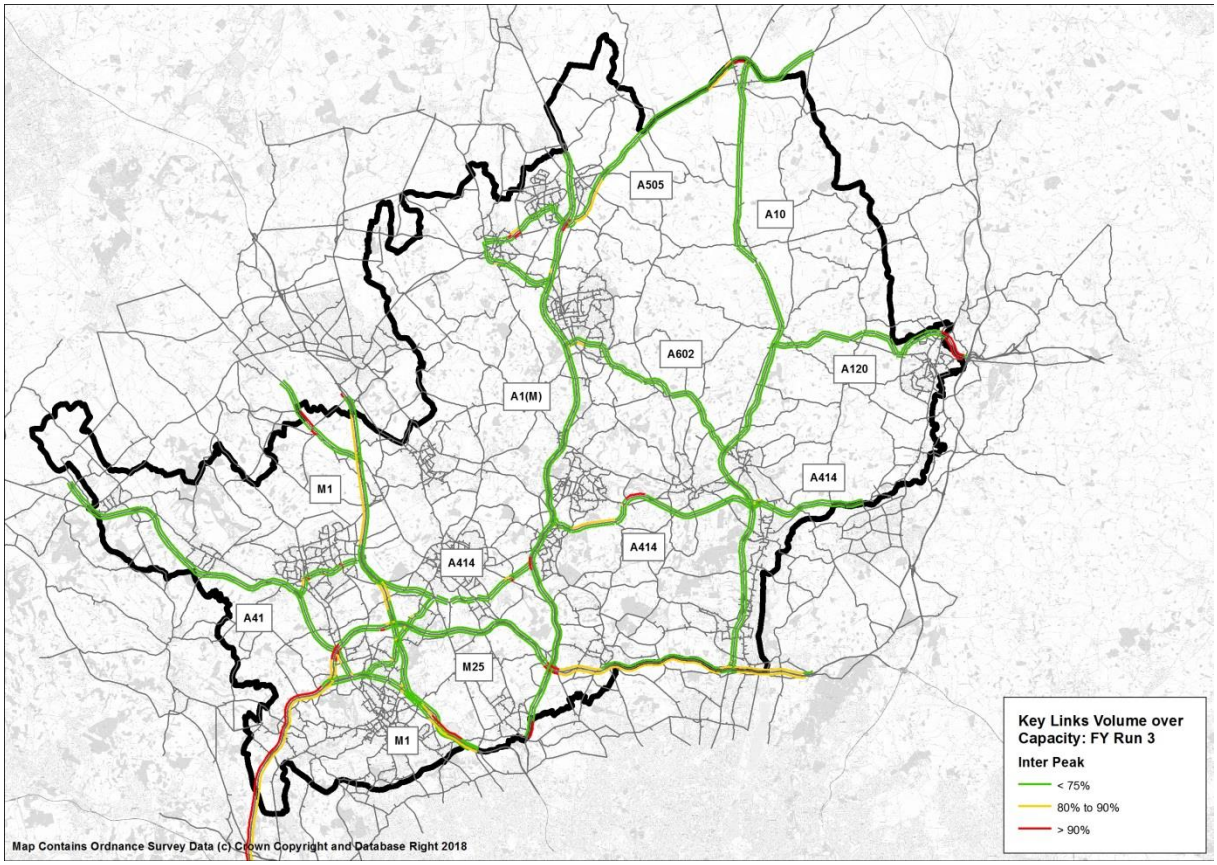


Figure 7.14: COMET 2031 Inter-peak Link V/C (All Links)

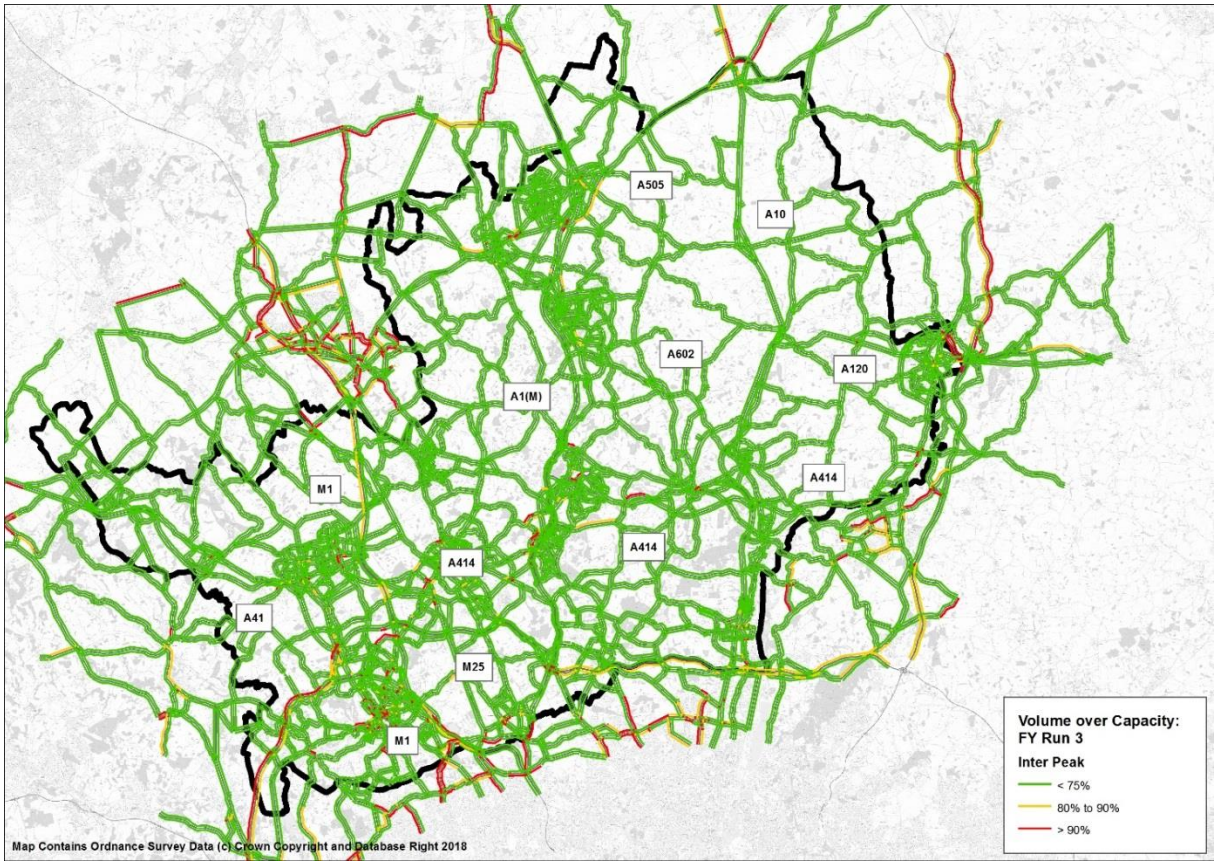


Figure 7.15: COMET 2031 PM Peak Link V/C (Key Links)

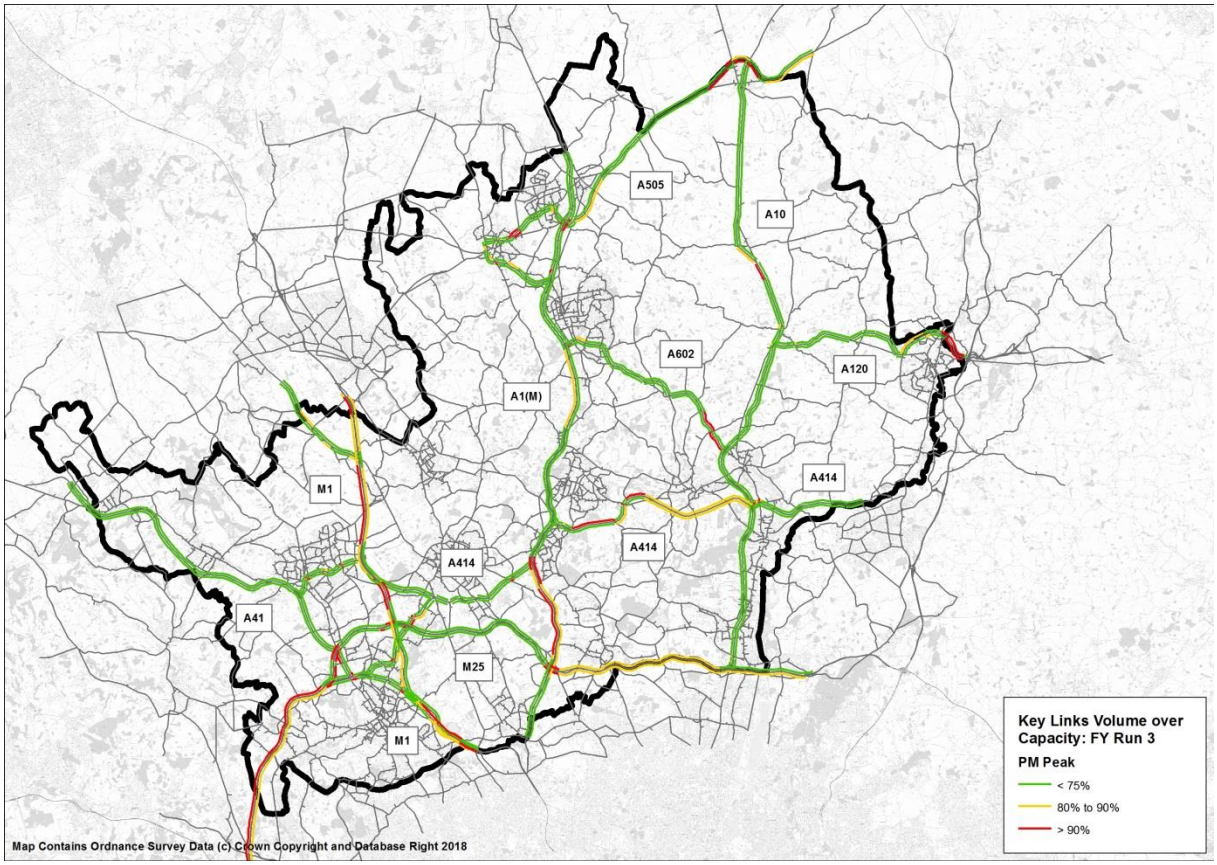
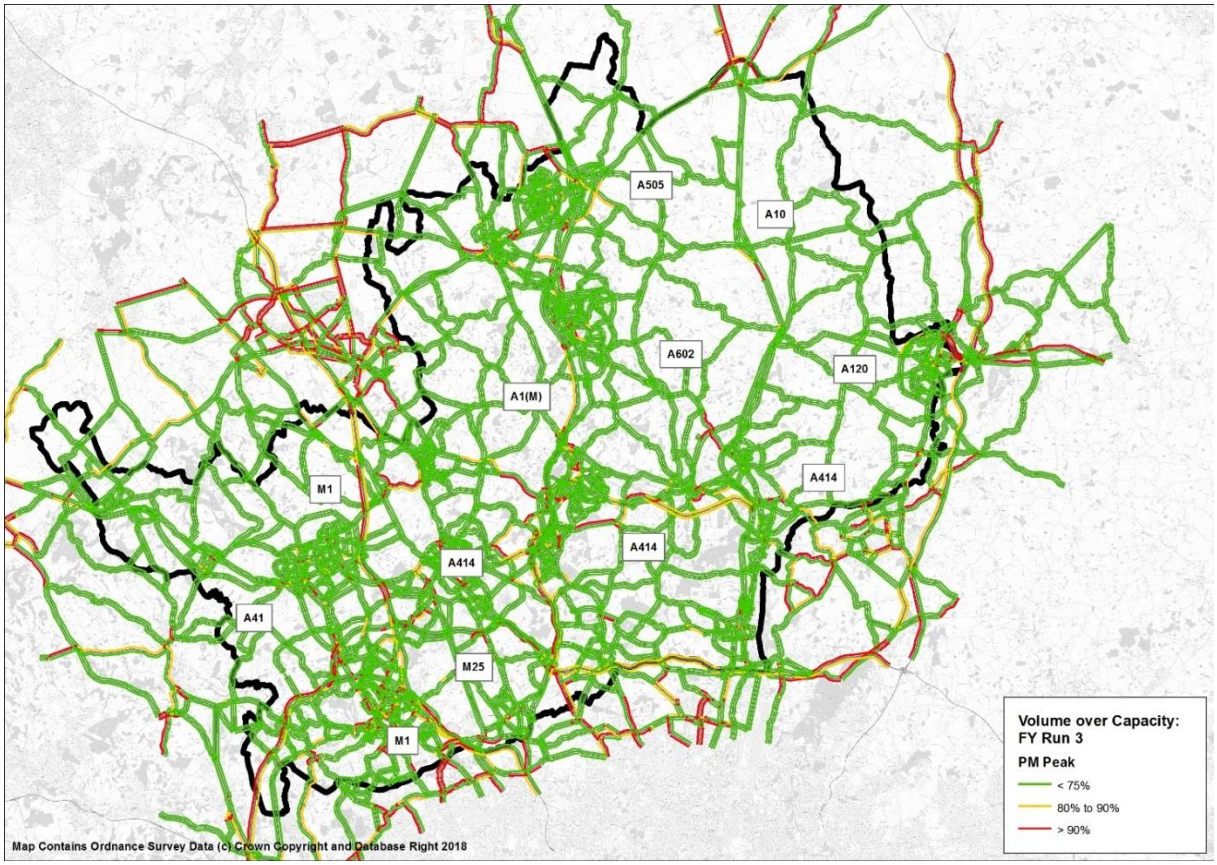


Figure 7.16: COMET 2031 PM Peak Link V/C (All Links)



Junction Delay

7.3.6 Junction delay per vehicle is presented in the following figures for the three modelled time periods in 2031. The delay shown for each junction is an average (weighted by vehicular flow) of the delays for each possible turn at that junction.

7.3.7 A notable observation regarding the level of junction delay concerns the A414 through Hertford. An expected outcome of introducing the A414 Hertford bypass would be a significant reduction in junction delay through the existing town due to strategic rerouting. However, as illustrated in several figures below (e.g. Figure 7.18, Figure 7.22 and Figure 7.28), delay in the vicinity of the Bluecoats roundabout in Hertford remains high in the forecast scenario. Indeed, in the PM Peak of the 2031 forecast, delay at this location is higher than in the Base Year. This is primarily due to high levels of vehicle loading and delay from zones representing Hertford town centre (zone 2099) and the industrial/residential area to the east of the town centre (zone 2139). This is a known area where COMET exhibits high levels of delay on zone access points, and is being addressed (with zone disaggregation and zone access point reconfiguration) as part of the ongoing model enhancement work (COMET version 5).

Figure 7.17: COMET 2031 AM Peak Delay (Key Junctions)

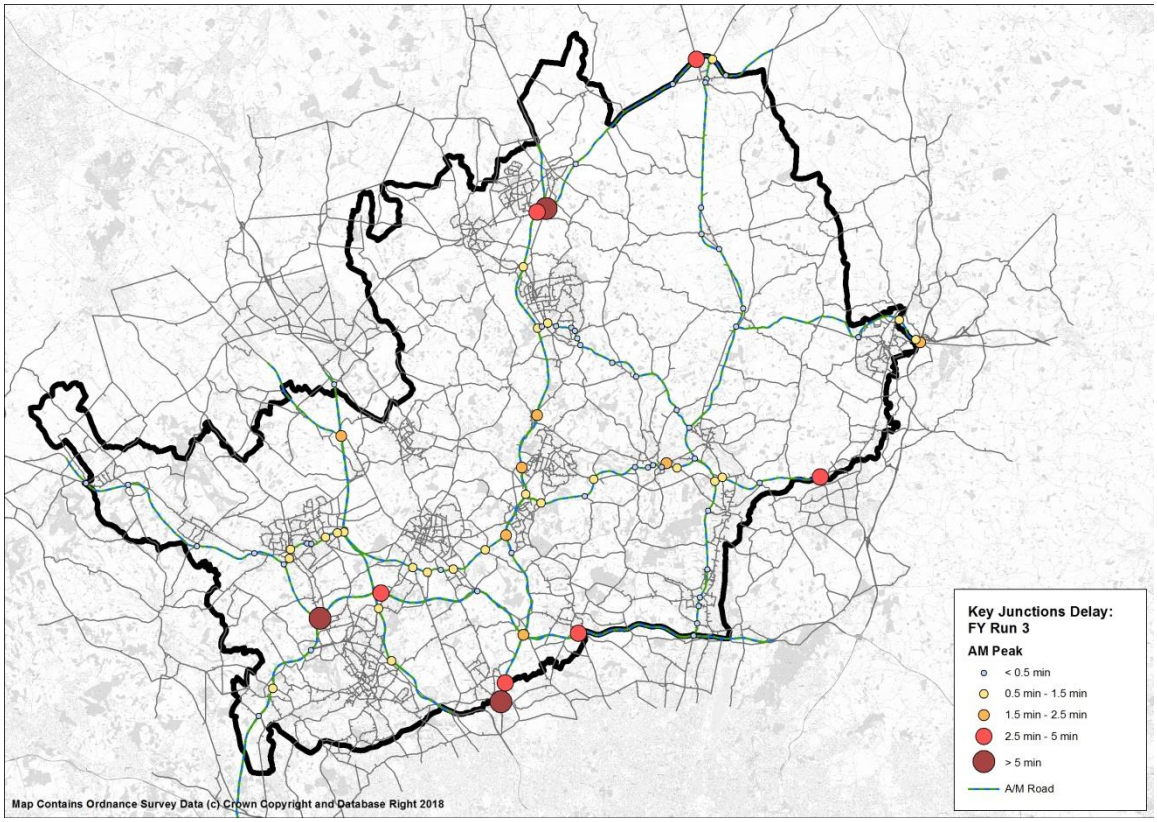


Figure 7.18: COMET 2031 AM Peak Delay (All Nodes)

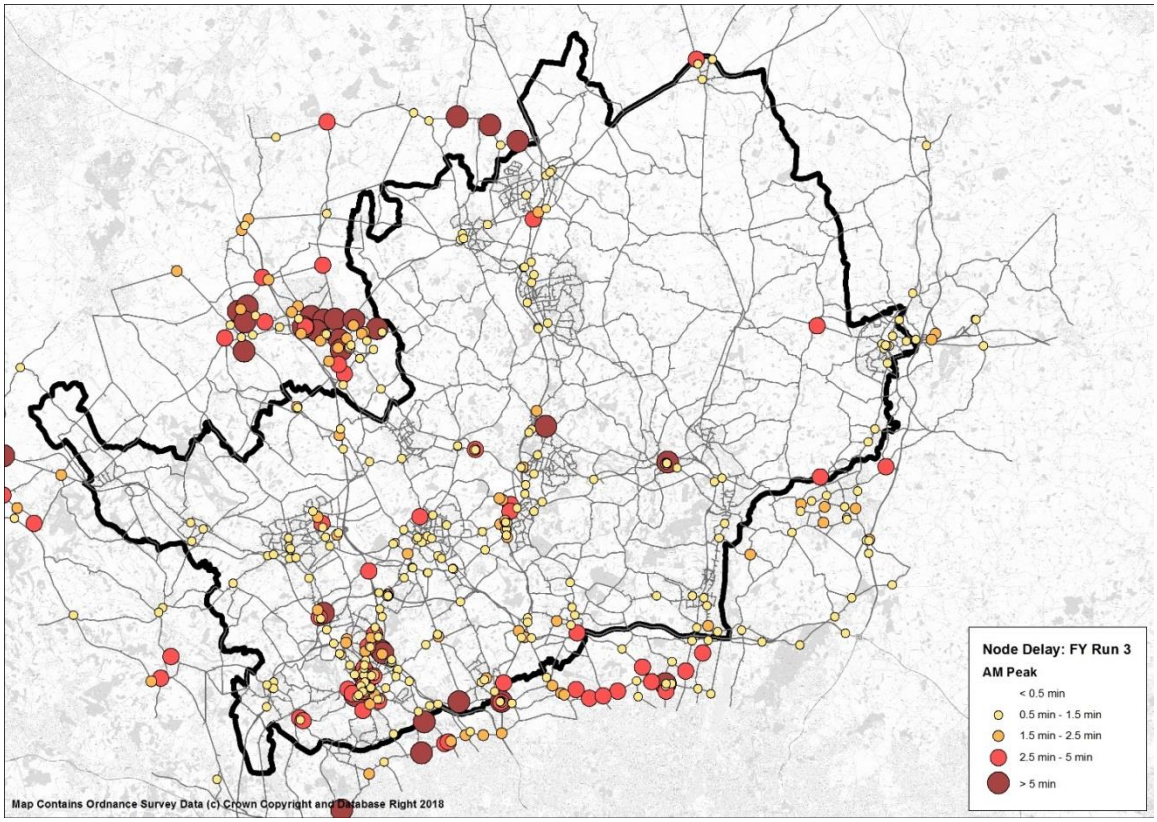


Figure 7.19: COMET 2031 Inter-peak Delay (Key Junctions)

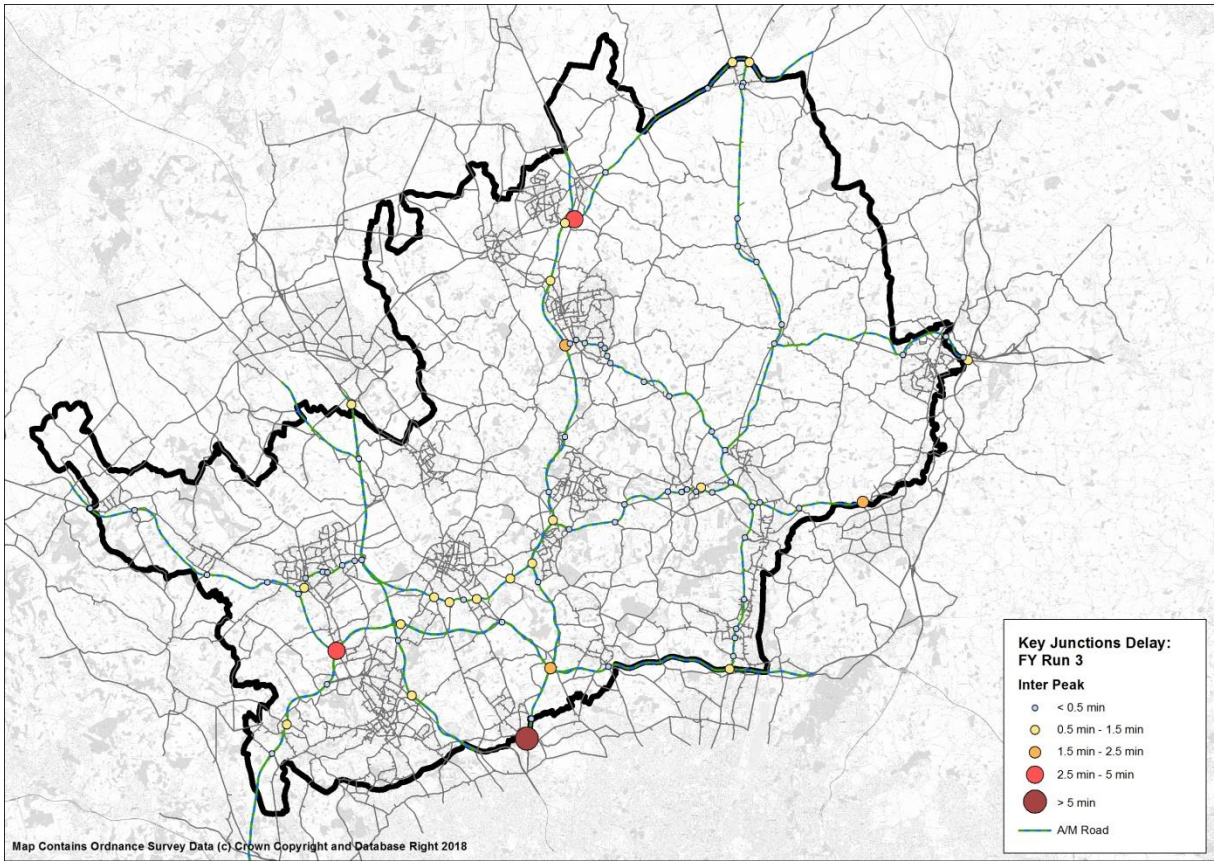


Figure 7.20: COMET 2031 Inter-peak Delay (All Nodes)

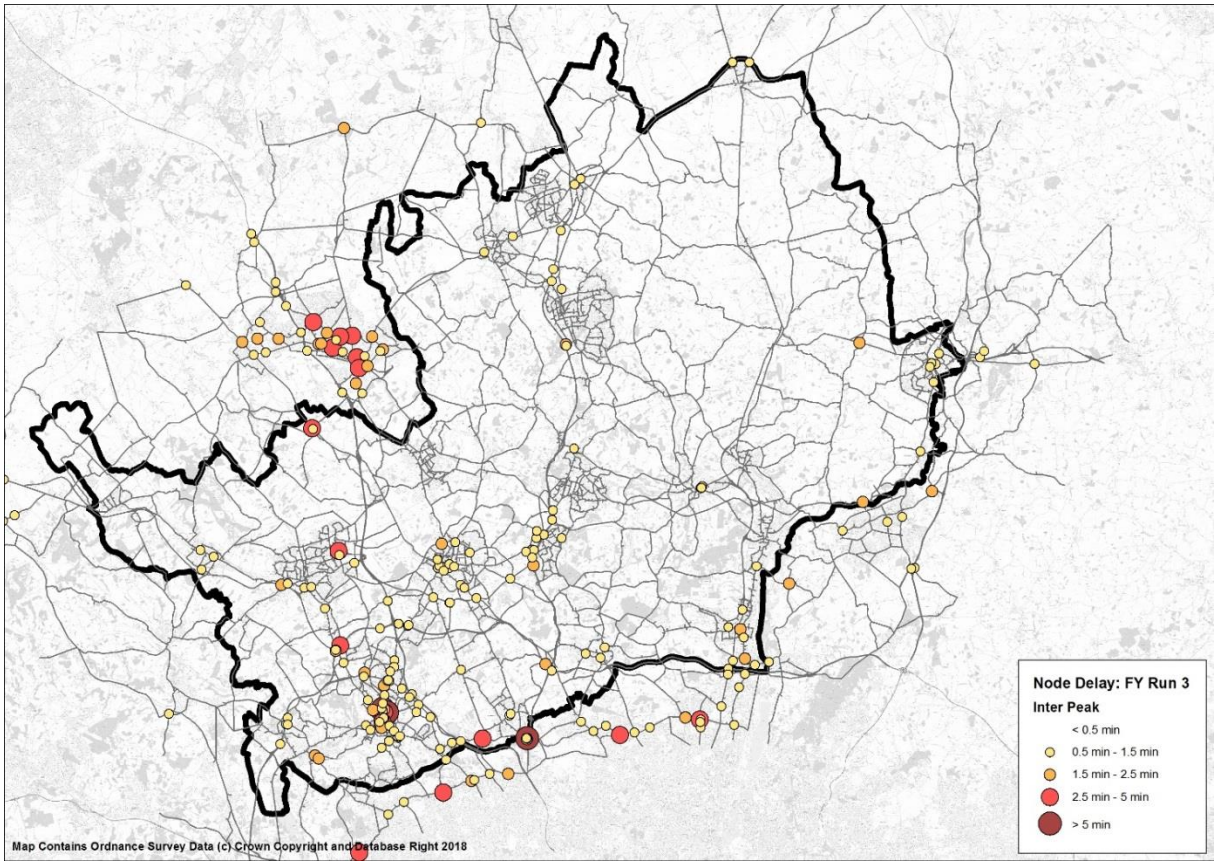


Figure 7.21: COMET 2031 PM Peak Delay (Key Junctions)

