

**T0390 A5036 Tier 1 Governance and
Business Case Support**
PCF Stage 2
Transport Model Package

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Contents

1.	Introduction	1
1.1	Background/Scheme Overview	1
1.2	Current Status	2
1.3	Purpose of the Report	2
1.4	Report Structure	2
2.	Model Overview	4
2.1	Introduction	4
2.2	Software Packages and Versions	4
2.3	Refinement of TPS RTM2 as a starting point	4
2.4	Time Periods	5
2.5	User Classes	5
2.6	Assignment Methodology	6
2.7	Generalised Costs	6
3.	Summary of Data	8
3.1	Introduction	8
3.2	Traffic Counts for Calibration and Validation	8
3.3	Journey Time Routes	10
4.	Network Development	17
4.1	Introduction	17
4.2	Network Definitions	17
4.3	Model Zone System	20
4.4	Centroid Connectors	22
4.5	Simulation Area	23
4.5.1	Network Checks	23
4.5.2	Additional Network	23
4.6	Coding Assumptions	26
4.6.1	Speed Flow Curves	26
4.6.2	Signalised Junctions	26
4.6.3	Priority Junctions	27
4.6.4	Roundabouts	28
4.6.5	Bus Routes	29
5.	Prior Matrix Development	30
5.1	Introduction	30
5.2	A5036 model Prior Matrices	30
5.3	Zone Disaggregation	30
5.4	Prior Matrix	32

5.5	Validation of Prior Matrices	33
6.	Model Calibration	37
6.1	Introduction	37
6.2	Calibration Process	37
6.3	Matrix Estimation Capping Process	37
6.4	Screenlines	38
6.4.1	Prior Matrix Screenline Calibration	43
6.4.2	Post ME Matrix Screenline Calibration	50
6.5	Link Flow Calibration	58
6.5.1	Prior Matrix Link Calibration	58
6.5.2	Post ME Matrix Link Flow Calibration	59
6.6	Impact of Matrix Estimation	63
6.6.1	Matrix Cell Value Changes	63
6.6.2	Matrix Trip End Changes	63
6.6.3	Trip Length Distribution	64
6.6.4	Sector to Sector Movements	67
6.7	Matrix Totals	71
7.	Model Validation	73
7.1	Introduction	73
7.2	Screenlines	73
7.3	Link Flows	76
7.4	Journey Times	81
7.5	Route Choice Validation	91
7.6	Matrix Stress Test	91
8.	Model Convergence and Assignment	92
8.1	Overview	92
8.2	Model Convergence	92
8.3	Traffic Assignment Outputs	93
9.	Variable Demand Modelling	94
9.1	Introduction	94
9.2	Approach to Variable Demand Modelling	94
9.3	TPS RTM2 Variable Demand Model Development	95
9.4	Realism Testing	97
9.5	Car Fuel Cost Elasticity	99
9.6	Public Transport Fare Elasticity	101
9.7	Car Journey Time Elasticity	101
9.8	Conclusions	102

10. Summary and Conclusion 103

10.1 Summary.....103

10.2 Conclusion103

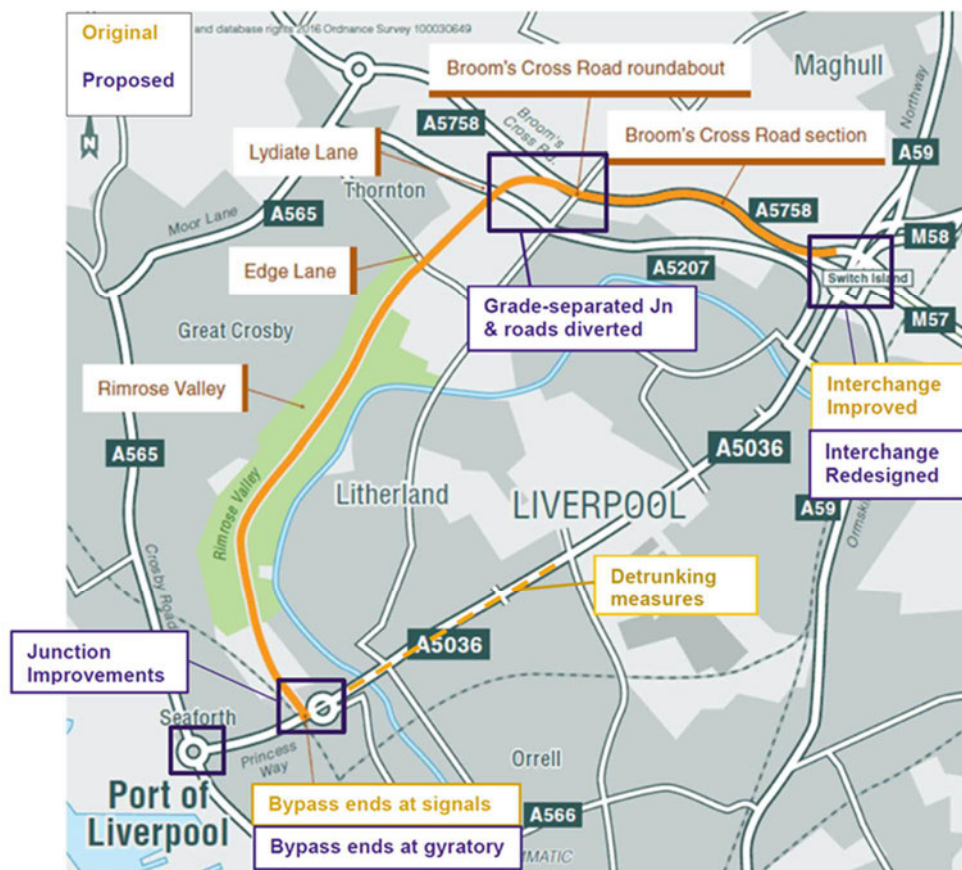
1. Introduction

1.1 Background/Scheme Overview

The 'A5036 Princess Way – access to the Port of Liverpool' scheme is intended to address problems of congestion, pollution and a poor safety record on the route of the A5036 connecting the Port of Liverpool to the motorway network at Switch Island. The preferred route announced in 2017 proposes to build a new dual-carriageway road through Rimrose Valley in Sefton, connecting with Princess Way at the southern end of the existing route and Brooms Cross Road at the northern end. The PRA scheme includes upgrading Brooms Cross Road between the connection with the new road and Switch Island, and the inclusion of that section into the SRN; and the detrunking of the existing A5036 between Switch Island and the junction of the new road and Princess Way.

In 2020, a review of the scheme led to the addition of improvements to Switch Island and to the junction of Princess Way with the A565 Crosby Road South to the scope of the scheme. The enhanced preferred route is shown in Figure 1-1.

Figure 1-1 Enhanced Preferred Route Announcement (PRA)



The scheme is being developed under the Project Control Framework (PCF) as the A5036 forms part of the SRN. As part of the PCF process, projects are expected to follow a standard lifecycle, which has been divided into defined stages as shown in Figure 1-2.

Figure 1-2 Project Control Framework (PCF)



1.2 Current Status

Following a review of Kier Highways' recommendations by WSP, the scheme's allocated Technical Assurance supplier, National Highways accepted the merits of the arguments put forward in support of the enhanced PRA scheme, that the new road would not fully deliver against the scheme objectives without the enhancements proposed. This inevitably had cost implications, however; and a revised assured estimate produced in early 2022 concluded that the cost would be £565 million, exceeding the £500 million limit on National Highways' licence. The scheme therefore needs to transfer to Tier 1, subject to DfT and HM Treasury agreement.

The move to Tier 1 requires an up-to-date Outline Business Case (OBC). The most recent approved OBC was produced for PCF Stage 2. Since then, the transport landscape has changed significantly in respect of:

- The opening of Liverpool 2 container terminal;
- Freeport proposals in the vicinity of the scheme;
- Changing Travel Patterns catalysed by Covid 19;
- Changing patterns of short sea and deep sea trade resulting from the UK's departure from the EU; and
- Revised environmental targets.

This means that the OBC is out of date. WSP have been commissioned to update the OBC.

The analytical requirements for the update are the same as those for PCF Stage 3. The updated OBC will be used to support the scheme's passage through National Highways' IDC and IC, and DfT's IPDC. PCF Stage 3 will effectively restart at the end of that process.

1.3 Purpose of the Report

The purpose of this report is to document the development of the A5036 model and report on the suitability of the model for use as the base model in the appraisal of the scheme. The report has been prepared in line with the specification set out in the Appraisal Specification Report and the Department for Transport's Transport Analysis Guidance (TAG).

1.4 Report Structure

This Transport Model Package has been prepared to summarise the development of the base year traffic model to be used during PCF Stages 1 and 2 of the A5036 scheme.

This document is structured as the following chapters.

- Chapter 2 provides an overview of the model and the initial starting point for the model development.
- Chapter 3 outlines the traffic and journey time data that have been used in the development of the model.
- Chapter 4 outlines the development of the network and zone system, and details the coding assumptions.
- Chapter 5 outlines the development of the prior demand matrices.
- Chapter 6 outlines the role of matrix estimation in the development of the base model.
- Chapter 7 presents the results of the model convergence and performance.
- Chapter 8 presents the model calibration and validation statistics.
- Chapter 9 outlines the variable demand modelling.
- Chapter 10 provides a summary of the report and conclusions on the suitability of the model.

2. Model Overview

2.1 Introduction

This section provides an overview of the key features of the base strategic traffic model and the processes used to develop the base model. The model is referred to as the A5036 model as the focus is on this alignment and traffic relief thereof.

The A5036 base model will be used to test the Stage 3 design of the project. It will be used to produce traffic forecasts which will be inputs for economic, social and environmental appraisal of the scheme as well as scheme design.

The A5036 model is a peak period model, verified as suitable for the delivery of the scheme in the Base Model Package.

2.2 Software Packages and Versions

The strategic highway model has been developed using SATURN version 11.4.07H.

2.3 Refinement of TPS RTM2 as a starting point

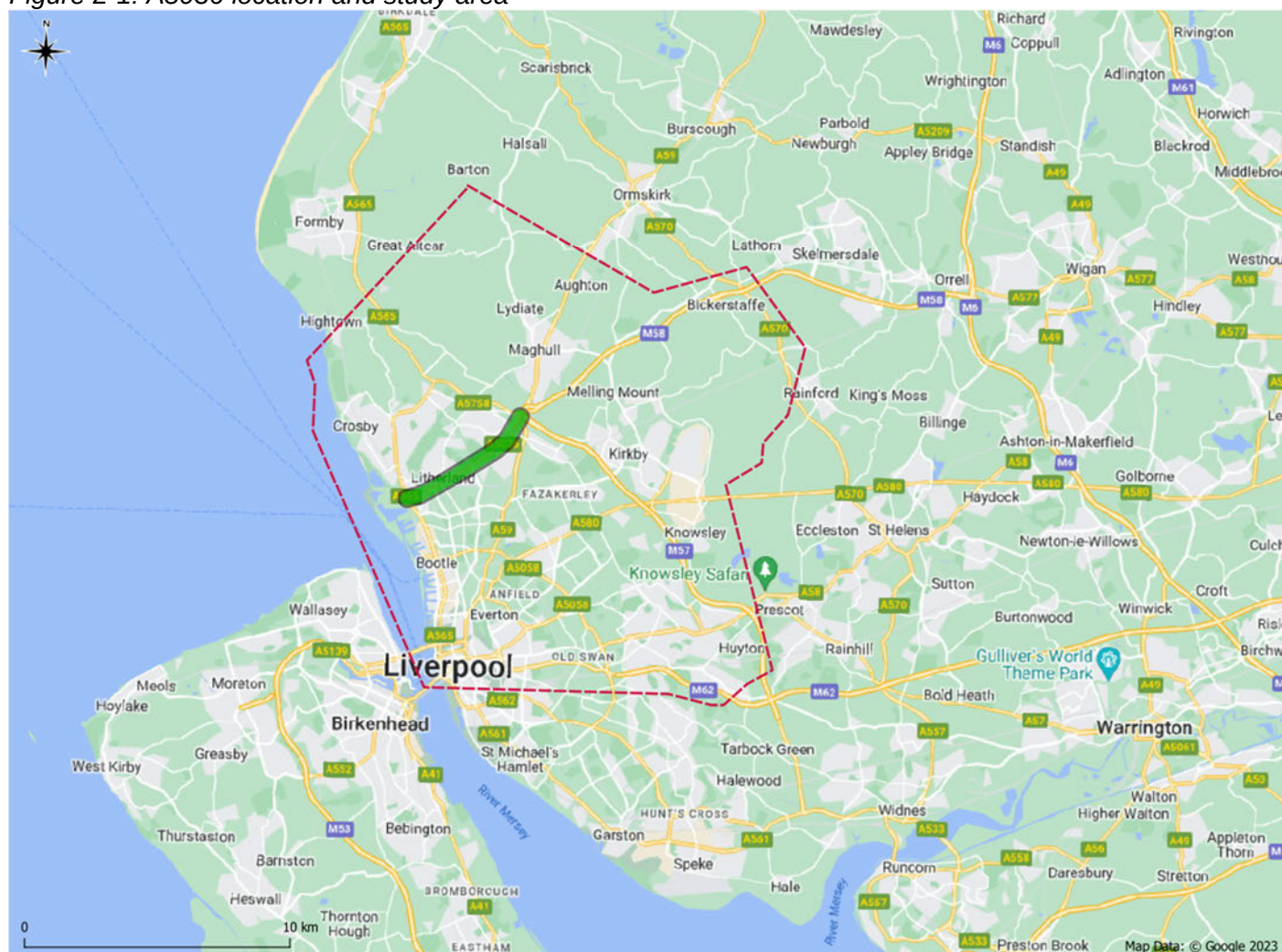
The TPS RTM2 model has been used as a starting point for the development of this model. The A5036 local area model, refreshed in 2019, was used to provide supplementary detail in the study area for the scheme, having been updated to review content and reflect the RTM model style of coding.

This approach was chosen because:

- The TPS RTM2 platform provides the most recent and comprehensive transport model platform
- The TPS RTM2 has been developed to be compliant with the Department for Transport's (DfT) Transport Appraisal Guidance (TAG).
- The scheme traffic is expected to be assigned across a wide area of the country
- The previous A5036 LAM (Local Area Model) provided a detailed model platform which has been nested within the wider tool.

The extent of the study area of the A5036 is shown in Figure 2-1. The TPS RTM2 network and zone system have been refined to add more detail to better reflect the conditions around the A5036 in urban areas of South Sefton and North Liverpool. Information on the revised network and zone system is provided in section 4.

Figure 2-1: A5036 location and study area



2.4 Time Periods

The A5036 base assignment model has three time periods, represented by average hours taken from each time period. The time periods are:

- AM Period (Average of 07:00 – 10:00)
- Interpeak Period (Average of 10:00 – 16:00)
- PM Period (Average of 16:00 – 19:00)

2.5 User Classes

The traffic demand within the A5036 base model has been segmented into three vehicle classes (Car, LGV and HGV), with cars being split further by trip purpose as retained from the TPS RTM2.

Given the A5036 focus on port traffic the HGV elements of the Port of Liverpool have been allocated into separate categories.

The user classes are given in Table 2-1.

Table 2-1 Model User Classes

User Class (UC)	Trip Purpose	Vehicle Class (VC)
1	Car – Employer's Business	1 – Car
2	Car – Commute	
3	Car – Other	
4	LGV	2 – LGV
5	HGV	3 – HGV – Non Port
5	HGV	3 – HGV – Port Intermodal
5	HGV	3 – HGV – Port Other

2.6 Assignment Methodology

The assignment of a model is the process of loading the traffic (demand) onto the network (supply) and predicting the routes that road users take between their origin and destination. Route selection is based on travel costs, which is dependent on the traffic flows and delays in the network.

The assignment method adopted for this model is based on Wardrop's Principle of traffic equilibrium, which states that "Drivers choose routes such that, at equilibrium, no individual trip maker can reduce their cost of travel by unilaterally changing route". This method involves iteratively assigning the demand matrices until the changes in flows compared to previous iterations and travel costs for trips stabilise and reach an equilibrium point. At this stage, the model is said to have "converged".

By using such methodology, a number of assumptions are made, in particular:

- The network conditions and travel demand do not vary within the modelled period;
- Those making journeys have had a long-term experience with these conditions, so they perceive the travel costs correctly and know the "best" routes to take; and
- All drivers within a particular User Class perceive travel costs in the same way. The travel costs are a combination of time and vehicle operating costs, referred to as 'generalised costs'.

Therefore, the model provides a representation of average driver behaviour under long-term conditions and a realistic spread of traffic across the alternative routes.

2.7 Generalised Costs

Values of Time (VOT) and Vehicle Operating Costs (VOC) are fixed values that help to inform the generalised cost formulation in route assignment for the different user classes. The units for VOT are pence per minute (PPM) and VOC are pence per kilometre (PPK). The parameters are influenced by a range of factors such as the purpose of travel, speeds travelled by vehicles and the number of passengers within a car.

The VoTs and VOCs have been derived following the approach in TAG Unit A1.3 and parameter values taken from the TAG Databook v1.20.2, January 2023.

The VoTs and VOCs for the A5036 base model are presented in Table 2-2.

Table 2-2 Generalised Cost Parameters 2019

User Class		AM		IP		PM	
		PPM	PPK	PPM	PPK	PPM	PPK
1	Car - Employer's Business	31.50	12.69	32.27	12.69	31.95	12.69
2	Car – Commute	21.12	6.28	21.47	6.28	21.19	6.28
3	Car – Other	14.57	6.28	15.52	6.28	15.26	6.28
4	LGV	22.83	13.86	22.83	13.86	22.83	13.86
5	HGV	52.28	43.51	52.28	43.51	52.28	43.51

3. Summary of Data

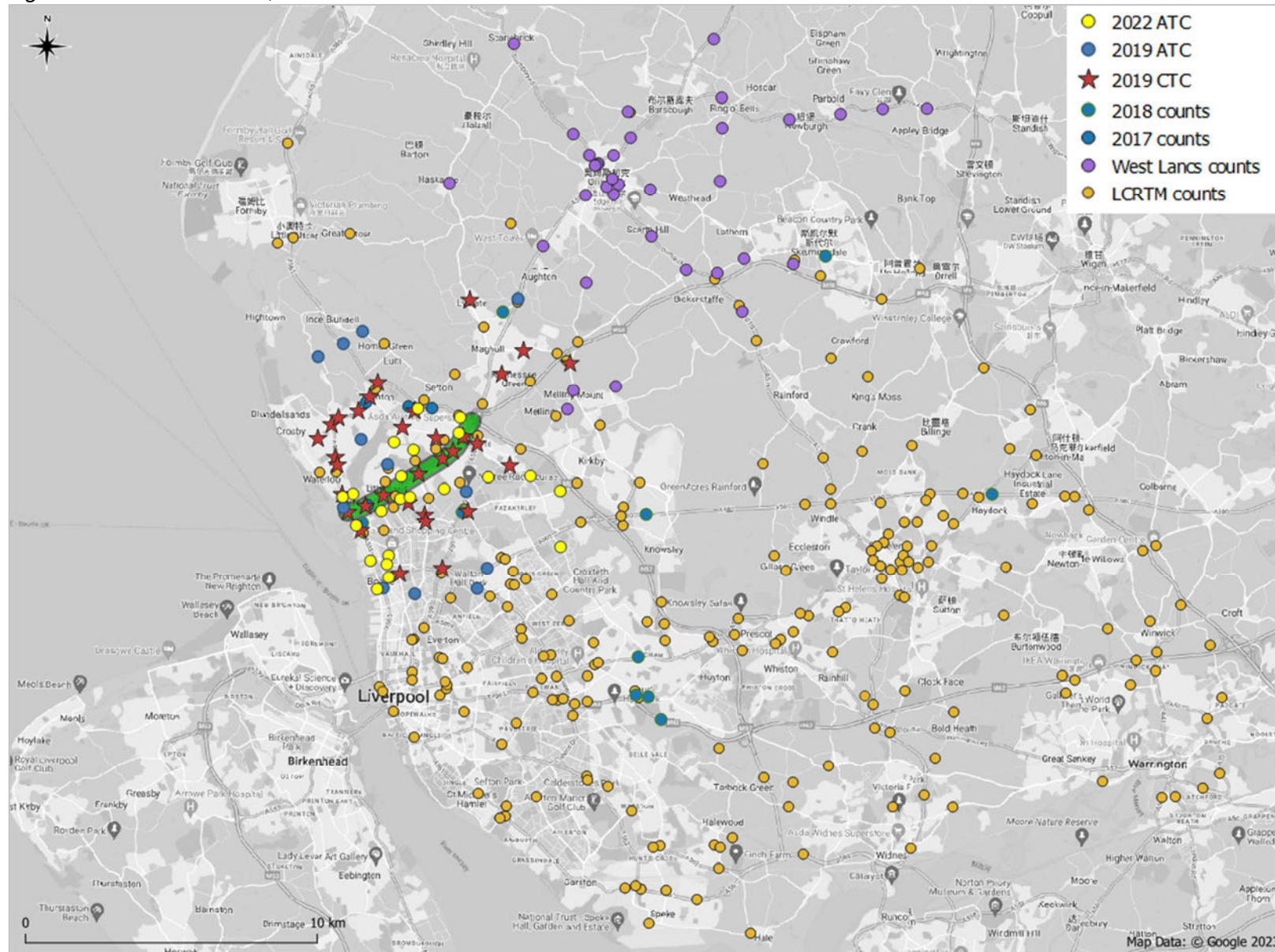
3.1 Introduction

The section provides a summary of the data used in the development of the A5036 base model, including calibration and validation. Further information about the data can be found in the Transport Data Package Report.

3.2 Traffic Counts for Calibration and Validation

A number of the traffic counts collected and obtained were used in the calibration and validation of the A5036 base model and are a mix of existing TPS RTM2 data and infill data collected and collated for the specific purposes of refining local detail. The count data was factored to March 2019 as detailed in the Transport Data Package Report. The majority of the counts were used to form the screenlines that have been used in the development of the model. Figure 3-1 shows the location of the traffic counts used in calibration and validation.

Figure 3-1 Calibration, Validation Count Sites



In total, there were 1541 link count sites used in the model calibration and validation process. Of the links count sites, 1321 were calibration and 220 were validation. This is summarised in Table 3-1.

Table 3-1 Summary of Calibration and Validation Sites

Count Type	Number of Sites
Calibration – RTM Screenline	1222
Calibration – New Screenline	99
Validation – RTM Screenline	142
Validation – New Screenline	78

3.3 Journey Time Routes

In total, 84 journey time routes have been identified to validate the A5036 base model, 14 of the routes are local to the A5036 and scheme. The local journey time routes, shown in Figure 3-2 and listed in Table 3-2, cover the main movements on motorways and A roads through the study area and roads around the A5036 scheme to ensure the model is representative of this area.

Figure 3-2 Journey Time Routes

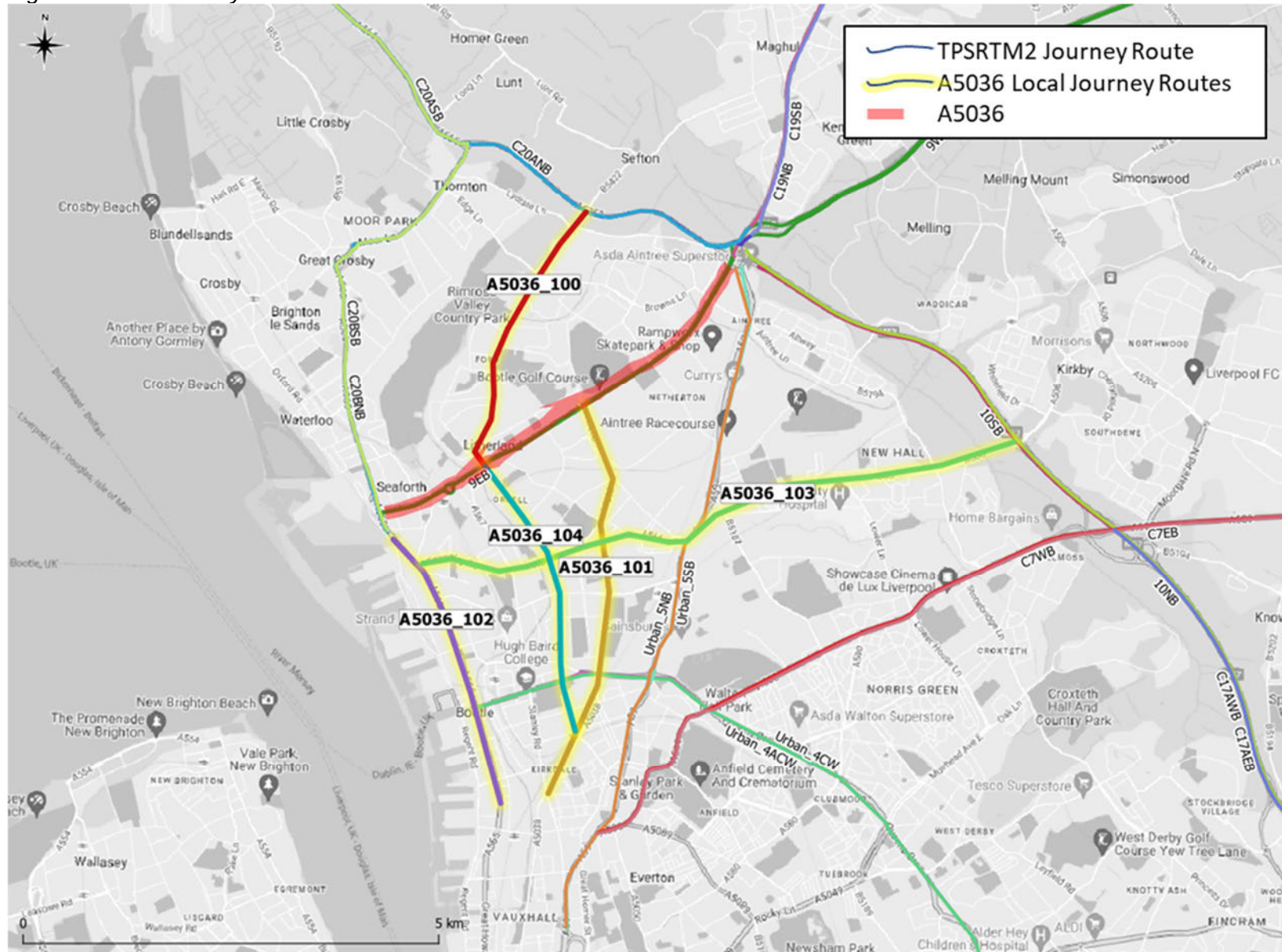


Table 3-2 Description of Journey Time Routes

Route Name	Description
1NB [G1]	M6 Northbound
1SB [G1]	M6 Southbound
2EB [G1]	M62 Eastbound
2WB [G1]	M62 Westbound
3NB [G1]	A1 Northbound
3SB [G1]	A1 Southbound
4NB [G1]	M1 Northbound
4SB [G1]	M1 Southbound
5NB [G1]	M18 Northbound
5SB [G1]	M18 Southbound
6EB [G1]	M56 Eastbound
6WB [G1]	M56 Westbound
7CW [G1]	M60 Clockwise
7ACW [G1]	M60 Anti-clockwise
8NB [G1]	M53 Northbound
8SB [G1]	M53 Southbound
9EB [G1]	M58 Eastbound
9WB [G1]	M58 Westbound
10NB [G1]	M57 Northbound
10SB [G1]	M57 Southbound
11NB [G1]	A585(T) Northbound
11SB [G1]	A585(T) Southbound
12EB [G1]	M55 Eastbound
12WB [G1]	M55 Westbound
13NB [G1]	M66 Northbound
13SB [G1]	M66 Southbound
14EB [G1]	M65 Eastbound
14WB [G1]	M65 Westbound
15NB [G1]	M61 Northbound
15SB [G1]	M61 Southbound
16AEB [G1]	M67 Eastbound (alternative section)
16EB [G1]	M67 Eastbound
16AWB [G1]	M67 Westbound (alternative section)
16WB [G1]	M67 Westbound
17NB [G1]	A64(T) Northbound
17SB [G1]	A64(T) Southbound
18EB [G1]	M180 Eastbound
18WB [G1]	M180 Westbound

Route Name	Description
19EB [G1]	M621 Eastbound
19WB [G1]	M621 Westbound
20NB [G1]	M606 Northbound
20SB [G1]	M606 Southbound
21NB [G1]	A627 Northbound
21SB [G1]	A627 Southbound
22EB [G1]	M602 Eastbound
22WB [G1]	M602 Westbound
23NB [G1]	A556(T) Northbound
23SB [G1]	A556(T) Southbound
24NB [G1]	A550(T) Northbound
24SB [G1]	A550(T) Southbound
25NB [G1]	M181 Northbound
25SB [G1]	M181 Southbound
C1NB [G1]	A164/A15 Northbound
C1SB [G1]	A164/A15 Southbound
C2EB [G1]	A59/A1079 Eastbound
C2WB [G1]	A59/A1079 Westbound
C3NB [G1]	A65 Northbound
C3SB [G1]	A65 Southbound
C4NB [G1]	A34 Northbound
C4SB [G1]	A34 Southbound
C5EB [G1]	A57 Eastbound
C5WB [G1]	A57 Westbound
C6EB [G1]	A646/A647 Eastbound
C6WB [G1]	A646/A647 Westbound
C7EB [G1]	A580 Eastbound
C7WB [G1]	A580 Westbound
C8NB [G1]	A6/A49 Northbound
C8SB [G1]	A6/A49 Southbound
C9EB [G1]	A534/A500 Eastbound
C9WB [G1]	A534/A500 Westbound
C10NB [G1]	A41 Northbound
C10SB [G1]	A41 Southbound
C11NB [G1]	A51/A560 Northbound
C11SB [G1]	A51/A560 Southbound
C12NB [G1]	A19 Northbound
C12SB [G1]	A19 Southbound
C13AEB [G1]	A166/A164 Eastbound
C13AWB [G1]	A166/A164 Westbound

Route Name	Description
C13BEB [G1]	A166/A163 Eastbound
C13BWB [G1]	A166/A163 Westbound
C14EB [G1]	A6/A623 Eastbound
C14WB [G1]	A6/A623 Westbound
C15NB [G1]	A624 Northbound
C15SB [G1]	A624 Southbound
C16NB [G1]	A570 Northbound
C16SB [G1]	A570 Southbound
C17AEB [G1]	M57/A533 Eastbound
C17AWB [G1]	M57/A533 Westbound
C17BEB [G1]	A533/A561 Eastbound
C17BWB [G1]	A533/A561 Westbound
C18NB [G1]	A666 Northbound
C18SB [G1]	A666 Southbound
C19NB [G1]	A59 Northbound
C19SB [G1]	A59 Southbound
C20ANB [G1]	A565/A59 Northbound (route A)
C20ASB [G1]	A565/A59 Southbound (route A)
C20BNB [G1]	A565/A59 Northbound (route B)
C20BSB [G1]	A565/A59 Southbound (route B)
C21EB [G1]	A58 Eastbound
C21WB [G1]	A58 Westbound
C22NB [G1]	A6 Northbound
C22SB [G1]	A6 Southbound
C23EB [G1]	A628/A635 Eastbound
C23WB [G1]	A628/A635 Westbound
C24NB [G1]	A61 Northbound
C24SB [G1]	A61 Southbound
C25EB [G1]	A635 Eastbound
C25WB [G1]	A635 Westbound
C26NB [G1]	A640 Northbound
C26SB [G1]	A640 Southbound
C27NB [G1]	A62 Northbound
C27SB [G1]	A62 Southbound
C30NB [G1]	A629 Northbound
C30SB [G1]	A629 Southbound
Diversion_1EB [G2]	A57 Manchester Rd EB
Diversion_1WB [G2]	A57 Manchester Rd WB
Diversion_10EB [G2]	B1210 Stallingboro Rd EB
Diversion_10WB [G2]	B1210 Stallingboro Rd WB

Route Name	Description
Diversion_11EB [G2]	A645 Weeland Rd EB
Diversion_11WB [G2]	A645 Weeland Rd WB
Diversion_12NB [G2]	A614 Thorne Rd NB
Diversion_12SB [G2]	A614 Thorne Rd SB
Diversion_13EB [G2]	A58 Whitehall Rd EB
Diversion_13WB [G2]	A58 Whitehall Rd WB
Diversion_14NB [G2]	A638 Dewsbury Rd NB
Diversion_14SB [G2]	A638 Dewsbury Rd SB
Diversion_2EB [G2]	A56 Chester Rd EB
Diversion_2WB [G2]	A56 Chester Rd WB
Diversion_3NB [G2]	B5151 Mount Rd NB
Diversion_3SB [G2]	B5151 Mount Rd SB
Diversion_4EB [G2]	A674 Chorley Rd EB
Diversion_4WB [G2]	A674 Chorley Rd WB
Diversion_5EB [G2]	A58 Rochdale Rd EB
Diversion_5WB [G2]	A58 Rochdale Rd WB
Diversion_6NB [G2]	A56 Manchester Rd NB
Diversion_6SB [G2]	A56 Manchester Rd SB
Diversion_7EB [G2]	A170 Pickering Rd EB
Diversion_7WB [G2]	A170 Pickering Rd WB
Diversion_8NB [G2]	A168 (A1M) NB
Diversion_8SB [G2]	A168 (A1M) SB
Diversion_9NB [G2]	A629 Upper Wortley Road NB
Diversion_9SB [G2]	A629 Upper Wortley Road SB
Urban_1EB [G2]	A635 Ashton Old Rd EB
Urban_1WB [G2]	A635 Ashton Old Rd WB
Urban_2NB [G2]	A56 Chester Rd NB
Urban_2SB [G2]	A56 Chester Rd SB
Urban_3ACW [G2]	A6010 Queens Way ACW
Urban_3CW [G2]	A6010 Queens Way CW
Urban_4ACW [G2]	A5058 Queens Drive ACW
Urban_4CW [G2]	A5058 Queens Drive CW
Urban_5NB [G2]	A59 County Rd NB
Urban_5SB [G2]	A59 County Rd SB
Urban_6EB [G2]	A6120 Leeds Ring Rd EB
Urban_6WB [G2]	A6120 Leeds Ring Rd WB
Urban_8ACW [G2]	A6102 Greenland Rd ACW
Urban_8CW [G2]	A6102 Greenland Rd CW
Urban_9NB [G2]	A1165 Stoneferry Rd NB
Urban_9SB [G2]	A1165 Stoneferry Rd SB

Route Name	Description
A5036_100_NB	Gorse Ln Northbound
A5036_100_SB	Gorse Ln Southbound
A5036_101_NB	A5038 Northbound
A5036_101_SB	A5038 Southbound
A5036_102_NB	A565 Northbound
A5036_102_SB	A565 Southbound
A5036_103_EB	A506 Eastbound
A5036_103_WB	A506 Westbound
A5036_104_NB	A5090 Northbound
A5036_104_SB	A5090 Southbound

The observed journey time data have been calculated using DfT GPS data obtained from Teletrac Navman, which provides a large sample of journey time data across the study area. Each journey time route has been split into route sub-sections and has been used when validating the model journey times to achieve a more accurate representation of the delays along the routes. Further information on the analysis checking of the journey time data is described in the Transport Data Package Report.

4. Network Development

4.1 Introduction

This section details the development of the base model network. This includes the definition of the model extents and enhancements made to the A5036 model network as well as the coding assumptions employed throughout.

