Salisbury Transport Model

Public Transport Local Model Validation Report

May 2009

Notice

This report was produced by Atkins for Wiltshire Council for the specific purpose of *Transport Models for Salisbury Project*.

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1. Introduction

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 Public Transport Local Model Validation Report forms deliverable 2.3 of the commission and it describes the development and validation of the Salisbury Transport Model's Public Transport Model (SPTM). The purpose of this model is to demonstrate a robust level of highway demand, and an ability for this demand to match observed flow and journey times on modelled links in Salisbury and to provide travel times (costs) to the Salisbury Demand Model to enable accurate representative of variable demand in Salisbury.

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 District 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" multi-modal model of Salisbury that represents movements to the city from its rural hinterland; through traffic, particularly that using the A36; and public transport movements including rail and park-and-ride.

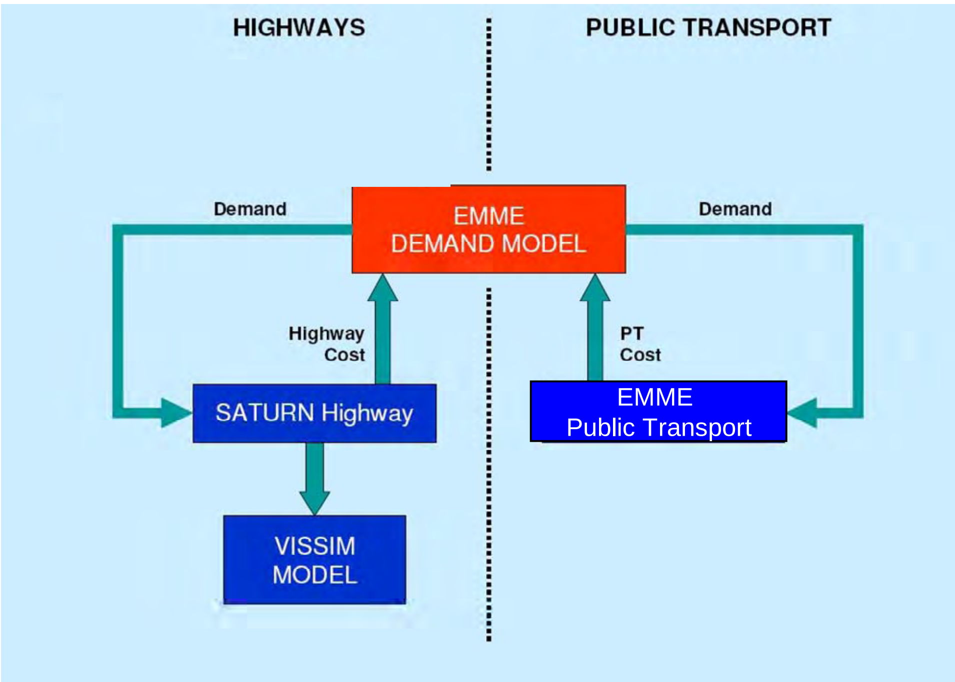
1.7 This model will be able to represent the impact of land use changes on travel demands and network performance – specifically being able to asses the impact of different development locations, scales of development and type of development including the impact of sustainable development principles. The model must also assess the impact of different trip distribution patterns arising from in-commuting from the City's hinterland.

1.8 Our approach to this "macro-level" model, collectively referred to as the Salisbury Transport Model (STM) is developed using:

- an EMME demand model representing modal switching and redistribution effects and is referred to as the Salisbury Demand Model (SDM);
- a SATURN to represent the highway network and highway travel demands, referred to as the Salisbury Highway Model (SHM); and
- an EMME model representing the public transport network with individual bus, rail and park and ride services coded and is referred to as the Salisbury Public Transport Model (SPTM).

1.9 Figure 1.1 displays the linkages between the modelling framework.

Figure 1.1 - Modelling Components and Linkages



1.10 The scope of the Salisbury Transport Model framework will be a 24 hour period of an average weekday. Within the full model framework four time periods are specifically modelled:

- morning peak (AM) from 07:00 to 10:00;
- inter-peak (IP) period of 10:00 to 16:00; and
- evening peak (PM) from 16:00 to 19:00.

1.11 The SDM will operate as a 24 hour model, explicitly using the costs from these time period models as input. This is to facilitate the use of production-attraction modelling format, as discussed below.

Public Transport Model

1.12 The SPTM model is a new 2008 model and has been developed using the SHM as its starting point. The development work has entailed the:

- estimation of bus demand matrices using up-to-date Wayfarer ticket data where available;
- estimation of rail demand matrices using up-to-date ticket and survey data; and
- coding all bus and rail services in the study area.

Weekday Model

1.13 The SPTM covers the key three time periods during the day through assignment of a single hour in each of the three peaks:

- morning peak (AM) assignment peak hour of 08:00 to 09:00;
- inter-peak (IP) assignment covering an average hour between 10:00 to 16:00; and
- evening peak (PM) assignment peak hour of 17:00 to18:00.

Saturday Model

1.14 The commission includes the development of a Saturday Model, which would focus on the period between 11:00 and 14:00 on a Saturday. This is to reflect the busy service centre and tourist destination that Salisbury is.

1.15 The Saturday demand model would not have time period choice but would cover the other modelling elements and be capable of determining the impact of changes to transport network and parking supply on a Saturday peak. The Saturday model would also be origin/destination based rather than production/attraction based.

1.16 The Saturday SPTM is based upon the weekday inter-peak model in terms of demand but includes Saturday public transport services.

Scope of Report

1.17 This draft LMVR consists of seven chapters. Following this introductory chapter:

- Chapter Two details the data collected for use in the model development;
- Chapter Three describes the development of the PT network and services;
- Chapter Four provides details of the public transport matrix development;
- Chapter Five presents the results of the model validation; and
- Chapter Six provides a concluding summary.

2. Data Collection

Introduction

2.1 Model development involves an extensive data collection and gathering exercise and processing, however, the data collection effort was focused on the highway model and limited public transport data was available for the development of the new model other than that provided from existing Public Transport operators in the study area.

2.2 The aim of this chapter is to describe the data collected for this study for the development of the Salisbury Public Transport Model (SPTM) and the processing of the data.

Public Transport Services

2.3 Service information, such as routeing, frequency and journey times for bus and rail modes were extracted from up-to-date timetable information for Autumn 2008 from the relevant Train Operating Companies (TOCs), Wilts & Dorset Bus, and other smaller bus operators.

Bus Demand

Wilts & Dorset Bus Ticketing Data

2.4 Wayfarer ticketing data was supplied by Wilts & Dorset Bus for their services in the sub-region, for the weekdays between Monday 1st October 2006 and Friday 14th October 2006. The data was grouped into three time periods:

- morning peak period (07:00 - 09:59);
- inter-peak period (10:00 – 15:59); and
- evening peak period (16:00 – 18:59).

2.5 Table 2.1 summarises the public transport services for which Wayfarer data was received.

Table 2.1 – Wayfarer Ticketed Services

Service No.	Service Description (From/To)	Operator
2a	Salisbury to Devizes	W&D
2b	Devizes to Salisbury	W&D
5a	Salisbury to Pewsey	W&D
5b	Pewsey to Salisbury	W&D
6a	Salisbury - Durrington	W&D
6b	Durrington to Salisbury	W&D
25a	Salisbury - Hindon - Bourton	W&D
25b	Bourton - Hindon - Salisbury	W&D
26a	Salisbury-Tisbury-Hindon	W&D
26b	Hindon - Tisbury - Salisbury	W&D
27a	Salisbury to Shaftesbury (Hill Farm Estate)	W&D
27b	Shaftesbury (Hill Farm Estate) to Salisbury	W&D

29a	Salisbury - Shaftesbury (via District Hospital)	W&D
29b	Shaftesbury - Salisbury	W&D
34a	Salisbury - Romsey	W&D
34b	Romsey - Salisbury	W&D
36a	Salisbury to Romsey	W&D
36b	Romsey to Salisbury	W&D
53	Salisbury - Devizes Road(Top)- Salisbury	W&D
55	Salisbury CC - West Harnham - Salisbury CC	W&D
57	Salisbury - Bishopdown - Salisbury	W&D
60a	Salisbury CC-Ditchampton	W&D
60b	Ditchampton -Salisbury CC	W&D
60Ab	Ditchampton -Salisbury (via L-Bemerton)	W&D
61a	Salisbury- Bulbridge - Ditchampton	W&D
61b	Ditchampton - Salisbury CC	W&D
62	Salisbury CC - Pauls Dene - Salisbury CC	W&D
63a	Salisbury – Porton – Allington – Tidworth	W&D
63b	Tidworth – Allington – Porton – Salisbury	W&D
64a	Salisbury – Porton – Allington – Tidworth	W&D
64b	Tidworth – Allington – Porton – Salisbury	W&D
71	Stratford Br - Salisbury - Harnham- Stratford Br	W&D
72	Salisbury -Laverstock - Salisbury	W&D
73	Salisbury CC- Bishopdown Farm	W&D
184a	Salisbury CC - Blandford - Weymouth	W&D
184b	Weymouth - Blandford - Salisbury	W&D
X3a	Salisbury to Bournemouth	W&D
X3b	Bournemouth to Salisbury	W&D
X7a	Salisbury to Southampton	W&D
X7b	Southampton to Salisbury	W&D
8a	Salisbury- Andover (WD, Stagecoach)	Other Operators
8b	Andover -Salisbury (WD, Stagecoach)	Other Operators

2.6 Data was supplied in passenger journeys in origin-destination format for each route, based upon fare stages. Some ticket types, such as season tickets, did not explicitly include the destination fare stage. Two-stop hop tickets did not include origin or destination data. In these instances the pattern of distribution matched the known origins and destinations.

