TECHNICAL NOTE

DERBY ROADSIDE NO2 MODELLING

T2 - LOCAL PLAN TRANSPORT MODEL VALIDATION REPORT FEB 19

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1. INTRODUCTION

1.1 Background

1.1.1 SYSTRA has been commissioned by Derby City Council to provide modelling support for the Roadside NO_2 Feasibility Study. The purpose of the modelling is understand the transportation and air quality impacts associated with imposing a scheme to improve the air quality within Derby City, including the potential assessment of charging Clean Air Zones (CAZ).

1.1.2 The first stage of this study was to undertake a check of the DATM3 highway model validation within an agreed area of influence of a potential charging CAZ scheme. It also entailed subsequent review of the impact area of the preferred option, which includes traffic management along Stafford Street. This Technical Note summarises the outcomes of this validation assessment.

1.2 Overview of the Derby Area Transport Model

1.2.1 The Derby Area Transport Model (DATM3) has been utilised to undertake the modelling work for this study. DATM3 has a base year of 2012.

1.2.2 DATM3 has a detailed representation of the transport networks and demand within the Derby Principal Urban Area (PUA). Network coverage and demand representations are of reduced detail for areas beyond Derby, for the adjacent counties and major urban areas including Derbyshire, Nottinghamshire, Leicestershire and Staffordshire. The simulation area that DATM3 covers is shown in Figure 1.

1.2.3 DATM3 has the following key components:

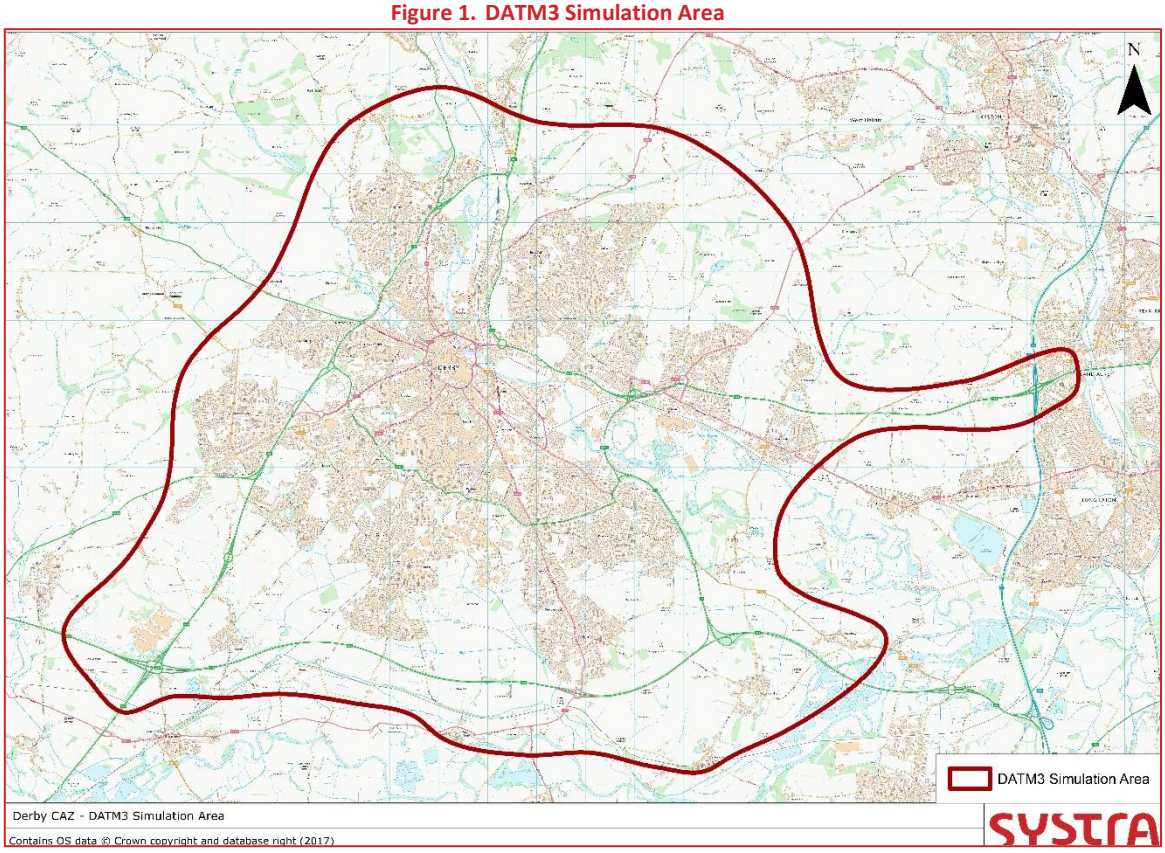
- SATURN highway assignment model capable of simulating the operation of the road links and junctions within the Derby area and determining the routes that vehicles will take based on the lowest generalised costs for the end to end journey.
- TRIPS public transport model with detailed representation of all major bus and rail services within the Derby area, and also the main inter urban services linking to towns and cities outside the immediate city boundary. The TRIPS model is capable of providing predictions of passenger boarding and alighting patterns.
- DATM3 variable demand model (VDM) which simulates the journey choices based on the costs associated with a range of journey options. The demand model also incorporates a parking model within Derby City Centre that simulates the supply, demand and payment effects of the on and off street parking within this area. WebTAG does not specify a single hierarchical order for demand choices, but does suggest that frequency should be the least sensitive to change in travel costs. WebTAG also recommends that macro time of day choice should follow frequency in the hierarchical order. The order set out in DATM3 (from least sensitive to most sensitive) includes:

    - Frequency.
    - Macro time of day choice – choice between morning and evening peak and off-peak time periods.
    - Mode – Car, public transport (rail/bus), park and ride, slow modes (walking and cycling).

- Destination (trip distribution) –journeys can alter their ultimate destination in the short term (for purposes such as shopping and leisure) or longer term (eg for commuting).
- Micro time of day choice – choice between shoulders of the peak, reflecting peak spreading.

- Delta Land Use Model – is a dynamic model which represents land use change over periods of time in response to variables including travel times and costs (predicted by the transport model). The model forecasts the take up and distribution of households, population, employment and floorspace based on economic circumstances and area accessibility.
- External Forecasting Model (EFM) – converts changes in land use to changes in trip patterns to be used in the demand model.

