Technical note

Project:	East Grinstead Stage 3	**To:**	Chris Owen, Guy Perfect (WSCC)
Subject:	TN01 - Local Model Validation	**From:**	Yogesh Patel, Chris Cary (Atkins)
Date:	6 December 2011	**cc:**	Darryl Hemmings (WSCC) Farshid Kamali (Atkins)

1. Introduction

Atkins was commissioned by the West Sussex County Council (WSCC) to evaluate the network capacity at the five key junctions on A22 London Road between Felbridge and Moat Road as part of the East Grinstead Transport Advice Study (Stage 3). The key objective of Stage 3 Study is to develop schemes which were fully tested and costed during the Stage 1 and 2 Studies so the impact of the future development assessed. In addition the purpose of Stage 3 Study is to form part of the local planning document informing the decisions on development allocations for inclusion in Mid Sussex District Council's (MSDC) District Plan and to assist East Grinstead Town Council (EGTC).

The base LinSig and VISSIM models have been developed to provide a robust representation of the base year (2011) traffic conditions in the Study Area. This note is intended to report on the validation of the base models as a Local Model Validation Report (LMVR) to ascertain the appropriateness of the model for forecast assessment. Following the satisfactory validation of these base models it can be used with confidence to deduce the spare capacity available and to assess the impacts of any additional future developments.

2. Model Area

The base LinSig models have been developed for the AM and PM peak periods at following two junctions:

- Felbridge Junction - A22 London Road / A264 Copthorne Road (signal controlled); and
- A22 London Road / Imberhorne Lane (signal controlled).

The base VISSIM models have been developed representing AM and PM peak periods for the following junctions:

- A22 London Road / Lingfield Road (priority controlled roundabout);
- A22 London Road / Maypole Road (priority controlled);
- A22 London Road / Garland Road (priority controlled); and
- A22 London Road / Station Road (priority controlled);
- A22 Station Road / Park Road (priority controlled).
- A22 London Road / A264 Moat Road (priority controlled – associated with pedestrian crossing);

3. Model Development

3.1. Technical Advice and Guidance

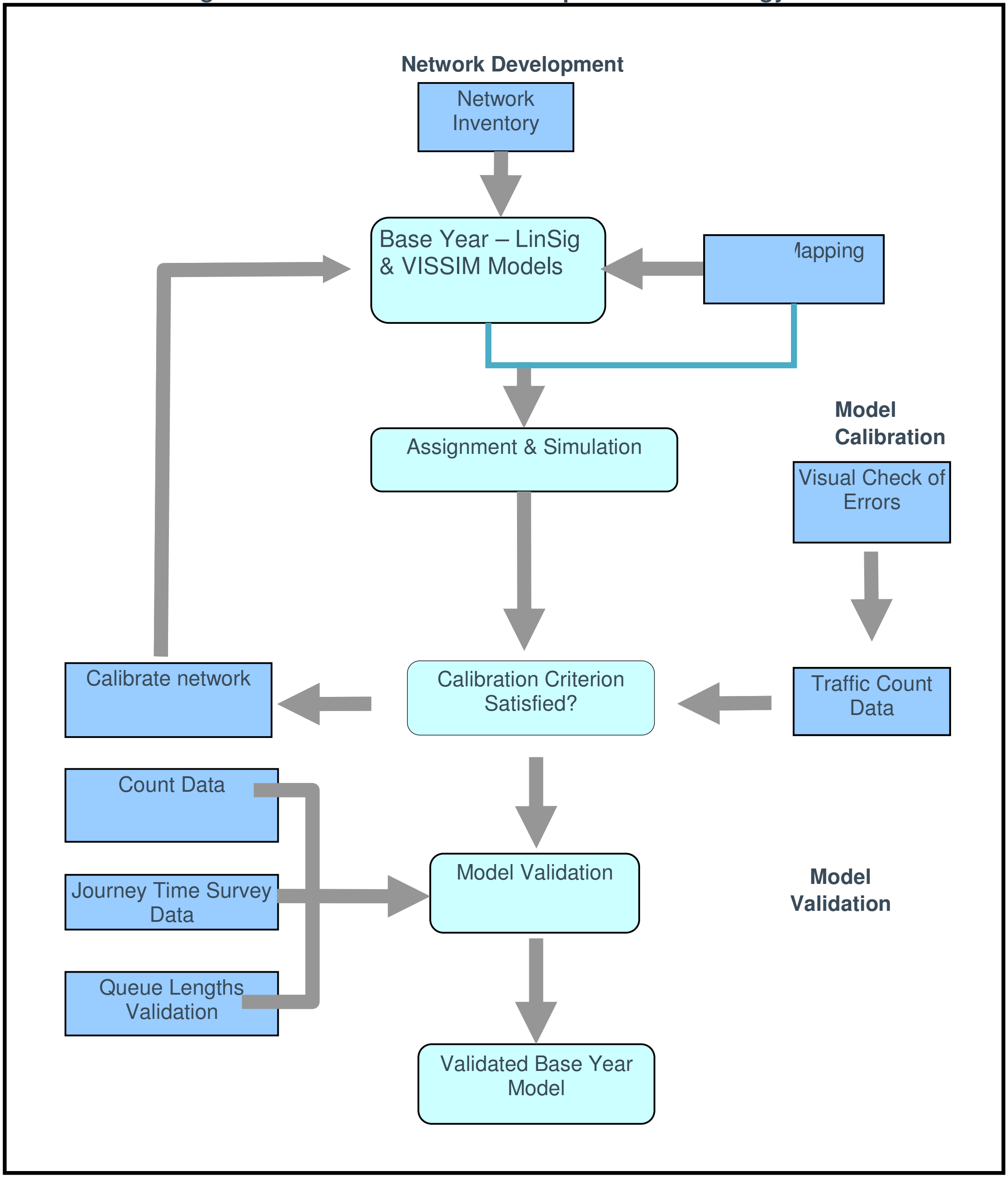
In the development of LinSig and VISSIM models, the following technical advice and guidance have been appropriately consulted:

- LinSig 3.1 User Guide (JCT Consultancy);
- VISSIM micro-simulation software was developed by PTV, Germany. PTV resources comprising the user manual, the PTV website for software specific literature and the Frequently Asked Questions (FAQ) section. These resources provided the necessary guidance required to implement and calibrate the model to reflect local conditions;

- Design Manual Road and Bridges (DMRB) Volume 12, section 1, Part 1: Traffic Appraisal of Road Schemes, which provides guidance on the calibration and validation of traffic models; and
- The Highway Agency's (HA) guidelines for the use of micro-simulation software (July 2007).

In mind of the recommended procedures in the above documentation, Figure 1 illustrates the model development methodology in developing the A22 London Road East Grinstead base models.

Figure 1. Base Model Development Methodology



3.2. Network Development

3.2.1. Network Geometry Data

Both LinSig and VISSIM models have been developed based on OS mapping and aerial mapping received from the WSCC. However these mappings have been verified during the site visit in terms of the lane restrictions, flare lengths, parking and loading restrictions, bus stop locations.

The Base VISSIM model has been developed employing static assignment tools.

3.2.2. Traffic Data

Traffic flows inputs were sourced from the recent traffic surveys conducted in November 2011. Manual Classified Counts (MCC) were carried out on 01st November 2011 coinciding with the queue lengths, journey times and Automatic Traffic Counts (ATC). ATC surveys were conducted from 30/10/11 to 06/11/11.

MCC and queue length surveys were collected over a 12 hour period (0700-1900 hours) at the following junctions:

- A22 London Road / A22 Eastbourne Road / A264 Copthorne Road;
- A22 London Road / Imberhorne Lane;
- A22 London Road / Lingfield Road;
- A22 London Road / Station Road;
- A22 London Road / A264 Moat Road;
- A22 London Road / Maypole Road;
- A22 London Road / Garland Road;
- A22 Station Road / Park Road;
- Park Road / Maypole Road; and
- Park Road / Garland Road.

Maypole Road and Garland Road junctions with Park Road have not been included in the modelling at this stage.

ATC data have been collected at the following locations coinciding with the other traffic surveys:

- A22 Eastbourne Road north of the junction with the A264 Copthorne Road;
- A264 Copthorne Road west of the junction with the A22;
- Imberhorne Lane south of the junction with the A22 London Road;
- A22 London Road between the Lingfield Road and Newlands Crescent junctions;
- Lingfield Road north of the junction with the A22 London Road;
- A22 London Road between the Maypole Road and Garland Road junctions;
- A264 Moat Road north of the junction with the A22 London Road;
- A22 London Road between the A264 Moat Road and St James's Road junctions; and
- A22 Station Road south of the junction with the A22 London Road.

The comparison between MCC and ATC flow shows that MCC flows are generally higher than average weekdays ATC flows at A22 London Road corridor. In this instant, MCC flows are considered more accurate compared to ATCs as these flows have been manually processed. Therefore MCC flows have been employed in the development of VISSIM models.

A journey time survey has also been undertaken during the morning (0730-0930) and evening (1700-1900) peak hours to cover the A22 London Road corridor between the A264 Copthorne Road and A264 Moat Road junctions. The journey time segments have been alternated to start on either the A22 Eastbourne Road or A264 Copthorne Road prior to the A22 London Road / A22 Eastbourne Road / A264 Copthorne Road junction at the western end, using the Station Road one way system to turn around at the eastern end. Based on DMRB guidance journey time survey has been carried out for minimum 10 runs.

Traffic survey data locations are outlined in Appendix A.

3.2.3. Model Time Periods

The MCC traffic surveys have been collected in fifteen minute intervals. From this data, the busiest peak hours have been established as follows:

- AM Peak Hour, from 0830 to 0930 hours; and
- PM Peak Hour, from 1700 to 1800 hours.

The LinSig and VISSIM AM and PM Peak Hour models have therefore been based on the above identified peak hours.

Peak hour vehicle traffic has been applied for two vehicle classes: cars/light goods vehicles (LGVs) and heavy goods vehicles (OGV1, OGV2s). Vehicle compositions have been derived from the observed traffic count data. The specific flows have been assigned on the routes within the network for both peak hours.

In order to achieve a realistic model performance at the beginning of the peak hour, additional traffic has been loaded onto the network prior to the start of the peak hour assessments which represent the "warm-up" periods; this has also been obtained from the MCC traffic survey data. The model loads 15 minutes pre peak hour traffic onto the network during the warm-up periods to ensure the network is populated prior to the peak hour of assessment. This is common practice to provide a realistic representation of the network performance. The model has also been set to run for 15 minutes after the peak hour which represent "cool-down" period. In order to assess the traffic situations at the end of the peak hour during this "cool-down" period no demands has been loaded onto the network.

Therefore the total VISSIM model simulation period will be:

- AM Peak Hour, from 0815 to 0945 hours; and
- PM Peak Hour, from 1645 to 1815 hours.

The traffic flows were balanced across the survey area on the turning movement diagrams giving priority to the A22 London Road counts. For example, A22 London Road flows have been used as a benchmark and other side road movements have been balanced based on the existing turning movements. This is achieved by tracing back the flows across the road network. The balanced turning movement diagram is presented in Appendix B.

The balanced flows were used to create a macro enabled excel spreadsheet designed for VISSIM model inputs, calibration and validation. In order to calibrate and validate the base VISSIM models, the spreadsheet has allowed direct comparison of the modelled and observed flows.

3.2.4. Model Parameters

Signal specifications for all signal controlled junctions including signal timings at pedestrian crossings have been obtained from WSCC. This signal cycle times have been employed for respective junctions in both LinSig and VISSIM models. The signal specifications have been supplemented by observed cycle timings during the site visits.

3.2.4.1. VISSIM Model Parameters

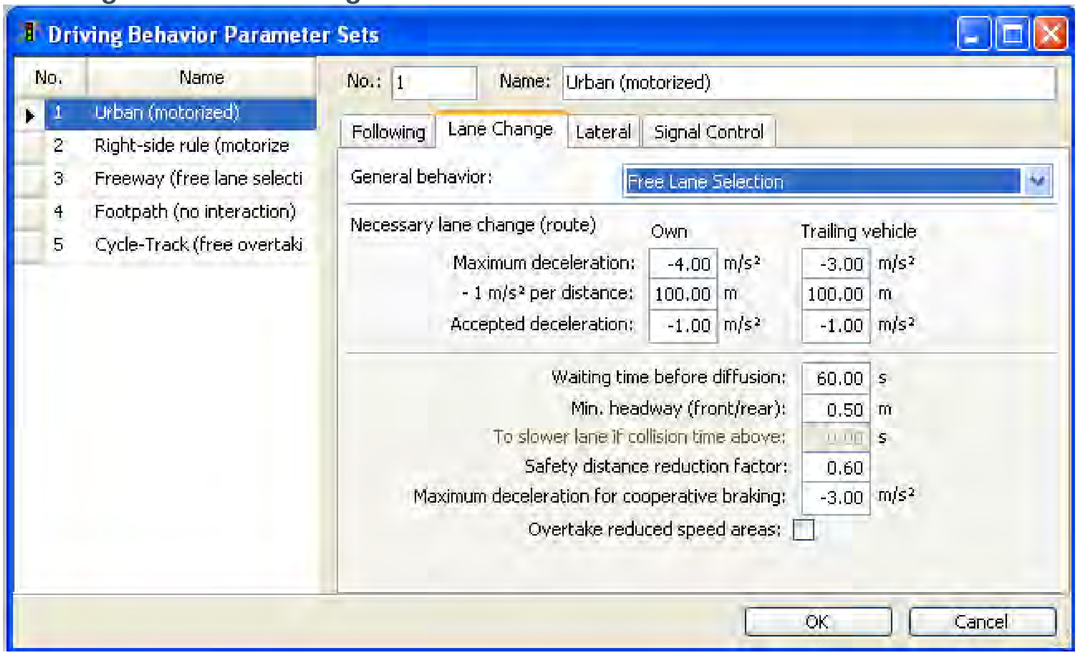
Bus dwell times have been received from WSCC for all the routes and this has been implemented in the base VISSIM models.

Network speed profiles have been derived from the ATC surveys based on recorded average speeds between Monday to Friday.

Default model parameters (base data) have been used in the majority of factors. Based on the site observations default 2 metre average standstill distance appears to be high on urban road link type therefore this has been updated to 1.1 metre.

As there is no motorway road type characteristics exist within the Study Area therefore only urban motorised behaviour parameters have been employed. Prior to model calibration stage all the lane change parameters have been kept at the default values as shown in Figure 2 below.

Figure 2. Driving Behaviour Parameters Urban Motorised Links



3.2.5. Network Coverage

Figure 3 provides VISSIM base model network, covering all the key junctions of the Model Area. The model run screenshots are presented in Appendix C for both the AM and PM Peak Hours.

The junction network layouts in LinSig are presented in Figures 4 and 5 for the Felbridge and Imberhorne Lane junctions respectively.

