



# A55 Knock Road

## Appendix A - BTM Analysis Report

NI004/CO00400445

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## 1. Introduction

- 1.1. Road Service has commissioned Amey to fully evaluate the impact associated with the proposed upgrade of the A55 Knock Road.
- 1.2. The purpose of this report is to provide further analysis of the strategic traffic modelling undertaken to assess and evaluate the impact of the preferred route option associated with the proposed widening of the A55 Knock Road.
- 1.3. This report provides an overview of the analysis of the outputs produced by the Belfast Transport Model (BTM) in 2006.
- 1.4. Following discussions with Roads Service Data Section, it was agreed that further analysis of the strategic modelling information was required to ascertain the geographic scope of any impacts associated with the proposed scheme.
- 1.5. A number of flow difference plots had been created in 2006 that identified a number of links throughout the greater Belfast area whereby there were changes in the link volumes. Further analysis was recommended to investigate these.
- 1.6. This report provides a brief overview of the modelling carried out in 2006, however, it does not contain any commentary on the economic output associated with this modelling as this has already been commented on in the Stage 2 Preferred Options Report (2006).
- 1.7. The report is based on both select link analysis and cost skim analysis based on an 8x8 sectorised matrix.

## 2. Modelling Process

- 2.1. In 2005 / early 2006 Amey, working in partnership with Roads Service Consultancy Eastern Division developed a number of options associated with the proposed upgrade of the A55 between Clarawood and the Kings Road.
- 2.2. The proposed options centred on the proposal outlined in the Belfast Metropolitan Transport Plan to widen this section of the A55 from two to four lanes.
- 2.3. In line with agreements reached with the Roads Service DaTA Section for schemes being developed / assessed by Amey in and around Belfast, the strategic impact of the proposed A55 scheme were evaluated by Atkins utilising the 2001 based Belfast Traffic Model.
- 2.4. Consideration was given to upgrading the existing strategic model to improve the level of local accuracy, however, in line with the guidance provided in the Traffic Appraisal Manual, the cost and effort associated with collecting sufficient traffic data to make these modifications was considered to be disproportionate to the potential additional output that such a model would provide.
- 2.5. The strategic modelling process adopted did however provide the information to enable a comparison of three options against the set 'Do Minimum' situation, which was confirmed as being the current highway network at the time, incorporating the following alterations:

### Quality Bus Corridors

- Bus Lane – Saintfield Road: Old Saintfield Road – Knockbracken Road;
- Bus Lane – Saintfield Road: Myrtledene Road – Glendale Park
- Bus Lane – Ormeau Road: Upper Knockbreda Road to Upper Galwally

### Bus Priority Lanes

- Bus Lane – Stranmillis Road: Stranmillis Embankment to Sandhurst Gardens
- Bus Lane – Woodstock Link: Beersbridge Road to Albertbridge Road
- Bus Lane – Ballyhenry Road: Ballyclare Road to Sandyknowes Roundabout
- Bus Lane – Ballygowan Road: Church Road to Brentwood Park
- Bus Lane – M1 Motorway: Stockman's Lane to Broadway

### Highways Schemes

- M1 - Blacks Road Slips
- M1 – Widening from Blacks Road to Stockman's Lane

- M1 – Widening from Stockman’s Lane to Broadway
- M1 – Broadway Interchange
- A12 – Broadway to Grosvenor Road
- A12 – Closure of Roden Street Access
- A12 – Grosvenor Road Interchange
- A12 – Westlink Busway
- A55 – Signalisation of Stockman’s Lane Roundabout
- A1 – M1 Link (excluding Knockmore Link)
- Lisburn North Feeder Road
- A8 Ballynure bypass
- Removal of Sprucefield on slips.

2.6. The three options assessed initially were:

**Option A:** The widening of the section of the A55 under consideration to a four lane single carriageway with no alteration to right turn facilities at the Shandon / Sandown Junction;

**Option B:** The widening of the section of the A55 under consideration to a four lane single carriageway with the provision of separate controlled right turns at the Shandon / Sandown Junction; and

**Option C:** The widening of the section of the A55 under consideration to a two lane all-purpose dual carriageway including the provision of separate controlled right turns at the Shandon / Sandown Junction, and the provision of a new four leg signalised junction at Cherryvalley.

2.7. Analysis of the outputs produced suggested that the scheme did not result in any significant change in strategic traffic flows.

2.8. Following Public Consultation in 2006, a ‘hybrid’ Preferred Option (Option D) was developed. Option D was similar to Option B with the only exception being that Ascot Link now accessed onto Shandon Park instead of the A55. The relocation of this link road was not considered to have any significant effect on the strategic traffic movements in the BTM therefore Option D was not specifically modelled using BTM. The outputs from the Option B model therefore apply to this Preferred Option and comparison tables in this report refer to Option B..

2.9. Following a Public Inquiry into the scheme the Inspectors expressed concerns as to the overall validity of the traffic modelling undertaken in relation to the preferred option and made recommendations that a more detailed local traffic model be

developed to assess the impact of traffic on the residents of Cherryvalley, Kensington and Shandon (RACKS area).

2.10. To complete this assessment, Amey asked Atkins to provide raw output information from the model runs undertaken in 2006 to supplement the information previously provided in the Stage 2 Preferred Options Report. The information provided was in the form of select link outputs and cost skim information and was provided for three scenarios:

- Do-Minimum;
- Option A; and
- Option B (Preferred Option).

2.11. Option C referred to earlier was not included in this assessment as it had already been identified that it was not the preferred option. As highlighted in paragraph 2.8, Option D was not specifically modelled and Option B provides the results for the preferred option.

2.12. The information from this select link analysis provides an understanding of how the preferred option performs on a strategic level. The analysis of Option A will also provide an understanding of the effects of providing separate controlled right turns at the Shandon Park / Sandown Road junction.

### 3. Model Output Analysis

#### 3.1. Select Link Analysis

- 3.1.1. Although the BTM covers Northern Ireland, it is more detailed closer to Belfast city centre, and as a result there are a number of local roads within our study area, whose interaction is not picked up due to the strategic nature of the BTM.
- 3.1.2. Analysis of the origin and destination information for traffic travelling along the A55 shows that there is an increase in origin/destination (O-D) pairings when Option B (preferred option) is modelled – compared to those that exist in the Do-minimum and Option A scenarios. This would suggest that local traffic previously using other roads is now using the A55 Knock Road. Details of these changes in numbers of O-D pairings are summarised in Table 1.

Location	No. O-D pairings (Do Min)	No. O-D pairings (Opt A)	No. O-D pairings (Opt B)
A55 (Kings Road – Shandon Park)	421	421	582
A55 (Shandon Park – Kings Road)	843	843	814
Shandon Park (to A55)	155	155	251
Shandon Park (from A55)	41	41	136
Kensington Road (to Gilnahirk Road)	40	40	50
Kensington Road (from Gilnahirk Road)	104	104	126

**Table 1 - Change in Origin-Destination pairings**

- 3.1.3. In relation to the volume of traffic using the road, the passenger car is adopted as the standard unit and other vehicles are assessed in terms of passenger car units (pcu). For information / reference it should also be noted that the factors used in this model to convert vehicles to pcu's are as follows:
- 1 car = 1.0 pcu
  - 1 HGV = 2.3 pcu
- 3.1.4. The plots in **Appendix A1** show the origins and destinations of traffic that is using the A55 Knock Road (Do-Min and Option B; AM Peak). Plots 1 and 2 show O-D information for traffic travelling along the A55 from Kings Road towards Shandon Park, whilst plots 3 and 4 show traffic O-D information for traffic travelling in the opposite direction from Shandon Park towards Kings Road. This information shows that the geographical locations associated with origins and destinations are similar for both the Do-Minimum and preferred option (Option B) scenarios

- 3.1.5. There are a number of O-D pairings that appear in the Option B (preferred option) scenario that were not present in the Do Minimum scenario, when considering traffic travelling along the A55 between Kings Road and Shandon Park. These are summarised in Table 2. It should be noted that these represent a very small amount of traffic.

Location	No. O-D pairs	No. pcus	No. pcus not associated with Zone 95	Total traffic on link
A55 (Kings Road – Shandon Park)	42	76.73	5.18	1575
A55 (Shandon Park – Kings Road)	94	126.31	63.13	1158

**Table 2 - Details of extra O-D pairings along A55 with introduction of Option B (preferred option)**

- 3.1.6. There are a number of additional zones (both origins and destination) that appear when Option B (preferred option) is analysed. There is no direct justification for the derivation of these additional O-D's. The tables in **Appendix A6** illustrate the magnitude of these extra trips and it is the modeller's view that these may be attributed to 'model noise'.
- 3.1.7. Table 3 shows the magnitude of change associated with selected links immediately outside the study area.



Link Description	From Node	To Node	Do Min	Opt A	Opt B	Comparison		
						Opt A to Do Min	Opt B to Opt A	Opt B to Do Min
Parkway to Knock	1025	1026	1389	1388	1461	100%	105%	105%
Parkway from Knock	1026	1025	824	649	657	79%	101%	80%
Haw'den Way to Knock	1026	1037	1365	1386	1547	102%	112%	113%
Haw'den Way from Knock	1037	1026	1128	971	1007	86%	104%	89%
Upper N'ards Rd to Stormont	1037	1082	838	1023	1043	122%	102%	125%
Upper N'ards from Stormont	1082	1037	1388	1502	1520	108%	101%	110%
Upper N'ards Rd - Ormiston Crescent to A55	1071	1037	256	242	274	95%	113%	107%
Upper N'ards Rd - A55 to Ormiston Crescent	1037	1071	1128	1126	1153	100%	102%	102%
Upper N'ards Rd - Belmont Church Rd to A55	9007	9323	209	192	194	92%	101%	93%
Upper N'ards Rd - A55 to Belmont Church Rd	9323	9007	1035	1029	1025	99%	100%	99%
Upper N'ards Rd at Ballyhackamore to A55	9008	9007	297	271	273	91%	101%	92%
Upper N'ards Rd at Ballyhackamore from A55	9007	9008	1098	1092	1079	99%	99%	98%
Upper N'ards Rd - Earlswood Rd to A55	1036	9008	304	277	279	91%	101%	92%
Upper N'ards Rd - A55 to Earlswood Rd	9008	1036	1100	1099	1080	100%	98%	98%
North Rd from Upper N'ards Rd	1035	9022	329	304	224	93%	74%	68%
North Rd to Upper N'ards Rd	9022	1035	429	419	410	98%	98%	95%
Orangefield Rd to Sandown Rd	9022	9320	119	132	113	111%	85%	95%
Orangefield Rd from Sandown Rd	9320	9022	406	515	420	127%	82%	103%
Grand Parade to Castlereagh Rd	1433	5523	623	594	399	95%	67%	64%
Grand Parade from Castlereagh Rd	5523	1433	299	268	262	90%	98%	88%
Montgomery Rd to Cregagh Rd	9334	5567	116	128	117	111%	92%	102%
Montgomery Rd to Castlereagh Rd	5567	9334	85	88	127	104%	144%	149%
Cregagh Rd to A55	5566	5524	193	203	200	105%	98%	103%
Cregagh Rd from A55	5524	5566	985	941	893	96%	95%	91%
A55 - To Cregagh Rd	9333	5524	3064	3124	2881	102%	92%	94%
A55 - From Cregagh Rd	5524	9333	988	1050	1057	106%	101%	107%
Ballygowan Rd to A55	1419	1060	1134	1053	1074	93%	102%	95%
Ballygowan Rd from A55	1060	1419	271	249	277	92%	111%	102%

**Table 3 - Change in traffic volumes outside study area (pcus) AM Peak Hour (2010)**

- 3.1.8. Analysis of the traffic volumes along routes outside the study area show a slight drop in traffic volume (-1%) overall, when Option B is considered against the Do Minimum scenario.
- 3.1.9. Table 4 shows the magnitude of change associated with selected links within the study area. Study area can be found in **Appendix A3**.

