AECOM

Milton Keynes Multi-Modal Transport Model

Milton Keynes City Plan Forecasting Report

Milton Keynes City Council

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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1. Overview

1.1 Introduction

1.1.1 AECOM was commissioned by Milton Keynes City Council (MKCC) to test the growth associated with the forthcoming Milton Keynes City Plan 2050 (MKCP) using the Milton Keynes Multi-Modal Model (MKMMM).

1.1.2 The base year for the MKMMM is 2019. A set of forecast models was developed for the years 2031, 2040 and 2050 using core growth scenario assumptions. The assumptions and model outputs for the latest Forecast Reference Case scenarios for 2031, 2040 and 2050 are documented in a Traffic Forecasting Report (TFR)[1].

1.1.3 In addition to the TFR, the following MKMMM base model reports are of relevance:

- Milton Keynes Multi-Modal Model, Demand Model Development Report, v2.0, 03/05/2023[2].
- Milton Keynes Multi-Modal Model, Highway Local Model Validation Report, v2.0, 05/05/2023[3].
- Milton Keynes Multi-Modal Model, Public Transport Model Local Model Validation Report, v2.0, 04/05/2023[4].

1.2 Purpose of the Report

1.2.1 This Forecasting Report describes the processes adopted to develop the 2050 MKCP forecast models together with details of the supporting analysis.

1.2.2 The remainder of this report is structured as follows:

- Chapter 2 - Forecasting Assumptions;
- Chapter 3 - Variable Demand Model and Highway Assignment Model Statistics;
- Chapter 4 - Milton Keynes City Plan Forecast Model Outputs; and
- Chapter 5 - Summary

[1] '*Milton Keynes Multi-Modal Model 2019 - Forecasting Report v3.1.pdf*'
[2] '*Milton Keynes Multi-Modal Model 2019 – Demand Model Development Report v2.0.pdf*'
[3] '*Milton Keynes Multi-Modal Model 2019 – Highway LMVR v2.0.pdf*'
[4] '*Milton Keynes Multi-Modal Model 2019 – Public Transport LMVR v2.0.pdf*'

2. Forecasting Assumptions

2.1 Introduction

2.1.1 This chapter details the assumptions adopted in preparing the MKCP scenario forecast models. This includes information on the MKCP growth assumptions, highway network amendments, the uncertainty log and the forecast economic parameters.

2.1.2 The following two forecast scenarios were requested to be prepared and run as part of the assessment of the proposed MKCP impacts, one of which also includes the proposed Mass Rapid Transit (MRT) scheme for Milton Keynes[5].

- Priority 1 – MKCP scenario tests in 2050 with the MRT (MKCPM2050).
- Priority 2 – MKCP scenario tests in 2050 without MRT and without MRT associated housing developments – sensitivity test (MKCP2050).

2.1.3 Several MKMMM scenarios are referred to in this report. The notations used are:

- Base 2019 - Base Year 2019;
- RC2023 - Reference Case 2023;
- RC2031 - Reference Case 2031;
- RC2040 - Reference Case 2040;
- RC2050 - Reference Case 2050;
- 2050 P1 - 2050 MKCP model with MRT (MKCPM2050); and
- 2050 P2 - 2050 MKCP model without MRT (NCP2050).

2.1.4 Table 2-1 summarises the characteristics of the MKMMM suite, including the model time periods and forecast years.

[5] https://mkmrt.commonplace.is/

Table 2-1: MKMMM Modelling Suite Summary of Characteristics and Assumptions

Characteristic	MKMMM Suite
Model Structure	Highway assignment model Public transport model Parking model 24 hour production-attraction variable demand model
Software Platforms	Highway assignment model: SATURN version 11.5.05N Public transport model: Emme v4.3.5 Variable demand model: Emme v4.3.5
Time Periods	Highway assignment model: *AM Peak hour (08:00 to 09:00)* *Interpeak representing an average hour (between 09:00 to 16:00)* *PM Peak hour (17:00 to 18:00)* Public transport model: *AM Peak period (07:00 to 09:00)* *Interpeak period (09:00 to 16:00)* *PM Peak period (16:00 to 19:00)* Variable demand model: *24-hour*
Trip Matrices (private transport modes)	User Class 1 – Heavy Goods Vehicle (HGV) User Class 2 – Light Goods Vehicle (LGV) User Class 3 – Car Business User Class 4 – Car Other User Class 5 – Car Commuting
Trip Matrices (public transport modes)	Bus Rail
Trip Matrices (active mode)	Active
PCU[6] Factors	User Class 1 (HGV) – 2.0, Bus[7] – 2.0, all other user classes 1.0
Base Year	2019
Forecast Years	2031, 2040, 2050

2.1.5 The MKMMM highway model covers all Great Britain, with the links outside the fully modelled area represented as fixed-speed buffer links within SATURN. Figure 2-1 shows the simulation network (in black), and the buffer network (in red) in the 2019 MKMMM base year highway network. The simulation / buffer network definitions for the forecast years are unchanged from the base model.

[6] Passenger Car Unit
[7] Bus routes and their service frequency are included in the model

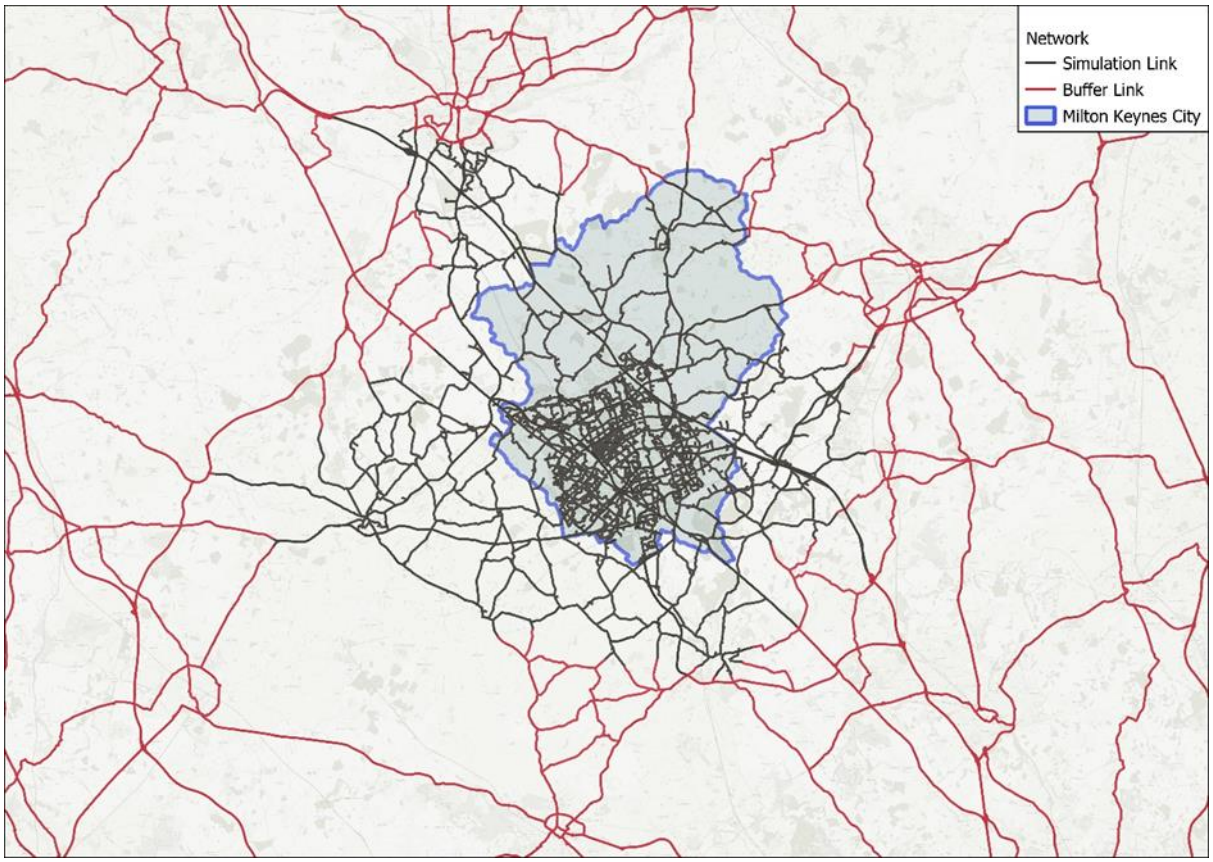

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Figure 2-1: Highway Modelled Area

2.2 Uncertainty Log

2.2.1 The purpose of the Uncertainty Log (UL) is to collate a list of assumptions relating to future development proposals that includes a level of certainty as to how likely they are to be built. This UL is used to inform the forecast year scenarios.

2.2.2 For the Reference Case, an uncertainty log for highway, public transport and parking schemes already exists. No updates were made for the Reference Case 2031, 2040 and 2050 Uncertainty Log (UL) which are documented in the Traffic Forecasting Report (TFR)[8].

2.2.3 MKCC supplied a list of MKCP growth assumptions for homes and employment by zone for 2050, which are in addition to the Reference Case data. The MKCP scenario runs included these assumptions, in addition to the developments included in the Reference Case.

2.2.4 All the MKCP development data is included in the model, irrespective of their uncertainty. This reflects the proposed use of these model scenarios in the forthcoming Local Plan assessment and the need to represent MKCC's most up to date view of future development growth.

[8] Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025

2.3 Growth Assumptions – Dwellings

2.3.1 No updates were made for the Reference Case 2031, 2040 and 2050 Uncertainty Log (UL) for dwellings and employment which are detailed in the Traffic Forecasting Report (TFR)[9].

2.3.2 Table 2-2 and Table 2-3 show the MKCP growth assumptions for the number of dwellings by sector for the 2050 Priority 1 and 2050 Priority 2 scenarios. By 2050, a total of approximately 33,743 dwellings has been included in the UL for 2050 Priority 1. For 2050 Priority 2, around 2,516 MRT-related dwellings were removed. Of the total dwellings, the majority (12,279) are expected to be located in Central Milton Keynes (CMK), followed by 7,750 dwellings in the eastern area of Milton Keynes.

Table 2-2 MK City Plan 2050 Housing Allocations - 2050 Priority 1

Sectors	Housing Allocations[10]
CMK	12,279
Internal East	7,750
Bletchley	3,423
Internal South	3,045
Furzton - Shenley -Crownhill - Fairfields	1,927
Kingsmead/Grange Farm	1,418
Oldbrook - Eagle stone - Netherfield	1,293
Campbell Park/Newlands	812
Internal West	800
Wolverton	400
Oakridge Park - Giffard Park	380
Monkston	229
Walton Park/Wavendon	208
Internal North	-221
Grand Total	**33,743**

Table 2-3 MK City Plan 2050 Housing Allocations - 2050 Priority 2

Sectors	Housing Allocations
CMK	12,279
Internal East	7,750
Bletchley	3,186
Internal South	3,045
Kingsmead/Grange Farm	1,392
Furzton - Shenley -Crownhill - Fairfields	1,244
Campbell Park/Newlands	812
Internal West	800
Wolverton	400
Monkston	229
Walton Park/Wavendon	208
Oakridge Park - Giffard Park	90

[9] Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025
[10] The total number of dwellings reflects the removal and modification of housing units as required.

Oldbrook - Eagle stone - Netherfield	13
Internal North	-221
Grand Total	**31,227**

2.4 Growth Assumptions – Employment

2.4.1 Table 2-4 presents the MKCP growth assumptions for employment by sectors for 2050. A total of 31,663 additional jobs are projected to be created by 2050, with the majority (15,030 jobs) expected in Central Milton Keynes, followed by 9,204 jobs in the eastern area of Milton Keynes as part of the Eastern Strategic City Extension (ESCE). It should be noted that the MKCP employment growth assumptions remain the same between the 2050 Priority 1 and 2050 Priority 2 scenarios.

Table 2-4: MK City Plan 2050 Employment Allocations - 2050

Sectors	Employment Allocations (Jobs)[11]
CMK	15,030
Internal East	9,204
Furzton - Shenley -Crownhill - Fairfields	3,907
Oldbrook - Eagle stone - Netherfield	1,103
Kingsmead/Grange Farm	491
Heelands/Stantonbury/Neathhill	488
Wolverton	460
Fox Milne/Willen/Tongwell	200
Loughton - Kiln Farm	184
Campbell Park/Newlands	183
Walton Park/Wavendon	164
Bletchley	107
Kingston/Broughton	99
Monkston	40
Oakridge Park - Giffard Park	6
Internal North	-3
Grand Total	**31,663**

2.5 Heat Intensity Plots

2.5.1 'Heat' intensity plots for housing development assumptions are shown for Priority 1 and Priority 2 in Figure 2-2 and Figure 2-3 respectively. Housing development is planned all around Milton Keynes and in areas around the town centre, A5, A421, Watling Street and north of the M1 around the A509 and A422 corridors. It should be noted that housing development in proposed urban extensions falling within the neighbouring planning authorities' areas are not included in the tables above, nor are shown in the plots. There are also areas where demolitions and changes in use are planned which lead to housing reductions.

2.5.2 Figure 2-4 indicates employment development assumptions, with the greatest development around the A5 and Watling Street corridors. Employment assumptions are consistent between Priority 1 and Priority 2.

[11] The total number of jobs reflects the removal and modification of employment sites as required.

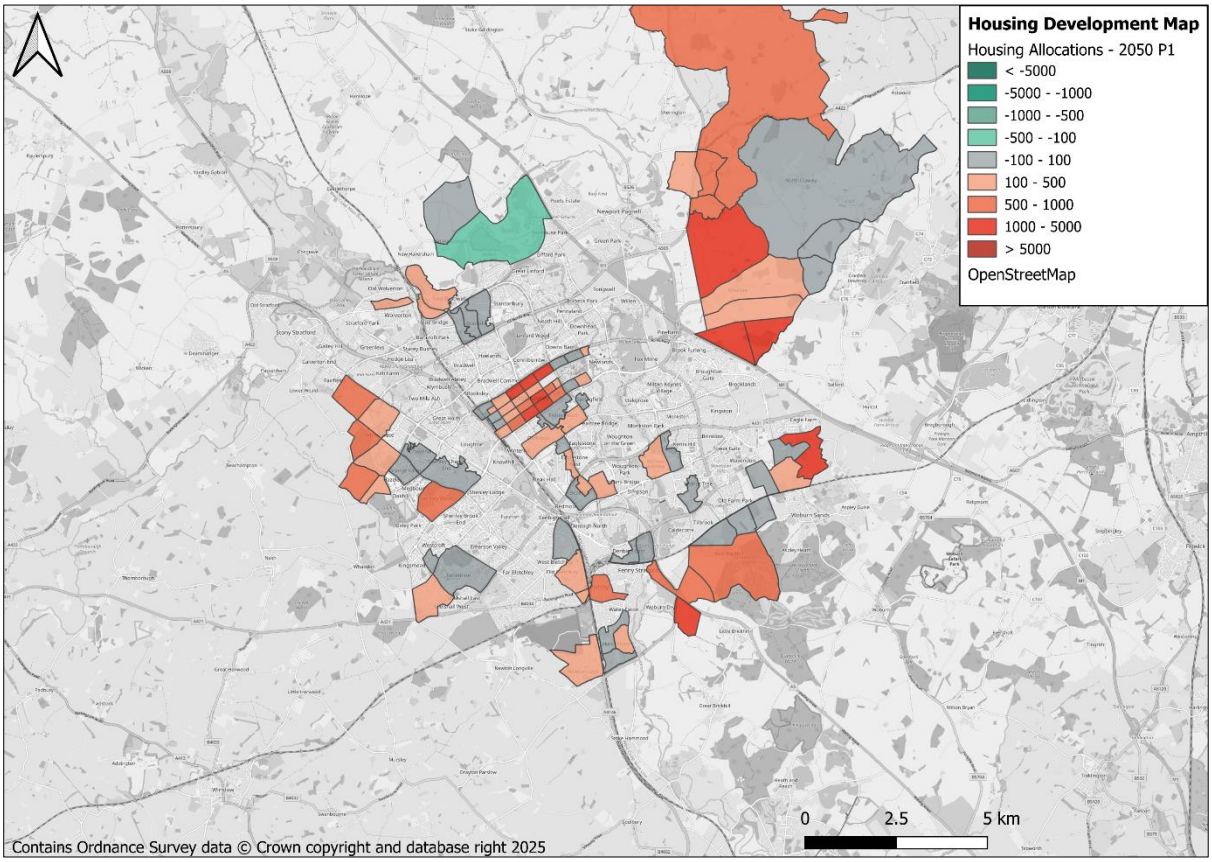

Figure 2-2: Housing Development Assumptions, Priority 1

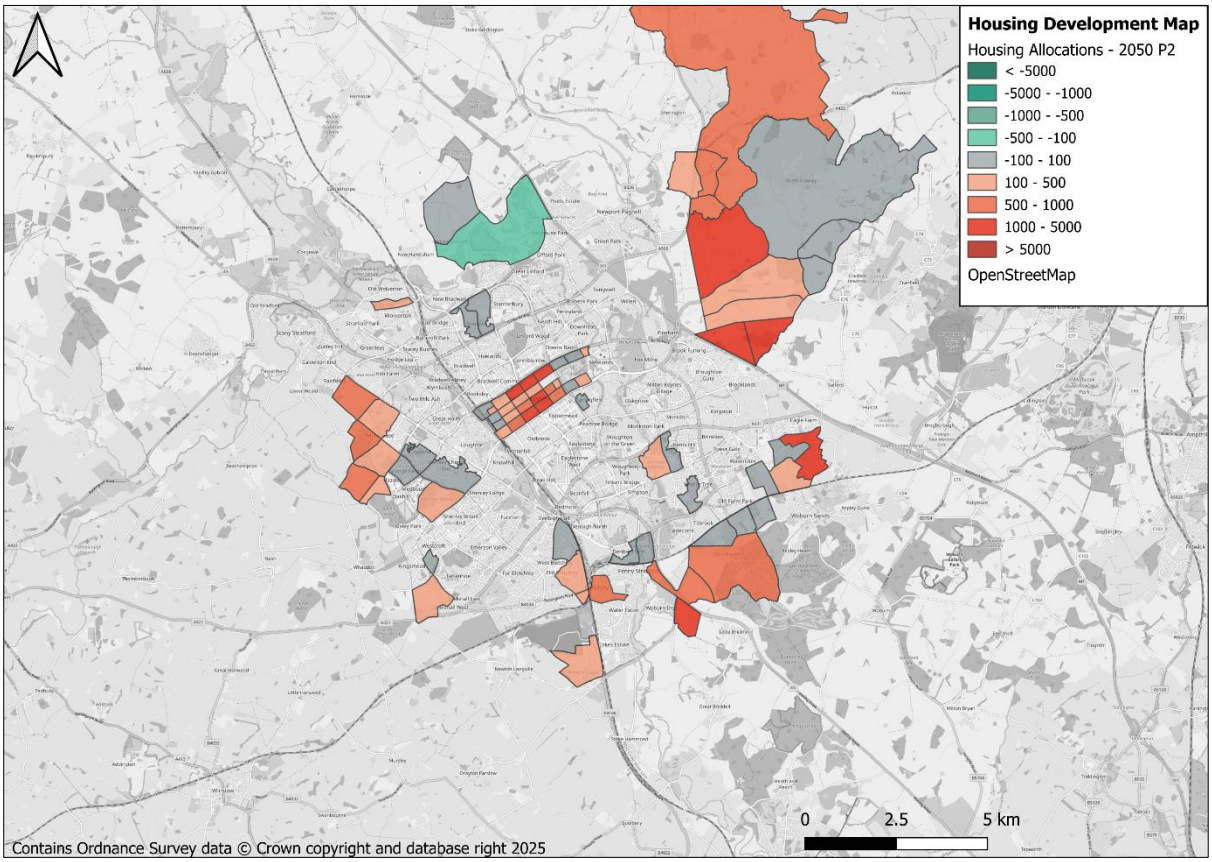

Figure 2-3: Housing Development Assumptions, Priority 2

Figure 2-4: Employment Development Assumptions

2.6 Trip-End Model

2.6.1 The MKCP forecast planning data was used to derive trip end growth and has only been constrained to National Trip End Model (NTEM) forecasts where forecast growth in the planning data is less than NTEM.

2.6.2 The uncertainty log datasets form inputs to the trip end model, which was run for the 2050 Priority 1 and 2050 Priority 2 scenarios. The data for dwellings was converted to households by applying a factor of 0.97, which was derived from 2011 census data as part of the base year trip end estimates that accounts for unoccupied homes.

2.7 MRT Model Assumptions

2.7.1 The 2050 Priority 1 model (MKCP scenario tests in 2050 with MRT - MKCPM2050) used the MRT model as a starting point. The 2050 MRT business case[12] supply model which featured partial signalisation of the junctions along the routes was used.

2.7.2 Figure 2-5 shows the three proposed MRT routes, which cover five radials intersecting at Central Milton Keynes:

- North South Route – Wolverton to The Lakes Estate via Central Milton Keynes;
- Eastern Development Corridor – Eastern Development to Central Milton Keynes; and
- East West Route – MRT corridor – Snelshall to Eagle Farm.

[12] MKMMM - MRT OBC Strategic Modelling Overview v1.2

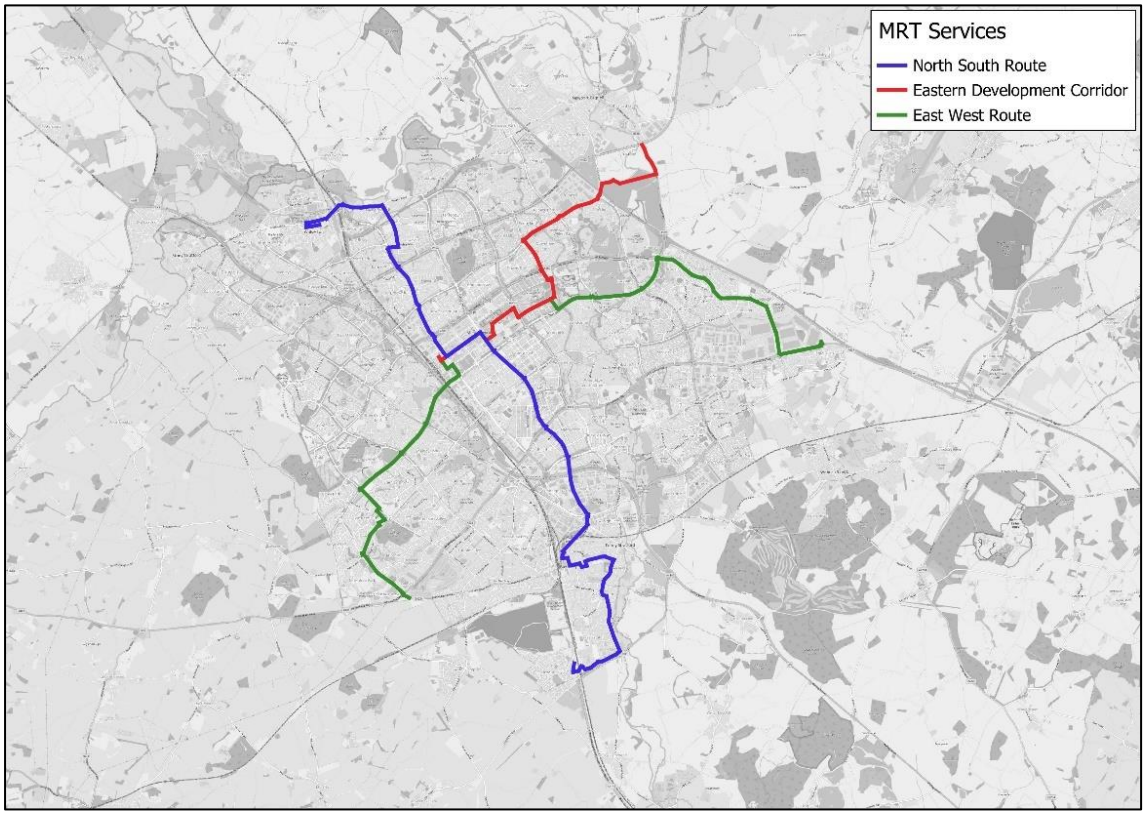

Figure 2-5: Mass Rapid Transport Routes

MRT Model Network Updates

2.7.3 Network changes were made to the 2050 Priority 1 model. The following links were included in the forecast models, having previously been omitted from the model network:

- Drift Way, Olney; and
- Guildford Avenue, Kingsmead

2.7.4 Changes made to the highway network around South East Milton Keynes (SEMK) in the forecast models were:

- Removal of Phoebe Lane connection between the H10 extension and Walton Road.
- SEMK by 2031: H10 extension stops at Phoebe Lane which acts as a spur road that provides access to the new development zones at Church Farm and the area of SEMK north of the railway.
- SEMK by 2031: The southern spine road was connected to Bow Brickhill Road, and the new road has become the southern part of the Woodleys Bridge Road (Figure 2-6).
- SEMK by 2040: The H10 extension was extended to meet the new road from Bow Brickhill Road ('Woodleys Bridge Road'), at a right-angle junction as per the current Reference Case coding (Figure 2-7). Woodleys Bridge Road is the new bridge over the railway line, which was included in scenarios from 2040 onwards. There is no connection between the H10 extension and Newport Road to comply with the SPD for this area.

2.7.5 Shenley Park development network:

- Links between A421 and H6 Childs Way provided as per developer's MKMMM proposal dated April 2024.
- Direct link between Shenley Road and Coddimoor Lane removed.

2.7.6 Other proposed changes to the highway network in the forecast models were:

- Fen Street by 2031: Mathias Lane to be connected with Broughton Road, but with an HGV weight restriction to prevent it being used as a lorry through-route.
- Marsh End Roundabout on the A422 by 2031: This roundabout was coded as signalised (Figure 2-8), with signal times obtained from the SATURN signal optimisation module. The dual carriageway for Willen Road will extend south only up to the new development (about halfway between Marsh End Roundabout and the M1 bridge on Willen Road). Beyond the development, the network will remain single carriageway over the motorway to Tongwell roundabout as there is no intention to widen the bridge.

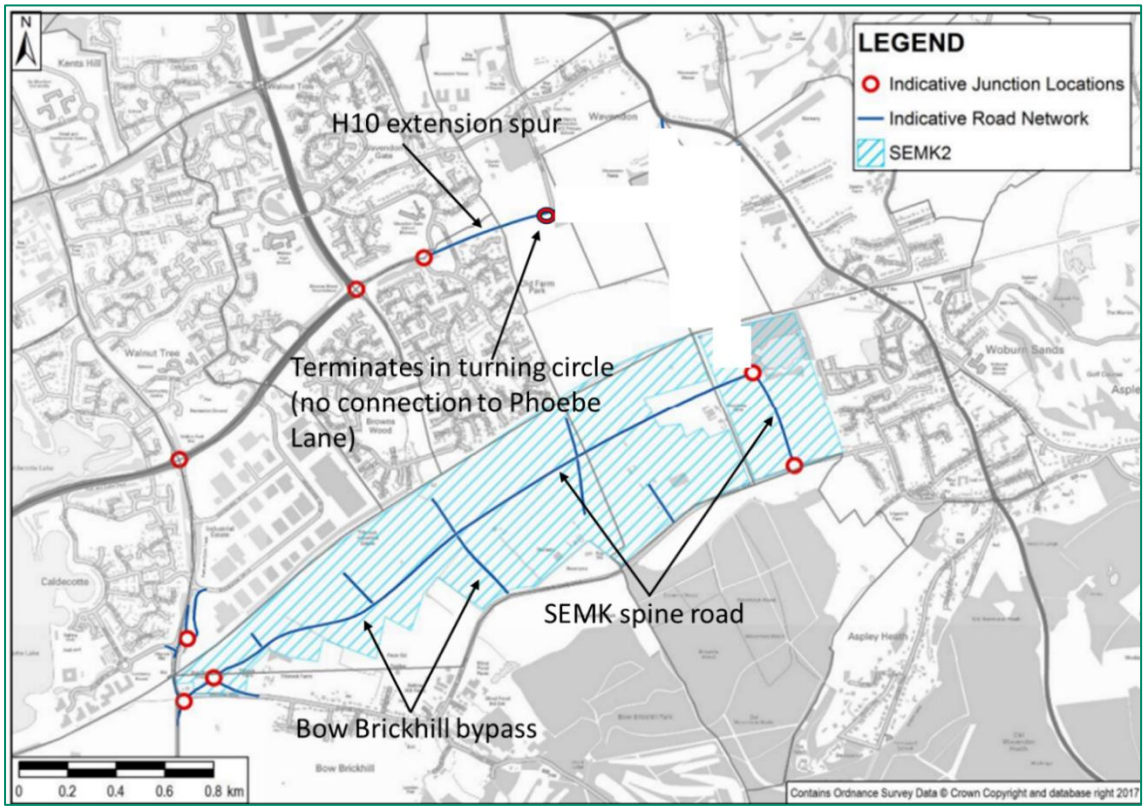

Figure 2-6: Reference Case 2031 SEMK Network

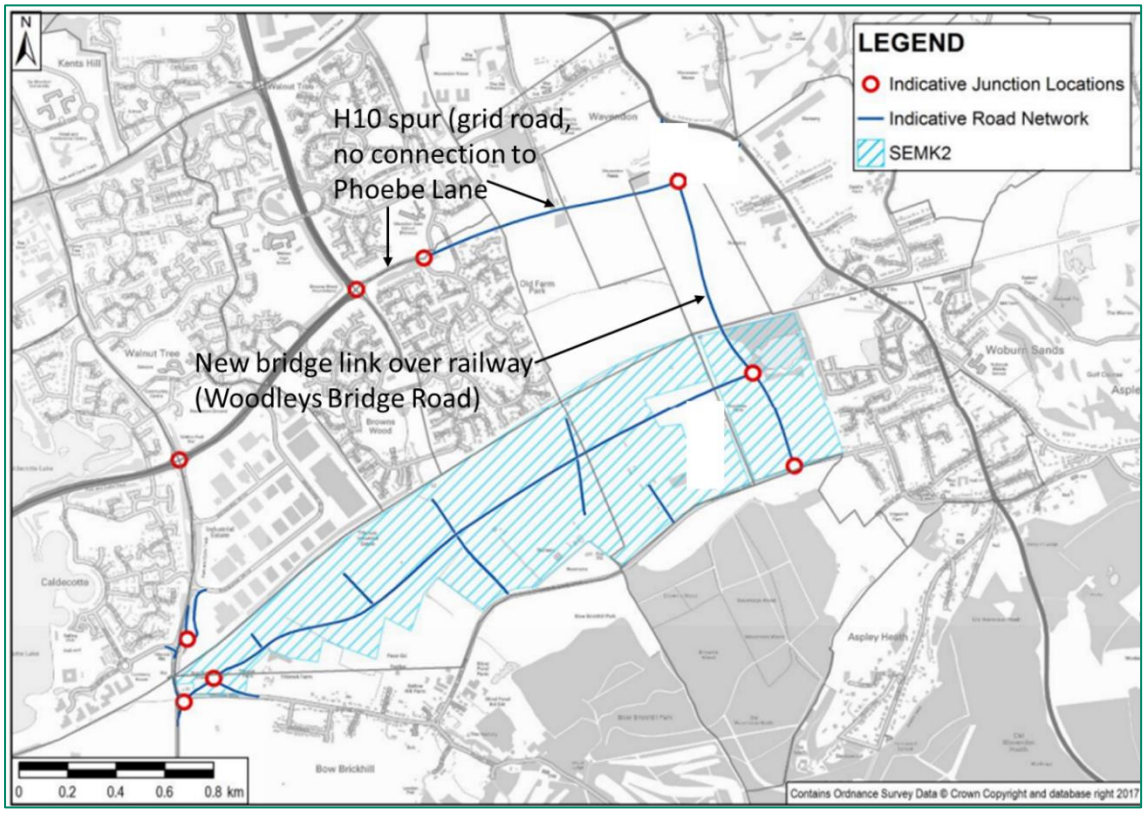

Figure 2-7: Reference Case 2040/2050 SEMK Network

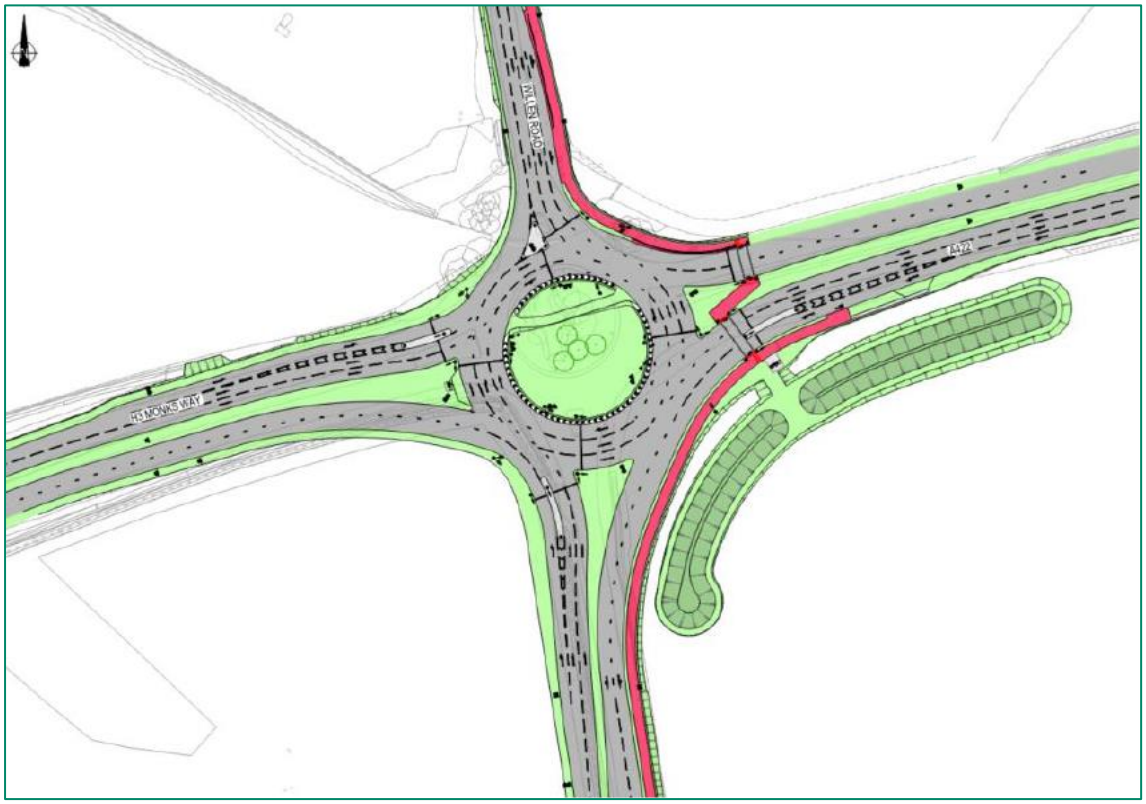

Figure 2-8: Marsh End Roundabout Layout

2.8 Further Infrastructure Updates

2.8.1 Upon further review of the modelled highway networks, additional updates were made to reflect the revised network infrastructure assumptions close to the development sites, as shown in Table 2-5.

2.8.2 Note that the updates at the Eastern Strategic City Extension (ESCE) are only associated with future development at the site; therefore, the changes were not included in the Reference Case 2050 model.

Table 2-5: Forecast Infrastructure Updates[13]

No.	Location	Updates	RC2050	2050 P1	2050 P2
1	South of Bow Brickhill	Connector to the development site is connected to Brickhill Road, changing from Watling Street.	✓	✓	✓
2	Levante Gate	Connector to the development site is now connected to the A4146 instead of the A5 Watling Street.	✓	✓	✓
3	Levante Gate	A priority T-junction to the east of Eaton Leys was converted to a four-arm signalised junction with non-hooking right turns.	✓	✓	✓
4	Eastern Strategic City extension	Broughton Grounds Lane (BGL) was closed to private motorised vehicles.		✓	✓
5	Eastern Strategic City extension	An internal distributor road was added, connecting Broughton Grounds Lane (BGL) to Newport Road, west of Moulsoe.		✓	✓
6	Eastern Strategic City extension	An internal distributor road was added, connecting Broughton Grounds Lane (BGL) to Cranfield Road, east of Moulsoe.		✓	✓

[13] as per email on the 12th of September

2.8.3 In addition, some amendments were made to some zone connector access points to ensure development traffic was able to access the network without significant delays. The junctions where the connector capacities were increased are detailed in Table 2-6. These amendments were agreed with Milton Keynes City Council.

Table 2-6 Connector Junction with increased capacity

Associated Development Sites	Associated Zones	Loading Node	Junction Locations
Western Expansion Area	1213	32136	Pembroke Lane/Barrosa Way
Western Expansion Area	1212	30388	Tiberius Drive/Vespasian Road
Eastern Strategic City extension	1567	99703	London Road/Langway Street
Eastern Strategic City extension	1567	99725	Newport Road/High Brink

2.8.4 No connections were coded between ESCE and roads maintained by adjacent highway authorities.

2.9 Public Transport Schemes Assumptions

2.9.1 The assumptions for public transport schemes remained the same as the latest Forecast Reference Case scenarios documented in the Traffic Forecasting Report (TFR)[14]

2.10 Parking Assumptions

2.10.1 The assumptions for parking remained the same as the latest Forecast Reference Case scenarios documented in the Traffic Forecasting Report (TFR)[15].

2.11 Economic Parameters

2.11.1 To be consistent with the latest core growth scenario (Reference Case) model runs, forecasting parameters were obtained from the November 2023 version of the TAG data book.

2.11.2 The Values of Time (VoT) and Vehicle operating Costs (VoC) used in the Base Year and 2031, 2040 and 2050 forecasts were calculated, and are shown as pence per minute (PPM) and pence per kilometres (PPK) in Table 2-7, Table 2-8, Table 2-9, and Table 2-10 respectively.

Table 2-7: 2019 VoT and VoC as PPM and PPK Values

User Class	AM Peak		Interpeak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
HGV	48.78	43.98	48.78	43.98	48.78	43.98
LGV	23.35	13.94	23.35	13.94	23.35	13.94
Car Business	31.40	12.90	32.18	12.90	31.85	12.90
Car Other	14.53	6.53	15.48	6.53	15.21	6.53
Car Commuting	21.06	6.53	21.40	6.53	21.13	6.53

[14] Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025
[15] Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025

Table 2-8: 2031 VOT and VoC as PPM and PPK Values

User Class	AM Peak		Interpeak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
HGV	52.90	43.58	52.90	43.58	52.90	43.58
LGV	25.32	13.69	25.32	13.69	25.32	13.69
Car Business	34.05	10.90	34.90	10.90	34.55	10.90
Car Other	15.76	5.76	16.78	5.76	16.50	5.76
Car Commuting	22.84	5.76	23.21	5.76	22.92	5.76

Table 2-9: 2040 VOT and VoC as PPM and PPK Values

User Class	AM Peak		Interpeak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
HGV	60.70	40.94	60.70	40.94	60.70	40.94
LGV	29.06	12.83	29.06	12.83	29.06	12.83
Car Business	39.08	9.35	40.04	9.35	39.64	9.35
Car Other	18.08	4.82	19.26	4.82	18.93	4.82
Car Commuting	26.21	4.82	26.63	4.82	26.30	4.82

Table 2-10: 2050 VOT and VoC as PPM and PPK Values

User Class	AM Peak		Interpeak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
HGV	69.45	40.02	69.45	40.02	69.45	40.02
LGV	33.25	12.19	33.25	12.19	33.25	12.19
Car Business	44.71	8.67	45.81	8.67	45.35	8.67
Car Other	20.68	4.27	22.03	4.27	21.66	4.27
Car Commuting	29.98	4.27	30.47	4.27	30.08	4.27

2.12 Buffer Network Speeds

2.12.1 In the MKMMM forecast scenarios, fixed speeds in the highway assignment buffer network area were adjusted using NRTP (National Road Traffic Projections) 2022 data for trunk roads. Factors are derived from NRTP22 by using the changes in average speeds projected. The resulting Reference Case scenario factors produce speeds that decline steadily from the base year speed over time as traffic is forecast to increase. This buffer network remains the same as the latest Forecast Reference Case scenarios documented in the Traffic Forecasting Report (TFR).

3. Variable Demand Model and Highway Assignment Model Statistics

3.1 Introduction

3.1.1 This chapter provides convergence statistics for the variable demand model, and the key statistics from the highway assignment model: vehicle kilometres, vehicle hours, and average speeds.

3.1.2 The demand model within the MKMMM suite is concerned with forecasting the changes in the demand estimates between the base year and a given forecast scenario, which is described in TAG as an “absolute model applied incrementally”. It was developed in-line with the guidance set out in TAG Unit M2.1 and the associated data book. Growth was applied within the demand model between base and future years.

3.1.3 The 2031, 2040 and 2050 trip ends produced from the trip end model were input into the variable demand model, which includes the highway, active travel and public transport components of the MKMMM.

3.2 Demand Model Convergence

3.2.1 For personal demand, the variable demand model loops through the assignment models (highway and public transport) and the demand choice calculations, taking updated costs from the assignment model at each iteration to update the demand choice calculations. This is repeated until a measure of convergence is met.

3.2.2 The measure of convergence is based on the change in forecast demand between the most recent and the previous iterations, and is calculated through the %GAP metric between iterations. According to TAG Unit M2.1 guidance, ‘tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%’.

3.2.3 The %GAP criterion for the demand model was set to 0.15% and was met or exceeded for all forecast years, as shown in Table 3-1. The 2031 scenario converged in six iterations, with the 2040 and 2050 Reference Case scenarios converging in seven iterations demonstrating that the demand model is stable. The 2050 Priority 1 (2050 MKCPM) and 2050 Priority 2 (2050 MKCP) scenarios converged in 12 and 11 iterations respectively.

Table 3-1: Demand Model Convergence

Iteration	RC2031 Aggregate %GAP	RC2040 Aggregate %GAP	RC2050 Aggregate %GAP	2050 P1 Aggregate %GAP	2050 P2 Aggregate %GAP
2	4.13	5.93	6.78	14.52	14.17
3	2.28	3.66	4.34	10.15	9.88
4	1.64	2.95	3.64	12.28	11.45
5	0.45	0.90	1.18	5.04	4.63
6	0.11	0.19	0.21	0.96	0.86
7		0.11	0.13	0.52	0.43
8				0.36	0.29
9				0.26	0.22
10				0.19	0.16
11				0.15	0.14
12				0.12	

3.3 Changes in Traffic Flow due to COVID

3.3.1 TAG recommends[16] that for models with base years prior to 2023, an adjustment should be made to account for the changes to travel observed following the COVID pandemic. For the forecast models described in this report, a post-variable demand model adjustment was applied to the forecast highway matrices which were reassigned to the highway networks. For the internal (simulation) area COVID factors as shown below were applied by time period:

- AM Peak – 0.941
- Interpeak – 0.932
- PM Peak – 0.927

3.3.2 The detailed work undertaken to assess the impact of the pandemic on traffic flows are documented in a Traffic Forecasting Report (TFR)[17]. The Reference Case 2031, 2040, and 2050 trip matrices, and 2050 Priority 1 and 2050 Priority 2 trip matrices were updated by applying the methodology described in the TFR.

3.3.3 Table 3-2 and Table 3-3 provide the highway matrix totals in the simulation areas for all trips and interzonal trips respectively. This data is provided for the 2019 base year, three reference case forecast years (RC2031, RC2040 and RC2050), and two development scenarios (2050 P1, 2050 P2) for all three time periods. Table 3-2 and Table 3-3 show that the largest percentage increase in trips is for LGVs followed by HGVs.

3.3.4 For interzonal trips, Table 3-3 shows that the increase in total trips for the PM Peak is higher than that of the AM Peak or the Interpeak. By purpose, Car Other trips have large increases. The second largest increase is in LGV trips. The lower growth for Car Commuting and Car Business trips is due to forecast reductions in jobs and workers and changes to demographics over time (as per NTEM).