Figure 3. Base VISSIM Model Area

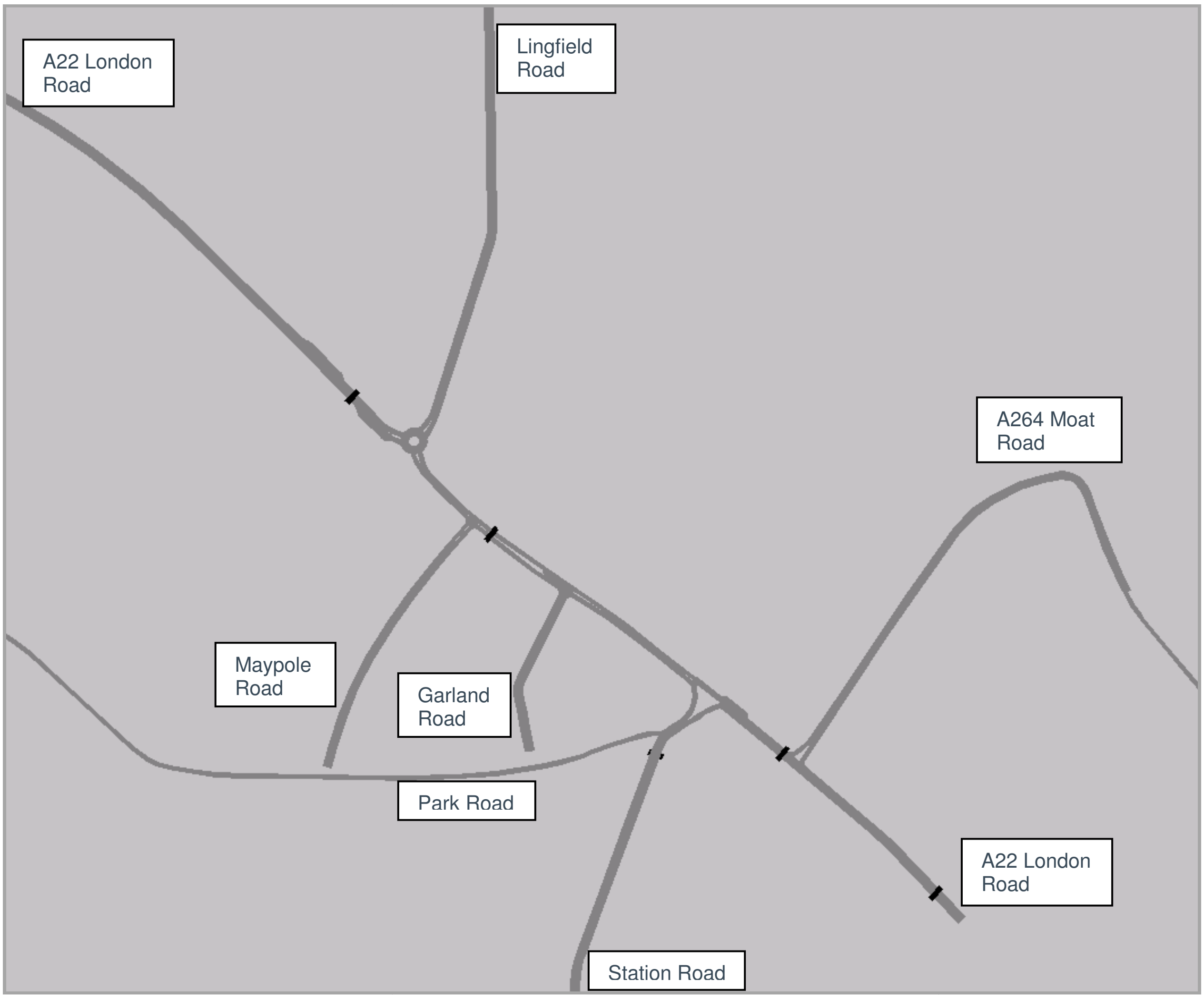


Figure 4. Felbridge Junction – A22 London Road / Copthorne Road

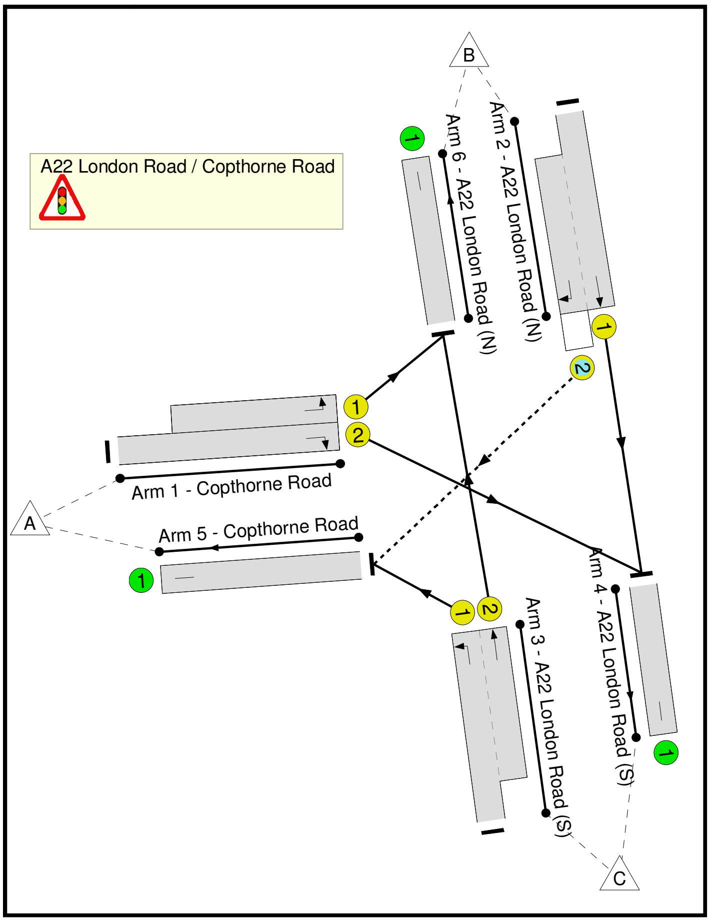
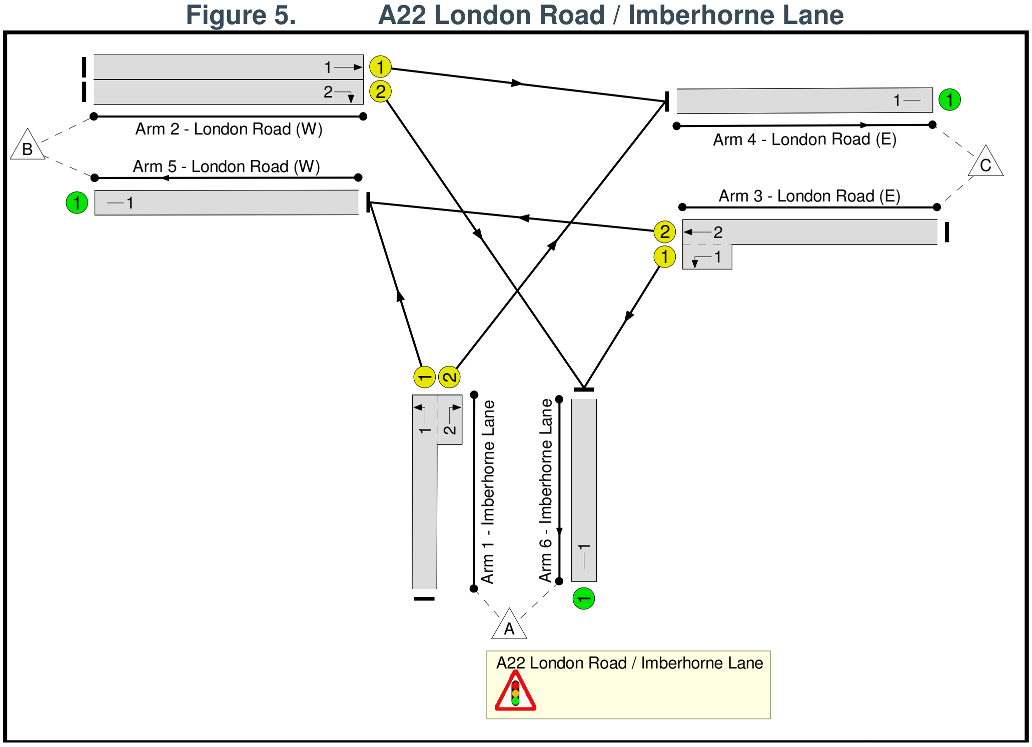


Figure 5. A22 London Road / Imberhorne Lane



4. Model Validation Criteria

4.1. Introduction

Model calibration entails checking that the model is performing logically and that all the elements of the network are accurately represented.

Model calibration is the process of tuning and refining the input data and parameters within the model in order for them to match with the observed data and traffic behaviour, thus providing a reliable tool upon which to base judgements.

4.2. Model Validation Criteria

4.2.1. Flows Validation Criteria

The DMRB sets out the criteria for the calibration and validation of traffic models. These relate mainly to the GEH statistic which is the standard method of comparing the modelled flows against observed flows and are discussed in the next chapter.

The GEH statistic was adopted as the main indicator of 'accuracy of fit' for the base models, i.e. the extent to which modelled traffic flows match corresponding observed traffic flows. The GEH statistic is a form of the chi-squared statistic described in Traffic Appraisal in Urban Areas - Chapter 4 (DMRB Vol. 12a). It is defined as:

$$GEH^{1} = \sqrt{\frac{(M-C)^2}{(M+C)/2}}$$

Where M = modelled flow; and

C = observed flow (or count).

4.2.2. Journey Times Validation Criteria

It is important that journey times are properly validated to make sure that traffic speeds on the modelled links and delays at junctions are accurately represented by the base model. This will give confidence in the model's ability to correctly forecast the likely impacts of changing traffic demand in the forecast scenarios. The criteria set out in DMRB are "Modelled journey times should be within ±15% of observed times (or ± 1 minute) on 85% of routes". This DMRB standard has been adopted in base VISSIM model validation.

4.2.3. Queue Lengths Validation Criteria

DMRB Volume 12, Section 2, Chapter 3: 'Data Requirements' (1996) states that "Queue length […] measurements provide information for the calibration of congested assignment models", although no specific comparison criteria is defined for validation purposes. An approximate criterion has therefore been assumed for comparison of observed and modelled queue lengths. However this is purely for informative purposes and will not be strictly considered in the model validation process.

4.3. Model Calibration Process

During the calibration process, the network has been comprehensively scrutinised and checked for errors through an internal audit process. Adjustments have been made as necessary to remove any errors, and to improve the overall performance of the model based on comparisons with the observed data. The following checks and adjustments were made after an internal audit:

[1] The GEH statistic was created by G.E. Havers and the term GEH is taken from his initials.

- Vehicles on A22 Station Road not able to find suitable gaps to change the lane in order to travel to A22 London Road northbound. Therefore default lane change distance at this location of 200 metres has been modified to 700 metres;
- HGVs were noticed crashing at Lingfield Road roundabout with Cars therefore higher gap times have been employed for HGVs; and
- Vehicles were not able to enter the network due to traffic congestion from Park Road, Moat Road and A22 Station Road therefore these links into the network have been extended further back in order to load all the demand.

After the above changes all the vehicles able to enter VISSIM network and has just two vehicles removed from the network due to unable to change the lane at A22 Station Road. Model calibration has been performed to collect five evaluation outputs and based on 95% confidence interval of each random seed's variation the starting random seed for the multi-run has been established.

4.4. Traffic Assignment in VISSIM

Traffic has been assigned to the highway network based on static route patterns from points of origin to destination. Actual traffic travelling on each of the routes is derived from the observed turning movement proportions.

The static assignment option in VISSIM allows the assigning of actual demand on a specific route. This technique is mostly adopted for a small network where limited or no potential route choices are available, which is the case for East Grinstead VISSIM model.

The base VISSIM model has each 15 minute peak period traffic segment derived from the MCC data. These 15 minutes flow profiles have been allocated to a specific route onto the existing network. Vehicle types and classifications are also derived from the MCC data for the respective peak hour traffic. This data is used to determine the vehicle class for input into the base network. Each vehicle class consisting of a vehicle type is employed to determine the vehicle characteristics such as performance and appearance.

There are two key advantages in using the static assignment:

- In a network possible routes between origins to destinations are fixed. The assigned flows on these routes represent the realistic conditions on the ground; and
- Key assessment indicators such as queue lengths, junction delays and journey times are more reliable to compare in the future year scenario as dynamic assignment might provide more significant variation in these.

The calibrated model has been simulated for five iterations for different random seeds to derive the suitable random seed to represent realistic behaviour for the journey time and queue validation process. Furthermore this process also ensures that simulation variation has achieved within 95 per cent confidence interval. The turning movement, link flows, journey times and queue lengths validation is described in detail in the next section.

5. Model Validation

5.1. LinSig Model Validation

The LinSig models were developed to evaluate the queue lengths, delays, and Degree of Saturation (DoS) at both junctions. Degree of Saturation (DoS) is a quantitative analysis of the level of congestion on the network and is used as the primary indicator of the operational performance of the junction. Generally, when a junction reaches 90 percent DoS it is considered to be at practical capacity and when it reaches 100 percent, at theoretical capacity.

The relationship between queues and DoS is such that queues begin to increase exponentially at high DoS (>85%). At junctions operating close to the zero practical reserve capacity, even small reductions in capacity can result in a significant increase in queuing and delay.

For validation purposes, comparisons of the modelling results were undertaken against observed queue data. The results of the queue comparisons and the other model results are presented in the tables below.

The queues are presented in terms of the average maximum queue in vehicles from the surveys and the mean max queue (MMQ) in PCUs (passenger car units) in LinSig. The PCUs are comparable to vehicles, with one PCU representing one car unit.

Table 5.1 – Summary of LinSig Validation and Results AM Peak Hour

A22 London Road / Copthorne Road	Observed Queue (vehs)	Modelled Queue (pcus)	DoS (%)	Average Delay (s/pcu)
A262 Copthorne Road	24	30	96	62
A22 Eastbourne Road (N)	11	9	84	46
A22 London Road (S)	15	10	80	14
A22 London Road / Imberhorne Lane				
Imberhorne Lane	17	15	75	45
A22 London Road (N) Ahead	4	6	42	5
A22 London Road (N) Right Turn	13	19	95	97
A22 London Road (S) Ahead / Left	19	23	76	27

Table 5.2 – Summary of LinSig Validation and Results PM Peak Hour

A22 London Road / Copthorne Road	Observed Queue (vehs)	Modelled Queue (pcus)	DoS (%)	Average Delay (s/pcu)
A262 Copthorne Road	22	26	91	45
A22 Eastbourne Road (N)	16	16	77	37
A22 London Road (S)	12	12	86	19
A22 London Road / Imberhorne Lane				
Imberhorne Lane	14	16	78	48
A22 London Road (N) Ahead	7	10	57	6
A22 London Road (N) Right Turn	6	17	91	84
A22 London Road (S) Ahead / Left	18	20	72	26

The queue length results presented in the tables above show a good comparison between the observed and the modelled queues at both junctions. The modelled queue on Copthorne Road appears higher than the observed queue for both peak periods; however it was apparent from site visits that this queue extended quite far back and the surveyor not be able to count vehicles stretching this far (i.e. beyond 100 metres).

The DoS results show that both junctions are currently operating just over their practical capacity and close to theoretical capacity in both peak periods, with the highest DoS in the AM Peak Hour recorded as 96% on Copthorne Road and 95% on A22 London Road (N) right turn at Imberhorne Lane. This is consistent with the conditions that have been observed during the site visit.

5.2. VISSIM Model Validation

The DMRB modelling guidelines state that model output results should be compared with on-street measurements to validate the base model. Therefore observed MCC's, journey time measurements and queue length records have been compared with the modelled outputs in order to ensure that the East Grinstead base VISSIM model accurately reflects the existing situation within the Study Area.

5.2.1. Turning Movements and Link Flows

Tables 5.3 and 5.4 summarised AM and PM Peak periods vehicle classified flows assigned to the base network respectively.

Table 5.3 – Traffic Volume AM Peak Period

Vehicle Class	Warm-up 0815 - 0830	Peak Hour 0830 - 0930	Total
Car/LGV/HGV/ Coach	3,083	12,267	15,350
Buses	6	53	59
Total	3,089	12,320	15,409

Table 5.4 – Traffic Volume PM Peak Period

Vehicle Class	Warm-up 1645 - 1700	Peak Hour 1700 - 1800	Total
Car/LGV/HGV/ Coach	3,163	13,635	16,798
Buses	9	45	54
Total	3,172	13,680	16,852

A total of 28 turning movements and 10 link flows were analysed, Table 5.5 presents a summary of the overall turning counts validation at all six junctions for the AM and PM Peak Hours. The individual turning movement validation at these locations is depicted in Appendix D. The validation results presented in the following table is based on an average of five random seed model runs.

Table 5.5 – Summary of Overall Turning Movements Validation AM & PM Peak Hours

AM Peak Hour	Observed Flows	Modelled Flows	Difference (%)	GEH
A22 London Rd/ Lingfield Rd Jn	2,217	2,158	-3	1.25
A22 London Rd/Maypole Rd Jn	2,136	2,075	-3	1.33
A22 London Rd/Garland Rd Jn	2,034	1,987	-2	1.05
A22 London Rd/Station Rd Jn	2,480	2,364	-5	2.36
A22 London Rd/A264 Moat Rd Jn	1,963	1,818	-7	3.34
Park Rd/Station Rd Jn	1,490	1,394	-6	2.53

PM Peak Hour				
A22 London Rd/ Lingfield Rd Jn	2,348	2,270	-3	1.62
A22 London Rd/Maypole Rd Jn	2,281	2,217	-3	1.35
A22 London Rd/Garland Rd Jn	2,282	2,215	-3	1.41
A22 London Rd/Station Rd Jn	2,871	2,755	-4	2.19
A22 London Rd/A264 Moat Rd Jn	2,142	2,025	-5	2.56
Park Rd/Station Rd Jn	1,756	1,696	-3	1.44

The turning movement evaluation demonstrates that East Grinstead base AM and PM Peak Hour models have satisfactorily achieved DMRB's recommended GEH validation criteria for all (100 per cent) the individual movements.

In addition to the turning movements validation, link flows validation have been carried out at the critical links and documented in Appendix D. Tables 5.6 and 5.7 presents summary of the link flows validation at A22 London Road, A264 Moat Road and A22 Station Road Junctions for both the AM and PM Peak Hours respectively.

Table 5.6 – Summary of Link Flows Validation AM Peak Hour

Links	Observed Flows	Modelled Flows	% Difference	GEH
A22 London Road (W) Inbound	631	629	0	0.09
A22 London Road (W) Outbound	689	647	-6	1.63
Lingfield Road Inbound	538	517	-4	0.91
Lingfield Road Outbound	487	489	0	0.10
Station Road Inbound	1,216	1,191	-2	0.74
A22 London Road (E) Outbound	1,546	1,431	-7	2.99
Moat Road Inbound	470	424	-10	2.20
Moat Road Outbound	417	383	-8	1.72

The AM Peak Hour modelled link flows at A22 London Road/ Moat Road Junction (A22 London Road (E) out bound) has 7 per cent difference compared to count data with GEH value of 2.99, which is acceptable and well below recommended value of 5.

Table 5.7 – Summary of Link Flows Validation PM Peak Hour

Links	Observed Flows	Modelled Flows	% Difference	GEH
A22 London Road (W) Inbound	703	620	-12	3.23
A22 London Road (W) Outbound	842	842	0	0.01
Lingfield Road Inbound	503	511	2	0.34
Lingfield Road Outbound	413	400	-3	0.67
Station Road Inbound	1,517	1,505	0	0.31
A22 London Road (E) Outbound	1,664	1,573	-1	2.26

Moat Road Inbound	401	383	-5	0.92
Moat Road Outbound	478	441	-8	1.71

Similar results as AM Peak Hour also evident in the PM Peak Hour link flow validation at A22 London Road corridor, which demonstrates that all GEH values are well below 5, with maximum GEH value of 3.23 at A22 London Road/ Lingfield Road Junction (A22 London Road (W) Inbound). The graphical view of observed flows Vs model flows and GEH for AM Peak and PM Peak are also shown in Appendix D.

It is recognised that overall modelled turning movement flows are slightly less than observed flows in both the AM and PM Peak Hour. Similar results are also noticed in the modelled link flows validation. The main reason for this is because the A22 London Road corridor experiences very heavy congestion. As a result of that at the end of the peak hour simulation 440 vehicles were still in the AM Peak Hour network and 350 vehicles were in the PM Peak Hour network. These vehicles are left the network during the cool-down period, which leads to slightly less modelled throughput flows compared to the surveyed flows. However, it should be noted that all the GEH values are less than the DMRB's recommended value of 5.

5.2.2. Journey Times

The journey time routes and location of measurement points are shown in Appendix A. The overall journey time validation is presented in Table 5.8 for the AM and PM Peak Hours.

