Essex Highways

Basildon Town Centre Modelling

Local Model Validation Report

May 2021

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1 Background

Introduction

As specialist consultant to Ringway Jacobs, the framework provider to Essex County Council (ECC), Jacobs developed the Basildon Town Centre VISSIM Model (BTCVM) in 2017 to assess the impact of proposed highway changes outlined in the Basildon Town Centre Masterplan (2016). In 2020, Jacobs also developed the Enhanced Essex Countywide Model (EECSM) to provide ECC with a tool to understand how people travel strategically within the region and how this might change with future growth and as major transport schemes are implemented. It has a base year of 2019 and covers the whole of the South Essex Region.

Jacobs has since been commissioned by ECC to update the existing VISSIM base model to 2019 flow and traffic condition and develop two modelling forecast scenarios using the BTCVM, to help identify the impacts of proposed revisions to the highway network in Basildon Town Centre and provide outputs thereon.

Study Area

Basildon town centre is situated approximately one mile from the A127 Southend Arterial Road and A13 London Road - both routes are key connectors to London and the M25. The study area is primarily made up of the following key routes - A1321 Broadmayne, A176 Nethermayne, Southernhay, and Cherrydown East. Basildon rail station is situated to the south of the town centre, approximately five minutes on foot from Basildon bus station. The extent of the town centre model is illustrated in Figure 1.1 below.

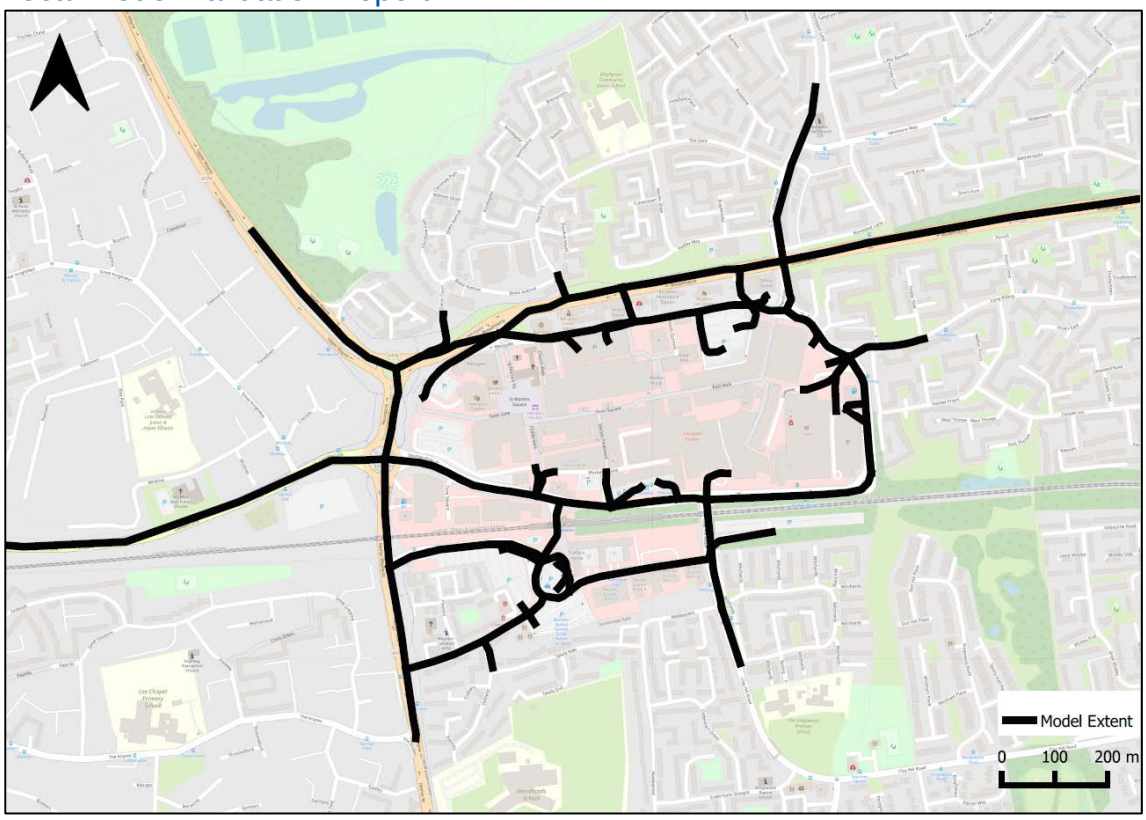

Figure 1.1: Model network extent

Modelling Approach

Three 2019 base year Basildon Town Centre models have been developed, using PTV's VISSIM micro simulation software (version 20), for the weekday AM and PM and Saturday peak periods respectively. The models represent an average term time weekday in 2019, the peak hours for each model are as follows:

- **AM** 08:00-09:00
- **PM** 17:00-18:00
- **Saturday** 12:00-13:00

Each peak hour model includes a 30 minute warm up and cool down period.

VISSIM models each vehicle individually, including driver behaviour characteristics, and provides a visual representation of the interaction between vehicles, assisting in the assessment of the road network operation and model calibration.

Report structure

The remaining sections in this report summarise the data used, and work carried out to produce, calibrate and validate the base model.

2. Traffic Data Analysis – This section outlines the traffic count and journey time data used to build, calibrate and validate the model including their source and collection information.

3. Model Calibration – The model calibration section describes the method used to build the model and the process that was undertaken to calibrate it.

4. Model Validation – The model validation section outlines the validation process and validation results. It also addresses the model error logs and other modelling issues.

5. Summary – Summarises the suitability of the model for its purpose based on the validation results.

Appendix A – Includes the full list of traffic flow calibration results.

Appendix B – Includes the full list of Journey time validation results

2 Traffic Data Analysis

Data Counts

This section covers the new and existing traffic count data used in this project. The new traffic counts were used to uplift the existing matrices from the 2016-based BTCVM, as well as to calibrate and validate the 2019 BTCVM. COVID hindered the collection of up to date traffic surveys, therefore, with the exception of 4 counts collected before 16th March 2020, all of the traffic data was gathered in 2019 and before, as shown in Table 2.1.

Where available, data has been obtained for neutral weekdays (in AM and PM models) and neutral months. This means that only data collected on Tuesday to Thursday in the months of March, April, May and September have been used, and dates outside of term time, weeks containing a Bank holiday, and the Thursday preceding a Bank holiday were excluded from analysis in these instances. This is in line with TAG Unit M1.2 Section 3.3.

Site ID	Site	Type	Date
20110-30	A176 Upper Mayne (S of A1235) BASILDON	Automatic Traffic Count (ATC)	MAR 2020
18179-01	A176 Nether Mayne + Roundacre BASILDON	Manual junction turning count (JCT)	MAR 2018
20118-01	Roundacre + Station Way BASILDON	JCT	MAR 2020
20118-02	Southernhay + Cherrydown East BASILDON	JCT	MAR 2020
20118-04	Cherrydown East + Ashdon Way BASILDON	JCT	MAR 2020
18121-68	A1321 Broadmayne (E) BASILDON	Manual Link Count (LNK)	APR 2018
161480102	A176 Upper Mayne BASILDON	LNK	MAY 2016
161481819	B1007 Laindon Link BASILDON	LNK	MAY 2016
161480809	A1321 Broadmayne BASILDON	LNK	MAY 2016

Table 2.1: New Survey Counts

Traffic count data has been used in the model to adjust base year matrices and network parameters (calibration), as well as to provide independent comparisons of the model against observed traffic data. The sections below describe the locations of counts used for each of these purposes. The 2016 base year matrices have been uplifted using the growth factor calculated by the new survey data collected between 2018-2020 and existing survey data collected in year 2016. The locations of both the new and existing traffic counts are displayed in Figure 2.1 below.

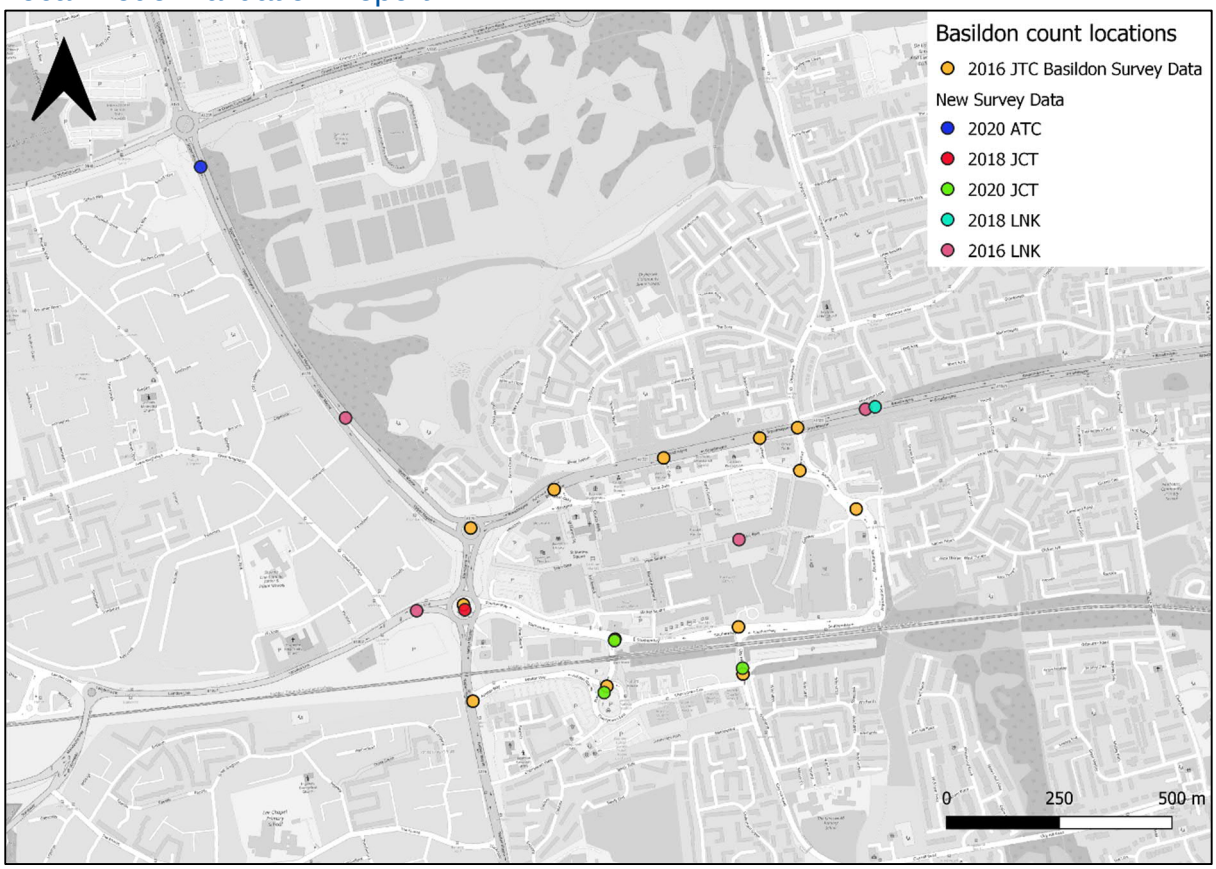

Figure 2.1: Basildon Count Locations

There is only one new survey count for Saturday, which is site 20110-30. The growth factor for Saturday demand is calculated by averaging the AM and PM peak due to the lack of Saturday data.

Automatic Traffic Counts (ATCs)

ATCs are counts where flows are compiled automatically without constant human supervision. This allows for counts which are collected continuously over a period of one or two weeks, providing a more reliable estimate of average flow.

The counts which are referred to as ATCs for the data in this model use two pneumatic tubes laid across the road to count traffic flows and to detect the direction in which the traffic is travelling. ATC data was collected for A176 Upper Mayne for the week commencing 14th March 2020.

Link Counts

Manual classified Link counts, which contrary to ATC are collected by manual rather than automatic means, were also collected over a 13-hr period at A1321 Broadmayne on 25th April 2018.

Junction Turning Counts (JTCs)

JTCs are manually collected surveys of turning movements at junctions. For this study, they were provided by ECC for 4 of the junctions in the Basildon model study

area. The data collection was undertaken during a 13-hr period from 06:00 to 19:00. Junction turning count data was collected for A176/Southernhay roundabout on the 28th March 2018 and for Roundacre/Station Way, Cherrydown East/Ashdown Way and Cherrydown East/Southernhay on 4th March 2020.

Journey Time Data

The journey time data for the model validation were provided by ECC. The data was extracted from the available Teletrac Data (the latest available for each time peak):

- AM: 2019
- PM: 2019
- Saturday: 2017 & 2019

The data was aggregated into journey time routes through the area covered by the modelled network for journey time validation. The routes used for journey time validation are listed in Table 2.2 and illustrated in Figure 2.2 below.

2019 journey time data was not available for all routes in the Saturday peak and therefore in the absence of 2019 data, 2017 was used. The routes that use 2017 journey time data for validation are Route 3 westbound, Route 4 northbound and Route 5.

Route	Colour	Road/s
Route 1	Red	A1321 - B1007
Route 2	Dark Blue	A176 - A1321
Route 3	Black	B1007 - Southernhay
Route 4 SB	Purple	A1321 - Clay Hill Road
Route 4 NB	Dark Green	Clay Hill Road - A1321
Route 5	Light Green	Clay Hill Road - Nether Mayne

Table 2.2: New Journey Time Routes

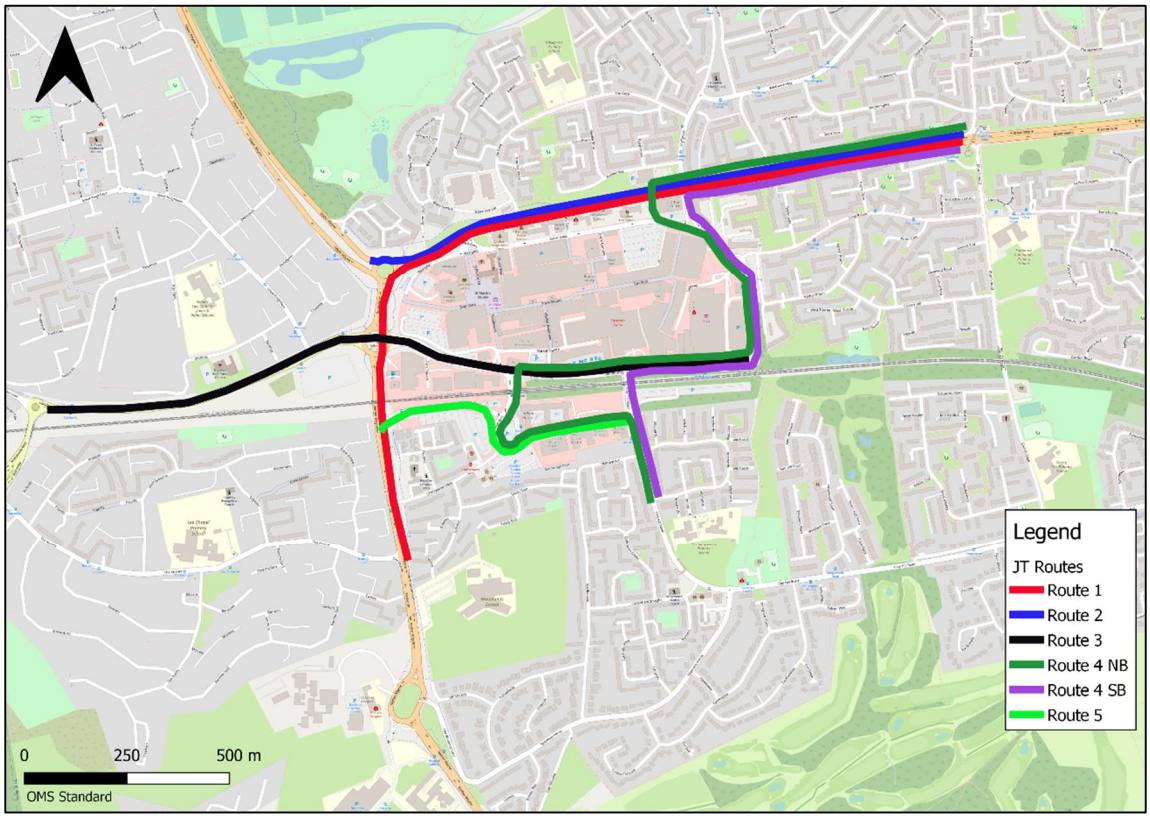

Figure 2.2: Journey Time validation Routes

3 Model Calibration

Network Data

An analysis of all observed traffic volume was undertaken to determine the hour with the busiest total traffic flows for each peak period. The analysis showed that the busiest hours are 08:00 to 09:00 for the weekday AM peak, 17:00-18:00 for the weekday PM peak and 12:00 to 13:00 for the Saturday peak. Therefore, these are the peak hours used in the model development. Derivation of model peak hours are shown in table 3.1 and table 3.2 below.

