

## Cumberland Infirmary Car Parking Study

Survey Report  
September 2014



## Quality Management

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# 1. Introduction

## 1.1 Background Information

The Cumberland Infirmary is a general hospital based in Carlisle. Along with West Cumberland Hospital in Whitehaven, the hospitals provide healthcare services as part of North Cumbria Hospitals NHS Trust. The Cumberland Infirmary provides a 24 hour Accident & Emergency service with Trauma Unit status, maternity services and special care baby unit, a wide range of clinical services and specialist services as well as outpatient clinics.

Cumberland Infirmary has 444 inpatient beds and serves the local population of Carlisle and the North Cumbria area. The Trust serves a resident population of about 340,000 who live in largely rural areas. The Trust thus attracts a considerable number of the county's residents throughout the year.

Capita Property and Infrastructure has been appointed by North Cumbria University Hospitals NHS Trust to undertake a car park survey to determine current levels of parking demand during a typical whole day period.

## 1.2 Site Location

Cumberland Infirmary is located on Newtown Road approximately one mile west of Carlisle City centre, which is the largest settlement in the county of Cumbria. To the North and North West, it is bound by existing open land across the river Eden and Newtown to the south, which is a predominantly residential area. The hospital lies within 1.5 miles of the Carlisle train station and is three miles from the M6 motorway. The location of the Hospital is indicated by the red star shown in Figure 1-1 below.

**Figure 1-1: Map of Carlisle showing the location of Cumberland Infirmary**



### 1.3 Purpose of the Report

This report presents the findings of the traffic surveys undertaken describing the baseline conditions relating to demand, usage and duration of stay within the hospitals car parks.

### 1.4 Report Structure

The remainder of the report will take the following structure;

Chapter 2 – Site Description and Existing Conditions

Chapter 3 – Methodology

Chapter 4 – Data Analysis

Chapter 5 – Conclusions



## 2. Site Description and Existing Conditions

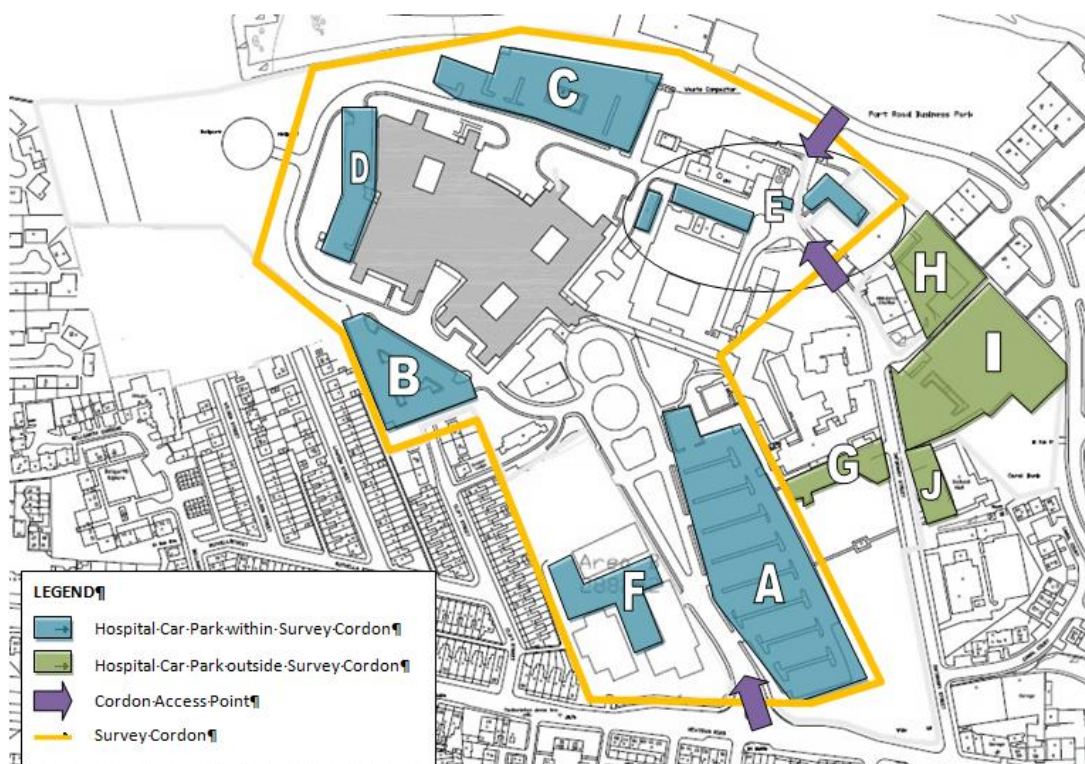
### 2.1 Site Layout

The hospital site covers an area of approximately 3,000sqm. There are three large buildings and numerous smaller buildings situated around the site. There are four large car parks and numerous smaller car parks serving the site. There are three access points to the hospital site including the main access from Newtown Road, Infirmary Road and a link road between Port Road Business Park and Infirmary Road.

Each of the hospital car parks and access points are illustrated in Figure 2-1 below although car park E is actually a collection of smaller car parks to the Northeast of the site. The yellow line indicates the survey cordon within which car park surveys have been conducted.

The car parks outside of the survey cordon have not been surveyed but are understood to experience similar issues to those within the cordon although less indiscriminate parking was observed in relation to these car parks during the site visit undertaken on 17<sup>th</sup> July 2014.

**Figure 2-1: Site Layout**



## 2.2 Car Park Capacities

The number of available parking spaces in each of the car parks identified in Figure 2-1 on the previous page is shown in Table 2-1 below.

**Table 2-1 – Hospital Car Park Capacities**

<b>Car Park</b>	<b>No. of Spaces</b>
A	321
B	88
C	161
D	56
E	45
F	35
<b>Cordon Total</b>	<b>706</b>
G	32
H	40
I	20
J	300
<b>TOTAL</b>	<b>1098</b>

## 2.3 Existing Conditions

All of the Hospitals parking sites are surface level car parks which are currently observed to be over capacity at various times of the day. This leads to indiscriminate parking including access blocking, parking in car park running lanes and parking on grass verges as shown in Figure 2-2 below and Figure 2-3 and Figure 2-4 overleaf. The purpose of the surveys undertaken for this report is to evaluate the scale and duration of this problem.