Use of Wayfarer data

2.7 The Wayfarer data was used for two purposes:

- to build partial bus passenger trip matrices (see chapter 4); and
- to estimate the passengers crossing the City centre cordon (see below), rather than to undertake conventional bus passenger counts.

Cordon Counts

2.8 Bus passenger flows on the main radial routes into and out of Salisbury were not available. These were estimated from the available Wayfarer records, based on the numbers recorded as boarding and alighting in the Salisbury central fare stage, which approximates to the City Cordon shown in Figure 2.2. These estimates, of necessity, only relate to the services for which Wayfarer data was available (see Table 2.1).

Figure 2.1 – Salisbury City Centre Cordon

Bus Journey Times

2.9 No specific bus journey time surveys were undertaken. Bus running times were abstracted from published timetables.

Rail Demand

2.10 Rail Surveys had been undertaken by Wiltshire Council and data was made available from those surveys. The surveys were undertaken at Wiltshire train stations and interviewed as many people boarding trains as possible. As the SPTM is only concerned with movements in Salisbury, only data from the Salisbury surveys were used.

3. Network and Services

Introduction

3.1 The SPTM uses the same zone system and network structure employed by the highway model and has been developed to represent a 2008 base year. SPTM includes:

- a network model representing all public transport services serving Salisbury; and
- travel demand in the form of trip matrices for bus passengers and rail passengers.

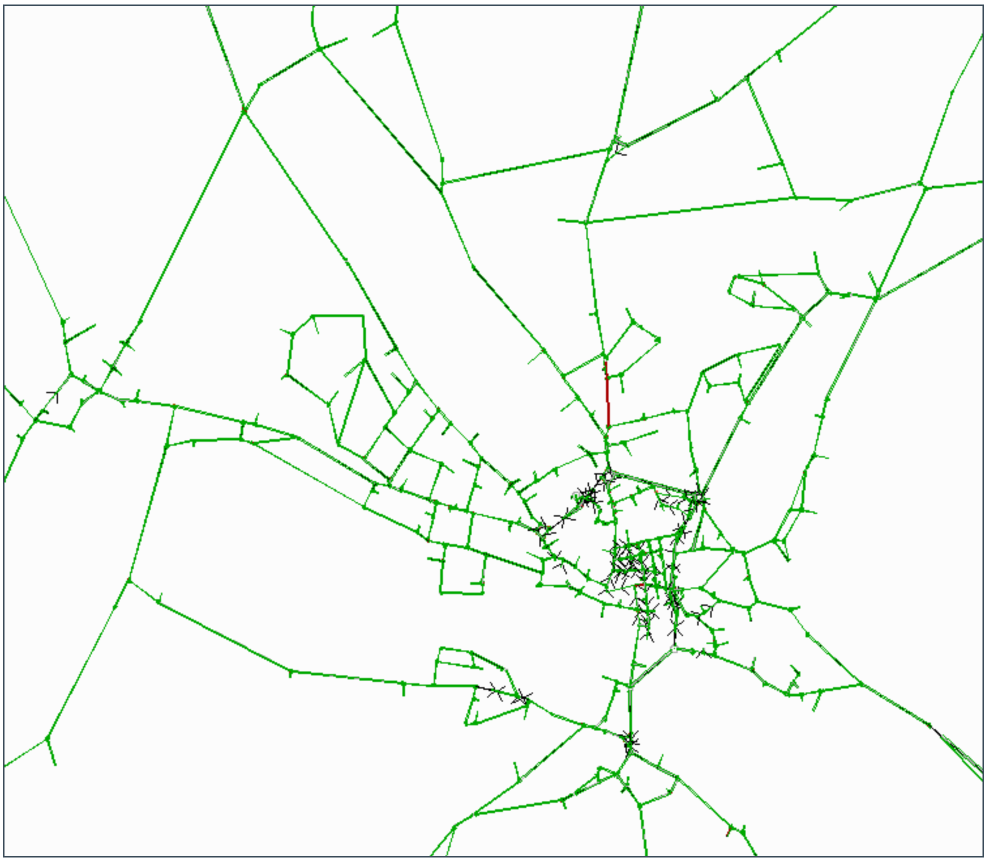
3.2 The base year model has been developed to represent two public transport modes: bus and rail. In the Salisbury Demand Model (SDM) park and ride is considered as a sub-mode to car travel and as a result is not modelled as part of the SPTM validation process.

3.3 The new public transport model is constructed in EMME/2 to enable it to be closely linked to the demand model, which is also in EMME/2.

Study Area

3.4 The Salisbury Study Area and highway network is the skeleton of the bus network and is shown in Figure 3.1. The highway network includes the seven principal approach roads towards Salisbury: A36 (Southampton Road); A338 (The Highway); A354 North east of Coombe Bissett; A36 (Salisbury Road); A329 (Devises Road); A345 (Castle Road); and A30 (London Road)

Figure 3.1 – Salisbury Highway Network



3.5 Almost all of the network shown has been developed to simulate delays at junctions. The network beyond this area does not simulate delays at junctions but focuses delays on links instead. This network covers the main roads in Wiltshire and the rest of Britain to reflect full trip costs.

Bus Network

Modes and Vehicles

3.6 The modes included in the SPTM are set out in Table 3.1 and include walk, bus, P&R bus and rail. The public transport services have a “vehicle type” allocated to them in EMME/2. The vehicle types used are set out in Table 3.2. These do not have an impact on the model as there is no implementation equivalent to “capacity restraint” but could be modified to provide detailed public transport information as and when required.

Table 3.1 - PT Modes

Mode	Description	Mode Type	Default Speed	Description
c	Car	Auto		
w	Walk	Aux transit	5kph	
b	WD Bus	Transit		Wilts & Dorset Bus
p	Park & Ride Bus	Transit		Park & Ride Bus
o	Other operators	Transit		Other Operators
x	Bus Dummy	Transit		
q	Quick Walk	Aux Transit	5kph	
r	Rail	Transit		Rail
d	Rail CC	Aux Transit	70 kph	Rail CC

Table 3.2 – Vehicle Types

Vehicle No	Description	Mode	Fleet Size	Capacity - seats	Capacity - total	PCU factor
1	Single Bus	b	999	200	200	3
2	Double Bus	b	999	200	200	3
3	Bendy Bus	b	999	200	200	3
4	Park&Ride	p	999	200	200	3
5	Other Ops	o	999	200	200	3
10	Rail-SW	r	999	1000	1000	100
11	Rail-FGW	r	999	1000	1000	100

Bus Services

3.7 To ensure that highway delays can be readily represented in the bus network, the bus network effectively mirrors it. The additions to create the bus network are non-highway walk links, such as interchange at stations and the bus services in the model.

3.8 The pattern of bus services incorporated in the model is summarised in Table 3.3 for principal services and in Table 3.4 for secondary local and school services.

3.9 In reality a bus runs on the highway network and stops at key points as identified in the published timetable and intermediate stops. In the model, for the more urban routes, this was relaxed to permit boarding and alighting at any node in the network for two reasons. Firstly because specific bus stop locations could not be incorporated into a network that had to retain node/link consistency with the highway model and secondly because some services in Salisbury are hail and ride and thus have no fixed stopping pattern. The services classed as “urban” for this purpose are shown in italics in Tables 3.3 and 3.4 respectively.

Table 3.3 Principal Bus Services and Headways Modelled

Service No.	Service Description (From/To)	Operator	Headway (in minutes)		
			AM	IP	PM
1a	Salisbury to Great Durnford	W&D	0	0	60
1b	Amesbury to Salisbury	W&D	60	0	0
2a	Salisbury to Devizes	W&D	60	60	60
2b	Devizes to Salisbury	W&D	60	60	60
4a	Salisbury to Devizes	W&D	0	0	60
4b	Devizes to Salisbury	W&D	60	0	0
5a	Salisbury to Pewsey	W&D	0	30	60
5b	Pewsey to Salisbury	W&D	60	60	60
6a	Salisbury - Durrington	W&D	60	60	60
6b	Durrington to Salisbury	W&D	30	60	60
25a	Salisbury - Hindon - Bourton	W&D	60	180	60
25b	Bourton - Hindon - Salisbury	W&D	60	180	60
26a	Salisbury-Tisbury-Hindon	W&D	0	180	0
26b	Hindon - Tisbury - Salisbury	W&D	0	180	0
27a	Salisbury to Shaftesbury (Hill Farm Estate)	W&D	0	180	30
27b	Shaftesbury (Hill Farm Estate) to Salisbury	W&D	60	0	60
29a	Salisbury - Shaftesbury (via District Hospital)	W&D	0	90	60
29b	Shaftesbury - Salisbury	W&D	60	90	60
34a	Salisbury - Romsey	W&D	60	60	60
34b	Romsey - Salisbury	W&D	60	60	60
36a	Salisbury to Romsey	W&D	60	120	60
36b	Romsey to Salisbury	W&D	60	90	30
53	*Salisbury - Devizes Road(Top)- Salisbury*	*W&D*	*30*	*30*	*30*
55	*Salisbury CC - West Harnham - Salisbury CC*	*W&D*	*60*	*30*	*30*
57	*Salisbury - Bishopdown - Salisbury*	*W&D*	*20*	*15*	*20*