Link Description	From Node	To Node	Do Min	Opt A	Opt B	Comparison		
						Opt A to Do Min	Opt B to Opt A	Opt B to Do Min
A55 - Kings Rd to Upper N'ards Rd	1051	1037	1645	1595	1637	97%	103%	100%
A55 - Upper N'ards to Kings Rd	1037	1051	1559	1605	1775	103%	111%	114%
Kings Rd from Dundonald to Gilnahirk Rd	9491	1052	1194	1175	1231	98%	105%	103%
Kings Rd from Gilnahirk Rd to Dundonald	1052	9491	395	392	349	99%	89%	88%
Kings Rd to A55	1080	1051	1309	1320	1332	101%	101%	102%
Kings Rd from A55	1051	1080	479	421	459	88%	109%	96%
A55 - Shandon Pk to Kings Rd	1050	1051	1103	1158	1332	105%	115%	121%
A55 - Kings Rd to Shandon PK	1051	1050	1456	1575	1935	108%	123%	133%
Kings Road from A55 Junction to Sandown Rd	1051	1073	505	611	551	121%	90%	109%
Kings Road from Sandown Rd to A55 Junction	1073	1051	113	120	142	106%	118%	125%
Sandown Rd from Kings Rd to Sandhill Gdns	1049	9023	370	488	374	132%	77%	101%
Sandown Rd from Sandhill Gdns to Kings Rd	9023	1049	164	172	158	105%	92%	97%
Sandown Rd to A55	9153	1050	124	127	188	102%	149%	151%
Sandown Rd from A55	1050	9153	207	198	215	96%	108%	104%
A55 - Clarawood to Shandon Pk	9024	1074	1182	1249	1412	106%	113%	119%
A55 - Shandon Pk to Clarawood	1074	9024	1784	1834	2457	103%	134%	138%
Shandon Pk (from A55 Junction)	1050	9330	11	80	170	749%	212%	1589%
Shandon Pk (to A55 Junction)	9330	1050	343	319	640	93%	201%	187%
Kensington Rd to Gilnahirk Rd	9330	1053	230	233	190	101%	81%	83%
Kensington Rd from Gilnahirk Rd	1053	9330	171	83	248	49%	299%	145%
Gilnahirk Rd from Kings Rd to Kensington Rd	1052	1053	494	427	393	86%	92%	80%
Gilnahirk Rd from Kensington Rd to Kings Rd	1053	1052	525	542	384	103%	71%	73%
Gilnahirk Rd to Lower Braniel	1053	9443	382	384	419	101%	109%	110%
Gilnahirk Rd to Kensington Rd Junction	9443	1053	354	349	468	99%	134%	132%
A55 - Glen Rd to Clarawood	1057	9024	1225	1289	1454	105%	113%	119%
A55 - Clarawood to Glen Rd	9024	1057	1906	1959	2523	103%	129%	132%
Glen Rd to A55	1056	1057	657	575	366	88%	64%	56%
Glen Rd from A55	1057	1056	348	335	472	96%	141%	136%
A55 - Glen Rd to C'reagh Rd	1057	5525	2195	2169	2265	99%	104%	103%
A55 - C'reagh Rd to Glen Rd	5525	1057	1206	1258	1301	104%	103%	108%
Lower Braniel Rd to Glen Rd	1076	1077	620	618	434	100%	70%	70%
Glen Rd to Lower Braniel Rd	1077	1076	159	149	23	94%	15%	14%

**Table 4 - Change in traffic volumes inside study area (pcus) AM Peak Hour (2010)**

- 3.1.10. Analysis of the traffic volumes along routes inside the study area show a slight increase in traffic volume (+8%) overall, when Option B is considered against the Do Minimum scenario. The figures in the table show large percentage increases on Shandon Park, however it is important to note that this is due to the low base flows on this link.
- 3.1.11. The nodes that are referenced in Tables 3 and 4 can be seen graphically in **Appendix A4**.
- 3.1.12. There are two links within BTM that relate directly to the RACKS area. The breakdown for each option is shown in Table 5 with an indication of the origins and destinations relating to these links shown in Table 6.

	From Node	To Node	Do Min vol (pcu)	Opt A vol (pcu)	Opt B vol (pcu)
Shandon Park (from A55 Junction)	1050	9330	11	80	170
Shandon Park (to A55 Junction)	9330	1050	343	319	640
Kensington Road to Gilnahirk Road	9330	1053	230	233	190
Kensington Road from Gilnahirk Road	1053	9330	171	83	248
<b>Total</b>			<b>754</b>	<b>715</b>	<b>1248</b>

**Table 5 - Traffic on links within RACKS area**

	From Node	To Node	Vol. on link for Opt B (PCUs)	to zone 95	to zone 93	from zone 95	from zone 93
Shandon Park from A55	1050	9330	170 (100%)	54 (32%)	116 (68%)	-	-
Shandon Park to A55	9330	1050	640 (100%)	-	-	493 (77%)	147 (23%)
Kensington Road to Gilnahirk Road	9330	1053	190 (100%)	-	116 (61%)	73 (38%)	-
Kensington Road from Gilnahirk Road	1053	9330	248 (100%)	101 (41%)	-	-	153* (62%)

\*only 14 PCUs account for trips from zone 93 to zone 95

**Table 6 - Summary of origins and destinations of traffic within RACKS area**

- 3.1.13. Analysis of the links shown in Table 6 show that all traffic on Shandon Park (from A55 Junction) is going to either zone 95 (which is the RACKS area) or zone 93 (area immediately to the east of zone 95). This can be considered 'local'. See Figure 1 for geographic extents of BTM zones.
- 3.1.14. The majority of traffic travelling from Shandon Park (to A55 Junction) originates in zone 95. There are some trips from zone 93 (Gilnahirk) but these are lower in volume and can also be considered 'local', as a high proportion of their destinations are in zones 77 and 322 - the Sandown Road / Ballyhackamore areas.
- 3.1.15. The magnitude of traffic from zones that neighbour zone 95 provides an indication to the extent of the 'local' area. For this analysis, local traffic is considered as that which either has an origin or a destination in zone 77, 92, 93, or 95.

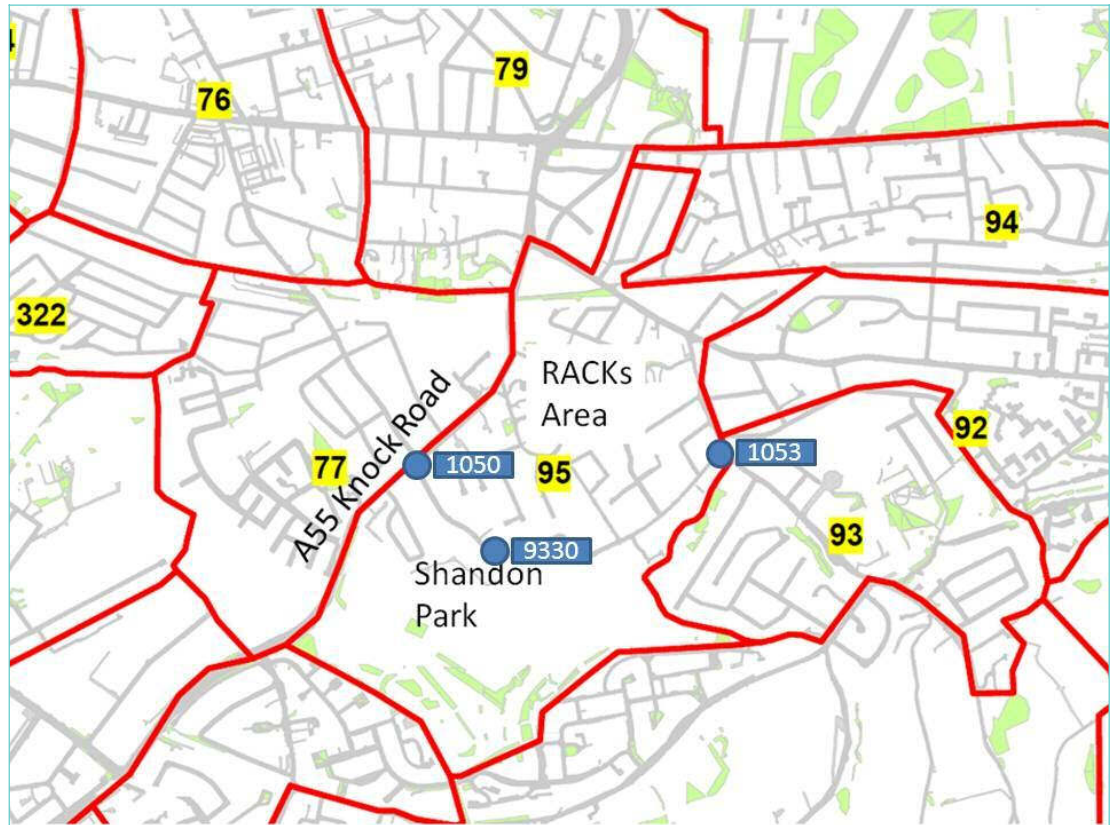


Figure 1 – Nodes relating to RACKS Area and BTM zone names in study area

3.1.16. Table 7 below considers the volume of 'local' traffic on selected links in the study area.

	From Node	To Node	Opt B vol. (pcu)	'local' traffic vol. (pcu)	% of traffic on link that is 'local'
Kings Road – Gilnahirk Road to A55	1080	1051	1332	586	44%
Kings Road - A55 to Gilnahirk Road	1051	1080	459	321	70%
A55 - Kings Road to Shandon Park	1051	1050	1935	219	11%
A55 - Shandon Park to Kings Road	1050	1051	1332	253	19%
Shandon Park (from A55 Junction)	1050	9330	170	170	100%
Shandon Park (to A55 Junction)	9330	1050	640	640	100%
Kensington Road to Gilnahirk Road	9330	1053	190	190	100%
Kensington Road from Gilnahirk Road	1053	9330	248	248	100%

Table 7 - Percentage of 'local' traffic on links in study area

3.1.17. A sectorised breakdown of traffic on the above links can be found in **Appendix A6**.

3.1.18. Table 8 is an extract from TA79/99 “Traffic Capacity of Urban Roads”. This, along with Tables 3 and 4, confirms that the increases in traffic volumes do not exceed the potential capacities associated with each section of road.

