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Appendix 7-2: Fore Consulting Modelling Report

Medway Council
Innovation Park, Rochester, Medway

Innovation Park Aimsun Modelling – Modelling Report

14 December 2018
Version 1.0
Draft

Fore

Contents

1 Introduction

1.1 Commission

Medway Council is preparing a new Local Plan to provide direction on the future growth of the area. Sweco and Fore Consulting Limited (Fore) have been previously appointed by Medway Council to prepare the Strategic Transport Assessment (STA) for the Local Plan. This commission has involved assessment of the impact on the highway network of various Strategic Development Options using the Medway Aimsun Model.

Using the Medway Aimsun Model, Fore Consulting Limited (Fore) have been commissioned by Medway Council to undertake microsimulation modelling of the traffic impacts of the proposed Innovation Park Medway (IPM) development at Rochester Airport.

This report sets out the detailed methodology used, as well as the results for the Reference Case, Reference Case + IPM development and Do Something scenarios for the years 2028 and 2035. As part of this report potential mitigation measures have also been considered.

1.2 Background

The Medway Aimsun Model covers the whole of UK. The Medway local authority area as well as parts of Gravesham, Tonbridge and Malling, Maidstone and Swale are modelled in detail, providing an appropriate study area for the Strategic Transport Assessment of the Local Plan.

The model is calibrated and validated at both macroscopic and microscopic levels enabling both the wide-area strategic and local detailed effects of the Plan to be assessed. The model base year is 2016 and it covers the AM (0800 to 0900) and PM (1700 to 1800) peak hours, as well as an interpeak hour (1300 to 1400), which can be taken to be representative of the whole interpeak period (1000 to 1600).

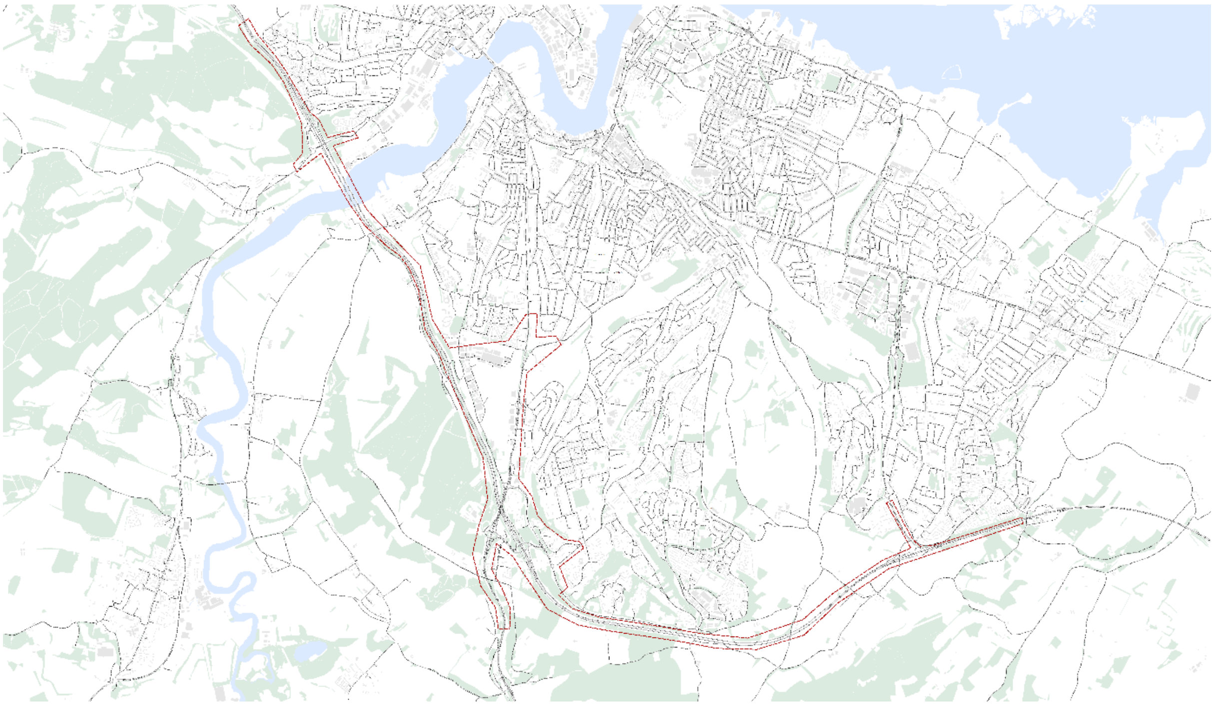
The base year model development, calibration and validation is set out in the *Medway Aimsun Model: Model Validation Report* dated 8 June 2017. This has been reviewed by both Medway Council and Highways England and the model is considered to be fit for purpose for assessing the Medway Local Plan and other proposed development. Therefore, the Medway Aimsun Model has been considered an appropriate tool to assess the traffic impacts of the IPM development on land at Rochester Airport, Medway.

As part of the Local Plan STA work, a microsimulation subnetwork has been developed, calibrated and validated covering the M2 within Medway, including Junction 3 and the immediate surrounding local highway network. Therefore, the subnetwork has been used to assess the detailed traffic impacts of the proposed development. However, the initial subnetwork developed for the Local Plan assessment did not extend to cover the development site as well as other key local junctions to the north on the A229. Consequently, the subnetwork has been extended to cover the IPM site and include the following additional junctions on the local highway network:

- B2097 Rochester Road / Lankester Parker Road;
- B2097 Rochester Road / Laker Road;
- A229 Maidstone Road / Shirley Avenue / retail park roundabout;
- Horsted Gyratory.

The extent of the subnetwork is shown on Screenshot 1.

Screenshot 1: Extent of Microsimulation Subnetwork



2 Modelling Methodology

2.1 Base Year Microsimulation Subnetwork Development

As mentioned in Section 1.2, an initial microsimulation subnetwork of the M2 Junction 2 to Junction 4 has already been developed at the request of Medway Council. The model has already been calibrated and validated at a microscopic level, as set out in the Model Validation Report. However, in the developing an extended subnetwork, the base year calibration of the microsimulation has been further refined using the following process:

- A static traversal is run for each time period to generate matrices for the subnetwork area. These can be considered as prior matrices.
- A series of static adjustment experiments are run to simultaneously time-slice the matrices into 15-minute periods and to make small adjustments to the matrices so that they better match the observed traffic counts. This process was constrained using matrix elasticities of 0.01 and centroid reliabilities of 1.0, such that adjustments away from the prior matrices would be heavily penalised. This will ensure that the patterns in the prior matrices are not significantly distorted whilst improving the overall traffic flow calibration.
- The models have then been run to ensure correct operation, with minor adjustments made to model parameters, as required.
- Journey times in the subnetworks have been validated using the same TrafficMaster journey time data that was used in the development of the overall model, but for local routes within the subnetwork areas.

An Image showing the extended subnetwork, together with the traffic flow calibration and journey time validation statistics are shown below. The results show that the subnetwork is an accurate representation of the existing situation and meet relevant guidelines with at least 85% of modelled flows and journey time routes being modelled within normal acceptability criteria.

Screenshot 2: Subnetwork Area

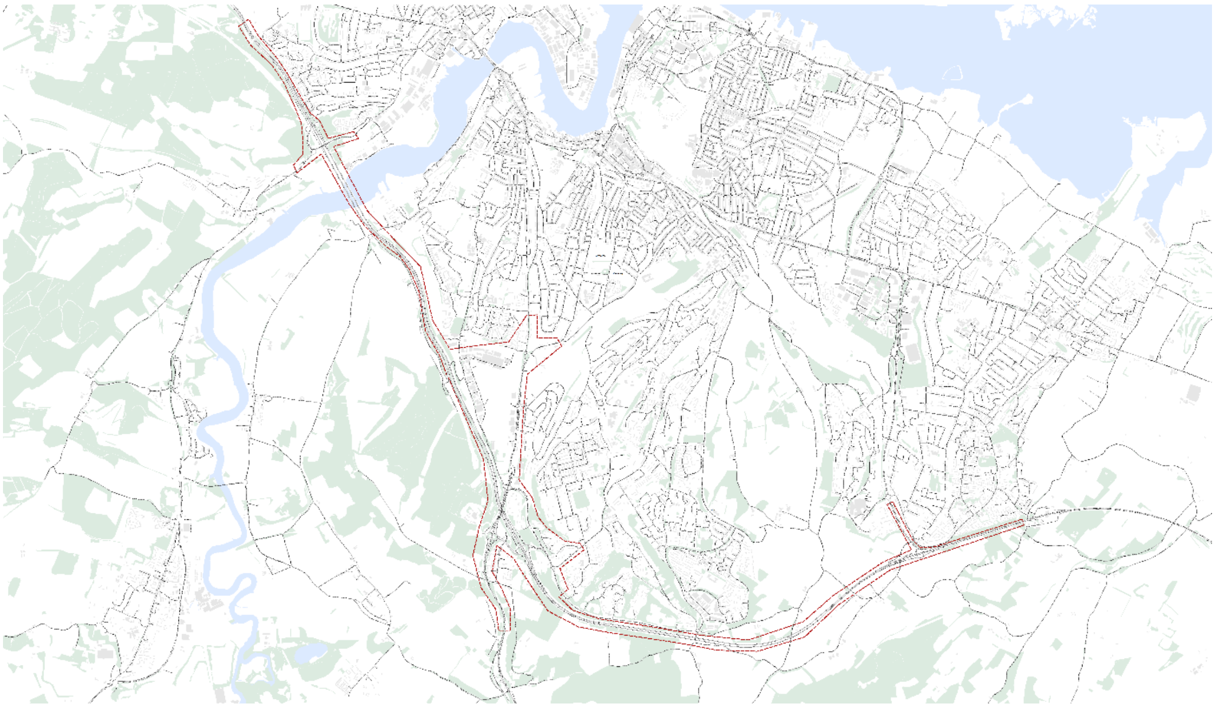


Table 1: Subnetwork 1 Traffic Flow Calibration

Peak Hour	Network Element	Percentage Meeting Criteria					Calibrates?
		Criteria 1	Criteria 2			Either Criteria	
		GEH Statistic less than 5.0	Count less than 700 vph modelled within 100 vph	Counts between 700 vph and 2,700 vph modelled within 15%	Count greater than 2,700 vph modelled within 400 vph		
AM Peak	Sections	95.4%	95.5%	96.2%	100.0%	97.4%	Yes
	Turns	92.2%	95.3%	91.5%	-	96.1%	Yes
PM Peak	Sections	91.4%	98.4%	91.3%	100.0%	94.7%	Yes
	Turns	90.2%	94.8%	94.6%	-	94.8%	Yes

