Technical Note

AECOM

Project:	**Milton Keynes Model**	Job No:	**60516496**
Subject:	**TN24 - South-East Milton Keynes (SEMK) Bridge Testing - FINAL**		
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Introduction

This technical note reviews options for highway infrastructure improvements relating to V10 Brickhill Street, V11 Tongwell Street and H10 Bletcham Way in the area of the proposed SEMK Strategic Urban Extension (SUE). An initial test to assess the impacts of the SEMK2 site on the Bow Brickhill level crossing was reported in TN15 Impacts of Scenario 2a[1]. Following on from this a series of additional model runs have been conducted to assess the implications of the SEMK development sites and primarily whether a bridge over the Bletchley to Bedford railway line is needed.

This note is focussed on the impacts in the strategic highway model. Further work to model key junctions in SEMK in a microsimulation model, to enable operational assessment and produce more detailed outputs, is currently being scoped by Milton Keynes Council (MKC).

MKC is looking into a number of growth options for Plan:MK which outlines development growth to 2031. The starting point to assess Plan:MK was to define and assess what was termed the Reference Case which incorporates currently committed growth across Milton Keynes to 2031. The Reference Case was described in detail in the MKMMM Traffic Forecasting Report[2] while more recent updates to the Reference Case are described in Technical Note TN20 Revised Reference Case[3].

The Milton Keynes Multi-Modal Model was used to assess the proposed developments. This assessment focussed on the 2031 AM (0800-0900) and PM (1700-1800) peaks but some output from the Inter-peak period (average hour of 1000-1600) model was also included. The additional model runs used networks based on variations of the Reference Case network and demand based on variations of the Scenario 1 demand.

As outlined in TN20 Revised Reference Case, a number of amendments were made to the Reference case network, primarily the new layout for A45/A4146, Kelly's Kitchen Roundabout and the removal of the left bypass lane for westbound traffic at the A421 roundabout adjacent to M1 junction 13. Although there was reduced delay at Kelly's Kitchen Roundabout and some redistribution of traffic in the vicinity accordingly, overall the modelled congestion issues highlighted in the original Reference Case (reported in the MKMMM Traffic Forecasting Report) remained unchanged.

Aims

The primary aims were:

- To establish whether a bridge is needed to accommodate traffic either for South Caldecotte only, for the SE SUE (SEMK2) only, or both elements of Plan:MK;
- If so, to estimate the optimum location in terms of mitigating congestion and delays on V10, H10 and A5 but also considering the wider effects of Plan:MK;
- In particular, how A5(S) towards Central Beds would be affected.

[1] Milton Keynes Model Update - TN15 Impacts of PlanMK Scenario2a_v4, November 2017
[2] Milton Keynes Multi-Modal Model Update Traffic Forecasting Report, November 2017
[3] Milton Keynes Model Update - TN20 Revised Reference Case, May 2018

More detailed issues that the tests are required to inform include:

- If a bridge is not built, will traffic conditions at the level crossings be acceptable?
- Plans to 'grid' V10 Brickhill Street from A5 to the railway form part of the South Caldecotte planning conditions. Will this compound the issue above; if there is no bridge at any point?
- If a bridge is deemed necessary based on the above, would an option to replace the Bow Brickhill level crossing with a bridge be feasible in highway terms, and effective in traffic terms?
- If an on-line bridge is not feasible, will a new road through the site and a new bridge provide sufficient capacity? (this is similar to what has already been tested in Scenario 2)
- Increased east-west rail train frequency assumptions may need to be checked as a sensitivity test to understand the possibility of underestimation of rail patronage and hence train service capacity.

Revised Reference Case Network

The original 2031 Reference Case highway improvements assumed are listed in Table 1 and shown in Figure 1. The changes in the area of the SE SUE was the extension of H10 Bletcham Way as a spur into the proposed development north of the railway (SEMK1) and additional barrier down time at the level crossings along the Marston Vale railway, including Bow Brickhill level crossing.

The subsequent Revised Reference Case added further changes, which in SEMK included upgrading the Kelly's Kitchen Roundabout to a hamburger and adding a new signalised junction for the Eaton leys development.

Table 1. Forecast Year Transport Schemes included in Reference Case

Scheme	Delivered by
A421 Dualling	By 2031
Monkston & Brinklow Junctions	2019
Crownhill & Loughton Junctions	2019
A5 Improvements	By 2031
Bletchley Station Highway Improvements	2017
Brooklands City Street Phase 2	2017
Nova City Street	2018
Calverton Lane/Fairways	2021
Kiln Farm Junction	2016
Bridge over Broughton Brook	2018
H10 Extension	2018
V2/H4 Extension	2021
East-West Rail	2024
M1 J13-J16 SMP	By 2031
M1 J16-J19 SMP	2021
M1 J11a / Dunstable Northern Bypass	2017
A5/A4146 Kelly's Kitchen Roundabout (including Eaton Leys Access)	By 2031

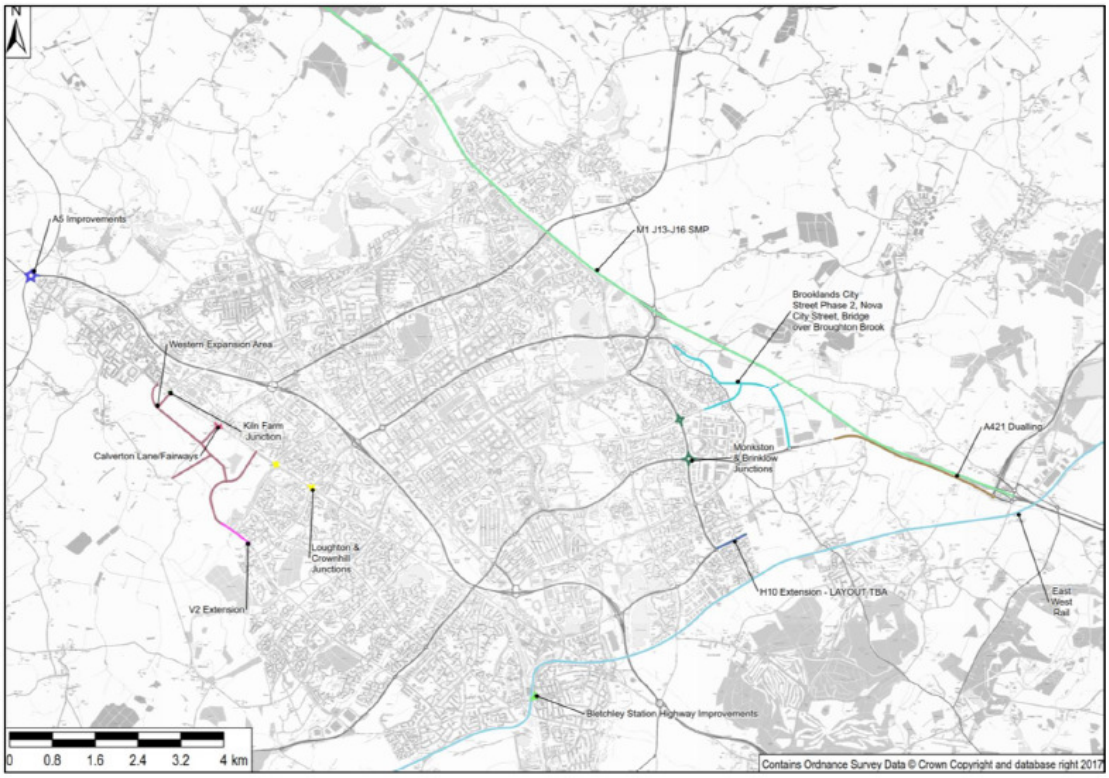

Figure 1. Uncertainty Log schemes included in the original 2031 Reference Case Scenario

East-West rail was expected to increase the train frequency across the level crossings from one per hour in each direction to two per hour.

The 2016 base year barrier downtimes were calculated by working backwards from core EWR barrier down times calculated for the EWR Phase 2 downtime assessment[4]. Timetables showed there was one train per hour in 2016 (in each direction) so the hourly 'down' times were halved from those shown in the table. It was then assumed that half the delay occurred twice per hour.

The additional two trains per hour in 2031 was represented in the highways model by halving the cycle time, from 30 minutes to 15 minutes, at the signal nodes representing the level crossings. The inter-green time (representing the barrier down time) was kept the same, but the total green time was reduced accordingly. An example of the barrier downtime at Bow Brickhill level crossing is shown in Table 2.

Table 2 Barrier down time at Bow Brickhill Level Crossing

	2016	2031
Total no. trains (and closures) per hour	2	4
Barrier down time per closure (inter-green)	216 seconds	216 seconds
Total barrier down time per hour	432	864
Percentage time closed per hour	12%	24%

[4] East West Rail – Phase 2 Level Crossing Barrier Downtime Assessment, 28th July 2015

Previous Assessment

The initial review of the SEMK2 site was based on Plan:MK Scenario 2a. This included the Scenario 2 growth except for the MK East development. The infrastructure assessed for SEMK2 for the test included a new bridge between Bow Brickhill level crossing and Woburn Sands and links through to Newport Road. The impacts of Scenario 2a were assessed against Scenario 1 so the impacts of the South Caldecotte jobs site were excluded from the analysis.

The tests covered by this technical note take a step back from the previous testing both in terms of modelled infrastructure and demand to enable a clearer view of the impacts of the crossing options (including a no bridge option) in line with alternative development scenarios.

Scenario 1 Demand

Scenario 1 consisted of the following growth assumptions over and above the housing and employment tested within the Reference Case 2031.

Housing:

- 4,620 homes within the urban area of Milton Keynes. This consisted of around 1,200 homes from permissions granted after the Reference Case was defined and additional Neighbourhood Plan allocations, and 3,420 from urban housing sites considered deliverable or developable within MKC's draft SHLAA 2017.
- 1,000 homes at land north of the railway within the South East Milton Keynes Allocation (SEMK1) contained within the Draft Plan:MK March 2017

Employment:

- 4,254 jobs within the industrial and logistics sector associated with the South Caldecotte allocation within the Draft Plan:MK March 2017

The dwellings and employment growth is shown in Figure 2. Whilst the dwellings growth was spread across Milton Keynes borough the jobs growth is focussed in South Caldecotte. The largest housing development site is 1000 dwellings in the Strategic Urban Extension South East near Woburn Sands.

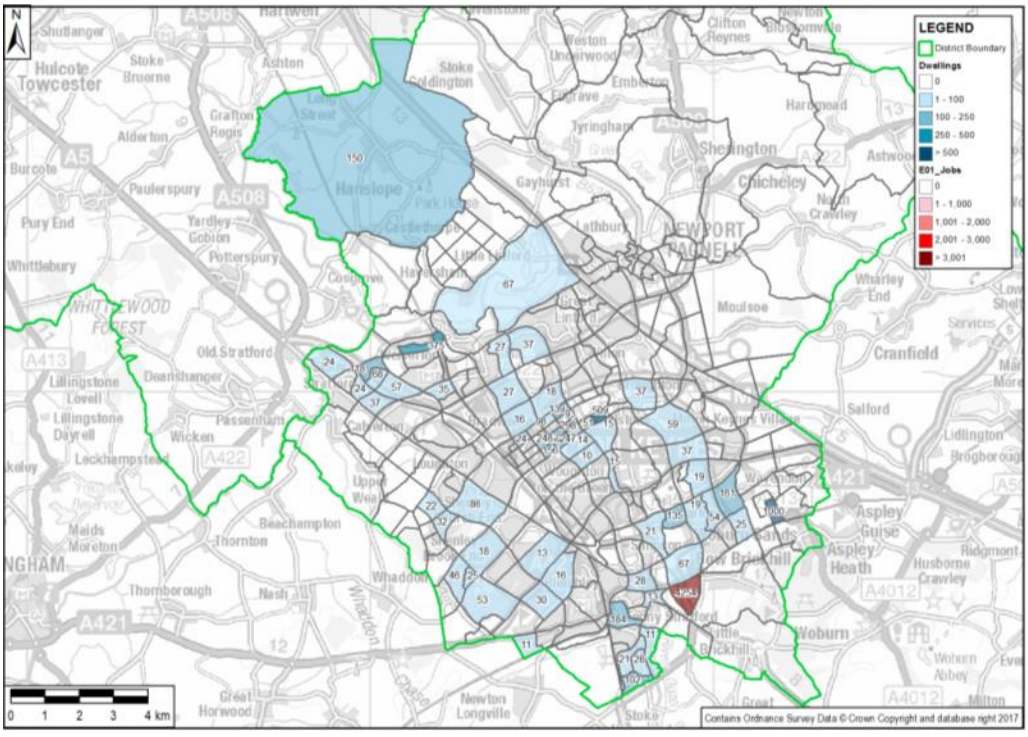

Figure 2. Plan:MK Scenario 1 : Additional Dwellings and Jobs Growth to 2031

SEMK Testing - demand

For consistency with other green field sites across the model, housing and jobs data was converted into trips using the trip end model element of MKMMM. The trip end model used trip rates derived at a strategic level from the national Trip End Model (NTEM) which are often lower than those from TRICS (the trip generation database used by developers for transport assessments).

Scenario 1 New (S1N)

This is as Scenario 1 but with the following amendments:

- South Caldecotte employment site excluded,
- 300 additional dwellings at SEMK1, north of railway line giving a total of 1300 dwellings for this site,
- 500 dwellings included for the Levante Gate development.

Scenario 1 New + South East (S1N+SE)

As S1N but with 2200 dwellings at SEMK2 site south of the railway included. (In Scenarios 2, 2a and 2b, 2000 dwellings were modelled at this site) This growth is split evenly across the two zones that represent the development site.

Scenario 1 New + South Caldecotte (S1N+SC)

As S1N but with 4254 jobs at the South Caldecotte Site

Scenario 1 New + Both (S1N+Both)

As S1N but with both the 2200 dwellings at SEMK2 and 4254 jobs at South Caldecotte included.

