Report

Pump Lane and Lower Rainham Transport Impact Appraisal Addendum 2 (2028 results)

On behalf of Medway Council

Sweco UK Limited
4th Floor, Radcliffe House
Blenheim Court
Solihull, B91 2AA
+44 121 711 6600

16/12/2020
Project Reference: [0]
Document Reference: [3]
Revision: [1]
Prepared For: Medway Council

Status / Revisions

Rev.	Date	Reason for issue	Prepared		Reviewed		Approved	
[1]	6.1.2021	First Draft	AP	6.1.2021	DH	7.1.2021	KJ	8.1.2021

Reg. Office Address:
Sweco UK Limited
Grove House
Mansion Gate Drive
Leeds, LS7 4DN
+44 113 262 0000

Reg. No.: 2888385
Reg. Office: Leeds

www.sweco.co.uk

Sweco UK Limited
4th Floor, Radcliffe House
Blenheim Court
Solihull, B91 2AA
+44 121 711 6600

Alkis Papadoulis
Transport Modeller

alkis.papadoulis@sweco.co.uk

Table of contents

Table of figures

Table of Tables

Appendices

1 Introduction

This report is an addendum to the “Pump Lane and Lower Rainham Transport Impact Appraisal Report” produced by Sweco in October 2020. This report was produced as a result of the discussions between Medway Council and the developer. As a result of these discussions, several additional modelling scenarios were developed. This report will present the results of the year 2028 scenarios only. The following sections present the amendments to the model, the demand used for each scenario and the results from the microsimulation for the selected subnetworks around the development area.

2 Model amendments

The two main differences between the modelling undertaken in this report and the previous report are:

i) The trip rates used for the demand to and from the development area and
ii) The centroid configuration around the development area.

2.1 Development Demand

The development demand as calculated by the developer along with the demand calculated by Sweco is presented in Table 1. It is observed that the demand calculated by the developer is 26% (214 two-way trips) and 31% (245 (two-way trips) lower than the strategic model demand that Sweco calculated in the AM and PM scenarios accordingly. The trip rates used to derive the strategic model demand have been presented in detail in the previous report and technical notes produced by Sweco (Note name “Pump_Farm_Lower_Rainham_ref_MC. 19.1566_Sweco_Response.docx on the 10th of December 2020).

This report will present the results of an Aimsun scenario using the demand calculated by the developer.

Table 1 Development demand

Demand	AM Peak			PM Peak		
	In	Out	Total	In	Out	Total
Developer Demand	187	398	585	365	193	558
Strategic Model Demand	175	624	799	497	306	803

2.2 Development zone configuration

The second issue around the modelling of the development area in the previous report, was the fact that the demand of the development zone was added on top of an existing centroid (Aimsun vehicle input and output) which included the demand of the reference case scenario and had a connection to Lower Bloors Lane as shown in Figure 1.

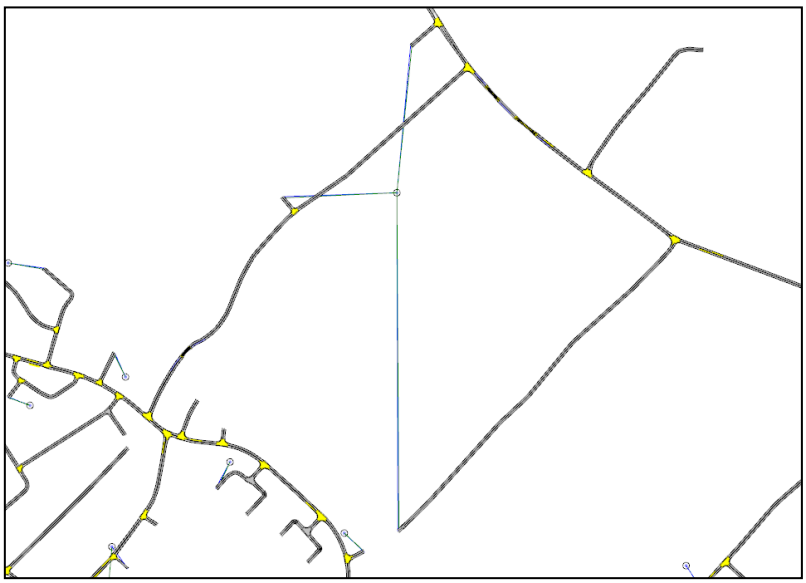

Figure 1 Original report development zone configuration in Aimsun

This report will present the results of the following new additional scenarios:

A) The **LRR Scenario 4** where the demand of the development is still added on top of the reference case demand in the same centroid, but the centroid connection to Lower Bloors Lane is removed, because, as proved by the select link analysis plots provided together with the previous report, the reference case traffic was not using the centroid connection to Lower Bloors Lane. The LRR Scenario 4 configuration is shown in Figure 2 (LRR Scenario 4)

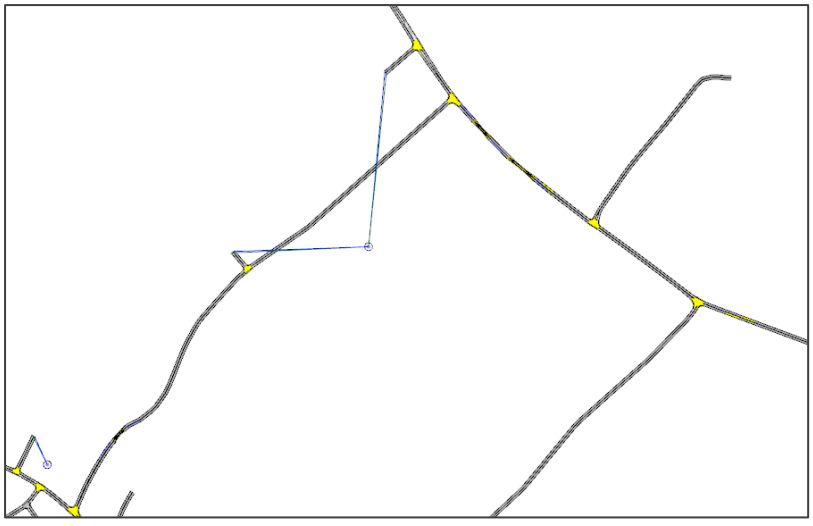

Figure 2 LRR Scenario 4 development zone configuration in Aimsun

B) The **LRR Scenario 5** and **LRR Scenario 6** where the demand of the development is assigned to a new standalone development zone (centroid), solely used for the modelling of the development, as shown in Figure 3. In Scenario 5, the development strategic model demand is used, while in Scenario 6, the developer demand is used.

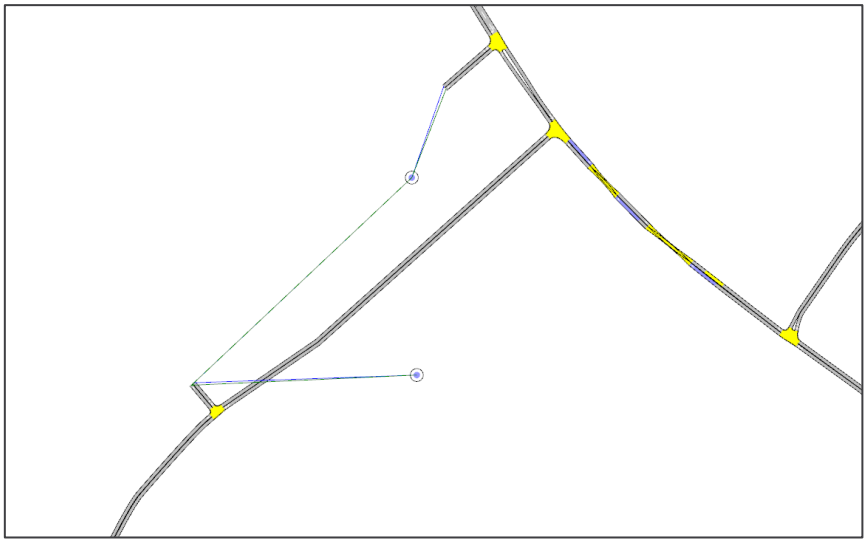

Figure 3 LRR Scenario 5 and 6 development zone configuration in Aimsun

2.3 Scenarios

The scenarios produced as a result of the aforementioned model amendments are presented in Table 2.