Service No.	Service Description (From/To)	Operator	Headway (in minutes)		
			AM	IP	PM
60a	*Salisbury CC-Ditchampton*	*W&D*	*30*	*60*	*30*
60b	*Ditchampton -Salisbury CC*	*W&D*	*30*	*60*	*30*
60Aa	*Salisbury - Ditchampton (via L-Bemerton)*	*W&D*	*0*	*60*	*0*
60Ab	*Ditchampton -Salisbury (via L-Bemerton)*	*W&D*	*0*	*60*	*0*
61a	*Salisbury- Bulbridge - Ditchampton*	*W&D*	*30*	*30*	*30*
61b	*Ditchampton - Salisbury CC*	*W&D*	*30*	*30*	*30*
62	*Salisbury CC - Pauls Dene - Salisbury CC*	*W&D*	*30*	*30*	*30*
63a	Salisbury – Porton – Allington – Tidworth	W&D	0	72	60
63b	Tidworth – Allington – Porton – Salisbury	W&D	30	120	60
64a	Salisbury – Porton – Allington – Tidworth	W&D	0	120	60
64b	Tidworth – Allington – Porton – Salisbury	W&D	60	120	60
69a	Salisbury - Porton Down via Old Sarum	W&D	60	0	60
69b	*Porton Down - Salisbury via Old Sarum*	*W&D*	*60*	*0*	*60*
69Aa	*Salisbury - Porton Down via Old Sarum*	*W&D*	*0*	*90*	*0*
69Ab	*Porton Down - Salisbury via Old Sarum*	*W&D*	*0*	*90*	*0*
71	*Stratford Br - Salisbury - Harnham- Stratford Br*	*W&D*	*0*	*72*	*0*
72	*Salisbury -Laverstock - Salisbury*	*W&D*	*30*	*30*	*30*
73	*Salisbury CC- Bishopdown Farm*	*W&D*	*0*	*60*	*0*
89a	*Salisbury to Winterslow*	*W&D*	*60*	*60*	*60*
89b	*Winterslow to Salisbury*	*W&D*	*60*	*60*	*0*
184a	Salisbury CC - Blandford - Weymouth	W&D	30	120	30
184b	Weymouth - Blandford - Salisbury	W&D	30	90	30
X3a	Salisbury to Bournemouth	W&D	30	30	30
X3b	Bournemouth to Salisbury	W&D	30	30	30
X7a	Salisbury to Southampton	W&D	60	60	60
X7b	Southampton to Salisbury	W&D	60	60	60
P1a	*Woodfalls to Bemerton Heath*	*Pulseline - W&D*	*60*	*60*	*60*
P1b	*Bemerton Heath to Woodfalls*	*Pulseline - W&D*	*60*	*60*	*60*
P2	*Salisbury (Hospital) to Bemerton Heath*	*Pulseline- W&D*	*10*	*10*	*10*
501a	Salisbury CC to Beehive P&R	P&R Service W&D	10	15	10
501b	Beehive P&R to Salisbury CC	P&R Service (W&D)	10	15	10
502a	Salisbury CC to Wilton P&R	P&R Service (W&D)	10	15	12

Service No.	Service Description (From/To)	Operator	Headway (in minutes)		
			AM	IP	PM
502b	Wilton P&R to Salisbury CC	P&R Service (W&D)	10	15	10
503a	Salisbury CC to Britford P&R	P&R Service (W&D)	12	15	10
503b	Britford P&R to Salisbury CC	P&R Service (W&D)	10	12	10
504a	Salisbury CC to London Road P&R	P&R Service (W&D)	10	15	10
504b	London Road P&R to Salisbury CC	P&R Service (W&D)	10	15	10
8a	Salisbury- Andover (WD, Stagecoach)	Other Operators	30	30	30
8b	Andover -Salisbury (WD, Stagecoach)	Other Operators	30	30	30
B24a	Salisbury - Warminster (Bodmans service)	Other Operators	0	60	60
B24b	Warminster- Salisbury (Bodmans service)	Other Operators	60	60	60
BX2a	Salisbury - Lackham College (Bodmans)	Other Operators	60	0	0
Bx2b	Lackham College - Salisbury (Bodmans)	Other Operators	0	0	60

Table 3.4 – Secondary Bus Services and Headways Modelled

Service	Service Description (From/To)	Operator	Headway (in minutes)		
			AM	IP	PM
348	B-Heath (School) to Ditchampton	W&D	0	360	0
601	Salisbury - Old Sarum - Stratford School	W&D	60	360	0
650	Salisbury-West Harnham - Laverstock	W&D	60	0	0
668	South Wilts School - Porton - Tidworth	W&D	0	360	0
40a	Salisbury to Fordingbridge	W&D	0	360	0
40b	Fordingbridge to Salisbury	W&D	0	360	0
41a	Salisbury to Ringwood	W&D	0	0	60
41b	Ringwood to Salisbury	W&D	60	360	0
45a	Salisbury to Downton	W&D	0	360	60
45b	Downton to Salisbury	W&D	30	0	0
602a	Salisbury school-Bemerton heath-Stapleford	W&D	0	360	0
602b	Druids Lodge-Salisbury School-B-Heath	W&D	60	0	0
622a	Bishopstone - Broad Chalke School	W&D	60	0	0
622b	Broad Chalke School - Bishopstone	W&D	0	360	0
648a	Fovant - Ludwell - Shaftesbury School	W&D	60	0	0
648b	Shaftesbury School - Ludwell - Fovant	W&D	0	360	0
666a	L-stock schools - Porton - Allignton	W&D	60	360	0

			Headway (in minutes)		
666b	Allington - Porton - L-stock Schools	W&D	60	0	0
667a	Fugglestone to Wilton School	W&D	60	0	0
670a	Osmunds School -Salisbury High School	W&D	0	360	0
670b	Salisbury school -Osmunds school	W&D	60	0	0
679a	W-bourne Earls to Ford	W&D	0	360	0
679b	Ford to W-bourne Earls	W&D	60	0	0
684b	Burgate School - Coombe Bissett - Salisbury	W&D	0	360	0
693a	Salisbury to Fordingbridge (Burgate School)	W&D	60	0	0
694a	Salisbury, Harnham - Downton (School)	W&D	60	0	0
696a	Petersfinger/West Dean to Downton (School)	W&D	60	0	0
699a	Salisbury to Downton (School) via Over	W&D	60	0	0
763a	Britford to B-hurst (College)	W&D	60	0	0
763b	B-hurst (College) to Britford	W&D	0	0	60
78a	Salisbury -Laverstock-Salisbury (Clock)	W&D	20	360	360
78b	Salisbury - Laverstock- Salisbury (Anti-clock)	W&D	0	360	360
88a	*Salisbury to Winterslow (School)*	*W&D*	*60*	*360*	*0*
88b	*Winterslow (School) to Salisbury*	*W&D*	*30*	*0*	*0*
C12a	Salisbury - Plaitford - B-hurst College	W&D	60	0	60
C12b	B-hurst College - Plaitford-Salisbury	W&D	0	0	0
X70	B-hurst College - Salisbury	W&D	0	0	0
X74a	Salisbury to Totton	W&D	60	60	60
X74b	Salisbury to Totton	W&D	0	0	60
X75a	Salisbury to Totton	W&D	60	0	0
X75b	Totton to Salisbury	W&D	0	0	60
285a	Salisbury-Test Valley-(Tourist Coaches)	Other Operators	60	0	0
285b	Test Valley-Salisbury -(Tourist Coaches)	Other Operators	0	360	0
X87a	Salisbury-Andover (WD and Stagecoach)	Other Operators	60	360	0
X87b	Andover-Salisbury (WD and Stagecoach)	Other Operators	60	0	60

Bus Journey Times

3.10 The bus-based element of the public transport network is extracted in its entirety from the SATURN highway network model. This enables a linkage to be established between highway travel times and bus travel times such that, in forecasting mode, the impact of increasing congestion levels on bus travel times is represented.

3.11 This linkage also allows the impact on bus journey times of new bus lanes and bus priority measures at junctions to be modelled. At the same time, it models the effects of capacity reduction on general traffic, and the effect this has, in turn, on bus journey times. Further details are provided below.

Mechanisms

3.12 The total journey time for a bus service is calculated as:

$$\sum BusLinkTime + BusTurnTime$$

3.13 The link and turn times are calculated using inputs from the SATURN model. Table 3.5 shows the attributes in the SATURN model that are imported into the EMME model.

Table 3.5 - SATURN / EMME/2 Attributes

SATURN Code	Filename	EMME/2 Attribute	Description
2033	*.blk	@bol	Bus Only Lane Marker
4023	*.clk	@clkp	Congested Link time
1633	*.ctu	@tup	Congested Turn Time
1803	*.flk	@flkp	Free flow link time

3.14 The congested link time is used when the bus mixes with general. The free flow link time is used when the bus is in a bus-only lane. The bus only lane marker is used to differentiate within EMME/2 which link time is used. The turn time is added to the link time to provide the total journey time.

3.15 However, there are some additional complexities that need to be incorporated into the calculation to ensure an accurate representation of the journey time, namely:

- if there are a large number of other users of the bus lane, such as taxis or high occupancy vehicles, the benefits will be diluted (the magnitude of the effect depends upon who is able to use the bus lanes, and the proportion of traffic this entails);
- the additional priority at junctions resulting in the installation of SVD will not be recognised within SATURN; therefore a calculation of the likely effect of additional bus priority is necessary;
- delays to bus run time occurring through boarding and alighting. Typical boarding times are as follows[1]:
  - 3 seconds (where majority of tickets are off-vehicle);
  - 6 seconds (where a high proportion involve cash transactions);
  - 9 seconds (where almost all ticketing involves cash transactions and change-giving); and
- alighting times are typically 1 to 1.5 seconds per person[1]., therefore alighting times may also have a bearing on journey times, although not as dramatic an impact as boarding.