4.2 Network Definitions

The network is divided into two key parts: the Fully Modelled Area and the External Area. These extents are described as follows:

- **Fully Modelled Area:** The area over which the proposed interventions are expected to have influence. This area is subdivided further as set out below and in Table 4-1:
 1. Detailed Simulation Area: This represents the simulation area where the greatest impacts of the A5036 scheme will occur and has the greatest level of detail and accuracy in the model. In this area, the majority of roads are included, and junctions are modelled in detail based on their layout, including saturation flows, correct turning movements, signal timings, and correct priorities are coded. Speed flow curves are present on longer links where appropriate. Zones are also smaller to capture the traffic movements more accurately at a local level.
 2. Rest of the Fully Modelled Area: This represents the wider North of England including the strategic road network in the North West, extending into Yorkshire and the Humber. It involves using standard grade saturation flows and utilises speed flow curves on longer links. Fixed speed coding is used in areas remote from the SRN.
- **External Area:** This represents the buffer area which impacts of the interventions will be so small they are reasonably assumed to be negligible. The network is increasingly coarse, the further away the network is from the simulation area. Links are included with the purpose being to connect external trips from other regions in the UK to the Fully Modelled Area. Fixed Speeds are used throughout this area.

Table 4-1 – Network Definitions

Area		SATURN	SATURN Detail
Fully Modelled Area	<u>Detailed Simulation Area</u>	Simulation	Junctions and links modelled in detail.
	<u>Rest of the Fully Modelled Area</u>	Simulation	Mainly sped flow curves and some fixed speed coding
External Area		Buffer	Fixed Speed Coding

As discussed in section 2.3, the A5036 LAM has formed the starting point for the A5036 updated model base model as it has focussed detail required for this study. Within the coincident simulation area network configuration has been merged with common (RTM) coding standards applied. This covers the area between Formby in the North, Liverpool City Centre in the South and the M57 to the east. The area outside the detailed simulation defaults to standard RTM coding.

The A5036 LAM network includes England, Scotland and Wales. This allows all in-scope trips and the full trip lengths to be included in the model. A map showing the simulation and buffer network is shown in Figure 4-1.

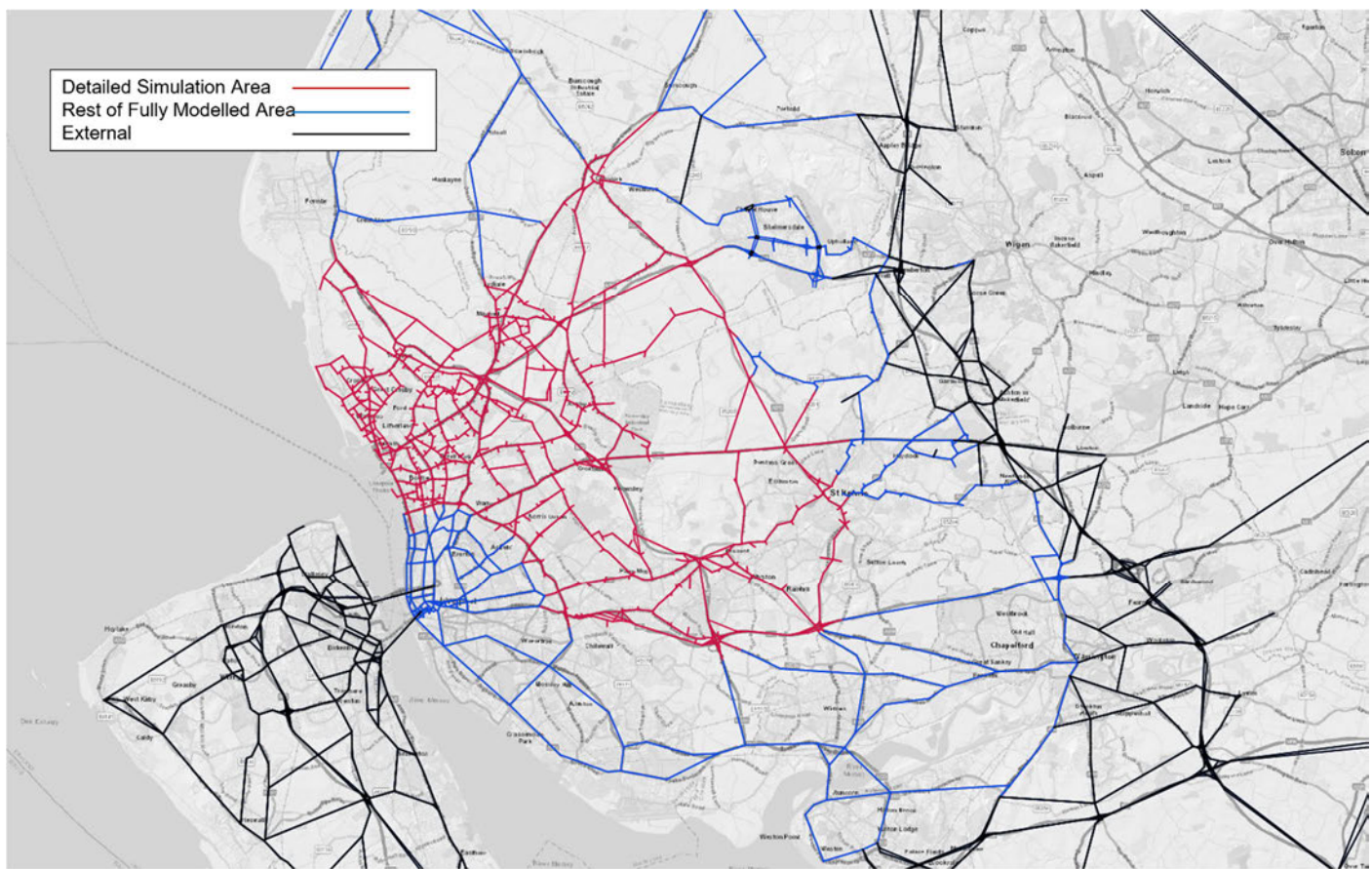
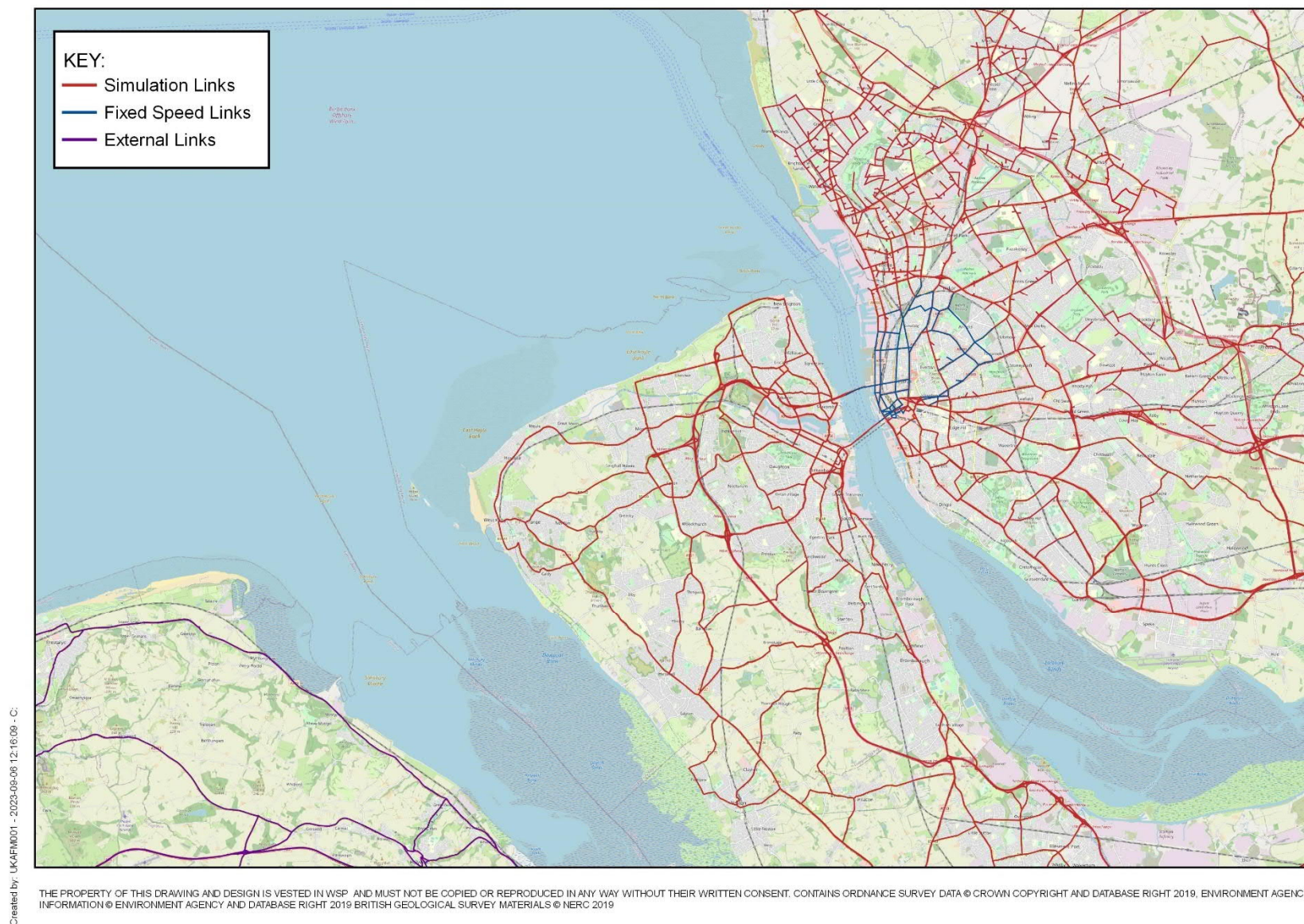


Figure 4-1 A5036 LAM Network

A map showing the detailed simulation area is given in Figure 4-2, with both the new A5036 simulation coding and continuation of the RTM simulation area shown. The coding in Liverpool city centre has been retained from the A5036 LAM as high capacity, fixed speed links. The boundary of the Detailed Simulation area is also shown on the map, with the rest of the simulation area forming the Rest of the Fully Modelled Area.

Figure 4-2 A5036 Model Local Area



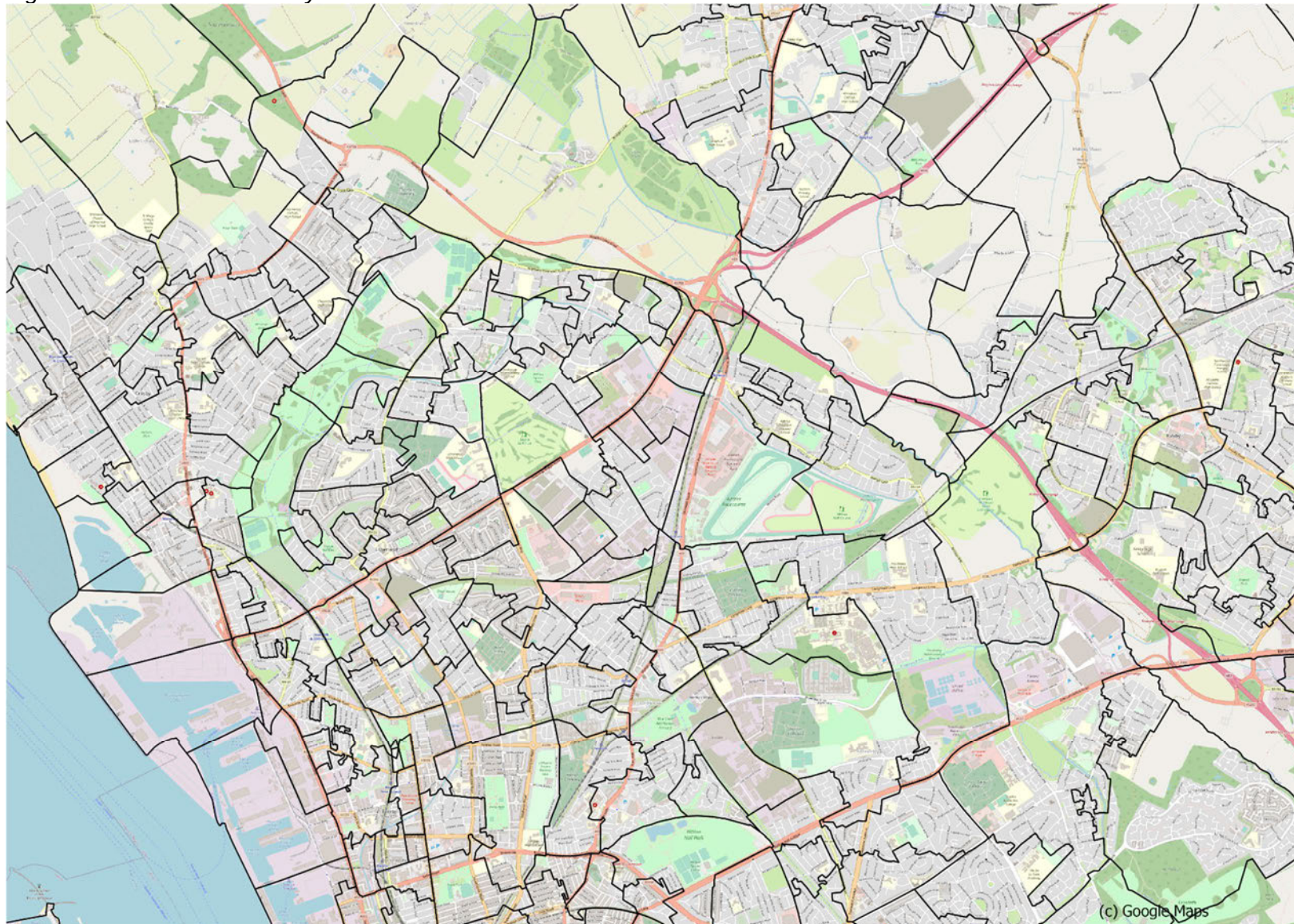
4.3 Model Zone System

The model zone system used in the A5036 model has been refined for this study to better represent localised trips between The Port of Liverpool and Switch Island, including Netherton and Litherland areas. This refinement has consisted of splitting Sefton zones between Crosby and Bootle to smaller entities at a Lower Super Output Area (LSOA) level. There were several reasons for this outlined below.

- Some of the original RTM zones in the A5036 catchment were urban areas with significant demand, requiring more granular representation. Having large trip end volumes could lead to issues in forecasting and in the economic appraisal, therefore splitting zones at this stage was necessary.
- Spatial heterogeneity or differentiation of land uses can be better represented by disaggregation, separating residential from commercial land uses and differentiating specific port areas and uses.
- More detailed network structure in the A5036 model necessitates change to the oversimplified RTM urban network. This provides for more localised routing, requiring detailed network centroid access and egress points to enhance model stability compared to multiple loading point zones where route choices can be impacted by non-modelled elements.

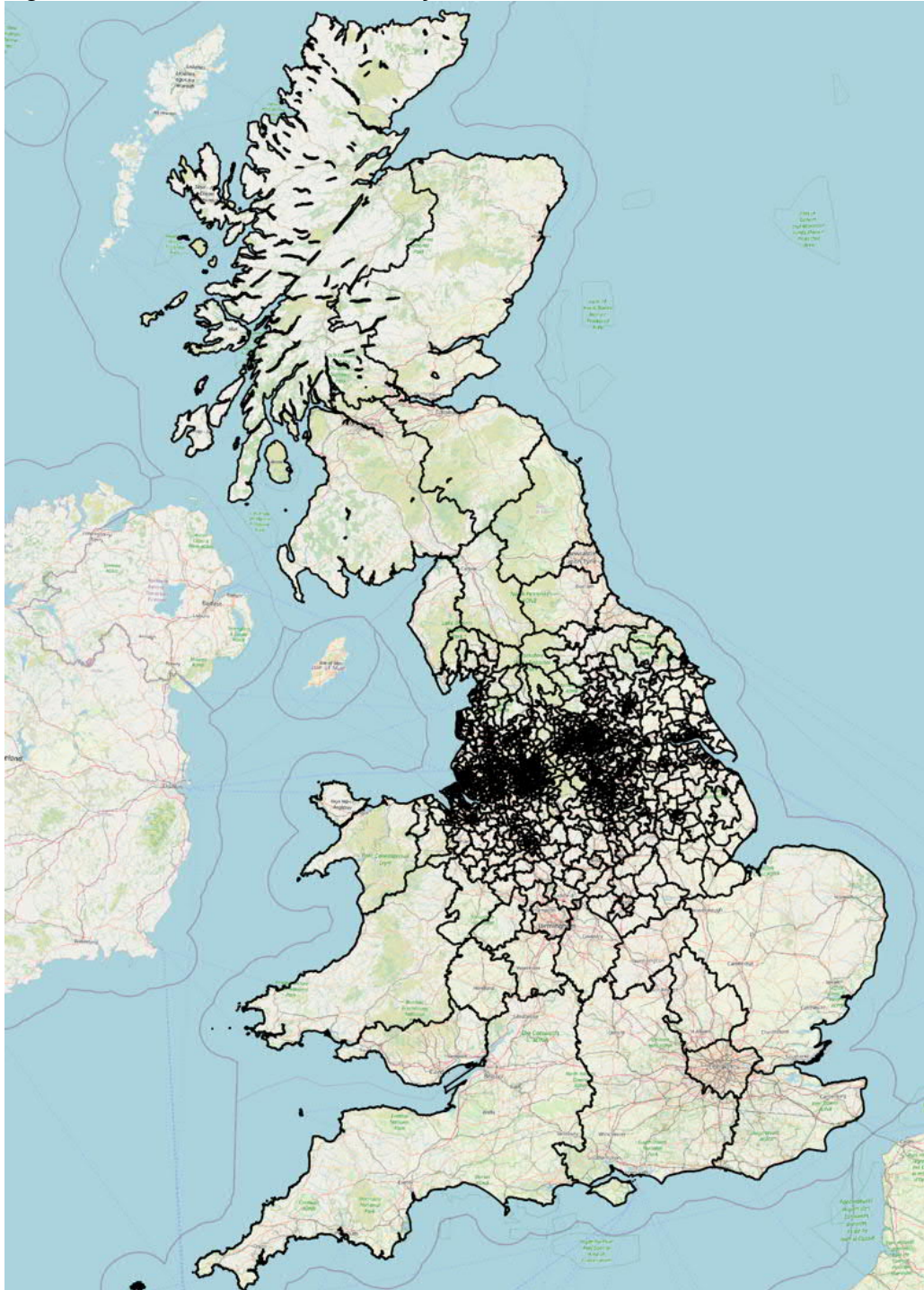
The zone system in the fully modelled area is shown in Figure 4-3.

Figure 4-3 Model Zone System around the A5036



Outside of the Detailed Simulation Area, the existing zone system has been retained and Figure 4-4 shows the wider zone system with the zones grouped by region. In total, there are 2,229 zones.

Figure 4-4 A5036 Model Zone System



4.4 Centroid Connectors

Centroid connectors define the locations where trips from zones are loaded onto the network. The disaggregation of zones required changes to some existing connectors and the addition of new connectors to be added for new zones.

Within the simulation area, zone connectors have been placed in locations to best represent realistic entry points to the networks. In line with the guidance in section 2.4 of TAG M3.1, all zones in the Detailed Simulation Area have been loaded using spigots, with all but one loaded via an independent junction so as not to directly impact junctions. Also, the number of zones with multiple centroid connectors has been minimised to maximise stability during assignment.

4.5 Simulation Area

4.5.1 Network Checks

As part of the development of the model, a review of the network in the Detailed Simulation Area was undertaken. These checks are documented in Table 4-2.

Table 4-2 Network Checks

No	Description	Format
1	Check for appropriate Junction types.	SATURN Google Maps
2	Check that the appropriate number of entry lanes have been coded and that flaring of approaches, where appropriate, are accounted for	SATURN Google Maps
3	Check that turn restrictions have been correctly identified.	SATURN Google Maps
4	Check that one-way roads and no entries, if applicable, have been correctly specified.	SATURN Google Maps
5	Check that saturation flows are appropriate (particularly if turn rates appear excessively high or low compared to straight ahead)	SATURN Google Maps
6	Check that link lengths, link types and cruise speeds for each direction of a link are consistent, and that the second and third do not vary unjustifiably along a series of links	GIS Google Maps Excel
7	Check of key junctions and intersections was undertaken. The review ensured that the junction types are correctly coded and represent their key characteristics. The review included the number of lanes at stop line, number of lanes on mid-link section, link type / cruise speed, representation of flaring, turn definitions and lane usage, location / presence of banned turns. For signals the representation of filters, definition of stages, cycle times and offsets, and green and inter-green times were reviewed.	SATURN Google Maps
8	Confirm that link types and cruise speeds (for example through SFCs) are appropriate	SATURN
9	Compare crow-fly link lengths against actual lengths	GIS
10	Document inherited/newly acquired or surveyed sources of data and document parts of the model inherited and those that are new	GIS SATURN

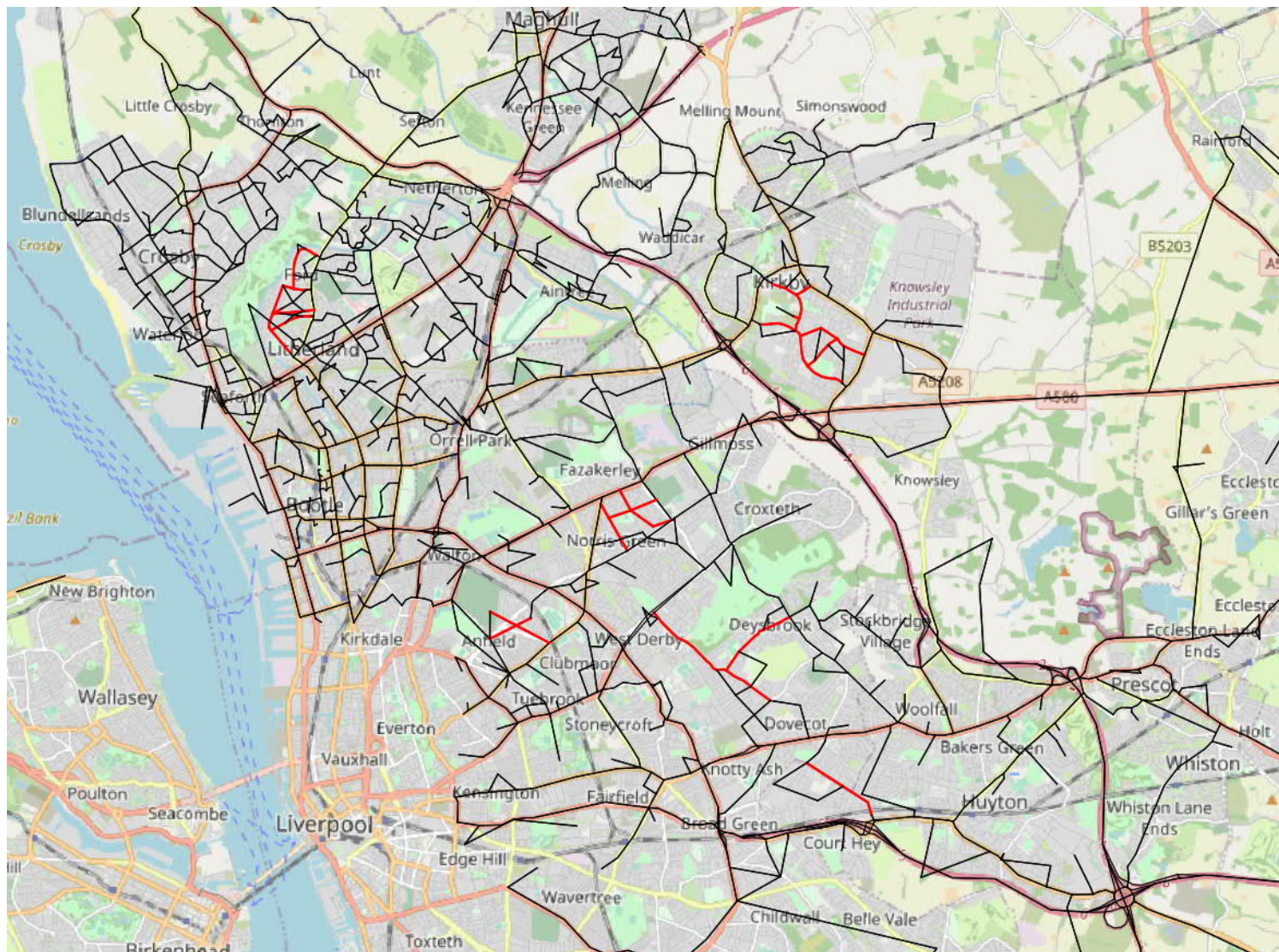
As part of the review, junctions and speed flow curves were coded to be more representative of 2019 conditions.

4.5.2 Additional Network

There is a greater importance to fully reflect existing movements in the Litherland to Ford and Kirkby areas compared to previous iterations of the model. From reviewing the area around the A5036 and urban areas of Litherland and Kirkby, it was found some areas of the network were underrepresented. Therefore, additional links have been added to the simulation area to better represent the network and model the possible alternative routes. The links added to the model are listed in Table 4-3 and their locations shown in Figure 4-5.

Table 4-3 Additional Links

Road ID Number	Road Name
1	Bewley Drive
2	Cherryfield Drive
3	Webster Drive
4	Broad Lane
5	Britonside Avenue
6	Hatton Hill Road
7	Sonning Avenue
8	Pinehurst Avenue
9	Ford Lane
10	Pitch Lane
11	Kirkstone Road West
12	Lower House Lane
13	Netherwood Road
14	Sedgemoor Road
15	Scar Green Avenue
16	Town Row
17	Leyfield Road
18	Blackmoor Drive



The new links were coded using the assumptions set out in section 4.6 as well as GIS to determine the link lengths and Google Maps to determine the road link classification.

4.6 Coding Assumptions

4.6.1 Speed Flow Curves

Speed flow curves were used on links to reflect the relationship between traffic volumes and traffic speed. A review of the speed flow curves used in the Fully Modelled Area was undertaken and adjustments made where it was thought another speed flow curve was more suitable. The speed flow curves from the A5036 LAM model were updated to be congruent with those developed and agreed within the RTM2 programme.

4.6.2 Signalised Junctions

The staging at signals were largely retained from the original RTM model aside from et values coded along the A5036 alignment which were sourced from the UTC system maintained by Sefton MBC. Average timings were taken over the peak period. Signal timings were later adjusted as part of the process to improve count and journey time validation where necessary, and therefore for several reasons these vary between time periods.

The junction coding of signals includes the saturation capacities for turning movements at each junction. Saturation capacities reflect the maximum number of PCUs per hour that can make a particular turning movement depending on a number of variables relating to the junction type, priority rules and other impedances. The A5036 model has used saturation flows consistent with those in the Regional Traffic Model (RTM) coding guide and are presented in Table 4-4 and Table 4-5.

Table 4-4 Signalised Junction - Straight Ahead Saturation Flows (PCU/hr)

Lane Width	1 Lane		2 Lanes		3 Lanes		4 Lanes	
	Nearside	Offside	Nearside	Offside	Nearside	Offside	Nearside	Offside
Single Lane Approach								
Narrow Lane (2.5m)	1870							
Standard Lane (3m)	1980							
Wide Lane (4.5m)	2070							
Multiple Lane Approach								
Narrow Lane (2.5m)		2010	3870	4010	5880	6020	7880	8020
Standard Lane (3m)		2060	3970	4110	6030	6170	8080	8220
Wide Lane (4.5m)		2210	4270	4410	6480	6620	8680	8820

Table 4-5 Signalised Junction - Turning Saturation Flows (PCU/hr) (Inc = inclusive turn, Exc = Exclusive turn)

Turn Radius	1 Lane		2 Lanes				3 Lanes				4 Lanes			
	Left	Right	Left		Right		Left		Right		Left		Right	
			Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc
			Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Single Lane Approach														
Tight	1530	1650												
Standard	1730	1800												

Turn Radius	1 Lane		2 Lanes				3 Lanes				4 Lanes			
	Left	Right	Left		Right		Left		Right		Left		Right	
			Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc
			Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Wide	1850	1890												
Multiple Lane Approach														
Tight	1480	1600	3060	N/A	3310	3430	4640	N/A	5030	5140	6220	N/A	6740	6850
Standard	1670	1750	3460	N/A	3610	3740	5240	N/A	5480	5610	7030	N/A	7350	7480
Wide	1790	1830	3700	N/A	3790	3920	5610	N/A	5740	5880	7520	N/A	7700	7830

4.6.3 Priority Junctions

The coding of priority junctions is based on the direct application of SATURN give-way, opposed traffic turn and merge priority markers to represent the individual turning movements at a junction.

The saturation flows used for priority junctions were taken from the RTM coding guide. The unopposed straight ahead saturation flows are the same as those in Table 4-4. The unopposed turning saturation flows are presented in Table 4-6, and the opposed turn saturation flows are presented in Table 4-6 and Table 4-8 with and without a central reserve (CR).

Table 4-6 Priority Junction – Unopposed Turning Saturation Flows (PCU/hr) (Inc = inclusive turn, Exc = Exclusive turn)

Turn Radius	1 Lane		2 Lanes				3 Lanes				4 Lanes			
	Left	Right	Left		Right		Left		Right		Left		Right	
			Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc	Inc	Exc
			Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Single Lane Approach														
Tight	1530	1530												
Standard	1730	1730												
Wide	1850	1850												
Multiple Lane Approach														
Tight	1480	1480	3060	N/A	3060	3430	4640	N/A	4640	4750	6220	N/A	6220	6330
Standard	1670	1670	3460	N/A	3460	3580	5240	N/A	5240	5370	7030	N/A	7030	7150
Wide	1790	1790	3700	N/A	3700	3920	5610	N/A	5610	5740	7520	N/A	7520	7650

Table 4-7 Priority Junctions - Opposed Saturation Flows for 1 Lane Approach (PCU/hr)

Geometric Data	Left	Minor to Major Give-way (G)				Major to Minor
		Ahead		Right		X
		Without CR	With CR	Without CR	With CR	Right
Poor visibility (to left 60m and to right 75m)						
Single Lane	640	510	540	510	540	610
Narrow Lane (2.5m)	720	570	620	570	620	680
Standard Lane (3m)	780	620	680	620	680	730
Average visibility (to left 120m and to right 150m)						
Single Lane	690	570	600	570	600	670

Geometric Data	Left	Minor to Major Give-way (G)				Major to Minor
		Ahead		Right		X
		Without CR	With CR	Without CR	With CR	Right
Narrow Lane (2.5m)	770	640	690	640	690	760
Standard Lane (3m)	830	690	760	690	760	820
Good visibility (to left 180m and to right 225m)						
Single Lane	730	630	660	630	660	740
Narrow Lane (2.5m)	820	700	760	700	760	830
Standard Lane (3m)	880	760	830	760	830	900

Table 4-8 Priority Junctions - Opposed Saturation Flows for 2 Lane Approach (PCU/hr)

Geometric Data	Left	Minor to Major Give-way (G)				Major to Minor
		Ahead		Right		X
		Without CR	With CR	Without CR	With CR	Right
Poor visibility (to left 60m and to right 75m)						
Single Lane	1280	1020	1070	1020	1070	1210
Narrow Lane (2.5m)	1350	1070	1140	1070	1140	1270
Standard Lane (3m)	1550	1230	1360	1230	1360	1460
Average visibility (to left 120m and to right 150m)						
Single Lane	1370	1130	1190	1130	1190	1340
Narrow Lane (2.5m)	1440	1190	1270	1190	1270	1420
Standard Lane (3m)	1660	1370	1510	1370	1510	1630
Good visibility (to left 180m and to right 225m)						
Single Lane	1460	1250	1320	1250	1320	1480
Narrow Lane (2.5m)	1540	1310	1400	1310	1400	1560
Standard Lane (3m)	1760	1510	1660	1510	1660	1800

4.6.4 Roundabouts

The classifications of saturation flows and other roundabout parameters (such as circulating capacity and the time to circulate the roundabout) are based on the roundabout size and the number of lanes approaching the roundabout. Roundabouts have been classified as mini-roundabouts, 'normal' roundabouts with single or flared approaches, and 'large' roundabouts with two or more lane approaches.

Saturation flows are applied to junction entries for all movements from a given arm. The saturation flows for a given entry are detailed in Table 4-9.

Table 4-9 Roundabout - Entry and Circulating Capacities (PCU/hr)

Roundabout Type	Lane Width	Circulating Time	GAP Value	Entry Capacity	Circulating Capacity
Mini Roundabout	Narrow	5	2.0	820	1820
	Standard	5	1.8	990	2050
	Wide	5	1.6	1220	2300
	Narrow	10	2.0	920	1830

Roundabout Type	Lane Width	Circulating Time	GAP Value	Entry Capacity	Circulating Capacity
1 lane approach 1 lane at stop line with no flare	Standard	10	1.6	1100	2250
	Wide	10	1.6	1380	2310
1 lane approach 2 lane at stop line with flare	Narrow	10	1.4	1370	2560
	Standard	10	1.3	1620	2770
	Wide	10	1.2	1920	3000
1 lane approach 3 lane at stop line with flare	Narrow	10	1.3	1560	2730
	Standard	10	1.2	1800	2910
	Wide	10	1.2	2100	3110
1 lane approach 4 lane at stop line with flare	Narrow	10	1.2	2170	3100
	Standard	10	1.5	2450	3200
	Wide	10	1.0	3250	3590
2 lane approach 2 lanes at stop line	Narrow	15	1.0	1810	3470
	Standard	15	1.0	2200	3780
	Wide	15	0.9	2710	4090
2 lane approach 3 lanes at stop line	Narrow	15	0.9	2310	3850
	Standard	15	0.9	2760	4120
	Wide	15	0.8	3330	4380
2 lane approach 4 lanes at stop line	Narrow	15	0.9	2670	4040
	Standard	15	0.8	3000	4400
	Wide	15	0.8	4010	4600
3 lane approach 3 lanes at stop line	Narrow	17	0.8	2730	4380
	Standard	17	0.8	3320	4680
	Wide	17	0.7	4090	4970
3 lane approach 4 lanes at stop line	Narrow	17	0.8	3170	4590
	Standard	17	0.7	3750	5000
	Wide	17	0.7	4760	5150

4.6.5 Bus Routes

The bus routes were taken from the existing A5036 model. A high-level check was carried out to ensure the bus routes were accurate for 2019 using an update list on the Mersey Travel website. The bus routes were confirmed to be accurate for 2019 and the existing bus route nodes needed updating because of the network merge. Any nodes that were now in the RTM2 area needed updating to the RTM2 node numbers from the previous A5036 node numbers.

5. Prior Matrix Development

5.1 Introduction

This section details the formation and development of the prior matrices.

5.2 A5036 model Prior Matrices

The A5036 base year model matrices have been developed using the TPS RTM2 prior matrices as a starting point. The TPS RTM2 prior matrices were derived primarily from 2019 mobile phone data procured by National Highways. Significant additional data verification, processing, and adjustment, including the synthesis of shorter distance trips, was undertaken to develop the final prior matrices.

The detailed TPS RTM2 matrix development methodology is documented in the RTM2 Matrix Development Report (National Highways, February 2022).

