MOTT MACDONALD

Ely to Cambridge Transport Study

Do Minimum Modelling Report

1 February 2018

Cambridgeshire County Council

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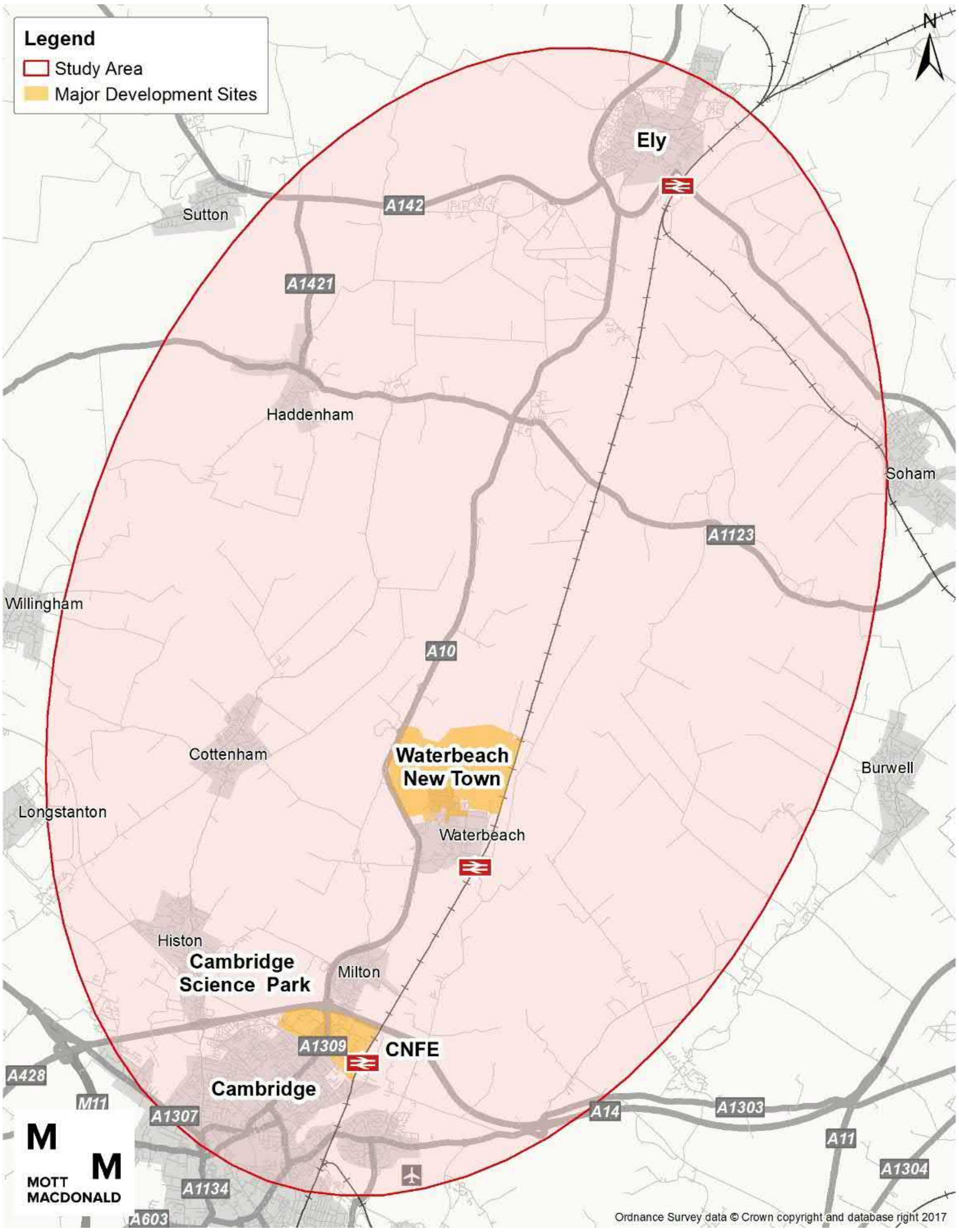
Contents

1 Introduction

1.1 Study Background

Mott MacDonald has been commissioned by Cambridgeshire County Council (CCC) to deliver the Ely to Cambridge Transport Study. The indicative Ely to Cambridge study area, which includes the A10 route between Cambridge and Ely plus any parallel alternative routes, is as follows:

Figure 1: Indicative Ely to Cambridge Transport Study Area



The study area includes key rail and highway links (both primary and secondary) between Cambridge, Ely, and beyond. It is also the focus of significant future development, with the new town north of Waterbeach and the Cambridge Northern Fringe East (CNFE) and Cambridge Science Park (CSP) sites being the potential future focus for significant residential and employment development. These key elements are shown in the indicative study area plan above.

As specified in the study brief, the outputs of the study will be:

- Strand 1 – An Options Study and Strategic Outline Business Case for the overall package of interventions in the Ely to Cambridge study area, including development of principles/mechanisms for securing appropriate developer contributions.
- Strand 2 – A Transport Study to identify the specific transport requirements, access options and measures, their costs, acceptability and any implications for the phasing of development of a new town north of Waterbeach.
- Strand 3 – A Transport Study to identify the specific transport requirements, access options and measures, their costs, acceptability and any implications for the levels of development and phasing of, a significant parcel of land in the north-east of Cambridge, known as Cambridge Northern Fringe East (CNFE) and Cambridge Science Park (CSP).

1.2 Report Purpose and Structure

In accordance with the above study scope, this report provides a summary of the Do Minimum modelling and analysis to assess the study area highway network implications of unmitigated development at CNFE, CSP and Waterbeach. The purpose of this analysis is to understand what future development-related transport impacts will require mitigation in order to deliver the developments in a sustainable manner.

The report is structured as follows:

- The modelling scenarios are summarised in Section 2
- The Future-Base Scenario model results are presented and discussed in Section 3
- The Waterbeach Scenario model results are presented and discussed with problem junctions identified in Section 4
- The CNFE/CSP Scenario model results are presented and discussed with problem junctions identified in Section 5
- The Combined Scenario model results presented and discussed with problem junctions identified in Section 6
- The report is summarised in Section 7

Supporting material is attached in appendices.

2 Modelling Scenarios

2.1 Introduction

This section summarises the strategy used for modelling each Do Minimum scenario. Further details of the modelling strategy can be found in our separate ‘Proposed Do Minimum Modelling Strategy’ note of 30 November 2016, which is included in Appendix A to this report, while an update of the demographics forecasting method provided by Atkins in 6 February 2017 are attached in Appendix B.

2.2 Modelling Approach for Study

The general modelling approach for this study is as follows:

1. Test future with and without-development scenarios with a ‘Do Minimum’ transport network in order to identify the unmitigated transport impacts of the new developments in the study area.
2. Develop transport schemes to mitigate significant development transport impacts in the study area, leading to a proposed ‘Do Something’ transport network.
3. Test future with-development scenarios with the Do Something networks to assess the effectiveness of the proposed mitigation.

The purpose of this report is to present the outcome of the first of the above steps, with a view to clarifying what solutions might be required to be developed for Steps 2 and 3 above.

2.3 Modelling Tool

The Do Minimum modelling has been carried out using Cambridgeshire County Council’s updated Cambridge Sub-Regional Model (CSRM2). CSRM2 is a WebTAG-compliant strategic model which uses base data from 2015, including:

- Validation against recently collected traffic and transportation counts
- All networks (highway, PT, walk, cycle)
- Representation of parking and Park & Ride
- Base transport movement data
- Base land use data
- Matrices with up-to-date mobile phone data

Investigations of model performance and journey times in the study area undertaken on behalf of CCC indicate that the model is fit for use in the assessment of this phase of the project.

All Do Minimum scenarios below are derived from the 2031 Foundation Case scenario, which reflects the future situation where Local Plan projected population and employment growth levels have taken place and where all planned transport schemes with a likelihood status of ‘certain’ or ‘near certain’ have been implemented (see full list in Appendix A).

All modelling results presented in this report are for the AM and PM weekday peak hours, which are:

- AM peak: 08:00-09:00
- PM peak: 17:00-18:00

2.4 Modelling Scenarios

2.4.1 Future-Base Scenario (‘Scenario 1’ in the Modelling Strategy note)

This scenario represents the hypothetical future situation in 2031 where neither the Waterbeach new town, CNFE nor CSP intensification developments take place. Instead, the population and employment levels which would otherwise be accommodated within these sites has been dispersed elsewhere within the wider Cambridgeshire sub-region by the model. This ensures that the level of housing and jobs in each scenario overall is the same, but the distribution is varied to reflect the development scenario. The main purpose of this scenario is not, therefore, to project a future planning position which is either proposed or envisaged, but to serve as a future hypothetical baseline against which to measure predicted development impacts.

The future schemes incorporated into the Do Minimum network are described in the Modelling Strategy note in Appendix A, while the population and employment forecasts assumed by this scenario are described in the Technical Note attached in Appendix B.

2.4.2 Waterbeach Scenario (‘Scenario 2’ in the Modelling Strategy note)

This scenario differs from the Future-Base Scenario by the addition of new development at the Waterbeach new town site in 2031, with the same level of development subtracted from across the wider subregion to compensate. No transport mitigation has been included for the development at this stage other than the introduction of site access arrangements. The scenario therefore provides an indication of the potential transport impacts of the new town north of Waterbeach in the absence of any transport mitigation measures.

Based on feedback from the site’s prospective developers, the full build-out aspirations are as described in Table 1 below. In agreement with stakeholders, this scenario assumes this level of full build-out by 2031.

Table 1: Development Proposals (Waterbeach)

Description	Development Class	Quantity	Profile Through Time				Units	Jobs
		Total	2016	2021	2026	2031		
Dwellings	Houses	10,000		2,100	2,500	5,400	Houses	
	Apartments						Apartments	
Retail (including food and drink)	Convenience	15,000		3,150	3,750	8,100	GFA sqm	750
	Comparison / Service						GFA sqm	
Industrial	Light Industrial						GFA sqm	
Other: Leisure and Health	Hotel(s)	6,000			6,000		GFA sqm	450
	Health / Fitness centre						GFA sqm	750
	Place of Worship						GFA sqm	
Office	Commercial	5,000		1,050	1,250	2,700	GFA sqm	320
	Academic Research						GFA sqm	
Pre-School							Pupils	800
Primary School		2,160		454	540	1166	Pupils	
Secondary School		1,800		378	450	972	Pupils	
Sixth Form		360		76	90	194	Students	
Adult Education							Students	
Other Uses/General/SG							GFA sqm	400
On Site Job Estimates								3,470
Homeworking								2,573
CRP								2,507
CRP Hotel								56
Jobs Estimate Total (including home working and CRP buildout)								**8,606**

Source: Peter Brett Associates on behalf of Urban & Civic and RLW

2.4.3 CNFE/CSP Scenario ('Scenario 3' in the Modelling Strategy note)

This scenario differs from the Future-Base Scenario by the addition of new development at the CNFE and CSP sites in 2031, together with the same level of development subtracted from across the wider subregion to compensate. No transport mitigation has been included for the development at this stage other than the introduction of site access arrangements. The scenario therefore provides an indication of the potential transport impacts of the development in the absence of any mitigation measures.

With regards the level of development modelled in this scenario, our Modelling Strategy note presented two development options for CNFE, based on developer aspirations: Option 2a and Option 4a. These proposals have since been updated to Option 2a+ and Option 4a+ and are summarised in the following two tables.

Table 2: Option 2a+ – CNFE Lower Level Developer option

Option 2a+ as amended by CB4	Units / Floorspace	Jobs	GFA per Job (m^2)
Chesterton Partnership And Nuffield Road Dwellings (no)	1,062	-	-
Chesterton Partnership - B1(a/b) Offices (GFA sqm)	248,932	20,919	12
Chesterton Partnership Retail (GFA sqm)	1,600	91	18
Chesterton Partnership Hotel (GFA sqm)	6,500	33	195
St.John's Innovation Park Office (GFA sqm)	25,000	2,101	12
Option 2a B1c/B2/B8 Industrial (GFA sqm)	50,180	1,416	35
Ancillary Facilities	To be agreed	To be calculated	-
Total Jobs	-	**24,560**	-
Total new jobs (assuming 3,800 existing)	-	**20,760**	-

Source: CCC

Table 3: Option 4a+ – CNFE Higher Level Developer option

Option 4a+ as amended by Grosvenor Estates	Units / Floorspace	Jobs	GFA per Job (m^2)
Grosvenor, Chesterton Partnership And Nuffield Rd Dwellings (no)	7,692	-	-
Grosvenor, Chesterton Partnership - B1(a/b) Offices (GFA sqm)	261,910	22,009	12
Grosvenor and Chesterton Partnership Retail (GFA sqm)	9,500	543	18
Grosvenor Leisure (GFA sqm)	18,000	277	65
Chesterton Partnership Hotel (GFA sqm)	6,500	33	195
St.John's Innovation Park Office (GFA sqm)	25,000	2,101	12
Option 4a+ B1c/B2/B8 Industrial (GFA sqm)	No space left	1,416	35
Ancillary Facilities	To be agreed	To be calculated	-
Total Jobs	-	**24,963**	-
Total new jobs (assuming 3,800 existing)	-	**21,263**	-

Source: CCC

Both of these options therefore propose similar levels of jobs, but Option 4a+ proposes 7,692 dwellings where Option 2a+ proposes 1,062.

In addition, the proposals for the intensification of CSP are for 5,992 new jobs, making the new jobs total for both sites about 27,000 in both options.

One of the challenges in modelling this level of new jobs at these two sites in CSRM, however, is that they do not form part of the Local Plan allocated growth for Cambridge and South Cambridgeshire. If these new jobs were therefore added to the CSRM model in addition to the Local Plan growth, problems would arise in the model as to where the population would come from to service these additional jobs. In agreement with the client group, therefore, it was decided to identify all Local Plan allocated employment sites which do not currently have planning approvals and to assume a reallocation of jobs from those potential sites to CNFE. This scenario was purely for the purposes of modelling development at CNFE within the constraints of keeping overall growth levels within Local Plan targets, and does not reflect a proposed future planning scenario.

This approach identified 19,100 jobs that could be reallocated. These jobs have been split with 80% at the CNFE and 20% at the CSP in reflection of the relative proportion of new jobs proposed above for each site. This therefore gives a total of 15,280 reallocated jobs to CNFE and 3,820 reallocated jobs to CSP, while 1,062 dwellings are also proposed for CNFE, as per Option 2a+.

This is therefore the land use mix for these sites which is modelled as part of this CNFE/CSP Scenario. The following table compares this development mix with that of Options 2a+ and 4a+.

Table 4: Comparison of new job totals per development option

Site	Option 2a+	Option 4a+	CNFE/CSP Scenario Option
CNFE	20,760	21,263	15,280
CSP	5,992	5,992	3,820
Total	**26,752**	**27,255**	**19,100**

This shows that the level of new jobs modelled at both sites by this scenario is about 71% of that proposed for Option 2a+.

2.4.4 Combined Scenario (‘Scenario 4’ in the Modelling Strategy note)

This scenario differs from the Future-Base Scenario by the addition of new development at both the Waterbeach new town and the CNFE and CSP sites in 2031, together with the same level of development subtracted from across the wider subregion to compensate. As for the other scenarios, no transport mitigation has been included for the developments at this stage other than the introduction of site access arrangements. The scenario therefore provides an indication of the potential combined transport impacts of the developments in the absence of any mitigation measures.

New development is represented at the Waterbeach site in the same way as described for the Waterbeach Scenario described above.

However, following the CNFE/CSP Scenario results presented below in Section 5 below, it was agreed with the client group to model a CNFE land use mix for the Combined Scenario which offers greater levels of internalisation and better balanced access and egress flows in order to reduce potential impact on the external network. The process for calculating the revised distribution is described in our separate ‘CNFE Alternative Land Use Options (Scenario 3a)’ report of 19 July 2017, but the resulting land use mix (from the ‘Option 2a+ Maximum Internalisation’ option) is summarised in the following table. The equivalent mix from the above CNFE/CSP Scenario is also shown to allow comparison.

Table 5: CNFE land use mix per Do Min modelling scenario

Scenario	New Dwellings	New Jobs
CNFE/CSP Scenario	1,062	15,280
Combined Scenario	3,920	3,908
Difference	+2,858	-11,372

This shows that the CNFE land use mix for the Combined Scenario involves more houses but fewer jobs than for the above CNFE/CSP Scenario.

The level of new jobs modelled for CSP is 5,992, as set out in the development mix in the modelling strategy note. In the CNFE/CSP Scenario, the number of jobs at CSP had to be reduced as only 19,000 jobs could be distributed between CNFE and CSP. However, in the Combined Scenario there are less jobs at CNFE and more housing, meaning that the full number of jobs can be redistributed to CSP.

3 Future-Base Scenario Results

3.1 Introduction

The purpose of this section is to present the 2031 AM and PM peak-period Do Minimum modelling results for the Future-Base Scenario. Results are presented in terms of:

- Traffic flows, to show the predicted distribution of traffic demand on the network – this shows where junctions are likely to experience capacity problems
- Junction performance, to show what proportion of junction capacity is predicted to be used up by the predicted traffic demand – this reveals where delays are likely to arise
- Junction delay, to show the total delay to users arising from the performance of each junction – this shows where the greatest congestion problems are occurring
- Journey times, to show the impact of junction delays on journey times – this allows the impact of junction delays to be understood in terms of overall journey time impact

3.2 AM Peak Period Results

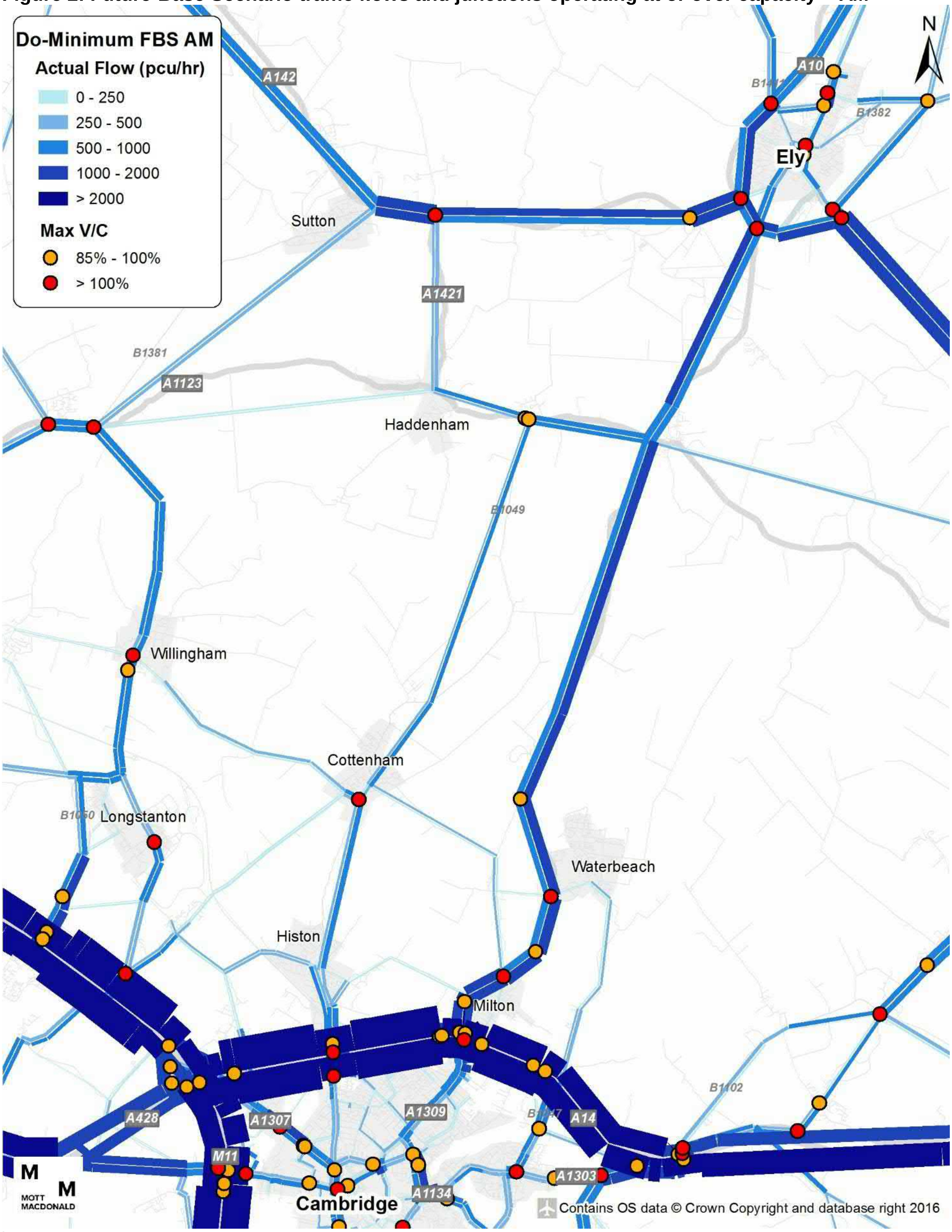
3.2.1 AM Peak Traffic Flow and Junction Performance

For the 2031 AM weekday peak period in the Future-Base Scenario, Figure 2 below shows:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C[1] of between 85% and 100% (shown orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

[1] V/C = 'Volume over Capacity'. This is a standard measure of junction performance and describes what proportion of traffic volume capacity on each junction arm is taken up by the actual predicted traffic volume. V/C values between 85% or 90% and 100% are considered to be at capacity, as it is in this range that queueing and delay starts to build up noticeably. V/C values of beyond 100% are considered to be over capacity, and significant queueing and delay can be expected under these circumstances.

Figure 2: Future-Base Scenario traffic flows and junctions operating at or over capacity – AM



`Source: CSRM

It is evident from Figure 2 that during the AM peak, the busiest sections of network within the study area are on the A14, M11, A142 and the A10, as is the case today.

South of Stretham, flows towards Cambridge on the A10 are higher than in the opposite direction, and substantial enough to cause most junctions south of Cambridge Research Park to be at or over capacity. These junctions are with:

- Green End
- Car Dyke Road / Waterbeach Road
- Landbeach Road
- Butt Lane
- Milton Interchange

Flows on the parallel B1049 between Wilburton and the A14 are also sufficient to cause junction capacity problems at Wilburton, Cottenham and at Histon Interchange, and while flows on the other parallel B1047 route through Horningsea are more minor, they are also sufficient to generate problems at the junctions with the A14 and Newmarket Road.

Within Cambridge, there are many over-capacity junctions on the main A roads through the city centre. This is in addition to a large number of over-capacity junctions further north in Ely, both within the city and the outlying roads. Around Ely on the A142 and A10, many junctions operate at or over capacity.

3.2.2 AM Peak Traffic Flow and Junction Delay

Figure 3 below shows, for the 2031 AM peak period in the Future-Base Scenario:

- The distribution of traffic flows on the modelled network, shown as ‘bandwidths’ and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU[2] flow through the junction by the average delay per PCU experienced at the junction.

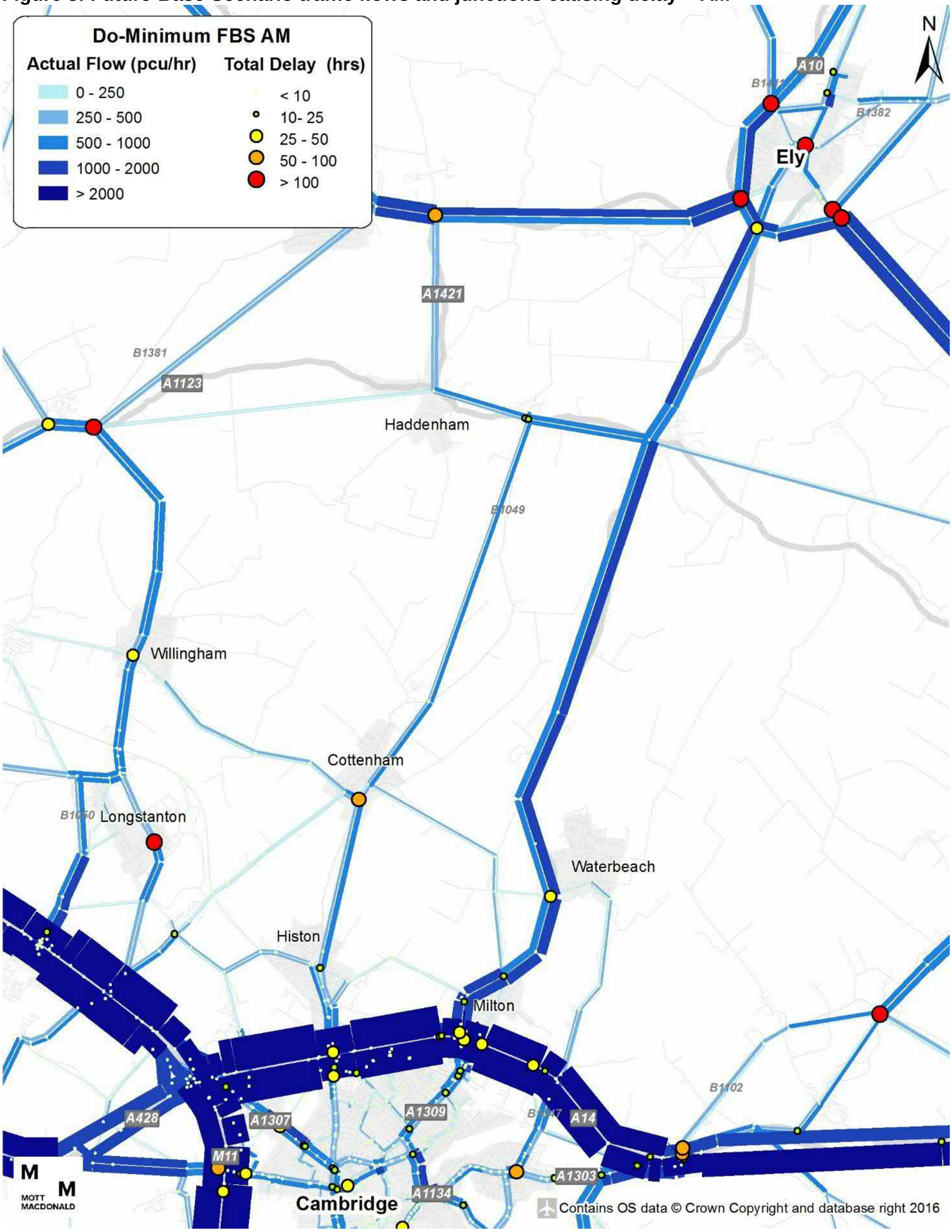
It should be noted that a value for total delay has been calculated for each individual node in the CSRM model and that a number of large junctions or roundabouts, such as Milton Interchange, have many nodes. Therefore these junctions are represented with many total delay figures, showing total delays at specific parts of that junction, and should be added together if a total delay figure is wanted for the junction as a whole.

It can be seen that the total delays shown below broadly correspond with the V/C values shown above in Figure 2, but give a better understanding of the actual impacts of each junction being at or over capacity as they take into account the number of users impacted in each case.

This figure shows that the highest delay impacts are predicted for the Ely bypass, whereas absolute delay levels at Histon Interchange and Milton Interchange appear lower. However, it is noted that these latter junctions are represented by multiple nodes and that these, when summed together, would also show high overall levels of delay. Delay at Cottenham on the B1049 and at Newmarket Road on the B1047 are also significant, but overall delays at the capacity constrained junctions of the A10 south of Cambridge Research Park are relatively minor overall as most of the delay occurs to side road traffic, as opposed to main line flows, where flows are lighter.

[2] ‘PCU’ = ‘Passenger Car Unit’. PCUs are an industry-standard unit for measuring traffic flows and provide a consistent way to represent flows of differing vehicle compositions by converting each vehicle type into an equivalent number of passenger cars

Figure 3: Future-Base Scenario traffic flows and junctions causing delay – AM



Source: CSRM

3.2.3 AM Peak Journey Time Performance

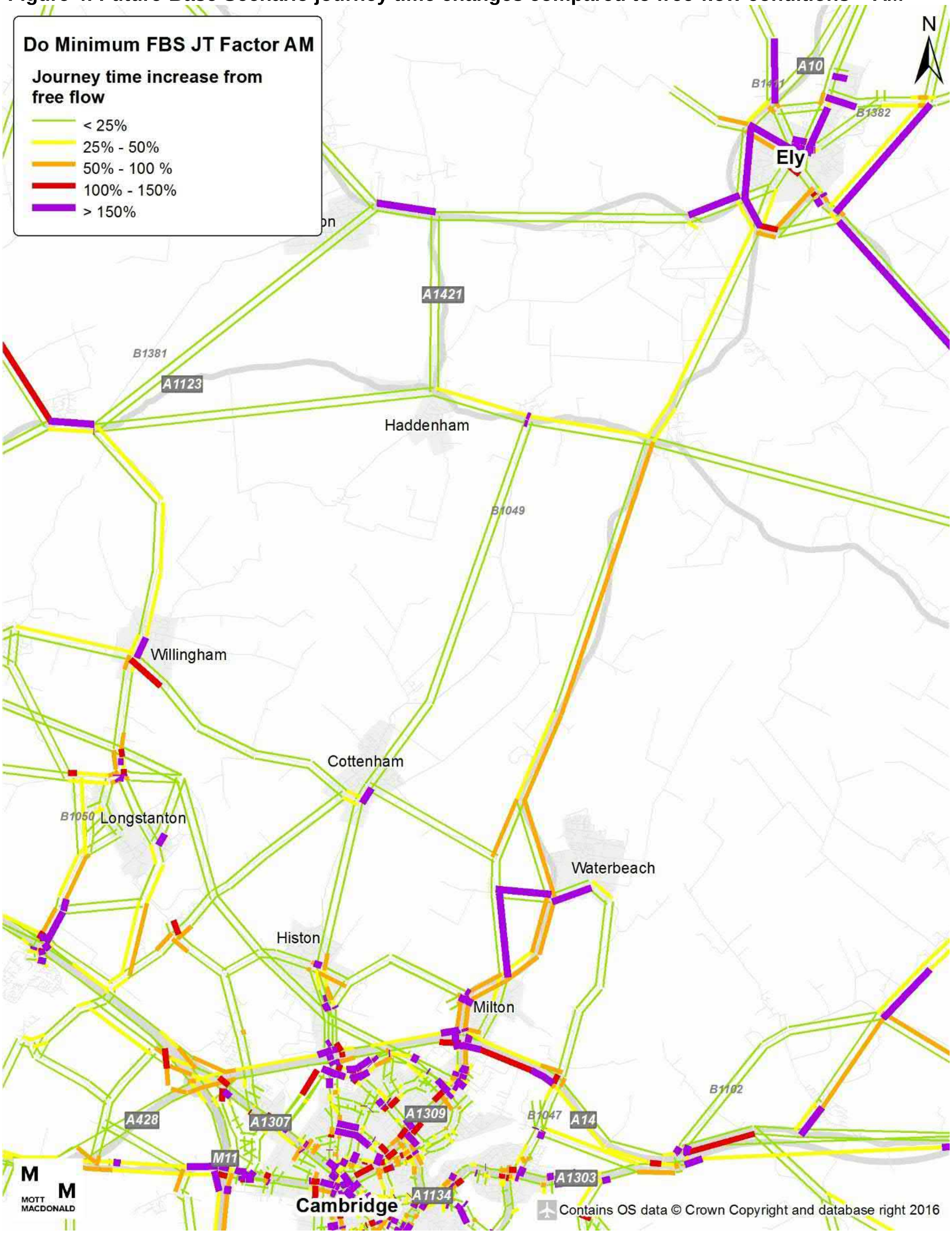
For the Future-Base Scenario, Figure 4 below shows the percentage increase in journey time in the 2031 AM peak period compared to equivalent free-flow conditions, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. This provides an indication of which links experience peak hour delay.

The figure shows that:

- The greatest AM peak hour journey time impacts are predicted to take place in and around Ely, which corresponds with the above junction delay results for this area
- Southbound on the A10 is generally slower than northbound, reflecting the higher traffic levels in this direction, while side-arms experience delays south of Cambridge Research Park and at Milton Interchange, as per the above junction delay results
- Journey times on the parallel B1049 and B1047 routes are generally similar to free-flow conditions, except at Cottenham, Histon Interchange and the junction with Newmarket Road

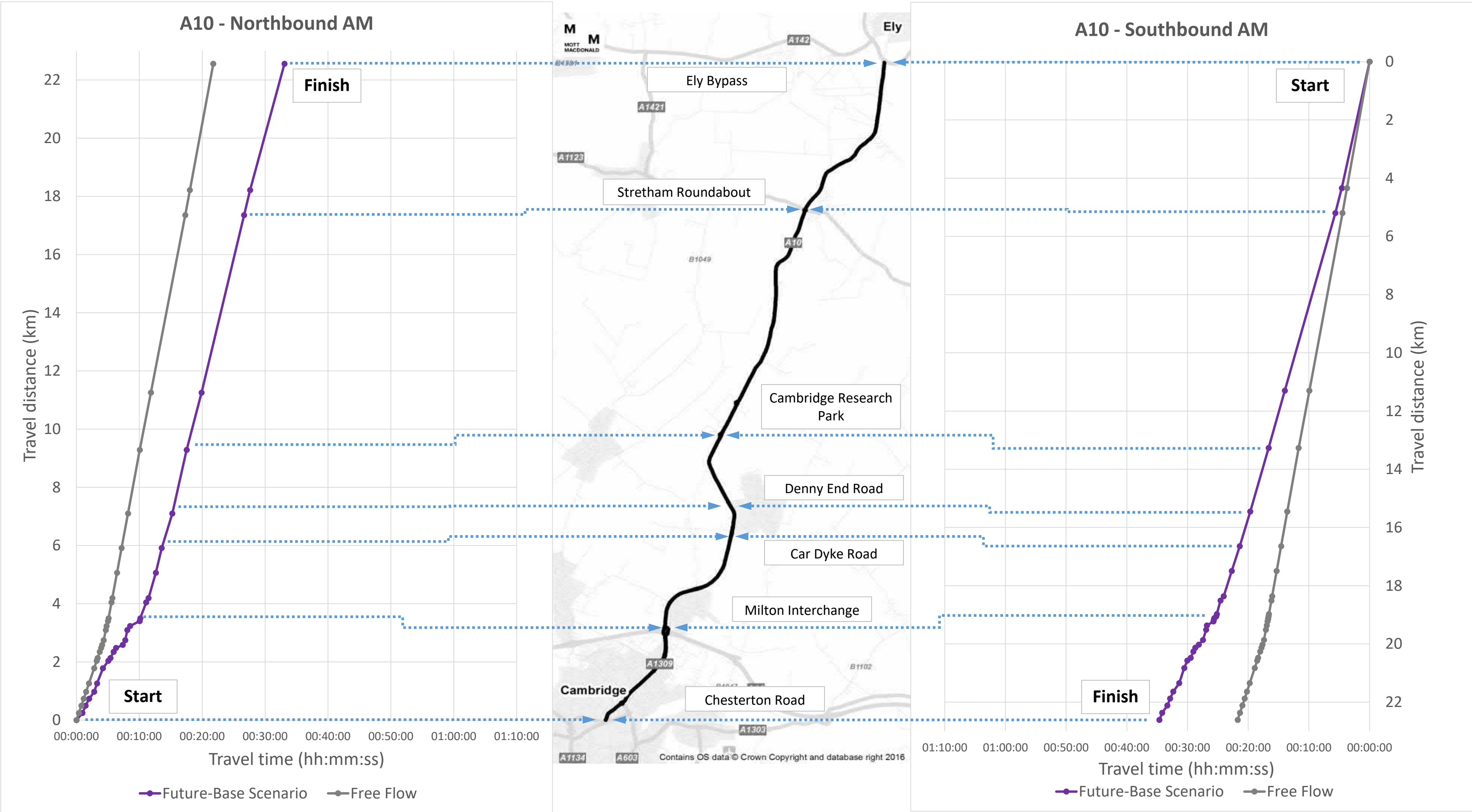
The subsequent Figure 5 below focusses on the study area, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, with free flow time included for comparison. These show that northbound and southbound trips are predicted to respectively take 52% and 59% longer than modelled free flow journey times.

Figure 4: Future-Base Scenario journey time changes compared to free-flow conditions – AM



Source: CSRM

Figure 5: Future-Base Scenario journey time on the A10 between Ely and Cambridge – AM



Source: CSRM

3.3 PM Peak Period Results

3.3.1 PM Peak Traffic Flow and Junction Performance

Figure 6 shows, for the PM peak in the Future-Base Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

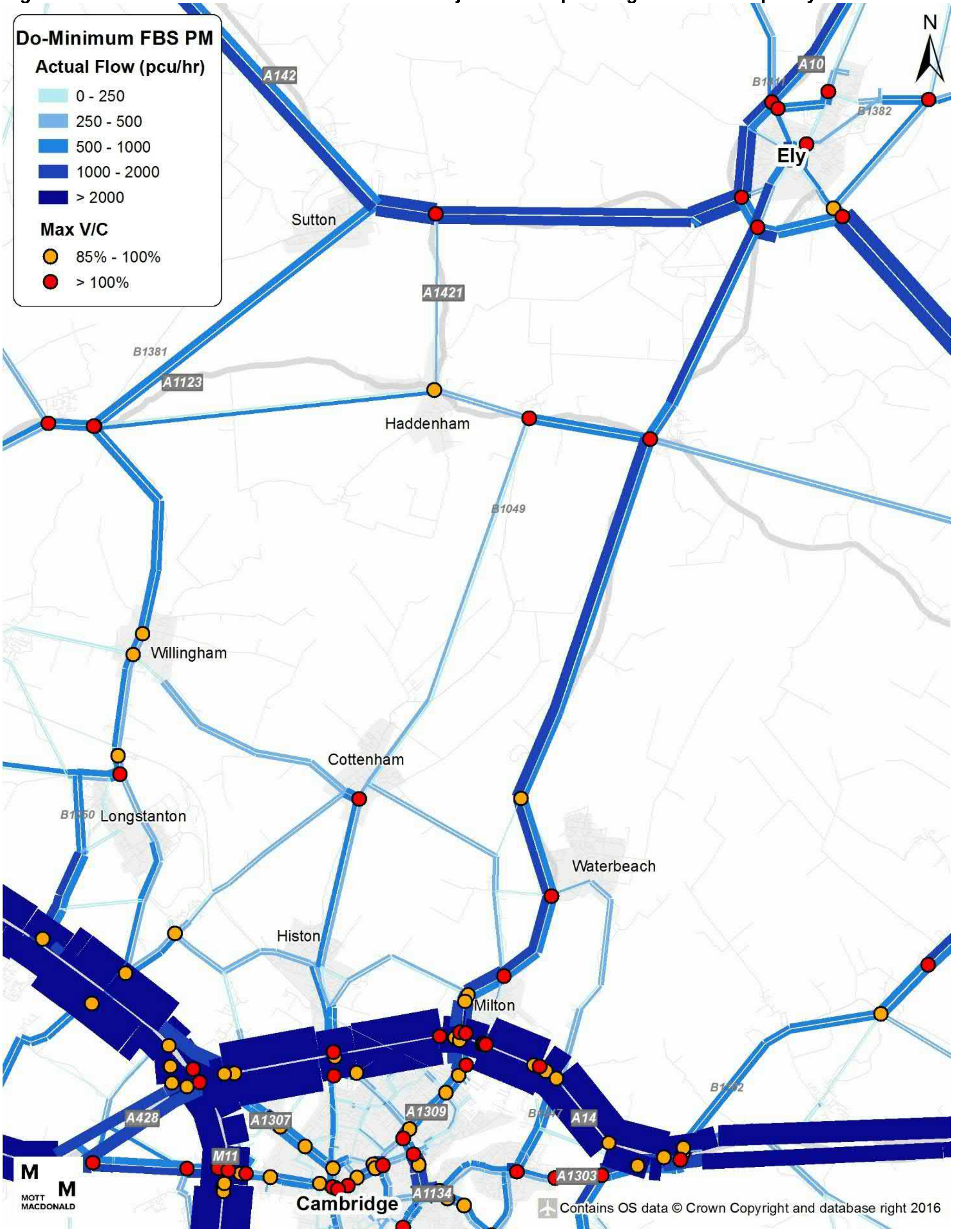
It is evident from Figure 6 that during the PM peak, the busiest sections of network within the study area are on the A14, M11, A142 and the A10, as is the case today.

As for the AM, many junctions in and around Ely and in Cambridge are operating at or over-capacity, but to a greater extent in the PM.

On the A10 route, the balance of flows is opposite to the AM with the higher flows being in the northbound direction. The same junctions south of Cambridge Research Park are showing substandard operation – with Milton Interchange experiencing greater capacity problems and Stretham roundabout also operating over-capacity in this peak hour.

On parallel routes, the same junctions on the B1049 and B1047 show performance problems, but with the junction at Wilburton also performing worse.

Figure 6: Future-Base Scenario traffic flows and junctions operating at or over capacity – PM



Source: CSRM

3.3.2 PM Peak Traffic Flow and Junction Delay

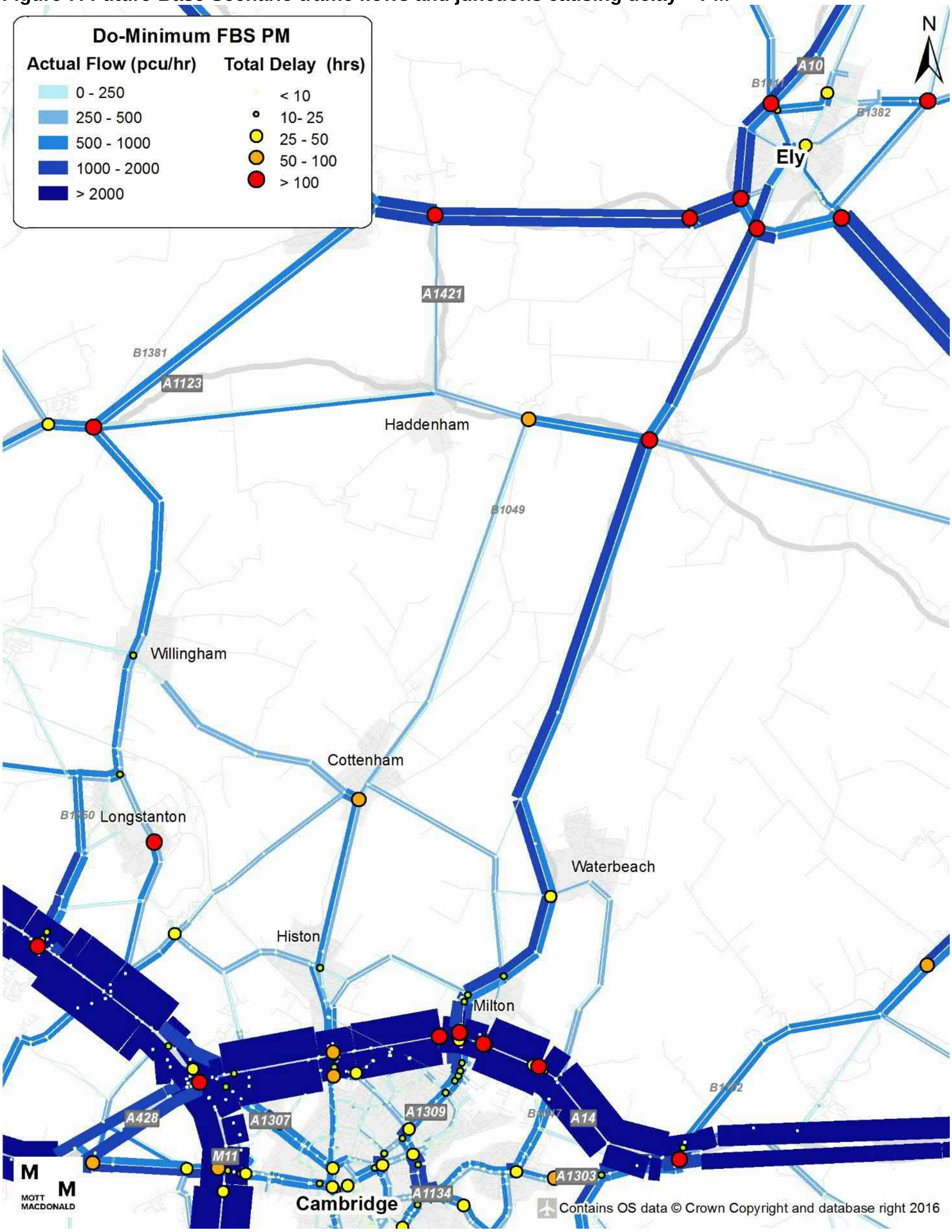
Figure 7 below shows, for the PM peak in the Future-Base Scenario:

- The distribution of traffic flows on the modelled network, shown as ‘bandwidths’ and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU[3] flow through the junction by the average delay per PCU experienced at the junction

As for the AM, the total delays shown below broadly correspond with the V/C values shown in Figure 6 above. Also as with the AM, the below figure shows high levels of delay in and around Ely. High levels of delay are also seen in the PM at junctions along the A14 (particularly Milton Interchange) and M11, and at Stretham roundabout. Delays at Histon Interchange and at Wilburton are also higher than in the AM, but delay levels at the A10 junctions around Waterbeach are of a similar order.

[3] ‘PCU’ = ‘Passenger Car Unit’. PCUs are an industry-standard unit for measuring traffic flows and provide a consistent way to represent flows of differing vehicle compositions by converting each vehicle type into an equivalent number of passenger cars

Figure 7: Future-Base Scenario traffic flows and junctions causing delay – PM



3.3.3 PM Peak Journey Time Performance

For the Future-Base Scenario, Figure 8 below shows the percentage increase in journey time in the 2031 PM peak period compared to equivalent free-flow conditions, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. This provides an indication of which links experience peak hour delay.

The figure shows:

- High peak-hour journey time increases in and around Ely, as for the AM
- Higher northbound journey time increases on the A10 than for southbound traffic in the AM, with the approaches to Stretham roundabout and Ely bypass being particularly delayed
- Greater delays around Milton Interchange and Histon Interchange than in the AM
- Limited increases in delay on the B1047 route through Horningsea, but high levels of journey time increase on the B1049 northbound between Cottenham and Wilburton

The subsequent Figure 9 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, with free flow time included for comparison. These show that southbound trips are predicted to take 40% longer than modelled free flow journey times, while northbound trips are predicted to take nearly 3 times longer.

Figure 8: Future-Base Scenario journey time changes compared to free-flow conditions – PM

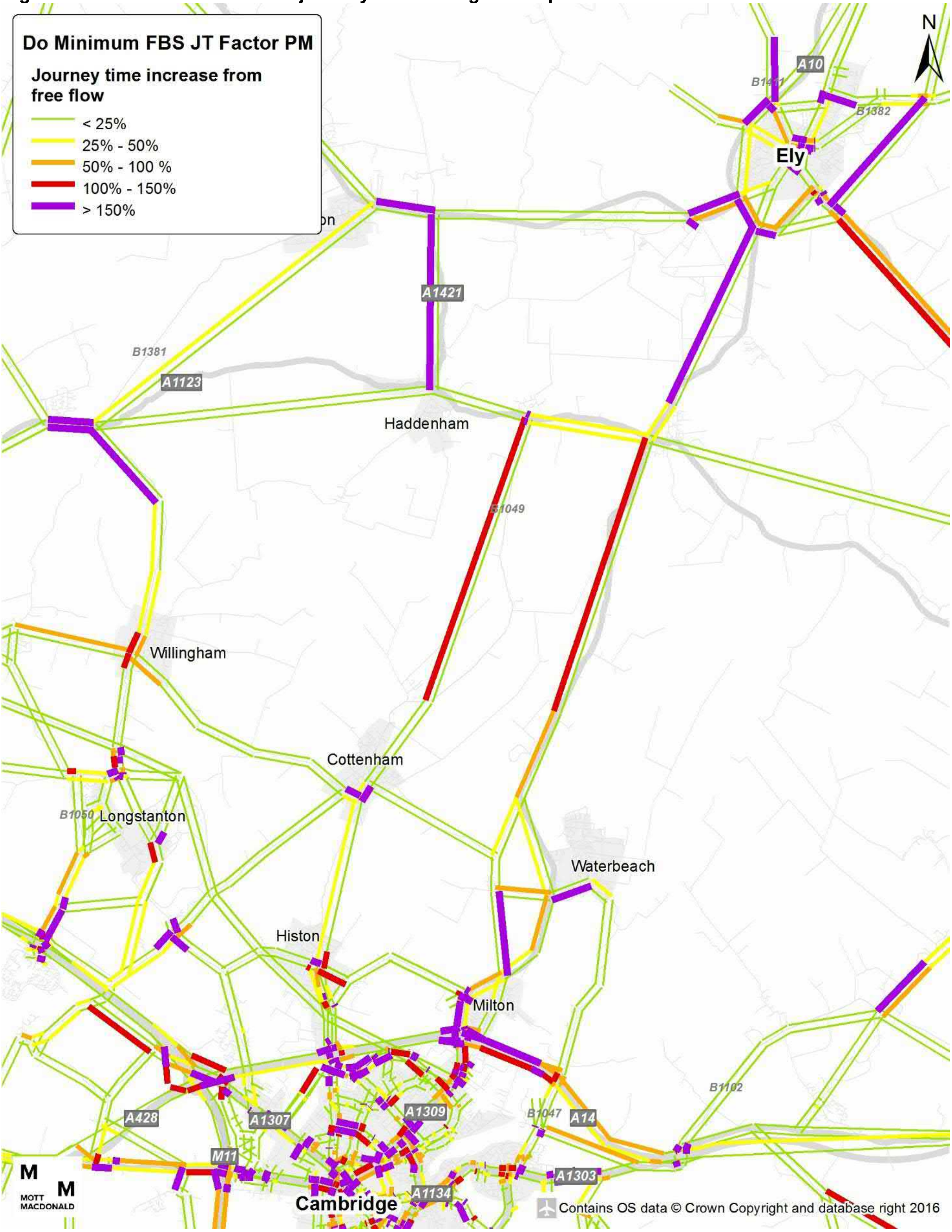
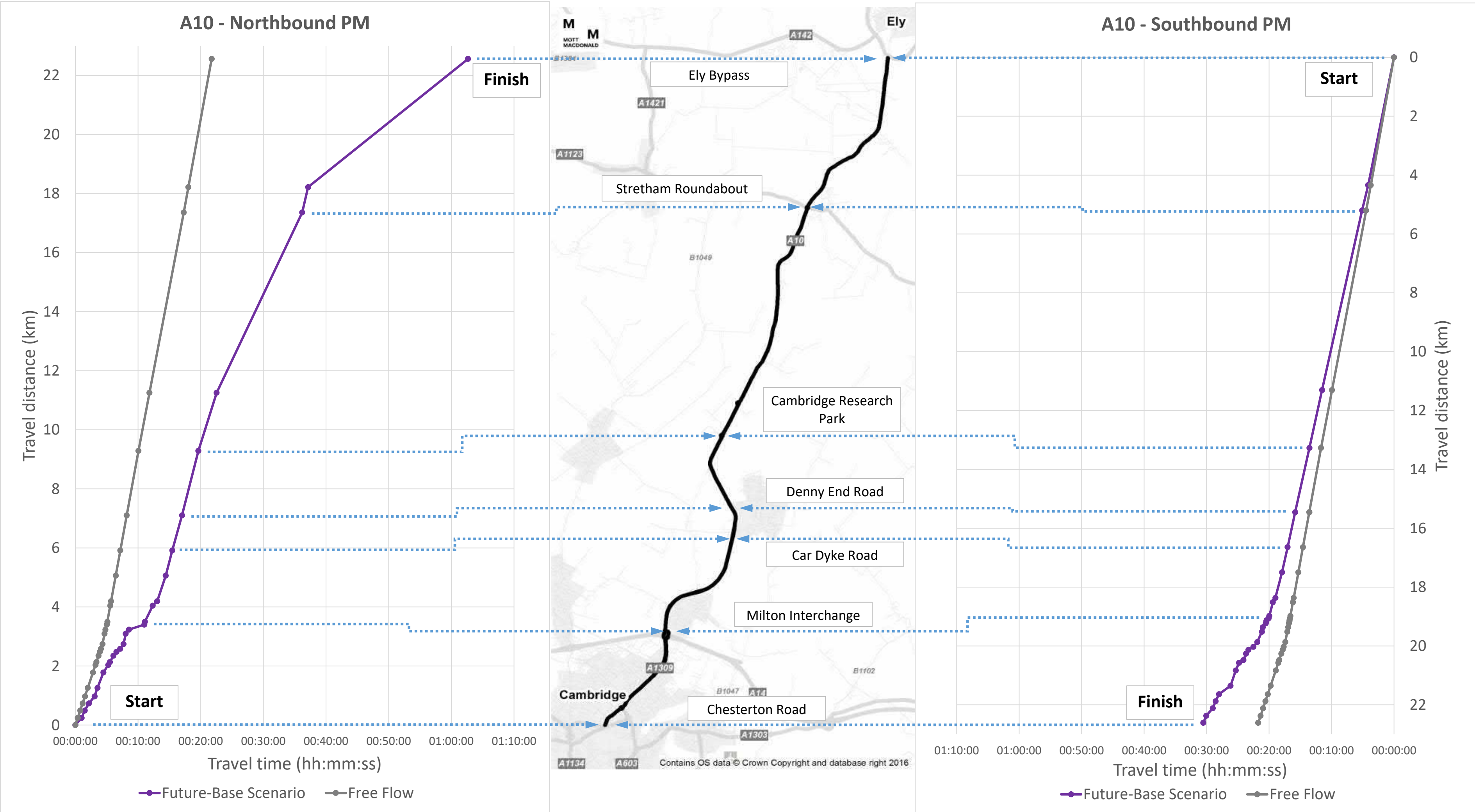


Figure 9: Future-Base Scenario journey time on the A10 between Ely and Cambridge – PM



Source: CSRM

3.4 Summary

The Future-Base Scenario Do Minimum modelling results for the 2031 weekday peak hours show a generally congested network within and around the study area, as would be expected. High levels of delay are seen in and around Ely, and particularly around the bypass. At the other end of the study area, Milton Interchange is at or over capacity in both peak hours and experiences high levels of delay in the PM peak.

