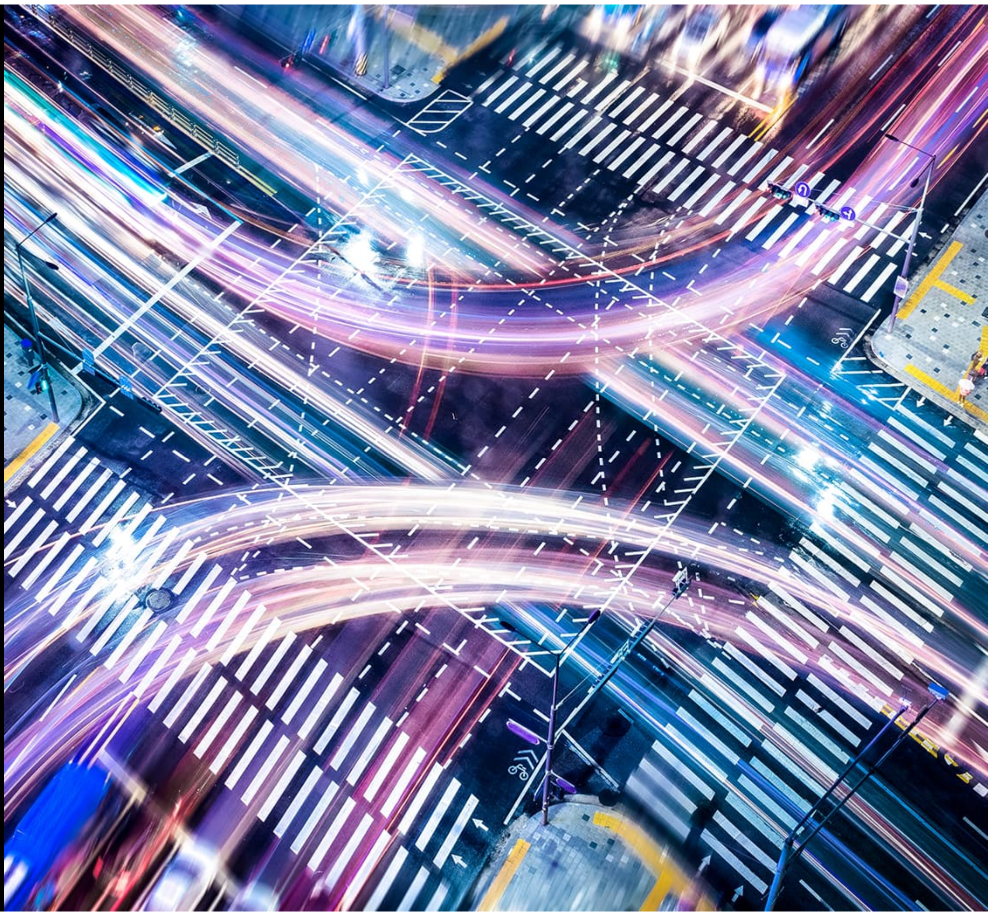
CLTM Base Year Re-Validation Report

Revision no: 2

Lancashire County Council

Central Lancashire Transport Model Update



CLTM Base Year Re-Validation Report

Client name: Lancashire County Council

Project name: Central Lancashire Transport Model Update

Project no: B2427708

Project manager: Sabin Karimbil

Revision no: 2

Prepared by: Witold Kogut

Date: 30/01/2025

File name: CLTM Base Model Re-Validation Report_v2

Doc status: Final – Ready to issue

Document History and Status

Revision	Date	Description	Author	Checked	Reviewed	Approved
0	02/08/2024	For TWG Review and Comments	WK	RB	SK	SK
1	22/10/2024	Revised Report after addressing NH/WSP and LCC Comments	WK	SK	SK	SK
2	30/01/2025	Revised Report after addressing NH/WSP Comments	WK	SK	SK	SK

Jacobs U.K. Limited

1 City Walk
Leeds, West Yorkshire LS11 9DX
United Kingdom

T +44 (0)113 242 6771
F +44 (0)113 389 1389
www.jacobs.com

Contents

List of Figures

List of Tables

1. Introduction

1.1 Background

Local Plans, created by local planning authorities in collaboration with their communities, outline a vision and framework for future area development. Once established, these plans become part of the statutory development plan, which serves as the basis for local planning application decisions. Every local planning authority in England is required to prepare a Local Plan.

The government mandates that all local councils develop a long-term plan detailing how and where land can be developed over the next 15 years to meet the needs of local residents and businesses. This plan guides development and informs planning decisions once adopted.

The three Central Lancashire authorities of Preston City Council, South Ribble Borough Council and Chorley Council are working together to produce a single Central Lancashire Local Plan. This will form part of the statutory development plan for each district alongside other documents such as Neighbourhood Plans. It will replace the Central Lancashire Core Strategy 2012 and the three district Local Plans adopted in 2015.

Due to its use as a basis for informing planning decisions, the Local Plan needs to be robust. This includes its strategies and policies being based on appropriate and credible evidence. From the perspective of transport, it is considered prudent to understand the cumulative transport impact of the Local Plan proposals on the transport network and to show how this translates into a transport strategy and potential transport improvements.

To achieve the above, Lancashire County Council has commissioned Jacobs to provide transport planning consultancy to support the Local Plan process. Jacobs has been appointed by Lancashire County Council (LCC) to provide transport planning consultancy to support the Local Plan process. One of the key tasks is to update the Central Lancashire Transport Model (CLTM) in order to assess the cumulative transport impact of the land use allocations in the draft Local Plan. The work will identify locations on the highway network which are forecast to suffer increased delays as a result of the proposals and therefore where the Council needs to concentrate its transport mitigation strategy. It will also show whether the mitigation strategy is able to accommodate the growth over the plan period. The results of this study will be used in further work to help identify potential transport improvements in the three districts. The improvements study will inform the Council's Infrastructure Delivery Plan, which forms part of the evidence base for the Local Plan.

The CLTM was originally calibrated and validated to Autumn 2013 data using 2015 TAG parameters (values of time and vehicle operating costs). In 2018, the model was re-calibrated to 2018 TAG for the purpose of the Preston Western Distributor (PWD) Full Business Case (FBC); nonetheless, the Base Year remained 2013 in the absence of more recent traffic data.

In line with TAG requirements and the feedback received from the Department for Transport (DfT) on the Transforming Cities Fund (TCF) Appraisal Specification Report (July 2019), the CLTM was due for an update since the age of the data used to build the model was reaching six years. For this purpose, a data collection exercise was undertaken to update and re-calibrate the model to Autumn 2019 traffic counts and journey times.

Subsequently, at the request of the DfT as part of the A582 OBC assurance, a Demand Model in Production and Attraction (PA) format was developed to ensure it followed the TAG recommended approach. The CLTM model was later upgraded to include a Rail (and Rail Park and Ride) Model in EMME and included mode choice between Rail and Car in DIADEM for the purposes of the Cottam Parkway Station Planning Application.

Building on the discussions with LCC about benefits of a Full Demand Model and in view of the ambitions for implementing sustainable travel in Central Lancashire with a focus on bus priority, the model was upgraded to include bus model in EMME. The most recent version of the strategic model consists of the following:

- Highway Assignment Model representing vehicle-based movements across the Lancashire area for a 2019 weekday morning peak hour (08:00 ‐ 09:00), an average inter ‐ peak hour (10:00 ‐ 16:00) and an evening peak hour (17:00 ‐ 18:00);
- Public Transport Assignment Model representing bus and rail-based movements across the same area and time periods to include the Park and Ride sub ‐ mode choice; and,
- Multi ‐ modal incremental VDM that forecasts change in choice of main mode and destination in response to changes in generalised costs.

In May 2023, the DfT issued new guidelines on integrating the effects of Covid-19 into model forecasts. These guidelines were part of the Transport Analysis Guidance Unit M4. In the context of the A582 OBC project, which used the CLTM traffic model for scheme evaluation, Jacobs had been in discussions with the DfT as part of the approval process for the scheme's funding. In line with the new guidelines and following discussions with the DfT, Jacobs conducted a benchmarking exercise to ensure adherence to the DfT's requirements for transport modelling in the post-Covid-19 period. A technical note summarising the analysis and findings was submitted to the DfT and is included in Appendix A.

The benchmarking exercise involved a comparison of the traffic flows modelled using 2019 data (base year) with the observed traffic flow data from 2023 in the A582 study area. The aim of this comparison was to identify any significant changes in traffic patterns between the time the traffic matrix was developed and the present.

1.2 Local Plan Context

Originally, CLTM was developed to support City Deal schemes in the Central Lancashire area. Consequently, it had a strong focus on Preston and South Ribble and was more robust in these areas compared to Chorley. However, the strategic model's calibration validation, which encompassed screenlines and journey time routes across all three districts, ensured that it offered a good overall representation of traffic movements, volumes on key routes, and journey times for vehicles on key routes through the network. Furthermore, the model was deemed fit for purpose in evaluating the cumulative impact of strategic growth in Preston, South Ribble, and Chorley. This signified that it could effectively assess the combined effects of various development proposals across these areas.

In order to better comprehend the required updates for the Chorley, an additional analysis was conducted using separate datasets (traffic flows and journey times) from those used during the 2019 model update process. This analysis helped identify specific areas in the model that need enhancements or modifications from the perspective of local plan testing.

Following discussions with the Central Lancashire Local Plan Technical Working Group, it was determined that the traffic model requires an update. This update will involve incorporating additional traffic surveys to ensure comprehensive coverage of the Local Plan Study Area. Furthermore, the revised model will account for the current traffic levels, which have changed since the onset of Covid-19, making it more suitable for its intended purpose.

A technical note was produced to summarise the traffic data gaps and proposed traffic counts required for the model update and is included in Appendix B.

1.3 Purpose of the Report

This document is an Addendum to the Base Year 2019 Re-Calibration Report and is intended to document the highway models development and demonstrate its suitability for the assessment. The report details the model's base year calibration and validation as well as its subsequent use for future year demand forecasting. The contents of this report have been determined by the standards and guidance provided by the Department for Transport (DfT) within Transport Analysis Guidance (TAG).

1.4 Related Documents

This document is accompanied by the following two documents that provide the complete model documentation:

- Traffic Data Collection Report (TDCR), Appendix C – This report summarises the survey data that was used to re-calibrate the highway model to the 2019 base
- Base Year 2019 Re-Calibration Report, Appendix D – This report details the data, processes, methodologies and results of the highway model recalibration to 2019 Base Year.
- Base Year Model Bus Calibration Report, Appendix E – This report details the data, processes, methodologies and results of the public transport model recalibration to 2019 Base Year and the new EMME VDM set up.

1.5 Report Structure

Following this introduction, the structure of this report is as follows:

- Chapter 2 – Provides an overview of the model, key characteristics, and the design principles.
- Chapter 3 – Summarises the modelling standards and acceptability criteria.
- Chapter 4 – Details the data used for model calibration and validation.
- Chapter 5 – Provides the details of the matrix development.
- Chapter 6 – Provides information on the calibration and validation of the trip matrices .
- Chapter 7 – Details the calibration and validation of the assignment .
- Chapter 8 – Details the development and validation of Variable Demand Model.
- Chapter 9 – Provides a summary of the model and its fitness for purpose.

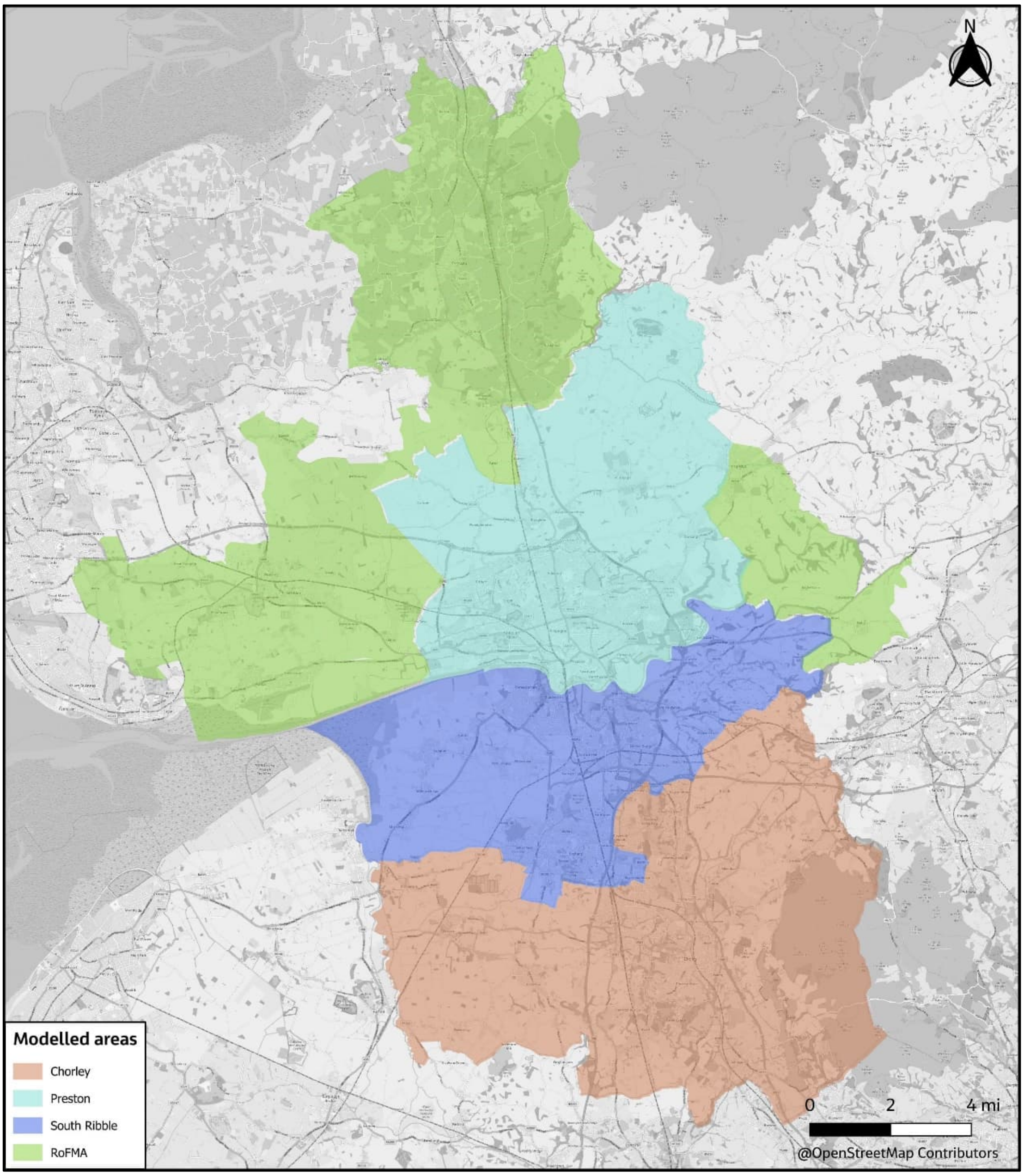
2. Model Description and Specification

2.1 Modelled Area

The geographical scope and the network of the updated CLTM model is generally consistent with the previous version of the model.

The primary use of the updated model is to help support the development of the Local Plan covering the three local authority districts which are: Chorley, Preston and South Ribble. Figure 2.1 show the boundaries of these three Local Authorities that form Central Lancashire and the extent of the fully modelled area and the rest of the area. The geographical scope of the model network and specifically the detailed/simulation area cover these areas of impacts of those schemes.

Figure 2.1: Central Lancashire Local Authorities



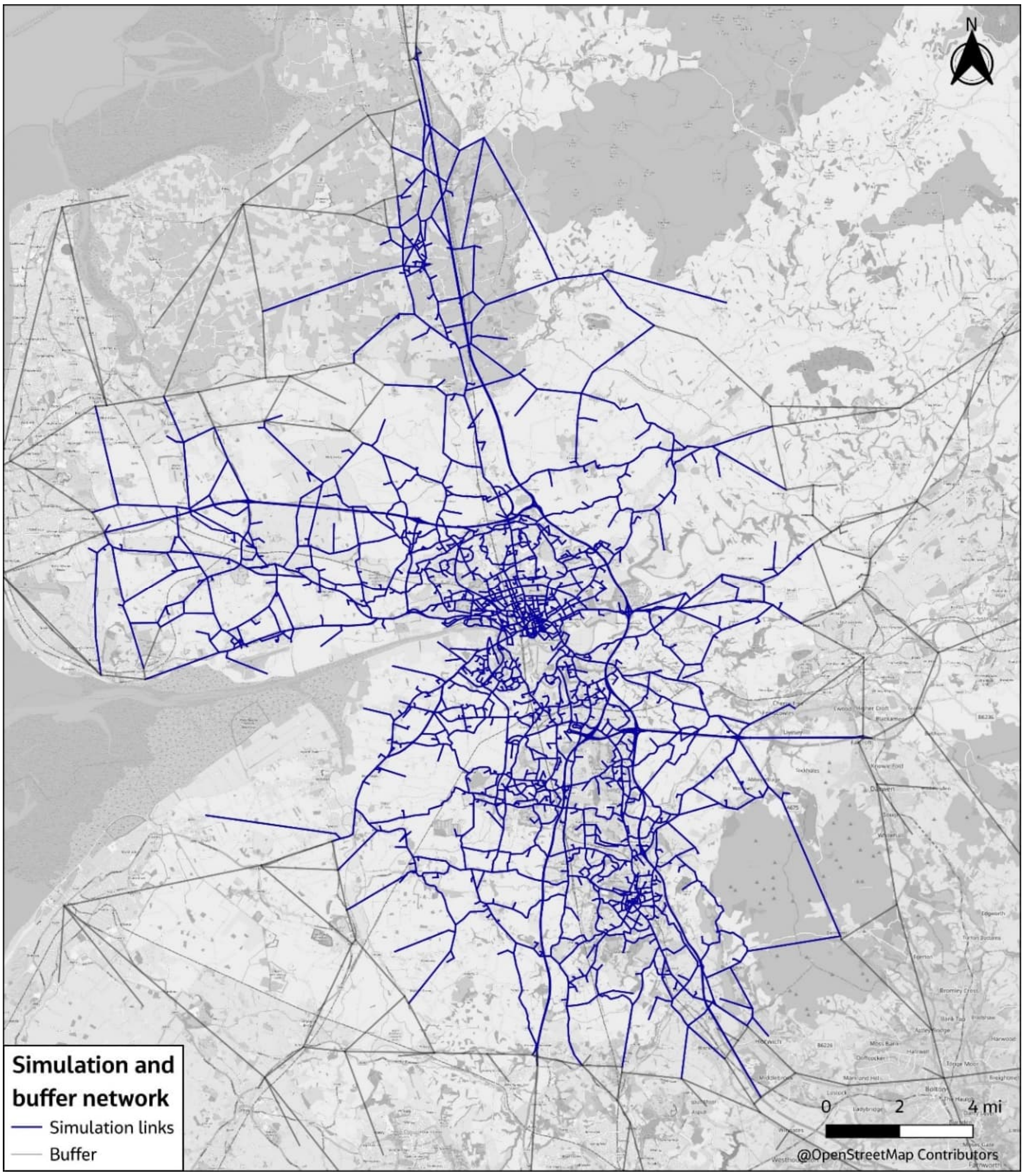
The modelled area makes use of a three-stage structure with levels of detail of network coding reducing away from the centre of the study area. The breakdown of the modelled area is outlined below:

Fully modelled area:

- Area of detailed modelling (AoDM) – highest detail
- Rest of fully modelled area (ROFMA) – reduced network coverage but variable travel times enabled
- External Area – lowest network coverage and fixed speeds used

Figure 2.2 shows the simulation and buffer network coded in the SATURN model.

Figure 2.2: CLTM Modelled Network



Outside of the detailed modelled area, typically Motorways, A and B Roads have been modelled, to reflect the more spatially aggregated nature of the zoning system. As these areas are further away from the study area, it is only necessary to have enough detail to ensure that the trips from these areas entering the study area are captured at the appropriate locations. Figure 2.3 shows the entire CLTM model network, covering trip distances, costs and public transport services across the whole of Britain, including the external modelled area. Figure 2.4 and Figure 2.5 then present bus services and rail lines coded in CLTM with the thickness of lines in Figure 2.5 representing the number of bus or rail services on that line. Bus stops or rail stations are represented by red points in Figure 2.4 and Figure 2.5.

Figure 2.3: CLTM Full Network

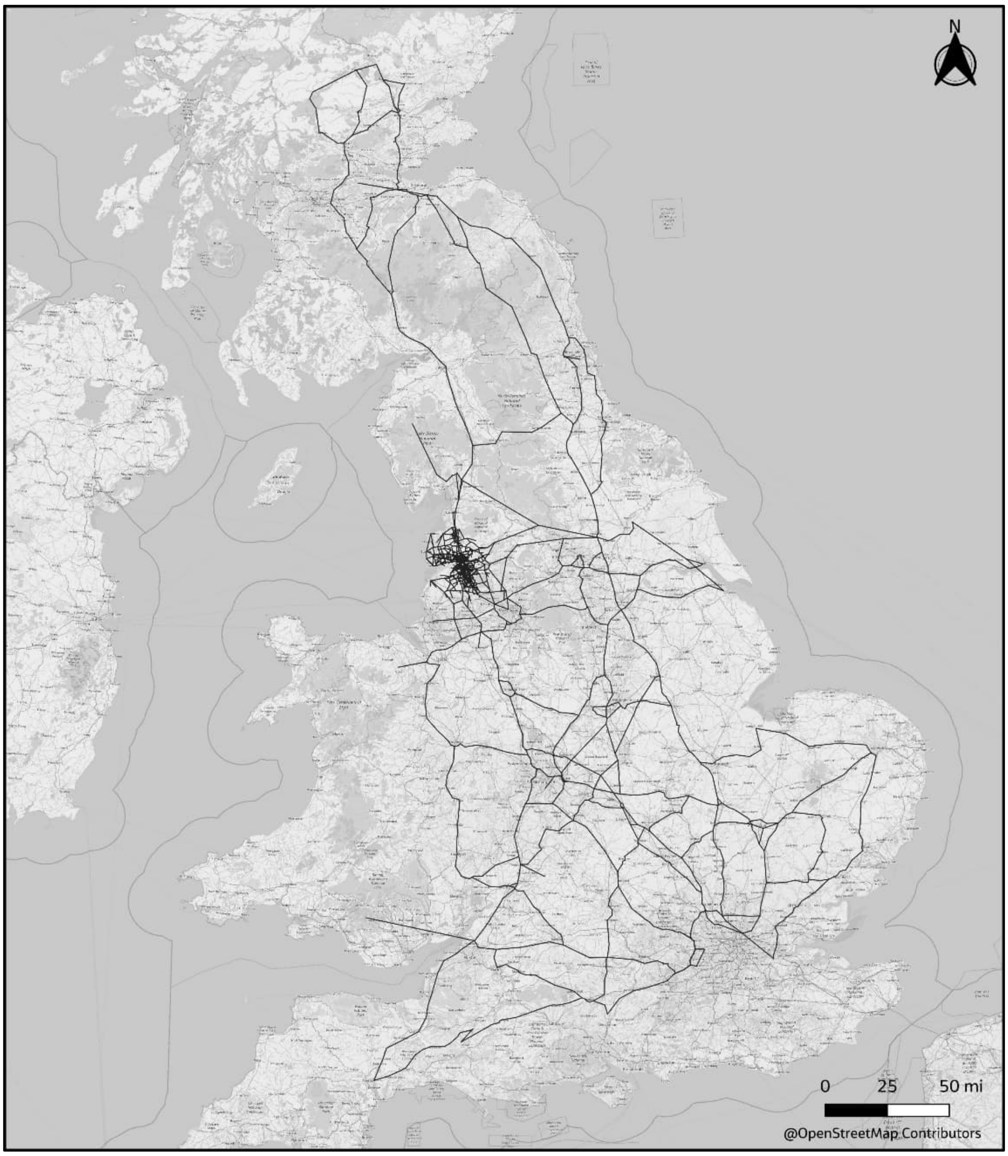


Figure 2.4: CLTM Bus Services

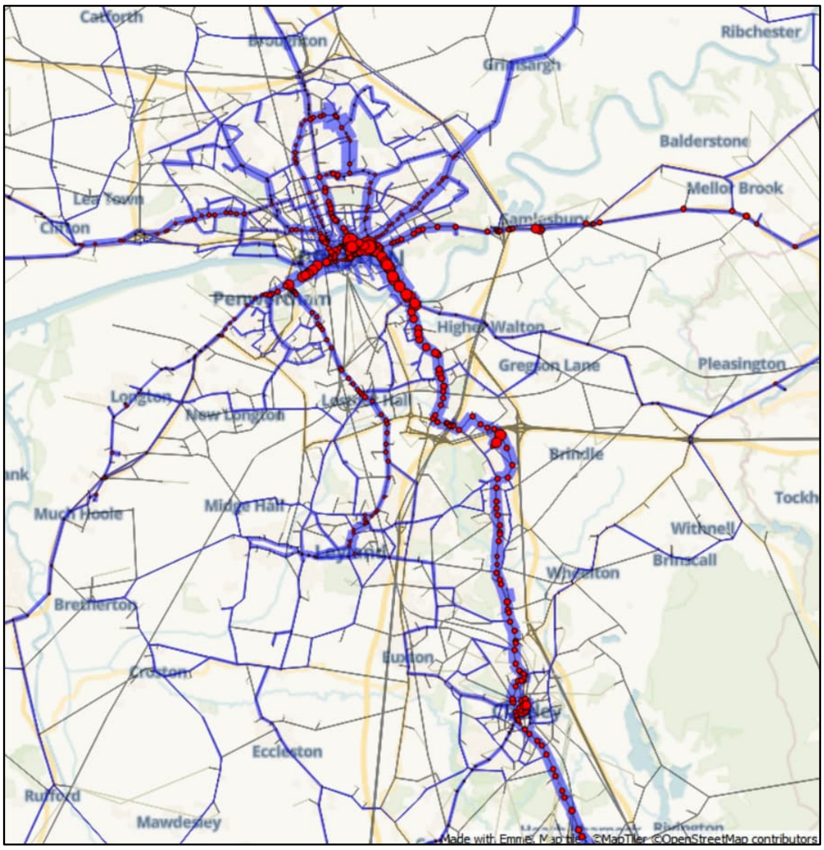
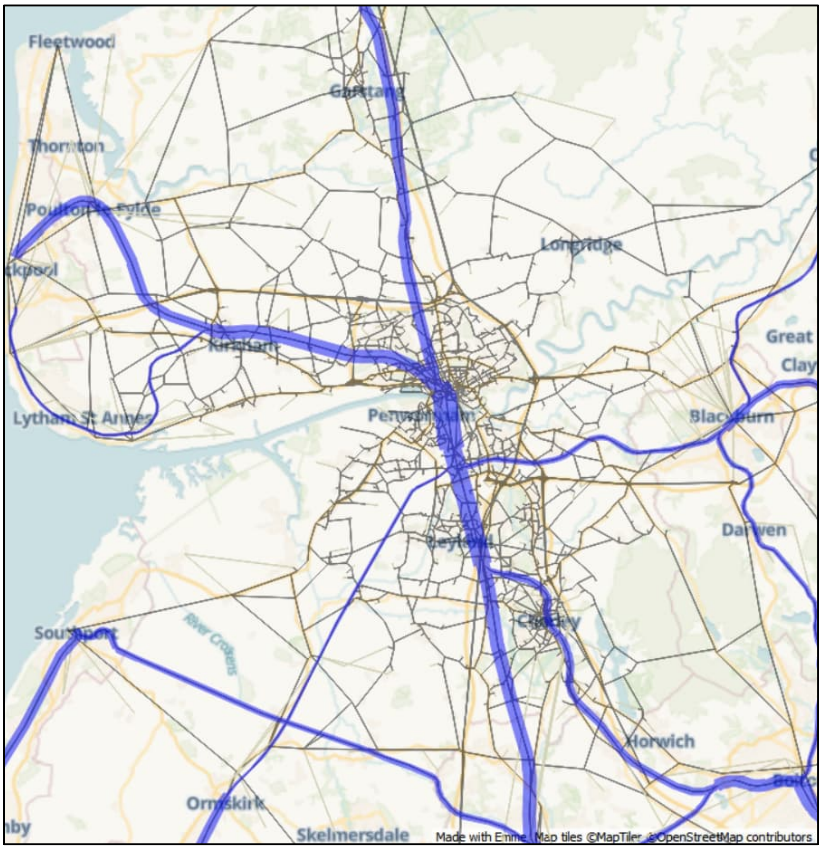


Figure 2.5: CLTM Rail Lines



2.2 Model Network

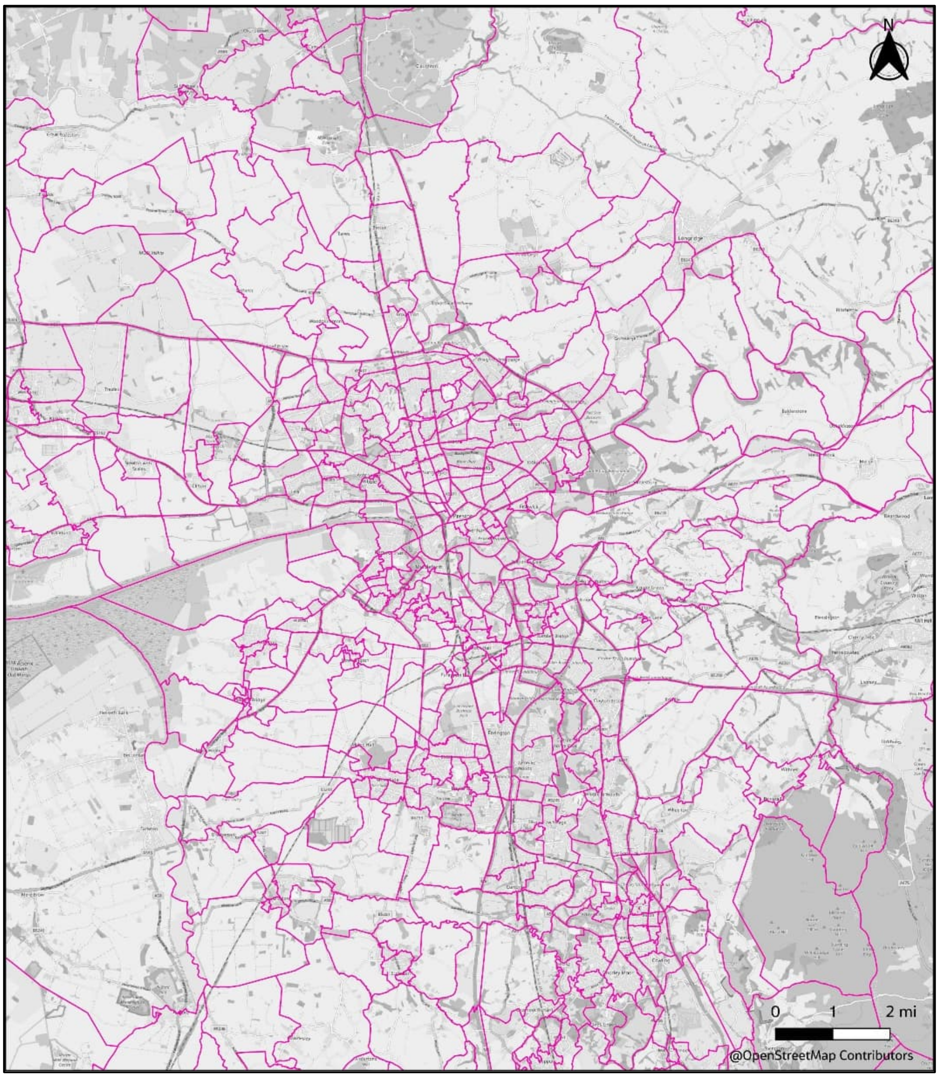
2.2.1 Model Zones and Centroid

The original model zone system built from Census Output Areas (COA) has been preserved in the updated model and comprises a total of 579 zones (including 5 spare zones).