**Figure 2-2: Indiscriminate Parking Blocking Access**





**Figure 2-3: Indiscriminate Parking within Parking Area**



**Figure 2-4: Indiscriminate Parking on Grass Verge**



## 3. Methodology

### 3.1 Data Collection

Acquiring accurate data in any research and selecting the appropriate data collection method and instruments are essential to maintaining the integrity of a survey. For this study, there are various methods of data collection used to acquire the necessary traffic data. All of the traffic surveys were undertaken during the week commencing Monday 14th July in order to quantify typical traffic movements, car park demand and vehicle routing while on site.

#### 3.1.1 *Manual Classified Counts*

High mast video cameras were installed to cover all areas of the junctions/roads/entrances as listed in Table 3-1 below and shown in Figure 1 in Appendix A. All the camera images were time synchronised to the second.

**Table 3-1 – Site Locations**

Traffic Count Location	Reference Number
Hospital Access Close to Newtown Road	1
Entrance to Kingston Court	2
Entrance to main visitor car park x4	3-6
Hospital Access Intermediate Link	7
Hospital Access Roundabout NB Circulatory	8
Hospital Access Roundabout SB Circulatory	9
Hospital Service Road W of Roundabout	10
Entrance to car park 2 x 2	11-12
Hospital Service Road S of Helipad	13
Entrance to car park 3 x 2	14-15
Hospital Service Road between car park 3 and car park 4	16
Infirmary Road	17
Infirmary Street	18

Cameras were installed to cover all 18 locations on the busiest day, with the four sites covering the entrances recorded for a whole week. As such the 18 sites could be factored from the 4 main count sites if required.

#### 3.1.2 *Automatic Number Plate Recognition*

Eight ANPR cameras were installed at various locations around the site, one for each direction at each of the four locations listed in Table 3-2 overleaf and shown in Figure 2 in Appendix A.

**Table 3-2: ANPR Survey Locations**

ANPR Survey Location	Reference Number
Hospital Access	1
Hospital Service Road S of Helipad	2
Infirmary Road	3
Infirmary Street	4

The ANPR cameras were installed to record for a 36 hour period concurrently with the automatic traffic counters.

The recorded images are processed by computer ANPR machines to extract the plates together with the exact time of passing. In addition, at each of the sites overview cameras were installed. From these cameras independent counts have been undertaken in order to compare the results against the numbers of registrations that have been extracted (per traffic lane and in 15 minute intervals). This provides an exact sample rate so that checks can be made to ensure that all plates have been extracted. Where this is not the case, the original data is reviewed and the missing plates extracted manually.

Plates that have not been already extracted may be due to queuing vehicles, poor weather conditions or dirty plates etc.

### 3.1.3 *Car Park Occupancy Surveys*

A car park occupancy survey has been carried out over a 24 hour period to cover the three main car parks within the survey cordon in 30 minute intervals. A concentration survey method was utilised to determine the total parking accumulation on the hospital site, noting the number of vehicles parked in each car park at the beginning of the study period, and also making count of the total number of vehicles accessing and egressing each car park. Car park occupancy surveys were undertaken in car parks labelled A, B and C in Figure 2-1.

Each of the surveys undertaken has been analysed, quantifying vehicle movements on site and determining levels of parking demand throughout the day. The findings of this analysis are presented in the following chapter.

## 3.2 Limitations

This section endeavours to identify any limitations to the entire analysis including the collection of the data, reliability and validity of the instruments used and in the interpretation of the data collated.

With the use of ANPR surveys, poor weather conditions may have impact on visibility of vehicle licence plates and vehicle dirty plates which may hinder the extraction of this data. Another limitation to this method of data collection is missing licence plates due to queuing vehicles, poor weather. However, no impact from bad weather affected this study because it was carried out under fine weather conditions.

## 4. Data Analysis

### 4.1 Hospital Access and Survey Area

The Manual Classified Counts recorded vehicles arriving and departing the hospital in 15 minute intervals at three locations. Site 1 represents the main vehicular access to the hospital site off Newtown Road, which carries the majority of traffic between the hospital site and the local highway network. Site 17 represents the link road between Infirmary Road and the Port Road Industrial Estate and carries very little traffic in and out of the hospital. Site 18 represents Infirmary Road at a point close to Site 17. The location of these sites is shown in Figure 1 in Appendix A.

The three sites represent a cordon which all vehicles accessing and egressing the surveyed car parks must cross. The data for each site is summarised in hourly intervals in Table 4-1 below.

**Table 4-1: Hourly Vehicle Counts from the Access Points**

Time	ACCESS POINTS			Time	ACCESS POINTS		
	IN	OUT	TOTAL		IN	OUT	TOTAL
00:00	18	29	47	12:00	240	261	501
01:00	10	11	21	13:00	418	339	757
02:00	5	11	16	14:00	428	409	837
03:00	5	6	11	15:00	306	396	702
04:00	8	9	17	16:00	251	530	781
05:00	17	14	31	17:00	200	421	621
06:00	165	43	208	18:00	322	221	543
07:00	377	155	532	19:00	202	184	386
08:00	582	196	778	20:00	90	283	373
09:00	318	270	588	21:00	75	111	186
10:00	258	228	486	22:00	40	75	115
11:00	229	259	488	23:00	12	36	48

The graph in Figure 4-1 below illustrates the data in Table 4-1 and clearly shows that access point *Site 1*, which is the main Hospital entry off Newtown Road carries the majority of traffic into and out of the hospital throughout the day, with *Site 18* carrying the least number of vehicles.