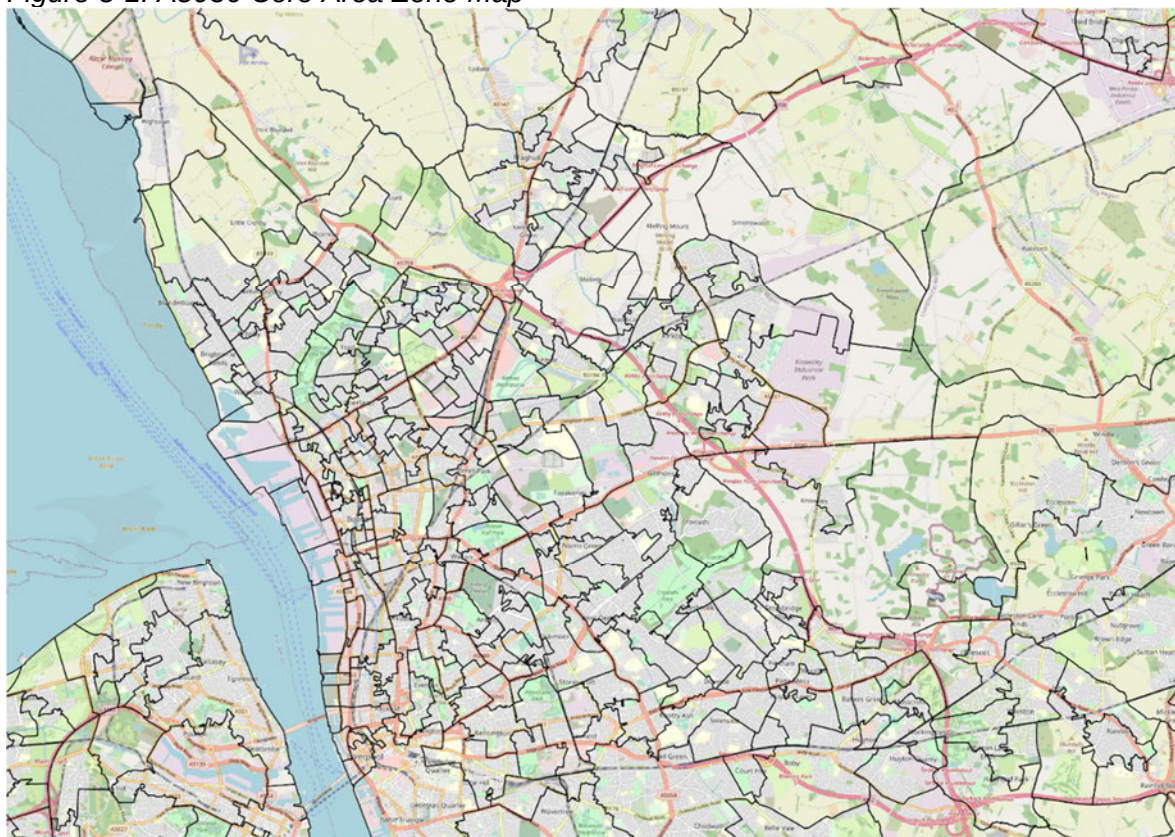
5.3 Zone Disaggregation

The creation of the A5036 model prior matrices from the TPS RTM2 prior matrices follows the below steps:

Step 1 – A5036 zone plan

The A5036 zone plan was created by dividing the TPS zones within the core part of the study area in order to have the required level of zonal refinement in the core area of the model. Outside of the core area, the A5036 model zone plan will remain the same as that for the TPS RTM2. The zones in the core area of the model are shown in *Figure 5-1* below.

Figure 5-1: A5036 Core Area Zone Map



Step 2 – Estimate zone splits

Where the TPS RTM2 model zone was to be subdivided into 2 or more zones for the A5036 model, estimations were made of the proportions of the tripends within the TPS RTM2 model zone that would be allocated to the A5036 model zones. The subdivision used LSOA population data and job data by workplace zones to estimate proportions for division. The disaggregation turned the 10,928 zones in the TPS RTM2 model into 11,145 zones in the A5036 model.

Step 3 – Generate Synthetic Matrix of A5036 zones

Gravity modelling principles were used to generate synthetic Origin-Destination trip matrices for the A5036 zones based on the TPS RTM2 matrix trip ends subdivided using the zone split proportions calculated in Step 2.

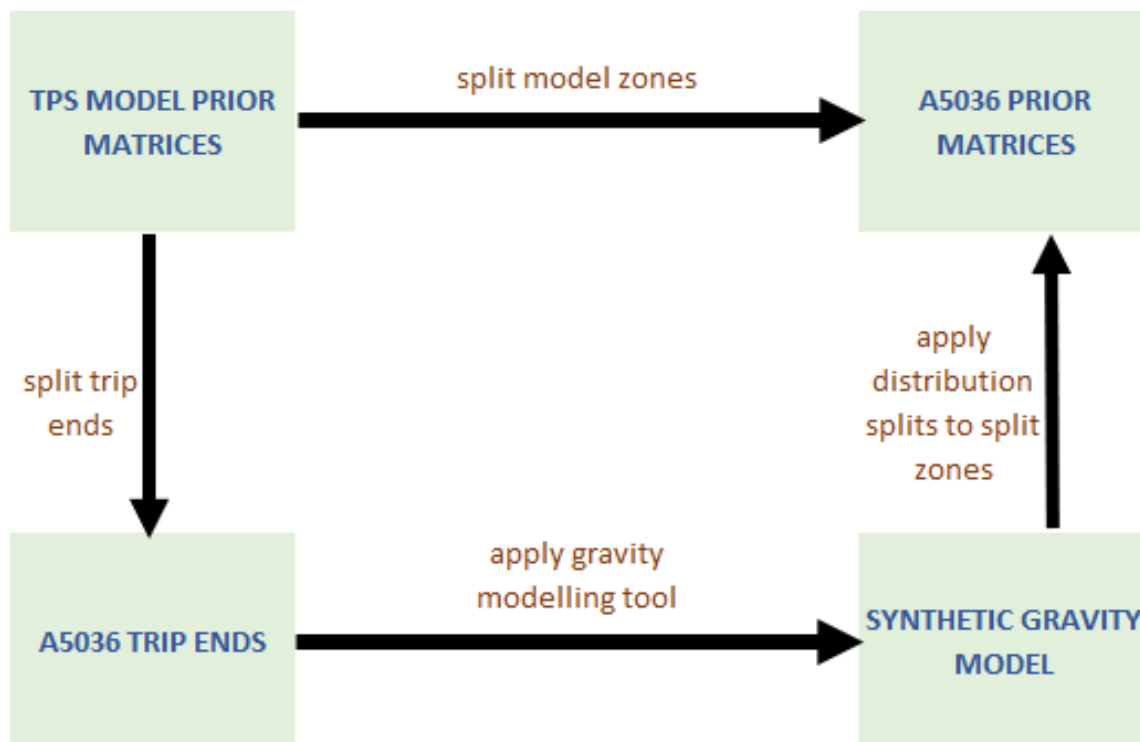
Step 4 – Disaggregation of TPS RTM2 model

The TPS RTM2 model trip matrices were then disaggregated into the A5036 zones. For the split zones, the distribution splits were proportional to those from the gravity model in Step 3. Furnessing was undertaken to fix the tripends in accordance with those in Step 2.

The disaggregated model matrices were then used as prior matrices, to be adjusted using calibration with observed traffic counts.

The process described above is summarised in *Figure 5-2*.

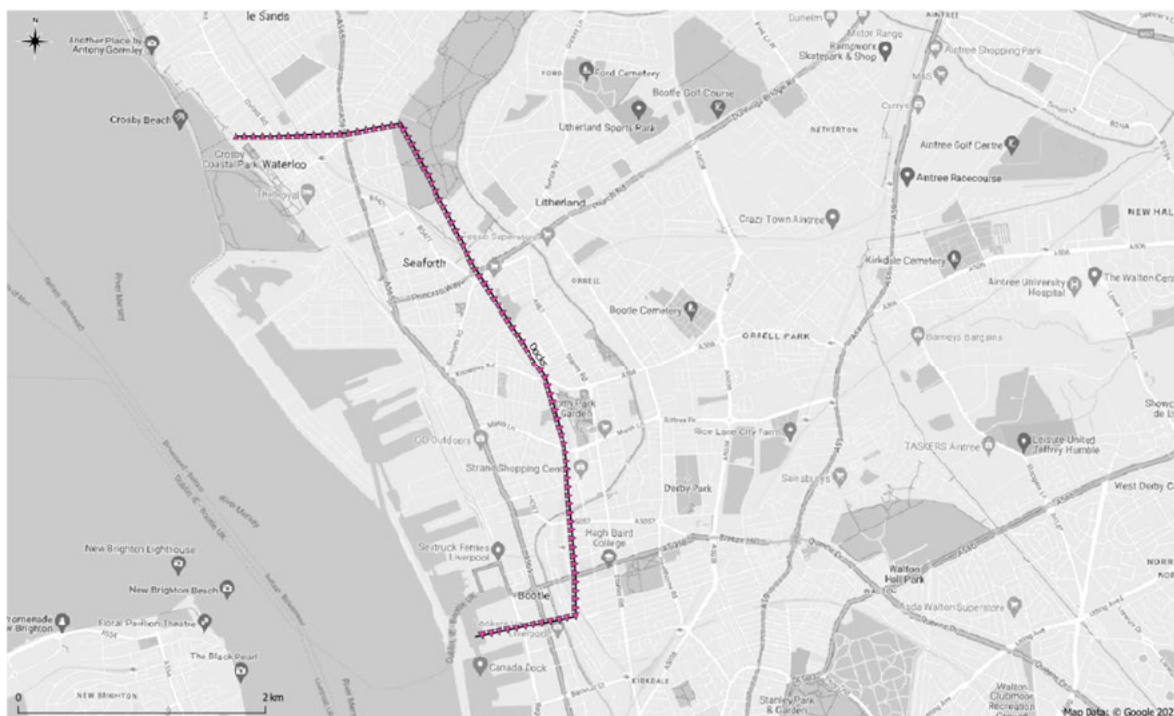
Figure 5-2: Zone Disaggregation Process



5.4 Prior Matrix

As part of the calibration process, changes were made to the Pre-Prior matrices to improve the calibration of the base model. A comparison of model and observed flow was undertaken. This demonstrated that there was a shortfall of modelled trips on A5036 Princess Way and A565 both north and south of the interchange with the A5036. This area of the model is of key importance to provide a robust assessment of the scheme. As such it was agreed to adjust the pre-prior matrix across the Liverpool Docks screenline. The screenline is shown in Figure 5-3 below.

Figure 5-3 – Liverpool Docks screenline used for Pre-Prior matrix adjustment



Changes were made based of the comparisons between the model flow data and the observed flow data. The matrices following these changes are referred to as the Prior matrices.

AM Period

The observed and assigned flows for AM peak are presented in Table 5-1 below. This shows a much improved model fit after pre-prior adjustment, especially for Cars and LGVs.

Table 5-1 – Changes in flow across Docks screenline before and after Matrix Adjustment – AM Peak

	All (veh/hr)			Car (veh/hr)			LGV (veh/hr)			HGV (veh/hr)		
Direction	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior
Inbound	4,670	3,063	4,663	3,804	2,446	3,821	498	331	478	367	286	365
Outbound	4,974	3,586	4,735	4,227	2,862	4,005	447	356	431	300	368	299

IP Period

The observed and assigned flows for inter peak are presented in Table 5-2 below. This shows a much improved model fit after pre-prior adjustment, especially for Cars and LGVs.

Table 5-2 – Changes in flow across Docks screenline before and after Matrix Adjustment – Inter Peak

Direction	All (veh/hr)			Car (veh/hr)			LGV (veh/hr)			HGV (veh/hr)		
	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior
Inbound	4,213	2,713	4,149	3,361	2,114	3,298	507	278	506	344	321	345
Outbound	4,667	2,855	4,458	3,727	2,198	3,545	552	297	528	388	360	385

PM Period

The observed and assigned flows for PM peak are presented in Table 5-3 below. This shows a much improved model fit after pre-prior adjustment, especially for Cars and LGVs.

Table 5-3 – Changes in flow across Docks screenline before and after Matrix Adjustment – PM Peak

Direction	All (veh/hr)			Car (veh/hr)			LGV (veh/hr)			HGV (veh/hr)		
	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior	Obs	Pre-Prior	Prior
Inbound	4,589	3,440	4,538	4,105	2,973	4,056	334	268	333	151	198	149
Outbound	5,291	3,510	5,154	4,664	2,984	4,536	403	310	393	225	216	225

5.5 Validation of Prior Matrices

The resultant Prior demand matrices have been compared to the TPS RTM2 prior matrices to demonstrate the trip patterns have been retained. Table 5-4 shows the changes in the matrix totals between the A5036 model Prior and the TPS RTM2 Prior matrices.

Table 5-4 Matrix Total Changes (PCUs)

Time Period	User Class	Description	TPS RTM2 Prior	A5036 model Prior	Difference	% Difference
AM	UC1	Car – Employer's Business	475,395	475,590	195	0.04%
	UC2	Car – Commute	1,778,902	1,779,886	984	0.06%
	UC3	Car – Other	2,772,713	2,773,626	913	0.03%
	UC4	LGV	696,376	696,575	199	0.03%
	UC5	HGV	853,302	853,363	61	0.01%
	Total		6,576,688	6,579,040	2,352	0.04%
IP	UC1	Car – Employer's Business	424,614	424,842	228	0.05%
	UC2	Car – Commute	528,929	529,247	318	0.06%
	UC3	Car – Other	3,684,939	3,686,637	1,698	0.05%
	UC4	LGV	603,042	603,435	393	0.07%
	UC5	HGV	852,866	853,014	148	0.02%
	Total		6,094,390	6,097,175	2,785	0.05%
PM	UC1	Car – Employer's Business	384,695	384,831	136	0.04%
	UC2	Car – Commute	1,911,719	1,912,516	797	0.04%
	UC3	Car – Other	3,260,312	3,261,604	1,292	0.04%
	UC4	LGV	648,139	648,271	132	0.02%
	UC5	HGV	530,140	530,068	-72	-0.01%
	Total		6,735,005	6,737,290	2,285	0.03%

It can be seen that the additional trips increase the trip total by 0.03% to 0.05% depending on the peak. At a sectoral level, the increase in trips is almost exclusively within the Merseyside sector. This reflects the shortfall in local private car trips detailed in Table 5-1 - Table 5-3 above.

The trip length distributions for the A5036 model Prior matrix are presented in Table 5-5 and the trip length distributions are shown in Figure 5-4 to Figure 5-6. The trip length distributions and changes in the means and standard deviations for the individual user classes are presented in Appendix B.

Table 5-5 Trip Length Distribution Mean and Standard Deviation for A5036 model Prior matrix

Time Period	Measure	A5036 RTM Prior (km)
AM	Mean	67.96
	Standard Deviation	90.30
IP	Mean	64.86
	Standard Deviation	89.99
PM	Mean	68.08
	Standard Deviation	90.65

Figure 5-4 Trip Length Distribution of the A5036 Prior - AM Period

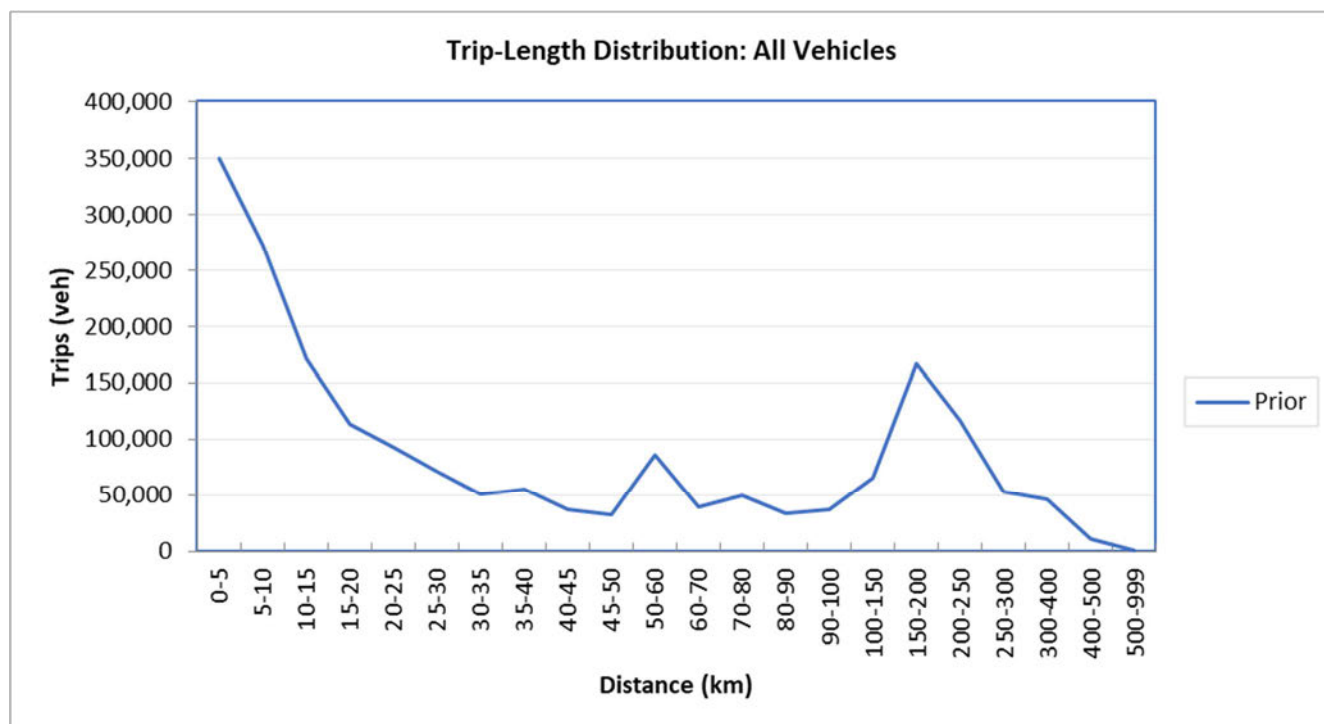


Figure 5-5 Trip Length Distribution of the A5036 Prior - IP Period

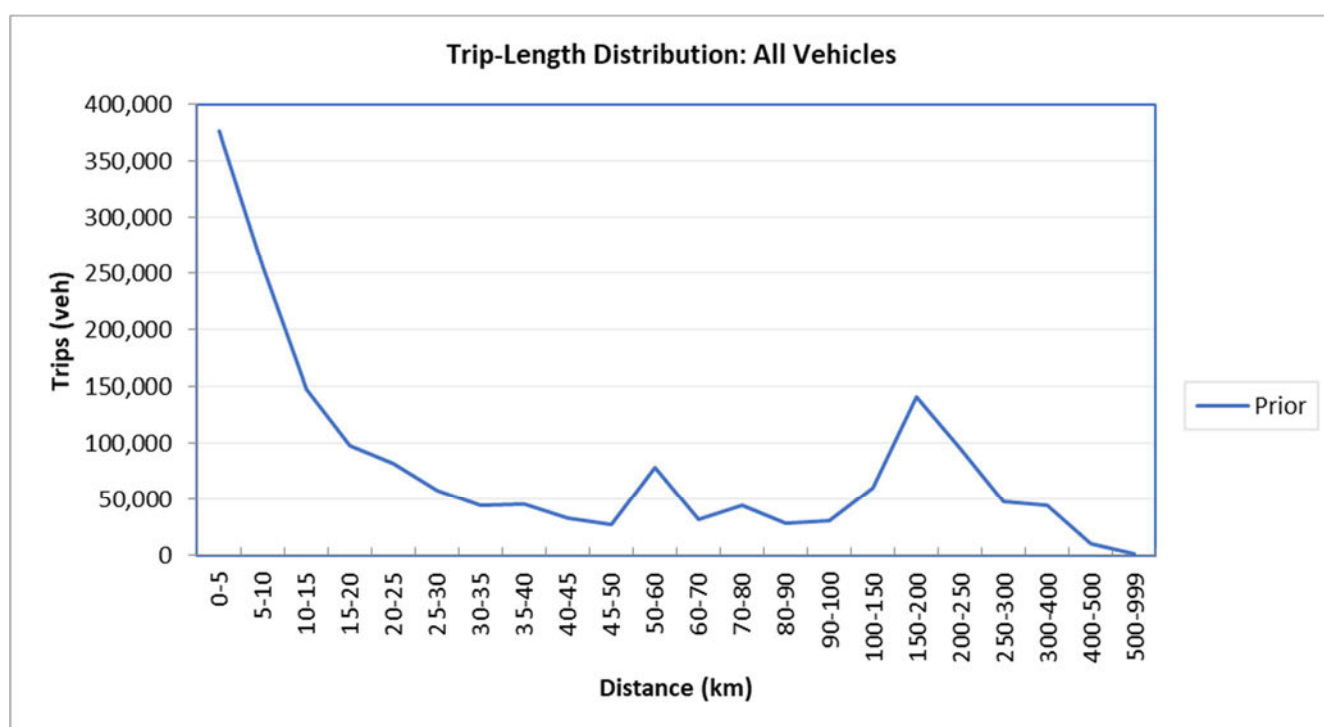


Figure 5-6 Trip Length Distribution of the A5036 Prior - PM Period

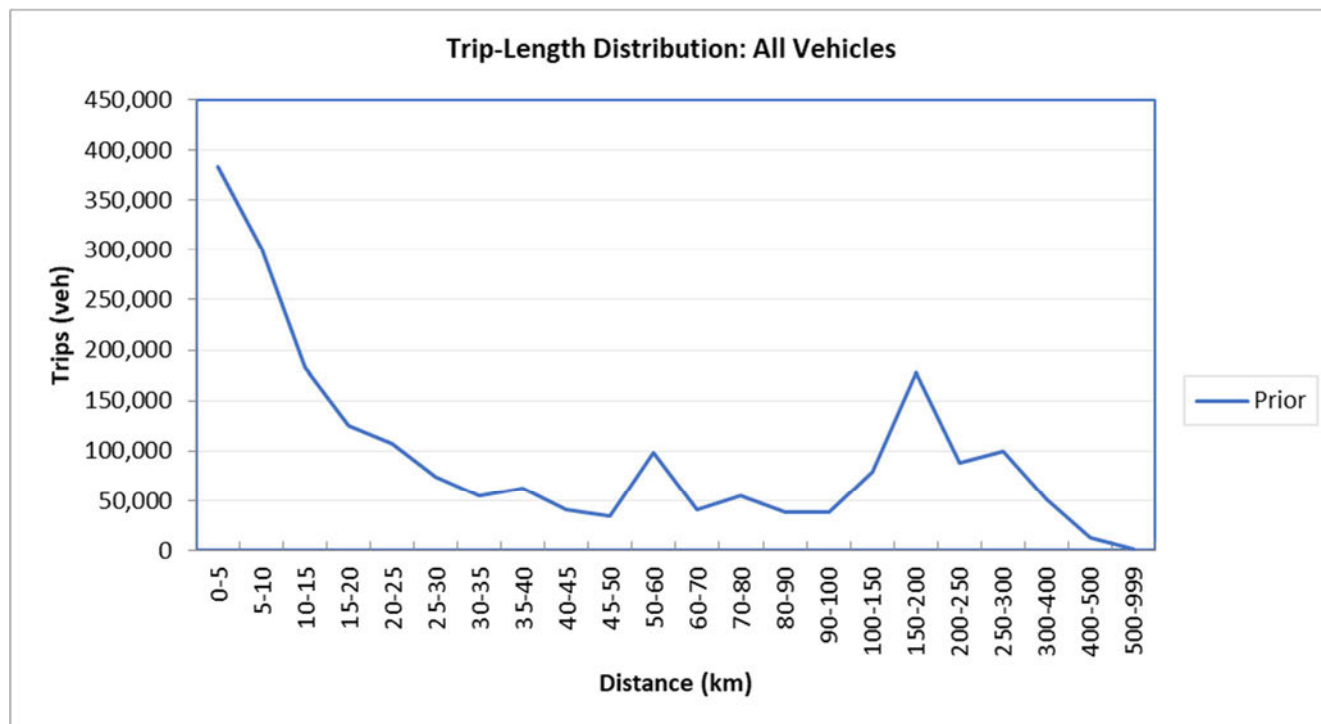


Figure 5-4 to Figure 5-6 show there are with the prior matrix assignment, the trip length distribution indicates that there are a large number of short distance trips and fewer medium distance trips. There is a larger number of trips of between 15km and 20 km length.

6. Model Calibration

6.1 Introduction

This section presents the processes undertaken to calibrate the A5036 base model, the calibration results and the verification of the matrix estimation process.

6.2 Calibration Process

Calibration has been undertaken to ensure the traffic flows in the model are closer to traffic flows from observed counts. To help achieve this, adjustments have been made to the network including the moving of centroid connectors and adjusting saturation flows, so the model is more representative of base conditions.

Matrix estimation has been undertaken to improve the level of calibration. Matrix Estimation (ME) is an iterative process by which the Prior demand matrices are factored in an attempt to match the model flows to observed count flows. Note that the Prior matrices were previously improved around the western end of the A5036, where it was found that the model flows and observed flows were too distant for ME alone to be able to match the flows. These changes are described in section 5.4.

The SATURN modules SATME2 and SATPIJA were used to undertake ME for this model and the process was undertaken for each vehicle class individually. Each peak underwent a maximum of six iterations.

The SATME2 files contain the parameters and constraints for running ME, with the main parameter being the XAMAX which defines the upper bound (XAMAX) and the lower bound (1/XAMAX) for the balancing factors. The XAMAX factors used for each vehicles class are detailed in Table 6-1.

Table 6-1 XAMAX Factors

Vehicle Class	XAMAX
Car	2
LGV	5
HGV	5

The 204 calibration link counts were used in the ME process with the standalone counts (opposed to screenlines) being used as constraints. The resultant matrices are referred to as the Post ME matrices.

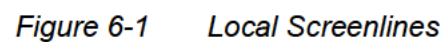
6.3 Matrix Estimation Capping Process

TAG advises on the maximum acceptable matrix estimation adjustments on a sectoral basis. The RTM series of models has set a hard limit on the levels of change. A post matrix estimation capping process is carried out to ensure that TAG levels of change in sector movements are not exceeded. This process was not applied for this model build.

6.4 Screenlines

Screenlines have been defined to ensure the correct volume of traffic enters and leaves certain areas of the model. The screenlines are made up of a series of counts and the total observed and model flows are compared.

Figure 6-1 shows the location of the local A5036 screenlines, Figure 6-2 shows the TPS RTM2 model calibration and validation screenlines, and Table 6-2 presents the number of links that make up each of the individual screenlines.



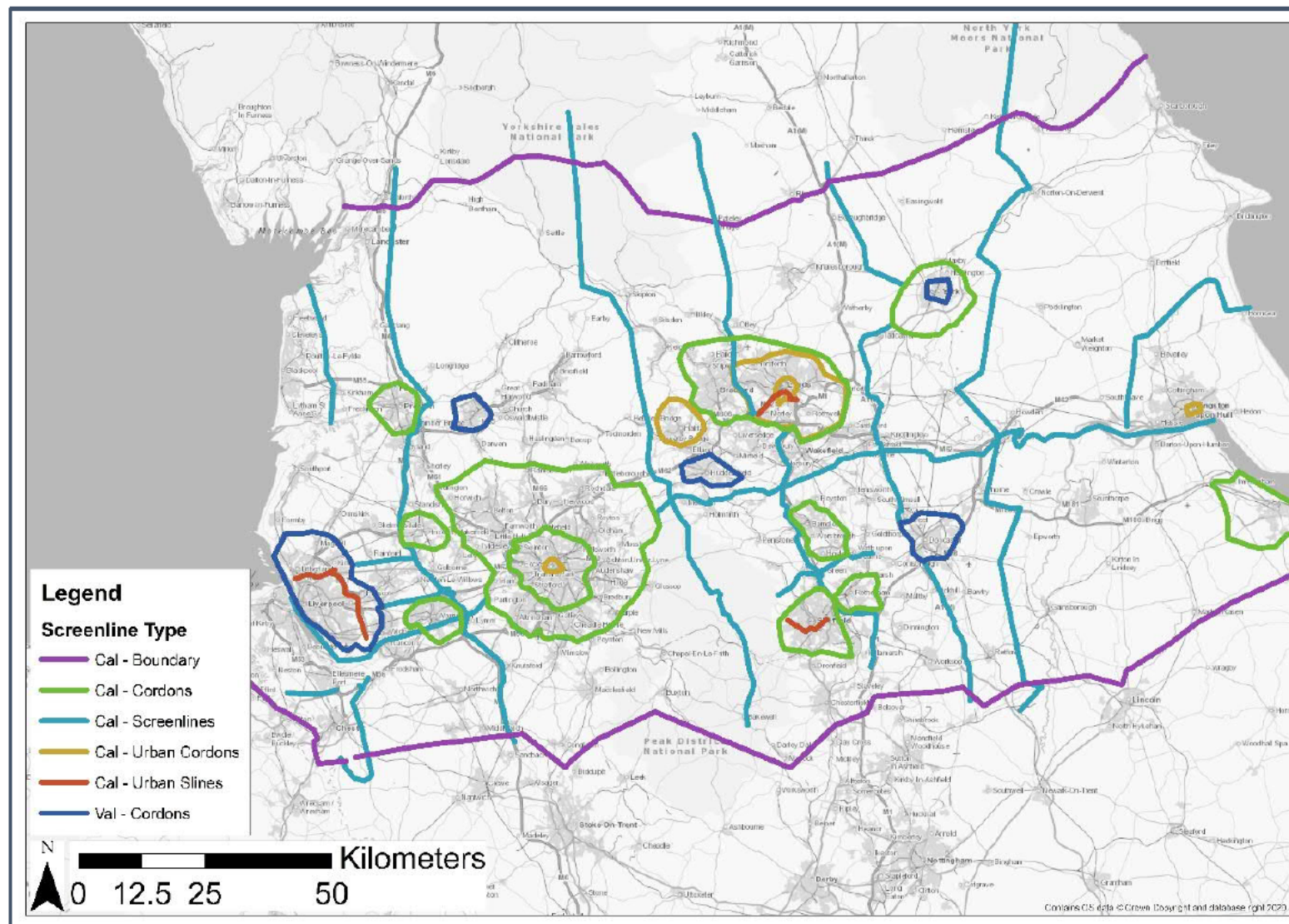


Figure 6-2 – TPS RTM2 Screenline

Table 6-2 Number of Links on Screenlines

Screenline	Direction	Calibration/Validation	No. of Links
Co_01 GM (Inner) [B1]	Inbound	Calibration	32
Co_01 GM (Inner) [B1]	Outbound	Calibration	32
Co_03 Leeds-Bradford [B1]	Inbound	Calibration	36
Co_03 Leeds-Bradford [B1]	Outbound	Calibration	36
Co_04 York [B1]	Inbound	Calibration	11
Co_04 York [B1]	Outbound	Calibration	11
Co_05 Sheffield [B1]	Inbound	Calibration	19
Co_05 Sheffield [B1]	Outbound	Calibration	19
Co_07 GM (External) [B1]	Inbound	Calibration	41
Co_07 GM (External) [B1]	Outbound	Calibration	42
Co_08 Grimsby UA [B1]	Inbound	Calibration	11
Co_08 Grimsby UA [B1]	Outbound	Calibration	11
Co_10 Warrington [B1]	Inbound	Calibration	13
Co_10 Warrington [B1]	Outbound	Calibration	13
Co_11 Wigan [B1]	Inbound	Calibration	11
Co_11 Wigan [B1]	Outbound	Calibration	11
Co_12 Barnsley [B1]	Inbound	Calibration	17
Co_12 Barnsley [B1]	Outbound	Calibration	17
Co_13 Rotherham [B1]	Inbound	Calibration	14
Co_13 Rotherham [B1]	Outbound	Calibration	14
Co_14 Preston [B1]	Inbound	Calibration	14
Co_14 Preston [B1]	Outbound	Calibration	14
Co_16 Halifax [B1]	Inbound	Calibration	11
Co_16 Halifax [B1]	Outbound	Calibration	11
Co_50 Hull Inner Urban [B3]	Inbound	Calibration	9
Co_50 Hull Inner Urban [B3]	Outbound	Calibration	9
Co_52 Leeds Inner Urban [B3]	Inbound	Calibration	18
Co_52 Leeds Inner Urban [B3]	Outbound	Calibration	18
Co_53 Leeds Outer Urban [B3]	Inbound	Calibration	23
Co_53 Leeds Outer Urban [B3]	Outbound	Calibration	23
Co_54 Manchester Urban [B3]	Inbound	Calibration	17
Co_54 Manchester Urban [B3]	Outbound	Calibration	18
Docks	Inbound	Calibration	10
Docks	Outbound	Calibration	10
LPL Radial N	Northbound	Calibration	6
LPL Radial N	Southbound	Calibration	6
N of A5036	Northbound	Calibration	7
N of A5036	Southbound	Calibration	8
Northern	Northbound	Calibration	7
Northern	Southbound	Calibration	7
Sc_01 M6 Screenline [B1]	Eastbound	Calibration	44
Sc_01 M6 Screenline [B1]	Westbound	Calibration	44

Screenline	Direction	Calibration/Validation	No. of Links
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	Calibration	5
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	Calibration	5
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	Calibration	5
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	Calibration	5
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	Calibration	5
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	Calibration	5
Sc_07 Transpennine SL [B1]	Eastbound	Calibration	21
Sc_07 Transpennine SL [B1]	Westbound	Calibration	21
Sc_08 M62 Screenline [B1]	Northbound	Calibration	44
Sc_08 M62 Screenline [B1]	Southbound	Calibration	44
Sc_09 M1 Screenline [B1]	Eastbound	Calibration	39
Sc_09 M1 Screenline [B1]	Westbound	Calibration	39
Sc_10 A1(M) West Yorks [B1]	Eastbound	Calibration	26
Sc_10 A1(M) West Yorks [B1]	Westbound	Calibration	26
Sc_11 Eastern Screenline [B1]	Eastbound	Calibration	16
Sc_11 Eastern Screenline [B1]	Westbound	Calibration	16
Sc_12 Hull & Beverly [B1]	Eastbound	Calibration	7
Sc_12 Hull & Beverly [B1]	Westbound	Calibration	7
Sc_13 Blackpool [B1]	Eastbound	Calibration	7
Sc_13 Blackpool [B1]	Westbound	Calibration	7
Sc_14 Chester [B1]	Eastbound	Calibration	5
Sc_14 Chester [B1]	Westbound	Calibration	5
Sc_15 A1(M) RIS Screenline [B1]	Northbound	Calibration	9
Sc_15 A1(M) RIS Screenline [B1]	Southbound	Calibration	9
Sc_16 Northern Boundary [A]	Northbound	Calibration	17
Sc_16 Northern Boundary [A]	Southbound	Calibration	17
Sc_17 Southern Boundary [A]	Northbound	Calibration	41
Sc_17 Southern Boundary [A]	Southbound	Calibration	41
Sc_18 North Wales Boundary [A]	Eastbound	Calibration	6
Sc_18 North Wales Boundary [A]	Westbound	Calibration	6
Sc_50 Leeds Central [B3]	Eastbound	Calibration	10
Sc_50 Leeds Central [B3]	Westbound	Calibration	10
Sc_51 Sheffield Central [B3]	Northbound	Calibration	6
Sc_51 Sheffield Central [B3]	Southbound	Calibration	6
South of E Lancs	Northbound	Calibration	7
South of E Lancs	Southbound	Calibration	7
West of M57	Northbound	Calibration	12
West of M57	Southbound	Calibration	12
Co_02 Merseyside [B1]	Inbound	Validation	16
Co_02 Merseyside [B1]	Outbound	Validation	16
Co_06 Doncaster [B1]	Inbound	Validation	8
Co_06 Doncaster [B1]	Outbound	Validation	8
Co_09 Huddersfield [B1]	Inbound	Validation	10

Screenline	Direction	Calibration/Validation	No. of Links
Co_09 Huddersfield [B1]	Outbound	Validation	10
Co_15 Blackburn [B1]	Inbound	Validation	12
Co_15 Blackburn [B1]	Outbound	Validation	12
Co_51 York Urban [B3]	Inbound	Validation	8
Co_51 York Urban [B3]	Outbound	Validation	8
Eastern	Eastbound	Validation	13
Eastern	Westbound	Validation	13
LPL Radial E & S	Eastbound	Validation	16
LPL Radial E & S	Westbound	Validation	16
S of A5036	Northbound	Validation	10
S of A5036	Southbound	Validation	10
Sc_52 Liverpool Urban North [B3]	Northbound	Validation	8
Sc_52 Liverpool Urban North [B3]	Southbound	Validation	8
Sc_53 Liverpool Urban East [B3]	Eastbound	Validation	9
Sc_53 Liverpool Urban East [B3]	Westbound	Validation	9

For the screenlines in the model to be acceptable, the criterion set by TAG shown Table 6-3 must be met.

