

Lower Thames Crossing

9.15 Localised Traffic Modelling Appendix E - Thurrock East-West VISSIM Local Model Validation Report

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9.15 Localised Traffic Modelling Appendix E - Thurrock East-West VISSIM Local Model Validation Report

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1 Introduction

1.1 Purpose of document

- 1.1.1 The purpose of this document is to present the local VISSIM model validation report for the local road network in Thurrock, south of the A13, extending from the Stifford interchange to west of the Orsett Cock junction in the east/west direction and from the A13 to Marshfoot roundabout in the north/south direction.

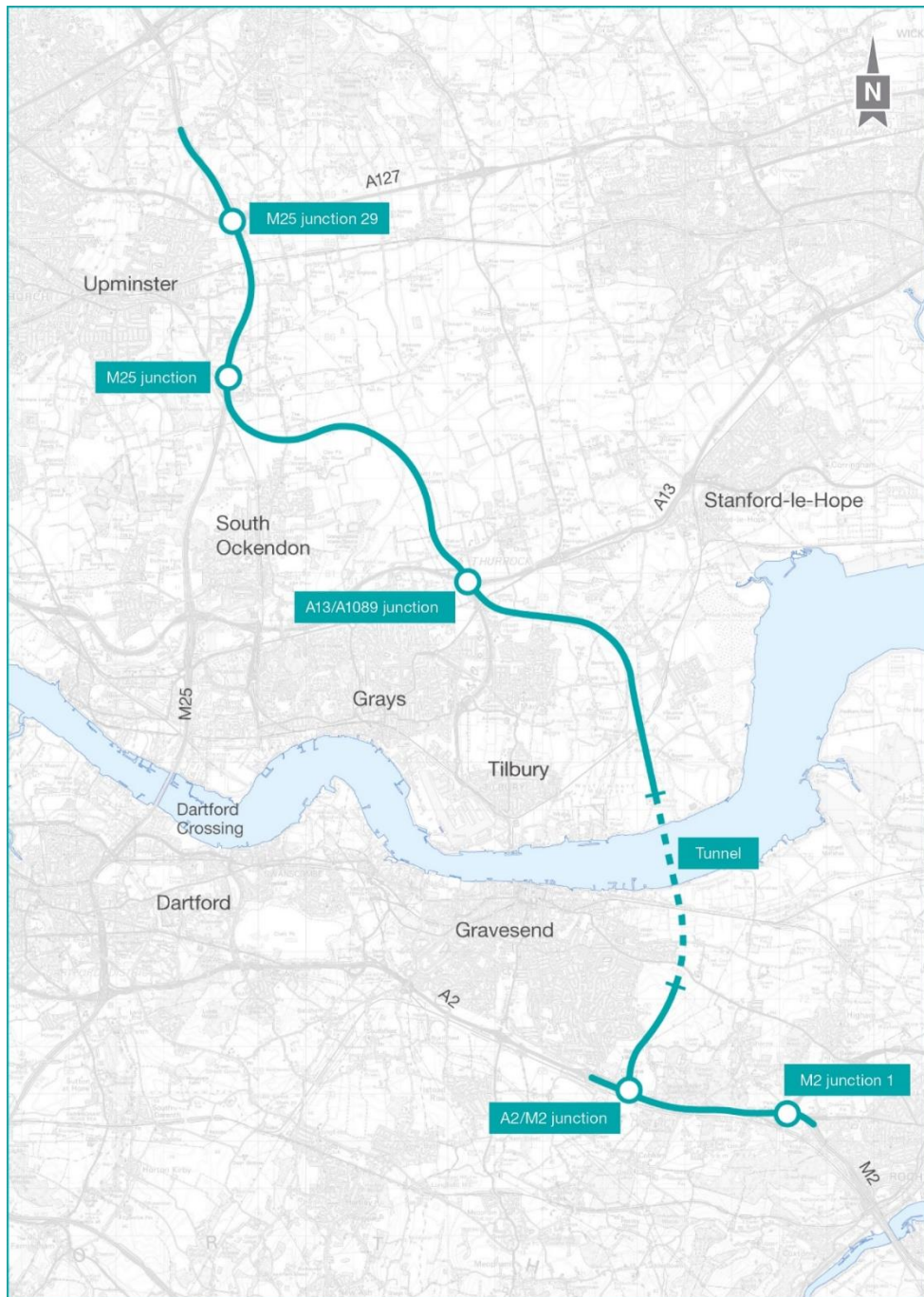
1.2 Modelling software

- 1.2.1 Road traffic micro-simulation models represent individual vehicles travelling within the road network, providing realistic driver behaviour such as lane changing and overtaking. The micro-simulation software selected for the Lower Thames Crossing is VISSIM. The model has been developed in VISSIM version 2020 (SP13).

1.3 The Project

- 1.3.1 The A122 Lower Thames Crossing (the Project) would provide a connection between the A2 and M2 in Kent, south-east of Gravesend, crossing under the River Thames through a tunnel, before joining the M25 south of junction 29. The Project route is presented in Plate 1.1.

Plate 1.1 Lower Thames Crossing route



- 1.3.2 The A122 would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13, M25 junction 29 and the M25 south of junction 29. The tunnel entrances would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.
- 1.3.3 Junctions are proposed at the following locations:
- New junction with the A2 to the south-east of Gravesend
 - Modified junction with the A13/A1089 in Thurrock

- c. New junction with the M25 between junctions 29 and 30
- 1.3.4 To align with NPSNN policy and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied in line with the Dartford Crossing. Vehicles would be charged for using the new tunnel.
- 1.3.5 The Project route would be three lanes in both directions, except for:
 - a. link roads
 - b. stretches of the carriageway through junctions
 - c. the southbound carriageway from the M25 to the junction with the A13/A1089, which would be two lanes
- 1.3.6 In common with most A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. The A122 design outside of the tunnel would include emergency areas. The tunnel would include a range of enhanced systems and response measures instead of emergency areas.
- 1.3.7 The A122 would be classified as an 'all-purpose trunk road' with green signs. For safety reasons, walkers, cyclists, horse-riders and slow-moving vehicles would be prohibited from using it.
- 1.3.8 The Project would include adjustment to a number of local roads. There would also be changes to a number of public rights of way, used by walkers, cyclists and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities, including gas mains, overhead electricity powerlines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.
- 1.3.9 The Project has been developed to avoid or minimise significant effects on the environment. Some of the measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

1.4 Structure of this report

- 1.4.1 The report summarises the methodology of the modelling process including:
 - a. Chapter 2: Study area justification;
 - a. Chapter 3: Traffic data analysis;
 - b. Chapter 4: Technical guidelines;
 - c. Chapter 5: VISSIM model calibration;
 - d. Chapter 6: Model validation results; and
 - e. Chapter 7: Conclusion.

2 Study area justification

2.1 Study area

2.1.1 The study area is located on the north-east part of Grays, south of the A13 and as drawn in Plate 2.1, covering 15 key junctions and four signalised pedestrian crossings.

Plate 2.1 Traffic Operations Study Area



2.1.2 The list of junctions included in the model is shown in Table 2.1, as well as the description of the junction type and the data source, while Table 2.2 lists the standalone signalised pedestrian crossings.

Table 2.1 Main Junctions and Source of Data

Nr	Junction	Date	Data	Junction Type
1	A13 / A1012 / Stifford Clays Rd / High Rd	17.05.2018	Automatic Number Plate Recognition (ANPR)	Priority Roundabout
2	Treacle Mine Roundabout	17.05.2018	Classified Turning Counts (CTC)	Signalised Roundabout
3	Lodge Lane / Nutberry Ave	17.05.2018	CTC	Priority
4	Lodge Lane / Hathaway Rd	17.05.2018	CTC	Signalised
5	Lodge Lane / Connaught Ave	17.05.2018	CTC	Priority
6	Lodge Lane / Victoria Ave	17.05.2018	CTC	Priority
7	Lodge Rd / Southend Rd	17.05.2018	CTC	Signalised
8	Daneholes Roundabout	17.05.2018	CTC	Priority Roundabout
9	A1013 Stanford Rd / King Edward Drive	17.05.2018	CTC	Priority
10	A1013 Stanford Rd / B188 Baker St / Heath Rd	17.05.2018	CTC	Priority
11	A1013 Stanford Rd / Rectory Rd	17.05.2018	CTC	Priority
12	Old Dock Approach Rd / Marshfoot Rd	17.05.2018	CTC	Priority Roundabout
13	Marshfoot Rd / Slip Rd	17.05.2018	CTC	Priority
14	Marshfoot Rd / B149 Chadwell Bypass / Chadwell Hill	2016	SATURN	Priority Roundabout
15	Chadwell Hill / Brentwood Rd / Linford Rd	2016	SATURN	Signalised

Table 2.2 Signalised Pedestrian Crossings

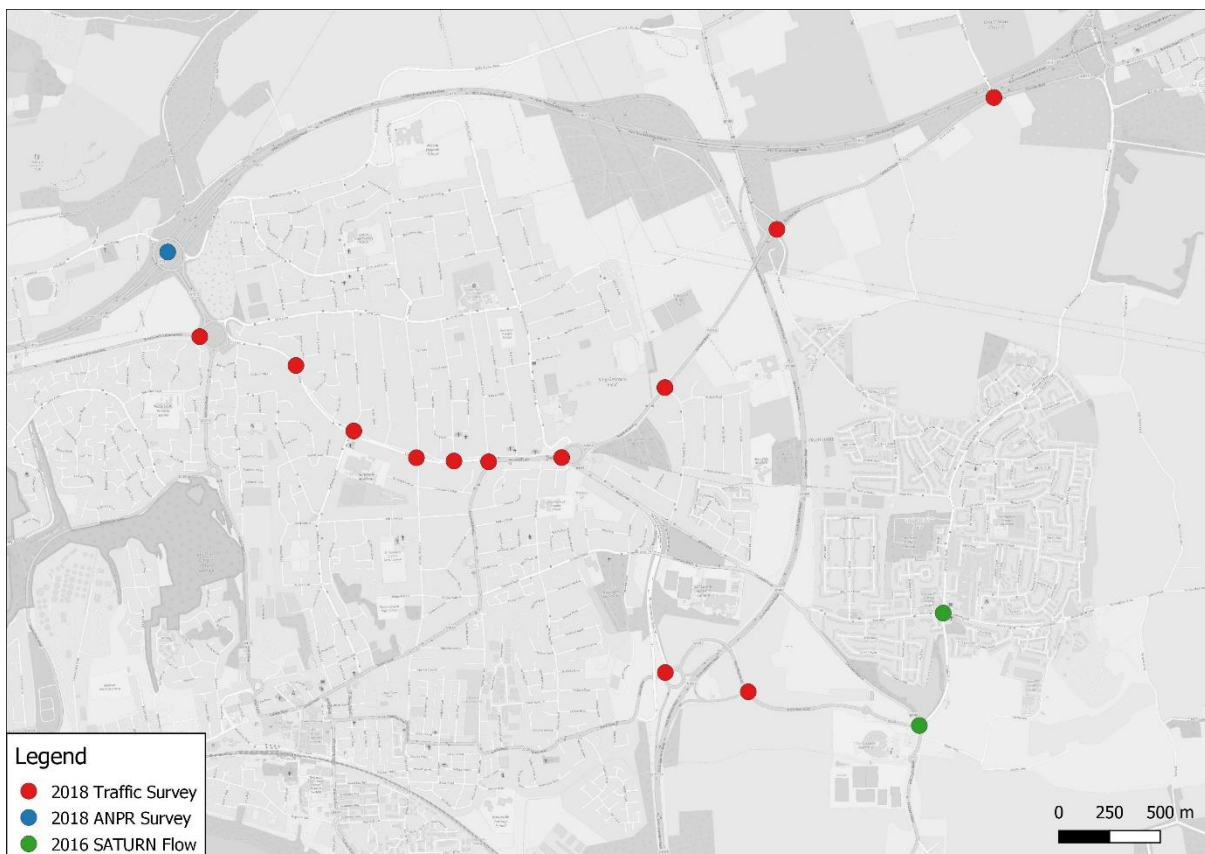
A	Pedestrian Crossings West of Daneholes Roundabout
B	Pedestrian Crossings East of Daneholes Roundabout
C	Pedestrian Crossing at A126 Marshfoot Road
D	Pedestrian Crossing at B149

3 Traffic data analysis

3.1 Traffic data collection

- 3.1.1 The traffic demand for the Thurrock East-West model was based on Manual Classified Junction Counts (MCJC) from 17 May 2018 (Thursday). The data was segregated by vehicle type – into Car, Light Goods Vehicle (LGV) and Heavy Goods Vehicle (HGV).
- 3.1.2 The traffic demand for A13 / A1012 / High Road / Stifford Clays Road roundabout was based upon the ANPR Euro Class Report data from 17 May 2018 (Thursday). The data was also segregated by vehicle type into Car, LGV and HGV.
- 3.1.3 The traffic demand for B149 / Marshfoot Road / St Chads Road / Chadwell Hill was based on the 2016 base year outputs from the Project's transport model (the Lower Thames Area Model (LTAM) (LR_N108R1_2016)) for the modelled morning peak hour (07.00 - 08.00) and the evening peak hour (17.00 - 18.00).
- 3.1.4 Plate 3.1 shows the location of the traffic data, as described above.

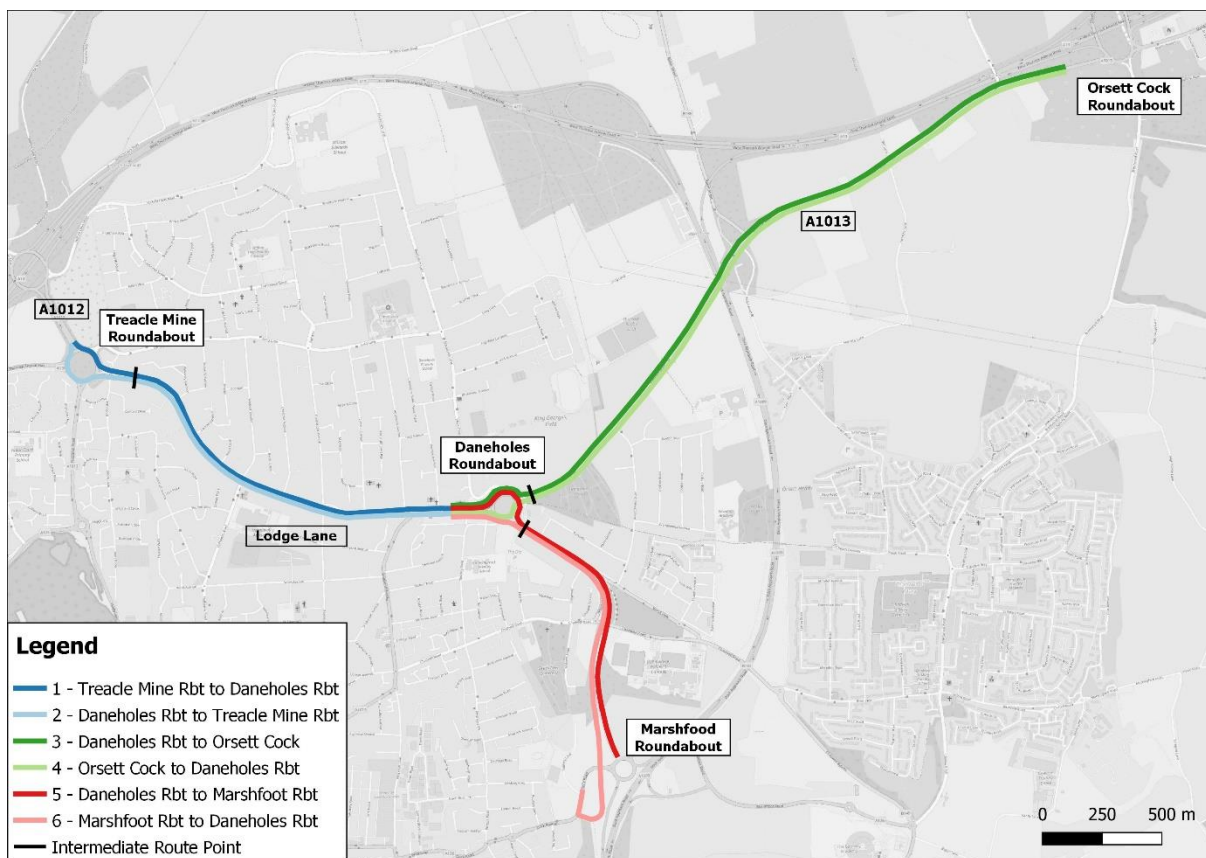
Plate 3.1 Traffic Count Locations



3.2 Journey time data

- 3.2.1 The journey time data used for the model validation was extracted from the ANPR data for Thursday, 17 May 2018.
- 3.2.2 The journey time routes cover the 3 main corridors of the model: Lodge Lane, A1013 Stanford Road and Old Dock Approach. There are six routes in total as shown in Plate 3.2, each route split in two shorter sections at the intermediate points also shown in Plate 3.2.
- 3.2.3 While the total route journey times were used for the model validation, the individual sections were also examined to make sure there is a good match between the observed and modelled journey times along each route, ensuring that the delays are replicated at the appropriate locations.