Within the detailed model study area (illustrated in Figure 2.6) the zones were comprised of COAs or aggregations thereof. In some instances, zones were based on a disaggregation of COAs in order to isolate individual pockets of land (for example, to separate large industrial land uses from residential uses). The area approximately covered by the Preston City Council boundary was zoned in this way.

Areas further away from the study area, where less spatial detail was required, were based on Middle Layer Super Output Area (MSOA) or district boundaries. In the area immediately surrounding the study area these were mostly comprised of single MSOA. Beyond that point, in the external area of the model, several district zones were aggregated to comprise the modelled zone.

Figure 2.6: Zone System Surrounding Preston



A small number of changes to the zoning system were required in the Chorley as part of the model update. They aimed to improve accuracy of demand loading onto the network by either adding additional zone connectors (this applies particularly for big zones) or moving existing ones.

2.2.2 Model Network

The starting point for the 2024 network was the CLTM 2019 Base Year model network. All scheme completed between 2019 and 2024 were identified in cooperation with LCC and coded into the updated model. A list of schemes is provided below, and the affected model network is highlighted in yellow in Figure 2.7.

- Preston Western Distributor Road and the East West Link Road - This project is segmented into three main parts, with Edith Rigby Way being the most substantial. This vital road, a part of the Preston Western Distributor project, links the A583 Blackpool Road and Riversway to a new junction on the M55. The project also includes two smaller link roads: William Young Way and Avice Pimblett Way. These roads establish connections to both new and existing residential areas in North West Preston and Cottam.

- Penwortham By-Pass - The new bypass is one of the major road schemes built as part of the Preston, South Ribble, and Lancashire City Deal. The aim of the new bypass is to remove traffic through the centre of Penwortham by providing a new route from the A59 Liverpool Road at Howick to the A582 at Broad Oak Roundabout. Following the opening of John Horrocks Way bypass, the slip road onto Guild Way was closed. Access to the flyover is possible via the roundabouts at the junctions of Leyland Road and Golden Way.
- The Cawsey Link Road – This Cross Borough Link Road serves as a vital connection between Penwortham and Walton-le-Dale, facilitating quicker travel between these areas while providing a viable alternative route for local residents. Additionally, it's anticipated to relieve traffic congestion, particularly at Tardy Gate, enhancing overall traffic flow in the region.
- Broadgate cyclops (Cycle Optimised Protected Signals) - This junction is a key part of the Penwortham to Preston Cycleway, and also forms part of the Preston Guild Wheel route. The improvements implemented at this junction prioritize safety by segregating cycling lanes from pedestrian pathways and general vehicular traffic. This segregation minimizes potential conflicts between different modes of transport, ensuring safer passage for cyclists and pedestrians while reducing congestion for motor vehicles.
- Corporation street closure – This update includes a bus gate between Heatley Street and Marsh Lane in both directions. The bus gate has been designed to reduce traffic along Corporation Street, make bus journeys faster and more reliable, and encourage more walking and cycling. The aim is to reduce traffic levels on Corporation Street, especially at peak times, improving this route to and from UCLan, Ring Way, the city centre and the railway station.

The signal timings for the signalized junctions pertaining to the network updates were obtained from LCC and subsequently updated in the model.

All SATURN global network parameters including locally calibrated ones (e.g. minimum gap accepted by a vehicle which gives way at the junction: GAP, GAPM, GAPR) were retained from the 2019 base year model.

All zonal and network updates are shown in Figure 2.8.

Figure 2.7: Highway schemes completed between 2019 and 2024

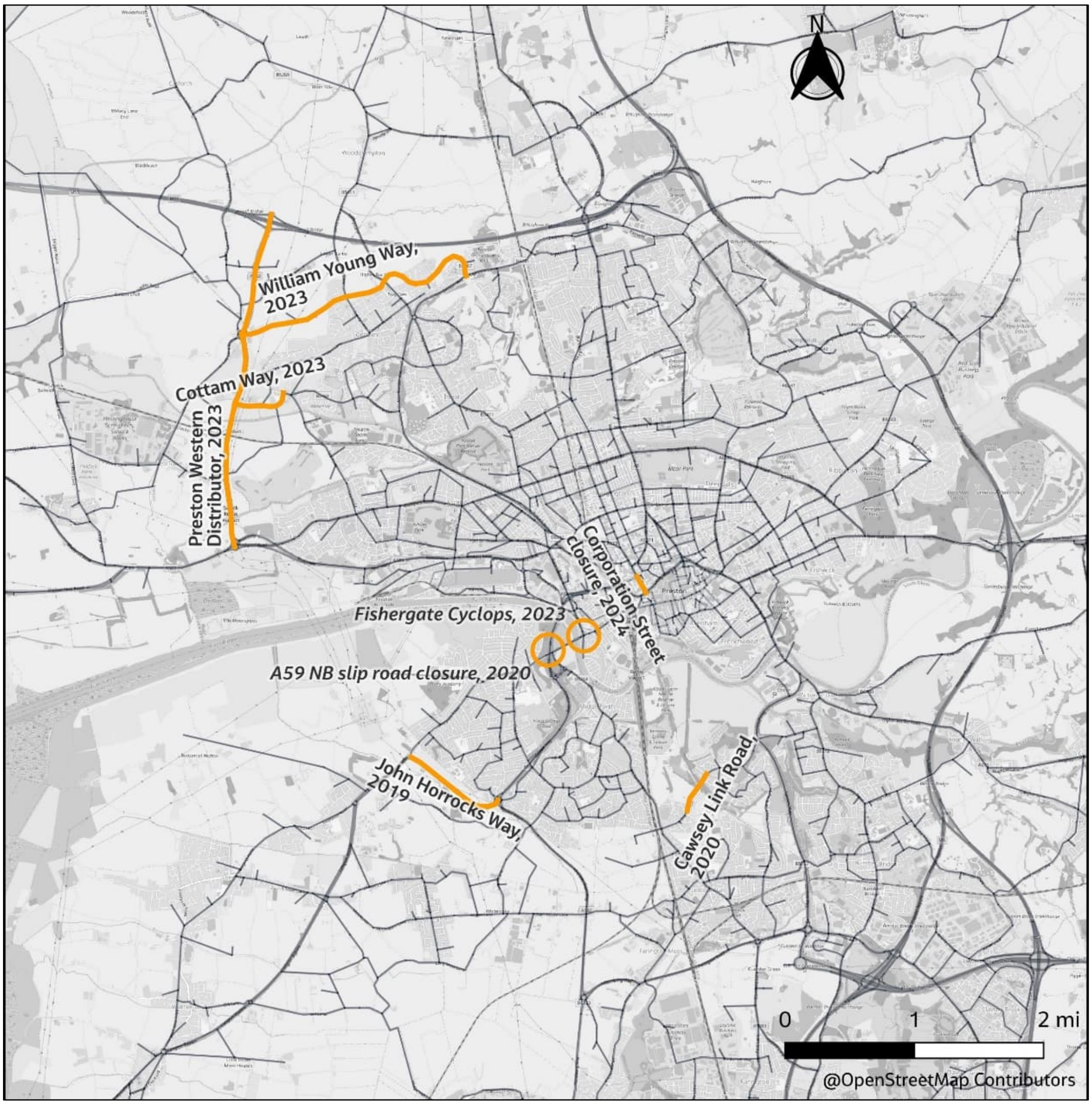
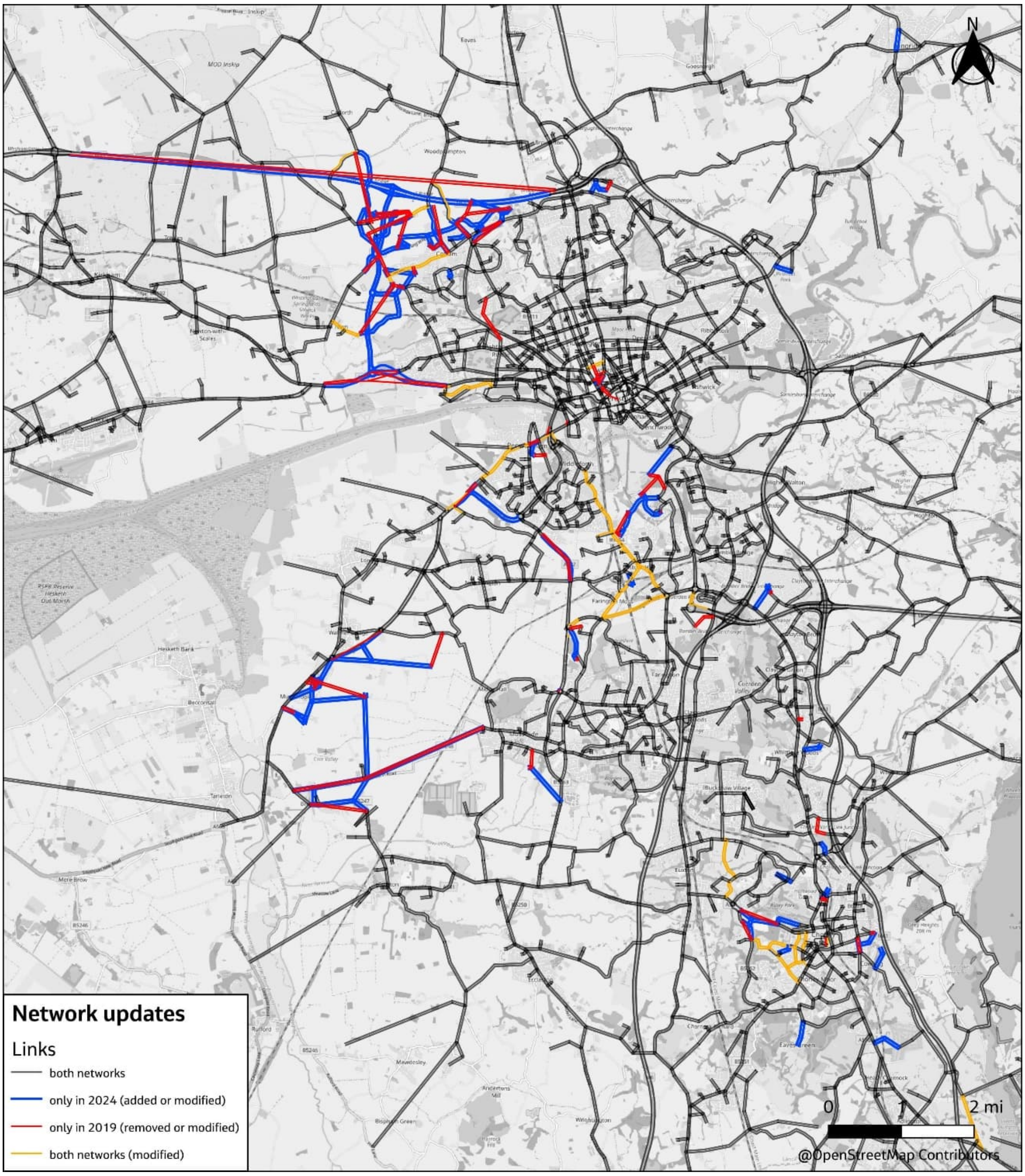


Figure 2.8: Network modifications compared to Base 2019 model



2.3 Zone Sectoring

For ease of analysis and understanding of the trip making patterns, the zoning system is grouped together into sectors. As with the zoning system itself, the sectors are more refined within the detailed modelled area, becoming coarser further out from the detailed area. The 34 sectors were created taking into account the model screen lines and sector-to-sector movements to, from and within the A582 scheme impact area.

This sector system is shown in Figure 2.9 and Figure 2.10. Table 2.1 includes a further description of the sectors.

Figure 2.9: CLTM Sectors

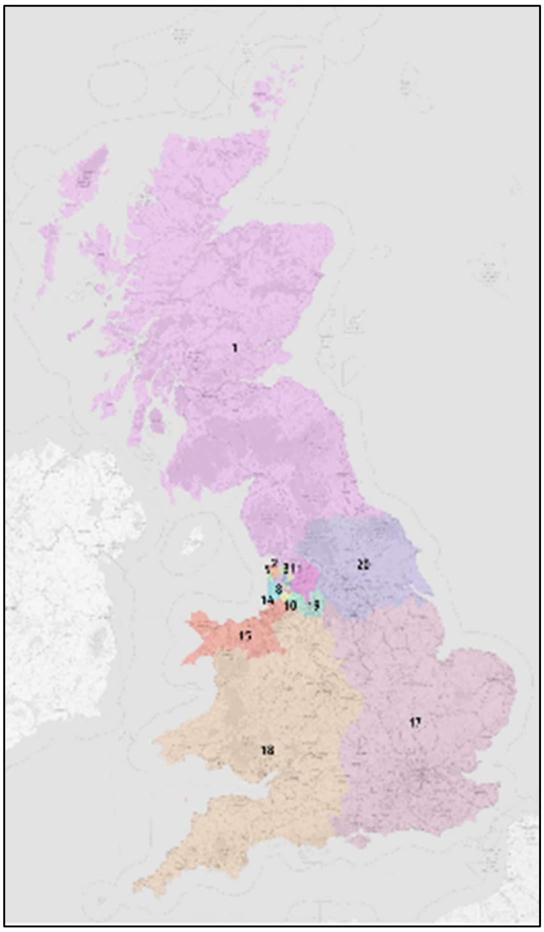


Figure 2.10: CLTM Sectors - Zoomed In

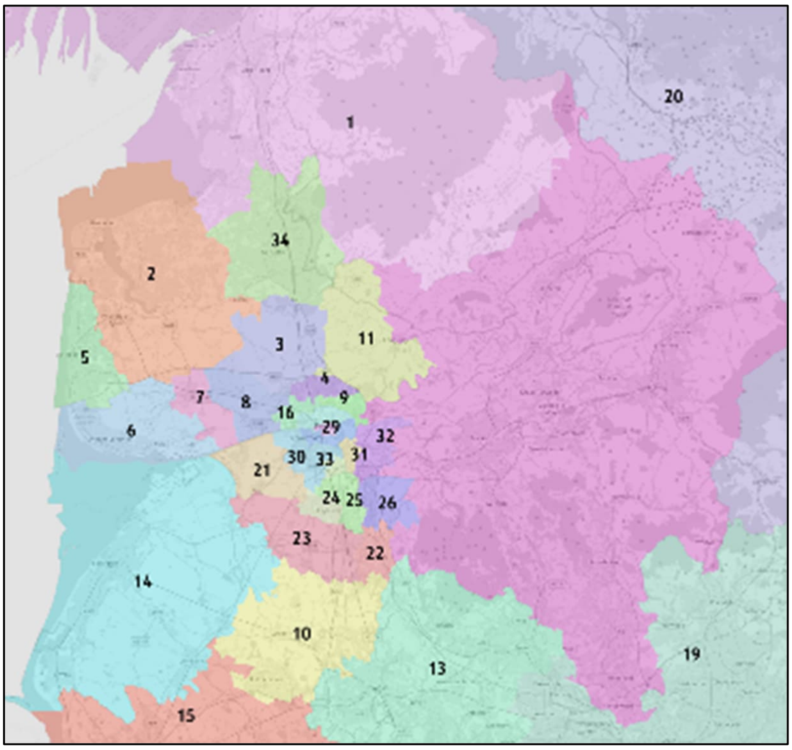


Table 2.1: Sector Description

Sector	Sector Name
1	North of Model
2	North West of Model - Poulton, Fleetwood etc
3	North Outer Screenline
4	North Preston
5	Blackpool
6	West of Model
7	Western Outer Screenline
8	North West Preston
9	Inner North Preston - North East
10	South of Model - Skelmersdale etc
11	North East Outer Screenline
12	East of Model - Blackburn etc
13	South East of Model - Wigan, Bolton etc
14	South West of Model
15	Northern Wales & Merseyside
16	Inner North Preston - North West
17	London, South East, East England & East Midlands
18	South West, West Midlands & Wales
19	Manchester
20	Yorkshire
21	Hutton
22	Chorley
23	South Outer Screenline
24	Leyland
25	East of Leyland
26	South East Preston
27	Inner South Preston
28	Preston City Centre
29	Inner North Preston - North
30	Penwortham and Lostock Hall
31	Bamber Bridge
32	Outer Eastern Screenline
33	Tardy Gate
34	Garstang

2.4 Key Model Components

2.4.1 Modelled Hours

The three modelled hours used in the previous model update (am peak hour, pm peak hour and average interpeak hour) were reconfirmed using the traffic counts collected for the project. More detail on the analysis of peak flows can be found in TDCR Section 5.1 (Jacobs, February 2020).

The modelled hours in the model are therefore:

- AM peak hour (08:00 – 09:00)
- PM peak hour (17:00 – 18:00)
- Average hour in the interpeak/IP (10:00 – 16:00)

The peak hour to peak period factors for the highway assignment were derived using 2019 ATC data at the RSI locations. Traffic counts at RSI screen line were used as they best represent the traffic flows for the study area. Average of two-week ATC bi-directional traffic flows were summed for each of the peak periods and were divided by the total flows for the identified peak hour to estimate the factor.

Bus modelled hour factors were derived from the bus operator data. For this purpose, total modelled hour boardings across the study area were extracted and divided by the total boardings in the corresponding time period and adjusted during model calibration to better match the initial synthetic demand matrices to observed travel patterns.

Rail peak hour factors were derived from National Travel Survey (NTS).

The relationship between peak hour and peak period derived from analysis of observed daily traffic flow profiles and census data in the modelled area is summarised in Table 2.2 below.

Table 2.2: Peak Hour to Peak Period Factor

Peak Period	Car Factor	Bus Factor	Rail Factor
AM (07:00 – 10:00)	2.668	2.5725	2.43
IP (10:00 – 16:00)	6.000	6.0000	5.99
PM (16:00 – 19:00)	2.776	2.8837	3.01

2.4.2 User Classes

Following the approach adopted in the original model, the updated CLTM model segregates trips by vehicle type and trip purpose. Different levels of segregation are used at different points of the model building process, as summarised in Table 2.3.

Table 2.3: Purpose/User Class/Vehicle Class Correspondence

<table>
<tr><th>Trip Purpose ID</th><th>Purpose</th><th>User Class (UC)</th><th>Vehicle Class (VC)</th><th>PCU Factor</th></tr>
<tr><td>1</td><td>Home Based Work (HBW)</td><td>UC1</td><td rowspan="5">VC1</td><td rowspan="5">1.0</td></tr>
<tr><td>2</td><td>Home Based Employer’s Business (HBEB)</td><td rowspan="2">UC2</td></tr>
<tr><td>3</td><td>Non-Home Based Employer’s Business (NHBEB)</td></tr>
<tr><td>4</td><td>Home Based Education (HBED)</td><td rowspan="2">UC3</td></tr>
<tr><td>5</td><td>Home Based Shopping (HBS)</td></tr>
</table>

6	Home Based Other (HBO)			
7	Non-Home Based Other (NHBO)			
8	LGV	UC4	VC2	1.0
9	HGV	UC5	VC3	2.0

These trip purpose and user class splits are consistent with the guidance contained in TAG Unit M3.1 and allow differing vehicle operating costs and values of time to be applied.

2.4.3 Software Packages

The updated model uses the SATURN version 11.4.07H (released in August 2018). The bus and rail assignment model uses EMME version 4.6.1.

The variable demand model was set up in EMME version 4.6.1.

2.4.4 Base Year

The updated model has been developed with a base year of 2024 with observed data based on data collection undertaken during 2023 and 2024, during the neutral month.

The bus operator and bus occupancy data are from October 2019 and the rail Mobile network data (MND data) was collected over a continuous period of 1 month for March 2019.

2.5 Summary of Key Model Components

Table 2.4 provides the summary of key model components used in the updated 2019 CLTM.

Table 2.4: Key Model Components

Characteristic	Model Approach
Model Type	Multi-modal assignment and variable demand model
Software Packages	Highway Assignment – SATURN version 11.4.07H Bus Assignment – EMME 4.6.1 Rail Assignment – EMME 4.6.1 Variable Demand Model – EMME 4.6.1
Base Year	2024
Time Periods	AM peak hour (08:00-09:00) Interpeak (average hour 10:00-16:00) PM peak hour (17:00-18:00)
User Classes	Car, PT – Commute Car, PT – Business Car, PT – Other LGV HGV
Zone System	579 zones (including 5 spare zones)
Assignment Methodology	Highway Assignment – SATURN Wardrop Equilibrium.

Characteristic	Model Approach
	Public Transport Assignment – Frequency based transit assignment, based on Optimal Strategies.
Capacity Restraint Mechanism	Highway Assignment – Capacity Index function on links, defined capacity at junctions, fixed speed buffer network Bus Assignment – None Rail Assignment – None
Variable Demand Model	P-A based VDM using EMME

2.6 Generalised Cost Formulations and Parameter Values

2.6.1 Highway Model

Within the SATURN assignment two parameters are defined for each user class to calculate generalised cost: value of time; and vehicle operating cost. Journey times, distances and any tolls included in the model are then combined into a standard unit of generalised time based on these two parameters.

The values of time (VOT) used in the present year model were taken from the latest available TAG data book (May 2024, v1.23) at the time of model development. The values are provided in Table 2.5.

Calculations were undertaken using perceived values of time and distance (i.e. with VAT for non-business and without VAT for business trips), and as per guidance and processes advised by both TAG and Highways England TPG, using Highways England's VOT/VOC calculation worksheet.

In line with TAG unit M3.1, the HGV VOT were doubled to better take into account the driver's and employer's VOT.

Table 2.5: Generalised Cost Parameters for 2024 in 2010 prices

Vehicle Type	Trip Purpose	Time Period	Value of Time / PPM (p/min)	Vehicle Operating Cost / PPK (p/km)
Car	Commute	AM	20.89	6.47
	Business		31.15	13.00
	Other		14.41	6.47
LGV	Business		22.58	13.72
HGV	Business		44.97	36.88
Car	Commute	IP	21.23	6.31
	Business		31.92	12.67
	Other		15.35	6.31
LGV	Business		22.58	13.69
HGV	Business		44.97	36.36
Car	Commute	PM	20.96	6.40
	Business		31.60	12.86

	Other		15.09	6.40
LGV	Business		22.58	13.74
HGV	Business		44.97	36.56

2.6.2 Public Transport Models

Within the public transport models the generalised costs (GCs) are calculated in terms of generalised minutes using the PT model time and distance skims as described below.

$$PTGeneralisedCost_{minutes} = W1 * Walktime + W2 * WaitTime + W3 * Invehicle\,Time + BoardingPenalty$$

Each component can be given its own weight or coefficient in order to convert them to common units and to ensure that the relative importance of each component for passengers is reflected. The components are:

- In-vehicle time.
- Wait time (time spent waiting for services).
- Walk time (time spent walking on-street, PT and zone access and egress).
- Boarding penalty (penalty associate with inconvenience of interchanging.

The parameter weightings used in the bus and rail assignment model are specified in Table 2.6.

Table 2.6: Waiting Time Weights and Boarding Penalty Factors

Mode	Walk time weight (W1)	Waiting time weight (W2)	Boarding time penalty
Bus	2.0	2.0	5.0
Rail	1.5	2.0	10.0

The boarding penalty was defined at a node level and set to 5 for bus and 10 for rail during the calibration process to better represent the inconvenience of transfer and to minimise an excessive/unnecessary number of transfers in places with a high transit frequency such as major roads or transit corridors.

The values of time (VOT) used in the present year model were taken from the latest available TAG data book (May 2024, v1.23) at the time of model development. The values are provided in Table 2.7.

Table 2.7: Generalised Cost Parameters for public transport modes 2024 in 2010 prices

Vehicle Type	Trip Purpose	Value of Time / PPM (p/min)
Bus	Commute	18.45
	Business	18.58
	Other	8.42

Rail	Commute	18.45
	Business	54.09
	Other	8.42

3. Model Standards

3.1 Introduction

The criteria used for calibration and validation for the model, and convergence standards applied to check the stability of the assignment results are based on the guidance set out in TAG Unit M3.1 for the highway model, and TAG Unit 3.2 for the public transport models.

The revalidation process has focused exclusively on the Highway model due to limitations in collecting observed data for public transport, stemming from time and cost constraints. However, it is essential to acknowledge that the public transport model underwent full calibration based on 2019 traffic conditions. For future projections up to the 2024 base year, the most reliable and available source, such as the National Transport Model (NTEM), has been utilised.

3.2 Highway Assignment

The guidance set out in TAG Unit M3.1 is set out in the following sections.

3.2.1 Validation Criteria and Acceptability Guidelines

The validation of the highway assignment has been quantified using the following measures taken from TAG Unit M3.1 paragraph 3.2.3:

- Assigned flows and counts totalled for each screenline or cordon, as a check on the quality of the trip matrices;
- Assigned flows and counts on individual links as a check on the quality of the assignment; and
- Modelled and observed journey times along routes, as a check on the quality of the network and the assignment.

3.2.1.1 Screenlines

Base matrix validation is defined as the differences between modelled and observed flows along screenlines within the model, the criteria to meet is set out in Table 3.1.

Table 3.1: 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

TAG specifies the following, within Unit M3.1 paragraph 3.2.6:

- Screenlines should normally consist of five or more links;
- The comparison of modelled and observed flows for screenlines containing high flow routes (such as motorways) should be presented both with and without such routes;
    - o The comparison should be presented separately for:
    - o Roadside interview screenlines;

    - Other screenlines used as constraints in matrix estimation; and
- Screenlines used as independent validation.
- The comparison should be presented by vehicle type.

It should be noted here that given a relatively small focus area, it was not always possible to create screenlines consisting of more than five links. This is also in part due to the rural nature of some areas outside Preston and a limited route choice, whilst also making best use of the data that was available.

The GEH value, defined in Section 3.2.1.2, has also been used to assess screenline performance. This is deemed prudent when percentage differences on short or low-flow screenlines, particularly for LGV and HGV, are above 5%.

3.2.1.2 Link Based Calibration and Validation

In addition to validation of total screenline flows, TAG Unit M3.1 also contains guidance on the validation criteria for individual links or turning movements.

These criteria are detailed in Table 3.2 and include reference to the GEH statistic measuring the difference between modelled and observed flows. The GEH statistic is of the form:

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

Where M is the modelled flow and C is the observed count.

Table 3.2: Link Flow and Turning Movement Validation 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

According to TAG Unit M3.1 paragraph 3.2.9 the above comparison of modelled and observed flows should be presented for total vehicle flows and for car flows, but not for LGV and HGV flows due to there being insufficient accuracy in the individual link counts for these vehicle types. In addition, the above information should be presented by time period and applied to link flows.

Data collection sites used in the validation of the base year, as well as those sites used in the development of the base year model are presented in the CLHTM 2019 Recalibration Report.

3.2.2 Journey Times

TAG also specifies acceptability guidelines for the validation of journey times. The acceptability criterion for journey time validation is given in Table 3.3.

Table 3.3: 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

3.2.3 Impact of Matrix Estimation

Independent validation as specified above quantifies the ability of the model to replicate base year travel conditions within the model area. To ensure these conditions have a sound basis TAG provides guidance as to the acceptable changes to the highway 'prior' matrices that should result from the application of matrix estimation. These have been reproduced in Table 3.4.

Table 3.4: 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%

TAG Unit M3.1 paragraph 8.3.15 states that all exceedances of the above should be noted and assessed as to their importance to assess the scheme.

3.2.4 Convergence Criteria and Standards

In order for the outcomes of the modelling to be reliable, the stability of the modelled flows needed to be confirmed. This ensures that when modelling the scheme, any flow changes which occur do so directly as a result of the scheme, rather than as a result of random flow changes due to poor convergence. In addition, the model should converge to a point in which routes obey Wardrop's First Principle of Traffic Equilibrium which TAG Unit M3.1 paragraph 2.7.3 defines 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."

This relates to how close the model is to a particular 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 Gap function.

The gap value therefore represents the excess cost incurred by failing to travel on the route with the lowest generalised cost and is expressed relative to that 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.

For the model to be considered sufficiently well converged, the gap value must be less than 0.1%.

TAG describes other measures for assessing the model convergence, as detailed in Table 3.5; in terms of both stability and proximity measures.

Table 3.5: Convergence Measures

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 cost	Four consecutive iterations less than 0.1%

The convergence statistics provided in the LPN output file enable the ability to both check and ensure the model converges within the TAG guidance provided above for the base year.

4. Calibration and Validation Data

4.1 Traffic Surveys

A series of traffic counts and journey time surveys were undertaken in April and June 2024 across the scheme study area. The traffic counts included fully classified turning counts at 16 junctions (Hours – 07:00-19:00 over two days) and ATC Surveys at 113 locations (1 week).

Moreover, recent Manual and ATC data collected by LCC at various locations and for various projects between 2022 and 2023 has also been obtained.

NH's TRIS count sites have also been utilised for SRN link flows. Given the less confidence on the vehicle classification, only the total counts is used and adjacent manual or ATC counts have been used to inform the vehicle splits.

The traffic counts covers the key roads and junctions including the Strategic Road Network (SRN) within the study area. 21 bi-directional screenlines were constructed using the traffic count information to capture the total flow of vehicles within and around the study area (Figure 4.1). Out of these screenlines, 14 were used for calibrating the transport model, while the remaining 7 screenlines were applied for validation purposes. These screenlines are illustrated in Figure 4.2.

