A1307 HAVERHILL TO CAMBRIDGE

MONITORING REPORT

CONFIDENTIAL

JULY 2017

WSP | PARSONS BRINCKERHOFF

A1307 HAVERHILL TO CAMBRIDGE

MONITORING REPORT

Cambridgeshire County Council

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TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1 WSP Parsons Brinckerhoff has been appointed by Cambridgeshire County Council (CCC) to review traffic survey data collected along the main corridors to the south east of Cambridge in October and November 2016. The traffic surveys were commissioned by Cambridgeshire County Council's City Deal team to inform the various corridor studies and central access studies which are currently ongoing. The surveys covered key links to the south east of Cambridge, including the A1307, M11 and A505.

1.1.2 The traffic surveys were undertaken by Intelligent Data and included:

- Manually Classified Turning Count (MCC) surveys,
- Automatic Traffic Counts (ATC) surveys; and
- Automatic Number Plate Recognition (ANPR) surveys.

1.2 AIM AND OBJECTIVES OF THE REPORT

1.2.1 The aim of this monitoring report is to review the traffic survey data collected and undertake high level analysis of the data. The objectives of the report are to:

- Review the consistency and quality of traffic survey data collected and understand whether the data is representative of typical conditions along key links;
- Summarise the Average Annual Weekday Traffic Flow (AAWT) and Average Annual Daily Traffic Flow (AADT) for key links within the study area;
- Describe the level of daily variation in traffic flow recorded along key links;
- Describe typical profile of traffic for key links;
- Identify the AM and PM Peak hour traffic flows for key links;
- Review the quality of Automatic Number Plate Recognition (ANPR) data collected; and
- Develop two spreadsheet tools that allow CCC to interrogate the ANPR origin destination and journey time data.

1.3 STRUCTURE OF REPORT

1.3.1 The remainder of the report is structured as follows:

- Section 2 provides information on the survey data collected;
- Section 3 discusses the quality of the ATC and MCC survey data;
- Section 4 provides high level analysis of the ATC and MCC survey data;
- Section 5 discusses the quality of the ANPR data collected;
- Section 6 discusses the analysis of ANPR data and the development of two spreadsheet tools to interrogate the data; and
- Section 7 concludes.

2 SURVEY DATA COLLECTED

2.1 INTRODUCTION

2.1.1 This section provides information on the survey data collected by Intelligent Data in October and November 2016, identifying any gaps in the data and any anomalous results that will be excluded from further analysis.

2.2 AUTOMATIC TRAFFIC COUNTS (ATC)

2.2.1 Automatic Traffic Count (ATC) surveys recording vehicle class and speed were undertaken at four sites between 3rd October 2016 and 13th November 2016. The location of the ATC surveys is summarised in Table 2.1 below.

Table 2.1: ATC Survey Locations

Site	Location	Co-ordinate
Site 1	B1061 West of Great Bradley	52.160188, 0.418065
Site 2	Unnamed Road, West of A1017 / Burton End Road Junction	52.075824, 0.407626
Site 3	Haverhill Road, North-west of A1307 / Haverhill Road Junction	52.097774, 0.357815
Site 4	West Wickham Road , South of Webb's Road / Streetly End Junction	52.106292, 0.356592

2.2.2 The location of each ATC survey is shown in Figure 2.1 below.

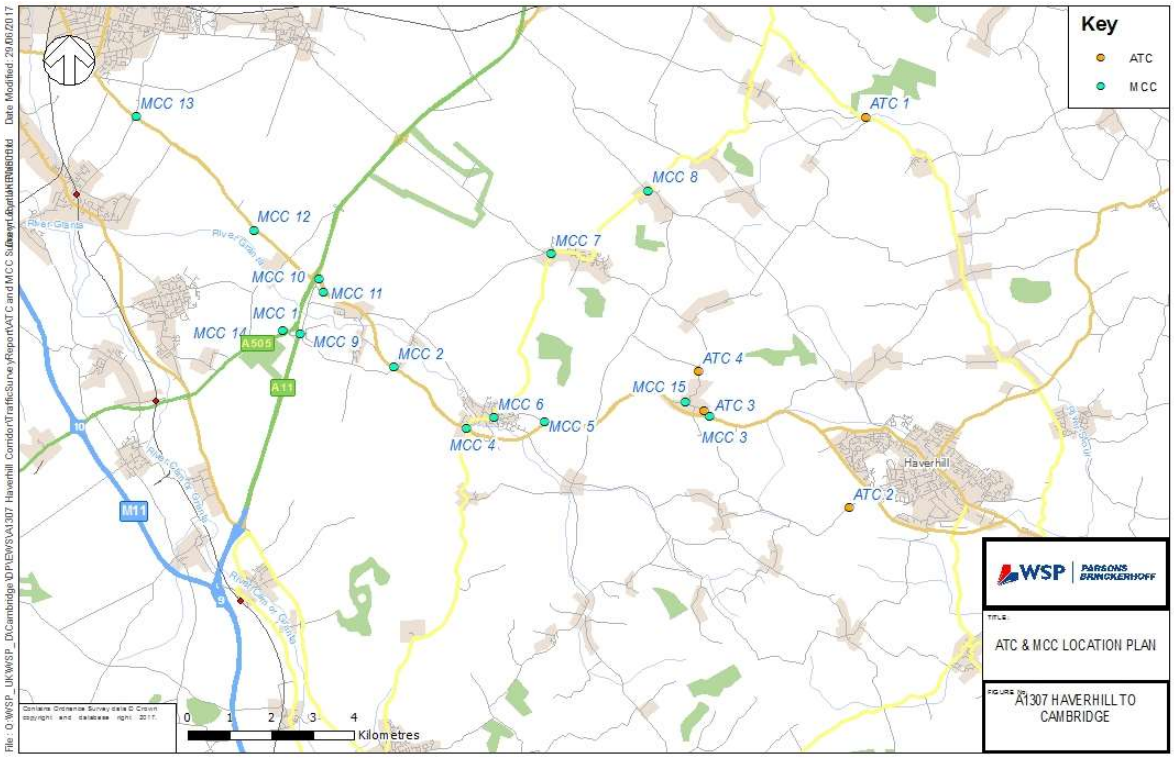

Figure 2.1: ATC and MCC Survey Locations

2.2.3 Each survey was undertaken for a minimum of seven days and recorded vehicle class and speed by direction.

2.2.4 It should be noted that the ATCs are unable to classify the difference between pedal cycles and motor cycles. As such data for Class 1 (very short (<1.7m) 2 axel vehicles) has been excluded from further analysis.

2.3 MANUALLY CLASSIFIED TURNING COUNTS (MCC)

2.3.1 Manual Classified Turning Count (MCC) surveys were carried at 15 sites on 18th and 19th October 2016 from 07:00 to 18:30. Resurveys were undertaken at sites 13 and 15 on 22nd November 2016 and site 7 on 24th to 25th January 2017.

2.3.2 The location of the MCC surveys is summarised in Table 2.2 below and shown in Figure 2.1 above.

Table 2.2: MCC Survey Locations

Site	Location	Co-ordinate (WGS84)
Site 1	A505 / Unnamed Road	52.117926, 0.210714
Site 2	A1307 / Pampisford Road	52.109341, 0.249283
Site 3	A1307 / Haverhill Road	52.096507, 0.359618
Site 4	Cambridge Road / High Street	52.095594, 0.27425
Site 5	A1307 / Horseheath Road	52.09652, 0.301923
Site 6	High Street / Balsham Road	52.097742, 0.284041
Site 7	Cambridge Road/ High Street / Linton Road	52.132803, 0.305881
Site 8	Honey Hill / Six Mile Bottom Road	52.145861, 0.340575
Site 9	Granta Park Roundabout	52.117288, 0.217166
Site 10	A1307 Cambridge Road / Unnamed Road	52.126112, 0.225512
Site 11	Cambridge Road / A11	52.128909, 0.224084
Site 12	Cambridge Road / Unnamed Road	52.139891, 0.201665
Site 13	Cherry Hinton Road / A1307 Babraham Road / Hinton	52.165365, 0.161506
Site 14	A505 / High Street	52.11471, 0.197806
Site 15	Linton Road / Haverhill Road / West Wickman Road	52.099832, 0.351522

2.3.3 Traffic flows were recorded at 30 minute intervals from 07:00 to 19:00. The following categories of vehicles were recorded: Cars, Light Goods Vehicles (LGV), OGV1, OGV2, Buses, Motor Cycles, and Pedal Cycles.

2.3.4 To assist with future traffic modelling, the observed vehicle mix has also been converted into Passenger Car Units (PCU). PCU values assigned for each category of vehicle is summarised in Table 2.3 below.

Table 2.3: PCU Values

PCU Value						
Car	**LGV**	**OGV1**	**OGV2**	**Bus**	**M/C**	**P/C**
1.0	1.0	1.9	2.9	2.5	0.4	0.2

2.4 AUTOMATIC NUMBER PLATE RECOGNITION

2.4.1 ANPR Surveys were undertaken on Tuesday 18th and Wednesday 19th October 2016. Data was collected in 30-minute intervals from 07:00 to 19:00. A total of 31 ANPR cameras were installed along the A1307 and A11 corridors from Addenbrooke's Hospital in the west to Haverhill in the east. The study area selected can be seen in Figure 2.2 below.