[16] Proportionate accounting for COVID-19 in prior-calibrated models, Section B.3, TAG Unit M4, Forecasting and Uncertainty, November 2023, Department for Transport, Transport Analysis Guidance (TAG) https://www.gov.uk/transport-analysis-guidance-tag

[17] Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025

Table 3-2: Highway Matrix Totals, All (Interzonal and Intrazonal) Trips (Units: PCUs)[18]

Year	Time Period	HGV	LGV	Car Business	Car Other	Car Commute	Grand Total
2019 Base	AM	681,274	888,077	567,707	3,252,296	2,387,186	7,776,540
	IP	639,083	807,654	400,097	4,311,120	299,308	6,457,262
	PM	329,476	828,933	379,785	5,100,948	2,092,862	8,732,003
RC2031	AM	727,150 (6.7%)	1,049,930 (18.2%)	611,560 (7.7%)	3,331,128 (2.4%)	2,473,295 (3.6%)	8,193,062 (5.4%)
	IP	683,097 (6.9%)	955,600 (18.3%)	432,624 (8.1%)	4,481,581 (4.0%)	310,454 (3.7%)	6,863,356 (6.3%)
	PM	351,864 (6.8%)	980,311 (18.3%)	404,743 (6.6%)	5,253,121 (3.0%)	2,173,282 (3.8%)	9,163,320 (4.9%)
RC2040	AM	763,660 (12.1%)	1,189,483 (33.9%)	634,639 (11.8%)	3,400,194 (4.5%)	2,479,885 (3.9%)	8,467,861 (8.9%)
	IP	717,635 (12.3%)	1,082,695 (34.1%)	449,869 (12.4%)	4,611,452 (7.0%)	311,400 (4.0%)	7,173,050 (11.1%)
	PM	369,862 (12.3%)	1,110,630 (34.0%)	415,863 (9.5%)	5,350,107 (4.9%)	2,187,446 (4.5%)	9,433,908 (8.0%)
RC2050	AM	798,454 (17.2%)	1,313,851 (47.9%)	637,845 (12.4%)	3,432,743 (5.5%)	2,433,734 (1.9%)	8,616,627 (10.8%)
	IP	750,261 (17.4%)	1,195,398 (48.0%)	452,697 (13.1%)	4,677,311 (8.5%)	305,592 (2.1%)	7,381,259 (14.3%)
	PM	386,849 (17.4%)	1,226,733 (48.0%)	415,468 (9.4%)	5,390,902 (5.7%)	2,151,661 (2.8%)	9,571,612 (9.6%)
2050 MKCPM	AM	798,346 (17.2%)	1,313,794 (47.9%)	638,409 (12.5%)	3,436,825 (5.7%)	2,436,893 (2.1%)	8,624,267 (10.9%)
	IP	750,597 (17.4%)	1,196,014 (48.1%)	453,269 (13.3%)	4,684,476 (8.7%)	306,460 (2.4%)	7,390,815 (14.5%)
	PM	386,897 (17.4%)	1,226,857 (48.0%)	415,937 (9.5%)	5,395,675 (5.8%)	2,155,266 (3.0%)	9,580,631 (9.7%)
2050 MKCP	AM	798,380 (17.2%)	1,313,814 (47.9%)	638,388 (12.5%)	3,437,225 (5.7%)	2,437,321 (2.1%)	8,625,128 (10.9%)
	IP	750,583 (17.4%)	1,195,972 (48.1%)	453,238 (13.3%)	4,684,549 (8.7%)	306,481 (2.4%)	7,390,822 (14.5%)
	PM	386,891 (17.4%)	1,226,887 (48.0%)	415,920 (9.5%)	5,396,209 (5.8%)	2,155,518 (3.0%)	9,581,425 (9.7%)

[18] Percentage increases in values against 2019 are shown in brackets

Table 3-3: Highway Matrix Totals, Interzonal Trips (Units: PCUs)

Year	Time Period	HGV	LGV	Car Business	Car Other	Car Commute	Grand Total	Change in grand total from 2019
2019 Base	AM	105,418	147,394	180,468	488,305	582,284	1,503,868	-
	IP	97,116	129,726	125,288	676,146	73,580	1,101,855	-
	PM	50,892	131,734	120,605	798,975	513,144	1,615,350	-
RC2031	AM	119,116	180,901	218,437	558,419	640,580	1,717,453	213,585
	IP	110,241	159,612	152,778	790,636	81,111	1,294,378	192,523
	PM	57,694	162,083	143,062	915,637	567,165	1,845,640	230,290
RC2040	AM	137,961	217,962	245,179	629,328	670,440	1,900,871	397,003
	IP	128,139	192,575	172,238	908,918	84,871	1,486,741	384,886
	PM	66,940	195,491	157,644	1,026,478	597,200	2,043,753	428,403
RC2050	AM	154,456	249,136	256,558	673,740	674,435	2,008,326	504,458
	IP	143,566	219,988	180,759	983,799	85,367	1,613,478	511,623
	PM	75,043	223,626	163,241	1,093,876	603,368	2,159,153	543,803
2050 MKCPM	AM	154,816	249,591	257,372	679,561	679,189	2,020,528	516,660
	IP	144,003	220,589	181,300	990,731	86,293	1,622,916	521,061
	PM	75,241	224,066	163,771	1,100,309	607,678	2,171,065	555,715
2050 MKCP	AM	154,797	249,561	257,328	679,629	679,450	2,020,764	516,896
	IP	143,991	220,551	181,269	990,804	86,301	1,622,915	521,060
	PM	75,241	224,051	163,758	1,100,685	607,927	2,171,662	556,312

3.4 Highway Assignment Convergence

3.4.1 When using the highway model in forecasting mode, achieving a good level of convergence is important for several reasons. Convergence refers to the level of stability of link flows and costs reached through successive loops of the SATURN assignment process. A high level of convergence reduces model 'noise' i.e. where assigned flows are less-sensitive to changes in travel costs, allowing a more precise comparison of assignment flows and times between scenarios.

3.4.2 The convergence of the highway assignment model was measured according to the criteria set out in TAG Unit M3.1. These measures are seen as minimum standards that should be achieved in the development of a highway model. The TAG convergence measures, and their acceptable values are shown in Table 3-4.

Table 3-4: TAG Convergence Measures and Base Model Acceptable Values

Measure of Convergence	Base Model Acceptable Values
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P)<1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2)<1%	Four consecutive iterations greater than 98%
Percentage change in total user costs (V)	Four consecutive iterations less than 0.1% (SUE only)

3.4.3 The parameters %*Flows* and %*Gap* were used to assess the convergence within the SATURN assignment model. The %*Flows* is the percentage of turn flows that differ by less than 1% between the assignment and simulation elements of the SATURN assignment process. The target for %*Flows* was set within SATURN to four consecutive iterations greater than 98%. The target %*Gap* value within the assignment is 0.01% for four consecutive iterations, which is below the target %*Gap* value of 0.1% identified in TAG guidance.

3.4.4 Table 3-5 to Table 3-7 show the %*Flows* and %*Gap* convergence values after four consecutive iterations met the convergence targets, for the highway assignment model for all forecast years. All highway assignment model runs met the TAG convergence criteria.

Table 3-5: Convergence Values, Reference Case Scenario 2031

Time Period	Iterations	%Flows	%Gap
AM Peak	24	98.9	0.00069
Interpeak	16	99.2	0.00006
PM Peak	27	99.3	0.00050

Table 3-6: Convergence Values, Reference Case Scenario 2040

Time Period	Iterations	%Flows	%Gap
AM Peak	30	98.6	0.00071
Interpeak	21	99.4	0.00010
PM Peak	27	98.8	0.00075

Table 3-7: Convergence Values, Reference Case Scenario 2050

Time Period	Iterations	%Flows	%Gap
AM Peak	28	99.3	0.00065
Interpeak	26	99.7	0.00009
PM Peak	33	98.7	0.00081

Table 3-8: Convergence Values, Priority 1 MKCPM 2050

Time Period	Iterations	%Flows	%Gap
AM Peak	43	98.6	0.00069
Interpeak	38	98.8	0.00065
PM Peak	32	98.3	0.00110

Table 3-9: Convergence Values, Priority 2 MKCP 2050

Time Period	Iterations	%Flows	%Gap
AM Peak	33	99.4	0.00078
Interpeak	34	98.4	0.00019
PM Peak	32	98.1	0.00120

3.5 Vehicle Kilometres

3.5.1 The vehicle kilometres are presented in Table 3-10 for all vehicles within the simulation area of the highway model. Vehicle kilometres increase each year from Base 2019 to the Reference Case 2050. When compared to Reference Case 2050, vehicle kilometres increase by 3 – 4% in 2050 Priority 1 due to the growth associated with the forthcoming MK City Plan and MRT (MKCPM2050).

3.5.2 Compared with 2050 Priority 1, 2050 Priority 2 removed the MRT related development. There is no significant change in vehicle kilometres between Priority 1 and Priority 2 as the change in vehicle kilometres associated with MRT related development is insignificant when compared to the total vehicle kilometres in the simulation area of the highway model. It is worth noting that there are two main variables when comparing P2 to P1:

- P2 removed approximately 2,500 houses, and
- P2's model does not include the MRT network in the public transport (PT) models.

3.5.3 These two factors counter act against each other impacting Vehicle Kilometres by highway mode. The removal of 2,500 houses reduces the number of car trips in P2, while the absence of the MRT network pushes more trips towards car mode, as MRT is no longer available as an option in P2 and the removal of the MRT will also add capacity to the road network. This explains why the overall change is negligible. However, a slight increase in vehicle kilometres in P2 is observed compared to P1, likely because the mode shift from MRT to cars outweighs the reduction caused by the 2,500 removed houses. Further analysis of routeing along the MRT routes would determine how traffic uses the network in the different scenarios.

3.5.4 The details of vehicle kilometres changes between different reference case years are detailed in the Traffic Forecasting Report (TFR)[19].

[19] Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025

Table 3-10: Vehicle Kilometres (PCU Kms)

Time Period	Base 2019	RC2031	Base 2019 to RC2031 %	RC 2050	RC2031 to RC2050 %	MKCPM 2050 Priority 1	RC2050 to Priority 1 %	MKCP 2050 Priority 2	Priority 1 to Priority 2 %
AM Peak	1,388,768	1,698,658	22%	1,838,849	8%	1,889,835	3%	1,893,373	0%
Interpeak	1,032,083	1,332,949	29%	1,533,028	15%	1,590,030	4%	1,590,332	0%
PM Peak	1,413,499	1,730,977	22%	1,885,913	9%	1,940,597	3%	1,945,456	0%

3.6 Vehicle Hours

3.6.1 The vehicle hours for the simulation area of the highway models are presented in Table 3-11. Similar to vehicle kilometres, there is an increase in vehicle hours across all three time periods in Reference Case 2031 and 2050 Reference Case when compared with the 2019 Base Year.

3.6.2 The vehicle hours increase by 7 – 11% in 2050 Priority 1 and Priority 2 compared to Reference Case 2050, due to the associated development growth in the MK City Plan. The increase in vehicle hours is proportionally greater than the increase in vehicle kilometres, which indicates that there are increased network delays in the 2050 Priority 1 and Priority 2 scenarios. There is no significant change in vehicle hours between 2050 Priority 1 and 2050 Priority 2 scenarios.

Table 3-11: Vehicle Hours (PCU Hrs)

Time Period	Base 2019	RC2031	Base 2019 to RC2031 %	RC 2050	RC2031 to RC2050 %	MKCPM 2050 Priority 1	RC2050 to Priority 1 %	MKCP 2050 Priority 2	Priority 1 to Priority 2 %
AM Peak	26,079	32,545	25%	36,900	13%	40,559	10%	40,378	0%
Interpeak	16,494	20,817	26%	25,161	21%	26,840	7%	26,713	0%
PM Peak	25,778	32,563	26%	37,567	15%	41,678	11%	41,495	0%

3.7 Average Speeds

3.7.1 The average network speeds for the simulation area by time period are shown in Table 3-12. The network speeds decrease gradually by year from the 2019 Base Year to the Reference Case 2050.

3.7.2 When compared to the 2050 Reference Case, the network speeds decrease by 3 – 7% due to increased network delay in the 2050 Priority 1 and Priority 2. There was only a 0.3 kph change in average speeds between the 2050 Priority 1 and 2050 Priority 2 scenarios.

Table 3-12: Average Speeds (KPH)

Time Period	Base 2019	RC2031	Base 2019 to RC2031 %	RC 2050	RC2031 to RC2050 %	MKCPM 2050 Priority 1	RC2050 to Priority 1 %	MKCP 2050 Priority 2	Priority 1 to Priority 2 %
AM Peak	53.3	52.2	-2%	49.8	-5%	46.6	-6%	46.9	1%
Interpeak	62.6	64	2%	60.9	-5%	59.2	-3%	59.5	1%
PM Peak	54.8	53.2	-3%	50.2	-6%	46.6	-7%	46.9	1%

4. Milton Keynes City Plan Forecast Model Outputs

4.1 Introduction

4.1.1 This chapter describes the highway assignment model results of the forecast year scenarios. This includes flow difference and link delay difference plots, volume over capacity (V/C) analysis, journey time changes, and public transport flow changes.

4.1.2 For the purpose of the outputs, the forecast scenarios are named accordingly:

- RC2031 – Reference Case 2031
- RC2050 – Reference Case 2050
- Priority 1 – MKCP scenario tests in 2050 with MRT (MKCPM2050)
- Priority 2 – MKCP scenario tests in 2050 without MRT and without MRT associated housing developments – sensitivity test (MKCP2050)

4.2 Mode Split Statistics

4.2.1 The 24-hour mode split for MKMMM internal (simulation) productions is shown Table 4-1. It shows the mode split statistics output from the variable demand model. The mode split for highway car increases slightly across the years from the 2019 Base Year to the Reference Case 2050, with the other modes decreasing. In 2050 Priority 1, the MRT has 1.8% mode share, and in 2050 Priority 2 this is redistributed across the other modes, with the exception of rail. This is expected as rail does not serve the shorter journeys the MRT would accommodate.

Table 4-1: Mode Split Statistics

Mode	Base 2019	RC2031	RC2050	2050 Priority 1	2050 Priority 2
Highway Car	79.8%	81.2%	83.0%	81.2%	82.3%
Public Transport Bus	3.0%	2.9%	2.7%	2.8%	3.0%
Public Transport Rail	1.6%	1.4%	1.3%	1.4%	1.4%
Active	15.7%	14.5%	13.0%	12.8%	13.2%
MRT	-	-	-	1.8%	-

4.3 Highway Flow Difference Plots

4.3.1 Forecast changes in highway traffic flow from the 2031 Reference Case to 2050 Priority 1 (i.e. the last Plan:MK and the proposed MKCP) are shown in Figure 4-1 to Figure 4-3. The flow difference is plotted as bandwidths to the left side of each link by direction with an increase shown in red and a decrease in green.

4.3.2 There is an increase in flows on the M1 and A5 across the three modelled hours, which are part of the strategic road network (SRN) where traffic growth has been anticipated. There are also increases around Central Milton Keynes, which are likely due to the growth in employment and leisure trips. As expected, there are increases on roads serving the South East Milton Keynes and the ESCE developments, which are present in all three modelled hours. There are some decreases along H6 Childs Way which are most prominent in the AM and PM Peak hours. There are also decreases on links travelling northbound on V6 Grafton Street, north of Central Milton Keynes. These decreases coincide with the MRT routes, which will become operational before the 2050 Priority 1 scenario.

4.3.3 The highway flow differences between 2050 Reference Case and 2050 Priority 1 are shown in Figure 4-4 to Figure 4-6. The pattern of these are similar to the highway flow differences shown between the 2031 Reference Case and 2050 Priority 1, but at a smaller magnitude. The reductions in flows are also attributed to the MRT in Priority 1 which follow the ‘spider’ alignments of the MRT around Milton Keynes where road capacity is reduced with the MRT in operation.

4.3.4 Highway flow differences between 2050 Priority 1 and 2050 Priority 2 are presented in Figure 4-7 to Figure 4-9. The largest differences are seen in the PM Peak hour, and the greatest increases are seen on H6 Childs Way in both directions and on V6 Grafton Street between Bradville Roundabout and Rooksley Roundabout. Similar to the previous comparison, the increases in flows follow the alignments of the MRT across Milton Keynes where road capacities are not reduced as in Priority 1. On these roads, the impact of retaining highway capacity is greater and there are no benefits from mode shifting person trips from the car to the MRT.

4.3.5 The highway absolute link flow plots are in Appendix B.

Figure 4-1: Highway Flow Difference, 2050 Priority 1 – 2031 Reference Case, AM Peak

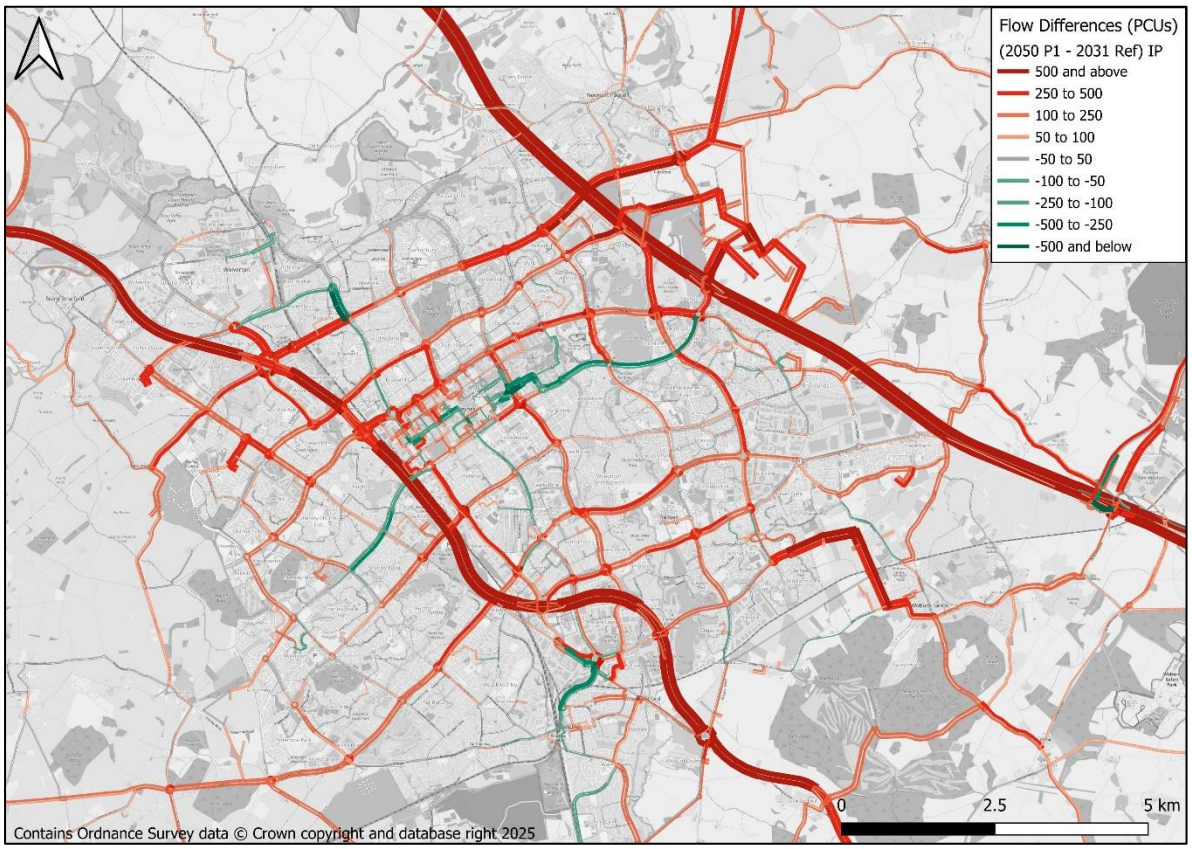

Figure 4-2: Highway Flow Difference, 2050 Priority 1 – 2031 Reference Case, Interpeak

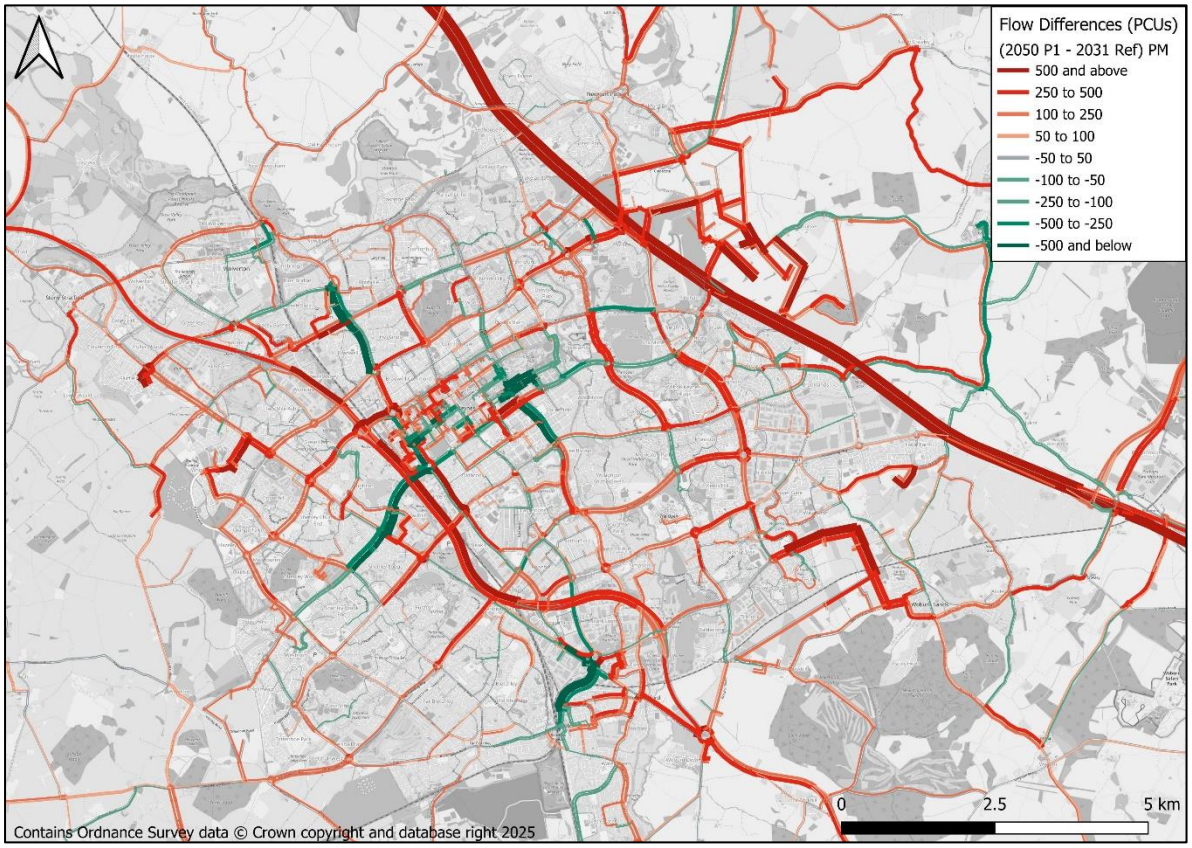

Figure 4-3: Highway Flow Difference, 2050 Priority 1 – 2031 Reference Case, PM Peak

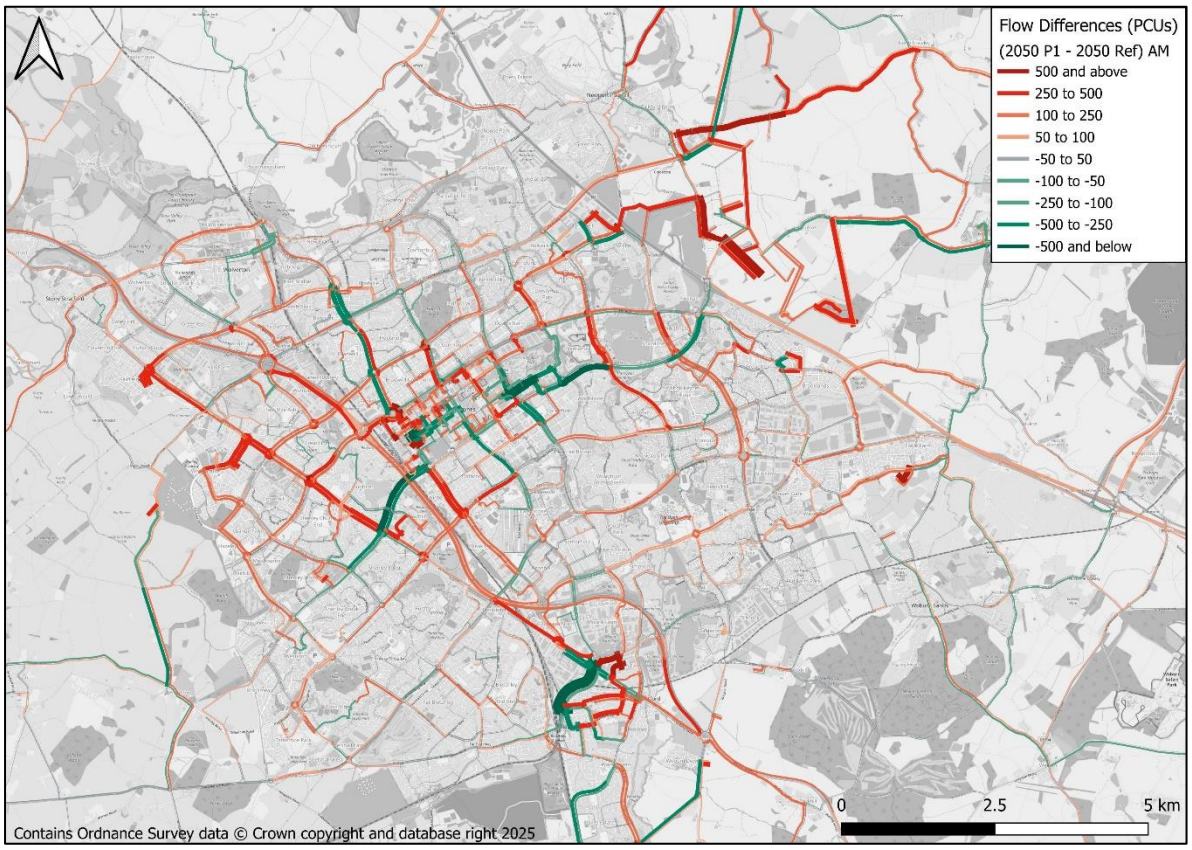

Figure 4-4: Highway Flow Difference, 2050 Priority 1 – 2050 Reference Case, AM Peak

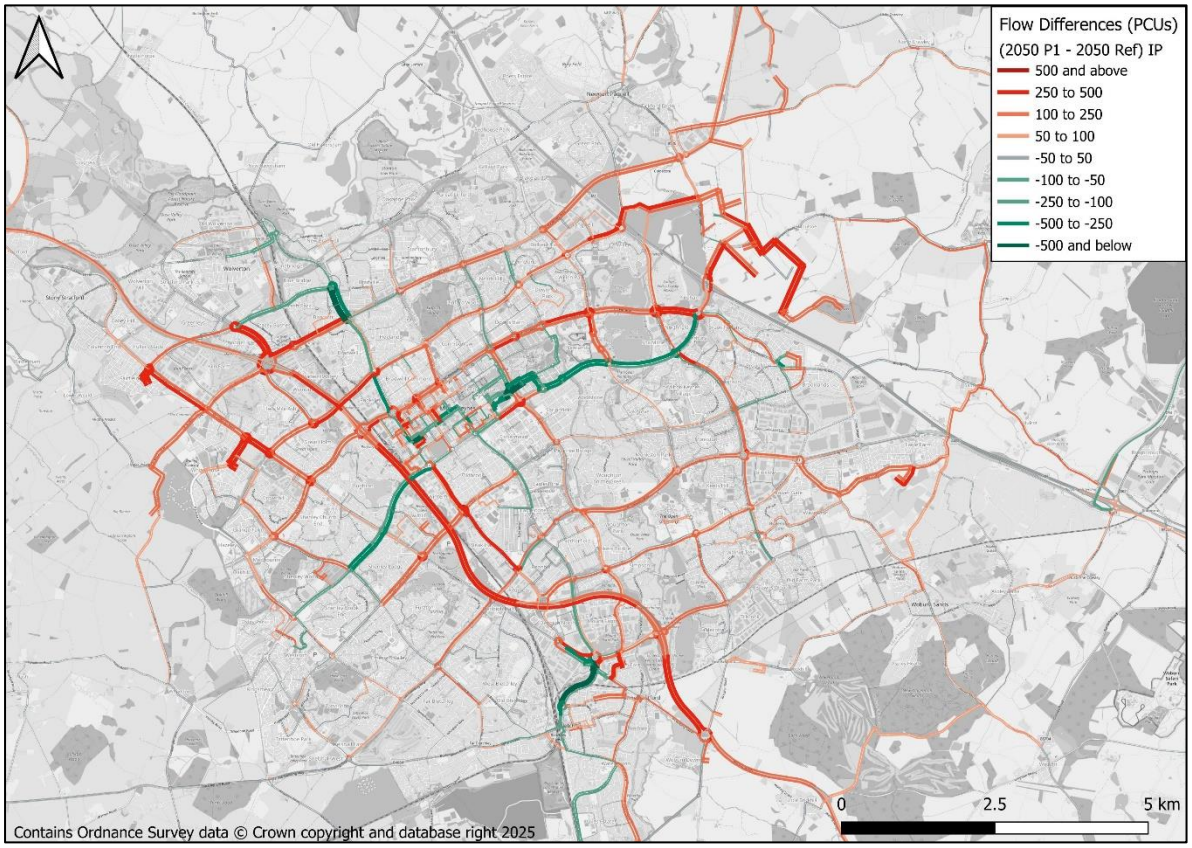

Figure 4-5: Highway Flow Difference, 2050 Priority 1 – 2050 Reference Case, Interpeak

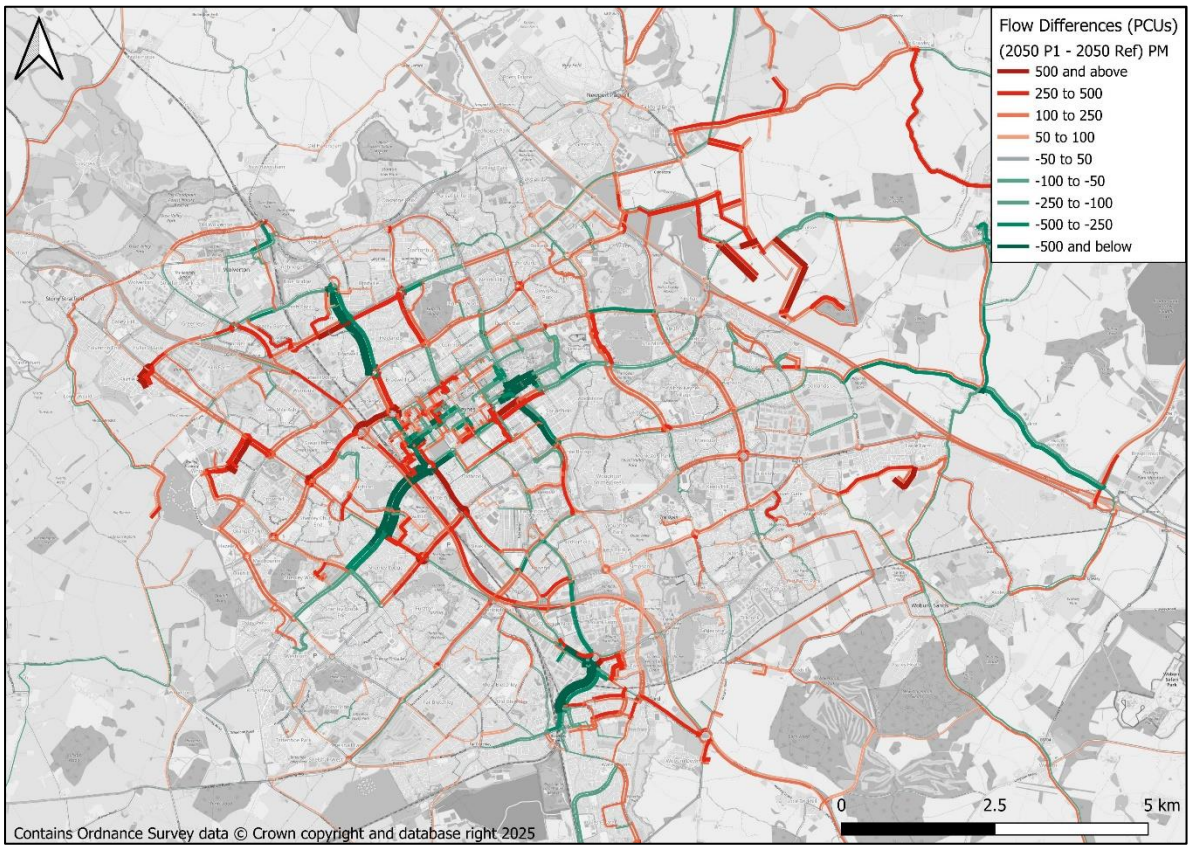

Figure 4-6: Highway Flow Difference, 2050 Priority 1 – 2050 Reference Case, PM Peak

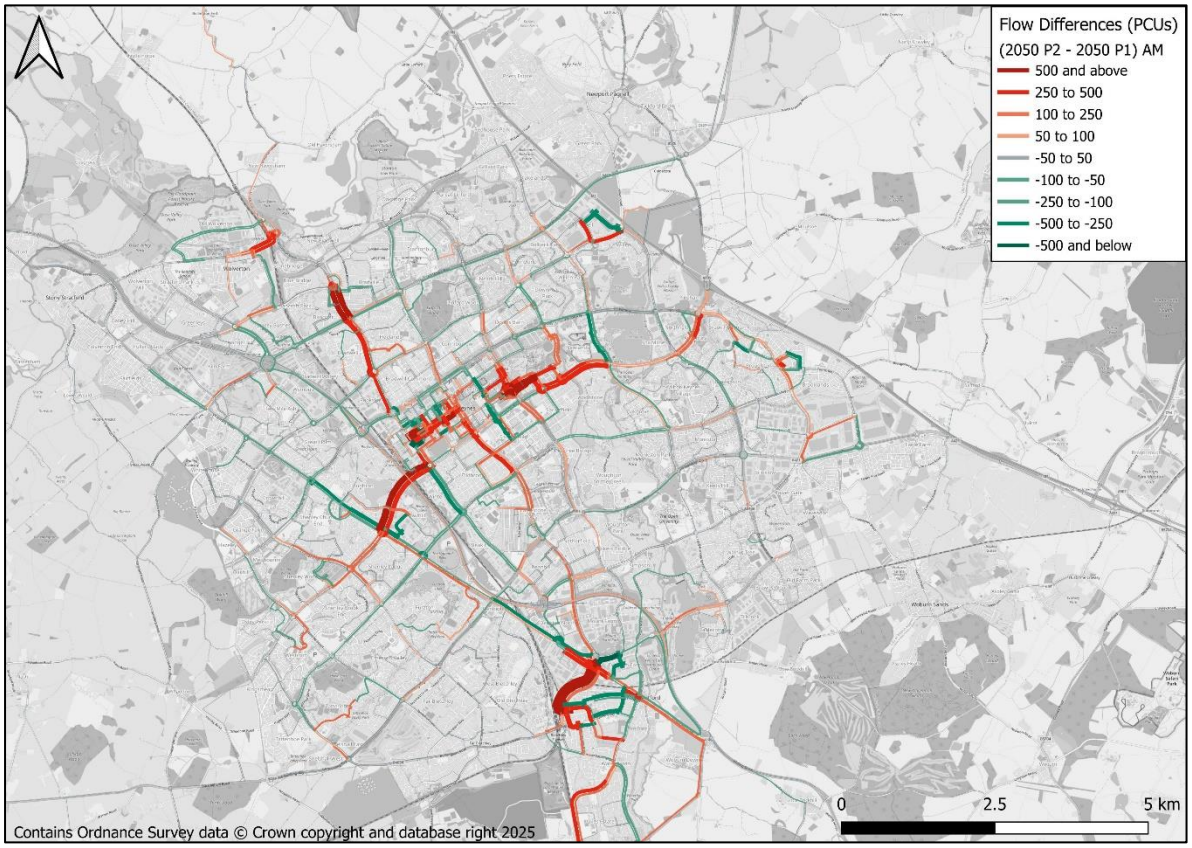

Figure 4-7: Highway Flow Difference, 2050 Priority 2 – 2050 Priority 1, AM Peak

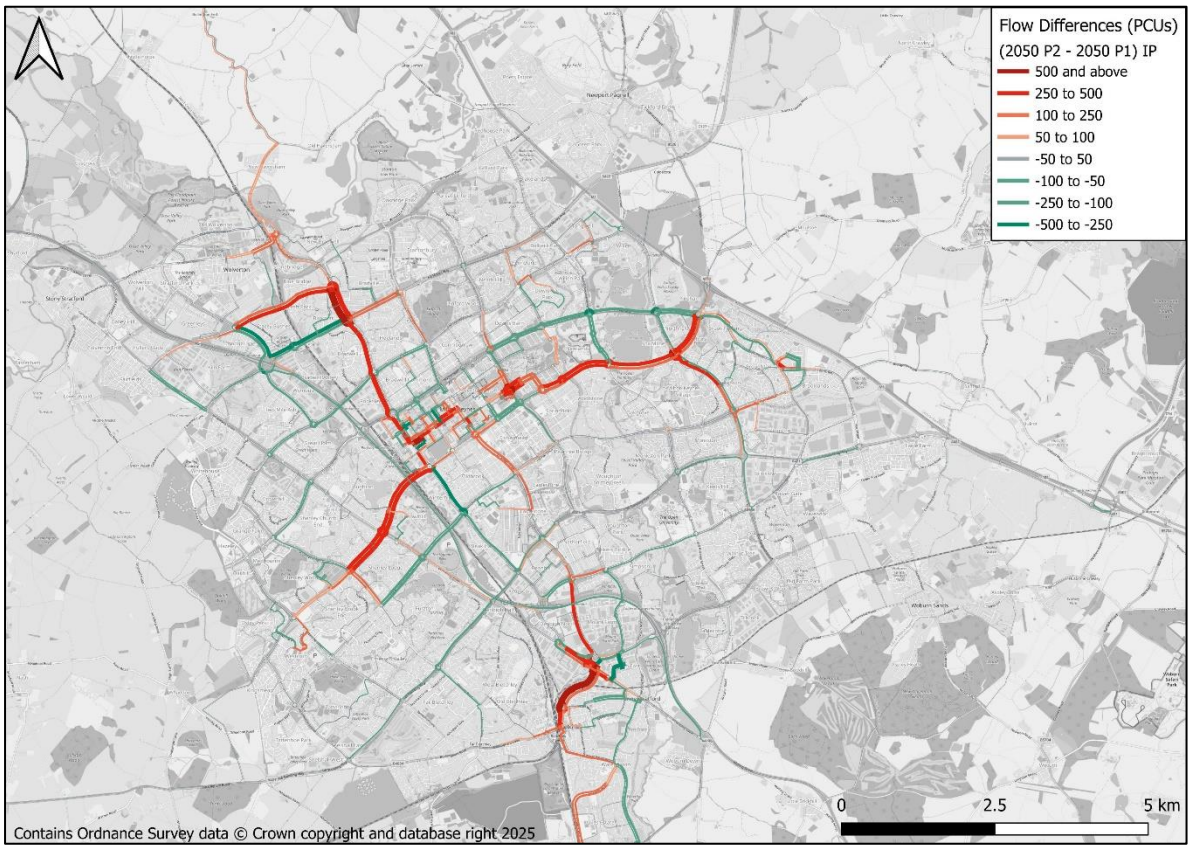

Figure 4-8: Highway Flow Difference, 2050 Priority 2 – 2050 Priority 1, Interpeak

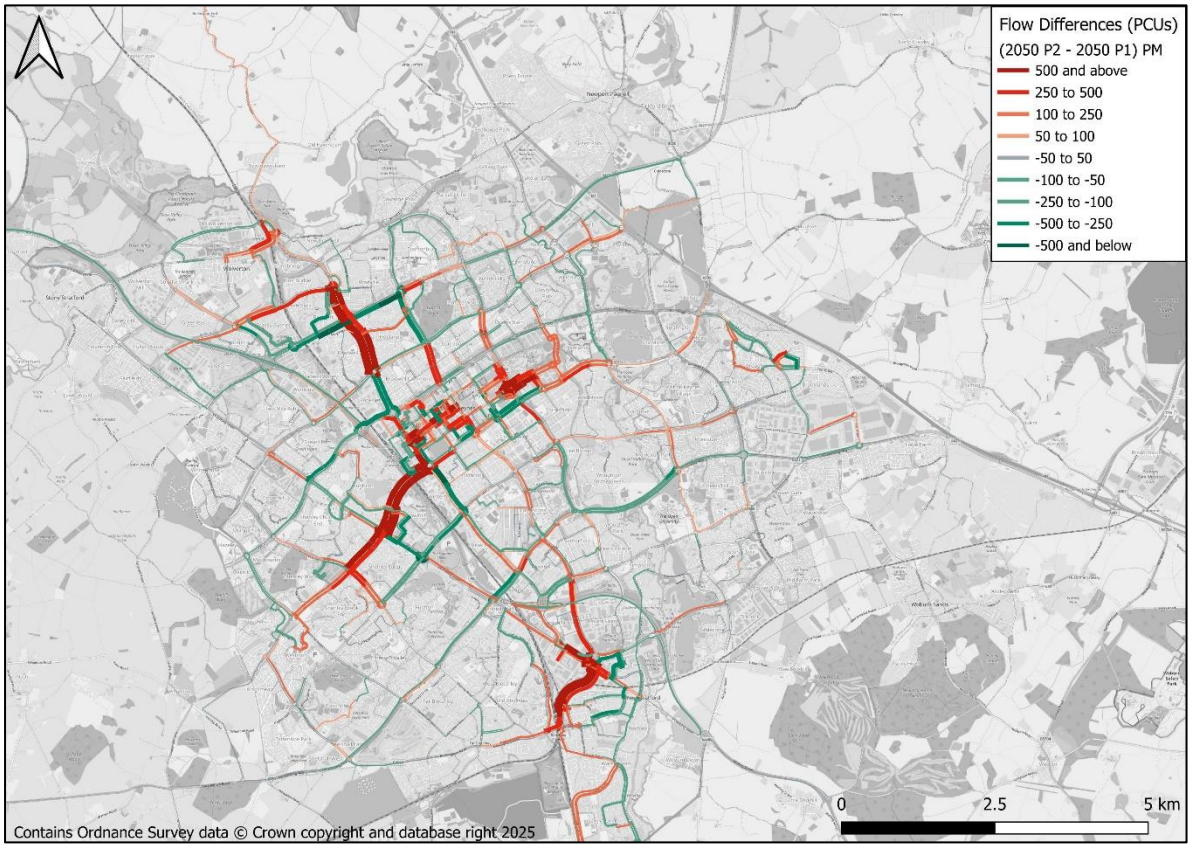

Figure 4-9: Highway Flow Difference, 2050 Priority 2 – 2050 Priority 1, PM Peak

4.4 Absolute Link and Junction V/C Plots

4.4.1 V/C (volume over capacity) ratio plots for the 2031 Reference Case, 2050 Reference Case, 2050 Priority 1 and 2050 Priority 2 scenarios are presented in Figure 4-10 to Figure 4-21. The junction V/C is a measure of the average headroom capacity on all approaches to the junction and are plotted as a coloured dot. Link V/C is a measure of the headroom capacity on each approach to a downstream junctions and are plotted as a coloured line.

4.4.2 Only ratios over 85% are displayed as this is when slow moving traffic, congestion and delays would start to occur. Over 100% indicates traffic volumes exceed the link (road) capacity and the link would be saturated.

4.4.3 Overall, V/C values increase by forecast year in each modelled hour, with higher V/C values noted in the AM and PM Peak hours. There are no links that have a V/C ratio greater than 115% in the 2031 Reference Case, however there are several links with a V/C ratio greater than 85% in the three modelled hours, particularly on H3 Monks Way and the A421.

4.4.4 In the 2050 Reference Case, the M1 links are showing a V/C ratio greater than 85% and is higher in the PM Peak hour. There are four links where the V/C ratio is above 115%, which are in the AM Peak hour, all in close proximity to the M1. These are: the section of H3 Monks Way travelling westbound across the M1, a link on approach to Tongwell Roundabout, the London Road southbound approach at M1 Junction 14, a new link as part of the ESCE development, and the A421 westbound on approach to Fen Roundabout.

4.4.5 The 2050 Priority 1 scenario generally has a greater number of links and nodes above the thresholds, particularly in Central Milton Keynes and around the ESCE development. The greatest number of links with a V/C ratio above 115% occurs in the AM Peak hour.

4.4.6 The V/C plots for 2050 Priority 2 are similar to 2050 Priority 1, with generally higher V/C ratios observed in 2050 Priority 1, because the headroom capacity at some junctions would be reduced to create space to operate the MRT.