Table 2: Subnetwork Journey Time Validation

Route	Length (km)	Observed (s)	Modelled (s)	Relative Difference (s)	Absolute Difference (%)	Validates?
AM Peak Hour						
Route 5.1.A: M2 Eastbound	15.77	535	564	28	5.32%	Yes
Route 5.1.B: M2 Westbound	16.29	616	582	-34	-5.56%	Yes
Route 5.2.A: Sundridge Hill (North) to M2 (West)	3.80	295	363	68	23.00%	No
Route 5.2.B: M2 (West) to Sundridge Hill (North)	3.29	209	189	-20	-9.42%	Yes
Route 5.3.A: Sundridge Hill (South) to M2 (East)	2.53	136	131	-5	-3.97%	Yes
Route 5.3.B: M2 (East) to Sundridge Hill (South)	2.27	188	131	-57	-30.44%	Yes
Route 5.4.A: A229 Maidstone Road (Northbound)	4.45	285	295	10	3.46%	Yes
Route 5.4.B: A229 Maidstone Road (Southbound)	4.88	371	386	15	4.01%	Yes
Route 5.5.A: A229 Maidstone Road (South) to M2 (West)	6.63	353	330	-23	-6.48%	Yes
Route 5.5.B: M2 (West) to A229 Maidstone Road (South)	7.06	410	406	-5	-1.18%	Yes
Route 5.6.A: A229 Maidstone Road (North) to M2 (East)	6.26	630	568	-62	-9.90%	Yes
Route 5.6.B: M2 (East) to A229 Maidstone Road (North)	6.22	473	529	56	11.93%	Yes
Route 5.7.A: M2 (East) to Hoath Way	2.36	153	132	-21	-13.48%	Yes
Route 5.7.B: Hoath Way to M2 (East)	2.24	102	101	0	-0.40%	Yes
Route 5.8.A: M2 (West) to Hoath Way	4.00	164	155	-9	-5.28%	Yes
Route 5.8.B: Hoath Way to M2 (West)	4.21	181	169	-12	-6.53%	Yes
Percentage of Routes Meeting Validation Criteria:						**93.8%**

Route	Length (km)	Observed (s)	Modelled (s)	Relative Difference (s)	Absolute Difference (%)	Validates?
PM Peak Hour						
Route 5.1.A: M2 Eastbound	15.77	632	568	-64	-10.09%	Yes
Route 5.1.B: M2 Westbound	16.29	531	575	44	8.19%	Yes
Route 5.2.A: Sundridge Hill (North) to M2 (West)	3.80	213	269	57	26.71%	Yes
Route 5.2.B: M2 (West) to Sundridge Hill (North)	3.29	242	202	-40	-16.53%	Yes
Route 5.3.A: Sundridge Hill (South) to M2 (East)	2.53	139	142	3	2.47%	Yes
Route 5.3.B: M2 (East) to Sundridge Hill (South)	2.27	133	137	4	2.87%	Yes
Route 5.4.A: A229 Maidstone Road (Northbound)	4.45	339	310	-29	-8.56%	Yes
Route 5.4.B: A229 Maidstone Road (Southbound)	4.88	469	398	-71	-15.12%	No
Route 5.5.A: A229 Maidstone Road (South) to M2 (West)	6.63	350	315	-35	-9.93%	Yes
Route 5.5.B: M2 (West) to A229 Maidstone Road (South)	7.06	419	366	-54	-12.79%	Yes
Route 5.6.A: A229 Maidstone Road (North) to M2 (East)	6.26	750	553	-197	-26.25%	No
Route 5.6.B: M2 (East) to A229 Maidstone Road (North)	6.22	468	454	-15	-3.14%	Yes
Route 5.7.A: M2 (East) to Hoath Way	2.36	147	115	-32	-21.67%	Yes
Route 5.7.B: Hoath Way to M2 (East)	2.24	119	103	-16	-13.32%	Yes
Route 5.8.A: M2 (West) to Hoath Way	4.00	199	157	-43	-21.42%	Yes
Route 5.8.B: Hoath Way to M2 (West)	4.21	171	168	-3	-1.80%	Yes
Percentage of Routes Meeting Validation Criteria:						**87.5%**

2.2 Future Year Scenario Development

2.2.1 Reference Case

Reference Case scenarios have been previously developed as part of the current Local Plan modelling by importing the Reference Case matrices into the Medway Aimsun Model. The scenario includes all committed developments and committed highway improvements (up to November 2017) that are expected to be in place by 2028 and 2035.

2.2.2 Development Option

For the purposes of assessing the impact of IPM, assumptions in terms of trip generation, trip distribution and mode share remain consistent with those detailed in the associated masterplan and transport assessment work. Modelling has been undertaken at both macroscopic and microscopic levels, with the former being used to assess reassignment effects over the wider network, and the latter to assess the detailed impacts of the proposed development.

It should be considered that trips associated with the IPM development have been added on top of the Reference Case scenario at the subnetwork level only. Therefore, the modelling does not take into account wider reassignments within the Medway area that may occur as a result of the development. For these reasons, the assessment is considered to be robust and present the impacts of the development as a worst case, but one that is consistent with the transport assessment.

2.2.3 Network Coding

The indicative masterplan for the site outlines several proposed points of access that connect the site to the existing highways infrastructure. For the northern site, three points of access are proposed with cars using the northern and southern access points to access the site. The central of the three access points from Laker Road is proposed as a bus priority link, therefore it has not been coded into the model for the purposes of this assessment.

For the southern site, access arrangement is proposed to remain consistent with the current layout, with vehicles gaining access via the existing A229 Maidstone Road / Innovation Centre junction. This is consistent within the model.

The access arrangements, as coding in the Aimsun model are shown on Screenshot 3 and Screenshot 4.

Screenshot 3: Aimsun Coding Showing Proposed Northern Site Access Arrangement on Laker Road

Screenshot 4: Aimsun Coding Showing Proposed Southern Site Access Arrangement on Maidstone Road

2.2.4 Scenarios Assessed

The transport work prepared by the applicant assumes a 2028 assessment year. It is therefore proposed that the impact of the development is assessed against the 2028 Reference Case scenario prepared for the Local Plan, since this corresponds to the applicant's assessment year. In addition to this, a 2035 assessment year has also been considered in order to provide a robust assessment. This scenario was also prepared for the Local Plan.

Therefore, the following scenarios have been developed and assessed:

- **2028 and 2035 Reference Case:** This is the scenario without the proposed development and will be used to determine the baseline against which impacts of the development are compared.

- **2028 and 2035 Reference Case with Proposed Development:** This scenario will include the Reference Case and the proposed development with no mitigation and will be used to determine the impact of the proposed development.

- **2028 Do Something:** This scenario will include the proposed development, associated access proposals and mitigation to negate the impact of the proposed development should the proposals show significant detriment to the surrounding highway network.

3 Results – Reference Case with Proposed Development

3.1 Network Wide Model Statistics

Network statistics provide a strategic overview of the performance of the whole network. These statistics have been extracted for the modelled subnetwork to understand the wider network impacts of the development. The statistics are summarised in Table 3 and Table 4 for the AM and PM peak hours with the development in place. The following statistics are reported:

- **Travel time -** mean time it takes for vehicles to travel through the network in the modelled time period (unit: s/km);
- **Delay time –** mean delay incurred by vehicles travelling through the network in the modelled time period and is calculated as the difference between actual travel time and free flow travel (unit: s/km);
- **Flow –** mean number of vehicles that pass through the network in the modelled time period (unit: veh/h);
- **Speed –** mean speed of vehicles in the network (unit: km/h);
- **Stop time -** mean amount of time that vehicles are stationary (unit: s/km);
- **Density -** the mean number of vehicles per km of road space and is an indicator of queuing and congestion (unit: veh/km);
- **Mean Queue –** the mean number of vehicles in queuing in the model (unit: veh);
- **Mean Virtual Queue -** the mean number of vehicles that have been generated by the model and cannot enter the model due to downstream congestion (unit: veh);
- **Waiting time in Virtual Queue –** the mean time a vehicle waits in the virtual queue before entering the model (unit: s);
- **Total Travelled Time (hours) -** the cumulative time travelled by all vehicles that have passed through the network in the modelled time period. In heavily congested scenarios, the total travelled time may actually reduce, because less vehicles can complete their journey and be included in the statistics (unit: hours);
- **Total Travelled Distance –** the cumulative distance travelled by all vehicles that have passed through the network in the modelled time period. In heavily congested

scenarios, the total travelled distance may actually reduce, because fewer vehicles can complete their journey and be included in the statistics (unit: km).

- **Average travel time per vehicle –** calculated by dividing the total travelled time by the number of vehicles that have passed through the network (unit: s);
- **Vehicles Out –** the total number of vehicles that have passed through the network during the modelled period and is equal to flow for a single hour (unit: veh);
- **Vehicles In –** the number of vehicles in the model at the end of the modelled period (unit: veh);
- **Vehicles waiting to enter –** mean number of vehicles waiting to enter the network at the end of the simulation period. This provides an indication to the extent of which the network is operating over capacity (unit: veh).

Table 3: Network Statistics – AM Peak Hour – Reference Case with Proposed Development

Statistic		AM Peak Hour (0800 to 0900)				
	Units	2016 Base Year	2028 Reference Case	2028 Reference Case + IPM	2035 Reference Case	2035 Reference Case + IPM
Summary Statistics						
Travel Time	sec/km	66.0	78.4	98.3	82.3	100.8
Delay	sec/km	18.4	30.9	51.1	34.9	53.7
Flow	veh/h	21,187.3	24,108.2	22,934.9	25,193.0	23,693.0
Speed	km/h	66.2	62.4	59.4	60.8	57.1
Stop Time	sec/km	13.1	24.1	42.5	27.3	44.4
Density	veh/km	10.1	13.2	17.0	14.9	19.3
Mean Queue	veh	296.9	612.3	1,333.2	786.0	1,604.5
Mean Virtual Queue	veh	22.8	155.1	566.9	243.7	623.8
Waiting Time in Virtual Queue	sec	4.1	13.6	16.9	15.7	14.7
Total Statistics						
Total Travelled Time	h	2,051	2,660	3,079	2,962	3,369
Total Travelled Distance	km	141,887	164,494	159,014	174,233	165,768
Average travel time / vehicle	s/veh	348	397	483	423	512
Throughput						
Vehicles Out	veh	21,187	24,108	22,935	25,193	23,693
Vehicles In	veh	1,634	2,310	3,531	2,683	4,236
Vehicles Waiting to Enter	veh	0	205	1,318	428	1,579
Total	veh	2,2821	26,623	27,784	28,304	29,508

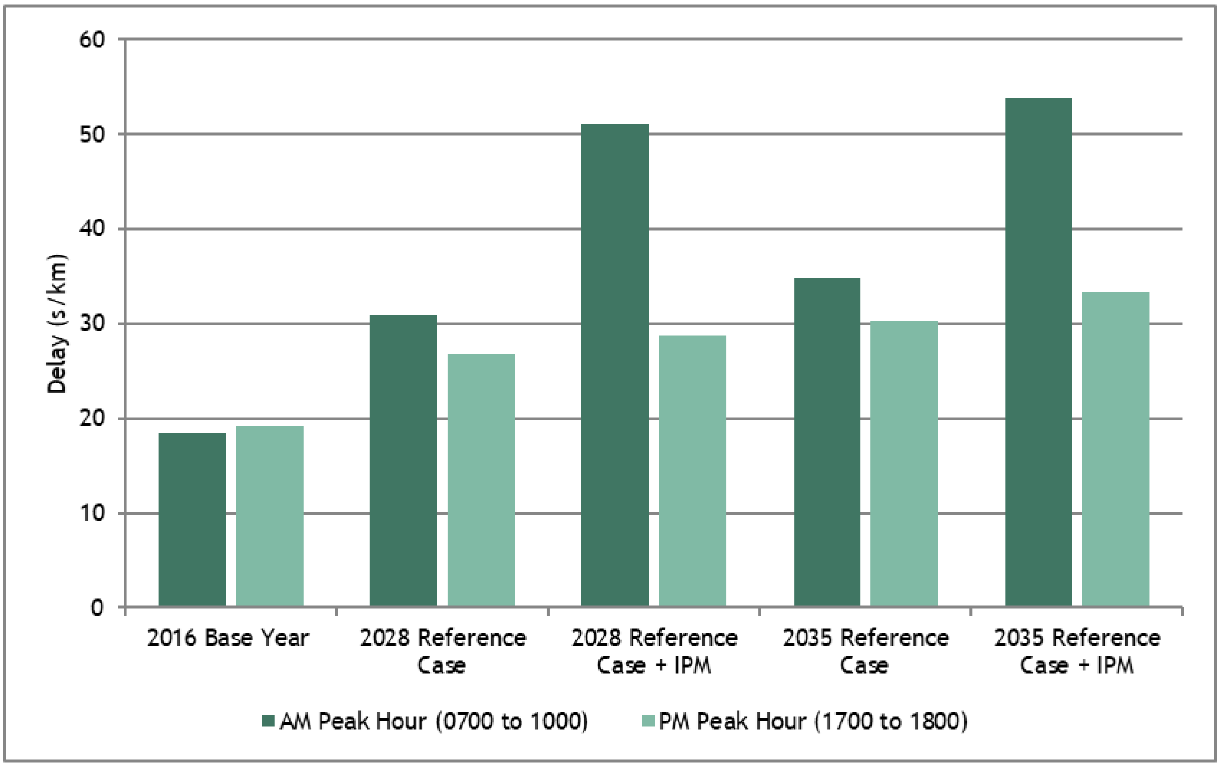
Table 4: Network Statistics – PM Peak Hour – Reference Case with Proposed Development