Table 2 Additional Pump Lane development evaluation scenarios

Scenario No	Year	Trip rates for development at Pump Lane (centroid 442792)	Development zone used	Centroid Configuration
Reference Case	2028	N/A	N/A	N/A
LRR Scenario 4	2028	Strategic Model Trip rates	Existing strategic zone	Two access points
LRR Scenario 5	2028	Strategic Model Trip rates	Standalone development zone	Two access points
LRR Scenario 6	2028	Developer Trip rates	Standalone development zone	Two access points

2.4 Additional output analysis

In addition to the results provided in the previous report produced by Sweco, this report will present the following additional results:

- Three additional junctions have been added to the Level of Service results presented in this report to provide a direct comparison between the results presented in the developer's report and Sweco's report. The methodology used to calculate the Level of Service results has been analysed in the original report.
- The travel time results for several key paths in the three subnetworks around the development area are presented in this report in order to underline the impacts of the development on traffic. The travel times have been extracted both for the reference case and the new additional scenarios. In order to calculate the travel time for the paths, the appropriate Subpaths have been defined in the Aimsun model, by selecting the corresponding sections for each of them. The path travel time results shown in the following subnetwork sections will also show the absolute difference and percent difference compared to the reference case scenario.

3 Results

3.1 Subnetwork 2

Initially, the Subnetwork 2 statistics for AM and PM peak times are presented in Table 3 and Table 4 accordingly. An increase in average travel time (25%), delay (around 45%) and queue (around 76% and 97% in the AM and PM peak time accordingly) is observed between the 2028 Reference case and the scenarios including the development (LRR Scenarios 4, 5 and 6). Consequently, a decrease in average speed is observed between the reference case and the development scenarios. It needs to be underlined that the difference in travel time, delay, speed and mean queue between the development scenarios (4,5 and 6) is small and can be attributed to the inherent randomness of the microsimulation. For example, the difference in travel time between LRR Scenario 4 and 5 is 1 second per kilometer which can be considered negligible. The percent change for each statistic is presented graphically in Figure 4 and Figure 5 for the AM and PM peak times accordingly.

Table 3 Subnetwork 2 Statistics AM peak

Statistic	AM Peak (0800 to 0900)				
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	193	245	246	246
Delay	sec/km	119	172	173	173
Speed	km/h	27.9	26.5	26.8	26.4
Mean Queue	veh	489	861	861	854

Table 4 Subnetwork 2 Statistics PM Peak

Statistic	PM Peak (1700 to 1800)				
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	165	205	206	206
Delay	sec/km	93	132	134	133
Speed	km/h	31.2	27.6	27.6	27.8
Mean Queue	veh	284	559	557	563

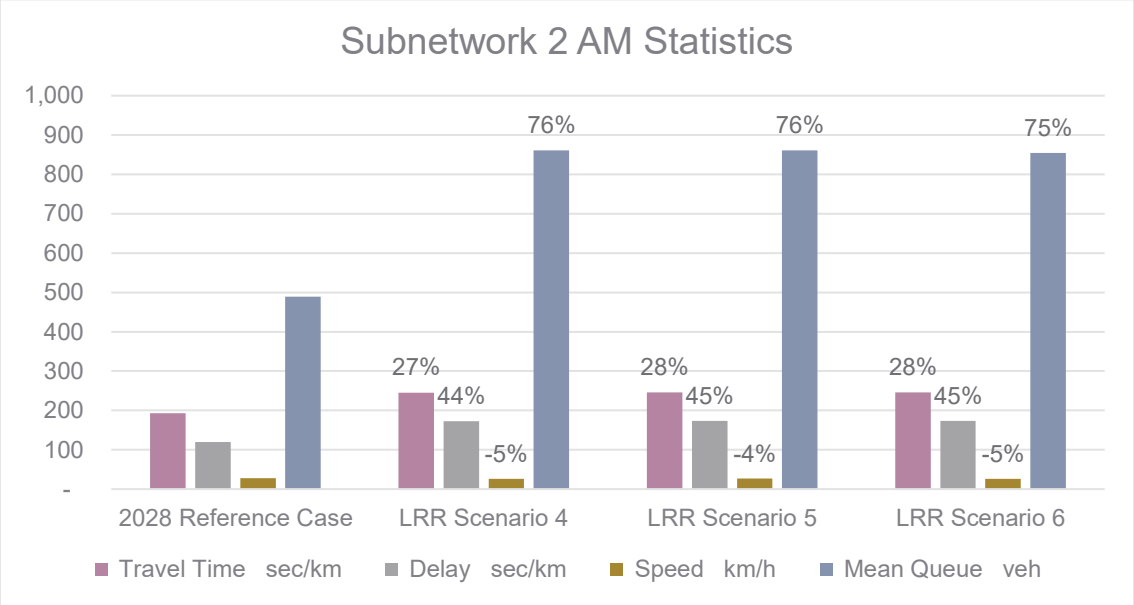

Figure 4 Subnetwork 2 AM Statistics

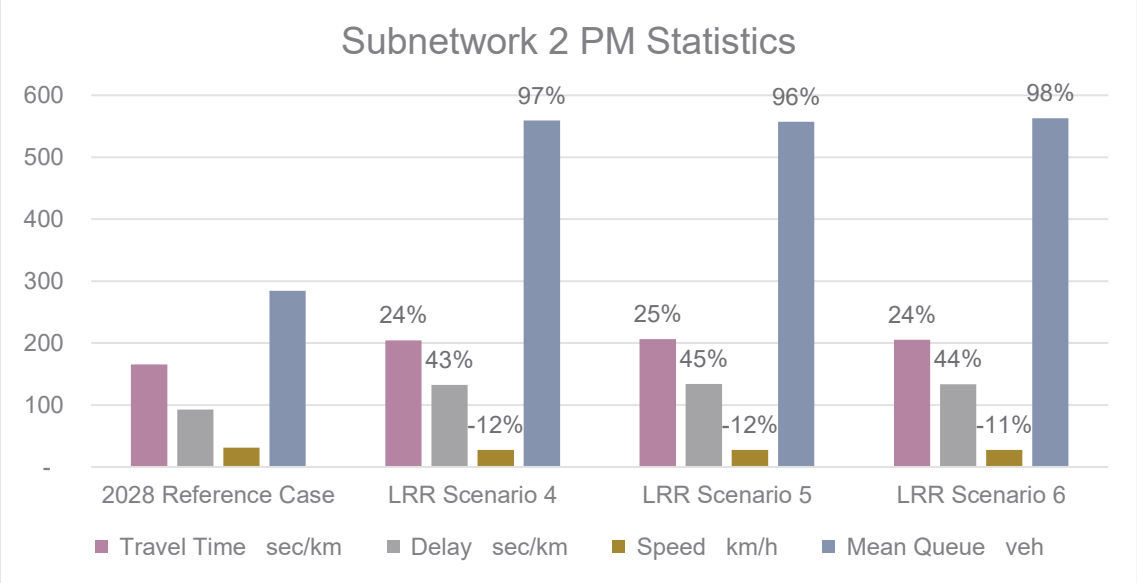

Figure 5 Subnetwork 2 PM Statistics

Table 5 and Table 6 present the Level of Service results for key junctions in Subnetwork 2. The location of each junction and roundabout is shown in Figure 6.

