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A55 Junctions 14 and 15 Improvements

Local Model Validation Report

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A55 JUNCTIONS 15 AND 16 IMPROVEMENTS
ASSIGNMENT MODEL VALIDATION REPORT (STAGE 3)

A55 JUNCTION 15 AND 16 IMPROVEMENTS
ASSIGNMENT MODEL VALIDATION REPORT

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1. INTRODUCTION

1.1 General Information and Summary of the Commission

1.1.1 The Welsh Government (WG) originally appointed Carillion in October 2017 to develop the design of the proposed A55 Junctions 15 and 16 Improvements up to publication of Draft Orders. Ramboll was the lead designer to Carillion. In January 2018, Carillion went into liquidation and WG appointed Ramboll directly.

1.1.2 Ramboll have undertaken a transport study on the A55 trunk road Junctions 15 and 16, following the Welsh Transport Planning and Appraisal Guidance 2017 (WelTAG). The study includes a Stage 3 Appraisal, building upon work already undertaken during the previous WelTAG Stage 1 and 2.

1.2 Purpose of the Report

1.2.1 The A55 transport model (A55TM) is used to understand current traffic conditions in the area, to provide evidence for the planning of changes to the transport network and to produce traffic forecasts that are used in the detailed economic, social and environmental appraisal of proposed interventions in the transport system.

1.2.2 The primary purpose of the model is to test the impact of the junction improvements on the A55 and local highway network.

1.2.3 This report presents the methodology used to build, calibrate and validate the base year Stage 3 SATURN model which will help assess the changes to the highway network as a result of the proposed junction improvements. The model has been developed in accordance with the Department for Transport's (DfT) Transport Assessment Guidance (WebTAG) and the Welsh Government's Welsh Transport Assessment Guidance (WelTAG).

1.3 Report Structure

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

- Chapter 2 provides an overview of the modelling approach
- Chapter 3 provides a summary of the data used to develop the A55TM
- Chapter 4 provides an overview of how the base SATURN model was built
- Chapter 5 outlines the development of the model network trip matrices
- Chapter 6 discusses the model's trip assignment methodology
- Chapter 7 details of the model's calibration and validation
- Chapter 8 provides a conclusion

2. MODEL SPECIFICATION

2.1 Introduction

2.1.1 The key requirement of the base year transport model is that it represents the base year traffic patterns on the road network and, therefore, forms a robust basis on which to forecast future year network conditions, both with and without changes to the transport network in the area.

2.2 Model Overview

2.2.1 This Stage 3 model has been developed using SATURN version 11.2.05. The basic inputs to the SATURN model are the transport 'demands', in the form of a matrix of trip movements between zones, and the 'supply' in the form of a detailed description of the road network.

2.2.2 Following development of the network, the trip matrix is assigned to the network using an iterative series of loops between 'assignment' and 'simulation' until the model has converged.

2.2.3 The 'assignment' process calculates the minimum cost routes for trips in terms of a weighted combination of time and distance. The 'simulation' stage then simulates the operation of each junction in the network. It should be noted that as route costs can depend upon the routes taken by other vehicles, the junction simulations can lead to a different set of minimum cost routes. The process is repeated, until successive assignment-simulation loops produce an acceptably low level of change in vehicle flows, when the model is deemed to have achieved convergence.

2.2.4 Following the convergence of the model, the model is calibrated. The modelled number of vehicles on the network is compared with the observed counts. The description of the road network (supply) is checked carefully and a matrix estimation procedure is used to adjust the trip patterns in the trip matrices (demand) if required.

2.2.5 The final stage is to validate the model, in which comparisons are made between modelled flows and a separate and independent set of traffic count data that was not used in the calibration process. Modelled journey times are also compared with observed times.

2.2.6 This section describes the core components of the model and provides a justification for adopting those elements.

2.2.7 Section 2.8 discusses the assignment process and parameters involved in the model.

2.3 Study Area

2.3.1 Within SATURN, the study area is made up of two defined areas and the remaining external area. These three elements are defined as:

1) Simulation Area – detailed area of modelling within the study area containing detailed junction coding and network data;
2) Buffer Area – area outside simulation area within the study area containing only network-based data; and
3) External Area – whole area outside the study area covering the rest of Wales and the UK.

2.3.2 The study area for the A55TM is shown in Figure 2.1 and consists of a detailed highway network along the A55 corridor between the west of Llanfairfechan and the eastern fringes of Conwy. The detailed study area consists of the simulation and buffer areas and the rest of the map denotes part of the external area which extends to the rest of the UK.

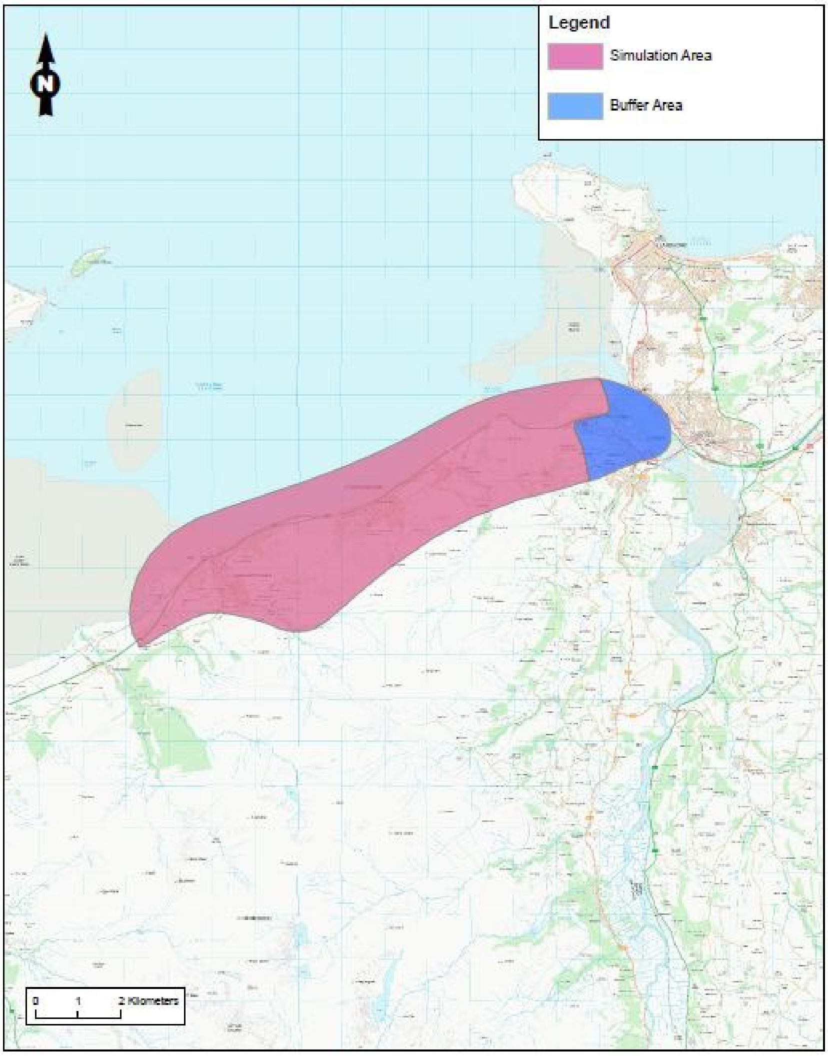

Figure 2.1: Study Area

2.3.3 The majority of the SATURN model comprises a simulation network, composed of detailed geometric parameters for links and junctions, enabling network delays to be fully assessed.

2.4 Base Year

2.4.1 The A55 Traffic Model (A55TM) has been calibrated and validated to a base year of 2016.

2.5 Model Time Periods

2.5.1 In accordance with WebTAG Unit M3.1 'Modelling', the model assesses the AM and PM peak periods and an average inter-peak hour. The peak periods are modelled as a single peak hour and are as follows:

- AM peak hour – 08:00 to 09:00
- PM peak hour – 17:00 to 18:00
- Inter-peak hour – 1-hour average between 10:00 to 16:00

2.5.2 These peak hours have been determined from assessment of the observed two-week ATC count data recorded across the study network and detailed within the Traffic and Accident Data Report (TADR) (Ref: A55J15J16-RAM-60-XX-RP-T-0001).

2.5.3 Within the data, it was observed that the peak period in the morning was between 07:00 and 10:00 and the actual peak hour was 08:00 to 09:00. In the evening, the peak period was 16:00 to 19:00, within which the peak hour was determined as 17:00 to 18:00. For the inter peak period, the data showed that inter peak conditions prevailed between 10:00 and 16:00. The modelled inter peak hour was taken as an average of the 6 hours in the inter peak period.

2.5.4 Table 2.2 below presents the total volumes at the 5 ATCs across the recorded two-week, 5-day ATC count period. These totals confirm the AM peak is 08:00 to 09:00 and that the PM peak is 17:00 to 18:00.

10 Day Total	ATC 1	ATC 2	ATC 3	ATC 4	ATC 5	Total
07:00-08:00	2193	723	1472	2598	373	7359
08:00-09:00	**4405**	**1097**	**2671**	**3829**	**768**	**12770**
09:00-10:00	3216	946	2282	3305	634	10383
16:00-17:00	4084	943	3095	3805	1124	13051
17:00-18:00	**4107**	**780**	**3007**	**4041**	**1360**	**13295**
18:00-19:00	2615	648	2500	3167	924	9854

Table 2.2: ATC Total Volumes (10 Day Total)

2.6 Modelled User Classes

2.6.1 Traffic demand in the model is segmented at a 5-user class level:

- Class 1 – Car – Employers Business (or Car Work)
- Class 2 - Car – Commute
- Class 3 – Car – Other
- Class 4 - Light Goods Vehicles (LGVs)
- Class 5 – Other Goods Vehicles (OGVs) / Heavy Goods Vehicles (HGVs)

2.6.2 The rationale for splitting the demand in this fashion is that the user classes have quite different values of time and/or vehicle operating costs. The values affect their choice of routes in the highway model, their response to changes in costs in the demand model, and also the economic evaluation of time savings in the cost benefits analysis.

2.6.3 All demand matrices for the traffic assignment are in origin-destination (OD) format. An OD matrix stores trips according to the actual origin and destination zones of a trip and this information is needed so that the trips can be assigned onto the road network.

2.6.4 Demand in the SATURN traffic assignment is expressed in terms of Passenger Car Units (PCU). For the purposes of assignment in SATURN, the heavy vehicle matrices were factored by 2.4 to represent equivalent PCU values. The PCU factor for HGVs has been calculated using local classified count data and is consistent with guidance given in WebTAG, being between the values of 2.0 and 2.5 suggested for 'Rigid' and 'Articulated' HGVs in WebTAG unit M3.1.

2.6.5 The factors used to convert from vehicles to PCUs are presented in Table 2.3 below.

User Class	Vehicle Type	PCU Factor
1	Cars	1.0
2	Light Goods Vehicles (LGV's)	1.0
3	Heavy Goods Vehicles (HGV's)	2.4

Table 2.3: Modelled User Classes in Traffic Assignment

2.7 Trip Matrices

2.7.1 Study trip matrices for Cars (Work, Commute and Other), LGV's and HGV's in the AM Peak, Inter Peak and PM Peak hours have been constructed from observed manual counts. The internal study area was divided into three distinct areas and cordon matrices derived from the count data for each. The three areas were Llanfairfechan, Penmaenmawr and an A55 cordon.

2.7.2 The trip ends within these cordons were constrained by manual turning count data and controls on the internal movements were obtained through the turning count data. The whole prior matrix was furnessed to produce a balanced cordon matrix for each area.

2.7.3 The individual cordon matrices were then added together to produce a prior study matrix for the scheme. These matrices were then assigned to the network and modelled link flows compared to the observed link flows to determine whether matrix estimation would be required to fill in any gaps in the data. In the event a very good match was obtained between the modelled prior matrix and the observed flows, matrix estimation techniques were not considered to be required.

2.7.4 This process is described in more detail in Chapter 5.

2.8 Assignment Method

2.8.1 The assignment process is critical to the validation of any traffic model as it predicts the routes that drivers choose based on levels of traffic demand and available road capacity. The assignment technique used for the A55TM is the Wardrop equilibrium assignment for multiple user classes. The principle of this assignment is that traffic arranges itself on the network such that the cost of travel on all routes used between each origin and destination is equal to the minimum cost of travel and all unused routes have equal or greater cost.

2.9 Generalised Costs

2.9.1 The Generalised Cost calculation is based on the following cost formula found within WebTAG Unit M3.1, Section 2.8.

Cost = (PPM x Time (in mins)) + (PPK x Distance (in km))

Where:

- PPM = Pence per minute
- PPK = Pence per kilometre

2.9.2 Values of the PPM and PPK parameters were derived from the method set out in WebTAG Unit A1.3 and incorporated values from the latest WebTAG Data Book May 2019. The values of PPM were taken from WebTAG Data Book Table A1.3.6 for all purposes except Car Work which was calculated from a combination of Table A1.3.2 (Value of Time per Person) and Table A1.3.3 (Car Occupancies). Values of PPK were calculated from Table A1.3.12 (fuel costs - work), Table A1.3.13 (fuel costs non-work) and Table A1.3.14 (non-fuel costs). These parameters are discussed in Chapter 6.

2.10 Calibration, Validation & Realism Testing

2.10.1 The SATURN highway assignment model has been calibrated and validated according to the latest WebTAG guidance. This includes link count validation using WebTAG criteria and the calculation of GEH values. Network journey times have been validated against observed journey times and delays within the study area.

2.10.2 Vehicle routeing through the modelled network has been subject to sense testing to ensure that realistic journeys are taking place in the model. The detail of these processes is discussed in chapters 6 and 7.

2.11 Assignment Convergence

2.11.1 Guidance on the degree of model convergence for a User Equilibrium Assignment, outlined in WebTAG Unit M3.1, Section 3.3.5, states the main measure of the convergence of a traffic assignment is the Delta statistic, or %GAP. This is the difference between the costs along chosen routes and those along the minimum cost routes, expressed as a percentage of the minimum costs. WebTAG recommends a guideline target for the %GAP value of 0.1% or less.

2.11.2 Additionally, the guidance suggests that there should be four consecutive assignment iterations where more than 98% of modelled flows change by less than 1%.

2.11.3 These convergence criteria have been adopted for the A55 Study and the convergence criteria can be seen in Chapter 6.

3. SUMMARY OF DATA

3.1.1 This chapter provides a summary of the data collected and a description of the existing sources of data that were used to develop the A55TM.

3.1.2 The main source of data for trips made in the study area has been derived from RSI data and census output area data. This source of data was further supplemented by existing sources of data described below and survey data outlined in the TADR and collected in 2016.

3.2 Data Sources

3.2.1 In order to facilitate the development of a fully validated base model, a detailed data collection programme was undertaken and is reported in more detail in the TADR.

3.2.2 The principal sources of data used in the development of the A55TM consist of:

- Roadside Interviews (RSIs)
- Automatic Number Plate Recognition (ANPR) Surveys
- Manual Classified Turning Counts (MCCs)
- Automatic Traffic Counts (ATCs)
- Link Count Data
- Journey Time Surveys
- Signal Junction Data
- Trafficmaster Journey Time Data

3.3 Summary of Existing Data

3.3.1 Local Authority Data – Signal Junction Data

3.3.1.1 Conwy County Borough Council (CCBC), as the local authority, was contacted to ascertain signal data for the only traffic signal junction and two pedestrian crossings located in the A55TM study area.

3.3.1.2 The Aber Road / Penmaenmawr Road / Village Road / Station Road signal junction in the village of Llanfairfechan is the only signalised junction within the A55TM. The signal data which includes the phase green, inter-green and cycle time is summarised in Table 3.1. These signal timings are the same details for all 3 peak periods (AM, Inter and PM peaks) and have been used to code the model network.

Stages	Phase Descriptions	Green Time
Stage 1	Aber Road & Penmaenmawr Rd Phases	20
	Inter-green	7
Stage 2	Village Road & Station Road Phases	10
	Inter-green	7
Stage 3	Pedestrian Phase	7
	Inter-green	9
Total Cycle Time		**61**

Table 3.1: Signal Data – Aber Road / Penmaenmawr Road / Village Road / Station Road Junction (AM / Inter / PM Peak)

3.3.1.3 Signal timing data was obtained for the two pedestrian crossings in Penmaenmawr, along with counts of pedestrian use. Average values from this data were used to determine coding details for these signals in the SATURN model.

3.4 Summary of Data Collection

3.4.1 Automatic Traffic Counts (ATCs)

3.4.1.1 Five temporary ATCs were undertaken on key links within the study area for a minimum of 14 continuous days between 23 April 2016 and 6 May 2016, covering the period when the RSIs were undertaken. The ATCs were split into 15-minute intervals and were classified to be compatible with the MCCs.

3.4.1.2 The summarised continuous ATC data was used to calculate average weekday factors for the 3 modelled time periods (AM, Inter and PM peak) for the 5 modelled vehicles classes to apply to the MCC data to convert the MCC data (which was recorded on one day) into average weekday flows.

3.4.1.3 Two separate ATCs to the five counts mentioned above were recorded as part of the RSIs (shown in Table 3.1) in both the interview and non-interview direction. The purpose of this was to record the trip distribution at each RSI site and to factor this distribution to the traffic volume at each site in the given interview direction. This was done for the 3 modelled time periods for the 5 vehicle classifications.

3.4.1.4 To calculate trip distribution in the (reverse) non-interview direction, the interview direction trip distribution was transposed, whereby the trip distribution in the non-interview direction in the PM peak would be the inverse of the trip distribution on the interview direction in the AM peak and likewise for the PM peak interview direction and AM peak non-interview direction. The inverse of the inter peak interview direction trip distribution is the trip distribution for the non-interview direction.

3.4.1.5 Once the trip distribution was calculated from the RSI sites, the trip volumes were factored to the number of vehicles that passed through the RSI in the interview and non-interview direction. Table 3.2 below shows the factors that were calculated to factor the interviewed RSI distribution to the actual observed traffic volume at the two RSI sites in the interview and non-interview direction, for each trip purpose.

3.4.1.6 These factors are combined factors to expand the number of interviews to match the total vehicles counted at each RSI site, by vehicle purpose.

3.4.1.7 For the 3 car trip purposes; Commute, Work and Other, the RSI data was interrogated to determine the proportional split for the three purposes. These proportions were combined with the total car expansion factor to produce an expansion factor for each car purpose to apply to the total cars interviewed. These combined factors are shown in Table 3.2.

3.4.1.8 The factors for applying to the interview data for LGV’s at Site 1 are high for both the interview direction in the evening peak and the non-interview direction in the morning peak period. This is due to the low number of LGV’s, interviewed during the evening, compared to the actual count of vehicles passing. This is therefore reflected in the high factor for the evening period but also, due to transposition of the data, a high factor in the non-interview direction in the morning period.

RSI Factors	AM Peak		Inter Peak		PM Peak	
RSI Distribution to RSI Volume	Interview Direction	Non-Interview Direction	Interview Direction	Non-Interview Direction	Interview Direction	Non-Interview Direction
RSI Site 1						
Car Work	0.611	1.659	0.731	0.759	0.112	0.04
Car Commute	1.333	3.619	1.348	1.401	3.468	1.24
Car Other	0.389	1.056	2.270	2.359	2.013	0.72
LGV	3.800	29.000	5.600	6.467	17.000	1.800
OGV	2.000	2.000	2.167	1.833	2.000	2.000
RSI Site 2						
Car Work	0.116	0.543	0.151	0.146	0.478	0.115
Car Commute	0.785	3.683	0.580	0.563	3.089	0.740
Car Other	0.684	3.207	1.741	1.688	4.273	1.024
LGV	1.667	0.639	3.583	4.250	0.694	0.733
OGV	2.571	1.286	10.143	10.429	0.714	0.429

Table 3.2: RSI Factors (Distribution to Volume)

3.4.2 Roadside Interviews (RSIs)

3.4.2.1 Table 3.3 identifies the two RSIs that were undertaken on Wednesday, 27 April 2016, between 07.00 and 19.00 at Aber Road in Llanfairfechan (interviewing vehicles travelling Eastbound) and at Conway Road in Penmaenmawr (interviewing vehicles travelling Westbound) to collect origin and destination data within the study area.

Site	Location	Survey Direction
RSI 1	Aber Road, Llanfairfechan	Eastbound
RSI 2	Conway Road, Penmaenmawr	Westbound

Table 3.3: RSI Survey Locations

3.4.2.2 The RSI data has been used to construct the observed matrices and provide a reliable source of the origin-destination movements of trips travelling in and around the A55 J15 and J16.