Statistic		PM Peak Hour (1700 to 1800)				
	Units	2016 Base Year	2028 Reference Case	2028 Reference Case + IPM	2035 Reference Case	2035 Reference Case + IPM
Summary Statistics						
Travel Time	sec/km	66.5	74.3	76.4	78.3	81.5
Delay	sec/km	19.2	26.7	28.8	30.3	33.3
Flow	veh/h	24,294.2	27,672.7	27,944.7	28,811.8	28,787.4
Speed	km/h	67.9	63.6	63.6	61.8	60.5
Stop Time	sec/km	13.3	18.8	21.0	21.5	24.0
Density	veh/km	12.3	15.5	16.0	17.1	18.2
Mean Queue	veh	416.3	654.0	771.9	822.1	1,004.7
Mean Virtual Queue	veh	69.5	170.6	367.3	375.3	652.6
Waiting Time in Virtual Queue	sec	1.0	9.1	9.2	20.7	26.2
Total Statistics						
Total Travelled Time	h	2,957	3,002	3,173	3,290	3,396
Total Travelled Distance	km	190,220	192,324	195,137	193,875	183,563
Average travel time / vehicle	s/veh	385	387	396	411	436
Throughput						
Vehicles Out	veh	24,294	27,673	27,945	28,812	28787
Vehicles In	veh	2,446	3,315	3,367	3,788	4,097
Vehicles Waiting to Enter	veh	131	310	743	740	1,266
Total	veh	26,871	31,297	32,055	33,340	34,151

In order to better understand the network statistics, a selection of these have been presented as graphs. Graph 1 shows network delay for each scenario during the AM and PM peak hours.

The graph indicates that overall network delay is likely to increase significantly as a result of background traffic growth by 2028, with increases of approximately 68% and 39% modelled in the AM and PM peak, respectively. The delivery of the development is likely to result in further increases in delay during both peak periods in 2028 and 2035. During the AM peak hour, the graph shows the addition of the development would likely have a large impact on delay, with an increase of approximately 65% and 54% reported. Whereas in the PM peak hour, a smaller increase in network delay is observed, equating to an 8% and 10% increase in 2028 and 2035, respectively.

Graph 1: Network Delay – Reference Case with Proposed Development

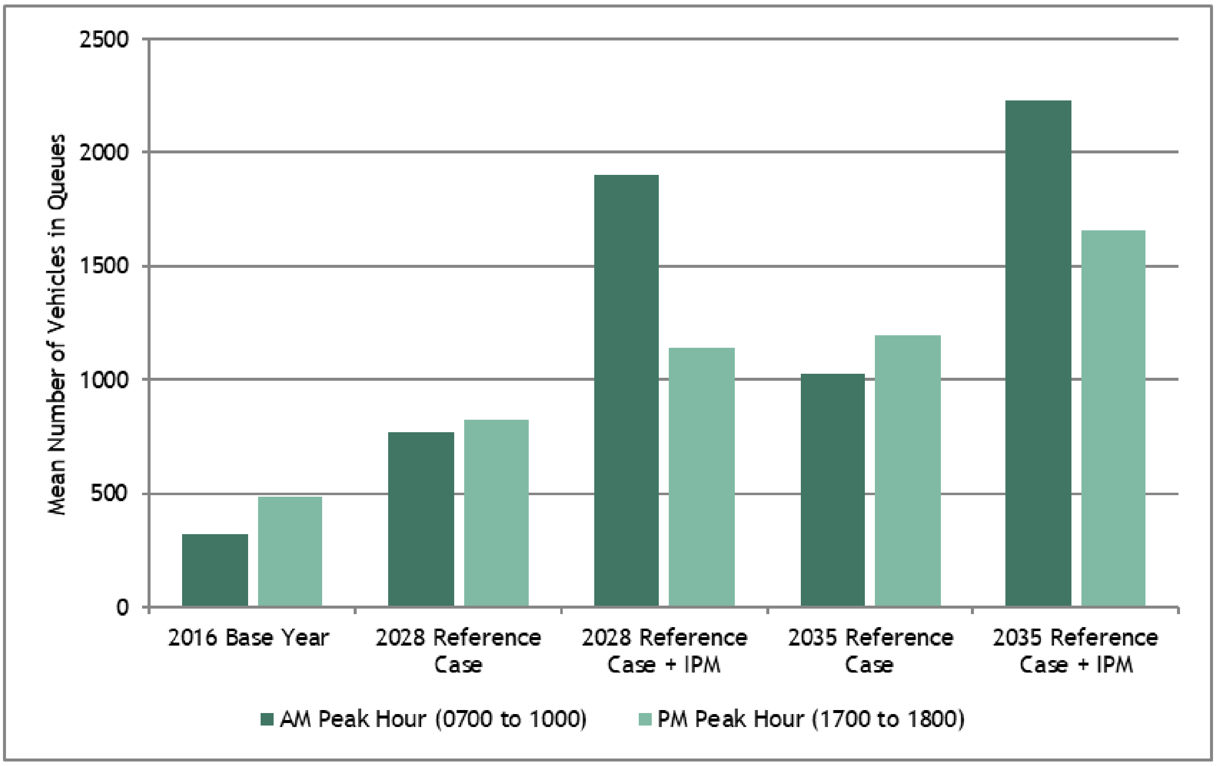


The above delay statistics are only collected for vehicles that have crossed the network (i.e. entered and exited the network) during the modelled period. As such, statistics for vehicles that are still in the network, or are in virtual queues waiting to enter the network, are not represented in the results. This means that the delay statistics reported are often understated.

For this reason, it is also important to consider the level of queuing in the model, which a direct indicator of congestion. However, it should be considered that in Aimsun vehicles are defined as entering a queue when their speed drops below 1 m/s, and leave the queue when their speed rises above 4 m/s whereas the on-street observations of whether a vehicle is in a queue may be more subjective.

Graph 2 shows mean queuing in the model. Again, the graph illustrates the significant increase in congestion as a result of background traffic growth in the 2028 and 2035 Reference Case scenarios. Graph 2 also indicates that the addition of the development would give rise to a significant impact on the local highway network, as additional traffic is added onto an already congested highway network. The addition of the development would likely result in increases in queuing of approximately 148% and 38% in the 2028 AM and PM peak hours, respectively. In 2035 this would equate to an increase in queuing of 116% in the AM peak and 38% in the PM peak.

Graph 2: Network Congestion – Reference Case with Proposed Development



In summary, the network in this area is forecast to operate over capacity in the Reference Case scenario and the network statistics demonstrate that the addition of the proposed development would result in significant further detriment on the surrounding highway network.

3.2 Impacts at Key Junctions

This section considers the impact of the proposed development on key junctions on the local highway network.

Flow, delay, mean queue and maximum queue on each approach to the considered junctions have been presented for the AM and PM peak hours with the development in place.

3.2.1 B2097 Rochester Road / Lankester Parker Road

The modelled results for the B2097 Rochester Road / Lankester Parker Road junction are summarised in Table 5 and Table 6.

Table 5: B2097 Rochester Road / Lankester Parker Road Junction Impacts - 2028

2028 Assessment Year		B2097 N		Lankester Park Road		B2097 S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	978	987	51	56	1159	1034
	Delay	3	31	59	136	16	7
	MeanQ	0	6	1	4	2	1
	MaxQ	13	38	7	11	28	7
PM	Flow	947	938	38	21	798	791
	Delay	106	128	643	1319	3	3
	MeanQ	23	27	17	20	0	0
	MaxQ	51	53	21	21	1	1

Table 6: B2097 Rochester Road / Lankester Parker Road Junction Impacts - 2035

2035 Assessment Year		B2097 N		Lankester Park Road		B2097 S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	985	990	52	52	1144	1015
	Delay	3	45	43	235	19	6
	MeanQ	0	10	1	5	3	0
	MaxQ	16	46	5	14	22	5
PM	Flow	950	936	21	16	778	820
	Delay	118	140	1168	1660	3	3
	MeanQ	26	29	19	20	0	0
	MaxQ	52	54	21	21	1	1

The above tables demonstrate that the proposed development would give rise to increases in delay and queuing on the B2097 Rochester Road north and Lankester Parker Road approach during all assessed periods. From observing the model it should be noted that the increases modelled here are largely attributable to congestion downstream at Bridgewood

Roundabout. This congestion causes queues to extend back along the B2097 Rochester Road to the Lankester Parker Road junction.

3.2.2 B2097 Rochester Road / Laker Road

The modelled results for the B2097 Rochester Road / Laker Road junction are summarised in Table 7 and Table 8.

Table 7: B2097 Rochester Road / Laker Road junction Impacts - 2028

2028 Assessment Year		B2097 N		Laker Road		B2097 S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	969	933	3	46	1169	1370
	Delay	3	163	6	952	4	16
	MeanQ	0	35	0	39	0	2
	MaxQ	4	75	1	53	1	11
PM	Flow	930	934	13	11	797	842
	Delay	235	251	664	2138	3	4
	MeanQ	51	53	9	49	0	0
	MaxQ	78	78	26	54	0	1

Table 8: B2097 Rochester Road / Laker Road junction Impacts - 2035

2035 Assessment Year		B2097 N		Laker Road		B2097 S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	971	930	4	47	1146	1338
	Delay	25	180	86	839	5	14
	MeanQ	5	39	0	36	0	1
	MaxQ	26	79	2	53	3	6
PM	Flow	932	934	10	10	776	872
	Delay	248	254	759	2165	3	4
	MeanQ	53	54	8	47	0	0
	MaxQ	77	78	21	54	0	1

The above tables demonstrate that the proposed development would give rise to increases in delay and queuing on the B2097 Rochester Road north approach during the AM peak hour during both assessment years. Similarly to the B2097 Rochester Road / Lankester Parker Road junction, increases in delay and queuing are likely resultant of congestion at Bridgewood Roundabout causing queues to extend back.

The above tables also indicate that the proposed development would likely lead to material increases in queuing along the Laker Road approach to the junction in both peak periods. Again, this is likely the result of congestion downstream; therefore additional demand associated with the development is added onto the back of existing queues.

3.2.3 A229 Maidstone Road / Innovation Centre Access

The modelled results for the A229 Maidstone Road / Innovation Centre Access junction are summarised in Table 9 and Table 10.

