Salisbury Transport Models

PD 2.5 Micro Simulation Model Validation Report

25th September 2009

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1. Introduction

Background

1.1 Wiltshire Council commissioned Atkins to develop Transport Models for Salisbury in September 2008. The commission was a response to a need to test the impact of significant proposed development in the Salisbury area.

1.2 This Micro Simulation Model Validation Report forms deliverable 2.5 of the commission and it describes the development and validation of two micro simulation models for Salisbury, one in Salisbury City Centre and the other along the A36 from Tesco on Southampton Road to the Harnham Gyratory.

Context

Planning

1.3 The Secretary of State's modifications to the South West Spatial Strategy shows that Salisbury City is required to accommodate a 8,700 new dwellings and provide 13,500 new employment opportunities by 2026. A range of potential sites have been identified. The strategy identifies sites in and around Salisbury, including potentially major changes in land use through the redevelopment of Churchfields and new developments to the north-west and south of the City.

1.4 As such, the Salisbury Transport Model must be able to:

- identify the impact on the transport network of locating development in each of the strategic residential and employment sites;
- identify the potential for maximising the use of public transport, walking and cycling for movements to from and within sites;
- identify the potentially significant switches in travel patterns arising from major changes in employment type and location;
- assess the potential impact on movements to/from Salisbury arising from the location of development outside Salisbury and Wilton; and
- support the Wiltshire Council through the Local Development Framework (LDF) process and any subsequent statutory processes.

Modelling Approach

1.5 Our response to these needs is to develop a fully up-to-date and appropriately validated area-wide traffic model of the Salisbury and Wilton area, supported by a demand model that is capable of representing the effect of mode switching and re-distribution of travel patterns as land uses change (macro modelling) and a detailed micro-simulation model of specific areas to view the impact of changes to land use and transport provision in more detail (micro modelling).

1.6 The "macro-level" highway modal model of Salisbury that represents movements to the city from its rural hinterland; through traffic, particularly that using the A36; is described in Atkins report "PD2.2 Salisbury Highway LMVR" (Atkins 2009).

1.7 The "micro-level" model has been built in VISSIM micro simulation. It takes hourly total vehicle movements from the "macro-level" highway model and assigns this to the highway network in a vehicle by vehicle form.

1.8 Two separate micro-simulation networks have been created which focus on the key parts of the Salisbury network in the City Centre and the approach to Salisbury along the A36 Southampton Road including the Exeter Street roundabout and Harnham Gyratory.

1.9 Three separate weekday models were modelled for the following time periods:

- morning peak hour (08:00-09:00),
- an average inter-peak hour (between 10:00-1600), and
- evening peak hour (17:00-1800).

1.10 The peak period model development is intended to capture the network at the times of the day where the greatest level of traffic and hence congestion is present, i.e. the network is under its greatest strain. The inter-peak period model is intended to capture the 'typical' conditions of the network under average traffic levels during the off peak period.

Scope of Report

1.11 The development of a Micro-simulation model suitable for above planning considerations & modelling approach is described in the following chapters:

- Chapter two describes the technical specification of the model in terms of simulation, vehicle data and driving behaviour
- Chapter describes the development of the micro-simulation network and the demand.
- Chapter four describes the calibration to independent data of the model assignment to observed network conditions in terms of flow and GEH values
- Chapters five and six describe the validation to independent data of the model assignment to observed network conditions in terms of Journey Times and Queue Length

2. Model Specification

Introduction

2.1 The aim of this chapter is to describe the specification of the Salisbury Micro-simulation Model (SMM). This chapter specifies the:

- simulation parameters;
- model units;
- background;
- desired speed distributions;
- vehicle data;
- driving behaviour and
- network inventory.

Simulation Parameters

2.2 The model run is for one hour duration with a 30 minute warm-up period prior to the run and a 30 minute cool down period after the run. The simulation parameters used in the model are:

- model time period is 7200 seconds as the model time shall be for a one hour period with 30 minute warm up and cool down period before and after the run;
- the model times are:
  - morning period: 0800 to 0900 with a warm-up period of 30 minutes as stated above, therefore the start time is given as 0730;
  - inter-peak period: 1200 to 1300 with a warm-up period of 30 minutes as stated above, therefore the start time is given as 1130; and
  - evening period: 1700 to 1800 with a warm-up period of 30 minutes as stated above, therefore the start time is given as 1630.

Background

2.3 Satellite images (received from the client in JPEG format) have been set as the background and Geo-referenced as per the British National Grid location. The aerial image for the VISSIM model area is shown in Figure 2.1 along with the two cordons where the micro-simulation network has been developed.

Figure 2.1 – VISSIM Background

Desired Speed Distributions

2.4 For any vehicle type the desired speed distribution (DSD) is an important parameter that has a significant influence on roadway capacity and achievable travel speeds. If not hindered by other vehicles, a driver will travel at his desired speed (with a small stochastic variation called oscillation). If overtaking is possible, any vehicle with a higher desired speed than its current travel speed is checking for the opportunity to pass - without endangering other vehicles. Stochastic distributions of desired speeds are defined for each vehicle type within each traffic composition.

2.5 Two DSD curves have been developed for the two Micro-Simulation networks from the average speed measured by the journey time surveys. Separate DSD curves have been developed for light and heavy vehicles for both networks. Figure 2.2 shows the DSD curves for central Salisbury while Figure 2.3 shows the DSD curves for A36 / Harnham junction (both lights & heavies).

Figure 2.2 – Speed Distribution curves for Central Salisbury

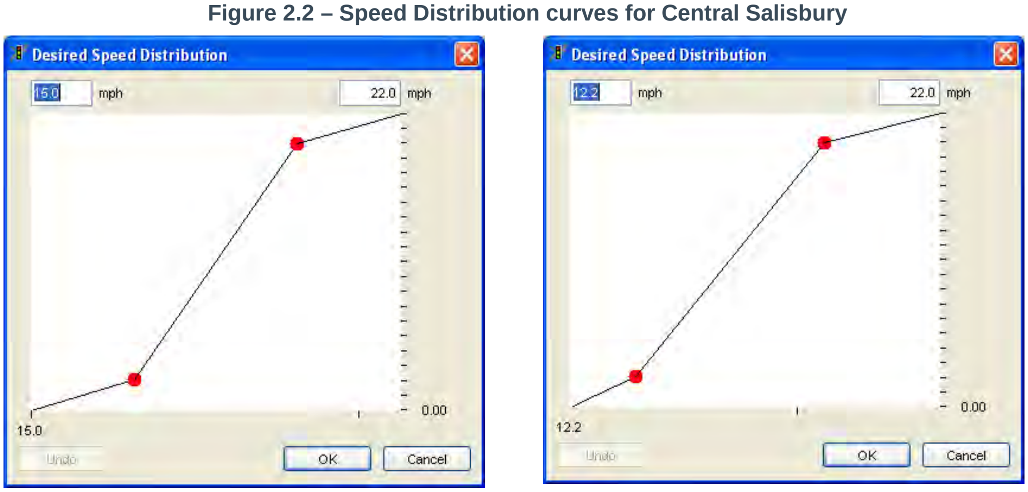
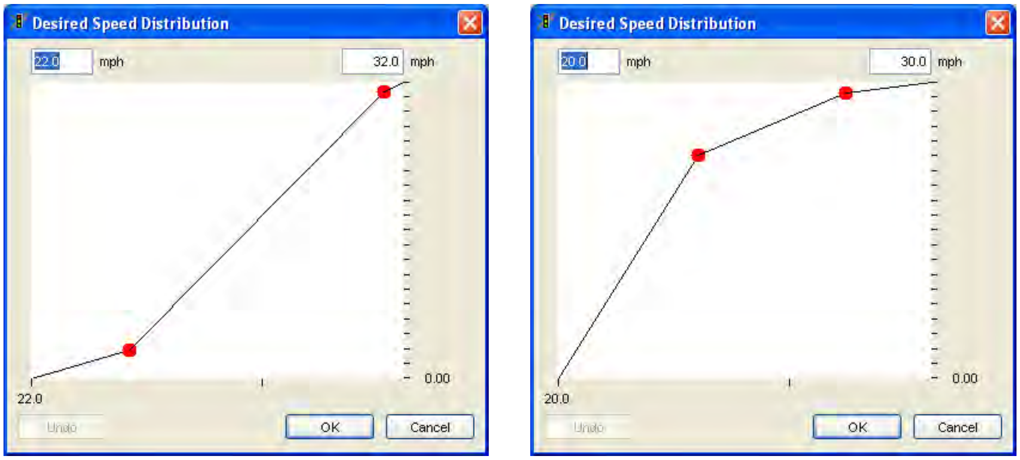


Figure 2.3 – Speed Distribution curves for A36 / Harnham junction



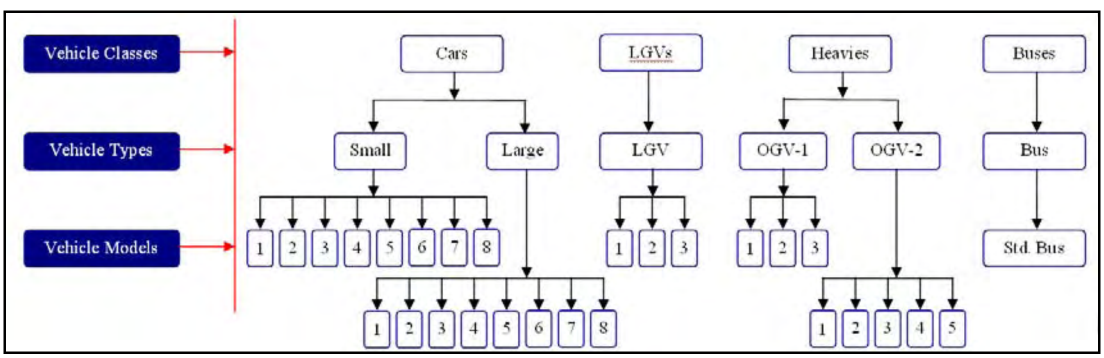
Vehicle Data

2.6 The vehicle data contains the following four classes:

- Cars;
- Light Good Vehicle (LGV);
- Heavy Goods Vehicle (HGV); and
- Buses.

2.7 There are two vehicle types called cars: small cars and large cars with each having 8 different types of model. Likewise, there are two HGV types: OGV-1 and OGV-2 with OGV-1 having two truck models and OGV-2 having five articulated truck models The Figure 2.4 shows the vehicle data selected for the model.

Figure 2.4 – Vehicle Data



Driving Behaviour

2.8 VISSIM simulates the traffic flow by moving "driver-vehicle-units" through a network. Every driver has specific behaviour characteristics that are assigned to a specific vehicle. As a consequence, the driving behaviour corresponds to the technical capabilities of his vehicle. Attributes characterising each driver-vehicle-unit can be discriminated into three categories:

- technical specifications of the vehicle.- length, maximum speed, potential acceleration, actual position in the network, actual speed and acceleration;
- behaviour of driver-vehicle-unit - psycho-physical sensitivity thresholds of the driver (ability to estimate, aggressiveness), memory of driver, acceleration based on current speed and driver's desired speed, and

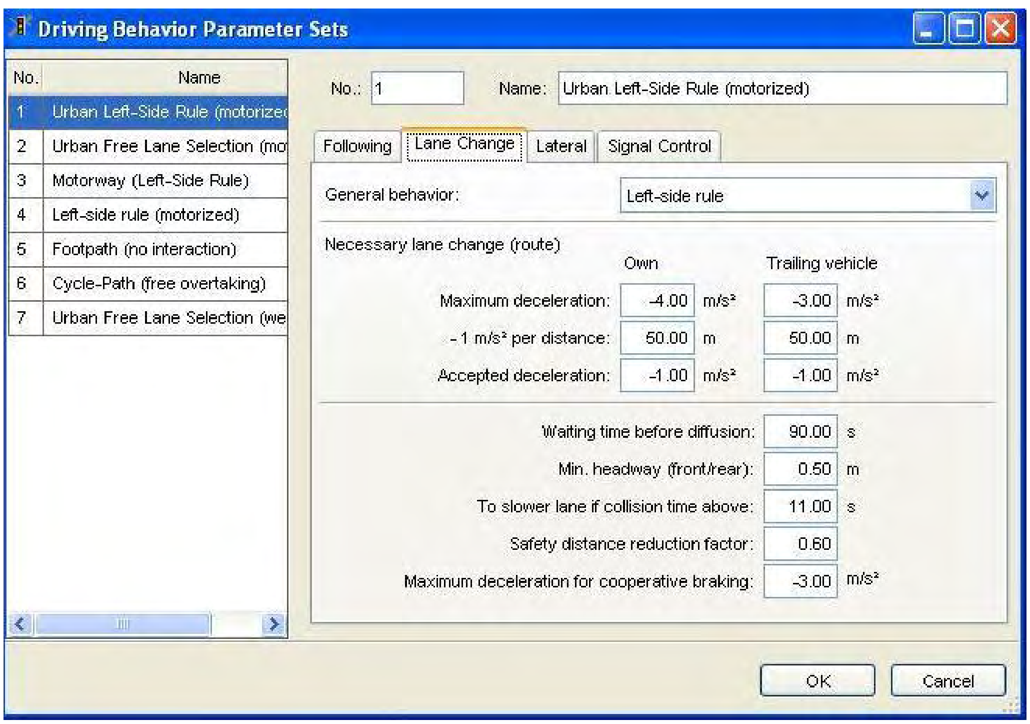
- interdependence of driver-vehicle-units - reference to leading and following vehicles on own and adjacent, travel lanes, reference to current link and next intersection, reference to next traffic signal.

2.9 The driving behaviour is linked to each link by its link type and the driving behaviour parameters used in the model are:

- look ahead distance: minimum value = 0 and maximum value = 250;
- number of observed vehicles = 4;
- the 'Wiedemann 74' car following model has been used; which states that a driver follows the preceding car without any conscious acceleration or deceleration and keeps the safety distance more or less constant, but again due to imperfect throttle control and imperfect estimation the speed difference oscillates around zero;
- average standstill distance = 1.5m; and
- additive part of safety distance have been left as their default value i.e. 2 & 3 as no saturation flow data is available at the moment for the modelled links.

2.10 Lane change parameters have been kept at the default values for 'Left-side rule' as shown in Figure 2.5 below

Figure 2.5 – Driving Behaviour



Network

2.11 The extent of micro simulation network in Salisbury are displayed in Figure 2.6 -and Figure 2.7. The networks have been built directly on top of aerial mapping of Salisbury provided to Atkins by Wiltshire Council (WC). In the first stage the networks are correctly scaled to ensure link lengths are correct. The networks replicates network characteristics such as speed limits, give ways, stop lines and lane allocations.

Figure 2.6 - Micro Simulation Network Cordon 1 (Central Salisbury)

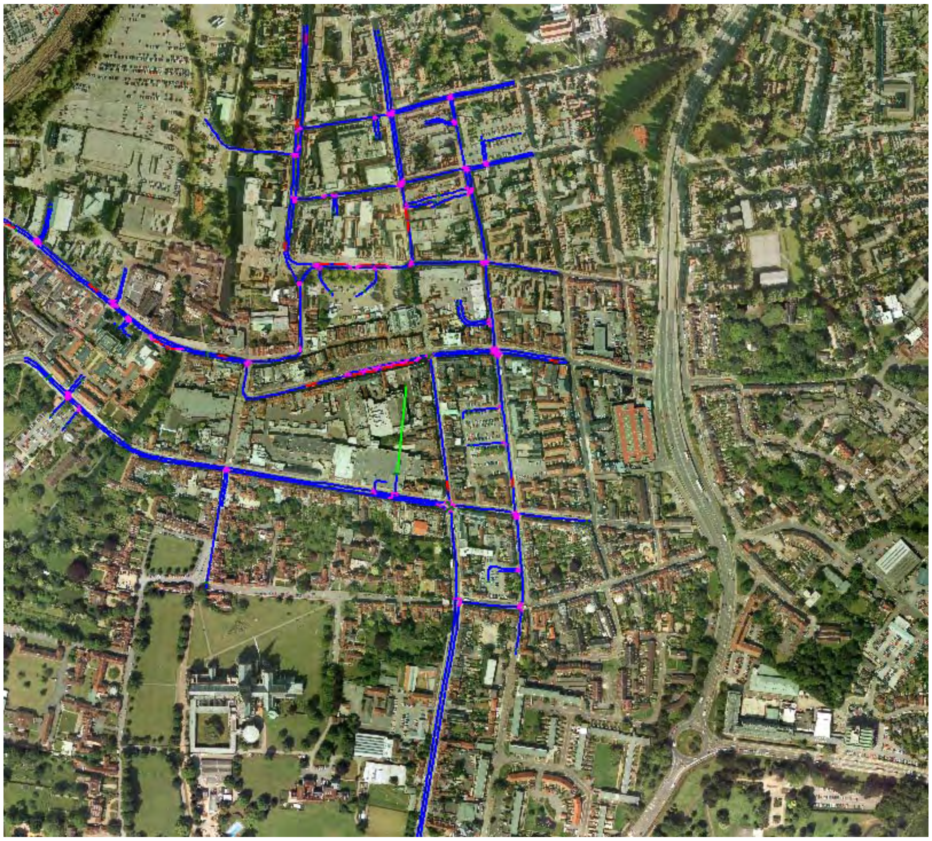


Figure 2.7 - Micro Simulation Network Cordon 2 (A36 / Southampton Road)

3. Model Development

Introduction

3.1 This chapter describes the development of the network for the Salisbury Micro-Simulation Model.

3.2 The micro-simulation network is a more detailed representation of the SATURN highway network. VISSIM is a micro-simulation model having links and connectors and therefore is able to represent junction characteristics with turning movements in considerable detail. The accurate representation of junctions and its movement is a key feature of the network inventory.

Network Development

Signal Timing

3.3 Signal times within the micro-simulation network can be divided into three categories:

- fixed time;
- pedestrian (Pelican); and
- SCOOT (Split Cycle Offset Optimisation Technique).

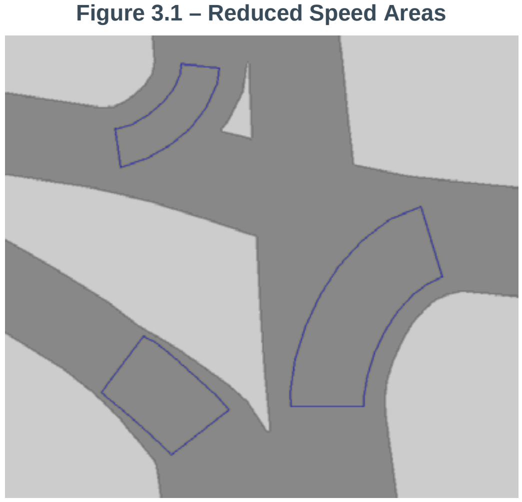
3.4 Fixed times and pedestrian demand (push button) have been provided to Atkins directly and coded within the model. SCOOT data was extracted from the Wiltshire ASTRID (Automatic SCOOT Traffic Information Database) which provides average green times by phase recorded at SCOOT controlled junctions. These have been coded by 15 minute intervals to ensure a greater level of accuracy with onsite conditions.

Priority rules and reduced speed areas

3.5 The network has ‘priority rules’ which are based on site observations and data gathered from the aerial mapping. Reduced speed areas have been used where appropriate to model speed reductions i.e. at roundabouts and turnings.

3.6 Upon arriving at a reduced speed areas, each vehicle is assigned a new desired speed from within the speed distribution assigned. After leaving the reduced speed areas the vehicle automatically reverts to its previous desired speed. Figure 3.1 gives the example of reduced speed definition at a junction

Figure 3.1 – Reduced Speed Areas



Public Transport

3.7 Public transport routes and frequencies are consistent with macro highway models, which in turn is consistent with timetabled journeys in October 2008.

Travel Demand

3.8 Vehicle demand is passed directly from the macro highway model to VISSIM through Atkins developed Excel based macros. This process creates the following three elements within the VISSIM:

- vehicle Inputs (by vehicle class CAR, LGV & HGV);
- vehicle compositions (by vehicle type, small car, large car, van, OGV1, OGV2) and
- static vehicle routes (by vehicle class)

3.9 This procedure effectively replicates the assignment within the SATURN in terms of route choice and vehicle volumes by user or vehicle class.

3.10 The model runs for 2 hours (7200 seconds) using a 30 minute warm up and cool down period. Pre-peak and post-peak traffic flows are factored based on flow proportions recorded during the automatic traffic count surveys conducted at road side interview sites for shoulder periods.

3.11 The calibration and validation of the macro highway model is discussed in *PD2.2 Salisbury Highway LMVR v2* (Akins 2009) while the calibration and validation of the micro-simulation model is discussed in further chapters.

4. Model Calibration

Introduction

4.1 This section describes the calibration of the two micro-simulation models for Salisbury. Calibration is the act of selecting model parameters that result in the model being able to represent observed flow, journey time and queue data.

Acceptability Criteria

4.2 The acceptability guidelines as outlined in DMRB are shown in Table 4.1.

Table 4.1 - DMRB Acceptability Guidelines

Criteria and Measure	Acceptability Guideline	
DMRB Flow Criteria		
Observed flow < 700vph	Modelled flow within ± 100vph	> 85% of links
Observed flow 700 to 2700vph	Modelled flow within ± 15%	
Observed flow > 2700vph	Modelled flow within ± 400vph	
DMRB GEH Criteria		
Total screen line flows (normally > 5 links) to be within ± 5%	All (or nearly all) screen lines	
GEH statistic for individual links <5	> 85% of links	
GEH statistic for screen line totals <4	All (or nearly all) screen lines	
Journey Time Criteria		
Modelled journey time within +/- 15% of observed journey time	All (or nearly all) journey time routes	
Queue Length Criteria		
Modelled queue length within +/- 15% of observed queue length	All (or nearly all) journey time routes	

GEH Statistic

4.3 The GEH statistic shown below is a generally accepted value used as an indicator of 'goodness of fit', i.e. the extent to which the modelled flows match the corresponding observed flows. This is recommended in the calibration guidelines contained in the Design Manual for Roads and Bridges (DMRB) Volume 12 and is defined as:

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

Where:

- M = modelled flow and
- C = observed flow

Network Flow Calibration

4.4 The traffic volume and routings are derived from the Salisbury Highway Model. Following initial network checks the model was calibrated against observed traffic flows recorded within the model area. In VISSIM the modelled flows are recorded using standard data collection points positioned within the network file. Traffic flows have been divided into three separate screenlines: city centre; A36 junctions and city centre car parks.

4.5 The network flow calibration results at an aggregate level for the two models are shown in Table 4.2. The table shows the number of links in each set of counts that meets the particular DMRB criteria. It can be seen that each set of counts meets either DMBR flow or GEH criteria in each time period.

Table 4.2 – Summary of Network Calibration

Cordon	Morning Period		Inter Peak Period		Evening Period	
	DMRB		DMRB		DMRB	
	Flow	GEH	Flow	GEH	Flow	GEH
City Centre	92%	85%	85%	69%	85%	85%
Car Parks (In)	100%	100%	100%	100%	100%	100%
Car Parks (Out)	100%	100%	100%	100%	100%	80%
A36 Corridor	96%	96%	83%	92%	92%	96%

4.6 The level of network flow calibration in the two models provides confidence that there is the right amount of traffic on the respective networks. More detailed information for each link in the respective data sets and time periods in shown in Tables 4.4 to 4.12.

4.7 A review of those counts that do not meat DMRB criteria generally suggest some inconsistencies between counts taken on neighbouring links on different days. For instance, the modelled movement from Churchill Way South to Exeter Street is typically outside of DMRB range yet the modelled flow into Churchill Way South from Southampton Road and Churchill Way East to the north meets DMRB criteria and the modelled flow from Churchill Way South to New Bridge also meets criteria.