Figure 4-10: Absolute Link and Junction V/C, 2031 Reference Case, AM Peak

Figure 4-11: Absolute Link and Junction V/C, 2031 Reference Case, Interpeak

Figure 4-12: Absolute Link and Junction V/C, 2031 Reference Case, PM Peak

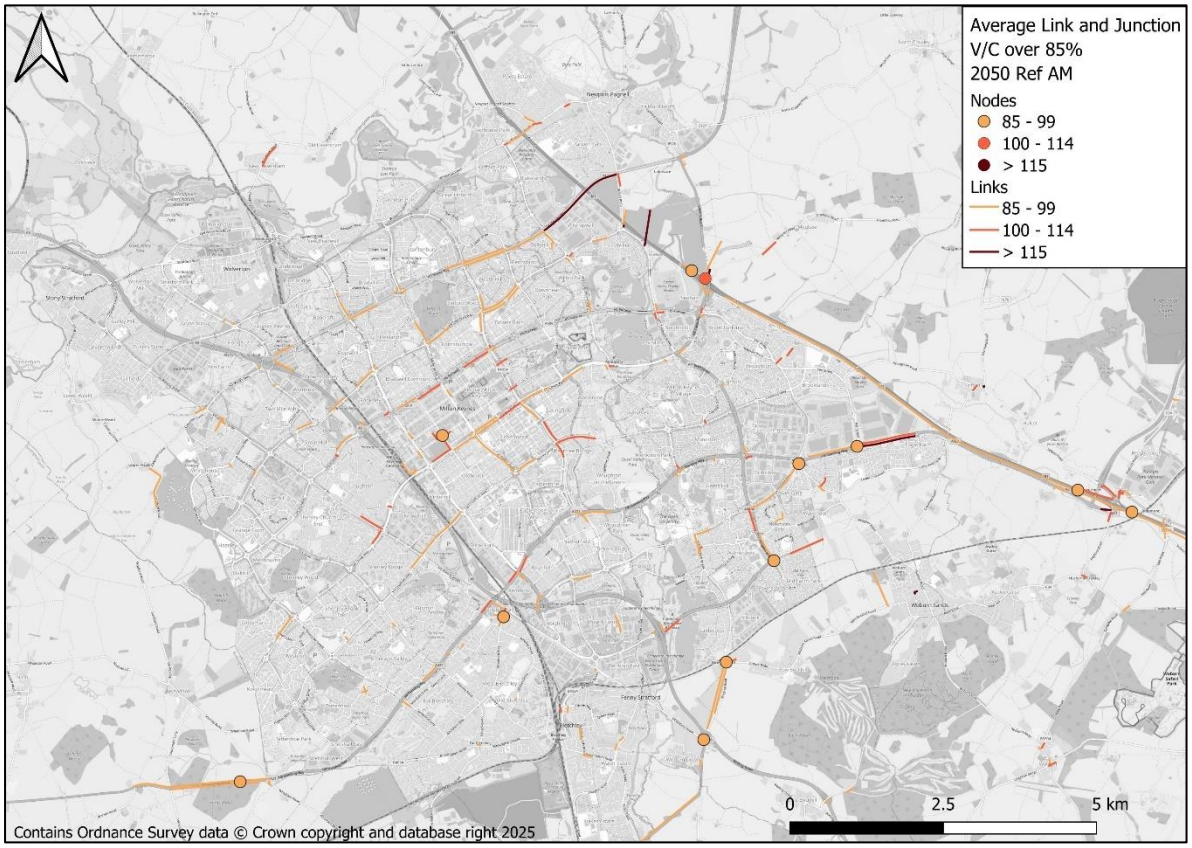

Figure 4-13: Absolute Link and Junction V/C, 2050 Reference Case, AM Peak

Figure 4-14: Absolute Link and Junction V/C, 2050 Reference Case, Interpeak

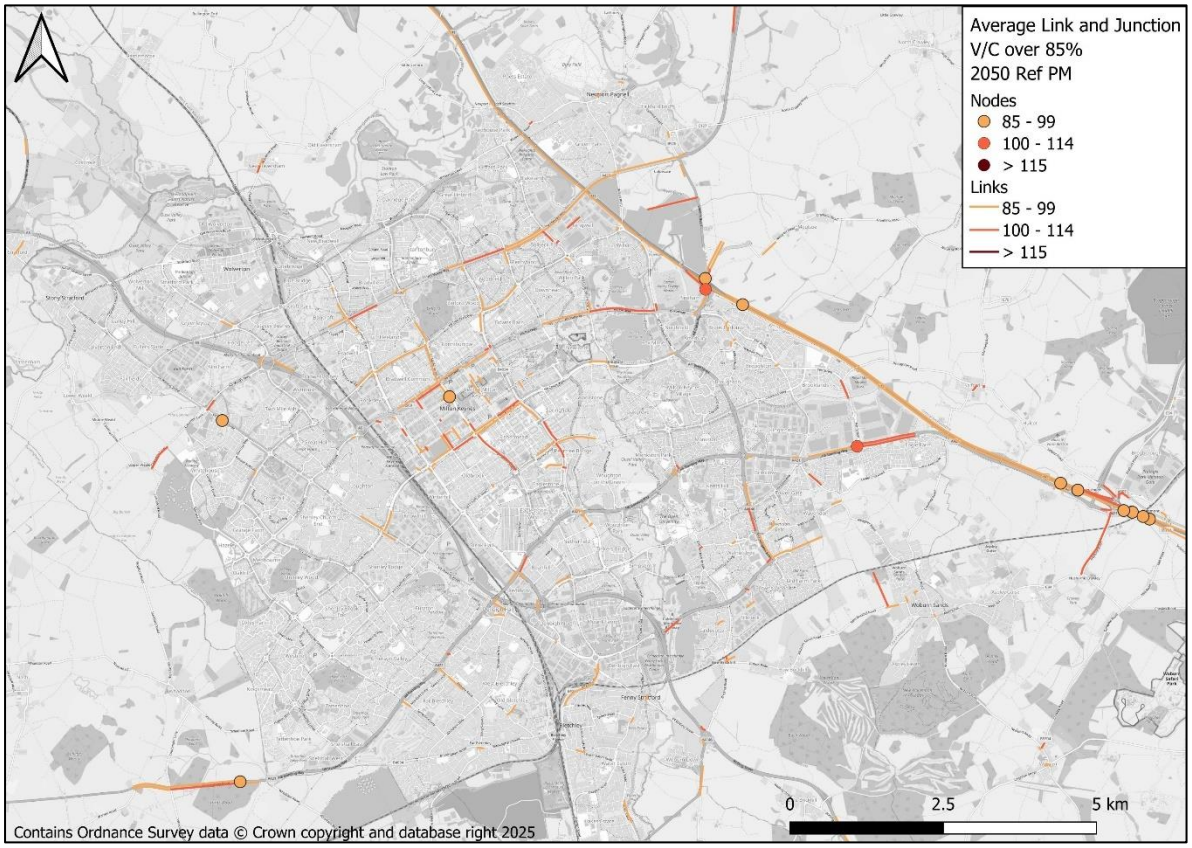

Figure 4-15: Absolute Link and Junction V/C, 2050 Reference Case, PM Peak

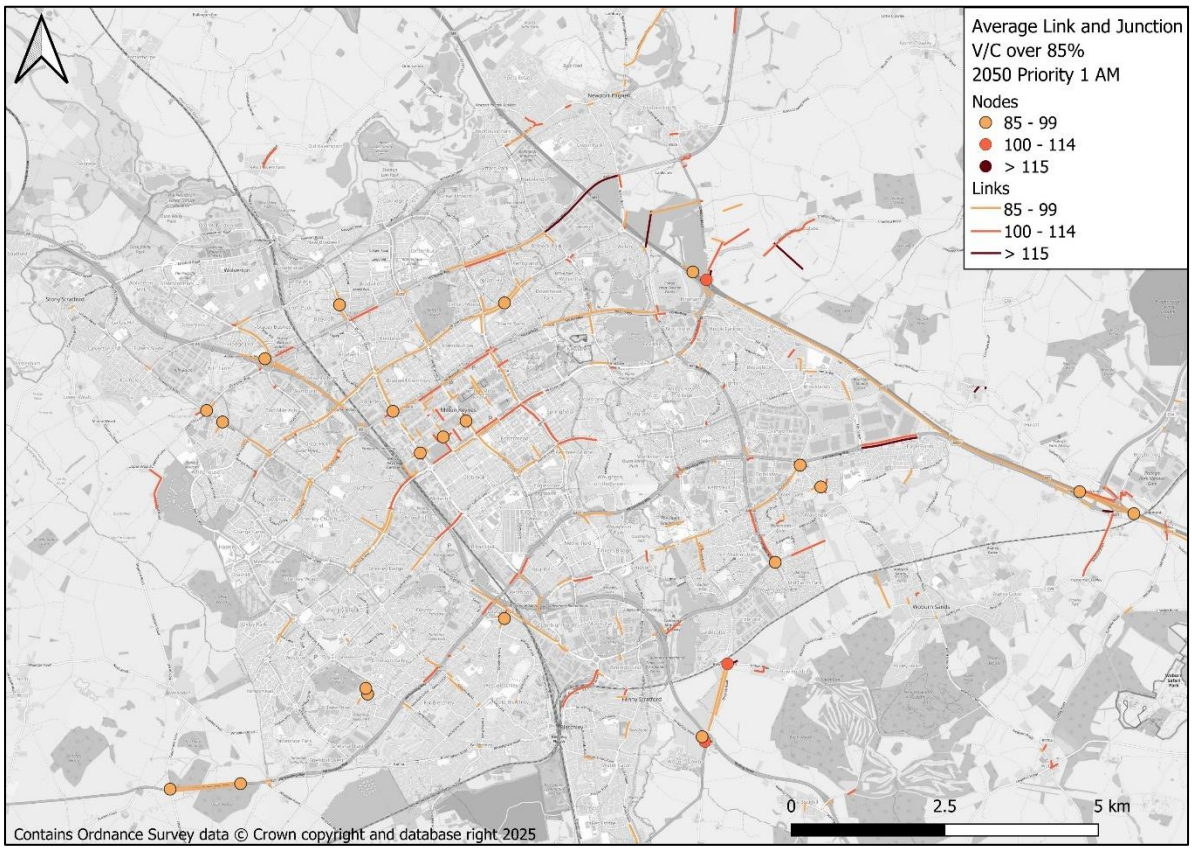

Figure 4-16: Absolute Link and Junction V/C, 2050 Priority 1, AM Peak

Figure 4-17: Absolute Link and Junction V/C, 2050 Priority 1, Interpeak

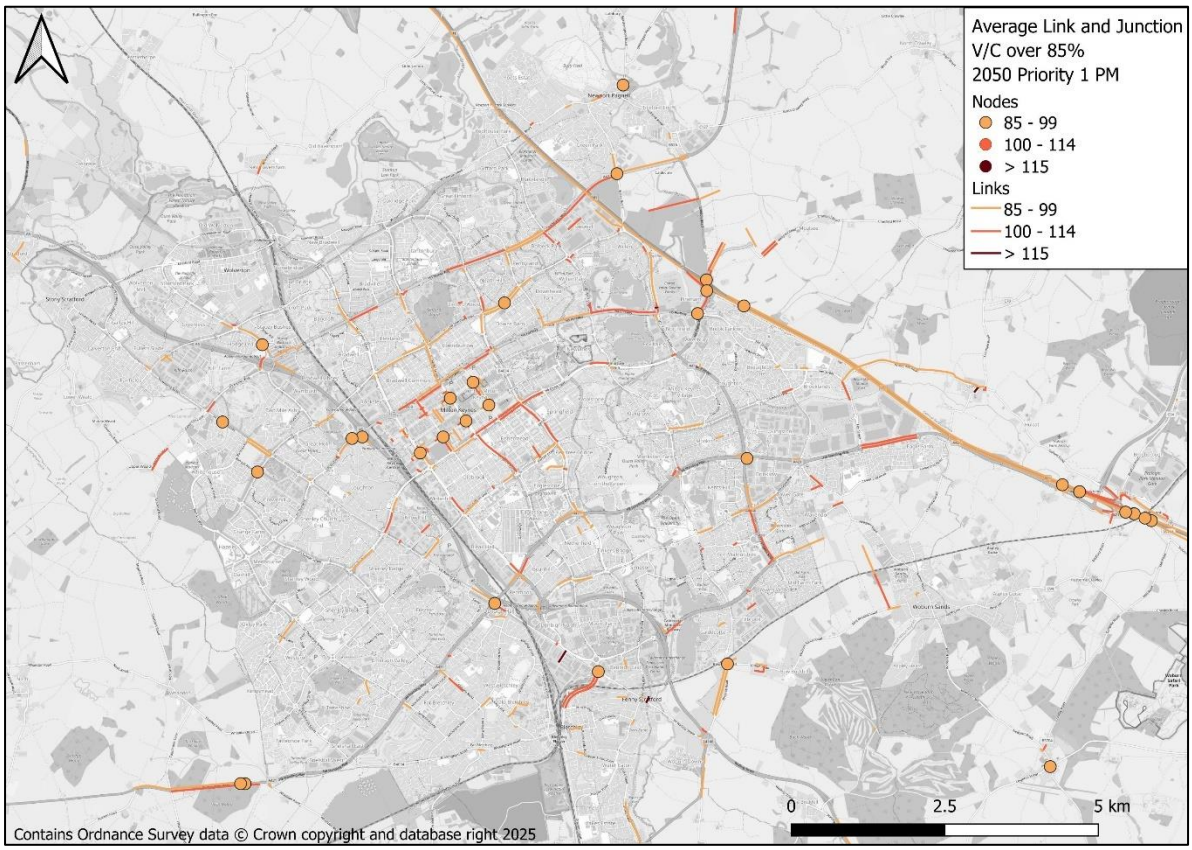

Figure 4-18: Absolute Link and Junction V/C, 2050 Priority 1, PM Peak

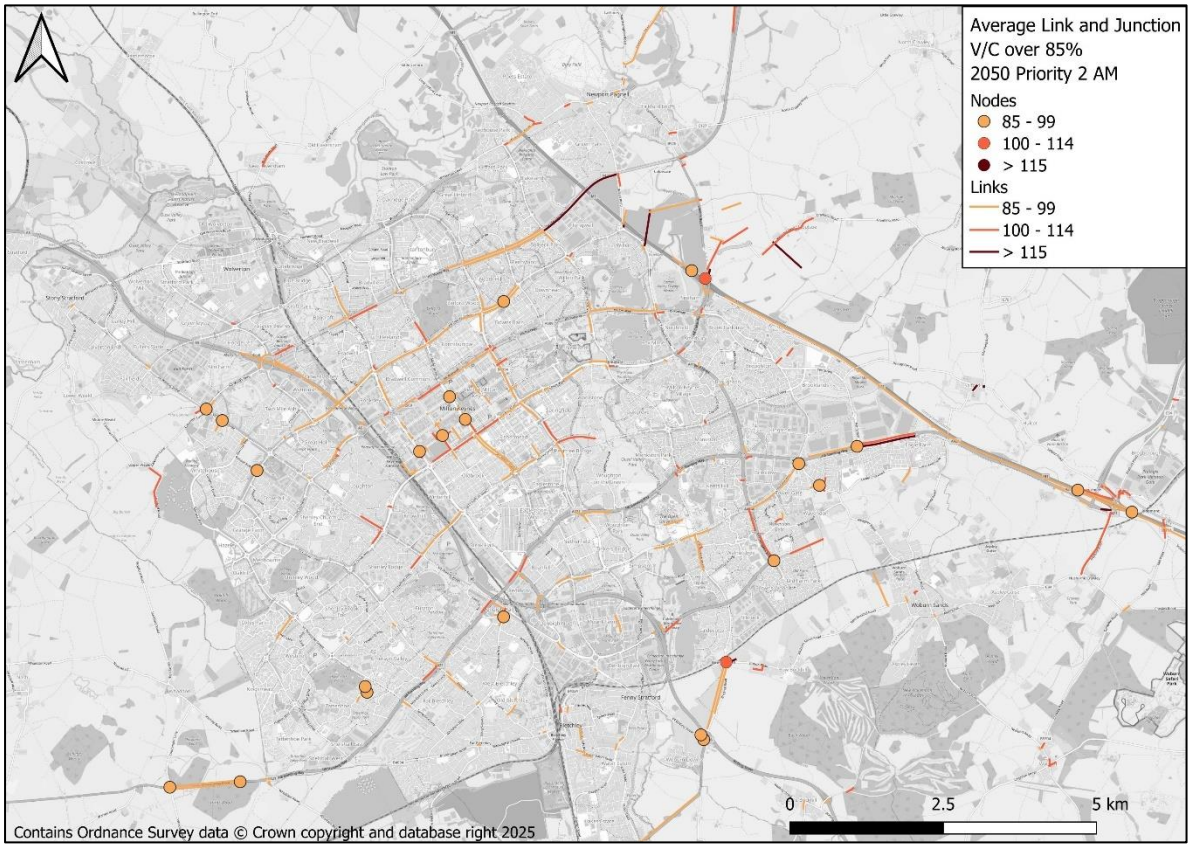

Figure 4-19: Absolute Link and Junction V/C, 2050 Priority 2, AM Peak

Figure 4-20: Absolute Link and Junction V/C, 2050 Priority 2, Interpeak

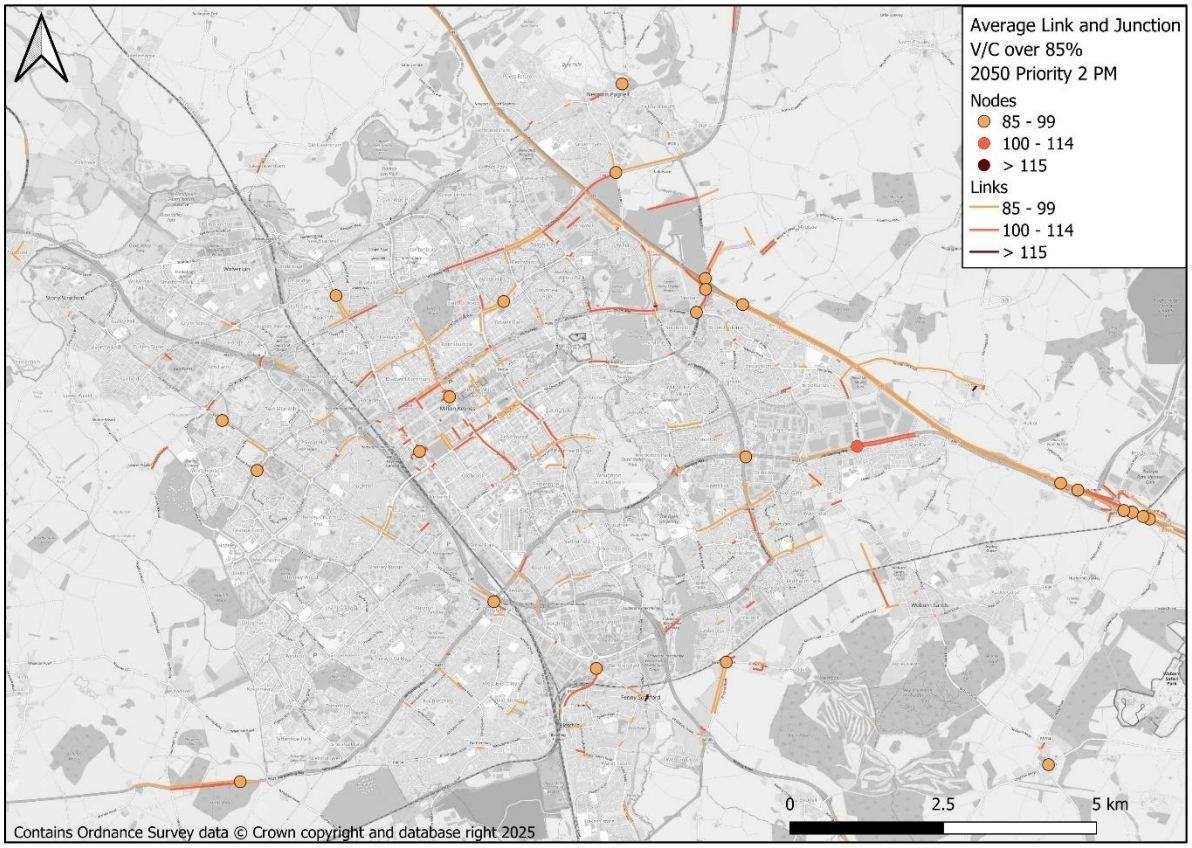

Figure 4-21: Absolute Link and Junction V/C, 2050 Priority 2, PM Peak

4.5 Link and Junction V/C Difference Plots

4.5.1 Forecast absolute changes[20] in volume over capacity (V/C) from the 2031 Reference Case to 2050 Priority 1 are shown in Figure 4-22 to Figure 4-24 for both links and nodes[21]. As expected, a general increase in V/C (represented in red) was observed across all time periods at both nodes and links. The increase in V/C is attributed to several factors, including future development growth between 2031 and 2050, development associated with the MKCP in 2050 Priority 1, and reduced highway capacity in 2050 Priority 1 as the MRT network reduces highway capacity. An increase in absolute V/C does not imply that a junction or link would exceed its capacity; these links and junctions might need to be monitored using local models.

4.5.2 Similar trends are observed between the 2050 Reference Case to 2050 Priority 1 as shown in Figure 4-25 to Figure 4-27 due to development associated with the MKCP, and reduced highway capacity in 2050 Priority 1. Some reduced V/C ratios were observed at certain nodes near Central MK and the Bletchley area. This is because certain routes have been designated as MRT-only routes, where cars are not permitted

4.5.3 A general decrease in network V/C (represented in green) is observed in 2050 Priority 2 compared to 2050 Priority 1, as shown in Figure 4-28 and Figure 4-30. This reduction is primarily due to the removal of MRT-associated housing developments in Central Milton Keynes (approximately 2,500 dwellings) and the absence of the MRT network in 2050 Priority 2, which results in increased highway capacity. Some increased link V/C were observed in certain areas of Milton Keynes. This is likely because the MRT-only routes in the 2050 Priority 1 scenario would displace traffic on parallel routes, which would not occur in the 2050 Priority 2 scenario which omits the MRT.

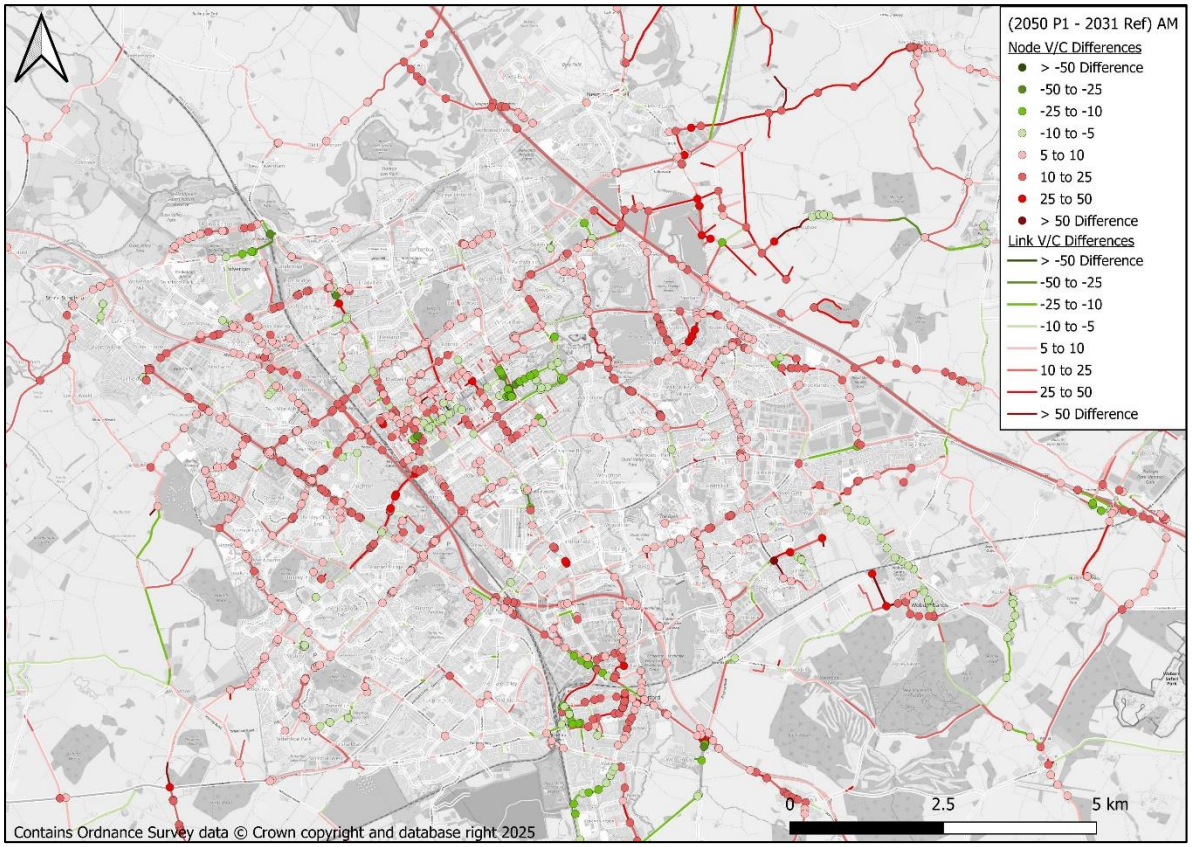

Figure 4-22: Link and Junction V/C Difference, 2050 Priority 1 – 2031 Reference Case, AM Peak

[20] This difference is in absolute terms e.g. 2050 P1 (70%) – RC2050(50%) = 20%
[21] Links represent roads whereas nodes represent junctions

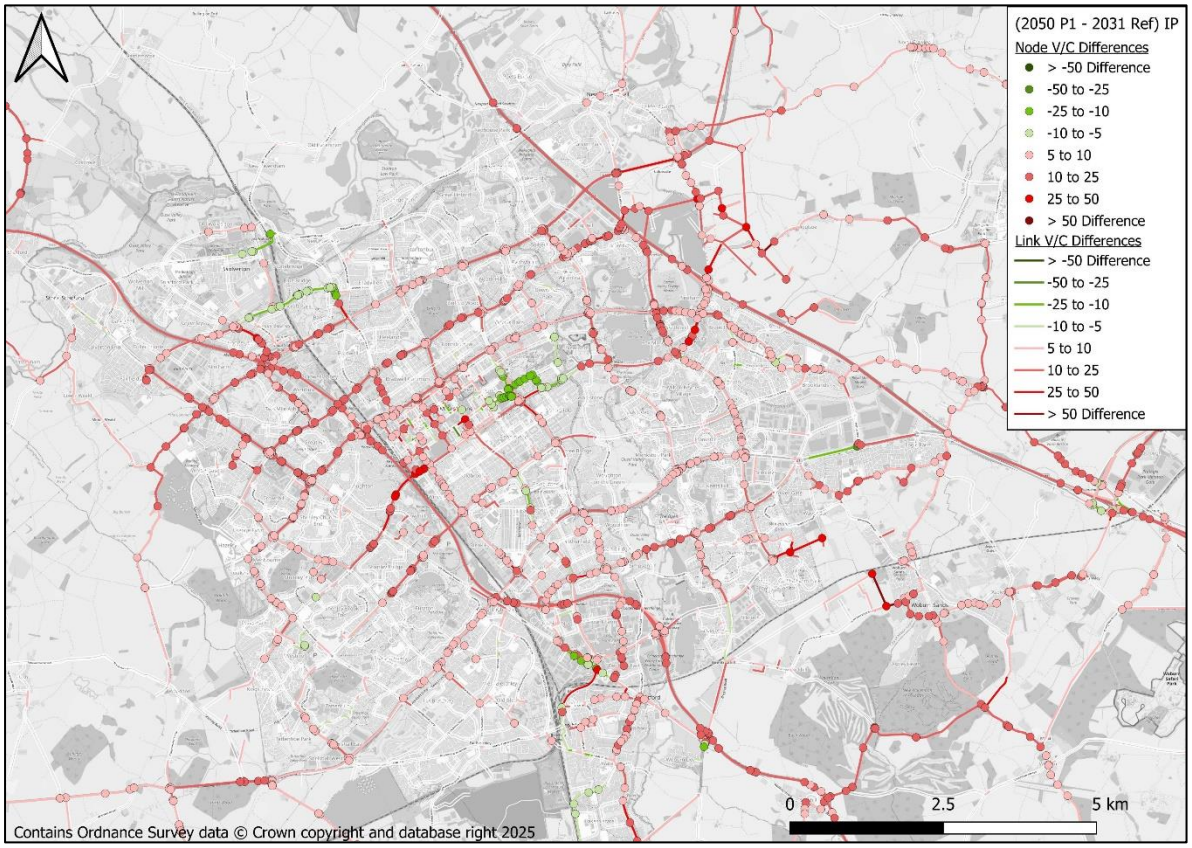

Figure 4-23: Link and Junction V/C Difference, 2050 Priority 1 – 2031 Reference Case, Interpeak

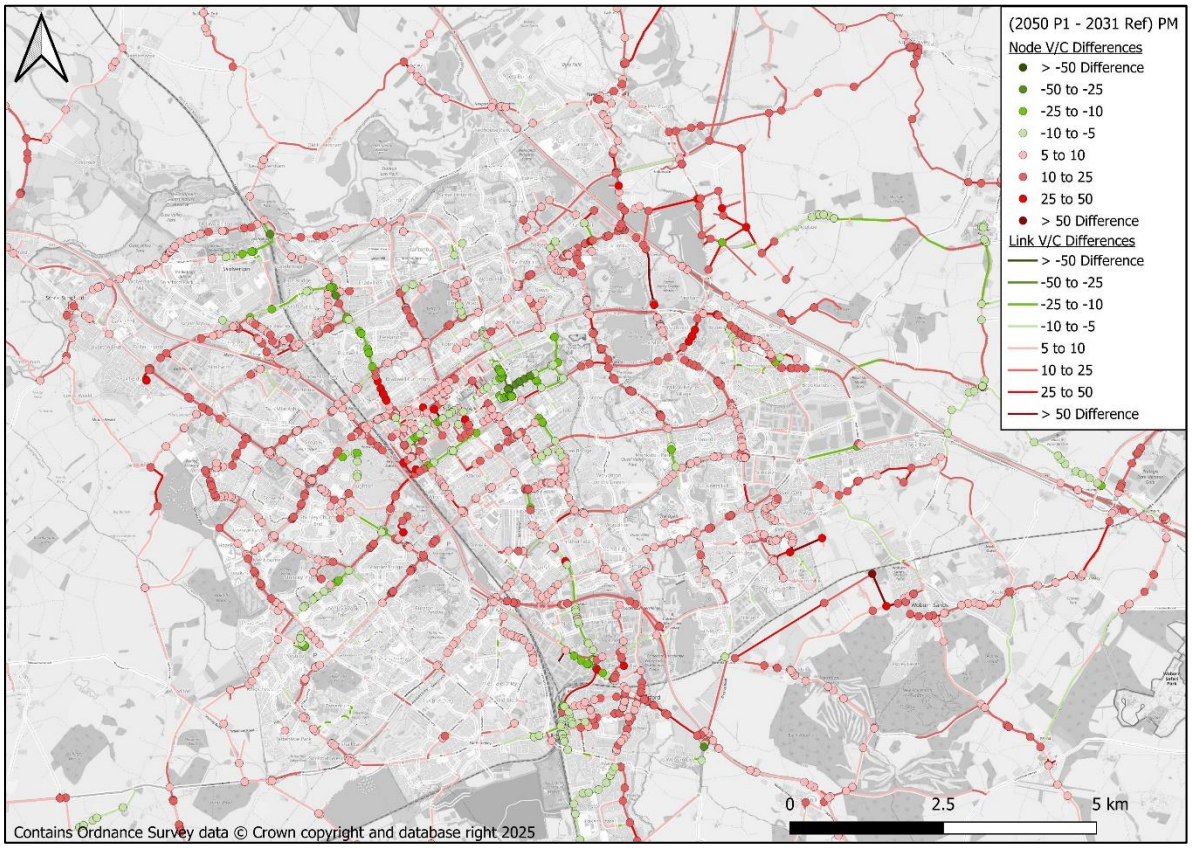

Figure 4-24: Link and Junction V/C Difference, 2050 Priority 1 – 2031 Reference Case, PM Peak

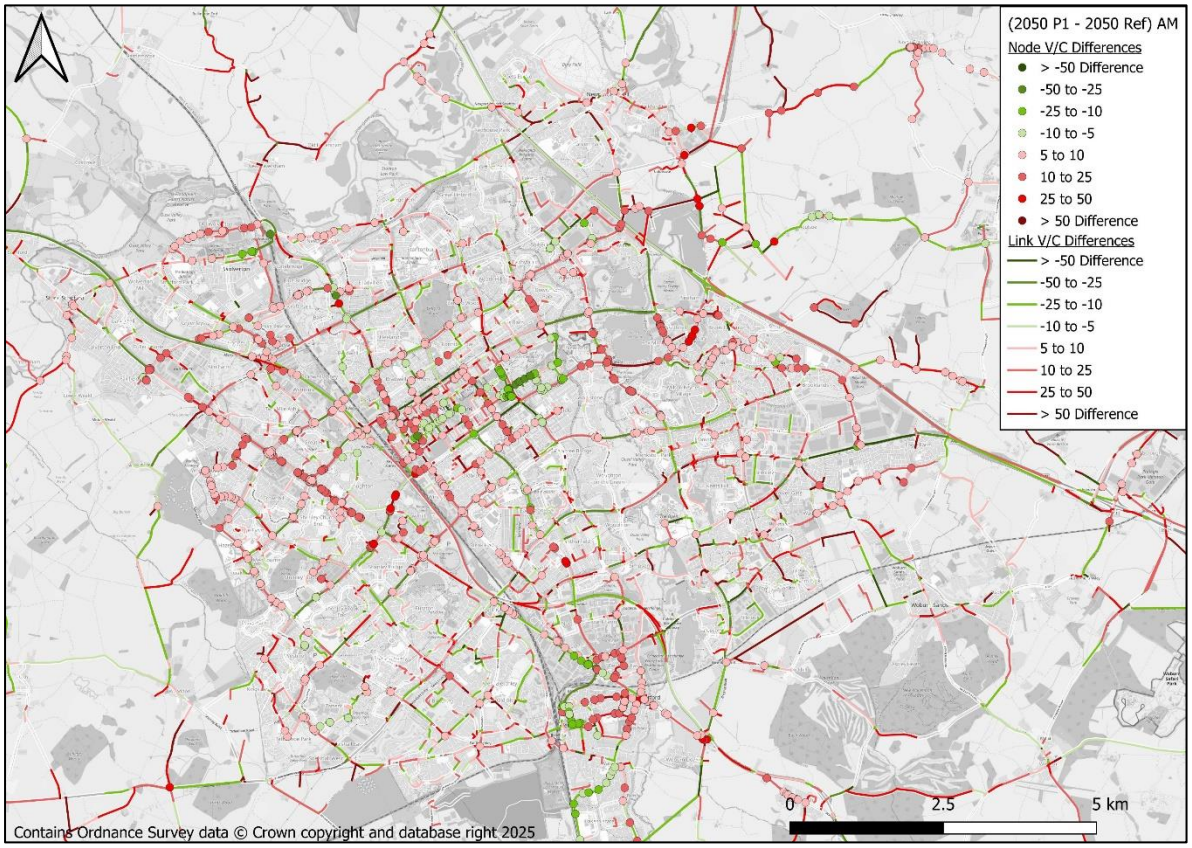

Figure 4-25: Link and Junction V/C Difference, 2050 Priority 1 – 2050 Reference Case, AM Peak

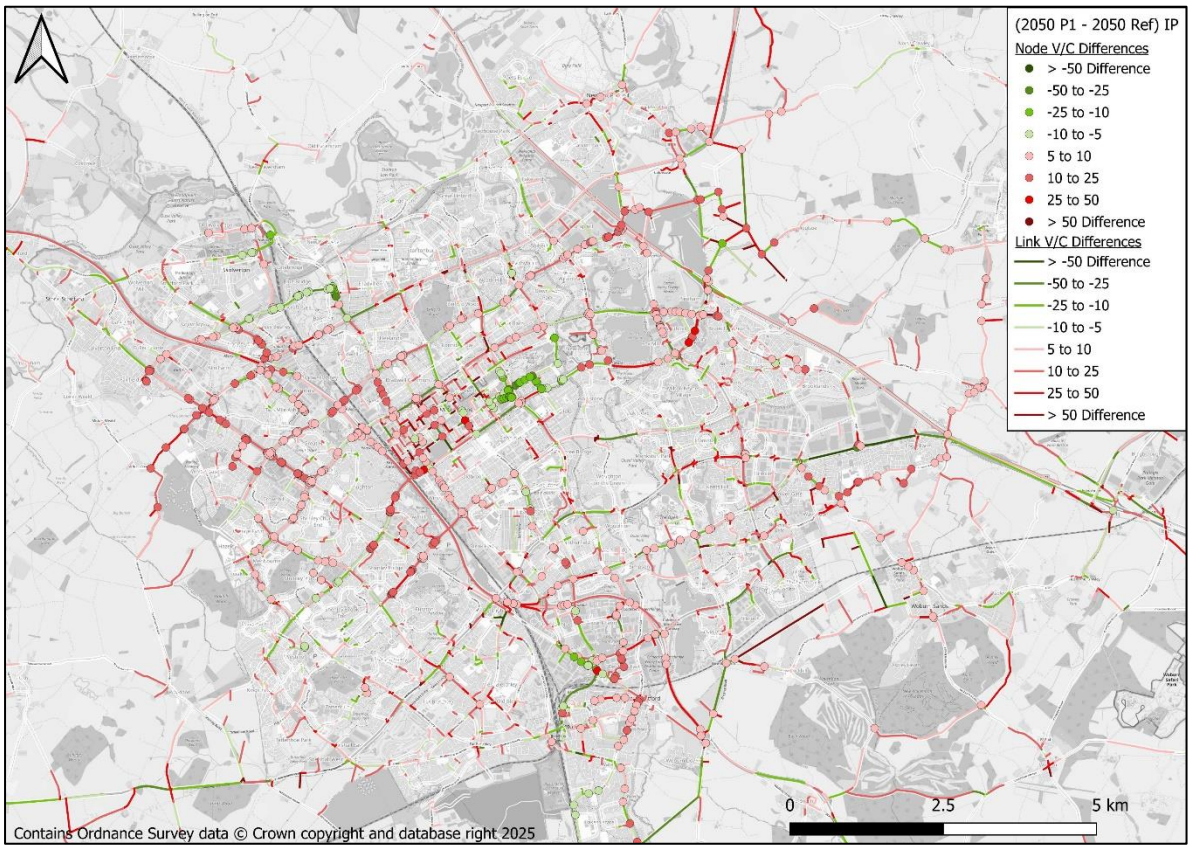

Figure 4-26: Link and Junction V/C Difference, 2050 Priority 1 – 2050 Reference Case, Interpeak

Figure 4-27: Link and Junction V/C Difference, 2050 Priority 1 – 2050 Reference Case, PM Peak

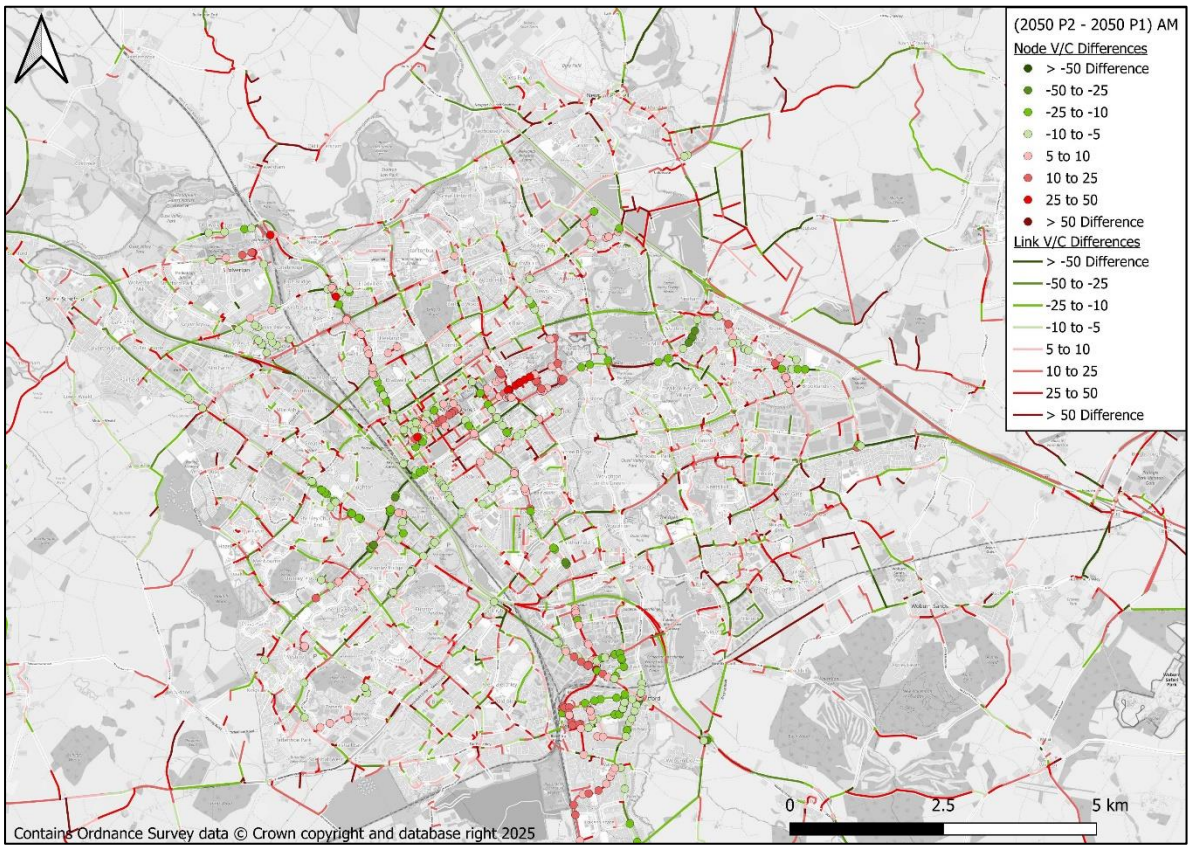

Figure 4-28: Link and Junction V/C Difference, 2050 Priority 2 – 2050 Priority 1, AM Peak

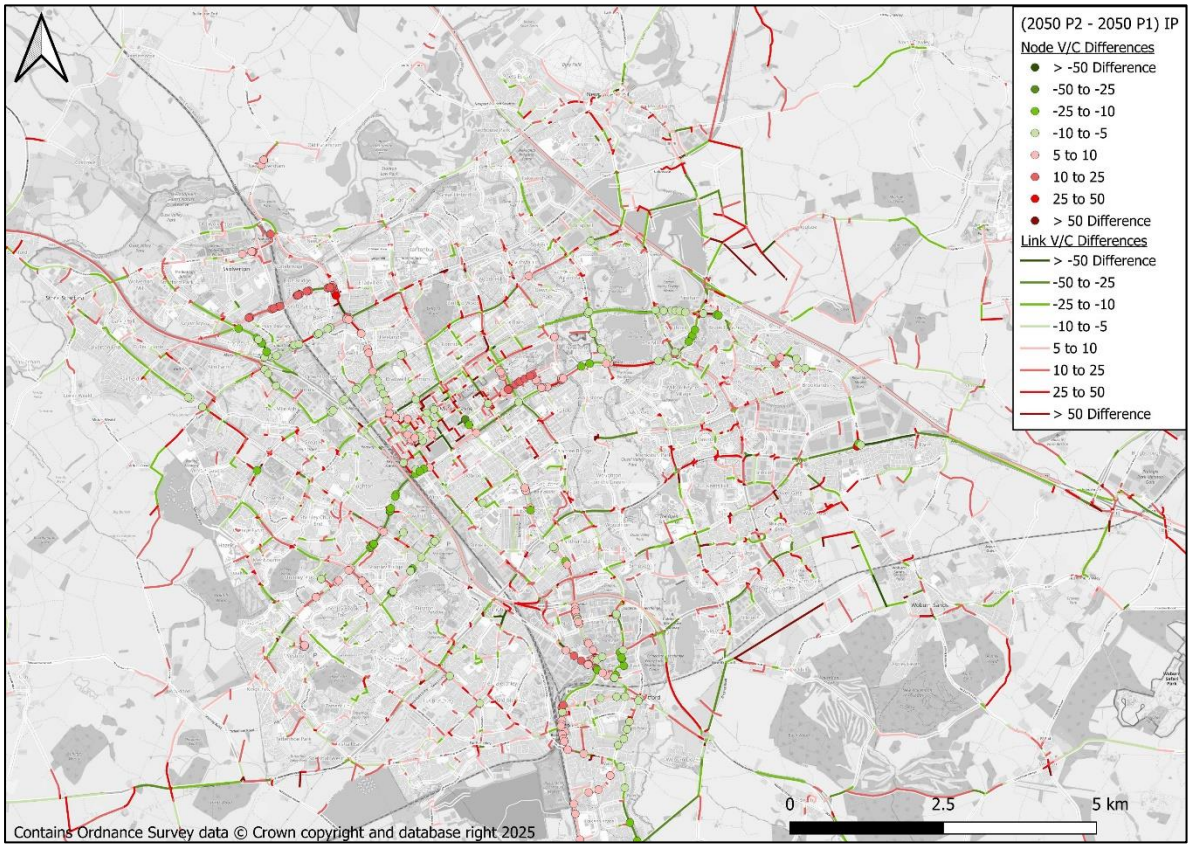

Figure 4-29: Link and Junction V/C Difference, 2050 Priority 2 – 2050 Priority 1, Interpeak

Figure 4-30: Link and Junction V/C Difference, 2050 Priority 2 – 2050 Priority 1, PM Peak

4.6 Link Delay Difference Plots

4.6.1 Forecast link delay differences from the 2031 Reference Case to 2050 Priority 1 are shown in Figure 4-31 to Figure 4-33. Similar to the V/C difference plots, a general increase of link delays (represented in red) is observed across years due to future development growth between 2031 and 2050. Similar trends are observed between 2050 Reference Case to 2050 Priority 1 as shown in Figure 4-34 to Figure 4-36 due to development associated with the MKCP, and reduced highway capacity in 2050 Priority 1.