Plate 3.2 Journey Time Routes



3.2.4 Table 3.1, Table 3.2 and Table 3.3 show the observed journey times in the AM Peak 07:00-08:00 (AM1) and 08:00-09:00 (AM2), and the PM Peak 17.00-18.00 respectively.

Table 3.1 Observed Journey Times AM1

Peak	Route	Name	Distance [m]	JT [s]	Average Speed [mph]
AM 07:00-08:00	1	Treacle Mine Rbt to Daneholes Rbt	1859	185	22.5
	2	Daneholes Rbt to Treacle Mine Rbt	1977	264	16.8
	3	Daneholes Rbt to Orsett Cock	3300	193	38.4
	4	Orsett Cock to Daneholes Rbt	3326	219	33.9
	5	Daneholes Rbt to Marshfoot Rbt	1591	95	37.6
	6	Marshfoot Rbt to Daneholes Rbt	1889	142	29.8

Table 3.2 Observed Journey Times AM2

Peak	Route	Name	Distance [m]	JT [s]	Average Speed [mph]
AM 08:00-09:00	1	Treacle Mine Rbt to Daneholes Rbt	1859	191	21.8
	2	Daneholes Rbt to Treacle Mine Rbt	1977	289	15.3
	3	Daneholes Rbt to Orsett Cock	3300	205	35.9
	4	Orsett Cock to Daneholes Rbt	3326	233	31.9
	5	Daneholes Rbt to Marshfoot Rbt	1591	112	31.9
	6	Marshfoot Rbt to Daneholes Rbt	1889	139	30.3

Table 3.3 Observed Journey Times PM

Peak	Route	Name	Distance [m]	JT [s]	Average Speed [mph]
PM 17:00-18:00	1	Treacle Mine Rbt to Daneholes Rbt	1859	220	18.9
	2	Daneholes Rbt to Treacle Mine Rbt	1977	259	17.1
	3	Daneholes Rbt to Orsett Cock	3300	211	34.9
	4	Orsett Cock to Daneholes Rbt	3326	227	32.8
	5	Daneholes Rbt to Marshfoot Rbt	1591	103	34.5
	6	Marshfoot Rbt to Daneholes Rbt	1889	140	30.3

4 Technical guidelines

- 4.1.1 The traffic modelling on the Lower Thames Crossing project complies with the requirements set out in National Highways' technical documentation and DfT Transport Appraisal Guidance (TAG). Guidance on methodology and reporting relevant for micro-simulation models can be found in the following documents:
- a. Design Manual for Roads and Bridges (DMRB).
 - b. Guidelines for the Use of Microsimulation Software, Highways Agency (now withdrawn).
- 4.1.2 A new issue of the DMRB was released early 2020. The new issue of the DMRB no longer includes the Traffic Appraisal of Roads Schemes (Volume 12). Instead, most of the guidance is now available in TAG.
- 4.1.3 TAG has little guidance specific to microsimulation models and the key chapters in the previous DMRB date from the early 1990s. Therefore, in accordance with industry best practice, this document references the Transport for London (TfL) modelling guidelines which cover microsimulation models, in particular:
- a. Traffic Modelling Guidelines, TfL, Version 4.0 (September 2021); and
 - b. Model Auditing Process (MAP) – Traffic Schemes in London Urban Network, TfL, Version 3.5 (March 2017).

5 VISSIM model calibration

5.1 Flow profile & peak hour identification

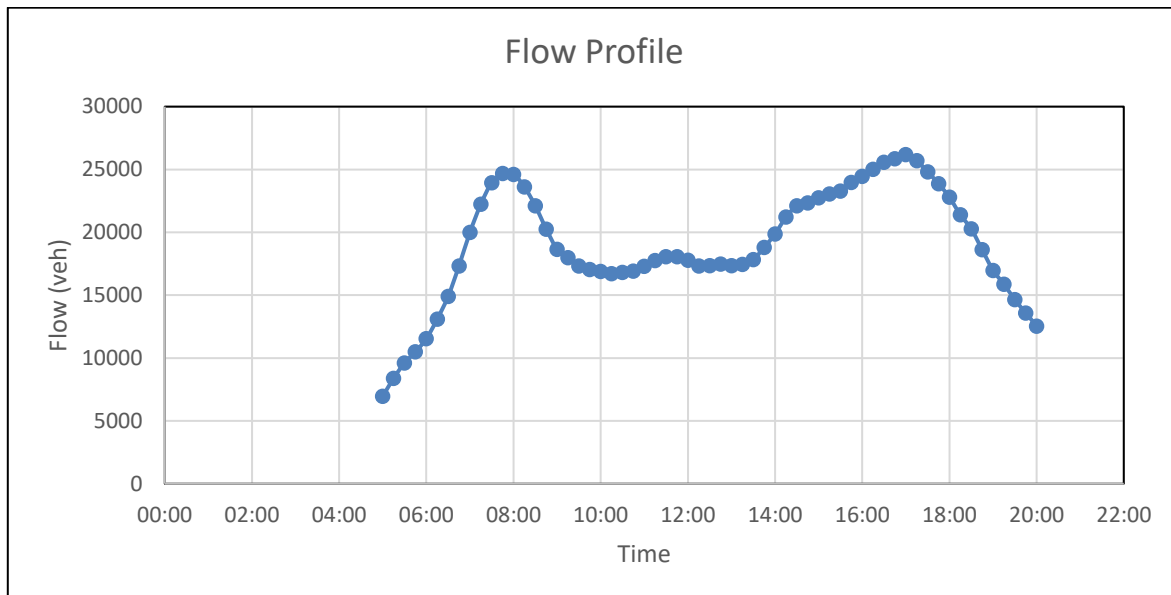
- 5.1.1 An analysis (summation of the turning counts at all surveyed junctions) of all observed traffic volume was undertaken to determine the hour with the busiest total traffic flows for each peak period. The analysis of the 2018 MCJC data, illustrated in Table 5.1 and Plate 5.1, shows that the busiest hours are 08:00 to 09:00 for the AM peak and 17:00 to 18:00 for the PM peak. The Traffic Flow diagrams are provided in Appendix A.
- 5.1.2 Based on the wider strategic road network, the AM peak is from 7:00 to 8:00. The LTAM uses this peak period in the AM as the model includes many SRN corridors with high traffic volumes. The traffic data analysed for the development of the Thurrock East-West VISSIM model is mainly for the local road network, where the AM peak is later. These results indicate there is a difference in the time of the AM peak between the strategic and local road network. For this reason, both hours are included in the model, extending the AM Peak from 7:00 to 9:00.
- 5.1.3 The derivation of the model peak hours are shown in Table 5.1, calculated from the May 2018 MCJC covering the area shown in Plate 3.1. The morning peak period has been modelled as a two-hour period 07:00-08:00 and 08:00 - 09:00, while the evening peak as single hour peak from 17.00 to 18.00.

Table 5.1 AM / PM Peak Hour Analysis

Hour starting	Total flows	Peak hour
6:00:00	11,537	
7:00:00	19,995	AM
8:00:00	24,615	AM
9:00:00	18,661	
10:00:00	16,897	
11:00:00	17,297	
12:00:00	17,784	
13:00:00	17,355	
14:00:00	19,871	
15:00:00	22,758	
16:00:00	24,449	
17:00:00	26,179	PM
18:00:00	22,795	

- 5.1.4 The graph of the flow profile from the data in Table 5.1 is shown in Plate 5.1. Based on this, the AM Peak is clearly defined at 08:00 based on the local road network traffic data, but the model is extended from 07:00 to 09:00 for the reasons explained above.

Plate 5.1 Journey Time Routes



- 5.1.5 The May 2018 base model was developed for the following time periods:
- AM peak weekday (7:00 to 9:00); and
 - PM peak weekday (17:00 to 18:00).
- 5.1.6 A 30-minute pre-load and cool-down period have been included at both ends of each modelling period.

5.2 Network

- 5.2.1 Link structure, including link lengths, connector turning movements, bus lanes and bus stop locations were coded using OS mapping provided by Thurrock Council and online mapping.
- 5.2.2 Reduced speed areas were set up on all turning movements, with tighter turns having lower reduced speed values. Desired speed decisions were used to set desired speeds on entry to the network and where there is a change in the posted speed limit. Vehicles attempt to travel in the model at this constant desired speed and will only adjust this speed if they approach a queue or are performing a lane change.
- 5.2.3 Priority rules have been used where one traffic movement has to give way to another traffic movement at priority junctions. The default values of a five-metre headway and three second gap time were used. Gap time and headway values were reviewed and updated as part of the model calibration process to replicate conditions on site and these were then adjusted based upon considerations of geometry, position and the types of vehicles stopping. The gap times for heavy vehicles (bus and HGV) are longer than for light vehicles. This reflects the fact that large vehicles have to wait for larger gaps in traffic than cars.

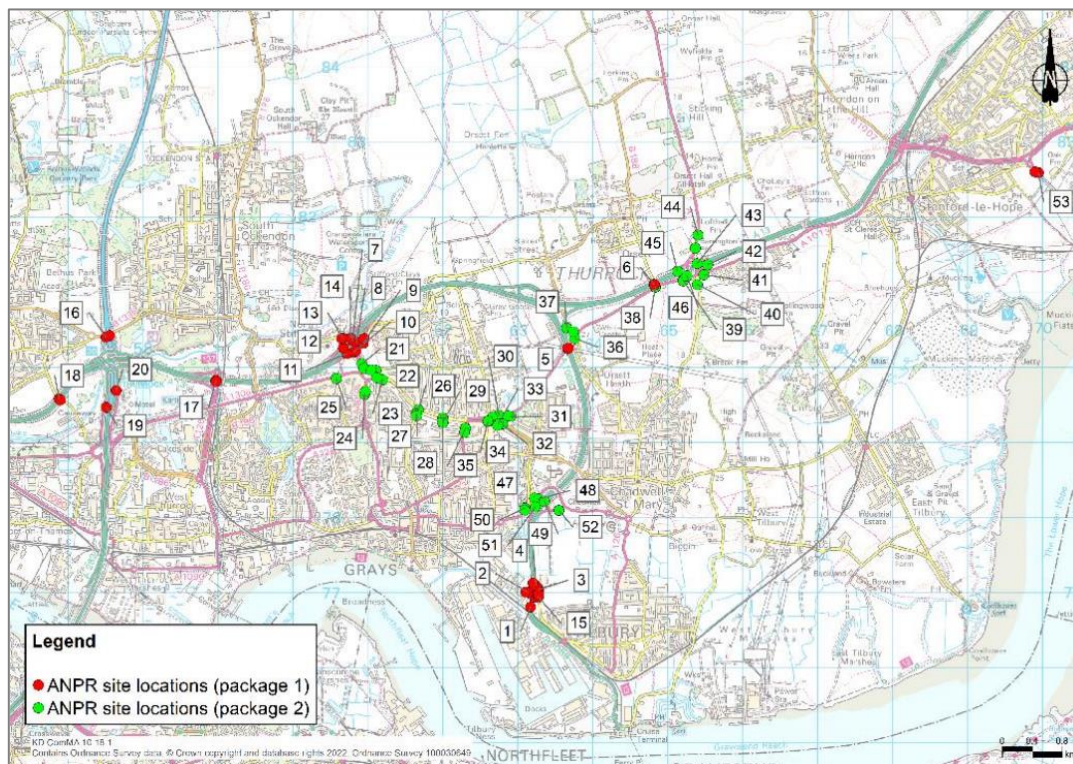
5.3 Signalised junctions and crossings

- 5.3.1 All signals within the VISSIM base models were coded using Vehicle Actuated Programming (VAP) control. All relevant PUA (interstage) files and VAP (controller logic) files accompany the VISSIM models.
- 5.3.2 Base model signal timings, intergreens and phase delays were taken from the corresponding signal plans and timing sheets supplied by Thurrock.
- 5.3.3 There are five signalised junctions (Table 2.1, Table 2.2) in the study area and five signalised pedestrian crossings, which are illustrated in Plate 2.1.

5.4 Traffic demand matrices

- 5.4.1 The model contains three vehicle classes:
 - a. Cars;
 - b. LGVs;
 - c. HGVs.
- 5.4.2 The hourly base model matrices for Cars, LGVs and HGVs were prepared using the available traffic counts and input from the May 2018 ANPR surveys of the area.
- 5.4.3 The ANPR surveys were undertaken in two packages. Package 1 surveys were scheduled between Wednesday 16 May 2018 and Sunday 20 May 2018 for 24 hours a day. Package 2 surveys were scheduled between Wednesday 16 May 2018 and Thursday 17 May 2018 between 05:00 and 21:00. The surveys cover a wider area than the model as shown in Plate 5.2.

Plate 5.2 ANPR Site Locations



- 5.4.4 Sites 7 to 14 were used to inform the Stifford interchange prior matrix, while sites 21 to 39 and sites 47 to 52 were used to inform the prior matrix for the rest of the model. The two matrices were subsequently combined into one, with relevant assumptions made to distribute traffic from site 21 to site 10. Appropriate adjustments were also introduced to the origin destination (OD) pairs that were directly known from the MCC data, producing the prior matrix used for the matrix estimation process.
- 5.4.5 The prior matrix was then finessed against the observed origin and destination totals, as indicated by the 2018 MCJC data. For the model area east of Marshfoot roundabout, that is not covered by any of the ANPR surveys, traffic was distributed proportionally to the junctions' turning movements as modelled in the LTAM. Appropriate adjustments were made to remove any minor flow discrepancies between the 2018 observed flows and 2016 LTAM flows.
- 5.4.6 This process produced the post matrix estimation matrix, which was used for the initial model runs and flow calibration. An iterative process then took place, aiming to improve the model's flow calibration. Appropriate manual adjustments based on engineering judgement were implemented to the matrix, which led to the final matrix for each vehicle class and for each peak hour.
- 5.4.7 The zoning system of the model consists of 31 zones, as shown in Plate 5.3.

Plate 5.3 Thurrock East - West VISSIM Model Zoning System



5.5 Public transport

5.5.1 The following bus routes have been included in the model:

- a. 66
- b. Z1
- c. 269
- d. 5X
- e. 88
- f. 73
- g. Z2
- h. 475
- i. 11
- j. 77
- k. Z4
- l. 5A
- m. 100
- n. 83
- o. 51
- p. 5B
- q. 27

5.5.2 Bus routes were coded separately from general traffic. They were coded using the VISSIM public transport lines feature, with a public transport line set up for each bus route. Bus route and frequency information was derived from publicly available bus timetable information. For all bus routes and bus stops, a dwell time of 10 seconds with a two second standard deviation has been modelled.

5.5.3 A summary of the modelled bus routes and their frequency is presented in Table 5.2.

Table 5.2 Modelled Bus Routes and Frequency

Bus Route	AM (07:00 – 08:00)	AM (08:00 – 09:00)	PM (17:00 – 18:00)
66	2 per hour	2 per hour	2 per hour
73 (EB)	2 per hour	3 per hour	1 per hour
73 (WB)	3 per hour	4 per hour	2 per hour
77 (EB)	1 per hour	0	1 per hour
77 (WB)	3 per hour	0	0
83 (EB)	2 per hour	2 per hour	1 per hour
83 (WB)	2 per hour	2 per hour	2 per hour
88 (EB)	1 per hour	2 per hour	2 per hour
88 (WB)	2 per hour	2 per hour	2 per hour
Z1	1 per hour	0	1 per hour
Z2 (EB)	4 per hour	0	2 per hour
Z2 (WB)	0	1 per hour	0
Z4 (SB)	2 per hour	0	0
51	1 per hour	0	1 per hour
269 (NB)	1 per hour	0	1 per hour
475	1 per hour	0	0
5A (NB)	0	1 per hour	1 per hour
5A (SB)	1 per hour	1 per hour	1 per hour
5B (NB)	2 per hour	1 per hour	1 per hour
5B (SB)	1 per hour	1 per hour	1 per hour
5X	0	1 per hour	0
11 (WB)	0	1 per hour	0
11 (EB)	0	1 per hour	0
100 (WB)	4 per hour	3 per hour	3 per hour
100 (EB)	3 per hour	3 per hour	3 per hour
27	1 per hour	0	0

5.5.4 The bus routes 5X, 475, Z4, 11 and 27 were excluded from PM peak model as they do not run during that hour.

5.6 Traffic assignment

- 5.6.1 The traffic is assigned using 'static assignment'. Static Origin-Destination (OD) routes are used to connect all zones in the model area. As there is no route choice in the model, each OD pair has a unique route.
- 5.6.2 This means that the 31x31 matrix that was produced as described in section 5.5 is converted into a list of 961 routes. This allows better control of lane allocation at the roundabouts and minimises the modelling processing time compared to the alternative assignment method (dynamic assignment) that also requires additional time to achieve model convergence.