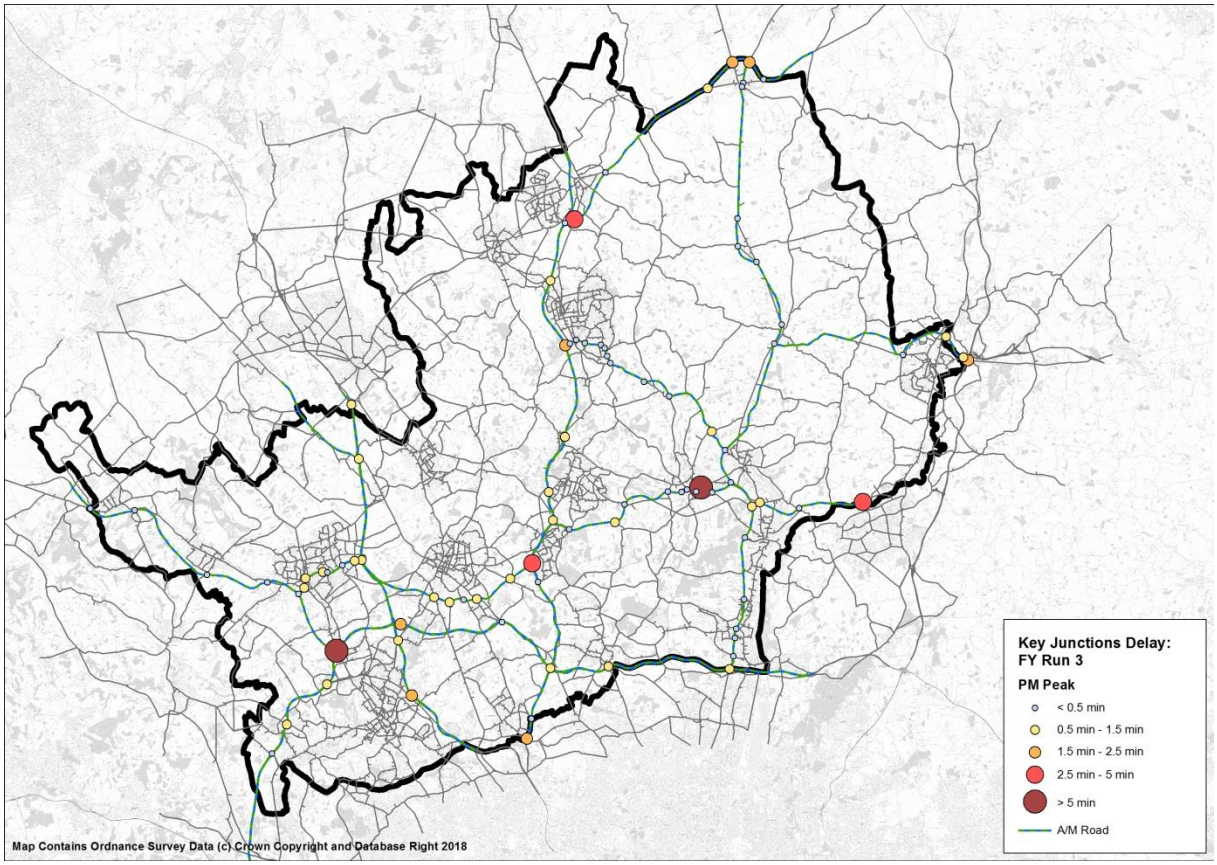
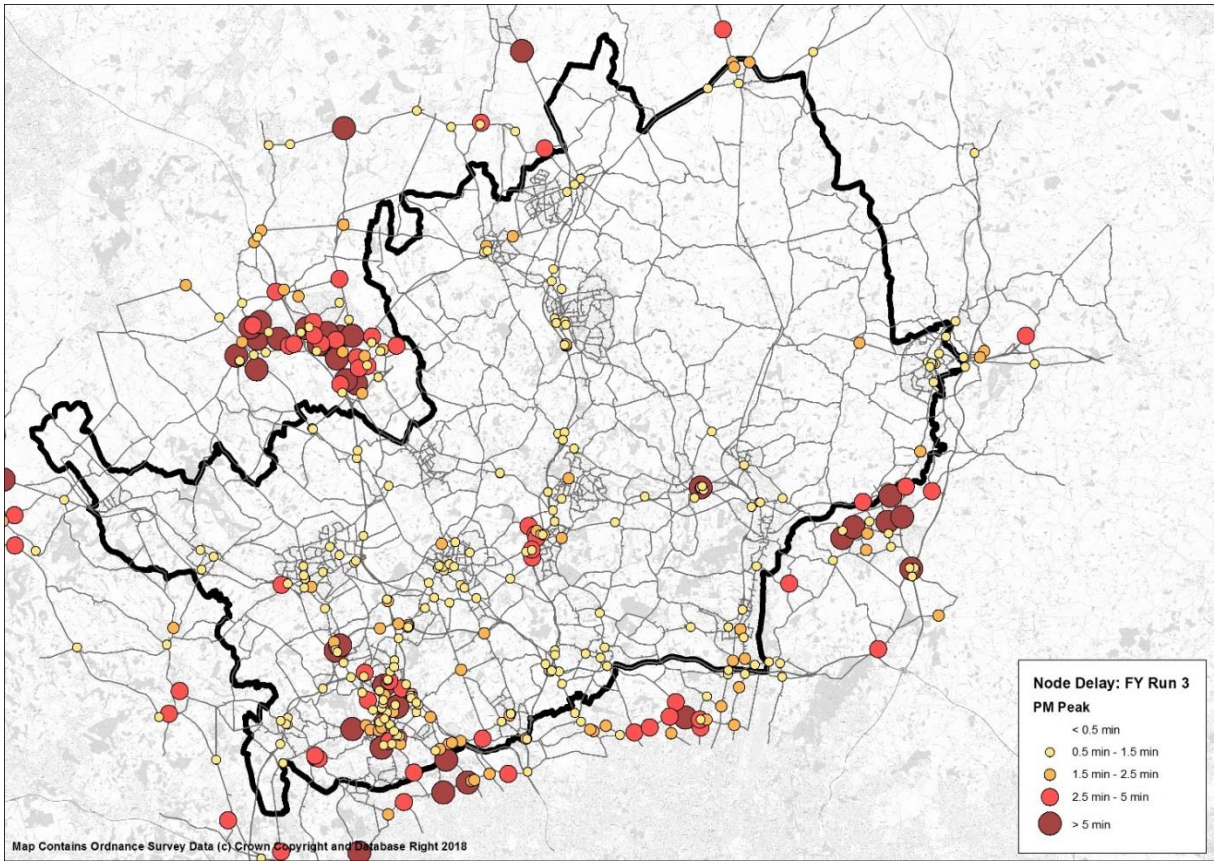


Figure 7.22: COMET 2031 PM Peak Delay (All Nodes)



7.3.8 The following figures show the node delay difference between the 2014 Base Year and 2031.

Figure 7.23: 2031 AM Peak Delay minus 2014 AM Peak (Key Junctions)

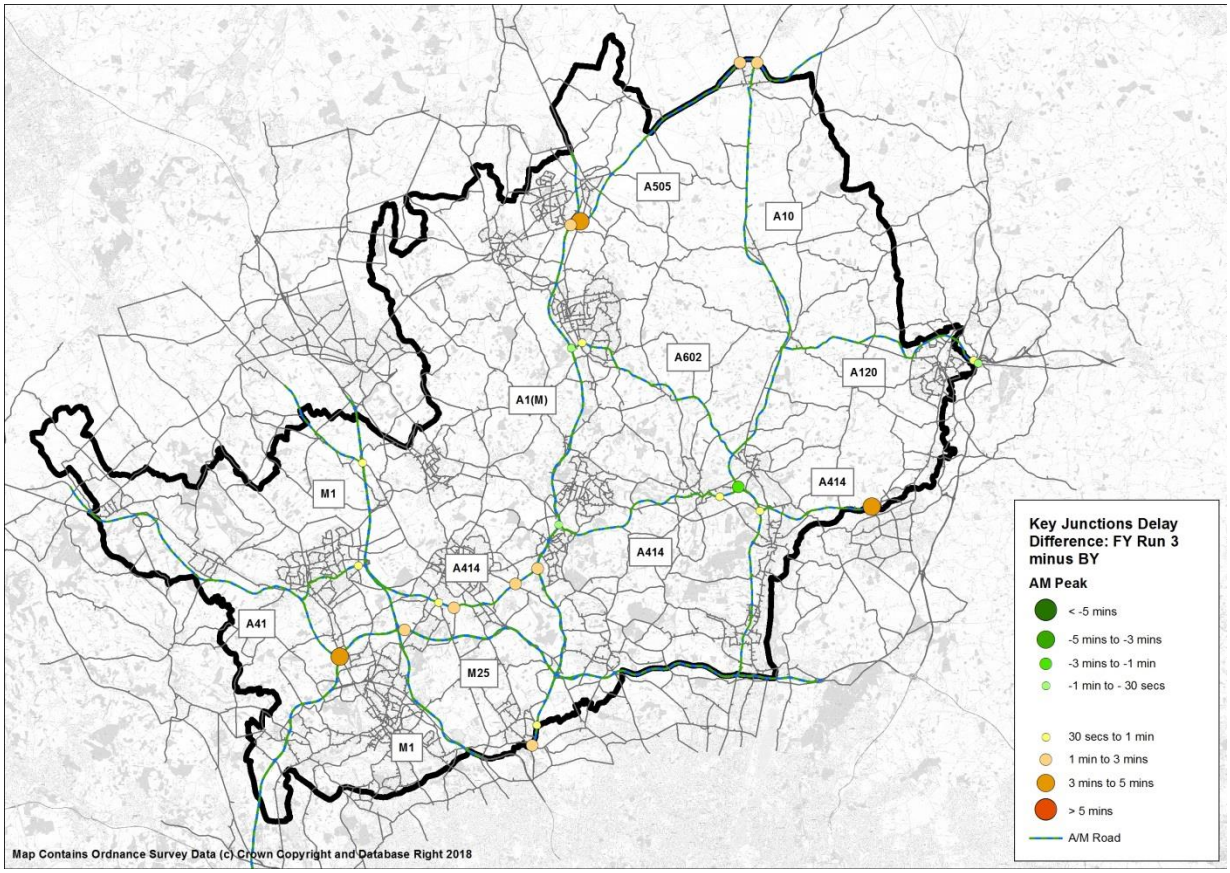


Figure 7.24: 2031 AM Peak Delay minus 2014 AM Peak (All Nodes)

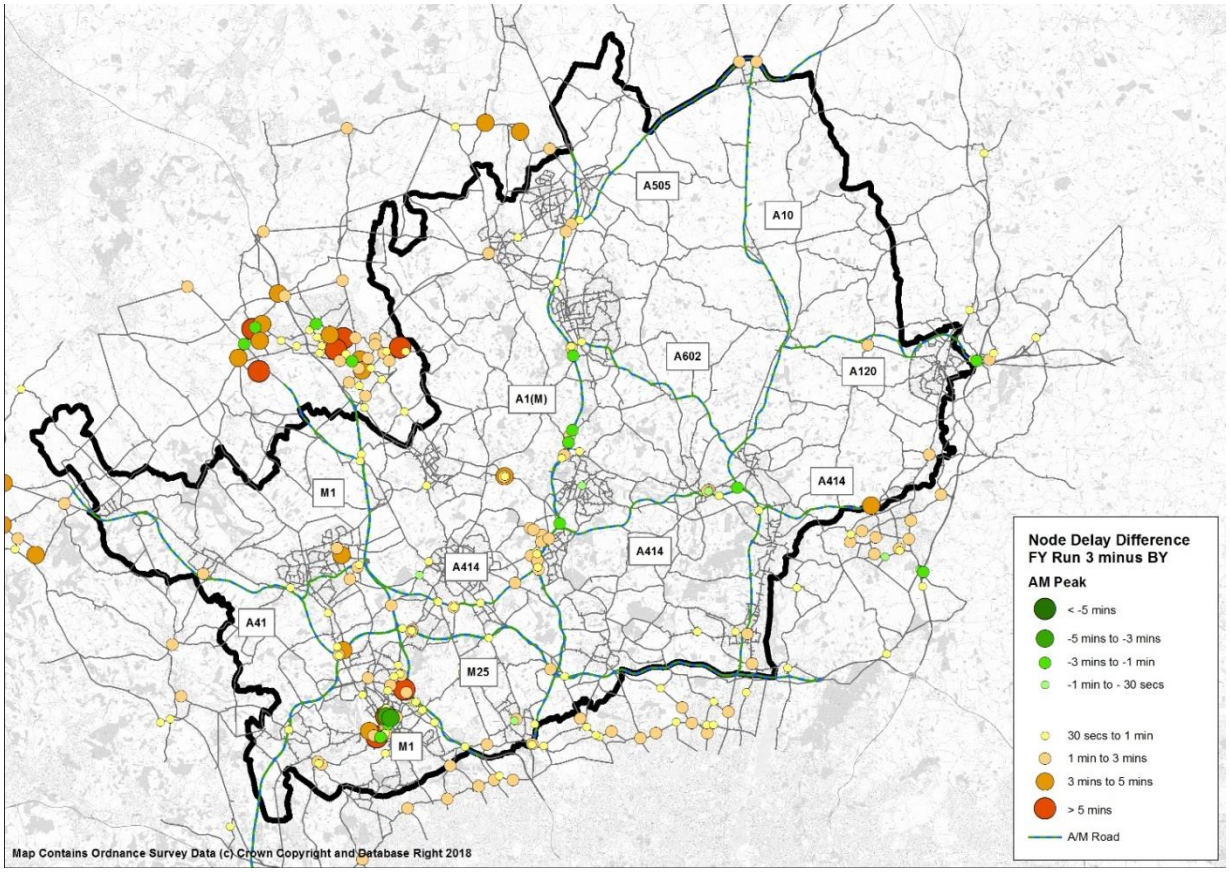


Figure 7.25: 2031 Inter-peak Delay minus 2014 Inter-peak (Key Junctions)

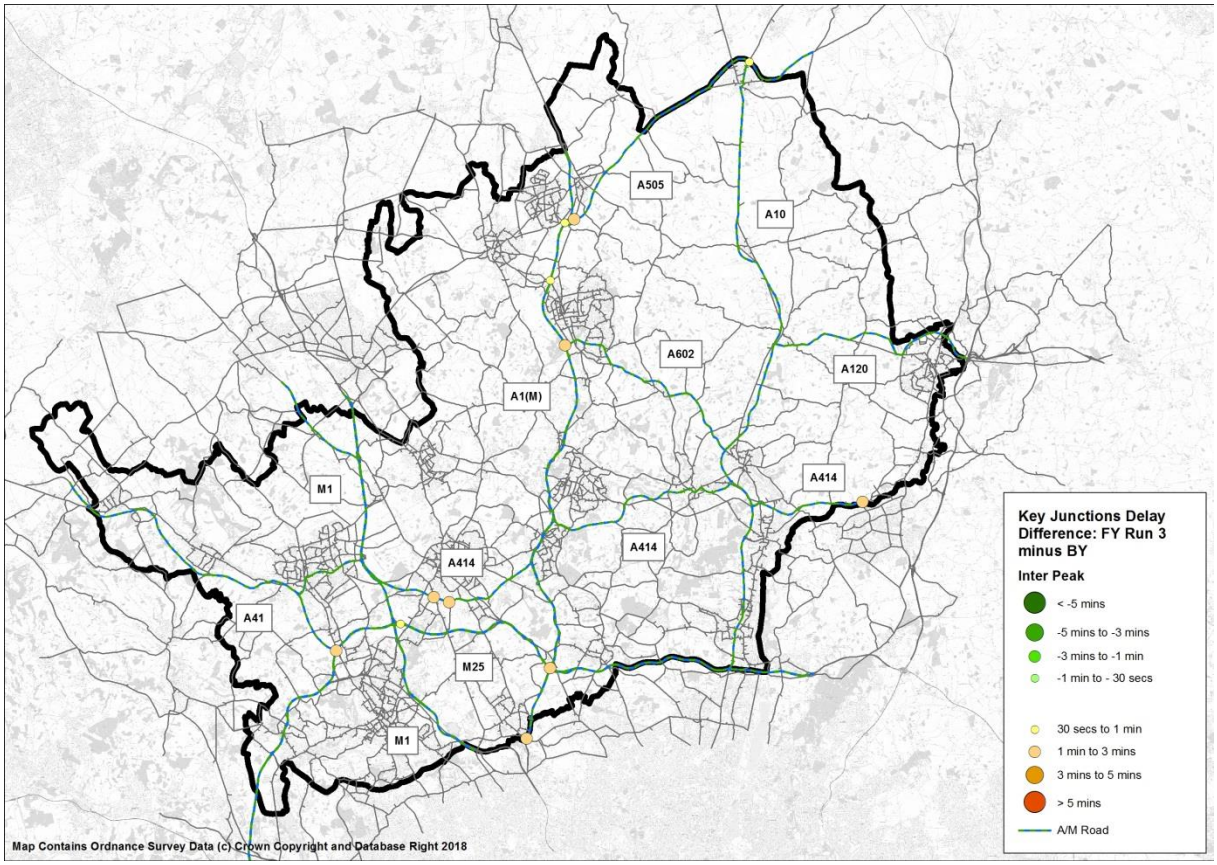


Figure 7.26: 2031 Inter-peak Delay minus 2014 Inter-peak (All Nodes)

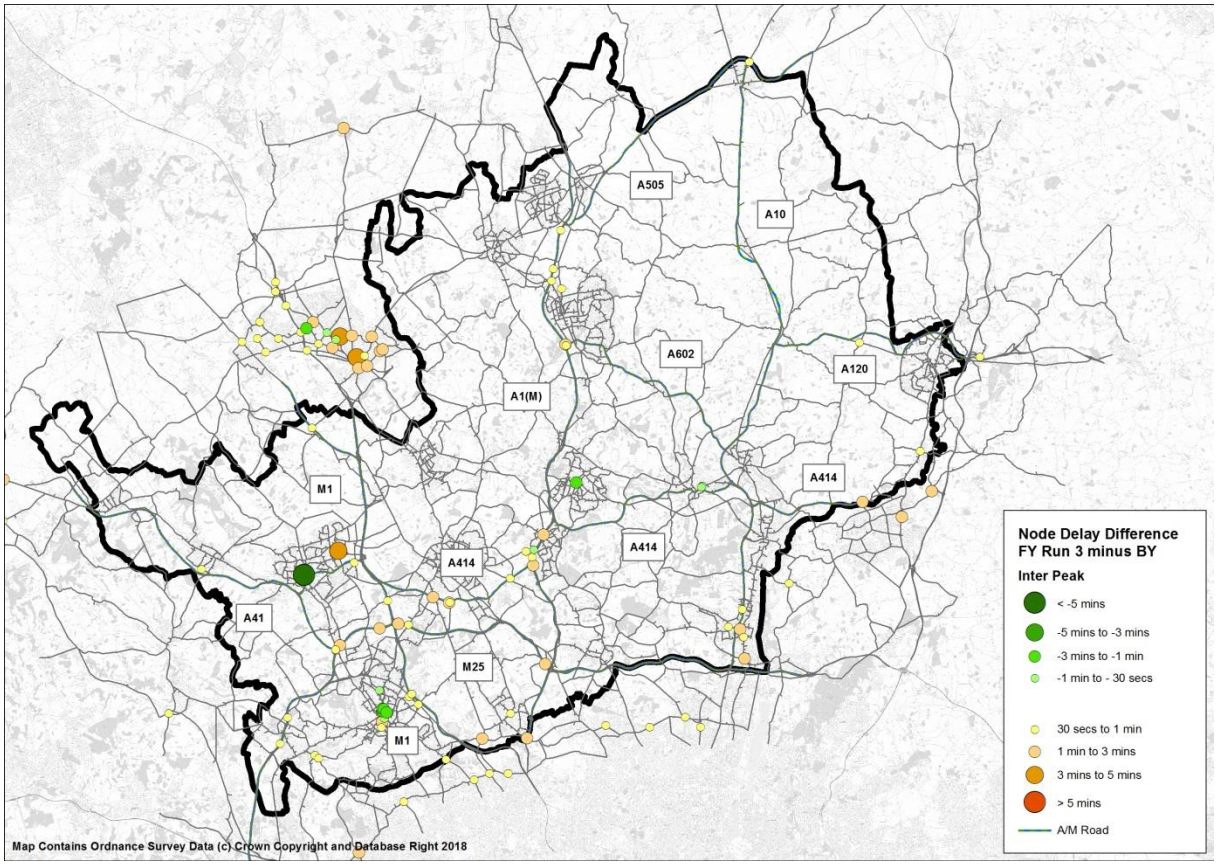


Figure 7.27: 2031 PM Peak Delay minus 2014 PM Peak (Key Junctions)

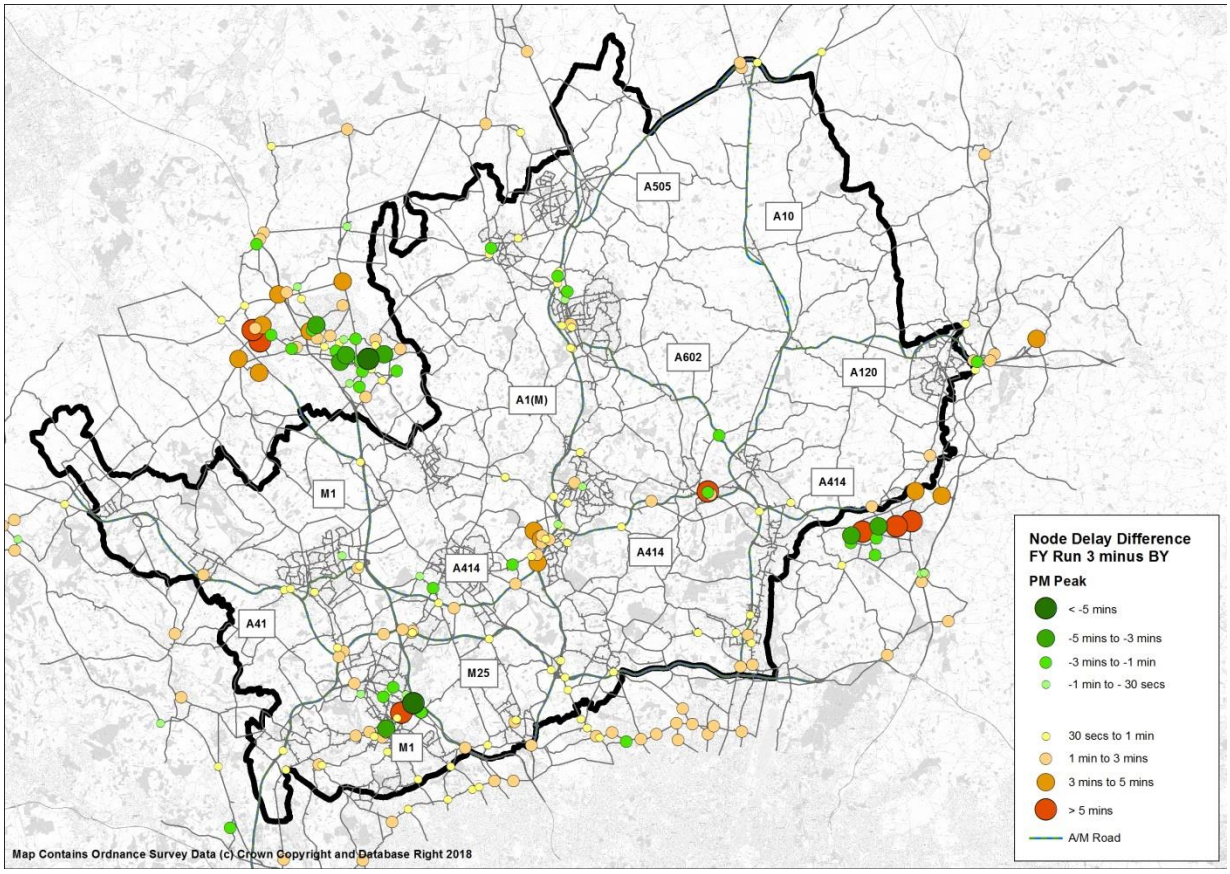
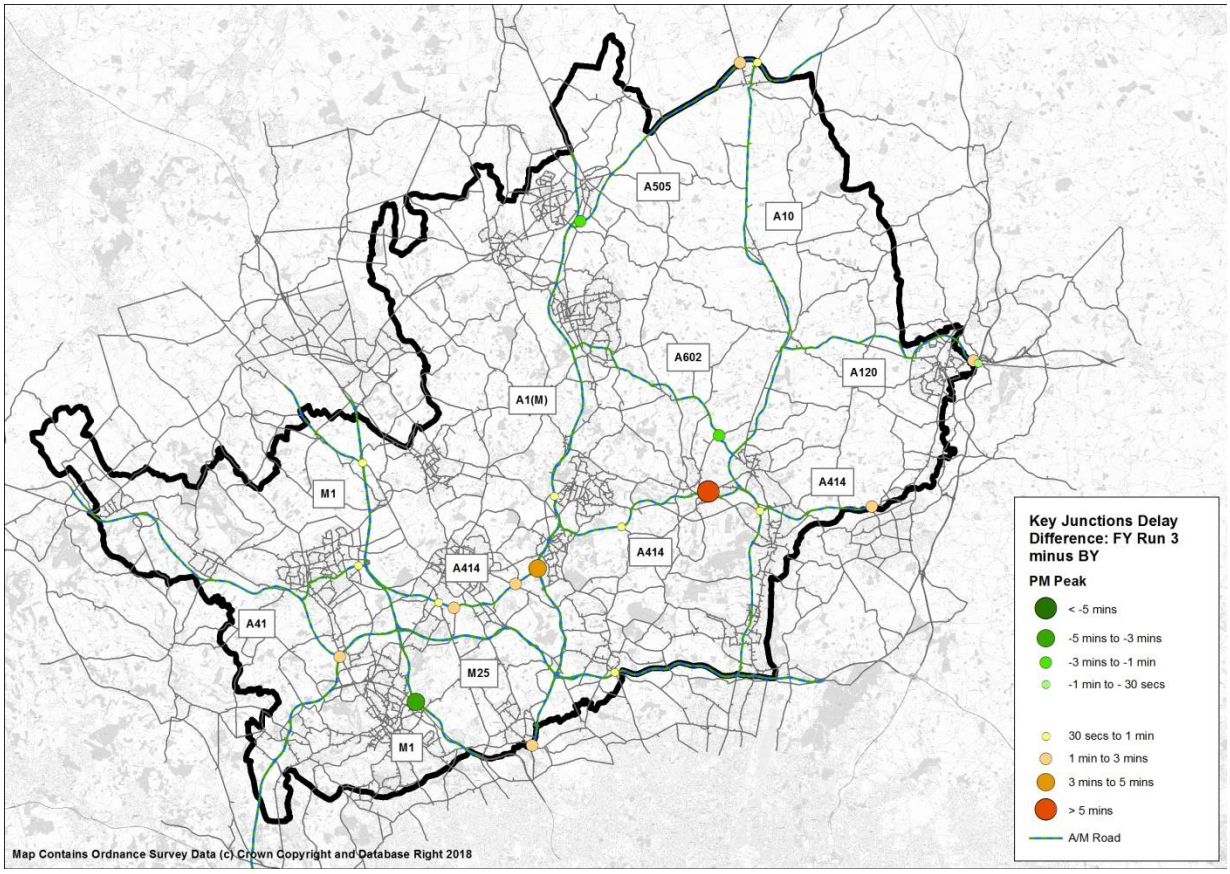


Figure 7.28: 2031 PM Peak Delay minus 2014 PM Peak (All Nodes)



Inter-urban Journey Times

7.3.9 Increased congestion in the Forecast Year causes a rise in the average journey time between urban areas in Hertfordshire. Changes in journey times between key towns are shown in *Appendix I: Inter-urban Journey Times*. The figures show journey times for:

- Base Year (2014)
- Local Plan DS (2031) – see description in Table 2.1
- Local Plan Run 3 (2031) – current forecast

8. Public Transport Forecast Results

8.1 Hertfordshire Statistics

8.1.1 The model forecast of change in public transport usage in Hertfordshire is summarised in the tables below. It should be noted that the COMET rail model does not consider capacity or passenger crowding, and is therefore unconstrained by congestion. While the model forecast is not considered implausibly high as a central assumption, it might require capacity improvements on the rail network to achieve.