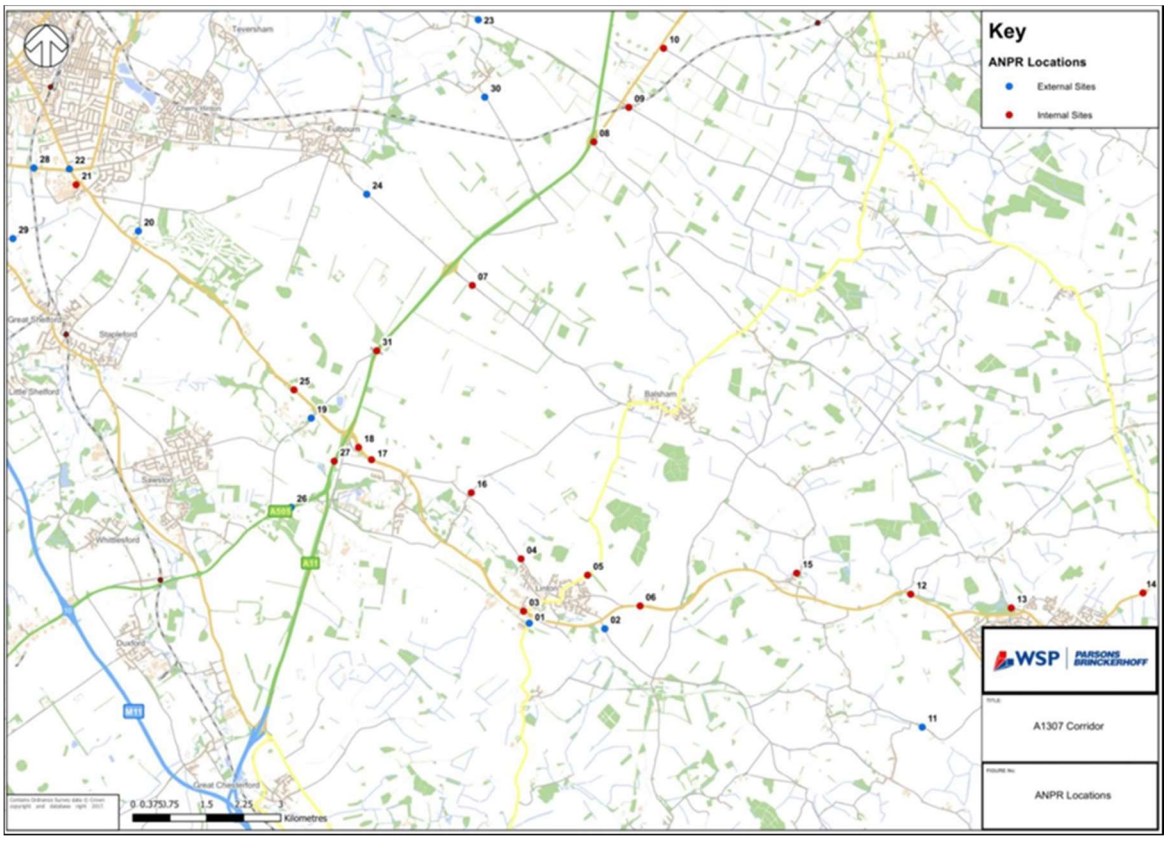

Figure 2.2: MCC and ATC Survey Locations

2.4.2 Each ANPR site has been classified as either 'external' or 'internal'. The classification of the site affects the way the OD matching process works. If a zone is classified as external it is assumed that the site will either be an origin of vehicles travelling into study area or destination of vehicle travelling out of the study area. Internal zones are sites considered to be possible through traffic sites for longer distance OD movements across ANPR study area and can be intermediate capture points for vehicles seen entering and exiting the study area elsewhere. Internal sites can also be the origin of a trip (if it is not captured elsewhere before) or the destination of a trip (if it is not captured again after).

2.4.3 Following the completion of the survey Intelligent Data provided Cambridgeshire County Council with an Origin Destination Report, Sample Rate Report, and Trip Chain Report. Data was provided as a total for all vehicle classes in addition to separate vehicle-class data sets for cars, LGVs, OGV1, OGV2, bus/coach, and motorcycles.

3 QUALITY OF ATC AND MCC SURVEY DATA COLLECTED

3.1 INTRODUCTION

3.1.1 This section discusses the quality of the ATC and MCC survey data collected.

3.2 MISSING DATA AND ANOMALOUS RESULTS

3.2.1 An initial review of ATC survey data has been undertaken to identify missing data and anomalous results. Where an error in the data has been identified, the respective day's data has been excluded from further analysis. The quality of the data collected at each ATC site is discussed in detail below.

ATC 1

3.2.2 ATC 1 was located on the B1061. The survey was undertaken from 10th October to 20th November 2016. No data was recorded between 00:00 on 10th October and 16:45 on 12th October and 17:00 on 12th November to 23:45 on 20th November. As such only data from 12th October to 11th November has been included for further analysis.

ATC 2

3.2.3 ATC 2 was located on an Unnamed Road west of the A1017 Burton End Road Junction. The survey was undertaken from 3rd October to 13th November 2016. No data was recorded from 00:00 on 3rd October to 17:30 on 7th October. As such only data from 7th October to 13th November has been included for further analysis.

ATC 3

3.2.4 ATC 3 was located on Haverhill Road, north-west of A1307-Haverhill Road Junction. The survey was undertaken from 7th October to 13th November 2016. No data was recorded from 00:00 on 7th October to 17:15 on 7th October. The data collected between 17:15 and 23:45 on 7th October and between 00:00 on 8th October and 23:45 on 13th November is considered to be valid and has been included for further analysis.

ATC 4

3.2.5 ATC 4 was located on West Wickham Road. The survey was undertaken from 10th October to 13th November 2016. No data was recorded between 00:00 on 3rd October to 16:45 on 7th October. The data collected between 16:45 and 23:45 on 7th October and between 00:00 on 8th October and 23:45 on 13th November is considered to be valid and has been included for further analysis.

3.3 CONSISTENCY OF MCC DATA

3.3.1 Resurveys were undertaken at a small number of MCC survey sites to check the consistency of traffic data collected in October 2016. If the October and November 2016 traffic flows are found to be consistent, it would suggest that the data collected in October 2016 is representative of typical conditions.

3.3.2 A comparison of the 12 hour traffic flows recorded at sites 13 and 15 on 18th October 2016 and 22nd November 2016 is provided in Table 3.1 and Table 3.2 below.

Table 3.1: Comparison of 12 hour total traffic flow (0700 to 1900) recorded at MCC Site 13 on 18th October 2016 and 22nd November 2016

Arm	18-Oct-16	22-Nov-16	Difference	% Change
Cherry Hinton Road	4112	4310	198	4.8%
A1307 Babraham Road East	8257	8310	53	0.6%
Hinton Way	2224	2261	37	1.6%
A1307 Babraham Road West	7317	7359	42	0.6%

3.3.3 Table 3.1 above shows that there is less than +-5% difference in the 12 hour flows recorded at MCC Site 13. This level of difference is considered to acceptable and within daily variation. As such the traffic surveys collected on 18th October and 22nd November are considered to be representative of typical conditions.

Table 3.2: Comparison of 12 hour total traffic flow recorded at site 15 on 18th October 2016 and 22nd November 2016.

Arm	18-Oct-16	22-Nov-16	Difference	% Change
West Wickham Road	780	744	-36	-4.6%
Haverhill Road	696	632	-64	-9.2%
Linton Road	316	291	-25	-7.9%

3.3.4 Table 3.2 above shows that there is a maximum difference of -9.2% between the 12 hour flows recorded on 18th October and 22nd November. Whilst this level of difference is greater than +-5%, the absolute level of variation remains relatively low. As such traffic surveys collected on 18th October and 22nd November are considered to be representative of typical conditions.

3.4 COMPARISON OF ATC AND MCC 12 HOUR TRAFFIC FLOW

3.4.1 To ensure the accuracy of the recorded ATC and MCC traffic flow data collected, the 12 hour (07:00 to 19:00) ATC traffic flow has been compared with the12 hour traffic flow of a nearby MCC site.

3.4.2 A comparison of the 12 hour traffic flow recorded at ATC Site 3, Haverhill Road, and MCC Site 15, Haverhill Road/A130 junction, is shown in Figure 3.1 and Figure 3.2 below.

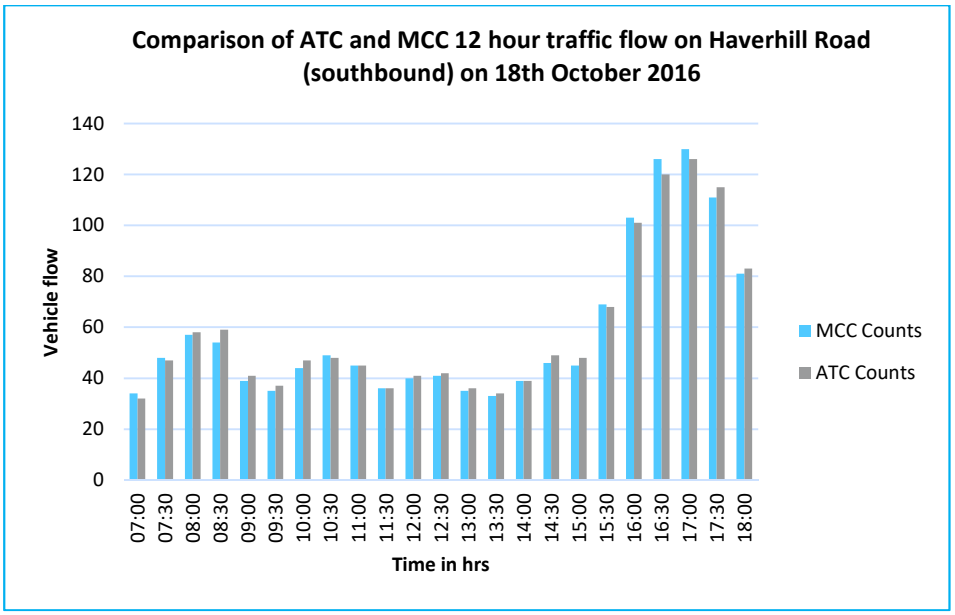

Figure 3.1: Comparison of ATC and MCC 12 hour traffic flow on Haverhill Road (southbound) on 18th October 2016

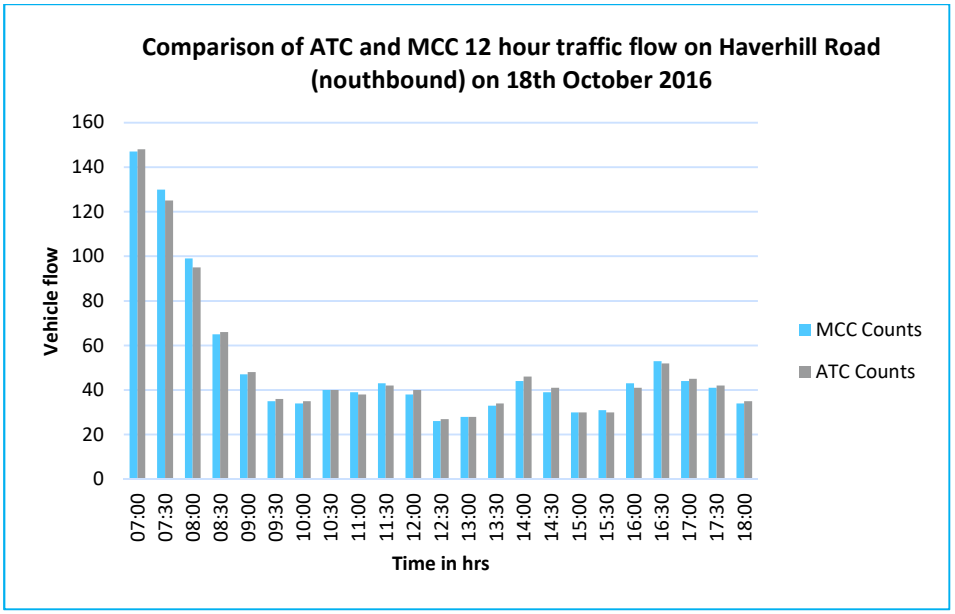

Figure 3.2: Comparison of ATC and MCC 12 hour traffic flow on Haverhill Road (northbound) on 18th October 2016

3.4.3 The above graphs show no significant difference between the MCC and ATC traffic flows. As such the ATC and MCC data is considered to be valid and suitable for further analysis.

4 ANALYSIS OF MCC AND ATC SURVEY DATA

4.1 INTRODUCTION

4.1.1 This section summarises the results of high level analysis of ATC and MCC survey data collected in October and November 2016.

4.2 AVERAGE DAILY AND WEEKDAY TRAFFIC FLOW

4.2.1 For each ATC site the 24 hour (00:00 to 23:59) and 18 hour (06:00 to 23:59) average daily and average weekday traffic flow has been calculated. This is summarised in Figure 4.1 below.