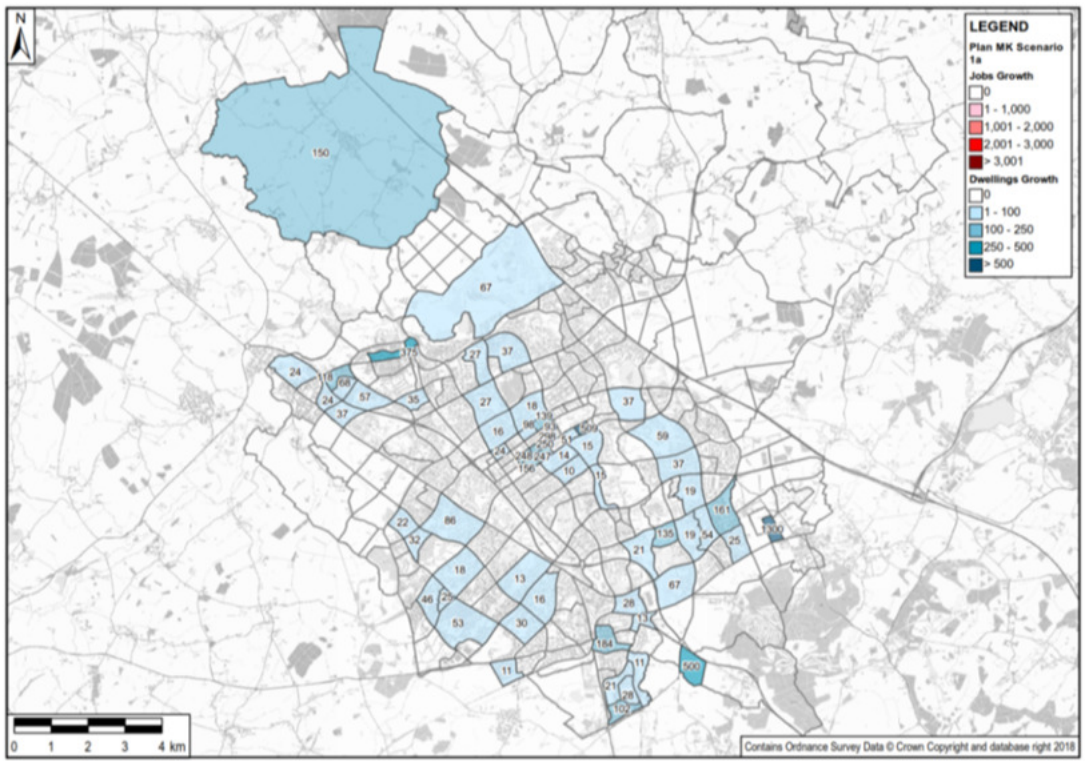

Figure 3. Plan:MK S1N: Additional Dwellings and Jobs Growth to 2031

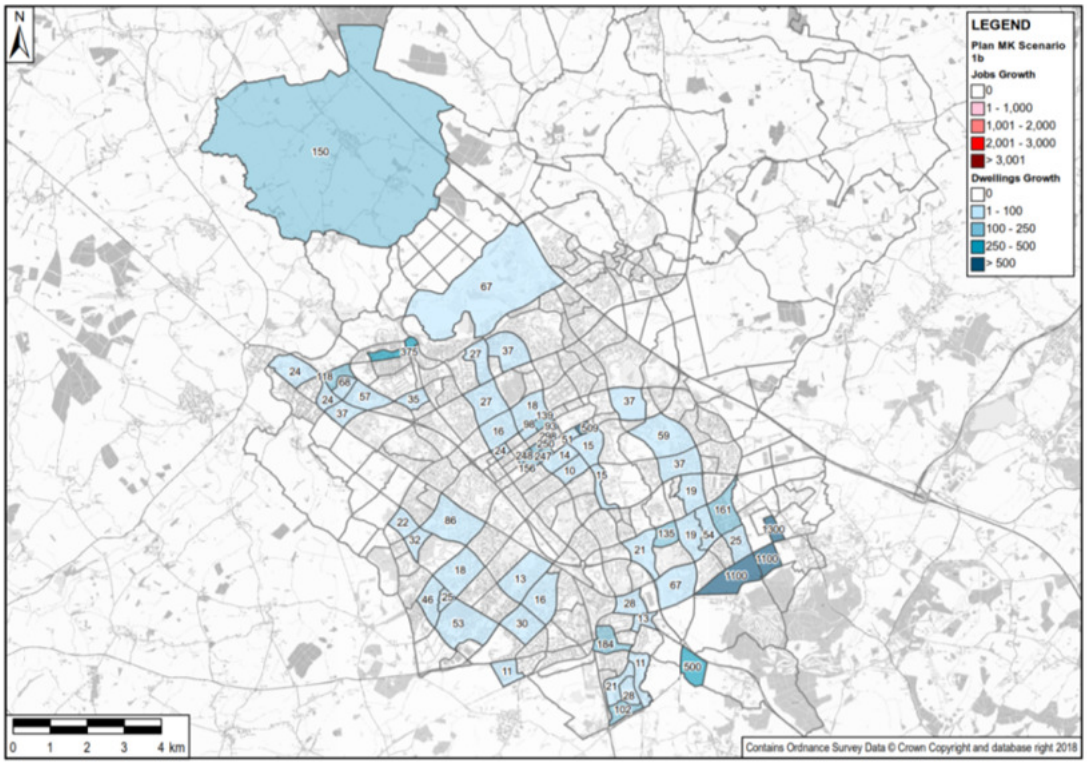

Figure 4. Plan:MK S1N+SE: Additional Dwellings and Jobs Growth to 2031

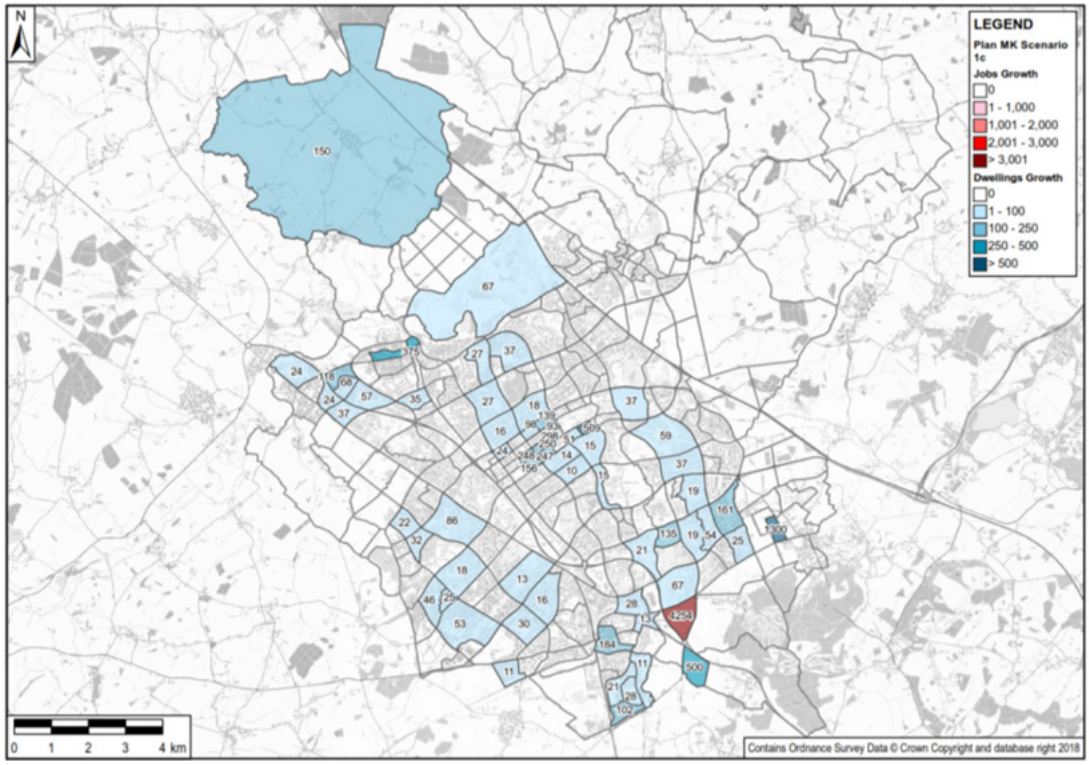

Figure 5. Plan:MK S1N+SC: Additional Dwellings and Jobs Growth to 2031

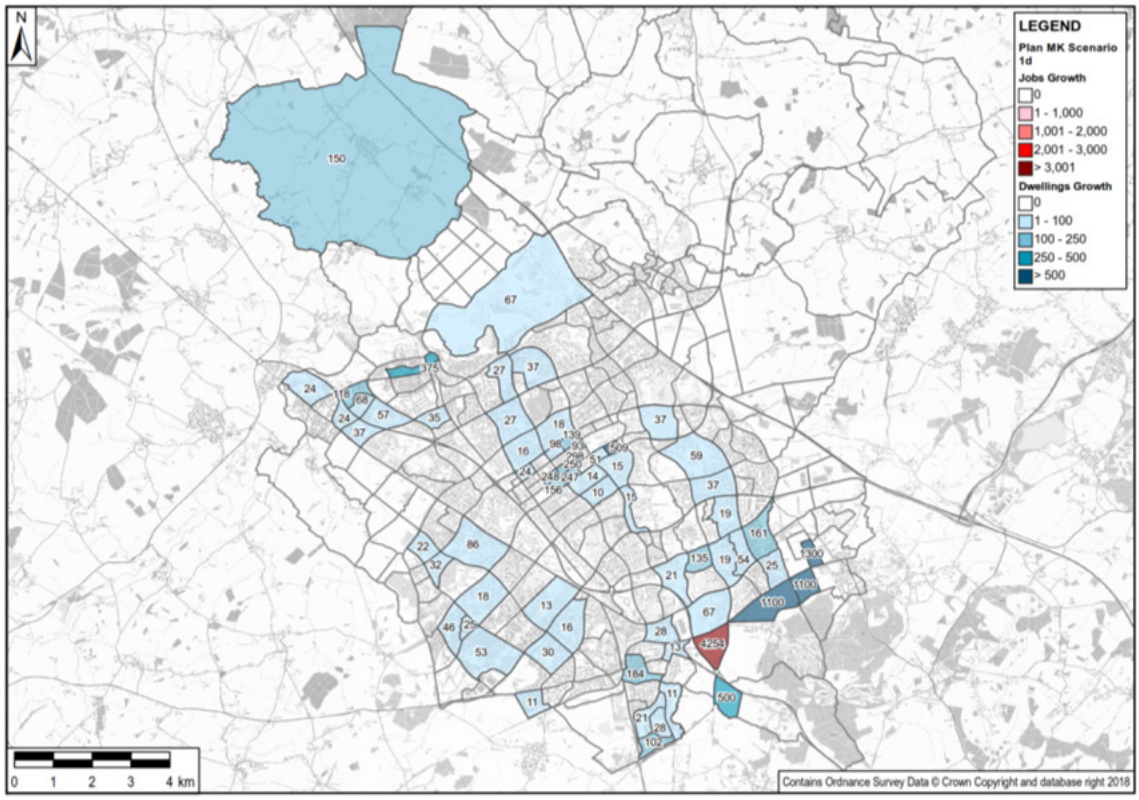

Figure 6. Plan:MK S1N+Both: Additional Dwellings and Jobs Growth to 2031

SEMK Testing - Networks

Revised Reference Case v2

Further edits were made to the Revised Reference Case to create the Revised Reference Case v2 (RRCv2), on which the different supply scenarios would be based. The RRCv2 included the following updates:

Levante Gate Access

As the Levante Gate development was to be included in the tests, the proposed development access was coded as a fourth arm on the signalised junction with the A4146 / Eaton leys access as shown in Figure 7.

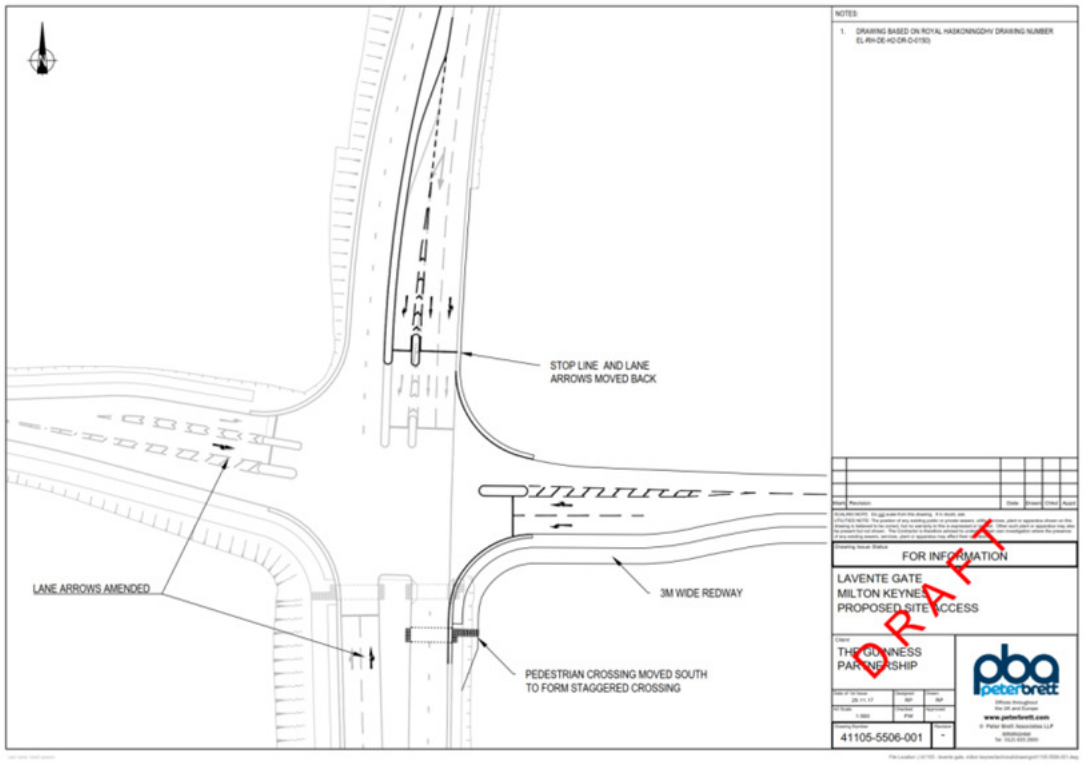

Figure 7. Levante Gate Access

H10 Extension

The H10 extension coding was updated using a newly supplied layout as presented in Figure 8. The most notable change is the Bletcham Way/ Gregories Dr./Britten Gr. roundabout is replaced by two priority junctions.

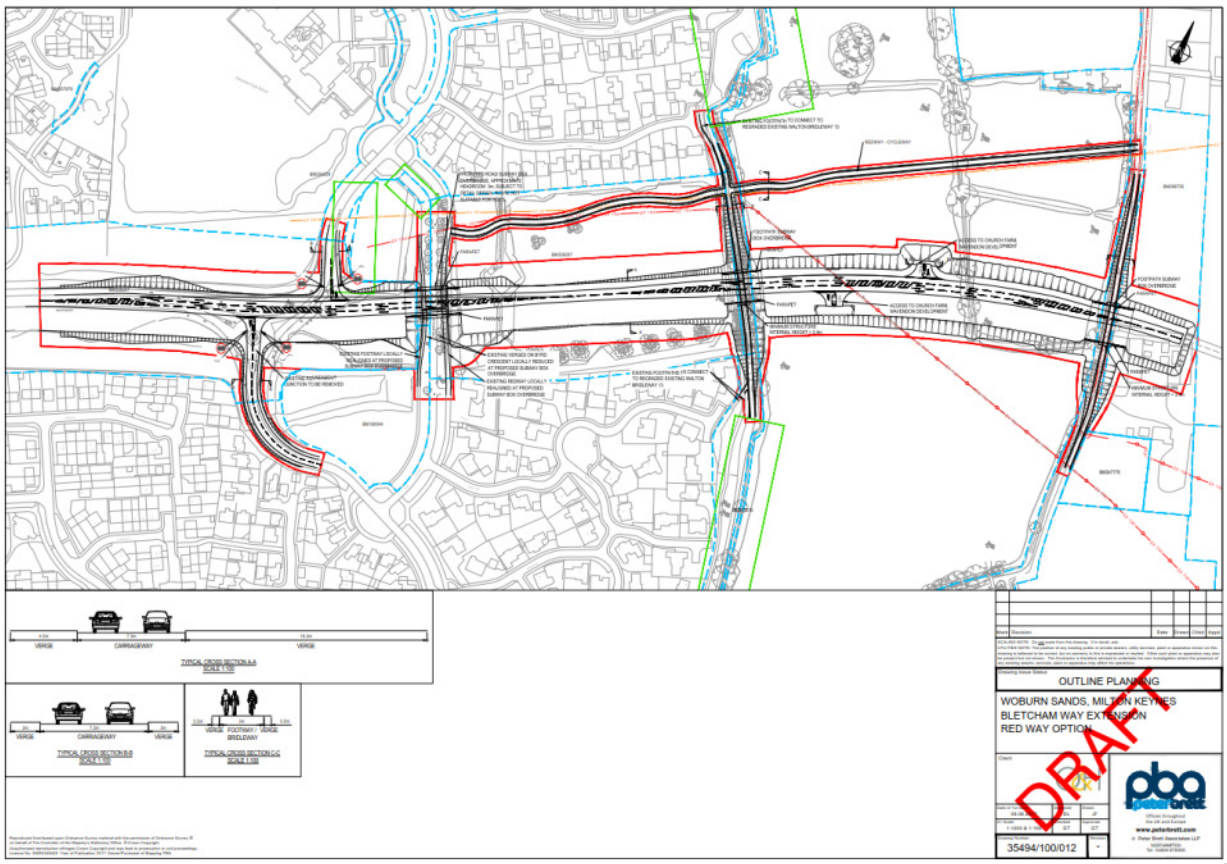

Figure 8. H10 grid road extension

Red Bull Access

The proposed Red Bull access as a forth arm onto Tilbrook Roundabout on Brickhill Street modelled in Plan:MK Scenario 2, 2a and 2b was coded into RRC v2.

Bow Brickhill Crossing

The coding for the section of Brick Hill Street between Station Road and Tilbrook Roundabout was updated to model the two lanes in the northbound direction.

Additional Network Nodes

Additional nodes were included to aid comparisons between Scenarios.

No Bridge Network

The 'No bridge' networks were the RRCv2 network which included the H10 extension, with accesses coded into the network for any additional demand, i.e. the South Caldecotte access via a roundabout onto Brickhill Street and the access roads through the SEMK2 with a 50mph speed limit on the spine road as shown in Figure 9.