Table 5.8 – Summary of Journey Times Validation AM & PM Peak Hours

AM Peak Hour	Modelled Time (Sec)	Observed Time (Sec)	Difference (%)	Acceptability (±15%)
Route 1	91.1	91.0	0.1	√
Route 2	200.4	210.0	-4.6	√
PM Peak Hour				
Route 1	90.9	95.0	-4.4	√
Route 2	142.9	132.0	8.3	√

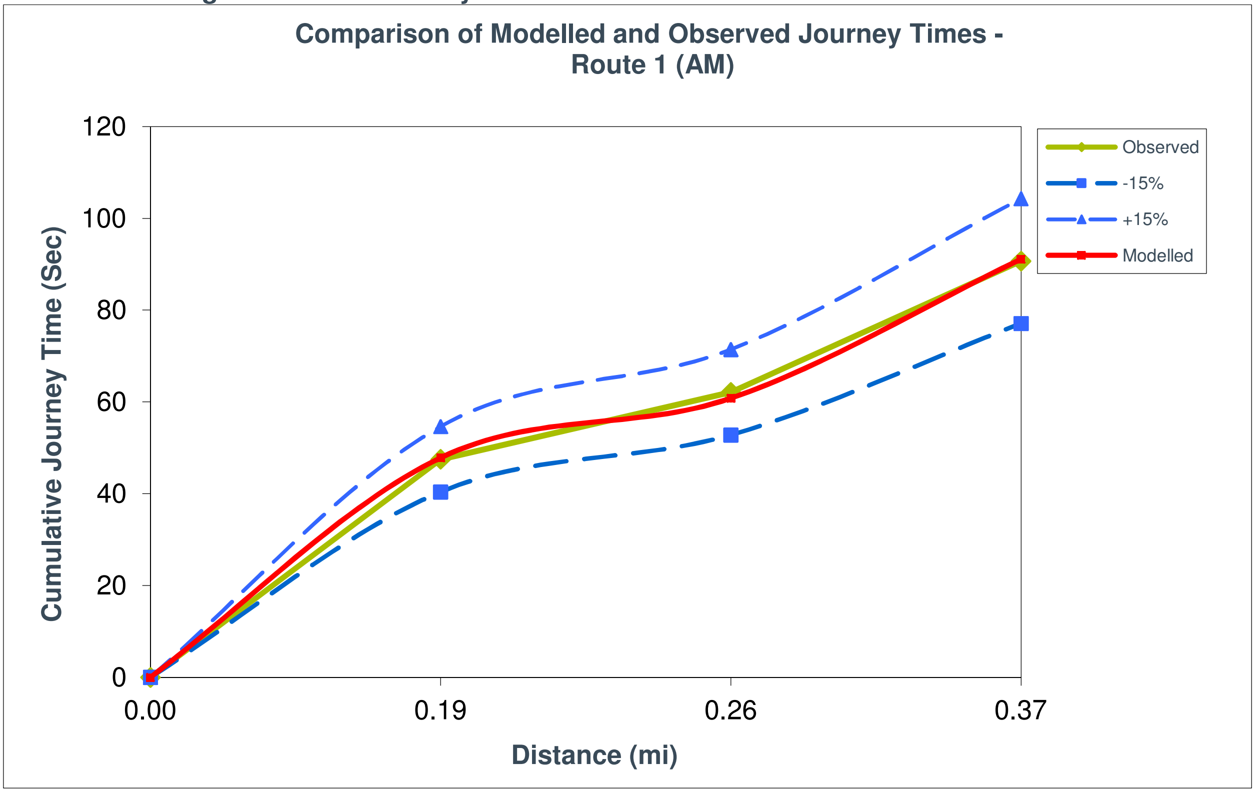
The overall modelled journey time for general traffic on Route 1, which starts from the A22 London Road (West of Lingfield Road) to A22 London Road (East of Moat Road) was 91.1 seconds compared to the average observed journey time of 91 seconds in AM Peak and was 90.9 seconds compared to the average observed journey time of 95 seconds in PM Peak. Figure 6 illustrates the comparison between observed and modelled journey time, and how the modelled journey time comfortably achieves ±15% criteria of the observed journey times (Appendix E provides detail calculation for individual segment values).

The modelled journey time for general traffic on Route 2, which starts from Station Road to the A22 London Road/ Lingfield Road Junction in the morning peak hour is 200.4 seconds compared to an acceptable observed journey time of 210 seconds. The modelled evening peak journey time for Route 2 was 142.9 seconds compare to observed journey time of 132 seconds. The Route 2 modelled journey time is within ±15% of the observed journey in both the AM and PM Peak Hours.

The difference between observed and modelled journey time for Route 2 is 4.6 and 8.3 per cent in the AM and PM Peak Hour respectively. Figure 7 shows Route 2 individual journey time segments are within ±15% of the observed journey times. Detailed information on the individual journey time segments is presented in Appendix E.

The East Grinstead base model is validated against observed journey times. Therefore base model deemed to be fit for the forecast assessment and base VISSIM model network parameters should be adopted in the forecast year scenario appraisal.

Figure 6. Journey Times Validation Route 1 AM & PM Peak Hours



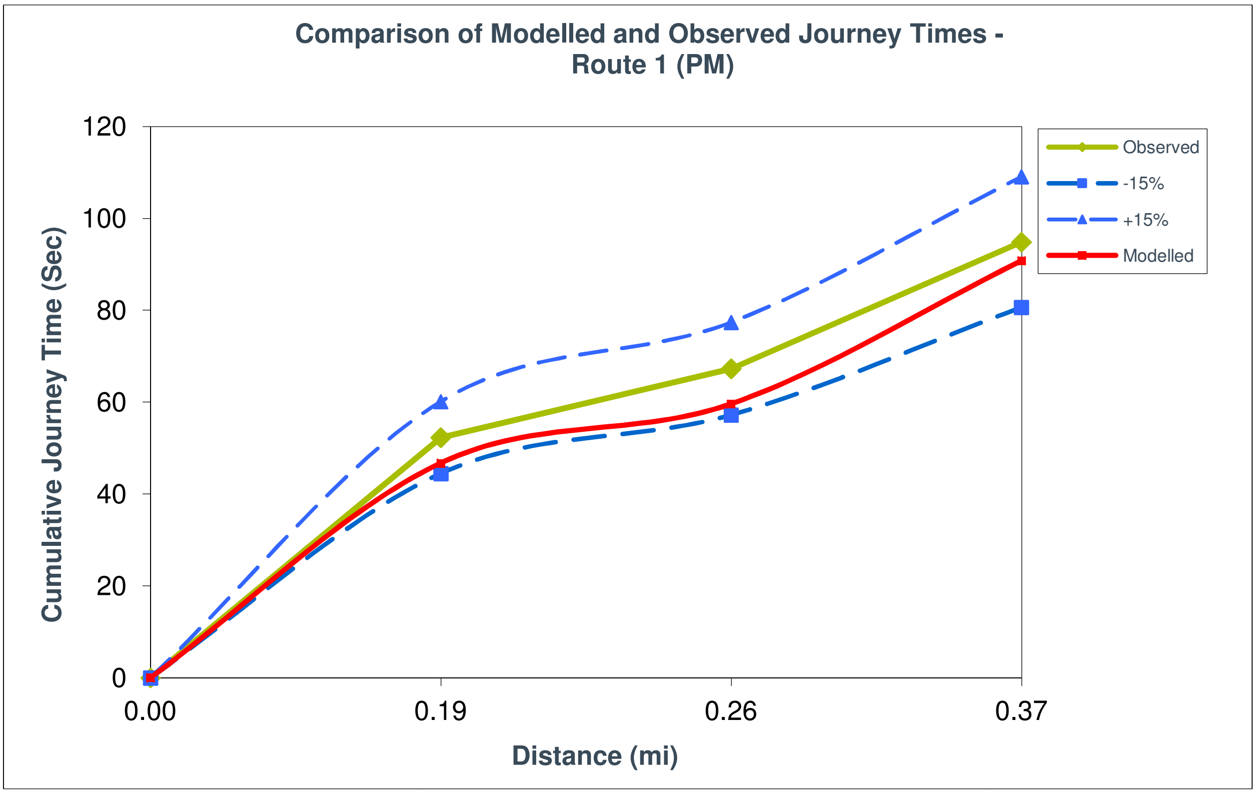
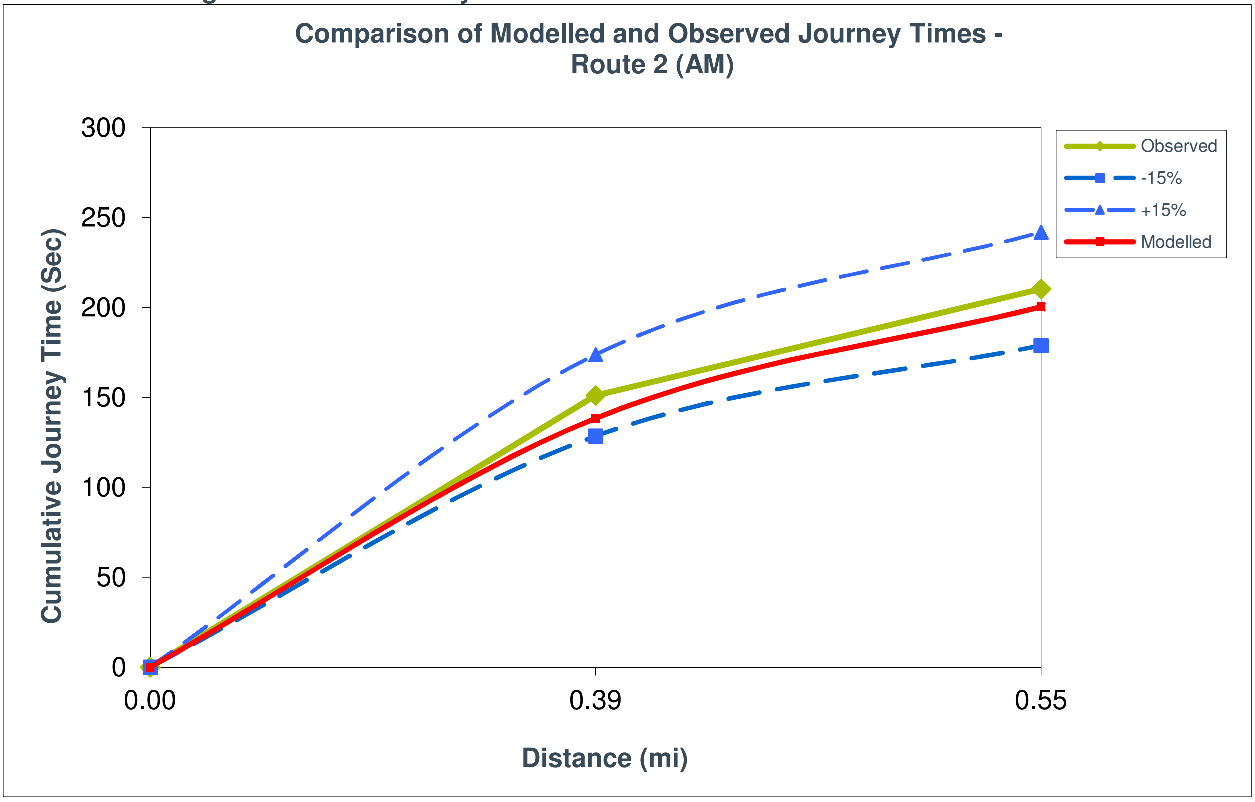
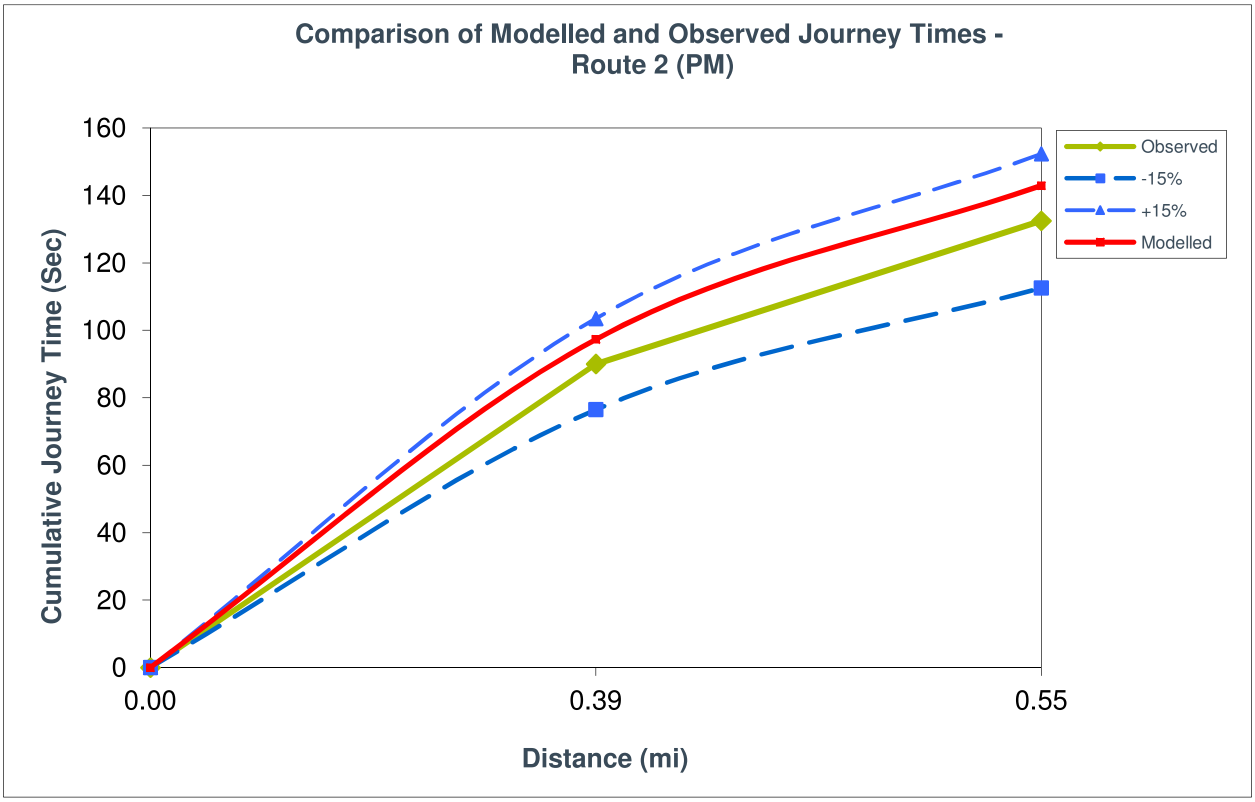


Figure 7. Journey Times Validation Route 2 AM & PM Peak Hours





5.2.3. Queue Lengths

Modelled maximum queue lengths have been recorded at 5 minute intervals, which is consistent with the on-site measurements. For each observed queue, a 95th percentile confidence interval[2] has been derived, in addition to a 15 per cent margin to allow for daily variation, since the observed queues were surveyed on a single weekday. The average queue length has been calculated from modelled maximum queues for both the AM and PM Peak Hours.

The location of queue length measurement points is shown in Appendix A.

Tables 5.9 and 5.10 presents modelled queue lengths comparison with the observed queue lengths for AM and PM Peak Hours respectively.

The queue length validation demonstrates how the modelled values validate against the observed queues for both the AM and PM Peak Hours. The comparison table shows that the majority of modelled queues fall within the variation boundaries for observed queues as specified above. The AM Peak Hour modelled queue length of 141 metres at A22 London Rd (W) which is higher than the observed value is acceptable, because the surveyor was not able to observe queues beyond 20 vehicles (115 metres) whereas during site observation it is noticed that around 26 vehicles (150 metres) were in queue at this location. Lingfield Road, Maypole Road, Station Road model queues are within confidence interval. The remaining queues are also validated compared to observed queue lengths.

The PM Peak Hour modelled queue lengths at A22 London Road (W) is 133 metres compared to upper confidence of an observed queue length of 115 metres. Again, this is considered as reasonable in comparison to the observed queue, as the queue was lengthy and the surveyor was unable to count vehicles extending further back than 115 metres from the junction. This represents only 16 per cent difference between the modelled and observed queue lengths. Similarly Lingfield Road, A22 London Road (E) modelled queue lengths are well within confidence interval of observed queue lengths.

The surveys only represent observed queues on a single weekday. Typically queue lengths can vary significantly on a daily basis. However, it is concluded that based on the observed queuing data available the modelled queue results provide a realistic representation of the existing situation at A22 London Road corridor and other the key approaches in the model Study Area.

[2] The confidence interval is a range on either side of a sample mean.

Table 5.9 – Queue Lengths Validation - AM Peak Hour

Queue Counter		Avg. Queue (m)	Max. Queue (m)	Lower Con.	Upper Con.	Modelled Queue (m)
A22 London Road/ Lingfield Road	A22 London Rd (W)	115	115	115	115	141
	Lingfield Rd	87	115	68	106	99
	A22 London Rd (E)	103	115	94	112	72
A22 London Road/ Maypole Road	Maypole Road	10	29	4	15	13
A22 London Rd/Station Rd	Station Road	109	115	98	121	121
A22 London Rd/Moat Rd	Moat Road	102	115	85	119	131

Table 5.10 – Queue Lengths Validation - PM Peak Hour

Queue Counter		Avg. Queue (m)	Max. Queue (m)	Lower Con.	Upper Con.	Modelled Queue (m)
A22 London Road/ Lingfield Road	A22 London Rd (W)	115	115	115	115	133
	Lingfield Rd	82	115	62	103	72
	A22 London Rd (E)	78	115	59	98	74
A22 London Road/ Maypole Road	Maypole Road	7	29	1	12	13
A22 London Rd/Station Rd	Station Road	103	115	94	112	132
A22 London Rd/Moat Rd	Moat Road	105	115	97	113	133

6. Conclusions

6.1. Model Fitness

The East Grinstead base models have been developed using LinSig and VISSIM software in accordance with industry best practice guidelines integrating traffic survey counts from November 2011.

Both models have validated well based on observed conditions. LinSig model demonstrates accurate DoS and queues as observed data. VISSIM model turning movement validation (Table 5.5 and Appendix D) demonstrates that all the turning movements have comfortably achieved DMRB criteria in both the AM and PM Peak Hours. Furthermore, link flow validation assessment (Tables 5.6 and 5.7) illustrates that modelled link flows are also within the criteria outlined in DMRB guidance compared to observed link flows, which represents robust validation of the base modelled flows.

The modelled journey times compared closely against the observed values for both morning and evening peak periods and were within ±15 per cent of the observed journey times. The modelled journey time validation (Table 5.8) deduces that both the AM and PM Peak Hour models have satisfactorily achieved DMRB's recommended journey time criteria, therefore the base model can be considered to represent realistic conditions at A22 London Road corridor for the East Grinstead Study Area.

A few of the queue length measurements appear slightly outside the confidence interval however it is evident that they compared very closely with the observed queue length measurements. Moreover, it is advisable to note that queue length comparison is not considered a strict factor in the validation criteria but merely a guide to model fitness. This is partly because queue length observations can be variable from day to day at the same site.

It is concluded that the base model validated well for the individual turning movements, link flows, journey times and queue lengths. The turning movement validation analysis for GEH less than 5 is achieved on all the movements (100%) including A22 London Road corridor in both the AM and PM Peak Periods.