3.4.2.3 Sample rates were monitored at half hourly periods during the survey. An ATC was also placed at each of the RSI sites to cover a two-week period.

3.4.2.4 The ATC data at both sites (as explained above) have been used to calculate factors to be applied to the RSI data to adjust the origin to destination data to a common time base and to validate the traffic flow output by the base year assignment model.

3.4.2.5 The RSI data was used to calibrate the trip distribution calculated by the model with the observed trip distribution recorded by the RSIs. Details of the calibration can be seen in Chapter 7.

3.4.3 Manual Classified Turning Counts (MCCs)

3.4.3.1 22 manual classified turning counts (MCCs) shown in Table 3.4 were undertaken over a 12-hour period (07:00 to 19:00) on a single neutral weekday, Tuesday 26 April 2016, on a different day to when the RSIs were undertaken.

Site	Junction Type	Junction Roads
MCC 1	3 Arm Priority	A55 J14, E/B Exit and Entry
MCC 2	3 Arm Priority	Aber Road A55 Access Road (J14 W/B on and off)
MCC 3	4 Arm Signal	Penmaenmawr Road / Station Road / Village Road
MCC 4	3 Arm Priority	Station Road / Plas Gwyn Road
MCC 5	3 Arm Priority	Caradog Place / Promenade / Car Park Entrance
MCC 6	3 Arm Priority	Penmaenmawr Road / Shore Road East
MCC 7	3 Arm Roundabout	A55 Junction 15
MCC 8	3 Arm Priority	High Street / Chapel Street
MCC 9	3 Arm Priority	Bangor Road / A55 Access Road (J15A E/B off)
MCC 10	4 Arm Priority	Bangor Road / Esplanade / St David's Road
MCC 11	3 Arm Priority	Bangor Road / Celyn Street
MCC 12	4 Arm Priority	Bangor Road / Brynmor Terrace / Pant-Yr-Afon / Fernbrook Road
MCC 13	3 Arm Priority	Pant-Yr-Afon / Ffordd Hen Conwy
MCC 14	3 Arm Priority	Ffordd Hen Conwy / Church Road
MCC15	4 Arm Staggered Priority	Conway Road / Station Road East
MCC 16	3 Arm Roundabout	A55 Junction 16
MCC 17	3 Arm Priority	Ffordd Hen Conwy / Treforris Road
MCC 18	3 Arm Priority	Ysguborwen Road / Gogarth Avenue
MCC 19	4 Arm Priority (split junction)	Ysguborwen Road / Glan-Yr-Afon Road / Old Mill Road
MCC 20	A55 J16A Westbound on and off slips	A55 W/B / A55 J16A
MCC 21	4 Arm Priority	A547 / A55 J17 (E/B slip roads)
MCC 22	4 Arm Priority	A547/A55 J17 (W/B slip roads)

Table 3.4: MCC Survey Locations

3.4.3.2 Vehicles were classified into the following categories:

- Cars (and Taxis)
- Light Goods Vehicles (LGV)
- Other Goods Vehicles 1 (OGV1)
- Other Goods Vehicles 2 (OGV2)
- Public Service Vehicles (PSV)
- Motor Bikes (MC)
- Pedestrians (PC)

3.4.3.3 As described in Section 2.6, the model is calibrated at a 5-user class level and all MCC data has been segmented into the 3 modelled user classes of; Cars, LGVs and HGVs. The car user class has been further split into Car Work, Car Commute and Car Other purposes by factoring according to the relative proportion of these purposes in the RSI data. For the purpose of the modelling; motor bikes and pedestrians have not been included in the model and PSVs have been included within HGVs.

3.4.3.4 All the MCCs presented in Table 3.4 have been used in the model to create and calibrate the model for the 3 peak period prior matrices for 5 modelled user classes.

3.4.3.5 All MCCs have been factored to average weekday flows by applying the average weekday factor calculated from the ATCs. These factored average weekday MCCs were then calibrated against the original MCCs. Details of the calibration results can be found in Chapter 5.

3.4.4 Journey Time Surveys

3.4.4.1 The journey time surveys were used to validate the travel times in the model. On the routes surveyed, several observations were made of travel times during each of the modelled time periods. These times were then compared to the modelled journey times to determine compatibility. Where differences were greater than the DMRB validation criteria, the modelled link capacities were adjusted to better reflect the actual journey times.

3.4.4.2 The Trafficmaster journey time data represented observations of journeys through the modelled area in April, May and June 2016. This dataset contained many more observations of trip movements and journey times than the individual journey time surveys. It has been used to complement the journey time surveys and further validate the journey times along the A55.

3.4.5 Link Count Data

3.4.5.1 The surveyed link count data was used to provide a set of independent observations of link flows. This data was separate to the calibration data used to build the model. The comparison of these observed counts with the modelled flows is detailed in Chapter 7.

4. NETWORK DEVELOPMENT

4.1.1 This chapter summarises the development of the SATURN network.

4.2 SATURN Network Development

4.2.1 The base SATURN network has been developed using site observations, OS Mapping, GIS analysis and traffic information obtained from the local highway authorities.

4.2.2 Within the study area, all significant junctions are fully simulated, and all links are coded to give a representation of their length, speed, capacity and traffic flow classifications. This level of detail reflects the significance of the key links and junctions in route choice decisions through the study network.

4.2.3 Standardised saturation flows, based on COBA derived values, were used for the turning movements at junctions and are presented in Table 4.1. However, as part of the model calibration process, junction turning saturation flows were reviewed and adjusted where required, to better represent the base conditions and junction operations.

Junction Type	Approach Link	Turning Movement	Saturation Flow (PCU/hour/lane)	Marker
Priority / Signals	Major	Left	1000	
		Straight	1380	
		Right	800	X - opposed
	Minor	Left	800	G – Give Way
		Straight	1380	G – Give Way
		Right	800	G – Give Way
Roundabout	Circulating		1500	
	Main carriageway		2100	

Table 4.1: Standardised Saturation Flows

4.3 Modelled Areas

4.3.1 The modelled highway network for this transport model represents the main strategic and local road network links within the fully modelled area and includes major 'A' roads, other 'A' roads, 'B' roads and minor roads. This network is shown on Figure 4.2.

4.3.2 This highway network forms the base network for the SATURN model and is presented in Figures 4.3 to Figure 4.7. Figure 4.3 presents a screen shot of the entire SATURN network and Figures 4.4 to 4.7 present screen shots of the network at a larger scale from west to east showing the network in more detail from Llanfairfechan in the west through to Conwy in the east.

Figure 4.2: Network Plan (OS Mapping)

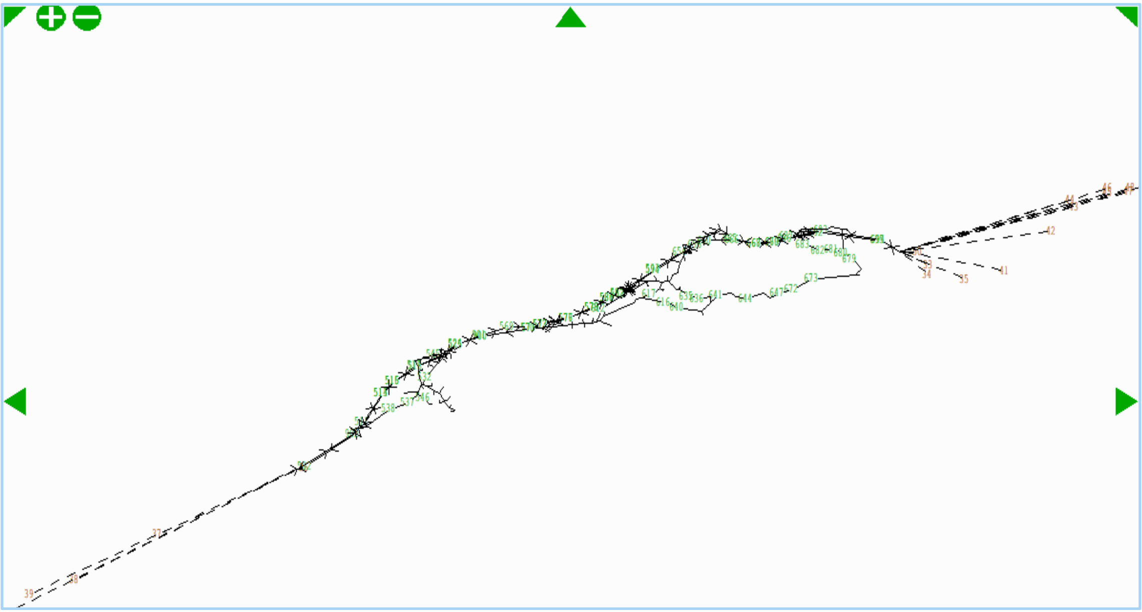

Figure 4.3: SATURN Network Plan

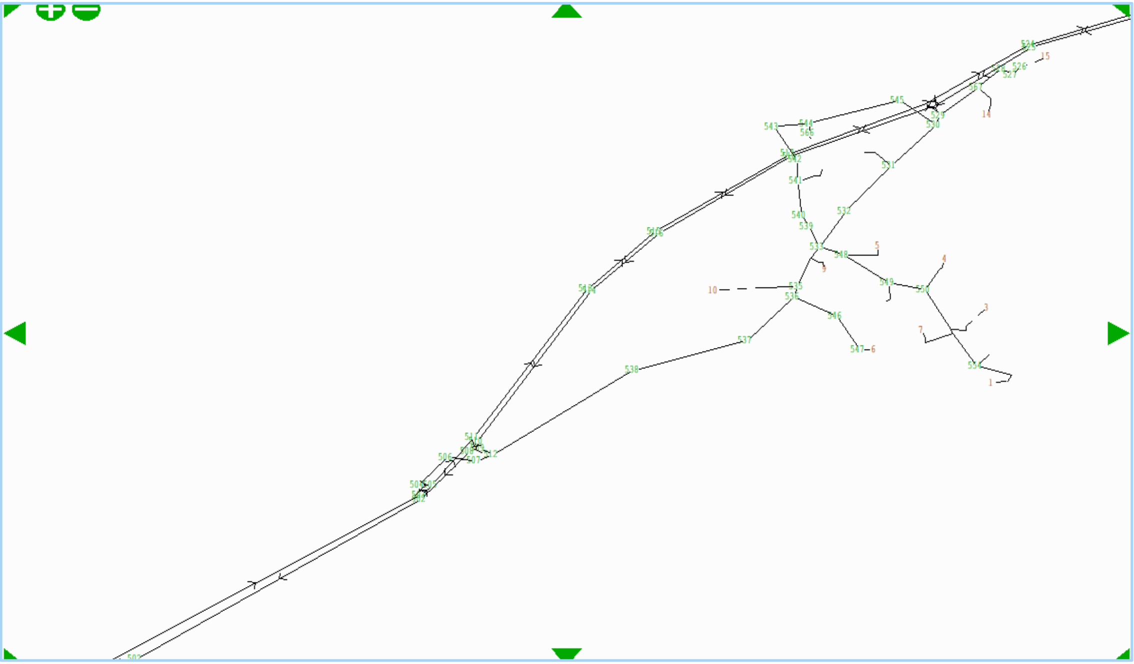

Figure 4.4: SATURN Network Plan (Llanfairfechan)

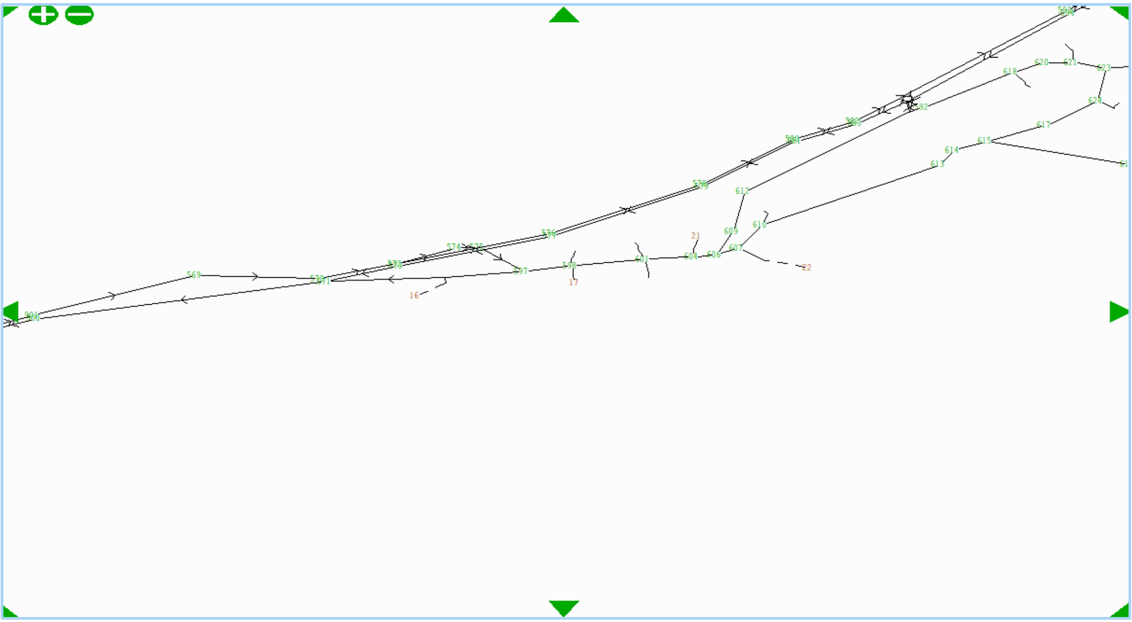

Figure 4.5: SATURN Network Plan (Penmaenmawr West)

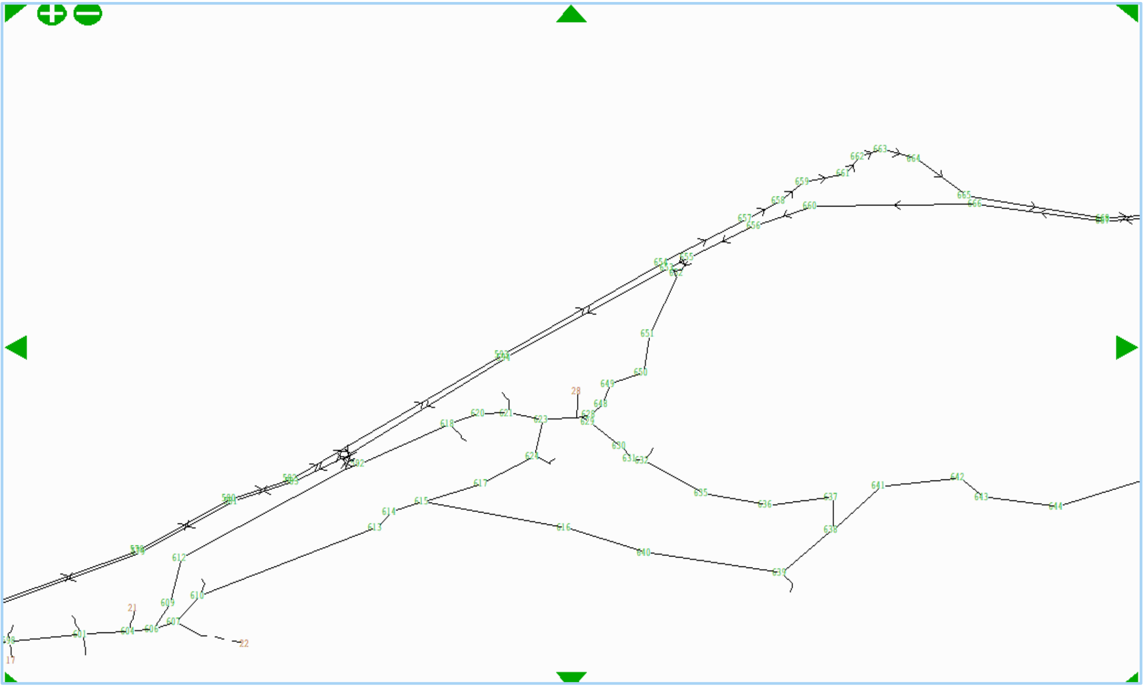

Figure 4.6: SATURN Network Plan (Dwygyfylchi)

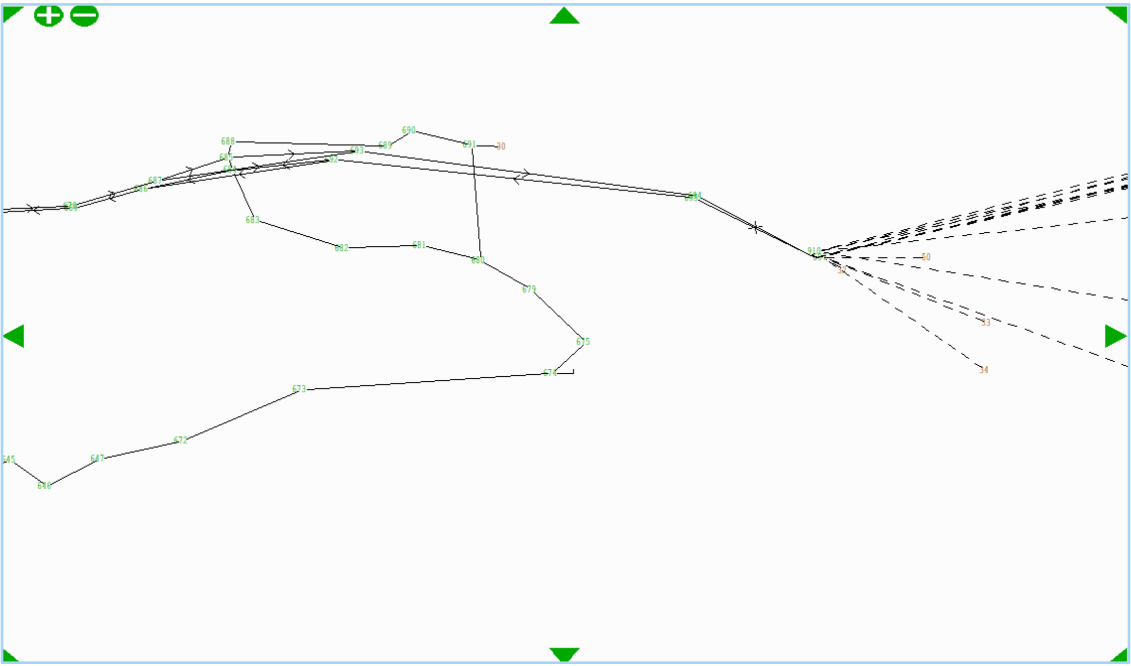

Figure 4.7: SATURN Network Plan (Conwy)

4.4 Network Coding

4.4.1 The network includes a series of links each of which has its own classification based on road type, defined length (measured by OS mapping and GIS) and a speed-flow relationship attributed to its speed flow type. All links required saturation flows and capacities which were taken from standard DfT COBA speed-flow curves. Speed flow curve descriptions used in the model are included in Table 4.8 below.

Speed at Free Flow (KPH)	Speed at Capacity (KPH)	Capacity (PCUs)	Power 'n'	Capacity Index	Description
109	84	6390	3.43	40	D3M
109	84	8520	3.43	41	D4M
104	78	4260	3.73	42	D2M
104	58	2100	4.47	43	D2 slip
98	76	4200	2.60	44	D2 Trunk
98	76	6300	2.60	45	D3 Trunk
98	76	4200	2.60	46	D2 Principal
88	62	1410	1.73	47	S2 Principal
64	35	1410	3.42	48	S2 Principal 40mph
48	25	1630	3.27	49	S2 Suburban 30mph
64	25	1630	3.27	50	S2 Suburban 40mph
80	25	1630	4.22	51	S2 Suburban 50mph
57	30	1380	2.55	52	S2 Outer Urban
34	15	920	1.07	53	S2 Urban Central
88	45	1410	3.85	54	S2 Other
64	45	1410	1.74	55	S2 Other 40mph
64	35	2820	3.42	56	S2 Other 40mph

Table 4.8: Speed Flow Curve Descriptions

4.5 Network Checks

4.5.1 The network files produced by SATURN contain a great deal of information to facilitate the identification of errors during network coding, and these were reviewed as part of the checking process. In addition to this, other checks were carried out, including:

- A review of link lengths, speeds and connectivity
- A review of junction coding, including junction types, capacities and lane allocations
- The checking of the minimum-cost routes through the network for selected traffic movements
- A review of network attributes to identify locations of poor convergence, long delays and high volume/capacity ratios

4.5.2 Following this process, the final base year SATURN networks were considered to accurately represent the physical layouts and operation of the highway network in the study area.