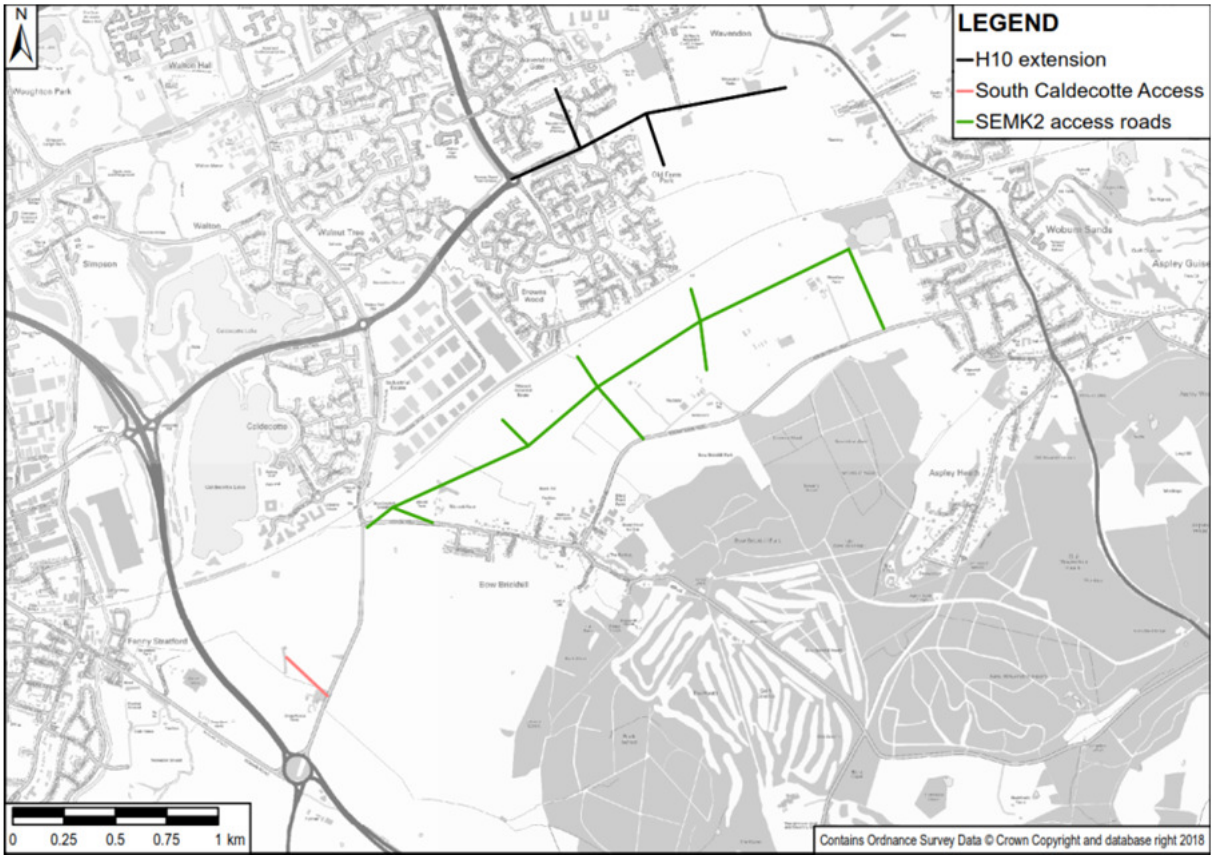

Figure 9. Proposed 'No Bridge' Network

Eastern Bridge

The eastern bridge connected the end of the H10 extension with Woburn Sands Road with a speed limit of 50mph. As with the no bridge scenarios accesses were included for any additional demand, but to facilitate use of the bridge a bypass around Bow Brickhill using part of the SEMK2 access road but with a 60mph speed limit was also included in the scenario without SEMK1 development as shown in Figure 10.

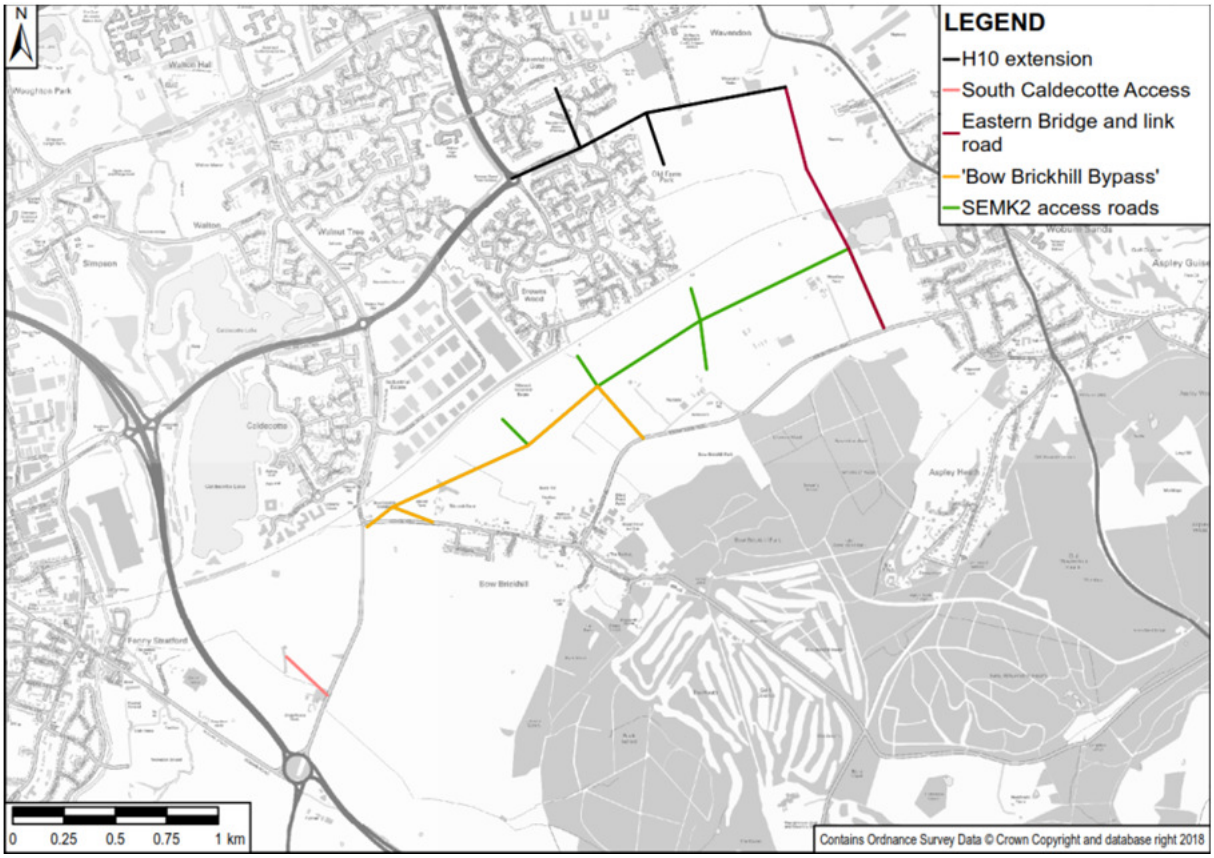

Figure 10. Proposed Eastern Bridge Network

Western Bridge

The Western bridge is proposed to extend V11 Tongwell Street down into the SEMK2 site and onto Woburn Sands Road with a 60mph speed limit on the new link. As with the eastern bridge scenarios, accesses were included for any additional demand as well as the bypass around Bow Brickhill in the scenario without SEMK1 development as shown in Figure 11.

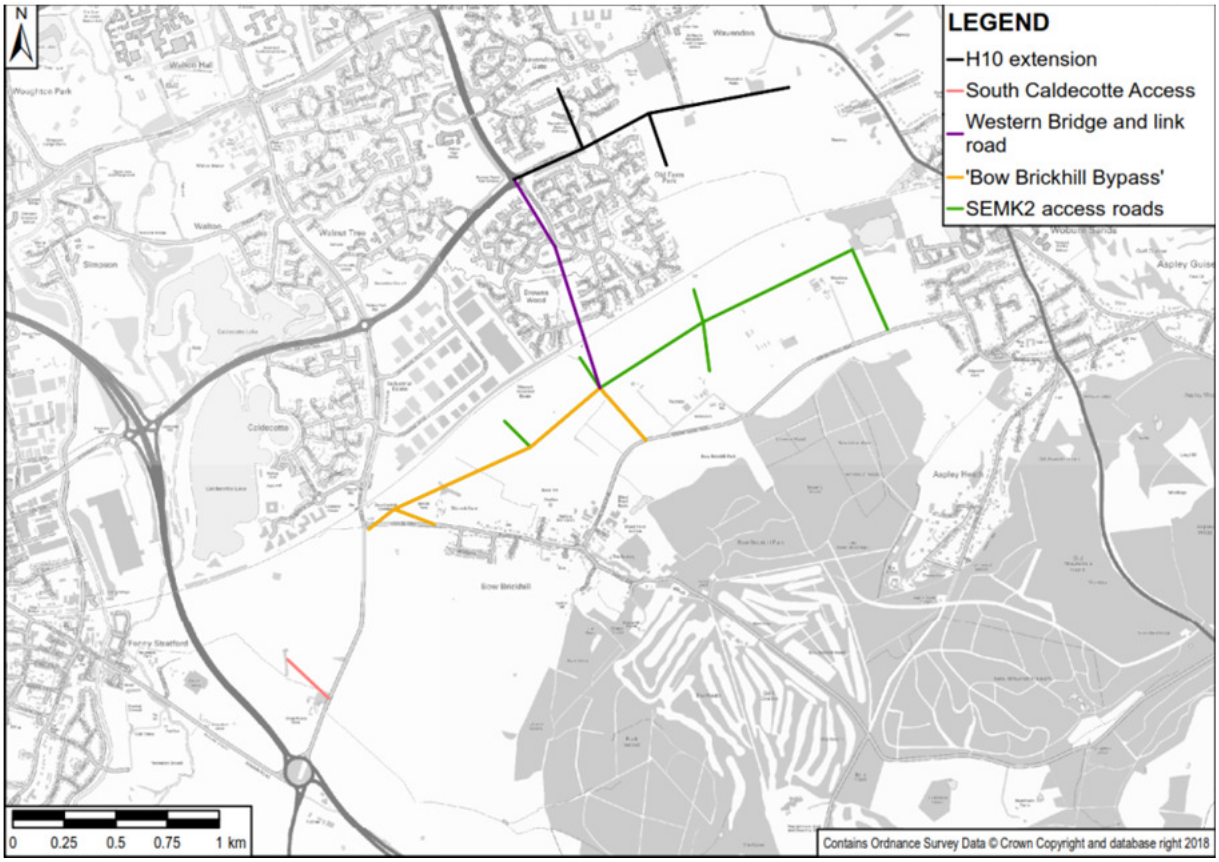

Figure 11. Proposed Western Bridge Network

Summary of demand and supply scenarios

A summary of the network and demand scenarios which includes the RRCv2 is presented in Table 3.

Table 3 Summary of network and demand Scenarios

Supply \ Demand		S1N	S1N+SE	S1N+SC	S1N+both
No Bridge	RRC v2	y	n/a	n/a	n/a
	RRC v2 + SEMK2 Access	n/a	y	n/a	n/a
	RRC v2 + SC access	n/a	n/a	y	n/a
	RRC v2 + SEMK2 Access + SC access	n/a	n/a	n/a	y
On-line Bridge	*RRCv2 + On-line Bridge + 'Bow Brickhill Bypass'*	*Pending highways feasibility check*			
	RRCv2 + On-line Bridge + 'Bow Brickhill Bypass' + remaining SEMK2 access				
	RRCv2 + On-line Bridge + 'Bow Brickhill Bypass' + SC access				
	RRCv2 + On-line Bridge + 'Bow Brickhill Bypass' + remaining SEMK2 access + SC access				
Eastern Bridge	RRCv2 + Eastern Bridge + 'Bow Brickhill Bypass' + remaining SEMK2 access	n/a	y	n/a	n/a
	RRCv2 + Eastern Bridge + 'Bow Brickhill Bypass' + SC access	n/a	n/a	y	n/a
	RRCv2 + Eastern Bridge + 'Bow Brickhill Bypass' + remaining SEMK2 access + SC access	n/a	n/a	n/a	y
Western Bridge	RRCv2 + Western Bridge + 'Bow Brickhill Bypass' + remaining SEMK2 access	n/a	y	n/a	n/a
	RRCv2 + Western Bridge + 'Bow Brickhill Bypass' + SC access	n/a	n/a	y	n/a
	RRCv2 + Western Bridge + 'Bow Brickhill Bypass' + remaining SEMK2 access + SC access	n/a	n/a	n/a	y

The 'No Bridge' scenarios were run as 'Do Minimum' models with the demand model pivoting off the base year costs. The Eastern Bridge and Western Bridge scenarios were run through the demand model as 'Do Something' models, pivoting off the costs from the 'No Bridge' networks with the same demand.

Impacts of S1N demand over the Reference Case

This section shows comparisons of S1N - No Bridge test against the Reference Case (RRCv2), which shows the impacts of the additional demand over and above the committed growth. The flow difference is plotted as bandwidths by direction, with green indicating an increase in flow between the Reference Case and S1N, and blue a decrease.

The most notable impact of S1N was as a result of the 1300 dwellings in SEMK1 which loads onto the H10 extension. In the AM peak the majority of this traffic travelled up V11 Tongwell Street with around a third continuing along H10. There was a reduction in traffic through Bow Brickhill with a reduction in modelled flow of 76 PCU on Station Road and 45 PCU travelling northbound across Bow Brickhill Level crossing. In the PM peak due to existing traffic taking alternative routes the main impact is along the H10 extension itself. The impacts in the inter-peak are less significant.

The inclusion of the 500 dwellings at Levante Gate has increased traffic at Kelly's Kitchen Roundabout but as with SEMK1 the additional flow is dispersed across the road network.

The flow change between S1N - No Bridge and the Reference Case are shown in Figure 12 to Figure 14.

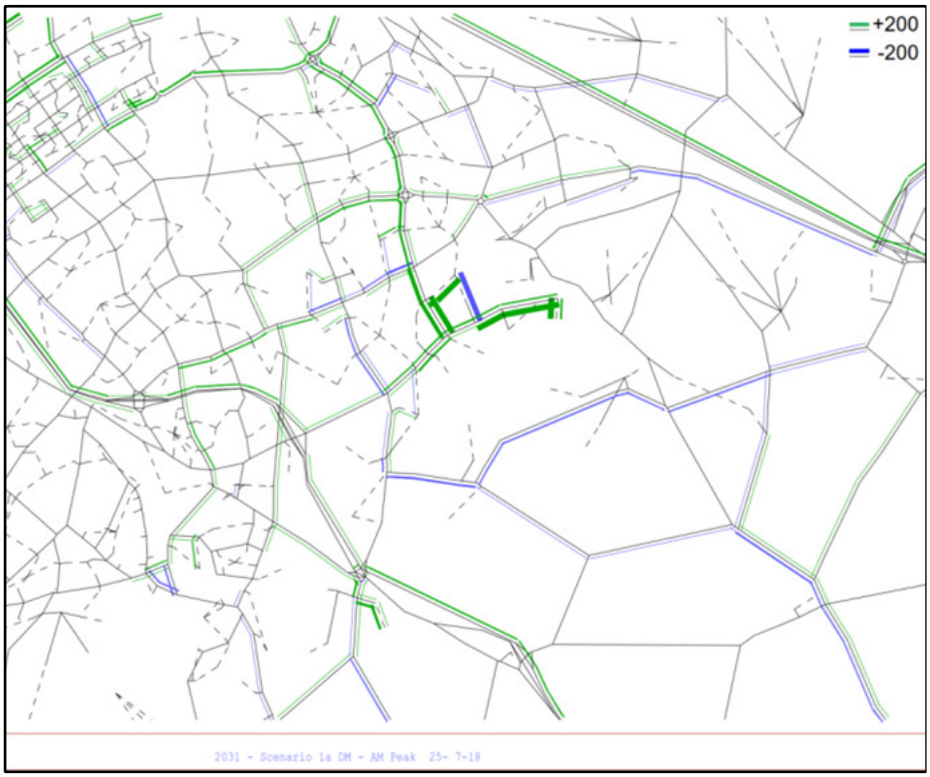

Figure 12. Change in modelled flow, S1N - No Bridge less Reference Case, AM peak

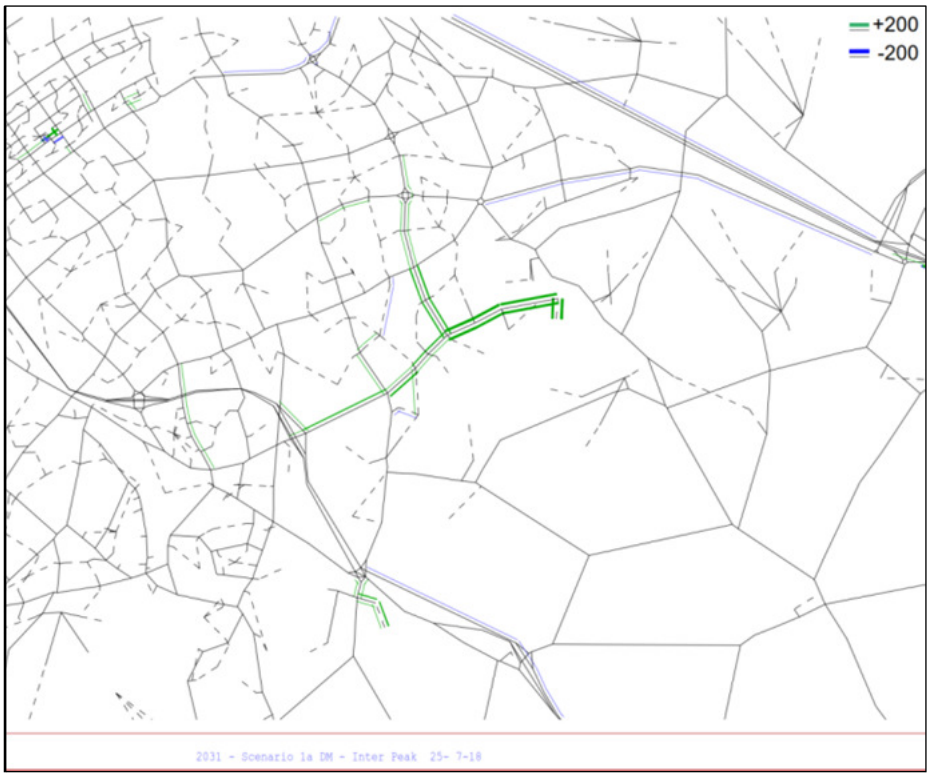

Figure 13. Change in modelled flow, S1N - No Bridge less Reference Case, Inter-peak