Therefore, it can be concluded that both the LinSig and VISSIM base models are considered to provide a robust representation of the existing situation.

6.2. Recommendations

The East Grinstead base model was largely developed using default VISSIM parameters, as advised in the HA's micro-simulation guidance. However, during the calibration process, these parameters were reviewed and some were adjusted to better fit observed driver behaviour and network operating conditions.

The base model validates well based on the pertinent technical advice and guidance for the individual link flow, journey times and queue lengths. The turning movements and journey time validation analysis demonstrates the model has achieved DMRB validation criteria effectively in both the AM and PM Peak Periods.

The base model provides a robust representation of the base year (2011) traffic conditions in the East Grinstead Study Area, and can therefore be used with confidence to forecast the likely impacts of the proposed development and to evaluate additional development the network could accommodate based on committed and planned mitigation measures.

The base model is therefore considered fit for purpose and can be adopted for the next stage of work, the development of the future year baseline model.

Appendix A. – Location of Traffic Surveys

Figure A.1 – Survey Count Locations

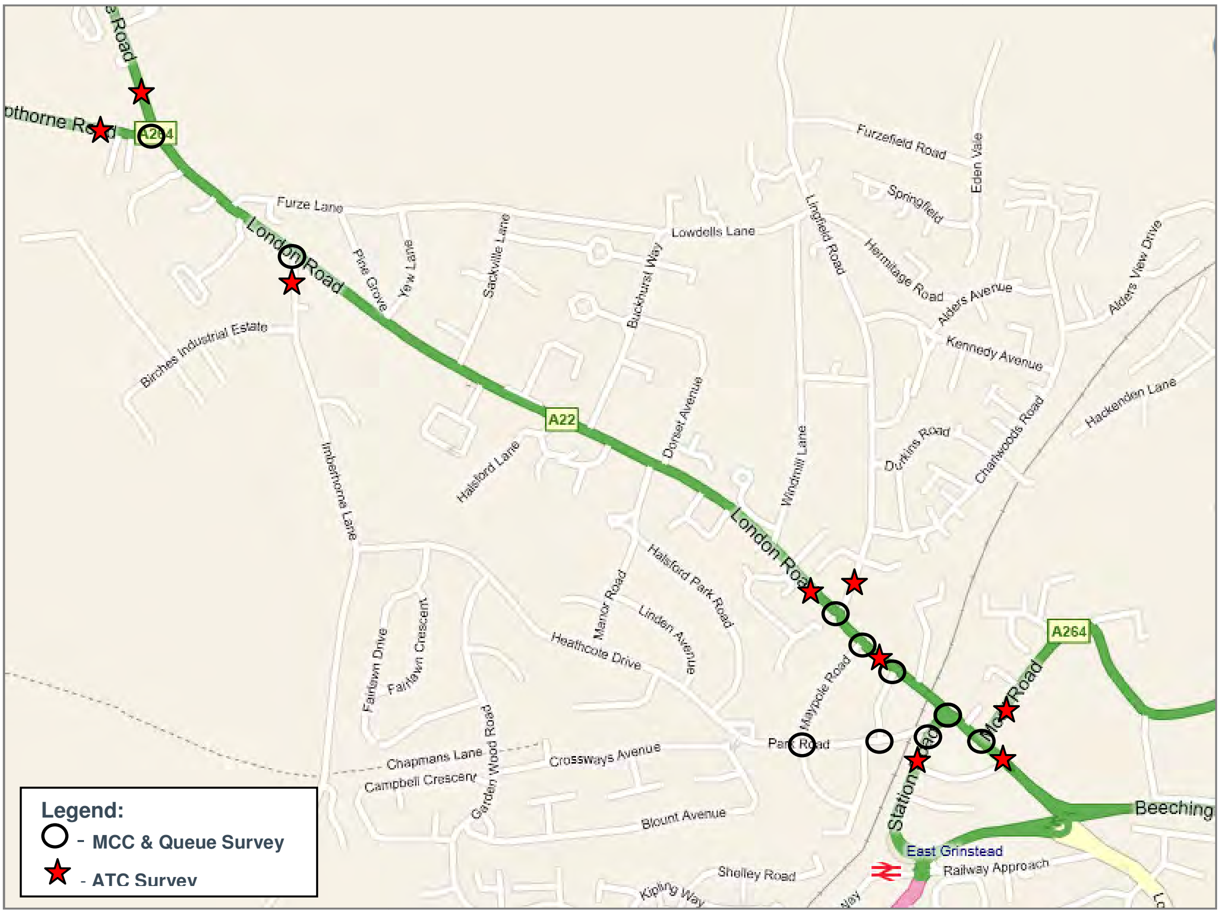


Figure A.2 – Route 1 Journey Time Segments

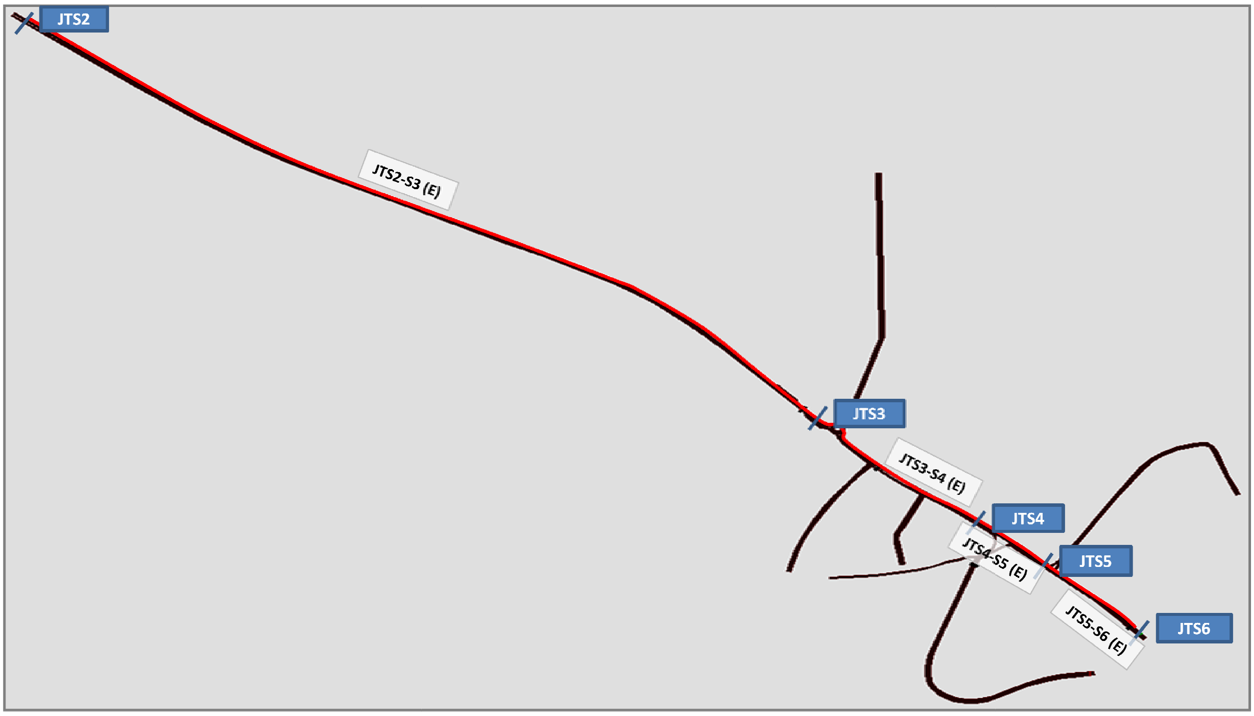


Figure A.3 – Route 2 Journey Time Segments

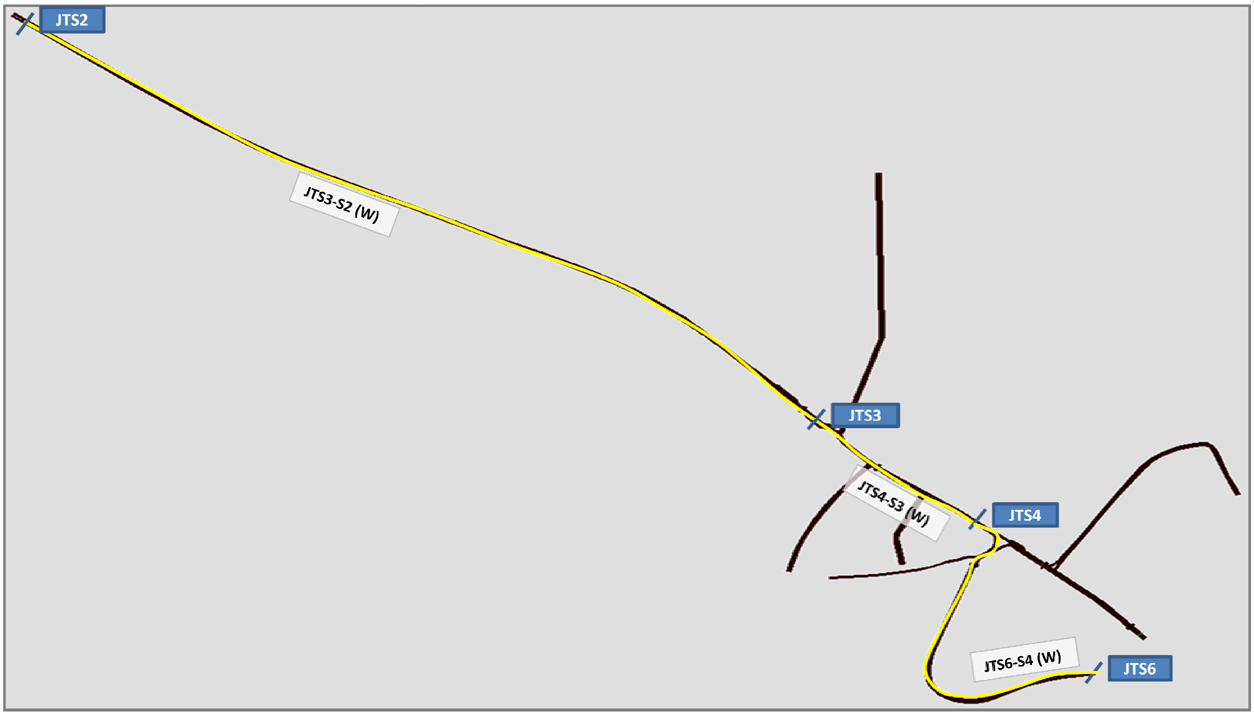


Table A.1 – Bus Time Tables for the EG Network (Source http://www.travelinesoutheast.org.uk)

Peak Times: 8.30 - 9.30 and 17.00 - 18.00	Start time AM	Start time PM
15 mins warm up time has also been allowed	08:15:00	16:45:00

Bus Number	Direction	Bus Stop Location	Time	Time Elapsed (Secs)
291 Tunbridge wells - East Grinstead - Crawley (-Gatwick)	W	East Grinstead Station	08:21:00	360
			08:56:00	2460
			09:44:00	5340
			17:08:00	1380
			17:36:00	3060
	E	Felbridge, The Star Inn	08:36:00	1260
			09:21:00	3960
			16:48:00	180
			17:02:00	1020
			17:34:00	2940
400 Caterham - Gatwick - East Grinstead	E	Felbridge Hotel & Spa, Felbridge	08:15:00	0
			09:32:00	4620
			10:32:00	8220
			17:41:00	3360
	W		09:12:00	3420
			17:12:00	1620
236 Oxtend - East Grinstead	S	East Grinstead , Prince of Wales (opp)	08:26:00	660
			09:14:00	3540
	N	East Grinstead Station	Outside Peak Time	-
			Outside Peak Time	-
509 East Grinstead - Caterham	N	East Grinstead Station	08:38:00	1380
			18:06:00	4860
	S	East Grinstead , Prince of Wales (opp)	Outside Peak Time	-
			17:14:00	1740
			18:14:00	5340
281 Crawley - East Grinstead	N	East Grinstead Station	08:47:00	1920
			17:00:00	900
			17:43:00	3480

Appendix B. – Balanced Traffic Flows

Figure B.1 – AM Peak Hour (08.30 – 09.30) Flows

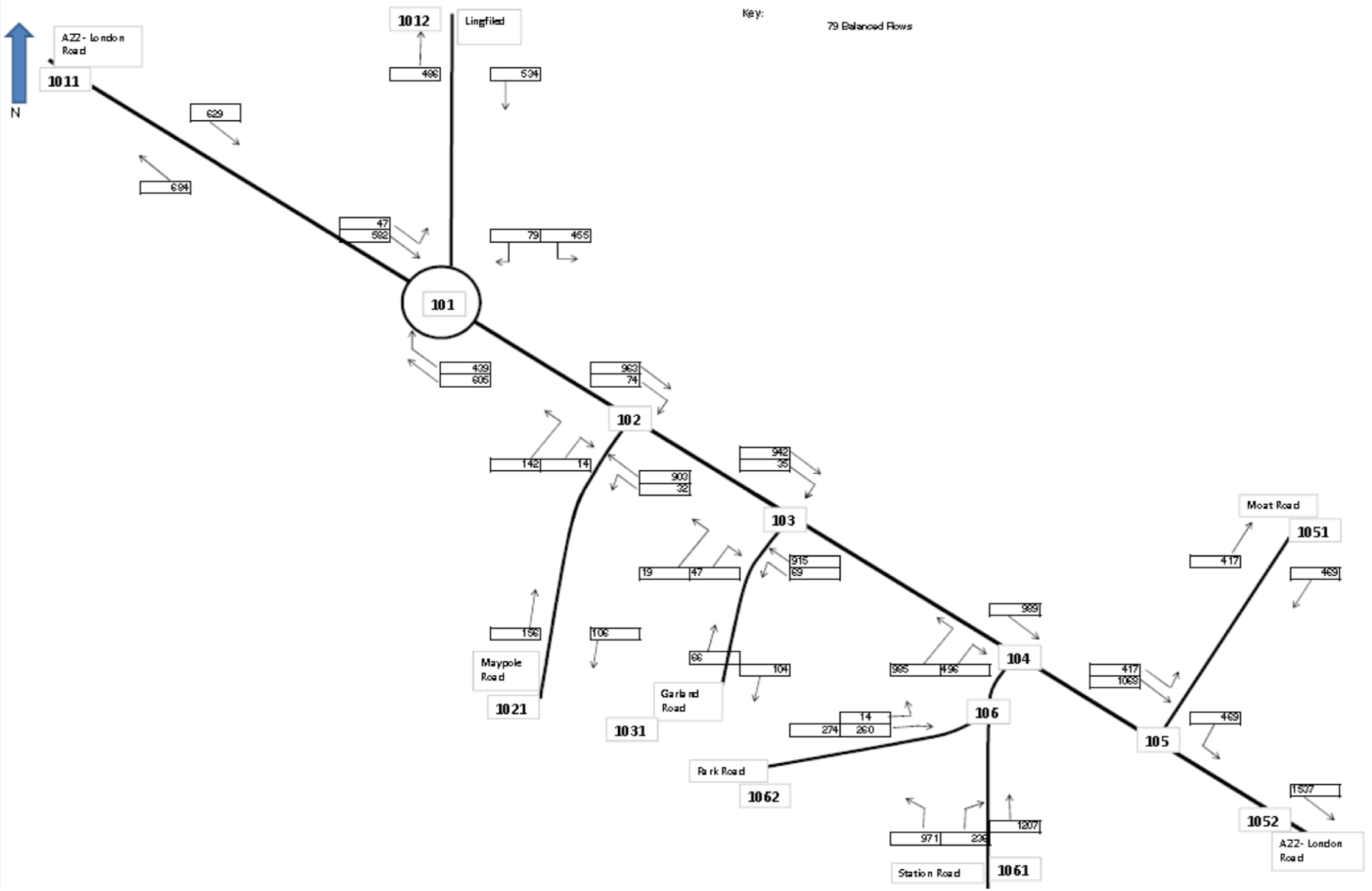
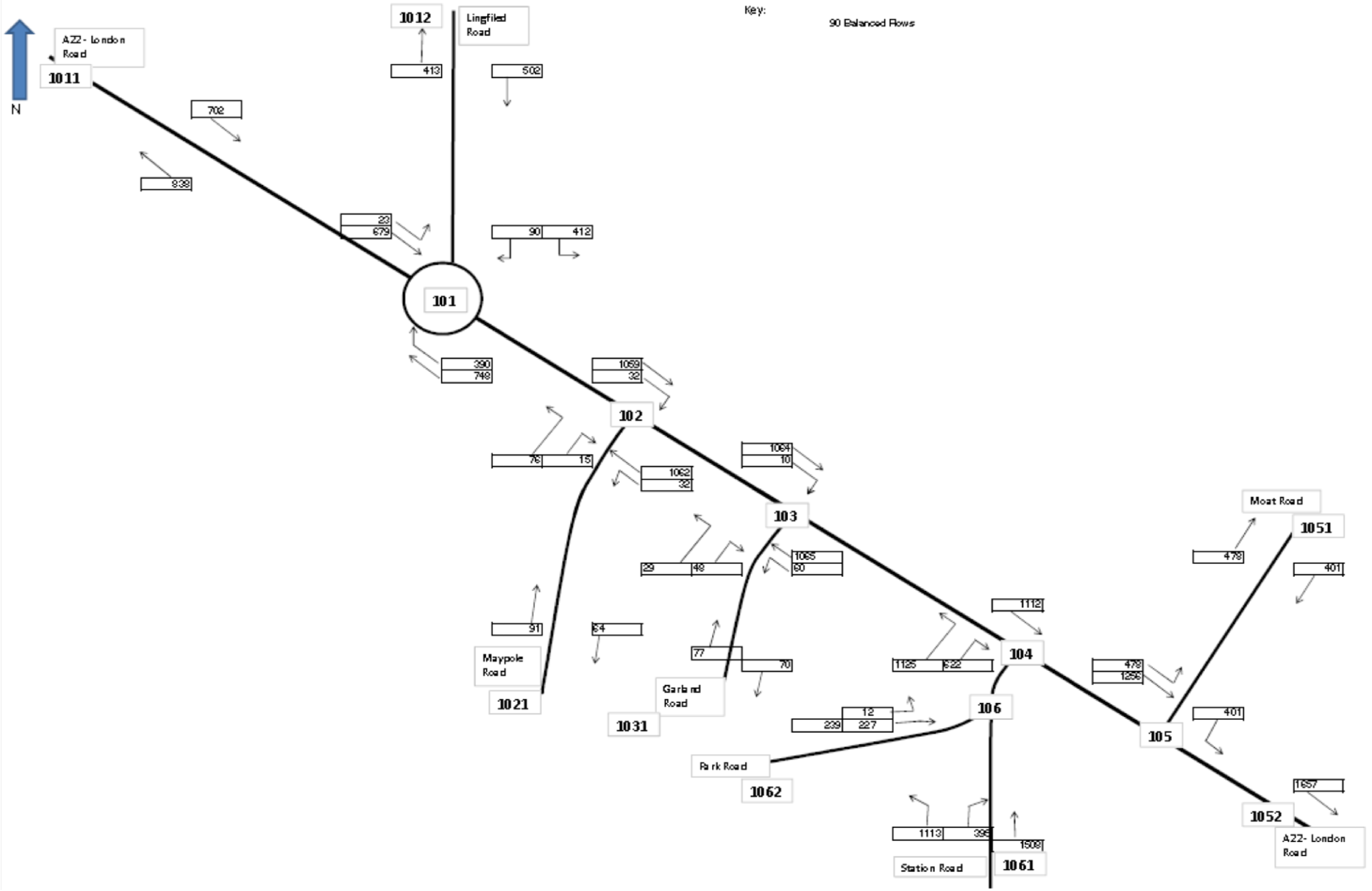