Figure 4.1: Traffic Count Sites

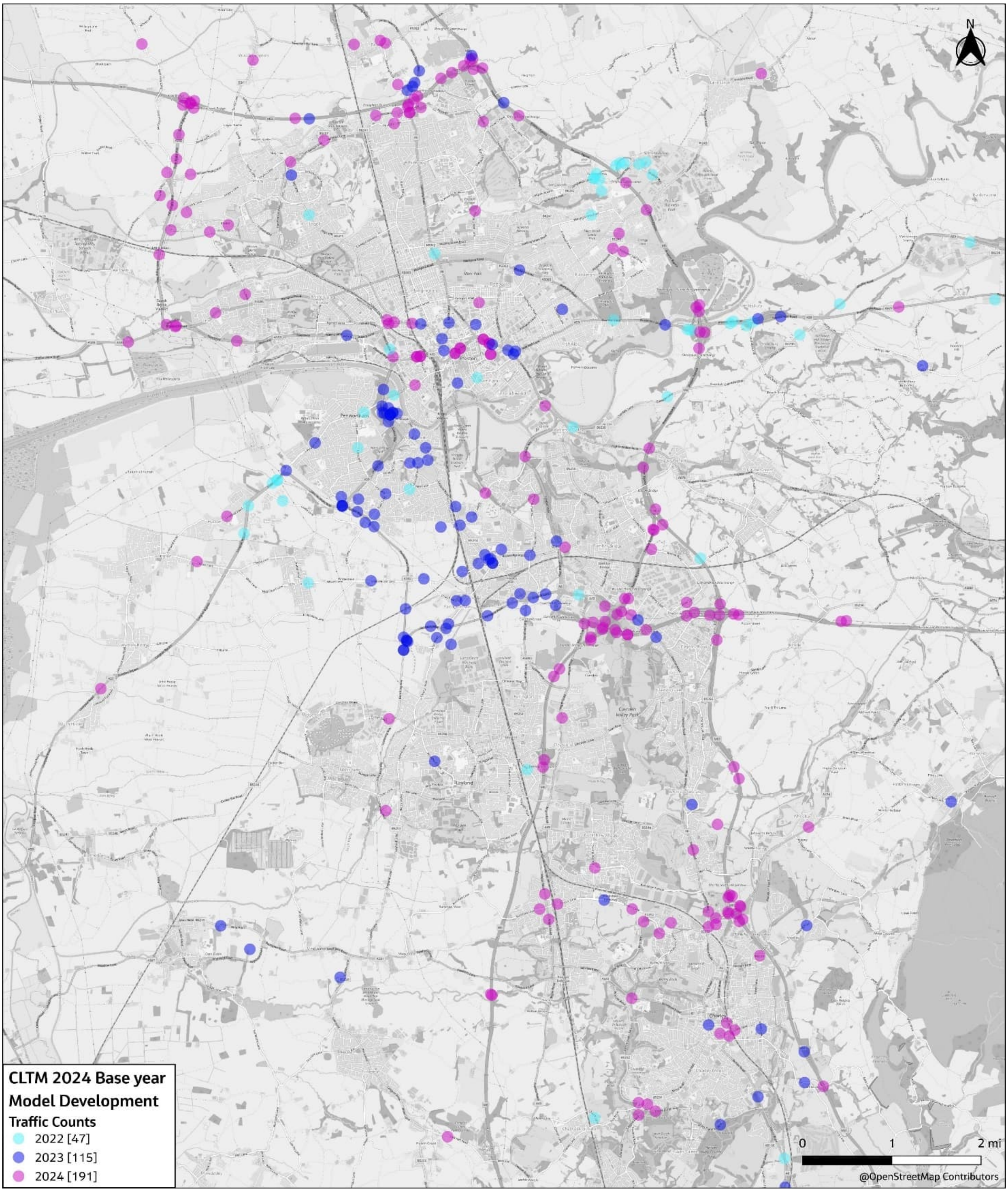


Figure 4.2: Model Screenlines

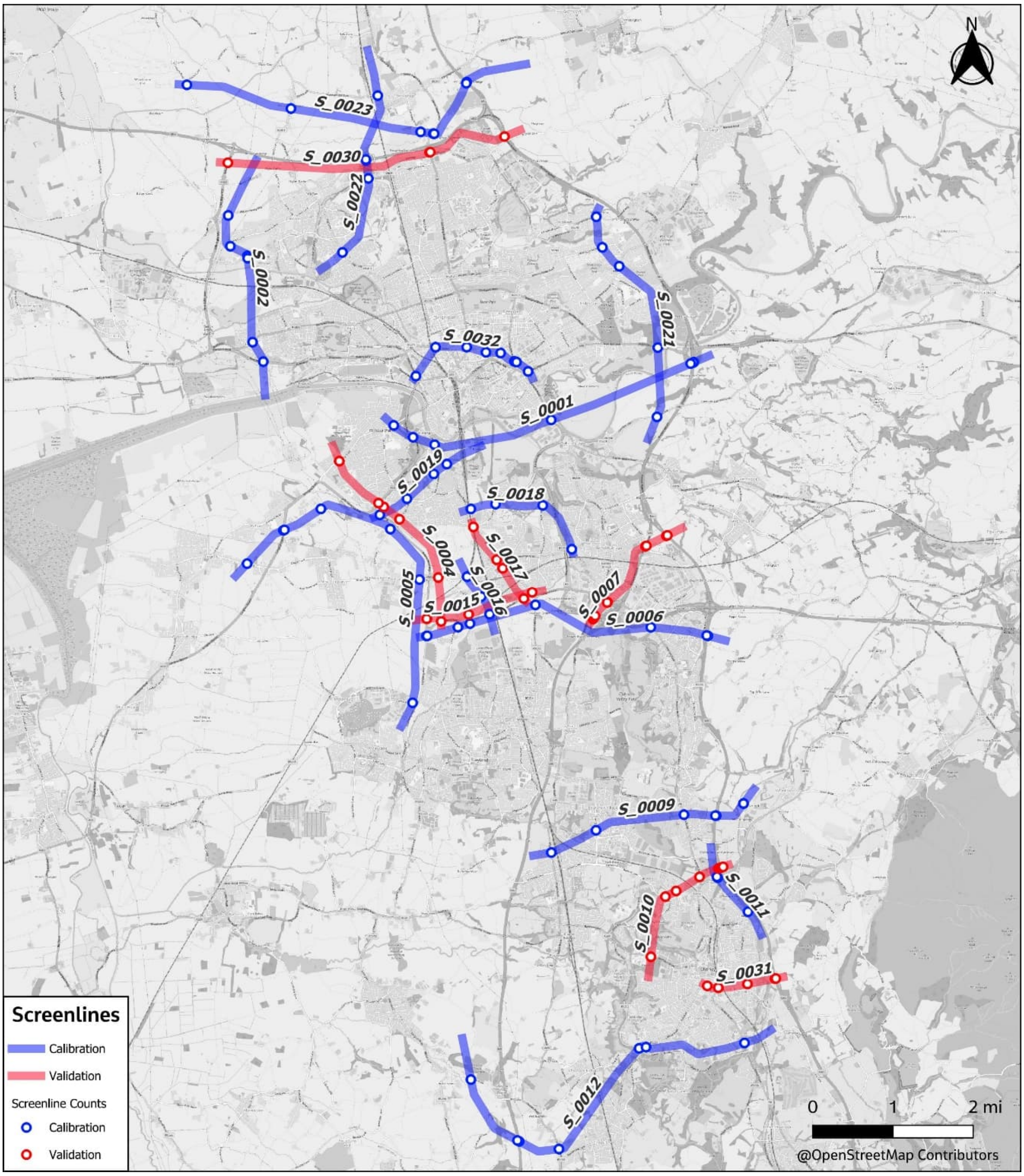


Table 4.1 summarises the number of survey sites by type.

Table 4.1: Number of survey sites (bi-directional)

Count type	Number of sites
Calibration	69
Validation	31
Individual Counts	162

4.2 Journey Time Surveys

Journey time data was used to check how well the model was performing in terms of replicating observed travel times. The 25 journey time routes used for the model were updated to cover both the local road network and SRN and takes into account the analysis of traffic delays and congestion using INRIX data.

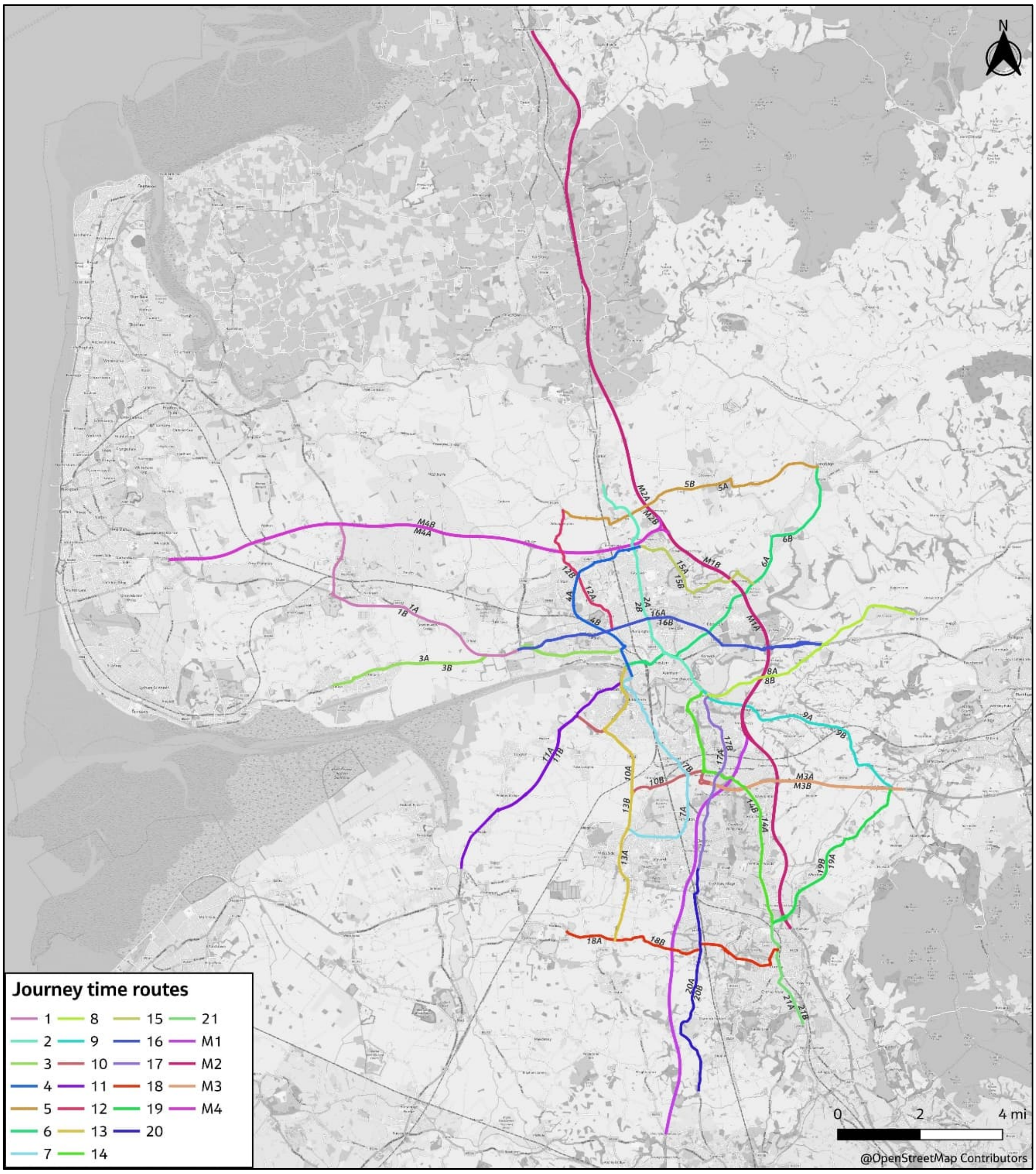
2024 journey times were obtained from the INRIX dataset and processed for the selected routes (both directions). Data period selection was consistent with TAG requirements, only neutral months and dates were used. Data quality assurance was undertaken to ensure no major outliers were included.

Robustness of the observed journey time surveys was analysed by using mean and median by checking the variation around the mean. The variation for most of the routes were found to be low, which confirmed a relatively stable set of observed times. However, a few routes had higher variation, and these were mainly the routes with signalised junctions where varying signal phase between the different observation runs could affect the variance.

Figure 4.3 illustrates the journey time routes used for the journey time validation.

As per TAG 3.1 guidelines, the journey time routes ideally should not be excessively long (greater than 15 km) and nor excessively short (3 km). There are a few routes that are greater than the threshold of 15 km, however, these routes are on Motorways and are split into smaller segments and journey times were checked for each of the segments to ensure there were no huge variances that could distort the overall route times.

Figure 4.3: Journey Time Routes



5. Matrix Development

5.1 Introduction

This section describes the process of developing the 2024 demand matrices for the highway and public transport model assignment. The demand is Production-Attraction (PA) based and is transformed into Origin-Destination (OD) format applying a set of factors that produce the hourly demand for three time periods.

5.2 Car Matrix Development

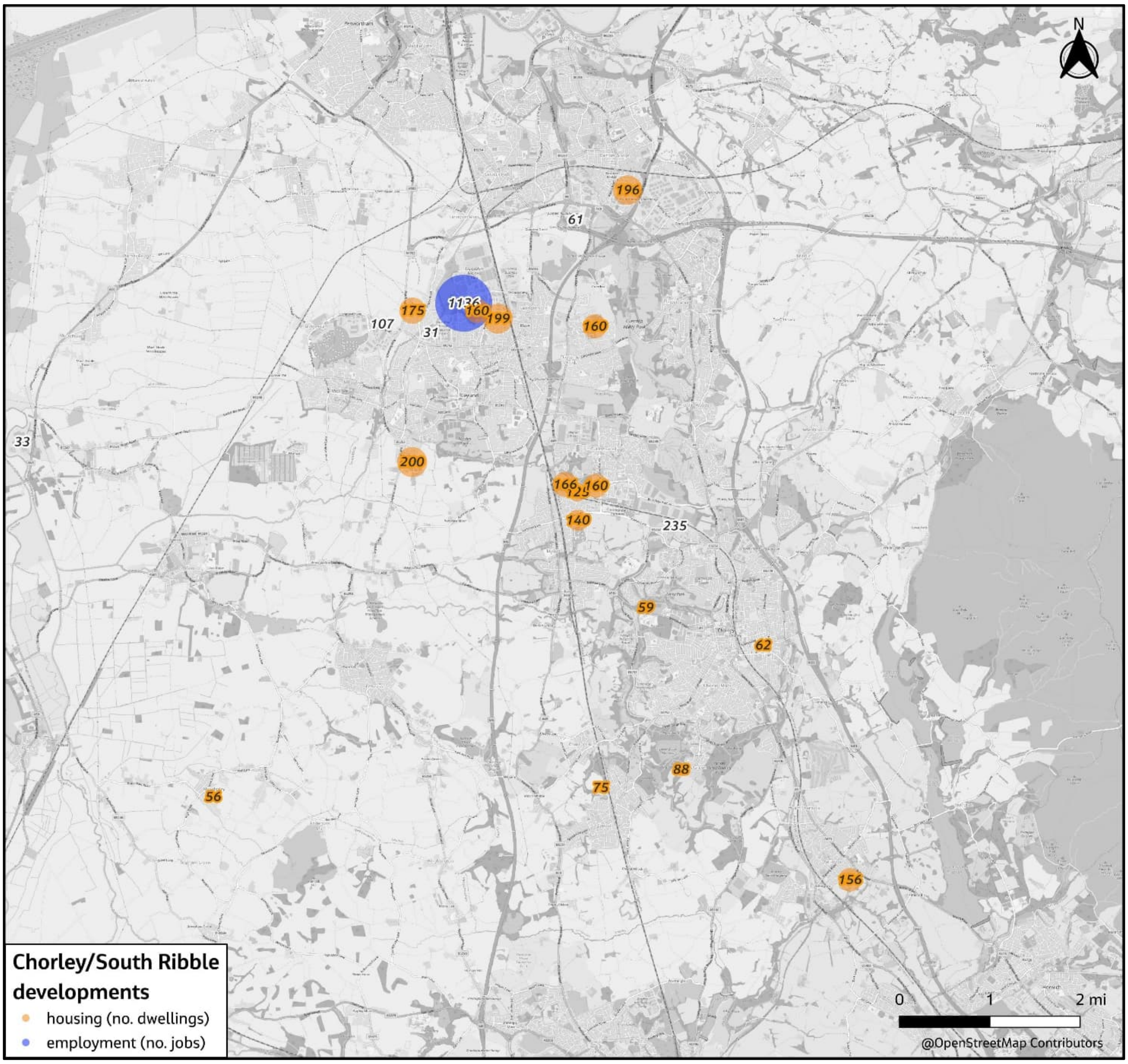
5.2.1 Uncertainty Log

An Uncertainty Log specific to the Local Plan Update has been created to consolidate the local planning assumptions in relation to the nature, timing, size and other details of the future developments. This log has been instrumental in producing the 2024 demand, encompassing information on housing and employment development sites within the three districts.

Within the Uncertainty Log, there are details regarding development completion years and phases, providing insights into developments that were concluded before 2024 and those that are anticipated to be fully or partially completed by 2024. The development location and the size is shown in Figure 5.1 and Figure 5.2. The Uncertainty log is included in Appendix F.

Figure 5.1: Developments included in 2024 Base Model, Preston and South Ribble

Figure 5.2: Developments included in 2024 Base Model, South Ribble and Chorley



5.2.2 Background Growth

24 hr PA NTEM growth factors were utilised to inform the growth from 2019 to 2024. Within NTEM 8.0, there are a set of adjustable planning assumptions which estimate the number of households and jobs per NTEM zone for each year between 2011 and 2061 based on the existing planning information.

Given that the development matrix accounts for some of the trips associated with the increase in numbers of households and jobs within the local area, the planning assumptions within NTEM were checked to avoid double counting the growth in households and jobs.

TAG recommends that this can be achieved by deducting the number of households or jobs associated with the developments from the number in the NTEM zone that the developments are located in NTEM then generates growth factors based on adjusted assumptions which exclude the explicitly modelled developments.

The UL data indicated a greater increase in households and jobs compared to the National Transport Model (NTEM) projections. Consequently, adjusting planning assumptions to exclude sites identified in the UL would result in negative growth. Given the higher confidence in the UL data for completed developments, the decision was made to have no background growth in the three districts, focusing growth solely on the sites identified in the UL. For the remaining areas, growth factor from NTEM 8.0 were used.

5.2.3 Development Trips

Once the relevant housing and employment developments were identified, the trip generation by mode of each development was calculated using trip rates derived from TRICS. The development trips are provided in Appendix G.

Since the trips patterns among future developments and existing zones are not present in the base year model, a gravity model was applied to distribute 24-hour trip ends by journey purpose using the base year calibrated trip length distribution. Use of a gravity model also results in trip distribution between the new zones. With parental zone distribution, there is no trip to or from green field developments and therefore using this method results in no trip between new development zones.

It should be noted that the resulting distribution is only applied to the development trips to produce standalone development matrices. The background growth trip ends (i.e. base year demand factored by adjusted TEMPro factors) were produced using a Furness procedure, and the resulting matrices are then combined with Development matrices to form the Final TEMPro constrained P/A matrices.

5.3 PT Demand

In the absence of any 2024 PT data, the 2024 bus demand has been forecasted using the NTEM growth and rail trips have been produced using DfT’s EDGE forecast. It's recognised that the absence of observed PT data means the PT demand lacks validation. Nevertheless, these projections were based on the calibrated 2019 demand and the best available forecasting data sources. Considering the limitations, this approach is deemed acceptable for the project purposes. The 2019 bus and rail demand development details are included in CLTM Bus Model Development and Calibration report included in Appendix E.

2023 PT demand comparison with 2019 demand is shown in Table 5.3.

Table 5.1: 2019 PT Demand Comparison with 2024 PT

TP	2019	2024	Growth
Bus			
HBW	10,584	10,365	0.979
HBEB	581	560	0.965
NHBEB	464	458	0.987
HBO	28,133	27,703	0.985
NHBO	4,713	4,678	0.993
Rail			
HBW	2,356	2,420	1.027
HBEB	1,189	1,203	1.012
NHBEB	752	764	1.016
HBO	5,946	6,020	1.013
NHBO	7,349	7,443	1.013

5.4 Goods Vehicles Demand Growth

In order to ensure a proportionate approach in line with TAG, non-development LGV and HGV growth are based on growth factors calculated for principal roads in England using NRTP22. These growth factors were applied to the 2019 base year matrices, and are shown in Table 5.2

Table 5.2: NRTP22 Road Traffic Growth Factors from 2019

Assessment Year	Vehicle Type	Northwest Region Growth Factor
2024	LGV	1.0240
	HGV	1.1094

Site specific GV trips were also estimated using the TRICS trip rates and are shown in Table 5.3.

Table 5.3: TRICS GV Hourly trip rates

Development type		Office		Business Park		Industrial Unit		Warehousing	
Vehicle class	Peak Hour	Origins	Dest.	Origins	Dest.	Origins	Dest.	Origins	Dest.
LGV	AM	0.004	0.006	0	0.001	0.010	0.038	0.007	0.015
	IP	0.005	0.005	0.004	0.004	0.020	0.017	0.012	0.011
	PM	0.002	0.002	0.002	0	0.036	0.005	0.007	0.004
HGV	AM	0	0.001	0	0	0.007	0.004	0.039	0.036
	IP	0	0	0	0	0.009	0.008	0.036	0.037
	PM	0	0	0	0	0.006	0.006	0.031	0.039

6. Matrix Calibration/ Validation

6.1 Matrix estimation

Following the prior matrix assignment and refining of the modelled network, the trip matrices underwent a process of 'matrix estimation' whereby trip matrices are adjusted such that the resulting assigned flows matches are able to match count data better; in a controlled as possible process.

The following parameters were used for matrix estimation:

- XAMAX – 4.0
- Number of iterations – 9

It is important when running a matrix estimation process that the original 'prior' (to estimation) trip matrices are not distorted in such a way that the underlying trip patterns are altered.

To ensure that there was minimum distortion, short screenlines (Combined constraints) were applied. Counts used as constraints in matrix estimation were derived from count data, and applied at the Car, LGV and HGV level.

To test whether this altering process has occurred, and resulted in minimum distortion to the trip matrices, the guidelines set out within TAG unit M3-1 were applied to the prior - and post-ME matrices, as detailed below:

Table 6.1: 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 significance of matrix estimation for each measure listed in the above table is described in the following section.

6.2 Matrix Cell Value Changes

Table 6.2 below shows for each time period and vehicle type (cars and HGVs), the cell values of the prior matrix plotted against the values in the same cell of the post matrix. The graphs are provided in Appendix H.

The guidance states that the trend line must have a gradient between 0.98 and 1.02, an intercept close to zero, and an R^2 value exceeding 0.95. It also suggests that the criteria should be met by car and total vehicle. In this study, the criteria have been separately applied to cars and HGVs to ensure that prior matrices are not significantly distorted by ME. These conditions are met for car, LGV and HGV matrices and the fit exceeds guidance by a greater margin in all time periods.

Table 6.2: Summary of Matrix Cell Value Changes

Vehicle Class	Measurement	Requirement	AM		IP		PM	
			Value	Result	Value	Result	Value	Result
Car	Slope	Within 0.98 and 1.02	1.000	Pass	1.000	Pass	1.000	Pass
	Intercept	Near 0	0.011	Pass	0.007	Pass	0.008	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass
LGV	Slope	Within 0.98 and 1.02	1.000	Pass	1.000	Pass	1.000	Pass
	Intercept	Near 0	-0.002	Pass	-0.003	Pass	-0.003	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass
HGV	Slope	Within 0.98 and 1.02	1.000	Pass	1.000	Pass	1.000	Pass
	Intercept	Near 0	0.006	Pass	0.005	Pass	0.002	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass

6.3 Matrix Trip End Changes

The check on how much matrix trip ends have been affected by matrix estimation is a similar one to the check on individual cell values in that the prior and post trip ends must be plotted on a graph and a trend line added. The graphs showing these are provided in Appendix H. A trend line, with equation and R^2 value has also been plotted.

The guidance on these trend lines is the following:

- Slope to be within 0.99 and 1.01
- Intercept near zero
- R Squared in excess of 0.98

As shown Table 6.3 and Table 6.4, in majority of cases the effect of ME on trip end values fall within the guidelines prescribed by TAG for all vehicle classes. And where it is observed not passing, the values fall slightly below the TAG criteria.

Table 6.3: Matrix Row Total Changes - Trend Line Statistics

Vehicle Class	Measurement	Requirement	AM		IP		PM	
			Value	Result	Value	Result	Value	Result
Car	Slope	Within 0.98 and 1.02	0.998	Pass	0.998	Pass	0.996	Pass
	Intercept	Near 0	7.507	Fail	4.818	Fail	6.865	Fail
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass
LGV	Slope	Within 0.98 and 1.02	1.000	Pass	1.000	Pass	1.000	Pass
	Intercept	Near 0	-1.368	Pass	-1.854	Pass	-1.663	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass
HGV	Slope	Within 0.98 and 1.02	1.000	Pass	0.999	Pass	0.998	Pass
	Intercept	Near 0	3.551	Fail	3.568	Fail	1.506	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass

Table 6.4: Matrix Column Total Changes - Trend Line Statistics

Vehicle Class	Measurement	Requirement	AM		IP		PM	
			Value	Result	Value	Result	Value	Result
Car	Slope	Within 0.98 and 1.02	0.997	Pass	0.997	Pass	0.996	Pass
	Intercept	Near 0	8.171	Fail	5.152	Fail	7.320	Fail
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass
LGV	Slope	Within 0.98 and 1.02	1.000	Pass	1.000	Pass	1.000	Pass
	Intercept	Near 0	-1.255	Pass	-1.857	Pass	-1.805	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass
HGV	Slope	Within 0.98 and 1.02	0.999	Pass	0.999	Pass	0.999	Pass
	Intercept	Near 0	3.966	Fail	3.559	Fail	1.252	Pass
	R^2	>0.95	1.000	Pass	1.000	Pass	1.000	Pass

6.4 Trip length distributions

For trip length distributions, it is stipulated in TAG that both the mean and standard deviation of the post matrix trip lengths should not differ by more than 5% from those of the prior matrices.

Whilst the change in average and standard deviation tip lengths for non E-E trips is negligible and well within guidelines, a more detailed assessment has been undertaken to derive the means and standard deviations broken down by internal and external movements as summarised in Table 6.5, Table 6.6 and Table 6.7 for AM, IP and PM respectively. Intrazonal trips have been excluded. All variations except for I-I for HGV/ LGV are in line with 5% tolerance required by the TAG.

Table 6.5: ME Trip Length Distribution Changes – AM

Mov.type	Veh Class	Pre_mean	Post_mean	diff.mean	result. mean	Pre_SD	Post_SD	diff.SD	result.sd
E-E	Car	18.81	18.70	1%	Pass	43.97	43.72	1%	Pass
E-E	HGV	32.03	31.58	1%	Pass	77.08	75.78	2%	Pass
E-E	LGV	10.32	10.33	0%	Pass	38.16	38.16	0%	Pass
E-I	Car	28.62	27.50	4%	Pass	41.76	41.18	1%	Pass
E-I	HGV	69.06	69.77	-1%	Pass	99.02	101.10	-2%	Pass
E-I	LGV	33.70	35.11	-4%	Pass	47.73	48.94	-3%	Pass
I-E	Car	29.21	28.74	2%	Pass	43.46	42.80	2%	Pass
I-E	HGV	75.71	73.56	3%	Pass	103.27	104.05	-1%	Pass
I-E	LGV	40.33	40.00	1%	Pass	57.38	55.95	2%	Pass
I-I	Car	6.37	6.26	2%	Pass	8.34	8.11	3%	Pass
I-I	HGV	9.00	10.98	-22%	Fail	10.76	12.52	-16%	Fail
I-I	LGV	5.21	5.29	-2%	Pass	7.61	7.81	-3%	Pass

Table 6.6: ME Trip Length Distribution Changes – IP

Mov.type	Veh Class	Pre_mean	Post_mean	diff.mean	result. mean	Pre_SD	Post_SD	diff.SD	result.sd
E-E	Car	19.27	19.23	0%	Pass	48.19	48.14	0%	Pass
E-E	HGV	30.69	30.15	2%	Pass	75.94	74.32	2%	Pass
E-E	LGV	9.77	9.80	0%	Pass	37.41	37.49	0%	Pass
E-I	Car	32.40	31.02	4%	Pass	50.54	48.52	4%	Pass
E-I	HGV	81.31	78.08	4%	Pass	115.15	110.49	4%	Pass
E-I	LGV	40.92	40.56	1%	Pass	58.33	57.42	2%	Pass
I-E	Car	32.40	30.86	5%	Pass	51.46	49.43	4%	Pass
I-E	HGV	72.48	71.74	1%	Pass	103.41	104.10	-1%	Pass
I-E	LGV	40.05	38.57	4%	Pass	59.40	56.50	5%	Pass
I-I	Car	5.75	5.53	4%	Pass	7.48	7.03	6%	Fail
I-I	HGV	8.48	10.54	-24%	Fail	10.19	12.17	-19%	Fail
I-I	LGV	5.36	5.08	5%	Fail	7.58	7.40	2%	Pass

Table 6.7: ME Trip Length Distribution Changes – PM

Mov.type	Veh Class	Pre_mean	Post_mean	diff.mean	result. mean	Pre_SD	Post_SD	diff.SD	result.sd
E-E	Car	20.83	20.57	1%	Pass	47.76	47.20	1%	Pass
E-E	HGV	32.49	32.01	1%	Pass	78.90	77.65	2%	Pass
E-E	LGV	10.26	10.23	0%	Pass	37.88	37.82	0%	Pass
E-I	Car	31.29	29.87	5%	Pass	47.95	45.23	5.7%	Fail
E-I	HGV	74.91	74.38	1%	Pass	106.97	107.67	-1%	Pass
E-I	LGV	39.41	38.14	3%	Pass	54.88	53.16	3%	Pass
I-E	Car	28.98	28.37	2%	Pass	43.31	43.40	0%	Pass
I-E	HGV	67.45	68.63	-2%	Pass	100.04	100.69	-1%	Pass
I-E	LGV	36.75	35.90	2%	Pass	52.84	51.18	3%	Pass
I-I	Car	6.27	6.14	2%	Pass	8.13	7.88	3%	Pass
I-I	HGV	6.81	9.35	-37%	Fail	9.38	11.43	-22%	Fail
I-I	LGV	5.11	4.98	2%	Pass	7.31	7.24	1%	Pass

Figure 6.1 to Figure 6.6 compare the trip length distributions in distance bands for prior and post matrices for all time periods for all vehicle class. These figures show the matrix estimation process has generally increased the number of trips within all distance bands.