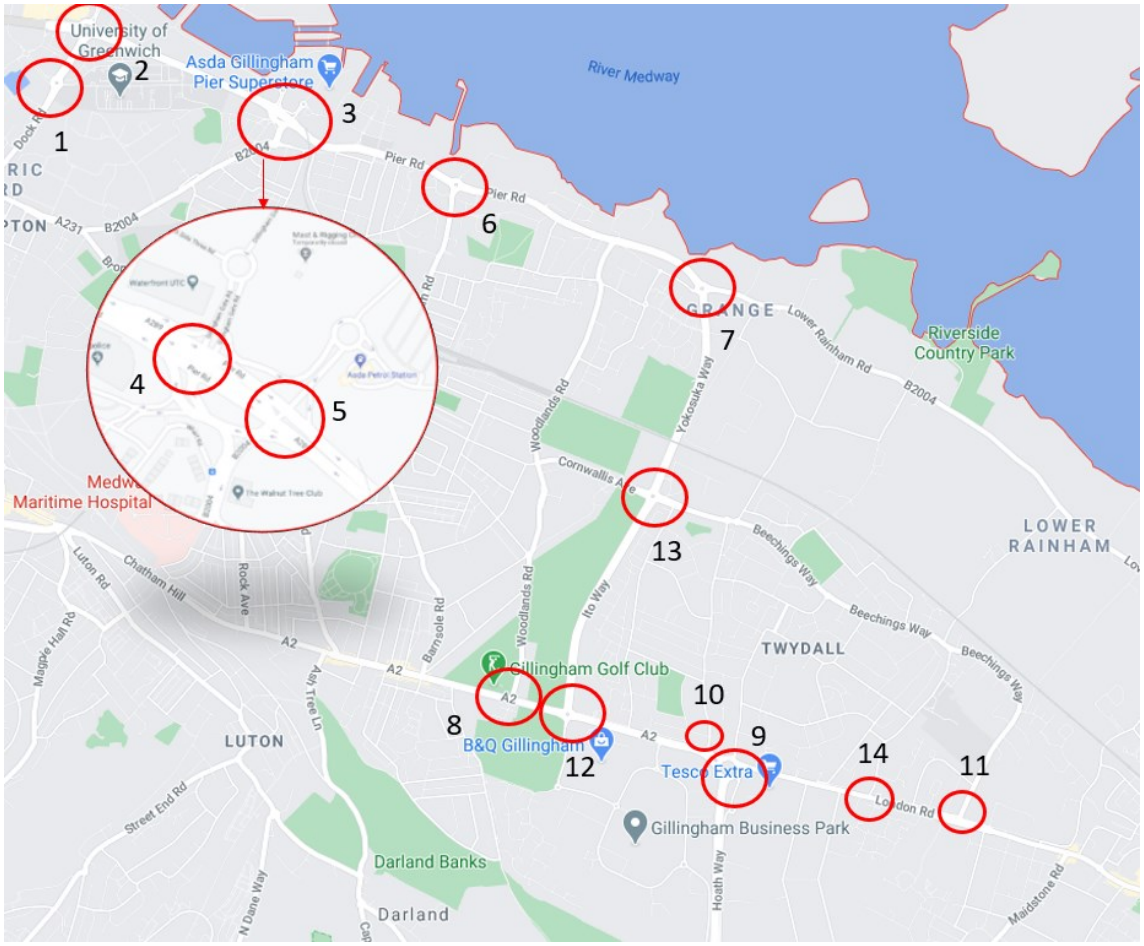

Figure 6 Subnetwork 2 Junctions and Roundabouts

It is observed that:

- Junctions number 8, 9 and 12 Level of Service goes to F where the demand of the junction exceeds capacity, in the AM scenarios where the development is present
- Junctions number 2, 4 ,9 and 10 Level of Service goes to F in the PM scenarios where the development is present
- Very small to no change is observed between the development scenarios (LRR Scenarios 4, 5 and 6)
- No additional Junctions with level of service F are observed in Subnetwork 2 junctions between years 2028 and 2037. The traffic growth between those years is not large enough to break the functionality of junctions.

Table 5 Subnetwork 2 Junction Level of Service AM Peak

Junction	ID	Ref AM	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Pembroke/Dock Road/Western Avenue/ Maritime Way Roundabout	1	C	C	C	C
A289 (Pier Road/ Maritime Way Roundabout)	2	C	C	C	C
A289 (Pier Road / Gillingham Gate Road)	3	D	D	D	D
A289 Pier Road / Gillingham Gate Road West	4	D	E	E	E
A289 Pier Road / Gillingham Gate Road East	5	C	C	C	C
A289 Pier Road / Church Street / Strand Junction	6	C	C	C	C
A289 (Yokosuka Way Roundabout)	7	F	F	F	F
A2 (Rotary Gardens / Woodlands Road / Sovereign Boulevard Junction)	8	D	F	F	F
A2 (Bowater Roundabout)	9	B	E	F	F
Eastcourt Lane / South Avenue	10	F	F	F	F
A2 (London Road / Bloors Lane Junction)	11	D	D	D	D
A289 (Ito Way / Sovereign Boulevard)	12	A	F	F	F
A2 (Yokosuka / Ito / Beechings Way Roundabout)	13	A	A	A	A
A2 / Pump Lane	14	A	E	E	E

Table 6 Subnetwork 2 Junction Level of Service PM Peak

Junction	ID	Ref PM	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Pembroke/Dock Road/Western Avenue/ Maritime Way Roundabout	1	A	A	A	A
A289 (Pier Road/ Maritime Way Roundabout)	2	C	F	F	F
A289 (Pier Road / Gillingham Gate Road)	3	D	D	E	D
A289 Pier Road / Gillingham Gate Road West	4	D	F	F	F
A289 Pier Road / Gillingham Gate Road East	5	B	C	C	C
A289 Pier Road / Church Street / Strand Junction	6	B	C	C	C
A289 (Yokosuka Way Roundabout)	7	A	A	A	A
A2 (Rotary Gardens / Woodlands Road / Sovereign Boulevard Junction)	8	C	D	E	E
A2 (Bowater Roundabout)	9	D	F	F	F
Eastcourt Lane / South Avenue	10	D	F	F	F
A2 (London Road / Bloors Lane Junction)	11	C	D	D	D
A289 (Ito Way / Sovereign Boulevard)	12	A	A	A	A
A2 (Yokosuka / Ito / Beechings Way Roundabout)	13	A	A	A	A
A2 / Pump Lane	14	A	D	D	D

Figure 7 shows the paths analysed in terms of travel time in subnetwork 2, while Table 7 and Table 8 present the path travel time results for the AM and PM Peak periods accordingly. The most outstanding difference is observed in:

- A289 (Church Street) to A278 (Hoath Way) and A2 (Watling to Sovereign Boulevard) where the travel time increases by 66-75% and 113-117% accordingly in the AM scenarios. This increase is around 10 minutes for and 13 minutes for Path 4. It is considered a significant increase and it is much higher than the increase observed in the corresponding values in 2037.
- A289 (Church Street) to A278 (Hoath Way) and A278 (Hoath Way) to A289 (Church Street) and A2 (Watling to Sovereign Boulevard) where the travel time increases by 31 to 40%, 37 to 55% and 94% to 104% accordingly in the PM scenarios. This increase is around 3-4 minutes, 3-4 minutes and 6-7 minutes accordingly and can be considered significant.
- The differences between the path travel time results of the development scenarios are considered small and can be attributed to the stochasticity (randomness) of the microsimulation.