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Table 4.3 – Network Calibration for Morning Period City Centre

Central Salisbury (Links & Turns)	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Exeter Street - Northbound	645	6	637	13	-1	0%	0.04	✓	✓
Cranebridge, Mill Road to High Street	372	16	452	0	64	16%	3.12	✓	✓
Fisherton Street, Eastbound	210	13	203	21	1	0%	0.07	✓	✓
Cranebridge, High Street to Mill Road	362	11	331	0	-42	-11%	2.24	✓	✓
Fisherton street, Westbound	137	8	218	17	90	62%	6.53	✓	×
Catherine St Junction, New Road to Catherine Street	66	3	90	3	24	35%	2.67	✓	✓
Catherine St Junction, St John Street to New Road	22	0	6	0	-16	-73%	4.28	✓	✓
Catherine St Junction, St John Street to Ivy Street	156	15	198	2	29	17%	2.13	✓	✓
Catherine St Junction, New Road to Ivy Street	430	10	460	0	20	5%	0.94	✓	✓
Catherine St Junction, St John St to Catherine St	404	21	304	13	-108	-25%	5.61	×	✓
Queen Street Junction, Catherine St to Milford St	323	25	305	16	-27	-8%	1.48	✓	✓
Queen Street Junction, Catherine St to New Canal	108	10	89	0	-29	-25%	2.85	✓	✓
Queen Street Junction, Milford St to New Canal	25	1	0	0	-26	-100%	7.21	✓	×
	3260	**139**	**3293**	**85**	**21**	**1%**	**0.4**	**12**	**11**

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Table 4.4 – Network Calibration for Morning Period A36 Corridor

A36 Corridor (Turns)	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Churchill Way/Southampton Road									
Southampton Road to Churchill Way South	490	26	490	11	-15	-3%	0.67	✓	✓
Southampton Road to Churchill Way East	577	30	611	57	61	10%	2.42	✓	✓
Churchill Way East to Southampton Rd	546	29	550	20	-5	-1%	0.21	✓	✓
Churchill Way East to Churchill Way South	678	36	692	43	21	3%	0.78	✓	✓
Churchill Way South to Churchill Way East	783	41	793	35	4	0%	0.14	✓	✓
Churchill Way South to Southampton Road	291	15	320	23	37	12%	2.05	✓	✓
Southampton Road/Bourne Way									
Bourne Way to Southampton Rd E	98	5	110	5	12	12%	1.15	✓	✓
Bourne Way to Southampton Rd W	198	10	193	6	-9	-4%	0.63	✓	✓
Southampton Rd E to Southampton Rd W	900	47	897	54	4	0%	0.13	✓	✓
Southampton Rd E to Bourne Way	128	7	87	2	-46	-34%	4.35	✓	✓
Southampton Rd W to Bourne Way	262	14	294	17	35	13%	2.04	✓	✓
Southampton Rd W to Southampton Rd E	575	30	500	41	-64	-11%	2.67	✓	✓
Exeter Street Roundabout									
New Bridge Rd to Churchill way	929	49	1047	58	127	13%	3.94	✓	✓
New Bridge Rd to Exeter St	536	28	457	5	-102	-18%	4.50	×	✓
Exeter St to Churchill Way South	146	8	60	0	-94	-61%	9.09	✓	×
Exeter St to New Bridge Rd	450	24	397	6	-71	-15%	3.39	✓	✓
Churchill Way South to New Bridge Rd	893	47	916	50	26	3%	0.84	✓	✓
Churchill Way South to Exeter St	274	14	222	4	-62	-22%	3.87	✓	✓
Harnham Gyratory									
Combe Rd Northbound	852	19	873	16	18	2%	0.61	✓	✓
Downton Rd Northbound	708	49	702	40	-15	-2%	0.55	✓	✓
New Harnham Rd EB	435	25	433	2	-25	-5%	1.18	✓	✓
Combe Rd Southbound	846	18	839	7	-18	-2%	0.62	✓	✓
Downton Rd Southbound	478	62	525	62	47	9%	1.98	✓	✓
New Harnham Rd WB	438	37	487	22	34	7%	1.53	✓	✓
	12511	**670**	**12495**	**586**	**100**	**1%**	**0.9**	**23**	**23**

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Table 4.5 –Network Calibration for Morning Period Car Parks

Car Parks	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Brown Street West Car Park- IN	44	0	54	0	10	23%	1.43	✓	✓
Market Square - IN	4	0	2	0	-2	-50%	1.15	✓	✓
Salt Lane Car Park - IN	35	0	38	0	3	8%	0.46	✓	✓
Lush House Car Park - IN	19	0	10	0	-9	-47%	2.36	✓	✓
Southampton road Car Park - IN	19	0	12	0	-7	-37%	1.78	✓	✓
Brown Street West Car Park- Out	15	0	19	0	4	27%	0.97	✓	✓
Market Square - Out	4	0	3	0	-1	-25%	0.53	✓	✓
Salt Lane Car Park - Out	14	0	13	0	-1	-6%	0.21	✓	✓
Lush House Car Park - Out	10	0	7	0	-3	-30%	1.03	✓	✓
Southampton road Car Park - Out	0	0	0	0	0	0%	0.00	✓	✓
Inbound	**121**	**0**	**116**	**0**	**5**	**4%**	**0.5**	**5**	**5**
Outbound	**43**	**0**	**42**	**0**	**1**	**2%**	**0.1**	**5**	**5**

Table 4.6 – Network Calibration for Inter Peak Period City Centre

Central Salisbury (Links & Turns)	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Exeter Street - Northbound	399	13	392	20	0	0%	0.02	✓	✓
Cranebridge, Mill Road to High Street	267	10	298	0	21	8%	1.24	✓	✓
Fisherton Street, Eastbound	209	9	287	16	85	39%	5.27	✓	×
Cranebridge, High Street to Mill Road	278	12	351	0	61	21%	3.41	✓	✓
Fisherton street, Westbound	164	7	165	21	15	9%	1.12	✓	✓
Catherine St Junction, New Road to Catherine Street	106	9	85	2	-28	-24%	2.79	✓	✓
Catherine St Junction, St John Street to New Road	31	1	25	0	-7	-22%	1.31	✓	✓
Catherine St Junction, St John Street to Ivy Street	247	25	226	0	-46	-17%	2.92	✓	✓
Catherine St Junction, New Road to Ivy Street	400	17	363	0	-54	-13%	2.73	✓	✓
Catherine St Junction, St John St to Catherine St	257	16	78	21	-174	-64%	12.76	×	×
Queen Junction, Catherine St to Milford St	326	10	79	21	-236	-70%	15.98	×	×
Queen Junction, Catherine St to New Canal	89	9	84	2	-12	-12%	1.25	✓	✓
Queen Junction, Milford St to New Canal	28	3	0	0	-31	-100%	7.87	✓	×
	2801	**141**	**2433**	**103**	**406**	**14%**	**7.8**	**11**	**9**

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Table 4.7 – Network Calibration for Inter Peak Period A36 Corridor

A36 Corridor (Turns)	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Churchill Way/Southampton Road									
Southampton Road to Churchill Way S	458	33	457	13	-21	-4%	0.96	✓	✓
Southampton Road to Churchill Way E	452	33	454	48	17	4%	0.77	✓	✓
Churchill Way E to Southampton Rd	455	33	473	31	16	3%	0.72	✓	✓
Churchill Way E to Churchill Way S	464	34	609	28	139	28%	5.83	×	✓
Churchill Way S to Churchill Way E	536	39	567	26	18	3%	0.74	✓	✓
Churchill Way S to Southampton Road	405	29	383	13	-38	-9%	1.87	✓	✓
Southampton Road/Bourne Way									
Bourne Way to Southampton	188	14	218	27	43	21%	2.88	✓	✓
Bourne Way to Salisbury	436	32	364	19	-85	-18%	4.12	✓	✓
Southampton to Salisbury	520	38	450	34	-74	-13%	3.24	✓	✓
Southampton to Bourne Way	108	8	104	7	-5	-4%	0.47	✓	✓
Southampton Rd W to Bourne Way	396	29	395	22	-8	-2%	0.39	✓	✓
Southampton Rd W to Southampton Rd E	464	34	359	38	-101	-20%	4.77	×	✓
Exeter Street Roundabout									
New Bridge Rd to Churchill way	699	51	790	41	81	11%	2.88	✓	✓
New Bridge Rd to Exeter St	413	30	347	7	-89	-20%	4.46	✓	✓
Exeter St to Churchill way	242	18	150	0	-110	-42%	7.68	×	×
Exeter St to New Bridge Rd	415	30	388	10	-47	-11%	2.29	✓	✓
Churchill Way to New Bridge Rd	705	51	761	36	41	5%	1.47	✓	✓
Churchill Way to Exeter St	452	33	288	5	-192	-40%	9.73	×	×
Harnham Gyratory									
Combe Rd Northbound	676	23	643	0	-56	-8%	2.16	✓	✓
Downton Rd Northbound	467	49	472	31	-13	-3%	0.58	✓	✓
New Harnham Rd EB	466	25	404	6	-81	-16%	3.82	✓	✓
Combe Rd Southbound	626	24	627	16	-7	-1%	0.28	✓	✓
Downton Rd Southbound	494	42	503	35	2	0%	0.09	✓	✓
New Harnham Rd WB	453	33	430	28	-28	-6%	1.29	✓	✓
	10990	**765**	**10636**	**521**	**598**	**5%**	**5.6**	**20**	**22**

Table 4.8 –Network Calibration for Inter Peak Period Car Parks

Car Parks	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Brown Street West Car Park- IN	68	0	39	0	-29	-43%	3.96	✓	✓
Market Square - IN	26	0	19	0	-7	-27%	1.48	✓	✓
Salt Lane Car Park - IN	63	0	56	0	-7	-10%	0.85	✓	✓
Lush House Car Park - IN	36	0	24	0	-12	-33%	2.19	✓	✓
Southampton road Car Park - IN	4	0	18	0	14	350%	4.22	✓	✓
Brown Street West Car Park- Out	70	0	62	0	-8	-11%	0.98	✓	✓
Market Square - Out	18	0	17	0	-1	-6%	0.24	✓	✓
Salt Lane Car Park - Out	64	0	63.45	0	-1	-1%	0.07	✓	✓
Lush House Car Park - Out	36	0	36	0	0	0%	0.00	✓	✓
Southampton road Car Park - Out	3	0	5	0	2	67%	1.00	✓	✓
Inbound	**197**	**0**	**156**	**0**	**41**	**21%**	**3.1**	**5**	**5**
Outbound	**191**	**0**	**183**	**0**	**8**	**4%**	**0.6**	**5**	**5**

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Table 4.9 – Network Calibration for Evening Period City Centre

Central Salisbury (Links & Turns)	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Exeter Street - Northbound	499	2	493	1	-7	-1%	0.33	✓	✓
Cranebridge, Mill Road to High Street	389	5	365	0	-29	-7%	1.49	✓	✓
Fisherton Street, Eastbound	247	6	225	9	-19	-8%	1.22	✓	✓
Cranebridge, High Street to Mill Road	371	9	467	0	87	23%	4.23	✓	✓
Fisherton street, Westbound	244	5	199	3	-47	-19%	3.13	✓	✓
Catherine St Junction, New Road to Catherine Street	168	6	142	2	-30	-17%	2.38	✓	✓
Catherine St Junction, St John Street to New Road	35	1	32	0	-4	-11%	0.69	✓	✓
Catherine St Junction, St John Street to Ivy Street	342	19	307	0	-54	-15%	2.95	✓	✓
Catherine St Junction, New Road to Ivy Street	338	7	367	0	22	6%	1.17	✓	✓
Catherine St Junction, St John St to Catherine St	373	9	170	1	-211	-55%	12.69	×	×
Queen Junction, Catherine St to Milford St	414	4	175	3	-240	-57%	13.90	×	×
Queen Junction, Catherine St to New Canal	144	6	137	0	-13	-9%	1.09	✓	✓
Queen Junction, Milford St to New Canal	18	0	0	0	-18	-100%	6.00	✓	✓
	3582	**79**	**3079**	**19**	**563**	**15%**	**9.7**	**11**	**11**

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Table 4.10 – Network Calibration for Evening Period A36 Corridor

A36 Corridor (Turns)	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Churchill Way/Southampton Road									
Southampton Road to Churchill Way S	482	12	435	11	-48	-10%	2.21	✓	✓
Southampton Road to Churchill Way E	418	10	468	18	58	14%	2.71	✓	✓
Churchill Way E to Southampton Rd	333	8	280	9	-52	-15%	2.93	✓	✓
Churchill Way E to Churchill Way S	776	19	893	6	104	13%	3.57	✓	✓
Churchill Way S to Churchill Way E	729	18	726	17	-4	-1%	0.15	✓	✓
Churchill Way S to Southampton Road	719	18	648	13	-76	-10%	2.87	✓	✓
Southampton Road/Bourne Way									
Bourne Way to Southampton	228	6	178	0	-56	-24%	3.90	✓	✓
Bourne Way to Salisbury	326	8	251	10	-73	-22%	4.23	✓	✓
Southampton to Salisbury	658	16	577	11	-86	-13%	3.42	✓	✓
Southampton to Bourne Way	102	3	81	5	-19	-18%	1.94	✓	✓
Southampton Rd W to Bourne Way	343	9	240	3	-109	-31%	6.32	×	✓
Southampton Rd W to Southampton Rd E	709	18	761	22	56	8%	2.04	✓	✓
Exeter Street Roundabout									
New Bridge Rd to Churchill way	1154	29	1141	29	-13	-1%	0.38	✓	✓
New Bridge Rd to Exeter St	448	11	413	1	-45	-10%	2.15	✓	✓
Exeter St to Churchill way	294	7	165	0	-136	-45%	8.91	×	×
Exeter St to New Bridge Rd	541	13	480	4	-70	-13%	3.07	✓	✓
Churchill way to New Bridge Rd	1030	26	1083	17	44	4%	1.34	✓	✓
Churchill way to Exeter St	228	6	205	0	-29	-12%	1.96	✓	✓
Harnham Gyratory									
Combe Rd Northbound	829	13	898	7	63	7%	2.13	✓	✓
Downton Rd Northbound	634	10	625	21	2	0%	0.08	✓	✓
New Harnham Rd EB	581	8	629	5	45	8%	1.82	✓	✓
Combe Rd Southbound	750	13	740	10	-13	-2%	0.47	✓	✓
Downton Rd Southbound	744	21	730	19	-16	-2%	0.58	✓	✓
New Harnham Rd WB	647	18	577	16	-72	-11%	2.87	✓	✓
	13703	**320**	**13224**	**254**	**545**	**4%**	**4.6**	**22**	**23**

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Table 4.11 –Network Calibration for Evening Period Car Parks

Car Parks	Count		Model		Diff	% Diff	GEH	DMRB	
Site name and direction	Lights	Heavies	Lights	Heavies				Flow*	GEH*
Brown Street West Car Park- IN	24	0	24	0	0	0%	0.00	✓	✓
Market Square - IN	12	0	11	0	-1	-8%	0.29	✓	✓
Salt Lane Car Park - IN	19	0	20	0	1	7%	0.31	✓	✓
Lush House Car Park - IN	13	0	18	0	5	38%	1.27	✓	✓
Southampton road Car Park - IN	1	0	0	0	-1	-100%	1.41	✓	✓
Brown Street West Car Park- Out	61	0	126	0	65	107%	6.72	✓	×
Market Square - Out	11	0	10	0	-1	-9%	0.31	✓	✓
Salt Lane Car Park - Out	47	0	50	0	3	6%	0.39	✓	✓
Lush House Car Park - Out	26	0	19	0	-7	-27%	1.48	✓	✓
Southampton road Car Park - Out	18	0	14	0	-4	-22%	1.00	✓	✓
Inbound	**69**	**0**	**73**	**0**	**-4**	**-6%**	**0.5**	**5**	**5**
Outbound	**163**	**0**	**219**	**0**	**-56**	**-34%**	**4.0**	**5**	**4**

Journey Time Calibration

4.8 The Atkins report *PD1.3 Data Collection Report v1.2* (Atkins 2009) describes the five separate journey time surveys conducted within the study area. The journey time routes within the micro-simulation models are shown from Figure 4.1 to Figure 4.5 and are described below:

- Route 1- Netherhampton Road (A3094) to A338 / Old Malthouse Lane Junction,
- Route 2- Southampton Road / Peters Finger Road Junction to Beehive P&R Roundabout,
- Route 3- Downton Road / Rowbarrow Junction, Salisbury to Queen Street / Kingsway,
- Route 4- A360 / The Avenue Road Junction to Old Malthouse Lane / A30 Junction,
- Route 5- Southampton Road / Peters Finger Road Junction to Churchill Way East / Churchill Way North Roundabout

Figure 4.1 – Journey Times Route 1

ROUTE- 1: NORTHBOUND

ROUTE- 1: SOUTHBOUND

Figure 4.2 – Journey Times Route 2

ROUTE- 2: NORTHBOUND

ROUTE 2 : SOUTHBOUND

Figure 4.3 – Journey Times Route 3

ROUTE 3 : NORTHBOUND

ROUTE 3 : SOUTHBOUND

Figure 4.4 – Journey Times Route 4

ROUTE 4 : EASTBOUND

ROUTE 4 : WESTHBOUND

Figure 4.5 – Journey Times Route 5

ROUTE 5 : NORTHBOUND

ROUTE 5 : SOUTHBOUND

4.9 Overall the journey time calibration across the five routes is compliant with DMRB criteria as demonstrated all of the routes being within +/-15%. The results of the journey time calibration are given in Table 4.12 to Table 4.14. The graphical representation of the journey times is given in Appendix-A for each route and time period.

Table 4.12 – Journey Time Calibration for Morning Period

ROUTE	Modelled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff
Route 1 Northbound	439	505	**-13.1%**
Route 1 Southbound	310	331	**-6.3%**
Route 2 Northbound	410	387	**5.9%**
Route 2 Southbound	417	383	**9.0%**
Route 3 Northbound	183	208	**-12.1%**
Route 3 Southbound	122	137	**-10.7%**
Route 4 Eastbound	167	184	**-9.0%**
Route 4 Westbound	305	303	**0.6%**
Route 5 Northbound	169	163	**3.9%**
Route 5 Southbound	145	136	**6.7%**

Table 4.13 – Journey Time Calibration for Inter Peak Period

ROUTE	Modelled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff
Route 1 Northbound	459	425	**7.9%**
Route 1 Southbound	319	335	**-4.7%**
Route 2 Northbound	408	434	**-6.0%**
Route 2 Southbound	393	460	**-14.6%**
Route 3 Northbound	125	128	**-2.2%**
Route 3 Southbound	115	105	**9.6%**
Route 4 Eastbound	189	212	**-10.7%**
Route 4 Westbound	409	449	**-9.0%**
Route 5 Northbound	149	149	**-0.1%**
Route 5 Southbound	138	150	**-7.7%**

Table 4.14 – Journey Time Calibration for Evening Period

ROUTE	Modelled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff
Route 1 Northbound	465	527	**-11.8%**
Route 1 Southbound	423	386	**9.5%**
Route 2 Northbound	447	440	**1.6%**
Route 2 Southbound	467	527	**-11.5%**
Route 3 Northbound	141	127	**11.3%**
Route 3 Southbound	141	161	**-12.6%**
Route 4 Eastbound	228	215	**5.9%**
Route 4 Westbound	417	450	**-7.4%**
Route 5 Northbound	184	160	**14.9%**
Route 5 Southbound	137	135	**1.8%**

Queue length Calibration

4.10 A single queue length survey was recorded on site at the approach to Churchill Way from Southampton Road for morning and evening time periods only. This survey records the longest length a queue reached within a fifteen minute period. This method of data collection is fairly subjective and has it has only been conducted on one day, it cannot be considered as a robust piece of data.

4.11 The calibration of modelled queue length compares observed queue lengths against the maximum number of queued vehicles every 15 minutes and the queue length is determined by average vehicle lengths for each class of queued vehicle. The results of the queue length calibration are given in Table 4.15 and Table 4.16 for morning and evening time periods respectively. The queue length calibration is displayed graphically in Figure 4.6 and Figure 4.7 for morning and evening time periods respectively.

Table 4.15 – Queue Length Calibration for Morning Period

Time Start	Observed Queue Length (metres)	Modelled Mean Maximum Queue Length (m)	% Difference
08:00	26	28	8%
08:15	26	29	12%
08:30	54	41	24%
08:45	26	32	23%
Average	**33**	**33**	**2%**

Figure 4.6 – Queue Length Calibration Graph for Morning Period

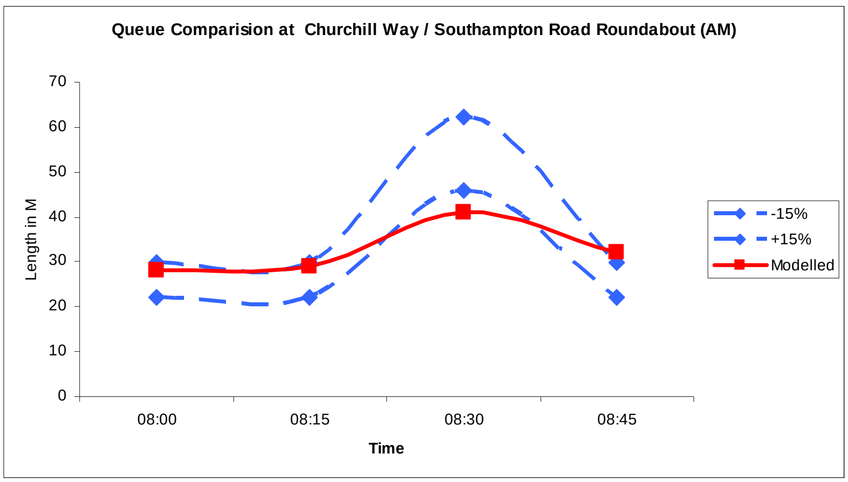
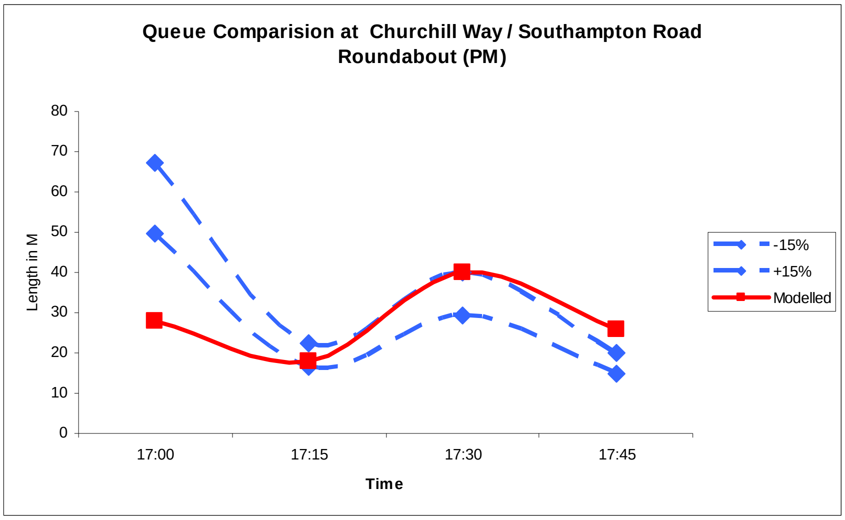


Table 4.16 – Queue Length Calibration for Evening Period

Time Start	Observed Queue Length (metres)	Modelled Mean Maximum Queue Length (m)	% Difference
08:00	59	28	52%
08:15	20	18	8%
08:30	35	40	15%
08:45	17	26	50%
Average	**33**	**28**	**14%**

Figure 4.7 – Queue Length Calibration Graph for Evening Period



4.12 Given the vagaries of this queue length data, this two profiles demonstrate a very reasonable calibration of queues on the A36 at Churchill Way / Sounthampton Road roundabout.

5. Multi-Seed Validation

Introduction

5.1 A VISSIM takes aggregately collected data (traffic movements and volumes for one hour) and translates this into individual vehicle flow. It does this stochastically with the parameters governed by a random number ‘seed’. Model calibration demonstrates that the model performs well against observed data for this particular seed. During validation, the model is tested for ten different ‘seed’ values. The seed values represent different starting points for the random number generator and can be considered as an arbitrary choice.

5.2 To demonstrate the validation of the model, the results of the average of the modelled journey times of the ten different-seed runs. If the average of these runs is within +/-15% of the observed value that it can be assumed that the chosen model seed is not responsible to the calibration of the model and the model validates.

Average Journey Time Validation

5.3 The results of the journey time validation, using the average journey time of the ten multi-seed model runs are presented in Table 5.1 to Table 5.3.

5.4 In the morning peak all runs fall with the +/-15% criteria whilst in the inter-peak eight out of ten meet the criteria and in evening peak nine out of ten meet the criteria. This demonstrates that the choice of seed value is not influencing the model performance and indicates a high degree of validation of the model.