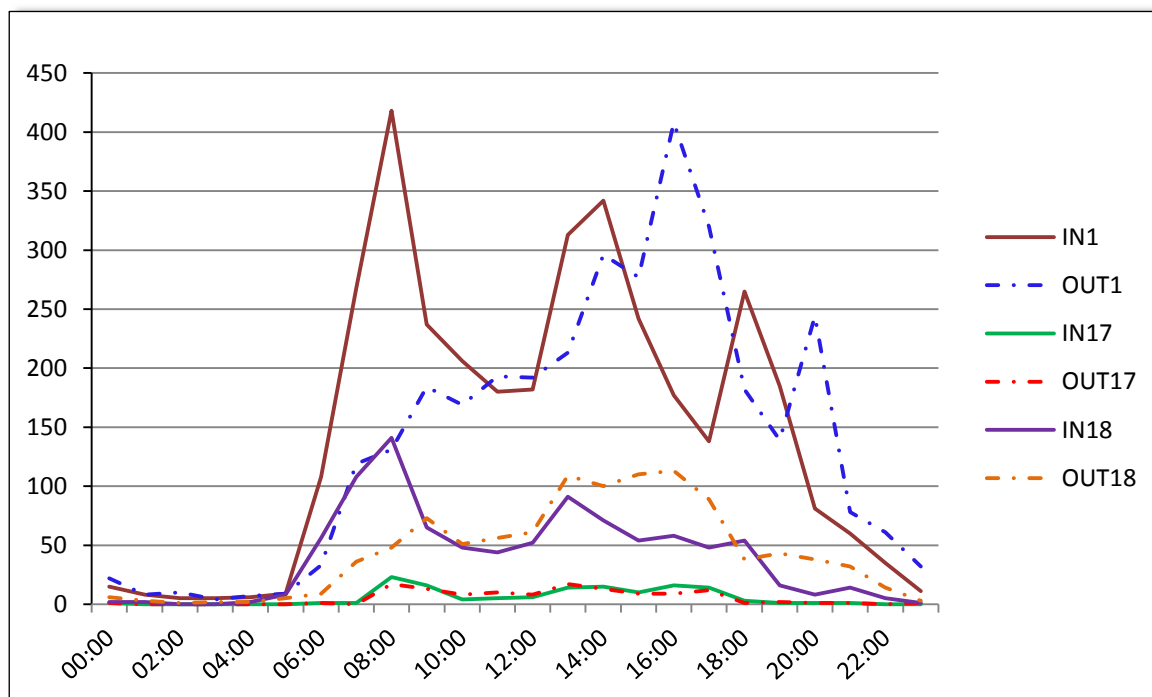
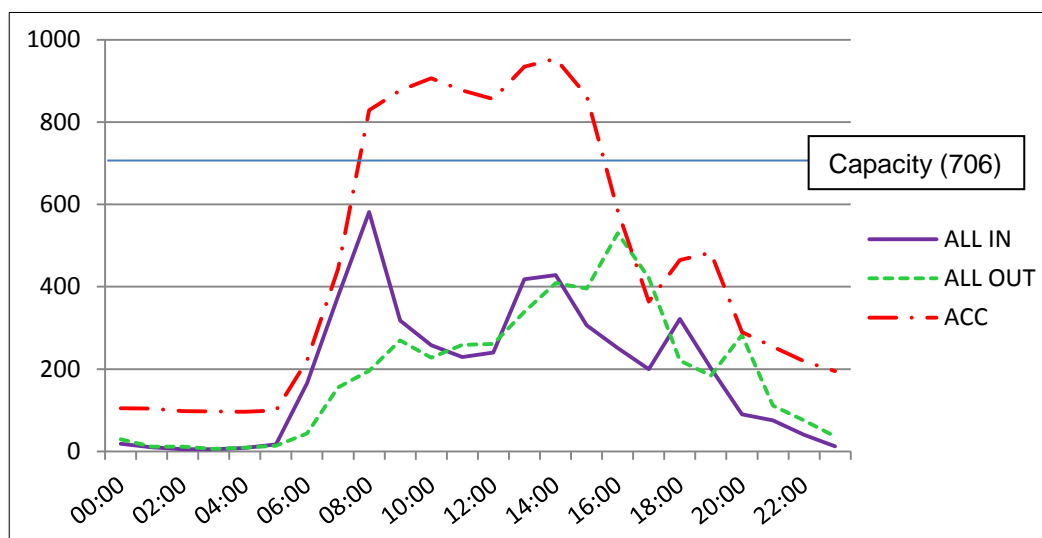
**Figure 4-1: Hourly Counts at Hospital Access Points**

Figure 4-1 also shows that there are two significant peak periods that the hospital exhibits, which are at 08:00 and 16:00 hours. The morning peak period is mostly made up of arrivals with 582 vehicles entering the survey cordon. The afternoon peak period comprises mostly of departing vehicles with a maximum recorded number of departing vehicles being 530 between 16:00 – 17:00 hours.

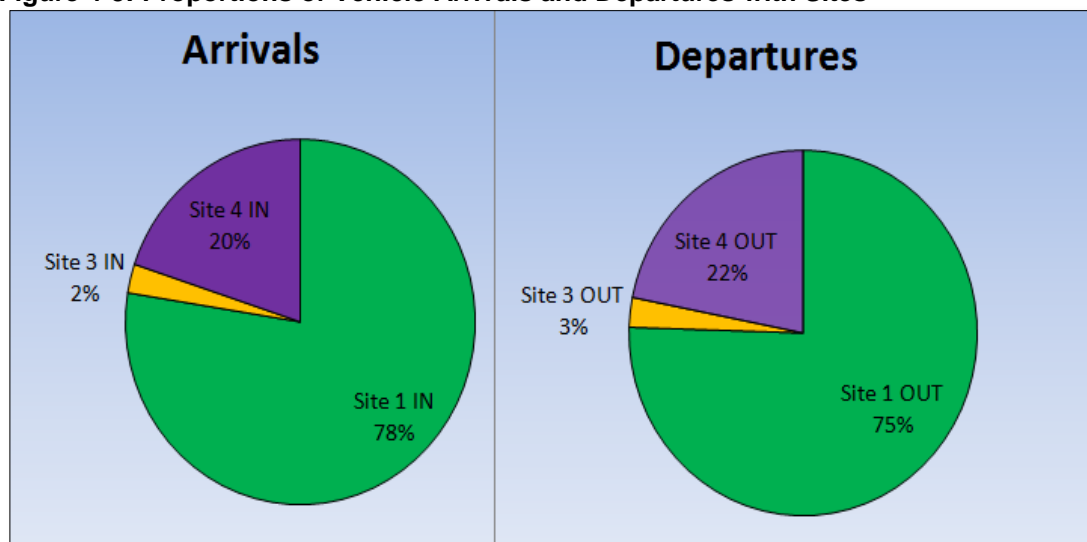
The general characteristic of the accumulation distribution is illustrated in Figure 4-2 overleaf. The graph tracks the relationship between the volume of traffic accessing and egressing the hospital site. The accumulation of vehicles within the survey cordon throughout the day has been profiled by adding the entries and subtracting the exits from the number of vehicles observed to be on site at the start of the survey period. This shows that the maximum number of parking spaces (706) within the cordon is exceeded between 08:00 and 16:00.