Figure 7 Subnetwork 2 Paths

Table 7 Subnetwork 2 Path travel time AM Peak

Path	2028 Reference Case AM	LRR Scenario 4 (sec)			LRR Scenario 5 (sec)			LRR Scenario 6 (sec)		
		Value	Abs Diff	% Diff	Value	Abs Diff	% Diff	Value	Abs Diff	% Diff
A289 (Church Street) to A278 (Hoath Way)	800	1,390	591	74%	1,400	601	75%	1,330	530	66%
A278 (Hoath Way) to A289 (Church Street)	604	638	34	6%	639	35	6%	615	11	2%
A2 (Sovereign Boulevard to Watling Road)	400	422	22	6%	427	27	7%	426	26	6%
A2 (Watling to Sovereign Boulevard)	672	1,460	788	117%	1,456	784	117%	1,433	760	113%
A289 (Church Street to Lower Rainham)	140	140	-	0%	141	1	1%	139	0	0%
A289 (Lower Rainham to Church Street)	121	123	2	2%	124	3	2%	123	2	2%

Table 8 Subnetwork 2 Path travel time PM Peak

Path	2028 Reference Case AM	LRR Scenario 4 (sec)			LRR Scenario 5 (sec)			LRR Scenario 6 (sec)		
		Value	Abs Diff	% Diff	Value	Abs Diff	% Diff	Value	Abs Diff	% Diff
A289 (Church Street) to A278 (Hoath Way)	565	791	226	40%	778	213	38%	740	175	31%
A278 (Hoath Way) to A289 (Church Street)	402	622	220	55%	576	174	43%	552	150	37%
A2 (Sovereign Boulevard to Watling Road)	384	400	16	4%	399	15	4%	396	12	3%
A2 (Watling to Sovereign Boulevard)	423	863	440	104%	845	422	100%	821	398	94%
A289 (Church Street to Lower Rainham)	156	161	5	3%	163	7	5%	160	3	2%
A289 (Lower Rainham to Church Street)	119	124	5	4%	122	3	3%	122	3	2%

3.1.1 Subnetwork 2 Summary

Initially, the subnetwork 2 statistics results showed that traffic conditions in the subnetwork deteriorate in all the scenarios where the development exists, and a substantial increase in delay, travel time and queue is observed between those scenarios and the reference case. The difference between the scenarios using the strategic model demand and the scenarios using the

developer demand seems to be small compared to the difference between the reference case and the development scenarios.

Additionally, Junction level of service results showed that the demand for Junctions number 8, 9 and 12 Level of Service exceeds capacity in the AM development scenarios. In the PM development scenarios, the demand for Junctions number 2, 4 ,9 and 10 exceeds capacity. Very small to no change is observed between the development scenarios in terms of Junction Level of Service.

Finally, path travel time results underlined that the travel time for paths A289 (Church Street) to A278 (Hoath Way) and A2 (Watling to Sovereign Boulevard) in the AM peak and paths A289 (Church Street) to A278 (Hoath Way), A278 (Hoath Way) to A289 (Church Street) and A2 (Watling to Sovereign Boulevard) in the PM peak increases substantially between the 2028 case scenario and the development scenarios. The large increase in travel time of the path A2 (Watling Road to Sovereign Boulevard) was not observed in the 2037 scenarios. The travel times results seemed to not show significant differences among the development scenarios.

Overall, it needs to be underlined that besides the A2 (Watling to Sovereign Boulevard) increase in travel time, no other additional congestion hotspots are observed in the 2028 results compared to the 2037 results.

3.2 Subnetwork 3

The Subnetwork 3 statistics for AM and PM peak times are presented in Table 9 and Table 10 accordingly. It is observed that the increase in average travel time, delay and queue between the reference case 2028 and the development scenarios is smaller than the increase observed in subnetwork 2. It needs to be underlined that the difference in travel time, delay, speed and mean queue between the three new LRR scenarios is small and can be attributed to the stochasticity of the microsimulation. For example, the difference in travel time between LRR Scenario 4 and 5 is 7 seconds per kilometer in the AM peak scenario which can be considered negligible. The percent change for each statistic is presented graphically in Figure 8 and Figure 9 for the AM and PM peak times accordingly.

Table 9 Subnetwork 3 Statistics AM Peak

Statistic		AM Peak (0800 to 0900)			
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	239	245	252	245
Delay	sec/km	153	160	166	160
Speed	km/h	19.0	19.3	19.5	19.5
Mean Queue	veh	63	71	75	70

Table 10 Subnetwork 3 Statistics PM Peak

Statistic	PM Peak (1700 to 1800)				
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	255	279	287	277
Delay	sec/km	169	193	201	192
Speed	km/h	18.3	18.0	17.7	18.0
Mean Queue	veh	65	95	97	95

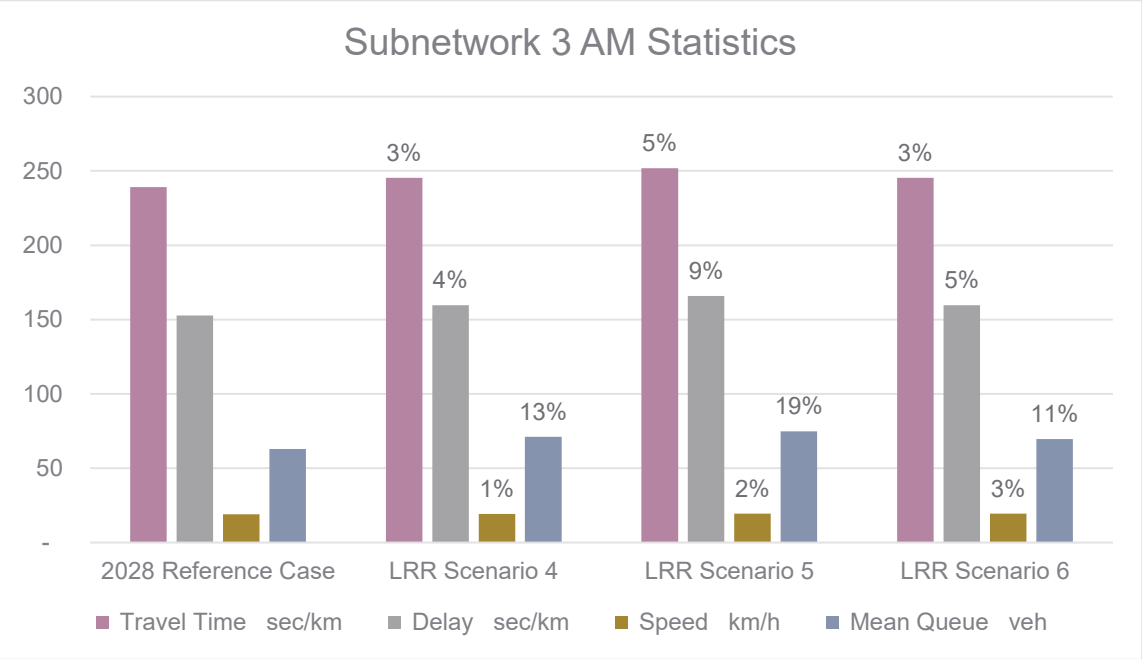

Figure 8 Subnetwork 3 Statistics AM

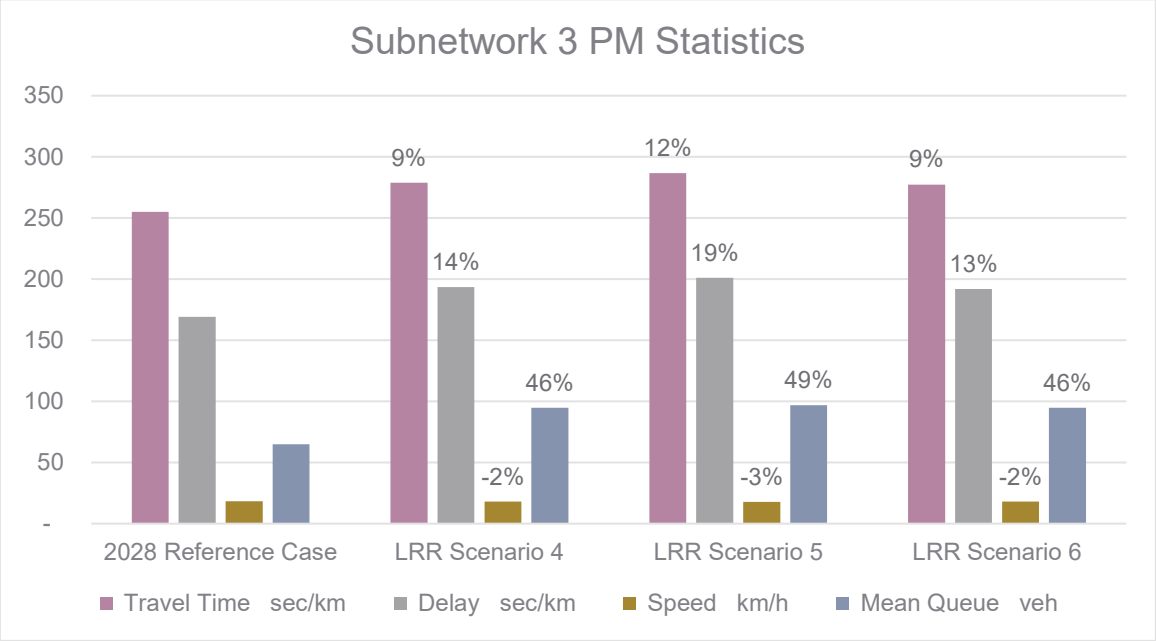

Figure 9 Subnetwork 3 Statistics PM

Table 11 and Table 12 present the Level of Service results for key junctions in Subnetwork 3. The location of each junction and roundabout is shown in Figure 10.