Table 3.1: AM/PM Peak Hour Analysis

Hour starting	Total flows	Peak hour
06:00:00	5127	
07:00:00	9090	
08:00:00	11439	AM
09:00:00	9514	
10:00:00	8867	
11:00:00	9418	
12:00:00	10027	
13:00:00	10847	
14:00:00	12029	
15:00:00	12723	
16:00:00	12689	
17:00:00	13553	PM
18:00:00	11924	

Table 3.2: Saturday Peak Hour Analysis

Hour starting	Total flows	Peak hour
10:00:00	2568	
11:00:00	2762	
12:00:00	3014	Saturday
13:00:00	2918	
14:00:00	2858	
15:00:00	2716	

Three models have been set up, covering the AM peak, the PM peak and the Saturday peak. Each model has a duration of 7200 seconds (two hours). This includes a 3600 seconds model hour and a 1800 second (30 minutes) warm up and cool down period.

The model times are as follows:

- AM Peak: 7:30 to 9:30 (modelled peak hour: 8:00-9:00)
- PM Peak: 16:30 to 18:30 (modelled peak hour: 17:00-18:00)
- Saturday Peak: 11:30 to 13:30 (modelled peak hour: 12:00-13:00)

Link Structure

Link structure, including link lengths, connector turning movements, bus lanes and bus stop locations have been coded using OS base data and aerial photography.

During the process of updating the 2019 BTCVM link structure, an additional zone was coded into the model. With available 2020 survey data for the Cherrydown East / Ashdon Way/ Station Way Junctions, it was possible to determine the flow going in to and out of the Basildon Station Short Stay Car Park, so this was added to the model as a new zone.

As part of the modelling scope Jacobs proposed to review if the inclusion of the Basildon town centre service roads within the 2019 BTCVM is needed. The service roads can be seen in Figure 3.1. Upon review of the model it was concluded that vehicle flow on these roads would be small and therefore have little impact on the performance of the model. Furthermore, there are zones in the model that cover the service road entrance points into the network and any flow produced, would be accounted for within the pre-defined zones. Therefore, the decision was made to not model the service roads within the network, as this would not be needed in order to fully assess the impacts of the changes to the town centre road layout in the future.

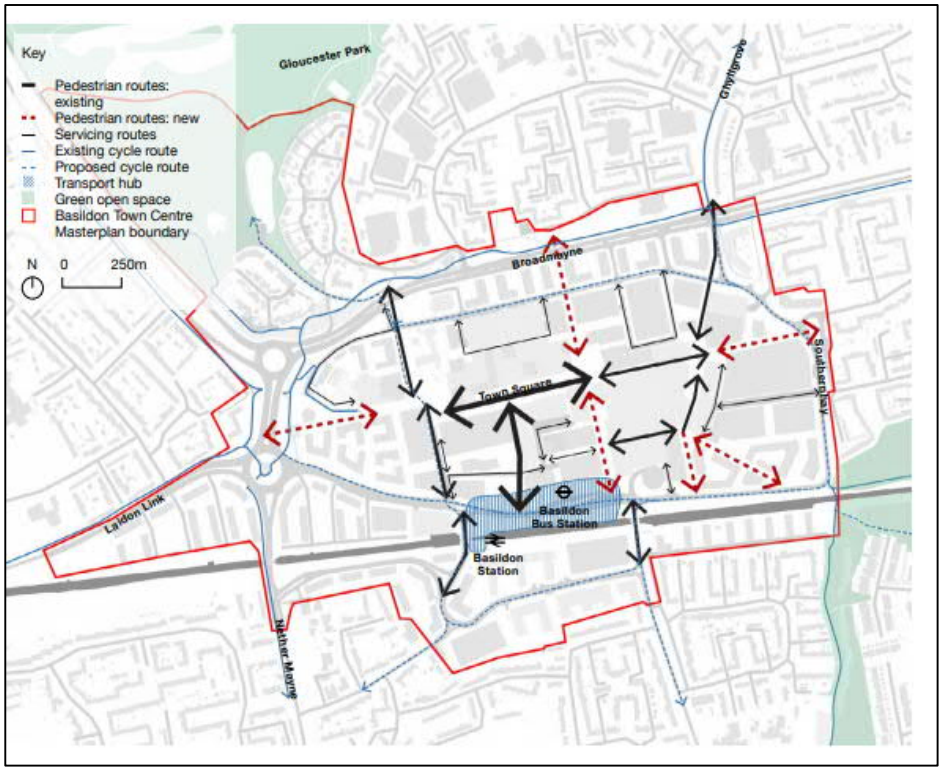

Figure 3.1 Service Roads within Basildon Town Centre

Reduced Speed Area and Desired Speed Decisions

Reduced speed areas have been set up on all turning movements and circulatories at roundabouts, with tighter turns having lower reduced speed values.

At many of the signalised junctions throughout the model, entry arms have been coded with reduced speed areas. This is to reflect the reduction in speed that is typically experienced by traffic approaching a signalised junction.

Desired Speed decisions have been used to set desired speeds on entry to the network and where there is a change in the posted speed limit. Within the network these range from 20-50mph.

Give Way Junctions

Priority rules have been used where one traffic movement has to give way to another traffic movement, including most give ways onto roundabouts.

Priority rules have also been added at the A1321/Linkway junction, A1321/Great Oaks junction in the AM and PM peak models and A1321/Southernhay junction in the Saturday peak model. This is to ensure traffic does not block the junctions on the A1321.

At roundabouts, gap times and clearance for buses and HGV's are slightly higher compared with cars. This reflects the fact that large vehicles require more time to enter the roundabout and therefore have to accept larger gaps than a car would.

For dual lane roundabouts, the priority rules have been offset and adjustments made to the inside lane's gap time and clearance to account for additional time and space required to cross into the inside lane.

Conflict areas have been applied to some junctions and roundabouts in order to define the rights of way for areas of the model where there are fewer conflicting flows. Conflict areas have also been applied to the exit of bus stop lay-bys.

Signal Timings

Most signal-controlled sites in the model have been coded using VISSIM Vehicle Actuated Programming (VAP). VAP allows for demand dependency and vehicle actuation (VA) to be accurately modelled. Logic used within the VAP programming has remained unchanged from the existing 2016-based BTCVM.

For VA junctions, detectors were setup on the approaches to a junction. The detectors call and extend a traffic signal stage up until a pre-set maximum value if there is a demand for that stage. The VAP then programs the signals to move to the next stage. If demand for the stage ends before the stage pre-set time is reached, then the junction will immediately move to the next stage.

For pedestrian crossings, the pedestrian stage has been configured as demand dependent and is activated when a pedestrian passes over a detector. The pedestrian volumes remain the same as in the 2016-based existing model.

The signal on the B1007 Laindon Link has remained coded as fixed time signal as found in the 2017 BTCVM. This means they have a set cycle time and are not demand dependent.

All signal timings across AM, PM and Saturday 2019 base models remain the same as used in the 2016 BTC VISSIM base model.

Demand Development

The AM and PM peak demand were developed using growth factors produced from a comparison between the approximate 2019 observed data (See Section 2) and 2016 observed data. Growth factors were calculated separately for each peak at 17 locations, for both directions. An additional general growth factor was also produced for each time peak. For details of the development of the demand in the original 2016 model, the previous LMVR should be consulted. This has been added to Appendix C.

Due to a lack of available observed data for the Saturday peak, a general growth factor was calculated by averaging the AM and PM general factors.

The calculated growth factors were then applied to the 2016 BTCVM matrix trip ends. For modelled zones corresponding to a location where 2016 and 2019 observed data were available, the specific growth factor calculated from those observations was applied. For modelled zones where new count data was not available, the general growth factor (i.e. that calculated from all the count data as a whole) was applied. The AM, PM and Saturday matrices from the 2016 model were furnessed (i.e. factored) to represent the appropriate level of growth from 2016.

The newly furnessed 2019 AM and PM matrices were further adjusted to ensure they accurately represent realistic traffic patterns in the network according to the observed turning counts. As there was no available Saturday observed data, no adjustments have been made to the Saturday matrix.

The matrix is inputted into the BTCVM in 15-minute intervals. The 2019 matrices were proportionated into 15-minute matrices based on 2016 15-minute matrix proportions. The same process was applied to the warm up and cool down 15-minute matrices.

Each 15-minutes matrix was then further proportioned into a separate ‘heavy’ and ‘light’ vehicle matrix, based on the equivalent 2016 15-minute matrix vehicle split.

Traffic Assignment

The BTCVM contains a number of route options for vehicles travelling between a given origin and destination. Therefore, the traffic is assigned using 'dynamic assignment'. Dynamic assignment allows traffic to choose their preferred route at the time they enter the simulation. The route choice of each vehicle is based on the "cost" of all accessible options; distance and travel time are the most important factors in determining cost.

Bus routes have been coded separately from general traffic. Bus routes 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 bus timetable information that is publicly available on the internet.

For all bus routes and bus stops, a dwell time of 12 seconds with a 6 second standard deviation has been modelled.

Convergence

Convergence is determined by the level of stability of the model whereby trip routing does not change significantly between iterations of the same model. Before any results from a traffic model are used to influence a decision, it should be confirmed that the model has reached an acceptable level of stability.

A high level of convergence for the highway assignment is particularly important, because inadequate convergence is likely to result in unstable and unreliable forecasts and assessments of user benefits associated with the scheme.

According to Transport for London (TfL) Traffic Modelling Guidelines on VISSIM modelling, convergence is be deemed to have been satisfactorily achieved when the following criteria have been met over the modelled peak hour:

- 95% of all path traffic volumes change by less than 5% for at least four consecutive iterations; and
- 95% of travel times on all paths change by less than 20% for at least four consecutive iterations.

Although the models don't meet all the above criteria, the AM, PM and Saturday base model convergences show an acceptable level of stability for some consecutive runs. The convergence performance of the 3 models can be seen in Figures 3.4 – 3.4.