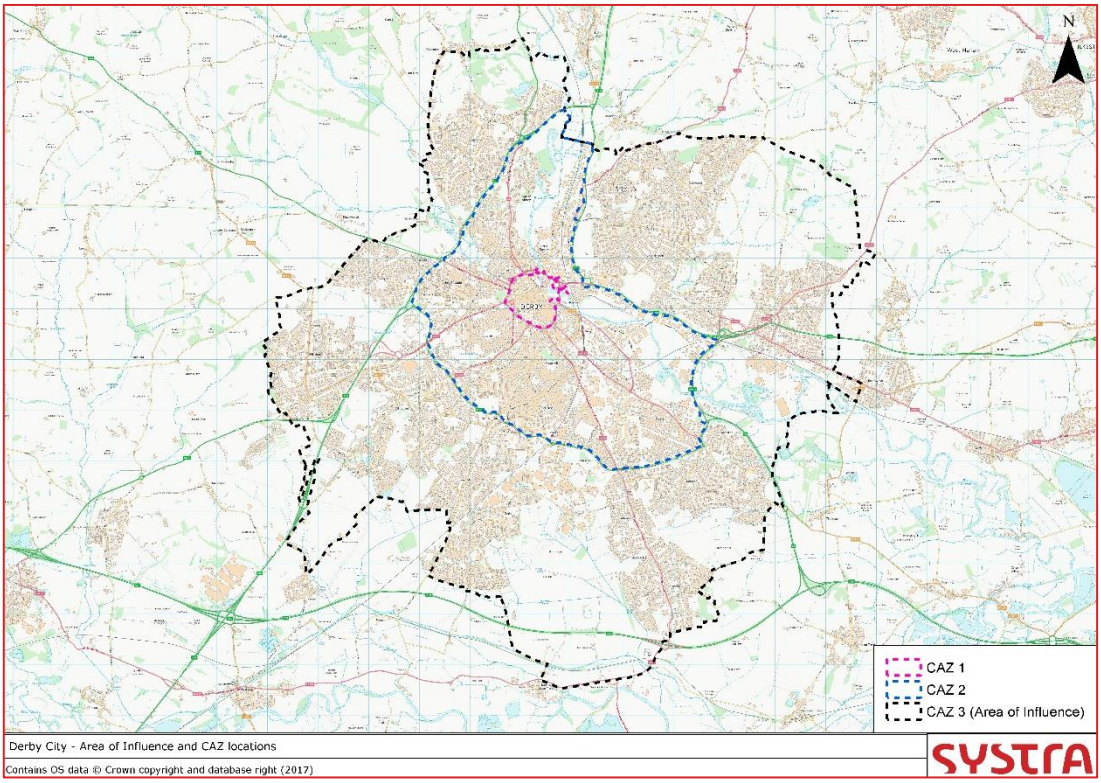
Figure 1. DATM3 Simulation Area



1.3 Derby CAZ Area of Influence

1.3.1 The area of influence contains all major roads and junctions expected to be included in a possible Clean Air Zone. The area of influence is shown in Figure 2.

Figure 2. Derby City Area of Influence



1.4 Assignment Convergence

1.4.1 During the development of the base year model, the assignment convergence was checked to ensure that reasonable levels of convergence were achieved. WebTAG guidance suggests that assignment models should achieve a lower value of %GAP than the 0.1% to ensure that scheme benefits can be estimated robustly above model 'noise'.

1.4.2 Table 1 provides that convergence statistics for each peak hour. For DELTA, % GAP and % Flows information for the last four loops have been provided. All three peak hour models converge well and exceed WebTAG criteria.

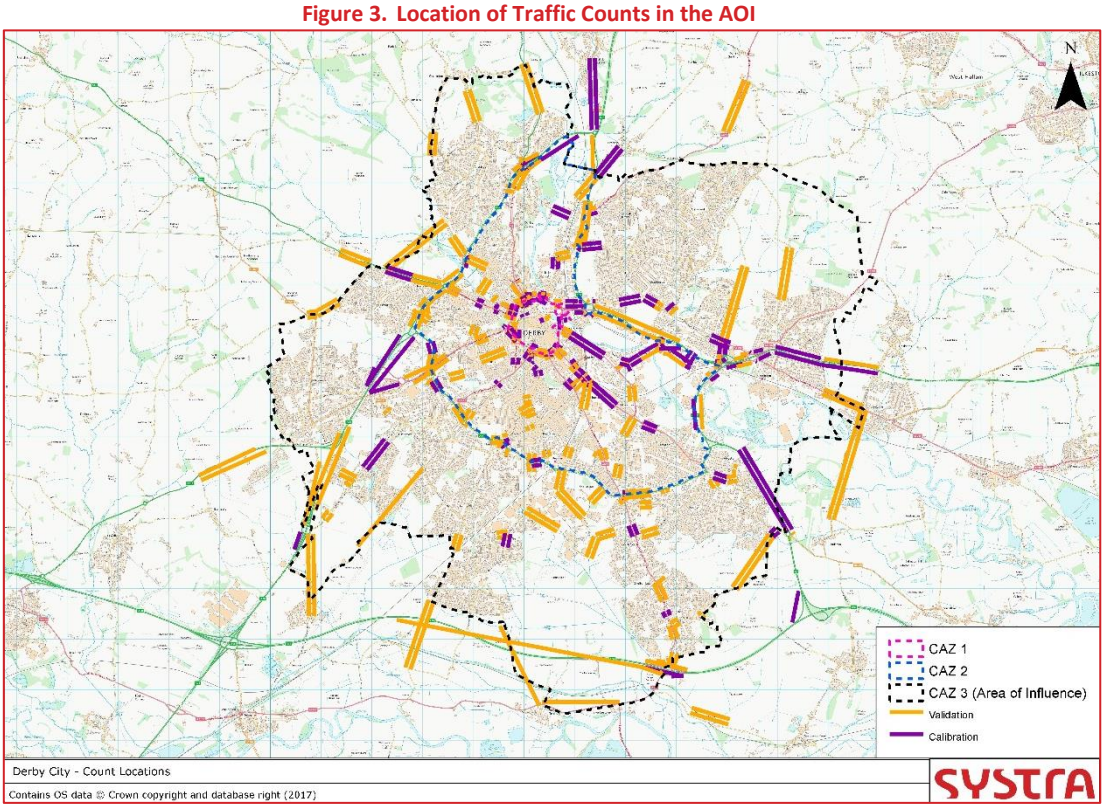
Table 1. Assignment Convergence

	LOOPS	DELTA	% GAP	% FLOWS
Guidance	-	Less than 0.1%	Less than 0.1%	98% for four consecutive loops
Morning Peak	133	0.0383 0.0260 0.0275 0.0266	0.030 0.025 0.028 0.026	98.6 98.5 99.8 99.7
Inter peak	56	0.0066 0.0042 0.0063 0.0039	0.0059 0.0048 0.0058 0.0053	99.1 98.6 99.0 98.9
Evening Peak	149	0.038 0.0363 0.0438 0.0369	0.052 0.052 0.054 0.054	98.1 97.4 98.6 98.3

1.5 Location of Traffic Counts in the AOI

1.5.1 Figure 3 shows the location of all counts within the AOI. Counts have only been selected and used in the validation check if they are post 2011. In addition to counts provided by Derby City and Derbyshire County Council, the analysis also includes additional A38 counts received from Highways England and used by AECOM in their recent business case assessments for the A38 grade separation schemes. Following the integration of both sets of data the observed count data was checked for consistency using ArcGIS and any anomaly counts have been removed.