		Two-way Single Carriageway - Busiest direction flow (Assumes a 60/40 directional split)	Dual Carriageway
		Total No. Lanes	No. Lanes in each direction
		3-4	2
Carriageway Width		13.5m	7.3m
Road Type	UAP2	1900 vehicles	3200 vehicles

**Table 8 - Capacities of Urban Roads**

3.1.19. The strategic nature of the BTM is such that all the trips to/from the RACKS area join/leave the model at one location (node 9330). There are only two links modelled in the BTM to represent the RACKS area (Shandon Park and Kensington Road). These are shown graphically in **Appendix A4**. In reality the local trips would leave this area on a number of different routes. A local assignment model is therefore required to provide the level of clarity needed to fully assess these movements. This local modelling has been undertaken using the SATURN software suite; details can be found in the *SATURN Modelling Report*<sup>1</sup>.

### 3.2. Cost Skim Analysis

3.2.1. The BTM is a numerical model representing the whole of Northern Ireland and its travel patterns. Northern Ireland is divided into zones and represented as such in the model. The model consists of 334 zones, each zone representing a relatively small area in Northern Ireland.

3.2.2. Each zone can act either as an origin or destination, leading to 111,556 OD pairs (334 origins x 334 destinations).

3.2.3. Each OD pair forms one trip.

3.2.4. Each trip extracted from BTM contains information on:

- Origin & Destination
- Distance
- Time Taken
- Speed

<sup>1</sup> Appendix D – SATURN Modelling Report, May 2012

- 3.2.5. The Cost Skim process is a way of collating this information into a large matrix where the information can be more readily interrogated. It is from this interrogation that it is possible to determine which of the 334 zones can be observed to benefit from the scheme. Benefits, for example, can result from less time spent completing a trip or less distance travelled.
- 3.2.6. Cost skim information was supplied for all O-D pairings across the model. This information was received for Time, Cost, and Distance. It should however be noted that as cost is a factor of time, we have used time and distance only.
- 3.2.7. The Do-Minimum, Option A and Option B (preferred option) information is summarised in Table 9, with further details shown in Tables 10 to 15.

	<b>Total time on network (minutes)</b>	<b>% change</b>	<b>Total distance on network (km)</b>	<b>% change</b>
<b>Do-Minimum</b>	3,308,399	-	2,731,052	-
<b>Option A</b>	3,304,266	-	2,728,819	-
<b>Option B</b>	3,297,428	-	2,731,462	-
<b>Do-Minimum to Option A</b>	Decrease of 4,133	-0.125	Decrease of 2,234	-0.08
<b>Do-Minimum to Option B</b>	Decrease of 10,971	-0.33	Increase of 410	0.015
<b>Option A to Option B</b>	Decrease of 6,838	-0.21	Increase of 2,644	0.1

**Table 9 - Cost Skim Summary (changes in time and distance)**

- 3.2.8. For the purposes of this analysis, the study area is shown in Figure 2 below, and in greater detail in Appendix G. There is a certain amount of crossover in BTM zones and the study area that we are interested in. Figures 2, 3, and 4 show the sectors used in the analysis.



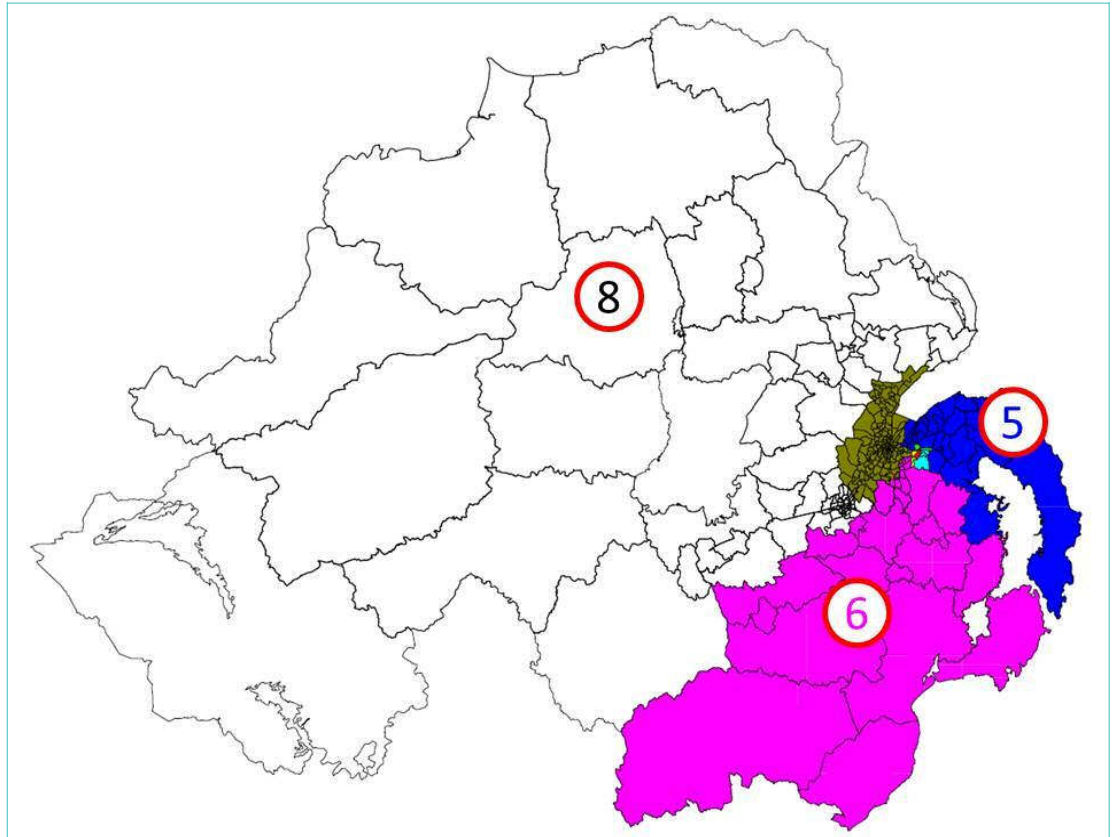


Figure 2 - 8x8 Matrix - Sector Extents (NI)

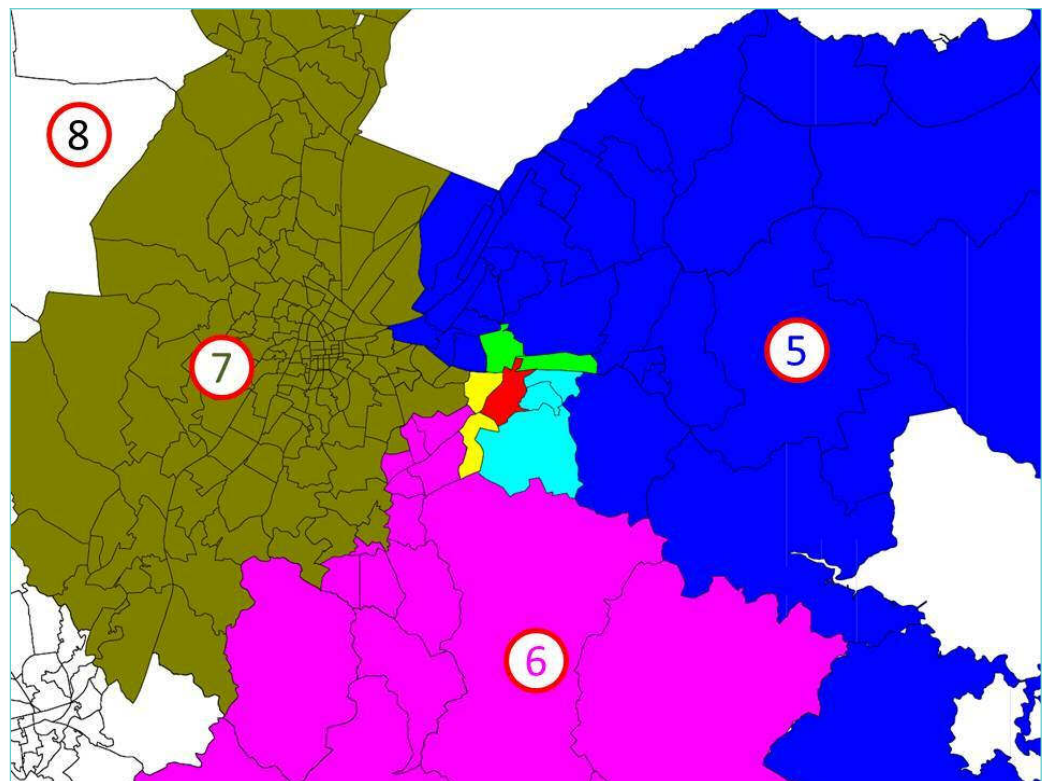


Figure 3 - 8x8 Matrix – Sector Extents (Belfast)