4.2.2 The average weekday traffic flow was calculated using traffic flow data for the first five consecutive weekdays that traffic flow data is available for and considered valid. The average daily traffic flow was calculated using traffic flow data for the first seven consecutive weekdays that data is available for and considered valid.

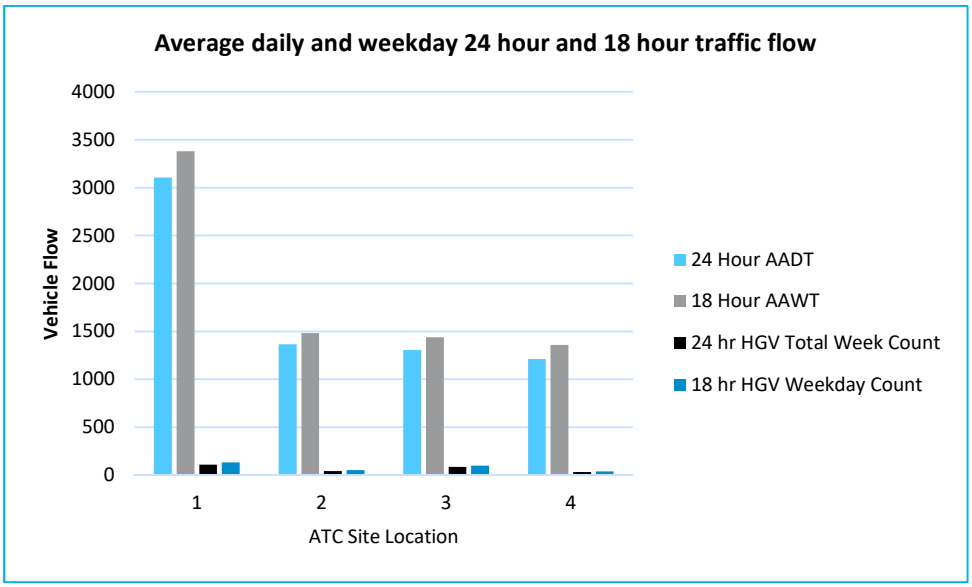

Figure 4.1: Average daily and weekday 24 hour (0000 to 2359) and 18 (0600 to 2359) hour traffic flow

4.2.3 The highest traffic flow was recorded at ATC 1 on the B1061, a key route between Newmarket and Haverhill.

4.3 LGVS AND HGVS

4.3.1 Figure 4.2 shows the average number of LGVs (< 3.5 tonnes, which includes private cars) and HGVs (>3.5 tonnes) recorded on a weekday at each ATC site.

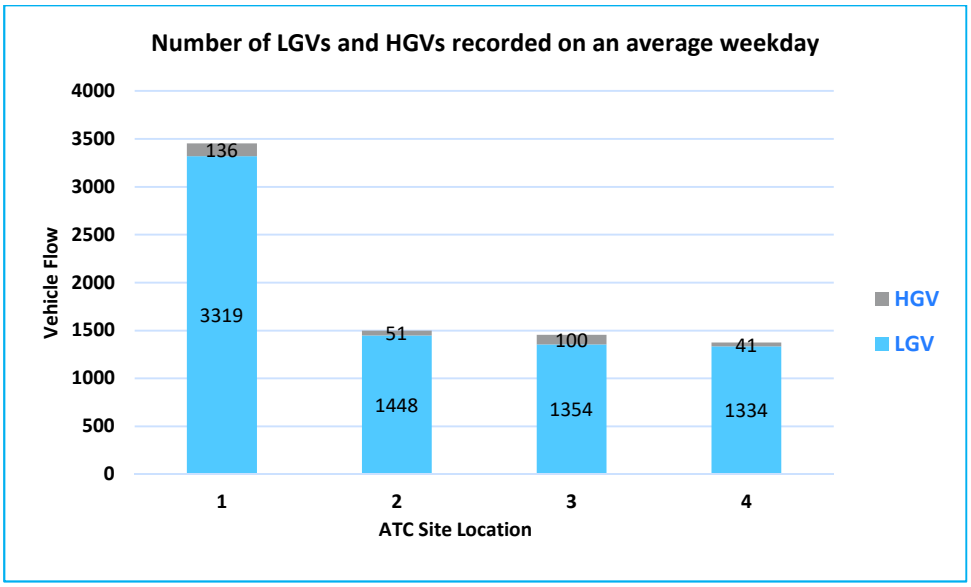

Figure 4.2: Average number of LGVs and HGVs recorded on a weekday at each ATC site

4.3.2 The highest number of LGVs and HGVs were recorded at ATC Site 1, B1061 West of Great Bradley.

4.3.3 Figure 4.3 shows the average number of LGVs (< 3.5 tonnes, which includes private cars) and HGVs (>3.5 tonnes) recorded on an average weekday at each MCC site.

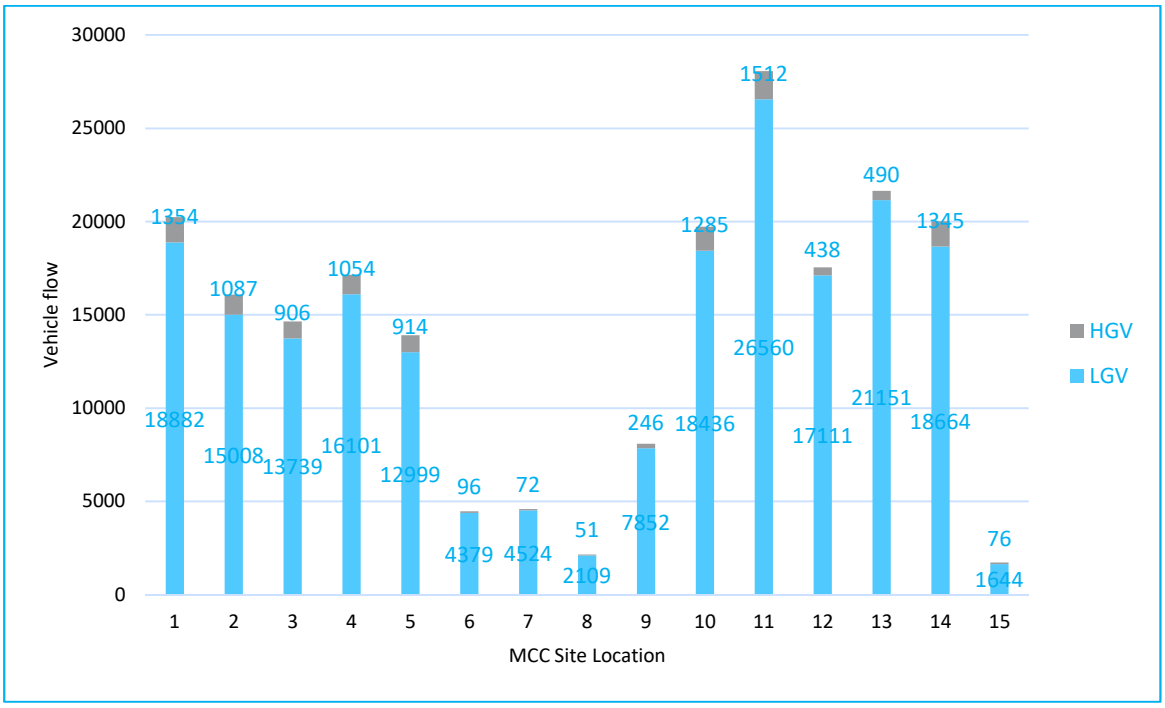

Figure 4.3: Average number of LGVs and HGVs recorded on a weekday at each MCC site

4.3.4 The highest number of HGVs was observed was at the junction of the A1307 / A11 (MCC 11).

4.3.5 A summary of the 24 hour average daily, 18 hour average weekday and 8 hour average weekday traffic flow and HGV percentage for each ATC site is summarised in Table 4.1 below.

Table 4.1: 24 hour average daily, 18 hour average weekday and 8 hour average weekday traffic flow and HGV percentage for each ATC site

Site Number	ATC	24 Hour AADT	Percentage HGV	18 Hour AAWT	Percentage HGV	8 Hour AAWT	Percentage HGV
1	Site 1	3106	3.6%	3380	4%	216	3%
2	Site 2	1364	3.0%	1482	3%	55	3%
3	Site 3	1304	6.5%	1438	7%	53	11%
4	Site 4	1211	2.6%	1359	3%	52	2%

4.3.6 The highest percentage of HGVs was recorded at ATC Site 3 B1061 and the lowest percent of HGVs was recorded at ATC 4, West Wickham Road. The location of ATC site 3 is shown in Figure 4.4 below.

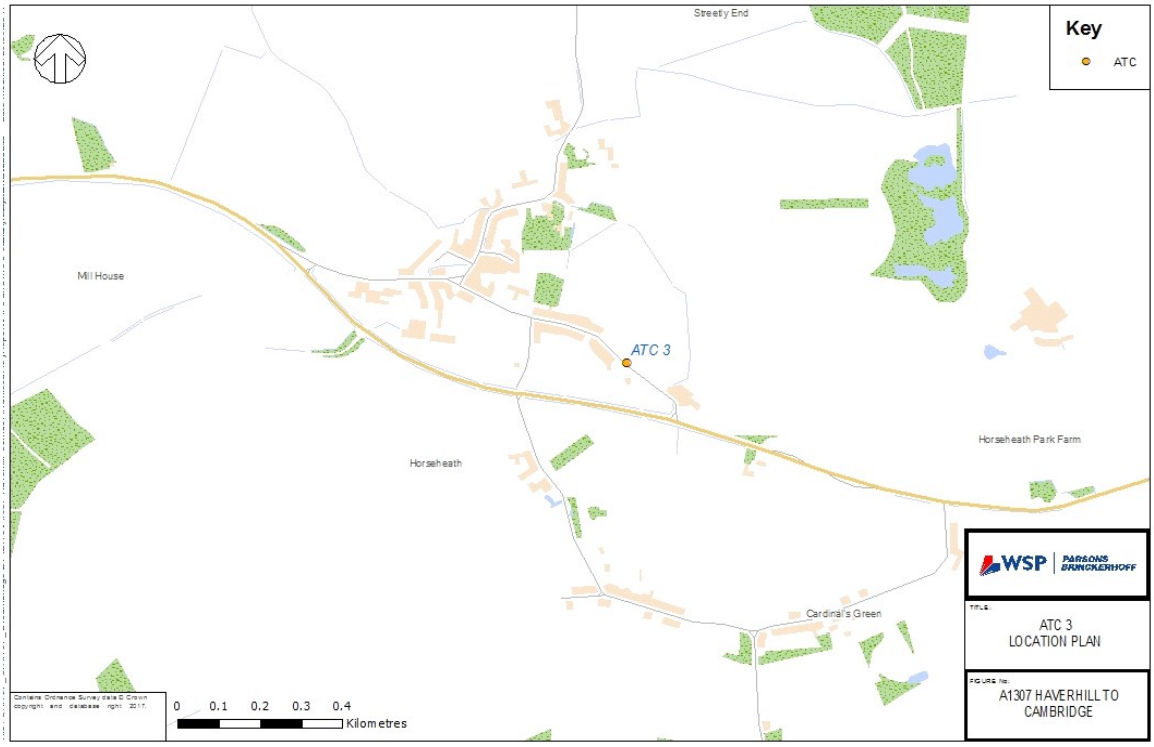

Figure 4.4: Location of ATC survey site 3

4.4 NETWORK PEAKS

4.4.1 The network peaks have been calculated using rolling hourly average weekday traffic flows from the ATC and MCC surveys. For ATC surveys a rolling average has been calculated at 15 minute intervals. For the MCC surveys a rolling average has been calculated at 30 minute intervals. The difference in approaches is due to the granularity of data recorded by the MCC and ATC surveys. For the MCC surveys traffic flows were recorded in 30 minute intervals whereas the traffic flows for the ATC surveys were recorded at 15 minute intervals.

