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Upper Gungate Feb 2016
Modelling Evaluations

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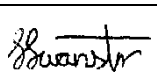
Signature:		

Previous Revisions
None

0.0 About this technical note

This technical note is intended for use by personnel experienced in traffic engineering and familiar with the area being analysed/designed. It is designed to help these technical personnel in the decision making process and its contents may be subsumed into a more comprehensive report without permission. This technical note should always be read in conjunction with models, drawing and or supplementary text and documents as outlined throughout the note. This is not intended to be a comprehensive report for the consumption of a wider and potentially non-technical audience. A technical note rather than a more descriptive report has been produced at the client's request. JCT are happy to provide supplementary information to others and provide information on the tasks undertaken in alternative format on instruction.

1.0 Background Information

1.0.1 In 2012 Staffordshire County Council (SCC) commissioned JCT Consultancy to evaluate the Upper Gungate road network, Tamworth. The corridor consists of sections of the A513 and B5493 from the Ashby Road / Comberford Road / Upper Gungate junction (Fountain's junction) to the Lichfield Street / Silver Street / Church Street / Aldergate junction. It included four traffic signal junctions.

1.0.2 JCT were tasked with producing calibrated and validated LinSig models representing the network, identify improvements that would improve performance and establish what level of additional traffic could be accommodated by the improved network. This work was included in TN12028.1 and TN12028.2.

1.0.3 Since this work was complete, JCT were asked to review modelling work that supported an additional 1000 housing development north of the corridor. This work was included in TN14034 and TN15005.

1.0.4 Following on from TN12028, SCC have now completed a number of improvements to the network. These include:

- Installation of a formal crossing south of Fountain's junction;
- Widening at the junction with Lichfield Street, which allows the heavier traffic flows from Aldergate and Lichfield Street to run together;
- Adjustments to phase delays and pedestrian facilities at the Offadrive and Hospital Street junctions;
- Provision of a right-turn bay for northbound traffic turning into Croft Street.

1.0.5 In early 2015, JCT were commissioned to evaluate the impact of the junction improvements since 2012, and show the impact of a committed development of 700 houses and proposed development of 1000 houses, with and without the LSTF project, used to promote sustainable transport along the corridor, in the year 2029. This work was described in TN15009.

2.0 Brief

2.0.1 JCT have been commissioned to produce additional modelling evaluations of the network, utilising the latest traffic surveys arranged by Peter Brett Associates (PBA) (15th October 2015).

2.0.2 This was agreed between SCC and PBA at a meeting on 27th January 2016, following a review of and discussion about the suitability of PBA's October 2015 data. The validity of SCC's April 2015 data, which was used in the previous modelling work, was questioned by PBA. Although SCC could not agree that it was shown to be statistically unreliable, there were concerns that PBA were adjusting this count data rather than using their latest October 2015 data. Therefore, as a way of moving things forward SCC and PBA agreed that SCC would commission JCT to re-model the corridor using PBA's October 2015 data.

2.0.3 The modelling was to include the AM and PM peak periods during the year 2029 and include the committed development. Scenarios were to be included to show the impact of additional proposed development of 100, 200, 300, 400, 500 and 1000 houses at Arkall Farm.

2.0.4 Traffic growth factors and distribution of development traffic was to be the same as that assumed in TN15009.

2.0.5 SCC provided the following files:

- Traffic Flows (in pcus)
- Queue Surveys
- Video Surveys from the traffic signal junctions (DVDs)
- Demand Dependency, Cycle Time and Average Intergreen measurements by PBA

3.0 Traffic Flows

3.1 Traffic Surveys

3.1.1 PBA arranged traffic surveys along the corridor, which were conducted on 15th October 2015.

3.1.2 The traffic surveys were processed by SCC into junction turning counts (in pcus) and sent to JCT. These included minor adjustments where imbalances existed between junctions. The junction turning counts are shown in **Appendix A**.

3.1.3 The junction turning count diagram did not include values for the priority junction north of the Fountain's junction, nor the junctions with Corporation Street and St John Street. Therefore, these flows were estimated based on previous modelling and the latest flows on the main corridor. These junctions were not critical to the network performance.

3.1.3 Queue surveys were conducted at the four signal controlled junctions. These were recorded at 5 minute time intervals.

3.1.4 The peak periods were assumed to be (consistent with prior modelling):

- AM Peak 0800 – 0900
- PM Peak 1700 – 1800

3.2 Growth to Year 2029

3.2.1 SCC provided suitable background traffic growth factors from year 2015 to 2029, taken from the NTM via TEMPRO. The factors were as follows:

- AM Peak 1.1065
- PM Peak 1.1119

Growth to 2029 is consistent with the Adopted Lichfield Local Plan which provides the planning context for this development proposal. This was agreed to be appropriate at a meeting between SCC and PBA / Barwoods on 2nd March 2015.

3.3 Development Traffic

3.3.1 SCC provided the additional trips resulting from the Committed (700 houses) and Proposed (1000 houses) developments. These development traffic flows were agreed with Peter Brett Associates (PBA). These are shown in **Table 1**.

Table 1: Development Trips

	Committed		Proposed	
	IN	OUT	IN	OUT
AM	93	311	133	444
Pre PM	202	127	288	181
PM	294	149	420	213
Sat	76	151	108	216

3.3.2 SCC also supplied the distribution of development trips through the Upper Gungate network which had been agreed with PBA.