8.1.2 As shown in Table 8.1, rail demand increases significantly (by 22%-42%), while bus demand falls slightly. Growth is generally larger in the inter-peak – this is due to the higher growth in "other" trips compared to commuting trips (see paragraph 5.7.9 for explanation of this trend). Bus demand in the AM and PM Peaks falls at a higher rate than in the inter-peak due to increased highway congestion in the peak hours.

Table 8.1: Public Transport Passenger Distance (passenger kms), Hertfordshire Only, Hourly

Period	Mode	2014 Base	2031 Local Plan	Change
AM	Rail	1,257,487	1,533,159	22%
IP	Rail	409,341	581,058	42%
PM	Rail	1,082,830	1,348,657	25%
AM	Bus	120,724	102,192	-15%
IP	Bus	116,638	111,120	-5%
PM	Bus	105,954	88,970	-16%

8.1.3 Table 8.2 presents the forecast results in terms of passenger boardings in Hertfordshire. It should be noted that whilst bus travel accounts for approximately 40% of total passenger transport boardings, it only represents a small minority (~8%) of total passenger distance. This is because rail trips are substantially longer.

8.1.4 The number of rail boardings in the AM Peak is much larger than in other periods, as much of the demand is heading outside Hertfordshire as commuting trips.

8.1.5 It should also be noted that while the model forecast for rail growth is fairly high relative to other modes, it is quite likely to be lower than the actual growth that will occur. UK rail growth in the past two decades has been close to 4% per year, which if continued, would imply 95% growth from 2014 to 2031. While past trends may not continue, it is likely that the model's rail growth forecast is in fact conservative.

Table 8.2: Public Transport Passenger Boardings, Hertfordshire Only

Period	Mode	2014 Base	2031 Local Plan	Change
AM	Rail	18,872	23,796	26%
IP	Rail	4,083	6,923	70%
PM	Rail	5,415	8,975	66%
AM	Bus	8,785	9,050	3%
IP	Bus	8,994	9,794	9%
PM	Bus	6,841	7,125	4%

8.1.6 Table 8.3 shows the average public transport fare per journey. The fare values are the actual average fare paid by an average passenger (i.e. *(Sum of demand x Cost)/Sum of Demand*.

8.1.7 The average fare increase for rail trips is similar to the input fare growth assumption of 18% (see Table 5.4). It is very slightly larger for bus trips, suggesting some slight lengthening of the average trip. However, the overall average public transport fare increase is much larger than this, at around 30%. This is because demand has shifted from bus travel (which has lower fares) to rail travel (which has higher fares).

Table 8.3: Average Public Transport Fare per Journey, Hertfordshire Only, 2010 prices

Period	Mode	2014 Base	2031 Local Plan	Change
AM	Rail	£8.48	£9.28	9%
IP	Rail	£8.32	£9.26	11%
PM	Rail	£7.84	£8.98	15%
AM	Bus	£0.91	£1.09	20%
IP	Bus	£0.88	£1.05	19%
PM	Bus	£0.87	£1.05	21%
AM	All	£6.07	£7.40	22%
IP	All	£3.10	£4.34	40%
PM	All	£3.77	£5.30	41%

8.1.8 Table 8.4 shows the average public transport journey distance per journey. Neither bus nor rail average journey distance change significantly, however, the overall public transport journey distance is notably higher. This is because rail growth is predicted to be higher than bus growth, and rail trips are significantly longer in the first place.

Table 8.4: Average Public Transport Journey Distance (km), Hertfordshire Only

Period	Mode	2014 Base	2031 Local Plan	Change
AM	Rail	38.24	36.79	-4%
IP	Rail	37.76	34.21	-9%
PM	Rail	36.02	33.30	-8%
AM	Bus	8.88	8.27	-7%
IP	Bus	7.71	7.37	-4%
PM	Bus	7.89	7.69	-3%
AM	All	28.89	28.88	0%
IP	All	16.67	18.12	9%
PM	All	19.60	21.41	9%

Bus Passenger Flow

8.1.9 Flow difference plots for bus demand are presented below. These show the differences between 2031 and 2014 passenger flow. Red bars indicate an increase in flow, while green bars indicate a decrease.

Figure 8.1: Bus Passenger Flow Change, 2014 to 2031, AM Peak Hourly Flow

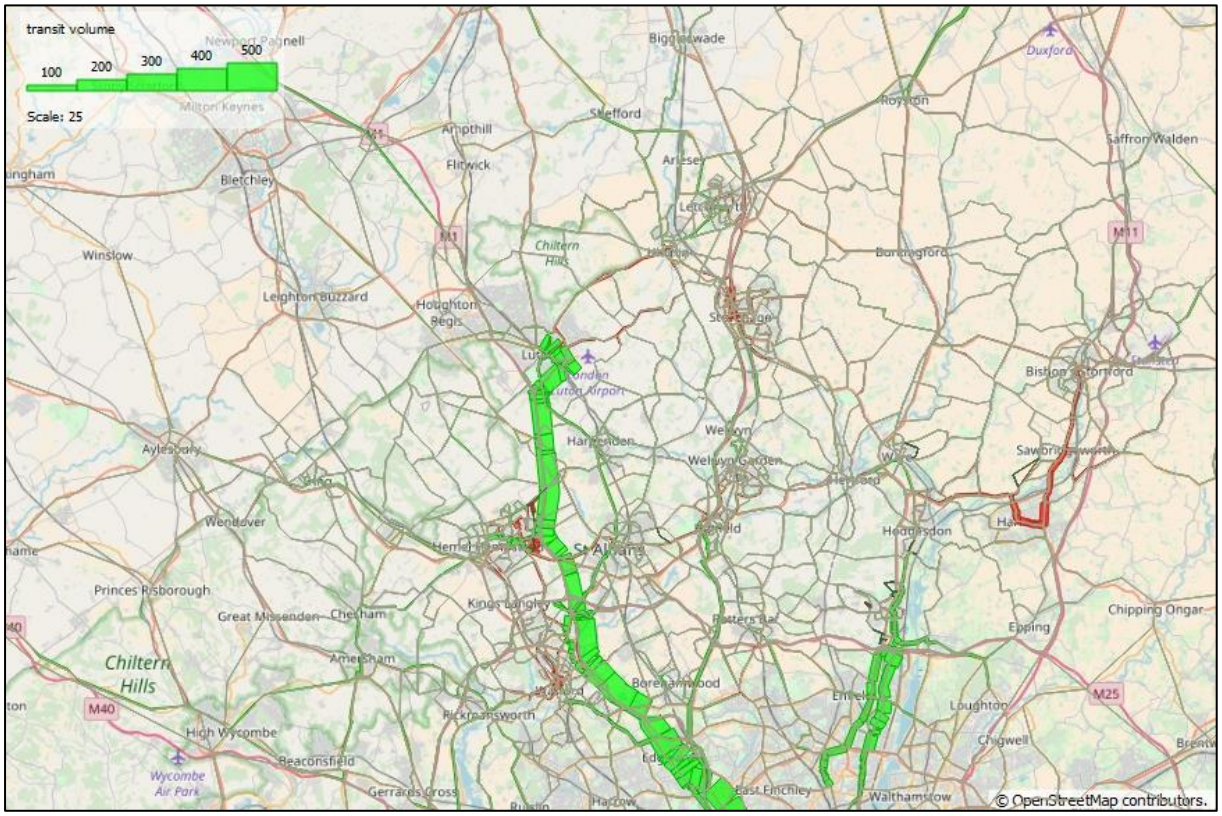


Figure 8.2: Bus Passenger Flow Change, 2014 to 2031, Inter peak Hourly Flow

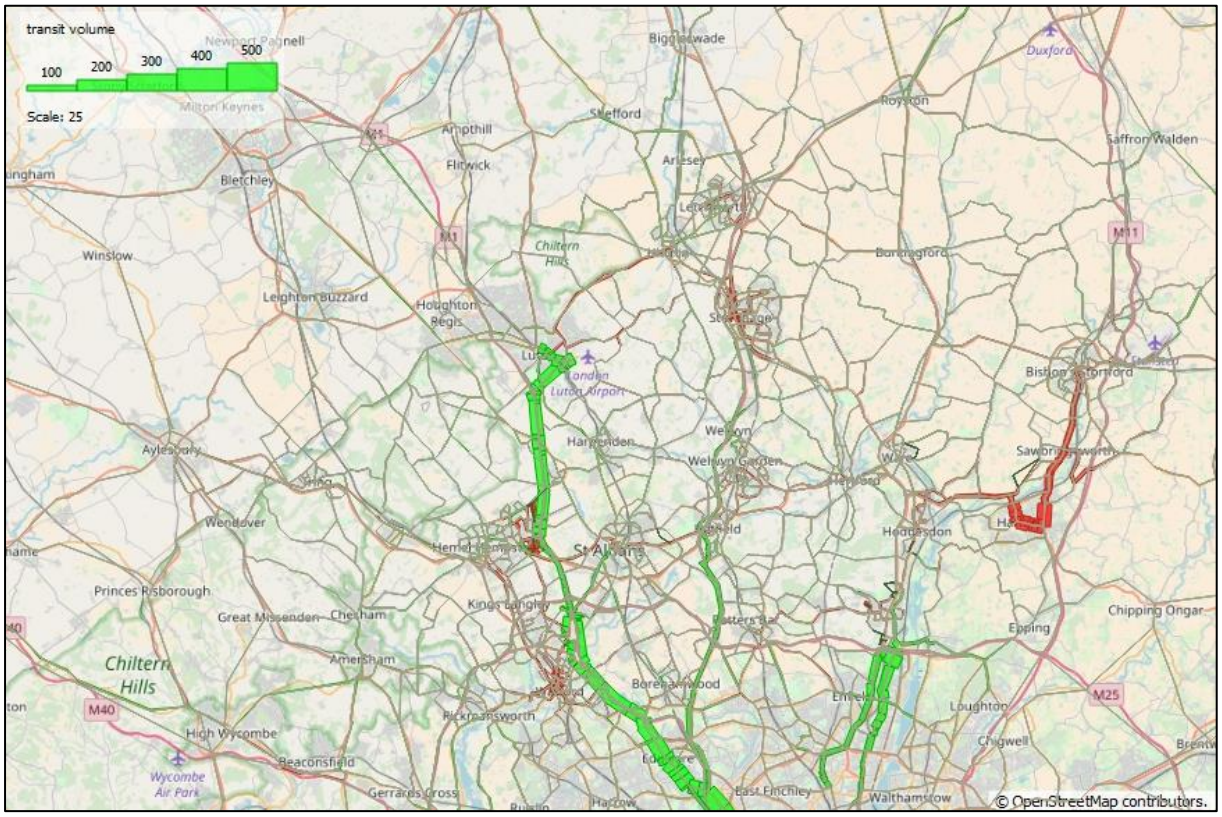
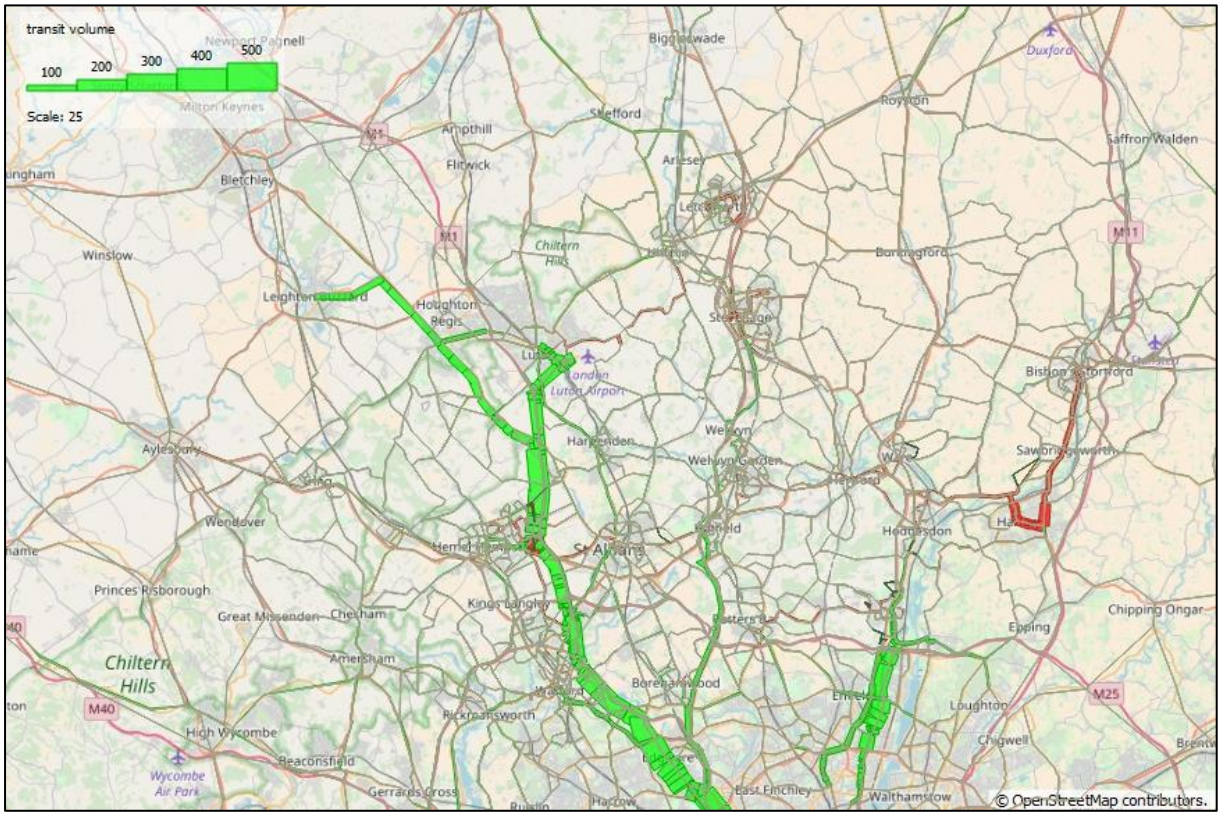


Figure 8.3: Bus Passenger Flow Change, 2014 to 2031, PM Peak Hourly Flow



8.1.10 The main increase in bus passenger flow is modelled between the Gilston development and Harlow town centre. The increased bus passenger flow is likely to be related to the introduction of an associated bus link into Harlow.This increase in passenger flow also continues (to a lesser extent) to Bishop's Stortford.

8.1.11 The largest decrease in bus passengers flow is observed along M1 corridor (where rail services between Luton and London operate) with a decrease of up to ~400 passengers in the southbound direction during AM peak and of a similar magnitude in the northbound direction during PM peak. This is due to:

- The growth in personal incomes is likely to be higher than the growth in rail fares. As incomes rise, rail becomes relatively more attractive than bus, so some demand moves from bus to rail (where the modes compete on the same corridor)
- Increasing congestion on the highway network encourages shift from bus (and highway) to rail (where the modes compete on the same corridor)

8.1.12 On the M1 corridor, for example, the decrease in bus passenger flow is likely to be related to a rise in rail passenger flow on Thameslink and Midland Main Line. The decrease in bus travel associated with this modal shift does not extend to any significant extent beyond Luton.

8.1.13 A decrease in bus passenger is also modelled along the Cheshunt-Enfield corridor (which has a competing rail service).

Rail Passenger Flow

8.1.14 Similar plots for rail flow are shown below. Of necessity, a different scale is used for the rail flows, as these are very much larger than bus.

Figure 8.4: Rail Passenger Flow Change, 2014 to 2031, AM Peak, Hourly Flow

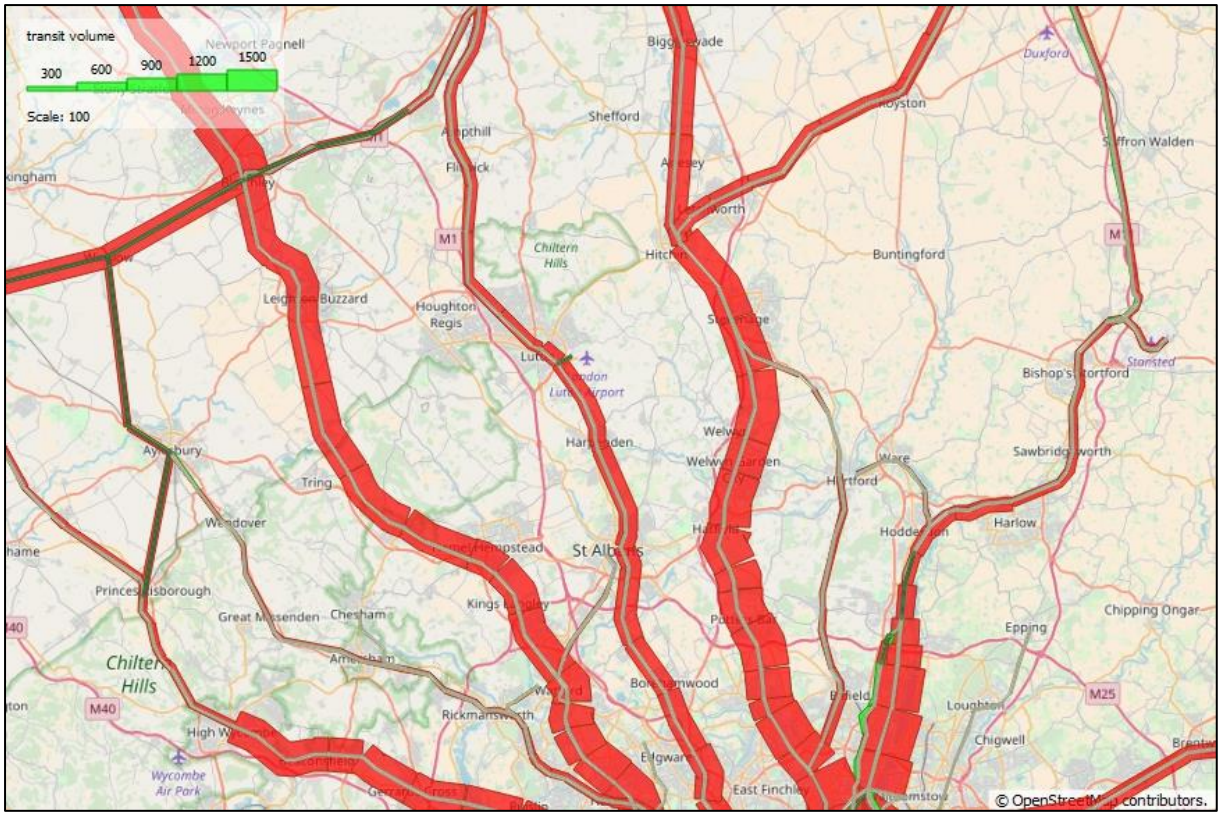


Figure 8.5: Rail Passenger Flow Change, 2014 to 2031, Inter peak, Hourly Flow

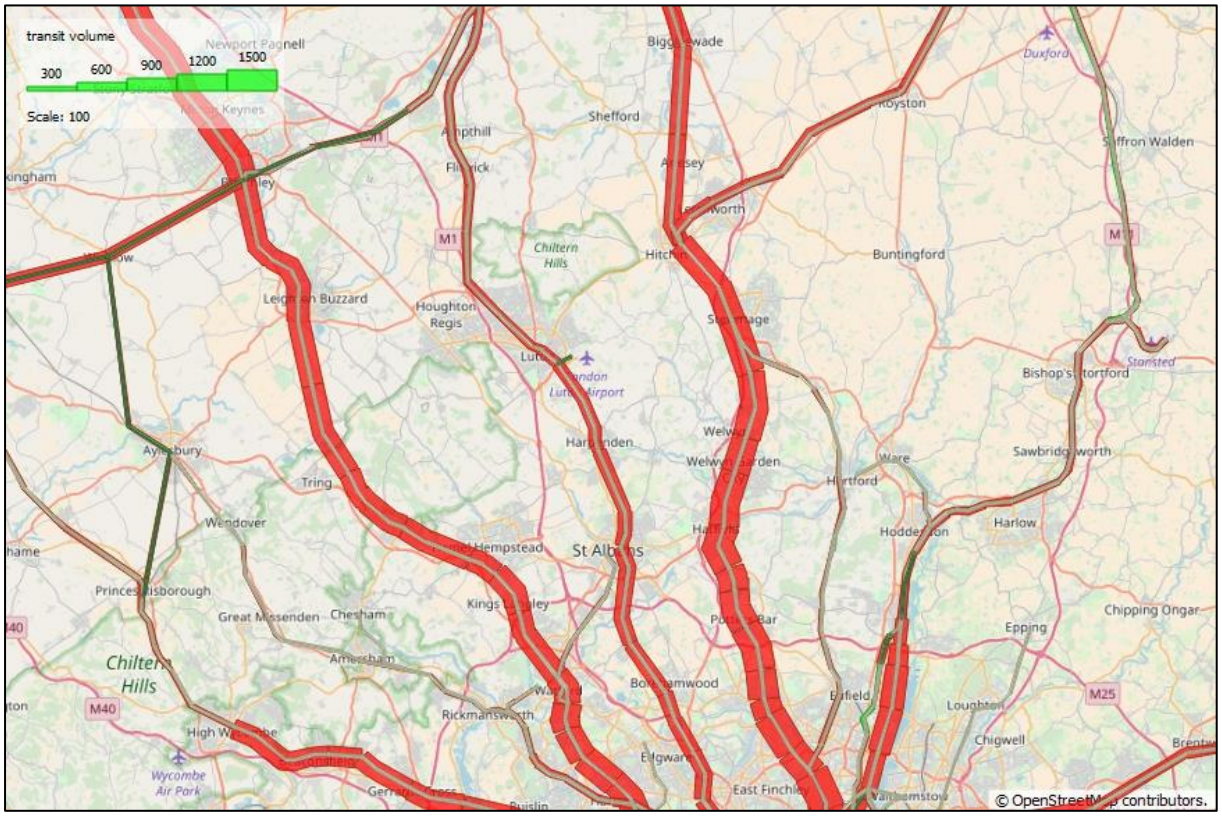
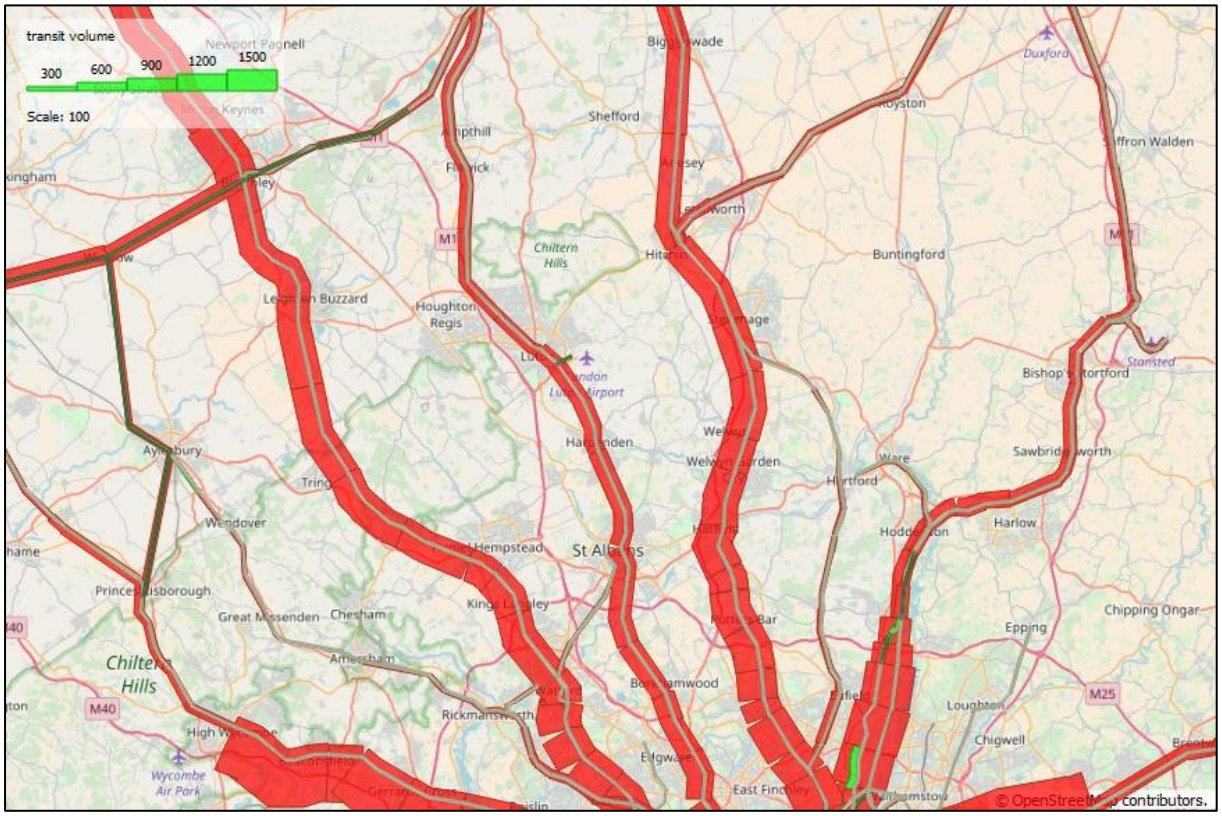


Figure 8.6: Rail Passenger Flow Change, 2014 to 2031, PM Peak, Hourly Flow



8.1.15 Apart from some switching of passenger demand from the London Overground service (between Cheshunt and Liverpool St) onto the West Anglia Mainline, all rail demand rises.