Figure 6.1: AM Car Trip Legth Distribution Comparison

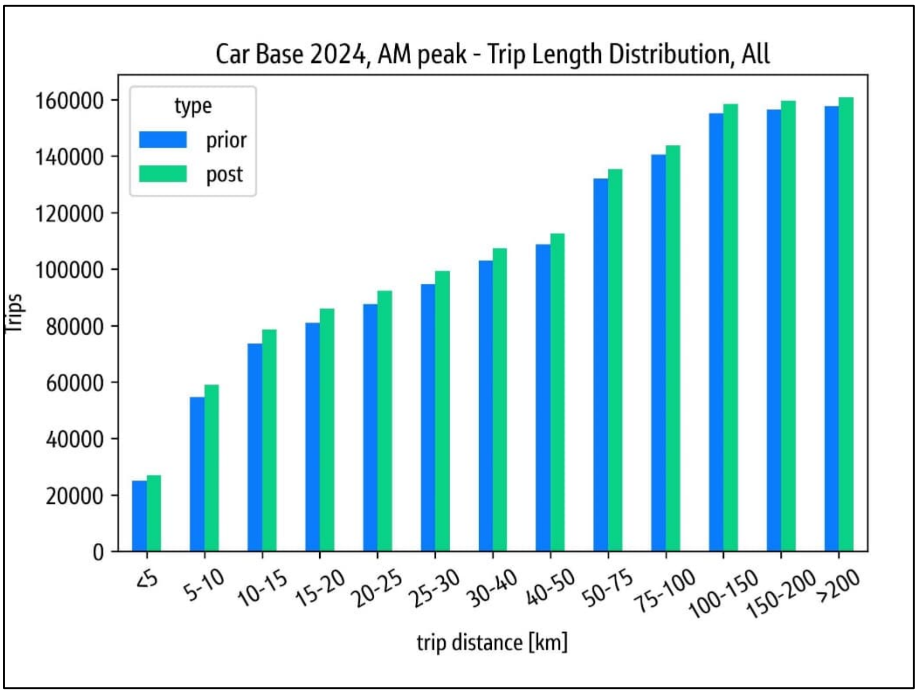


Figure 6.2: AM HGV Trip Legth Distribution Comparison

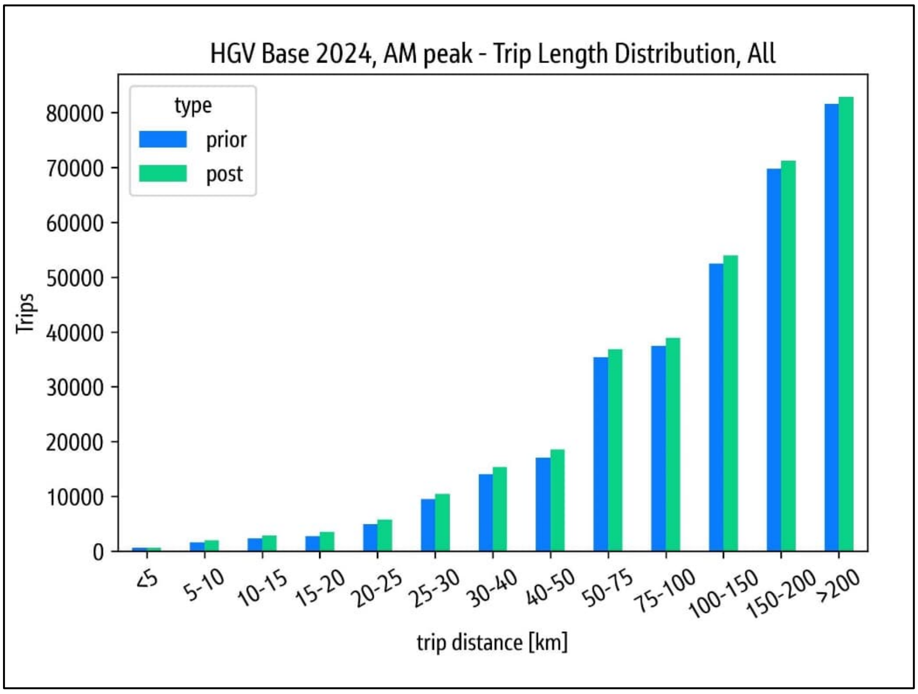


Figure 6.3: IP Car Trip Legth Distribution Comparison

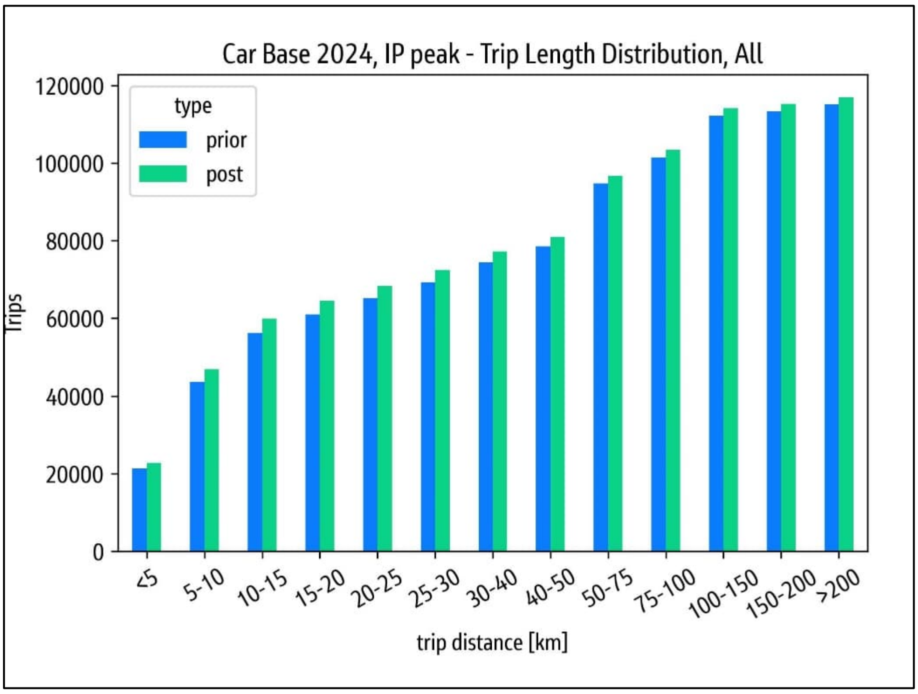


Figure 6.4: IP HGV Trip Legth Distribution Comparison

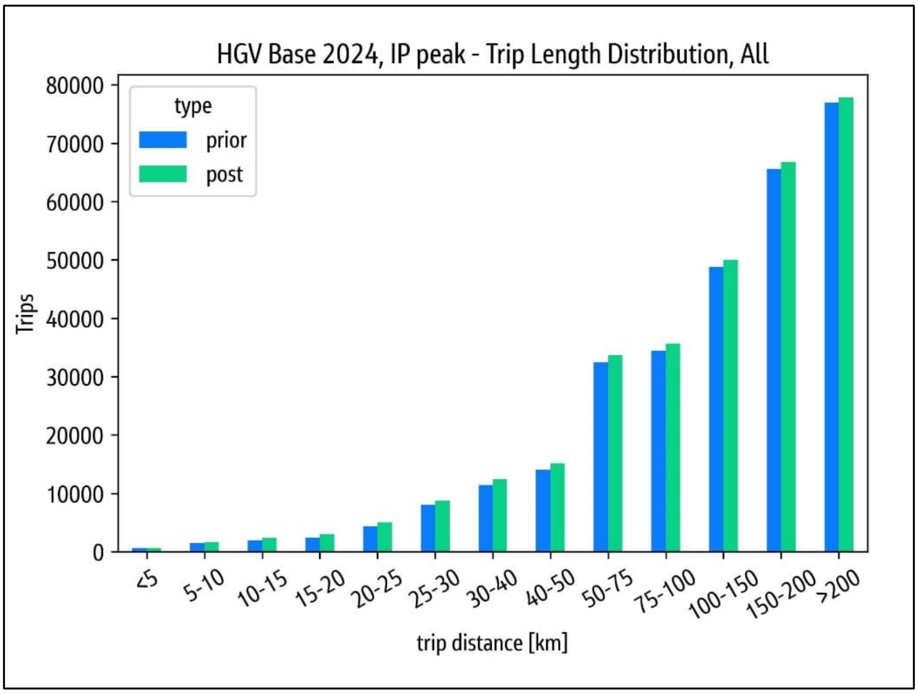


Figure 6.5: PM Car Trip Legth Distribution Comparison

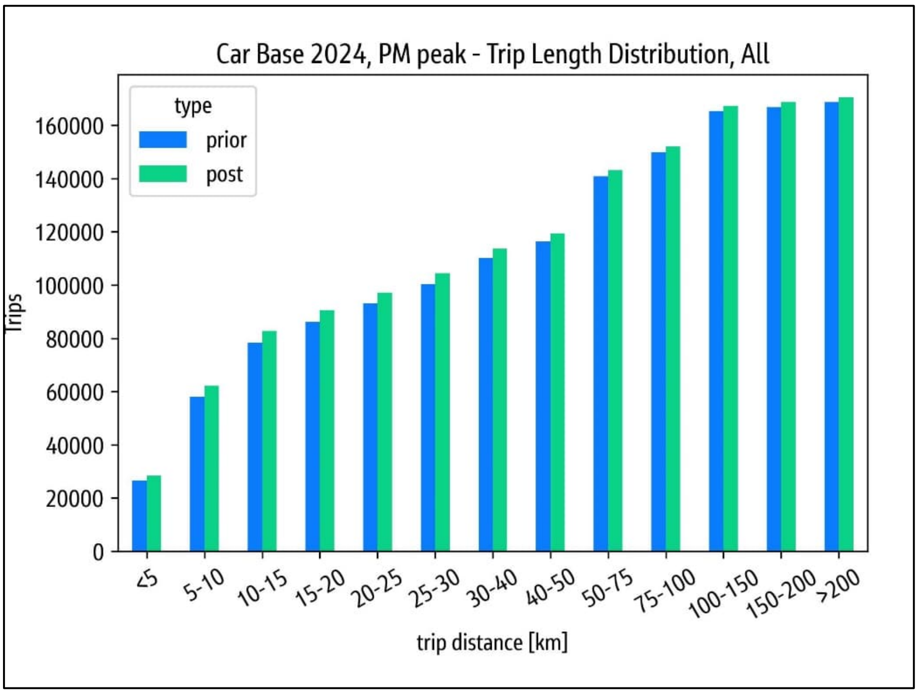
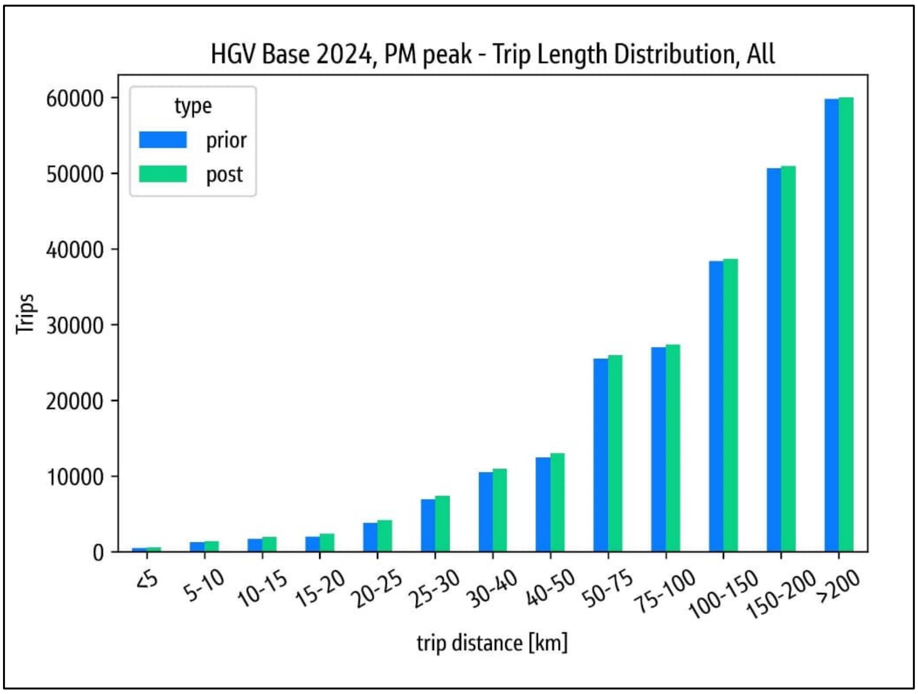


Figure 6.6: PM HGV Trip Legth Distribution Comparison



6.5 Sector to Sector movements

Finally, the guidelines require a check on the matrix cells on a sector basis. The guidelines state that trips should not change by more than 5% prior and post Matrix Estimation.

Table 6.9, Table 6.12 and Table 6.15 show the percentage differences between the prior and post Matrix Estimation for sector movements for each time period. The table shows only the cell values that change by more than 50 vehicles and the percent difference is above 5% as a result of Matrix Estimation. It is assumed that a change of less than 50 vehicles can be considered as minor given the size of the sectors. A high percentage change for the sector-to-sector movements of less than 50 is acceptable as the overall number of trips is low. These values are highlighted to help distinguish a pattern in all three time periods.

There are few sector-to-sector movements that change by more than 5%. These changes are as expected as there is no observed O-D data available to inform the 2024 prior matrices. The prior matrices are built on the 2019 validated matrices as explained in Section 5.2.

In order to further investigate the significance of these changes, the GEH values were calculated and presented in Table 6.10, Table 6.13 and Table 6.16. There are very few sector pairs with GEH above 5 and although it is acknowledged that ME resulted in some noticeable changes at sector level the overall scale of variation from the prior is relatively minor and considered satisfactory.

The highest GEH is observed for AM peak, followed by PM. The highest changes are observed for Chorley sector (22), Leyland sector (24 and 25) and some sectors in Preston (28 and 29). Some of these are big sectors and therefore the variations are big.

The changes brought by ME were necessary for improving the overall model performance and therefore is deemed to be acceptable considering the synthetic nature of some demand.

The sector-to-sector movement changes for HGVs are shown in Appendix I. The percentage difference tables only show trip movements that differ by 5% or more, and where the number of HGVs has increased by more than 50 vehicles. It should be noted that there are large percentage changes, but in terms of the total HGV trip numbers, the number of trip changes and GEH values are relatively small in most cases.

Based on the above results, the comparison of the prior and post ME matrices did not show significant distortions and therefore is considered acceptable.

Table 6.8: Sector to Sector Changes - Cars AM Trips

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	0	0	2	78	-4	-137	-16	-12	26	-20	88	-112	-126	-22	-27	18	-9	-52	-72	0	-6	-22	-12	-13	-21	-11	-43	-31	16	-16	7	-24	-11	0
2	0	0	-2	30	0	0	3	29	-2	1	3	28	1	-2	8	-8	0	9	-11	8	3	2	1	0	0	1	-21	-15	8	-2	-11	3	-14	0
3	15	0	71	96	-7	-6	0	12	26	0	32	13	-2	-2	0	24	0	0	-16	3	1	2	-1	1	-1	1	-8	27	69	-16	-1	1	-11	3
4	14	2	16	70	-4	4	5	76	80	-1	15	18	-7	-3	0	20	-1	0	-35	2	-2	-2	-4	-5	-5	1	-53	-54	-11	-34	0	1	-9	-6
5	0	0	-4	5	0	0	6	40	6	1	-7	16	2	-1	5	-6	0	6	-3	4	2	1	0	0	1	3	-13	-4	0	-2	0	2	0	0
6	42	0	-9	10	0	0	8	29	0	0	-4	24	-1	1	3	1	0	4	-8	3	3	3	1	0	-1	1	-20	-34	14	-3	8	3	1	-2
7	5	1	0	38	5	5	6	16	-4	0	-9	11	0	1	1	10	0	1	-7	2	1	8	-1	0	-1	0	16	-6	23	1	3	2	-7	-2
8	5	-14	-9	30	-19	-1	-3	2	-9	0	-4	12	0	-1	1	-1	0	3	-2	3	0	1	0	1	0	1	-3	118	34	-1	0	1	0	-5
9	0	7	-6	74	-3	2	2	31	70	0	28	28	-9	0	-1	12	-4	-2	-26	0	-2	15	-8	-11	-5	0	-15	-40	29	-9	-7	-11	-2	-1
10	-1	-5	1	-1	-4	-4	0	0	0	9	-5	-3	-1	0	1	-6	0	2	-1	1	3	98	13	-15	15	-1	-2	3	-28	-6	3	-14	-17	0
11	4	18	20	174	3	0	1	4	40	-1	146	-3	-10	-4	0	41	-1	-1	-21	2	-1	-1	-1	-3	-5	-1	-16	-30	-5	9	2	-5	-2	41
12	60	-9	23	59	-11	-22	-3	16	39	10	28	-65	44	-3	16	7	0	33	-4	1	-31	93	25	-48	-92	25	-81	-43	-13	-36	-124	-39	-34	14
13	1	-19	4	4	-13	-13	-4	-3	-2	16	-18	10	-100	2	-1	-1	0	-3	-10	3	4	172	34	-7	-23	-28	0	9	-61	8	-8	-38	14	2
14	0	-16	-2	-7	-26	-6	-5	-1	-3	2	-17	-1	2	0	0	-3	0	0	0	2	-56	32	0	-5	33	0	11	-24	-111	1	-6	-15	-4	0
15	4	-3	2	10	-1	-4	-1	0	0	0	0	32	-1	0	0	0	0	0	0	0	-5	3	-6	-7	-9	-2	-2	0	-41	-3	5	-6	0	3
16	7	-29	3	32	-6	52	3	14	-9	-9	-8	21	-1	0	-1	11	0	0	-12	0	9	-15	-5	1	-2	4	-32	-30	24	-8	0	0	-2	-2
17	1	-1	0	0	0	-1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-2	1	-1	16	0	0	0	-1	5	0	0
18	4	-3	4	9	-1	-7	-1	0	0	0	1	54	-2	0	0	0	0	0	0	0	-3	6	-10	-11	-15	-4	-2	-5	-29	-5	14	-8	0	5
19	-2	-14	4	5	-9	-35	-5	-3	-5	6	-15	-11	-9	0	0	-6	0	0	0	0	2	20	40	-7	6	-40	-2	-10	-44	8	-17	-26	26	7
20	2	1	0	12	1	0	0	6	1	2	1	5	3	-1	1	1	0	1	0	0	-4	6	-1	-7	0	1	-20	0	1	-2	0	0	0	0
21	-1	-2	1	16	-8	-1	0	0	6	-3	1	-16	-5	-34	-5	0	-1	-4	-6	-3	16	53	35	52	0	-1	18	-3	-20	78	0	-3	26	0
22	-1	-4	1	21	-2	-6	-2	-2	-1	61	-8	-61	73	18	11	-4	0	24	6	1	16	423	183	136	245	117	-3	-2	-12	10	-16	-21	12	1
23	-6	0	1	5	-1	-11	-2	-1	0	4	-1	-10	49	4	-4	-3	0	-15	16	-2	14	142	48	36	9	-16	-5	-18	-70	-7	-42	-43	0	1
24	12	6	6	14	2	-28	0	-3	1	-12	10	62	-22	-2	-3	-11	-2	-7	-52	0	16	115	39	65	-1	3	-19	-15	-37	-5	-56	-5	2	2
25	11	-1	4	14	-1	3	6	0	1	7	2	-50	14	48	-5	7	0	-13	8	-1	7	251	72	3	7	-7	6	4	-13	58	23	-30	-2	2
26	-13	-8	-1	-10	-5	-18	-4	-2	-3	-9	-36	-36	-18	-9	-12	-3	0	-27	-5	0	-7	226	-4	-20	21	-6	-10	-11	-9	-16	5	-71	-20	0
27	0	-3	5	63	-5	1	1	8	10	1	-2	0	-5	13	1	19	0	0	-5	-3	10	3	-2	-14	-6	8	-4	-2	45	22	-2	-7	1	0
28	7	-24	82	24	-12	0	1	20	8	-1	-2	0	-1	0	-1	24	0	0	-3	0	1	0	-7	-3	-5	-4	-6	14	10	-12	-8	-6	-2	2
29	1	-18	6	60	-27	21	-15	11	31	-1	-36	61	-7	4	1	46	6	0	-12	0	8	0	-20	5	2	4	-8	-6	326	44	11	-3	24	-1
30	9	-11	1	3	-35	-11	13	-1	-7	-1	-12	-2	6	13	14	8	0	1	12	-1	100	54	-16	-8	2	18	190	-26	-139	236	18	13	129	-2
31	-2	-3	5	27	1	0	-1	1	1	-1	-4	-18	-13	-9	4	9	0	-2	-10	-12	-1	9	1	19	16	2	-4	-5	16	17	4	7	24	2
32	0	-6	7	16	-2	-3	-1	-1	0	-4	-9	-28	-9	-13	-7	28	0	-16	10	0	-3	44	-1	1	3	-5	3	-3	47	16	66	27	34	1
33	2	-2	6	5	0	-3	0	-1	3	-1	-5	6	6	-10	2	9	0	1	10	0	7	7	-19	-29	7	20	20	4	9	49	16	18	27	4
34	0	0	4	9	0	-1	-1	0	10	-1	7	-11	-6	-2	-5	28	-1	-9	-29	0	0	-2	0	-1	-3	-1	-4	0	23	0	-6	-3	-6	0

Table 6.9: Sector to Sector % Changes - Cars AM Trips (Masked)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	--	--	--	163%	--	-56%	--	--	--	--	59%	-23%	-50%	--	--	--	--	-33%	-57%	--	--	--	--	--	--	--	-60%	-45%	--	--	--	--	--	--
2	--	--	--	46%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3	--	--	23%	86%	--	--	--	--	--	--	50%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	58%	--	--	--	--	--
4	--	--	--	6%	--	--	--	52%	17%	--	--	--	--	--	--	--	--	--	-33%	--	--	--	--	--	--	--	-44%	-40%	--	-36%	--	--	--	--
5	--	--	--	--	--	--	--	86%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	48%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-33%	--	--	--	--	--	--
7	--	--	--	58%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	18%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	151%	44%	--	--	--	--	--
9	--	--	--	16%	--	--	--	55%	33%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-11%	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36%	--	--	--	--	--	--	--	--	--	--	--	--
11	--	--	--	143%	--	--	--	--	42%	--	27%	--	--	--	--	92%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	123%
12	15%	--	--	34%	--	--	--	--	52%	--	--	--	--	--	--	--	--	--	--	--	-32%	16%	--	-32%	-29%	--	-31%	-28%	--	-24%	-36%	-11%	-22%	--
13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31%	13%	--	--	--	--	--	-55%	--	--	-32%	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-30%	29%	--	--	51%	--	--	--	-42%	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	21%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-63%	--	--	--	--	--
16	--	--	--	6%	--	69%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-27%	--	--	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	22%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	-32%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	62%	--	--	-54%	--	--	-36%	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--	--	-34%	--	--	--	--	--	--	--	115%	44%	39%	--	--	--	--	--	39%	--	--	--	--
22	--	--	--	--	--	--	--	--	--	55%	--	-10%	18%	--	--	--	--	--	--	--	--	35%	109%	92%	149%	59%	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--	--	20%	--	--	--	--	--	--	--	--	75%	13%	10%	--	--	--	--	-51%	--	-37%	-47%	--	--
24	--	--	--	--	--	--	--	--	--	--	--	67%	--	--	--	--	--	--	-45%	--	--	69%	15%	8%	--	--	--	--	-46%	--	-43%	--	--	--
25	--	--	--	--	--	--	--	--	--	--	--	-13%	--	83%	--	--	--	--	--	--	--	116%	58%	--	--	--	--	--	--	58%	--	-17%	--	--
26	--	--	--	--	--	--	--	--	--	--	-42%	-9%	--	--	--	--	--	--	--	--	--	62%	--	--	--	--	--	--	--	--	--	-39%	--	--
27	--	--	--	53%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17%	--	--	--	--	--
28	--	--	104%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
29	--	--	--	25%	--	--	--	--	9%	--	-23%	43%	--	--	--	22%	--	--	--	--	--	--	--	--	--	--	--	--	40%	44%	--	--	--	--
30	--	--	--	--	-56%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	56%	81%	--	--	--	--	81%	--	-23%	34%	--	--	149%	--
31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	68%	--	--	--	--	--	--	62%	--	28%	--	92%	--
33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21%	--	--	--	--
34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 6.10: Sector to Sector GEH Values- Cars AM Trips (Masked)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1				8		10					6	5	9					5	8								6	4						
2				3																														
3			4	8							4																		6					
4				2				6	4										4								5	5		4				
5								5																										
6	4																											4						
7				4																														
8				2																								10	3					
9				3				4	4																			2						
10																						5												
11				12					4		6					5																		6
12	3			4					4												3	4		4	6		5	4		3	7	2	3	
13																						7	2						7			4		
14																					4	3			4				8					
15												2																	6					
16				1		5																					3							
17																																		
18												3																						
19						4																	4			5			4					
20																																		
21														4								6	4	4						5				
22										5		3	3									11	11	9	14	7								
23													3									9	2	2					7		4	5		
24												6							5			8	2	2					5		6			
25												3		5								14	6							5		2		
26											4	2										10										6		
27				5																									3					
28			7																															
29				4					2		3	5				3													10	4				
30					5																7	6					10		6	8			10	
31																																		
32																						5							5		4		5	
33																														3				
34																																		

Table 6.11: Sector to Sector Changes - Cars IP Trips

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	0	0	0	-10	1	24	5	4	-1	-19	17	66	-17	-18	-15	-3	-3	-24	-5	0	-6	-19	-6	-4	-13	-12	1	-4	0	-5	3	-8	2	0
2	0	0	1	2	0	0	6	19	4	0	8	13	5	-10	3	-24	2	3	8	3	-1	0	0	0	0	0	-1	-8	-17	-6	2	1	0	0
3	-1	0	62	13	-5	-9	-6	7	7	-1	16	-4	-5	-1	-5	-23	-1	-9	-14	0	-1	-2	-1	-2	-5	-5	4	13	-2	2	0	-2	-8	1
4	17	-46	35	55	-26	-41	-16	-1	87	-5	36	-17	-23	-8	-14	14	-3	-24	-37	-1	-2	-13	-6	-6	-13	-23	18	-24	85	-14	2	-3	1	3
5	1	0	1	4	0	0	9	17	1	1	3	15	7	-6	4	-26	2	5	10	2	-1	0	0	-1	0	1	-3	-10	-15	-10	1	1	2	0
6	59	0	4	-8	0	0	9	10	1	-2	1	15	2	-1	3	12	0	4	3	2	-1	-3	-2	-2	-2	-1	3	-7	-1	-1	0	0	1	2
7	11	5	2	0	6	7	9	11	8	0	-1	3	1	1	1	8	0	0	2	0	1	0	0	-1	0	0	12	1	19	2	1	4	1	-1
8	5	12	5	13	15	16	16	4	17	0	8	2	0	2	0	4	1	0	1	0	0	0	-1	-1	0	0	9	29	29	3	2	0	4	0
9	-3	-22	4	9	-11	-11	6	14	61	-2	12	-17	-7	-1	0	10	-9	-2	-20	-10	0	-9	-2	-1	-3	-12	0	-3	7	-6	5	-5	13	-4
10	-3	0	-1	-4	0	0	0	0	0	-4	-3	-4	30	-1	0	0	0	0	12	-1	6	118	-5	-4	-3	-6	6	2	-2	0	-4	-15	4	-1
11	32	0	13	91	-9	-7	-4	11	52	-6	158	5	-20	-11	-10	-5	-2	-21	-27	1	-3	-7	-2	-2	-4	-13	-8	-71	-44	-2	-10	-6	-3	13
12	-31	-2	-5	-24	0	-3	-2	4	-4	-2	17	-190	-1	-8	-34	-7	-1	-65	1	1	-1	29	13	-20	-18	16	-14	-11	-26	-12	-8	-17	46	-5
13	7	6	-2	-11	5	5	0	2	0	23	-10	-18	-30	1	-1	-1	0	-2	3	2	3	27	15	-14	-15	-33	2	-1	-4	-11	-11	-38	17	-2
14	-2	-14	-2	-2	-11	2	5	1	0	-1	-5	-6	1	0	0	-1	0	0	0	-4	19	13	4	-1	8	-2	13	0	0	-2	-1	-21	3	-1
15	0	2	-2	-7	2	3	1	1	0	0	-4	-30	0	0	0	-1	0	0	0	0	4	-1	-3	-5	-7	-5	-1	2	2	0	-2	-13	4	-3
16	6	-11	13	18	-16	25	17	17	22	0	5	4	-3	3	-1	7	-1	-1	-2	0	3	-2	-3	-1	1	-2	43	0	33	20	1	2	3	5
17	2	0	0	-2	0	-2	0	1	0	0	0	-1	0	0	0	-1	0	0	0	0	0	0	0	-1	0	-1	0	0	0	-1	-1	-1	0	-1
18	0	1	-4	-13	1	2	0	2	0	0	-8	-59	-1	0	0	-1	0	0	0	0	1	-4	-7	-10	-14	-11	0	2	1	-2	-2	-23	10	-4
19	-1	1	-7	-21	3	7	0	4	-1	10	-11	-1	4	0	0	-7	0	0	0	1	1	15	22	-13	-1	-18	-3	-3	-7	-6	-7	-14	11	-10
20	0	1	1	3	0	-1	0	1	-1	-1	1	0	1	-6	0	-2	0	0	0	0	0	0	-1	0	0	0	-2	-1	-3	-4	-1	0	0	0
21	-8	-6	-1	2	-3	1	2	0	1	4	-2	-4	-2	20	3	0	-1	5	-6	0	2	1	16	16	-4	-8	8	0	1	-9	-5	14	-5	0
22	-16	-2	-2	-12	0	-2	-3	-1	-1	106	-6	9	118	19	4	-2	1	8	46	1	8	296	135	117	142	70	-1	-5	-6	-2	-15	-28	7	-1
23	-9	-5	-1	-4	-2	0	0	0	-1	-5	-4	-13	1	9	-3	-1	0	-7	16	-1	20	97	46	38	29	4	16	-1	5	1	11	-16	-6	-1
24	-4	0	-2	-5	-3	-1	-1	0	-1	-2	-3	-26	-11	0	0	-3	-1	0	-28	0	35	47	43	75	6	-6	-1	-3	-6	9	-15	-30	-19	0
25	5	0	-2	-7	5	-3	-1	0	-1	7	-3	-15	-11	4	-3	-2	0	-5	-3	0	3	91	12	2	-6	-16	43	10	7	20	13	-28	-5	-1
26	-17	-2	-3	-22	-2	-7	-2	-1	-2	-3	-11	-14	-15	-2	-4	-3	-1	-9	-20	0	-6	132	-8	-2	-8	-5	0	8	2	-8	-21	-45	-4	-1
27	-9	-6	3	57	-10	3	5	4	-3	-3	-4	-1	-6	1	-5	8	-2	-1	-11	1	19	-3	19	30	30	-9	2	37	77	48	-2	1	13	11
28	16	-30	-5	-41	-10	-3	8	-20	6	-3	1	-19	-4	8	-4	-79	0	-2	-5	-1	6	-7	2	-4	5	-11	49	-13	-100	16	-23	-23	7	9
29	1	-18	5	13	-13	12	6	-5	20	-1	-5	-7	-4	1	0	-13	0	-1	-12	0	4	-8	-1	-5	11	-9	106	34	147	4	25	22	35	7
30	-24	-9	-1	3	-12	7	0	2	1	-1	-6	-1	-1	-11	-1	9	-1	-3	-9	0	42	-5	-6	-8	-1	-12	59	10	68	74	10	11	45	0
31	8	4	1	18	10	3	3	1	8	-4	1	5	-3	-2	-3	4	-2	-2	-4	0	-1	-7	11	-4	16	44	-7	6	20	-6	11	53	23	0
32	0	4	-2	-5	1	-1	-1	0	0	-8	-6	24	-7	-6	-7	8	1	-13	4	0	2	-2	-9	-1	-1	-5	0	9	19	-2	27	12	32	-1
33	-6	0	-5	-10	1	-1	0	-2	-1	0	-5	21	5	8	1	1	0	2	1	0	2	-1	-9	-44	5	-14	9	7	20	62	30	36	6	-2
34	0	0	4	2	0	-2	-1	1	-1	-1	39	-6	-4	-3	-7	-4	-3	-11	-25	0	0	-1	0	0	-1	-2	0	-5	-4	0	-1	-2	-1	0