Figure 3. Location of Traffic Counts in the AOI



1.6 Traffic Growth

1.6.1 All counts have been factored to represent 2012 Base Model year conditions using local TEMPRO 7.2 factors. Table 2 shows 2015 to 2012 factors.

Table 2. TEMPRO factors 2015 – 2012

PEAK	FACTOR
AM	0.9656
IP	0.9619
PM	0.9637

1.6.2 Unfortunately we could not locate a representative set of survey data from which we could identify the growth in traffic between 2012 and 2015. However, we have used the Annual Average Daily Flow (AADF) information for Derby from the DfT Traffic Counts web site[1] which covers a range of count locations within Derby and provides data for each year between 2012 and 2015.

1.6.3 This has led to the following growth profile for the area based on an average of around 60 sites within Derby City. Overall the recorded growth in Derby between 2012 and 2015 is 2.75% and the equivalent 24hr growth from TEMPRO 7.2 is around 2.11%. Therefore the TEMPRO growth is broadly representative of the actual growth. This confirms that the approach adopted for amending the various traffic counts used in the model validation assessment to a 2012 transport modelling base year is appropriate and is representative of general growth patterns in the area.

Table 3. TEMPRO 7.2 v AADF Comparison

YEAR	AVERAGE TOTAL	YEARLY PERCENTAGE CHANGE	TEMPRO 7.2
2012	27,622		
2013	27,091	-1.92%	0.69%
2014	28,195	4.07%	0.69%
2015	28,381	0.66%	0.70%
2012-2015		2.75%	2.11%

[1] http://www.dft.gov.uk/traffic-counts/area.php?region=East+Midlands&la=Derby

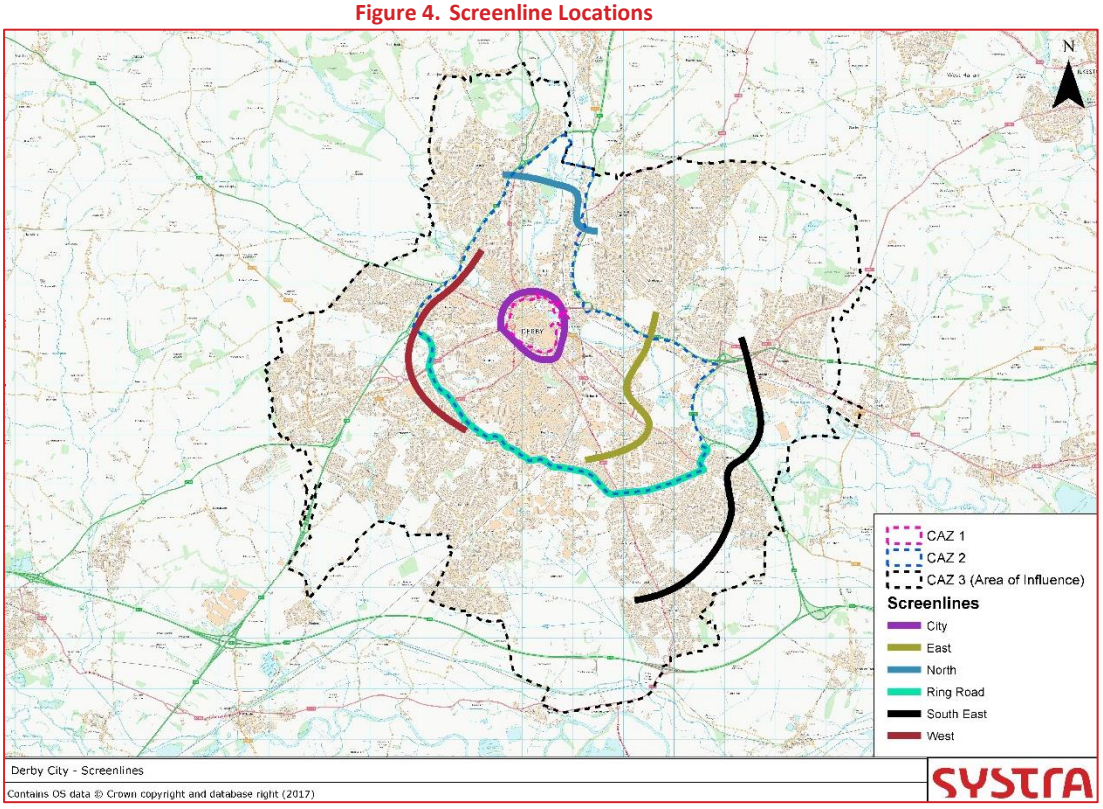
2. VALIDATION CHECK

2.1 Screenline Validation

2.1.1 The DfT guidelines for the validation of highway models are based on those laid out in WebTAG Unit M3.1 and The Design Manual for Roads and Bridges (DMRB) Volume 12, Section 2, Part 1, Chapter 4.

2.1.2 Screenlines provide a measure of how well the trip matrix validates. Four screenlines have been identified. Figure 4 shows the location of these screenlines. Where possible each screenline is comprised of 5 or more counts.

Figure 4. Screenline Locations



2.1.3 Tables 4, 5 and 6 show the performance of the model (all vehicle classes) for each screenline for morning peak, inter peak and evening peak respectively. Guidance suggests that the total modelled screenline flow should be within 5% of the total observed flow.

2.1.4 The correlation between total modelled and observed screenline flows is good. In the morning peak 67% of the screenlines meet the WebTAG criteria and are within 5% of the observed flow. In particular, the City and North screenlines meet criteria in both directions as do the East (inbound), West and Ring Road screenlines.