Table 6-3 Screenline flow validation criterion

Criterion	Acceptability guideline
Differences between modelled flows and counts should be less than 5% of the counts.	All or nearly all screenlines (i.e., 95%)

TAG also specifies the following, within unit M3.1 paragraph 3.3.8:

- Screenlines should normally be made up of five links or more.
- The comparison should be presented separately for other screenlines used as constraints in matrix estimation and for screenlines used as independent validation.
- The comparison should be presented by vehicle type.

The GEH statistic can be more appropriate than percentage differences when comparing the closeness of two data sets of low values, such as the observed and modelled HGV volumes, which are generally much lower than car totals. This is because GEH takes into account the magnitude of the numbers involved. The GEH statistic is defined below:

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

where: *M* is the modelled flow on a link, and *C* is the observed flow.

Therefore, for the purposes of calibration it deemed that the LGVs or HGVs on a screenline pass if the GEH on the screenline is less than 4.

6.4.1 Prior Matrix Screenline Calibration

A summary of the results for the calibration screenlines for the Prior models are presented in Table 6-4.

Table 6-4 Summary of Calibration Screenlines – Prior Models

Peak	Vehicle Class	% Screenlines with flows within 5%		% Screenlines with GEH <4		Overall	
		Number	%	Number	%	Number	%
AM	All	18/84	21%	18/84	21%	18/84	21%
	Car	18/84	21%	18/84	21%	18/84	21%
	LGV	24/84	29%	60/84	71%	60/84	71%
	HGV	18/84	21%	42/84	50%	42/84	50%
IP	All	18/84	21%	18/84	21%	18/84	21%
	Car	24/84	29%	18/84	21%	24/84	29%
	LGV	36/84	43%	66/84	79%	66/84	79%
	HGV	18/84	21%	48/84	57%	48/84	57%
PM	All	18/84	21%	18/84	21%	18/84	21%
	Car	12/84	14%	12/84	14%	12/84	14%
	LGV	24/84	29%	54/84	64%	54/84	64%
	HGV	24/84	29%	60/84	71%	60/84	71%

Table 6-4 shows that the Prior matrices do not fulfil the TAG criteria and in fact less than 30% of the screenlines have modelled flows within 5% of the observed flows. The detailed screenline results for the total number of vehicles is provided in Table 6-5 to Table 6-7.

Table 6-5 Prior Model Calibration Screenlines - AM Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Co_01 GM (Inner) [B1]	Inbound	12,870	12,133	-5.70%	6.6	Fail
Co_01 GM (Inner) [B1]	Outbound	12,050	11,373	-5.60%	6.3	Fail
Co_03 Leeds-Bradford [B1]	Inbound	12,793	10,832	-15.30%	18	Fail
Co_03 Leeds-Bradford [B1]	Outbound	15,267	14,035	-8.10%	10.2	Fail
Co_04 York [B1]	Inbound	8,430	7,553	-10.40%	9.8	Fail
Co_04 York [B1]	Outbound	8,263	8,380	1.40%	1.3	Pass
Co_05 Sheffield [B1]	Inbound	3,342	3,932	17.70%	9.8	Fail
Co_05 Sheffield [B1]	Outbound	4,902	4,845	-1.20%	0.8	Pass
Co_07 GM (External) [B1]	Inbound	5,045	5,130	1.70%	1.2	Pass
Co_07 GM (External) [B1]	Outbound	5,641	6,277	11.30%	8.2	Fail
Co_08 Grimsby UA [B1]	Inbound	5,736	5,111	-10.90%	8.5	Fail
Co_08 Grimsby UA [B1]	Outbound	6,739	6,383	-5.3%	4.4	Fail
Co_10 Warrington [B1]	Inbound	7,064	5,292	-25.10%	22.6	Fail
Co_10 Warrington [B1]	Outbound	8,277	7,196	-13.10%	12.3	Fail
Co_11 Wigan [B1]	Inbound	12,870	12,133	-5.70%	6.6	Fail
Co_11 Wigan [B1]	Outbound	12,050	11,373	-5.60%	6.3	Fail
Co_12 Barnsley [B1]	Inbound	12,793	10,832	-15.30%	18	Fail
Co_12 Barnsley [B1]	Outbound	15,267	14,035	-8.10%	10.2	Fail
Co_13 Rotherham [B1]	Inbound	8,430	7,553	-10.40%	9.8	Fail

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Co_13 Rotherham [B1]	Outbound	8,263	8,380	1.40%	1.3	Pass
Co_14 Preston [B1]	Inbound	3,342	3,932	17.70%	9.8	Fail
Co_14 Preston [B1]	Outbound	4,902	4,845	-1.20%	0.8	Pass
Co_16 Halifax [B1]	Inbound	5,045	5,130	1.70%	1.2	Pass
Co_16 Halifax [B1]	Outbound	5,641	6,277	11.30%	8.2	Fail
Co_50 Hull Inner Urban [B3]	Inbound	5,736	5,111	-10.90%	8.5	Fail
Co_50 Hull Inner Urban [B3]	Outbound	6,739	6,383	-5.3%	4.4	Fail
Co_52 Leeds Inner Urban [B3]	Inbound	7,064	5,292	-25.10%	22.6	Fail
Co_52 Leeds Inner Urban [B3]	Outbound	8,277	7,196	-13.10%	12.3	Fail
Co_53 Leeds Outer Urban [B3]	Inbound	12,870	12,133	-5.70%	6.6	Fail
Co_53 Leeds Outer Urban [B3]	Outbound	12,050	11,373	-5.60%	6.3	Fail
Co_54 Manchester Urban [B3]	Inbound	12,793	10,832	-15.30%	18	Fail
Co_54 Manchester Urban [B3]	Outbound	15,267	14,035	-8.10%	10.2	Fail
Docks	Inbound	8,430	7,553	-10.40%	9.8	Fail
Docks	Outbound	8,263	8,380	1.40%	1.3	Pass
LPL Radial E & S	Eastbound	3,342	3,932	17.70%	9.8	Fail
LPL Radial E & S	Westbound	4,902	4,845	-1.20%	0.8	Pass
LPL Radial N	Northbound	5,045	5,130	1.70%	1.2	Pass
LPL Radial N	Southbound	5,641	6,277	11.30%	8.2	Fail
N of A5036	Northbound	5,736	5,111	-10.90%	8.5	Fail
N of A5036	Southbound	6,739	6,383	-5.3%	4.4	Fail
Northern	Northbound	7,064	5,292	-25.10%	22.6	Fail
Northern	Southbound	8,277	7,196	-13.10%	12.3	Fail
S of A5036	Northbound	12,870	12,133	-5.70%	6.6	Fail
S of A5036	Southbound	12,050	11,373	-5.60%	6.3	Fail
Sc_01 M6 Screenline [B1]	Eastbound	12,793	10,832	-15.30%	18	Fail
Sc_01 M6 Screenline [B1]	Westbound	15,267	14,035	-8.10%	10.2	Fail
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	8,430	7,553	-10.40%	9.8	Fail
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	8,263	8,380	1.40%	1.3	Pass
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	3,342	3,932	17.70%	9.8	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	4,902	4,845	-1.20%	0.8	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	5,045	5,130	1.70%	1.2	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	5,641	6,277	11.30%	8.2	Fail
Sc_07 Transpennine SL [B1]	Eastbound	5,736	5,111	-10.90%	8.5	Fail
Sc_07 Transpennine SL [B1]	Westbound	6,739	6,383	-5.3%	4.4	Fail
Sc_08 M62 Screenline [B1]	Northbound	7,064	5,292	-25.10%	22.6	Fail
Sc_08 M62 Screenline [B1]	Southbound	8,277	7,196	-13.10%	12.3	Fail
Sc_09 M1 Screenline [B1]	Eastbound	12,050	11,373	-5.60%	6.3	Fail
Sc_09 M1 Screenline [B1]	Westbound	12,793	10,832	-15.30%	18	Fail
Sc_10 A1(M) West Yorks [B1]	Eastbound	15,267	14,035	-8.10%	10.2	Fail

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Sc_10 A1(M) West Yorks [B1]	Westbound	8,430	7,553	-10.40%	9.8	Fail
Sc_11 Eastern Screenline [B1]	Eastbound	8,263	8,380	1.40%	1.3	Pass
Sc_11 Eastern Screenline [B1]	Westbound	3,342	3,932	17.70%	9.8	Fail
Sc_12 Hull & Beverly [B1]	Eastbound	4,902	4,845	-1.20%	0.8	Pass
Sc_12 Hull & Beverly [B1]	Westbound	5,045	5,130	1.70%	1.2	Pass
Sc_13 Blackpool [B1]	Eastbound	5,641	6,277	11.30%	8.2	Fail
Sc_13 Blackpool [B1]	Westbound	5,736	5,111	-10.90%	8.5	Fail
Sc_14 Chester [B1]	Eastbound	6,739	6,383	-5.3%	4.4	Fail
Sc_14 Chester [B1]	Westbound	7,064	5,292	-25.10%	22.6	Fail
Sc_15 A1(M) RIS Screenline [B1]	Northbound	8,277	7,196	-13.10%	12.3	Fail
Sc_15 A1(M) RIS Screenline [B1]	Southbound	12,870	12,133	-5.70%	6.6	Fail
Sc_16 Northern Boundary [A]	Northbound	12,050	11,373	-5.60%	6.3	Fail
Sc_16 Northern Boundary [A]	Southbound	12,793	10,832	-15.30%	18	Fail
Sc_17 Southern Boundary [A]	Northbound	15,267	14,035	-8.10%	10.2	Fail
Sc_17 Southern Boundary [A]	Southbound	8,430	7,553	-10.40%	9.8	Fail
Sc_18 North Wales Boundary [A]	Eastbound	8,263	8,380	1.40%	1.3	Pass
Sc_18 North Wales Boundary [A]	Westbound	3,342	3,932	17.70%	9.8	Fail
Sc_50 Leeds Central [B3]	Eastbound	4,902	4,845	-1.20%	0.8	Pass
Sc_50 Leeds Central [B3]	Westbound	5,045	5,130	1.70%	1.2	Pass
Sc_51 Sheffield Central [B3]	Northbound	5,641	6,277	11.30%	8.2	Fail
Sc_51 Sheffield Central [B3]	Southbound	5,736	5,111	-10.90%	8.5	Fail
South of E Lancs	Northbound	6,739	6,383	-5.3%	4.4	Fail
South of E Lancs	Southbound	7,064	5,292	-25.10%	22.6	Fail
West of M57	Northbound	8,277	7,196	-13.10%	12.3	Fail
West of M57	Southbound	12,050	11,373	-5.60%	6.3	Fail

Table 6-6 Prior Model Calibration Screenlines - IP Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Co_01 GM (Inner) [B1]	Inbound	26,713	26,646	-0.25%	0.4	Pass
Co_01 GM (Inner) [B1]	Outbound	29,669	29,757	0.30%	0.5	Pass
Co_03 Leeds-Bradford [B1]	Inbound	28,859	27,677	-4.10%	7.0	Pass
Co_03 Leeds-Bradford [B1]	Outbound	29,935	29,290	-2.16%	3.7	Pass
Co_04 York [B1]	Inbound	6,238	6,001	-3.80%	3.0	Pass
Co_04 York [B1]	Outbound	6,576	6,317	-3.94%	3.2	Pass
Co_05 Sheffield [B1]	Inbound	11,846	11,499	-2.93%	3.2	Pass
Co_05 Sheffield [B1]	Outbound	12,088	12,260	1.43%	1.6	Pass
Co_07 GM (External) [B1]	Inbound	31,070	30,506	-1.82%	3.2	Pass
Co_07 GM (External) [B1]	Outbound	31,332	31,794	1.48%	2.6	Pass
Co_08 Grimsby UA [B1]	Inbound	3,504	3,106	-11.36%	6.9	Fail
Co_08 Grimsby UA [B1]	Outbound	3,485	3,131	-10.16%	6.2	Fail
Co_10 Warrington [B1]	Inbound	6,098	6,134	0.60%	0.5	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Co_10 Warrington [B1]	Outbound	6,164	6,048	-1.88%	1.5	Pass
Co_11 Wigan [B1]	Inbound	5,882	5,607	-4.67%	3.6	Pass
Co_11 Wigan [B1]	Outbound	5,887	5,728	-2.70%	2.1	Pass
Co_12 Barnsley [B1]	Inbound	7,178	6,814	-5.07%	4.4	Fail
Co_12 Barnsley [B1]	Outbound	7,022	6,688	-4.76%	4.0	Pass
Co_13 Rotherham [B1]	Inbound	6,624	6,154	-7.10%	5.9	Fail
Co_13 Rotherham [B1]	Outbound	6,814	6,391	-6.22%	5.2	Fail
Co_14 Preston [B1]	Inbound	8,739	9,275	6.14%	5.7	Fail
Co_14 Preston [B1]	Outbound	8,825	9,377	6.26%	5.8	Fail
Co_16 Halifax [B1]	Inbound	6,197	6,332	2.18%	1.7	Pass
Co_16 Halifax [B1]	Outbound	6,189	6,680	7.93%	6.1	Fail
Co_50 Hull Inner Urban [B3]	Inbound	6,626	9,989	50.76%	36.9	Fail
Co_50 Hull Inner Urban [B3]	Outbound	6,863	10,656	55.27%	40.5	Fail
Co_52 Leeds Inner Urban [B3]	Inbound	14,967	16,187	8.15%	9.8	Fail
Co_52 Leeds Inner Urban [B3]	Outbound	14,995	16,430	9.57%	11.4	Fail
Co_53 Leeds Outer Urban [B3]	Inbound	25,309	24,043	-5.00%	8.1	Pass
Co_53 Leeds Outer Urban [B3]	Outbound	25,573	25,073	-1.95%	3.1	Pass
Co_54 Manchester Urban [B3]	Inbound	10,521	11,733	11.53%	11.5	Fail
Co_54 Manchester Urban [B3]	Outbound	11,019	11,847	7.51%	7.7	Fail
Docks	Inbound	4,985	2,362	-52.62%	43.3	Fail
Docks	Outbound	5,584	2,817	-49.55%	42.7	Fail
LPL Radial E & S	Eastbound	13,134	12,618	-3.93%	4.6	Pass
LPL Radial E & S	Westbound	12,265	11,788	-3.89%	4.4	Pass
LPL Radial N	Northbound	4,191	3,694	-11.85%	7.9	Fail
LPL Radial N	Southbound	3,840	3,440	-10.44%	6.6	Fail
N of A5036	Northbound	2,762	2,304	-16.58%	9.1	Fail
N of A5036	Southbound	2,826	2,281	-19.30%	10.8	Fail
Northern	Northbound	2,351	1,989	-15.40%	7.8	Fail
Northern	Southbound	2,300	1,870	-18.69%	9.4	Fail
S of A5036	Northbound	4,834	3,940	-18.51%	13.5	Fail
S of A5036	Southbound	5,431	3,685	-32.14%	25.9	Fail
Sc_01 M6 Screenline [B1]	Eastbound	26,845	26,626	-0.82%	1.3	Pass
Sc_01 M6 Screenline [B1]	Westbound	27,022	26,689	-1.23%	2.0	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	1,685	1,333	-20.87%	9.1	Fail
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	1,511	1,412	-6.59%	2.6	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	6,197	5,772	-6.86%	5.5	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	5,614	5,193	-7.50%	5.7	Fail
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	2,692	2,091	-22.33%	12.3	Fail
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	2,619	2,274	-13.19%	7.0	Fail
Sc_07 Transpennine SL [B1]	Eastbound	8,399	8,917	6.17%	5.6	Fail
Sc_07 Transpennine SL [B1]	Westbound	8,322	8,760	5.26%	4.7	Fail
Sc_08 M62 Screenline [B1]	Northbound	33,648	34,451	2.39%	4.3	Pass
Sc_08 M62 Screenline [B1]	Southbound	33,942	35,173	3.63%	6.6	Pass
Sc_09 M1 Screenline [B1]	Eastbound	27,342	26,409	-3.41%	5.7	Pass
Sc_09 M1 Screenline [B1]	Westbound	26,746	26,120	-2.34%	3.9	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Sc_10 A1(M) West Yorks [B1]	Eastbound	16,280	16,476	1.21%	1.5	Pass
Sc_10 A1(M) West Yorks [B1]	Westbound	16,508	16,804	1.79%	2.3	Pass
Sc_11 Eastern Screenline [B1]	Eastbound	7,779	7,664	-1.48%	1.3	Pass
Sc_11 Eastern Screenline [B1]	Westbound	7,867	7,736	-1.66%	1.5	Pass
Sc_12 Hull & Beverly [B1]	Eastbound	3,318	3,388	2.09%	1.2	Pass
Sc_12 Hull & Beverly [B1]	Westbound	3,113	3,342	7.38%	4.0	Fail
Sc_13 Blackpool [B1]	Eastbound	3,791	3,434	-9.43%	5.9	Fail
Sc_13 Blackpool [B1]	Westbound	3,870	3,552	-8.20%	5.2	Fail
Sc_14 Chester [B1]	Eastbound	5,073	4,708	-7.19%	5.2	Fail
Sc_14 Chester [B1]	Westbound	5,222	5,214	-0.16%	0.1	Pass
Sc_15 A1(M) RIS Screenline [B1]	Northbound	3,049	3,302	8.30%	4.5	Fail
Sc_15 A1(M) RIS Screenline [B1]	Southbound	3,123	2,779	-11.00%	6.3	Fail
Sc_16 Northern Boundary [A]	Northbound	8,395	8,349	-0.56%	0.5	Pass
Sc_16 Northern Boundary [A]	Southbound	8,730	8,952	2.54%	2.4	Pass
Sc_17 Southern Boundary [A]	Northbound	20,889	19,569	-6.32%	9.3	Fail
Sc_17 Southern Boundary [A]	Southbound	19,805	18,871	-4.72%	6.7	Pass
Sc_18 North Wales Boundary [A]	Eastbound	7,261	8,246	13.56%	11.2	Fail
Sc_18 North Wales Boundary [A]	Westbound	6,902	7,889	14.31%	11.5	Fail
Sc_50 Leeds Central [B3]	Eastbound	8,851	8,600	-2.83%	2.7	Pass
Sc_50 Leeds Central [B3]	Westbound	8,067	8,373	3.79%	3.4	Pass
Sc_51 Sheffield Central [B3]	Northbound	4,158	6,134	47.53%	27.6	Fail
Sc_51 Sheffield Central [B3]	Southbound	4,420	5,758	30.29%	18.8	Fail
South of E Lancs	Northbound	5,251	5,765	9.78%	6.9	Fail
South of E Lancs	Southbound	5,381	6,108	13.51%	9.6	Fail
West of M57	Northbound	7,121	6,061	-14.88%	13.1	Fail
West of M57	Southbound	7,068	6,352	-10.12%	8.7	Fail

Table 6-7 Prior Model Calibration Screenlines - PM Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Co_01 GM (Inner) [B1]	Inbound	31,074	31,616	1.7%	3.1	Pass
Co_01 GM (Inner) [B1]	Outbound	38,055	38,235	0.5%	0.9	Pass
Co_03 Leeds-Bradford [B1]	Inbound	33,977	32,221	-5.2%	9.6	Fail
Co_03 Leeds-Bradford [B1]	Outbound	40,124	39,544	-1.4%	2.9	Pass
Co_04 York [B1]	Inbound	7,836	7,560	-3.5%	3.1	Pass
Co_04 York [B1]	Outbound	8,414	8,325	-1.1%	1.0	Pass
Co_05 Sheffield [B1]	Inbound	13,383	13,360	-0.2%	0.2	Pass
Co_05 Sheffield [B1]	Outbound	15,626	15,764	0.9%	1.1	Pass
Co_07 GM (External) [B1]	Inbound	36,362	36,716	1.0%	1.9	Pass
Co_07 GM (External) [B1]	Outbound	40,050	42,793	6.8%	13.5	Fail
Co_08 Grimsby UA [B1]	Inbound	5,123	3,728	-27.2%	21.0	Fail
Co_08 Grimsby UA [B1]	Outbound	4,854	3,959	-18.4%	13.5	Fail
Co_10 Warrington [B1]	Inbound	8,193	8,568	4.6%	4.1	Pass
Co_10 Warrington [B1]	Outbound	7,965	7,858	-1.3%	1.2	Pass
Co_11 Wigan [B1]	Inbound	7,438	7,127	-4.2%	3.6	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Co_11 Wigan [B1]	Outbound	7,253	7,341	1.2%	1.0	Pass
Co_12 Barnsley [B1]	Inbound	9,173	8,650	-5.7%	5.5	Fail
Co_12 Barnsley [B1]	Outbound	8,441	8,005	-5.2%	4.8	Fail
Co_13 Rotherham [B1]	Inbound	8,056	7,324	-9.1%	8.3	Fail
Co_13 Rotherham [B1]	Outbound	8,423	7,635	-9.3%	8.8	Fail
Co_14 Preston [B1]	Inbound	11,314	11,784	4.2%	4.4	Pass
Co_14 Preston [B1]	Outbound	11,300	12,311	8.9%	9.3	Fail
Co_16 Halifax [B1]	Inbound	6,887	7,081	2.8%	2.3	Pass
Co_16 Halifax [B1]	Outbound	7,455	8,228	10.4%	8.7	Fail
Co_50 Hull Inner Urban [B3]	Inbound	5,961	10,173	70.7%	46.9	Fail
Co_50 Hull Inner Urban [B3]	Outbound	7,987	12,234	53.2%	42.2	Fail
Co_52 Leeds Inner Urban [B3]	Inbound	15,912	18,683	17.4%	21.1	Fail
Co_52 Leeds Inner Urban [B3]	Outbound	20,873	23,455	12.4%	17.3	Fail
Co_53 Leeds Outer Urban [B3]	Inbound	28,037	27,784	-0.9%	1.5	Pass
Co_53 Leeds Outer Urban [B3]	Outbound	34,210	34,089	-0.4%	0.7	Pass
Co_54 Manchester Urban [B3]	Inbound	10,301	13,040	26.6%	25.4	Fail
Co_54 Manchester Urban [B3]	Outbound	13,870	17,264	24.5%	27.2	Fail
Docks	Inbound	5,233	3,274	-37.4%	30.0	Fail
Docks	Outbound	6,721	3,749	-44.2%	41.1	Fail
LPL Radial E & S	Eastbound	16,649	15,695	-5.7%	7.5	Fail
LPL Radial E & S	Westbound	15,300	13,910	-9.1%	11.5	Fail
LPL Radial N	Northbound	5,564	4,970	-10.7%	8.2	Fail
LPL Radial N	Southbound	4,048	3,645	-10.0%	6.5	Fail
N of A5036	Northbound	3,744	3,022	-19.3%	12.4	Fail
N of A5036	Southbound	3,105	2,350	-24.3%	14.5	Fail
Northern	Northbound	3,097	2,880	-7.0%	4.0	Fail
Northern	Southbound	2,619	2,113	-19.3%	10.4	Fail
S of A5036	Northbound	6,195	5,164	-16.6%	13.7	Fail
S of A5036	Southbound	5,393	4,013	-25.6%	20.1	Fail
Sc_01 M6 Screenline [B1]	Eastbound	34,263	33,465	-2.3%	4.3	Pass
Sc_01 M6 Screenline [B1]	Westbound	35,017	35,392	1.1%	2.0	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	2,760	2,111	-23.5%	13.1	Fail
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	1,952	1,738	-10.9%	5.0	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	7,694	7,682	-0.2%	0.1	Pass
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	5,765	5,639	-2.2%	1.7	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	3,672	3,230	-12.0%	7.5	Fail
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	2,890	2,604	-9.9%	5.5	Fail
Sc_07 Transpennine SL [B1]	Eastbound	9,081	9,656	6.3%	5.9	Fail
Sc_07 Transpennine SL [B1]	Westbound	9,615	10,140	5.5%	5.3	Fail
Sc_08 M62 Screenline [B1]	Northbound	39,886	41,021	2.8%	5.6	Pass
Sc_08 M62 Screenline [B1]	Southbound	43,509	45,052	3.5%	7.3	Pass
Sc_09 M1 Screenline [B1]	Eastbound	32,060	31,834	-0.7%	1.3	Pass
Sc_09 M1 Screenline [B1]	Westbound	34,254	34,152	-0.3%	0.6	Pass
Sc_10 A1(M) West Yorks [B1]	Eastbound	20,574	20,693	0.6%	0.8	Pass
Sc_10 A1(M) West Yorks [B1]	Westbound	20,458	20,263	-1.0%	1.4	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Difference	GEH	Pass/Fail
Sc_11 Eastern Screenline [B1]	Eastbound	10,083	9,527	-5.5%	5.6	Fail
Sc_11 Eastern Screenline [B1]	Westbound	8,586	8,644	0.7%	0.6	Pass
Sc_12 Hull & Beverly [B1]	Eastbound	3,825	3,874	1.3%	0.8	Pass
Sc_12 Hull & Beverly [B1]	Westbound	3,825	4,120	7.7%	4.7	Fail
Sc_13 Blackpool [B1]	Eastbound	4,326	3,952	-8.6%	5.8	Fail
Sc_13 Blackpool [B1]	Westbound	5,052	4,416	-12.6%	9.2	Fail
Sc_14 Chester [B1]	Eastbound	5,925	5,665	-4.4%	3.4	Pass
Sc_14 Chester [B1]	Westbound	7,020	6,859	-2.3%	1.9	Pass
Sc_15 A1(M) RIS Screenline [B1]	Northbound	3,974	4,439	11.7%	7.2	Fail
Sc_15 A1(M) RIS Screenline [B1]	Southbound	3,717	3,574	-3.8%	2.4	Pass
Sc_16 Northern Boundary [A]	Northbound	9,094	9,270	1.9%	1.8	Pass
Sc_16 Northern Boundary [A]	Southbound	9,061	9,374	3.4%	3.3	Pass
Sc_17 Southern Boundary [A]	Northbound	24,093	21,972	-8.8%	14.0	Fail
Sc_17 Southern Boundary [A]	Southbound	22,912	21,789	-4.9%	7.5	Pass
Sc_18 North Wales Boundary [A]	Eastbound	7,236	8,775	21.3%	17.2	Fail
Sc_18 North Wales Boundary [A]	Westbound	8,679	9,141	5.3%	4.9	Fail
Sc_50 Leeds Central [B3]	Eastbound	11,365	11,480	1.0%	1.1	Pass
Sc_50 Leeds Central [B3]	Westbound	9,183	9,645	5.0%	4.8	Pass
Sc_51 Sheffield Central [B3]	Northbound	4,613	7,595	64.7%	38.2	Fail
Sc_51 Sheffield Central [B3]	Southbound	5,917	8,185	38.3%	27.0	Fail
South of E Lancs	Northbound	6,565	7,833	19.3%	14.9	Fail
South of E Lancs	Southbound	7,048	7,151	1.5%	1.2	Pass
West of M57	Northbound	9,192	8,070	-12.2%	12.1	Fail
West of M57	Southbound	8,861	8,073	-8.9%	8.6	Fail

Table 6-5 to Table 6-7 show overall the Prior models do not satisfy the TAG criteria. However, 84% of the screenlines have a total flow difference within 20% of the observed flow in AM and IP periods and 89% in PM period.

6.4.2 Post ME Matrix Screenline Calibration

A summary of the calibration screenline results are given in Table 6-8 for the Post ME matrices following the matrix estimation exercise. Local Screenline results are given in Table 6-9 to Table 6-11. The detailed screenline results for the total number of vehicles is provided in Table 6-12 to Table 6-14 for the AM, IP and PM periods. The screenline results by vehicle class are provided in Appendix A.

Table 6-8 Summary of Calibration Screenlines

Peak	Vehicle Class	% Screenlines with flows within 5%		% Screenlines with GEH <4		Overall	
		Number	%	Number	%	Number	%
AM	All	57/80	71%	51/80	64%	57/80	71%
	Car	53/80	66%	48/80	60%	53/80	66%
	LGV	64/80	80%	78/80	98%	78/80	98%
	HGV	52/80	65%	74/80	93%	74/80	93%
IP	All	58/80	73%	55/80	69%	55/80	69%

	Car	52/80	65%	52/80	65%	52/80	65%
	LGV	64/80	80%	78/80	98%	78/80	98%
	HGV	52/80	65%	77/80	96%	77/80	96%
PM	All	54/80	68%	45/80	56%	45/80	56%
	Car	50/80	63%	44/80	55%	44/80	55%
	LGV	66/80	83%	79/80	99%	79/80	99%
	HGV	52/80	65%	72/80	90%	72/80	90%

Table 6-9 Summary of Local Calibration Screenlines

Peak	Vehicle Class	% Screenlines with flows within 5%		% Screenlines with GEH <4		Overall	
		Number	%	Number	%	Number	%
AM	All	6/12	50%	8/12	67%	8/12	67%
	Car	6/12	50%	8/12	67%	8/12	67%
	LGV	7/12	58%	11/12	92%	11/12	92%
	HGV	5/12	42%	12/12	100%	12/12	100%
IP	All	10/12	83%	10/12	83%	10/12	83%
	Car	8/12	67%	10/12	83%	10/12	83%
	LGV	7/12	58%	12/12	100%	12/12	100%
	HGV	5/12	42%	12/12	100%	12/12	100%
PM	All	9/12	75%	9/12	75%	9/12	75%
	Car	7/12	58%	8/12	67%	8/12	67%
	LGV	8/12	67%	12/12	100%	12/12	100%
	HGV	5/12	42%	12/12	100%	12/12	100%

Table 6-10 Local Validation Screenline Flow Difference Performance

	Number				%			
	<5%	5% - 10%	>10%	Total	<5%	5% - 10%	>10%	Total
Flows Difference Absolute %								
AM	6	5	1	12	50.0%	41.7%	8.3%	100%
IP	10	1	1	12	83.3%	8.3%	8.3%	100.0%
PM	9	1	2	12	75.0%	8.3%	16.7%	100.0%

Table 6-11 Local Validation Screenline GEH Performance

	Number					%				
GEH	<4	4 - 7.5	7.5 - 10	>10	Total	<4	4 - 7.5	7.5 - 10	>10	Total
AM	8	4	0	0	12	66.7%	33.3%	0.0%	0.0%	100%
IP	10	2	0	0	12	83.3%	16.7%	0.0%	0.0%	100%
PM	9	2	1	0	12	75.0%	16.7%	8.3%	0.0%	100%

In the AM and IP, the results show that more than 70% of screenlines meet the TAG criteria of being within 5% of the observed flow with respect to the total flow and 68% in the PM. Twenty seven screenlines fail to meet criteria in the AM period, twenty five in the IP and thirty in the PM. However, only two screen lines in the AM period have GEHs of over 7.5, four screenlines in the IP and six screenlines in the PM period.

There are 50% of local screenlines that pass in AM, 83% in IP and 75% in PM. In the AM nearly all the screenlines that don't pass have a percentage difference less than 10%. IP and PM meet the TAG criteria and are acceptable.