5.7 Number of random seed records

- 5.7.1 Traffic conditions on the road are variable and this affects:
- a. **Overall traffic volumes**, accounted for in VISSIM by selecting a representative peak hour.
 - b. **Traffic flow profiles**, corresponding to the variation in short-term flow rate within a modelled period, accounted for in VISSIM by profiling the traffic inputs into 15 minutes time periods; and
 - c. **Random Driver Behaviours**, Traffic conditions vary day-to-day as a result of random driver behaviours such as speed selection, lane changing, route choice and bus dwell times. The stochastic microsimulation traffic model in VISSIM attempts to replicate this day-to-day random variability by altering individual driver decisions based on random numbers. The set of random numbers is generated from an initial 'seed' value specified at the start of a simulation run. A single set of random numbers, generated by a single seed value, therefore represents one potential outcome, or one particular day of traffic operation. The actual value of the seed has no significance; however, the seeds for different runs must be different from each other in order to produce different outcomes. Based on UK modelling guidelines, the recommended number of random seed runs is:
 - i. A minimum of 20 (TfL Traffic Modelling Guidelines, Version 4.0)
 - ii. Typically recommended being 10 (Section 5.5.2 - Guidelines for the Use of Microsimulation Software, Highways Agency).
- 5.7.2 The number of runs specified in the guidelines is indicative and the number of random seeds should be set based on the variability of the travel time results.
- 5.7.3 Model outputs based on 20 runs with different random seeds were considered adequate for the Thurrock East - West VISSIM model. This is also consistent with the other VISSIM models developed for the Project.

6 Model validation results

6.1 Traffic flow validation

- 6.1.1 For the calibration process, each model time period was run 20 times with 20 different random seeds. This method is representative of the variation that is observed on a day-to-day basis. The final model output data used in the calibration tables are the averages of all 20 seed runs, and this has been compared against observed data.
- 6.1.2 The purpose of the traffic flow comparison process is to verify whether the total flows and traffic movements generated by the model are comparable with the surveyed flows.
- 6.1.3 For VISSIM, Traffic Modelling Guidelines from TfL recommends the use of the GEH statistic to demonstrate that traffic flows within the model match counts to an acceptable level of accuracy. The GEH statistic gives greater weighting to higher flows, highlighting differences that are more significant. This statistic is a derivative of the Chi-squared statistic, and is defined as:

$$GEH = \sqrt{\frac{(M - C)^2}{(M + C)/2}}$$

where: GEH is the GEH statistic;
M is the modelled flow; and
C is the observed flow.

- 6.1.4 Modelled flows should be averaged over multiple seeds. It is recommended that GEH statistic should be:
- Less than 5 for at least 85% of turns/ links; and
 - Less than 3 for all important/critical links.
- 6.1.5 TAG also recommends that modelled link flows should:
- Be within 100 vehicles per hour of observed flows, where those observed flows are less than 700 vehicles per hour;
 - Be within 15% of observed flows where those observed flows are between 700 vehicles per hour and 2,700 vehicles per hour; and
 - Be within 400 vehicles per hour of observed flows where those observed flows are greater than 2,700 vehicles per hour.
- 6.1.6 The modelled flows are extracted from VISSIM using Node Evaluation for turns and data collection points on links. They are separated by vehicle type.
- 6.1.7 Plate 6.1 provides a summary of the percentage of movements meeting the above criteria and it demonstrates that all turning movements in the model pass the required calibration thresholds and therefore meet the calibration criteria.

Appendix B provides a more detailed summary of the calibration status of each turning movement.

Plate 6.1 GEH Flow Calibration

Peak	Number of Counts	% of movements within a GEH<5	% Satisfying TAG Flow Criteria
AM 7.00 - 8.00	160	100%	100%
AM 8.00 - 9.00	160	100%	100%
PM 17.00 - 18.00	160	100%	100%

6.1.8 The results show that 100% of AM and PM turning counts have GEH < 5 and for all peaks the TAG Flow Criteria are met.

6.2 Journey time validation

6.2.1 Validation of the Thurrock East - West VISSIM model was also carried out following TAG and TfL's Traffic modelling guidelines for journey times.

6.2.2 For the validation process, each model time period was run 20 times with 20 different random seeds. The final journey time output data used in the validation tables are the averages of all 20 seed runs.

6.2.3 For VISSIM TfL's Modelling Guidelines and TAG it is recommended that modelled journey times should be within 15% of surveyed values or within one minute for routes longer than 3km.

6.2.4 Journey time measurements have been undertaken within the models along the same route sections as those extracted from the ANPR data. Table 6.1 summarises the journey time validation. The table shows that journey times in the AM and PM, when compared with ANPR data, satisfy the validation criteria of validating to within 15% or 1 minute of observed values for 85% of routes – 100% of routes achieved the validation criteria. The one minute criterion was applied only for routes longer than 3km.

6.2.5 Tables showing the full journey time validation for each route are shown in Appendix C.

6.2.6 More detailed journey time results, with each route broken down into a number of timing points along each route and presented in the form of cumulative distance and time graphs, are provided in Appendix D.

Table 6.1 Journey Time Summary Table

Peak	Validation (all routes)	Validation (all routes)	Validation (>3km only)	Average Speed [mph]	
	<15% or <1min	<15%	<1min	Observed	Modelled
AM 07:00-08:00	100%	100%	100%	29.8	28.7
AM 08:00-09:00	100%	100%	100%	27.9	27.1
PM 17:00-18:00	100%	100%	100%	28.1	27.2

- 6.2.7 The graphs contained in Appendix D show a graphical comparison between ANPR Data and modelled VISSIM travel time results. Each graph shows the 'error bar' within 15% up and down of the observed value.
- 6.2.8 For both AM (07:00 – 08:00 and 08:00 – 09:00) and for PM (17:00 – 18:00) hours, all routes validated within the 15% or one minute threshold.
- 6.2.9 Overall, the journey time validation demonstrates a good match against the observed data and the model is considered to provide a good representation of traffic conditions in 2018.

6.3 Queue length analysis

- 6.3.1 Queue length is not a validation criterion for VISSIM due to the subjective nature of queue measurement, but the models have been visually sense-checked to ensure that the model is accurately reflecting location-specific delays and capacity bottlenecks. This was further confirmed by breaking down the journey time routes in shorter segments, as shown in Appendix D and the relative delay plots in Appendix E, ensuring the location-specific delays are replicated accurately.

6.4 Error logs

- 6.4.1 Following a review of the error log files no significant errors were identified.

6.5 Network performance

- 6.5.1 In addition to the flow calibration and journey time validation results, some general statistics are also provided. These are not part of the calibration/validation process but supply some general metrics about the network performance and are a good baseline to compare against when evaluating the future year models. Table 6.2 summarises the network performance statistics for the modelled network.

Table 6.2 Network Performance Statistics

	AM (7-8)	AM (8-9)	PM (17-18)
Average Delay [sec]	47	70	70
Average Stops	1	1	3
Average Speed [km/h]	53.1	44.7	46.2
Total Distance [km]	41,200	43,670	48,609
Total Travel Time [hr]	776	976	1052
Total Vehicles [veh]	16,366	18,223	19,505
Latent Delay [hr]	1	4	31
Latent Demand [veh]	2	5	83

- 6.5.2 Table 6.2 indicates that in the second AM peak hour, the average delay is the same as in the PM peak hour and the average speed is 1.5km/h slower. The first AM Peak hour is slightly less congested than the PM peak and significantly less congested than the second AM peak hour, which is expected as based on the flow profile analysis the main morning peak on the local road network is from 08:00 to 09:00.
- 6.5.3 Latent demand is the number of vehicles not able to deploy in the network within the evaluation period because of congestion and is typically the total difference between the demand flow and the modelled flow on all the entry links. A small number of vehicles were unable to deploy in the second AM peak hour (08:00-09:00) and in the PM peak hour (17:00-18:00) and deployed in the cool down period instead, while in the first peak hour (07:00-08:00) the level of latent demand is only two vehicles. Overall, the levels of latent demand are considered negligible.

7 Conclusion

- 7.1.1 The calibration and validation processes show a good correlation between the modelled and observed traffic flows and journey times within the study area.
- 7.1.2 Considering this, and noting the limitations and constraints described in this note the models are considered fit-for-purpose in providing a robust representation of the existing situation and can be used with confidence to test the performance of the network with future traffic forecasts.

References

Transport for London (September 2021). Traffic Modelling Guidelines Version 4.0.

<https://content.tfl.gov.uk/traffic-modelling-guidelines.pdf>

Transport for London (March 2017). Model Auditing Process (MAP) Version 3.5. Engineer Guide for Design Engineer (DE), Checking Engineer (CE) and Model Auditing Engineer (MAE).

<https://content.tfl.gov.uk/map-v3-5-engineer-guide.pdf>

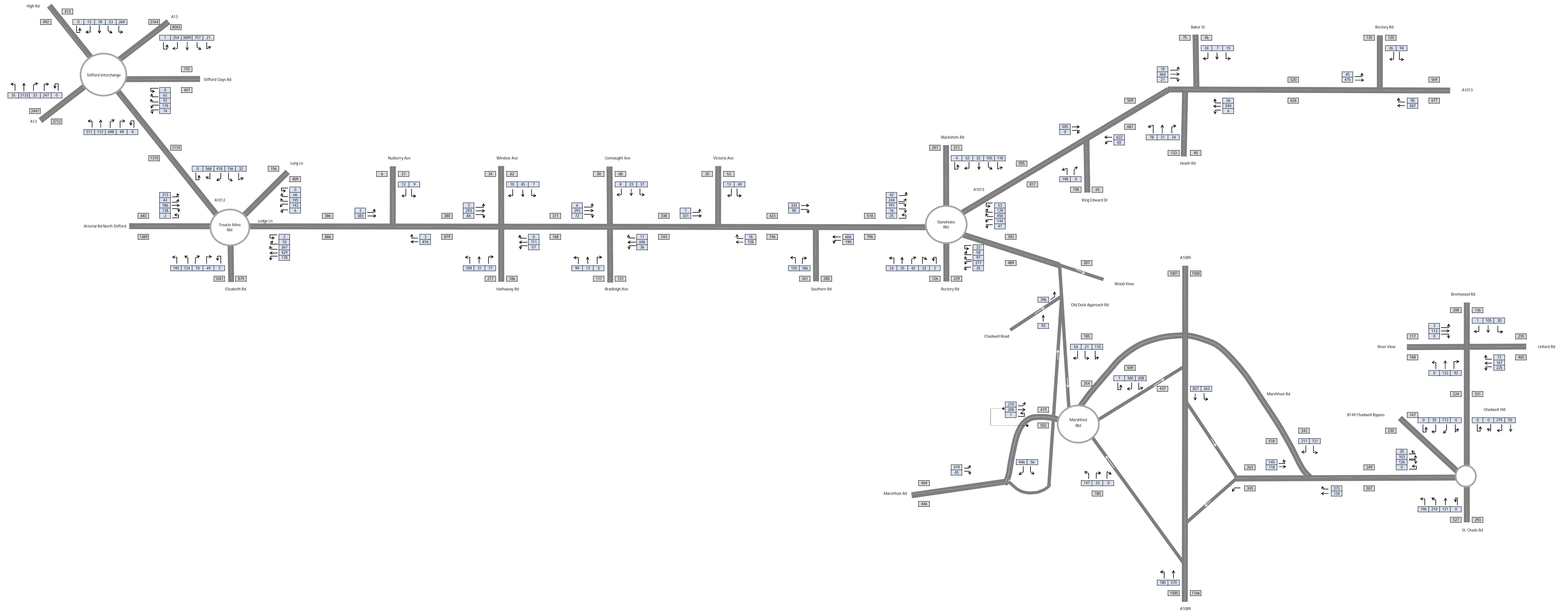
Glossary

Term	Explanation
ANPR	Automatic Number Plate Recognition
ATC	Automatic Traffic Count
DCO	Development Consent Order - Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIPs)
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges: A comprehensive manual which contains requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (National Highways, Transport Scotland, the Welsh Government or the Department for Regional Development (Northern Ireland)) is the highway authority. For the Lower Thames Crossing, the Overseeing Organisation is National Highways.
Do Minimum	A future year scenario which includes changes to the road network and planned development that is forecast to go ahead, but not the Lower Thames Crossing.
Do Something	A future year scenario which includes changes to the road network and planned development that is forecast to go ahead, and the Lower Thames Crossing.
EB	Eastbound
GEH	A formula used to compare two traffic volumes, named after its originator, Geoff E. Havers. It is similar to a chi-squared test.
HGV	Heavy Goods Vehicle
LGV	Light Goods Vehicle
LinSig	A Design and Assessment Tool for Traffic Signal Junctions and Urban Networks
LMVR	Local Model Validation Report
LTC	Lower Thames Crossing
NB	Northbound
OS	Ordnance Survey
PTV	German for Planning Transport and Traffic Software package
SATURN	Simulation and Assignment of Traffic to Urban Networks
SB	Southbound
TAG	Transport Analysis Guidance published by DfT
TfL	Transport for London - The integrated body responsible for London's transport system

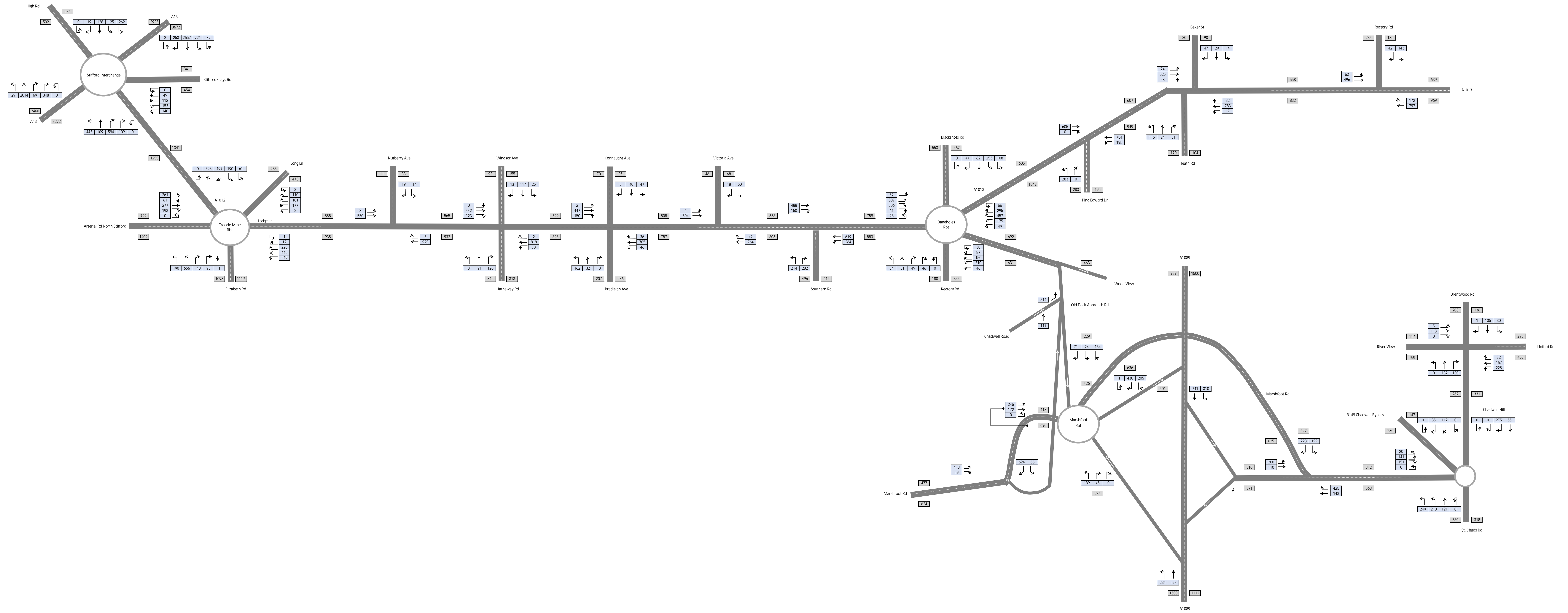
Term	Explanation
VISSIM	Micro-simulation software developed by PTV. Verkehr In Städten - SIMulationsmodell (German for "Traffic in cities - simulation model)
WB	Westbound