2.1.5 In the Interpeak 33% of the screenlines meet the criteria of 5% difference however 75% are within 10% of the observed flow. The East and West screenlines are narrowly outside the 5% threshold, however, apart from the Outbound East screenline and Ring Road screenlines, the total flows for these screenlines meet the GEH and DMRB criteria. Considering that there is a limited number of interpeak counts available in these areas and a vast number of counts not been used in calibration this level of inter peak screenline validation is considered acceptable.

2.1.6 In the evening peak 67% of the screenlines meet the criteria and 92% have differences less than 10%. The City, South East and North screenlines meet criteria. The modelled flows on the outbound East screenline also meets criteria, and whilst the remaining screenlines narrowly miss the 5% threshold the total flows meet the GEH and DMRB criteria.

2.1.7 Appendix A provides details on the Car, LGV and HGV screenline performance .

Table 4. Morning Peak Screenline Validation (Total Vehicles)

	MOD	OBS	DIFF	% DIFF	GEH	DMRB
City - Inbound	7285	7370	-85	-1%	1.0	Y
City - Outbound	6871	6891	-20	0%	0.2	Y
North - Inbound	2297	2327	-30	-1%	0.6	Y
North - Outbound	1245	1298	-53	-4%	1.5	Y
East - Inbound	5529	5612	-83	-1%	1.1	Y
East - Outbound	3077	2747	330	12%	6.1	Y
West - Inbound	2687	2589	98	4%	1.9	Y
West - Outbound	3082	2698	384	14%	7.1	Y
South East - Inbound	2004	1849	155	8%	3.5	Y
South East - Outbound	723	803	-80	-10%	2.9	Y
Ring Road - Inbound	5366	5209	157	3%	2.2	Y
Ring Road - Outbound	6022	5809	212	4%	2.8	Y

Table 5. Inter Screenline Validation (Total Vehicles)

	MOD	OBS	DIFF	% DIFF	GEH	DMRB
City - Inbound	4410	4614	-204	-4%	3.0	Y
City - Outbound	5114	5031	83	2%	1.2	Y
North - Inbound	808	836	-28	-3%	1.0	Y
North - Outbound	865	871	-5	-1%	0.2	Y
East - Inbound	4716	4359	357	8%	5.3	Y
East - Outbound	2720	3485	-765	-22%	13.7	N
West - Inbound	2806	2571	234	9%	4.5	Y
West - Outbound	2408	2570	-162	-6%	3.2	Y
South East - Inbound	171	134	36	27%	3.0	Y
South East - Outbound	143	153	-11	-7%	0.9	Y
Ring Road - Inbound	5945	5451	494	9%	6.5	N
Ring Road - Outbound	5087	4619	468	10%	6.7	N

Table 6. Evening Peak Screenline Validation (Total Vehicles)

	MOD	OBS	DIFF	% DIFF	GEH	DMRB
City - Inbound	6447	6281	166	3%	2.1	Y
City - Outbound	8086	7825	261	3%	2.9	Y
North - Inbound	982	1032	-50	-5%	1.6	Y
North - Outbound	1671	1705	-34	-2%	0.8	Y
East - Inbound	4402	4118	284	7%	4.4	Y
East - Outbound	4336	4236	100	2%	1.5	Y
West - Inbound	2522	3140	-618	-20%	11.6	N
West - Outbound	3502	3561	-59	-2%	1.0	Y
South East - Inbound	2519	2407	112	5%	2.2	Y
South East - Outbound	2798	2947	-150	-5%	2.8	Y
Ring Road - Inbound	6583	6157	426	7%	5.3	N
Ring Road - Outbound	6371	6306	65	1%	0.8	Y

2.2 Link Flow Validation

2.2.1 The DfT guidelines for the validation of highway models are based on those laid out in WebTAG Unit M3.1 and The Design Manual for Roads and Bridges (DMRB) Volume 12, Section 2, Part 1, Chapter 4. In respect of the link flow comparisons presented in this section, there are two separate sets of criteria against which the counts and modelled flow comparisons should be measured. In both cases the criteria are expected to be met in 85% of cases. The two sets of criteria are:

GEH Statistic:

- Links should have a GEH value of less than 5.

DMRB Vehicle Flow Comparison (DMRB criteria 1-3):

- Where observed flow is less than 700 vehicles per hour, the modelled flow should be within 100 vehicles of the observed flow;
- Where the observed flow is between 700 and 2,700 vehicles per hour, the modelled flow should be within 15% of the observed flow; and
- Where observed flow is greater than 2,700 vehicles per hour, the modelled flow should be within 400 vehicles of the observed flow.

2.2.2 With regard to DfT guidelines on the acceptability of validation statistics, WebTAG Unit 3.19 section 3.2.7 discusses validation statistics for counts meeting GEH and DMRB criteria, stating that:

"These two measures are broadly consistent and link flows that meet either criterion should be regarded as satisfactory."

2.2.3 The Derby City study area validation checks have been undertaken in line with these criteria. Table 7, 8 and 9 provides the statistics for counts used in the latest DATM3 calibration for each possible charging CAZ area, reflecting the city centre only, within the outer ring road and full city CAZ options.

Table 7. Headline Calibration Statistics – City Centre (CAZ1)

	COUNTS	GEH < 5	DMRB	GEH < 5 or DMRB
Morning Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	4	100%	100%	100%
HGV	4	100%	100%	100%
Total	4	100%	100%	100%
Inter Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	8	88%	100%	100%
HGV	8	100%	100%	100%
Total	8	90%	100%	100%
Evening Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	3	100%	100%	100%
HGV	3	100%	100%	100%
Total	3	100%	100%	100%

Table 8. Headline Calibration Statistics –Outer Ring Road (CAZ2)

	COUNTS	GEH < 5	DMRB	GEH < 5 or DMRB
Morning Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	85	84%	86%	87%
HGV	85	96%	100%	100%
Total	87	83%	86%	87%
Inter Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	58	72%	71%	74%
HGV	58	97%	100%	100%
Total	68	78%	78%	79%
Evening Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	77	91%	91%	94%
HGV	77	96%	100%	100%
Total	83	89%	90%	93%

Table 9. Headline Calibration Statistics – Full City (CAZ3)

	COUNTS	GEH < 5	DMRB	GEH < 5 or DMRB
Morning Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	122	85%	87%	88%
HGV	122	97%	100%	100%
Total	129	84%	87%	88%
Inter Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	90	76%	73%	78%
HGV	90	94%	100%	100%
Total	117	77%	76%	79%
Evening Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	145	86%	86%	89%
HGV	145	94%	100%	100%
Total	159	85%	86%	89%

2.2.4 The model shows a good correlation between the modelled flows and observed counts within the AOI and it validates to a high degree. In the AM peak, 88% of the counts meet either GEH or DMRB criteria. A total of 89% of the counts match in the PM peak. This level of calibration is considered good given the strategic nature and vast extent of the model.