The accumulation of vehicles within the survey cordon (and each individual car park) can be compared to the number of available car parking spaces to determine the levels of indiscriminate parking at various times of the day.



**Figure 4-2: Overall Hospital Vehicle Accumulation**

Further analysis indicates that the highest demand for car parking space was recorded between 1300 – 1400 hours. At this time the overall demand for parking within the cordoned area reached 138% of the available spaces. The lowest level of demand for parking spaces was recorded to be between 01:00 – 05:00 with a capacity of around 18%.

**Figure 4-3: Proportions of Vehicle Arrivals and Departures with Sites**

The Figure 4-3 above illustrates the proportion of vehicle arrivals and departures across the entry sites and it shows that majority of vehicles accessing the study area utilise the main Hospital access off Newtown Road and only 22% of vehicles accessing the hospital use the other two entry sites.

## 4.2 Car Park Occupancy

Car park occupancy surveys have been carried out at the three main hospital car parks within the survey area. Because of their locations around the hospital, each of them have required individual surveys at their respective points of entry and exit which is detailed in the sections proceeding sections of this report.

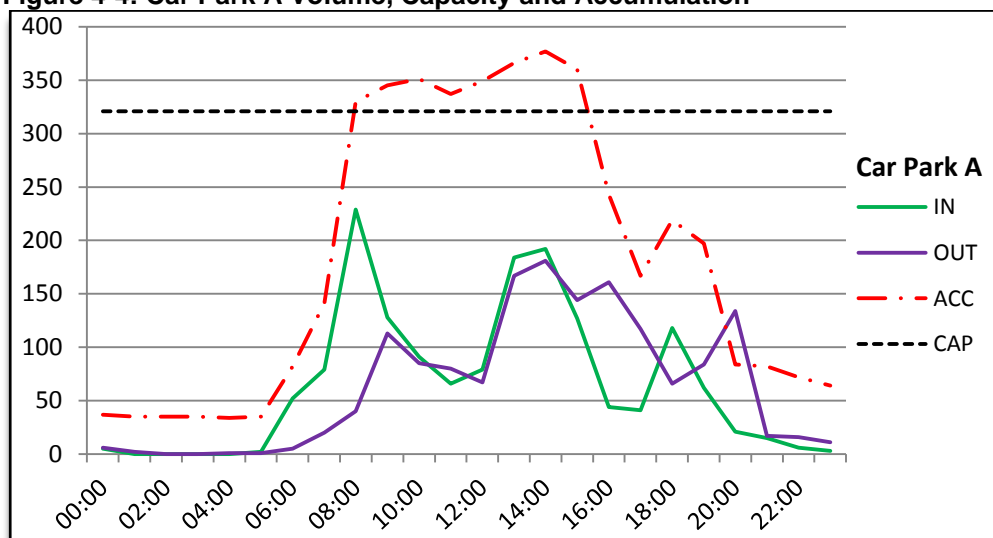
### 4.2.1.1 Car Park A

This surface level car park is the main visitor's car park with a capacity of 321 parking spaces. Vehicles can access this car park using any of the four different entry/exit points off the main hospital access. These are labelled as Sites 3, 4, 5 and 6 in Figure 1 in Appendix A.

Occupancy of the car park at 00:00 hours was 38 vehicles from which time manual classified counts were made for every vehicle entering and exiting the car park. The survey results are summarised in Table 4-2 and Figure 4-4 overleaf. The results show that between 08:00 and 16:00 the car park is over capacity with peak occupancy of 117.5%.

**Table 4-2: Hourly Counts for Vehicles Accessing Car Park A**

Time	CAR PARK A			Time	CAR PARK A		
	IN	OUT	Acc		IN	OUT	Acc
00:00	5	6	37	12:00	79	67	349
01:00	0	2	35	13:00	184	167	366
02:00	0	0	35	14:00	192	181	377
03:00	0	0	35	15:00	127	144	360
04:00	0	1	34	16:00	44	161	243
05:00	2	1	35	17:00	41	117	167
06:00	52	5	82	18:00	118	66	219
07:00	79	20	141	19:00	62	84	197
08:00	229	40	330	20:00	21	134	84
09:00	128	113	345	21:00	15	17	82
10:00	91	85	351	22:00	6	16	72
11:00	66	80	337	23:00	3	11	64