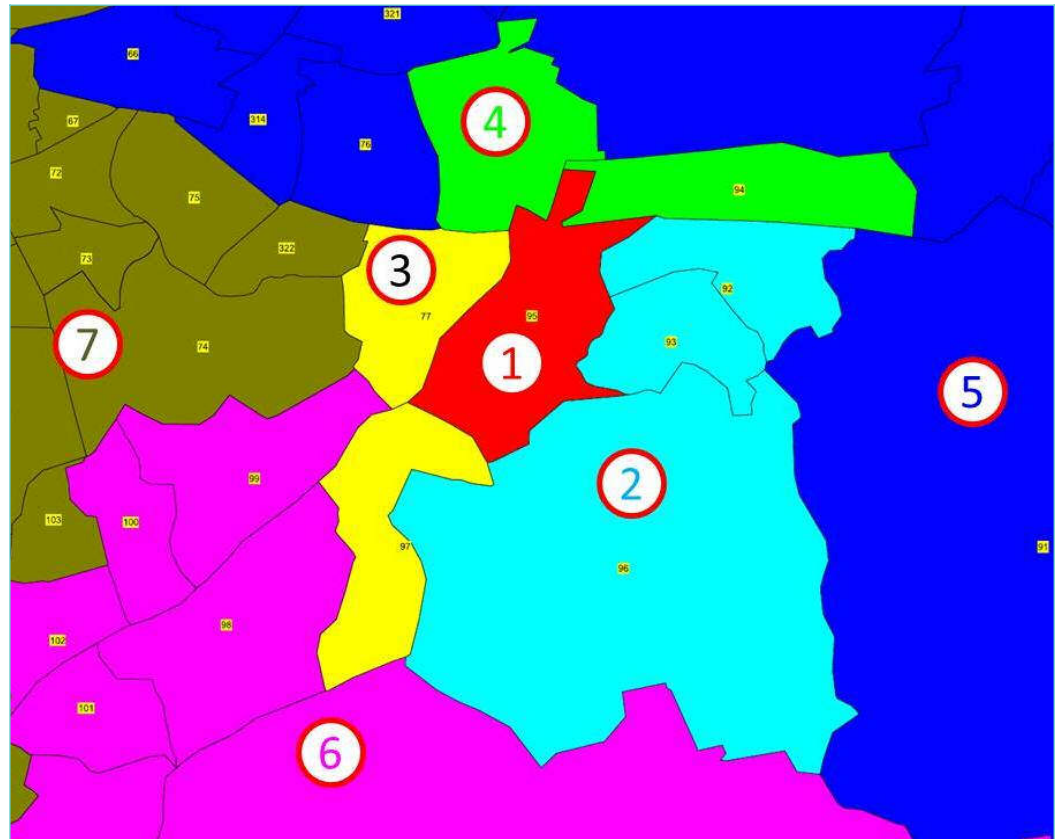


Figure 4 - 8x8 Matrix - Sector Extents (Study Area)

3.2.9. Tables 10 to 12 below show how the total time on the network changes with the introduction of Option A and Option B (preferred option).

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	1	0	3	6	92	34	136
	2	0	0	0	-1	-5	-12	-14	-14	-46
	3	0	0	0	-1	-8	1	3	8	3
	4	0	0	0	0	0	-12	19	-5	2
	5	-4	-4	-5	0	0	-131	-206	89	-260
	6	-10	-2	2	-13	-111	30	-153	-52	-309
	7	-108	-57	-11	-50	-662	-211	-1793	-327	-3218
	8	-62	-9	16	-30	-146	80	-308	18	-440
Total		-185	-73	5	-94	-929	-248	-2361	-248	-4133

Table 10 - Changes in TIME on network (minutes) - Option A (compared against Do Min)



		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	-4	-5	-43	-53	-368	-172	<b>-645</b>
	2	0	-1	-8	-7	-70	-99	-563	-324	<b>-1071</b>
	3	-4	-5	-3	-1	-15	-74	-25	-135	<b>-261</b>
	4	0	-3	-6	0	1	-116	-93	-198	<b>-416</b>
	5	7	-8	-55	10	51	-839	-759	-707	<b>-2300</b>
	6	-39	-13	-4	-16	-162	9	-404	-125	<b>-754</b>
	7	-443	-80	-35	-34	-483	-73	-2157	-319	<b>-3623</b>
	8	-178	-19	1	-26	-457	-21	-1151	-50	<b>-1900</b>
Total		<b>-656</b>	<b>-129</b>	<b>-113</b>	<b>-78</b>	<b>-1178</b>	<b>-1266</b>	<b>-5519</b>	<b>-2030</b>	<b>-10971</b>

Table 11 - Changes in TIME (minutes) - Option B (compared against Do Min)

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	-5	-5	-46	-60	-459	-206	<b>-781</b>
	2	0	-1	-8	-6	-65	-88	-548	-310	<b>-1025</b>
	3	-3	-4	-3	0	-7	-75	-28	-143	<b>-264</b>
	4	0	-3	-6	0	1	-104	-112	-193	<b>-417</b>
	5	11	-4	-51	10	51	-708	-552	-797	<b>-2040</b>
	6	-29	-11	-6	-3	-51	-21	-251	-73	<b>-445</b>
	7	-335	-23	-24	16	179	138	-364	8	<b>-405</b>
	8	-116	-10	-15	4	-311	-102	-843	-68	<b>-1460</b>
Total		<b>-472</b>	<b>-56</b>	<b>-118</b>	<b>16</b>	<b>-249</b>	<b>-1018</b>	<b>-3158</b>	<b>-1782</b>	<b>-6838</b>

Table 12 - Changes in TIME (minutes) - Option B (compared against Option A)

3.2.10. Tables 13 to 15 below show how the total distance on the network changes with the introduction of Option A and Option B (preferred option).

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	-5	16	30	13	<b>54</b>
	2	0	0	0	0	-11	-11	116	-4	<b>90</b>
	3	0	0	0	0	-3	-1	25	9	<b>29</b>
	4	0	0	0	0	0	-1	32	-12	<b>19</b>
	5	3	-2	-5	7	24	-30	546	49	<b>593</b>
	6	0	-2	-1	0	-13	-71	-123	-98	<b>-307</b>
	7	7	-49	0	-12	-92	-721	-486	-524	<b>-1879</b>
	8	-1	1	4	-2	-143	-460	-252	19	<b>-834</b>
Total		<b>10</b>	<b>-52</b>	<b>-2</b>	<b>-7</b>	<b>-243</b>	<b>-1279</b>	<b>-112</b>	<b>-548</b>	<b>-2234</b>

Table 13 - Changes in DIST on network (km) - Option A (compared against Do Min)

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	3	-1	34	11	<b>48</b>
	2	0	0	0	0	-7	-40	-16	-294	<b>-357</b>
	3	-2	0	0	0	-10	3	25	-11	<b>5</b>
	4	0	-2	0	0	0	-18	28	-265	<b>-258</b>
	5	0	-12	-17	4	22	-191	675	-218	<b>264</b>
	6	-26	-8	-1	-4	-93	-72	30	-112	<b>-285</b>
	7	-86	-105	1	21	169	-429	-139	461	<b>-107</b>
	8	-57	55	56	54	267	-115	814	28	<b>1102</b>
Total		<b>-171</b>	<b>-72</b>	<b>39</b>	<b>75</b>	<b>353</b>	<b>-863</b>	<b>1451</b>	<b>-400</b>	<b>410</b>

Table 14 - Changes in DIST on network (km) - Option B (compared against Do Min)

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	8	-17	4	-2	<b>-6</b>
	2	0	0	0	0	4	-29	-132	-291	<b>-447</b>
	3	-2	0	0	0	-7	5	-1	-20	<b>-25</b>
	4	0	-2	0	0	0	-18	-4	-253	<b>-277</b>
	5	-3	-10	-13	-4	-2	-161	130	-267	<b>-329</b>
	6	-26	-6	0	-4	-80	-1	153	-14	<b>22</b>
	7	-93	-56	1	33	262	293	347	985	<b>1771</b>
	8	-57	53	52	56	410	344	1066	10	<b>1936</b>
Total		<b>-181</b>	<b>-21</b>	<b>41</b>	<b>82</b>	<b>595</b>	<b>416</b>	<b>1563</b>	<b>148</b>	<b>2644</b>

Table 15 - Changes in DIST on network (km) - Option B (compared against Option A)

- 3.2.11. When analysing the cost skim information for this scheme it can be seen that there is a small decrease in the total time on the network (0.33%). The increase in total distance on the network is 0.015%.
- 3.2.12. Tables 13 to 15 illustrate where changes in travel time and distance vary as a result of Option A and/or Option B (preferred option). In the study area (sectors 1 to 4) there is no real increase in the journey length but there is a very slight improvement in journey times.
- 3.2.13. The values in tables 10 to 15 represent the AM Peak hour. This provides an indication of the likely changes in travel distance and time associated with the widening and inclusion of additional controlled movements as those proposed for the Shandon Park / Sandown Road junction, however, it should be noted that the signal timings modelled reflect a broad modelling estimate and do not reflect the final design solution.

## 4. Conclusions

- 6.1. The results of the analysis of traffic movements in and around the A55 Knock Road (as shown in Appendix A3) show that there is a change in traffic patterns as a result of the introduction of the preferred option.
- 6.2. The changes in traffic patterns are concentrated to the area in the immediate vicinity of the A55 Knock Road. The widening of the A55 Knock Road does not result in any significant changes to strategic traffic patterns (origin and destination zones are similar).
- 6.3. There is an increase of traffic on the A55 Knock road of approximately 25%. The sectorised breakdown in Appendix A6 (A6-3) confirms that the origins and destinations of these trips are the same. Traffic is re-assigning to the strategic road network.
- 6.4. As set out in Table 7, increases on the A55 Knock Road, and surrounding roads remain such that the potential capacities are not exceeded.
- 6.5. There are decreases in total time on the network and increases in total distance travelled on the network. The magnitudes of these changes are very small. **This reinforces Amey's original opinion that introduction of the scheme would not have a significant strategic impact.**

