Calibration Report
Salisbury Town Centre
City of Salisbury

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aurecon

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1. Executive Summary

This report outlines the development, calibration, and validation of the Aimsun Salisbury Town Centre model built on behalf of the City of Salisbury (CoS) by Aurecon.

The modelling centres on the delivery of a network analysis modelling methodology at an appropriate level to analyse the performance and connectivity issues and to test proposed actions associated with the local road network within the study area.

Stage 1 of this process was the development of a fully calibrated/ validated base Aimsun model reflecting existing traffic conditions. The subsequent stages assess the future probable schemes and associated traffic generation/ growth associated with the Salisbury Town Centre.

The base Aimsun model has been developed reflecting traffic conditions in the morning period, 07:00-09:30 and evening period, 15:00-18:00, replicating observed traffic conditions for year 2011.

The road network was constructed and calibrated utilising the Aimsun microscopic traffic simulation software. Detailed coding of lane and junction descriptions were developed using aerial photographs of the region, on-street measurements and knowledge of the network operation. During the calibration process, model parameters have been adjusted, to improve model operation. All model form changes that deviate from default are described in this report.

The first stage of the model build was to ascertain the traffic movements through the study area. These were derived from the higher tier MASTEM modelling with a cordoned matrix extract reflecting the Aimsun study area. Development of the matrices utilised traffic count data to derive appropriate matrices for both the morning and evening periods.

The second stage involved comparisons of observed and the modelled data comparing the following statistics:

- Turn counts
- Link counts
- Screenline counts

Lastly the validation process centred on the following elements:

- Journey time analysis
- Queue length assessment

The analysis concludes the Aimsun Salisbury Town Centre model is appropriately calibrated/ validated reflecting existing conditions for both peak periods. With this it is considered that the model is a suitable tool to analyse the performance and connectivity issues and to test the proposed actions associated with the local road network within the study area.

2. Introduction

This report sets out the traffic modelling associated with the Salisbury Town Centre and surrounding area. This report focuses on the aspects of the model development, operation, and adherence to good practice and summarises the results of the model calibration/ validation.

2.1 Background

The City of Salisbury (CoS) appointed Aurecon to undertake the traffic/transport modelling for the revitalisation of the Salisbury Town Centre. The transport modelling involved the following:

- MASTEM modelling of the impacts of providing the Saints Road Extension
- Aimsun microscopic modelling of the existing conditions and the modelling of options and recommended scheme in the vicinity of the Town Centre area.

The initial stage of the modelling centres on the development of a base model with which all schemes will be assessed. The model has been developed to reflect both the morning and evening peak periods and with dynamic route capability to reflect the vehicle route choice and their reaction to the prevailing traffic conditions. This provides an additional level of confidence regarding the Salisbury operation in calibration and more importantly option testing.

2.2 Purpose

Microscopic simulation models have been developed of the Salisbury Town Centre area and calibrated to existing network and traffic conditions. The calibrated model of the existing situation can then be used to assess future changes within the model and traffic impacts of various transport concepts. These assessments provide valuable information that can be used as input to decisions regarding the future of the Salisbury area. The foundation for this assessment is the creation of an agreed base case model.

3. Model Form

3.1 Aimsun

The model suite used for this commission was Aimsun. Aimsun represents traffic flows within a network, by simulating individual vehicles and their interactions with other vehicles and the surrounding road environment. As with real traffic conditions, these interactions can vary for each model run, resulting in unique results.

The Aimsun version used is version 6.1.3. All option testing should be undertaken using the same version of the software.

To obtain statistically meaningful results the average network performance is taken from multiple simulation runs. Previous experience indicates that ten model runs are sufficient to obtain stable results for a network of this size, nature and purpose.

3.2 Base Model Network

The base model network, as shown in Figure 1, is primarily the area enclosed by Salisbury Highway to the west, Commercial Road to the north and Park Terrace to the south. All roads considered major within this area have been integrated in the model. Driveways and roads carrying what is considered low traffic volumes which do not significantly influence traffic flow within the model have not been included.

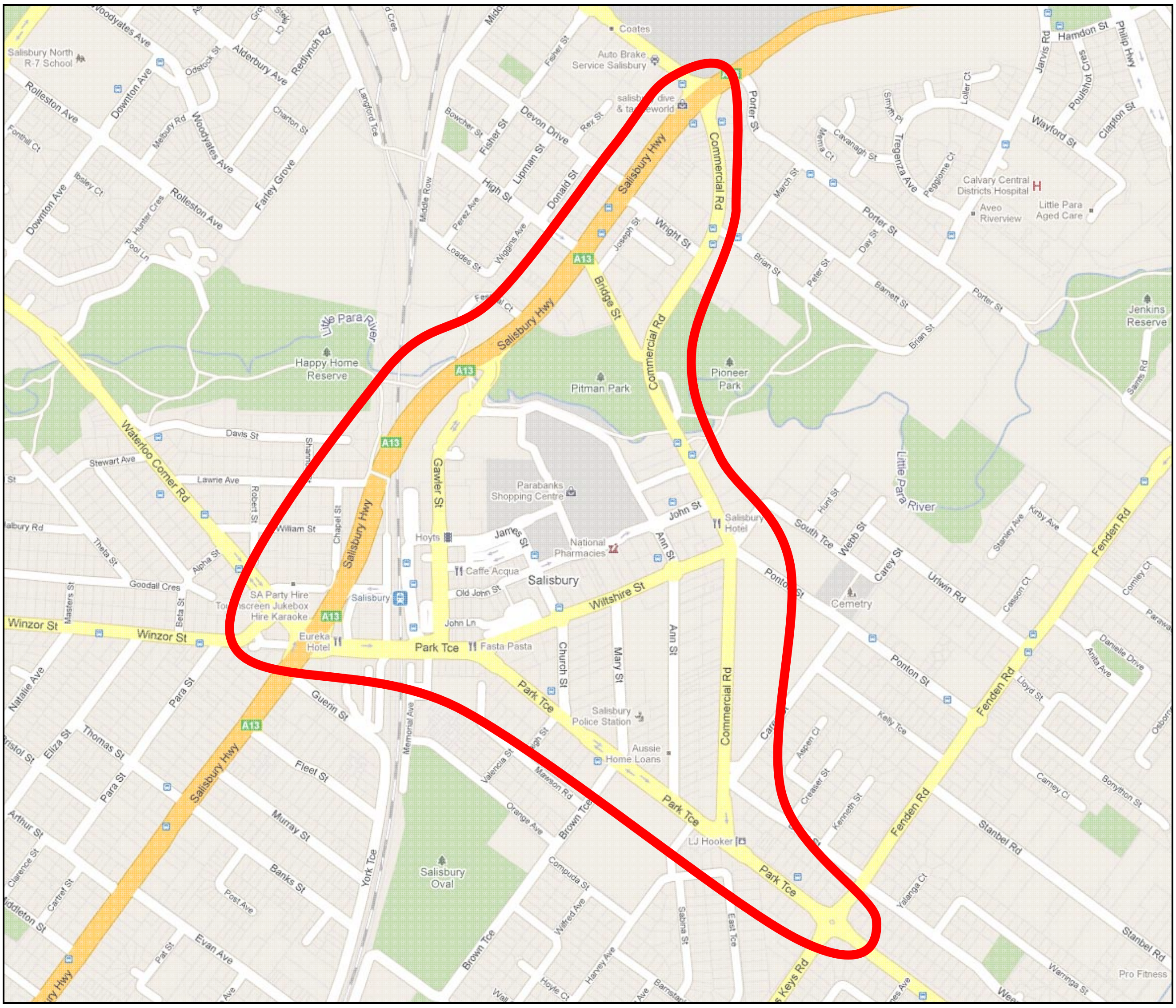

Figure 1 - Study area

The base model was compiled using available digital aerial photography, with site visits to confirm the accuracy and operation of the modelled network. Based on the supplied data, the model was constructed to a 1:1 scale, ensuring correct vehicle operation and accurate reaction to the road geometry and other vehicles.

3.3 Model Periods

The Aimsun model has been developed for a morning and evening traffic periods:

- Morning period (AM) – 07:00 to 09:30
- Evening period (PM) – 15:00 to 18:00

The following peak hours have been calculated for each of the above model periods, based on observed survey data.

- Morning peak hour – 08:15 to 09:15
- Evening peak hour – 16:15 to 17:15

Model duration of greater than two hours ensures the shoulders to the peaks of the background traffic and development traffic are adequately modelled. This allows the model to adequately accommodate peak hour spreading which could result with future growth within the study area. Due to these reasons and the late morning peak hour, an additional 30 minute cool down has been added to the morning model.

3.4 Site Visits

Site visits were undertaken by Aurecon staff on the 3rd, 4th and 5th of May 2011 to confirm the model form and ensure realistic vehicle behaviour is replicated within the model.

4. Traffic Data Collection

4.1 Survey Data

Peak period count data was collected by HDS, in addition to supplement this count data was received from both CoS and DTEI to supplement. The following section summarises the traffic data collection process undertaken.

Turn count data was provided for the key intersections throughout the Salisbury area. Given the count data is from different months/ different weeks/ different days there is likely to be some disparity between intersections in addition to the expected human errors that comes with count data.

4.1.1 Turn Count Data

In total 19 intersections were surveyed, recording turn counts by vehicle type in fifteen minute intervals. These counts consisted of both full and partial turning count data. Full count refers to all movements that is both turns and through movements collected for all approaches to the intersection. Partial counts refer to the collection of turns only.

Those intersections counted are listed below and presented in Figure 2.

Full turning counts (all movements):

- Park Terrace / Mary Terrace / Brown Terrace
- Wiltshire Street / Church Street
- Wiltshire Street / Ann Street
- Church Street / John Street / Old John Street
- Ann Street / John Street / Old John Street
- Gawler Street / James Street
- Gawler Street / Shopping Centre Access
- Commercial Road / Wiltshire Street / Ponton Street

Partial turning counts (turns only):

- Bridge Street at Commercial Road
- Bridge Street at Salisbury Highway
- Brian Street at Commercial Road
- Wright Street at Commercial Road
- Church Street at Park Terrace
- Ann Street at Park Terrace
- Carey Street at Commercial Road
- John Street at Commercial Road
- Shopping Centre Access (Barnacle Bills) at Commercial Road
- Church Street at James Street
- Old John Street at Gawler Street

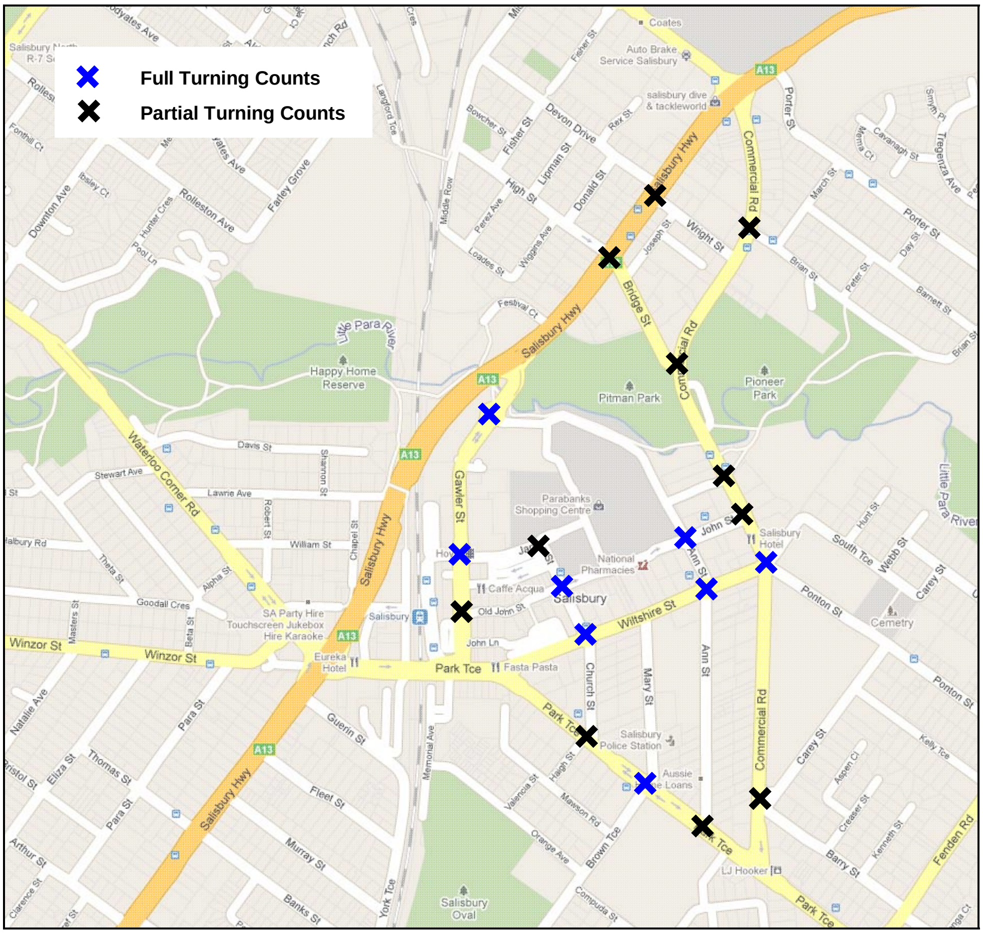

Figure 2 - Turn count survey locations

4.1.2 Loop Count Information

Loop count information in the form of tube counts, were collected at 8 locations on the 4th and 5th of May 2011. The location of these counts centred on the access points to the Salisbury Mall in addition to locations where a comparison between turn count data could be undertaken.

The location of the loop count collection points is presented in Figure 3 below.

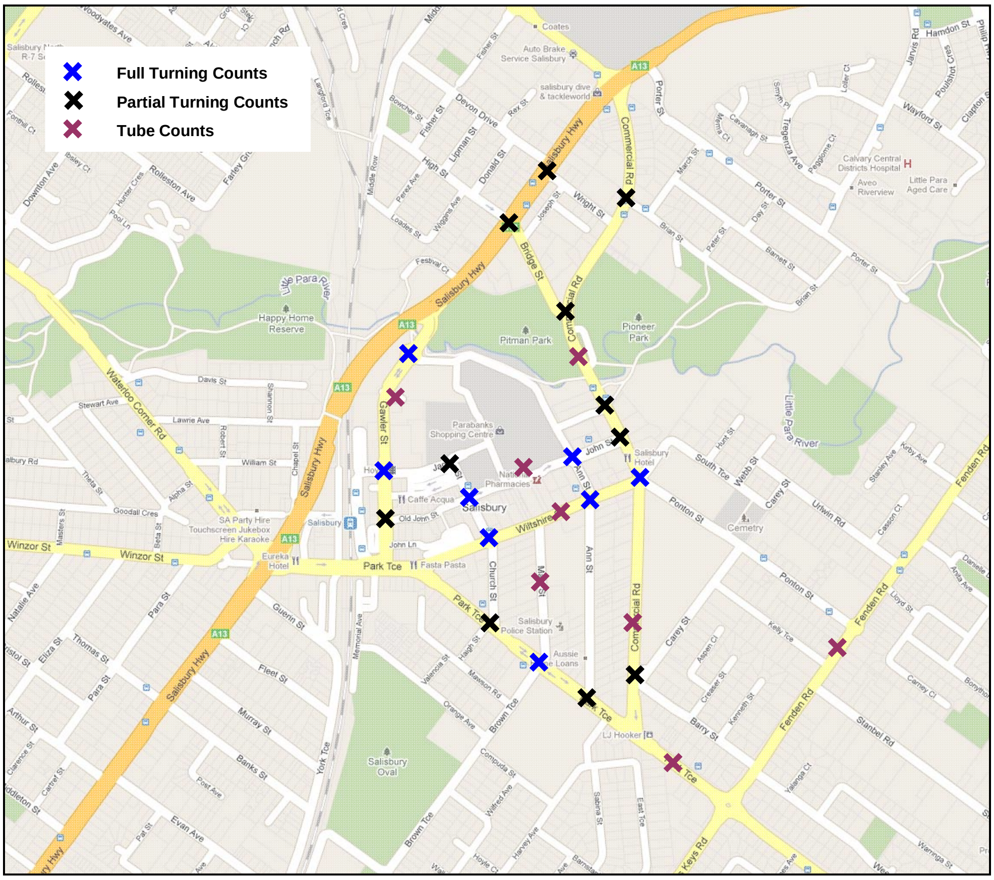

Figure 3 - Tube count survey locations

4.1.3 Additional Survey Data

Historic traffic survey data was provided by DTEI ranging from year 2008 to 2010. Given the age of this data factoring was required to align these counts with the latest counts. This was undertaken using SCATS "VS" volume count data and intersections listed in Section 4.1.1 and Section 4.1.2 which are situated adjacent to the intersections provided by DTEI. These additional data sets are listed in Table 1 below with their respective survey dates.

