ST HELENS SATURN MODEL

LOCAL MODEL VALIDATION REPORT

MAY 2018

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St Helens Council

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1 EXECUTIVE SUMMARY

This Local Model Validation Report presents a summary of the development, calibration and validation of the base model for St Helens SATURN Model (SHSM). This report covers:

- Model purpose
- Model standards
- Model description and specification
- Summary of data collection
- Network development
- Matrix development
- Network calibration
- Matrix calibration
- Assignment calibration and validation
- Summary of model performance.

This report confirms the suitability the model for potential applications in testing the impacts of developments and highway improvements on traffic in St Helens district.

The model meets the Department for Transport's WebTAG criteria for link and screenline validation, journey time validation and an acceptable level of assignment convergence.

2 INTRODUCTION

2.1 BACKGROUND

WSP was appointed by St Helens Council to produce a 2017 base highway model of St Helens district. The St Helens SATURN Model (SHSM) signifies the intention by the Council to invest in a tool that will assist and add value to decision making on matters that are critical to the district in meeting the Liverpool City Region Combined Authority's 'Transport Plan for Growth' strategy.

2.2 PURPOSE OF THE MODEL

SHSM is designed to be a highway only assignment model, used to assess the traffic impact of schemes within St Helens district. The model will bridge the gap between the strategic Liverpool City Region Transport Model (LCRTM) and microsimulation models such as the A570 corridor model.

A number of developments and highway schemes have been identified where SHSM could be used to test the traffic impacts. These include:

- M6 J23
- Infrastructure requirements scenario testing – employment and housing allocations/ greenbelt
- Town centre strategy re-development option modelling
- A580 corridor enhancement/ assessment
- Evidence to enhance motorway connectivity (e.g. M62 J7, M6 J22, M6 J24)
- A570 Linkway Major Scheme Business Case review

To ensure that the model is sufficiently robust to be applied to the schemes above, the following key features have been considered during model development:

- Comprehensive traffic data was collected within the study area so that the model is able to demonstrate a good fit to observed flows within St Helens district.
- Focus on the Strategic Road Network (SRN) and Key Route Network (KRN) when coding the network to ensure that these routes are represented correctly both in flows and journey times.
- The zoning structure for the base model has been created so that future developments can easily be added in.

2.3 PURPOSE OF THIS REPORT

This Local Model Validation Report (LMVR) describes the development of SHSM. The model has been developed in accordance with the Department for Transport's (DfT) Transport Appraisal Guidance (TAG) to provide St Helens Council with a highway modelling tool that can be used to gain insight into the St Helens road network.

The focus of the model calibration and validation has been the Key Route Network (KRN) and junctions at key locations within St Helens district. During model development, LCRTM was utilised as a starting point from which network detail was added within St Helens and matrix improvements were made. This report explains the process used to create SHSM and the level to which it accurately represents highway travel patterns.

2.4 STRUCTURE OF THIS REPORT

This report is structured as follows:

- **Section 3** - Defines the standards adopted for model calibration and validation and for assignment convergence
- **Section 4** - Describes the key features of the highway model and its development
- **Section 5** - Describes the traffic count data that has been used for model calibration and validation
- **Section 6** - Describes the highway network development
- **Section 7** - Describes the trip matrix development
- **Section 8** - Provides information on the network calibration and validation
- **Section 9** - Demonstrates matrix calibration and validation
- **Section 10** - Covers assignment calibration and validation
- **Section 11** - Provides a summary of model development, standards achieved and appropriateness for use.

3 MODEL STANDARDS

3.1 INTRODUCTION

Throughout the model development process reported here, reference was made to the guidance provided in DfT TAG Unit M3.1, *Highway Assignment Modelling*[1]. Specific reference was made to the criteria and standards appropriate for highway assignment validation and for model convergence.

The general objective of model development has been to exceed the minimum standards wherever possible.

3.2 CALIBRATION/ VALIDATION

The following criteria was used to assess the model's validation levels.

TRIP MATRIX VALIDATION

The following criteria for matrix validation and acceptability guidelines for matrix validation were targeted in terms of screenline flow validation:

Table 3-1 - Screenline Validation Criteria

Measure	Acceptability Guideline
Differences between modelled flows and counts should be less than 5% of counts	all or nearly all screenlines

LINK FLOW AND TURNING MOVEMENT VALIDATION

The criteria for followed for link flow validation are set out below.

Table 3-2 - Link flow Validation Criteria

Criteria		Acceptability Guideline
1	individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	> 85% of cases
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	> 85% of cases
2	GEH <5 for individual flows	> 85% of cases

[1] https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling

JOURNEY TIME VALIDATION

Journey time comparisons were undertaken as part of the SHSM validation process, to match the objectives set out in **Table 3-3**.

Table 3-3 Journey Time Validation Criteria

Criteria	Acceptability Guideline
Modelled times along routes should be within 15% of observed times (or 1 minute if higher than 15%)	> 85% of routes

In all cases, these criteria were applied to combined all-vehicle flows and journey times.

3.3 MODEL CONVERGENCE

TAG guidelines suggested the criteria listed in **Table 3-4** to measure model convergence.

Table 3-4 TAG Convergence Criteria

Measure of Convergence	Base Model Acceptable Values
Delta and % Gap	less than 0.1% or at least stable with convergence fully documented and all other criteria met
percentage of links with flow change (P) < 1%	four consecutive iterations greater than 98%
percentage of links with cost change (P2) < 1%	four consecutive iterations greater than 98%
Percentage change in total user costs (V)	Four consecutive iterations > 0.1%

3.4 FITNESS FOR PURPOSE

A model is 'fit for purpose' if robust conclusions can be drawn from the model outputs in relation to the defined model purpose as discussed in **Section 2.2**.

The achievement of the validation acceptability guidelines specified in this section does not guarantee that a model is 'fit for purpose' and likewise a failure to meet the specified validation standards does not mean that a model is not 'fit for purpose'.

4 MODEL DESCRIPTION AND SPECIFICATION

4.1 INTRODUCTION

The St Helens SATURN Model (SHSM) has been developed using the latest SATURN version (11.3.12W) and calibrated against 2017 traffic conditions. The following section provides an overview of the key model features of SHSM.

The St Helens SATURN model has been developed by utilising key features such as network structure and matrices from the Liverpool City Region Transport Model. LCRTM is a strategic link based model, built using CUBE Voyager software, with a 2012 base year. The study area for LCRTM covers Merseyside, Halton, West Lancashire and Warrington.

4.2 STUDY AREA

The network for SHSM was created using the structure of Liverpool City Region Transport Model (LCRTM) for network links.

In order to develop a model network, three separate areas must be defined, these are: simulation, buffer and external.

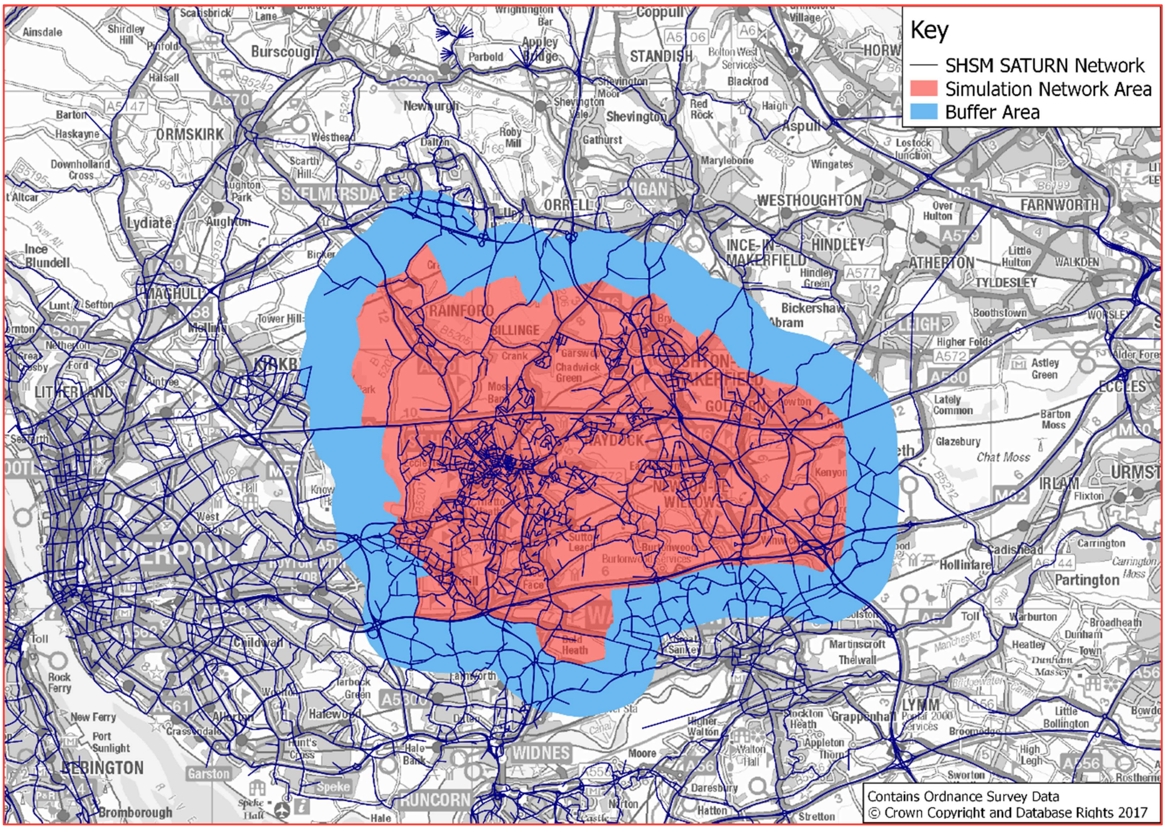
The ***simulation area*** is the network area where significant impacts of interventions are expected. Within the simulation area, junctions are modelled and include blocking back, zones are also smaller offering a finer level of detail. For SHSM, the network in the simulation area was created using LCRTM network structure with additional network detail added to better represent route choice.

The ***buffer network*** is defined as the area over which the impacts of interventions are considered to be quite likely but relatively weak in magnitude. In this area, no junctions are modelled but the links still have capacity constraints in the form of speed/flow curves. The network detail in the buffer area is less detailed but still allows correct routing into the simulation area, this area will also have larger zones than in the simulation area. For SHSM, the buffer network retained LCRTM links and their associated speed/flow curves where possible. A 2km area around the simulation area was defined where all links in this area had speed/flow curves. The purpose of this watertight buffer was to create better routings in and out of the simulation network.

The ***external network*** is the area where impacts of interventions would be so small as to be reasonably assumed to be negligible. This part of the network will have larger zones and far less network detail than other areas. The demand from zones in this area will be a subset of the full demand from these regions as the model will only include trips that interact with buffer/ simulation areas. For SHSM, The network in the external area was derived from LCRTM and is a mix of speed/flow curves and fixed speed network.

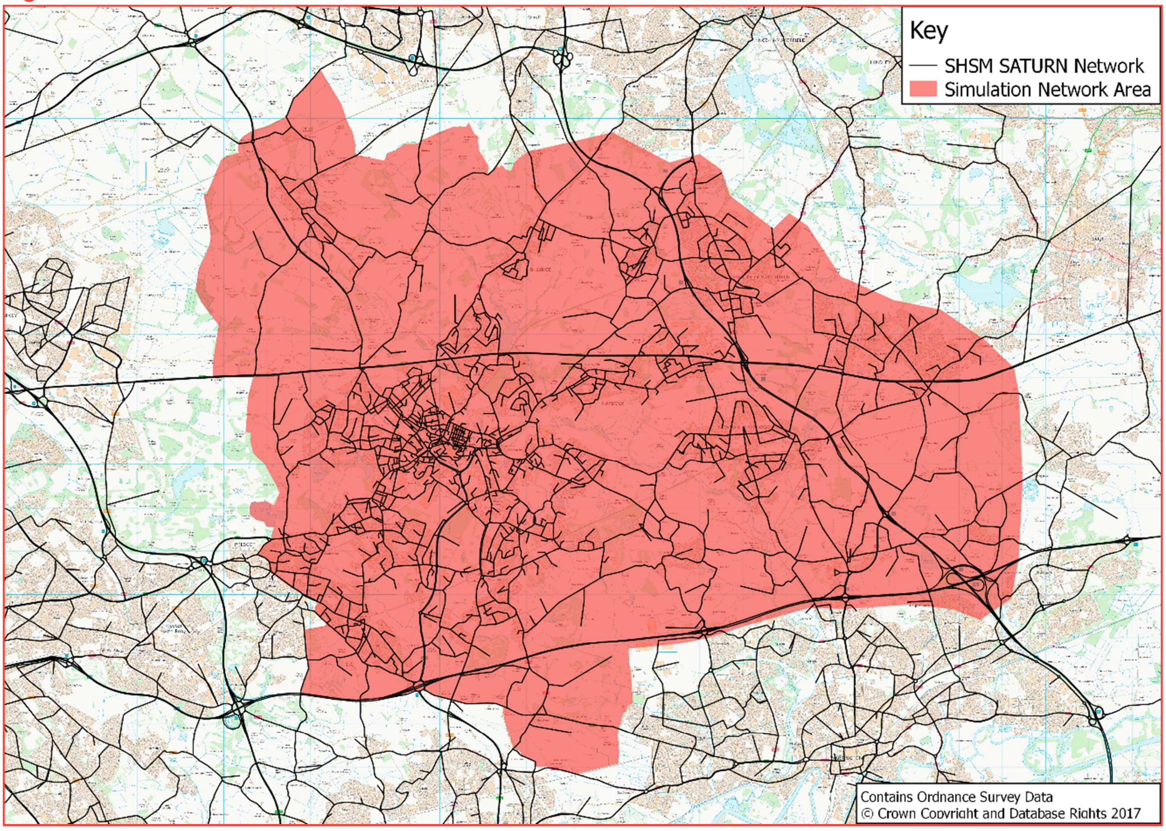
The St Helens SATURN Model network is shown in Figure 4-1**.**

Figure 4-1 St Helens SATURN Model Study Area



It was agreed with St Helens Council that the extent of the SHSM simulation area would incorporate the St Helens district as well as an area to the east of the M6 (parts of Wigan district) and all of the key junctions on the M62 boundary. The simulation area is shown in **Figure 4-2**.

Figure 4-2 – St Helens SATURN Model Simulation Area



4.3 ZONING SYSTEM

The zoning system is based on the 467 zones in the Liverpool City Region Transport Model (LCRTM). Zones within the SHSM simulation area were split in order to achieve a greater level of detail in St Helens. Zones in the buffer and external areas of the model are unchanged from LCRTM. This resulted in 810 SHSM zones, including 22 spare zones reserved for development sites in the forecast models.

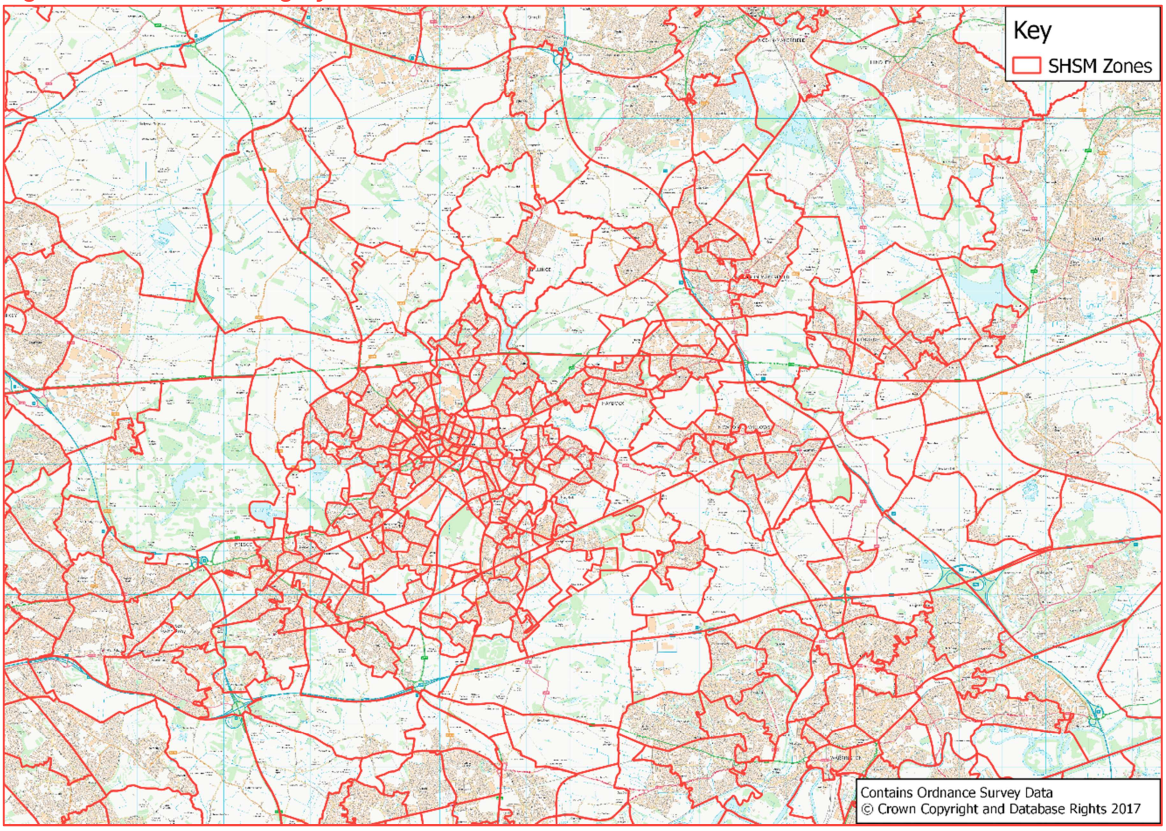
A detailed review of zones within the simulation area was undertaken to establish what splitting should be applied. This review considered:

- Land use by visual inspection
- Correspondence to Census Medium Super Output Area (MSOA) boundaries
- Correspondence to LCRTM zone boundaries

This review resulted in a zoning system with a greater level of zone density in urban areas and larger zones in rural areas. Additionally, the size of a zone in the model is proportionate to its proximity to the study area. Generally his means that, the further away from the study area zone is, the larger area it will cover.

The zoning system for St Helens SATURN Model is shown in **Figure 4-3**.