[1] The demand for public transport – TRL Report 593, 2004

3.16 Additional attributes within EMME/2 are used to calculate bus journey times, shown in Table 3.6.

Table 3.6 – Additional EMME Attributes

EMME Attribute	Description
@svd	Marker for SVD at Signalised Junction
@bsd	Bus Stop Density - number of bus stops per km

@svd = 1 if there is selective vehicle detection for buses at a given node (signalised junction).

@bsd is calculated from empirical data for a number of bus routes in Bristol. @bsd = 2.83 for urban roads; 1.70 for rural roads. This is, in effect, the number of bus stops per kilometre.

Link Time Calculation

3.17 The following formulae are used to calculate the bus journey time on links:

$$Bus\ Link\ Time = 1.36*(Link\ time + Link\ length*BSD*delay)$$

where:

- Link time = SATURN congested link time (if no bus lane)
- Link time = SATURN free-flow link time (if a bus lane exists)
- BSD = Bus Stop Density per km (2.83 (urban), 1.70 (rural) – based on SATURN link types – derived from actual bus stop intervals).
- Delay = 20 seconds

3.18 The factor of 1.36 has been derived from other studies as a comparison between bus and car journey times on coincident links.

Turn Time Calculation

3.19 The following formula is used to calculate the bus delay at turns:

$$Bus\ turn\ time = SATURN\ turn\ time$$

3.20 However, there are a number of complications to this formulae, depending on the presence of a bus lane that leads up to the stopline and if SVD exists. Little information exists as to the effects on turn times for buses at such facilities. The numbers presented in Table 3.7 are considered a best estimate.

Table 3.7 – The Assumed Effect of Bus Priority on Turn Times

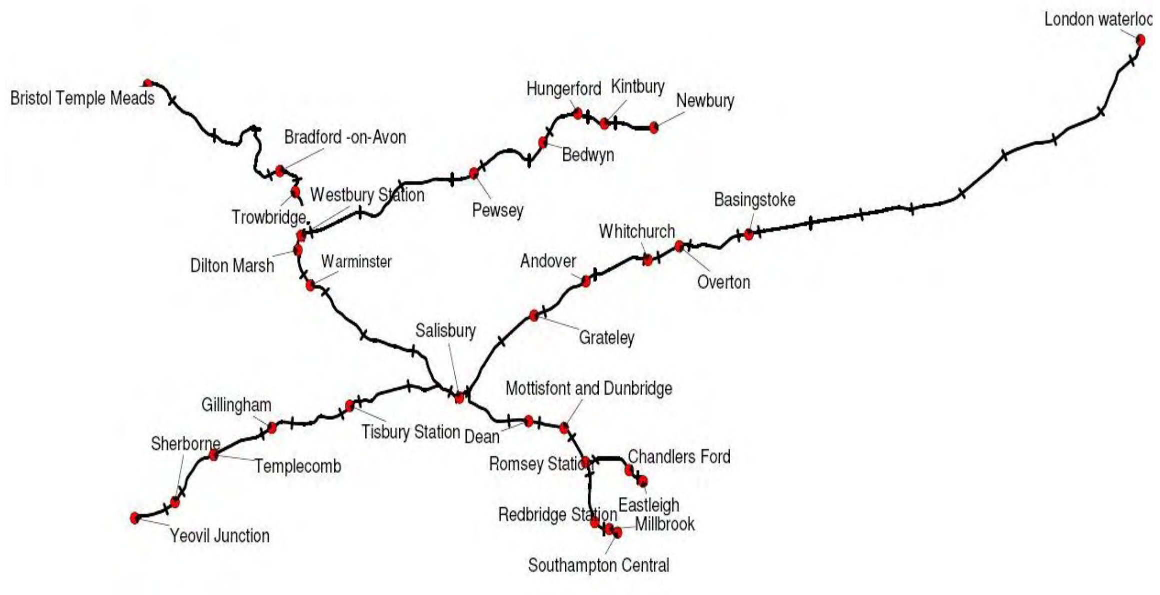
Bus priority measure		Factor on turn time
Bus Lane	SVD	
N	N	1.00
Y	Y	0.05
Y	N	0.15
N	Y	0.90

Rail Network

3.21 Rail lines are added to the bus/highway network to provide a full PT network. Appropriate connecting links are also added. All stations in the study area are included, together with a series of indicative stations outside the study area.

3.22 Figure 3.2 shows the local rail network graphically. The section of route between Westbury and Newbury, which does not carry services to or from Salisbury, is not utilised.

Figure 3.2 - Rail Network



3.23 The rail stations coded in the model are listed in Table 3.8.

Table 3.8 – Rail Stations Modelled

Number	Description
5001	Salisbury
5002	Tisbury
5003	Gillingham
5004	Templecombe
5005	Sherborne
5006	Warminster
5007	Dilton Marsh
5008	Westbury
5009	Trowbridge

Number	Description
5010	Bradford
5011	Bedwyn
5012	Hungerford
5013	Kintbury
5014	Newbury
5015	Grateley
5016	Andover
5017	Whitchurch
5018	Overton
5019	Basingstoke
5020	Eastleigh
5021	Southampton Central
5022	Millbrook
5023	Redbridge
5024	Romsey
5025	Mottisford & Dunbridge
5026	Dean
5027	Chandler's Ford
5028	Pewsey
5029	Bristol Temple Meads
5030	Yeovil
5031	London Waterloo

3.24 As regards rail services, these have been simplified and represent the pattern of services serving Salisbury station. Through services are represented, but the complication of "splitting" train services has been replaced by services terminating at Salisbury. The impact of this simplification is only to increase travel time for through passengers (by the sum of the additional waiting time and the boarding penalty such passengers are modelled as incurring), with no impact on passengers starting or finishing their rail journey at Salisbury station.

3.25 Accordingly, the services operated during each of the modelled time periods were abstracted from the relevant timetables and coded in to the relevant EMME/2 scenario. The services and frequencies are given in Table 3.9.

Table 3.9 – Rail Services Modelled in each Time Period

Operator	Origin	Modelled From	Via	Modelled To	Destination	Notes	Services in Period			Speed (Km/Hr)
							AM	IP	PM	
SWT	Exeter	Yeovil	Salisbury	London	London		1	2		90
SWT	Yeovil	Yeovil	Salisbury	London	London		1	3		90
SWT	Paignton	Yeovil	Salisbury	London	London			1		90
SWT	Plymouth	Yeovil	Salisbury	London	London			1		90
SWT		Salisbury	Salisbury	London	London	Starts Sal.		5	2	90
SWT	Exeter	Yeovil	Salisbury	Salisbury				1		90
SWT	Yeovil	Yeovil	Salisbury	Salisbury				1	1	70
SWT	Bristol	Bristol	Salisbury	Salisbury				2	1	70
SWT		Salisbury	Salisbury	London	London	Combined		2	1	90
SWT	London	London	Salisbury	Yeovil	Yeovil		1	2		90
SWT	London	London	Salisbury	Yeovil	Paignton		1	1		90
SWT	London	London	Salisbury	Yeovil	Exeter			1	1	90
SWT	London	London	Salisbury	Gillingham	Gillingham			1	1	90
SWT	London	London	Salisbury	Salisbury		Ends Sal.		5		90
SWT		Salisbury	Salisbury	Yeovil	Plymouth			2		70
SWT		Salisbury	Salisbury	Bristol	Bristol			2		70
SWT	London	London	Salisbury	Salisbury		Combined		2		90
SWT	Romsey	Romsey	Eastleigh	Salisbury	Salisbury	via Eastleigh	1	6	1	55
SWT	Salisbury	Salisbury	Southampton	Romsey	Romsey	via Eastleigh	1	6	1	55
FGW	Westbury	Westbury	Salisbury	Southampton	Southampton			1		70
FGW	G Malvern	Bristol	Salisbury	Southampton	Brighton			1		70
FGW	Cardiff	Bristol	Salisbury	Southampton	Portsmouth		1	6	1	70
FGW	Portsmouth	Southampton	Salisbury	Bristol	Cardiff		1	6	1	70
FGW	Southampton	Southampton	Salisbury	Bristol	Worcester			1		70
FGW	Brighton	Southampton	Salisbury	Bristol	G Malvern			1		70

3.26 Services have been coded using relevant train timetable information. All rail services that call at Salisbury in the modelled time periods are included (i.e. 08:00 to 09:00, between 10:00 - 16:00 and 17:00 to 18:00).

3.27 The main focus of the rail network is upon rail services that provide movements within the study area, focussed on Salisbury.

3.28 The rail network also includes a significant number of access/egress walk links to enable bus/rail connections to zones that do not have a direct link to railway stations.

Journey Times

3.29 Rather than collate and utilise timetables for specific train journey times, which had been undertaken initially, a simplified approach of line specific average speeds has been adopted. This avoids the problems associated with estimating train times where a different stopping pattern is assumed in forecasting mode. These average speeds, shown in Table 3.9, are based on an initial analysis of the current timetable routes and times.

Model Parameters

Assignment

3.30 The public transport assignment model uses the parameters based on those provided in WebTAG Unit 3.11.2 which in turn are derived from work undertaken by Institute of Highways and Transportation establishing guidelines for urban transport strategies and subsequent work undertaken for the DFT on the value of travel time savings. Further details, including the various references, may be found in the aforementioned WebTAG Unit.

3.31 The parameter values are provided below in Table 3.10.

Table 3.10 – Assignment Model Parameters

Parameter	Value
Wait time factor	0.5
Wait time weight	2.5
Walk time weight	2.0
Interchange (Boarding) penalty	10

3.32 The model does not include any representation of service crowding or capacity restraint, either for bus or rail. As such, since there is no modelling of crowding, the assignment is not flow-dependent and the EMME/2 algorithm assigns users to their minimum generalised cost routes.