Intersection	Survey Date
Park Terrace/ Commercial Road	28 May 2008
Park Terrace/ Fenden Road	29 April 2008
Park Terrace/ Gawler Street	26 October 2008
Park Terrace/ Wiltshire Street	14 May 2008
Salisbury Highway/ Commercial Road	9 November 2010
Salisbury Highway/ Gawler Street	15 May 2008
Salisbury Highway/ Park Terrace/ Waterloo Corner Road	28 October 2010
Waterloo Corner Road/ Winzor Street	13 March 2003
Wiltshire Street/ Mary Street	2 April 2009

Table 1 – Historical survey data

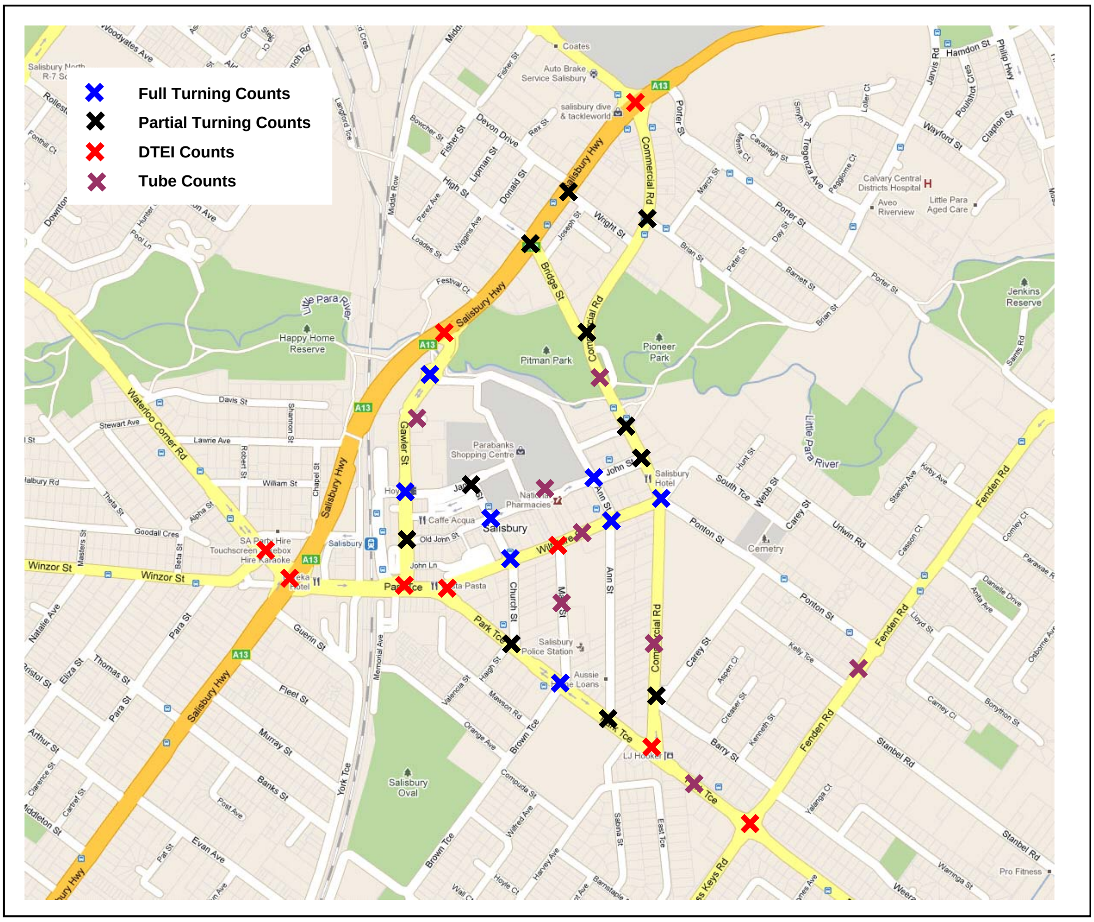

Figure 4 - Turn count survey locations

4.1.4 Journey Time Data

To form part of the validation process travel time surveys have been undertaken through the modelled area. In total four routes were selected with travel times being recorded for each modelled period, in each direction of travel.

The four routes selected are as follows.

- **Route 1:** Salisbury Highway – Park Terrace to John Rice Avenue
- **Route 2:** Park Terrace – Salisbury Highway to Fenden Road
- **Route 3:** Commercial Road – Park Terrace to Salisbury Highway
- **Route 4:** Gawler Street – Park Terrace to Salisbury Highway

The travel time surveys were undertaken on the 5th of May 2011 and were traversed repeatedly for the following time periods:

- Morning period – 07:00 to 09:30
- Evening period – 15:00 to 18:00

The routes surveyed are shown in the Figure 5 below.

Figure 5 – Journey time route

4.1.5 Traffic Signal Data

SCATS traffic data was collected from the 2nd to the 6th of May 2011. In total data for 7 signalised intersections and 3 pedestrian crossings was obtained. The data was supplied via VS, SM, and IDM files in addition to the LX and database files. This data enabled the fixed signal timings to be derived for each of the modelled periods. In addition traffic signal offsets, pedestrian activations, rail crossing operations, and lane induced loop volumes was also calculated for input to the models.

The signalised intersections and pedestrian crossings are listed below.

- Salisbury Highway / Park Terrace, TCS 200
- Salisbury Highway / Gawler Street, TCS 321
- Salisbury Highway / Commercial Road, TCS 244
- Park Terrace / Rail Crossing, TCS 470
- Park Terrace Bus Station Exit, TCS 470
- Park Terrace / Gawler Street, TCS 470
- Park Terrace / Wiltshire Street, TCS 525

- Park Terrace / Mary Street, TCS 468
- Commercial Rd/ Wiltshire Street, TCS457
- Park Terrace Pedestrian Crossing, PC 322
- Commercial Road Pedestrian Crossing between Bridge St and John St, PC 241
- Commercial Road Pedestrian Crossing between Wiltshire St and Carey Street, PC 235

4.1.6 Public Transport Information

All bus route data entered into the base models was obtained from the Adelaide Metro website and consisted of routes, schedules, and stop locations. Train scheduling was obtained from Adelaide Metro Northern Train timetable.

Further details regarding the bus and train information provided and included in the models are detailed in Section 5.5 of this report.

5. Traffic Demand and Assignment

5.1 Zone Structure

There is a degree of interdependence between the definitions of the study area/ zoning system and the network, such that one should not define one with out reference to the other.

The foremost component in defining the zoning structure for the microsimulation model was the existing zone structure utilised with the higher tier MASTEM model. Disaggregation of these MATSEM zones has been undertaken where considered applicable.

Disaggregation of the MASTEM zones was based on the main areas of trip generation through Salisbury.

In total 27 zones have been applied to the model. The zone layout is shown in Figure 6.

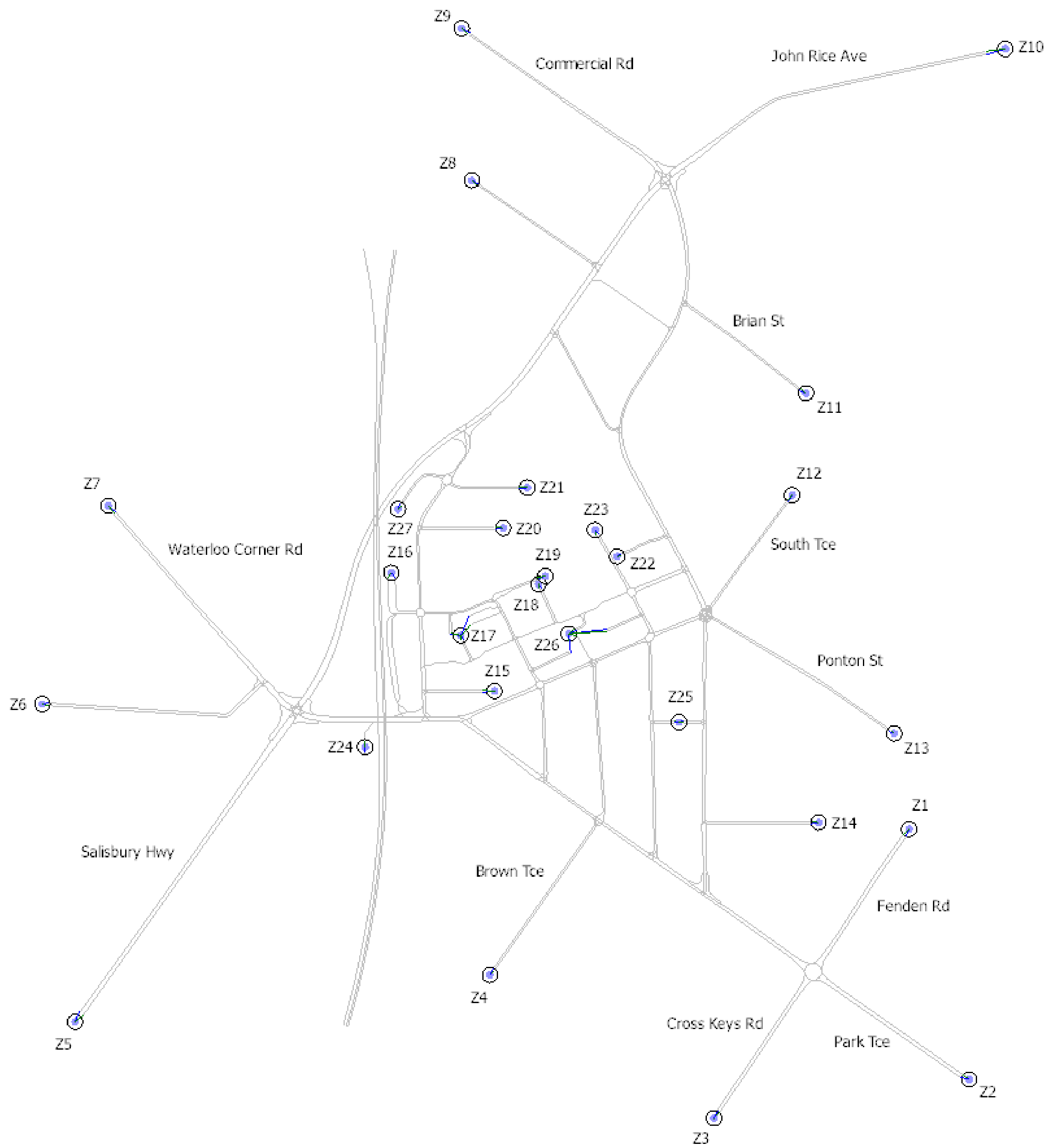

Figure 6 - Network zone configuration

5.2 Demand Matrices Development

In total 4 vehicle demand matrices have been assigned to the network. These represent cars, lights goods vehicles (LGVs), medium goods vehicles (MGVs), and heavy goods vehicles (HGVs). These both use the MASTEM prior matrix as a base.

5.2.1 MASTEM Demand Matrices

MASTEM cordon matrices were extracted from the 2011 MASTEM model. These matrices are considered coarse in the Salisbury model area with a total of 9 zones covering the model area. It was noted that no internal zones are defined for both the Salisbury Town and the Parabanks Shopping Centres which are considered large trip generators. This is not surprising given the extent of the MASTEM model area.

With this, the MASTEM matrices were under went a calibration process to better reflect the traffic generators within the model area.

5.2.2 Aimsun Matrix Development

The methodology for the creation of the demand matrix development is detailed below.

1. Cordon origin/ destination (O/D) demand matrices for both car and truck were extracted from the 2011 MASTEM model as hourly traffic volumes. These were manipulated to reflect the AIMSUN proposed zone structure. Disaggregation was also undertaken to reflect the areas within the AIMSUN model where no zones were available in the MASTEM model.

2. The peak hour matrices were adjusted to collected survey data using the Furness method. Trip end totals for each Aimsun zone were formed from external link survey data, internal link survey data, and other filler zones representing car parks with values based on their survey differences, surrounding land use, and number of individual car parks.

3. As part of the calibration process the matrices were manually adjusted to refine distributions created by the MASTEM zone disaggregation. A seed matrix was established to enable any shortcomings of the MASTEM model to be adjusted; this is adjusting the initial cell to cell trip numbers to influence the final matrix. The Furness method of matrix updating was then undertaken again with an iterative process to derive matrices that resulted in the best match when running the model and analysing the statistics.

Comparison of the Morning and Evening prior matrices is shown below and shows the only significant change from the final matrices compared to the prior matrices from the MASTEM model is for zone 5 (Salisbury Highway), zone 7 (Waterloo Corner Rd), and zone 10 (John Rice Avenue). The MASTEM outputs showed a large flow towards the Adelaide CBD in the morning period and low volumes heading toward the Adelaide CBD in the evening period. However survey data showed that a tidal flow was not so apparent and if anything traffic had destinations involving the industrial areas to the north of Salisbury the morning period.