2.2.5 Although the interpeak calibration is slightly lower than WebTAG criteria it calibrates well considering the number of calibration counts within the modelled area. A total of 79% of the counts meet either the GEH or DMRB criteria.

2.2.6 Tables 10, 11 and 12 provide the statistics for the counts used in the latest DATM3 validation for each CAZ cordon.

Table 10. Headline Validation Statistics – City Centre (CAZ1)

	COUNTS	GEH < 5	DMRB	GEH < 5 or DMRB
Morning Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	10	60%	90%	90%
HGV	10	100%	100%	100%
Total	10	80%	90%	90%
Inter Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	5	40%	60%	60%
HGV	5	100%	100%	100%
Total	5	40%	60%	60%
Evening Peak				
Cars	-	-	-	-
LGV	-	-	-	-
Car/LGVs	10	70%	90%	90%
HGV	10	100%	100%	100%
Total	10	80%	90%	90%

Table 11. Headline Validation Statistics – Ring Road (CAZ2)

	COUNTS	GEH < 5	DMRB	GEH < 5 or DMRB
Morning Peak				
Cars	49	59%	63%	65%
LGV	49	84%	100%	100%
Car/LGVs	75	75%	84%	91%
HGV	124	89%	99%	99%
Total	127	73%	81%	81%
Inter Peak				
Cars	61	77%	82%	85%
LGV	61	87%	100%	100%
Car/LGVs	43	63%	63%	67%
HGV	104	95%	100%	100%
Total	110	69%	72%	75%
Evening Peak				
Cars	53	70%	77%	81%
LGV	53	70%	100%	100%
Car/LGVs	70	80%	81%	91%
HGV	123	97%	100%	100%
Total	124	75%	76%	80%

Table 12. Headline Calibration Statistics – Full City (CAZ3)

	COUNTS	GEH < 5	DMRB	GEH < 5 or DMRB
Morning Peak				
Cars	132	63%	70%	73%
LGV	132	82%	96%	96%
Car/LGVs	127	79%	85%	93%
HGV	259	85%	100%	100%
Total	276	77%	81%	83%
Inter Peak				
Cars	151	75%	83%	86%
LGV	151	84%	97%	97%
Car/LGVs	57	68%	67%	92%
HGV	208	90%	100%	100%
Total	227	73%	74%	78%
Evening Peak				
Cars	136	63%	69%	73%
LGV	136	71%	96%	96%
Car/LGVs	127	81%	81%	92%
HGV	263	87%	97%	97%
Total	277	70%	71%	75%

2.2.7 The model shows a good correlation between the modelled flows and observed counts within the AOI and it validates to a high degree. In the AM peak, 83% of the counts meet either GEH or DMRB criteria. A total of 75% of the counts match in the PM peak. This level of validation is considered good given the strategic nature and vast extent of the model. The validation statistics also include a significant number of new counts undertaken as part of the A38 study. The high validation statistics provides further confidence that the model is replicating observed traffic patterns across the AOI.

2.3 Overall Link Flow Performance

2.3.1 Figure 5 below illustrates counts in the morning peak which meet the DfT requirements and counts which fail to meet the requirements. Figures 6 and 7 show the same information but for Inter Peak and Evening Peak. This shows there is no bias in the model as the locations that do not meet the criteria are spread throughout the AOI.