4.6.2 A decrease in link delays (represented in green) is observed in 2050 Priority 2 compared to 2050 Priority 1, as shown in Figure 4-37 and Figure 4-39. This reduction is primarily due to the removal of MRT-associated housing developments in central MK and the absence of the MRT in 2050 Priority 2, which reinstates highway capacity.

4.6.3 A key issue noted in the modelling is the delays for traffic from the new developments north of the M1 wishing to access Central Milton Keynes. As there are only limited routes across the M1, the additional demand results in greater levels of delay in the model on these routes.

4.6.4 Absolute link delay plots for each year and scenario are in Appendix C.

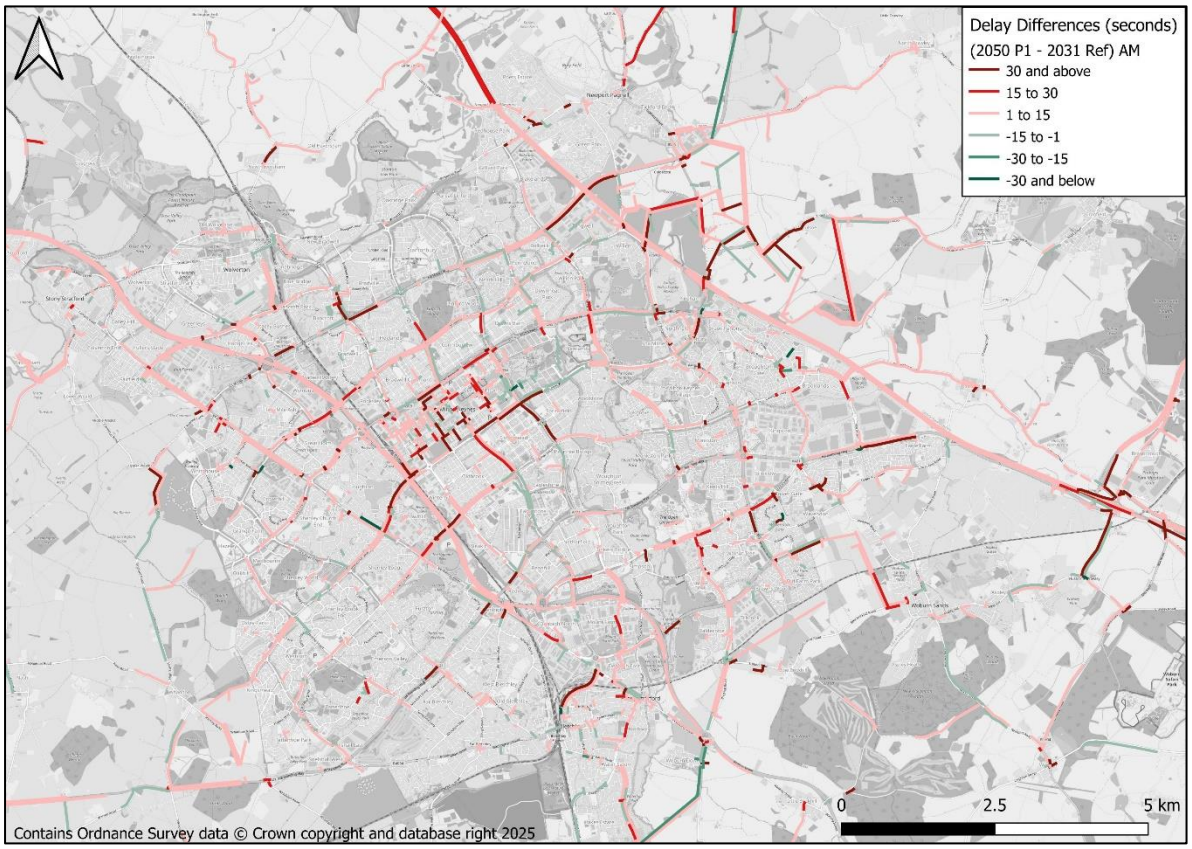

Figure 4-31: Link Delay Difference, 2050 Priority 1 – 2031 Reference Case, AM Peak

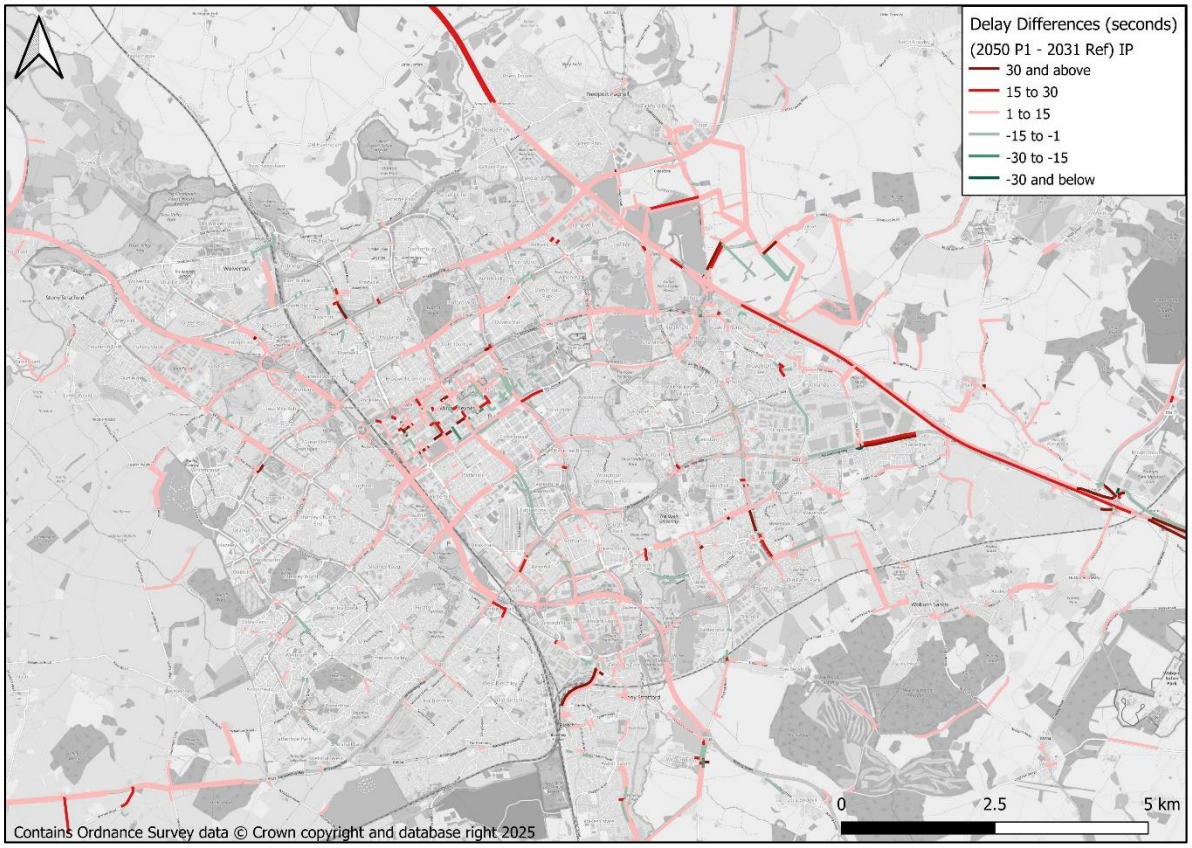

Figure 4-32: Link Delay Difference, 2050 Priority 1 – 2031 Reference Case, Interpeak

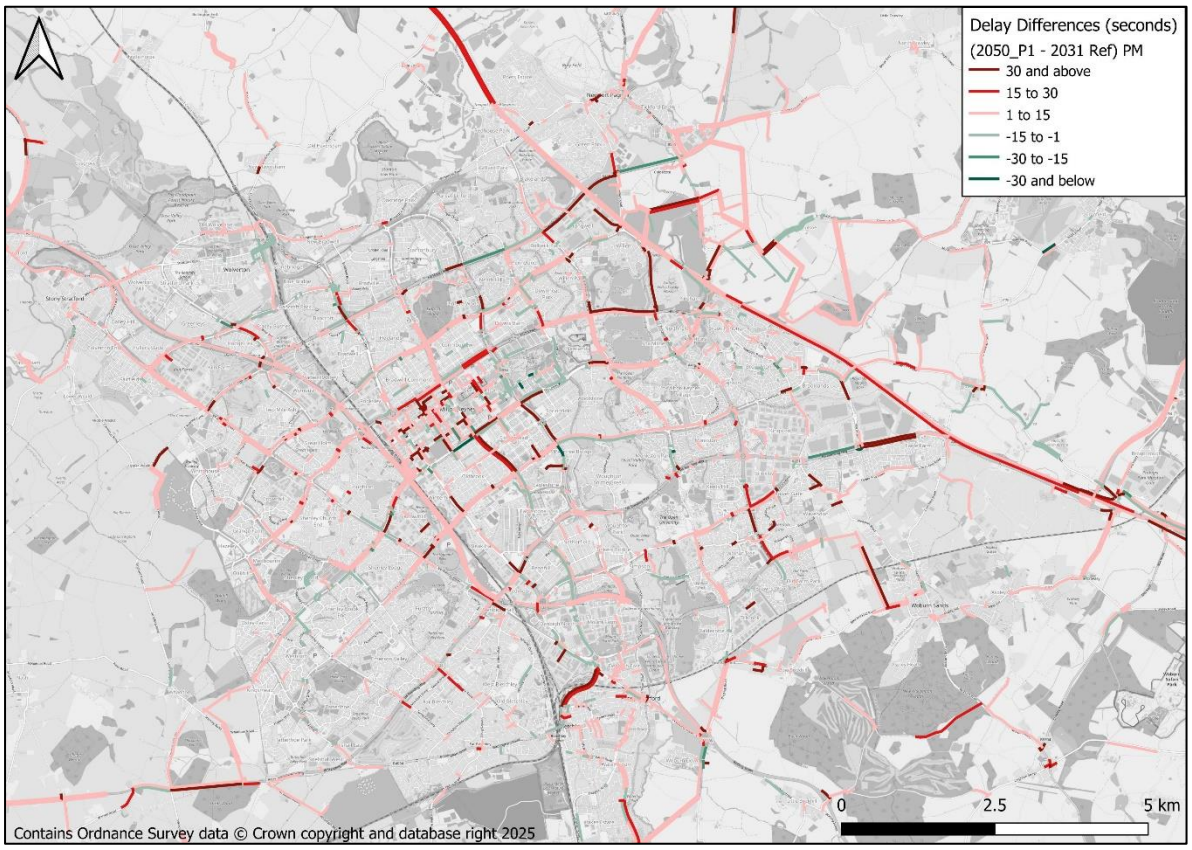

Figure 4-33: Link Delay Difference, 2050 Priority 1 – 2031 Reference Case, PM Peak

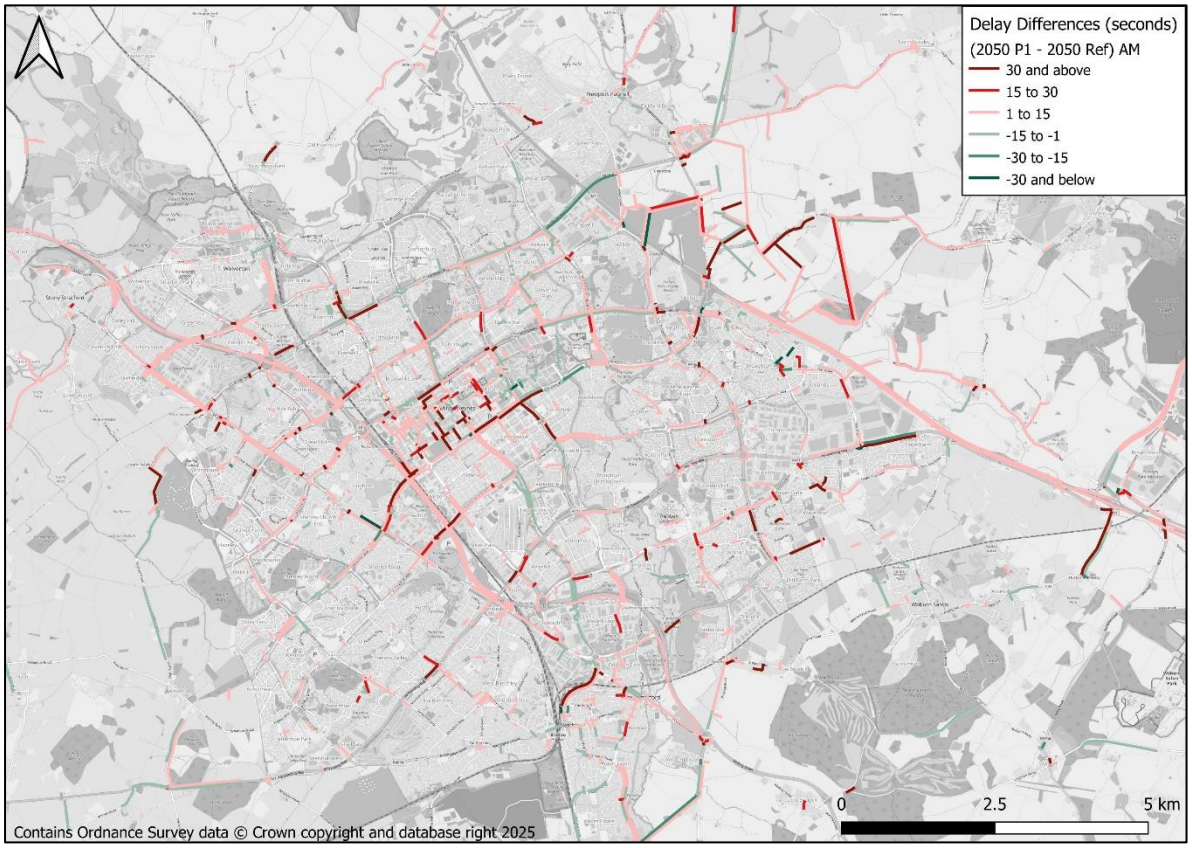

Figure 4-34: Link Delay Difference, 2050 Priority 1 – 2050 Reference Case, AM Peak

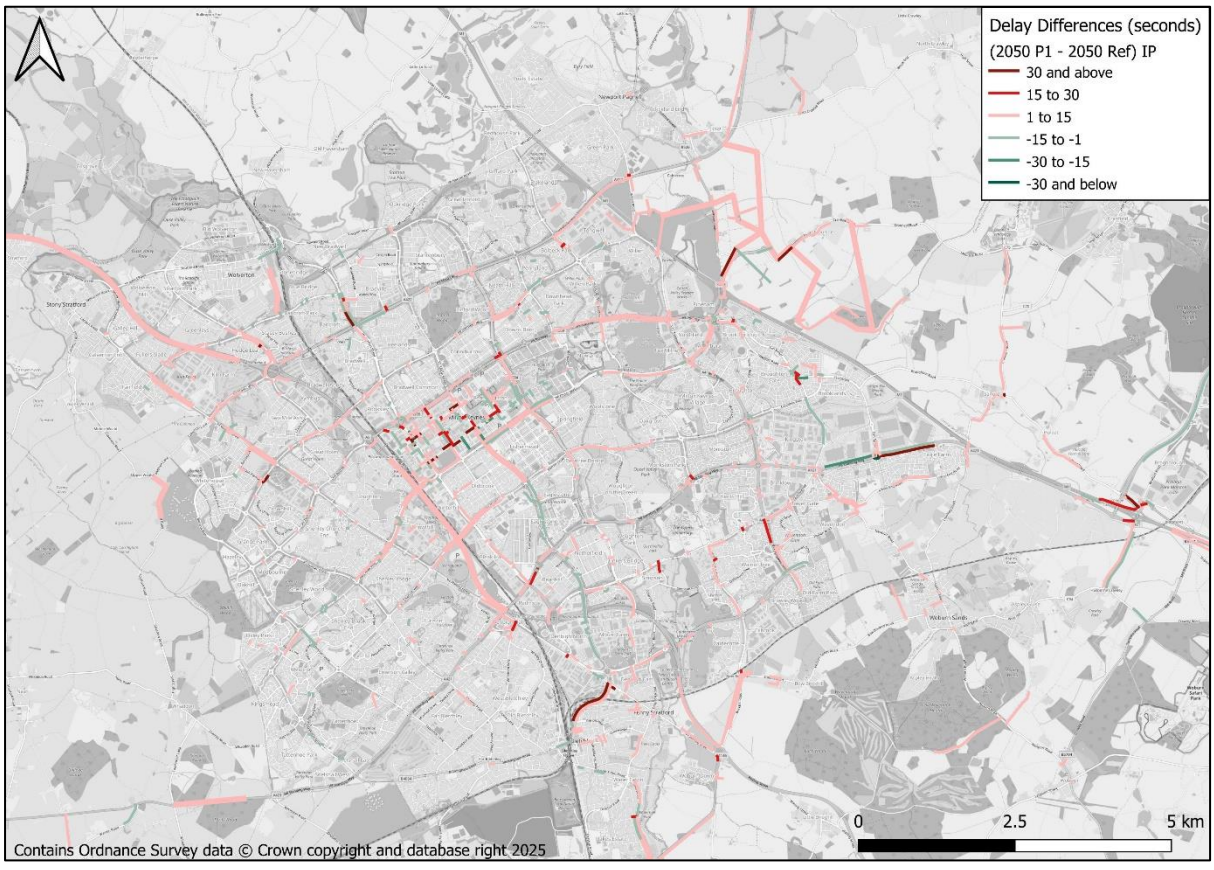

Figure 4-35: Link Delay Difference, 2050 Priority 1 – 2050 Reference Case, Interpeak

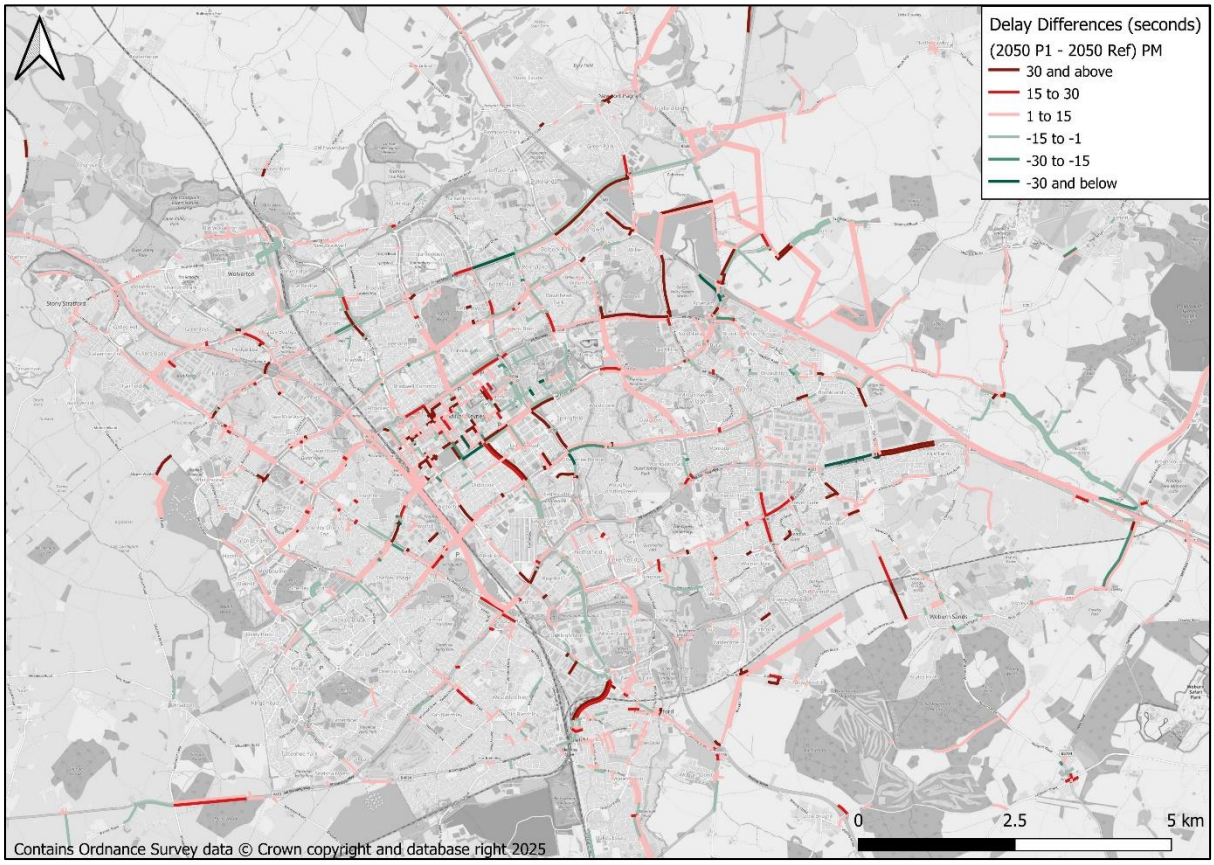

Figure 4-36: Link Delay Difference, 2050 Priority 1 – 2050 Reference Case, PM Peak

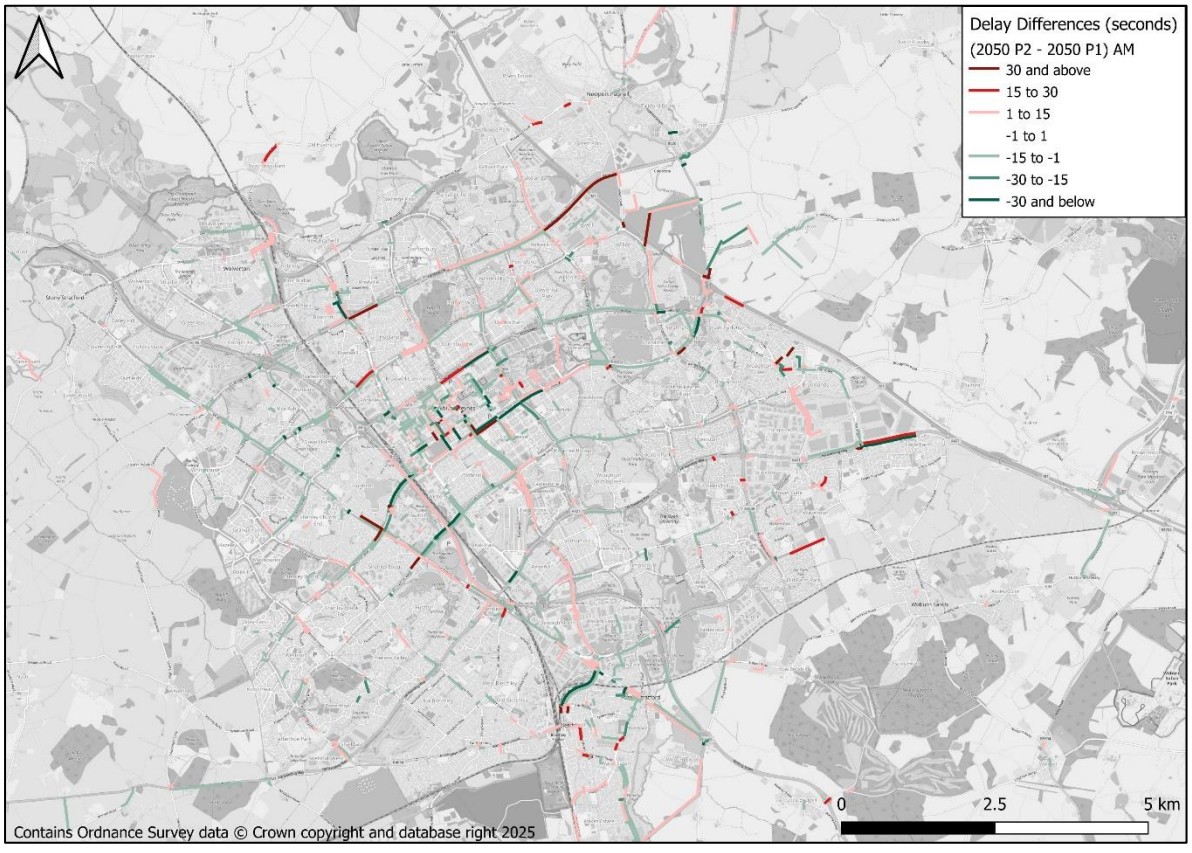

Figure 4-37: Link Delay Difference, 2050 Priority 2 – 2050 Priority 1, AM Peak

Figure 4-38: Link Delay Difference, 2050 Priority 2 – 2050 Priority 1, Interpeak

Figure 4-39: Link Delay Difference, 2050 Priority 2 – 2050 Priority 1, PM Peak

4.7 Journey Time Changes

4.7.1 The journey time routes used in the model validation (as shown in Figure 4-40 and Figure 4-41) were assessed to provide a measure of impacts in the 2031 Reference Case, 2050 Reference Case, 2050 Priority 1 and 2050 Priority 2 scenarios. The total journey time changes along each route are presented in Table 4-2, Overall, the journey times across all routes increase by 10% in the AM Peak hour, 5% in the Interpeak, and 9% in the PM Peak hour between 2031 and 2050 Reference Case.

4.7.2 For 2050 Priority 1, the journey times increase by 26%, 10% and 25% in the AM Peak hour, Interpeak and PM Peak hour respectively compared to the 2031 Reference Case. For 2050 Priority 2, the increases from 2031 Reference Case are slightly less than 2050 Priority 1, with 23% in the AM Peak hour, 8% in the Interpeak, and 23% in the PM Peak hour.

4.7.3 There are large increases in journey times in 2050 Priority 1 and 2050 Priority 2 along Route 4 as a result of the MKCP developments. These create additional delay as shown with increased V/C on the H5 Portway links, particularly in the PM Peak hour.

4.7.4 Route 5 also experiences large increases, up to 57% in the 2050 Priority 1 AM Peak hour travelling westbound. This route travels along H6 Childs Way and across Central Milton Keynes where the V/C at many links and nodes exceeds 85%. In addition, part of this route follows the East West MRT route, hence there is a reduction in road capacity in 2050 Priority 1.

4.7.5 There are large increases, particularly in the AM Peak hour on Route 11 in 2050 Priority 1 and 2050 Priority 2. This route travels along the A421 and along V8 Marlborough Street which experiences an increase in delays, particularly in 2050 Priority 1 around Fen Roundabout and Marlborough Street between Fishermead Roundabout and Marina Roundabout.

4.7.6 Route 5 also experiences large increases, up to 57% in the 2050 Priority 1 AM Peak hour travelling westbound. This route travels along H6 Childs Way and across Central Milton Keynes where the V/C at many links and nodes exceeds 85%. Part of this route also follows the East West MRT route, hence there will be a reduction in road capacity in 2050 Priority 1. There are large increases, particularly in the AM Peak hour, on Route 11 in 2050 Priority 1 and 2050 Priority 2. This route travels along the A421 and along V8 Marlborough Street which experiences an increase in delays, particularly in 2050 Priority 1.

4.7.7 Route 13 travels along the A5, through Milton Keynes and then continues through the ESCE development area, where there are increases in delays and V/C in the 2050 Priority 1 and 2050 Priority 2 scenarios. These delays contribute to the increased journey times seen on this route, particularly in the AM and PM Peak hours.

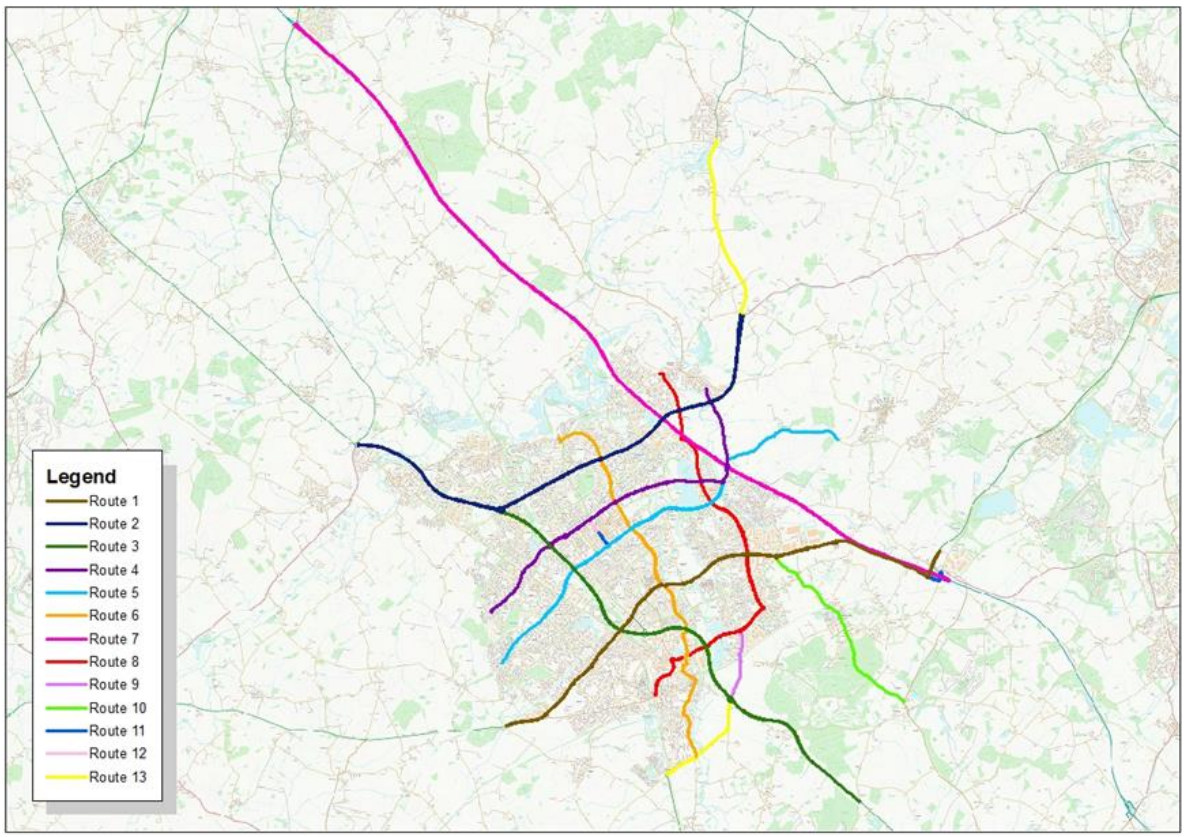

Figure 4-40: Journey Time Routes

Figure 4-41: Journey Time Routes (routes hidden in previous figure)

Table 4-2: Journey Times Changes RC2031, RC2050, 2050 Priority 1 and 2050 Priority 2 Scenarios

Route	Direction	Journey Times												% Change from 2031 Ref Case								
		2031 Ref Case			2050 Ref Case			2050 Priority 1			2050 Priority 2			2050 Ref Case			2050 Priority 1			2050 Priority 2		
		AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
Route 1	EB	24:02	18:28	23:24	25:15	19:19	25:21	26:58	19:35	27:06	26:24	19:30	27:30	5%	5%	8%	12%	6%	16%	10%	6%	18%
Route 1	WB	26:46	19:17	21:50	28:58	20:24	22:59	30:16	20:55	25:20	30:25	20:50	24:35	8%	6%	5%	13%	8%	16%	14%	8%	13%
Route 2	EB	16:05	14:13	19:53	16:49	14:44	21:55	18:19	15:25	23:52	18:13	15:25	23:51	5%	4%	10%	14%	8%	20%	13%	9%	20%
Route 2	WB	23:14	14:44	18:14	26:06	15:09	20:02	29:08	15:26	22:32	29:26	15:28	22:42	12%	3%	10%	25%	5%	24%	27%	5%	24%
Route 3	NB	15:48	13:38	16:29	16:33	14:10	18:00	18:00	14:28	18:49	17:38	14:23	19:04	5%	4%	9%	14%	6%	14%	12%	6%	16%
Route 3	SB	14:50	13:33	16:46	15:35	14:12	18:56	16:07	14:32	20:36	16:04	14:30	20:35	5%	5%	13%	9%	7%	23%	8%	7%	23%
Route 4	NB	20:57	17:40	21:15	22:00	18:12	24:30	27:41	19:50	29:08	26:16	19:20	28:50	5%	3%	15%	32%	12%	37%	25%	9%	36%
Route 4	SB	26:23	17:08	20:59	30:27	17:35	21:57	34:53	18:30	27:23	34:43	18:17	26:48	15%	3%	5%	32%	8%	31%	32%	7%	28%
Route 5	EB	22:00	18:52	22:46	23:34	19:28	24:44	29:38	21:28	33:43	27:59	20:56	33:02	7%	3%	9%	35%	14%	48%	27%	11%	45%
Route 5	WB	27:21	17:51	22:21	31:50	18:24	23:54	42:55	20:27	33:00	42:03	19:45	30:39	16%	3%	7%	57%	15%	48%	54%	11%	37%
Route 6	NB	21:25	18:35	20:39	22:03	18:50	20:59	25:09	19:39	23:11	23:57	19:07	22:17	3%	1%	2%	17%	6%	12%	12%	3%	8%
Route 6	SB	20:45	18:11	21:46	20:56	18:29	22:56	22:14	19:08	25:14	21:51	18:55	25:19	1%	2%	5%	7%	5%	16%	5%	4%	16%
Route 7	NB	18:22	18:26	18:35	20:05	20:53	20:24	20:15	20:51	20:37	20:30	20:50	20:39	9%	13%	10%	10%	13%	11%	12%	13%	11%
Route 7	SB	17:59	17:31	18:28	19:27	18:53	21:24	19:31	18:55	21:39	19:34	18:56	21:35	8%	8%	16%	9%	8%	17%	9%	8%	17%
Route 8	NB	22:41	18:18	20:50	24:04	19:10	22:32	28:50	20:42	28:17	26:57	20:07	26:36	6%	5%	8%	27%	13%	36%	19%	10%	28%
Route 8	SB	23:30	17:32	21:18	27:16	18:02	22:04	29:36	18:47	25:52	29:38	18:38	25:45	16%	3%	4%	26%	7%	21%	26%	6%	21%
Route 9	NB	02:53	02:32	02:36	02:47	02:25	02:31	02:54	02:27	02:39	02:51	02:27	02:39	-3%	-5%	-3%	1%	-3%	2%	-1%	-3%	2%
Route 9	SB	03:04	02:41	05:03	02:57	02:42	05:28	03:01	03:03	06:45	03:01	02:59	06:44	-4%	1%	8%	-2%	14%	34%	-2%	11%	33%
Route 10	NB	09:28	08:26	08:44	09:57	08:25	08:45	12:21	08:43	09:19	12:31	08:43	09:14	5%	0%	0%	30%	3%	7%	32%	3%	6%
Route 10	SB	08:29	08:15	10:54	08:25	08:12	11:18	08:42	08:33	13:17	08:43	08:30	13:24	-1%	-1%	4%	3%	4%	22%	3%	3%	23%
Route 11	EB	21:45	18:20	25:45	29:59	20:21	29:56	40:36	21:02	33:47	38:53	21:15	33:12	38%	11%	16%	87%	15%	31%	79%	16%	29%
Route 11	WB	24:41	17:07	20:07	27:36	18:13	20:55	31:17	18:39	24:39	29:32	18:35	23:36	12%	6%	4%	27%	9%	23%	20%	8%	17%
Route 12	EB	14:17	13:47	17:14	15:04	14:34	22:17	15:56	15:21	23:11	15:57	15:05	23:54	5%	6%	29%	11%	11%	35%	12%	9%	39%

Route	Direction	Journey Times												% Change from 2031 Ref Case								
		2031 Ref Case			2050 Ref Case			2050 Priority 1			2050 Priority 2			2050 Ref Case			2050 Priority 1			2050 Priority 2		
		AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
Route 12	WB	19:05	13:13	14:16	19:59	14:32	15:17	21:58	14:42	16:24	20:53	14:39	16:08	5%	10%	7%	15%	11%	15%	9%	11%	13%
Route 13	NB	31:56	27:35	32:39	34:15	29:19	36:30	40:58	31:36	41:22	39:10	31:05	41:35	7%	6%	12%	28%	15%	27%	23%	13%	27%
Route 13	SB	36:11	26:35	32:53	41:00	28:02	36:18	48:59	29:17	41:52	48:37	29:07	41:07	13%	5%	10%	35%	10%	27%	34%	10%	25%
Total		8hr 33	6hr 52	8hr 15	9hr 22	7hr 12	9hr 1	10hr 46	7hr 31	10hr 19	10hr 19	7hr 27	10hr 11	10%	5%	9%	26%	10%	25%	23%	8%	23%

4.8 MRT Boarders

4.8.1 Table 4-3 presents the MRT patronage as boarders for each time period in the 2050 Priority 1 scenario. This shows the greatest number of boarders are in the Interpeak, followed by the AM Peak hour, then the PM Peak hour. This is expected as the network is least congested in the Interpeak.

Table 4-3: MRT Boarders

Mode	Boarders
AM Peak Hour	3,038
Interpeak	3,118
PM Peak Hour	2,098

4.9 Bus Flow Difference Plots

4.9.1 Plots showing the flow changes in bus passenger volumes between the 2031 Reference Case and the 2050 Priority 1 scenario are presented below in Figure 4-42 to Figure 4-44. These show an increase in flows across the model, but more specifically on the proposed MRT routes (as these are included). The largest increases are forecast for the Interpeak.

4.9.2 The bus flow differences between the 2050 Reference Case and 2050 Priority 1 scenarios are shown in Figure 4-45 to Figure 4-47. The difference pattern is similar to those between the 2031 Reference Case and the 2050 Priority 1 scenario but with higher volumes.

4.9.3 Finally, the flow changes comparing 2050 Priority 1 to 2050 Priority 2 are presented in Figure 4-48 to Figure 4-50. There are decreases across the MRT routes due to the omission of the MRT in 2050 Priority 2.