Appendix A Traffic flow diagrams

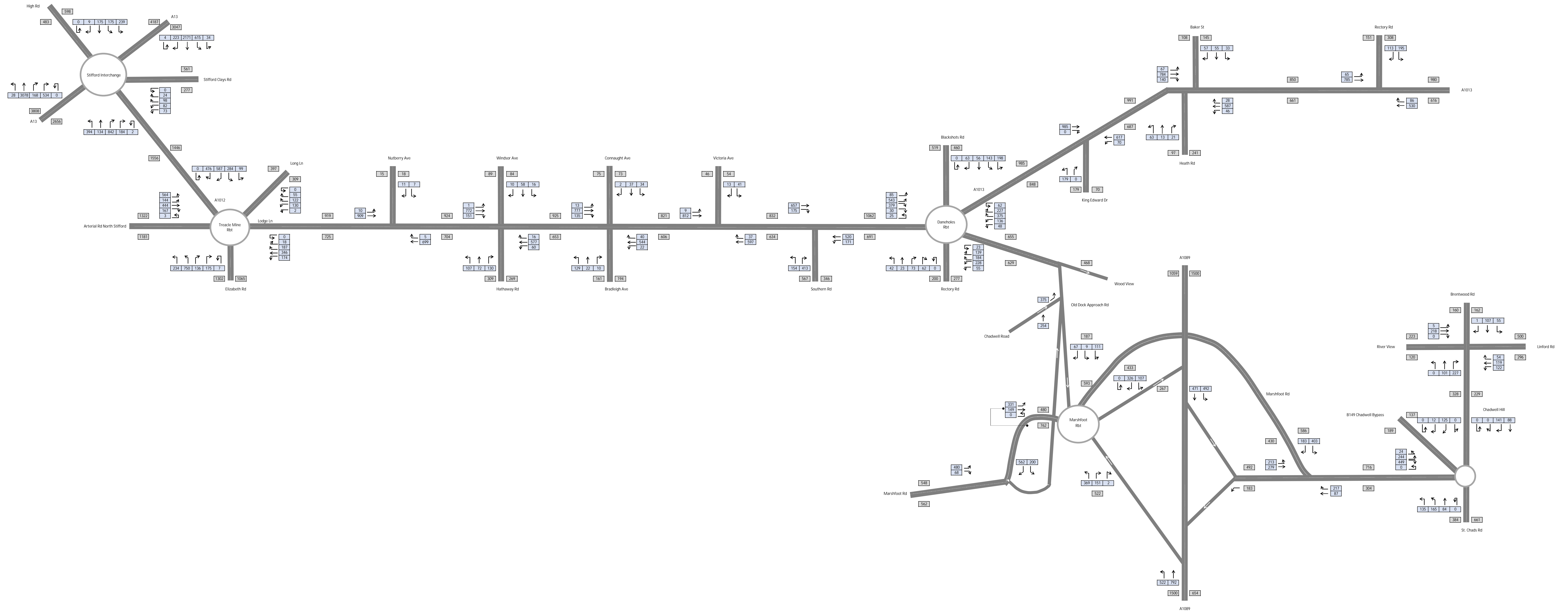
Traffic Flow Diagram AM 7-8
(All Vehicles)



Traffic Flow Diagram AM 8-9
(All Vehicles)



Traffic Flow Diagram PM 17-18
(All Vehicles)



Appendix B Traffic flow comparison

Table B.1 AM 07:00 – 08:00 Flow Comparison

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A13 / A1012 / Stifford Clays Rd / High Rd	A13 South (slip off)	High Rd	20	10	5	35	21	9	4	34	0	0	0	0	PASS
		A13 North (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Stifford Clays Rd	25	6	1	33	24	7	1	32	0	0	0	0	PASS
		A1012	196	40	11	247	194	41	10	245	0	0	0	0	PASS
		A13 South (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	High Rd	A13 North (slip on)	225	43	0	269	217	43	0	260	1	0	0	1	PASS
		Stifford Clays Rd	51	2	0	53	50	2	0	52	0	0	0	0	PASS
		A1012	71	7	0	78	73	6	0	79	0	1	0	0	PASS
		A13 South (slip on)	9	4	0	13	9	4	0	13	0	0	0	0	PASS
		High Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A13 North (slip off)	Stifford Clays Rd	14	5	3	21	11	5	2	18	1	0	0	1	PASS
		A1012	560	158	39	757	552	164	39	755	0	0	0	0	PASS
		A13 South (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		High Rd	212	34	8	254	207	33	10	250	0	0	1	0	PASS
		A13 North (slip on)	0	0	1	1	0	0	1	1	0	0	0	0	PASS
	Stifford Clays Rd	A1012	66	6	1	74	73	8	2	83	1	1	0	1	PASS
		A13 South (slip on)	147	29	2	179	143	31	1	175	0	0	1	0	PASS
		High Rd	75	16	2	92	72	15	1	88	0	0	0	0	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
		A13 North (slip on)	54	8	0	62	55	8	0	63	0	0	0	0	PASS
		Stifford Clays Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1012	A13 South (slip on)	421	80	10	511	378	79	13	470	2	0	1	2	PASS
		High Rd	103	9	0	112	97	7	0	104	1	1	0	1	PASS
		A13 North (slip on)	497	123	78	698	492	123	74	689	0	0	0	0	PASS
		Stifford Clays Rd	39	7	3	49	32	5	4	41	1	1	0	1	PASS
		A1012	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Treacle Mine Roundabout	Arterial Rd North Stifford	A1012 North	213	47	53	313	202	44	52	298	1	0	0	1	PASS
		Long Ln	39	4	1	44	34	3	1	38	1	1	0	1	PASS
		Lodge Ln	164	20	2	186	147	18	3	168	1	0	1	1	PASS
		A1012 Elizabeth Rd	103	22	13	138	95	22	12	129	1	0	0	1	PASS
		Arterial Rd North Stifford	0	2	0	2	0	2	0	2	0	0	0	0	PASS
	A1012 North	Long Ln	30	2	0	32	29	1	0	30	0	1	0	0	PASS
		Lodge Ln	129	27	0	156	126	27	0	153	0	0	0	0	PASS
		A1012 Elizabeth Rd	296	96	26	418	288	96	26	410	0	0	0	0	PASS
		Arterial Rd North Stifford	449	94	25	568	438	92	24	554	1	0	0	1	PASS
		A1012 North	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	Long Ln	Lodge Ln	6	0	0	6	14	0	0	14	3	0	0	3	PASS
		A1012 Elizabeth Rd	120	20	2	142	117	22	2	141	0	0	0	0	PASS
		Arterial Rd North Stifford	175	20	0	195	171	20	0	191	0	0	0	0	PASS
		A1012 North	57	8	1	66	55	6	1	62	0	1	0	1	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
		Long Ln	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	Lodge Ln	A1012 Elizabeth Rd	143	34	1	178	120	29	3	152	2	1	1	2	PASS	
		Arterial Rd North Stifford	369	57	3	429	314	42	4	360	3	2	1	3	PASS	
		A1012 North	233	33	1	267	210	34	2	246	2	0	1	1	PASS	
		Long Ln	10	0	0	10	9	0	0	9	0	0	0	0	PASS	
		Lodge Ln	2	0	0	2	0	0	0	0	2	0	0	2	PASS	
	A1012 Elizabeth Rd	Arterial Rd North Stifford	165	19	11	195	164	18	11	193	0	0	0	0	PASS	
		A1012 North	556	131	37	724	547	132	36	715	0	0	0	0	PASS	
		Long Ln	64	5	1	70	67	5	1	73	0	0	0	0	PASS	
		Lodge Ln	41	7	1	49	31	6	1	38	2	0	0	2	PASS	
		A1012 Elizabeth Rd	3	0	0	3	3	0	0	3	0	0	0	0	PASS	
	Lodge Lane / Nutberry Avenue	Lodge Ln West	Nutberry Ave	2	1	0	3	2	0	0	2	0	1	0	1	PASS
			Lodge Ln East	324	56	3	383	315	51	4	370	1	1	1	1	PASS
		Nutberry Ave	Lodge Ln East	8	1	0	9	5	0	0	5	1	1	0	2	PASS
			Lodge Ln West	11	1	0	12	9	0	0	9	1	1	0	1	PASS
Lodge Ln East		Lodge Ln West	742	127	7	876	673	108	10	791	3	2	1	3	PASS	
		Nutberry Ave	3	0	0	3	2	0	0	2	1	0	0	1	PASS	
Lodge Lane / Hathaway Road	Lodge Ln West	Windsor Ave	2	1	0	3	1	1	0	2	1	0	0	1	PASS	
		Lodge Ln East	252	38	3	293	245	39	4	288	0	0	1	0	PASS	
		Hathaway Rd	76	8	0	84	68	10	0	78	1	1	0	1	PASS	
		Lodge Ln East	6	1	0	7	7	1	0	8	0	0	0	0	PASS	

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
	Windsor Ave	Hathaway Rd	43	2	0	45	43	2	0	45	0	0	0	0	PASS	
		Lodge Ln West	8	1	1	10	6	1	1	8	1	0	0	1	PASS	
	Lodge Ln East	Hathaway Rd	50	7	0	57	56	9	0	65	1	1	0	1	PASS	
		Lodge Ln West	601	105	5	711	574	99	9	682	1	1	2	1	PASS	
		Windsor Ave	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	Hathaway Rd	Lodge Ln West	96	13	0	109	101	8	0	109	1	2	0	0	PASS	
		Windsor Ave	28	3	0	31	27	3	0	30	0	0	0	0	PASS	
		Lodge Ln East	64	13	0	77	55	14	0	69	1	0	0	1	PASS	
	Lodge Lane / Connaught Avenue	Lodge Ln West	Connaught Ave	5	1	0	6	6	3	0	9	0	1	0	1	PASS
Lodge Ln East			244	45	4	293	236	42	4	282	1	0	0	1	PASS	
Bradleigh Ave			64	8	0	72	62	8	0	70	0	0	0	0	PASS	
Connaught Ave		Lodge Ln East	30	6	1	37	27	6	0	33	1	0	1	1	PASS	
		Bradleigh Ave	21	2	0	23	20	2	0	22	0	0	0	0	PASS	
		Lodge Ln West	5	3	0	8	5	2	0	7	0	1	0	0	PASS	
Lodge Ln East		Bradleigh Ave	28	6	2	36	42	5	0	47	2	0	2	2	PASS	
		Lodge Ln West	584	107	5	696	553	93	9	655	1	1	2	2	PASS	
		Connaught Ave	6	4	1	11	4	3	0	7	1	1	1	1	PASS	
Bradleigh Ave		Lodge Ln West	85	14	0	99	87	15	0	102	0	0	0	0	PASS	
		Connaught Ave	11	2	0	13	10	2	0	12	0	0	0	0	PASS	
		Lodge Ln East	4	1	0	5	6	0	0	6	1	1	0	0	PASS	
			Victoria Ave	7	0	0	7	8	1	0	9	0	1	0	1	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
Lodge Lane / Victoria Avenue	Lodge Ln West	Lodge Ln East	273	53	5	331	261	47	4	312	1	1	0	1	PASS
	Victoria Ave	Lodge Ln East	33	7	0	40	26	6	0	32	1	0	0	1	PASS
		Lodge Ln West	12	1	0	13	12	1	0	13	0	0	0	0	PASS
	Lodge Ln East	Lodge Ln West	608	112	8	728	587	101	9	697	1	1	0	1	PASS
		Victoria Ave	17	1	0	18	15	1	0	16	1	0	0	0	PASS
Lodge Road / Southend Road	Lodge Ln West	Lodge Ln East	281	49	3	333	230	41	4	275	3	1	1	3	PASS
		Southend Road	74	15	1	90	55	12	0	67	2	1	1	3	PASS
	Lodge Ln East	Southend Road	171	16	3	190	184	18	4	206	1	0	1	1	PASS
		Lodge Ln West	518	84	4	606	482	93	8	583	2	1	2	1	PASS
	Southend Road	Lodge Ln West	135	16	4	155	122	9	1	132	1	2	2	2	PASS
		Lodge Ln East	167	18	1	186	191	29	4	224	2	2	2	3	PASS
Daneholes Roundabout	A1013 Lodge Ln	Blackshots Ln	34	6	2	42	38	12	0	50	1	2	2	1	PASS
		A1013 Stanford Rd	211	32	1	244	181	25	3	209	2	1	1	2	PASS
		B149 Wood View	164	26	1	191	169	21	2	192	0	1	1	0	PASS
		Rectory Rd	14	2	0	16	15	5	0	20	0	2	0	1	PASS
		A1013 Lodge Ln	17	8	0	25	16	7	3	26	0	0	2	0	PASS
	Blackshots Ln	A1013 Stanford Rd	106	12	0	118	121	12	0	133	1	0	0	1	PASS
		B149 Wood View	87	18	0	105	88	16	0	104	0	0	0	0	PASS
		Rectory Rd	30	2	0	32	29	2	0	31	0	0	0	0	PASS
		A1013 Lodge Ln	47	4	1	52	32	2	0	34	2	1	1	3	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
		Blackshots Ln	4	0	0	4	2	0	0	2	1	0	0	1	PASS	
	A1013 Stanford Rd	B149 Wood View	29	12	0	41	17	10	0	27	3	1	0	2	PASS	
		Rectory Rd	128	16	0	144	117	13	0	130	1	1	0	1	PASS	
		A1013 Lodge Ln	389	59	2	450	424	71	1	496	2	1	1	2	PASS	
		Blackshots Ln	101	27	1	129	119	14	3	136	2	3	1	1	PASS	
		A1013 Stanford Rd	43	10	0	53	52	10	0	62	1	0	0	1	PASS	
	B149 Wood View	Rectory Rd	30	5	0	35	29	4	0	33	0	0	0	0	PASS	
		A1013 Lodge Ln	236	38	3	277	192	33	8	233	3	1	2	3	PASS	
		Blackshots Ln	80	16	1	97	77	13	1	91	0	1	0	1	PASS	
		A1013 Stanford Rd	50	8	0	58	66	8	0	74	2	0	0	2	PASS	
		B149 Wood View	13	7	2	22	19	5	1	25	2	1	1	1	PASS	
	Rectory Rd	A1013 Lodge Ln	23	1	0	24	18	1	0	19	1	0	0	1	PASS	
		Blackshots Ln	23	2	0	25	22	2	0	24	0	0	0	0	PASS	
		A1013 Stanford Rd	36	6	0	42	37	6	0	43	0	0	0	0	PASS	
		B149 Wood View	31	2	0	33	30	1	0	31	0	1	0	0	PASS	
		Rectory Rd	0	0	2	2	0	0	2	2	0	0	0	0	PASS	
	A1013 Stanford Road / King Edward Drive	A1013 Stanford Rd East	A1013 Stanford Rd West	440	64	1	505	454	60	3	517	1	1	1	1	PASS
		A1013 Stanford Rd West	King Edward Drive	62	3	0	65	63	3	0	66	0	0	0	0	PASS
			A1013 Stanford Rd East	539	80	3	622	589	79	4	672	2	0	1	2	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	King Edward Drive	A1013 Stanford Rd West	160	38	0	198	154	39	0	193	0	0	0	0	PASS
A1013 Stanford Road / B188 Baker St / Heath Road	A1013 Stanford Rd West	B188 Baker St	15	3	0	18	15	2	0	17	0	1	0	0	PASS
		A1013 Stanford Rd East	411	52	1	464	413	52	3	468	0	0	1	0	PASS
		Heath Rd	21	6	0	27	21	5	0	26	0	0	0	0	PASS
	B188 Baker St	A1013 Stanford Rd East	11	4	0	15	14	2	0	16	1	1	0	0	PASS
		Heath Rd	6	1	0	7	6	1	0	7	0	0	0	0	PASS
		A1013 Stanford Rd West	19	5	0	24	13	6	0	19	2	0	0	1	PASS
	A1013 Stanford Rd East	Heath Rd	6	0	0	6	5	0	0	5	0	0	0	0	PASS
		A1013 Stanford Rd West	521	70	3	594	573	68	4	645	2	0	1	2	PASS
		B188 Baker St	21	4	1	26	23	3	1	27	0	1	0	0	PASS
	Heath Rd	A1013 Stanford Rd West	72	6	0	78	71	8	0	79	0	1	0	0	PASS
		B188 Baker St	27	4	0	31	24	4	0	28	1	0	0	1	PASS
		A1013 Stanford Rd East	20	4	0	24	22	2	0	24	0	1	0	0	PASS
A1013 Stanford Road / Rectory Road	A1013 Stanford Rd West	Rectory Rd	43	2	0	45	46	2	0	48	0	0	0	0	PASS
		A1013 Stanford Rd East	407	65	3	475	394	53	3	450	1	2	0	1	PASS
	Rectory Rd	A1013 Stanford Rd East	75	18	1	94	75	18	1	94	0	0	0	0	PASS
		A1013 Stanford Rd West	21	5	0	26	36	5	0	41	3	0	0	3	PASS
	A1013 Stanford Rd East	A1013 Stanford Rd West	516	66	5	587	571	66	5	642	2	0	0	2	PASS
		Rectory Rd	76	13	1	90	72	12	1	85	0	0	0	1	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
Old Dock Approach Rd / Marshfoot Rd	Old Dock Approach Rd	A126 Marshfoot Rd North	88	21	1	110	86	15	2	103	0	1	1	1	PASS
		A1089 Dock Approach Rd (slip on)	17	4	0	21	14	0	0	14	1	3	0	2	PASS
		A126 Marshfoot Rd South	45	9	0	54	41	9	0	50	1	0	0	1	PASS
	A126 Marshfoot Rd North	A1089 Dock Approach Rd (slip on)	164	33	11	208	171	38	2	211	1	1	4	0	PASS
		A126 Marshfoot Rd South	247	44	9	300	269	30	16	315	1	2	2	1	PASS
		A126 Marshfoot Rd North	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1089 Dock Approach Rd (slip off)	A126 Marshfoot Rd South	132	14	1	147	122	14	1	137	1	0	0	1	PASS
		A126 Marshfoot Rd North	26	4	3	33	25	7	1	33	0	1	1	0	PASS
		A1089 Dock Approach Rd (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Marshfoot Rd South	A126 Marshfoot Rd North	188	22	0	210	203	20	0	223	1	0	0	1	PASS
		A1089 Dock Approach Rd (slip on)	164	37	7	208	159	36	7	202	0	0	0	0	PASS
		A126 Marshfoot Rd South	0	1	0	1	0	0	0	0	0	1	0	1	PASS
Marshfoot Rd / Slip Road	A126 Marshfoot Rd North	A126 Marshfoot Rd South	112	17	2	131	127	22	1	150	1	1	1	2	PASS
		A126 Marshfoot Rd West	188	21	2	211	186	20	2	208	0	0	0	0	PASS
	A126 Marshfoot Rd South	A126 Marshfoot Rd West	123	6	5	134	113	2	3	118	1	2	1	1	PASS
		A126 Marshfoot Rd North	313	51	9	373	316	51	14	381	0	0	1	0	PASS
		A126 Marshfoot Rd North	116	21	8	145	129	18	3	150	1	1	2	0	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A126 Marshfoot Rd West	A126 Marshfoot Rd South	93	20	5	118	92	21	2	115	0	0	2	0	PASS
Marshfoot Rd / B149 Chadwell Bypass / Chadwell Hill	B149 Chadwell Bypass	Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		St. Chads Rd	71	37	4	112	69	36	4	109	0	0	0	0	PASS
		A126 Marshfoot Rd	34	1	0	35	19	1	0	20	3	0	0	3	PASS
		B149 Chadwell Bypass	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	Chadwell Hill	St. Chads Rd	54	0	1	55	52	0	1	53	0	0	0	0	PASS
		A126 Marshfoot Rd	254	21	1	275	274	26	3	303	1	1	2	2	PASS
		B149 Chadwell Bypass	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	St. Chads Rd	A126 Marshfoot Rd	147	35	14	196	143	27	14	184	0	2	0	1	PASS
		B149 Chadwell Bypass	200	2	9	210	198	2	10	210	0	0	0	0	PASS
		Chadwell Hill	117	0	4	121	136	0	2	138	2	0	1	2	PASS
		St. Chads Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Marshfoot Rd	B149 Chadwell Bypass	20	0	0	20	19	0	1	20	0	0	1	0	PASS
		Chadwell Hill	92	10	1	103	95	15	0	110	0	1	2	1	PASS
		St. Chads Rd	93	27	6	126	101	27	2	130	1	0	2	0	PASS
		A126 Marshfoot Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Chadwell Hill / Brentwood Road /	Brentwood Rd	Linford Rd	22	7	1	30	23	6	0	29	0	0	2	0	PASS
		Chadwell Hill	103	1	1	105	99	2	0	101	0	1	1	0	PASS
		River View	0	0	0	1	0	0	0	0	1	1	0	1	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
Linford Road	Linford Rd	Chadwell Hill	205	20	1	225	229	23	4	256	2	1	2	2	PASS
		River View	131	16	20	167	124	15	19	158	1	0	0	1	PASS
		Brentwood Rd	57	12	3	72	58	13	3	74	0	0	0	0	PASS
	Chadwell Hill	River View	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Brentwood Rd	128	0	4	132	128	5	1	134	0	3	2	0	PASS
		Linford Rd	81	10	1	92	98	10	2	110	2	0	1	2	PASS
	River View	Brentwood Rd	3	0	0	3	3	0	0	3	0	1	0	0	PASS
		Linford Rd	88	4	21	113	86	4	20	110	0	0	0	0	PASS
		Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Table B.2 AM 08:00 – 09:00 Flow Comparison