**Figure 4-4: Car Park A Volume, Capacity and Accumulation**

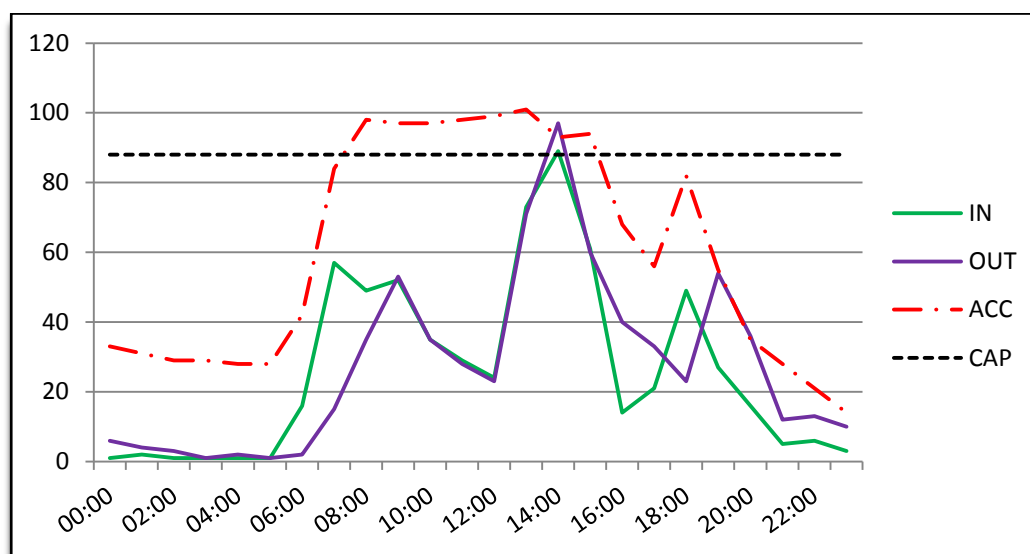
#### 4.2.1.2 Car Park B

Car Park B is a surface level car park with a capacity of 88 parking spaces. Access into and out of this car park is through access points marked *Site 11*, and *Site 12* as illustrated in Figure 1 in Appendix A. This car park is designated for staff and as an overflow of visitor parking from car park A.

Occupancy of the car park was 38 vehicles at 00:00 hours from which time classified counts were done for vehicles entering and exiting the car park. The survey results are summarised in hourly intervals in Table 4-3 below. The results show that between 08:00 and 15:00 that the car park is over capacity with a peak occupancy of 115% at 13:00.

**Table 4-3: Hourly Counts on Car Park B**

Time	CAR PARK B			Time	CAR PARK B		
	IN	OUT	Acc		IN	OUT	Acc
00:00	1	6	33	12:00	24	23	99
01:00	2	4	31	13:00	73	71	101
02:00	1	3	29	14:00	89	97	93
03:00	1	1	29	15:00	61	60	94
04:00	1	2	28	16:00	14	40	68
05:00	1	1	28	17:00	21	33	56
06:00	16	2	42	18:00	49	23	82
07:00	57	15	84	19:00	27	54	55
08:00	49	35	98	20:00	16	36	35
09:00	52	53	97	21:00	5	12	28
10:00	35	35	97	22:00	6	13	21
11:00	29	28	98	23:00	3	10	14

**Figure 4-5: Car Park B Volumes, Capacity and Accumulation**

Traffic arriving and departing this car park follow a similar pattern, throughout the day. The peak period demand for this car park is noted to be between 13:00 and 15:00. Car Park B is also over capacity with the Figure 4-5 above showing that car parking demand exceeds supply between 08:00 and 15:00.

#### 4.2.1.3 Car Park C

This is a staff designated car park with a capacity of 161 parking spaces. Access into and out of this car park is through access points marked *Site 14*, and *Site 15* as illustrated in Figure 1 in Appendix A.

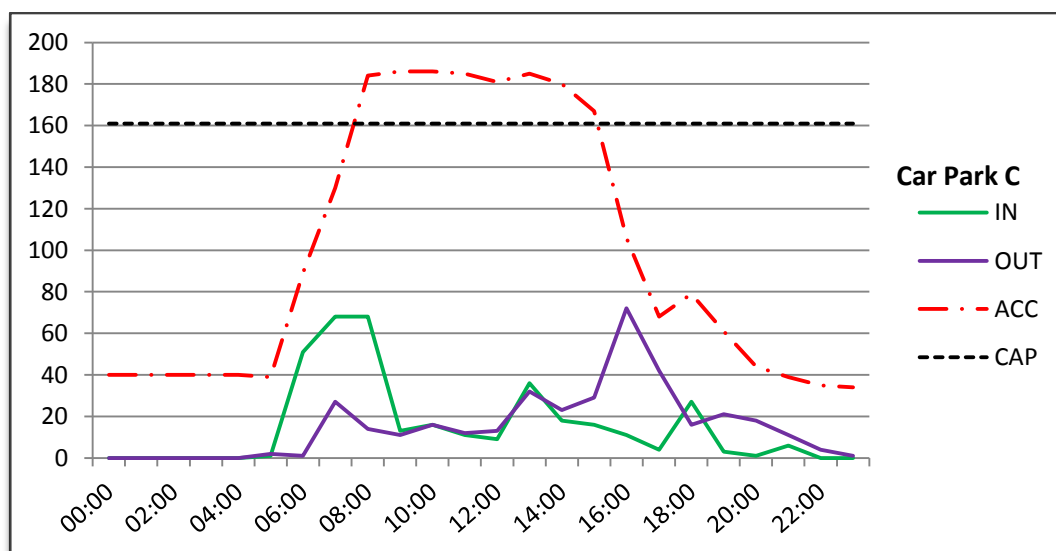
Occupancy of the car park was 40 vehicles when observed at 00:00 hours at the start of the study. Manual classified counts were made for every vehicle entering and exiting the car park. The summarised counts are displayed in hourly intervals in Table 4-4 and in Figure 4-6. These results indicate that between 08:00 and 16:00 the car park is over capacity with peak occupancy being around 116% for much of this period.

Table 4-4: Hourly Counts on Car Park C

Time	CAR PARK C			Time	CAR PARK C		
	IN	OUT	Acc		IN	OUT	Acc
00:00	0	0	40	12:00	9	13	181
01:00	0	0	40	13:00	36	32	185
02:00	0	0	40	14:00	18	23	180
03:00	0	0	40	15:00	16	29	167
04:00	0	0	40	16:00	11	72	106
05:00	1	2	39	17:00	4	42	68
06:00	51	1	89	18:00	27	16	79
07:00	68	27	130	19:00	3	21	61
08:00	68	14	184	20:00	1	18	44
09:00	13	11	186	21:00	6	11	39
10:00	16	16	186	22:00	0	4	35
11:00	11	12	185	23:00	0	1	34

Further analysis indicates that the highest demand for car parking space was recorded between 13:00 – 14:00 hours where the parking accumulation reached 114% of the available parking spaces. On the other hand, the least demand for parking spaces was recorded between 01:00 and 05:00 hours at 18% of capacity.