4.9.4 The absolute bus link flow plots are included in Appendix D.

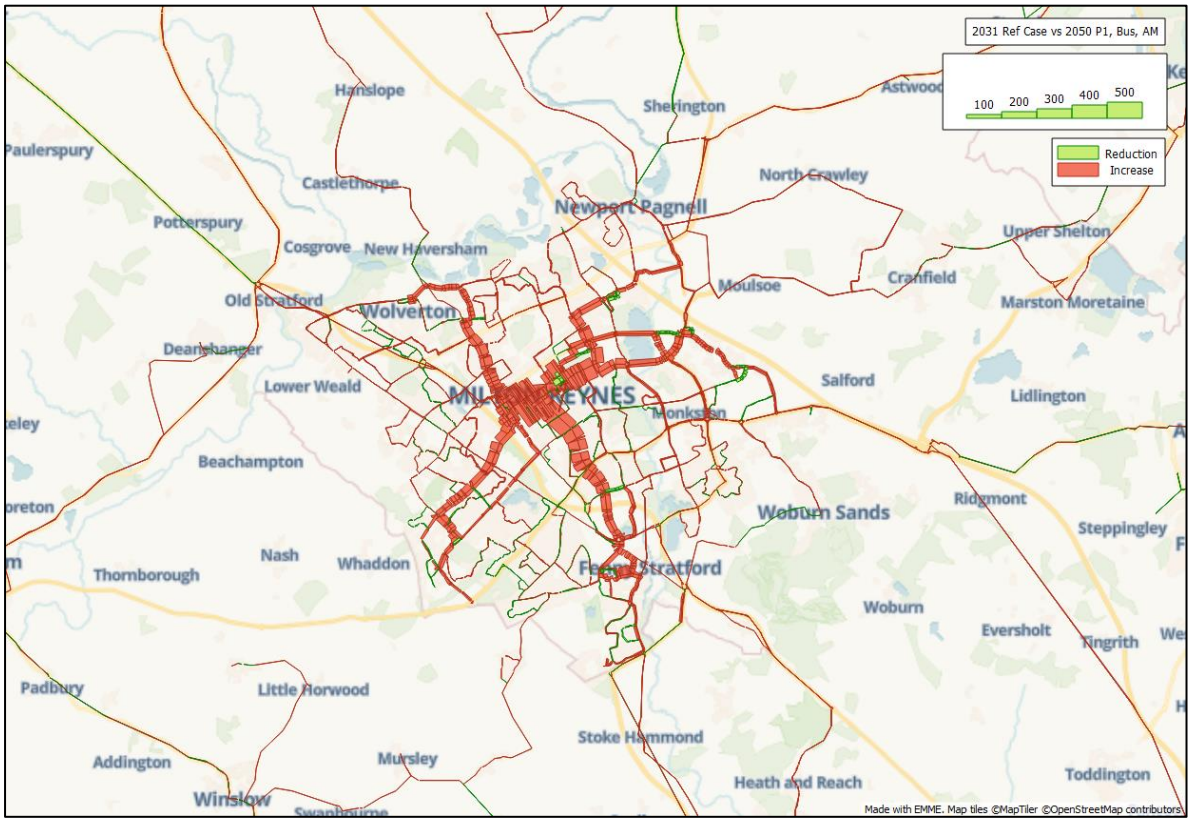

Figure 4-42: Bus Flow Difference, 2050 Priority 1 – 2031 Reference Case, AM Peak

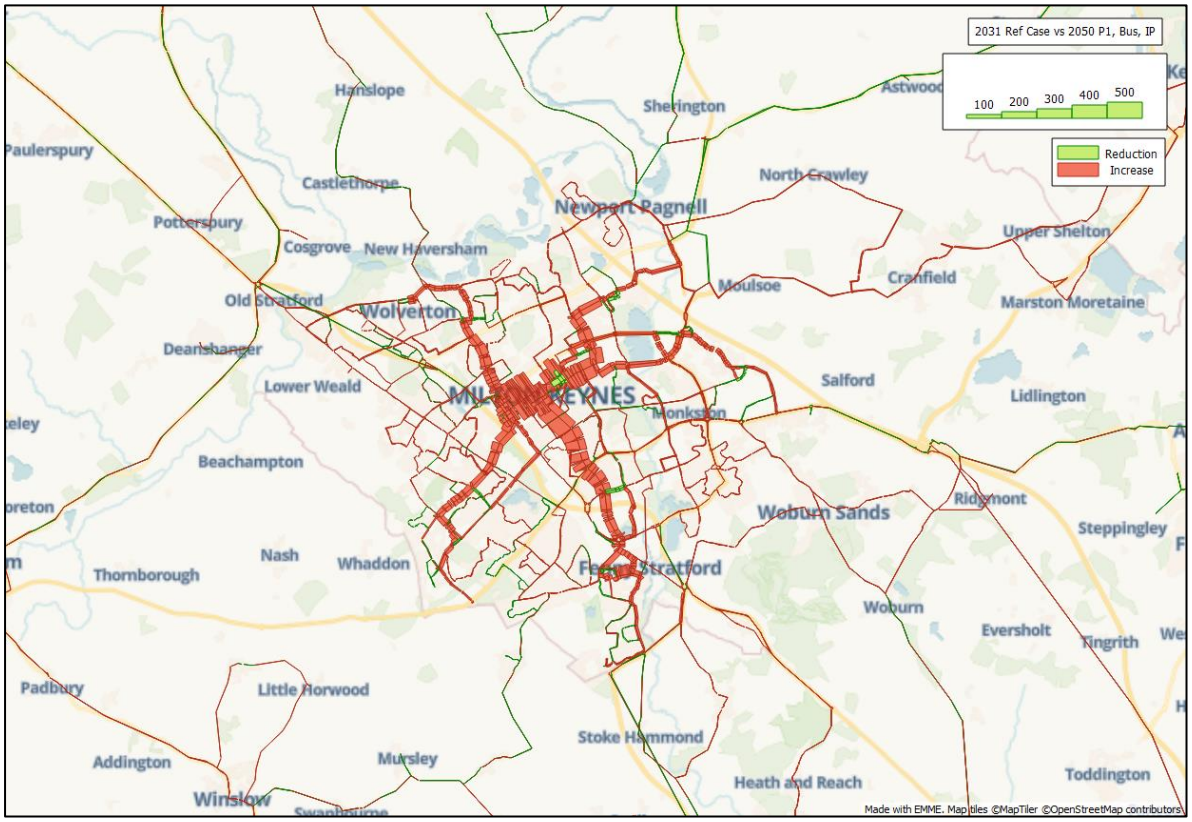

Figure 4-43: Bus Flow Difference, 2050 Priority 1 – 2031 Reference Case, Interpeak

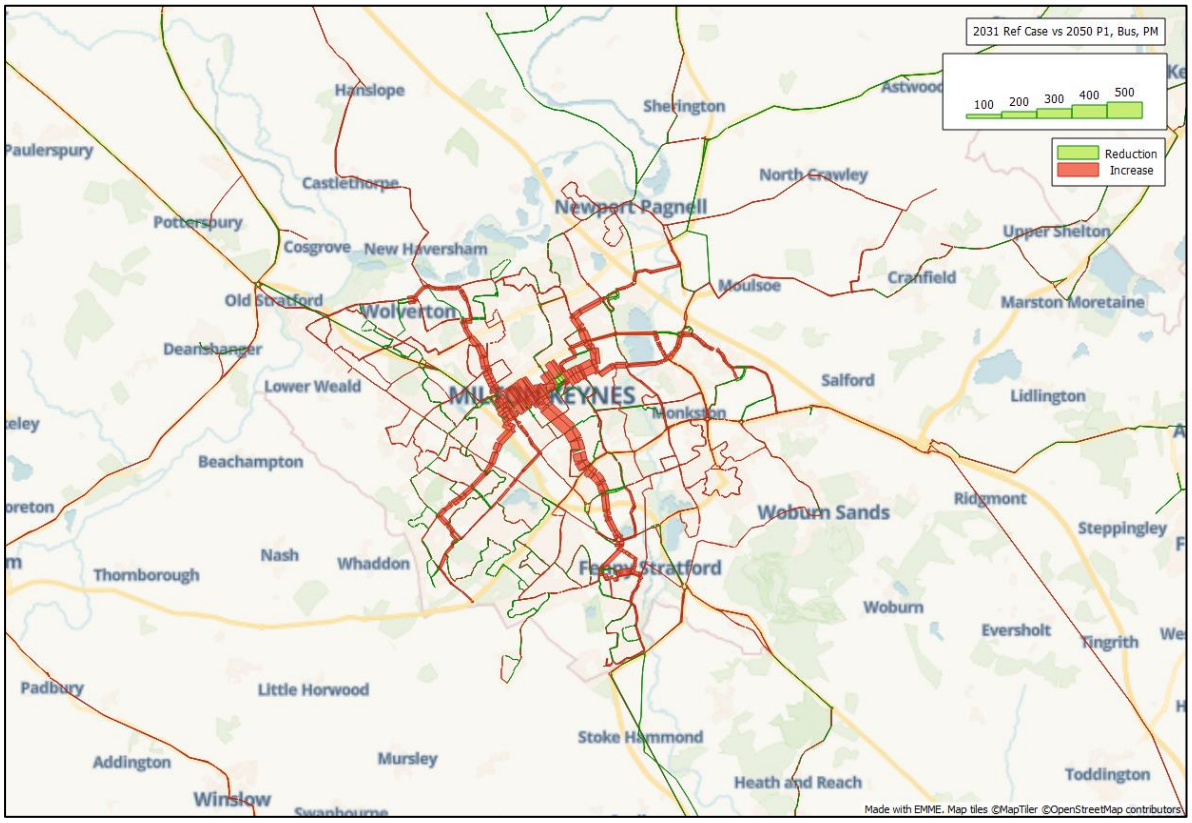

Figure 4-44: Bus Flow Difference, 2050 Priority 1 – 2031 Reference Case, PM Peak

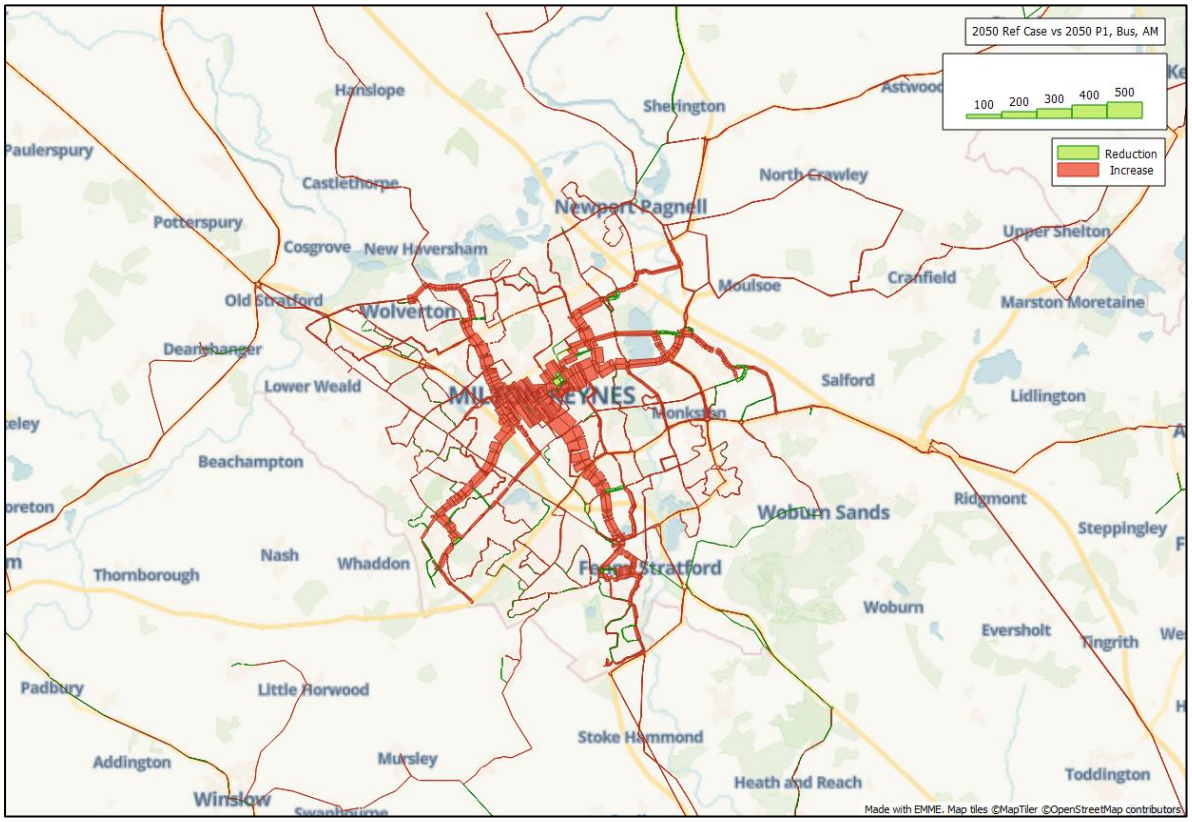

Figure 4-45: Bus Flow Difference, 2050 Priority 1 – 2050 Reference Case, AM Peak

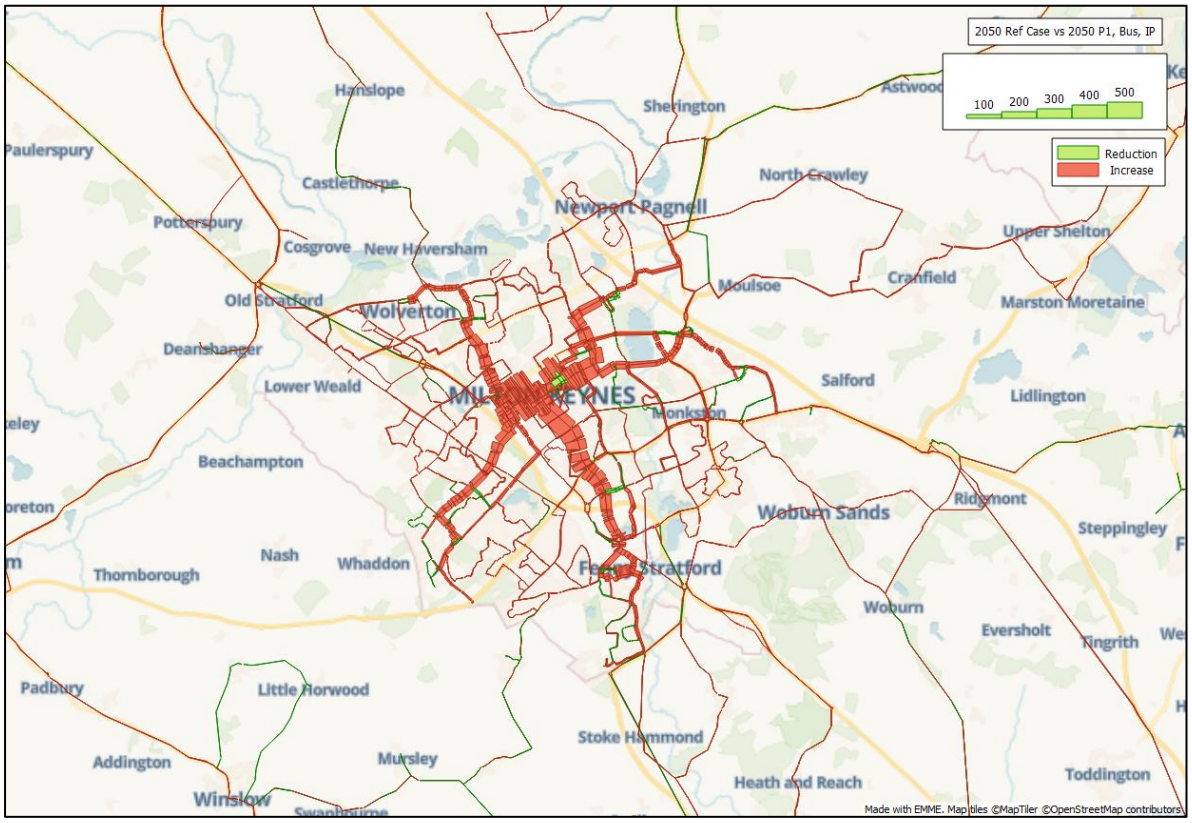

Figure 4-46: Bus Flow Difference, 2050 Priority 1 – 2050 Reference Case, Interpeak

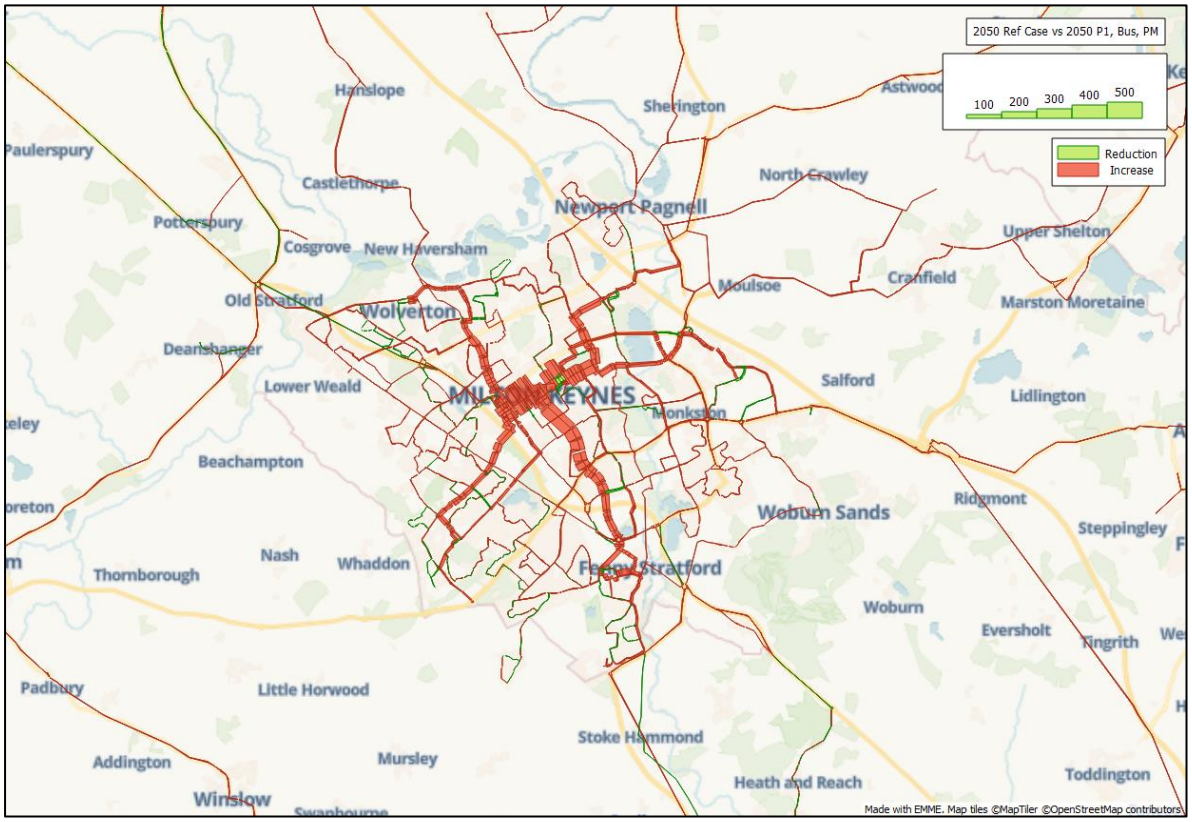

Figure 4-47: Bus Flow Difference, 2050 Priority 1 – 2050 Reference Case, PM Peak

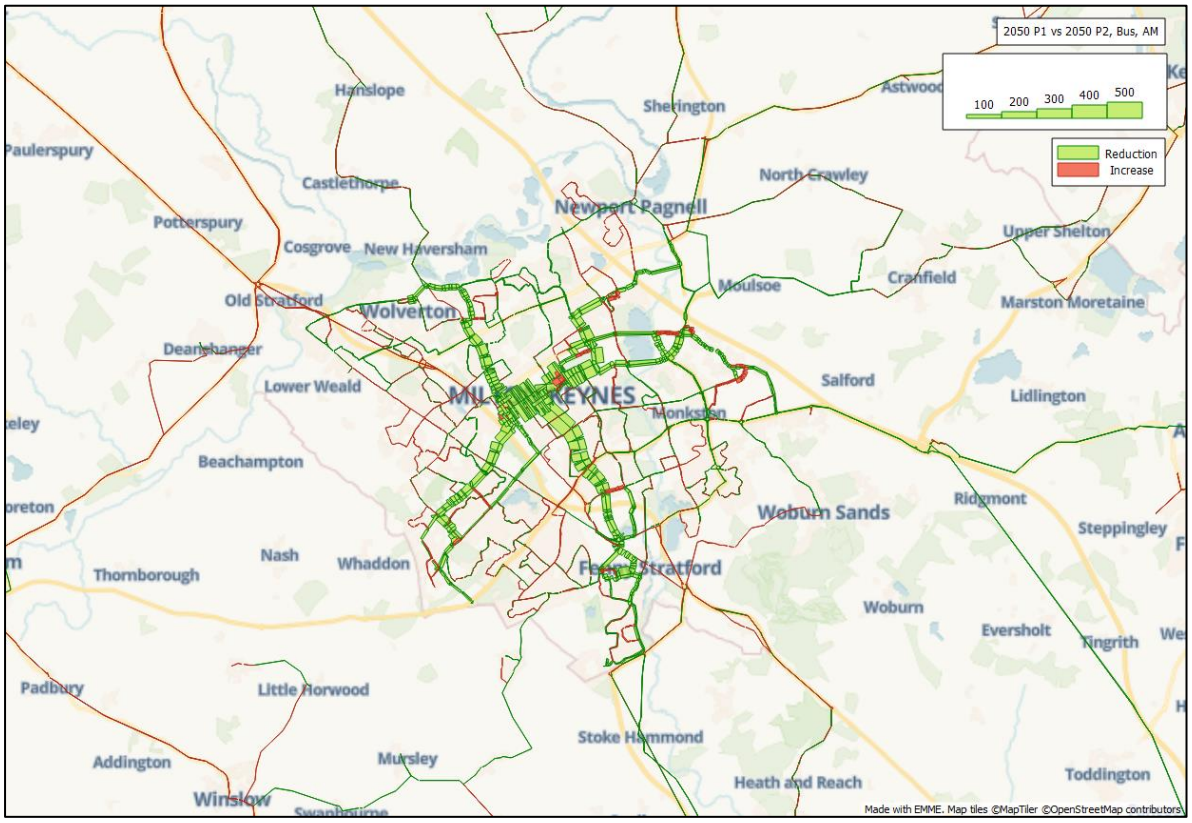

Figure 4-48: Bus Flow Difference, 2050 Priority 2 – 2050 Priority 1, AM Peak

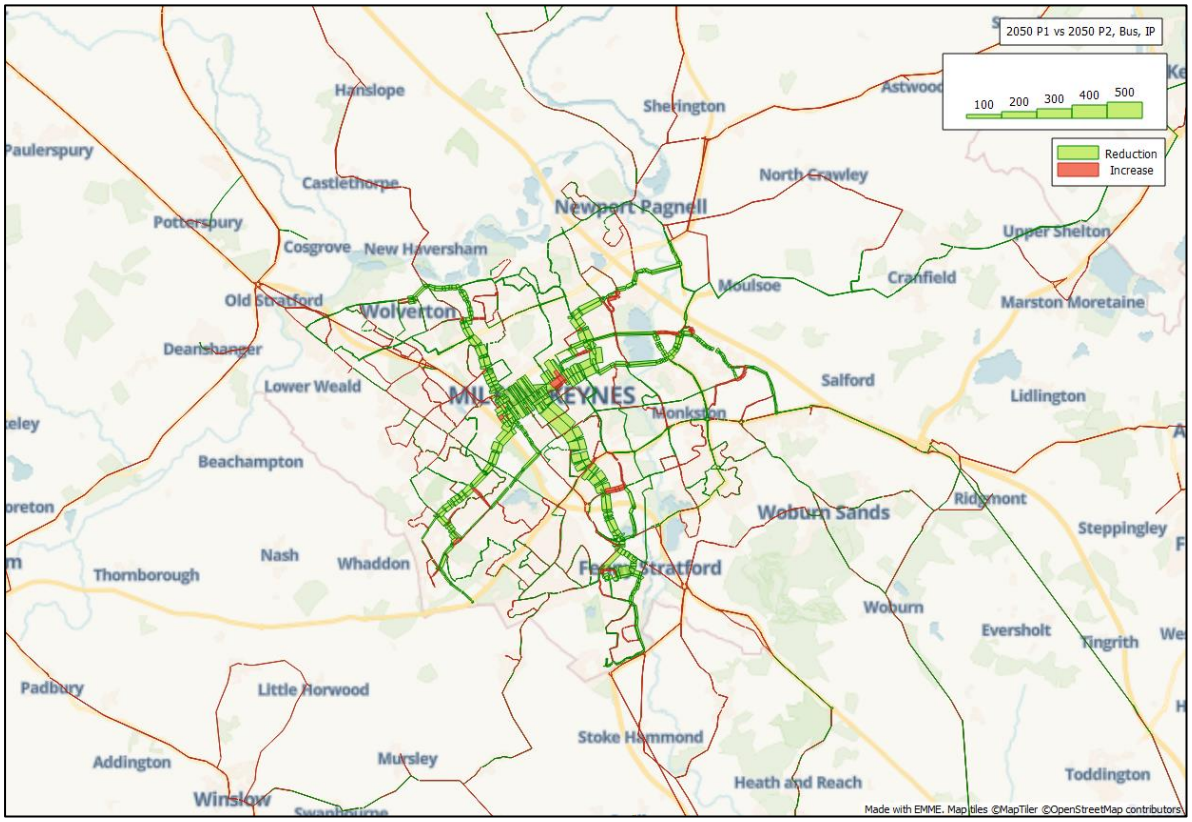

Figure 4-49: Bus Flow Difference, 2050 Priority 2 – 2050 Priority 1, Interpeak

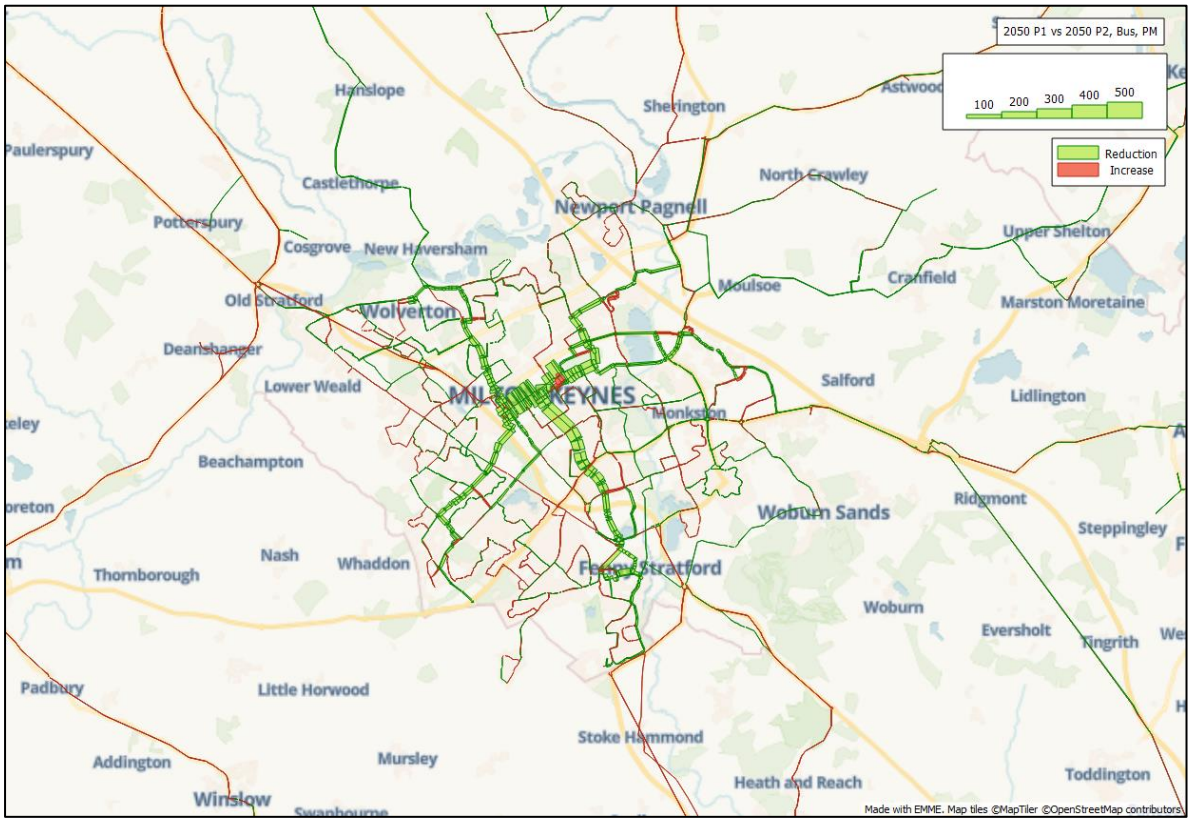

Figure 4-50: Bus Flow Difference, 2050 Priority 2 – 2050 Priority 1, PM Peak

4.10 Rail Flow Difference Plots

4.10.1 Plots showing the flow changes in rail passenger volumes[22] between the 2031 Reference Case and the 2050 Priority 1 scenarios are presented in Figure 4-51 to Figure 4-53. These show small reductions in passenger volumes travelling southbound in the AM Peak hour, and similar reductions travelling northbound in the PM Peak hour. Flows increase northbound to Milton Keynes in the AM and southbound from Milton Keynes in the PM. There are small increases in east-west rail travel in across all time periods and scenario comparisons. There are small changes in the Interpeak.

4.10.2 The rail flow differences between 2050 Reference Case and 2050 Priority 1 scenarios are shown in Figure 4-54 to Figure 4-56. These show small increases on all rail lines in the three peak hours which are driven by the increased demand.

4.10.3 Finally, the flow changes comparing 2050 Priority 1 to 2050 Priority 2 are presented in Figure 4-57 to Figure 4-59. There are very little rail flow differences between the two scenarios.

4.10.4 The absolute rail link flow plots are included in Appendix E.

Figure 4-51: Rail Flow Difference, 2050 Priority 1 – 2031 Reference Case, AM Peak

[22] Generally, rail volumes over time are influenced by longer term changes in cost of travel driven by economic parameters in the modelling

Figure 4-52: Rail Flow Difference, 2050 Priority 1 – 2031 Reference Case, Interpeak

Figure 4-53: Rail Flow Difference, 2050 Priority 1 – 2031 Reference Case, PM Peak

Figure 4-54: Rail Flow Difference, 2050 Priority 1 – 2050 Reference Case, AM Peak

Figure 4-55: Rail Flow Difference, 2050 Priority 1 – 2050 Reference Case, Interpeak

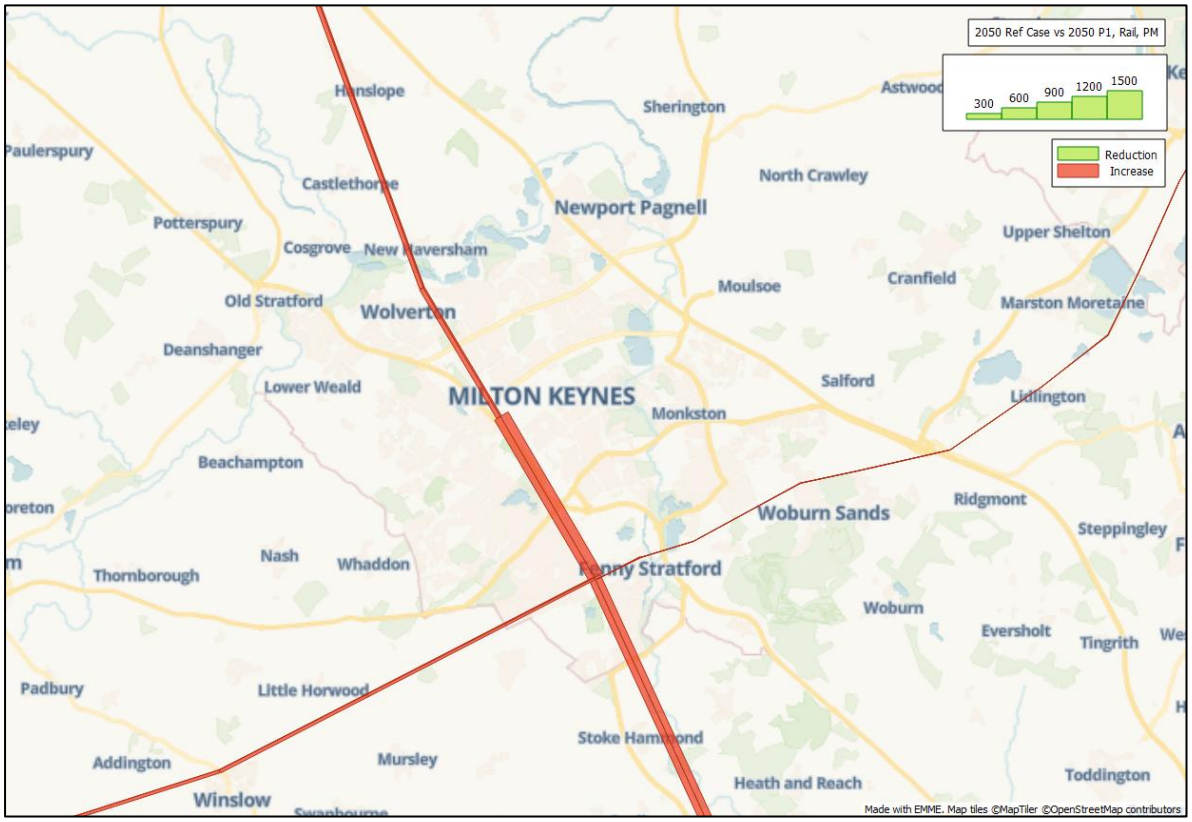

Figure 4-56: Rail Flow Difference, 2050 Priority 1 – 2050 Reference Case, PM Peak

Figure 4-57: Rail Flow Difference, 2050 Priority 2 – 2050 Priority 1, AM Peak

Figure 4-58: Rail Flow Difference, 2050 Priority 2 – 2050 Priority 1, Interpeak

Figure 4-59: Rail Flow Difference, 2050 Priority 2 – 2050 Priority 1, PM Peak

4.11 Impacted Junctions

4.11.1 Table 4-4 lists the junctions that are adversely impacted in the 2050 Priority 1 (P1) scenario compared to the Reference Case 2050 scenario. These junctions were selected based on the criteria that the volume-over-capacity (V/C) ratio[23] exceeds 85% in 2050 P1 and increases by more than 5% (in absolute terms) compared to the Reference Case 2050 scenario. The table also indicates whether these junctions (8 out of 27) already show high V/C ratios (>85%) in the Reference Case 2050 (RC2050) or in the Reference Case 2031 (RC2031) scenarios.

Table 4-4 Junctions adversely impacted in 2050 P1

Number	Junction Location	RC2050	RC2031
1	A422 Newport Road/Chicheley Road	no	no
2	A5 EB to Abbey Hill Roundabout	no	no
3	A5 NB to Portway Roundabout	no	no
4	A4146 NB approach to Kelly's Kitchen Roundabout	yes	no
5	V4 Watling St EB approach to Kelly's Kitchen Roundabout	no	no
6	V6 Grafton Street to North Grafton Roundabout	no	no
7	H8 Standing Way WB to Brinklow Roundabout	no	no
8	Newport Road EB to Kingston Roundabout	yes	yes
9	Coddimoor Lane/A421 roundabout	no	no
10	North Square/High Street Junction	no	no
11	Park Street/High Street Junction	no	no
12	Roman Roundabout	no	no
13	Station Rd/Brickhill Rd/V10 Brickhill St Junction	yes	yes
14	Randall Avenue/H4 Dansteed Way Junction	no	yes
15	Avebury Boulevard/V6 Grafton Gate	no	no
16	Silbury Boulevard/Secklow Gate Junction	no	no
17	V4 Watling St/The High St junction	yes	yes
18	Stonegate/v6 Grafton Street	no	no
19	Witan Gate/Avebury Boulevard Junction	yes	yes
20	Fairways Roundabout	no	no
21	V7 Saxon Gate/Avebury Boulevard Junction	no	no
22	Avebury Boulevard/Secklow Gate Junction	no	no
23	Newport Road/Dankworth Way Junction	no	no
24	Plymouth Grove/Langerstone Lanes Roundabout	no	yes
25	Winfold Lane/Langerstone Lane Roundabout	no	yes
26	V5 Great Monks Street/Heathfield Junction	no	no
27	Marsh End Roundabout	no	no

[23] Averaged V/C over the whole node. The % ratio of the total actual flow arriving at the stop line summed over each entry link divided by the sum of the capacities per entry link.

4.11.2 Similarly, Table 4-5 lists the junctions that are adversely affected under the 2050 – Priority 2 (P2) scenario when compared to Reference Case 2050 scenario. The table also indicates whether these junctions already show high V/C ratios (>85%) in the 2050 Priority 1, Reference Case 2050 and Reference Case 2031 scenarios.

4.11.3 2050 Priority 2 has fewer adversely affected junctions compared to 2050 P1, and most of these junctions record high V/C ratios in the 2050 P1 scenario.

Table 4-5 Junctions adversely impacted in 2050 P2

Number	Junction Name	2050 P1	RC2050	RC2031
1	A422 Newport Road/Chicheley Road	yes	no	no
2	A4146 NB approach to Kelly's Kitchen Roundabout	yes	yes	no
3	H5 Portway to Northfield Roundabout	yes	no	no
4	Coddimoor Lane/A421 roundabout	yes	no	no
5	Park Street/High Street Junction	yes	no	no
6	Roman Roundabout	no	no	no
7	Station Rd/Brickhill Rd/V10 Brickhill St Junction	yes	yes	yes
8	Randall Avenue/H4 Dansteed Way Junction	yes	no	yes
9	Avebury Boulevard/V6 Grafton Gate	yes	no	no
10	V4 Watling St/The High St junction	yes	yes	yes
11	Witan Gate/Avebury Boulevard Junction	yes	yes	yes
12	Fairways Roundabout	yes	no	no
13	V7 Saxon Gate/Avebury Boulevard Junction	yes	no	no
14	V7 Saxon Gate/Silbury Boulevard Junction	yes	yes	yes
15	Newport Road/Dankworth Way Junction	yes	no	no
16	Marsh End Roundabout	yes	no	no

5. Summary

5.1 Introduction

5.1.1 Milton Keynes City Council commissioned AECOM to test the impacts associated with the forthcoming Milton Keynes City Plan 2050 (MKCP) using the Milton Keynes Multi-Modal Model (MKMMM).

5.1.2 This Forecasting Report describes the processes applied to develop the 2050 MKCP forecast models and the results.

5.2 Forecasting Assumptions

5.2.1 The following two forecast scenarios were prepared as part of the assessment of the proposed MKCP impacts, one of which also includes the proposed Mass Rapid Transit (MRT) scheme for Milton Keynes.

- Priority 1 – MKCP scenario tests in 2050 with the MRT (MKCPM2050).
- Priority 2 – MKCP scenario tests in 2050 without MRT and without MRT associated housing developments – sensitivity test (MKCP2050).

5.2.2 No updates were made for the Reference Case 2031, 2040 and 2050 Uncertainty Log (UL) which were documented previously[24]. MKCC supplied a list of MKCP growth assumptions for homes and employment by zone for 2050, which were in addition to the Reference Case data.

5.2.3 By 2050, a total of approximately 33,743 dwellings were included in the UL for 2050 Priority 1. For 2050 Priority 2, around 2,516 MRT-related dwellings were removed. A total of 31,663 additional jobs were projected to be created by 2050, and the MKCP employment growth assumptions remained the same between 2050 Priority 1 and 2050 Priority 2.

5.2.4 The uncertainty log datasets form inputs to the trip-end model, which was run to generate trips for the 2050 Priority 1 and 2050 Priority 2 scenarios.

5.2.5 The highway network of 2050 P1 with MRT (MKCPM2050) was updated as outlined in paragraphs 2.7 in Chapter 2 to reflect the envisaged network infrastructure updates. Further infrastructure updates were made on both 2050 P1 and 2050 P2 to reflect the revised network infrastructure assumptions associated with the MKCP. Amendments were also made to increase the capacity around key developments to ensure all traffic could access the network as detailed in Chapter 2.

5.2.6 The assumptions for public transport schemes, parking, economic parameters and buffer network speeds remained the same as the 2050 Reference Case forecasts.

5.3 Variable Demand Model and Highway Assignment Model Statistics

5.3.1 For the forecast models described in this report, a post-variable demand model adjustment to account for COVID's impact on traffic[25] was applied to the forecast highway matrices. The calculated factors were only applied to trips within and between Milton Keynes and the surrounding areas. External trips remain unchanged.

5.3.2 Both demand and highway assignment models satisfied the TAG convergence criteria for all forecast years and time periods.

5.3.3 The increase in total trips for the AM Peak was 5% between the 2019 Base Year and 2031 Reference Case, and 11% between the 2019 Base Year and 2050 Reference Case, 2050 Priority 1, or 2050 Priority 2 scenarios. The corresponding values for the PM Peak were 5%

[24] Revised Shenley Park assumptions were included in the Reference Case Uncertainty Log
[25] Detailed in section 4.3 of the Milton Keynes Multi-Modal Transport Model Forecasting Report v3.1, Milton Keynes City Council, 11th February 2025

and 10%. The increase in total trips for the Interpeak was higher than that of the AM and PM Peaks.

5.3.4 Both vehicle kilometres and vehicle hours increased by the 2050 forecast year, with forecast network speeds reducing from 2031. When compared to the Reference Case 2050, the vehicle kilometres and vehicle hours increased in 2050 Priority 1 due to the growth associated with the forthcoming MK City Plan and MRT. There was no change in vehicle kilometres or vehicle hours between 2050 Priority 1 and 2050 Priority 2. The network speeds in the 2050 Priority 1 and 2050 Priority 2 scenarios decreased compared to the 2050 Reference Case.

5.4 Milton Keynes City Plan Forecast Model Outputs

5.4.1 The following outputs were produced from the MKMMM scenarios:

- Mode split statistics;
- Absolute highway link flow plots;
- Highway flow difference plots;
- Absolute link and junction V/C plots;
- Link and junction V/C difference plots;
- Absolute link delay plots;
- Link delay difference plots;
- Journey time changes;
- MRT boarders;
- Absolute bus link flow plots;
- Bus flow difference plots;
- Absolute rail link flow plots;
- Rail flow difference plots;
- List of affected junctions.

5.4.2 In 2050 Priority 1, the MRT has a 1.8% mode share, and in 2050 Priority 2 this is redistributed across the other modes, apart from rail since rail does not the cater for the shorter journeys the MRT would accommodate.

5.4.3 The flow difference plots show a general increase in flows from the 2031 Reference Case, with the largest increases on the M1 and A5, across the three time periods. The highway flow differences between the 2050 Reference Case and 2050 Priority 1 show displacements in flows attributed to the MRT in Priority 1 which follow the ‘spider’ alignments of the MRT around Milton Keynes where road capacity is reduced with the MRT in operation. A similar pattern is shown between the 2050 Priority 1 and 2050 Priority 2 scenarios.

5.4.4 In general, V/C values increase by forecast year for each peak hour, with higher V/C values noted in the AM and PM Peak hours. The 2050 Priority 1 scenario generally has a greater number of links and nodes above the thresholds, particularly in Central Milton Keynes and around the ESCE development.

5.4.5 There is a general increase in link delays between 2031 and 2050. Similar trends were observed between the 2050 Reference Case to 2050 Priority 1 due to development associated with the MKCP, and reduced highway capacity in 2050 Priority 1. A decrease in link delays was observed in 2050 Priority 2 compared to 2050 Priority 1, primarily due to the removal of MRT-dependent housing developments in Central Milton Keynes, and the omission of the MRT which retained highway capacity.

5.4.6 Overall, the journey times increased across each forecast year, and for 2050 Priority 1, the journey times increased by 26%, 10% and 25% in the AM Peak hour, Interpeak and PM

Peak hour respectively, from the 2031 Reference Case. For 2050 Priority 2, the increases from 2031 Reference Case were slightly less compared to 2050 Priority 1, with 23% in the AM Peak hour, 8% in the Interpeak, and 23% in the PM Peak hour.

5.4.7 Bus flow difference plots showed an increase in flows across the model, but more specifically on the proposed MRT routes. There were decreases across the MRT routes due to the removal of the MRT in 2050 Priority 2. Finally, the rail flow difference plots show small reductions travelling southbound in the AM Peak hour, and similar reductions travelling northbound in the PM Peak hour, when comparing the 2031 Reference Case to the 2050 Priority 1 scenarios.

5.4.8 Twenty-seven junctions were identified as being adversely affected under the 2050 Priority 1 (P1) scenario, where the volume-to-capacity (V/C) ratios exceed 85% and increase by more than 5% compared to the RC2050 scenario. The 2050 Priority 2 (P2) scenario recorded eleven fewer adversely affected junctions, with most recording high V/C levels in the 2050 P1 scenario.