Assignment Checks

3.33 As part of the checking process following a public transport assignment, the following statistics have been checked and are further discussed below:

- unassigned demand;
- intra-zonal demand;
- demand using “auxiliary transit” (walk) only; and

- inappropriate routes or mode.

3.34 Unassigned demand, where a journey from one origin to a destination cannot find a route, can occur if a zone is not effectively connected to the pattern of services in a particular time period. Each of the six assignments required for the PT model (3 time periods for rail demand and bus demand each) were checked and all showed zero unassigned demand.

3.35 Intra-zonal demand, where passengers are represented in the demand matrix as having the same origin zone as destination zone, can result in insufficient passenger flows on the network in that vicinity. This phenomenon is discussed and reported in Chapter 4 below. In summary, whilst there is marked intra-zonal demand in the bus passenger matrices, this will not be a cause for concern in the Salisbury area of the model.

3.36 Demand using “auxiliary transit” (walk) only is where the model finds a shorter route for a passenger to walk to their destination than to use public transport. This is possible given the impact of waiting time and boarding penalty on very short journeys. At an early stage of model development, the impact of the boarding penalty in this respect was tested, and values greater than four minutes were found to exacerbate the level of such activity in the bus assignments. Accordingly, this value was retained for a system-wide boarding penalty, as there is no evidence to support a higher value. Investigation of the assignment results showed that these “walk only” routes tend to be short distance, and often associated with larger outer zones where zone connectors of adjacent zones are closely located. In each modelled hour the total of these walk only trips is approximately 40, or under 5% of bus demand. This level of under assignment is not unusual and considered acceptable.

3.37 Inappropriate routes or modes can include the use solely of buses for a journey in the rail passenger assignment. In the rail assignments, the bus network is available to allow it to be used as a feeder mode, but the demand relates to rail passengers. Checks were undertaken to identify where the bus was being used more as the primary mode than as a feeder mode, and it was found that this only occurred for journeys between outlying zones, where it is unlikely that the passenger would normally have travelled through Salisbury. There is also limited use of the “walk” mode for trips associated with external zones to access the bus network in preference to the rail network, but this is not significant or likely to distort the times passed back to the demand model.

3.38 The conclusion from these checks was that the networks and matrices were in a reasonable state to permit the model calibration process to be undertaken.

ATKINS

4. Matrix Development

Introduction

4.1 The aim of this chapter is to describe the development of the demand matrices for the Salisbury Public Transport Model (SPTM).

4.2 The data collection exercise for this study was limited and only the following data is available for matrix construction:

- Wilts and Dorset Wayfarer (ticket) data; and
- Wiltshire Council rail survey.

Spatial Detail

Zones

- In the first instance existing zones were adjusted to TEMPRO (**T**rip **E**nd **M**odel Presentation **PRO**gramme) boundaries. This stage is necessary for forecasting future year trip rates from the National Trip End Model data extracted from TEMPRO (

4.3 and Figure Figure 4.2Following the review of TEMPRO boundaries each existing zone was considered for current land use and likely public transport (PT) catchments. As an example a supermarket site is expected to have different trip patterns to a residential area. If combined within an existing zone, different land uses were divided into two separate zones (Figure 4.3).

4.4 The zoning in areas also being modelled in micro-simulation was carefully considered for the loading of trips to the network. Trips within the micro-simulation model are loaded at the location of zone to network connectors in the SATURN network. To accommodate this, zones must be of a suitable size that connections to the network give an accurate representation of trips in the micro-simulation model. As a general principle smaller zones are required in such cases (Figure 4.4).

4.5 It is often easier to visualise the trip matrix in a condensed form. For the Salisbury Transport Model the following sectoring system is used (and is shown in Figure 4.5):

- Salisbury City Centre;
- Salisbury urban area;
- Salisbury District Council;
- Wiltshire; and
- Rest of Britain.