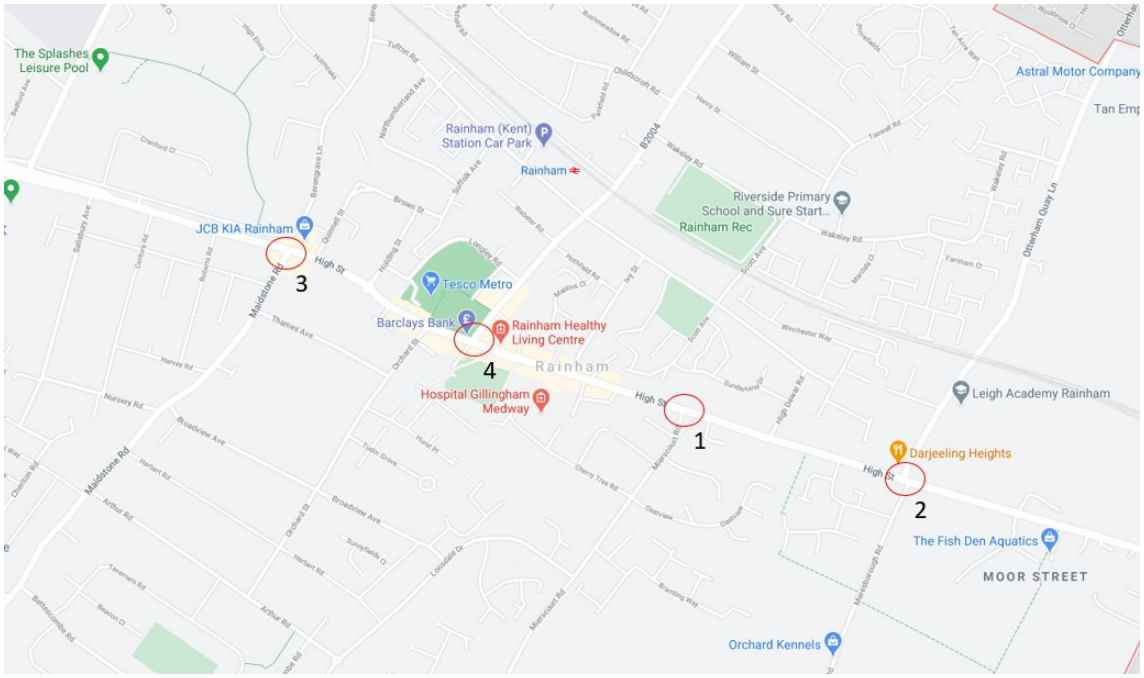

Figure 10 Subnetwork 3 Junctions and Roundabouts

It is observed that the demand at Junction 2 (A2 (Otterham Quay Lane/Merersborough Road) in the new LRR scenarios exceeds capacity, an effect which is not present in the reference case scenario. For this specific junction, in 2037, the results had showed an increase between sensitivity 1 scenario results and Scenarios 1,2 and 3 from D to F, which was attributed to the loss of the Lower Bloors lane centroid connector from the development.

A small increase in level of service is observed in the rest of the junctions but in none of them the demand exceeds capacity. The results between the new LRR scenarios do not show any difference. The 2028 results do not seem to be different than the 2037 results.

Table 11 Subnetwork 3 Junction Level of Service AM

Junction	ID	2028 RC AM	LRR Scenario 4 AM	LRR Scenario 5 AM	LRR Scenario 6 AM
A2 (Mierscourt Road_High Street Junction)	**1**	C	E	E	E
Otterham Quay Lane_Meresborough	**2**	D	F	F	F
Sovereign Bd & Maidstone Rd	**3**	C	D	D	D
Sovereign Bd & Station Rd	**4**	C	D	D	D

Table 12 Subnetwork 3 Junction Level of Service PM

Junction	ID	2028 RC PM	LRR Scenario 4 PM	LRR Scenario 5 PM	LRR Scenario 6 PM
Mierscourt Road_High Street Junction	**1**	D	E	E	E
Otterham Quay Lane_Meresborough	**2**	D	F	F	F
Sovereign Bd & Maidstone Rd	**3**	C	D	D	D
Sovereign Bd & Station Rd	**4**	C	D	D	D

Finally, Figure 11 shows the location of the subnetwork 3 paths which are analysed in terms of travel time, while the travel time results are presented in Table 13 and Table 14 for the AM peak and PM peak scenarios accordingly. A large increase is observed for the path A2 (Moor Street to Sovereign Boulevard) in both the AM and the PM peak scenarios. More specifically, in the PM peak scenario travel time for the A2 corridor (WB) is increased by 278 (64%) to 314 (72%) seconds which is approximately 5 minutes.

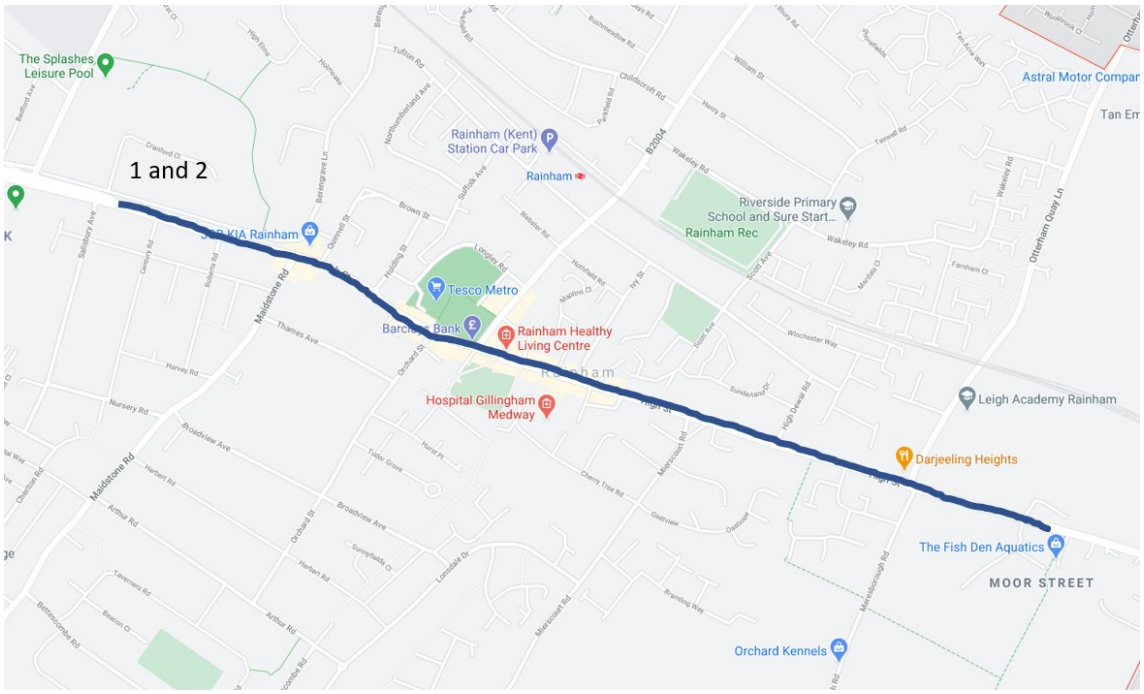

Figure 11 Subnetwork 3 Paths

Table 13 Subnetwork 3 Path travel time AM

Path	2028 Reference Case AM	LRR Scenario 4 (sec)			LRR Scenario 5 (sec)			LRR Scenario 6 (sec)		
		Value	Abs Diff	% Diff	Value	Abs Diff	% Diff	Value	Abs Diff	% Diff
A2 (Moor Street to Sovereign Boulevard)	538	629	91	17%	674	136	25%	619	81	15%
A2 (Sovereign Boulevard to Moor Street)	321	341	20	6%	341	20	6%	336	16	5%