4.6 Zone System

4.6.1 The zone system used within the traffic model comprises:

- A large number of small local zones within the detailed model area
- A small number of moderate–sized zones alongside the detailed model area
- A small number of large "external" zones outside the detailed model area

4.6.2 The zone system adopted by the A55TM model is defined by 50 entry zones which represent all areas of the study area, North Wales, England and Scotland and are based on 2015 Census Output Areas, which provide detailed origin and destination data for Wales and the entire UK. The A55TM's modelled area focusses along the A55 corridor (as shown in Figure 3.6) and local villages between Conway to the east and Bangor to the west.

4.6.3 The final 50 A55TM zones were made up of 31 internal zones situated within the fully modelled area and 19 external zones situated outside the fully modelled area. The internal zones were based on the Census Output Area boundaries and checked to ensure that they represented areas with appropriate connections to the highway network. The zones immediately outside the detailed model area were formed by groups of Census Output Areas. The external zones were based on District boundaries closer to the modelled area and on regional area boundaries further away from the detailed model area.

4.6.4 Table 4.9 presents a list of the final 50 zonal areas for which trips in the base year trip matrix described in Chapter 5 are derived.

Zone No.	Zone Location	Zone Centre (Easting / Northing)	Zone No.	Zone Location	Zone Centre (Easting / Northing)
1	Llanfairfechan	268287.543 / 374206.667	27	Dwygyfylchi	274301.802 / 377828.887
2	Llanfairfechan	269100.823 / 374234.626	28	Dwygyfylchi	273592.609 / 377435.041
3	Llanfairfechan	268786.399 / 374572.175	29	Dwygyfylchi	274758.467 / 376823.302
4	Llanfairfechan	268634.770 / 374666.288	30	Conwy	276450.335 / 378508.100
5	Llanfairfechan	268388.676 / 374831.793	31	Conwy	277864.331 / 377226.019
6	Llanfairfechan	268349.804 / 374300.625	32	Conwy	278022.390 / 381033.325
7	Llanfairfechan	268446.362 / 374460.429	33	Conwy	284110.456 / 379383.454
8	Llanfairfechan	268285.283 / 374529.891	34	Denbighshire	305175.298 / 357881.141
9	Llanfairfechan	268131.093 / 374629.770	35	Conwy	280984.685 / 356468.209
10	Llanfairfechan	268411.686 / 373365.917	36	Bangor East	264245.902 / 368478.917
11	Llanfairfechan	267988.257 / 375108.843	37	Bangor	257412.355 / 370310.276
12	Llanfairfechan	268257.333 / 375241.733	38	Anglesey	241764.346 / 379354.319
13	Llanfairfechan	266976.418 / 375879.884	39	Caernarfon	253761.333 / 354213.353
14	Llanfairfechan	270650.097 / 374024.125	40	South Gwynedd	266415.469 / 327625.275
15	Llanfairfechan	268971.353 / 375697.800	41	Flintshire / Wrexham	329201.600 / 353058.200
16	Penmaenmawr	270654.919 / 375889.967	42	Mid Wales	269994.758 / 251335.168
17	Penmaenmawr	271422.839 / 375896.461	43	South Wales	307595.998 / 195652.112
18	Penmaenmawr	271389.306 / 376327.017	44	Merseyside	338872.572 / 394036.071
19	Penmaenmawr	271831.944 / 376061.440	45	Greater Manchester	381448.423 / 402169.230
20	Penmaenmawr	271760.470 / 376392.339	46	Midlands	432337.915 / 302757.917
21	Penmaenmawr	272030.955 / 376360.993	47	South England	459366.496 / 174213.303
22	Penmaenmawr	272551.491 / 376055.785	48	Northumberland / Yorkshire	434562.093 / 494264.228
23	Penmaenmawr	272835.869 / 374755.074	49	Cumbria / Lancashire	347779.395 / 496173.334
24	Dwygyfylchi	273229.034 / 377624.037	49	Cheshire	365451.056 / 367362.626
25	Dwygyfylchi	273335.640 / 377429.890	50	Scotland	277103.534 / 753540.781
26	Dwygyfylchi	273313.301 / 376848.508			

Table 4.9: A55TM Final Zones

4.6.5 Figures 4.10 to 4.12 present the A55TM zones in the local area along the A55, Figure 4.13 presents the A55TM zones within the North Wales regional area and Figure 4.14 presents the A55TM zones throughout the UK.

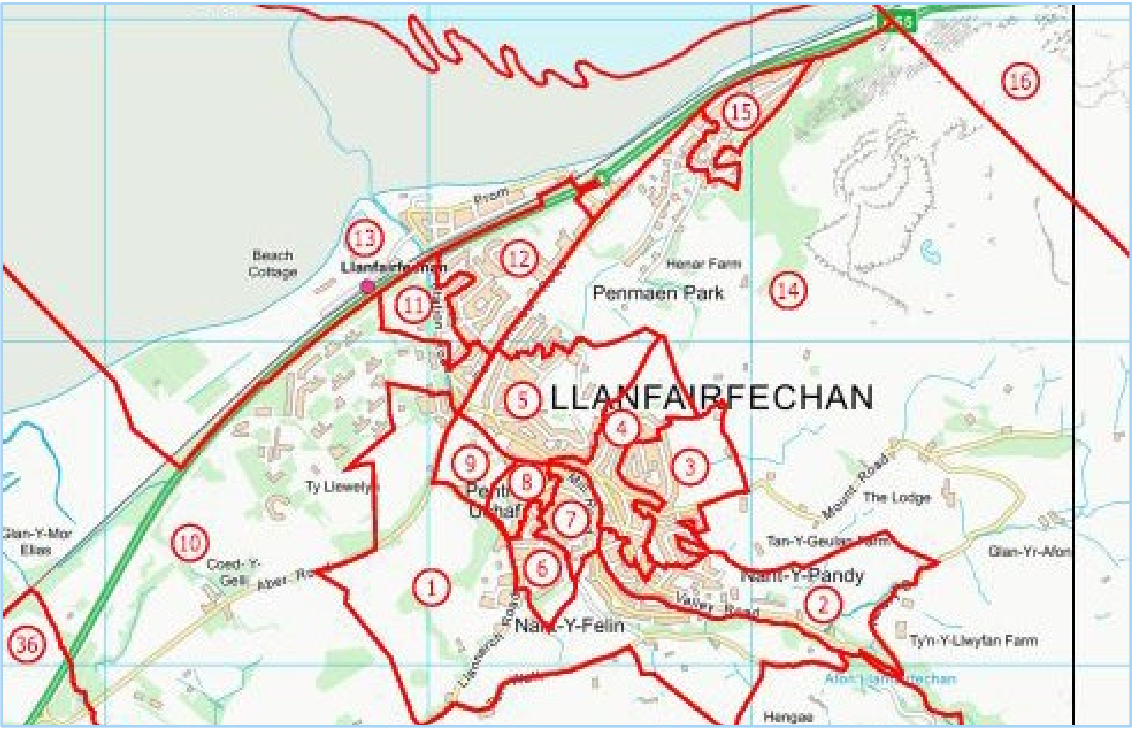

Figure 4.10: A55TM Zone Plan (Local West - Llanfairfechan)

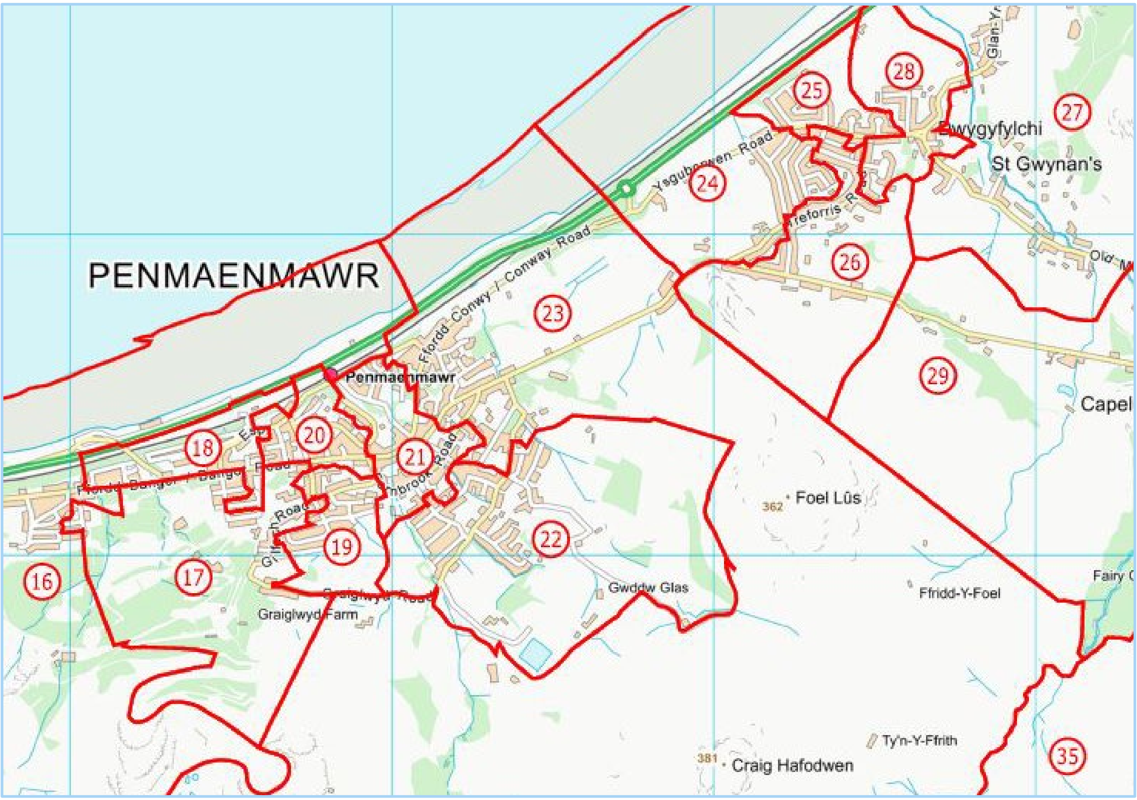

Figure 4.11: A55TM Zone Plan (Local Central - Penmaenmawr)

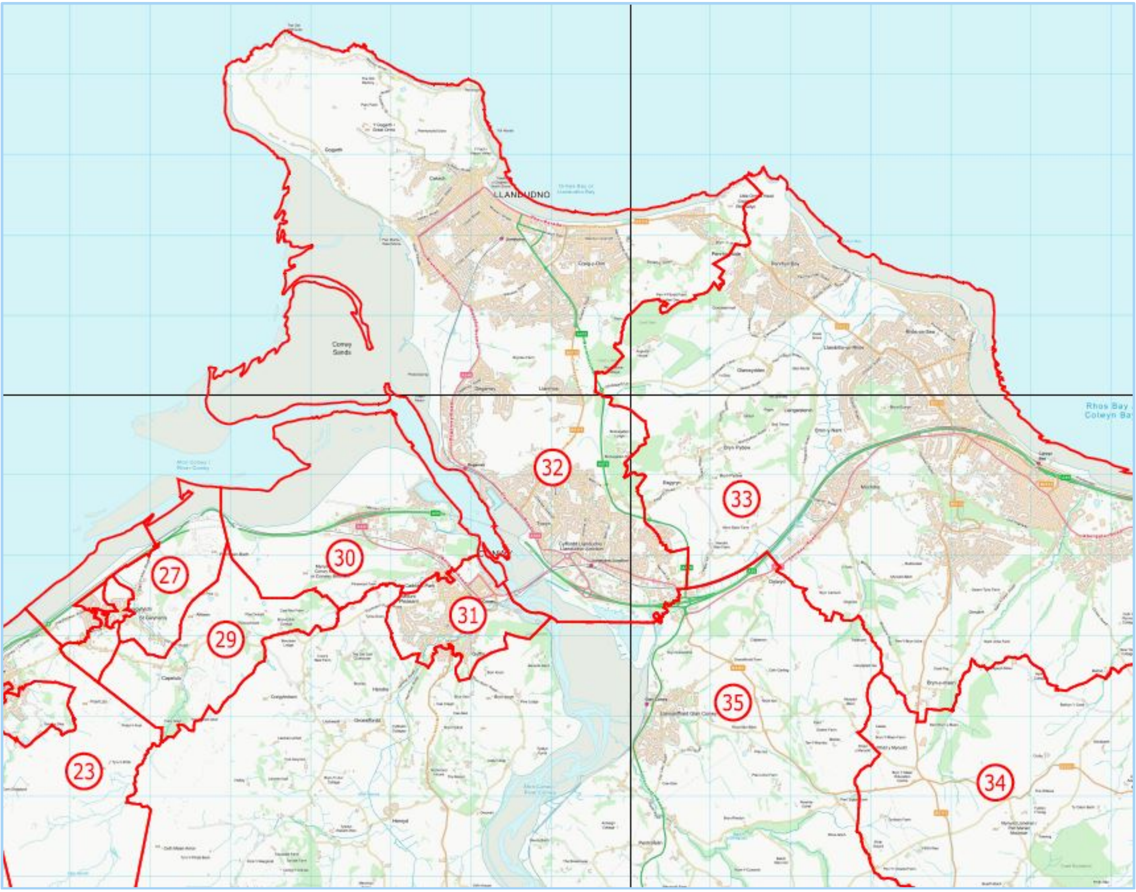

Figure 4.12: A55TM Zone Plan (Local East – Conwy)

Figure 4.13: A55TM Zone Plan (Regional – North Wales)

Figure 4.14: A55TM Zone Plan (UK)

5. TRIP MATRIX DEVELOPMENT

5.1.1 This chapter describes the production of the 2016 base year demand matrices based on the 50-zone system described in chapter 4.

5.2 Approach to Matrix Development

5.2.1 Study trip matrices for Cars (Work, Commute and Other), LGV's and HGV's in the AM, Inter and PM Peak hours have been constructed from observed manual counts presented in Figure 5.1. The count data represents a comprehensive set of 'control' data throughout the study area. The internal study area was divided into three distinct areas and cordon matrices derived from the count data for each. These three areas were Llanfairfechan, Penmaenmawr and a A55 cordon and are shown in Figure 5.2.

5.2.2 The steps taken to build the prior matrices are listed below:

- Build the Llanfairfechan matrix. Constrain the cordon external and internal trip ends to observed MCC and turning counts.
- Create the internal to external cordon trip distribution from observed RSI data.
- Furness the cordon matrix to produce a balanced distribution within the trip matrix.
- Expand the external trip ends to match the observed RSI distribution and produce a 50x50 zonal cordon prior matrix.

- Build the Penmaenmawr matrix. Constrain the cordon external and internal trip ends to observed MCC and turning counts.
- Create the internal to external cordon trip distribution from observed RSI data.
- Furness the cordon matrix to produce a balanced distribution within the trip matrix.
- Expand the external trip ends to match the observed RSI distribution and produce a 50x50 zonal cordon prior matrix.

- Build the A55 corridor matrix. Constrain the cordon external trip ends to observed MCC and turning counts.
- Create the cordon trip distribution from observed ANPR data.
- Furness the cordon matrix to produce a balanced distribution within the trip matrix.
- Expand the external trip ends for A55 West and A55 East trips to match the observed RSI distribution and produce a 50x50 zonal cordon prior matrix.

- Merge the three cordon matrices, ensuring no double counting at the interface between A55 cordon and both the Llanfairfechan and Penmaenmawr cordons.
- The output from this process is a final 50x50 zonal study prior matrix.

5.2.3 The study matrix was then assigned to the network and modelled link flows compared to observed flows to determine whether matrix estimation would be required to fill in any gaps in the data. A very good match was obtained between the modelled prior matrix and the observed flows and matrix estimation was not required.

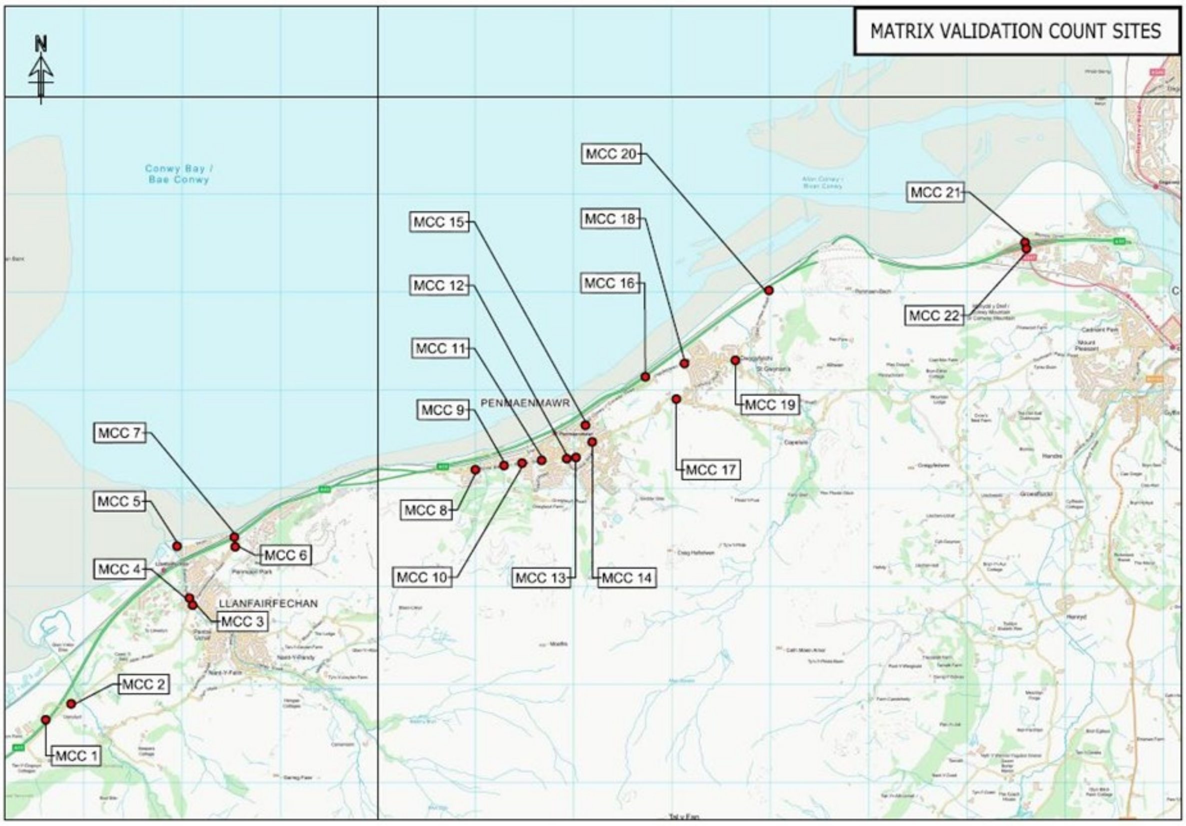

Figure 5.1: Matrix calibration count sites

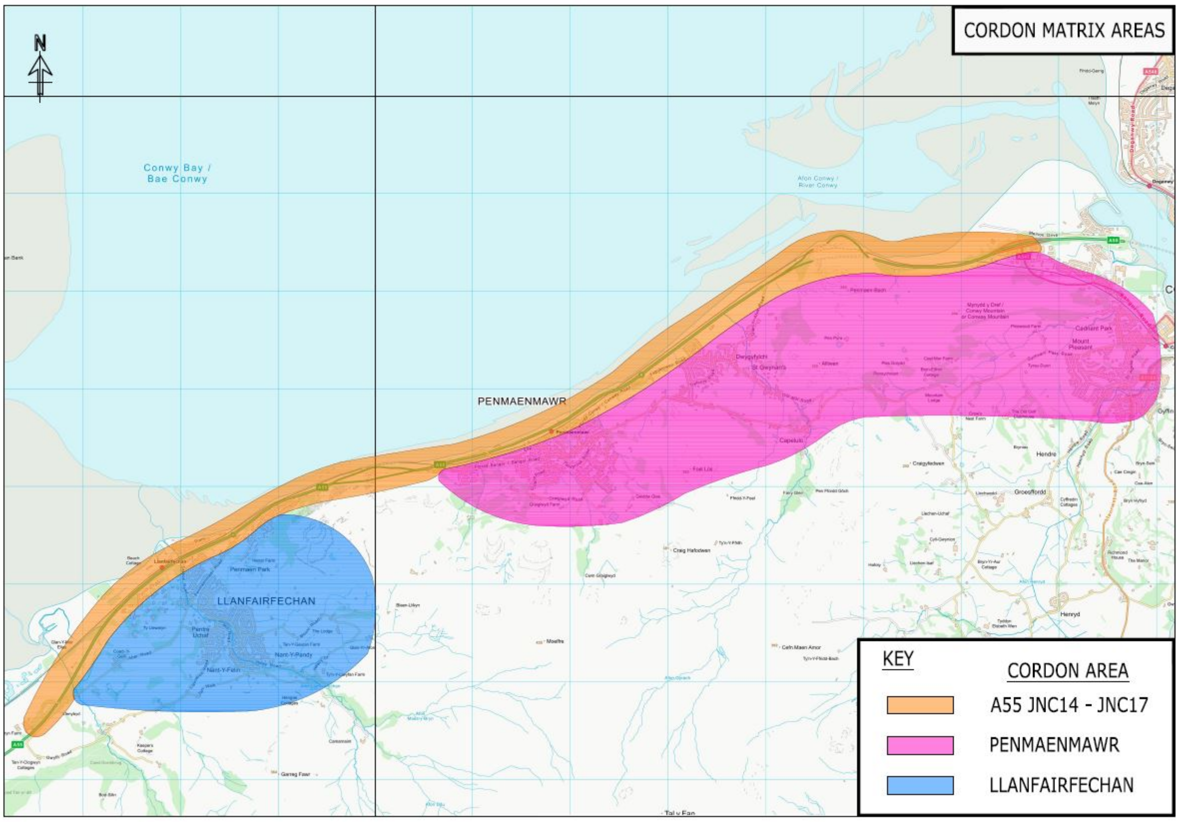

Figure 5.2: Cordon Matrix Areas

5.3 Base Trip Matrices

5.3.1 For summary and display purposes, the final 50x50 base zone study matrices were aggregated into 5x5 sector matrices. The sectors were defined as the main groups of zones within Llanfairfechan, Penmaenmawr, Conwy and external areas to the east and west of the main study area. The 5x5 sectors are described in Table 5.3 and are shown graphically in Figure 5.4.