Table 9: A229 Maidstone Road / Innovation Centre Access Junction Impacts - 2028

2028 Assessment Year		A229 S		Innovation Centre	
		Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1744	1793	23	61
	Delay	1	1	18	16
	MeanQ	0	0	0	0
	MaxQ	1	1	3	5
PM	Flow	2455	2473	20	133
	Delay	1	1	32	40
	MeanQ	0	0	0	1
	MaxQ	1	1	4	9

Table 10: A229 Maidstone Road / Innovation Centre Access Junction Impacts - 2035

2035 Assessment Year		A229 S		Innovation Centre	
		Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1750	1790	25	58
	Delay	1	1	16	17
	MeanQ	0	0	0	0
	MaxQ	1	2	3	5
PM	Flow	2526	2545	18	132
	Delay	1	1	30	48
	MeanQ	0	0	0	2
	MaxQ	2	1	2	11

The above tables demonstrate that the proposed development would give rise to broadly neutral impacts at the A229 Maidstone Road / Innovation Centre junction in both 2028 and 2035.

3.2.4 A229 Maidstone Road / Asda Access

The modelled results for the A229 Maidstone Road / Asda Access junction are summarised in Table 11 and Table 12.

Table 11: A229 Maidstone Road / Asda Access Junction Impacts - 2028

2028 Assessment Year		A229 N		Asda	
		Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1872	1210	127	114
	Delay	24	337	43	185
	MeanQ	3	35	1	4
	MaxQ	14	52	5	19
PM	Flow	2059	2194	320	325
	Delay	4	5	25	26
	MeanQ	0	0	1	1
	MaxQ	8	8	9	9

Table 12: A229 Maidstone Road / Asda Access Junction Impacts - 2035

2035 Assessment Year		A229 N		Asda	
		Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1918	1125	125	111
	Delay	12	368	31	197
	MeanQ	2	37	1	4
	MaxQ	9	53	4	17
PM	Flow	2076	2188	323	333
	Delay	4	5	26	26
	MeanQ	0	0	1	1
	MaxQ	8	8	9	9

The above tables demonstrate that the proposed development would give rise to increases in delay and queuing on the A229 Maidstone Road north and Adsa access approach during the AM peak hour in both 2028 and 2035. From observing the model it should be noted that the increases modelled here are largely caused by congestion downstream at Bridgewood Roundabout, which results in queues extending back along the A229. This is highlighted by the 35% and 41% decrease in flow observed on the A229 Maidstone Road north approach in both 2028 and 2035, respectively.

3.2.5 A229 Maidstone Road / Shirley Avenue / Retail Park

The modelled results for the A229 Maidstone Road / Shirley Avenue / Retail Park roundabout are summarised in Table 13 and Table 14.

Table 13: A229 Maidstone Road / Shirley Avenue / Retail Park Roundabout Impacts - 2028

2028 Assessment Year		A229 N		Shirley Ave		A229 S		Retail Park	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1609	1273	422	193	1503	1510	62	62
	Delay	8	236	10	647	5	4	3	4
	MeanQ	1	35	1	93	0	0	0	0
	MaxQ	12	89	9	220	11	11	2	2
PM	Flow	1376	1458	588	541	2060	2184	307	299
	Delay	17	22	194	373	10	9	12	11
	MeanQ	2	3	30	59	1	1	0	0
	MaxQ	24	28	70	121	22	21	8	6

Table 14: A229 Maidstone Road / Shirley Avenue / Retail Park Roundabout Impacts - 2035

2035 Assessment Year		A229 N		Shirley Ave		A229 S		Retail Park	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1620	1158	437	179	1507	1498	64	59
	Delay	8	272	10	621	5	9	3	4
	MeanQ	1	39	1	108	0	1	0	0
	MaxQ	14	90	11	258	11	25	2	2
PM	Flow	1391	1449	614	566	2146	2243	291	303
	Delay	19	22	209	379	14	12	14	15
	MeanQ	3	3	33	64	2	2	0	1
	MaxQ	23	37	74	126	30	28	6	10

The above tables demonstrate that the proposed development would give rise to increases in delay and queuing on the A229 Maidstone Road north and Shirley Avenue approach to the roundabout during the AM peak hour in both 2028 and 2035. Similar to A229 / Asda junction, the increases modelled here are the result of congestion downstream at Bridgewood Roundabout causing queues to extend back along the A229. This is demonstrated by the 21% and 29% decrease in flow observed on the A229 Maidstone Road north approach in 2028 and 2035, respectively. In addition to this, a decrease in flow of over 50% is observed on Shirley Avenue in both assessment years during the AM peak hour.

It should be noted that increases in delay and queue lengths are also observed on Shirley Avenue during the PM peak hour in both 2028 and 2035.

3.2.6 Horsted Gyratory

The modelled results for the Horsted Gyratory are summarised in Table 15 and Table 16.

Table 15: Horsted Gyratory Impacts - 2028

2028 Assessment Year		A229 N		Pilots View		A229 S		Marconi Way	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	383	224	37	32	805	702	9	7
	Delay	48	536	14	224	27	29	25	28
	MeanQ	4	52	0	3	2	3	0	0
	MaxQ	21	154	3	9	27	44	1	1
PM	Flow	282	268	39	37	614	604	77	129
	Delay	46	73	12	12	34	37	30	86
	MeanQ	3	5	0	0	3	3	1	3
	MaxQ	18	24	3	3	31	34	4	11

Table 16: Horsted Gyratory Impacts - 2035

2035 Assessment Year		A229 N		Pilots View		A229 S		Marconi Way	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	380	209	36	31	843	674	8	7
	Delay	33	675	14	224	27	42	31	26
	MeanQ	3	67	0	3	2	6	0	0
	MaxQ	19	187	3	9	24	58	1	1
PM	Flow	279	281	34	34	622	607	83	114
	Delay	53	80	13	12	37	37	32	90
	MeanQ	4	6	0	0	3	3	1	3
	MaxQ	18	22	3	3	36	35	5	11

The above tables demonstrate that the proposed development would only give rise to large increases in delay and queuing on the A229 City Wall approach to the gyratory during the

AM peak hour in both 2028 and 2035. Again, the increases in delay and queue length modelled here are the result of congestion downstream along the A229. This is demonstrated by the 41% and 45% decrease in flow observed on the A229 City Wall approach in 2028 and 2035, respectively.

3.2.7 Bridgewood Roundabout

The modelled results for the Bridgewood Roundabout are summarised in Table 17 and Table 18.

Table 17: Bridgewood Roundabout Impacts - 2028

2028 Assessment Year		A229 N		W'slade Woods		A229 S		B2097	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	417	299	1156	1083	568	900	965	944
	Delay	148	420	151	279	25	79	147	521
	MeanQ	8	17	20	45	1	7	27	110
	MaxQ	19	26	78	95	6	34	60	178
PM	Flow	745	859	943	898	899	899	952	956
	Delay	19	18	27	24	22	21	629	646
	MeanQ	2	2	2	2	1	1	131	134
	MaxQ	8	10	11	8	7	7	182	183

Table 18: Bridgewood Roundabout Impacts - 2035

2035 Assessment Year		A229 N		W'slade Woods		A229 S		B2097	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	393	288	1343	1253	641	955	934	939
	Delay	143	432	165	217	27	175	302	537
	MeanQ	7	17	28	39	1	24	60	112
	MaxQ	17	26	78	89	7	61	116	182
PM	Flow	748	825	910	916	935	1002	951	956
	Delay	19	19	35	32	20	20	644	652
	MeanQ	2	2	2	2	1	1	134	135
	MaxQ	9	9	13	11	6	7	180	183

The above tables demonstrate that the proposed development would give rise to increases in delay and queuing on the A229 Maidstone Road north approach to the roundabout during the AM peak hour in both assessment years. Whilst this increase only equates to mean queue length increase of 9 and 10 vehicles in 2028 and 2035, it should be noted that there is only a finite amount of stacking space between Bridgewood Roundabout and the previous junction upstream. As a result queue lengths associated with the A229 Maidstone north approach are underrepresented in the tables above. Notwithstanding this an increase in delay of 184% and 203% is observed in 2028 and 2035, respectively. This congestion results in a bottleneck at the roundabout causing queues to extend back along the A229 affecting junctions further upstream.

The above tables also highlight increases in delay at the Walderslade Woods approach of 85% and 31% during AM peak hour in 2028 and 2035, respectively. As this approach is already operating close to/over capacity in the Reference Case scenarios, the additional demand associated with the development is simply added onto the back of existing queues.

The addition of the development will likely lead to small to moderate increases in delay and queuing along the A229 south approach to the roundabout during the AM peak hour in both assessment years. This is largely attributable to the increased demand associated with the development, with an increase in flow of 58% and 49% observed in 2028 and 2035, respectively.

Table 17 and Table 18 indicate that the B2097 Rochester Road approach to the roundabout will likely operate over capacity in both Reference Case scenarios. Therefore additional demand associated with the development is simply added onto the back of existing queues. This leads to queues impacting junctions further upstream such as the Laker Road and Lankester Parker Road junctions.

3.2.8 Lord Lees Roundabout

The modelled results for the Lord Lees Roundabout are summarised in Table 19 and Table 20.

Table 19: Lord Lees Roundabout Impacts - 2028

2028 Assessment Year		A229 From M'stone Rd		A229 From B'wood Rbt		A229 E		A229 S		Christian Centre	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1252	1235	1252	1235	2567	2565	1994	2083	6	6
	Delay	19	53	19	65	75	83	30	67	20	22
	MeanQ	2	5	2	8	13	15	4	11	0	0
	MaxQ	8	19	7	29	36	40	19	52	2	2
PM	Flow	1011	980	1011	980	2471	2502	2778	2772	41	42
	Delay	16	16	16	17	25	25	29	28	16	16
	MeanQ	1	1	1	1	3	4	3	3	0	0
	MaxQ	7	6	6	6	23	24	21	20	3	3

Table 20: Lord Lees Roundabout Impacts - 2035

2035 Assessment Year		A229 From M'stone Rd		A229 From B'wood Rbt		A229 E		A229 S		Christian Centre	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1398	1332	1398	1332	2566	2629	2169	2157	7	9
	Delay	19	50	19	57	74	81	90	117	20	63
	MeanQ	2	5	2	8	13	15	12	21	0	0
	MaxQ	8	19	8	30	36	39	37	103	2	2
PM	Flow	1008	1012	1008	1012	2701	2650	2839	2850	44	46
	Delay	16	16	16	17	33	34	50	49	17	16
	MeanQ	1	1	1	1	5	5	6	5	0	0
	MaxQ	6	7	6	6	29	29	38	32	4	4

The above tables demonstrate that the proposed development would give rise to a small impact in terms of delay and queue length along the A229 north approaches in both AM peak scenarios.

The tables also indicate that the proposed development would give rise to broadly neutral impact along the A229 east approach in both 2028 and 2035. Given the amount of stacking space on these approaches are constrained by adjacent junctions, the negligible impacts are likely due to residual congestion present at this location in the Reference Case scenarios.

The addition of the development will likely lead increases in delay and queuing along the A229 south approach to the roundabout during the AM peak hour in both assessment years. This increase equates to an increase in max queue length of 33 and 66 vehicles in 2028 and 2035, respectively. This is likely attributable to the increased demand associated with the development, as vehicles are added onto the back of existing queues.

3.2.9 Taddington Wood Roundabout

The modelled results for the Taddington Wood Roundabout are summarised in Table 21 and Table 22.