Along the A10 route, junctions south of Cambridge Research Park are at or over-capacity, with delays experienced by side road traffic seeking to join the A10 rather than mainline traffic flows. Stretham roundabout, on the other hand, suffers significant delays in the PM peak, though less so in the morning. Overall, modelled PM peak journey times along the route in the northbound direction are over twice as long as in the off-peak.

On parallel routes, the B1049 experiences greater flows and delay than does the B1047 and particularly in the PM peak. Junctions experience capacity issues at Histon Interchange, Cottenham and Wilburton on the B1049 and at Newmarket Road on the B1047.

4 Waterbeach Scenario Results

4.1 Introduction

This section presents the 2031 AM and PM peak period Do Minimum modelling results for the Waterbeach Scenario, in order to understand the predicted highway network impact of full development at Waterbeach. Results are presented, both as absolute values and in comparison to the Future-Base Scenario, in terms of:

- Traffic flows, to show the predicted distribution of traffic demand on the network – this shows where junctions are likely to experience capacity problems
- Junction performance, to show what proportion of junction capacity is predicted to be used up by the predicted traffic demand – this reveals where delays are likely to arise
- Junction delay, to show the total delay to users arising from the performance of each junction – this shows where the greatest congestion problems are occurring
- Journey times, to show the impact of junction delays on journey times – this allows the impact of junction delays to be understood in terms of overall journey time impact

4.2 Development Demand

4.2.1 Introduction

In this section, the impacts of the new town north of Waterbeach in the CSRM model is considered in terms of the transport parameters of total person trip generation, mode share, site internalisation levels and external trip distributions.

In order to understand how travel demand for the new town north of Waterbeach has been represented in the CSRM model, outputs from the CSRM demand model have been interrogated. The peak periods used in the demand model are as follows:

- AM Peak (07:00-10:00)
- PM Peak (16:00-19:00)

Conversion factors provided by Atkins have been applied to convert the 3-hour peaks to 1-hour peaks to keep the results consistent with the highway model outputs. Therefore the peaks investigated are:

- AM Peak (08:00-09:00)
- PM Peak (17:00-18:00)

4.2.2 Development Person Trip Generation

The level of all-mode person trip generation calculated by the CSRM demand model for the new town north of Waterbeach is shown in Table 6 below.

Table 6: Development person trip generation

Parameter	AM (08:00-09:00)		PM (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
External	3,265	1,233	2,077	3,403
Internal	1,952	1,952	1,280	1,280
All	**5,218**	**3,186**	**3,356**	**4,683**

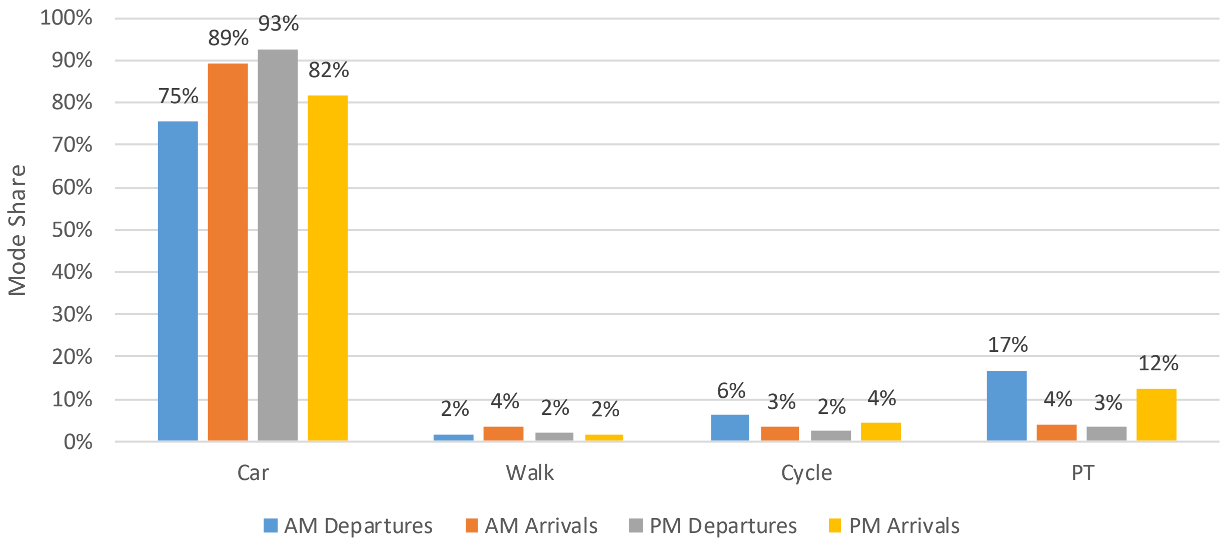
Source: CSRM

The table shows that a higher number of person trips are expected to depart the development in the AM peak rather than arrive, with the opposite being true in the PM peak. During the AM peak there is expected to be a higher number of internal arrivals than external arrivals, though this is not the case in the PM peak or for departures.

4.2.3 Development Trip Mode Share

Figure 10 below shows the mode share for new town north of Waterbeach external trips. These are the trips which generate impact on the external transport network.

Figure 10: Forecast mode share for external trips



Source: CSRM2

This chart shows that the model forecasts a lower car mode share for trips generated from the site in the morning and returning in the evening than for trips attracted to the site in the morning and leaving in the evening. This is because more of the trips generated by the site are attracted to nearby Cambridge, for which there are a range of non-car travel options, whereas trips attracted to the site are less likely to be drawn from Cambridge and more likely to be drawn from areas where travel by car is the main option.

4.2.4 Development Trip Internalisation Levels

Table 7 shows the level of internalisation estimated by CSRM for new town north of Waterbeach trips in both peak hours.

Table 7: Level of development trip internalisation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Internal	External	Internal	External
Internalisation level	46%	54%	32%	68%

Source: CSRM

This shows that internalisation levels are predicted to be higher in the morning peak than in the evening, which is partly reflective of how internal education trips take place in the morning but not the evening peak.

Table 8 compares how the above internalisation levels equate to external car trips.

Table 8: External car trip generation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
Person trips by car	2,409	1,086	1,922	2,784
Number of cars	1,733	791	1.266	1,990

Source: CSRM

4.2.5 External Development Trip Distribution

Table 9 shows the top 7 sectors between which trips are generated by the proposed development at Waterbeach, and lists the actual 12-hour trip levels predicted to be undertaken by mode. Only the top 7 have been shown due to these sectors having over 5,000 total trips during the time period, whilst the remaining sectors have a far lower number. A map showing the sectors used in the CSRM model can be found in Appendix C.

Table 9: Total trips to and from the new town north of Waterbeach by sector, 07:00 – 19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Waterbeach new town	2,978	14,626	854	0	0	0	0	18,458
South Cambs Outer	8,388	23	72	1	78	0	0	8,562
East Cambs Rural	7,752	5	29	7	91	0	0	7,884
Cambridge Outer	5,176	38	642	17	817	0	154	6,844
City Fringe	6,205	139	169	16	51	0	0	6,580
Ely	5,398	0	16	1	210	0	0	5,625
Cambridge Central	2,369	27	628	1	1,808	0	421	5,253

Source: CSRM

This table shows that, after the development itself, the sectors generating most external development trips are South Cambridgeshire and East Cambridgeshire, followed by Cambridge areas and Ely. It is noted, however, that summing the three Cambridge sectors would make the City the greatest single external origin/destination for development related trips.

Table 10 below presents the above information in terms of mode share by sector.

Table 10: Total trips to and from the new town north of Waterbeach sector (%), 07:00 – 19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Waterbeach new town	16%	79%	5%	0%	0%	0%	0%	100%
South Cambs Outer	98%	0%	1%	0%	1%	0%	0%	100%
East Cambs Rural	98%	0%	0%	0%	1%	0%	0%	100%
Cambridge Outer	76%	1%	9%	0%	12%	0%	2%	100%
City Fringe	94%	2%	3%	0%	1%	0%	0%	100%
Ely	96%	0%	0%	0%	4%	0%	0%	100%
Cambridge Central	45%	1%	12%	0%	34%	0%	8%	100%

Source: CSRM

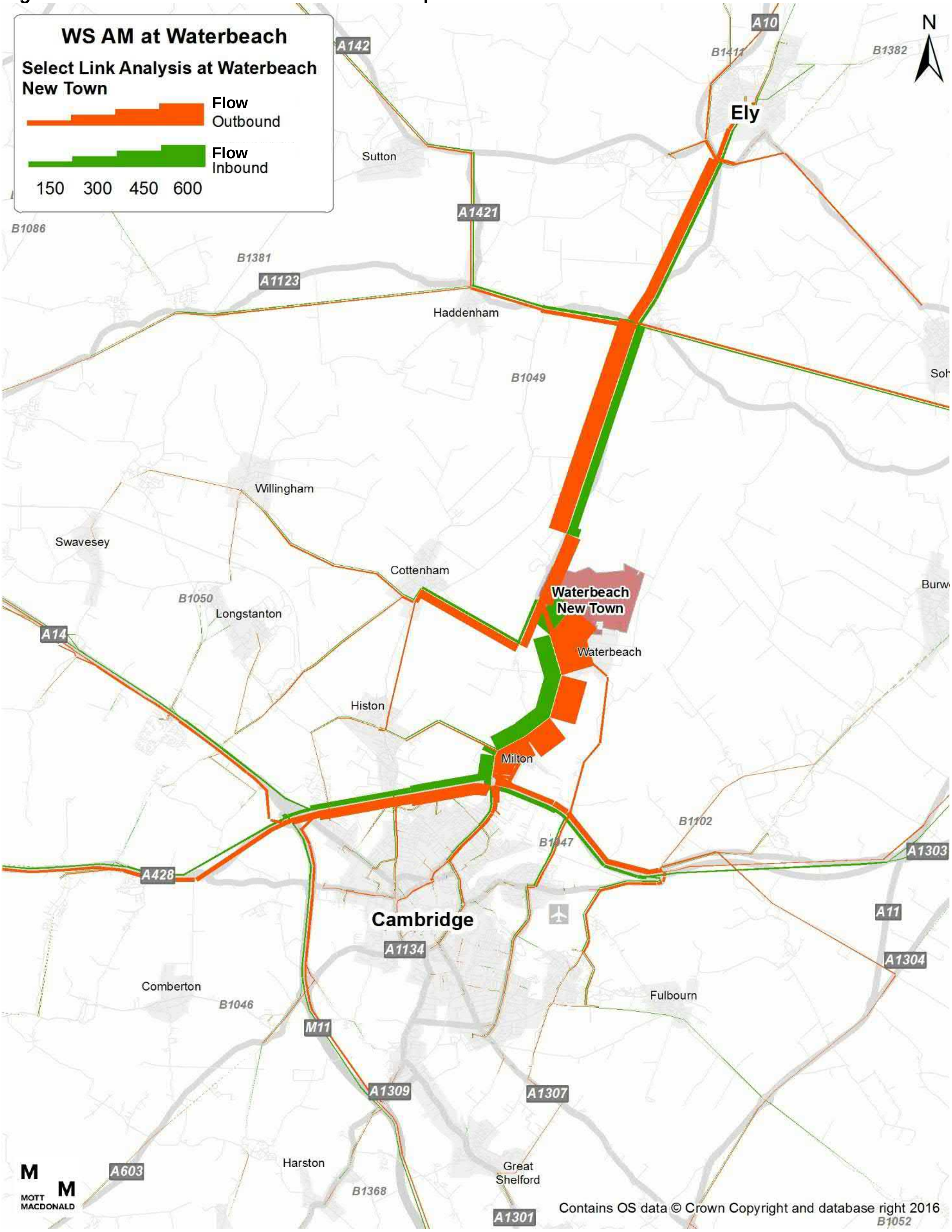
This shows clear distinction in mode share depending on which sector is being travelled to/from by development related trips. Trips to South and East Cambridgeshire show the highest car mode share, closely followed by trips to Ely. Conversely, trips to Cambridge Central, for which there are other modal options, show the lowest car mode share for external trips. This applies less to Cambridge Outer, however, and hardly at all to the City Fringe, highlighting the challenges of serving non central Cambridge trips by other modes.

Figure 11 and Figure 12 show how the above distribution of car trips to and from the new town north of Waterbeach site impacts the 2031 highway network in terms of development flow distribution during both the AM and PM peak periods respectively.

These figures show:

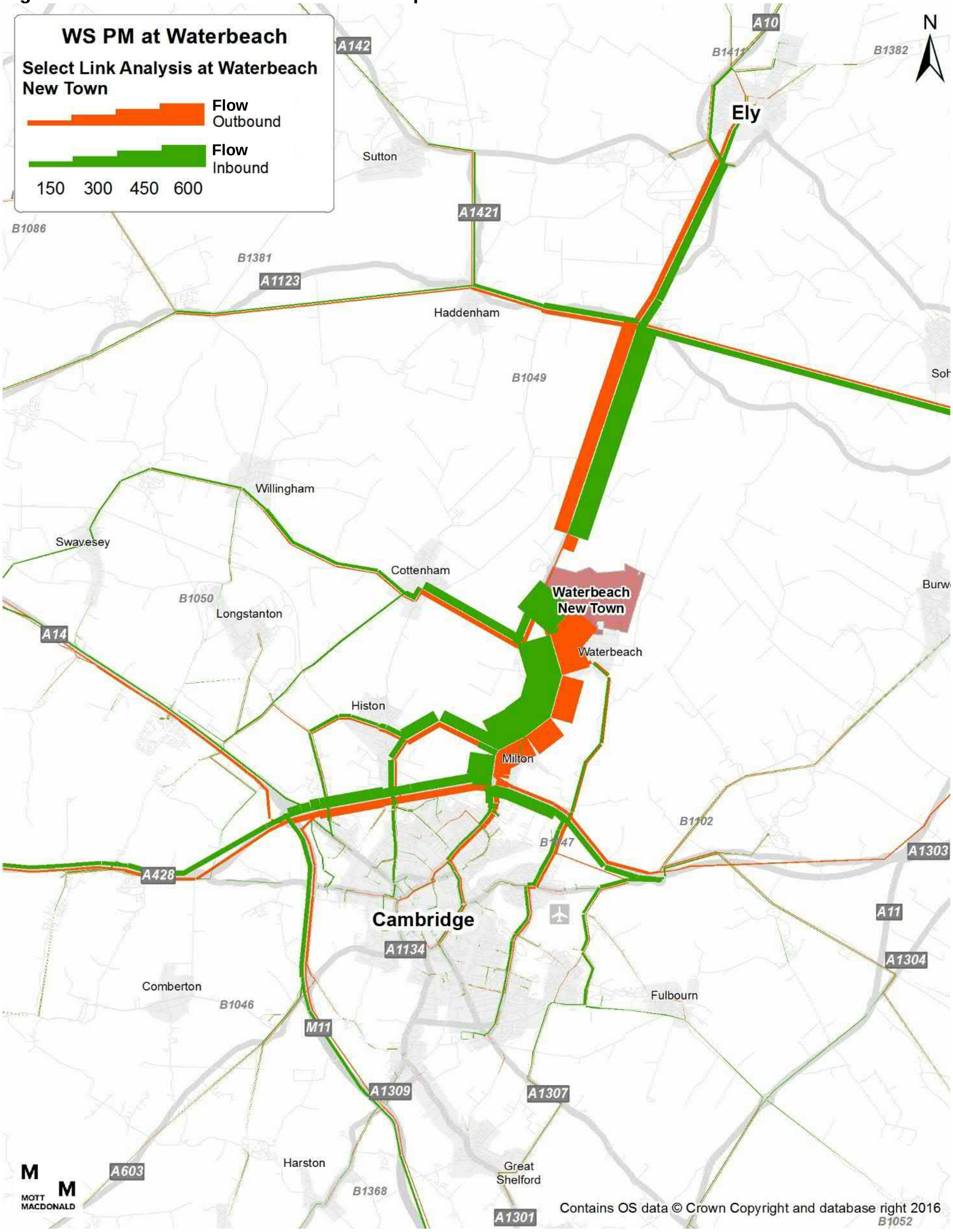
- Highest level of flow impact on A10 between the site and Milton Interchange
- Next highest level of flow impact on A10 between the site and Stretham roundabout, followed by the A10 to Ely and also on the A14
- Flow increases on Cottenham Road as far as Cottenham in both peaks, and on Milton Road / Butt Lane in the PM peak
- By contrast, relatively low levels of development flow on the Clayhithe Road route into Cambridge

Figure 11: Waterbeach New Town vehicles trip distribution – 2031 AM Peak



Source: CSRM

Figure 12: Waterbeach New Town vehicle trip distribution – 2031 PM Peak



Source: CSRM

4.3 Development Network Impact

4.3.1 Introduction

The following section examines the predicted performance of the study area highway network in the Waterbeach Scenario, both in absolute terms and in direct comparison to Future Base (ie: without development) Scenario. The latter comparison allows the specific impacts of the proposed development at Waterbeach to be isolated and identified. The impacts considered are as follows:

- Traffic flows
- Junction performance, in terms of worst-arm V/C levels and total delay levels
- Link and route performance, in terms of journey times

The AM peak results are presented first, followed by the PM peak results.

4.3.2 AM Peak Period Results

4.3.2.1 AM Peak Traffic Flow and Junction Performance

As per the results shown for the Future Base Scenario, Figure 13 shows for the AM peak period in the Waterbeach Scenario:

- The distribution of predicted traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown in orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

To show how these results differ from the Future Base Scenario, thereby isolating the impacts of development at Waterbeach, the subsequent figure (Figure 14) shows for the AM peak period in the Waterbeach Scenario:

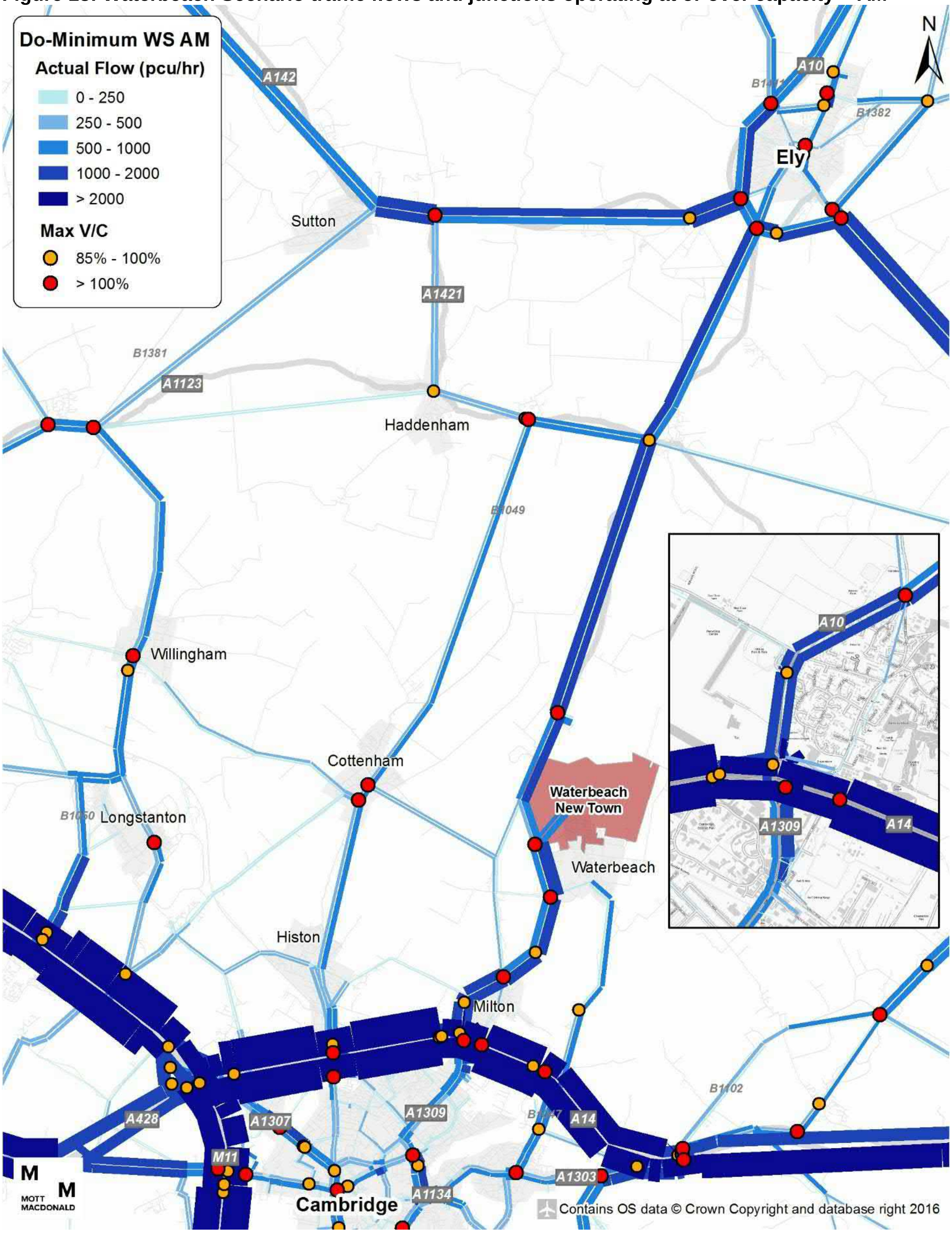
- The change in predicted traffic flows compared to the Without-Development Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- The change in junction worst-arm V/C compared to the Without-Development Scenario, where orange or red junctions show key deteriorations and green junctions show key improvements. Junctions where neither level of impact is predicted are not shown

These figures show no net increase in flow on the A10 between Car Dyke Road and Milton Interchange. This is despite Figure 11 above predicting a large development flow along these links in the AM. This implies that these links are already at-capacity without the development and can only accommodate the new flows by displacing background traffic to other routes. Such displacement can be seen on the southbound links to the north of the development, which show a significant reduction in traffic compared to the Without-Development Scenario, and on the parallel B1049 and B1047 routes, which show significant increases despite Figure 11 above showing little to no development traffic on these routes.

As a result of the extra pressures caused by the development on both the A10 routes and its two parallel routes, these figures predict a deterioration in performance at most junctions along all three routes, including where they meet the A14, Ely Bypass and the A1123 at Stretham roundabout.

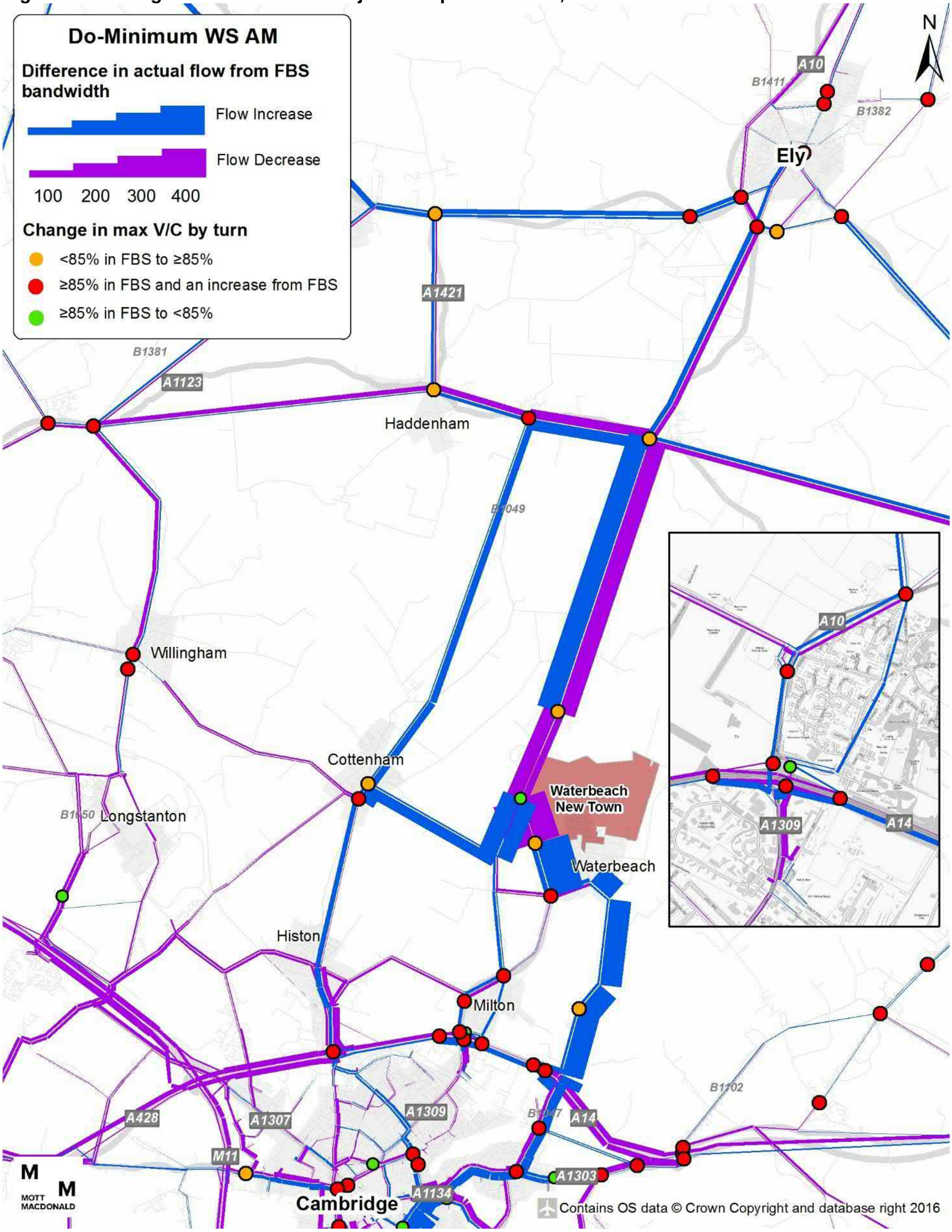
It is noted that there are predicted to be a number of other flow decreases further away from the site. These are associated with the different distribution of development in the Future-Base and Waterbeach Scenarios, with the housing allocated to Waterbeach in the latter being dispersed around Cambridgeshire in the former. This reallocation of future housing growth from around the sub-region to a single site causes some small traffic reduction effects on links further from the site, but these effects do not significantly affect the study area.

Figure 13: Waterbeach Scenario traffic flows and junctions operating at or over capacity – AM



Source: CSRM

Figure 14: Change in traffic flows and junction performance, W'beach vs Future-Base Scenario – AM



Source: CSRM

4.3.2.2 AM Peak Traffic Flow and Junction Delay

Figure 15 shows, for the AM peak period in the Waterbeach Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU flow through the junction by the average delay per PCU experienced at the junction

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts the development at Waterbeach, the subsequent Figure 16 shows for the AM peak period in the Waterbeach Scenario:

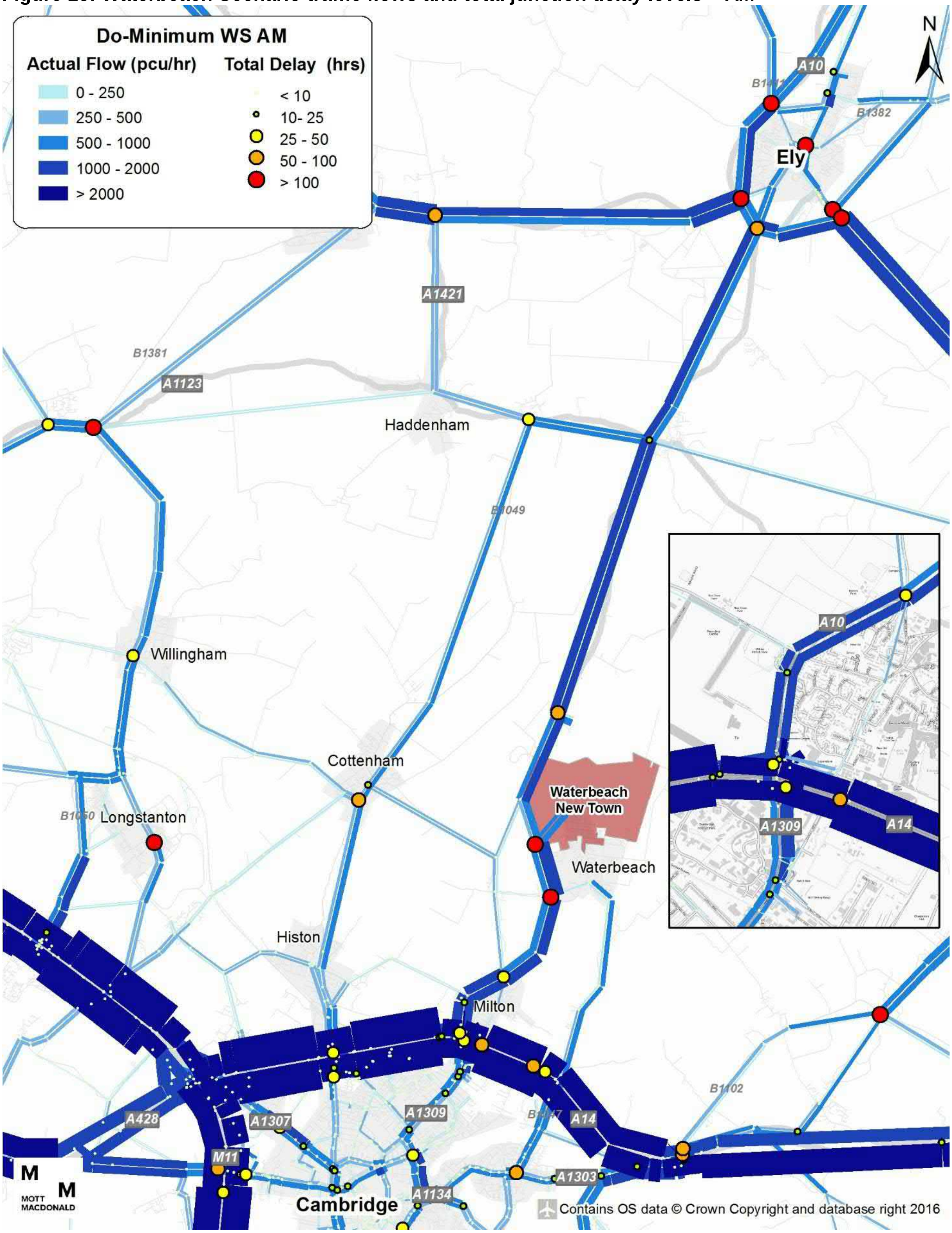
- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- Increases in total junction delay compared to the Future-Base Scenario, shown as banded changes in vehicle-hours for junctions with a V/C[4] ratio over 85% in the Waterbeach Scenario (in order to isolate junctions impacted by development)

Comparing the latter figure with Figure 14 above – which shows junctions with capacity impacts – reveals a more nuanced picture of the development's impact on the surrounding network. In particular, it reveals that:

- Though many junctions suffer a capacity impact on the A10 route, the main delay impacts are concentrated at the two development accesses and at the Car Dyke Rd / Waterbeach Road junction
- Though Milton Interchange suffers capacity impacts, the primary delay impacts appear to be on the mainline merge points rather than at the roundabout. A similar result emerges for the B1047 / A14 junction
- Histon Interchange is unaffected in terms of delay, though junctions at Cottenham and Wilburton do show relatively significant increases in delay
- Though many junctions in and around Ely show a capacity impact in Figure 14, the main delay increases are on the A142 section of the bypass

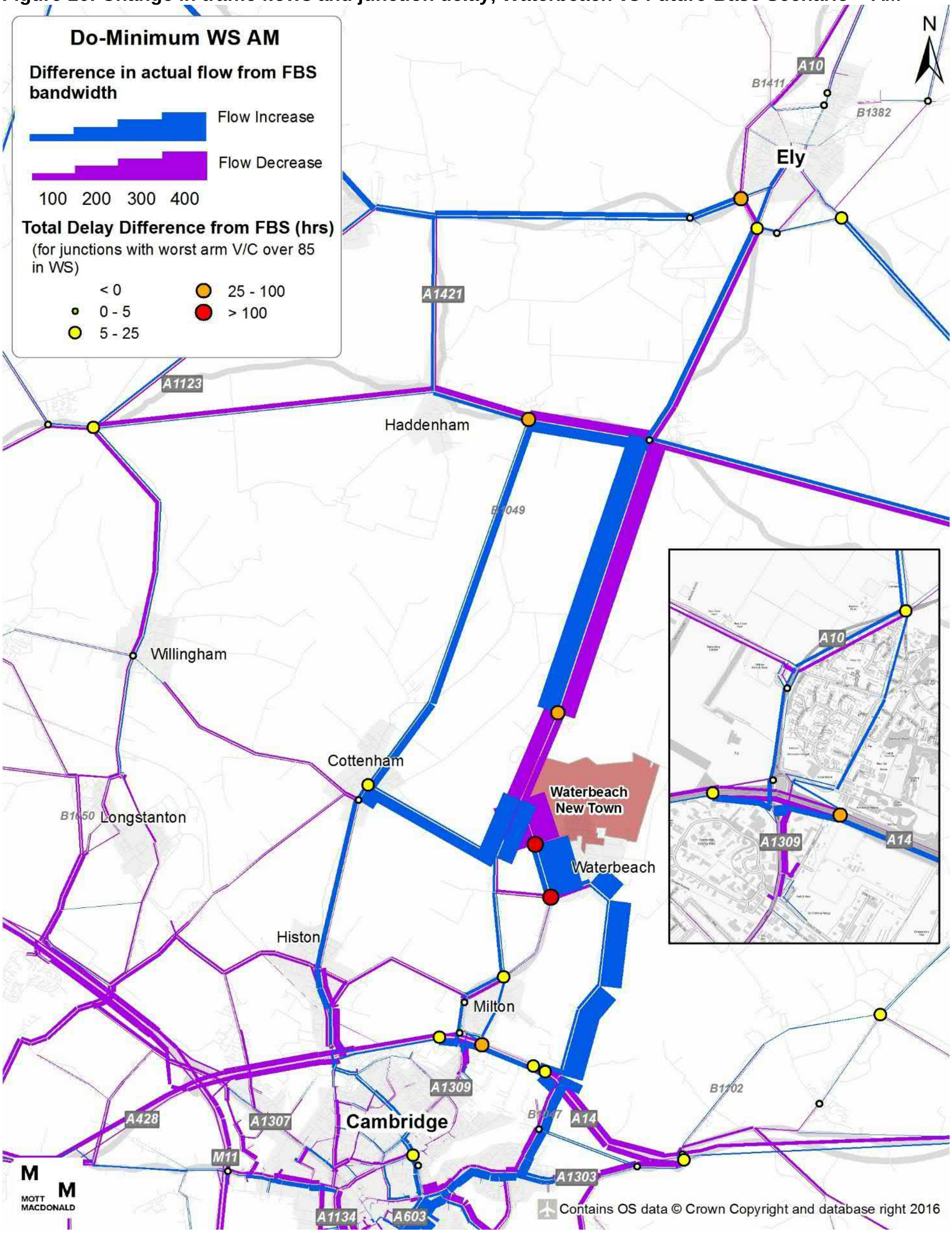
[4] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 15: Waterbeach Scenario traffic flows and total junction delay levels – AM



Source: CSRM

Figure 16: Change in traffic flows and junction delay, Waterbeach vs Future-Base Scenario – AM



Source: CSRM

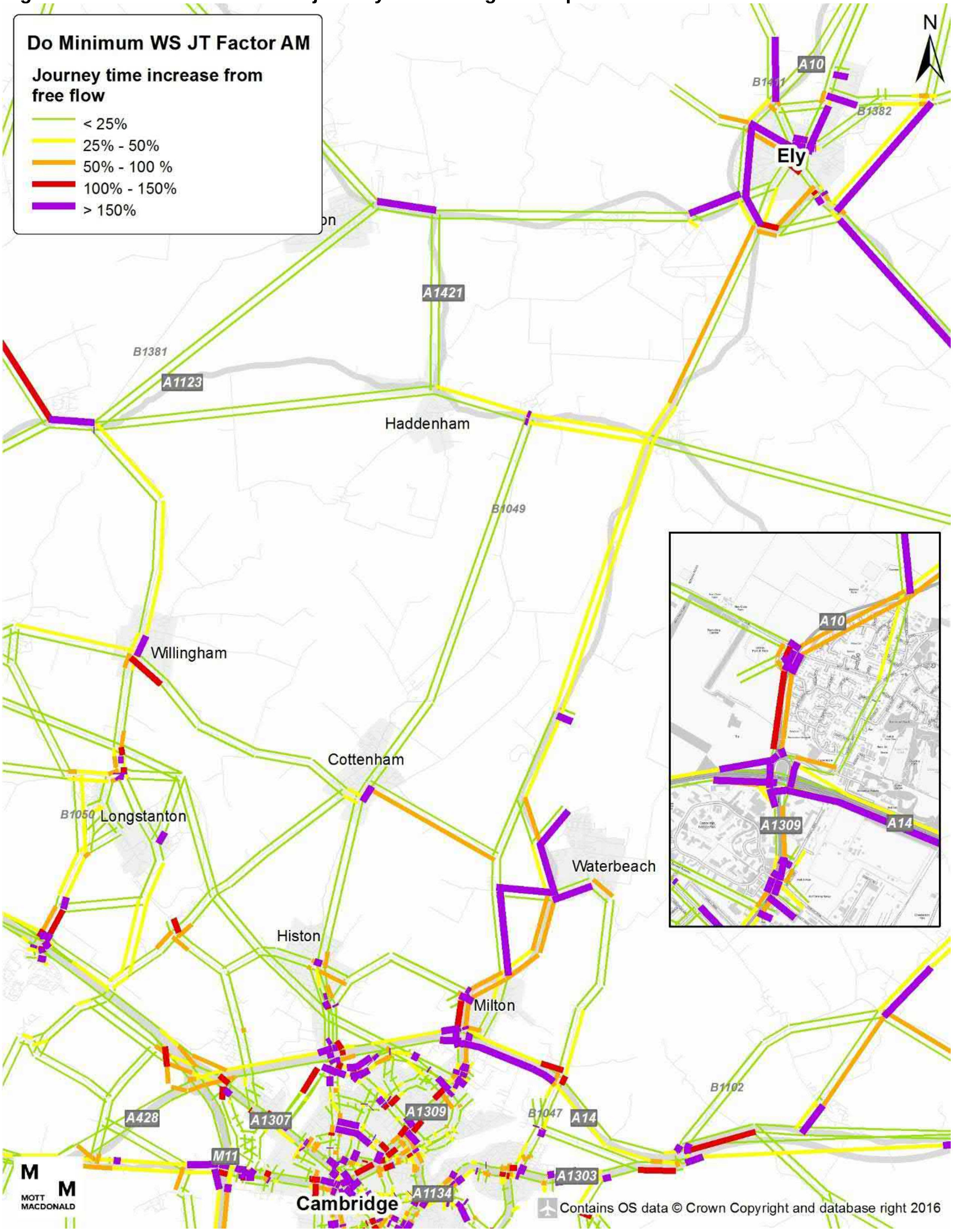
4.3.2.3 AM Peak Journey Time Performance

Figure 17 shows the percentage increase in journey time compared to free-flow conditions, for the AM peak period in the Waterbeach Scenario, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. Comparing with Figure 4 above, which shows the equivalent the Future-Base Scenario result, this suggests that the main impact of the proposed development on study area journey times is:

- A faster journey time southbound on the A10 between Stretham roundabout and the northern development access due to the reduced traffic level predicted above for this section, but then much greater delay levels south of this
- Conversely, slower journey times north of the development on the A10 in the northbound direction as far as Ely, due to the predicted traffic increase as a result of development traffic
- Increased delay between Landbeach and Cottenham, as a result of development traffic
- Increased delay westbound on the A14 approach to Milton Interchange

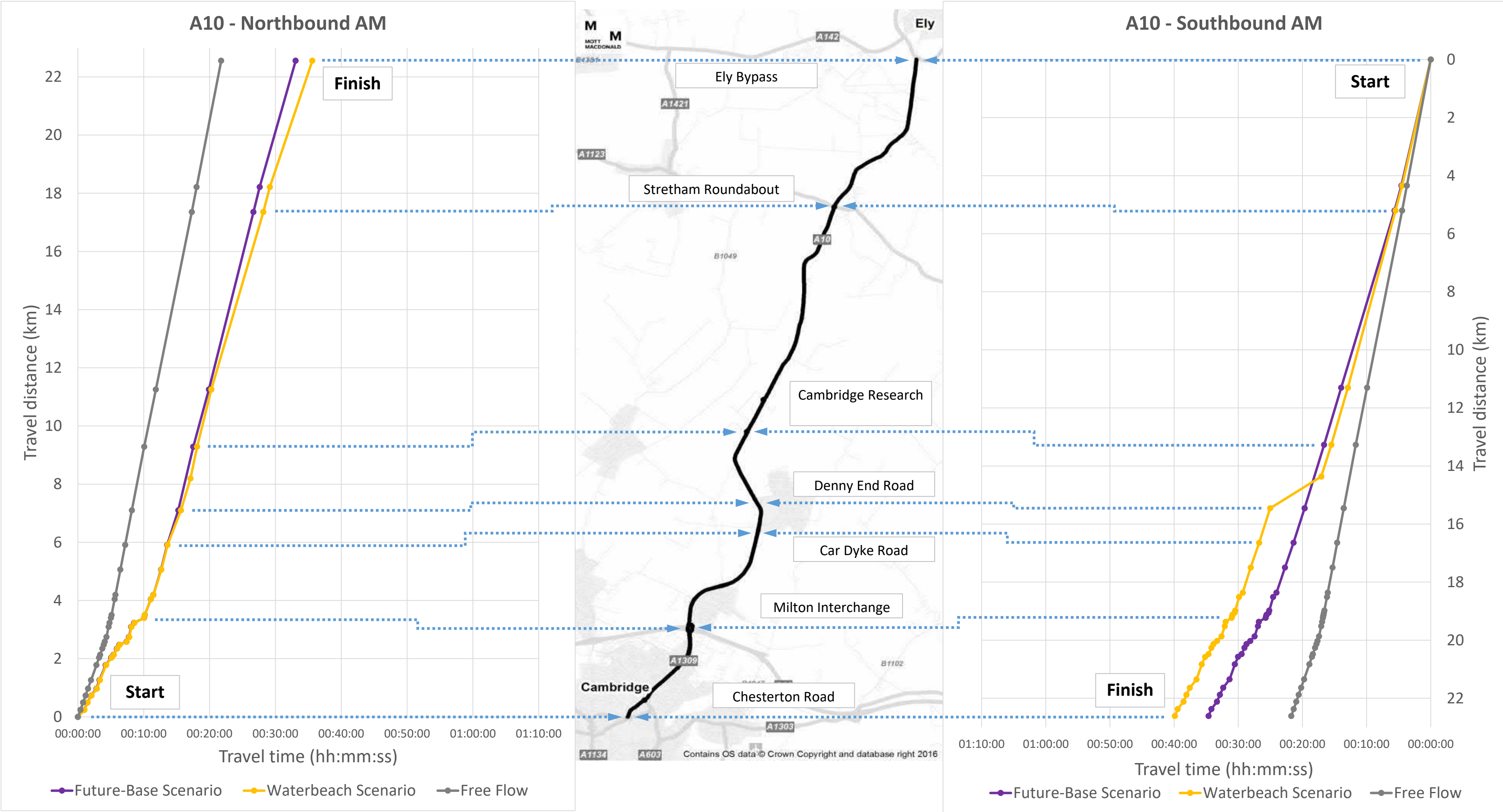
The subsequent Figure 18 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, for both the Future-Base and Waterbeach Scenarios, with free flow time included for further comparison. These show that northbound and southbound trips are predicted to respectively take 8% and 15% longer than Future-Base journey times.

Figure 17: Waterbeach Scenario journey time changes compared to free-flow conditions – AM



Source: CSRM

Figure 18: Journey time on the A10 between Ely and Cambridge – AM



Source: CSRM

4.3.3 PM Peak Period Results

4.3.3.1 PM Peak Traffic Flow and Junction Performance

As per the results shown for the AM peak, Figure 19 shows for the PM peak period in the Waterbeach Scenario:

- The distribution of predicted traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown in orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts of development at Waterbeach, the subsequent Figure 20 shows for the PM peak period in the Waterbeach Scenario:

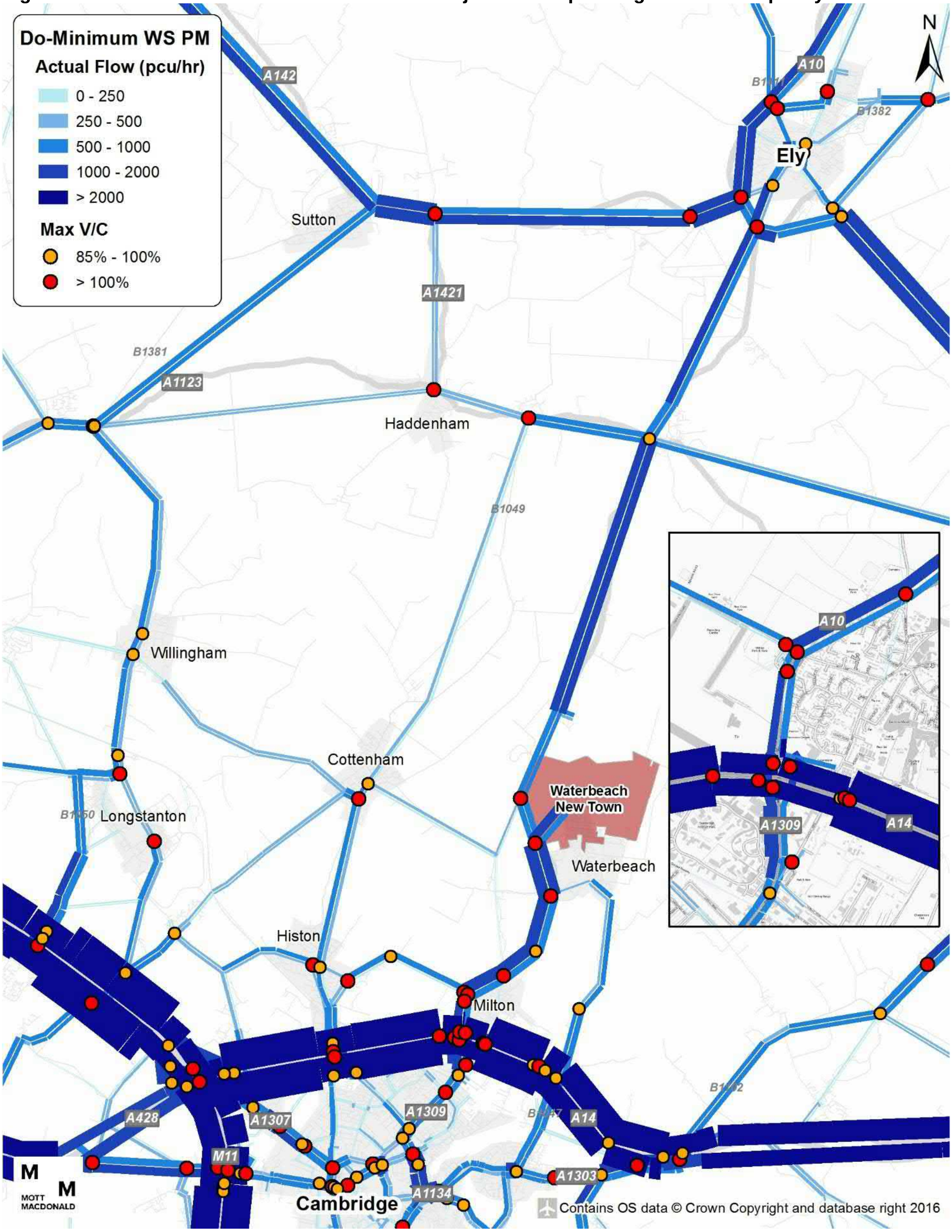
- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- The change in junction worst-arm V/C compared to the Future-Base Scenario, where orange or red junctions show key deteriorations and green junctions show key improvements. Junctions where neither level of impact is predicted are not shown

These figures show a generally more congested picture than for the AM peak, particularly on the A10 between Waterbeach and Cambridge, and at junctions along the A14 and M11. As for the AM peak, there are also a number of over-capacity junctions in and around Ely.

In terms of changes compared to the Future-Base Scenario PM peak, it can be seen from Figure 20 that the A10 north of the development experiences increased flow in the southbound direction, which reference to Figure 12 shows is a direct result of flows returning to the development along this route. In the northbound direction, however, flows are predicted to decrease overall. This is because development flows on the A10 south of the development result in a significant amount of northbound background traffic being displaced to other routes, modes or times of day.

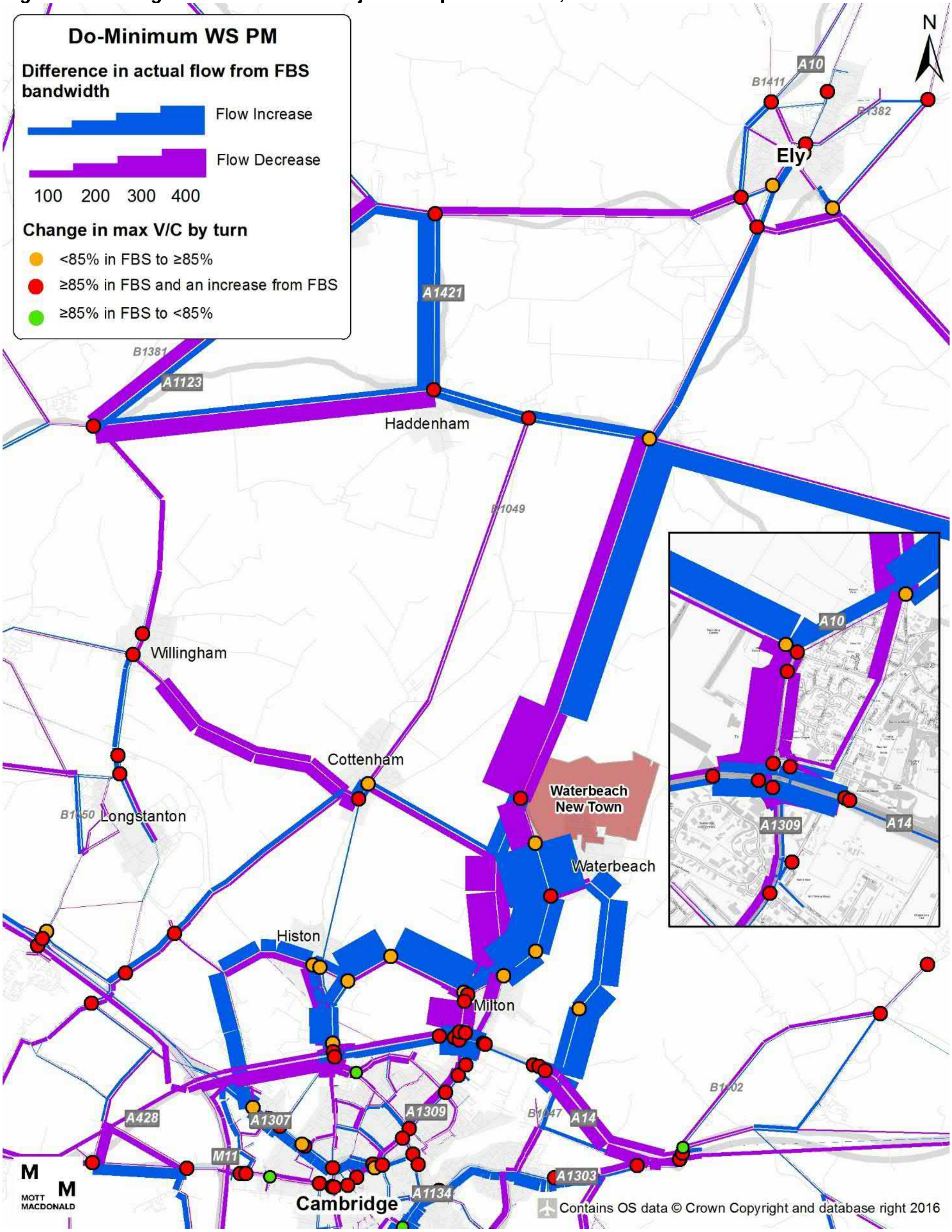
The delays south of the development are most pronounced at Milton Interchange which is showing more capacity problems in this period than in the AM peak. As a result, background traffic is diverting to other routes to avoid it. Some westbound A14 traffic appears to stay on the mainline until Histon Interchange and then routes to the A10 via Butt Lane, while some traffic from the city centre is heading north on Huntingdon Road and then to the A10 via Girton and Impington. The parallel B1047 route through Horningsea also shows a significant increase, though reference to Figure 12 suggests this is due to background traffic changes rather than direct development traffic.