Table 14 Subnetwork 3 Path travel time PM

Path	2028 Reference Case AM	LRR Scenario 4 (sec)			LRR Scenario 5 (sec)			LRR Scenario 6 (sec)		
		Value	Abs Diff	% Diff	Value	Abs Diff	% Diff	Value	Abs Diff	% Diff
A2 (Moor Street to Sovereign Boulevard)	433	747	314	72%	734	301	69%	734	278	64%
A2 (Sovereign Boulevard to Moor Street)	372	409	38	10%	423	51	14%	419	48	13%

3.2.1 Subnetwork 3 Summary

Initially, the subnetwork average statistics showed that even though there is an increase in average travel time, delay and queue between the reference case 2028 and the development scenarios, it is smaller than the increase observed in subnetwork 2.

Furthermore, demand at Junction 2 (A2 (Otterham Quay Lane/Merersborough Road) in the new LRR scenarios exceeds capacity, an effect which is not present in the reference case scenario. Finally, an increase of 2 and 5 minutes (65-70% and 61% accordingly) is observed for A2 (Moor Street to Sovereign Boulevard) in subnetwork 3 in both the AM and the PM peak scenarios. Overall, no substantial difference was observed between the results of the new LRR scenarios.

3.3 Subnetwork 7

Initially, the Subnetwork 7 statistics for AM and PM peak times are presented in Table 15 and Table 16 accordingly. It is observed that even though there is a very large increase in queue between reference case and all the scenarios where the development is present (LRR Scenario 4,5 and 6), the results between the development scenarios do not show big fluctuations. The statistics results are presented graphically in Figure 12 and Figure 13. It is observed that in the scenarios where the development is present, the travel time remains almost constant in the PM Peak scenarios.

Table 15 Subnetwork 7 Statistics AM Peak

Statistic	AM Peak (0800 to 0900)				
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	139	163	163	158
Delay	sec/km	59	83	83	78
Speed	km/h	36.1	34.0	34.0	34.3
Mean Queue	veh	54	151	157	136

Table 16 Subnetwork 7 Statistics PM Peak

Statistic	PM Peak (1700 to 1800)				
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	123	150	153	152
Delay	sec/km	42	69	72	71
Speed	km/h	37.9	36.2	36.0	36.3
Mean Queue	veh	27	57	61	59

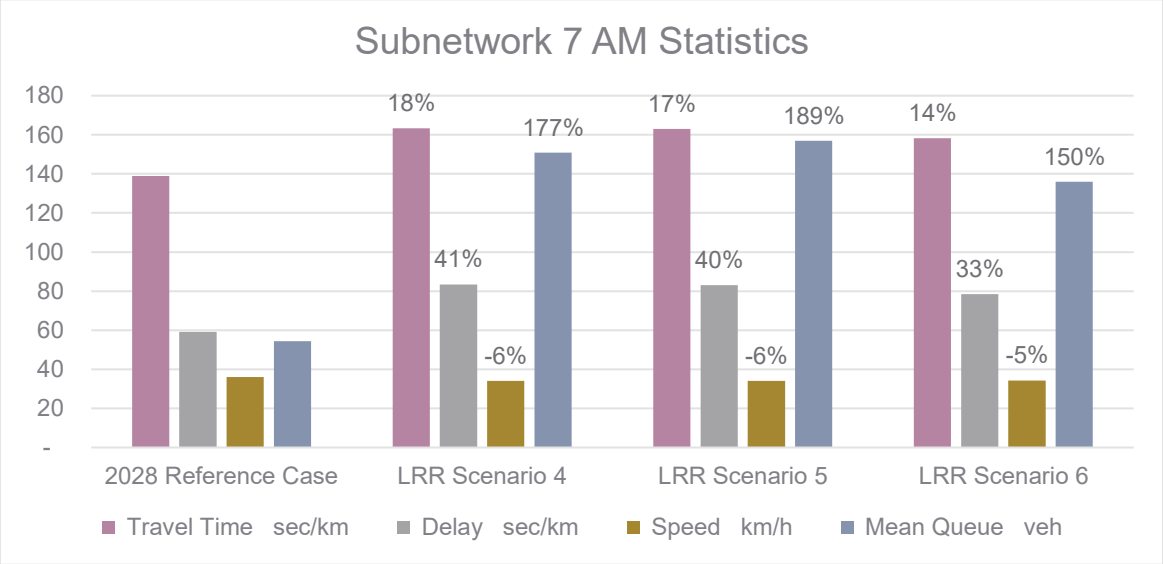

Figure 12 Subnetwork 7 Statistics AM

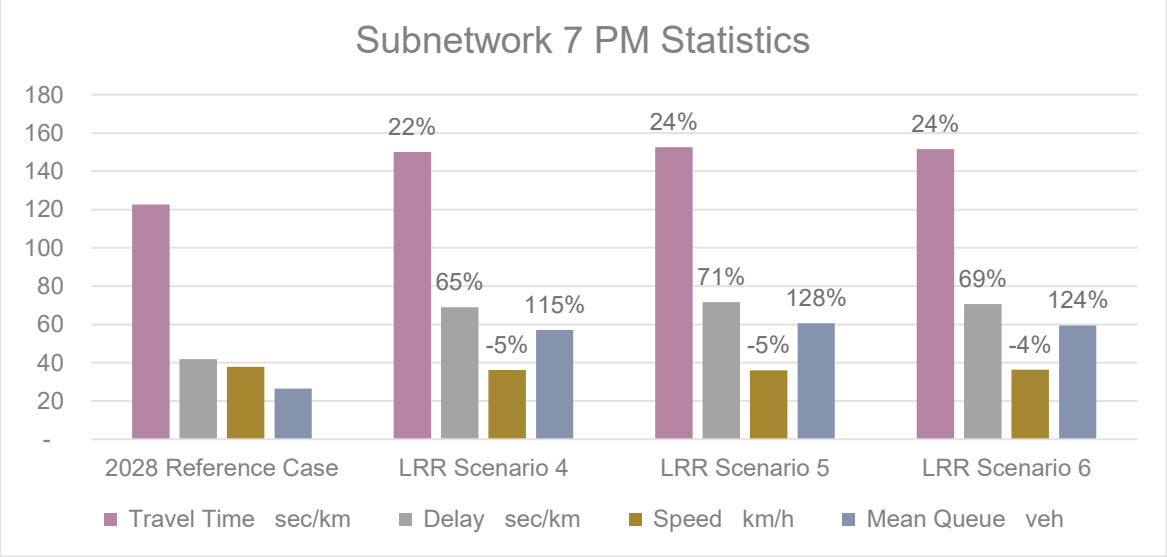

Figure 13 Subnetwork 7 Statistics PM

Table 17 and Table 18 present the Level of Service results for key junctions in Subnetwork 7. The location of each junction and roundabout is shown in Figure 14.