Table 6.12: Sector to Sector % Changes – Car IP Trips (Masked)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	--	--	--	--	--	--	--	--	--	--	--	13%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3	--	--	28%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4	--	-42%	39%	8%	--	-50%	--	--	26%	--	21%	--	--	--	--	--	--	--	-49%	--	--	--	--	--	--	--	--	--	23%	--	--	--	--	--
5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	67%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	--	--	--	--	--	--	--	--	25%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	51%	--	--	--	--	--	--	--	--	--	--	--	--
11	51%	--	--	47%	--	--	--	--	57%	--	35%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-37%	-36%	--	--	--	--	--
12	-9%	--	--	--	--	--	--	--	--	--	--	--	--	--	-17%	--	--	-17%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	94%	--
13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-25%	--	--	--	--	--	-56%	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	56%	--	8%	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	-21%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	--	--	46%	--	--	26%	--	--	--	--	--	35%	--	--	24%	40%	85%	74%	23%	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	39%	18%	24%	--	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	43%	31%	18%	12%	--	--	--	--	--	--	--	-52%	--	--
25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	51%	--	--	--	--	72%	--	--	--	--	--	--	--
26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	48%	--	--	--	--	--	--	--	--	--	-40%	--	--
27	--	--	--	43%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23%	28%	41%	--	--	--	--
28	--	--	--	-21%	--	--	--	--	--	--	--	--	--	--	--	-31%	--	--	--	--	--	--	--	--	--	--	45%	--	-14%	--	--	--	--	--
29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	49%	7%	20%	--	--	--	57%	--
30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28%	--	--	--	--	--	34%	--	34%	21%	--	--	37%	--
31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	58%	--	--	--	--	--	45%	--	--
32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	58%	--
33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	###	--	--	--	--	--	50%	--	72%	--	--
34	--	--	--	--	--	--	--	--	--	--	125%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 6.13: Sector to Sector GEH Values- Cars IP Trips

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1												3																						
2																																		
3			4																															
4		5	3	2		5			4		3								5										4					
5																																		
6	5																																	
7																																		
8																																		
9									4																									
10																						7												
11	4			6					5		7																	6	4					
12	2														3			3															5	
13																										3						5		
14																																		
15																																		
16																											4		2					
17																																		
18												4																						
19																																		
20																																		
21																																		
22										6			5						4			8	7	8	9	4								
23																						6	3	3										
24																					4	4	3	3								5		
25																						6					5							
26																						7										5		
27				4																								3	4	4				
28				3												5											4		4					
29																											6	2	5				4	
30																					3						4		4	4			4	
31																										4						4		
32																																	4	
33																								4						5		4		
34											5																							

Table 6.14: Sector to Sector Changes - Cars PM Trips

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	0	0	1	0	-1	-28	-5	0	2	-31	12	-132	-158	-19	-16	8	-8	-26	-56	1	-13	-43	-11	-3	-28	-2	1	-1	20	13	-1	-27	-19	0
2	0	0	0	1	0	0	4	-1	12	-1	13	-2	-6	-15	-1	-28	-1	-3	-20	0	0	-5	-1	0	-2	0	1	1	-2	1	-1	-5	-3	0
3	-5	-1	87	-9	-7	-12	-2	-12	11	-2	24	-17	-10	-4	-6	-12	-1	-10	-29	0	-1	-5	-2	-1	-5	-2	-1	7	14	2	-1	-3	-7	6
4	19	7	43	68	3	21	16	50	120	-6	48	-34	-33	-28	-7	29	-1	-13	-50	6	-14	-23	-10	-10	-8	0	-7	-67	100	-69	8	-20	-6	1
5	1	0	0	3	0	0	14	47	4	0	8	4	-2	-11	2	-11	0	2	-7	0	-1	-3	-1	0	-3	1	2	-1	4	1	-1	-2	-1	0
6	31	0	11	23	0	0	9	5	5	0	2	7	-1	-3	2	22	-2	3	-11	2	1	-5	0	6	3	4	4	-5	10	20	2	-1	2	2
7	9	4	7	33	11	10	9	20	3	0	0	4	-1	-2	0	14	0	0	-2	1	3	0	2	3	1	1	8	-15	14	3	1	0	0	1
8	12	33	2	18	43	32	24	1	16	0	16	14	0	-1	-2	13	2	4	3	-3	0	-9	0	1	0	0	6	8	26	7	3	1	0	-1
9	-2	-2	7	54	-15	5	8	3	69	0	28	-12	-8	-13	-1	-16	-5	0	-57	1	-3	-17	-4	-6	-4	-2	-4	0	24	-16	9	-12	3	-3
10	-3	-4	0	1	-2	-4	-2	0	0	12	-3	-2	20	0	0	-3	0	-1	1	1	6	69	16	2	2	-1	1	-2	-1	0	-7	-4	2	0
11	2	0	22	220	-7	-23	-12	21	76	-7	234	22	-43	-20	-9	5	-1	-19	-49	8	-16	-17	-5	-3	-12	-7	-19	-75	-21	-31	-25	-21	-4	25
12	-35	-30	-5	16	-15	-11	1	4	38	-1	-27	-383	47	-13	-5	3	0	-9	-8	8	-26	63	-44	-27	-38	47	-10	2	68	6	-41	-38	62	-2
13	-5	-20	-2	8	-11	-18	-2	2	1	20	-13	7	-57	0	-2	-1	0	-3	-10	5	8	53	49	-1	-40	-12	-1	-22	-1	-10	-42	-18	26	-1
14	-5	-21	-3	1	-22	0	5	2	1	2	-6	-6	1	0	0	-1	0	0	0	0	6	1	-12	-3	20	-2	1	10	2	10	-12	-7	2	-1
15	-2	-12	-2	5	-4	-5	0	1	0	1	-3	-9	0	0	0	-1	0	0	0	0	2	0	-2	-4	-8	-2	-8	-1	-1	-2	-14	-5	1	0
16	32	-9	19	32	-23	18	13	9	12	0	11	14	0	-2	0	13	0	0	-23	2	-2	-19	-2	0	2	1	2	-14	83	0	-4	-5	6	10
17	0	-3	0	0	-1	-2	0	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	7	-4	-2	0	0	0
18	-2	-15	-2	8	-5	-6	1	2	1	2	-7	-17	0	0	0	0	0	0	0	1	2	-1	-3	-8	-17	-4	-9	-1	-2	-3	-10	-8	4	-1
19	-7	-29	-8	5	-8	-15	-14	-6	4	17	-11	0	2	0	0	-1	0	0	0	2	-10	-23	-6	-10	-2	-10	-2	-10	-8	-7	-29	-23	28	-4
20	0	0	0	2	-1	-1	1	0	3	0	1	0	5	-2	0	1	0	0	0	0	-3	1	-1	0	0	0	-5	1	3	-1	-9	0	0	0
21	0	-4	-1	0	-12	1	1	1	0	6	1	-17	0	-32	-3	0	6	4	-3	-2	4	-1	8	7	-2	-4	5	9	-4	7	-1	6	-17	0
22	4	-2	0	8	-1	0	1	1	1	39	-3	45	165	-6	-1	1	0	-2	35	11	17	476	71	125	193	35	6	-5	1	9	-13	-7	14	0
23	-4	-2	-1	0	-2	-2	-3	0	0	18	-2	28	60	-2	-4	-1	0	-9	49	1	33	117	74	61	41	7	7	19	8	29	4	-6	11	0
24	-5	-2	-2	-3	-2	-8	-3	-1	-1	4	-5	-24	-10	-7	0	-9	-2	0	-45	1	44	52	24	38	3	-5	13	-1	-5	6	-10	0	-43	0
25	-5	-4	-4	14	-1	-3	12	4	-1	41	-8	-20	-15	41	-4	5	0	-7	-3	2	18	229	19	-10	-15	1	99	9	-38	16	13	5	2	-1
26	-12	-4	-3	-8	-2	-7	-2	-2	0	-1	-11	-38	-41	-13	-5	0	0	-10	-20	2	-16	64	6	-5	2	-5	2	-9	-18	-15	29	-23	0	-1
27	5	-21	10	56	-27	3	17	11	6	2	0	-2	3	14	-1	76	-2	-1	1	2	43	-4	25	56	33	0	4	143	54	58	-2	8	15	0
28	18	-32	-11	42	-13	0	24	-39	23	-1	-2	-48	-5	-22	-1	-34	-2	-6	-6	-2	-3	-6	-9	18	10	-2	17	-9	-162	-4	-42	-28	36	14
29	10	-46	-9	48	-37	19	24	-30	113	-1	0	73	-4	-85	-1	25	0	0	-19	-1	-18	-22	-31	11	0	0	50	51	283	-212	7	15	21	8
30	-2	-25	-6	-1	-66	-9	-4	-4	2	0	2	-41	9	-5	0	-30	-1	-2	-6	-3	84	-4	-2	-4	-3	-3	106	40	-5	93	-1	5	17	-1
31	40	9	4	64	4	7	5	0	8	-3	7	-30	-4	-6	-2	28	-1	-4	-3	1	-2	-13	-38	-40	15	92	11	-7	17	14	47	138	27	5
32	0	-4	0	5	-1	-2	-1	-1	1	-17	-11	-107	-11	-14	-8	3	4	-13	24	1	0	-10	-8	-3	30	42	20	0	16	10	75	48	39	0
33	-8	-4	-8	-6	-3	-31	-9	-4	-1	5	-10	42	18	-1	5	1	1	9	10	1	-19	4	-22	-91	-19	11	68	24	51	10	36	44	10	-2
34	0	0	6	-2	0	-4	0	-4	3	-1	20	-11	-6	-1	-5	-1	-1	-8	-27	0	0	-3	-1	0	-2	-1	-1	-1	8	-3	-2	-6	-2	0

Table 6.15: Sector to Sector % Changes - Cars PM Trips (Masked)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1	--	--	--	--	--	--	--	--	--	-25%	--	-20%	-28%	--	--	--	--	--	-36%	--	--	-53%	--	--	--	--	--	--	--	--	--	--	--	--
2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3	--	--	37%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4	--	--	39%	7%	--	--	--	22%	28%	--	32%	-14%	-27%	--	--	--	--	--	-35%	--	--	--	--	--	--	--	--	-43%	24%	-25%	--	--	--	--
5	--	--	--	--	--	--	--	67%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6	23%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
7	--	--	--	65%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8	--	34%	--	--	35%	27%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	--	--	--	18%	--	--	--	--	31%	--	--	--	--	--	--	--	--	--	-31%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31%	--	--	--	--	--	--	--	--	--	--	--	--
11	--	--	--	142%	--	--	--	--	43%	--	43%	--	-42%	--	--	--	--	--	-42%	--	--	--	--	--	--	--	--	-35%	--	-37%	--	--	--	--
12	-9%	--	--	--	--	--	--	--	77%	--	--	--	--	--	--	--	--	--	--	--	--	9%	-25%	--	-9%	15%	--	--	40%	--	-16%	-13%	26%	--
13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9%	13%	--	-15%	--	--	--	--	--	-42%	--	--	--
14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
16	154%	--	--	9%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26%	--	--	--	--	--
17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--	--	--	--	--	--	-18%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
22	--	--	--	--	--	--	--	--	--	16%	--	8%	20%	--	--	--	--	--	11%	--	--	35%	21%	64%	62%	10%	--	--	--	--	--	--	--	--
23	--	--	--	--	--	--	--	--	--	--	--	--	24%	--	--	--	--	--	54%	--	76%	67%	22%	45%	31%	--	--	--	--	--	--	--	--	--
24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-59%	--	29%	30%	--	5%	--	--	--	--	--	--	--	--	-25%	--
25	--	--	--	--	--	--	--	--	--	56%	--	--	--	52%	--	--	--	--	--	--	--	78%	--	--	--	--	75%	--	-52%	--	--	--	--	--
26	--	--	--	--	--	--	--	--	--	--	--	-9%	-22%	--	--	--	--	--	--	--	--	15%	--	--	--	--	--	--	--	--	--	--	--	--
27	--	--	--	44%	--	--	--	--	--	--	--	--	--	--	--	59%	--	--	--	--	77%	--	--	54%	38%	--	--	70%	30%	49%	--	--	--	--
28	--	-18%	--	18%	--	--	--	-43%	--	--	--	-24%	--	--	--	-12%	--	--	--	--	--	--	--	--	--	--	--	--	-18%	--	-36%	--	98%	--
29	--	-48%	--	10%	-48%	--	--	-21%	23%	--	--	41%	--	-63%	--	--	--	--	--	--	--	--	-36%	--	--	--	13%	10%	26%	-27%	--	--	--	--
30	--	--	--	--	-71%	--	--	--	--	--	--	-22%	--	--	--	-31%	--	--	--	--	47%	--	--	--	--	--	52%	24%	--	21%	--	--	--	--
31	147%	--	--	113%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-22%	-18%	--	185%	--	--	--	--	15%	73%	--	--
32	--	--	--	--	--	--	--	--	--	--	--	-18%	--	--	--	--	--	--	--	--	--	--	--	--	--	40%	--	--	--	--	33%	26%	103%	--
33	--	--	--	--	--	-52%	--	--	--	--	--	42%	--	--	--	--	--	--	--	--	--	--	--	-38%	--	--	109%	--	137%	--	86%	122%	--	--
34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 6.16: Sector to Sector GEH Values- Cars PM Trips

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1										3		5	7						5			6												
2																																		
3			5																															
4			4	2				3	5		4	2	3						5									6	5	4				
5								5																										
6	3																																	
7				4																														
8		3			4	3																												
9				3					4										5															
10																						4												
11				13					5		9		5						5									6		4				
12	2								5													2	4		2	3			5		3	2	4	
13																						2	2		3						5			
14																																		
15																																		
16	5			2																									4					
17																																		
18																																		
19																																		
20																																		
21														3																				
22										2		2	5						2			12	4	8	10	2								
23													4						5		4	8	4	5	3									
24																			6		3	4		1									3	
25										4				4								11					7		5					
26												2	3									3												
27				5												6					5			5	3			9	4	5				
28		3		3				5				4				2													6		4		5	
29		5		2	5			3	5			5		9									4				2	2	8	8				
30					9							3				3					6						7	3		4				
31	6			7																			3	3		9					3	9		
32												5														4					5	3	5	
33						5						4												7			7		6		5	6		
34																																		

7. Assignment, Calibration and Validation

This chapter details the calibration and validation results within the Central Lancashire Transport Model, in relation to the required model standards, as outlined in Section 3.

7.1 Model Convergence

Model assignment of trips to the highway network remained consistent with the original model and was undertaken based on a 'Wardrop User Equilibrium', which seeks to minimise travel costs on all routes for traffic flows in the network through an iterative process. Convergence of the model was monitored as a measurement of the stability of the traffic model, i.e. traffic flows remain stable between successive iterations, and the proximity of the model, i.e. reflecting how close the current flow and cost pattern is to the assignment objective (Wardrop equilibrium), providing a robust platform for further modelling and confidence for the user.

A converged model is therefore stable and produces results that are consistent and robust.

Convergence results as set out in TAG M3.1 are shown in Table 7.1.

Table 7.1: Model Convergence Results

Time Period	Assignment Simulation Loop	Loop	Proximity Indicators		Stability Indicators		
			% Delta	% Gap	% Flow	% Delays	RAAD
AM	35	32	0.0011	0.0018	99	99.6	0.03
		33	0.0022	0.0015	98	99.6	0.04
		34	0.001	0.0023	99	99.7	0.03
		35	0.0017	0.0013	98	99.6	0.05
IP	17	14	0.0011	0.002	98	99.8	0.04
		15	0.0011	0.0017	99	99.8	0.03
		16	0.0012	0.0015	99	99.8	0.03
		17	0.0009	0.0012	99	99.9	0.03
PM	34	31	0.0024	0.0013	99	99.7	0.03
		32	0.0012	0.0034	99	99.7	0.02
		33	0.0023	0.0019	98	99.6	0.04
		34	0.0016	0.0016	99	99.7	0.02

% Delta: Less than 0.1% or at least stable with convergence fully documented and all other criteria met

%Gap: Less than 0.1% or at least stable with convergence fully documented and all other criteria met

% Flow: Link Flows Differing by < 1% Between Assignment & Simulation

% Delays: Turn Delays Differing by < 1% Between Assignment & Simulation

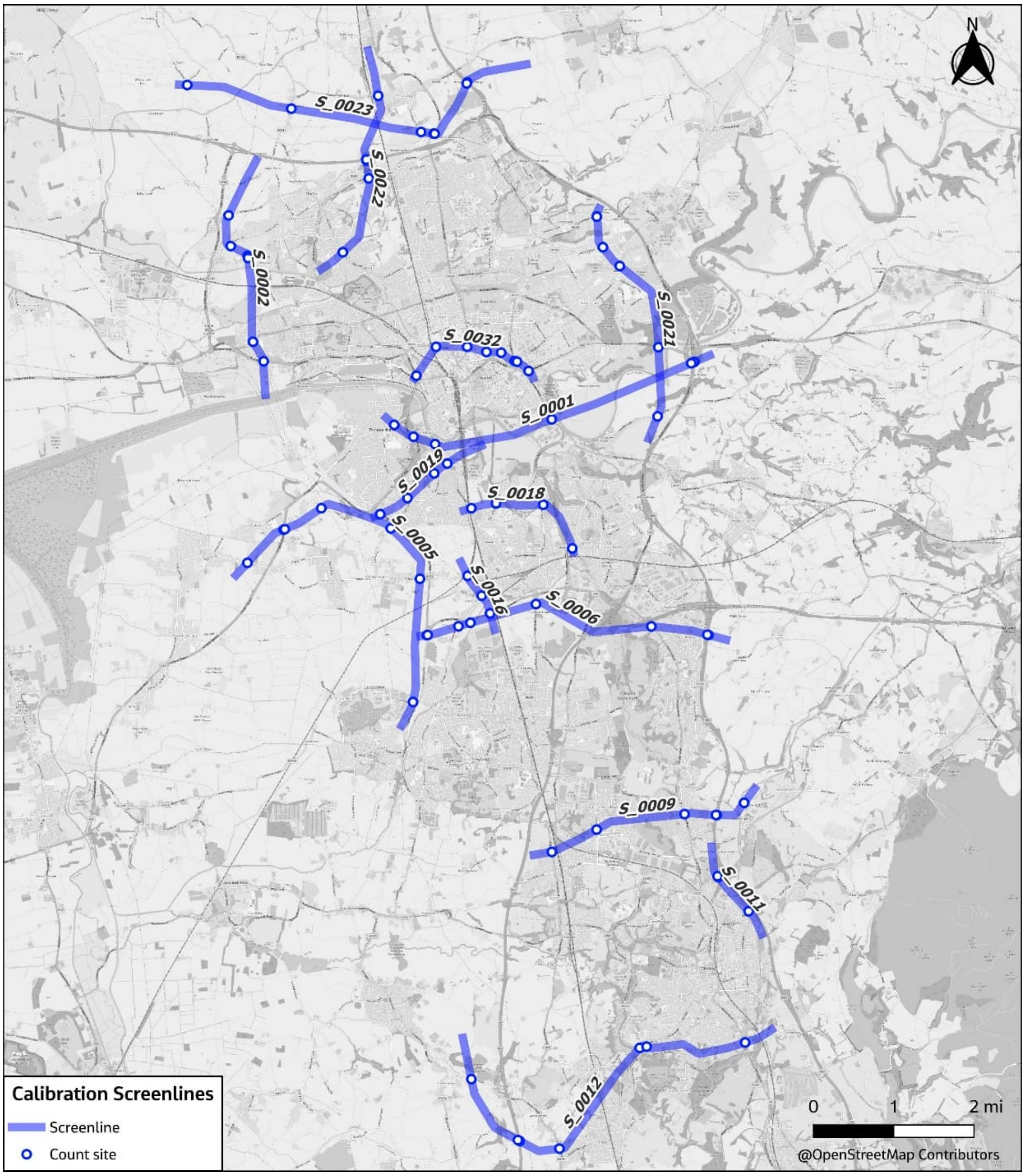
RAAD: % Relative Average Absolute Difference in Link Flows

The results show that the model achieves a high level of convergence, in line with TAG Unit M3.1, Table 4. Results are robust, consistent and stable for at least four consecutive assignment/simulation loops and all proximity and stability indicators comfortably exceed the targets specified in TAG. As a result, the model can be said to be suitably converged locally at every location and outstandingly convergence when considering global model characteristics. It can be noted that AM has more assignment loops than other peaks due to higher congestion.

7.2 Calibration Results

The locations of counts used for calibration (i.e. those counts used as part of the creation of the trip matrices and/or the matrix estimation) are shown in Figure 7.1.

Figure 7.1: Location of Calibration Counts



The performance of the model in terms of comparisons with count data are measured in two ways. The first of these is the GEH statistic, as defined below:

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

Where: M is the modelled flow on a link, and O is the observed.

The second is made by reference to the following table, extracted from TAG Unit M 3-1:

Table 7.2: Link Flow Validation Criterion

Size of observed flow	Criteria for valid modelled flow
< 700 vehicles/hour	Modelled flow within 100 vehicles/hour of observed flow
700-2,700 vehicles/hour	Modelled flow within 15% of observed flow
> 2,700 vehicles/hour	Modelled flow within 400 vehicles/hour of observed

TAG advises that in ordinary circumstances the practitioner should aim to reach a state where 85% of modelled links have a GEH of less than 5 or satisfy the criterion in link flow.

There were 356 calibration counts used in the base year model. The comparison of modelled flows against these counts is summarised in Table 7.3, Table 7.4 and Table 7.5, for all time periods.

Table 7.3: Calibration Count Summary – AM Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	Result	Not compliant	Total Count	Compliant	Result	Not compliant
Individual flows within 100 vph for <700 vph	217	93%	Pass	16	252	93%	Pass	17
Individual flows within 15% for 700-2,700 vph	118	92%	Pass	9	97	92%	Pass	8
Individual flows within 400 vph for >2,700 vph	21	100%	Pass	0	7	100%	Pass	0
Total of above								
GEH: Individual flows GEH <5	356	93%	Pass	25	356	93%	Pass	25
Links meeting either TAG criteria	**356**	**97%**	Pass	**9**	**356**	**98%**	Pass	**8**

Table 7.4: Calibration Count Summary – IP Average Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	Result	Not compliant	Total Count	Compliant	Result	Not compliant
Individual flows within 100 vph for <700 vph	271	97%	Pass	9	293	98%	Pass	7
Individual flows within 15% for 700-2,700 vph	74	97%	Pass	2	57	93%	Pass	4
Individual flows within 400 vph for >2,700 vph	11	100%	Pass	0	6	100%	Pass	0
Total of above								
GEH: Individual flows GEH <5	356	97%	Pass	11	356	97%	Pass	11
Links meeting either TAG criteria	**356**	**99%**	Pass	**2**	**356**	**99%**	Pass	**4**

Table 7.5: Calibration Count Summary – PM Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	Result	Not compliant	Total Count	Compliant	Result	Not compliant
Individual flows within 100 vph for <700 vph	219	90%	Pass	22	234	90%	Pass	23
Individual flows within 15% for 700-2,700 vph	117	93%	Pass	8	113	96%	Pass	4
Individual flows within 400 vph for >2,700 vph	20	100%	Pass	0	9	100%	Pass	0
Total of above								
GEH: Individual flows GEH <5	356	92%	Pass	30	356	92%	Pass	27
Links meeting either TAG criteria	**356**	**98%**	Pass	**8**	**356**	**99%**	Pass	**4**

In line with guidance, the statistics are shown for all vehicles combined and for cars separately.

The table demonstrates that 85% of sites meet link flow criteria and GEH criteria for both car and total vehicles for all time periods.

The results are encouraging as it gives confidence that modelled flows are representative of real-life traffic flows.

A full breakdown of the comparison at the individual count level is included in Appendix J.

7.3 Calibration Screenlines

As indicated above, many of the counts are arranged along screenlines. TAG has a separate criterion for total screenline flows, which is that total modelled flows on all links crossing a screenline should be within 5% of the observed totals. Since percentage difference is not always the best measure, particularly for low flows, a relaxed criterion based on GEH criterion has also been used for assessing screenline performance. It is assumed that a GEH of less than 4 is considered as a pass.

The performance of the models along the calibration screenlines are summarised in the tables below.

Table 7.6: AM Calibration Screenlines – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0002	Eastbound	East of PWD	2381	2283	98	4%	Pass	2	Pass	Pass
S_0002	Westbound	East of PWD	2206	2234	-28	-1%	Pass	1	Pass	Pass
S_0023	Northbound	North of Preston	4106	4048	58	1%	Pass	1	Pass	Pass
S_0023	Southbound	North of Preston	3905	3845	60	2%	Pass	1	Pass	Pass
S_0009	Northbound	North of Chorley - Buckshaw Village	1640	1595	45	3%	Pass	1	Pass	Pass
S_0009	Southbound	North of Chorley - Buckshaw Village	2021	1919	102	5%	Pass	2	Pass	Pass
S_0006	Southbound	South of A582	8990	9252	-262	-3%	Pass	3	Pass	Pass
S_0006	Northbound	South of A582	9945	10171	-226	-2%	Pass	2	Pass	Pass
S_0012	Southbound	Southern Chorley	5674	5691	-17	0%	Pass	0	Pass	Pass
S_0012	Northbound	Southern Chorley	6870	6895	-25	0%	Pass	0	Pass	Pass
S_0011	Westbound	East of Chorley	2449	2329	120	4.9%	Pass	2	Pass	Pass
S_0011	Eastbound	East of Chorley	2047	2093	-46	-2%	Pass	1	Pass	Pass
S_0005	Inbound	New Longton Area Cordon	2570	2495	75	3%	Pass	1	Pass	Pass
S_0005	Outbound	New Longton Area Cordon	2572	2540	32	1%	Pass	1	Pass	Pass
S_0018	Southbound	Northern Lostock Hall	3249	3285	-36	-1%	Pass	1	Pass	Pass
S_0018	Northbound	Northern Lostock Hall	3624	3630	-6	0%	Pass	0	Pass	Pass
S_0021	Eastbound	Eastern Preston	2365	2382	-17	-1%	Pass	0	Pass	Pass
S_0021	Westbound	Eastern Preston	2605	2609	-4	0%	Pass	0	Pass	Pass
S_0001	Northbound	South of Preston - River Ribble	10438	10252	186	2%	Pass	2	Pass	Pass
S_0001	Southbound	South of Preston - River Ribble	8192	8191	1	0%	Pass	0	Pass	Pass
S_0022	Eastbound	Cottam-Broughton	4837	4708	129	3%	Pass	2	Pass	Pass
S_0022	Westbound	Cottam-Broughton	1482	1437	45	3%	Pass	1	Pass	Pass
S_0019	Southeastbound	South of A59, Middleforth	1868	1785	83	4.4%	Pass	2	Pass	Pass
S_0019	Northwestbound	South of A59, Middleforth	2499	2521	-22	-1%	Pass	0	Pass	Pass
S_0016	Eastbound	West of Lostock Hall	1389	1269	120	9%	Fail	3	Pass	Pass
S_0016	Westbound	West of Lostock Hall	1480	1517	-37	-2%	Pass	1	Pass	Pass
S_0032	Northbound	North of Preston City Centre	3347	3363	-16	0%	Pass	0	Pass	Pass
S_0032	Southbound	North of Preston City Centre	3070	3304	-234	-8%	Fail	4	Pass	Pass
						Total Pass	26		28	28
						Total Count	28		28	28
						Pass %	93%		100%	100%

Table 7.7: IP Calibration Screenlines – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0002	Eastbound	East of PWD	1478	1429	49	3%	Pass	1	Pass	Pass
S_0002	Westbound	East of PWD	1502	1464	38	3%	Pass	1	Pass	Pass
S_0023	Northbound	North of Preston	3805	3562	243	6%	Fail	4	Pass	Pass
S_0023	Southbound	North of Preston	3728	3879	-151	-4%	Pass	2	Pass	Pass
S_0009	Northbound	North of Chorley - Buckshaw Village	1375	1404	-29	-2%	Pass	1	Pass	Pass
S_0009	Southbound	North of Chorley - Buckshaw Village	1419	1430	-11	-1%	Pass	0	Pass	Pass
S_0006	Southbound	South of A582	8168	8071	97	1%	Pass	1	Pass	Pass
S_0006	Northbound	South of A582	7602	7538	64	1%	Pass	1	Pass	Pass
S_0012	Southbound	Southern Chorley	5300	5313	-13	0%	Pass	0	Pass	Pass
S_0012	Northbound	Southern Chorley	5004	5009	-5	0%	Pass	0	Pass	Pass
S_0011	Westbound	East of Chorley	1586	1540	46	3%	Pass	1	Pass	Pass
S_0011	Eastbound	East of Chorley	1533	1533	0	0%	Pass	0	Pass	Pass
S_0005	Inbound	New Longton Area Cordon	1645	1627	18	1%	Pass	0	Pass	Pass
S_0005	Outbound	New Longton Area Cordon	1690	1675	15	1%	Pass	0	Pass	Pass
S_0018	Southbound	Northern Lostock Hall	2573	2574	-1	0%	Pass	0	Pass	Pass
S_0018	Northbound	Northern Lostock Hall	2504	2496	8	0%	Pass	0	Pass	Pass
S_0021	Eastbound	Eastern Preston	1754	1656	98	6%	Fail	2	Pass	Pass
S_0021	Westbound	Eastern Preston	1806	1830	-24	-1%	Pass	1	Pass	Pass
S_0001	Northbound	South of Preston - River Ribble	7242	7147	95	1%	Pass	1	Pass	Pass
S_0001	Southbound	South of Preston - River Ribble	8333	8402	-69	-1%	Pass	1	Pass	Pass
S_0022	Eastbound	Cottam-Broughton	3479	3466	13	0%	Pass	0	Pass	Pass
S_0022	Westbound	Cottam-Broughton	1262	1263	-1	0%	Pass	0	Pass	Pass
S_0019	Southeastbound	South of A59, Middleforth	1599	1582	17	1%	Pass	0	Pass	Pass
S_0019	Northwestbound	South of A59, Middleforth	1514	1529	-15	-1%	Pass	0	Pass	Pass
S_0016	Eastbound	West of Lostock Hall	1128	1088	40	4%	Pass	1	Pass	Pass
S_0016	Westbound	West of Lostock Hall	1068	1045	23	2%	Pass	1	Pass	Pass
S_0032	Northbound	North of Preston City Centre	3290	3290	0	0%	Pass	0	Pass	Pass
S_0032	Southbound	North of Preston City Centre	3007	3032	-25	-1%	Pass	0	Pass	Pass
						Total Pass	26		28	28
						Total Count	28		28	28
						Pass %	93%		100%	100%

Table 7.8: PM Calibration Screenlines – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0002	Eastbound	East of PWD	2246	2078	168	7%	Fail	4	Pass	Pass
S_0002	Westbound	East of PWD	2182	2116	66	3%	Pass	1	Pass	Pass
S_0023	Northbound	North of Preston	4246	3936	310	7%	Fail	5	Fail	Fail
S_0023	Southbound	North of Preston	4033	4107	-74	-2%	Pass	1	Pass	Pass
S_0009	Northbound	North of Chorley - Buckshaw Village	1797	1791	6	0%	Pass	0	Pass	Pass
S_0009	Southbound	North of Chorley - Buckshaw Village	1964	1956	8	0%	Pass	0	Pass	Pass
S_0006	Southbound	South of A582	10342	10638	-296	-3%	Pass	3	Pass	Pass
S_0006	Northbound	South of A582	9288	9354	-66	-1%	Pass	1	Pass	Pass
S_0012	Southbound	Southern Chorley	6866	6879	-13	0%	Pass	0	Pass	Pass
S_0012	Northbound	Southern Chorley	6258	6272	-14	0%	Pass	0	Pass	Pass
S_0011	Westbound	East of Chorley	2333	2248	85	3.6%	Pass	2	Pass	Pass
S_0011	Eastbound	East of Chorley	2017	2031	-14	-1%	Pass	0	Pass	Pass
S_0005	Inbound	New Longton Area Cordon	2335	2346	-11	0%	Pass	0	Pass	Pass
S_0005	Outbound	New Longton Area Cordon	2210	2227	-17	-1%	Pass	0	Pass	Pass
S_0018	Southbound	Northern Lostock Hall	3649	3631	18	1%	Pass	0	Pass	Pass
S_0018	Northbound	Northern Lostock Hall	3579	3513	66	2%	Pass	1	Pass	Pass
S_0021	Eastbound	Eastern Preston	2461	2470	-9	0%	Pass	0	Pass	Pass
S_0021	Westbound	Eastern Preston	2824	2828	-4	0%	Pass	0	Pass	Pass
S_0001	Northbound	South of Preston - River Ribble	8331	8292	39	0%	Pass	0	Pass	Pass
S_0001	Southbound	South of Preston - River Ribble	10736	10685	51	0%	Pass	0	Pass	Pass
S_0022	Eastbound	Cottam-Broughton	4150	4172	-22	-1%	Pass	0	Pass	Pass
S_0022	Westbound	Cottam-Broughton	1844	1807	37	2%	Pass	1	Pass	Pass
S_0019	Southeastbound	South of A59, Middleforth	2331	2241	90	3.9%	Pass	2	Pass	Pass
S_0019	Northwestbound	South of A59, Middleforth	1908	2030	-122	-6%	Fail	3	Pass	Pass
S_0016	Eastbound	West of Lostock Hall	1389	1255	134	10%	Fail	4	Pass	Pass
S_0016	Westbound	West of Lostock Hall	1501	1483	18	1%	Pass	0	Pass	Pass
S_0032	Northbound	North of Preston City Centre	3707	3619	88	2%	Pass	1	Pass	Pass
S_0032	Southbound	North of Preston City Centre	3612	3737	-125	-3%	Pass	2	Pass	Pass
						Total Pass	24		27	27
						Total Count	28		28	28
						Pass %	86%		96%	96%

A total of 14 calibration screenlines are used. The tables above show that the vast majority of calibration screenlines meet the 5% difference criterion in all peaks. In AM peak only 2 screenlines fail to meet the TAG criterion, falling slightly short of passing it. However, all three screenlines pass the GEH 4 criterion. In IP peak, two screenline falls short of passing the TAG criterion but meets the GEH criterion. In PM peak, four screenlines fail to pass the TAG criterion, narrowly missing it. However, all four screenlines pass the GEH 4 criterion.