Figure 4-3 - SHSM Zoning System

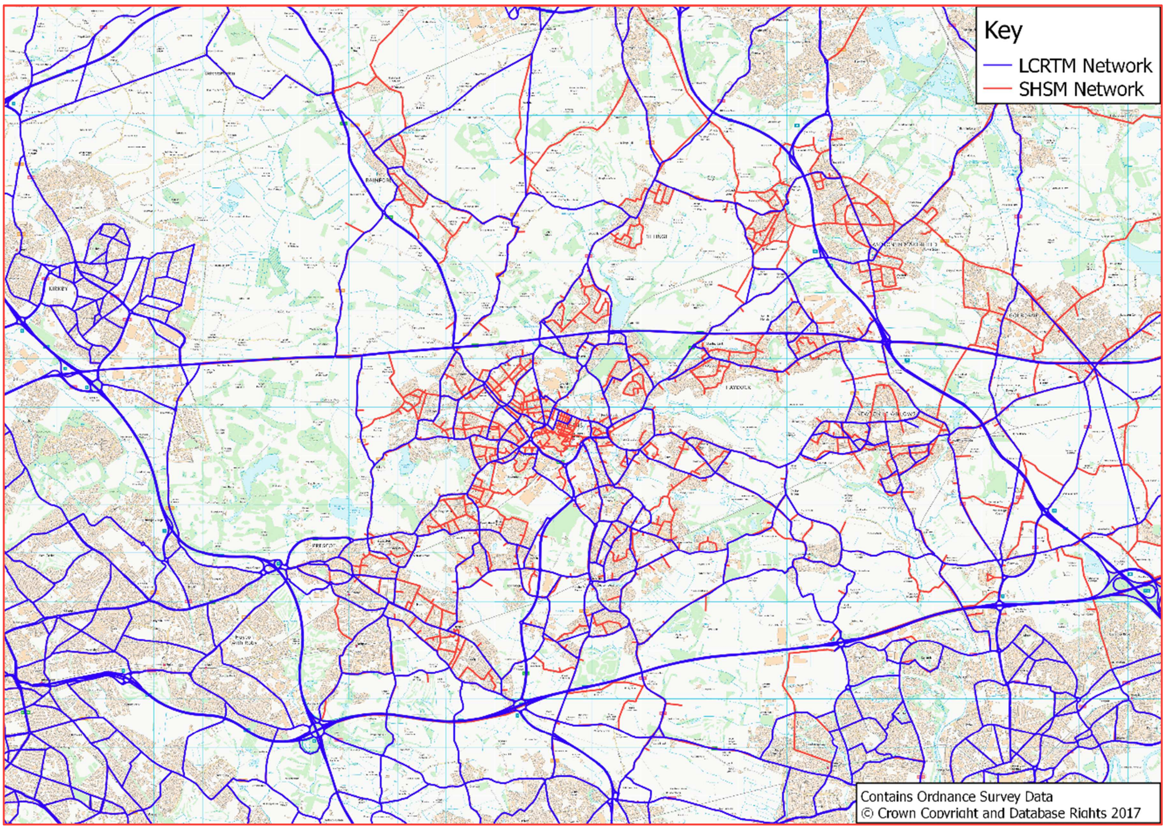


4.4 NETWORK STRUCTURE

The skeleton network for SHSM was taken from LCRTM, however this model had limited coverage within St Helens and a large amount of additional links had to be included to provide reasonable coverage of the district. Figure 4-4 shows the LCRTM network and additional links added in for the SHSM network.

The simulation network consists of 4426 links and 1587 nodes.

Figure 4-4 St Helens SATURN Model Network



4.5 MODELLED TIME PERIODS

When developing the SHSM matrices, Liverpool City Region Transport Model (LCRTM) was used to provide parent matrices. The LCRTM matrices were provided for three time periods:

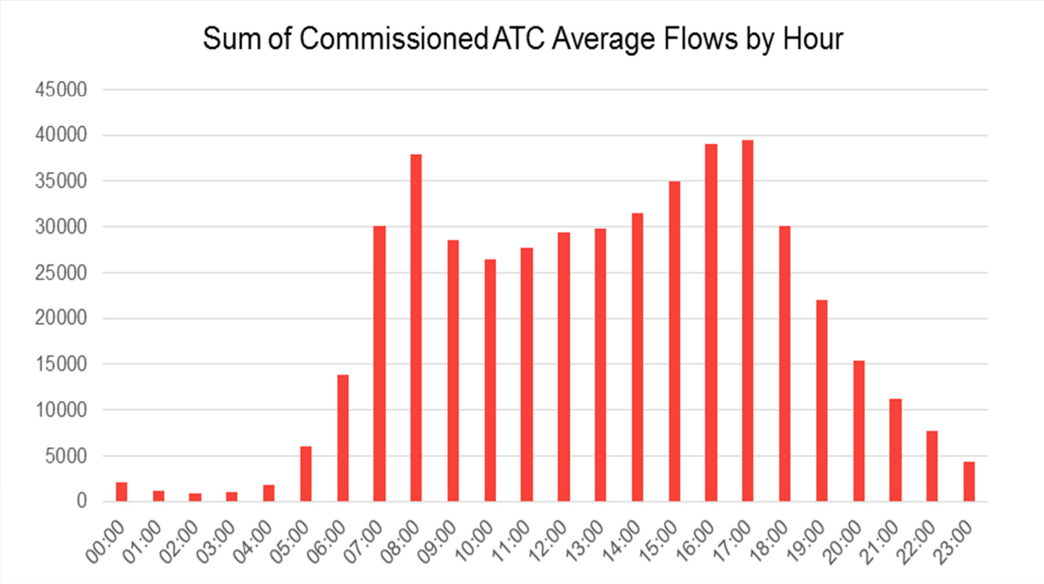
- AM Period (07:00-10:00)
- Inter-Peak (IP) Period (10:00-16:00)
- PM Period (16:00-19:00).

Checking against traffic count survey data as shown in **Figure 4-5**, observed traffic data gave peak hours as follows:

- AM Peak hour (08:00-09:00)
- Inter-Peak (IP) average hour (10:00-16:00)
- PM Peak hour (17:00-18:00)

These are the peak hours that were used for SHSM.

Figure 4-5 ATC Average Flows by Hour



4.6 USER CLASSES

Fiver user classes have been modelled, reflecting the vehicle type and journey purpose:

- UC1: Cars – employer business
- UC2: Cars – commute
- UC3: Cars – other
- UC4: Light Goods Vehicles (LGV)
- UC5: Heavy Goods Vehicles (HGV)

4.7 PASSENGER CAR UNITS

Highway assignment models such as SATURN operate in passenger car units (PCU) rather than vehicle units. In order to use traffic counts and demand matrices during assignment, it was required to convert vehicles into PCUs.

The following PCUs per vehicle were applied to each of the user classes in SHSM:

- Car – 1.0
- LGV – 1.0
- HGV – 2.3

4.8 ASSIGNMENT METHODOLOGY

The St Helens SATURN model uses SATURN v11.3.12W. The standard Wardrop User Equilibrium, using the Frank-Wolfe algorithm, has been used as the assignment procedure.

The cost of travel is expressed in terms of generalised cost minutes, which can be related to the value of time and out of pocket costs. A multiple user class assignment method was used that allows different user classes to be assigned simultaneously to the same network but using different generalised cost functions.

4.9 GENERALISED COSTS

The components of the generalised cost function used in the traffic model were based on TAG unit M3.1 and data contained in the latest DfT approved WebTAG databook (July 2017). It calculates the costs of travel based on the assumptions of the value of money which a traveller is willing to pay to compensate for the time and out of pocket expenses spent driving on the road.

Values of pence per kilometre (PPK) and pence per minute (PPM) for three vehicle classes (Car, LGV, HGV) by purpose type (Work, Commute, Other) were calculated for all three time periods for input to SATURN. The values used are shown in Table 4-1.

Table 4-1 SHSM Generalised Costs

Vehicle Class	Trip Purpose	AM		IP		PM	
		PPM	PPK	PPM	PPK	PPM	PPK
Car	Business	30.49	12.03	31.24	12.03	30.93	12.03
Car	Commuting	20.45	5.47	20.78	5.47	20.52	5.47
Car	Other	14.11	5.47	15.03	5.47	14.77	5.47
LGV	LGV	21.55	13.12	21.55	13.12	21.55	13.12
HGV	HGV	50.32	37.05	50.32	37.05	50.32	37.05

4.10 CAPACITY RESTRAINT MECHANISMS: JUNCTION MODELLING AND SPEED/FLOW RELATIONSHIPS

Simulated junction coding was used throughout the simulation area, including all of St Helens district.

Speed flow curves (SFCs) have been applied to the main roads in St Helens. This covers the A570 St Helens Linkway, A580, M62 and M6. Additionally, SFCs have been used to control route choice between competing links and links longer than 1km.

Outside the simulation area, a 2 km buffer network was included that maintained LCRTM SFC close to the study area. Further from the study area, LCRTM SFC have been maintained where possible.

5 SUMMARY OF DATA COLLECTION

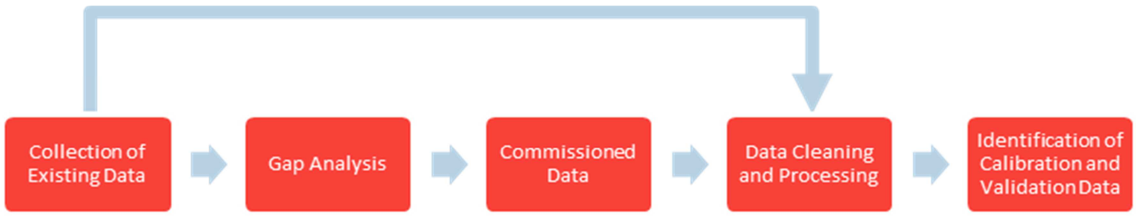
5.1 INTRODUCTION

Traffic count data was collected for the purpose of model calibration and validation. A large amount of data was received from a range of sources including St Helens Council, Liverpool City Region Transport Model, WebTRIS, DfT and local authorities adjacent to St Helens. A set of additional counts were commissioned by WSP where gaps were found in existing data.

The data received was a combination of Manual Classified Counts (MCCs) and Automatic Traffic Counts (ATCs) for various locations in and around St Helens district.

Figure 5-1 summarises the process of traffic count data collection for St Helens SATURN Model.

Figure 5-1 Data Collection Process



Journey time data was received from Merseytravel to aid in model validation. The journey time data used in model validation is 2012 whole period journey times.

5.2 COLLECTION OF EXISTING DATA

WSP collected traffic count survey data from St Helens Council and the surrounding councils of Warrington, Wigan and Knowsley. Count data used in the development of LCRTM was received for relevant locations in the study area. Permanent traffic counts found using the Highways England tool WebTRIS were collected for motorway counts. Finally, DfT one day MCC counts were collected from an online database for St Helens and surrounding districts.

ST HELENS COUNCIL

St Helens Council provided ATC data that was collected for planning applications. The data received is summarised in **Table 5-1**. **Figure 5-2** shows the locations of these counts.

Table 5-1 St Helens Council ATC Summary

Location	Year	Duration
Mill Lane	2016	24 hr from 13/10/16 to 19/10/16
Warrington Road	2016	24 hr from 13/10/16 to 19/10/16
A580 East Lancashire Road	2016	24 hr from 23/06/15 to 29/06/15
Burtonhead Road	2016	24 hr from 07/07/16 to 13/07/16
Elton Head Road	2016	24 hr from 07/07/16 to 13/07/16
Sherdley Road	2016	24 hr from 07/07/16 to 13/07/16

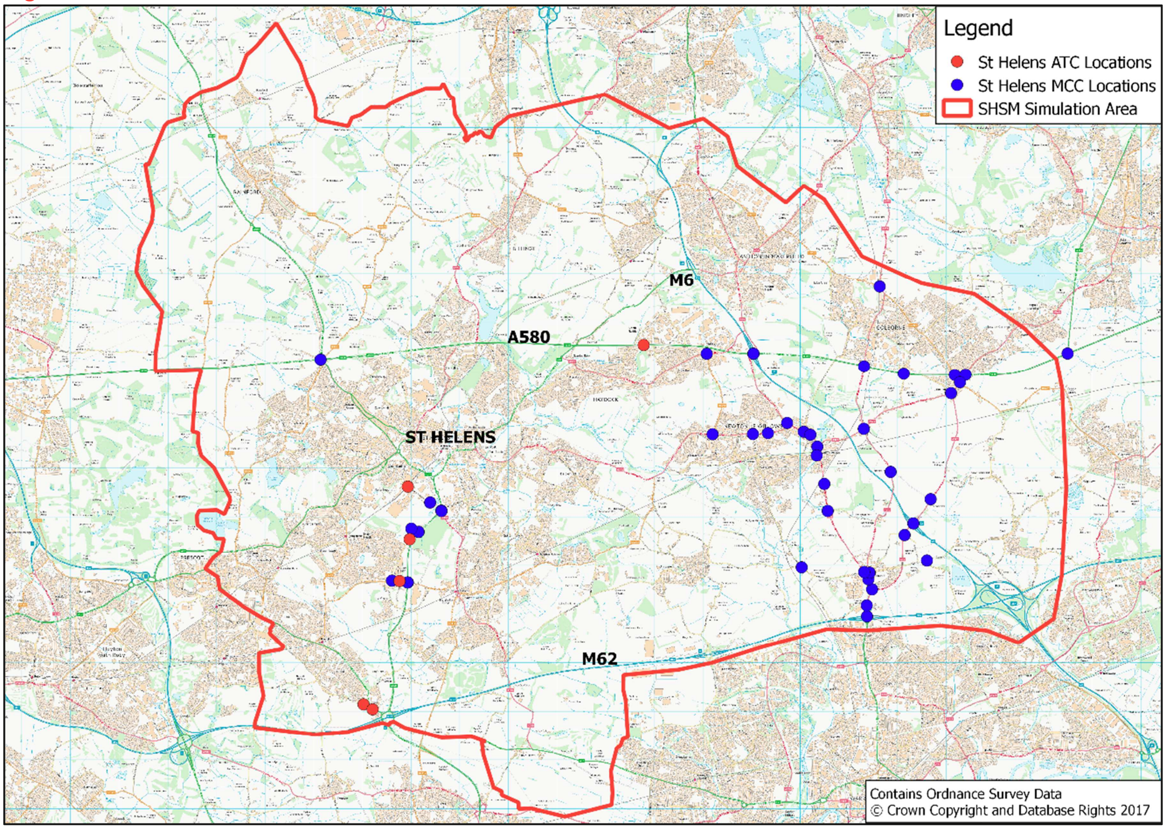
MCC data was provided for several locations, these are summarised in **Table 5-2**.

Table 5-2 St Helens Council MCC Summary

Location	Year	Duration
St Helens Linkway / Sherdley Road Roundabout	2017	07:00-10:00 and 16:00-19:00 on 03/05/2017
St Helens Linkway / Sutton Heath Road	2017	07:00-10:00 and 16:00-19:00 on 03/05/2017
St Helens Linkway / Elton Head Road	2017	07:00-10:00 and 16:00-19:00 on 03/05/2017
B5207 Ashton Road / A573 Wigan Road	2017	07:00-19:00 on 13/7/2017
A49 High Street / Rob Lane / Golborne Street	2017	07:00-19:00 on 13/7/2017
A572 Crow Lane West / B5209 Vista Road	2017	07:00-19:00 on 13/7/2017
Alder Lane / Alder Root Lane	2017	07:00-19:00 on 13/7/2017
A49 Winwick Link Road / Waterworks Lane / Highfield Lane	2017	07:00-19:00 on 13/7/2017
Myddleton Lane / Southworth Lane / Delph Lane	2017	07:00-19:00 on 13/7/2017
Stone Cross Lane / A580 East Lancashire Road	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
A579 Atherleigh Way / A580 East Lancashire Road	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
A599 Penny Lane (East Arm) /Vista Road	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
M6 J23	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
Water St / Crown Lane E / Victoria Road	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
Queens Drive / A572 Crown Lane E / Sanderling Road	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
A49 / Park Road	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
A49 / Alfred Street	2017	07:30-10:00 and 15:30-18:00 on 7/3/2017
M6 J23	2016	07:00-10:00 and 16:00-19:00 on 2/2/2016
St Helens Linkway / Sutton Heath Road	2016	06:00-10:00 and 16:00-20:00 on 7/7/2016
Sherdley Road / Sutton Heath Road	2016	06:00-10:00 and 16:00-20:00 on 7/7/2016
Elton Head Road / Sherdley Road	2016	06:00-10:00 and 16:00-20:00 on 7/7/2016
St Helens Linkway / Elton Head Road	2016	06:00-10:00 and 16:00-20:00 on 7/7/2016
St Helens Linkway / Burtonhead / Sherdley / Scorecross	2016	06:00-10:00 and 16:00-20:00 on 7/7/2016
Burtonhead Road/ Retail Park	2016	06:00-10:00 and 16:00-20:00 on 7/7/2016
M62 J9	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A49 Winwick Park Avenue / Newton Road / Winwick Link Road	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
M6 Junction 22	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
Delph Lane Retail Park Access	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A49 Winwick Road / Site Access	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A49 Hermitage Green Lane	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A49/ Hollins Lane	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A49/ Golborne Road	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
Golborne Road / Myddleton Lane	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
Winwick Lane / Barrow Lane	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
Parkside Road / Barrow Lane	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A572 Southworth Road / Parkside Road / Golborne Dale Road	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A572 / A49 Southworth Road	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A49 / Crow Lane East	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A573 / A580	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A580 / Church Lane	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A572 / A580	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
B5207 / A572	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A572 / A579	2015	06:00-20:00 from 17/11/2015 to 18/11/2015
A580 / A570 Junction	2015	07:00-19:00 on 3/12/2015
St Helens Linkway / Sherdley Road	2015	07:00-19:00 on 3/12/2015

Location	Year	Duration
Roundabout		
St Helens Linkway / Elton Head Road	2015	07:00-19:00 on 3/12/2015
M6 J22	2014	07:00-10:00 and 16:00-19:00 on 4/2/2014
A49 Newton Road / Hollins Lane	2014	07:00-10:00 and 16:00-19:00 on 4/2/2014
M6 J23	2014	07:00-10:00 and 16:00-19:00 on 13/5/2014
St Helens Linkway / Sherdley Road Roundabout	2012	07:00-10:00 and 16:00-19:00 on 10/10/2012
St Helens Linkway / Elton Head Road	2012	07:00-10:00 and 16:00-19:00 on 10/10/2012
St Helens Linkway	2012	24 hr from 10/10/2012 to 12/10/2012

Figure 5-2 St Helens Count Data



DATA FROM ADJACENT COUNCILS

Three local authorities adjacent to St Helens (Warrington, Wigan and Knowsley) provided ATC/ MCC data. The counts from this set that fell within SHSM study area are summarised in the tables below, the ATCs are listed in **Table 5-3** and MCCs in

Table 5-4. **Figure 5-3** shows the locations of counts provided by adjacent councils.