Figure 19: Waterbeach Scenario traffic flows and junctions operating at or over capacity – PM



Source: CSRM

Figure 20: Change in traffic flows and junction performance, W'beach vs Future-Base Scenario – PM



Source: CSRM

4.3.3.2 PM Peak Traffic Flow and Junction Delay

Figure 21 shows, for the PM peak period in the Waterbeach Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU flow through the junction by the average delay per PCU experienced at the junction

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts the development at Waterbeach, the subsequent Figure 22 shows for the PM peak period in the Waterbeach Scenario:

- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- Increases in total junction delay compared to the Future-Base Scenario, shown as banded changes in vehicle-hours for junctions with a V/C[5] ratio over 85% in the Waterbeach Scenario (in order to isolate junctions impacted by development)

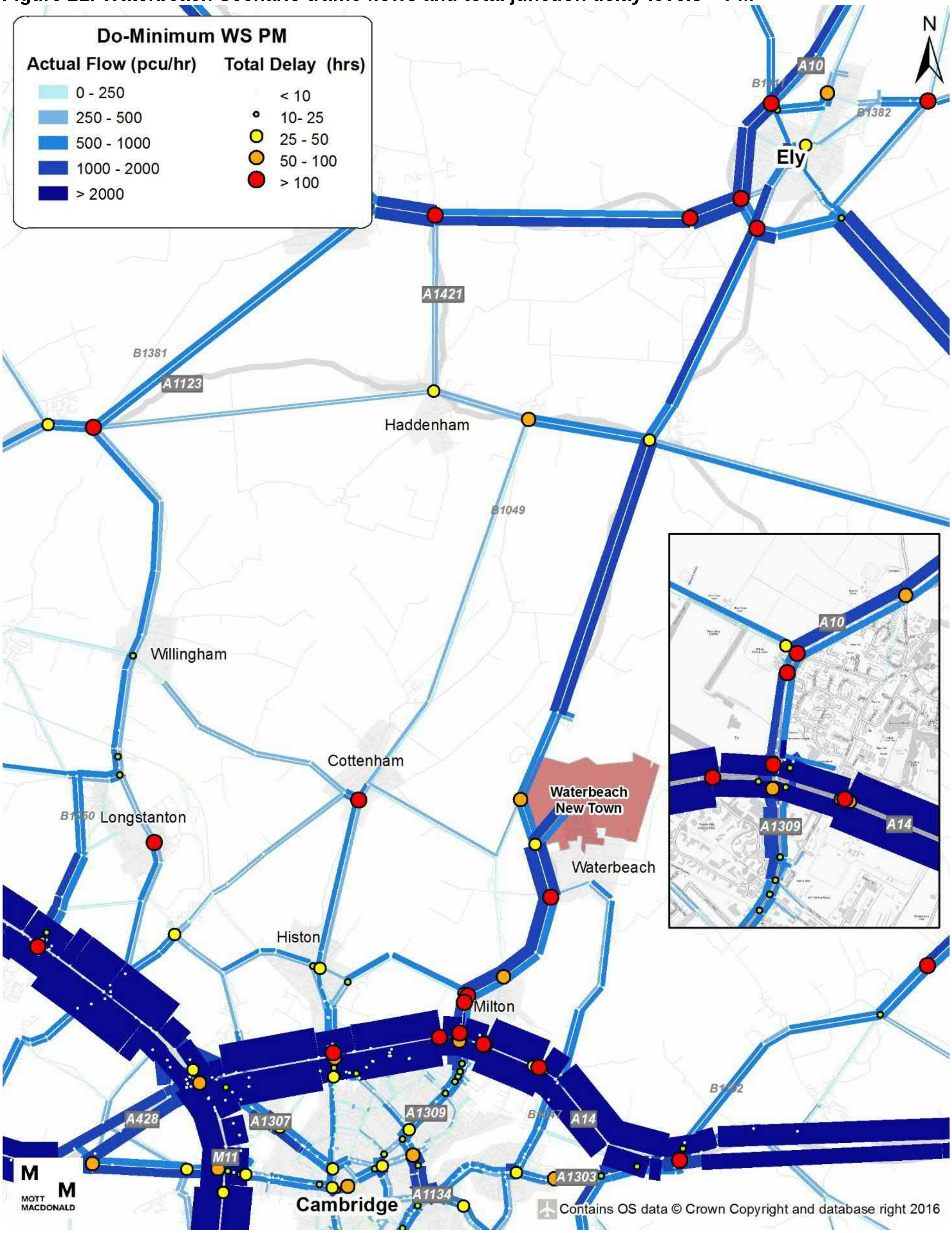
These images also show a more congested picture than for the AM peak. Comparing the latter figure with Figure 20 above – which shows junctions with capacity impacts in the PM peak – reveals a more nuanced picture of the development's impact on the surrounding network. In particular, it reveals that:

- Though many junctions suffer a capacity impact on the A10 route between Waterbeach and Cambridge, the main delay impacts are between the development and Milton Interchange
- Though many junctions in and around Ely show a capacity impact in Figure 20, the most impacted junction is at the junction of the Ely bypass with the A10 and Cambridge Road
- Though Figure 20 shows many capacity-impacted junctions on routes away from the A10, the greatest delay impacts are seen at the Histon Interchange, in Impington, Cottenham and Haddenham

The Waterbeach Scenario therefore predicts significant levels of delay in the PM peak period, and especially between the development and the A14.

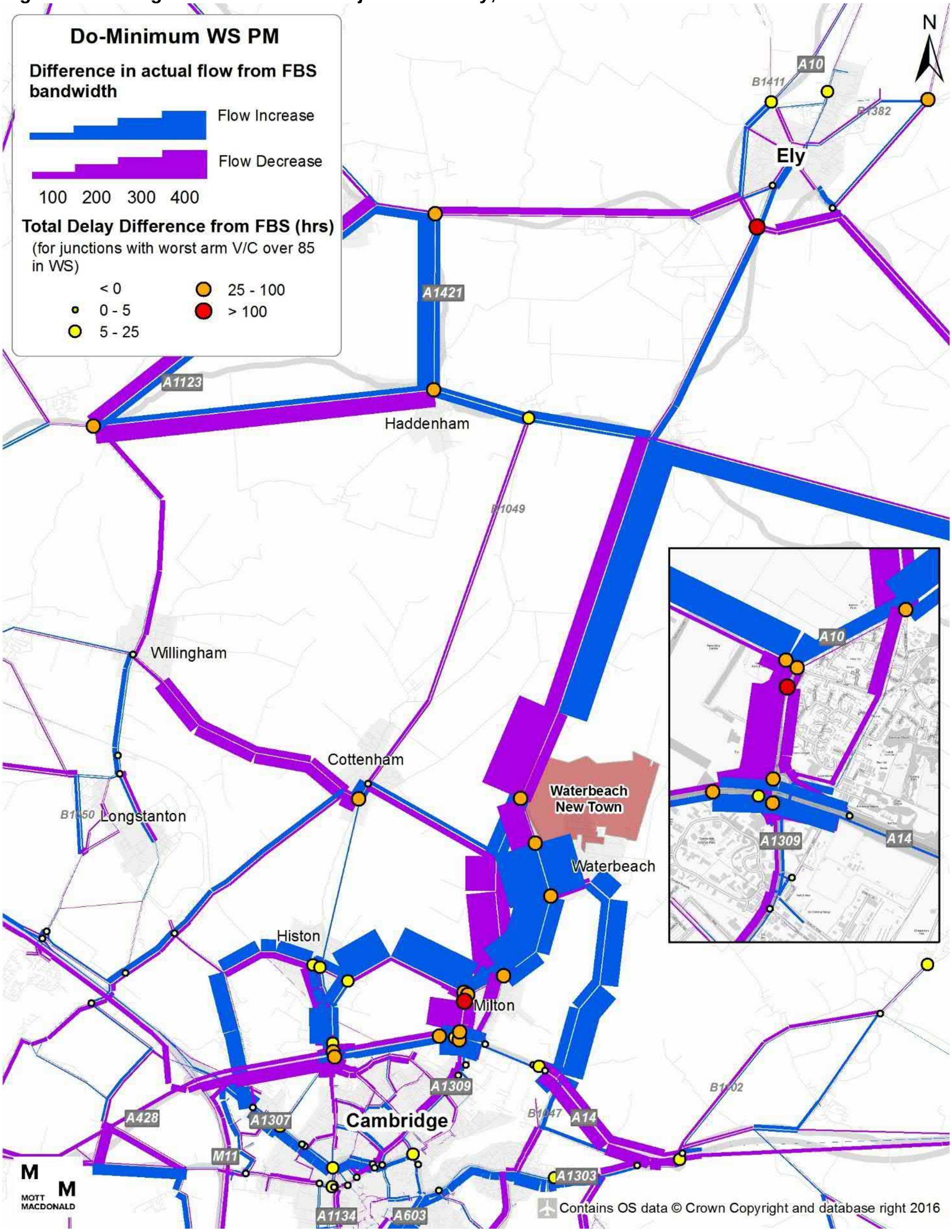
[5] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 21: Waterbeach Scenario traffic flows and total junction delay levels – PM



Source: CSRM

Figure 22: Change in traffic flows and junction delay, Waterbeach vs Future-Base Scenario – PM



Source: CSRM

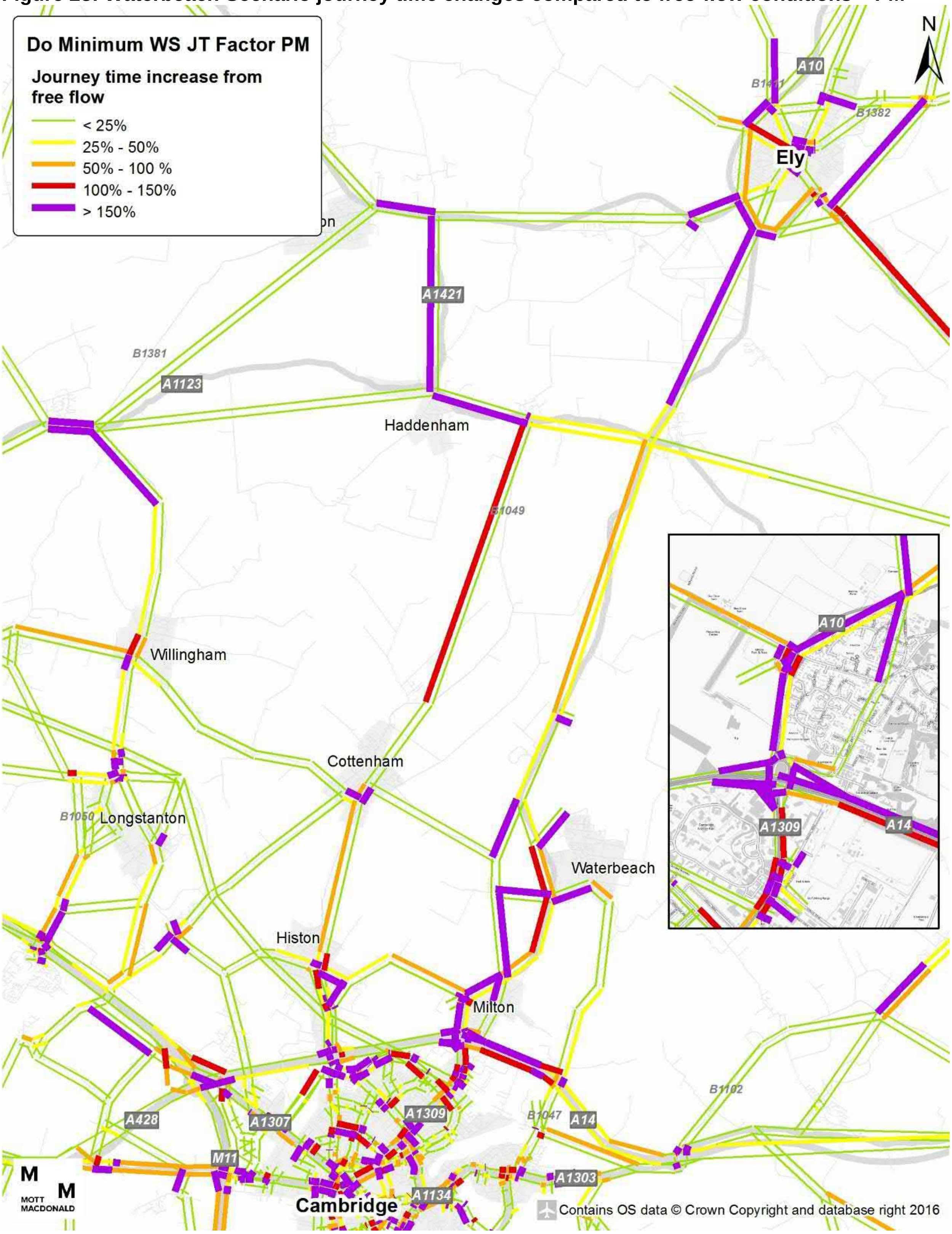
4.3.3.3 PM Peak Journey Time Performance

Figure 23 shows the percentage increase in journey time compared to free-flow conditions, for the PM peak period in the Waterbeach Scenario, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. Comparing with Figure 8 above, which shows the equivalent Future-Base Scenario result, suggests that the main impact of the proposed development on study area journey times is:

- A faster journey time northbound on the A10 between Cambridge Research Park and Stretham roundabout due to the reduced traffic level predicted above for this section, but then much greater delay levels south of this
- Conversely, slower journey times on the A10 in the southbound direction from Stretham roundabout, due to the predicted traffic increase as a result of development traffic
- Increased delay between Histon and Cottenham, as a result of diverted background traffic
- Increased delay westbound between Wilburton and Haddenham

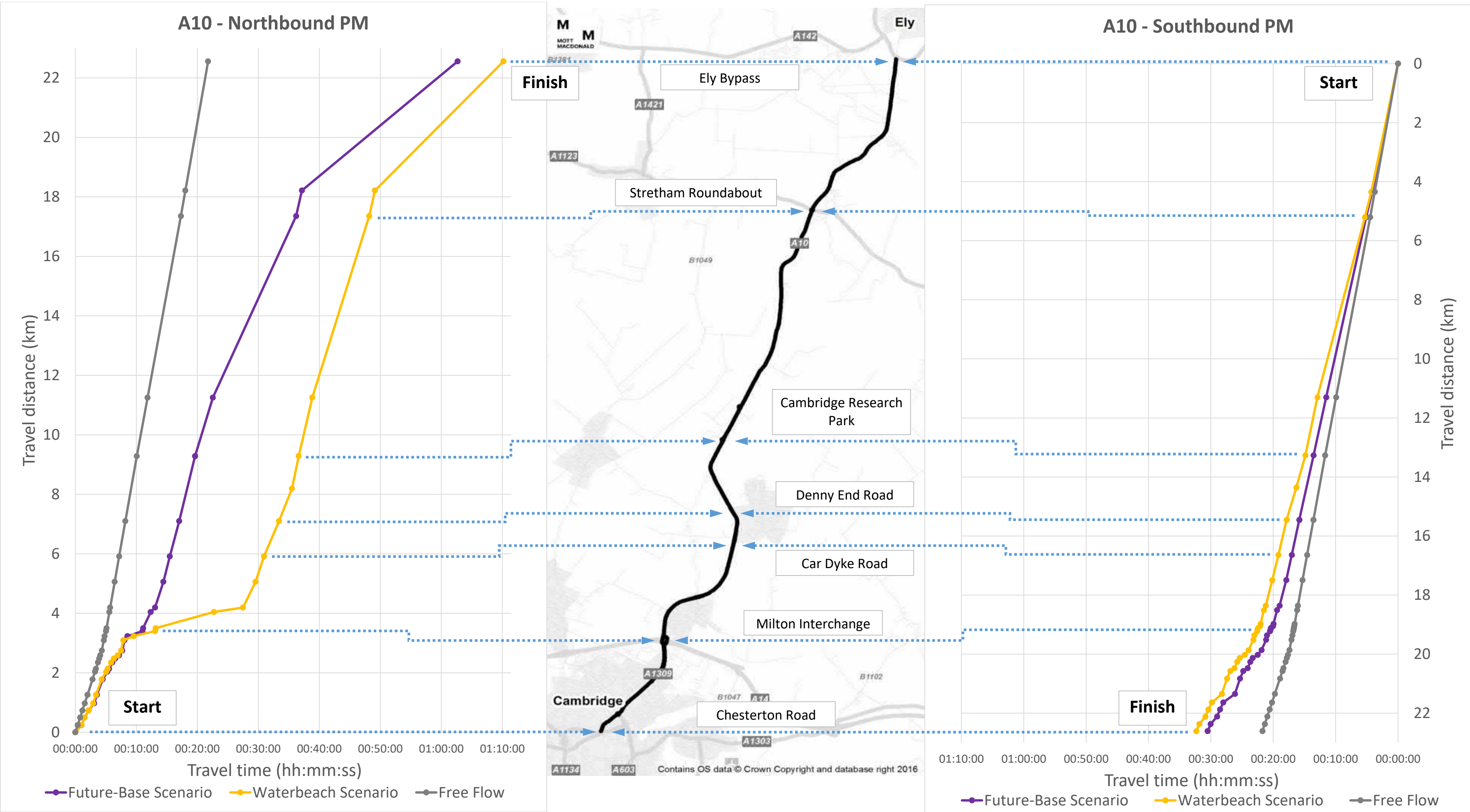
The subsequent Figure 24 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, for both the Future-Base and Waterbeach Scenarios, with free flow time included for further comparison. These show that southbound and northbound trips are predicted to respectively take 12% and 40% longer than Future-Base journey times.

Figure 23: Waterbeach Scenario journey time changes compared to free-flow conditions – PM



Source: CSRM

Figure 24: Journey time on the A10 between Ely and Cambridge - PM



Source: CSRM

4.3.4 Identification of Impacted Junctions

In terms of identifying highway impacts, paragraph 32 of the National Planning Policy Framework (NPPF) states that planning decisions should take account of whether:

> *"improvements can be undertaken within the transport network that cost effectively limit the significant impacts of the development. Development should only be prevented or refused on transport grounds where the residual cumulative impacts of development are severe."*

According to NPPF, therefore, the focus should be on 'limiting' the 'significant' transport impacts of new development in order to avoid an overall 'severe' transport impact.

Traditionally, Transport Assessments consider junctions to be over effective capacity once the V/C value exceeds 85%. If a junction therefore goes from a V/C level of below 85% to over 85% as a result of development impact, or if the V/C level is already over 85% but goes up further as a result of development impact, then such a junction can be considered to be negatively impacted by the development and potentially requiring mitigation.

The model results also show that not all junctions which trigger this impact threshold are actually directly affected by development traffic. Some junctions show a V/C deterioration but an actual decrease in flow. Where this happens, it is because an adjacent junction is over-capacity and causing queueing to block back through the junction in question, in which case it is the adjacent junction which is the problem.

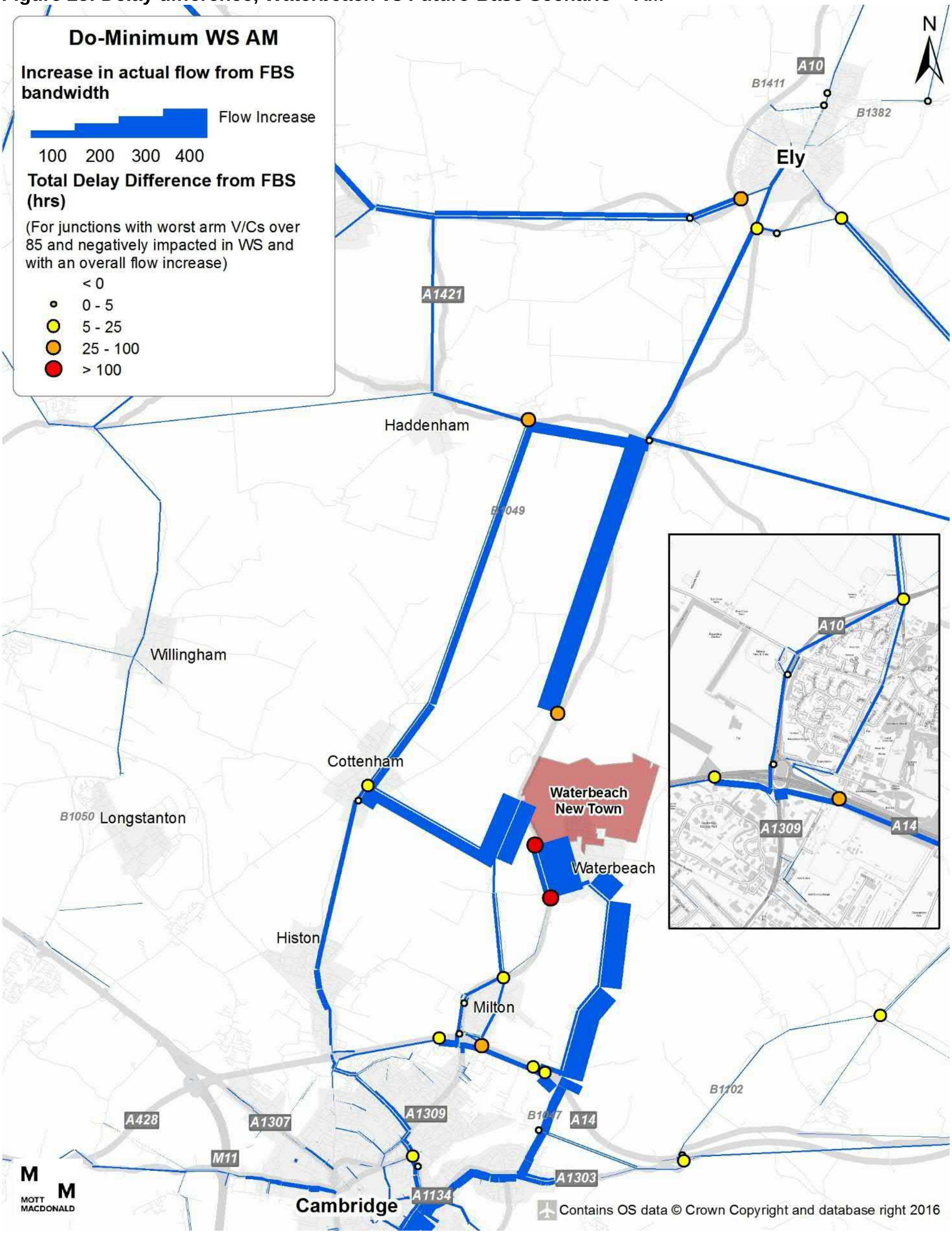
Similarly, the model also shows that not all junctions which show a V/C deterioration over the threshold level actually result in a significant increase in user delay. This can happen where the arm showing the V/C deterioration does not carry significant traffic, so that the total delay increase experienced by users at that junction is not significant.

Overall, therefore, the junctions considered by this study to be impacted by the development are those which meet the following criteria:

1. Worst-arm V/C less than 85% in the Future-Base Scenario and more than or equal to 85% in the Waterbeach Scenario, or more than 85% in the Future-Base Scenario but worse still in the Waterbeach Scenario
2. Traffic flow through junction in the Waterbeach Scenario higher than in the Future-Base Scenario
3. Increase in total delay in peak hour

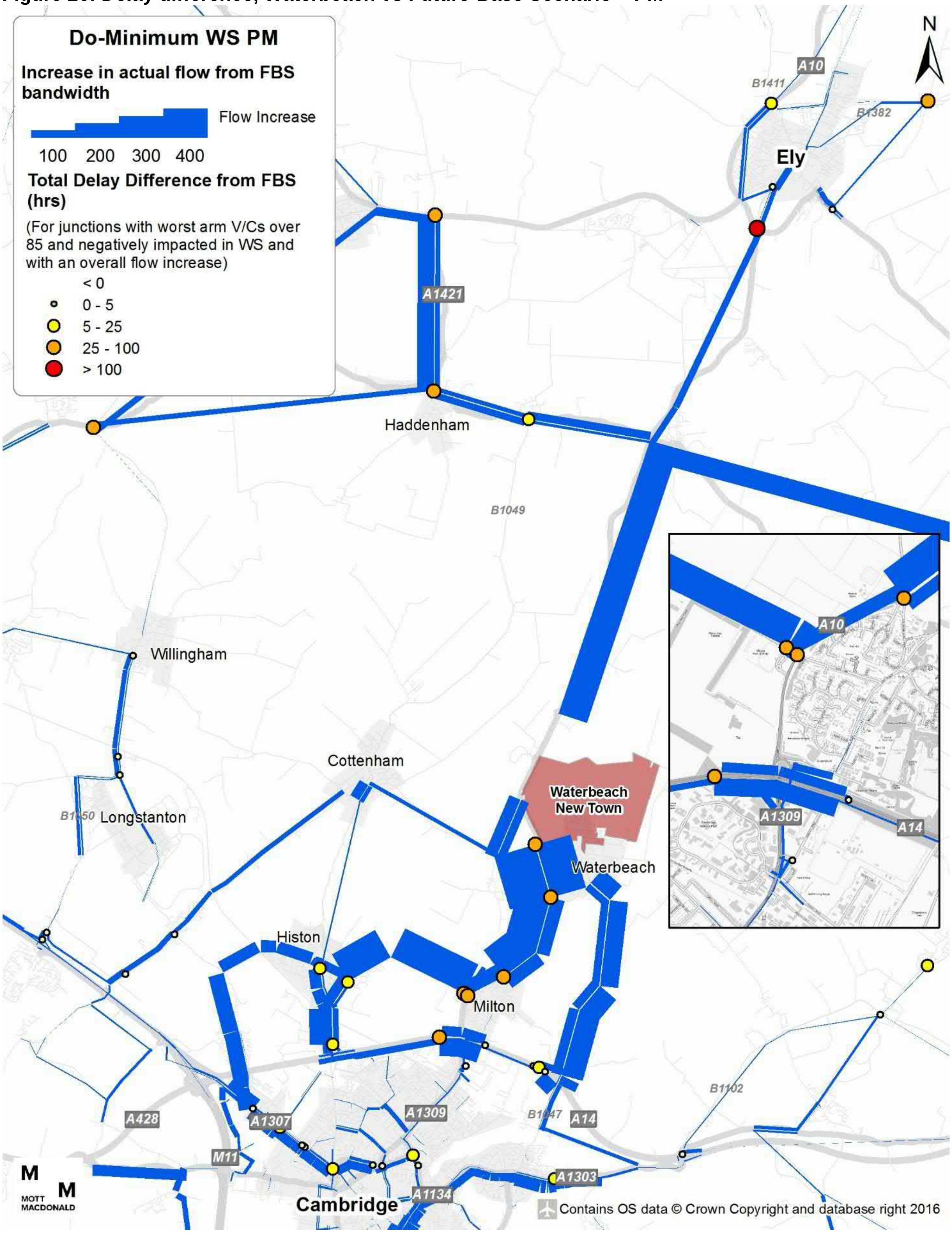
Based on this approach, the following two figures show, for the AM and PM peak respectively, junction delay increase levels for all junctions meeting the above V/C change and traffic flow change criteria.

Figure 25: Delay difference, Waterbeach vs Future-Base Scenario – AM



Source: CSRM

Figure 26: Delay difference, Waterbeach vs Future-Base Scenario – PM

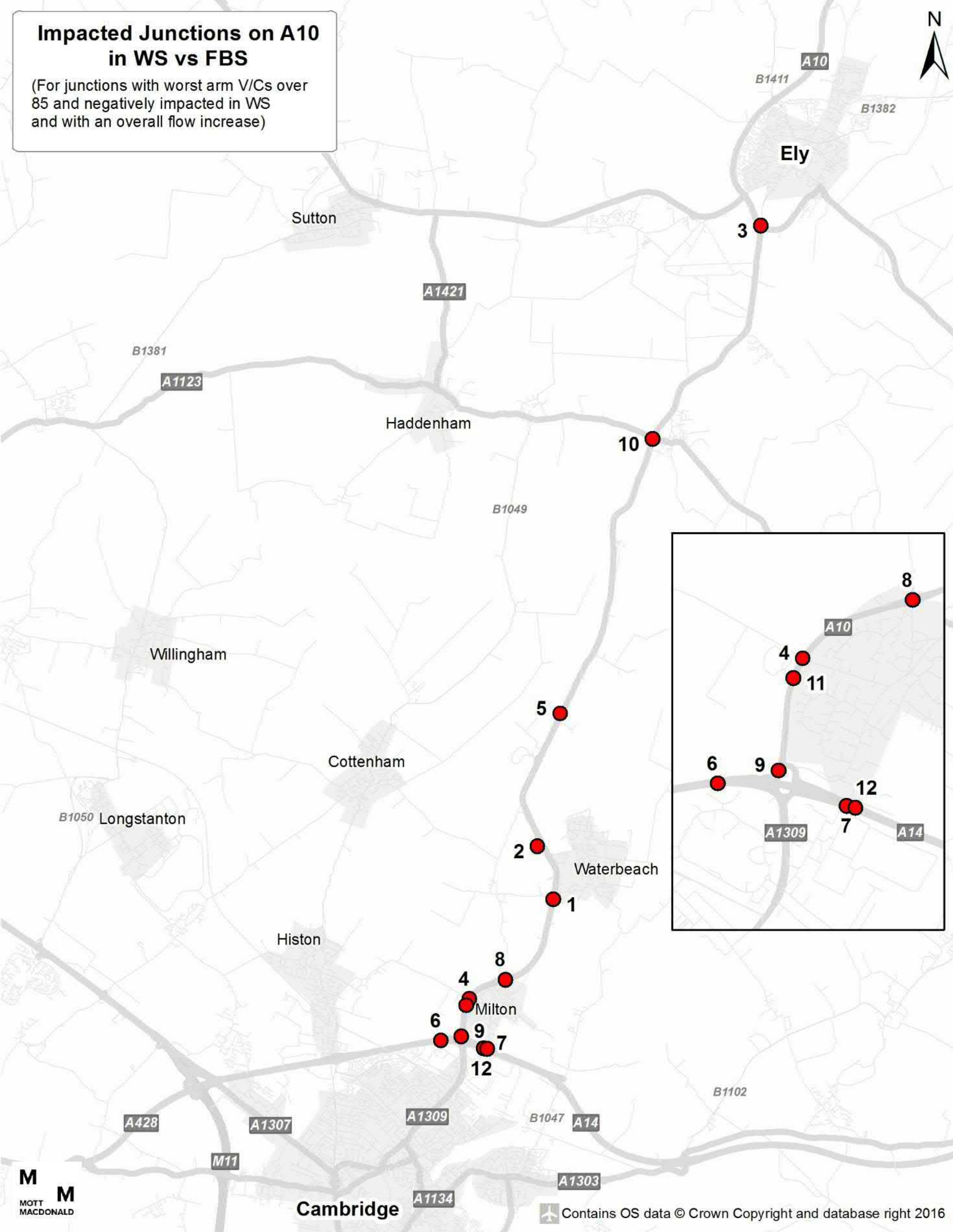


Source: CSRM

Junctions meeting this criteria in either or both peak hours are therefore identified as impacted junctions in the pre-mitigated Do Minimum situation. The impacted junctions on the A10 are shown in Figure 27 and are labelled in descending order of delay impact. ie 1=highest impact.

In accordance with the brief for this study, the demand and supply side measures for the Do Something modelling will focus on the A10, therefore only junctions along the A10 have been shown in Figure 27.

Figure 27: Junctions impacted by the development in the Waterbeach Scenario Do Min model runs



Source: CSRM

4.4 Summary

The above modelling results show that the primary impact of the proposed development at Waterbeach is on the section of A10 route between the development and the A14, for this is the section where development flows are predicted to be highest (see Figure 11 and Figure 12). This might be expected as Table 9 above shows that, from the top-6 highest trip-attracting external sectors, 63% of trips are most likely to be drawn southwards.

This level of demand on an already congested route results in link and junction capacity impacts on the section itself, and particularly at the proposed site accesses, the junctions with Car Dyke Road junction and Butt Lane, and at Milton Interchange. The latter in particular will significantly impact on the effectiveness of the existing P&R site.

The secondary impacts of this congestion are those caused by the displacement of background traffic. Such displacement is seen on the parallel B1047 and B1049 routes, which results in increased junction delays at the two junctions with the A14, and also in Histon, Impington, Cottenham, Wilburton and Haddenham.

A full list of A10 junctions impacted by the development under Do Minimum conditions is shown above in Figure 27. This level of impact will be reduced by the demand and supply side measures derived through the Do Something modelling process.

5 CNFE/CSP Scenario Results

5.1 Introduction

The purpose of this section is to present the 2031 AM and PM peak period Do Minimum modelling results for the CNFE/CSP Scenario, in order to understand the predicted highway network impact of development at CSP and CNFE. Results are presented, both as absolute values and in comparison to the Future-Base Scenario, in terms of:

- Traffic flows, to show the predicted distribution of traffic demand on the network – this shows where junctions are likely to experience capacity problems
- Junction performance, to show what proportion of junction capacity is predicted to be used up by the predicted traffic demand – this reveals where delays are likely to arise
- Junction delay, to show the total delay to users arising from the performance of each junction – this shows where the greatest congestion problems are occurring
- Journey times, to show the impact of junction delays on journey times – this allows the impact of junction delays to be understood in terms of overall journey time impact

5.2 Development Demand

5.2.1 Introduction

In this section, the impacts of both the CNFE and CSP developments in the CSRM model are considered in terms of total person trip generation, mode share, site internalisation levels and external trip distributions and assignment.

The peak periods used in the demand model are as follows:

- AM Peak (07:00-10:00)
- PM Peak (16:00-19:00)

Conversion factors provided by Atkins have been applied to convert the 3-hour peaks to 1-hour peaks so that a direct comparison can be made with other scenarios. Additionally the data for the CNFE and CSP have been aggregated to show the full impact of the developments.

5.2.2 Development Person Trip Generation

The level of person trip generation calculated by the CSRM demand model for the CNFE and CSP developments is shown in Table 11 below. For ease of reporting and interpretation, the two sites have been aggregated. Trips between CNFE and CSP have been counted as external trips, as vehicles travelling between the sites will interact with the Milton Road, therefore having an impact on the network.

Table 11: Development person trip generation

Parameter	AM (08:00-09:00)		PM (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
External	1,442	6,407	6,145	1,134
Internal	234	234	233	233
All	**1,676**	**6,640**	**6,378**	**1,366**

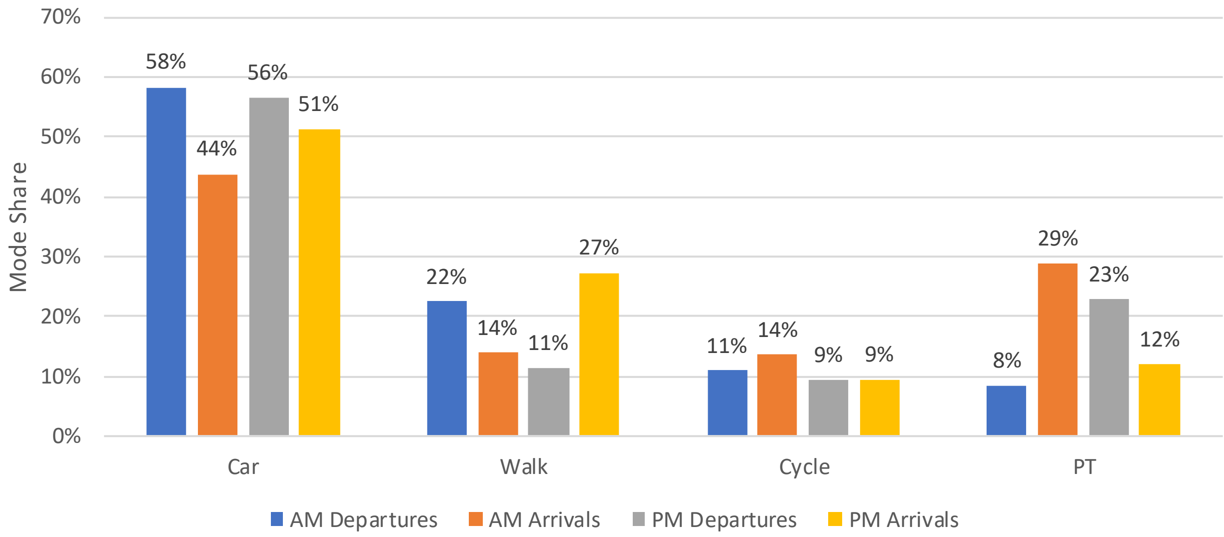
Source: CSRM

The table shows that a far higher number of person trips are expected to arrive at the developments in the AM peak rather than depart, with the opposite being true in the PM peak. Internal trips are substantially lower than external trips for arrivals and departures in both time periods, reflecting the employment-led nature of the proposals tested, and the low level of housing assumed, in the land use mix described in Section 2.

5.2.3 Development Trip Mode Share

Figure 28 below shows the mode share calculated for the CNFE and CSP development's external trips. These are the trips which generate impact on the external transport network.

Figure 28: Forecast mode share for external development trips



Source: CSRM

This chart suggests a difference in the mode share of trips leaving in the AM and returning in the PM, which are more likely to be residential trips, compared to those arriving in the AM and leaving in the PM, which are more likely to be employment trips. The residential-type trips are a little more likely to use the car and less likely to use public transport than the employment-type trips, but also more likely to walk. Both types of trips show similar levels of cycling.

It is noted that Figure 7.9 of the Baseline Report shows a Census 2011 car mode share for all commuting trips to the CNFE and CSP Medium Super Output Area of 76%, which is noticeably higher than the car mode share predicted above by the model. Figure 7.15 of the Baseline Report also shows that this mode share dropped from about 80% in 2001. The model is therefore predicting a further decline in car travel to and from these sites in the face of increased congestion in 2031 and increased take-up of non-car means of travel. Figure 7.9 of the Baseline Report also shows that mode shares for trips from Cambridge are substantially lower than those for trips from further afield, so an increase in the proportion of local trips would also bring the car share down.

5.2.4 Development Trip Internalisation Levels

Table 12 shows the level of internalisation estimated for CNFE and CSP development trips in both peak hours.

Table 12: Level of development trip internalisation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Internal	External	Internal	External
Internalisation level	6%	94%	6%	94%

Source: CSRM

This shows that internalisation levels are predicted to be relatively low which, as noted above, is due to the high level of job numbers proposed in this scenario, and the low level of housing, by the land use mix for this option. Table 13 shows how the above internalisation levels equate to external car trips.

Table 13: External car trip generation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
Person trips	839	2,685	3,600	589
Number of cars	658	2,191	2,943	423

Source: CSRM

5.2.5 External Development Trip Distribution

Table 14 shows the top 6 sectors between which trips are generated by the proposed developments at CNFE and CSP, and the 12-hour trip levels predicted to be undertaken by mode. Only the top 6 have been shown due to these sectors having over 4,000 total trips during the time period, whilst the remaining sectors have a far lower number. A map showing the sectors used in the CSRM model can be found in Appendix C.

Table 14: Total trips to and from CNFE and CSP by sector, 07:00-19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Cambridge Outer	5,572	6,382	4,227	1,805	414	33	90	18,523
City Fringe	4,892	2,343	964	785	299	21	0	9,304
South Cambs Outer	6,511	14	233	233	703	399	0	8,092
Cambridge Northern Fringe	1,201	4,667	452	0	0	0	0	6,320
Cambridge Central	1,735	1,145	1,446	1,398	214	0	98	6,036
East Cambs Rural	3,239	1	25	224	1,103	0	0	4,592

Source: CSRM

This table shows that, excluding the CNFE sector, the sectors generating the most external development trips are Cambridge Outer, the City Fringe and Cambridge Central. It is noted that the top 5 sectors are within or on the outskirts of Cambridge.

Table 15 presents the above information in terms of mode share by sector.

Table 15: Total Trips to and from CNFE and CSP Development sector (%), 07:00-19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Cambridge Outer	30%	34%	23%	10%	2%	0%	0%	41%
City Fringe	53%	25%	10%	8%	3%	0%	0%	21%
South Cambs Outer	80%	0%	3%	3%	9%	5%	0%	18%
Cambridge Northern Fringe	19%	74%	7%	0%	0%	0%	0%	14%
Cambridge Central	29%	19%	24%	23%	4%	0%	2%	13%
East Cambs Rural	71%	0%	1%	5%	24%	0%	0%	10%

Source: CSRM

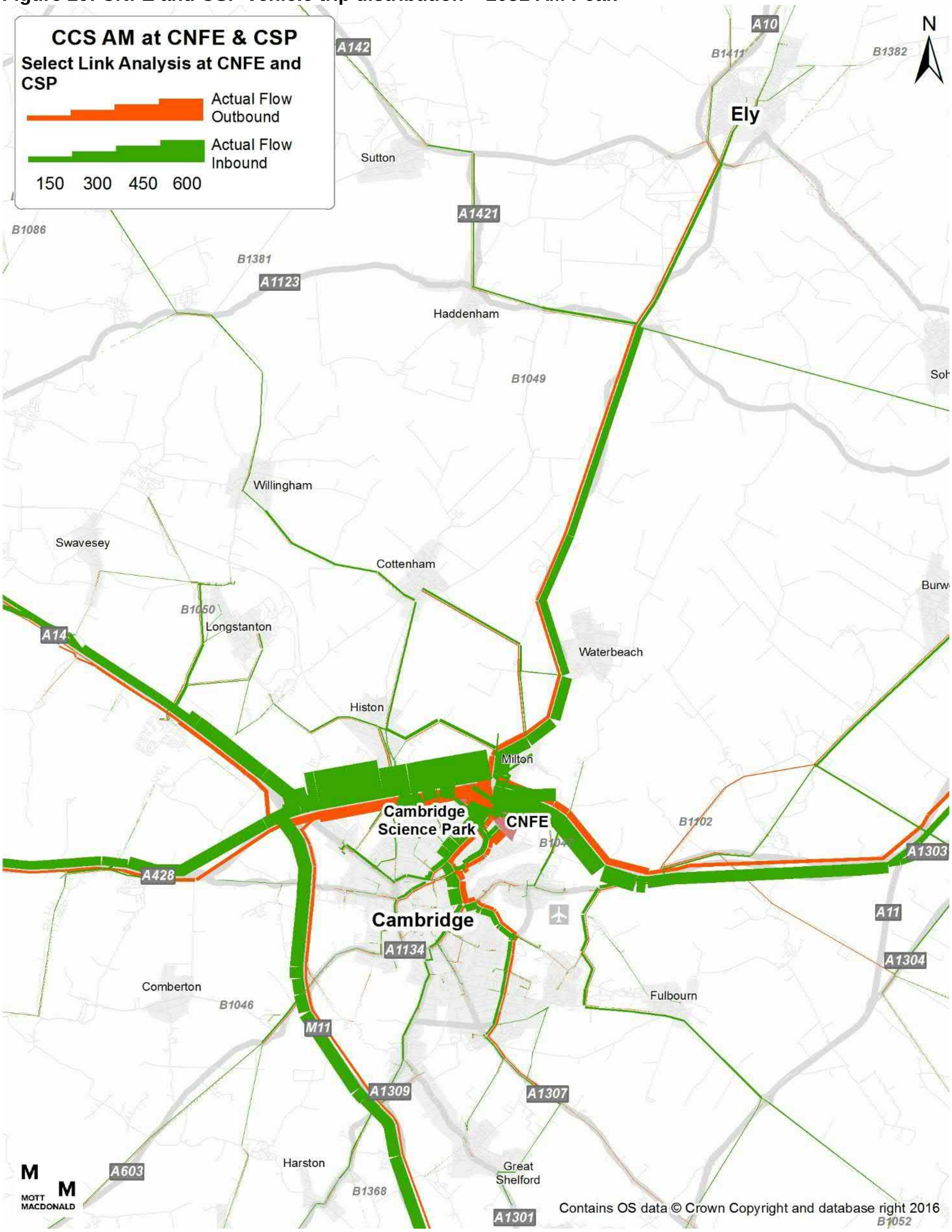
This shows clear distinction in mode share depending on which sector is being travelled to/from by development related trips. Trips to and from South Cambridgeshire Outer and East Cambridgeshire Rural have the highest car mode share. Conversely, trips to Cambridge Central and Cambridge Outer, for which there are multiple mode options, show the lowest car mode share for external trips. This applies less to the City Fringe sector, however, highlighting the challenges of serving less central trips by other modes.

Figure 29 and Figure 30 show how the above distribution of car trips to and from the CNFE and CSP development sites impact the 2031 highway network in terms of development flow distribution during both the AM and PM peak periods respectively.

These figures show:

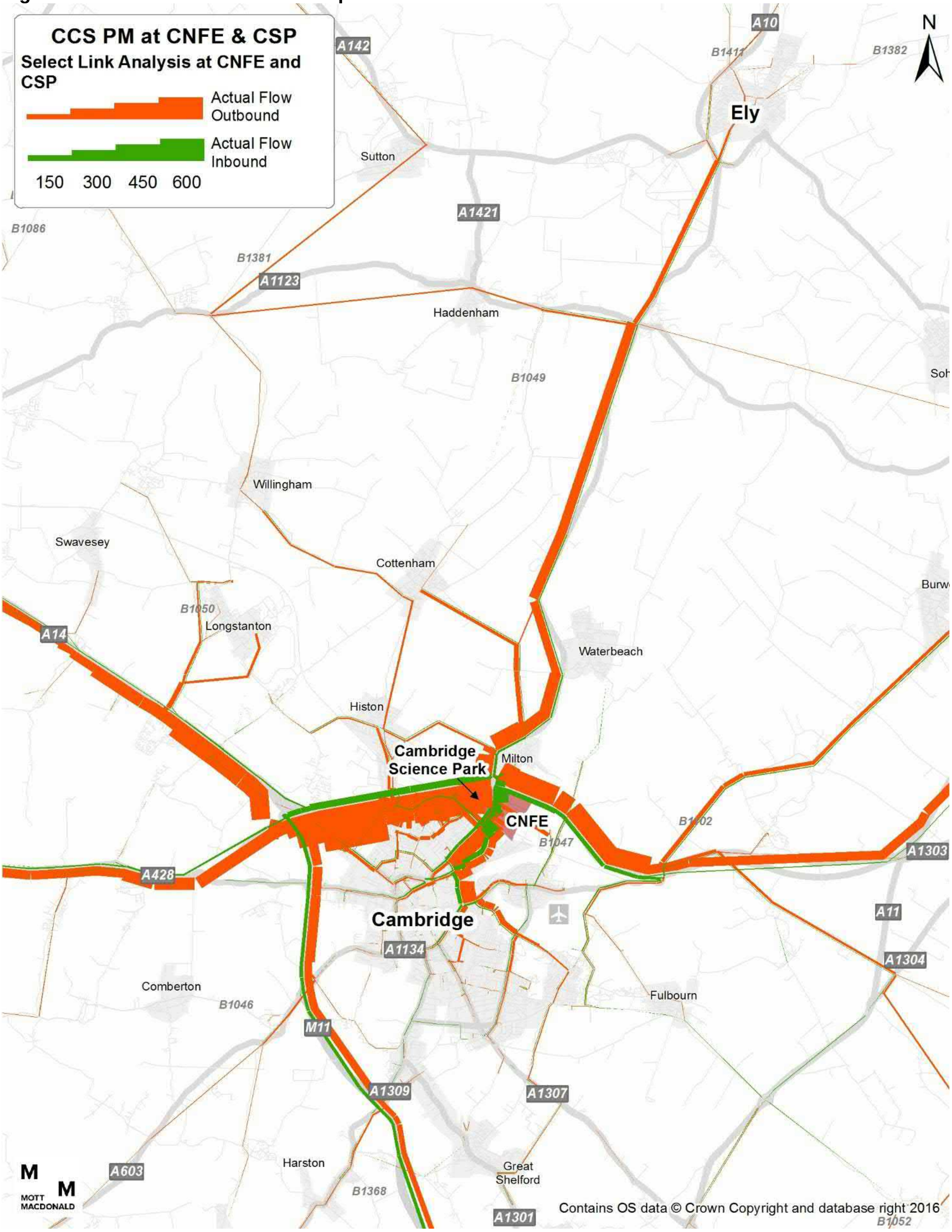
- During the morning peak (Figure 30), the highest level of flow impact is eastbound on the A14 between the M11 and Milton Interchange, with much of this traffic being drawn from the M11 south, A428, and A14 (west)
- There is also a significant westbound demand on the A14 east and southbound on the A10 from Ely and intermediate settlements
- There is increased demand for travel from within Cambridge to the site via Milton Road
- During the evening peak (Figure 31) similar patterns can be observed but in reverse given the tidal nature of forecast traffic generation levels

Figure 29: CNFE and CSP vehicle trip distribution – 2031 AM Peak



Source: CSRM

Figure 30: CNFE and CSP vehicle trip distribution – 2031 PM Peak



Source: CSRM

5.3 Development Network Impact

5.3.1 Introduction

The following section examines the predicted performance of the study area highway network in the CNFE/CSP Scenario, both in absolute terms and in direct comparison to the Future-Base Scenario. The latter comparison allows the specific impacts of the proposed development at CNFE and CSP to be isolated and identified. The impacts considered are as follows:

- Traffic flows
- Junction performance, in terms of worst-arm V/C levels and total delay levels
- Link and route performance, in terms of journey times

The AM peak results are presented first, followed by the PM peak results.