Figure 5. Performance of All Counts within the AOI – Morning Peak

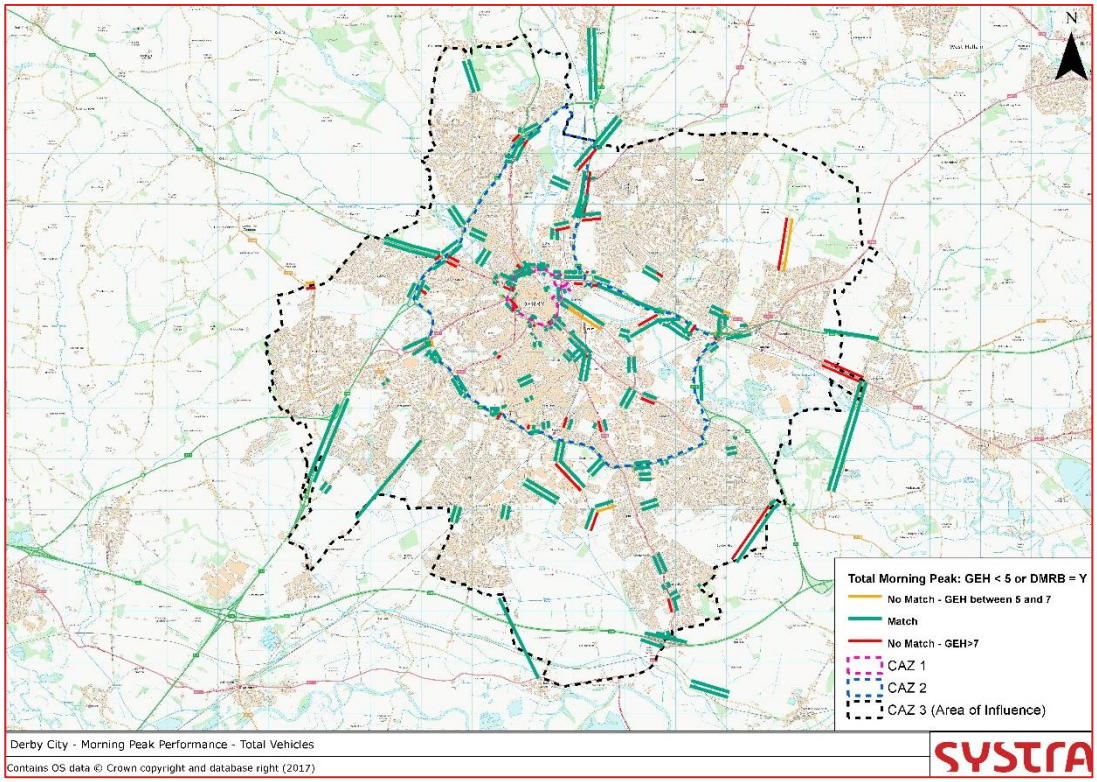


Figure 6. Performance of All Counts within the AOI –Inter Peak

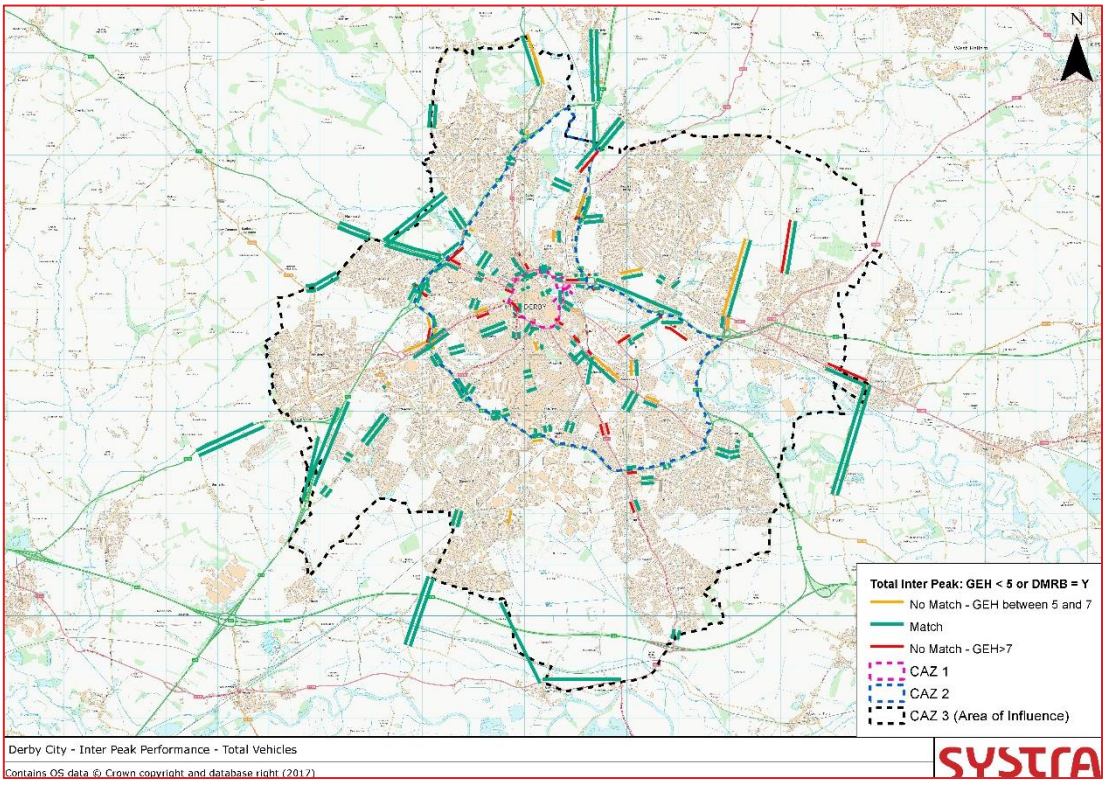
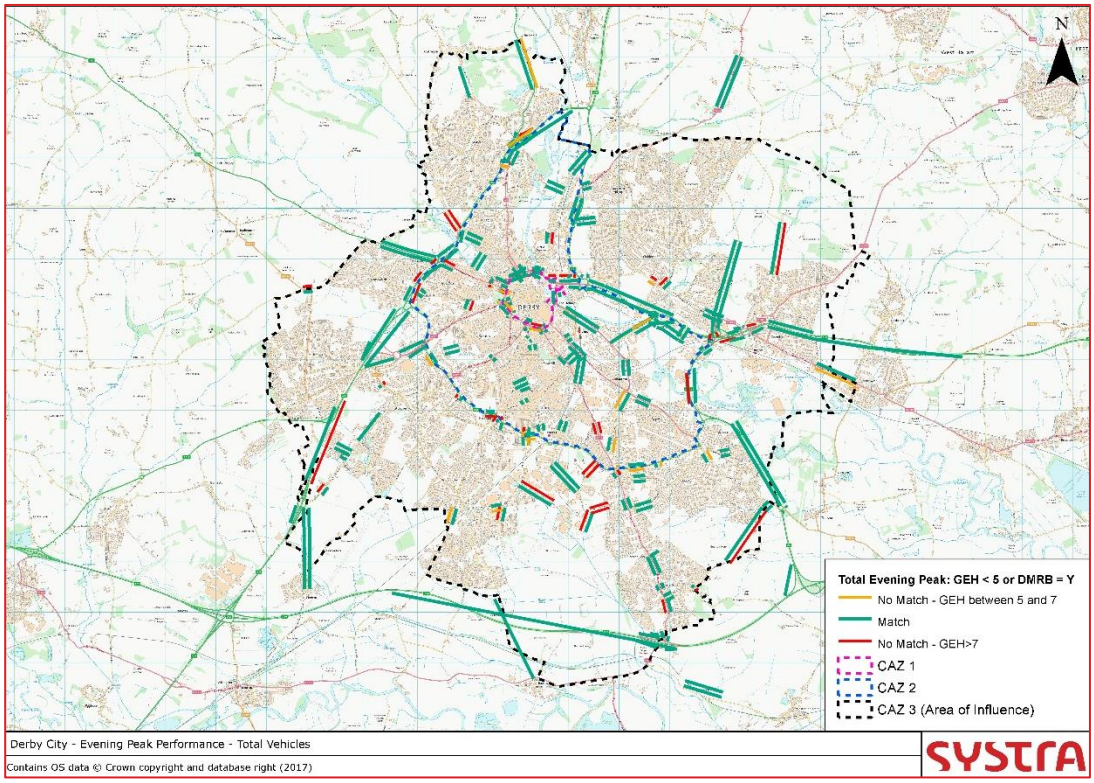