Figure 14 Subnetwork 7 Junctions and Roundabouts

The level of service results are consistent across the reference case and development scenarios. This can be attributed to the fact that subnetwork 7 is less congested overall than the other two subnetworks presented above. There is no substantial difference between the 2028 results and the 2037 results presented in the previous Sweco Pump Lane and Lower Rainham Transport Impact Appraisal Addendum.

Table 17 Subnetwork 7 Junction Level of Service AM Peak

Junction	Reference Case 2028 AM	LRR Scenario 4 AM	LRR Scenario 5 AM	LRR Scenario 6 AM
B2004 Lower Rainham Road / Pump Lane	A	A	A	A
Beechings Way / Pump Lane (North)	A	A	A	A
Beechings Way / Pump Lane (South)	A	A	A	A
B2004 Lower Rainham Road / Berengrave Lane	C	C	C	C
B2004 Lower Rainham Road / B2004 Station Road	A	A	A	A
Lower Rainham Road / Otterham Quay Lane	A	A	A	A

Table 18 Subnetwork 7 Junction Level of Service PM Peak

Junction	Reference Case 2028 PM	LRR Scenario 4 PM	LRR Scenario 5 PM	LRR Scenario 6 PM
B2004 Lower Rainham Road / Pump Lane	A	A	A	A
Beechings Way / Pump Lane (North)	A	A	A	A
Beechings Way / Pump Lane (South)	A	A	A	A
B2004 Lower Rainham Road / Berengrave Lane	C	C	C	C
B2004 Lower Rainham Road / B2004 Station Road	A	A	A	A
Lower Rainham Road / Otterham Quay Lane	A	A	A	A

Finally, Figure 15 shows the location of paths analysed in subnetwork 7, while Table 19 and Table 20 present the travel time results. The most outstanding finding from these tables is the increase in the travel time for Lower Rainham Road Westbound, where the travel time increases by 131% to 156% between the Reference case and the development scenarios. This increase can be translated to 10 minutes approximately increase in travel time for this specific path. This issue had been underlined in the original Sweco report, using the V/C plots around in the Lower Rainham Road westbound direction. This result should be combined with the Junction Level of Service results presented in Subnetwork 2 for A289 (Yokosuka Way Roundabout) which has a level of service F for all AM scenarios, including Reference case. It is clear that this roundabout, despite the mitigation scheme applied in the development scenarios, cannot accommodate the demand from the development.

The main difference between the 2037 presented in the previous Sweco Pump Lane and Lower Rainham Transport Impact Appraisal Addendum and the 2028 results presented in this report, is that the increase in travel time in Pump Lane northbound and southbound is slightly larger in the 2028 results but overall is relatively small in terms of absolute number of seconds.

Figure 15 Subnetwork 7 Paths

Table 19 Subnetwork 7 Path travel time AM Peak

Path	2028 Reference Case AM	LRR Scenario 4 (sec)			LRR Scenario 5 (sec)			LRR Scenario 6 (sec)		
		Value	Abs Diff	% Diff	Value	Abs Diff	% Diff	Value	Abs Diff	% Diff
Pump Lane NB	80	101	21	26%	113	33	41%	102	22	28%
Pump Lane SB	86	94	7	9%	95	9	10%	95	9	10%
B2004 (Lower Rainham Road) WB	429	1,084	655	152%	1,098	669	156%	992	562	131%
B2004 (Lower Rainham Road) EB	450	452	2	0%	459	8	2%	452	2	0%
Otterham Quay Lane NB	99	100	1	1%	100	1	1%	100	1	1%
Otterham Quay Lane SB	98	98	-	0%	98	-	0%	98	-	0%

Table 20 Subnetwork 7 Path travel time PM Peak

Path	2028 Reference Case AM	LRR Scenario 4 (sec)			LRR Scenario 5 (sec)			LRR Scenario 6 (sec)		
		Value	Abs Diff	% Diff	Value	Abs Diff	% Diff	Value	Abs Diff	% Diff
Pump Lane NB	78	103	25	32%	102	24	31%	102	25	32%
Pump Lane SB	72	93	21	29%	93	21	29%	91	19	27%
B2004 (Lower Rainham Road) WB	401	452	51	13%	451	55	14%	454	53	13%
B2004 (Lower Rainham Road) EB	423	430	7	2%	432	8	2%	429	6	1%
Otterham Quay Lane NB	98	99	1	1%	99	1	1%	99	1	1%
Otterham Quay Lane SB	98	98	0	0%	98	0	0%	99	1	1%

3.3.1 Subnetwork 7 Summary

The subnetwork 7 statistics results showed that even though there is a very large increase in queue between reference case and all the scenarios where the development is present (LRR Scenario 4,5 and 6), the results between the development scenarios do not show big fluctuations.

The junctions analysed in subnetwork 7, do not show any problematic junctions, however, the travel time results indicated that Lower Rainham Road westbound direction shows a large increase in travel time (approximately 10-11 minutes) between the reference case and the development scenarios in the AM peak. These results should be combined with the A289/Yokosuka Way roundabout results presented in Subnetwork 2 where, despite the mitigation scheme, the level of service indicates that the demand in this roundabout exceeds capacity even in the reference case. This problem was underlined as well in the analysis of the 2037 results presented in the Sweco Pump Lane and Lower Rainham Transport Impact Appraisal Addendum (2037 results).

4 Summary

This report presented the results of a new set of additional modelling scenarios for the year 2028 around the development area in Pump Lane in Lower Rainham. These scenarios examined the sensitivity between different centroid configurations and trip rates, employed by the strategic model developed by Sweco and the developer.

The results showed that there is no improvement in terms of congestion hotspots between the results provided in the scenario where the developer trip rates are used (Scenario 6) and the scenarios where the strategic model trip rates are used (Scenario 4 and 5). The junctions that were proven problematic in the previous original Sweco report, remain problematic in LRR Scenarios 4, 5 and 6.

When comparing the 2037 with the 2028 results, no significant difference in terms of congestion hotspots can be observed. The problems in the road network underlined in the Pump Lane and Lower Rainham Transport Impact Appraisal Addendum (2037 results) remain, despite the reduction in traffic growth.

More specifically, the results showed the issues in the following road network elements:

Junctions

The following junctions reach level of service F in the AM Scenarios:

- A2 (Rotary Gardens / Woodlands Road / Sovereign Boulevard Junction)
- A2 (Bowater Roundabout)
- A289 (Ito Way / Sovereign Boulevard)
- A2 (Otterham Quay Lane / Merersborough Road)

The following junctions reach level of service F in the PM Scenarios:

- A289 (Pier Road / Maritime Way Roundabout)
- A289 (Pier Road / Gillingham Gate Road West)
- A2 (Bowater Roundabout)
- Eastcourt Lane / South Avenue
- A2 (Otterham Quay Lane / Merersborough Road)

In all the aforementioned junctions the demand exceeds capacity in the corresponding peak development scenario. This practically means that the functionality of the junction breaks, ultimately causing long queues and additional delays.

Path travel time

The following paths show significant increase in travel time:

- Lower Rainham Road westbound direction shows a large increase in travel time (approximately 10-11 minutes) between the reference case and the development scenarios in the AM peak.

- A2 (Moor Street to Sovereign Boulevard) shows an increase of 2 and 5 minutes (65-70% and 61% accordingly) in subnetwork 3 in both the AM and the PM peak scenarios
- Paths A289 (Church Street) to A278 (Hoath Way) and A2 (Watling to Sovereign Boulevard) in the AM peak show a substantial increase in travel time in subnetwork 2
- Paths A289 (Church Street) to A278 (Hoath Way), A278 (Hoath Way) to A289 (Church Street) and A2 (Watling to Sovereign Boulevard) show a substantial increase in travel time in subnetwork 2 in the PM peak. The significant increase in A2 path was not observed in the 2037 results.