5.3.2 AM Peak Period Results

5.3.2.1 AM Peak Traffic Flow and Junction Performance

As per the results shown for the Future-Base Scenario, Figure 31 shows for the AM peak period in the CNFE/CSP Scenario:

- The distribution of predicted traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown in orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

To show how these results differ from the Future-Base Scenario, so isolating the impacts of development at CNFE and CSP, the subsequent Figure 32 shows for the AM peak period in the CNFE/CSP Scenario:

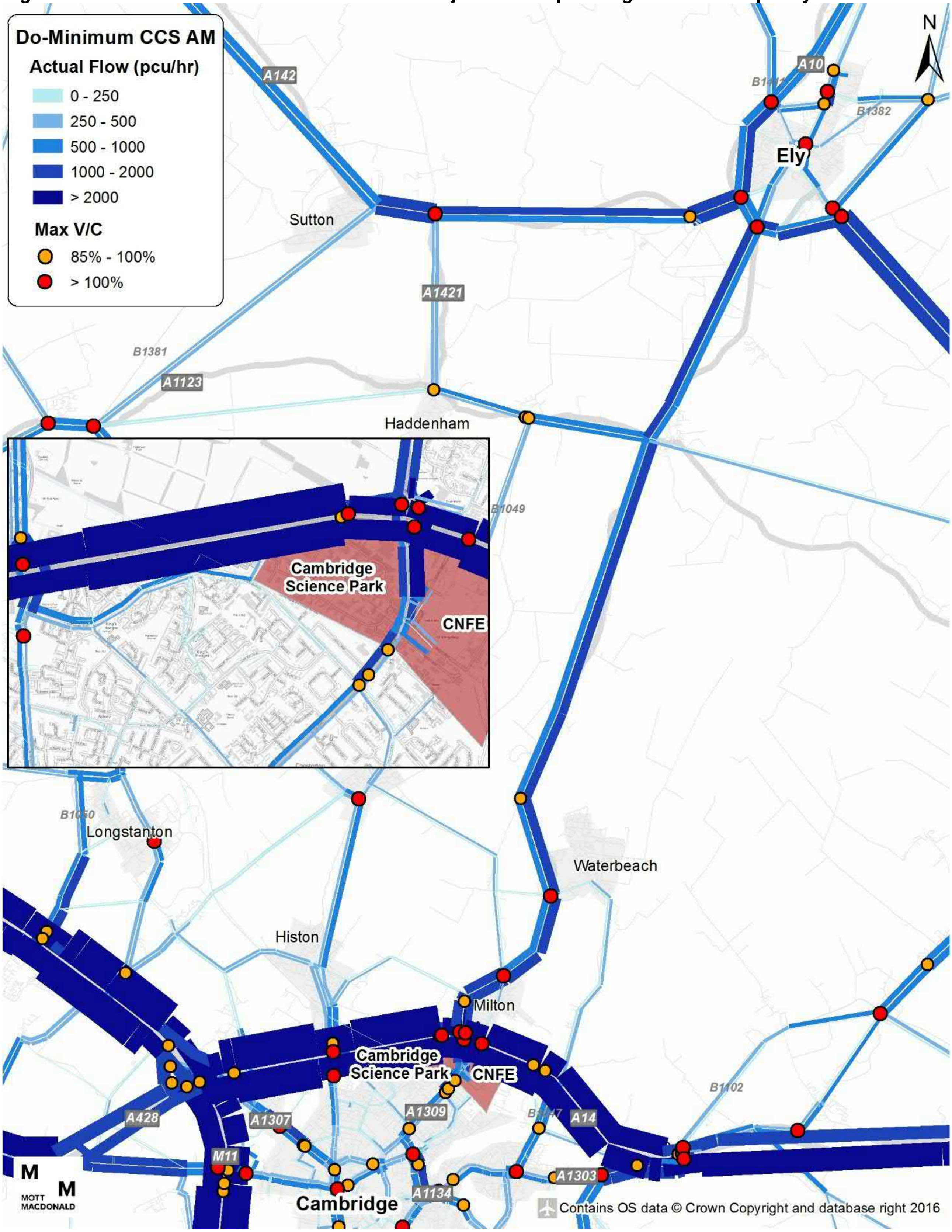
- The *change* in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- The *change* in junction worst-arm V/C compared to the Future-Base Scenario, where orange or red junctions show key deteriorations and green junctions show key improvements. Junctions where neither level of impact is predicted are not shown

These figures suggest that the development will lead to:

- Large increases in flow in the immediate vicinity of the CNFE and CSP sites, as would be expected, with the deterioration in the operation of the local network leading to increased flows on Kings Hedges Road, and also onto Newmarket Road/Elizabeth Way/Green End Road.
- Relatively little net change in traffic flows on the A10 southbound despite the increased demand associated with CNFE and CSP (shown in Figure 30)
- Some displacement of traffic that would have previously used the A10 southbound on to other parallel routes with increased flows being forecast via Histon and Impington, on the B1049 from Cottenham, and on the route via Clayhithe and Horningsea

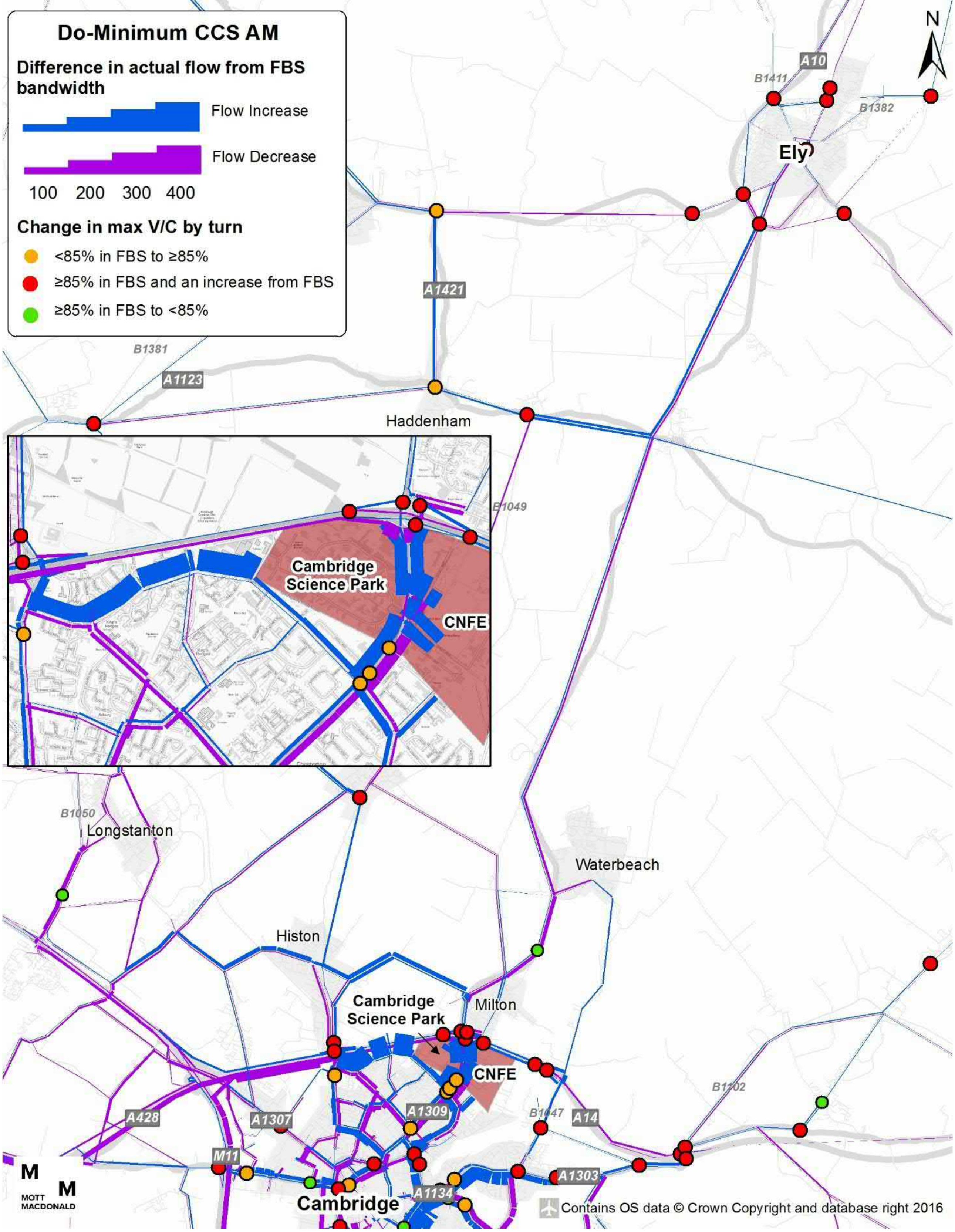
Additionally, there are predicted to be a number of flow decreases further away from the site. These are primarily associated with the different distribution of development in the Future-Base and CNFE/CSP Scenarios with the reallocation of potential growth in employment from around the sub-region to CNFE and CSP causing some small traffic reduction effects on links further from the site. These effects do not significantly affect the study area.

Figure 31: CNFE/CSP Scenario traffic flows and junctions operating at or over capacity – AM



Source: CSRM

Figure 32: Change in traffic flows and junction performance, CNFE/CSP vs Future-Base Scenario, AM



Source: CSRM

5.3.2.2 AM Peak Traffic Flow and Junction Delay

Figure 33 shows, for the AM peak period in the CNFE/CSP Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU flow through the junction by the average delay per PCU experienced at the junction

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts the development at CNFE and CSP, the subsequent Figure 34 shows for the AM peak period in the CNFE/CSP Scenario:

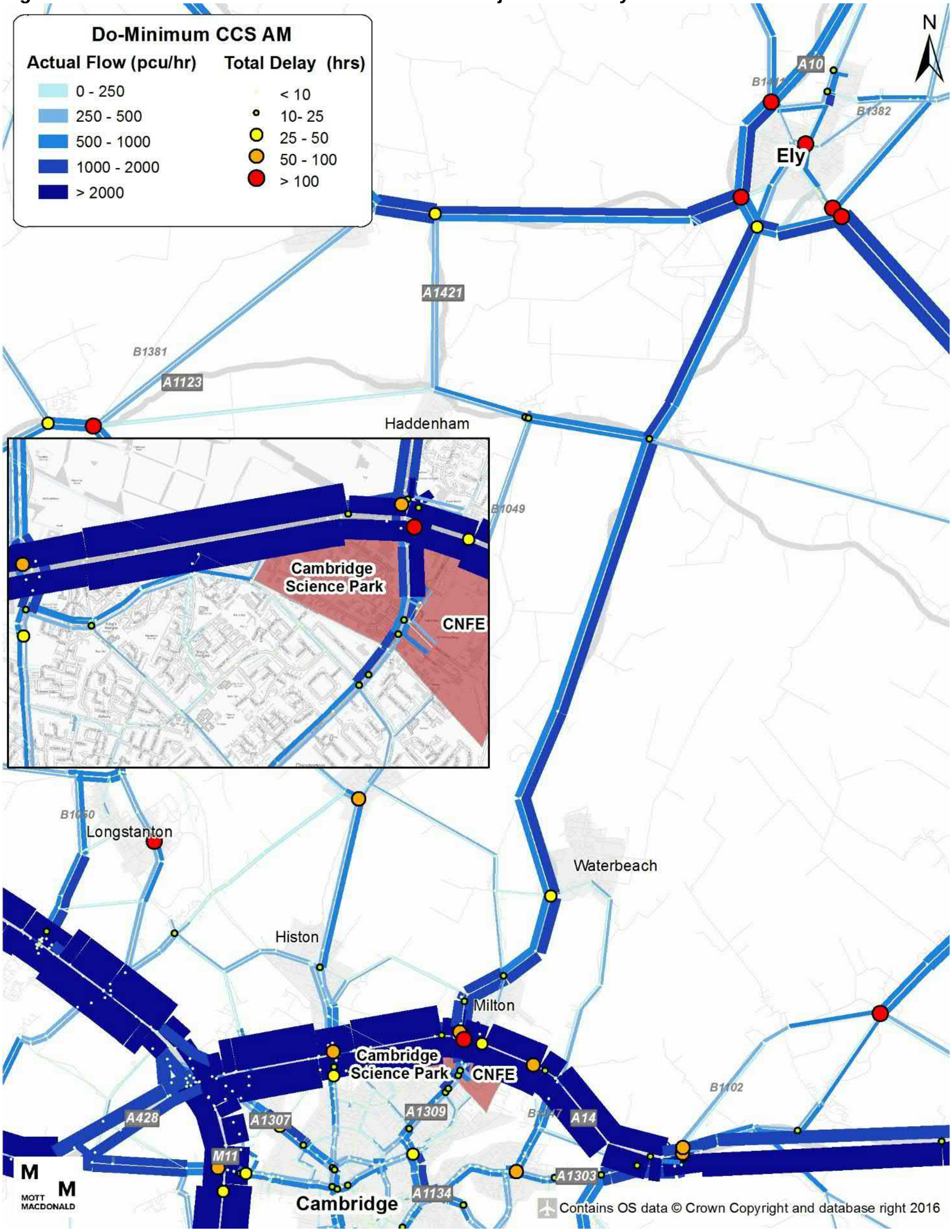
- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- Increases in total junction delay compared to the Future-Base Scenario, shown as banded changes in vehicle-hours for junctions with a V/C[6] ratio over 85% in the CNFE/CSP Scenario (in order to isolate junctions impacted by development)

Comparing the latter figure with Figure 32 above – which shows junctions with capacity impacts – reveals a more nuanced picture of the development's impact on the surrounding network. In particular, it reveals that:

- The main delay impacts are at Milton Interchange and Histon Interchange, with the biggest impact being at Milton Interchange
- There are many relatively small increases in total delay, especially within central Cambridge
- Impacts on the Ely area are limited with the greatest increases in total delay occurring on the bypass

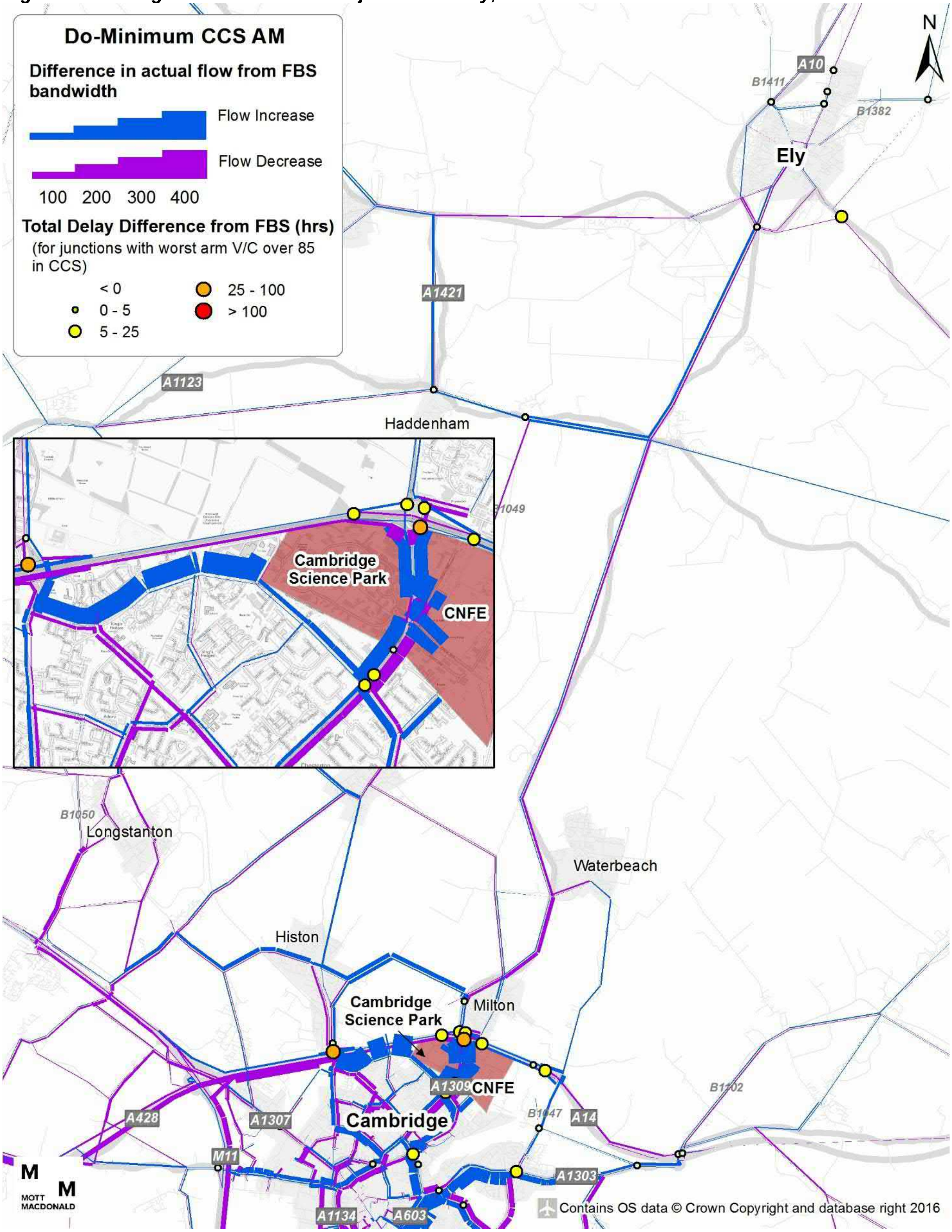
[6] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 33: CNFE/CSP Scenario traffic flows and total junction delay levels – AM



Source: CSRM

Figure 34: Change in traffic flows and junction delay, CNFE/CSP vs Future-Base Scenario – AM



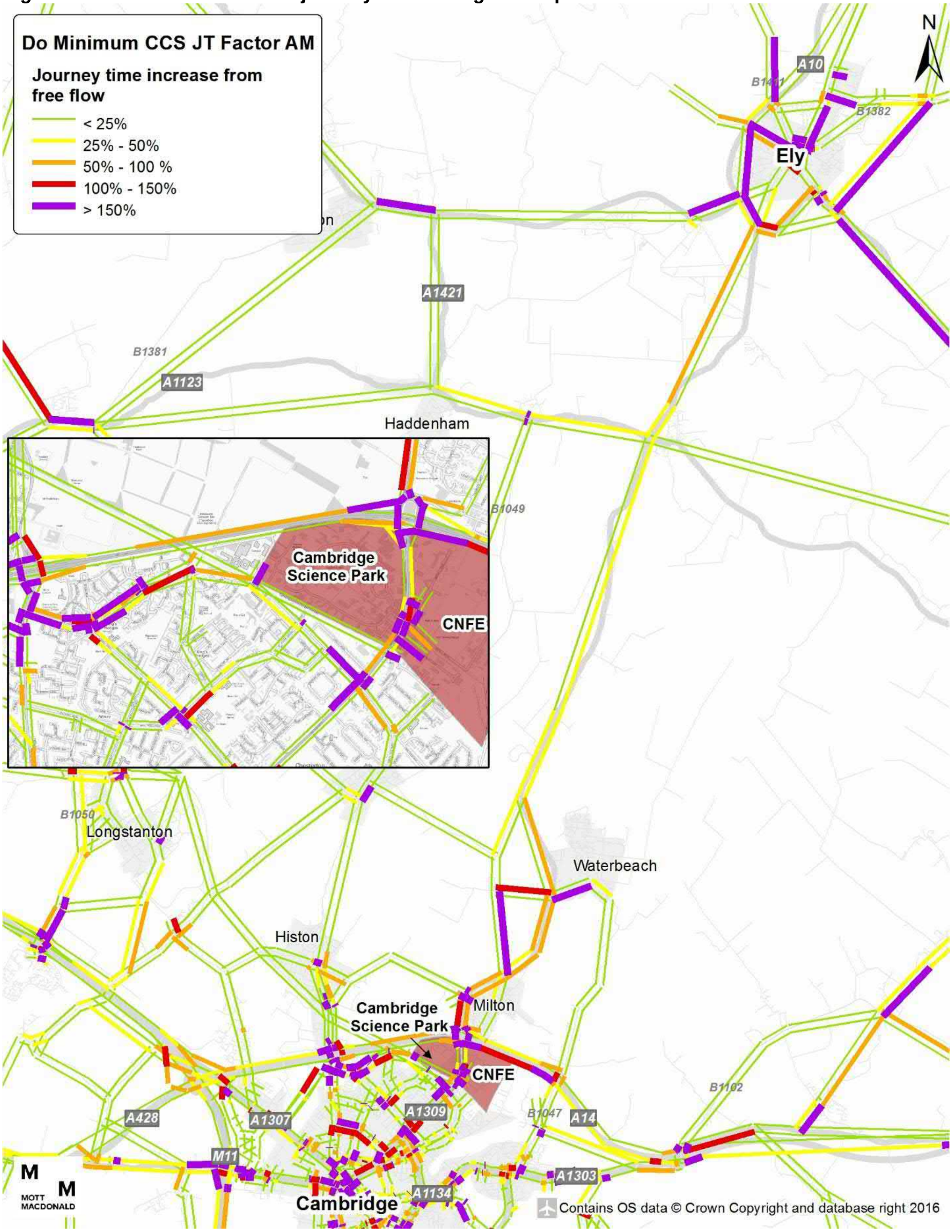
Source: CSRM

5.3.2.3 AM Peak Journey Time Performance

Figure 35 shows the percentage increase in journey time compared to free-flow conditions, for the AM peak period in the CNFE/CSP Scenario, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. Comparing with Figure 4 above, which shows the equivalent the Future-Base Scenario result, this suggests there is limited incremental impact from the proposed developments on study area journey times.

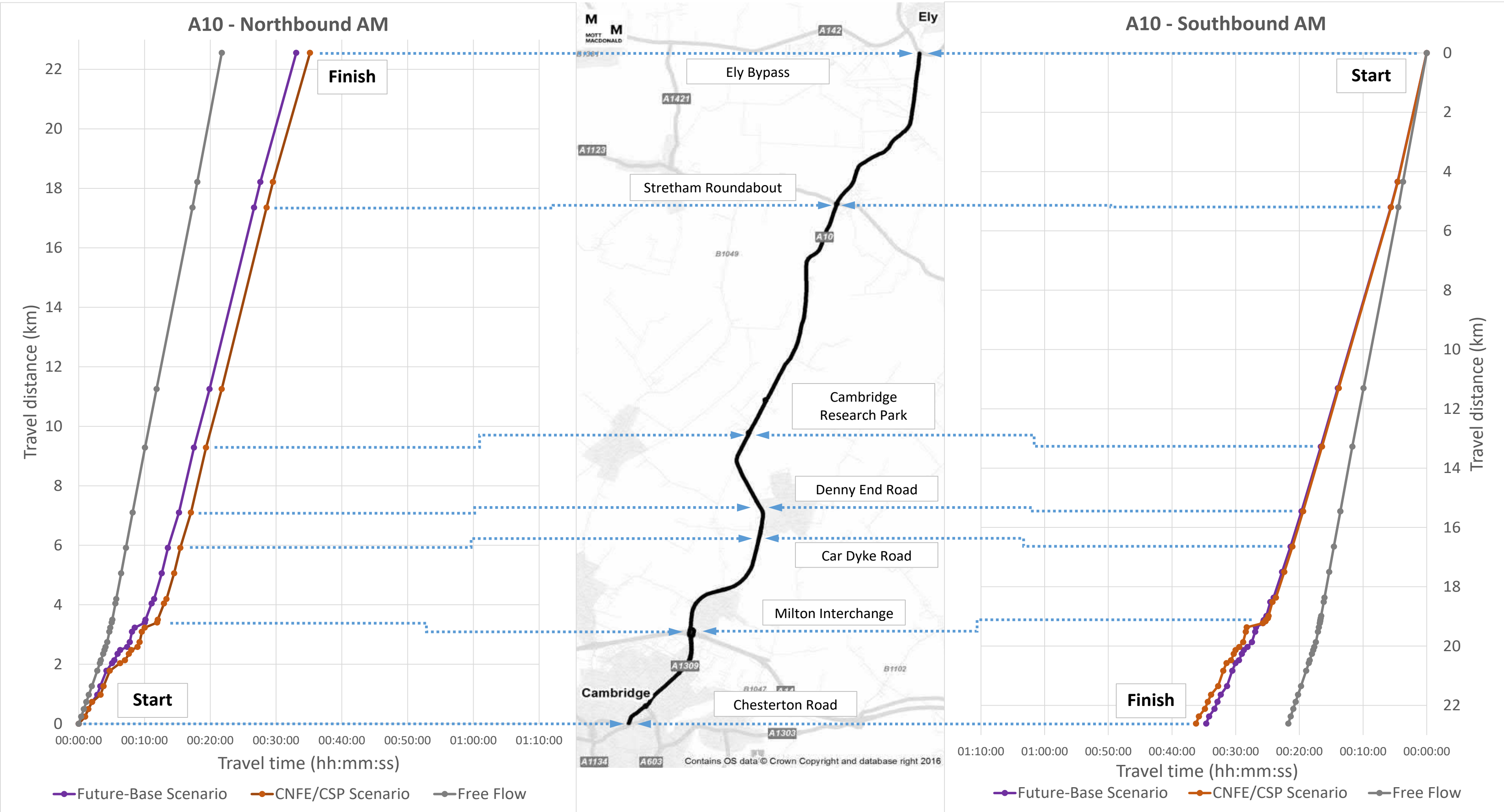
The subsequent Figure 36 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, for both the Future-Base and CNFE/CSP Scenarios, with free flow time included for further comparison. These show that northbound and southbound trips are predicted to respectively take 6% and 5% longer than Future-Base journey times.

Figure 35: CNFE/CSP Scenario journey time changes compared to free-flow conditions – AM



Source: CSRM

Figure 36: Journey time on the A10 between Ely and Cambridge – AM



Source: CSRM

5.3.3 PM Peak Period Results

5.3.3.1 PM Peak Traffic Flow and Junction Performance

As per the results shown for the AM peak, Figure 37 shows for the PM peak period in the CNFE/CSP Scenario:

- The distribution of predicted traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown in orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts of development at CNFE and CSP, the subsequent Figure 38 shows for the PM peak period in the CNFE/CSP Scenario:

- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- The change in junction worst-arm V/C compared to the Future-Base Scenario, where orange or red junctions show key deteriorations and green junctions show key improvements. Junctions where neither level of impact is predicted are not shown

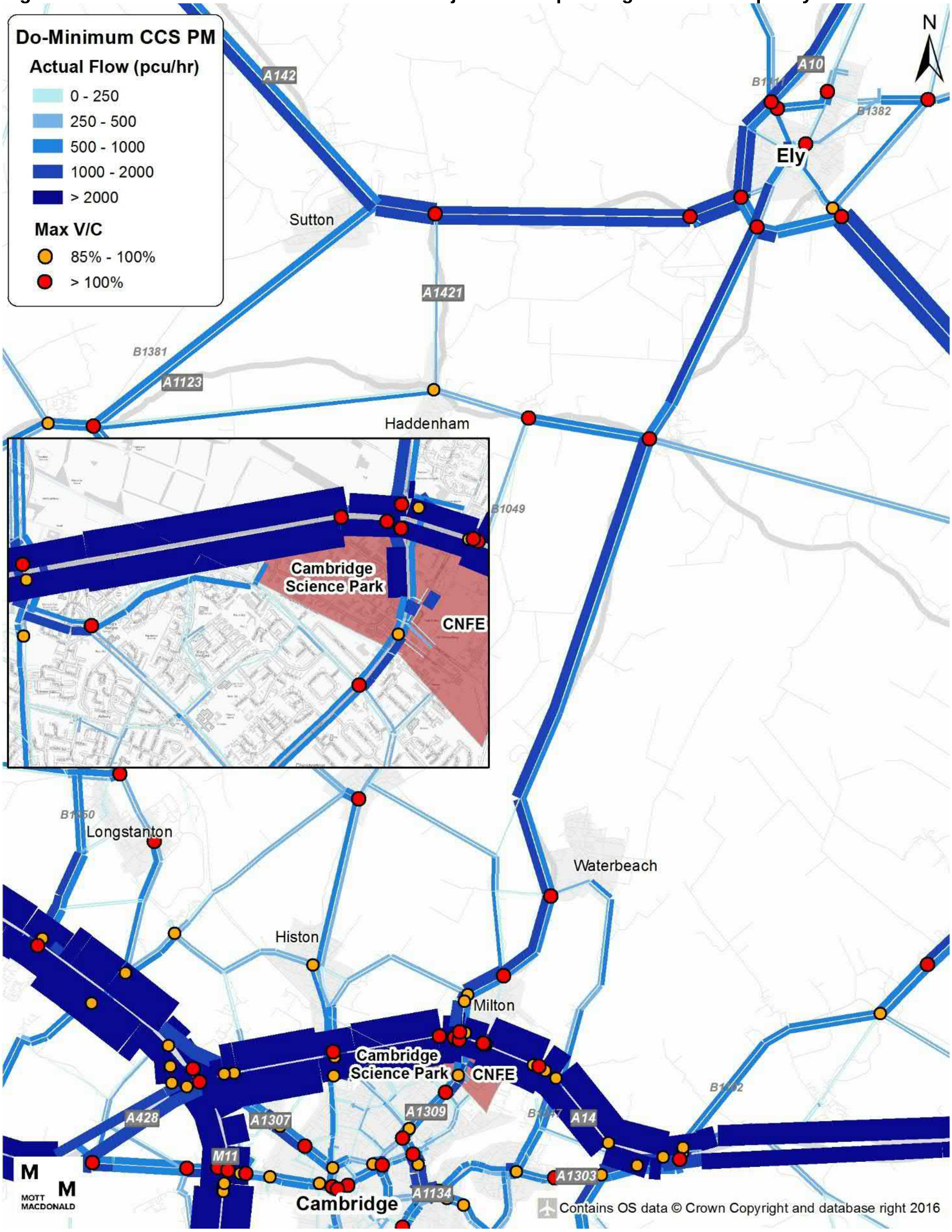
These figures show a generally more congested picture than the AM peak, particularly on the A10, M11 and within Cambridge. As with the AM peak, there are also a number of over-capacity junctions in and around Ely.

In terms of changes compared to the Future-Base Scenario PM peak, it can be seen from Figure 38 that the A10 to the south of the A10 / Green End junction experiences decreased flows in the southbound direction, whilst the parallel route through Horningsea along Clayhithe Road has an increase in flow. This increase in flow is not development flow, as can be seen by Figure 30, but instead displaced background flow seeking to avoid Milton Interchange which itself is impacted by development-related traffic entering the junction from the A14. This results in a decrease in flow in the A10 overall north of the interchange. The capacity of some junctions on the A10 still deteriorate, however, even with decreases in flow, due to an increase in traffic entering or exiting the A10 at these junctions.

The performance of both the Milton and Histon Interchanges deteriorates in the PM peak and are further over-capacity than in the AM. As a result, background traffic diverts to other routes to avoid them; for example, along Clayhithe Road or through central Cambridge.

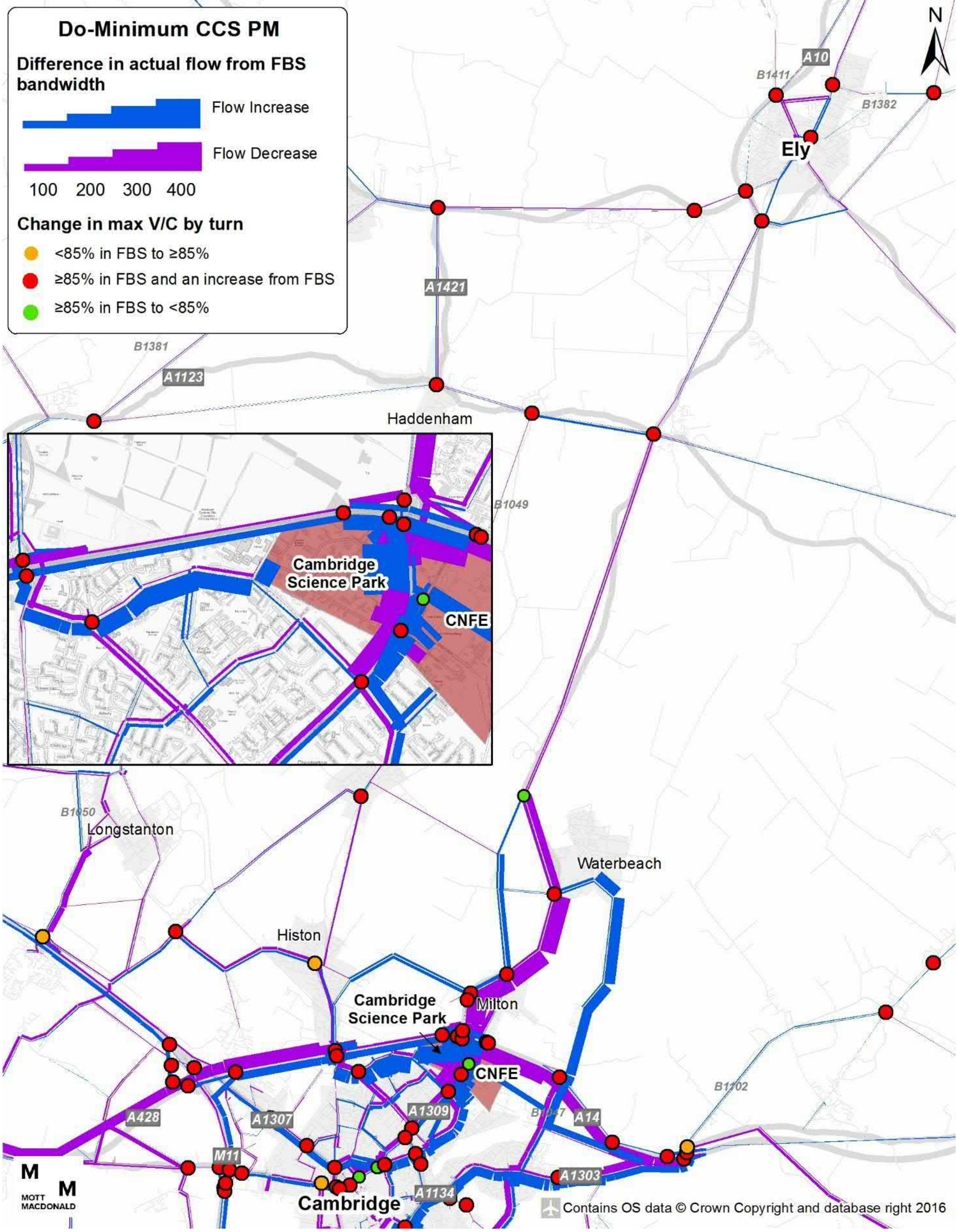
Within the City, many junctions become further over-capacity due to increases in flow, including along the A1309, A1307 and the A1303. However some of these flows are displaced flows rather than development flows, as can be seen from Figure 30. As with the AM, the biggest difference in flow between the Future-Base and CNFE/CSP Scenarios is around the CNFE and CSP sites, with a large increase along King Hedges Road from the CSP.

Figure 37: CNFE/CSP Scenario traffic flows and junctions operating at or over capacity – PM



Source: CSRM

Figure 38: Change in traffic flows and junction performance, CNFE/CSP vs Future-Base Scenario, PM



Source: CSRM

5.3.3.2 PM Peak Traffic Flow and Junction Delay

Figure 39 shows, for the PM peak period in the CNFE/CSP Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU flow through the junction by the average delay per PCU experienced at the junction

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts the developments at CNFE and CSP, the subsequent Figure 40 shows for the PM peak period in the CNFE/CSP Scenario:

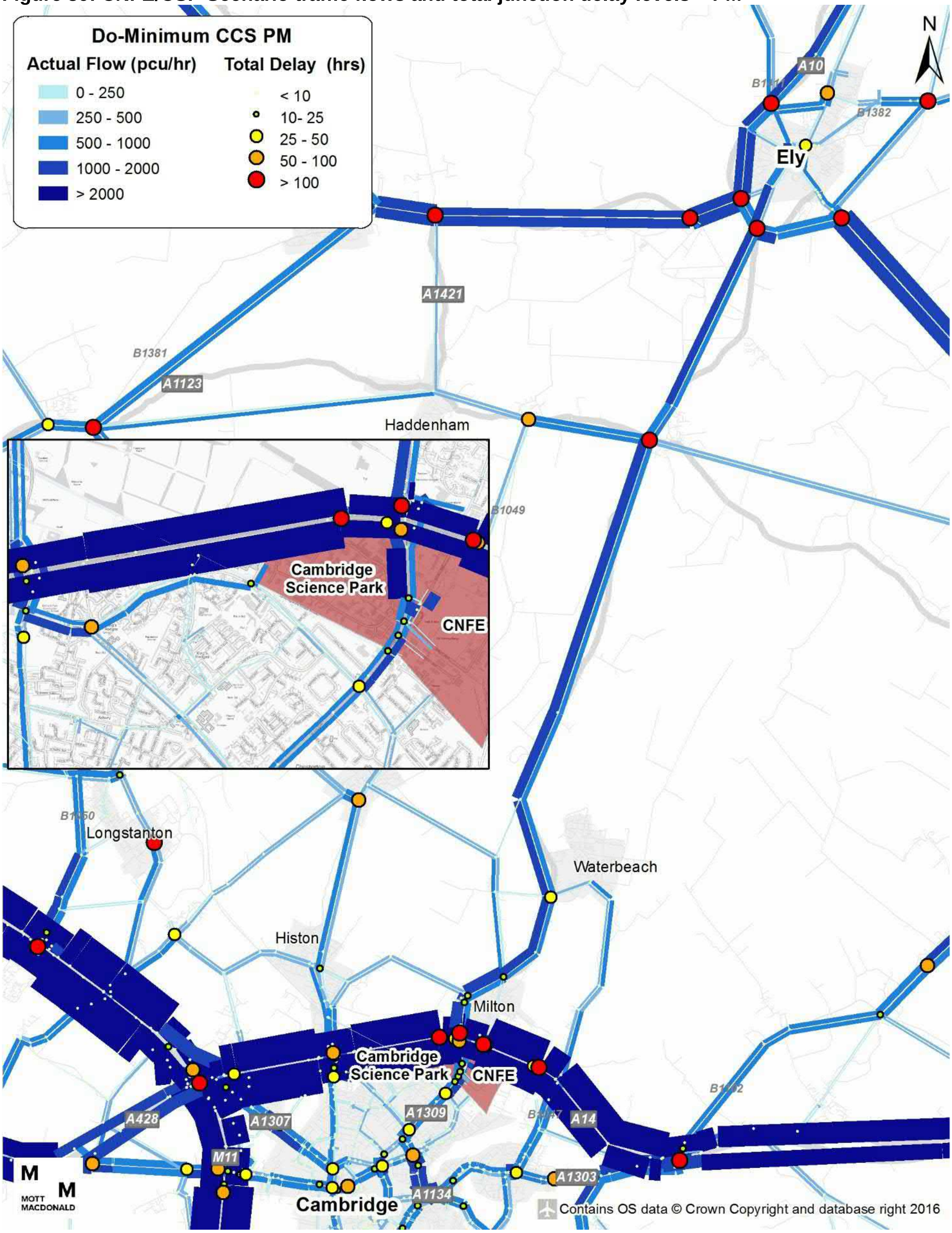
- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- Increases in total junction delay compared to the Future-Base Scenario, shown as banded changes in vehicle-hours for junctions with a V/C[7] ratio over 85% in the CNFE/CSP Scenario (in order to isolate junctions impacted by development)

Comparing the latter figure with Figure 38 above – which shows junctions with capacity impacts in the PM peak – reveals a more nuanced picture of the development's impact on the surrounding network. In particular, it reveals that:

- The main delay impacts are concentrated at Milton Interchange, with increases in delay also found on Chesterton Road and the A1303/Newmarket Road in Cambridge
- Although the Histon Interchange experiences increased demand and a deterioration in performance, the net increase in delay is more limited
- Though there are a number of over-capacity junctions on the A10 between Ely and Milton Interchange, only Stretham Roundabout and the A10 / Landbeach Road junction show a particularly significant increase in total delay
- Though many junctions in and around Ely show a capacity impact in Figure 38, many of these junctions show relatively minor increases in delay.

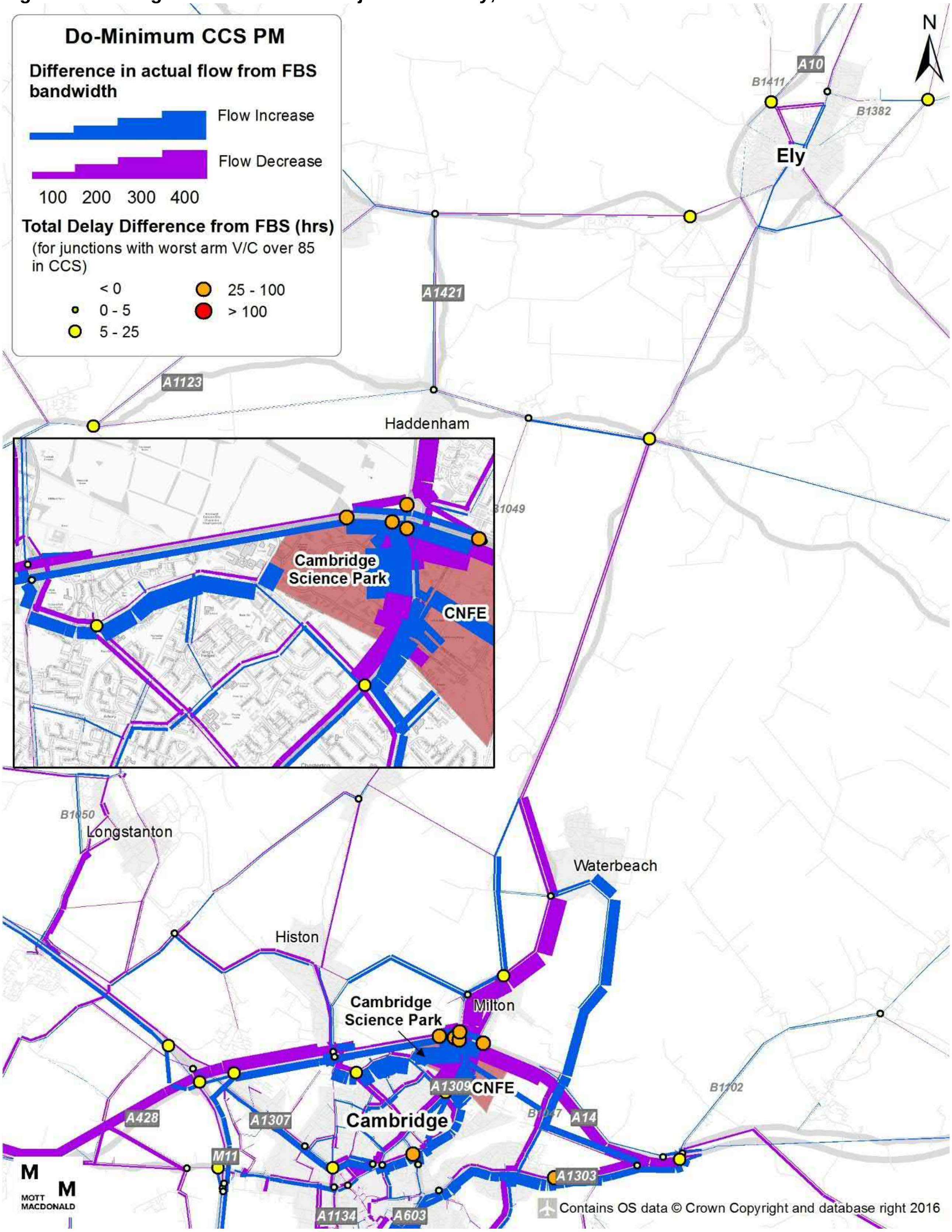
[7] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 39: CNFE/CSP Scenario traffic flows and total junction delay levels – PM



Source: CSRM

Figure 40: Change in traffic flows and junction delay, CNFE/CSP vs Future-Base Scenario – PM



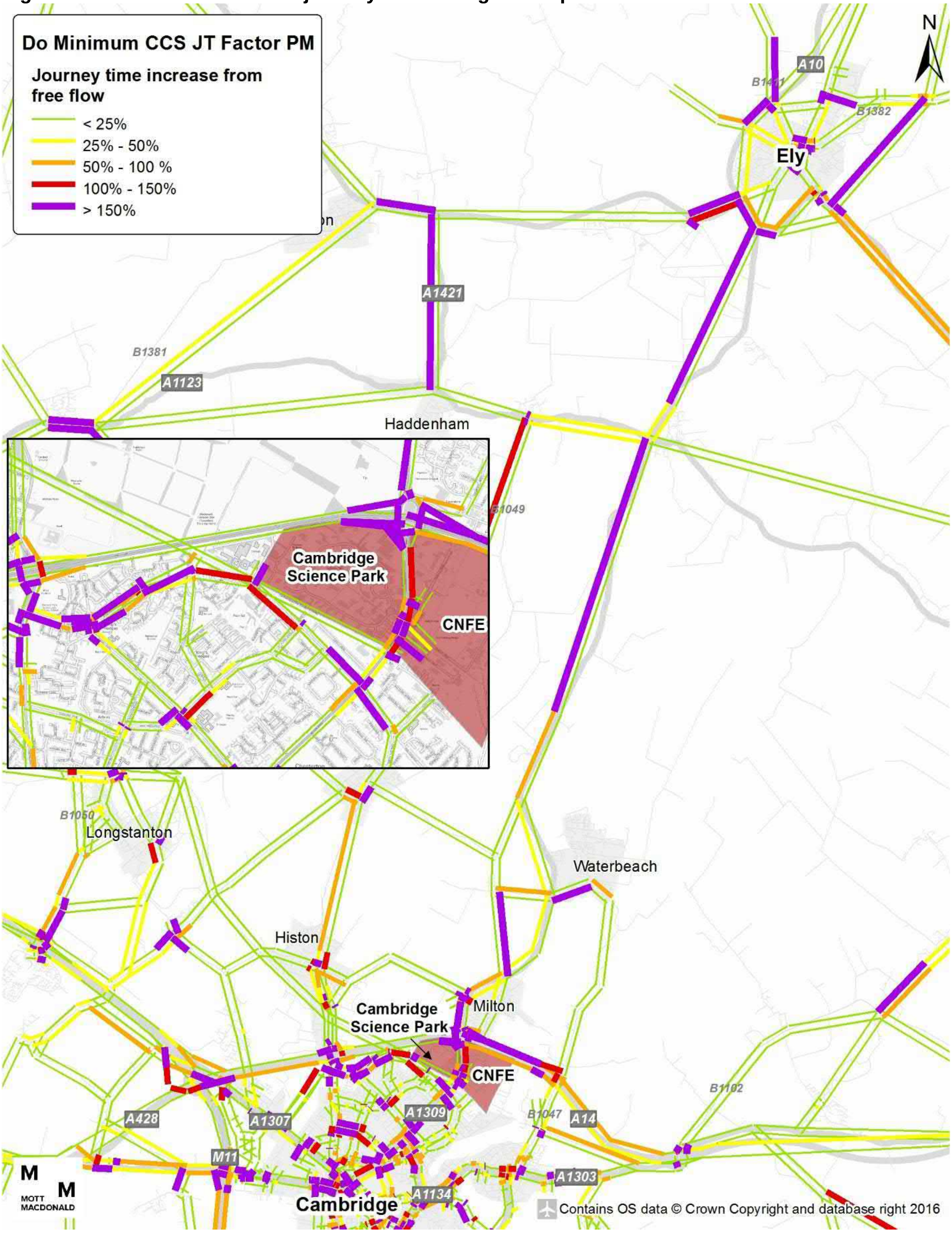
Source: CSRM

5.3.3.3 PM Peak Journey Time Performance

Figure 41 shows the percentage increase in journey time compared to free-flow conditions, for the PM peak period in the CNFE/CSP Scenario, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. Comparing with Figure 8 above, which shows the equivalent Future-Base Scenario result, suggests that there is little difference in journey times between the Future-Base Scenario and the CNFE/CSP Scenario within the study area.

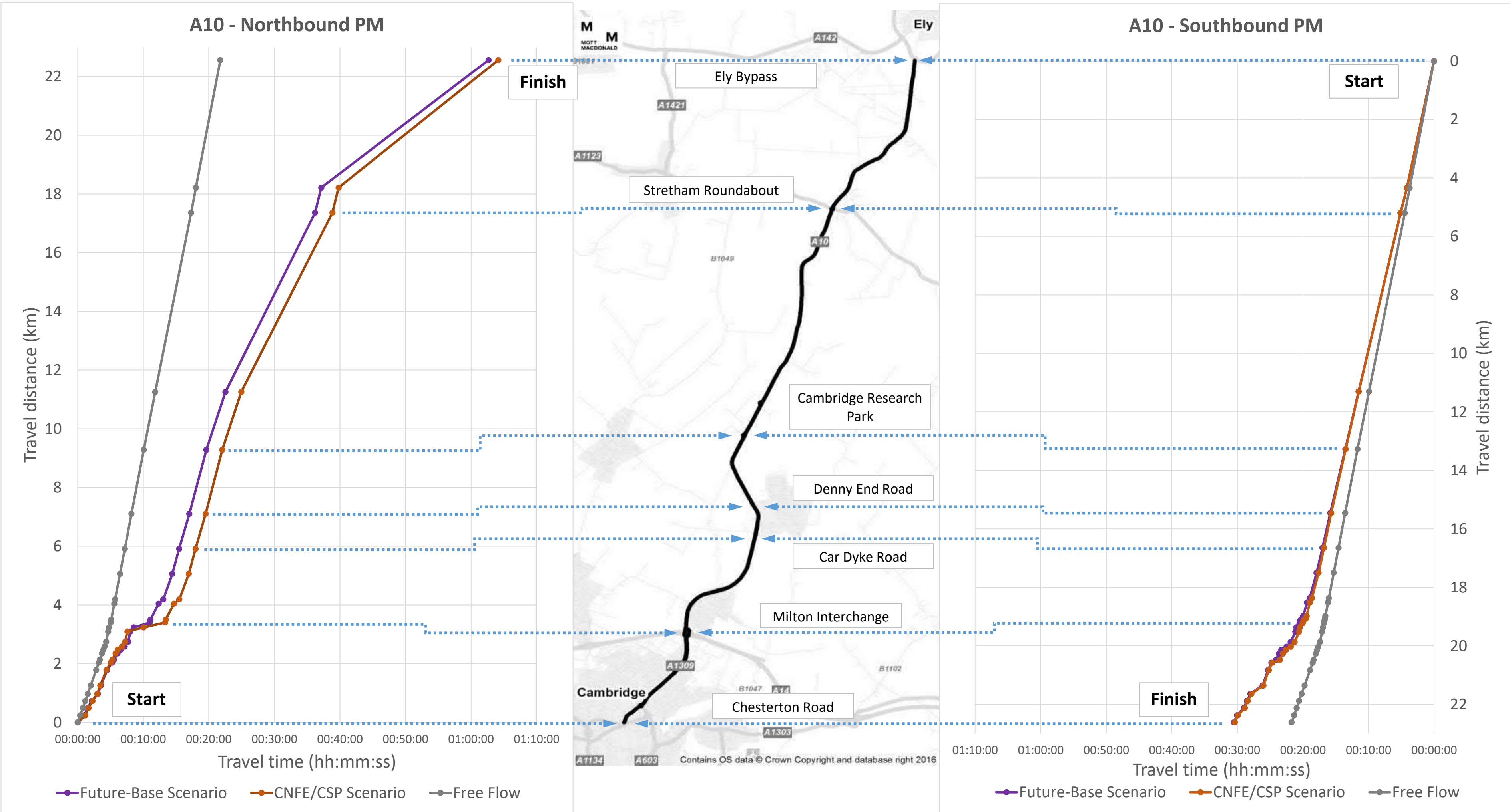
The subsequent Figure 42 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, for both the Future-Base and CNFE/CSP Scenarios, with free flow time included for further comparison. These show that southbound trips are predicted to take about the same time as Future-Base trips, while northbound trips are predicted to be 2% longer.