4.0 Modelling Assumptions

4.1 General

4.1.1 The base model from TN15009 was updated with the latest traffic flows from the October 2015 survey only (file: Gungate Network 2016.lsg3x). This was used to provide a comparison of modelled queues and surveyed queues.

4.1.2 The average cycle time was measured at each junction, and used in the base scenarios. However, higher cycle times were used in future year scenarios (with one exception noted in Paragraph 4.3.5), as this will naturally occur as more traffic needs to be catered for.

4.1.3 Demand dependency and average lost time were calculated using the provided DVDs. These were compared, along with the average cycle times, with values independently measured by PBA. Note, the modelling by JCT was based on the measurements by JCT, with more detail provided below.

4.1.4 All future year and development scenarios were tested in the model "Gungate Network 2016 Improved.lsg3x". This model included adjustments to the signals at Offadrive, aimed at improving capacity.

4.2 Fountain's Junction

4.2.1 The average cycle times were 52 seconds and 46 seconds for the AM and PM peak periods respectively. These reflected the 51 seconds and 46 seconds measured by PBA.

4.2.2 The pedestrian demand frequency was 50.7% and 10.1% for the AM and PM peak periods respectively. These reflected the 49.3% and 11.4% measured by PBA.

4.2.3 The average intergreen following the pedestrian phase was 7 seconds and 8 seconds during the AM and PM peak periods respectively. PBA measured these as 7 and 9 seconds.

4.2.4 In the modelling associated with TN15009, a negative bonus green of 2 seconds was applied to Comberford Road, during the AM peak period, to account for blocking back from the pedestrian crossing. The degree of blocking back from the DVDs could not be estimated. However, the negative bonus green was reduced to 1 second, given that the demand for the crossing was less than assumed in previous modelling (from 61.5% to 50.7%). Note, the same assumption was used for all AM peak scenarios. This could result in optimistic results, given that blocking could become more frequent as traffic increases.

4.2.5 Bonus greens were applied to traffic stoplines at the pedestrian crossing, to account for demand dependency. The stage sequence assumes the pedestrian phase is called every cycle. This results in an additional lost time to traffic of 22 seconds. Bonus greens were calculated as follows:

AM Peak:

Average Lost Time	=	22 x 50.7%	=	11 seconds
Bonus Green	=	22 – 11	=	11 seconds

PM Peak:

Average Lost Time	=	22 x 10.1%	=	2 seconds
Bonus Green	=	22 – 2	=	20 seconds

4.2.6 The bonus greens applied in Paragraph 4.2.5 will have no impact to the modelling results for the Fountain's junction, as the crossing operates on a separate stage stream.

4.3 Salter's Lane / Offadrive

4.3.1 The average cycle times were 95 seconds and 100 seconds for the AM and PM peak periods respectively. These reflected the 95 seconds and 100 seconds measured by PBA.

4.3.2 The variable intergreen following Phase J (Upper Gungate pedestrian crossing) was measured as rarely extending beyond the minimum of 5 seconds. This was used in the model. Junction capacity is reduced when this intergreen is extended, as it delays the start of Phases C, D and K.

4.3.3 The improvements at the Offadrive junction included the addition of 3 second phase delays on Phases A and K from Stage 1 to 2. In addition, Phase K (Upper Gungate southbound) was started 4 seconds before Phase C (Upper Gungate southbound internal), allowing traffic to move off early, whilst arriving at the internal stopline as the signals change to green. This required the removal of intergreens between Phase K to Phases F, L and J. The interstage period is shown in **Figure 1**.

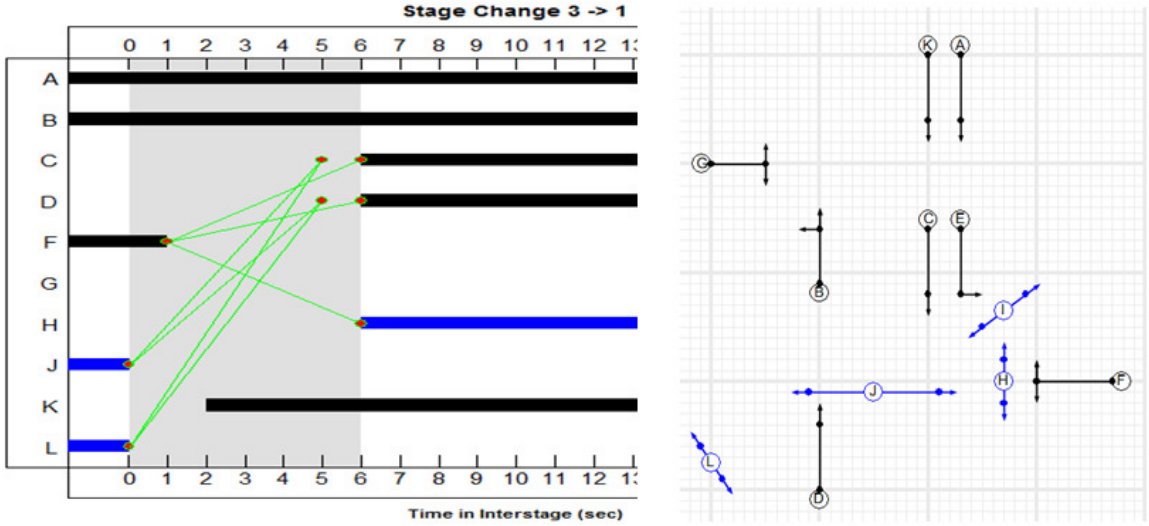


Figure 1: Offadrive, Stage 3-1 Interstage period update

4.3.4 The improvements at the junction were considered as a method of increasing the theoretical capacity. From a practical point of view, achieving the relative starting times of green shown in Figure 1 would require careful consideration due to the complication of variable intergreens following pedestrian phase J. If the intergreen was extended beyond 6 seconds, Phases C and D would be delayed, yet Phase K green would continue to begin 2 seconds after Stage 3. This would result in traffic being released from the Upper Gungate southbound stopline and arriving at the internal stopline whilst Phase C is red.