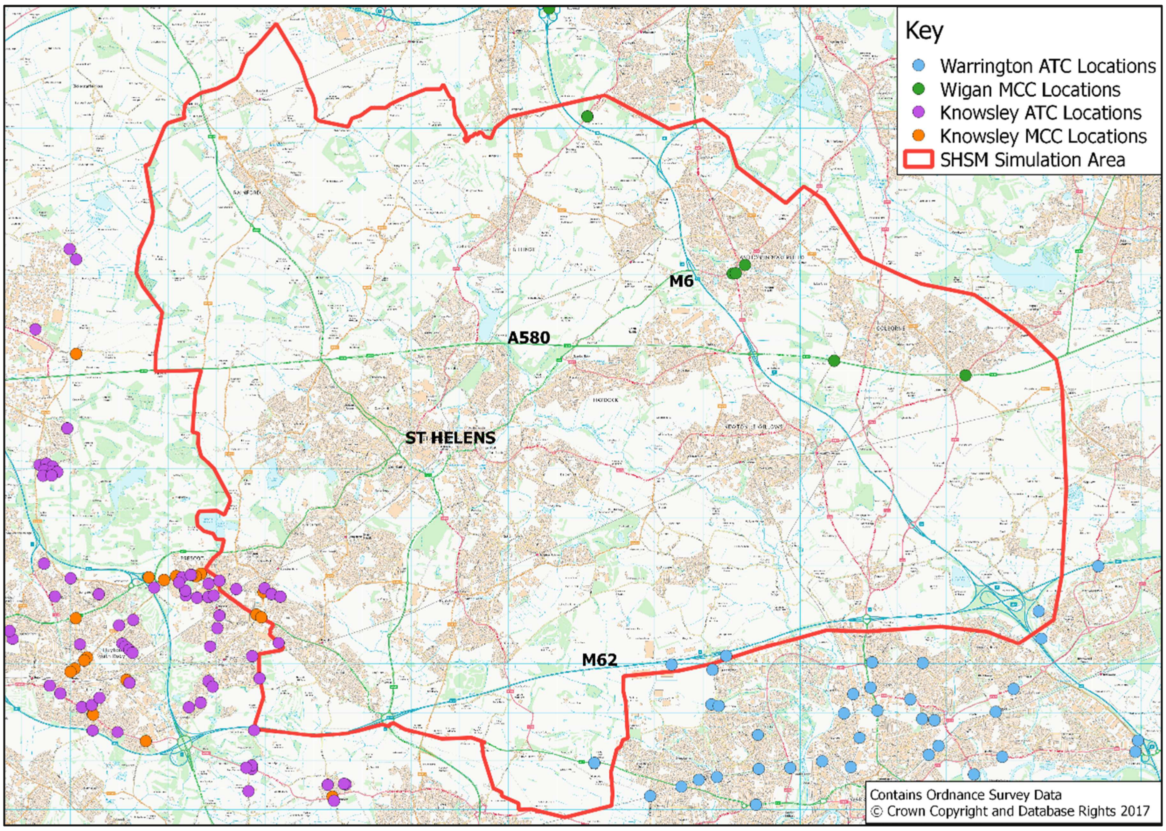
Table 5-3 Adjacent Councils' ATC Summary

Location	Council	Year	Duration
Mill House Lane	Warrington	2016	24 hr for 2 weeks in June/July 2016
Charon Way	Warrington	2016	24 hr for 2 weeks in June/July 2016
Burtonwood Road	Warrington	2016	24 hr for 2 weeks in June/July 2016
Skyline Drive	Warrington	2016	24 hr for 2 weeks in June/July 2016
Warrington Road	Warrington	2016	24 hr for 2 weeks in June/July 2016
Portico Lane	Knowsley	2015	24 hr from 2/3/2015 to 8/3/2015
Warrington Road	Knowsley	2014	24 hr from 11/4/2014 to 16/4/2014
Two Butt Lane	Knowsley	2013	24 hr from 13/5/2013 to 19/5/2013
Two Butt Lane	Knowsley	2013	24 hr from 13/5/2013 to 19/5/2013
Scotchbarn Lane	Knowsley	2013	24 hr from 23/1/2013 to 29/1/2013
Two Butt Lane	Knowsley	2012	24 hr from 1/9/2012 to 7/9/2012
Two Butt Lane	Knowsley	2012	24 hr from 1/9/2012 to 7/9/2012

Table 5-4 Adjacent Councils' MCC Summary

Location	Council	Year	Duration
A580 East Lancashire Road	Wigan	2017	07:30-18:00 on 8/3/2017
A58 Liverpool Road	Wigan	2014	07:30-18:00 on 4/2/2014
A58 Liverpool Road	Wigan	2014	07:30-18:00 on 4/2/2014
Scotchbarn Lane	Knowsley	2013	07:00-19:00 on 26/6/2013
A580 East Lancashire Road	Wigan	2012	07:30-18:00 on 19/11/2012
A580 East Lancashire Road	Wigan	2012	07:30-18:00 on 19/11/2012
Warrington Road / Dragon Lane	Knowsley	2012	07:00-19:00 on 10/7/2012
Warrington Road/ Delph Lane	Knowsley	2012	07:00-19:00 on 10/7/2012
Bryn Street / Liverpool Road	Wigan	2011	07:30-18:00 on 12/5/2011
Bolton Road / Wigan Road	Wigan	2011	07:30-18:00 on 12/5/2011

Figure 5-3 Adjacent Councils Count Data



LIVERPOOL CITY REGION TRANSPORT MODEL

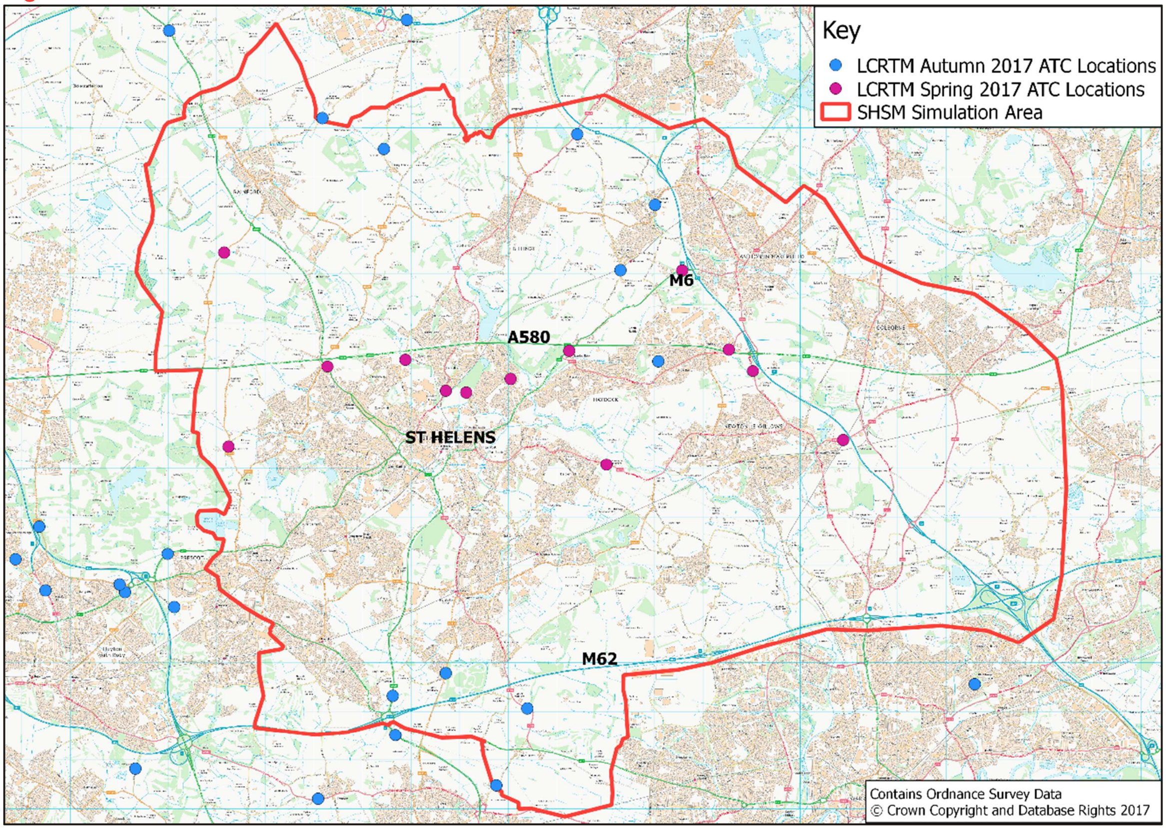
Two sets of ATCs were received that had been used for development of the LCRTM. All counts in this set are from 2017 and there are 25 counts in SHSM study area. Details of these counts are provided in **Table 5-5**. Their locations are shown **in Figure 5-4**.

Table 5-5 LCRTM ATC Summary

Location	Year	Duration
B5203 Gillars Lane	2017	24 hr from 12/6/2017 to 09/7/2017
B5203 Mossborough Road	2017	24 hr from 12/6/2017 to 09/7/2017
A570 Rainford Road	2017	24 hr from 12/6/2017 to 09/7/2017
City Road	2017	24 hr from 12/6/2017 to 09/7/2017
A571 Haresfinch Road	2017	24 hr from 12/6/2017 to 23/7/2017
Islands Brow	2017	24 hr from 12/6/2017 to 23/7/2017
Chain Lane	2017	24 hr from 12/6/2017 to 23/7/2017
A58 Stanley Bank Way	2017	24 hr from 12/6/2017 to 23/7/2017
A58 Liverpool Road	2017	24 hr from 26/6/2017 to 16/7/2017
A599 Penny Lane	2017	24 hr from 12/6/2017 to 23/7/2017
A49 Lodge Lane	2017	24 hr from 12/6/2017 to 23/7/2017
A572 Pennington Lane	2017	24 hr from 12/6/2017 to 23/7/2017
A572 Southworth Road	2017	24 hr from 26/6/2017 to 23/7/2017
A5027 Duke Street	2017	24 hr from 11/9/2017 to 24/9/2017
B5207 Downall Green Road	2017	24 hr from 11/9/2017 to 24/9/2017
A571 Wigan Road	2017	24 hr from 11/9/2017 to 24/9/2017
B5419 Jubits Lane	2017	24 hr from 11/9/2017 to 24/9/2017
A569 Clock Face Road	2017	24 hr from 11/9/2017 to 24/9/2017
Garswood Road	2017	24 hr from 11/9/2017 to 24/9/2017

Location	Year	Duration
Pimbo Road	2017	24 hr from 11/9/2017 to 24/9/2017
Crawford Road	2017	24 hr from 11/9/2017 to 24/9/2017
Piele Road	2017	24 hr from 11/9/2017 to 24/9/2017
Mill Lane	2017	24 hr from 11/9/2017 to 24/9/2017

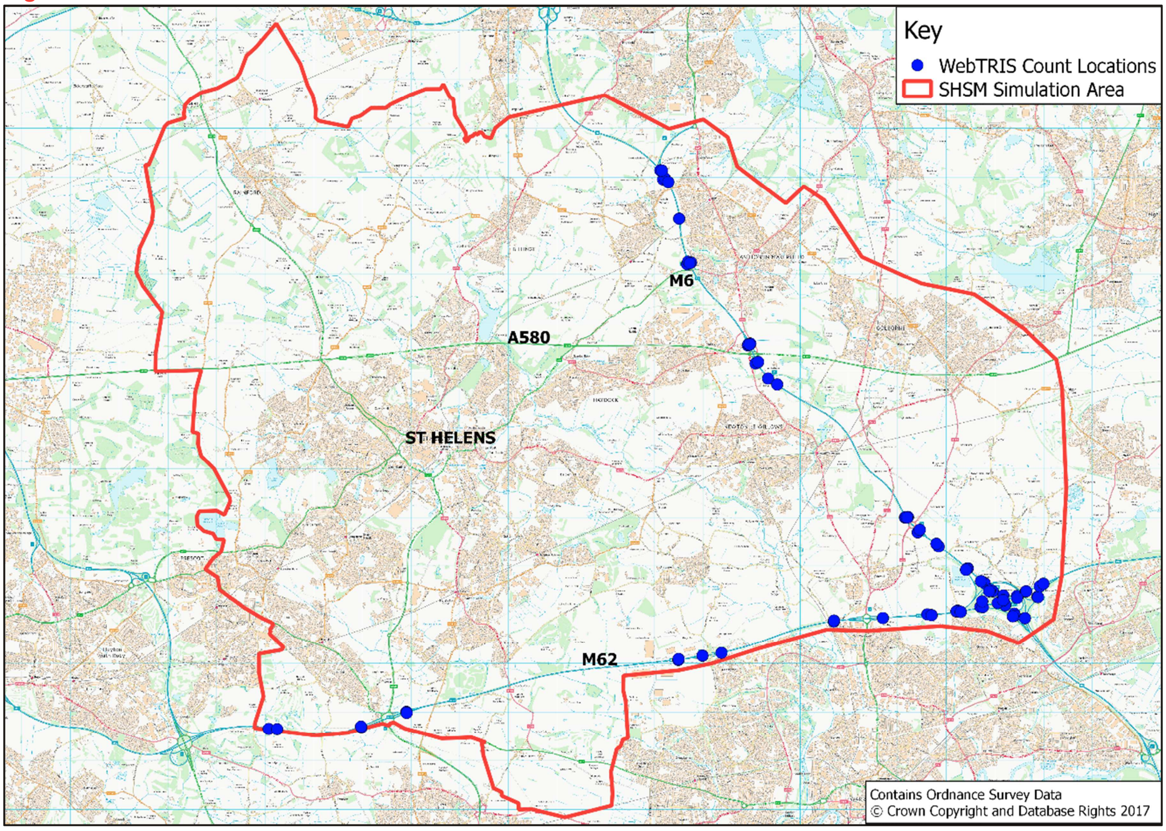
Figure 5-4 LCRTM ATC Locations



HIGHWAYS ENGLAND WEBTRIS DATA

WebTRIS is an online tool maintained by Highways England through which a database of permanent traffic counts can be accessed. For SHSM, this dataset provided traffic counts for all links on the M6 and M62 motorways. Data was collected for the count locations shown in **Figure 5-5**.

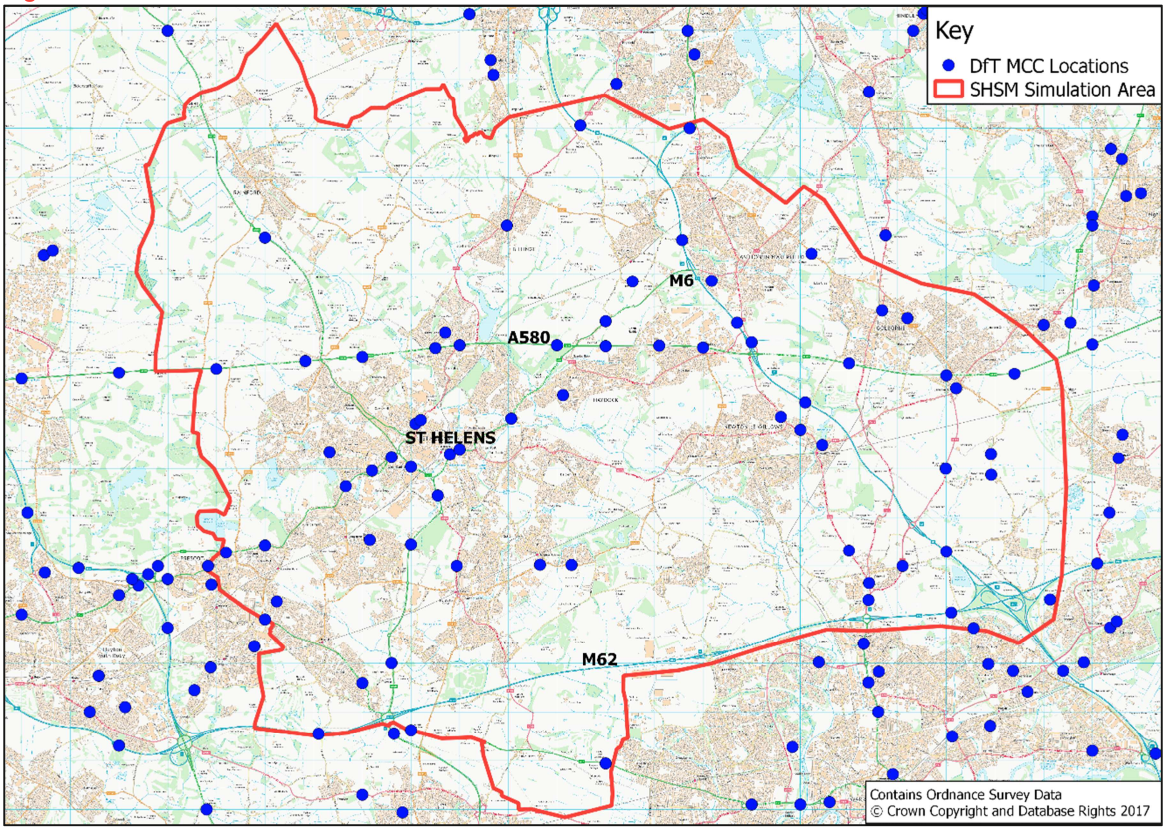
Figure 5-5 - WebTRIS Count Locations



DFT

Each year, DfT commissions a set of MCCs at various locations that they use to calculate estimated traffic volumes on every road. The raw data used for this process was collected for St Helens and all adjacent districts for 2011-2016. The count locations covered from this dataset are shown in **Figure 5-6**.