Table 6-12 Calibration Screenlines - AM Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Co_01 GM (Inner) [B1]	Inbound	4,339	4,530	4.4%	2.9	Pass
Co_01 GM (Inner) [B1]	Outbound	34,370	33,889	-1.4%	2.6	Pass
Co_03 Leeds-Bradford	Inbound	28,220	28,265	0.2%	0.3	Pass
Co_03 Leeds-Bradford	Outbound	36,977	36,267	-1.9%	3.7	Pass
Co_04 York [B1]	Inbound	31,036	30,479	-1.8%	3.2	Pass
Co_04 York [B1]	Outbound	8,362	7,980	-4.6%	4.2	Pass
Co_05 Sheffield [B1]	Inbound	7,500	6,864	-8.5%	7.5	Fail
Co_05 Sheffield [B1]	Outbound	14,833	14,125	-4.8%	5.9	Pass
Co_07 GM (External) [B1]	Inbound	11,549	10,400	-9.9%	11.0	Fail
Co_07 GM (External) [B1]	Outbound	37,489	36,757	-2.0%	3.8	Pass
Co_08 Grimsby UA [B1]	Inbound	34,675	34,243	-1.2%	2.3	Pass
Co_08 Grimsby UA [B1]	Outbound	4,725	4,539	-3.9%	2.7	Pass
Co_10 Warrington [B1]	Inbound	4,465	4,417	-1.1%	0.7	Pass
Co_10 Warrington [B1]	Outbound	7,114	6,690	-6.0%	5.1	Fail
Co_11 Wigan [B1]	Inbound	7,437	6,949	-6.6%	5.8	Fail
Co_11 Wigan [B1]	Outbound	6,733	6,602	-1.9%	1.6	Pass
Co_12 Barnsley [B1]	Inbound	6,542	6,519	-0.3%	0.3	Pass
Co_12 Barnsley [B1]	Outbound	7,483	7,055	-5.7%	5.0	Fail
Co_13 Rotherham [B1]	Inbound	8,745	8,217	-6.0%	5.7	Fail
Co_13 Rotherham [B1]	Outbound	7,253	7,050	-2.8%	2.4	Pass
Co_14 Preston [B1]	Inbound	7,163	7,023	-2.0%	1.7	Pass
Co_14 Preston [B1]	Outbound	11,428	10,853	-5.0%	5.4	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Co_16 Halifax [B1]	Inbound	10,463	10,222	-2.3%	2.4	Pass
Co_16 Halifax [B1]	Outbound	7,030	6,713	-4.5%	3.8	Pass
Co_50 Hull Inner Urban	Inbound	6,599	6,548	-0.8%	0.6	Pass
Co_50 Hull Inner Urban	Outbound	7,971	7,824	-1.8%	1.7	Pass
Co_52 Leeds Inner Urban	Inbound	5,965	6,384	7.0%	5.3	Fail
Co_52 Leeds Inner Urban	Outbound	22,119	21,508	-2.8%	4.1	Pass
Co_53 Leeds Outer Urban	Inbound	14,556	13,972	-4.0%	4.9	Pass
Co_53 Leeds Outer Urban	Outbound	32,837	32,490	-1.1%	1.9	Pass
Co_54 Manchester Urban	Inbound	26,742	26,619	-0.5%	0.8	Pass
Co_54 Manchester Urban	Outbound	14,554	13,747	-5.5%	6.8	Fail
Docks	Inbound	9,335	9,752	4.5%	4.3	Pass
Docks	Outbound	4,705	4,564	-3.0%	2.1	Pass
LPL Radial N	Northbound	4,940	4,667	-5.5%	3.9	Fail
LPL Radial N	Southbound	3,505	3,324	-5.2%	3.1	Fail
N of A5036	Northbound	5,747	5,308	-7.6%	5.9	Fail
N of A5036	Southbound	2,578	2,541	-1.5%	0.7	Pass
Northern	Northbound	3,987	3,897	-2.3%	1.4	Pass
Northern	Southbound	2,696	2,395	-11.1%	6.0	Fail
Sc_01 M6 Screenline [B1]	Eastbound	2,973	3,011	1.3%	0.7	Pass
Sc_01 M6 Screenline [B1]	Westbound	32,599	32,429	-0.5%	0.9	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	32,245	31,631	-1.9%	3.4	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	1,712	1,517	-11.4%	4.8	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	2,405	2,113	-12.2%	6.2	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	6,521	6,434	-1.3%	1.1	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	7,726	7,355	-4.8%	4.3	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	2,550	2,390	-6.3%	3.2	Fail
Sc_07 Transpennine SL	Eastbound	3,514	3,377	-3.9%	2.3	Pass
Sc_07 Transpennine SL	Westbound	9,029	8,629	-4.4%	4.3	Pass
Sc_08 M62 Screenline [B1]	Northbound	8,539	8,144	-4.6%	4.3	Pass
Sc_08 M62 Screenline [B1]	Southbound	42,297	41,593	-1.7%	3.4	Pass
Sc_09 M1 Screenline [B1]	Eastbound	38,600	38,413	-0.5%	1.0	Pass
Sc_09 M1 Screenline [B1]	Westbound	31,766	31,340	-1.3%	2.4	Pass
Sc_10 A1(M) West Yorks	Eastbound	29,148	28,664	-1.7%	2.8	Pass
Sc_10 A1(M) West Yorks	Westbound	19,522	19,351	-0.9%	1.2	Pass
Sc_11 Eastern Screenline [B1]	Eastbound	19,385	19,518	0.7%	1.0	Pass
Sc_11 Eastern Screenline [B1]	Westbound	8,788	8,823	0.4%	0.4	Pass
Sc_12 Hull & Beverly [B1]	Eastbound	9,746	9,436	-3.2%	3.2	Pass
Sc_12 Hull & Beverly [B1]	Westbound	4,003	4,006	0.1%	0.0	Pass
Sc_13 Blackpool [B1]	Eastbound	3,600	3,595	-0.1%	0.1	Pass
Sc_13 Blackpool [B1]	Westbound	4,630	4,302	-7.1%	4.9	Fail
Sc_14 Chester [B1]	Eastbound	4,440	4,305	-3.0%	2.0	Pass
Sc_14 Chester [B1]	Westbound	5,951	5,800	-2.5%	2.0	Pass
Sc_15 A1(M) RIS Screenline [B1]	Northbound	6,474	6,438	-0.6%	0.4	Pass
Sc_15 A1(M) RIS Screenline [B1]	Southbound	3,338	3,285	-1.6%	0.9	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Sc_16 Northern Boundary [A]	Northbound	3,776	3,480	-7.8%	4.9	Fail
Sc_16 Northern Boundary [A]	Southbound	8,515	8,537	0.3%	0.2	Pass
Sc_17 Southern Boundary [A]	Northbound	8,571	8,670	1.2%	1.1	Pass
Sc_17 Southern Boundary [A]	Southbound	22,485	21,816	-3.0%	4.5	Pass
Sc_18 North Wales Boundary [A]	Eastbound	22,749	22,199	-2.4%	3.7	Pass
Sc_18 North Wales Boundary [A]	Westbound	7,985	8,052	0.8%	0.7	Pass
Sc_50 Leeds Central [B3]	Eastbound	7,140	7,679	7.5%	6.3	Fail
Sc_50 Leeds Central [B3]	Westbound	9,135	8,129	-11.0%	10.8	Fail
Sc_51 Sheffield Central [B3]	Northbound	10,958	10,707	-2.3%	2.4	Pass
Sc_51 Sheffield Central [B3]	Southbound	5,654	6,114	8.1%	6.0	Fail
South of E Lancs	Northbound	4,013	3,833	-4.5%	2.9	Pass
South of E Lancs	Southbound	6,839	7,398	8.2%	6.6	Fail
West of M57	Northbound	6,869	6,971	1.5%	1.2	Pass
West of M57	Southbound	8,371	8,649	3.3%	3.0	Pass

Table 6-13 Calibration Screenlines - IP Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Co_01 GM (Inner) [B1]	Inbound	4,339	4,530	4.4%	2.9	Pass
Co_01 GM (Inner) [B1]	Outbound	34,370	33,889	-1.4%	2.6	Pass
Co_03 Leeds-Bradford	Inbound	28,220	28,265	0.2%	0.3	Pass
Co_03 Leeds-Bradford	Outbound	36,977	36,267	-1.9%	3.7	Pass
Co_04 York [B1]	Inbound	31,036	30,479	-1.8%	3.2	Pass
Co_04 York [B1]	Outbound	8,362	7,980	-4.6%	4.2	Pass
Co_05 Sheffield [B1]	Inbound	7,500	6,864	-8.5%	7.5	Fail
Co_05 Sheffield [B1]	Outbound	14,833	14,125	-4.8%	5.9	Pass
Co_07 GM (External) [B1]	Inbound	11,549	10,400	-9.9%	11.0	Fail
Co_07 GM (External) [B1]	Outbound	37,489	36,757	-2.0%	3.8	Pass
Co_08 Grimsby UA [B1]	Inbound	34,675	34,243	-1.2%	2.3	Pass
Co_08 Grimsby UA [B1]	Outbound	4,725	4,539	-3.9%	2.7	Pass
Co_10 Warrington [B1]	Inbound	4,465	4,417	-1.1%	0.7	Pass
Co_10 Warrington [B1]	Outbound	7,114	6,690	-6.0%	5.1	Fail
Co_11 Wigan [B1]	Inbound	7,437	6,949	-6.6%	5.8	Fail
Co_11 Wigan [B1]	Outbound	6,733	6,602	-1.9%	1.6	Pass
Co_12 Barnsley [B1]	Inbound	6,542	6,519	-0.3%	0.3	Pass
Co_12 Barnsley [B1]	Outbound	7,483	7,055	-5.7%	5.0	Fail
Co_13 Rotherham [B1]	Inbound	8,745	8,217	-6.0%	5.7	Fail
Co_13 Rotherham [B1]	Outbound	7,253	7,050	-2.8%	2.4	Pass
Co_14 Preston [B1]	Inbound	7,163	7,023	-2.0%	1.7	Pass
Co_14 Preston [B1]	Outbound	11,428	10,853	-5.0%	5.4	Pass
Co_16 Halifax [B1]	Inbound	10,463	10,222	-2.3%	2.4	Pass
Co_16 Halifax [B1]	Outbound	7,030	6,713	-4.5%	3.8	Pass
Co_50 Hull Inner Urban	Inbound	6,599	6,548	-0.8%	0.6	Pass
Co_50 Hull Inner Urban	Outbound	7,971	7,824	-1.8%	1.7	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Co_52 Leeds Inner Urban	Inbound	5,965	6,384	7.0%	5.3	Fail
Co_52 Leeds Inner Urban	Outbound	22,119	21,508	-2.8%	4.1	Pass
Co_53 Leeds Outer Urban	Inbound	14,556	13,972	-4.0%	4.9	Pass
Co_53 Leeds Outer Urban	Outbound	32,837	32,490	-1.1%	1.9	Pass
Co_54 Manchester Urban	Inbound	26,742	26,619	-0.5%	0.8	Pass
Co_54 Manchester Urban	Outbound	14,554	13,747	-5.5%	6.8	Fail
Docks	Inbound	9,335	9,752	4.5%	4.3	Pass
Docks	Outbound	4,705	4,564	-3.0%	2.1	Pass
LPL Radial N	Northbound	4,940	4,667	-5.5%	3.9	Fail
LPL Radial N	Southbound	3,505	3,324	-5.2%	3.1	Fail
N of A5036	Northbound	5,747	5,308	-7.6%	5.9	Fail
N of A5036	Southbound	2,578	2,541	-1.5%	0.7	Pass
Northern	Northbound	3,987	3,897	-2.3%	1.4	Pass
Northern	Southbound	2,696	2,395	-11.1%	6.0	Fail
Sc_01 M6 Screenline [B1]	Eastbound	2,973	3,011	1.3%	0.7	Pass
Sc_01 M6 Screenline [B1]	Westbound	32,599	32,429	-0.5%	0.9	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	32,245	31,631	-1.9%	3.4	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	1,712	1,517	-11.4%	4.8	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	2,405	2,113	-12.2%	6.2	Fail
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	6,521	6,434	-1.3%	1.1	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	7,726	7,355	-4.8%	4.3	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	2,550	2,390	-6.3%	3.2	Fail
Sc_07 Transpennine SL	Eastbound	3,514	3,377	-3.9%	2.3	Pass
Sc_07 Transpennine SL	Westbound	9,029	8,629	-4.4%	4.3	Pass
Sc_08 M62 Screenline [B1]	Northbound	8,539	8,144	-4.6%	4.3	Pass
Sc_08 M62 Screenline [B1]	Southbound	42,297	41,593	-1.7%	3.4	Pass
Sc_09 M1 Screenline [B1]	Eastbound	38,600	38,413	-0.5%	1.0	Pass
Sc_09 M1 Screenline [B1]	Westbound	31,766	31,340	-1.3%	2.4	Pass
Sc_10 A1(M) West Yorks	Eastbound	29,148	28,664	-1.7%	2.8	Pass
Sc_10 A1(M) West Yorks	Westbound	19,522	19,351	-0.9%	1.2	Pass
Sc_11 Eastern Screenline [B1]	Eastbound	19,385	19,518	0.7%	1.0	Pass
Sc_11 Eastern Screenline [B1]	Westbound	8,788	8,823	0.4%	0.4	Pass
Sc_12 Hull & Beverly [B1]	Eastbound	9,746	9,436	-3.2%	3.2	Pass
Sc_12 Hull & Beverly [B1]	Westbound	4,003	4,006	0.1%	0.0	Pass
Sc_13 Blackpool [B1]	Eastbound	3,600	3,595	-0.1%	0.1	Pass
Sc_13 Blackpool [B1]	Westbound	4,630	4,302	-7.1%	4.9	Pass
Sc_14 Chester [B1]	Eastbound	4,440	4,305	-3.0%	2.0	Pass
Sc_14 Chester [B1]	Westbound	5,951	5,800	-2.5%	2.0	Pass
Sc_15 A1(M) RIS Screenline [B1]	Northbound	6,474	6,438	-0.6%	0.4	Pass
Sc_15 A1(M) RIS Screenline [B1]	Southbound	3,338	3,285	-1.6%	0.9	Pass
Sc_16 Northern Boundary [A]	Northbound	3,776	3,480	-7.8%	4.9	Pass
Sc_16 Northern Boundary [A]	Southbound	8,515	8,537	0.3%	0.2	Pass
Sc_17 Southern Boundary [A]	Northbound	8,571	8,670	1.2%	1.1	Pass
Sc_17 Southern Boundary [A]	Southbound	22,485	21,816	-3.0%	4.5	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Sc_18 North Wales Boundary [A]	Eastbound	22,749	22,199	-2.4%	3.7	Pass
Sc_18 North Wales Boundary [A]	Westbound	7,985	8,052	0.8%	0.7	Pass
Sc_50 Leeds Central [B3]	Eastbound	7,140	7,679	7.5%	6.3	Pass
Sc_50 Leeds Central [B3]	Westbound	9,135	8,129	-11.0%	10.8	Pass
Sc_51 Sheffield Central [B3]	Northbound	10,958	10,707	-2.3%	2.4	Pass
Sc_51 Sheffield Central [B3]	Southbound	5,654	6,114	8.1%	6.0	Pass
South of E Lancs	Northbound	4,013	3,833	-4.5%	2.9	Pass
South of E Lancs	Southbound	6,839	7,398	8.2%	6.6	Pass
West of M57	Northbound	6,869	6,971	1.5%	1.2	Pass
West of M57	Southbound	8,371	8,649	3.3%	3.0	Pass

Table 6-14 Calibration Screenlines - PM Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Co_01 GM (Inner) [B1]	Inbound	4,339	4,530	4.4%	2.9	Pass
Co_01 GM (Inner) [B1]	Outbound	34,370	33,889	-1.4%	2.6	Pass
Co_03 Leeds-Bradford	Inbound	28,220	28,265	0.2%	0.3	Pass
Co_03 Leeds-Bradford	Outbound	36,977	36,267	-1.9%	3.7	Pass
Co_04 York [B1]	Inbound	31,036	30,479	-1.8%	3.2	Pass
Co_04 York [B1]	Outbound	8,362	7,980	-4.6%	4.2	Pass
Co_05 Sheffield [B1]	Inbound	7,500	6,864	-8.5%	7.5	Pass
Co_05 Sheffield [B1]	Outbound	14,833	14,125	-4.8%	5.9	Pass
Co_07 GM (External) [B1]	Inbound	11,549	10,400	-9.9%	11.0	Pass
Co_07 GM (External) [B1]	Outbound	37,489	36,757	-2.0%	3.8	Pass
Co_08 Grimsby UA [B1]	Inbound	34,675	34,243	-1.2%	2.3	Pass
Co_08 Grimsby UA [B1]	Outbound	4,725	4,539	-3.9%	2.7	Pass
Co_10 Warrington [B1]	Inbound	4,465	4,417	-1.1%	0.7	Pass
Co_10 Warrington [B1]	Outbound	7,114	6,690	-6.0%	5.1	Pass
Co_11 Wigan [B1]	Inbound	7,437	6,949	-6.6%	5.8	Pass
Co_11 Wigan [B1]	Outbound	6,733	6,602	-1.9%	1.6	Pass
Co_12 Barnsley [B1]	Inbound	6,542	6,519	-0.3%	0.3	Pass
Co_12 Barnsley [B1]	Outbound	7,483	7,055	-5.7%	5.0	Pass
Co_13 Rotherham [B1]	Inbound	8,745	8,217	-6.0%	5.7	Pass
Co_13 Rotherham [B1]	Outbound	7,253	7,050	-2.8%	2.4	Pass
Co_14 Preston [B1]	Inbound	7,163	7,023	-2.0%	1.7	Pass
Co_14 Preston [B1]	Outbound	11,428	10,853	-5.0%	5.4	Pass
Co_16 Halifax [B1]	Inbound	10,463	10,222	-2.3%	2.4	Pass
Co_16 Halifax [B1]	Outbound	7,030	6,713	-4.5%	3.8	Pass
Co_50 Hull Inner Urban	Inbound	6,599	6,548	-0.8%	0.6	Pass
Co_50 Hull Inner Urban	Outbound	7,971	7,824	-1.8%	1.7	Pass
Co_52 Leeds Inner Urban	Inbound	5,965	6,384	7.0%	5.3	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Co_52 Leeds Inner Urban	Outbound	22,119	21,508	-2.8%	4.1	Pass
Co_53 Leeds Outer Urban	Inbound	14,556	13,972	-4.0%	4.9	Pass
Co_53 Leeds Outer Urban	Outbound	32,837	32,490	-1.1%	1.9	Pass
Co_54 Manchester Urban	Inbound	26,742	26,619	-0.5%	0.8	Pass
Co_54 Manchester Urban	Outbound	14,554	13,747	-5.5%	6.8	Pass
Docks	Inbound	9,335	9,752	4.5%	4.3	Pass
Docks	Outbound	4,705	4,564	-3.0%	2.1	Pass
LPL Radial N	Northbound	4,940	4,667	-5.5%	3.9	Pass
LPL Radial N	Southbound	3,505	3,324	-5.2%	3.1	Pass
N of A5036	Northbound	5,747	5,308	-7.6%	5.9	Pass
N of A5036	Southbound	2,578	2,541	-1.5%	0.7	Pass
Northern	Northbound	3,987	3,897	-2.3%	1.4	Pass
Northern	Southbound	2,696	2,395	-11.1%	6.0	Pass
Sc_01 M6 Screenline [B1]	Eastbound	2,973	3,011	1.3%	0.7	Pass
Sc_01 M6 Screenline [B1]	Westbound	32,599	32,429	-0.5%	0.9	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Northbound	32,245	31,631	-1.9%	3.4	Pass
Sc_02 M6 RIS Screenline 1 [B1]	Southbound	1,712	1,517	-11.4%	4.8	Pass
Sc_03 M6 RIS Screenline 2 [B1]	Northbound	2,405	2,113	-12.2%	6.2	Pass
Sc_03 M6 RIS Screenline 2 [B1]	Southbound	6,521	6,434	-1.3%	1.1	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Northbound	7,726	7,355	-4.8%	4.3	Pass
Sc_04 M53 RIS Screenline 1 [B1]	Southbound	2,550	2,390	-6.3%	3.2	Pass
Sc_07 Transpennine SL	Eastbound	3,514	3,377	-3.9%	2.3	Pass
Sc_07 Transpennine SL	Westbound	9,029	8,629	-4.4%	4.3	Pass
Sc_08 M62 Screenline [B1]	Northbound	8,539	8,144	-4.6%	4.3	Pass
Sc_08 M62 Screenline [B1]	Southbound	42,297	41,593	-1.7%	3.4	Pass
Sc_09 M1 Screenline [B1]	Eastbound	38,600	38,413	-0.5%	1.0	Pass
Sc_09 M1 Screenline [B1]	Westbound	31,766	31,340	-1.3%	2.4	Pass
Sc_10 A1(M) West Yorks	Eastbound	29,148	28,664	-1.7%	2.8	Pass
Sc_10 A1(M) West Yorks	Westbound	19,522	19,351	-0.9%	1.2	Pass
Sc_11 Eastern Screenline [B1]	Eastbound	19,385	19,518	0.7%	1.0	Pass
Sc_11 Eastern Screenline [B1]	Westbound	8,788	8,823	0.4%	0.4	Pass
Sc_12 Hull & Beverly [B1]	Eastbound	9,746	9,436	-3.2%	3.2	Pass
Sc_12 Hull & Beverly [B1]	Westbound	4,003	4,006	0.1%	0.0	Pass
Sc_13 Blackpool [B1]	Eastbound	3,600	3,595	-0.1%	0.1	Pass
Sc_13 Blackpool [B1]	Westbound	4,630	4,302	-7.1%	4.9	Pass
Sc_14 Chester [B1]	Eastbound	4,440	4,305	-3.0%	2.0	Pass
Sc_14 Chester [B1]	Westbound	5,951	5,800	-2.5%	2.0	Pass
Sc_15 A1(M) RIS Screenline [B1]	Northbound	6,474	6,438	-0.6%	0.4	Pass
Sc_15 A1(M) RIS Screenline [B1]	Southbound	3,338	3,285	-1.6%	0.9	Pass
Sc_16 Northern Boundary [A]	Northbound	3,776	3,480	-7.8%	4.9	Pass
Sc_16 Northern Boundary [A]	Southbound	8,515	8,537	0.3%	0.2	Pass
Sc_17 Southern Boundary [A]	Northbound	8,571	8,670	1.2%	1.1	Pass

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass /Fail
Sc_17 Southern Boundary [A]	Southbound	22,485	21,816	-3.0%	4.5	Pass
Sc_18 North Wales Boundary [A]	Eastbound	22,749	22,199	-2.4%	3.7	Pass
Sc_18 North Wales Boundary [A]	Westbound	7,985	8,052	0.8%	0.7	Pass
Sc_50 Leeds Central [B3]	Eastbound	7,140	7,679	7.5%	6.3	Pass
Sc_50 Leeds Central [B3]	Westbound	9,135	8,129	-11.0%	10.8	Pass
Sc_51 Sheffield Central [B3]	Northbound	10,958	10,707	-2.3%	2.4	Pass
Sc_51 Sheffield Central [B3]	Southbound	5,654	6,114	8.1%	6.0	Pass
South of E Lancs	Northbound	4,013	3,833	-4.5%	2.9	Pass
South of E Lancs	Southbound	6,839	7,398	8.2%	6.6	Pass
West of M57	Northbound	6,869	6,971	1.5%	1.2	Pass
West of M57	Southbound	8,371	8,649	3.3%	3.0	Pass

Where a screenline does fail for Total flow or Cars, the difference is less than 15% and considered acceptable, with the exception of four screenlines.

6.5 Link Flow Calibration

The locations of the calibration counts are shown in Figure 3-1 and, in total, 206 calibration links have been considered.

The TAG criteria for link flow calibration are shown in *Table 6-15* and for a link to pass it only needs to satisfy one of the two criteria.

Table 6-15 Link flow TAG criteria

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

TAG guidance unit M3.1, paragraph 3.3.12, states that the above comparison of modelled and observed flows should be presented for total vehicle flows and for car flows.

6.5.1 Prior Matrix Link Calibration

A summary of the Prior model calibration results is presented in *Table 6-16*.

Table 6-16 Summary of Prior Model Calibration Results

Time Period	Vehicle Class	Link		GEH		Overall	
		Number Pass	% Pass	Number Pass	% Pass	Number Pass	% Pass
AM	All	97	47%	95	46%	95	46%

Time Period	Vehicle Class	Link		GEH		Overall	
		Number Pass	% Pass	Number Pass	% Pass	Number Pass	% Pass
	Car	102	50%	105	51%	105	51%
IP	All	103	50%	117	57%	117	57%
	Car	102	50%	115	56%	115	56%
PM	All	98	48%	100	49%	100	49%
	Car	64	67%	87	42%	87	42%

Table 6-16 shows less than 50% of links meet the link flow criteria in the AM and PM period. Less than 60 % of links meet the link flow criteria in the IP period. Therefore, the Prior models do not on their own meet the TAG link flow criteria for total link flows.

6.5.2 Post ME Matrix Link Flow Calibration

A summary of the link flow calibration results is provided in Table 6-17 for the total flow and cars, with the results for each link are provided in Appendix A.

Table 6-17 Summary of Calibration Results

Time Period	Vehicle Class	Link Flow		GEH		Overall	
		Number Pass	% Pass	Number Pass	% Pass	Number Pass	% Pass
AM	All	171	84%	178	87%	184	90%
	Car	172	84%	178	87%	185	91%
IP	All	175	86%	189	93%	195	96%
	Car	175	86%	188	92%	194	95%
PM	All	167	82%	180	88%	186	91%
	Car	163	80%	179	88%	185	91%

Table 6-17 shows over 90% of links satisfy the calibration link flow criteria in the AM, Inter peak and PM, exceeding the minimum of 85% of links as set out in TAG. This gives confidence that all time periods model flow on the individual links matches the observed counts.

Figure 6-3 to Figure 6-5 geographically show the passing and failing calibration links near the A5036 based on total flows.

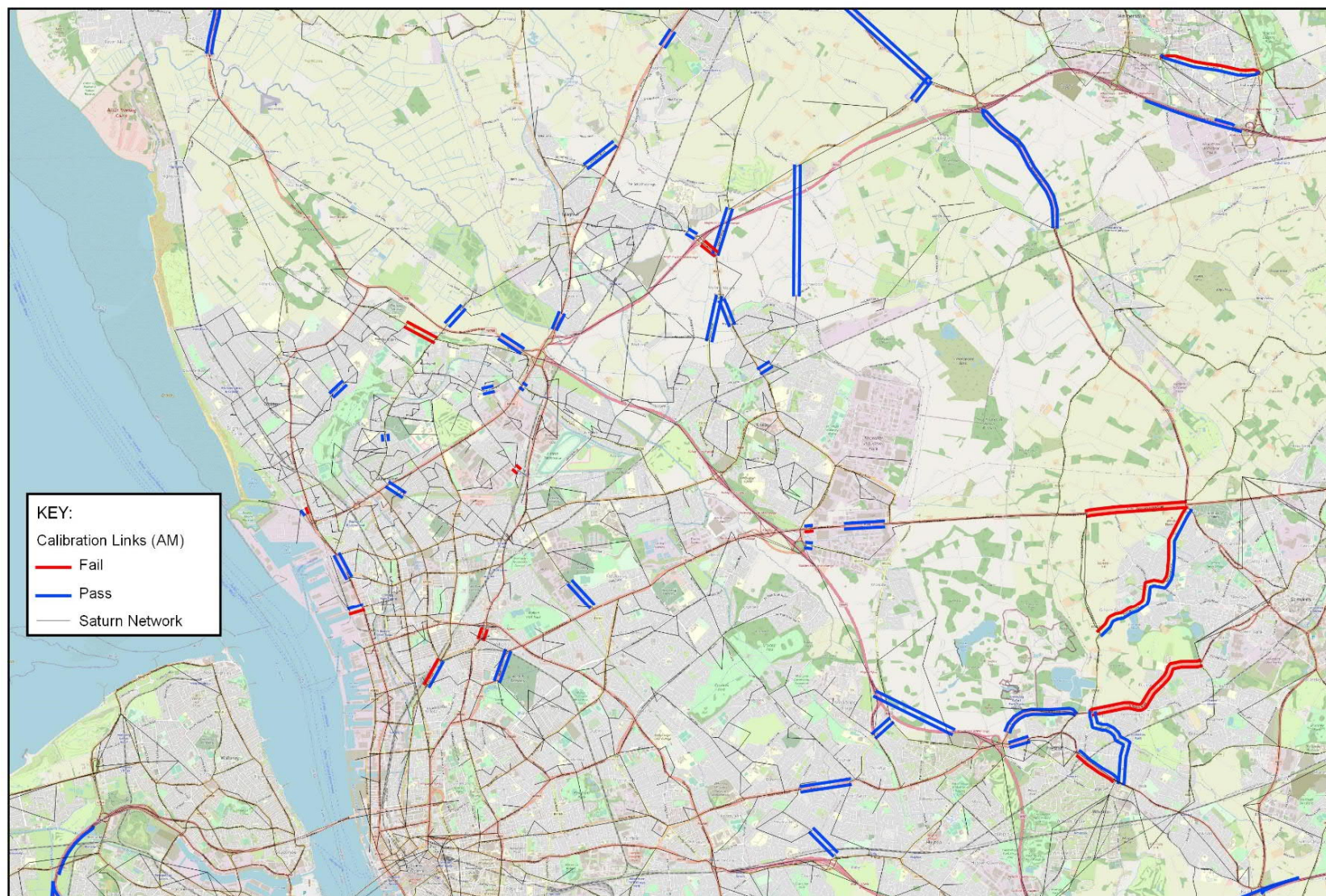


Figure 6-3 Calibration Links based on Total Flow - AM Period

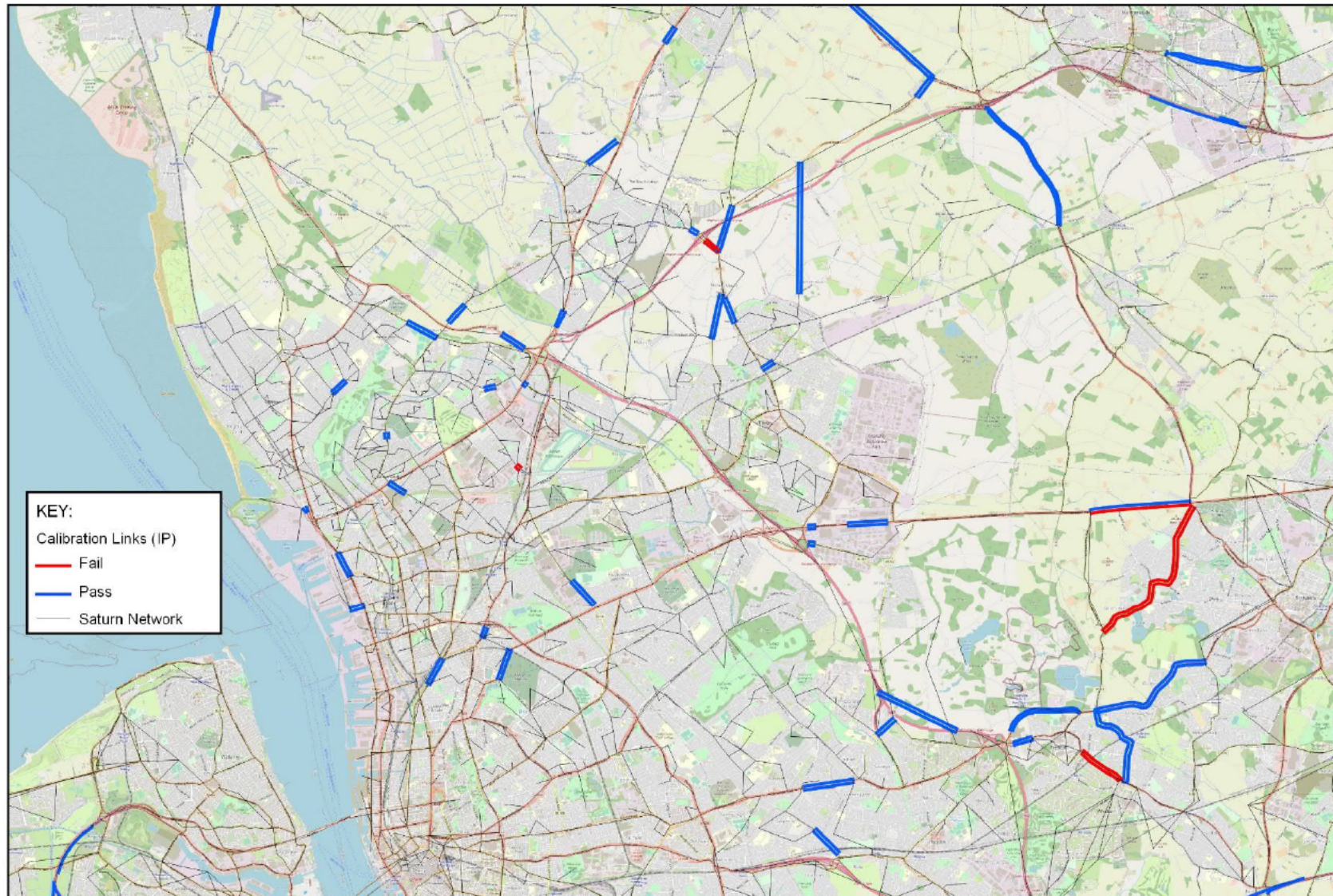


Figure 6-4 Calibration Links based on Total Flow - IP Period

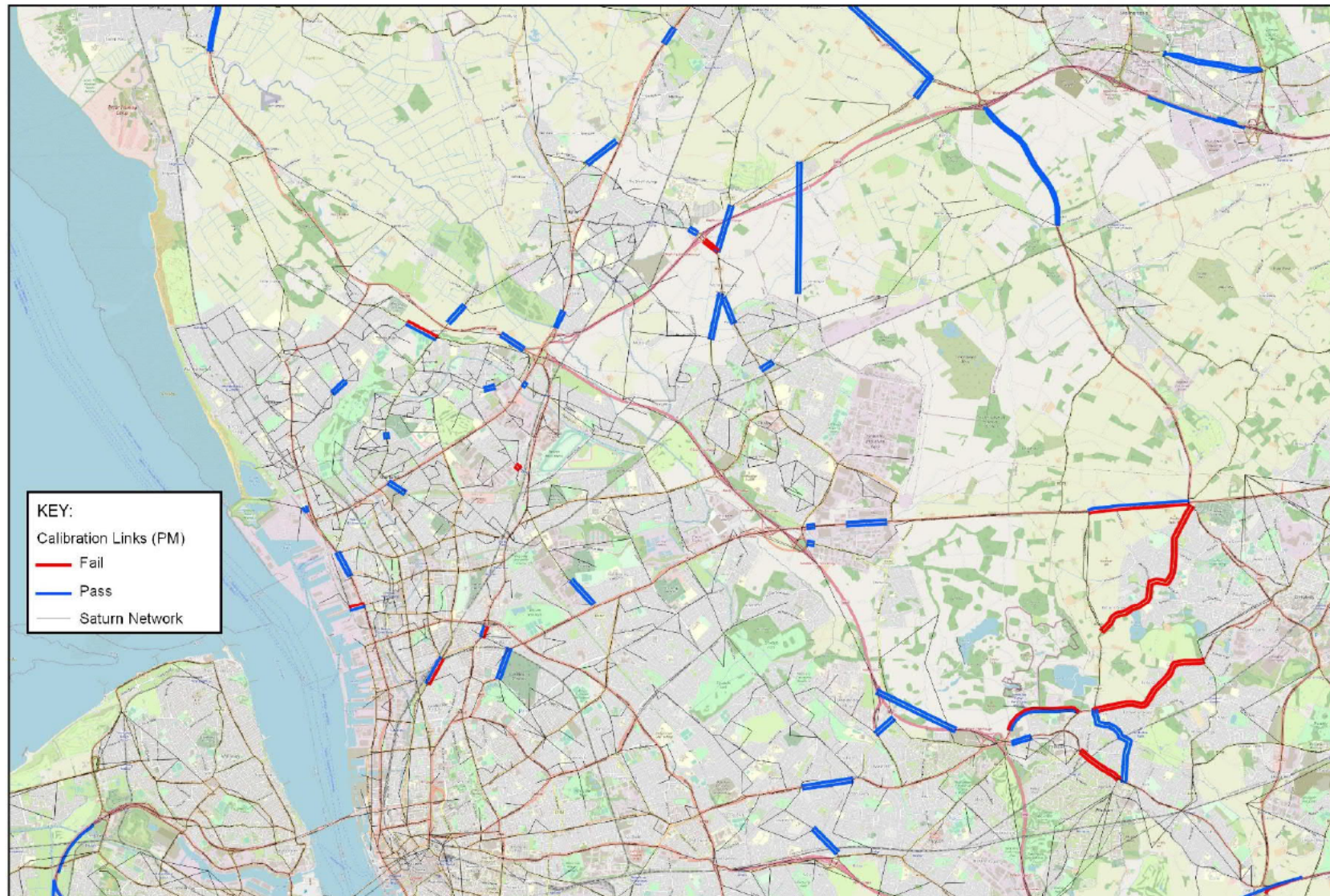


Figure 6-5 Calibration Links based on Total Flow - PM Period

The figures show most of the links on and around the A5036 satisfy the link flow criteria in all 3 time periods. The links that fail on and around the A5036 are either close to passing with a GEH of 8 or less or are links with low flows. This indicates that the model performs well in the area around the A5036 which gives confidence that the models provide a good representation of the traffic flows in this area.

6.6 Impact of Matrix Estimation

When undertaking ME it is important that the effects of ME are minimised such that the trip patterns of the Prior matrix are retained in the Post ME matrix. TAG M3.1 provides a set of criteria to assess the significance of matrix estimation changes which are shown in Table 6-18.

Table 6-18 Significance of Matrix Estimation changes

Measure	Significance Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zone trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

The changes resulting from ME for the A5036 model are detailed in the sections below. The changes have been checked for the whole model and also the Fully Modelled Area to ensure changes closer to the schemes are within the TAG criteria bounds.

6.6.1 Matrix Cell Value Changes

The cell values of the Prior matrix have been plotted against the same cell of the Post ME matrix and the trend line evaluated for both the full model and Fully Modelled Area. The results for each peak are presented in Table 6-19. Intrazonal trips have been removed from analysis.

Table 6-19 Matrix Cell Value Changes

Time Period	Full Matrix			Fully Modelled Area		
	Intercept	Slope	R^2	Intercept	Slope	R^2
AM	0.002	1.000	1.000	0.005	0.999	0.994
IP	0.001	1.000	1.000	0.002	1.000	0.998
PM	0.002	1.000	1.000	0.008	0.998	0.994

Table 6-19 shows the matrix cell value changes meet the TAG criteria for both the full matrix and Fully Modelled Area as all intercepts are close to zero, all slopes are between 0.99 and 1.01, and all R^2 values are greater than 0.98.

6.6.2 Matrix Trip End Changes

The origin trip ends for each zone in the Prior matrix has been plotted against the origin trip ends for the same zone in the Post ME matrix and trend line evaluated for both the full matrix and Fully Modelled Area. The same process has been undertaken for the destination trip ends. The results

for the origin trip ends in each peak are presented in Table 6-20 and destination trip ends in Table 6-21. Regression plots for the origin and destination trip ends can be found in Appendix B.

Table 6-20 *Origin Trip End Changes*

Time Period	Full Matrix			Fully Modelled Area		
	Intercept	Slope	R ²	Intercept	Slope	R ²
AM	-11.2	0.998	0.9993	0.064	1.008	0.997
IP	-9.7	0.999	0.9991	0.72	1.003	0.999
PM	-12.3	0.998	0.9990	3.834	1.000	0.994

Table 6-21 *Destination Trip End Changes*

Time Period	Full Matrix			Fully Modelled Area		
	Intercept	Slope	R ²	Intercept	Slope	R ²
AM	-10.6	0.998	0.9993	2.811	0.998	0.996
IP	-10.0	0.999	0.9994	1.052	1.001	0.998
PM	-12.3	0.998	0.9994	3.834	1.007	0.997

Table 6-20 and Table 6-21 show that the full matrix satisfies the slope and R² criteria for the matrix zone trip ends in all time periods. The intercepts for the full matrix are negative in all time periods resulting from ME decreasing the demand, and still relatively small in magnitude and close to 0. Given the Slopes and R² values are equal to 1, the intercept values are considered acceptable.