Figure 4.1 - National Zoning System

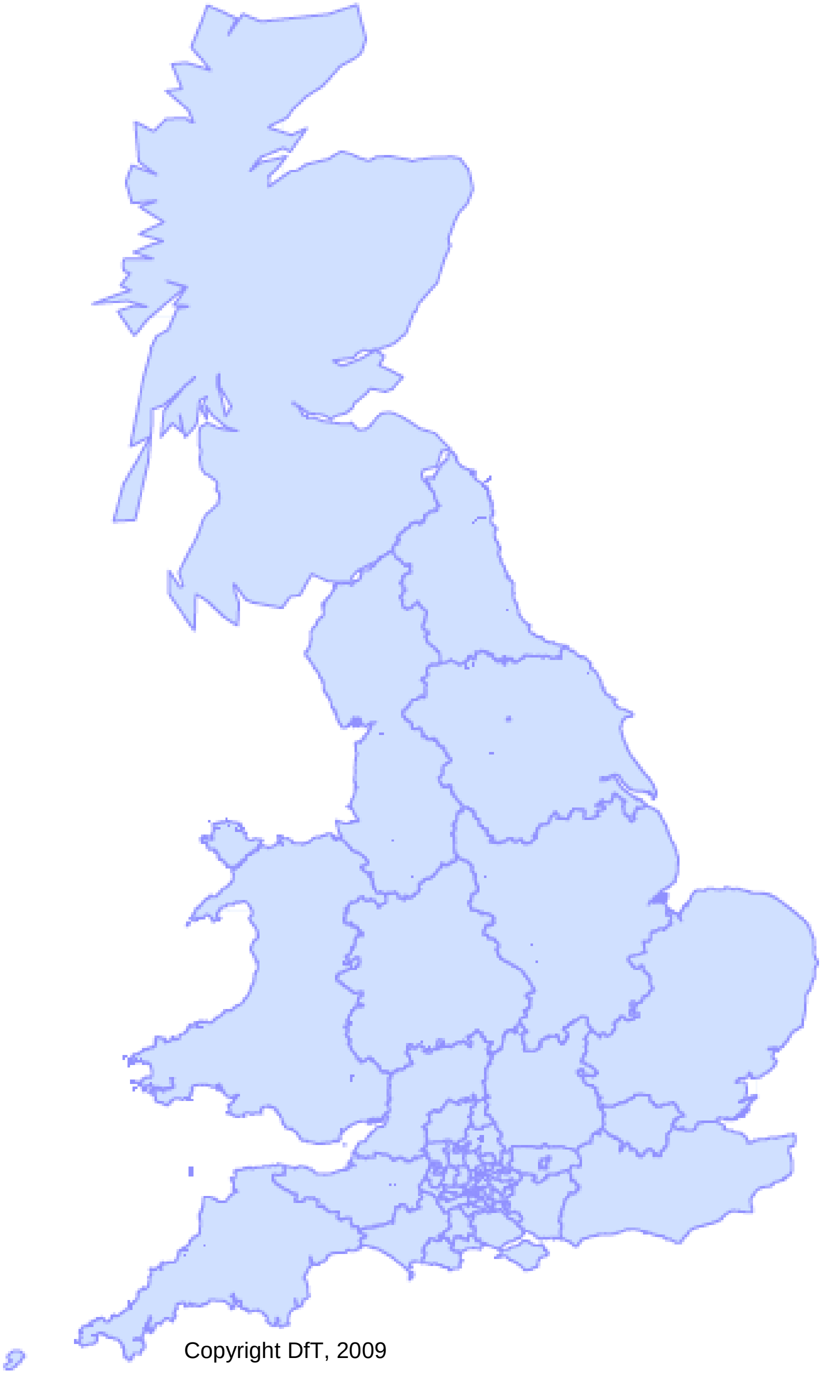


Figure 4.2 – Zoning System Within Wiltshire

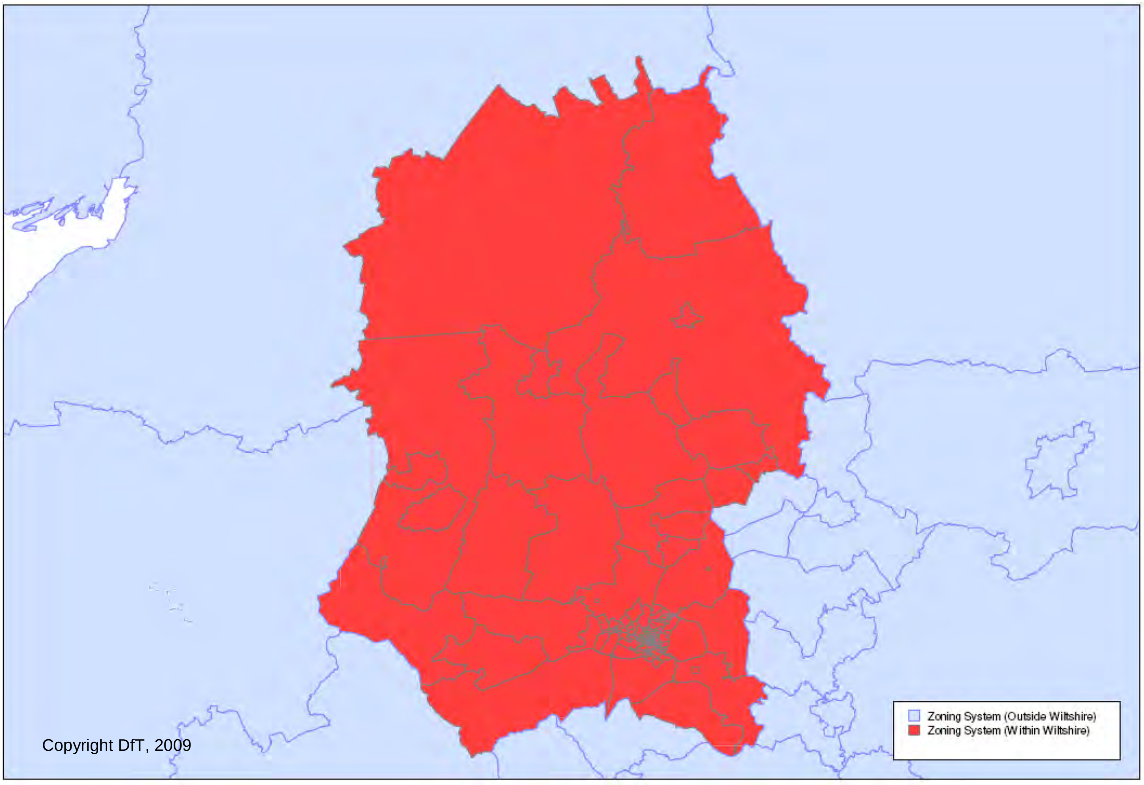


Figure 4.3 – Zoning System Within Salisbury District

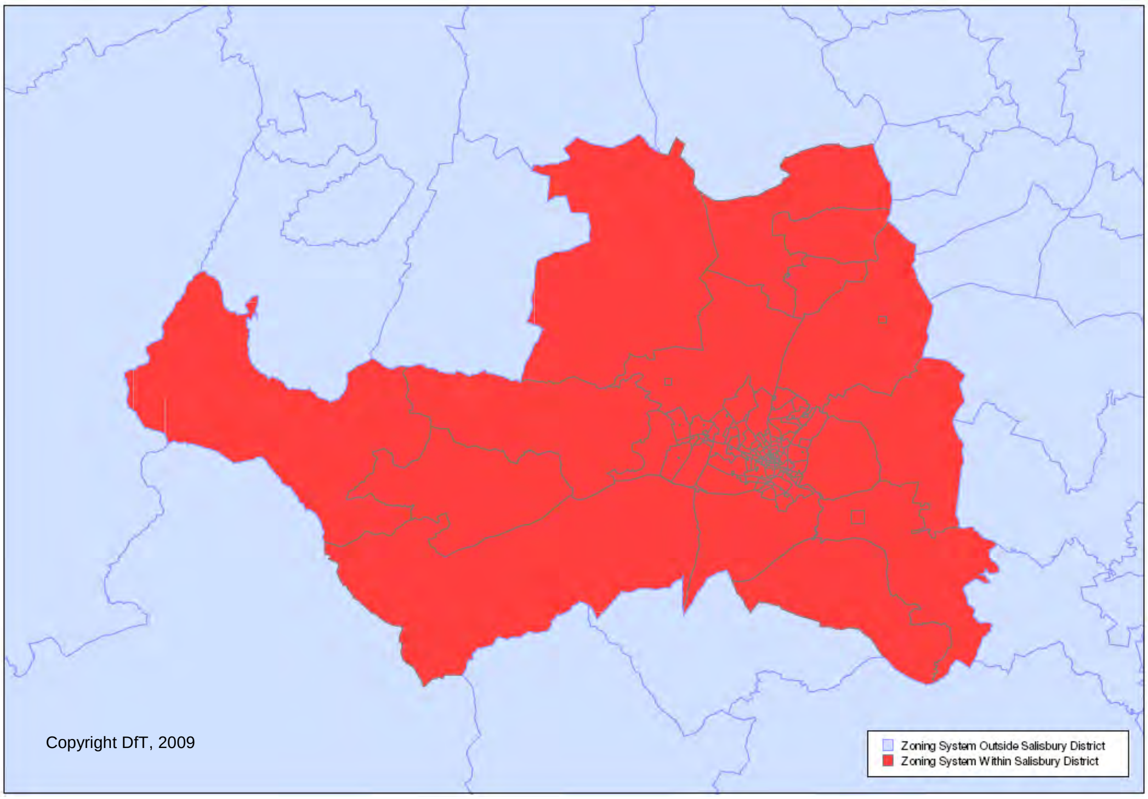


Figure 4.4 – Zoning System Within Salisbury City Centre

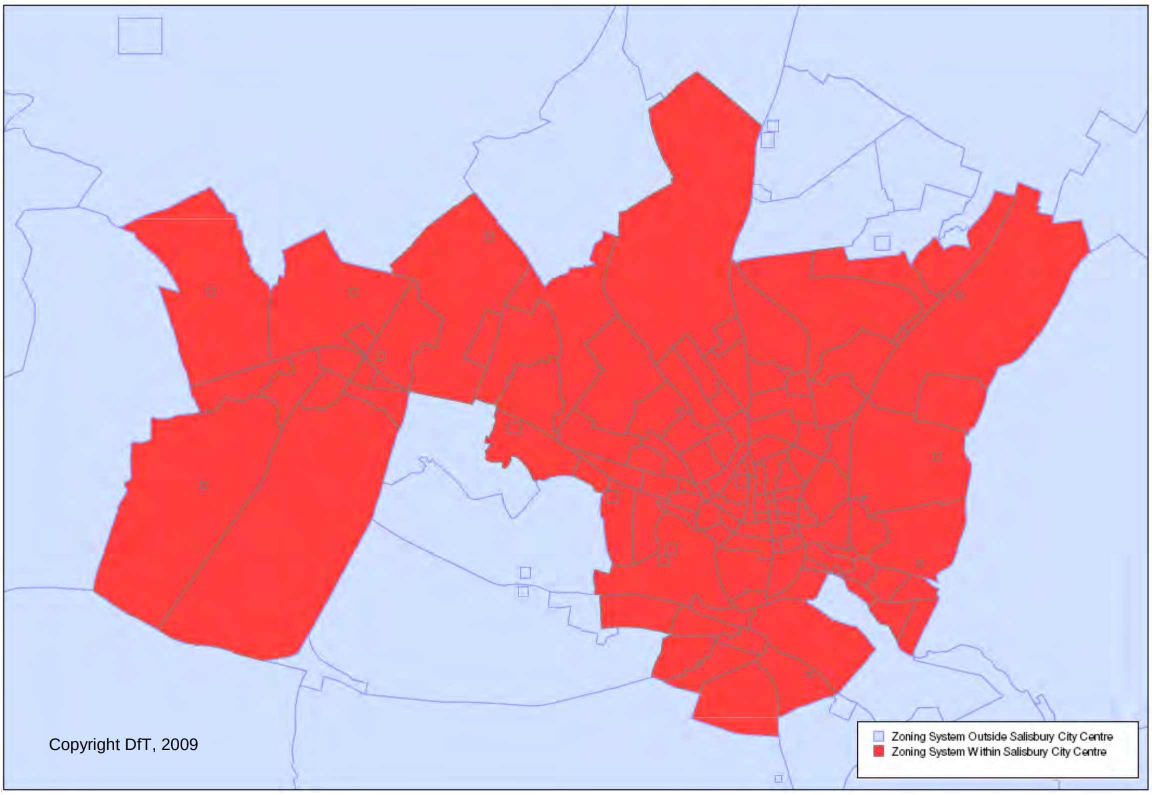
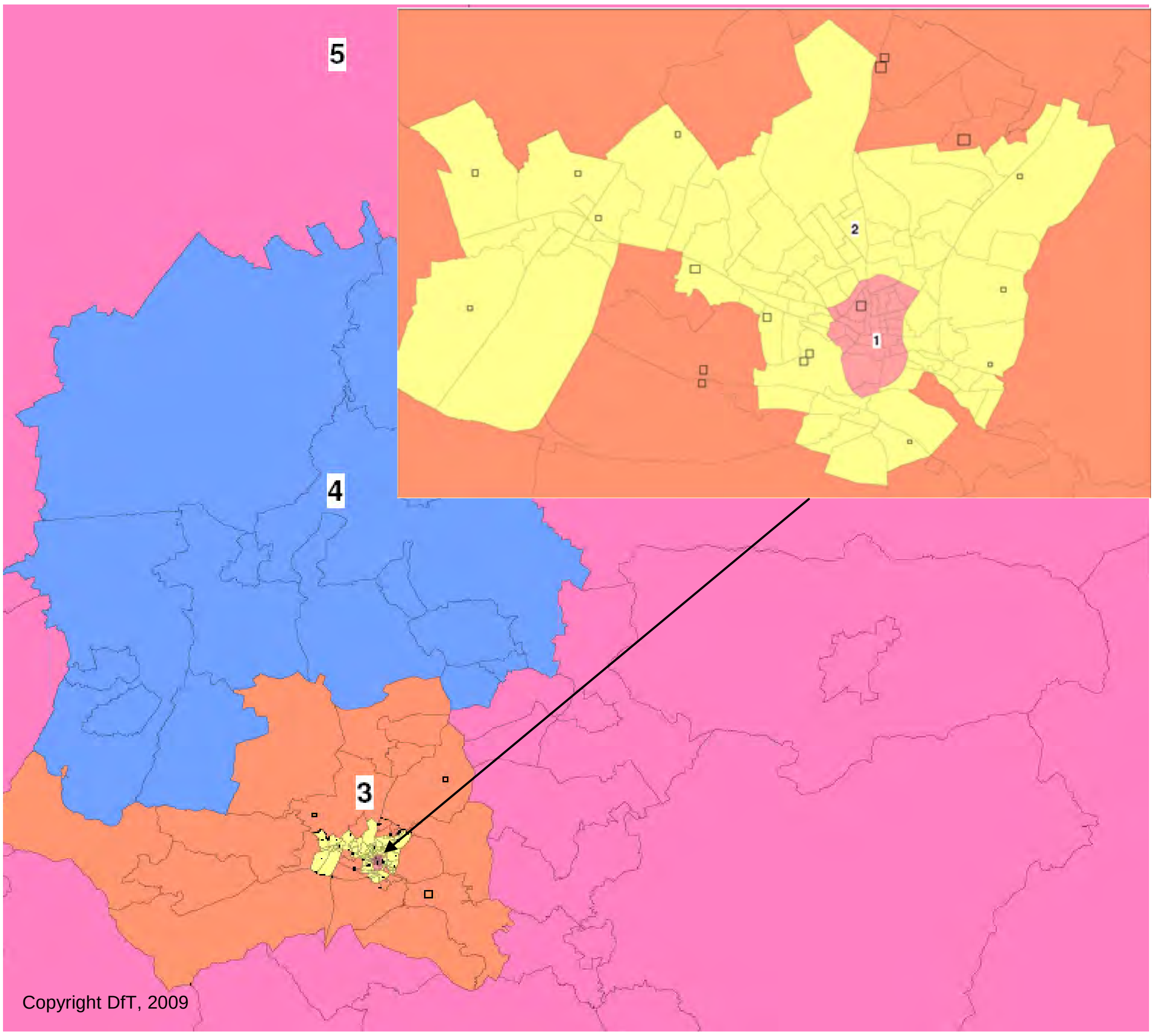


Figure 4.5 – Sector System



ATKINS

Bus Matrix Development

Use of Wayfarer Data

4.6 A total of 30 Wayfarer workbooks, containing numbers of boarding and alighting passengers at route stages, have been used to derive demand between these stages. The stages are used by the buses to determine fares, and one stage may encompass a number of stops.