Figure 41: CNFE/CSP Scenario journey time changes compared to free-flow conditions – PM



Source: CSRM

Figure 42: Journey time on the A10 between Ely and Cambridge – PM



Source: CSRM

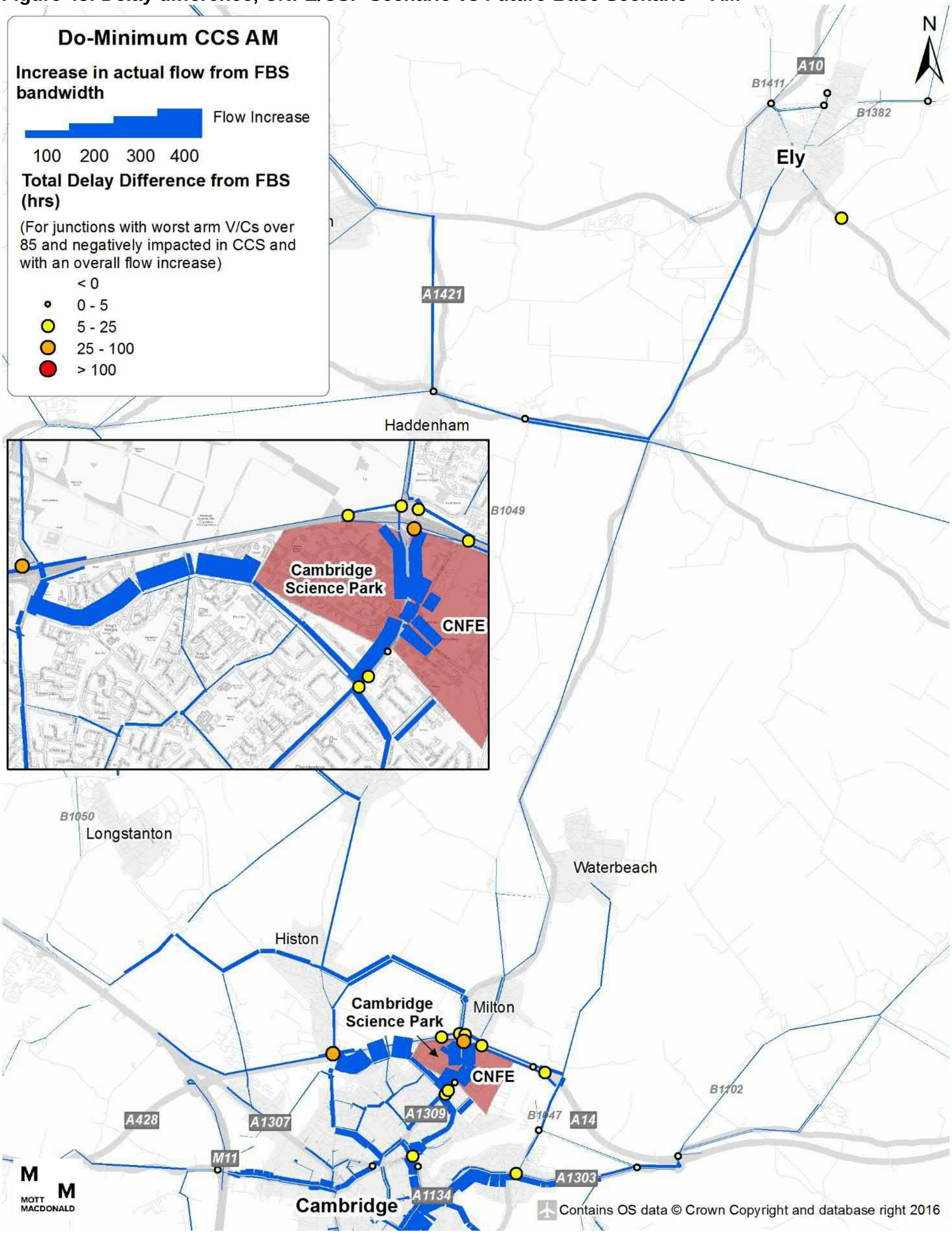
5.3.4 Identification of Impacted Junctions

As described for the Waterbeach Scenario in Section 4.3.4 above, the junctions considered by this study to be impacted by the development are those which meet the following criteria:

1. Worst-arm V/C less than 85% in the Future-Base Scenario and more than or equal to 85% in the CNFE/CSP Scenario, or more than 85% in the Future-Base Scenario but worse still in the CNFE/CSP Scenario
2. Traffic flow through junction in the CNFE/CSP Scenario higher than in the Future-Base Scenario
3. Increase in total delay in peak hour

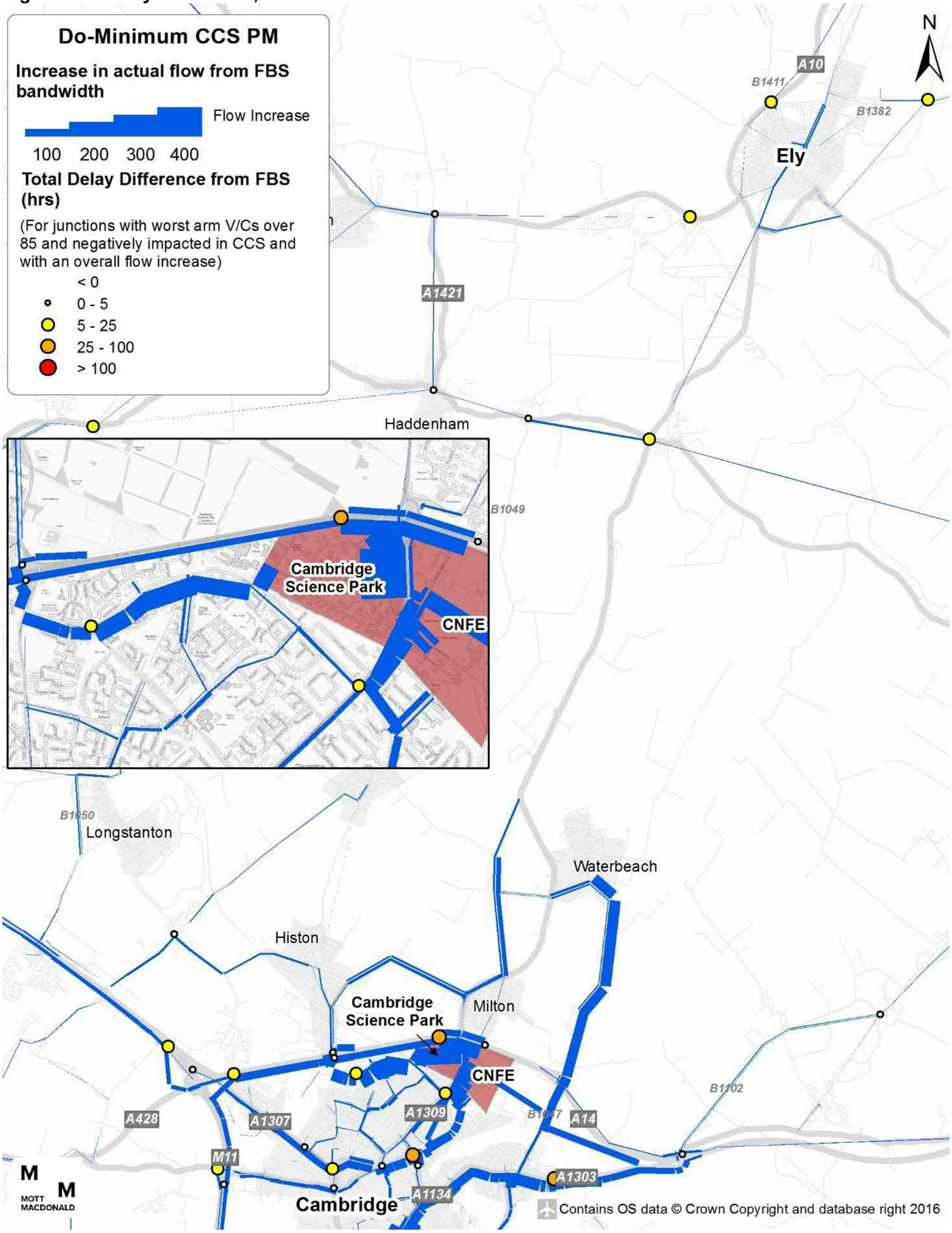
Based on this approach, the following two figures show, for the AM and PM peak respectively, junction delay increase levels for all junctions meeting the above V/C change and traffic flow change criteria.

Figure 43: Delay difference, CNFE/CSP Scenario vs Future-Base Scenario – AM



Source: CSRM

Figure 44: Delay difference, CNFE/CSP Scenario vs Future-Base Scenario – PM

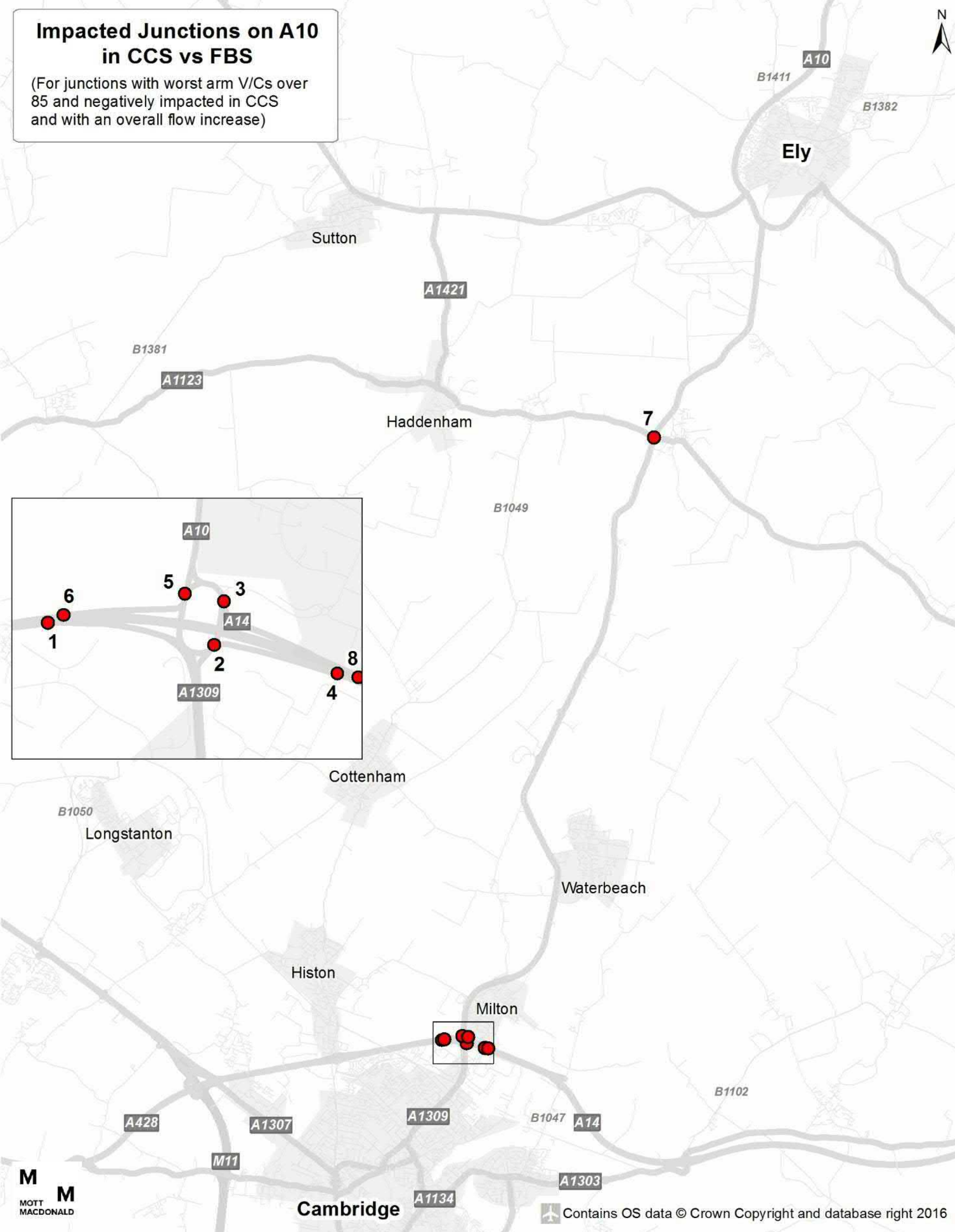


Source: CSRM

Junctions meeting this criteria in either or both peak hours are therefore identified as impacted junctions in the pre-mitigated Do Minimum situation. The impacted junctions on the A10 and at the CNFE and CSP accesses are shown in Figure 45 and are labelled in descending order of delay impact. ie 1=highest impact.

In accordance with the brief for this study, the demand and supply side measures for the Do Something modelling will focus on the A10 and Milton Road at the CNFE and CSP accesses, therefore only junctions along this route have been shown in Figure 45.

Figure 45: Junctions impacted by the development in the CNFE/CSP Scenario Do Min model runs



Source: CSRM

5.4 Summary

The above modelling results show that the highest level of flow impact caused by the CNFE and CSP sites is on the A14 between the M11 and Milton Interchange. There is also significant demand on the A14 to the east of Milton Interchange, on the A10 and within Cambridge.

The greatest delay impact of these flows is on Milton Interchange, followed by other junctions along the A14. This is leading to the redistribution of traffic to avoid these junctions, with a large amount of flow being redistributed through Cambridge. There is also a notable change in flow along the A10 during the evening peak, with a large decrease in flows to the south of Waterbeach. A significant portion of the redistributed flows from this section are travelling via Horningsea.

Whilst there is a significant development flow along the A10, there is a decrease in overall flow during both time periods. This is due to the redistribution of north-south traffic avoiding the Milton Interchange which suffers from increased congestion due to higher levels of development-related traffic entering the junction from the A14. There is also some impact as a result of jobs being reallocated to CNFE and CSP in the CNFE/CSP Scenario that were already accessed via the A10 in the Future-Base Scenario.

Milton Interchange is the only key point of significant delay for journeys along the A10. Since the A10 shows a decrease in flow, the journey times are similar to those in the Future-Base Scenario.

The access junctions at the CNFE and CSP sites will be redesigned to work within capacity by the time the developments are complete. Therefore, for strategic modelling purposes, the capacities of the CNFE and CSP access junctions have been set so that they do not create a constraint on traffic generation from the site and hence give a better representation of potential off-site impacts.

6 Combined Scenario Results

6.1 Introduction

The purpose of this section is to present the 2031 AM and PM peak period Do Minimum modelling results for the Combined Scenario, in order to understand the predicted highway network impact of full development at Waterbeach, CNFE and CSP. Results are presented, both as absolute values and in comparison to the Future-Base Scenario, in terms of:

- Traffic flows, to show the predicted distribution of traffic demand on the network – this shows where junctions are likely to experience capacity problems
- Junction performance, to show what proportion of junction capacity is predicted to be used up by the predicted traffic demand – this reveals where delays are likely to arise
- Junction delay, to show the total delay to users arising from the performance of each junction – this shows where the greatest congestion problems are occurring
- Journey times, to show the impact of junction delays on journey times – this allows the impact of junction delays to be understood in terms of overall journey time impact

6.2 Development Demand

6.2.1 Introduction

In this section, the impacts of the Waterbeach, CNFE and CSP developments in the CSRM model are considered in terms of the transport parameters of total person trip generation, mode share assignment, site internalisation levels and external trip distributions.

In order to understand how travel demand for the developments have been represented in the CSRM model, outputs from the CSRM demand model have been interrogated. The peak periods used in the demand model are as follows:

- AM Peak (07:00-10:00)
- PM Peak (16:00-19:00)

Conversion factors provided by Atkins have been applied to convert the 3-hour peaks to 1-hour peaks so that a direct comparison can be made with other scenarios. Additionally the data for the CNFE and CSP have been aggregated to show the full impact of the developments.

6.2.2 New Town North of Waterbeach Demand

6.2.2.1 Development Person Trip Generation

The level of person trip generation calculated by the CSRM demand model for the new town north of Waterbeach is shown in Table 16 below.

Table 16: Development person trip generation

Parameter	AM (08:00-09:00)		PM (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
External	3,466	1,176	2,109	3,591
Internal	2,007	2,007	1,320	1,320
All	**5,473**	**3,182**	**3,428**	**4,911**

Source: CSRM

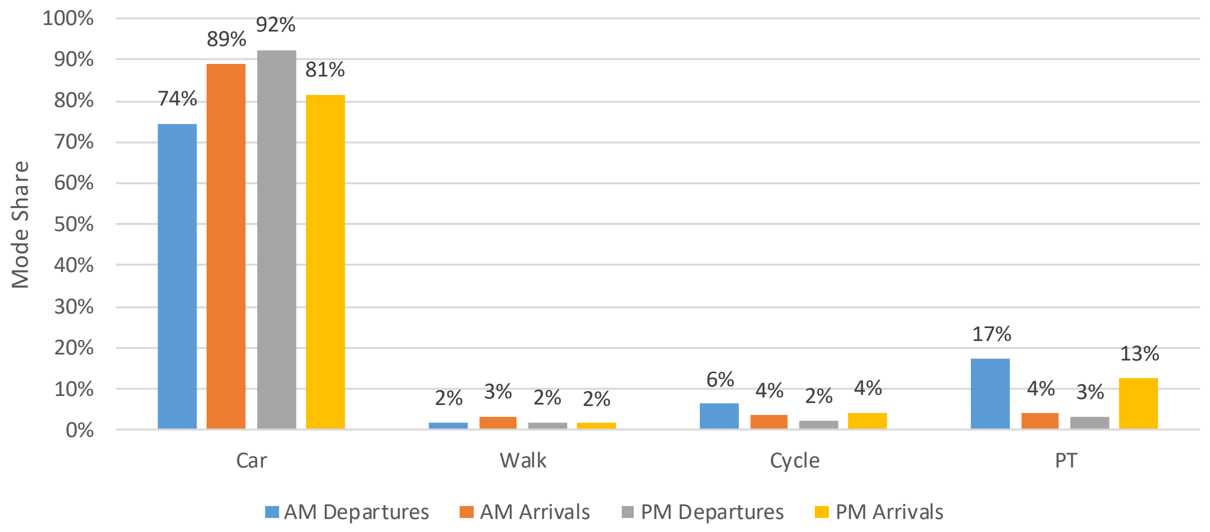
The table shows that, as in the Waterbeach Scenario presented in Section 4, a higher number of person trips are expected to depart the development in the AM peak rather than arrive, with the opposite being true in the PM peak.

In comparison to the Waterbeach scenario, the Combined Scenario predicts a slightly higher number of person trips. The development site has the same number of houses in both scenarios, but different scaling parameters have been used in the Combined Scenario to maintain district-wide levels of population growth whilst incorporating new housing proposals at CNFE.

6.2.2.2 Development Trip Mode Share

Figure 46 below shows the mode share for the new town north of Waterbeach external trips. These are the trips which generate impact on the external transport network.

Figure 46: Forecast mode share for external trips



Source: CSRM2

This chart shows that the model forecasts the same trip mode share at the new town north of Waterbeach in the Combined Scenario and in the Waterbeach Scenario.

6.2.2.3 Development Trip Internalisation Levels

Table 17 shows the level of internalisation estimated for the new town north of Waterbeach trips in both peak hours.

Table 17 Level of development trip internalisation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Internal	External	Internal	External
Internalisation level	46%	54%	32%	68%

Source: CSRM

This shows that internalisation levels are also the same as in the Waterbeach Scenario.

Table 18 compares how the above internalisation levels equate to external car trips.

Table 18: External car trip generation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
Person trips	2,524	1,032	1,947	2,923
Number of cars	1,812	759	1,280	2,088

Source: CSRM

The table shows that, as with the person trip generation, there are expected to be more cars departing the site in both time periods and arriving in the PM peak compared to the Waterbeach Scenario.

6.2.2.4 External Development Trip Distribution

Table 19 shows the top 7 sectors between which trips are generated by the proposed development at Waterbeach, and lists the actual 12-hour trip levels predicted to be undertaken by mode. Only the top 7 have been shown due to these sectors having over 5,000 total trips during the time period, whilst the remaining sectors have a far lower number. The CNFE and CSP sectors have also been included to show the connection between these sites and the new town north of Waterbeach. A map showing the sectors used in the CSRM model can be found in Appendix C.

Table 19: Total trips to and from the new town north of Waterbeach by sector, 07:00 – 19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Waterbeach new town	2,913	15,000	1,729	0	0	0	0	19,642
South Cambs Outer	8,425	23	75	0	85	0	0	8,608
East Camb Rural	7,901	5	29	7	90	0	0	8,032
Cambridge Outer	5,105	41	688	18	901	0	165	6,917
City Fringe	6,168	150	179	17	54	0	0	6,568
Ely	5,699	0	17	1	219	0	0	5,936
Cambridge Central	2,401	29	679	1	1,983	0	431	5,524
Cambridge Northern Fringe	821	20	179	15	26	0	0	1,061
Cambridge Science Park	786	31	142	47	0	0	0	1,006

Source: CSRM

This table shows that as with the Waterbeach Scenario, after the development itself, the sectors generating most external development trips are South Cambridgeshire and East Cambridgeshire, followed by Cambridge areas and Ely. Whilst the total trips to and from CNFE and CSP are lower than the other sectors, they have a relatively high number of trips via foot, cycle and bus.

Table 10Table 20 below presents the above information in terms of mode share by sector.

Table 20: Total trips to and from the new town north of Waterbeach sector (%), 07:00 – 19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Waterbeach new town	15%	76%	9%	0%	0%	0%	0%	35%
South Cambs Outer	98%	0%	1%	0%	1%	0%	0%	15%
East Camb Rural	98%	0%	0%	0%	1%	0%	0%	14%
Cambridge Outer	74%	1%	10%	0%	13%	0%	2%	12%
City Fringe	94%	2%	3%	0%	1%	0%	0%	12%
Ely	96%	0%	0%	0%	4%	0%	0%	11%
Cambridge Central	43%	1%	12%	0%	36%	0%	8%	10%
Cambridge Northern Fringe	77%	2%	17%	1%	2%	0%	0%	2%
Cambridge Science Park	78%	3%	14%	5%	0%	0%	0%	2%

Source: CSRM

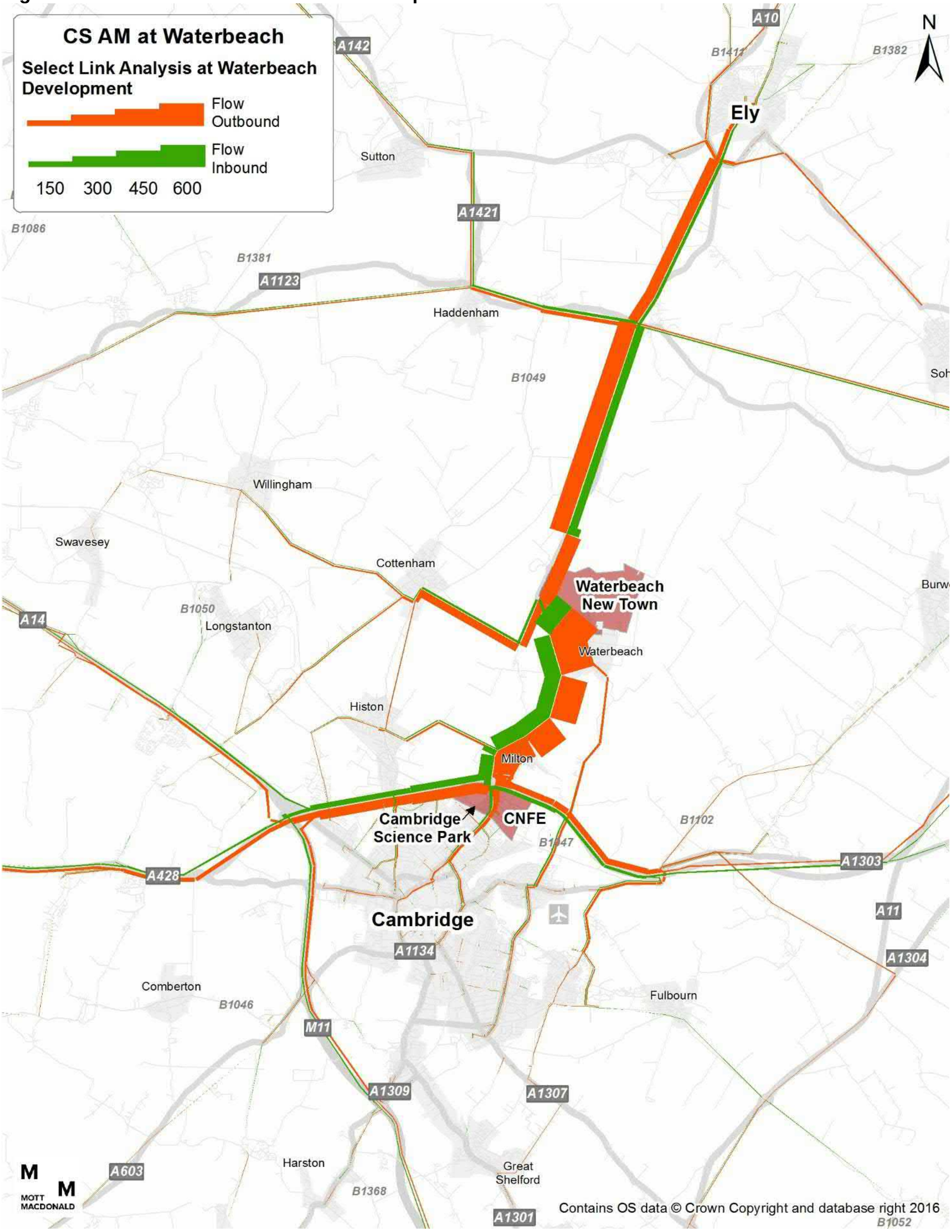
This table shows similar results to the Waterbeach Option, with only minimal change. Within the new town north of Waterbeach the cycle mode share is greater in the Combined Scenario compared to the Waterbeach Scenario. Respectively CNFE and CSP have 77% and 78% car mode share for trips to/from the new town north of Waterbeach. This highlights the potential to improve sustainable modes between the new development sites.

Figure 47 and Figure 48 show how the above distribution of car trips to and from the new town north of Waterbeach impacts the 2031 highway network in terms of development flow distribution during both the AM and PM peak periods respectively.

These figures show that as with the Waterbeach Scenario:

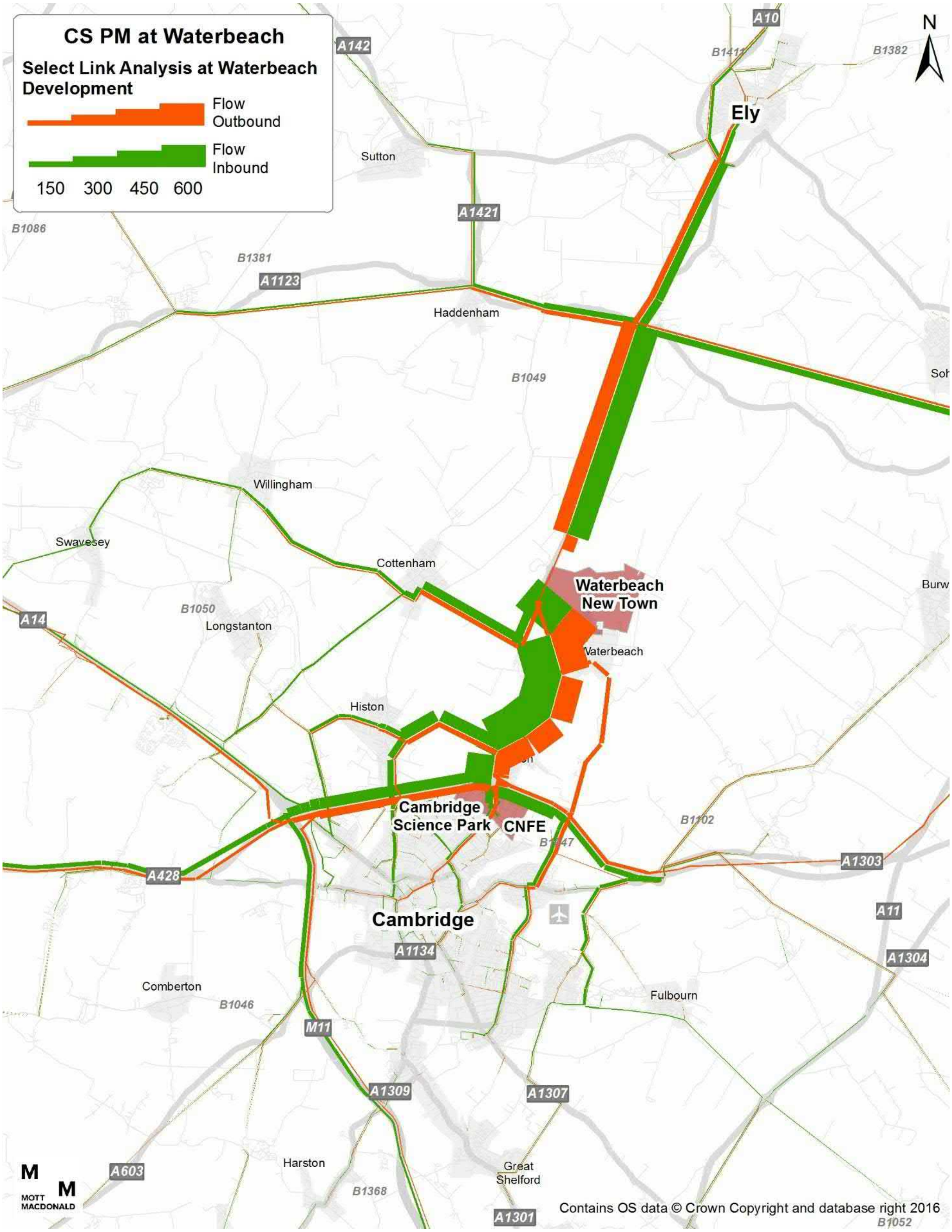
- Highest level of flow impact on A10 between the site and Milton Interchange
- Next highest level of flow impact on A10 between the site and Stretham roundabout, followed by the A10 to Ely and also on the A14
- Flow increases on Cottenham Road as far as Cottenham in both peaks, and on Milton Road / Butt Lane in the PM peak
- By contrast, relatively low levels of development flow on the Clayhithe Road route into Cambridge

Figure 47: Waterbeach New Town vehicle trip distribution – Combined Scenario 2031 AM Peak



Source: CSRM

Figure 48: Waterbeach New Town vehicle trip distribution – Combined Scenario 2031 PM Peak



Source: CSRM

6.2.3 CNFE and CSP Development Demand

6.2.3.1 Development Person Trip Generation

The level of person trip generation calculated by the CSRM demand model for the CNFE and CSP developments is shown in Table 21 below.

Table 21: Development person trip generation

Parameter	AM (08:00-09:00)		PM (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
External	2,601	5,178	4,878	2,130
Internal	343	343	334	334
All	**2,944**	**5,521**	**5,212**	**2,464**

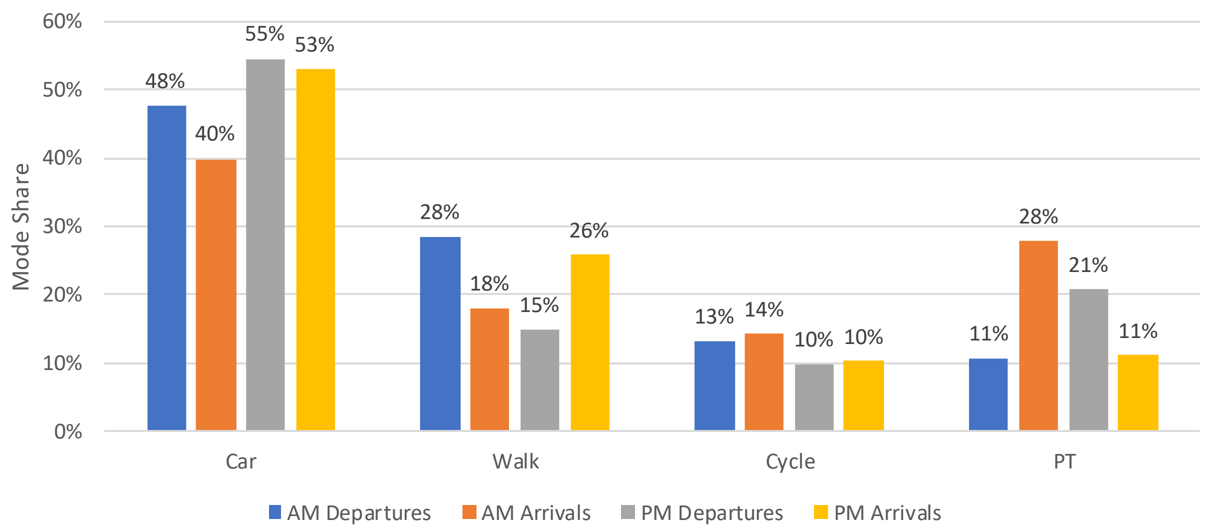
Source: CSRM

The table shows that a far higher number of person trips are expected to arrive at the developments in the AM peak rather than depart, with the opposite being true in the PM peak, as in the CNFE/CSP Scenario. Whilst internal trips are substantially lower than external trips for arrivals and departures in both time periods, in comparison to the CNFE/CSP Scenario there is a higher number of internal trips due to the improved jobs/homes balance. Additionally there are more departures and less arrivals at the two development sites in both time periods. This reflects the increase in housing at the CNFE site, detailed in Section 2 above.

6.2.3.2 Development Trip Mode Share

Figure 49 below shows the mode share for the CNFE and CSP development's external trips. These are the trips which generate impact on the external transport network.

Figure 49: Forecast mode share for external development trips



Source: CSRM

This chart shows that the forecast mode share for the CNFE and CSP sites is similar in the Combined Scenario as in the CNFE/CSP Scenario. The main exception being a decrease in the car mode share in the AM peak, for both arrivals and departures, with the biggest difference being in departures. Instead there is an increase in the mode share for walking, cycling and public transport for AM departures. This is due to there being more houses at CNFE in the Combined Scenario.

6.2.3.3 Development Trip Internalisation Levels

Table 22 shows the level of internalisation estimated by CSRM for CNFE and CSP development trips in both peak hours.

Table 22: Level of development trip internalisation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Internal	External	Internal	External
Internalisation level	8%	92%	9%	91%

Source: CSRM

This shows that internalisation levels are predicted to be relatively low, although higher than in the CNFE/CSP Scenario. This increase is due to an increase in the amount of housing at the CNFE site in the Combined Scenario. Table 23 shows how the above internalisation levels equate to external car trips.

Table 23 External car trip generation

Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Departures	Arrivals	Departures	Arrivals
Person trips	1,189	1,954	2,762	1,145
Number of cars	892	1,559	2,163	815

Source: CSRM

6.2.3.4 External Development Trip Distribution

Table 24 shows the top 6 sectors between which trips are generated by the proposed developments at CNFE and CSP, and the 12-hour trip levels predicted to be undertaken by mode. Only the top 7 have been shown due to these sectors having over or close to 4,000 total trips during the time period, whilst the remaining sectors have a far lower number. A map showing the sectors used in the CSRM model can be found in Appendix C. The trips between the new town north of Waterbeach from CNFE and CSP can be found in Table 19.

Table 24: Total trips to and from CNFE and CSP by sector, 07:00-19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Cambridge Outer	5,687	7,859	4,169	1,773	478	28	79	20,073
Cambridge Northern Fringe	1,234	7,372	838	0	0	0	0	9,444
City Fringe	4,522	2,257	746	658	244	17	0	8,443
Cambridge Central	2,268	2,093	1,927	1,494	238	0	123	8,145
South Cambs Outer	5,767	13	165	190	576	303	0	7,013
Cambridge Science Park	739	3,324	218	0	0	0	0	4,281
East Cambs Rural	2,738	1	22	212	997	0	0	3,970

Source: CSRM

This table shows that, excluding the CNFE sector, the sectors generating the most external development trips are Cambridge Outer, the City Fringe and Cambridge Central.

In comparison to the CNFE/CSP Scenario there are more trips at CNFE and CSP, either internally or between the sites. This, as noted above, is likely due to the increased housing at CNFE. Additionally each of the other top 6 have an increase in trips between CNFE and CSP, with only East Cambs Rural having a decrease compared to the CNFE/CSP Scenario.

Table 25 presents the above information in terms of mode share by sector.

Table 25: Total Trips to and from CNFE and CSP Development sector (%), 07:00-19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Cambridge Outer	28%	39%	21%	9%	2%	0%	0%	45%
Cambridge Northern Fringe	13%	78%	9%	0%	0%	0%	0%	21%
City Fringe	54%	27%	9%	8%	3%	0%	0%	19%
Cambridge Central	28%	26%	24%	18%	3%	0%	2%	18%
South Cambs Outer	82%	0%	2%	3%	8%	4%	0%	16%
Cambridge Science Park	17%	78%	5%	0%	0%	0%	0%	10%
East Cambs Rural	69%	0%	1%	5%	25%	0%	0%	9%

Source: CSRM

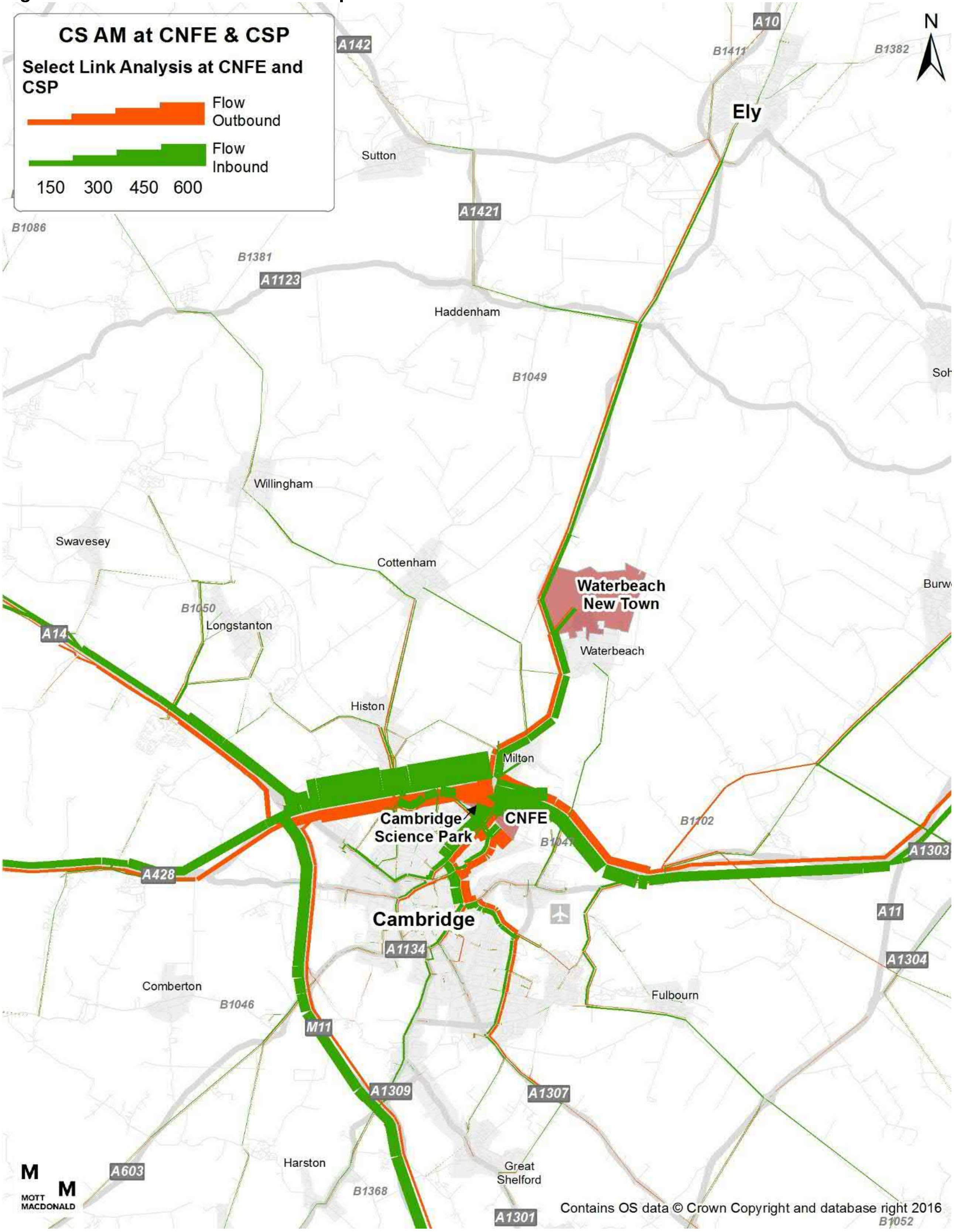
The table shows that there is little difference in external mode share compared to the CNFE/CSP Scenario, with there being a clear distinction depending on which sector is being travelled to/from by development related trips.

Figure 50 and Figure 51 show how the above distribution of car trips to and from the CNFE and CSP development sites impact the 2031 highway network in terms of development flow distribution during both the AM and PM peak periods respectively.

These figures show:

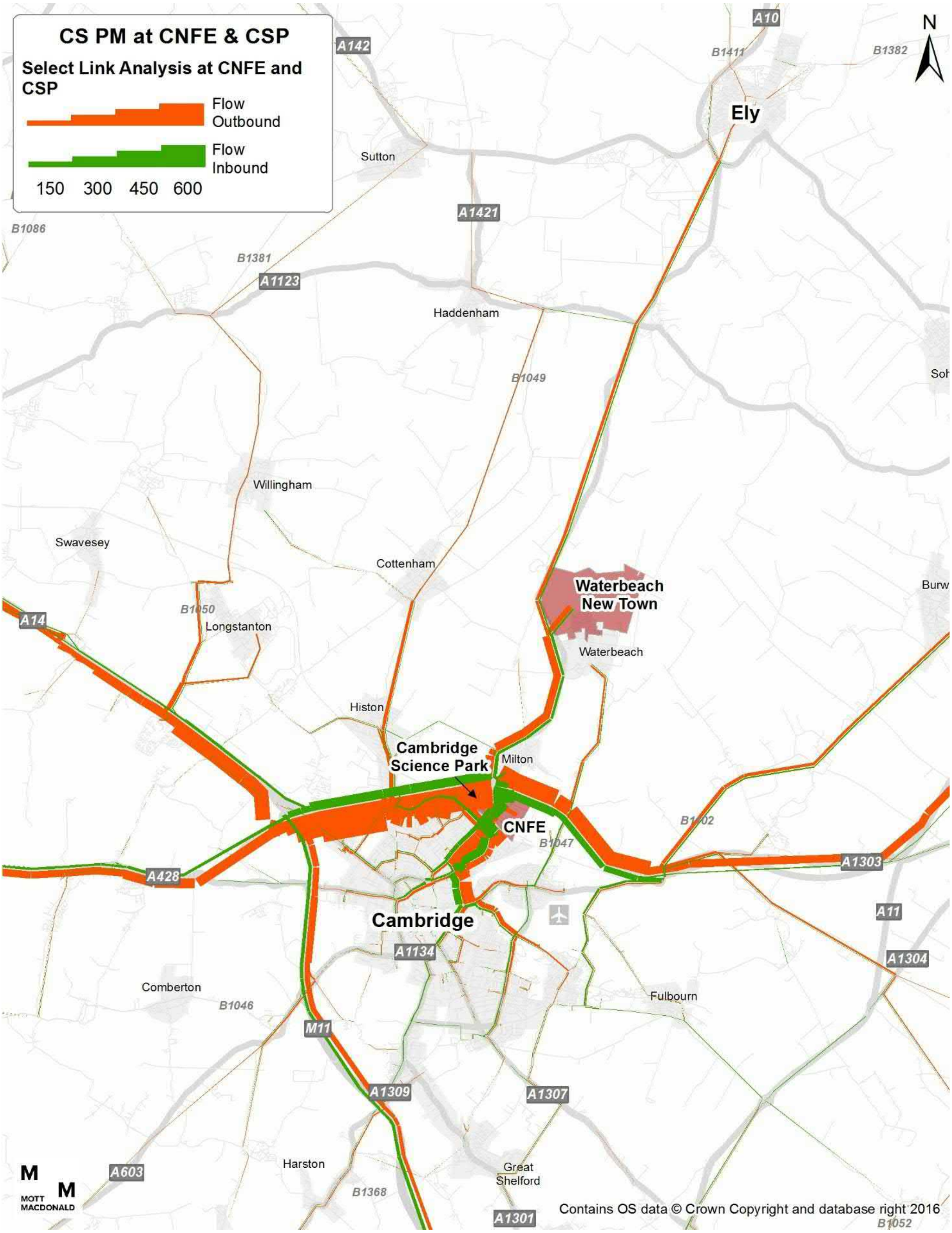
- Highest level of flow impact on the A14 between Milton Interchange and the M11
- Further significant flow on the A14 to the east of Milton Interchange
- A large proportion of A10 development flow coming from/to the new town north of Waterbeach
- High levels of flow from within Cambridge to the sites via Milton road

Figure 50: CNFE and CSP vehicle trip distribution – Combined Scenario 2031 AM Peak



Source: CSRM

Figure 51: CNFE and CSP vehicle trip distribution – Combined Scenario 2031 PM Peak



Source: CSRM

6.3 Development Network Impact

6.3.1 Introduction

The following section examines the predicted performance of the study area highway network in the Combined Scenario, both in absolute terms and in direct comparison to the Future-Base Scenario. The latter comparison allows the full impacts of the combination of all three proposed developments at CNFE, CSP and Waterbeach to be identified. The impacts considered are as follows:

- Traffic flows
- Junction performance, in terms of worst-arm V/C levels and total delay levels
- Link and route performance, in terms of journey times

The AM peak results are presented first, followed by the PM peak results

6.3.2 AM Peak Periods Results

6.3.2.1 AM Peak Traffic Flow and Junction Performance

As per the results shown for the Future-Base Scenario, Figure 52 shows for the AM peak period in the Combined Scenario:

- The distribution of predicted traffic flows on the modelled network, shown as ‘bandwidths’ and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown in orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

To show how these results differ from the Future-Base Scenario, so isolating the impacts of the developments at CNFE, CSP and Waterbeach, the subsequent Figure 53 shows for the AM peak period in the Combined Scenario:

- The *change* in predicted traffic flows compared to the Future-Base Scenario, shown as ‘bandwidths’ and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- The *change* in junction worst-arm V/C compared to the Future-Base Scenario, where orange or red junctions show key deteriorations and green junctions show key improvements. Junctions where neither level of impact is predicted are not shown

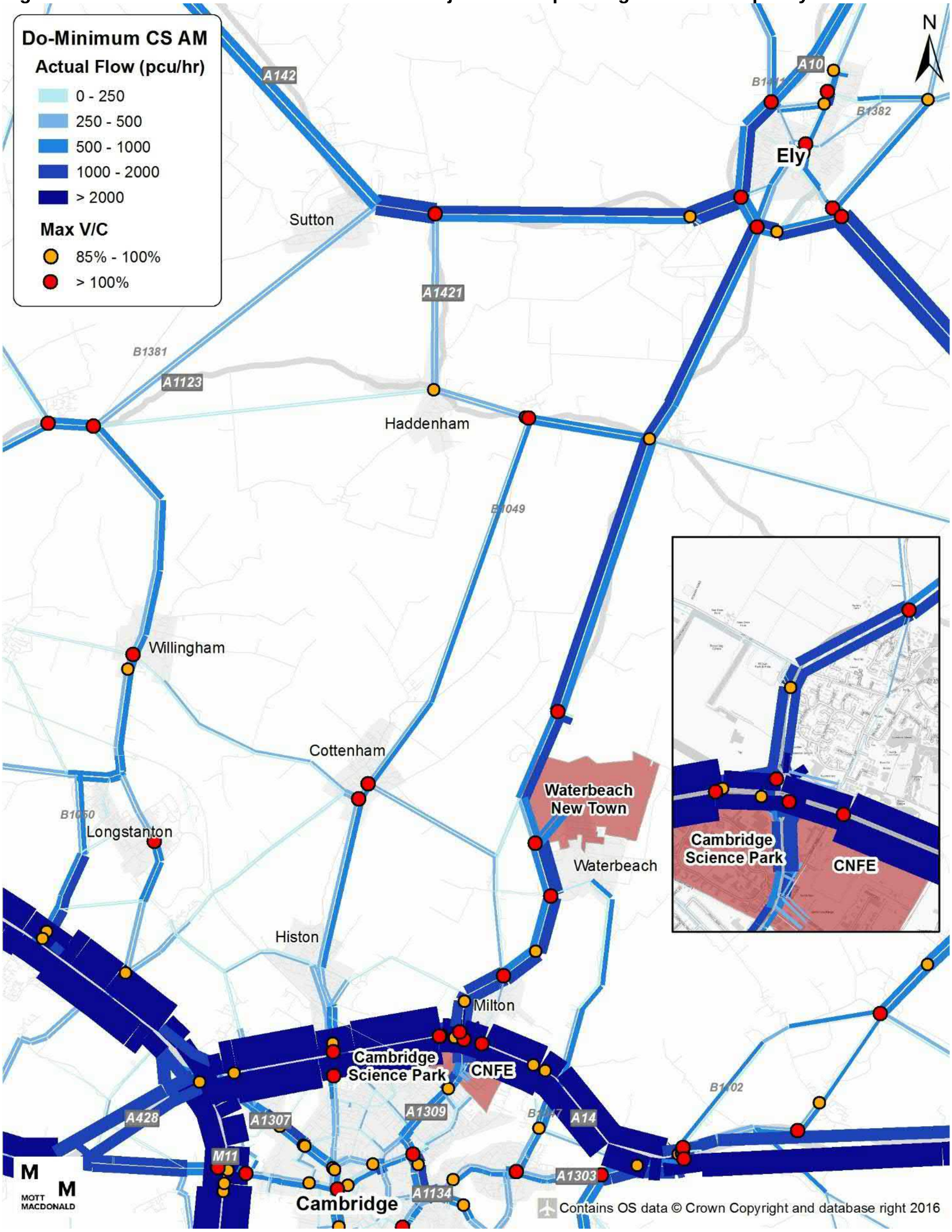
These figures suggest that the developments will lead to:

- Large increases in flow both northbound and southbound from the new town north of Waterbeach, with a large number of vehicles being displaced by development traffic on the A10 to the south of Waterbeach. This traffic is instead using Clayhithe Road and then the B1047 to access Cambridge
- Additional displaced traffic that would have previously used the A10 instead on parallel routes through Cottenham and Histon
- Some sections of the A10 having a decrease in flow southbound, even with increased demand from the CNFE/CSP sites and the new town north of Waterbeach. This is due to a high number of junctions on the A10 and many arms on Milton Interchange (due in large part to increased entry flows from the A14) being over capacity and thereby discouraging use of the A10 for those trips that have a route-choice.
- Increases in flow in the vicinity of the CNFE and CSP sites, with the deterioration of the local road network leading to increased flow on King Hedges Road, the A1134 and other routes through central Cambridge

- A large decrease in flow on the A14 travelling westbound past Milton interchange, caused by an increase in traffic turning off the A14 onto Milton Interchange and then re-joining the A14 afterwards. This is due to delays on the A14, meaning it is quicker for some vehicles to instead travel via the roundabout

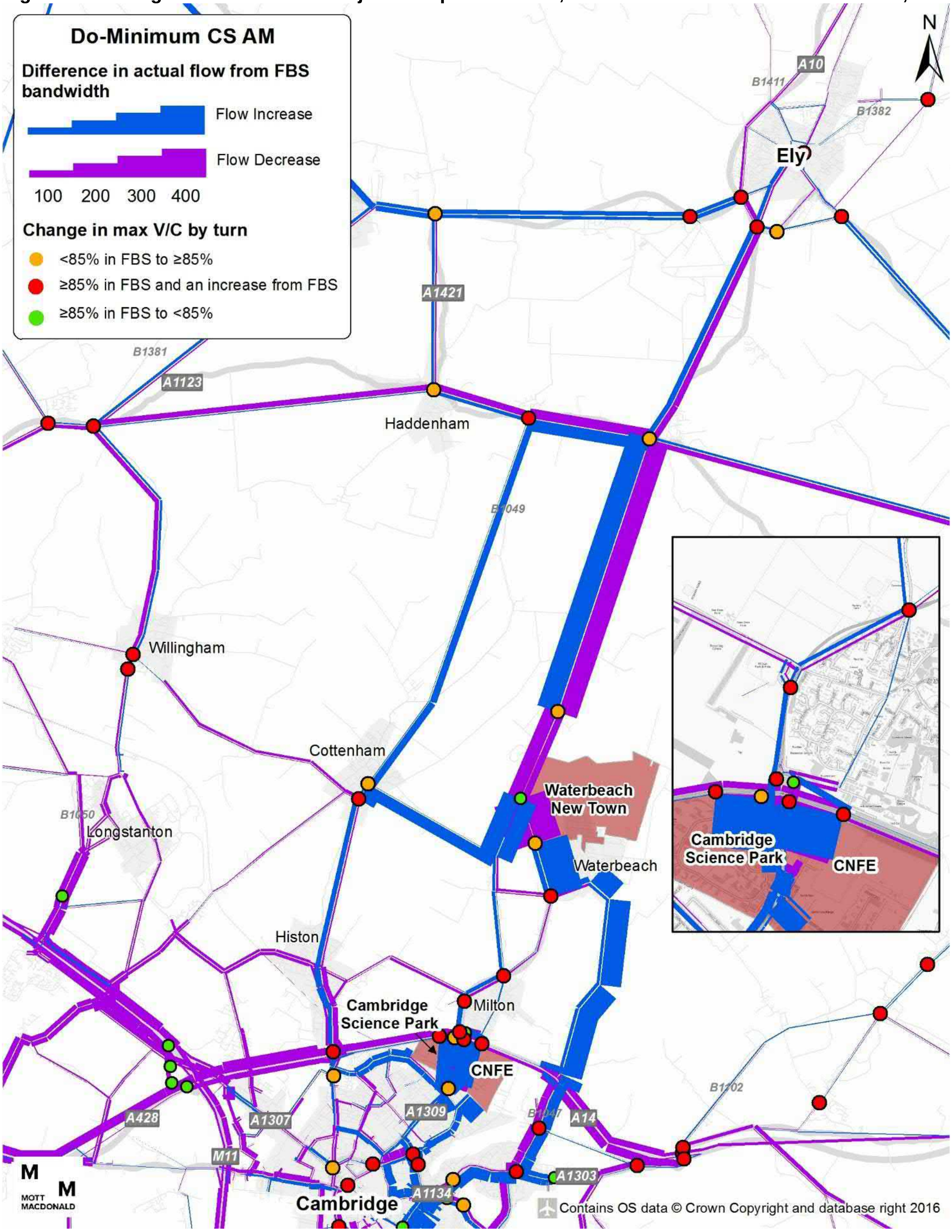
Additionally, there are predicted to be a number of flow decreases further away from the site. These are associated with the different distribution of development in the Future-Base and Combined Scenarios with the reallocation of potential growth in employment from around the sub-region to CNFE, CSP and Waterbeach causing some small traffic reduction effects on links further from the site. These effects do not significantly affect the study area.