In the fully modelled area, the R² values are greater than 0.98 for both origins and destinations, and all of the slopes satisfy the TAG criteria as they are between 0.99 and 1.01. The intercepts in all peaks have a positive intercept value which results from matrix estimation increasing demand in the fully modelled area in all time periods.

For all time periods, the regression plots were examined and outliers from the regression line investigated. The outliers were related to zones near calibration counts involved in matrix estimation. In all cases, the changes brought about by matrix estimation were considered reasonable.

6.6.3 Trip Length Distribution

Table 6-22 presents the mean and standard deviation of the trip length distributions for the three time periods. The results exclude the impact of external trips that do not pass through the fully modelled area, i.e. trips between zones in sector 11 and trip between zones in sector 12. The zoning is relatively coarse and as such inclusion of these trips will skew the mean and standard deviation reported.

Table 6-22 *Impact of ME on Trip Length Distribution*

Time Period	Measure	Prior (km)	Post ME (km)	% Difference
AM	Mean	19.03	19.40	2%
	Standard Deviation	44.50	44.78	1%
IP	Mean	17.77	18.46	4%

Time Period	Measure	Prior (km)	Post ME (km)	% Difference
	Standard Deviation	44.23	45.84	4%
PM	Mean	18.19	18.51	2%
	Standard Deviation	42.22	42.68	1%

Table 6-22 shows the difference in the mean and standard deviation between the Prior and Post ME trip length distributions are less than 5% in all three time periods and therefore satisfy the TAG criteria.

Figure 6-6 to Figure 6-8 shows the trip length distributions in distance bands for the Prior and Post ME models for the three time periods. The trip length distributions and changes in the means and standard deviations for the individual user classes are presented in Appendix B.

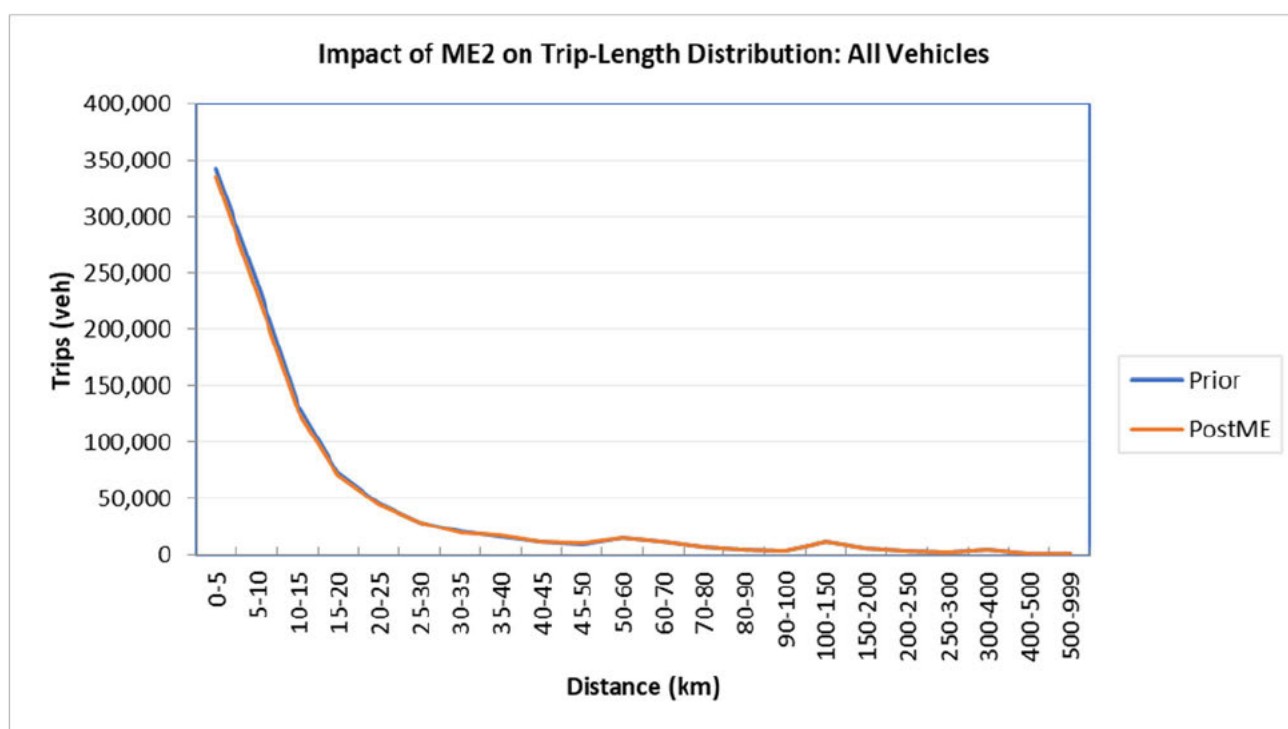


Figure 6-6 Trip Length Distribution for All Vehicles - AM Period

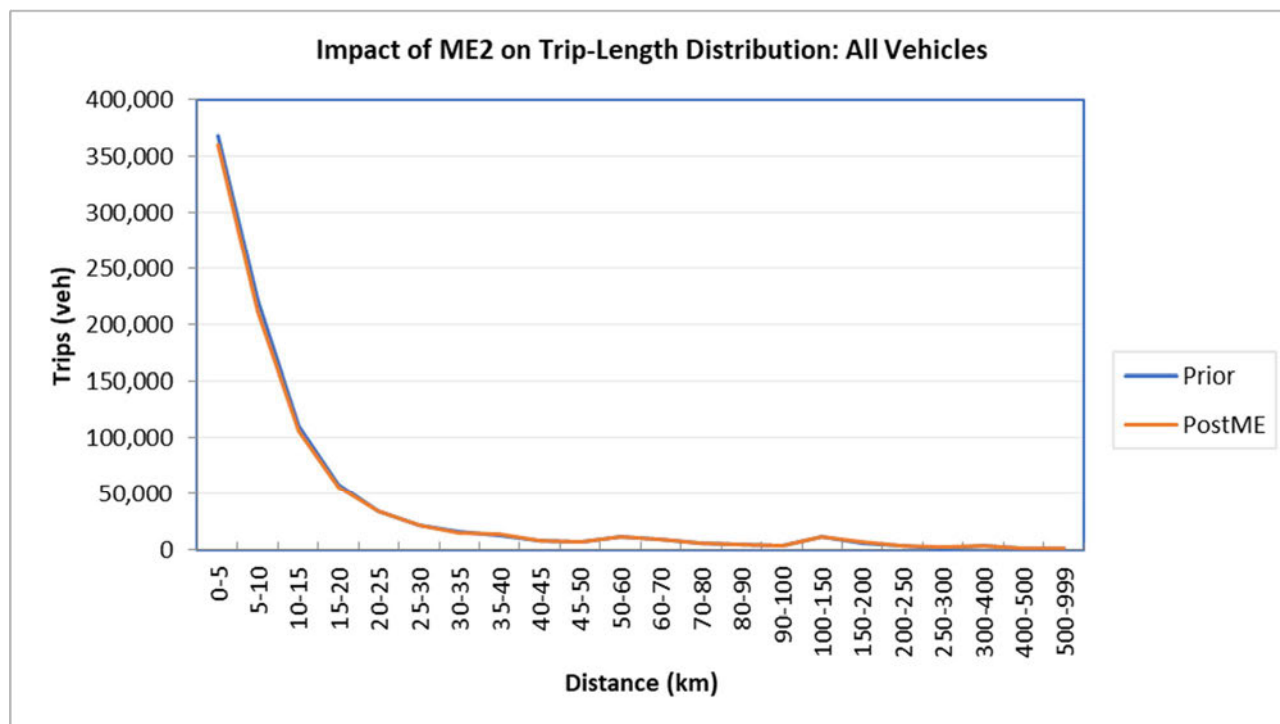


Figure 6-7 Trip Length Distribution for All Vehicles - IP Period

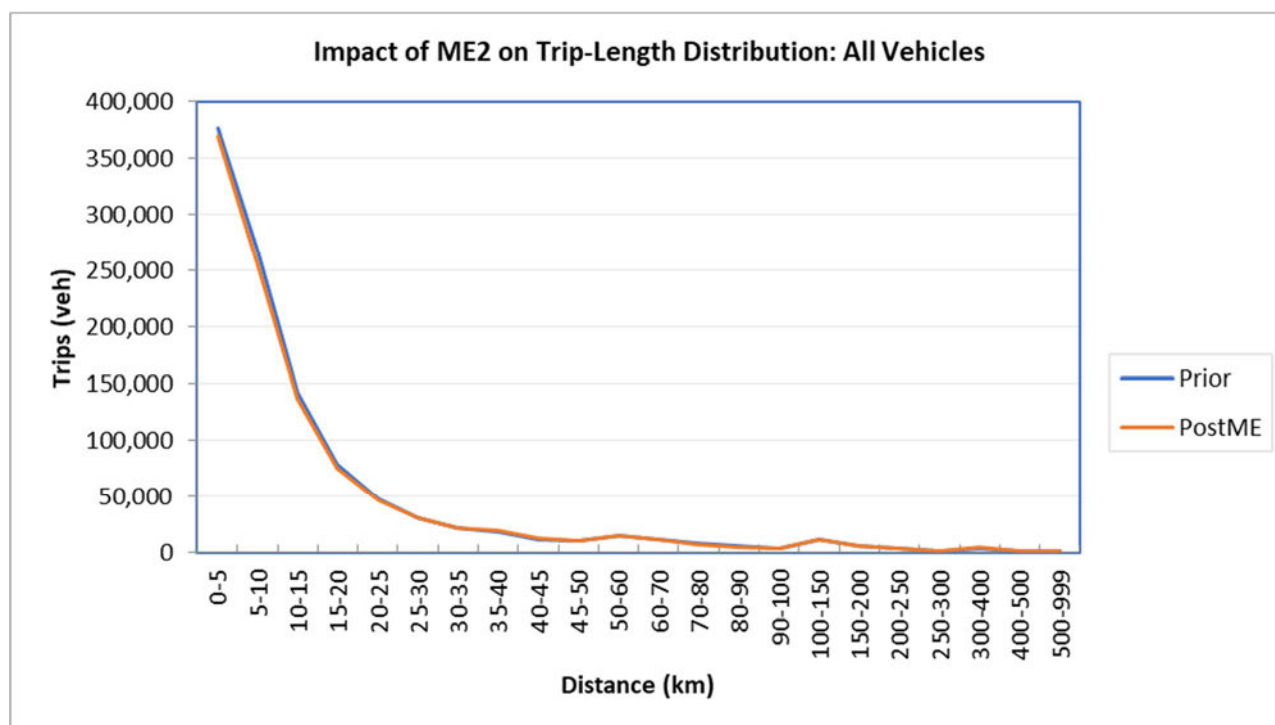


Figure 6-8 Trip Length Distribution for All Vehicles - PM Period

Figure 6-6 to Figure 6-8 show the trip length distributions of the Prior and Post ME models are similar. The largest proportional change is a decrease in trips in the 0-5km distance band in all three time periods.

6.6.4 Sector to Sector Movements

To evaluate the sector-to-sector level changes, the sector system was derived, the sector areas are presented in Table 6-23 and Figure 6-9.

Table 6-23 Model Sectors

Sector No	Sector Name
1	North Yorkshire
2	North Lincs
3	Lancashire
4	Merseyside
5	GM North
6	GM South
7	Cheshire
8	Bradford
9	Leeds
10	South Yorkshire
11	External North
12	External South

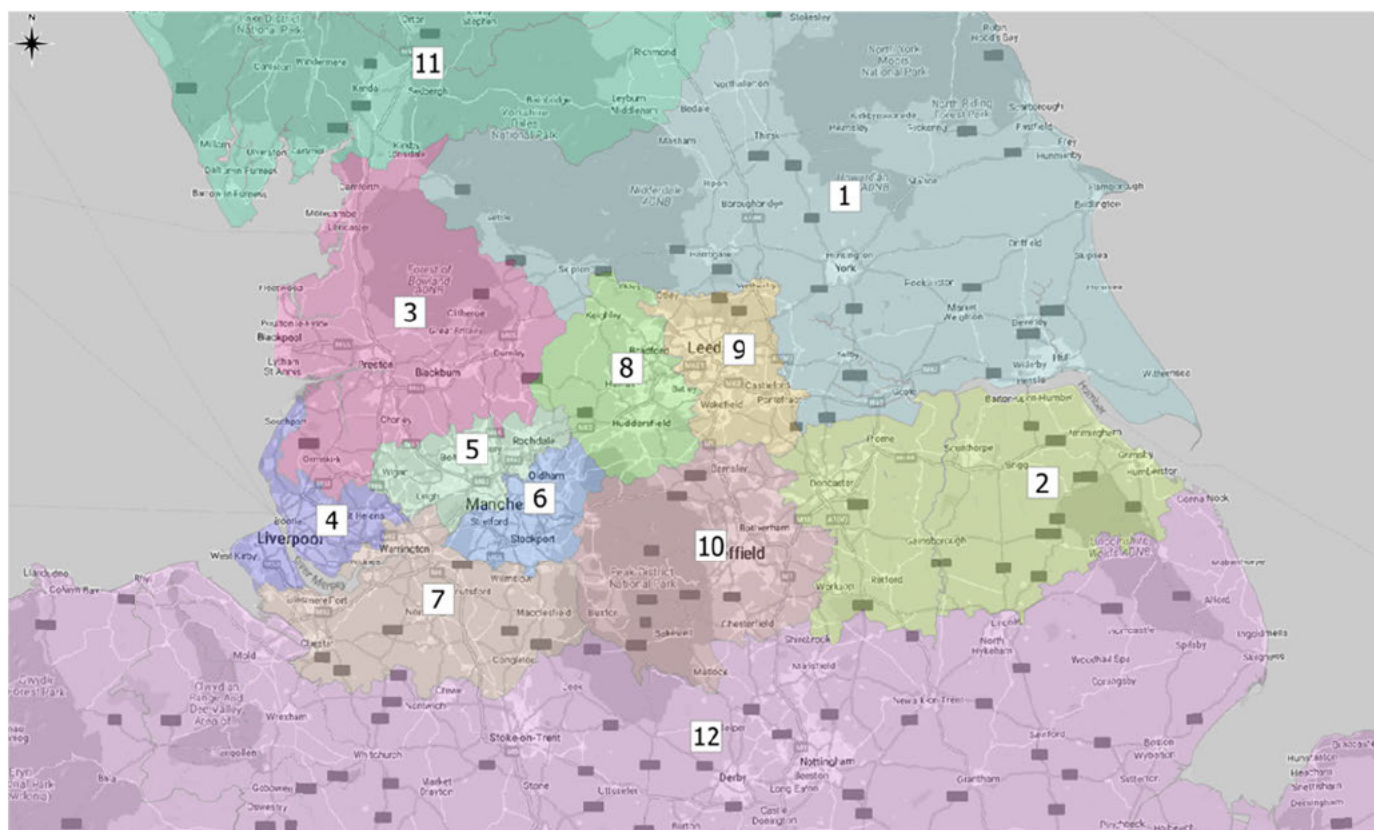


Figure 6-9 – Model Sector Map

TAG advises that the volume of trips should not change by more than 5% between pairs of sectors. As some sectors contained a smaller number of trips, it was considered that using the absolute differences to monitor the change in sector movements was more appropriate where the volume of trips should not change by more than 500. Table 6-24 provides a summary of the percentage of movements with a GEH of less than 4 and less than 10.

Table 6-24 Summary of Sector-to-Sector Changes

Time Period	% Movements Change <5% (200 trips minimum in Prior)	% Movements GEH <5	% Movements GEH <10
AM	41.5%	58.3%	95.1%
IP	40.7%	75.0%	96.5%
PM	37.1%	75.7%	93.1%

Table 6-24 shows 75 % of sector-to-sector movements have a GEH of 5 or less from comparing the Prior and Post ME matrices in IP and PM, with nearly all having a GEH less than 10. In the AM period there are 58% of sector-to-sector movements that have a GEH of less than 5. Where the GEH is greater than 10, the reason for the change has been investigated further.

The sector changes at a whole matrix level are presented in Table 6-25 for the AM period, Table 6-27 for the IP period and Table 6-29 for the PM period. Cells with a change of greater than 500 have been highlighted, blue for negative and green for positive.

The sector changes at a whole matrix level are presented as GEH in Table 6-26 for the AM period, Table 6-28 for the IP period and Table 6-30 for the PM period. Cells where the GEH is greater than 5 have been highlighted in red.

Table 6-25 Sector-to-Sector Changes – AM Period (all vehicles)

OD	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	-7,296	-69	13	73	20	-174	40	301	-302	43	22	51	-7,279
2	-71	-806	0	21	10	-39	7	96	-91	295	22	538	-19
3	-9	-10	-1,403	-281	60	-502	186	-83	-61	-47	-192	47	-2,297
4	92	41	33	82	250	271	-125	97	105	-9	23	250	1,112
5	-26	-3	-19	188	-1,096	-321	555	-109	-77	-53	15	15	-930
6	-67	1	-68	33	-196	-4,191	477	-177	-131	-223	6	-219	-4,754
7	18	15	14	-284	304	463	-1,155	9	13	-23	17	418	-190
8	345	78	-53	32	-81	-345	2	-1,157	-465	-148	55	174	-1,563
9	212	-39	-14	35	-39	-357	13	-458	-5,610	-154	26	188	-6,197
10	132	455	-50	-42	-72	-610	-87	-96	-178	-3,966	43	-90	-4,561
11	-21	16	-39	-27	17	-62	27	70	-53	-4	-1	-155	-231
12	107	300	91	36	11	-394	124	84	268	-176	38	-1,949	-1,461
Total	-6,584	-22	-1,496	-133	-811	-6,262	64	-1,423	-6,582	-4,465	74	-731	-28,370

Table 6-26 Sector-to-Sector Changes (GEH) – AM Period (all vehicles)

OD	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	26.3	1.6	0.5	6.2	1.5	7.9	4.0	6.9	3.9	1.5	0.4	1.5	23.9
2	1.6	3.8	0.1	2.9	1.4	3.1	0.9	6.0	2.7	4.2	1.3	7.1	0.1
3	0.3	1.2	4.3	4.0	0.7	9.0	5.7	3.0	3.6	4.2	4.8	1.4	6.4
4	6.8	5.3	0.5	0.3	4.9	5.9	1.3	6.8	7.3	0.9	1.8	5.3	3.4
5	1.6	0.3	0.2	3.4	4.2	2.5	8.9	4.4	4.2	4.2	1.0	0.5	2.9
6	4.0	0.1	1.4	0.7	1.7	13.5	5.4	6.6	6.8	6.0	0.3	5.3	13.3
7	1.8	2.3	0.5	3.1	6.3	5.2	5.1	0.9	1.2	1.2	1.5	4.8	0.7
8	6.9	4.8	2.0	2.6	3.4	10.2	0.2	4.5	4.2	4.9	4.2	6.9	5.3
9	2.8	1.3	1.2	3.2	2.4	14.8	1.3	4.6	20.8	3.1	1.5	5.5	20.2
10	4.6	6.1	5.6	4.1	5.5	14.7	3.6	2.9	2.9	14.1	2.9	1.2	14.4
11	0.4	1.1	1.2	2.6	1.2	3.0	2.4	5.0	2.7	0.2	0.0	4.2	0.6
12	3.2	4.5	3.0	0.8	0.5	8.7	1.3	3.9	7.3	2.1	1.1	2.2	1.6
Total	21.5	0.1	4.2	0.4	2.6	17.1	0.2	4.9	20.9	14.3	0.2	0.8	20.2

Table 6-27 Sector-to-Sector Changes – IP Period (all vehicles)

OD	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	-6,775	-77	11	60	16	-97	41	157	-254	28	-28	47	-6,870
2	-124	-1,235	9	34	33	21	39	79	-110	122	-19	413	-736
3	13	-16	-572	-134	195	-292	126	-76	-49	-27	119	99	-615
4	143	43	-6	-290	153	124	-391	62	130	-22	-24	76	-1
5	-41	-9	-56	16	-929	-575	431	-126	-53	-37	-4	-23	-1,405
6	-111	19	-339	-192	242	-3,284	878	-204	-164	-177	-62	-1	-3,394
7	12	22	30	-296	286	597	-513	-26	45	-3	-2	591	742
8	223	97	-57	26	-102	-245	9	-1,128	-42	-171	52	81	-1,257
9	-248	-66	8	76	1	-184	80	-384	-3,881	-15	-42	281	-4,374
10	50	113	-13	-47	7	-318	-16	-119	-90	-5,210	29	-294	-5,907
11	-41	11	-2	-30	38	-64	43	43	-71	-13	-1	28	-59
12	129	424	295	-10	56	31	326	59	267	-93	128	-2,049	-437
Total	-6,770	-674	-692	-786	-3	-4,286	1,053	-1,662	-4,271	-5,617	145	-752	-24,314

Table 6-28 Sector-to-Sector Changes (GEH) – IP Period (all vehicles)

OD	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	24.9	1.9	0.4	4.3	1.1	5.9	3.4	3.7	4.2	1.1	0.5	1.6	23.2
2	3.2	5.7	1.3	4.1	3.9	2.0	4.8	5.5	3.5	1.8	1.2	6.6	3.0
3	0.5	2.0	1.8	2.2	2.7	6.5	4.3	3.1	3.3	2.7	3.4	3.1	1.8
4	8.2	4.5	0.1	1.0	3.5	3.2	4.8	3.8	7.5	2.5	1.8	1.9	0.0
5	2.8	1.0	0.8	0.4	3.5	5.3	8.7	6.1	3.3	3.3	0.3	0.9	4.6
6	6.5	1.6	7.0	5.0	2.2	10.9	11.6	7.9	8.4	5.1	3.0	0.0	9.9
7	0.9	2.8	1.1	3.6	6.4	8.3	2.3	2.0	3.1	0.2	0.2	7.0	2.8
8	5.2	5.9	2.5	1.9	4.5	9.8	0.7	4.4	0.5	6.5	3.5	3.5	4.5
9	4.0	2.2	0.5	5.3	0.0	9.4	5.8	4.1	14.9	0.3	2.0	8.0	14.9
10	2.3	1.7	1.6	4.6	0.6	8.7	0.8	4.7	1.9	18.4	2.0	3.7	19.0
11	0.7	0.8	0.0	2.5	2.3	3.1	2.8	2.8	3.4	0.8	0.0	0.8	0.1
12	4.1	6.3	8.6	0.2	2.1	0.7	3.9	2.7	7.3	1.2	3.8	2.4	0.5
Total	22.8	2.7	2.0	2.5	0.0	12.6	3.9	5.9	14.5	18.0	0.4	0.9	18.1

Table 6-29 Sector-to-Sector Changes – PM Period (all vehicles)

OD	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	-7,632	-103	31	96	38	-95	33	169	-112	40	-60	-6	-7,600
2	-171	-983	5	25	22	5	16	53	-129	505	-40	479	-213
3	38	-11	-834	-334	-37	-147	27	-68	-48	-16	39	33	-1,358
4	89	23	154	-598	106	81	-251	14	-8	-14	1	144	-260
5	-2	-4	-391	584	-1,766	-414	630	-88	-66	-30	-14	-16	-1,578
6	-113	3	-814	-481	-1,154	-3,918	189	-224	-216	-414	-186	-217	-7,544
7	20	15	68	-575	409	324	179	-18	-25	-8	0	706	1,093
8	293	66	-122	37	-148	-276	1	-990	-551	-127	53	86	-1,678
9	-201	-3	-40	74	-23	-236	30	-717	-3,718	-170	-98	162	-4,941
10	118	553	-4	-1	2	-150	12	-135	-143	-6,013	15	-357	-6,103
11	-42	5	-113	-38	33	-51	12	23	-35	-61	-1	-158	-424
12	146	578	202	-158	0	87	-450	93	401	388	-12	-2,569	-1,295
Total	-7,457	138	-1,858	-1,370	-2,518	-4,790	428	-1,889	-4,650	-5,919	-304	-1,714	-31,903

Table 6-30 Sector-to-Sector Changes (GEH) – PM Period (all vehicles)

OD	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	26.6	2.2	1.0	7.3	2.3	5.2	3.4	3.4	1.5	1.3	0.9	0.2	24.0
2	3.6	4.3	0.8	3.7	2.7	0.6	2.3	3.8	4.1	6.5	2.5	6.7	0.8
3	1.4	1.6	2.5	4.6	0.4	3.0	0.9	2.4	3.6	1.5	1.1	1.1	3.7
4	5.0	2.4	2.2	1.9	1.9	2.0	2.8	0.8	0.5	1.5	0.1	3.5	0.8
5	0.2	0.5	4.3	9.3	6.4	3.4	10.8	3.5	4.4	2.4	0.8	0.7	4.8
6	6.6	0.3	14.0	11.5	8.9	12.2	2.1	7.0	11.5	9.7	9.0	5.2	20.3
7	1.6	1.8	2.0	5.7	7.0	4.0	0.7	1.2	1.9	0.3	0.0	7.2	3.6
8	6.5	4.3	4.2	2.7	5.5	9.1	0.1	3.7	5.3	4.2	3.3	3.9	5.6
9	2.6	0.1	2.2	5.6	1.1	10.7	2.8	6.2	13.4	2.8	4.2	4.4	15.3
10	4.4	7.5	0.5	0.1	0.2	4.0	0.6	4.5	2.6	20.2	0.9	4.2	18.5
11	0.7	0.4	2.6	3.3	1.9	2.5	1.0	1.6	1.9	3.4	0.0	4.7	0.9
12	4.7	7.7	6.1	3.7	0.0	2.1	4.9	4.2	11.4	4.5	0.4	2.8	1.4
Total	23.6	0.5	5.0	4.0	7.6	13.1	1.4	6.2	14.7	17.8	0.7	1.8	21.7

6.7 Matrix Totals

The overall change in demand between the Prior and Post ME matrices are given in Table 6-31.

Table 6-31 Matrix Total Changes (PCUs)

Time Period	User Class	Description	Prior Matrix	Post ME Matrix	Difference	% Difference
AM	UC1	Car – Employer's Business	473,462	475,590	2,128	0.45%
	UC2	Car – Commute	1,770,808	1,779,886	9,078	0.51%

Time Period	User Class	Description	Prior Matrix	Post ME Matrix	Difference	% Difference
	UC3	Car – Other	2,763,861	2,773,626	9,765	0.35%
	UC4	LGV	691,109	696,575	5,465	0.79%
	UC5	HGV	848,527	8,53,363	4,836	0.57%
	Total		6,547,768	6579,039	3,1272	0.48%
IP	UC1	Car – Employer's Business	423,509	424,842	1,333	0.31%
	UC2	Car – Commute	526,410	529,247	2,838	0.54%
	UC3	Car – Other	3,671,833	3,686,637	14,804	0.40%
	UC4	LGV	599,869	603,435	3,567	0.59%
	UC5	HGV	8,48,584	853,014	4,430	0.52%
	Total		6,070,204	6,097,176	26,972	0.44%
PM	UC1	Car – Employer's Business	153,124	151,186	1,938	0.90%
	UC2	Car – Commute	706,385	696,223	10,163	1.10%
	UC3	Car – Other	1,052,421	1,040,058	12,363	0.90%
	UC4	LGV	186,386	179,778	6,608	4.40%
	UC5	HGV	50,784	49,274	1,510	2.90%
	Total		2,149,101	2,116,519	32,582	1.30%

7. Model Validation

7.1 Introduction

In line with TAG unit M3.1, model outputs have been compared to observed data that is independent of the calibration process. This includes comparison of traffic flows on screenlines and at individual sites, journey times along routes and route assignment. This section presents the validation results for these aspects and the results of the matrix stress test.

7.2 Screenlines

Twenty screenlines have been used in the model validation, shown in Figure 6-1, including one running parallel to A5036 intercepting north-south movements south of the A5036, and one running northwest-southeast including a validation site on the A5036 itself.

A summary of the Post ME results is presented in Table 7-1 and summaries of local results are presented in Table 7-2 to Table 7-4. The results for the total flows on screenlines in Table 7-5 to Table 7-7 for the three time periods. The results for the three vehicle classes are presented in Appendix C.

Table 7-1 Summary of All Validation Screenlines

Peak	Vehicle Class	% Screenlines with flows within 5%		% Screenlines with GEH <4		Overall	
		Number	%	Number	%	Number	%
AM	All	14/20	70%	13/20	65%	14/20	70%
	Car	13/20	65%	12/20	60%	13/20	65%
	LGV	5/20	25%	14/20	70%	14/20	70%
	HGV	4/20	20%	12/20	60%	12/20	60%
IP	All	11/20	55%	10/20	50%	10/20	50%
	Car	9/20	45%	11/20	55%	11/20	55%
	LGV	5/20	25%	12/20	60%	12/20	60%
	HGV	8/20	40%	13/20	65%	13/20	65%
PM	All	10/20	50%	7/20	35%	7/20	35%
	Car	13/20	65%	11/20	55%	11/20	55%
	LGV	2/20	10%	10/20	50%	10/20	50%
	HGV	3/20	15%	10/20	50%	10/20	50%

Table 7-2 Summary of Local Validation Screenlines

Peak	Vehicle Class	% Screenlines with flows within 5%		% Screenlines with GEH <4		Overall	
		Number	%	Number	%	Number	%
AM	All	4/6	67%	4/6	67%	4/6	67%
	Car	4/6	67%	3/6	50%	4/6	67%
	LGV	0/6	0%	3/6	50%	3/6	50%
	HGV	3/6	50%	5/6	83%	5/6	83%
IP	All	3/6	50%	3/6	50%	3/6	50%
	Car	4/6	67%	4/6	67%	4/6	67%
	LGV	0/6	0%	2/6	33%	3/6	33%
	HGV	2/6	33%	5/6	83%	5/6	83%

PM	All	4/6	67%	2/6	33%	4/6	67%
	Car	4/6	67%	3/6	50%	4/6	67%
	LGV	0/6	0%	3/6	50%	3/6	50%
	HGV	1/6	17%	4/6	67%	4/6	67%

Table 7-3 Local Validation Screenline Flow Difference Performance

	Number				%			
Flows Difference Absolute %	<5%	5% - 10%	>10%	Total	<5%	5% - 10%	>10%	Total
AM	4	2	0	6	67%	33.3%	0.0%	100%
IP	3	2	1	6	50%	33.3%	16.7%	100%
PM	4	2	0	6	67%	33.3%	0.0%	100%

Table 7-4 Local Validation Screenline GEH Performance

	Number					%				
GEH	<4	4 - 7.5	7.5 - 10	>10	Total	<4	4 - 7.5	7.5 - 10	>10	Total
AM	4	2	0	0	6	67%	33.3%	0.0%	0.0%	100%
IP	3	3	0	0	6	50%	50.0%	0.0%	0.0%	100%
PM	2	3	0	1	6	33%	50.0%	0.0%	16.7%	100%

Table 7-5 Validation Screenlines - AM Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass/Fail
Co_02 Merseyside [B1]	Inbound	14,360	14,447	0.6%	0.7	Pass
Co_02 Merseyside [B1]	Outbound	12,865	13,389	4.1%	4.6	Fail
Co_06 Doncaster [B1]	Inbound	5,480	5,596	2.1%	1.6	Pass
Co_06 Doncaster [B1]	Outbound	4,718	4,767	1.0%	0.7	Pass
Co_09 Huddersfield [B1]	Inbound	6,542	6,420	-1.9%	1.5	Pass
Co_09 Huddersfield [B1]	Outbound	5,484	5,501	0.3%	0.2	Pass
Co_15 Blackburn [B1]	Inbound	7,455	7,787	4.4%	3.8	Pass
Co_15 Blackburn [B1]	Outbound	6,908	6,861	-0.7%	0.6	Pass
Co_51 York Urban [B3]	Inbound	4,424	5,035	13.8%	8.9	Fail
Co_51 York Urban [B3]	Outbound	3,191	3,426	7.4%	4.1	Fail
Eastern	Eastbound	11,895	11,959	0.5%	0.6	Pass
Eastern	Westbound	11,970	11,999	0.2%	0.3	Pass
LPL Radial E & S	Eastbound	13,314	13,601	2.2%	2.5	Pass
LPL Radial E & S	Westbound	15,418	15,396	-0.1%	0.2	Pass
S of A5036	Northbound	4,368	4,036	-7.6%	5.1	Fail

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass/Fail
S of A5036	Southbound	6,350	5,882	-7.4%	6.0	Fail
Sc_52 Liverpool Urban North [B3]	Northbound	6,733	6,885	2.2%	1.8	Pass
Sc_52 Liverpool Urban North [B3]	Southbound	9,889	8,931	-9.7%	9.9	Fail
Sc_53 Liverpool Urban East [B3]	Eastbound	8,066	9,339	15.8%	13.6	Fail
Sc_53 Liverpool Urban East [B3]	Westbound	8,432	8,616	2.2%	2.0	Pass

Table 7-6 Validation Screenlines - IP Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass/Fail
Co_02 Merseyside [B1]	Inbound	10,960	10,651	-2.8%	3.0	Pass
Co_02 Merseyside [B1]	Outbound	11,151	11,706	5.0%	5.2	Fail
Co_06 Doncaster [B1]	Inbound	4,792	4,815	0.5%	0.3	Pass
Co_06 Doncaster [B1]	Outbound	5,422	5,249	-3.2%	2.4	Pass
Co_09 Huddersfield [B1]	Inbound	5,506	5,295	-3.8%	2.9	Pass
Co_09 Huddersfield [B1]	Outbound	5,452	5,267	-3.4%	2.5	Pass
Co_15 Blackburn [B1]	Inbound	5,421	5,794	6.9%	5.0	Fail
Co_15 Blackburn [B1]	Outbound	5,551	5,818	4.8%	3.5	Pass
Co_51 York Urban [B3]	Inbound	3,067	3,701	20.7%	10.9	Fail
Co_51 York Urban [B3]	Outbound	3,456	3,878	12.2%	7.0	Fail
Eastern	Eastbound	10,071	10,317	2.4%	2.4	Pass
Eastern	Westbound	9,803	10,496	7.1%	6.9	Fail
LPL Radial E & S	Eastbound	13,169	13,078	-0.7%	0.8	Pass
LPL Radial E & S	Westbound	12,465	11,713	-6.0%	6.8	Fail
S of A5036	Northbound	4,834	4,696	-2.9%	2.0	Pass
S of A5036	Southbound	4,730	4,243	-10.3%	7.3	Fail
Sc_52 Liverpool Urban North [B3]	Northbound	6,902	6,446	-6.6%	5.6	Fail
Sc_52 Liverpool Urban North [B3]	Southbound	6,611	5,727	-13.4%	11.3	Fail
Sc_53 Liverpool Urban East [B3]	Eastbound	7,021	7,488	6.6%	5.5	Fail
Sc_53 Liverpool Urban East [B3]	Westbound	6,987	7,294	4.4%	3.6	Pass

Table 7-7 Validation Screenlines - PM Period Total Flow

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass/Fail
Co_02 Merseyside [B1]	Inbound	14,175	13,679	-3.5%	4.2	Fail
Co_02 Merseyside [B1]	Outbound	14,575	15,821	8.6%	10.1	Fail
Co_06 Doncaster [B1]	Inbound	5,183	5,570	7.5%	5.3	Fail
Co_06 Doncaster [B1]	Outbound	6,625	6,205	-6.3%	5.2	Fail

Screenline Name	Direction	Observed Flow (veh)	Modelled Flow (veh)	% Diff	GEH	Pass/Fail
Co_09 Huddersfield [B1]	Inbound	6,063	5,821	-4.0%	3.1	Pass
Co_09 Huddersfield [B1]	Outbound	6,373	6,337	-0.6%	0.4	Pass
Co_15 Blackburn [B1]	Inbound	7,313	7,308	-0.1%	0.1	Pass
Co_15 Blackburn [B1]	Outbound	7,822	7,803	-0.2%	0.2	Pass
Co_51 York Urban [B3]	Inbound	3,420	3,988	16.6%	9.3	Fail
Co_51 York Urban [B3]	Outbound	4,095	5,250	28.2%	16.9	Fail
Eastern	Eastbound	12,441	12,950	4.1%	4.5	Fail
Eastern	Westbound	13,715	13,459	-1.9%	2.2	Pass
LPL Radial E & S	Eastbound	16,698	15,955	-4.4%	5.8	Fail
LPL Radial E & S	Westbound	15,398	14,048	-8.8%	11.1	Fail
S of A5036	Northbound	6,195	6,179	-0.2%	0.2	Pass
S of A5036	Southbound	5,125	4,636	-9.5%	7.0	Fail
Sc_52 Liverpool Urban North [B3]	Northbound	9,552	8,745	-8.5%	8.4	Fail
Sc_52 Liverpool Urban North [B3]	Southbound	7,449	6,312	-15.3%	13.7	Fail
Sc_53 Liverpool Urban East [B3]	Eastbound	9,642	9,607	-0.4%	0.4	Pass
Sc_53 Liverpool Urban East [B3]	Westbound	9,687	9,191	-5.1%	5.1	Fail

The results show that in the AM period 70% of all validation screenlines pass, in the Inter peak period 50% of all screenlines pass and 35% pass in the PM period. In the AM period there are only three screenlines that have a GEH higher than 7.5, two screenlines in the IP and six in the PM.