## **APPENDIX A1**

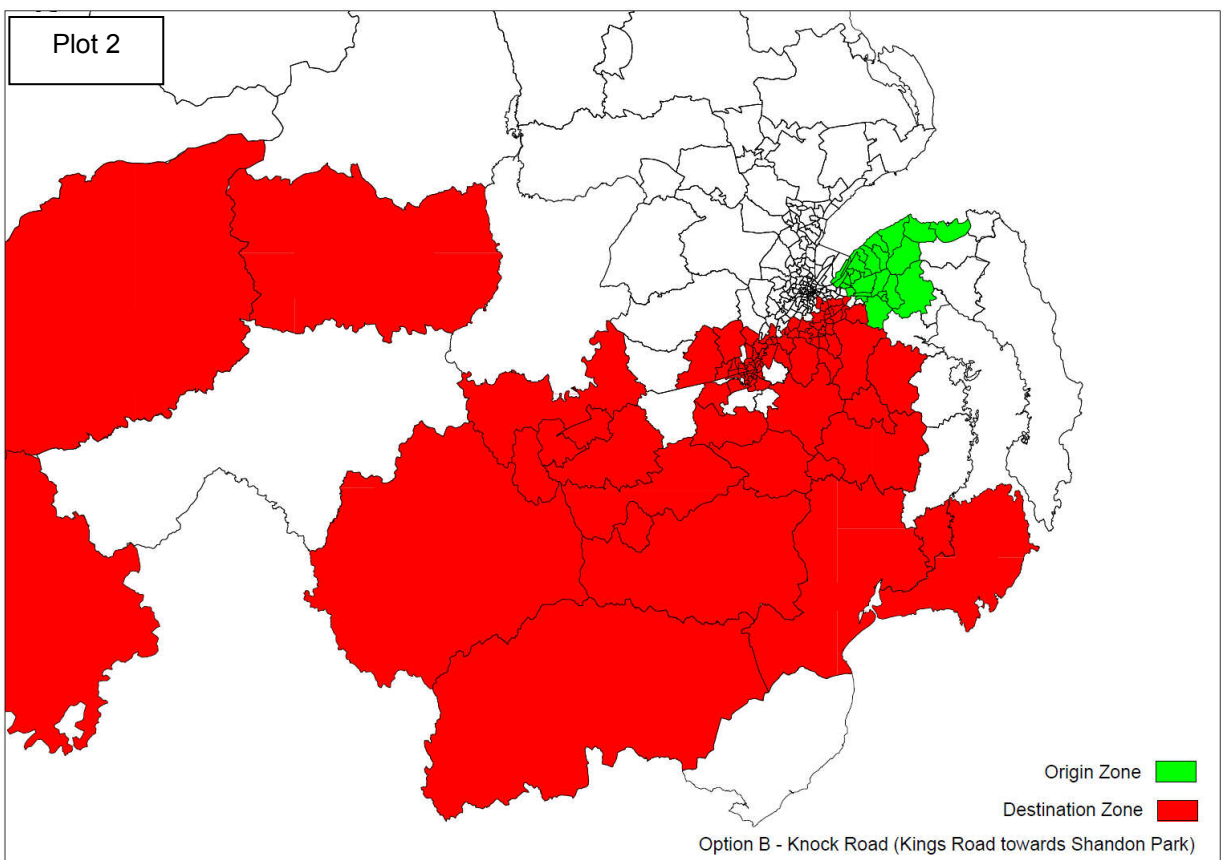
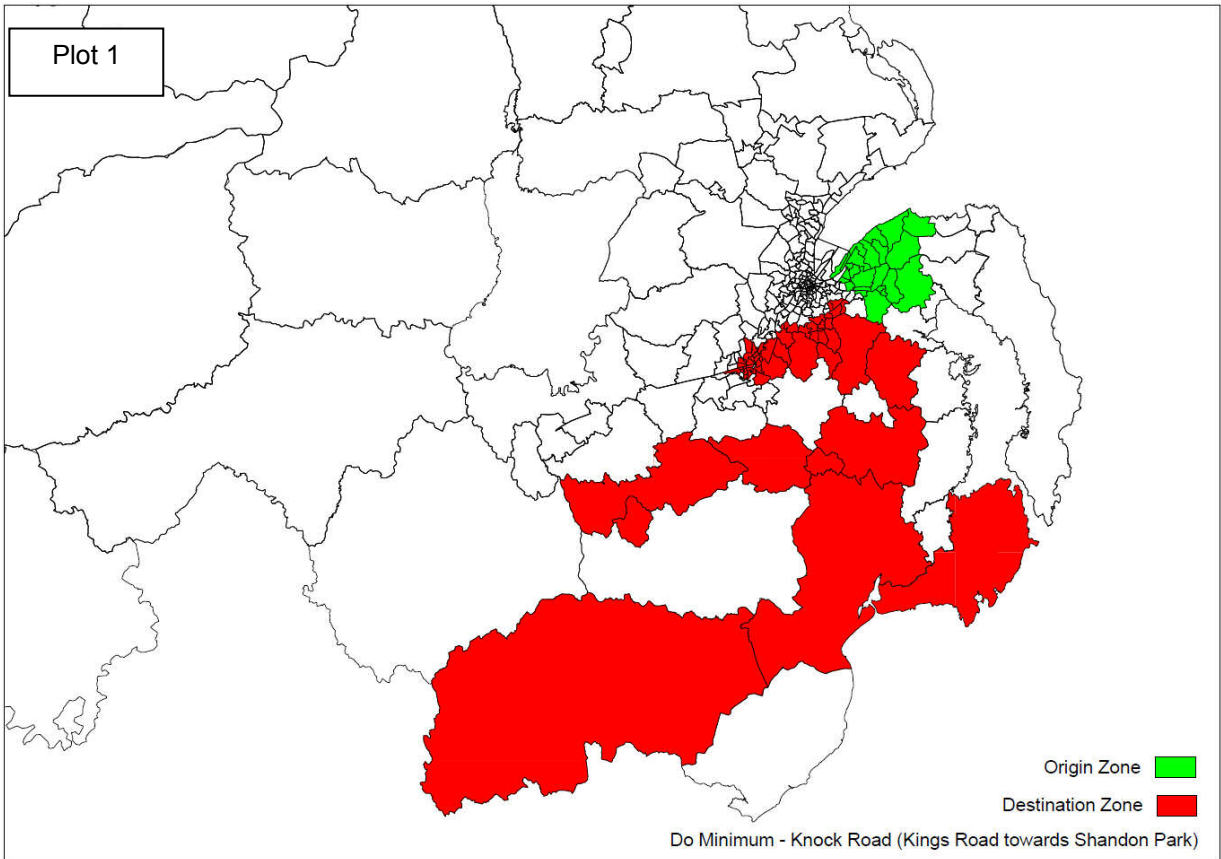
### **Origin-Destination Plots**

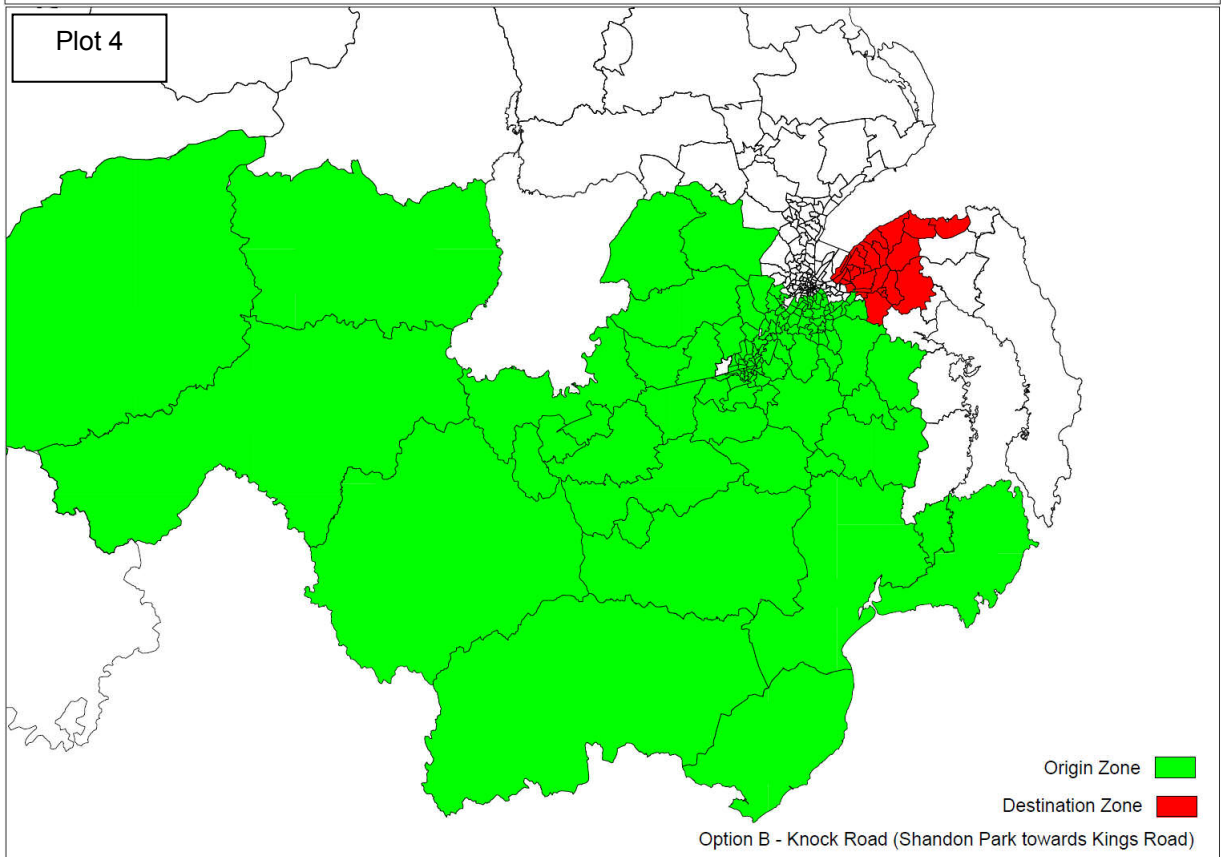
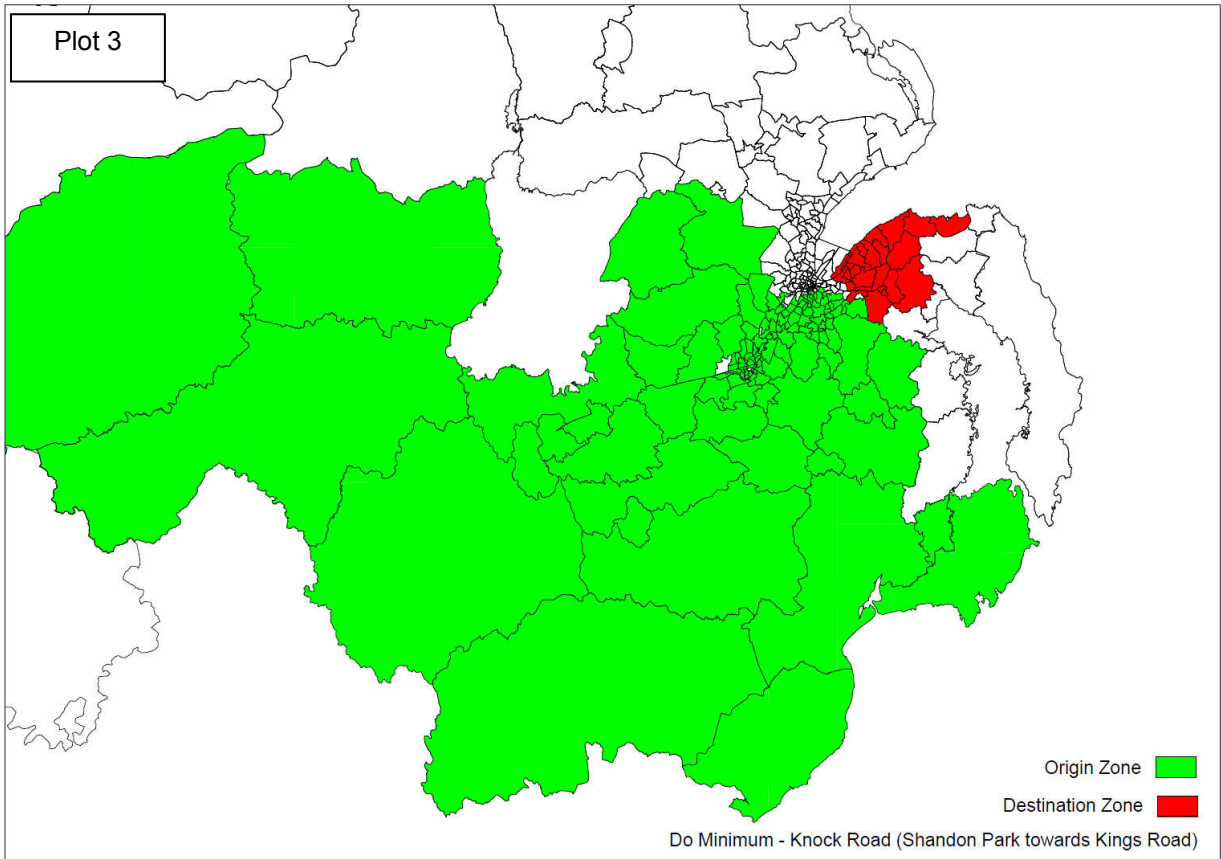
**Plot 1: Kings Road to Shandon Park – Do-Minimum**