4.3.5 The model assumed the junction could run with a cycle time up to 102 seconds. This was used for all future year PM peak scenarios. However, the AM peak benefitted from a lower cycle time. Therefore, a cycle time of 70 seconds was used for all future year AM peak scenarios.

4.4 Hospital Street Junction

4.4.1 The average cycle times were 71 seconds and 80 seconds for the AM and PM peak periods respectively. These reflected the 72 seconds and 81 seconds measured by PBA.

4.4.2 The pedestrian demand frequency was 68.6% and 53.3% for the AM and PM peak periods respectively. These reflected the 72.0% and 52.3% measured by PBA.

4.4.3 The average intergreen following the pedestrian phase was 14 seconds and 14 seconds during the AM and PM peak periods respectively. PBA measured these as 14 and 14 seconds.

4.4.4 The intergreen following pedestrian phases M, N, O and P was changed to 14 seconds to reflect the average intergreen.

4.4.5 Bonus greens were applied to traffic stoplines at the pedestrian crossing, to account for demand dependency. The stage sequence assumes the pedestrian phase is called every cycle. This results in an additional lost time to traffic of 23 seconds. Bonus greens were calculated as follows:

AM Peak:

Average Lost Time	=	23 x 68.6%	=	16 seconds
Bonus Green	=	23 – 16	=	7 seconds

PM Peak:

Average Lost Time	=	23 x 53.3%	=	12 seconds
Bonus Green	=	23 – 12	=	11 seconds

4.5 Lichfield Street Junction

4.5.1 The average cycle times were 90 seconds and 90 seconds for the AM and PM peak periods respectively. These reflected the 90 seconds and 90 seconds measured by PBA.

4.5.2 The pedestrian demand frequency was 80.0% and 72.5% for the AM and PM peak periods respectively. These reflected the 77.5% and 70.0% measured by PBA.

4.5.3 The average intergreen following the pedestrian phase E could not be measured from the video, so a value of 7 seconds was assumed. PBA measured a value of 9 seconds for both the AM and PM peak periods.

4.5.5 Bonus greens were applied to traffic stoplines at the pedestrian crossing, to account for demand dependency. The stage sequence assumes the pedestrian phase is called every cycle. This results in an additional lost time to traffic of 14 seconds. Bonus greens were calculated as follows:

AM Peak:

Average Lost Time	=	14 x 80.0%	=	11 seconds
Bonus Green	=	14 – 11	=	3 seconds

PM Peak:

Average Lost Time	=	14 x 72.5%	=	10 seconds
Bonus Green	=	14 – 10	=	4 seconds

5.0 Modelling Results

5.1 Base Modelling Queue Comparison

5.1.1 A comparison between the modelled queues and those from the queue survey is shown in **Table 2**.

Table 2: Queue Comparison

LinSig queues are end of red queues

Queues		AM		PM	
		Survey	Model	Survey	Model
FOUNTAINS	Ashby Rd	3.4	3.8	3.2	2.4
	Upper Gungate	2.4	2.5	3.5	3.0
	Comberford Rd	3.4	3.6	3.7	3.6
OFFADRIVE	Upper Gungate (N)	7.9	6.7	4.8	5.4
	Offadrive	8.9	8.0	12.0	9.2
	Upper Gungate (S)	4.7	3.3	6.6	6.4
	Salter's Ln	5.6	4.7	5.3	3.9
HOSPITAL ST	Upper Gungate	7.3	4.2	4.2	3.8
	Upper Gungate LT	0.8	0.0	0.7	0.0
	Lower Gungate LT	2.7	2.0	2.6	2.1
	Lower Gungate A	0.6	0.6	1.8	1.4
	Lower Gungate RT	0.4	0.7	0.8	1.4
	Aldergate	5.2	3.5	9.5	5.7
	Hospital St	3.6	2.7	4.8	4.7
LICHFIELD ST	Aldergate	3.6	3.1	5.7	3.8
	Church St	1.5	2.2	3.6	2.7
	Silver St	0.5	0.5	1.1	1.1
	Lichfield St	8.2	6.3	16.7	6.8*

* DVD shows that queue a result of blocking back

5.1.2 The modelled queues represent the queue at the end of the red period. These are different to mean maximum queues (MMQ). The MMQ accounts for the fact that a queue continues to increase following the red signal for a period of time.

5.1.3 The modelled queues show a close correlation to those from the queue survey. The largest difference is on Lichfield Street during the PM peak. The modelled queue was 6.8 pcus, whilst the average measurement from the queue survey was 16.7 pcus. Analysis of the DVD revealed that the longer queue observed on site was due to traffic blocking back from the northbound exit. The cause of this blocking back could not be identified.

5.1.4 The DVDs did not show that this was due to queues on Aldergate from the Hospital Street junction, so it was assumed there must have been some form of temporary obstruction in between these two junctions.