Figure 5-6 - DfT Count Locations



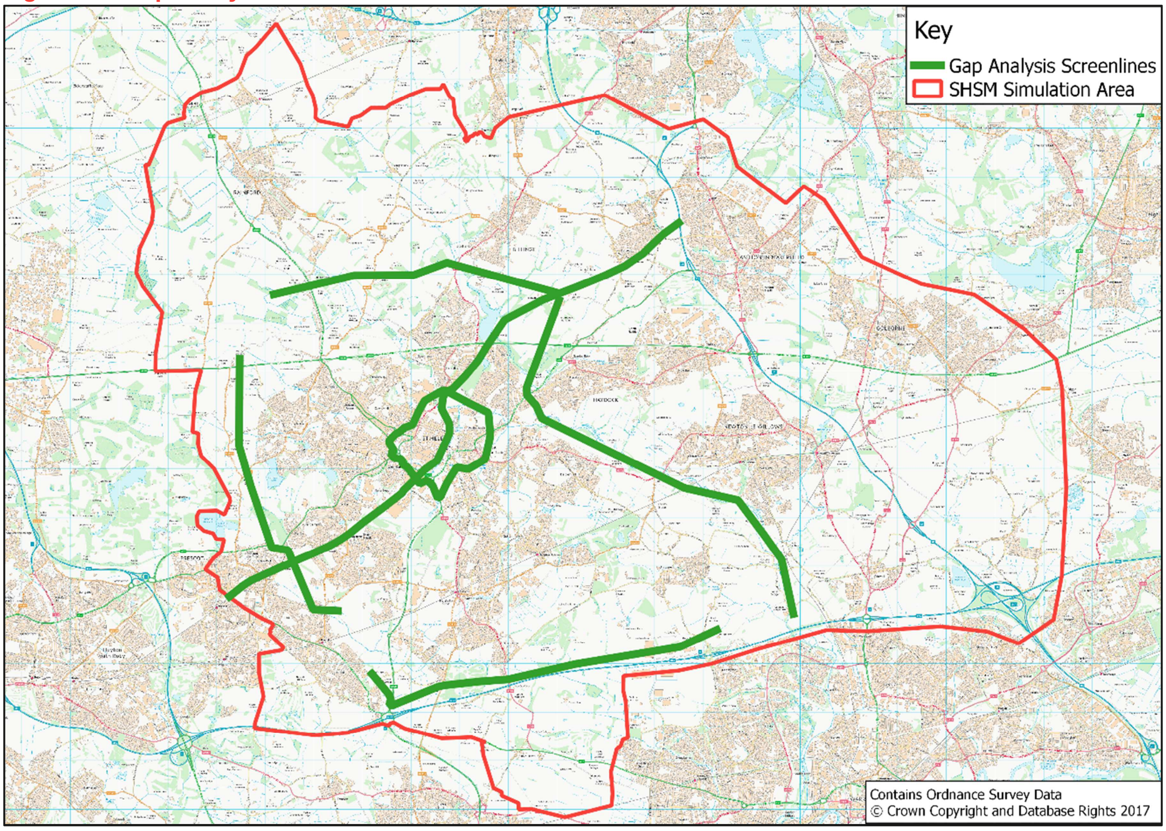
5.3 GAP ANALYSIS

Gap analysis is a process undertaken in order to review any existing data collected and establish if any additional data needs to be collected before model calibration.

The first stage of the gap analysis involved establishing where screenlines were required for the model as this would define where additional counts, if any, were required. The screenlines decided during the gap analysis are shown in **Figure 5-7**. They consist of:

- An ***inner cordon*** surrounding St Helens town centre, designed to capture traffic that moves into/ out of St Helens town centre.
- An ***outer cordon***, made of four separate screenlines, designed to capture traffic travelling between St Helens and the wider area.
- The final screenline decided during gap analysis broadly follows the Wigan to Huyton ***railway*** that runs through St Helens. This feature was included as a railway has limited crossing points to car traffic so provides a good option for a screenline. The position of the rail line allowed this screenline to capture movements of traffic travelling between the north-east and south-west regions of St Helens district.

Figure 5-7 Gap Analysis Screenlines



The gap analysis undertaken found that the availability of traffic data within the simulation area was limited. In particular it was found that there were few ATCs in locations that could be used for the proposed screenlines.

It was decided that a new set of ATCs and supporting MCCs should be commissioned within St Helens. The commissioned data is discussed in detail **in Section 5.4**.

5.4 COMMISSIONED DATA

After the gap analysis to establish if additional data was required, WSP commissioned a series of two week ATC counts from 2nd October - 16th October at various locations within the study area. A total of 45 counts were undertaken.

The site locations for the commissioned ATC counts are listed in **Table 5-6** and shown in

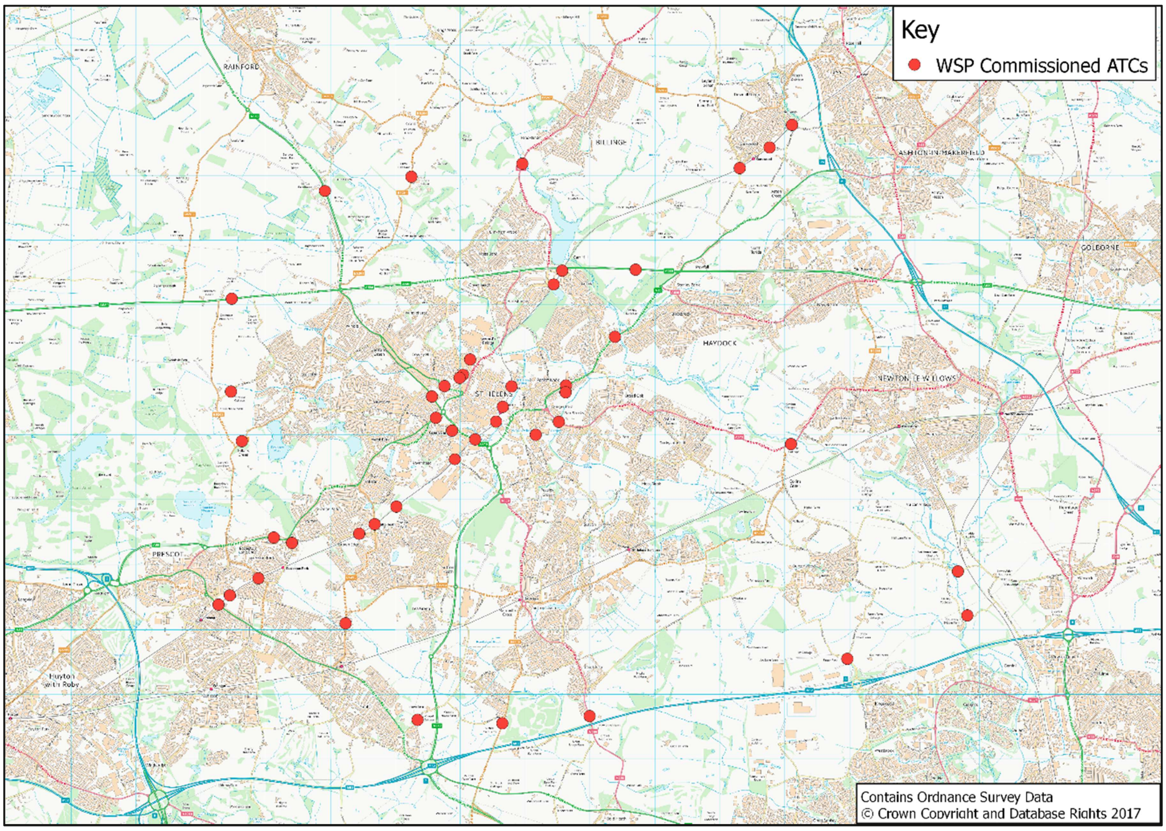
Figure 5-8.

Table 5-6 - WSP Commissioned ATC Locations

No.	Road	Location Description	Comment
1	A570	Between St Helens Road and St Helens Road spurs	
2	B5201	North of Fairfield Independent Hospital	
3	A571	Between Moss Bank Road and Lime Vale Road	
4	A580	Between A58 and Carr Mill Road	
5	A58	Between O'Sullivan Crescent and St Helens Canal	
6	A572	Between Pickford Lane and Wharf Road, south of river bridge	
7	Alder Lane	Between Old Alder Lane and Alder Root Lane	
8	Old Alder Lane	East of Sankey Brook but before junction with Mill Lane	
9	Burtonwood Road	Between Wright's Lane and Tan House Lane	
10	A569	Between Bridge Road and M62	
11	B5419	Between Bell Lane and Union Bank Lane	
12	A570	Between M62 Roundabout and Chapel Lane	Two day camera survey conducted instead of ATC
13	Chapel Lane	Between St Helens Linkway and Mooreway	
14	B5413	Between Gardeners Way and Brookfield Avenue	
15	Portico Lane	Between Park Avenue and Scholes Lane	
16	A58	Between Park Avenue and Valencia Grove	
17	B5201	Between B5203 and Seddon Close	
18	Howard's Lane	Between B5203 and Laurel Drive	
19	A580	Between Sadler's Lane and Houghtons Lane	
20	Cowley Street	Between Victoria Street and Albert Street	
21	Crab Street	Between Union Street and North Road	
22	North Road	Between Crab Street and Mill Street	
23	Duke Street	Between Lowe Street and Talbot Close	
24	A570	Between Roundabout and Albion Street	
25	A58	Between Liverpool Road and Roundabout avoiding Pedestrian Crossing	
26	Canal Street	Between Bold Street and A58	
27	Milverny Way	Between A570 and Roundabout	
28	Peasley Cross Lane	Between Parr Street and Warrington Old Road	ATC not installed due to safety concerns
29	A58	Between Atlas Street and Jackson Street	
30	Earl Street	Between Vernon Street and Graham Street	
31	Pocket Nook Street	Between Vernon Street and Wood Street	
32	B5413	Between Elephant Lane and Springfield Road	

No.	Road	Location Description	Comment
33	B5201	Between Vining Road and Alder Road	
34	Spindle Hillock	Between Camp Road and Austin Avenue	
35	Scotchbarn Lane	Between Sutherland Road and Sinclair Avenue	
36	Scholes Lane	Between Hayes Street and Heath Street	
37	Parr Street	Between Shaw Street and Watts Clift Way	
38	Standish Street	Between Railway Street and Atlas Street	
39	Laffak Road	Between :Laburnum Avenue and Carr Mill Road	
40	Woodlands Road	Between :Laburnum Avenue and Carr Mill Road	
41	Strange Road	Between Coldstone Drive and Gibbons Road	
42	A570 Linkway West	Between Linkway East Roundabout and Chalon Way West	
43	Corporation Street	Between Shaw Street and Phoenix Brow	
44	Elm Road	Between St John Street and Enfield Close	
45	A57 Warrington Road	Between St James Road and Broadlands Road	
6	Merton Bank Road	Between Lock Street and Markfield Crescent	ATC not installed due to safety concerns
47	Garswood Road	Between Tithebarn Road and School Lane	
48	Recreation Street	Prospect Road and Waine Street	

Figure 5-8 - WSP Commissioned ATC Locations



Together with the commissioned ATCs, MCCs were undertaken at a subset of these locations. A total of 16 MCC locations were surveyed.

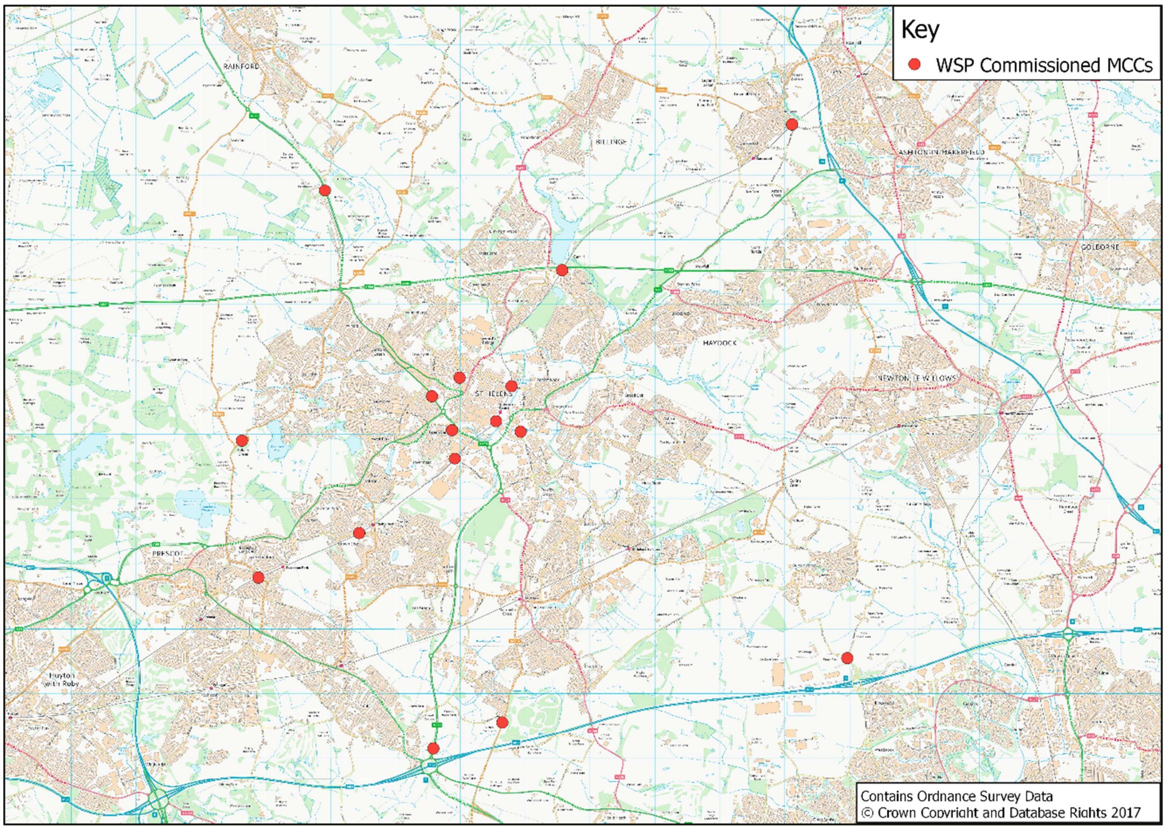
The site locations for the commissioned ATC counts are listed in **Table 5-7** and shown in

Figure 5-9.

Table 5-7 - WSP Commissioned MCC Locations

No.	Road	Location Description
1	A570	Between St Helens Road and St Helens Road spurs
9	Burtonwood Road	Between Wright's Lane and Tan House Lane
11	B5419	Between Bell Lane and Union Bank Lane
12	A570	Between M62 Roundabout and Chapel Lane
17	B5201	Between B5203 and Seddon Close
22	North Road	Between Crab Street and Mill Street
24	A570	Between Roundabout and Albion Street
26	Canal Street	Between Bold Street and A58
27	Milverny Way	Between A570 and Roundabout
28	Peasley Cross Lane	Between Parr Street and Warrington Old Road
33	B5201	Between Vining Road and Alder Road
34	Spindle Hillock	Between Camp Road and Austin Avenue
36	Scholes Lane	Between Hayes Street and Heath Street
37	Parr Street	Between Shaw Street and Watts Clift Way
38	Standish Street	Between Railway Street and Atlas Street
39	Laffak Road	Between :Laburnum Avenue and Carr Mill Road

Figure 5-9 - WSP Commissioned MCC Locations



5.5 DATA CLEANING AND PROCESSING

Following the data collection stage, steps were taken to remove errors and process the raw data into a usable format. The key elements of data processing carried out were:

- → All classified traffic count data has been standardised into Cars, LGVs and HGVs and each link count has been assigned to an A-B link in the network.
- → ATC data has been processed to remove any outliers based on 2 standard deviations from the mean. An additional manual check of ATC data has been undertaken to identify any inconsistent patterns in the data.
- → Cleaned ATC data has been processed in order to derive the average weekday flow by taking the mean of Monday-Friday counts.
- → The total volume from ATC counts has been split into Cars, LGVs and HGVs using proportions from MCCs on the same road or a road of similar classification.
- → Flow profiles have been checked to confirm they fit with expected peak hours and that tidality is seen in both directions if present.
- → Counts on adjacent links have been analysed to ensure there is no conflict in the data.

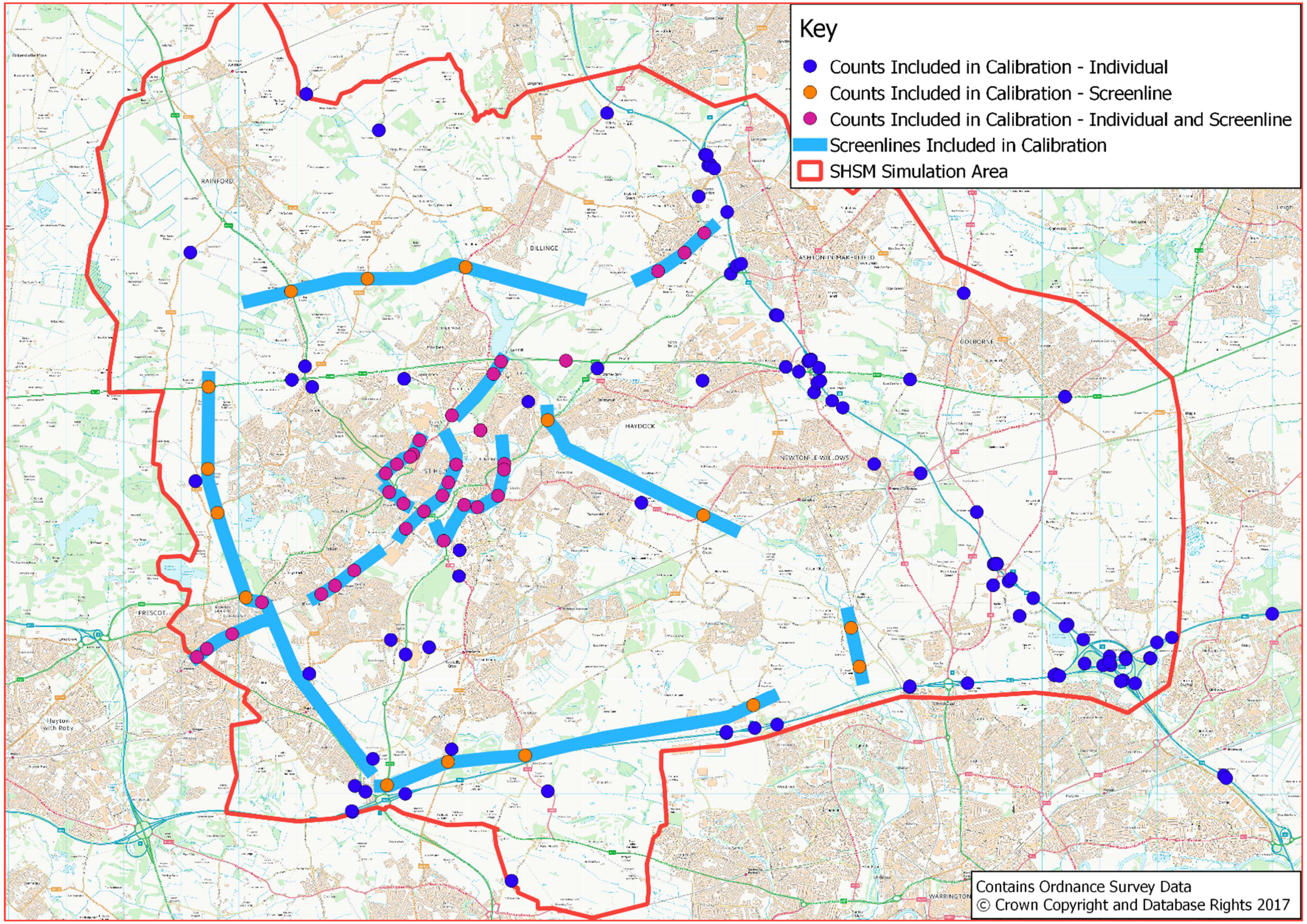
5.6 IDENTIFICATION OF CALIBRATION DATA

Once the collected data had been cleaned and a set of counts were available to use, the traffic counts were grouped into screenlines for calibration.