Table 5.1 – Multi-Run Journey Time Validation for Morning Period

ROUTE	Modelled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff
Route 1 Northbound	463	505	-8.4%
Route 1 Southbound	313	331	-5.4%
Route 2 Northbound	418	387	7.9%
Route 2 Southbound	429	383	12.1%
Route 3 Northbound	190	208	-8.9%
Route 3 Southbound	123	137	-10.4%
Route 4 Eastbound	168	184	-8.5%
Route 4 Westbound	312	303	2.9%
Route 5 Northbound	174	163	6.7%
Route 5 Southbound	146	136	7.1%

Table 5.2 – Multi-Run Journey Time Validation for Inter Peak Period

ROUTE	Modelled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff
Route 1 Northbound	452	425	6.4%
Route 1 Southbound	318	335	-5.0%
Route 2 Northbound	410	434	-5.6%
Route 2 Southbound	397	460	-13.6%
Route 3 Northbound	127	128	-1.1%
Route 3 Southbound	115	105	10.0%
Route 4 Eastbound	196	212	-7.3%
Route 4 Westbound	389	449	-13.4%
Route 5 Northbound	148	149	-0.8%
Route 5 Southbound	139	150	-7.2%

Table 5.3 – Multi-Run Journey Time Validation for Evening Period

ROUTE	Modelled Travel Time (Sec)	Mean Observed Time(Sec)	% Diff
Route 1 Northbound	476	527	-9.6%
Route 1 Southbound	420	386	8.8%
Route 2 Northbound	441	440	0.2%
Route 2 Southbound	491	527	-6.9%
Route 3 Northbound	160	127	26.1%
Route 3 Southbound	144	161	-10.4%
Route 4 Eastbound	233	215	8.4%
Route 4 Westbound	417	450	-7.4%
Route 5 Northbound	171	160	6.9%
Route 5 Southbound	136	135	1.0%

6. Summary

6.1 This Micro Simulation Model Validation Report forms deliverable 2.5 of the Transport Models for Salisbury commission and it describes the development, calibration and validation of two micro simulation models for the Salisbury, one in Salisbury City Centre and the other along the A36 from Tesco on Southampton Road to the Harnham Gyratory.

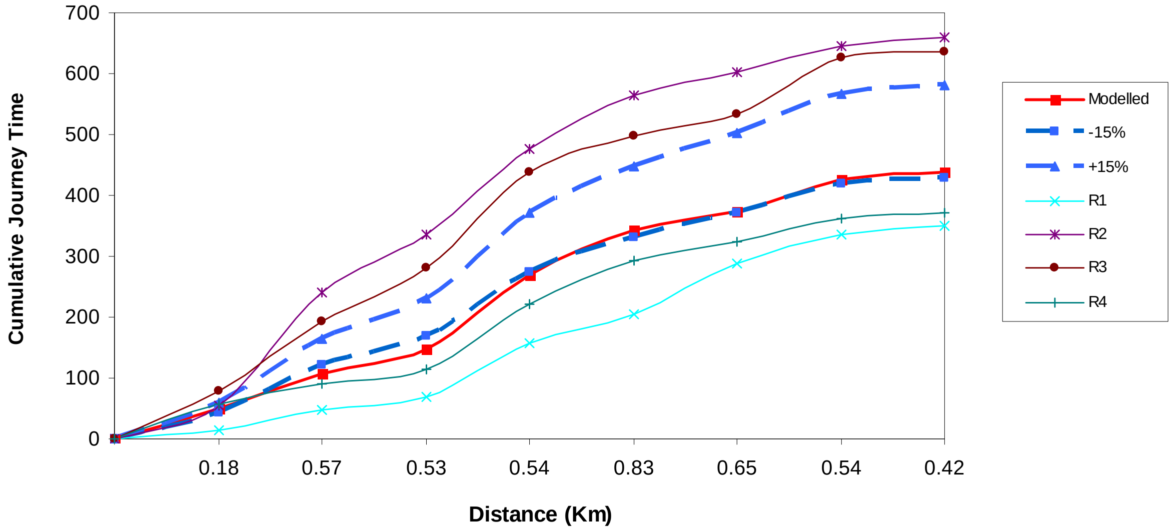
6.2 The model represents a typical weekday (Monday – Thursday) in neutral month (October) of 2008. It covers the morning and evening peak hours (08:00 to 09:00 and 17:00 to 18:00 respectively) and an average hour in the inter-peak period (between 10:00 and 16:00).

6.3 The Salisbury Micro-simulation Model (SMM) has been shown to replicate traffic flows, journey times and a queue length during the calibration process.

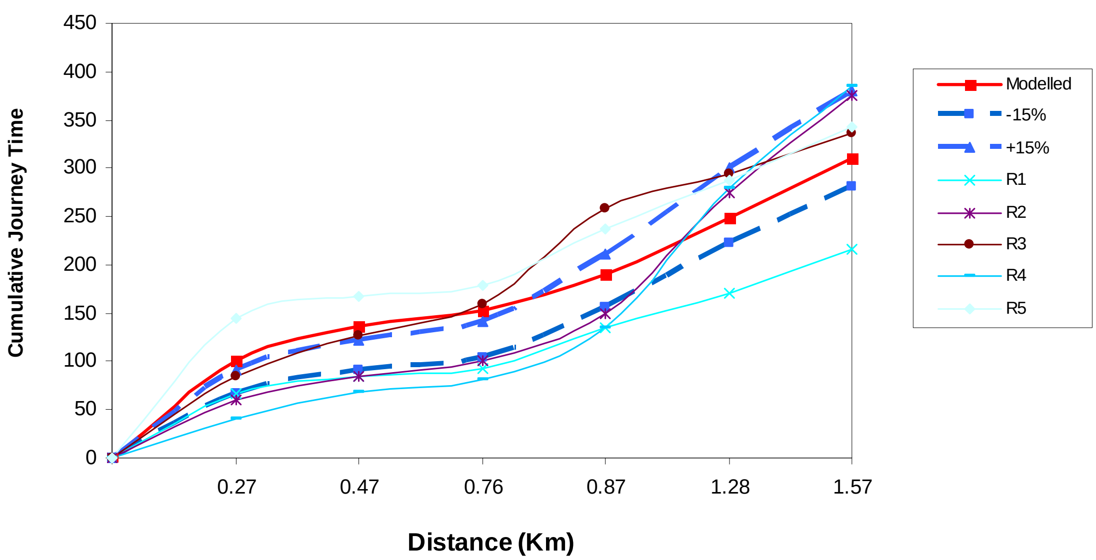
6.4 The validation process compares the average of the journey time results for ten additional model runs, each using a different random number seed. The results demonstrate that the model validates satisfactorily.

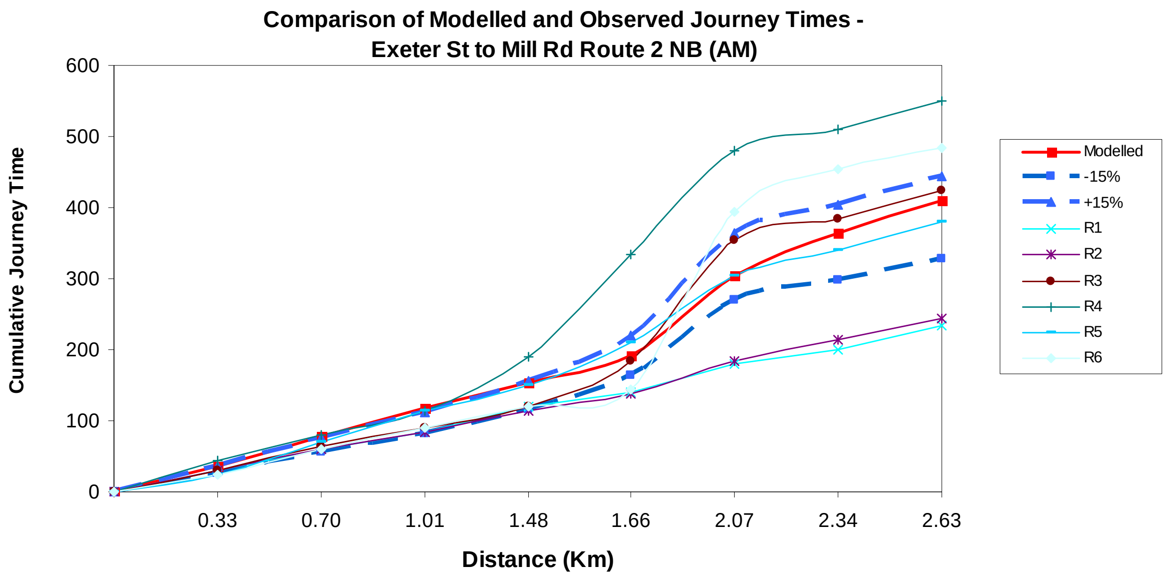
Appendix A
Journey Time Plots

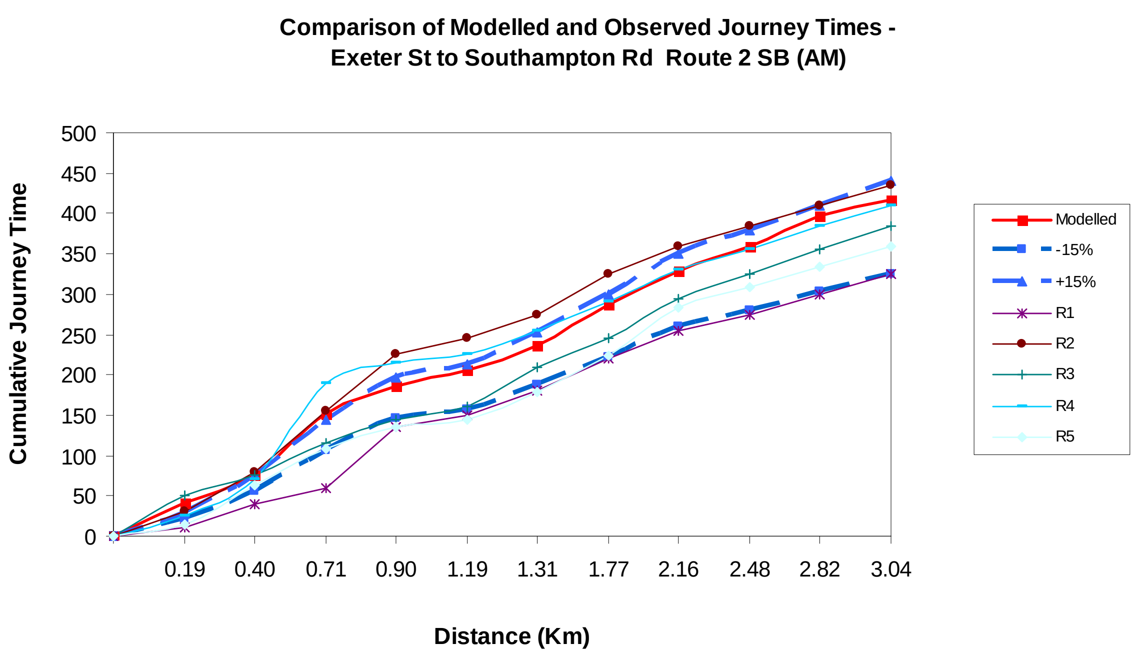
Comparison of Modelled and Observed Journey Times - Exeter street to Mildford Street Route 1 NB (AM)

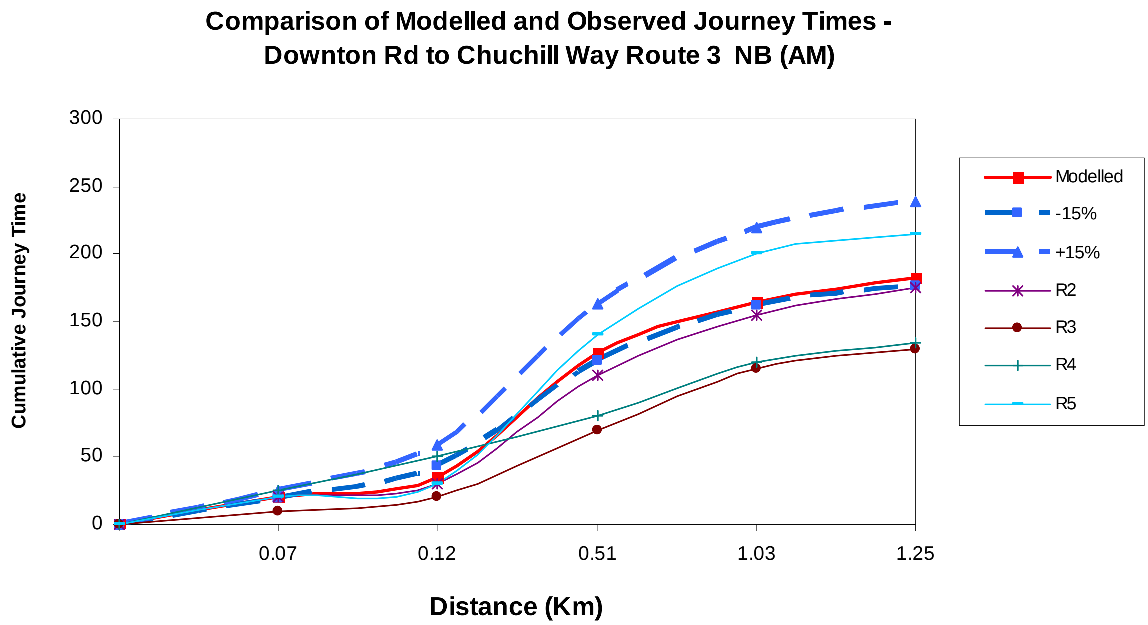


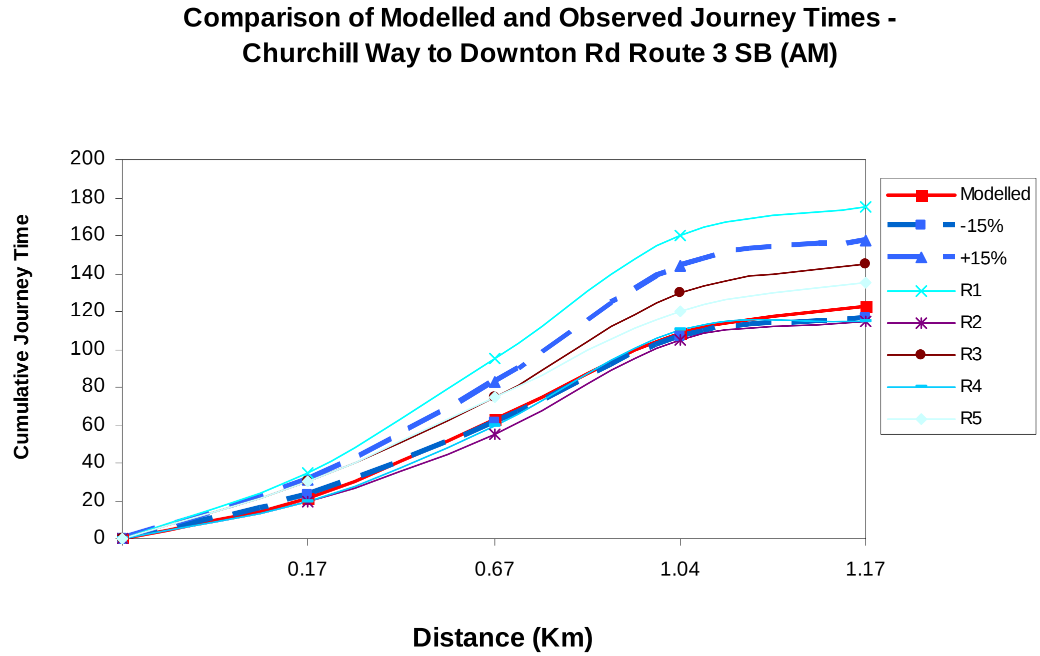
Comparison of Modelled and Observed Journey Times - Exeter street to New Harnham St Route 1 SB (AM)

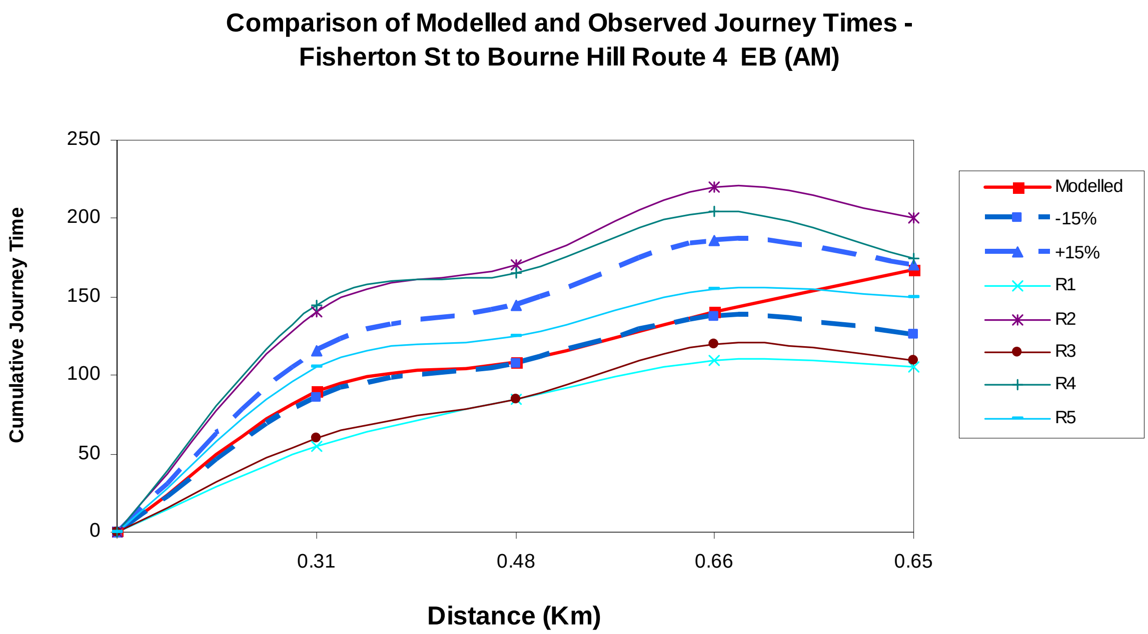


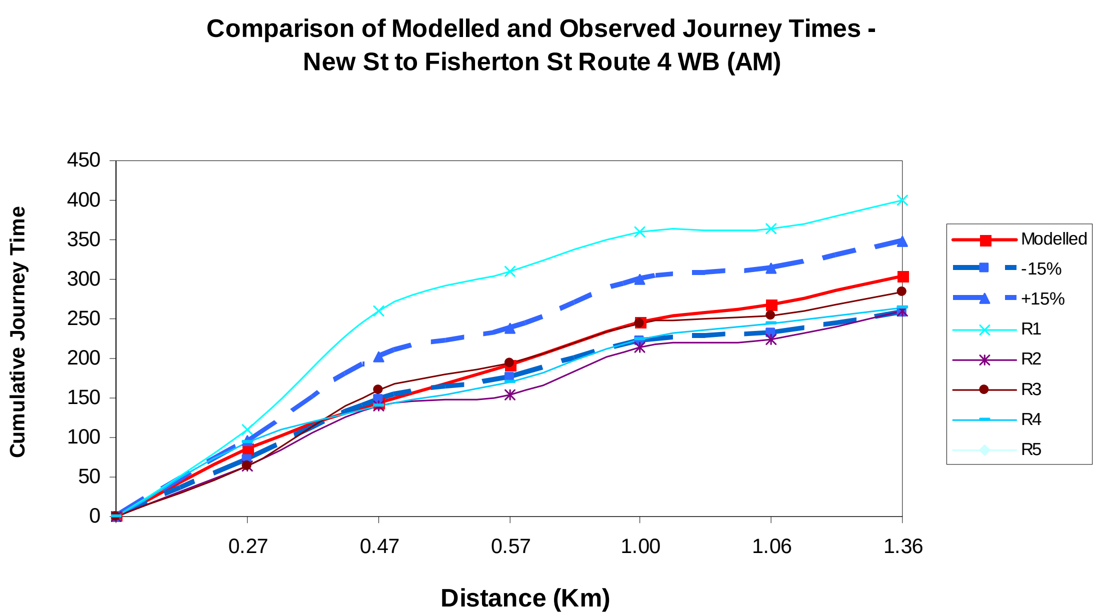

Comparison of Modelled and Observed Journey Times -
Exeter St to Mill Rd Route 2 NB (AM)
Cumulative Journey Time
600
500
400
300
200
100
0
0.33
0.70
1.01
1.48
1.66
2.07
2.34
2.63
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

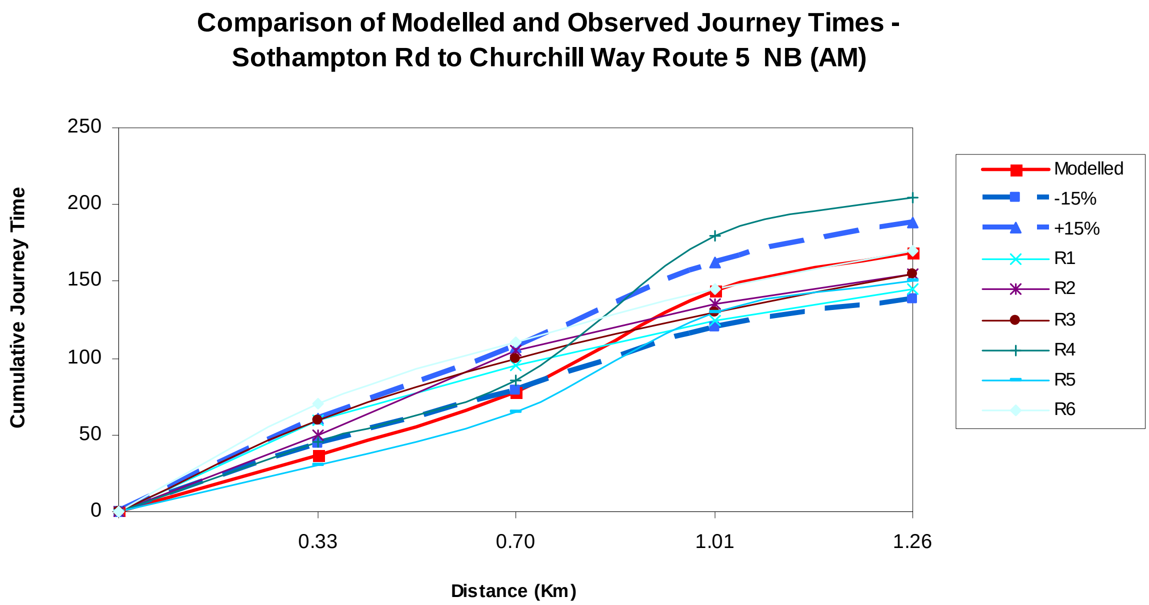

Comparison of Modelled and Observed Journey Times -
Exeter St to Southampton Rd Route 2 SB (AM)
Cumulative Journey Time
500
450
400
350
300
250
200
150
100
50
0
0.19
0.40
0.71
0.90
1.19
1.31
1.77
2.16
2.48
2.82
3.04
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

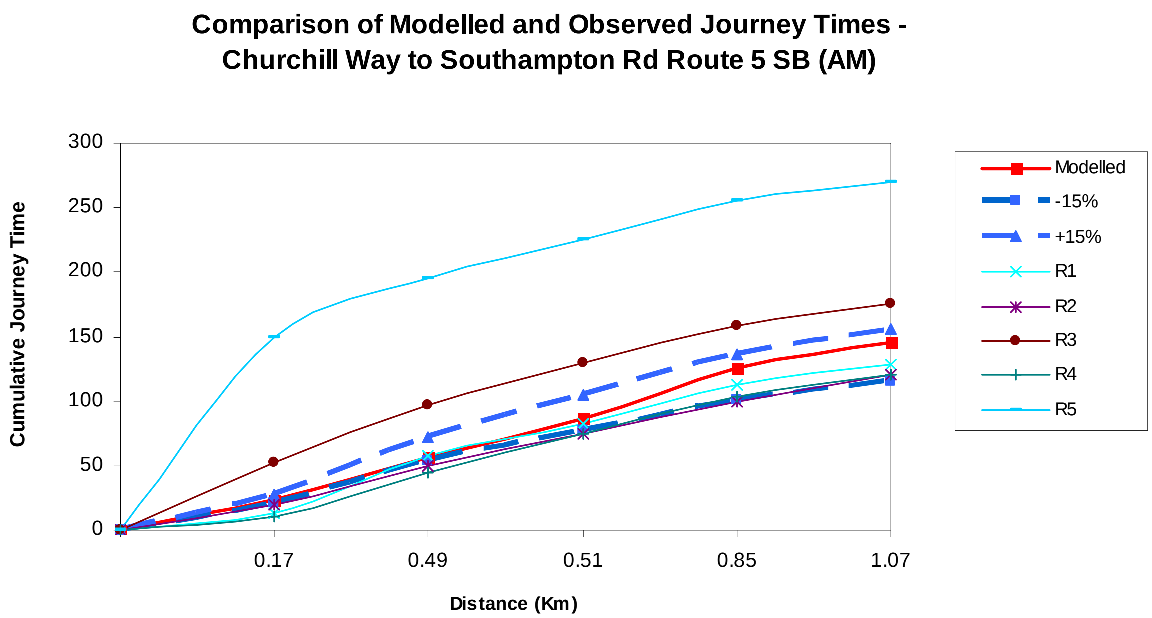

Comparison of Modelled and Observed Journey Times -
Downton Rd to Chuchill Way Route 3 NB (AM)
Cumulative Journey Time
300
250
200
150
100
50
0
0.07
0.12
0.51
1.03
1.25
Distance (Km)
Modelled
-15%
+15%
R2
R3
R4
R5