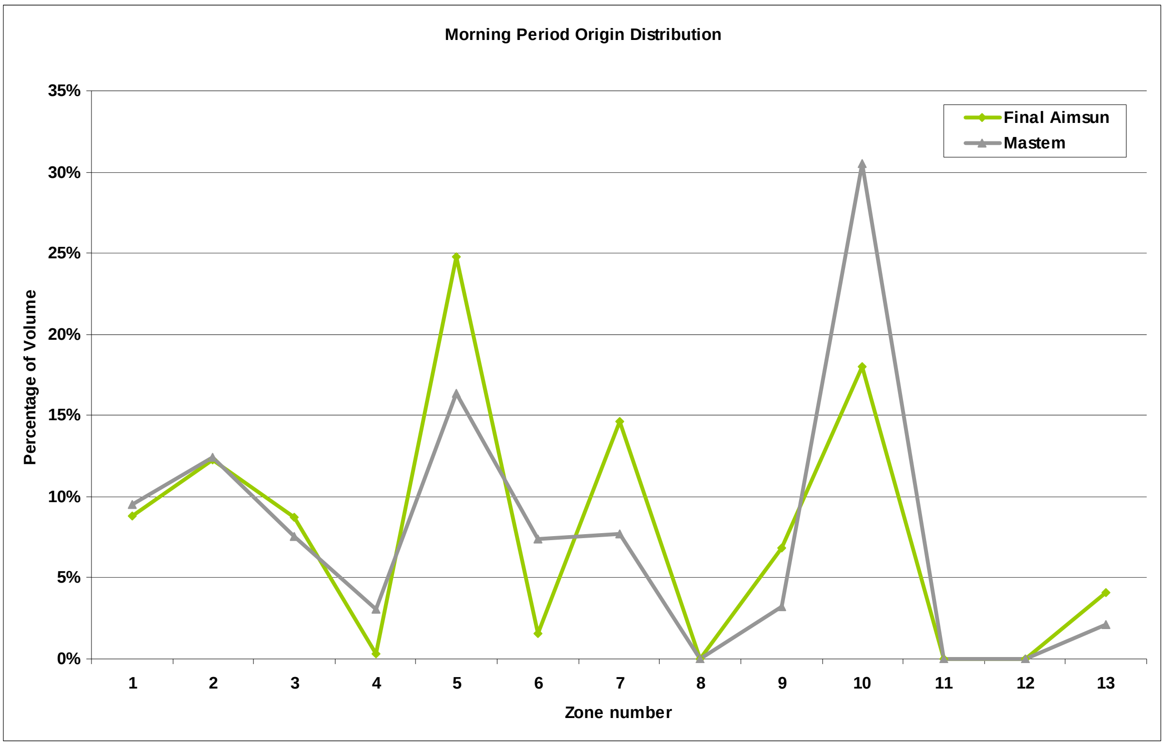

Figure 7 – Morning period origin distribution comparison

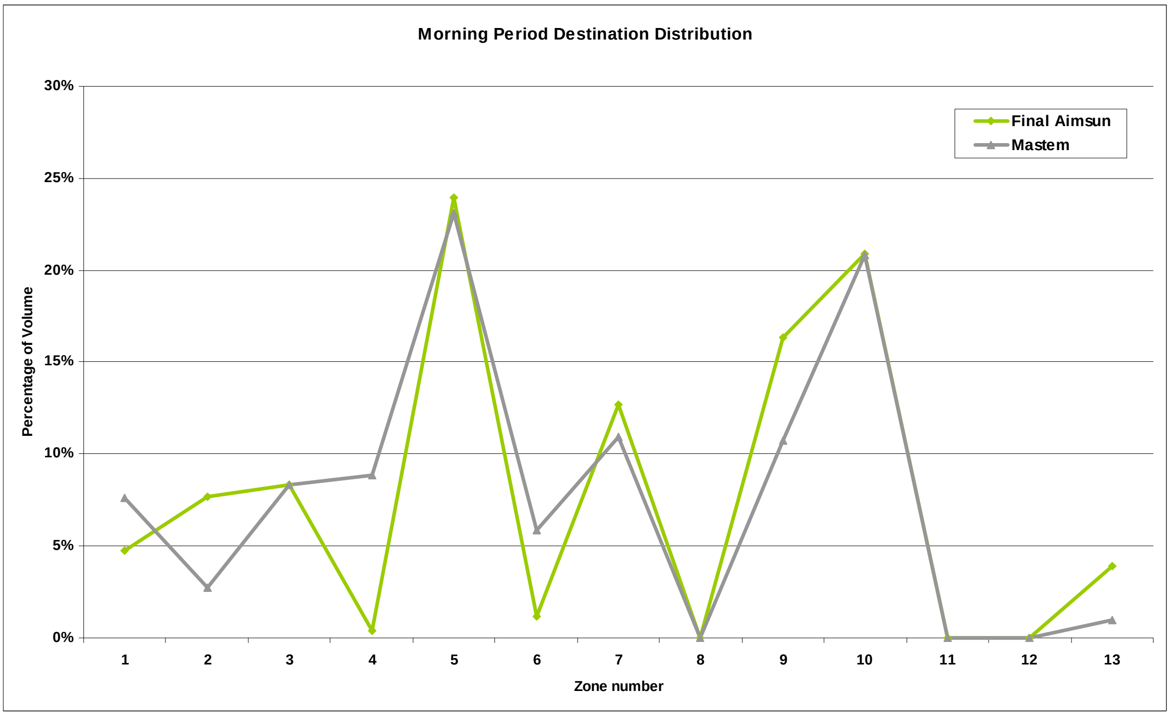

Figure 8 – Morning period destination distribution comparison

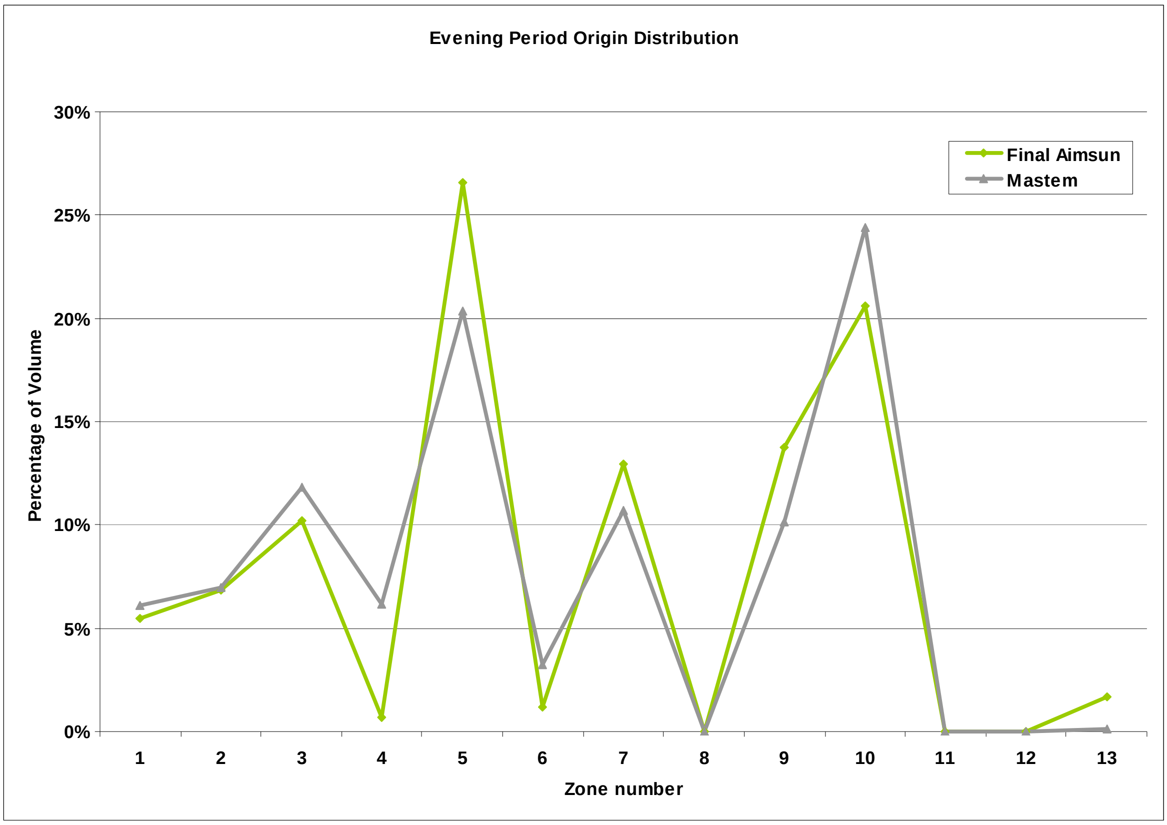

Figure 9 – Evening period origin distribution comparison

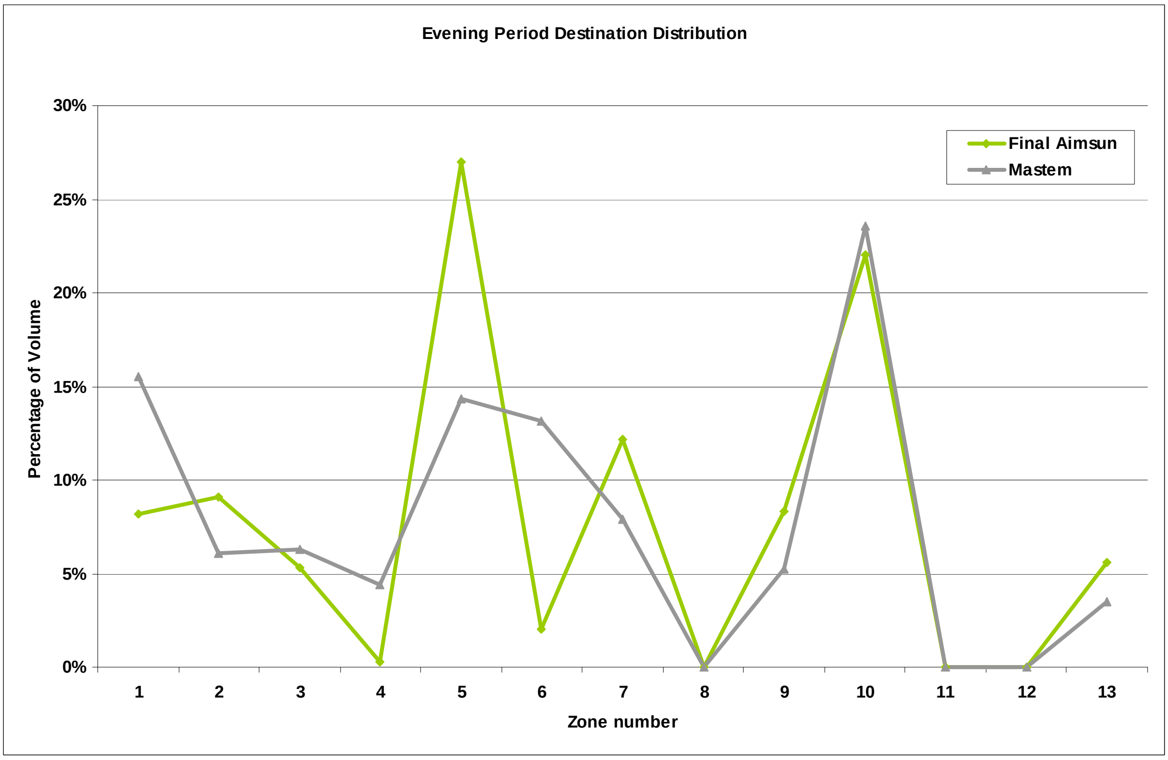

Figure 10 – Evening period destination distribution comparison

5.3 Traffic Demand Profiles

Demand profiles have been applied to dispense traffic demands in defined time intervals over the model periods. Global release profiles have been developed for car and goods vehicles (GV). These profiles were developed based on the May 2011 survey data which was collated in 15 minute intervals.

The demand release profiles, labelled as traffic flow factors, are displayed in Table 2 and Table 1 and are a percentage of the peak hour matrices.

AM	Cars %	GV %
07:00	14.4	16.7
07:15	18.9	22.7
07:30	17.1	24.9
07:45	21.0	23.7
08:00	21.2	26.4
08:15	25.1	24.6
08:30	25.5	19.9
08:45	27.0	23.6
09:00	22.4	32.0
09:15	19.2	35.7

Table 2 - AM demand profiles

PM	Cars %	GV %
15:00	25.4	43.3
15:15	25.6	41.9
15:30	23.3	51.6
15:45	24.3	35.8
16:00	24.6	42.1
16:15	25.2	26.3
16:30	24.6	26.3
16:45	24.3	16.9
17:00	25.9	30.5
17:15	25.5	13.7
17:30	22.3	9.4
17:45	21.3	5.4

Table 3 - PM demand profiles

The split of LGVs, MGVs, and HGVs was been based on survey data and is calculated as 80.3%, 18.2%, and 1.5% respectively, for both periods. LGV vehicles are represented by the “Truck DTEI” vehicle type, MGV by “Truck &Semi DTEI”, and HGV by “B-Double - DTEI”.

5.4 Vehicle Characteristics

The DTEI AIMSUN templates, stated in the DTEI Aimsun Model Development Manual, 28 August 2010, have been used to form vehicle types and kinematics. One deviation from this relates to the addition of two train types that are variations of the DTEI train with the differences solely relating to length.

Name	Mean	Deviation	Min	Max	Units
Length	4.6	0.45	3.35	5.35	meters
Width	1.75	0	1.75	1.75	meters
Max Desired Speed	110	10	80	120	km/h
Max Acceleration	2.7	0.2	2.2	3.5	m/s2
Normal Deceleration	3.5	0.2	3	4	m/s2
Max Deceleration	6	0.5	5	7	m/s2
Speed Acceptance	0.958	0.088	0.75	1.12	
Min Distance Veh	1.85	0.8	0.5	3.2	meters
Give Way Time	15	5	5	30	Secs
Guidance Acceptance	100	0	100	100	%
Sensitivity Factor	1	0	1	1	
Minimum Headway	1.1	0.2	0.5	2	Secs

Table 4 - Vehicle standard file (from Aimsun)

5.5 Public Transport

5.5.1 Bus Routes

All bus routes in operation in the study area have been included in the model. Route and schedule information was obtained from the Adelaide Metro website and is listed in Appendix F.

5.5.2 Bus Stops

In total 28 bus stops have been applied to the model, including 8 at the Salisbury Interchange. This has been replicated using information from site visits and from the aerials within the model.

5.5.3 Bus Stop Dwell Times

Without wide scale surveys bus stop dwell are difficult to ascertain. Given this data was not readily available an estimated bus stop dwell time of 30 seconds was applied within the town centre with 20 seconds dwell time applied to the outer suburbs bus stops. These dwell times include the physical stop time at the bus stop. The bus entry and exit delay is assumed to be reflected in the model.

5.5.4 Trains

Train schedules, stops, and dwell times for the two stops at the Salisbury Station were collected from a combination of the Adelaide Metro website, site visits, and aerials. To supplement this data SCATS outputs from May 5th 2011 was used to determine the freight train movements.

The signalised barrier controlled rail crossing on Park Terrace is replicated in the model by way of an actuated control plan with loops on the tracks. When a scheduled train activates the loops, the signals on Park Terrace (TCS 470) switch to amber, then red, stopping the Park Terrace traffic. As the train leaves the station it activates a second loop which allows the signals on Park Terrace to return to normal operation. The green time of the main phase of TCS 470 is extended to maintain the coordination to those signals at adjacent to the rail crossing, i.e.: those at Salisbury Highway and Wiltshire Street. This was undertaken as it reflects the operation of the signals on street which was determined with through assessment of the LX file for the area.

Queue detection loops also exist on-street on either side of the rail crossing in both directions and operate by changing specific signals at the Gawler Street/ Park Terrace intersection, the Salisbury Highway/ Park Terrace intersection, and the rail crossing to red when a queue is detected to be encroaching towards or from the rail crossing. This stops the queue increasing in length any further so that there is no possibility of any queue overlapping the rail tracks or spilling back through the Gawler Street/ Park Terrace and Salisbury Highway/ Park Terrace intersections. This queue detection function has been replicated in the model by implementing a *traffic management strategy* so that when a queue extends towards the rail crossing or adjacent intersections, traffic is stopped at specific locations, depending on where the queue has been detected. The relationships between the locations of the queue detection and the operation of the signals are given below.

Detected Queue Location	Signal Operation
Eastbound before the rail crossing	Waterloo Corner Rd through movement and Salisbury Highway South right turn movement change to red at the Salisbury Highway/ Waterloo Corner Rd intersection
Eastbound immediately after the rail crossing	Rail crossing eastbound changes to red
Westbound before the rail crossing	Gawler Street approach and Park Terrace westbound through movement change to red at the Park Terrace/ Gawler Street intersection
Westbound immediately after the rail crossing	Rail crossing westbound changes to red

Through sensitivity testing this method also operates satisfactorily with increased traffic volumes as may possibly be the case with future model years.

5.6 Pedestrians

Whilst individual pedestrian movements have not been modelled within the base model, the effect of pedestrian movements on traffic signals and timings has been taken into account. This has been done by firstly including all signalised and zebra pedestrian crossings. Timings for these crossings are either based from the collected signal data or have been approximated from on-site observations.

Secondly, the arrow protected pedestrian movements at signalised intersections cause delay to turning vehicles on-street. These have been replicated in the model by keeping each turning movement red for the first 10 seconds of their particular signal phase.