Figure 4-6: Car Park C, Volumes, Capacity and Accumulation





### 4.3 Duration of Stay

Between Tuesday 15 July and Wednesday 16 July 2014 Automated Number Plate Recognition (ANPR) surveys were undertaken to allow the collection of registrations of vehicles accessing the Cumberland Infirmary. The aim of this survey was to acquire information on car park usage and in particular to ascertain the duration of stay for vehicles utilising hospital parking.

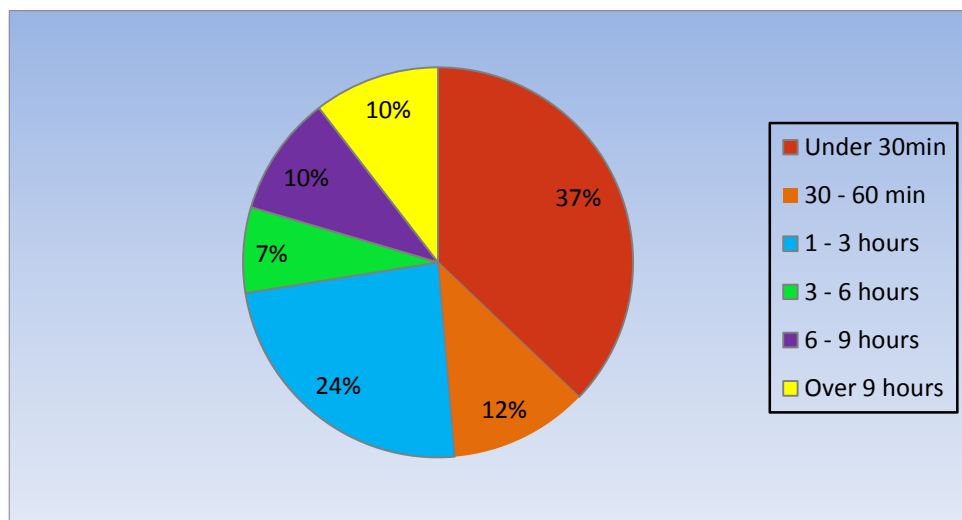
The survey was conducted using 8 ANPR cameras positioned facing vehicles on four location sites around the hospital site as shown in Figure 2 in Appendix A. The four different location sites are listed as illustrated in Table 4-5 below.

**Table 4-5: ANPR Location Sites**

Site	Direction	Location
1	IN	Hospital Access
1	OUT	Hospital Access
2	NB	Hospital Service Road/ South of Helipad
2	SB	Hospital Service Road/ South of Helipad
3	IN	Infirmary Road
3	OUT	Infirmary Road
4	IN	Infirmary Street
4	OUT	Infirmary Street

Subsequent analysis of the ANPR video footage was carried out and vehicle registrations were matched to give account on vehicle arrivals, movements and durations of stay within the hospital area. The duration of stay and movement of vehicles was obtained by capturing the time at which a particular vehicle crossed one site location to the time the same vehicle crossed another site location around the hospital which information was later grouped into the different time segments as shown in proportions in Figure 4-7 below.

**Figure 4-7: Average Duration of Stay for Vehicles on Site**



It has been assumed that any movements through site 2 which were recorded as being less than 30 minutes are internal movements and have not been included within the duration of stay analysis which is presented in Figure 4-7 on the previous page. Duration of stay records for movements not passing through site 2 are assumed to be pick-up/ drop-off or servicing. . From the same figure, it shows that approximately 50% of vehicles arriving at the hospital stay for less than 60 minutes compared to 20% of vehicles that stay for long durations (6 – 9 hours and over 9 hours), which are likely to be associated with hospital staff.

**Table 4-6: Overall Length of Stay for Vehicles on Site**

Site		Under 30min	30 - 60 min	1 - 3 hours	3 - 6 hours	6 - 9 hours	Over 9 hours
From	To						
1IN	1OUT	1106	285	623	136	199	237
1IN	2NB	587	15	25	8	4	4
2NB	2SB	86	25	49	12	36	16
2NB	3OUT	20	0	2	1	0	0
2NB	4OUT	275	27	57	16	9	7
2SB	2NB	41	0	7	4	1	0
2SB	1OUT	451	20	23	12	9	3
3IN	4OUT	44	1	6	1	3	0
3IN	2SB	38	3	1	0	0	0
3IN	3OUT	7	1	0	0	0	1
4IN	3OUT	64	1	1	0	6	2
4IN	2SB	223	7	14	10	18	19
4IN	4OUT	135	35	63	59	79	93
	Total	3077	420	871	259	364	382

Table 4-6 above shows the overall length of stay that vehicles accessing the hospital take. It is noticeable in this table that a significant number of vehicles that were captured spent under 30 minutes between different sites.

#### 4.3.1 Car Parks

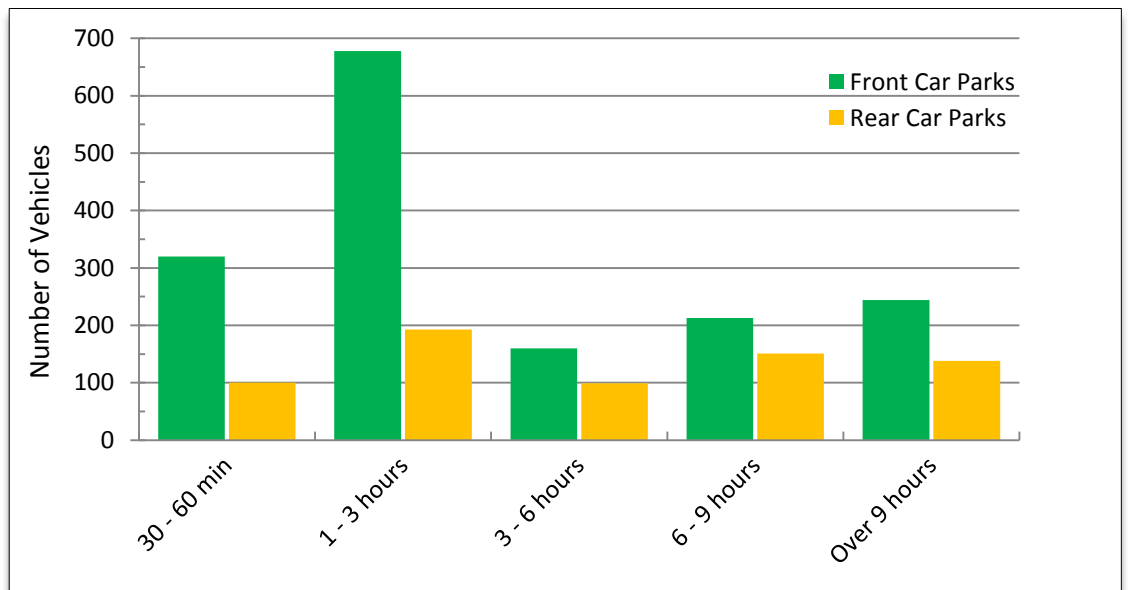
Cumberland Infirmary is made up of many car parks as shown in Figure 2-1 in chapter 2. However, the car parks within the hospital cordon have been grouped into two for the purpose of this study since information on individual car parks could not be generated because of the ANPR camera positioning. Thus car parks A, B and F have been categorised as the *Front Car Parks* whereas car parks C, D and E categorised as the *Rear Car Parks*. The Front car parks therefore consist of 444 collective parking spaces whereas the Rear Car Parks collectively are made up of 262 parking spaces as earlier indicated in Table 2-1 in chapter 2.