Comparison of Modelled and Observed Journey Times -
Churchill Way to Downton Rd Route 3 SB (AM)
Cumulative Journey Time
200
180
160
140
120
100
80
60
40
20
0
0.17
0.67
1.04
1.17
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

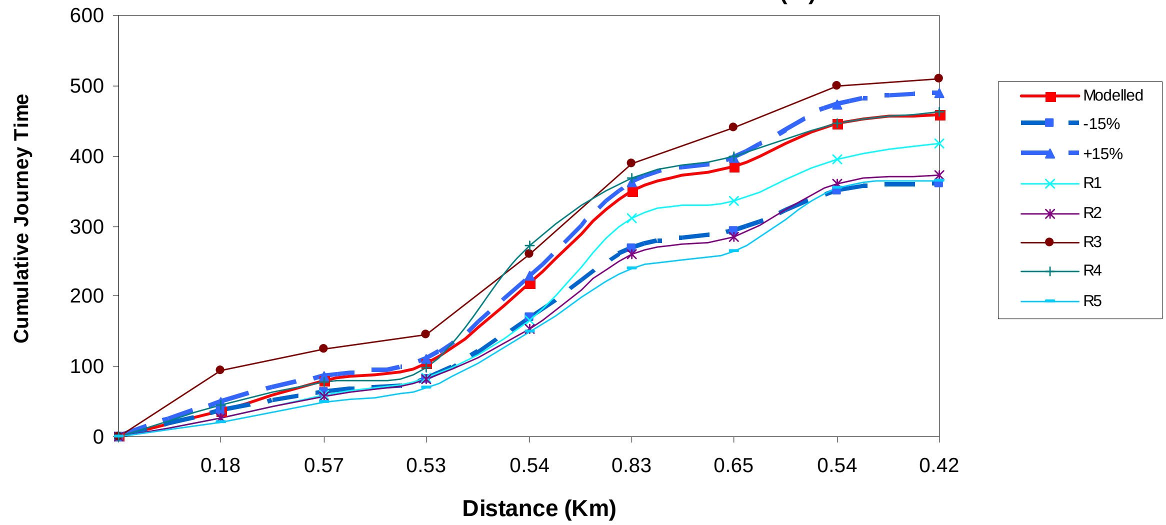

Comparison of Modelled and Observed Journey Times -
Fisherton St to Bourne Hill Route 4 EB (AM)
250
200
150
100
50
0
Cumulative Journey Time
0.31
0.48
0.66
0.65
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5


Comparison of Modelled and Observed Journey Times -
New St to Fisherton St Route 4 WB (AM)
450
400
350
300
250
200
150
100
50
0
Cumulative Journey Time
0.27
0.47
0.57
1.00
1.06
1.36
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

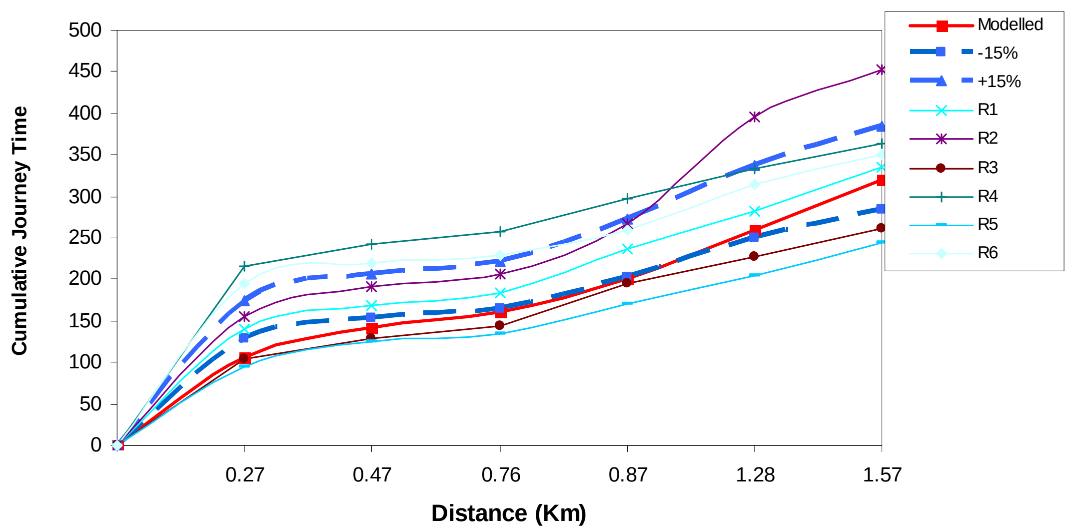

Comparison of Modelled and Observed Journey Times -
Sothampton Rd to Churchill Way Route 5 NB (AM)
Cumulative Journey Time
250
200
150
100
50
0
0.33
0.70
1.01
1.26
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

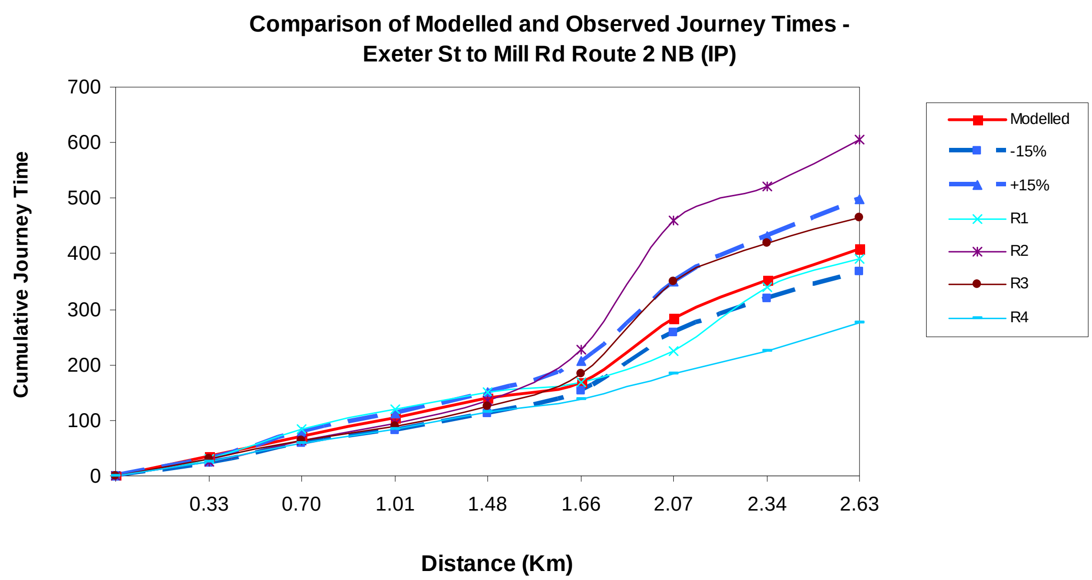

Comparison of Modelled and Observed Journey Times -
Churchill Way to Southampton Rd Route 5 SB (AM)
Cumulative Journey Time
300
250
200
150
100
50
0
0.17
0.49
0.51
0.85
1.07
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

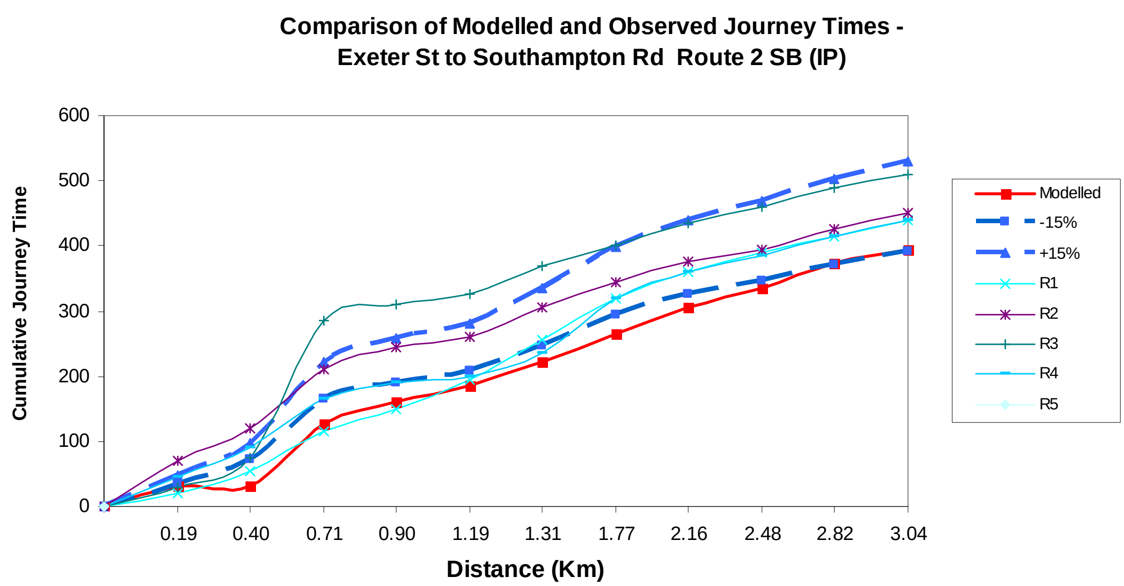
Comparison of Modelled and Observed Journey Times - Exeter street to Mildford Street Route 1 NB (IP)

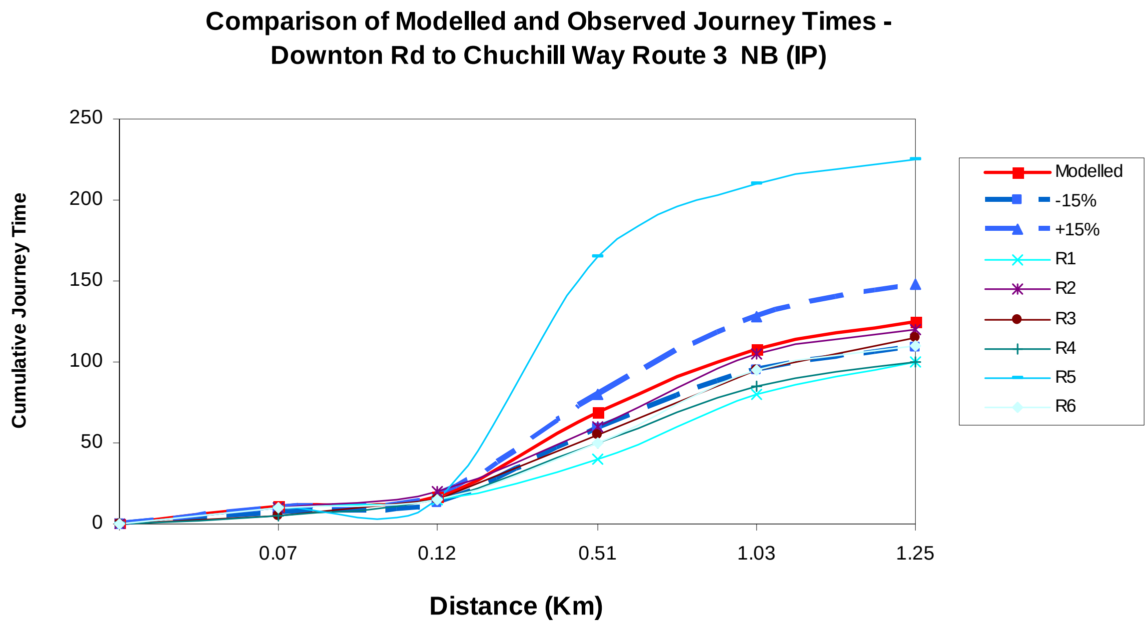


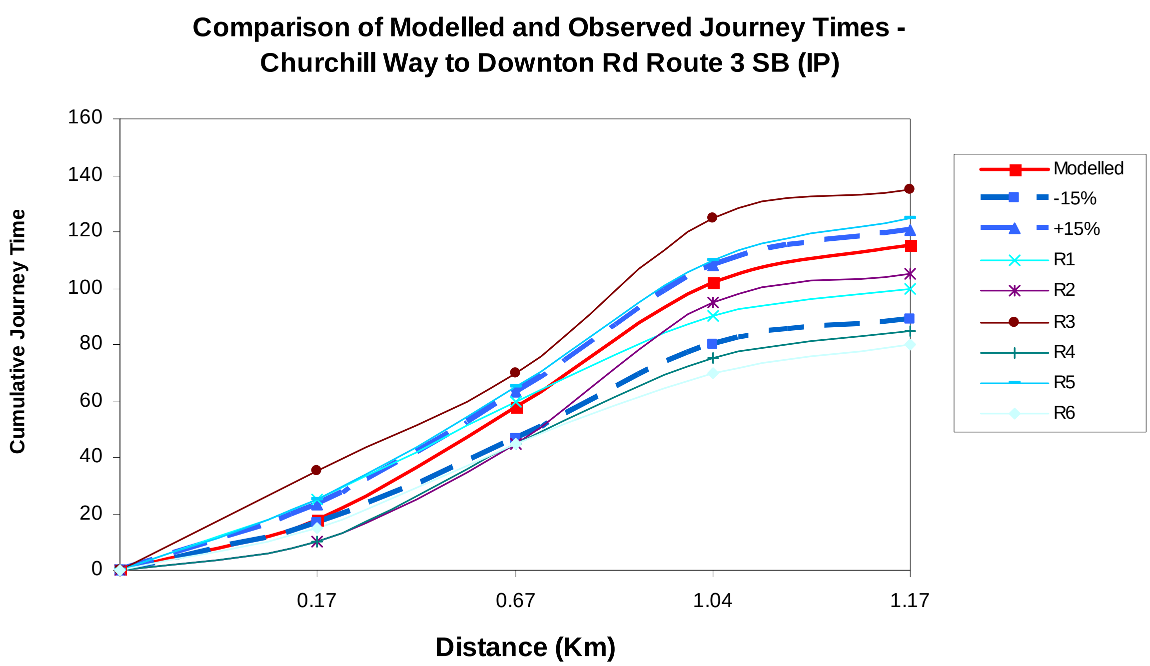
Comparison of Modelled and Observed Journey Times - Exeter street to New Harnham St Route 1 SB (IP)

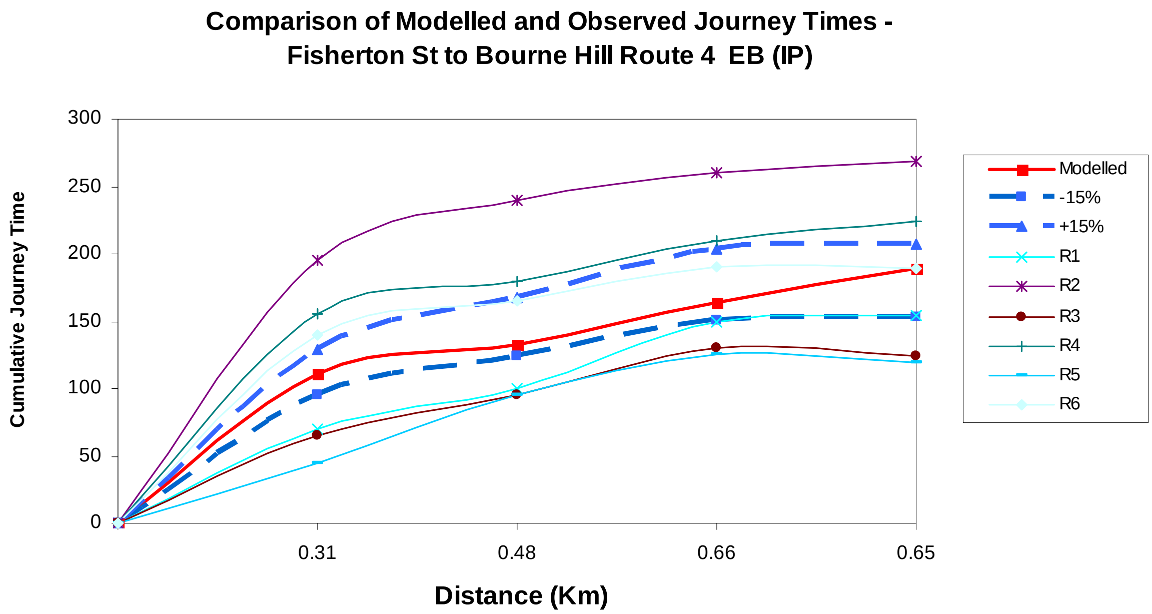


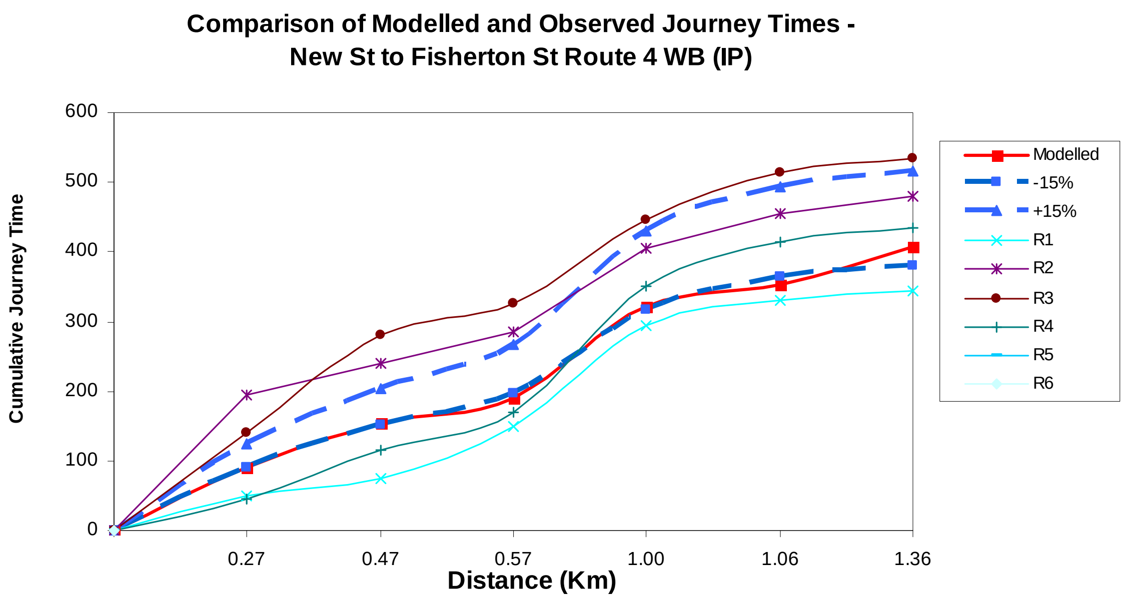

Comparison of Modelled and Observed Journey Times -
Exeter St to Mill Rd Route 2 NB (IP)
Cumulative Journey Time
0
100
200
300
400
500
600
700
0.33
0.70
1.01
1.48
1.66
2.07
2.34
2.63
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4

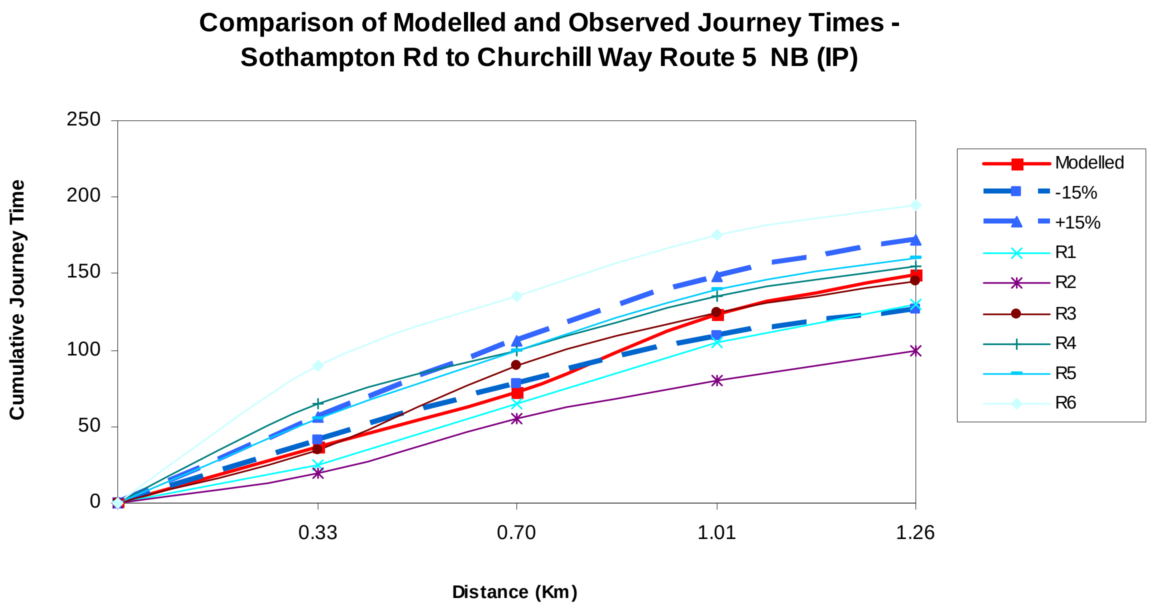

Comparison of Modelled and Observed Journey Times -
Exeter St to Southampton Rd Route 2 SB (IP)
Cumulative Journey Time
0
100
200
300
400
500
600
0.19
0.40
0.71
0.90
1.19
1.31
1.77
2.16
2.48
2.82
3.04
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

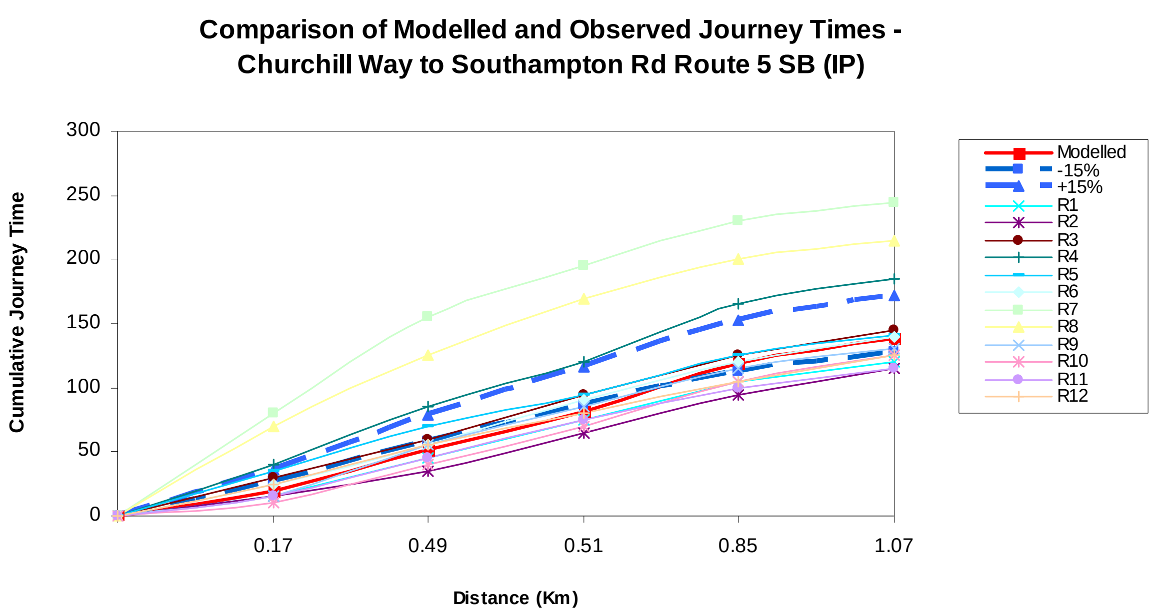

Comparison of Modelled and Observed Journey Times -
Downton Rd to Chuchill Way Route 3 NB (IP)
Cumulative Journey Time
250
200
150
100
50
0
0.07
0.12
0.51
1.03
1.25
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

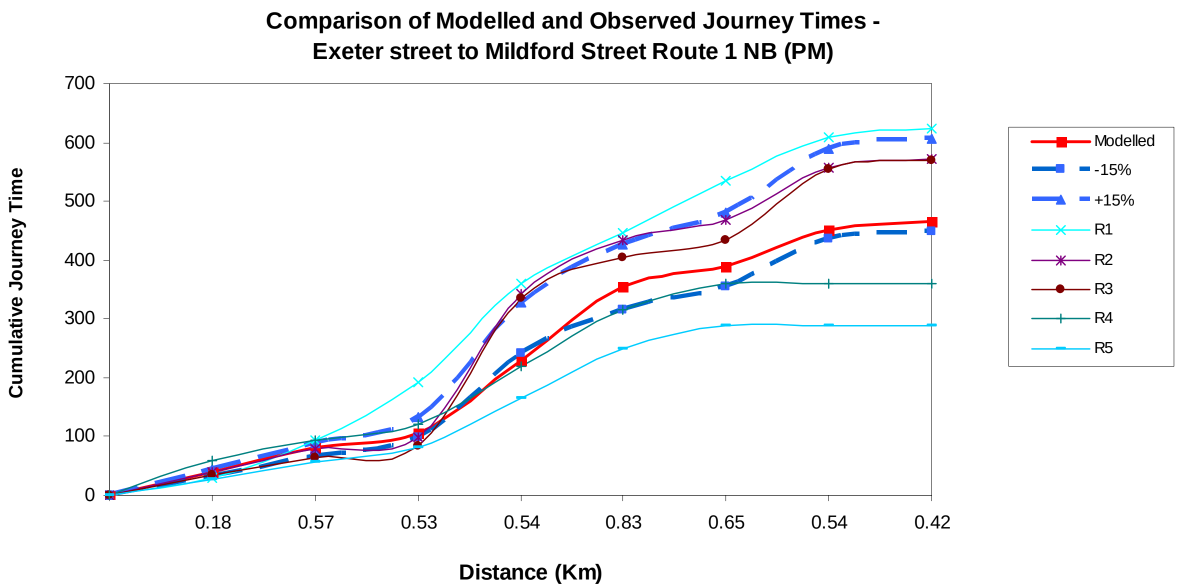

Comparison of Modelled and Observed Journey Times -
Churchill Way to Downton Rd Route 3 SB (IP)
Cumulative Journey Time
160
140
120
100
80
60
40
20
0
0.17
0.67
1.04
1.17
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