6. Traffic Assignment Calibration Process

6.1 Stochastic Assignment

Stochastic route choice uses dynamic travel time information, both past and current points of time in the simulation, to determine the routing for each vehicle. Thus, vehicles react to the prevailing traffic conditions, selecting the optimal route prior to loading onto the network and in some cases, dynamically changing this route to a lower cost route if available. The total cost of each route is represented by a travel time value with the routes with the lowest travel times for an OD pair being preferable.

Stochastic route choice is not considered ideal to represent non-recurrent situations (i.e. traffic incidents, unusual rerouting or deviations), as it tends to create the 'optimal' solution with drivers assumed to have perfect knowledge of the network and prevailing conditions. With this, modelled drivers would react to congestion finding other an alternative optimal route based on lowest cost to destination. It is considered that this underestimates the realistic congestion situation as observed in Salisbury, this in general is drivers are aware of congestion levels within peak periods about the Salisbury Town Centre with the majority unlikely to choice an alternative route but rather stick to the main streets.

The initial assignment of traffic through the network utilised the "Fixed using travel times collected under free-flow conditions" routes stochastic assignment tool within Aimsun as previously discussed with 100% of the traffic demand assigned to the network.

Visual observations of the model operating revealed two roads, Bridge Street and Wright Street, were the optimal route for many OD pairs. With the cost to destination influenced by section attractiveness, the default attractiveness values of these two roads, allocated by their capacities, was reduced to enable routing that was more accurate to what was seen on street.

6.2 Dynamic Route Choice

Upon achieving good calibration with the stochastic assignment, the initial path assignment file was collected as an *.apa* file and then loaded with each model run. The percentage of stochastic assignment was then reduced to what is considered to be realistic for a model of this size; this is 50% of traffic through the network follow the stochastic assignment with the remainder being dynamic.

The settings used with the modelling are listed below.

Parameter	Value
Route Choice	
Cycle	0:02:30
Number of Intervals	3
Attractiveness Waiting	3
User Defined Cost Weight	0
Use of O/D Routes and Path Assignment Results	
Car and LGV following O/D Routes	0%
Car and LGV following Path Assignment Results	50%
MGV and HGV following O/D Routes	0%
MGV and HGV following Path Assignment Results	50%
Route Choice Model	
Route Choice Model	C-Logit
Dynamic	Enabled
Initial K-SPs	3
Max Number to Keep	6
Max Number of Paths	3
Parameters	
Scale	24
Beta	0.15
Gamma	1

Table 5 - Traffic Assignment Parameters

7. Model Coding

Through the calibration process adjustments have been made to the modelling parameters to ensure the model replicates the existing observed traffic conditions.

7.1 Behaviour

DTEI default values have been retained.

7.2 Configuration

Global arrivals release style

The release style of uniform has been used.

Simulation Step

The time step value of 0.45 seconds is used in the models.

Mean Reaction Time

The mean reaction time of each driver, in seconds, is associated with the lag in time between a change in speed of the preceding vehicle and the following vehicles reaction to the change. The value of 0.9 seconds is utilised in this model with a reaction time at stop of 1.25 seconds.

7.3 Distance zones

The default node zone distance has been used for most sections; however some have been modified to better replicate the lane changing behaviour on street.

7.4 Road types

In total 5 road types have been used in the model. The road types generally reflect the speed, capacities, and distance zones of the roads within the network.

7.5 Turn speeds

Some turning speeds have been reduced to 20 km/h at priority intersections and left slip lanes as the default turn speeds appeared unrealistic for a give-way movement.

7.6 Version

The model has been developed in version 6.1.3 R9501 of Aimsun. This was the latest current version at the time of model development.

8.1 Calibration/ Validation criteria

Model calibration/ validation is necessary to ensure that a model accurately represents an existing traffic situation and can be used with confidence to test alternatives. Model calibration for this model has been based on the following:

- **Vehicle Behaviour:** Undertaking a visual check to confirm the observed on-street vehicle behaviour is consistent with that observed in the model
- **Turn Counts:** Comparing observed and modelled turning movements for general traffic over the modelled peak hour periods
- **Link Counts:** Comparing observed and modelled link counts for general traffic over the modelled peak hour periods
- **Screenlines:** Comparing observed and modelled total link counts for general traffic across defined boundary lines over the modelled peak hour periods
- **Journey Times:** Comparing observed and modelled journey travel times for general traffic over the modelled peak hour periods
- **Queue Lengths:** Undertaking a visual check to confirm the modelled queue operation is consistent with those observed on site

The sets of criteria, recommended by different sources, have been referenced to assess the acceptability of the level of calibration achieved in the model. These are presented in full in the following table are sourced from the DTEI Aimsun Model Development Manual dated 28 August 2010.

Type	Criterion Source	Criteria and Measures (Observed vs. Modelled)	Calibration Target
Model Stability	Aurecon	The overall network statistics such as mean flow, density, mean speed, mean travel time, mean delay, total travel distance and total travel time.	The coefficient of variation (CoV) within 5%
Turn Counts and Link Flows	UK Dept of Transport	Within 100 vph for flows <700 vph	>85% of cases
		Within 15% for 700 vph < flows < 2700 vph	>85% of cases
		Within 400 vph for flows > 2700 vph	>85% of cases
		Sum of all flows	Within 5%
		GEH statistics <5 for individual flows	>85% of cases
		GEH statistics for sum of all flows	<4
Turn Counts and Link Flows	NZTA EEM	R2 value modelled vs observed values	>0.85
		Percentage RMSE	<30%
Screenlines	NZTA EEM	R2 value modelled vs observed values	>0.85
Journey Time	DMRB	Travel times not greater than 6 minutes, within 1 minute	>85% of cases
		Travel times greater than 6 minutes, within 15%	>85% of cases

Table 6 – Calibration criteria

All data listed in Section 4.1.1 was used to calibrate the model with the addition of historical 2010 data at Salisbury Highway/ Park Terrace and Salisbury Highway/ Commercial Road. Calibration of the model using all data available including all historical data is presented in Appendix D and Appendix E.

Detailed comparisons between observed and modelled calibration statistics are presented in the following sections for the peak hours. Statistics for the full periods, including the shoulders periods, is presented in Appendix A, Appendix B, and Appendix C.

8.2 Model Stability

The coefficient of variation (COV) has been used to assess the variability between each run on the network statistics. The COV is a measure of the variation between model runs. Typically 5% is considered a good level of correlation. The coefficient of variance is calculated by divided the mean by the standard deviation as follows:

$$COV = \frac{SD}{\mu} \times 100$$

Where: SD = Standard Deviation

μ = Mean

Log Run	Average Travel Time (s)	Total Distance (km)	Total Number of Vehicles	Mean Speed (kph)
Mean	121	21,042	18,585	34
Std Dev	1	123	63	0
Min	119	20,893	18,465	34
Max	123	21,239	18,678	34
Range	4	347	213	0
CoV	**0.90%**	**0.59%**	**0.34%**	**0.39%**

Table 7 – Morning period, network statistics (10 runs)

Log Run	Average Travel Time (s)	Total Distance (km)	Total Number of Vehicles	Mean Speed (kph)
Mean	130	28,802	25,685	31
Std Dev	2	176	66	0
Min	127	28,499	25,572	31
Max	131	29,013	25,821	32
Range	4	515	249	1
CoV	**1.27%**	**0.61%**	**0.26%**	**0.90%**

Table 8 – Evening period, network statistics (10 runs)

The general network statistics for both periods predict a CoV of less than 3%. Overall it is considered that the model is stable however it was found that approximately one in every three the model would become blocked by a bus within Aimsun either unable to complete a movement around a small roundabout or unable to exit a bus stop correctly. These blocked runs were removed from the analysis. Average unreleased and lost vehicle numbers for the peak hour periods are given below.

Period	Unreleased vehicles	Vehicles lost
Morning	2	32
Evening	4	11

Table 9 – Unreleased and lost vehicle numbers

8.3 Turn count calibration

The following sections make comparisons between observed and modelled turn counts for each peak hour period, by organising the observed counts into volume ranges. This allows the data to be assessed with more emphasis placed on the higher volume movements. The comparison includes averaged modelled results from all ten runs. Graphical comparisons are also presented for each period.

8.3.1 Morning Peak Hour Turn Count Comparisons

The following table presents the results achieved comparing observed and modelled count data for each individual link with a survey target during the morning peak hour period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	99%	149	150
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	100%	4	4
Sum of All Flows	Within 5%	2%		
GEH < 5 for Individual Flows	>85% of cases	82%		
GEH for Sum of All Flows	GEH<4	2.8		
R2 value for modelled versus observed flows	>0.85	0.9736		
% RMSE	<30%	25%		

Table 10 - Morning peak hour observed versus modelled turn counts

The number of individual turning movements with GEH values less than 5 is below the 85% criteria at 82% however all of these turning movements with a GEH greater than 5 are counts that are less than 700 vph. Also the table illustrates that virtually all of the modelled turning counts are within 15% or 100 vph of the observed volume at 99%.

The following graph presents a plot of observed counts against modelled counts for the morning peak period.

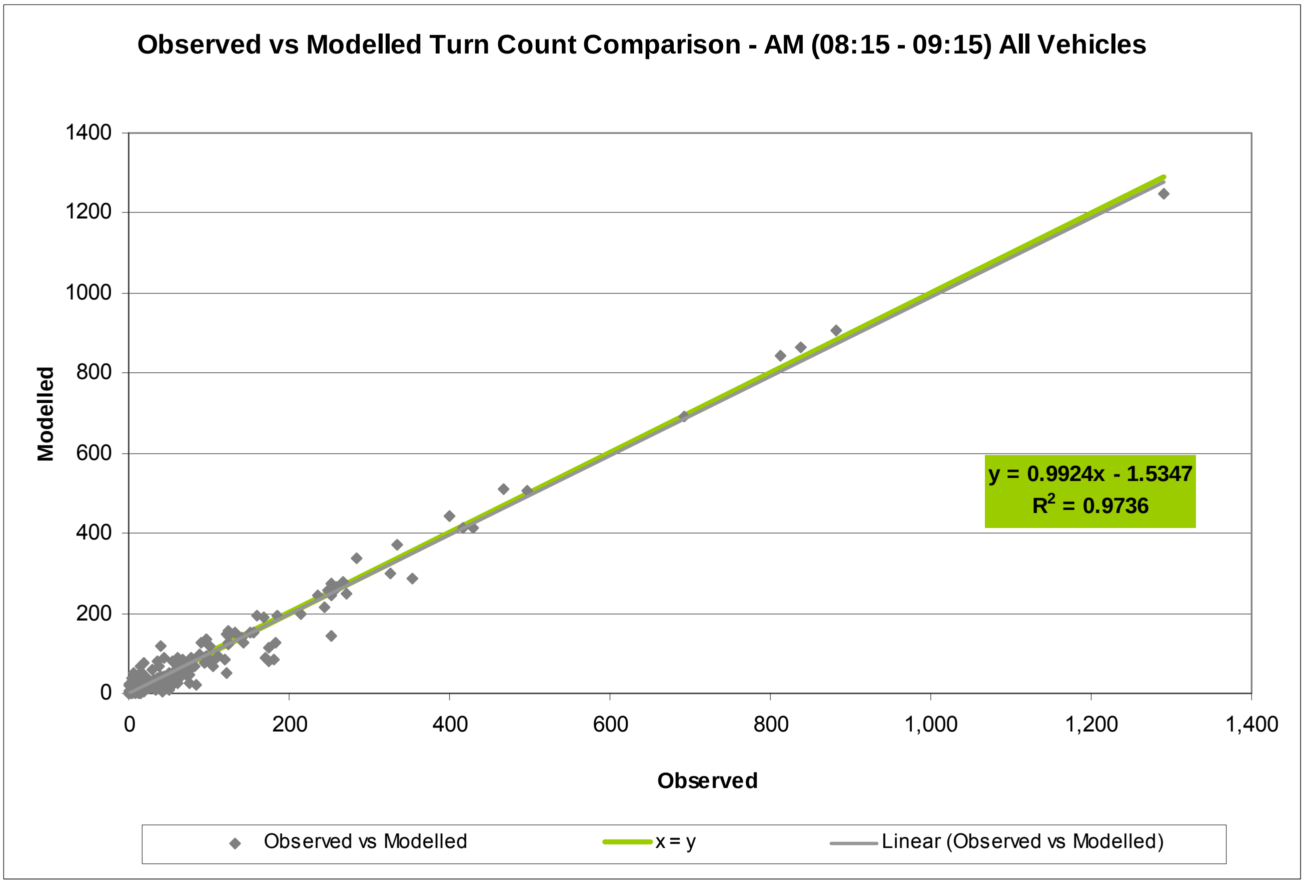

Figure 11 – Morning peak hour observed versus modelled turn counts

The graph illustrates a strong correlation between observed and modelled counts, reinforced by the R^2 value of 0.9736.

8.3.2 Evening Peak Hour Turn Count Comparisons

The following table presents the results achieved comparing observed and modelled count data for each individual turn with a survey target during the Evening peak hour period. The turns have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	97%	146	150
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	100%	4	4
Sum of All Flows	Within 5%	1%		
GEH < 5 for Individual Flows	>85% of cases	82%		
GEH for Sum of All Flows	GEH<4	1.1		
R2 value for modelled versus observed flows	>0.85	0.9731		
% RMSE	<30%	26%		

Table 11 – Evening peak hour observed versus modelled turn counts

The number of individual turning movements with GEH values less than 5 is below the 85% criteria at 82% however, as with the morning period, all of these turning movements with a GEH greater than 5 are counts that are less than 700 vph. Also the table illustrates that virtually all of the modelled turning counts are within 15% or 100 vph of the observed volume at 97%.

The following graph shows a plot of observed counts against modelled counts for the evening peak hour period.

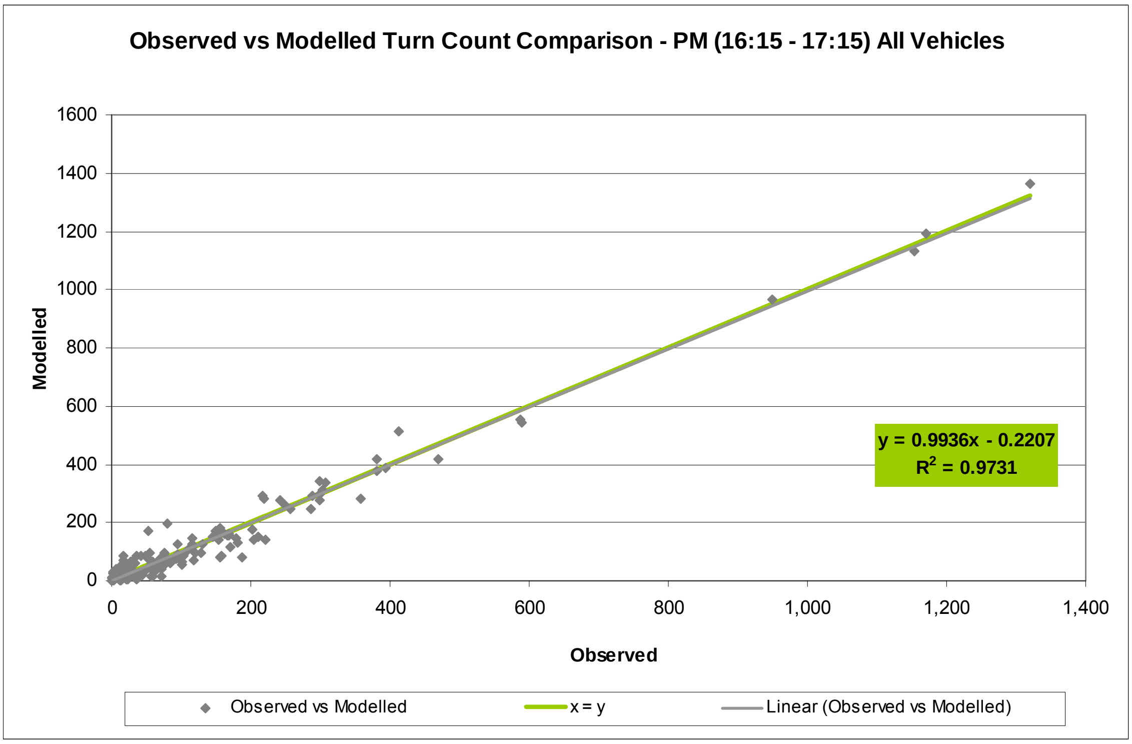

Figure 12 – Evening peak hour observed versus modelled turn counts

The graph illustrates a strong correlation between observed and modelled counts, reinforced by the R^2 value of 0.9731.