Figure B.2 – PM Peak Hour (17.00 – 18.00) Flows



Appendix C. – Screenshots AM & PM

Figure C.1 – Model Screenshot Part 1 – AM Peak Hour

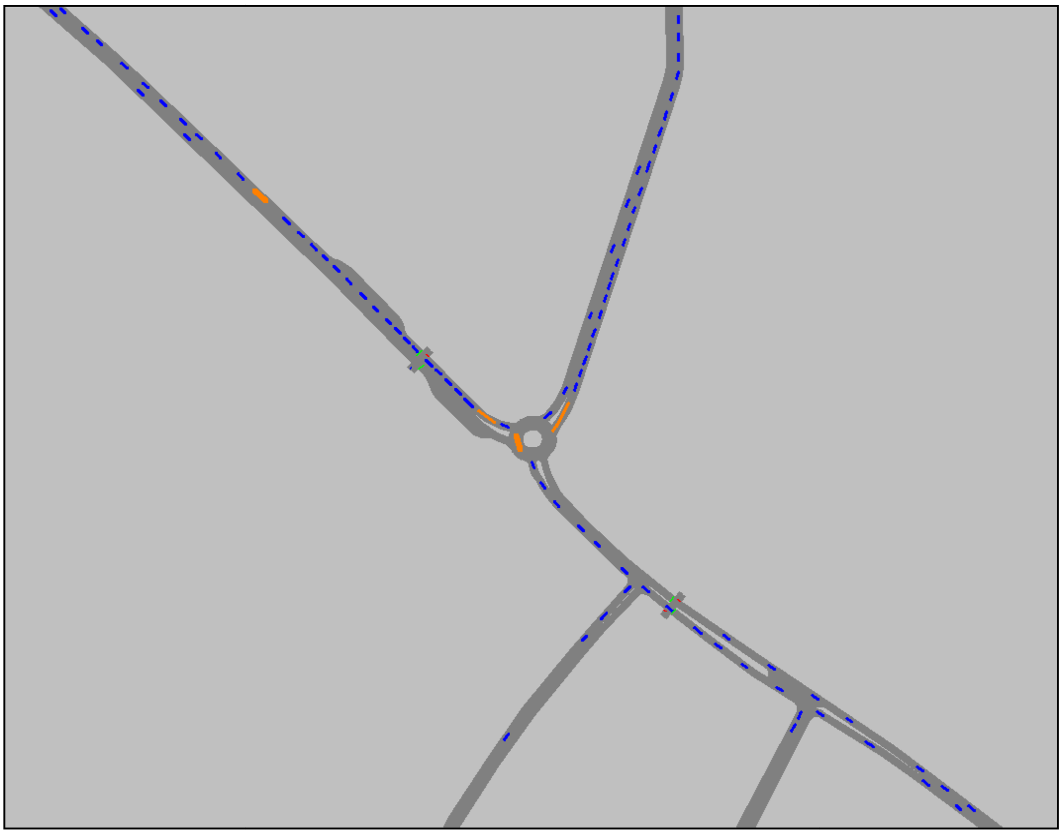


Figure C.2 – Model Screenshot Part 2 – AM Peak Hour

Figure C.3 – Model Screenshot Part 1 – PM Peak Hour

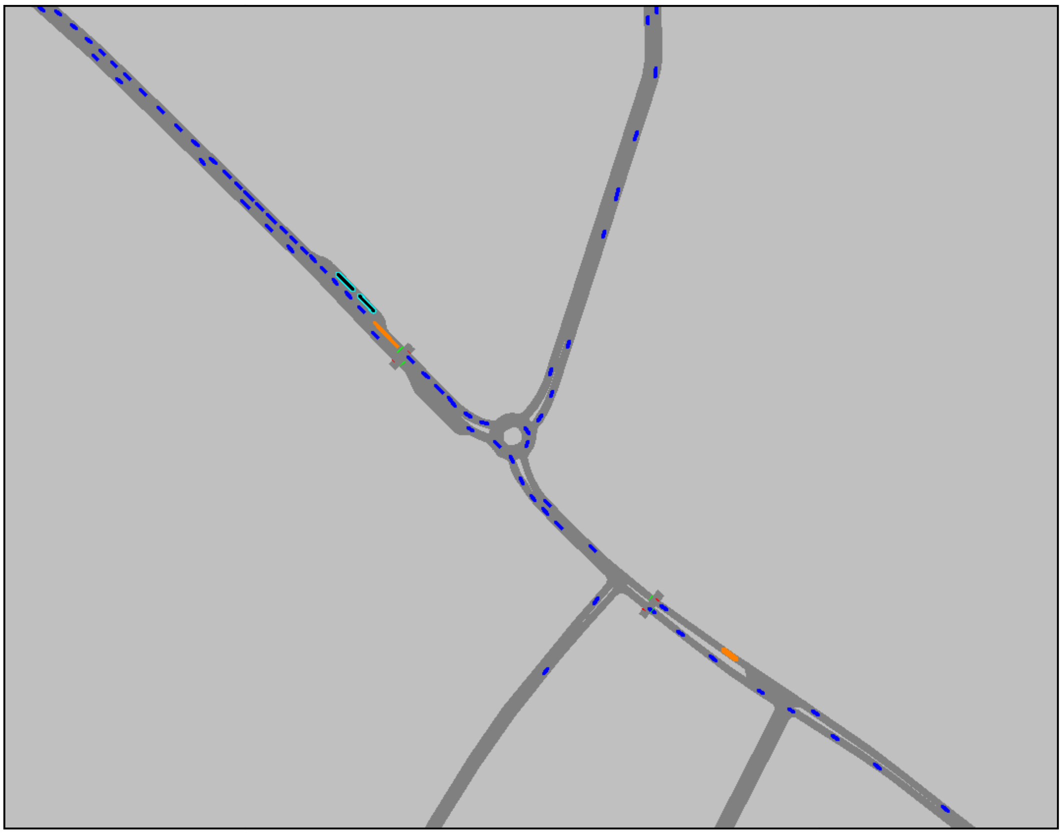
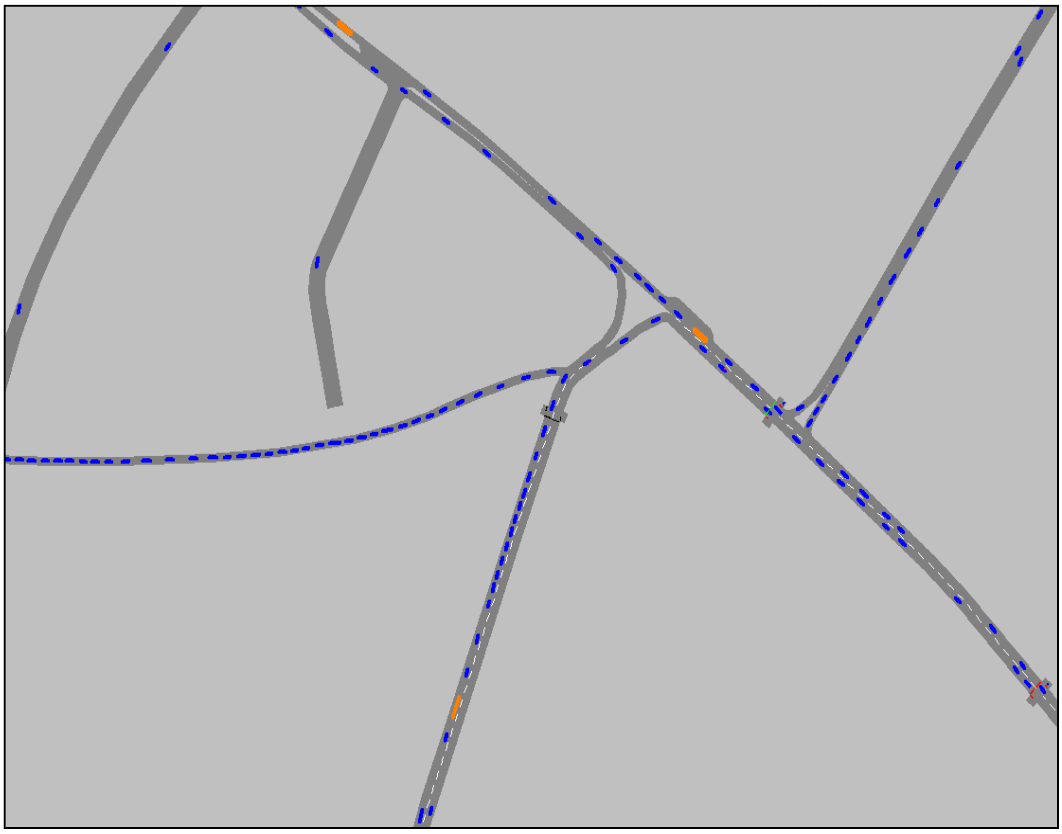


Figure C.4 – Model Screenshot Part 2 – PM Peak Hour



Appendix D. – TMC & Link Flows Validation

Table D.1 – Turning Movement and Link Flows Validation AM Peak Hour

Node Number	Junction	From Approach	To Approach	From Link	To link	Count AM	Model	Diff	% Diff	GEH	GEH Acceptance	Flow Acceptance
101	A22 London Rd/ Lingfield Road	A22 London Rd (W)	Lingfield Rd	1	4	47	53	6	13%	0.89	✓	✓
101		A22 London Rd (W)	A22 London Rd (E)	1	6	584	583	-1	0%	0.03	✓	✓
101		Lingfield Rd	A22 London Rd (E)	3	6	457	436	-21	-5%	0.98	✓	✓
101		Lingfield Rd	A22 London Rd (W)	3	2	81	77	-4	-5%	0.41	✓	✓
101		A22 London Rd (E)	A22 London Rd (W)	12	2	608	562	-46	-8%	1.90	✓	✓
101		A22 London Rd (E)	Lingfield Rd	12	4	440	446	6	1%	0.29	✓	✓
101	***Junction Total***					**2217**	**2158**	**-59**	**-3%**	**1.25**	✓	✓
102	A22 London Rd/Maypole Rd	A22 London Rd (W)	A22 London Rd (E)	6	6	967	951	-16	-2%	0.52	✓	✓
102		A22 London Rd (W)	Maypole Rd	6	8	74	72	-2	-3%	0.27	✓	✓
102		A22 London Rd (E)	Maypole Rd	12	8	32	31	-1	-4%	0.24	✓	✓
102		A22 London Rd (E)	A22 London Rd (W)	12	12	907	865	-42	-5%	1.41	✓	✓
102		Maypole Rd	A22 London Rd (W)	7	12	142	143	1	1%	0.11	✓	✓
102		Maypole Rd	A22 London Rd (E)	7	6	14	13	-1	-5%	0.18	✓	✓
102	***Junction Total***					**2136**	**2075**	**-61**	**-3%**	**1.33**	✓	✓
103	A22 London Rd/Garland Rd	A22 London Rd (W)	A22 London Rd (E)	6	6	945	925	-20	-2%	0.65	✓	✓
103		A22 London Rd (W)	Garland Rd	6	10	35	36	1	3%	0.17	✓	✓
103		A22 London Rd (E)	Garland Rd	12	10	69	80	11	16%	1.31	✓	✓
103		A22 London Rd (E)	A22 London Rd (W)	12	12	919	881	-38	-4%	1.26	✓	✓
103		Garland Rd	A22 London Rd (W)	9	12	19	18	-1	-5%	0.23	✓	✓
103		Garland Rd	A22 London Rd (E)	9	6	47	46	-1	-1%	0.10	✓	✓
103	***Junction Total***					**2034**	**1987**	**-47**	**-2%**	**1.05**	✓	✓
104	A22 London Rd/Station Rd	A22 London Rd (W)	A22 London Rd (E)	6	14	992	970	-22	-2%	0.71	✓	✓
104		Station Rd	A22 London Rd (W)	19	12	989	966	-23	-2%	0.75	✓	✓
104		Station Rd	A22 London Rd (E)	18	14	499	428	-71	-14%	3.28	✓	✓
104	***Junction Total***					**2480**	**2364**	**-116**	**-5%**	**2.36**	✓	✓
105	A22 London Rd/Moat Rd	A22 London Rd (W)	Moat Rd	14	16	417	385	-32	-8%	1.60	✓	✓
105		A22 London Rd (W)	A22 London Rd (E)	14	14	1076	1014	-62	-6%	1.91	✓	✓
105		Moat Rd	A22 London Rd (E)	35	14	470	418	-52	-11%	2.45	✓	✓
105	***Junction Total***					**1963**	**1818**	**-145**	**-7%**	**3.34**	✓	✓
106	Park Rd/Station Rd	Park Rd	A22 London Rd (W)	34	19	14	12	-2	-14%	0.55	✓	✓
106		Park Rd	A22 London Rd (E)	34	18	260	197	-63	-24%	4.19	✓	✓

106		Station Rd (S)	A22 London Rd (W)	36	19	975	954	-21	-2%	0.69	✓	✓
106		Station Rd (S)	A22 London Rd (E)	36	18	241	232	-9	-4%	0.61	✓	✓
106	***Junction Total***					**1490**	**1394**	**-96**	**-6%**	**2.53**	✓	✓
0	**AM Peak Link Flows Validation**											
1	A22 London Rd Eastbound towards Lingfield Rd Roundabout					631	629	-2	0%	0.09	✓	✓
2	A22 London Rd Westbound away from Lingfield Rd Roundabout					689	647	-42	-6%	1.63	✓	✓
3	Lingfield Rd Southbound					538	517	-21	-4%	0.91	✓	✓
4	Lingfield Rd Northbound					487	489	2	0%	0.10	✓	✓
5	A22 London Rd Westbound towards Maypole Rd					938	899	-39	-4%	1.30	✓	✓
6	A22 London Rd Eastbound towards Garland Rd					980	950	-30	-3%	0.97	✓	✓
7	Station Rd Northbound					1216	1191	-26	-2%	0.74	✓	✓
8	Moat Rd Southbound					470	424	-47	-10%	2.20	✓	✓
9	Moat Rd Northbound					417	383	-34	-8%	1.72	✓	✓
10	A22 London Rd Eastbound after Moat Rd Junction					1546	1431	-115	-7%	2.99	✓	✓

Table D.2 – Turning Movement and Link Flows Validation PM Peak Hour

Node Number	Junction	From Approach	To Approach	From Link	To link	Count	Model	Diff	% Diff	GEH	GEH Acceptance	Flow Acceptance
101	A22 London Rd/ Lingfield Road	A22 London Rd (W)	Lingfield Rd	1	4	23	14	-9	-38%	2.01	✓	✓
101		A22 London Rd (W)	A22 London Rd (E)	1	6	680	619	-61	-9%	2.41	✓	✓
101		Lingfield Rd	A22 London Rd (E)	3	6	413	428	15	4%	0.75	✓	✓
101		Lingfield Rd	A22 London Rd (W)	3	2	90	76	-14	-15%	1.50	✓	✓
101		A22 London Rd (E)	A22 London Rd (W)	12	2	752	760	8	1%	0.28	✓	✓
101		A22 London Rd (E)	Lingfield Rd	12	4	390	373	-17	-4%	0.89	✓	✓
101	***Junction Total***					**2348**	**2270**	**-78**	**-3%**	**1.62**	✓	✓
102	A22 London Rd/Maypole Rd	A22 London Rd (W)	A22 London Rd (E)	6	6	1061	1014	-47	-4%	1.46	✓	✓
102		A22 London Rd (W)	Maypole Rd	6	8	32	29	-3	-9%	0.54	✓	✓
102		A22 London Rd (E)	Maypole Rd	12	8	32	29	-3	-10%	0.61	✓	✓
102		A22 London Rd (E)	A22 London Rd (W)	12	12	1065	1052	-13	-1%	0.40	✓	✓
102		Maypole Rd	A22 London Rd (W)	7	12	76	79	3	4%	0.38	✓	✓
102		Maypole Rd	A22 London Rd (E)	7	6	15	14	-1	-7%	0.26	✓	✓
102	***Junction Total***					**2281**	**2217**	**-64**	**-3%**	**1.35**	✓	✓
103	A22 London Rd/Garland Rd	A22 London Rd (W)	A22 London Rd (E)	6	6	1067	1020	-47	-4%	1.44	✓	✓
103		A22 London Rd (W)	Garland Rd	6	10	10	8	-2	-17%	0.55	✓	✓
103		A22 London Rd (E)	Garland Rd	12	10	60	59	-1	-1%	0.09	✓	✓
103		A22 London Rd (E)	A22 London Rd (W)	12	12	1068	1048	-20	-2%	0.63	✓	✓
103		Garland Rd	A22 London Rd (W)	9	12	29	34	5	18%	0.95	✓	✓
103		Garland Rd	A22 London Rd (E)	9	6	48	45	-3	-6%	0.44	✓	✓
103	***Junction Total***					**2282**	**2215**	**-67**	**-3%**	**1.41**	✓	✓
104	A22 London Rd/Station Rd	A22 London Rd (W)	A22 London Rd (E)	6	14	1115	1060	-55	-5%	1.68	✓	✓
104		Station Rd	A22 London Rd (W)	19	12	1130	1107	-23	-2%	0.70	✓	✓
104		Station Rd	A22 London Rd (E)	18	14	626	588	-38	-6%	1.53	✓	✓
104	***Junction Total***					**2871**	**2755**	**-116**	**-4%**	**2.19**	✓	✓
105	A22 London Rd/Moat Rd	A22 London Rd (W)	Moat Rd	14	16	478	448	-30	-6%	1.41	✓	✓
105		A22 London Rd (W)	A22 London Rd (E)	14	14	1263	1202	-61	-5%	1.74	✓	✓
105		Moat Rd	A22 London Rd (E)	35	14	401	375	-26	-6%	1.30	✓	✓
105	***Junction Total***					**2142**	**2025**	**-117**	**-5%**	**2.56**	✓	✓
106	Park Rd/Station Rd	Park Rd	A22 London Rd (W)	34	19	12	9	-3	-25%	0.93	✓	✓
106		Park Rd	A22 London Rd (E)	34	18	227	198	-29	-13%	2.01	✓	✓