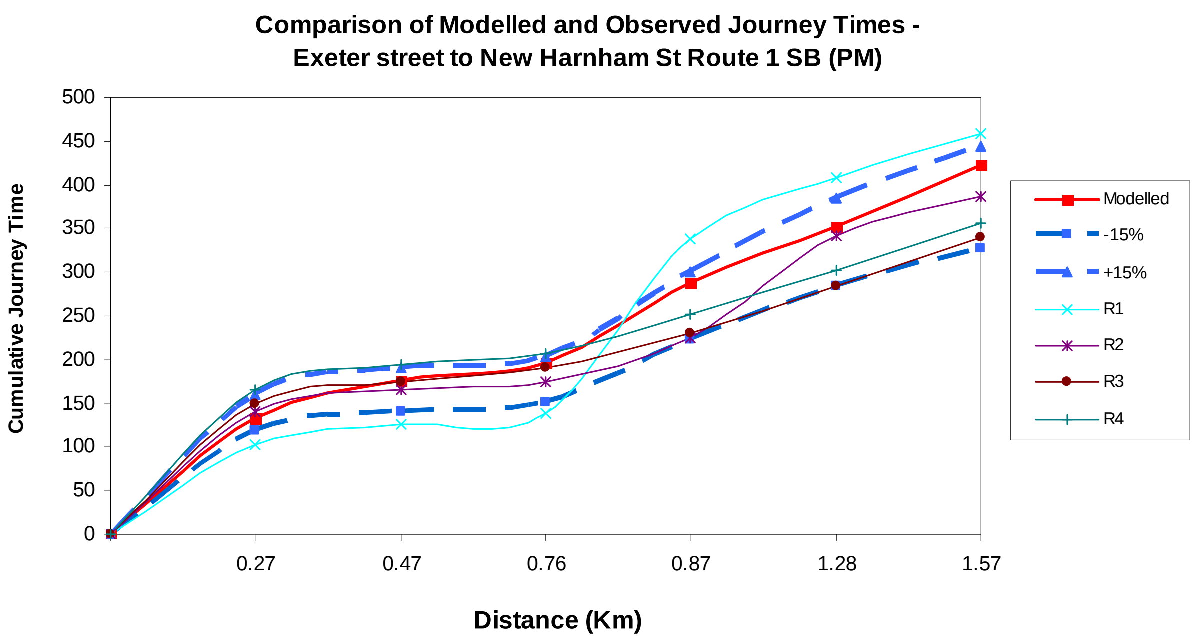

Comparison of Modelled and Observed Journey Times -
Fisherton St to Bourne Hill Route 4 EB (IP)
Cumulative Journey Time
300
250
200
150
100
50
0
0.31
0.48
0.66
0.65
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

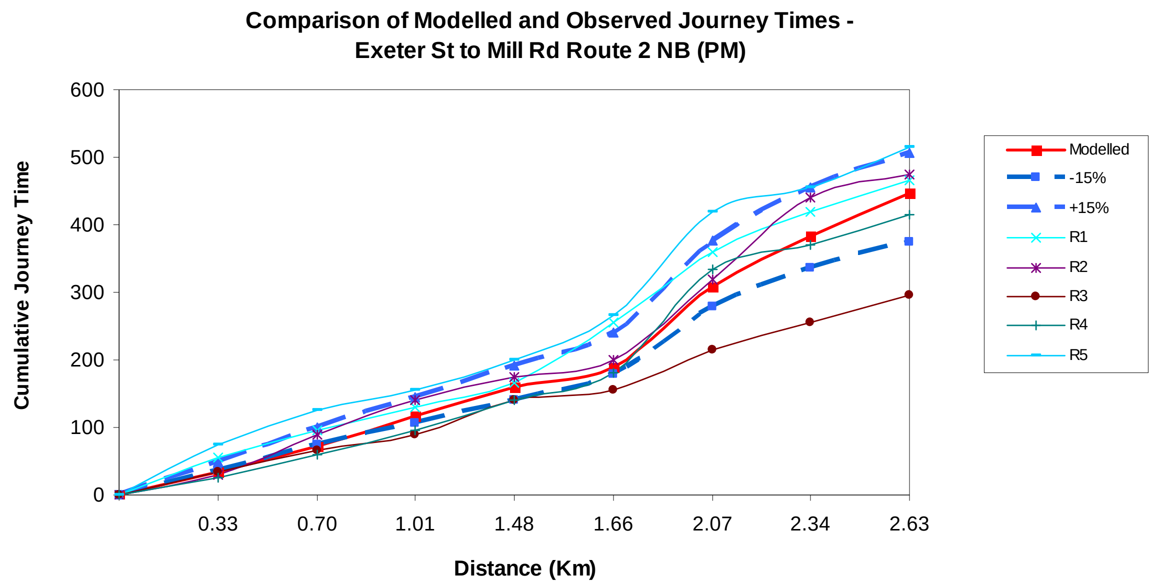

Comparison of Modelled and Observed Journey Times -
New St to Fisherton St Route 4 WB (IP)
Cumulative Journey Time
600
500
400
300
200
100
0
0.27
0.47
0.57
1.00
1.06
1.36
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

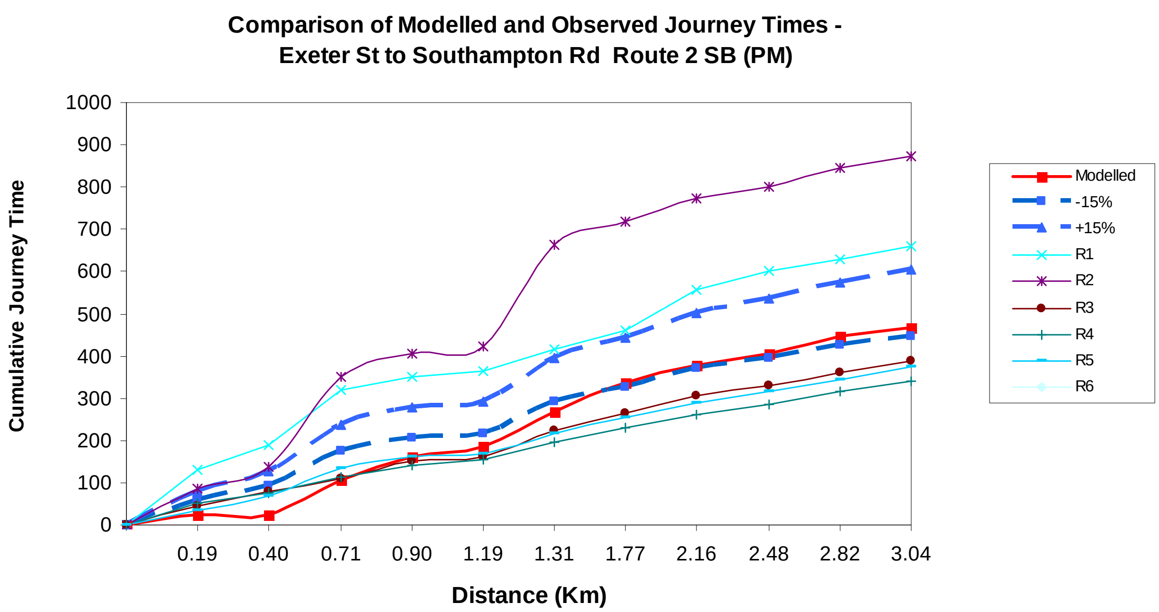

Comparison of Modelled and Observed Journey Times -
Sothampton Rd to Churchill Way Route 5 NB (IP)
Cumulative Journey Time
250
200
150
100
50
0
0.33
0.70
1.01
1.26
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

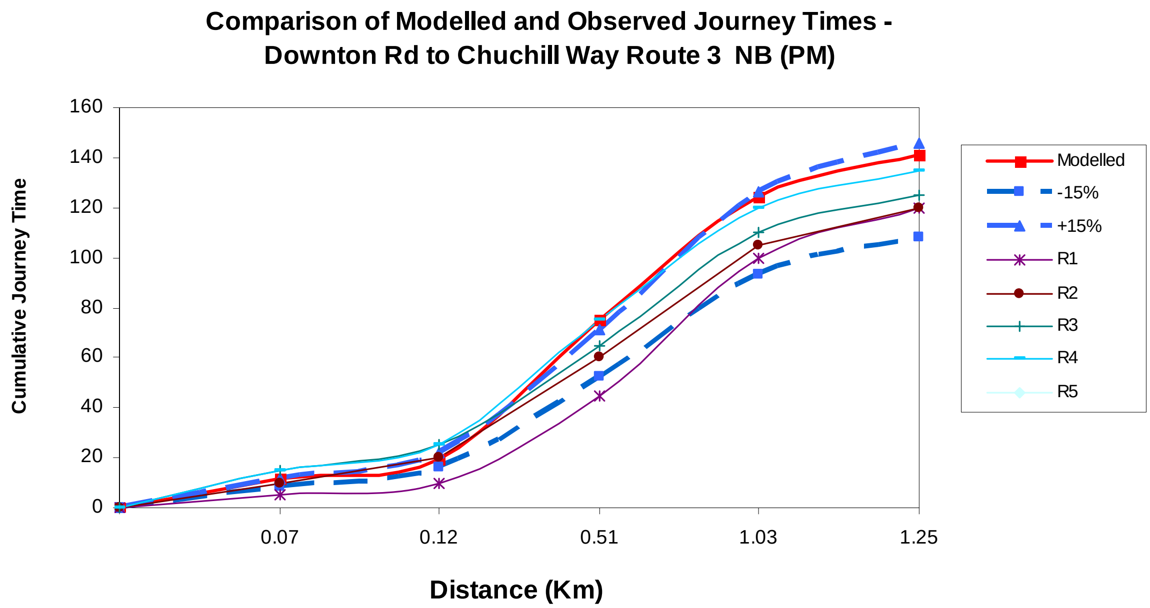

Comparison of Modelled and Observed Journey Times -
Churchill Way to Southampton Rd Route 5 SB (IP)
Cumulative Journey Time
300
250
200
150
100
50
0
0.17
0.49
0.51
0.85
1.07
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12

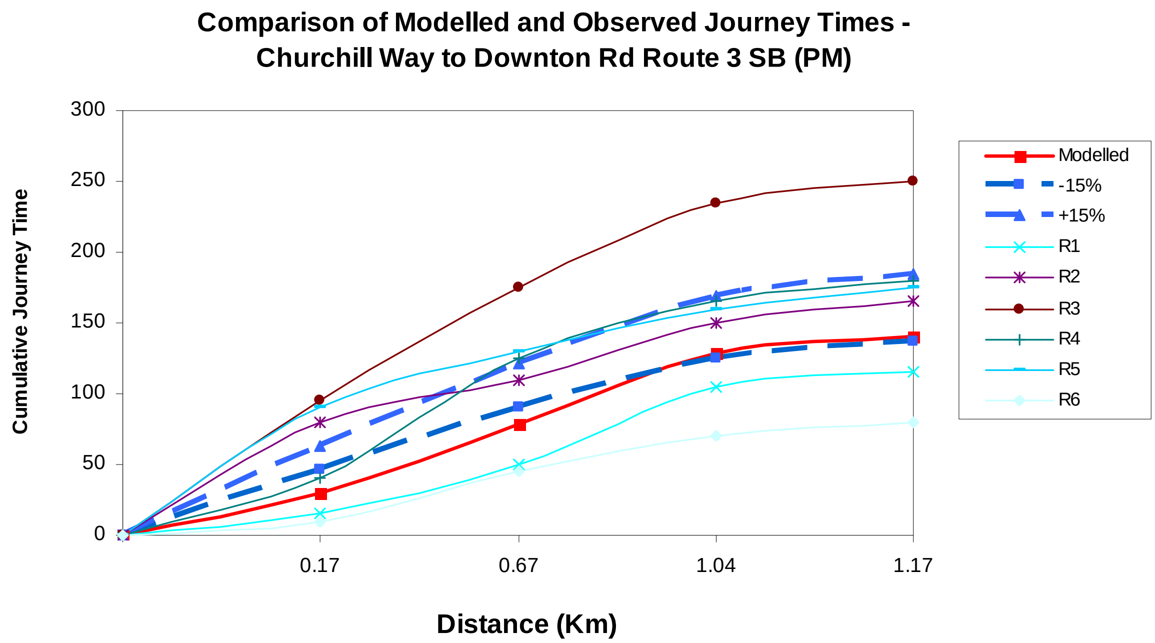

Comparison of Modelled and Observed Journey Times -
Exeter street to Mildford Street Route 1 NB (PM)
Cumulative Journey Time
0
100
200
300
400
500
600
700
0.18
0.57
0.53
0.54
0.83
0.65
0.54
0.42
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

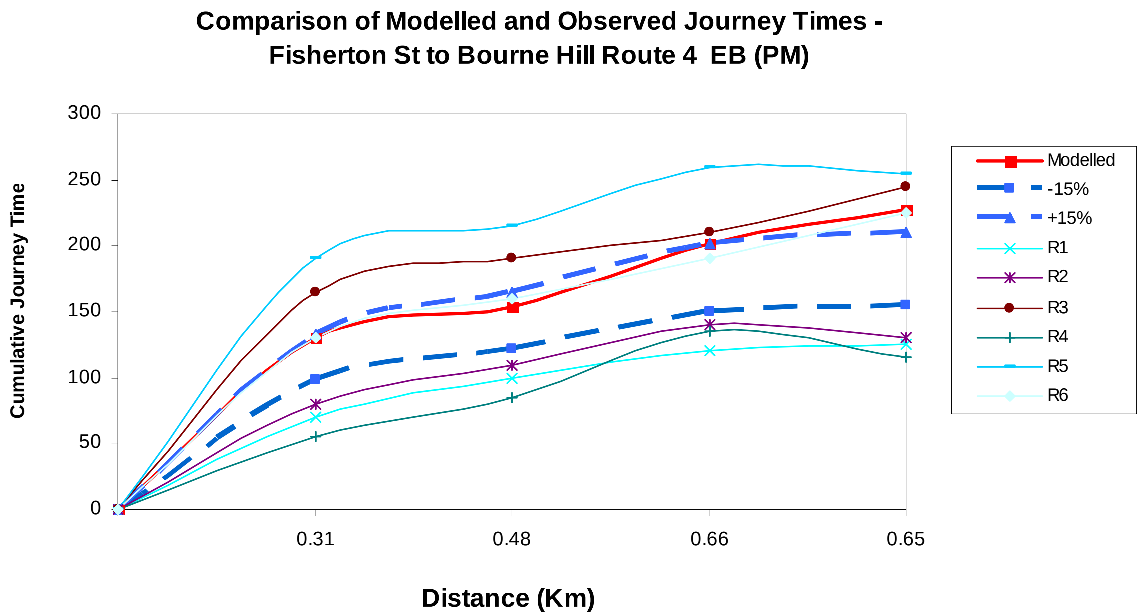

Comparison of Modelled and Observed Journey Times -
Exeter street to New Harnham St Route 1 SB (PM)
Cumulative Journey Time
0
50
100
150
200
250
300
350
400
450
500
0.27
0.47
0.76
0.87
1.28
1.57
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4

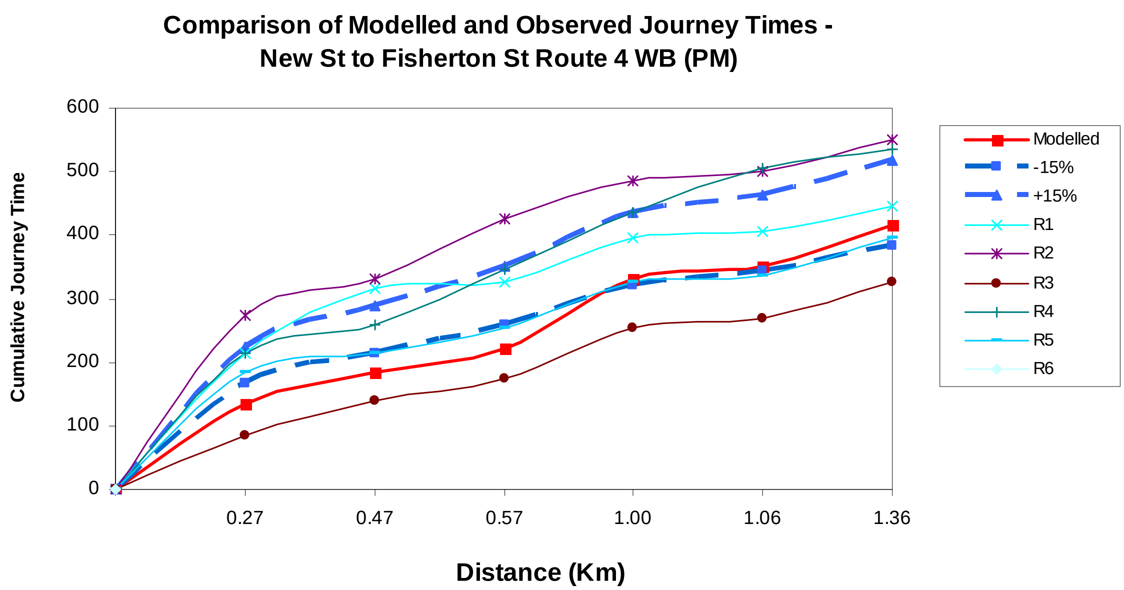

Comparison of Modelled and Observed Journey Times -
Exeter St to Mill Rd Route 2 NB (PM)
Cumulative Journey Time
600
500
400
300
200
100
0
0.33
0.70
1.01
1.48
1.66
2.07
2.34
2.63
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

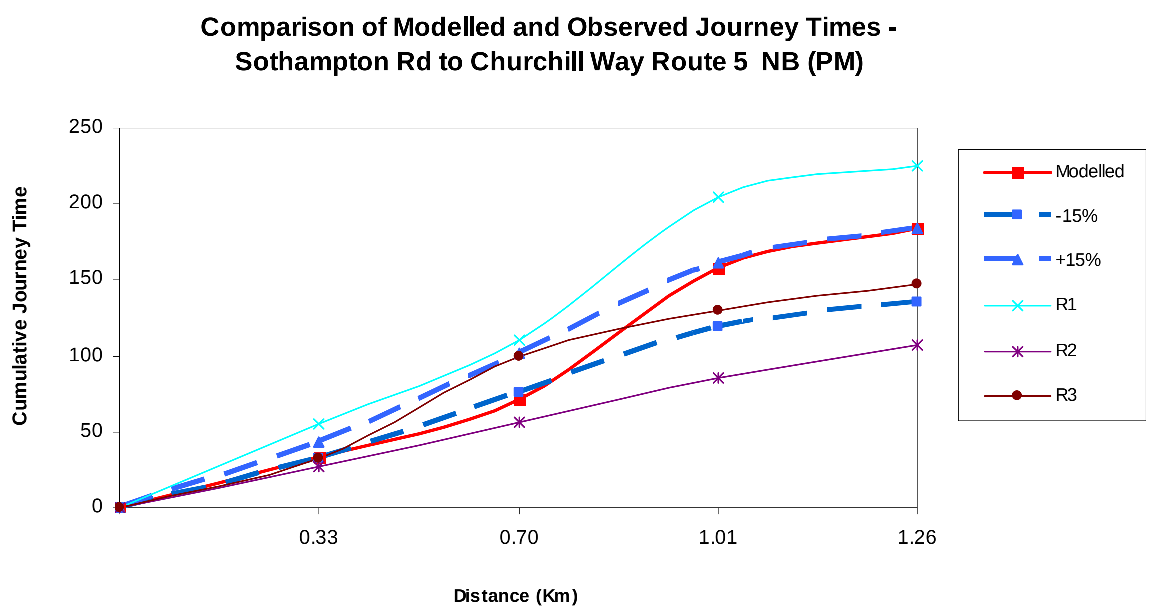

Comparison of Modelled and Observed Journey Times -
Exeter St to Southampton Rd Route 2 SB (PM)
Cumulative Journey Time
1000
900
800
700
600
500
400
300
200
100
0
0.19
0.40
0.71
0.90
1.19
1.31
1.77
2.16
2.48
2.82
3.04
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

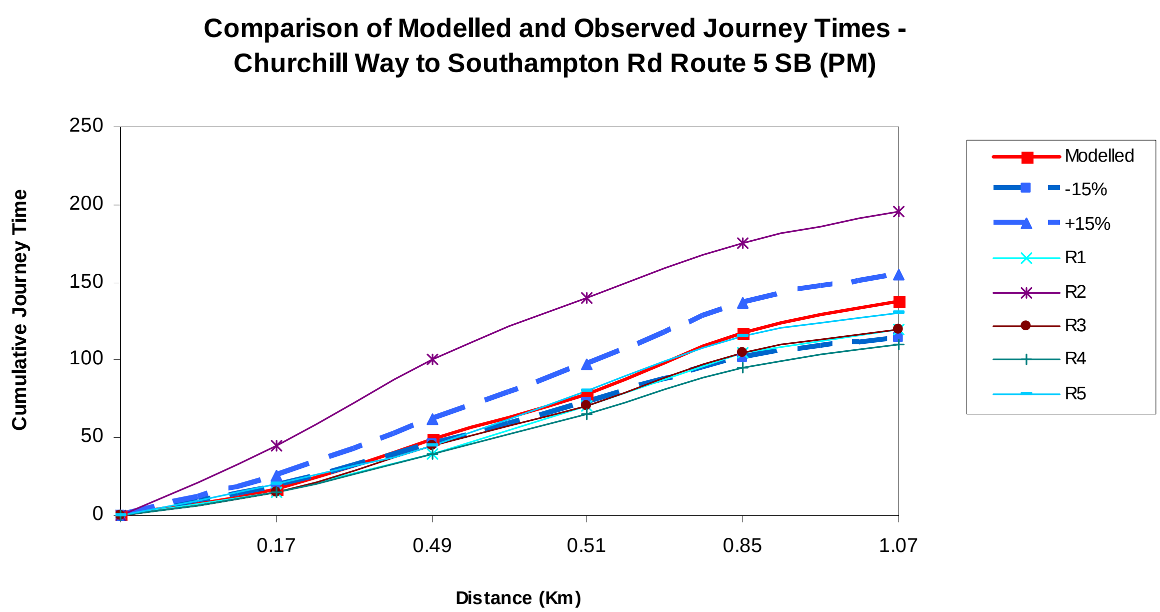

Comparison of Modelled and Observed Journey Times -
Downton Rd to Chuchill Way Route 3 NB (PM)
Cumulative Journey Time
160
140
120
100
80
60
40
20
0
0.07
0.12
0.51
1.03
1.25
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5


Comparison of Modelled and Observed Journey Times -
Churchill Way to Downton Rd Route 3 SB (PM)
Cumulative Journey Time
300
250
200
150
100
50
0
0.17
0.67
1.04
1.17
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