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A13 / A1012 / Stifford Clays Rd / High Rd	A13 South (slip off)	High Rd	22	3	3	29	20	3	2	25	0	0	1	1	PASS
		A13 North (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Stifford Clays Rd	54	10	5	69	53	8	5	66	0	1	0	0	PASS
		A1012	300	35	14	348	308	34	14	356	0	0	0	0	PASS
		A13 South (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	High Rd	A13 North (slip on)	236	21	5	262	238	21	5	264	0	0	0	0	PASS
		Stifford Clays Rd	116	7	2	125	107	7	2	116	1	0	0	1	PASS
		A1012	107	18	3	128	111	20	2	133	0	0	1	0	PASS
		A13 South (slip on)	13	1	5	19	13	1	4	18	0	0	0	0	PASS
		High Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A13 North (slip off)	Stifford Clays Rd	35	3	1	39	30	3	1	34	1	0	0	1	PASS
		A1012	586	95	40	721	611	95	38	744	1	0	0	1	PASS
		A13 South (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		High Rd	231	19	2	253	226	18	2	246	0	0	0	0	PASS
		A13 North (slip on)	2	1	0	2	0	0	0	0	2	1	0	2	PASS
	Stifford Clays Rd	A1012	126	12	2	140	125	12	2	139	0	0	0	0	PASS
		A13 South (slip on)	124	24	5	153	112	23	4	139	1	0	1	1	PASS
		High Rd	97	13	2	112	104	12	1	117	1	0	1	1	PASS
		A13 North (slip on)	44	5	1	49	48	5	1	54	1	0	0	1	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A1012	Stifford Clays Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		A13 South (slip on)	375	56	11	443	432	58	12	502	3	0	0	3	PASS
		High Rd	94	13	3	109	98	11	1	110	0	1	1	0	PASS
		A13 North (slip on)	462	81	52	594	489	87	55	631	1	1	0	1	PASS
		Stifford Clays Rd	98	8	2	109	76	7	2	85	2	0	0	2	PASS
		A1012	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Treacle Mine Roundabout	Arterial Rd North Stifford	A1012 North	188	38	35	261	192	40	36	268	0	0	0	0	PASS
		Long Ln	47	13	1	61	49	12	1	62	0	0	0	0	PASS
		Lodge Ln	248	27	2	277	209	25	2	236	3	0	0	3	PASS
		A1012 Elizabeth Rd	158	18	17	193	154	20	17	191	0	0	0	0	PASS
		Arterial Rd North Stifford	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1012 North	Long Ln	42	17	2	61	40	16	1	57	0	0	1	1	PASS
		Lodge Ln	165	25	0	190	206	21	1	228	3	1	1	3	PASS
		A1012 Elizabeth Rd	411	55	31	497	406	55	32	493	0	0	0	0	PASS
		Arterial Rd North Stifford	500	69	24	593	494	71	23	588	0	0	0	0	PASS
		A1012 North	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	Long Ln	Lodge Ln	2	0	0	2	4	1	0	5	1	1	0	2	PASS
		A1012 Elizabeth Rd	155	22	0	177	150	20	0	170	0	0	0	1	PASS
		Arterial Rd North Stifford	173	8	0	181	165	8	0	173	1	0	0	1	PASS
		A1012 North	105	5	0	110	104	5	0	109	0	0	0	0	PASS
		Long Ln	3	0	0	3	3	0	0	3	0	0	0	0	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	Lodge Ln	A1012 Elizabeth Rd	221	23	5	249	238	23	6	267	1	0	0	1	PASS
		Arterial Rd North Stifford	408	35	2	445	423	33	1	457	1	0	1	1	PASS
		A1012 North	195	32	1	228	244	35	1	280	3	1	0	3	PASS
		Long Ln	11	1	0	12	5	0	0	5	2	1	0	2	PASS
		Lodge Ln	1	0	0	1	0	0	0	0	1	0	0	1	PASS
	A1012 Elizabeth Rd	Arterial Rd North Stifford	164	15	11	190	164	16	11	191	0	0	0	0	PASS
		A1012 North	541	83	32	656	544	82	32	658	0	0	0	0	PASS
		Long Ln	130	16	2	148	128	17	2	147	0	0	0	0	PASS
		Lodge Ln	85	12	1	98	61	11	1	73	3	0	0	3	PASS
		A1012 Elizabeth Rd	0	1	0	1	0	1	0	1	0	0	0	0	PASS
Lodge Lane / Nutberry Avenue	Lodge Ln West	Nutberry Ave	8	0	0	8	7	0	0	7	0	0	0	0	PASS
		Lodge Ln East	477	72	1	550	471	59	4	534	0	2	2	1	PASS
	Nutberry Ave	Lodge Ln East	13	1	0	14	10	0	0	10	1	1	0	1	PASS
		Lodge Ln West	18	1	0	19	17	0	0	17	0	1	0	0	PASS
	Lodge Ln East	Lodge Ln West	830	91	8	929	882	89	8	979	2	0	0	2	PASS
		Nutberry Ave	3	0	0	3	3	0	0	3	0	0	0	0	PASS
Lodge Lane / Hathaway Road	Lodge Ln West	Windsor Ave	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Lodge Ln East	387	52	3	442	379	46	4	429	0	1	1	1	PASS
		Hathaway Rd	109	14	0	123	98	12	0	110	1	1	0	1	PASS
	Windsor Ave	Lodge Ln East	22	3	0	25	22	4	0	26	0	1	0	0	PASS
		Hathaway Rd	113	4	0	117	109	3	0	112	0	1	0	0	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
	Lodge Ln East	Lodge Ln West	13	0	0	13	15	0	0	15	1	0	0	1	PASS	
		Hathaway Rd	68	5	0	73	77	5	0	82	1	0	0	1	PASS	
		Lodge Ln West	720	90	8	818	734	74	8	816	1	2	0	0	PASS	
	Hathaway Rd	Windsor Ave	2	0	0	2	2	0	0	2	0	0	0	0	PASS	
		Lodge Ln West	117	14	0	131	132	14	0	146	1	0	0	1	PASS	
		Windsor Ave	79	12	0	91	78	11	0	89	0	0	0	0	PASS	
	Lodge Lane / Connaught Avenue	Lodge Ln West	Lodge Ln East	113	7	0	120	96	8	0	104	2	0	0	2	PASS
			Connaught Ave	2	0	0	2	3	0	0	3	1	0	0	1	PASS
			Lodge Ln East	400	45	2	447	383	49	4	436	1	1	1	1	PASS
Connaught Ave		Bradleigh Ave	135	15	0	150	108	8	0	116	2	2	0	3	PASS	
		Lodge Ln East	44	3	0	47	43	5	0	48	0	1	0	0	PASS	
		Bradleigh Ave	38	2	0	40	36	2	0	38	0	0	0	0	PASS	
Lodge Ln East		Lodge Ln West	6	2	0	8	3	0	0	3	1	2	0	2	PASS	
		Bradleigh Ave	45	1	0	46	48	9	0	57	0	4	0	2	PASS	
		Lodge Ln West	623	76	6	705	681	59	8	748	2	2	1	2	PASS	
Bradleigh Ave		Connaught Ave	30	6	0	36	26	4	0	30	1	1	0	1	PASS	
		Lodge Ln West	140	21	1	162	139	20	0	159	0	0	1	0	PASS	
		Connaught Ave	31	1	0	32	32	1	0	33	0	0	0	0	PASS	
Lodge Lane /		Lodge Ln West	Lodge Ln East	11	2	0	13	14	3	1	18	1	1	1	1	PASS
			Victoria Ave	4	0	0	4	7	2	0	9	1	2	0	2	PASS
			Lodge Ln East	451	51	2	504	432	56	5	493	1	1	2	0	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
Victoria Avenue	Victoria Ave	Lodge Ln East	48	2	0	50	43	6	0	49	1	2	0	0	PASS
		Lodge Ln West	18	0	0	18	16	1	0	17	0	1	0	0	PASS
	Lodge Ln East	Lodge Ln West	679	79	6	764	742	71	8	821	2	1	1	2	PASS
		Victoria Ave	36	6	0	42	37	1	0	38	0	3	0	1	PASS
Lodge Road / Southend Road	Lodge Ln West	Lodge Ln East	447	38	3	488	359	44	4	407	4	1	1	4	PASS
		Southend Road	131	19	0	150	115	17	1	133	1	0	1	1	PASS
	Lodge Ln East	Southend Road	238	24	2	264	242	20	1	263	0	1	1	0	PASS
		Lodge Ln West	541	74	4	619	582	63	6	651	2	1	1	1	PASS
	Southend Road	Lodge Ln West	198	15	1	214	198	10	1	209	0	1	0	0	PASS
		Lodge Ln East	250	30	2	282	238	36	2	276	1	1	0	0	PASS
Daneholes Roundabout	A1013 Lodge Ln	Blackshots Ln	48	9	0	57	45	10	1	56	0	0	1	0	PASS
		A1013 Stanford Rd	274	32	1	307	236	28	1	265	2	1	0	2	PASS
		B149 Wood View	276	28	2	306	241	35	4	280	2	1	1	2	PASS
		Rectory Rd	55	6	0	61	52	7	0	59	0	0	0	0	PASS
		A1013 Lodge Ln	25	2	1	28	21	0	0	21	1	2	1	1	PASS
	Blackshots Ln	A1013 Stanford Rd	87	19	2	108	90	17	1	108	0	0	1	0	PASS
		B149 Wood View	241	12	0	253	233	12	0	245	1	0	0	1	PASS
		Rectory Rd	58	4	0	62	54	5	0	59	1	0	0	0	PASS
		A1013 Lodge Ln	37	7	0	44	32	7	1	40	1	0	1	1	PASS
		Blackshots Ln	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		B149 Wood View	44	3	2	49	36	5	0	41	1	1	2	1	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A1013 Stanford Rd	Rectory Rd	158	17	0	175	164	18	0	182	0	0	0	1	PASS
		A1013 Lodge Ln	410	46	1	457	444	39	4	487	2	1	2	1	PASS
		Blackshots Ln	267	25	3	295	232	25	2	259	2	0	1	2	PASS
		A1013 Stanford Rd	60	5	1	66	77	10	1	88	2	2	0	3	PASS
	B149 Wood View	Rectory Rd	45	1	0	46	48	1	0	49	0	0	0	0	PASS
		A1013 Lodge Ln	272	36	2	310	293	32	2	327	1	1	0	1	PASS
		Blackshots Ln	135	14	1	150	134	12	0	146	0	1	1	0	PASS
		A1013 Stanford Rd	82	4	1	87	103	2	0	105	2	1	1	2	PASS
		B149 Wood View	26	10	2	38	26	10	0	36	0	0	2	0	PASS
	Rectory Rd	A1013 Lodge Ln	30	3	1	34	28	3	0	31	0	0	1	1	PASS
		Blackshots Ln	46	5	0	51	47	5	0	52	0	0	0	0	PASS
		A1013 Stanford Rd	43	5	1	49	45	5	2	52	0	0	1	0	PASS
		B149 Wood View	38	8	0	46	25	8	0	33	2	0	0	2	PASS
		Rectory Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1013 Stanford Road / King Edward Drive	A1013 Stanford Rd East	A1013 Stanford Rd West	545	55	5	605	549	61	5	615	0	1	0	0
A1013 Stanford Rd West		King Edward Drive	191	3	1	195	191	2	0	193	0	1	1	0	PASS
		A1013 Stanford Rd East	672	76	6	754	661	81	6	748	0	1	0	0	PASS
King Edward Drive		A1013 Stanford Rd West	267	16	0	283	293	16	0	309	2	0	0	2	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A1013 Stanford Road / B188 Baker St / Heath Road	A1013 Stanford Rd West	B188 Baker St	23	1	0	24	22	0	0	22	0	1	0	0	PASS
		A1013 Stanford Rd East	475	44	6	525	476	55	5	536	0	2	0	0	PASS
		Heath Rd	53	5	0	58	51	6	0	57	0	0	0	0	PASS
	B188 Baker St	A1013 Stanford Rd East	13	1	0	14	15	1	0	16	1	0	0	1	PASS
		Heath Rd	29	0	0	29	29	0	0	29	0	0	0	0	PASS
		A1013 Stanford Rd West	41	6	0	47	35	6	0	41	1	0	0	1	PASS
	A1013 Stanford Rd East	Heath Rd	15	2	0	17	16	1	0	17	0	1	0	0	PASS
		A1013 Stanford Rd West	713	62	8	783	717	67	7	791	0	1	0	0	PASS
		B188 Baker St	32	0	0	32	37	0	0	37	1	0	0	1	PASS
	Heath Rd	A1013 Stanford Rd West	103	12	0	115	101	10	0	111	0	1	0	0	PASS
		B188 Baker St	23	1	0	24	23	1	0	24	0	0	0	0	PASS
		A1013 Stanford Rd East	28	3	0	31	31	5	0	36	1	1	0	1	PASS
A1013 Stanford Road / Rectory Road	A1013 Stanford Rd West	Rectory Rd	57	4	1	62	70	6	2	78	2	1	1	2	PASS
		A1013 Stanford Rd East	441	51	4	496	454	55	4	513	1	1	0	1	PASS
	Rectory Rd	A1013 Stanford Rd East	130	10	3	143	128	9	3	140	0	0	0	0	PASS
		A1013 Stanford Rd West	41	1	0	42	56	2	0	58	2	1	0	2	PASS
	A1013 Stanford Rd East	A1013 Stanford Rd West	725	65	7	797	711	67	7	785	1	0	0	0	PASS
		Rectory Rd	159	12	1	172	159	12	1	172	0	0	0	0	PASS
Old Dock Approach Rd /	Old Dock Approach Rd	A126 Marshfoot Rd North	124	9	1	134	129	13	3	145	0	1	1	1	PASS
		A1089 Dock Approach Rd (slip on)	23	1	0	24	17	0	0	17	1	1	0	2	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
Marshfoot Rd		A126 Marshfoot Rd South	61	7	3	71	60	8	0	68	0	0	2	0	PASS	
	A126 Marshfoot Rd North	A1089 Dock Approach Rd (slip on)	172	23	10	205	178	20	2	200	0	1	3	0	PASS	
		A126 Marshfoot Rd South	376	46	8	430	339	48	10	397	2	0	1	2	PASS	
		A126 Marshfoot Rd North	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	A1089 Dock Approach Rd (slip off)	A126 Marshfoot Rd South	162	21	6	189	157	19	4	180	0	0	1	1	PASS	
		A126 Marshfoot Rd North	39	3	3	45	29	1	1	31	2	1	1	2	PASS	
		A1089 Dock Approach Rd (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	A126 Marshfoot Rd South	A126 Marshfoot Rd North	221	23	2	246	222	22	2	246	0	0	0	0	PASS	
		A1089 Dock Approach Rd (slip on)	143	20	9	172	143	20	9	172	0	0	0	0	PASS	
		A126 Marshfoot Rd South	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	Marshfoot Rd / Slip Road	A126 Marshfoot Rd North	A126 Marshfoot Rd South	176	21	2	199	190	22	3	215	1	0	1	1	PASS
			A126 Marshfoot Rd West	206	18	4	228	190	14	3	207	1	1	1	1	PASS
A126 Marshfoot Rd South		A126 Marshfoot Rd West	132	9	2	143	151	12	1	164	2	1	1	2	PASS	
		A126 Marshfoot Rd North	377	40	8	425	352	34	4	390	1	1	2	2	PASS	
A126 Marshfoot Rd West		A126 Marshfoot Rd North	169	25	6	200	164	34	7	205	0	2	0	0	PASS	
		A126 Marshfoot Rd South	75	27	8	110	68	35	3	106	1	1	2	0	PASS	
Marshfoot Rd / B149		Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
		St. Chads Rd	71	37	4	112	70	34	4	108	0	0	0	0	PASS	