Sector Matrix Descriptions		
1	Llanfairfechan Sector	Internal Sector
2	Penmaenmawr Sector	Internal Sector
3	Conwy Sector	Internal Sector
4	External East Sector	External Sector
5	External West Sector	External Sector

Table 5.3: 5x5 Sector Matrix Descriptions

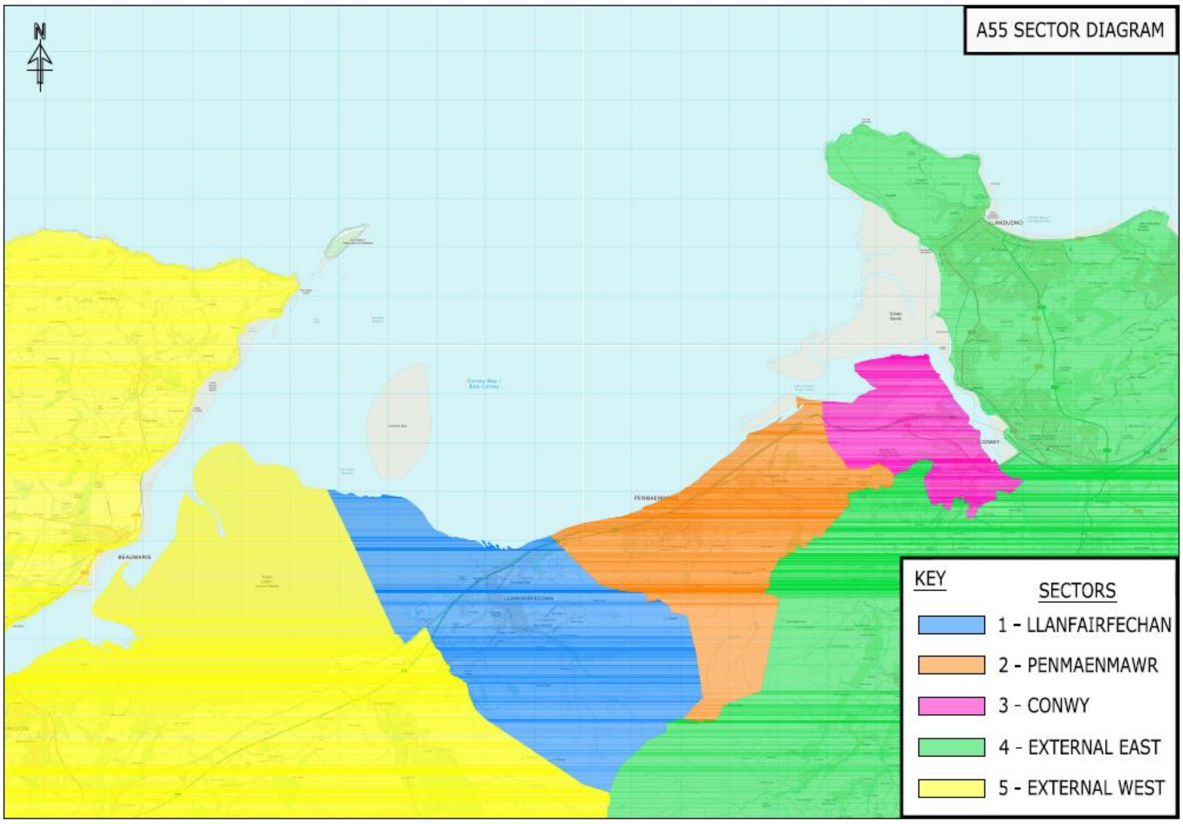

Figure 5.4: 5x5 Sector Matrix Areas

5.3.2 A final set of base sector matrices were developed for the model study area and Tables 5.5 to 5.19 below present these 2016 Base Sector Trip Matrices for the 3 modelled time periods (AM, Inter & PM peaks) for the 5 user classes; Car Work, Car Commute, Car Other, LGVs and HGVs. There are 15 base sector trip matrices in total, with 5 user class matrices per time period measured in Passenger Car Units (PCU).

5.3.3 Along with presenting the individual sector matrix trips, Tables 5.5 to 5.19 present a summary of the inter-sector trips between the three internal sector zones (sector zones 1 to 3) and the two external sector zones (4 to 5). These inter-sector trips have been summarised into the following three categories: trips to/from the three internal zones, trips to/from the internal and external zones and trips to/from the external zones.

A55 Sector Matrix – AM Peak – Car Work (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	5	0	3	26	30	**64**			
2	0	1	1	34	17	**53**	Internal to Internal Trips	17	4%
3	2	1	4	11	23	**41**	Internal to External &		
4	18	13	35	0	98	**164**	External to Internal Trips	244	51%
5	18	7	12	119	0	**156**	External to External Trips	217	45%
Total	**43**	**22**	**55**	**190**	**168**	**478**	**Total**	**478**	**100%**

Table 5.5: A55 Sector Matrix – AM Peak – Car Work

A55 Sector Matrix – AM Peak – Car Commute (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	18	0	10	88	101	**217**			
2	0	2	4	117	58	**181**	Internal to Internal Trips	59	4%
3	8	2	15	38	77	**140**	Internal to External &		
4	60	43	120	0	333	**556**	External to Internal Trips	826	51%
5	60	24	40	404	0	**528**	External to External Trips	737	45%
Total	**146**	**71**	**189**	**647**	**569**	**1622**	**Total**	**1622**	**100%**

Table 5.6: A55 Sector Matrix – AM Peak – Car Commute

A55 Sector Matrix – AM Peak – Car Other (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	11	0	6	53	61	**131**			
2	0	1	3	70	35	**109**	Internal to Internal Trips	36	4%
3	5	1	9	23	46	**84**	Internal to External &		
4	36	26	72	0	199	**333**	External to Internal Trips	496	51%
5	36	14	24	242	0	**316**	External to External Trips	441	45%
Total	**88**	**42**	**114**	**388**	**341**	**973**	**Total**	**973**	**100%**

Table 5.7: A55 Sector Matrix – AM Peak – Car Other

A55 Sector Matrix – AM Peak – LGV (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	6	0	0	18	26	**50**			
2	0	12	6	20	25	**63**	Internal to Internal Trips	37	7%
3	0	4	9	23	18	**54**	Internal to External &		
4	17	24	20	0	186	**247**	External to Internal Trips	233	43%
5	16	7	19	85	0	**127**	External to External Trips	271	50%
Total	**39**	**47**	**54**	**146**	**255**	**541**	**Total**	**541**	**100%**

Table 5.8: A55 Sector Matrix – AM Peak – LGV

A55 Sector Matrix – AM Peak – HGV (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	6	0	0	23	11	**40**			
2	0	2	0	27	21	**50**	Internal to Internal Trips	21	4%
3	0	1	12	36	12	**61**	Internal to External &		
4	15	35	22	0	170	**242**	External to Internal Trips	274	45%
5	13	25	34	141	0	**213**	External to External Trips	311	51%
Total	**34**	**62**	**68**	**257**	**183**	**606**	**Total**	**606**	**100%**

Table 5.9: A55 Sector Matrix – AM Peak – HGV

A55 Sector Matrix – Inter Peak – Car Work (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	3	0	1	12	9	**25**			
2	0	0	1	12	7	**20**	Internal to Internal Trips	9	4%
3	1	0	3	8	11	**23**	Internal to External &		
4	10	12	9	0	46	**77**	External to Internal Trips	110	51%
5	8	4	8	51	0	**71**	External to External Trips	97	45%
Total	**22**	**16**	**22**	**83**	**73**	**216**	**Total**	**216**	**100%**

Table 5.10: A55 Sector Matrix – Inter Peak – Car Work

A55 Sector Matrix – Inter Peak – Car Commute (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	8	0	4	32	24	**68**			
2	0	1	2	32	18	**53**	Internal to Internal Trips	28	4%
3	4	1	8	22	29	**64**	Internal to External &		
4	28	34	25	0	128	**215**	External to Internal Trips	301	51%
5	23	12	22	140	0	**197**	External to External Trips	268	45%
Total	**63**	**48**	**61**	**226**	**199**	**597**	**Total**	**597**	**100%**

Table 5.11: A55 Sector Matrix – Inter Peak – Car Commute

A55 Sector Matrix – Inter Peak – Car Other (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	20	0	10	81	60	**171**			
2	0	3	5	81	46	**135**	Internal to Internal Trips	70	4%
3	9	3	20	57	74	**163**	Internal to External &		
4	72	87	64	0	323	**546**	External to Internal Trips	764	51%
5	57	30	55	354	0	**496**	External to External Trips	677	45%
Total	**158**	**123**	**154**	**573**	**503**	**1511**	**Total**	**1511**	**100%**

Table 5.12: A55 Sector Matrix – Inter Peak – Car Other

A55 Sector Matrix – Inter Peak – LGV (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	3	0	0	19	12	**34**			
2	0	0	0	19	10	**29**	Internal to Internal Trips	12	3%
3	0	0	9	19	14	**42**	Internal to External &		
4	19	17	16	0	93	**145**	External to Internal Trips	190	49%
5	11	8	26	93	0	**138**	External to External Trips	186	48%
Total	**33**	**25**	**51**	**150**	**129**	**388**	**Total**	**388**	**100%**

Table 5.13: A55 Sector Matrix – Inter Peak – LGV

A55 Sector Matrix – Inter Peak – HGV (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	2	0	0	32	17	**51**			
2	0	0	0	23	18	**41**	Internal to Internal Trips	14	2%
3	0	4	8	38	7	**57**	Internal to External &		
4	20	30	19	0	242	**311**	External to Internal Trips	279	34%
5	19	18	38	278	0	**353**	External to External Trips	520	64%
Total	**41**	**52**	**64**	**371**	**284**	**813**	**Total**	**813**	**100%**

Table 5.14: A55 Sector Matrix – Inter Peak – HGV

A55 Sector Matrix – PM Peak – Car Work (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	2	0	0	5	5	**12**			
2	0	0	0	5	4	**9**	Internal to Internal Trips	5	4%
3	1	0	2	6	7	**16**	Internal to External &		
4	6	10	4	0	34	**54**	External to Internal Trips	69	48%
5	7	5	5	33	0	**50**	External to External Trips	67	48%
Total	**16**	**15**	**11**	**49**	**50**	**141**	**Total**	**141**	**100%**

Table 5.15: A55 Sector Matrix – PM Peak – Car Work

A55 Sector Matrix – PM Peak – Car Commute (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	26	0	5	53	57	**141**			
2	0	4	4	53	42	**103**	Internal to Internal Trips	65	4%
3	6	2	18	68	82	**176**	Internal to External &		
4	71	120	41	0	392	**624**	External to Internal Trips	776	48%
5	76	55	58	379	0	**568**	External to External Trips	771	48%
Total	**179**	**181**	**126**	**553**	**573**	**1612**	**Total**	**1612**	**100%**

Table 5.16: A55 Sector Matrix – PM Peak – Car Commute

A55 Sector Matrix – PM Peak – Car Other (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	25	0	5	50	55	**135**			
2	0	4	4	50	40	**98**	Internal to Internal Trips	63	4%
3	6	2	17	64	78	**167**	Internal to External &		
4	68	114	39	0	372	**593**	External to Internal Trips	737	48%
5	72	52	55	360	0	**539**	External to External Trips	732	48%
Total	**171**	**172**	**120**	**524**	**545**	**1532**	**Total**	**1532**	**100%**

Table 5.17: A55 Sector Matrix – PM Peak – Car Other

A55 Sector Matrix – PM Peak – LGV (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	0	0	0	17	17	34			
2	0	6	3	15	12	36	Internal to Internal Trips	20	4%
3	0	3	8	19	12	42	Internal to External &		
4	22	31	14	0	121	188	External to Internal Trips	215	48%
5	18	14	24	91	0	147	External to External Trips	212	48%
Total	**40**	**54**	**49**	**142**	**162**	**447**	**Total**	**447**	**100%**

Table 5.18: A55 Sector Matrix – PM Peak – LGV

A55 Sector Matrix – PM Peak – HGV (PCUs)									
Zone Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Two Way Inter-Sector Trips**	**Trips**	**Trips %**
1	2	0	0	30	10	42			
2	0	1	0	18	18	37	Internal to Internal Trips	4	1%
3	0	0	1	12	4	17	Internal to External &		
4	2	17	1	0	63	83	External to Internal Trips	182	42%
5	18	37	15	189	0	259	External to External Trips	252	57%
Total	**22**	**55**	**17**	**249**	**95**	**438**	**Total**	**438**	**100%**

Table 5.19: A55 Sector Matrix – PM Peak – HGV

Total Inter-Sector Trips	**Total Trips**	**Total Trip %**
Internal to Internal Trips	464	4%
Internal to External & External to Internal Trips	5690	48%
External to External Trips	5760	48%
Total	**11914**	**100%**

Table 5.20: Total Inter-Sector Trips – All Time Periods – All Vehicles

5.3.4 Table 5.20 presents the total inter-sector trips and indicates that 48% of total traffic for all the time periods is through traffic occurring between the two external sectors, a further 48% of total trips occur between the internal and external sectors and the remaining 4% of total trips are local in nature and occur between the three internal sectors. These sector trips reflect the MCC counts derived from the ANPR trip distribution surveys.

Total Sector Trips	Trips	Trip %
Car Work Trips	885	8%
Car Commute Trips	3238	27%
Car Other Trips	4557	38%
LGV Trips	1376	11%
HGV Trips	1857	16%
Total	**11914**	**100%**

Table 5.21: Total Trips by User Class – All Time Periods – All Vehicles

Table 5.21 presents the total trips by user class and identifies that 73% of the total trips are made by car of which 27% are car commute trips, 8% are car work trips and 38% are car other trips. The remaining 11% of total traffic comprises LGV trips and 16% HGV trips. This split is commensurate with the strategic nature of the majority of traffic in the study area.

5.4 Matrix Validation

5.4.1 In order to test the efficacy of the derived study trip matrices and to demonstrate robust trip distribution patterns, comparisons were made between observed trip distributions and modelled trip distributions at the Roadside Interview sites (RSI). Select link matrices were derived for the model at each of the RSI site locations and these were compared to the expanded observed, RSI trip distributions for the 5 user classes for the 3 peak periods. These comparisons are shown in Tables 5.22 to 5.51 below.

5.4.2 RSI Site 1 – AM Peak

AM Peak - Car Work- RSI 1						Modelled	AM Peak - Car Work - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	48	**48**	**1**	0	0	0	0	42	**42**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	2	**2**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	25	0	0	0	0	**25**	**5**	29	0	0	0	0	**29**
Total	**25**	**0**	**0**	**0**	**48**	**73**	**Total**	**29**	**0**	**0**	**0**	**44**	**73**

Table 5.22: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – Car Work – RSI Site 1

AM Peak – Car Commute - RSI 1						Modelled	AM Peak – Car Commute - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	104	**104**	**1**	0	0	0	0	91	**91**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	3	**3**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	55	0	0	0	0	**55**	**5**	63	0	0	0	0	**63**
Total	**55**	**0**	**0**	**0**	**104**	**159**	**Total**	**63**	**0**	**0**	**0**	**94**	**157**

Table 5.23: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – Car Commute – RSI Site 1

AM Peak – Car Other - RSI 1						Modelled	AM Peak - Car Other – RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	30	**30**	**1**	0	0	0	0	27	**27**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	1	**1**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	16	0	0	0	0	**16**	**5**	18	0	0	0	0	**18**
Total	**16**	**0**	**0**	**0**	**30**	**46**	**Total**	**18**	**0**	**0**	**0**	**166**	**46**

Table 5.24: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – Car Other – RSI Site 1

AM Peak - LGV - RSI 1						Modelled	AM Peak - LGV - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	22	**22**	**1**	4	0	0	0	29	**33**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	16	0	0	0	0	**16**	**5**	16	0	0	0	0	**16**
Total	**16**	**0**	**0**	**0**	**22**	**38**	**Total**	**20**	**0**	**0**	**0**	**29**	**49**

Table 5.25: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – LGV – RSI Site 1

AM Peak - HGV - RSI 1						Modelled	AM Peak - HGV - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	7	**7**	**1**	0	0	0	0	5	**5**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	10	0	0	0	0	**10**	**5**	12	0	0	0	0	**12**
Total	**10**	**0**	**0**	**0**	**7**	**17**	**Total**	**12**	**0**	**0**	**0**	**5**	**17**

Table 5.26: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – HGV – RSI Site 1

5.4.3 RSI Site 2 – AM Peak

AM Peak – Car Work - RSI 2						Modelled	AM Peak – Car Work - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	1	0	1	0	**2**
2	0	0	0	13	0	**13**	**2**	1	2	2	9	1	**15**
3	0	0	0	0	0	**0**	**3**	0	1	0	0	0	**1**
4	0	5	0	0	0	**5**	**4**	1	4	0	0	0	**5**
5	0	0	0	0	0	**0**	**5**	0	0	0	0	0	**0**
Total	**0**	**5**	**0**	**13**	**0**	**18**	**Total**	**2**	**8**	**2**	**10**	**1**	**23**

Table 5.27: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – Car Work – RSI Site 2

AM Peak – Car Commute - RSI 2						Modelled	AM Peak - Car Commute - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	4	0	7	0	**11**
2	0	0	1	86	0	**87**	**2**	4	14	10	61	5	**94**
3	0	0	0	0	0	**0**	**3**	0	5	0	0	0	**5**
4	0	33	0	0	0	**33**	**4**	4	24	0	0	0	**28**
5	0	0	0	0	0	**0**	**5**	0	0	0	0	0	**0**
Total	**0**	**33**	**1**	**86**	**0**	**120**	**Total**	**8**	**47**	**10**	**68**	**5**	**138**

Table 5.28: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – Car Commute – RSI Site 2

AM Peak - Car Other - RSI 2						Modelled	AM Peak - Car Other - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	4	0	6	0	**10**
2	0	0	1	75	0	**76**	**2**	4	12	9	53	5	**83**
3	0	0	0	0	0	**0**	**3**	0	5	0	0	0	**5**
4	0	29	0	0	0	**29**	**4**	3	21	0	0	0	**24**
5	0	0	0	0	0	**0**	**5**	0	0	0	0	0	**0**
Total	**0**	**29**	**1**	**75**	**0**	**105**	**Total**	**7**	**42**	**9**	**59**	**5**	**122**

Table 5.29: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – Car Other – RSI Site 2