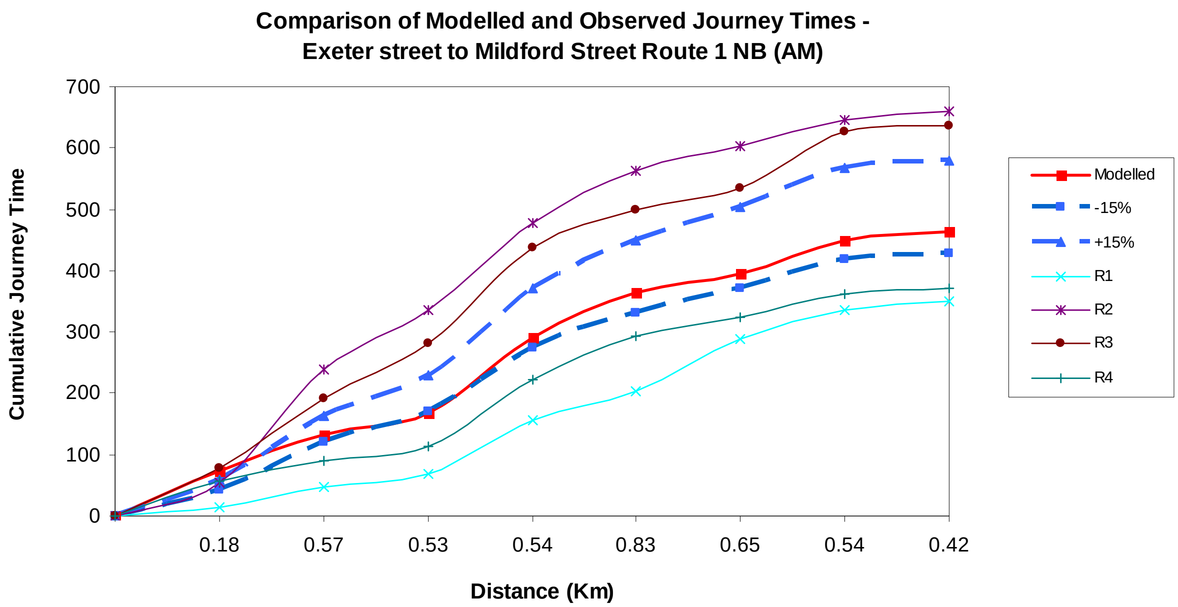

Comparison of Modelled and Observed Journey Times -
Fisherton St to Bourne Hill Route 4 EB (PM)
Cumulative Journey Time
300
250
200
150
100
50
0
0.31
0.48
0.66
0.65
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

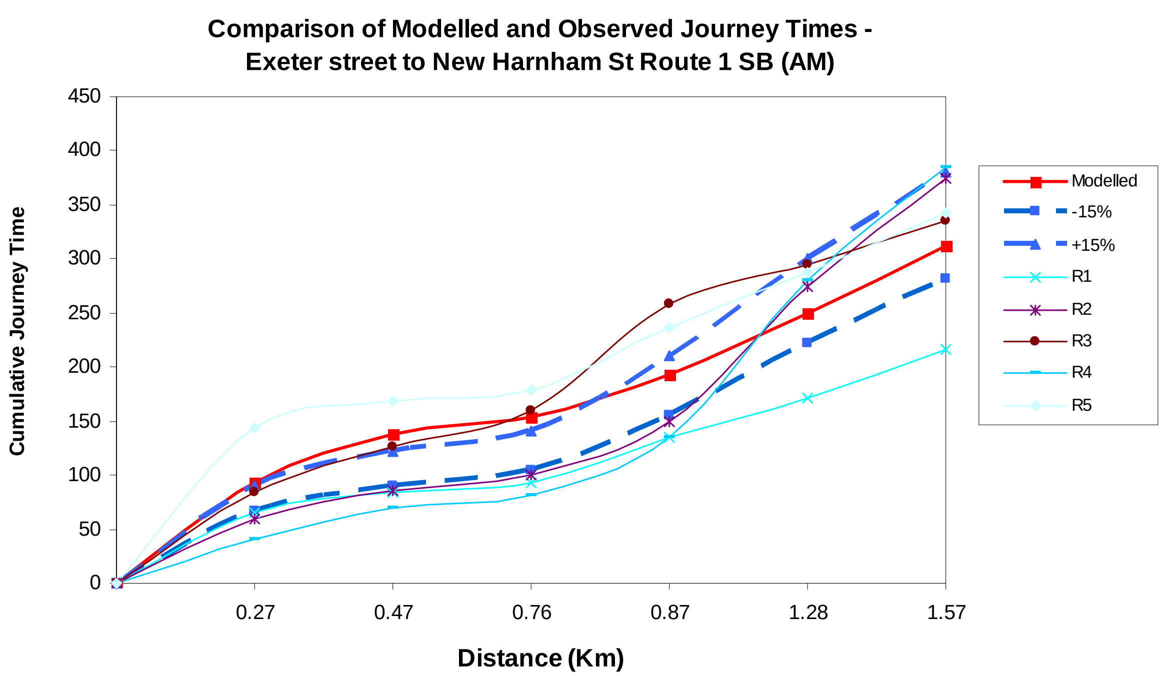

Comparison of Modelled and Observed Journey Times -
New St to Fisherton St Route 4 WB (PM)
Cumulative Journey Time
600
500
400
300
200
100
0
0.27
0.47
0.57
1.00
1.06
1.36
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

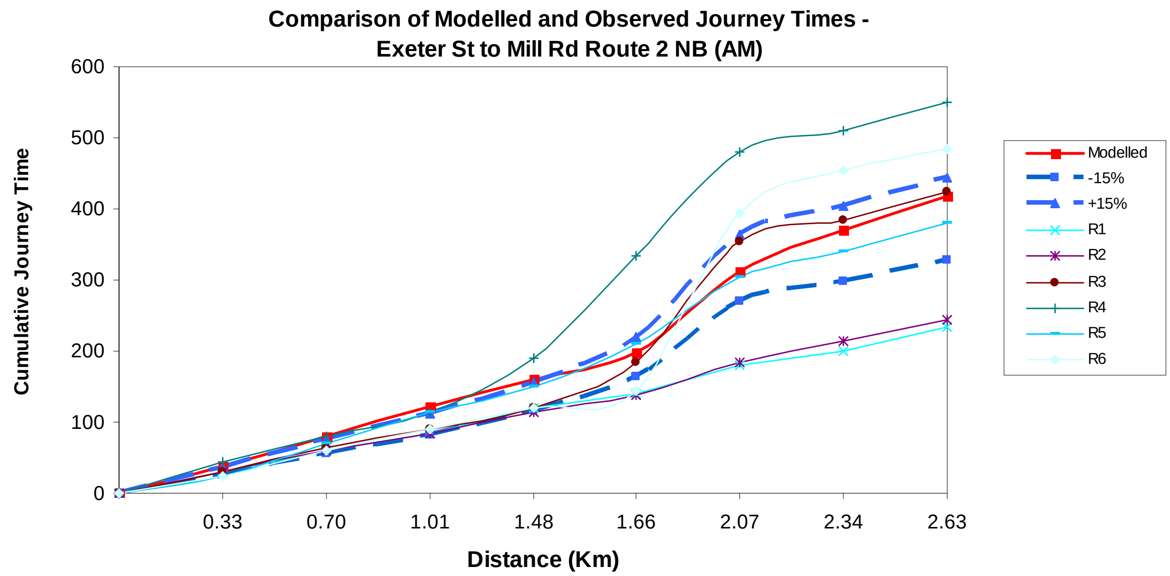

Comparison of Modelled and Observed Journey Times -
Sothampton Rd to Churchill Way Route 5 NB (PM)
Cumulative Journey Time
250
200
150
100
50
0
0.33
0.70
1.01
1.26
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3

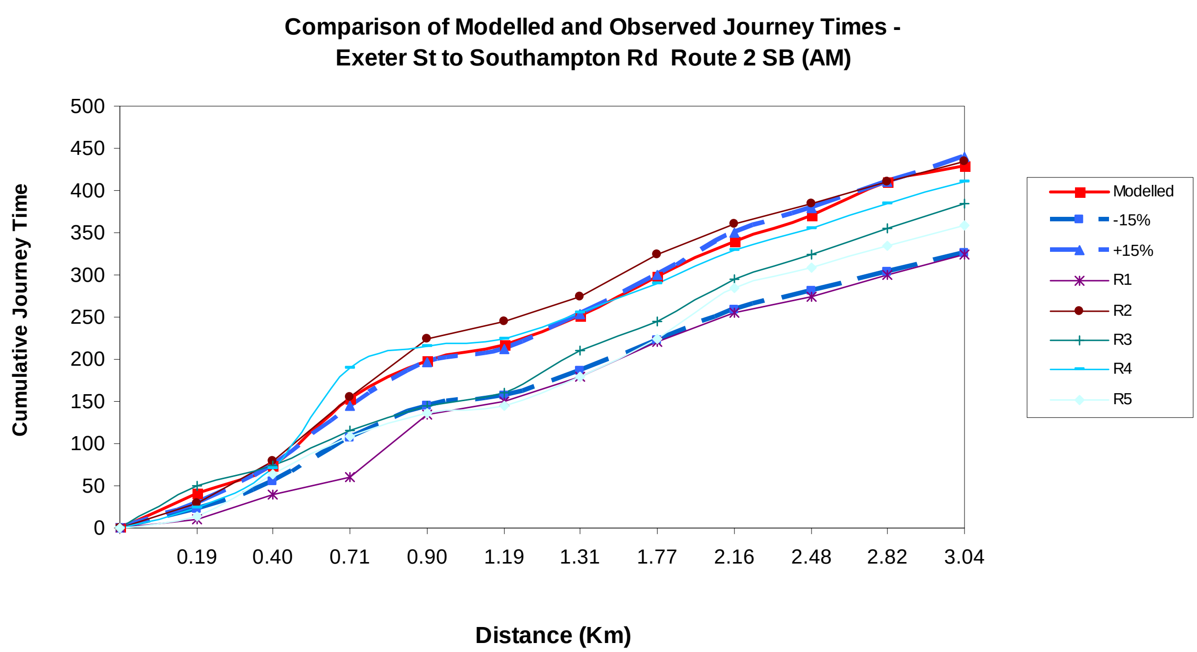

Comparison of Modelled and Observed Journey Times -
Churchill Way to Southampton Rd Route 5 SB (PM)
Cumulative Journey Time
250
200
150
100
50
0
0.17
0.49
0.51
0.85
1.07
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

Appendix B
Multi-Seed Journey Time Plots

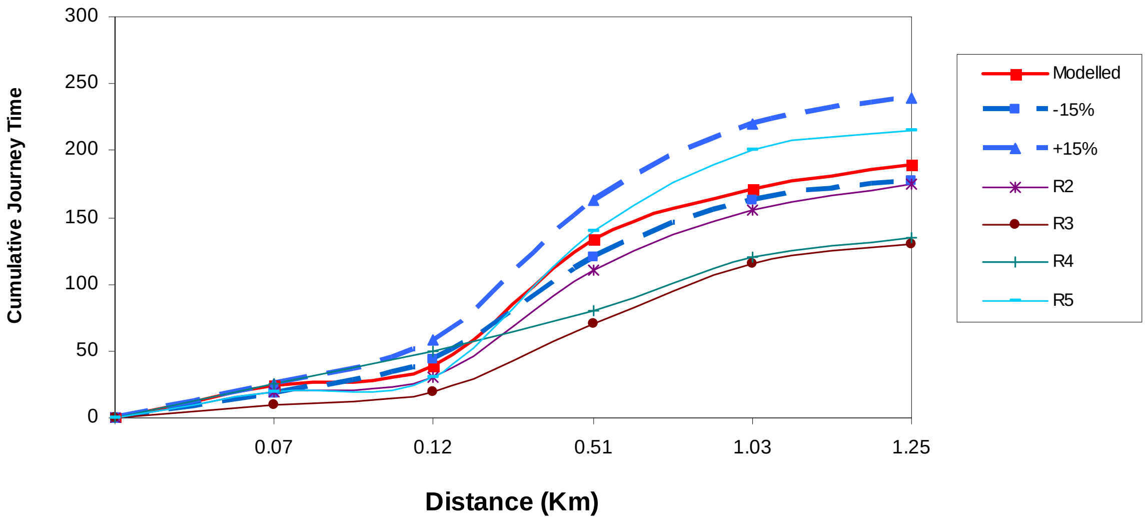

Comparison of Modelled and Observed Journey Times -
Exeter street to Mildford Street Route 1 NB (AM)
Cumulative Journey Time
700
600
500
400
300
200
100
0
0.18
0.57
0.53
0.54
0.83
0.65
0.54
0.42
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4


Comparison of Modelled and Observed Journey Times -
Exeter street to New Harnham St Route 1 SB (AM)
Cumulative Journey Time
450
400
350
300
250
200
150
100
50
0
0.27
0.47
0.76
0.87
1.28
1.57
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

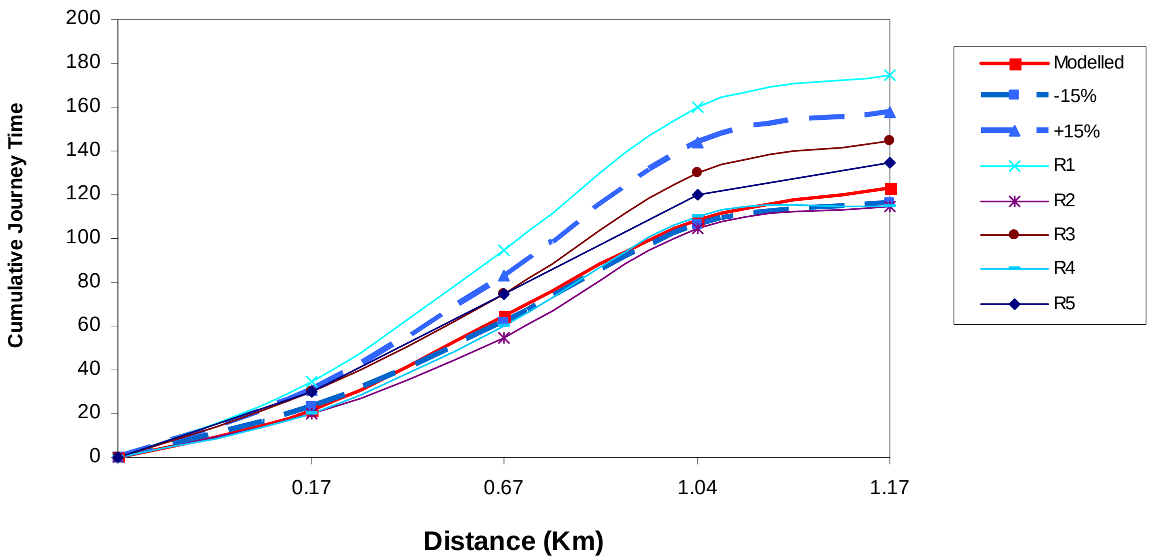

Comparison of Modelled and Observed Journey Times -
Exeter St to Mill Rd Route 2 NB (AM)
Cumulative Journey Time
600
500
400
300
200
100
0
0.33
0.70
1.01
1.48
1.66
2.07
2.34
2.63
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

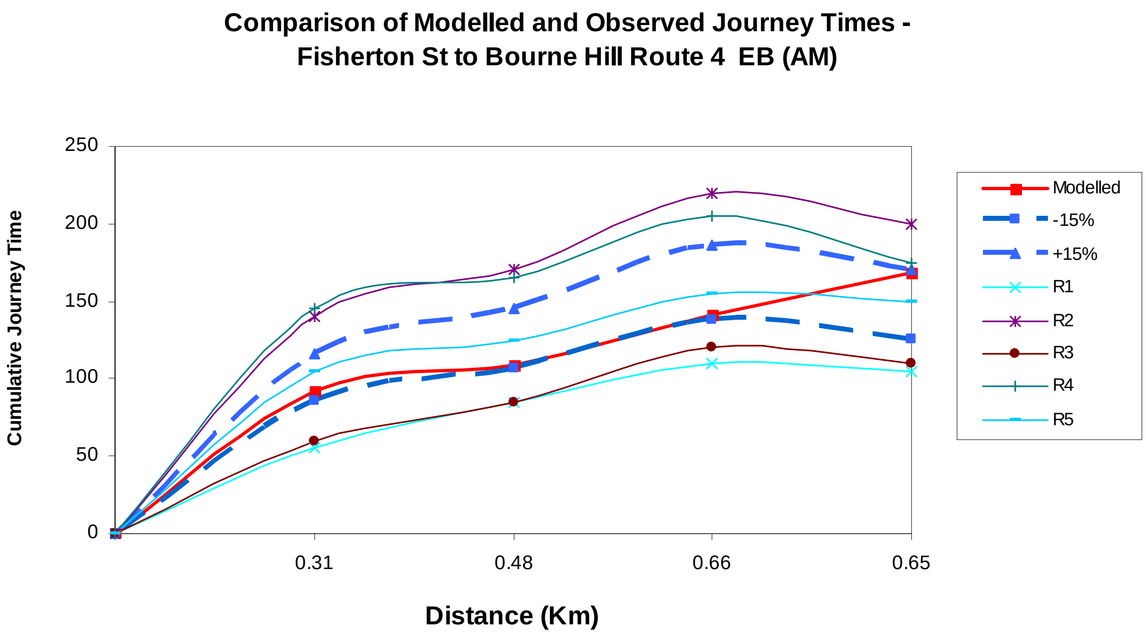

Comparison of Modelled and Observed Journey Times -
Exeter St to Southampton Rd Route 2 SB (AM)
Cumulative Journey Time
500
450
400
350
300
250
200
150
100
50
0
0.19
0.40
0.71
0.90
1.19
1.31
1.77
2.16
2.48
2.82
3.04
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

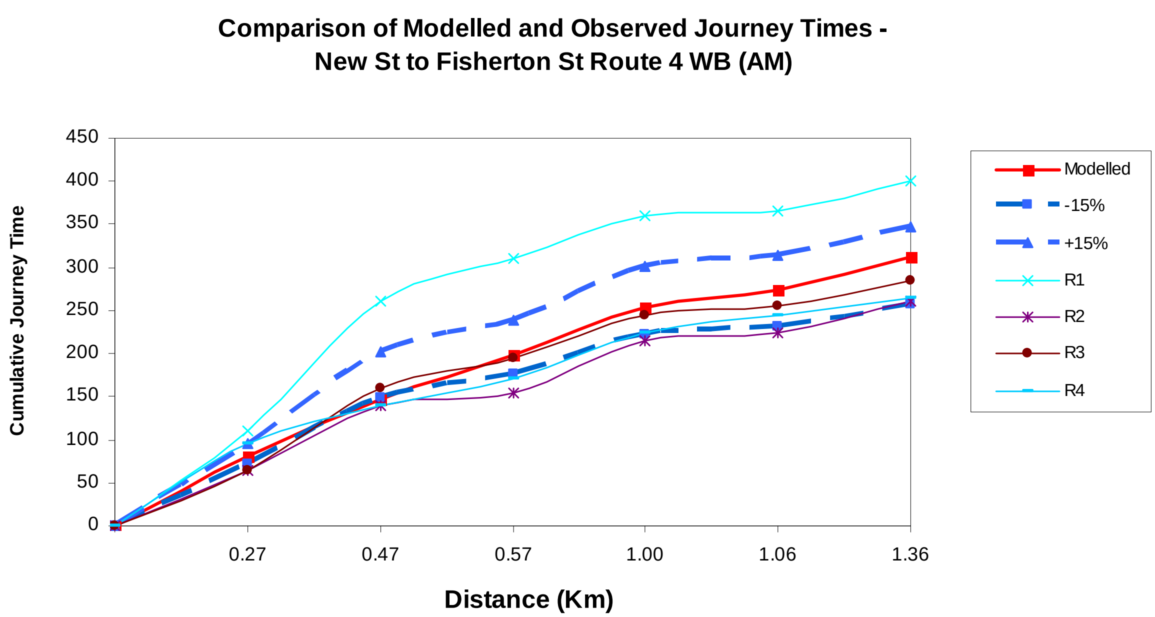
Comparison of Modelled and Observed Journey Times - Downton Rd to Chuchill Way Route 3 NB (AM)



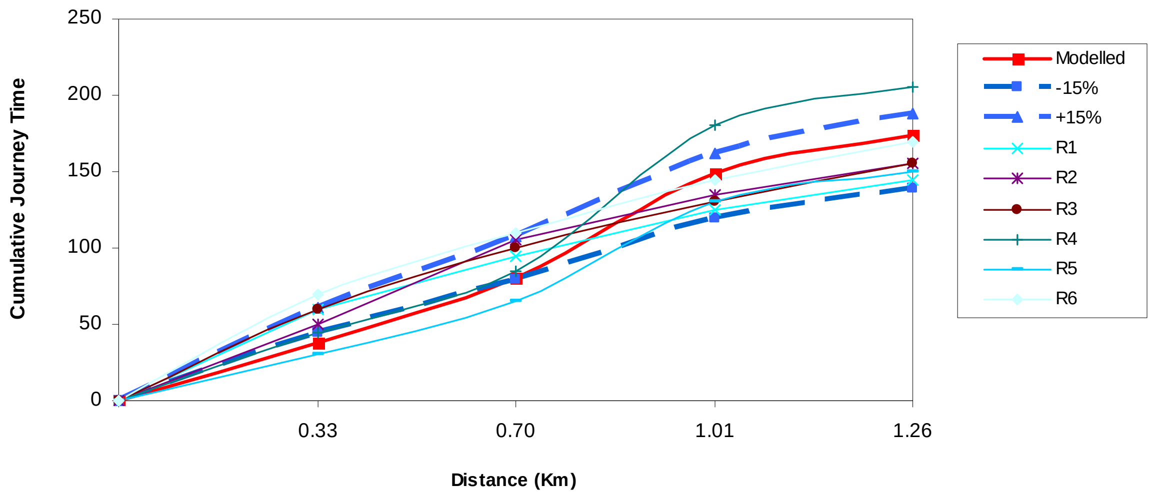
Comparison of Modelled and Observed Journey Times - Churchill Way to Downton Rd Route 3 SB (AM)



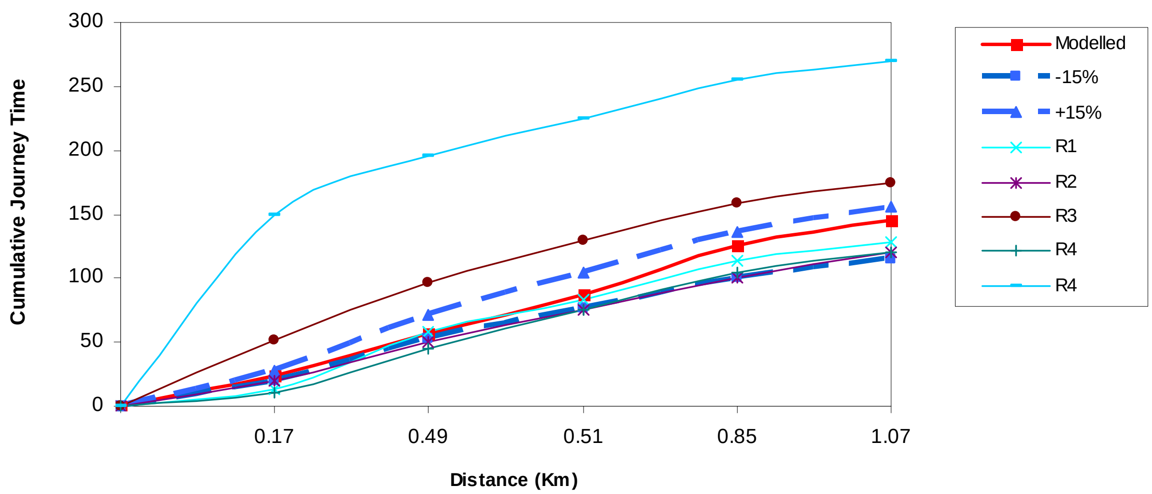

Comparison of Modelled and Observed Journey Times -
Fisherton St to Bourne Hill Route 4 EB (AM)
Cumulative Journey Time
250
200
150
100
50
0
0.31
0.48
0.66
0.65
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

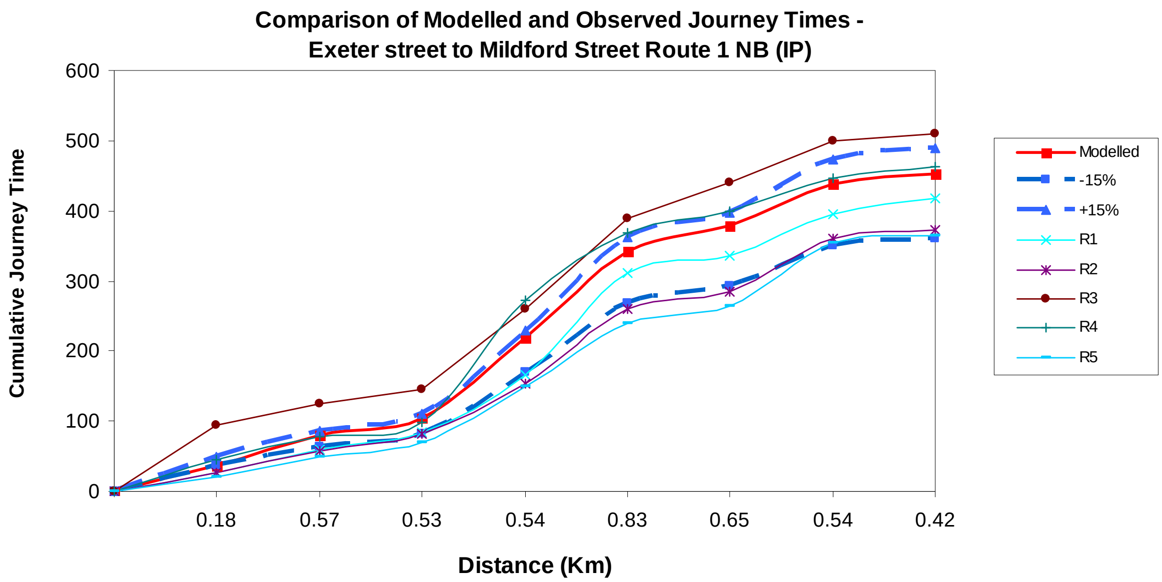

Comparison of Modelled and Observed Journey Times -
New St to Fisherton St Route 4 WB (AM)
Cumulative Journey Time
450
400
350
300
250
200
150
100
50
0
0.27
0.47
0.57
1.00
1.06
1.36
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4