4.7 All stages across the 30 routes were assigned a unique ID number; in total there are 409 stages identified. Each of these stages falls within all or part of a zone in the model, or across a number of zones. Generally stages towards the centre of Salisbury will fall into more zones, where the model is more detailed.

4.8 A matrix was then produced of all stage to stage demand. This stage to stage demand does not relate immediately to the modal's zoning system so a GIS-based correspondence tool is used to determine the proportion of stages in model zones.

Stage to Zone Factors

4.9 The factors used to assign stage demand to the model zones use the number of bus stops within the zone to distribute demand towards areas with high bus stop density. In addition the zone population is incorporated into this factor, to distribute demand to zones with higher population.

4.10 A resulting matrix of unique stage ID, model zone and a distribution factor was applied to the Wayfarer stage to stage demand matrix.

Peak Hour Demand Factors

4.11 The Wayfarer data was collected over a period of ten weekdays, over a larger peak period than specified for the model. Peak hour factors, as given in Table 4.1, were then applied to represent the hourly demand used in the SPTM.

Table 4.1 - Factors to convert period demand to peak hour demand

Period	Wayfarer Period	Adjustment Factor
AM	07:00-10:00	0.4305
IP	10:00-16:00	0.1667
PM	16:00-19:00	0.3447

4.12 It should be noted that the demand is a partial matrix, as Wayfarer data was not available for all services.

4.13 The final Bus passenger demand matrices are compressed and reported in Tables 4.2 to 4.4, for each respective hour.

Table 4.2 – Morning Peak Hour Sectored Bus Demand Matrix

Sector	1	2	3	4	5	Total
1	32	71	57	5	7	171
2	162	60	34	10	17	283
3	95	133	103	13	12	357
4	18	14	6	28	14	80
5	20	50	6	5	128	209
Total	328	327	208	60	177	1,100

Table 4.3 – Inter-Peak Hour Sectored Bus Demand Matrix

Sector	1	2	3	4	5	Total
1	39	137	82	13	16	286
2	102	42	59	9	38	249
3	66	53	56	8	8	191
4	8	7	11	16	7	48
5	17	42	5	11	114	188
Total	231	280	213	57	182	963

Table 4.4 – Evening Peak Hour Sectored Bus Demand Matrix

Sector	1	2	3	4	5	Total
1	34	143	125	19	23	343
2	59	35	146	18	62	320
3	51	24	41	7	7	130
4	2	3	6	7	10	28
5	7	22	8	13	100	151
Total	153	227	327	63	201	972

4.14 A further check on the matrices is the extent of "intra-zonal" trips, i.e. trips with the same zone for origin and destination. Such trips, which purport to represent actual bus passenger journeys, cannot be assigned in the model and thus can lead to a model not reporting the level of travel observed. Table 4.5 provides information on the level of such intra-zonal demand in the bus passenger matrices.

Table 4.5 – Intra-zonal Bus Demand

Period:	AM	IP	PM
Total Demand	1100	963	972
Intra-zonal Demand	220	148	115
Proportion of Intra-zonal Demand	20%	15%	12%

4.15 It can be seen that, overall, there is a significant level of intra-zonal trips (up to 20% in the AM Peak). This could be a matter of concern, but it transpires that the majority of these intra-zonal trips are associated with the larger zones in the outlying areas – where fare stages are also large. In these areas, the under assignment of local journeys is not of importance for the current application of the model. If, in the future, it was intended to use the bus demand to investigate travel in such outlying areas, the model would require further refinement.

Rail Matrix Development

4.16 The basic steps undertaken in manipulating the Rail Passenger data provided by Wiltshire Council were as follows:

- geocode survey data origins and destinations and match to Salisbury zoning system;
- split survey data into peak period groups:
  - morning peak - 07:00 to 10:00,
  - inter-peak between 10:00 and 16:00, and
  - evening peak – 16:00 to 19:00;
- create a matrix of observed zone to zone movements for each time period;
- factor the observed movements to match the total number of boardings at Salisbury Station for each time period to create outbound matrices;
- transpose the outbound matrices for each time period for inward journeys;
- create final matrices as follows:
  - morning peak = morning peak outbound + evening peak inbound
  - inter-peak = inter-peak peak outbound + inter-peak peak inbound; and
  - evening peak = evening peak outbound + morning peak inbound.
  - convert peak period matrices to peak hour, using the peak hour factors in paragraph below
    - morning peak factor = 0.311
    - inter-peak factor = 0.167
    - evening peak factor = 0.394

4.17 The size of the data tables at each stage are summarised in Table 4.6.

Table 4.6 – Rail Passenger Demand Data Processing

Summary total of Matrices	AM	IP	PM	Commentary
Survey Totals	135	166	129	Excludes trips with no origin/destination recorded
Factored up surveys	839	1068	1025	Factored to Boarding counts at Salisbury Station
Peak Period totals	1864	2136	1864	Based on data available, transposing full matrices
Final model hour totals	580	356	746	

4.18 It should be noted that this process means that the demand does not directly represent the modelled hour but ensures a greater distribution of travel.

4.19 The rail demand is summarised by the 5 sectors in Tables 4.7 to 4.9 for each modelled hour.

Table 4.7 - AM Peak Hour Sectored Rail Demand Matrix

Sector	1	2	3	4	5	Total
1	0	0	0	0	12	12
2	0	0	0	2	112	114
3	5	17	2	5	39	68
4	22	2	2	0	19	46
5	57	109	40	6	129	340
Total	84	129	44	13	310	580

Table 4.8 - IP Average Hour Sectored Rail Demand Matrix

Sector	1	2	3	4	5	Total
1	0	0	0	5	31	36
2	0	0	3	11	42	56
3	0	3	2	1	22	29
4	5	11	1	0	5	22
5	31	42	22	5	111	212
Total	36	56	29	22	212	356

Table 4.9 - PM Peak Hour Sectored Rail Demand Matrix

Sector	1	2	3	4	5	Total
1	0	0	6	29	73	108
2	0	0	22	3	140	165
3	0	0	2	3	51	57
4	0	2	6	0	8	17
5	15	144	50	24	166	399
Total	15	147	87	59	438	746

4.20 As with the bus demand matrices, the rail demand has been checked for the extent of intra-zonal trips. In this case, the level is very small – no more than 2 passengers per hour in any of the three matrices – so no further investigation is merited.

5. Calibration and Validation

Introduction

5.1 A number of calibration checks have been undertaken to demonstrate that the SPTM are a robust representation of 2008 public transport demand and supply. These checks included detailed comparisons of bus / rail stop loadings and flows across cordon crossings, as and where appropriate.

5.2 In addition, and more importantly for the SPTM, is the checks on the model journey times, as these are passed back to the demand model and hence directly influence the level of road and public transport demand when the model is used in forecasting mode.

Calibration and Validation criteria

5.3 The public transport calibration guidelines in WebTAG Unit 3.11.2 state that "Across modelling screenlines, modelled flows should, in total, be within 15% of the observed values. On individual links in the network, modelled flows should be within 25% of the counts, except where the observed flows are particularly low (less than 150)."

GEH Statistic

5.4 As well as differences in flow, the GEH statistic has been included in the tables below as an indicator of 'goodness of fit', i.e. the extent to which the modelled flows match the corresponding observed flows.

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

where M = modelled flow and C =observed flow

Journey Time Validation

5.5 The DMRB journey time validation criteria for highway models states that modelled journey times over the whole survey route should be within +/- 15% of observed times (or +/- 1 minute if higher) on 85% of routes. There are no such criteria for public transport models but a similar level of rigour has been assumed.

Bus Model

Calibration of the Bus Network and Demand Matrices

5.6 WebTAG Unit 3.11 recommends that validation should be undertaken by comparing modelled and observed passenger flows across screenlines and cordons by public transport mode. These comparisons are described below.

5.7 However, for the Salisbury Bus network, only a partial demand matrix and estimated counts, based on the same data source, were available. This means that the normal criteria for validation cannot readily be applied. As such, we can only demonstrate that the model calibrates to demand data rather than independently validates.

5.8 Tables 5.1 to 5.4 show the results of the link calibration for the morning peak inbound, inter-peak inbound and outbound, and evening peak period outbound respectively. These results are for a sub-network which included only those bus routes from which the demand data was derived. As noted above, the estimated flows is the best available estimate from the Wayfarer boarding and alighting data for the Salisbury city centre fare stage. Also shown in this Table are the passenger flows assigned as walking on the relevant cordon corridors, which can be seen to be relatively small in comparison with the bus passenger flows.