AM Peak - LGV - RSI 2						Modelled	AM Peak - LGV - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	3	0	13	0	**16**	**2**	0	5	3	16	2	**26**
3	0	0	0	0	0	**0**	**3**	0	8	0	0	0	**8**
4	0	18	0	0	0	**18**	**4**	0	17	0	0	4	**21**
5	0	0	0	0	0	**0**	**5**	0	0	0	2	0	**2**
Total	**0**	**21**	**0**	**13**	**0**	**34**	**Total**	**0**	**30**	**3**	**18**	**6**	**57**

Table 5.30: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – LGV – RSI Site 2

AM Peak - HGV - RSI 2						Modelled	AM Peak - HGV - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	0	0	27	0	**27**	**2**	0	0	0	19	2	**22**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	34	0	0	0	**34**	**4**	0	43	0	0	0	**43**
5	0	0	0	0	0	**0**	**5**	0	7	0	0	0	**7**
Total	**0**	**34**	**0**	**27**	**0**	**61**	**Total**	**0**	**50**	**0**	**19**	**2**	**72**

Table 5.31: Modelled Sector Matrix v Observed Sector Matrix – AM Peak – HGV – RSI Site 2

5.4.4 RSI Site 1 – Inter Peak

Inter Peak - Car Work - RSI 1					Modelled		Inter Peak – Car Work - RSI 1					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	14	**14**	**1**	0	0	0	0	13	**13**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	1	**1**
5	13	0	0	0	0	**13**	**5**	13	0	0	1	1	**15**
Total	**13**	**0**	**0**	**0**	**14**	**27**	**Total**	**13**	**0**	**0**	**1**	**15**	**29**

Table 5.32: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – Car Work – RSI Site 1

Inter Peak - Car Commute - RSI 1					Modelled		Inter Peak - Car Commute - RSI 1					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	26	**26**	**1**	1	0	0	0	24	**25**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	1	**1**
5	24	0	0	0	0	**24**	**5**	23	0	0	1	2	**26**
Total	**24**	**0**	**0**	**0**	**26**	**50**	**Total**	**24**	**0**	**0**	**1**	**27**	**52**

Table 5.33: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – Car Commute – RSI Site 1

Inter Peak – Car Other - RSI 1					Modelled		Inter Peak – Car Other - RSI 1					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	44	**44**	**1**	1	0	0	0	42	**43**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	2	**2**
5	40	0	0	0	0	**40**	**5**	39	0	0	2	3	**44**
Total	**40**	**0**	**0**	**0**	**44**	**84**	**Total**	**40**	**0**	**0**	**2**	**47**	**89**

Table 5.34: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – Car Other – RSI Site 1

Inter Peak - LGV - RSI 1					Modelled		Inter Peak - LGV - RSI 1					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	11	**11**	**1**	0	0	0	0	17	**17**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	10	0	0	0	0	**10**	**5**	12	0	0	0	0	**12**
Total	**10**	**0**	**0**	**0**	**11**	**21**	**Total**	**12**	**0**	**0**	**0**	**17**	**29**

Table 5.35: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – LGV – RSI Site 1

Inter Peak - HGV - RSI 1					Modelled		Inter Peak - HGV - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	17	**17**	**1**	0	0	0	0	14	**14**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	1	**1**
5	14	0	0	0	0	**14**	**5**	14	0	0	1	0	**15**
Total	**14**	**0**	**0**	**0**	**17**	**31**	**Total**	**14**	**0**	**0**	**1**	**15**	**30**

Table 5.36: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – HGV – RSI Site 1

5.4.5 RSI Site 2 – Inter Peak

Inter Peak - Car Work - RSI 2					Modelled		Inter Peak - Car Work - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	0	0	6	0	**6**	**2**	0	2	0	4	5	**11**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	6	0	0	0	**6**	**4**	0	4	0	0	0	**4**
5	0	0	0	0	0	**0**	**5**	0	0	0	0	0	**0**
Total	**0**	**6**	**0**	**6**	**0**	**12**	**Total**	**0**	**6**	**0**	**4**	**5**	**15**

Table 5.37: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – Car Work – RSI Site 2

Inter Peak - Car Commute - RSI 2					Modelled		Inter Peak - Car Commute - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	1	0	0	0	**1**
2	0	0	1	24	0	**25**	**2**	1	7	1	16	1	**26**
3	0	0	0	0	0	**0**	**3**	0	1	0	0	0	**1**
4	0	23	0	0	0	**23**	**4**	0	16	0	0	1	**17**
5	0	0	0	0	0	**0**	**5**	0	5	0	3	0	**8**
Total	**0**	**23**	**1**	**24**	**0**	**48**	**Total**	**1**	**30**	**1**	**19**	**2**	**53**

Table 5.38: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – Car Commute – RSI Site 2

Inter Peak - Car Other - RSI 2					Modelled		Inter Peak - Car Other - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	1	2	0	1	0	**4**
2	0	1	2	73	0	**76**	**2**	2	22	4	47	4	**79**
3	0	1	0	0	0	**1**	**3**	0	4	0	0	0	**4**
4	0	71	0	0	0	**71**	**4**	1	49	0	1	2	**53**
5	0	0	0	0	0	**0**	**5**	0	4	0	2	0	**6**
Total	**0**	**73**	**2**	**73**	**0**	**148**	**Total**	**4**	**81**	**4**	**51**	**6**	**146**

Table 5.39: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – Car Other – RSI Site 2

Inter Peak - LGV - RSI 2					Modelled		Inter Peak - LGV - RSI 2					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	0	0	14	0	**14**	**2**	0	6	2	12	1	**21**
3	0	0	0	0	0	**0**	**3**	0	2	0	0	0	**2**
4	0	10	0	0	0	**10**	**4**	0	11	0	0	1	**12**
5	0	0	0	0	0	**0**	**5**	0	1	0	1	0	**2**
Total	**0**	**10**	**0**	**14**	**0**	**24**	**Total**	**0**	**19**	**2**	**13**	**2**	**36**

Table 5.40: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – LGV – RSI Site 2

Inter Peak - HGV - RSI 2					Modelled		Inter Peak - HGV - RSI 2					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	0	0	15	0	**15**	**2**	0	0	0	19	3	**22**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	17	0	0	0	**17**	**4**	0	18	0	0	0	**18**
5	0	0	0	0	0	**0**	**5**	0	3	0	0	0	**3**
Total	**0**	**17**	**0**	**15**	**0**	**32**	**Total**	**0**	**21**	**0**	**19**	**3**	**43**

Table 5.41: Modelled Sector Matrix v Observed Sector Matrix – Inter Peak – HGV – RSI Site 2

5.4.6 RSI Site 1 – PM Peak

PM Peak - Car Work - RSI 1					Modelled		PM Peak - Car Work - RSI 1					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	2	**2**	**1**	0	0	0	0	2	**2**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	2	0	0	0	0	**2**	**5**	3	0	0	0	0	**3**
Total	**2**	**0**	**0**	**0**	**2**	**4**	**Total**	**3**	**0**	**0**	**0**	**2**	**5**

Table 5.42: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – Car Work – RSI Site 1

PM Peak - Car Commute - RSI 1					Modelled		PM Peak - Car Commute - RSI 1					Observed	
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	65	**65**	**1**	0	0	0	0	60	**60**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	57	0	0	0	0	**57**	**5**	94	4	0	0	0	**98**
Total	**57**	**0**	**0**	**0**	**65**	**122**	**Total**	**94**	**4**	**0**	**0**	**60**	**158**

Table 5.43: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – Car Commute – RSI Site 1

PM Peak - Car Other - RSI 1					Modelled	PM Peak – Car Other - RSI 1					Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	38	**38**	**1**	0	0	0	0	35	**35**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	33	0	0	0	0	**33**	**5**	54	2	0	0	0	**56**
Total	**33**	**0**	**0**	**0**	**38**	**71**	**Total**	**54**	**2**	**0**	**0**	**35**	**91**

Table 5.44: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – Car Other – RSI Site 1

PM Peak - LGV - RSI 1						Modelled	PM Peak - LGV - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	12	**12**	**1**	2	0	0	0	8	**10**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	11	0	0	0	0	**11**	**5**	17	0	0	0	0	**17**
Total	**11**	**0**	**0**	**0**	**12**	**23**	**Total**	**19**	**0**	**0**	**0**	**8**	**27**

Table 5.45: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – LGV – RSI Site 1

PM Peak - HGV - RSI 1						Modelled	PM Peak - HGV - RSI 1						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	10	**10**	**1**	0	0	0	0	10	**10**
2	0	0	0	0	0	**0**	**2**	0	0	0	0	0	**0**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	0	0	0	0	**0**	**4**	0	0	0	0	0	**0**
5	14	0	0	0	0	**14**	**5**	14	0	0	0	0	**14**
Total	**14**	**0**	**0**	**0**	**10**	**24**	**Total**	**14**	**0**	**0**	**0**	**10**	**24**

Table 5.46: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – HGV – RSI Site 1

5.4.7 RSI Site 2 – PM Peak

PM Peak - Car Work - RSI 2						Modelled	PM Peak - Car Work - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	1	0	0	0	**1**
2	0	0	0	5	0	**5**	**2**	1	2	1	3	0	**7**
3	0	0	0	0	0	**0**	**3**	0	1	0	0	0	**1**
4	0	11	0	0	0	**11**	**4**	1	8	0	0	0	**9**
5	0	0	0	0	0	**0**	**5**	0	1	0	0	0	**1**
Total	**0**	**11**	**0**	**5**	**0**	**16**	**Total**	**2**	**13**	**1**	**3**	**0**	**19**

Table 5.47: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – Car Work – RSI Site 2

PM Peak - Car Commute - RSI 2						Modelled	PM Peak - Car Commute - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	4	0	3	0	**7**
2	0	1	1	35	0	**37**	**2**	4	13	5	21	0	**43**
3	0	0	0	0	0	**0**	**3**	0	9	0	0	0	**9**
4	0	69	0	0	0	**69**	**4**	6	53	0	0	0	**59**
5	0	0	0	0	0	**0**	**5**	0	5	0	0	0	**5**
Total	**0**	**70**	**1**	**35**	**0**	**106**	**Total**	**10**	**84**	**5**	**24**	**0**	**123**

Table 5.48: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – Car Commute – RSI Site 2

PM Peak - Car Other - RSI 2						Modelled	PM Peak - Car Other - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	5	0	4	0	**9**
2	0	1	2	48	0	**51**	**2**	5	17	7	29	0	**58**
3	0	1	0	0	0	**1**	**3**	0	13	0	0	0	**13**
4	0	95	0	0	0	**95**	**4**	9	74	0	0	0	**83**
5	0	0	0	0	0	**0**	**5**	0	7	0	0	0	**7**
Total	**0**	**97**	**2**	**48**	**0**	**147**	**Total**	**14**	**116**	**7**	**33**	**0**	**170**

Table 5.49: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – Car Other – RSI Site 2

PM Peak - LGV - RSI 2						Modelled	PM Peak - LGV - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	2	0	13	0	**15**	**2**	0	5	4	8	0	**17**
3	0	0	0	0	0	**0**	**3**	0	3	0	0	0	**3**
4	0	18	0	0	0	**18**	**4**	0	16	0	0	2	**18**
5	0	0	0	0	0	**0**	**5**	0	2	0	2	0	**4**
Total	**0**	**20**	**0**	**13**	**0**	**33**	**Total**	**0**	**26**	**4**	**10**	**2**	**42**

Table 5.50: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – LGV – RSI Site 2

PM Peak - HGV - RSI 2						Modelled	PM Peak - HGV - RSI 2						Observed
Sector	**1**	**2**	**3**	**4**	**5**	**Total**	**Sector**	**1**	**2**	**3**	**4**	**5**	**Total**
1	0	0	0	0	0	**0**	**1**	0	0	0	0	0	**0**
2	0	1	0	12	0	**13**	**2**	0	0	0	14	0	**14**
3	0	0	0	0	0	**0**	**3**	0	0	0	0	0	**0**
4	0	11	0	0	0	**11**	**4**	0	10	0	0	0	**10**
5	0	0	0	0	0	**0**	**5**	0	2	0	0	0	**2**
Total	**0**	**11**	**0**	**12**	**0**	**24**	**Total**	**0**	**12**	**0**	**14**	**0**	**26**

Table 5.51: Modelled Sector Matrix v Observed Sector Matrix – PM Peak – HGV – RSI Site 2

5.4.8 The above tables show that there is a very good fit between the trip distribution patterns of the observed and modelled trip matrices, across all time periods and vehicle types, when comparing observed and modelled data at RSI site 1, in Llanfairfechan. Overall traffic volumes are low at this point and any differences are very minor. There is slightly greater variability between some of the actual trip volumes between sector 5 and sector 1. These are trips from A55 West to Llanfairfechan, using A55 junction 14 to access the town. In the model a slightly greater proportion of these trips travel to junction 15 to access the town compared to observed values. This represents itself as a slight reduction in the modelled flows for this movement in the RSI comparison.

5.4.9 At RSI site 2 there is the potential for some trips to reroute past the RSI site and this is reflected in the fact that a slightly different trip distribution pattern can be seen between the observed trip matrix and the modelled select link matrix. RSI site 2 is situated on Conwy Road, immediately west of A55 junction 16 and just to the south is Conwy Old Road that runs parallel between Penmaenmawr and Dwygyfylchi.

5.4.10 In the model there are slightly more trips between sector 2 and sector 4; and between sector 4 and sector 2. There are fewer trips between sector 2 and sector 2. Intra-sector trips in sector 2 are trips between Penmaenmawr and Dwygyfylchi, some of which, in the model, travel along Conwy Old Road, bypassing the RSI site.

5.4.11 Trips between sector 2 and sector 4 are those travelling between Penmaenmawr and A55 East. In the model there is a greater concentration of these trips using A55 junction 16 and thus passing through the interview site.

5.4.12 In the observed data a small number of trips avoid A55 junction 16 and enter Penmaenmawr from A55 East via junction 16a and travel through Dwygyfylchi and Old Conwy Road. In the reverse direction, a small number of trips travel from Penmaenmawr, back to A55 junction 15a before heading east, thus avoiding the RSI site near junction 16. This difference in trip distribution is reflected in a slight change in vehicle numbers in the comparative trip matrices.

5.4.13 The overall comparison of the observed trips and the modelled trips remains very good for all time periods and vehicle classes. As such, it is symptomatic of the model providing a robust interpretation of the distribution of local trips in the modelled area.

6. TRIP ASSIGNMENT METHODOLOGY

6.1.1 This chapter explains the trip assignment methodology undertaken within the A55TM.

6.1.2 As described in Section 2.6, matrix development has been based on representing the five A55TM vehicle categories; Car Work, Car Commute, Car Other, LGV and HGV. These separate vehicle matrices were input to the assignment process as a stacked, all-vehicle matrix and assigned simultaneously.

6.2 Generalised Costs

6.2.1 The generalised cost of travel is based on a combination of factors that drivers take into account when choosing routes, mainly time and distance. Generalised cost parameters are used in SATURN to represent travellers' value of time, by pence per minute (PPM) and distance, by pence per kilometre (PPK). The Generalised Cost calculation is based on the following cost formula found within WebTAG Unit M3.1, Section 2.8.

Cost = (PPM x Time (in mins)) + (PPK x Distance (in km))

Where:

- PPM = Pence per minute
- PPK = Pence per kilometre

6.2.2 Where a choice of route exists, these values are used to determine which available route has a lower 'cost' to the traveller. If the PPK value is high, low cost routes will be those which minimise distance, conversely if PPM is high, low cost routes will be those that minimise the travel time.

6.2.3 As mentioned, values of the PPM and PPK parameters were derived from the method set out in WebTAG Unit A1.3 and incorporated values from the latest WebTAG Data Book – May 2019. The values are both expressed in 2010 prices and in perceived costs, reflecting the users 'awareness' of indirect taxation. The values of PPM were taken from WebTAG Data Book Table A1.3.6 for all purposes except Car Work which was calculated from a combination of Table A1.3.2 (Value of Time per Person) and Table A1.3.3 (Car Occupancies). Values of PPK were calculated from Table A1.3.12 (fuel costs - work), Table A1.3.13 (fuel costs non-work) and Table A1.3.14 (non-fuel costs). The generalised cost parameters used in the model, determined by both time period and user class are shown in Table 6.1 below.

User Class	AM Peak		Inter Peak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
Car Work	32.08	9.64	31.81	9.64	31.28	9.64
Car Commute	20.27	7.54	20.6	7.54	20.34	7.54
Car Other	13.98	7.54	14.89	7.54	14.64	7.54
LGV's	25.05	10.54	25.05	10.54	25.05	10.54
HGV's	25.81	29.67	25.81	29.67	25.81	29.67

Table 6.1: Generalised Cost Parameter Values

6.3 Assignment Convergence

6.3.1 Convergence of the model is important in providing consistent and robust model results. In particular, there needs to be confidence that any differences reported by the model between a 'Do-Minimum' and a 'Do-Something' scenario are real, rather than relating to differing degrees of model convergence.

6.3.2 Guidance on the degree of model convergence for a User Equilibrium Assignment, outlined in WebTAG Unit M3.1, Section 3.3.5, states the main measure of the convergence of a traffic assignment is the Delta statistic, or %GAP. This is the difference between the costs along chosen routes and those along the minimum cost routes, expressed as a percentage of the minimum costs. WebTAG recommends a guideline target for the %GAP value of 0.1% or less.

6.3.3 Additionally, the guidance suggests that there should be four consecutive assignment iterations where more than 98% of modelled flows change by less than 1%.

6.3.4 Table 6.2 shows the level of convergence achieved by the A55TM for each time period. The results indicate that the model achieves a very good level of convergence for all measures tested and complies with the criteria set out in DMRB.

	AM Peak	Inter Peak	PM Peak
No. of Iterations	13	58	24
%GAP	0%	0.00003%	0%
Flow change <1% (final)	100%	100%	100%
Flow change <1% (final-1)	100%	100%	100%
Flow change <1% (final-2)	100%	99.71%	100%
Flow change <1% (final-3)	100%	99.71%	100%

Table 6.2: A55TM Convergence Statistics

7. MODEL CALIBRATION & VALIDATION

7.1.1 This chapter describes the calibration and validation of the model links and journey times used to build the A55TM.

7.2 Traffic Flow Calibration

7.2.1 The method for checking model calibration and validation is to compare observed flows with modelled flows against WebTAG criteria using DMRB and GEH statistical comparison. These comparisons are presented in terms of percentage or absolute difference in modelled flows and GEH. GEH is a form of chi square test that incorporates both relative and absolute errors. The GEH formula is outlined below:

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

Where:

GEH is the GEH statistic
M is the modelled flow
C is the observed flow

7.2.2 These criteria are described in WebTAG Unit M3.1, Section 3.2.7 and are reproduced in Table 7.1 below.

Link Flow Validation Criteria		
Criteria	**Description of Criteria**	**Acceptability Guideline**
1	Individual flows within 100 vehicles of counts for flows less than 700 vehicles	>85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 vehicles	>85% of cases
	Individual flows within 400 vehicles of counts for flows more than 2,700 vehicles	>85% of cases
2	GEH <5 for individual flows	>85% of cases

Table 7.1: Link Flow Validation Criteria

7.2.3 The counts used for comparison for the model calibration are shown in Figure 7.2. Tables 7.3 to 7.5 show the comparison of the observed traffic flows with the modelled flows for the AM, Inter and PM peaks respectively. Differences are noted and the GEH statistic calculated for each comparison.

7.2.4 Additionally, summary statistics are provided for total vehicles; Cars (Work, Commute and Other), LGV's and HGV's separately for each time period, outlining the 'Goodness of fit' of the modelled data against the WebTAG criteria. The RSI data was used to derive the proportions for each of the three car purposes and these were applied to the observed counts at the calibration and validation sites in order to provide an 'observed' count for this data to compare to the modelled data.