The screenlines were defined so that the modelled area was reasonably covered as this allows model calibration to work effectively. Several counts did not fit into a screenline but were included independently into calibration to further improve model accuracy. Screenlines for reporting have been broken down into smaller screenlines for calibration.

Figure 5-10 shows the locations of all traffic counts included in model calibration and the calibration screenlines.

Figure 5-10 - Counts and Screenlines for Model Calibration



5.7 JOURNEY TIME SURVEYS FOR VALIDATION

Journey time data was processed for ten routes (both directions) across the study area, this set covers all of the significant roads within the study area.

Initially, WSP received 2016 peak hour data from Merseytravel but once this data was assigned to routes it was found that the speeds given for the Inter-peak period were slower than the AM and PM peaks. This is unusual as the AM and PM peaks generally have more traffic which results in slower journey times. Further checks of processing were undertaken by Merseytravel after which it was considered unlikely to be caused by human error and so the 2016 data set was discarded.

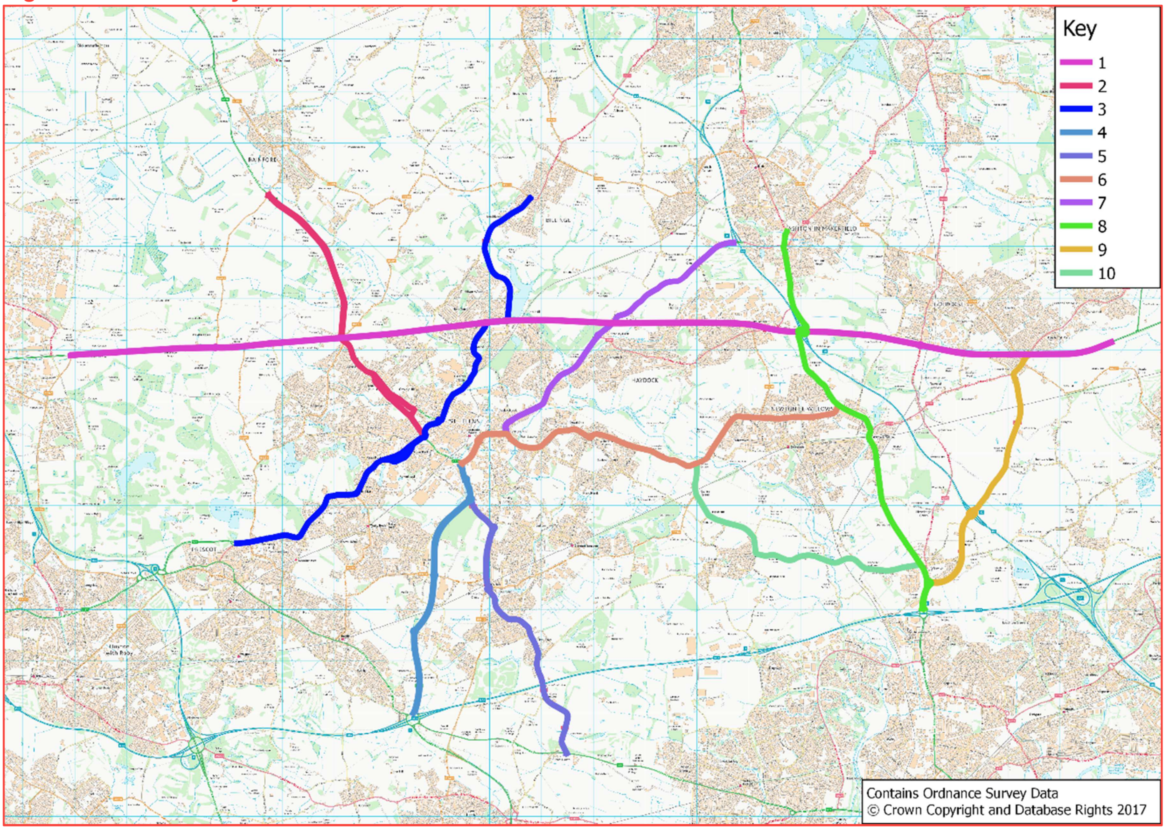
As an alternative, the 2012 whole period data was received, this data was checked and it was found to have more reasonable patterns than the 2016 data. As this was the only data available, the 2012 data was used for journey time validation however it was noted that because this data is whole period instead of peak hour, the AM and PM observed journey times may be faster than modelled.

A description of the routes assessed is provided in Table **5-8** and the routes are plotted in **Figure 5-11**.

Table 5-8 - Journey Time Route Descriptions

ROUTE	DESCRIPTION
1 EB	A580 from B5202 to A579
1 WB	A580 from A579 to B5202
2 NB	A570 from A58 to B5203
2 SB	A570 from B5203 to A58
3 EB	A58 from A58/St Helens Road roundabout to A58/A571 roundabout then A571 to B5205 via A580
3 WB	B5205 to A58/A571 roundabout via A580 then A58 to A58/St Helens Road roundabout
4 NB	A570 from M62 J7 roundabout to A58 St Helens Linkway West
4 SB	A570 from St Helens Linkway West to M62 J7 roundabout
5 NB	A569 from A57 to St A570 St Helens Linkway
5 SB	A569 from A570 St Helens Linkway to A57
6 EB	A58 from A570/A58 roundabout to A572 then A572 from A58 to A49
6 WB	A572 from A49 to A58 then A58 from A572 to A570/A58 roundabout
7 EB	A58 from A572 to M6
7 WB	A58 from M6 to A572
8 NB	A49 from M62 J9 roundabout to Wigan Road (Ashton-in-Makerfield)
8 SB	A49 from Wigan Road (Ashton-in-Makerfield) to M62 J9 roundabout
9 NB	A49 (Winwick Link Road) from M62 J9 roundabout to M6 J22 roundabout then A579 from M6 J22 roundabout to A580
9 SB	A579 from A580 to M6 J22 roundabout then A49 (Winwick Link Road) from M6 J22 roundabout to M62 J9 roundabout
10 EB	A572 from A58 to Penkford Lane then Penkford Lane / Collins Green Lane / Lumber Lane / Alder Lane / Hollins Lane to A49
10 WB	Hollins Lane from A49 to Alder Lane / Lumber Lane / Collins Green Lane / Penkford Lane to A572 then A572 to A58

Figure 5-11 - Journey Time Routes



6 NETWORK DEVELOPMENT

6.1 INTRODUCTION

In order to create a SATURN model, there are two main elements: the demand matrices and the supply network. The network is a system of nodes, representing junctions, and links, representing roads connecting junctions. The model simulation network is shown in **Figure 4-2**.

This section provides an overview of the steps taken in developing the highway network for St Helens SATURN Model.

6.2 NETWORK STRUCTURE

To produce the skeleton network for SHSM, the LCRTM network structure was imported and additional links were created using CUBE Voyager software to create a GIS map. Through this process, link lengths and node coordinates were automatically generated.

6.3 SIMULATION NETWORK

For links within St Helens district, information was provided by St Helens council detailing various road features. These included:

- Speed limits
- Roads with traffic calming measures
- Roads with weight restrictions
- Roads with height restrictions
- Roads with width restrictions
- Vehicle prohibitions
- Bus lanes.

This information was used to code the simulation network using the actions shown in **Table 6-1**.

Table 6-1 - Coding Action for Road Features

NETWORK CHARACTERISTIC	CODING ACTION
Speed limits	Speed limits were applied with adjustments made for road condition
Traffic Calming	Network speed reduced
Weight Restrictions	HGVs banned for weight restrictions greater than 3t
Height Restrictions	HGVs banned for height restrictions smaller than 14'6"
Width Restrictions	Ban HGVs
Vehicle Prohibitions	Ban relevant vehicles according to prohibition type
Bus Lanes	Incorporate into coding as required

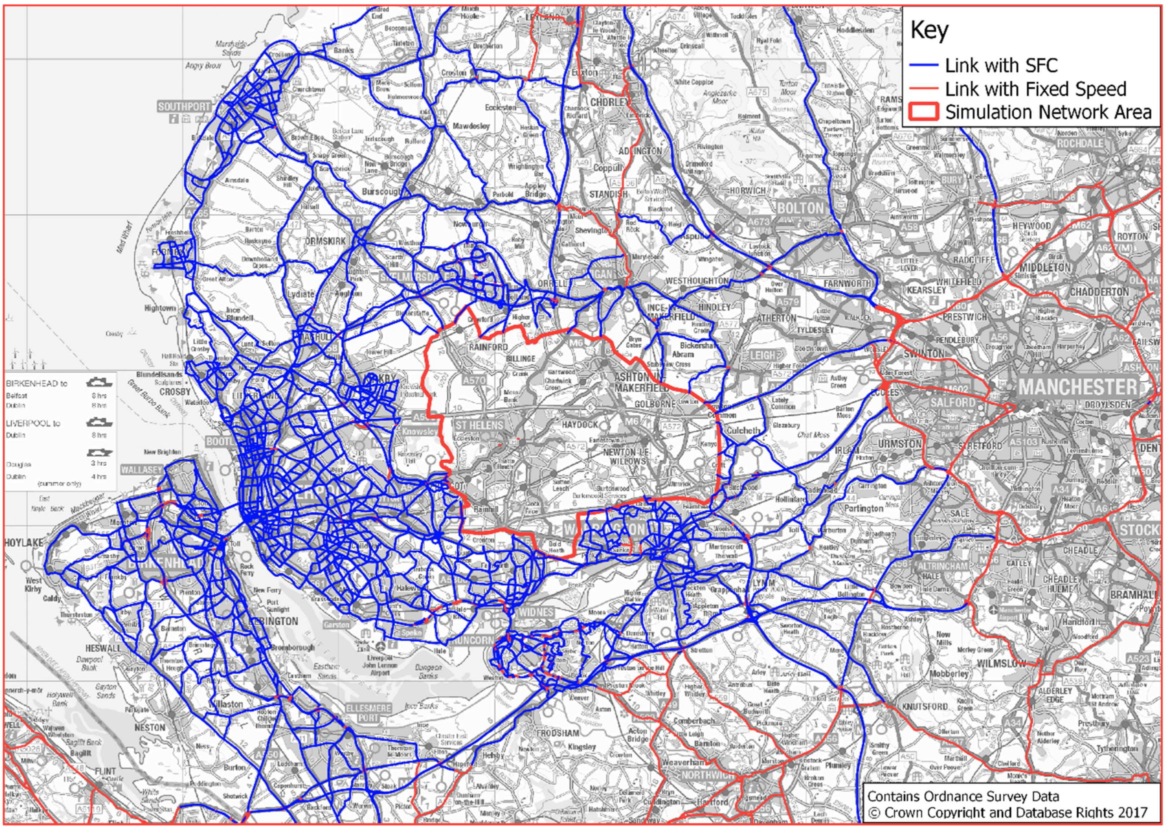
6.4 BUFFER NETWORK

Outside of the simulation area, LCRTM network structure has been maintained where possible.

To help SATURN assignments achieve the correct routing into the simulation area, the network has a 2 km buffer around the simulation area where every link has a speed flow curve (SFC).

Further away from the study area, links have retained the LCRTM SFC where possible, however some SFC have been replaced or removed (fixed speed applied instead) for links where capacity problems occurred. **Figure 6-1** demonstrates those links have SFC and those that are represented by fixed speeds.

Figure 6-1 - Links with SFC/ Fixed Speed Outside SHSM Simulation Area



6.5 JUNCTION MODELLING

In order to represent traffic delay and queues at junctions, junctions have been modelled in detail within the study area. The network development for SHSM required each junction within the simulation area to be coded from scratch. The parameters for these junctions such as saturation flows and gap values were based on the Regional Traffic Models Network Coding Manual (*Highways England, December 2015*). Some of these parameters have been customised for individual junctions during calibration of the network.

For signalised junctions, St Helens and surrounding councils provided WSP with signal specifications. These specifications were used to define the stages and signal timings for each signalised junction. For pedestrian crossings, no details were provided so a default rate was applied.

6.6 ZONE CONNECTORS

Traffic has been loaded onto the network using centroid connectors at appropriate locations to enable traffic to realistically disperse throughout the network. Efforts were made to only use one loading point for each zone so that reliance was not placed on SATURN assignment to distribute traffic between the two zone connectors.

22 additional zones have been added to the base year network to represent future development sites within St Helens. These zones will represent various developments in the future years but currently have no trips so their loading points have not been considered.

6.7 BUS SERVICES

St Helens Council provided details of the bus routes and their service frequencies. Bus services were included in the model along with the service frequency as fixed flows on the network.

Furthermore, a GIS file of the bus lanes in St Helens was provided by the Council. This was used to code in bus lanes in the correct locations within St Helens district.

6.8 CHECKS UNDERTAKEN ON NETWORK CODING

The coding process used to develop the network files for SATURN utilised WSP's in-house GIS based SATURN coding tool which allowed several users to code the network in a consistent manner. This coding tool uses values for junction parameters such as saturation flows, gap values and roundabout circulating flows that are given in Regional Traffic Models Network Coding Manual (Highways England, Dec 2015). Using this procedure for coding results in a network where junctions are standardised prior to calibration. This process also ensures consistency between networks for different time periods.

Once the network files were produced, further manual checks were undertaken. These checks included:

- Check of coding in areas coded by different people to ensure a consistent approach had been used.
- Check of key junctions and link coding on the M6 and M62.
- Check of key junctions and link coding on the A580, A572, A58, A570, A599, A569, A571, A49 and A57.
- Check of network speed limits and number of lanes.
- Check of the location of traffic signals as well as the stages and timings.

The following amendments were made to improve the network coding:

- Any differences in network coding between coders was resolved.
- Reviewed signal coding and updated as needed.
- Amended junction coding to add flares where appropriate.

Once the network was built in SATURN (i.e. a *.UFN file was created), a list of warnings was reviewed from the .LPN file. It should be noted that it is acceptable to have a network with warnings as many of these warnings are advisory and are typically logic checks that may not always be applicable for certain junction layouts.

7 MATRIX DEVELOPMENT

7.1 INTRODUCTION

Individual source LCRTM matrices were used as the demand basis for the SHSM matrices, including synthetic, RSI observed and Trafficmaster observed matrices. The primary aim of the SHSM matrix development was to split the LCRTM matrices into a more detailed zoning system suitable for the intended uses of the SHSM. In order for this disaggregation to be credible, attention was given to visible land-use within the study area and TEMPro and TRICS data were incorporated to inform the redistribution of the demand.

Due to the reliance on synthetic data for the majority of movements in the matrix, it was understood that matrix estimation would be used to a greater extent to calibrate the matrices than when building matrices from newly collected observed data. As the SHSM study area falls within the study area of the LCRTM it was felt that the prior matrix was of sufficient quality that matrix estimation was a suitable mechanism for producing a validated model.

Matrix development was conducted in tandem with the network development in order to provide the best possible foundation for assignments.

7.2 DESCRIPTION OF THE ZONE STRUCTURE

Land-use areas were derived based on visual inspection of land use in the simulation area in order to allow the splitting of the LCRTM zone system. Output areas were initially considered as a basis for zoning, however it was decided that due to too much variability in size, and boundaries which did not correlate well with the network structure, output areas would not be suitable. Land-use areas were defined with attention given to preserving the LCRTM boundaries as well as incorporating medium super output area (MSOA) boundaries to facilitate the application of growth factors to the matrix.

Due to the constraints mentioned above and the fact that land use factors are easier to define for smaller areas, the land-use areas were defined at a considerably higher level of detail than would be appropriate to use as the model zone system when running assignments. Model zones were therefore defined by aggregating land-use areas to an appropriate level of detail. As some LCRTM zone boundaries were illogical in the context of the SHSM, this aggregation did not attempt to preserve the LCRTM boundaries within the SHSM zone system. Checks were performed on the splitting zone trip totals to ensure no trips from the LCRTM were removed during the re-zoning process.

The correspondence between the land-use areas and the model zones was preserved to allow the LCRTM trip matrix to be split and then re-aggregated into the SHSM zone structure. The land-use areas can be thought of as an interface layer between the large LCRTM zones and the SHSM zones.

7.3 DEMAND SEGMENTATION

The LCRTM matrices were supplied already separated into five demand segments and this segmentation was considered to be valid and appropriate for the SHSM model. These segments are defined as:

→ Car – Employers business (EB)

- Car – Commute
- Car – Other
- LGV
- OGV

A PCU factor of 2.3 was applied to OGV trips, with a factor of 1 applied to all other user classes.

In order to distribute trips for each demand segment over the more detailed SHSM zone system, land use factors were used to define likely trip ends for each demand segment. These allowed each LCRTM Origin-Destination (O-D) movement to be distributed differently for each demand segment, so for example AM commute trips would occur between different O-D pairs to AM goods vehicle trips. LCRTM O-D totals were preserved for each demand segment so that no trips were gained or lost between LCRTM zones during the distribution process.

7.4 SOURCE MATRICES

Matrices were provided from the LCRTM model based on 2012 data. The matrices were derived from RSI data and synthetic infill data. These were provided as separate matrices and were merged independently for SHSM. Trafficmaster O-D matrices were also provided, however it was felt that this data was less suitable for the SHSM demand and so were discarded.

7.5 MATRIX DEVELOPMENT PROCESS

Matrix O-D totals were checked against the supplied LCRTM matrices prior to merging to ensure no trips had been lost during the splitting process. Totals were calculated by summing trip volumes assigned to land-use areas up to the LCRTM zones as an exact correspondence exists between these geometries unlike the partial correspondence between SHSM zones and LCRTM zones. Matrix grand totals for SHSM matrices where also checked against LCRTM totals to ensure trip volumes are maintained.