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
Chadwell Bypass / Chadwell Hill	B149 Chadwell Bypass	A126 Marshfoot Rd	34	1	0	35	36	2	0	38	0	1	0	0	PASS	
		B149 Chadwell Bypass	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	Chadwell Hill	St. Chads Rd	54	0	1	55	60	0	1	61	1	0	0	1	PASS	
		A126 Marshfoot Rd	254	21	1	275	248	18	3	269	0	1	2	0	PASS	
		B149 Chadwell Bypass	0	0	0	0	2	0	0	2	2	0	0	2	PASS	
		Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	St. Chads Rd	A126 Marshfoot Rd	220	27	2	249	216	26	2	244	0	0	0	0	PASS	
		B149 Chadwell Bypass	200	2	9	210	202	2	8	212	0	0	0	0	PASS	
		Chadwell Hill	117	0	4	121	90	0	3	93	3	0	1	3	PASS	
		St. Chads Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	A126 Marshfoot Rd	B149 Chadwell Bypass	20	0	0	20	17	0	0	17	1	0	0	1	PASS	
		Chadwell Hill	92	48	1	141	106	54	2	162	1	1	1	2	PASS	
		St. Chads Rd	139	0	12	151	136	2	4	142	0	2	3	1	PASS	
		A126 Marshfoot Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	Chadwell Hill / Brentwood Road / Linford Road	Brentwood Rd	Linford Rd	22	7	1	30	23	8	0	31	0	0	2	0	PASS
			Chadwell Hill	103	1	1	105	82	0	0	82	2	1	1	2	PASS
River View			0	0	0	1	0	0	0	0	1	1	0	1	PASS	
Linford Rd		Chadwell Hill	205	20	1	225	227	18	4	249	2	0	2	2	PASS	
		River View	131	16	20	167	131	18	19	168	0	0	0	0	PASS	
		Brentwood Rd	57	12	3	72	57	11	3	71	0	0	0	0	PASS	

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	Chadwell Hill	River View	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Brentwood Rd	128	0	4	132	112	3	3	118	1	2	1	1	PASS
		Linford Rd	81	48	1	130	87	50	2	139	1	0	1	1	PASS
	River View	Brentwood Rd	3	0	0	3	3	0	0	3	0	1	0	0	PASS
		Linford Rd	88	4	21	113	86	4	20	110	0	0	0	0	PASS
		Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Table B.3 PM 17.00 – 18.00 Flow Comparison

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A13 / A1012 / Stifford Clays Rd / High Rd	A13 South (slip off)	High Rd	19	7	3	28	19	8	3	30	19	7	3	28	PASS
		A13 North (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Stifford Clays Rd	137	25	6	168	135	26	6	167	137	25	6	168	PASS
		A1012	430	86	18	534	444	84	13	541	430	86	18	534	PASS
		A13 South (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	High Rd	A13 North (slip on)	223	14	2	239	176	14	2	192	223	14	2	239	PASS
		Stifford Clays Rd	154	18	3	175	127	16	3	146	154	18	3	175	PASS
		A1012	154	22	0	175	129	21	0	150	154	22	0	175	PASS
		A13 South (slip on)	6	2	0	9	5	5	0	10	6	2	0	9	PASS
		High Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A13 North (slip off)	Stifford Clays Rd	31	3	0	34	28	4	0	32	31	3	0	34	PASS
		A1012	537	54	24	615	562	63	19	644	537	54	24	615	PASS
		A13 South (slip on)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		High Rd	203	18	1	223	197	20	1	218	203	18	1	223	PASS
		A13 North (slip on)	4	0	0	4	4	0	0	4	4	0	0	4	PASS
	Stifford Clays Rd	A1012	70	0	2	73	71	10	2	83	70	0	2	73	PASS
		A13 South (slip on)	68	14	1	82	65	15	1	81	68	14	1	82	PASS
		High Rd	87	10	1	98	84	10	1	95	87	10	1	98	PASS
		A13 North (slip on)	24	0	0	24	26	0	0	26	24	0	0	24	PASS
		Stifford Clays Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A1012	A13 South (slip on)	354	32	8	394	355	36	8	399	354	32	8	394	PASS
		High Rd	113	14	7	134	117	14	7	138	113	14	7	134	PASS
		A13 North (slip on)	727	94	21	842	743	98	18	859	727	94	21	842	PASS
		Stifford Clays Rd	168	15	0	184	162	15	0	177	168	15	0	184	PASS
		A1012	2	0	0	2	0	0	0	0	2	0	0	2	PASS
Treacle Mine Roundabout	Arterial Rd North Stifford	A1012 North	494	54	16	564	489	50	16	555	494	54	16	564	PASS
		Long Ln	137	7	0	144	137	7	0	144	137	7	0	144	PASS
		Lodge Ln	414	30	0	444	384	28	1	413	414	30	0	444	PASS
		A1012 Elizabeth Rd	133	17	17	167	130	14	16	160	133	17	17	167	PASS
		Arterial Rd North Stifford	1	0	2	3	1	0	2	3	1	0	2	3	PASS
	A1012 North	Long Ln	81	18	0	99	74	17	0	91	81	18	0	99	PASS
		Lodge Ln	219	65	0	284	245	55	1	301	219	65	0	284	PASS
		A1012 Elizabeth Rd	494	74	19	587	474	71	18	563	494	74	19	587	PASS
		Arterial Rd North Stifford	426	35	15	476	402	34	14	450	426	35	15	476	PASS
		A1012 North	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	Long Ln	Lodge Ln	2	0	0	2	7	1	0	8	2	0	0	2	PASS
		A1012 Elizabeth Rd	119	11	0	130	117	10	0	127	119	11	0	130	PASS
		Arterial Rd North Stifford	115	7	0	122	114	6	0	120	115	7	0	122	PASS
		A1012 North	49	6	0	55	48	7	0	55	49	6	0	55	PASS
		Long Ln	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	Lodge Ln	A1012 Elizabeth Rd	143	31	0	174	131	30	0	161	143	31	0	174	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
		Arterial Rd North Stifford	313	31	2	346	324	30	1	355	313	31	2	346	PASS
		A1012 North	167	19	1	187	193	28	0	221	167	19	1	187	PASS
		Long Ln	18	0	0	18	29	0	0	29	18	0	0	18	PASS
		Lodge Ln	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1012 Elizabeth Rd	Arterial Rd North Stifford	215	15	4	234	209	16	5	230	215	15	4	234	PASS
		A1012 North	654	77	19	750	648	77	18	743	654	77	19	750	PASS
		Long Ln	124	12	0	136	130	11	0	141	124	12	0	136	PASS
		Lodge Ln	159	16	0	175	144	17	1	162	159	16	0	175	PASS
		A1012 Elizabeth Rd	7	0	0	7	8	0	0	8	7	0	0	7	PASS
	Lodge Lane / Nutberry Avenue	Lodge Ln West	Nutberry Ave	10	0	0	10	11	0	0	11	10	0	0	10
Lodge Ln East			824	85	0	909	768	101	3	872	824	85	0	909	PASS
Nutberry Ave		Lodge Ln East	6	1	0	7	6	1	0	7	6	1	0	7	PASS
		Lodge Ln West	11	0	0	11	11	0	0	11	11	0	0	11	PASS
Lodge Ln East		Lodge Ln West	619	78	2	699	672	90	1	763	619	78	2	699	PASS
		Nutberry Ave	5	0	0	5	3	0	0	3	5	0	0	5	PASS
Lodge Lane / Hathaway Road	Lodge Ln West	Windsor Ave	1	0	0	1	4	0	0	4	1	0	0	1	PASS
		Lodge Ln East	701	71	0	772	649	88	3	740	701	71	0	772	PASS
		Hathaway Rd	140	11	0	151	123	15	0	138	140	11	0	151	PASS
	Windsor Ave	Lodge Ln East	16	0	0	16	15	2	0	17	16	0	0	16	PASS
		Hathaway Rd	52	6	0	58	52	5	0	57	52	6	0	58	PASS
		Lodge Ln West	9	1	0	10	10	0	0	10	9	1	0	10	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
	Lodge Ln East	Hathaway Rd	57	3	0	60	68	0	0	68	57	3	0	60	PASS	
		Lodge Ln West	517	59	1	577	542	79	0	621	517	59	1	577	PASS	
		Windsor Ave	14	2	0	16	19	3	0	22	14	2	0	16	PASS	
	Hathaway Rd	Lodge Ln West	94	12	1	107	123	11	1	135	94	12	1	107	PASS	
		Windsor Ave	70	2	0	72	68	2	0	70	70	2	0	72	PASS	
		Lodge Ln East	121	9	0	130	95	9	0	104	121	9	0	130	PASS	
Lodge Lane / Connaught Avenue	Lodge Ln West	Connaught Ave	13	0	0	13	10	0	0	10	13	0	0	13	PASS	
		Lodge Ln East	706	70	1	777	623	90	3	716	706	70	1	777	PASS	
		Bradleigh Ave	128	7	0	135	126	10	0	136	128	7	0	135	PASS	
	Connaught Ave	Lodge Ln East	32	2	0	34	32	2	0	34	32	2	0	34	PASS	
		Bradleigh Ave	34	3	0	37	34	3	0	37	34	3	0	37	PASS	
		Lodge Ln West	2	0	0	2	2	0	0	2	2	0	0	2	PASS	
	Lodge Ln East	Bradleigh Ave	20	2	0	22	26	2	0	28	20	2	0	22	PASS	
		Lodge Ln West	487	56	1	544	506	72	0	578	487	56	1	544	PASS	
		Connaught Ave	34	6	0	40	35	6	0	41	34	6	0	40	PASS	
	Bradleigh Ave	Lodge Ln West	118	11	0	129	121	10	0	131	118	11	0	129	PASS	
		Connaught Ave	20	2	0	22	20	2	0	22	20	2	0	22	PASS	
		Lodge Ln East	9	1	0	10	8	2	0	10	9	1	0	10	PASS	
	Lodge Lane / Victoria Avenue	Lodge Ln West	Victoria Ave	7	2	0	9	6	2	0	8	7	2	0	9	PASS
			Lodge Ln East	740	71	1	812	657	92	3	752	740	71	1	812	PASS
			Lodge Ln East	35	6	0	41	35	7	0	42	35	6	0	41	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	Victoria Ave	Lodge Ln West	11	2	0	13	11	1	0	12	11	2	0	13	PASS
	Lodge Ln East	Lodge Ln West	540	56	1	597	556	79	0	635	540	56	1	597	PASS
		Victoria Ave	36	1	0	37	37	1	0	38	36	1	0	37	PASS
Lodge Road / Southend Road	Lodge Ln West	Lodge Ln East	592	65	0	657	547	83	3	633	592	65	0	657	PASS
		Southend Road	157	18	0	175	143	16	0	159	157	18	0	175	PASS
	Lodge Ln East	Southend Road	158	12	1	171	171	17	2	190	158	12	1	171	PASS
		Lodge Ln West	468	51	1	520	478	65	0	543	468	51	1	520	PASS
	Southend Road	Lodge Ln West	142	12	0	154	115	15	0	130	142	12	0	154	PASS
		Lodge Ln East	392	20	1	413	424	16	0	440	392	20	1	413	PASS
Daneholes Roundabout	A1013 Lodge Ln	Blackshots Ln	78	7	0	85	109	7	0	116	78	7	0	85	PASS
		A1013 Stanford Rd	510	33	0	543	486	29	0	515	510	33	0	543	PASS
		B149 Wood View	336	42	1	379	320	57	3	380	336	42	1	379	PASS
		Rectory Rd	29	1	0	30	35	6	0	41	29	1	0	30	PASS
		A1013 Lodge Ln	23	2	0	25	23	0	0	23	23	2	0	25	PASS
	Blackshots Ln	A1013 Stanford Rd	177	20	1	198	176	20	1	197	177	20	1	198	PASS
		B149 Wood View	133	9	1	143	106	9	0	115	133	9	1	143	PASS
		Rectory Rd	53	3	0	56	51	3	0	54	53	3	0	56	PASS
		A1013 Lodge Ln	62	1	0	63	59	1	0	60	62	1	0	63	PASS
		Blackshots Ln	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		B149 Wood View	42	5	1	48	51	9	0	60	42	5	1	48	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A1013 Stanford Rd	Rectory Rd	115	20	1	136	118	16	3	137	115	20	1	136	PASS
		A1013 Lodge Ln	342	31	2	375	349	38	2	389	342	31	2	375	PASS
		Blackshots Ln	205	22	0	227	193	21	0	214	205	22	0	227	PASS
		A1013 Stanford Rd	53	9	0	62	58	9	0	67	53	9	0	62	PASS
	B149 Wood View	Rectory Rd	49	5	1	55	40	4	0	44	49	5	1	55	PASS
		A1013 Lodge Ln	197	31	0	228	185	40	0	225	197	31	0	228	PASS
		Blackshots Ln	166	18	0	184	125	17	0	142	166	18	0	184	PASS
		A1013 Stanford Rd	129	10	0	139	142	15	0	157	129	10	0	139	PASS
		B149 Wood View	17	6	0	23	25	11	0	36	17	6	0	23	PASS
	Rectory Rd	A1013 Lodge Ln	36	6	0	42	34	3	0	37	36	6	0	42	PASS
		Blackshots Ln	20	3	0	23	20	3	0	23	20	3	0	23	PASS
		A1013 Stanford Rd	65	8	0	73	81	10	0	91	65	8	0	73	PASS
		B149 Wood View	55	7	0	62	54	8	0	62	55	7	0	62	PASS
		Rectory Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1013 Stanford Road / King Edward Drive	A1013 Stanford Rd East	A1013 Stanford Rd West	909	75	1	985	940	84	1	1025	909	75	1	985
A1013 Stanford Rd West		King Edward Drive	61	8	1	70	61	9	0	70	61	8	1	70	PASS
		A1013 Stanford Rd East	561	53	3	617	613	68	5	686	561	53	3	617	PASS
King Edward Drive		A1013 Stanford Rd West	154	25	0	179	160	25	0	185	154	25	0	179	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A1013 Stanford Road / B188 Baker St / Heath Road	A1013 Stanford Rd West	B188 Baker St	58	9	0	67	54	10	0	64	58	9	0	67	PASS
		A1013 Stanford Rd East	729	54	1	784	758	51	1	810	729	54	1	784	PASS
		Heath Rd	124	16	0	140	127	22	0	149	124	16	0	140	PASS
	B188 Baker St	A1013 Stanford Rd East	29	4	0	33	40	4	0	44	29	4	0	33	PASS
		Heath Rd	35	16	4	55	33	16	4	53	35	16	4	55	PASS
		A1013 Stanford Rd West	51	6	0	57	38	6	0	44	51	6	0	57	PASS
	A1013 Stanford Rd East	Heath Rd	39	7	0	46	38	4	0	42	39	7	0	46	PASS
		A1013 Stanford Rd West	532	51	4	587	583	63	5	651	532	51	4	587	PASS
		B188 Baker St	25	3	0	28	27	3	0	30	25	3	0	28	PASS
	Heath Rd	A1013 Stanford Rd West	57	6	0	63	57	7	0	64	57	6	0	63	PASS
		B188 Baker St	12	1	0	13	11	1	0	12	12	1	0	13	PASS
		A1013 Stanford Rd East	17	4	0	21	18	3	0	21	17	4	0	21	PASS
A1013 Stanford Road / Rectory Road	A1013 Stanford Rd West	Rectory Rd	58	7	0	65	61	8	0	69	58	7	0	65	PASS
		A1013 Stanford Rd East	738	45	2	785	753	50	1	804	738	45	2	785	PASS
	Rectory Rd	A1013 Stanford Rd East	171	23	1	195	176	21	1	198	171	23	1	195	PASS
		A1013 Stanford Rd West	105	8	0	113	127	10	0	137	105	8	0	113	PASS
	A1013 Stanford Rd East	A1013 Stanford Rd West	472	53	5	530	525	60	5	590	472	53	5	530	PASS
		Rectory Rd	77	9	0	86	77	9	0	86	77	9	0	86	PASS
Old Dock Approach		A126 Marshfoot Rd North	99	10	2	111	101	18	3	122	99	10	2	111	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC	
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total		
Rd / Marshfoot Rd	Old Dock Approach Rd	A1089 Dock Approach Rd (slip on)	8	0	1	9	7	0	0	7	8	0	1	9	PASS	
		A126 Marshfoot Rd South	62	5	0	67	53	8	0	61	62	5	0	67	PASS	
	A126 Marshfoot Rd North	A1089 Dock Approach Rd (slip on)	87	18	2	107	72	23	1	96	87	18	2	107	PASS	
		A126 Marshfoot Rd South	277	48	1	326	329	41	1	371	277	48	1	326	PASS	
		A126 Marshfoot Rd North	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	A1089 Dock Approach Rd (slip off)	A126 Marshfoot Rd South	326	40	3	369	300	38	3	341	326	40	3	369	PASS	
		A126 Marshfoot Rd North	133	17	1	151	107	14	1	122	133	17	1	151	PASS	
		A1089 Dock Approach Rd (slip on)	2	0	0	2	0	0	0	0	2	0	0	2	PASS	
	A126 Marshfoot Rd South	A126 Marshfoot Rd North	288	42	1	331	290	23	1	314	288	42	1	331	PASS	
		A1089 Dock Approach Rd (slip on)	120	25	4	149	119	26	4	149	120	25	4	149	PASS	
		A126 Marshfoot Rd South	0	0	0	0	0	0	0	0	0	0	0	0	PASS	
	Marshfoot Rd / Slip Road	A126 Marshfoot Rd North	A126 Marshfoot Rd South	356	46	1	403	389	39	2	430	356	46	1	403	PASS
			A126 Marshfoot Rd West	160	20	3	183	109	16	3	128	160	20	3	183	PASS
A126 Marshfoot Rd South		A126 Marshfoot Rd West	77	8	2	87	80	19	0	99	77	8	2	87	PASS	
		A126 Marshfoot Rd North	185	30	2	217	196	25	1	222	185	30	2	217	PASS	
A126 Marshfoot Rd West		A126 Marshfoot Rd North	179	33	1	213	204	40	1	245	179	33	1	213	PASS	
		A126 Marshfoot Rd South	227	48	4	279	207	45	1	253	227	48	4	279	PASS	