Of the local screenlines 67% of screenlines have a difference of less than 5% in the AM and PM. In the IP there are 50% of screenlines with a difference of less than 5%. The screenlines all have a difference of less than 10% except one in the IP and all have a GEH of less than 7.5 except one in the PM.

7.3 Link Flows

In total, 445 validation links have been assessed using the criteria in *Table 6-15*. A summary of the link flow validation results is provided in *Table 7-8* and the results for each link are provided in *Appendix C*.

Table 7-8 Summary of Validation Results

Time Period	Vehicle Class	Link Flow		GEH		Overall	
		Number Pass	% Pass	Number Pass	% Pass	Number Pass	% Pass
AM	All	264	59%	249	56%	286	64%
	Car	250	56%	246	55%	289	65%
IP	All	278	63%	273	61%	315	71%
	Car	257	58%	276	62%	313	70%
PM	All	282	63%	258	58%	300	67%

Time Period	Vehicle Class	Link Flow		GEH		Overall	
		Number Pass	% Pass	Number Pass	% Pass	Number Pass	% Pass
	Car	264	59%	250	56%	298	67%

The results show that at least 60% validation is achieved for total vehicles and cars in all three time periods, which equates to at least 286 of the 445 validation links passing.

Figure 7-1 to Figure 7-3 shows the location of the validation links on the network and whether they are passing or failing, with the flow difference and GEH shown for failing links.

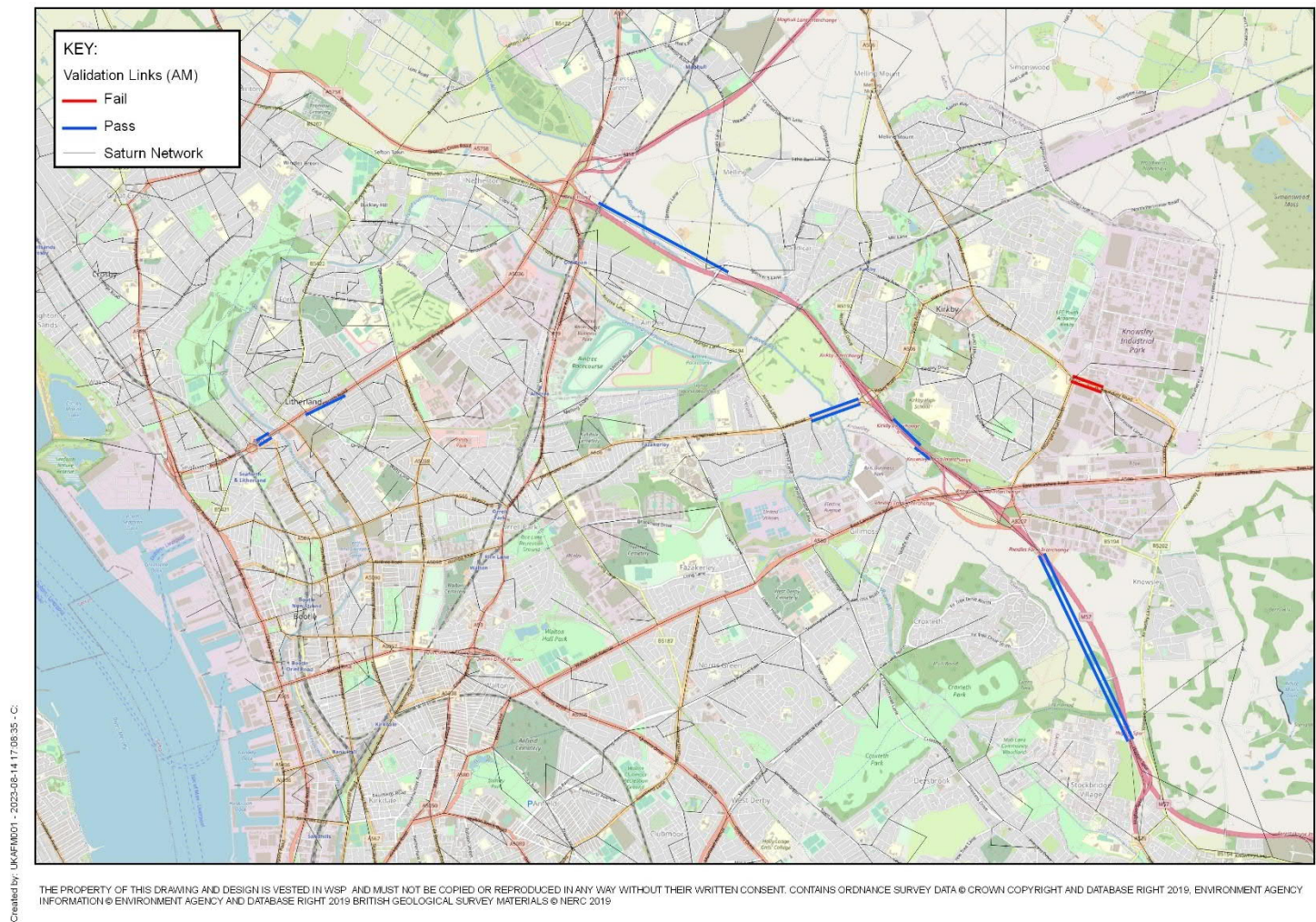


Figure 7-1 Validation Links based on Total Flow - AM Period

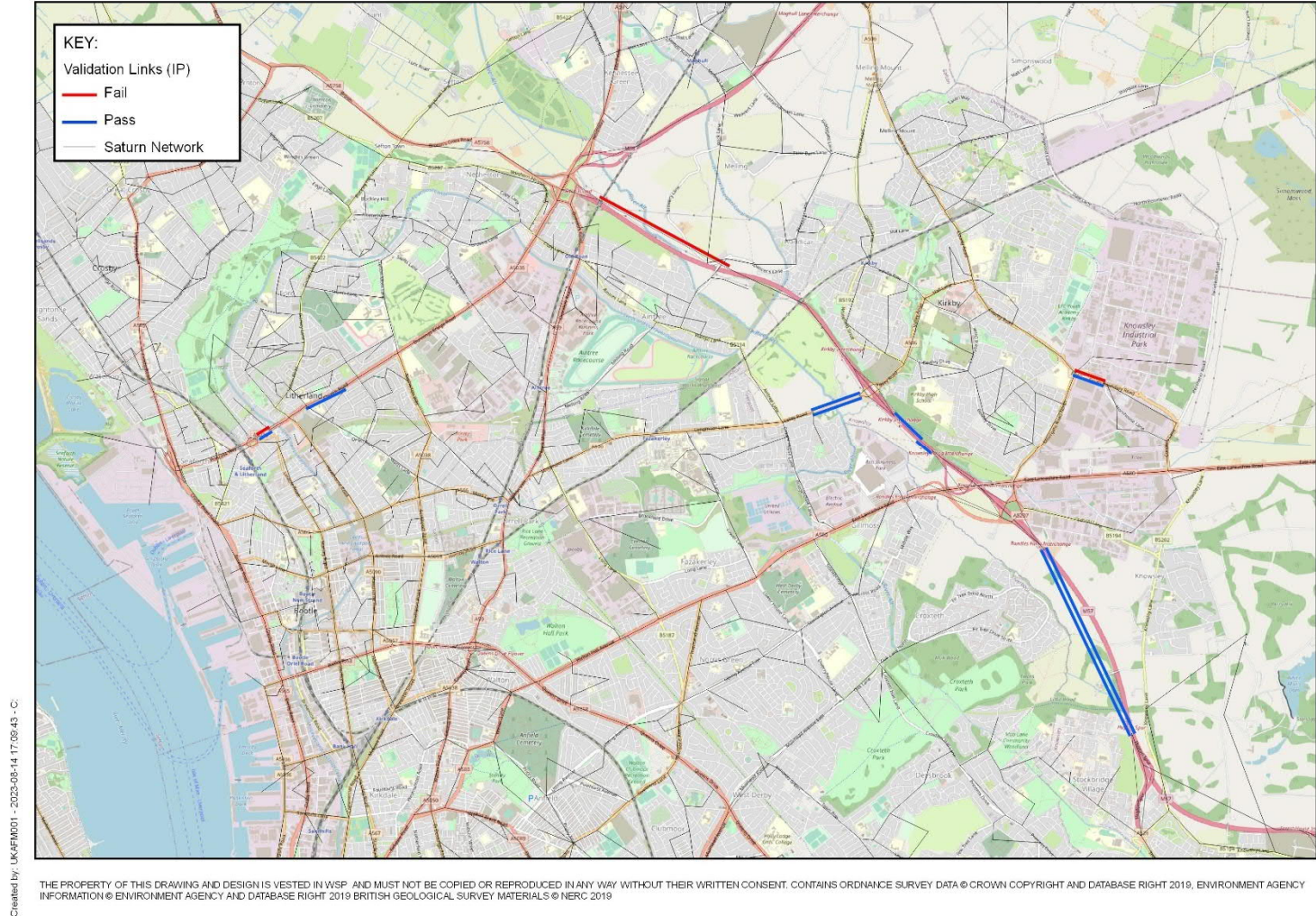


Figure 7-2 Validation Links based on Total Flow - IP Period

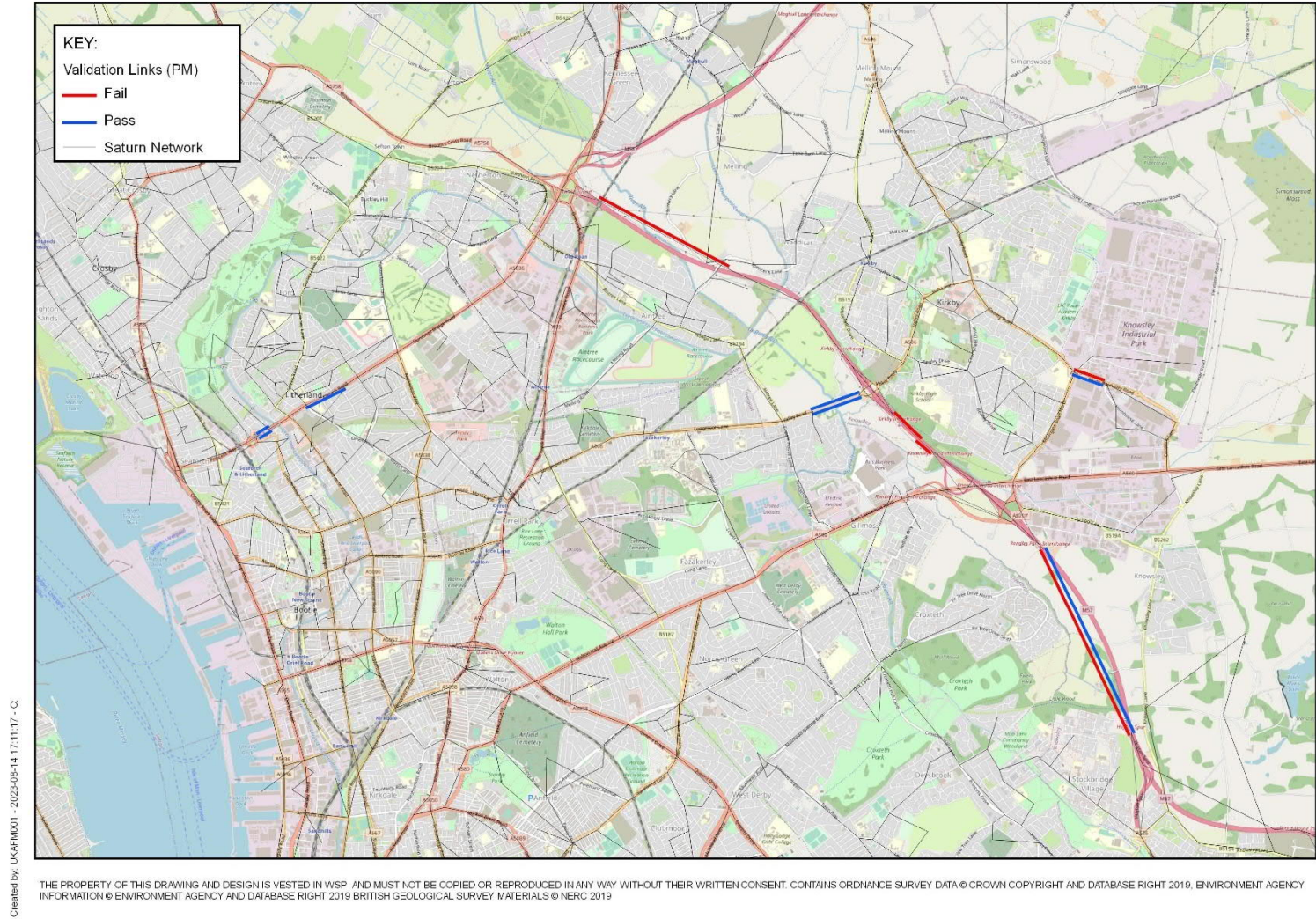


Figure 7-3 Validation Links based on Total Flow - PM Period

The maps show the validation sites on the A5036 passes in all three time periods (except one in the IP). The figures also show the validation links on the M57 generally pass in the AM and IP, with mixed results in the PM.

Table 7-9 Local Link Validation Performance

	GEH Range					Flow Criterion			GEH or Flow Criterion		
	<5	5 - 7.5	7.5 - 10	>10	Total	Pass	Fail	Total	Pass	Fail	Total
AM	8	3	2	0	13	9	4	13	9	4	13
IP	10	1	1	1	13	10	3	13	10	3	13
PM	8	2	0	3	13	8	5	13	8	5	13

Table 7-10 Local Link Validation Performance in %

	GEH Range					Flow Criterion			GEH or Flow Criterion		
	<5	5 - 7.5	7.5 - 10	>10	Total	PASS	FAIL	Total	PASS	FAIL	Total
AM	61.5%	23.1%	15.4%	0.0%	100.0%	69.2%	30.8%	100.0%	69.2%	30.8%	100%
IP	76.9%	7.7%	7.7%	7.7%	100.0%	76.9%	23.1%	100.0%	76.9%	23.1%	100%
PM	61.5%	15.4%	0.0%	23.1%	100.0%	61.5%	38.5%	100.0%	61.5%	38.5%	100%

For local links, 69% pass in AM, 77% pass IP with 62% passing in the PM. In the AM none of the links have a GEH of greater than 10 and in the IP only one link has a GEH greater than 10.

7.4 Journey Times

Modelled journey times have been validated against the observed journey time routes along the 14 routes previously identified. These are local routes around the A5036.

The location of the routes is shown in Figure 7-4.

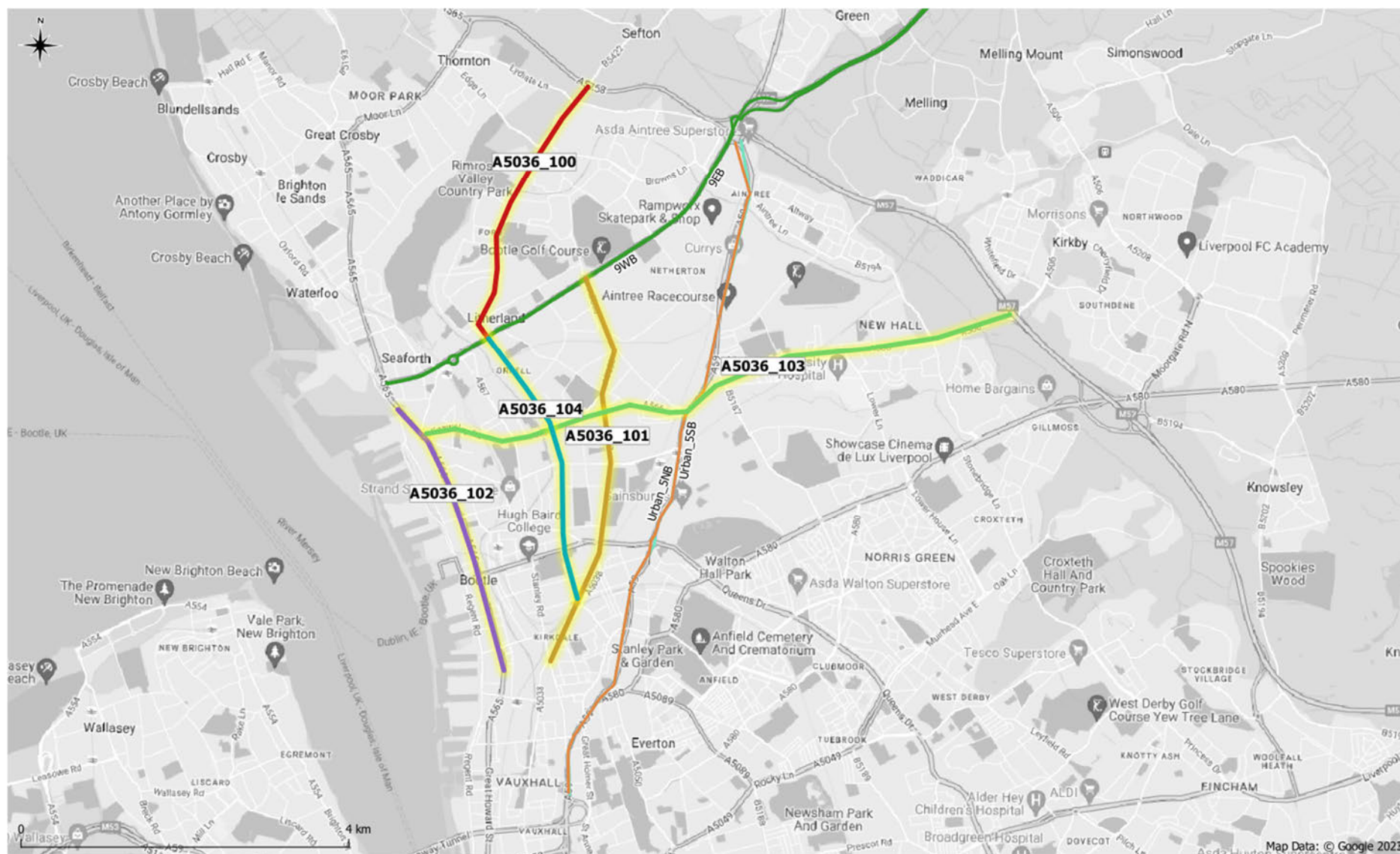


Figure 7-4 Journey Time Routes

The TAG criterion and acceptability guideline for the validation of journey times are provided in Table 7-11.

Table 7-11 Journey time validation criterion

Criterion	Acceptability Guideline
Modelled times along routes should be within 15% of surveyed times, or 1 minute if higher	> 85% of routes

The local journey time results for the three time periods are detailed in Table 7-12 and Table 7-13.

Table 7-12 Journey Route Summary vs TAG criterion

Journey Time Criterion from TAG	Number			%		
	PASS	FAIL	Total	PASS	FAIL	Total
AM	7	7	14	50.0%	50.0%	100%
IP	12	2	14	85.7%	14.3%	100%
PM	13	1	14	92.9%	7.1%	100%

Table 7-13 Journey Route Summary – percentage difference between modelled and observed times

JT Difference Absolute %	Number				%			
	<15%	15% - 25%	>25%	Total	<15%	15% - 25%	>25%	Total
AM	6	6	2	14	42.9%	42.9%	14.3%	100%
IP	11	3	0	14	78.6%	21.4%	0.0%	100%
PM	12	2	0	14	85.7%	14.3%	0.0%	100%

For local JT Routes in the AM peak 50% of Local Journey Times pass, in the IP 86% pass and 93% pass in the PM peak. The IP and PM both have more than 85% passing so are acceptable according to TAG criteria.

The local journey times for the three time periods are detailed in Table 7-14 to Table 7-16.

Table 7-14 Journey Time Validation - AM Period

Route Name	Direction	Route Description	Observed JT	Modelled JT	Time Difference	% Diff	Pass
9	EB	A5036 – Seaforth to/from Switch Island	10:16	12:16	02:00	19.5%	Fail
	WB		11:48	14:44	02:56	24.9%	Fail
100	NB	Gorse Ln	07:06	07:35	00:29	6.9%	Pass

	SB		07:08	09:38	02:30	35.1%	Fail
101	NB	A5038	09:19	08:31	-00:48	-8.6%	Pass
	SB		09:36	10:05	00:30	5.1%	Pass
102	NB	A565	04:23	05:10	00:47	18.0%	Pass
	SB		07:52	06:11	-01:41	-21.3%	Fail
103	EB	A506	14:27	16:18	01:50	12.7%	Pass
	WB		13:38	16:55	03:16	24.0%	Fail
104	NB	A5090	06:15	06:51	00:36	9.6%	Pass
	SB		07:20	07:24	00:03	0.8%	Pass
U5	NB	A59 County Rd	13:17	15:37	02:21	17.7%	Fail
	SB		16:23	20:58	04:35	28.0%	Fail

Table 7-15 Journey Time Validation - IP Period

Route Name	Direction	Route Description	Observed JT	Modelled JT	Time Difference	% Diff	Pass
9	EB	A5036 – Seaforth to/from Switch Island	10:32	11:55	01:24	13.2%	Pass
	WB		11:00	13:12	02:12	20.1%	Fail
100	NB	Gorse Ln	06:43	07:18	00:35	8.6%	Pass
	SB		06:27	08:03	01:36	24.8%	Fail
101	NB	A5038	09:15	08:40	-00:36	-6.4%	Pass
	SB		08:16	08:04	-00:12	-2.3%	Pass
102	NB	A565	04:34	05:28	00:54	19.7%	Pass
	SB		06:10	05:29	-00:41	-11.2%	Pass
103	EB	A506	14:24	14:46	00:22	2.6%	Pass
	WB		14:26	15:58	01:31	10.5%	Pass
104	NB	A5090	06:26	07:12	00:46	11.9%	Pass
	SB		06:15	06:45	00:29	7.8%	Pass
U5	NB	A59 County Rd	15:11	16:16	01:05	7.2%	Pass
	SB		15:32	15:42	00:10	1.1%	Pass

Table 7-16 Journey Time Validation - PM Period

Route Name	Direction	Route Description	Observed JT	Modelled JT	Time Difference	% Diff	Pass?
9	EB	A5036 – Seaforth to/from Switch Island	12:50	12:23	-00:27	-3.5%	Pass
	WB		12:13	13:58	01:45	14.4%	Pass
100	NB	Gorsey Ln	08:13	07:52	-00:21	-4.2%	Pass
	SB		07:54	08:21	00:26	5.6%	Pass
101	NB	A5038	10:36	09:33	-01:04	-10.0%	Pass
	SB		09:28	08:27	-01:02	-10.8%	Pass
102	NB	A565	05:08	06:00	00:52	17.1%	Pass
	SB		04:37	05:14	00:36	13.1%	Pass
103	EB	A506	16:11	15:49	-00:22	-2.3%	Pass
	WB		14:42	16:58	02:16	15.4%	Fail
104	NB	A5090	07:09	07:26	00:17	3.9%	Pass
	SB		07:05	06:50	-00:15	-3.6%	Pass
U5	NB	A59 County Rd	18:50	19:42	00:51	4.5%	Pass
	SB		16:33	16:24	-00:09	-0.9%	Pass

A full list of journey times can be found in Appendix D.

The journey time validation results for the full model show 82% of journey times pass in the AM and 96% in IP period. 96% of journey times in the PM period, IP and PM both meet the TAG criteria of at least 85% of journey times passing.

Of particular importance to this study is Route 9 - Seaforth to/from M6 J26. In the eastbound direction the modelled journey times are within 20% of observed journey times in all time periods, and in the westbound direction the differences are within 24% in all time periods.

The journey times along Route 9 have been analysed on a section-by-section basis. Table 7-17 and Figure 7-5 to Figure 7-7 show the comparison of the journey times for each section in the Eastbound direction.

Table 7-17 Eastbound Route 9 Journey Time Summary

From	To	AM			IP			PM		
		Obs (mm:ss)	Model (mm:ss)	%Diff	Obs (mm:ss)	Model (mm:ss)	%Diff	Obs (mm:ss)	Model (mm:ss)	%Diff
Seaforth Interchange	Switch Island	10:16	12:16	-16.30%	10:32	11:55	-11.61%	12:50	12:23	3.63%
Switch Island	M6 J26	8:27	7:56	6.51%	8:06	7:54	2.53%	8:40	7:56	9.24%

From	To	AM			IP			PM		
		Obs (mm:ss)	Model (mm:ss)	%Diff	Obs (mm:ss)	Model (mm:ss)	%Diff	Obs (mm:ss)	Model (mm:ss)	%Diff
Total		18:42	20:12	-7.43%	18:38	19:49	-5.97%	21:30	20:19	5.82%

Table 7-17 shows the modelled journey times for all of the sections in the IP and PM period and all but one of the sections in the AM period are within 15% of the observed journey time for the corresponding section. For the Seaforth interchange to Switch Island section all models are slower than the observed journey times and for the Switch Island to M6 J26 section all models are faster than the observed journey times.

Figure 7-5 Cumulative Journey Time Route 9 Eastbound - AM period

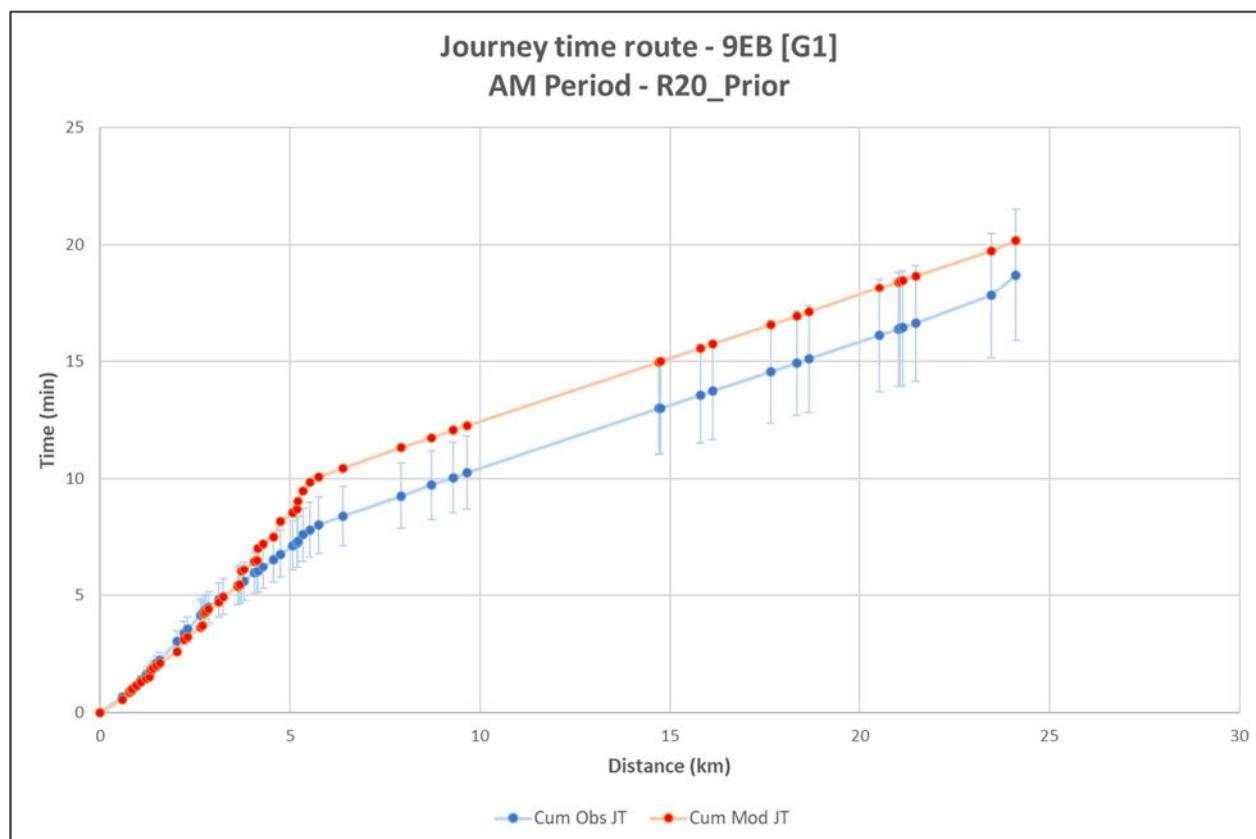


Figure 7-6 Cumulative Journey Time Route 1 Northbound - IP period

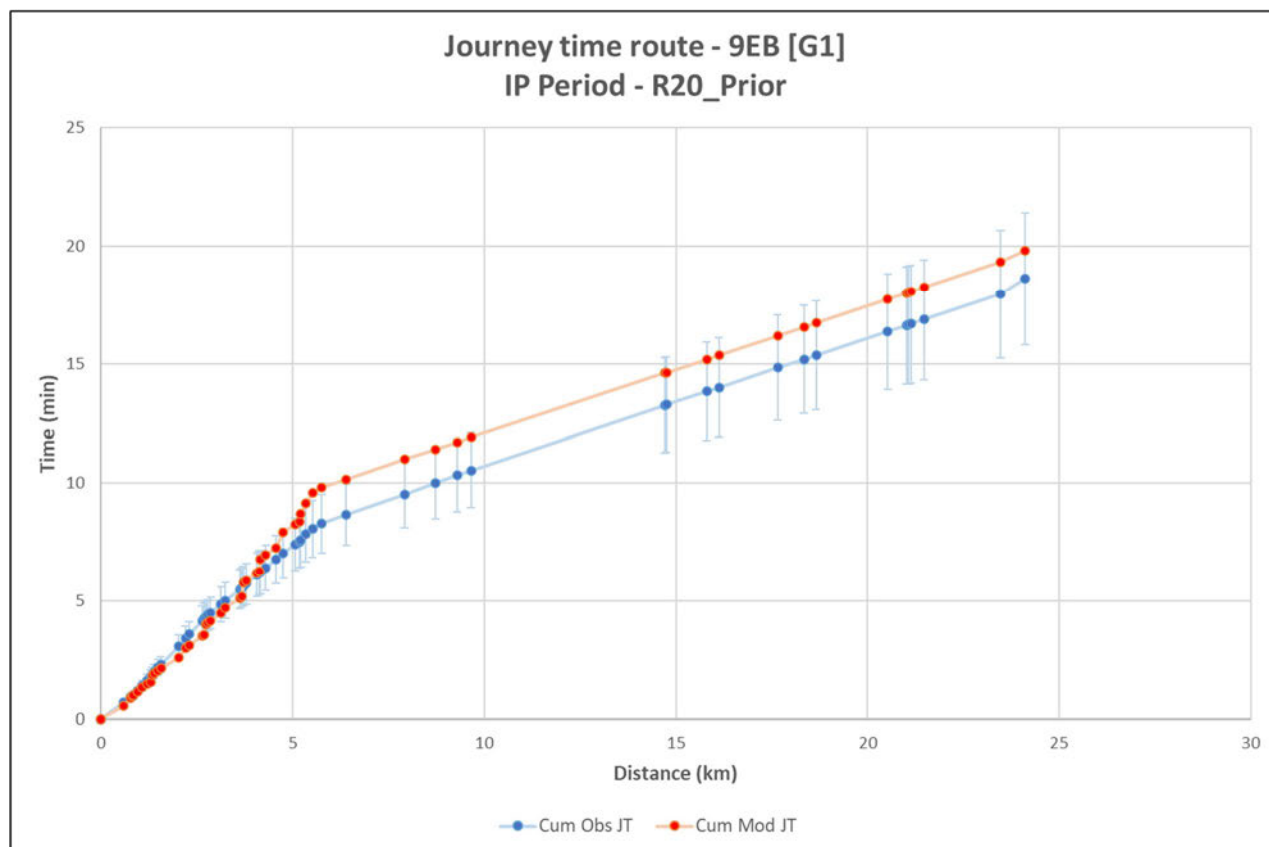
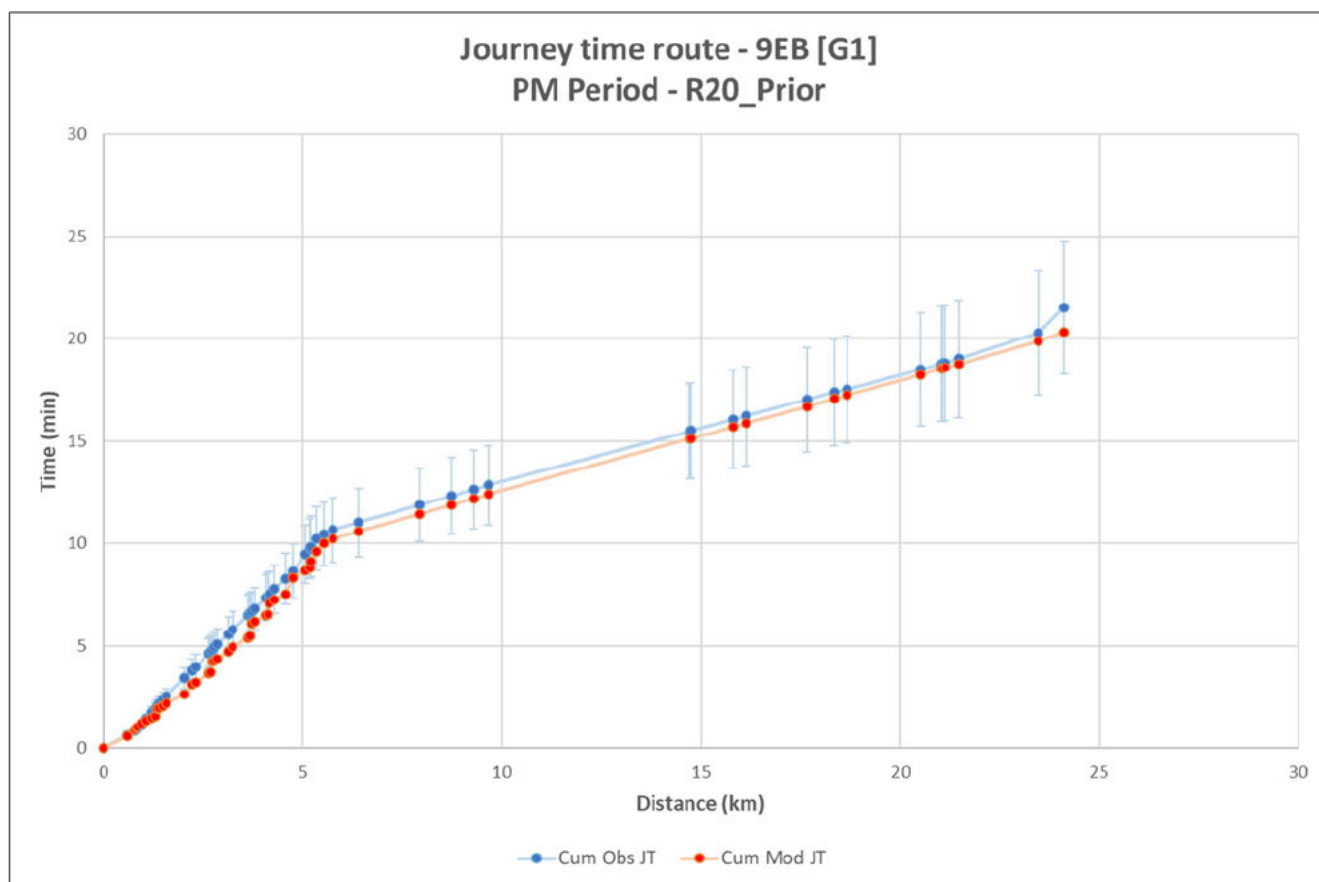


Figure 7-7 Cumulative Journey Time Route 1 Northbound - PM period



The figures show the cumulative journey times achieve a good fit to and are within 15% of the observed journey time.