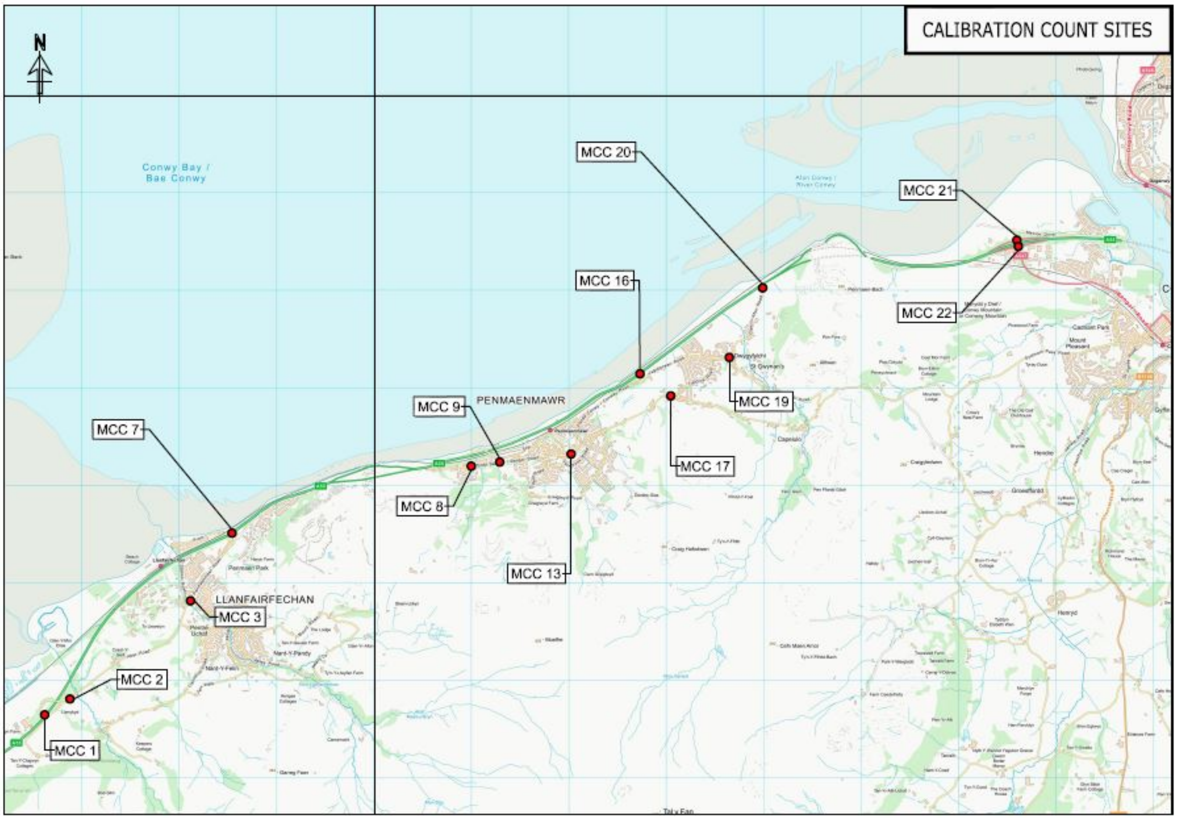

Figure 7.2: Traffic Counts Used in Link Flow Calibration

7.3 AM Peak Link Flow Calibration

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J14 E/B - Off Slip	MCC 1	127	122	2850	-4	-3.71	0.42
A55 J14 E/B - On Slip	MCC 1	4	0	1000	-3	-100	2.83
A55 J14 W/B - Off Slip	MCC 2	4	0	2867	-3	-100	2.83
A55 J14 W/B - On Slip	MCC 2	205	211	1199	6	3.01	0.43
A55 J15a E/B - Off Slip	MCC 9	83	100	2777	17	20.93	1.81
A55 J15a W/B - On Slip	MCC 8	122	124	381	2	1.5	0.16
A55 J16a W/B - Off Slip	MCC 20	50	23	2737	-26	-54.92	4.56
A55 J16a W/B - On Slip	MCC 20	37	0	926	-36	-100	8.6
A55 J17 E/B - Off Slip Left	MCC 21	24	23	691	0	-5.38	0.27
A55 J17 E/B - Off Slip Right	MCC 21	158	98	742	-59	-38.09	5.32
A55 J17 E/B - Merion Drive (N) Left	MCC 21	31	25	989	-5	-19.27	1.13
A55 J17 W/B - Merion Drive (N) Right	MCC 22	15	15	682	0	-2.45	0.1

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J17 W/B - Off Slip Left	MCC 22	158	234	741	76	48.32	5.45
A55 J17 W/B - Off Slip Right	MCC 22	38	36	525	-1	-6.12	0.38
A55 J17 W/B - Bangor Road (S) Left	MCC 22	154	178	922	24	15.5	1.85
A55 J17 E/B - Bangor Road (S) Right	MCC 21	81	108	771	27	33.06	2.76
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Left	MCC 3	20	30	371	10	47.89	1.92
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Straight	MCC 3	82	40	511	-41	-51.61	5.43
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Right	MCC 3	41	55	152	14	33.09	1.96
Aber Rd / Station Rd, Llanfairfechan E/B - Station Road Left	MCC 3	4	0	21	-3	-92.39	2.52
Aber Rd / Station Rd, Llanfairfechan W/B - Station Road Straight	MCC 3	16	3	42	-12	-83.95	4.41
Aber Rd / Station Rd, Llanfairfechan W/B - Station Road Right	MCC 3	30	34	300	4	13.85	0.73
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Left	MCC 3	69	69	369	0	-0.64	0.05
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Straight	MCC 3	103	42	457	-60	-58.78	7.1
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Right	MCC 3	19	0	125	-18	-98.48	6.02
Aber Rd / Station Rd, Llanfairfechan W/B - Village Road Left	MCC 3	143	152	168	9	6.24	0.74
Aber Rd / Station Rd, Llanfairfechan E/B - Village Road Straight	MCC 3	16	6	28	-9	-63.08	3.05
Aber Rd / Station Rd, Llanfairfechan E/B - Village Road Right	MCC 3	137	142	214	5	3.59	0.42
Pant-yr-Afon, Penmaenmawr E/B – Pant-yr-Afon Straight	MCC 13	171	188	863	17	9.97	1.27
Pant-yr-Afon, Penmaenmawr E/B – Pant-yr-Afon Right	MCC 13	56	48	614	-7	-14.15	1.1
Pant-yr-Afon, Penmaenmawr E/B - Conwy Road Left	MCC 13	8	9	918	1	12.02	0.33
Pant-yr-Afon, Penmaenmawr W/B - Conwy Road Straight	MCC 13	111	114	1368	3	2.38	0.25
Pant-yr-Afon, Penmaenmawr W/B - Conwy Old Road Left	MCC 13	36	25	742	-10	-30.26	1.97
Pant-yr-Afon, Penmaenmawr W/B - Conwy Old Road Right	MCC 13	41	30	697	-10	-26.53	1.82

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 between J14/J15 E/B	MCC 7	1174	1220	10000	46	3.94	1.34
A55 between J15/J15a E/B	MCC 7	1393	1426	10000	33	2.35	0.87
A55 between J15a/J16 E/B	MCC 16	1356	1325	10000	-30	-2.26	0.84
A55 between J16/J16a E/B	MCC 16	1675	1588	10000	-86	-5.18	2.15
A55 J15 Minor E/B	MCC 7	256	242	618	-13	-5.31	0.86
A55 J16 Minor E/B	MCC 16	334	304	616	-29	-8.91	1.67
Sychnant Pass E/B	MCC 17/19	42	44	10000	2	3.74	0.24
A55 between J14/J15 W/B	MCC 7	1332	1333	10000	1	0.09	0.03
A55 between J15/J15a W/B	MCC 7	1480	1478	10000	-1	-0.16	0.06
A55 between J15a/J16 W/B	MCC 16	1379	1354	10000	-24	-1.83	0.68
A55 between J16/J16a W/B	MCC 16	1489	1442	10000	-46	-3.16	1.23
A55 between J17/J16a W/B	MCC 20	1503	1464	10000	-38	-2.56	1
A55 J15 Minor W/B	MCC 7	189	181	1270	-7	-4.08	0.57
A55 J16 Minor W/B	MCC 16	125	130	1410	5	3.62	0.4
Sychnant Pass W/B	MCC 17/19	53	7	10000	-45	-87.26	8.46

Table 7.3: AM Peak Link Flow Calibration

7.3.1 AM Peak DMRB & GEH Statistics – Total Vehicles

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW <700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 40 OUT OF 40

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100% - 9 OUT OF 9

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 49 OUT OF 49

ALL LINKS - GEH STATISTIC < 5.0 = 85.71% - 42 OUT OF 49

7.3.2 AM Peak DMRB & GEH Statistics – Car Work

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW <700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 47 OUT OF 47

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 47 OUT OF 47
ALL LINKS - GEH STATISTIC < 5.0 = 100% - 47 OUT OF 47

7.3.3 AM Peak DMRB & GEH Statistics – Car Commute

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW <700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 48 OUT OF 48

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 48 OUT OF 48
ALL LINKS - GEH STATISTIC < 5.0 = 93.75% - 45 OUT OF 48

7.3.4 AM Peak DMRB & GEH Statistics – Car Other

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW <700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 48 OUT OF 48

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 48 OUT OF 48
ALL LINKS - GEH STATISTIC < 5.0 = 97.92% - 47 OUT OF 48

7.3.5 AM Peak DMRB & GEH Statistics – LGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW <700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 46 OUT OF 46

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 46 OUT OF 46

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 46 OUT OF 46

7.3.6 AM Peak DMRB & GEH Statistics – HGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW <700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 38 OUT OF 38

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 38 OUT OF 38

ALL LINKS - GEH STATISTIC < 5.0 = 92.11% - 35 OUT OF 38

7.3.7 AM Peak Summary

7.3.8 The above analysis shows that the AM Peak model calibrates very well against both the DMRB and GEH criteria, for total vehicles and each individual vehicle type. This demonstrates that there is a good degree of fit between the modelled flows and the observed traffic flows.

7.4 Inter-Peak Link Flow Calibration

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J14 E/B - Off Slip	MCC 1	119	101	2928	-17	-15	1.7
A55 J14 E/B - On Slip	MCC 1	8	0	1023	-7	-100	4
A55 J14 W/B - Off Slip	MCC 2	5	0	3126	-4	-100	3.16
A55 J14 W/B - On Slip	MCC 2	114	113	1218	0	-1.3	0.14
A55 J15a E/B - Off Slip	MCC 9	96	88	2866	-7	-7.87	0.79
A55 J15a W/B - On Slip	MCC 8	97	87	953	-9	-9.82	0.99
A55 J16a W/B - Off Slip	MCC 20	68	55	2889	-12	-19.48	1.69
A55 J16a W/B - On Slip	MCC 20	25	0	934	-24	-100	7.07
A55 J17 E/B - Off Slip Left	MCC 21	18	22	674	4	23.72	0.95
A55 J17 E/B - Off Slip Right	MCC 21	123	113	744	-9	-8.23	0.93
A55 J17 E/B - Merion Drive (N) Left	MCC 21	48	44	991	-3	-7.91	0.56
A55 J17 W/B - Merion Drive (N) Right	MCC 22	17	12	686	-4	-30.2	1.35
A55 J17 W/B - Off Slip Left	MCC 22	69	92	732	23	33.9	2.6
A55 J17 W/B - Off Slip Right	MCC 22	38	40	660	2	6.56	0.4
A55 J17 W/B - Bangor Road (S) Left	MCC 22	120	131	927	11	9.44	1.01
A55 J17 E/B - Bangor Road (S) Right	MCC 21	85	101	764	16	18.26	1.61
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Left	MCC 3	30	38	372	8	25.08	1.29
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Straight	MCC 3	72	38	500	-33	-46.93	4.55
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Right	MCC 3	62	63	80	1	2.3	0.18

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
Aber Rd / Station Rd, Llanfairfechan E/B - Station Road Left	MCC 3	13	0	189	-12	-99.62	5.07
Aber Rd / Station Rd, Llanfairfechan W/B - Station Road Straight	MCC 3	26	6	277	-19	-75.61	4.89
Aber Rd / Station Rd, Llanfairfechan W/B - Station Road Right	MCC 3	25	40	326	15	60.31	2.64
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Left	MCC 3	88	104	386	16	18.69	1.68
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Straight	MCC 3	68	19	408	-48	-71.59	7.37
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Right	MCC 3	24	0	80	-23	-99.79	6.91
Aber Rd / Station Rd, Llanfairfechan W/B - Village Road Left	MCC 3	59	65	235	6	10.61	0.79
Aber Rd / Station Rd, Llanfairfechan E/B - Village Road Straight	MCC 3	25	5	240	-19	-79.8	5.15
Aber Rd / Station Rd, Llanfairfechan E/B - Village Road Right	MCC 3	78	88	296	10	12.83	1.1
Pant-yr-Afon, Penmaenmawr E/B – Pant-yr-Afon Straight	MCC 13	136	119	868	-16	-12.71	1.53
Pant-yr-Afon, Penmaenmawr E/B – Pant-yr-Afon Right	MCC 13	32	44	671	12	36.12	1.88
Pant-yr-Afon, Penmaenmawr E/B - Conwy Road Left	MCC 13	10	7	912	-2	-27.5	0.94
Pant-yr-Afon, Penmaenmawr W/B - Conwy Road Straight	MCC 13	144	121	1370	-22	-15.98	2
Pant-yr-Afon, Penmaenmawr W/B - Conwy Old Road Left	MCC 13	34	24	754	-9	-29.83	1.89
Pant-yr-Afon, Penmaenmawr W/B - Conwy Old Road Right	MCC 13	23	17	714	-5	-24.9	1.28
A55 between J14/J15 E/B	MCC 7	1145	1153	10000	8	0.71	0.24
A55 between J15/J15a E/B	MCC 7	1310	1327	10000	17	1.27	0.46
A55 between J15a/J16 E/B	MCC 16	1231	1238	10000	7	0.58	0.2
A55 between J16/J16a E/B	MCC 16	1413	1393	10000	-19	-1.41	0.53
A55 J15 Minor E/B	MCC 7	194	199	694	5	2.41	0.33
A55 J16 Minor E/B	MCC 16	208	190	677	-17	-8.89	1.31
Sychnant Pass E/B	MCC 17/19	47	37	10000	-9	-21.19	1.54
A55 between J14/J15 W/B	MCC 7	1071	1074	10000	3	0.27	0.09

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 between J15/J15a W/B	MCC 7	1214	1229	10000	15	1.22	0.42
A55 between J15a/J16 W/B	MCC 16	1147	1141	10000	-5	-0.49	0.17
A55 between J16/J16a W/B	MCC 16	1287	1250	10000	-36	-2.89	1.04
A55 between J17/J16a W/B	MCC 20	1321	1305	10000	-15	-1.24	0.45
A55 J15 Minor W/B	MCC 7	174	180	1344	6	3.45	0.45
A55 J16 Minor W/B	MCC 16	165	143	1410	-21	-13.26	1.76
Sychnant Pass W/B	MCC 17/19	42	15	10000	-26	-64.46	5.07

Table 7.4: Inter-Peak Link Flow Calibration

7.4.1 Inter-Peak DMRB & GEH Statistics – Total Vehicles

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 40 OUT OF 40

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100.00% - 9 OUT OF 9

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 49 OUT OF 49

ALL LINKS - GEH STATISTIC < 5.0 = 87.76% - 43 OUT OF 49

7.4.2 Inter-Peak DMRB & GEH Statistics – Car Work

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 48 OUT OF 48

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 48 OUT OF 48

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 48 OUT OF 48

7.4.3 Inter-Peak DMRB & GEH Statistics – Car Commute

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 49 OUT OF 49

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 49 OUT OF 49

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 49 OUT OF 49

7.4.4 Inter-Peak DMRB & GEH Statistics – Car Other

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 49 OUT OF 49

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 49 OUT OF 49

ALL LINKS - GEH STATISTIC < 5.0 = 95.92% - 47 OUT OF 49

7.4.5 Inter-Peak DMRB & GEH Statistics – LGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 49 OUT OF 49

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 49 OUT OF 49

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 49 OUT OF 49

7.4.6 Inter-Peak DMRB & GEH Statistics – HGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 47 OUT OF 47

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 47 OUT OF 47

ALL LINKS - GEH STATISTIC < 5.0 = 93.62% - 44 OUT OF 47

7.4.7 Inter-Peak Peak Summary

7.4.8 The above analysis shows that the Inter Peak model calibrates very well against both the DMRB and GEH criteria, for total vehicles and each individual vehicle type. This demonstrates that there is a good degree of fit between the modelled flows and the observed traffic flows.

7.5 PM Peak Link Flow Calibration

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J14 E/B - Off Slip	MCC 1	162	118	2657	-43	-27.01	3.7
A55 J14 E/B - On Slip	MCC 1	10	0	926	-9	-100	4.47
A55 J14 W/B - On Slip	MCC 2	124	136	1182	12	9.77	1.06
A55 J15a E/B - Off Slip	MCC 9	163	133	2682	-29	-18.22	2.44
A55 J15a W/B - On Slip	MCC 8	87	106	876	19	22.12	1.96
A55 J16a W/B - Off Slip	MCC 20	114	89	2583	-24	-22.05	2.5
A55 J16a W/B - On Slip	MCC 20	16	0	891	-15	-100	5.66
A55 J17 E/B - Off Slip Left	MCC 21	17	17	645	0	1.46	0.06
A55 J17 E/B - Off Slip Right	MCC 21	146	141	742	-4	-3.55	0.43
A55 J17 E/B - Merion Drive (N) Left	MCC 21	41	42	989	1	2.64	0.17
A55 J17 W/B - Merion Drive (N) Right	MCC 22	20	15	655	-4	-26.21	1.26
A55 J17 W/B - Off Slip Left	MCC 22	66	62	730	-3	-6.28	0.52
A55 J17 W/B - Off Slip Right	MCC 22	38	36	677	-1	-5.88	0.37
A55 J17 W/B - Bangor Road (S) Left	MCC 22	171	180	907	9	5.18	0.67
A55 J17 E/B - Bangor Road (S) Right	MCC 21	142	129	767	-12	-9.22	1.12
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Left	MCC 3	32	47	370	15	46.38	2.36
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Straight	MCC 3	65	41	487	-23	-36.6	3.26
Aber Rd / Station Rd, Llanfairfechan E/B - Aber Road Right	MCC 3	100	66	80	-33	-33.77	3.7
Aber Rd / Station Rd, Llanfairfechan E/B - Station Road Left	MCC 3	8	0	190	-7	-99.87	3.99
Aber Rd / Station Rd, Llanfairfechan W/B - Station Road Straight	MCC 3	26	5	277	-20	-80.6	5.32
Aber Rd / Station Rd, Llanfairfechan W/B - Station Road Right	MCC 3	20	36	322	16	78.04	2.96
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Left	MCC 3	127	171	387	44	35.01	3.64

Location	Ref.	Count	Model	Capacity	Diff.	% Diff.	GEH
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Straight	MCC 3	67	17	315	-49	-74.06	7.64
Aber Rd / Station Rd, Llanfairfechan W/B - Penmaenmawr Road Right	MCC 3	21	0	80	-20	-100	6.48
Aber Rd / Station Rd, Llanfairfechan W/B - Village Road Left	MCC 3	48	85	251	37	77.72	4.57
Aber Rd / Station Rd, Llanfairfechan E/B - Village Road Straight	MCC 3	34	4	232	-29	-88.14	6.87
Aber Rd / Station Rd, Llanfairfechan E/B - Village Road Right	MCC 3	79	77	281	-1	-3.06	0.27
Pant-yr-Afon, Penmaenmawr E/B – Pant-yr-Afon Straight	MCC 13	135	103	887	-31	-23.49	2.91
Pant-yr-Afon, Penmaenmawr E/B – Pant-yr-Afon Right	MCC 13	33	27	668	-5	-18.53	1.12
Pant-yr-Afon, Penmaenmawr E/B - Conwy Road Left	MCC 13	10	5	854	-4	-54.47	2.02
Pant-yr-Afon, Penmaenmawr W/B - Conwy Road Straight	MCC 13	209	201	1374	-7	-3.8	0.55
Pant-yr-Afon, Penmaenmawr W/B - Conwy Old Road Left	MCC 13	32	25	736	-6	-21.28	1.27
Pant-yr-Afon, Penmaenmawr W/B - Conwy Old Road Right	MCC 13	17	17	701	0	-2.19	0.09
A55 between J14/J15 E/B	MCC 7	1282	1443	10000	161	12.53	4.35
A55 between J15/J15a E/B	MCC 7	1431	1535	10000	104	7.3	2.71
A55 between J15a/J16 E/B	MCC 16	1371	1402	10000	31	2.27	0.84
A55 between J16/J16a E/B	MCC 16	1487	1502	10000	15	0.99	0.38
A55 J15 Minor E/B	MCC 7	185	172	629	-12	-7.08	0.98
A55 J16 Minor E/B	MCC 16	163	155	610	-7	-4.76	0.62
Sychnant Pass E/B	MCC 17/19	65	24	10000	-40	-63.64	6.21
A55 between J14/J15 W/B	MCC 7	1195	1288	10000	93	7.8	2.64
A55 between J15/J15a W/B	MCC 7	1360	1461	10000	101	7.41	2.68
A55 between J15a/J16 W/B	MCC 16	1294	1354	10000	60	4.67	1.66
A55 between J16/J16a W/B	MCC 16	1521	1547	10000	26	1.72	0.67
A55 between J17/J16a W/B	MCC 20	1636	1636	10000	0	0	0
A55 J15 Minor W/B	MCC 7	204	252	1321	48	23.33	3.15
A55 J16 Minor W/B	MCC 16	273	248	1410	-24	-9.04	1.53
Sychnant Pass W/B	MCC 17/19	42	11	10000	-30	-74.62	6.11

Table 7.5: PM Peak Link Flow Calibration

7.5.1 PM Peak DMRB & GEH Statistics – Total Vehicles

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 39 OUT OF 39

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100% - 9 OUT OF 9

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 48 OUT OF 48

ALL LINKS - GEH STATISTIC < 5.0 = 85.42% - 41 OUT OF 48

7.5.2 PM Peak DMRB & GEH Statistics - Car Work

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 44 OUT OF 44

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 44 OUT OF 44

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 44 OUT OF 44

7.5.3 PM Peak DMRB & GEH Statistics – Car Commute

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 48 OUT OF 48

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 48 OUT OF 48

ALL LINKS - GEH STATISTIC < 5.0 = 89.58% - 43 OUT OF 48

7.5.4 PM Peak DMRB & GEH Statistics - Car Other

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 48 OUT OF 48

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 48 OUT OF 48

ALL LINKS - GEH STATISTIC < 5.0 = 97.92% - 47 OUT OF 48

7.5.5 PM Peak DMRB & GEH Statistics – LGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 44 OUT OF 44

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 44 OUT OF 44

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 44 OUT OF 44

7.5.6 PM Peak DMRB & GEH Statistics – HGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 32 OUT OF 32

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 32 OUT OF 32

ALL LINKS - GEH STATISTIC < 5.0 = 96.88% - 31 OUT OF 32

7.5.7 PM Peak Summary

7.5.8 The above analysis shows that the PM Peak model calibrates very well against both the DMRB and GEH criteria, for total vehicles and each individual vehicle type. This demonstrates that there is a good degree of fit between the modelled flows and the observed traffic flows.