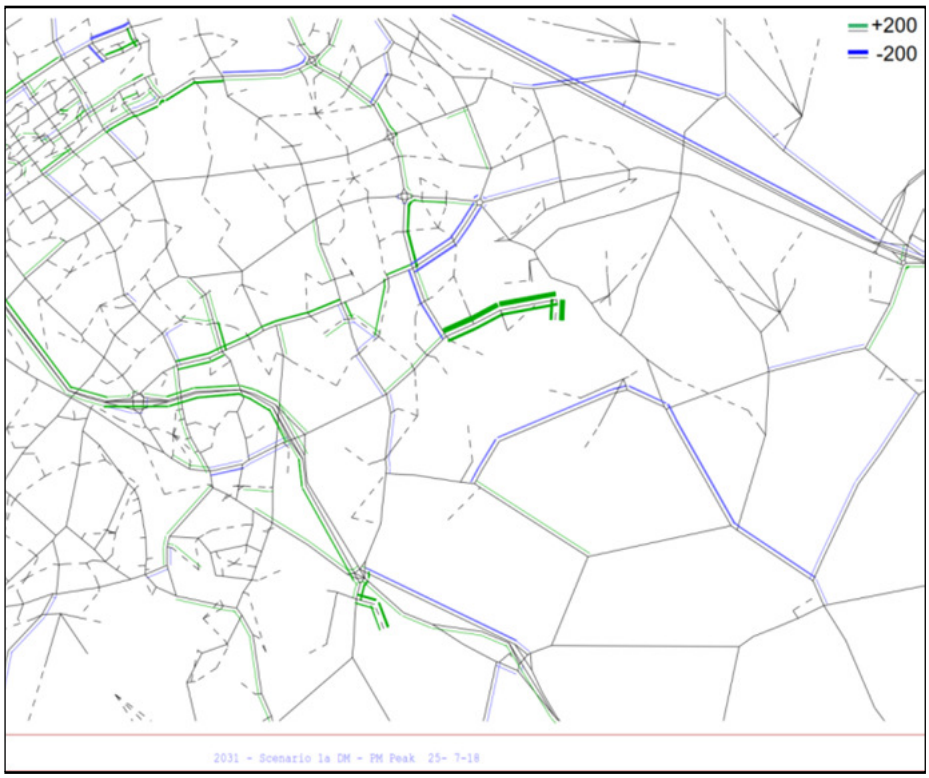

Figure 14. Change in modelled flow, S1N - No Bridge less Reference Case, PM peak

The only notable modelled impact of S1N - No Bridge over the Reference Case, in terms of delay was at Brown's Wood Roundabout, where in the AM peak the modelled delay increased by 2 minutes on the northbound approach and about 2.5 minutes on the westbound approach. Despite the additional traffic from Levante gate there was little modelled impact in terms of delay at Kelly's Kitchen Roundabout. The change in modelled delay between S1N - No Bridge and the Reference Case is shown in Figure 15 to Figure 17.

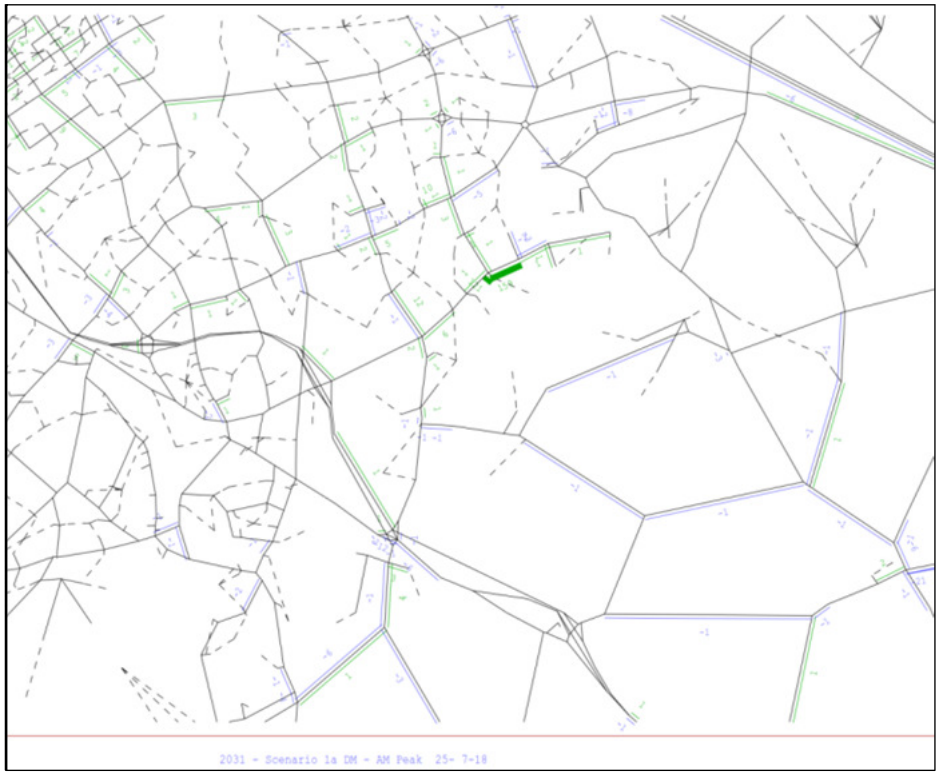

Figure 15. Change in modelled delay, S1N - No Bridge less Reference Case, AM peak

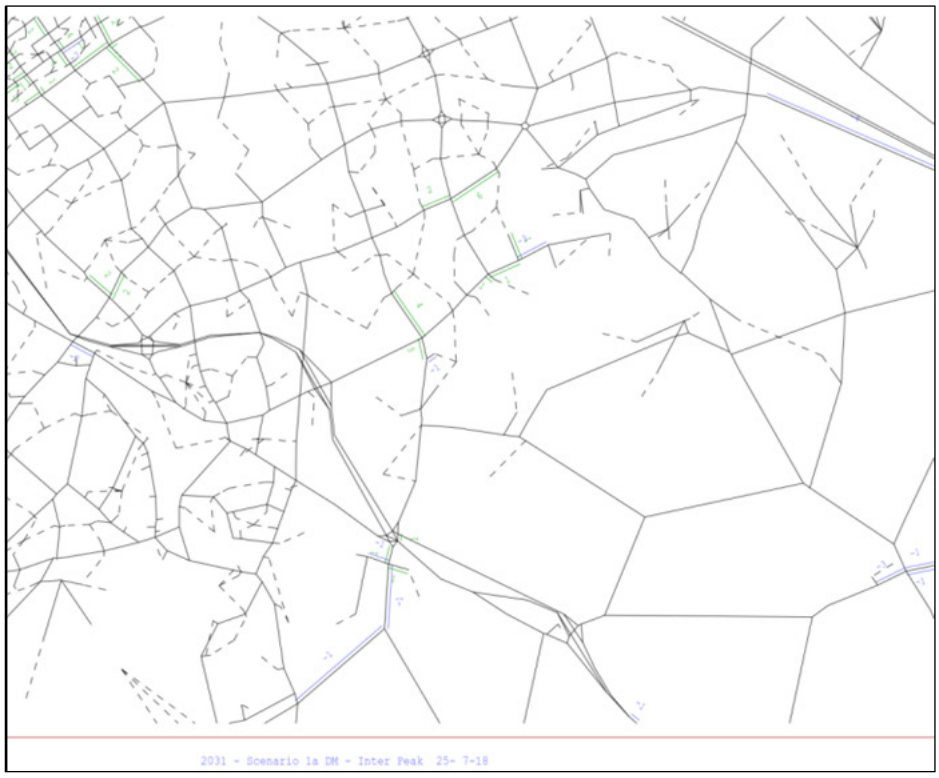

Figure 16. Change in modelled delay, S1N - No Bridge less Reference Case, Inter-Peak

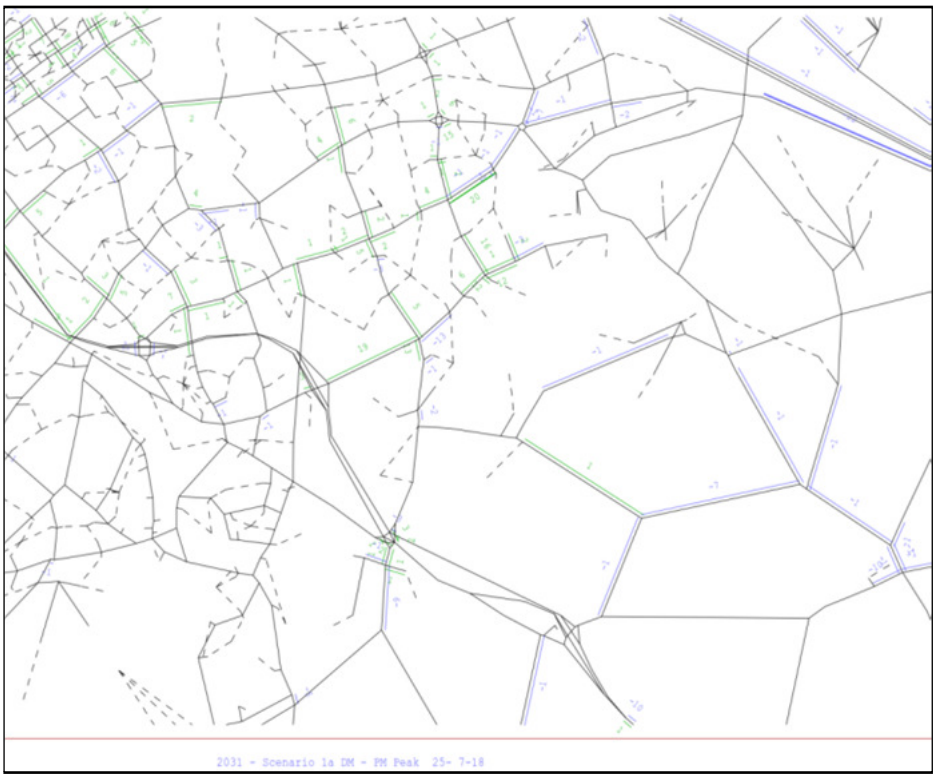

Figure 17. Change in modelled delay, S1N - No Bridge less Reference Case, PM peak

Impact of SEMK testing on Traffic flows across the railway line

Comparisons of flows across the railway line between Bow Brickhill and Woburn Sands for each model period and direction are shown in Table 4 to Table 9.

Total traffic flow crossing the railway

Although the percentage increase in flows is greater in the opposite direction to the peak tidal flows, in terms of absolute numbers S1N+SE had the biggest impact in the direction of tidal flow. S1N+Both had similar impact in terms of absolute numbers in both directions. In terms of congestion, it was the tidal flow direction that is most significant.

In terms of the tidal flows, northbound in the AM peak and southbound in the PM Peak, the South Caldecotte development without SEMK2 had minimal impact. For example in the no bridge scenario, total flows across the railway increased in the direction of tidal flow by 3% in the AM and 4% in the PM peak when SEMK2 was included.

The increase in flow across the railway line in the with bridge scenarios is higher than the same demand scenario with no bridge. Although S1N+SC had little impact on flows crossing the railway in the No Bridge test there is 4% increase in flow in the tidal direction in the AM and PM peaks which suggests a bridge would attract some traffic from elsewhere in the network. The largest increases for South Caldecotte as in the No Bridge test were in the opposite direction to the tidal flow.

The growth in traffic crossing the railway from S1N - No Bridge was generally comparable between the Eastern and Western Bridge tests. In the AM peak the northbound tidal flow increase is 2-3% higher with the western bridge than the eastern bridge. This was likely to be because of the congestion being worse in the latter.

The bridge also allowed some re-assignment of traffic across the network, with a small reduction in flows on the A5 and across both Bow Brickhill and Woburn Sands level crossings.

Flow using Bow Brickhill Crossing

In the S1N - No bridge test the AM northbound flow across the Bow Brickhill crossing was 870 PCU. The largest AM northbound modelled flow across Bow Brickhill level crossing out of the No Bridge tests of 921 PCU was in the S1N+Both scenario. In S1N - No Bridge the PM southbound flow across Bow Brickhill level crossing was 929 PCU. The largest southbound PM flow in the No bridge tests; 984 PCU was in the S1N+SE scenario.

The bridge takes flows away from the Bow Brickhill Crossing, for example in S1N+Both the AM peak northbound flow at Bow Brickhill crossing drops from 921 PCU with no bridge to 889 PCU and 844 PCU with the eastern and western bridges respectively. Similarly in the PM peak, the southbound flows decrease from 950 PCU with no bridge to 794 PCU with the eastern bridge and down to 649 PCU with the western bridge.

Flow using the new Bridge

The modelled traffic flows using the bridge were highest in the PM peak in both directions, with the western bridge carrying more traffic than the eastern. Looking at tidal flows, in S1N+Both in the PM southbound direction the western bridge carried a modelled flow of 798 PCU. In the AM northbound direction the bridge takes just half this, 400 PCU. In the inter-peak there was a flow of 518 northbound; while in the PM peak there was a northbound flow of 683 PCU. This pattern suggests the congestion and long delays at Brown's Wood Roundabout in the AM peak was discouraging traffic from using the bridge.