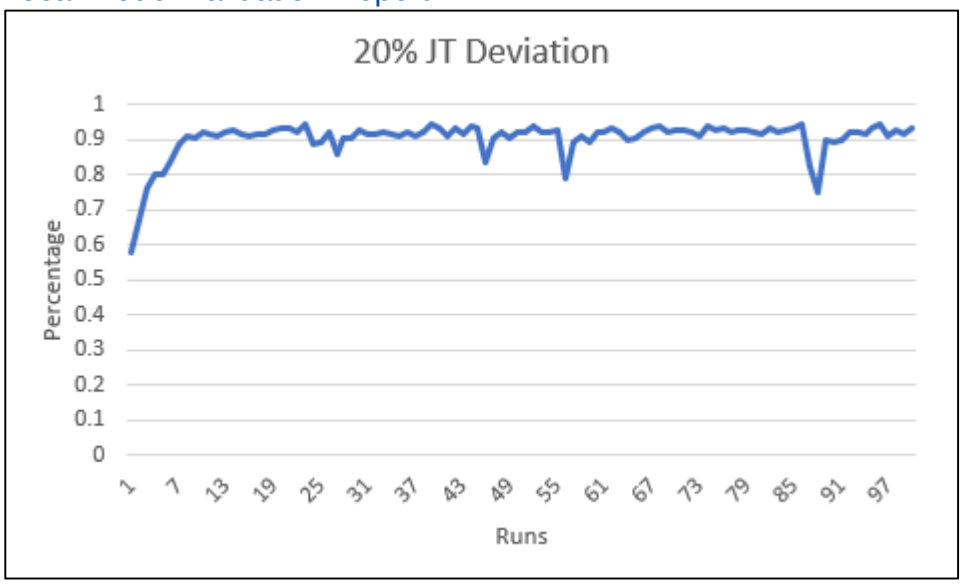

Figure 3.2 AM 2019 Base Model Journey Time Convergence

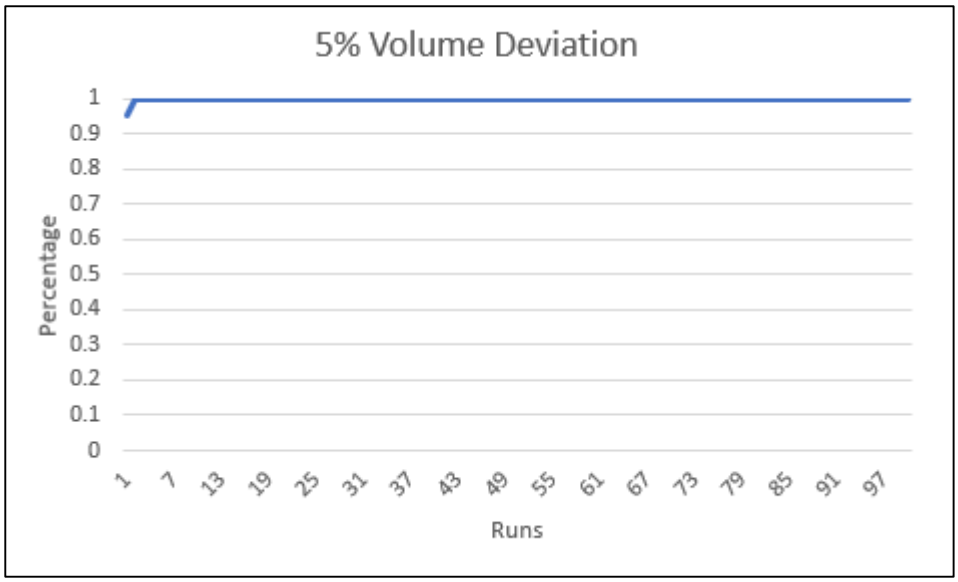

Figure 3.3 AM 2019 Base Model Traffic Volume Convergence

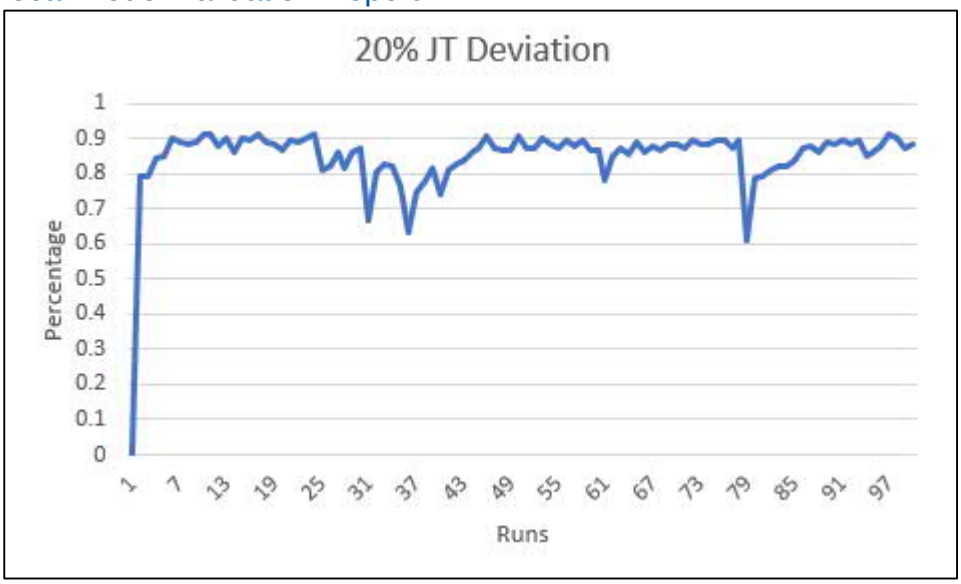

Figure 3.4 PM 2019 Base Model Journey Time Convergence

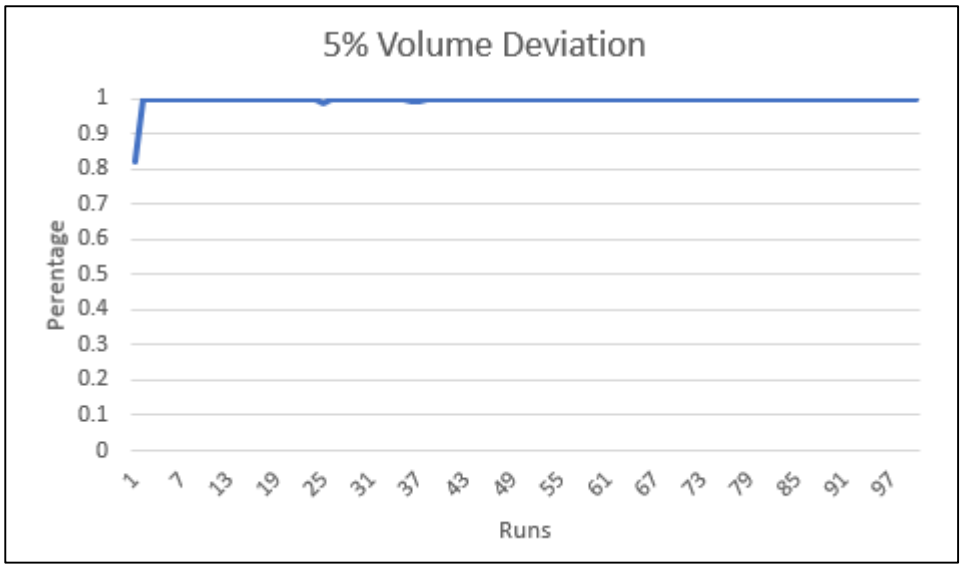

Figure 3.5 PM 2019 Base Model Traffic Volume Convergence

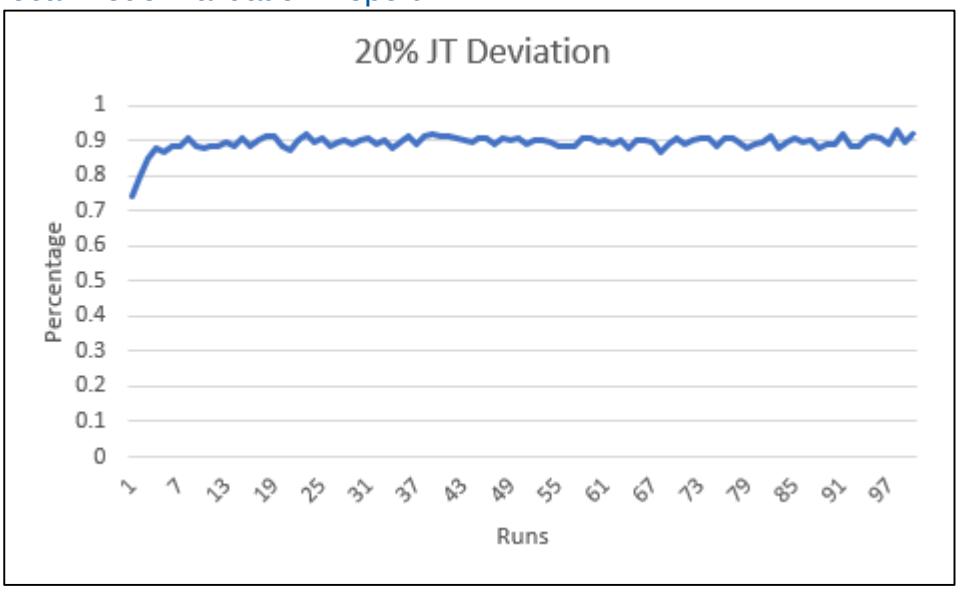

Figure 3.6 Saturday 2019 Base Model Journey Time Convergence

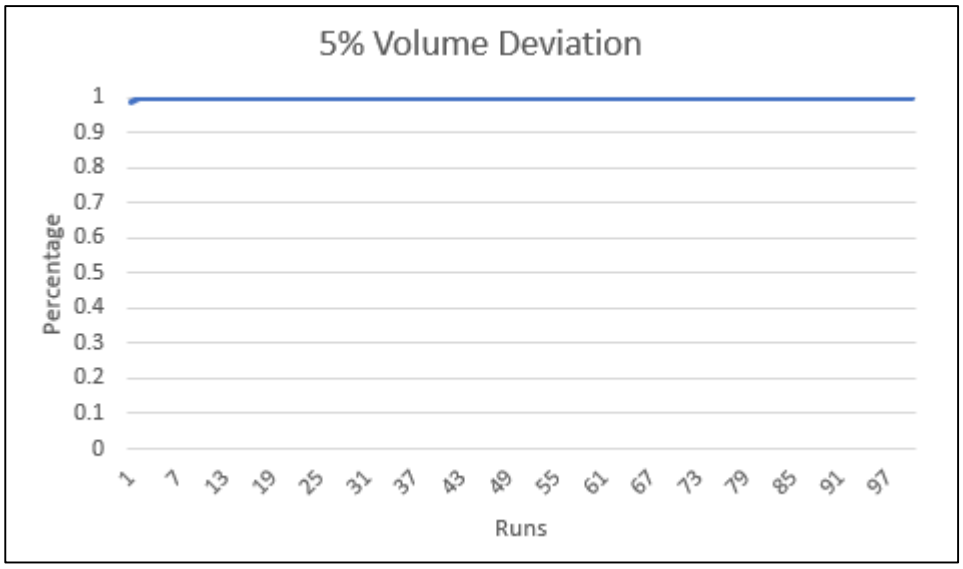

Figure 3.7 Saturday 2019 Base Model Traffic Volume Convergence

Since the convergences have been stable for some runs but then lost in subsequent iterations, a set of cost and path file, which show best convergence, were chosen to be used for producing the calibration and validation model runs.

The cost and path files store the costs and routes chosen in the desired iteration of the model based on their stability and convergence. The following runs were used for each model:

- AM Peak: Run 85
- PM Peak: Run 75
- Saturday Peak: Run 41

As can be seen on the figures above, the convergence criteria of journey time changes are not met for all three time periods. Different methods suggested by PTV or TfL Modelling Guideline were tested to achieve convergence, but they were not successful. For congested networks, it is possible that the model convergence criteria are not achieved. However, Figure 3.2 shows that the percentages of journey times which have less than 20% difference are relatively high and stable at around 90% in the AM peak between run 61 and 85. Figure 3.4 shows that 85% to 88% of journey times meet the criteria between run 65 and 75 in the PM peak. Figure 3.6 shows the percentages are steady from run 25 to 67 for the Saturday peak. These figures show that the journey time changes are relatively small for at least four consecutive model runs, which indicates that the models are performing stable runs. It is assumed that the models are suitable to test the scheme if the models are producing stable results. Figure 3.2 to Figure 3.7 show that the models are producing stable journey time and traffic flow results. Therefore, the models are suitable for testing schemes

Traffic Flow Comparison

Calibration of the 2019 BTCVM has been carried out using the modelling guidelines included in the following reference documents:

- Department for Transport's (DfT) Transport Analysis Guidance (TAG)
- Transport for London (TfL) Traffic Modelling Guidelines

For the calibration process, each model time period has been run 10 times with 10 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 10 seed runs, and this has been compared against observed data.

The scope of the traffic flow comparison process is to verify that the total flows and traffic movements generated by the model are comparable with the surveyed flows.

To test the level of model calibration, guidance has been followed from TAG unit M3.1. The guideline in TAG is that 85% of all links and turning movements, modelled flows should meet either the flow difference or GEH criteria.

To pass the flow difference tests, modelled link flows should:

- Be within 100 vehicles per hour of observed flows, where those observed where 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.

To pass the GEH test, the link GEH statistic must be below 5.0. 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.

The traffic flows measured from VISSIM are the average of 10 seed runs. The modelled turning flows are extracted from VISSIM using Node Evaluation and are separated by vehicle type. Table 3.3 provides a summary of the percentage of movements meeting the above criteria and it demonstrates that most turning movements in the model pass the required calibration thresholds and therefore meet the calibration criteria. Appendix A provides a more detailed summary of the calibration status of each turning movement.

Due to a lack of observed data, the Saturday turning movements cannot be calibrated against turning flow. The 2016 observed data has been factored up to 2019 level and checked against the modelled 2019 turning flow for 38 turning movements. The results show that 76% of turning counts have GEH < 5 and this is considered reasonable.

Table 3.3: GEH Flow Calibration

Peak	No. of Turning Movements	% of movements within a GEH 5	Pass
AM	49	92%	Pass
PM	49	94%	Pass
Saturday	38	76%	-

4 Model Validation

Validation of the 2019 BTCVM has also been carried out following TAG and TfL's Traffic modelling guidelines.

For the validation process, each model time period has been run 10 times with 10 different random seeds. The final output data used in the validation tables are the averages of all 10 seed runs.

Journey Time Comparison

The observed journey times have been compared to modelled journey times. TAG Unit M3.1 guidelines are that 85% of routes should have modelled journey times within 15% or 1 minute of those observed.

Journey time measurements have been undertaken within the models along the same route sections as those extracted from the Teletrac Data. The validation of the models against surveyed travel times was undertaken for the AM, PM and Saturday peak periods and the results are presented in Table 4.1, Table 4.2, and Table 4.3 respectively. More detailed journey time results, with each route broken down into a number of timing points, can be found in Appendix B. The tables demonstrate that journey time validation in the AM, PM and Saturday against Teletrac Data for 85% of routes satisfy the TAG Unit M3.1 criteria, validating to within 15% of observed values.

Table 4.1 Journey Time Table for AM Peak

Route	Road Name	Direction	Observed Time (Sec)	Modelled Time (Sec)	Percentage	Pass
1	A1321/ Roundacre/ Nether Mayne	SB	368	313	-15%	PASS
1	A1321/ Roundacre/ Nether Mayne	NB	238	271	14%	PASS
2	A176/ A1321	EB	146	151	4%	PASS
2	A176/ A1321	WB	223	193	-13%	PASS
3	B1007/ Southernhay	EB	286	261	-8%	PASS
3	B1007/ Southernhay	WB	209	237	13%	PASS
4	A1321/ Southernhay/ Clayhill Rd	SB	199	178	-10%	PASS
4	A1321/ Southernhay/ Clayhill Rd	NB	345	307	-11%	PASS
5	Cherrydown East	WB	121	138	14%	PASS
Total % of routes meeting TAG criteria						100%

Table 4.2 Journey Time Table for PM Peak

Route	Road Name	Direction	Observed Time (Sec)	Modelled Time (Sec)	Percentage	Pass
1	A1321/ Roundacre/ Nether Mayne	SB	283	308	9%	PASS
1	A1321/ Roundacre/ Nether Mayne	NB	278	289	4%	PASS
2	A176/ A1321	EB	198	170	-14%	PASS
2	A176/ A1321	WB	191	180	-6%	PASS
3	B1007/ Southernhay	EB	283	238	-16%	NOT PASS
3	B1007/ Southernhay	WB	188	215	14%	PASS
4	A1321/ Southernhay/ Clayhill Rd	SB	187	177	-5%	PASS
4	A1321/ Southernhay/ Clayhill Rd	NB	364	321	-12%	PASS
5	Cherrydown East	WB	110	119	8%	PASS
Total % of routes meeting TAG criteria						89%

Table 4.3 Journey Time Table for Saturday Peak

Route	Road Name	Direction	Observed Time (Sec)	Modelled Time (Sec)	Percentage	Pass
1	A1321/ Roundacre/ Nether Mayne	SB	266	287	8%	PASS
1	A1321/ Roundacre/ Nether Mayne	NB	241	275	14%	PASS
2	A176/ A1321	EB	171	159	-7%	PASS
2	A176/ A1321	WB	186	190	2%	PASS
3	B1007/ Southernhay	EB	301	259	-14%	PASS
3	B1007/ Southernhay	WB	159	155	-3%	PASS
4	A1321/ Southernhay/ Clayhill Rd	SB	176	184	5%	PASS
4	A1321/ Southernhay/ Clayhill Rd	NB	408	315	-23%	NOT PASS
5	Cherrydown East	WB	86	93	8%	PASS
Total % of routes meeting TAG criteria						89%

Error Logs

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

5 Summary

The results of the validation process show a good correlation between the modelled and observed, traffic flows and journey times within the study area. With this in mind and given the limitations and constraints described in this note as well as the required level of accuracy for this study, the models are considered fit-for-purpose in providing a robust representation of the existing situation and can be used with confidence to form future scenarios for forecasting using the model