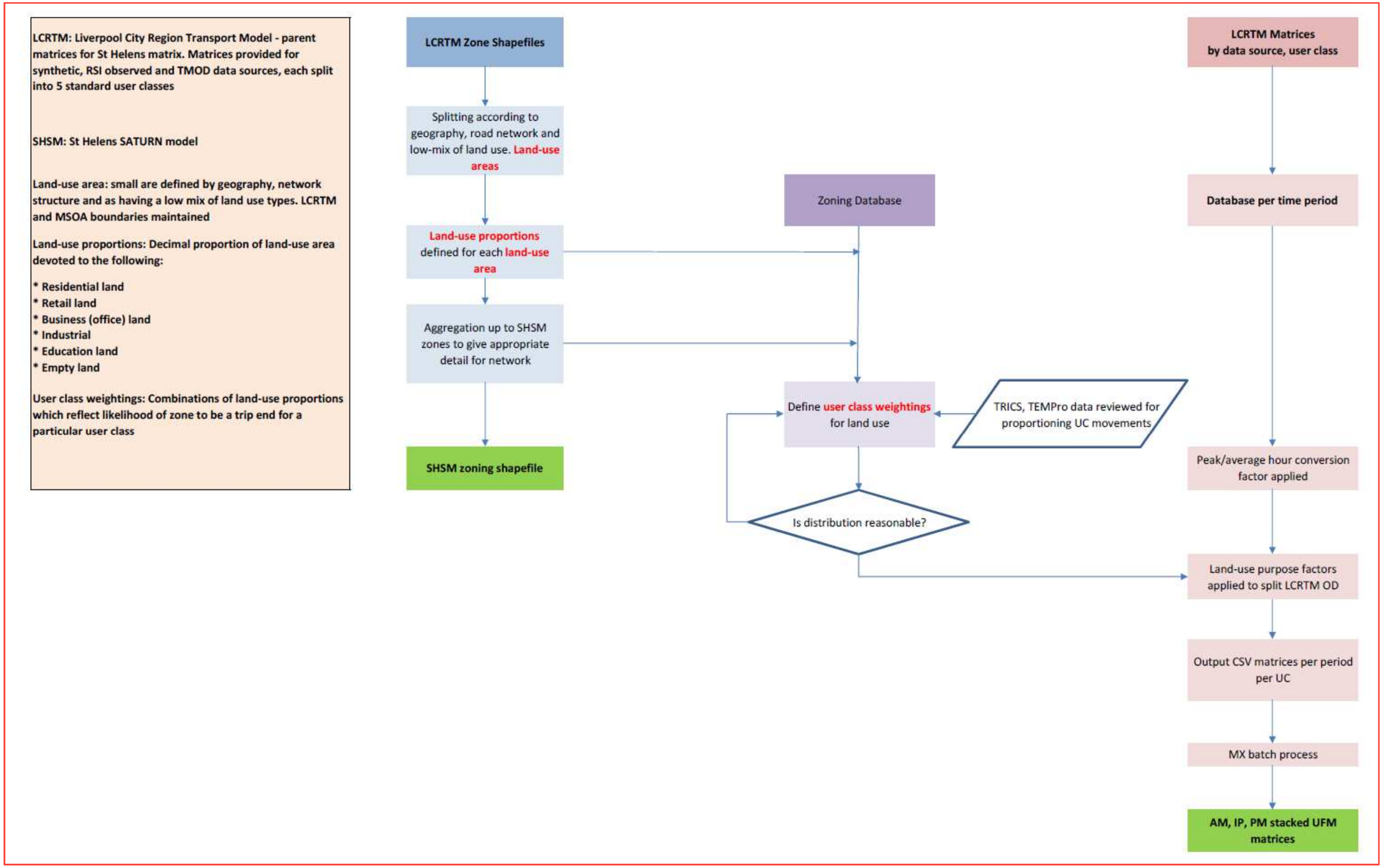
A cordon was defined within the study area from the locations given of RSI sites in the LCRTM model. Only movements crossing this cordon were defined using values from the RSI matrices in order to avoid double counting, all other movements were derived from the synthetic matrices only. For cordon crossing movements, the total trips incorporated into the prior matrix was given by taking 90% of the RSI matrix value and 10% synthetic. This accords with the methodology adopted in the LCRTM barring the inclusion of TMOD data.

TEMPro OD trip volumes by trip purpose were used to inform the zone-share of trip-ends for each of the five user classes based on identified land use areas. This was checked by inspecting GIS heat maps of the redistributed trips-end totals for different user classes and time periods and was found to be appropriate. Redistributing trips in such a manner allowed for much finer detail to be incorporated into the trip distribution within the study area than was present in the LCRTM parent matrices, providing a better starting point for matrix estimation. Trip rates for employment and retail sites given by TRICS were also used in apportioning demand by land use.

The LCRTM matrices gave demand for peak and inter-peak periods, so factors were applied to convert to peak or average hour as appropriate. These factors were derived from daily flow profiles observed by the commissioned ATC surveys. A growth factor for St Helens district was extracted from TEMPro in order to scale the prior matrix from 2012 to 2017 levels. This was in order to provide the best representation of base year trip volumes for the study area prior to refining by means of matrix estimation.

A summary of the matrix development process can be seen in **Figure 7-1**.

Figure 7-1 - Matrix development process flow


LCRTM: Liverpool City Region Transport Model - parent matrices for St Helens matrix. Matrices provided for synthetic, RSI observed and TMOD data sources, each split into 5 standard user classes
SHSM: St Helens SATURN model
Land-use area: small are defined by geography, network structure and as having a low mix of land use types. LCRTM and MSOA boundaries maintained
Land-use proportions: Decimal proportion of land-use area devoted to the following:
* Residential land
* Retail land
* Business (office) land
* Industrial
* Education land
* Empty land
User class weightings: Combinations of land-use proportions which reflect likelihood of zone to be a trip end for a particular user class
LCRTM Zone Shapefiles
Splitting according to geography, road network and low-mix of land use. Land-use areas
Land-use proportions defined for each land-use area
Aggregation up to SHSM zones to give appropriate detail for network
SHSM zoning shapefile
Zoning Database
Define user class weightings for land use
TRICS, TEMPro data reviewed for proportioning UC movements
Is distribution reasonable?
LCRTM Matrices by data source, user class
Database per time period
Peak/average hour conversion factor applied
Land-use purpose factors applied to split LCRTM OD
Output CSV matrices per period per UC
MX batch process
AM, IP, PM stacked UFM matrices

7.6 PRE CALIBRATION CHECKS

Before calibration of the SHSM matrices, checks were undertaken on the prior matrix to ensure that the trip totals of the component matrices were maintained through the redistribution process from LCRTM to SHSM zones. User class proportions for SHSM blended matrix were compared to the LCRTM synthetic matrix to ensure the blended matrix did not deviate significantly, as this would indicate a potential flaw in the blending process. Plots of trip ends were also used to provide assurance that the distribution of trip ends correlated with visible land uses.

Analysis was undertaken to establish whether any external – external trips inherited from LCRTM should be removed. To do this, the prior matrices were used to run an assignment and the external and buffer network was checked for delays. In some areas, delays were caused by large amounts of trips travelling between zones in the external area along links with SFC applied. These trips were of no relevance to traffic in the simulation area but the delays caused by them could be preventing traffic from these regions reaching the simulation area.

To stop this problem from occurring, trips between the following zone pairs have been removed:

- All trips between zones in Greater Manchester.
- Trips between Greater Manchester zones and Leigh, Blackburn and Rossendale.
- Trips between Chorley, Preston and Blackburn.

8 NETWORK CALIBRATION

8.1 INTRODUCTION

This section describes the refinements made to the network coding of St Helens SATURN Model during calibration. Calibration of a model is an iterative process and several loops refinements take place after the initial assignments are ran.

8.2 NETWORK CALIBRATION

Throughout calibration, problems were isolated and adjustments were made by comparing modelled flows to observed data. Areas of the network were targeted that were shown to have poor validation against observed count data. In many of these instances, the coding was not found to have an error but adjustments were made so that the model better represented traffic flows. **Table 8-1** provides a summary of the network changes that were made during calibration to improve the model's representation of the road network.

Table 8-1 - Network Calibration Changes

NETWORK CHARACTERISTIC	DESCRIPTION
Number of lanes/ flares	For junctions where large delays occurred, the number of lanes was checked and the use of flares was reviewed. Any errors were corrected and flares added if the lane was large enough to accommodate two vehicles at the stop line.
Buffer network links	After the initial model assignments, it was found that there was a large amount of traffic to/ from zones in the eastern region of the buffer/ external network close to the simulation area. These large zones were causing large delays in this region as the network density was not detailed enough for the amount of traffic in this area. In order to relieve the strain on the existing links in this area, additional network links were added. Adjustments to SFCs were also applied to increase capacity.
Zone connectors	In addition to extra network detail being added in the eastern buffer/ external area, multiple zone connectors were added to these large zones. This was done so that the large amounts of demand were spread out around the network rather than all loaded on at one location.
Network speeds	Network speeds were reviewed for links where modelled flows varied significantly from observed flows.
Signal timings	Signal timings were developed using signal specifications provided by local authorities. Signal specifications only provide max/min green times and traffic signals often use traffic signal control software to calibrate signals to live traffic flows. As SATURN can only model fixed signal timings within a time period, local signal optimisation was used to represent the varying signal timings under traffic signal control software.
Speed Flow Curves (SFCs)	Speed flow curves were adjusted for routes that were found to have capacity issues.
Saturation flows	Saturation flows were initially coded using RTM guidance. Local adjustments were made for junctions where capacity issues occurred.

Further network checks were undertaken following the analysis of journey time data, these included:

- Delays at junctions
- Review of speed-flow curves

- Review of link speeds to check they reflect speed limits, road condition and that similar routes are consistent

If required, coding refinements were undertaken to improve model accuracy.

9 MATRIX CALIBRATION

9.1 INTRODUCTION

This section of the report describes the SATURN matrix estimation process used to calibrate the trip matrix. Before running matrix estimation, checks were undertaken on the prior matrix to ensure that the trip totals from LCRTM were maintained and that the distribution of trip ends was logical when compared against land uses.

The model incorporates the LCRTM zone and network structure for zones outside the study area but is calibrated with routes and counts within the study area. As such the SHSM should not be used for detailed analysis of schemes outside the St. Helens study area despite the network detail in the Liverpool city region.

9.2 MATRIX ESTIMATION PROCESS

The matrix estimation process is part of model calibration and is designed to refine the travel demand using observed traffic counts. Through matrix estimation, trips are adjusted in the matrix to produce a new estimated matrix that has greater consistency with traffic counts.

The matrix of trips input into matrix estimation is called the prior matrix and the matrix output from matrix estimation is called the post matrix.

The calibration process for SHSM has used matrix estimation processes contained within the SATURN program SATME2. The process of matrix estimation within SATME2 is shown in **Figure 9-1**.

In order to run matrix estimation using SATURN, count data to be used for matrix estimation and parameters to constrain matrix changes must be input. Two SATURN programs are then run, SATPIJA and SATME2, to produce an updated post ME matrix.

Matrix estimation is often repeated for multiple iterations, using the post matrix from the previous loop to create a new set of PIJA factors for use in SATME2.

For the calibration of the SHSM base year model, six matrix estimation loops were used. The values for parameters used in matrix estimation are given in **Table 9-1**.

Count data was input into matrix estimation for both individual sites and screenlines.

Screenlines are created by grouping the total flow over a series of counts together and are used to ensure that the model is not just meeting individual counts but that overall movements between different areas are represented correctly. For input into calibration, screenlines have been broken down into minor screenlines in order to group counts together that represent trips between similar areas.

Figure 9-2 shows the locations of the major summary screenlines, screenlines used for calibration, individual count locations and the counts input as part of a screenline as well as an individual count.

Figure 9-1 - Matrix Estimation Process in SATURN

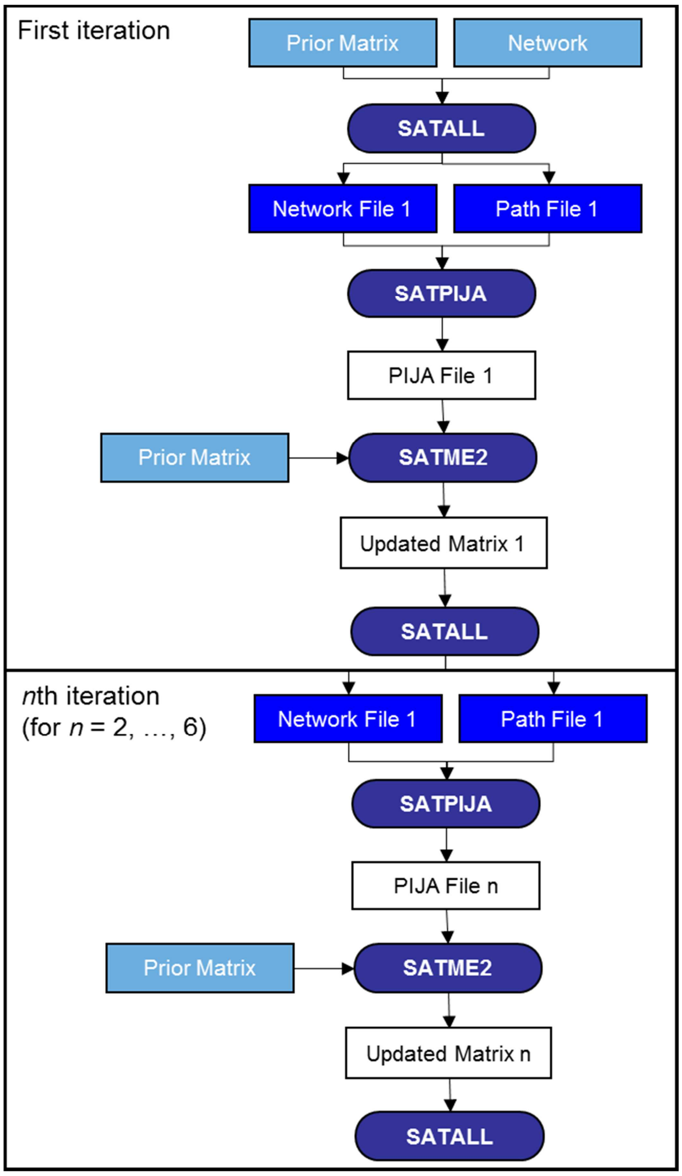
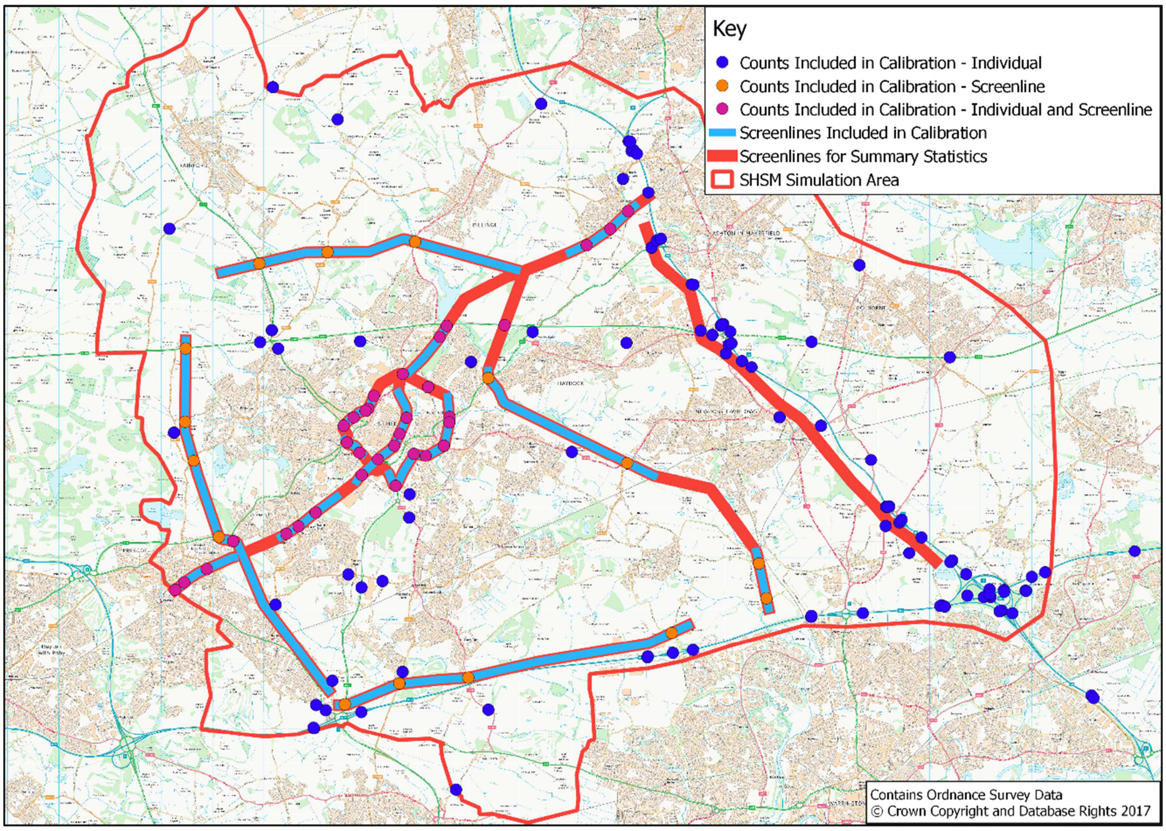


Table 9-1 Parameter Definitions for Matrix Analysis

PARAMETER	DESCRIPTION	VALUE
XAMAX	Maximum balancing factor used to limit excessive change to the old trip matrix. (N.B. Minimum value is set by the inverse of XAMAX)	2
ITERMX	Maximum number of iterations that will be run if convergence is not met	120
EPSILN	Convergence criteria for the difference between observed counts and model flows.	0.01

Figure 9-2 Screenlines and Individual Count Sites for Calibration



9.3 MATRIX CALIBRATION

Matrix estimation was undertaken using the data shown in **Figure 9-2**. The change in matrix totals by each user class is summarised in **Table 9-2**.

Table 9-2 - Change in Matrix Totals, Prior to PostME

User Class	AM Peak		Inter-Peak		PM Peak	
	Prior	PostME	Prior	PostME	Prior	PostME
Business	15,960	15,190	11,652	11,637	18,162	17,761
%Change		*-4.8%*		*-0.1%*		*-2.2%*
Commute	136,722	130,970	31,053	30,908	104,950	102,215
%Change		*-4.2%*		*-0.5%*		*-2.6%*
Other	148,989	144,714	156,451	155,272	164,860	161,725
%Change		*-2.9%*		*-0.8%*		*-1.9%*
LGV	28,918	26,263	25,659	23,664	25,922	24,233
%Change		*-9.2%*		*-7.8%*		*-6.5%*
HGV	10,297	8,950	7,617	7,315	8,737	8,081
%Change		*-13.1%*		*-4.0%*		*-7.5%*
Totals	**340,885**	**326,088**	**232,430**	**228,796**	**322,631**	**314,015**
%Change		***-4.3%***		***-1.6%***		***-2.7%***

The results of the statistical analysis undertaken on the prior and post matrix estimation matrices are presented below for all time periods, along with the relevant TAG criteria.

In addition to the standard TAG analysis, the zonal cell and trip end analysis has been undertaken for a subset of the original data to remove trips that have neither an origin nor destination within the study area. This investigation was necessary as some LCRTM zones in the external area that had large trip volumes remained unchanged through matrix estimation. This resulted in the summary statistics not being representative of the changes that were happening to the zones with fewer trips. The results of this analysis is presented in **Section 9.4**.