**Plot 2: Kings Road to Shandon Park – Option B (Preferred Option)**

**Plot 3: Shandon Park to Kings Road – Do-Minimum**

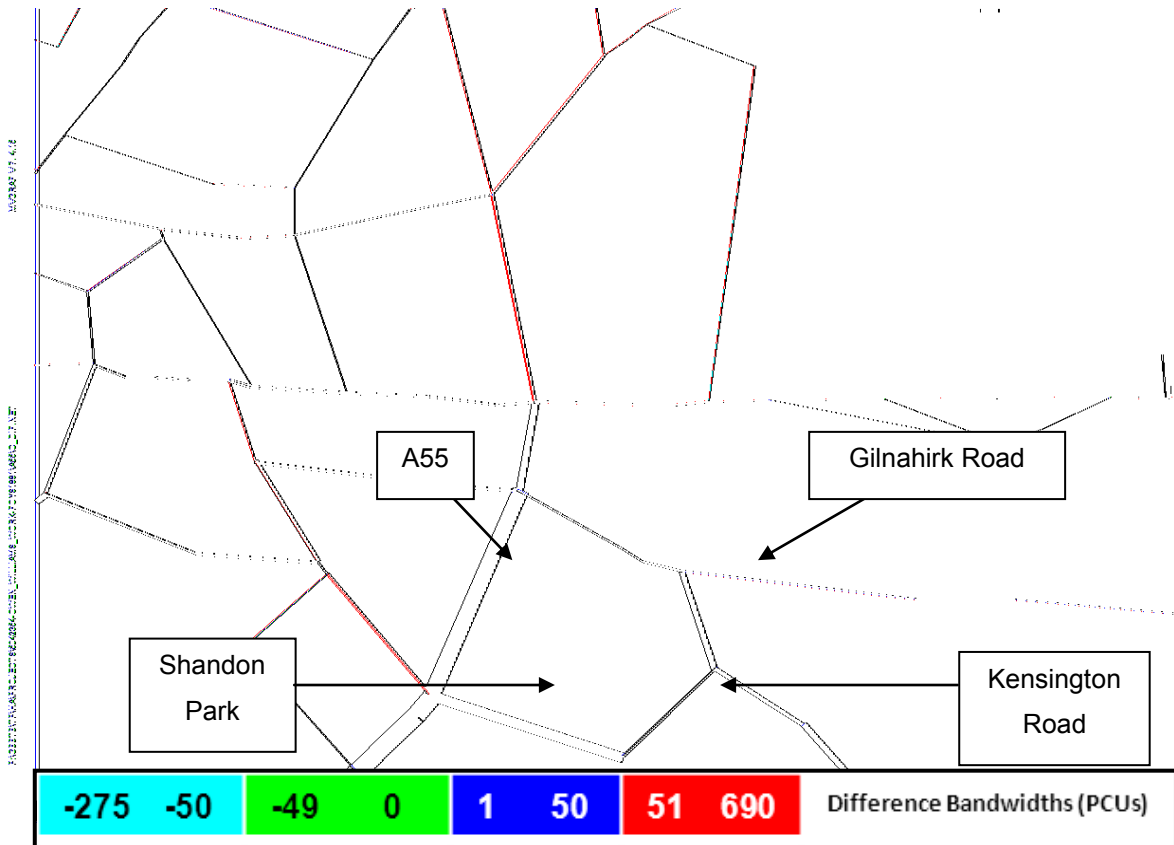
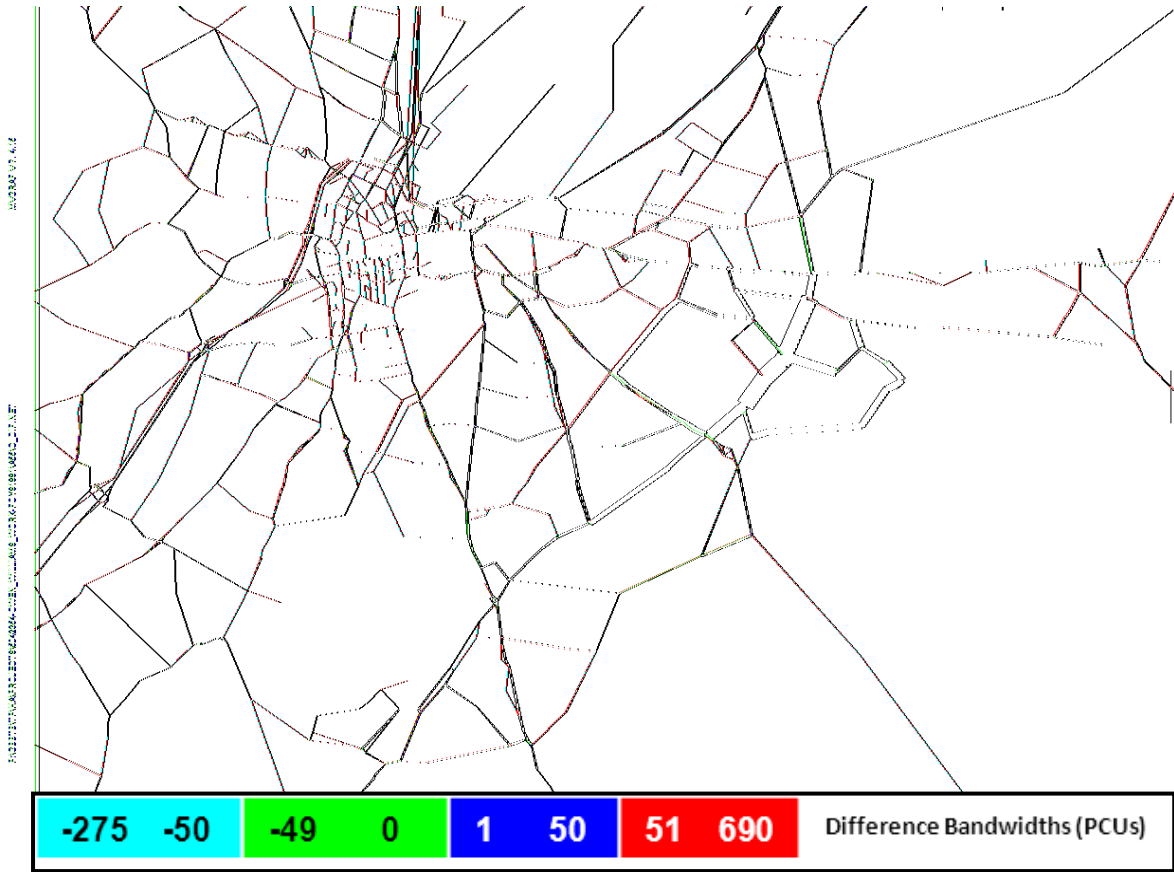
**Plot 4: Shandon Park to Kings Road – Option B (Preferred Option)**





## **APPENDIX A2**

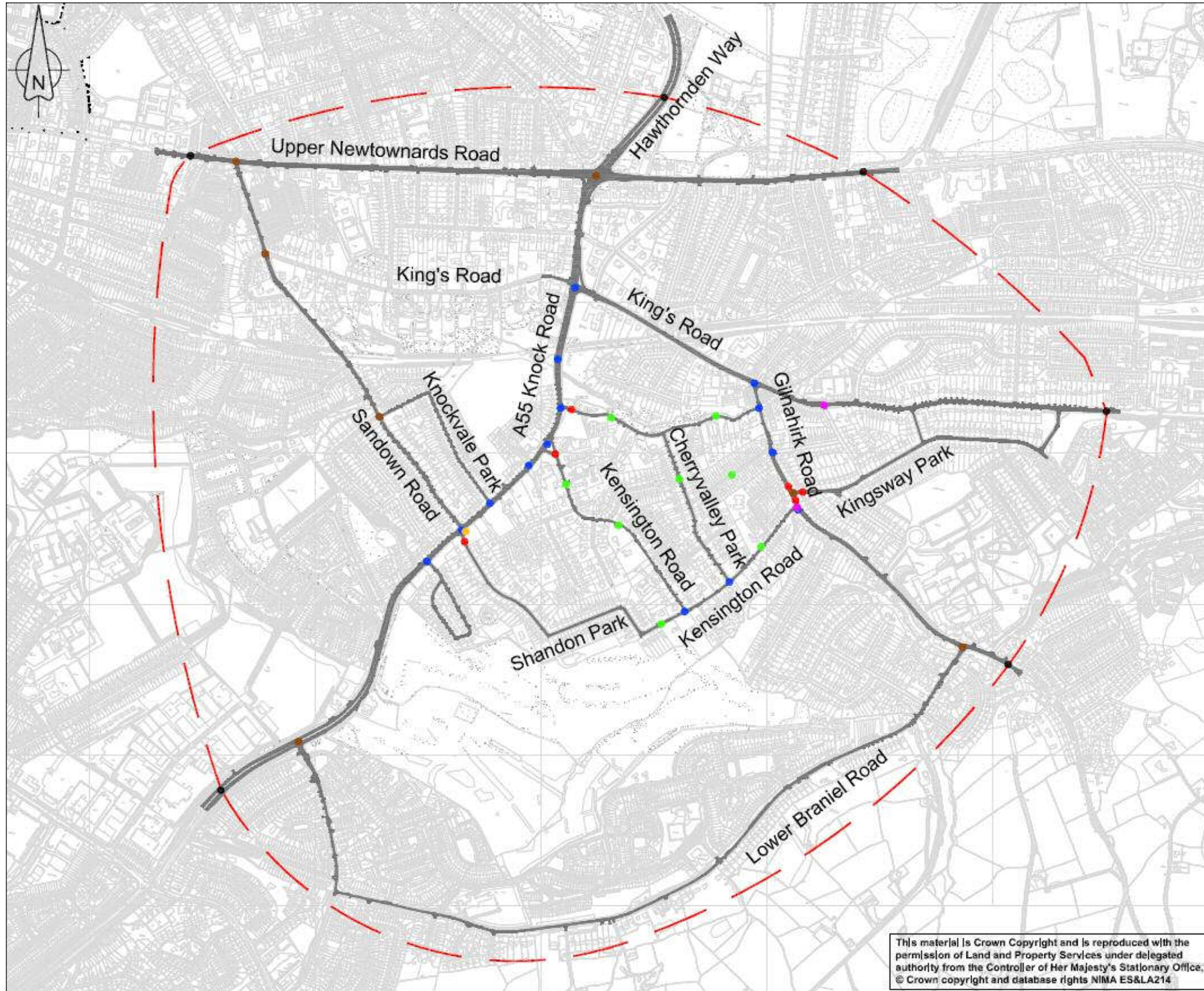
### **Original Difference Plots (Option B (Preferred Option) less Do-Minimum)**