Appendix A: Traffic Flow Calibration

AM Traffic Flow Calibration

Junction Name	From Road	To Road	Observed	Modelled	Difference-Total	Difference-%	GEH	Individual flows within 15% for flows 700 – 2700 vph	Individual flows within 100 vph for flows < 700 vph	Individual flows within 400 vph for flows > 2700 vph	PASS
B1007/ Southernhay RBT	A176 Roundacre	A176 Roundacre	2	0	-2	-100%	2.00	N/A	Pass	N/A	PASS
		Southernhay	261	251	-10	-4%	0.63	N/A	Pass	N/A	PASS
		A176 Nether Mayne	690	680	-10	-1%	0.38	N/A	Pass	N/A	PASS
		B1007 Laindon Link	523	509	-14	-3%	0.62	N/A	Pass	N/A	PASS
	Southernhay	A176 Roundacre	236	240	4	2%	0.26	N/A	Pass	N/A	PASS
		Southernhay	1	6	5	500%	2.67	N/A	Pass	N/A	PASS
		A176 Nether Mayne	65	18	-47	-72%	7.30	N/A	Pass	N/A	FAIL
		B1007 Laindon Link	286	203	-83	-29%	5.31	N/A	Pass	N/A	FAIL
	A176 Nether Mayne	A176 Roundacre	752	794	42	6%	1.51	Fail	N/A	N/A	PASS
		Southernhay	186	246	60	32%	4.08	N/A	Pass	N/A	PASS
		A176 Nether Mayne	126	85	-41	-33%	3.99	N/A	Pass	N/A	PASS
		B1007 Laindon Link	277	272	-5	-2%	0.30	N/A	Pass	N/A	PASS
	B1007 Laindon Link	A176 Roundacre	493	544	51	10%	2.24	N/A	Pass	N/A	PASS
		Southernhay	323	264	-59	-18%	3.44	N/A	Pass	N/A	PASS
		A176 Nether Mayne	305	312	7	2%	0.40	N/A	Pass	N/A	PASS
		B1007 Laindon Link	0	0	0	#DIV/0!	0.00	N/A	Pass	N/A	PASS
Roundacre / Station Way	Southernhay	Southernhay	573	571	-2	0%	0.08	N/A	Pass	N/A	PASS
	Southernhay	Southernhay	21	24	3	14%	0.63	N/A	Pass	N/A	PASS
	Station Way	Southernhay	419	430	11	3%	0.53	N/A	Pass	N/A	PASS
		Southernhay	289	227	-62	-21%	3.86	N/A	Pass	N/A	PASS
Southernhay / Clay Hill Rd,	Eastgate car park	Southernhay	12	6	-6	-50%	2.00	N/A	Pass	N/A	PASS
		Clay Hill Rd	10	16	6	60%	1.66	N/A	Pass	N/A	PASS
	Southernhay E	Eastgate car park	62	49	-13	-21%	1.75	N/A	Pass	N/A	PASS
		Clay Hill Rd	399	473	74	19%	3.54	N/A	Pass	N/A	PASS
		Southernhay	20	14	-6	-30%	1.46	N/A	Pass	N/A	PASS
	Southernhay W	Eastgate car park	99	98	-1	-1%	0.10	N/A	Pass	N/A	PASS
		Southernhay	338	285	-53	-16%	3.00	N/A	Pass	N/A	PASS
		Clay Hill Rd	297	210	-87	-29%	5.46	N/A	Pass	N/A	FAIL
Clay Hill Rd/ Cherrydown East	Clay Hill Rd	Station car park	10	9	-1	-10%	0.32	N/A	Pass	N/A	PASS
		Clay Hill Rd	391	367	-24	-6%	1.23	N/A	Pass	N/A	PASS
		Cherrydown East	305	321	16	5%	0.90	N/A	Pass	N/A	PASS
	Station car park	Clay Hill Rd	1	1	0	0%	0.00	N/A	Pass	N/A	PASS
		Cherrydown East	9	4	-5	-56%	1.96	N/A	Pass	N/A	PASS
	Clay Hill Rd	Cherrydown East	502	587	85	17%	3.64	N/A	Pass	N/A	PASS
Cherrydown E/ Cherrydow E	Cherrydown E	Cherrydown East	49	51	2	4%	0.28	N/A	Pass	N/A	PASS
	Cherrydown E	Cherrydown East	833	912	79	9%	2.67	Fail	N/A	N/A	PASS

Cherrydown E/ Cherrydown W/Ashdon Way/Stationway	Cherrydown E	Station Way	519	542	23	4%	1.00	N/A	Pass	N/A	PASS
		Cherrydown East	4	4	0	0%	0.00	N/A	Pass	N/A	PASS
		Cherrydown West	79	105	26	33%	2.71	N/A	Pass	N/A	PASS
		Ashdon Way	240	311	71	30%	4.28	N/A	Pass	N/A	PASS
	Cherrydown West	Station Way	112	105	-7	-6%	0.67	N/A	Pass	N/A	PASS
		Cherrydown East	0	0	0	#DIV/0!	0.00	N/A	Pass	N/A	PASS
		Cherrydown West	1								
		Ashdon Way	9	5	-4	-44%	1.51	N/A	Pass	N/A	PASS
	Ashdon Way	Station Way	47	12	-35	-74%	6.44	N/A	Pass	N/A	FAIL
		Cherrydown East	45	45	0	0%	0.00	N/A	Pass	N/A	PASS
		Cherrydown West	22								
		Ashdon Way	19								
A176 Upper Mayne	A176 Upper Mayne (NB)	A176 Upper Mayne (NB)	1405	1304	-101	-7%	2.74	Fail	N/A	N/A	PASS
	A176 Upper Mayne (SB)	A176 Upper Mayne (SB)	1200	1277	77	6%	2.20	Fail	N/A	N/A	PASS
A1321 Broadmayne	A1321 Broadmayne (EB)	A1321 Broadmayne (EB)	798	827	29	4%	1.02	Fail	N/A	N/A	PASS
	A1321 Broadmayne (WB)	A1321 Broadmayne (WB)	1199	1268	70	6%	1.98	Fail	N/A	N/A	PASS

PM Traffic Flow Calibration

Junction Name	From Road	To Road	Observed	Modelled	Difference-Total	Difference-%	GEH	Individual flows within 15% for flows 700 – 2700 vph	Individual flows within 100 vph for flows < 700 vph	Individual flows within 400 vph for flows > 2700 vph	PASS
B1007/ Southernhay RBT	A176 Roundacre	A176 Roundacre	3	0	-3	-100%	2.45	N/A	Pass	N/A	PASS
		Southernhay	418	362	-56	-13%	2.84	N/A	Pass	N/A	PASS
		A176 Nether Mayne	886	821	-65	-7%	2.22	Fail	N/A	N/A	PASS
		B1007 Laindon Link	561	562	1	0%	0.04	N/A	Pass	N/A	PASS
	Southernhay	A176 Roundacre	239	189	-50	-21%	3.42	N/A	Pass	N/A	PASS
		Southernhay	2	9	7	350%	2.98	N/A	Pass	N/A	PASS
		A176 Nether Mayne	135	129	-6	-4%	0.52	N/A	Pass	N/A	PASS
		B1007 Laindon Link	367	365	-2	-1%	0.10	N/A	Pass	N/A	PASS
	A176 Nether Mayne	A176 Roundacre	698	645	-53	-8%	2.05	N/A	Pass	N/A	PASS
		Southernhay	162	136	-26	-16%	2.13	N/A	Pass	N/A	PASS
		A176 Nether Mayne	106	65	-41	-39%	4.43	N/A	Pass	N/A	PASS
		B1007 Laindon Link	228	221	-7	-3%	0.47	N/A	Pass	N/A	PASS
	B1007 Laindon Link	A176 Roundacre	499	571	72	14%	3.11	N/A	Pass	N/A	PASS
		Southernhay	382	350	-32	-8%	1.67	N/A	Pass	N/A	PASS
		A176 Nether Mayne	254	264	10	4%	0.62	N/A	Pass	N/A	PASS
		B1007 Laindon Link	0	0	0	#DIV/0!	0.00	N/A	Pass	N/A	PASS
Roundacre / Station Way	Southernhay	Southernhay	916	849	-67	-7%	2.26	Fail	N/A	N/A	PASS
	Southernhay	Southernhay	32	23	-9	-28%	1.72	N/A	Pass	N/A	PASS
	Station Way	Southernhay	391	385	-6	-2%	0.30	N/A	Pass	N/A	PASS
		Southernhay	289	248	-41	-14%	2.50	N/A	Pass	N/A	PASS
Southernhay / Clay Hill Rd,	Eastgate car park	Southernhay	82	72	-10	-12%	1.14	N/A	Pass	N/A	PASS
		Clay Hill Rd	109	109	0	0%	0.00	N/A	Pass	N/A	PASS
	Southernhay E	Eastgate car park	27	27	0	0%	0.00	N/A	Pass	N/A	PASS
		Clay Hill Rd	239	306	67	28%	4.06	N/A	Pass	N/A	PASS
		Southernhay	17	13	-4	-24%	1.03	N/A	Pass	N/A	PASS
	Southernhay W	Eastgate car park	63	69	6	10%	0.74	N/A	Pass	N/A	PASS
		Southernhay	491	454	-37	-8%	1.70	N/A	Pass	N/A	PASS
		Clay Hill Rd	483	463	-20	-4%	0.92	N/A	Pass	N/A	PASS
Clay Hill Rd/ Cherrydown East	Clay Hill Rd	Station car park	1	1	0	0%	0.00	N/A	Pass	N/A	PASS
		Clay Hill Rd	554	661	107	19%	4.34	N/A	Fail	N/A	PASS
		Cherrydown East	276	216	-60	-22%	3.83	N/A	Pass	N/A	PASS
	Station car park	Clay Hill Rd	2	0	-2	-100%	2.00	N/A	Pass	N/A	PASS
		Cherrydown East	6	1	-5	-83%	2.67	N/A	Pass	N/A	PASS
	Clay Hill Rd	Cherrydown East	300	409	109	36%	5.79	N/A	Fail	N/A	FAIL
Cherrydown E/ Cherrydow E	Cherrydown E	Cherrydown East	46	52	6	13%	0.86	N/A	Pass	N/A	PASS
	Cherrydown E	Cherrydown East	508	624	116	23%	4.88	N/A	Fail	N/A	PASS

Cherrydown E/ Cherrydown W/Ashdon Way/Stationway	Cherrydown E	Station Way	450	494	44	10%	2.03	N/A	Pass	N/A	PASS
		Cherrydown East	4	4	0	0%	0.00	N/A	Pass	N/A	PASS
		Cherrydown West	1	10	9	900%	3.84	N/A	Pass	N/A	PASS
		Ashdon Way	91	168	77	85%	6.77	N/A	Pass	N/A	FAIL
	Cherrydown West	Station Way	152	128	-24	-16%	2.03	N/A	Pass	N/A	PASS
		Cherrydown East	0	0	0	#DIV/0!	0.00	N/A	Pass	N/A	PASS
		Cherrydown West	0								
		Ashdon Way	5	6	1	20%	0.43	N/A	Pass	N/A	PASS
	Ashdon Way	Station Way	47	11	-36	-77%	6.69	N/A	Pass	N/A	FAIL
		Cherrydown East	30	19	-11	-37%	2.22	N/A	Pass	N/A	PASS
		Cherrydown West	0								
		Ashdon Way	8								
A176 Upper Mayne	A176 Upper Mayne (NB)	A176 Upper Mayne (NB)	1085	1117	32	3%	0.95	Fail	N/A	N/A	PASS
	A176 Upper Mayne (SB)	A176 Upper Mayne (SB)	1530	1713	183	12%	4.54	Fail	N/A	N/A	PASS
A1321 Broadmayne	A1321 Broadmayne (EB)	A1321 Broadmayne (EB)	1422	1368	-54	-4%	1.43	Fail	N/A	N/A	PASS
	A1321 Broadmayne (WB)	A1321 Broadmayne (WB)	588	638	50	9%	2.02	N/A	Pass	N/A	PASS

Essex Highways

Saturday Traffic Flow Calibration

Junction Name	From Road	To Road	Observed	Modelled	Difference-Total	Difference-%	GEH	Individual flows within 15% for flows 700 – 2700	Individual flows within 100 vph for flows < 700 vph	Individual flows within 400 vph for flows > 2700 vph	PASS
B1007/ Southernhay RBT	A176 Roundacre	A176 Roundacre	0	0	0	#DIV/0!	0.00	N/A	Pass	N/A	PASS
		Southernhay	573.11516	580	7	1%	0.29	N/A	Pass	N/A	PASS
		A176 Nether Mayne	799.07454	508	-291	-36%	11.39	Fail	N/A	N/A	FAIL
		B1007 Laindon Link	403.64562	521	117	29%	5.46	N/A	Fail	N/A	FAIL
	Southernhay	A176 Roundacre	239.31153	324	85	35%	5.05	N/A	Pass	N/A	FAIL
		Southernhay	0	21	21	#DIV/0!	0.00	N/A	Pass	N/A	PASS
		A176 Nether Mayne	163.30701	90	-73	-45%	6.51	N/A	Pass	N/A	FAIL
		B1007 Laindon Link	428.29573	255	-173	-40%	9.38	N/A	N/A	N/A	FAIL
	A176 Nether Mayne	A176 Roundacre	832.96844	722	-111	-13%	3.98	Fail	N/A	N/A	PASS
		Southernhay	135.57563	200	64	48%	4.97	N/A	Pass	N/A	PASS
		A176 Nether Mayne	0	3	3	#DIV/0!	0.00	N/A	Pass	N/A	PASS
		B1007 Laindon Link	174.60498	207	32	19%	2.35	N/A	Pass	N/A	PASS
	B1007 Laindon Link	A176 Roundacre	418.02485	504	86	21%	4.00	N/A	Pass	N/A	PASS
		Southernhay	394.40183	280	-114	-29%	6.23	N/A	N/A	N/A	FAIL
		A176 Nether Mayne	191.03839	250	59	31%	3.97	N/A	Pass	N/A	PASS
		B1007 Laindon Link	0	0	0	#DIV/0!	0.00	N/A	Pass	N/A	PASS
Roundacre / Station Way	Southernhay	Southernhay	930.54181	834	-97	-10%	3.25	Fail	N/A	N/A	PASS
	Southernhay	Southernhay	40.056436	23	-17	-43%	3.04	N/A	Pass	N/A	PASS
	Station Way	Southernhay	398.51018	397	-2	0%	0.08	N/A	Pass	N/A	PASS
		Southernhay	242.39279	119	-123	-51%	9.18	N/A	N/A	N/A	FAIL
Southernhay / Clay Hill Rd,	Eastgate car park	Southernhay	103.7359	71	-33	-32%	3.50	N/A	Pass	N/A	PASS
		Clay Hill Rd	152.00904	146	-6	-4%	0.49	N/A	Pass	N/A	PASS
	Southernhay E	Eastgate car park	90.383752	93	3	3%	0.27	N/A	Pass	N/A	PASS
		Clay Hill Rd	248.55532	230	-19	-7%	1.20	N/A	Pass	N/A	PASS
		Southernhay	22.595938	13	-10	-42%	2.27	N/A	Pass	N/A	PASS
	Southernhay W	Eastgate car park	214.66141	247	32	15%	2.13	N/A	Pass	N/A	PASS
		Southernhay	499.16481	374	-125	-25%	5.99	N/A	N/A	N/A	FAIL
		Clay Hill Rd	298.88263	261	-38	-13%	2.26	N/A	Pass	N/A	PASS
Clay Hill Rd/ Cherrydown East	Clay Hill Rd	Station car park	7.1896166	6	-1	-17%	0.46	N/A	Pass	N/A	PASS
		Clay Hill Rd	415.97068	424	8	2%	0.39	N/A	Pass	N/A	PASS
		Cherrydown East	277.31378	207	-70	-25%	4.52	N/A	Pass	N/A	PASS
	Station car park	Clay Hill Rd	0	4	4	#DIV/0!	0.00	N/A	Pass	N/A	PASS
		Cherrydown East	0	8	8	#DIV/0!	0.00	N/A	Pass	N/A	PASS
	Clay Hill Rd	Cherrydown East	367.69754	378	10	3%	0.53	N/A	Pass	N/A	PASS
A176 Upper Mayne	A176 Upper Mayne (NB)	A176 Upper Mayne (NB)	1730.6434	1756	25	1%	0.61	Fail	N/A	N/A	PASS
	A176 Upper Mayne (SB)	A176 Upper Mayne (SB)	1658.7473	1624	-35	-2%	0.86	Fail	N/A	N/A	PASS
A1321 Broadmayne	A1321 Broadmayne (EB)	A1321 Broadmayne (EB)	1181.1513	1121	-60	-5%	1.77	Fail	N/A	N/A	PASS
	A1321 Broadmayne (WB)	A1321 Broadmayne (WB)	824.75174	1169	344	42%	10.90	Fail	N/A	N/A	FAIL