MATRIX ZONAL CELL VALUES

Table 9-3 shows the guidance for criteria regarding matrix zonal cell value changes during matrix estimation, as defined in Table 5 of TAG unit M3.1.

Table 9-3 – TAG Criteria for Matrix Zonal Cell Value Changes

MEASURE	DESCRIPTION
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95

Table 9-4 shows the outcome of the post and prior matrix estimation analysis, at a zonal level for all the trips the AM, IP and PM models.

Table 9-4 – Matrix Zonal Cell Value Change Statistics

Measure	AM	IP	PM
Slope	0.995	0.998	0.996
Intercept	-0.023	-0.005	-0.012
R^2	0.996	0.997	0.997

The overall matrix zonal cell value changes are within TAG guidance, however this is not reflective of the changes in cell pairs of smaller volume. This is due to large external zones that are unchanged from prior to post which skew the overall statistics. Analysis of changes in matrix zonal cell values for zones within the simulation area is discussed in **Section 9.4**.

MATRIX ZONAL TRIP ENDS

Table 9-5 states the guidance for criteria regarding matrix zonal trip end changes during matrix estimation, as defined in Table 5 of TAG unit M3.1.

Table 9-5 – TAG Criteria for Matrix Zonal Trip End Changes

MEASURE	DESCRIPTION
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98

Table 9-6 shows the outcome of the post and prior matrix estimation analysis, at a zonal level for all time periods.

Table 9-6 - Matrix Zonal Trip End Change Statistics

Trip End	Measure	AM	IP	PM
Origin	Slope	0.932	0.985	0.976
Origin	Intercept	10.189	-0.237	-1.115
Origin	R^2	0.989	0.992	0.997
Destination	Slope	0.934	0.952	0.911
Destination	Intercept	9.397	9.318	24.776
Destination	R^2	0.990	0.987	0.980

Overall, the TAG criteria is not satisfied for zonal trip ends even when including all zones in this analysis, this indicates that the prior matrices are not sufficiently comprehensive. As with the matrix zonal cell changes, these statistics do not fully demonstrate the changes occurring for zones in the simulation area. Analysis of changes in matrix zonal trip ends for zones within the simulation area is discussed in **Section 9.4**.

TRIP LENGTH DISTRIBUTIONS

Table 9-7 states the guidance for measuring the effects of matrix estimation on trip lengths as defined in Table 5 of TAG unit M3.1.

Table 9-7 – TAG Criteria for Trip Length Distributions

MEASURE	DESCRIPTION
Trip length distributions	Means within 5% Standard deviations within 5%

Table 9-8 shows the change in mean trip length and standard deviation in the prior and post matrices for all time periods.

Table 9-8 - Trip Length Distribution Statistics

Measure	AM	IP	PM
Mean Trip Length Prior (km)	23.47	23.48	24.58
Mean Trip Length Post (km)	21.82	23.04	23.28
% Difference between Means	**-7.02%**	**-1.86%**	**-5.26%**
Standard Deviation Prior	19.82	19.62	20.42
Standard Deviation Post	18.96	20.31	19.93
% Difference between Standard Deviations	**-4.31%**	**3.52%**	**-2.41%**

For the prior and post matrices, the mean trip length differs by less than 5% in the IP and is only just over 5% in the PM. The change in standard deviation is less than 5% in all time periods.

SECTOR TO SECTOR LEVEL MATRIX CHANGES

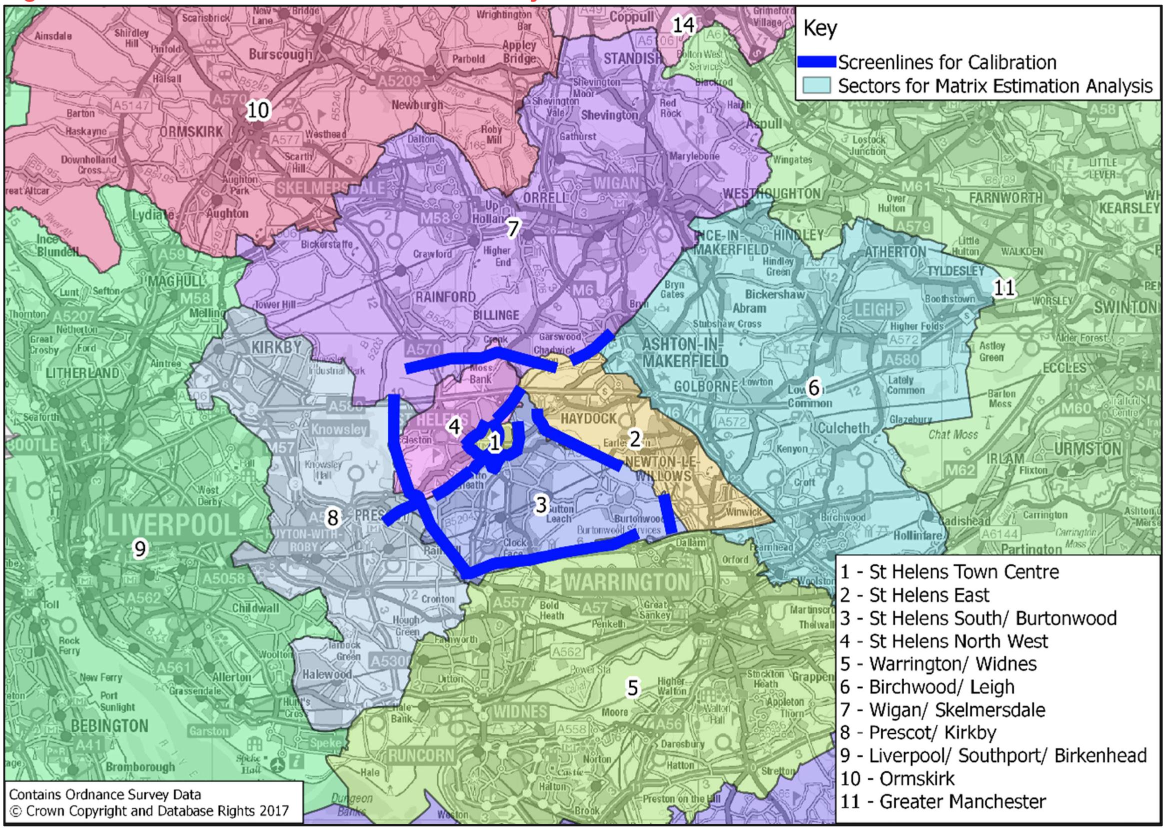
Table 9-9 shows the criteria for the comparison of prior and post matrix estimation sector-sector level matrices as defined in Table 5 of TAG unit M3.1.

Table 9-9 – TAG Criteria for Sector-Sector Level Matrix Changes

MEASURE	DESCRIPTION
Sector to sector level matrices	Differences within 5%

For this analysis, zones were grouped into sectors by locations in relation to screenlines. The sector system used and its relation to the calibration screenlines is shown in **Figure 9-3**.

Figure 9-3 - Sectors for Matrix Estimation Analysis



The results of sector to sector analysis is shown in **Table 9-10**, **Table 9-11** and **Table 9-12**.

As can be seen in these tables, the changes in sector to sector movements are greater than TAG criteria. The total trips have changed between -1.6% and -4.3% from prior to post but some individual sectors have changed significantly more than this.

This large change seen between the prior and post matrices is largely to do with the original matrices from LCRTM containing limited detail of trips within St Helens. In addition, the prior matrices contain a lot of external trips that aren't relevant for St Helens district. As a result of these factors, matrix estimation requires a greater level of change in order to meet targets.

Table 9-10 - AM % Change Sector to Sector Movements

OD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	12.1%	13.2%	139.4%	57.9%	-9.5%	-19.5%	-23.7%	62.8%	-27.2%	-3.3%	-57.7%	-46.7%	-39.8%	-8.4%	-5.2%	**17.6%**
2	18.4%	1.1%	31.1%	46.5%	-2.8%	1.7%	-18.6%	-12.2%	-24.7%	-35.0%	-24.1%	34.5%	2.9%	-30.2%	29.1%	**-2.1%**
3	54.0%	17.6%	28.4%	77.7%	-7.3%	0.9%	3.9%	41.1%	-14.0%	5.5%	-57.3%	-19.2%	-17.6%	-8.2%	-17.2%	**10.5%**
4	35.7%	80.3%	112.9%	27.8%	-4.5%	-22.4%	26.8%	64.9%	-3.5%	96.7%	-29.6%	-4.8%	-17.4%	2.5%	12.9%	**29.9%**
5	-1.8%	-8.6%	34.6%	49.7%	-0.3%	-7.0%	-15.8%	-6.5%	-8.1%	2.7%	-19.8%	1.1%	-6.5%	-12.4%	2.7%	**-4.0%**
6	-53.4%	-30.8%	-24.6%	-34.8%	-14.5%	-10.1%	-34.1%	-61.1%	-50.2%	-27.1%	-10.8%	-6.2%	-7.0%	-3.0%	-9.0%	**-19.5%**
7	13.7%	-14.6%	48.8%	7.7%	-46.0%	-29.9%	-0.8%	-28.2%	-18.5%	-0.3%	-20.2%	6.3%	-17.9%	-1.1%	7.7%	**-9.0%**
8	2.8%	18.3%	55.7%	44.6%	-10.9%	-43.5%	20.4%	9.4%	2.0%	25.0%	-58.0%	-7.9%	-42.8%	-7.1%	-18.7%	**1.8%**
9	-21.7%	-18.7%	-0.6%	-11.5%	-13.0%	-45.7%	0.1%	2.8%	0.0%	-0.1%	-48.5%	-1.8%	-33.0%	-6.2%	-15.0%	**-2.5%**
10	-2.1%	-54.7%	5.7%	-32.9%	-44.8%	-54.1%	-0.3%	-9.0%	-2.3%	0.0%	-35.2%	-16.7%	-26.1%	-0.3%	-2.1%	**-6.2%**
11	-69.8%	-55.9%	-30.3%	-48.5%	-14.9%	-11.5%	-28.5%	-63.2%	-48.7%	-26.6%	0.0%	-1.8%	0.0%	0.3%	-6.7%	**-16.4%**
12	-45.3%	-6.9%	-5.2%	-24.7%	0.9%	-7.1%	-5.9%	-13.8%	-2.2%	9.9%	-5.5%	0.0%	-0.2%	1.4%	0.0%	**-1.3%**
13	-69.6%	-25.0%	-41.3%	-44.7%	-6.9%	-8.2%	-18.7%	-50.0%	-30.6%	-1.2%	0.0%	-0.1%	0.0%	3.9%	0.0%	**-2.6%**
14	-39.6%	-57.6%	-31.7%	-4.0%	-51.7%	-22.4%	-1.4%	-35.9%	-21.4%	-0.5%	-0.1%	-16.1%	-0.2%	0.0%	-4.1%	**-4.9%**
15	-64.9%	0.0%	38.8%	11.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-11.8%	0.0%	0.0%	27.3%	0.0%	**27.1%**
Total	**7.9%**	**-13.5%**	**32.0%**	**25.2%**	**-7.0%**	**-15.3%**	**-8.8%**	**-0.7%**	**-3.5%**	**-0.3%**	**-15.9%**	**-0.7%**	**-1.5%**	**-1.0%**	**-13.3%**	**-4.3%**

Table 9-11 - IP % Change Sector to Sector Movements

OD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	23.6%	29.3%	198.2%	147.8%	-8.8%	-41.8%	-12.8%	77.4%	-10.5%	14.1%	-59.9%	-17.1%	-33.3%	-53.6%	53.3%	**43.0%**
2	44.8%	6.3%	41.0%	79.0%	-12.3%	-8.1%	-18.0%	-37.9%	-51.1%	-19.1%	-28.2%	55.3%	30.1%	-23.8%	70.8%	**-2.8%**
3	193.2%	34.4%	39.9%	266.9%	-17.8%	-7.5%	18.7%	39.8%	-11.9%	32.1%	-32.8%	-3.7%	3.8%	-15.6%	34.1%	**33.1%**
4	75.6%	54.7%	234.2%	52.5%	32.8%	-36.9%	-33.3%	50.5%	-27.9%	-29.8%	-43.3%	40.9%	-7.5%	-35.0%	73.5%	**38.5%**
5	-0.6%	-7.2%	-5.0%	45.4%	0.5%	-8.5%	-25.6%	-4.5%	-5.8%	4.6%	-8.8%	2.9%	2.8%	-8.5%	9.6%	**-2.8%**
6	-44.1%	-26.6%	-13.7%	-16.5%	-6.6%	-6.7%	-22.2%	-59.2%	-47.2%	-10.6%	-11.6%	-6.7%	-6.5%	-1.2%	-7.5%	**-14.4%**
7	-14.6%	-24.9%	46.1%	-17.0%	-39.4%	-22.0%	-1.1%	-27.6%	-17.1%	-0.5%	-20.5%	68.0%	20.7%	-1.5%	109.6%	**-8.4%**
8	50.7%	-19.2%	39.4%	44.8%	-10.0%	-56.6%	-24.3%	10.8%	1.8%	3.5%	-56.7%	-0.6%	-16.0%	-24.9%	24.3%	**-1.7%**
9	-16.0%	-44.0%	-18.3%	-24.4%	-12.6%	-50.1%	-16.7%	2.6%	0.0%	0.0%	-46.2%	0.9%	-13.0%	-4.3%	20.8%	**-3.4%**
10	13.3%	-24.6%	78.1%	-24.2%	-12.0%	-6.9%	-0.2%	0.7%	-0.1%	0.0%	-16.3%	96.7%	99.3%	-0.2%	222.9%	**0.2%**
11	-48.0%	-33.8%	-6.1%	-12.0%	-1.8%	-7.3%	-11.9%	-41.9%	-30.0%	5.7%	0.0%	2.1%	0.0%	1.2%	8.2%	**-6.7%**
12	-6.3%	43.7%	18.8%	49.0%	3.3%	5.5%	30.1%	1.6%	2.3%	52.5%	0.1%	0.0%	0.2%	63.1%	0.0%	**1.9%**
13	-26.4%	21.9%	-15.3%	24.3%	7.6%	1.2%	14.0%	3.1%	6.9%	71.4%	0.0%	0.1%	0.0%	12.3%	0.0%	**0.1%**
14	-24.8%	-29.3%	-0.7%	11.5%	-27.6%	-1.4%	-1.4%	-33.6%	-5.4%	-0.2%	2.5%	78.8%	18.8%	0.0%	173.6%	**0.8%**
15	22.8%	0.0%	103.7%	82.5%	17.6%	0.0%	55.6%	271.6%	0.0%	0.0%	5.9%	0.0%	0.0%	118.8%	0.0%	**86.5%**
Total	**31.9%**	**-6.7%**	**40.7%**	**59.4%**	**-3.8%**	**-12.6%**	**-7.4%**	**1.6%**	**-2.0%**	**1.2%**	**-12.3%**	**2.2%**	**0.4%**	**0.6%**	**38.8%**	**-1.6%**

Table 9-12 - PM % Change Sector to Sector Movements

OD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	3.8%	15.9%	101.0%	63.2%	-30.7%	-66.2%	-8.5%	19.8%	-13.0%	17.3%	-76.5%	-52.7%	-62.9%	-62.3%	-29.8%	**9.2%**
2	56.8%	6.4%	5.8%	74.7%	-6.0%	-13.5%	-2.9%	2.7%	-15.0%	-29.5%	-41.1%	28.1%	15.7%	-29.7%	21.8%	**-4.9%**
3	149.2%	18.6%	43.0%	133.1%	-3.4%	-10.9%	28.8%	44.7%	-4.2%	34.9%	-51.2%	-11.6%	-19.6%	-30.3%	-10.8%	**20.7%**
4	91.7%	62.2%	155.2%	36.9%	26.1%	-49.7%	3.7%	63.5%	-13.3%	-31.3%	-59.9%	-11.4%	-30.4%	-31.9%	24.9%	**34.8%**
5	44.2%	-5.4%	14.3%	45.2%	0.6%	-3.0%	-15.5%	0.0%	-0.2%	-11.1%	-32.3%	0.8%	-13.7%	-17.1%	0.1%	**-4.9%**
6	23.8%	6.2%	11.6%	52.1%	2.6%	-3.4%	-18.6%	-20.0%	-25.1%	-30.3%	-7.8%	4.9%	0.3%	-11.9%	5.4%	**-6.2%**
7	15.4%	-9.7%	34.6%	-13.1%	-38.2%	-27.2%	-0.9%	-3.7%	-6.2%	-0.9%	-32.4%	22.5%	-12.6%	-1.3%	28.3%	**-9.8%**
8	49.1%	-7.3%	66.1%	92.2%	-7.5%	-58.8%	-16.9%	10.6%	2.6%	-0.2%	-66.2%	-11.3%	-28.3%	-25.5%	54.2%	**-0.9%**
9	-25.4%	-28.7%	-15.1%	1.6%	-12.4%	-51.1%	-11.3%	2.2%	0.0%	-0.2%	-55.2%	-2.9%	-40.2%	-7.9%	-20.5%	**-4.1%**
10	-5.8%	-10.3%	59.6%	-26.6%	-19.5%	-17.6%	-0.3%	19.5%	0.1%	0.0%	-28.9%	40.4%	12.5%	-0.4%	70.4%	**-1.7%**
11	-30.6%	-18.1%	-10.0%	56.2%	1.5%	-5.8%	-5.6%	-38.7%	-23.5%	-8.1%	0.0%	-1.1%	0.0%	0.2%	-3.2%	**-4.8%**
12	-60.3%	24.9%	0.1%	29.6%	2.6%	-6.2%	24.4%	-6.3%	0.0%	15.5%	-8.2%	0.0%	-0.7%	16.6%	0.0%	**-0.9%**
13	-2.1%	0.6%	12.5%	-59.2%	2.6%	-7.3%	2.3%	42.7%	-15.4%	3.2%	0.0%	0.0%	0.0%	2.9%	0.0%	**-0.3%**
14	9.4%	-11.0%	26.5%	-15.9%	-26.6%	-2.1%	-0.9%	-18.1%	-4.9%	-0.2%	0.6%	40.0%	7.4%	0.0%	62.3%	**0.0%**
15	0.0%	0.0%	31.4%	49.7%	3.4%	-10.0%	18.8%	0.0%	0.0%	0.0%	-19.0%	0.0%	0.0%	9.1%	0.0%	**36.9%**
Total	**35.2%**	**0.6%**	**35.5%**	**47.2%**	**-2.5%**	**-13.7%**	**-4.4%**	**4.1%**	**-1.1%**	**-1.3%**	**-21.4%**	**0.1%**	**-2.1%**	**-1.9%**	**-2.6%**	**-2.7%**

9.4 ANALYSIS OF MATRIX ESTIMATION ON CELLS IN THE SIMULATION AREA

In this section, the results of the cell and trip end value analysis for zones within the simulation area are discussed. The zone pairs included in this analysis have been selected if either the origin or destination is in the simulation area. This has been done to remove the large external – external trips that are masking the results of the zones with fewer trips from the original analysis.