Table 21: Taddington Wood Roundabout Impacts - 2028

2028 Assessment Year		M2 SB Off Slip		A2045		M2 NB Off Slip		A229 W	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1719	1785	1293	1155	1390	1484	2329	2109
	Delay	20	52	94	119	88	77	54	72
	MeanQ	1	7	15	17	11	10	9	11
	MaxQ	9	33	28	28	51	46	28	32
PM	Flow	2365	2355	1173	1179	1235	1264	2519	2522
	Delay	219	203	25	25	20	20	22	21
	MeanQ	41	37	3	3	1	1	3	3
	MaxQ	112	104	16	15	8	8	18	18

Table 22: Taddington Wood Roundabout Impacts - 2035

2035 Assessment Year		M2 SB Off Slip		A2045		M2 NB Off Slip		A229 W	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1848	1831	1298	1213	1583	1654	2364	2074
	Delay	21	148	99	108	112	196	42	88
	MeanQ	2	26	16	16	16	34	7	14
	MaxQ	12	91	28	28	65	107	24	39
PM	Flow	2306	2236	1123	1132	1448	1467	2558	2529
	Delay	297	383	22	23	23	26	21	19
	MeanQ	61	80	3	3	2	2	3	3
	MaxQ	156	198	14	14	11	14	17	16

The above tables demonstrate that the proposed development would give rise to moderate increases in delay and queuing on the M2 southbound off-slip approach to the roundabout in most assessed periods. Given the above, the modelling indicates that this approach is already operating close to/over capacity in the Reference Case scenarios, particularly in the PM peak. As a result additional demand associated with the development is simply added onto the back of existing queues.

Table 21 and Table 22 also indicate that increase demand associated with the development would likely result in broadly neutral impacts in terms of delay and queuing along the M2 northbound off-slip approach to the roundabout. The only exception to this is during the 2035 AM peak hour scenario where an 18 and 42 vehicle increase in mean and max queue length is observed, respectively.

The modelling demonstrates that the proposed development would give rise to negligible impacts along the A2045 and A229 west approaches in terms of delay and queue length. Similar to other junctions in the vicinity the amount of stacking space on these approaches is constrained by adjacent junctions. Therefore the negligible impacts are likely due to residual congestion present at this location in the Reference Case scenarios, particularly in the AM peak hour.

3.2.10 A2045 Walderslade Woods / A2045

The modelled results for the A2045 Walderslade Woods / A2045 junction are summarised in Table 23 and Table 24.

Table 23: A2045 Walderslade Woods / A2045 Junction Impacts - 2028

2028 Assessment Year		A2045 Walderslade Woods N		A2045		A2045 Walderslade Woods S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	607	489	517	667	413	388
	Delay	85	67	59	110	113	149
	MeanQ	6	3	5	12	14	17
	MaxQ	22	15	24	36	43	46
PM	Flow	1293	1323	683	632	226	221
	Delay	40	31	54	57	49	49
	MeanQ	5	3	7	8	2	2
	MaxQ	23	17	34	36	14	14

Table 24: A2045 Walderslade Woods / A2045 Junction Impacts - 2035

2035 Assessment Year		A2045 Walderslade Woods N		A2045		A2045 Walderslade Woods S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	758	609	667	674	545	592
	Delay	97	78	73	142	126	151
	MeanQ	9	5	7	17	16	18
	MaxQ	31	20	30	38	45	47
PM	Flow	1368	1414	640	627	212	219
	Delay	41	32	50	47	48	46
	MeanQ	5	4	6	5	2	2
	MaxQ	27	18	33	30	12	13

The above table demonstrates that the proposed development would give rise to broadly neutral impacts at the A2045 Walderslade Woods / A2045 junction in both 2028 and 2035. Since this junction is constrained by adjacent junctions in close proximity, the negligible impacts are likely due to residual congestion present at this location in the Reference Case scenarios.

3.2.11 A2045 Walderslade Woods / Fostington Way

The modelled results for the A2045 Walderslade Woods / Fostington roundabout are summarised in Table 25 and Table 26.

Table 25: A2045 Walderslade Woods / Fostington Way Roundabout Impacts - 2028

2028 Assessment Year		A2045 Walderslade Woods N		Fostington Way		A2045 Walderslade Woods S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	934	837	833	830	735	586
	Delay	3	3	80	130	190	305
	MeanQ	0	0	15	25	28	38
	MaxQ	7	5	73	83	68	75
PM	Flow	2095	2159	579	567	568	587
	Delay	4	4	6	7	4	4
	MeanQ	0	0	0	0	0	0
	MaxQ	5	5	10	15	4	4

Table 26: A2045 Walderslade Woods / Fostington Way Roundabout Impacts - 2035

2035 Assessment Year		A2045 Walderslade Woods N		Fostington Way		A2045 Walderslade Woods S	
		Ref	Ref + IPM	Ref	Ref + IPM	Ref	Ref + IPM
AM	Flow	1094	937	875	890	628	623
	Delay	5	4	114	93	295	272
	MeanQ	0	0	23	19	38	36
	MaxQ	9	7	82	89	76	75
PM	Flow	2085	2051	587	611	535	521
	Delay	3	3	7	6	4	4
	MeanQ	0	0	0	0	0	0
	MaxQ	4	4	13	10	4	3

The above tables demonstrate that the proposed development would give rise to small increases in delay and queuing on the Fostington Way and A2045 Walderslade Woods south approaches to the roundabout during the 2028 AM peak hour. Observations from the model indicate that queues along these approaches stem from congestion further upstream, which is highlighted by the relatively low flows modelled at these approaches in the Reference Case scenarios. As a result, additional demand associated with the development is added onto the back of these existing queues.

4 Results – Do Something

4.1 Introduction

Based on the model results a number of possible mitigation schemes have been identified and these are set out in the following sections. It should be noted that the mitigation schemes have only been tested within the model and no assessment of engineering feasibility or deliverability (e.g. need for third party land) has been undertaken at this stage.

4.2 Possible Mitigation Schemes

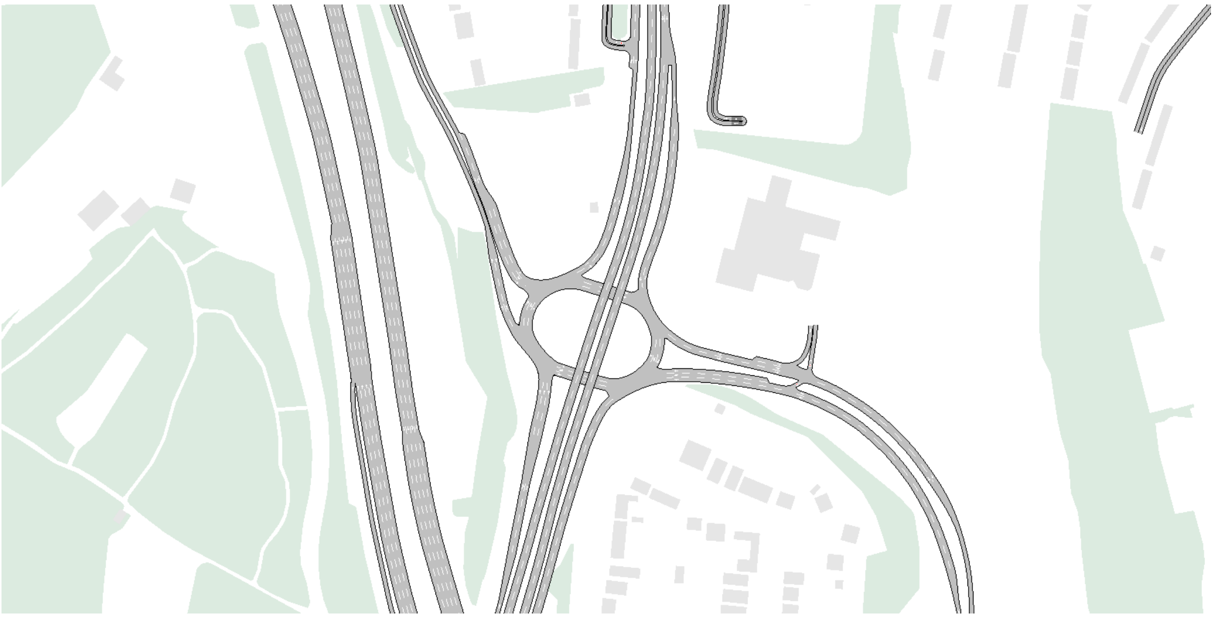
4.2.1 Bridgewood Roundabout

A two-lane exit is suggested for the B2097 Rochester Road exit from the Bridgewood Roundabout alongside changes to lane allocations on the roundabout. This allows more efficient use of the available capacity on the other approaches to the roundabout and alleviates the large queue that blocks back along the A2045 Walderslade Woods in the AM peak future year scenarios.

Widening of the flare on the B2097 Rochester Road entry to the model is also suggested in order to discharge the large demand associated with the proposed development on this arm of the junction, particularly during the PM peak hour.

The suggested mitigation, as coded in the model, is shown in Screenshot 5.

Screenshot 5: Bridgewood Roundabout Possible Mitigation

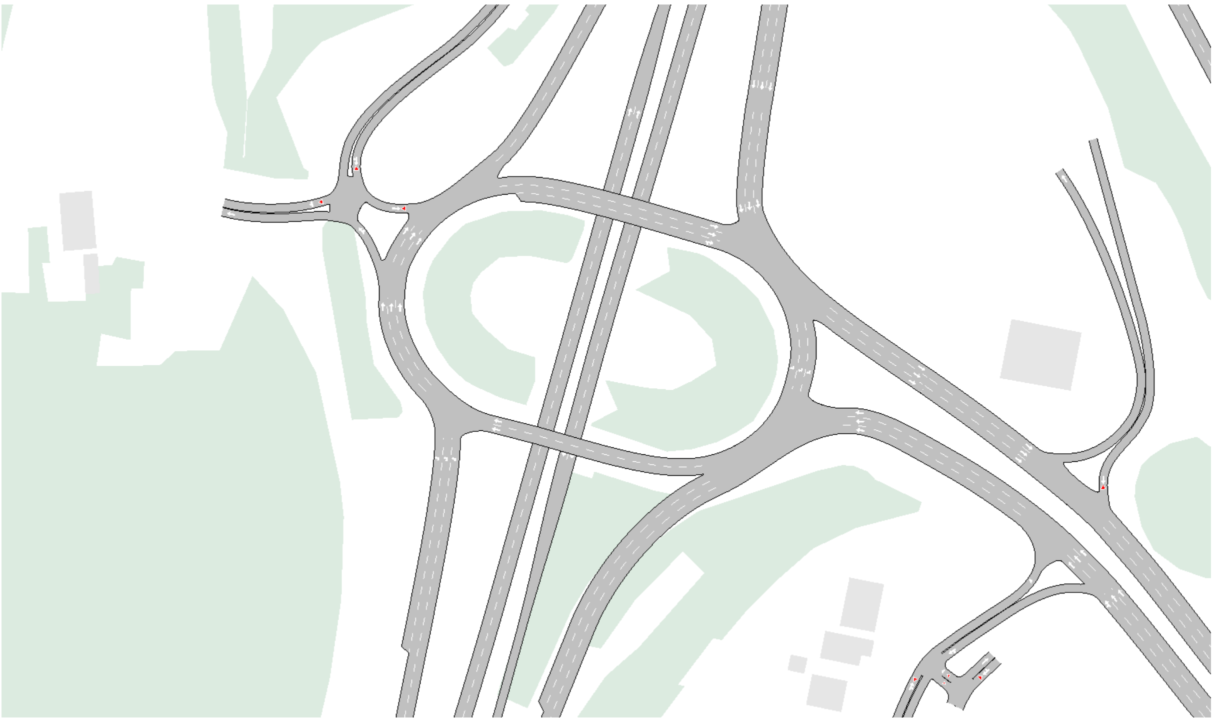


4.2.2 Lord Lees Roundabout

At the Lord Lees Roundabout, it is suggested that the three-lane flare on the southbound approach is lengthened, three lanes are provided on the eastern side of the circulatory, and a three lane exit is provided on the southbound exit from the roundabout. This provides additional capacity on the eastern side of the roundabout which addresses the large queue that forms on the southbound approach. Also, by providing more capacity on the circulatory carriageway, a small amount of green time can be reallocated to the A229 westbound approach, reducing queueing and delay on this arm of the junction.