7.6 Link Flow Validation

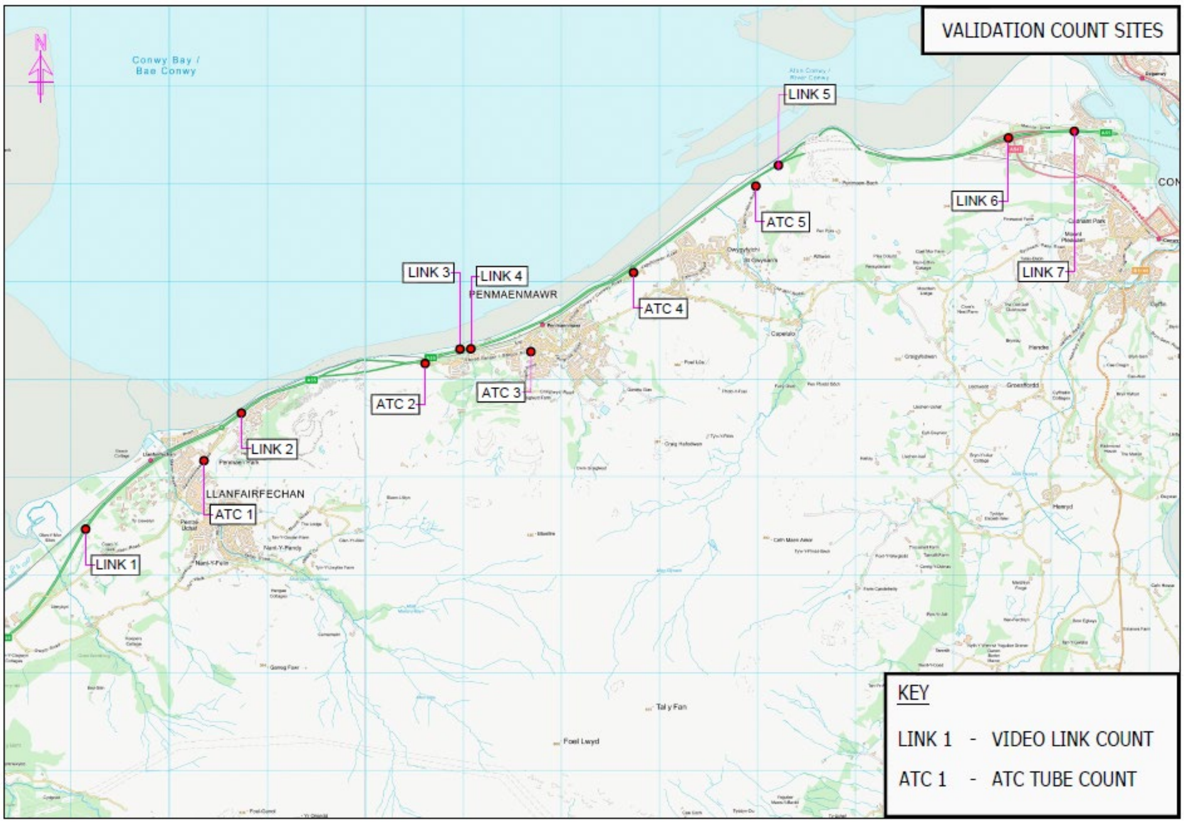

Figure 7.6: Traffic Counts Used in Link Flow Validation

7.7 AM Peak Link Flow Validation

Location	Ref No.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J14-15 E/B	LINK 1	1308	1220	10000	-87	-6.71	2.47
A55 J14-15 W/B	LINK 1	1480	1333	10000	-146	-9.91	3.91
A55 J15-15a E/B	LINK 2	1525	1426	10000	-98	-6.51	2.58
A55 J15-15a W/B	LINK 2	1608	1478	10000	-129	-8.11	3.32
A55 J15a E/B - Off Slip	LINK 3	83	100	10000	17	20.93	1.81
A55 J15a-16 E/B	LINK 4	1412	1325	10000	-86	-6.14	2.34
A55 J15a-16 W/B	LINK 4	1469	1354	10000	-114	-7.84	3.07
A55 16a-J17 E/B	LINK 5	1770	1588	10000	-181	-10.27	4.44
A55 J17-16a W/B	LINK 5	1580	1464	10000	-115	-7.31	2.96
A55 J17 E/B - Mainline	LINK 6	1587	1468	4067	-118	-7.52	3.05
A55 J17 W/B - Mainline	LINK 6	1324	1272	4008	-51	-3.93	1.44
A55 J17-18 E/B	LINK 7	1706	1600	10000	-105	-6.19	2.6
A55 J17-18 W/B	LINK 7	1683	1542	4200	-140	-8.38	3.51

Location	Ref No.	Count	Model	Capacity	Diff.	% Diff.	GEH
ATC 1 Penmaenmawr Road E/B	ATC 1	234	179	1379	-54	-23.49	3.82
ATC 1 Penmaenmawr Road W/B	ATC 1	88	113	1265	25	28.57	2.51
ATC 2 High St W/B	ATC 2	116	124	381	8	6.75	0.71
ATC 3 Bangor Road E/B	ATC 3	152	128	920	-23	-15.69	2.01
ATC 3 Bangor Road W/B	ATC 3	152	120	1459	-31	-21.12	2.75
ATC 4 J16 Minor E/B	ATC 4	245	304	616	59	24.18	3.58
ATC 4 J16 Minor W/B	ATC 4	162	130	1410	-31	-20.04	2.69
ATC 5 Glan yr Afon Road E/B	ATC 5	37	0	1410	-36	-100	8.6
ATC 5 Glan yr Afon Road W/B	ATC 5	44	23	10000	-20	-48.77	3.72

Table 7.7: AM Peak Link Flow Validation

7.7.1 AM Peak DMRB & GEH Statistics – Total Vehicles

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 10 OUT OF 10

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100% - 12 OUT OF 12

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 95.45% - 21 OUT OF 22

7.7.2 AM Peak DMRB & GEH Statistics – Car Work

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.7.3 AM Peak DMRB & GEH Statistics – Car Commute

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 20 OUT OF 20

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100% - 2 OUT OF 2

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 95.45% - 21 OUT OF 22

7.7.4 AM Peak DMRB & GEH Statistics – Car Other

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.7.5 AM Peak DMRB & GEH Statistics – LGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.7.6 AM Peak DMRB & GEH Statistics – HGVs

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 20 OUT OF 20

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 20 OUT OF 20

ALL LINKS - GEH STATISTIC < 5.0 = 95.00% - 19 OUT OF 20

7.7.7 AM Peak Link Count Validation Summary

7.7.8 The above analysis shows that the AM Peak model validates very well against both the DMRB and GEH criteria, for total vehicles and each individual vehicle type. This demonstrates that there is a good degree of fit between the modelled flows and the observed traffic flows.

7.8 Inter Peak Link Flow Validation

Location	Ref No.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J14-15 E/B	LINK 1	1106	1153	10000	47	4.22	1.39
A55 J14-15 W/B	LINK 1	1112	1068	10000	-43	-3.98	1.34
A55 J15-15a E/B	LINK 2	1235	1327	10000	92	7.42	2.56
A55 J15-15a W/B	LINK 2	1238	1229	10000	-8	-0.74	0.26
A55 J15a E/B - Off Slip	LINK 3	70	88	10000	18	26.34	2.07
A55 J15a-16 E/B	LINK 4	1153	1238	10000	85	7.39	2.46
A55 J15a-16 W/B	LINK 4	1179	1141	10000	-37	-3.24	1.12
A55 16a-J17 E/B	LINK 5	1326	1393	10000	67	5.06	1.82
A55 J17-16a W/B	LINK 5	1309	1306	10000	-2	-0.24	0.09
A55 J17 E/B - Mainline	LINK 6	1203	1258	4055	55	4.56	1.57
A55 J17 W/B - Mainline	LINK 6	1223	1161	4055	-61	-5.04	1.78
A55 J17-18 E/B	LINK 7	1346	1403	10000	57	4.21	1.53
A55 J17-18 W/B	LINK 7	1346	1294	4200	-51	-3.84	1.42
ATC 1 Penmaenmawr Road E/B	ATC 1	154	139	1378	-14	-9.51	1.21
ATC 1 Penmaenmawr Road W/B	ATC 1	158	121	1358	-36	-23.24	3.11
ATC 2 High St W/B	ATC 2	76	88	953	12	15.75	1.32
ATC 3 Bangor Road E/B	ATC 3	112	100	920	-11	-10.65	1.16
ATC 3 Bangor Road W/B	ATC 3	139	105	1401	-33	-24.67	3.11
ATC 4 J16 Minor E/B	ATC 4	172	188	676	16	9.13	1.17
ATC 4 J16 Minor W/B	ATC 4	165	143	1410	-21	-13.26	1.76
ATC 5 Glan yr Afon Road E/B	ATC 5	20	0	1410	-19	-100	6.32
ATC 5 Glan yr Afon Road W/B	ATC 5	60	55	10000	-4	-8.74	0.69

Table 7.8: Inter Peak Link Flow Validation

7.8.1 Inter Peak DMRB & GEH Statistics – Total Vehicles

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 10 OUT OF 10

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100% - 12 OUT OF 12

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 95.45% - 21 OUT OF 22

7.8.2 Inter Peak DMRB & GEH Statistics - Car Work

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.8.3 Inter Peak DMRB & GEH Statistics – Car Commute

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.8.4 Inter Peak DMRB & GEH Statistics - Car Other

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.8.5 Inter Peak DMRB & GEH Statistics – LGV's

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.8.6 Inter Peak DMRB & GEH Statistics – HGV's

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 20 OUT OF 20

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 20 OUT OF 20

ALL LINKS - GEH STATISTIC < 5.0 = 85.00% - 17 OUT OF 20

7.8.7 Inter Peak Link Count Validation Summary

7.8.8 The above analysis shows that the Inter Peak model validates very well against both the DMRB and GEH criteria, for total vehicles and each individual vehicle type. This demonstrates that there is a good degree of fit between the modelled flows and the observed traffic flows.

7.9 PM Peak Link Flow Validation

Location	Ref No.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J14-15 E/B	LINK 1	1411	1443	10000	32	2.24	0.84
A55 J14-15 W/B	LINK 1	1372	1288	10000	-83	-6.11	2.3
A55 J15-15a E/B	LINK 2	1558	1535	10000	-22	-1.45	0.57
A55 J15-15a W/B	LINK 2	1558	1461	10000	-96	-6.24	2.5
A55 J15a E/B - Off Slip	LINK 3	120	133	10000	13	11.08	1.18
A55 J15a-16 E/B	LINK 4	1461	1402	10000	-58	-4.03	1.56
A55 J15a-16 W/B	LINK 4	1451	1354	10000	-96	-6.65	2.58
A55 16a-J17 E/B	LINK 5	1586	1502	10000	-83	-5.32	2.15
A55 J17-16a W/B	LINK 5	1662	1636	10000	-25	-1.57	0.64

Location	Ref No.	Count	Model	Capacity	Diff.	% Diff.	GEH
A55 J17 E/B - Mainline	LINK 6	1531	1344	4029	-186	-12.24	4.94
A55 J17 W/B - Mainline	LINK 6	1562	1441	4005	-120	-7.72	3.11
A55 J17-18 E/B	LINK 7	1714	1515	10000	-198	-11.63	4.96
A55 J17-18 W/B	LINK 7	1643	1539	4200	-103	-6.33	2.61
ATC 1 Penmaenmawr Road E/B	ATC 1	183	140	1377	-42	-23.45	3.38
ATC 1 Penmaenmawr Road W/B	ATC 1	226	178	1371	-47	-21.44	3.41
ATC 2 High St W/B	ATC 2	73	106	876	33	45.54	3.51
ATC 3 Bangor Road E/B	ATC 3	136	134	743	-1	-1.82	0.21
ATC 3 Bangor Road W/B	ATC 3	176	126	1386	-49	-28.18	4.03
ATC 4 J16 Minor E/B	ATC 4	145	155	610	10	7.06	0.84
ATC 4 J16 Minor W/B	ATC 4	269	248	1410	-20	-7.69	1.29
ATC 5 Glan yr Afon Road E/B	ATC 5	18	0	1410	-17	-100	6
ATC 5 Glan yr Afon Road W/B	ATC 5	121	89	10000	-31	-26.56	3.14

Table 7.9: PM Peak Link Flow Validation

7.9.1 PM Peak DMRB & GEH Statistics – Total Vehicles

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 10 OUT OF 10

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = 100% - 12 OUT OF 12

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 95.45% - 21 OUT OF 22

7.9.2 PM Peak DMRB & GEH Statistics - Car Work

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.9.3 PM Peak DMRB & GEH Statistics – Car Commute

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.9.4 PM Peak DMRB & GEH Statistics - Car Other

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 95.45% - 21 OUT OF 22

7.9.5 PM Peak DMRB & GEH Statistics – LGV’s

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 22 OUT OF 22

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 22 OUT OF 22

ALL LINKS - GEH STATISTIC < 5.0 = 100% - 22 OUT OF 22

7.9.6 PM Peak DMRB & GEH Statistics – HGV’s

MODELLED v COUNTS SATISFYING THE DMRB RULES: (IN ALL 4 TESTS THE OK % SHOULD BE > 85%)

FLOW < 700: MODELLED WITHIN +-100 OF OBSERVED = 100% - 18 OUT OF 18

700 < FLOW < 2700: MODELLED WITHIN 15% OF OBSERVED = NO SUCH LINKS INCLUDED

FLOW > 2700: MODELLED WITHIN 400 OF OBSERVED = NO SUCH LINKS INCLUDED

COMPLIANCE SUMMED OVER ALL FLOW RANGES = 100% - 18 OUT OF 18

ALL LINKS - GEH STATISTIC < 5.0 = 88.89% - 16 OUT OF 18

7.9.7 PM Peak Link Count Validation Summary

7.9.8 The above analysis shows that the PM Peak model validates very well against both the DMRB and GEH criteria, for total vehicles and each individual vehicle type. This demonstrates that there is a good degree of fit between the modelled flows and the observed traffic flows.

7.10 Journey Time Validation

7.10.1 Journey time data was obtained by journey time surveys undertaken for Welsh Government and described in the TADR. Three routes were surveyed consisting of A55 between junctions 14 and 17; the local route through Llanfairfechan and the local route through Penmaenmawr. The routes surveyed are shown on the plan below.

7.10.2 The journey time validation criteria adopted for the comparison was set as the WebTAG Unit M3.1, Section 3.2.10 criteria which states that modelled journey times should be within 15% of observed journey times for at least 85% of routes, or within 1 minute of the observed times.

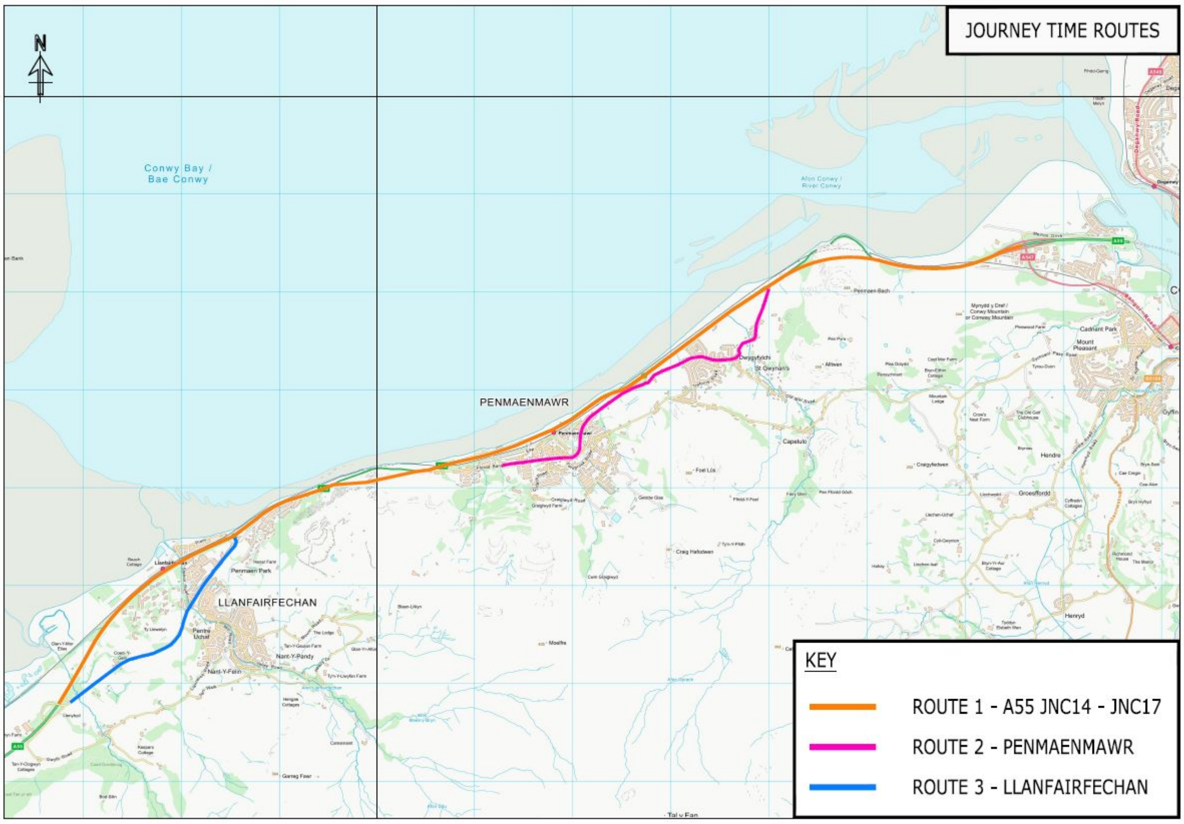

Figure 7.10: Journey Time Validation Routes

7.10.3 The tables below show the journey time validation for the three routes in the local model area.

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
Route 1	EB	8:33	8:25	-0:08	-1.6%	Y
A55	WB	7:35	7:29	-0:06	-1.3%	Y
Route 2	EB	4:26	4:31	0:05	1.9%	Y
Penmaenmawr	WB	3:34	3:47	0:13	6.1%	Y
Route 3	EB	2:25	2:38	0:13	8.9%	Y
Llanfairfechan	WB	2:52	2:41	-0:11	-6.4%	Y

Table 7.11: AM Peak Journey Time Validation

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
Route 1	EB	8:43	8:17	-0:26	-5.9%	Y
A55	WB	7:50	7:21	-0:29	-5%	Y
Route 2	EB	4:29	4:25	-0:04	-1.5%	Y
Penmaenmawr	WB	3:21	3:48	0:27	13.4%	Y
Route 3	EB	2:31	2:37	0:06	4%	Y
Llanfairfechan	WB	2:39	2:40	0:01	0.0%	Y

Table 7.12: Inter Peak Journey Time Validation

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
Route 1	EB	8:35	8:29	-0:06	-1.2%	Y
A55	WB	8:22	7:31	-0:51	-10.1%	Y
Route 2	EB	4:42	4:25	-0:17	-6%	Y
Penmaenmawr	WB	3:30	3:58	0:28	13.3%	Y
Route 3	EB	2:41	2:38	-0:03	-1.9%	Y
Llanfairfechan	WB	2:35	2:45	0:10	6.4%	Y

Table 7.13: PM Peak Journey Time Validation

7.10.4 The journey times for all time periods demonstrate that all modelled journey times are within 85% of the observed journey times and no modelled times are in excess of one-minute difference to the observed times. The model shows a good fit with the observed journey times and all modelled times satisfy the WebTAG criteria.