5.2 Fountains Modelling Results

5.2.1 The results for the surveyed traffic flows, at the existing junction are shown in **Table 3**.

Table 3: Fountains Junction October 2015 Results

Ashby Rd (North) - AM Peak	AM		PM	
	DoS	MMQ	DoS	MMQ
Ashby Rd	67.7%	6.6	48.4%	3.5
Upper Gungate	50.3%	2.8	67.8%	4.6
Comberford Rd	66.2%	5.8	78.1%	6.7
Upper Gungate SB	54.9%	4.1	40.8%	0.5
Upper Gungate NB	42.9%	3.2	55.1%	1.2
PRC	32.9%		15.2%	
Cycle Time	52		46	
File	Gungate Network 2016.lsg3x			

5.2.2 The impact of the proposed development in the year 2029 is shown in **Table 4**.

Table 4: Fountains Junction Proposed Development, Year 2029

Ashby Rd (North) - AM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Ashby Rd	82.2%	16.3	83.6%	17.2	86.9%	18.9	88.1%	19.9	91.3%	22.5	92.5%	23.9	103.3%	53.7
Upper Gungate	62.7%	7.4	62.7%	7.4	63.8%	7.5	63.7%	7.5	64.7%	7.5	63.4%	7.4	64.5%	8.0
Comberford Rd	81.6%	11.7	84.7%	12.3	84.7%	12.3	88.1%	13.2	88.1%	13.2	91.7%	14.7	100.1%	21.9
Upper Gungate SB	69.6%	8.6	71.6%	8.7	73.4%	8.8	75.4%	9.0	77.2%	9.1	79.2%	9.3	86.6%	11.1
Upper Gungate NB	47.9%	4.3	48.5%	4.4	49.0%	4.4	49.6%	4.5	50.1%	4.5	49.7%	4.5	51.4%	4.9
PRC	9.5%		6.3%		3.6%		2.2%		-1.4%		-2.7%		-14.8%	
Cycle Time	78		78		78		78		78		78		78	
File	Gungate Network 2016 Improved.lsg3x													

Ashby Rd (North) - PM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Ashby Rd	51.6%	7.4	52.0%	7.4	53.4%	7.8	53.8%	7.9	55.1%	8.3	55.4%	8.4	61.0%	9.8
Upper Gungate	100.7%	46.6	102.1%	54.4	105.2%	74.8	106.4%	84.8	109.4%	132.7	110.4%	142.5	121.7%	239.6
Comberford Rd	98.0%	20.4	102.3%	26.8	102.3%	26.8	106.9%	36.1	106.9%	36.1	111.9%	46.6	117.4%	57.8
Upper Gungate SB	50.5%	1.0	50.7%	1.0	51.5%	1.0	51.3%	1.0	52.1%	1.0	51.9%	1.0	54.8%	1.1
Upper Gungate NB	71.8%	2.4	73.4%	2.6	75.0%	2.7	76.6%	3.3	78.2%	3.5	79.8%	3.7	87.4%	6.7
PRC	-11.9%		-13.6%		-16.9%		-18.7%		-21.5%		-24.3%		-35.6%	
Cycle Time	78		78		78		78		78		78		78	
File	Gungate Network 2016 Improved.lsg3x													

5.2.3 The impact of the proposed development in the year 2029 with LSTF is shown in **Table 5**.

Table 5: Fountains Junction Proposed Development, Year 2029 with LSTF

Ashby Rd (North) - AM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Ashby Rd	78.2%	14.9	79.6%	15.6	82.9%	17.1	84.1%	17.9	85.2%	18.9	88.5%	20.9	99.3%	37.8
Upper Gungate	61.6%	7.4	61.5%	7.4	62.6%	7.4	62.6%	7.4	62.4%	7.4	63.6%	7.5	65.6%	8.6
Comberford Rd	76.6%	9.9	79.6%	10.4	79.6%	10.4	82.9%	11.0	86.5%	11.8	86.5%	11.8	94.7%	15.3
Upper Gungate SB	65.8%	7.4	67.7%	7.5	69.6%	7.6	71.5%	7.7	73.4%	7.8	75.4%	8.0	84.8%	9.2
Upper Gungate NB	47.9%	4.3	48.5%	4.4	49.0%	4.4	49.6%	4.5	50.1%	4.5	50.8%	4.6	53.2%	5.1
PRC	15.1%		13.0%		8.6%		7.0%		4.1%		1.7%		-10.3%	
Cycle Time	78		78		78		78		78		78		78	
File	Gungate Network 2016 Improved.lsg3x													

Ashby Rd (North) - PM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Ashby Rd	51.6%	7.4	53.2%	7.8	53.4%	7.8	55.0%	8.1	55.1%	8.3	56.6%	8.6	61.0%	9.8
Upper Gungate	96.7%	31.1	99.9%	41.6	101.2%	50.2	104.2%	67.3	105.3%	76.1	108.4%	123.9	118.4%	200.8
Comberford Rd	98.0%	20.4	98.0%	20.4	102.3%	26.4	102.3%	26.8	106.9%	36.1	106.9%	36.1	117.4%	57.7
Upper Gungate SB	50.5%	1.0	51.3%	1.0	51.5%	1.0	52.4%	1.0	52.1%	1.0	52.9%	1.0	54.8%	1.1
Upper Gungate NB	68.4%	2.2	70.0%	2.3	71.6%	2.4	73.2%	2.5	74.7%	2.7	76.4%	3.3	84.3%	4.9
PRC	-8.9%		-11.0%		-13.6%		-15.8%		-18.7%		-20.4%		-31.5%	
Cycle Time	78		78		78		78		78		78		78	
File	Gungate Network 2016 Improved.lsg3x													

5.2.4 The results show that the junction will be more congested during the PM peak period. Before any proposed development is considered, the PRC was predicted to be -11.9%. This falls to -8.9% with LSTF.