4.4.2 The ATC profile for Haverhill Road (ATC Ste 3), north west of the A1307 Haverhill Road junction is provided in Figure 4.5 below.

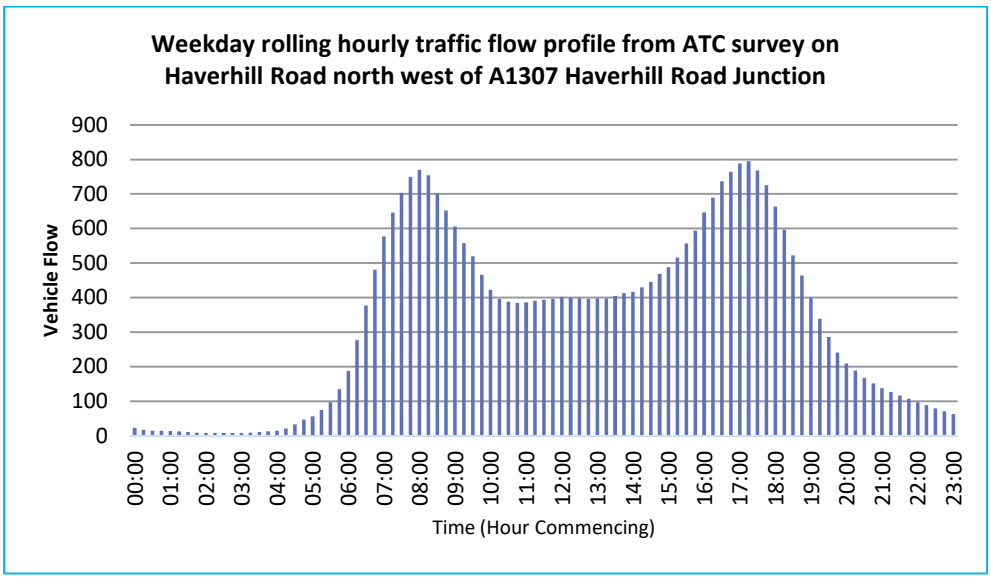

Figure 4.5: Average weekday traffic flow profile from ATC survey on Haverhill Road north west of A1307 Haverhill Road Junction

4.4.3 Figure 4.5 above shows the peak hour traffic flow on Haverhill Road to be 07:00 to 08:00 in the AM and 17:15 to 18:15 in the PM. In the AM Peak the rolling hourly traffic flow exceeds 700 vehicles per hour between 07:30 and 09:30 and in the PM peak the rolling hourly traffic flow exceeds 700 vehicles between 16:30 and 19:15.

4.4.4 The average daily traffic profile across all MCC sites is summarised in Figure 4.6 below. This shows a rolling total hourly traffic flow across all 15 MCC sites. The total flow in PCUs has been calculated using the values in Table 2.3 above.

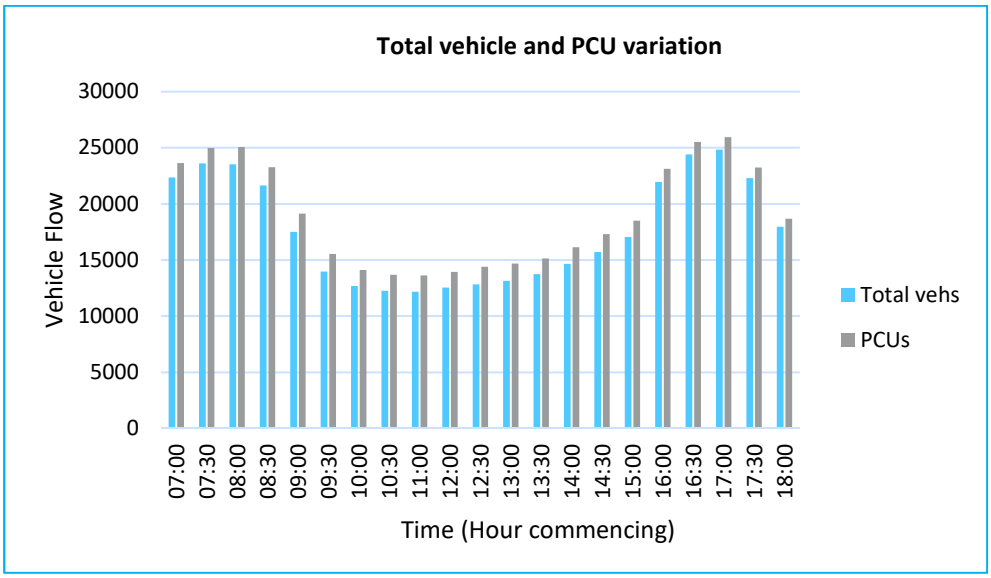

Figure 4.6: Average weekday traffic flow profile across all MCC sites

4.4.5 Figure 4.6 above shows the network peak hour traffic flows to be 08:00 to 09:00 in the AM Peak and 17:00 to 18:00 in the PM Peak. Whilst the highest volume of traffic is recorded within these time periods, the network peak generally lasts between 07:00 and 09:30 in the AM and 16:00 and 18:30 in the PM.

4.4.6 The difference in the reported PM Peak hour between the ATC and MCC surveys is due to the difference in the granularity of the rolling peak hours, with more detailed traffic flow data provided by the ATC surveys.

4.5 TRAFFIC FLOW VARIATION

4.5.1 The variation in average weekday traffic flows across all ATC sites is shown in Figure 4.7 below.

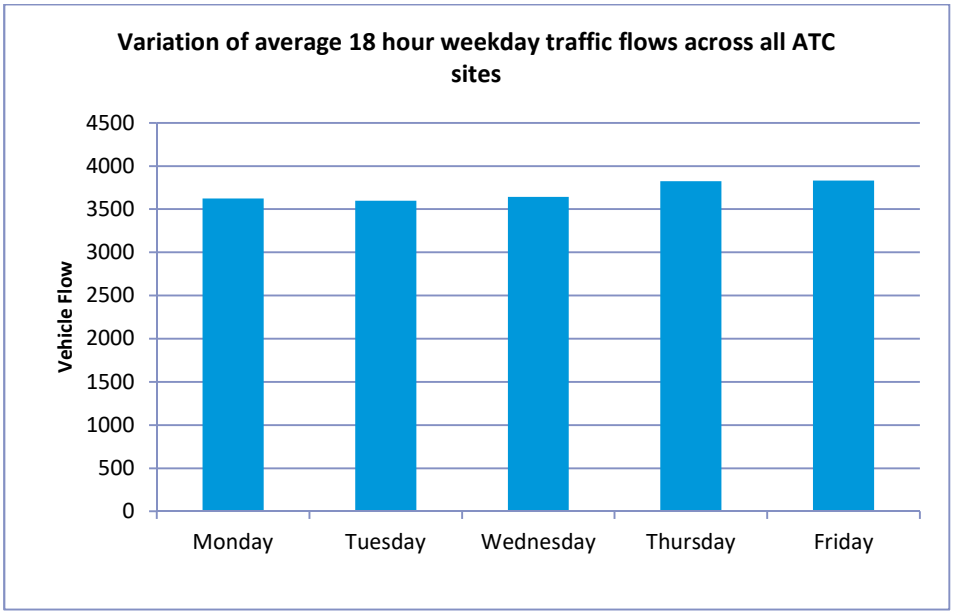

Figure 4.7: Variation of average total weekday traffic flows across all ATC sites

4.5.2 Figure 4.7 above shows that the highest traffic flows were recorded on a Friday (3,832) and lowest traffic flows were recorded on a Tuesday (3,598).

4.5.3 The percentage variation of traffic flows across an average week is summarised in Table 4.2 below.

Table 4.2: Comparison of recorded weekday 18 hour traffic flows

Weekday	Weekday Traffic Flow		Average 18 Hour Weekday Traffic Flow	Percentage Variation
	18 Hour Max	18 Hour Min		
Monday	3624	3624	3704	2.17%
Tuesday	3598	3598		2.85%
Wednesday	3642	3642		1.69%
Thursday	3824	3824		-3.23%
Friday	3832	3832		-3.47%

4.5.4 There is a maximum variation of +/- 3.5% from the average weekday traffic flow.

4.5.5 The weekly variation of traffic flows at each ATC site is shown in Figure 4.8 below.

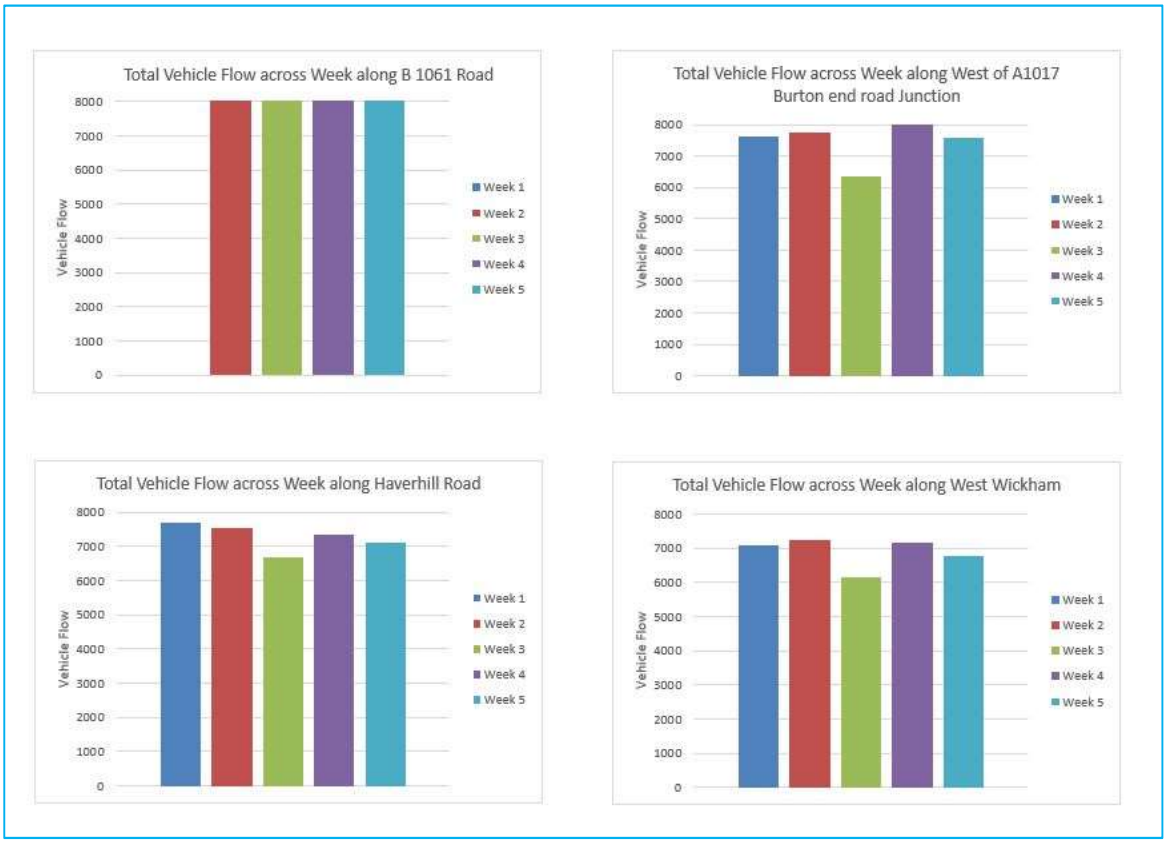

Figure 4.8: Weekly variation of traffic flows at each ATC site

4.5.6 Figure 4.8 above shows that traffic flows followed a similar trend at each ATC site. Week three shows a reduction in the total number of vehicles recorded across all ATC sites. This is likely to be attributable to it being half term week for Schools in Cambridge (October 24th to October 28th).