Appendix A – Buffer Network Link Speeds

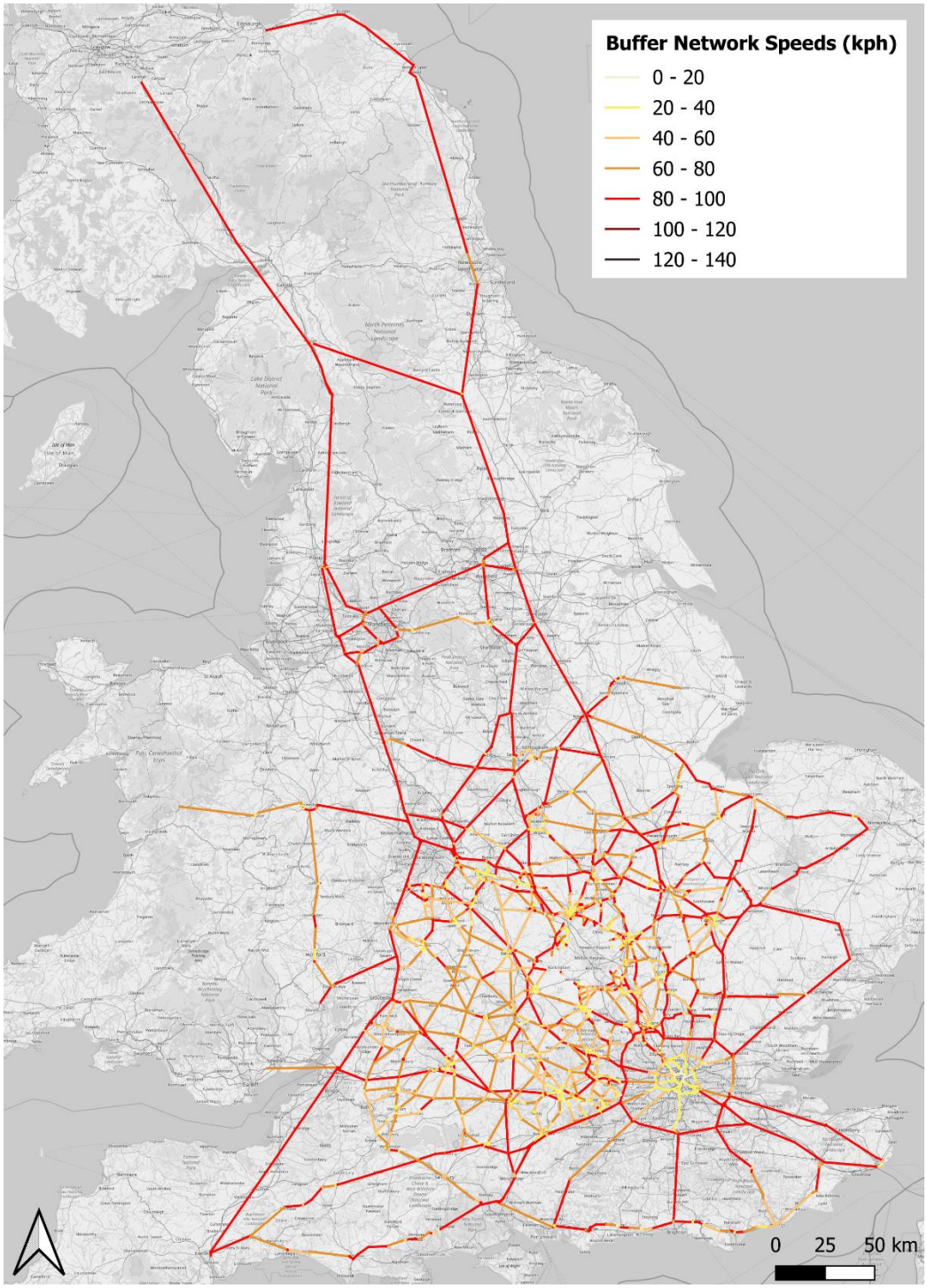

Figure A-1: 2031 – Buffer Network Link Speeds

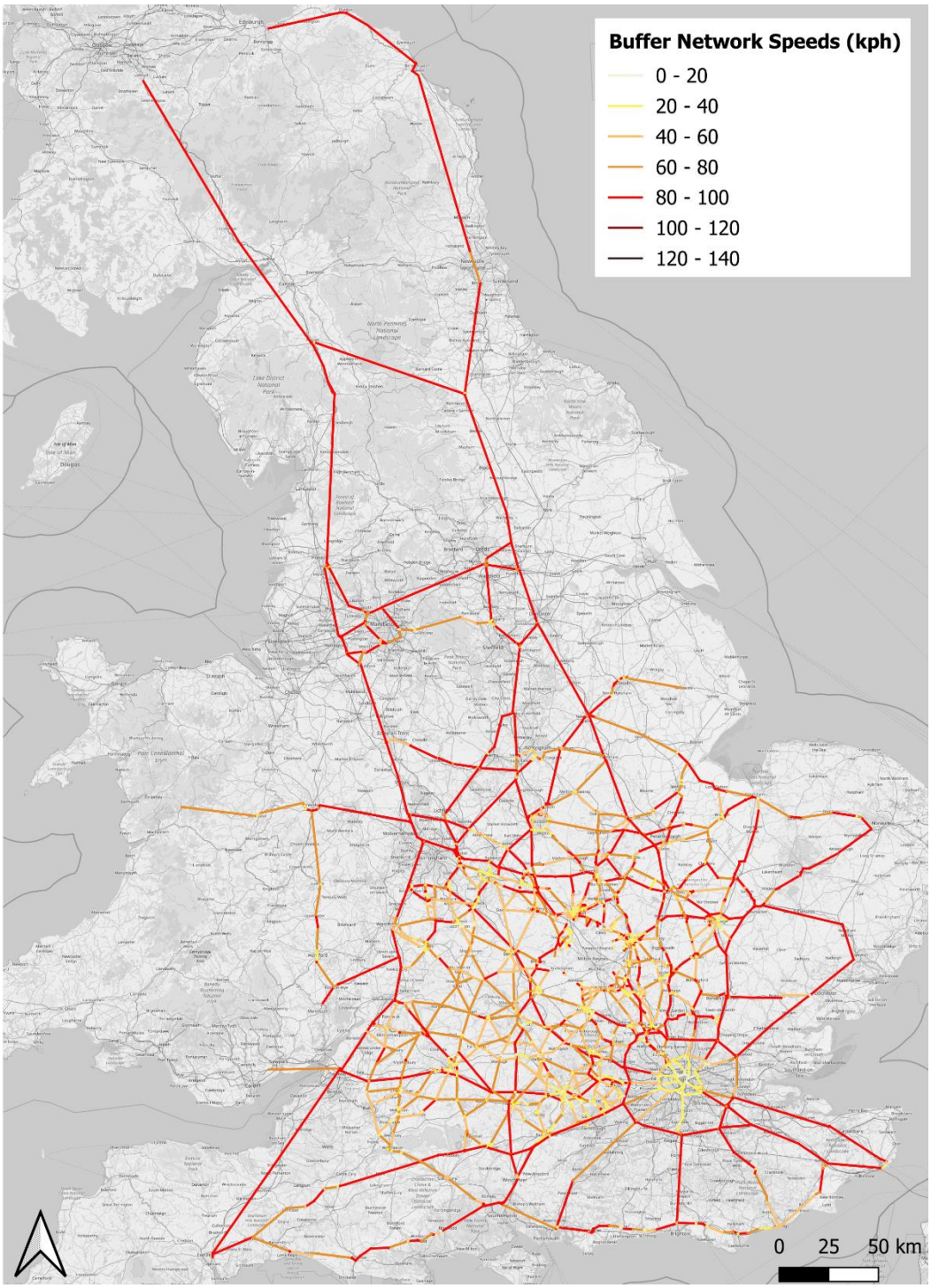

Figure A-2: 2040 – Buffer Network Link Speeds

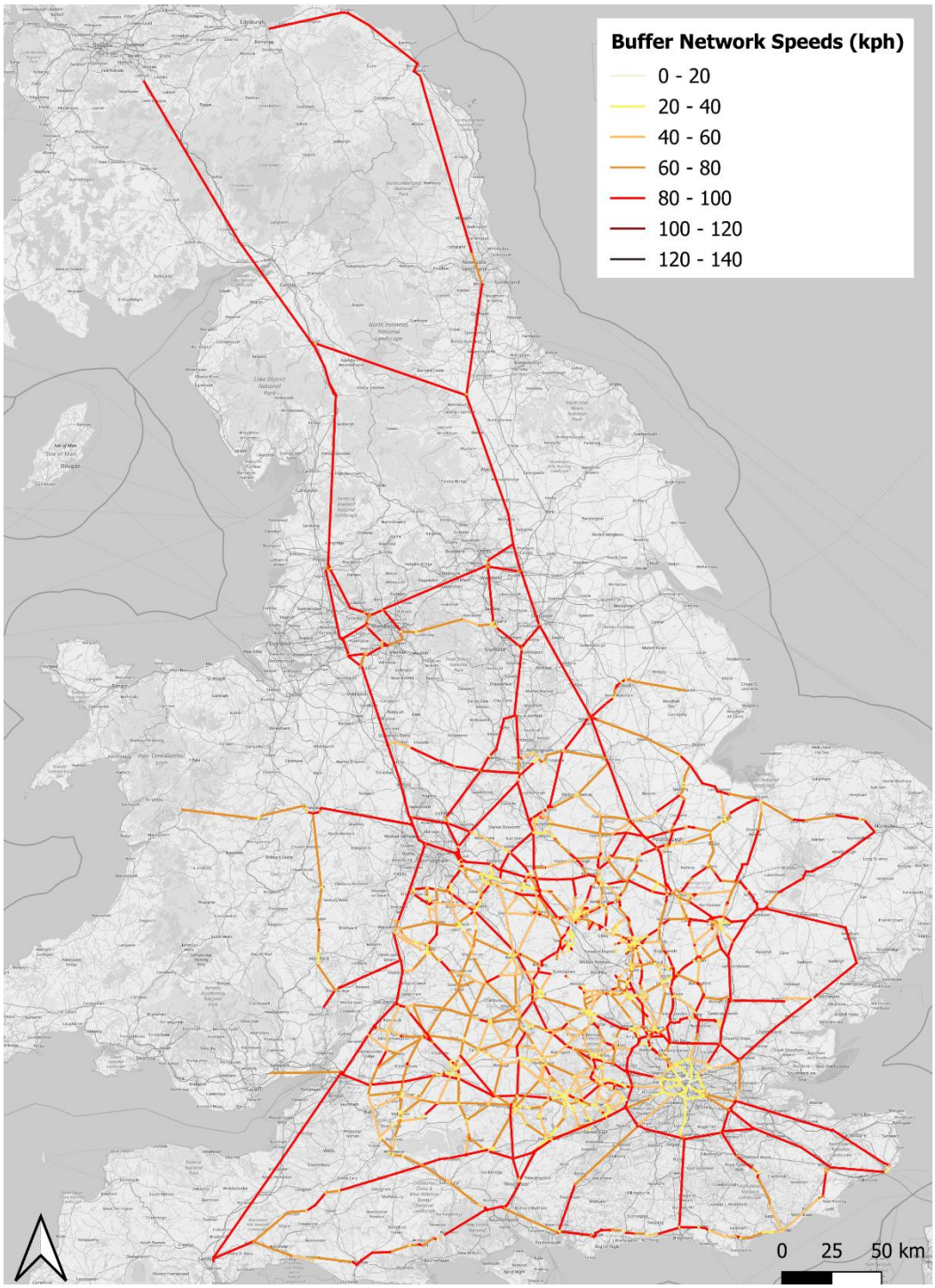

Figure A-3: 2050 – Buffer Network Link Speeds

Appendix B – Absolute Highway Link Flow Plots

Absolute link flows for all highway modes in the 2031 Reference Case, 2050 Priority 1, and 2050 Priority 2 are shown in Figure to Figure , for the AM Peak, Interpeak and PM Peak.

The largest absolute highway link flows are on the strategic road network, in particular the M1 and the A5. There are also large flows (greater than 1,000 PCUs) on some key grid roads, including H3 Monks Way, and H5 Portway. The greatest flows are in the AM and PM Peak hours, and are generally similar between the three 2050 scenarios, with larger flows in 2050 Priority 1 and 2050 Priority 2 due to the additional MKCP development.