Table 5.1 – Bus Passenger Flows: Morning Peak Hour (Inbound)

Corridor	Bus passenger volumes at cordon (Pass./Hr)					Modelled Walk Flow (Pass/Hr)
	Modelled	Estimated	Absolute Difference	% Difference	GEH	
North	91	97	-6	-6%	0.63	10
North East	138	132	6	4%	0.48	1
South East	51	64	-13	-21%	1.76	20
South	109	142	-33	-23%	2.97	15
West	151	124	26	21%	2.24	5
Total	539	559	-21	-4%	0.85	51

Table 5.2 – Bus Passenger Flows: Inter-Peak Hour (Inbound)

Corridor	Bus passenger volumes at cordon (Pass./Hr)					Modelled Walk Flow (Pass/Hr)
	Modelled	Estimated	Absolute Difference	% Difference	GEH	
North	53	70	-17	-24%	2.13	13
North East	76	53	23	43%	2.84	0
South East	30	26	4	14%	0.70	14
South	114	82	32	39%	3.23	27
West	72	68	4	6%	0.49	10
Total	345	299	46	15%	2.56	64

Table 5.3 – Bus Passenger Flows: Inter-Peak Hour (Outbound)

Corridor	Bus passenger volumes at cordon (Pass./Hr)					Modelled Walk Flow (Pass/Hr)
	Modelled	Estimated	Absolute Difference	% Difference	GEH	
North	65	43	21	49%	2.89	6
North East	68	101	-32	-32%	3.53	0
South East	21	30	-10	-32%	1.91	28
South	111	93	18	19%	1.75	33
West	104	70	34	49%	3.69	21
Total	369	338	31	9%	1.65	87

Table 5.4 – Bus Passenger Flows: Evening Peak Hour Outbound

Corridor	Bus passenger volumes at cordon (Pass./Hr)					Modelled Walk Flow (Pass/Hr)
	Modelled	Estimated	Absolute Difference	% Difference	GEH	
North	86	132	-46	-35%	4.37	7
North East	97	87	10	12%	1.09	0
South East	51	72	-21	-29%	2.64	30
South	118	122	-4	-3%	0.36	22
West	141	110	32	29%	2.83	23
Total	493	522	-28	-5%	1.29	82

5.9 The total passengers modelled crossing the cordon in each modelled period can be seen to be reasonably close to the estimated value. However, the distribution between the corridors is not as good as might be expected given the source data. There are a number of reasons for this, but the main reason is the difficulty in splitting the Wayfarer data into modlled zones without observed data to assist the process.

5.10 Against the WebTAG criteria, each cordon total meets or is better than the 15% error level. The only link or corridor values to exceed the 25% error level are ones where the flow is less than 150 passengers.

5.11 This is confirmed by the GEH statistics, where a value of less than 5 is considered acceptable; the highest GEH value found was 4.37.

Bus Journey Time Validation

5.12 The bus link time and bus turn times both contribute to a modelled journey time. Initially this information was sense checked to ensure all link speeds were realistic. Subsequently travel times have been compared to timetables published by Wilts and Dorset Bus. As the highway network becomes more simplified outside the Salisbury simulation area, the link times may not validate so well to the timetables outside of the urban area. In addition, the timetables may include extra time, or "recovery time", to improve apparent reliability of services. To avoid such effects, the check on bus journey times reported here represents the inter-peak period (which should have more reliable highway times and thus more reliable scheduled bus times), with separate summaries for City centre sections in Table 5.5, and for more rural sections in Table 5.6.

Table 5.5 – Daytime Journey Time to Salisbury Bus Station (City Centre) From Locations Within the Urban Area.

Location	Modelled (minutes)	Timetabled (minutes)
Salisbury Hospital	15	15
West Harnham - Upper Street	15	12
Wilton Centre	19	17
Top Devizes Road	19	14
Stratford Bridge	20	16
Old Sarum	13	14
Bishopsdown	15	13
Laverstock	13	10
Britford	16	11
Coombe Bissett	25	24
Salisbury Rail Station	5	9

Timetables from Wiltshire and Dorset buses http://www.wdbus.co.uk/

Table.5.6 – Daytime Journey Time to Salisbury Bus Station (City Centre) From Regional Bus Destinations.

Location	Modelled (minute)	Timetabled (minutes)
Southampton	65	62
Romsey	62	65
Blandford	61	60
Hindon	54	54
Stapleford	22	29
Devizes	64	70
Amesbury	32	23
Tidworth	48	54
Winterslow	23	25
Warminster	55	54

Timetables from Wiltshire and Dorset buses http://www.wdbus.co.uk/

5.13 It can be seen that the modelled journey times for journeys within Salisbury tend to be slightly higher than the timetable, whilst those journey times for more rural services are generally very close to the published timetable. These comparisons of journey times give a general reassurance that the inter-peak period is being modelled with reasonable consistency to the published timetable.

5.14 Inspection of the modelled bus times for the morning and evening peak periods has shown that, as could be expected, the increasing highway congestion in the city is impacting on the bus operation, although the impact is generally small and there is no available data to confirm actual bus operations.

ATKINS

Rail Model

Calibration of the Rail Network and Demand Matrices

5.15 For the rail model, there is only one station of direct interest: Salisbury. The rail passenger matrices were derived from the surveys of passengers using Salisbury station, who were a combination of through passengers changing train and people using Salisbury as an access to the rail system. As already noted, through services such as London Waterloo to Exeter, have been modelled explicitly; however, this does not apply to splitting or joining services which have been modelled independently. As a result, the modelled figures for passengers boarding or alighting at Salisbury could be expected to be higher than the observed values

5.16 In addition, the application of a simple factor to convert the peak period to a single hour does not take into account the situation where there is a different profile over the period for arriving as opposed top departing passengers. The Tables below are not therefore representing the same entities, other than during the inter-peak period. The "Modelled" column represents a factored hourly representation of the three hour peak period, whilst the "observed" column is the number of passengers during the single hour (commencing at 08:00 or 17:00 for the morning peak or evening peak respectively).

5.17 The rail demand for each modelled hour was assigned to a complete network representation, so rail passengers could use walk or bus to access the rail network. However, this means it is possible for a "rail passenger" to adopt a route which avoids using rail, choosing to travel all the way by bus. Assignment results were checked and this was apparent for some totally external movements, which were unlikely to travel via Salisbury in any event. This is a result of the process adopted to generate the rail demand and allocate it to zones.

5.18 Table 5.7 gives the available information for boarding passengers, whilst Table 5.8 gives the equivalent information for alighting passengers.

Table 5.7 – Boarding Passengers per hour at Salisbury Station

Period	Modelled	Observed	% Difference	GEH
Morning peak	282	261	8%	1.27
Inter-peak	202	178	13%	1.74
Evening peak	402	400	1%	0.10

Table 5.8 – Alighting Passengers per hour at Salisbury Station

Period	Modelled	Observed	% Difference	GEH
Morning peak	279	491	-36%	8.26
Inter-peak	201	167	20%	2.51
Evening peak	356	328	9%	1.51

5.19 With the exception of the AM Peak hour, these results satisfy the WebTAG criterion of being within 25%. Also, the GEH statistic is generally well within the value of 5 accepted as satisfactory. The nature of matrix construction, apply peak period to peak hour factors, means that one direction (boarding) will match observed counts whilst direction (alighting) may not do so. This does not affect the costs that are passed to the demand model.

Rail Journey Time Validation

5.20 As already explained, the rail journey times are based on assessed average speeds, based on previous analysis of the rail timetable. The same speeds have been assumed in all three time periods.

5.21 To validate these average speeds, the modelled journey time from Salisbury to key destinations in each rail corridor have been extracted from the AM Peak Hour model and are compared with available timetable information for departures between 08:00 and 09:00, averaged where required, on a typical weekday. The results are to be found in Table 5.9.

Table 5.9 – Rail Journey Times from Salisbury (Minutes)

To	Modelled	Timetable
Yeovil Junction	42	42
Bristol Temple Meads	72	78
London Waterloo	95	90
Southampton Central	35	37

5.22 The WebTAG criterion for journey times in highway models is that the model should be within +/-15% of observed. There is no equivalent criterion for PT models, but the results shown above would be within this criterion.

5.23 These comparisons demonstrate that the model is adequately representing rail journey times in all four rail corridors serving Salisbury.

6. Conclusions

6.1 The Salisbury Public Transport Model (SPTM) has been developed to simulate the movement of people on the public transport network within an area centred on Salisbury. It will be used, in conjunction with the related highway and demand models to test and assess the impacts of future land-use scenarios and proposed highway and public transport improvements.

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 model represents bus and rail demand on their respective sub-modal networks. Bus demand was developed from Wayfarer electronic ticket data supplied by Wilts & Dorset Bus for movements made in October 2008. Rail demand was developed from data collected in rail passenger surveys undertaken by Wiltshire Council in 2008.

6.4 This Local Model Validation Report has described the development of the modelled networks and trip matrices in Chapters Three and Four. Chapters Four and Five demonstrate that the model is an appropriate representation of the public transport network for Salisbury, both in terms of reproducing the observed demand as well as timetabled journey times. On this basis, the model is considered to be fit for the purposes described in Chapter One and may therefore be used with confidence to support the demand model in estimating the impacts of proposed interventions in the transport system in the study area.

6.5 Were the public transport model required to support the development of a public transport initiative through the planning process, we have highlighted in Steering Group meetings and recorded on the Issues Log that additional resources be expended to collect additional demand and flow data to enable a more refined model to be developed and rigorously validated.