8.1.16 The scale of increase is largely proportional to the level of demand in the Base Year model; however, it is noticeable that the shorter, more local lines especially Watford – St Albans experience large proportional growth (see section below). This is because of bus trips switching to rail (there is negligible bus competition for most strategic and London commuter routes), and is also likely to be related to the proposed service frequency increase on the Abbey Line (services every 30 minutes). This local effect does not, however, correlate with past trends, which have generally been for lower growth on such lines.

8.1.17 It must be acknowledged that as a multi-modal logit model, COMET is not an ideal tool for assessing most strategic rail schemes; this would more usually be done with a rail elasticity model based on the Passenger Demand Forecasting Handbook (PDFH).

8.1.18 As discussed above, the overall rail growth in COMET is significantly lower than might be expected from a rail elasticity model. It would be possible to use the COMET rail assignment model to develop a PDFH-style rail forecasting tool, but this is not the subject of this document.

Watford – St Albans Abbey Line

8.1.19 The scale of growth in passenger numbers on the Abbey Line (and lines in the vicinity) relative to the Base Year is illustrated in Figure 8.7 to Figure 8.9. Depending on time period, direction, and section of the line, passenger volumes are forecast to increase by between approximately 90-170%. As discussed above, this increase is likely to be driven by a shift from bus to rail, as well as the proposed frequency increases (services every 30 minutes).

Figure 8.7: Relative Rail Passenger Flow Change, 2014 to 2031, AM Peak, Hourly Flow

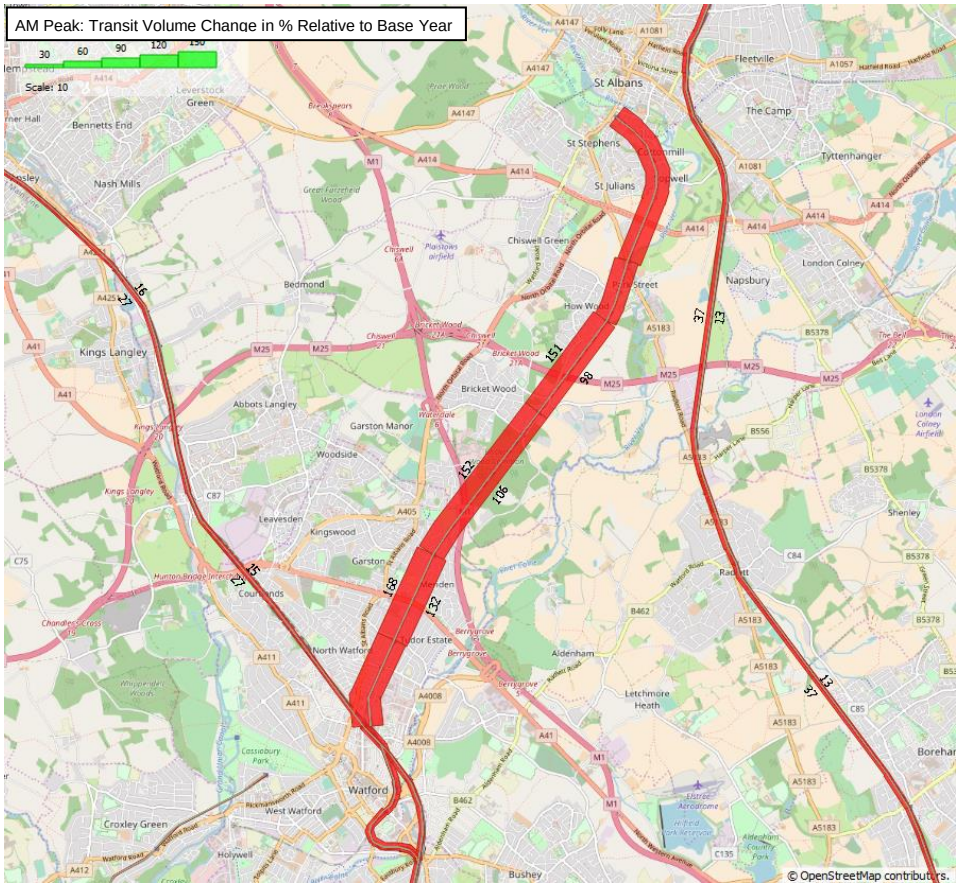


Figure 8.8: Relative Rail Passenger Flow Change, 2014 to 2031, Inter peak, Hourly Flow

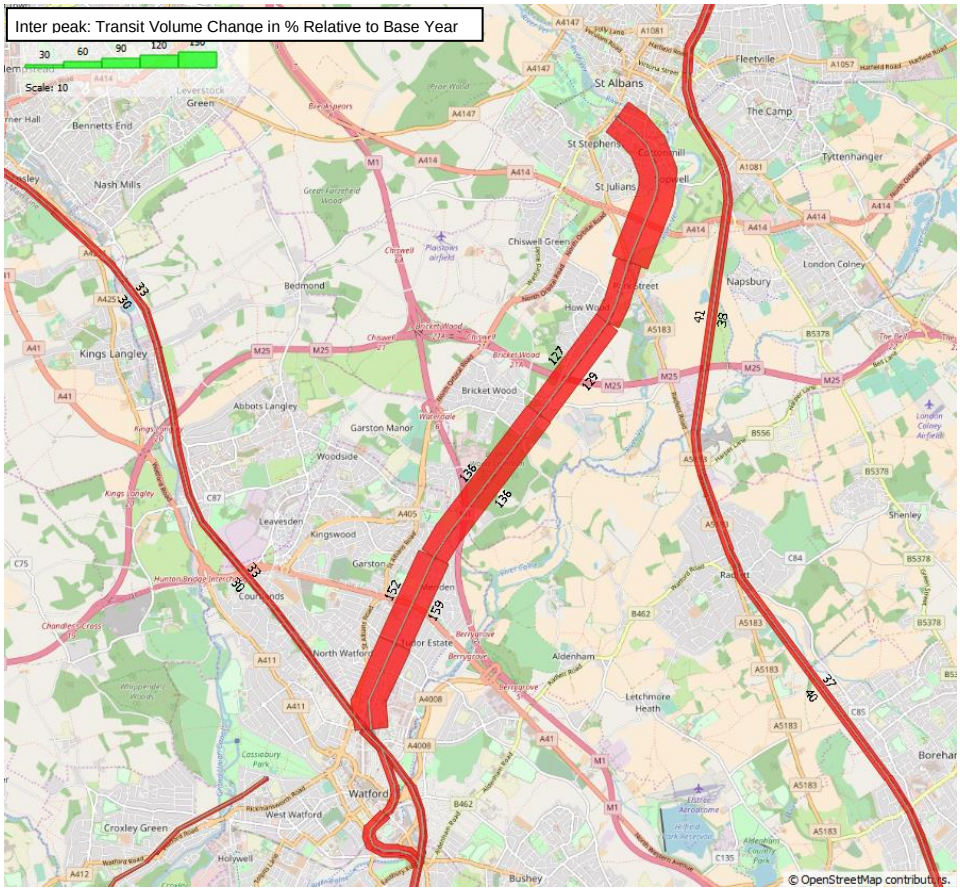
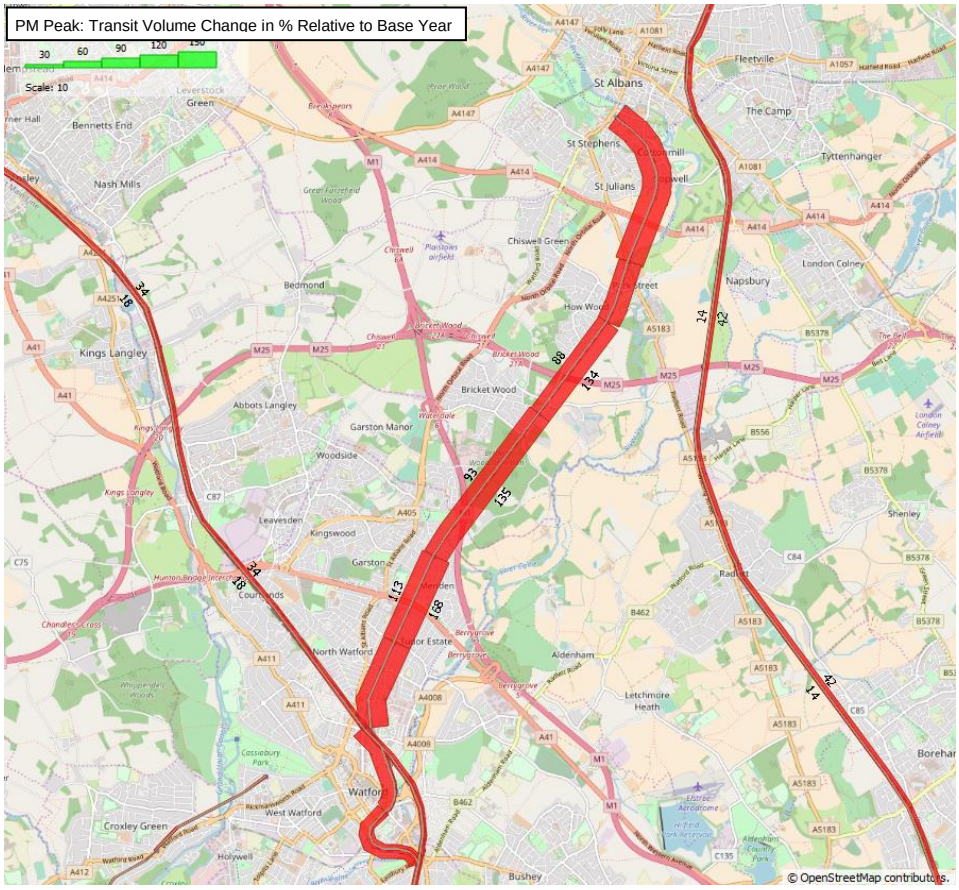


Figure 8.9: Relative Rail Passenger Flow Change, 2014 to 2031, PM Peak, Hourly Flow



9. Summary and Discussion

9.1 Summary

9.1.1 A 2031 forecast has been developed using COMET to understand the cumulative impact of Local Plan growth in Hertfordshire and selected neighbouring authorities[9] on the transport network.

9.1.2 This document outlines the forecasting approach, development of forecast networks and trip matrices, and presents the results in terms of highway and public transport assignments. This forecast shows that the variable demand, highway and public transport models all behave as expected and provide reasonable results.

9.1.3 In terms of highway trips in Hertfordshire and its immediate vicinity[10], an increase of approximately 19% (at a 24 hour level) is forecast between 2014 and 2031. This increase is accompanied by a rise in travel distance of 19%-27% (depending on time period), but an increase in travel time of up to 39% (AM Peak). The relatively sharp rise in travel time compared to travel distance is indicative of increasing congestion, and is corroborated by the fall in average network speed of up to 13% in the AM Peak.

9.1.4 Forecast results show some significant congestion on key urban and inter-urban roads in 2031:

- The highest levels of congestion are in the urban areas of Watford, St Albans, Hemel Hempstead, Hatfield, Hertford and Broxbourne towns.
- Modelling also shows congestion (although to a lower level) in the urban areas of Welwyn Garden City, Stevenage, Hitchin, Letchworth Garden City, Baldock and Bishop's Stortford.
- A414 through Hemel Hempstead and between the M1 and A10.
- Various sections of the M25, A1(M) and M1
- A120 around Bishop's Stortford
- A505 near Letchworth Garden City and around Royston
- A602 near Ware

9.1.5 Forecast results also indicate that the rail network in Hertfordshire will experience an increase in passenger usage by approximately 25% in the AM and PM Peaks between 2014 and 2031. Bus travel, by comparison, is likely to remain stable or decline (~-15%) as a result of rising personal incomes.

9.2 Discussion

Future Uncertainty and COMET Forecasts

9.2.1 The COMET forecasting methodology takes into consideration future changes in population, number of jobs and dwellings, as well as rising costs of travel and proposed transport infrastructure schemes.

[9] Luton, Buckinghamshire (all districts), part of Essex (i.e. Epping Forest, Harlow, and Uttlesford), and part of Cambridgeshire (i.e. South Cambs and Cambridge)
[10] COMET Simulation Area

9.2.2 However, there is currently no allowance for factors that may fundamentally alter the nature of travel in Hertfordshire or elsewhere in Great Britain. These factors may include the introduction of new technologies (e.g. autonomous vehicles) or a significant shift in travel patterns relative to the Base Year model as a result of behavioural change. Such behavioural change may be brought about by factors such as changing demographic characteristics / consumer preferences, economic instability, climate change and globalisation.

9.2.3 Consequently, COMET forecasts should be viewed as possible representations of the future in Hertfordshire among a number of potentially different alternatives that require unconventional approaches to planning and investment in the county.

Sustainable Transport

9.2.4 It should be noted that the approach to modelling modal shift in a multi-modal model (such as COMET) should be based on the inclusion/coding of infrastructure to facilitate such behaviour change in the forecast network. Without doing so (as applies to this forecast) the modelled modal shift is not a result of COMET's Variable Demand Model representing behavioural change; rather, it is the result of a parameter adjustments that are currently not based on any specific interventions to the transport network. Once more specific scheme assumptions regarding the proposed sustainable travel initiatives are known, these should be coded into COMET as other forecast schemes already are.

Related HCC Projects

9.2.5 The forecast results presented in this document suggest that the usage of Hertfordshire's transport network will continue to grow until 2031. This is particularly the case during the peak hours and in the county's known congestion hotspots. One such hotspot is the A414 corridor that runs through the core of the county, and will be a major focus of growth in future housing and employment.

9.2.6 These results therefore reinforce the critical nature of ongoing and related HCC projects including the A414 Corridor Strategy and Hertford Transport and Movement Package. These projects will contribute to the evidence-based development of interventions that promote sustainable and future-proof transport in Hertfordshire.

10. Appendices

10.1 Appendix I: Inter-urban Journey Times

10.1.1 Changes in journey times between key towns are shown in the figures in this section. The figures show journey times for:

- Base Year (2014)
- Local Plan DS (2031) – see description in Table 2.1
- Local Plan Run 3 (2031) – current forecast

AM Peak Inter-urban Journey Times

Figure 10.1: Changes in Journey Times from Borehamwood (AM Peak 2014 and AM Peak 2031)

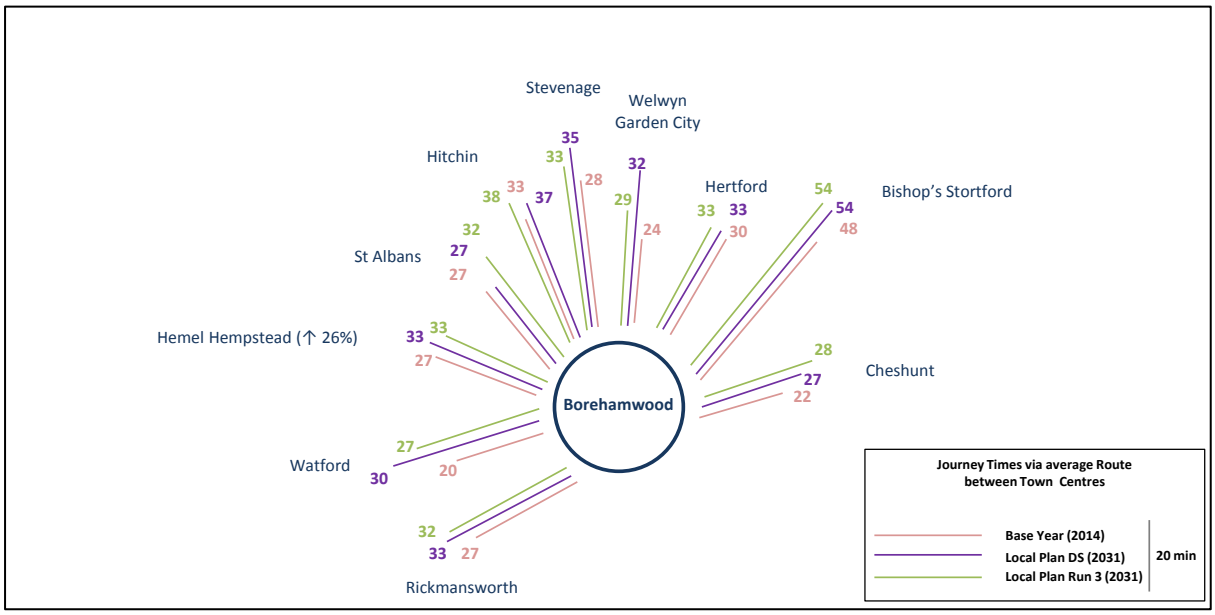


Figure 10.2: Changes in Journey Times from Watford (AM Peak 2014 and AM Peak 2031)

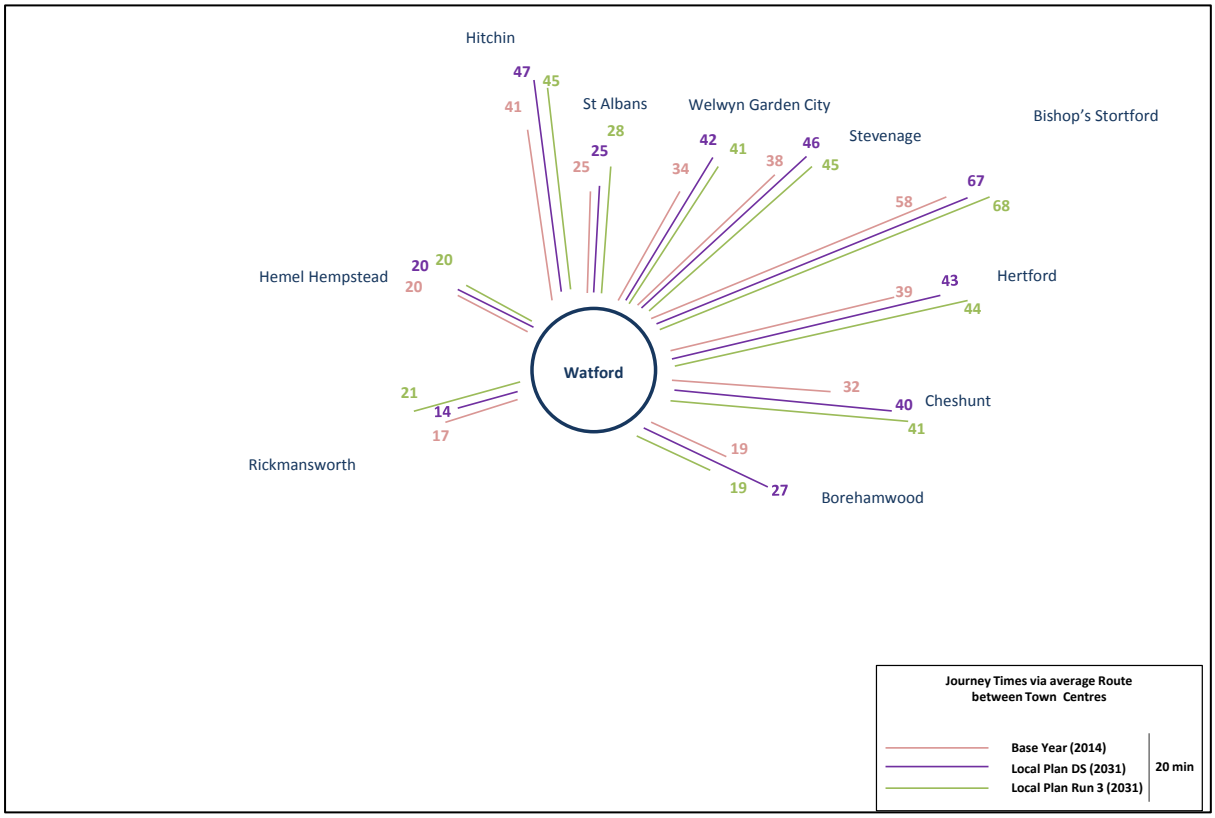


Figure 10.3: Changes in Journey Times from Welwyn Garden City (AM Peak 2014 and AM Peak 2031)

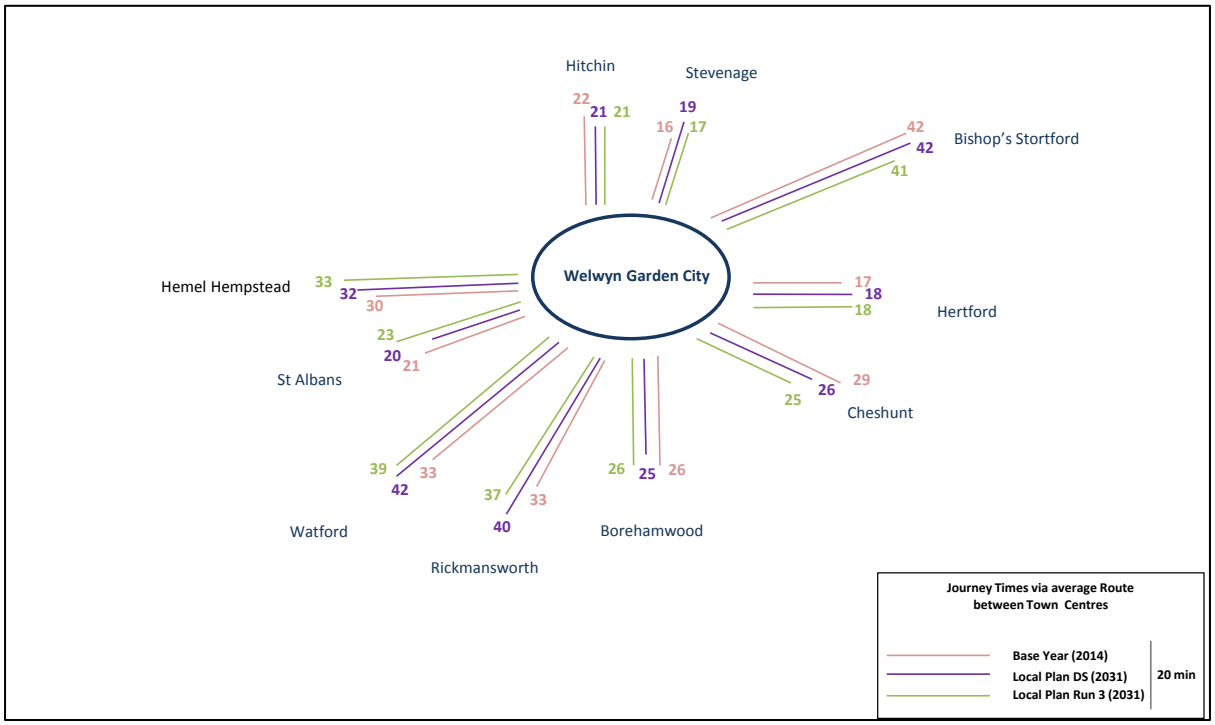


Figure 10.4: Changes in Journey Times from Stevenage (AM Peak 2014 and AM Peak 2031)

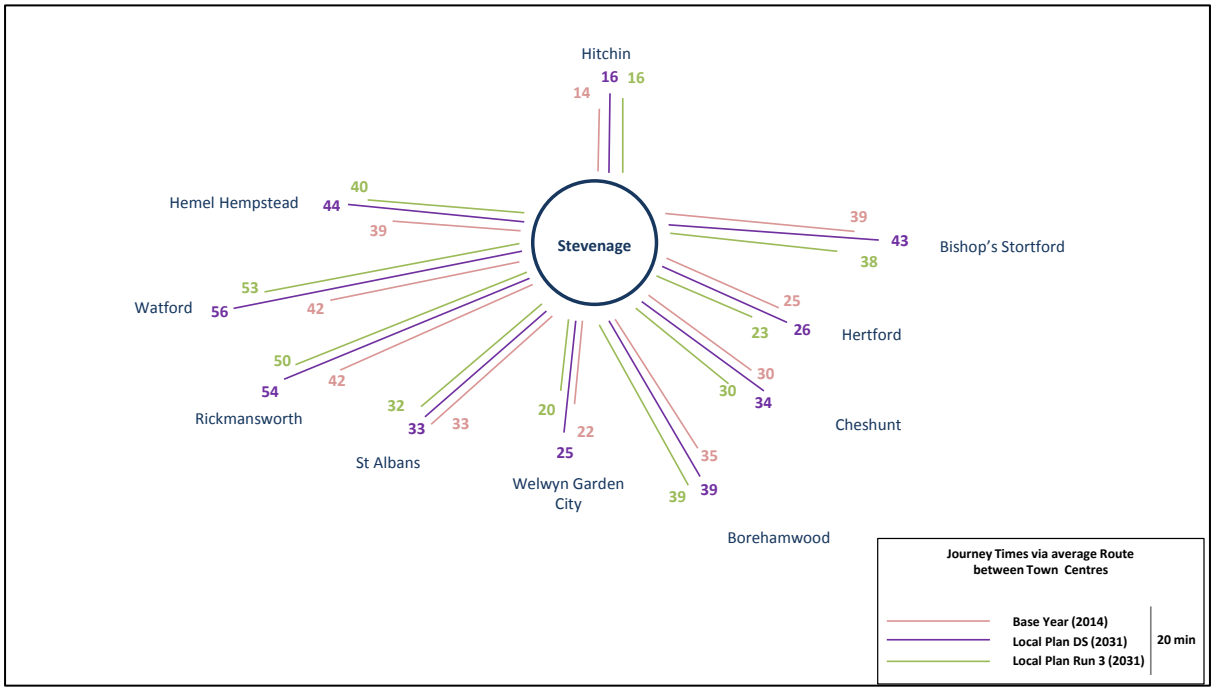


Figure 10.5: Changes in Journey Times from Hitchin (AM Peak 2014 and AM Peak 2031)

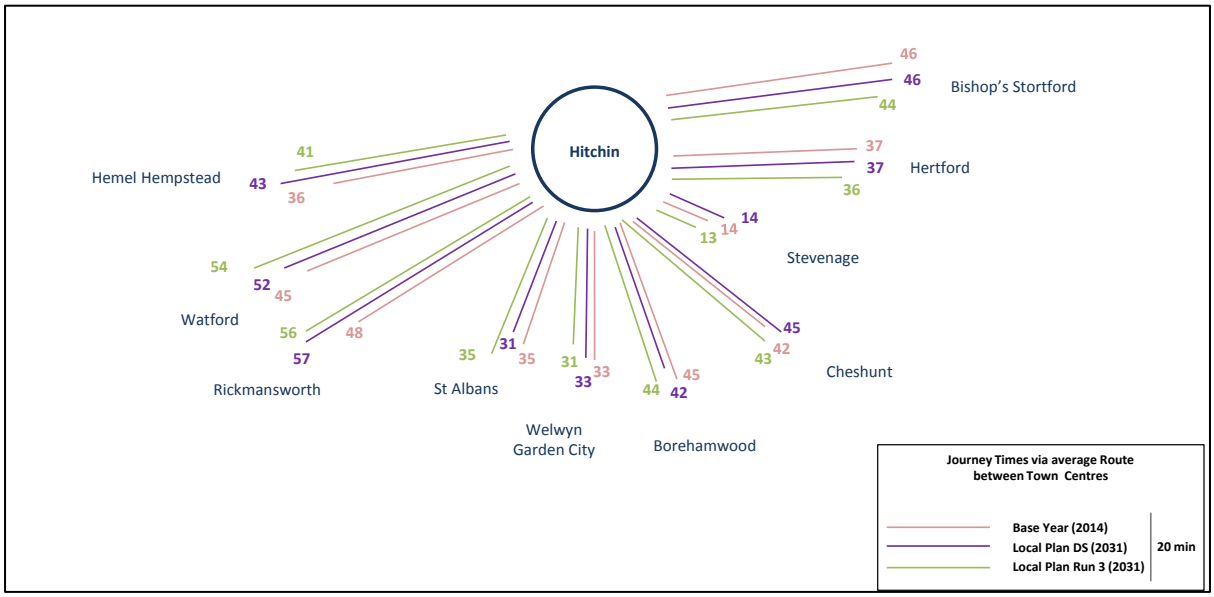


Figure 10.6: Changes in Journey Times from Bishop's Stortford (AM Peak 2014 and AM Peak 2031)