The suggested mitigation, as coded in the model, is shown in Screenshot 6.

Screenshot 6: Lord Lees Roundabout Possible Mitigation



4.2.3 B2097 Rochester Road / Rochester Airport Estate Access

The proposed development increases the demand at the existing right turn into the Rochester Airport Estate from the B2097 Rochester Road. At the same time, opposing traffic flows in the southbound direction are also increased, reducing the capacity of the right turn manoeuvre, which results in a large queue extending south along Rochester Road. It is suggested that a ghost-island right turn lane is provided at this junction, to prevent vehicles blocking traffic going ahead and resulting in a large queue.

The suggested mitigation, as coded in the model, is shown in Screenshot 7.

Screenshot 7: B2097 Rochester Road / Rochester Airport Estate Access Possible Mitigation

4.3 Network Wide Model Statistics

Network statistics provide a strategic overview of the performance of the whole network. These statistics have been extracted for the modelled subnetwork to understand the wider network impacts of the development. The statistics are summarised in Table 27 and Table 28 for the AM and PM peak hours with the development and the possible mitigation in place.

Table 27: Do Something Network Statistics – AM Peak Hour – Do Something

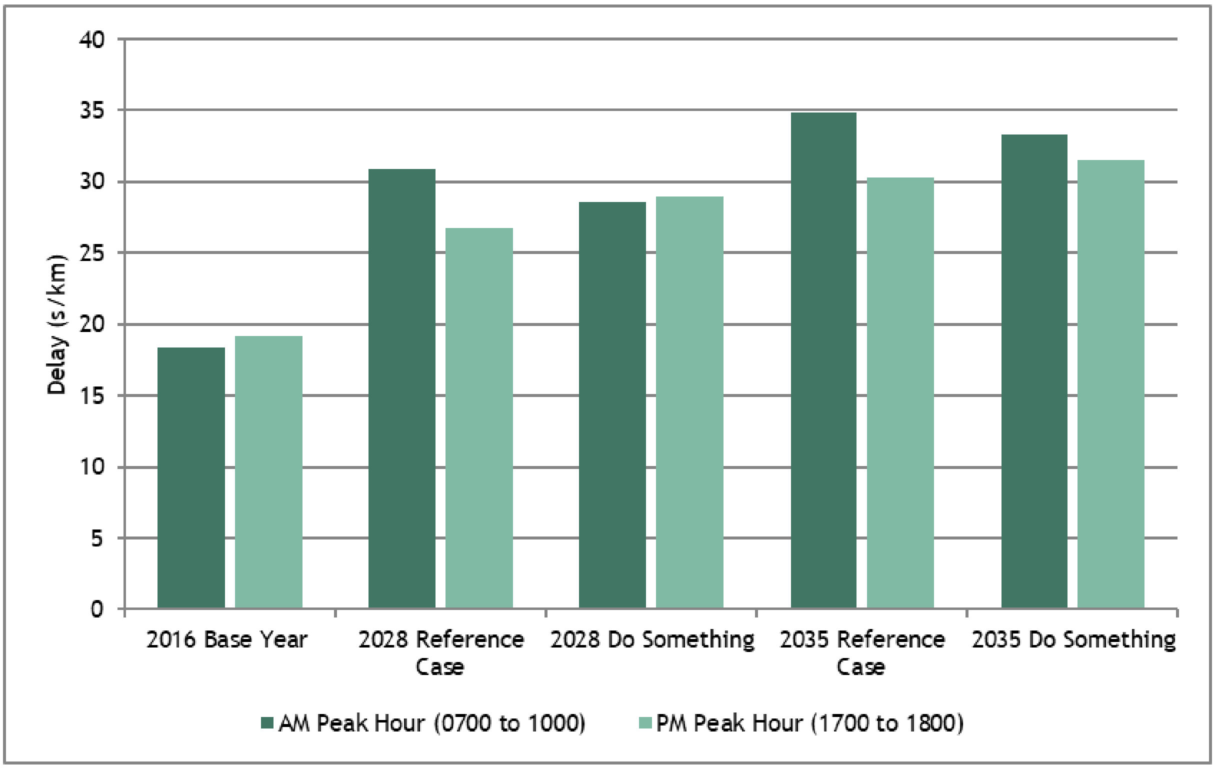
Statistic		AM Peak Hour (0800 to 0900)				
	Units	2016 Base Year	2028 Reference Case	2028 Do Something	2035 Reference Case	2035 Do Something
Summary Statistics						
Travel Time	sec/km	66.0	78.4	76.6	82.3	81.1
Delay	sec/km	18.4	30.9	28.6	34.9	33.3
Flow	veh/h	21,187.3	24,108.2	25,193.9	25,193.0	26,183.3
Speed	km/h	66.2	62.4	62.7	60.8	61.2
Stop Time	sec/km	13.1	24.1	21.9	27.3	26.0
Density	veh/km	10.1	13.2	13.2	14.9	15.0
Mean Queue	veh	296.9	612.3	553.6	786.0	741.5
Mean Virtual Queue	veh	22.8	155.1	112.8	243.7	262.1
Waiting Time in Virtual Queue	sec	4.1	13.6	10.3	15.7	15.8
Total Statistics						
Total Travelled Time	h	2,051	2,660	2,661	2,962	2,968
Total Travelled Distance	km	141,887	164,494	169,401	174,233	178,609
Average travel time / vehicle	s/veh	348	397	380	423	408
Throughput						
Vehicles Out	veh	21,187	24,108	25,194	25,193	26,183
Vehicles In	veh	1,634	2,310	2,363	2,683	2,715
Vehicles Waiting to Enter	veh	0	205	149	428	489
Total	veh	22,821	26,623	27,706	28,304	29,387

Table 28: Network Statistics – PM Peak Hour – Do Something

Statistic		PM Peak Hour (1700 to 1800)				
	Units	2016 Base Year	2028 Reference Case	2028 Do Something	2035 Reference Case	2035 Do Something
Summary Statistics						
Travel Time	sec/km	66.5	74.3	76.9	78.3	79.7
Delay	sec/km	19.2	26.7	29.0	30.3	31.5
Flow	veh/h	24,294.2	27,672.7	28,308.8	28,811.8	29,202.9
Speed	km/h	67.9	63.6	62.0	61.8	60.1
Stop Time	sec/km	13.3	18.8	21.0	21.5	22.5
Density	veh/km	12.3	15.5	15.9	17.1	17.7
Mean Queue	veh	416.3	654.0	641.4	822.1	839.9
Mean Virtual Queue	veh	69.5	170.6	156.1	375.3	382.8
Waiting Time in Virtual Queue	sec	1.0	9.1	11.9	20.7	24.9
Total Statistics						
Total Travelled Time	h	2,358	2,957	3,057	3,173	3,282
Total Travelled Distance	km	165,664	190,220	192,919	195,137	195,631
Average travel time / vehicle	s/veh	349	385	389	396	405
Throughput						
Vehicles Out	veh	24,294	27,673	28,309	28,812	29,203
Vehicles In	veh	2,446	3,315	3,427	3,788	4,173
Vehicles Waiting to Enter	veh	131	310	254	740	695
Total	veh	26,871	31,297	31,990	33,340	34,071

A selection of statistics have been presented as graphs, consistent with Section 4.1. Graph 3 shows network delay for each scenario during the AM and PM peak hours. The graph indicates that implementation of the mitigation scheme would provide an overall betterment when compared to the Reference Case during both AM peak periods. This would equate to a 7% reduction in delay in 2028 and a 4% reduction in 2035. During the PM peak the mitigation scheme would not provide nil detriment. However, the impact of the development is much smaller during this period, equating to a 9% to 4% increase in network delay in the Do Something scenarios. Therefore, the AM peak is considered the critical period in terms of development impact.

Graph 3: Network Delay – Do Something

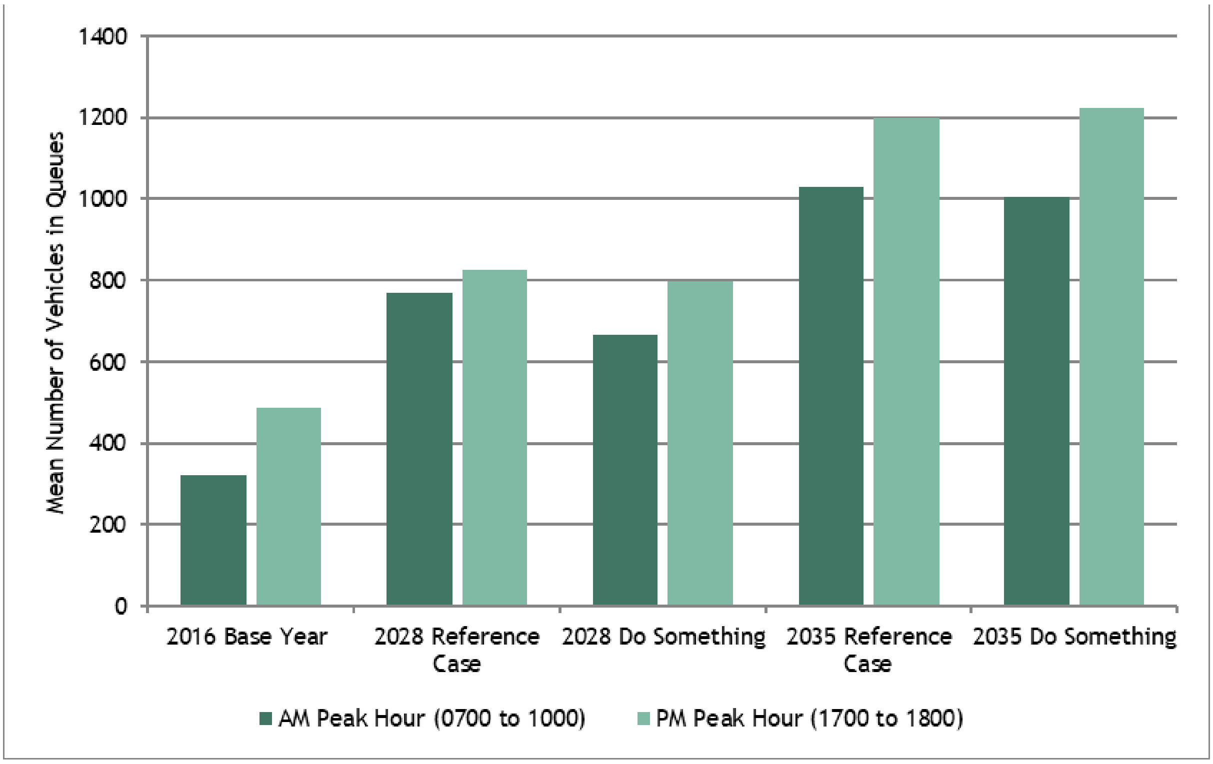


As mentioned in Section 3.1, the above delay statistics are only collected for vehicles that have crossed the network (i.e. entered and exited the network) during the modelled period. As such, statistics for vehicles that are still in the network, or are in virtual queues waiting to enter the network, are not represented in the results. This means that the delay statistics reported are often understated.