5.3 Offadrive Modelling Results

5.3.1 The results for the surveyed traffic flows, at the existing junction are shown in **Table 6**.

Table 6: Offadrive Junction October 2015 Results

Offadrive - AM Peak	AM		PM	
	DoS	MMQ	DoS	MMQ
Upper Gungate (N)	82.8%	13.0	73.3%	8.8
Offadrive	81.4%	12.3	73.9%	13.0
Upper Gungate (S)	38.6%	4.1	68.1%	11.4
Salter's Ln	79.7%	7.2	69.3%	5.3
PRC	8.7%		21.9%	
Cycle Time	95		100	
File	Gungate Network 2016.lsg3x			

5.3.2 The impact of the proposed development in the year 2029 is shown in **Table 7**.

Table 7: Offadrive Junction Proposed Development, Year 2029

Offadrive - AM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate (N)	95.0%	20.6	95.3%	21.7	97.5%	26.5	99.8%	34.1	102.0%	46.3	102.2%	48.9	108.5%	95.9
Offadrive	90.6%	12.8	96.0%	16.1	96.5%	16.6	97.2%	16.9	97.9%	17.6	103.9%	26.5	107.3%	33.5
Upper Gungate (S)	55.4%	5.0	49.8%	3.8	50.4%	3.8	51.0%	3.9	50.9%	3.9	49.3%	3.7	49.2%	3.7
Salter's Ln	93.3%	8.9	93.3%	8.9	93.3%	8.9	93.3%	8.9	93.3%	8.9	93.3%	8.9	105.0%	15.6
PRC	-5.6%		-6.7%		-8.4%		-10.8%		-13.3%		-15.4%		-20.6%	
Cycle Time	70		70		70		70		70		70		70	
File	Gungate Network 2016 Improved.lsg3x													

Offadrive - PM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate (N)	82.0%	14.0	82.6%	14.4	83.6%	15.1	83.6%	15.1	84.7%	15.9	83.1%	14.8	86.4%	17.6
Offadrive	86.5%	18.4	87.9%	19.0	89.1%	19.8	90.4%	20.8	91.8%	21.6	93.1%	22.9	100.1%	32.1
Upper Gungate (S)	88.0%	19.2	89.5%	20.2	91.3%	21.5	93.0%	23.0	94.4%	24.5	93.3%	23.7	98.9%	32.3
Salter's Ln	85.8%	7.5	85.8%	7.5	85.8%	7.5	85.8%	7.5	85.8%	7.5	94.4%	9.5	94.4%	9.5
PRC	2.3%		0.5%		-1.5%		-3.4%		-4.9%		-4.9%		-11.3%	
Cycle Time	102		102		102		102		102		102		102	
File	Gungate Network 2016 Improved.lsg3x													

5.3.3 The impact of the proposed development in the year 2029 with LSTF is shown in **Table 8**.

Table 8: Offadrive Junction Proposed Development, Year 2029 with LSTF

Offadrive - AM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate (N)	90.5%	14.2	92.9%	16.9	93.2%	17.9	95.5%	21.3	95.8%	22.2	98.1%	28.6	107.0%	85.5
Offadrive	90.6%	12.8	91.4%	12.8	91.6%	13.3	92.0%	13.7	97.7%	17.4	98.3%	18.1	101.5%	23.0
Upper Gungate (S)	55.2%	4.4	55.3%	4.3	53.9%	4.3	54.7%	4.4	51.5%	4.0	55.2%	4.8	52.5%	4.2
Salter's Ln	84.0%	6.7	84.0%	6.7	93.3%	8.9	93.3%	8.9	93.3%	8.9	93.3%	8.9	105.0%	15.5
PRC	-0.7%		-3.2%		-3.7%		-6.1%		-8.6%		-9.2%		-18.9%	
Cycle Time	70		70		70		70		70		70		70	
File	Gungate Network 2016 Improved.lsg3x													

Offadrive - PM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate (N)	83.4%	14.3	84.8%	15.4	85.0%	15.5	86.5%	17.0	86.0%	16.6	87.4%	17.8	88.9%	19.4
Offadrive	83.4%	17.5	85.1%	18.1	86.0%	18.7	87.6%	19.4	88.8%	20.2	90.1%	21.1	96.9%	27.4
Upper Gungate (S)	84.7%	17.2	87.0%	18.4	86.4%	17.9	88.0%	18.8	90.6%	20.5	91.9%	21.6	98.3%	30.1
Salter's Ln	85.8%	7.5	85.8%	7.5	85.8%	7.5	85.8%	7.5	85.8%	7.5	85.8%	7.5	94.4%	9.5
PRC	4.9%		3.4%		4.2%		2.3%		-0.6%		-2.1%		-9.2%	
Cycle Time	102		102		102		102		102		102		102	
File	Gungate Network 2016 Improved.lsg3x													

5.3.4 The results show that the junction will be more congested during the AM peak period. Before any proposed development is considered, the PRC was predicted to be -5.6%. This falls to -0.7% with LSTF.