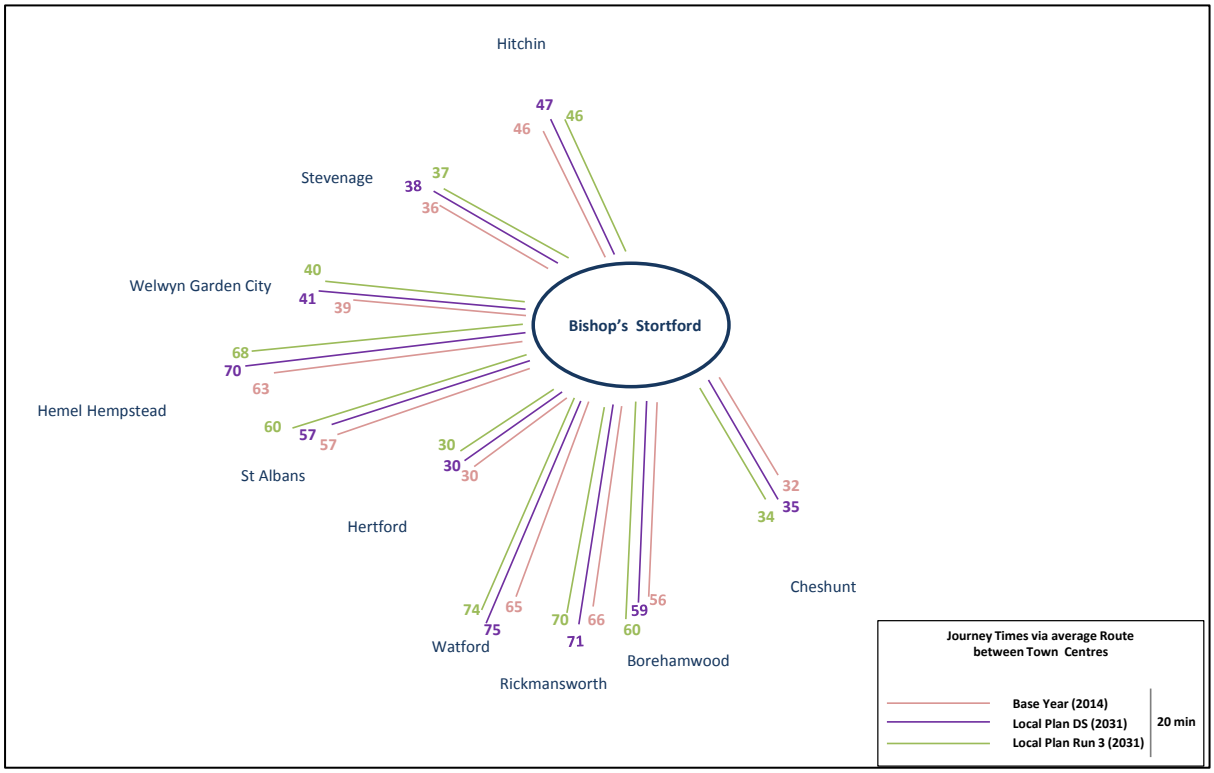


Figure 10.7: Changes in Journey Times from Cheshunt (AM Peak 2014 and AM Peak 2031)

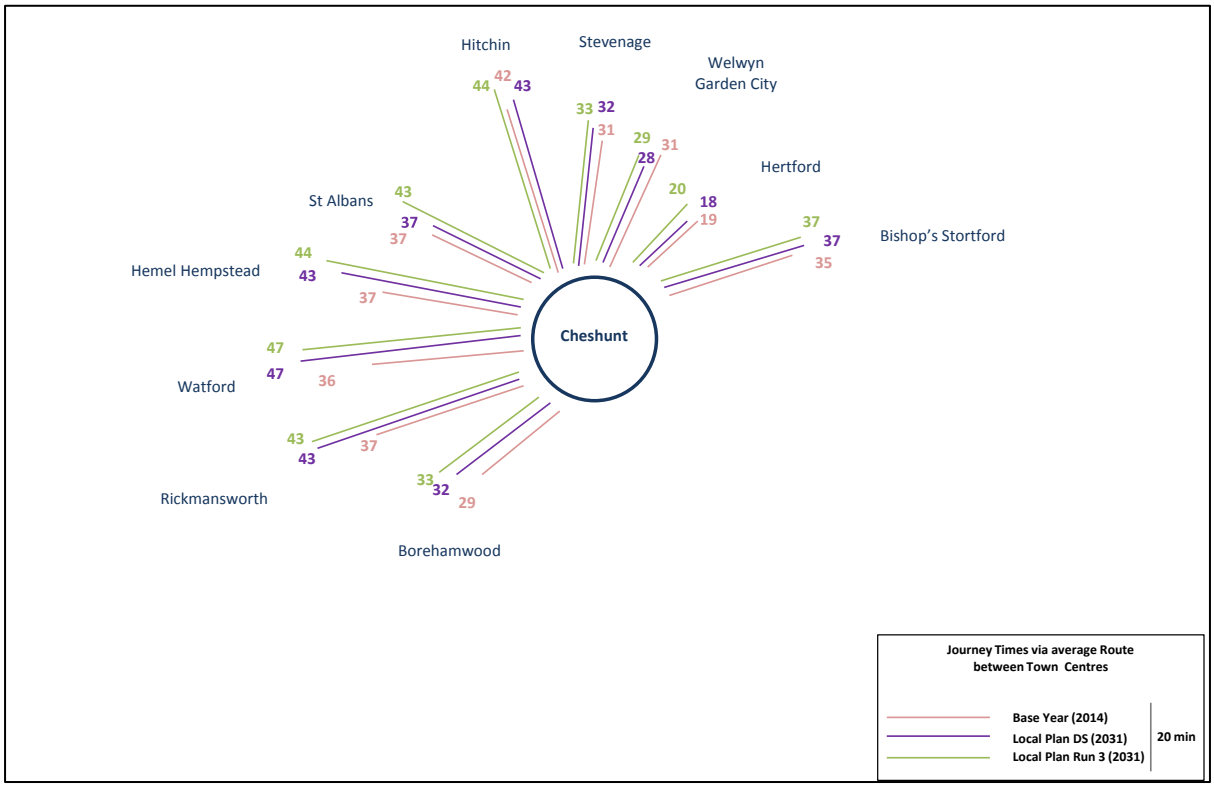


Figure 10.8: Changes in Journey Times from Hertford (AM Peak 2014 and AM Peak 2031)

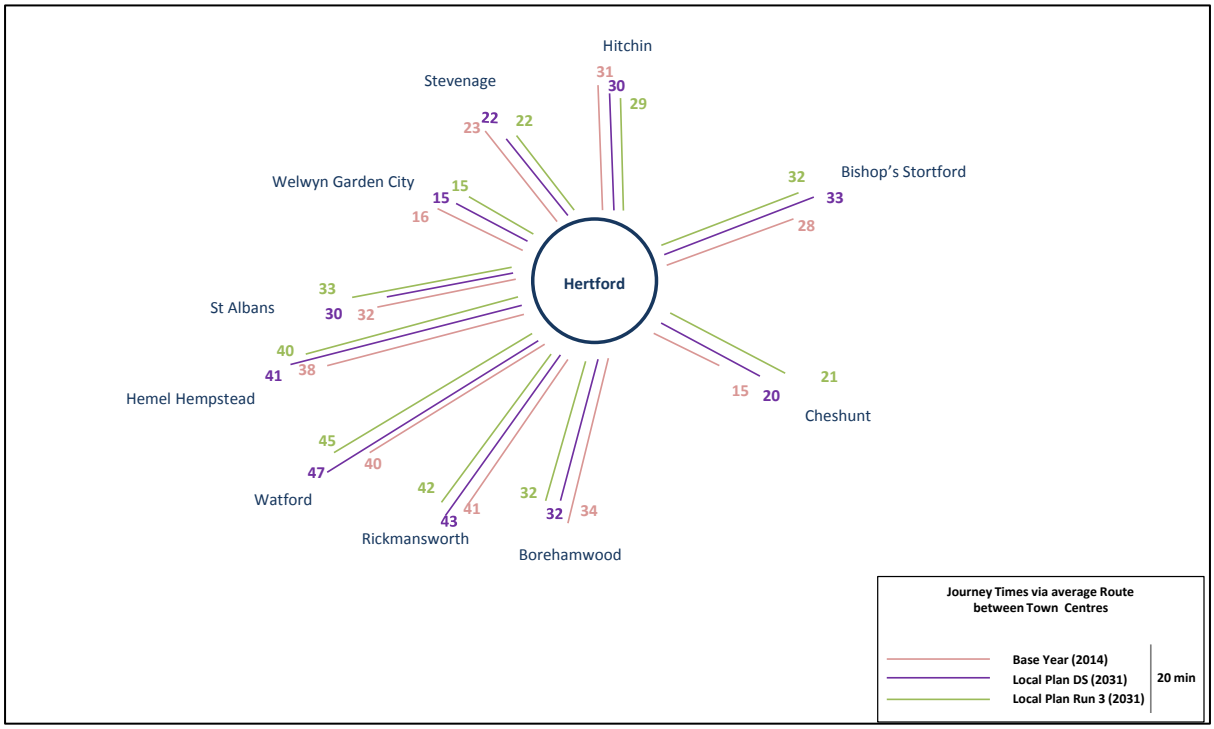
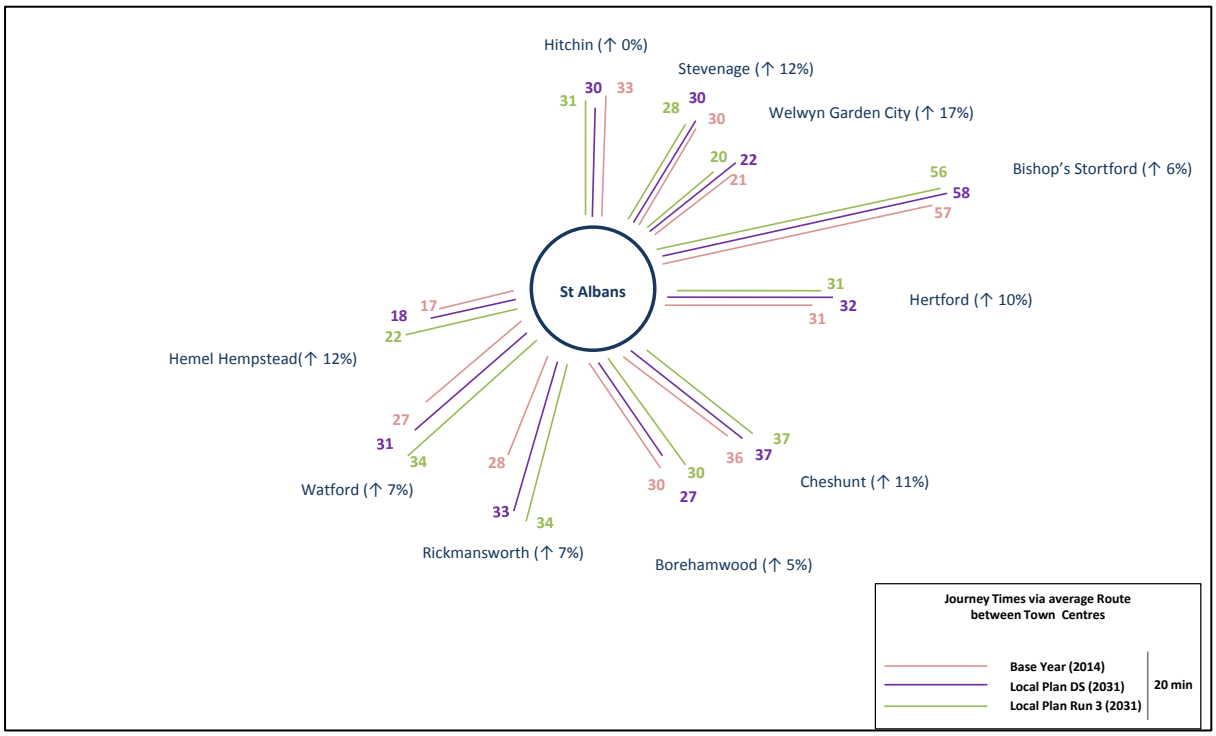


Figure 10.9: Changes in Journey Times from St Albans (AM Peak 2014 and AM Peak 2031)



PM Peak Inter-urban Journey Times

Figure 10.10: Changes in Journey Times from Bishop's Stortford (PM Peak 2014 and PM Peak 2031)

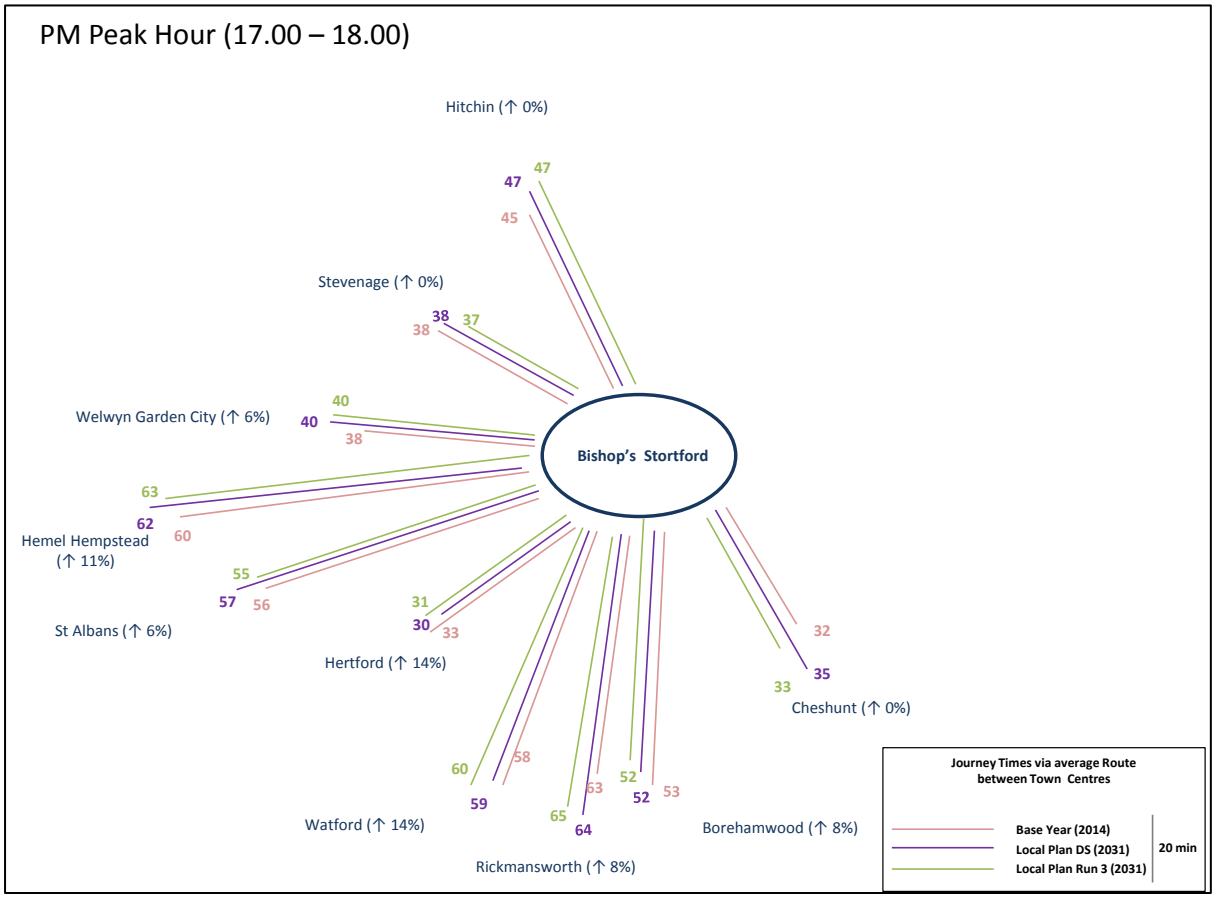


Figure 10.11: Changes in Journey Times from Watford (PM Peak 2014 and PM Peak 2031)

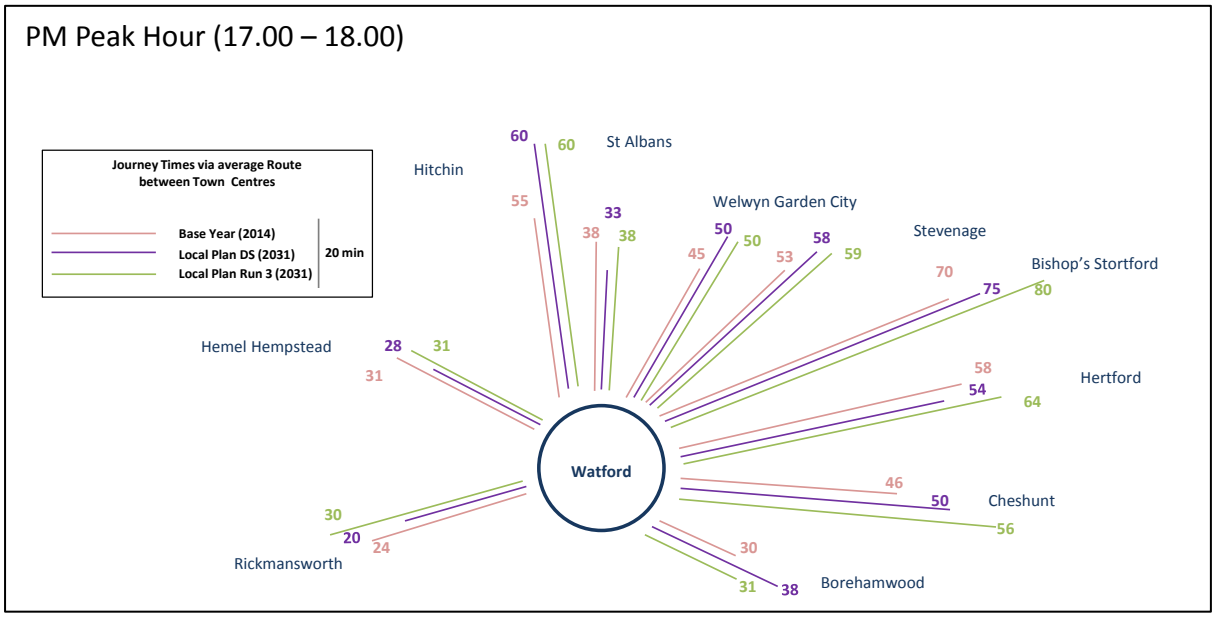


Figure 10.12: Changes in Journey Times from Cheshunt (PM Peak 2014 and PM Peak 2031)

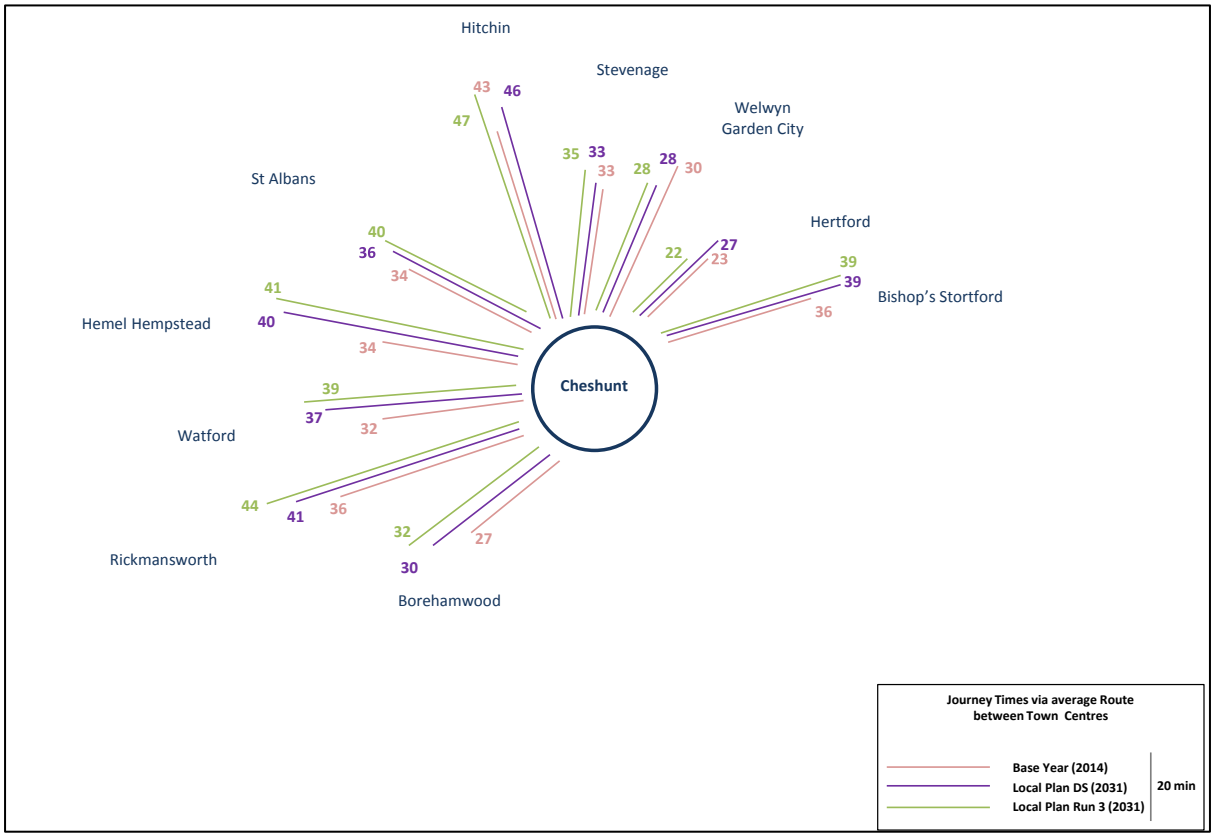


Figure 10.13: Changes in Journey Times from Hemel Hempstead (PM Peak 2014 and PM Peak 2031)

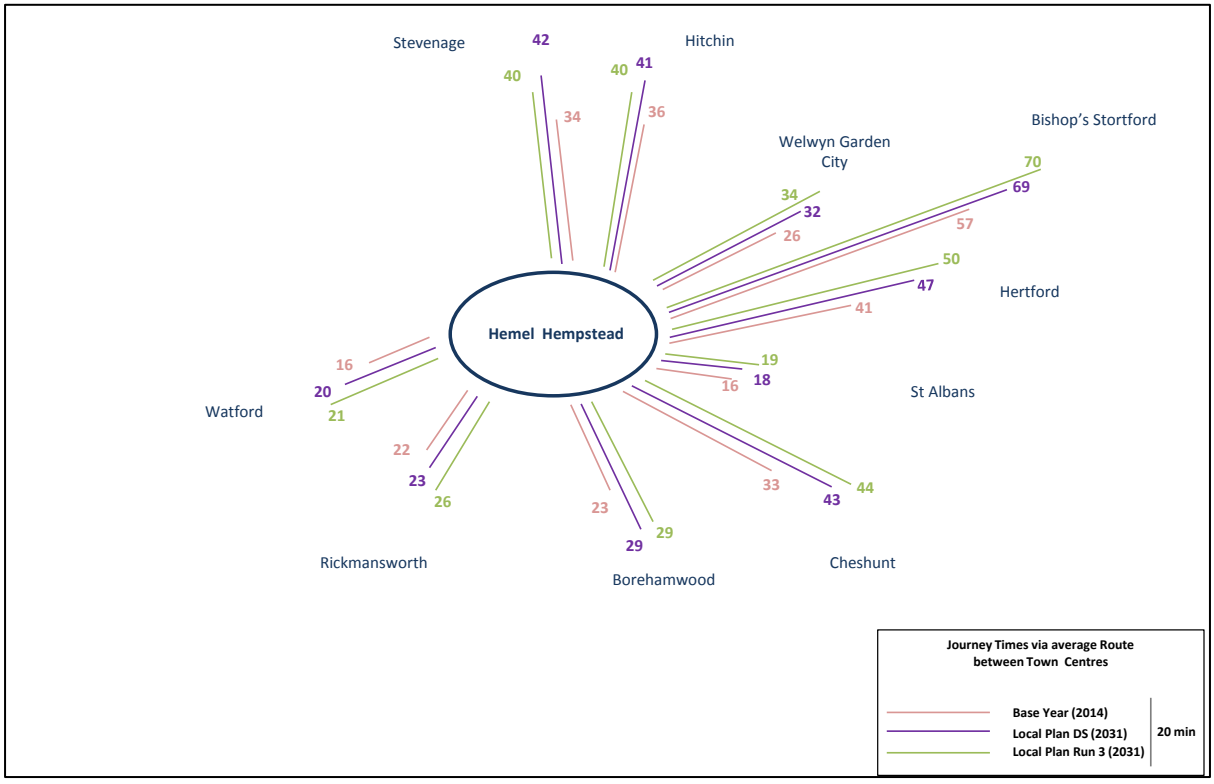


Figure 10.14: Changes in Journey Times from Hertford (PM Peak 2014 and PM Peak 2031)