For this reason, it is also important to consider the level of queuing in the model, which a direct indicator of congestion.

Graph 4 shows mean queuing in the Do Something scenarios. The graph illustrates the efficacy of the mitigation scheme during both AM peak hour scenarios. The introduction of the scheme would likely provide an overall betterment on the Reference Case, resulting in a 13% and 3% decrease in queuing across the network. Similarly to network delay, the mitigation proposals would have a smaller impact on network queuing during the PM peak hour. In 2028 this would result in a slight betterment on the Reference Case scenario, equating to a decrease of 3%. Whereas in 2035 a 2% increase is reported. This increase is not observed to cause significant detriment to the network in the vicinity of the development.

Graph 4: Network Congestion – Do Something



In summary, the delivery of the mitigation scheme would provide material benefits to the network in this area during the AM peak. These benefits are considered to offset the small impacts of the development during the PM peak, where the development does not result in significant detriment on the surrounding highway network.

4.4 Impacts at Key Junctions

This section considers the impact of the proposed development on key junctions on the local highway network.

Flow, delay, mean queue and maximum queue on each approach to the considered junctions have been presented for the AM and PM peak hours with the mitigation scheme in place, and also for the reference case, which is the benchmark against which the impact of the development should be compared.

4.4.1 B2097 Rochester Road / Lankester Parker Road

The modelled results for the B2097 Rochester Road / Lankester Parker Road junction are summarised in Table 29 and Table 30.

Table 29: B2097 Rochester Road / Lankester Parker Road Junction Impacts – 2028 Do Something

2028 Assessment Year		B2097 N		Lankester Park Road		B2097 S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	978	1022	51	67	1159	1253
	Delay	3	3	59	21	16	6
	MeanQ	0	0	1	0	2	1
	MaxQ	13	13	7	5	28	12
PM	Flow	947	1076	38	375	798	792
	Delay	106	2	643	159	3	3
	MeanQ	23	0	17	16	0	0
	MaxQ	51	8	21	22	1	1

Table 30: B2097 Rochester Road / Lankester Parker Road Junction Impacts – 2035 Do Something

2035 Assessment Year		B2097 N		Lankester Park Road		B2097 S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	985	1012	52	65	1144	796
	Delay	3	3	43	25	19	3
	MeanQ	0	0	1	0	3	0
	MaxQ	16	13	5	5	22	1
PM	Flow	950	1205	21	316	778	805
	Delay	118	5	1168	195	3	3
	MeanQ	26	1	19	17	0	0
	MaxQ	52	13	21	22	1	1

The above tables demonstrate that the mitigation proposals would provide benefits in terms of delay and queuing across all approaches to the junction in all assessed scenarios.

4.4.2 B2097 Rochester Road / Laker Road

The modelled results for the B2097 Rochester Road / Laker Road junction are summarised in Table 31 and Table 32.

Table 31: B2097 Rochester Road / Laker Road junction Impacts – 2028 Do Something

2028 Assessment Year		B2097 N		Laker Road		B2097 S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	969	1028	3	176	1169	1717
	Delay	3	3	6	10	4	14
	MeanQ	0	0	0	0	0	1
	MaxQ	4	1	1	5	1	12
PM	Flow	930	1408	13	197	797	840
	Delay	235	12	664	97	3	4
	MeanQ	51	3	9	8	0	0
	MaxQ	78	19	26	23	0	1

Table 32: B2097 Rochester Road / Laker Road junction Impacts – 2035 Do Something

2035 Assessment Year		B2097 N		Laker Road		B2097 S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	971	1010	4	149	1146	845
	Delay	25	3	86	9	5	4
	MeanQ	5	0	0	0	0	0
	MaxQ	26	1	2	5	3	2
PM	Flow	932	1476	10	125	776	856
	Delay	248	20	759	483	3	4
	MeanQ	53	5	8	25	0	0
	MaxQ	77	29	21	45	0	2

The above tables demonstrate that the proposed mitigation would give rise to significant decreases delay and queuing, as well as increases in flow on the B2097 Rochester Road north approach to the junction. These improvements are the result of capacity improvements upstream at Bridgewood Roundabout.

Whilst Table 31 and Table 32 indicate that queue lengths on the Laker Road approach would increase with the mitigation scheme in place, large decreases in delay are observed, particularly in the PM peak. It should also be noted that significant increases in flow are reported at this approach demonstrating an increase in capacity.

4.4.3 A229 Maidstone Road / Innovation Centre Access

The modelled results for the A229 Maidstone Road / Innovation Centre Access junction are summarised in Table 33 and Table 34.

Table 33: A229 Maidstone Road / Innovation Centre Access Junction Impacts – 2028 Do Something

2028 Assessment Year		A229 S		Innovation Centre	
		Ref	DS	Ref	DS
AM	Flow	1744	1997	23	65
	Delay	1	1	18	19
	MeanQ	0	0	0	0
	MaxQ	1	2	3	6
PM	Flow	2455	2573	20	126
	Delay	1	2	32	55
	MeanQ	0	0	0	2
	MaxQ	1	8	4	13

Table 34: A229 Maidstone Road / Innovation Centre Access Junction Impacts – 2035 Do Something

2035 Assessment Year		A229 S		Innovation Centre	
		Ref	DS	Ref	DS
AM	Flow	1750	1974	25	123
	Delay	1	1	16	47
	MeanQ	0	0	0	2
	MaxQ	1	1	3	13
PM	Flow	2526	2557	18	120
	Delay	1	2	30	68
	MeanQ	0	0	0	2
	MaxQ	2	11	2	15

The above tables demonstrate that the mitigation proposals would result in negligible impacts at the A229 Maidstone Road / Innovation Centre junction. However, it should be noted that the development was observed to have a marginal impact at this junction.

4.4.4 A229 Maidstone Road / Asda Access

The modelled results for the A229 Maidstone Road / Asda Access junction are summarised in Table 35 and Table 36.

Table 35: A229 Maidstone Road / Asda Access Junction Impacts – 2028 Do Something

2028 Assessment Year		A229 N		Asda	
		Ref	DS	Ref	DS
AM	Flow	1872	2141	127	122
	Delay	24	4	43	22
	MeanQ	3	0	1	0
	MaxQ	14	5	5	3
PM	Flow	2059	2079	320	321
	Delay	4	17	25	42
	MeanQ	0	2	1	2
	MaxQ	8	15	9	14

Table 36: A229 Maidstone Road / Asda Access Junction Impacts – 2035 Do Something

2035 Assessment Year		A229 N		Asda	
		Ref	DS	Ref	DS
AM	Flow	1918	2195	125	317
	Delay	12	4	31	31
	MeanQ	2	0	1	1
	MaxQ	9	6	4	12
PM	Flow	2076	2072	323	315
	Delay	4	15	26	42
	MeanQ	0	2	1	2
	MaxQ	8	13	9	14

The above tables demonstrate that the proposed mitigation would not result in material changes in delay and queuing at the junction. Notwithstanding this, the results indicate an improvement in flow at the A229 Maidstone Road north approach during the AM peak, which is the result of capacity improvements upstream at Bridgewood Roundabout.

4.4.5 A229 Maidstone Road / Shirley Avenue / Retail Park

The modelled results for the A229 Maidstone Road / Shirley Avenue / Retail Park roundabout are summarised in Table 37 and Table 38.

Table 37: A229 Maidstone Road / Shirley Avenue / Retail Park Roundabout Impacts – 2028 Do Something

2028 Assessment Year		A229 N		Shirley Ave		A229 S		Retail Park	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	1609	1828	422	420	1503	1638	62	57
	Delay	8	15	10	13	5	6	3	5
	MeanQ	1	2	1	1	0	1	0	0
	MaxQ	12	24	9	11	11	15	2	2
PM	Flow	1376	1411	588	569	2060	2223	307	293
	Delay	17	26	194	306	10	33	12	27
	MeanQ	2	4	30	50	1	7	0	1
	MaxQ	24	41	70	108	22	57	8	11

Table 38: A229 Maidstone Road / Shirley Avenue / Retail Park Roundabout Impacts – 2035 Do Something

2035 Assessment Year		A229 N		Shirley Ave		A229 S		Retail Park	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	1620	1853	437	440	1507	1622	64	60
	Delay	8	13	10	14	5	5	3	5
	MeanQ	1	1	1	1	0	1	0	0
	MaxQ	14	25	11	11	11	14	2	2
PM	Flow	1391	1377	614	586	2146	2198	291	297
	Delay	19	51	209	364	14	28	14	21
	MeanQ	3	9	33	61	2	7	0	1
	MaxQ	23	67	74	126	30	59	6	11

The above tables demonstrate that the mitigation scheme would result in an improvement in flow at the A229 Maidstone Road north approach during the AM peak, due to the capacity improvements upstream. The proposed mitigation would not alleviate the queuing along the Shirley Avenue approach to the roundabout, where 112 and 155 seconds of extra delay are incurred per vehicle in the 2028 and 2035 PM peak hour, respectively.

4.4.6 Horsted Gyratory

The modelled results for the Horsted Gyratory are summarised in Table 39 and Table 40.

Table 39: Horsted Gyratory Impacts – 2028 Do Something

2028 Assessment Year		A229 N		Pilots View		A229 S		Marconi Way	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	383	396	37	38	805	815	9	9
	Delay	48	210	14	16	27	30	25	34
	MeanQ	4	17	0	0	2	3	0	0
	MaxQ	21	37	3	3	27	27	1	1
PM	Flow	282	266	39	38	614	635	77	120
	Delay	46	136	12	12	34	46	30	215
	MeanQ	3	9	0	0	3	4	1	7
	MaxQ	18	29	3	3	31	40	4	16

Table 40: Horsted Gyratory Impacts – 2035 Do Something

2035 Assessment Year		A229 N		Pilots View		A229 S		Marconi Way	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	380	399	36	36	843	843	8	8
	Delay	33	234	14	17	27	31	31	28
	MeanQ	3	18	0	0	2	3	0	0
	MaxQ	19	39	3	4	24	29	1	2
PM	Flow	279	270	34	36	622	605	83	124
	Delay	53	128	13	15	37	41	32	184
	MeanQ	4	9	0	0	3	4	1	6
	MaxQ	18	29	3	3	36	41	5	16

The above tables demonstrate that with the mitigation scheme in place, the proposed development would still give rise to increase in delay and queuing along the A229 City Wall approach to the gyratory. In 2028 this would equate to a 13 and 6 vehicle increase in mean queue length in the AM and PM peak, respectively. Whereas in 2035, this would likely be a 15 and 5 vehicle increase in the AM and PM peak, respectively. It should also be noted that an increase in delay and queuing is observed on Marconi Way with the development in place.

4.4.7 Bridgewood Roundabout

The modelled results for the Bridgewood Roundabout are summarised in Table 41 and Table 42.