Figure 7. Performance of all counts within the AOI – Evening Peak



2.4 Journey Time Validation

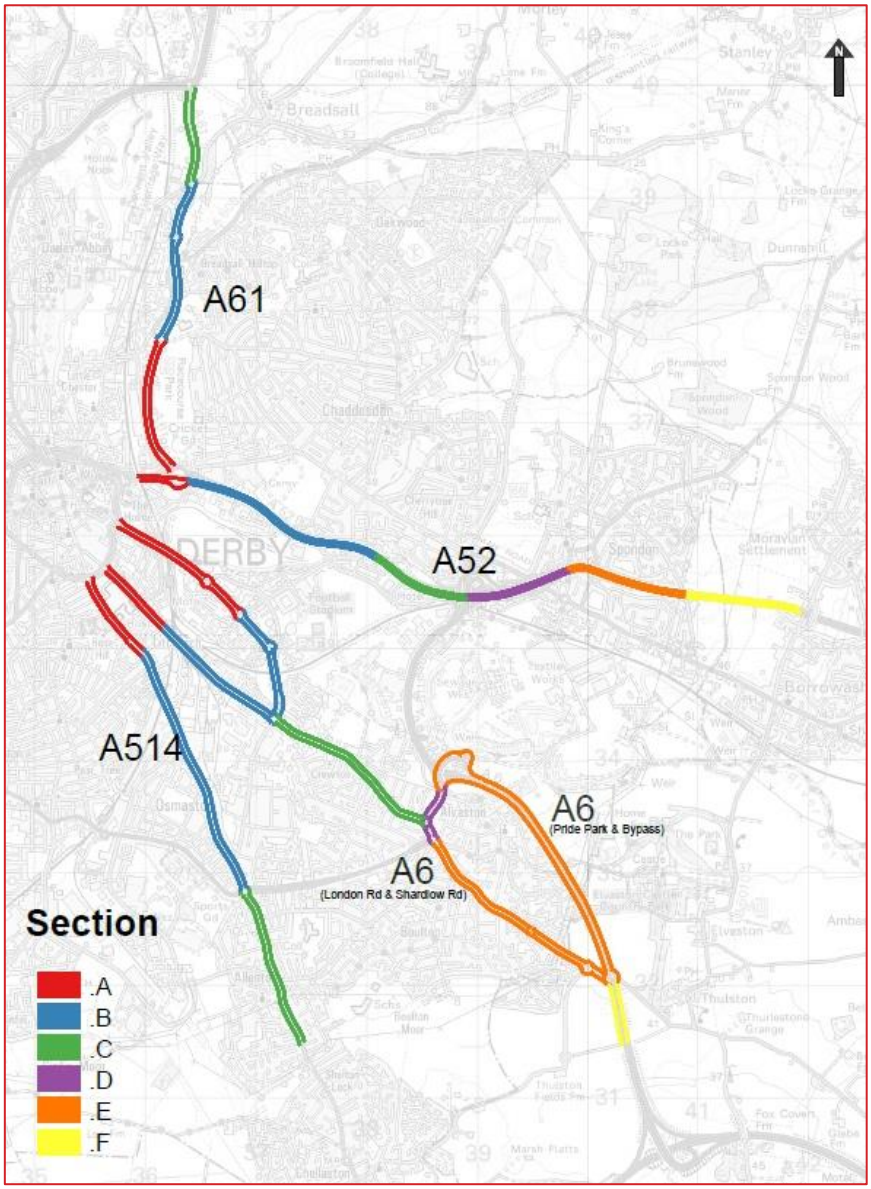
2.4.1 The DfT guidelines for the validation of journey times are based on those laid out in WebTAG Unit M3.1 and The Design Manual for Roads and Bridges (DMRB) Volume 12, Section 2, Part 1, Chapter 4. This guidance suggests that the total modelled journey times should be within +/- 15% of the observed journey time.

2.4.2 Observed journey time information was available for morning and evening peaks for 5 routes across Derby City. The Journey Time data used in the validation was provided by Derby City Council and came from TomTom data. TomTom do not divulge their processing methodology and therefore the only information that we have in terms of how this was derived is on the website[2]. TomTom is now a standard source for Journey Time data and is being used by Government organisations throughout the UK.

2.4.3 Observed journey times were compared against modelled journey times to provide an indication of journey time validation in the CAZ AOI. Figure 8 shows the location of these journey time routes.

[2] http://www.tomtom.com/lib/img/HISTORICAL_TRAFFIC_WHITEPAPER.pdf

Figure 8. Journey Time Routes



2.4.4 The modelled and observed journey time comparison is shown in Table 13 for morning peak, Table 14 for inter peak and Table 15 for evening peak. Journey time routes that are within +/- 15% of the observed journey times have been shaded green. Those just outside this 15% threshold have been highlighted in yellow.

2.4.5 In the morning peak 40% of the routes match the criteria of +/-15%. 70% are within +/- 20% of the observed journey times. In the evening peak 50% of routes match the criteria and 60% of routes are within 20% of the observed journey times.

2.4.6 The interpeak journey times are based on free flow speeds. There is no data for routes along the A6 Pride Park and A514. In total 50% of routes match the criteria. In the instances where the journey times do not match, the observed free flow time is considered to be too fast for the specific roads. London Road and the A52 Westbound are locations which experience severe congestion across the day and it is unlikely that free flow speeds are representative. However, as the link flow validation is good along these roads during the interpeak the model is considered to provide a good representation of these roads.

2.4.7 Past DATM3 validation exercises have concentrated on flow validation as a primary focus and improvements to journey time validation has been shown to significantly affect the flow validation due to the levels of congestion on the network.

2.4.8 To ensure that modelled journey times are suitable for air quality analysis we will adjust the journey time outputs (links speeds) after the transport model has run to address the inconsistencies between observed and modelled journey times.

Table 13. Morning Peak Journey Time Routes (seconds)

	OBS	MOD	% CHANGE	STATUS
A61 NB	320	264	-18%	No Match
A61 SB	606	307	-49%	No Match
A52 EB	252	283	12%	Match
A52 WB	1092	446	-59%	No Match
A6 London Rd SB	730	852	17%	No Match
A6 London Rd NB	1032	1107	7%	Match
A6 Pride Park & Bypass SB	642	747	16%	No Match
A6 Pride Park & Bypass NB	992	999	1%	Match
A514 SB	741	691	-7%	Match
A514 NB	939	602	-36%	No Match

Table 14. Inter Peak Journey Time Routes (seconds)

	OBS	MOD	% CHANGE	STATUS
A61 NB	215	225	5%	Match
A61 SB	191	210	10%	Match
A52 EB	249	287	15%	Match
A52 WB	274	345	26%	No Match
A6 London Rd SB	416	759	83%	No Match
A6 London Rd NB	451	969	115%	No Match

Table 15. Evening Peak Journey Time Routes (seconds)

	OBS	MOD	% CHANGE	STATUS
A61 NB	691	310	-55%	No Match
A61 SB	317	202	-36%	No Match
A52 EB	307	324	5%	Match
A52 WB	506	448	-12%	Match
A6 London Rd SB	852	1184	39%	No Match
A6 London Rd NB	693	902	30%	No Match
A6 Pride Park & Bypass SB	1043	1149	10%	Match
A6 Pride Park & Bypass NB	948	878	-7%	Match
A514 SB	667	721	8%	Match
A514 NB	800	664	-17%	No Match

3. CONCLUSIONS

3.1.1 The model shows a good correlation between the modelled flows and observed counts within the AOI and it validates to a high degree.