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
Marshfoot Rd / B149 Chadwell Bypass / Chadwell Hill	B149 Chadwell Bypass	Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		St. Chads Rd	118	5	2	125	116	4	0	120	118	5	2	125	PASS
		A126 Marshfoot Rd	11	1	0	12	15	0	0	15	11	1	0	12	PASS
		B149 Chadwell Bypass	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	Chadwell Hill	St. Chads Rd	87	0	0	88	84	0	0	84	87	0	0	88	PASS
		A126 Marshfoot Rd	126	14	1	141	113	19	1	133	126	14	1	141	PASS
		B149 Chadwell Bypass	0	0	0	0	4	0	0	4	0	0	0	0	PASS
		Chadwell Hill	0	0	0	0	3	0	0	3	0	0	0	0	PASS
	St. Chads Rd	A126 Marshfoot Rd	111	23	1	135	149	24	0	173	111	23	1	135	PASS
		B149 Chadwell Bypass	151	12	3	165	152	11	3	166	151	12	3	165	PASS
		Chadwell Hill	82	0	2	84	86	0	2	88	82	0	2	84	PASS
		St. Chads Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Marshfoot Rd	B149 Chadwell Bypass	24	0	0	24	26	4	0	30	24	0	0	24	PASS
		Chadwell Hill	184	59	1	244	187	52	1	240	184	59	1	244	PASS
		St. Chads Rd	415	31	3	449	382	28	2	412	415	31	3	449	PASS
		A126 Marshfoot Rd	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Chadwell Hill / Brentwood Road / Linford Road	Brentwood Rd	Linford Rd	46	9	0	55	46	9	0	55	46	9	0	55	PASS
		Chadwell Hill	106	1	0	107	97	2	0	99	106	1	0	107	PASS
		River View	1	0	0	1	1	0	0	1	1	0	0	1	PASS
	Linford Rd	Chadwell Hill	108	14	1	122	107	18	1	126	108	14	1	122	PASS
		River View	104	3	11	119	105	3	11	119	104	3	11	119	PASS

Junction	Approach	To	Observed				Modelled				GEH<5				FC
			Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
		Brentwood Rd	39	14	1	54	37	12	1	50	39	14	1	54	PASS
	Chadwell Hill	River View	0	0	0	0	0	0	0	0	0	0	0	0	PASS
		Brentwood Rd	98	0	2	101	108	2	0	110	98	0	2	101	PASS
		Linford Rd	168	59	1	227	166	50	3	219	168	59	1	227	PASS
	River View	Brentwood Rd	4	0	0	5	4	0	0	4	4	0	0	5	PASS
		Linford Rd	188	4	26	218	186	4	24	214	188	4	26	218	PASS
		Chadwell Hill	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Appendix C Journey time validation

Table C.1 07:00 – 08:00 JT Validation

Route	Name	Distance [m]		JT [s]		Difference		Validation <15% or <60s	Average Speed [mph]	
		Observed	Modelled	Observed	Modelled	Total [s]	%		Observed	Modelled
1	Treacle Mine Rbt to Daneholes Rbt	1859	1860	185	193	8	4%	PASS	22.5	21.6
2	Daneholes Rbt to Treacle Mine Rbt	1977	1976	264	275	11	4%	PASS	16.8	16.1
3	Daneholes Rbt to Orsett Cock	3300	3302	193	210	18	9%	PASS	38.4	35.2
4	Orsett Cock to Daneholes Rbt	3326	3327	219	223	3	2%	PASS	33.9	33.4
5	Daneholes Rbt to Marshfoot Rbt	1591	1591	95	103	9	9%	PASS	37.6	34.5
6	Marshfoot Rbt to Daneholes Rbt	1889	1890	142	135	-6	-4%	PASS	29.8	31.2
								100%	29.8	28.7

Table C.2 08:00 – 09:00 JT Validation

Route	Name	Distance [m]		JT [s]		Difference		Validation <15% or <60s	Average Speed [mph]	
		Observed	Modelled	Observed	Modelled	Total [s]	%		Observed	Modelled
1	Treacle Mine Rbt to Daneholes Rbt	1859	1860	191	212	21	11%	PASS	21.8	19.6
2	Daneholes Rbt to Treacle Mine Rbt	1977	1976	289	319	30	11%	PASS	15.3	13.8
3	Daneholes Rbt to Orsett Cock	3300	3302	205	216	10	5%	PASS	35.9	34.3
4	Orsett Cock to Daneholes Rbt	3326	3327	233	236	3	1%	PASS	31.9	31.5
5	Daneholes Rbt to Marshfoot Rbt	1591	1591	112	106	-6	-5%	PASS	31.9	33.7
6	Marshfoot Rbt to Daneholes Rbt	1889	1890	139	143	4	3%	PASS	30.3	29.5
								100%	27.9	27.1

Table C.3 17:00 – 18:00 JT Validation

Route	Name	Distance [m]		JT [s]		Difference		Validation <15% or <60s	Average Speed [mph]	
		Observed	Modelled	Observed	Modelled	Total [s]	%		Observed	Modelled
1	Treacle Mine Rbt to Daneholes Rbt	1859	1860	220	235	15	7%	PASS	18.9	17.7
2	Daneholes Rbt to Treacle Mine Rbt	1977	1976	259	288	29	11%	PASS	17.1	15.4
3	Daneholes Rbt to Orsett Cock	3300	3302	211	228	17	8%	PASS	34.9	32.4
4	Orsett Cock to Daneholes Rbt	3326	3327	227	224	-2	-1%	PASS	32.8	33.2
5	Daneholes Rbt to Marshfoot Rbt	1591	1591	103	111	8	8%	PASS	34.5	32.0
6	Marshfoot Rbt to Daneholes Rbt	1889	1890	140	130	-10	-7%	PASS	30.3	32.6
								100%	28.1	27.2

Appendix D Journey time validation charts

Plate D.1 Journey Time Validation Charts AM (7.00 – 8.00)

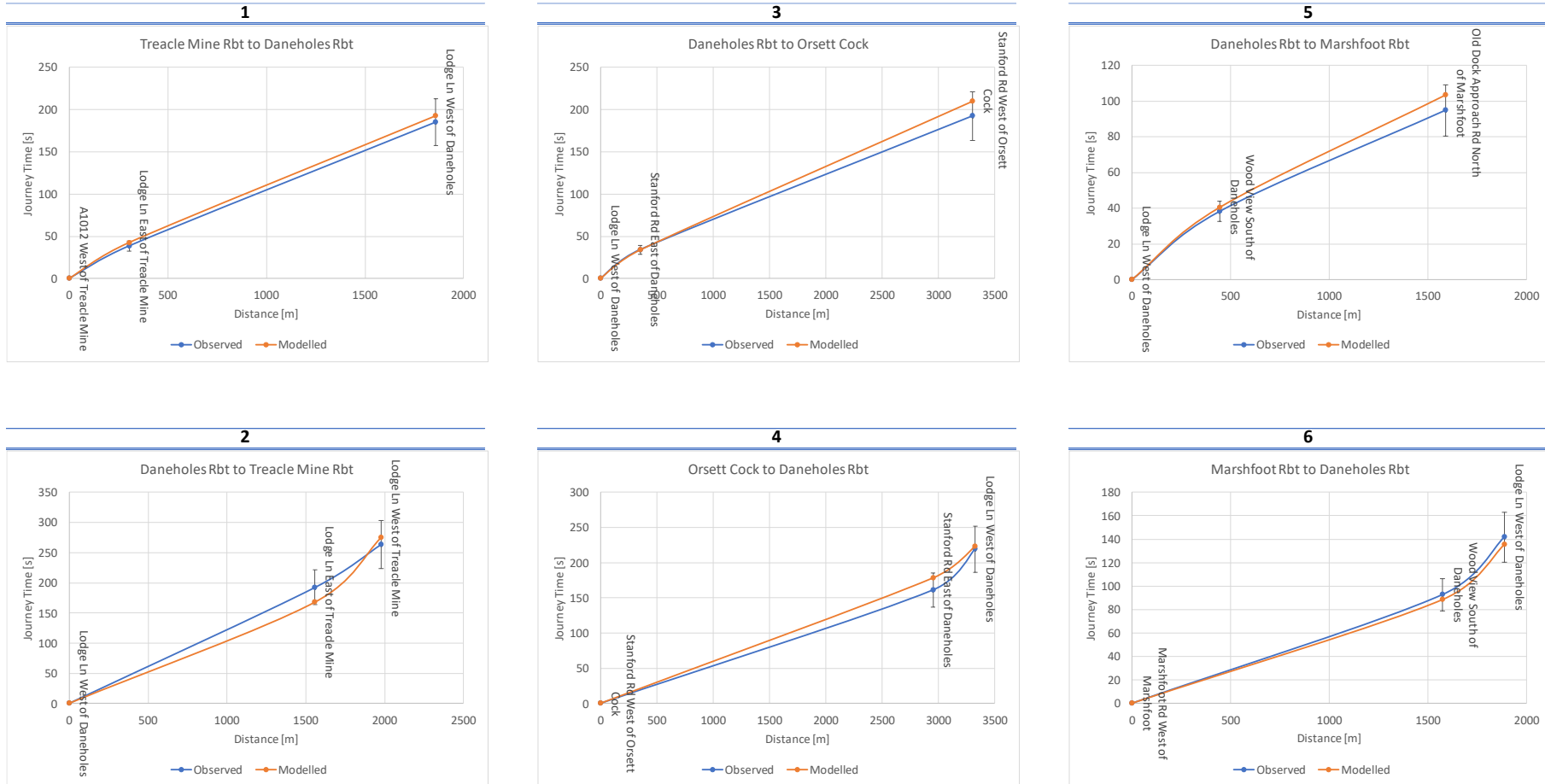


Plate D.2 Journey Time Validation Charts AM (8.00 – 9.00)