Table 4. Northbound traffic flows across the Marston Vale railway (PCU) - AM Peak

Scenario	A5 railway bridge	Bow Brickhill Level Crossing	New railway bridge	Woburn Sands Level Crossing	Total	Change in total flow from S1N, No bridge	
						Abs.	%
S1N, No Bridge	2928	870	n/a	435	**4233**	n/a	n/a
S1N+SE, No Bridge	2952	868	n/a	537	**4357**	124	3%
S1N+SC, No Bridge	2905	876	n/a	437	**4218**	-15	0%
S1N+Both, No Bridge	2927	921	n/a	517	**4365**	132	3%
S1N+SE, Eastern Bridge	2955	824	264	459	**4502**	268	6%
S1N+SC, Eastern Bridge	2905	775	194	423	**4297**	64	2%
S1N+Both, Eastern Bridge	2931	889	266	452	**4538**	306	7%
S1N+SE, Western Bridge	2947	809	397	447	**4600**	367	9%
S1N+SC, Western Bridge	2875	745	348	427	**4395**	162	4%
S1N+Both, Western Bridge	2931	844	400	452	**4627**	394	9%

Table 5. Northbound traffic flows across the Marston Vale railway (PCU) - Inter-Peak

Scenario	A5 railway bridge	Bow Brickhill Level Crossing	New railway bridge	Woburn Sands Level Crossing	Total	Change in total flow from S1N, No bridge	
						Abs.	%
S1N, No Bridge	1737	423	n/a	211	**2370**	n/a	n/a
S1N+SE, No Bridge	1755	479	n/a	224	**2457**	87	4%
S1N+SC, No Bridge	1756	456	n/a	221	**2433**	63	3%
S1N+Both, No Bridge	1798	484	n/a	234	**2516**	146	6%
S1N+SE, Eastern Bridge	1725	318	358	157	**2559**	188	8%
S1N+SC, Eastern Bridge	1742	304	326	152	**2524**	154	6%
S1N+Both, Eastern Bridge	1732	369	363	157	**2622**	251	11%
S1N+SE, Western Bridge	1714	194	515	151	**2573**	202	9%
S1N+SC, Western Bridge	1729	225	450	140	**2544**	174	7%
S1N+Both, Western Bridge	1723	250	518	153	**2643**	273	12%

Table 6. Northbound traffic flows across the Marston Vale railway (PCU) - PM Peak

Scenario	A5 railway bridge	Bow Brickhill Level Crossing	New railway bridge	Woburn Sands Level Crossing	Total	Change in total flow from S1N, No bridge	
						Abs.	%
S1N, No Bridge	2021	302	n/a	335	**2658**	n/a	n/a
S1N+SE, No Bridge	2062	339	n/a	330	**2731**	73	3%
S1N+SC, No Bridge	2131	352	n/a	349	**2832**	174	7%
S1N+Both, No Bridge	2161	389	n/a	351	**2901**	243	9%
S1N+SE, Eastern Bridge	1902	242	525	231	**2900**	242	9%
S1N+SC, Eastern Bridge	1982	311	494	238	**3025**	367	14%
S1N+Both, Eastern Bridge	2000	340	540	241	**3121**	463	17%
S1N+SE, Western Bridge	1846	218	656	218	**2938**	280	11%
S1N+SC, Western Bridge	1963	241	573	233	**3010**	352	13%
S1N+Both, Western Bridge	1932	258	683	242	**3116**	458	17%

Table 7. Southbound traffic flows across the Marston Vale railway (PCU) - AM Peak

Scenario	A5 railway bridge	Bow Brickhill Level Crossing	New railway bridge	Woburn Sands Level Crossing	Total	Change in total flow from S1N, No bridge	
						Abs.	%
S1N, No Bridge	1379	464	n/a	355	**2198**	n/a	n/a
S1N+SE, No Bridge	1453	423	n/a	353	**2229**	31	1%
S1N+SC, No Bridge	1548	500	n/a	404	**2452**	254	12%
S1N+Both, No Bridge	1545	530	n/a	387	**2462**	264	12%
S1N+SE, Eastern Bridge	1393	343	379	298	**2413**	215	10%
S1N+SC, Eastern Bridge	1489	432	341	309	**2571**	373	17%
S1N+Both, Eastern Bridge	1497	468	372	310	**2648**	450	20%
S1N+SE, Western Bridge	1332	349	426	298	**2405**	207	9%
S1N+SC, Western Bridge	1429	377	433	297	**2536**	338	15%
S1N+Both, Western Bridge	1486	429	433	310	**2658**	460	21%

Table 8. Southbound traffic flows across the Marston Vale railway (PCU) - Inter-Peak

Scenario	A5 railway bridge	Bow Brickhill Level Crossing	New railway bridge	Woburn Sands Level Crossing	Total	Change in total flow from S1N, No bridge	
						Abs.	%
S1N, No Bridge	1820	495	n/a	221	**2535**	n/a	n/a
S1N+SE, No Bridge	1837	543	n/a	229	**2609**	74	3%
S1N+SC, No Bridge	1873	488	n/a	222	**2583**	48	2%
S1N+Both, No Bridge	1895	534	n/a	230	**2658**	123	5%
S1N+SE, Eastern Bridge	1737	457	367	152	**2713**	178	7%
S1N+SC, Eastern Bridge	1802	371	348	143	**2663**	128	5%
S1N+Both, Eastern Bridge	1819	417	365	154	**2755**	220	9%
S1N+SE, Western Bridge	1678	405	472	157	**2712**	177	7%
S1N+SC, Western Bridge	1777	336	389	154	**2656**	121	5%
S1N+Both, Western Bridge	1788	344	473	158	**2763**	228	9%

Table 9. Southbound traffic flows across the Marston Vale railway (PCU) - PM Peak

Scenario	A5 railway bridge	Bow Brickhill Level Crossing	New railway bridge	Woburn Sands Level Crossing	Total	Change in total flow from S1N, No bridge	
						Abs.	%
S1N, No Bridge	2962	929	n/a	540	**4431**	n/a	n/a
S1N+SE, No Bridge	3061	984	n/a	564	**4609**	178	4%
S1N+SC, No Bridge	2989	912	n/a	545	**4446**	15	0%
S1N+Both, No Bridge	3086	950	n/a	572	**4608**	177	4%
S1N+SE, Eastern Bridge	2945	790	643	462	**4840**	409	9%
S1N+SC, Eastern Bridge	2899	748	586	425	**4657**	226	5%
S1N+Both, Eastern Bridge	3007	794	645	457	**4903**	472	11%
S1N+SE, Western Bridge	2872	681	801	473	**4828**	397	9%
S1N+SC, Western Bridge	2861	641	637	464	**4603**	172	4%
S1N+Both, Western Bridge	2934	649	798	465	**4846**	415	9%

Comparison of Additional Demand Scenarios

This section compares the No Bridge scenarios that include the additional demand on top of S1N with the No Bridge S1N scenario. These comparisons show the impacts of the South Caldecotte Site, SEMK2 development and their site access roads on the SEMK road network. Due to the lesser impacts in the Inter-peak this section focusses on the AM and PM peaks.

It is important to note that no comparisons are plotted on new links added as part of the SEMK2 development.

Scenario 1N+SE against Scenario 1N

As shown by Figure 18 and Figure 19, the largest change in flow was along the eastern section of Station Road and Woburn Sands Road through Brickhill with through traffic transferring to the new development road in both directions in the AM Peak, and eastbound (the tidal direction) in the PM Peak. In the AM peak there is a reduction of around 220-260 PCU's westbound whilst in the PM peak there is forecast reduction of around 200-300 PCU's eastbound.

In the AM peak the largest increase was on the short western section of Station Road between the western access to new development road and Brickhill Street with an increase of 214 PCU. There was an increase of around 100 PCU southbound on Brickhill Street between Station Road and Kelly's Kitchen roundabout and northbound along Watling Street. There was a similar increase northbound on Newport Road through Woburn Sands also. Due to the re-assignment of existing traffic there was little impact northbound across Bow Brickhill level crossing.

In the PM peak mirroring the AM peak the largest increase was on Station Road between Brickhill Street and the development access road eastbound towards the SEMK2 site with an increase of around 250 PCU. There was an increase of around 70 PCU southbound on Watling Street and almost 150 PCU northbound on Brickhill Street between Kelly's Kitchen Roundabout and Station Road. Unlike the AM peak there is little change on Newport Road but there is more of an impact on the A5 between H10 and Kelly's Kitchen Roundabout and on Brickhill Street north of Station Road. This is likely to be because of the congestion issues around SEMK being less severe in the PM peak, so traffic is not having to re-route around the area.

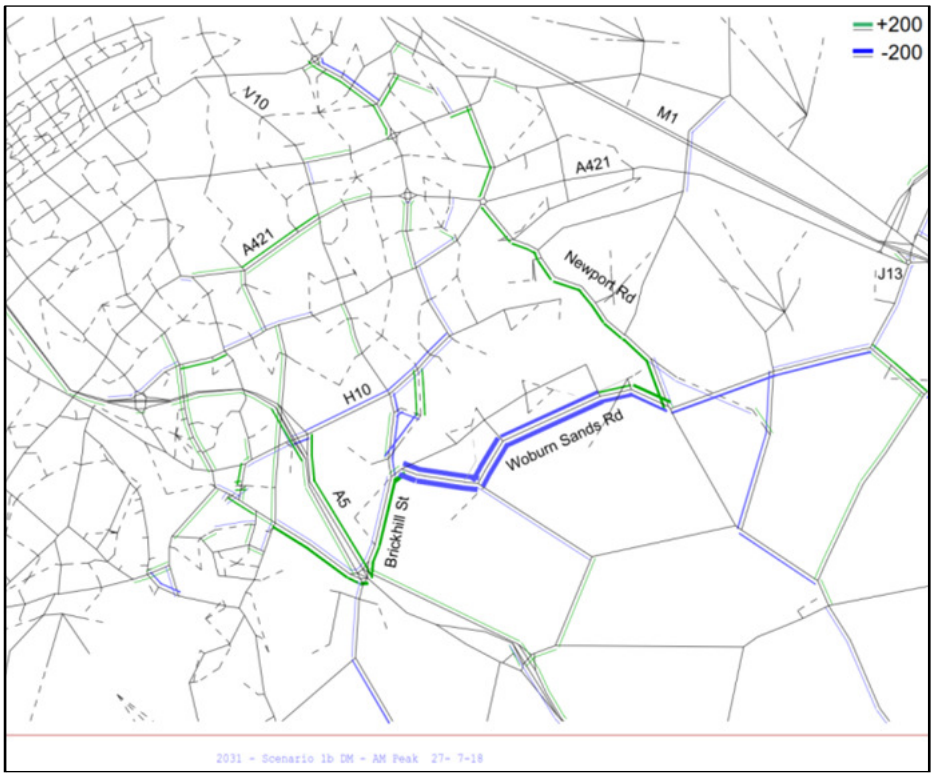

Figure 18. Change in modelled flow, S1N+SE less S1N, AM peak

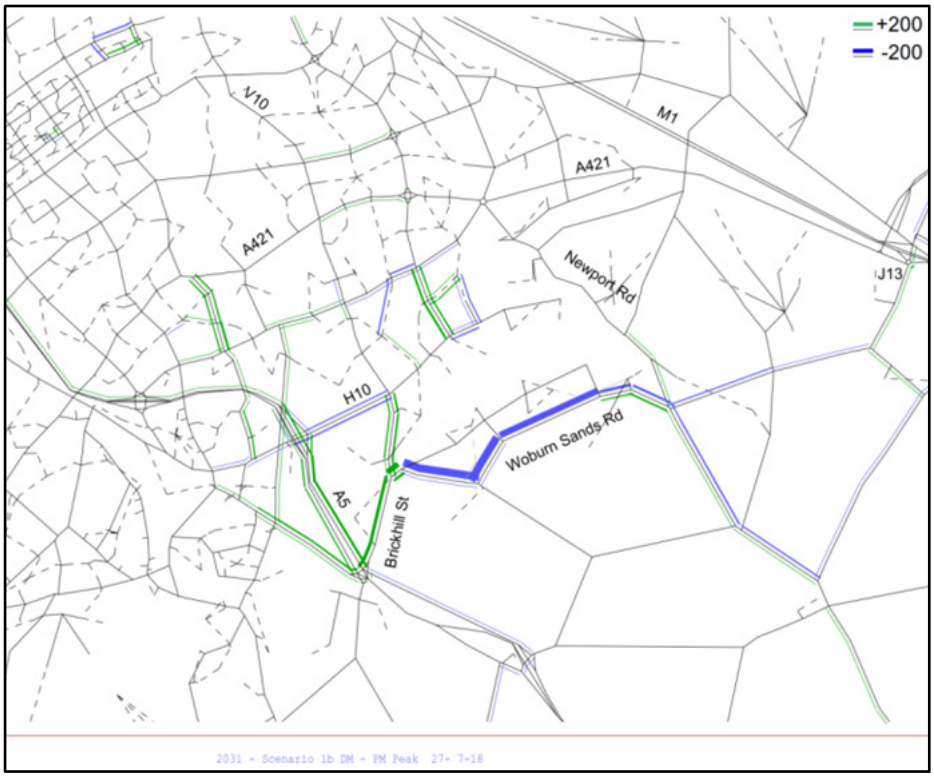

Figure 19. Change in modelled flow, S1N+SE less S1N, PM peak

Scenario 1N+SC against Scenario 1N

As shown by Figure 20 and Figure 21 the impacts of South Caldecotte jobs site are less apparent than those of SEMK2. Most of the additional modelled trips approach South Caldecotte in the AM peak from Kelly's Kitchen roundabout with an additional flow of 267 PCU northbound from Kelly's Kitchen Roundabout to South Caldecotte. Much of this traffic used the A5 southbound on which flows increased by 169 PCU, before then travelling northbound up Brickhill Street. There was also traffic accessing South Caldecotte by travelling southbound down Brickhill Street but this additional traffic displaced traffic previously using Brickhill Street which is why the flow change is lower. North of Station road there was negligible flow change and south of Station Road there was a small increase of 108 PCU.

In the PM Peak most of the modelled traffic from South Caldecotte headed south to Kelly's Kitchen Roundabout and then northbound along Watling Street and A5. There was only a small increase of 65 PCU along Brickhill Street north of South Caldecotte towards Station Road.

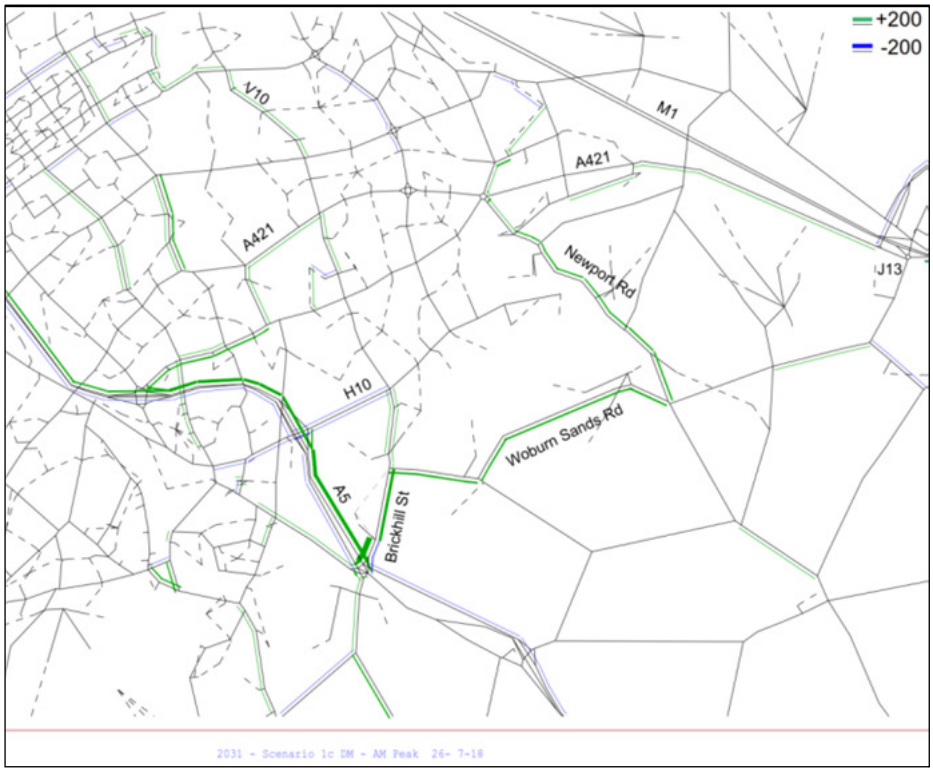

Figure 20. Change in modelled flow, S1N+SC less S1N, AM peak

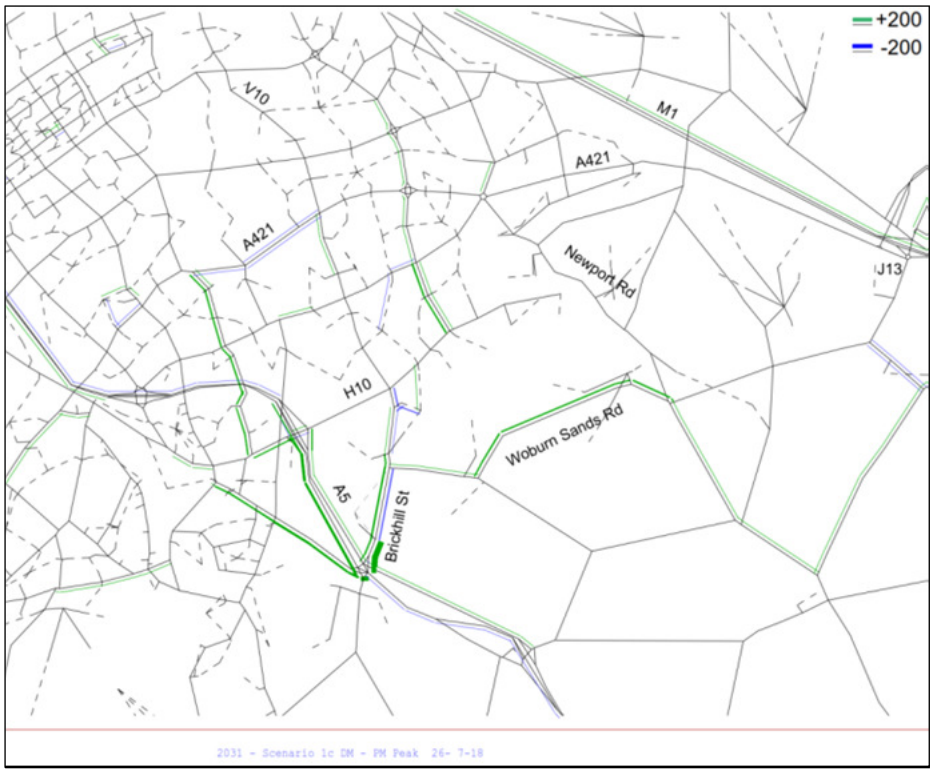

Figure 21. Change in modelled flow, S1N+SC less S1N, PM peak

Scenario 1N+Both against Scenario 1N

The traffic flow difference plots as shown in Figure 22 and Figure 23 for S1N+Both less S1N are a combination of the previous two comparisons. In the AM peak the predominant traffic flows were from SEMK2 travelling towards Milton Keynes and flows travelling to South Caldecotte from Milton Keynes, and vice versa in the PM Peak. As such when both developments were included the flow increases are generally in opposing directions for each site and hence did not conflict with each other.