Appendix B: Split Journey Time Validation

AM Journey Time Validation

Route	Direction	Road	Section	Survey	Modelled	Difference	%	PASS/ NOT PASS
1	SWB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	67	73	5	8%	PASS
			A1321/Southernhay - A1321/Linkway	20	17	-3	-3%	PASS
			A1321/Linkway - A1321/Little Oaks	33	26	-8	-6%	PASS
			A1321/Little Oaks - A1321/Great Oaks	63	44	-19	-11%	PASS
			A1321/Great Oaks - Upper Mayne RBT	39	33	-6	-3%	PASS
		Roundacre	Upper Mayne RBT - B1007/ Southernhay RBT	36	36	0	0%	PASS
		Nether Mayne	B1007/ Southernhay RBT - Nether Mayne/The Knares	109	83	-26	-7%	PASS
	Total			**368**	**313**	**-55**	**-15%**	**PASS**
	NEB	Nether Mayne	Nether Mayne	0	0	0	0%	PASS
			Nether Mayne/The Knares - B1007/ Southernhay RBT	77	84	7	9%	PASS
		Roundacre	B1007/ Southernhay RBT - Upper Mayne RBT	15	30	15	16%	NOT PASS
		A1321	Upper Mayne RBT - A1321/Great Oaks	36	37	1	1%	PASS
			A1321/Great Oaks - A1321/Little Oaks	16	23	7	5%	PASS
			A1321/Little Oaks - A1321/Linkway	34	26	-8	-5%	PASS
			A1321/Linkway - A1321/Southernhay	21	26	5	2%	PASS
			A1321/Southernhay - A1321/Church Road	38	44	6	3%	PASS
	Total			**238**	**271**	**33**	**14%**	**PASS**
2	EB	A176	A176	0	0	0	0%	PASS
		A1321	Upper Mayne RBT - A1321/Great Oaks	36	31	-5	-14%	PASS
			A1321/Great Oaks - A1321/Little Oaks	16	23	7	14%	PASS
			A1321/Little Oaks - A1321/Linkway	34	26	-8	-10%	PASS
			A1321/Linkway - A1321/Southernhay	21	26	5	5%	PASS
			A1321/Southernhay - A1321/Church Road	38	44	6	4%	PASS
	Total			**146**	**151**	**5**	**4%**	**PASS**
	WB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	67	73	5	8%	PASS
			A1321/Southernhay - A1321/Linkway	20	17	-3	-3%	PASS
			A1321/Linkway - A1321/Little Oaks	33	26	-8	-6%	PASS
			A1321/Little Oaks - A1321/Great Oaks	63	44	-19	-11%	PASS
			A1321/Great Oaks - Upper Mayne RBT	39	33	-6	-3%	PASS
	Total			**223**	**193**	**-30**	**-13%**	**PASS**
3	EB	B1007	B1007/Mandeville Way RBT	0	0	0	0%	PASS
			B1007/Mandeville Way RBT - B1007/ Southernhay RBT	137	148	11	8%	PASS
		Southernhay	58	64	52	-12	-6%	PASS
			Southernhay/Station Way - Southernhay/Clay Hill Rd	50	32	-18	-7%	PASS
			Southernhay/Clay Hill Rd - Southernhay RBT	34	29	-5	-2%	PASS
	Total			**286**	**261**	**-24**	**-8%**	**PASS**
	WB	Southernhay	Southernhay RBT	0	0	0	0%	PASS
			Southernhay RBT - Southernhay/Clay Hill Rd	30	79	49	162%	NOT PASS
			Southernhay/Clay Hill Rd - Southernhay/Station Way	0	0	0	0%	PASS
			Southernhay/Station Way - B1007/ Southernhay RBT	78	41	-37	-34%	NOT PASS
		B1007	B1007/ Southernhay RBT - B1007/Mandeville Way RBT	101	117	16	8%	PASS
	Total			**209**	**237**	**28**	**13%**	**PASS**

4	SWB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	67	67	0	0%	PASS
		Southernhay	A1321/Southernhay - Southernhay/Long Riding RBT	45	24	-21	-47%	NOT PASS
		Southernhay	Southernhay/Long Riding RBT - Southernhay/Clay Hill Rd	59	68	9	16%	NOT PASS
		Clay Hill Rd	Southernhay/Clay Hill Rd - Clay Hill Rd/Wichards	28	19	-9	-31%	NOT PASS
	Total			**199**	**178**	**-21**	**-10%**	**PASS**
	NEB	Clay Hill Rd	Clay Hill Rd/Wichards	0	0	0	0%	PASS
			Clay Hill Rd/Wichards - Clay Hill Rd/ Cherrydown East	7	9	2	26%	NOT PASS
		Cherrydown East	Clay Hill Rd/ Cherrydown East - Station Way/ Ashton Way	57	39	-18	-31%	NOT PASS
		Station Way	Station Way/ Ashton Way - Station Way/Southernhay	37	36	0	0%	PASS
		Southernhay	Station Way/Southernhay - Southernhay/Clay Hill Rd	51	30	-20	-14%	PASS
		Southernhay	Southernhay/Clay Hill Rd - Southernhay/Long Riding RBT	58	52	-7	-3%	PASS
		Southernhay	Southernhay/Long Riding RBT - Southernhay/ Great Oaks	38	33	-5	-2%	PASS
		Great Oaks/Linkway	Southernhay/ Great Oaks - Linkway/A1321	36	36	-1	0%	PASS
		A1321	Linkway/A1321 - A1321/Southernhay	23	28	5	2%	PASS
		A1321	A1321/Southernhay - A1321/Church Road	38	44	6	2%	PASS
	Total			**345**	**307**	**-38**	**-11%**	**PASS**
5	WB	Cherrydown East	Clay Hill Rd/ Cherrydown East	0	0	0	0%	PASS
			Clay Hill Rd/ Cherrydown East - Cherrydown East Junction	38	38	0	0%	PASS
		Cherrydown East	Cherrydown East Junction - Ashdon Way/Nether Mayne	83	99	17	20%	NOT PASS
	Total			**121**	**138**	**17**	**14%**	**PASS**

PM Journey Time Validation

Route	Direction	Road	Section	Survey	Modelled	Difference	%	PASS/ NOT PASS
1	SWB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	62	64	2	3%	PASS
			A1321/Southernhay - A1321/Linkway	23	18	-5	-6%	PASS
			A1321/Linkway - A1321/Little Oaks	27	20	-7	-6%	PASS
			A1321/Little Oaks - A1321/Great Oaks	45	43	-1	-1%	PASS
			A1321/Great Oaks - Upper Mayne RBT	34	35	1	1%	PASS
		Roundacre	Upper Mayne RBT - B1007/ Southernhay RBT	28	34	6	3%	PASS
		Nether Mayne	B1007/ Southernhay RBT - Nether Mayne/The Knares	64	94	29	10%	PASS
	Total			**283**	**308**	**24.44**	**9%**	**PASS**
	NEB	Nether Mayne	Nether Mayne	0	0	0	0%	PASS
			Nether Mayne/The Knares - B1007/ Southernhay RBT	67	83	16	24%	NOT PASS
		Roundacre	B1007/ Southernhay RBT - Upper Mayne RBT	13	30	16	20%	NOT PASS
		A1321	Upper Mayne RBT - A1321/Great Oaks	44	37	-7	-6%	PASS
			A1321/Great Oaks - A1321/Little Oaks	20	23	3	2%	PASS
			A1321/Little Oaks - A1321/Linkway	74	54	-21	-10%	PASS
			A1321/Linkway - A1321/Southernhay	23	23	0	0%	PASS
			A1321/Southernhay - A1321/Church Road	37	41	4	1%	PASS
	Total			**278**	**289**	**10.91**	**4%**	**PASS**
2	EB	A176	A176	0	0	0	0%	PASS
		A1321	Upper Mayne RBT - A1321/Great Oaks	44	31	-14	-31%	NOT PASS
			A1321/Great Oaks - A1321/Little Oaks	20	23	3	4%	PASS
			A1321/Little Oaks - A1321/Linkway	74	54	-21	-15%	PASS
			A1321/Linkway - A1321/Southernhay	23	23	0	0%	PASS
			A1321/Southernhay - A1321/Church Road	37	41	4	2%	PASS
	Total			**198**	**170**	**-27.88**	**-14%**	**PASS**
	WB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	62	64	2	3%	PASS
			A1321/Southernhay - A1321/Linkway	23	18	-5	-6%	PASS
			A1321/Linkway - A1321/Little Oaks	27	20	-7	-6%	PASS
			A1321/Little Oaks - A1321/Great Oaks	45	43	-1	-1%	PASS
			A1321/Great Oaks - Upper Mayne RBT	34	35	1	1%	PASS
	Total			**191**	**180**	**-10.58**	**-6%**	**PASS**
3	EB	B1007	B1007/Mandeville Way RBT	0	0	0	0%	PASS
			B1007/Mandeville Way RBT - B1007/ Southernhay RBT	123	121	-2	-2%	PASS
		Southernhay	B1007/ Southernhay RBT - Southernhay/Station Way	71	56	-15	-8%	PASS
			Southernhay/Station Way - Southernhay/Clay Hill Rd	59	33	-26	-10%	PASS
			Southernhay/Clay Hill Rd - Southernhay RBT	30	28	-1	-1%	PASS
	Total			**283**	**238**	**-45**	**-16%**	**NOT PASS**
	WB	Southernhay	Southernhay RBT	0	0	0	0%	PASS
			Southernhay RBT - Southernhay/Clay Hill Rd	33	33	0	1%	PASS
			Southernhay/Clay Hill Rd - Southernhay/Station Way	0	0	0	0%	PASS
			Southernhay/Station Way - B1007/ Southernhay RBT	61	59	-3	-3%	PASS
		B1007	B1007/ Southernhay RBT - B1007/Mandeville Way RBT	94	124	30	16%	NOT PASS
	Total			**188**	**215**	**27**	**14%**	**PASS**

4	SWB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	62	61	-1	-2%	PASS
		Southernhay	A1321/Southernhay - Southernhay/Long Riding RBT	25	25	-1	-1%	PASS
		Southernhay	Southernhay/Long Riding RBT - Southernhay/Clay Hill Rd	60	74	14	9%	PASS
		Clay Hill Rd	Southernhay/Clay Hill Rd - Clay Hill Rd/Wichards	39	17	-22	-12%	PASS
	Total			**187**	**177**	**-10**	**-5%**	**PASS**
	NEB	Clay Hill Rd	Clay Hill Rd/Wichards	0	0	0	0%	PASS
			Clay Hill Rd/Wichards - Clay Hill Rd/ Cherrydown East	5	6	1	14%	PASS
		Cherrydown East	Clay Hill Rd/ Cherrydown East - Station Way/ Ashton Way	72	43	-29	-41%	NOT PASS
		Station Way	Station Way/ Ashton Way - Station Way/Southernhay	43	36	-7	-6%	PASS
		Southernhay	Station Way/Southernhay - Southernhay/Clay Hill Rd	59	33	-26	-15%	NOT PASS
		Southernhay	Southernhay/Clay Hill Rd - Southernhay/Long Riding RBT	52	51	-1	-1%	PASS
		Southernhay	Southernhay/Long Riding RBT - Southernhay/ Great Oaks	37	33	-5	-2%	PASS
		Great Oaks/Linkway	Southernhay/ Great Oaks - Linkway/A1321	33	55	22	7%	PASS
		A1321	Linkway/A1321 - A1321/Southernhay	25	24	0	0%	PASS
		A1321	A1321/Southernhay - A1321/Church Road	37	41	4	1%	PASS
	Total			**364**	**321**	**-42**	**-12%**	**PASS**
5	WB	Cherrydown East	Clay Hill Rd/ Cherrydown East	0	0	0	0%	PASS
			Clay Hill Rd/ Cherrydown East - Cherrydown East Junction	54	42	-12	-22%	NOT PASS
		Cherrydown East	Cherrydown East Junction - Ashdon Way/Nether Mayne	55	77	21	19%	NOT PASS
	Total			**110**	**119**	**9**	**8%**	**PASS**

Local Model Validation Report

Saturday Journey Time Validation

Route	Direction	Road	Section	Survey	Modelled	Difference	%	PASS/ NOT PASS
1	SWB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	62	73	10	17%	NOT PASS
			A1321/Southernhay - A1321/Linkway	25	19	-6	-22%	NOT PASS
			A1321/Linkway - A1321/Little Oaks	28	24	-4	-14%	PASS
			A1321/Little Oaks - A1321/Great Oaks	43	41	-2	-4%	PASS
			A1321/Great Oaks - Upper Mayne RBT	28	33	5	19%	NOT PASS
		Roundacre	Upper Mayne RBT - B1007/ Southernhay RBT	24	25	1	5%	PASS
		Nether Mayne	B1007/ Southernhay RBT - Nether Mayne/The Knares	56	72	16	28%	NOT PASS
	Total			**266**	**287**	**21**	**8%**	**PASS**
	NEB	Nether Mayne	Nether Mayne	0	0	0	0%	PASS
			Nether Mayne/The Knares - B1007/ Southernhay RBT	56	77	22	39%	NOT PASS
		Roundacre	B1007/ Southernhay RBT - Upper Mayne RBT	14	32	18	130%	NOT PASS
		A1321	Upper Mayne RBT - A1321/Great Oaks	36	38	2	5%	PASS
			A1321/Great Oaks - A1321/Little Oaks	16	23	7	46%	NOT PASS
			A1321/Little Oaks - A1321/Linkway	60	33	-27	-46%	NOT PASS
			A1321/Linkway - A1321/Southernhay	25	25	1	3%	PASS
			A1321/Southernhay - A1321/Church Road	34	46	12	35%	NOT PASS
	Total			**241**	**275**	**34**	**14%**	**PASS**
2	EB	A176	A176	0	0	0	0%	PASS
		A1321	Upper Mayne RBT - A1321/Great Oaks	36	31	-5	-14%	PASS
			A1321/Great Oaks - A1321/Little Oaks	16	23	7	46%	NOT PASS
			A1321/Little Oaks - A1321/Linkway	60	33	-27	-46%	NOT PASS
			A1321/Linkway - A1321/Southernhay	25	25	1	3%	PASS
			A1321/Southernhay - A1321/Church Road	34	46	12	35%	NOT PASS
	Total			**171**	**159**	**-12**	**-7%**	**PASS**
	WB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	62	73	10	17%	NOT PASS
			A1321/Southernhay - A1321/Linkway	25	19	-6	-22%	NOT PASS
			A1321/Linkway - A1321/Little Oaks	28	24	-4	-14%	PASS
			A1321/Little Oaks - A1321/Great Oaks	43	41	-2	-4%	PASS
			A1321/Great Oaks - Upper Mayne RBT	28	33	5	19%	NOT PASS
	Total			**186**	**190**	**4**	**2%**	**PASS**
3	EB	B1007	B1007/Mandeville Way RBT	0	0	0	0%	PASS
			B1007/Mandeville Way RBT - B1007/ Southernhay RBT	109	136	27	25%	NOT PASS
		Southernhay	B1007/ Southernhay RBT - Southernhay/Station Way	73	53	-20	-27%	NOT PASS
			Southernhay/Station Way - Southernhay/Clay Hill Rd	74	40	-34	-46%	NOT PASS
			Southernhay/Clay Hill Rd - Southernhay RBT	46	29	-16	-36%	NOT PASS
	Total			**301**	**259**	**-43**	**-14%**	**PASS**
	WB	Southernhay	Southernhay RBT	0	0	0	0%	PASS
			Southernhay RBT - Southernhay/Clay Hill Rd	25	38	12	49%	NOT PASS
			Southernhay/Clay Hill Rd - Southernhay/Station Way	0	0	0	0%	PASS
			Southernhay/Station Way - B1007/ Southernhay RBT	46	0	-46	-100%	NOT PASS
		B1007	B1007/ Southernhay RBT - B1007/Mandeville Way RBT	87	117	30	34%	NOT PASS
	Total			**159**	**155**	**-4**	**-3%**	**PASS**