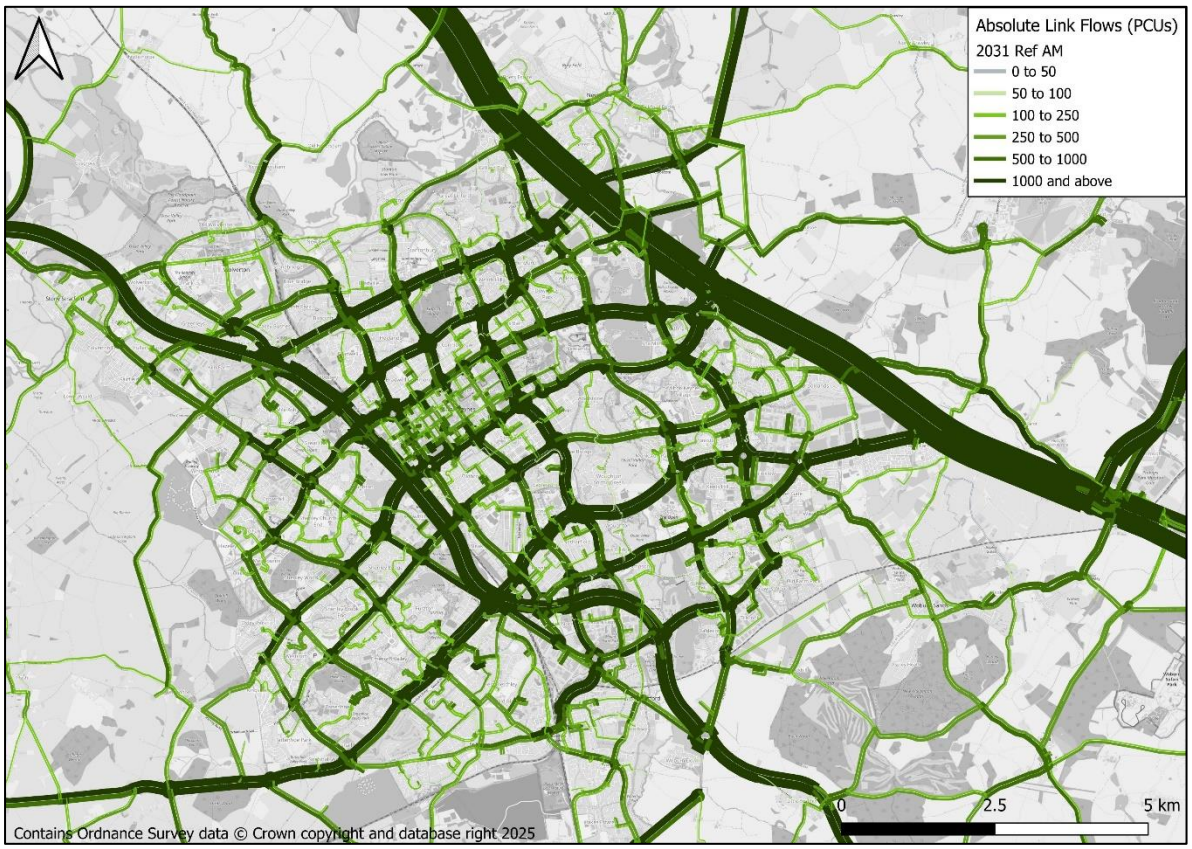

Figure B-1: Highway Absolute Link Flows, 2031 Reference Case, AM Peak

Figure B-2: Highway Absolute Link Flows, 2031 Reference Case, Interpeak

Figure B-3: Highway Absolute Link Flows, 2031 Reference Case, PM Peak

Figure B-4: Highway Absolute Link Flows, 2050 Reference Case, AM Peak

Figure B-5: Highway Absolute Link Flows, 2050 Reference Case, Interpeak

Figure B-6: Highway Absolute Link Flows, 2050 Reference Case, PM Peak

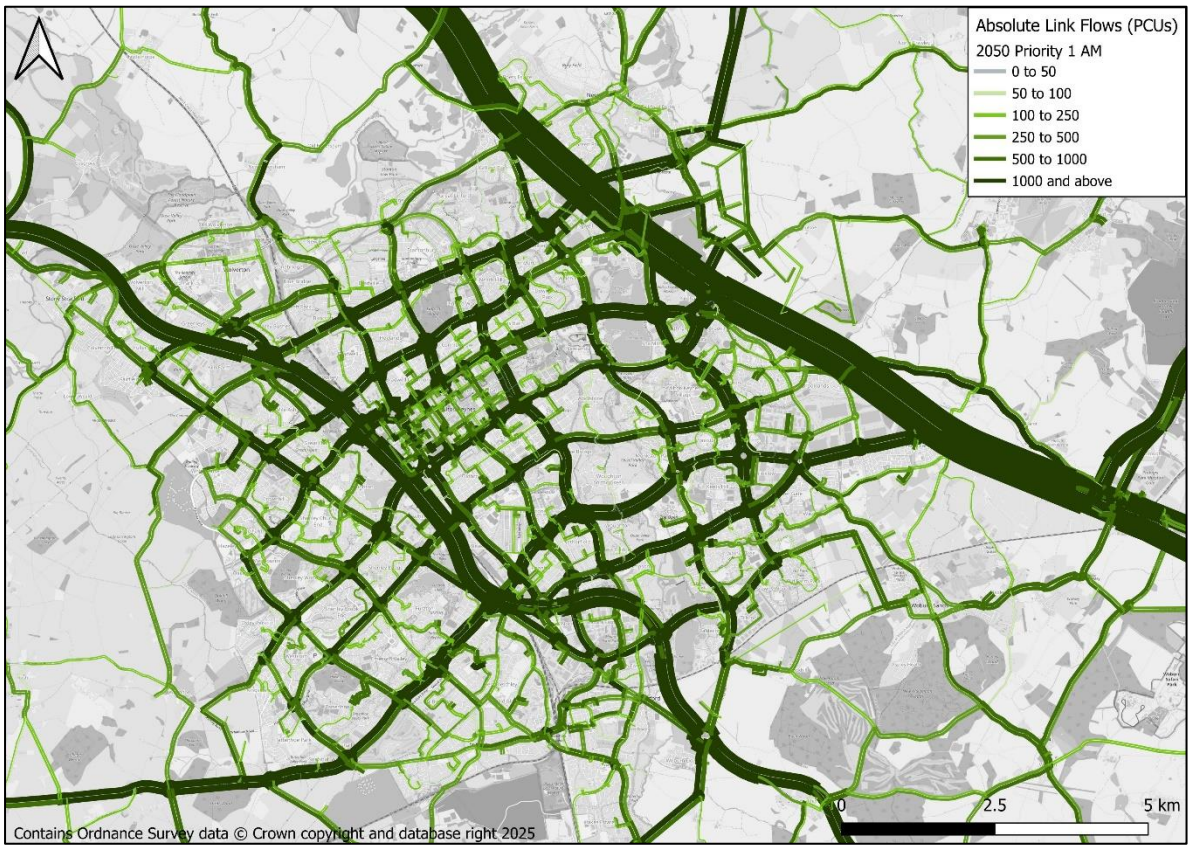

Figure B-7: Highway Absolute Link Flows, 2050 Priority 1, AM Peak

Figure B-8: Highway Absolute Link Flows, 2050 Priority 1, Interpeak

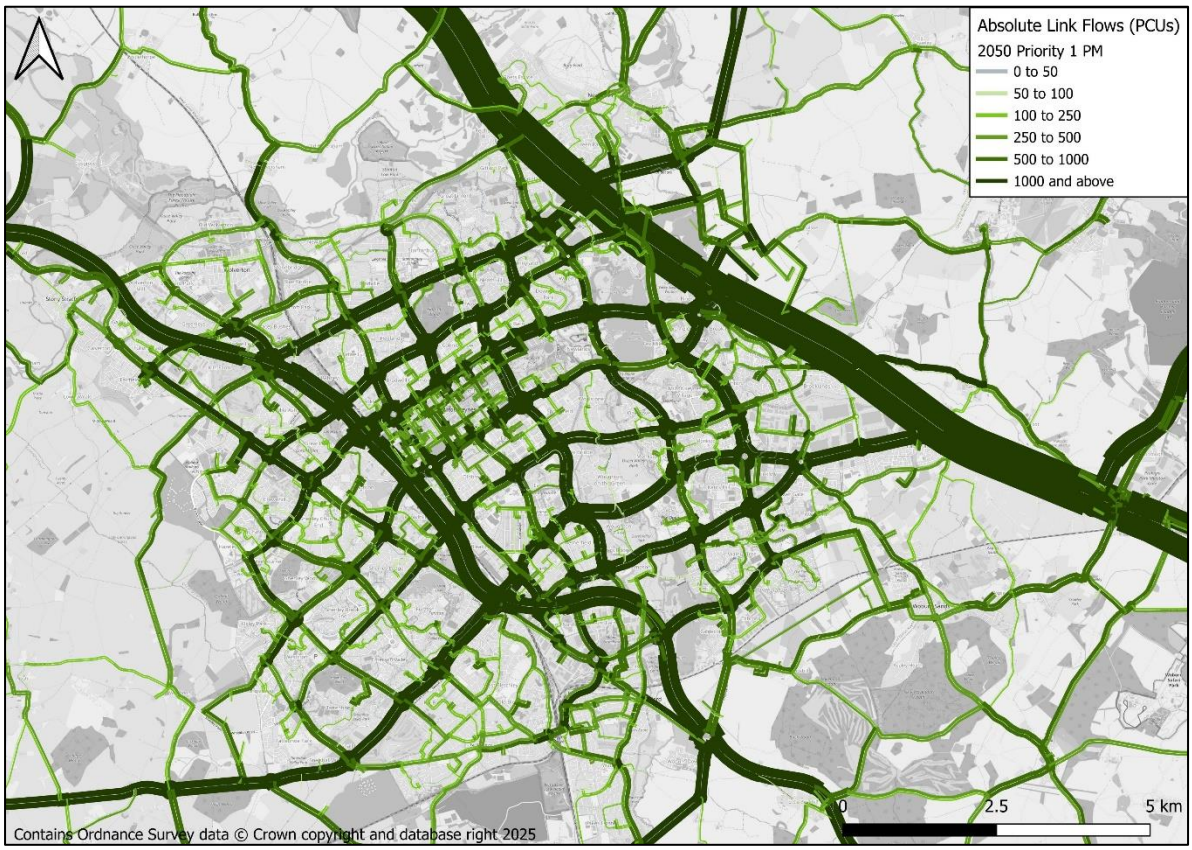

Figure B-9: Highway Absolute Link Flows, 2050 Priority 1, PM Peak

Figure B-10: Highway Absolute Link Flows, 2050 Priority 2, AM Peak

Figure B-11: Highway Absolute Link Flows, 2050 Priority 2, Interpeak

Figure B-12: Highway Absolute Link Flows, 2050 Priority 2, PM Peak

Appendix C – Absolute Link Delay Plots

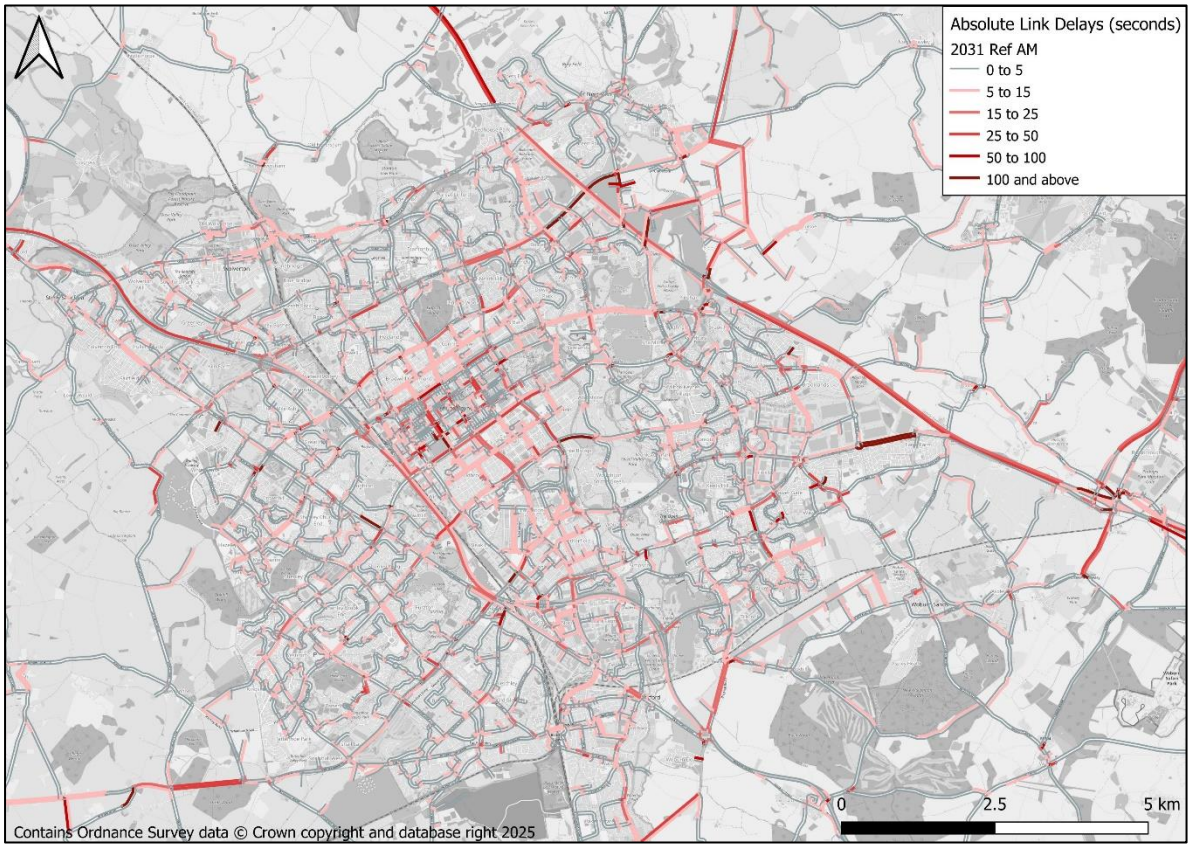

Figure C-1: Absolute Link Delays, 2031 Reference Case, AM Peak

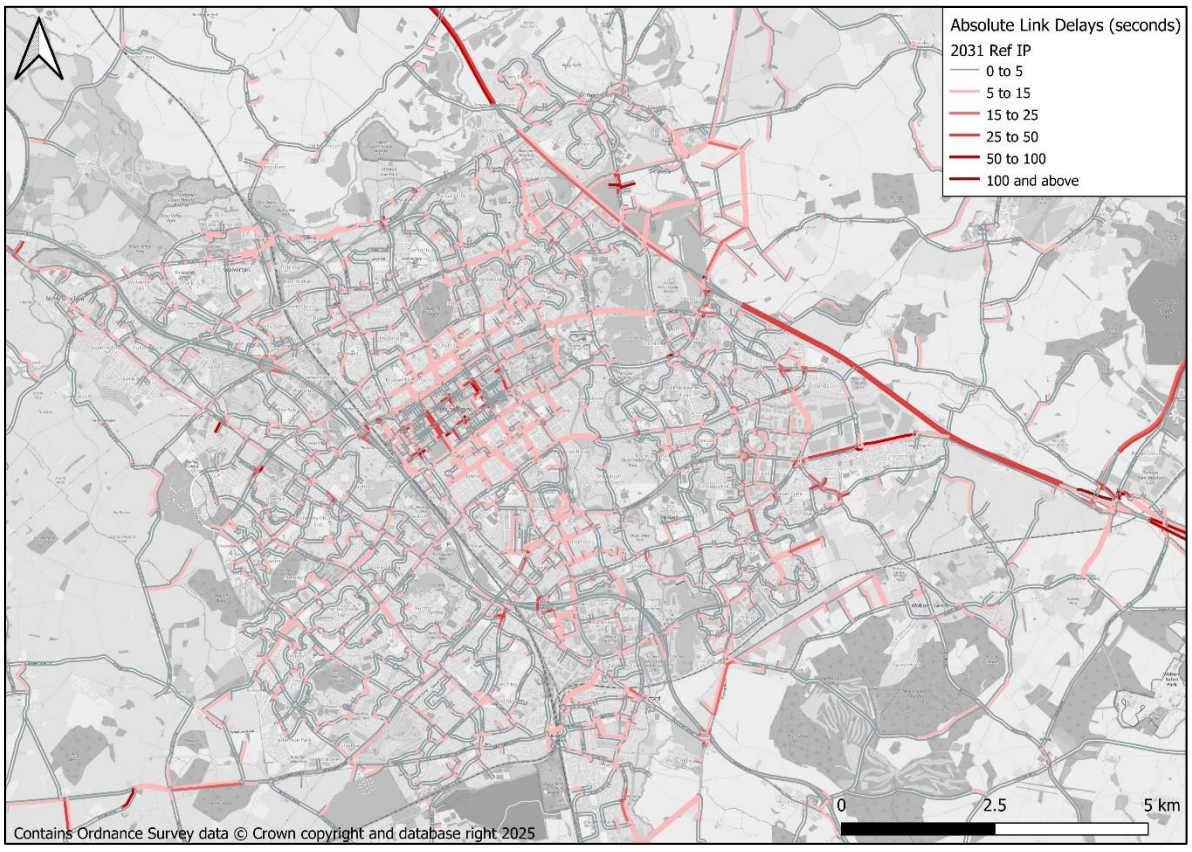

Figure C-2: Absolute Link Delays, 2031 Reference Case, Interpeak

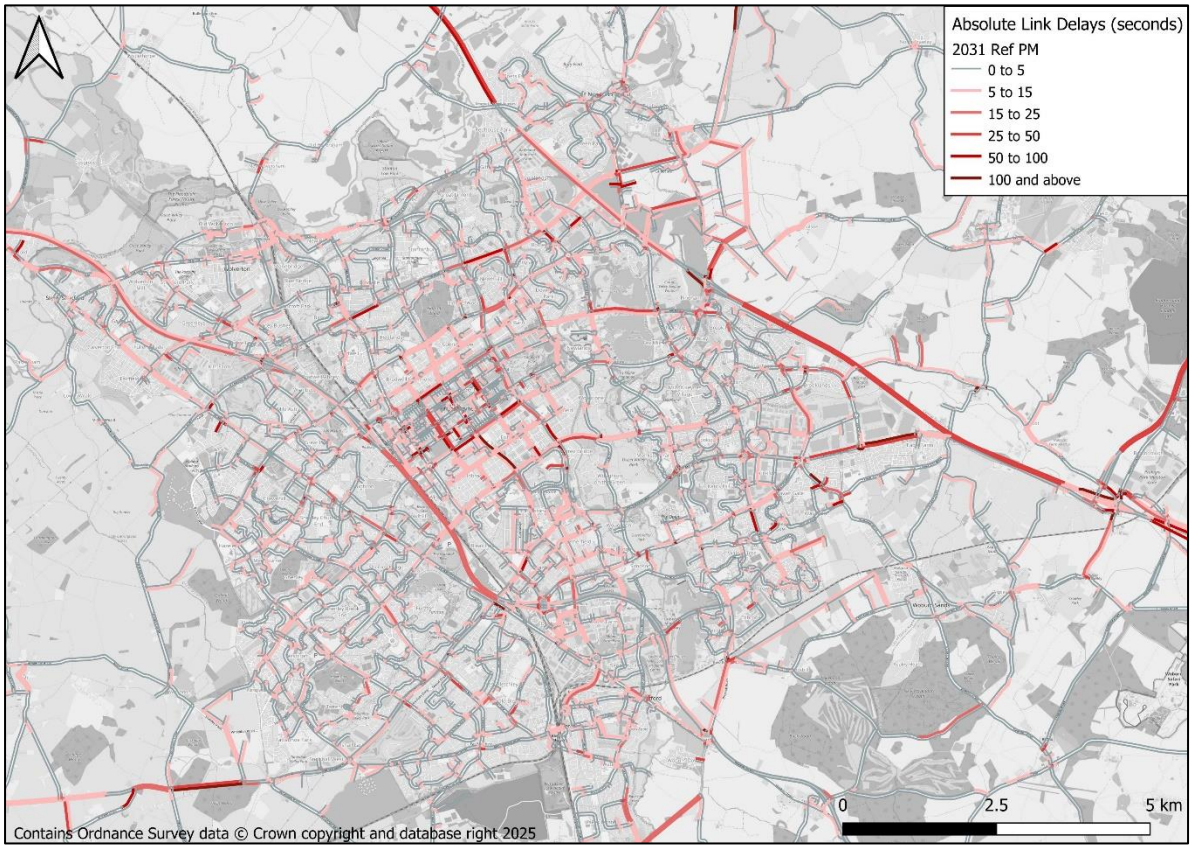

Figure C-3: Absolute Link Delays, 2031 Reference Case, PM Peak

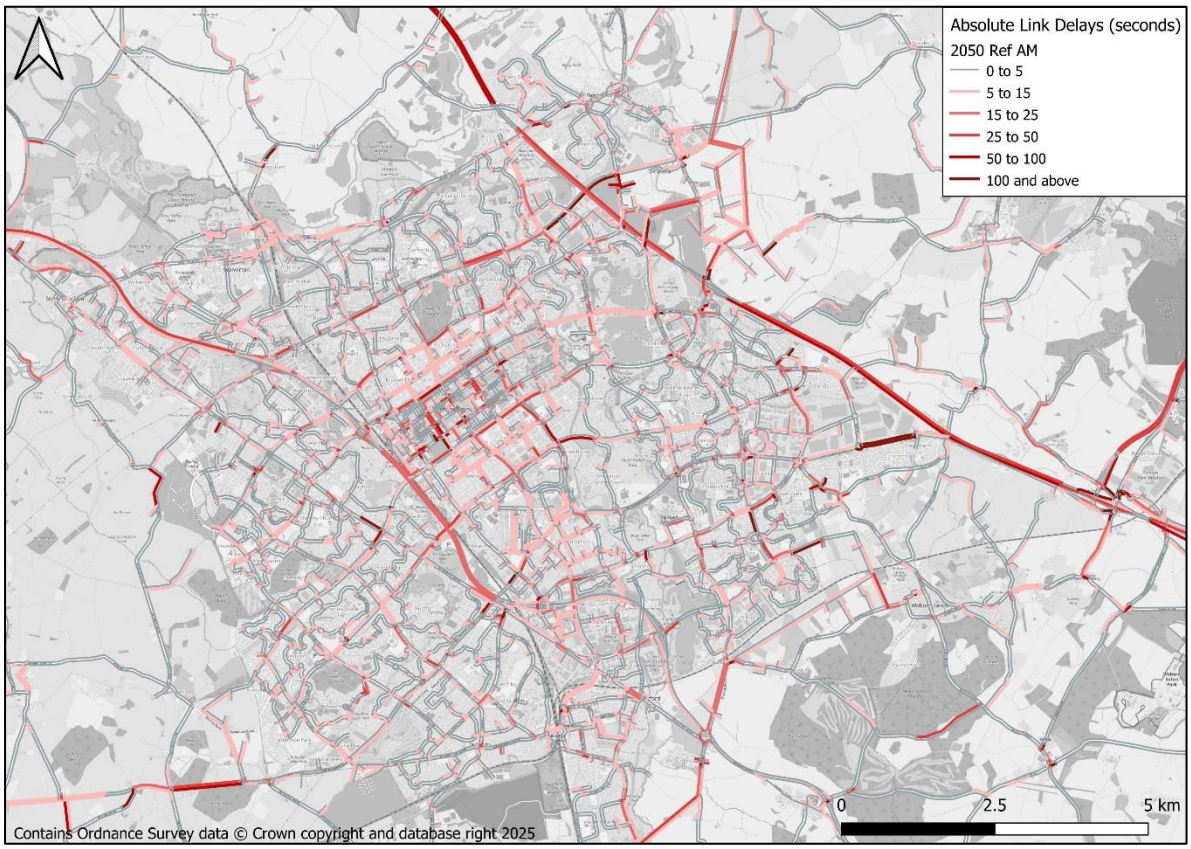

Figure C-4: Absolute Link Delays, 2050 Reference Case, AM Peak

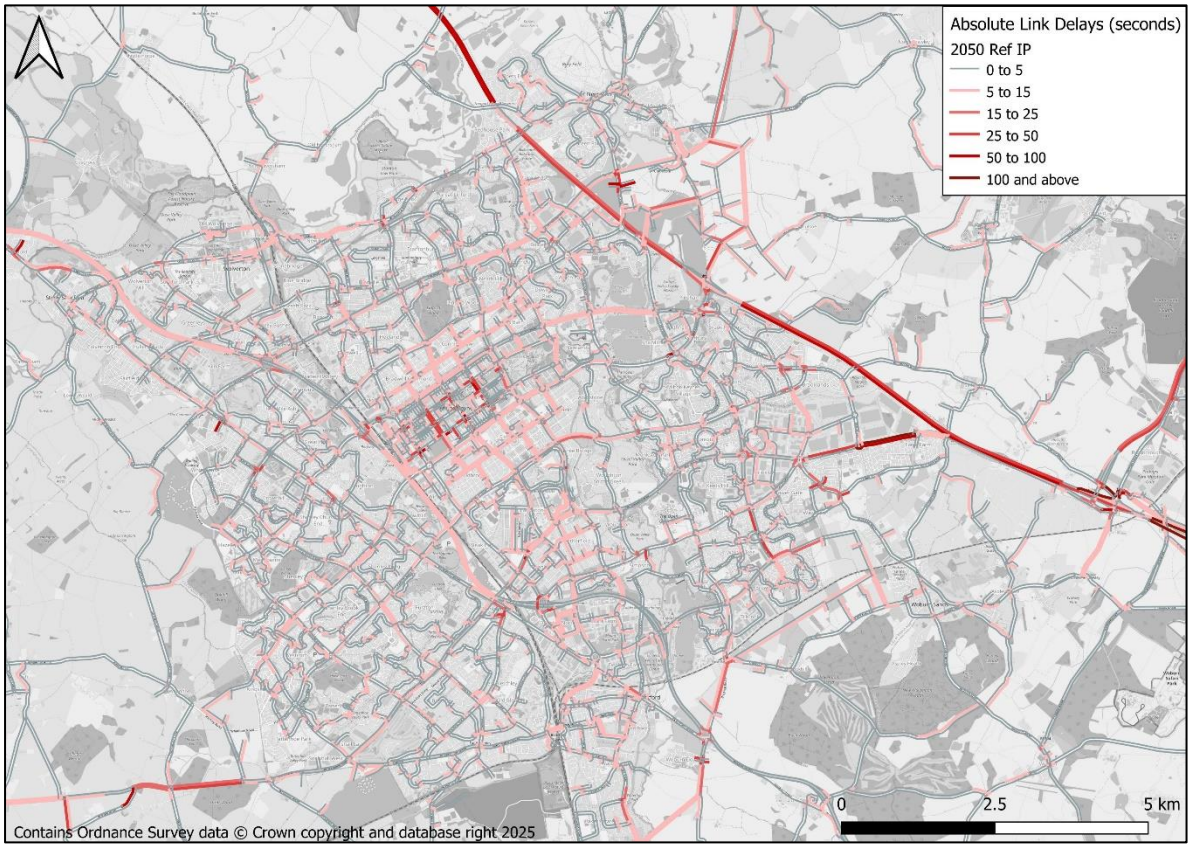

Figure C-5: Absolute Link Delays, 2050 Reference Case, Interpeak

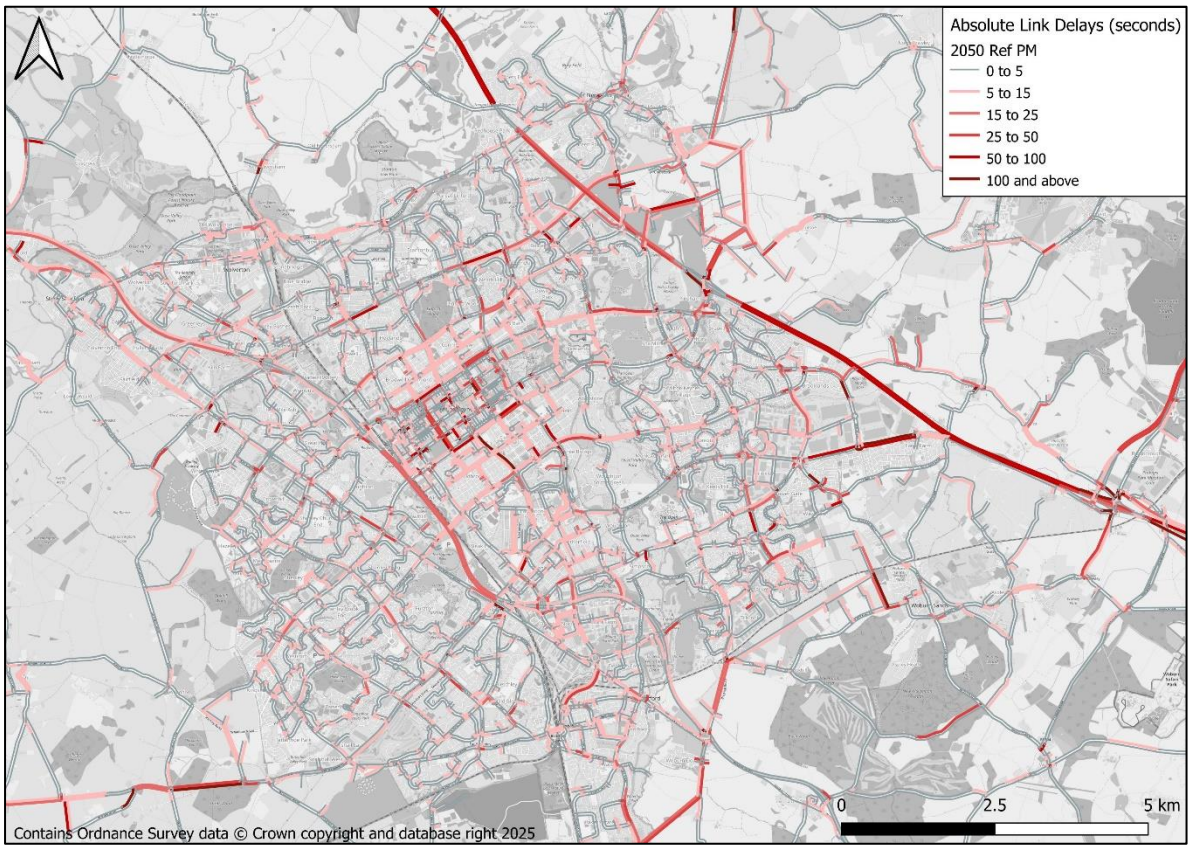

Figure C-6: Absolute Link Delays, 2050 Reference Case, PM Peak

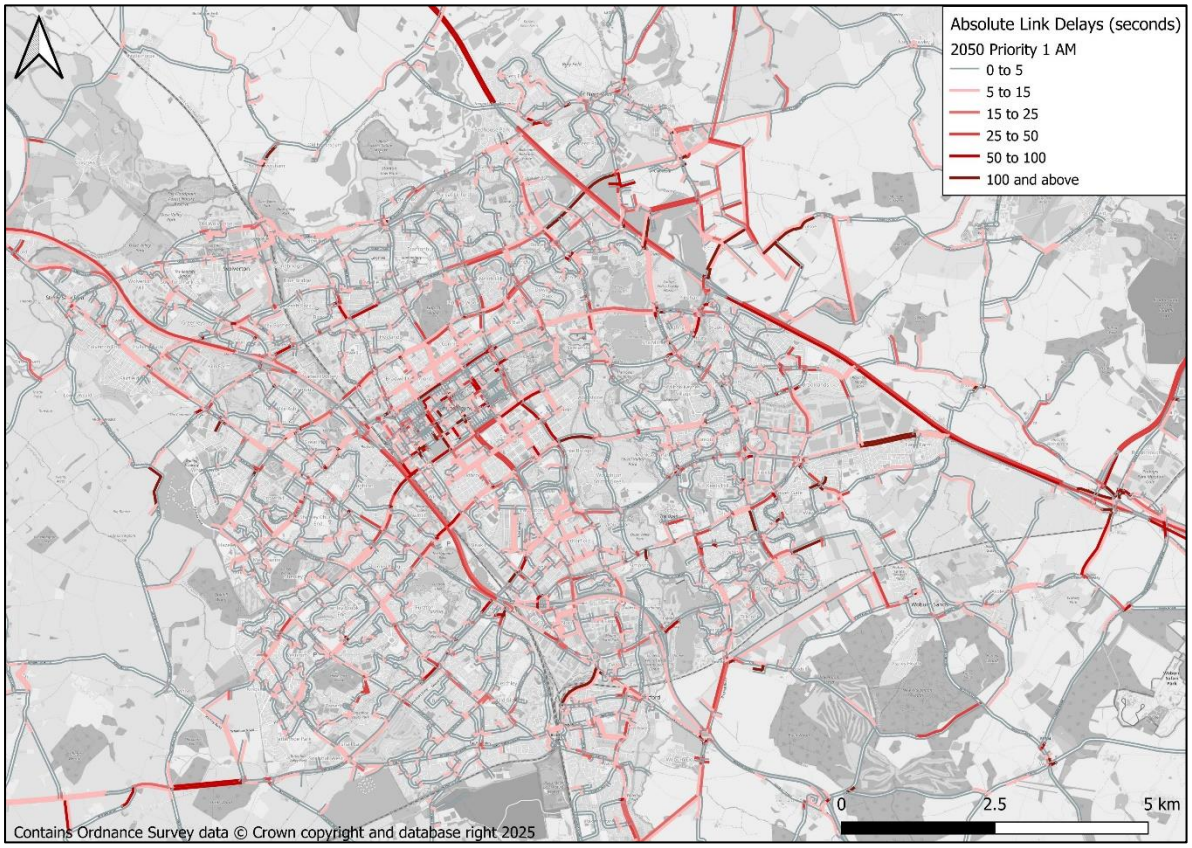

Figure C-7: Absolute Link Delays, 2050 Priority 1, AM Peak

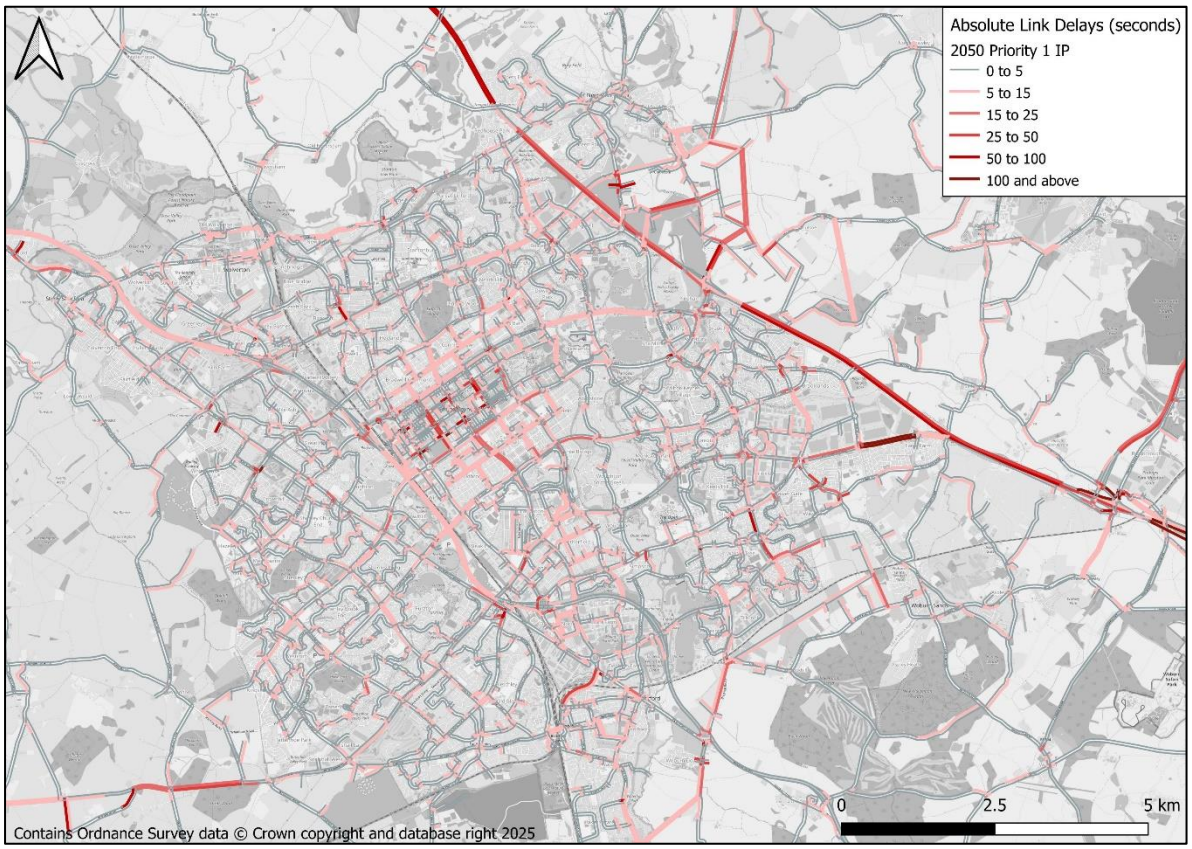

Figure C-8: Absolute Link Delays, 2050 Priority 1, Interpeak

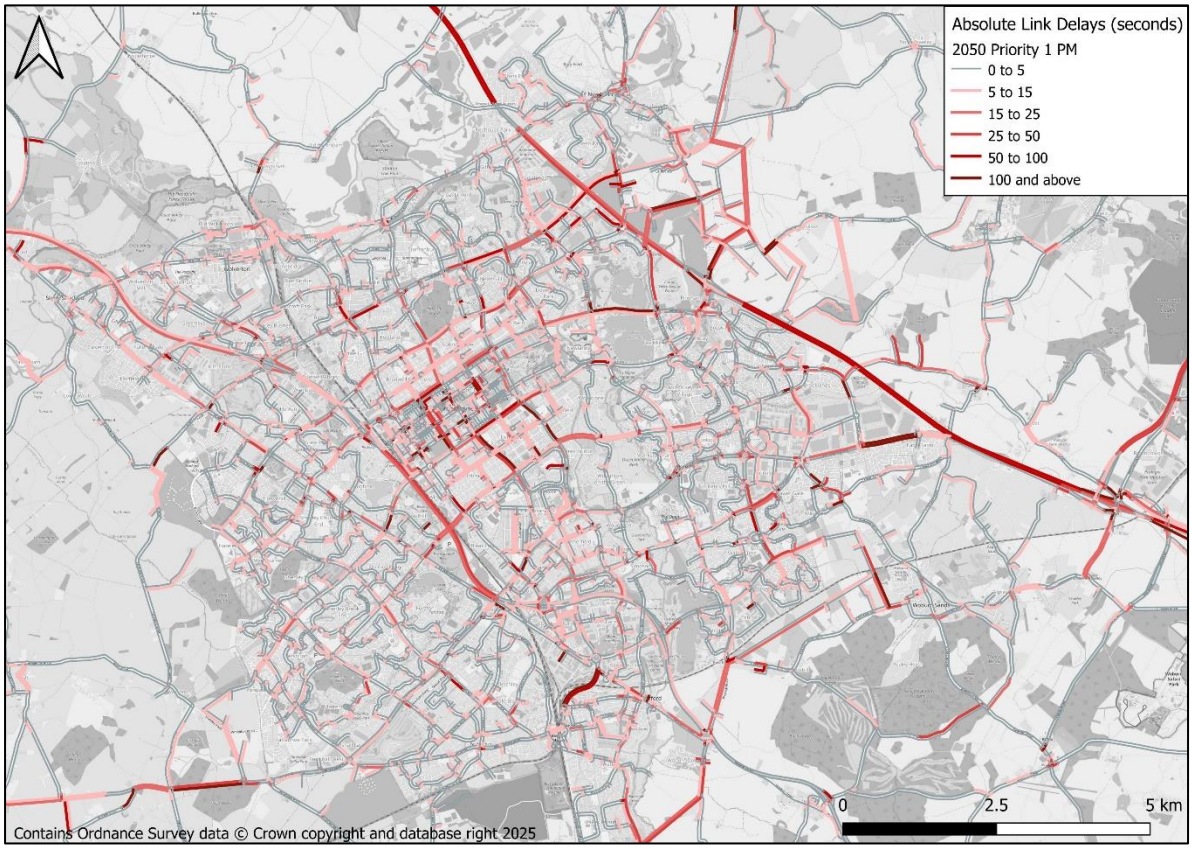

Figure C-9: Absolute Link Delays, 2050 Priority 1, PM Peak

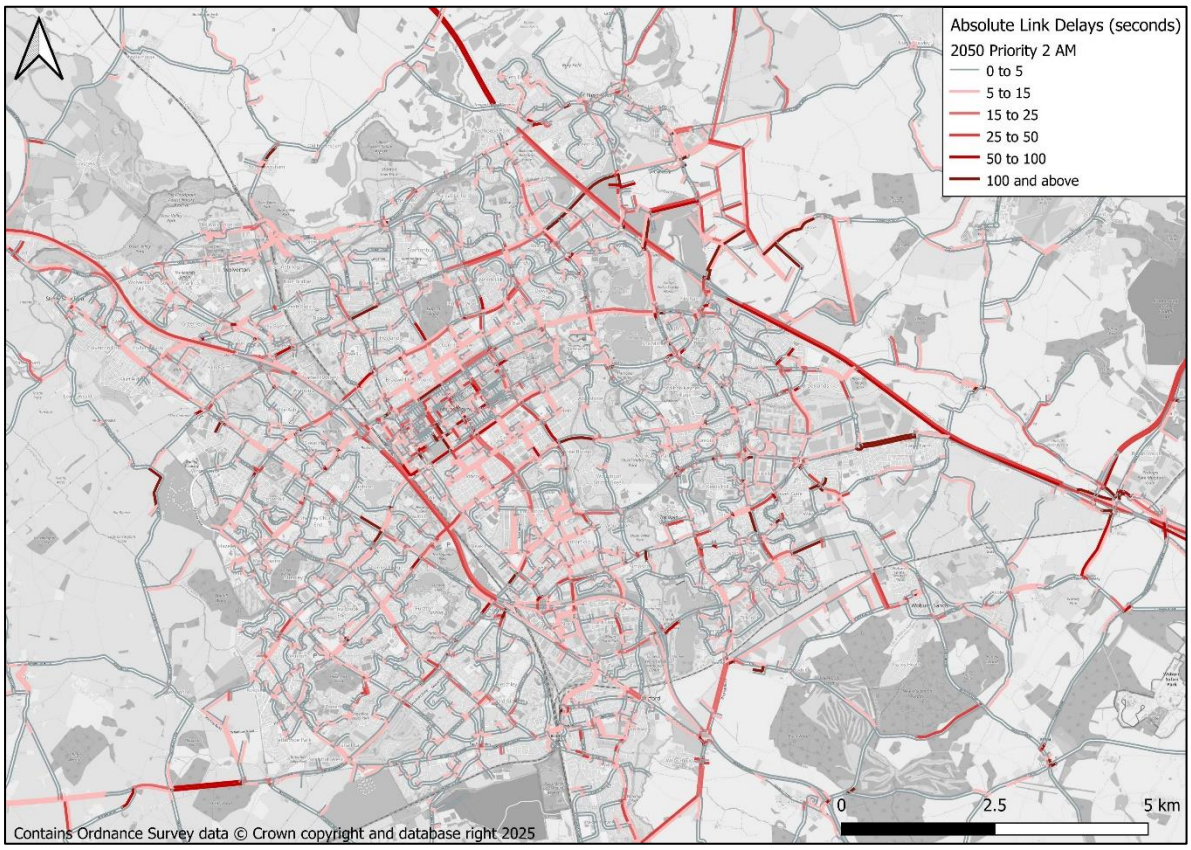

Figure C-10: Absolute Link Delays, 2050 Priority 2, AM Peak

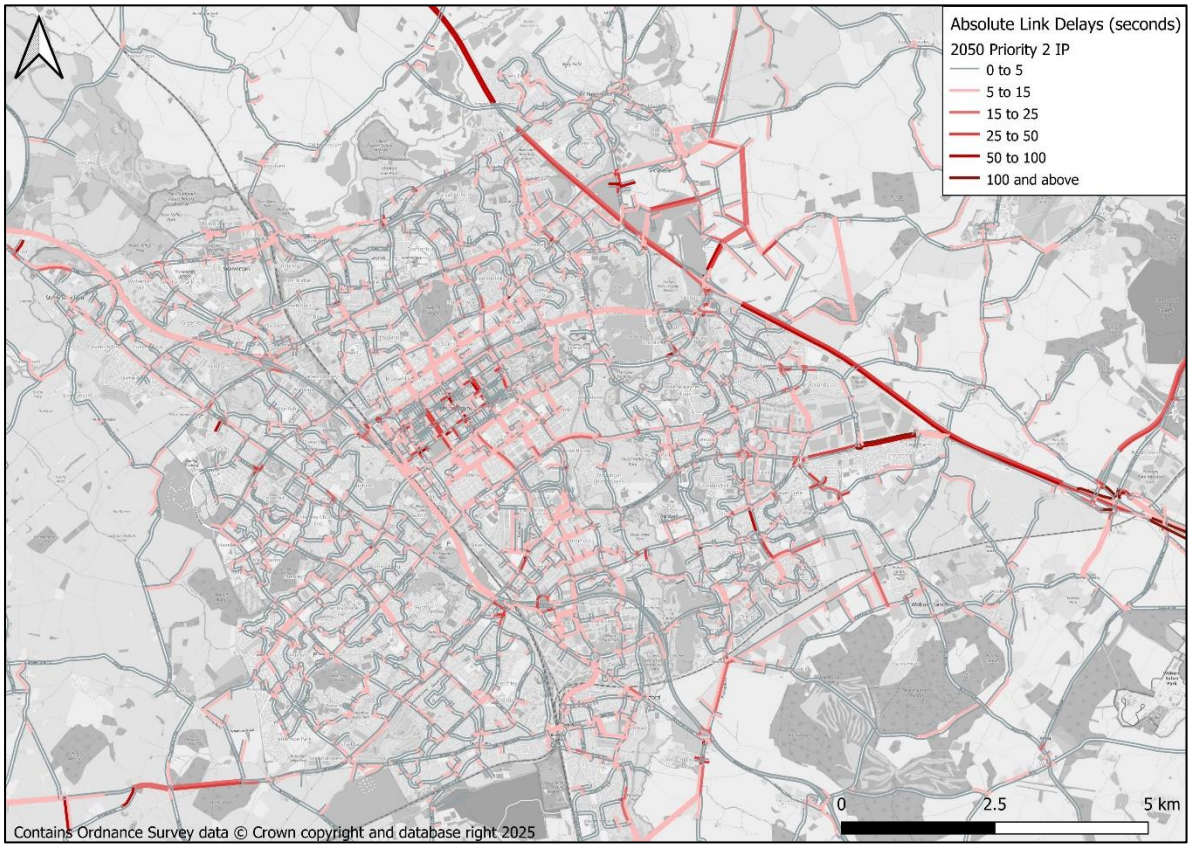

Figure C-11: Absolute Link Delays, 2050 Priority 2, Interpeak

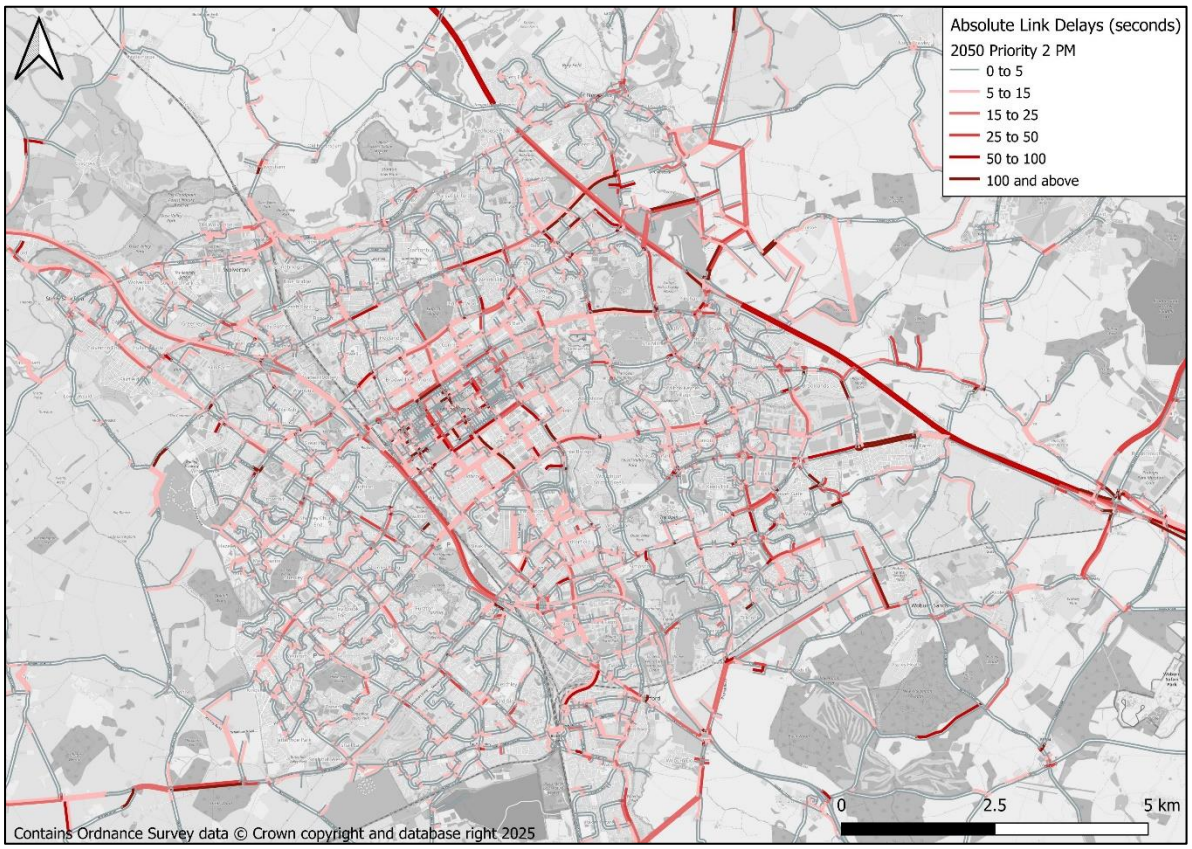

Figure C-12: Absolute Link Delays, 2050 Priority 2, PM Peak

Appendix D – Absolute Bus Link Flow Plots

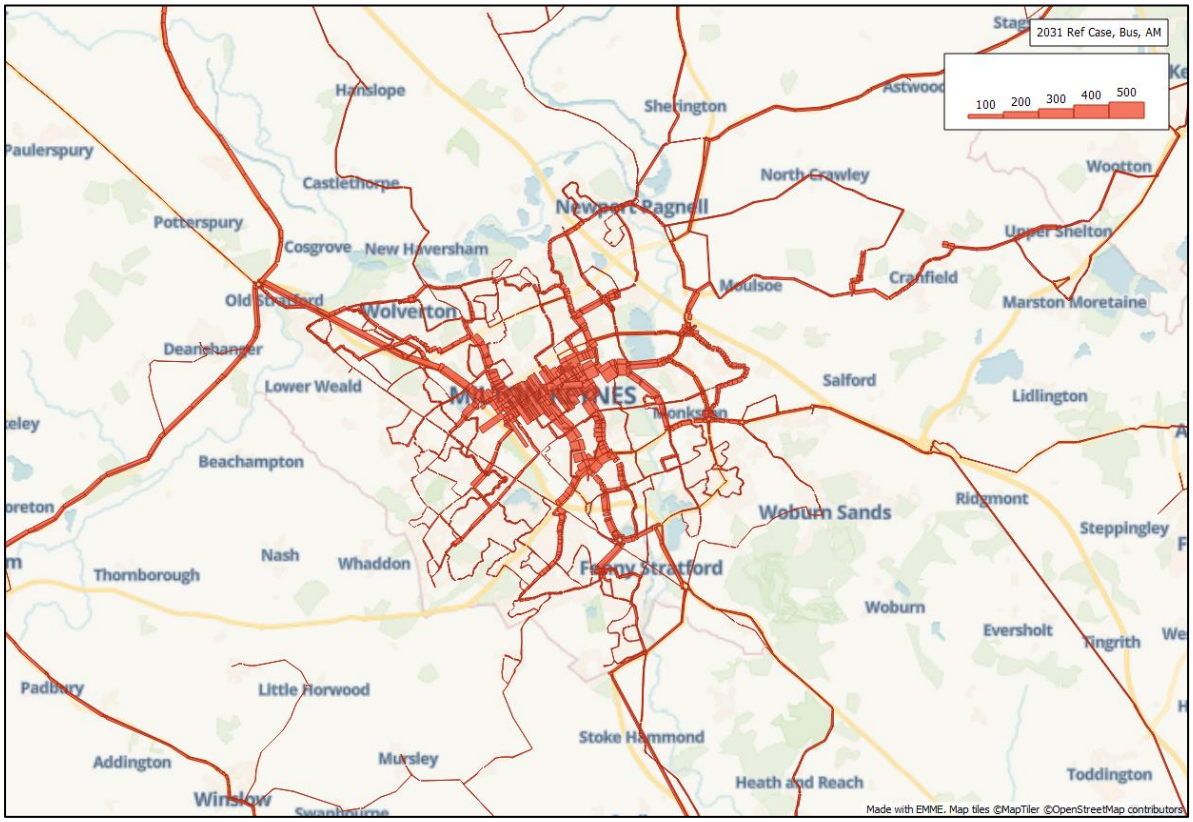

Figure D-1: Bus Absolute Link Flows, 2031 Reference Case, AM Peak

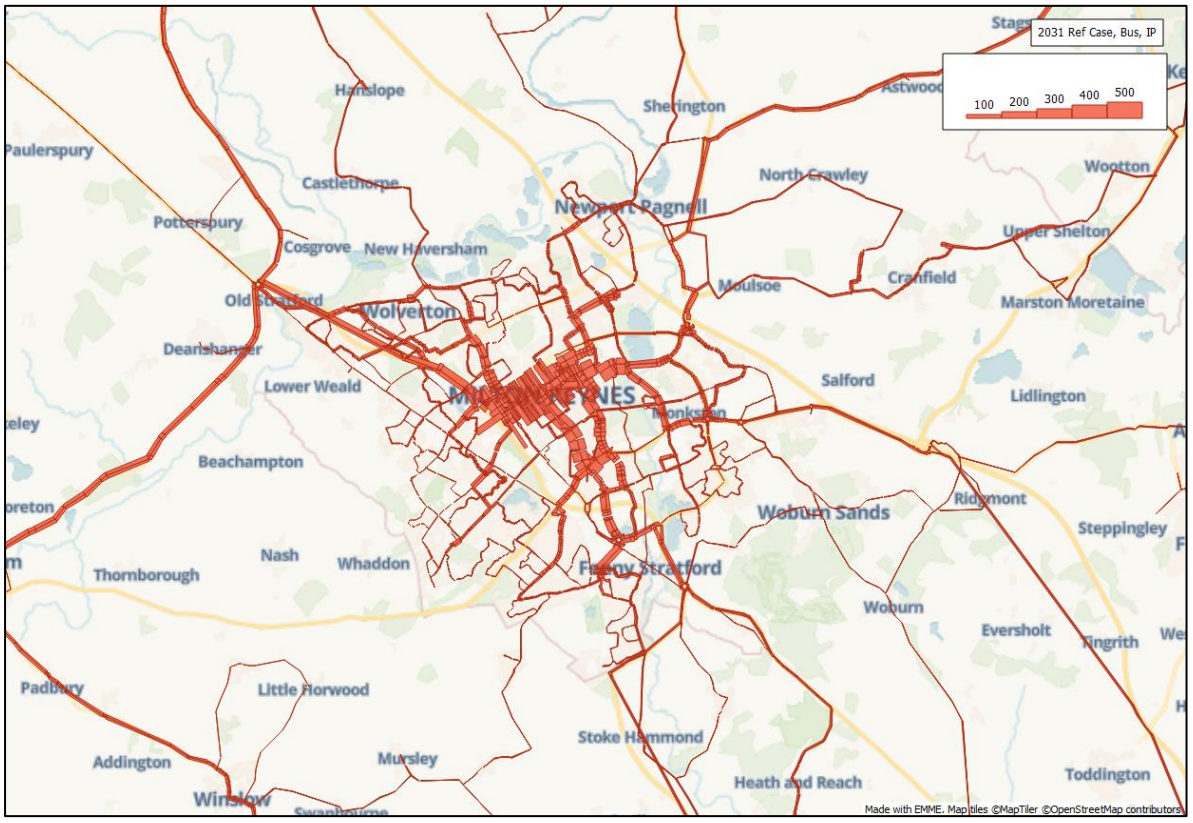