The exception is along Brickhill Street between South Caldecotte access and Station road where the flows were modelled to increase southbound in the AM and northbound in the PM because of both sites, with the southbound am flow increasing by 269 PCU and northbound PM flow by 235. Despite notable changes in flow along this part of Brickhill Street, the A5 and Watling Street, there is a much smaller change along Brickhill Street north of Station Road and in particular across the level crossing.

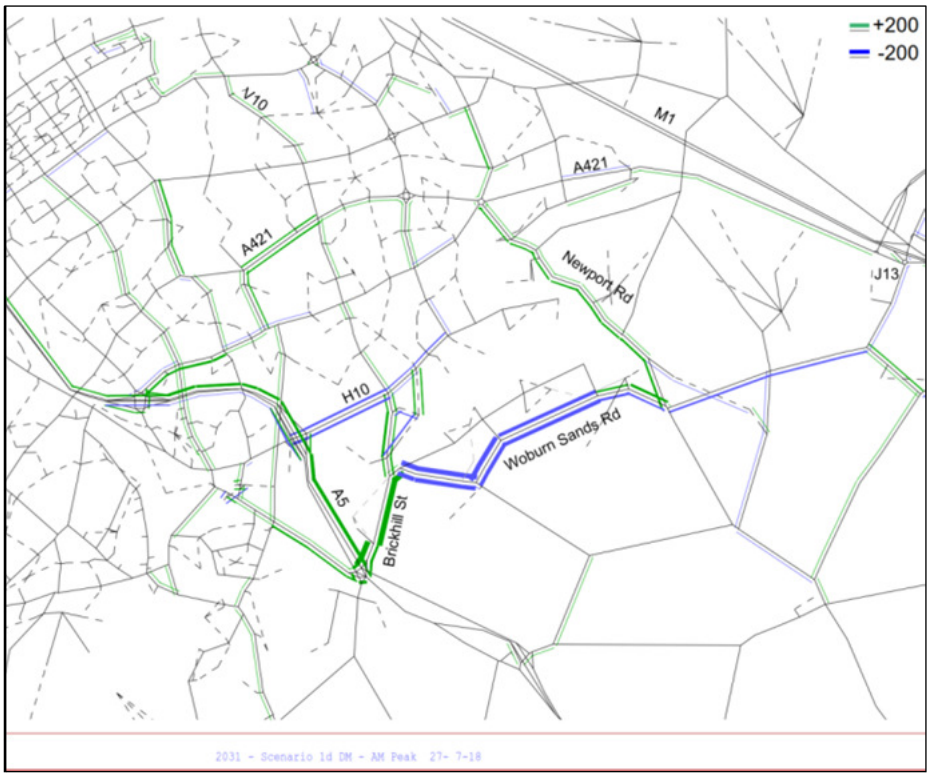

Figure 22. Change in modelled flow, S1N+Both less S1N, AM peak

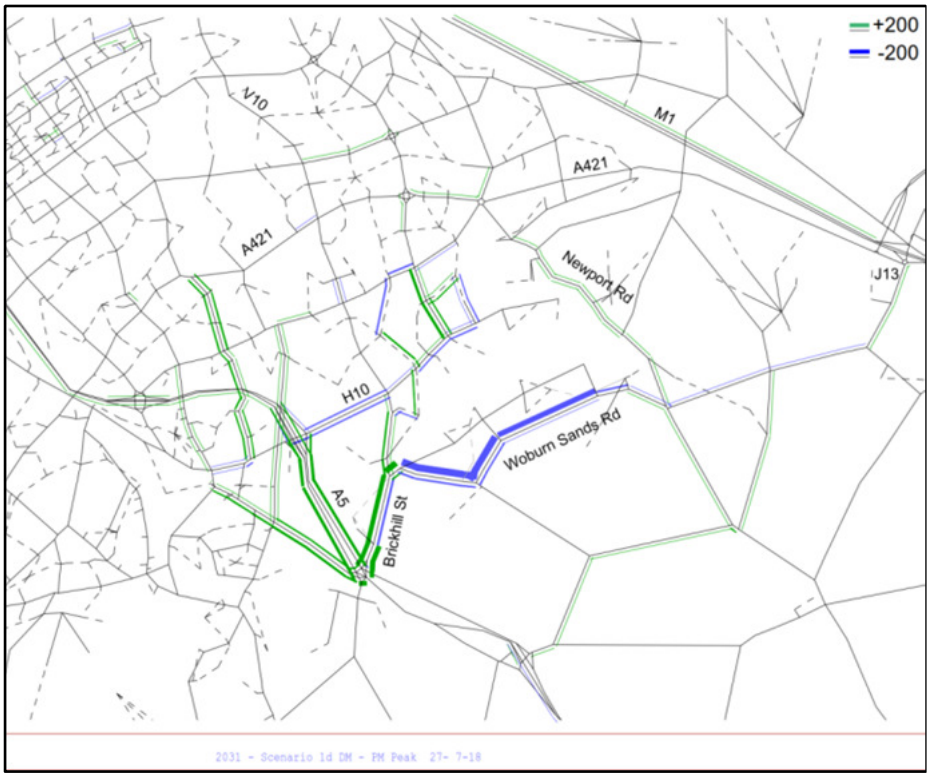

Figure 23. Change in modelled flow, S1N+Both less S1N, PM peak

Impact of the bridges on modelled flow

From the analysis of flows crossing the railway line the biggest impacts were from the S1N+Both demand. As such this section looks in more detail at the impacts of the eastern and western bridges under the S1N+Both scenario.

Eastern Bridge

Flow comparison plots showing the difference in modelled flow between the Eastern Bridge and No bridge scenarios for the S1N+Both demand are shown in Figure 24 to Figure 26.

The largest change in flow was in the AM peak where because of the higher permitted speed along the development road bypassing Bow Brickhill there.

The model showed that the eastern bridge took traffic away from Newport Road north of Woburn Sands as it provided a more direct route towards central Milton Keynes, but also attracted more traffic along A5130 through Woburn Sands itself, particularly in the PM Peak where southbound flow increased by around 200 PCU.

Excluding the redistribution of traffic through Bow Brickhill, the impacts in the inter-peak were similar in magnitude to those of the AM peak. This along with the flow comparisons across the railway line suggests that congestion in the model was impacting the AM flow changes given there were fewer trips in the inter-peak.

In the AM Peak the model showed little impact on A5, there was a small reduction southbound on the section that crosses the railway but north of H10 there was an increase in northbound traffic of a similar magnitude. In the PM peak there was a more notable reduction in flow on the section that crosses the railway with a smaller increase in southbound traffic north of H10.

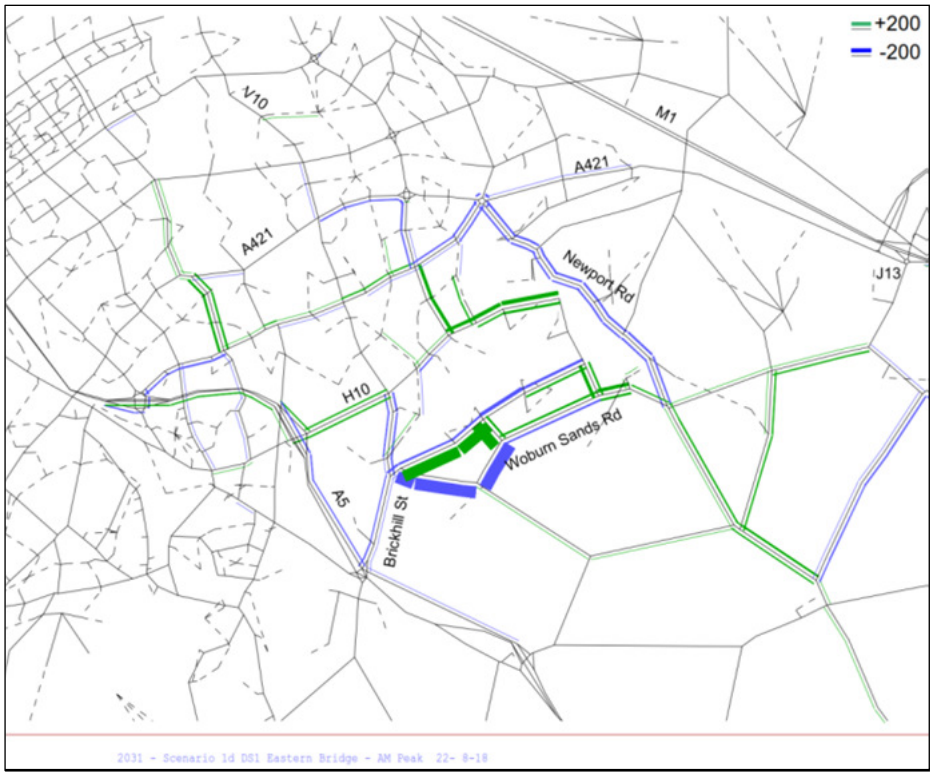

Figure 24 Change in modelled flow, S1N+Both - Eastern Bridge less S1N, AM peak

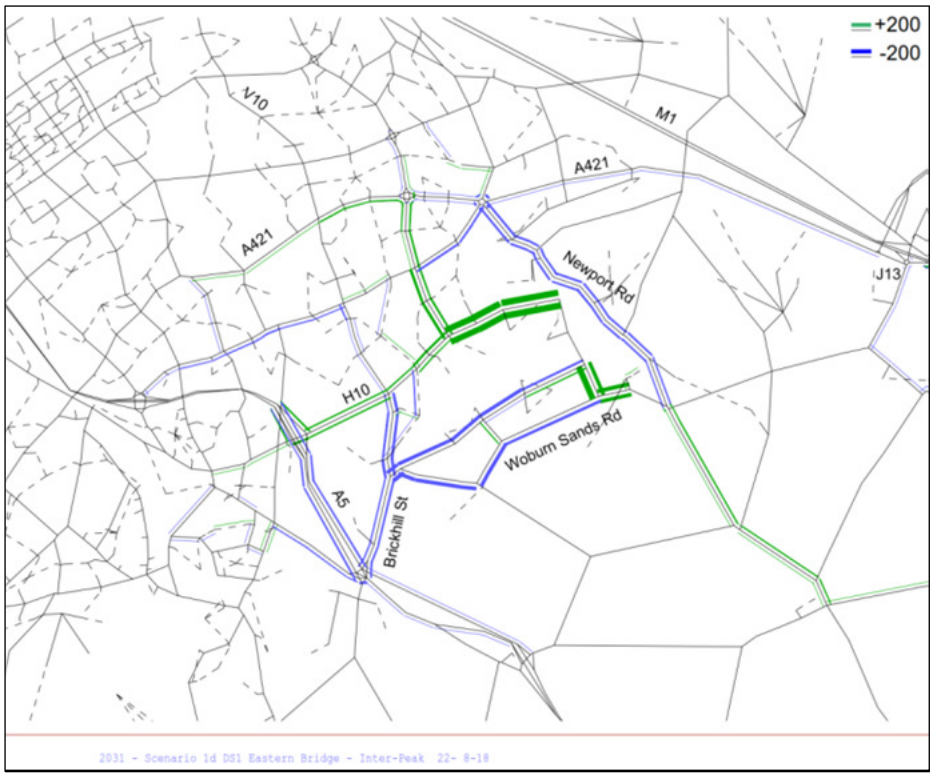

Figure 25. Change in modelled flow, S1N+Both - Eastern Bridge less S1N, Inter-Peak

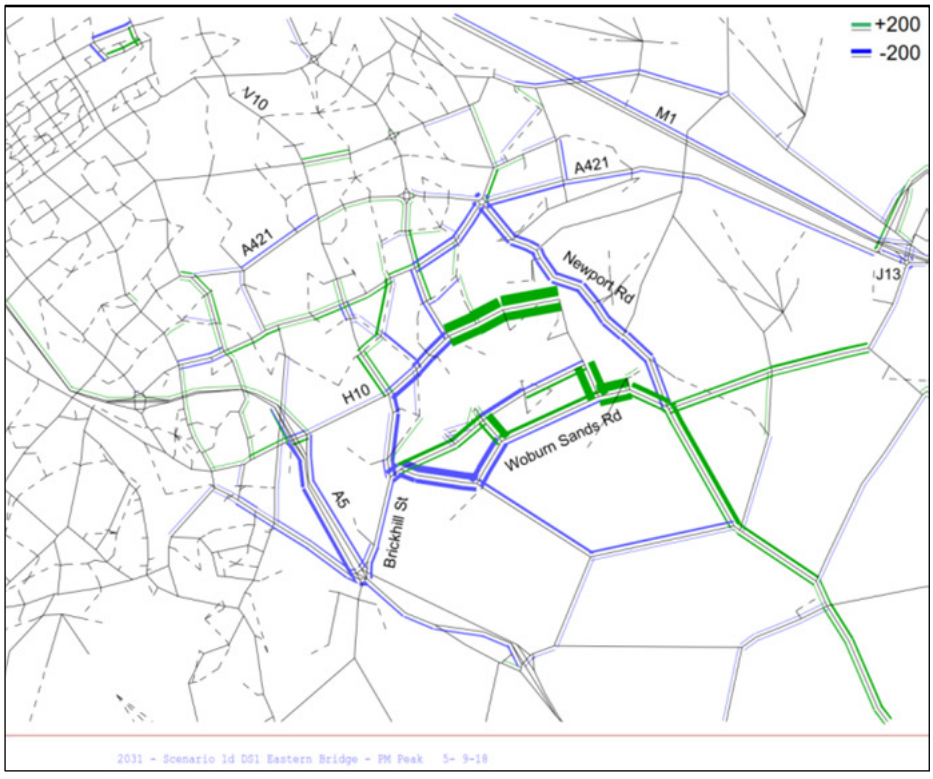

Figure 26. Change in modelled flow, S1N+Both - Eastern Bridge less S1N, PM peak

Western Bridge

Flow comparison plots showing the change in modelled flow between the Western Bridge scenario and No bridge scenario with the S1N+Both demand are shown in Figure 27 to Figure 29. The western bridge had a comparable impact to the eastern bridge in terms of traffic flows along the A5 and A5130 Newport Road and A5130. There is a larger increase in southbound flow along V11 Tongwell street between H9 and H10, in the AM Peak and PM peaks, and a larger increase along H10 between Brickhill Street and the A5 in the AM Peak.

The western bridge also gave the largest reduction in modelled flow along Brickhill Street between Station Road and H10.

As with the eastern bridge, the impacts in the inter-peak beyond Bow Brickhill are comparable to the AM Peak.