Calibration screenlines results for each vehicle type are provided in Appendix K.

Additionally calibration screenline without high flows such as motorway flows is also summarised in Table 7.9 through Table 7.11. The results indicate that without high flows, in both AM and IP peak 89% of the screenlines pass the TAG criteria, but all screenlines pass the GEH criteria. In PM peak 82% of the screenlines pass the TAG criteria, but all screenlines pass the GEH criteria.

Table 7.9: AM Calibration Screenlines without High Flows – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0002	Eastbound	East of PWD	2381	2283	98	4%	Pass	2	Pass	Pass
S_0002	Westbound	East of PWD	2206	2234	-28	-1%	Pass	1	Pass	Pass
S_0023	Northbound	North of Preston	1639	1587	52	3%	Pass	1	Pass	Pass
S_0023	Southbound	North of Preston	1810	1816	-6	0%	Pass	0	Pass	Pass
S_0009	Northbound	North of Chorley - Buckshaw Village	1640	1595	45	3%	Pass	1	Pass	Pass
S_0009	Southbound	North of Chorley - Buckshaw Village	2021	1919	102	5%	Pass	2	Pass	Pass
S_0006	Southbound	South of A582	2688	2778	-90	-3%	Pass	2	Pass	Pass
S_0006	Northbound	South of A582	2682	2742	-60	-2%	Pass	1	Pass	Pass
S_0012	Southbound	Southern Chorley	2547	2564	-17	-1%	Pass	0	Pass	Pass
S_0012	Northbound	Southern Chorley	3135	3139	-4	0%	Pass	0	Pass	Pass
S_0011	Westbound	East of Chorley	2449	2329	120	4.9%	Pass	2	Pass	Pass
S_0011	Eastbound	East of Chorley	2047	2093	-46	-2%	Pass	1	Pass	Pass
S_0005	Inbound	New Longton Area Cordon	2570	2495	75	3%	Pass	1	Pass	Pass
S_0005	Outbound	New Longton Area Cordon	2572	2540	32	1%	Pass	1	Pass	Pass
S_0018	Southbound	Northern Lostock Hall	3249	3285	-36	-1%	Pass	1	Pass	Pass
S_0018	Northbound	Northern Lostock Hall	3624	3630	-6	0%	Pass	0	Pass	Pass
S_0021	Eastbound	Eastern Preston	2001	2019	-18	-1%	Pass	0	Pass	Pass
S_0021	Westbound	Eastern Preston	2417	2406	11	0%	Pass	0	Pass	Pass
S_0001	Northbound	South of Preston - River Ribble	4086	3948	138	3%	Pass	2	Pass	Pass
S_0001	Southbound	South of Preston - River Ribble	3047	3045	2	0%	Pass	0	Pass	Pass
S_0022	Eastbound	Cottam-Broughton	2011	1869	142	7%	Fail	3	Pass	Pass
S_0022	Westbound	Cottam-Broughton	1482	1437	45	3%	Pass	1	Pass	Pass
S_0019	Southeastbound	South of A59, Middleforth	1868	1785	83	4.4%	Pass	2	Pass	Pass
S_0019	Northwestbound	South of A59, Middleforth	2499	2521	-22	-1%	Pass	0	Pass	Pass
S_0016	Eastbound	West of Lostock Hall	1389	1269	120	9%	Fail	3	Pass	Pass
S_0016	Westbound	West of Lostock Hall	1480	1517	-37	-2%	Pass	1	Pass	Pass
S_0032	Northbound	North of Preston City Centre	3347	3363	-16	0%	Pass	0	Pass	Pass
S_0032	Southbound	North of Preston City Centre	3070	3304	-234	-8%	Fail	4	Pass	Pass
						Total Pass	**25**		**28**	**28**
						Total Count	**28**		**28**	**28**
						Pass %	**89%**		**100%**	**100%**

Table 7.10: IP Calibration Screenlines without High Flows – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0002	Eastbound	East of PWD	1478	1429	49	3%	Pass	1	Pass	Pass
S_0002	Westbound	East of PWD	1502	1464	38	3%	Pass	1	Pass	Pass
S_0023	Northbound	North of Preston	1416	1191	225	16%	Fail	6	Fail	Fail
S_0023	Southbound	North of Preston	1175	1150	25	2%	Pass	1	Pass	Pass
S_0009	Northbound	North of Chorley - Buckshaw Village	1375	1404	-29	-2%	Pass	1	Pass	Pass
S_0009	Southbound	North of Chorley - Buckshaw Village	1419	1430	-11	-1%	Pass	0	Pass	Pass
S_0006	Southbound	South of A582	2072	2079	-7	0%	Pass	0	Pass	Pass
S_0006	Northbound	South of A582	1961	1998	-37	-2%	Pass	1	Pass	Pass
S_0012	Southbound	Southern Chorley	2075	2087	-12	-1%	Pass	0	Pass	Pass
S_0012	Northbound	Southern Chorley	2071	2077	-6	0%	Pass	0	Pass	Pass
S_0011	Westbound	East of Chorley	1586	1540	46	2.9%	Pass	1	Pass	Pass
S_0011	Eastbound	East of Chorley	1533	1533	0	0%	Pass	0	Pass	Pass
S_0005	Inbound	New Longton Area Cordon	1645	1627	18	1%	Pass	0	Pass	Pass
S_0005	Outbound	New Longton Area Cordon	1690	1675	15	1%	Pass	0	Pass	Pass
S_0018	Southbound	Northern Lostock Hall	2573	2574	-1	0%	Pass	0	Pass	Pass
S_0018	Northbound	Northern Lostock Hall	2504	2496	8	0%	Pass	0	Pass	Pass
S_0021	Eastbound	Eastern Preston	1587	1488	99	6%	Fail	3	Pass	Pass
S_0021	Westbound	Eastern Preston	1622	1646	-24	-2%	Pass	1	Pass	Pass
S_0001	Northbound	South of Preston - River Ribble	2431	2281	150	6%	Fail	3	Pass	Pass
S_0001	Southbound	South of Preston - River Ribble	3100	3187	-87	-3%	Pass	2	Pass	Pass
S_0022	Eastbound	Cottam-Broughton	1244	1230	14	1%	Pass	0	Pass	Pass
S_0022	Westbound	Cottam-Broughton	1262	1263	-1	0%	Pass	0	Pass	Pass
S_0019	Southeastbound	South of A59, Middleforth	1599	1582	17	1.1%	Pass	0	Pass	Pass
S_0019	Northwestbound	South of A59, Middleforth	1514	1529	-15	-1%	Pass	0	Pass	Pass
S_0016	Eastbound	West of Lostock Hall	1128	1088	40	4%	Pass	1	Pass	Pass
S_0016	Westbound	West of Lostock Hall	1068	1045	23	2%	Pass	1	Pass	Pass
S_0032	Northbound	North of Preston City Centre	3290	3290	0	0%	Pass	0	Pass	Pass
S_0032	Southbound	North of Preston City Centre	3007	3032	-25	-1%	Pass	0	Pass	Pass
						Total Pass	**25**		**27**	**27**
						Total Count	**28**		**28**	**28**
						Pass %	**89%**		**96%**	**96%**

Table 7.11: PM Calibration Screenlines without High Flows – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0002	Eastbound	East of PWD	2246	2078	168	7%	Fail	4	Pass	Pass
S_0002	Westbound	East of PWD	2182	2116	66	3%	Pass	1	Pass	Pass
S_0023	Northbound	North of Preston	1691	1523	168	10%	Fail	4	Pass	Pass
S_0023	Southbound	North of Preston	1375	1396	-21	-2%	Pass	1	Pass	Pass
S_0009	Northbound	North of Chorley - Buckshaw Village	1797	1791	6	0%	Pass	0	Pass	Pass
S_0009	Southbound	North of Chorley - Buckshaw Village	1964	1956	8	0%	Pass	0	Pass	Pass
S_0006	Southbound	South of A582	2922	3148	-226	-8%	Fail	4	Pass	Pass
S_0006	Northbound	South of A582	2561	2692	-131	-5%	Pass	3	Pass	Pass
S_0012	Southbound	Southern Chorley	3088	3101	-13	0%	Pass	0	Pass	Pass
S_0012	Northbound	Southern Chorley	2875	2894	-19	-1%	Pass	0	Pass	Pass
S_0011	Westbound	East of Chorley	2333	2248	85	3.6%	Pass	2	Pass	Pass
S_0011	Eastbound	East of Chorley	2017	2031	-14	-1%	Pass	0	Pass	Pass
S_0005	Inbound	New Longton Area Cordon	2335	2346	-11	0%	Pass	0	Pass	Pass
S_0005	Outbound	New Longton Area Cordon	2210	2227	-17	-1%	Pass	0	Pass	Pass
S_0018	Southbound	Northern Lostock Hall	3649	3631	18	1%	Pass	0	Pass	Pass
S_0018	Northbound	Northern Lostock Hall	3579	3513	66	2%	Pass	1	Pass	Pass
S_0021	Eastbound	Eastern Preston	2198	2203	-5	0%	Pass	0	Pass	Pass
S_0021	Westbound	Eastern Preston	2426	2443	-17	-1%	Pass	0	Pass	Pass
S_0001	Northbound	South of Preston - River Ribble	2717	2675	42	2%	Pass	1	Pass	Pass
S_0001	Southbound	South of Preston - River Ribble	4576	4511	65	1%	Pass	1	Pass	Pass
S_0022	Eastbound	Cottam-Broughton	1449	1485	-36	-3%	Pass	1	Pass	Pass
S_0022	Westbound	Cottam-Broughton	1844	1807	37	2%	Pass	1	Pass	Pass
S_0019	Southeastbound	South of A59, Middleforth	2331	2241	90	3.9%	Pass	2	Pass	Pass
S_0019	Northwestbound	South of A59, Middleforth	1908	2030	-122	-6%	Fail	3	Pass	Pass
S_0016	Eastbound	West of Lostock Hall	1389	1255	134	10%	Fail	4	Pass	Pass
S_0016	Westbound	West of Lostock Hall	1501	1483	18	1%	Pass	0	Pass	Pass
S_0032	Northbound	North of Preston City Centre	3707	3619	88	2%	Pass	1	Pass	Pass
S_0032	Southbound	North of Preston City Centre	3612	3737	-125	-3%	Pass	2	Pass	Pass
						Total Pass	**23**		**28**	**28**
						Total Count	**28**		**28**	**28**
						Pass %	**82%**		**100%**	**100%**

7.4 Count Validation

Count validation relies on making similar comparisons to the ones made for the count calibration, but against independent counts, i.e. those not used in the model building process up to this point, in either the matrix building or the matrix estimation.

The locations of these counts are show in Figure 7.2.

Figure 7.2: Validation Screenlines

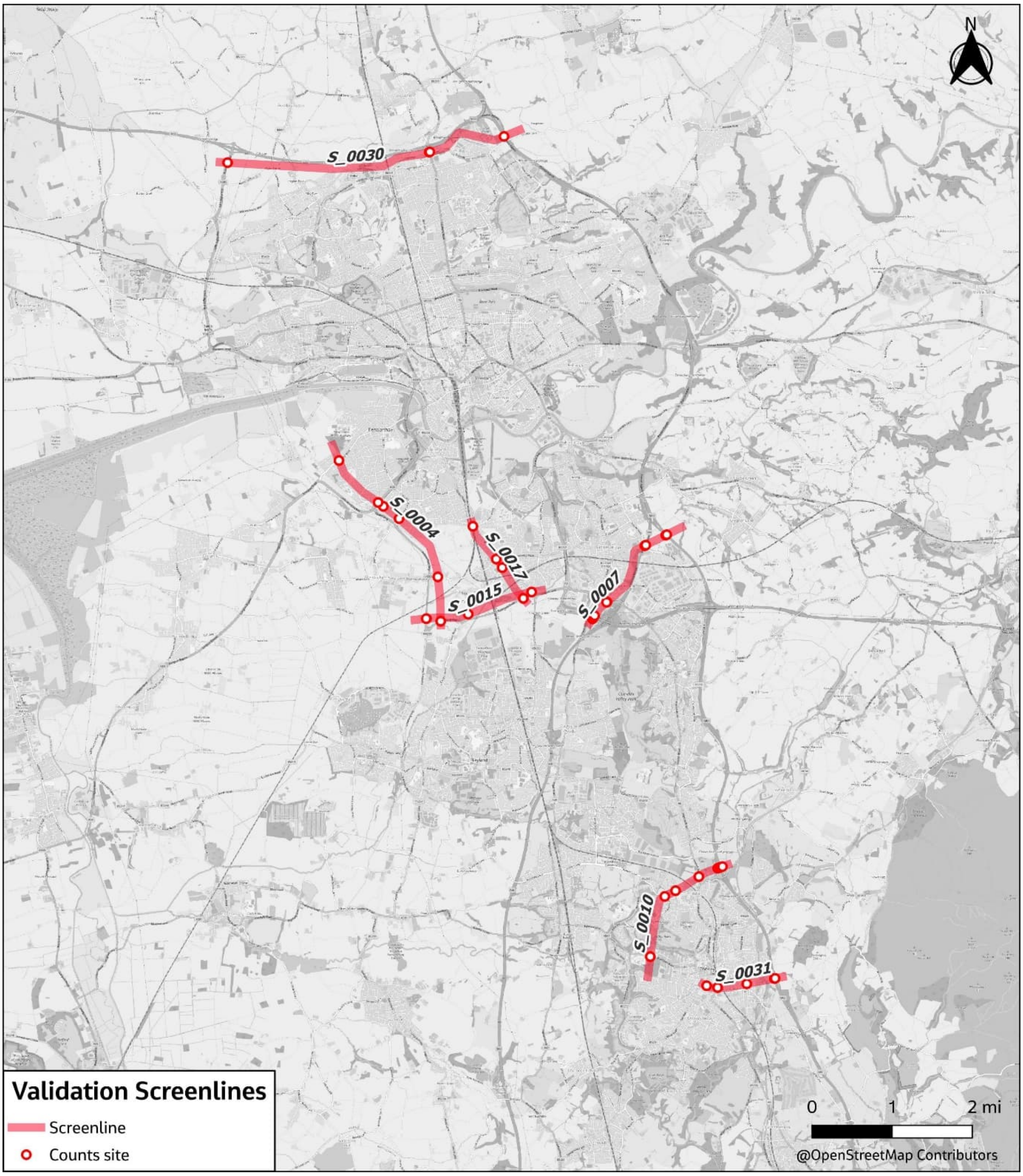


Table 7.12 to Table 7.5 below provide a summary of the detailed results. Full validation results for total vehicles are contained in Appendix L.

Table 7.12: Validation Count Summary – AM Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	Result	Not compliant	Total Count	Compliant	Result	Not compliant
Individual flows within 100 vph for <700 vph	81	93%	Pass	6	99	92%	Pass	8
Individual flows within 15% for 700-2,700 vph	66	94%	Pass	4	52	94%	Pass	3
Individual flows within 400 vph for >2,700 vph	6	100%	Pass	0	2	100%	Pass	0
al of above								
GEH: Individual flows GEH <5	153	93%	Pass	10	153	93%	Pass	11
Links meeting either TAG criteria	**153**	**97%**	Pass	**4**	**153**	**98%**	Pass	**3**

Table 7.13: Validation Count Summary – IP Average Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	Result	Not compliant	Total Count	Compliant	Result	Not compliant
Individual flows within 100 vph for <700 vph	106	99%	Pass	1	130	98%	Pass	3
Individual flows within 15% for 700-2,700 vph	44	100%	Pass	0	22	95%	Pass	1
Individual flows within 400 vph for >2,700 vph	3	100%	Pass	0	1	100%	Pass	0
al of above								
GEH: Individual flows GEH <5	153	99%	Pass	1	153	97%	Pass	4
Links meeting either TAG criteria	**153**	**100%**	Pass	**0**	**153**	**99%**	Pass	**1**

Table 7.14: Validation Count Summary – PM Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	Result	Not compliant	Total Count	Compliant	Result	Not compliant
Individual flows within 100 vph for <700 vph	77	90%	Pass	8	91	93%	Pass	6
Individual flows within 15% for 700-2,700 vph	69	94%	Pass	4	59	95%	Pass	3
Individual flows within 400 vph for >2,700 vph	7	100%	Pass	0	3	100%	Pass	0
al of above								
GEH: Individual flows GEH <5	153	92%	Pass	12	153	94%	Pass	9
Links meeting either TAG criteria	**153**	**97%**	Pass	**4**	**153**	**98%**	Pass	**3**

The above results show that the traffic model fully meet 85% criteria for all link flows for all time periods.

7.5 Validation Screenlines

Similar to the calibration counts, the validation counts are also arranged along screenlines. The performance of the models along the validation screenlines are provided in the tables below.

Table 7.15: AM Validation Screenlines – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0007	Northwestbound	East of Bamber Bridge	9739	9589	150	2%	Pass	2	Pass	Pass
S_0007	Southeastbound	East of Bamber Bridge	5611	5679	-68	-1.2%	Pass	1	Pass	Pass
S_0010	Northwestbound	Nortern Chorley	5372	5302	70	1%	Pass	1	Pass	Pass
S_0010	Southwestbound	Nortern Chorley	5863	5632	231	4%	Pass	3	Pass	Pass
S_0004	Eastbound	East of A582 and A59	3976	4008	-32	-1%	Pass	0	Pass	Pass
S_0004	Westbound	East of A582 and A59	3479	3764	-285	-8%	Fail	4	Pass	Pass
S_0017	Westbound	West of B5254	1387	1405	-18	-1.3%	Pass	0	Pass	Pass
S_0017	Eastbound	West of B5254	1443	1401	42	3%	Pass	1	Pass	Pass
S_0030	Northbound	Northern Preston	7274	7244	30	0%	Pass	0	Pass	Pass
S_0030	Southbound	Northern Preston	6882	6963	-81	-1%	Pass	1	Pass	Pass
S_0015	Northbound	North of A582	1887	1993	-106	-6%	Fail	2	Pass	Pass
S_0015	Southbound	North of A582	1961	2000	-39	-2.0%	Pass	1	Pass	Pass
S_0031	Southbound	Chorley City Center	4468	4327	141	3%	Pass	2	Pass	Pass
S_0031	Northbound	Chorley City Center	4628	4772	-144	-3%	Pass	2	Pass	Pass
						Total Pass	12		14	14
						Total Count	14		14	14
						Pass %	86%		100%	100%

Table 7.16: IP Validation Screenlines – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0007	Northwestbound	East of Bamber Bridge	7080	7168	-88	-1%	Pass	1	Pass	Pass
S_0007	Southeastbound	East of Bamber Bridge	5268	5291	-23	-0.4%	Pass	0	Pass	Pass
S_0010	Northwestbound	Nortern Chorley	4738	4635	103	2%	Pass	1	Pass	Pass
S_0010	Southwestbound	Nortern Chorley	4597	4568	29	1%	Pass	0	Pass	Pass
S_0004	Eastbound	East of A582 and A59	2592	2543	49	2%	Pass	1	Pass	Pass
S_0004	Westbound	East of A582 and A59	2559	2606	-47	-2%	Pass	1	Pass	Pass
S_0017	Westbound	West of B5254	1114	1109	5	0.5%	Pass	0	Pass	Pass
S_0017	Eastbound	West of B5254	1214	1208	6	1%	Pass	0	Pass	Pass
S_0030	Northbound	Northern Preston	5633	5695	-62	-1%	Pass	1	Pass	Pass
S_0030	Southbound	Northern Preston	6257	6096	161	3%	Pass	2	Pass	Pass
S_0015	Northbound	North of A582	1443	1542	-99	-7%	Fail	3	Pass	Pass
S_0015	Southbound	North of A582	1473	1526	-53	-3.6%	Pass	1	Pass	Pass
S_0031	Southbound	Chorley City Center	4056	3944	112	3%	Pass	2	Pass	Pass
S_0031	Northbound	Chorley City Center	4130	4032	98	2%	Pass	2	Pass	Pass
						Total Pass	13		14	14
						Total Count	14		14	14
						Pass %	93%		100%	100%

Table 7.17: PM Validation Screenlines – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
S_0007	Northwestbound	East of Bamber Bridge	8954	9018	-64	-1%	Pass	1	Pass	Pass
S_0007	Southeastbound	East of Bamber Bridge	6688	6793	-105	-1.6%	Pass	1	Pass	Pass
S_0010	Northwestbound	Nortern Chorley	5878	5805	73	1%	Pass	1	Pass	Pass
S_0010	Southwestbound	Nortern Chorley	5755	5737	18	0%	Pass	0	Pass	Pass
S_0004	Eastbound	East of A582 and A59	3489	3435	54	2%	Pass	1	Pass	Pass
S_0004	Westbound	East of A582 and A59	3955	3966	-11	0%	Pass	0	Pass	Pass
S_0017	Westbound	West of B5254	1552	1598	-46	-3.0%	Pass	1	Pass	Pass
S_0017	Eastbound	West of B5254	1402	1457	-55	-4%	Pass	1	Pass	Pass
S_0030	Northbound	Northern Preston	7173	7298	-125	-2%	Pass	1	Pass	Pass
S_0030	Southbound	Northern Preston	7213	7224	-11	0%	Pass	0	Pass	Pass
S_0015	Northbound	North of A582	2167	2220	-53	-2%	Pass	1	Pass	Pass
S_0015	Southbound	North of A582	1917	1926	-9	-0.5%	Pass	0	Pass	Pass
S_0031	Southbound	Chorley City Center	5715	5365	350	6%	Fail	5	Fail	Fail
S_0031	Northbound	Chorley City Center	4980	5016	-36	-1%	Pass	1	Pass	Pass
						Total Pass	**13**		**13**	**13**
						Total Count	**14**		**14**	**14**
						Pass %	**93%**		**93%**	**93%**

The performance of the model along the validation screenlines shows that for AM, two screenlines fail and in IP all except one screenline pass the flow difference but all screenlines passes the GEH criteria. In PM peak only one screenline fails to satisfy threshold by a small margin.

Additionally validation screenline without high flows such as motorway flows is also summarised in Table 7.18 through Table 7.20. The results indicate that without high flows, in AM peak 71% of the screenlines pass the TAG criteria, but all screenlines pass the GEH criteria. In IP peak 64% of the screenlines pass the TAG criteria, but all screenlines pass the GEH criteria and in PM peak 79% of the screenlines pass the TAG criteria, and all except one screenlines pass the GEH criteria.

Table 7.18: AM Validation Screenlines without High Flows – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
0007	Northwestbound	East of Bamber Bridge	400	445	-45	-11%	Fail	2	Pass	Pass
0007	Southeastbound	East of Bamber Bridge	300	321	-21	-7%	Fail	1	Pass	Pass
0010	Northwestbound	Nortern Chorley	2190	2197	-7	0%	Pass	0	Pass	Pass
0010	Southwestbound	Nortern Chorley	2737	2591	146	5%	Pass	3	Pass	Pass
0004	Eastbound	East of A582 and A59	3976	4008	-32	-1%	Pass	0	Pass	Pass
0004	Westbound	East of A582 and A59	3479	3764	-285	-8%	Fail	4	Pass	Pass
0017	Westbound	West of B5254	1387	1405	-18	-1%	Pass	0	Pass	Pass
0017	Eastbound	West of B5254	1443	1401	42	3%	Pass	1	Pass	Pass
0030	Northbound	Northern Preston	925	1004	-79	-9%	Fail	3	Pass	Pass
0030	Southbound	Northern Preston	1050	1106	-57	-5%	Pass	2	Pass	Pass
0015	Northbound	North of A582	1887	1993	-106	-5%	Pass	2	Pass	Pass
0015	Southbound	North of A582	1961	2000	-39	-2%	Pass	1	Pass	Pass
0031	Southbound	Chorley City Center	1548	1466	82	5%	Pass	2	Pass	Pass
0031	Northbound	Chorley City Center	1871	1837	34	2%	Pass	1	Pass	Pass
						Total Pass	**10**		**14**	**14**
						Total Count	**14**		**14**	**14**
						Pass %	**71%**		**100%**	**100%**

Table 7.19: AM Validation Screenlines without High Flows – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
0007	Northwestbound	East of Bamber Bridge	222	255	-33	-15%	Fail	2	Pass	Pass
0007	Southeastbound	East of Bamber Bridge	232	255	-23	-10%	Fail	1	Pass	Pass
0010	Northwestbound	Nortern Chorley	2024	2031	-7	0%	Pass	0	Pass	Pass
0010	Southwestbound	Nortern Chorley	1997	1962	35	2%	Pass	1	Pass	Pass
0004	Eastbound	East of A582 and A59	2592	2543	49	2%	Pass	1	Pass	Pass
0004	Westbound	East of A582 and A59	2559	2606	-47	-2%	Pass	1	Pass	Pass
0017	Westbound	West of B5254	1114	1109	5	0%	Pass	0	Pass	Pass
0017	Eastbound	West of B5254	1214	1208	6	1%	Pass	0	Pass	Pass
0030	Northbound	Northern Preston	510	555	-45	-9%	Fail	2	Pass	Pass
0030	Southbound	Northern Preston	478	486	-8	-2%	Pass	0	Pass	Pass
0015	Northbound	North of A582	1443	1542	-99	-7%	Fail	3	Pass	Pass
0015	Southbound	North of A582	1473	1526	-53	-4%	Pass	1	Pass	Pass
0031	Southbound	Chorley City Center	1519	1397	122	8%	Fail	3	Pass	Pass
0031	Northbound	Chorley City Center	1498	1460	38	3%	Pass	1	Pass	Pass
						Total Pass	**9**		**14**	**14**
						Total Count	**14**		**14**	**14**
						Pass %	**64%**		**100%**	**100%**

Table 7.20: AM Validation Screenlines without High Flows – All Vehicles

Screenline Number	Screenline Direction	Screenline Name	Observed Flow	Modelled Flow	Actual Difference	% Difference	WebTAG Criteria 1	GEH	GEH Criteria	Passes at least 1 criterion
0007	Northwestbound	East of Bamber Bridge	299	334	-35	-12%	Fail	2	Pass	Pass
0007	Southeastbound	East of Bamber Bridge	341	372	-31	-9%	Fail	2	Pass	Pass
0010	Northwestbound	Nortern Chorley	2595	2592	3	0%	Pass	0	Pass	Pass
0010	Southwestbound	Nortern Chorley	2298	2284	14	1%	Pass	0	Pass	Pass
0004	Eastbound	East of A582 and A59	3489	3435	54	2%	Pass	1	Pass	Pass
0004	Westbound	East of A582 and A59	3955	3966	-11	0%	Pass	0	Pass	Pass
0017	Westbound	West of B5254	1552	1598	-46	-3%	Pass	1	Pass	Pass
0017	Eastbound	West of B5254	1402	1457	-55	-4%	Pass	1	Pass	Pass
0030	Northbound	Northern Preston	900	1066	-166	-18%	Fail	5	Fail	Fail
0030	Southbound	Northern Preston	910	946	-36	-4%	Pass	1	Pass	Pass
0015	Northbound	North of A582	2167	2220	-53	-2%	Pass	1	Pass	Pass
0015	Southbound	North of A582	1917	1926	-9	0%	Pass	0	Pass	Pass
0031	Southbound	Chorley City Center	2143	2079	64	3%	Pass	1	Pass	Pass
0031	Northbound	Chorley City Center	1761	1752	9	0%	Pass	0	Pass	Pass
						Total Pass	**11**		**13**	**13**
						Total Count	**14**		**14**	**14**
						Pass %	**79%**		**93%**	**93%**

7.6 Journey Time Validation

Journey times within the model were checked by comparison of the modelled journey times against the observed times along the routes identified as shown in Figure 7.3.