Figure D-2: Bus Absolute Link Flows, 2031 Reference Case, Interpeak

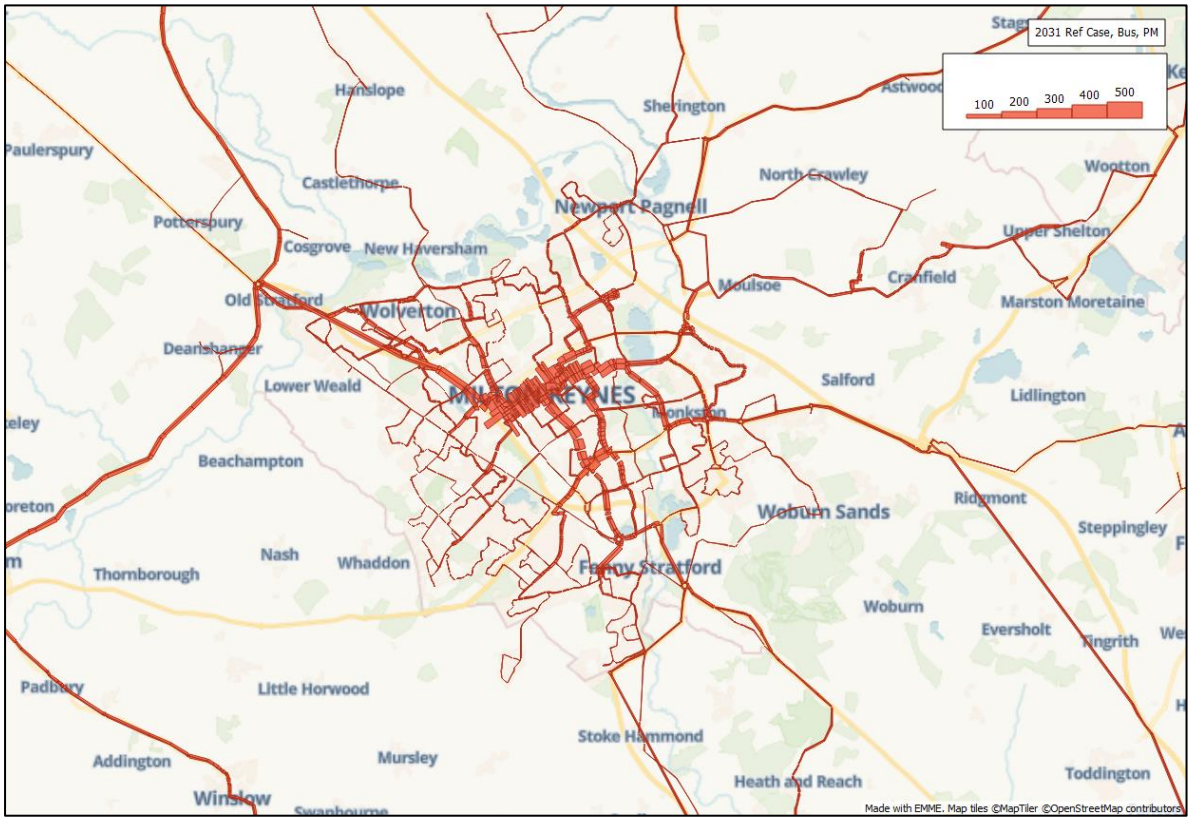

Figure D-3: Bus Absolute Link Flows, 2031 Reference Case, PM Peak

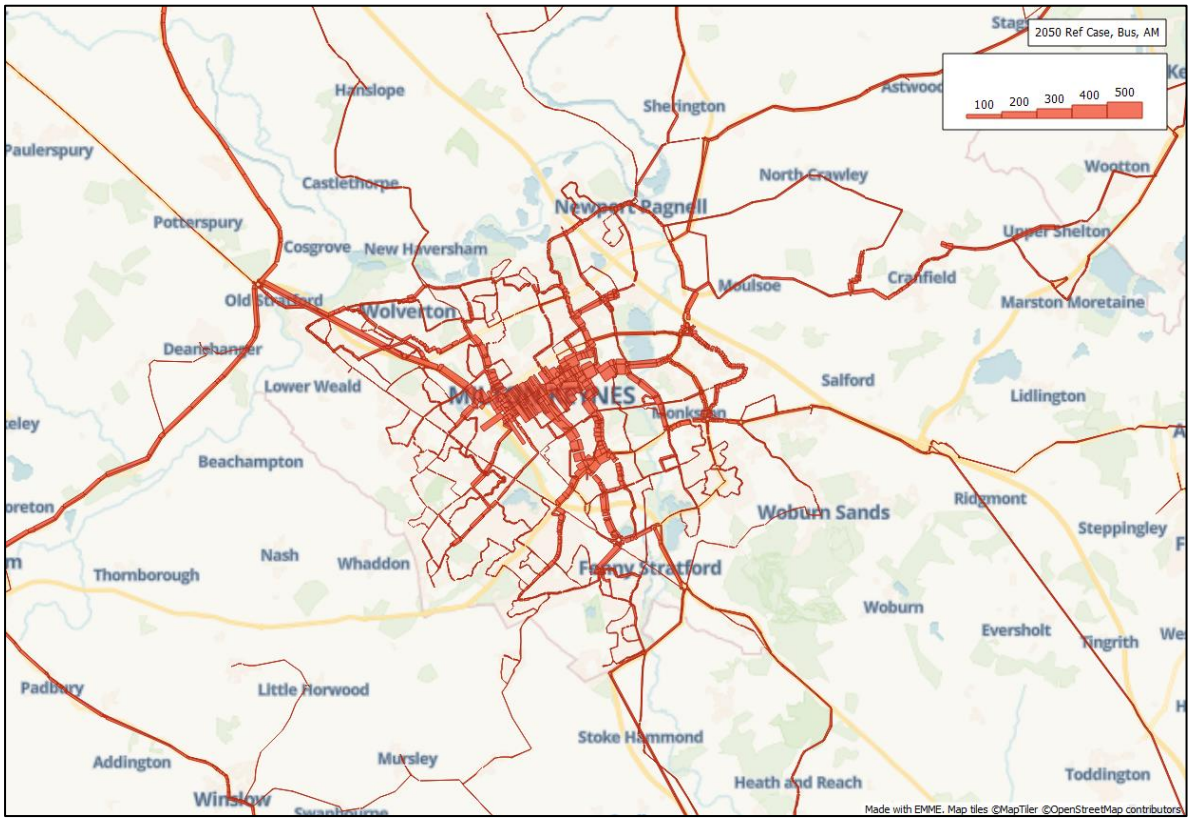

Figure D-4: Bus Absolute Link Flows, 2050 Reference Case, AM Peak

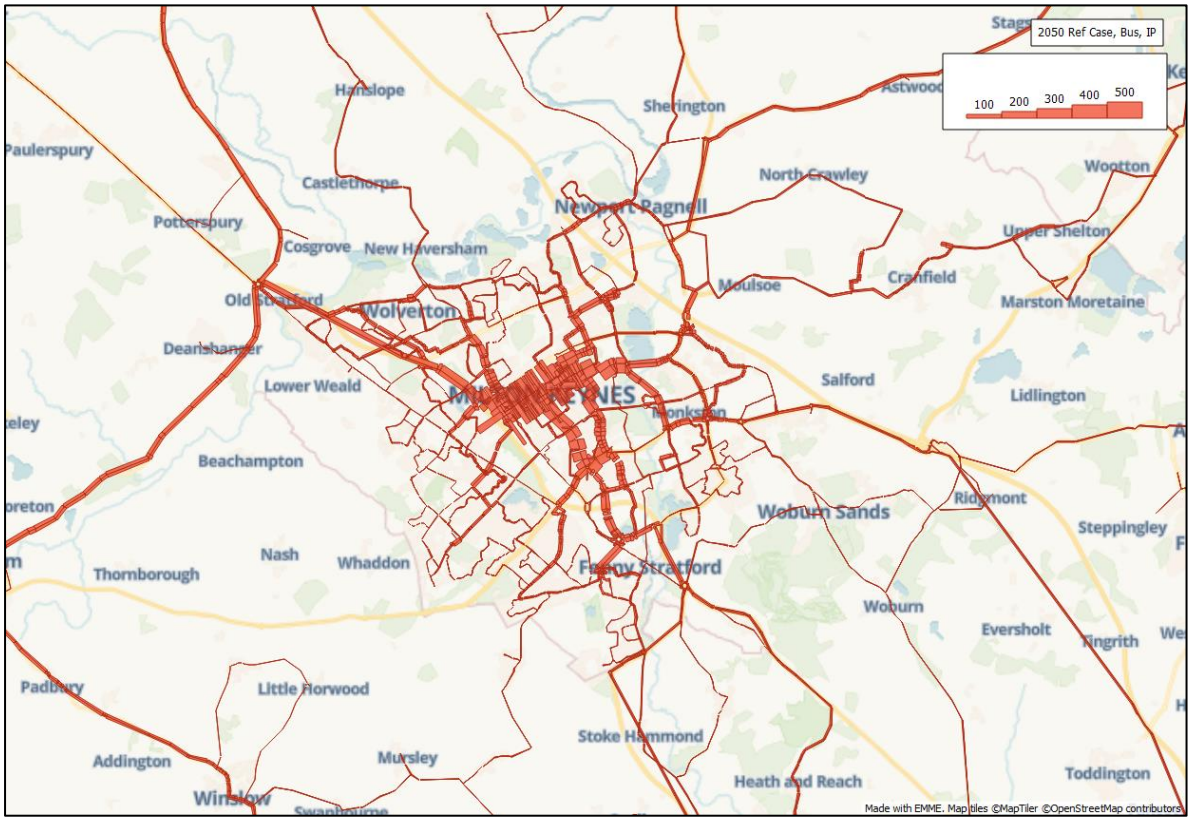

Figure D-5: Bus Absolute Link Flows, 2050 Reference Case, Interpeak

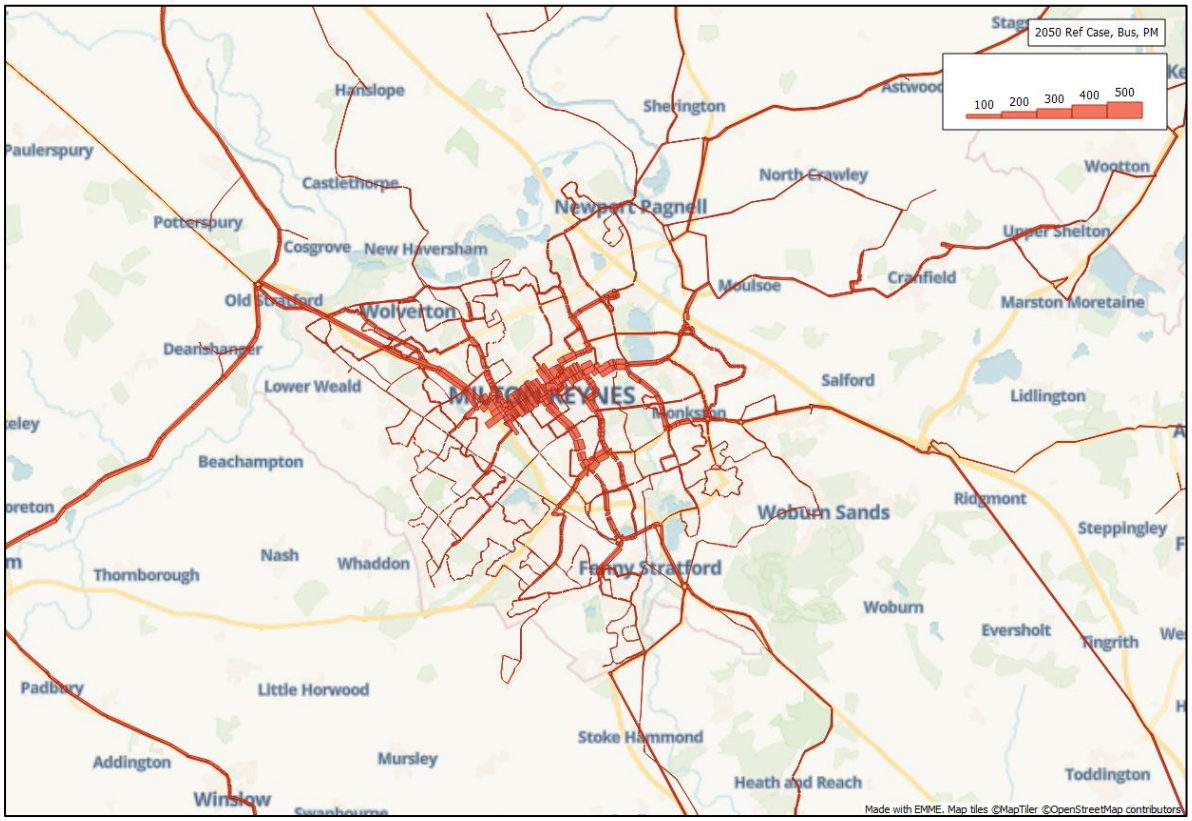

Figure D-6: Bus Absolute Link Flows, 2050 Reference Case, PM Peak

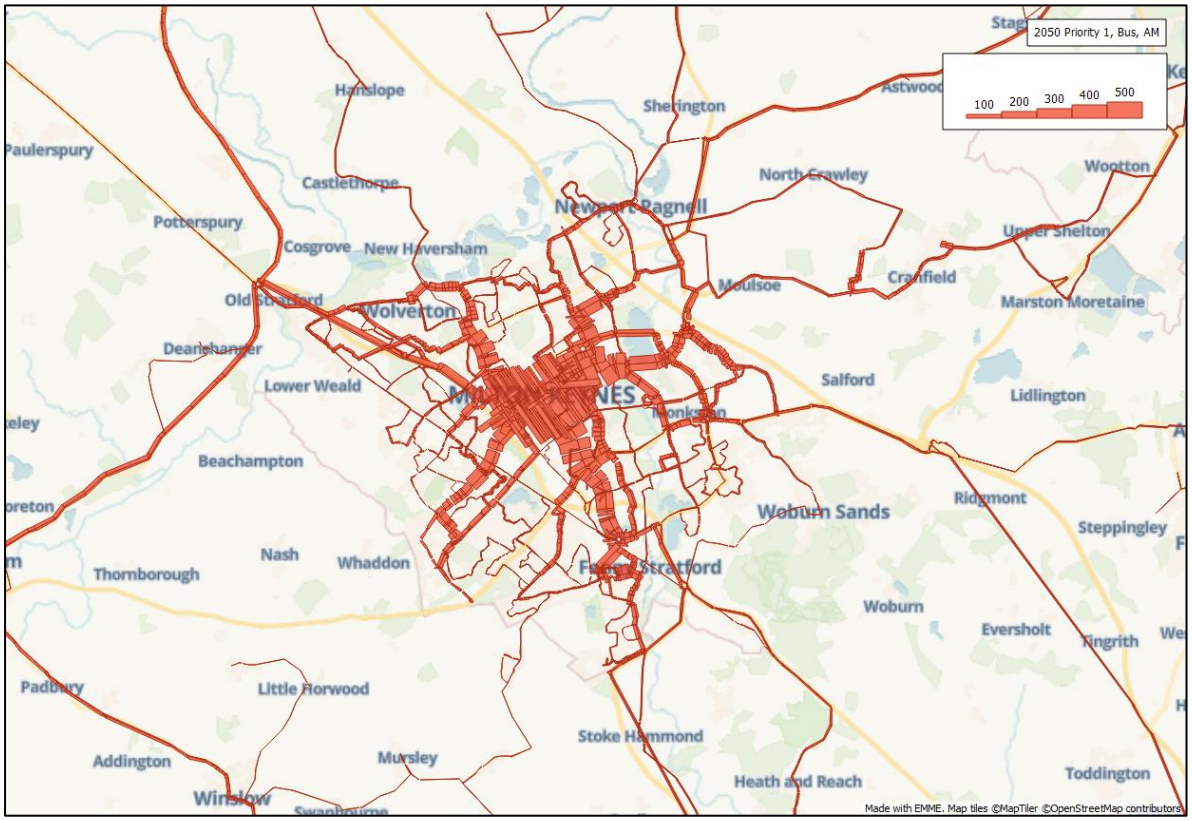

Figure D-7: Bus Absolute Link Flows, 2050 Priority 1, AM Peak

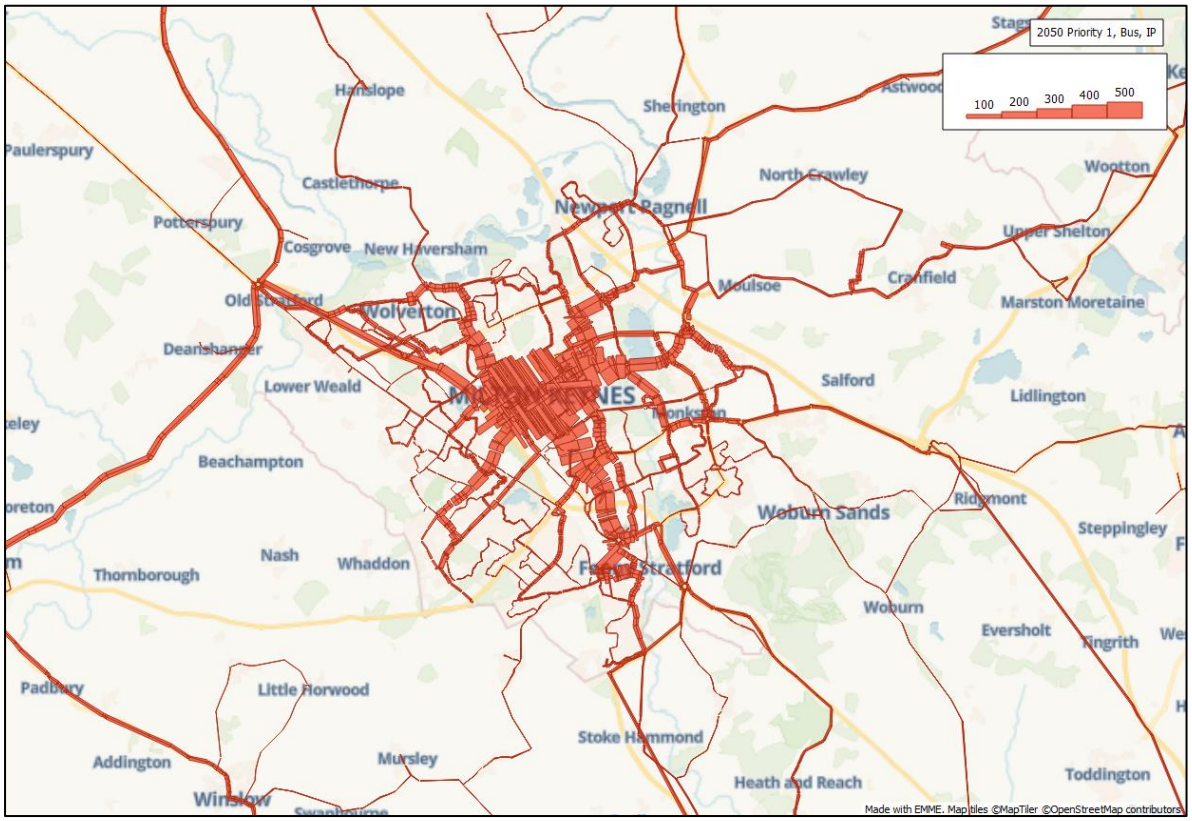

Figure D-8: Bus Absolute Link Flows, 2050 Priority 1, Interpeak

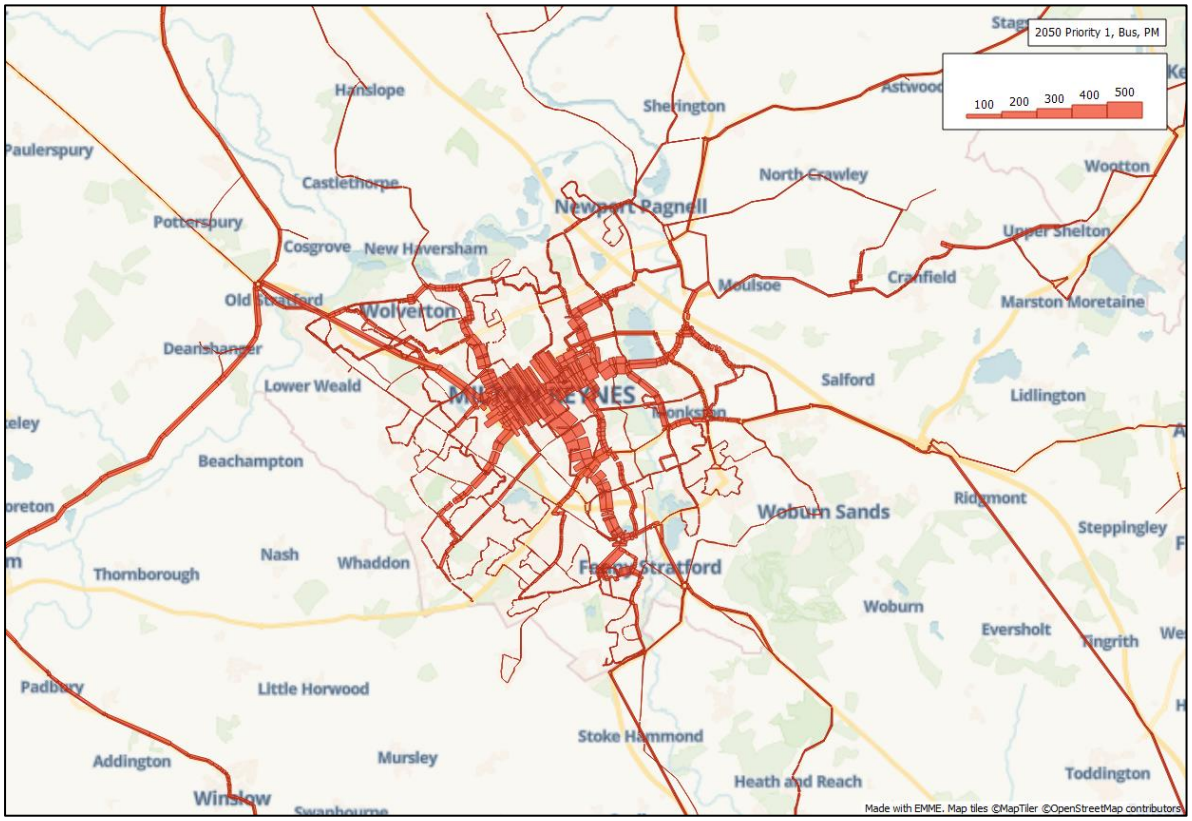

Figure D-9: Bus Absolute Link Flows, 2050 Priority 1, PM Peak

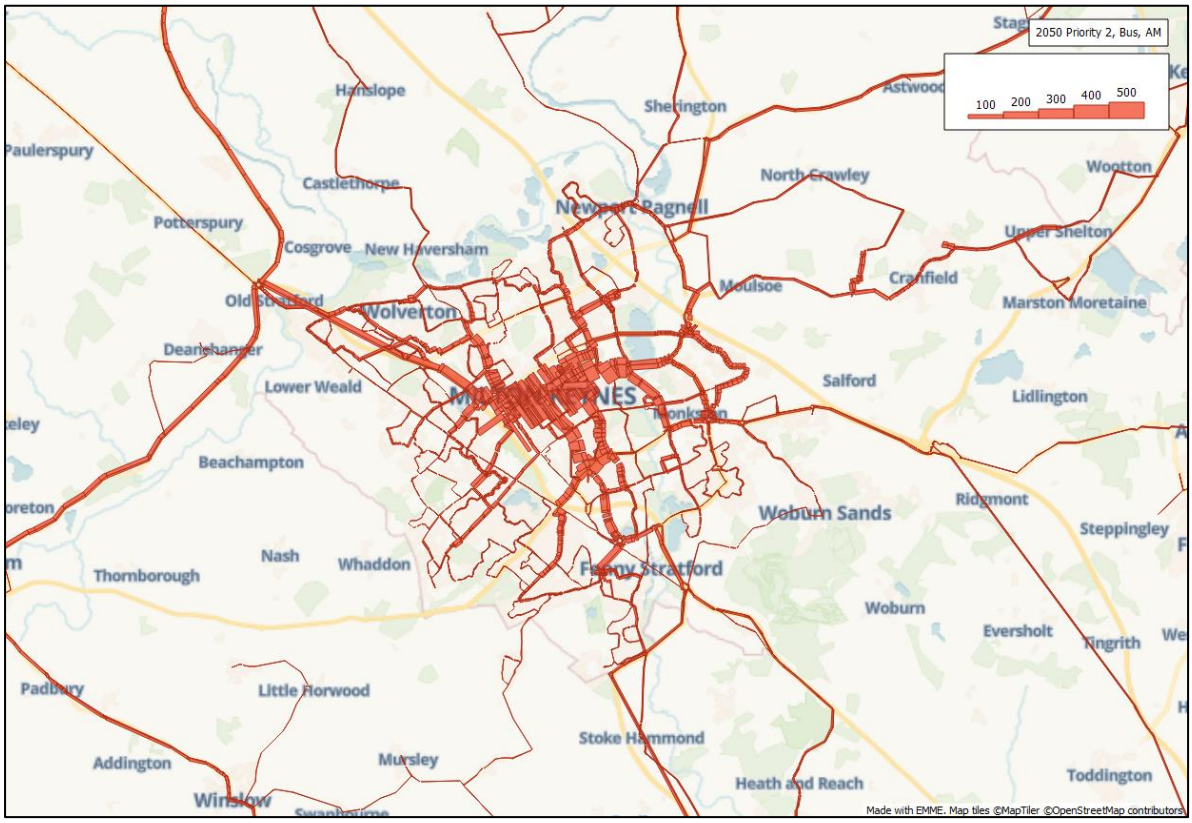

Figure D-10: Bus Absolute Link Flows, 2050 Priority 2, AM Peak

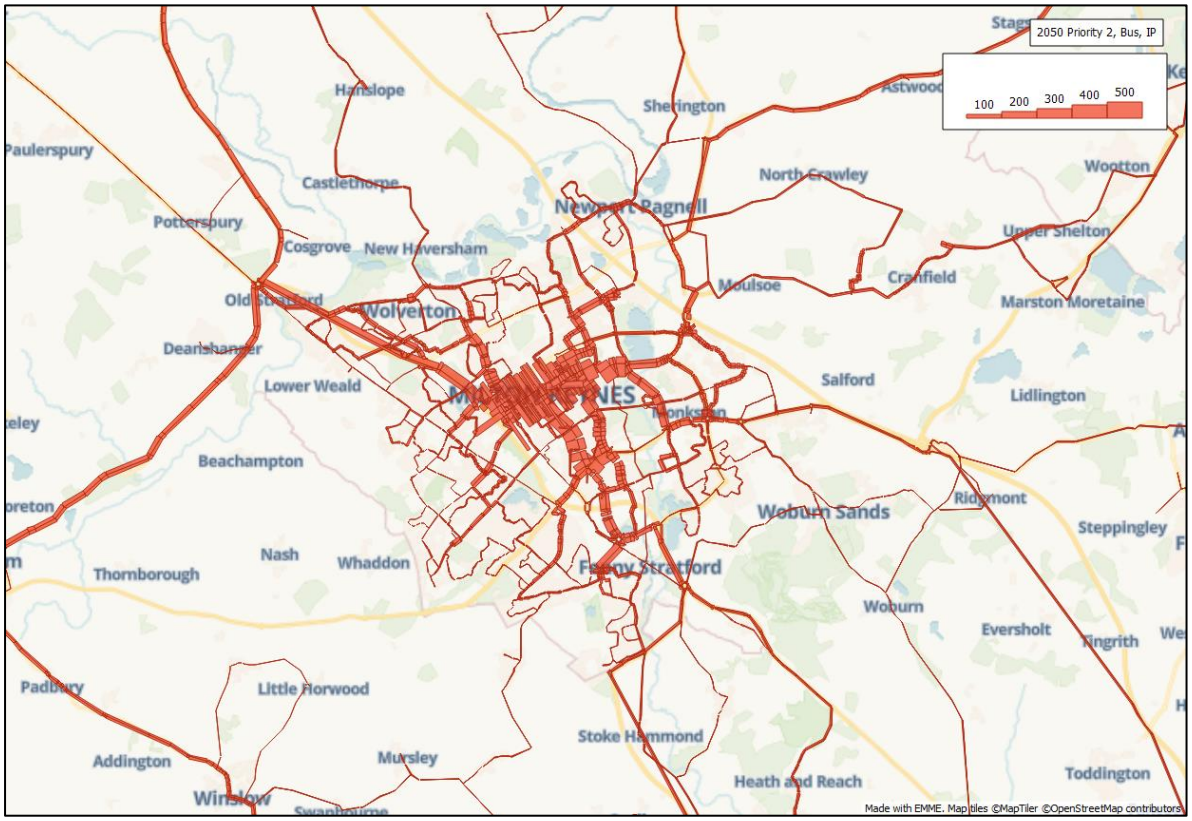

Figure D-11: Bus Absolute Link Flows, 2050 Priority 2, Interpeak

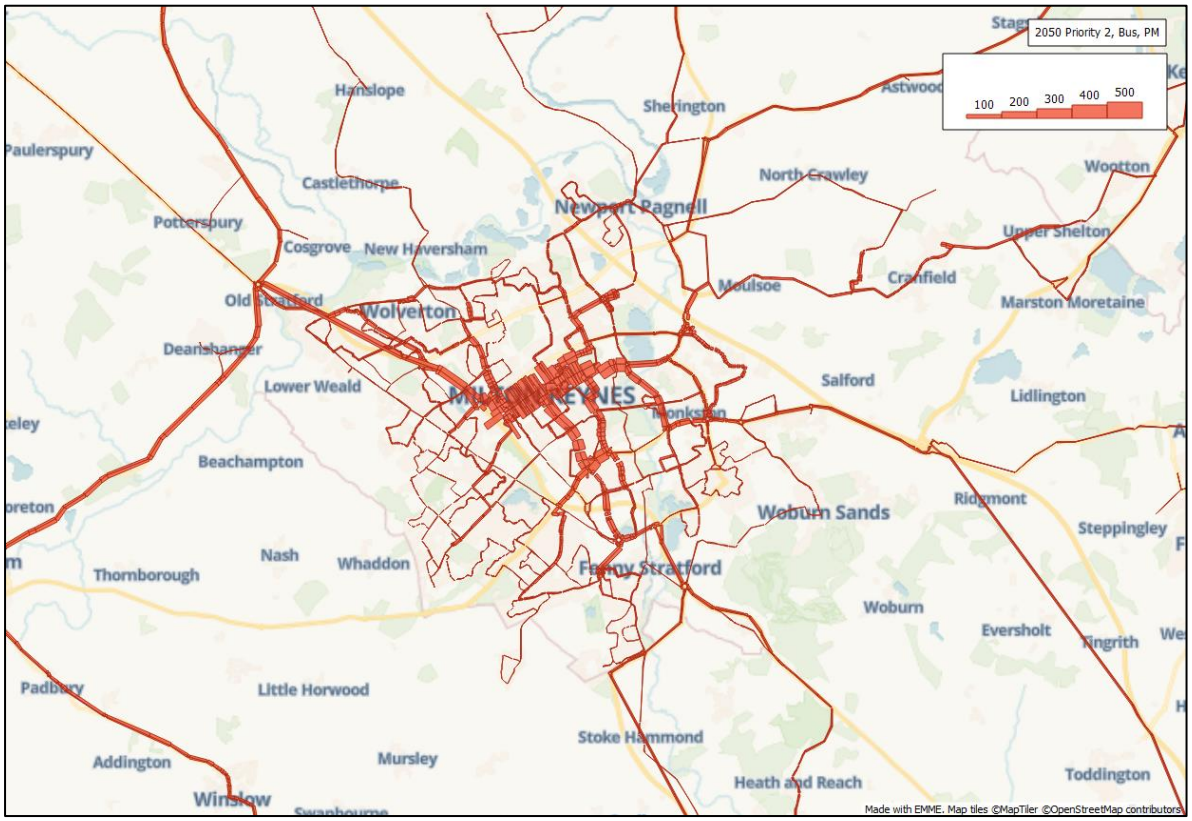

Figure D-12: Bus Absolute Link Flows, 2050 Priority 2, PM Peak

Appendix E – Absolute Rail Link Flow Plots

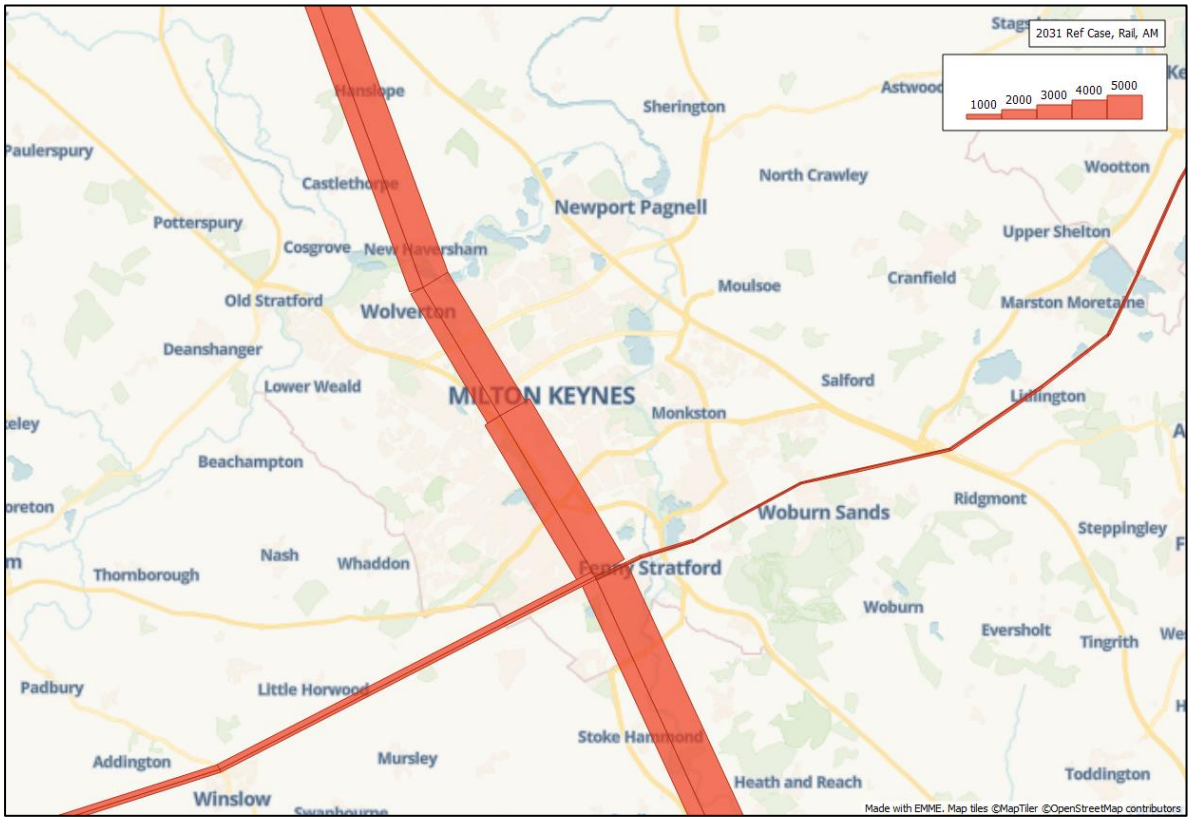

Figure E-1: Rail Absolute Link Flows, 2031 Reference Case, AM Peak

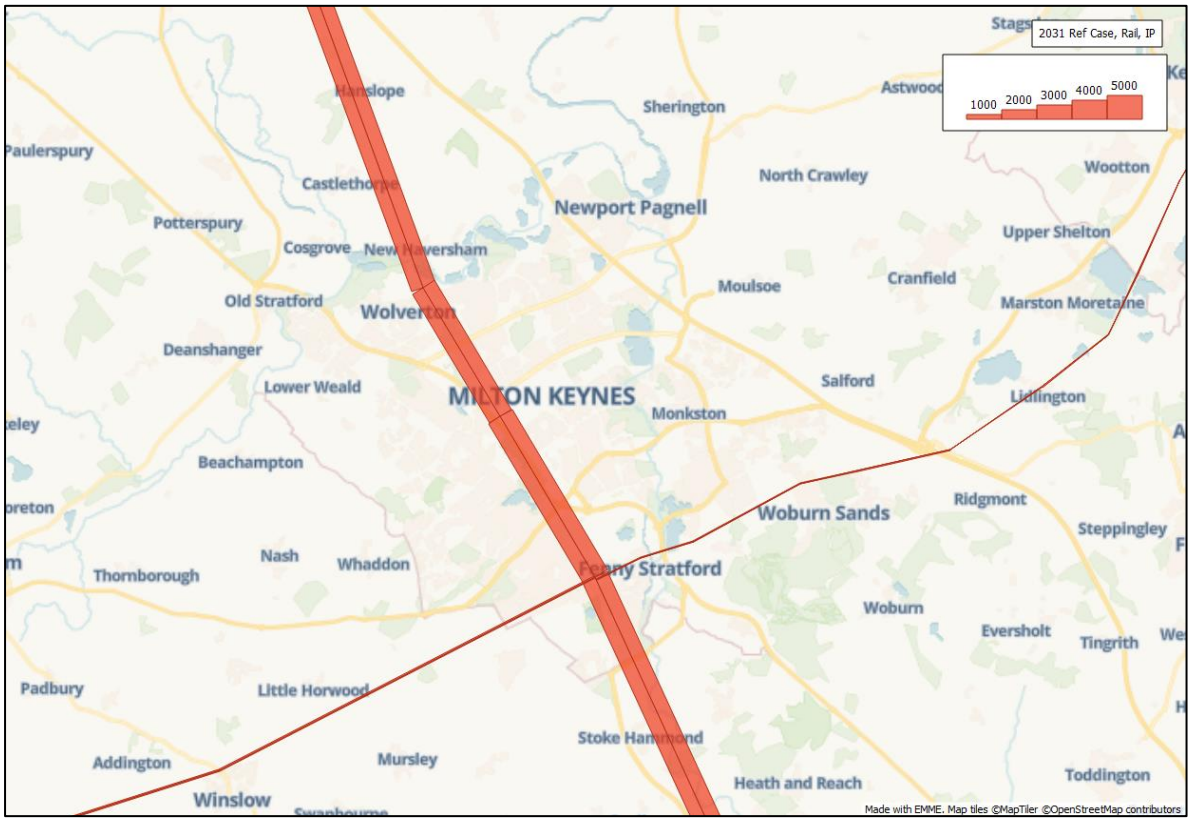

Figure E-2: Rail Absolute Link Flows, 2031 Reference Case, Interpeak

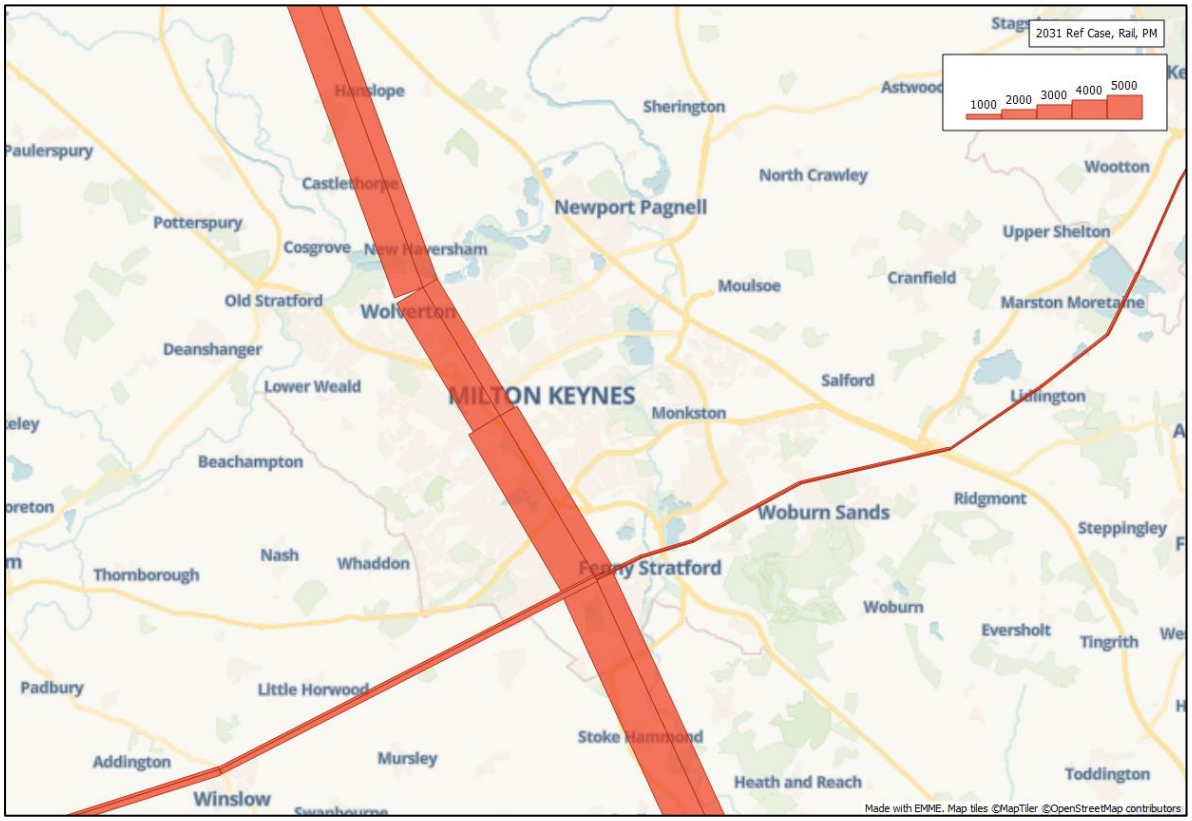

Figure E-3: Rail Absolute Link Flows, 2031 Reference Case, PM Peak

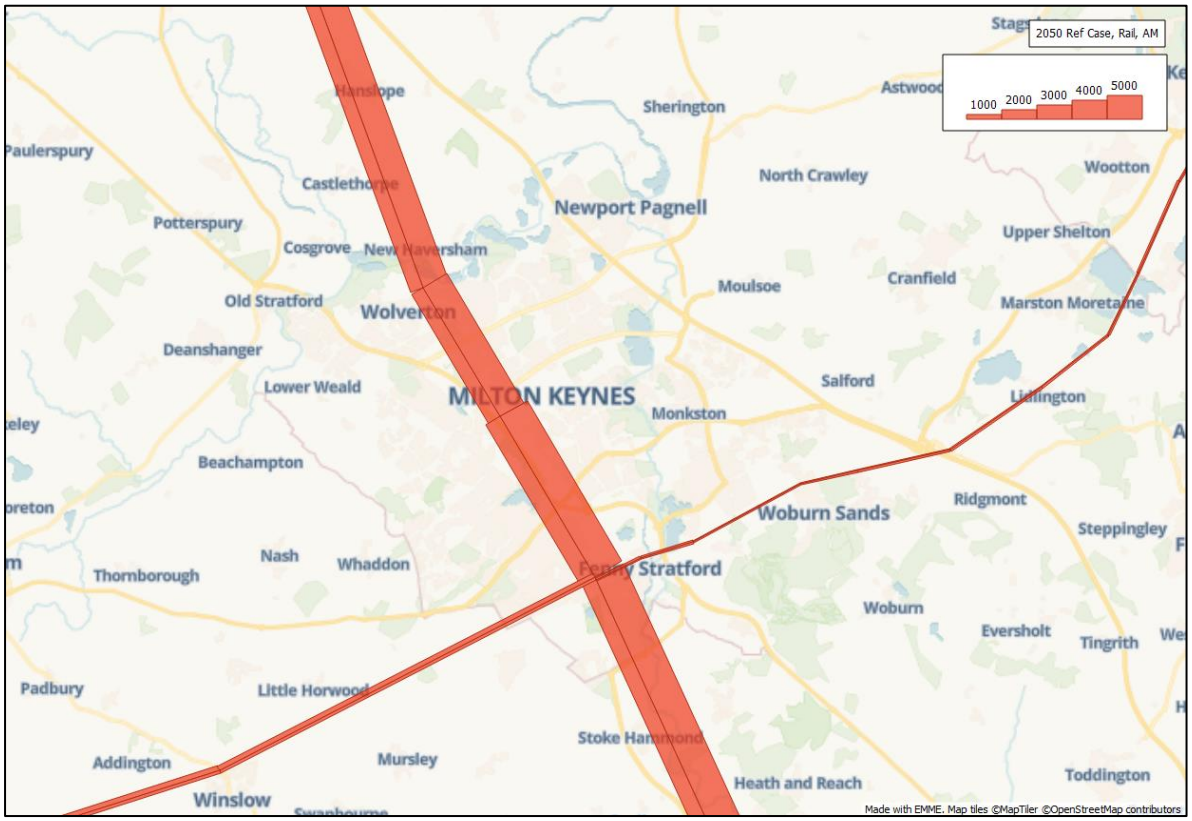

Figure E-4: Rail Absolute Link Flows, 2050 Reference Case, AM Peak

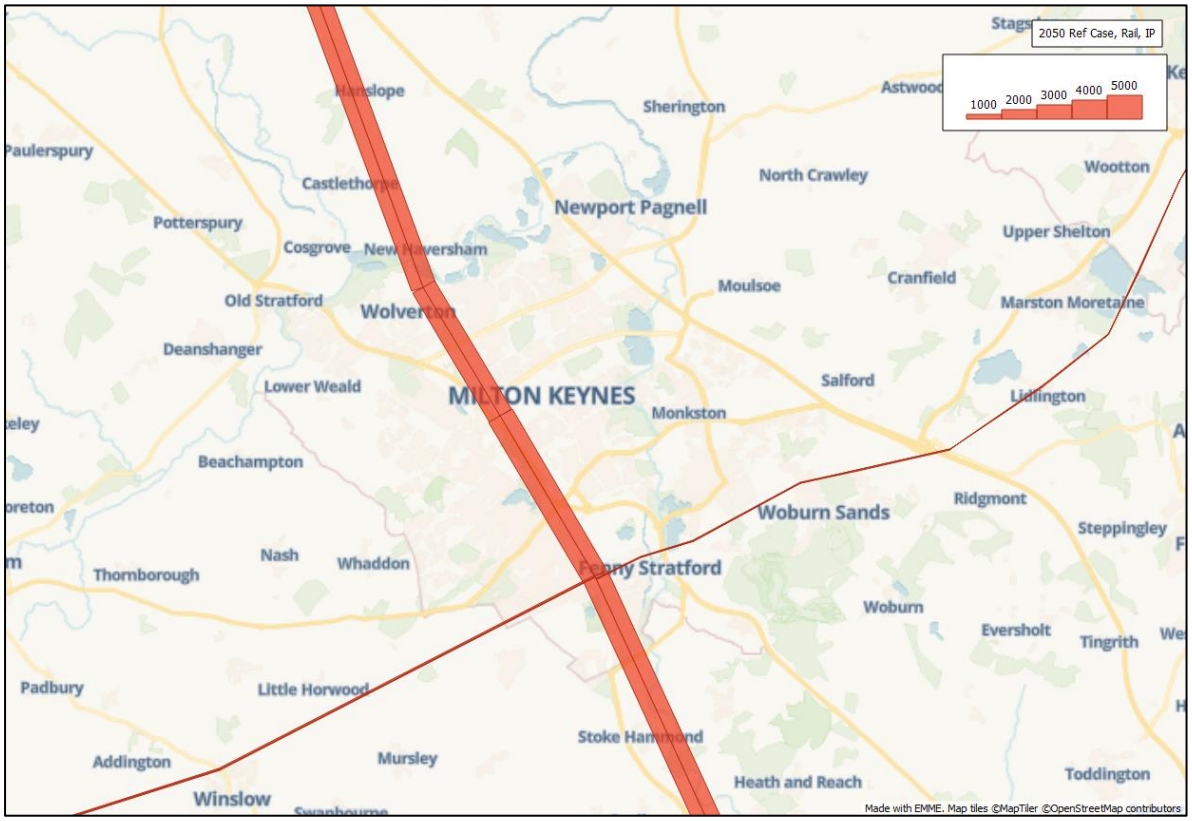

Figure E-5: Rail Absolute Link Flows, 2050 Reference Case, Interpeak

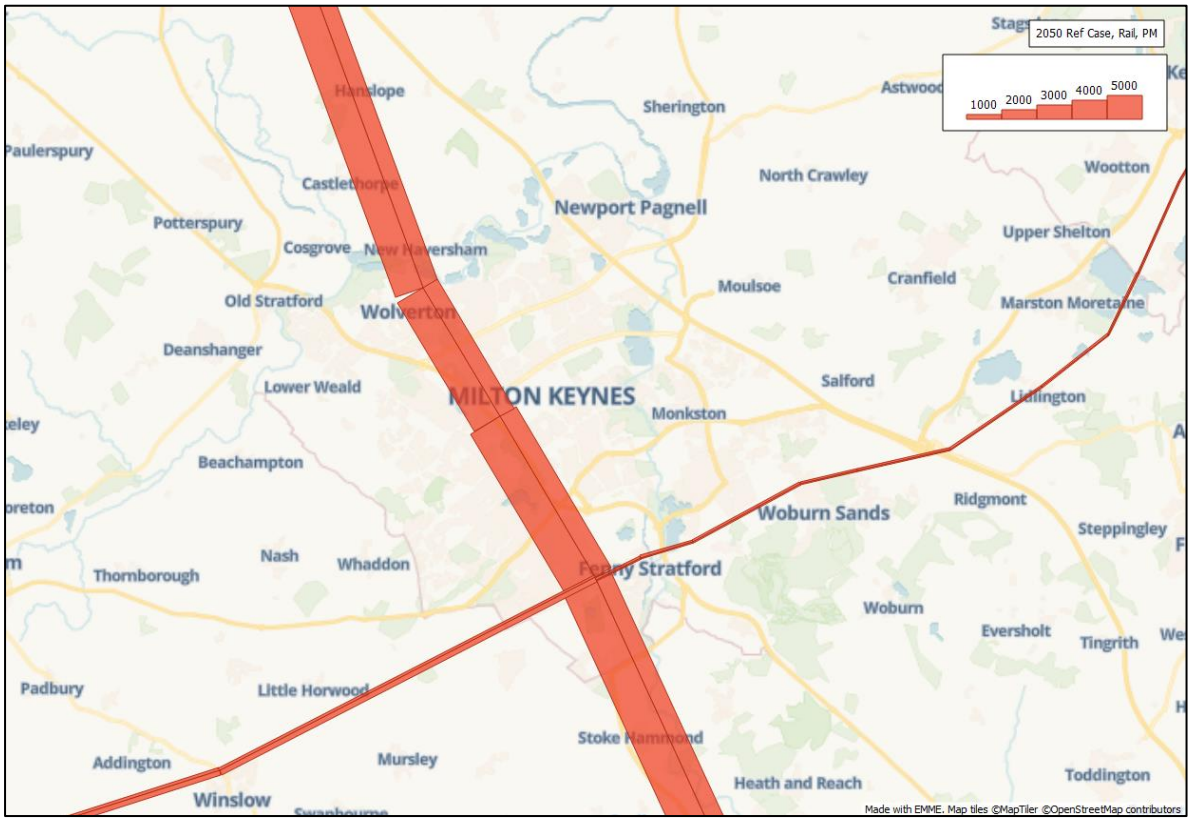

Figure E-6: Rail Absolute Link Flows, 2050 Reference Case, PM Peak

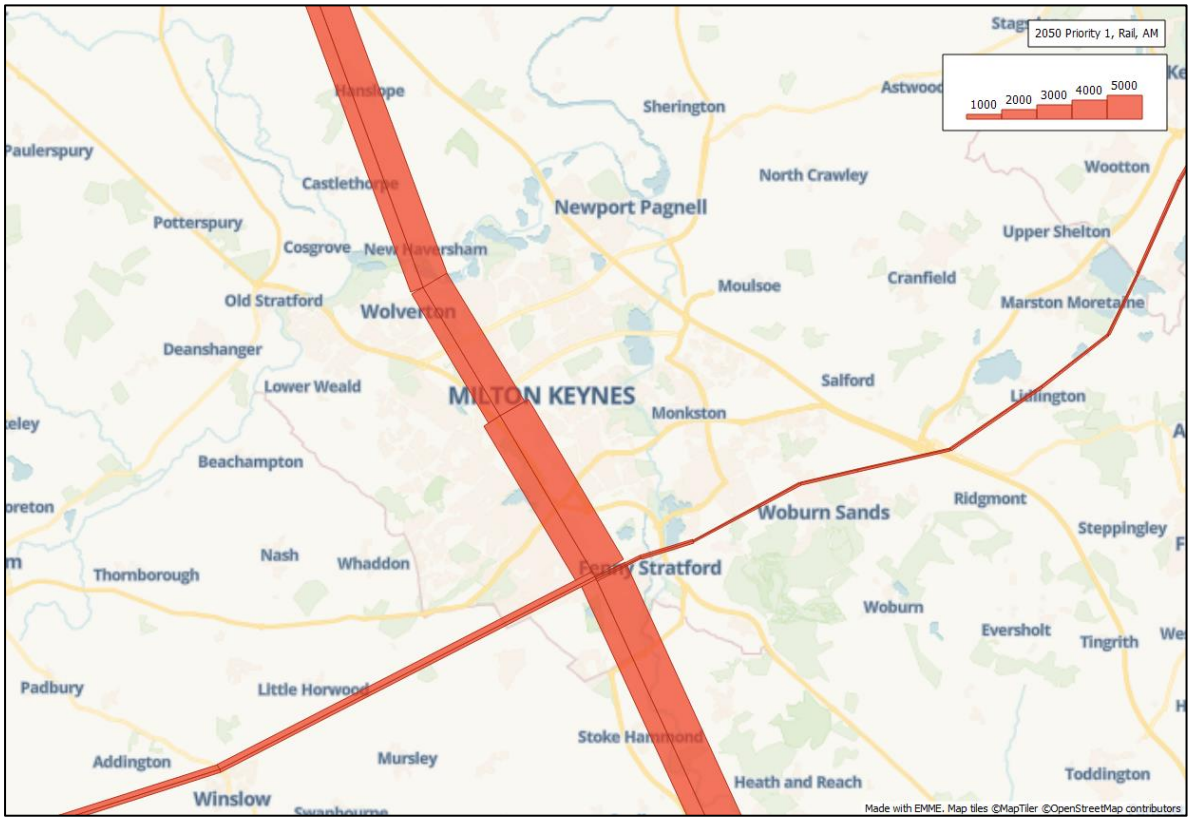

Figure E-7: Rail Absolute Link Flows, 2050 Priority 1, AM Peak

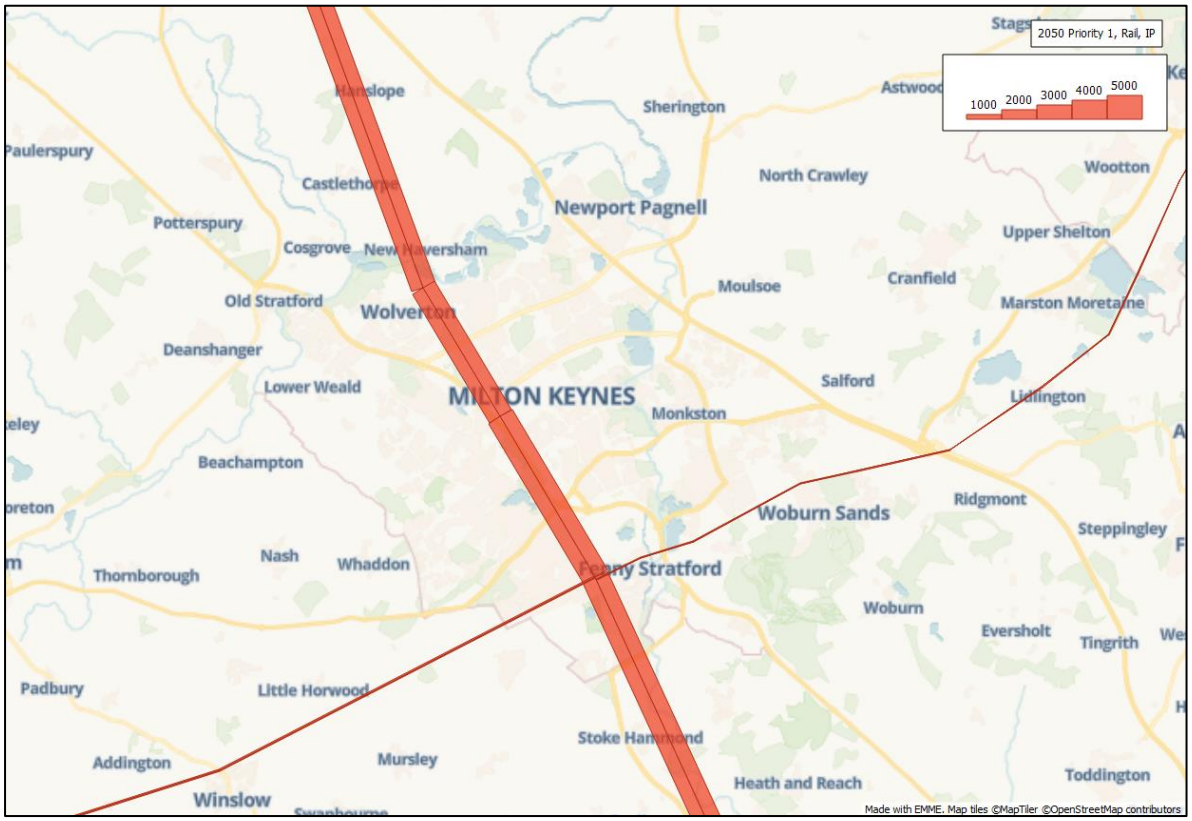

Figure E-8: Rail Absolute Link Flows, 2050 Priority 1, Interpeak

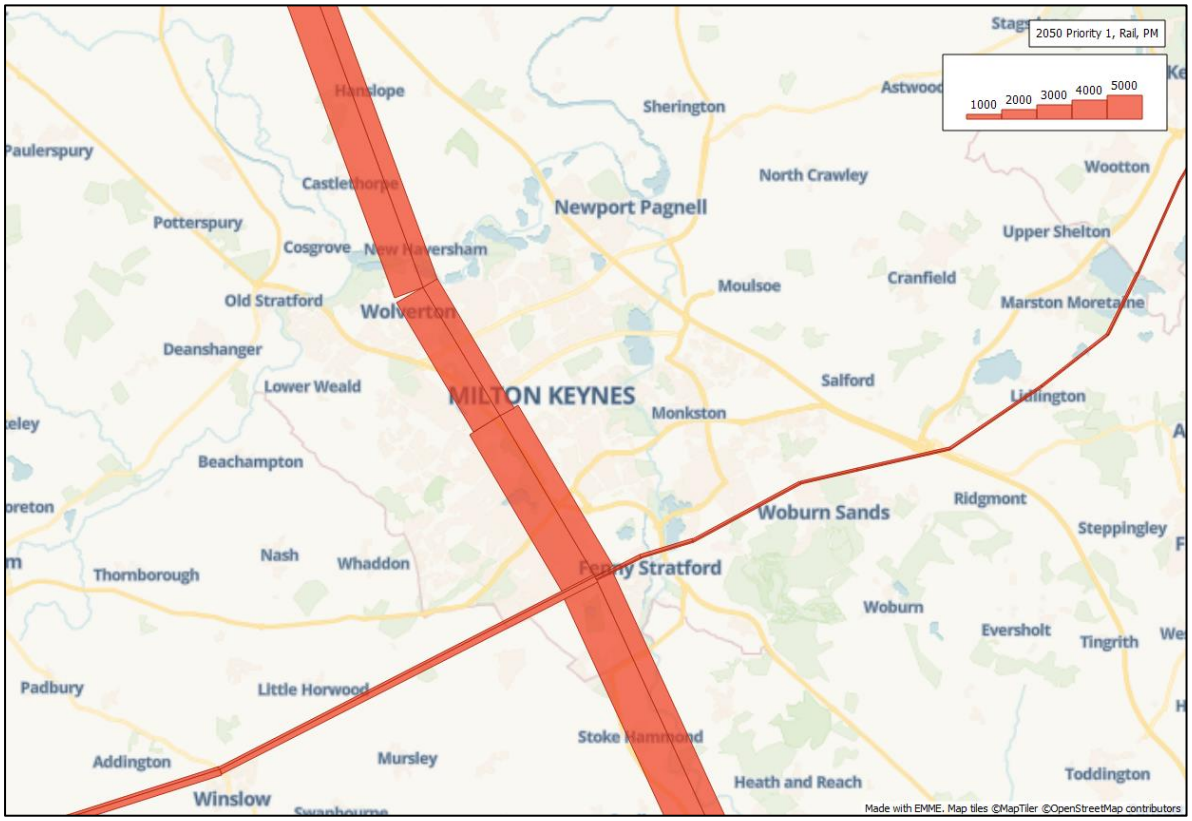

Figure E-9: Rail Absolute Link Flows, 2050 Priority 1, PM Peak

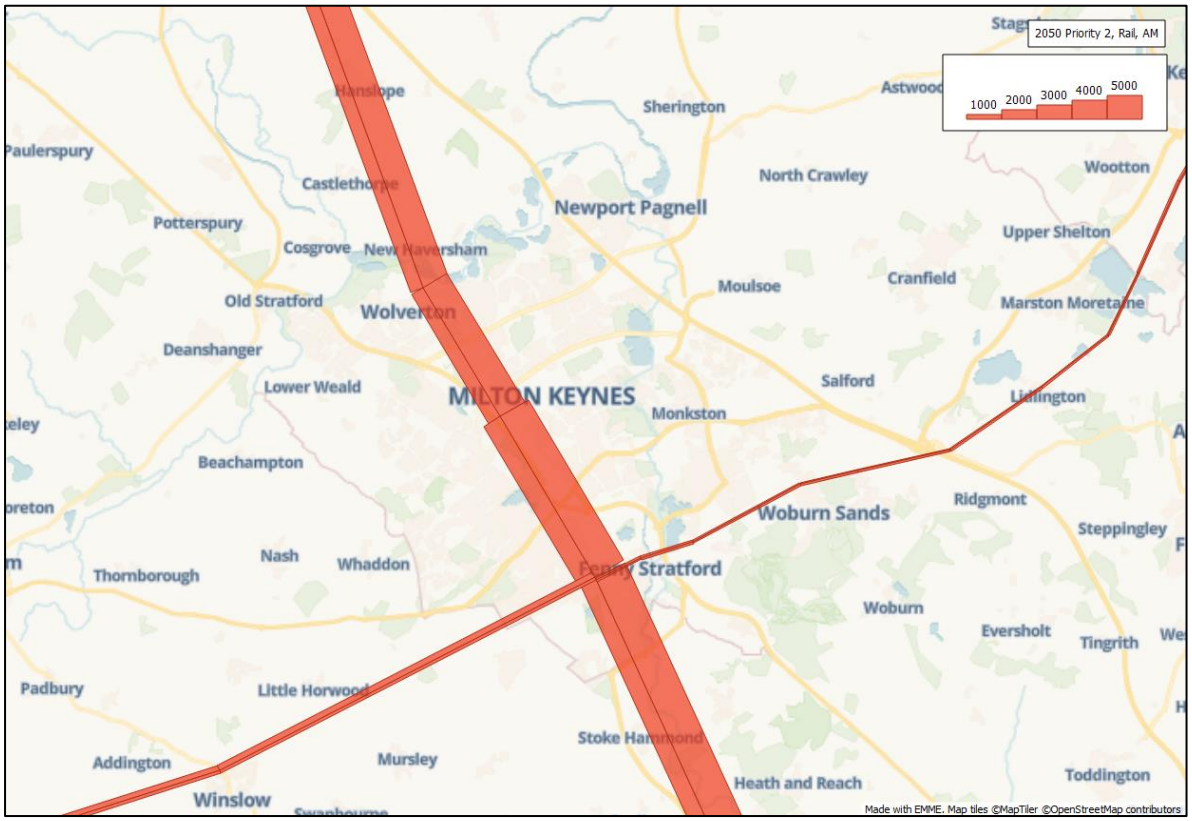

Figure E-10: Rail Absolute Link Flows, 2050 Priority 2, AM Peak

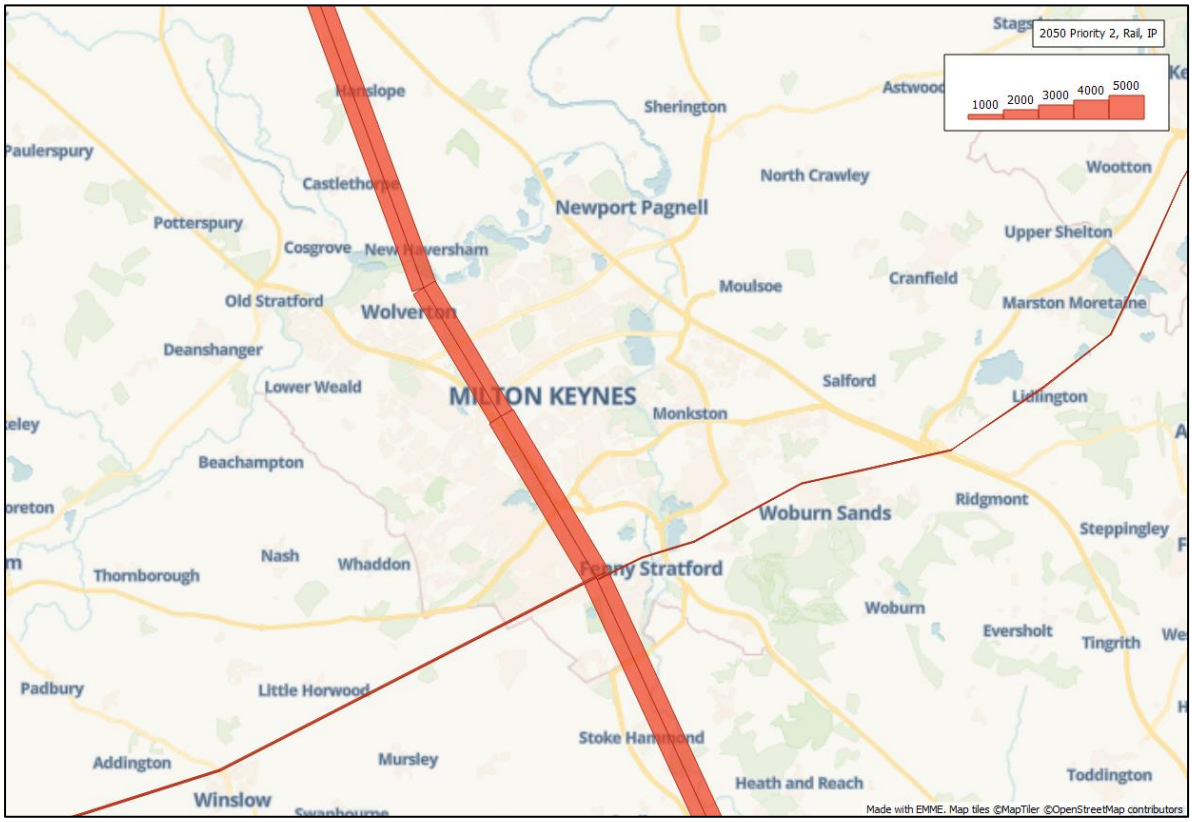

Figure E-11: Rail Absolute Link Flows, 2050 Priority 2, Interpeak

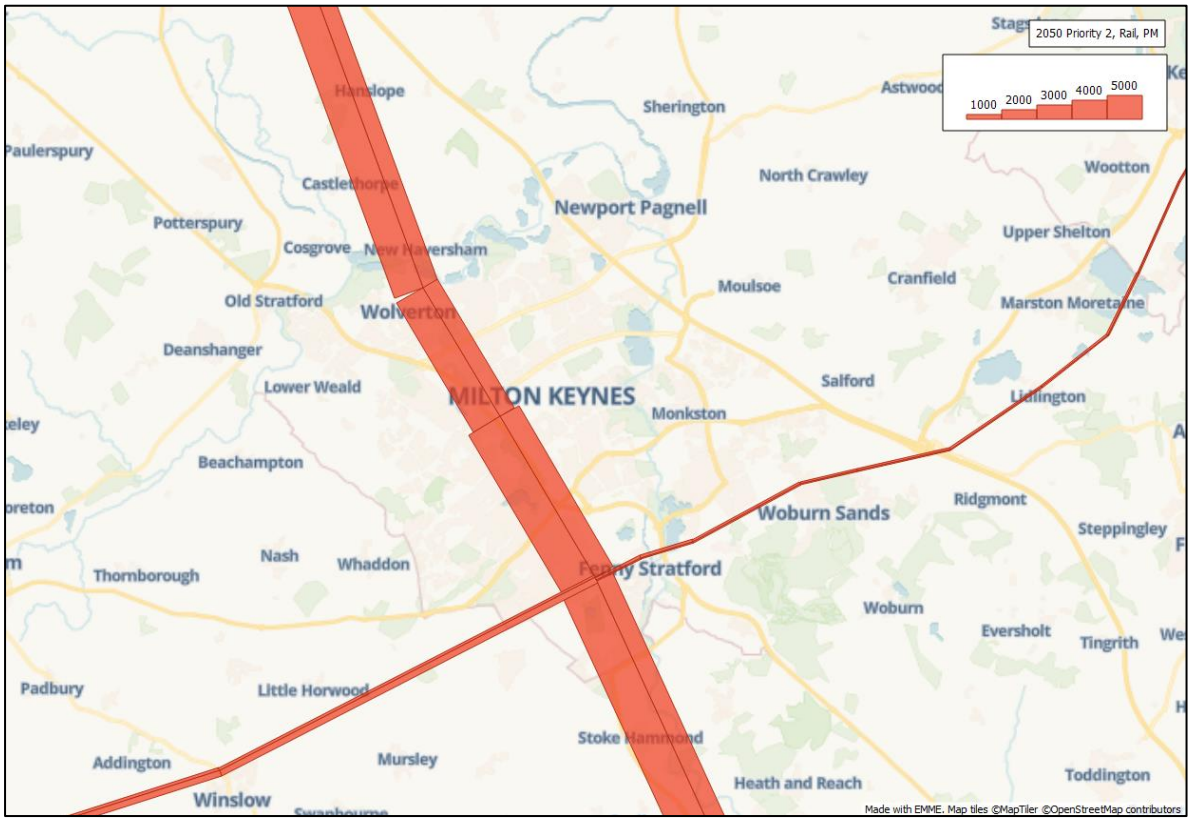

Figure E-12: Rail Absolute Link Flows, 2050 Priority 2, PM Peak