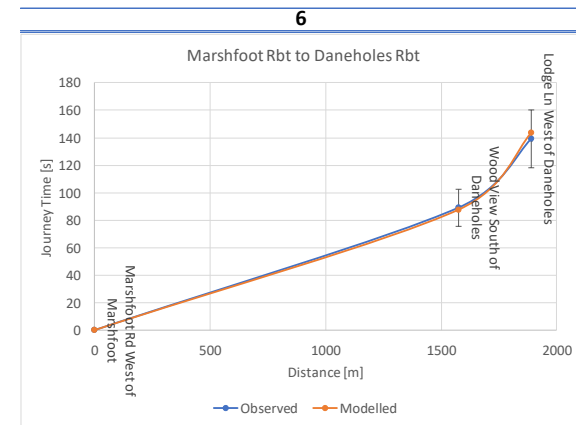
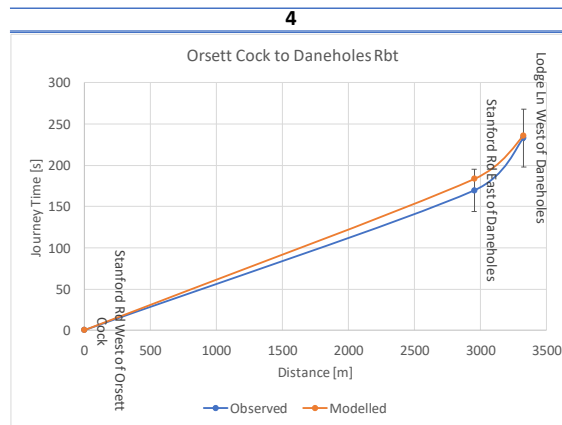
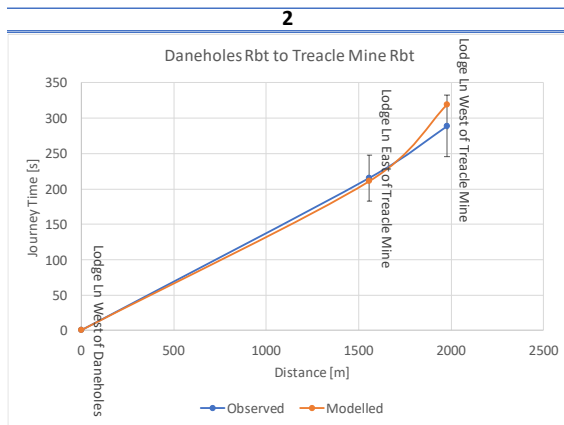
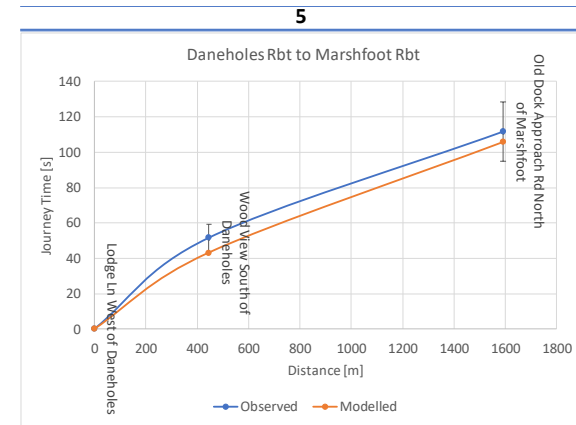
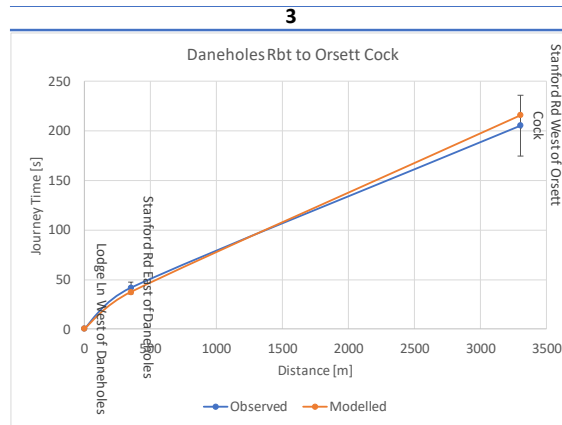
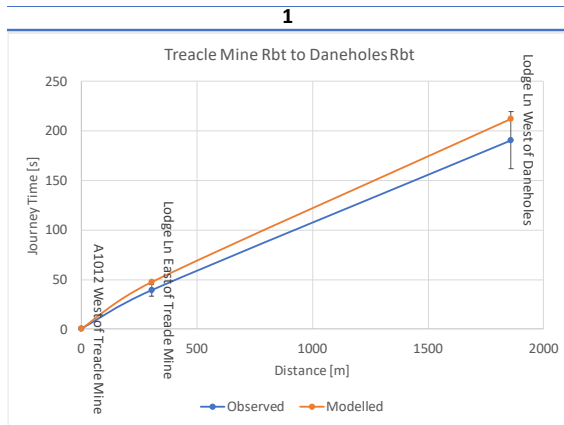
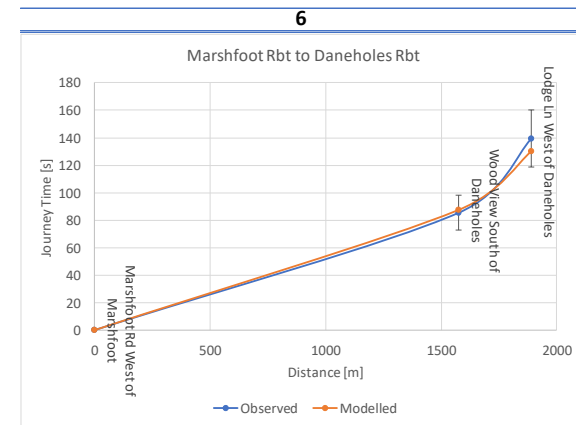
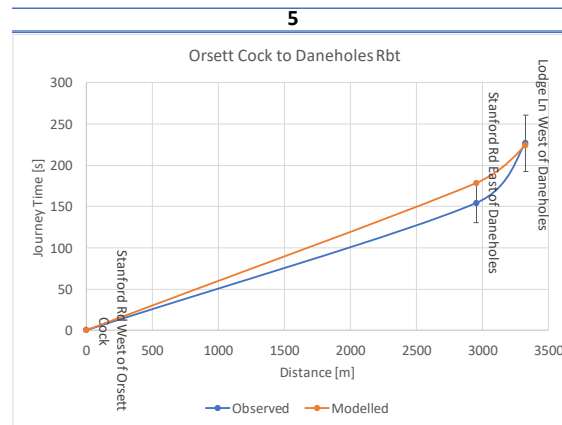
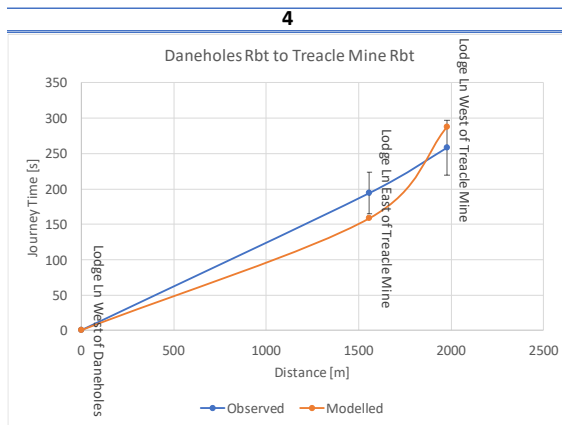
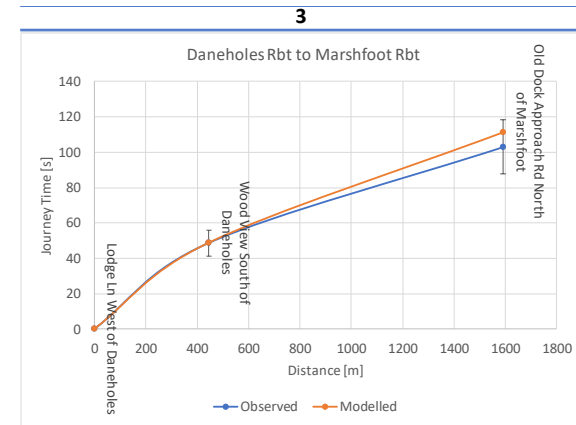
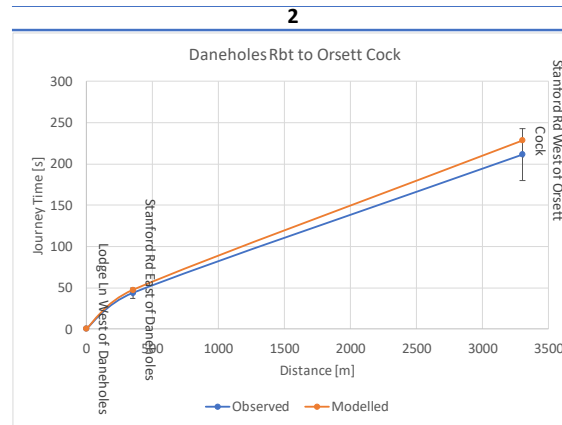
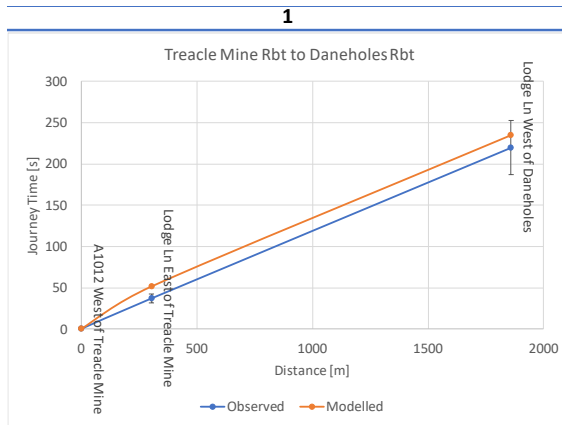


Plate D.3 Journey Time Validation Charts PM (17.00 – 18.00)



Appendix E Relative delay plots

Plate E.1 Relative Delay Plot AM (7.00 – 8.00)

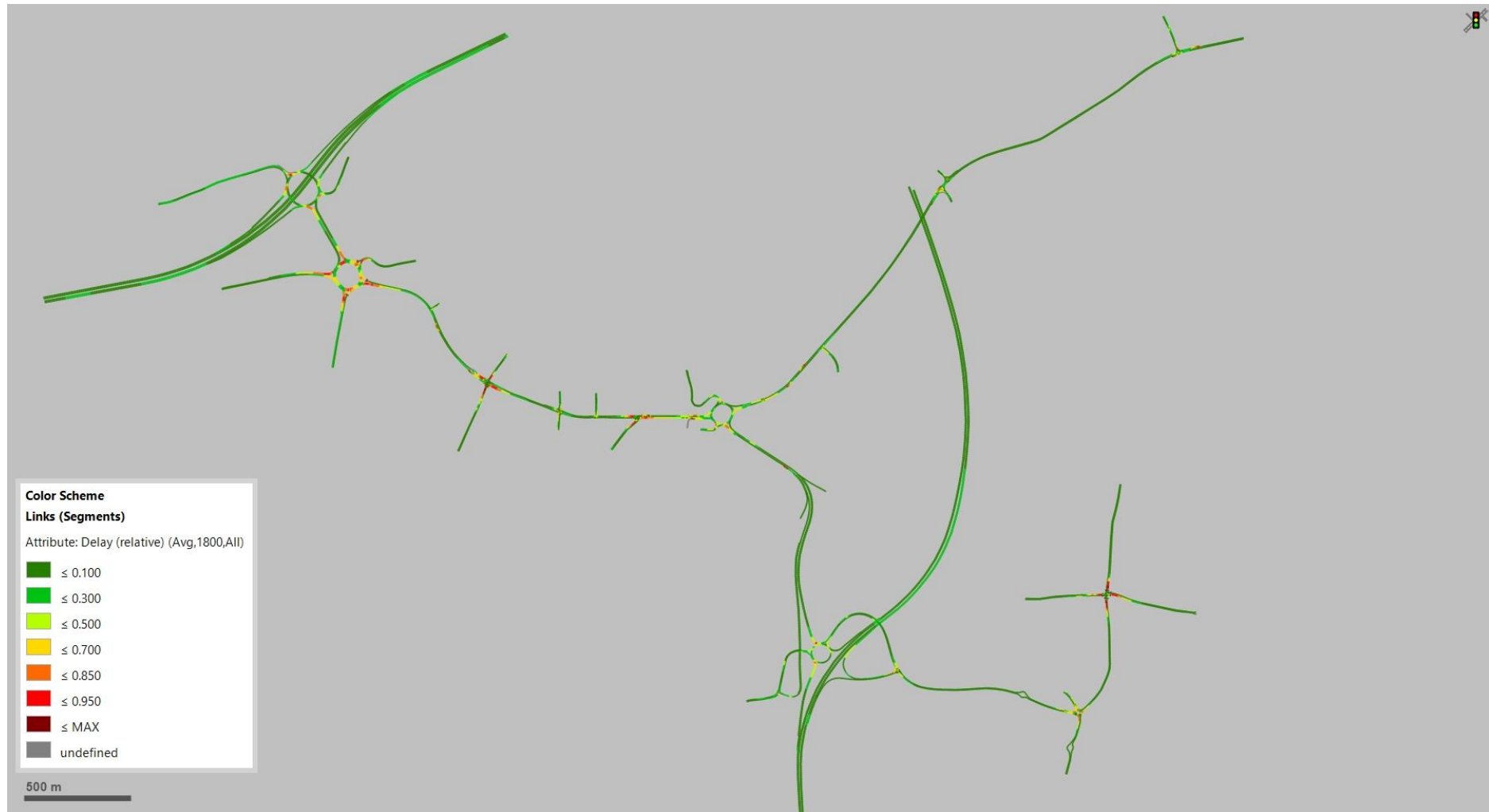


Plate E.2 Relative Delay Plot AM (8.00 – 9.00)

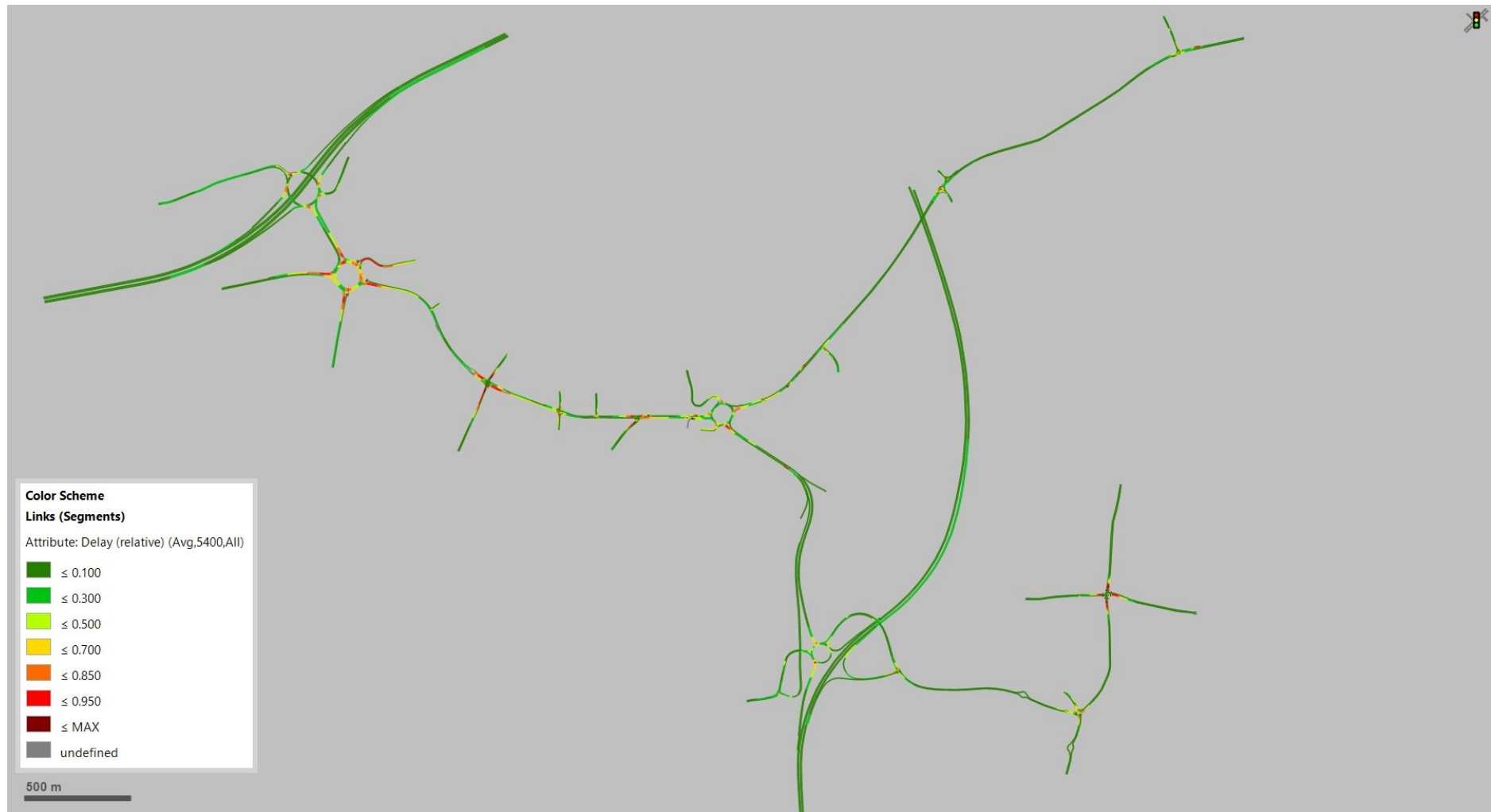
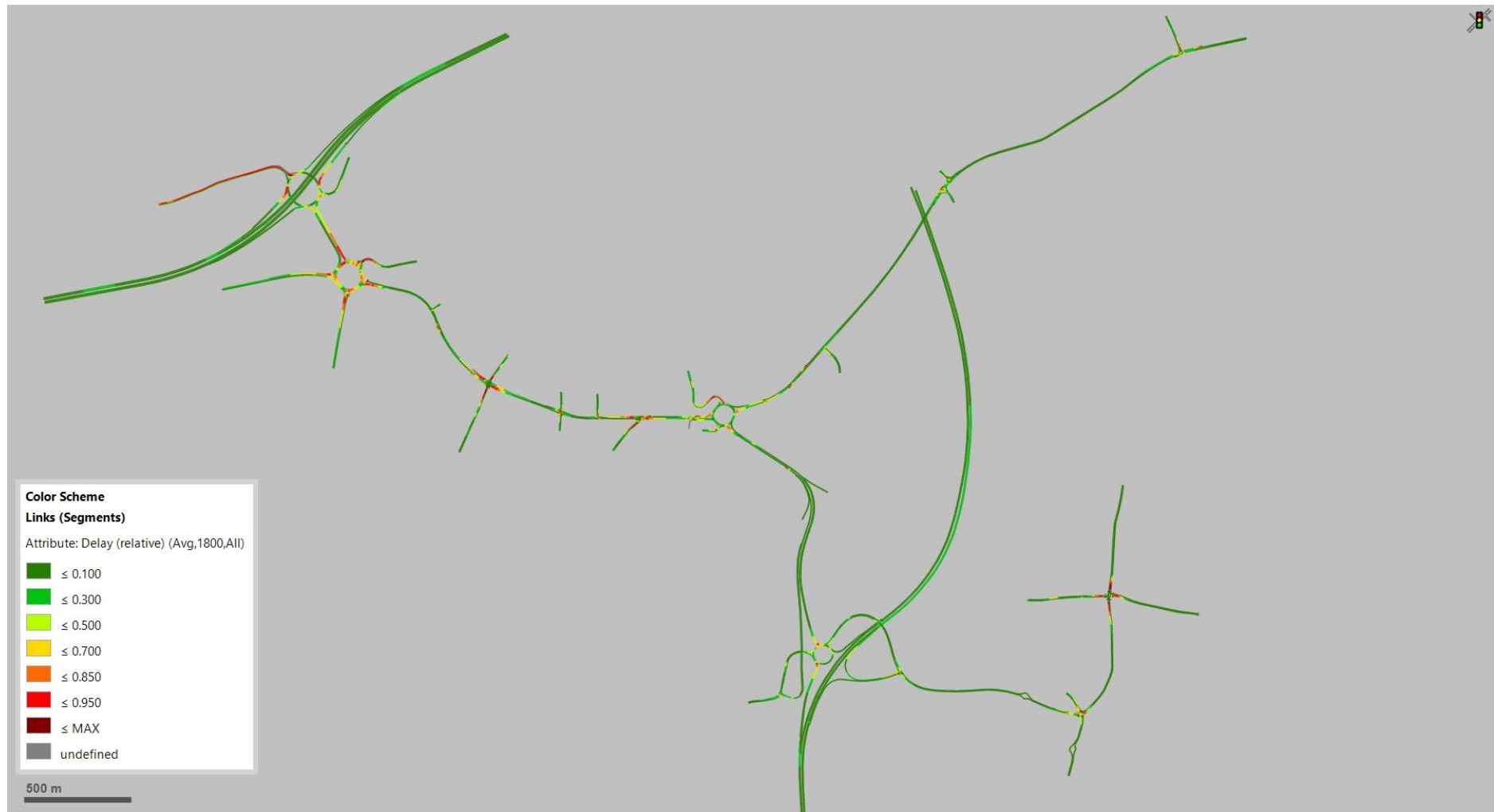


Plate E.3 Relative Delay Plot PM (17.00 – 18.00)



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