4.6 PEDAL CYCLES

4.6.1 In order to understand the level of cycling across the study area the total number of pedal cycle users recorded at each MCC site has been reviewed. Figure 4.9 below shows the total number of pedal cycles recorded over a 12 hour period at each MCC site.

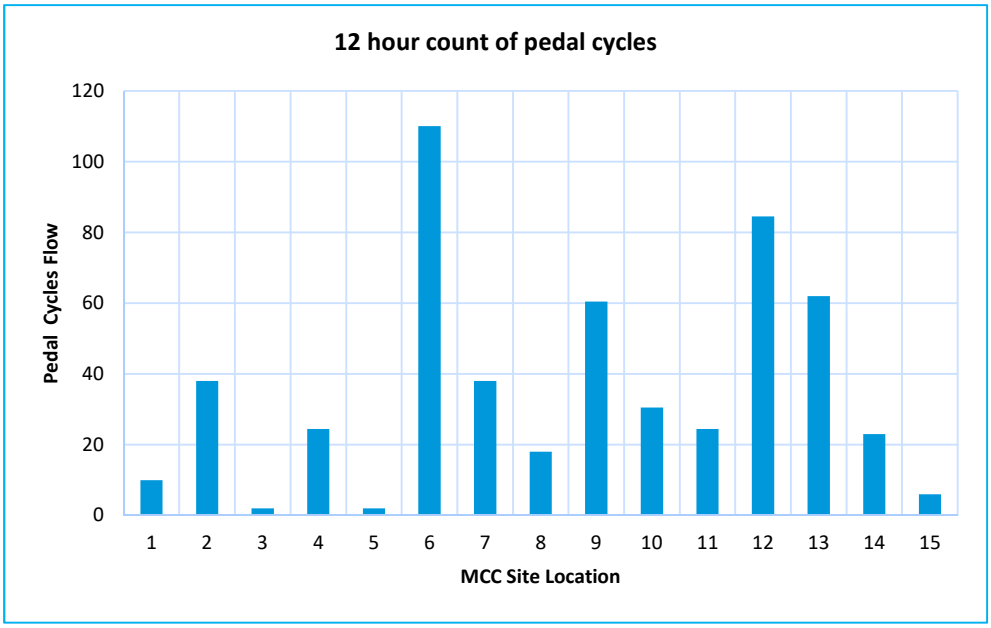

Figure 4.9: 12 Hour pedal cycle users recorded at each MCC site

4.6.2 The highest number of pedal cycle users was recorded at MCC site 6, High Street / Balsham Road junction, and is likely to be due to the proximity of the site to Linton Village College. A large number of pedal cycles were also recorded at MCC sites 9, 12 and 13. The location of these MCC sites is shown in Figure 4.10 below.

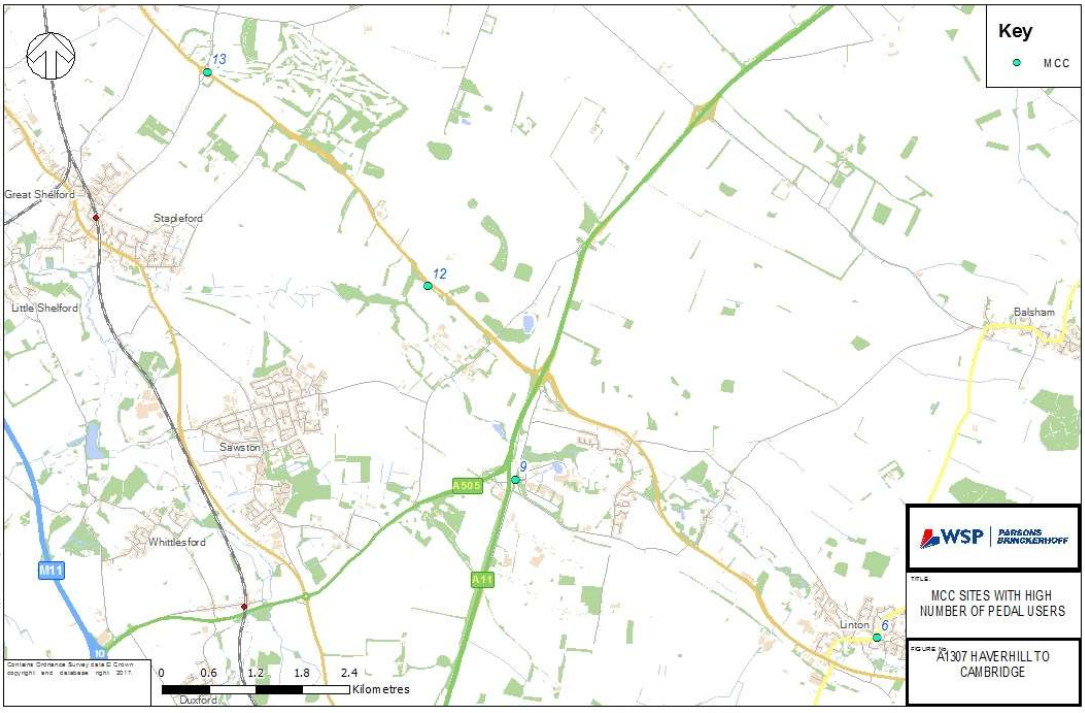

Figure 4.10: MCC sites with high number of pedal cycles recorded

4.7 TRAFFIC FLOWS ALONG THE A1307 AND A505 CORRIDORS

4.7.1 MCC survey data has been reviewed in order to understand weekday traffic movements along the A1307 and A505 corridors.

A1307 CORIDOR

4.7.2 A flow diagram showing the 12 hour weekday traffic flow (0700 to 1900) along the A1307 corridor is provided in Figure 4.11 below.

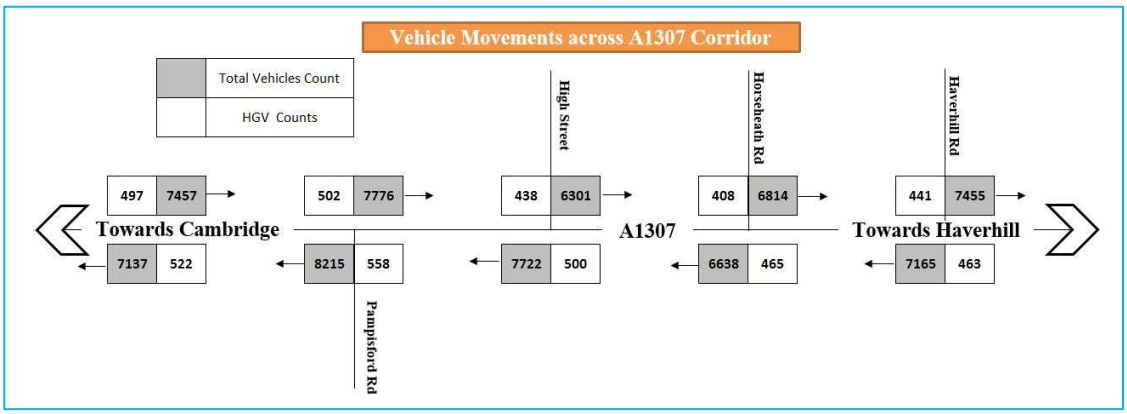

Figure 4.11: 12 Hour weekday traffic flow along the A1307 corridor

4.7.3 The 12 hour turning counts at the A11 / A1307 junction is provided in Figure 4.12 below.

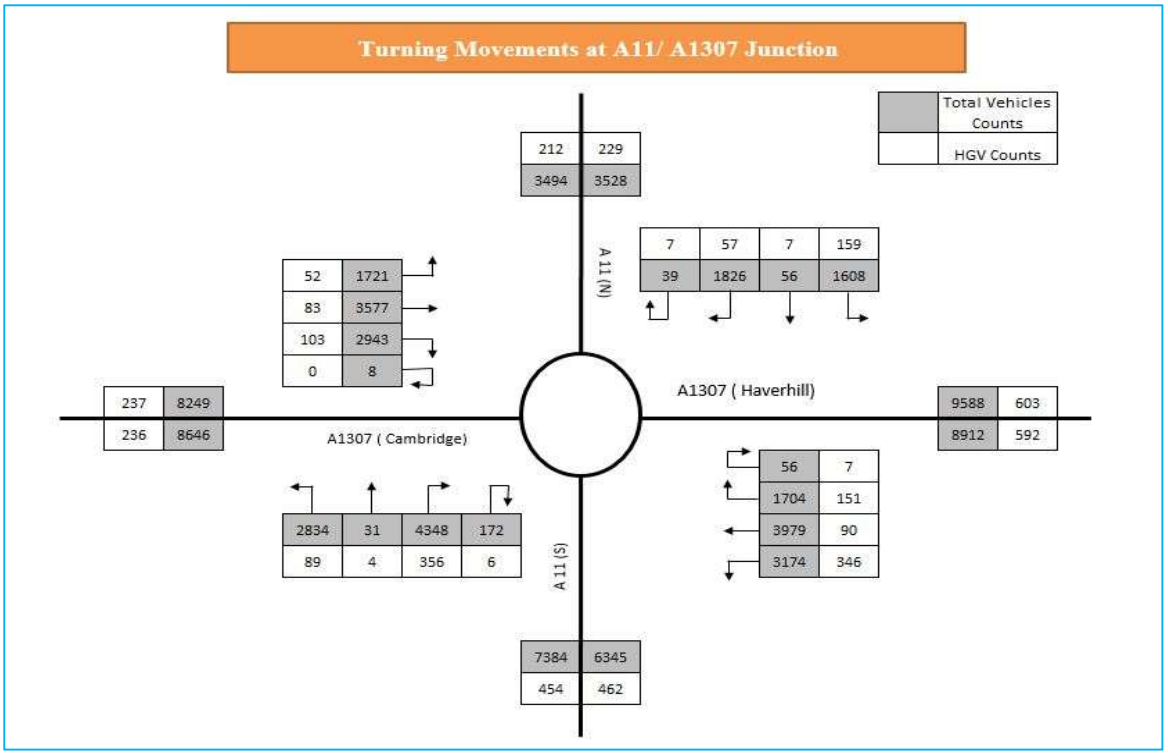

Figure 4.12: 12 Hour weekday traffic flow A11 / A1307 Junction

4.7.4 Figure 4.12 above shows that a significant proportion of traffic access the A11 from the A1307. Approximately 20% of all A1307 traffic accesses the A11 North and 36% of traffic access the A11 South.