8.4 Link Count Calibration

Link counts have been compared based on approach and exit link flows at intersections. That is, the link counts are comprised from the same set of data used for turn count comparisons.

The following sections compare the observed and modelled link counts for each peak hour period, by organising the observed counts into volume ranges. This allows the data to be assessed with more emphasis placed on the higher volume movements. The comparison includes averaged modelled results from all ten runs. Graphical comparisons are also presented for each period.

The link count calibration for the full three hour periods is shown in Appendix B.

8.4.1 Morning Peak Hour Link Count Comparisons

The following table presents the results achieved from comparing observed and modelled count data for each individual link with a survey target during the Morning peak hour period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	93%	80	86
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	100%	15	15
Sum of All Flows	Within 5%	2%		
GEH < 5 for Individual Flows	>85% of cases	85%		
GEH for Sum of All Flows	GEH<4	3.7		
R2 value for modelled versus observed flows	>0.85	0.9853		
% RMSE	<30%	14%		

Table 12 – Morning peak hour observed versus modelled link counts

The table illustrates that the majority of the modelled link counts are within 15% or 100 vph of the observed volume and all other criteria has been met.

The following graph presents a plot of observed counts against modelled counts for the morning peak period.

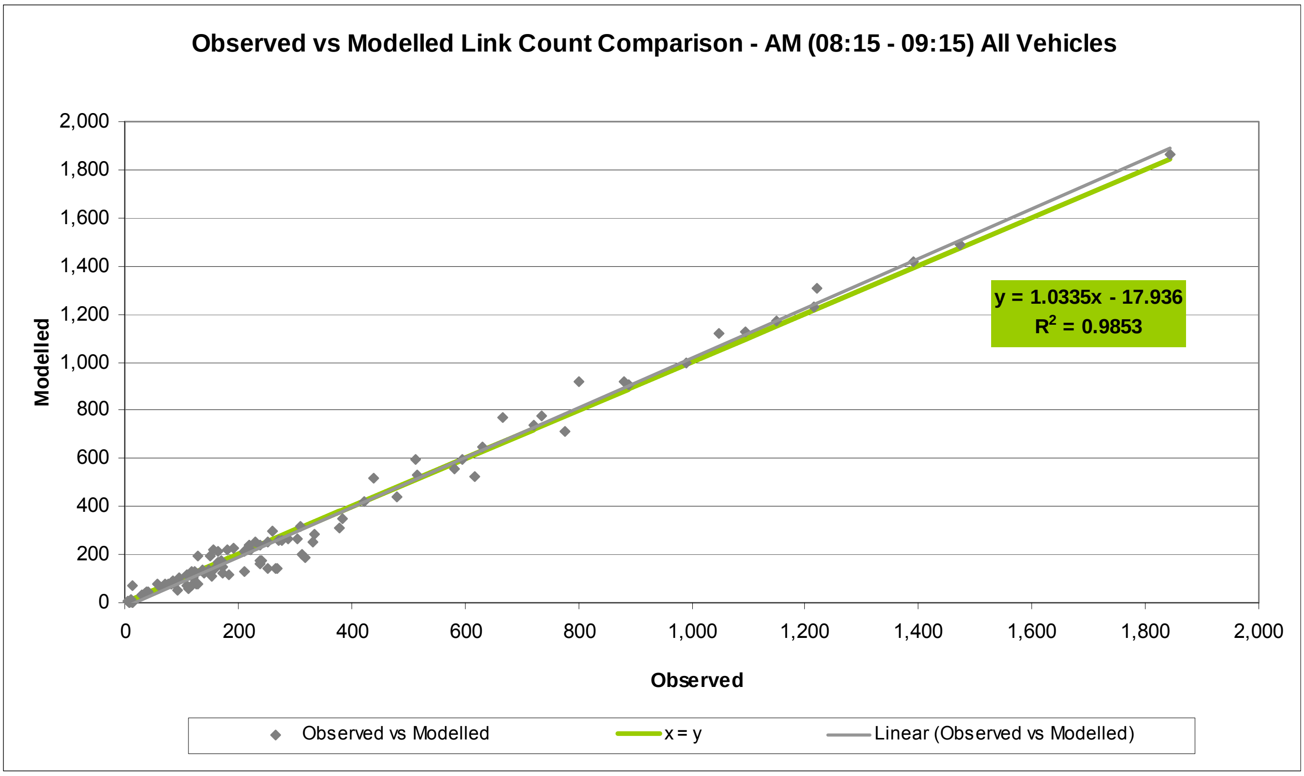

Figure 13 – Morning peak hour observed versus modelled link counts

The graph illustrates a good correlation between observed and modelled counts, reinforced by the R^2 value of 0.9853.

8.4.2 Evening Peak Hour Link Count Comparisons

The following table presents the results achieved comparing the observed and modelled count data for each individual link with a survey target during the Evening peak hour period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	94%	82	87
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	93%	13	14
Sum of All Flows	Within 5%	1%		
GEH < 5 for Individual Flows	>85% of cases	88%		
GEH for Sum of All Flows	GEH<4	1.8		
R2 value for modelled versus observed flows	>0.85	0.9868		
% RMSE	<30%	13%		

Table 13 – Evening Peak Hour Observed Versus Modelled Link Counts

The table illustrates that the majority of the modelled link counts are within 15% or 100 vph of the observed volume. It also shows that the sum of all links is within acceptable limits as is the GEH limits.

The following graph shows a plot of observed counts against modelled counts for the Evening peak period.

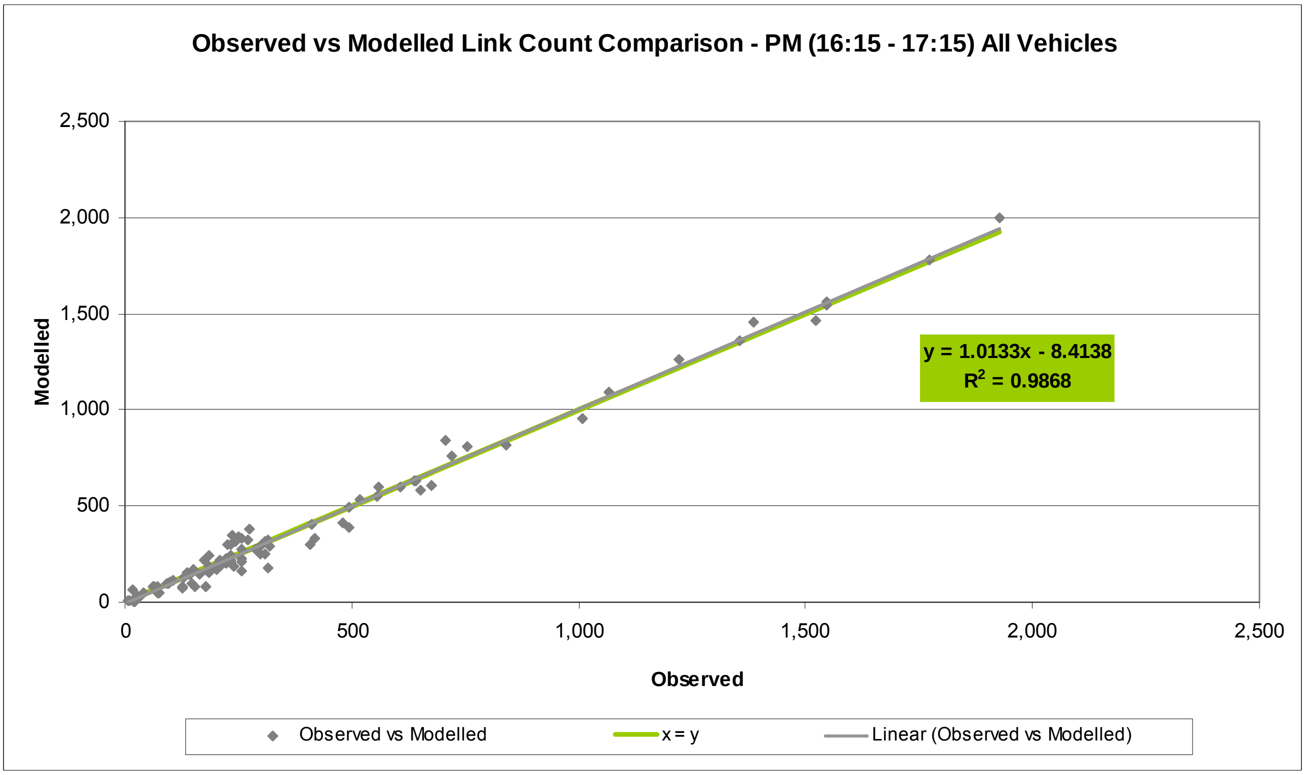

Figure 14 – Evening peak hour observed versus modelled link counts

The graph illustrates a strong correlation between observed and modelled counts, reinforced by the R^2 value of 0.9868.

8.5 Screenline Calibration

Screenline locations for the calibration process have been undertaken at the following locations. For the purpose of the screenline evaluations, the historical data at the intersection of Fenden Road and Park Terrace has been used.

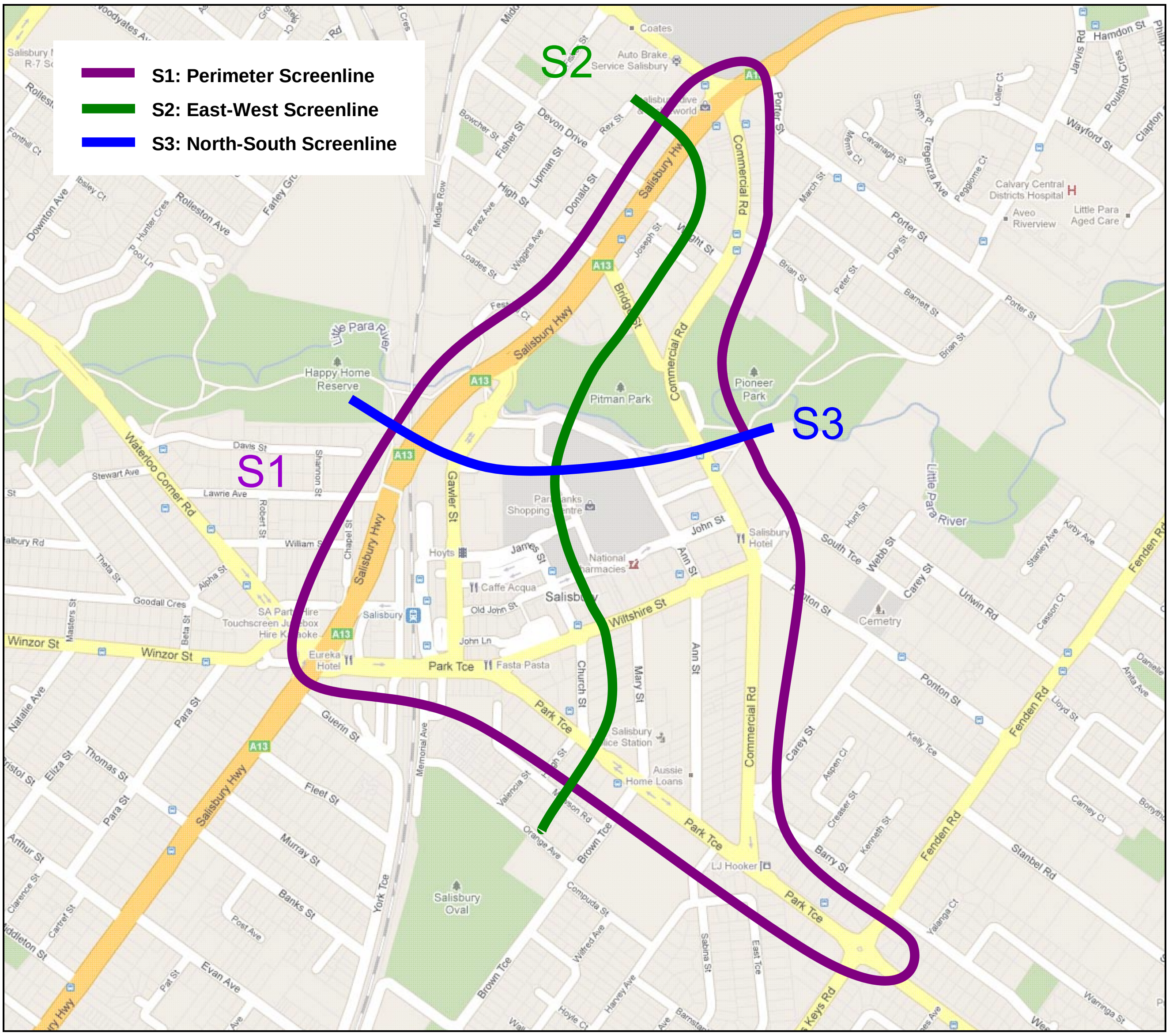

Figure 15 – Screenline locations

Comparison of the observed and modelled screenline totals are shown below in Table 14 for the morning peak hour. According to the DTEI Aimsun Model Development Manual the criteria for screenlines is an R2 value greater than 0.85 must be obtained.

Screenline	Observed	Modelled	Diff	% Diff	GEH
S1 Perimeter Inbound	7,859	7,977	118	1.5%	1.3
S1 Perimeter Outbound	6,409	6,630	221	3.4%	2.7
S2 East-West Eastbound	2,231	2,271	40	1.8%	0.8
S2 East-West Westbound	2,229	2,281	52	2.3%	1.1
S3 North-South Northbound	2,369	2,333	-36	-1.5%	0.7
S3 North-South Southbound	2,049	1,968	-81	-3.9%	1.8
Sum of all screenlines	**23,146**	**23,460**	**314**	**1.4%**	**2.1**
R2 value	**0.9951**				

Table 14 – Morning peak hour screenline comparisons

All screenlines for the morning period have a % difference less than 5% and all GEH values less than 3. Also the R2 value is greater than 0.85 and meets the set criteria.

Comparison of the observed and modelled screenline totals are shown below in Table 15 for the evening peak hour.

Screenline	Observed	Modelled	Diff	% Diff	GEH
S1 Perimeter Inbound	7,360	7,464	104	1.4%	1.2
S1 Perimeter Outbound	8,006	8,048	42	0.5%	0.5
S2 East-West Eastbound	2,502	2,596	94	3.8%	1.9
S2 East-West Westbound	2,380	2,342	-38	-1.6%	0.8
S3 North-South Northbound	2,384	2,223	-161	-6.8%	3.4
S3 North-South Southbound	2,663	2,421	-242	-9.1%	4.8
Sum of all screenlines	**25,295**	**25,093**	**-202**	**-0.8%**	**1.3**
R2 value	**0.9925**				

Table 15 – Evening peak hour screenline comparisons

All screenlines for the evening period have a percentage difference less than 10% and the R2 value is greater than 0.85 so meets the set criteria.

8.6 Journey Time Calibration

Journey time comparisons have been undertaken for the entire peak modelled hours for the routes described earlier in this report in Section 4.1.4. The comparison includes the average of the average model results from all ten runs.