4	SWB	A1321	A1321/Church Road	0	0	0	0%	PASS
			A1321/Church Road - A1321/Southernhay	62	67	4	7%	PASS
		Southernhay	A1321/Southernhay - Southernhay/Long Riding RBT	25	24	0	-1%	PASS
		Southernhay	Southernhay/Long Riding RBT - Southernhay/Clay Hill Rd	56	71	15	26%	NOT PASS
		Clay Hill Rd	Southernhay/Clay Hill Rd - Clay Hill Rd/Wichards	33	22	-11	-33%	NOT PASS
	Total			**176**	**184**	**8**	**5%**	**PASS**
	NEB	Clay Hill Rd	Clay Hill Rd/Wichards	0	0	0	0%	PASS
			Clay Hill Rd/Wichards - Clay Hill Rd/ Cherrydown East	5	8	3	65%	NOT PASS
		Cherrydown East	Clay Hill Rd/ Cherrydown East - Station Way/ Ashton Way	81	35	-46	-57%	NOT PASS
		Station Way	Station Way/ Ashton Way - Station Way/Southernhay	58	35	-23	-40%	NOT PASS
		Southernhay	Station Way/Southernhay - Southernhay/Clay Hill Rd	75	40	-34	-46%	NOT PASS
		Southernhay	Southernhay/Clay Hill Rd - Southernhay/Long Riding RBT	70	51	-18	-26%	NOT PASS
		Southernhay	Southernhay/Long Riding RBT - Southernhay/ Great Oaks	34	33	-1	-2%	PASS
		Great Oaks/Linkway	Southernhay/ Great Oaks - Linkway/A1321	26	38	12	45%	NOT PASS
		A1321	Linkway/A1321 - A1321/Southernhay	26	28	2	8%	PASS
		A1321	A1321/Southernhay - A1321/Church Road	34	46	12	35%	NOT PASS
	Total			**408**	**315**	**-93**	**-23%**	**NOT PASS**
5	WB	Cherrydown East	Clay Hill Rd/ Cherrydown East	0	0	0	0%	PASS
			Clay Hill Rd/ Cherrydown East - Cherrydown East Junction	40	35	-6	-14%	PASS
		Cherrydown East	Cherrydown East Junction - Ashdon Way/Nether Mayne	46	59	13	27%	NOT PASS
	Total			**86**	**93**	**7**	**8%**	**PASS**

Appendix C: 2017 Basildon Town Centre LMVR

Basildon Town Centre

VISSIM Local Model Validation Report

January 2017

integrated expertise

Essex County Council

Document Control Sheet

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Contents

1 Background

1.1 Introduction

Basildon Town Centre highway proposals are being progressed as part of the Basildon Integrated Transport Package – South East Local Enterprise Partnership (SELEP) Business Case. Part of these improvements include aspirations arising from the Basildon Town Centre Masterplan planning document, produced on behalf of Basildon Council. The Masterplan document suggests modified signal control, closing links to traffic and two-way operation instead of existing one-way streets. In order to assess the impact of the proposed highway changes, Essex County Council commissioned Essex Highways to develop a town centre VISSIM model. The model has been built to assess the likely impact of these potential Masterplan aspirations on the town centre highway network.

1.2 Modelling Approach

Three base year (2016) Basildon town centre models were developed, using PTV's VISSIM micro simulation software (version 7), for the weekday AM and PM and Saturday peak periods respectively. These models were then utilised to test the likely impact of the Masterplan options in each of the three peak periods. The options were also tested in a 2036 scenario with future growth of traffic in the network. The results of the option testing will be presented in the forecasting report.

VISSIM models each vehicle individually, including driver behaviour characteristics, and provides a visual representation of the interaction between vehicles, assisting in the assessment of the road network operation and model calibration.

1.3 Study Area

Basildon town centre is situated approximately one mile from the A127 Southend Arterial Road and A13 London Road - both routes are key connectors to London and the M25. The study area is primarily made up of the following key routes - A1321 Broadmayne, A176 Nethermayne, Southernhay, and Cherrydown East. Basildon rail station is situated to the south of the town centre, approximately five minutes on foot from Basildon bus station. The town centre study area is illustrated below in Figure 1-1.

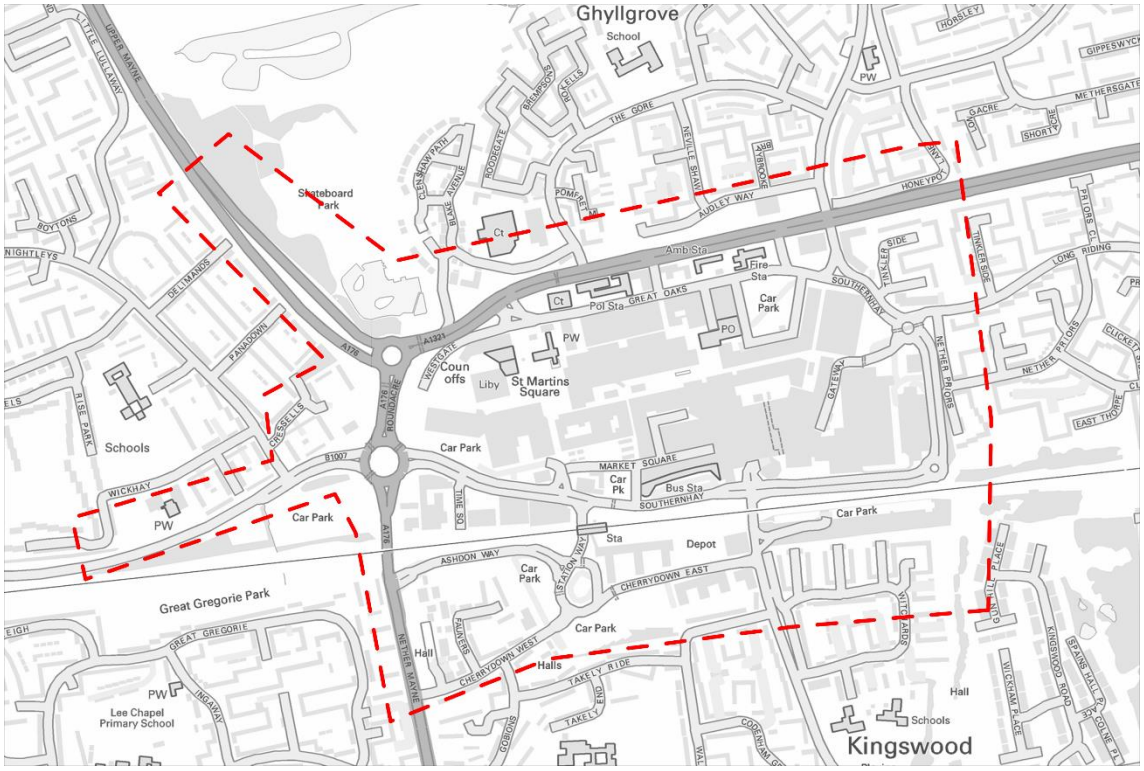

Figure 1-1: Basildon town centre VISSIM model study area

1.4 Project Objectives

The key objective of this assessment is to:

- Model the current operational issues and vehicular traffic delays experienced during the three peak periods identified in Basildon town centre.

2 Data Collection

2.1 Introduction

In order to undertake the Basildon VISSIM modelling a comprehensive programme of traffic surveys was conducted in Basildon town centre in May 2016.

Four types of surveys were undertaken (see Figure 2-1):

- Classified Junction Turning Counts;
- Automatic Traffic Counters (ATCs);

- Automatic Number Plate Recognition (ANPR) Surveys which were set up as an outer and inner cordon to capture vehicle movements around Basildon town centre
- Link counts were carried out using additional video cameras at all ANPR locations to obtain traffic flows at these locations; and
- Pedestrian Crossing Surveys (signalised crossings and subways).

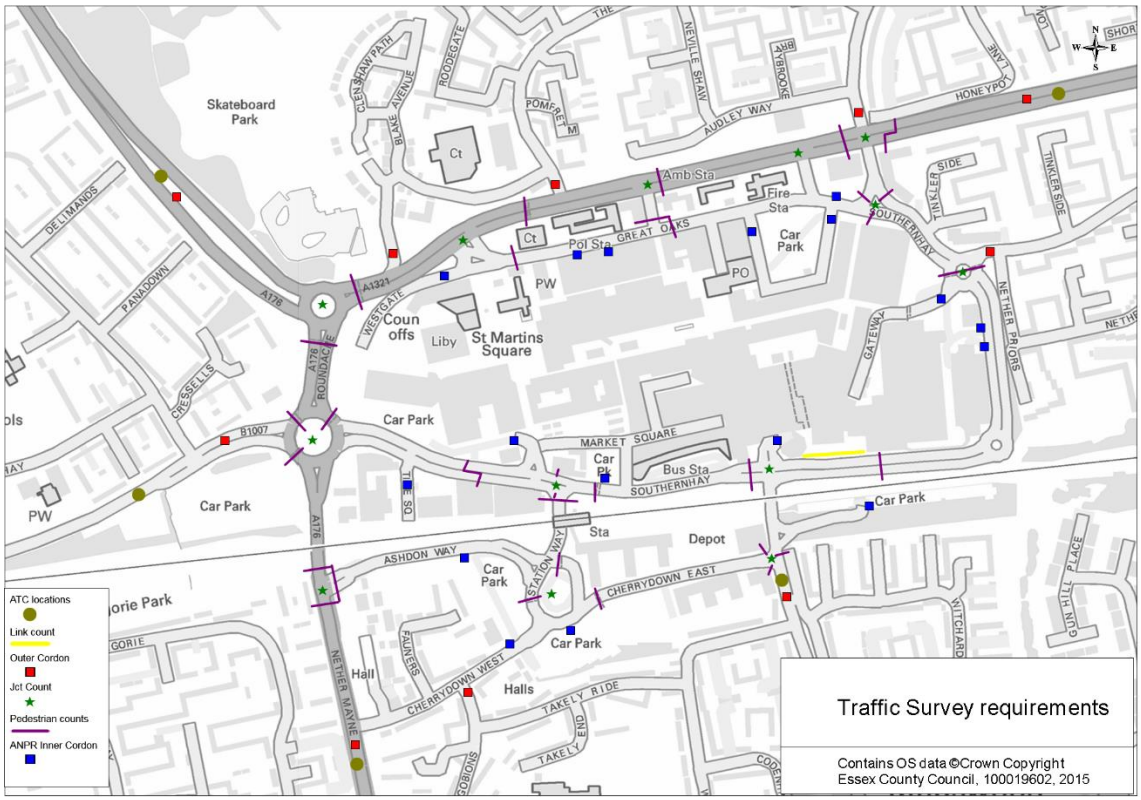

Figure 2-1 Traffic Data surveys

2.2 Classified Junction Turning Count Surveys

Classified Junction Turning Counts were undertaken to record the type of vehicle by turning movement for all vehicles passing through specified junctions in the study area.

The vehicle classifications collected were:

- Pedal cycles;
- Motorcycles;
- Cars;
- Light goods vehicles;

- Buses and coaches;
- Heavy goods vehicles (two or three axles rigid, above 7.5 tonnes gvw); and
- Heavy goods vehicles (four axles rigid, three to six axles articulated).

The Classified Junction Turning Counts were undertaken at 13 locations as specified below in Table 2-1 between the hours of 06:00 and 19:00 on Thursday 12th May 2016. Saturday counts were undertaken between the hours of 09:00 and 16:00 on Saturday 14th May 2016.

Count Location No.	Count Location	No. of Arms	Junction Type
1	Clayhill Road / Cherrydown East	4	Signalised Jct
2	Station Way / Ashton Way	3	Signalised Jct
3	Roundacre / Southernhay	3	Signalised Jct
4	A176 Uppermayne / Ashdon Way	3	Signalised Jct
5	A1321 Broadmayne / Great Oaks	3	Signalised Jct
6	A1321 Broadmayne / Little Oaks	3	Signalised Jct
7	A1321 Broadmayne / Linkway	3	Signalised Jct
8	B1321 Broadmayne / Southernhay / Ghyllgrove	4	Signalised Jct
9	Southernhay / Great Oaks	3	Signalised Jct
10	Southernhay / Clayhill Road / Eastgate Car Park	4	Signalised Jct
11	A176 Roundacre / Southernhay / A176 Nethermayne / Laindon Link	4	Roundabout
12	A176 Uppermayne / A1321 Broadmayne / A176 Roundacre	3	Roundabout
13	Southernhay / Long Riding / Gateway	4	Roundabout

Table 2-1: Junction locations for classified junction turning counts

2.3 Automatic Number Plate Recognition Survey

ANPR cameras were located at 25 locations. The ANPR surveys were from 06:00 until 19:00 on Thursday 12th May and from 09:00 until 16:00 on Saturday 14th May to capture movements between the boundary of the study area and the car parks within the study area in either direction and movements crossing the boundary of the study area twice without entering or exiting a car park within the study area.

Link counts were undertaken at each of the ANPR camera locations. As the ANPR does not capture 100% of traffic, these link counts are used to factor up the junction counts as part of the Furness process, explained in Section 3.3. An individual link count was also undertaken to provide details for a small car park access on Southernhay, to the south of ASDA.

2.4 Automatic Traffic Counter Surveys

ATCs were located at five locations. All five ATCs were installed for a 7 day period during May 2016.

2.5 Pedestrian Surveys

Pedestrian surveys were undertaken at 24 locations. The pedestrian surveys covered the period from 06:00 until 19:00 on Thursday 12th May and from 09:00 until 16:00 on Saturday 14th May. They captured pedestrian movements using subways or signalised crossing facilities within the study area.

3 Base Modelling

3.1 Introduction

Base year models have been built to represent traffic flow in the weekday morning, weekday evening and Saturday peak periods for May 2016. The three base models simulate the following peak time periods:

- 08:00 – 09:00 weekday AM peak period;
- 17:00 – 18:00 weekday PM peak period; and
- 12:00 – 13:00 Saturday peak period.

The periods were selected based on a review of junction data – network entry flows were totalled for all manually counted junctions to assess the peak hours across the network.

A warm up and cool down period of thirty minutes before and after each peak hour has been included in the model simulations. These warm up and cool down periods enable realistic traffic numbers to be present on the highway before and after the evaluated time periods and to allow traffic within the peak period to clear the network.

3.2 Model Development

One of the main benefits of VISSIM modelling is its ability to route traffic using path and cost parameters. For instance, in this study VISSIM can model the likely effect of a series of proposed changes to the highway infrastructure in Basildon town centre as vehicles will reassign to the most cost and time effective routes.

A transport model in VISSIM consists of transport supply and travel demand data. Transport supply data is represented in a network, which includes the following network objects that can be modified interactively:

- **Links**: Represent single or multi-lane carriageways with a specified direction of flow.
- **Connectors**: Provide continuous routes between links. In order to join links together connectors are used to construct junctions and changes in road layout.
- **Vehicle Inputs**: Define the total number of vehicles which enter the network on a link (at the extremities of the model) for each defined time period. There are 22 zones where vehicles enter and exit the Basildon town centre model. Individual 22 x 22 Origin / Destination (O/D) matrices were developed using the May 2016 traffic survey data for each of the weekday AM, weekday PM and Saturday peak periods. This exercise provided the matrices required for the VISSIM modelling in which the traffic was assigned to each of the models using the Dynamic Assignment functionality in VISSIM.
- **Priority Rules**: Define rights of way at non signalised junctions. Includes gap acceptance assumptions which can be adjusted.
- **Desired Speed Decision**: Dictates the speed at which a vehicle wishes to travel.
- **Reduced Speed Areas**: Dictates the speed at which the vehicle will travel. These are used to model short areas of speed change for example at sharp bends and junctions.
- **Vehicle Classes:** Categorise the vehicle types used in the model. The vehicle classes used in this model include light vehicles (motorcyclists, cars and LGVs), buses and heavy vehicles (HGVs). Train travel was also represented within the model to provide a visual representation of how public transport may link. All vehicles with the exception of scheduled bus services were input to the models using zone to zone matrices based on the May 2016 traffic survey. All scheduled bus services in Basildon town centre were input independently based on their timetabled routes correct at the date of the traffic survey. HGV matrices were produced for each time segment from the junction counts. HGV flows in Basildon are very low

during peak traffic periods and destinations limited to a small number of service yards. On-site observations of destinations facilitated this process.