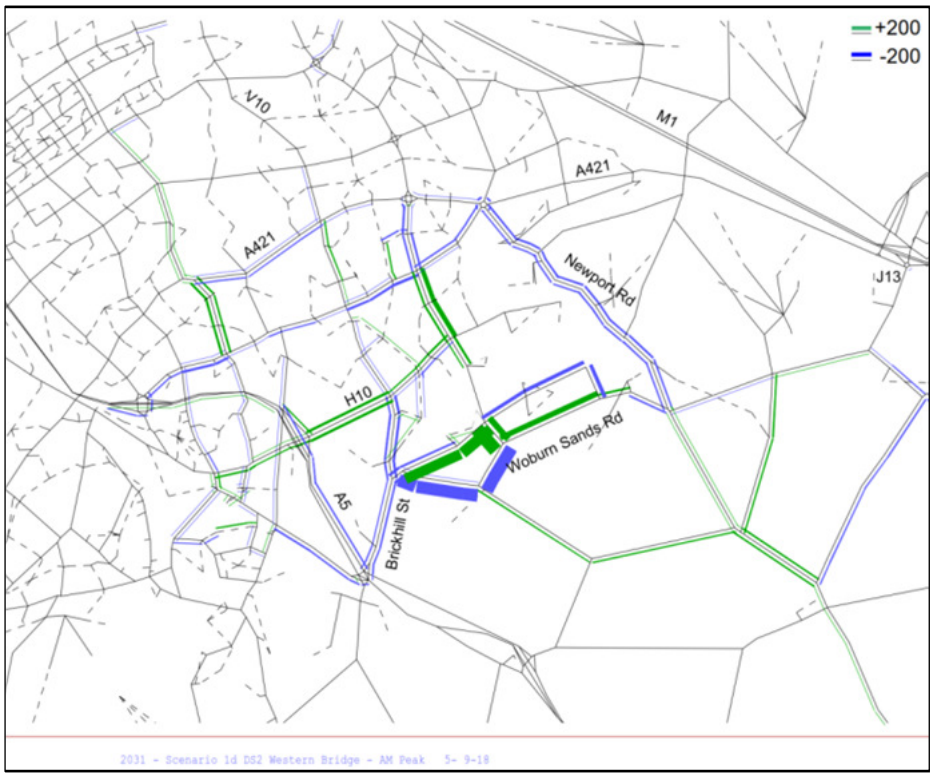

Figure 27 Change in modelled flow, S1N+Both - Western Bridge less S1N, AM peak

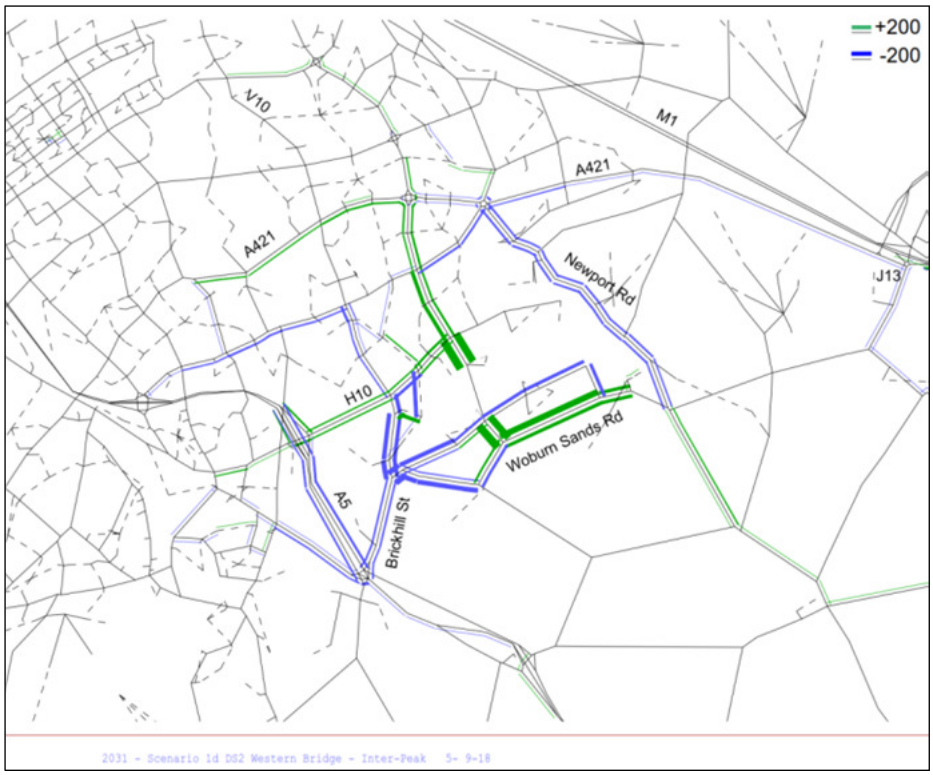

Figure 28. Change in modelled flow, S1N+Both - Western Bridge less S1N, Inter-Peak

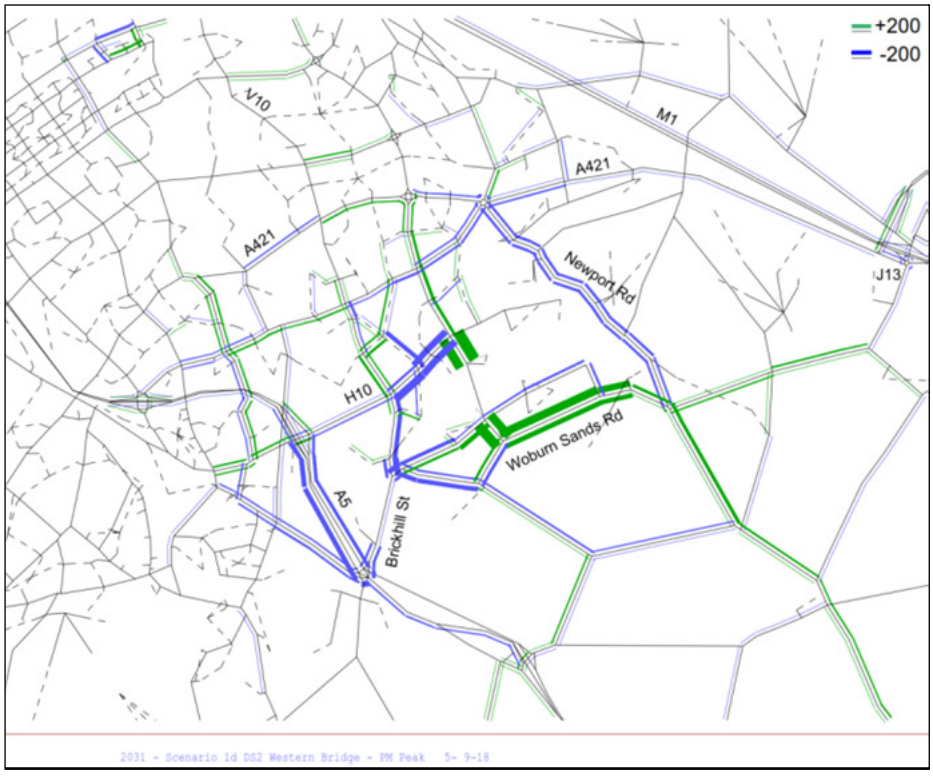

Figure 29. Change in modelled flow, S1N+Both - Western Bridge less S1N, PM peak

Delays

Delays at Bow Brickhill Crossing

A comparison of average delay for the direction of tidal flow at Bow Brickhill level crossing between scenarios is presented in Table 10. The AM peak delay was much lower than that in the PM Peak as there are two lanes northbound across the crossing which is the peak traffic direction in the morning. It is evident that the inclusion of SEMK and / or South Caldecotte has little impact on the delays. This is due to existing traffic re-routing to use alternative roads.

Table 10 : Average Model Delay at Bow Brickhill Crossing

Scenario	Average Delay per PCU (seconds)	
	AM NB	PM SB
S1N, No Bridge	34	52
S1N+SE, No Bridge	34	55
S1N+SC, No Bridge	34	51
S1N+Both, No Bridge	35	53
S1N+SE, Eastern Bridge	34	46
S1N+SC, Eastern Bridge	33	44
S1N+Both, Eastern Bridge	34	46
S1N+SE, Western Bridge	33	42
S1N+SC, Western Bridge	33	40
S1N+Both, Western Bridge	34	41

Scenario 1N, No Bridge

Average Delays in S1N, No Bridge are shown in Figure 30 to Figure 32 with a colour scale indicating delays from less than 0.5 minutes to over 5 minutes. The most severe delay was in the AM peak on the westbound approach to Walnut Tree roundabout with a delay of around 5.5 minutes per vehicle. There were also modelled delays on the northbound and westbound approaches to Brown's Wood Roundabout of 2.5 and 3 minutes respectively. There was also a significant delay at the H10 Groveway/ Brickhill Street roundabout with the largest delay being around 2.5 minutes on the northbound approach.

In the inter-peak the delays were lower due to lower volumes of traffic on the network. Given the low levels of delay in the inter-peak the remainder of this section will focus on the AM and PM Peaks.

In the PM Peak, the delays in south east Milton Keynes were generally less than in the AM peak but there was still notable delay at H10 Groveway/ Brickhill Street roundabout with delays of around 2.5 minutes on both Brickhill Street approaches.

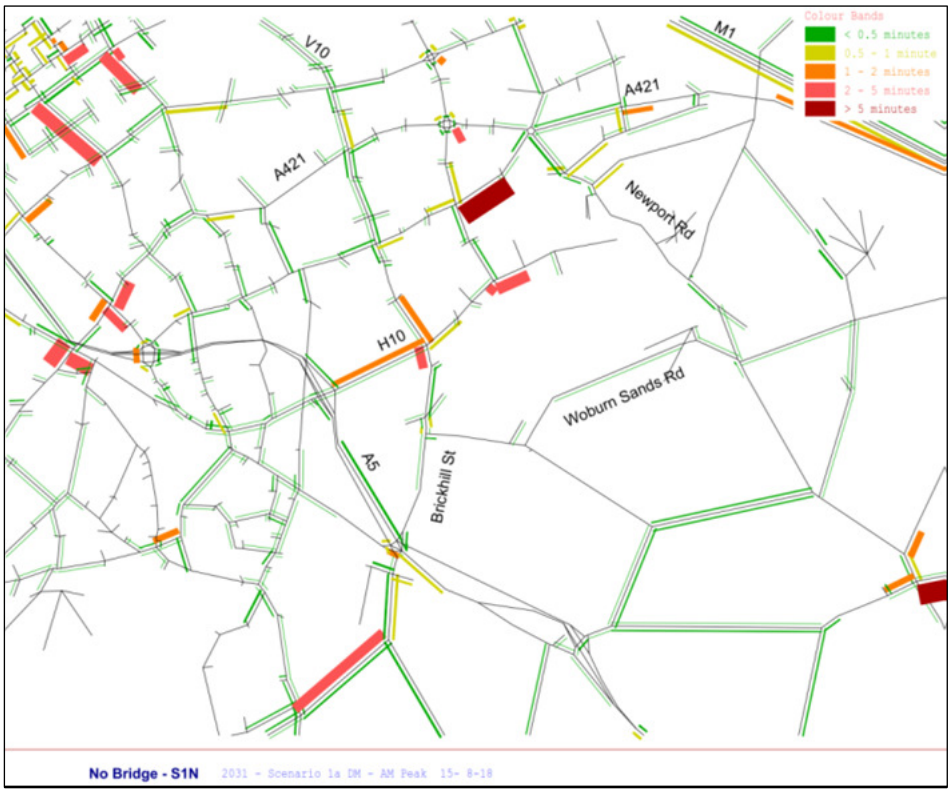

Figure 30. Average Delay (seconds), S1 N - No Bridge, AM Peak

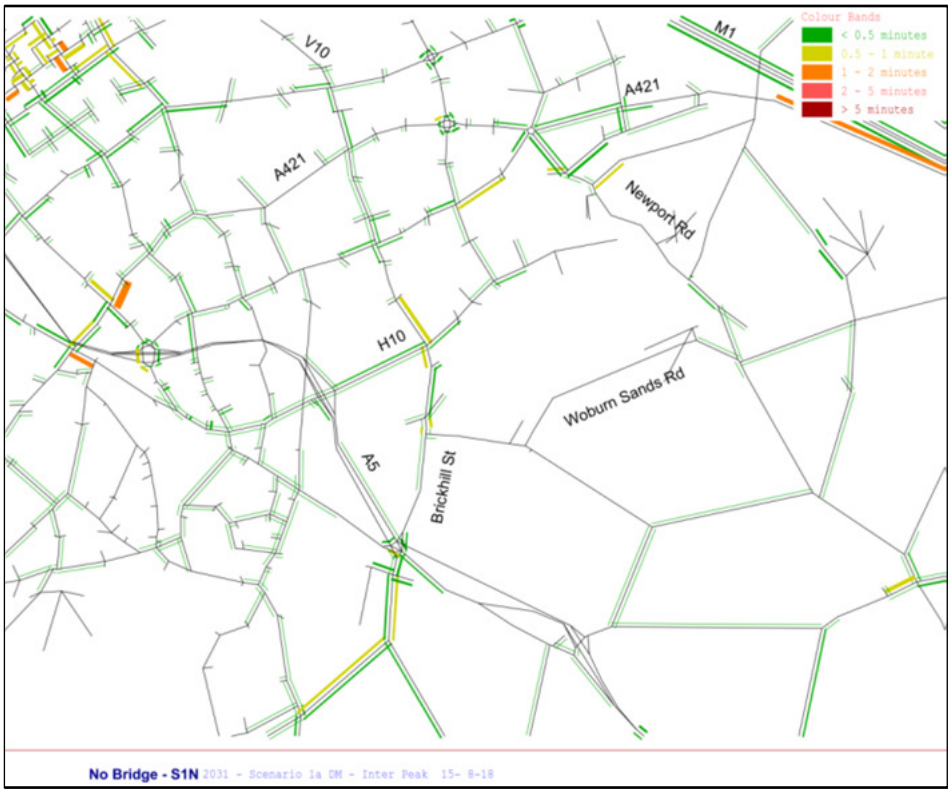

Figure 31. Average Delay (seconds), S1N - No Bridge, Inter-Peak

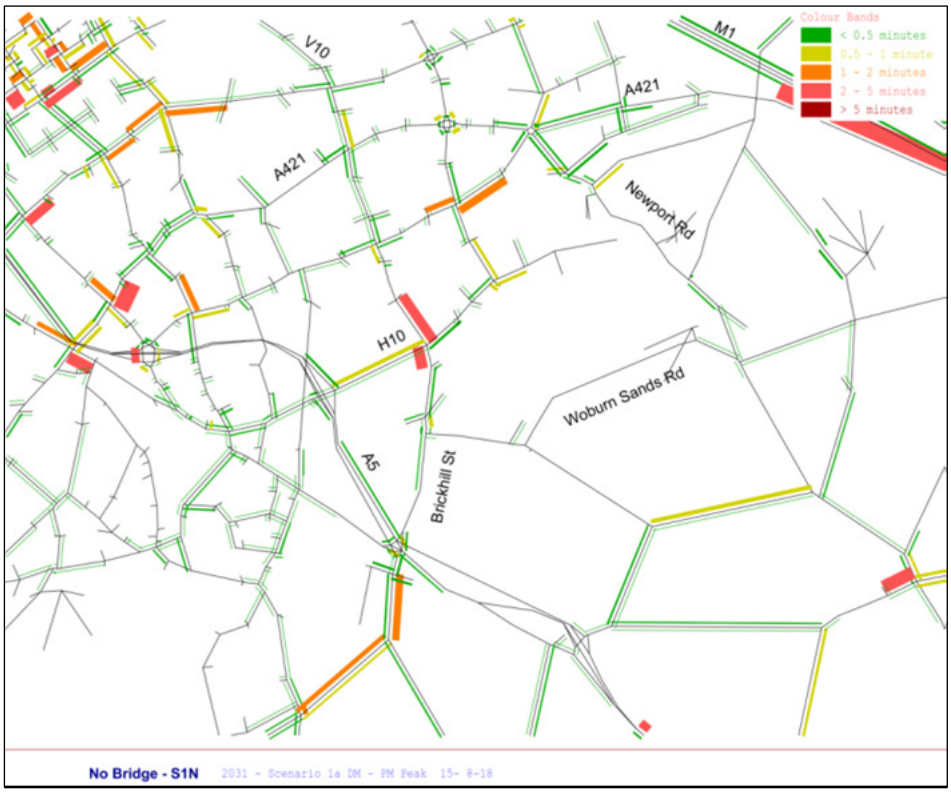

Figure 32. Average Delay (seconds), S1N - No Bridge, PM-Peak

Scenario 1N+Both and No Bridge

The average delay plots for S1N+Both and No Bridge are shown in Figure 33 and Figure 34. In the AM Peak, delay on the westbound approach to Brown's Wood Roundabout had decreased, As shown by Figure 22, the flow comparison plots, there was a small decrease in flow on the eastbound and southbound approaches to the junction. Given the roundabout is over capacity it was sensitive to these changes in flow which has led to a reduction in the delay although this was still over 1 minute.

In both the AM and PM Peak hours, delays on the northbound approach to H10 Groveway/Brickhill Street roundabout have increased to over 3.5 minutes.

Delays on the southbound A5 approach to Kelly's Kitchen roundabout slightly worsened in the AM Peak.