It is also worth noting that the modelled journey times comprise of numerous vehicle runs over the period specified however the observed journey times comprise of a few runs undertaken sometime during this period. This should be taken into consideration when reviewing the results below.

The specified criteria state the journey times should be 1 minute if less than 6 minutes in travel, otherwise within 15%. Refer Figure 5 for route details.

8.6.1 Morning Peak Hour Travel Time Comparisons

The observed and modelled journey times in minutes are presented in the following table with difference and percentages for the AM peak hour period.

Route Name	Observed			Modelled	Diff	% Diff
	Minimum	Average	Maximum	Average		
R1 – Salisbury Highway Northbound	2:48	3:00	3:09	2:12	-0:48	-26%
R1 – Salisbury Highway Southbound	2:20	2:24	2:31	1:58	-0:26	-18%
R2 – Park Terrace Eastbound	1:57	2:10	2:34	2:20	0:10	8%
R2 – Park Terrace Westbound	3:45	4:06	4:17	3:22	-0:44	-18%
R3 – Commercial Road Northbound	2:08	3:29	4:52	3:52	0:24	11%
R3 – Commercial Road Southbound	2:15	2:25	2:32	2:23	-0:02	-1%
R4 – Gawler Street Northbound	1:09	1:17	1:26	2:25	1:08	88%
R4 – Gawler Street Southbound	2:00	2:18	2:52	2:08	-0:10	-7%

Table 16 – Morning peak hour journey time comparison

The table illustrates a good correlation between observed and modelled journey times with all routes having a difference that is less than 1 minute with the exception of R4 - Gawler Street Northbound which shows a 1:08 minutes difference when compared to observed data. This is considered to be a reflection of the queuing on Gawler Street at Salisbury Highway where the model over predicts this when compared to on-street observations.

8.6.2 Evening Hour Travel Time Comparisons

The observed and modelled journey times in minutes are presented in the following table with difference and percentages for the PM peak hour period.

Route Name	Observed			Modelled	Diff	% Diff
	Minimum	Average	Maximum	Average		
R1 – Salisbury Highway Northbound	2:25	2:49	3:13	2:39	-0:10	-6%
R1 – Salisbury Highway Southbound	-	2:20	-	1:59	-0:21	-15%
R2 – Park Terrace Eastbound	1:59	2:01	2:02	2:01	0:00	0%
R2 – Park Terrace Westbound	3:10	3:26	3:42	3:28	0:02	1%
R3 – Commercial Road Northbound	-	3:26	-	3:21	-0:05	-2%
R3 – Commercial Road Southbound	2:21	2:41	3:01	2:14	-0:27	-17%
R4 – Gawler Street Northbound	-	1:20	-	2:35	1:15	94%
R4 – Gawler Street Southbound	-	2:20	-	2:54	0:34	25%

Table 17 – Evening peak hour journey time comparison

The majority of the modelled evening journey time routes are within the 15% or 1 minute criteria when compared against observed data. As was noted with the morning period, R4 - Gawler Street Northbound is showing a journey time greater than 1 minute when comparing modelled and observed. This is reflective of larger than observed queues on Gawler Street Northbound. It is noted that the observed data only consists of one journey time observation during the peak.

8.7 Queue Length Calibration

Queues were observed visually within Aimsun over numerous model runs. In addition, comparisons have been made between observed and modelled queue length data.

Queuing is an inherently unstable phenomenon which can vary greatly from day to day. Queue measurements can be very subjective as the definition of what vehicles count as “queued” can differ between observers and between modelling packages.

Not withstanding the issues relating to queue variability, queue comparisons are still valuable and have been made between observed and modelled queue length data to ensure queue patterns are appropriately represented in the model.

Queuing was observed on-street in both peak periods on Park Terrace eastbound and westbound between Salisbury Highway and Wiltshire Street. This is predominantly due to the operation of the rail crossing barrier and the effect on the rail crossing traffic signals. The traffic queues on Park Terrace are considered to be replicated in the model to a suitable level. In addition, queues were observed to form on the south approach to the Salisbury Highway / Park terrace intersection in the evening; this is reflected in the model.

As pointed out with the journey time comparison, the area at the northern end of Gawler Street with its intersection with Salisbury Highway exhibits increased delay in the model when compared to observations. In addition queuing in the evening period on the western approach to the John Street/ Commercial Road intersection in the model is greater than observed. It is thought that these areas of unexpected modelled queuing are caused by the lack of micro-routing in the model in those areas. The routing factors such as the

Attractiveness Weight have been adjusted to reflect the global routing replicating model wide routing however the queue build-up at these intersection is a result of the inability of traffic to react to queues on a very micro level. To adjust this, global routing would require altering which would be at the expense of the wider model. It was considered that this queuing was acceptable, but would be noted with any option testing undertaken.

8.8 Calibration Results Summary

The calibration summary below, recommended by different sources, has been referenced to assess the acceptability of the level of calibration achieved in the model. Queue calibration has also been undertaken, however this is not referenced in the criteria. However, in summary the comparisons showed observed queues are appropriately replicated by Aimsun and are representative of actual vehicle operation during each peak hour period.

Type	Criteria and Measures (Observed vs Modelled)	Calibration Target	AM	PM
Model Stability	The overall network statistics such as mean flow, density, mean speed, mean travel time, mean delay, total travel distance and total travel time.	The coefficient of variation (CoV) within 5%	0.90%	1.27%
Turn Counts	Within 100 vph for flows <700 vph	>85% of cases	99%	97%
	Within 15% for 700 vph < flows < 2700 vph	>85% of cases	100%	100%
	Sum of all flows	Within 5%	2%	1%
	GEH statistics <5 for individual flows	>85% of cases	82%	82%
	GEH statistics for sum of all flows	<4	2.8	1.1
	R2 value modelled vs observed values	>0.85	0.97	0.97
	Percentage RMSE	<30%	25%	26%
Link Flows	Within 100 vph for flows <700 vph	>85% of cases	100%	93%
	Within 15% for 700 vph < flows < 2700 vph	>85% of cases	93%	94%
	Sum of all link/ movement flows	Within 5%	2%	1%
	GEH statistics <5 for individual flows	>85% of cases	85%	88%
	GEH statistics for sum of all flows	<4	3.7	1.8
	R2 value modelled vs observed values	>0.85	0.98	0.98
	Percentage RMSE	<30%	14%	13%
Screenlines	R2 value modelled vs observed values	>0.85	0.99	0.99
Journey Time	Travel times not greater than 6 minutes, within 1 minute	>85% of cases	88%	88%

Table 18 – Calibration Summary

The above table demonstrates the model adheres to the calibration/ validation criteria. The exceptions to this are the individual turn count GEH values less than 5 is not greater than 85% of case for both periods. This is considered acceptable given at least 97% of turn counts are within 15% or 100vph and in addition the link counts are shown to meet the criteria. Also all turning movements with values above 700 vph have GEH values less than 5 for both periods.

9. Summary and Conclusions

A traffic model for the Salisbury Town Centre has been developed using Aimsun simulation software version 6.1.3 to model a 2011 base year.

Statistical analysis demonstrates that the modelled network and output results are stable.

Comparisons have been made between the following modelled and observed measures:

- Turn count
- Link counts
- Screenlines
- Journey Times
- Queue lengths

Comparisons illustrate existing traffic conditions have been represented by the models for the both peak hours. Any deficiencies in all periods are noted and will be taken into consideration with any option testing undertaken.

It is considered that the Aimsun Salisbury Town Centre base models can be used for traffic analysis constrained to the study area.

Appendix A
Full Peak Period Turn Count Calibration Results

Appendix A – Turn Count Calibration

The following sections make comparisons between observed and modelled turn counts for each full two and a half and three hour period incorporating the shoulder periods. The comparison includes averaged modelled results from all ten runs. Graphical comparisons are also presented for each period.

Morning Peak Period Turn Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count for each individual link with a survey target during the morning peak period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 veh, for Flows <700 veh	>85% of cases	89%	127	142
Within 15%, for 700 veh< Flows <2700 veh	>85% of cases	55%	6	11
Within 400 veh, Flows >2700 veh	>85% of cases	100%	1	1
Sum of All Flows	Within 5%	3%		
R2 value for modelled versus observed flows	>0.85	0.9674		
% RMSE	<30%	33%		

Table 19 - Morning two and a half hour observed versus modelled turn counts

The following graph presents a plot of observed counts against modelled counts for the morning peak period.

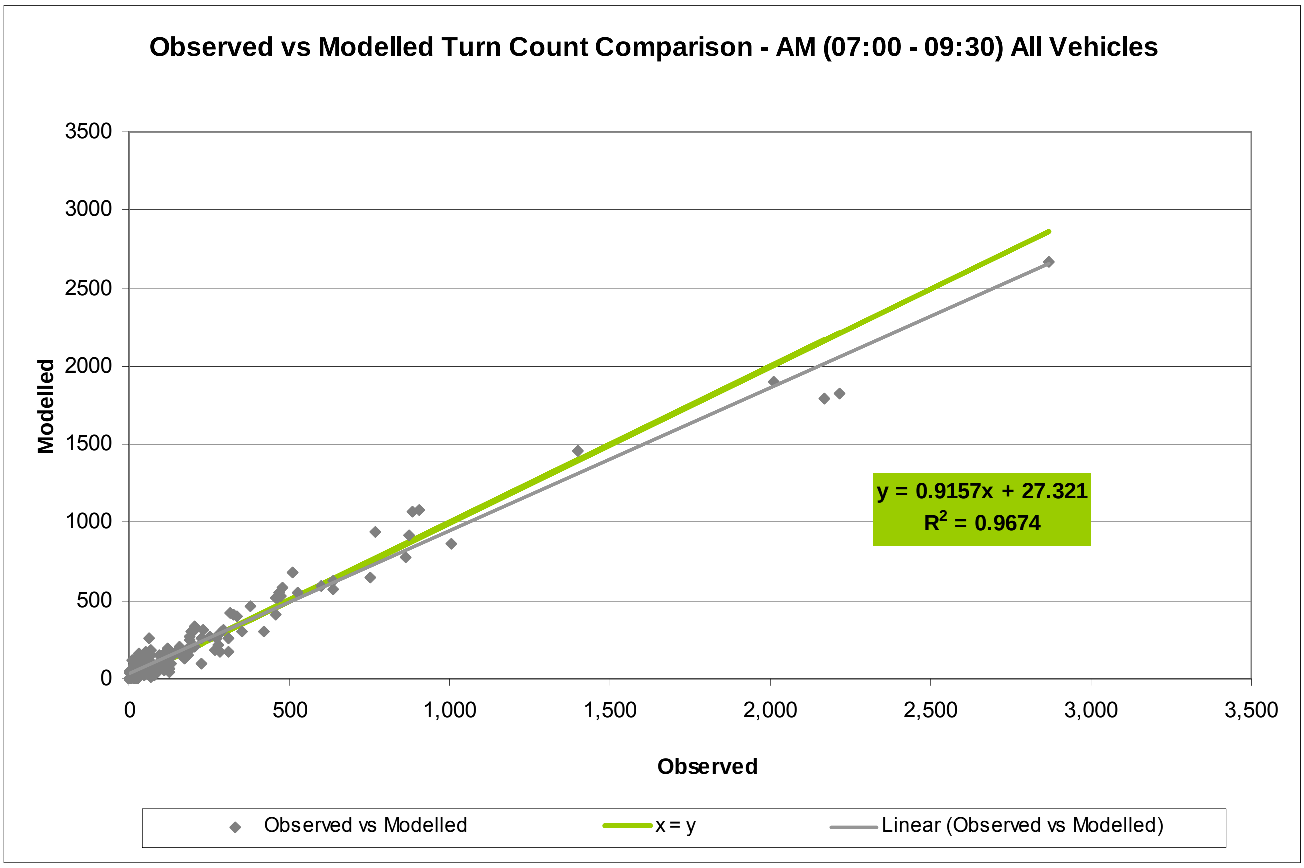

Figure 16 – Morning two and a half hour observed versus modelled turn counts

Evening Peak Period Turn Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count for each individual turn with a survey target during the evening peak period. The turns have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 veh, for Flows <700 veh	>85% of cases	73%	97	132
Within 15%, for 700 veh< Flows <2700 veh	>85% of cases	83%	15	18
Within 400 veh, Flows >2700 veh	>85% of cases	100%	4	4
Sum of All Flows	Within 5%	2%		
R2 value for modelled versus observed flows	>0.85	0.9687		
% RMSE	<30%	28%		

Table 20 – Evening three hour observed versus modelled turn counts

The following graph shows a plot of observed counts against modelled counts for the evening peak hour period.

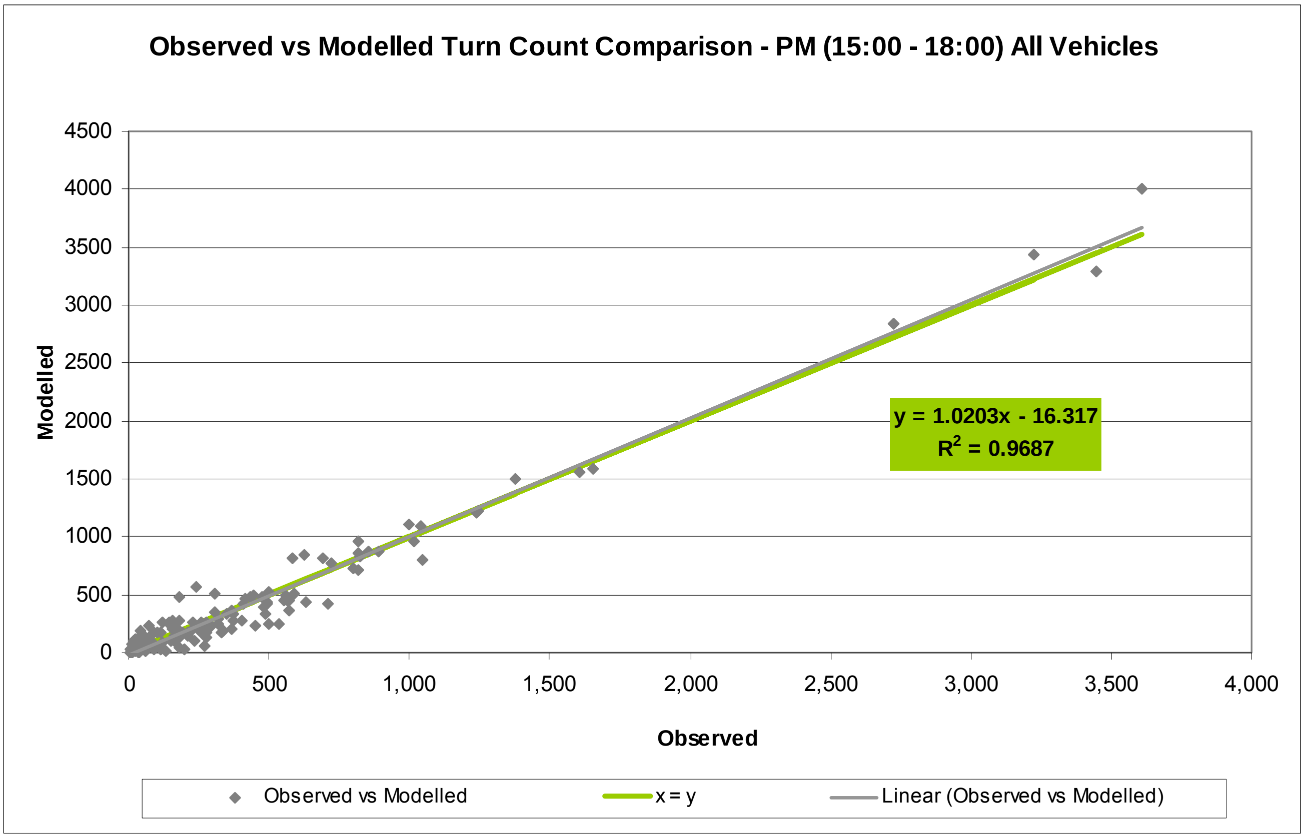

Figure 17 – Evening three hour observed versus modelled turn counts

Appendix B
Full Peak Period Link Count Calibration Results

Appendix B – Link Count Calibration

Link counts have been compared based on approach and exit link flows at intersections. That is, the link counts are comprised from the same set of data used for turn count comparisons.