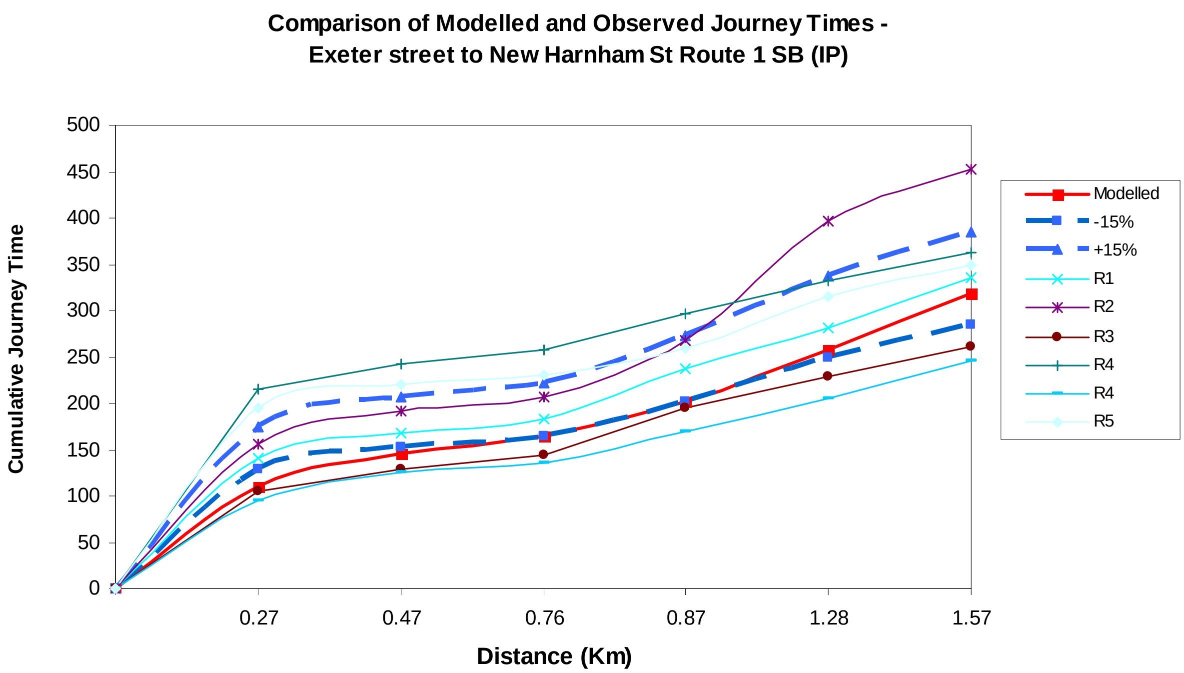
Comparison of Modelled and Observed Journey Times - Sothampton Rd to Churchill Way Route 5 NB (AM)

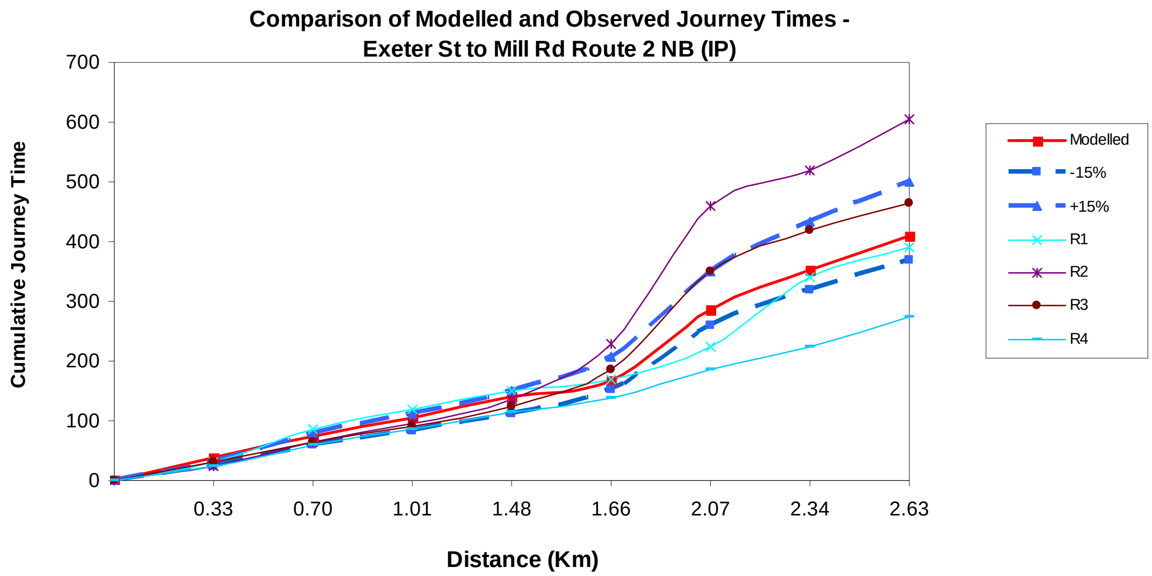


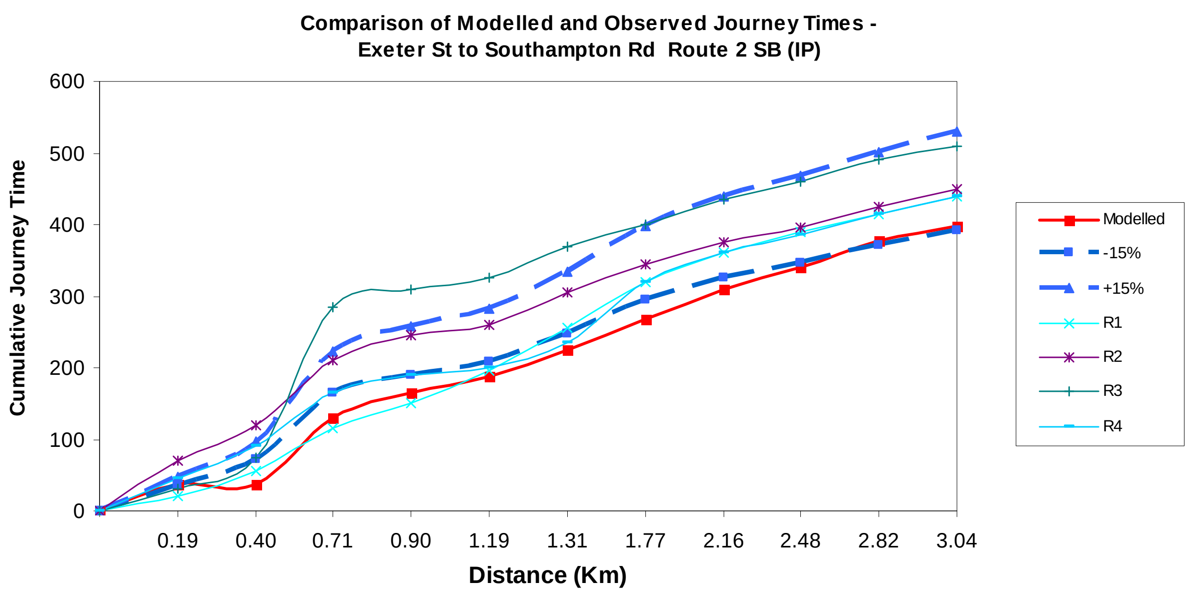
Comparison of Modelled and Observed Journey Times - Churchill Way to Southampton Rd Route 5 SB (AM)

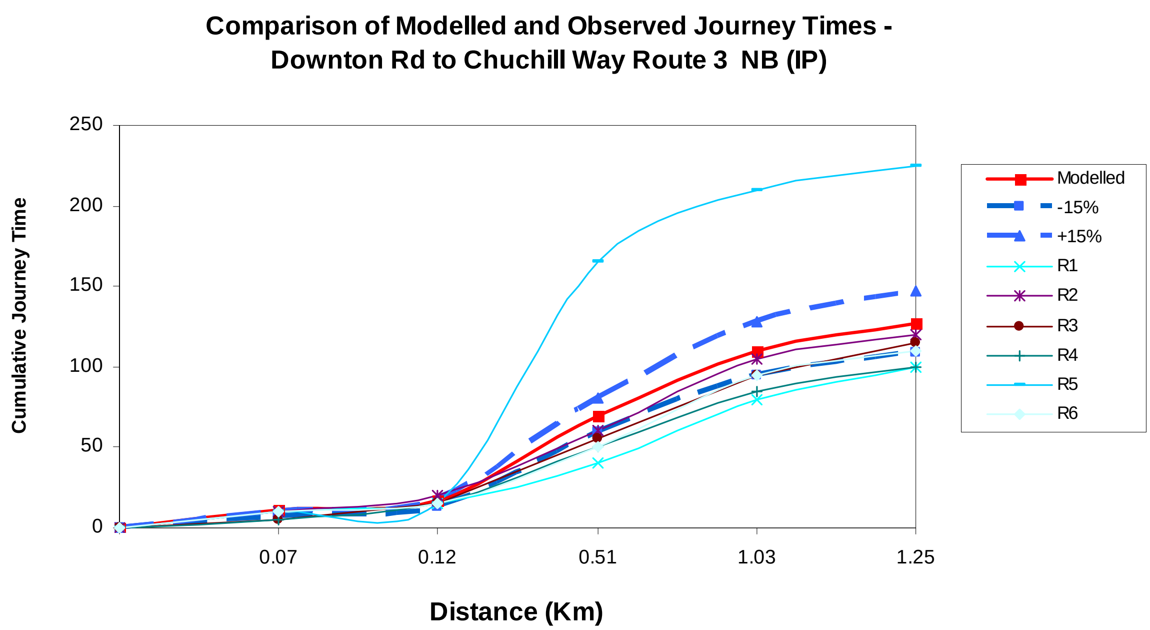


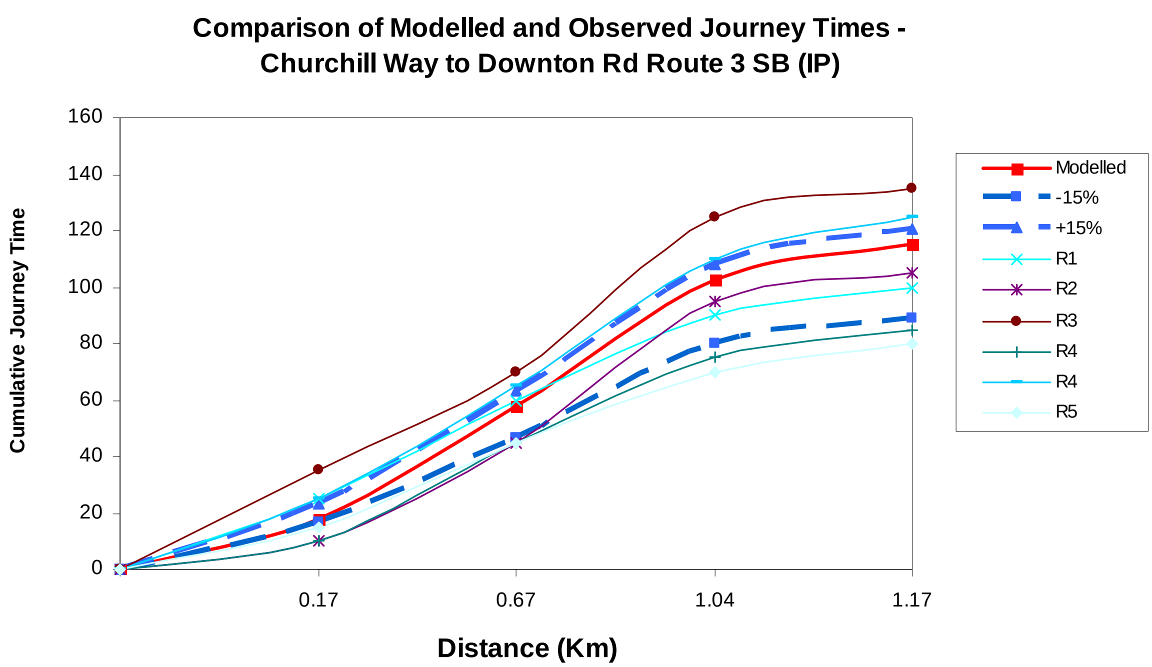

Comparison of Modelled and Observed Journey Times -
Exeter street to Mildford Street Route 1 NB (IP)
Cumulative Journey Time
600
500
400
300
200
100
0
0.18
0.57
0.53
0.54
0.83
0.65
0.54
0.42
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

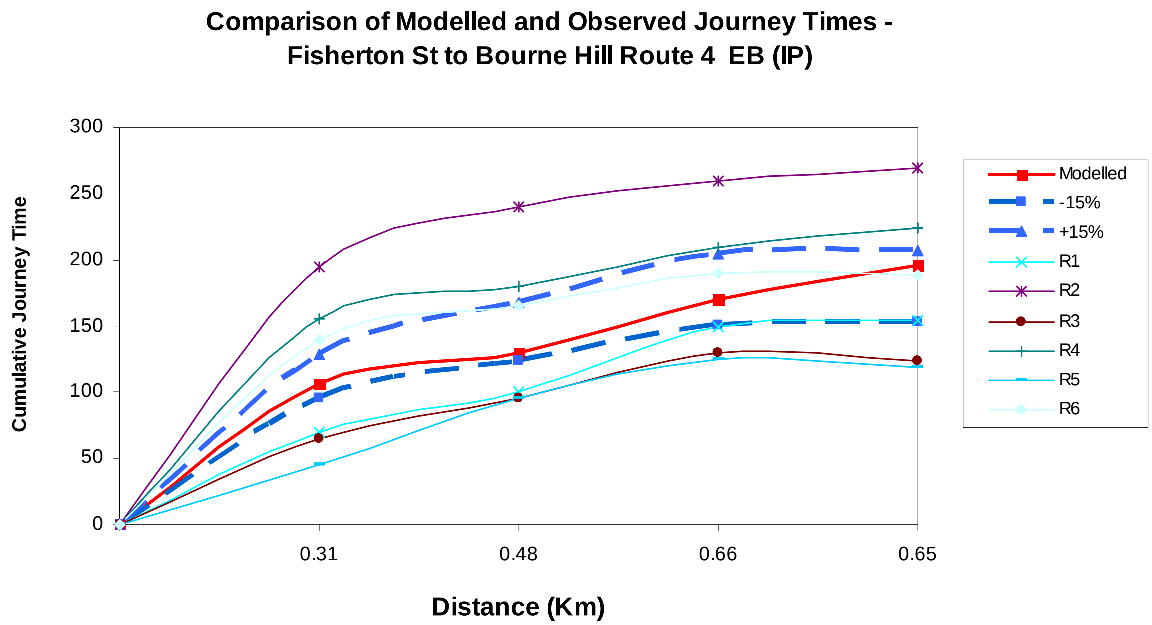

Comparison of Modelled and Observed Journey Times -
Exeter street to New Harnham St Route 1 SB (IP)
Cumulative Journey Time
500
450
400
350
300
250
200
150
100
50
0
0.27
0.47
0.76
0.87
1.28
1.57
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4
R5

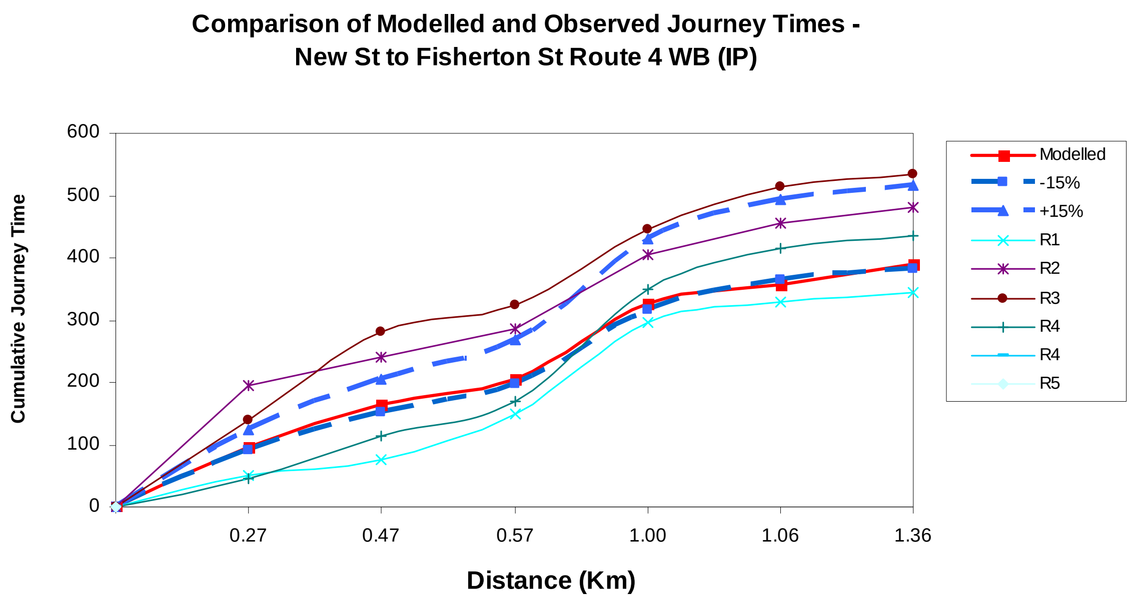

Comparison of Modelled and Observed Journey Times -
Exeter St to Mill Rd Route 2 NB (IP)
Cumulative Journey Time
700
600
500
400
300
200
100
0
0.33
0.70
1.01
1.48
1.66
2.07
2.34
2.63
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4

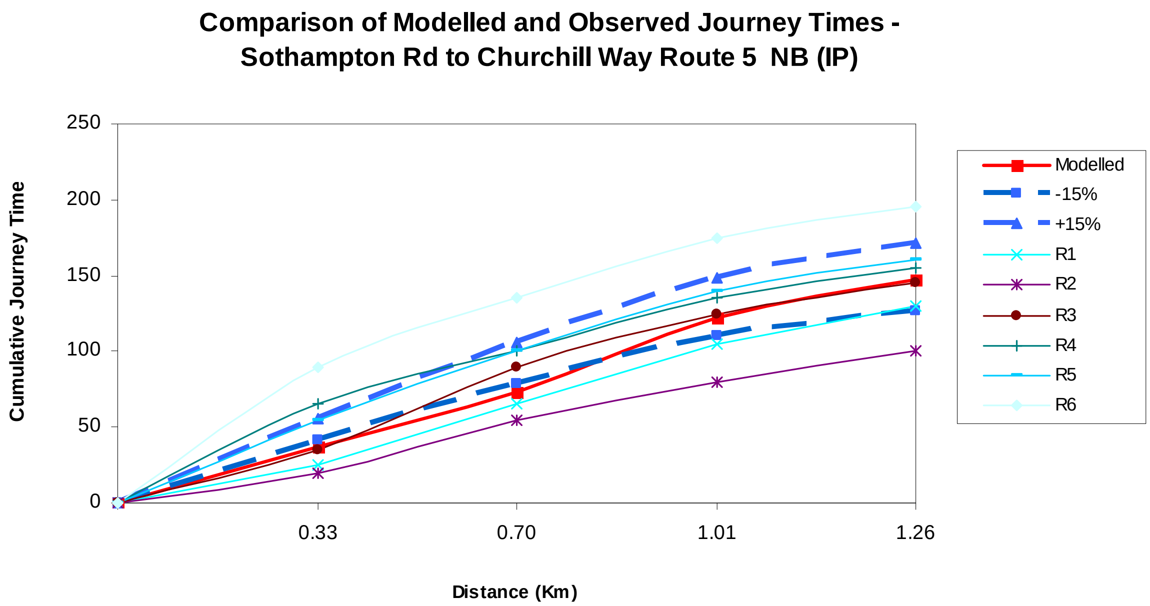

Comparison of Modelled and Observed Journey Times -
Exeter St to Southampton Rd Route 2 SB (IP)
Cumulative Journey Time
600
500
400
300
200
100
0
0.19
0.40
0.71
0.90
1.19
1.31
1.77
2.16
2.48
2.82
3.04
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4

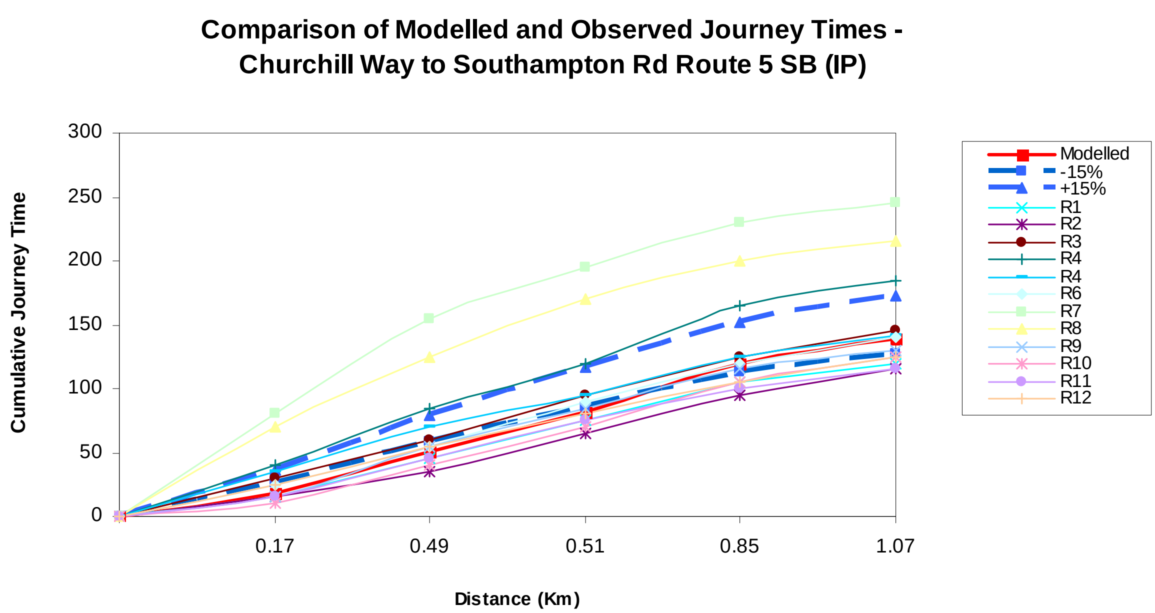

Comparison of Modelled and Observed Journey Times -
Downton Rd to Chuchill Way Route 3 NB (IP)
Cumulative Journey Time
250
200
150
100
50
0
0.07
0.12
0.51
1.03
1.25
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

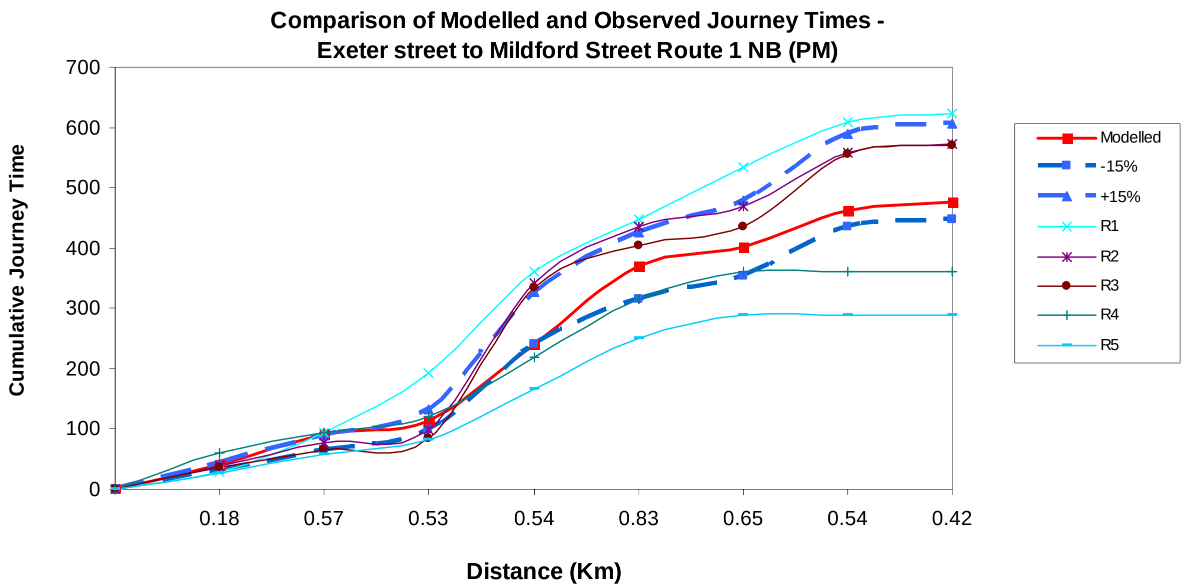

Comparison of Modelled and Observed Journey Times -
Churchill Way to Downton Rd Route 3 SB (IP)
Cumulative Journey Time
160
140
120
100
80
60
40
20
0
0.17
0.67
1.04
1.17
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4
R5