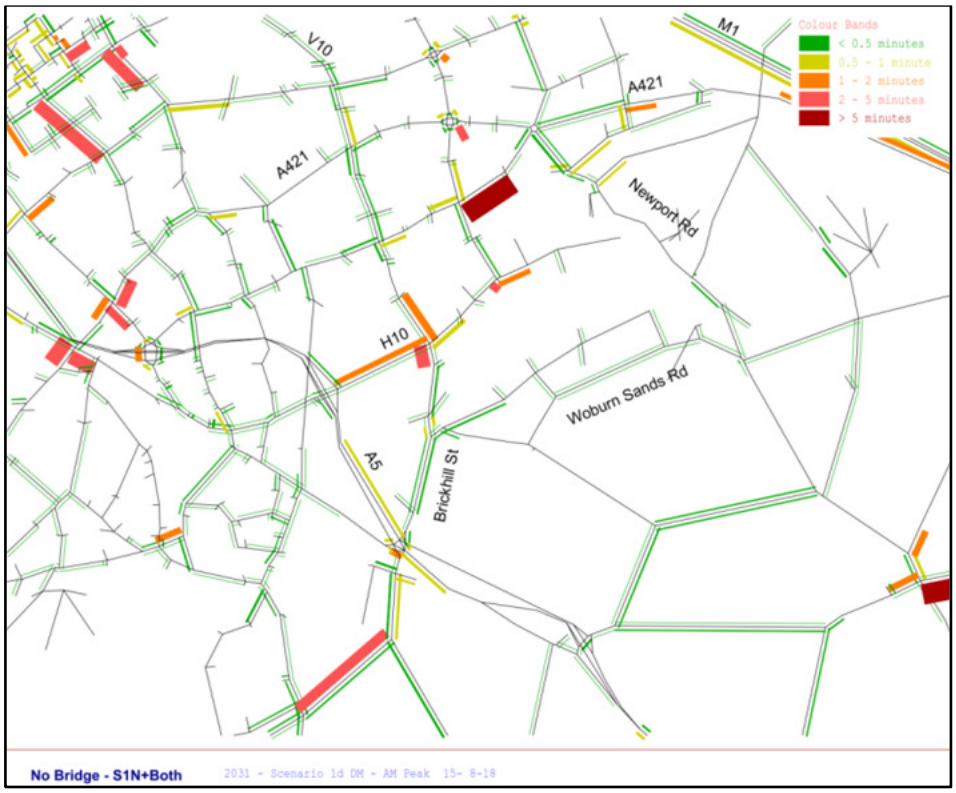

Figure 33. Average Delay (seconds), S1N+Both - No Bridge, AM Peak

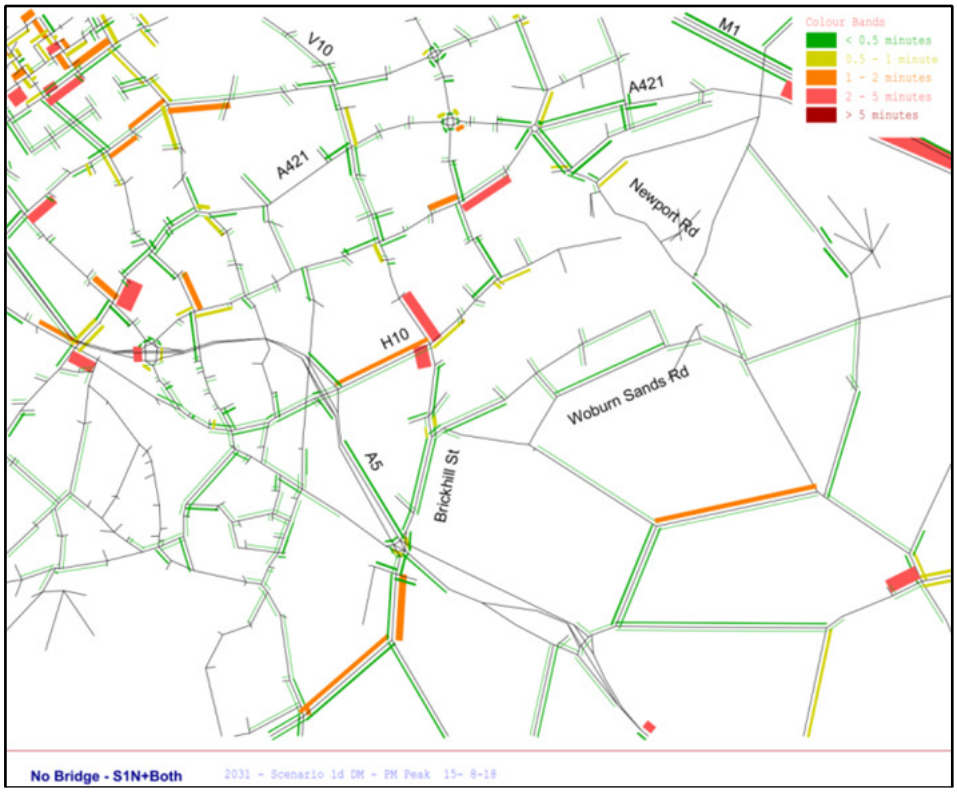

Figure 34. Average Delay (seconds), S1N+Both - No Bridge, PM Peak

Scenario 1N+Both and Eastern Bridge

The most apparent impact in terms of delay with the eastern bridge was on the westbound approach to Brown's Wood Roundabout. This was already over capacity in the no bridge scenario and the additional traffic using the bridge has worsened the delay to 5 minutes.

Although there was a slight reduction in delay at the H10 Groveway/Brickhill Street roundabout the delays are still comparable.

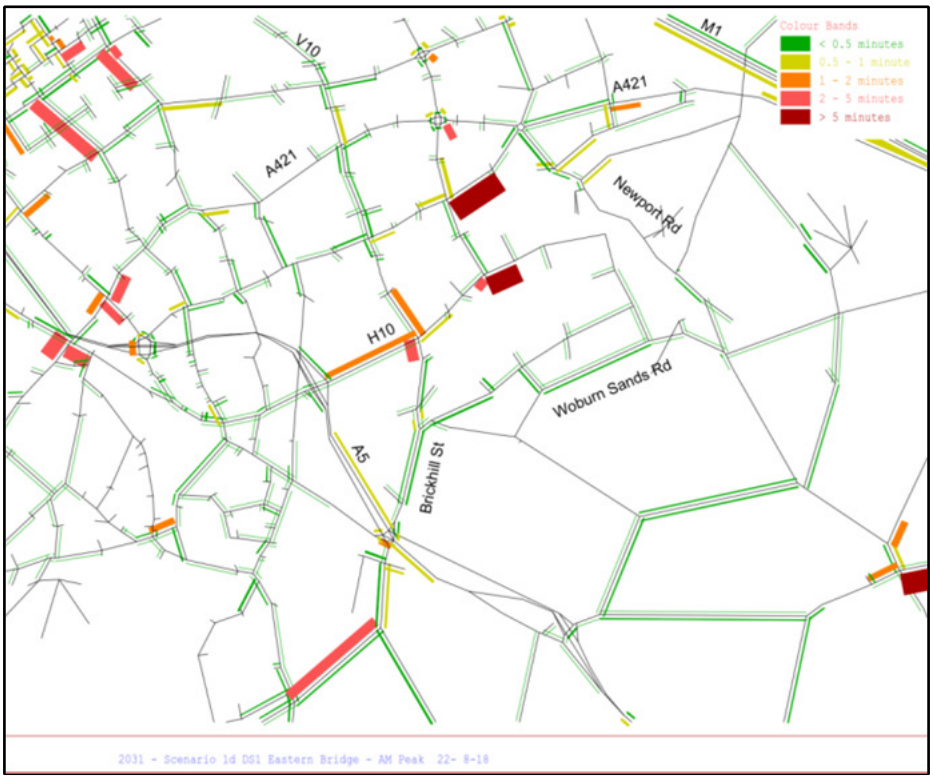

Figure 35. Average Delay (seconds), S1N+Both - Eastern Bridge, AM Peak

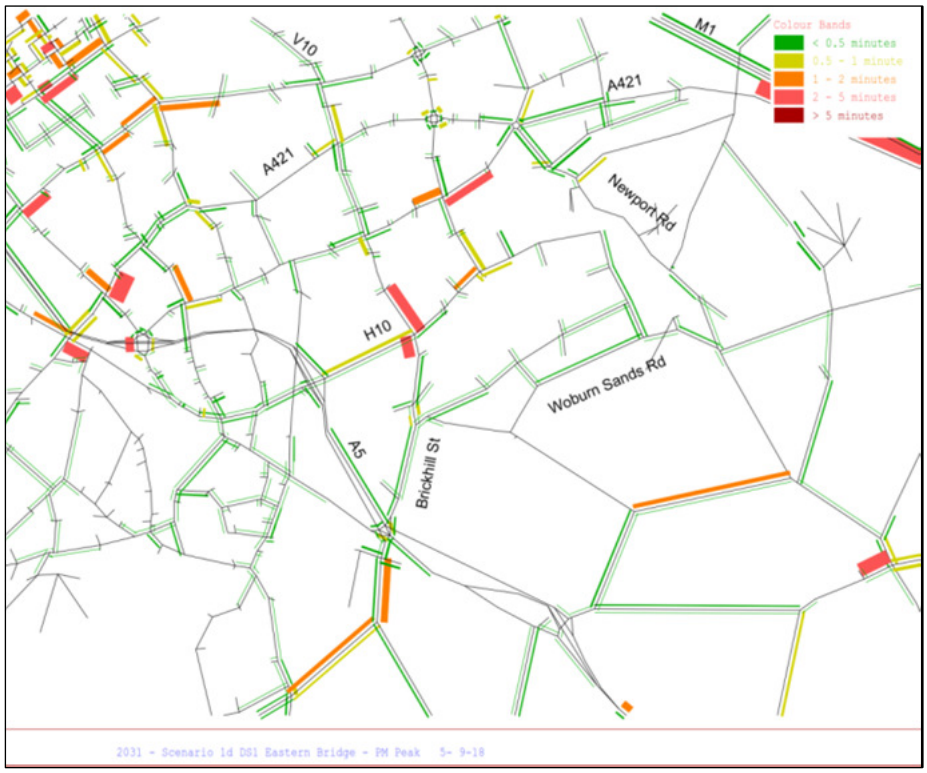

Figure 36. Average Delay (seconds), S1N+Both - Eastern Bridge , PM-Peak

Scenario 1N+Both and Western Bridge

As with the eastern bridge, the most apparent impact in terms of delay with the western bridge was on the westbound approach to Brown's Wood Roundabout in the AM Peak. However the modelled delay in the western bridge scenario is much more severe, with very large modelled delays of 27 minutes per vehicle. This large delay was is because this is only access for the development trips from SEMK1 to access the network, and as the western bridge connects onto this junction the southbound flow using the bridge was obstructing the westbound approach.

There was a more notable reduction in congestion at the H10 Groveway/Brickhill Street roundabout but in the AM peak this may in part have been due to the traffic queued up the at Brown's Wood Roundabout.

Similar to the eastern bridge scenario, delays on the southbound A5 approach to Kelly's Kitchen roundabout slightly worsened in the AM Peak.

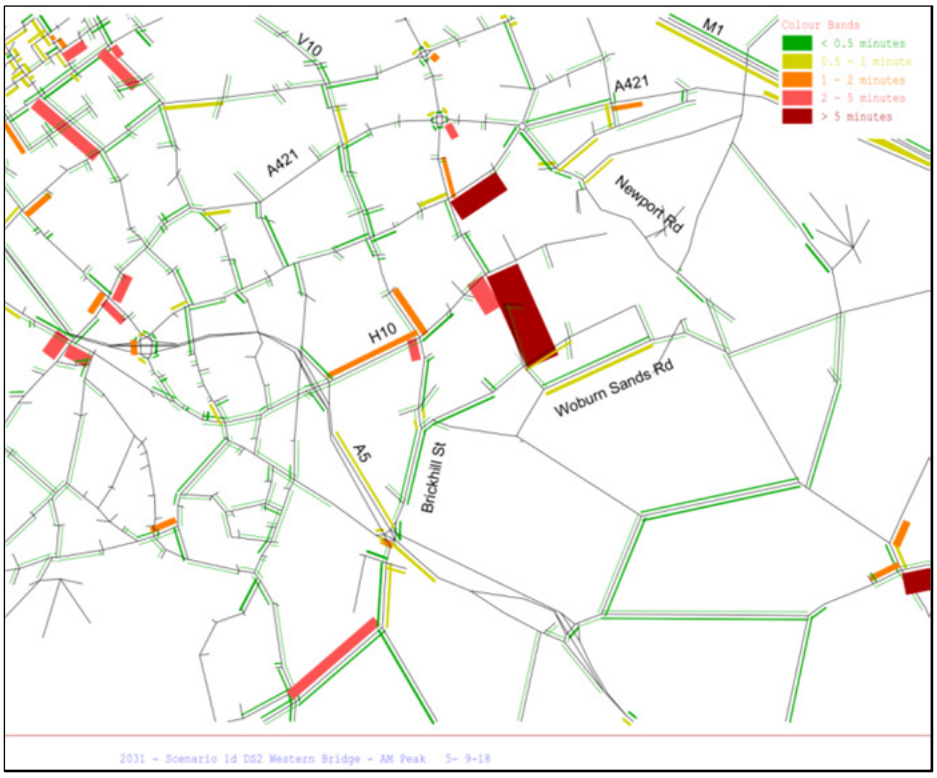

Figure 37. Average Delay (seconds), S1N+Both - Western Bridge, AM Peak

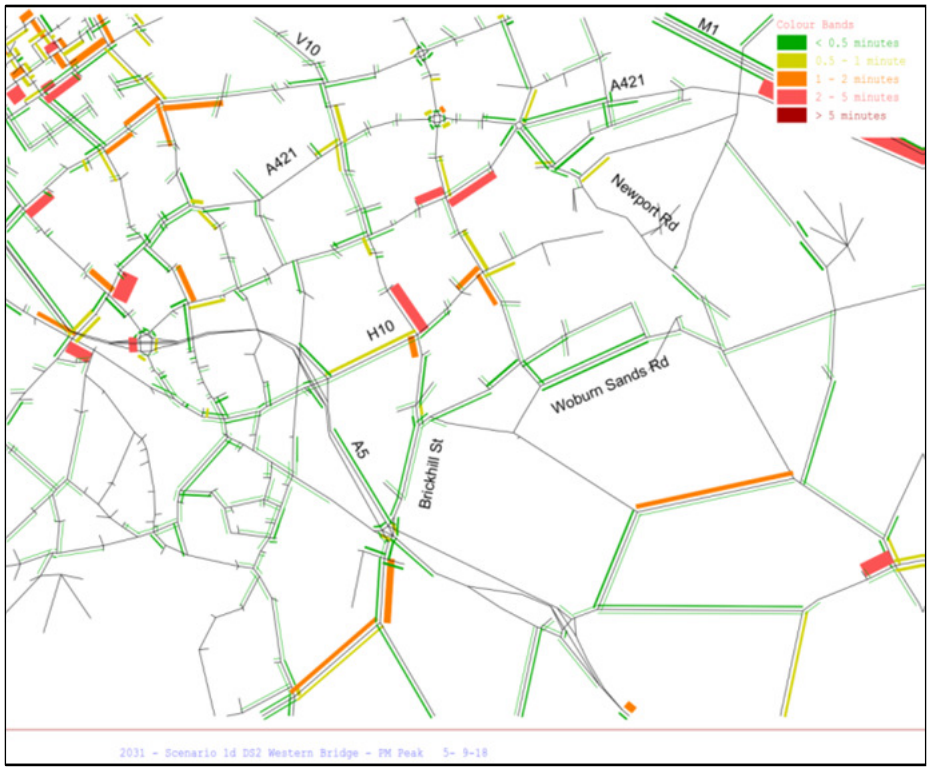

Figure 38. Average Delay (seconds), S1N+Both - Western Bridge, PM-Peak

Conclusions

The strategic modelling suggests that an additional railway crossing is not needed to accommodate the South Caldecotte development. This is because the trips to and from this site are predominantly travelling against the direction of peak flow and hence have less impact on delays at key junctions than the other proposed developments.

Although the testing with no bridge shows minimal impact of the SEMK2 housing growth in terms of flow at the Bow Brickhill crossing, this was due to traffic in the model being re-assigned to alternative routes. The 'with bridge' tests showed that up to around 800 PCU could use a new bridge. Removing other causes of congestion at the junction on H10 with Brickhill Street and Tongwell street would likely encourage more traffic to use the bridge in the AM Peak.

In terms of the A5 there was a small impact in terms of flow change due to the additional demand, without the bridge but this is mitigated when the bridge is modelled. The modelling showed little impact in terms of trips down the A5 to and from Central Bedfordshire. However there was a notable increase in modelled traffic along Watling Street from Kelly's Kitchen Roundabout with the SEMK2 demand.

Similarly the increase in flow along Newport Road in the S1N+SE and S1N+Both no bridge options was cancelled out in the models with the bridge in place.

Although the eastern bridge took a higher volume of modelled traffic, the overall modelled impacts are comparable between the eastern and western bridge options with the only significant difference being the delay at Brown's Wood roundabout.

The modelling indicated that the provision of a bridge would provide additional capacity across the railway line and help alleviate congestion on parallel routes to some extent, but would not be sufficient alone to mitigate congestion issues in the SEMK area and in the case of the western bridge would make congestion at Brown's Wood roundabout considerably worse.

Recommendations

That further work be undertaken to identify and test mitigation measures at Brown's Wood and the H10 Groveway / Brickhill Street roundabout. Measures identified should also be tested in conjunction with the bridge options as delays modelled at this junction impact on the attraction of the bridge options, particularly in the AM Peak.

Subject to MKC's feasibility study, testing of the Brickhill Street on-line bridge option should be undertaken.

A microsimulation model covering the key SEMK network should be developed to undertake an operational assessment which would provide more detailed outputs on junction and network performance. This is currently being scoped by Milton Keynes Council.