The following sections compare the observed and modelled link counts for each three hour period, incorporating the shoulder periods. The comparison includes averaged modelled results from all ten runs. Graphical comparisons are also presented for each period.

Morning Full Peak Period Link Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count data for each individual link with a survey target during the morning peak period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 veh, for Flows <700 veh	>85% of cases	76%	56	74
Within 15%, for 700 veh< Flows <2700 veh	>85% of cases	74%	14	19
Within 400 veh, Flows >2700 veh	>85% of cases	100%	6	6
Sum of All Flows	Within 5%	3%		
R2 value for modelled versus observed flows	>0.85	0.9762		
% RMSE	<30%	19%		

Table 21 – Morning two and a half hour observed versus modelled link counts

The following graph shows a plot of observed counts against modelled counts for the morning peak period.

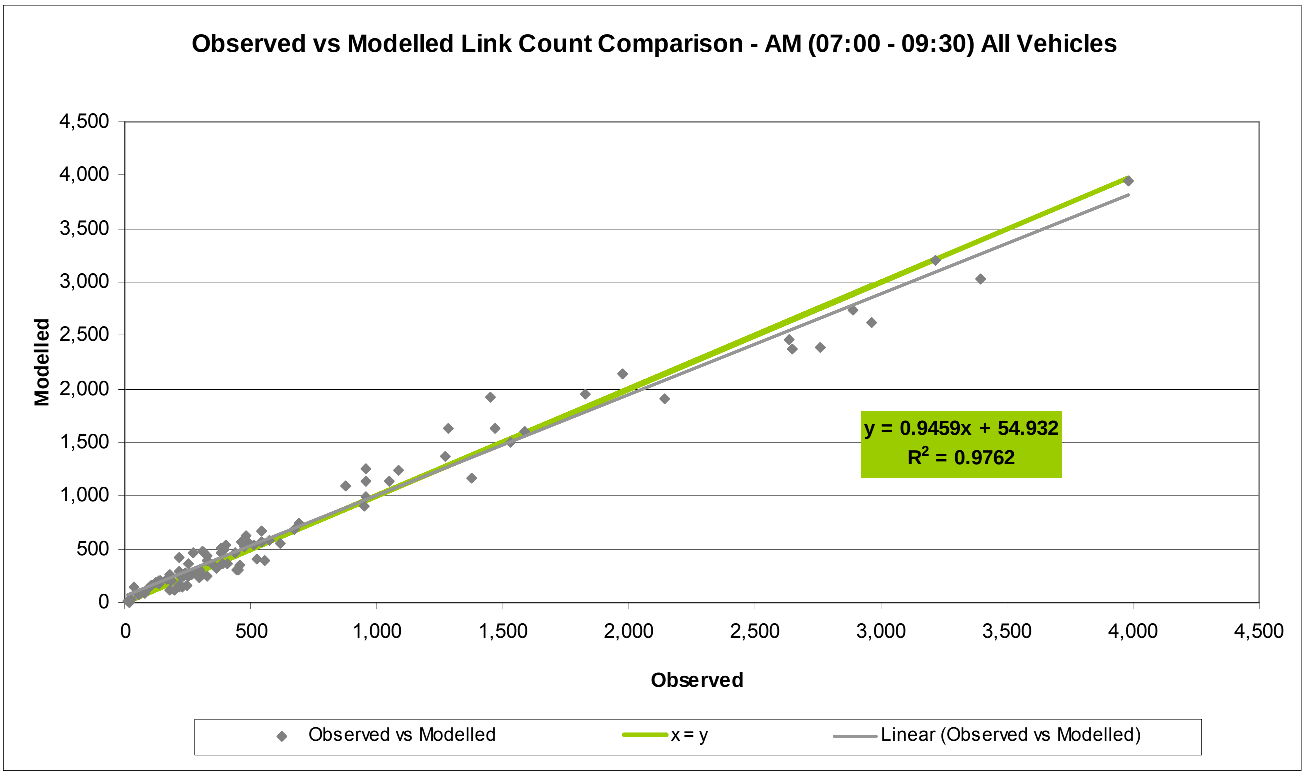

Figure 18 – Morning two and a half hour observed versus modelled link counts

Evening Full Peak Period Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count data for each individual link with a survey target during the evening peak period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 veh, for Flows <700 veh	>85% of cases	71%	35	49
Within 15%, for 700 veh< Flows <2700 veh	>85% of cases	63%	25	40
Within 400, Flows >2700 veh	>85% of cases	100%	10	10
Sum of All Flows	Within 5%	2%		
R2 value for modelled versus observed flows	>0.85	0.9860		
% RMSE	<30%	13%		

Table 22 – Evening three hour observed versus modelled link counts

The following graph shows a plot of observed counts against modelled counts for the evening peak period.

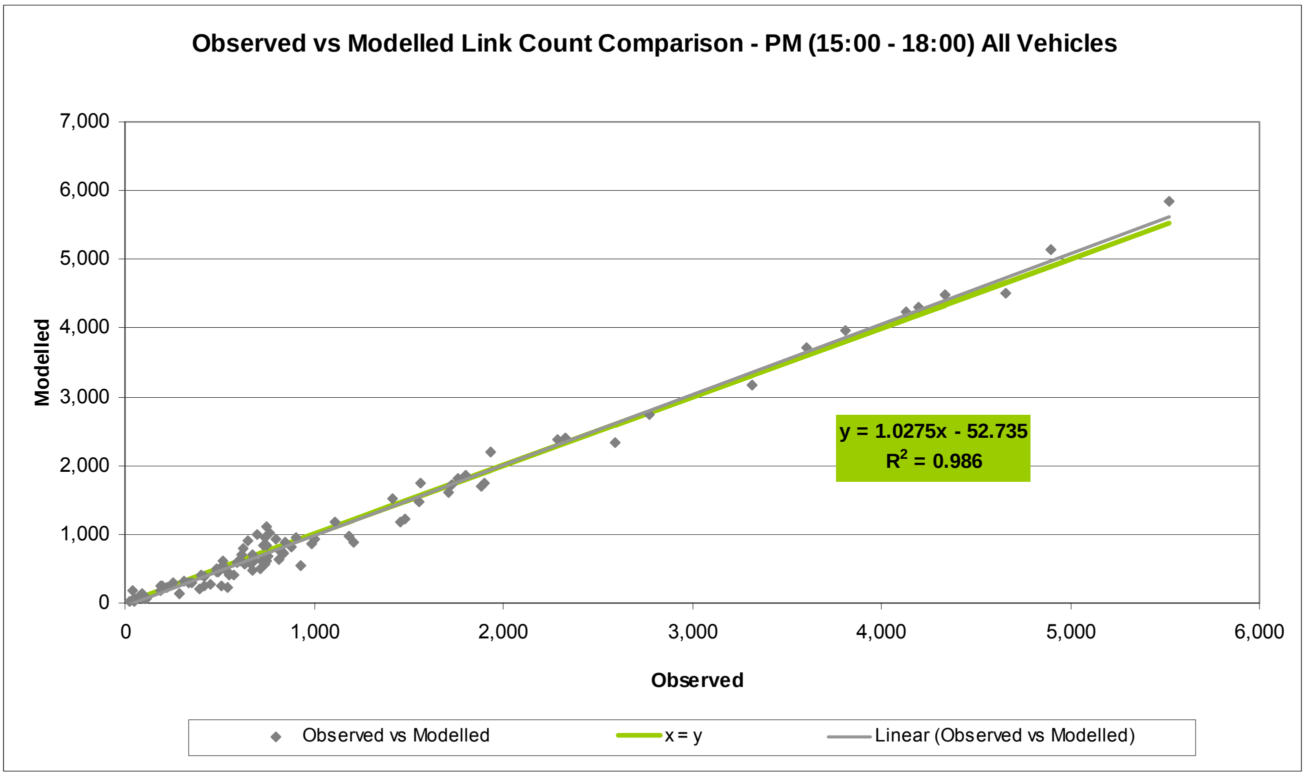

Figure 19 – Evening three hour observed versus modelled link counts

Appendix C
Full Peak Period Screenline Calibration Results

Appendix C – Screenline Calibration

Below are the screenline comparisons for the full peak periods incorporating the shoulder periods.

Screenline	Observed	Modelled	Diff	% Diff
S1 Perimeter Inbound	16,526	16,957	431	2.6%
S1 Perimeter Outbound	14,157	14,025	-132	-0.9%
S2 East-West Eastbound	4,714	4,795	81	1.7%
S2 East-West Westbound	4,941	4,858	-84	-1.7%
S3 North-South Northbound	5,173	4,976	-198	-3.8%
S3 North-South Southbound	4,500	4,181	-320	-7.1%
Sum of all screenlines	**50,011**	**49,790**	**-221**	**-0.4%**
R2 value	**0.9951**			

Table 23 – Morning two and a half hour period screenline comparisons

Screenline	Observed	Modelled	Diff	% Diff
S1 Perimeter Inbound	21,882	21,731	-151	-0.7%
S1 Perimeter Outbound	23,211	23,285	74	0.3%
S2 East-West Eastbound	7,450	7,528	-78	-1.0%
S2 East-West Westbound	6,917	6,804	-114	-1.6%
S3 North-South Northbound	6,860	6,486	-374	-5.5%
S3 North-South Southbound	7,545	6,999	-546	-7.2%
Sum of all screenlines	**73,865**	**72,832**	**-1,033**	**-1.4%**
R2 value	**0.9907**			

Table 24 – Evening three hour period screenline comparisons

Appendix D
All Data Peak Hour Turn Count Calibration Results

Appendix D – Turn Count Calibration

The following sections make comparisons between all the observed data including historical and modelled turn counts for the peak hour periods, by organising the observed counts into volume ranges. This allows the data to be assessed with more emphasis placed on the higher volume movements. The comparison includes averaged modelled results from all ten runs. Graphical comparisons are also presented for each period.

Morning Peak Hour Turn Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count for each individual link with a survey target during the morning peak hour period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	99%	179	181
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	100%	6	6
Sum of All Flows	Within 5%	0%		
GEH < 5 for Individual Flows	>85% of cases	83%		
GEH for Sum of All Flows	GEH<4	0.7		
R2 value for modelled versus observed flows	>0.85	0.9770		
% RMSE	<30%	23%		

Table 25 - Morning peak hour observed versus modelled turn counts

The following graph presents a plot of observed counts against modelled counts for the morning peak period.

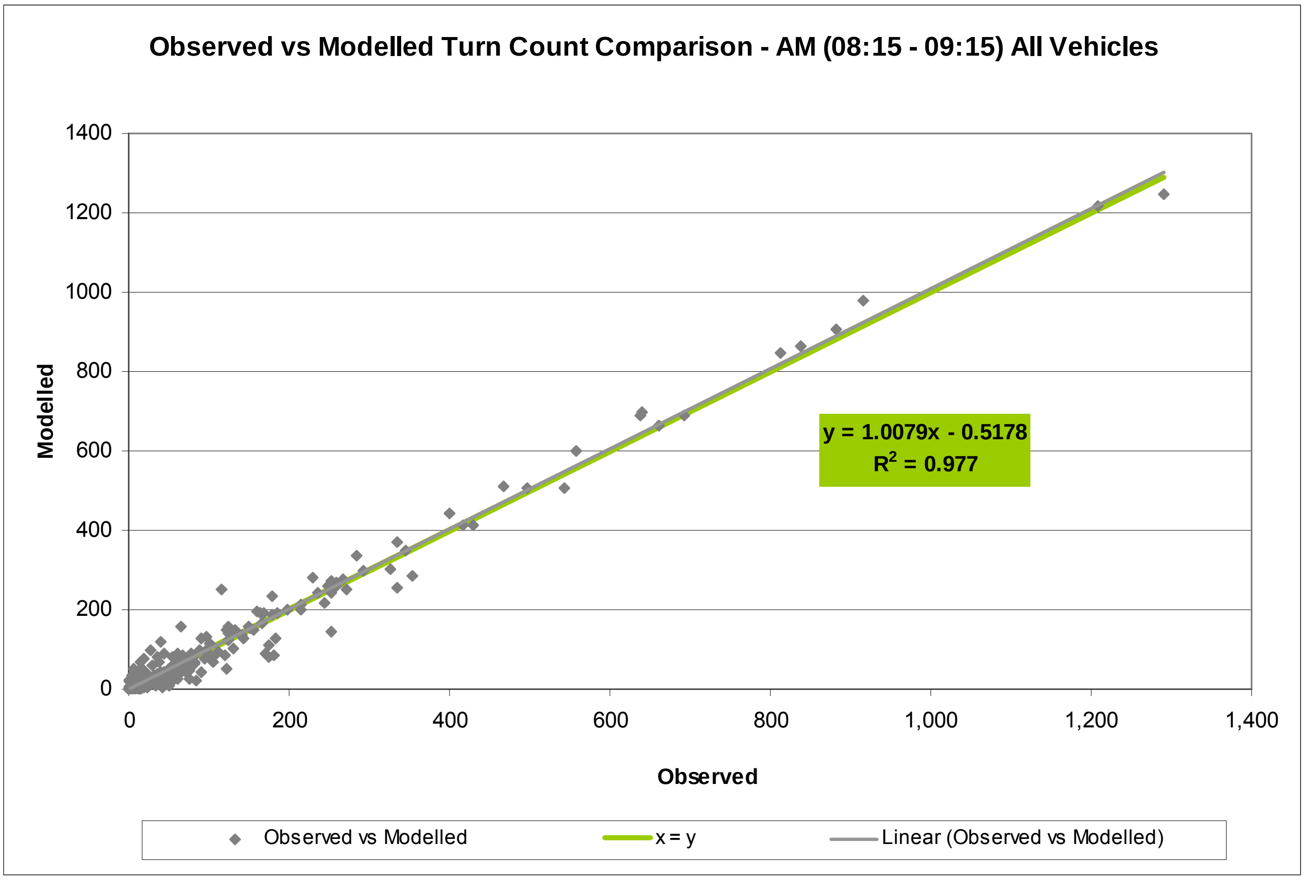

Figure 20 – Morning peak hour observed versus modelled turn counts

Evening Peak Hour Turn Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count for each individual turn with a survey target during the Evening peak hour period. The turns have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	96%	173	180
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	100%	7	7
Sum of All Flows	Within 5%	1%		
GEH < 5 for Individual Flows	>85% of cases	83%		
GEH for Sum of All Flows	GEH<4	1.2		
R2 value for modelled versus observed flows	>0.85	0.9743		
% RMSE	<30%	24%		

Table 26 – Evening peak hour observed versus modelled turn counts

The following graph shows a plot of observed counts against modelled counts for the evening peak hour period.