Table 7-18 and Figure 7-8 to Figure 7-10 show the comparison of journey times on Route 9 in the westbound direction (M6 J26 – Seaforth Interchange).

Table 7-18 Southbound Route 1 Journey Time Summary

From	To	AM			IP			PM		
		Obs (mm:ss)	Model (mm:ss)	%Diff	Obs (mm:ss)	Model (mm:ss)	%Diff	Obs (mm:ss)	Model (mm:ss)	%Diff
M6 J26	Switch Island	7:54	7:48	-1.1%	7:59	7:45	-2.8%	7:44	7:47	0.8%
Switch Island	Seaforth Interchange	11:48	14:44	24.9%	10:60	13:12	20.1%	12:13	13:58	14.4%
Total		19:42	22:33	-12.63%	18:58	20:57	-9.47%	19:57	21:45	-8.28%

Table 7-18 shows that the modelled journey times are within the passing threshold however, the Switch Island to Seaforth Interchange section does not pass in the AM period. The M6 J26 to Switch Island Sections have a faster modelled time than observed time and the Switch Island to Seaforth interchange sections have a slower modelled time than observed time.

Figure 7-8 Cumulative Journey Time Route 1 Southbound - AM period

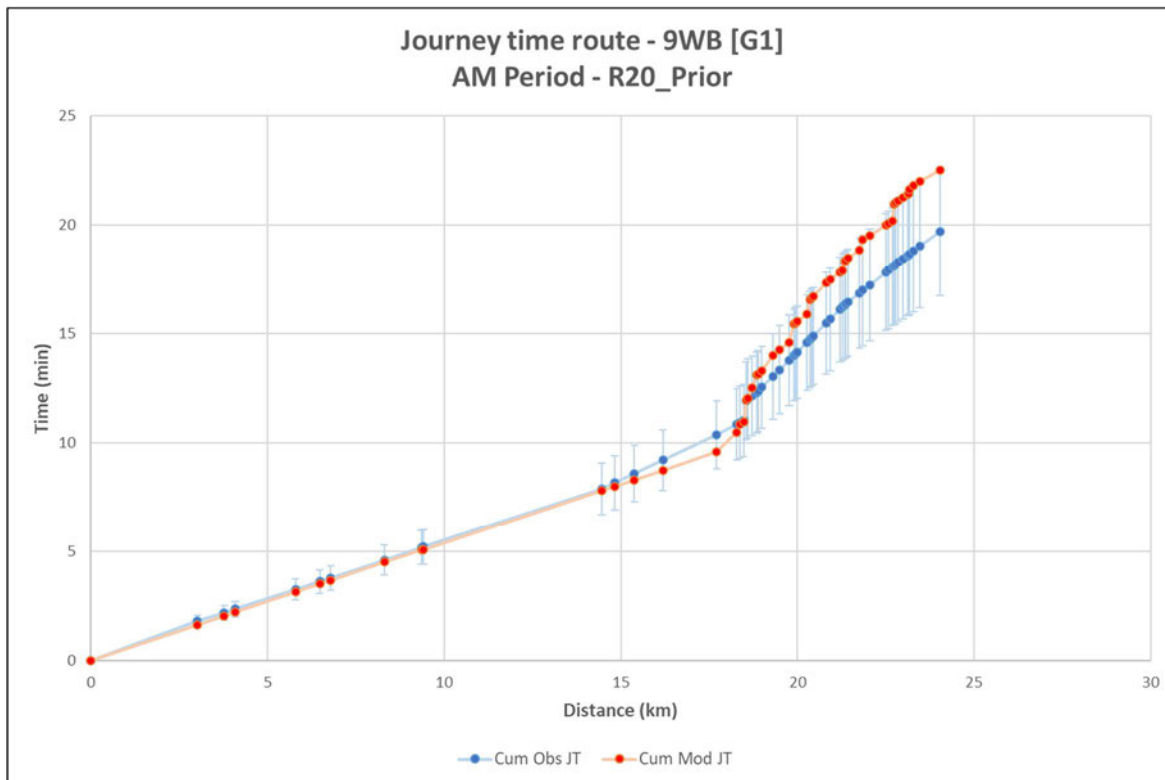


Figure 7-9 Cumulative Journey Time Route 1 Southbound - IP period

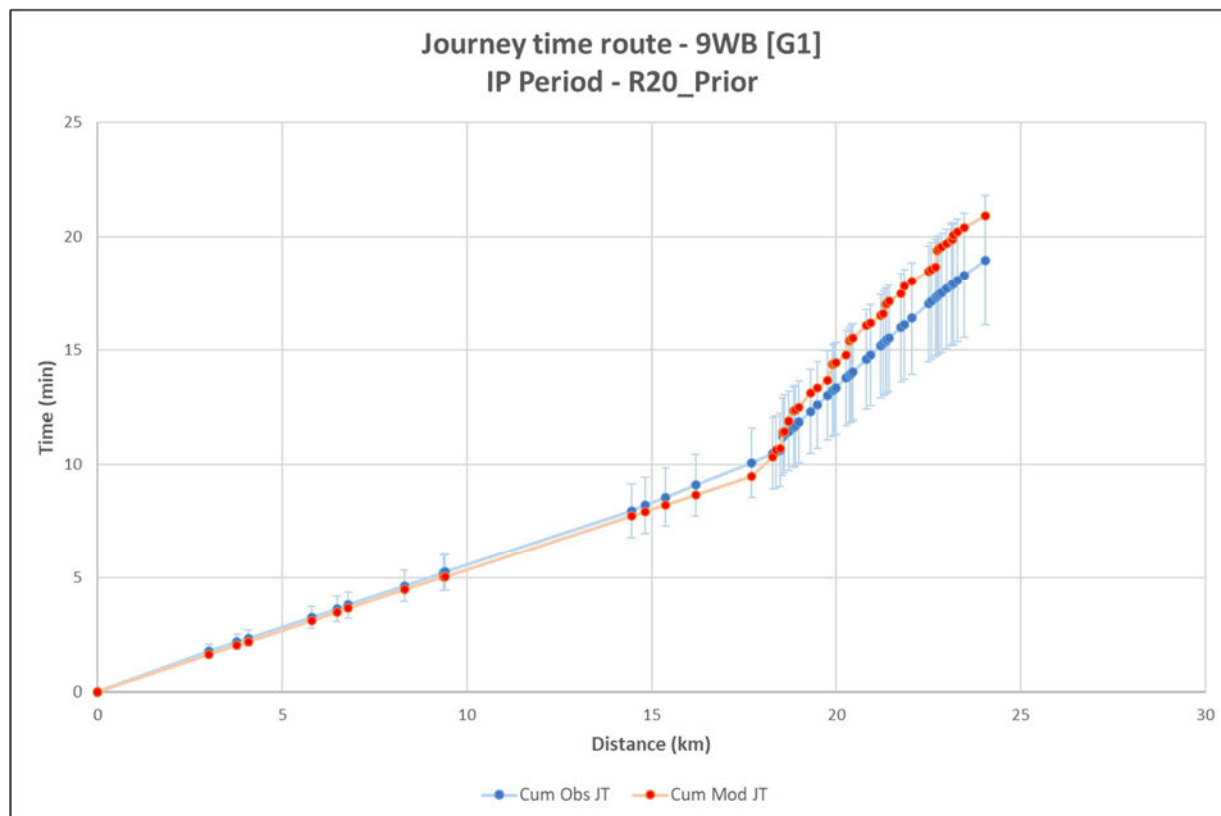
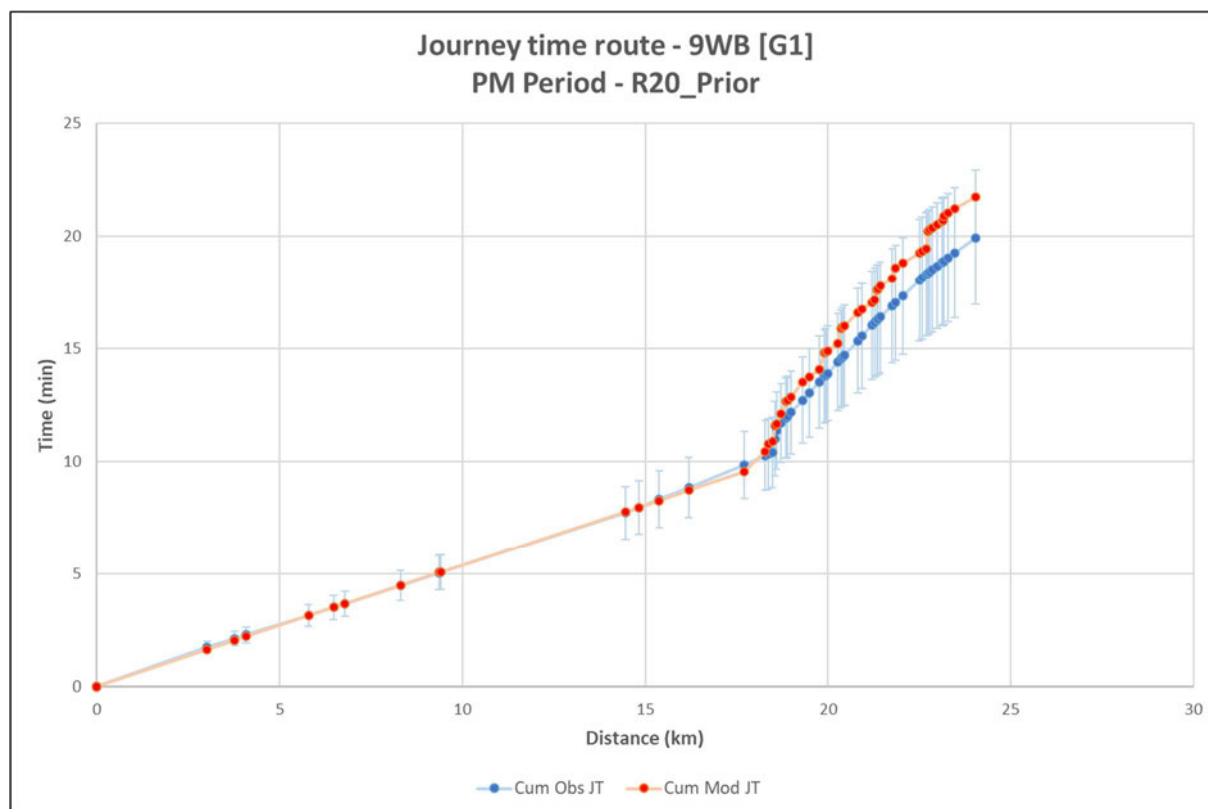


Figure 7-10 Cumulative Journey Time Route 1 Southbound - PM period



The figures show the cumulative journey time is a relatively good fit to the observed and are within the 15% margins overall across the route.

Journey time graphs detailing the modelled and observed journey times in sections along the other routes are presented in Appendix D.

7.5 Route Choice Validation

Route choice validation has been undertaken to ensure the routing between zones is logical. Twenty modelled routes have been checked against Google Maps for the accuracy of the routing in the model.

From the routing checks, it is considered that the routing in the model is logical and realistic.

7.6 Matrix Stress Test

As suggested in TAG M3.1, a stress test of the A5036 base model undertaken to check if any undetected errors in the network were present. This was undertaken with a 20% growth rate in traffic applied to the Post ME matrices.

All models converged to an acceptable level of convergence. On inspection of the stress test models, it was noted there were large delays in the network around Burton-on-Trent and Swadlincote in all time periods. The loading of the two zones was changed to load onto spigots as the zones are located in the Rest of the Fully Modelled Area so had not been previously changed.

Following the changes, delays were reduced to an acceptable level in this area and the changes were implemented to the Prior and Post ME networks presented in this report.

A further stress test was carried out with a 20% growth rate in traffic. All time periods converged to an acceptable level and no further changes were required.

8. Model Convergence and Assignment

8.1 Overview

To confirm that the model outcomes are reliable, the stability of the assignment should be assessed. This section presents the results of the model convergence and the performance statistics of the base model.

8.2 Model Convergence

Assessing the stability of the assignment ensures that any flow changes do not occur as a result of random flow changes due to poor convergence. TAG advises that the model should converge to a point in which routes obey Wardrop's First Principle of Traffic Equilibrium. TAG unit M3.1 paragraph 2.7.3 defines this as:

"Traffic arranges itself on networks such that the cost of travel on all routes used between each OD pair is equal to the minimum cost of travel and all unused routes have equal or greater cost."

In order to assess this, SATURN uses the following measures of convergence:

- Proximity to the assignment objective; and
- Stability of model outputs between consecutive iterations.

The first measure relates to how close the model is to a converged solution, which varies depending on the preferences of the user or software package being used. In SATURN this equates to how close the model is to Wardrop's Principle of Equilibrium and is measured using the Delta (or Gap) function.

The Delta value represents the excess cost incurred by failing to travel on the route with the lowest generalised cost and is expressed relative to the minimum route cost. The excess cost is summed over each route between each O/D pair and multiplied by the number of trips between each O/D pair. This is divided by the minimum cost summed over each route between each O/D pair, also multiplied by the number of trips between each O/D pair.

The second measure relates to the level of flow change on links between iterations.

The convergence criteria provided by TAG are detailed in Table 8-1; in terms of both stability and proximity measures. The criteria should be satisfied to give confidence that the model results are stable, consistent and robust.

Table 8-1 Convergence criteria

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

The convergence statistics of the models have been assessed against these criteria and the results are given in Table 8-2.

Table 8-2 Model Convergence Results

Time Period	Assignment Simulation Loop	Loop	Proximity indicator:	Stability Indicator:	Stability Indicator:
			Delta (δ) / (Gap (%))	% Flow (Link Flows Differing by < 1% Between Assignment & Simulation)	% Delays (Turn Delays Differing by < 1% Between Assignment & Simulation)
AM	F-3	12	0.0052	98.8	98.9
	F-2	13	0.0052	98.5	98.8
	F-1	14	0.0049	98.7	98.9
	Final Iteration (F)	15	0.0048	98.8	98.9
IP	F-3	10	0.0057	99.0	99.4
	F-2	11	0.0033	98.8	99.3
	F-1	12	0.0058	99.2	99.4
	Final Iteration (F)	13	0.0034	98.6	99.3
PM	F-3	13	0.0057	98.7	98.9
	F-2	14	0.0049	98.7	98.8
	F-1	15	0.0066	98.8	98.9
	Final Iteration (F)	16	0.0051	98.5	98.8

Table 8-2 shows that model converges within the acceptability values in the TAG criteria. Both stability indicators are higher than the TAG requirement of greater than 98% of links changing by 1% for four consecutive loops, with both indicators exceeding 99% in all time periods. The proximity indicator is also lower than the TAG requirement of 0.1%.

8.3 Traffic Assignment Outputs

The model performance statistics for the three time periods are presented in Table 8-3.

Table 8-3 Model Performance Statistics

Statistic	AM	IP	PM
Transient Queues (PCU.HRS/HR)	49,765	37,421	50,018
Over-Capacity Queues (PCU.HRS/HR)	14,404	6,806	14,574
Link Cruise Time (PCU.HRS/HR)	2,013,338	1,747,941	2,167,008
Total Travel Time (PCU.HRS/HR)	2,077,508	1,792,167	2,231,600
Total Travel Distance (PCU.KMS/HR)	143,922,464	127,742,320	153,785,024
Overall Average Speed (KPH)	69	71	69

9. Variable Demand Modelling

9.1 Introduction

A variable demand model has been developed for the A5036 Port of Liverpool Model. This section outlines the approach to constructing the variable demand model and parameters for use in the forecasting.

9.2 Approach to Variable Demand Modelling

The principles applied to develop the variable demand model follow DfT guidance, set out in TAG Unit M2-1: Variable Demand Modelling.

The established Trans Pennine South 2 RTM (TPS RTM2) demand model has been used as the basis for variable demand for the A5036 model. The TPS RTM2 demand model uses DIADEM, or the DfT's 'Dynamic Integrated Assignment and Demand Modelling' software which provides a tool for modelling multi-stage demand models from SATURN assignments. This tool allows incremental hierarchical logit modelling of the following in line with TAG:

- Trip frequency,
- Mode choice,
- Distribution and;
- Time of day choice

Figure 9.1 illustrates how DIADEM interfaces with SATURN and, if required a PT model.

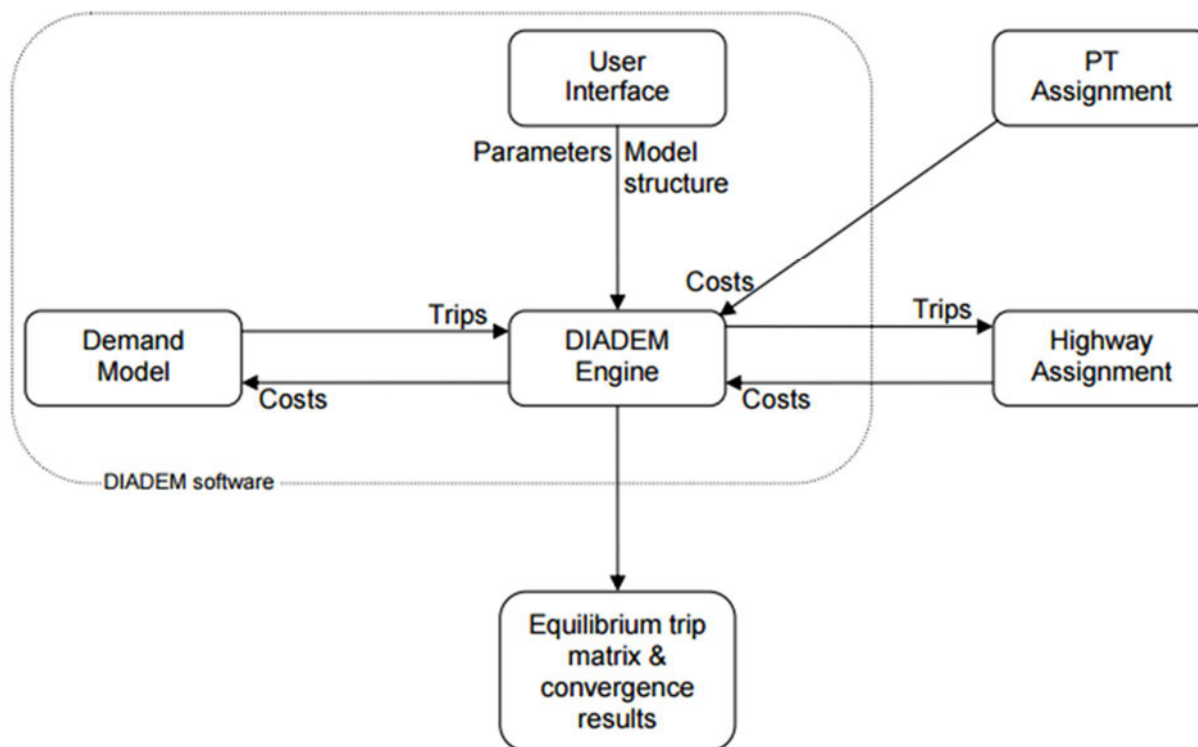


Figure 9-1 DIADEM Software Structure

The premise of variable demand modelling is that any change in travel cost due to traffic intervention or changes in travel demand is liable to either induce or suppress traffic. Any proposed improvements will likely make journeys quicker and cheaper for existing users by relieving congestion in the network and as such users will either re-route from other less appealing roads, change the destination of travel where previously inaccessible locations now become available, or shift travel from public transport to car and generate new trips that previously did not travel.

9.3 TPS RTM2 Variable Demand Model Development

National Highways Trans Pennine South 2 Transport Model (TPS RTM2) was developed to represent the strategic road network and other roads of importance specifically with the aim of being used to assess schemes on the National Highways network. The area affected by the A5036 scheme is covered by the TPS RTM2 which has been validated to appropriate standards for a strategic model throughout the model area. However, the level of detail included in the study area is insufficient to fully understand the impact of the A5036 scheme to be assessed. To provide more detail in the scheme area, 39 TPS RTM2 zones were replaced with 256 split zones increasing the number of zones in the A5036 model to 2,229. TPS RTM2 zonal demand was apportioned to the split zones using proportions estimated from a gravity model created from NTS trip data. The process has been described above in Section 5. The model has therefore been subject to alterations to improve the representation of the scheme study area whilst retaining the overall model structure and data already in use.

TPS RTM2 has been used to generate a base model for use in the study, with the above mentioned network and zone system changes so that the established demand model can implemented for the A5036 scheme, without the need to create a new demand model for the

study. The existing TPS RTM2 demand model has been used with the calibrated model parameters and realism testing undertaken to ensure the model is still performing within expected parameters with the updated and recalibrated A5036 model.

Key TPS RTM2 model parameters, across the demand and supply models are listed below.

Time Periods

- AM average hour (07:00 to 10:00)
- Inter Peak average hour (10:00 to 16:00)
- PM average hour (16:00 to 19:00)

Number of model zones:

- 2,229 in the A5036 model

Assigned user classes (Highway):

- Car Employers Business
- Car Commute
- Car Other
- Light Goods Vehicles
- Heavy Goods Vehicles

Public Transport (PT) trip matrices:

- Rail commuting
- Rail Other
- Rail Employers business

VDM segments:

- Home Based Employers Business
- Home Based Commute
- Home Based Other
- Non Home Based Employers Business
- Non Home Based Other
- Fixed – Employers Business
- Fixed – Commute
- Fixed – Other
- Fixed - Light Goods Vehicles
- Fixed - Heavy Goods Vehicles

VDM modal coverage:

- Highway
- Rail based Public Transport

VDM model responses:

- Time of Day
- Mode
- Distribution

Mode, destination and (macro) time period choices are represented in the demand model.

The structure of the Variable Demand Model is summarised below in Table 9-1.

Table 9-1: Variable Demand Model Structure

User Class	Time Period	Format	Demand Responses
Car, Employer Business – Home Based	24 Hour	Production/Attraction	Time Period Choice, Mode Choice, Distribution (Production Constrained)
Car, Commute – Home Based	24 Hour	Production/Attraction	Time Period Choice, Mode Choice, Distribution (Doubly Constrained)
Car, Other – Home Based	24 Hour	Production/Attraction	Time Period Choice, Mode Choice, Distribution (Production Constrained)
Car, Employer Business – Non Home Based	AM, IP, PM, and OP time periods	Origin/Destination	Time Period Choice, Mode Choice, Distribution (Origin Constrained)
Car, Other – Non Home Based	AM, IP, PM, and OP time periods	Origin/Destination	Time Period Choice, Mode Choice, Distribution (Origin Constrained)
Car, Employer Business – Fixed	AM, IP, PM, and OP time periods	Origin/Destination	Fixed – no VDM
Car, Commute – Fixed	AM, IP, PM, and OP time periods	Origin/Destination	Fixed – no VDM
Car, Other – Fixed	AM, IP, PM, and OP time periods	Origin/Destination	Fixed – no VDM
LGV	AM, IP, PM, and OP time periods	Origin/Destination	Fixed – no VDM
HGV	AM, IP, PM, and OP time periods	Origin/Destination	Fixed – no VDM

The TPS RTM2 uses the following software versions, which have been retained for use in this study:

- Saturn v11.4.07H
- Diadem 7.0

9.4 Realism Testing

The established TPSRTM2 demand model has been used as the basis for variable demand for the A5036 model. The same model structure and parameters have been used with an increased number of zones for the A5036 base year demand model. To validate the sensitivity of the A5036

base year demand model to changes in input values, a number of realism tests have been performed in line with TAG Unit M2.1. This part of the process is to ensure that the A5036 demand model validates to TAG criteria in its responses to changes in generalised costs via the elasticity (realism) tests.

The realism tests performed were as follows:

- Test 1: 10% increase in car fuel cost;
- Test 2: 10% increase in public transport fares;
- Test 3: Car journey time derived from car fuel cost test.

All realism tests calculate an elasticity which is defined in TAG Unit M2 section 6.4.5 as a measure of the proportionate change in travel in response to a proportionate change in cost. It is calculated as follows:

$$e = \frac{\log(T_1) - \log(T_0)}{\log(C_1) - \log(C_0)}$$

Where: C0 and C1 are the costs before and after the change
T0 and T1 are the travel demands before and after the change in costs
T0 and T1 are in terms of vehicle-kms for Test 1 and Test 3,
and person trips for Test 2.

Figure 9-2 MRTM and A5 Model Areas

To account for congestion and crowding, the elasticities have been calculated from converged runs of the demand/supply loop iterations. The procedure for realism testing with DIADEM was followed, as set out in section 8.1 of the User Manual.

Recommended ranges for the logit choice parameters are provided in TAG Unit M2-1, May 2020 Table 5.1 and Table 5.2 respectively (see Figure 9-3 and Figure 9-4 below).

Figure 9-3: Extract from WebTAG Unit M2 (Table 5.1)

Table 5.1 Illustrative Destination Choice Parameters				
TRIP PURPOSE AND MODE	MINIMUM	MEDIAN	MAXIMUM	SAMPLE
CAR				
Home-based work	0.054	0.065	0.113	7
Home-based employers business	0.038	0.067	0.106	5
Home-based other	0.074	0.090	0.160	4
Non-home-based employers business	0.069	0.081	0.107	3
Non-home-based other	0.073	0.077	0.105	3
PUBLIC TRANSPORT				
Home-based work	0.023	0.033	0.043	7
Home-based employers business	0.030	0.036	0.044	4
Home-based other	0.033	0.036	0.062	4
Non-home-based employers business	0.038	0.042	0.045	2
Non-home-based other	0.032	0.033	0.035	3

Figure 9-4: Extract from WebTAG Unit M2 (Table 5.2)

Table 5.2 Illustrative Main Mode Choice Scaling Parameters

TRIP PURPOSE	MINIMUM	MEDIAN	MAXIMUM	SAMPLE
Home-based work	0.50	0.68	0.83	6
Home-based employers business	0.26	0.45	0.65	2
Home-based other	0.27	0.53	1.00	4
Non-home-based employers business	0.73	0.73	0.73	1
Non-home-based other	0.62	0.81	1.00	2

The realism testing for the A5036 model used the logit choice parameters that had been established for the TPS RTM2. These parameters were within the range of the WebTAG values given above, and are shown in Table 9-2.

Table 9-2: Logit Model Parameters for Choice Responses

Car Purpose	Car Destination Choice - λ	PT Destination Choice - λ	Mode Choice - Θ	Time Period Choice - Θ
Home Based Employer Business	-0.060	-0.036	-0.45	1
Home Based Commuting	-0.059	-0.033	-0.68	1
Home Based Other	-0.081	-0.036	-0.53	1
Non Home Based Employer Business	-0.073	-0.042	-0.73	1
Non Home Based Other	-0.069	-0.033	-0.81	1

9.5 Car Fuel Cost Elasticity

The car fuel cost elasticity is the percentage change in car vehicle-kms with respect to the percentage change in car fuel cost. It has been calculated for all purposes and time periods both on a matrix with a fully-converged run of the demand model. The change in car fuel cost has been applied to the car fuel cost component of the VOCs of both the SATURN highway assignment and the DIADEM demand model. As for TPS RTM2 convergence stop gaps were set at 0.1% for the full model and 0.2% for the subarea. The demand model reached an acceptable gap after 6 iterations for the car fuel cost test, as shown in Table 9-3.

Table 9-3 Convergence – Car Fuel Cost

Iteration	Max Flow Change	Objective Function	Absolute Gap	Relative Gap
1	0	5,152,990,90	50,191,536	1.90%
2	5,564	128,503,950	24,586,661	0.94%
3	2779	32,083,726	12,225,631	0.47%
4	1388	8,019,117	6,167,503.4	0.24%
5	694	2,092,859	3,246,3184	0.12%
6	347	540,400	1,738,950	0.07%

In the matrix-based method, the change in car vehicle-kms in the model subarea was calculated from the skimmed distance matrices and the car trip matrices which relate to the with and without fuel cost change DIADEM demand model runs.

As per DfT's TAG Unit M2 section 6.4, the combined average fuel cost elasticity should lie within the range of -0.25 to -0.35 across all journey purposes, with:

- Values for employers' business trips being nearer to -0.1;
- Values for discretionary trips being nearer to -0.4;
- Values for commuting being near the average;
- Peak period values being generally lower than inter-peak ones.

The car fuel cost realism test outturn elasticities are shown below in Table 9-4 below. The results are similar to those from the TPS RTM2 as shown in Table 9-5. The outturn elasticities are within or nearly within the recommended WebTAG ranges.

Table 9-4: Car Fuel Cost Realism Test Outturn Elasticities (Matrix Based) – A5036 Model

Car Purpose	AM Peak	Inter Peak	PM Peak	Off Peak	Weekday
Car - Business	-0.19	-0.17	-0.16	-0.26	-0.18
Car - Commuting	-0.17	-0.19	-0.19	-0.23	-0.18
Car - Other	-0.46	-0.44	-0.43	-0.51	-0.45
All Purpose	-0.28	-0.34	-0.29	-0.41	-0.33

Table 9-5: Car Fuel Cost Realism Test Outturn Elasticities (Matrix Based) – TPS RTM2

Car Purpose	AM Peak	Inter Peak	PM Peak	Off Peak	Weekday
Car - Business	-0.20	-0.20	-0.16	-0.22	-0.19
Car - Commuting	-0.18	-0.20	-0.19	-0.21	-0.19
Car - Other	-0.43	-0.41	-0.41	-0.41	-0.42
All Purpose	-0.28	-0.34	-0.28	-0.31	-0.30

9.6 Public Transport Fare Elasticity

The public transport fare elasticity is the percentage change in public transport trips by all public transport modes with respect to the percentage change in public transport fares. The calculations have been carried out on a matrix basis, by time period and demand stratum. They have then been aggregated over time periods and demand strata to produce elasticities by trip purpose and an overall average elasticity. As for the TPS RTM2, convergence stop gaps were set at 0.1% for the full model and 0.2% for the subarea. The demand model reached an acceptable gap after 4 iterations for the public transport fare test, as shown in *Table 9-6*.

Table 9-6 Convergence – Public Transport Fare

Iteration	Max Flow Change	Objective Function	Absolute Gap	Relative Gap
1	0	19,944,857	11,263,834	0.43%
2	1,208	499,3814	5,744,910	0.22%
3	604	1,257,126	2,987,532	0.12%
4	302	320,060	1,595,471	0.06%

The public transport fare realism results are given below in *Table 9-7*.

Table 9-7: Public Transport Fare Elasticity – A5036 and TPS RTM2

Purpose	A5036 Model	TPS RTM2
Public Transport - Business	-0.29	-0.26
Public Transport – Commuting	-0.21	-0.20
Public Transport – Other	-0.81	-0.73
Public Transport - All Purposes	-0.48	-0.44

Table 9-7 shows elasticities within the recommended range of -0.2 to -0.9 for all car user classes. The A5036 model PT elasticities are similar to those from the TPS RTM2.

9.7 Car Journey Time Elasticity

Due to the limitations of the DIADEM software it is not possible to calculate journey time elasticities exactly. Therefore, the journey time elasticities were approximated from vehicle-km fuel cost elasticities using the method set out in Section 8.1.3 of the DIADEM manual.

The car journey time realism results are given in *Table 9-8* below.

Table 9-8: Car Journey Time Elasticity – A5036 Model

Car Purpose	AM Peak	Inter Peak	PM Peak	Off Peak	Weekday
Car - Business	-0.23	-0.21	-0.17	-0.32	-0.22

Car Purpose	AM Peak	Inter Peak	PM Peak	Off Peak	Weekday
Car - Commuting	-0.28	-0.30	-0.31	-0.36	-0.30
Car - Other	-0.83	-0.76	-0.77	-0.86	-0.78
All Purpose	-0.43	-0.53	-0.45	-0.62	-0.51

These values are weaker than -2.0 and meet the requirement in the TAG guidance.

9.8 Conclusions

The result of the Realism Testing of the A5036 model is summarised in Table 9-9.

Table 9-9 Summary of Realism Test Results

Realism Test	Recommended Elasticity Range (TAG M2 Table 6.2)		A5036 Model Elasticity Results
	High	Low	All User Classes and Time Periods
Average Car Fuel Cost (kms)	-0.35	-0.25	-0.33
PT Main Mode Fare (trips)	-0.9	-0.2	-0.48
Car Journey Time (trips)	No stronger than -2.0		-0.51

The A5036 model is shown to produce elasticities within the recommended ranges for all three tests. It is therefore concluded that the A5036 model is suitable for variable demand forecasting for the A5036 Port of Liverpool Scheme.

10. Summary and Conclusion

10.1 Summary

This report has detailed the development and key features of the National Highways Port of Liverpool (A5036 model) base model with a base year of 2019. The model has been developed to be able to test the A5036 scheme.

The TPS RTM2 was used as the starting point for developing the model principally due to the coverage of the network and existence of matrices and traffic data. Further data obtained for this study has also been used in the development of the model. Both the network and the zone system were refined to improve the accuracy of the representation of the network and movements on and around the A5036.

Matrix estimation has been undertaken to calibrate the model and factor the model flows so they are closer to the observed flows. It has been demonstrated that the impact of matrix estimation on the models has been suitably minimised in line with TAG.

In all three time periods, the model meets the TAG requirements for calibration for screenlines and links. The models also validate to a reasonable standard that is considered suitable for the model's purpose. Journey time routes across the model have been validated in each time period with nearly all routes meeting the TAG criteria.

Of particular importance is the A5036, for which additional count data has been applied to derive local screenlines and links for calibration and validation. Link flows on and around the A5036 are close to the observed flows in all time periods. The journey time route on the A5036 also provides a good representation of the observed data.

A variable demand model has been developed in line with the guidance in TAG and realism testing has been undertaken. The overall elasticities meet the TAG criteria, and the detailed values are either within or close to being within acceptable ranges.

10.2 Conclusion

In conclusion, it is considered the model is a good representation of the 2019 conditions. Therefore, the A5036 model can be considered fit for purpose and suitable to take forward as the base model in the assessment of the A5036 Port of Liverpool scheme.