Appendix A – Detailed Subnetwork Statistics

Subnetwork 2 Statistics		AM Peak (0800 to 0900)			
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	193	245	246	246
Delay	sec/km	119	172	173	173
Flow	veh/h	11,316	11,418	11,361	11,344
Speed	km/h	28	26	27	26
Stop Time	sec/km	106	159	160	159
Mean Queue	veh	489	861	861	854
Mean Virtual Queue	veh	144	563	580	505
Waiting Time in Virtual Queue	sec	45	174	180	156
Total Statistics					
Total Travelled Time	h	2,206	2,955	2,943	2,938
Total Travelled Distance	km	52,485	53,062	52,915	52,897
Average travel time per vehicle	s/veh	351	466	466	466
Total Waiting Time in Virtual Queue	h	2	551	567	492
Total travel time including virtual queue	h	2,207	3,505	3,510	3,430
Total Queue	veh	633	1,424	1,441	1,359
Throughput					
Vehicles Out	veh	22,633	22,835	22,722	22,688
Vehicles In	veh	6	6	6	6
Vehicles Waiting to Enter	veh	-	-	-	-
Total	veh	22,639	22,841	22,727	22,694
Vehicles In and Waiting to Enter	veh	6	6	6	6

Subnetwork 2 Statistics		PM Peak (1700 to 1800)			
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	165	205	206	206
Delay	sec/km	93	132	134	133

Flow	veh/h	10,877	11,291	11,336	11,260
Speed	km/h	31	28	28	28
Stop Time	sec/km	81	118	120	119
Mean Queue	veh	284	559	557	563
Mean Virtual Queue	veh	169	268	290	290
Waiting Time in Virtual Queue	sec	56	84	91	91
Total Statistics					
Total Travelled Time	h	1,693	2,370	2,377	2,367
Total Travelled Distance	km	50,297	53,009	53,343	52,722
Average travel time per vehicle	s/veh	280	378	377	378
Total Waiting Time in Virtual Queue	h	3	6	7	7
Total travel time including virtual queue	h	1,696	2,377	2,384	2,375
Total Queue	veh	453	827	848	853
Throughput					
Vehicles Out	veh	21,753	22,582	22,672	22,519
Vehicles In	veh	6	6	6	6
Vehicles Waiting to Enter	veh	-	-	-	-
Total	veh	21,759	22,588	22,678	22,525
Vehicles In and Waiting to Enter	veh	6	6	6	6

Subnetwork 3 Statistics		**AM Peak (0800 to 0900)**			
	Units	2028 Reference Case	**LRR Scenario 4**	**LRR Scenario 5**	**LRR Scenario 6**
Travel Time	sec/km	239	245	252	245
Delay	sec/km	153	160	166	160
Flow	veh/h	2,474	2,500	2,486	2,493
Speed	km/h	19	19	20	20
Stop Time	sec/km	138	144	150	144
Mean Queue	veh	63	71	75	70
Mean Virtual Queue	veh	8	28	39	35
Waiting Time in Virtual Queue	sec	12	41	57	51
Total Statistics					

Total Travelled Time	h	236	259	266	254
Total Travelled Distance	km	3,608	3,789	3,764	3,740
Average travel time per vehicle	s/veh	172	186	192	184
Total Waiting Time in Virtual Queue	h	0	0	1	1
Total travel time including virtual queue	h	236	259	266	255
Total Queue	veh	71	100	114	105
Throughput					
Vehicles Out	veh	4,949	5,000	4,973	4,987
Vehicles In	veh	2	1	1	2
Vehicles Waiting to Enter	veh	-	-	-	-
Total	veh	4,950	5,001	4,974	4,988
Vehicles In and Waiting to Enter	veh	2	1	1	2

Subnetwork 3 Statistics		**PM Peak (1700 to 1800)**			
	Units	2028 Reference Case	**LRR Scenario 4**	**LRR Scenario 5**	**LRR Scenario 6**
Travel Time	sec/km	255	279	287	277
Delay	sec/km	169	193	201	192
Flow	veh/h	2,486	2,610	2,578	2,579
Speed	km/h	18	18	18	18
Stop Time	sec/km	154	176	184	175
Mean Queue	veh	65	95	97	95
Mean Virtual Queue	veh	7	68	51	57
Waiting Time in Virtual Queue	sec	11	94	71	80
Total Statistics					
Total Travelled Time	h	245	321	321	319
Total Travelled Distance	km	3,802	4,131	4,076	4,103
Average travel time per vehicle	s/veh	177	221	224	223
Total Waiting Time in Virtual Queue	h	0	2	1	1
Total travel time including virtual queue	h	245	322	322	321
Total Queue	veh	72	163	147	152
Throughput					
Vehicles Out	veh	4,973	5,219	5,156	5,157

Vehicles In	veh	2	2	2	2
Vehicles Waiting to Enter	veh	-	-	-	-
Total	veh	4,975	5,221	5,158	5,159
Vehicles In and Waiting to Enter	veh	2	2	2	2

Subnetwork 7 Statistics		**AM Peak (0800 to 0900)**			
	Units	2028 Reference Case	**LRR Scenario 4**	**LRR Scenario 5**	**LRR Scenario 6**
Travel Time	sec/km	139	163	163	158
Delay	sec/km	59	83	83	78
Flow	veh/h	5,898	6,190	6,168	6,076
Speed	km/h	36	34	34	34
Stop Time	sec/km	50	72	71	67
Mean Queue	veh	54	151	157	136
Mean Virtual Queue	veh	5	65	48	21
Waiting Time in Virtual Queue	sec	3	37	27	12
Total Statistics					
Total Travelled Time	h	437	687	700	643
Total Travelled Distance	km	12,956	14,135	14,160	13,770
Average travel time per vehicle	s/veh	133	200	204	190
Total Waiting Time in Virtual Queue	h	0	1	0	0
Total travel time including virtual queue	h	437	688	700	643
Total Queue	veh	60	216	205	157
Throughput					
Vehicles Out	veh	11,796	12,381	12,336	12,152
Vehicles In	veh	2	2	2	2
Vehicles Waiting to Enter	veh	-	-	-	-
Total	veh	11,798	12,383	12,338	12,154
Vehicles In and Waiting to Enter	veh	2	2	2	2

Subnetwork 7 Statistics	PM Peak (1700 to 1800)				
	Units	2028 Reference Case	LRR Scenario 4	LRR Scenario 5	LRR Scenario 6
Travel Time	sec/km	123	150	153	152
Delay	sec/km	42	69	72	71
Flow	veh/h	5,434	5,935	5,935	5,800
Speed	km/h	38	36	36	36
Stop Time	sec/km	34	59	62	61
Mean Queue	veh	27	57	61	59
Mean Virtual Queue	veh	2	27	46	50
Waiting Time in Virtual Queue	sec	1	17	28	31
Total Statistics					
Total Travelled Time	h	347	440	453	443
Total Travelled Distance	km	11,866	12,798	12,996	12,708
Average travel time per vehicle	s/veh	115	133	137	138
Total Waiting Time in Virtual Queue	h	0	0	0	0
Total travel time including virtual queue	h	347	440	453	444
Total Queue	veh	28	84	106	110
Throughput					
Vehicles Out	veh	10,867	11,869	11,870	11,600
Vehicles In	veh	2	2	2	2
Vehicles Waiting to Enter	veh	-	-	-	-
Total	veh	10,869	11,871	11,872	11,602
Vehicles In and Waiting to Enter	veh	2	2	2	2

Appendix B – Macro model Flow Plots

The macro model flow plots are included in the PDF attachments in the “Flow_plots.zip” folder.

Appendix C – Macro model Select link analysis plots

The select link analysis plots for the centroid containing the demand of the development are included in the PDF files of the “SLA_plots.zip” folder.

Appendix D – Macro model section V/C plots

The section V/C plots are included in the PDF files of the “VC_sections.zip” folder.

Appendix E – Macro model turn V/C plots

The turn V/C plots are included in the PDF files of the “VC_turns.zip” folder.

Appendix F – Micro model section delay plots

The turn V/C plots are included in the PDF files of the “Simulated Delays.zip” folder.