Figure 52: Combined Scenario traffic flows and junctions operating at or over capacity – AM



Source: CSRM

Figure 53: Change in traffic flows and junction performance, Combined vs Future-Base Scenario, AM



Source: CSRM

6.3.2.2 AM Peak Traffic Flow and Junction Delay

Figure 54 shows, for the AM peak period in the Combined Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU flow through the junction by the average delay per PCU experienced at the junction

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts the development at CNFE and CSP, the subsequent Figure 55 shows for the AM peak period in the CNFE/CSP Scenario:

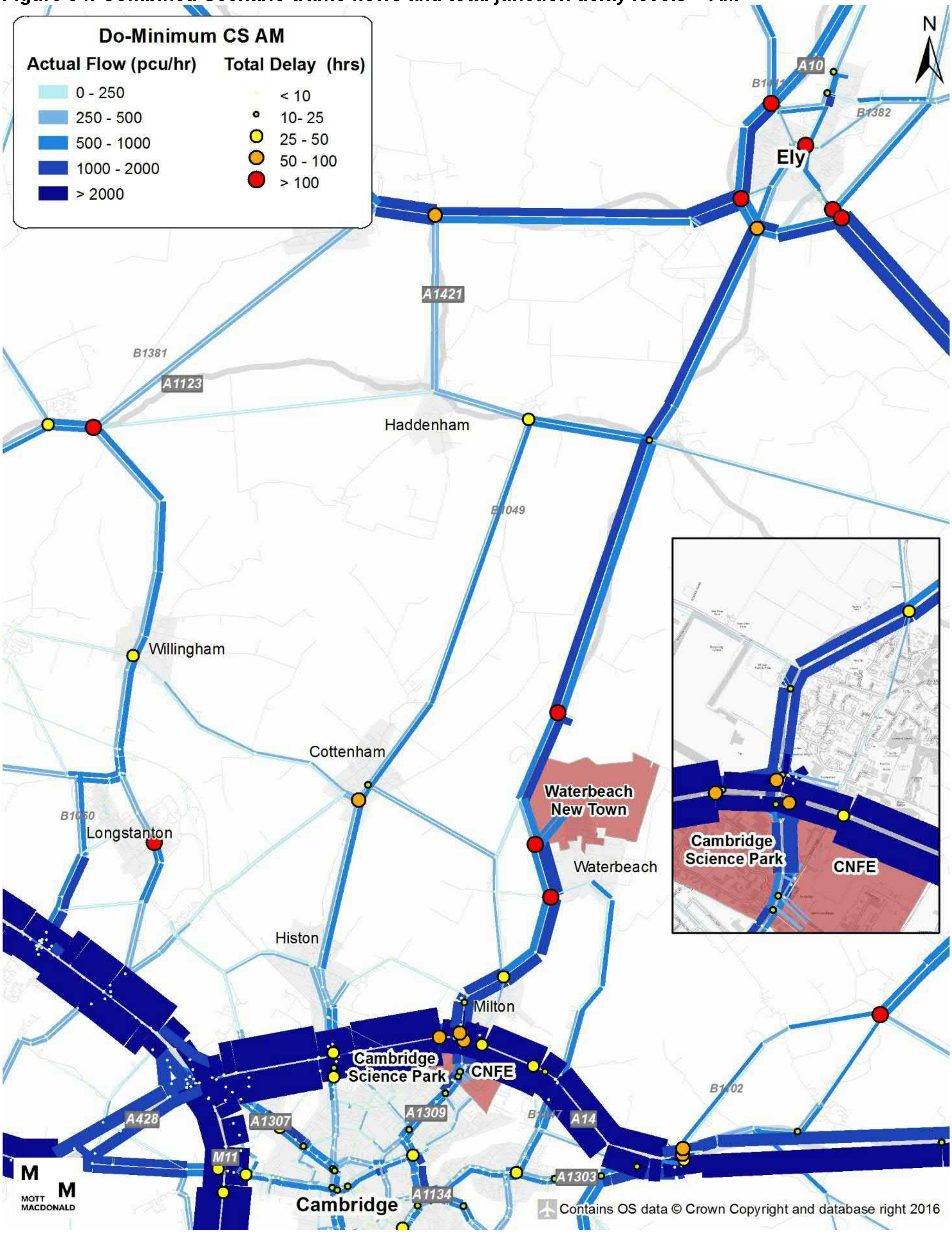
- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- Increases in total junction delay compared to the Future-Base Scenario, shown as banded changes in vehicle-hours for junctions with a V/C[8] ratio over 85% in the Combined Scenario (in order to isolate junctions impacted by development)

Comparing the latter figure with Figure 53 above – which shows junctions with capacity impacts – reveals a more nuanced picture of the development's impact on the surrounding network. In particular, it reveals that:

- The main delay impacts are on the A10 around Waterbeach, at the development accesses and at the A10/Waterbeach Road/Car Dyke Road junction
- There are large increases in total delay at multiple point on Milton Interchange, leading to a very high delay increase for Milton Interchange as a whole
- There are relatively few increases in total delay within Cambridge and Ely, with larger increases in delay around Ely focused on the A142 and A10.

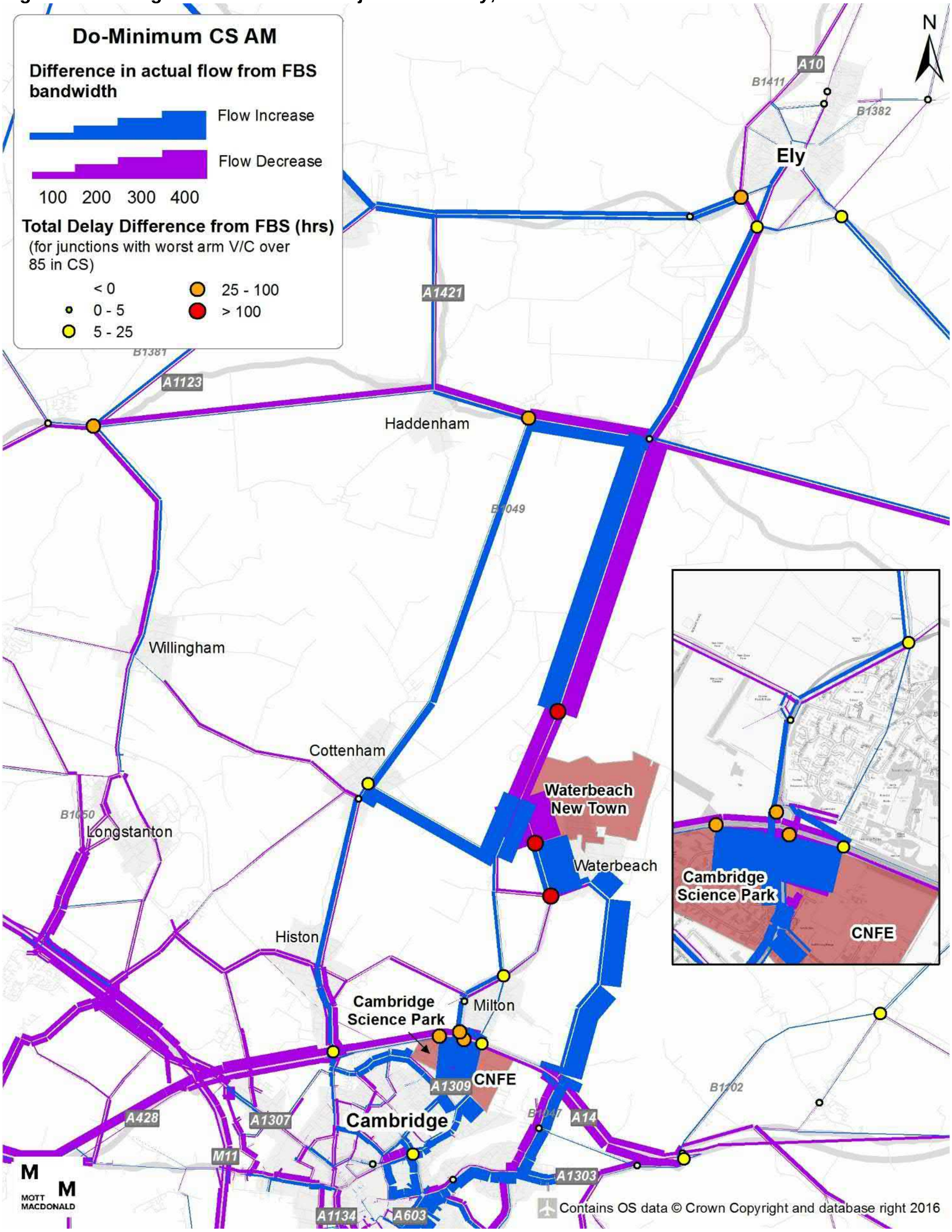
[8] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 54: Combined Scenario traffic flows and total junction delay levels – AM



Source: CSRM

Figure 55: Change in traffic flows and junction delay, Combined vs Future-Base Scenario – AM



Source: CSRM

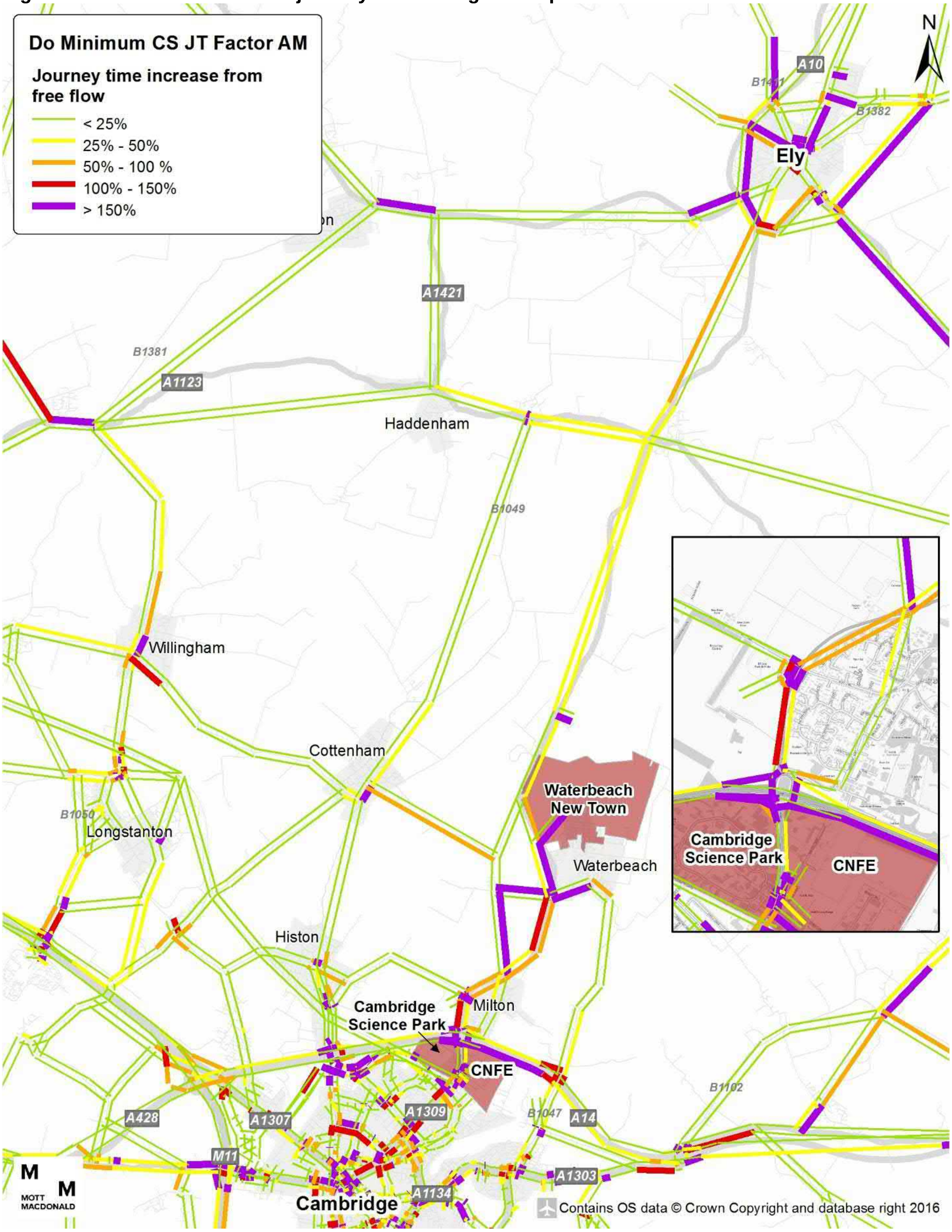
6.3.2.3 AM Peak Journey Time Performance

Figure 56 shows the percentage increase in journey time compared to free-flow conditions, for the AM peak period in the Combined Scenario, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. Comparing with Figure 4 above, which shows the equivalent the Future-Base Scenario result, this suggests that the main impact of the proposed development on study area journey times is:

- A faster journey time southbound on the A10 between Stretham roundabout and the A10/Green End junction, likely caused by the decrease in flow on this section
- Conversely, slower journey times northbound on many sections of the A10 between Cambridge and Ely, caused by areas with increases in flow
- Increased delay towards Cottenham and on Clayhithe Road/Horningsea Road as a result of displaced traffic from the A10

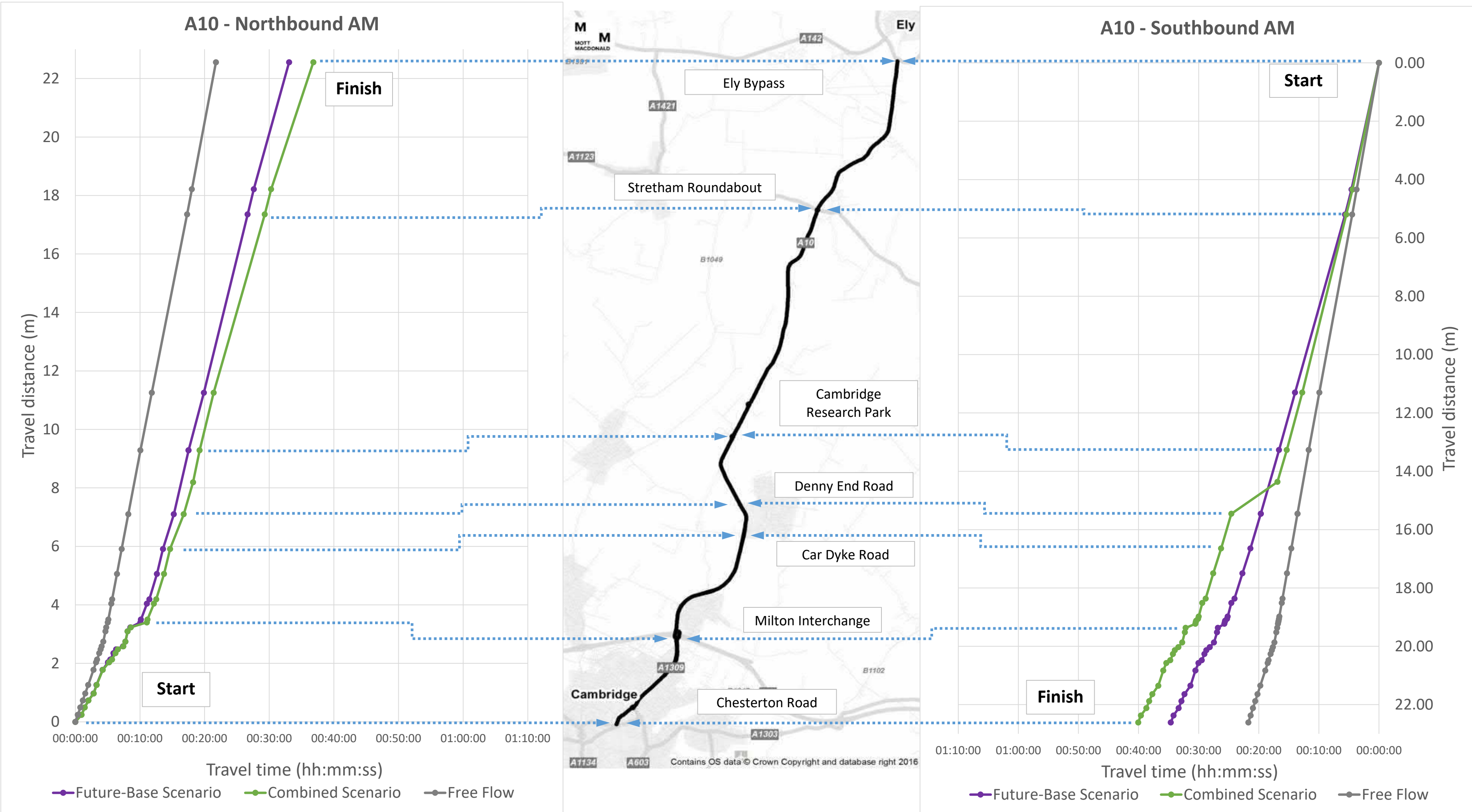
The subsequent Figure 57 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, for both the Future-Base and Combined Scenarios, with free flow time included for further comparison. These show that northbound and southbound trips are predicted to respectively take 11% and 16% longer than Future-Base journey times.

Figure 56: Combined Scenario journey time changes compared to free-flow conditions – AM



Source: CSRM

Figure 57: Journey time on the A10 between Ely and Cambridge – AM



Source: CSRM

6.3.3 PM Peak Period Results

6.3.3.1 PM Peak Traffic Flow and Junction Performance

As per the results shown for the AM peak, Figure 58 shows for the PM peak period in the Combined Scenario:

- The distribution of predicted traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels
- Junctions on the network where at least one arm is operating at or over capacity, where the former is defined by a V/C of between 85% and 100% (shown in orange), and the latter by a V/C of over 100% (shown red). All junctions operating within capacity (ie <85% V/C) are not shown

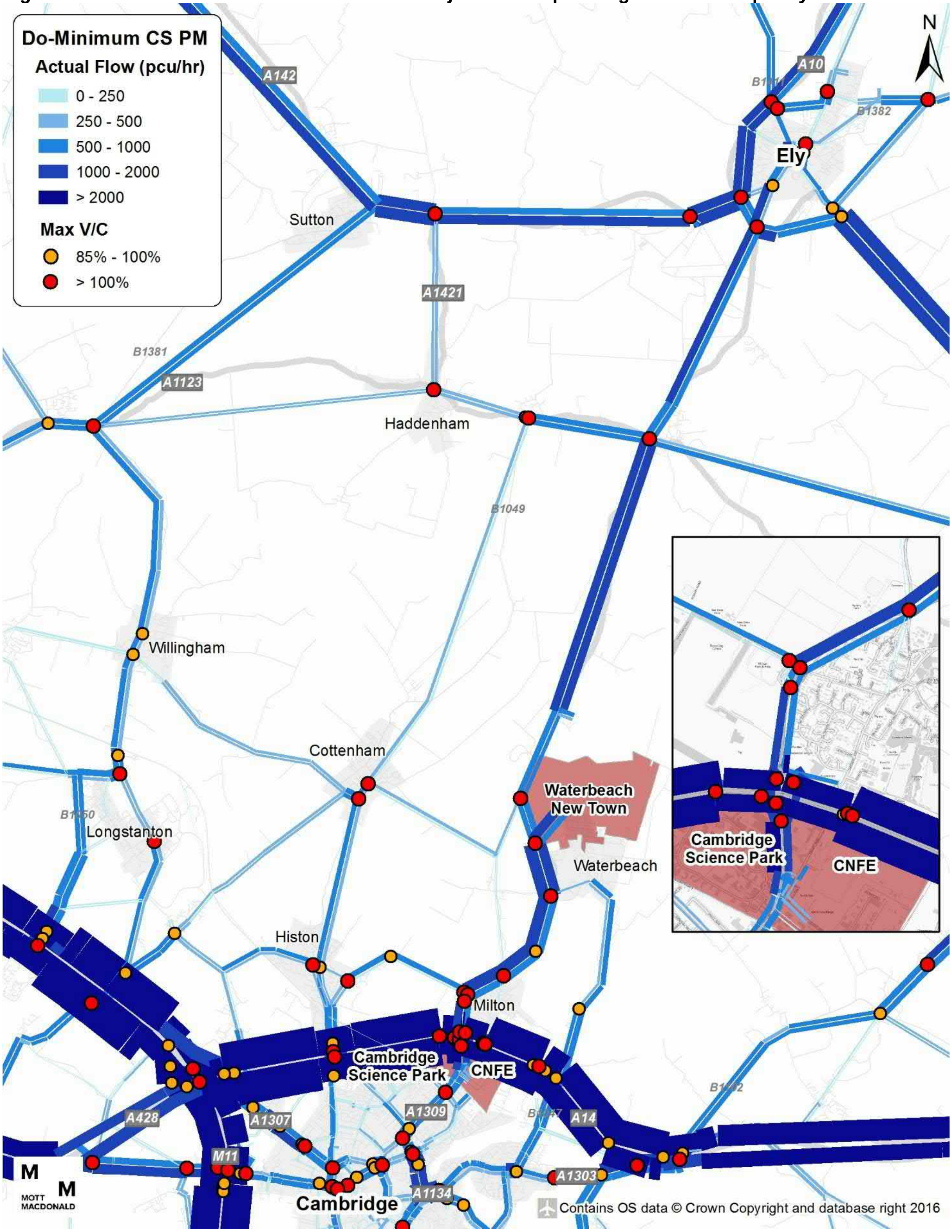
To show how these results differ from the Future-Base Scenario, thereby isolating the impacts of development at CNFE, CSP and Waterbeach, the subsequent Figure 59 shows for the PM peak period in the Combined Scenario:

- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- The change in junction worst-arm V/C compared to the Future-Base Scenario, where orange or red junctions show key deteriorations and green junctions show key improvements. Junctions where neither level of impact is predicted are not shown

These figures suggest that the development will lead to:

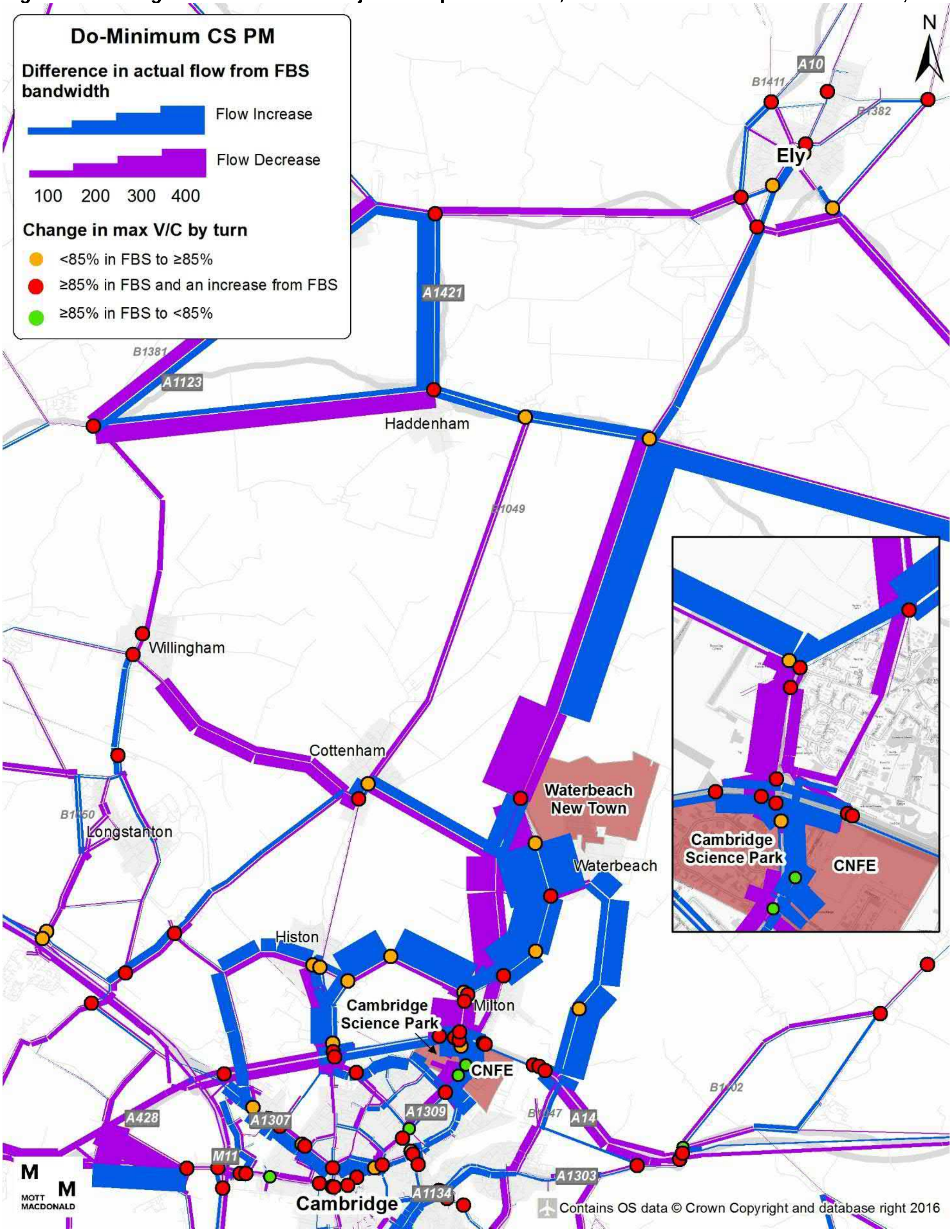
- Every junction between Milton Interchange and the A10/Green End junction deteriorating compared to the Future-Base Scenario and with each junction being over capacity
- Increased flows through Histon and Impington, either via Histon Interchange or Girton Road, leading to Histon Interchange and other junctions in Histon and Impington being over capacity. This is the result of traffic avoiding the A10 between Milton Interchange and Milton P&R, resulting in traffic instead using the A14 or travelling through Cambridge to access the A10 further to the north, leading to additional deterioration of junctions in Cambridge
- Displaced flow from the A10 through, not only Histon and Impington, but also on Clayhithe Road
- Increase in flow southbound on the A10 to the north of the northern access of the new town north of Waterbeach, with additional flow joining this from the A1123 impacting further on the Stretham Roundabout.

Figure 58: Combined Scenario traffic flows and junctions operating at or over capacity – PM



Source: CSRM

Figure 59: Change in traffic flows and junction performance, Combined vs Future-Base Scenario, PM



Source: CSRM

6.3.3.2 PM Peak Traffic Flow and Junction Delay

Figure 60 shows, for the PM peak period in the Combined Scenario:

- The distribution of traffic flows on the modelled network, shown as 'bandwidths' and colour coded from light blue to dark blue to denote flow levels.
- Total delay (in PCU-hours) through each junction, measured by multiplying the total PCU flow through the junction by the average delay per PCU experienced at the junction.

To show how these results differ from the Future-Base Scenario, thereby isolating the impacts the development at CNFE, CSP and Waterbeach, the subsequent Figure 61 shows for the PM peak period in the Combined Scenario:

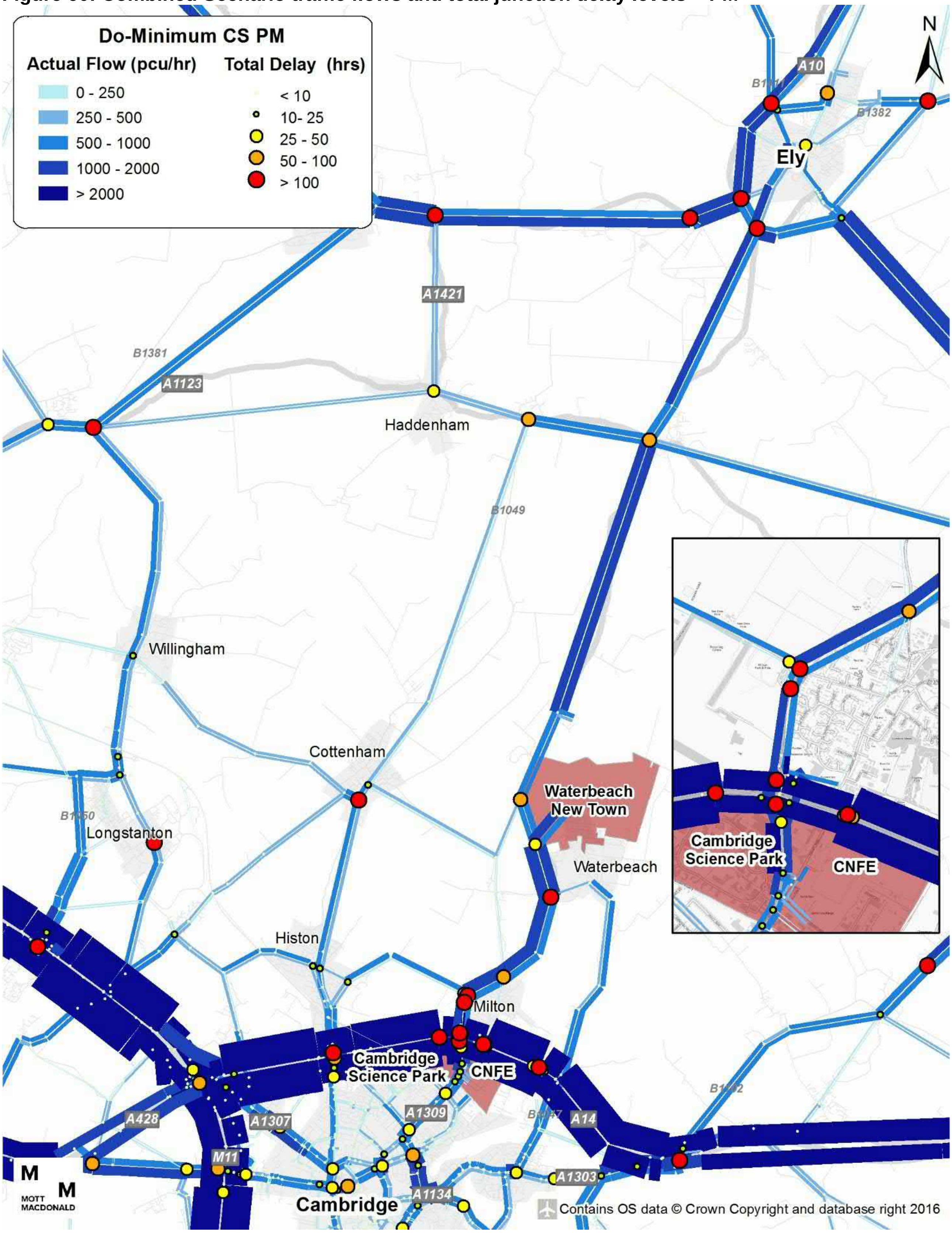
- The change in predicted traffic flows compared to the Future-Base Scenario, shown as 'bandwidths' and colour coded as purple for flow decreases and as blue for flow increases (note that the bandwidth scale is different to the above absolute flow results)
- Increases in total junction delay compared to the Future-Base Scenario, shown as banded changes in vehicle-hours for junctions with a V/C[9] ratio over 85% in the Combined Scenario (in order to isolate junctions impacted by development)

Comparing the latter figure with Figure 59 above – which shows junctions with capacity impacts in the PM peak – reveals a more nuanced picture of the development's impact on the surrounding network. In particular, it reveals that:

- There are many areas with large delay impacts on the A10 to the south of Waterbeach, most notably at Milton P&R and Milton Interchange with many parts of each junction having large total delays
- Further north on the A10 there is a large increase in total delay at the A10/A142/Cambridge Road junction
- Large total delay increases around Histon and at Histon Interchange
- Within Cambridge there are expected to be some relatively low increases in total delay, but also a few areas with larger increases such as on Chesterton Road and Milton Road

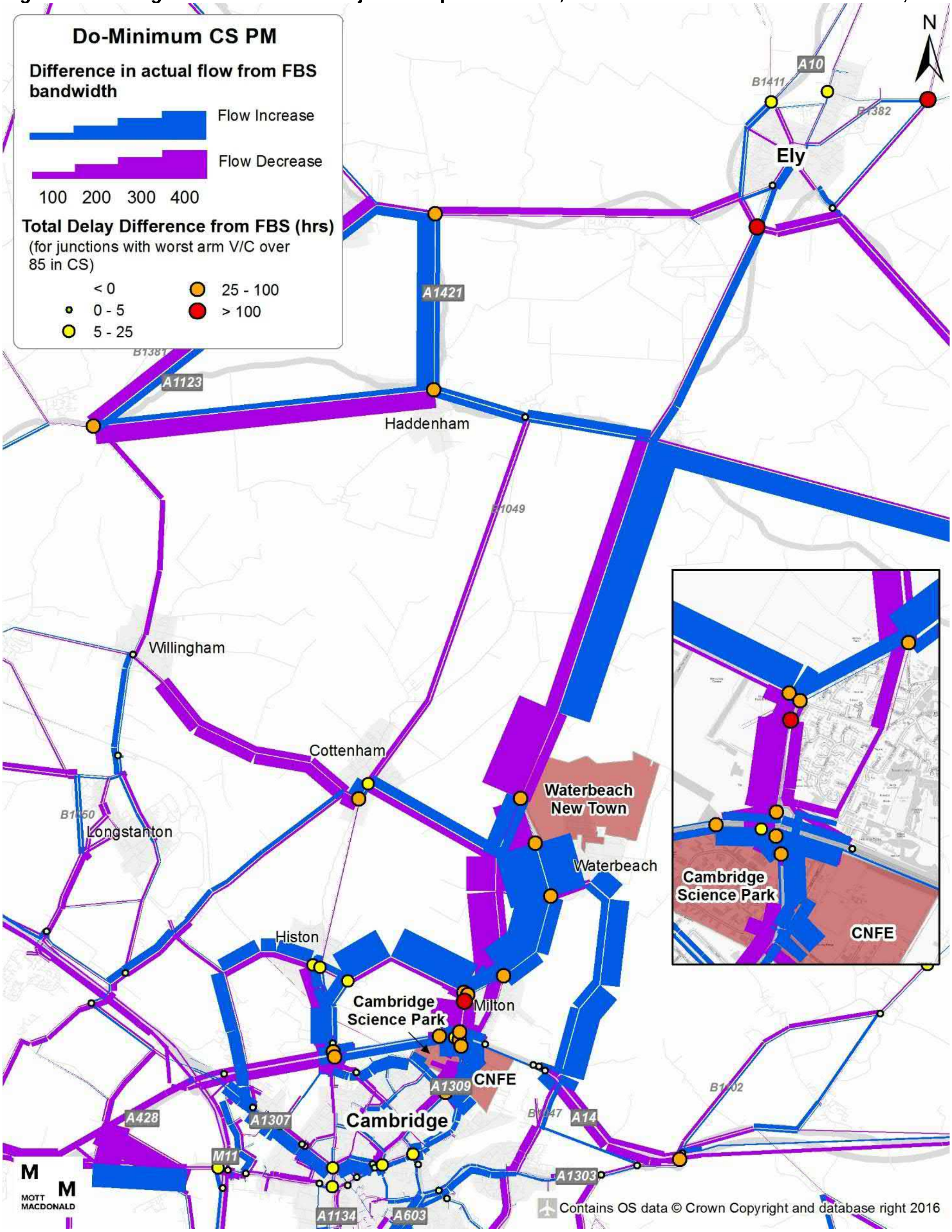
[9] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 60: Combined Scenario traffic flows and total junction delay levels – PM



Source: CSRM

Figure 61: Change in traffic flows and junction performance, Combined vs Future-Base Scenario, PM



Source: CSRM

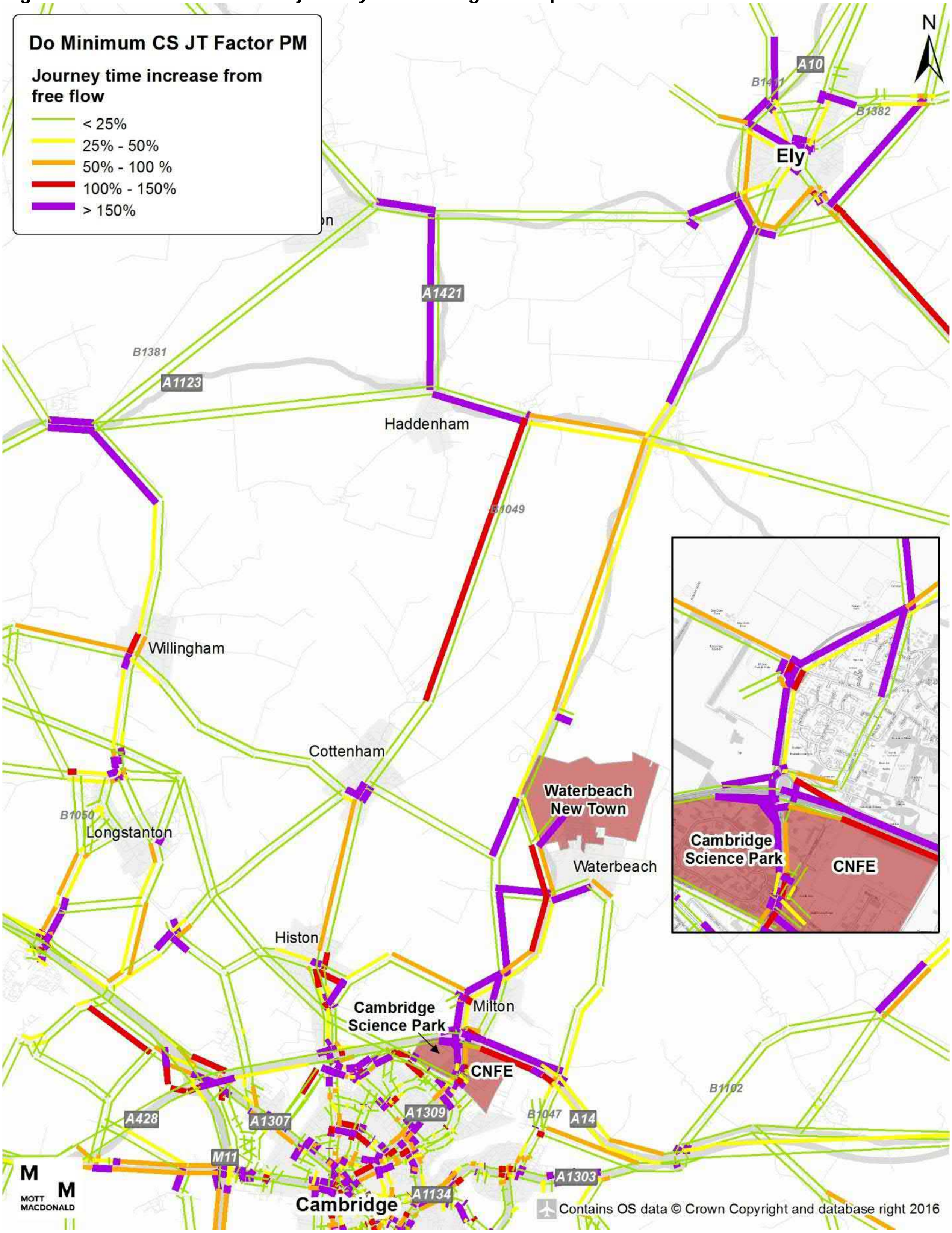
6.3.3.3 PM Peak Journey Time Performance

Figure 62 shows the percentage increase in journey time compared to free-flow conditions, for the PM peak period in the Combined Scenario, where the latter is taken from each link's 'Free Flow Time' parameter in the CSRM model. Comparing with Figure 8 above, which shows the equivalent Future-Base Scenario result, suggests that the main impact of the proposed development on study area journey times is:

- A slower journey time southbound on the majority of the A10 between Stretham Roundabout and Milton Interchange
- An additional slower journey time on the A10 northbound between Milton Interchange and Waterbeach, but a faster journey time to the north of the new town north of Waterbeach until Stretham Roundabout
- Slower journey times around Histon, especially towards Cottenham and on Milton Road/Butt Lane

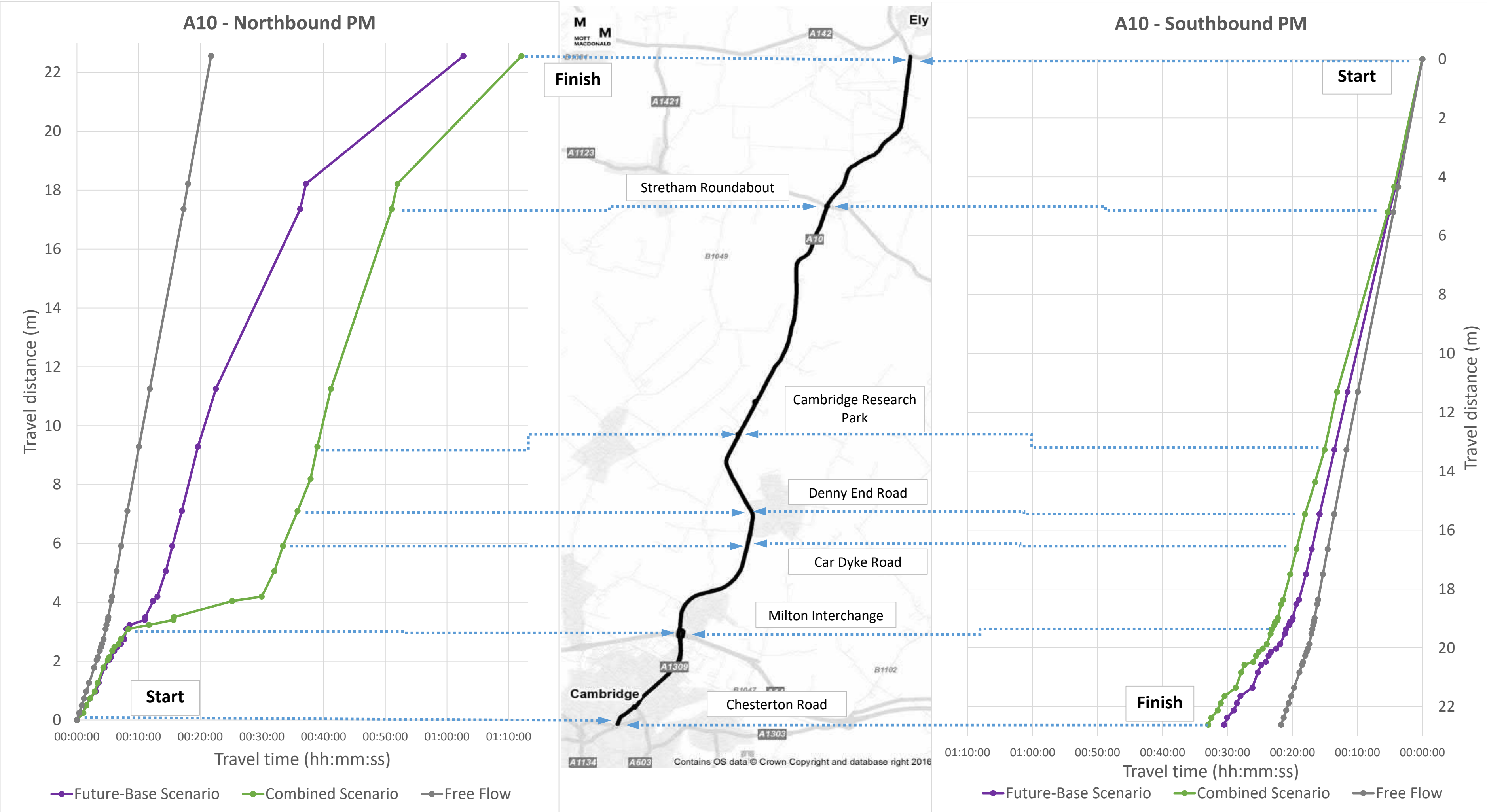
The subsequent Figure 63 below focusses on the A10 route, showing modelled northbound and southbound journey times along the route between Chesterton Road in Central Cambridge and Ely, for both the Future-Base and Combined Scenarios, with free flow time included for further comparison. These show that southbound and northbound trips are predicted to respectively take 8% and 15% longer than Future-Base journey times.

Figure 62: Combined Scenario journey time changes compared to free-flow conditions – PM



Source: CSRM

Figure 63: Journey time on the A10 between Ely and Cambridge – PM



Source: CSRM

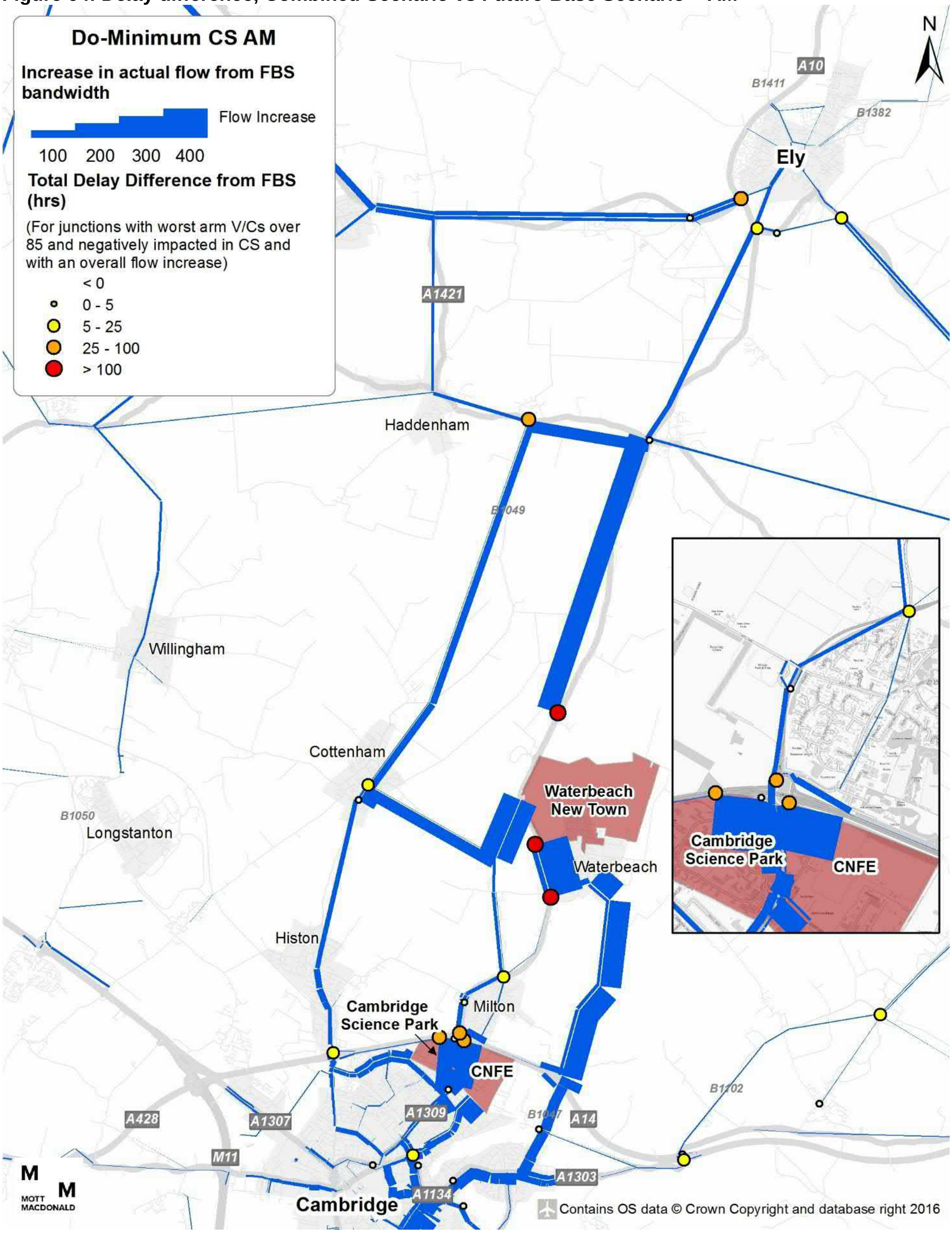
6.3.4 Identification of Impacted Junctions

As described for the Waterbeach Scenario in Section 4.3.4 above, the junctions considered by this study to be impacted by the development are those which meet the following criteria:

1. Worst-arm V/C less than 85% in the Future-Base Scenario and more than or equal to 85% in the Combined Scenario, or more than 85% in the Future-Base Scenario but worse still in the Combined Scenario
2. Traffic flow through junction in the Combined Scenario higher than in the Future-Base Scenario
3. Increase in total delay in peak hour

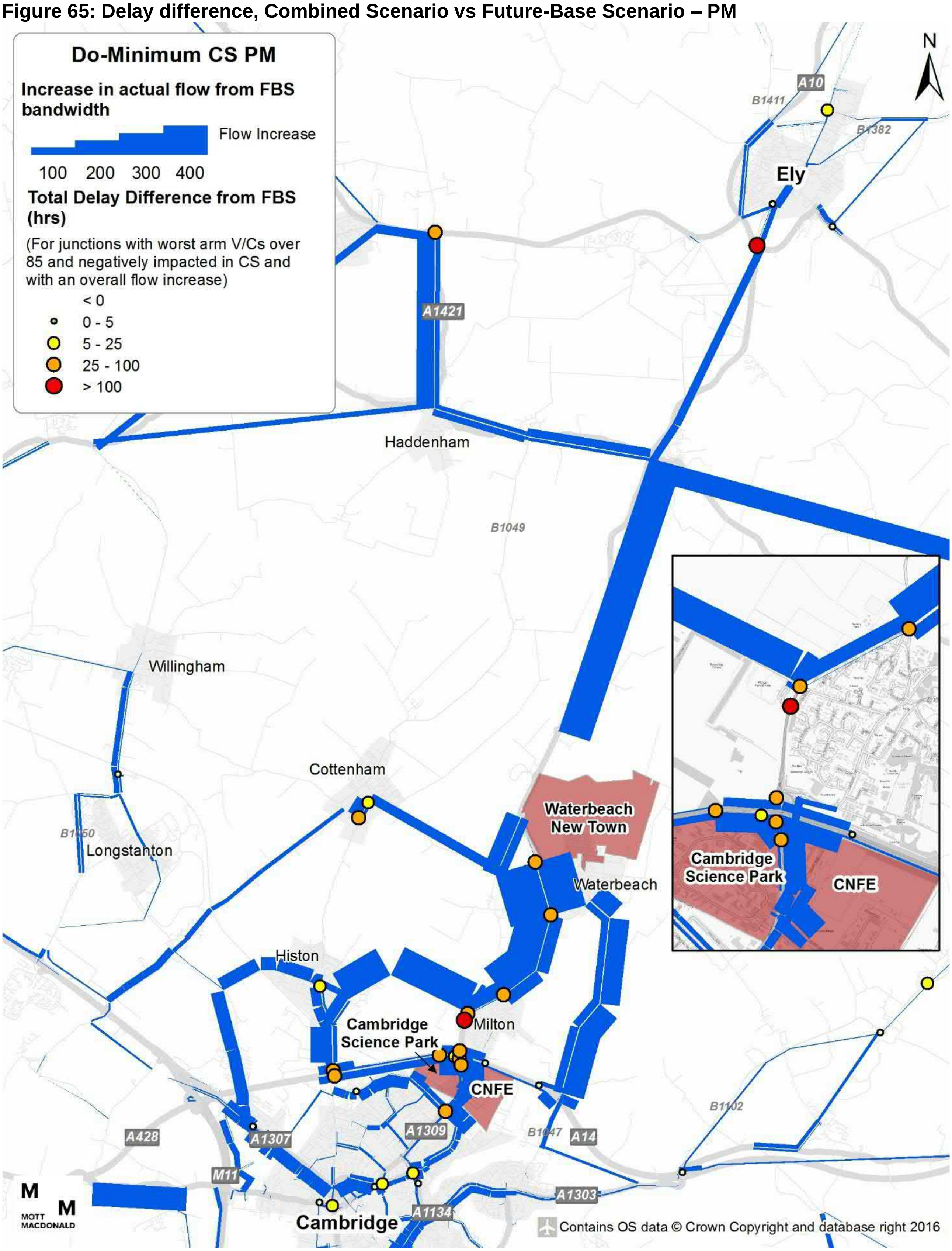
Based on this approach, the following two figures show, for the AM and PM peak respectively, junction delay increase levels for all junctions meeting the above V/C change and traffic flow change criteria.