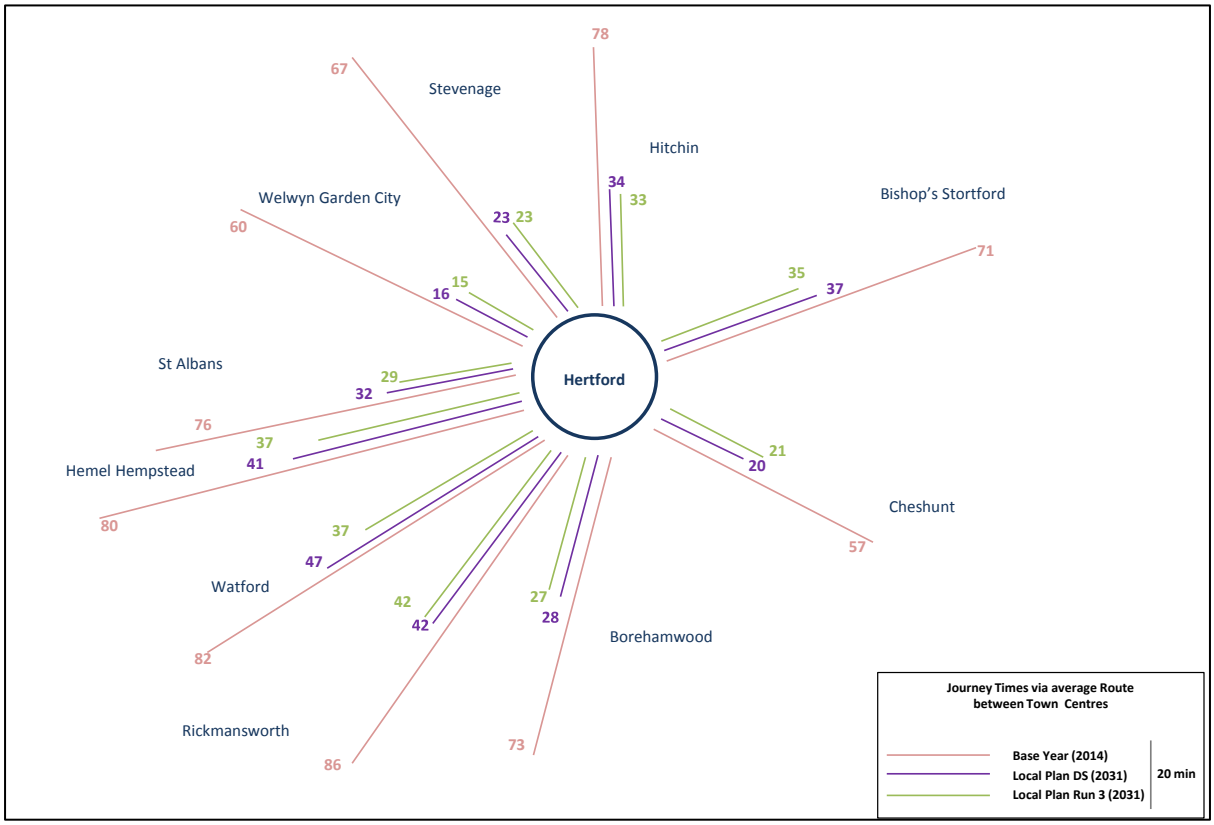


Figure 10.15: Changes in Journey Times from Hitchin (PM Peak 2014 and PM Peak 2031)

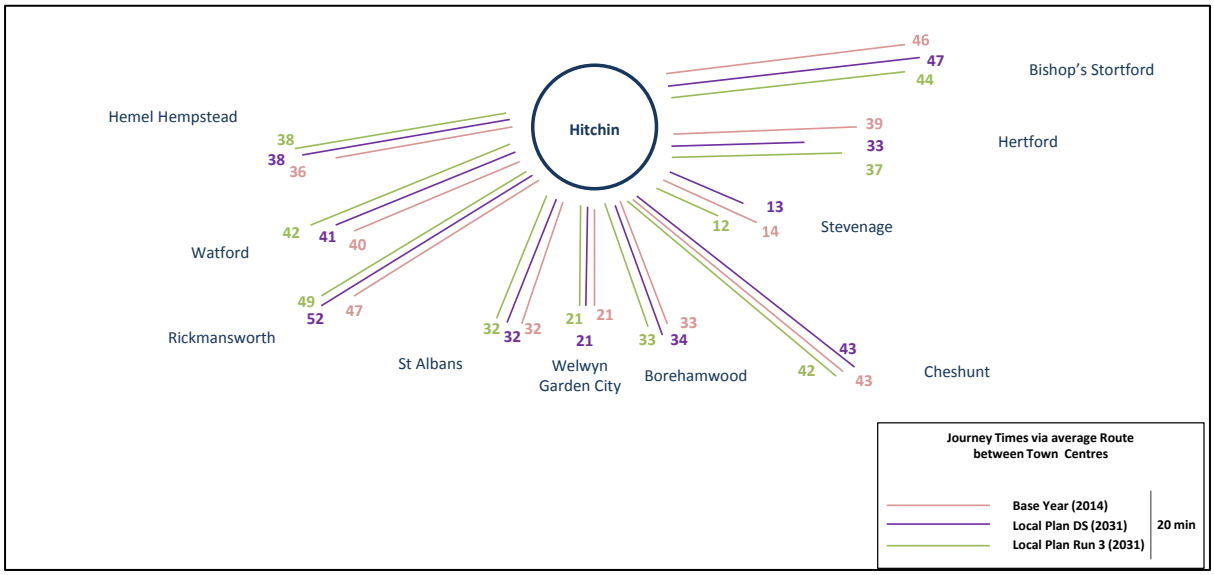


Figure 10.16: Changes in Journey Times from St Albans (PM Peak 2014 and PM Peak 2031)

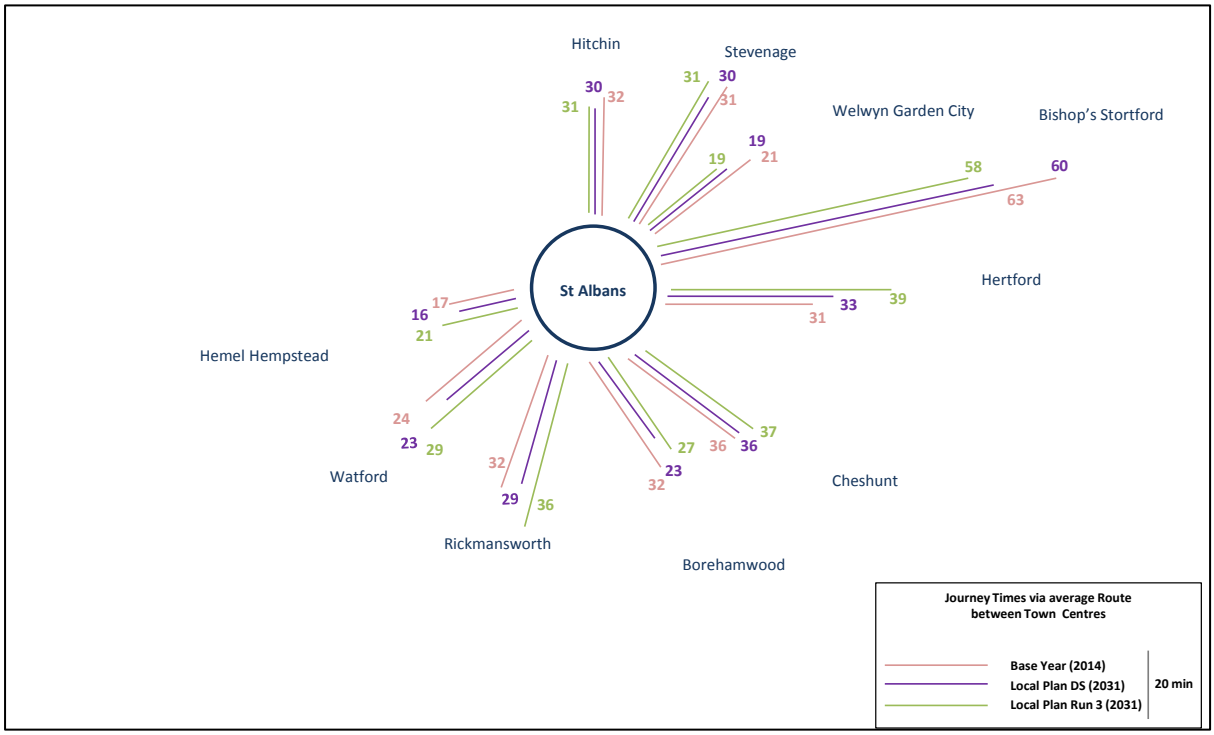


Figure 10.17: Changes in Journey Times from Stevenage (PM Peak 2014 and PM Peak 2031)

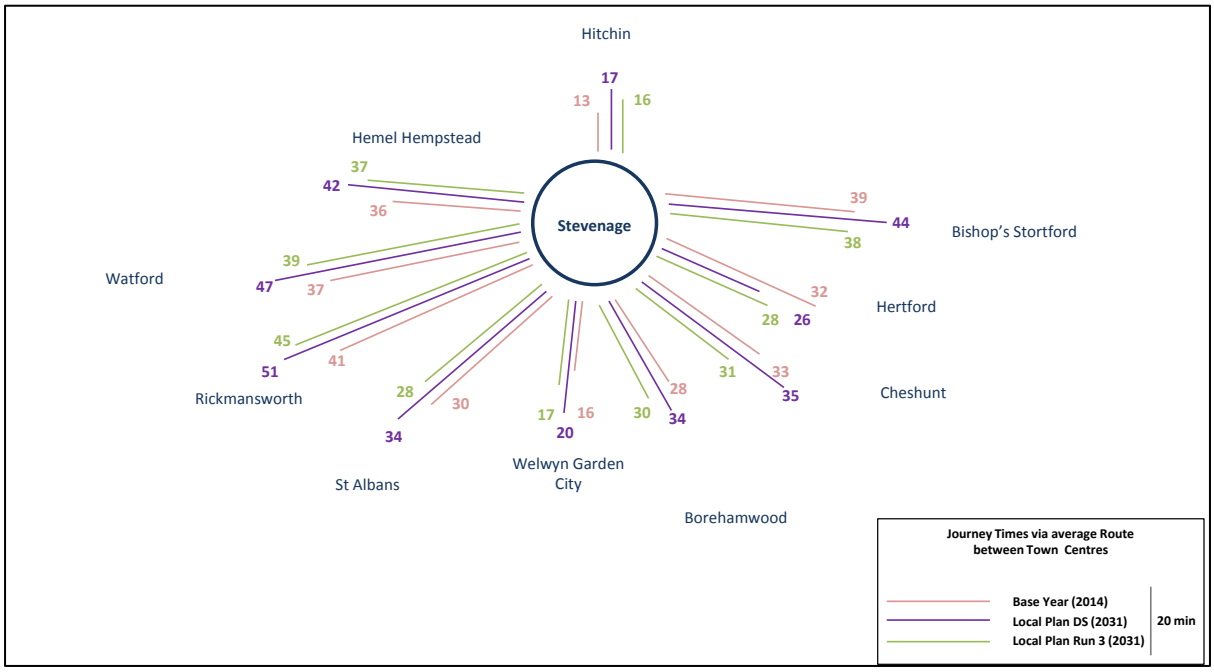


Figure 10.18: Changes in Journey Times from Borehamwood (PM Peak 2014 and PM Peak 2031)

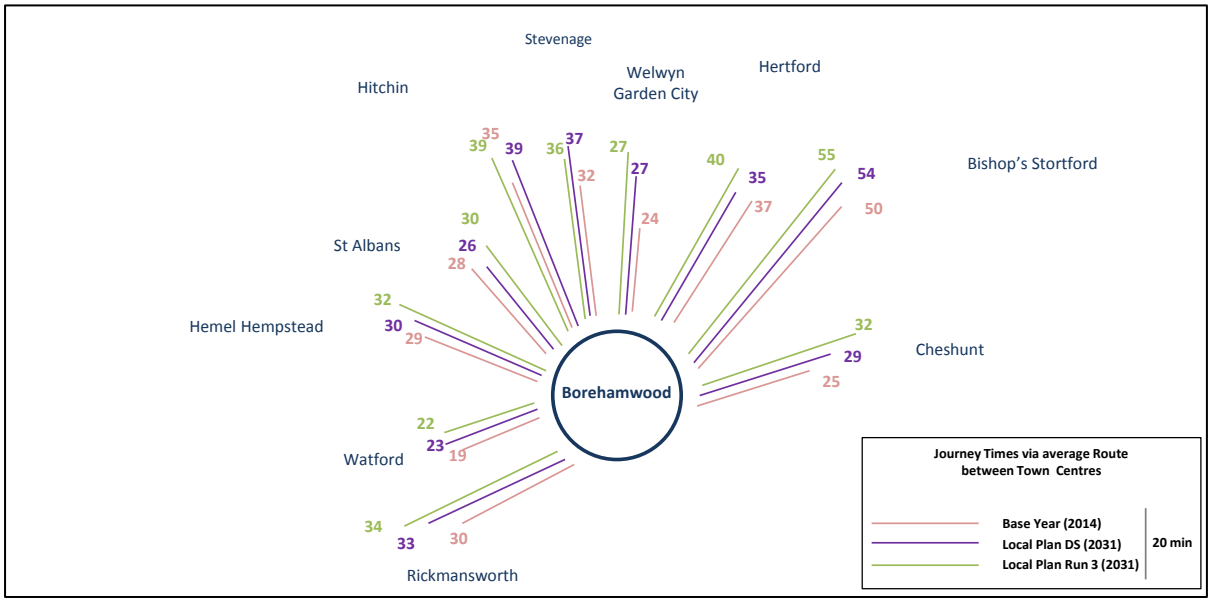
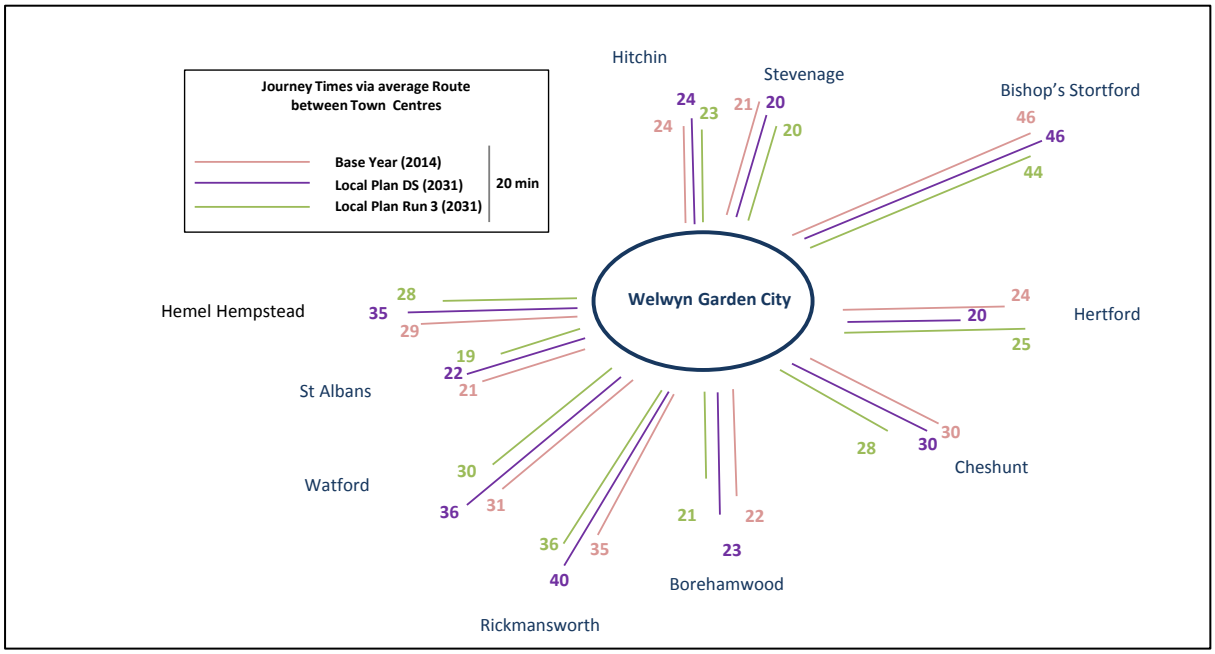


Figure 10.19: Changes in Journey Times from Welwyn Garden City (PM Peak 2014 and PM Peak 2031)