To ensure rigour in the modelled delays and journey times, the modelled times have been compared to the observed times not just for the total time along the routes, but also along the sections within each route. To that end, distance versus time graphs for the modelled and observed times are provided in Appendix M.

INRIX 2024 data was used to calculate observed journey times. The weighted average of the vehicle types were used to provide the average journey time for each of the identified journey time routes. These averaged journey times were then compared with the averaged PCU journey times within the SATURN models.

TAG requires that for the total route length, the modelled journey time from start to finish is within 15% (or 1 minute) of the observed time, and this must be the case for 85% of all the routes. However, that simple comparison ignores the fact that modelled and observed journey times could deviate significantly from each other along specific sections of a route, and the overall time still be within the specified acceptance criteria.

Figure 7.3 shows the journey time routes and Table 7.21 to Table 7.23 summarises the performance of the model in terms of the TAG criteria for each modelled time period.

Figure 7.3: Journey Time Validation Routes

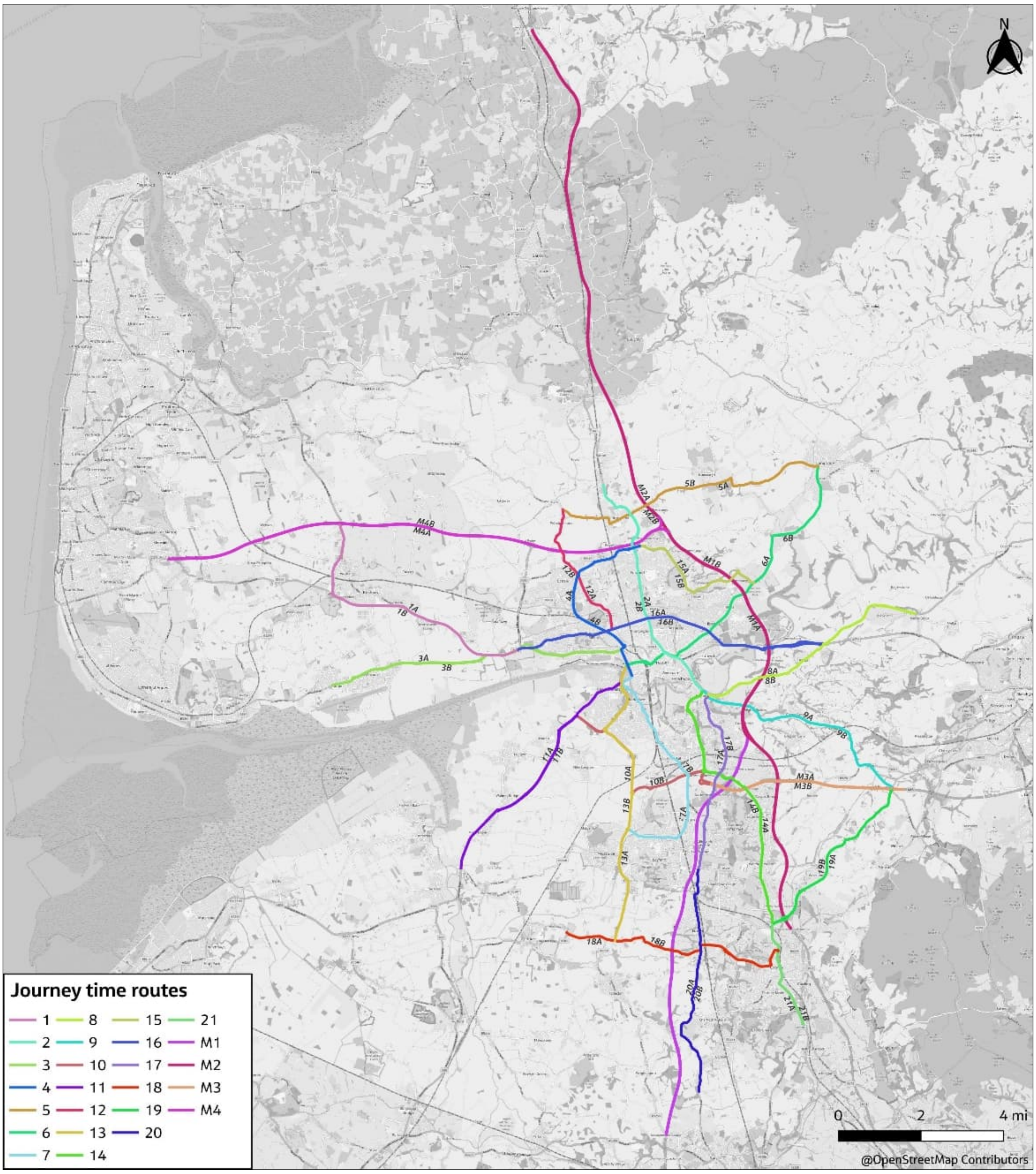


Table 7.21: Comparison of Modelled Journey Time against the Observed, AM Peak

Route	Route Name	Direction	Total Observed (s)	Total Modelled (s)	Diff (s)	Rel. Diff	Result
1A	M55 J3 - Preston Blackpool Rd - M6 J1	EB	721	703	-19	-3%	Pass
1B	Preston Blackpool Rd - M55 J3	WB	752	769	17	2%	Pass
2A	Broughton - Preston	SB	1332	1240	-91	-7%	Pass
2B	Preston - Broughton	NB	1425	1349	-76	-5%	Pass
3A	Warton - Preston - Penwortham - Moss Side	SEB	791	875	83	11%	Pass
3B	Preston - Warton	NWB	978	904	-74	-8%	Pass
4A	Penwortham - Fulwood	NB	861	883	21	2%	Pass
4B	Fulwood - Penwortham	SB	830	971	142	17%	Fail
5A	Longridge - Woodplumpton	WB	952	797	-155	-16%	Fail
5B	Cottam - Woodplumpton - Longridge	EB	891	801	-90	-10%	Pass
6A	Preston - Longridge - Grimsargh	NEB	1507	1653	146	10%	Pass
6B	Longridge - Grimsargh - Preston	SWB	1510	1744	235	15%	Pass
7A	Leyland - Lostock Hall - Preston	NB	1283	1234	-49	-4%	Pass
7B	Preston - Lostock Hall - Leyland	SB	1104	1240	136	12%	Pass
8A	Leyland - Bamber Bridge - Walton-le-Dale - Mellor Brook	EB	608	680	72	12%	Pass
8B	Mellor Brook - Walton-le-Dale - Bamber Bridge - Leyland	WB	614	675	61	10%	Pass
9A	Walton-le-Dale- Coupe Green - M65 J3	EB	670	604	-66	-10%	Pass
9B	M65 J3 - Coupe Green - Walton-le-Dale	WB	657	625	-32	-5%	Pass
10A	M65 J29 - Tank Roundabout	WB	743	797	54	7%	Pass
10B	Tank Roundabout - M65 J29	EB	719	768	49	7%	Pass
11A	Walmer Bridge - Penwortham	NEB	804	752	-52	-6%	Pass
11B	Penwortham - Walmer Bridge	SWB	735	869	134	18%	Fail
12A	Woodplumpton - Cottam	SB	671	527	-144	-21%	Fail
12B	Woodplumpton - Cottam	NB	595	516	-80	-13%	Pass
13A	Preston - Penwortham - Moss Side	SB	868	977	109	13%	Pass
13B	Moss Side - Penwortham - Preston	NB	963	1047	84	9%	Pass
14A	Bamber Bridge - Chorley	SB	878	863	-15	-2%	Pass
14B	Chorley - Bamber Bridge	NB	958	1050	92	10%	Pass
15A	Fulwood - M6 J31A	EB	649	654	5	1%	Pass
15B	M6 J31A - Fulwood	WB	608	637	28	5%	Pass
16A	Preston Blackpool Rd - M6 J1	EB	1434	1374	-60	-4%	Pass
16B	M6 J1 - Preston Blackpool Rd	WB	1428	1422	-6	0%	Pass
17A	Leyland - Bamber Bridge - Walton-le-Dale - Mellor Brook	NB	781	867	87	11%	Pass
17B	Mellor Brook - Walton-le-Dale - Bamber Bridge - Leyland	SB	737	782	45	6%	Pass
18A	Chorley - Euxton - Croston	WB	901	733	-169	-19%	Fail
18B	Croston - Euxton - Chorley	EB	868	747	-121	-14%	Pass
19A	M65 J3 - Wheelton - M61 J8	SB	558	527	-31	-6%	Pass
19B	M65 J8 - Wheelton - M65 J3	NB	526	536	11	2%	Pass
20A	Coppul - Euxton - Leyland	N	832	750	-81	-10%	Pass
20B	Leyland - Euxton - Coppul	S	776	757	-18	-2%	Pass
21A	Chorley	NB	590	566	-24	-4%	Pass
21B	Chorley	SB	524	526	2	0%	Pass
M1A	M1	NB	1715	1661	-53	-3%	Pass
M1B	M1	SB	1665	1609	-56	-3%	Pass
M2A	M2	SB	1369	1305	-64	-5%	Pass
M2B	M2	NB	1462	1358	-104	-7%	Pass
M3A	M3	EB	325	278	-46	-14%	Pass
M3B	M3	WB	312	294	-18	-6%	Pass
M4A	M4	WB	717	652	-65	-9%	Pass
M4B	M4	EB	705	655	-50	-7%	Pass
							90%

Table 7.22: Comparison of Modelled Journey Time against the Observed, IP

Route	Route Name	Direction	Total Observed (s)	Total Modelled (s)	Diff (s)	Rel. Diff	Result
1A	M55 J3 - Preston Blackpool Rd - M6 J1	EB	695	697	2	0%	Pass
1B	Preston Blackpool Rd - M55 J3	WB	749	754	5	1%	Pass
2A	Broughton - Preston	SB	1099	1205	105	10%	Pass
2B	Preston - Broughton	NB	1047	1263	216	21%	Fail
3A	Warton - Preston - Penwortham - Moss Side	SEB	765	856	90	12%	Pass
3B	Preston - Warton	NWB	871	875	4	1%	Pass
4A	Penwortham - Fulwood	NB	755	803	48	6%	Pass
4B	Fulwood - Penwortham	SB	759	919	160	21%	Fail
5A	Longridge - Woodplumpton	WB	845	772	-73	-9%	Pass
5B	Cottam - Woodplumpton - Longridge	EB	830	785	-46	-5%	Pass
6A	Preston - Longridge - Grimsargh	NEB	1410	1521	111	8%	Pass
6B	Longridge - Grimsargh - Preston	SWB	1351	1604	253	19%	Fail
7A	Leyland - Lostock Hall - Preston	NB	992	1172	180	18%	Fail
7B	Preston - Lostock Hall - Leyland	SB	981	1103	122	12%	Pass
8A	Leyland - Bamber Bridge - Walton-le-Dale - Mellor Brook	EB	581	638	58	10%	Pass
8B	Mellor Brook - Walton-le-Dale - Bamber Bridge - Leyland	WB	584	643	59	10%	Pass
9A	Walton-le-Dale- Coupe Green - M65 J3	EB	651	596	-55	-8%	Pass
9B	M65 J3 - Coupe Green - Walton-le-Dale	WB	660	586	-74	-11%	Pass
10A	M65 J29 - Tank Roundabout	WB	580	658	78	13%	Pass
10B	Tank Roundabout - M65 J29	EB	604	712	107	18%	Fail
11A	Walmer Bridge - Penwortham	NEB	718	709	-9	-1%	Pass
11B	Penwortham - Walmer Bridge	SWB	707	800	93	13%	Pass
12A	Woodplumpton - Cottam	SB	611	510	-101	-17%	Fail
12B	Woodplumpton - Cottam	NB	556	503	-54	-10%	Pass
13A	Preston - Penwortham - Moss Side	SB	800	841	41	5%	Pass
13B	Moss Side - Penwortham - Preston	NB	813	845	32	4%	Pass
14A	Bamber Bridge - Chorley	SB	816	860	44	5%	Pass
14B	Chorley - Bamber Bridge	NB	842	966	124	15%	Pass
15A	Fulwood - M6 J31A	EB	530	597	67	13%	Pass
15B	M6 J31A - Fulwood	WB	496	550	54	11%	Pass
16A	Preston Blackpool Rd - M6 J1	EB	1333	1349	16	1%	Pass
16B	M6 J1 - Preston Blackpool Rd	WB	1301	1358	57	4%	Pass
17A	Leyland - Bamber Bridge - Walton-le-Dale - Mellor Brook	NB	690	789	99	14%	Pass
17B	Mellor Brook - Walton-le-Dale - Bamber Bridge - Leyland	SB	683	755	71	10%	Pass
18A	Chorley - Euxton - Croston	WB	807	718	-89	-11%	Pass
18B	Croston - Euxton - Chorley	EB	800	716	-85	-11%	Pass
19A	M65 J3 - Wheelton - M61 J8	SB	518	497	-21	-4%	Pass
19B	M65 J8 - Wheelton - M65 J3	NB	502	502	0	0%	Pass
20A	Coppul - Euxton - Leyland	N	747	723	-25	-3%	Pass
20B	Leyland - Euxton - Coppul	S	725	723	-1	0%	Pass
21A	Chorley	NB	470	513	43	9%	Pass
21B	Chorley	SB	449	512	63	14%	Pass
M1A	M1	NB	1667	1598	-69	-4%	Pass
M1B	M1	SB	1677	1632	-45	-3%	Pass
M2A	M2	SB	1394	1318	-75	-5%	Pass
M2B	M2	NB	1385	1311	-74	-5%	Pass
M3A	M3	EB	291	256	-35	-12%	Pass
M3B	M3	WB	282	260	-22	-8%	Pass
M4A	M4	WB	695	639	-56	-8%	Pass
M4B	M4	EB	710	646	-64	-9%	Pass
							88%

Table 7.23: Comparison of Modelled Journey Time against the Observed, PM Peak

Route	Route Name	Direction	Total Observed (s)	Total Modelled (s)	Diff (s)	Rel. Diff	Result
1A	M55 J3 - Preston Blackpool Rd - M6 J1	EB	667	695	28	4%	Pass
1B	Preston Blackpool Rd - M55 J3	WB	750	777	27	4%	Pass
2A	Broughton - Preston	SB	1281	1246	-35	-3%	Pass
2B	Preston - Broughton	NB	1190	1356	167	14%	Pass
3A	Warton - Preston - Penwortham - Moss Side	SEB	743	862	119	16%	Fail
3B	Preston - Warton	NWB	946	1014	68	7%	Pass
4A	Penwortham - Fulwood	NB	875	894	19	2%	Pass
4B	Fulwood - Penwortham	SB	892	983	91	10%	Pass
5A	Longridge - Woodplumpton	WB	877	786	-91	-10%	Pass
5B	Cottam - Woodplumpton - Longridge	EB	818	802	-16	-2%	Pass
6A	Preston - Longridge - Grimsargh	NEB	1653	1717	64	4%	Pass
6B	Longridge - Grimsargh - Preston	SWB	1520	1650	131	9%	Pass
7A	Leyland - Lostock Hall - Preston	NB	1180	1329	149	13%	Pass
7B	Preston - Lostock Hall - Leyland	SB	1282	1280	-2	0%	Pass
8A	Leyland - Bamber Bridge - Walton-le-Dale - Mellor Brook	EB	641	655	14	2%	Pass
8B	Mellor Brook - Walton-le-Dale - Bamber Bridge - Leyland	WB	659	690	30	5%	Pass
9A	Walton-le-Dale- Coupe Green - M65 J3	EB	696	626	-70	-10%	Pass
9B	M65 J3 - Coupe Green - Walton-le-Dale	WB	674	597	-76	-11%	Pass
10A	M65 J29 - Tank Roundabout	WB	701	778	77	11%	Pass
10B	Tank Roundabout - M65 J29	EB	632	776	144	23%	Fail
11A	Walmer Bridge - Penwortham	NEB	813	708	-105	-13%	Pass
11B	Penwortham - Walmer Bridge	SWB	866	931	65	7%	Pass
12A	Woodplumpton - Cottam	SB	462	525	63	14%	Pass
12B	Woodplumpton - Cottam	NB	579	521	-59	-10%	Pass
13A	Preston - Penwortham - Moss Side	SB	885	932	47	5%	Pass
13B	Moss Side - Penwortham - Preston	NB	868	945	77	9%	Pass
14A	Bamber Bridge - Chorley	SB	910	1051	141	15%	Pass
14B	Chorley - Bamber Bridge	NB	918	1019	101	11%	Pass
15A	Fulwood - M6 J31A	EB	588	645	57	10%	Pass
15B	M6 J31A - Fulwood	WB	612	608	-4	-1%	Pass
16A	Preston Blackpool Rd - M6 J1	EB	1409	1378	-31	-2%	Pass
16B	M6 J1 - Preston Blackpool Rd	WB	1457	1348	-109	-7%	Pass
17A	Leyland - Bamber Bridge - Walton-le-Dale - Mellor Brook	NB	746	797	51	7%	Pass
17B	Mellor Brook - Walton-le-Dale - Bamber Bridge - Leyland	SB	725	765	40	5%	Pass
18A	Chorley - Euxton - Croston	WB	834	740	-95	-11%	Pass
18B	Croston - Euxton - Chorley	EB	838	727	-111	-13%	Pass
19A	M65 J3 - Wheelton - M61 J8	SB	567	522	-45	-8%	Pass
19B	M65 J8 - Wheelton - M65 J3	NB	522	528	6	1%	Pass
20A	Coppul - Euxton - Leyland	N	770	830	60	8%	Pass
20B	Leyland - Euxton - Coppul	S	717	780	63	9%	Pass
21A	Chorley	NB	512	555	43	8%	Pass
21B	Chorley	SB	513	576	64	12%	Pass
M1A	M1	NB	1627	1617	-11	-1%	Pass
M1B	M1	SB	1650	1655	5	0%	Pass
M2A	M2	SB	1358	1333	-25	-2%	Pass
M2B	M2	NB	1366	1331	-35	-3%	Pass
M3A	M3	EB	305	279	-26	-9%	Pass
M3B	M3	WB	285	275	-9	-3%	Pass
M4A	M4	WB	691	649	-42	-6%	Pass
M4B	M4	EB	683	649	-34	-5%	Pass
							96%

The above results show that the traffic model validates well against journey times, exceeding the TAG criteria, with more than 85% of journey time routes within the required criteria.

It can be noted that 90% of journey time routes pass in the AM time period, 88% of journey times pass in the IP time period, and 96% of journey time routes pass in the PM time period.

To further ensure that the journey times are not totally off from the observed, comparison of modelled journey time was done with observed using the median times rather than mean. This was done to remove any major outliers and it was noted that all failing routes passed with this method. However, for consistency, average observed times were used for the reporting purpose.

It is also notable that the differences in times are not consistently positive or negative, suggesting there is no underlying bias of high or low journey times in the model.

7.7 Strategic Road Network (SRN)

It is acknowledged that the future developments in the study are likely to have an impact on the SRN. To ensure the model is sufficiently robust to support the analysis of development impacts on the SRN, it was agreed with NH's that as part of model calibration the SRN links and junctions will be benchmarked against the best available observed.

Table 7.24 to Table 7.26 below provide a summary of the link validation results. Full validation results are contained in Appendix L.

Table 7.24: Validation Count Summary – AM Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	%Compliant	Result	Total Count	Compliant	%Compliant	Result
Low Flow (<700v)	14	14	100%	Pass	29	28	97%	Pass
Mid Flow (700v - 2700v)	49	48	98%	Pass	50	49	98%	Pass
High Flow (>2700v)	25	25	100%	Pass	9	9	100%	Pass
Total	88	87	99%	Pass	88	86	98%	Pass
GEH	88	85	97%	Pass	88	86	98%	Pass
Links meeting either WebTAG criteria	88	87	99%	Pass	88	87	99%	Pass

Table 7.25: Validation Count Summary – IP Average Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	%Compliant	Result	Total Count	Compliant	%Compliant	Result
Low Flow (<700v)	32	31	97%	Pass	43	40	93%	Pass
Mid Flow (700v - 2700v)	42	41	98%	Pass	38	37	97%	Pass
High Flow (>2700v)	14	14	100%	Pass	7	7	100%	Pass
Total	88	86	98%	Pass	88	84	95%	Pass
GEH	88	86	98%	Pass	88	85	97%	Pass
Links meeting either WebTAG criteria	88	86	98%	Pass	88	85	97%	Pass

Table 7.26: Validation Count Summary – PM Peak Hour

TAG Guideline Values	All Vehicles				Cars			
	Total Count	Compliant	%Compliant	Result	Total Count	Compliant	%Compliant	Result
Low Flow (<700v)	18	18	100%	Pass	23	21	91%	Pass
Mid Flow (700v - 2700v)	44	43	98%	Pass	53	53	100%	Pass
High Flow (>2700v)	26	26	100%	Pass	12	12	100%	Pass
Total	88	87	99%	Pass	88	86	98%	Pass
GEH	88	86	98%	Pass	88	87	99%	Pass
Links meeting either WebTAG criteria	88	88	100%	Pass	88	88	100%	Pass

TAG advises that in ordinary circumstances the practitioner should aim to reach a state where 85% of modelled links have a GEH of less than 5 or satisfy the criterion in link flow. The table demonstrates that 85% of sites meet link flow criteria and GEH criteria for both car and total vehicles for all time periods. The results are encouraging as it gives confidence that modelled flows along SRN are representative of observed traffic flows.

In response to NH's request for detailed analysis of SRN junctions, we have also analysed traffic flow diagrams for the key junctions, which are included in the Appendix N. The comparison reveals that, for the majority of approach flows, the model aligns well with the observed flows.

Journey time validation along the SRN links is also undertaken. The routes are shown in Figure 7.3 and the JT comparison is shown in Table 7.27 through Table 7.29. The results show that all SRN JT routes pass the TAG criteria.

Table 7.27: Comparison of Modelled Journey Time against the Observed SRN Routes, AM Peak

Route	Route Name	Direction	Total Observed (s)	Total Modelled (s)	Diff (s)	Rel. Diff	Result
M1A	M1	NB	1715	1661	-53	-3%	Pass
M1B	M1	SB	1665	1609	-56	-3%	Pass
M2A	M2	SB	1369	1305	-64	-5%	Pass
M2B	M2	NB	1462	1358	-104	-7%	Pass
M3A	M3	EB	325	278	-46	-14%	Pass
M3B	M3	WB	312	294	-18	-6%	Pass
M4A	M4	WB	717	652	-65	-9%	Pass
M4B	M4	EB	705	655	-50	-7%	Pass
							100%

Table 7.28: Comparison of Modelled Journey Time against the Observed SRN Routes, IP Peak

Route	Route Name	Direction	Total Observed (s)	Total Modelled (s)	Diff (s)	Rel. Diff	Result
M1A	M1	NB	1667	1598	-69	-4%	Pass
M1B	M1	SB	1677	1632	-45	-3%	Pass
M2A	M2	SB	1394	1318	-75	-5%	Pass
M2B	M2	NB	1385	1311	-74	-5%	Pass
M3A	M3	EB	291	256	-35	-12%	Pass
M3B	M3	WB	282	260	-22	-8%	Pass
M4A	M4	WB	695	639	-56	-8%	Pass
M4B	M4	EB	710	646	-64	-9%	Pass
							100%

Table 7.29: Comparison of Modelled Journey Time against the Observed SRN Routes, PM Peak

Route	Route Name	Direction	Total Observed (s)	Total Modelled (s)	Diff (s)	Rel. Diff	Result
M1A	M1	NB	1627	1617	-11	-1%	Pass
M1B	M1	SB	1650	1655	5	0%	Pass
M2A	M2	SB	1358	1333	-25	-2%	Pass
M2B	M2	NB	1366	1331	-35	-3%	Pass
M3A	M3	EB	305	279	-26	-9%	Pass
M3B	M3	WB	285	275	-9	-3%	Pass
M4A	M4	WB	691	649	-42	-6%	Pass
M4B	M4	EB	683	649	-34	-5%	Pass
							100%

8. Variable Demand

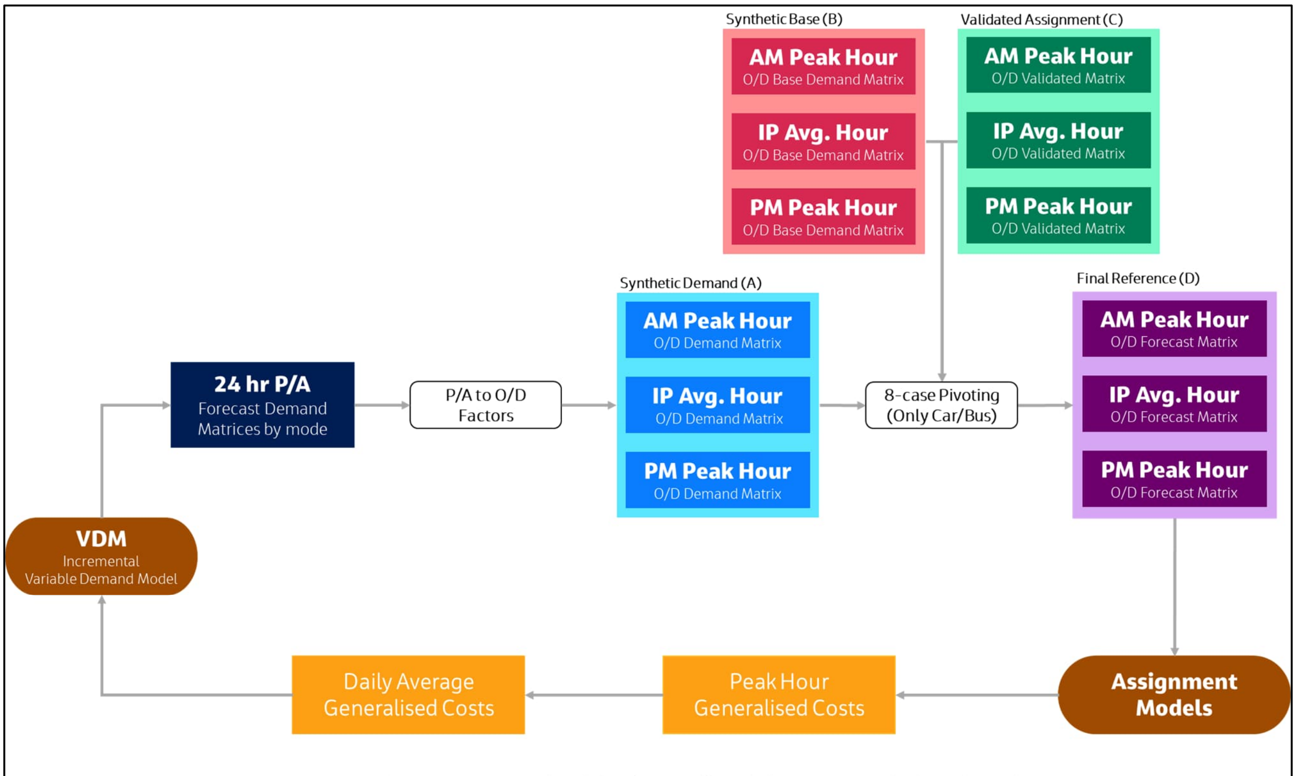
8.1 Introduction

The CLTM has been built following TAG Unit M2.1 guidance and a multi-modal variable demand model has been developed to estimate the changes in demand due to the variations in transport conditions. This section provides a description of structure, scope, and calibration of the variable demand model (VDM).

8.2 Variable Demand Model Overview

The demand model operates at a 24-hour Production/Attraction level utilising an incremental logit model that responds to changes in daily generalised costs. Such costs are obtained from highway and public transport assignment models and then converted to the daily weighted average costs taking account of the time period and direction of journey prior to the demand modelling. As shown in Figure 8.1, new assignment OD matrices are calculated using the 24-hour demand that was obtained in the previous step, and new costs are extracted. This process is repeated iteratively until convergence is reached i.e. when the difference in demand and cost between successive iterations are sufficiently small.

Figure 8.1: Relationship between Demand Model and Assignment Models

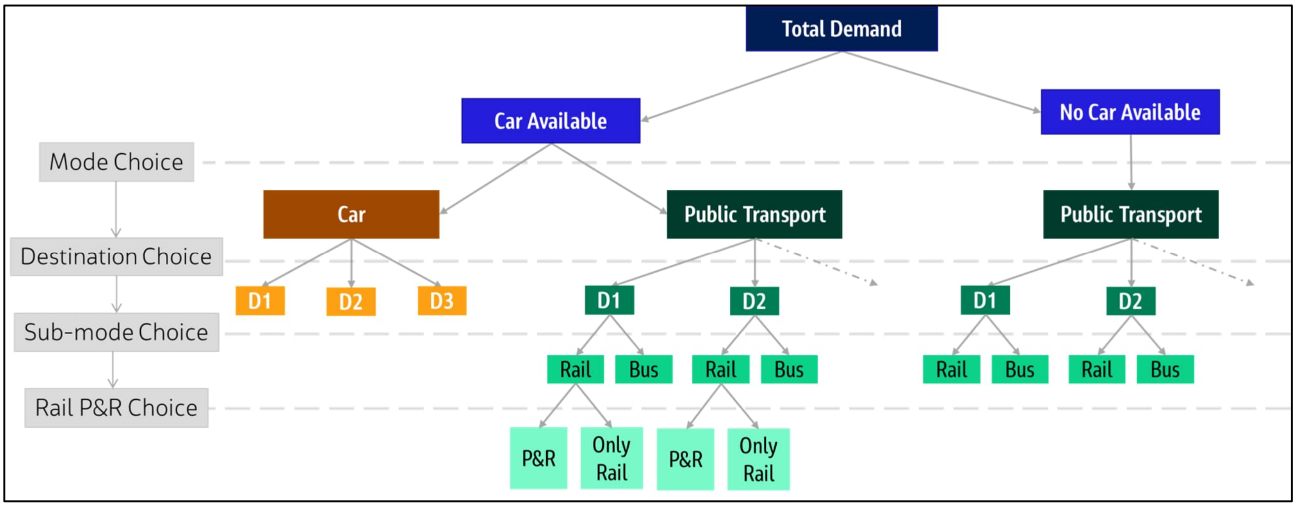


- P/A to O/D Factors: Time of Day, Tour Factors and Peak hour factors. Also vehicle occupancy for highway demand.
- (A): DIADEM Output demand in O/D format. It is the result of the addition of Home-based and non-home based demand.
- (B): Base Year Demand in OD format. Used to calculate the demand differences with the DIADEM output.
- (C): Validated Matrix. Demand matrix of the validated assignment.
- (D): Final Forecast Reference matrix. For Highway and PT-Bus, the demand after pivoting.

The demand model has been implemented in EMME following Appendix D of TAG Unit M2.1. Subsequently, the demand model has been calibrated in accordance with the methodology laid out in TAG Unit M2.1. This process involved adjusting the model parameters, in accordance with the values outlined in TAG Unit M2 until plausible results were produced from the realism testing.