Figure 64: Delay difference, Combined Scenario vs Future-Base Scenario – AM



Source: CSRM

Figure 65: Delay difference, Combined Scenario vs Future-Base Scenario – PM

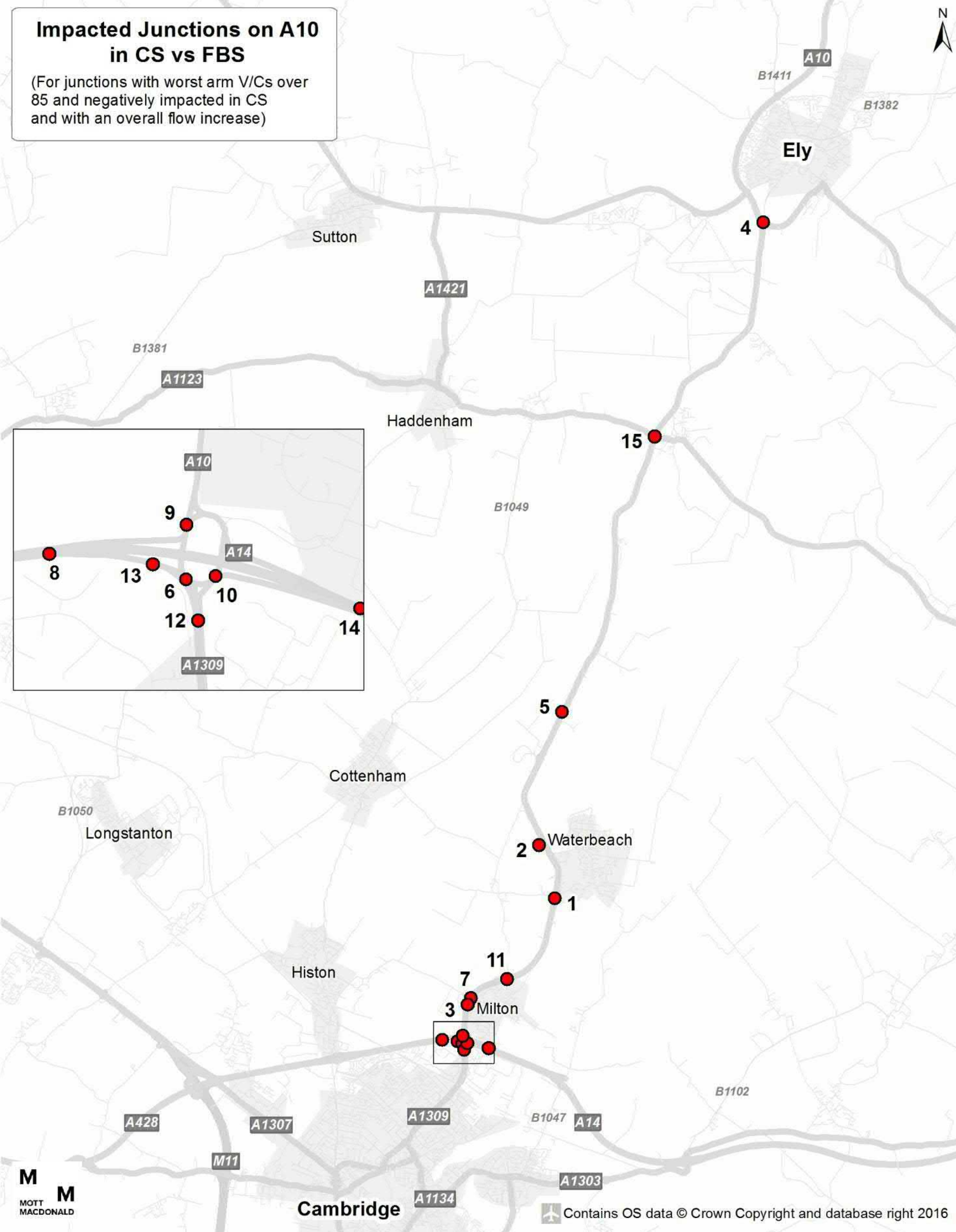


Source: CSRM

Junctions meeting this criteria in either or both peak hours are therefore identified as impacted junctions in the pre-mitigated Do Minimum situation. The impacted junctions on the A10 and at the CNFE and CSP accesses are shown in Figure 66 and are labelled in descending order of delay impact. ie 1=highest impact.

The demand and supply side measures for the Do Something modelling will focus on the A10 and Milton Road at the CNFE and CSP accesses, therefore only junctions along this route have been shown in Figure 66.

Figure 66: Junctions impacted by the development in the Combined Scenario Do Min model runs



Source: CSRM

6.4 Summary

The above modelling results show that the primary impact of the proposed developments at Waterbeach, CNFE and CSP is on the A10 between Milton Interchange and the new town north of Waterbeach. This is the section where the new town north of Waterbeach traffic is predicted to be the highest, with additional development traffic related to CNFE and CSP.

Whilst there is significant development flow along the A10, there is a net decrease in overall flow southbound to the south of Waterbeach in the AM and in both directions between Milton Interchange and Milton P&R in the PM, due to delay increases. The increase of development flow and in delays along the A10, and at the A14/A10 Milton Interchange due to increased entry flows from the A14, is leading to displaced background traffic that has a route-choice. In the AM this displaced traffic is primarily travelling along Clayhithe Road and through Cottenham, whereas in the PM there is further displacement via Histon and Impington.

The greatest total delay impacts are at Milton Interchange and around the new town north of Waterbeach, with additional impacts at Milton P&R and in Histon during the PM. The large total delay increases at Milton Interchange and Milton P&R displace traffic, causing increases in delay elsewhere.

As in the CNFE/CSP Scenario, for strategic modelling purposes, the capacities of the CNFE and CSP access junctions have been set so that they do not create an undue constraint on traffic generation from the site and hence give a better representation of potential off-site impacts. This has been done as it is assumed that the access junctions at the CNFE and CSP sites will be explored in detail through detailed subsequent assessment and design work.

7 Summary

7.1 Introduction

This section provides a summary of the Do Minimum modelling results for the 2031 weekday peak hours for each scenario. This gives an overview of the predicted highway network impact for combinations of development at Waterbeach, CNFE and CSP.

7.2 Summary of Modelling Results

7.2.1 Future-Base Scenario

The Future-Base Scenario Do Minimum modelling results show a generally congested network within and around the study area. High levels of delay are seen in and around Ely, and particularly around the bypass. At the southern end of the study area, Milton Interchange is at or over capacity in both peak hours and experiences high levels of delay, particularly in the PM peak.

Along the A10, junctions south of Cambridge Research Park are at or over-capacity, but do not experience particularly high levels of total delay in either peak hour as the main delay impacts are experienced by lighter flows on joining side-roads. Stretham roundabout, on the other hand, suffers significant delays in the PM peak, though less so in the morning.

On parallel routes, the B1049 experiences greater flows and delay than the B1047, particularly in the PM peak. Junctions experience capacity issues at Histon Interchange, Cottenham and Wilburton on the B1049 and at Newmarket Road on the B1047.

7.2.2 Waterbeach Scenario

The Waterbeach Scenario modelling results show that the primary impact of the proposed development at Waterbeach is on the section of A10 route between the development and the A14, as this is the section where development flows are predicted to be highest.

This level of demand on an already congested route results in link and junction capacity impacts on the section itself, and particularly at the proposed site accesses, the junctions with Car Dyke Road junction and Butt Lane, and at Milton Interchange.

Secondary impacts of this congestion includes the displacement of background traffic that has a wider route-choice. Such displacement is seen on the parallel B1047 and B1049 routes, which results in increased junction delays at the two junctions with the A14, and also in Histon, Impington, Cottenham, Wilburton and Haddenham.

7.2.3 CNFE/CSP Scenario

The CNFE/CSP Scenario modelling results show that the highest level of flow impact caused by the CNFE and CSP sites is on the A14 between the M11 and Milton Interchange. There is also significant demand on the A14 to the east of Milton Interchange, on the A10, and within Cambridge.

The greatest delay impact of these flows is on Milton Interchange, followed by other junctions along the A14. This is leading to the redistribution of traffic to avoid these junctions, with a large amount of flow being redistributed through Cambridge. There is also a notable change in flow along the A10 during the evening peak, with a decrease in flows to the south of Waterbeach as traffic re-routes to avoid the Milton Interchange and other congested junctions. A significant portion of the redistributed flows from this section are travelling via Horningsea.

7.2.4 Combined Scenario

The Combined Scenario modelling results show that the primary impact of the proposed developments at Waterbeach, CNFE and CSP is on the A10 between Milton Interchange and the new town north of Waterbeach. This is the section where the new town north of Waterbeach traffic is predicted to be the highest, with additional development traffic from CNFE and CSP.

Whilst there is significant development flow along the A10, there is a decrease in flow southbound to the south of Waterbeach in the AM and in both directions between Milton Interchange and Milton P&R in the PM, due to delay increases. Much of this is due to increased delay at the Milton Interchange resulting from increased entry flows from the A14, which leads to the displacement of background traffic that has a route-choice. In the AM this displaced traffic is travelling along Clayhithe Road and through Cottenham, whereas in the PM there are also impacts in Histon and Impington.

7.2.5 Next Steps

This report summarises the key Do Minimum modelling assumptions and outputs from the CSRM modelling that has been undertaken as part of the Ely to Cambridge Transport Study. The Do Minimum scenarios provide an indication of how the transport networks could perform in the absence of mitigation, in order to identify the impacts that mitigation is required to address. Appropriate forms of mitigation will be developed and explored at the next stage of modelling, which is the Do Something stage.

Appendices

A. Do Minimum Modelling Strategy Note

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A10 (N) Cambridge to Ely Transport Study

Proposed Do Minimum Modelling Strategy

30 November 2016

Cambridgeshire County Council

Issue and revision record

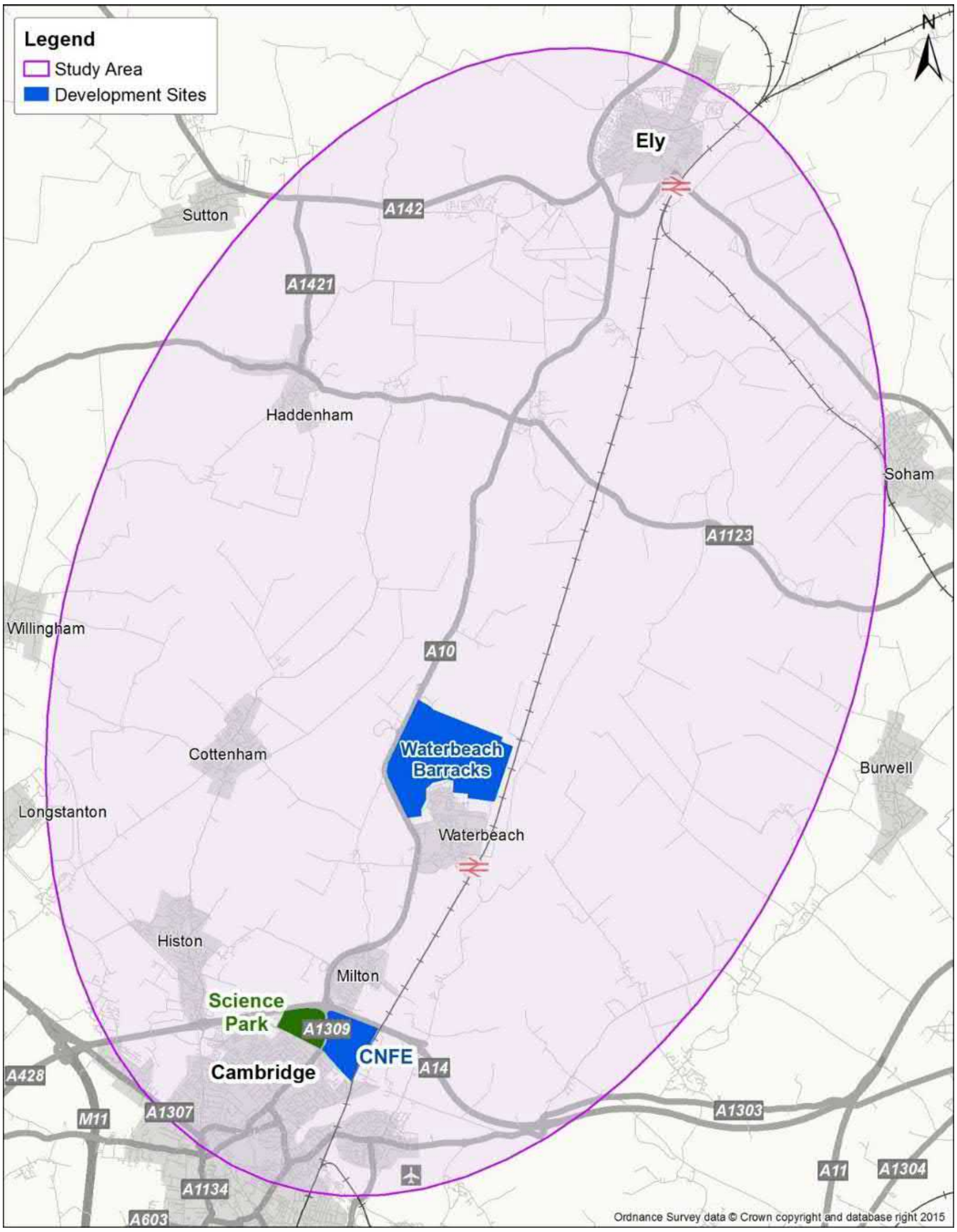
Revision	Date	Originator	Checker	Approver	Description
A	22/12/15	PP/CB	CB	PS	Draft
B	06/01/16	ST	CB	PS	Second Draft
C	13/01/16	PP	CB	PS	Third draft for discussion
D	21/01/16	PP	CB	PS	Fourth draft
E	20/07/16	PP	CB		Fifth draft
F	01/09/16	ST	PP		Sixth draft
G	23/11/16	PP	CB		Seventh draft
H	30/11/16	PP	CB	PS	First issue

Information class: Standard

1 Introduction

The purpose of this note is to set out the proposed strategy for undertaking the Do Minimum modelling for the A10 Corridor Study. The indicative A10 corridor study area is as follows:

Figure 1: Indicative A10 (N) Study Area



The A10 corridor is a focus for growth with strategic sites and other development anticipated along the corridor over the period to 2031 and beyond. The Ely to Cambridge Corridor (A10 (N)) Transport Study will make recommendations for transport schemes able to accommodate major development proposals along the corridor.

The study has three strands:

- Strand 1: Cambridge to Ely corridor overall transport requirements;
- Strand 2: Waterbeach New Town Transport Study (1,400 – 2,100 houses by 2031, 8-10k in total); and
- Strand 3: Cambridge Northern Fringe East (CNFE) and Cambridge Science Park (CSP) (Number of jobs TBC).

2 Modelling Strategy Overview

The main aims of the modelling element of this study are:

1. To identify the transport impacts of development at Waterbeach, the CNFE site and Cambridge Science Park.
2. To identify suitable transport schemes to mitigate development transport impacts.
3. To identify scheme funding sources, including developer contributions and preparation of an Outline Business Case for government funding.

The general modelling approach to be followed to achieve the first two of these aims is as follows:

- Test future with and without-development scenarios with a Do Minimum transport network in order to identify transport impacts of the new development.
- Develop transport schemes to mitigate development transport impacts, leading to a proposed Do Something transport network.
- Test future with-development scenario with the Do Something network to demonstrate effective mitigation.

In order to achieve the third of the above aims, it is important that the final modelling output from this study accords with DfT WebTAG guidance and provides a robust basis for negotiating appropriate S106 contributions from developers. This requirement has been taken into account in the preparation of this methodology.

More detailed modelling of individual junctions will also be undertaken as part of the study following this initial round of strategic modelling and analysis.

3 Modelling Tools

The Do Minimum and Do Something modelling will be carried out using the updated Cambridgeshire County Council's Cambridgeshire Sub-Regional Model (CSRM2). According to the CSRM LMVR:

> *"The CSRM allows stand-alone testing of road, PT, cycle, walk schemes, standard economic benefit tests using the highway and demand model with fixed trip ends, as well as complex tests of strategic policy options incorporating land use responses."*

CSRM2 will be a WebTAG compliant strategic model which uses base data from 2015 including:

- Validation against recently collected traffic and transportation counts
- All networks (highway, PT, walk, cycle)
- Representation of parking and Park & Ride
- Base transport movement data
- Base land use data
- Matrices with up-to-date mobile phone data

Figure 3.1 shows the area that the model covers, which shows that it includes detailed representation for the Cambridgeshire districts of Huntingdonshire, East Cambridgeshire, South Cambridgeshire and the City of Cambridge. The A10 study area is also highlighted for reference.

The main planning inputs required for the model are as follows:

Table 1: Planning Inputs

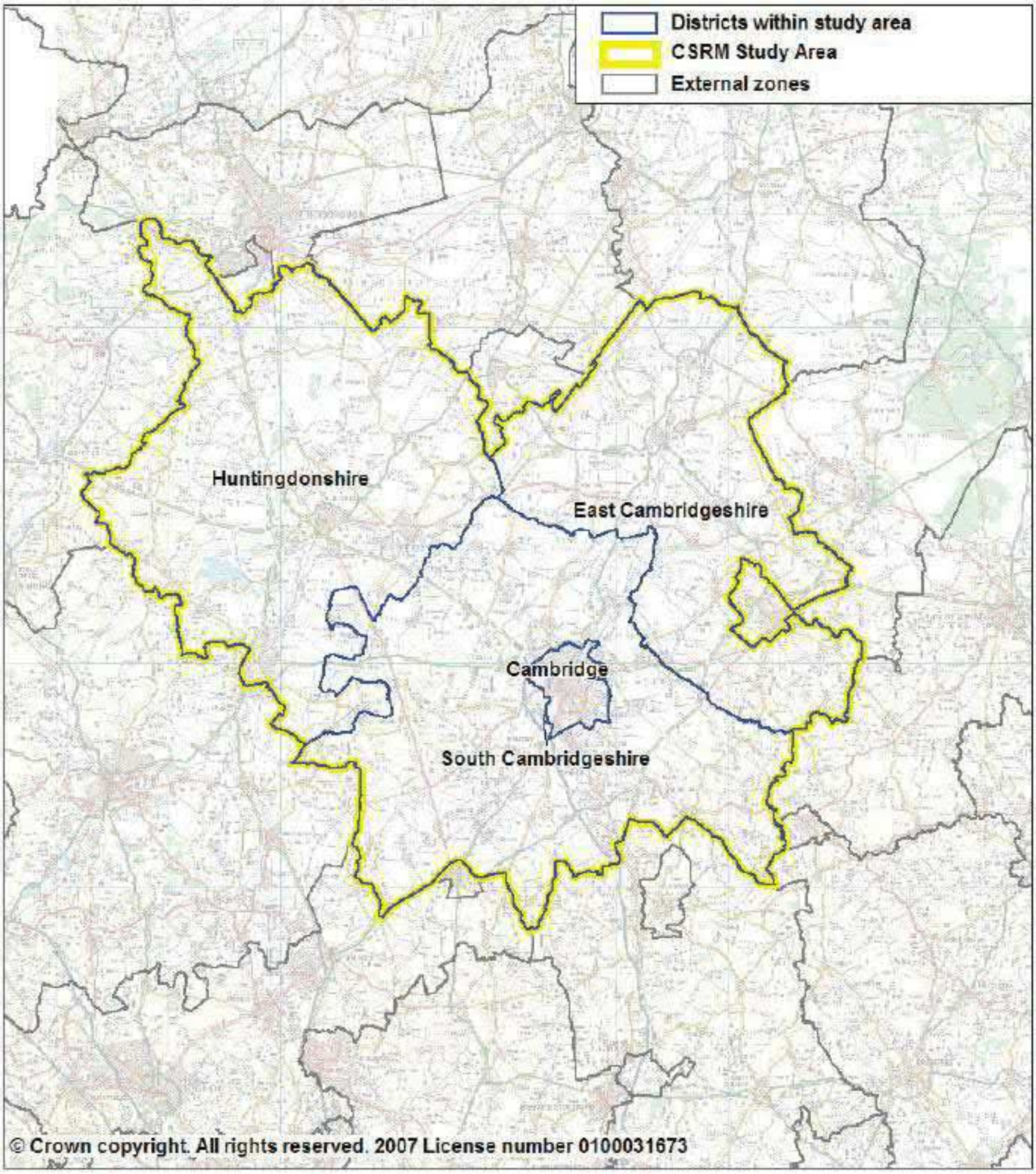
Input	Units
District Level	
Population	Persons
Jobs	Jobs
Development Level	
Houses	Houses
Employment	GFA sqm
Education	Pupils/students

Source: Atkins

According to National Planning Practice Guidance, GFA is the gross amount of floor space (all storeys, including basements and garaging), including the thickness of any external and internal walls.[1]

[1] National Planning Practice Guidance (2014): Paragraph 018 http://planningguidance.communities.gov.uk/blog/guidance/fees-for-planning-applications/calculating-fees-for-planning-applications/

Figure 2: CSRM study area



Source: CSRM LMVR - Atkins

4 A10 Land Use Developments

4.1 Introduction

The main proposed land use schemes which will affect the A10 corridor are:

- Housing development at Waterbeach new town
- Employment-led mixed-use development at Cambridge Northern Fringe East and Cambridge Science Park

Details for each development which are relevant to the Do Minimum modelling scenario are provided in the following subsections.

4.2 Waterbeach

The South Cambridgeshire Local Plan provides an indicative housing capacity for the Waterbeach site of 8,000 to 9,000 houses. The latest housing trajectory supporting the Local Plan estimates that, of these, about 2,050 will be delivered by the end of the Plan period, which is 2031. Full build-out would then follow in the remainder of that decade and beyond.

The two developers for the site propose the following development quantum, mix and phasing as shown in Table 2.

Table 2: Development Proposals (Waterbeach)

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses	10,000		2,100	2,500	5,400			Houses	
	Apartments								Apartments	
Retail (including food and drink)	Convenience	15,000		3,150	3,750	8,100			GFA sqm	750
	Comparison / Service								GFA sqm	
Industrial	Light Industrial								GFA sqm	
Other: Leisure and Health	Hotel(s)	6,000			6,000				GFA sqm	450
	Health / Fitness / Community Centre								GFA sqm	750
	Place of Worship								GFA sqm	
Office	Commercial	5,000		1,050	1,250	2,700			GFA sqm	320
	Academic Research								GFA sqm	
Pre-School									Pupils	800
Primary School		2,160		454	540	1166			Pupils	
Secondary School		1,800		378	450	972			Pupils	
Sixth Form		360		76	90	194			Students	
Adult Education									Students	
Other Uses / General / Sui Generis									GFA sqm	400
On Site Job Estimates										3,470
Homeworking										2,573
Cambridge Research Park										2,507
Cambridge Research Park Hotel										56
Jobs Estimate Total (including home working and CRP buildout)										**8,606**

Source: Peter Brett Associates on behalf of Urban & Civic and RLW

The developers propose a range of transport measures to enable this development to be delivered sustainably and with the least negative impact on the surrounding transport networks. However, for the purpose of the Do Minimum with-development scenario, only the most basic enabling measures will be included to connect the development to surrounding networks within the model. All wider measures to promote above average sustainable travel patterns will be included in the Do Something package of transport measures.

It is proposed for the purposes of this modelling exercise to assume full build out of Waterbeach as per the developers' proposals of 10,000 dwellings by 2031.

In addition, the proposals include the jobs growth predicted at nearby Cambridge Research Park and the proposed hotel at Cambridge Research Park. A figure for homeworking is also included and this will be factored in as part of assessing the number of trips generated by the proposals.

4.3 Cambridge Northern Fringe East Site (CNFE)

The Cambridge and South Cambridgeshire Local Plans identify CNFE as a strategic site that represents *"the largest brownfield regeneration opportunity in Greater Cambridge"*. The councils are currently in the process of developing a joint Area Action Plan (AAP) to guide development of the site, which will also benefit from the opening of the Cambridge North rail station.

4.3.1 Joint Council Options

The CNFE Issues and Options consultation report proposed four potential scales of redevelopment for the site.

Following consultation in December 2014, officers of the Joint Councils' proposed two further modified options, 2a and 4a, for further investigation. Option 2a was to explore higher densities than in Option 2, and Option 4a to include a greater proportion of residential developments than in Option 4. In November 2015, South Cambridgeshire District Council agreed to investigate both options. Cambridge City Council only supported Option 2a, but recognised there was a need to investigate all reasonable options for the AAP.

In 2016, further discussions with developers led to a review of Option 4a and resulted in the formation of a revised CNFE Developer Option which will now be the subject of the initial transport modelling runs.

Table 3 and Table 4 provide land use assumptions for the CNFE site based on current knowledge informed by the Councils' masterplanning work. In agreement with the study stakeholders, it is proposed for the purposes of this initial modelling exercise to assume full build-out of CNFE by 2031 for Option 2a, but the higher Developer Option runs to 2041.

Table 3: Development Proposals: CNFE Option 2a

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses	1,062				1,062			Houses	
	Apartments								Apartment	
Retail (including food and drink)	Convenience / Comparison / Service	1,600				1,600			GFA sqm	91
Industrial	Light Industrial	50,180				50,180			GFA sqm	1,416
Other Uses / General / Sui Generis									GFA sqm	
Other: Leisure and Health	Hotel(s)	6,500				6,500			GFA sqm	33
	Health / Fitness / Community Centre								GFA sqm	
	Place of Worship								GFA sqm	
Office	Commercial / Academic Research	261,437				261,437			GFA sqm	21,969
Pre-School									Pupils	
Primary School									Pupils	
Secondary School									Pupils	
Sixth Form									Students	
Adult Education									Students	
									On Site Job Estimates	**23,510**

Source: Joint Councils

Table 4: Development Proposals: CNFE Developer Option

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses	5,616				5,616			Houses	
	Apartments								Apartment	
Retail (including food and drink)	Convenience / Comparison / Service	7,900				7,900			GFA sqm	451
Industrial	Light Industrial								GFA sqm	
Other Uses / General / Sui Generis									GFA sqm	
Other: Leisure and Health	Hotel(s)	6,500				6,500			GFA sqm	33
	Health / Fitness / Community Centre	18,000				9,000		9,000	GFA sqm	277
	Place of Worship								GFA sqm	
Office	Commercial / Academic Research	352,505				197,505		155,000	GFA sqm	29,622
Pre-School									Pupils	
Primary School									Pupils	
Secondary School									Pupils	
Sixth Form									Students	
Adult Education									Students	
									On Site Job Estimates	**30,384**

Source: Cambridge City Council

4.3.2 Specific Developer Proposals

Developers with proposals for the Cambridge Northern Fringe East Site are key stakeholders in the study. The following private sector development partners are involved in developing the study:

- Grosvenor Estates / Anglian Water
- Chesterton Partnership including Brookgate
- St Johns College

Each developer was consulted on their proposals and the scale of development planned for the site. This information was used to inform the modelling scenarios in lieu of an adopted AAP. What follows is a short description of the discussions and proposals.

4.3.2.1 Grosvenor Greater North Cambridge

Grosvenor's vision is to transform the area into the City's first Innovation District. Representatives from Grosvenor presented an ambitious vision for the long term growth with comprehensive master planning and integration. The development is intended to act as a catalyst for the intensification of surrounding areas.

The proposals are set out in a phased approach to 2031, 2036 and 2041.

The job numbers are calculated using floor space to jobs factor relevant to the specific mix.

Table 5: Development Proposals: Grosvenor Greater North Cambridge (Core Area - phases 1a, 1b, 2a, 2b ,3, 4)

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses	3,200			1,500	2,500	3,200		Homes	
	Apartments								Apartments	
Retail (including food and drink)	Convenience	3,500			1,000	2,300			GFA sqm	165
	Comparison / Service	2,800			1,000	1,000	1,000		GFA sqm	100
Industrial	Light Industrial	n/a							GFA sqm	
Other Uses / General / Sui Generis										
Other: Leisure and Health	Hotel(s)	10,000				10,000			GFA sqm	
	Health / Fitness / Leisure / Community Centres	20,000			3,000	6,000	9,000		GIFA sqm	
	Place of Worship					2,000				
Civic	Open space / Structural Landscape / Streets	131,000			35,000	20,000	70,000	6000		
Pre-School		19,400			1,500					
Primary School					4,200					
Secondary School						7,000				
Sixth Form										
Adult Education							6,700			
Commercial (Split)	Offices	140,000				35,000	35,000	70,000		2,500
	R&D	56,000				25,000	20,000	11,000	GIFA sqm	500
	Laboratory space	49,000				30,000	19,000		GFA sqm	1,304
									On Site Job Estimates	4,569
									Total Jobs (including post-2031)	**13,565**

Source: CCC

4.3.2.2 Chesterton Partnership including Brookgate

Chesterton Partnership has a long standing objective of securing the early phasing of development around the new Cambridge North Rail Station.

The proposals include approx. 900 dwellings to 2031 with an early phase of development including 500 dwellings, approx. 5000 sqm of commercial space and a 265 bed hotel.

Table 6: Development Proposals: Chesterton Partnership including Brookgate (CB4)

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses	900		500	400				Houses	
	Apartments								Apartments	
Retail (including food and drink)	Convenience	1,000		600	400				GFA sqm	
	Comparison / Service	600		600	0				GFA sqm	
Industrial	Light Industrial								GFA sqm	
Other Uses / General / Sui Generis										
Other: Leisure and Health	Food and Drink	1,000		700	300				GFA sqm	
	Hotel(s)	6,500		6,500					GFA sqm	
	Health / Fitness / Community Centre								GFA sqm	
	Place of Worship								GFA sqm	
Office	Commercial	95,000		5,000	45,000	45,000			GFA sqm	
	Academic Research									
Ancillary A1/A3		1,000		1,000					GFA sqm	
Pre-School									Pupils	
Primary School									Pupils	
Secondary School									Pupils	
Sixth Form									Students	
Adult Education									Students	
On Site Job Estimates										**5,789**

Source: Bidwells

4.3.2.3 St John's Innovation Centre

Representatives for St John's College have outlined their proposals for the Innovation Centre which includes 12,505 sqm of commercial space and which equates to 1,051 new jobs on the site. More information is available in the Joint Councils Cambridge Northern Fringe East Options 2a and 4a Land Use Figures document (19 May 2016).

Table 7: Development Proposals: St John's Innovation Centre

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses								Houses	
	Apartments								Apartment	
Retail (including food and drink)	Convenience								GFA sqm	
	Comparison / Service								GFA sqm	
Industrial	Light Industrial								GFA sqm	
Other Uses / General / Sui Generis										
Other: Leisure and Health	Hotel(s)								GFA sqm	
	Health / Fitness / Community Centre								GFA sqm	
	Place of Worship								GFA sqm	
Office	Commercial	12,505							GFA sqm	1,051 (also included in Options 2a and 4a)
	Academic Research								GFA sqm	
Pre-School									Pupils	
Primary School									Pupils	
Secondary School									Pupils	
Sixth Form									Students	
Adult Education									Students	
									On Site Job Estimates	**1,051**

Source: Cambridge City Council and South Cambridgeshire District Council CNFE Land Use options paper 27 01 2016

4.4 Cambridge Science Park

Cambridge Science Park (CSP) has been identified in the South Cambridgeshire Local Plan as suitable for intensification. Increased development at this site would create transport impacts on the A10(N) corridor, so the implications of these proposals are therefore to be considered in this study.

Development proposals for Cambridge Science Park are shown in Table 8, including development quantum, mix and phasing for 2016, as well as estimated net proposals through to 2036. In agreement with the study stakeholders, it is proposed for the purposes of this modelling exercise to assume full build-out of the CSP expansion by 2031.

In addition to the figures provided in Table 8, a second set of development information has been provided which includes:

- 60,387 sqm at 27 including a new building plus car park
- 4,181 sqm at 108 for the Bradford Centre
- 60,387 sqm at Biochrom for a multi storey car park
- 27,871 sqm – Two large redevelopments by May – June 2017
- 3,716 sqm at Cambridge Consultants
- New RBS building to be built later in 2016
- Astex are planning to expand to another building

Table 8: Development Proposals: Trinity Cambridge Science Park

Description	Development Class	Quantity	Profile Through Time						Units	Jobs
		Total	2016	2021	2026	2031	2036	2041		
Dwellings	Houses								Houses	
	Apartments								Apartment	
Retail	Convenience								GFA sqm	
	Comparison / Service								GFA sqm	
Industrial	Light Industrial								GFA sqm	
Other: Leisure and Health	Food and Drink								GFA sqm	
	Leisure								GFA sqm	
	Health / Fitness / Community Centre								GFA sqm	
	Place of Worship								GFA sqm	
Office	Commercial / Academic Research	35,653	10,624	8,343	8,343	8,344			GFA sqm	2,996
	Academic Research	35,653	10,624	8,343	8,343	8,344			GFA sqm	2,996
Primary School									Pupils	
Secondary School									Pupils	
Sixth Form									Students	
									On Site Job Estimates	**5,992**

Source: Source: Cambridgeshire County Council

Table 1 to Table 8 will be used to support Atkins in the modelling of the scheme, therefore all development proposals should be included in order to ensure that the modelling is reliable and robust.

4.5 Summary

The approach taken in this study is to utilise CSRM2 and in addition off model transport planning techniques to understand the impacts of the major developments (Waterbeach New Town, CNFE and CSP) as they are currently envisaged. Such is the quantum of development proposed additional analysis beyond the outputs from CSRM is required. In order to ensure a robust and realistic set of outputs from the study it is proposed to undertake model runs based on the levels of growth in the Cambridge and South Cambridgeshire Local Plan scenarios up to 2031 and to 'add-on' the additional development growth using off-line techniques for the additional growth up to 2031 and for growth beyond 2031 which is not in the CSRM2 forecast period.

For the purposes of this modelling exercise, the assumed full build-out year for these three development sites is 2031. The assumed full quantum of Waterbeach new town is a significant development of 10,000 homes. The preferred scenario for the scale of developments at CNFE and CSP is still to be determined, but at this stage it is proposed that only the CNFE Developer Option is tested in the model to ascertain what is the worst case scenario of the two options.

In line with this, Table 9 summarises development forecasts for the Waterbeach site.

Table 9: Summary of Development Proposals for Waterbeach up to 2031

Development Site	Dwellings (homes)	Retail (Convenience) (GFA sqm)	Hotels (GFA sqm)	Office (Commercial) (GFA sqm)	Education (primary, secondary, sixth form) (sqm)
Waterbeach New Town	10,000	15,000	6,000	5,000	4,320

Table 10 and Table 11 summarise the development proposals for CNFE and CSP.

Table 10: Summary of Development Proposals for CNFE Option 2a / CSP up to 2031

Proposals	Dwellings (no)	Retail (GFA sqm)	B2/B8 Industrial (GFA sqm)	Hotel (GFA sqm)	B1(a/b) Offices (GFA sqm)	Jobs (no)
CNFE Option 2a	1,062	1,600	50,180	6,500	261,437	23,510
CSP Intensification					71,306	5,992
Total	**1,062**	**1,600**	**50,180**	**6,500**	**332,743**	**29,502**

Table 11: Summary of Development Proposals for CNFE Developer Option / CSP up to 2041

Proposals	Dwellings (no)	Retail (GFA sqm)	Hotel (GFA sqm)	Leisure (GFA sqm)	B1(a/b) Offices (GFA sqm)	Jobs (no)
CNFE Option 4a, <= 2031	5,616	7,900	6,500	9,000	197,505	17,219
CNFE Option 4a, > 2031				9,000	155,000	13,165
CSP Intensification, <= 2031					71,306	5,992
Total	**5,616**	**7,900**	**6,500**	**18,000**	**423,811**	**36,376**

5 Population and Employment Forecasting

5.1 Model Forecast Years

The CSRM2 model forecast year is 2031. The CNFE site is not expected to be built out by this point and the proposals presented by developers go beyond this forecast year. Therefore in order to understand the full impacts, it is proposed to test phased development to 2031 using the CSRM2. Offline analysis will then be undertaken to test the remaining development in the years post 2031.

5.2 Forecast Source

Schemes which will lead to a formal business case application for funding should usually be tested according to WebTAG guidance, and WebTAG unit M4 requires that forecast population and employment levels be constrained to NTEM (National Trip End Model). The following table shows the difference between forecasts derived by applying growth from the latest version of NTEM (v7) and the forecasts contained in Local Plans.

Table 12: Local Plan and NTEM v7 projections from 2011 Census levels

Category	Area	Projected Population Growth			Projected Jobs Growth		
		Local Plan	NTEM 7	Difference	Local Plan	NTEM 7	Difference
2011 levels	Cambridge	123,867[*]	121,463	-2,404	84,944[*]	97,445	12,501
	South Cams	148,755[*]	147,427	-1,328	58,748[*]	76,787	18,039
Growth (abs)	Cambridge	26,460[+]	29,610	3,150	22,100[+]	11,604	-10,496
	South Cams	35,910[+]	48,900	12,990	22,000[+]	11,216	-10,784
Growth (%)	Cambridge	21%	24%[†]	3%	26%	12%[†]	-14%
	South Cams	24%	33%[†]	9%	37%	15%[†]	-23%
2031 levels	Cambridge	150,327	151,073	746	107,044	109,049	2,005
	South Cams	184,665	196,327	11,662	80,748	88,003	7,255

[*] From 2011 Census
[+] From Local Plan
[†] From NTEM v7

This table shows that:

- NTEM 7 predicts greater population growth than the Local Plans but also starts from a lower base level. The 2031 estimates from both are similar for Cambridge but higher with NTEM 7 for South Cambs
- Conversely for employment, NTEM 7 begins from a higher base but predicts significantly less growth than the Local Plans. The 2031 result is again a similar result for Cambridge but higher with NTEM 7 for South Cambs

Despite the 2031 population and employment levels being similar between the Local Plans and NTEM v7, modelling protocol is to use NTEM for growth estimates and not for absolute values. Conventional application of the above NTEM growth estimates to the above 2011 Census values produces the 2031 values shown in the following table.

Table 13: 2031 projections from applying Local Plan and NTEM v7 growth to 2011 Census

Area	2031 Population				2031 Jobs			
	Local Plan	Forecast 1	Abs Change	% Change	Local Plan	Forecast 1	Abs Change	% Change
Cambridge	150,327	154,063	3,736	2%	107,044	95,059	-11,985	-11%
South Cambs	184,665	198,095	13,430	7%	80,748	67,329	-13,419	-17%

Source: 2011 Census, Local Plan and NTEM v7

This table shows a similar result for population levels but a greater disparity in employment projections. This will make it difficult to both model the employment growth predicted for the CNFE and CSP sites and constrain to NTEM v7 levels of growth. This matter will be discussed with DfT.

It is noted that the East Cambs Local Plan is due to be adopted in February 2018. For this study, it is therefore understood that interim Local Plan trajectories will be provided.

5.3 With and Without Development Forecasts

As per WebTAG good practice (see unit M4), it is proposed that the population and employment levels per district, or at least at the County level, should be the same in both the with and without development scenarios.

In the without development scenario, therefore, the full population or employment level will need to be met by all other existing and proposed development areas within the district.

In the with-development scenarios, the growth absorbed by the development will need to result in a commensurate decrease in growth across the rest of the district or surrounding districts.

Cambridgeshire County Council has requested that the new CNFE jobs should be additional to the Local Plan job projection, which would therefore require these jobs to be appropriately reallocated from surrounding districts in the relevant with-development scenario.

A suitable reallocation method needs to be proposed by Atkins and submitted for approval by Mott MacDonald to DfT.

6 Do Minimum Transport Network

The proposed 2031 forecasting year is consistent with the modelling undertaken to support the Cambridge and South Cambridgeshire Local Plans. To be consistent with that process, it is proposed that the same list of Do Minimum transport schemes are adopted as applied to the Local Plan modelling scenarios[2], except for those which are most likely to be required to support the Waterbeach, CNFE, and Cambridge Science Park expansion.

The following table outlines the schemes included in the Local Plan modelling (Phase 3, preferred option) and identifies those schemes that will be removed in order to create the Do Minimum transport network for the A10 study. It is noted that, in accordance with WebTAG requirements that all future transport schemes fall into the categories of 'more than likely' or 'near certain', the schemes in this table are all deemed by Cambridgeshire County Council to meet that requirement.

Table 14: Proposed A10 Study Do Minimum transport schemes

Category	Scheme Description	A10 DM Inclusion?
Highway	A428 Black Cat - Caxton Gibbet dualling	✓
	A14 Cambridge to Huntingdon Improvement scheme Development Consent Order	✓
	Core Scheme Extension demand management package - closure of East Road and Mill Road to through traffic (additionally Hills Road closure for bus priority).	✓
Bus / Guided Bus	Access controls close to Cambridge Ring Road	✓
	Segregated bus lanes for major routes into Cambridge	✓
	High Quality Public Transport services on the St Neots (A428), Haverhill (A1307) and Royston (A10) corridors	✓
	Additional Park and Ride sites on the A428, the A1307 and at Hauxton on the A10, and the re-location of Newmarket Road P&R to Airport Way.	✓
	Western Orbital bus service from Cambridge Science Park Station to Addenbrooke's	✓
	Inner Park and Ride site expansion of capacity - Segregated access at Babraham Rd P&R, Milton P&R bus priority at Milton Interchange and Hauxton M11 P&R access improvements. Relocation of Newmarket Rd P&R site to east of Airport Way (as TIF) coded for 2021 onwards.	✓
	Parking charges at the city P&R and CGB sites from 2016 onwards	✓
	A busway from Waterbeach to Cambridge	×
	New / enhanced bus priority through junctions and pinch points on key radial routes into Cambridge. Newmarket Road segregated busway crossings between football stadium and Elizabeth Way and Hills Road closure and bus priority between Station Road and Lensfield Road coded for 2021 onwards.	✓
Rail	Improvements in rail services, speed and capacity, including Thameslink upgrade and improved rolling stock to provide improved capacity to London, and onward accessibility to south London.	✓
Cycle	A major network of cycling improvements in and around Cambridge, including segregated routes along major roads and elimination of gaps in the network	✓

We assume that the rail improvements item in the above table includes the new Cambridge North station. We also assume that the cycle improvements item includes the new Chisolm Trail route.

[2] As per Appendix B of 'Local Plans CSRM Cambridge and South Cambridgeshire Local Plans Transport Report'

7 Proposed Do Minimum Modelling Scenarios

The following scenarios are required to understand the impacts of the above land use development proposals which affect the study corridor. Each scenario should include:

- 2031 population and employment forecasts, as described in Section 5.2 above
- 2031 Do Min transport network, as described in Section 6 above

Each scenario forecast will require a full demand model run.

It is noted that Scenarios 3 and 4 require a degree of offline work before the level of modellable development at CNFE / CSP is determined. Until then, however, Scenarios 1 and 2 can be modelled immediately.

7.1 Scenario 1 – Without Development Scenario

This scenario should represent the hypothetical future situation where neither the Waterbeach new town, CNFE nor CSP intensification developments take place. It should not include any of the transport mitigation measures for these developments.This will therefore provide a 'future base' against which to compare the impacts of each of the with-development scenarios listed below. This model run should follow the methodology described in Section 5.3 above.

TO BE TESTED IN CSRM2 :Foundation Case (Cambridge / South Cambridgeshire Local Plan scenario + Transport Schemes committed / expected to 2031) minus any growth at Waterbeach New Town and CNFE / CSP and related transport schemes.

7.2 Scenario 2 – Waterbeach New Town Only

The with-development forecast for this scenario should differ from the without-development scenario by the addition of the land use data presented for the forecast year of 2031 in Table 2 above. This scenario is tested entirely in the CSRM2.

TO BE TESTED IN CSRM2: As per Scenario 1 but with Waterbeach New Town full build out to 2031.

7.3 Scenario 3 – CNFE Developer Option / CSP Only

The with-development forecast for this scenario should differ from the without-development scenario by the addition of the land use data presented for the forecast year of 2031 in Table 4 and Table 8 above.

This scenario involves testing CNFE / CSP growth currently included in the Local Plan tests using the CSRM2 up to 2031. It will also include a level of additional growth calculated through assessment of Scenario 1 outputs, the Foundation Case and offline work to test a level of growth that would be technically workable for the model. Mott MacDonald will then undertake further offline work using the outputs of this model run to the full level of development proposed for CNFE / CSP.

TO BE TESTED IN CSRM2: As per Scenario 1 but with a level of CNFE / CSP growth to be advised.

7.4 Scenario 4 – Waterbeach and CNFE Developer Option / CSP

The with-development forecast for this scenario should differ from the without-development scenario by the addition of the land use data presented for the forecast year of 2031 in Table 2, Table 4 and Table 8 above

This scenario involves testing Waterbeach New Town proposals in their entirety to 2031 in the CSRM2.

This scenario involves testing CNFE / CSP growth currently included in the Local Plan tests using the CSRM2 up to 2031. In addition, offline analysis will be undertaken to test the remainder of the growth proposed up to 2031 and for the period 2031-2041.

TO BE TESTED IN CSRM2: As per Scenario 1 but with Waterbeach New Town full build out to 2031 and a level of CNFE / CSP growth to be advised.

8 Modelling Outputs Required

Using the above model scenario runs, we will assess the with-development and corresponding without-development outputs in order to identify the absolute values and difference in:

- Link flows (i.e. flow difference plot)
- Change in vehicle KM
- Junction and link RFCs
- Link delays

We will also interrogate the model to understand for the new development sites (i.e. Waterbeach, CNFE and CSP) what the model assumes in terms of mode share and levels of internalisation so that the robustness of these parameters can be assessed.

Other output types may be requested once the above outputs have been analysed.

As stated earlier, this initial phase of strategic modelling using CSRM2 will be supplemented by more detailed junction specific modelling as the study progresses.

It is noted that CSRM2 is a strategic model and so should not be directly relied upon for local level flows and turning counts etc. This risk can be mitigated by applying suitable caution to the application of results at specific local levels.

B. Demographics Forecasting Method Note

Technical note

ATKINS

Project:	Cambridge City Deal A10 North Study	**To:**	Cambridgeshire County Council Mott MacDonald
Subject:	CSRM2 Do Minimum Trip End Methodology	**From:**	Atkins
Date:	6th February 2017	**cc:**	

Version Control

Version	Date	Created	Reviewed	Authorised	Notes
0.1	19/01/2017	MA	TJG		
0.2	20/01/2017	AM	TJG		
0.3	25/01/2017	AM	TJG		
0.4	30/01/2017	AM			
0.5	31/1/17	TJG			Extended introduction to add discussion of trip end elements and structure, modified in/out-commuting section, still some work to do.
0.6	01/02/2017	AM			Made formatting changes in relation to TJG comments in v0.5.
0.7	03/02/2017	TJG			Completed Section 3, with text on in/out-commuting and conclusions, added revised NTEM method to Section 4
0.8	06/02/2017	MA/AM	DW	***TJG***	Reworked section 4. Final formatting improvements.
1.0	06/02/2017	MA			Set to version 1.0 for issue to client.

1. Introduction

1.1. Background

Atkins is working with Cambridgeshire County Council (CCC) and Mott MacDonald to develop a series of Do Minimum (DM) scenarios for the Cambridge City Deal A10 North study to be tested in the Cambridge Sub-Regional Model 2 (CSRM2). Mott MacDonald have proposed four DM scenarios with varying levels of development at key sites on the A10 North corridor: Waterbeach new town, Cambridge Northern Fringe East (CNFE), and Cambridge Science Park (CSP).

CSRM2 is an integrated transport demand and network assignment model that allows stand-alone testing of road, PT, cycle, walk schemes, standard economic benefit tests using the highway and demand model with fixed trip ends. The model can be used to assess the impact of development scenarios, with model outputs being used to aid development of appropriate mitigation measures.

CSRM2 has recently been refreshed to a base year of 2015, with a 2031 Foundation Case forecast year scenario based on Local Plan employment and housing growth forecasts provided by the individual districts. It is Atkins' understanding that Mott MacDonald and CCC require the forecast year model to be constrained to growth from the NTEM 7.0 dataset accessed through the TEMPro software for the purposes of using model outputs to feed into Major Scheme Business Case Submission (MSBC) per the guidance in WebTAG unit M4.

1.2. Document Purpose

This technical note is intended to summarise the Local Plan employment and housing growth assumptions used in the 2031 Foundation Case and compare against NTEM v7.0 so that the differences and the implications for the trip end generation are fully understood. The note goes on to outline a methodology for calculating trip ends for each of the four development scenarios to be agreed by all parties (CCC, Mott MacDonald and Atkins) before further work proceeds.

1.3. Requirements and Methodology

The requirements for trip ends to serve the A10 study (and other City Deal projects) have yet to be firmly defined. It is anticipated that full appraisal and business cases for investment will be required, and that the forecasting of trip ends for appraisal purposes will need to follow WebTAG guidance[1].

A major part of the guidance concerns the use of the DfT's National Trip End Model (NTEM) and the need to align trip end growth used for appraisal to these forecasts. NTEM forecasts are based on a number of national and local assumptions, which are discussed in Section 1.4 below.

Another major requirement will be for the trip end growth to reflect fully the range of development scenarios which have been requested for the current A10 study. This is a requirement which it is not possible to fulfil directly using NTEM.

As testing these scenarios is the focus of the current work, it is proposed that priority is given to this latter requirement at this stage. It is expected that a level of compliance with the NTEM growth forecasts will need to be achieved for appraisal purposes, either by applying the growth levels directly or by agreeing with DfT an alternative scenario which can be derived via the TEMPRO software scenario generator (see WebTAG M4, Section 7.3).

In order to provide appropriate insights both for the current work, and inform any decision to apply NTEM growth vs alternative scenarios, this note considers the range of factors affecting trip end growth, and compares current CSRM2 assumptions with those available from NTEM.

Note re: current NTEM data versions: It should be noted that DfT have signalled their intention to release a revision to the NTEM v7.0 dataset in February 2017. It is not anticipated that NTEM v7.2 will produce major changes in growth rates for Cambridgeshire. Once new NTEM datasets are published it would be appropriate to apply those for any future work, but unless there are major changes it would be unlikely that existing work would need to be re-done.

1.4. Elements of Trip End Growth

There are many factors which will impact the growth of travel demand and therefore Trip Ends. It is helpful to consider these and how they are represented within NTEM and the CSRM2 before making comparisons of the data.

Additional Dwellings (Households): Future dwelling growth is available at a CSRM2 zone level, and variations in these assumptions are a key component of the scenario tests anticipated for the City Deal (see Section 4 below). NTEM does not report dwellings, though Local Authority (LA) dwelling projections are used as one of the NTEM inputs (alongside regional household and population projects). It is therefore desirable to match the zonal distribution of dwelling growth as in CSRM2 currently, whilst considering overall NTEM household growth at a District level.

Additional Employment: The CSRM2 Foundation Case employment growth assumptions will be based on the individual District Local Plan assumptions (which were originally derived from the East of England Forecasting Model (EEFM) operated by CCC's Research Group). The Foundation Case will also distribute this growth using information on employment development sites obtained from the LA Districts. The Local Plan and NTEM employment growth figures are compared in this note.

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[1] WebTAG Unit M2 Variable Demand Modelling, section 2.5.11, Unit M4 Forecasting and Uncertainty, section 7.3, and Unit A1.1 Cost Benefit Analysis

Demographic mix: CSRM2 trip end inputs segment the population by broad economic groups/life stages (education stage, employed, non-employed, retired), car ownership and income group. No direct information is available from CSRM2 to consider how the population mix will change over time, though some broad assumptions from the CSRM1 Land Use model are available. NTEM does take into account projected demographic trends when forecasting trip ends.

Trip Rates: The current CSRM2 methodology allows for trip rates to be varied through time. However, no adjustments are currently applied. DfT Planning Guidance states that trip rates fell between 2011 and 2016, and are assumed to be static thereafter.

Household size (persons per dwelling or headship): The overall population (and therefore number of Trip Ends) is determined in CSRM2 using zonal persons per dwelling. This allows for variations in population due to building in zones with historically high or low household size (and can also be set to bespoke values for any future development where there is a specific expectation of household size). The persons per dwelling can also be adjusted to account for future trends in household size. NTEM Trip Ends incorporate projections of household size changing through time.