4.7.5 It should be noted that Figure 4.12 does not show the A11 Mainline traffic flow and as such it is not possible to calculate the percentage of A11 traffic accessing the A1307.

A1307 CORIDOR

4.7.6 A flow diagram showing the 12 hour weekday traffic flow (07:00 to 19:00) along the A505 corridor is provided in Figure 4.13 below.

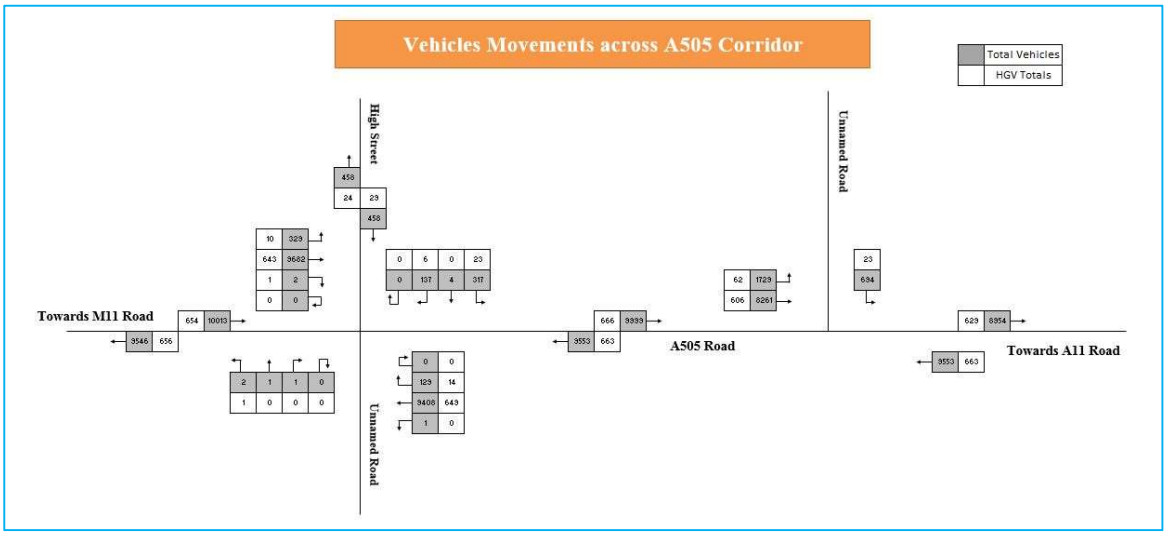

Figure 4.13: 12 Hour weekday traffic flow along A505 Corridor

4.7.7 Figure 4.13 above shows that relatively few vehicles enter and exit the A505 corridor from local roads. The majority of vehicles access the A505 corridor from A11 as this is the only access to the corridor from the east.

5 QUALITY OF ANPR DATA COLLECTED

PRINCIPLES OF ANPR

5.1.1 ANPR data is collected using a series of video cameras which gather footage and attempt to read the number plates of any vehicle passing by. The technology is fairly well developed and whilst it is expected that most vehicles passing an ANPR camera will be identified, a small proportion of vehicles will pass by unidentified.

5.1.2 A traffic flow count is conducted at the same time as number plate logging to enable a sample rate to be calculated. This sample rate can be thought of as a number plate reading success rate at a single camera location. It is the amount of number plates read as a proportion of the total number of vehicles passing the camera.

5.1.3 The purpose of reading the number plates is to enable each vehicle to be uniquely identified. A series of cameras are installed on-street at the same time to allow a number plate matching task to take place. Any number plate that is identified by 2 or more cameras can be used to trace where a vehicle has come from and gone to with respect to the survey study area. It may be that a number plate is identified by the cameras three or more times, in which case the start and end points of the vehicle's journey can be identified in addition to one or more intermediate / via points which helps to provide an indication of the routes that vehicles are taking to get from A to B if a choice exists.

5.1.4 Some records may only feature in the dataset once, in which case it is assumed that the vehicle left the study area via a route not covered by ANPR cameras, or it could have been part of the small number of vehicles where a camera failed to pick up their plate. Single records are discarded as they cannot be matched and therefore do not provide any additional data above that provided by the traffic count.

SAMPLE RATE

5.1.5 The sample rate (the amount of number plates read as a proportion of the total flow) has been provided by Intelligent Data for each site, by direction for each day. Ideally all of the vehicles passing the camera would have their number plate successfully read (i.e. a sample rate of 100%) but in reality there are many factors which often affect the reliability of ANPR cameras and auto-recognition such as poor weather conditions, number plates partially obscured by other vehicles and dirty number plates.

5.1.6 Most of the sites achieved sample rates in excess of 75% which indicates that the sample of data collected is likely to be representative of all vehicles at that site. The exceptions to this are as follows:

- Site 20-inbound (Limekiln Road, southbound) received a total flow of 1842 vehicles over the two 12-hour periods but only 953 number plates were read (52%).
- Site 16-inbound (Hildersham Road, westbound - just west of Linton) received a flow of 490 vehicles over the two 12-hour periods but only 267 number plates were read (54%)
- Site 17-outbound (A1307, just east of the A11) which received a flow of 16503 vehicles over the two 12-hour periods but only 5262 number plates were read (32%).

5.1.7 When an ANPR camera is installed it has to be calibrated for that particular site by allowing a number of vehicles to pass, checking to see whether their number plates have been logged correctly and adjusting settings and repeating if not. At sites with low flows it is more difficult to calibrate the cameras as there are fewer test vehicles available to use as a basis for making adjustments. Therefore quieter sites may have lower sample rates, but things like level of light (Limekiln Road does not have streetlights) and the angle of the camera (often based on available street furniture) can have an impact too. Site 23 (Wilbraham Road, Little Wilbraham) is a low flow site, but it does have streetlights which may have helped to improve the sample rate here.

Table 5.1: Sample Rate on Tuesday 18th and Wednesday 19th October, combined

	Overall Sample Rates			Inbound Sample Rates			Outbound Sample Rates		
Site	Observed flow (MCC)	Captured Plates	Sample Rate	Observed flow (MCC)	Captured Plates	Sample Rate	Observed flow (MCC)	Captured Plates	Sample Rate
EXTERNAL SITES (origin / destination points)									
01	5614	5211	93%	2973	2822	95%	2641	2389	90%
02	4723	4302	91%	2477	2360	95%	2246	1942	86%
11	2666	2446	92%	1300	1143	88%	1366	1303	95%
18	10183	9518	93%	5099	4876	96%	5084	4642	91%
19	5324	4638	87%	2323	1881	81%	3001	2757	92%
20	3770	2731	72%	1842	953	52%	1928	1778	92%
22	20458	17783	87%	9812	9509	97%	10646	8274	78%
23	356	319	90%	235	214	91%	121	105	87%
24	15707	14630	93%	7663	7044	92%	8044	7586	94%
26	39071	34858	89%	19998	18015	90%	19073	16843	88%
27	51607	45533	88%	26740	23974	90%	24867	21559	87%
28	24109	21781	90%	12852	12433	97%	11257	9348	83%
29	19855	17843	90%	10431	8885	85%	9424	8958	95%
30	5522	5200	94%	2960	2722	92%	2562	2478	97%
All	**208965**	**186793**	**89%**	**106705**	**96831**	**91%**	**102260**	**89962**	**88%**
INTERNAL SITES (via points)									
03	31526	28819	91%	15434	14923	97%	16092	13896	86%
05	3224	2938	91%	1659	1477	89%	1565	1461	93%
06	27183	23805	88%	13883	12270	88%	13300	11535	87%
07	8002	7500	94%	3916	3648	93%	4086	3852	94%
08	1821	1627	89%	917	797	87%	904	830	92%
09	2375	2168	91%	1129	1017	90%	1246	1151	92%
10	87	74	85%	43	34	79%	44	40	91%
12	28560	25299	89%	14529	12810	88%	14031	12489	89%
13	4836	4552	94%	2359	2260	96%	2477	2292	93%
14	12960	11918	92%	6344	5759	91%	6616	6159	93%
15	2477	2267	92%	1180	1099	93%	1297	1168	90%
16	959	717	75%	490	267	54%	469	450	96%
17	34265	20596	60%	17762	15334	86%	16503	5262	32%
21	5724	5306	93%	0	7	-	5724	5299	93%
25	33472	30087	90%	16796	16073	96%	16676	14014	84%
31	73398	64522	88%	37130	31835	86%	36268	32687	90%
All	**270869**	**232195**	**86%**	**133571**	**119610**	**90%**	**137298**	**112585**	**82%**

5.1.8 Site 4 on Back Road in Linton was installed and operating, however the data became corrupted and therefore cannot be used and has been excluded from the analysis.

MATCH RATE

5.1.9 Intelligent Data have also provided match rate analysis of the data which shows how many plates number were able to be matched over two or more sites. It should be noted that number plate matching has only happened for external sites (shown in blue) that have traffic inbound into the study area.

Table .5.2: Inbound Sample and Match Rates, over 24 hours, 12 hours on Tuesday 18th and 12 hours on Wednesday 19th October, combined (external zones only)

		Inbound Sample and Match Rates (2 x 12hrs)			
Site	Description	Observed inbound flow (MCC)	Inbound plates read	Inbound plates matched at other sites	Inbound match rate
01	B1062 south of A1307, Linton Linton	2973	2822	2210	74%
02	Unnamed road south of A1307 near Bartlow Road	2477	2360	1975	80%
11	Unnamed road at Nosterfield End, south-west of Haverhill	1300	1143	328	25%
18	A1307 between Granta Park access and A11	5099	4876	3841	75%
19	High Street, Babraham	2323	1881	1753	75%
20	Cherry Hinton Road between Babraham Park and Ride eastern access and A1307	1842	953	529	29%
22	A1307 Hills Road, north of Long Road	9812	9509	5692	58%
23	Unnamed road between A14 and A11, north east of Little Wilbraham	235	214	167	71%
24	Balsham Road between Fulbourn and A11	7663	7044	5151	67%
26	A505 between A11 and High Street	19998	18015	16231	81%
27	A11 between A505 and A1307	26740	23974	22231	83%
28	Long Road between railway bridge and Addenbrooke's access	12852	12433	4833	38%
29	Addenbrooke's Road, west of Hobson's Brook	10431	8885	3368	32%
30	Mill Road, south-east of Great Wilbraham	2960	2722	2342	79%
Total		**52504**	**106705**	**96831**	**66%**

5.1.10 It can be seen that most inbound sites have been able to capture a number plate and match it in another location for at least 50% of vehicles. There are four sites where only 20-40% of vehicles have been able to be identified and matched – these are at sites 11 (Minor Road in Shudy Camps), 20 (Babraham Road Park and Ride Site), 28 (Addenbrooke's Hospital) and 29 (Addenbrooke's Road).