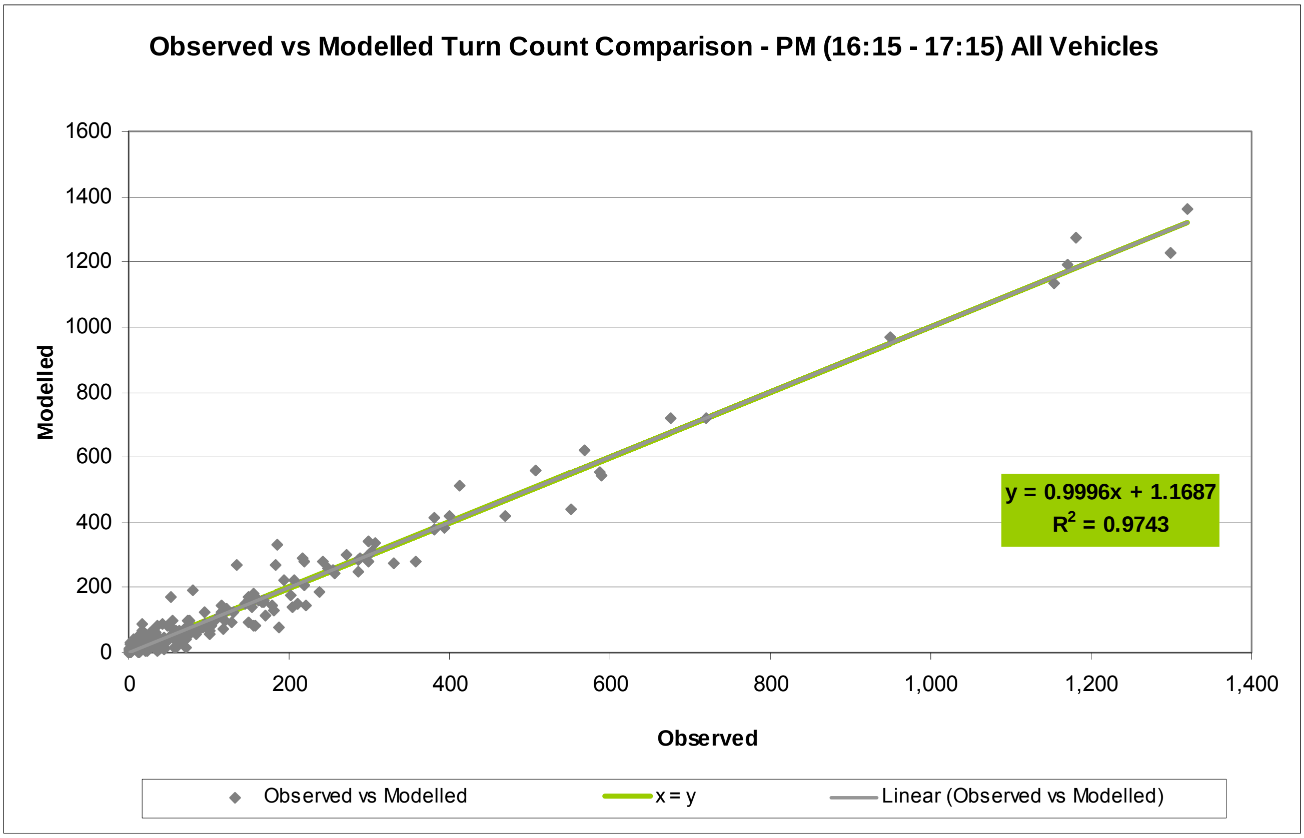

Figure 21 – Evening peak hour observed versus modelled turn counts

Appendix E
All Data Peak Hour Link Count Calibration Results

Appendix E – Link Count Calibration

Link counts have been compared based on approach and exit link flows at intersections. That is, the link counts are comprised from the same set of data used for turn count comparisons.

The following sections compare all the observed data including historical and modelled link counts for each three hour period, by organising the observed counts into volume ranges. This allows the data to be assessed with more emphasis placed on the higher volume movements. The comparison includes averaged modelled results from all ten runs. Graphical comparisons are also presented for each period.

Morning Peak Hour Link Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count data for each individual link with a survey target during the morning peak hour period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	93%	95	102
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	95%	20	21
Sum of All Flows	Within 5%	1%		
GEH < 5 for Individual Flows	>85% of cases	88%		
GEH for Sum of All Flows	GEH<4	1.1		
R2 value for modelled versus observed flows	>0.85	0.9826		
% RMSE	<30%	14%		

Table 27 – Morning peak hour observed versus modelled link counts

The following graph shows a plot of observed counts against modelled counts for the morning peak period.

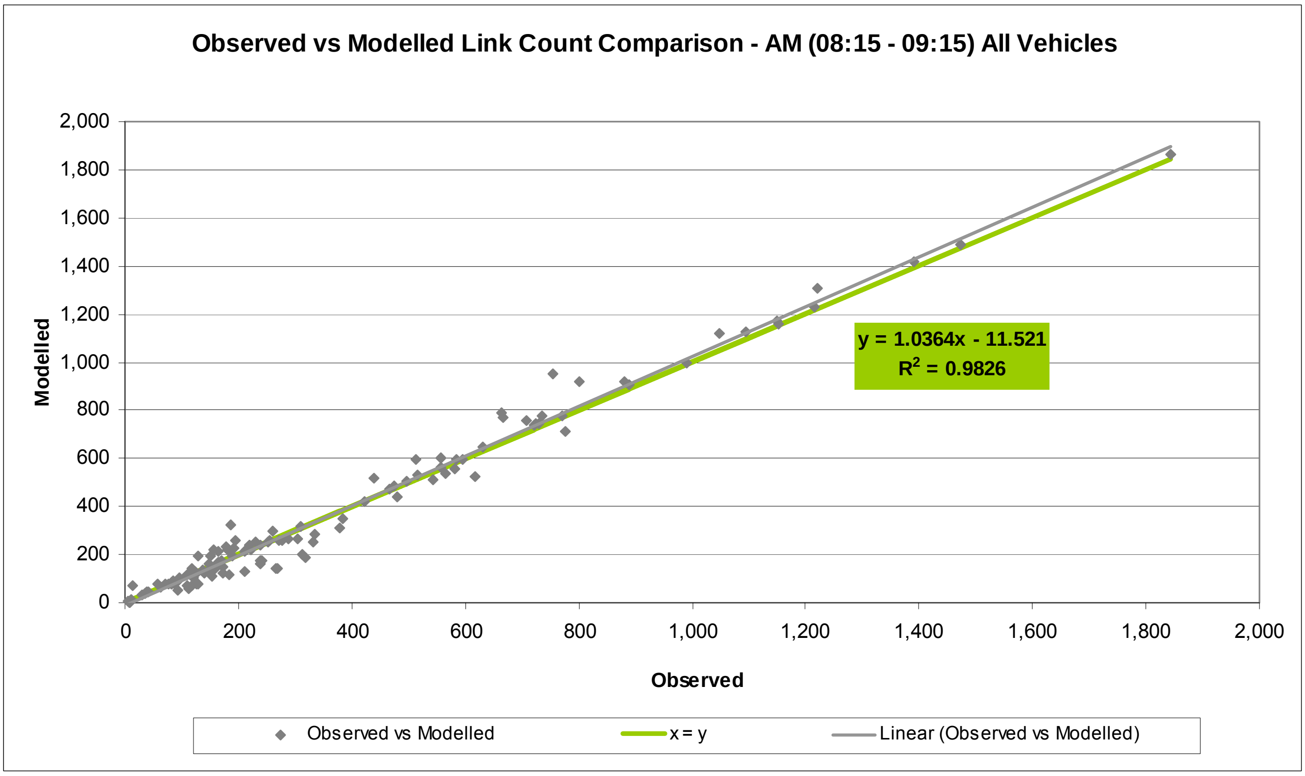

Figure 22 – Morning peak hour observed versus modelled link counts

Evening Peak Hour Link Count Comparisons

The following table shows the results achieved from comparing the observed and modelled count data for each individual link with a survey target during the evening peak hour period. The links have been organised into ranges by their observed count.

Criteria and Measures	Calibration Acceptance Targets	Result	Number meeting criteria	Total number of counts
Within 100 vph, for Flows <700 vph	>85% of cases	93%	94	101
Within 15%, for 700 vph< Flows <2700 vph	>85% of cases	91%	20	22
Sum of All Flows	Within 5%	1%		
GEH < 5 for Individual Flows	>85% of cases	89%		
GEH for Sum of All Flows	GEH<4	1.8		
R2 value for modelled versus observed flows	>0.85	0.9833		
% RMSE	<30%	13%		

Table 28 – Evening peak hour observed versus modelled link counts

The following graph shows a plot of observed counts against modelled counts for the evening peak period.

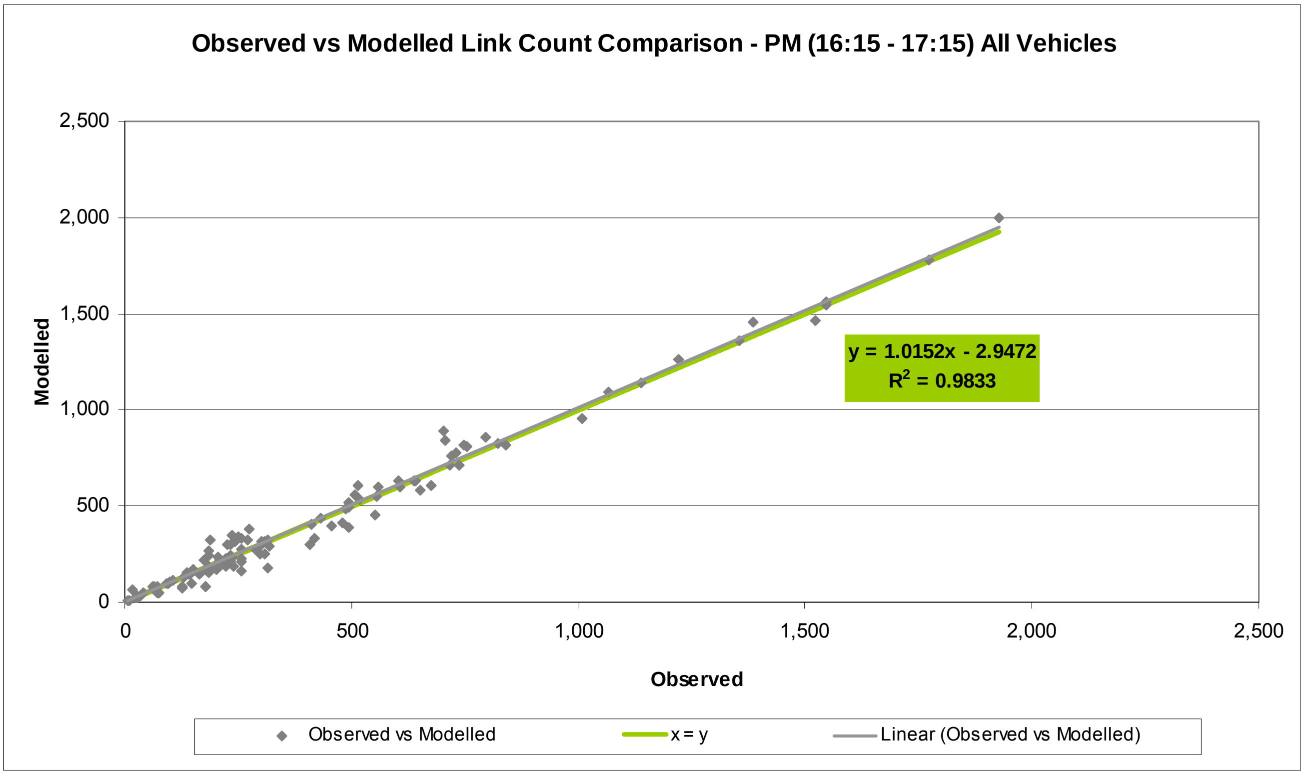

Figure 23 – Evening peak hour observed versus modelled link counts

Appendix F
Bus Routes

Appendix F – Bus Routes

Route Number	Bus Route	AM		PM	
		Start	Interval	Start	Interval
205F	City to Salisbury Interchange and Elizabeth Interchange	07:26	0:15:00	15:07	0:15:00
205F	Elizabeth Interchange and Salisbury Interchange to city	08:27	0:16:40	15:27	0:15:00
206F	City to Salisbury Interchange and Elizabeth Interchange	07:37	2:30:00	17:39	3:00:00
206F	Elizabeth Interchange and Salisbury Interchange to city	07:09	0:30:00	16:36	3:00:00
224, 224X, 224F	City to Elizabeth interchange	07:23	0:30:00	15:29	0:25:43
224, 224X, 224F	Elizabeth Interchange to City	07:08	0:21:24	15:02	0:30:00
225,225M,225F	Gepps Cross and Mawson Interchange to Salisbury Interchange	07:12	0:25:00	15:16	0:30:00
225,225M	Salisbury Interchange to Mawson Interchange and Gepps Cross with transfers to City	07:12	0:18:45	15:03	0:22:30
400	Salisbury North to Elizabeth Interchange	07:03	0:18:45	15:11	0:21:26
400	Elizabeth Interchange to Salisbury North	07:06	0:30:00	15:01	0:18:45
400A	Salisbury North to Elizabeth Interchange	08:22	1:15:00	-	-
400A	Elizabeth Interchange to Salisbury North	07:20	2:30:00	16:20	3:00:00
401,403,900	Paralowie and Salisbury North to Salisbury	07:17	0:16:40	15:07	0:15:00
401,403,900	Salisbury to Salisbury North and Paralowie	07:09	0:10:43	15:08	0:12:51
404-P1	Salisbury to Paralowie to Salisbury Anti-Clockwise Loop	07:01	0:50:00	15:07	1:00:00
404-P2	Salisbury to Paralowie to Salisbury Anti-Clockwise Loop	07:37	0:50:00	15:13	1:00:00
405-P1	Salisbury to Paralowie to Salisbury Clockwise Loop	07:16	0:50:00	15:22	0:45:00
405-P2	Salisbury to Paralowie to Salisbury Clockwise Loop	07:15	0:50:00	15:58	1:00:00
411	Mawson Interchange to Salisbury Interchange and Salisbury	07:03	0:16:40	15:07	0:13:51
411,411U	Salisbury and Salisbury Interchange to Mawson Interchange	07:12	0:15:00	15:12	0:15:00
415 to 404-P1	Greenwith to Salisbury Interchange	07:26	1:15:00	15:03	0:45:00
415 to 404-P2	Greenwith to Salisbury Interchange	07:30	2:30:00	15:07	0:45:00
415 to 405-P1	Greenwith to Salisbury Interchange	07:12	2:30:00	15:49	3:00:00
415 to 405-P1	Greenwith to Salisbury Interchange	07:16	1:15:00	15:53	3:00:00
415, 415V	Salisbury Interchange to Greenwith and Elizabeth Interchange	07:37	1:15:00	15:09	0:36:00
415, 415V	Elizabeth Interchange and Greenwith to Salisbury Interchange	08:13	2:30:00	16:42	1:00:00

Route Number	Bus Route	AM		PM	
421	Salisbury Interchange to Defence Science and Technology Organisation and Edinburgh	07:39	1:15:00	16:41	3:00:00
430	Salisbury Interchange to Greenwith and Elizabeth Interchange	07:15	0:50:00	15:13	0:45:00
430	Elizabeth Interchange and Greenwith to Salisbury Interchange	07:37	2:30:00	15:57	3:00:00
430 to 405-P1	Elizabeth Interchange and Greenwith to Salisbury Interchange	08:04	1:15:00	15:18	1:00:00
430 to 405-P2	Elizabeth Interchange and Greenwith to Salisbury Interchange	08:08	1:15:00	15:22	1:00:00
560,560A	Tea Tree Plaza Interchange to Mawson Interchange and Salisbury Interchange	07:30	0:50:00	15:23	0:25:43
560,560A	Salisbury Interchange and Mawson Interchange to Tea Tree Plaza Interchange	07:25	0:37:30	15:25	0:36:00
T500, 500X	City and Paradise Interchange to Mawson Interchange and Elizabeth Interchange	07:02	0:36:00	15:11	0:25:43
T500, 500X	Elizabeth Interchange, Mawson Interchange and Ingle Farm to City	07:04	0:16:40	15:40	0:30:00

Table 29 – Bus routes and scheduling

Appendix G
Calibrated Base Model (Aimsun)