The upgraded CLTM is built to recreate the travel behaviour in terms of mode choice and trip distribution in the study area. The trip distribution response considers the attractiveness of alternative destinations whereas the mode choice response considers demand switching between car and public transport. Since mode choice depends on whether a traveller has a car available for the journey, the model also distinguishes between households that have a car available and those that do not. Under the public transport choice model there is also a sub-mode choice between rail and bus. Additionally, for the car-available rail trips, there is a sub-mode choice for the rail Park-and-Ride and rail only. A schematic of the structure of the mode choice model and the hierarchy of responses is presented in Figure 8.2.

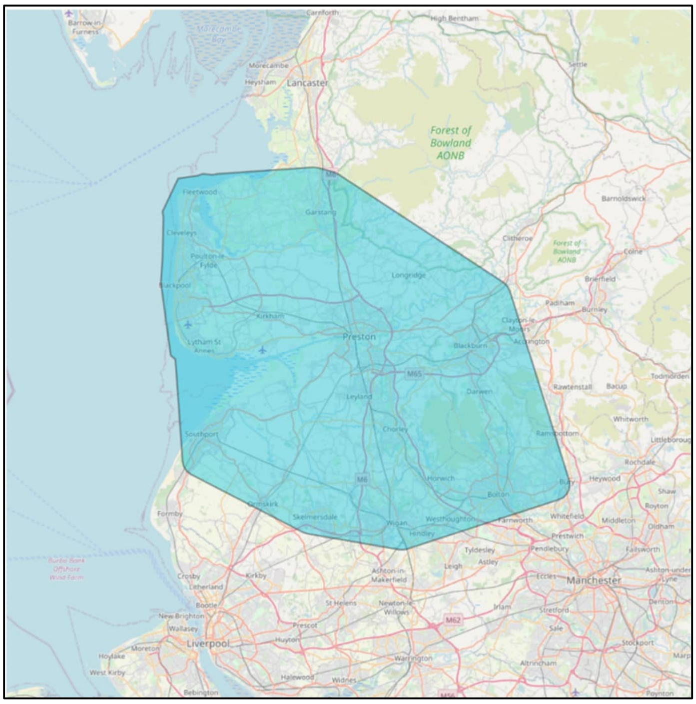
Figure 8.2: Mode Choice Structure



8.3 Cost Responsive Model Area

The area covered by the model and the zoning system are described in Sections 2.1 and 2.2.2. For the demand model, any trip starting or ending within the modelled area, as shown in Figure 8.3, is within the scope of the VDM and hence is fully responsive to cost changes. Any other trip both starting and ending outside of the shaded area, i.e., between two external zones, is fixed within the variable demand model.

Figure 8.3: Cost Responsive Area



8.4 Demand Segmentation

The following journey purpose segmentation is used in the CLTM demand model:

- Home-Based Work (HBW) – trips from home to work (and return) – a typical commuting journey.
- Home-Based Employer's Business (HBEB) – trips from home to a destination where the traveller is in employers' time as soon as leaving home (and return).
- Home-Based Other (HBO) – trips from home to a non-work-related location including shopping and education (and return).
- Non-Home-Based Employer's Business (NHBEB) – trips during employers' time, such as travelling from a place of work to a business meeting, visiting customers etc.
- Non-Home-Based Other (NHBO) – trips between two non-home locations e.g., from work to shops.

These journey purposes are used across car, public transport car available, and public transport no car available modes. Public transport is further segmented into Bus and Rail (including rail P&R). In line with TAG guidance, Home-Based Work purpose trips are doubly constrained within the variable demand model, while the other purpose trips are singly (Production) constrained.

A summary of the correspondence between the journey purposes and assignment user classes for all modes is presented in Table 8.1.

Table 8.1: Assignment User Classes by Mode and Demand Segments Correspondence

<table>
<tr><th>Demand Model Purpose</th><th colspan="5">Assignment User Class</th></tr>
<tr><th></th><th>Car</th><th colspan="2">Bus</th><th colspan="2">Rail</th></tr>
<tr><td>Home-Based Work</td><td>Car commute
Car Available</td><td rowspan="5">Bus Only
Car Available</td><td rowspan="5">Bus Only
No Car Available</td><td rowspan="4">Must Use Rail
Car Available</td><td rowspan="5">Must Use Rail
No Car Available</td></tr>
<tr><td>Home-Based Employers Business</td><td rowspan="2">Car Employer business
Car Available</td></tr>
<tr><td>Non-Home-Based Employers Business</td></tr>
<tr><td>Home-Based Other</td><td rowspan="2">Car Other
Car Available</td></tr>
<tr><td>Non-Home-Based Other</td><td></td></tr>
</table>

Also, Light, and Heavy Good vehicles are included as two separate user classes in the highway assignment model. However, they are treated as fixed demand i.e., they are not included in the demand model calculations.

8.5 Generalised Costs

All the elements that were considered for the calculation of the generalised costs used in the assignments of each mode are described in Section 2.6. Other components of the generalised costs which are considered in the demand model are described below.

8.5.1 Public Transport Fare

For the Public Transport assignment, and following guidance from TAG Unit M3.2, Public Transport fares were not included as part of the assignment as they are not thought to sufficiently affect route choice in the CLTM.

Matrices of fares were included in the Variable Demand Model and added to the generalised cost as they will be an important influence on mode choice for some trips. The following sections outline the process for deriving the rail and bus fares.

8.5.2 Rail Fares

Rail fares were estimated from MOIRA and calculated by:

- Aggregate MOIRA into a unique station-station matrix with sum of annual demand and revenue (i.e. group ticket types and Summer/Winter)
- Join (1) with National Rail Travel Survey (NRTS) sample network distances
- Calculate the average revenue per passenger kilometre from (2). Use distance bands as price/km will decrease for longer distance trips.
- Join Mobile Network Data (MND) station catchment zones with PT model distances from zone-station.

- Compare distance bands from (4) against NRTS access/egress observed data.
- From (5) adjust catchments (e.g. remove very long-distance access legs).
- Finalise assignment of zones to stations - check for zones without station and vice versa.
- Assign station-station average MOIRA fare to the zone-zone matrix. Where average fare is missing, use the average price/km travelled (3) * station-station network distance.
- Where a zone can use more than one station, weight fares is based on a probability of station choice

8.5.3 Bus Fares

Bus fares for each OD pair and trip purpose are derived using the Stagecoach ticket options valid for August 2019. Using GIS, all OD movements are assigned to a corresponding ticketing zone. Assuming that every purpose completes one return journey per day, single-trip fares are calculated as follows:

- Business trip purpose = Day Ticket divided by 2
- Commute trip purpose = Weekly Ticket divided by 10
- Other trip purpose = Day Ticket divided by 2

A simple fare calculation provides only the 'Adult single' fare does not take into account the mixture of different passengers using the bus service such as concessionary fare users who travel at reduced fares. To address this, percentage of split of ticket types using bus services in the study area throughout the day was estimated and using the percentage splits, a reduction factor was applied to the fare. According to the ticketing information provider by Stagecoach, 27.8% of the trips correspond to concessionary users under the English National Concessionary Scheme. To reflect the mixture of tickets used by all users, the base fare matrices have been adjusted using a factor of 0.722.

Fares for external-to-external zonal OD pairs are set at £9999 as they are excluded from the mode choice model.

8.5.4 Parking Charges

Parking charges in Preston City Centre are sourced from published data from relevant websites. In addition to the dedicated station parking, Fishergate shopping centre car park, located next to the station is also considered as a potential parking location for rail passengers as there is good chance that people would use this facility instead of the station car park due to lower parking charges.

Station parking costs for Preston Railway Station is as summarised in Table 8.2 below.

The daily weekday parking fee was converted into highway generalised cost using the Value of Time (VoT) corresponding to each of the demand segment. The parking cost was halved to spread the cost for outbound and return trip.

Table 8.2: Parking Charges

Car Park	Capacity	Opening hours	Parking Fee
Preston Railway Station car park	1,025	Monday to Sunday (available at all times)	Daily: £12.00 Saturday: £6.00 Sunday: £6.00 Monthly: £166.00 Three Monthly: £374.00 Annual: £1,200.00
Fishergate shopping centre	720	Sunday - 08:00 -18:00 Monday to Saturday - 08:00 - 19:00	Up to 1 hour £1.50 Up to 2 hours £2.00 Up to 3 hours £2.50 Up to 4 hours £3.50 Up to 5 hours £4.50 Up to 8 hours £7.50 Over 8 hours £8.50

8.6 Bus and Highway Assignments Integration

Bus link speeds are adjusted in every iteration in order to estimate the likely impact of changes in car traffic on the bus travel times. First, highway assignments are run and travel times for all simulation links are extracted. Subsequently, the bus network was updated with times from highway assignments. Bus times from CIF files were added to each of transit lines segment. The time between bus stops was divided proportionally between each transit line segment (link) between stops (split time macro). If the segment speed was greater than 90 km/h then the segment time was changed to match the highway assignments times. These times determine the base year bus travel times.

For forecast year and realism testing scenarios the following steps are taken:

- Base year and forecast year times from highway assignments are compared and the percentage difference is calculated for each link
- The base year segment times are then factored by the percentage change from the highway assignments to create the forecast year segment times.
- If the calculated forecast year bus speed is greater than 90 km/h then the speed is limited to 89 km/h.

8.7 Variable Demand Model Calibration

8.7.1 Demand Model Distribution Parameters

The demand model parameters control the sensitivity of the model's mode, destination, and sub-mode choice responses. These parameters are sensitivity parameters (λ) and the scaling parameters (θ). Scaling factors represent the ratio of sensitivity parameters from successive levels of the demand model choice structure (e.g. the sensitivity of main mode choice relative to that of destination choice).

The strength of the sensitivity parameters should be in line with the model hierarchy, i.e. these need to be stronger at lower levels of the model hierarchy than at the higher level. To be consistent with

TAG recommended hierarchy of destination choice following main mode choice, the main mode choice scaling parameters should be less than or equal to one. TAG Unit M2.1 Section 5.6 provides a number of illustrative parameter values defined individually by mode and by purpose.

For the sensitivity parameters, the calibrated parameters from the previous model update by trip purpose and mode were used to undertake the realism testing. The final calibrated variable demand model parameters from previous model update are shown in Table 8.4.

Detailed process of parameter calibration is documented in Base Year Model Bus Calibration Report and is included in Appendix E.

Table 8.3: Sensitivity Parameters (Before Realism Testing)

Trip Purpose	Bottom Level Sensitivity Parameters			Destination Choice Scaling Parameters θ	Mode Choice Scaling Parameters θ
	Highway	Bus	Rail		
HB Commute	0.08125	0.043	0.033	1	0.68
HB Employer Business	0.05025	0.045	0.036	1	0.45
HB Other	0.0675	0.06	0.036	1	0.53
NHB Employer Business	0.06075	0.0525	0.042	1	0.73
NHB Other	0.05775	0.04125	0.033	1	0.81

These sensitivity parameter values have then been subject to realism testing as defined by TAG Unit M2.

8.7.2 Cost Damping

There is strong empirical evidence that the sensitivity of demand responses to changes in generalised cost reduces with increasing trip length. The mechanisms by which this may be achieved are generally referred to as 'cost damping'. TAG prescribes the application of cost damping in those instances where a model fails to yield elasticities within TAG specified ranges. In view of early analyses of the outturn elasticities from the model set up with TAG median parameter values, a decision was taken to employ generalised cost damping as a function of distance.

TAG states that if cost damping is employed, it should apply to all person demand responses. The same cost damping function should be applied to both car and public transport costs. While the starting position should be that the same cost damping parameter values are used for both modes, it may be necessary to vary the cost damping parameters between the modes in order to achieve satisfactory realism test results. It may also be necessary to vary cost damping parameters by trip purpose. However, these variations by mode and purpose should be avoided unless it is essential to achieve acceptable model performance.

The damped cost applied in the demand model follows the formula:

$$G' = \left(\frac{d}{k}\right)^{-\alpha} \cdot \left(t + \frac{c}{\text{VOT}}\right)$$

Where:

- G' is the damped generalised cost

- t and c are the trip time and monetary cost, respectively
- VoT is the value of time
- d is the trip length; and
- α and k are parameters that need to be calibrated

α must be positive and less than 1 and should be determined by experimentation in the course of adjusting the model so that it meets the requirements of realism tests. k must also be positive and in the same units as d.

To prevent short-distance trips, particularly intra-zonal trips, becoming unduly sensitive to cost changes, a cut-off is applied. Parameter d' represents the distance below which generalised costs would not be reduced. As per TAG unit M2.1 guidance, some commonly used parameter values are presented below:

- α = 0.5
- k = 30 km
- d' = 30 km.

These initial values were used for realism testing and then subject to further refinement.

8.7.3 Parameter Estimation

8.7.3.1 Realism Testing Overview

To ensure that the variable demand model behaves 'realistically', a series of tests have to be undertaken by changing the various components of travel costs and checking the overall demand response. The suitability of the model's responses is evaluated through its demand elasticities. Acceptable demand elasticities are achieved by varying the distribution and cost damping parameters described before.

Demand elasticities are calculated by changing a cost or time component and calculating the proportionate change in travel. The elasticity is calculated using the following formula:

$$\varepsilon = \frac{In(T_1) - ln(T_0)}{In(C_1) - ln(C_0)}$$

where the superscripts 0 and 1 indicate values of demand, T, and cost, C, before and after the change in cost, respectively. The demand can be expressed in terms of vehicle kilometres (for car demand) or person trips (for public transport modes). The model tests have been applied to the base model to demonstrate appropriate responsiveness to changes in highway fuel cost, highway journey times, public transport fares (rail and bus), and bus fares in isolation.

8.7.3.2 Car Fuel Elasticity

The car fuel cost elasticity measures the percentage change in car vehicle kilometres with respect to the percentage change in fuel cost. TAG states that the calculations should be carried out for a 10% or a 20% fuel cost increase. A 20% increase was used in this study.

The matrix-based approach compares the change in car vehicle kilometres using the car trip matrices and skimmed distance matrices relating to the before and after fuel cost change model runs. The movements included in this calculation relate only to the movements to which the full range of demand responses apply (internal productions) in the demand model. The calculations have been carried out at a time period and 24-hour production-attraction basis.

The network-based approach measures changes in car vehicle kilometres accumulated over the model network (links) from the before and after fuel cost change model runs. The network used for this calculation extends to cover the area over which the highway assignment model has been validated but excludes external to external movements.

8.7.3.3 Car Journey Time Elasticity

The car journey time elasticity measures the change in car trips with respect to a change in journey time. Car journey time elasticities were calculated using the fuel cost elasticities and cost damping, using the equation below:

$$\varepsilon^{time} = \varepsilon^{fuel} \frac{p^{time}}{p^{fuel}}$$

Where :

- p^{time} is cost of travel as a proportion of generalised cost; and
- $p^{fuel}$is the cost of fuel as a proportion of total generalised cost.

Furthermore, if the total vehicle kilometres (K) and total vehicle hours (T) are known then the following relationship can be derived:

$$\frac{p^{time}}{p^{fuel}} = \frac{aT}{bK}$$

where a is the cost per hour; and b is the cost per km.

8.7.3.4 Public Transport Fares Elasticities

The public transport fare elasticity measures the percentage change in public transport trips by all public transport modes with respect to the percentage change in public transport fares. A fare increase of 20% was used for these two tests, applied to all public transport modes equally, and only to bus. Public transport fare elasticities are calculated on a matrix basis, by time period and trip purpose. The movements included in this calculation relate only to the movements to which the full range of demand responses apply in the demand model (internal productions).

8.7.3.5 Target Elasticities

Table 8.4 summarises the TAG Unit M2.1 (May 2024) recommended elasticity ranges that should be achieved by the realism tests.

Table 8.4: Recommended Elasticities

Test	High	Low
Fuel cost (km)	-0.35	-0.15
PT main mode fare (trips)	-0.9	-0.2
Bus fare (trips)	-0.9	-0.35
Rail fare (trips)	-1.5	-0.7
Car Journey Time (trips)	No stronger than -0.75	

8.8 Realism tests

8.8.1 Car Fuel Elasticity

Car fuel elasticity was estimated using the final model parameters (Run 10) from the previous model update as shown in Table 8.5. A further run was undertaken to ensure the realism tests were in line with the TAG recommended values. Detailed description related to each run is included in the Base Year Model Bus Calibration Report (Appendix E).

Table 8.5: Car Fuel Cost Test - Distribution Parameters

Run ID	Distribution Parameter Trip (Lambda)					Cost Damping		
	HBW	HBEB	NHB EB	HB Other	NHB Other	HBW	EB	Other
1	-0.065	-0.067	-0.081	-0.090	-0.077	-	-	-
2	-0.049	-0.050	-0.061	-0.068	-0.058	-	-	-
3	-0.081	-0.084	-0.101	-0.113	-0.096	-	-	-
4	-0.065	-0.067	-0.081	-0.090	-0.077	d'=k=30000; α = 0.5		
5	-0.049	-0.050	-0.061	-0.068	-0.058	d'=k=30000; α = 0.5		
6	-0.081	-0.084	-0.101	-0.113	-0.096	d'=k=30000; α = 0.5		
7	-0.081	-0.050	-0.061	-0.068	-0.058	-	d'=k=30000; α = 0.5	
8	-0.081	-0.050	-0.061	-0.068	-0.058	-	d'=k=20000; α = 0.5	
9	-0.081	-0.050	-0.061	-0.068	-0.058	-	d'=k=20000; α = 0.55	
10	-0.081	-0.050	-0.061	-0.068	-0.058	-	d'=k=20000; α = 0.6	
11	-0.081	-0.050	-0.061	-0.068	-0.058	-	d'=k=20000; α = 0.65	

Table 8.6 presents the outturn fuel cost elasticities obtained with final parameters. The average 24-hour demand elasticity of -0.304 lies within the TAG recommended range (-015 to -0.35), and the AM and PM peak period elasticities are weaker than the inter-peak elasticities. The overall elasticity lies on the right side of -0.25.

Furthermore, the relative pattern of elasticities across different journey purposes is in line with expectations and deemed plausible with discretionary trips (Other) exhibiting the strongest elasticities.

Table 8.6: Car Fuel Cost Elasticities - Results

Period	Purpose	Final Parameters
AM	Commute	-0.218
	Employer Business	-0.152
	Other	-0.334
	Average	**-0.242**
IP	Commute	-0.241
	Employer Business	-0.168
	Other	-0.407
	Average	**-0.327**
PM	Commute	-0.223
	Employer Business	-0.154
	Other	-0.400

Period	Purpose	Final Parameters
	Average	**-0.288**
12 HR	Commute	-0.225
	Employer Business	-0.161
	Other	-0.394
	Total	**-0.294**
24 HR	Commute	-0.228
	Employer Business	-0.163
	Other	-0.399
	Total	**-0.304**

The corresponding network elasticities are presented in Table 8.7. Results are in line with matrix-based elasticities presented before. No External-to-External movements were included in the calculation.

Table 8.7: Car Fuel Cost - Network Based Elasticities

Trip Purpose	AM	IP	PM
Commute	-0.244	-0.262	-0.253
Employer Business	-0.126	-0.137	-0.137
Other	-0.350	-0.429	-0.420

8.8.2 Car Journey Time Elasticity

Car journey time elasticities derived from the fuel cost elasticities, as described in Section 8.7.3.3, are summarised in Table 8.8. The demand elasticities with respect to journey time are not overly strong and are weaker than -0.75 across all journey purposes and time periods except for Other in IP and PM peaks.

Table 8.8: Car Journey Time Elasticity Results

Trip Purpose	AM	IP	PM
Commute	-0.690	-0.750	-0.708
Employer Business	-0.268	-0.295	-0.274
Other	-0.739	-0.882	-0.884

8.8.3 Public Transport Fares Elasticities

8.8.3.1 Overall Increase

As described before, the public transport fares elasticity test included an increase of the fare component of generalised cost by 20%. The model was run to convergence and the results for internal productions are shown in Table 8.9. The results show that the elasticity is close to TAG recommended value of -0.2.

Table 8.9: Public Transport Fare Test Elasticity Results

Period	Mode	Final Parameters
AM	Rail	-0.700
	Bus	-0.236

Period	Mode	Final Parameters
	All	**-0.265**
IP	Rail	-0.754
	Bus	-0.275
	All	**-0.304**
PM	Rail	-0.672
	Bus	-0.275
	All	**-0.290**
12 hr	Rail	-0.706
	Bus	-0.264
	All	**-0.286**
24 hr	Rail	-0.717
	Bus	-0.268
	All	**-0.287**

The demand model converged after one iteration. Convergence metrics are presented in Table 8.14.

8.8.3.2 Bus Fare Increase

The public transport sub-mode (bus) fares elasticity test was undertaken by increasing the bus fare matrices by 20%. The model was run iteratively to convergence. As shown in Table 8.10, bus response is within the target range (-0.35 to -0.9) for all periods and 24-hours.

The elasticity is slightly weak response, however, was deemed as acceptable given two key characteristics of the local demand. Bus share in Lancashire is lower than in the region and the rest of the country, the number of passengers per head of population are 32.5 for Lancashire, 50.0 in the North-West, and 72.4 in England. Although concessionary users are not segmented explicitly, including them can reduce the response. Considering that the proportion of the concessionary journeys in Lancashire is higher (29%) than the national average (22%), according to DfT's Local transport statistics (Tables BSU0109 and BUS0113), a weaker response to bus fare increases can be expected.

Table 8.10: Bus Fare Test Elasticity Result

Period	Mode	Final Parameters
AM	Bus	-0.396
IP	Bus	-0.507
PM	Bus	-0.508
12 hr	Bus	-0.476
24 hr	Bus	-0.486

8.9 Final Sensitivity Parameters

Given the model passed all realism tests, no further sensitivity testing were undertaken. Table 8.11 summarises the final choice parameters of the variable demand model.

Table 8.11: Final Choice Parameters

Trip Purpose	Bottom Level Sensitivity Parameters			Destination Choice Scaling Parameters θ	Mode Choice Scaling Parameters θ
	Highway	Bus	Rail		
HB Commute	0.08125	0.043	0.033	1	0.68
HB Employer Business	0.05025	0.045	0.036	1	0.45
HB Other	0.0675	0.06	0.036	1	0.53
NHB Employer Business	0.06075	0.0525	0.042	1	0.73
NHB Other	0.05775	0.04125	0.033	1	0.81

8.10 Convergence

In assessing the outputs of the model runs, the main parameter of importance is the 'relative gap', which is the measure of convergence between demand and supply. Current TAG guidance recommends a relative gap of at least 0.2%. The base year realism testing models converged to less than 0.2%, with all runs reaching convergence within 7 iterations, which suggests the demand - supply convergence of the variable demand traffic model is acceptable. It has therefore been shown that the traffic model is stable and has converged to an acceptable standard. Convergence metrics for the Car Fuel Cost, the Bus Fare Test and the overall PT Fare test are presented in Table 8.12 through Table 8.14.

Table 8.12: Car Fuel Cost – Convergence metrics

OD Pairs	Convergence (Relative Gap %)			
	Rail	Bus	Car	All
All	0.0338	0.0872	0.0610	0.0614
Internal to Internal	0.0413	0.0880	0.0869	0.0853

Table 8.13: Bus Fare Test – Convergence Metrics

OD Pairs	Convergence (Relative Gap %)			
	Rail	Bus	Car	All
All	0.0329	0.0874	0.0526	0.0545
Internal to Internal	0.0370	0.0877	0.0730	0.0742

Table 8.14: Public Transport Fare Test – Convergence Metrics

OD Pairs	Convergence (Relative Gap %)			
	Rail	Bus	Car	All
All	0.0256	0.0791	0.0445	0.0463
Internal to Internal	0.0302	0.0786	0.0626	0.0640

8.11 Conclusion

The variable demand model for the upgraded CLTM model has been calibrated in accordance with the methodology and recommendations set out in TAG unit M2.

Realism tests have readily converged in line with TAG Unit M2 and all assignments comply with the corresponding criteria.

The results presented in the preceding sections demonstrate that:

- The demand model structure and response hierarchy have been set up correctly and comply with TAG Unit M2 requirements;
- The calculations and the methodology used for fuel cost elasticities are compliant to TAG Unit M2 guidance;
- The outturn elasticity results fall within the TAG Unit M2 expectations and requirements; and
- The distribution parameters that are adopted in the model are TAG Unit M2 compliant and within recommendations.
- The highway transport models have been validated against observed data collected in 2024 representing an average weekday (Mon-Fri) in a neutral month. Realism test elasticities have been shown to lie within the TAG criteria. It is therefore it is expected annual average elasticity will also lie within the expected range.

Overall, the demand model responses to change are realistic and within the requirements of TAG Unit M2. Thus, these calculated parameters will be considered suitable for variable demand modelling for future year forecasting.

9. Summary of Model Development, Standards Achieved and Fitness for Purpose

9.1 Summary of Model Development

The CLTM model has been updated to 2024 using newly collected traffic and journey time data for the three districts, following the guidance in TAG Units M1, M2, and M3.

The new developments completed since 2019 were reviewed and confirmed with the respective districts and incorporated into the base models. Network completions from 2019, including PPM and PPK updates, were integrated into the model network, with extensive checks on the coded network.

The modelled assignment satisfies TAG criteria for a well converged model.

Modelled flows and journey times compares well to observed data, both for data used as part of the model building process, and independent data.

Both screenline and journey time validation in the model meets the criteria set out in guidance for the majority of the comparisons made.

The CLTM includes a bus and rail assignment model and a variable demand model in EMME, following guidance laid out in TAG Units M1, M2 and M3. The P/A VDM has been calibrated to pass realism testing prescribed in TAG.

The Bus and Rail assignment has not been calibrated to 2024 observed data due to data limitations and program constraints. However, it has been calibrated and validated to 2019 conditions, with the best available sources used to project demand from 2019 to 2024.

9.2 Summary of Standards Achieved

The standards to which the model aimed to conform are set out in Chapter 3. Table 9.1 summarises how the model performs against those standards.

Table 9.1: Model Performance Standards

Model Aspect	Criterion	Acceptability Guidelines	Actual Model Performance
Highway Calibration /Validation 2024	Screenline Flows within 5% of observed	All or nearly all screenlines	Calibration: ▪ For AM Peak, 93% screenlines pass the TAG criteria and all screenline pass the GEH criteria. ▪ For IP Peak, 93% screenlines pass the TAG criteria and all screenline pass the GEH criteria. ▪ For PM Peak, 86% screenlines pass the TAG criteria and all

Model Aspect	Criterion	Acceptability Guidelines	Actual Model Performance
			screenline pass the GEH criteria. Validation: ▪ For AM Peak, 86% screenlines pass the TAG criteria and all screenline pass the GEH criteria. ▪ For IP Peak, 93% screenlines pass the TAG criteria and all screenline pass the GEH criteria. ▪ For PM Peak, 93% screenlines pass the TAG criteria and all screenline pass the GEH criteria
	Link Calibration - Individual flows within 100 veh/hr of counts for flows less than 700 veh/hr	> 85% of cases	For all time periods, the link total and car flows pass the flow difference and GEH criteria.
	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	
	GEH < 5 for individual flows	> 85% of cases	
	Journey Times within 15% (or one minute if higher)	> 85% of Routes	Criteria met for 90% of journey time routes in the AM, 88% in the IP and 96% in the PM time period.
VDM Realism Testing - 2024	Fuel Cost Elasticity	-0.35 to -0.15	▪ All peak average elasticities between -0.24 and -0.33
	Car Journey Time Elasticity	No stronger than -0.75	▪ All elasticities weaker than -0.75 except for IP and PM peak for Other.
	PT Main Mode Fare Elasticity	-0.9 to -0.2	▪ All peak and mode elasticities between -0.9 and -0.2

Model Aspect	Criterion	Acceptability Guidelines	Actual Model Performance
	Bus Fare Elasticity	-0.9 to -0.35	▪ Bus response within the target range.
Bus Network -2019	Journey Times within 15% (or one minute if higher)	> 85% of Routes	▪ AM Peak – 88% ▪ Inter-peak – 85% ▪ PM Peak – 85%
Bus Prior Matrix Calibration -2019	Link Flows within 25% of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour).	> 85% of Links	▪ AM Peak – 61% ▪ Interpeak – 71% ▪ PM Peak – 75% Links GEH > 5: ▪ AM Peak – 46% ▪ Interpeak – 71% ▪ PM Peak – 57%
	City Centre Cordon within 15% of the counts.		Interpeak and PM Peak Inbound to Preston are within 15% of observed, with AM Peak (-21%) failing to meet the criteria. No period Outbound is within 15% of observed with AM Peak (-29%), Interpeak (-17%) and PM Peak (-41%) failing to meet the criteria.
	Sector Boardings within 25% of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour).	> 85% of Sectors	▪ AM Peak – 77% ▪ Interpeak – 92% ▪ PM Peak – 92% Sector GEH > 5: ▪ AM Peak – 65% ▪ Interpeak – 58% ▪ PM Peak – 77%
Bus Matrix Estimation -2019	Matrix Zonal Cell Values	Slope within 0.98 and 1.02 Intercept near zero R2 in excess of 0.95	Slope between 0.88 and 0.96, Intercepts near zero, and R^2 between 0.91 and 0.93.
	Matrix Zone Trip Ends	Slope within 0.99 and 1.01 Intercept near zero R2 in excess of 0.98	Slope between 0.92 and 0.99, Intercepts near zero, and R^2 between 0.97 and 0.99.
	Trip Length Distribution	Means within 5% Standard deviations within 5%	Means within 8%. Standard deviation within 10%
	Sector-to-Sector Difference GEH < 5	All or nearly all sectors	99% of all sector-to-sector movements have

Model Aspect	Criterion	Acceptability Guidelines	Actual Model Performance
			a GEH of less than 5 in all time periods.
Bus Final Matrix Calibration -2019	Link Flows within 25% of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour).	> 85% of Links	▪ AM Peak – 79% ▪ Interpeak – 93% ▪ PM Peak – 82% Links GEH > 5: ▪ AM Peak – 71% ▪ Interpeak – 93% ▪ PM Peak – 75%
	City Centre Cordon within 15% of the counts.	All or nearly all cordons	AM Peak, Interpeak and PM Peak Inbound to Preston are all within 15% of observed. AM Peak and Interpeak Outbound are within 15% of observed with PM Peak (-25%) failing to meet the criteria.
	Sector Boardings within 25% of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour).	> 85% of Sectors	Individua Sector: ▪ AM Peak – 76% ▪ Interpeak – 76% ▪ PM Peak – 95%
Rail -2019	Station entry / exits 25% of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour).	> 85% of Stations	Stations > 150 Observations - 93% All Links GEH > 5 – 89%

Table 9.1 demonstrates that the majority of the model standards are met.

Some of the criteria related to matrix estimation performance are not met, however, there are understood reasons why that is the case, as detailed in each of the previous sections.

Given that the model has been demonstrated to have been constructed in a manner consistent with guidance, has been developed in conjunction with local LCC checks and TAG guidance, and is representative of traffic conditions, it is expected that a high degree of confidence may be placed in the model for the purposes of testing impacts and providing mitigation measures for future allocations as part of the local plan update.