5.1.11 As the cordon that the external sites forms is not water tight there will be some vehicles that are picked up at a single site that continue their journeys via a road that is not covered by an ANPR camera and therefore a match is not made. We are unlikely to be able to cover all origins for trips entering sites with a large draw, such as Addenbrooke's and Babraham Park and Ride site which both attract trips from areas outside of the A1307 / A11 corridor. The Nosterfield End site (#11, near Shudy Camps) is situated on the south-eastern extremity of the ANPR cordon and it is quite plausible that many vehicles being recorded here head south or east towards Haverhill rather than heading west towards the ANPR cordon which is why they aren't well matched at other sites.

SUMMARY

5.1.12 Overall, the sample rate and match rates of the data are acceptable. It is unreasonable to expect a 100% sample rate due to the limitations of the ANPR camera technology, the overall sample rate achieved was just under 85% which indicates that the majority of vehicles were identified at least once. The overall match rate achieved was 66% on both survey days which indicates that a reasonable number of journeys were able to be traced through the study area. Those vehicles that were not traced are likely to have avoided detection as there were a number of routes in and out of the study area that were not covered by cameras. As the matched data set only covers 66% of observed trips, it should not be used to draw any conclusions relating to absolute numbers of vehicles making a particular journey. An appropriate use of the data would be to look at the percentage distribution of trips beginning from a particular point and conclude that it is likely to be representative of all trips starting from that point, an example of this type of analysis can be seen in Table 6.1 and can be conducted using the OD spreadsheet tool provided by WSP Parsons Brinkerhoff.

5.1.13 It would not be appropriate to use matrix estimation to estimate volumetric origin destination flows. This is due to the sample rate being only 66%, the low sample rate at some ANPR sites and a large number of sources where vehicles could enter and exit the ANPR network without passing through an ANPR site.

6 ANALYSIS OF ANPR DATA

6.1 ORIGIN AND DESTINATION OF VEHICLE TRIPS

6.1.1 Intelligent Data have processed the raw data matches into an origin-destination matrix for all 31 sites. The OD matrices summarise the origin and destination of vehicle trips by each half hour time period. Separate matrices are provided for OD movements greater than and less than 30 minutes in length. Additional matrices are provided for different classes of vehicles.

6.1.2 The OD matrices do not show whether a vehicle was captured at any internal sites. This information can only be obtained from reviewing the trip chain report which provides a full record of each individual capture and a summary of each trip chain observed.

6.1.3 Using the information in the trip chain report WSP Parsons Brinkerhoff has produced a tool to allow Cambridgeshire County Council to interrogate the origin-destination data with more clarity. The origin-destination interrogation spreadsheet tool allows users to compare the use of routes to / from an origin / destination.

6.1.4 Users are also able to specify internal capture sites that vehicles must pass through. Users can also add an asterisk as a wildcard to specify that any number of internal ANPR sites can be travelled through. As noted above, due to the classification structure of the ANPR network, only internal sites can be specified as a being an intermediary waypoint along a route being compared. External zones can only be an origin or destination.

6.1.5 The tool calculates the total number of journeys recorded via each specified route, this is then presented as a percentage of total journeys recorded along all of the specified routes. As such if only one route is entered the tool will report a value of 100%. It is recommended that where a user is looking to estimate the distribution of vehicle trips to a give origin / destination; all likely route combinations should be specified.

6.1.6 Example origin-destination data that can be extracted using the spreadsheet tool is provided below. The example below analyses the distribution of car trips to Cambridge Biomedical Campus (ANPR Site 21 – CBC Access from Babraham Road) in the AM Peak (0800 to 0900) from the northern half of the ANPR network. The distribution is summarised in the table below.

Table 6.1: Origin of car trips to CBC in the AM Peak (0800 to 0900) – average of data collected on Tuesday 18th October 2016 and Wednesday 19th October 2016

Route	Origin	Destination	Percentage Distribution
1	A1307 Hills Road, north of Long Road	CBC access from Babraham Rd	16.7%
2	A11 at Worsted Lodge Farm	CBC access from Babraham Rd	19.3%
3	A11 between A505 and A1307	CBC access from Babraham Rd	4.5%
4	A1307 north-west of Little Abington and east of Granta Park access	CBC access from Babraham Rd	43.1%
5	Cherry Hinton Road between Babraham Park and Ride eastern access and A1307	CBC access from Babraham Rd	16.4%
6	High Street, Babraham	CBC access from Babraham Rd	0.0%

6.1.7 The above table indicates that in the AM peak between 0800 and 0900 43.1% of the captured vehicle trips to CBC are from the A1307 north-west of Little Abington and east of Granta Park access and that 19.3% of trips are from the A11. A second example is provided below. The example analyses the distribution of vehicle trips from Haverhill in the AM Peak and towards Haverhill in the PM Peak.

Table 6.2: Origin of car trips from Haverhill in the AM Peak (1700 to 1800) – average of data collected on Tuesday 18th October 2016 and Wednesday 19th October 2016

Route	Origin	Destination	Percentage Distribution
1	A1307 Horseheath to Haverhill	West Wickham Road, Horseheath	23.6%
2	A1307 Horseheath to Haverhill	Unnamed road south of A1307 near Bartlow Road	6.6%
3	A1307 Horseheath to Haverhill	B1062 south of A1307, Linton	29.9%
4	A1307 Horseheath to Haverhill	B1052 Balsham Road, Linton	2.8%
5	A1307 Horseheath to Haverhill	A11 at Worsted Lodge Farm	4.9%
6	A1307 Horseheath to Haverhill	High Street, Babraham	18.4%
7	A1307 Horseheath to Haverhill	Unnamed Road, north of Hildersham and hildersham Road junction	0.0%
8	A1307 Horseheath to Haverhill	A11 between A505 and A1307	2.8%
9	A1307 Horseheath to Haverhill	A1307 between A11 and Babraham Institute access	11.1%

Table 6.3: Origin of car trips towards Haverhill in the PM Peak (1700 to 1800) – average of data collected on Tuesday 18th October 2016 and Wednesday 19th October 2016

Route	Origin	Destination	Percentage Distribution
1	West Wickham Road, Horseheath	A1307 Horseheath to Haverhill	36.7%
2	Unnamed road south of A1307 near Bartlow Road	A1307 Horseheath to Haverhill	2.8%
3	B1062 south of A1307, Linton	A1307 Horseheath to Haverhill	4.4%
4	B1052 Balsham Road, Linton	A1307 Horseheath to Haverhill	9.1%
5	High Street, Babraham	A1307 Horseheath to Haverhill	0.9%
6	Unnamed Road, north of Hildersham Road junction	A1307 Horseheath to Haverhill	0.0%
7	A11 between A505 and A1307	A1307 Horseheath to Haverhill	6.4%
8	A1307 between A11 and BRC access	A1307 Horseheath to Haverhill	35.4%
9	A11(N of A1307) at Worsted Lodge	A1307 Horseheath to Haverhill	4.3%

6.1.8 The above tables indicate that the destination of the majority of car movements from Haverhill in the AM Peak and origin in the PM Peak are Horseheath, Linton and A1307 west of the A11. In the AM Peak 11.1% of all vehicles travelling on the A1307 from Haverhill have a destination west of the A11, in the PM Peak 35.4% of vehicle trips travelling on the A1307 towards Haverhill have an origin west of A11.

6.1.9 It is important to note that the ANPR network is not water tight and large numbers of vehicle trips are likely to originate from areas other than those in the table above (i.e. any roads not included in the ANPR network). Furthermore the analysis does not pick up vehicle trips that originate within the ANPR cordon (i.e. picked up by ANPR site 21 only). For this reason the wider distribution of car trips estimated by the Origin-Destination Interrogation Spreadsheet Tool should be used with some degree of caution.

6.2 JOURNEY TIMES

6.2.1 The trip-chain report provides details on the internal ANPR sites that a vehicle passed through. The trip chain data provides a date and time-stamp for each recorded number plate match and a list of sites where that vehicle was identified. This data also includes a travel time for each leg of a route in minutes.

6.2.2 Using information in the trip chain report it is possible to extract journey time information. WSP Parsons Brinkerhoff has developed a tool to allow Cambridgeshire County Council to interrogate the ANPR journey time data.

6.2.3 The journey time interrogation spreadsheet tool allows the user to query the ANPR data and extract the journey time for a specified trip chain. The tool works by extracting journey times from each recorded trip chain across the ANPR network based on a series of criteria set by the user.

6.2.4 Journey times can be queried by date, class of vehicle and time of day (hour beginning). For some hours, classes of vehicles and trip chains, no or limited data was recorded and a journey time cannot be provided.

6.2.5 The tool requires the user to select ANPR camera sites along the route that a journey time is required. All ANPR sites along the route must be entered, omitting a site could lead to an incorrect journey time being calculated. The tool allows users to select a route comprised of up to 17 ANPR sites. This value is based on the maximum trip chain recorded.

6.2.6 The tool provides the average, median, maximum and minimum journey times (in minutes) for the route selected by the user. The total number of journey time entries that match the criteria set by the user is also provided.

6.2.7 One of the limitations of ANPR data is the inability to identify whether a vehicle was travelling continuously through the study area, or broke their trip with a stop mid-journey (e.g. going to the shops, dropping or picking children up from school). As a result, there is the potential for journey times to be skewed by trips that were broken between ANPR sites. Given this uncertainty journey times have been presented in minutes only (no decimals). To overcome this limitation the tool includes a function for users to exclude vehicle journey time that exceed the 85th percentile journey time for that particular route. For the above reasons the ANPR journey times should be considered as estimates of typical journey times between each ANPR site. It is suggested that additional analysis using DfT Trafficmaster Data is undertaken if more detailed journey time information is required.

6.2.8 Example journey time information that can be extracted using the journey time spreadsheet tool is provided below.

6.2.9 Figure 6.1: shows the extent of the A1307 corridor included within the ANPR network. As noted above it is not possible to identify whether vehicles travelled continuously along the A1307 corridor, routed between sites via an alternative route (e.g. using minor roads parallel to the A1307), or broke their journey mid-way between sites. However it is considered highly likely that the majority of vehicles travelling between the ANPR sites shown in Figure 6.1: routed via the A1307 and as such is a good estimation of typical journey times along this link.