5.4 Hospital Street Modelling Results

5.4.1 The results for the surveyed traffic flows, at the existing junction are shown in **Table 9**.

Table 9: Hospital Street Junction October 2015 Results

Hospital St - AM Peak	AM		PM	
	DoS	MMQ	DoS	MMQ
Upper Gungate	54.8%	6.0	40.1%	4.7
Lower Gungate	42.6%	2.6	51.5%	2.6
Aldergate	46.8%	4.4	61.5%	8.3
Hospital St	55.0%	3.8	67.6%	6.6
PRC	63.6%		33.1%	
Cycle Time	71		80	
File	Gungate Network 2016.lsg3x			

5.4.2 The impact of the proposed development in the year 2029 is shown in **Table 10**.

Table 10: Hospital Street Junction Proposed Development, Year 2029

Hospital St - AM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate	61.1%	10.1	61.1%	10.1	62.3%	10.6	63.5%	10.9	63.9%	11.1	64.4%	11.2	66.1%	11.8
Lower Gungate	44.3%	3.5	47.3%	3.6	47.3%	3.6	47.3%	3.6	47.3%	3.6	47.3%	3.6	47.3%	3.6
Aldergate	48.2%	6.6	47.6%	6.4	47.9%	6.6	48.3%	6.7	48.6%	6.7	49.0%	6.8	50.7%	7.3
Hospital St	57.9%	5.1	61.8%	5.3	61.8%	5.3	61.8%	5.3	61.8%	5.3	62.1%	5.4	62.1%	5.4
PRC	47.3%		45.7%		44.5%		41.7%		40.7%		39.7%		36.2%	
Cycle Time	90		90		90		90		90		90		90	
File	Gungate Network 2016 Improved.lsg3x													

Hospital St - PM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate	46.6%	6.8	46.9%	6.9	47.5%	7.1	46.7%	6.9	46.8%	7.1	47.3%	7.1	48.3%	7.3
Lower Gungate	68.9%	3.1	69.6%	3.2	70.3%	3.2	71.0%	3.3	71.7%	3.3	73.1%	3.4	76.7%	3.8
Aldergate	74.0%	14.2	75.1%	14.7	76.2%	15.3	75.8%	15.3	76.9%	15.9	78.0%	16.4	81.8%	18.6
Hospital St	72.7%	8.4	72.7%	8.4	72.9%	8.5	76.8%	8.8	77.0%	8.9	77.0%	8.9	81.9%	9.6
PRC	21.6%		19.8%		18.1%		17.2%		16.9%		15.3%		10.0%	
Cycle Time	90		90		90		90		90		90		90	
File	Gungate Network 2016 Improved.lsg3x													

5.4.3 The impact of the proposed development in the year 2029 with LSTF is shown in **Table 11**.

Table 11: Hospital Street Junction Proposed Development, Year 2029 with LSTF

Hospital St - AM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate	57.6%	9.1	58.8%	9.5	60.1%	9.9	61.3%	10.2	61.3%	10.3	62.5%	10.7	65.3%	11.5
Lower Gungate	44.3%	3.5	44.3%	3.5	44.3%	3.5	44.3%	3.5	47.3%	3.6	47.3%	3.6	47.3%	3.6
Aldergate	48.2%	6.6	48.6%	6.7	48.9%	6.8	49.3%	6.8	48.6%	6.7	49.0%	6.8	50.7%	7.3
Hospital St	57.9%	5.1	57.9%	5.1	57.9%	5.1	57.9%	5.1	61.8%	5.3	62.1%	5.4	62.1%	5.4
PRC	55.4%		53.0%		49.8%		46.7%		45.7%		43.9%		37.8%	
Cycle Time	90		90		90		90		90		90		90	
File	Gungate Network 2016 Improved.lsg3x													

Hospital St - PM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Upper Gungate	46.6%	6.8	47.2%	6.9	46.5%	6.8	47.2%	7.1	47.2%	7.1	47.8%	7.2	48.7%	7.4
Lower Gungate	62.7%	3.2	63.4%	3.2	64.1%	3.3	64.8%	3.3	65.5%	3.3	66.9%	3.3	70.4%	3,3
Aldergate	71.6%	13.3	72.8%	13.9	72.4%	13.9	73.6%	14.2	74.6%	14.7	75.7%	15.3	79.6%	17.3
Hospital St	69.7%	7.9	69.7%	7.9	73.6%	8.3	73.6%	8.3	73.9%	8.4	73.9%	8.4	78.5%	8.9
PRC	25.6%		23.7%		22.2%		22.2%		20.6%		18.8%		13.1%	
Cycle Time	90		90		90		90		90		90		90	
File	Gungate Network 2016 Improved.lsg3x													

5.4.4 The results show that the junction should operate within capacity for all scenarios.

5.5 Lichfield Street Modelling Results

5.5.1 The results for the surveyed traffic flows, at the existing junction are shown in **Table 12**.

Table 12: Lichfield Street Junction October 2015 Results

Lichfield St - AM Peak	AM		PM	
	DoS	MMQ	DoS	MMQ
Aldergate	31.1%	4.2	37.9%	5.3
Church St	60.1%	3.1	62.2%	3.8
Silver St	14.2%	0.6	29.9%	1.3
Lichfield St	59.8%	10.1	65.1%	11.5
PRC	49.7%		38.3%	
Cycle Time	90		90	
File	Gungate Network 2016.lsg3x			