The Table 4-7 below represents the average duration of stay for the Front and Rear Car Parks. Vehicles staying longer than 6 hours make up 28% of the overall vehicles utilising this car park compared to 42% of vehicles staying longer than 6 hours in the Rear car park despite the fact that the front car parks hold approximately 63% of the overall parking spaces within the hospital cordon.

**Table 4-7: Duration of Stay in the Car Parks**

Front Car Parks (A, B and F)						
From	To	30 - 60 min	1 - 3 hours	3 - 6 hours	6 - 9 hours	Over 9 hours
1IN	1OUT	285	623	136	199	237
1 IN	2NB	15	25	8	4	4
2SB	2NB	0	7	4	1	0
2SB	1OUT	20	23	12	9	3
<b>TOTAL</b>		320	678	160	213	244
Rear Car Parks (C, D and E)						
From	To	30 - 60 min	1 - 3 hours	3 - 6 hours	6 - 9 hours	Over 9 hours
2NB	2SB	25	49	12	36	16
2NB	3OUT	0	2	1	0	0
2NB	4OUT	27	57	16	9	7
3IN	3OUT	1	0	0	0	1
3IN	4OUT	1	6	1	3	0
3IN	2SB	3	1	0	0	0
4IN	3OUT	1	1	0	6	2
4IN	2SB	7	14	10	18	19
4IN	4OUT	35	63	59	79	93
<b>TOTAL</b>		100	193	99	151	138

Further analysis of the survey results from both the Front and Rear car parks identified vehicles staying 1 – 3 hours making up a big proportion of duration stays where a total of 871 vehicles (38%) were recorded to park within this duration as is illustrated in Figure 4-8 overleaf.

**Figure 4-8: Car Park Duration of Stay**

## 5. Conclusions

This parking study was undertaken in order to better understand hospital car parking demand, usage and accumulation.

A number of surveys have been carried out on what was considered to be a typical day in order to quantify the number of vehicles accessing and egressing the survey cordon, the demand for parking spaces within the 3 main car parks and the survey cordon and the typical duration of stay.

The analysis of the data collected has been presented and demonstrates that the current level of parking provision at the hospital falls well short of the demand for parking spaces. Between the hours of 08:00 and 16:00 the demand for parking spaces exceeds supply by around 16%.

The survey results therefore reinforce and support the observations of indiscriminate parking made during the site visit and demonstrate that these conditions are experienced throughout much of the day. Such conditions within the hospitals car parks are likely to result in other problems such as patients being late for appointments, growing levels of frustration, indiscriminate parking on neighbouring roads, etc.

In order to develop a better understanding of the causes of the excessive parking demand and consider appropriate measures to alleviate these issues it is recommended that a more detailed study be undertaken. Such a study would consider the basis for the parking demand, the split between staff and visitor parking, car park management (including permits, parking charges and enforcement) and a range of possible solutions best suited to tackle the problem.

Whilst the obvious solution would be to increase parking provision within the hospital site, any planning application for such a proposal would need to provide supporting information to demonstrate that other measures have been considered and that the proposals would also be supported by effective car park management and measures to support and promote sustainable transport including the implementation of an effective travel plan.