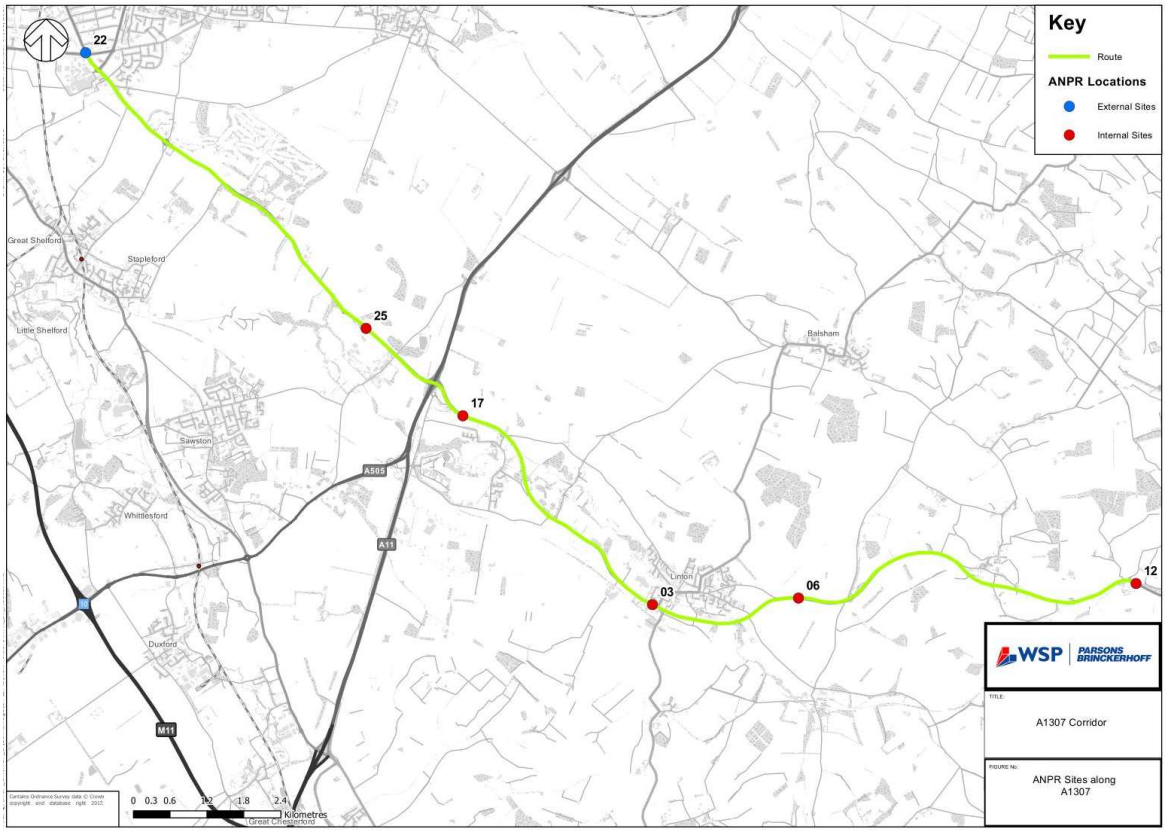

Figure 6.1: ANPR Sites along A1307 Corridor

6.2.10 The data in the tables below relate specifically to the A1307 corridor. All journey times are presented in minutes.

6.2.11 The journey times presented are based on the following criteria:

- Cars only;
- Journey times that exceed the 85th percentile have been excluded; and
- Average of journey times collected on 18/10/2016 and 19/10/2016.

Table 6.4: AM Peak (0800 to 0900) Journeys Times along A1307 Corridor

Towards Cambridge									
Link	*From*	*To*	*Description*	*Average*	*Maximum*	*Minimum*	*Range*	*Median*	*Count*
1	12	6	A1307 W of Haverhill to A1307 E of Linton	00:04:54	00:05:52	00:03:35	00:02:17	00:04:53	1001
2	6	3	A1307 E of Linton to A1307 W of Linton	00:06:02	00:09:56	00:01:51	00:08:05	00:06:00	815
3	3	17	A1307 W of Linton to A1307 E of A11	00:03:43	00:04:23	00:02:54	00:01:29	00:03:41	159
4	17	25	A1307 E of A11 to A1307 Babraham Research Campus	00:02:12	00:03:39	00:01:38	00:02:01	00:02:07	101
5	25	22	A1307 Babraham Research Campus to A1037 / A1134	00:18:01	00:25:51	00:07:32	00:18:19	00:17:39	169
From Cambridge									
Link	*From*	*To*		*Average*	*Maximum*	*Minimum*	*Range*	*Median*	*Count*
1	22	25	A1037 / A1134 to A1307 Babraham Research Campus	00:08:58	00:11:03	00:07:08	00:03:55	00:08:59	141
2	25	17	A1307 Babraham Research Campus to A1307 E of A11	00:01:46	00:02:02	00:01:26	00:00:36	00:01:46	190
3	17	03	A1307 E of A11 to A1307 W of Linton	00:03:50	00:04:34	00:02:55	00:01:39	00:03:48	472
4	03	06	A1307 W of Linton to A1307 E of Linton	00:02:08	00:02:25	00:01:36	00:00:49	00:02:09	433
5	06	12	A1307 E of Linton to A1307 W of Haverhill	00:04:29	00:04:59	00:03:22	00:01:37	00:04:29	465

Table 6.5: PM Peak (1700 to 1800) Journeys Times along A1307 Corridor

Towards Cambridge									
Link	*From*	*To*	*Description*	*Average*	*Maximum*	*Minimum*	*Range*	*Median*	*Count*
1	12	6	A1307 W of Haverhill to A1307 E of Linton	00:04:38	00:05:06	00:03:47	00:01:19	00:04:41	501
2	6	3	A1307 E of Linton to A1307 W of Linton	00:02:05	00:02:26	00:01:29	00:00:57	00:02:05	408
3	3	17	A1307 W of Linton to A1307 E of A11	00:03:34	00:03:59	00:02:53	00:01:06	00:03:35	79
4	17	25	A1307 E of A11 to A1307 Babraham Research Campus	00:11:43	01:06:10	00:01:37	01:04:33	00:01:58	47
5	25	22	A1307 Babraham Research Campus to A1037 / A1134	00:12:53	00:16:49	00:06:32	00:10:17	00:13:00	783
From Cambridge									
Link	*From*	*To*		*Average*	*Maximum*	*Minimum*	*Range*	*Median*	*Count*
1	22	25	A1037 / A1134 to A1307 Babraham Research Campus	00:11:38	00:14:02	00:09:06	00:04:56	00:11:37	247
2	25	17	A1307 Babraham Research Campus to A1307 E of A11	00:03:33	00:05:58	00:01:39	00:04:19	00:03:23	640
3	17	03	A1307 E of A11 to A1307 W of Linton	00:07:33	00:09:55	00:03:18	00:06:37	00:07:24	1103
4	03	06	A1307 W of Linton to A1307 E of Linton	00:02:06	00:02:22	00:01:37	00:00:45	00:02:06	1041
5	06	12	A1307 E of Linton to A1307 W of Haverhill	00:04:37	00:04:58	00:03:52	00:01:06	00:04:38	1326

6.2.12 A large number of journey times in excess of 10 minutes were recorded along Link 4 in a westbound direction (towards Cambridge) in the PM peak. This has resulted in a maximum and average journey time being calculated that is significantly higher than the median.

6.2.13 Excluding journey times in excess of the 85th percentile, the maximum journey time recorded along this link was 1 hour 6 minutes and 10 seconds and the average journey time recorded along this link was 11 minutes 43 seconds. Given that the median journey time for this link is 1 minute 58 seconds, it is considered that any journey time in excess of 10 minutes is unlikely to be representative of a vehicle travelling continuously between ANPR sites 17 and 25. Instead these vehicles are likely to have broken their journey, or travelled via a less direct route.

6.2.14 A possible explanation for the above results is the low number of journey times recorded between ANPR sites 17 and 25. In the PM Peak only 47 journey times were recorded between ANPR sites 17 and 25. This is likely to be attributable to site 17's low sample rate. Site 17 has a total flow of 16,503 vehicles over the two 12 hour survey periods, but only 5,262 number plates were read during this time. This equates to a sample rate at this site of 32% and is significantly lower than other ANPR Sites, which is generally between 70 and 90%.

6.2.15 Based on the above it is suggested that the average journey time is not used as this is susceptible to being skewed by anomalous results, vehicles that broke their journey or by vehicles that took a less direct route. Instead it is recommended that the median journey time is used.

6.2.16 The ability to determine the route that a vehicle travelled between sites is a limitation of ANPR data. For the calculation of more accurate journey times along the corridor it is recommended that additional analysis of Traffic Master data is undertaken.

7 CONCLUSION

7.1 SUMMARY

7.1.1 Of the four ATC sites analysed in this report, the highest traffic flow was recorded at ATC Site 1, B1061. This is a major road connecting Haverhill and Newmarket. At ATC Site 3, Haverhill Road, a higher traffic flow was recorded in the westbound direction in the AM and a higher traffic flow was recorded eastbound in the PM, suggesting that people are travelling towards Cambridge in the AM and from Cambridge in the PM. The highest percent of HGV movements was recorded at ATC Site 3 Haverhill Road (6.5%) and the lowest percent of HGV movements was recorded at ATC Site 4, West Wickham Road (2.6%).

7.1.2 The MCC surveys recorded the highest number of pedal cyclists in the village of Linton. This is likely to be due to the close proximity of this survey site to Linton Village College. The MCC with the second highest number of cyclists was on the junction of the A1307 and The Babraham Research Campus.

7.1.3 ANPR data collected in October 2016 has been reviewed. A sample rate of in excess of 75% was observed at the majority of ANPR sites, indicating that the data collected was representative of vehicles travelling through the ANPR Network. The overall match rate achieved was 66% on both survey days which indicates that a reasonable number of journeys were able to be traced through the ANPR study area. However as the matched data set only covers 66% of observed trips, the data should not be used to make any conclusions relating to absolute numbers of vehicles making a particular journey.

7.1.4 The raw ANPR trip chain information has been analysed to produce two spreadsheet tools that allow users to interrogate the data as per their specific requirement. The first spreadsheet tool enables the origin and destination of vehicle movements to be interrogated, allowing the user to estimate the distribution of vehicle trips to and from a specific origin or destination. A second spreadsheet tool was produced to interrogate ANPR journey times between specific sites. Using these spreadsheet tools journey times along the A1307 corridor in the AM, IP and PM Peak has been calculated and the distribution of vehicle trips towards Cambridge Biomedical Campus estimated.

7.1.5 The origin and destination of car movements from Haverhill in the AM and PM Peak has been analysed using the origin destination spreadsheet tool. This revealed in the AM Peak that 11.1% of all vehicles travelling on the A1307 from Haverhill have a destination west of the A11, in the PM Peak 35.4% of vehicle trips travelling on the A1307 towards Haverhill have an origin west of A11.

7.1.6 The journey time spreadsheet tool has been used to calculate the AM and PM Peak journeys times between the junction of A1037 / A1134 and A1307 west of Haverhill. The median AM Peak journey time towards Cambridge was calculated as 36 minutes and 32 seconds and the median PM peak journey time from Cambridge was calculated as 30 minutes and 1 second.