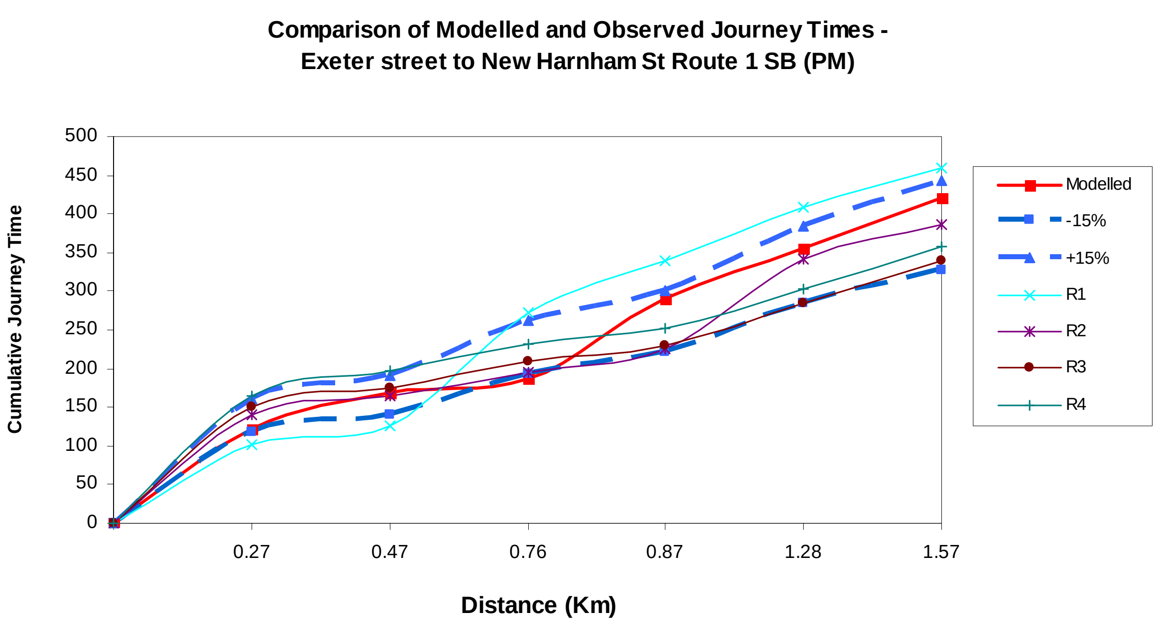

Comparison of Modelled and Observed Journey Times -
Fisherton St to Bourne Hill Route 4 EB (IP)
Cumulative Journey Time
300
250
200
150
100
50
0
0.31
0.48
0.66
0.65
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

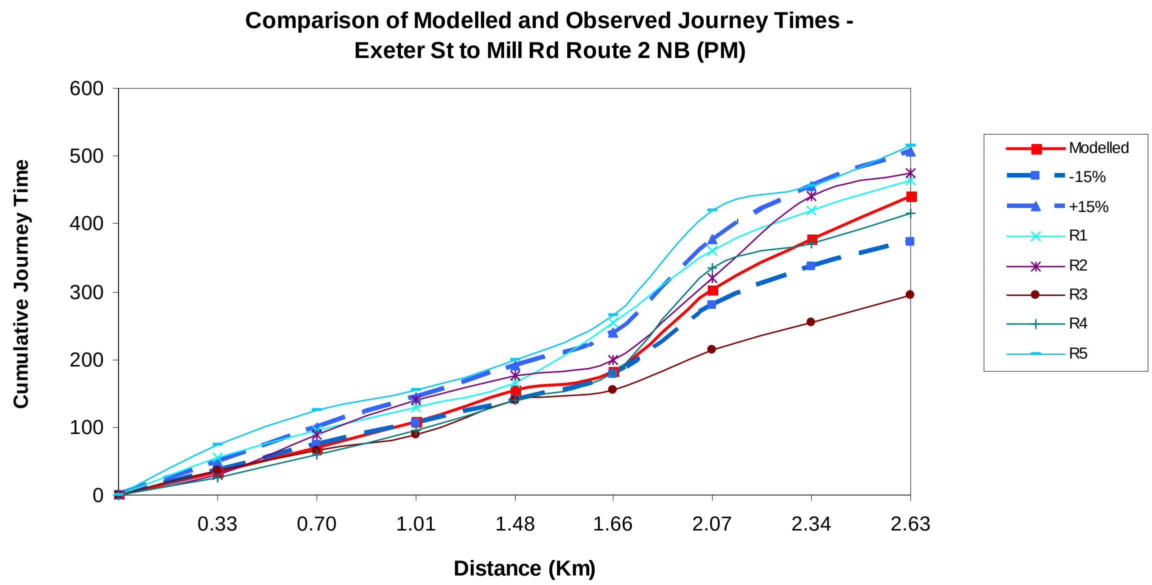

Comparison of Modelled and Observed Journey Times -
New St to Fisherton St Route 4 WB (IP)
Cumulative Journey Time
600
500
400
300
200
100
0
0.27
0.47
0.57
1.00
1.06
1.36
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4
R5

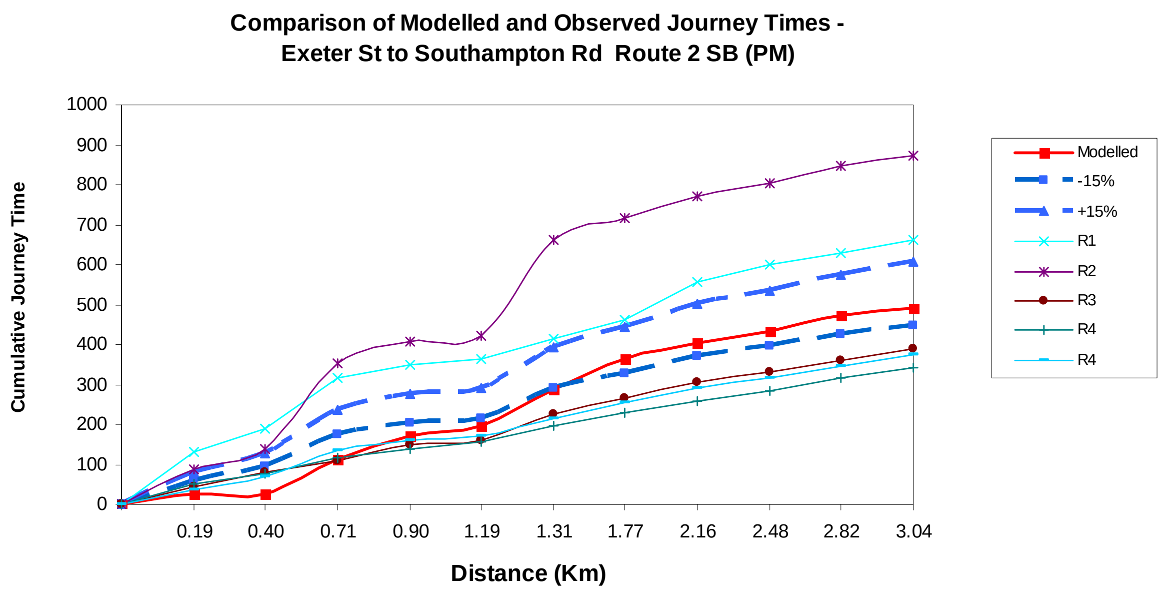

Comparison of Modelled and Observed Journey Times -
Sothampton Rd to Churchill Way Route 5 NB (IP)
Cumulative Journey Time
250
200
150
100
50
0
0.33
0.70
1.01
1.26
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6

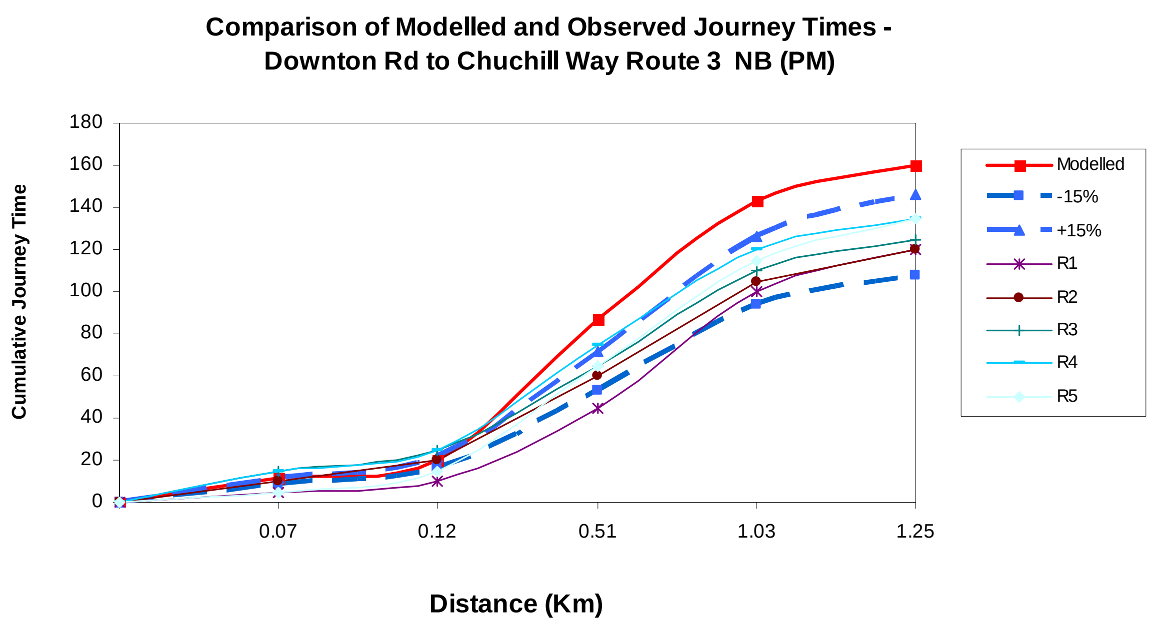

Comparison of Modelled and Observed Journey Times -
Churchill Way to Southampton Rd Route 5 SB (IP)
Cumulative Journey Time
300
250
200
150
100
50
0
0.17
0.49
0.51
0.85
1.07
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4
R6
R7
R8
R9
R10
R11
R12

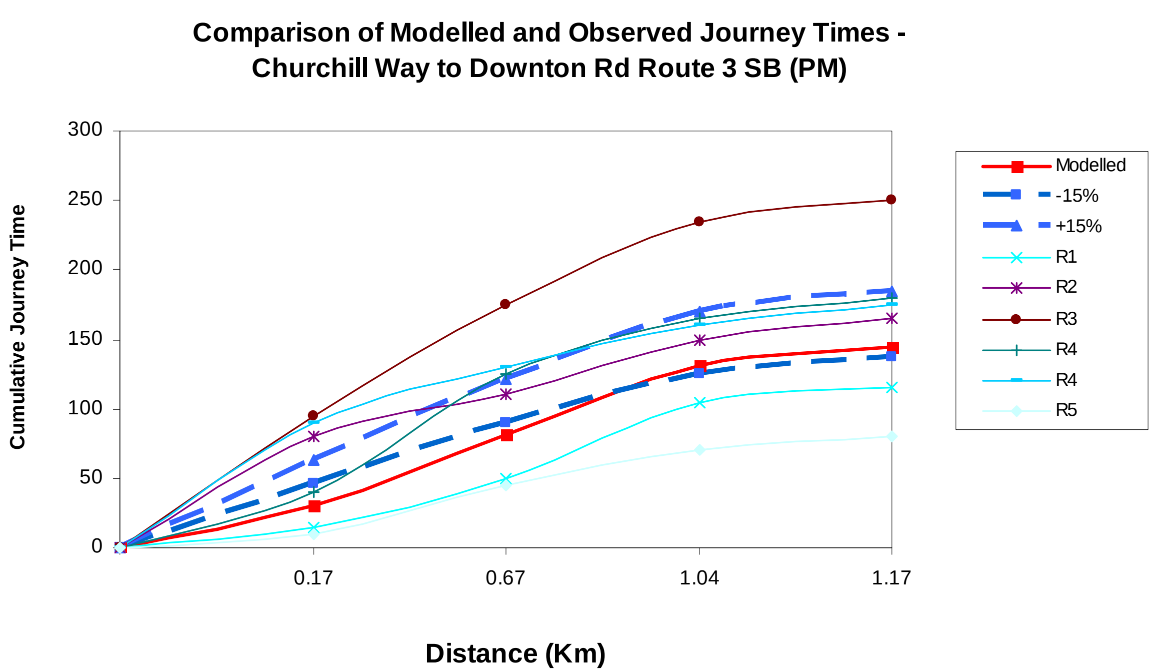

Comparison of Modelled and Observed Journey Times -
Exeter street to Mildford Street Route 1 NB (PM)
Cumulative Journey Time
0
100
200
300
400
500
600
700
0.18
0.57
0.53
0.54
0.83
0.65
0.54
0.42
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

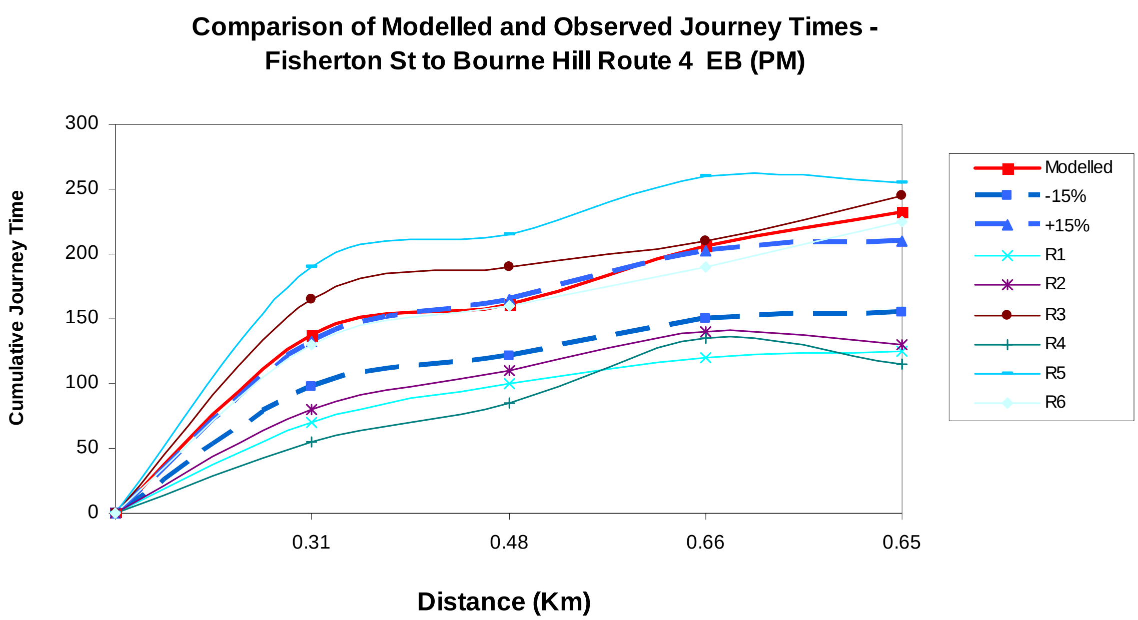

Comparison of Modelled and Observed Journey Times -
Exeter street to New Harnham St Route 1 SB (PM)
Cumulative Journey Time
0
50
100
150
200
250
300
350
400
450
500
0.27
0.47
0.76
0.87
1.28
1.57
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4

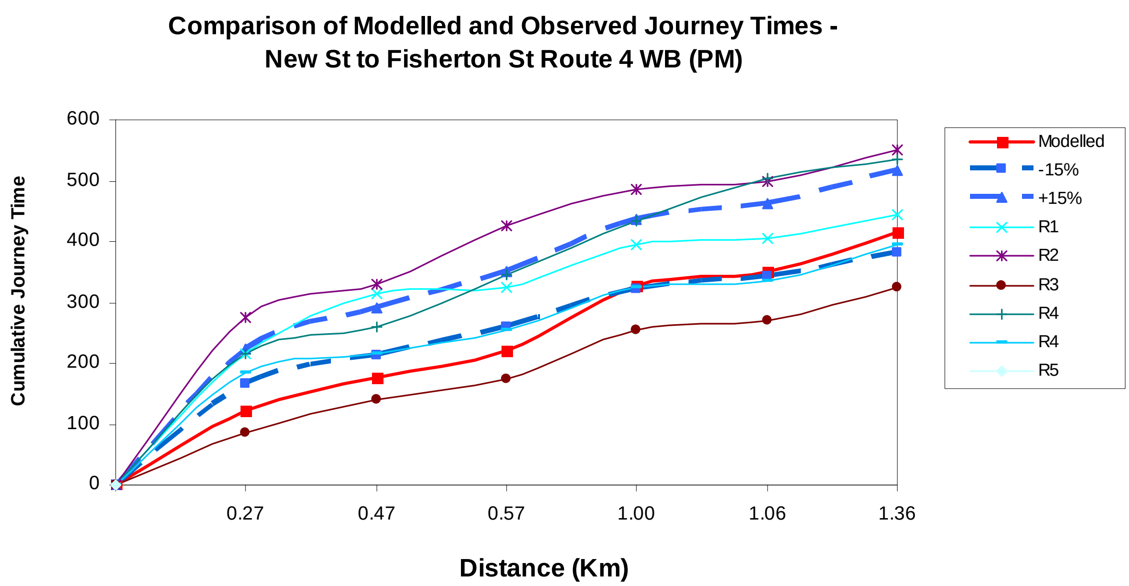

Comparison of Modelled and Observed Journey Times -
Exeter St to Mill Rd Route 2 NB (PM)
Cumulative Journey Time
0
100
200
300
400
500
600
0.33
0.70
1.01
1.48
1.66
2.07
2.34
2.63
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5

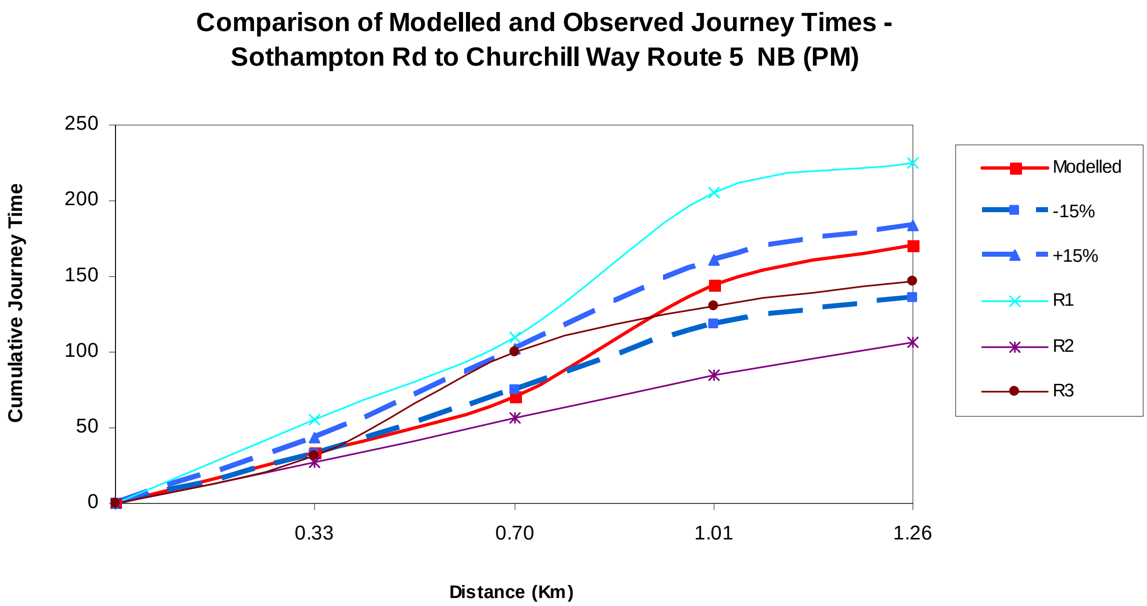

Comparison of Modelled and Observed Journey Times -
Exeter St to Southampton Rd Route 2 SB (PM)
Cumulative Journey Time
0
100
200
300
400
500
600
700
800
900
1000
0.19
0.40
0.71
0.90
1.19
1.31
1.77
2.16
2.48
2.82
3.04
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4

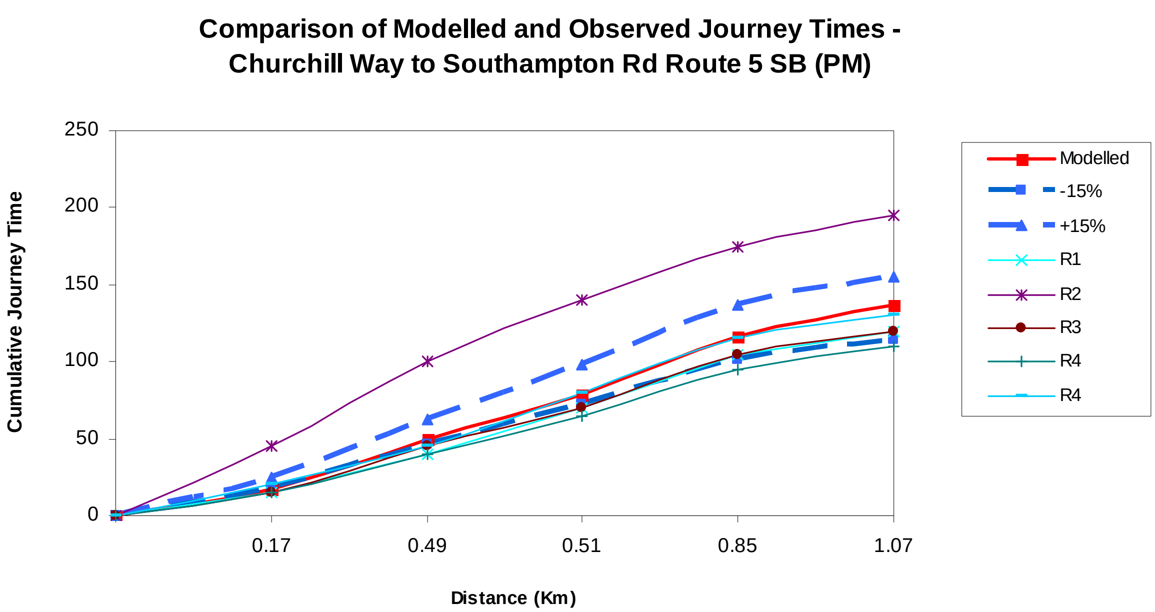

Comparison of Modelled and Observed Journey Times -
Downton Rd to Chuchill Way Route 3 NB (PM)
Cumulative Journey Time
180
160
140
120
100
80
60
40
20
0
0.07
0.12
0.51
1.03
1.25
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5


Comparison of Modelled and Observed Journey Times -
Churchill Way to Downton Rd Route 3 SB (PM)
Cumulative Journey Time
300
250
200
150
100
50
0
0.17
0.67
1.04
1.17
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4
R5


Comparison of Modelled and Observed Journey Times -
Fisherton St to Bourne Hill Route 4 EB (PM)
Cumulative Journey Time
300
250
200
150
100
50
0
0.31
0.48
0.66
0.65
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R5
R6


Comparison of Modelled and Observed Journey Times -
New St to Fisherton St Route 4 WB (PM)
Cumulative Journey Time
600
500
400
300
200
100
0
0.27
0.47
0.57
1.00
1.06
1.36
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4
R5


Comparison of Modelled and Observed Journey Times -
Sothampton Rd to Churchill Way Route 5 NB (PM)
Cumulative Journey Time
0
50
100
150
200
250
0.33
0.70
1.01
1.26
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3


Comparison of Modelled and Observed Journey Times -
Churchill Way to Southampton Rd Route 5 SB (PM)
Cumulative Journey Time
0
50
100
150
200
250
0.17
0.49
0.51
0.85
1.07
Distance (Km)
Modelled
-15%
+15%
R1
R2
R3
R4
R4