During the development stage of the network, Ordinance Survey (OS) data in electronic format (CAD) was used to replicate the existing highway arrangement in VISSIM. Junction layouts and markings were obtained from OS MasterMap and from on-site observations.

The full extent of the Basildon town centre VISSIM model is shown below in Figure 3-1.

Figure 3-1: Basildon Town Centre model extents

Speed limits and road restrictions were identified during site visits and using Google Street view. Where appropriate, vehicle speeds have been restricted to ensure that the model replicates on site behaviour. Speed limits vary throughout the model between 30 and 40 mph.

In order to replicate the traffic signal timings while incorporating the demand dependent element into the signals, the Vehicle Actuated Programming (VAP) module within VISSIM has been used. Logic used within the VAP programming has been taken directly from the traffic signal timing data provided by the Intelligent Traffic Systems (ITS) department within Essex Highways.

3.3 Matrices Furnessing

From the ANPR data, trip matrices of movements between cameras were produced for each time period – AM, PM, and Saturday. As ANPR cameras do

not read 100% of vehicle number plates, the resultant matrices required furnessing to reflect junction count and link count data. The furnessing process uses the actual and required trip totals to and from each zone, as well as the starting matrix from the ANPR data. The zones for this model can be seen in Figure 3-2. Furnessing is then undertaken using Visual Basic for Applications (VBA) to distribute traffic proportionally across the matrix to match the vehicle volumes from the junction and link counts.

Figure 3-2: Basildon zonal map

3.4 Base Model Calibration Results

Model calibration is defined within the Design Manual for Roads and Bridges (DMRB) as:

'*Adjusting the parameters used within the various methods mathematical relationships within the model to reflect the data as well as is necessary to reflect the models objectives*.'

The calibration of the three Basildon base models is focused on fitting the models to the turning movement counts and a review of the model network and driver behaviour.

Model validation is an essential part of the development of a base year model. Validation acts as a confirmation of the ability of the model to represent the

current traffic conditions and patterns in the modelled area. A successfully validated base model substantiates the model as a robust tool for future scheme assessments and proposed transport intervention testing in the modelled area.

The Department for Transport's guidance recommends that model validation of traffic flows meets two criteria.

The first criterion is that 85% of modelled flows and turning movements should have a GEH of less than 5.0. The GEH value (named after Geoffrey E. Havers, who proposed it in the 1970s) is in the form of a Chi-squared statistic and incorporates both relative and absolute errors, giving an overall measure of the accuracy of the model by comparing modelled and observed flows. Smaller values of GEH represent a better fit, a zero value would indicate a perfect fit.

The formula for the statistic is presented below:

$$GEH = \sqrt{\frac{(M-C)^2}{0.5 \times (M+C)}}$$

M = Modelled Flow
C = Observed Flow

The second criterion is that 85% of the modelled flows should meet the relevant condition:

- Individual flows within 15% for flows 700 – 2700 vehicles per hour (vph);
- Individual flows within 100 vph for flows less than 700 vph; or
- Individual flows within 400 vph for flows greater than 2700 vph.

The following calibration results against the validation criteria are based on a minimum of five runs, with different random seeds, ensuring that daily variation in vehicle arrival times were replicated.

Initially, it was also intended as part of this commission to validate the model against observed journey time data, however, due to time constraints it was agreed with ECC that this step would not be undertaken as the model is well calibrated, as demonstrated later, and it also replicates delay on the expected sections of the network at the various times of day as witnessed on site.

Turning Movement Counts

Observed turning movement counts at the 15 junctions in the network have been compared against the base model turning movement counts. There was some discrepancy between the observed counts and modelled results which meant that traffic volume adjustments were required.

The Broadmayne/Ghyllgrove/Southernhay junction proved to be problematic as there were discrepancies in the various traffic data available. Some manual reassignment has been undertaken, however, the model still would not fully calibrate on some of the approaches. This has been identified later on in this section.

Minor manual reassignment was undertaken to ensure that flows within the network closely approximated junction counts carried out as part of this project. Differences were encountered between the link counts for Broadmayne and Ghyllgrove and the adjacent junction count, so the flows were adjusted to more closely match the junction count, as this more closely matched counts at adjacent junctions.

Table 3-1 to Table 3-3 below illustrate the full turning movement GEH statistic results for the weekday AM, weekday PM and Saturday base model simulations.

The AM peak hour model (see Table 3-1) meets the GEH criteria with 90% achieved and the flow criteria with 96% achieved.

Turning Volume Calibration for AM model								
Junction No	Junction Name	From	To	Observed	Modelled	Difference-Total	GEH	Individual flow criteria
				vehs	vehs			
1	Broadmayne / Uppermayne roundabout	Roundacre link	Broadmayne	657	657	0	0.0	Pass
		Roundacre link	Uppermayne NW	803	902	99	3.4	Pass
		Broadmayne W	Roundacre link	705	814	109	4.0	Fail
		Broadmayne W	Broadmayne	0	59	59	N/A	Pass
		Broadmayne W	Uppermayne NW	665	581	-84	3.4	Pass
		Uppermayne NW	Roundacre link	791	786	-5	0.2	Pass
		Uppermayne NW	Broadmayne	583	581	-2	0.1	Pass
2	Broadmayne / Great Oaks / Westgate	Broadmayne	Broadmayne E	1182	1187	5	0.1	Pass
		Broadmayne	Westgate	71	105	34	3.6	Pass
		Broadmayne E	Broadmayne W	1062	1141	79	2.4	Pass
		Great Oaks	Broadmayne W	309	267	-42	2.5	Pass
		Great Oaks	Broadmayne E	47	11	-36	6.7	Pass
		Great Oaks	Westgate	59	56	-3	0.4	Pass
		Westgate	Broadmayne W	29	34	5	0.9	Pass
3	Broadmayne / Little Oaks	Broadmayne W	Little Oaks	292	284	-8	0.5	Pass
		Broadmayne W	Broadmayne E	880	854	-26	0.9	Pass
		Broadmayne E	Broadmayne W	1064	1152	88	2.6	Pass
5	Broadmayne / Linkway	Broadmayne E	Broadmayne E	871	853	-18	0.6	Pass
		Broadmayne	Broadmayne E	1140	1065	-75	2.3	Pass
		Linkway	Broadmayne E	17	85	68	9.5	Pass
		Linkway	Broadmayne E	397	408	11	0.5	Pass
6	Broadmayne / Ghyllgrove / Southernhay	Broadmayne E	Ghyllgrove	432	460	28	1.3	Pass
		Broadmayne E	Broadmayne E	697	795	98	3.6	Pass
		Ghyllgrove	Southernhay	254	291	37	2.2	Pass
		Ghyllgrove	Broadmayne	380	127	-253	15.9	Fail
		Ghyllgrove	Broadmayne E	72	47	-25	3.2	Pass
		Broadmayne E	Southernhay	421	337	-84	4.3	Pass
		Broadmayne E	Broadmayne	760	474	-286	11.5	Fail
9	Southernhay / Great Oaks	Southernhay S	Great Oaks	491	432	-59	2.7	Pass
		Southernhay N	Great Oaks	367	377	10	0.5	Pass
10	Southernhay / Long Ridings	Southernhay	Southernhay	17	0	-17	5.8	Pass
		Southernhay	Long Ridings	41	70	29	3.9	Pass
		Southernhay	Southernhay S	259	182	-77	5.2	Pass
		Long Ridings	Southernhay	203	172	-31	2.3	Pass
		Long Ridings	Southernhay S	211	248	37	2.4	Pass
		Southernhay	Southernhay	288	210	-78	4.9	Pass
		Southernhay	Long Ridings	76	67	-9	1.1	Pass
13	Southernhay / Clayhill Road / Car Park A	Roundacre/Southernhay	Southernhay W	326	259	-67	3.9	Pass
		Roundacre/Southernhay	Car Park A	82	75	-7	0.8	Pass
		Southernhay E	Clayhill Road	282	271	-11	0.7	Pass
		Southernhay E	Southernhay Buses	19	20	1	0.2	Pass
		Southernhay E	Clayhill Road	345	270	-75	4.3	Pass
		Southernhay right turn	Car Park A	43	27	-16	2.7	Pass
		Car Park A exit ahead	Clayhill Road	1	1	0	0.0	Pass
		Car Park A exit left	Southernhay W	2	1	-1	0.8	Pass
16	Rouandacre / Southernhay / Station Way	Roundacre/Southernhay	Roundacre/Southernhay	605	514	-91	3.8	Pass
		Southernhay Buses	Roundacre	30	21	-9	1.8	Pass
		Station Way	Roundacre/Southernhay	226	194	-32	2.2	Pass
		Station Way	Roundacre	401	368	-33	1.7	Pass
19	Broadmayne / Laindon Link / Roundacre Roundabout	Laindon Link	Roundacre link	459	425	-34	1.6	Pass
		Laindon Link	Roundacre	181	177	-4	0.3	Pass
		Laindon Link	Nethermayne	393	309	-84	4.5	Pass
		Roundacre link	Laindon Link	464	450	-14	0.7	Pass
		Roundacre link	Roundacre	281	298	17	1.0	Pass
		Roundacre link	Nethermayne	756	853	97	3.4	Pass
		Roundacre	Laindon Link	354	339	-15	0.8	Pass
		Roundacre	Roundacre link	148	198	50	3.8	Pass
		Roundacre	Nethermayne	65	23	-42	6.3	Pass
		Nethermayne	Laindon Link	228	228	0	0.0	Pass
		Nethermayne	Roundacre link	862	939	77	2.6	Pass
		Nethermayne	Roundacre	177	165	-12	0.9	Pass
21	Nethermayne / Ashdon Way	Nethermayne	Ashdon Way	72	172	100	9.1	Pass
		Nethermayne	Nethermayne	1139	1036	-103	3.1	Pass
		Ashdon Way	Nethermayne	162	96	-66	5.8	Pass
		Nethermayne	Netermayne N	1342	1345	3	0.1	Pass
		Nethermayne	Ashdon Way	30	17	-13	2.7	Pass
24	Clayhill Road / Cherrydown East / Car Park 13	Clayhill Road	Cherrydown East	280	202	-78	5.0	Pass
		Clayhill Road	Clayhill Road	352	333	-19	1.0	Pass
		Clayhill Road	Car Park 13	8	8	0	0.0	Pass
		Clayhill Road S	Cherrydown East	481	481	0	0.0	Pass
	% criteria met						90%	96%

Table 3-1: Weekday AM Peak hour calibration results

The PM peak hour model (see Table 3-2) meets the GEH criteria with 86% achieved and the flow criteria with 96% achieved.

Turning Volume Calibration for PM model								
Junction No	Junction Name	From	To	Observed	Modelled	Difference-Total	GEH	Individual flow criteria
				vehs	vehs			
1	Broadmayne / Uppermayne roundabout	Roundacre link	Broadmayne	634	697	63	2.4	Pass
		Roundacre link	Uppermayne NW	1059	960	-99	3.1	Pass
		Broadmayne W	Roundacre link	686	637	-49	1.9	Pass
		Broadmayne W	Broadmayne	0	40	40	N/A	Pass
		Broadmayne W	Uppermayne NW	605	600	-5	0.2	Pass
		Uppermayne NW	Roundacre link	1059	1080	21	0.6	Pass
		Uppermayne NW	Broadmayne	900	900	0	0.0	Pass
2	Broadmayne / Great Oaks / Westgate	Broadmayne	Broadmayne E	1699	1582	-117	2.9	Pass
		Broadmayne	Westgate	41	44	3	0.5	Pass
		Broadmayne E	Broadmayne W	663	735	72	2.7	Pass
		Great Oaks	Broadmayne W	496	449	-47	2.2	Pass
		Great Oaks	Broadmayne E	151	94	-57	5.1	Pass
		Great Oaks	Westgate	26	21	-5	1.0	Pass
		Westgate	Broadmayne W	140	92	-48	4.5	Pass
3	Broadmayne / Little Oaks	Broadmayne W	Little Oaks	104	104	0	0.0	Pass
		Broadmayne W	Broadmayne E	1543	1417	-126	3.3	Pass
		Broadmayne E	Broadmayne W	677	745	68	2.6	Pass
5	Broadmayne / Linkway	Broadmayne E	Broadmayne E	1524	1409	-115	3.0	Pass
		Broadmayne	Broadmayne E	647	602	-45	1.8	Pass
		Linkway	Broadmayne E	41	148	107	11.0	N/A
		Linkway	Broadmayne E	619	563	-56	2.3	Pass
6	Broadmayne / Ghyllgrove / Southernhay	Broadmayne E	Ghyllgrove	408	404	-4	0.2	Pass
		Broadmayne E	Broadmayne E	1490	1543	53	1.4	Pass
		Ghyllgrove	Southernhay	195	290	95	6.1	Pass
		Ghyllgrove	Broadmayne	254	90	-164	12.5	Fail
		Ghyllgrove	Broadmayne E	61	73	12	1.5	Pass
		Broadmayne E	Southernhay	192	125	-67	5.3	Pass
		Broadmayne E	Broadmayne	390	269	-121	6.7	Fail
9	Southernhay / Great Oaks	Southernhay S	Great Oaks	718	636	-82	3.2	Pass
		Southernhay N	Great Oaks	231	188	-43	3.0	Pass
10	Southernhay / Long Ridings	Southernhay	Southernhay	35	5	-30	6.7	Pass
		Southernhay	Long Ridings	108	185	77	6.4	Pass
		Southernhay	Southernhay S	367	386	19	1.0	Pass
		Long Ridings	Southernhay	78	173	95	8.5	Pass
		Long Ridings	Southernhay S	101	166	65	5.6	Pass
		Southernhay	Southernhay	185	127	-58	4.6	Pass
		Southernhay	Long Ridings	124	124	0	0.0	Pass
13	Southernhay / Clayhill Road / Car Park A	Roundacre/Southernhay	Southernhay W	432	371	-61	3.0	Pass
		Roundacre/Southernhay	Car Park A	18	15	-3	0.7	Pass
		Southernhay E	Clayhill Road	495	429	-66	3.1	Pass
		Southernhay E	Southernhay Buses	19	21	2	0.4	Pass
		Southernhay E	Clayhill Road	256	244	-12	0.8	Pass
		Southernhay right turn	Car Park A	6	4	-2	0.9	Pass
		Car Park A exit ahead	Clayhill Road	112	82	-30	3.0	Pass
		Car Park A exit left	Southernhay W	67	72	5	0.6	Pass
16	Rouandacre / Southernhay / Station Way	Roundacre/Southernhay	Roundacre/Southernhay	760	648	-112	4.2	Pass
		Southernhay Buses	Roundacre	28	22	-6	1.2	Pass
		Station Way	Roundacre/Southernhay	315	268	-47	2.8	Pass
		Station Way	Roundacre	363	317	-46	2.5	Pass
19	Broadmayne / Laindon Link / Roundacre Roundabout	Laindon Link	Roundacre link	519	527	8	0.3	Pass
		Laindon Link	Roundacre	171	195	24	1.8	Pass
		Laindon Link	Nethermayne	407	367	-40	2.0	Pass
		Roundacre link	Laindon Link	361	422	61	3.1	Pass
		Roundacre link	Roundacre	351	420	69	3.5	Pass
		Roundacre link	Nethermayne	1039	876	-163	5.3	Fail
		Roundacre	Laindon Link	293	303	10	0.6	Pass
		Roundacre	Roundacre link	231	269	38	2.4	Pass
		Roundacre	Nethermayne	124	56	-68	7.2	Pass
		Nethermayne	Laindon Link	216	214	-2	0.1	Pass
		Nethermayne	Roundacre link	753	856	103	3.6	Pass
		Nethermayne	Roundacre	116	110	-6	0.6	Pass
21	Nethermayne / Ashdon Way	Nethermayne	Ashdon Way	33	2	-31	7.4	Pass
		Nethermayne	Nethermayne	1252	1307	55	1.5	Pass
		Ashdon Way	Nethermayne	96	68	-28	3.1	Pass
		Nethermayne	Netermayne N	1098	1191	93	2.7	Pass
		Nethermayne	Ashdon Way	17	23	6	1.3	Pass
24	Clayhill Road / Cherrydown East / Car Park 13	Clayhill Road	Cherrydown East	272	201	-71	4.6	Pass
		Clayhill Road	Clayhill Road	585	553	-32	1.3	Pass
		Clayhill Road	Car Park 13	3	3	0	0.0	Pass
		Clayhill Road S	Cherrydown East	293	294	1	0.1	Pass
	% criteria met						86%	96%

Table 3-2: Weekday PM Peak hour calibration results

The Saturday peak hour model (see Table 3-3) meets the GEH criteria with 87% achieved and the flow criteria with 96% achieved.