5.5.2 The impact of the proposed development in the year 2029 is shown in **Table 13**.

Table 13: Lichfield Street Junction Proposed Development, Year 2029

Lichfield St - AM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Aldergate	38.8%	6.6	40.0%	6.8	41.1%	7.1	42.3%	7.3	42.9%	7.6	43.7%	7.7	46.4%	8.3
Church St	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8
Silver St	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8
Lichfield St	61.0%	13.1	61.4%	13.4	61.7%	13.5	62.1%	13.6	62.4%	14.6	62.8%	13.9	64.4%	14.5
PRC	47.5%		46.6%		45.9%		44.9%		44.3%		43.4%		39.7%	
Cycle Time	110		110		110		110		110		110		110	
File	Gungate Network 2016 Improved.lsg3x													

Lichfield St - PM Peak	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Aldergate	40.8%	7.1	41.3%	7.2	41.8%	7.3	42.1%	7.3	42.6%	7.5	43.0%	7.6	44.5%	8.0
Church St	70.5%	5.2	70.5%	5.2	70.5%	5.2	70.5%	5.2	70.5%	5.2	70.5%	5.2	76.9%	5.7
Silver St	40.4%	1.9	40.4%	1.9	40.4%	1.9	40.4%	1.9	40.4%	1.9	40.4%	1.9	40.4%	1.9
Lichfield St	70.5%	16.8	71.6%	17.3	72.7%	17.7	73.8%	18.2	74.9%	18.7	75.9%	19.3	79.9%	21.6
PRC	27.6%		25.7%		23.8%		22.0%		20.2%		18.5%		12.6%	
Cycle Time	110		110		110		110		110		110		110	
File	Gungate Network 2016 Improved.lsg3x													

5.5.3 The impact of the proposed development in the year 2029 with LSTF is shown in **Table 14**.

Table 14: Lichfield Street Junction Proposed Development, Year 2029 with LSTF

Lichfield St - AM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Aldergate	36.5%	6.1	37.7%	6.3	38.8%	6.6	40.0%	6.8	41.1%	7.1	42.3%	7.3	45.8%	8.2
Church St	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8	58.9%	3.8
Silver St	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8	18.9%	0.8
Lichfield St	61.0%	13.1	61.4%	13.4	61.7%	13.5	62.1%	13.6	62.4%	13.6	62.8%	13.9	64.4%	14.5
PRC	47.5%		46.6%		45.9%		44.9%		44.3%		43.4%		39.7%	
Cycle Time	110		110		110		110		110		110		110	
File	Gungate Network 2016 Improved.lsg3x													

Lichfield St - PM Peak LSTF	2029+C		2029+C+P100		2029+C+P200		2029+C+P300		2029+C+P400		2029+C+P500		2029+C+P1000	
	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ	DoS	MMQ
Aldergate	41.5%	7.2	41.4%	7.2	41.8%	7.3	42.4%	7.5	42.6%	7.5	43.2%	7.6	44.7%	8.0
Church St	65.1%	5.0	70.5%	5.2	70.5%	5.2	70.5%	5.2	70.5%	5.2	70.5%	5.2	76.9%	5.7
Silver St	39.0%	1.8	39.0%	1.8	39.0%	1.8	39.0%	1.8	39.0%	1.8	39.0%	1.8	39.0%	1.8
Lichfield St	69.6%	16.3	69.6%	16.3	70.6%	16.8	71.7%	17.4	72.8%	17.7	73.9%	18.2	77.9%	20.5
PRC	29.3%		27.7%		27.4%		25.5%		23.6%		21.8%		15.5%	
Cycle Time	110		110		110		110		110		110		110	
File	Gungate Network 2016 Improved.lsg3x													

5.5.4 The results show that the junction should operate within capacity for all scenarios.

5.6 Other Modelling Results

5.6.1 The degree of saturation predicted for Croft Street in the PM 2029 + 1000 houses scenario was 124.2% (MMQ of 18.8). This drops to 84.0% (MMQ of 4.2) with LSTF. However, it is difficult to place too much reliability on these estimates, as capacity is likely to be sensitive to driver behaviour, with slow moving traffic likely on Upper Gungate.

6.0 Conclusions

6.0.1 The base modelling results show a close correlation with the provided queue surveys.

6.0.2 The results show that, during the AM peak period, the most critical junction is the one with Offadrive, and is over-capacity in all scenarios. However, it is close to capacity with LSTF and before any proposed development is added, with a PRC of -0.7%.

6.0.3 The results show that, during the PM peak period, the most critical junction is Fountain's, and is over-capacity in all scenarios. Before any proposed development is added, the PRC was -11.9%. This dropped to -8.9% with LSTF.

6.0.4 The junctions with Hospital Street and Lichfield Street were predicted to be within capacity for all scenarios.

6.0.5 Care should be taken when reading predicted Mean Maximum Queues. These are the maximum extents of a queue each cycle, average over all cycles throughout the modelled period. In reality, these could be much longer (or shorter) during each individual cycle. The variation of queues on the Upper Gungate network could be large, especially when considering the following:

- Volume of school traffic may result in variation of flow arrivals through the peak periods, rather than expecting uniform arrivals throughout.
- Variable intergreens, particularly at the junction with Hospital Street, can introduce significant additional lost time to traffic when fully extended.