10.2 Appendix II: Forecast Highway Network Schemes

Figure 10.20: A120 Little Hadham Bypass and Bishop's Stortford Schemes

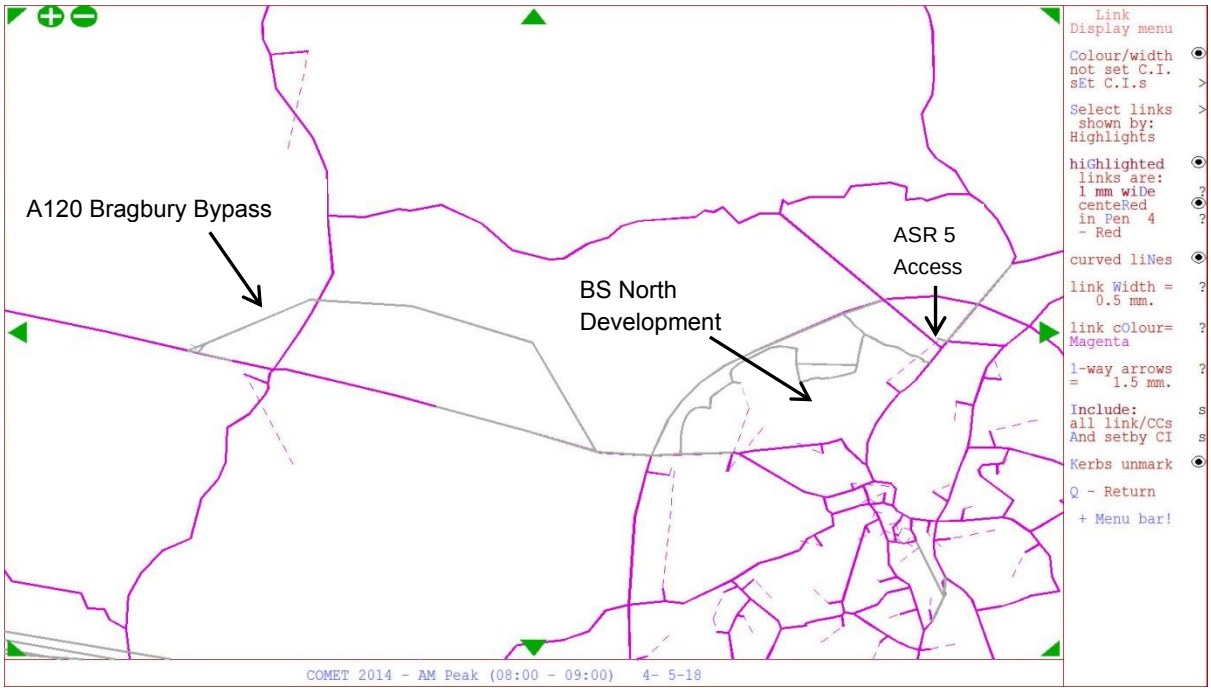


Figure 10.21: A5 – M1 Link

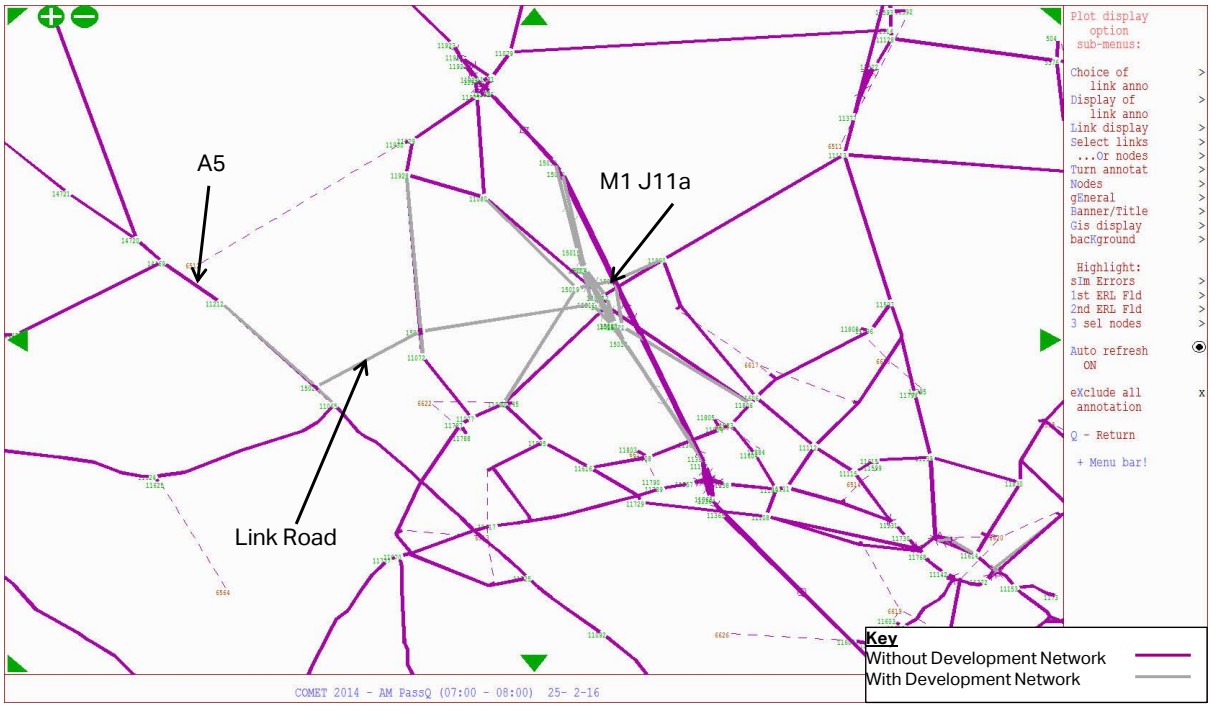


Figure 10.22: Radlett Rail Freight

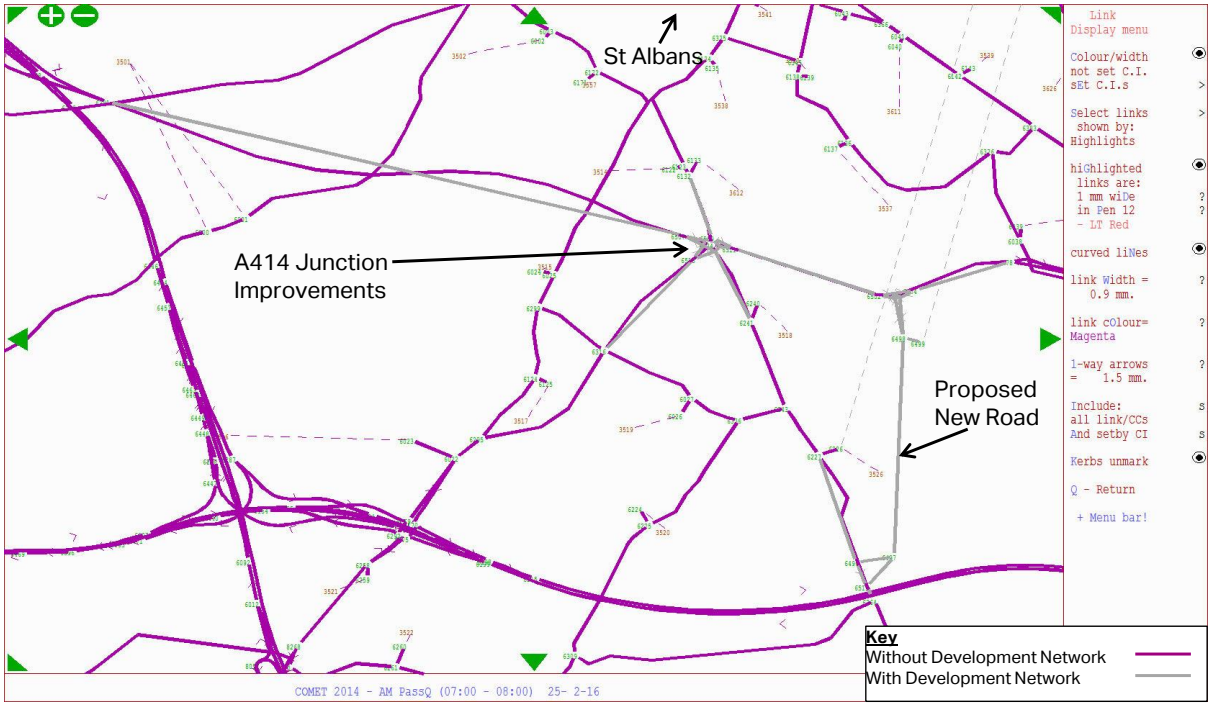


Figure 10.23: Watford Health Campus Link

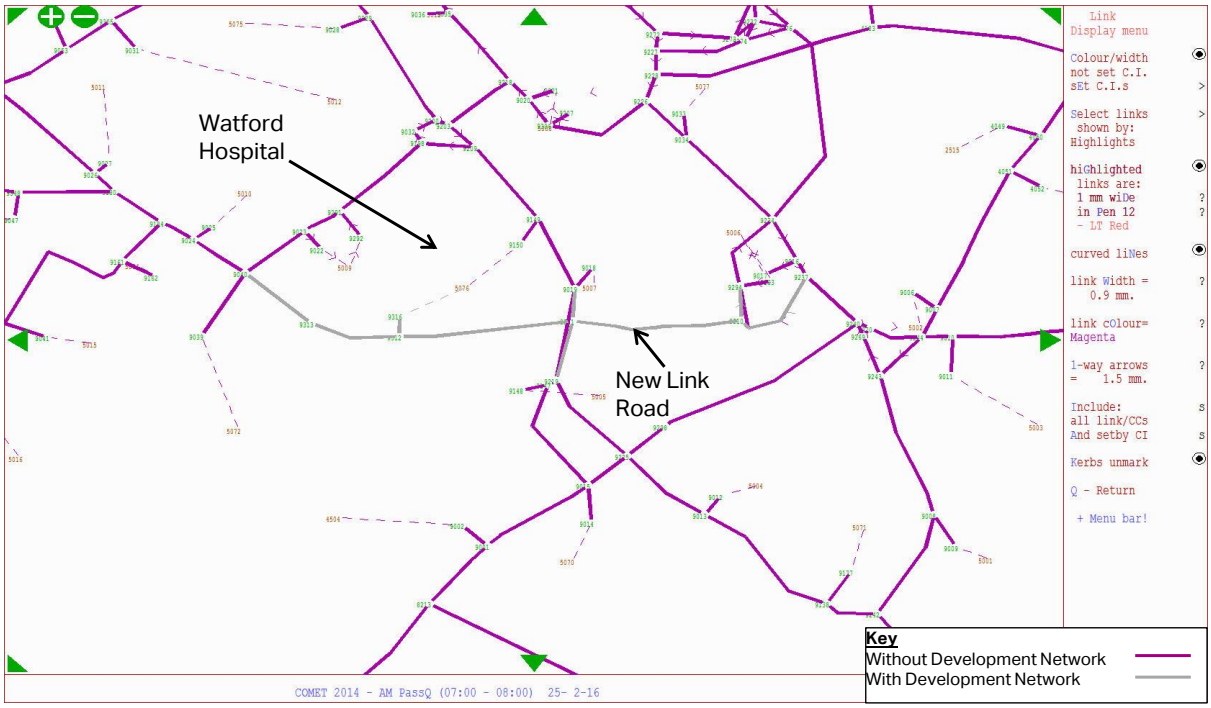


Figure 10.24: West Hoddesdon Development and junction improvements

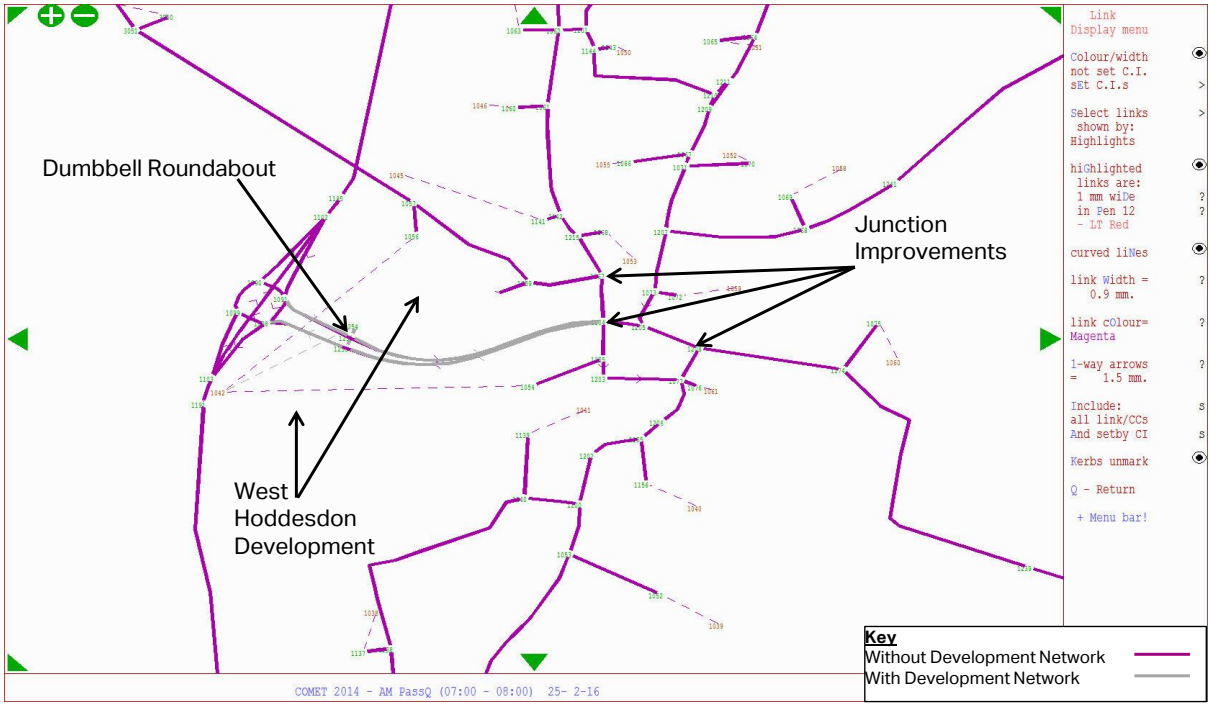


Figure 10.25: M11 J7A - A414 Schemes

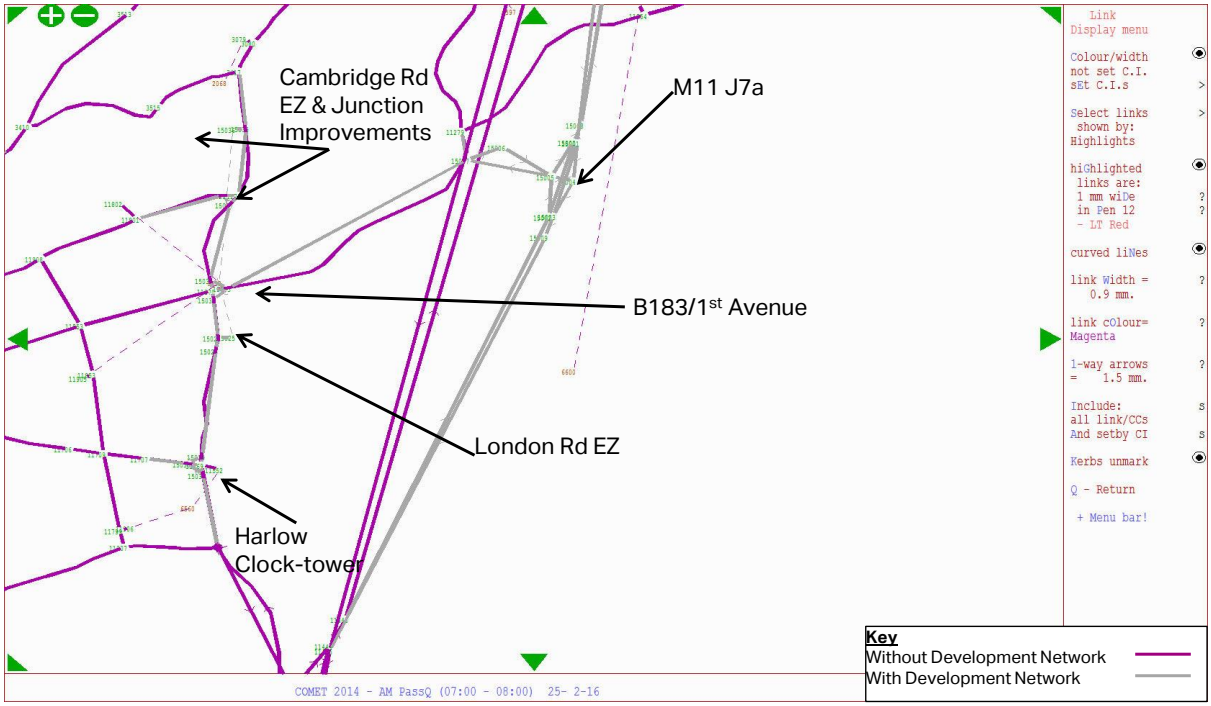


Figure 10.26: Land North and East of Ware Spine Road

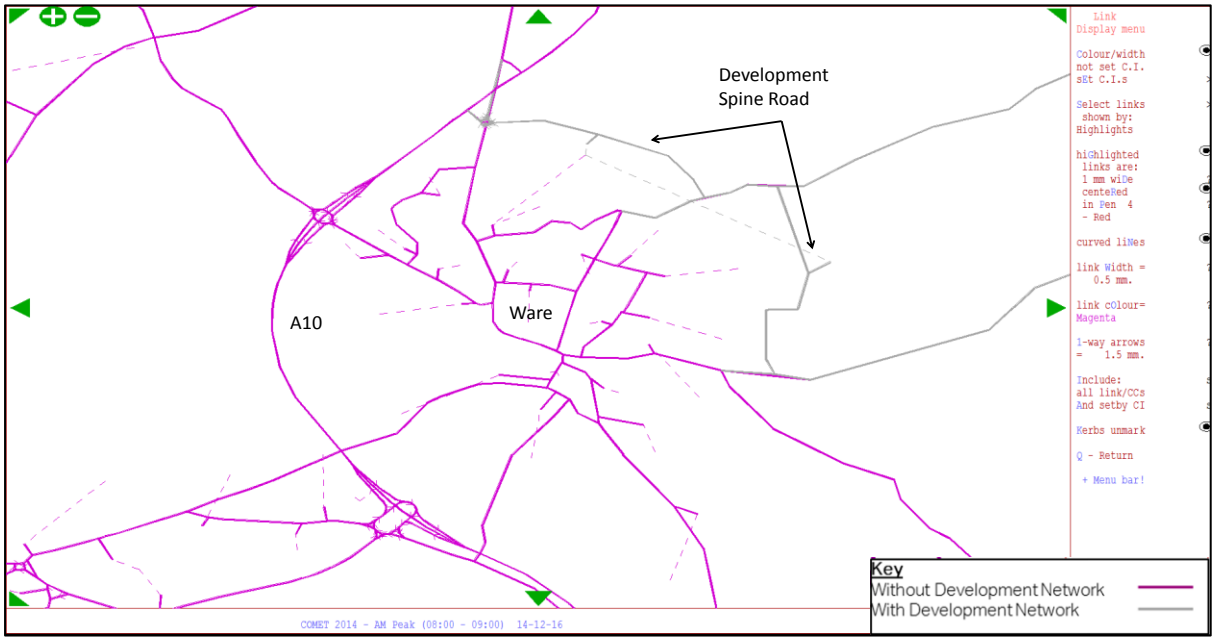


Figure 10.27: Western Hemel Hempstead Development Access

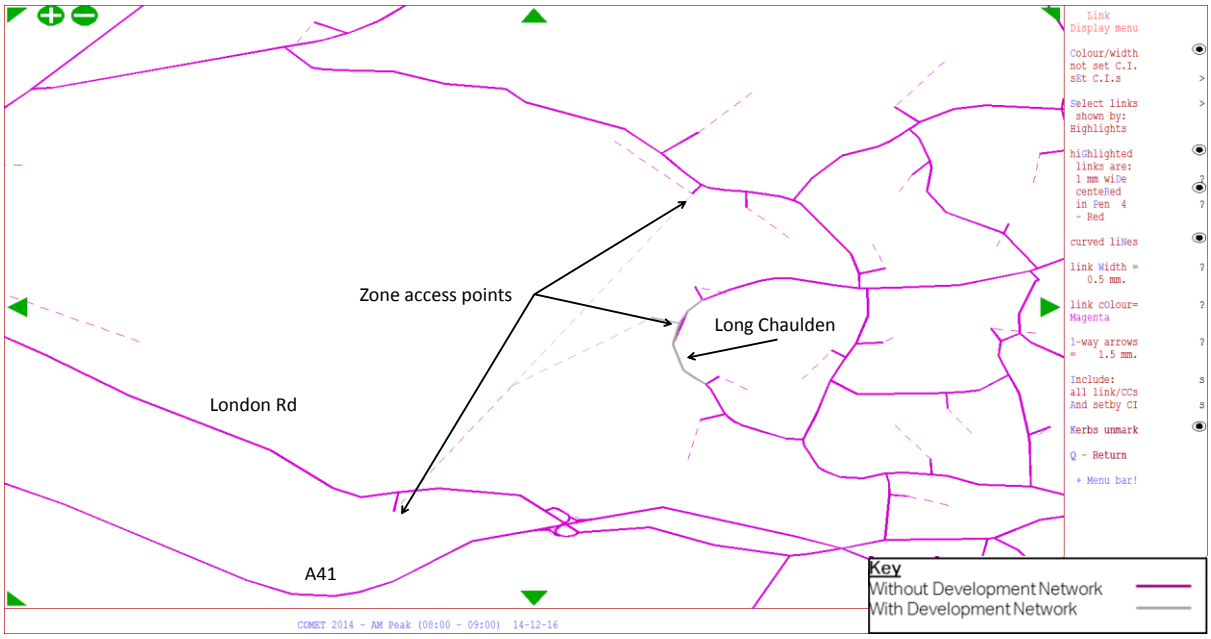


Figure 10.28: North of Baldock Development

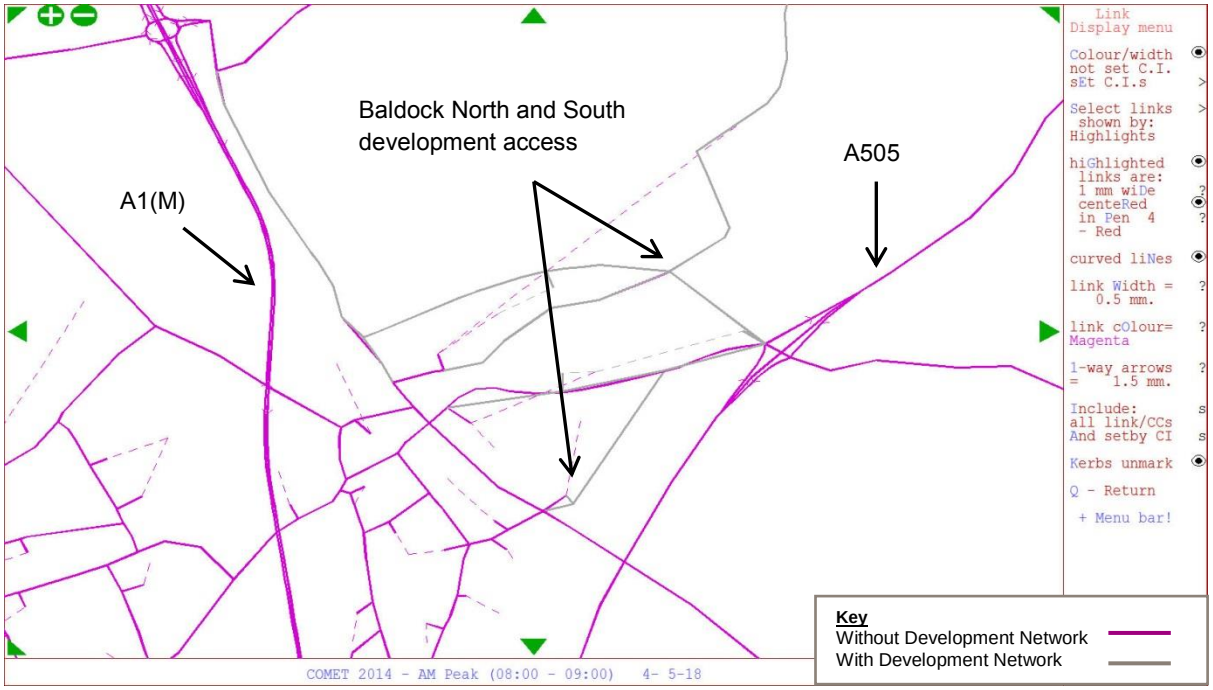


Figure 10.29: Hertford Bypass

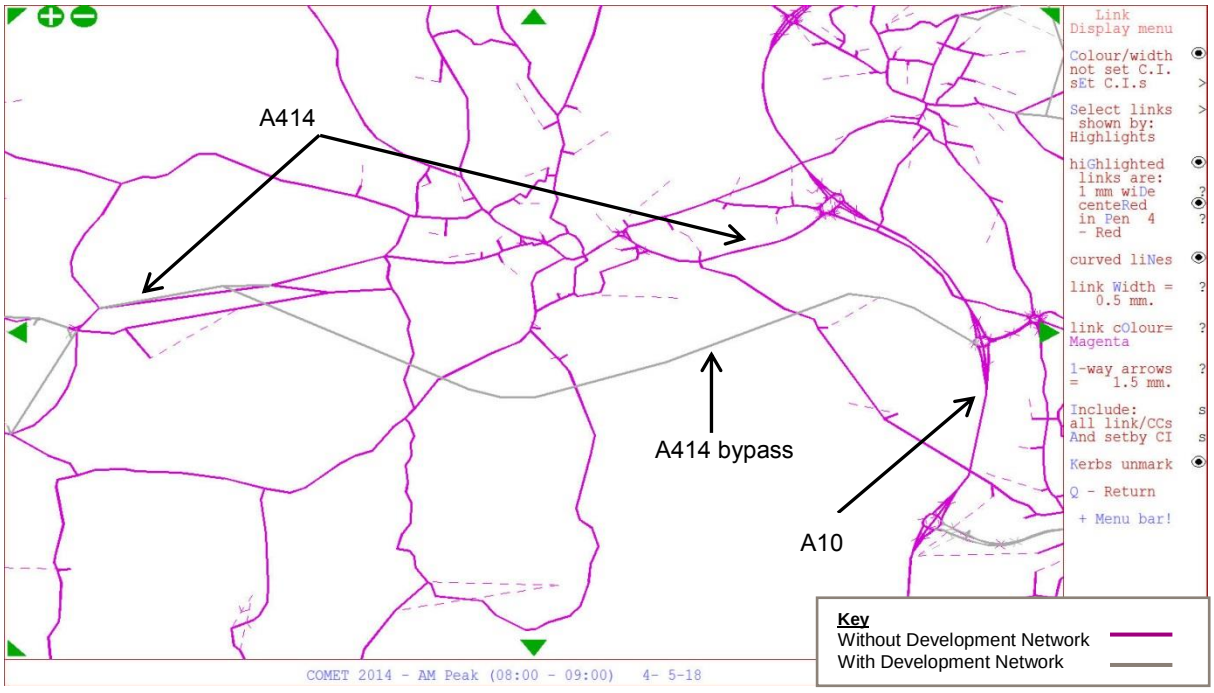


Figure 10.30: Oaklands Development

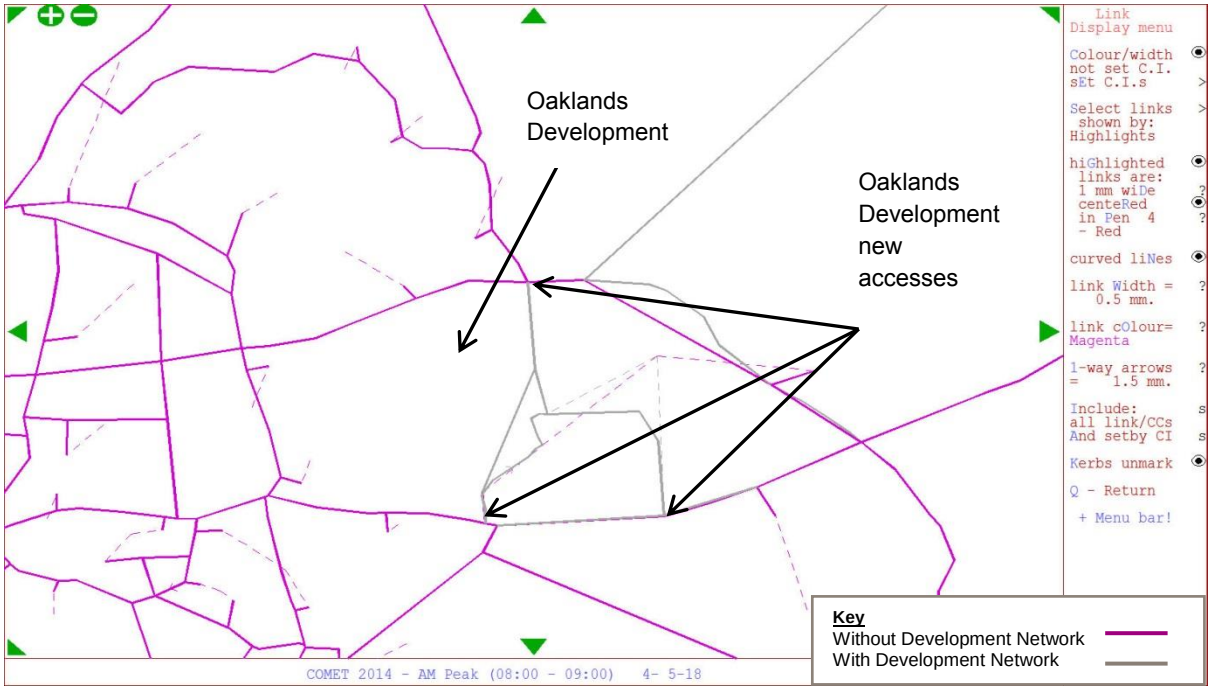


Figure 10.31: M1 Junction 8

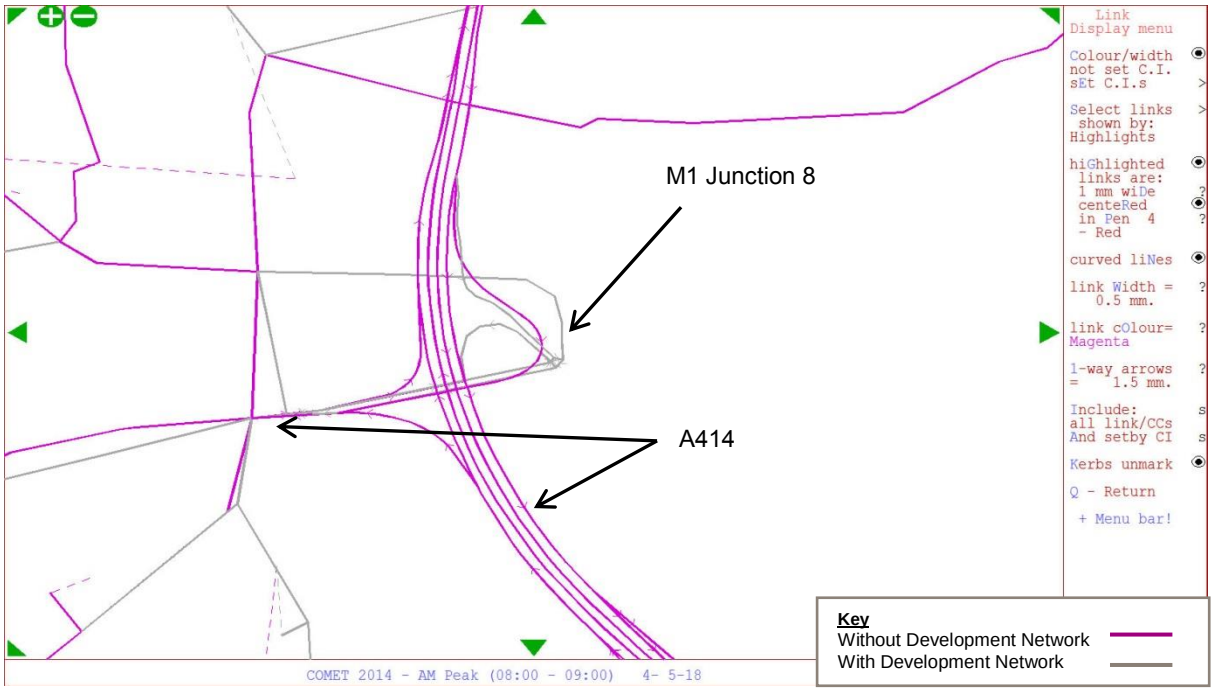


Figure 10.32: Maylands Area Schematic – Forecast Network

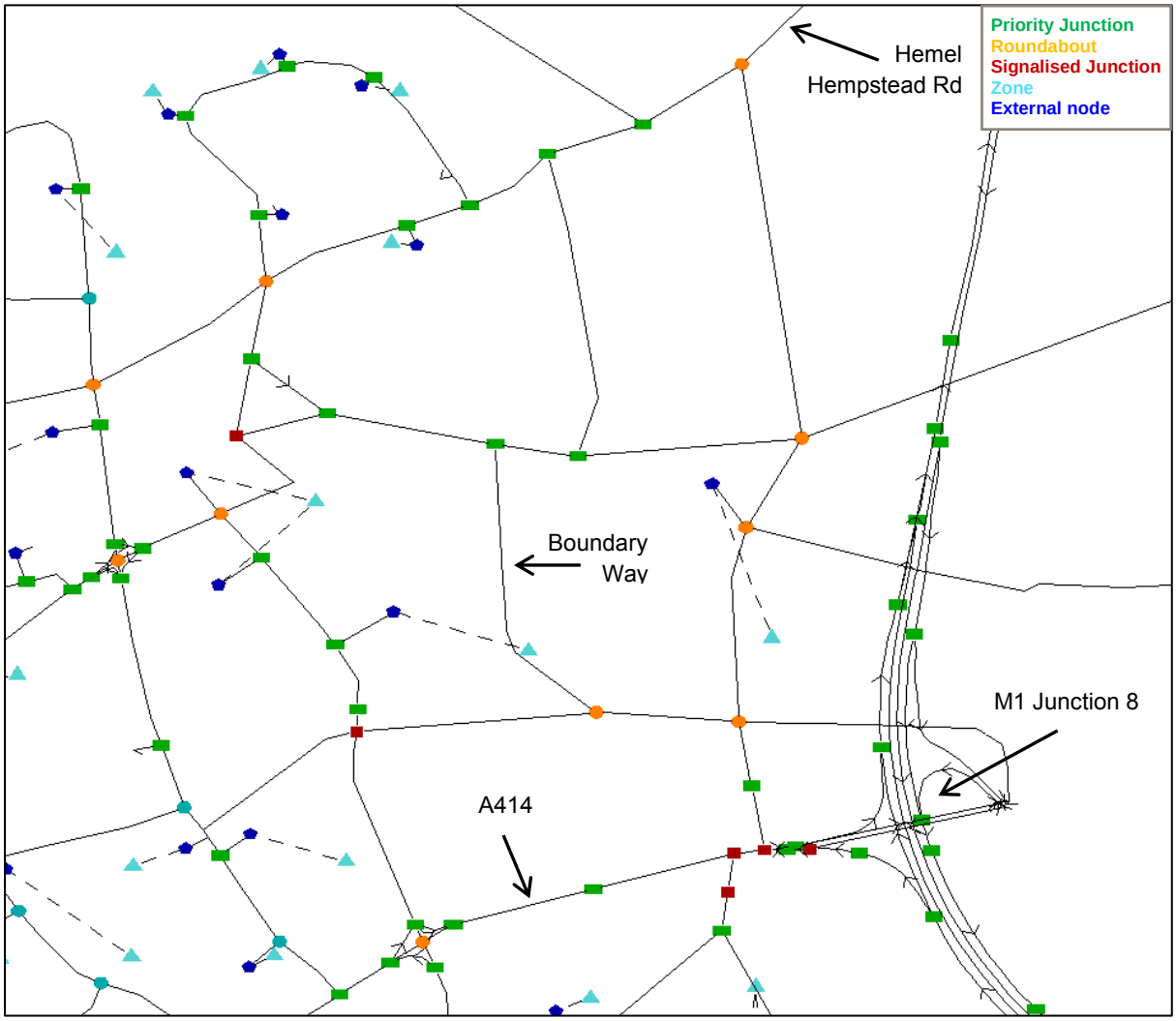


Figure 10.33: A10 / Lieutenant Ellis Way

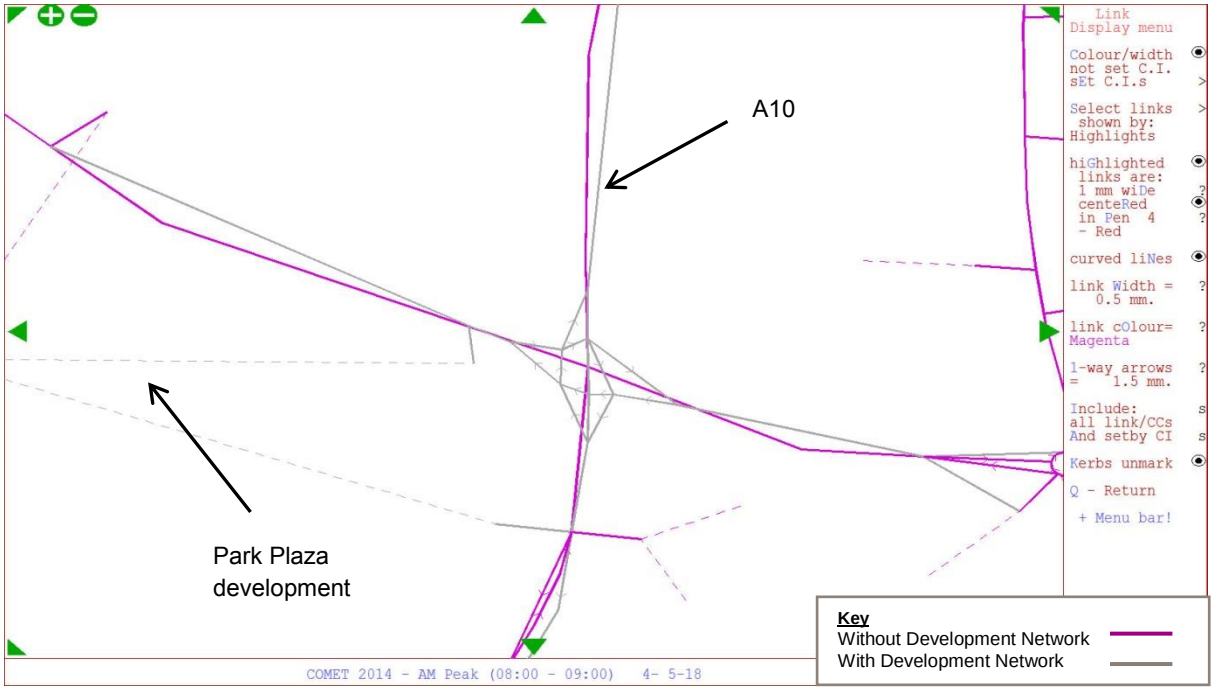
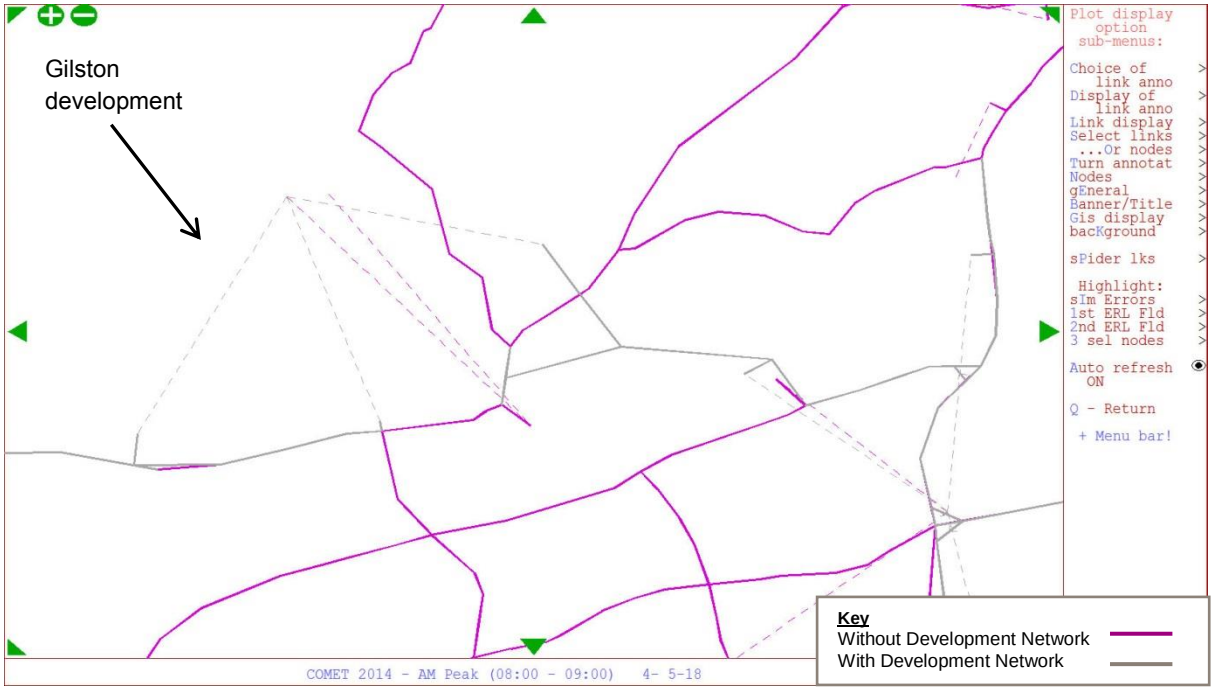