3.1.2 Screenline validation has been undertaken to compare modelled and observed flows into and out of the city centre and on key radial routes east, west and north of the city. This validation shows a good correlation between total modelled and observed flows. In instances where the screenlines do not match the guidance of 5%, the GEH and DMRB criteria are met.

3.1.3 The model shows a good correlation between the modelled flows and observed counts within the AOI. In the AM peak, 84% of the counts meet either GEH or DMRB criteria. A total of 75% of the counts match in the PM peak. This level of validation is considered good given the strategic nature and vast extent of the model. The validation statistics also include a significant number of new counts undertaken as part of the A38 study. The high validation statistics provides further confidence that the model is replicating observed traffic patterns across the AOI.

3.1.4 Journey time validation for morning and evening peaks shows that the majority of key routes meet, or are close to meeting, the WebTAG guidance of +/- 15%.

3.1.5 A further review of the modelled highway network, in the vicinity of the preferred option traffic management scheme along Stafford Street, has also been undertaken to ensure that the model closely replicates the operation of the current highway network along the Inner Ring Road and also within the adjacent residential and commercial areas. This included checking of the coding along Uttoxeter Old Road and the main routes that lead into this route.

3.1.6 This review concluded that the model replicates the operation of the current highway network along Stafford Street and the Inner Ring Road, along the main radial routes leading to the Inner Ring Road and also along the routes that are likely to act as an alternative route to Stafford Street with the traffic management scheme in place (i.e. Uttoxeter Old Road and the residential routes to the east of Stafford Street). The Inner Ring Road flow validation cordon has a maximum GEH value of 3 over all three peaks and therefore is well within the WEBTAG validation criteria.

3.1.7 In conclusion, the model is ‘fit for purpose’ in the assessment of the both the preferred option, which includes traffic management along Stafford Street and associated wider network management measures, and the Benchmark charging CAZ option in the area within the Outer Ring Road.

Appendix A – Screenline Validation by Vehicle

Morning Peak

SCREENLINE	CAR				LGV				CAR + LGV				HGV			
	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB
City - Inbound	2318	2481	3.3	Y	308	132	11.9	N					191	176	1.1	Y
City - Outbound	2097	2206	2.3	Y	266	175	6.1	Y					154	140	1.2	Y
North - Inbound									2179	2226	1.0	Y	118	101	1.7	Y
North - Outbound									1211	1207	0.1	Y	34	91	7.2	Y
South East - Inbound	978	1407	12.4	N	129	118	1.0	Y					148	134	1.1	Y
South East - Outbound	682	791	4.0	Y	95	83	1.3	Y					155	126	2.4	Y
South West - Inbound	1860	1731	3.1	Y	166	206	2.9	Y					62	83	2.4	Y
South West - Outbound	2128	1752	8.5	N	143	154	1.0	Y					59	72	1.7	Y
South East Outer - Inbound									1823	1698	3.0	Y	21	19	0.4	Y
South East Outer - Outbound	255	347	5.3	Y	61	38	3.4	Y					22	35	2.3	Y
Ring Road - Inbound	2537	2557	0.4	Y	250	288	2.3	Y					348	203	8.7	N
Ring Road - Outbound	2909	2956	0.9	Y	360	285	4.2	Y					268	239	1.8	Y

Inter Peak

SCREENLINE	CAR				LGV				CAR + LGV				HGV			
	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB
City - Inbound	504	544	1.7	Y	68	59	1.1	Y					107	106	0.1	Y
City - Outbound	961	1691	20.0	N	155	146	0.7	Y					81	98	1.8	Y
North - Inbound									801	821	0.7	Y	7	9	0.9	Y
North - Outbound									828	860	1.1	Y	37	7	6.4	Y
South East - Inbound	1188	1000	5.7	N	88	95	0.7	Y					88	129	3.9	Y
South East - Outbound	680	1117	14.6	N	93	96	0.3	Y					113	114	0.2	Y
South West - Inbound	2548	2251	6.1	Y	189	212	1.6	Y					68	109	4.4	Y
South West - Outbound	2147	2203	1.2	Y	205	218	0.9	Y					56	149	9.1	Y
South East Outer - Inbound	140	130	0.9	Y	29	0	7.5	Y					1	4	1.8	Y
South East Outer - Outbound	97	148	4.6	Y	42	0	9.1	Y					4	5	0.8	Y
Ring Road - Inbound	1864	1490	9.1	N	118	165	4.0	Y					219	222	0.2	Y
Ring Road - Outbound	1845	1680	3.9	Y	165	193	2.1	Y					149	161	1.0	Y

Evening Peak

SCREENLINE	CAR				LGV				CAR + LGV				HGV			
	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB	Mod	Obs	GEH	DMRB
City - Inbound	2154	1909	5.4	Y	177	63	10.4	N					44	42	0.4	Y
City - Outbound	2800	2846	0.9	Y	232	84	11.8	N					25	33	1.6	Y
North - Inbound								Y	970	1023	1.7	Y	12	9	0.9	Y
North - Outbound								Y	1652	1690	0.9	Y	18	15	0.8	Y
South East - Inbound	1074	927	4.6	N	78	41	4.9	Y					39	41	0.4	Y
South East - Outbound	1527	1388	3.6	Y	56	50	0.9	Y					70	85	1.7	Y
South West - Inbound	1346	2034	16.7	N	143	120	1.9	Y					77	70	0.8	Y
South West - Outbound	2922	2777	2.7	Y	128	159	2.6	Y					18	140	13.8	N
South East Outer - Inbound	2351	2286	1.4	Y	60	40	2.9	Y					4	2	1.2	Y
South East Outer - Outbound	2077	2141	1.4	Y	32	38	0.9	Y					4	1	1.9	Y
Ring Road - Inbound	4126	3807	5.1	Y	179	97	7.0	Y					6	3	1.4	Y
Ring Road - Outbound	4236	3960	4.3	Y	124	171	3.9	Y					6	3	1.4	Y