Number of in-commuting and out-commuting trips: Analysis of the 2011 Census JTW data shows that 20% of the jobs in the CSRM2 study area are filled by workers residing outside the study area. Similarly, 17% of the employed residents have jobs outside the study area. Overall, this means that just under one third of the commuting trips made to, from or within the study area have an external trip end.
Hence the extent of in/out-commuting is a crucial part of the production of trip ends, particularly related to peak travel. The change over time in in- and out-commuting will be affected by:

- The relative growth of jobs and workers in the study area (with the number of workers being determined by the number of dwellings, the household size and the proportion of workers). If the number of jobs increases more rapidly than the number of workers, then (all other things being equal) in-commuting may be expected to increase.

- The proportion of residents who choose to take jobs outside the study area, and the competition from in-commuters for local jobs. This is influenced by a very wide range of economic factors, including the jobs market in external areas (e.g. jobs growth in Peterborough or London). At a local level, the location of new developments and quality of transport links may influence in/out-commuting, though whether this impacts the numbers at a study area level would be hard to determine.

Conclusions

For the current work, it is suggested that the most critical elements to consider are:

- The overall growth rates of population and employment;
- The locations of these developments, and how these will impact on the transport network;
- The differences in in/out-commuting likely to arise in scenarios with different levels of employment and dwellings.

1.5. Document structure

The remainder of this document is structured as follows:

Section 2: A summary of the 2031 CSRM2 Foundation Case assumptions as currently proposed.

Section 3: A comparison of the district level CSRM2 assumptions with NTEM v7.0 growth for dwellings, employment and population, and the impact on in/out-commuting.

Section 4: A summary of the proposed A10 Do Minimum scenario inputs.

Section 5: Conclusions on the way forward.

ATKINS

2. 2031 Foundation Case Population and Land Use Inputs

The employment and housing growth assumed in the 2031 Foundation Case forecast year scenario is currently based on the 2031 Cambridge and South Cambridgeshire Local Plan for all districts with the exception of Huntingdonshire which is based on the recent Local Plan core development scenario, see Table 1. Growth was provided by the LA's from the most recent Census year of 2011 at the individual development site level, which has then been allocated to the appropriate model zone. There is also an element of 'windfall' housing development (included in the district totals below) that is spread across the district based on the 2011 distribution. Dwelling and employment growth is precisely as defined in Local Plan preferred strategy[2].

Table 1. Growth Assumptions 2011 to 2031

District	Dwellings (including windfall)	Employment	Population
Cambridge	15,182	22,100	33,370
East Cambridgeshire	8,699	9,639	15,082
Huntingdonshire	15,868	17,049	28,658
South Cambridgeshire	21,281	22,000	43,667
Total	**61,030**	**70,788**	**120,777**

Dwelling growth between 2011 and 2015 is derived from CCC dwellings completions data at a zonal level. Employment growth between 2011 and 2015 is taken from CCC estimates of employment growth at MSOA level, which are in turn derived from the Business Register Employment Survey (BRES).

A detailed breakdown of the dwelling and employment assumptions used for the 2031 Foundation Case can be found in the previously shared inventory document[3]. 2011-2031 employment and dwelling growth at the key development sites of interest for the A10 North study are presented below in Table 2.

Table 2. 2011-2031 Employment and Dwelling Growth – A10 North Development Sites

Development	Dwellings	Employment
Waterbeach New Town	2,050	1,300
Cambridge Science Park	-	1,800
Cambridge Northern Fringe East	-	2,000

Population

Population growth in the 2031 Foundation Case is derived from population per dwelling ratios. The location and scale of developments in conjunction with population:dwelling ratios are used to calculate forecast year dwelling derived population by individual model zone.

[2] http://www.cambridgeshire.gov.uk/download/downloads/id/2722/2014-01-23_tscsc_strategy_-_v40_jstspg_changes_post_jst_and_spgpdfTSCSC Transport Strategy and High Level Programme

[3] CSRM Refresh Foundation Case Inventory_v0.5.4.xlsm

3. NTEM v7.0 vs. Local Plan Inputs

This section compares Local Plan input data used in the current 2031 CSRM2 Foundation Case against recently published NTEM v7.0 values at a district level.

3.1. Dwellings / Households

Figure 1 & Table 3 below show the absolute difference between NTEM v7.0 and CSRM2, whilst Figure 2 compares the percentage growth in dwellings / households. Households are used for NTEM v7.0 as they are the closest published equivalent to dwellings.

The absolute totals across the two data sources are comparable in 2011 and 2015. Growth from 2011 to 2015 is based on actual dwelling completion figures provided by the districts. In 2031, Cambridge dwelling / household totals are higher in CSRM2 compared to NTEM v7.0, whereas in the other districts the absolute totals are lower in CSRM2.

In terms of percentage growth in dwellings / households between 2011 and 2031, differences are apparent between the two data sources. NTEM v7.0 growth is higher across all districts, most notably in East Cambridgeshire and Huntingdonshire.

Figure 1. Dwellings / Households Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (Absolute Values)

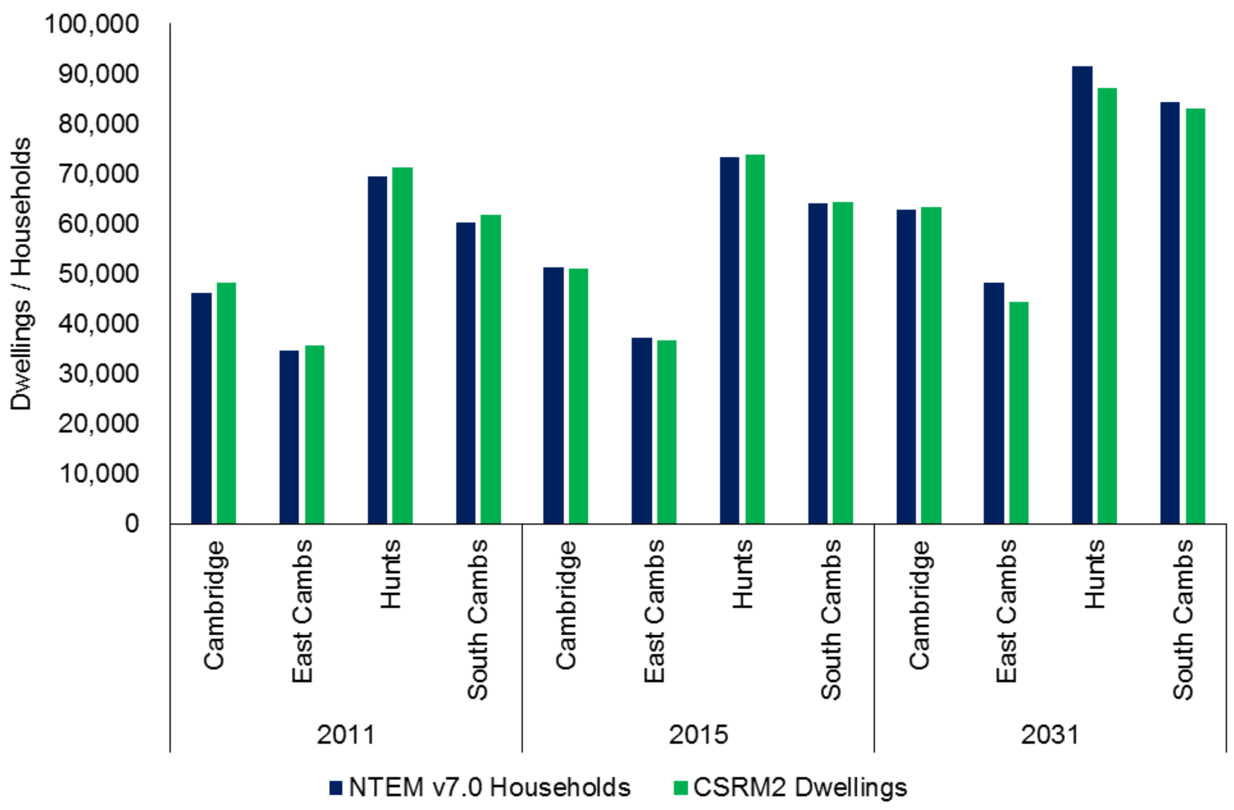
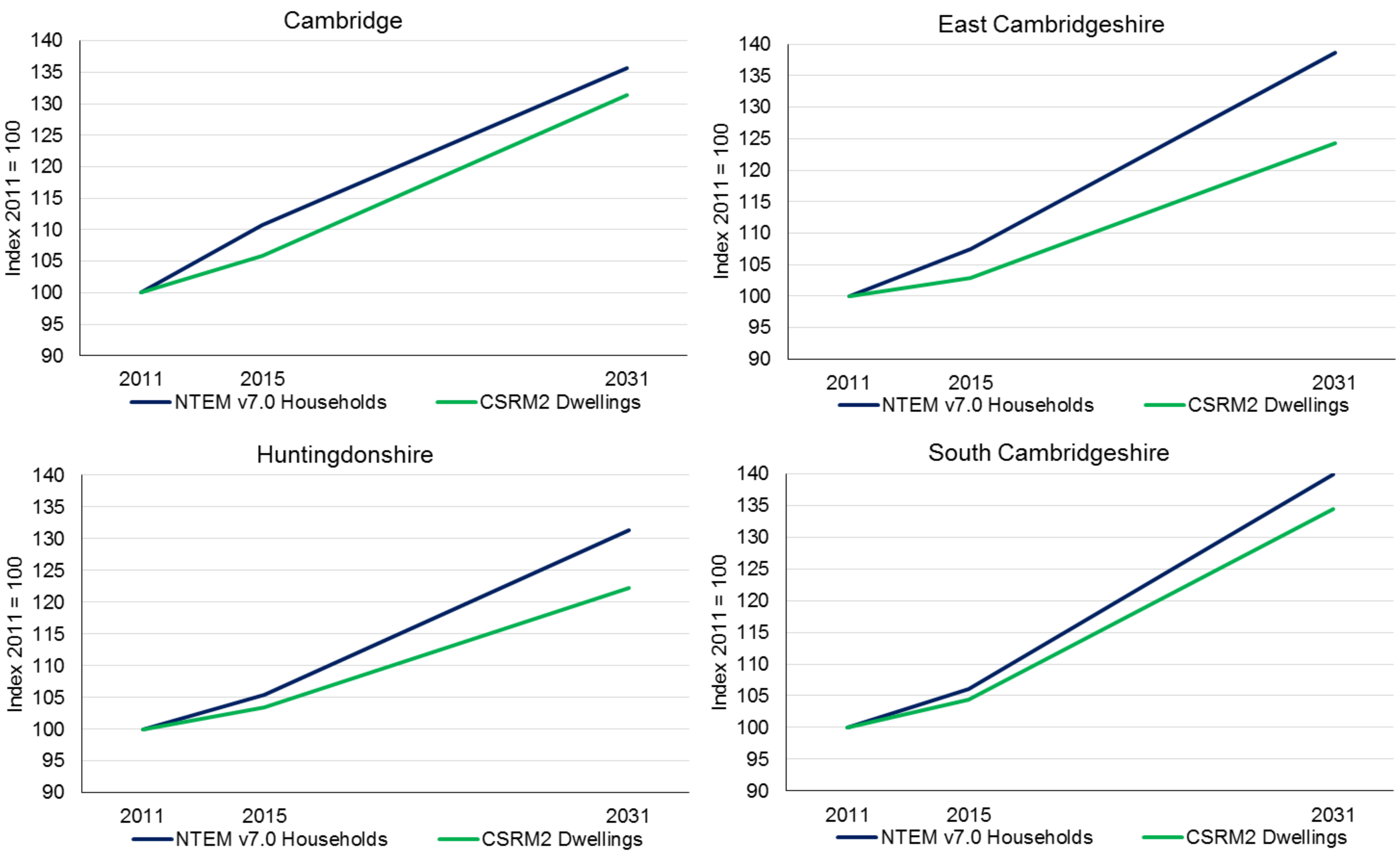


Table 3. Dwellings / Households Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (Absolute Values)

Year	District	NTEM v7.0	CSRM2
2011	Cambridge	46,291	48,288
	East Cambridgeshire	34,761	35,747
	Huntingdonshire	69,592	71,399
	South Cambridgeshire	60,404	61,724
2015	Cambridge	51,256	51,138
	East Cambridgeshire	37,335	36,759
	Huntingdonshire	73,375	73,875
	South Cambridgeshire	64,082	64,469
2031	Cambridge	62,830	63,470
	East Cambridgeshire	48,208	44,446
	Huntingdonshire	91,451	87,267
	South Cambridgeshire	84,452	83,005

Figure 2. Dwellings / Households Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (% Growth)



3.2. Employment

Figure 3 & Table 4 show the absolute difference between NTEM v7.0 and CSRM2, whilst Table 5 compares the growth in jobs.

Comparison of absolute employment figures is slightly problematic as the measurement of jobs differs between CSRM2 and NTEM. CSRM2 jobs are based on the workplace population reported in the 2011 Census, and therefore include only the 'first job' reported. NTEM however includes all jobs, including second and third jobs. This may not be the only difference in accounting for job numbers: comparisons in absolute terms are notoriously difficult. Therefore percentage growth as shown in Figure 4 is perhaps most helpful. The absolute charts do however show that employment in the CSRM2 Foundation Case (based on the Local Plan) overtakes NTEM in absolute terms in all districts by 2031.

In terms of percentage growth in employment, considerable differences are apparent between the two data sources. It is worth noting that the 2015 NTEM v7.0 values are a projection from 2011, whereas 2015 CSRM2 values are based on annual BRES data. Figure 4 shows that NTEM and CSRM2 have similar growth rates for 2011 to 2015, except for East Cambridgeshire where CSRM2 has higher growth between 2011 and 2031. CSRM2 shows a greater level of growth across all districts when compared against NTEM v7.0, most notably in East Cambridgeshire and Huntingdonshire.

Table 5 summarises the impact on jobs growth in CSRM2 terms should the NTEM v7.0 growth rates be applied. This shows that the overall employment growth would be 30,000 **less** for a scenario with NTEM growth rates applied.

Figure 3. Jobs Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (Absolute Values)

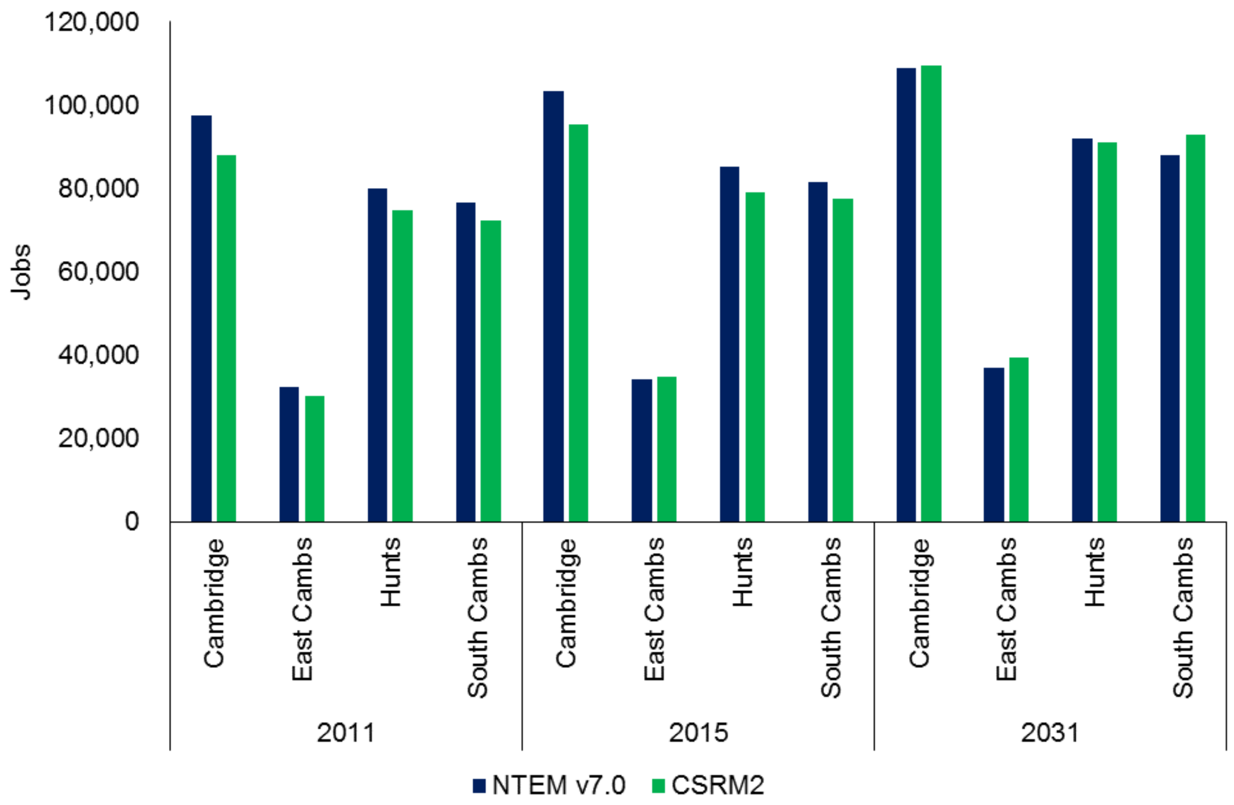


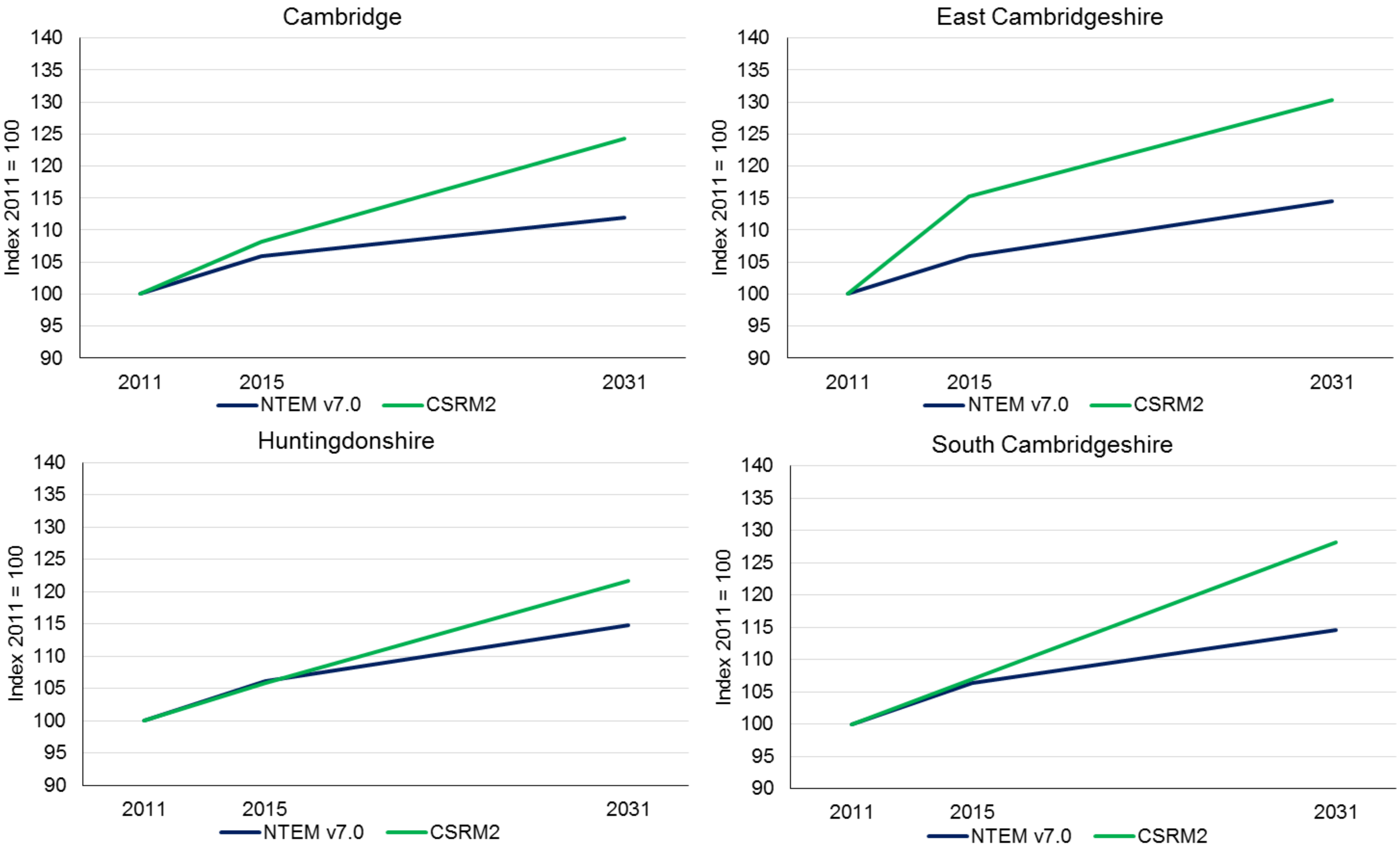
Table 4. Jobs Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (Absolute Values, note NTEM and CSRM2 jobs figures are not directly comparable)

Year	District	NTEM v7.0	CSRM2 Foundation Case
2011	Cambridge	97,445	88,145
	East Cambridgeshire	32,355	30,242
	Huntingdonshire	80,163	74,793
	South Cambridgeshire	76,787	72,487
	Total	**286,750**	**265,667**
2015	Cambridge	103,229	95,351
	East Cambridgeshire	34,286	34,875
	Huntingdonshire	85,134	79,114
	South Cambridgeshire	81,695	77,523
	Total	**304,344**	**286,863**
2031	Cambridge	109,049	109,615
	East Cambridgeshire	37,032	39,399
	Huntingdonshire	92,006	90,989
	South Cambridgeshire	88,003	92,912
	Total	**326,090**	**332,915**
2011-2031 Growth	Cambridge	11,604	21,470
	East Cambridgeshire	4,677	9,157
	Huntingdonshire	11,843	16,196
	South Cambridgeshire	11,216	20,425
	Total	**39,340**	**67,248**

Table 5. Impact of applying NTEM Jobs Growth to CSRM 2011 Employment

Year	District	CSRM2 (NTEM Growth)	Difference to Foundation Case
2031	Cambridge	98,642	-10,973
	East Cambridgeshire	34,614	-4,785
	Huntingdonshire	85,843	-5,146
	South Cambridgeshire	83,075	-9,837
	Total	**302,173**	**-30,742**

Figure 4. Employment Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (% Growth)



Technical note

3.3. Population and Household Size

Figure 5 & Table 6 show the absolute difference in population between NTEM v7.0 and CSRM2, whilst Figure 6 compares the growth in population and Figure 7 compares population per dwelling (CSRM2) / household (NTEM v7.0). As discussed in section 1.4, population growth in CSRM2 is directly related to the combination of dwelling growth and the population per dwelling, therefore comparing trends in population per dwelling at the district level is helpful to understand what is driving population trends.

The absolute totals across the two data sources are comparable in 2011 and 2015. In 2031, Cambridge population is greater in CSRM2 compared to NTEM v7.0, whereas in the other districts the absolute totals are lower in CSRM2.

In terms of growth in population between 2015 and 2031, differences are apparent between the two data sources. CSRM2 shows a greater level of growth in Cambridge and South Cambridgeshire when compared against NTEM v7.0, whereas growth in East Cambridgeshire and Huntingdonshire is lower in CSRM2.

In regards to population per dwelling / household, both CSRM2 and NTEM assume a fall over time, and show similar levels of change to 2015 and 2031. This trend will tend to lower the overall population growth for a given amount of housing increase, and is in line with long-term trends. Cambridge City, and to a lesser extent South Cambridgeshire, have a weaker decreasing trend in CSRM2 than NTEM. This is due to projections made during the South Cambridgeshire and Cambridge City Local Plan work with CSRM1, which assumed that high competition for housing in those Districts would lead to more stable housing occupancy.

Figure 5. Population Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (Absolute Values)

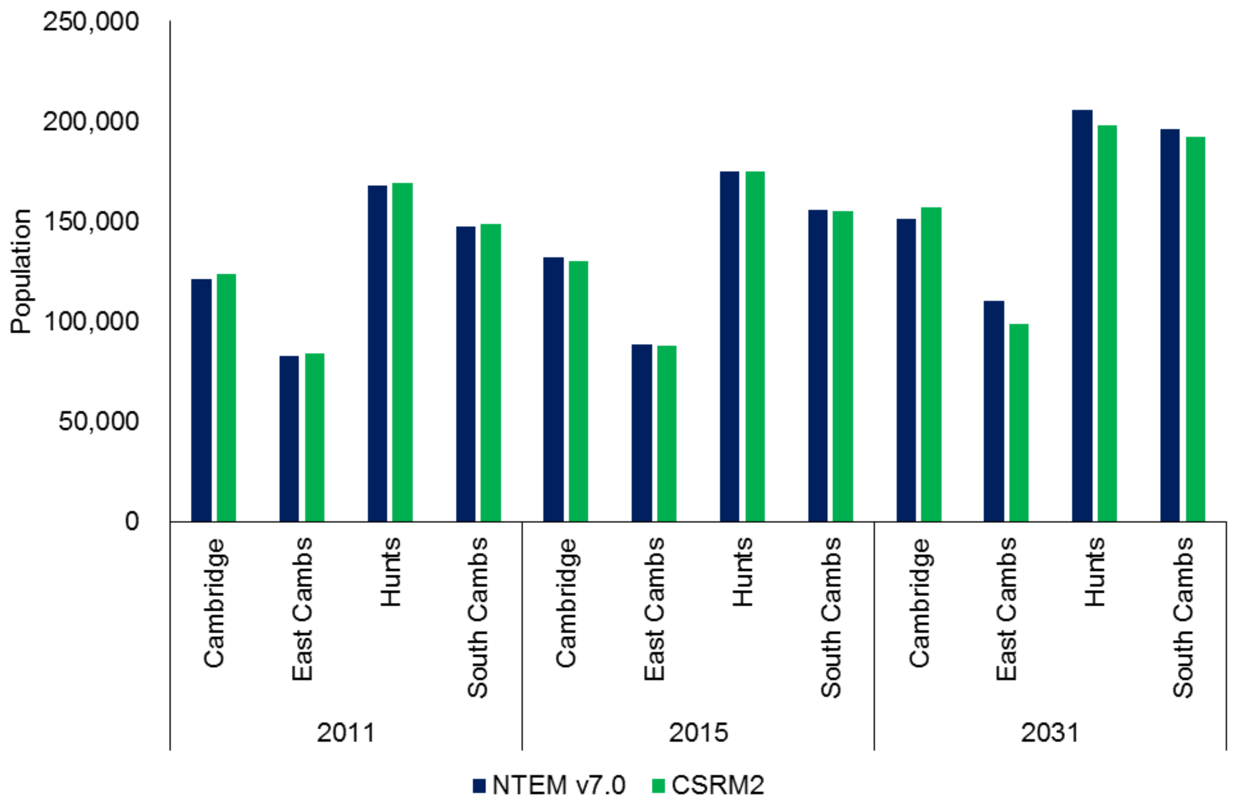


Table 6. Population Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (Absolute Values)

Year	District	NTEM v7.0	CSRM2
2011	Cambridge	121,463	123,867
	East Cambridgeshire	82,677	83,818
	Huntingdonshire	168,270	169,508
	South Cambridgeshire	147,427	148,755
2015	Cambridge	132,282	130,132
	East Cambridgeshire	88,523	87,746
	Huntingdonshire	174,895	175,079
	South Cambridgeshire	155,731	155,208
2031	Cambridge	151,073	157,237
	East Cambridgeshire	110,262	98,900
	Huntingdonshire	206,071	198,166
	South Cambridgeshire	196,327	192,422

Figure 6. Population Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (% Growth)

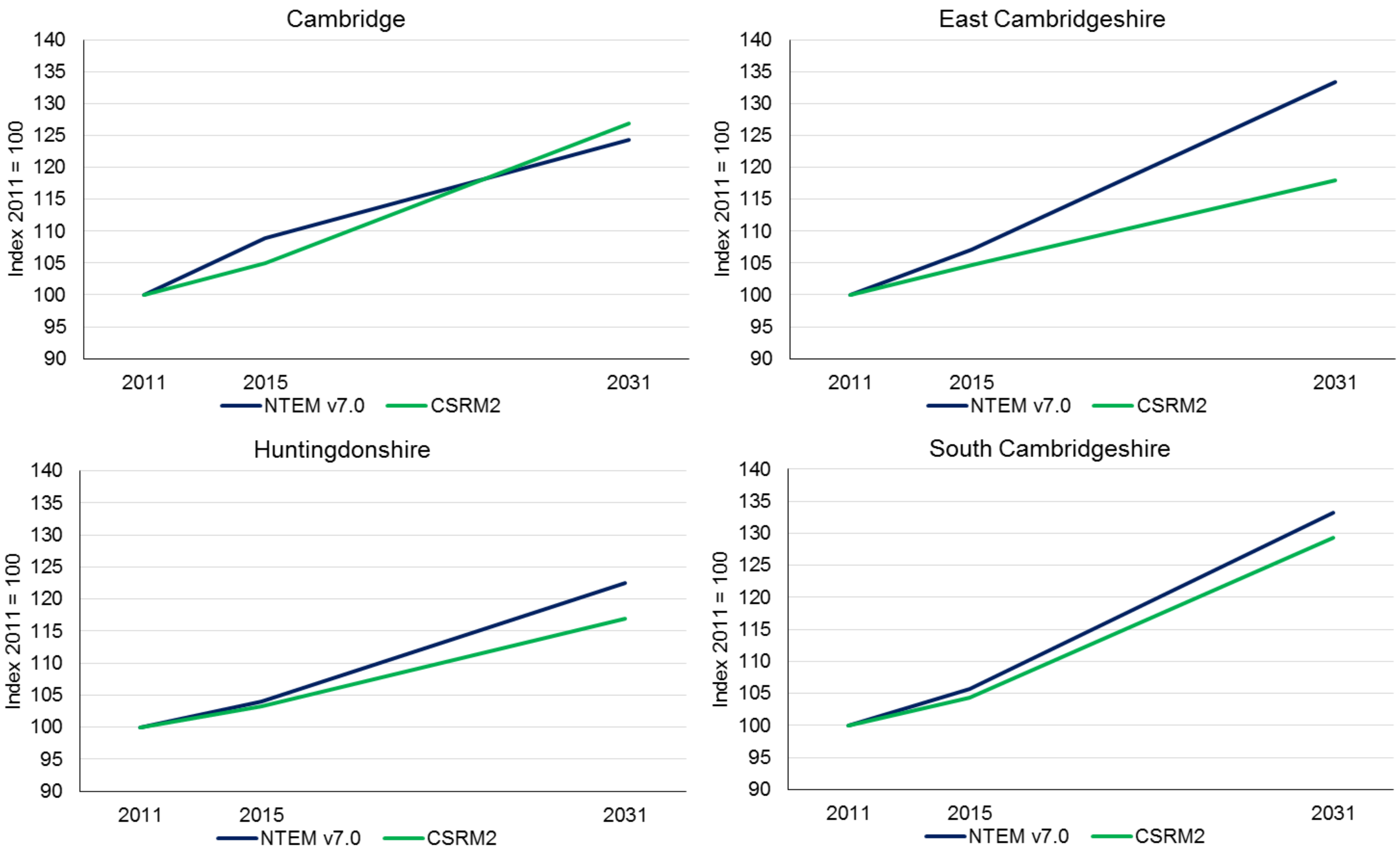
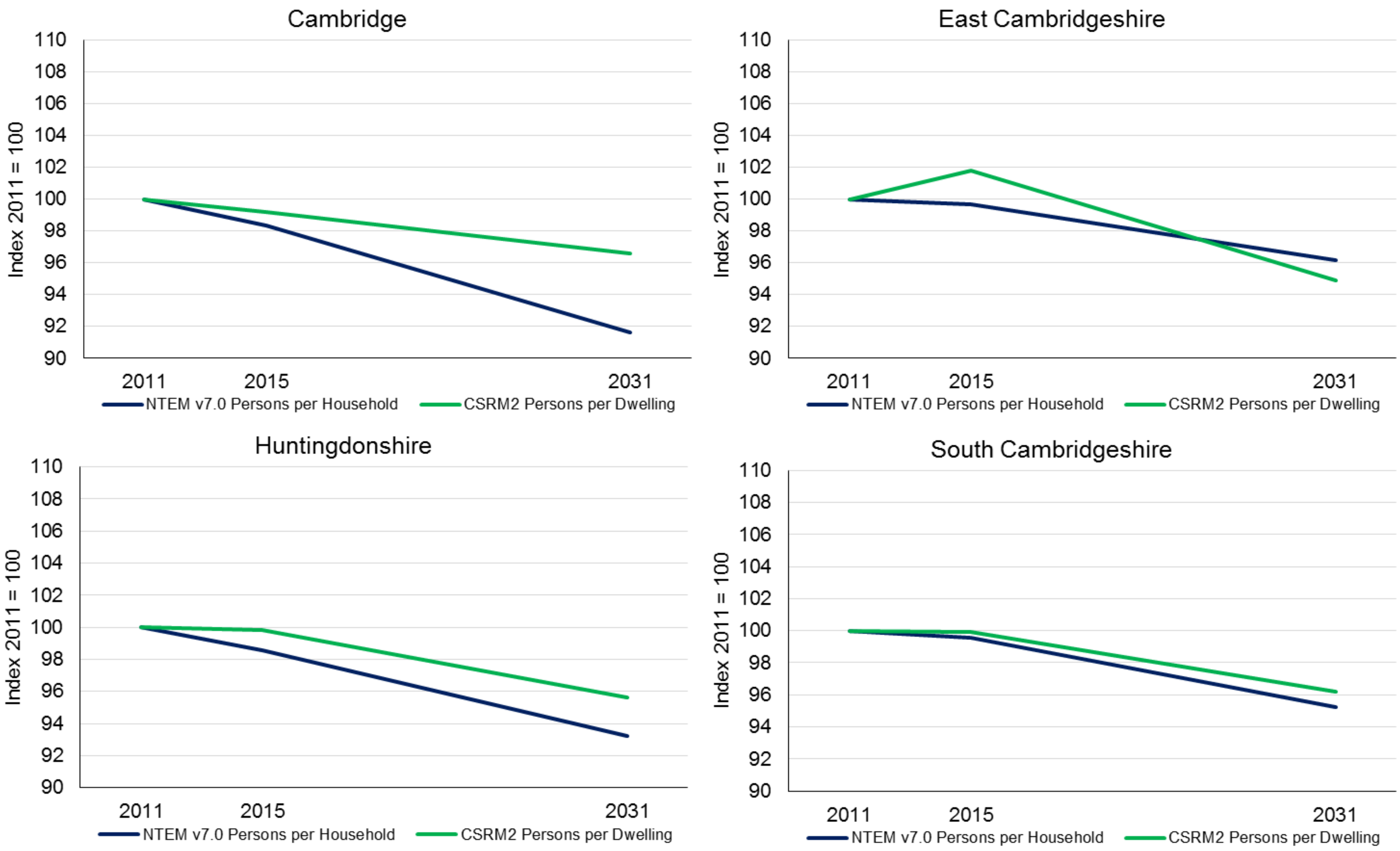


Figure 7. Population per Dwellings / Households Comparison - NTEM v7.0 vs. CSRM2 Foundation Case (% Growth)



3.4. Working Population (Workers)

There is no firm assumption for the Foundation Case as yet regarding the growth in the number of workers. This is a particularly difficult issue due to the very strong decreasing trend included in NTEM, which was not reflected in the CSRM1 work carried out for the Local Plan.

The difference arises because NTEM is using a very wide area demographic trend, and also assuming a lower growth in local jobs, which can be serviced with a smaller working population. For the CSRM1 Local Plan work, investigation of the 2001 and 2011 Census was used to demonstrate that Cambridge City and South Cambridgeshire had a stable or growing working population, and this trend was applied.

The impact is that the CSRM1 Local Plan work projected a 4% increase in the proportion of Cambridge residents employed, compared with a 5% fall in NTEM v7.0 0 (Table 7). The other Districts had declines in CSRM1, but of a smaller magnitude than for NTEM v7.0.

The overall study area impact is an 8% relative difference in the proportion of workers. Given population projections of approximately 650,000 for the study area by 2031, this equates to a gap of over 50,000 workers available in the CSRM1 Local Plan, which would not be available under NTEM assumptions.

Depending on the employment assumptions used, this difference will have large implications for in/out-commuting which are discussed in the next section.

Table 7. Percentage of population which is working (NTEM 'Workers')

		2011	2031	Change
Cambridge	NTEM v7.0	48%	43%	-5%
	CSRM1 LP	48%	52%	4%
East Cambridgeshire	NTEM v7.0	52%	44%	-8%
	CSRM1 LP	50%	48%	-2%
Huntingdonshire	NTEM v7.0	52%	43%	-9%
	CSRM1 LP	51%	49%	-1%
South Cambridgeshire	NTEM v7.0	53%	44%	-9%
	CSRM1 LP	51%	49%	-2%
Total	NTEM v7.0	51%	43%	-8%
	CSRM1 LP	50%	50%	0%

3.5. In / Out-commuting

As discussed in section 1.4, the levels of in and out-commuting are of great importance in determining future trip ends, as in- and out-commuting form 32% of all commuting trips, based on 2011 Census figures. Where alternative levels of growth lead to differing levels of employment and population growth, understanding the differences becomes even more critical.

The in and out-commuting must be in balance with the number of internal jobs and workers. However, there is no firm mechanism available to determine the total number of future in and out-commuting trips, as to some extent these balance each other. For example, a rise in internal jobs could result in any of the following (or a combination):

(a) a rise in in-commuting,
(b) a fall in out-commuting,
(c) a rise in the total number of workers.

Table 8 below compares the future in and out-commuting which might arise comparing Local Plan and NTEM-based growth scenarios. For convenience this is presented in the form of a 2x2 matrix but note that this does NOT represent numbers of trips, but instead the relevant number of works in each category:

	Internal Jobs	External Jobs
Internal Workers	Workers living and working internally	Out-commuters: workers living internally, filling external jobs
External Workers	In-commuters: workers living externally, filling internal jobs	Workers living and working externally, not represented in the model

In this example, 2031 figures are shown using either Local Plan levels or NTEM levels of growth for workers and jobs, but from the same (2011 Census) base.

The table shows differences in work and jobs growth between the two methods in line with the charts shown above, with Local Plan having higher growth than NTEM in both internal workers (48,191 vs 18,089) and internal jobs (67,248 vs 36,506). However, in both cases the rise in internal jobs is approximately 19,000 higher than the rise in internal workers.

To balance the jobs and worker growth, it has been assumed that the proportion of the internal workers who out-commute remains fixed (at 18%), and that additional in-commuters are created to create account for the gap in workers needed to fill internal jobs. This leads to a rise in the proportion of jobs filled by in-commuters, from 17% in 2011, to 22% in 2031 (in both scenarios)

Note that the percentage rise in trips implied is greater using Local Plan growth than NTEM, an overall growth of 24% vs 13%, with the growth in in-commuting being 62% and 49% respectively. The overall difference absolute terms is ~35,000 home-work pairs, equivalent to around 25,000 daily commuting trips. [4]

[4] Note that it is also possible to assume that the number of out-commuters rises less rapidly, or remains fixed, leading to a smaller rise in in-commuting, and less travel overall. At the extreme out-commuting could be assumed to remain fixed, reducing the proportion of the population who out-commute.

Table 8. Balance of internal and external works and jobs, illustrating impact of NTEM vs Local Plan jobs growth, with worker growth based on NTEM, with jobs growth either from Local Plan or NTEM.

			Jobs (workplace)					
			2011			2031		
Workers (home)	Local Plan Growth		Internal	External	Total	Internal	External	Total
		Internal	221,343	47,329	268,672	261,045	55,818	316,863
		External	44,324	n/a	44,324	71,871	n/a	71,871
		Total	265,667	47,329	312,996	332,915	55,818	388,733
	NTEM Growth		Internal	External	Total	Internal	External	Total
		Internal	As above (Census-based)			236,246	50,515	286,761
		External				65,927	n/a	65,927
		Total				302,173	50,515	352,688
			2011-2031 Growth			2011-2031 Growth (%age)		
Workers (home)	Local Plan Growth		Internal	External	Total	Internal	External	Total
		Internal	39,702	8,489	48,191	18%	18%	18%
		External	27,546	n/a	27,546	62%	n/a	62%
		Total	67,248	8,489	75,738	25%	18%	24%
	NTEM Growth		Internal	External	Total	Internal	External	Total
		Internal	14,903	3,187	18,089	7%	7%	7%
		External	21,603	n/a	21,603	49%	n/a	49%
		Total	36,506	3,187	39,692	14%	7%	13%

3.6. Conclusion

This section has compared the implications of Local Plan—based and NTEM v6.2- based growth on the drivers of trip end growth. This has shown that:

- The Local Plan-based growth leads to considerably higher growth in commuting trips, likely to be 24% from 2011-2031, compared with 13% using NTEM v6.2. This is equivalent to an estimated difference of ~25,000 commuting trips per day, though this would need confirming in the final model;
- The difference arises because both the number of workers and the number of jobs in the study area grow more rapidly in the Local Plan assumptions than in NTEM;
- The number of additional dwellings and population growth are however similar in NTEM and the Local Plan, except for East Cambridgeshire (for which Local Plan assumptions are being reviewed);
- The higher growth in workers in the Local Plan-based assumptions arises due to different assumptions on the proportion of the population who are working: NTEM v7.0 assumes this proportion falls by 8%, whereas for the Local Plan the overall proportion is static (rising in Cambridge);
- Both NTEM and the figures derived for CSRM2 show a more rapid employment growth from 2011-2015 than in the period 2015-2031. This has been discussed with CCC Research Group and the Atkins NTEM team, and is considered to be a realistic assumption, related to bounce-back from the recession.

It can be concluded from this that the NTEM and Local Plan assumptions on jobs and workers need to be taken together: applying NTEM assumptions on worker growth, with Local Plan growth in jobs would lead to an increased gap between jobs and workers, of a further 30,000. This would need to be made up either with additional in-commuting and/or a very large reduction in the number of out-commuters.

It appears very likely that the strategic and economic business cases could be influenced by the extent of these differences, though the implications and likely actions would be a matter for CCC and the City Deal scheme consultants to consider.

No judgement can be made in the current document on the credibility or appropriateness of either the Local Plan or NTEM growth assumptions. However, it is recommended that the following is considered:

- Whether there is a case to be made for applying locally sourced employment growth in place of NTEM;
- To what extent the NTEM assumption of decreasing proportions of working population are relevant to the Cambridge Sub Region;
- Whether sensitivity tests should be conducted early in the A10 work or other City Deal studies to test impacts of differing assumptions.

However, at present it should be possible to proceed with NTEM v7.0 assumptions for the beginning of this work, noting the likely differences to the Foundation Case Scenario.

4. A10 North Do Minimum Scenario Inputs

Mott MacDonald have proposed four A10 North development scenarios to be modelled in CSRM2 as summarised in Table 9 below which is taken from the modelling brief (A10 Modelling Strategy v8.7). This section outlines the proposed methodology for preparing inputs to the trip end generation process for each scenario.

Table 9. A10 North Development Scenarios

Scenario	Description	Specification
1	Without development	Foundation Case (Cambridge / South Cambridgeshire Local Plan scenario + Transport Schemes committed / expected to 2031) with trip ends adjusted to TEMPro minus any growth at Waterbeach New Town and CNFE / CSP and related transport schemes.
2	Waterbeach New Town Only	As per Scenario 1 but with Waterbeach New Town full build out to 2031.
3	CNFE Develop Options / CSP Only	As per Scenario 1 but with a level of CNFE / CSP growth to be advised.
4	Waterbeach and CNFE Developer Option / CSP	As per Scenario 1 but with Waterbeach New Town full build out to 2031 and a level of CNFE / CSP growth to be advised.

4.1. Constraining to NTEM Trip Ends

Based on the guidance discussed in Section 1.3, it is proposed to apply the NTEM constraint at the level of total all day trip ends by purpose, for the Study Area as a whole (rather than individual districts). The growth constraint will be applied for internal Production and Attraction trip ends, in terms of percentage growth only: i.e. the number of 2031 trip ends input to CSRM2 will equal:

CSRM2 2011 Trips Ends x (NTEM 2031 Trip Ends / NTEM 2011 Trip Ends)

As outlined in Section 3 above, this will lead to a smaller number of commuting trips. There will also be changes in numbers of other trips, but this should be less marked as the total population growth would be similar.

This constraint will be applied in an identical manner for the internal trip ends across each of the scenarios, so that each scenario will maintain the same number of internal Production and Attraction trip ends by purpose. The number of external commuting trip ends (in and out-commuting) will be adjusted at the worker and job level using the method described in Section 3.5, which will also create identical results for all scenarios.

Therefore the tests will reflect differences in **distribution of growth**, rather than changes in the overall trip ends. This is broadly suitable for calculation of economic benefits (though it is understood that no such analysis is proposed at present), though the precise method outlined here should be considered by the scheme consultant and agreed as satisfactory with the DfT.

Caveats

As outlined in Section 3.6, it is recommended that some strategic investigation of the impact of Local Plan assumptions is considered.

Atkins are aware that larger scale growth at Waterbeach and CNFE is potentially to be considered post-2031. It should be noted that where this includes very large changes in employment WITHOUT commensurate

It should be noted that the scaling of Trip Ends will produce slight variations in the number of trips to/from zones around the A10 corridor which in terms of Land Use inputs are fixed. Moreover, the development zones themselves will also have their trip ends scaled as part of the process, though the impact is likely to be small.

4.2. Scenario 1 – Without Development

This scenario removes all development at the key sites on the A10 North corridor form the 2031 Foundation Case. Trip ends are then scaled to 2011 Census plus TEMPro 2011-2031 growth.

- Dwelling and employment growth at the key A10 North corridor developments of Waterbeach New Town, CSP and CNFE (see Table 2) will be removed.

4.3. Scenario 2 – Waterbeach New Town Only

This scenario tests in isolation the impact of introducing the Waterbeach New Town development. As in Scenario 1 all development at the key sites on the corridor will be removed, then the proposed scale of development at Waterbeach reintroduced. Trip ends are then scaled to 2011 Census plus TEMPro 2011-2031 growth.

- Dwelling and employment growth at the key A10 North corridor developments of Waterbeach New Town, CSP and CNFE (see Table 2) will be removed.
- Add in the development dwelling and employment assumptions for Waterbeach New Town as detailed in Table 2 of brief. This comprises of 10,000 new dwellings and 6,033 jobs (total jobs excluding homeworking jobs). This represents a significantly different distribution of growth in Waterbeach compared to Local Plan assumptions, which had growth of 2,050 new dwellings and 1,300 employment over the same time period. Employment types will be applied as detailed in Table 2 of brief.

4.4. Scenario 3 – CNFE Developer Options / CSP Only

This scenario tests in isolation the impact of introducing the CNFE Develop Options and CSP development. As in Scenario 1 all development at the key sites on the corridor will be removed, then the proposed scale of development at CNFE/CSP reintroduced. Trip ends are then scaled to 2011 Census plus TEMPro 2011-2031 growth.

- Dwelling and employment growth at the key A10 North corridor developments of Waterbeach New Town, CSP and CNFE (see Table 2) will be removed.
- Add in the development dwelling and employment assumptions CNFE / CSP only. **The scale of development at these sites to be confirmed following analysis of Scenario 1 and 2 outputs.**

4.5. Scenario 4 – Waterbeach and CNFE Developer Option / CSP

This scenario tests the combination of development at both Waterbeach New Town and CNFE/CSP. As in Scenario 1 all development at the key sites on the corridor will be removed, then the proposed scale of development at Waterbeach and CNFE/CSP reintroduced. Trip ends are then scaled to 2011 Census plus TEMPro 2011-2031 growth.

- Dwelling and employment growth at the key A10 North corridor developments of Waterbeach New Town, CSP and CNFE (see Table 2) will be removed.
- Add in the development dwelling and employment assumptions for Waterbeach New Town as summarised under Scenario 2.
- Add in the development dwelling and employment assumptions CNFE / CSP only. The scale of development at these sites to be confirmed following analysis of Scenario 1 and 2 outputs.

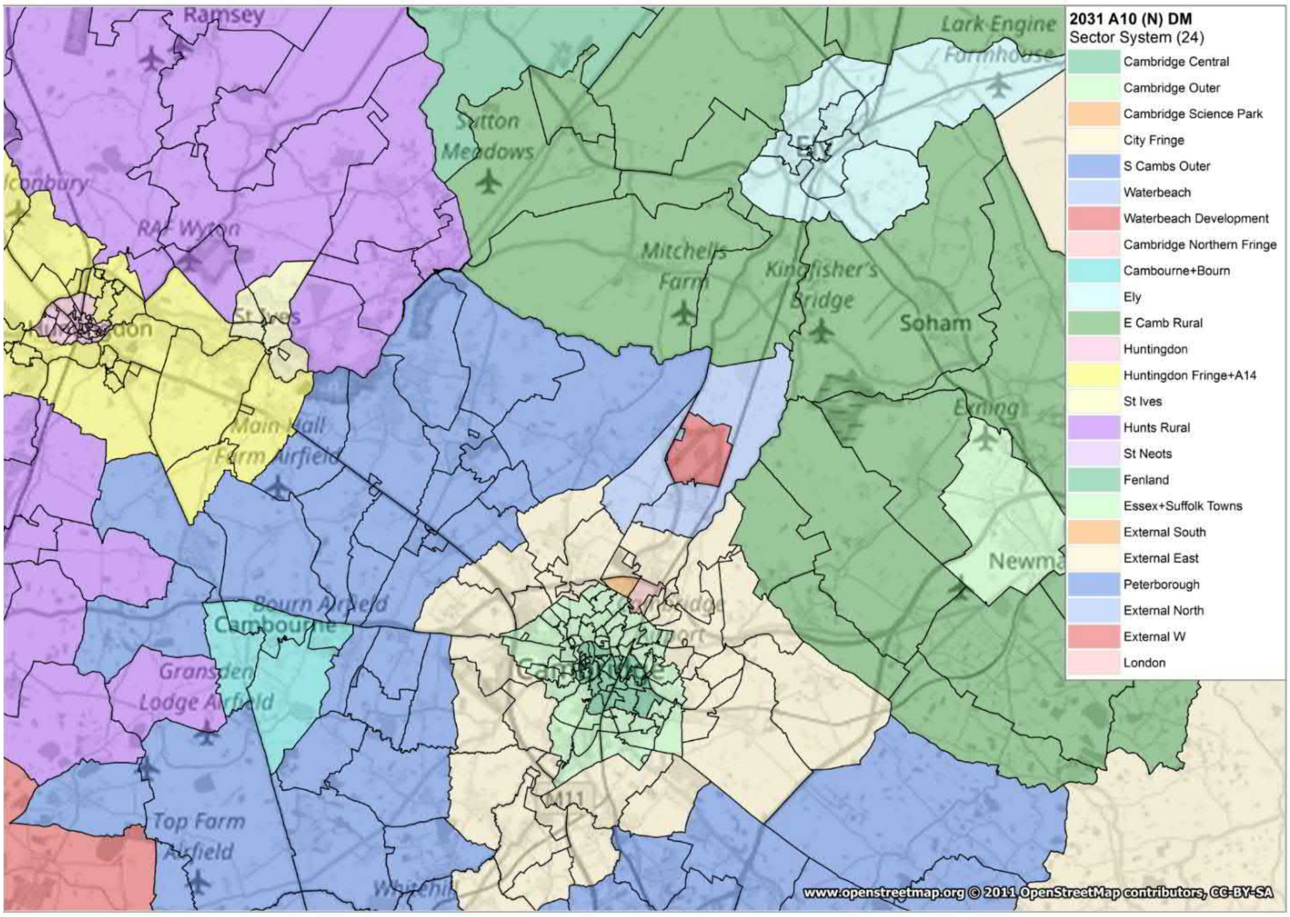
5. Summary and Conclusions

This document presents 2031 Foundation Case inputs, drawing on comparisons against NTEM v7.0 in order to highlight differences between the two sets of growth assumptions. In regards to percentage growth in dwellings, employment and population between 2011 and 2031, differences are apparent between the two data sources. In general, growth in dwellings is higher in NTEM v7.0, but growth in employment is lower. Population is a function of the number of dwellings, thus a similar trend exists. The adoption of NTEM v7.0 employment and dwelling growth will affect trip end totals, especially the volume of in and out commuter trips in the model.

For each of the 2031 A10 North DM scenarios methodologies are discussed and recommendations have been provided on the preferred approach. This technical note should be the basis for seeking agreement on the proposed methodology from both CCC and Mott MacDonald before work can be progressed.

C. CSRM Sector System

Figure 67: CSRM Sector System for Cambridgeshire



Source: Atkins

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