Table 41: Bridgewood Roundabout Impacts – 2028 Do Something

2028 Assessment Year		A229 N		W'slade Woods		A229 S		B2097	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	417	698	1156	1263	568	769	965	1209
	Delay	148	26	151	58	25	20	147	26
	MeanQ	8	2	20	7	1	1	27	2
	MaxQ	19	11	78	41	6	5	60	11
PM	Flow	745	695	943	1090	899	1113	952	1617
	Delay	19	101	27	23	22	17	629	111
	MeanQ	2	9	2	2	1	1	131	15
	MaxQ	8	28	11	8	7	7	182	53

Table 42: Bridgewood Roundabout Impacts – 2035 Do Something

2035 Assessment Year		A229 N		W'slade Woods		A229 S		B2097	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	393	682	1343	1357	641	835	934	1169
	Delay	143	35	165	73	27	19	302	31
	MeanQ	7	3	28	10	1	1	60	2
	MaxQ	17	13	78	60	7	5	116	14
PM	Flow	748	665	910	1097	935	1170	951	1588
	Delay	19	91	35	26	20	20	644	186
	MeanQ	2	8	2	2	1	2	134	26
	MaxQ	9	24	13	9	6	9	180	74

The above tables demonstrate that with the mitigation scheme in place, both delay and queuing would be reduced on the A229 Maidstone Road north approach in the AM peak when compared to the Reference Case. Whilst this decrease only equates to mean queue length increase of 6 and 4 vehicles in 2028 and 2035, it should be noted that queue lengths associated with the A229 Maidstone north approach are underrepresented in the tables above. This is due to the finite amount of stacking space between Bridgewood Roundabout and the previous junction upstream. When considering flow along the approach, an increase of 67% and 74% is reported in 2028 and 2035, respectively. These benefits effectively eliminate the queues that extended back along the A229 in the Reference Case with Proposed Development scenario. It should be noted that minor increases in delay and queue lengths are still observed in the PM peak hours, however these are seen an acceptable given the AM peak is the critical period in terms of development impact.

Table 41 and Table 42 also highlight the benefits observed along the Walderslade Woods approach to the roundabout. During the respective AM peak periods a reduction in incurred delay and mean queue length of over 50% is reported.

At the A229 south approach the small to moderate increases in delay and queuing reported in the Reference Case with Proposed Development scenario has been eliminated, resulting in nil detriment.

Given that the B2097 Rochester Road approach to the roundabout would likely operate over capacity in both Reference Case scenarios, the capacity improvements provided by the mitigation proposals would provide significant benefits in terms of reported delay and queuing. The mitigation scheme would likely result in a mean queue length decrease of more than 90% and 80% during AM and PM peak hours, respectively.

4.4.8 Lord Lees Roundabout

The modelled results for the Lord Lees Roundabout are summarised in Table 43 and Table 44.

Table 43: Lord Lees Roundabout Impacts – 2028 Do Something

2028 Assessment Year		A229 From M'stone Rd		A229 From B'wood Rbt		A229 E		A229 S		Christian Centre	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	1252	1283	1252	1283	2567	2759	1994	2101	6	6
	Delay	19	24	19	25	75	44	30	29	20	19
	MeanQ	2	2	2	2	13	8	4	4	0	0
	MaxQ	8	11	7	10	36	34	19	19	2	1
PM	Flow	1011	1610	1011	1610	2471	2297	2778	2773	41	38
	Delay	16	24	16	25	25	31	29	23	16	17
	MeanQ	1	3	1	3	3	4	3	2	0	0
	MaxQ	7	12	6	12	23	22	21	18	3	3

Table 44: Lord Lees Roundabout Impacts – 2035 Do Something

2035 Assessment Year		A229 From M'stone Rd		A229 From B'wood Rbt		A229 E		A229 S		Christian Centre	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	1398	1377	1398	1377	2566	2842	2169	2287	7	7
	Delay	19	23	19	23	74	44	90	86	20	19
	MeanQ	2	2	2	2	13	8	12	12	0	0
	MaxQ	8	11	8	11	36	33	37	39	2	1
PM	Flow	1008	1682	1008	1682	2701	2412	2839	2891	44	48
	Delay	16	20	16	20	33	32	50	27	17	21
	MeanQ	1	2	1	2	5	5	6	3	0	0
	MaxQ	6	11	6	10	29	23	38	20	4	5

The above tables demonstrate that with the mitigation scheme in place, the proposed development would result in broadly nil detriment at both A229 north approaches when considering incurred delay and queuing. However, it should be noted that a significant increase in flow is reported at the approach during both PM peak scenarios. This is likely the result of capacity improvements reducing congestion on the network in this area.

At the A229 east approach to the roundabout, the mitigation scheme would likely provide small benefits in terms of delay and queuing during the assessed AM peak hour scenarios. During the PM peak scenarios, the introduction of the scheme would provide nil detriment when compared to the Reference Case scenario.

Table 43 and Table 44 also indicate that with the mitigation scheme in place, the proposed development would still likely provide no detriment to the A229 south approach during both AM peak hours. During the PM peak hours, the proposed mitigation would provide a slight betterment on the Reference Case scenarios.

4.4.9 Taddington Wood Roundabout

The modelled results for the Taddington Wood Roundabout are summarised in Table 45 and Table 46.

Table 45: Taddington Wood Roundabout Impacts – 2028 Do Something

2028 Assessment Year		M2 SB Off Slip		A2045		M2 NB Off Slip		A229 W	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	1719	1784	1293	1403	1390	1534	2329	2357
	Delay	20	19	94	88	88	29	54	43
	MeanQ	1	1	15	15	11	2	9	7
	MaxQ	9	9	28	28	51	20	28	23
PM	Flow	2365	2286	1173	1158	1235	1247	2519	2603
	Delay	219	257	25	23	20	20	22	26
	MeanQ	41	51	3	3	1	1	3	5
	MaxQ	112	137	16	14	8	7	18	16

Table 46: Taddington Wood Roundabout Impacts – 2035 Do Something

2035 Assessment Year		M2 SB Off Slip		A2045		M2 NB Off Slip		A229 W	
		Ref	DS	Ref	DS	Ref	DS	Ref	DS
AM	Flow	1848	1945	1298	1326	1583	1728	2364	2454
	Delay	21	22	99	99	112	74	42	43
	MeanQ	2	2	16	16	16	10	7	7
	MaxQ	12	13	28	28	65	50	24	23
PM	Flow	2306	2199	1123	1143	1448	1448	2558	2659
	Delay	297	377	22	23	23	22	21	30
	MeanQ	61	83	3	3	2	2	3	6
	MaxQ	156	212	14	13	11	10	17	18

The above tables demonstrate that with the mitigation scheme in place, the proposed development would result in nil detriment on the M2 southbound off-slip approach to the roundabout during the assessed AM peak periods. However, during the PM peak the development would result in a small to moderate impact on the M2 southbound off-slip. This impact would equate to a 10 and 22 vehicle increase in mean queue length during the 2028 and 2035 PM peak hour, respectively.

Table 45 and Table 46 also indicate that the mitigation proposals would likely give rise to benefits at the M2 northbound off-slip approach to the roundabout during both AM peak scenarios. These benefits would equate to a decrease in incurred delay and mean queue length of over 65% in 2028 and more than 30% in 2035. During the assessed PM peak scenarios, the delivery of the proposed development with mitigation scheme would result in nil detriment to this approach.

The modelling demonstrates that the proposed development with the mitigation scheme in place would result in nil detriment to the A2045 and A229 west approaches in terms of delay and queue length.

4.4.10 A2045 Walderslade Woods / A2045

The modelled results for the A2045 Walderslade Woods / A2045 junction are summarised in Table 47 and Table 48.

Table 47: A2045 Walderslade Woods / A2045 Junction Impacts – 2028 Do Something

2028 Assessment Year		A2045 Walderslade Woods N		A2045		A2045 Walderslade Woods S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	607	697	517	554	413	516
	Delay	85	109	59	60	113	113
	MeanQ	6	9	5	5	14	15
	MaxQ	22	26	24	25	43	44
PM	Flow	1293	1558	683	778	226	264
	Delay	40	53	54	58	49	46
	MeanQ	5	8	7	8	2	2
	MaxQ	23	35	34	35	14	13

Table 48: A2045 Walderslade Woods / A2045 Junction Impacts – 2035 Do Something

2035 Assessment Year		A2045 Walderslade Woods N		A2045		A2045 Walderslade Woods S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	758	700	667	712	545	235
	Delay	97	150	73	66	126	46
	MeanQ	9	14	7	6	16	2
	MaxQ	31	31	30	29	45	14
PM	Flow	1368	1563	640	805	212	237
	Delay	41	54	50	55	48	46
	MeanQ	5	8	6	7	2	2
	MaxQ	27	35	33	35	12	13

The above tables demonstrate that with the mitigation scheme in place, the proposed development would result in broadly neutral impacts at the A2045 Walderslade Woods / A2045 junction in all assessed periods.

4.4.11 A2045 Walderslade Woods / Fostington Way

The modelled results for the A2045 Walderslade Woods / Fostington roundabout are summarised in Table 49 and Table 50.

Table 49: A2045 Walderslade Woods / Fostington Way Roundabout Impacts – 2028 Do Something

2028 Assessment Year		A2045 Walderslade Woods N		Fostington Way		A2045 Walderslade Woods S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	934	986	833	858	735	840
	Delay	3	4	80	58	190	174
	MeanQ	0	0	15	11	28	27
	MaxQ	7	7	73	80	68	72
PM	Flow	2095	2241	579	573	568	570
	Delay	4	3	6	5	4	4
	MeanQ	0	0	0	0	0	0
	MaxQ	5	5	10	10	4	4

Table 50: A2045 Walderslade Woods / Fostington Way Roundabout Impacts - 2035 Do Something

2035 Assessment Year		A2045 Walderslade Woods N		Fostington Way		A2045 Walderslade Woods S	
		Ref	DS	Ref	DS	Ref	DS
AM	Flow	1094	1010	875	943	628	533
	Delay	5	5	114	112	295	4
	MeanQ	0	0	23	24	38	0
	MaxQ	9	8	82	85	76	3
PM	Flow	2085	2189	587	607	535	533
	Delay	3	3	7	6	4	4
	MeanQ	0	0	0	0	0	0
	MaxQ	4	4	13	15	4	3

The above tables demonstrate that with the mitigation scheme in place, the proposed development would result in nil detriment to A2045 Walderslade Woods / Fostington Way roundabout in all assessed periods.

5 Summary and Conclusions

5.1 Summary

This report presents the impact on the highway network for the proposed IPM development, which has been tested using the Medway Aimsun Model.

A Reference Case scenario, which was previously developed as part of the Local Plan modelling has been modelled to determine the baseline against which impacts of the development can be compared. The scenario includes all committed developments and committed highway improvements (up to November 2017) that are expected to be in place by the assessment years.

In addition to this, a Reference Case scenario has also been developed with IPM in place to determine the impact of the proposed development. Given the reported impacts of the development, a final Do Something scenario was developed, which includes mitigation proposals to negate the impact of the proposed development on the surrounding highway network.

Network wide statistics from the micro modelling forecast the network in this area to operate over capacity in the Reference Case scenario and demonstrate that the addition of the proposed development would result in significant further detriment on the surrounding highway network. However, the delivery of the development alongside the proposed mitigation scheme would provide material benefits to the network in this area during the AM peak. These benefits are considered to offset the small impacts of the development during the PM peak, where the development does not result in significant detriment on the surrounding highway network.

Detailed impacts at key junctions on the local highway network indicate the delivery of IPM and the associated mitigation would largely provide nil detriment on the Reference Case scenario and, at some locations, provide a betterment on this scenario. However, it should be noted that additional traffic associated with IPM would result in some detriment to the surrounding network at some locations, such as the A229 City Wall approach to the Horsted Gyratory, where increases in delay and queue lengths are reported. Notwithstanding this, these impacts do not result in significant detriment to the operation of the highway network.

5.2 Limitations

Regarding the local highway network in the vicinity of the site, the Reference Case scenario only includes Local Plan commitments and committed highway improvements up to November 2017. Therefore, it does not include sites in the vicinity such as the Horsted Retail Park application. It should be considered that such development proposals near the site will have an impact on key junctions if no mitigation measures are proposed.