6.0.6 It should also be noted that, when the degree of saturation exceeds 100%, traffic demand exceeds capacity. This means that, on average, the queue will build from cycle to cycle. The mean maximum queue, as it is providing an average over the hour, will represent the approximate position of the queue midway through the modelled period. The queue at the end of the period will be longer, given the building of the queue from cycle to cycle.

6.0.7 The model takes into account a marginal amount of blocking back at the Fountains junction. However, no additional blocking back was accounted for in future year scenarios. It could be expected that, with increasing traffic demand and queue variation, the amount of blocking back will increase. Therefore, the modelling results are likely to provide an optimistic reflection as to junction performance in the year 2029.

6.0.8 Following the refinements to the model in this and previous exercises, the model is likely to be running as optimistically as possible in all 2029 forecast scenarios, potentially leaving SCC vulnerable to excessive congestion and queuing should certain parameters change or suggested capacity improvements cannot be implemented. For example, the current capacity maximised settings at Fountains and the potential conflict with school safety; phase delays and co-ordination on the Upper Gungate Southbound approach of the Offadrive junction; LSTF benefits not being realised; etc.

Appendix A

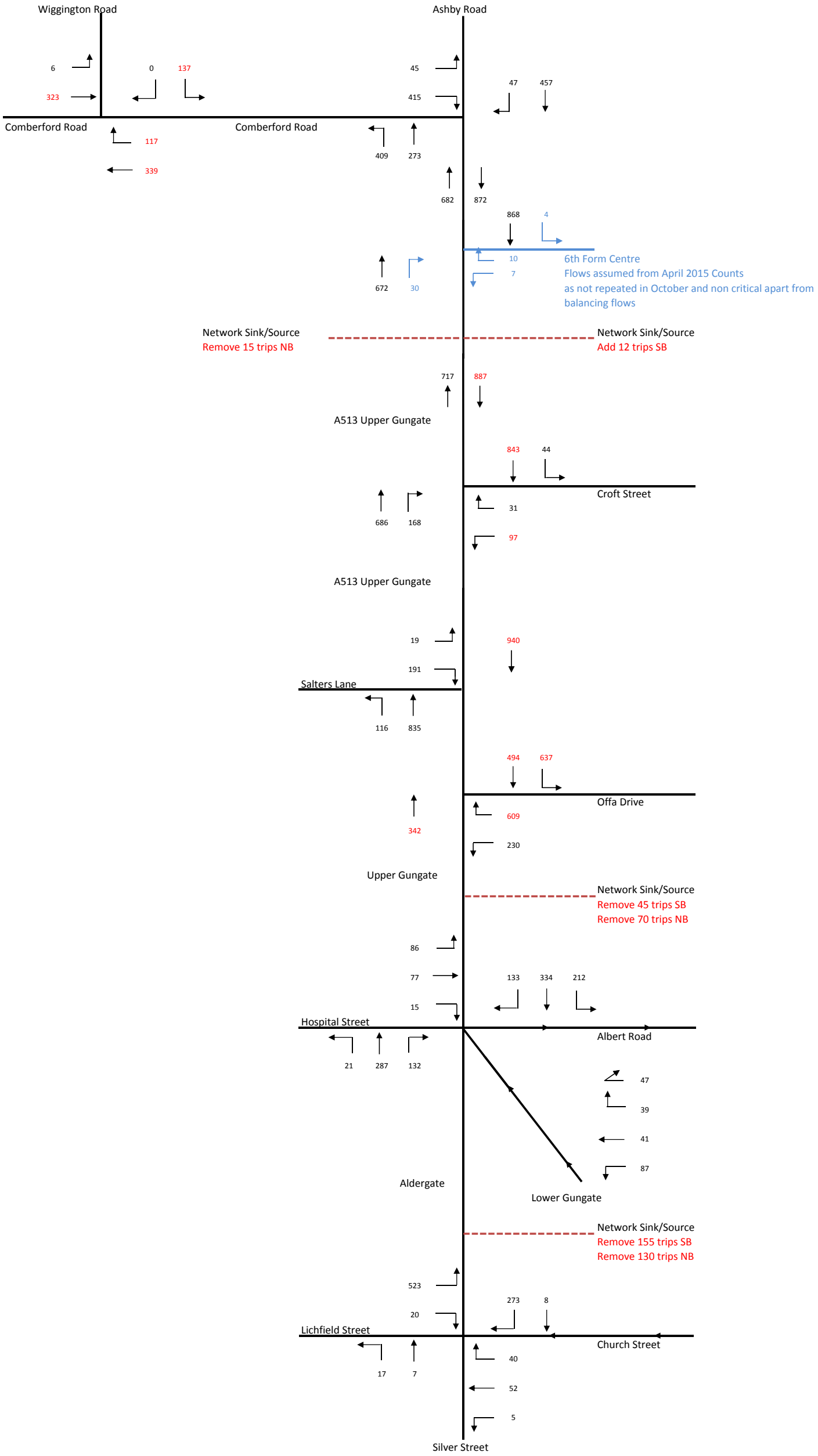
Traffic Flows

Upper Gungate Corridor

Full Network for Matrix Creation…

Thursday 15th October 2015 (PBA Data)
AM Peak (0800 - 0900)
PCUs

Class	PCU Factor
PC	0
MC	0.4
LGV	1
HGV	2.3



Upper Gungate Corridor

Full Network for Matrix Creation…

Thursday 15th October 2015 (PBA Data)
PM Peak (1700 - 1800)
PCUs

Class	PCU Factor
PC	0
MC	0.4
LGV	1
HGV	2.3