## Appendix A - Figures

Figure 1: Manual Classified Count Sites

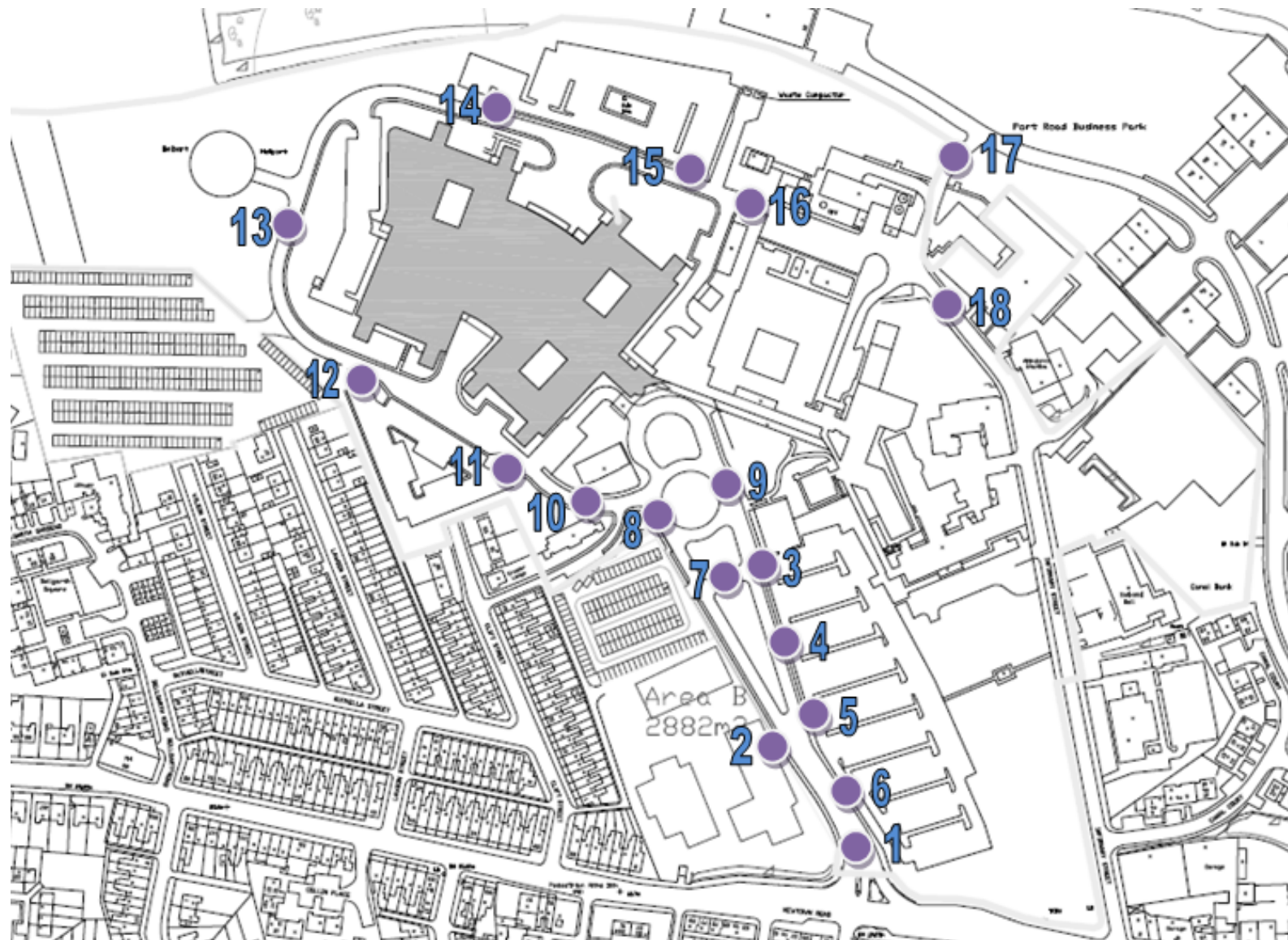
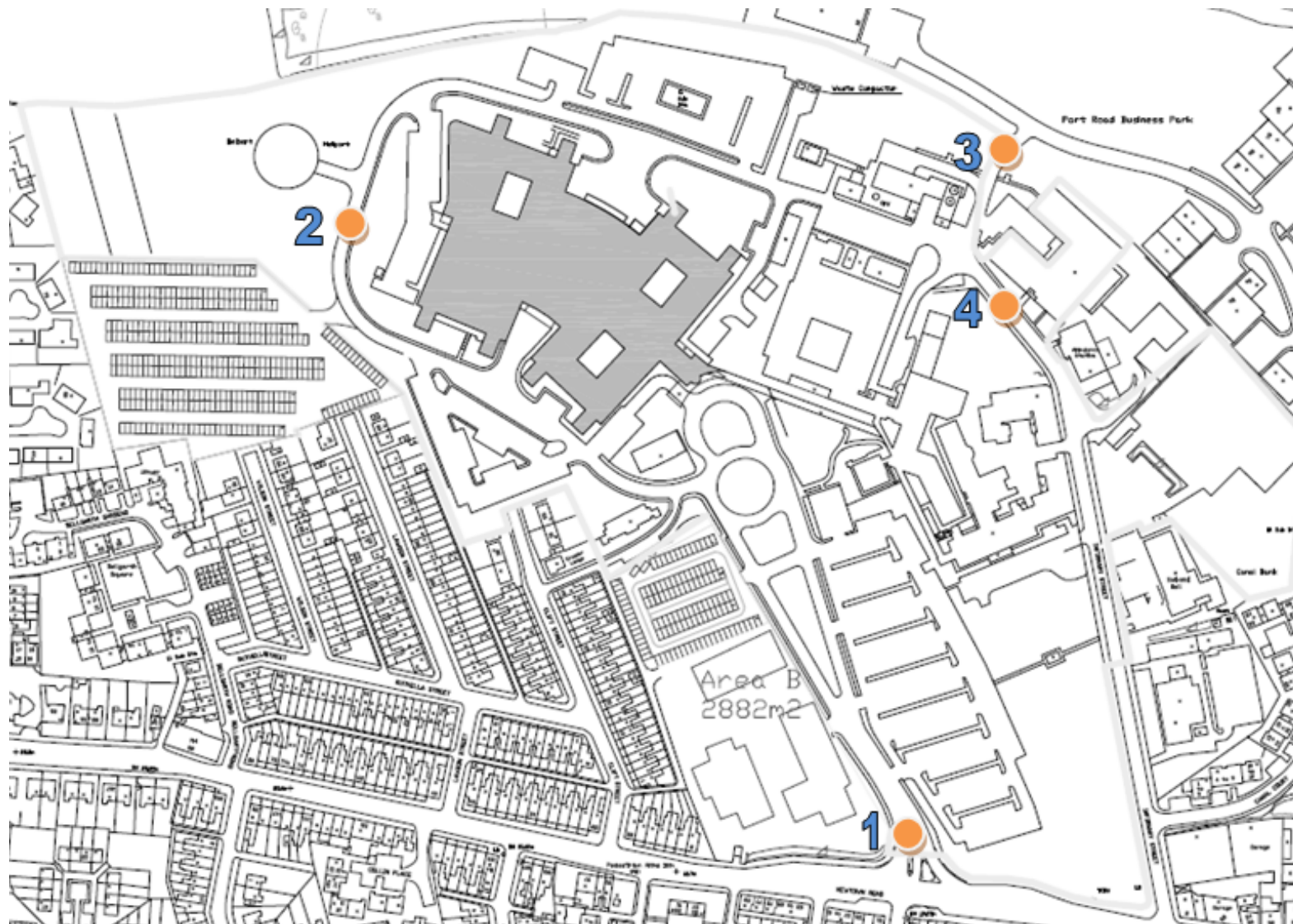


Figure 2: Automatic Number Plate Survey Sites



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