## **APPENDIX A3**

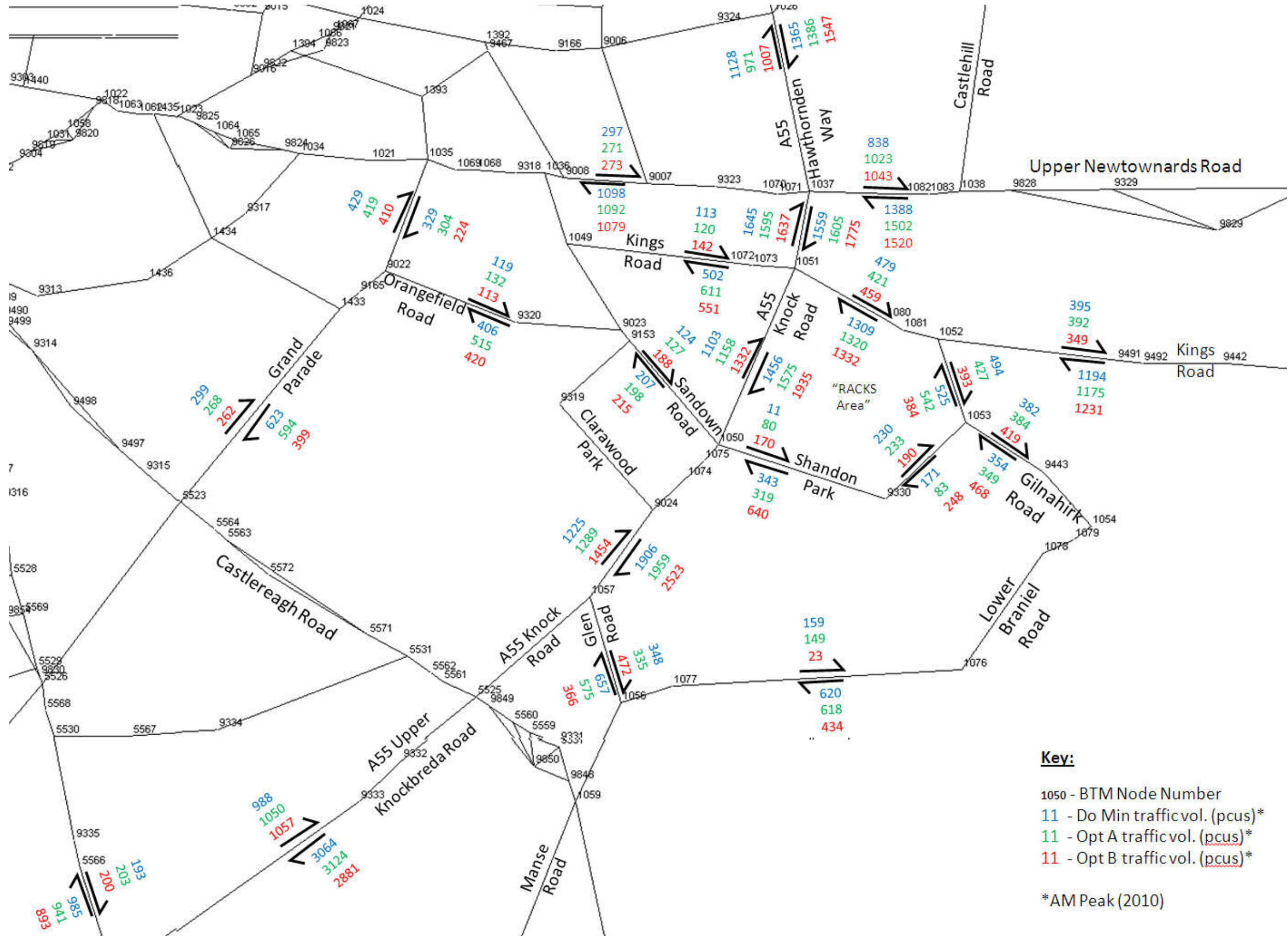
### **Local traffic model – study area**



## **APPENDIX A4**

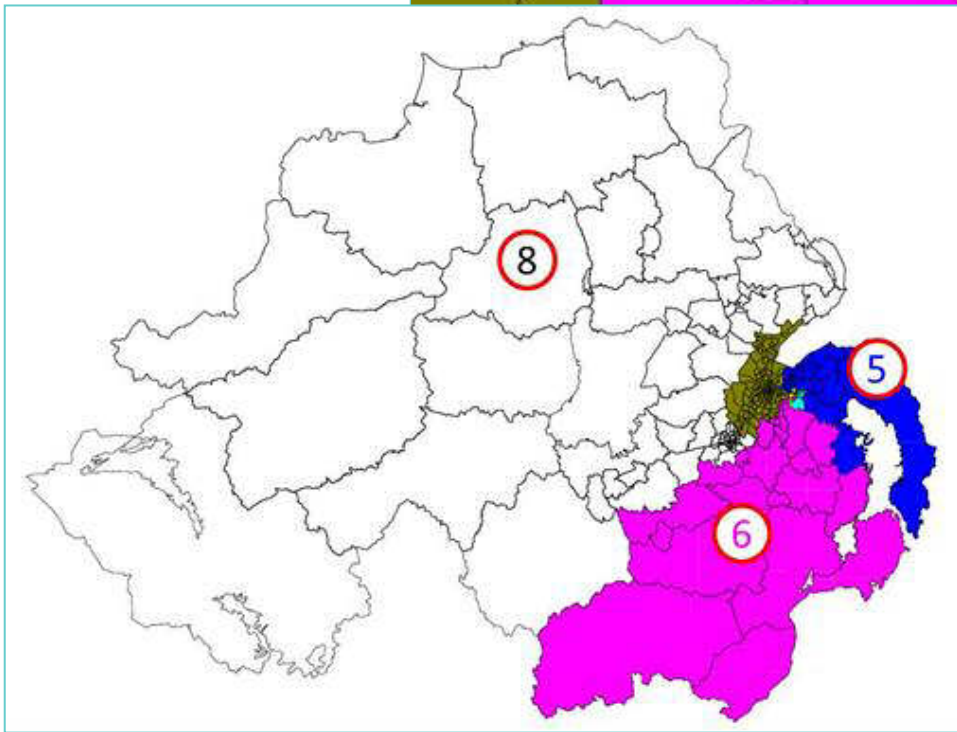
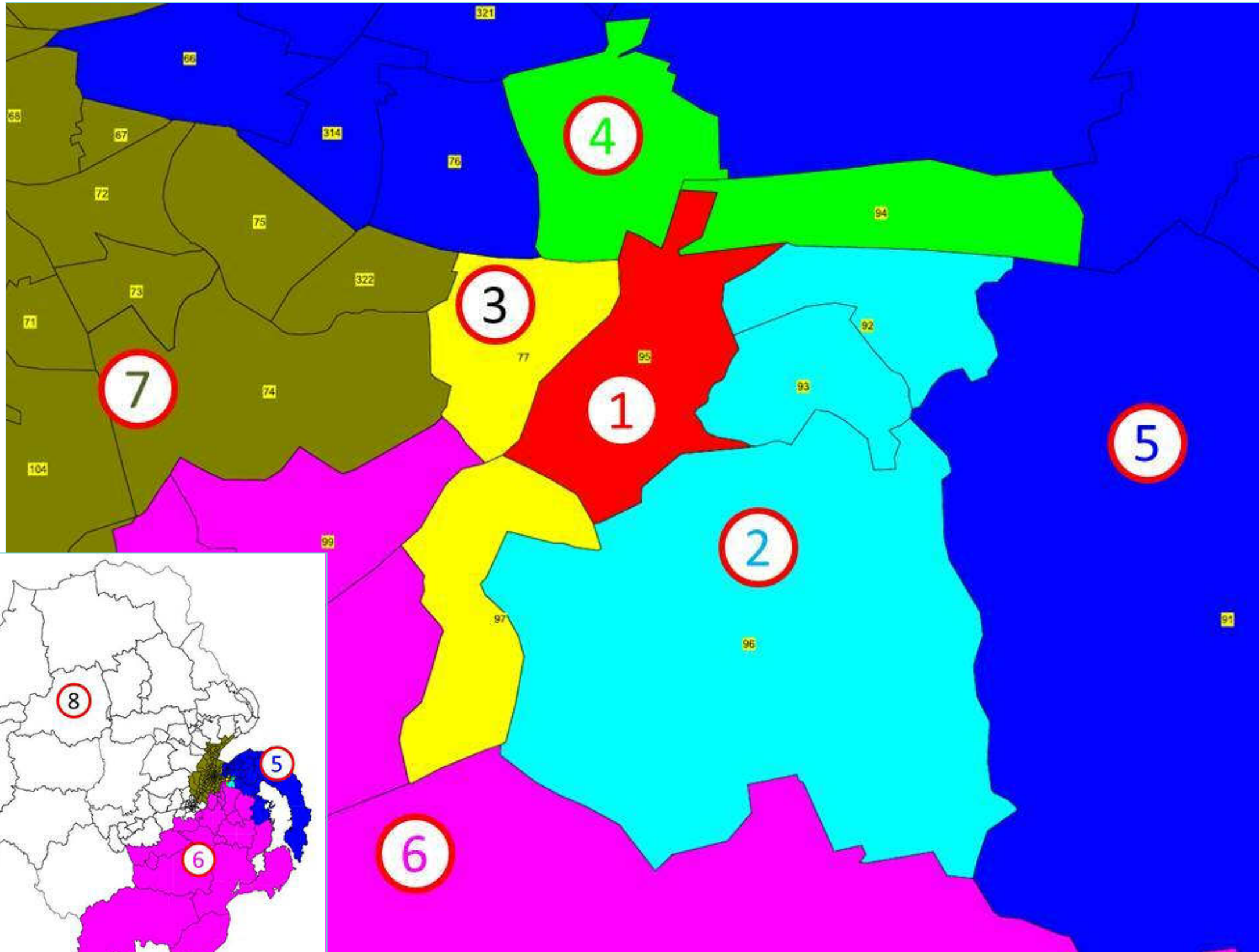
### **Study Area showing BTM Nodes and Traffic Volumes**