Figure 10.34: Gilston Devleopment



10.3 Appendix III: SATURN Highway Assignment Parameters

LOGICAL PARAMETERS

AMY = F
ASHORT = T
ATLAS = F
AUTNUC = T
AUTOK = T
AUTONA = T
AUTOX = F
AUTOZ = F
BANKER = F
BB109 = T
BEAKER = T
BUSKER = T
CLIMAX(5) = T
COMPAS = F
CROWCC = F
CUMULO = F
DCSV = F
DIDDLE = T
DOUBLE = T
DUALEX = T
DUTCH = F
ERTM = F
EXPERT = T
EZBUS = T
FIFO = T
FOZZY = T
FREDDY = F
FREEKY = F
FREEXY = T
FREE77 = F
FREE88 = F
FUNNEL = F
ICING = F
ILOVEU = T
KERMIT = F
KINKY = T
KONAL = F
LCR108 = T
LEFTDR = T
LIST = T
MINDER = F
MONACO = T
M108 = T
MULTIC = T
NOXYC = F
NO333C = F
PARTAN = F
PHILIP = F
PRINT = F
PRINTF = F
PRSFD = F
QUEEN = F
QUIKSA = F
QRTP = F
Q105 = T
RAGS = T
RB106 = T
REDMEN = F
REFFUB = F
ROSIE = F
RTP108 = T
SATOFF = F
SATTIT = T
SAVEIT = T
SAVUFO = T
SECRET = F
SHANDY = T
SIGOPT = F
SIM109 = T
SIM111 = F
SOWHAT = F
SPARSE = T
SPEEDS = T
SPIDER = T
STOLL = F
STUART = F
SUZIE = F
SUZIEQ = T
TOPUP = T
UFC109 = T
UFC111 = T
UNIQUE = F
UPBUS = T
USEUFO = T
WHATHO = F
WINDY = T
WRIGHT = T
ZILCH = F
GIS7 = T

INTEGER PARAMETERS

IBUSVC = 1
IFCC = 2
IFRL = 1
IPERT = 0
IROCKY = 0
ISTOP = 98
KANGA = 9999
KARL = 50
KDF = 1
KLUNK = 1
KNOBS = 0
KOB = 0
KOMBI = 0
KONSTP = 5
KORN = 0
KPHMIN = 10

KPHMAX = 120
LCY = 120
LRTP = 60
LTP = 60
MANOFF = 0
MASL = 100
MASL_F = 0
MASL_M = 1
MAXDTP = 10
MAXLSF = 3000
MAXQCT = 60
MAXSPA = 30
MAXZN =99999
MCALG = 1
MCNUM = 0
MCCS = 3
MCGILL = 0
MCUBC = 0
MET = 0
MINLSF = 300
MINRED = 10
MINSAT = 500
MODET = 1
MYTVV = 5
NFT = 113
NIPS = 2
NISTOP = 4
NITA = 20
NITA_C = 256
NITA_F = 0
NITA_M = 3
NITA_S = 99
NITS = 30
NITS_M = 5
NOMADS = 5
NOPD = 0
NOPMAX = 1
NOTUK = 0
NUC = 25
NUCMIN = 1

REAL PARAMETERS

AFTERS = 0.5000
AK_MIN = 0.2000
ALEX = 5.7500
APRESV = 1.0000
BBKING = 0.9500
BCRP = 2.0000
BETA = 0.1000
BETA_2 = 0.1000
BETA_D = 0.1000
BETA_T = 0.1000
BTKNOB = 0.0000
BUSPCU(1) = 2.2000
BUSSPK = 0.0000
CAPMIN = 30.0000
COBAF = 1.0000
DEFCAP = 1250.0000
DMWL = 300.0000
DMWL2 = 2000.0000
FISTOP = 0.0500
FLAREF = 2.0000
FLAREX = 2.0000
FLPK = 0.0700
FLPH = 1.2000
FLPPS = 0.0160
FLPSS = 0.0050
FRED = 1.0000
GAP = 1.5000
GAPM = 1.0000
GAPR = 2.0000
GAPRF = 1.0000
GONZO = 1.0000
OBAMAX = 0.1000
PCNEAR = 1.0000
PMAX = 5.0000
POWER = -1.0000
PPK = 0.0000
PPM = 1.0000
QDMAX = 226.0000
QVCMIN = 0.7500
RESIDD = 0.0000
RESIDR = 0.0000
RSTOP = 97.5000
SHADOW = 0.0000
STPCPU = 1000.0000
STPGAP = 0.0500
SUET = 0.2000
TAX = 2.0000
TDEL = 3.0000
TIJMIN = 0.0000
UNCRTS = 0.0200
VCPCU = 1.0000
VCPCU(2) = 1.0000
VCPCU(3) = 2.3000
WLMIN = 300.0000
WLMAX = 2000.0000
W32D = 0.0010
W32T = 0.1000
W32KPH = 1.5000
XFSTOP = 0.0500
XYUNIT = 1.0000

CHARACTER PARAMETERS

COINS = 'PENCE'
CURNCY = 'POUNDS'
FILGIS = 'COMET.GIS'
UCNAME(1) = 'Car Commute'
UCNAME(2) = 'Car Employers Business'
UCNAME(3) = 'Car Other'
UCNAME(4) = 'LGV'
UCNAME(5) = 'HGV'
VCNAME(1) = 'Lights'
VCNAME(2) = 'HGV'
XYFORM = '2I10'

10.4 Appendix IV: Highway Simulation Area Statistics by User Class

Table 10.1: Simulation Area Assignment Statistics – Car Commuting (PCU = Passenger Car Unit)

	AM Peak			Inter-peak			PM Peak		
	2014	2031	Δ	2014	2031	Δ	2014	2031	Δ
Travel Distance (PCU km)	1,437,884	1,586,388	10%	233,873	276,167	18%	1,402,415	1,540,300	10%
Total Travel Time (PCU hours)	30,562	38,683	26%	4,735	5,952	26%	33,249	38,570	16%
Average Speed (Kph)	47	41	-13%	49	45	-6%	42	40	-15%
Over-Capacity Queues (PCU hours)	3,404	6,437	106%	188	436	132%	7,044	8,674	23%
Transient Queues (PCU hours)	4,900	6,437	31%	786	1,042	32%	4,646	5,856	26%

Table 10.2: Simulation Area Assignment Statistics – Car Employers Business (PCU = Passenger Car Unit)

	AM Peak			Inter-peak			PM Peak		
	2014	2031	Δ	2014	2031	Δ	2014	2031	Δ
Travel Distance (PCU km)	561,623	614,081	9%	369,784	414,055	12%	758,054	834,843	10%
Total Travel Time (PCU hours)	9,192	11,924	30%	5,400	6,823	26%	12,502	15,4678	24%
Average Speed (Kph)	61	52	-16%	69	61	-11%	61	54	-11%
Over-Capacity Queues (PCU hours)	769	1,760	129%	160	410	157%	1,576	2,364	50%
Transient Queues (PCU hours)	1,109	1,693	53%	611	958	57%	1,312	2,002	53%

Table 10.3: Simulation Area Assignment Statistics – Car Other (PCU = Passenger Car Unit)

	AM Peak			Inter-peak			PM Peak		
	2014	2031	Δ	2014	2031	Δ	2014	2031	Δ
Travel Distance (PCU km)	1,347,248	1,710,802	27%	1,771,458	2,326,566	31%	1,441,050	1,825,401	27%
Total Travel Time (PCU hours)	28,573	41,179	44%	32,495	45,674	41%	35,840	47,340	32%
Average Speed (Kph)	47	42	-12%	55	51	-7%	40	39	-4%
Over-Capacity Queues (PCU hours)	3,403	7,724	127%	1,320	3,209	143%	8,012	11,012	37%
Transient Queues (PCU hours)	4,610	6,819	48%	5,053	7,601	50%	5,237	7,418	42%

Table 10.4: Simulation Area Assignment Statistics – LGV (PCU = Passenger Car Unit)

	AM Peak			Inter-peak			PM Peak		
	2014	**2031**	**Δ**	**2014**	**2031**	**Δ**	**2014**	**2031**	**Δ**
Travel Distance (PCU km)	419,958	613,201	46%	366,533	542,393	48%	414,482	579,425	40%
Total Travel Time (PCU hours)	9,507	15,354	62%	6,728	10,427	55%	10,081	14,577	45%
Average Speed (Kph)	44	40	-10%	55	52	-5%	41	40	-3%
Over-Capacity Queues (PCU hours)	1,303	3,114	139%	297	744	151%	2,075	3,215	55%
Transient Queues (PCU hours)	1,612	2,604	61%	1,069	1,725	61%	1,548	2,339	51%

Table 10.5: Simulation Area Assignment Statistics – HGV (PCU = Passenger Car Unit)

	AM Peak			Inter-peak			PM Peak		
	2014	**2031**	**Δ**	**2014**	**2031**	**Δ**	**2014**	**2031**	**Δ**
Travel Distance (PCU km)	759,722	899,750	21%	827,649	1,015,648	23%	546,450	651,527	19%
Total Travel Time (PCU hours)	10,564	14,209	39%	10,393	14,171	36%	7,873	10,383	32%
Average Speed (Kph)	72	63	-13%	80	72	-10%	69	63	-10%
Over-Capacity Queues (PCU hours)	580	1,398	128%	244	672	176%	724	1,184	64%
Transient Queues (PCU hours)	1,000	1,625	45%	859	1,576	83%	679	1,149	69%

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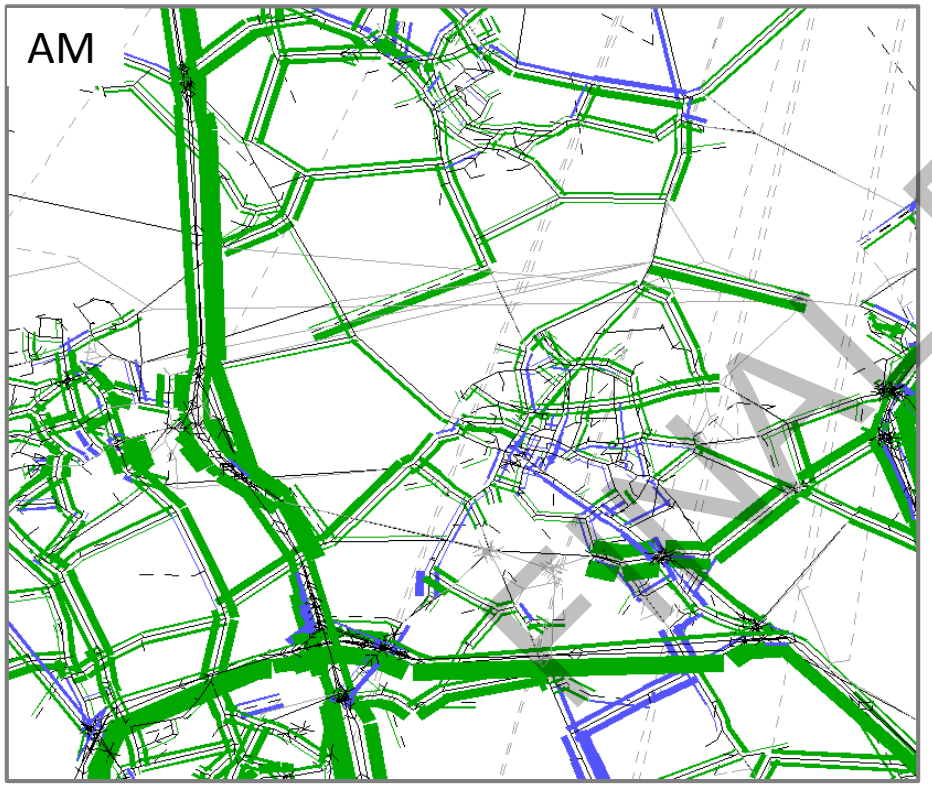
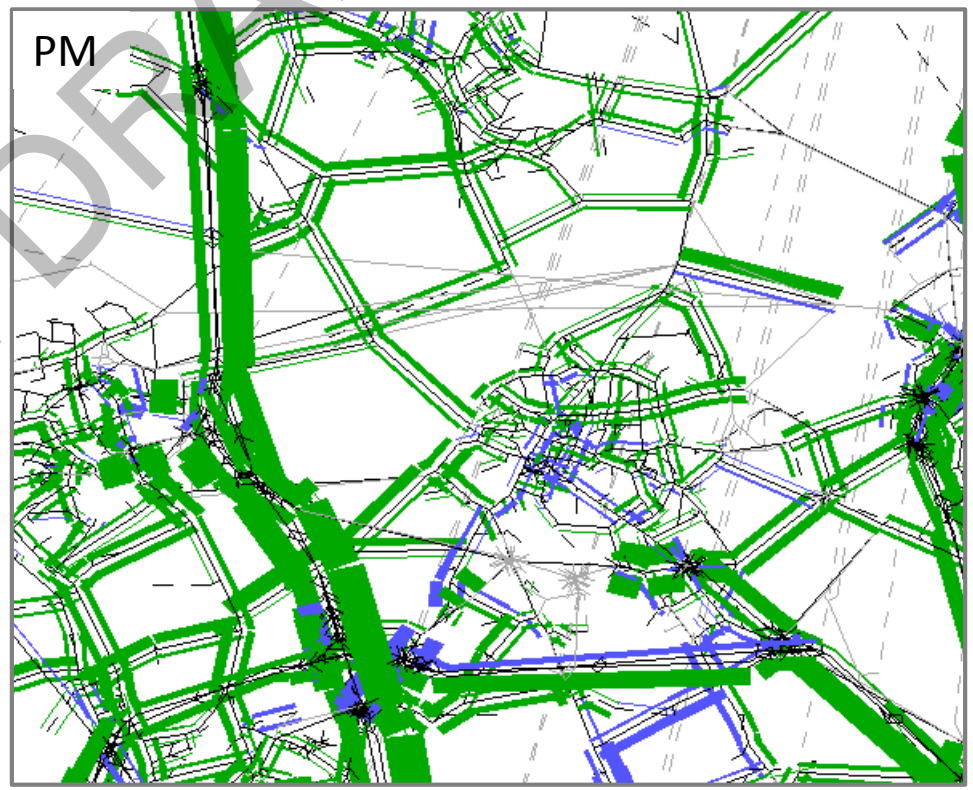
Appendix 42: Hertfordshire County Council COMET – Initial Results St Albans Final Draft (2018)

Flow Difference Plots: LP4 2036 vs Base Year 2014

- Flows increase across strategic network, specifically M1 and M25
- Flow increases in the area are associated with new developments, specifically East and North Hemel Hempstead, near M25 J22 and Tyttenhanger Estate in Hertsmere, and to the north of St Albans and Harpenden.
- Rerouting eastbound from M25 onto A414 observed in both peaks, but most noticeable in PM peak.
- Rerouting to use new link road near Park Street Garden Village.





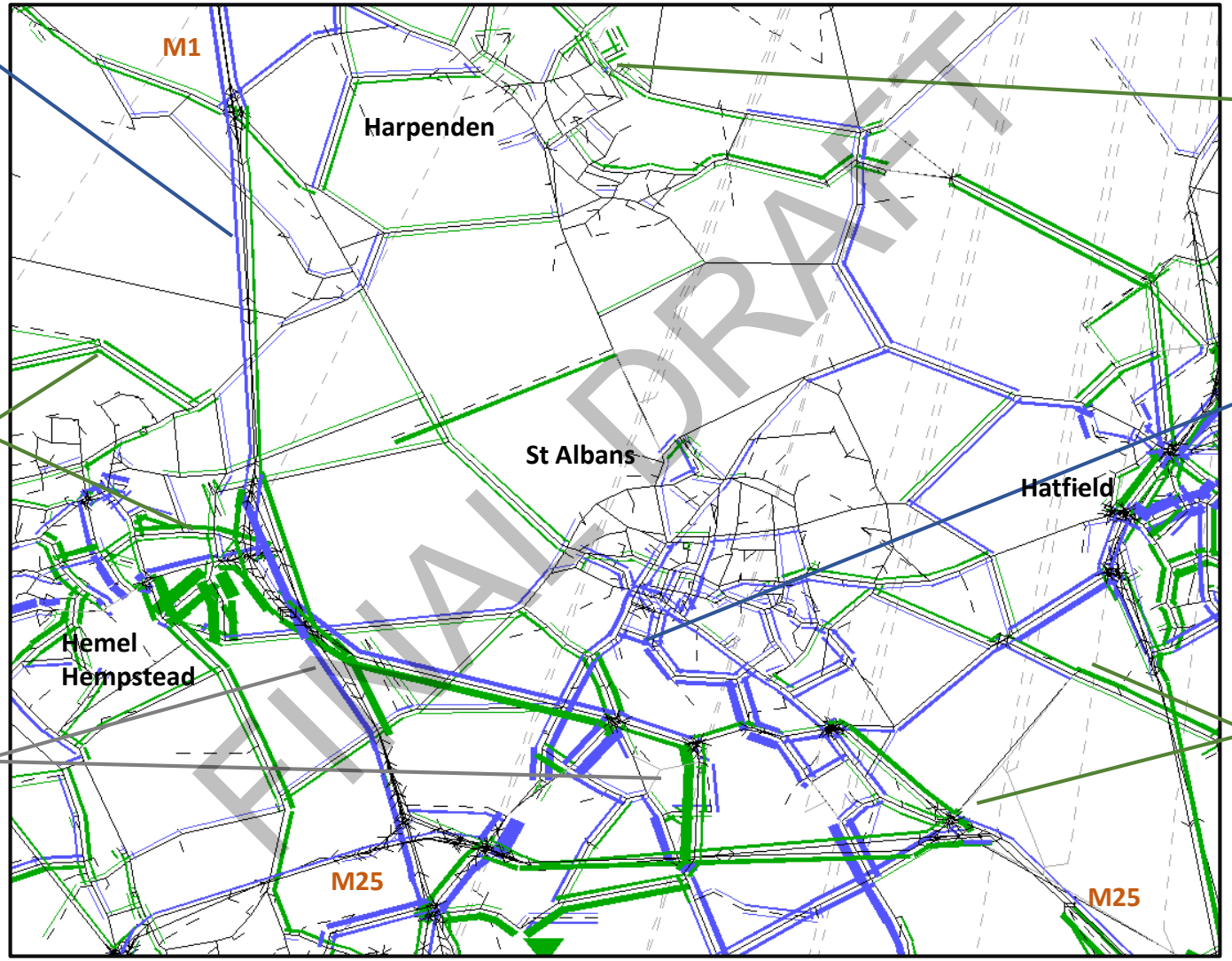
AM Flow Difference Plots: LP4 2036 vs LP3 2031

Reduction in traffic on M1, strategic traffic uses alternative routes

Increase in flows in eastern Hemel Hempstead and M1 J8 due to East and North Hemel Developments

Traffic from north Hertsmere and Park Street Garden Village uses A414 to access M1 NB or East Hemel Hempstead rather than M25-M1.

Associated with a decrease in M1 NB between J6 and J8



Increase in flows in Harpenden most likely as a result of new developments

Flow reductions in St Albans Town Centre and on southern approaches due to changes in planning data –location of some proposed developments has changed between 2031 and 2036

Reductions in flows along Watford Road, and Barnet Road

Flows around M25 J22, Tollgate Road, and A1081 increase due to new Tyttenhanger Estate in Hertsmere

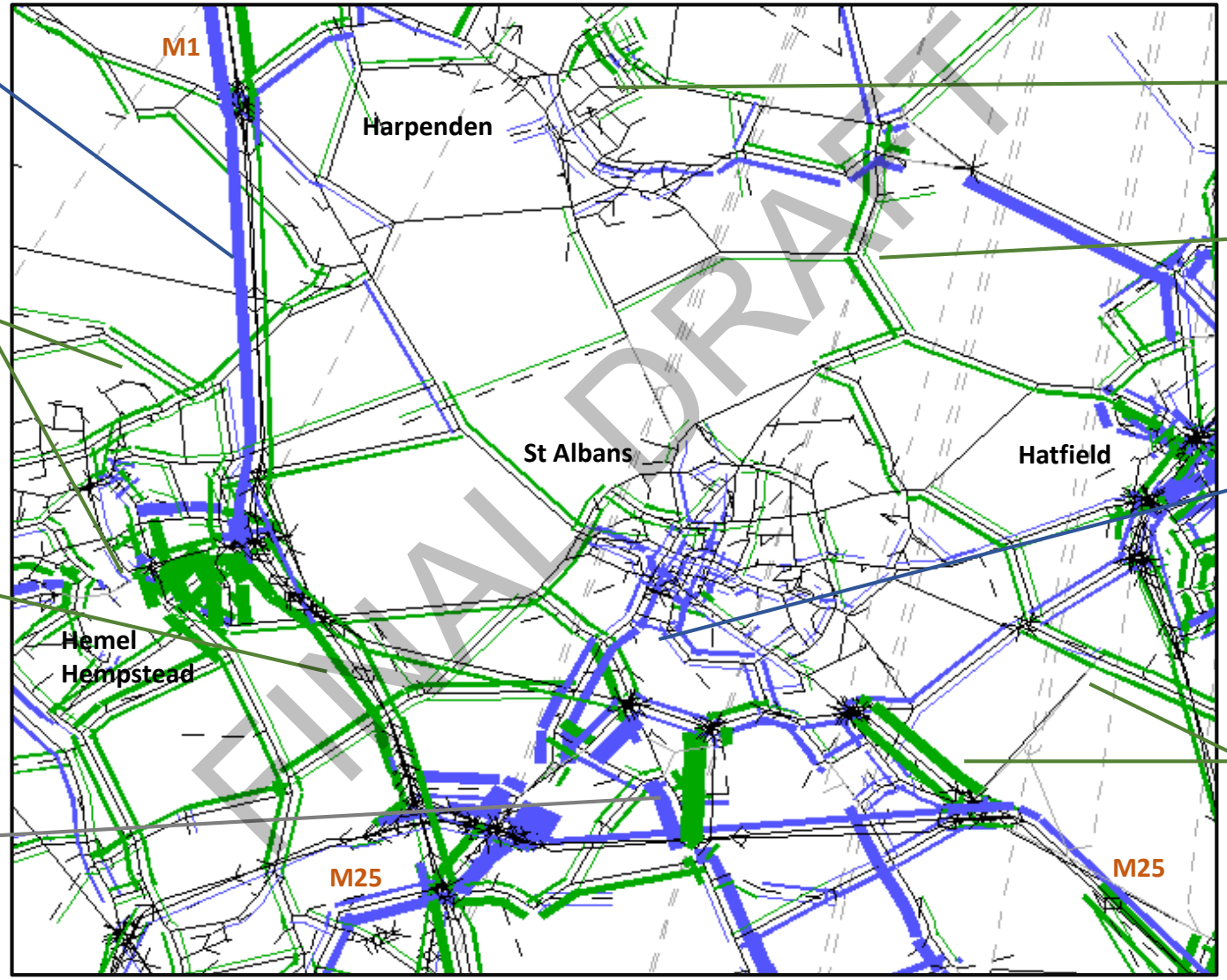
PM Flow Difference Plots: LP4 2036 – LP3 2031

Reduction in traffic on M1, strategic traffic uses alternative routes

Increase in flows in eastern Hemel Hempstead and M1 J8 due to East and North Hemel Developments

Increase in flows on M1 Northbound to J8, due to Eastern Hemel developments

Traffic from north Hertsmere uses A414 to access M1 NB or East Hemel Hempstead rather than M25-M1



Increase in flows in Harpenden most likely as a result of new developments

Increase traffic on cross country routes between Harpenden and St Albans/Hatfield, likely to be the result of development locations

Flow reductions in St Albans Town Centre and on southern approaches due to changes in planning data –location of some proposed developments has changed between 2031 and 2036

Reductions in flows along Watford Road, and Barnet Road

Flows around M25 J22, Tollgate Road, and A1081 increase due to new Tyttenhanger Estate in Hertsmere