106		Station Rd (S)	A22 London Rd (W)	36	19	1117	1098	-19	-2%	0.57	✓	✓
106		Station Rd (S)	A22 London Rd (E)	36	18	400	391	-9	-2%	0.44	✓	✓
106	***Junction Total***					**1756**	**1696**	**-60**	**-3%**	**1.44**	✓	✓
0	**PM Link Flows Validation**											
1	A22 London Rd Eastbound towards Lingfield Rd Roundabout					703	620	-83	-12%	3.23	✓	✓
2	A22 London Rd Westbound away from Lingfield Rd Roundabout					842	842	0	0%	0.01	✓	✓
3	Lingfield Rd Southbound					503	511	8	2%	0.34	✓	✓
4	Lingfield Rd Northbound					413	400	-14	-3%	0.67	✓	✓
5	A22 London Rd Westbound towards Maypole Rd					1097	1094	-4	0%	0.11	✓	✓
6	A22 London Rd Eastbound towards Garland Rd					1077	1018	-60	-6%	1.84	✓	✓
7	Station Rd Northbound					1517	1505	-12	-1%	0.31	✓	✓
8	Moat Rd Southbound					401	383	-18	-5%	0.92	✓	✓
9	Moat Rd Northbound					478	441	-37	-8%	1.71	✓	✓
10	A22 London Rd Eastbound after Moat Rd Junction					1664	1573	-91	-5%	2.26	✓	✓

Figure D.1 – Graphical Presentation of Flows Validation AM Peak Hour

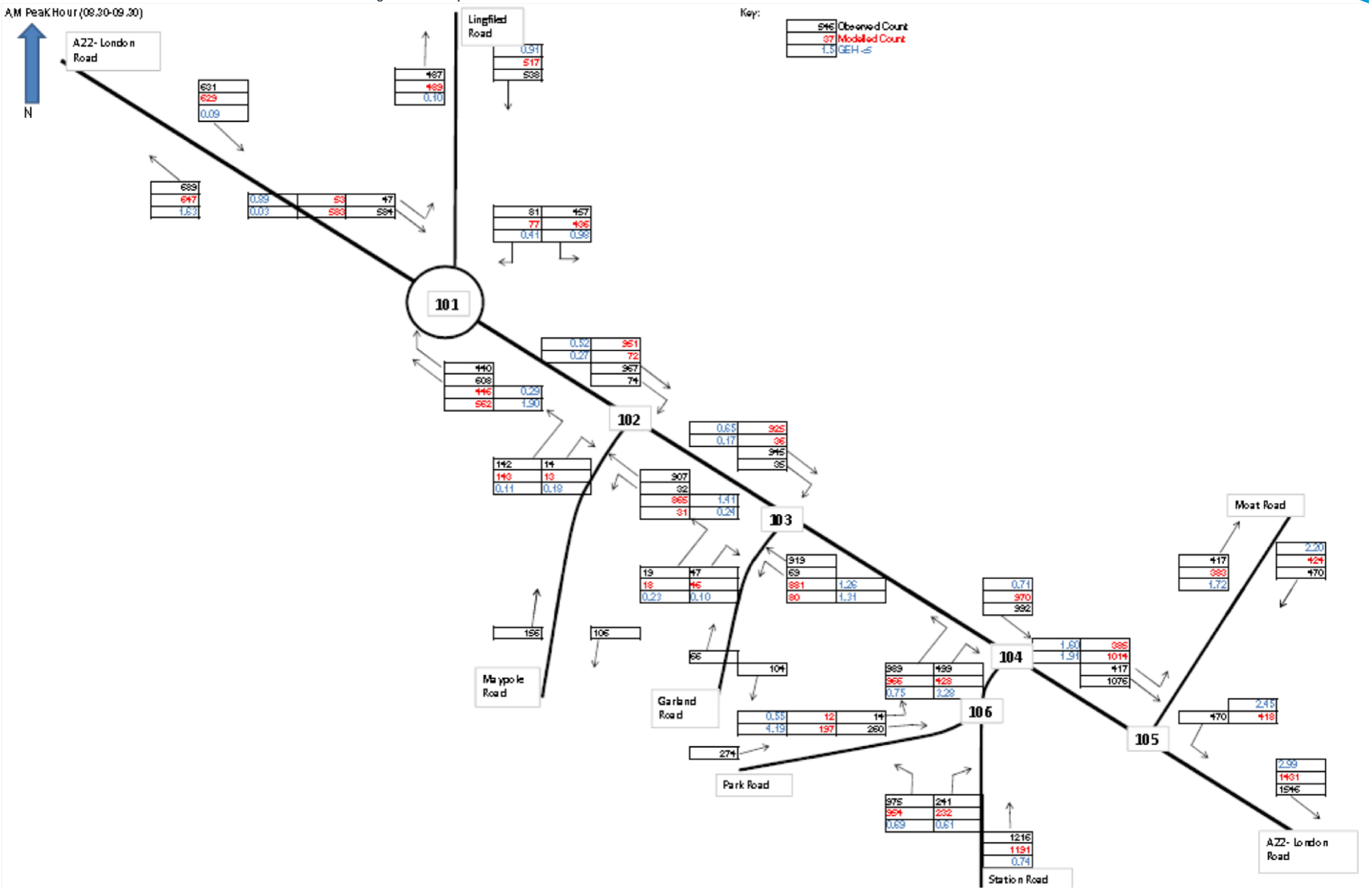


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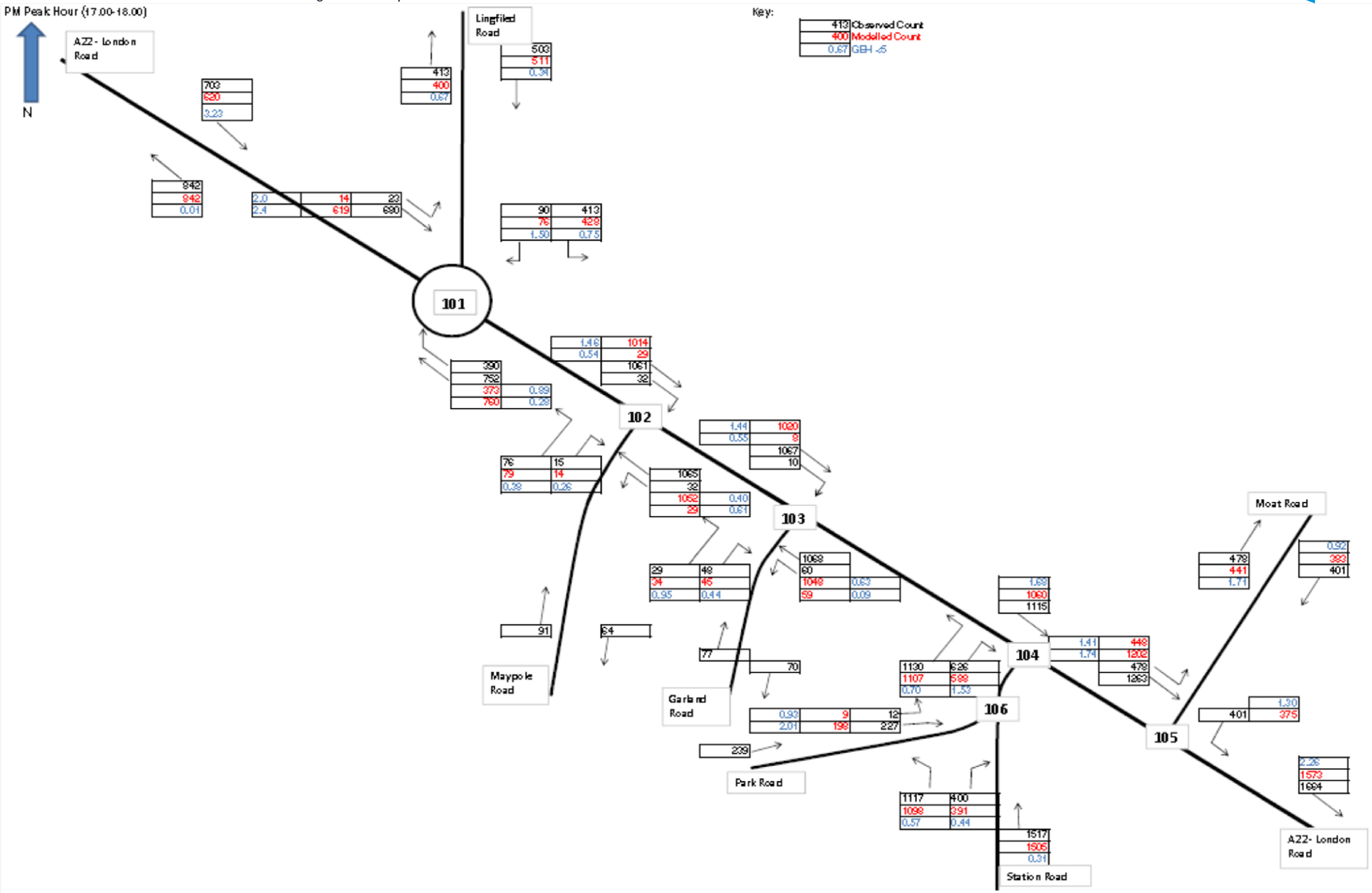
Figure D.2 – Graphical Presentation of Flows Validation PM Peak Hour



Appendix E. – Journey Time Validation

Table D.1 – Journey Time validation Route 1 AM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Modeled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff	JT Acceptance
JTS3							
JTS4	JTS3-S4 (E)	0.189	0.189	47.8	47.5	0.7%	√
JTS5	JTS4-S5 (E)	0.066	0.255	13.0	14.6	-11.2%	√
JTS6	JTS5-S6 (E)	0.1150	0.37	30.3	28.6	6.1%	√
	TOTAL	0.370		91.1	91.0	**0.1%**	√

Table D.2 – Journey Time validation Route 2 AM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Modeled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff	JT Acceptance
JTS6							
JTS4	JTS6-S4 (W)	0.386	0.386	138.4	151.1	-8.4%	√
JTS3	JTS4-S3 (W)	0.165	0.551	62.0	59.2	4.7%	√
	TOTAL	0.551		200.4	210.0	**-4.6%**	√

Table D.3 – Cumulative Journey Time Validation Route 1 AM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Cumulative Observed Time	85%	115 %	Cumulative Modelled Time	JT Acceptance
JTS3		0	0	0	0	0	0	
JTS4	JTS3-S4 (E)	0.189	0.189	48	40	55	48	√
JTS5	JTS4-S5 (E)	0.066	0.255	62	53	71	61	√
JTS6	JTS5-S6 (E)	0.1150	0.37	99	84	114	91	√

Table D.4 – Cumulative Journey Time Validation Route 2 AM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Cumulative Observed Time	85%	115 %	Cumulative Modelled Time	JT Acceptance
JTS6			0	0	0	0	0	
JTS4	JTS6-S4 (W)	0.386	0.386	148	125	170	138	√
JTS3	JTS4-S3 (W)	0.165	0.551	207	176	238	200	√

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Table D.5 – Journey Time validation Route 1 PM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Modeled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff	JT Acceptance
JTS3		0	0				
JTS4	JTS3-S4 (E)	0.189	0.189	46.8	52.3	-10.6%	√
JTS5	JTS4-S5 (E)	0.066	0.255	12.9	15.0	-14.3%	√
JTS6	JTS5-S6 (E)	0.1150	0.37	31.2	27.6	13.2%	√
	TOTAL	0.3700		90.9	95.0	**-4.4%**	√

Table D.6 – Journey Time validation Route 2 PM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Modeled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff	JT Acceptance
JTS6			0				
JTS4	JTS6-S4 (W)	0.386	0.386	97.3	90.0	8.1%	√
JTS3	JTS4-S3 (W)	0.165	0.551	45.6	42.5	7.4%	√
	TOTAL	0.5510		142.9	132.0	**8.3%**	√

Table D.7 – Cumulative Journey Time Validation Route 1 PM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Cumulative Observed Time	85%	115 %	Cumulative Modelled Time	JT Acceptan ce
JTS3		0	0	0	0	0	0	
JTS4	JTS3-S4 (E)	0.189	0.189	52	44	60	47	√
JTS5	JTS4-S5 (E)	0.066	0.255	67	57	77	60	√
JTS6	JTS5-S6 (E)	0.1150	0.37	95	81	109	91	√

Table D.8 – Cumulative Journey Time Validation Route 2 PM Peak Hour

Timing Points	Sections	Link Distance(mi)	Cumulative Distance(mi)	Cumulative Observed Time	85%	115 %	Cumulative Modelled Time	JT Acceptan ce
JTS6			0	0	0	0	0	
JTS4	JTS6-S4 (W)	0.386	0.386	114	97	131	97	√
JTS3	JTS4-S3 (W)	0.165	0.551	156	133	180	143	√

Technical note

Project:	East Grinstead Stage 3	**To:**	Chris Owen, Guy Perfect (WSCC)
Subject:	TN04 - Forecasting & Assessment	**From:**	Yogesh Patel, Chris Cary (Atkins)
Date:	13 January 2012	**cc:**	Darryl Hemmings (WSCC) Farshid Kamali (Atkins)

1. Introduction

Atkins was commissioned by the West Sussex County Council (WSCC) to evaluate the network capacity at the five key junctions on A22 London Road between Felbridge and Moat Road as part of the East Grinstead Transport Advice Study (Stage 3). The base LinSig and VISSIM models have been developed to provide a robust representation of the base year (2011) traffic conditions in the Study Area.

Atkins submitted a Local Model Validation note on the 6th December 2011 presenting the base models validation results and robustness of these models. The validated base models have been employed in the evolution of the future baseline models (Do Nothing - DN). In addition to the future baseline models, the Do Minimum (DM) and the Do Something (DS) scenario models have been developed to appraise the proposed scheme performance and associated impacts. This also enables identifying the junction capacity by comparing with and without a suggested improvement option at a particular junction.

This note is intended to report on the forecast models performance for the above scenarios and provides the scheme performance indicators to ascertain the predicted operation of the highway network at these locations and provide the basis for assessment of the development enablement in each of these scenarios.

2. Forecast Scenarios

2.1. Do Nothing Scenario

2.1.1. Network Development

The DN LinSig and micro-simulation VISSIM networks have been developed from the validated base 2011 models with a committed junction improvement at Imberhorne Lane considered in the DN models. Details of these and other network changes carried out in the DN future year model are provided below.

- Imberhorne Lane committed scheme has been included in the future base LinSig models;
- VISSIM network highway links have been extended, in particular A22 London Road (West), Lingfield Road, Moat Road, A22 Station Road and Park Road, to allow the committed and proposed development demand to be entered onto the network; and
- Lane change distances have been adjusted to reflect the above extended links, particularly at A22 Station Road.

All the network driving behaviour parameters have been retained as per the validated base models.

2.1.2. Network Demand

As agreed with WSCC no background traffic growth has been assumed beyond the realisation of known committed and proposed developments. Table 1 provides details about the committed and proposed development included in the future year assessments.

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Table 1. Committed and Proposed Developments

Ward	Number of Dwellings
Ashplats	185
Baldwins	48
Herontye	53
Imberhorne	215
Town	264
Total	**765**

Committed and proposed development trip generation and distribution employed in the forecasting models are considered further below.

2.1.3. Trip Generation

Following interrogation of the TRICS database, Atkins agreed the deployment of common trip rates for all the committed and proposed development with WSCC. Committed and proposed developments vehicular trip rates are delineated in Table 2.

Table 2. Committed and Proposed Developments

Trip Rate	AM Peak Hour			PM Peak Hour		
	Arr.	Dep.	Two-way	Arr.	Dep.	Two-way
Vehicular Trip Rate (per HH)	0.15	0.41	0.56	0.39	0.22	0.61
Trip Generation						
Ashplats	28	76	104	72	41	113
Baldwins	7	20	27	19	11	29
Herontye	8	22	30	21	12	33
Imberhorne	32	88	120	84	47	131
Town	40	108	148	103	58	161
Total	**115**	**314**	**429**	**298**	**168**	**467**

There are total 429 and 467 vehicular trips are predicted to generate from the committed and proposed developments in East Grinstead for AM and PM Peak Hours respectively.

2.1.4. Trip Distribution

In order to distribute committed and proposed development trips on to A22 London Road corridor Atkins has interrogated Census Journey to Work (2001) data for East Grinstead. Based on this key highway entry/exit road for each ward has been identified. The ward map associated with these key highway links are illustrated in Figure 1.

The proportion of car trips and associated highway links that they might use to arrive and depart from their origin and destination is derived based on East Grinstead's Journey to Work data. This is shown in Table 3.