Turning Volume Calibration for Saturday model								
Junction No	Junction Name	From	To	Observed	Modelled	Difference-Total	GEH	Individual flow criteria
				vehs	vehs			
1	Broadmayne / Uppermayne roundabout	Roundacre link	Broadmayne	506	514	8	0.4	Pass
		Roundacre link	Uppermayne NW	917	949	32	1.0	Pass
		Broadmayne W	Roundacre link	723	779	56	2.0	Pass
		Broadmayne W	Broadmayne	21	43	22	3.9	Pass
		Broadmayne W	Uppermayne NW	768	807	39	1.4	Pass
		Uppermayne NW	Roundacre link	967	965	-2	0.1	Pass
		Uppermayne NW	Broadmayne	648	651	3	0.1	Pass
2	Broadmayne / Great Oaks / Westgate	Broadmayne	Broadmayne E	1134	1157	23	0.7	Pass
		Broadmayne	Westgate	46	54	8	1.1	Pass
		Broadmayne E	Broadmayne W	859	822	-37	1.3	Pass
		Great Oaks	Broadmayne W	593	722	129	5.0	Pass
		Great Oaks	Broadmayne E	123	83	-40	3.9	Pass
		Great Oaks	Westgate	21	13	-8	1.9	Pass
		Westgate	Broadmayne W	65	58	-7	0.9	Pass
3	Broadmayne / Little Oaks	Broadmayne W	Little Oaks	179	180	1	0.1	Pass
		Broadmayne W	Broadmayne E	995	956	-39	1.2	Pass
		Broadmayne E	Broadmayne W	836	832	-4	0.1	Pass
5	Broadmayne / Linkway	Broadmayne E	Broadmayne E	978	970	-8	0.3	Pass
		Broadmayne	Broadmayne E	805	850	45	1.6	Pass
		Linkway	Broadmayne E	87	0	-87	13.2	Pass
		Linkway	Broadmayne E	727	745	18	0.7	Pass
6	Broadmayne / Ghyllgrove / Southernhay	Broadmayne E	Ghyllgrove	322	439	117	6.0	Pass
		Broadmayne E	Broadmayne E	1113	1240	127	3.7	Pass
		Ghyllgrove	Southernhay	215	252	37	2.4	Pass
		Ghyllgrove	Broadmayne	297	74	-223	16.4	Fail
		Ghyllgrove	Broadmayne E	37	126	89	9.9	Pass
		Broadmayne E	Southernhay	435	483	48	2.2	Pass
		Broadmayne E	Broadmayne	506	377	-129	6.1	Fail
9	Southernhay / Great Oaks	Southernhay S	Great Oaks	969	800	-169	5.7	Fail
		Southernhay N	Great Oaks	413	433	20	1.0	Pass
10	Southernhay / Long Ridings	Southernhay	Southernhay	57	29	-28	4.3	Pass
		Southernhay	Long Ridings	80	118	38	3.8	Pass
		Southernhay	Southernhay S	438	494	56	2.6	Pass
		Long Ridings	Southernhay	151	249	98	6.9	Pass
		Long Ridings	Southernhay S	133	206	73	5.6	Pass
		Southernhay	Southernhay	344	262	-82	4.7	Pass
		Southernhay	Long Ridings	63	55	-8	1.0	Pass
13	Southernhay / Clayhill Road / Car Park A	Roundacre/Southernhay	Southernhay W	486	484	-2	0.1	Pass
		Roundacre/Southernhay	Car Park A	209	207	-2	0.1	Pass
		Southernhay E	Clayhill Road	291	279	-12	0.7	Pass
		Southernhay E	Southernhay Buses	22	20	-2	0.4	Pass
		Southernhay E	Clayhill Road	242	239	-3	0.2	Pass
		Southernhay right turn	Car Park A	88	68	-20	2.3	Pass
		Car Park A exit ahead	Clayhill Road	148	161	13	1.0	Pass
		Car Park A exit left	Southernhay W	101	93	-8	0.8	Pass
16	Rouandacre / Southernhay / Station Way	Roundacre/Southernhay	Roundacre/Southernhay	906	909	3	0.1	Pass
		Southernhay Buses	Roundacre	39	20	-19	3.5	Pass
		Station Way	Roundacre/Southernhay	236	253	17	1.1	Pass
		Station Way	Roundacre	388	357	-31	1.6	Pass
19	Broadmayne / Laindon Link / Roundacre Roundabout	Laindon Link	Roundacre link	407	398	-9	0.4	Pass
		Laindon Link	Roundacre	384	385	1	0.1	Pass
		Laindon Link	Nethermayne	186	228	42	2.9	Pass
		Roundacre link	Laindon Link	393	470	77	3.7	Pass
		Roundacre link	Roundacre	558	612	54	2.2	Pass
		Roundacre link	Nethermayne	778	668	-110	4.1	Pass
		Roundacre	Laindon Link	417	368	-49	2.5	Pass
		Roundacre	Roundacre link	233	255	22	1.4	Pass
		Roundacre	Nethermayne	159	109	-50	4.3	Pass
		Nethermayne	Laindon Link	170	166	-4	0.3	Pass
		Nethermayne	Roundacre link	811	810	-1	0.0	Pass
		Nethermayne	Roundacre	132	205	73	5.6	Pass
21	Nethermayne / Ashdon Way	Nethermayne	Ashdon Way	16	1	-15	5.1	Pass
		Nethermayne	Nethermayne	1027	1015	-12	0.4	Pass
		Ashdon Way	Nethermayne	108	114	6	0.6	Pass
		Nethermayne	Netermayne N	1102	1168	66	2.0	Pass
		Nethermayne	Ashdon Way	22	21	-1	0.2	Pass
24	Clayhill Road / Cherrydown East / Car Park 13	Clayhill Road	Cherrydown East	270	283	13	0.8	Pass
		Clayhill Road	Clayhill Road	405	388	-17	0.9	Pass
		Clayhill Road	Car Park 13	7	6	-1	0.4	Pass
		Clayhill Road S	Cherrydown East	358	363	5	0.3	Pass
	% criteria met						87%	96%

Table 3-3: Saturday peak hour calibration results

The results above all indicate that all three base models have been well calibrated.

3.5 Convergence Measures and Acceptable Values

Convergence is associated with the level of stability of the model whereby trip routing does not alter substantially between runs of the same model, i.e. the model is in equilibrium.

Before any results from a traffic model are used to influence a decision, it should be confirmed that the model has reached an acceptable level of stability. A high level of convergence for the highway assignment is particularly important, because inadequate convergence is likely to result in unstable and unreliable forecasts and assessments of user benefits associated with the scheme.

The convergence criteria were obtained from WebTAG Unit M3.1 Highway Assignment Modelling. Table 3-4 below sets out the criteria which are required to be met.

Measure of convergence	Base Model Acceptance Values
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flows change (P)<1%	Four consecutive iterations greater than 98%
Percentage of links with flows change (P2)<1%	Four consecutive iterations greater than 98%
Percentage change in total user costs	Four consecutive iterations less than 0.1%

Table 3-4: WebTAG Unit M3.1, Table 4 appropriate convergence measures and values considered acceptable in establishing a base model

VISSIM outputs convergence tables based upon the percentage of links with flow changes criteria. These have been analysed to show that the models have converged.

The AM model converged within a small number of iterations (see Figure 3-3)

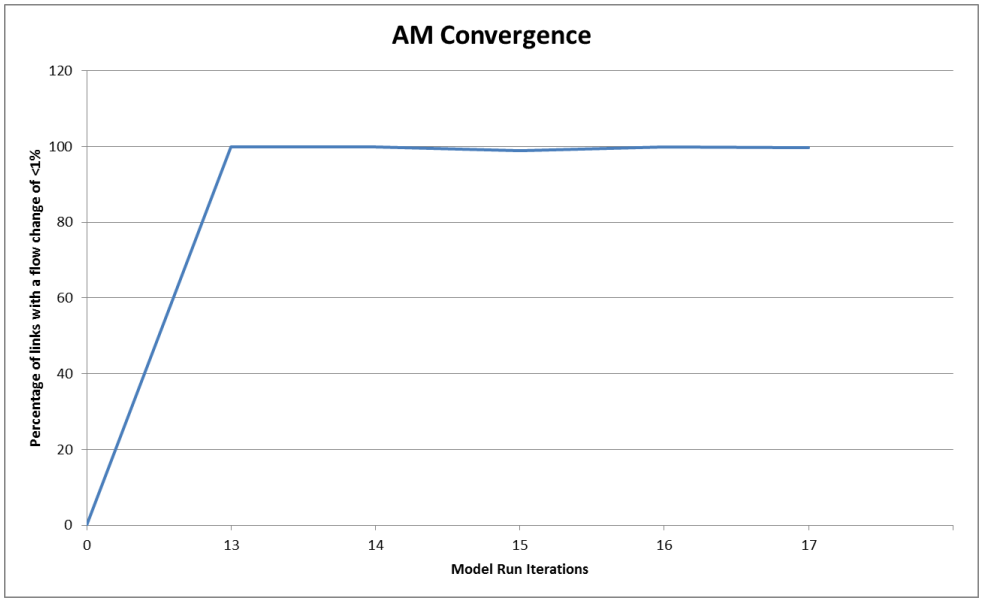

Figure 3-3: Weekday AM Convergence

PM convergence (Figure 3-4) is met, as each iteration is within acceptable levels.

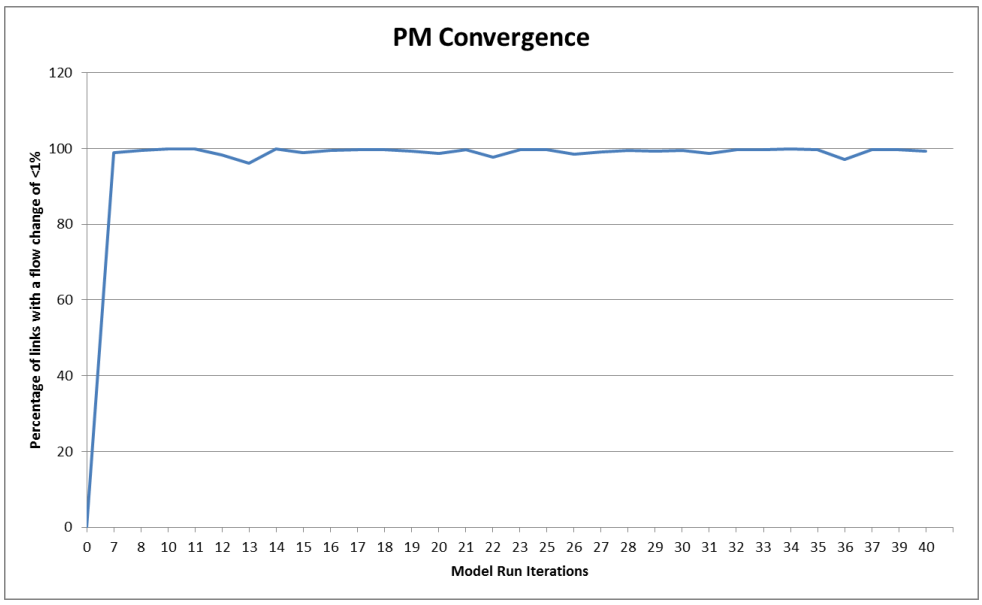

Figure 3-4: Weekday PM Convergence

Saturday convergence (Figure 3-5) is met as there are four consecutive instances where 98% or higher. Overall, the Saturday model is less reliable than the weekday AM and PM peak hours, however it meets the modelling convergence criteria.

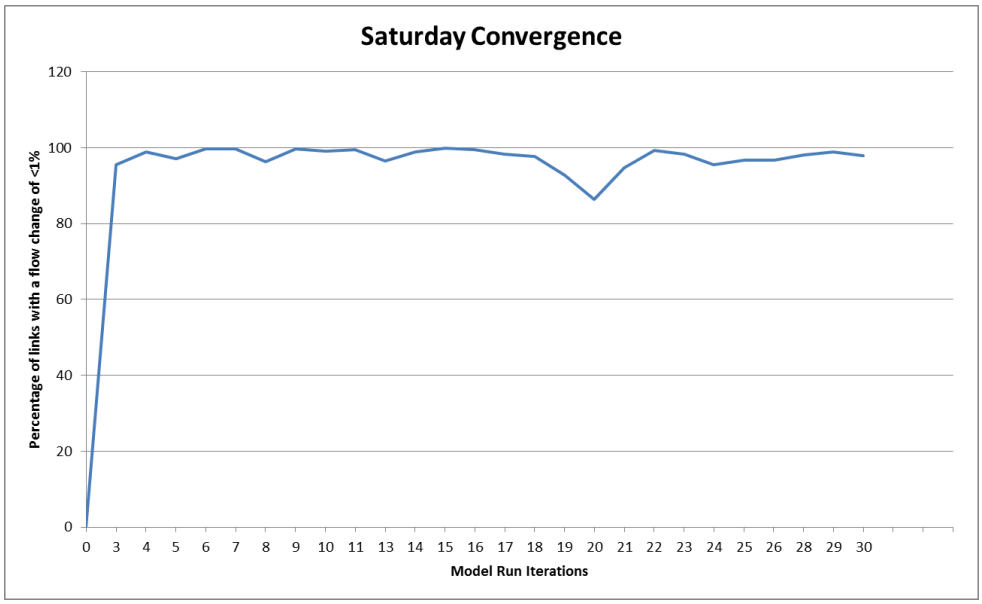

Figure 3-5: Saturday Convergence

4 Summary and Conclusions

This report details the methodology used to develop the base VISSIM model including the on-site data collection and model calibration.

The following sources of data have been used to develop and validate the Basildon town centre base VISSIM model. The data collected has been listed below:

- May 2016 – Classified Junction Turning Counts;
- May 2016 – Automatic Traffic Counters;
- May 2016 – Link Count;
- May 2016 – Automatic Number Plate Recognition Surveys; and
- May 2016 – Pedestrian Crossing Surveys.

The coding of the Basildon town centre model has been based on CAD OS MasterMap data, on-site observations and aerial photography. Signal data was obtained from the ITS team and coded into to the VISSIM model using the VAP programming module.

The key calibration and validation results for the Basildon town centre base VISSIM model have been detailed in Section 3.3 of this report. It is considered that the Basildon town centre base model provides a good replication of the current on-site situation.