The TAG criteria for matrix zonal cell values and trip ends are shown in **Table 9-3** and **Table 9-5**.

MATRIX ZONAL CELL VALUES

Table 9-13 – Matrix Zonal Cell Value Change Statistics - Simulation Zones

Measure	AM	IP	PM
Slope	0.789	0.810	0.887
Intercept	0.021	0.017	0.017
R^2	0.719	0.710	0.755

MATRIX ZONAL TRIP ENDS

Table 9-14 - Matrix Zonal Trip End Change Statistics - Simulation Zones

Trip End	Measure	AM	IP	PM
Origin	Slope	1.005	0.946	0.962
Origin	Intercept	5.397	10.102	9.078
Origin	R^2	0.900	0.816	0.883
Destination	Slope	0.911	0.976	1.086
Destination	Intercept	10.623	10.286	7.672
Destination	R^2	0.870	0.835	0.884

Clearly the values presented in these tables do not meet TAG criteria, this demonstrates that matrix estimation has had to make larger changes to demand in order to meet traffic data due to poor validation against count data in the prior matrices.

Due to the methods used in the matrix build, it was expected that matrix estimation would need to make larger than usual adjustments to the model demand in order to meet count data. For the prior matrix build, the matrices have been constructed by disaggregating matrices formed of much larger zones, using land use to provide a best estimate of trip distribution. Additionally, the growth factor applied to take the prior matrices from 2012 to 2017 was applied uniformly to zones. These elements of the matrix build lead to prior matrices that had only an approximate trip distribution based on available data.

10 ASSIGNMENT CALIBRATION AND VALIDATION

10.1 INTRODUCTION

This section presents the results of calibration at screenline and link flow level for the prior and post matrices. Results are also presented for count locations on the Strategic Road Network (SRN) and Key Route Network (KRN) as it is essential that these routes perform well if the model is to be fit for purpose.

For calibration of SHSM, all count locations were used for calibration in order to improve estimation of trips by the model.

Results of the journey time validation for the 10 routes discussed in **Section 5.7** and model convergence statistics are also presented in this section.

Detailed results are provided in the Appendices to this report.

10.2 ASSIGNMENT CALIBRATION

The following section presents details of screenline and link flow statistics from calibration.

LINK FLOW ANALYSIS

Table 10-1 and **Table 10-2** show the percentage of counts meeting link flow acceptability criteria, as set out in WebTAG Unit M3-1 Table 2, for prior and post matrix estimation respectively.

Table 10-1 - Prior Matrix Estimation Results, All Counts

Time Period	Number of Counts	% Counts Passing TAG Flow Criteria	% Counts Passing TAG GEH Criteria
AM	235	42%	35%
IP	235	94%	91%
PM	235	43%	40%

Table 10-2 - Post Matrix Estimation Results, All Counts

Time Period	Number of Counts	% Counts Passing TAG Flow Criteria	% Counts Passing TAG GEH Criteria
AM	235	91%	88%
IP	235	94%	91%
PM	235	90%	88%

This analysis shows that post matrix estimation, the model flows are representative of observed counts to an acceptable level.

SCREENLINE ANALYSIS

Table 10-3 to **Table 10-5** show summary statistics for post matrix estimation at a screenline level for all time periods.

Table 10-3 - AM Peak Screenlines

Description	Direction	Observed	Modelled	Difference	% Difference	GEH
A - North	Nb	1,408	1,457	49	3%	1.3
A - North	Sb	1,801	1,779	-22	-1%	0.5
B - East	Eb	3,266	3,305	39	1%	0.7
B - East	Wb	3,238	3,332	94	3%	1.6
C - South	Nb	2,517	2,567	50	2%	1.0
C - South	Sb	2,526	2,617	92	4%	1.8
D - West	Eb	2,819	2,973	154	5%	2.9
D - West	Wb	3,351	3,508	157	5%	2.7
E - Town Centre Cordon	In	7,723	7,694	-29	0%	0.3
E - Town Centre Cordon	Out	5,863	5,678	-185	-3%	2.4
F - Railway	Nw Bound	5,626	5,594	-32	-1%	0.4
F - Railway	Se Bound	6,011	5,922	-89	-1%	1.2
G - M6	Eb	4,645	4,705	60	1%	0.9
G - M6	Wb	4,313	4,225	-88	-2%	1.3

Table 10-4 - IP Screenlines

Description	Direction	Observed	Modelled	Difference	% Difference	GEH
A - North	Nb	1,024	1,036	12	1%	0.4
A - North	Sb	1,042	1,052	10	1%	0.3
B - East	Eb	2,307	2,418	111	5%	2.3
B - East	Wb	2,402	2,410	8	0%	0.2
C - South	Nb	1,573	1,588	15	1%	0.4
C - South	Sb	1,617	1,674	56	3%	1.4
D - West	Eb	2,109	2,170	61	3%	1.3
D - West	Wb	1,988	2,089	101	5%	2.2
E - Town Centre Cordon	In	6,317	6,034	-283	-4%	3.6
E - Town Centre Cordon	Out	6,604	6,465	-139	-2%	1.7
F - Railway	Nw Bound	4,872	4,844	-28	-1%	0.4
F - Railway	Se Bound	4,925	4,762	-163	-3%	2.3
G - M6	Eb	3,324	3,307	-16	0%	0.3
G - M6	Wb	3,356	3,241	-115	-3%	2.0

Table 10-5 - PM Peak Screenlines

Description	Direction	Observed	Modelled	Difference	% Difference	GEH
A - North	Nb	1,719	1,719	0	0%	0.0
A - North	Sb	1,406	1,431	25	2%	0.7
B - East	Eb	3,205	3,283	78	2%	1.4
B - East	Wb	3,492	3,396	-96	-3%	1.6
C - South	Nb	2,646	2,737	91	3%	1.8
C - South	Sb	2,277	2,373	96	4%	2.0
D - West	Eb	3,401	3,463	62	2%	1.1
D - West	Wb	2,594	2,666	72	3%	1.4
E - Town Centre Cordon	In	6,846	6,658	-188	-3%	2.3
E - Town Centre Cordon	Out	8,160	8,203	43	1%	0.5
F - Railway	Nw Bound	6,385	6,432	46	1%	0.6
F - Railway	Se Bound	5,998	5,716	-282	-5%	3.7
G - M6	Eb	4,669	4,535	-134	-3%	2.0
G - M6	Wb	5,042	5,079	37	1%	0.5

WebTAG guidance given in TAG Unit M3.1 Table 1 is that differences between modelled and observed counts should be less than 5% of the count value for all or nearly all screenlines.

This criteria is met in all but two screenlines; the two screenlines that do not pass this criteria fail by less than 1%.

SRN/ KRN ANALYSIS

Additional analysis has been undertaken to establish the strength of the model on the SRN and KRN within the simulation area. The results of this analysis are shown in **Table 10-6**.

Table 10-6 - SRN and KRN Results

Time Period	Number of SRN Counts	SRN Counts % Passing TAG Flow Criteria	SRN Counts % Passing TAG GEH Criteria	Number of KRN Counts	KRN Counts % Passing TAG Flow Criteria	KRN Counts % Passing TAG GEH Criteria
AM	13	100%	100%	64	89%	88%
IP	13	100%	100%	64	95%	97%
PM	13	100%	100%	64	92%	94%

This analysis demonstrates the model strength on the SRN and KRN within the simulation area and provides assurance that the model performs well on the key routes in St Helens.

10.3 JOURNEY TIME VALIDATION

Table 10-7 to

Table 10-9 show the results of the journey time validation for the routes given in **Section 5.7**, measured against TAG guidance given in Unit M3.1 Table 3.

TAG guidance states that 85% of journey time routes should pass criteria. In SHSM, 90% pass in the AM and IP models and 80% pass in PM. The PM is only one route away from passing with route 7 EB only 0.3% away from passing WebTAG criteria.

Table 10-7 – AM Journey Time Validation

Route Number	Description	Observed Time	Modelled Time	Difference	% Difference	WebTAG
1	A580: EB	00:20:01	00:20:09	00:00:08	0.6%	✓
1	A580: WB	00:22:51	00:21:14	-00:01:37	-7.1%	✓
2	A570: NB	00:08:00	00:09:12	00:01:12	15.0%	✓
2	A570: SB	00:09:00	00:07:52	-00:01:08	-12.6%	✓
3	A571_A58: EB	00:17:13	00:17:54	00:00:41	4.0%	✓
3	A571_A58: WB	00:17:40	00:20:02	00:02:22	13.4%	✓
4	Linkway: NB	00:05:02	00:04:55	-00:00:07	-2.4%	✓
4	Linkway: SB	00:04:59	00:04:51	-00:00:08	-2.5%	✓
5	A569: NB	00:07:40	00:07:59	00:00:19	4.1%	✓
5	A569: SB	00:07:25	00:08:04	00:00:39	8.7%	✓
6	Linkway East_A572: EB	00:15:24	00:15:27	00:00:03	0.4%	✓
6	Linkway East_A572: WB	00:15:58	00:16:09	00:00:11	1.2%	✓
7	A58_Liverpool Road: EB	00:09:24	00:10:43	00:01:19	14.1%	✓
7	A58_Liverpool Road: WB	00:10:18	00:10:12	-00:00:06	-1.0%	✓
8	A49: NB	00:13:33	00:13:38	00:00:05	0.6%	✓
8	A49: SB	00:17:28	00:14:13	-00:03:15	-18.7%	×
9	Winwick Link Road_A579: NB	00:09:43	00:07:54	-00:01:49	-18.7%	×
9	Winwick Link Road_A579: SB	00:08:50	00:07:54	-00:00:56	-10.7%	✓
10	A572_Alder Lane: EB	00:12:48	00:14:17	00:01:29	11.6%	✓
10	A572_Alder Lane: WB	00:14:49	00:14:30	-00:00:19	-2.2%	✓

Table 10-8 - IP Journey Time Validation

Route Number	Description	Observed Time	Modelled Time	Difference	% Difference	WebTAG
1	A580: EB	00:18:55	00:17:50	-00:01:05	-5.7%	✓
1	A580: WB	00:19:07	00:18:18	-00:00:49	-4.3%	✓
2	A570: NB	00:07:47	00:07:23	-00:00:24	-5.2%	✓
2	A570: SB	00:08:48	00:06:56	-00:01:52	-21.2%	×
3	A571_A58: EB	00:17:16	00:16:47	-00:00:29	-2.8%	✓
3	A571_A58: WB	00:17:28	00:18:05	00:00:37	3.5%	✓
4	Linkway: NB	00:04:59	00:04:15	-00:00:44	-14.7%	✓
4	Linkway: SB	00:05:04	00:04:27	-00:00:37	-12.2%	✓
5	A569: NB	00:07:48	00:07:44	-00:00:04	-0.8%	✓
5	A569: SB	00:07:44	00:07:45	00:00:01	0.3%	✓
6	Linkway East_A572: EB	00:15:33	00:15:08	-00:00:25	-2.7%	✓
6	Linkway East_A572: WB	00:16:06	00:15:39	-00:00:27	-2.8%	✓
7	A58_Liverpool Road: EB	00:09:01	00:09:46	00:00:45	8.3%	✓
#	A58_Liverpool Road: WB	00:09:46	00:09:33	-00:00:13	-2.2%	✓
8	A49: NB	00:12:37	00:13:16	00:00:39	5.1%	✓
8	A49: SB	00:15:28	00:13:07	-00:02:21	-15.2%	×
9	Winwick Link Road_A579: NB	00:08:13	00:07:44	-00:00:29	-5.8%	✓
9	Winwick Link Road_A579: SB	00:07:00	00:07:39	00:00:39	9.2%	✓
10	A572_Alder Lane: EB	00:12:34	00:13:39	00:01:05	8.6%	✓
10	A572_Alder Lane: WB	00:14:10	00:14:01	-00:00:09	-1.1%	✓

Table 10-9 - PM Journey Time Validation

Route Number	Description	Observed Time	Modelled Time	Difference	% Difference	WebTAG
1	A580: EB	00:20:32	00:19:50	-00:00:42	-3.4%	✓
1	A580: WB	00:21:36	00:24:49	00:03:13	14.9%	✓
2	A570: NB	00:08:25	00:09:02	00:00:37	7.2%	✓
2	A570: SB	00:09:30	00:07:36	-00:01:54	-20.0%	×
3	A571_A58: EB	00:18:06	00:17:52	-00:00:14	-1.3%	✓
3	A571_A58: WB	00:18:22	00:18:49	00:00:27	2.5%	✓
4	Linkway: NB	00:05:07	00:04:35	-00:00:32	-10.5%	✓
4	Linkway: SB	00:05:20	00:05:02	-00:00:18	-5.7%	✓
5	A569: NB	00:07:54	00:07:59	00:00:05	1.1%	✓
5	A569: SB	00:07:43	00:07:56	00:00:13	2.9%	✓
6	Linkway East_A572: EB	00:15:57	00:15:31	-00:00:26	-2.7%	✓
6	Linkway East_A572: WB	00:16:19	00:15:58	-00:00:21	-2.1%	✓
7	A58_Liverpool Road: EB	00:09:42	00:11:11	00:01:29	15.3%	×
7	A58_Liverpool Road: WB	00:11:28	00:10:36	-00:00:52	-7.6%	✓
8	A49: NB	00:14:00	00:14:21	00:00:21	2.5%	✓
8	A49: SB	00:18:26	00:14:06	-00:04:20	-23.5%	×
9	Winwick Link Road_A579: NB	00:11:21	00:09:20	-00:02:01	-17.8%	×
9	Winwick Link Road_A579: SB	00:08:32	00:08:12	-00:00:20	-3.8%	✓
10	A572_Alder Lane: EB	00:12:49	00:14:01	00:01:12	9.3%	✓
10	A572_Alder Lane: WB	00:15:13	00:14:47	-00:00:26	-2.9%	✓

10.4 MODEL CONVERGENCE

For SHSM, the convergence criteria used was %GAP = 0.05 and percentage of links with flow change <1% = 99%. This criteria is better than that needed for TAG requirements. Model convergence statistics for each time period are presented in **Table 10-10**.

Table 10-10 - St Helens SATURN Model Convergence Statistics

Convergence Measure	AM	IP	PM
% GAP	0.036	0.021	0.043
Percentage of Routes with Flow Change less than 1%	99.2	99.5	99.6
Number of Assignment Loops	52	16	40
Convergence Reached?	Yes	Yes	Yes

All three time periods converged to a high level within a reasonable number of iterations. This indicates that the model reaches stability relatively quickly and provides assurance of robust model outputs.

11 CONCLUSIONS

11.1 SUMMARY OF MODEL DEVELOPMENT

A SATURN model has been developed to assist St Helens council in assessing the traffic impacts of schemes in the district. This model has been built from the Liverpool City Region Transport Model (LCRTM) network and matrices with additional detail added in St Helens district. The key stages of SHSM model development were:

- Count data was compiled for various locations in the simulation area, additional counts were commissioned where any gaps in data were identified. Counts were processed to remove outliers and produce average weekday flow values for the modelled hours.
- The network has been developed from the LCRTM structure with additional detail added in St Helens. Junction coding has been added in the simulation area and SFCs used in LCRTM have been reviewed.
- Matrices have been developed using the 2012 base year LCRTM matrices, detail was added in the study area through splitting zones. Factors were applied to adjust the matrices to 2017 base year.
- Refinements were made to properties of the network during network calibration so that the model better represented road conditions.
- Finally, matrix estimation was used to refine travel demand to better match observed count data.

11.2 SUMMARY OF MODEL VALIDATION

The base year model validation has been developed following TAG M3.1 ‘Highway Assignment Modelling’ guidance (January 2014). The model converges to an acceptable level for all time periods.

The matrix changes that occur through matrix estimation are larger than TAG guidance. As LCRTM matrices were not based on comprehensive Origin-Destination data for St Helens and only had a general growth factor applied, this is to be expected in order to achieve a good level of flow validation.

Screenlines have been chosen to capture trips between St Helens and other districts as well as movements within St Helens. The model performs well at a screenline level for all time periods and in line with the standards expected from TAG.

The model performs well in terms of reproducing observed traffic volumes at a link level for both GEH and flows in all time periods. Additional analysis has been undertaken to demonstrate the strength of model calibration on the SRN/ KRN, this analysis shows that the model can represent the key traffic flows within St Helens to a good standard.

For journey time validation, the model exceeds TAG criteria of 85% of modelled journey time routes being within 15% or 1 minute of the observed data in the AM and IP and only misses this criteria by one journey time route in the PM (and in this instance the model and observed data differ by only 0.3%).

11.3 MODEL FITNESS FOR PURPOSE

St Helens SATURN Model covers the whole of St Helens district as well as Ashton-in-Makerfield, Golborne and Winwick through to M62 Junction 10. The model has been developed as a tool for testing local developments across St Helens district. Potential applications of the model include:

- M6 J23 Feasibility Study
- Infrastructure requirements scenario testing – employment and housing allocations/ greenbelt
- Town centre strategy re-development option modelling
- A580 corridor enhancement/ assessment
- Evidence to enhance motorway connectivity (M62 J7, M6 J22, M6 J24)
- A570 Linkway MSBC review

The statistics presented in this report demonstrate that the model can represent traffic flows within St Helens to an acceptable standard. The model performs well at a screenline level and on the Key Route Network, demonstrating that the key traffic movements in St Helens are captured in the model. When compared against journey time routes the model performs well in most cases, this gives confidence that the modelled speeds and delays at junctions are reasonable.

If the model is to be used for additional purposes, such as assessment of specific planning applications, then a review of the model performance in the area impacted by the scheme should be undertaken. Furthermore, in the case of applications of the model to inform business cases and economic appraisal it should be recognised that more specific O-D data may be required to replace movements that have been derived from LCRTM and to reduce the reliance on matrix estimation techniques. This would need to be reviewed on a scheme by scheme basis and take into account the stage of the scheme development (i.e. at option identification and sifting this is less likely to be a significant concern compared to later stages where more certainty is required for the economic appraisal of the scheme).

Although adjustments have been made to allow traffic to enter the study area at the correct points it must be noted that this model lacks the detail required, in both network and zone structure, to properly represent traffic in the buffer area to the east of the simulation area.

Appendix A

APPENDIX A-1