Figure 1. Committed and Proposed Trip Distribution – Ward level

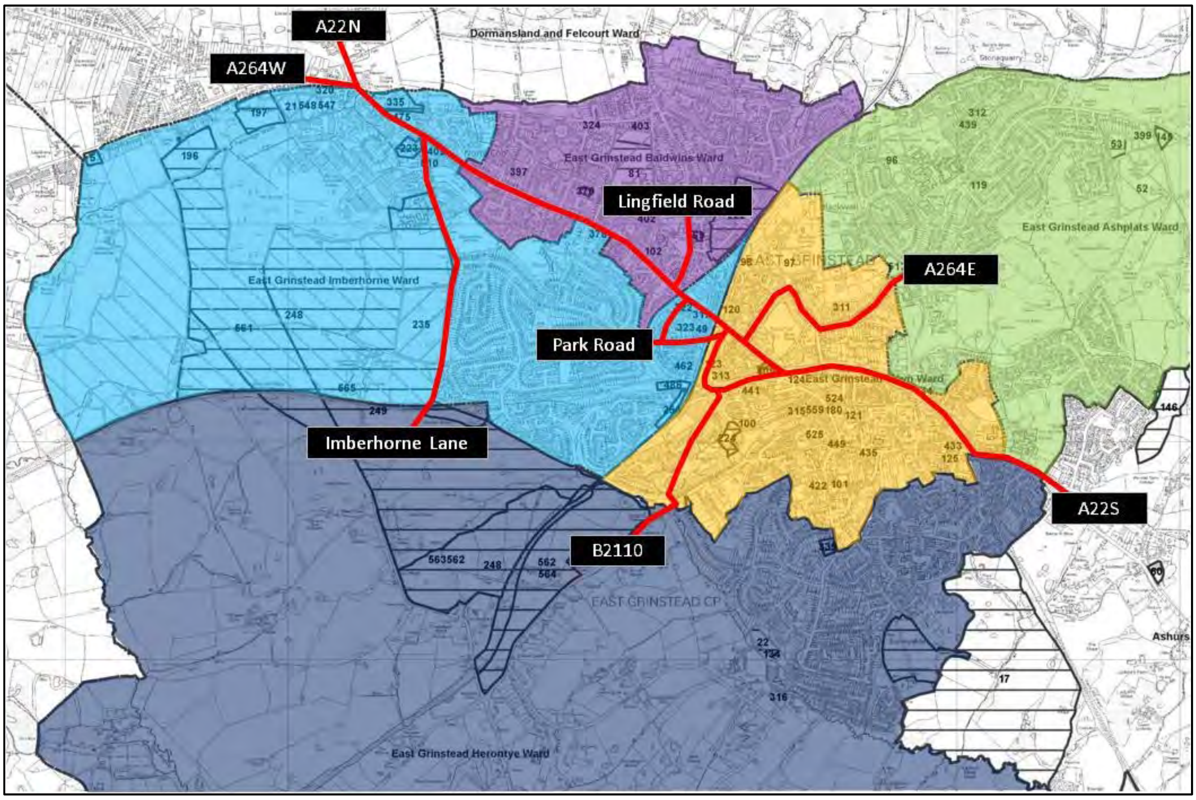

Table 3. Origin/Destination for East Grinstead – JTW (2001)

Highway Link	Car Trips	%
A264 (W)	2,583	36.2
A264 (E)	576	8.1
A22 (N)	1,381	19.4
A22 (S)	1,337	18.8
B2110	460	6.5
Lingfield Road	312	4.4
Imberhorne Lane	478	6.7
Total	**7,127**	**100**

The above has been assigned to committed and proposed development trips identified in Table 2 and trips distributed accordingly onto A22 London Road corridor.

2.2. Do Minimum Scenario

2.2.1. Network Development

The Do-Minimum (DM) LinSig and micro-simulation VISSIM networks have been developed from the DN models with committed and proposed development trips. A range of DM scenarios were developed to appraise various proposed traffic intervention schemes within the existing highway boundary as part of an iterative option evolution process aimed at arriving at preferred solutions to optimise the performance of the A22 London Road corridor, summarised in the Stage Three Report. The impacts of the two options identified as the most preferable schemes are presented in this Technical Note. Details of these network changes carried out in the DM future year models are summarised below. Broadly, DM A seeks to maximise improvements for pedestrians whilst DM B aims to achieve pedestrian improvements without the context of maximising network capacity within the highway boundary.

2.2.2. Do-Minimum A Network

- Felbridge Junction – includes all red phase for pedestrians;
- Imberhorne Lane Junction – same as DN;
- A22 London Road / Lingfield Road – signal controlled as the WSCC scheme drawing “East Grinstead Lingfield Road sheet 1 overview.pdf” (with Advanced Stop Line)
- A22 Station Road / London Road – Pelican crossings included at Station Road (left and right turn); and
- No other junction intervention schemes included.

2.2.3. Do-Minimum B Network

- Felbridge Junction – includes uncontrolled pedestrian phase;
- Imberhorne Lane Junction – same as DN;
- A22 London Road / Lingfield Road – signal controlled as the WSCC scheme drawing “East Grinstead Lingfield Road sheet 1 overview.pdf” (with Advanced Stop Lines); and
- No other junction intervention schemes included.

2.3. Do Something Scenario

2.3.1. Network Development

The future DS LinSig and micro-simulation VISSIM networks have been developed from the DM networks. The key objective of Do-Something (DS) assessment is to evaluate capacity enhancement of network by various highway intervention schemes including local widening beyond existing highway boundary. Again, a range of solutions were developed iteratively and the preferred options are summarised below. Broadly, DS A seeks to maximise improvements for pedestrians whilst DS B aims to achieve pedestrian improvements without the context of maximising network capacity.

2.3.2. Do-Something A Network

- Felbridge Junction – includes Atkins proposed junction widening scheme with all red phase for pedestrians;
- Imberhorne Lane Junction – includes Atkins proposed junction widening scheme with all red phase for pedestrians;
- A22 London Road/ Lingfield Road – includes Atkins proposed junction widening scheme. This includes A22 London Road (northbound) right turn extended flare by providing **one lane on A22 London Road southbound**;
- A22 London Road/ Station Road – vehicle actuated signal controlled junction with pelican crossings at A22 Station Road (left and right turn)
- A22 London Road/ Moat Road – Atkins proposed junction widening scheme with A22 London Road left turn flare and Refuge Island is provided for pedestrians on Moat Road.

2.3.3. Do-Something B Network

- Felbridge Junction – includes Atkins proposed junction widening scheme without pedestrian phase;
- Imberhorne Lane Junction – includes Atkins proposed junction widening scheme without all red phase for pedestrians; and
- A22 London Road/ Lingfield Road – includes Atkins proposed junction widening scheme. This includes A22 London Road (northbound) right turn short flare with **two lanes on A22 London Road southbound**.

All other schemes such as; A22 London Road/ Station Road and A22 London Road / Moat Road are same as the Do-Something A scenario.

2.3.4. Do-Something C Network

The Do-Something C scenario network is evolved from the Do-Something A scenario to compare key network capacity benefits with the Do-Minimum (scenario B). The junction improvement options considered are:

- A22 London Road/ Lingfield Road – includes Atkins proposed junction widening scheme. This includes A22 London Road (northbound) right turn short flare with **one lane southbound on A22 London Road**; and
- Without any other junction intervention schemes.

Consequently it has been considered in VISSIM only.

2.3.5. Do-Something D Network

The Do-Something D scenario network is evolved from the Do-Something A scenario to compare key network capacity benefits with the Do-Minimum (scenario B). The junction improvement options considered are:

- A22 London Road / Lingfield Road – includes Atkins proposed junction widening scheme. This includes A22 London Road (northbound) right turn short flare with **one lane southbound on A22 London Road**; and
- A22 London Road / Moat Road – includes signal controlled junction with controlled pedestrian crossings on Moat Road.

Consequently it has been considered in VISSIM only.

The modelled evaluation for all the above scenarios is presented in the following section, including comparisons between each scenario.

3. Forecast Networks Evaluation

3.1. Junction Capacity Assessments

3.1.1. Felbridge and Imberhorne Lane

The LinSig results comparing all scenarios at the Felbridge (A22 / Copthorne Road) and A22 / Imberhorne Lane junctions are presented in Tables 4 and 5 below for the AM and PM peak periods. The results demonstrate that the DN shows a slight worsening in conditions and queues over the existing Base with the addition of the committed and proposed development traffic. In addition the improvements associated with the committed scheme at Imberhorne Lane, including the pedestrian crossings, add delays overall. The DN model predicted that committed scheme at the Imberhorne Lane junction able to accommodate the committed and proposed development trips without adverse impact on junction operation.

The DM (scenario A) shows a similar situation at Imberhorne Lane as the scenario has remained the same as the committed scheme. Whereas in the DM (scenario A), Felbridge junction experiences over capacity in both peak hours with pedestrian crossings on all arms. The DM (scenario B) assesses without pedestrian crossings with the local widening within the existing highway boundary. These results in an overall improvement in operating conditions compared to the Future Base with the highest degree of saturation predicted as 90% on London Road South in the AM peak period.

The DS (scenario A) shows that at the Felbridge junction there would be an improvement in conditions over the Future Base in the AM peak period but a worsening in the PM peak period with an all red stage causing the junction to be over capacity. The DS (scenario B) test without the pedestrian crossings shows a notable improvement in the results compared to the Future Base in both peak periods at the Felbridge junction, with the highest degree of saturation predicted as 79% on Copthorne Road (PM peak period).

At Imberhorne Lane, the DS (scenario A) with an all red stage to include the additional crossing on the south-eastern arm of the junction results in the junction being over capacity in both peak hours with the highest degree of saturation recorded as 116% on the A22 London Road south approach in AM peak period. The DS (scenario B) without the all red stage and no pedestrian crossing on the south-eastern arm results in an improvement with all degrees of saturation below 97% and below 91% in the AM and PM peak periods respectively.

Overall DS (scenario B) results are very similar to the Future Base scenario and offers minimal discernable benefits.

3.1.2. A22 London Road/Lingfield Road Junction Assessments

In order to assess the junction capacity, addition to the above isolated junction assessments Atkins has carried out ARCADY and LinSig model at A22 London Road/Lingfield Road junction for AM and PM peak periods. The isolated junction outputs comparing all scenarios at this junction is presented in Tables 6 and 7 below for the AM and PM peak periods.

At Lingfield Road, the ARCADY results demonstrate that the Ratio of Flows to Capacity (RFC), queues and delays in DN scenario are over the capacity with significant queues compared to Base model with the addition of the committed and proposed development traffic.

The DM (scenario A) shows that there would be improvement in conditions over the Future Base in AM and PM peak periods with the extended flares at roundabout within the existing highway boundaries, however roundabout exceeds the capacity with highest RFC of 1.27 in AM peak period. The DM (scenario B) assumes signal controlled junction as per WSCC highway improvement scheme. This LinSig results shows a notable improvement in both peak periods at the Lingfield Road junction, with the highest degree of saturation predicted as 99% on Lingfield Road (AM peak period). However, it is very close to the junctions' theoretical capacity.

The DS scenario assumes that the junction is signal controlled as per improvements suggested by Atkins with local widening. The model results demonstrate a significant improvement with the highest degree of saturation as 90% and 89% at A22 London Road (N) in the AM and PM peaks periods respectively.

3.1.3. A22 London Road/Moat Road Junction Assessments

In order to assess the capacity of this junction, Atkins has carried out PICADY for existing and LinSig for forecast modelling at A22 London Road/Moat Road junction for AM and PM peak periods. The isolated junction outputs comparing all scenarios at this junction is presented in Tables 6 and 7 below for the AM and PM peak periods.

At Moat Road, the PICADY results demonstrate that the Ratio of Flows to Capacity (RFC), queues and delays in DN scenario are over the capacity with significant queues compared to base model with the addition of the committed and proposed development traffic. The DN model output shows that the junction exceeds the capacity with highest RFC of 2.25 in AM peak period and 1.42 in the PM peak period. No improvements are proposed in the DM scenario.

DS (Scenario A) includes signal controlled junction associated with controlled pedestrian crossings on London Road and Moat Road. The model results demonstrate a significant improvement with the highest degree of saturation as 88% at A22 London Road (N) in both the AM and PM peaks periods.

Table 4. Felbridge and Imberhorne Junction Model Results – AM Peak Hour

Junction and Link	Base 2011			Do Nothing			Do Minimum (A)			Do Minimum (B)			Do Something (A)			Do Something (B)		
	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)
A22 London Road / Copthorne Road																		
A262 Copthorne Rd	**95**	30	62	**97**	33	66	**115**	86	307	**88**	18	43	**85**	17	38	**66**	9	19
A22 Eastbourne Rd (N)	**84**	9	46	**81**	10	43	**92**	14	74	**82**	9	40	**84**	13	56	**67**	10	38
A22 London Rd (S)	**80**	10	14	**97**	28	39	**104**	78	124	**90**	14	20	**103**	28	158	**73**	13	42
A22 London Road / Imberhorne Lane																		
Imberhorne Lane	**75**	15	45	**87**	19	59	**87**	19	59	N/A	N/A	N/A	**97**	25	98	**87**	19	61
A22 London Rd (N) Ahead	**42**	6	5	**46**	7	5	**46**	7	5	N/A	N/A	N/A	**28**	5	11	**24**	3	5
A22 London Rd (N) Right Turn	**95**	19	97	**96**	20	99	**96**	20	99	N/A	N/A	N/A	**115**	48	337	**97**	21	109
A22 London Rd (S) Ahead/ Left	**76**	23	27	**92**	34	43	**92**	34	43	N/A	N/A	N/A	**116**	109	329	**94**	36	51

Note: DoS is Degree of Saturation. Delay is average delay per PCU (in s/pcu)

Table 5. Felbridge and Imberhorne Junction Model Results – PM Peak Hour

Junction and Link	Base 2011			Do Nothing			Do Minimum (A)			Do Minimum (B)			Do Something (A)			Do Something (B)		
	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)
A22 London Road / Copthorne Road																		
A262 Copthorne Rd	**91**	26	45	**95**	33	54	**109**	66	216	**85**	17	35	**109**	66	216	**79**	14	29
A22 Eastbourne Rd (N)	**77**	16	37	**92**	23	58	**100**	32	103	**72**	16	31	**103**	38	133	**78**	17	33
A22 London Rd (S)	**86**	12	19	**96**	25	37	**102**	63	100	**84**	12	15	**76**	13	46	**55**	11	29
A22 London Road / Imberhorne Lane																		
Imberhorne Lane	**78**	16	48	**81**	18	50	**79**	17	49	N/A	N/A	N/A	**94**	22	80	**83**	18	53
A22 London Rd (N) Ahead	**57**	10	6	**66**	14	7	**66**	14	7	N/A	N/A	N/A	**40**	8	12	**34**	5	5

Junction and Link	Base 2011			Do Nothing			Do Minimum (A)			Do Minimum (B)			Do Something (A)			Do Something (B)		
	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)	DoS (%)	Queue (pcu)	Delay (s/pcu)
A22 London Rd (N) Right Turn	**91**	17	84	**87**	17	68	**83**	15	62	N/A	N/A	N/A	**112**	43	288	**91**	18	80
A22 London Rd (S) Ahead/ Left	**72**	20	26	**85**	27	36	**85**	27	36	N/A	N/A	N/A	**105**	58	161	**86**	28	38

Note: DoS is Degree of Saturation. Delay is average delay per PCU (in s/pcu)

Table 6. Lingfield Road and Moat Road Junction Model Results – AM Peak Hour

Junction and Link	Base 2011*			Do Nothing*			Do Minimum (A)*			Do Minimum (B)#			Do Something (A)#		
	RFC	Queue (pcu)	Delay (min)	RFC	Queue (pcu)	Delay (min)	RFC	Queue (pcu)	Delay (min)	DoS (%)	Queue (pcu)	Delay (min)	DoS (%)	Queue (pcu)	Delay (min)
A22 London Road / Lingfield Road															
Lingfield Road	1.18	57	7	1.22	67	9	1.27	70	9	99	22	3	87	14	1
A22 London Road (N)	1.28	101	11	1.39	149	18	1.08	28	5	85	16	0	90	18	1
A22 London Road (S)	1.25	141	9	1.29	168	12	1.13	75	4	97	37	2	66	7	0
A22 London Road / Moat Road															
Moat Road	1.21	45	503	2.25	177	1688	2.25	177	1688	2.25	177	1688	69	8	3
A22 London Road (N)	1.08	63	745	1.27	179	1977	1.27	179	1977	1.27	179	1977	88	16	7

Note: * - ARCADY/PICADY Model; # - LinSig Model; RFC is Ratio of Flow to Capacity; DoS is Degree of Saturation

Table 7. Lingfield Road and Moat Road Junction Model Results – PM Peak Hour

Junction and Link	Base 2011*			Do Nothing*			Do Minimum (A)*			Do Minimum (B)#			Do Something (A)#		
	RFC	Queue (pcu)	Delay (min)	RFC	Queue (pcu)	Delay (min)	RFC	Queue (pcu)	Delay (min)	DoS (%)	Queue (pcu)	Delay (min)	DoS (%)	Queue (pcu)	Delay (min)
A22 London Road / Lingfield Road															
Lingfield Road	1.16	48	6	1.18	52	8	1.20	58	10	87	17	1	85	15	1
A22 London Road (N)	1.28	109	11	1.37	142	16	1.39	144	22	90	22	1	89	22	1
A22 London Road (S)	1.34	215	13	1.38	232	15	1.42	238	17	82	24	0	70	9	0
A22 London Road / Moat Road															

Moat Road	1.01	19	264	1.04	29	342	1.04	29	342	1.04	29	342	72	7	3
A22 London Road (N)	1.34	224	853	1.42	567	7412	1.42	567	7412	1.42	567	7412	88	18	7

Note: * - ARCADY/PICADY Model; # - LinSig Model; RFC is Ratio of Flow to Capacity; DoS is Degree of Saturation

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3.2. VISSIM Network Model Assessments

The future year scenarios assessed with the VISSIM model are outlined in the following sections and includes the comparison between DN, DM (scenarios A and B) and DS (scenarios A, B, C and D) scenarios for improvements to the A22 London Road at Lingfield Junction, A22 Station Road and A264 Moat Road. The key evaluation indicators considered for all scenarios are:

- Journey Times – general vehicles & buses;
- Delays – general vehicles & buses; and
- Queue Lengths.

The modelled queue length result includes any vehicles not able to enter the network due to the traffic congestion on a particular approach. This is mainly identified at Lingfield Road, A22 Station Road and Moat Road approaches. Separate journey times for the general vehicles and buses on both routes are presented for all the scenarios. Delays for the each journey time segments measured in terms of an average total delay per vehicle in seconds are also assessed separately for the general vehicles and buses.

3.2.1. Journey Times

The modelled journey time results for all scenarios for the general vehicle is presented below in Tables 8 and 9 for AM and PM Peak Hours respectively. The journey time segment locations are presented in Appendix A.

The result shows that in AM and PM Peak Hours, the journey times for the DN is higher than the base scenario with an addition of committed and proposed development traffic. The DM (scenario A), journey times are improved in the A22 London Road southbound route and worsen in the northbound direction this is mainly because of a pelican crossing scheme at the A22/London Road/Station Road junction and with implementing an ASL at the Lingfield Road junction.