## **APPENDIX A5**

### **Origin-Destination Analysis (8x8 Sector Matrix)**



## **APPENDIX A6**

### **Sectored Origin-Destination Information**

**(units = PCUs)**

- A6-1. Kings Road – Gilnahirk Road to A55**
- A6-2. Kings Road - A55 to Gilnahirk Road**
- A6-3. A55 Knock Road - Kings Road to Shandon Park**
- A6-4. A55 Knock Road - Shandon Park to Kings Road**
- A6-5. Shandon Park - from A55 to Kensington Road**
- A6-6. Shandon Park - to A55 from Kensington Road**
- A6-7. Kensington Road to Gilnahirk Road**
- A6-8. Kensington Road from Gilnahirk Road**
- A6-9. Hawthornden Way to Knock**
- A6-10. Hawthornden Way from Knock**



**A6-1**
**Kings Road - Gilnahirk Road to A55  
1080 - 1051**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	15	111	0	0	0	126
	2	0	0	0	40	283	36	65	58	482
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	12	54	256	64	299	4	688
	6	0	0	0	2	3	0	8	0	13
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
Total		0	0	12	110	654	100	371	62	1309

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	15	115	0	0	0	130
	2	0	0	0	40	290	37	76	58	501
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	13	18	196	64	364	19	675
	6	0	0	0	0	1	0	13	1	15
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
Total		0	0	13	73	603	100	453	78	1320

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	43	301	98	78	64	583
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	12	18	172	80	418	35	735
	6	0	0	0	0	1	0	12	1	15
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
Total		0	0	12	60	475	178	508	100	1332



**A6-2**
**Kings Road - A55 to Gilnahirk Road  
1051 - 1080**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	2	0	0	9	0	0	0	11
	4	9	36	0	0	1	0	0	0	47
	5	48	147	0	0	17	0	0	0	213
	6	0	0	0	0	13	0	0	0	13
	7	17	71	0	0	60	0	0	0	148
	8	3	0	0	0	45	0	0	0	47
	Total	78	257	0	0	144	0	0	0	479

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	2	0	0	9	0	0	0	11
	4	0	36	0	0	1	0	0	0	38
	5	0	148	0	0	17	0	0	0	165
	6	1	0	0	0	14	0	0	0	15
	7	5	79	0	0	60	0	0	0	144
	8	4	0	0	0	45	0	0	0	49
	Total	10	265	0	0	146	0	0	0	421

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	2	0	0	9	0	0	0	11
	4	9	35	0	0	1	0	0	0	46
	5	48	147	0	0	17	0	0	0	212
	6	0	0	0	0	14	0	0	0	14
	7	0	71	0	0	60	0	0	0	131
	8	0	0	0	0	45	0	0	0	45
	Total	57	255	0	0	146	0	0	0	459

**A6-3**
**Knock Road - Kings Road to Shandon Park  
1051 - 1050**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	27	14	58	99
	3	0	0	0	0	0	0	0	0	0
	4	0	0	11	0	0	47	14	12	83
	5	0	0	33	0	0	1066	160	15	1274
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	0	44	0	0	1139	188	84	1456

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	27	14	58	99
	3	0	0	0	0	0	0	0	0	0
	4	9	0	11	0	0	47	14	13	94
	5	49	0	36	0	0	1101	167	17	1369
	6	0	0	0	0	0	0	0	0	0
	7	13	0	0	0	0	0	0	0	13
	8	0	0	0	0	0	0	0	0	0
	Total	72	0	47	0	0	1175	195	87	1575

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	98	49	64	210
	3	0	0	0	0	0	0	0	0	0
	4	0	1	15	0	0	73	18	24	131
	5	0	0	44	0	0	1250	257	41	1593
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	1	60	0	0	1420	324	129	1935

**A6-4**
**Knock Road - Shandon Park to Kings Road  
1050 - 1051**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	8	57	0	0	0	65
	2	0	0	0	4	13	0	0	0	17
	3	0	1	0	3	22	0	0	0	25
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	38	380	0	0	0	418
	7	4	19	0	65	240	0	0	0	328
	8	3	0	0	23	225	0	0	0	250
Total		8	19	0	140	936	0	0	0	1103

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	7	56	0	0	0	63
	2	0	0	0	4	13	0	0	0	17
	3	0	1	0	3	22	0	0	0	26
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	1	0	0	38	384	0	0	0	423
	7	5	19	0	69	269	0	0	0	361
	8	4	0	0	23	241	0	0	0	268
Total		10	20	0	144	984	0	0	0	1158

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	25	208	0	0	0	233
	2	0	0	0	4	23	0	0	0	27
	3	0	1	0	3	22	0	0	0	26
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	39	383	0	0	0	422
	7	0	19	0	71	271	0	0	0	360
	8	0	0	0	23	242	0	0	0	264
Total		0	20	0	164	1149	0	0	0	1332

## A6-5

**Shandon Park - A55 to Kensington Road  
1050 - 9330**

## Do Min

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	9	0	0	0	0	0	0	0	9
	8	1	0	0	0	0	0	0	0	1
	Total	11	0	0	0	0	0	0	0	11

## Option A

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	9	0	0	0	0	0	0	0	9
	5	49	0	0	0	0	0	0	0	49
	6	0	0	0	0	0	0	0	0	0
	7	22	0	0	0	0	0	0	0	22
	8	0	0	0	0	0	0	0	0	0
	Total	80	0	0	0	0	0	0	0	80

## Option B

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	1	0	0	0	0	0	0	0	2
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	10	12	0	0	0	0	0	0	22
	7	28	99	0	0	0	0	0	0	127
	8	15	5	0	0	0	0	0	0	20
	Total	54	117	0	0	0	0	0	0	170

**A6-6**
**Shandon Park - Kensington Road to A55  
9330 - 1050**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	13	8	66	45	144	39	315
	2	0	0	3	0	6	0	19	0	28
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	0	16	8	72	45	163	39	343

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	13	7	64	44	143	39	311
	2	0	0	3	0	2	0	3	0	8
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	0	15	7	66	44	147	39	319

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	14	25	218	48	149	40	493
	2	0	0	3	0	2	48	91	2	146
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	0	17	25	220	96	240	42	640

## A6-7

**Kensington Road - Shandon Park to Gilnahirk Road  
9330 - 1053**

## Do Min

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	2	0	15	214	0	0	0	230
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	2	0	15	214	0	0	0	230

## Option A

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	2	0	15	216	0	0	0	233
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	0	2	0	15	216	0	0	0	233

## Option B

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	2	0	0	72	0	0	0	73
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0
	6	0	12	0	0	0	0	0	0	12
	7	0	99	0	0	0	0	0	0	99
	8	0	5	0	0	0	0	0	0	5
	Total	0	118	0	0	72	0	0	0	190

**A6-8**
**Kensington Road - Gilnahirk Road to Shandon Park  
1053 - 9330**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	12	0	3	0	6	0	19	0	39
	3	1	0	0	0	0	0	0	0	1
	4	9	0	0	0	0	0	0	0	9
	5	80	0	0	0	0	0	0	0	80
	6	11	0	0	0	0	0	0	0	11
	7	17	0	0	0	0	0	0	0	17
	8	13	0	0	0	0	0	0	0	13
	Total	143	0	3	0	6	0	19	0	171

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	12	0	3	0	2	0	3	0	20
	3	1	0	0	0	0	0	0	0	1
	4	0	0	0	0	0	0	0	0	0
	5	32	0	0	0	0	0	0	0	32
	6	11	0	0	0	0	0	0	0	11
	7	5	0	0	0	0	0	0	0	5
	8	14	0	0	0	0	0	0	0	14
	Total	75	0	3	0	2	0	3	0	83

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	12	0	3	0	2	48	91	2	158
	3	0	0	0	0	0	0	0	0	0
	4	9	0	0	0	0	0	0	0	9
	5	79	0	0	0	0	0	0	0	79
	6	1	0	0	0	0	0	0	0	1
	7	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0
	Total	101	0	3	0	2	48	91	2	248

**A6-9**
**Hawthornden Way to Knock  
1026 - 1037**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	47	92	36	12	106	744	188	12	1236
	6	0	0	0	0	0	0	0	0	0
	7	7	52	0	1	66	0	0	0	126
	8	0	0	0	0	2	0	0	0	3
	Total	54	143	36	14	174	744	188	12	1365

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1		0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	47	92	36	12	103	762	191	14	1257
	6	0	0	0	0	0	0	0	0	0
	7	7	52	0	1	66	0	0	0	127
	8	0	0	0	0	2	0	0	0	3
	Total	54	144	36	13	172	762	191	14	1386

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1		0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0
	5	46	92	34	12	97	847	301	32	1461
	6	0	0	0	0	0	0	0	0	0
	7	0	17	0	1	65	0	0	0	83
	8	0	0	0	0	2	0	0	0	2
	Total	46	109	34	13	164	847	301	32	1547



**A6-10**
**Hawthornden Way from Knock  
1037 - 1026**
**Do Min**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	103	0	0	0	103
	2	0	0	0	0	138	0	1	0	139
	3	0	0	0	0	32	0	0	0	32
	4	0	0	0	0	53	0	0	0	53
	5	0	0	0	0	401	0	4	0	405
	6	0	0	0	0	219	0	1	0	219
	7	0	0	0	0	99	0	0	0	99
	8	0	0	0	0	77	0	0	0	77
	Total	0	0	0	0	1123	0	5	0	1128

**Option A**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	75	0	0	0	75
	2	0	0	0	0	85	0	0	0	85
	3	0	0	0	0	25	0	0	0	25
	4	0	0	0	0	53	0	0	0	53
	5	0	0	0	0	394	0	0	0	394
	6	0	0	0	0	169	0	0	0	169
	7	0	0	0	0	89	0	0	0	89
	8	0	0	0	0	80	0	0	0	80
	Total	0	0	0	0	971	0	0	0	971

**Option B**

		Destination Sector								Total
		1	2	3	4	5	6	7	8	
Origin Sector	1	0	0	0	0	105	0	0	0	105
	2	0	0	0	0	87	0	0	0	87
	3	0	0	0	0	26	0	0	0	26
	4	0	0	0	0	53	0	0	0	53
	5	0	0	0	0	392	0	0	0	392
	6	0	0	0	0	169	0	0	0	169
	7	0	0	0	0	95	0	0	0	95
	8	0	0	0	0	80	0	0	0	80
	Total	0	0	0	0	1007	0	0	0	1007

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**Amey UK plc. Registered office address:**

The Sherard Building, Edmund Halley Road, Oxford OX4 4DQ

**Head office and principal place of business:**

Serrano Galvache, 56 Edificio Madroño, 28033 Madrid, Spain

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