Table 8. Journey Time Comparison (General Vehicle) – AM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	47.8	48.2	23.5	24.5	32.7	25.3	27.1	27.3
JTS4-S5 (E)	13	12.8	13.4	13.2	22.8	24.6	13.8	26.4
JTS5-S6 (E)	30.3	30.8	29.8	29.2	31	30.8	29.2	30.8
Route1 TOTAL	**91.1**	**91.8**	**66.7**	**66.9**	**86.5**	**80.7**	**70.1**	**84.5**
Percent diff. (%)			-27%	-27%	-6%	-12%	-24%	-8%
JTS6-S4 (W)	138.4	180.4	453.3	365.3	279.5	367.7	202.5	197.9
JTS4-S3 (W)	62	63.8	92	112.4	33.6	74.8	50.8	41.4
Route2 TOTAL	**200.4**	**244.2**	**545.3**	**477.7**	**313.1**	**442.5**	**253.3**	**239.3**
Percent diff. (%)			123%	96%	28%	81%	4%	-2%

Table 9. Journey Time Comparison (General Vehicle) – PM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	46.8	49.7	30.6	29.2	80.6	74	36.6	41.4
JTS4-S5 (E)	12.9	13.6	16.7	16.1	29.7	29.9	15.7	25.1
JTS5-S6 (E)	31.2	31.3	30.9	30.9	31.3	31.1	30.9	30.5
Route1 TOTAL	**90.9**	**94.6**	**78.2**	**76.2**	**141.6**	**135**	**83.2**	**97**
Percent diff. (%)			-17%	-19%	50%	43%	-12%	3%
JTS6-S4 (W)	97.3	158.1	357.5	64.5	321.3	314.5	61.7	68.5
JTS4-S3 (W)	45.6	56.8	35.7	39.7	9.5	29.1	10.1	21.5
Route2 TOTAL	**142.9**	**214.9**	**393.2**	**104.2**	**330.8**	**343.6**	**71.8**	**90**
Percent diff. (%)			83%	-52%	54%	60%	-67%	-58%

3.2.1.1. AM Peak Hour

In the DM (scenario B) without pelican crossings, the journey times are improved compared to DM scenario A for the Route Two, however, the journey times are 96% higher than the DN scenario in contrast the Route One journey time shows 27% reduction in the AM Peak Hour.

The DS (scenario A) resulted in the reduction in Route Two journey times (313 seconds) compared to the DM scenario A (545 seconds) however this represent a 28% increase in the journey times compared to the DN modelled journey times in the AM Peak Hour.

The DS (scenario B) scheme showed a little improvement in the journey times (81 seconds) compared to the DS scenario A (87 seconds). However, Route Two journey times increased from 313 seconds to 443 seconds. Overall model has predicted Route Two journey time increases by 81% compared to the DN scenario model therefore it is prudent to have two lane in the A22 London Road northbound direction at Lingfield Road junction as in Scenario A rather than two lanes southbound leaving the junction.

The DS (scenario C) scheme includes Lingfield Road junction signalised with London Road one lane southbound without any other junction improvement scheme. This scheme shows improvement in the journey times compared to any other DM and DS scenarios. Furthermore the model predicted journey time decreases by 24% (Route One) with an implementation of the Lingfield Road scheme whereas slight increased (four percent) predicted in the Route Two journey times compared to the DN model.

The DS (scenario D) scheme includes Lingfield Road junction signalised with London Road one lane southbound together with Moat Road junction improvement scheme. This scheme shows better improvement in the journey times compared to any other DM and DS scenarios. Furthermore the model predicted journey time decreases by eight percent (Route One) with an implementation of the Lingfield Road and Moat Road schemes whereas two percent decreases predicted in the Route Two compared to the DN model.

3.2.1.2. PM Peak Hour

The PM Peak Hour journey time results are very similar to the AM Peak Hour with the DM (scenario B) model predicted decrease by 19 and 52% in the Routes One and Two respectively compared to the DN Model.

The DS scenario C illustrates journey time benefits of 67% in the Route Two compared to the DN model. The DS scenario D with Lingfiled Road and Moat Road schemes predicted to decrease journey time by 58% for the Route Two.

The bus journey time comparisons are presented in Tables 10 and 11 for both the AM and PM Peak Hour respectively for all the VISSIM modelling scenarios.

Table 10. Journey Times Comparisons (Buses) – AM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	37.1	52.1	17.6	13.4	31.2	29.8	30	24.4
JTS4-S5 (E)	28	20	35.2	29.6	44.2	37.2	34.2	48.6
JTS5-S6 (E)	32.3	32.5	33.1	30.1	31.7	34.3	31.9	32.9
Route1 TOTAL	**97.4**	**104.6**	**85.9**	**73.1**	**107.1**	**101.3**	**96.1**	**105.9**
Percent diff. (%)			-18%	-30%	2%	-3%	-8%	1%
JTS6-S4 (W)	154.2	149	446.2	394.8	432	556	293.2	223.2
JTS4-S3 (W)	64.1	66.4	67.8	112.6	65.2	69.8	66.2	55.8
Route2 TOTAL	**218.3**	**215.4**	**514**	**507.4**	**497.2**	**625.8**	**359.4**	**279**
Percent diff. (%)			139%	136%	131%	191%	67%	30%

Table 11. Journey Times Comparisons (Buses) – PM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	60.2	54	17.1	16.9	96.3	72.9	34.7	35.7
JTS4-S5 (E)	23.9	27.3	42.7	32.3	66.1	58.7	39.9	40.3
JTS5-S6 (E)	29.9	32.8	31.2	32	29.8	32.8	32	30.4
Route1 TOTAL	**114**	**114.1**	**91**	**81.2**	**192.2**	**164.4**	**106.6**	**106.4**
Percent diff. (%)			-20%	-29%	68%	44%	-7%	-7%
JTS6-S4 (W)	84.6	135.5	311.4	63.4	247.2	133.6	98.4	106.6
JTS4-S3 (W)	45.1	70.5	46.4	73.2	29.2	80.2	28.2	27.8
Route2 TOTAL	**129.7**	**206**	**357.8**	**136.6**	**276.4**	**213.8**	**126.6**	**134.4**
Percent diff. (%)			74%	-34%	34%	4%	-39%	-35%

The Route One bus journey times are predicted to improve in the DM scenarios with the highest reduction in journey times by 30% in the AM Peak Hour. Nevertheless the model is showing a significant increase in Route Two journey times.

The DS (scenario C) model predicted bus journey times decreases by eight percent compare to the DN for the Route One in the PM Peak Hour however model shows 67% increase in journey time for the Route Two.

3.2.2. Delays

The modelled delays at each journey time segments are summarised in Tables 12 and 13 for the AM and PM Peak Hours respectively.

Table 12. Delays Comparison (General Vehicle) – AM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	13.5	14.4	7.4	7.2	12	5.6	5.6	6.4
JTS4-S5 (E)	3.1	3.1	3	3	13.4	15	4	17
JTS5-S6 (E)	4.4	4.7	3.5	2.7	4.5	3.7	2.5	4.3
Route1 TOTAL	**21**	**22.2**	**13.9**	**12.9**	**29.9**	**24.3**	**12.1**	**27.7**
Percent diff. (%)			-37%	-42%	35%	9%	-45%	25%
JTS6-S4 (W)	80.6	65.2	353.5	334.7	275.9	342.1	198.9	186.3
JTS4-S3 (W)	31	38.7	64.8	82	16.4	66.2	25.4	24.2
Route2 TOTAL	**111.6**	**103.9**	**418.3**	**416.7**	**292.3**	**408.3**	**224.3**	**210.5**
Percent diff. (%)			303%	301%	181%	293%	116%	103%

Table 13. Delay Comparison (General Vehicle) – PM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	16.4	18.2	7.4	7.2	58.2	59.4	14.8	18.8
JTS4-S5 (E)	4	3.5	5.9	7.5	20.3	22.1	6.9	15.7
JTS5-S6 (E)	5	5.1	3.9	4.5	4.5	4.5	3.9	3.9
Route1 TOTAL	**25.4**	**26.8**	**17.2**	**19.2**	**83**	**86**	**25.6**	**38.4**
Percent diff. (%)			-36%	-28%	210%	221%	-4%	43%
JTS6-S4 (W)	60.9	68.6	285.6	69.4	288.2	297.4	16.4	26.2
JTS4-S3 (W)	23.8	31.7	3.3	27.7	-9.5	13.1	-5.9	2.5
Route2 TOTAL	**84.7**	**100.3**	**288.9**	**97.1**	**278.7**	**310.5**	**10.5**	**28.7**
Percent diff. (%)			188%	-3%	178%	210%	-90%	-71%

The DM (scenario A) Route One delays are improved compared to the DN modelled delays, however, it has increased for the Route Two due to the pelican crossing at the A22 Station Road/London Road junction. As expected without a pelican crossing at the A22 Station Road/London Road junction, northbound delays are predicted to decrease from 289 seconds (DMA) to 97 seconds (DMB).

The DS scenarios A and B are showing similar results as journey time results in both the AM and PM Peak Hours. The DS scenario D (with improvement options at Lingfield Road and Moat Road junctions) delays are predicted to increase slightly from 22.2 seconds in the DN to 27.7 seconds in the AM Peak Hour. Similar results are also noticed in the PM Peak Hour.

Delays evaluation for buses is presented in Tables 14 and 15 below for the AM and PM Peak Hour respectively.

Table 14. Delays Comparisons (Buses) – AM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	11.9	23.3	7.8	4.6	5.3	9.2	10.9	10.9
JTS4-S5 (E)	13.9	7.1	7.3	4.3	19.1	17.3	9.1	26.5
JTS5-S6 (E)	2.9	4.4	2.2	2	1	3.2	2.1	2.6
Route1 TOTAL	**28.7**	**34.8**	**17.3**	**10.9**	**25.4**	**29.7**	**22.1**	**40**
Percent diff. (%)			-50%	-69%	-27%	-15%	-36%	15%
JTS6-S4 (W)	57.1	71.7	311.9	380.3	407.7	456.3	241.3	190.1
JTS4-S3 (W)	21.5	35.2	40.3	30.1	27.5	40.5	10.5	29.1
Route2 TOTAL	**78.6**	**106.9**	**352.2**	**410.4**	**435.2**	**496.8**	**251.8**	**219.2**
Percent diff. (%)			229%	284%	307%	365%	136%	105%

Table 15. Delays Comparisons (Buses) – PM Peak Hour

Segments	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
JTS3-S4 (E)	19.4	21.5	7.4	8.2	77.9	70.9	15.3	16.7
JTS4-S5 (E)	8.4	7.8	14.9	14.1	40.1	20.3	26.1	22.5
JTS5-S6 (E)	3.8	3.9	8.9	9.1	4.1	8.7	7.7	5.1
Route1 TOTAL	**31.6**	**33.2**	**31.2**	**31.4**	**122.1**	**99.9**	**49.1**	**44.3**
Percent diff. (%)			-6%	-5%	268%	201%	48%	33%
JTS6-S4 (W)	52.3	68.4	290	107.2	224.6	248	41	72.8
JTS4-S3 (W)	25.8	37	25.1	31.9	4.9	29.5	19.9	7.5
Route2 TOTAL	**78.1**	**105.4**	**315.1**	**139.1**	**229.5**	**277.5**	**60.9**	**80.3**
Percent diff. (%)			199%	32%	118%	163%	-42%	-24%

The tables above shows delays for buses are improved in the DM scenario B compare to the DM (scenario A) in both the AM and PM Peak Hours for Route One. However, Route Two delays are predicted to increase in both the AM and PM Peak Hours.

The DS (scenario C) model predicted a decrease in delays from 22.1 seconds to 34.8 seconds in the AM Peak Hour. The PM Peak Hour model predicted a negligible increase in the Route One compare to the DN scenario. The DS (scenario D) model predicted decrease in journey times by 24% (Route Two) compared to the DN model.

3.2.3. Queue Lengths

The error files, which are generated at the end of each model runs are compiled and summarised in Table 16 below.

Table 16. Error File Summary

Entry Approaches	Base	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C
			DMA	DMB			
AM Peak Hour							
Moat Road	2	0	19	13	0	0	0
Lingfield Road	0	0	12	29	0	0	25
A22 Station Road	0	0	84	92	0	47	0
PM Peak Hour							
Moat Road	0	0	0	0	0	0	0
Lingfield Road	0	0	0	0	0	0	0
A22 Station Road	0	0	0	0	0	0	0

The above Table presents the number of vehicles not able to enter into the A22 London Road network. This number of vehicles are then converted into lengths and added to the modelled queue lengths. The total queue lengths (in metres) for all the forecasting scenarios including the base year is summarised in Tables 17 and 18 for AM and PM Peak Hours.

Table 17. Queue Lengths (metres) – AM Peak Hour

Location	Base 2011	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
A22 London Rd (W)	141	511	57	55	65	58	59	58
Lingfield Rd	99	163	526	962	778	501	787	860
A22 London Rd (E)	72	84	79	73	78	83	74	66
Maypole Rd	13	40	43	20	10	4	29	43
Station Rd	121	336	1018	1649	1067	822	757	379
Moat Rd	131	328	624	863	350	246	721	330

Table 18. Queue Lengths (metres) – PM Peak Hour

Location	Base 2011	Do Nothing	Do-Minimum		Do-Something A	Do-Something B	Do-Something C	Do-Something D
			DMA	DMB				
A22 London Rd (W)	133	452	112	114	135	112	98	127
Lingfield Rd	72	76	190	304	381	376	262	392
A22 London Rd (E)	74	82	91	83	70	75	79	68
Maypole Rd	13	9	14	17	25	22	12	16
Station Rd	132	401	492	419	448	750	449	155
Moat Rd	133	308	276	367	168	49	232	280

The DN scenario modelled queue lengths are generally higher than the Base (2011) in both the AM and PM Peak Hour. This is mainly because addition of the committed and proposed development traffic. The DM scenario modelled queue lengths are predicted to decrease at the A22 London Road corridor compared to the DN particularly in the AM Peak Hour. In contrast, the DM models predicted increase in the queue lengths at Lingfield Road, A22 Station Road and Moat Road compared to the Future Base model.

The DS (scenario D) queue lengths are showing significant reduction (379 metres) at A22 Station Road compared to the DM scenario (863 metres) in the AM Peak Hour. Similar large reduction in queue lengths is noticed in the PM Peak Hour model at the same location. Furthermore with implementation of the Moat Road scheme shows reduction in queues at Moat Road approach in both the AM and PM Peak Hours compared to the DM scenarios.

During the model run it is also noticed that right turn traffic at the A22 London Road/Maypole Road junction blocks the A22 London Road southbound through traffic and queues are occasionally noticed blocking the Lingfield Road junction.

3.3. Advanced Stop Line Assessment

The DS modelled queue length results predicting a significant decrease compared to the DM scenario model. To evaluate the junction capacity implication due to the implementation of the Advanced Stop Line (ASL), Atkins has carried out model simulation for with and without ASL at the Lingfield Road junction in the DM scenario. Table 19 summarises calculated saturation flows at the A22 London Road (northbound).

Table 19. Capacity Assessment with and without ASL

Junction	Approach	Descriptions	Average Saturation Flows (PCUs)
A22 London Road / Lingfield Road	A22 London Rd (northbound)	WSCC scheme – **with** ASL	1222
	A22 London Rd (northbound)	WSCC scheme – **without** ASL	1456

Above assessment demonstrates that the implementation of ASL diminished junction throughputs by 19% at the A22 London Road / Lingfield Road junction.

3.4. Summary

Isolated junction assessments at the Felbridge and Imberhorne Lane junctions demonstrates that the DS (scenario B) highway improvement schemes does provides a spare capacity in order to accommodate the committed and proposed development related trips. In order to assess the quantum of any future development trips that the network might accommodate, it can be appraised using these robust models when each development comes forward and details are known.

Based on the LinSig and VISSIM model evaluation, Table 20 summarises the preferred scenarios forming the DM and the DS schemes based on the model performance indicators.

Table 20. Scheme Performance Recommendations

Junction Improvement Scheme	Do-Minimum	Do-Something
A22 London Road / A262 Copthorne Road	DM (scenario B)	DS (scenario B)
A22 London Road / Imberhorne Lane	Imberhorne Lane - committed scheme	Imberhorne Lane - committed scheme
A22 London Road / Lingfield Road	DM (scenario B)	DS (scenario D)
A22 Station Road / A22 London Road	Existing	Existing
A22 Station Road / Moat Road	Existing	DS (scenario D)

4. Summary and Conclusions

The DM VISSIM model assessment shows the substantial increases in journey time and delays for Route Two (A22 Station Road - London Road to Lingfield Road junction) in the AM Peak Hour, when compared to the DN. Furthermore, the DM modelled queue lengths are predicted to increases significantly at Lingfield Road, A22 Station Road and Moat Road, whereas considerably decreases at A22 London Road (West).

Generally, it can be concluded that based on a review of the isolated junction modelling analysis of the identified scenarios, the preferred DM scheme are predicted to mitigate the impact committed and proposed development in East Grinstead and in comparison to the 2011 existing scenario improve the performance of the A22 London Road, returning it within theoretical capacity. It is noted that this is achieved within the boundary of the existing highway network and further that signal co-ordination will serve to control the arrival patterns of vehicles at each junction through the network and offer increased capacity above that identified in this assessment.

It is recognised that the DS schemes appraised in VISSIM model are not showing consistent performance at all the locations and in both peak hours, however, the DS scenario D predicts the most favourable evaluations overall. It can be considered that a ‘DS’ scheme with more onerous levels of interventions (improvements beyond the highway boundary) are likely to be necessary to fully address traffic congestion and provide sufficient capacity to accommodate committed and proposed development with some reserve capacity. The preferred schemes have been identified where practical at critical locations, namely Felbridge and Imberhorne Junctions to improve capacity however may remain constrained at intervening locations.

At this stage, it is also considered that without significant interventions to the wider town centre network, improvements to pedestrian movements at A22 London Road / A22 Station Road are not practically deliverable without compromising the capacity of the highway network in this location. These could, however, be considered as a part of onward review of town centre improvements.

Appendix A. – Journey Time Segments

Figure A.1 – Route 1 Journey Time Segments

Figure A.2 – Route 2 Journey Time Segments