7.10.5 It is worth noting that Route 2 westbound has a longer journey time in the model than observed for all time periods. The journey times validate but at the higher end of the validation criteria and can be explained due to the fact that there was a low sample rate for this survey data and therefore greater variability in the observed dataset.

7.10.6 The A55 Route 1 modelled journey times were also compared to the Trafficmaster observed data, as shown in Table 7.14, below.

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
A55	EB	8:15	8:25	0:10	2%	Y
AM Peak	WB	7:18	7:29	0:11	2.5%	Y
A55	EB	8:14	8:17	0:03	0.6%	Y
Inter Peak	WB	7:17	7:21	0:04	0.9%	Y
A55	EB	8:10	8:29	0:19	3.9%	Y
PM Peak	WB	7:13	7:31	0:18	4.1%	Y

Table 7.14: A55 Journey Time Validation (Trafficmaster)

7.10.7 This data comparison shows a high degree of compatibility across all time periods. In general, the modelled journey times are marginally greater than the observed data but have a difference of significantly less than 5%. This comparison shows that there is a very good fit between the modelled and observed data and all the WebTAG criteria are exceeded.

7.11 Route Choice Validation

7.11.1 In addition to link flow and journey time validation, WebTAG also requires a model to demonstrate sensible and logical route choice for any particular trip.

7.11.2 In order to test this requirement, a number of discrete origin-destination pairs were chosen to represent all key movements within the modelled area. The route paths between these OD pairs were viewed using the 'Forest' option within SATURN and demonstrated logical routeing patterns through the modelled network. These trip paths are shown in the diagrams below. This exercise confirmed that the model was showing a realistic and logical series of travel patterns through the network.

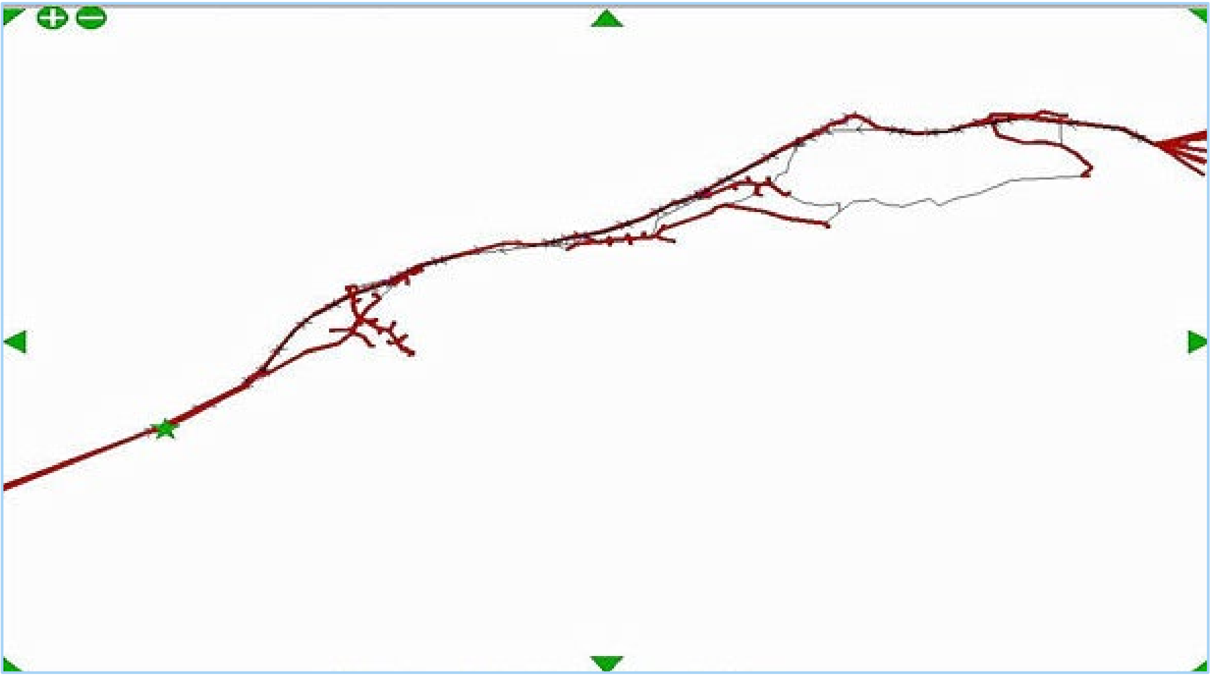

Figure 7.14: Trip Destination Routes for Zone 36, Bangor East

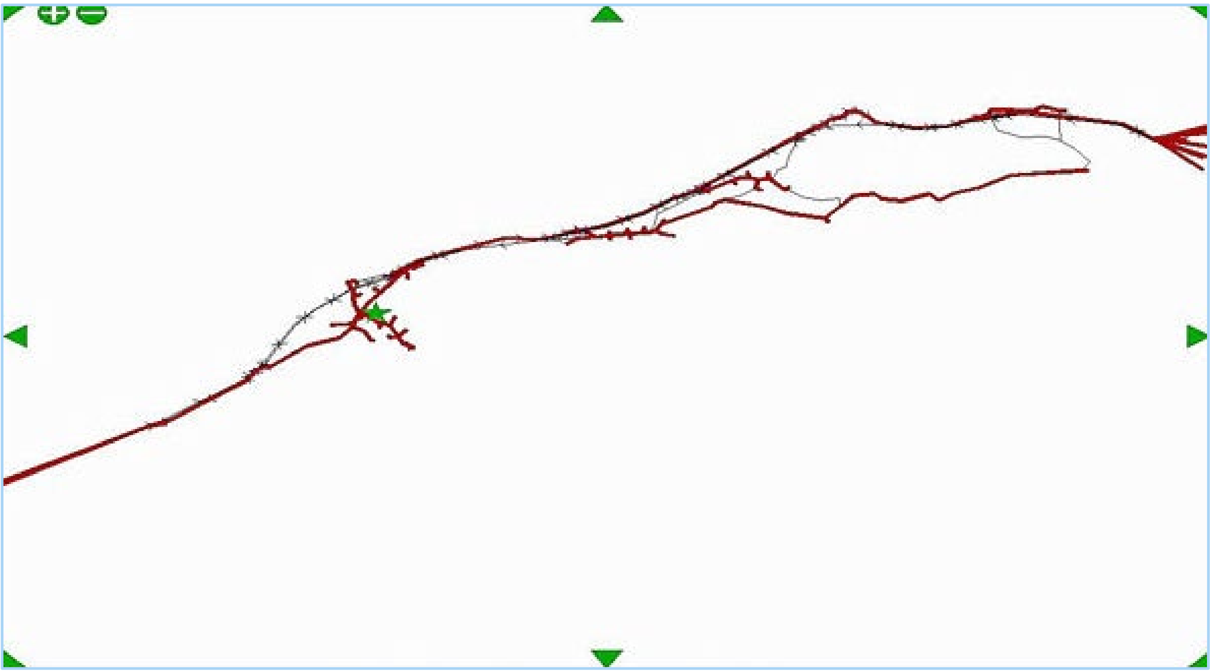

Figure 7.15: Trip Destination Routes for Zone 5, Llanfairfechan

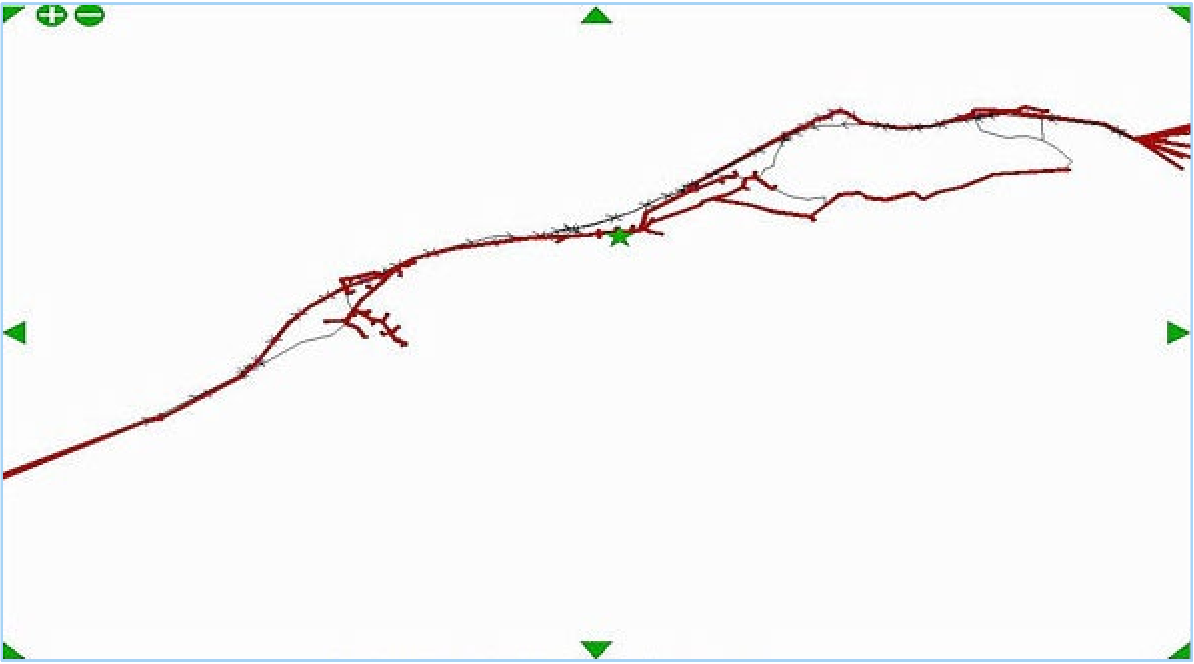

Figure 7.16: Trip Destination Routes for Zone 19, Penmaenmawr

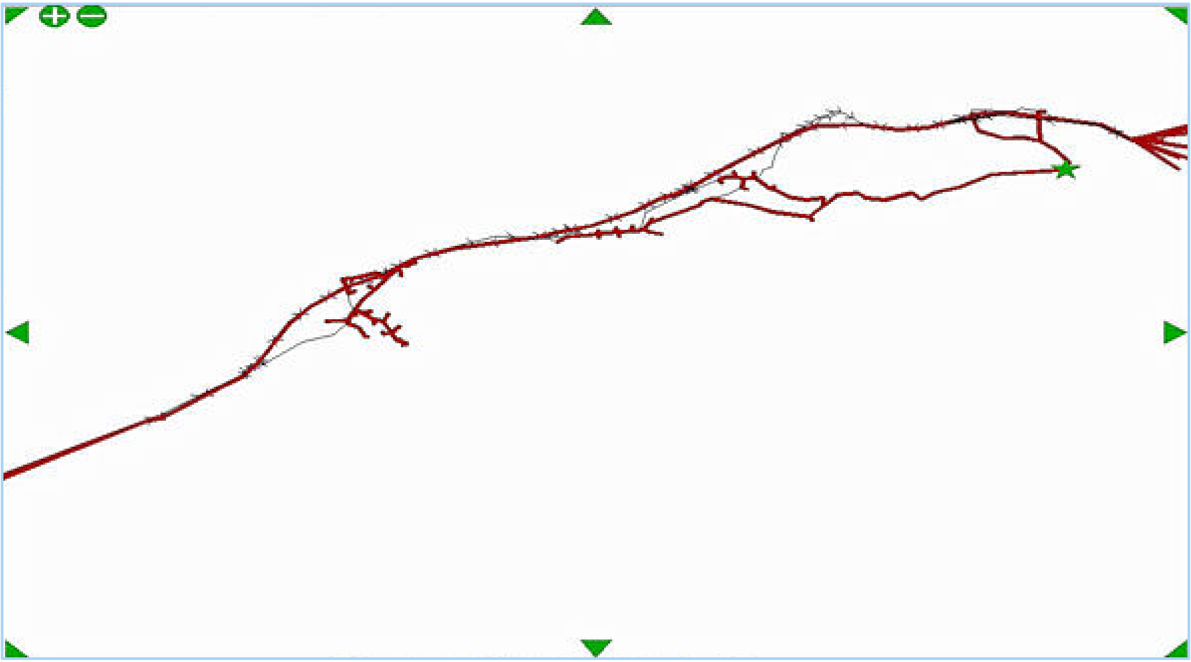

Figure 7.17: Trip Destination Routes for Zone 31, Conwy

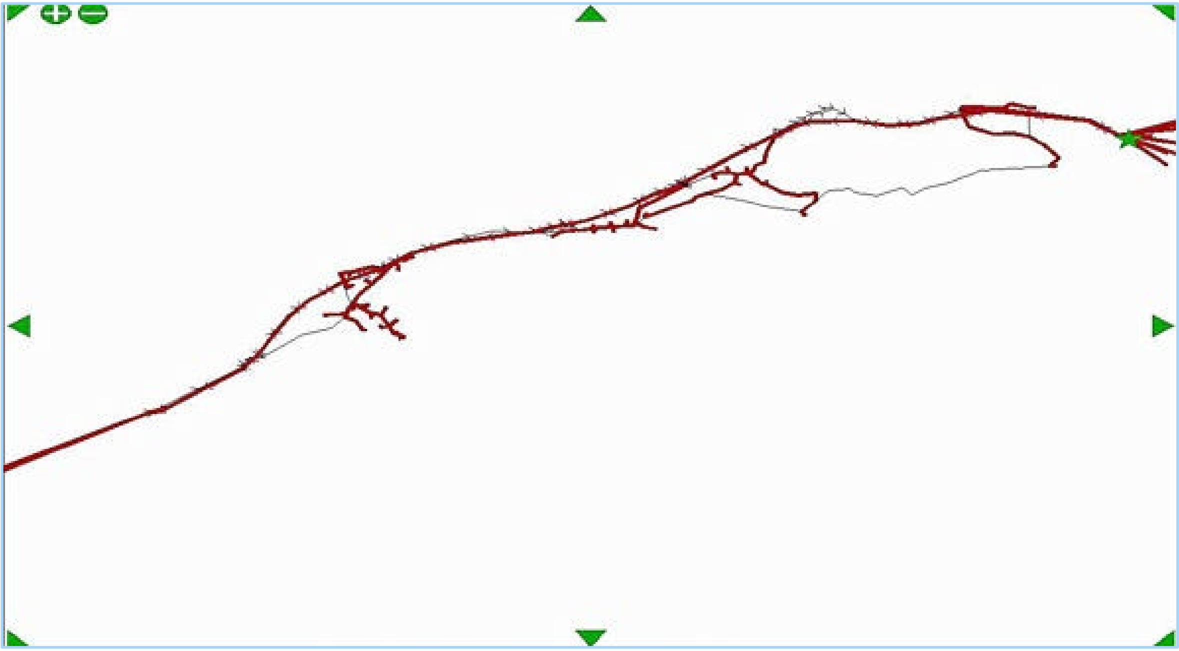

Figure 7.18: Trip Destination Routes for Zone 32, Llandudno

7.12 Base Year Traffic Flows

The final, validated, modelled base year traffic flows for junction 15 are shown in Figure 7.19 and Figure 7.20 for junction 16. These figures present the 2016 'Do Nothing' two-way modelled flows for the A55TM for the AM peak, Inter peak, PM peak and AADT for the cars, LGVs and HGVs. The figures also present total vehicles and percentage heavies for each peak period and AADT.

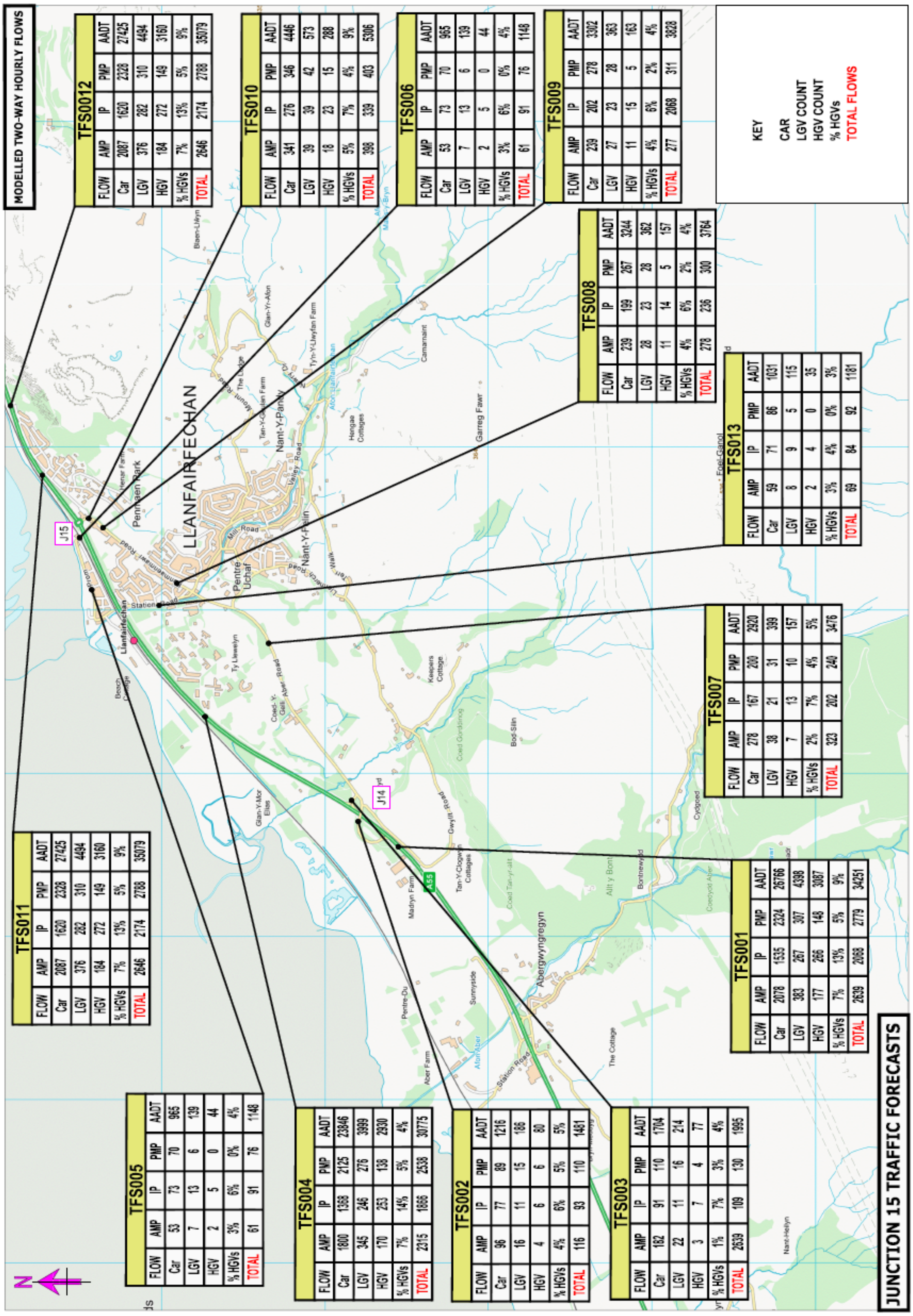

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Figure 7.19: 2016 'Do Nothing' Modelled Flows (Junction 15)

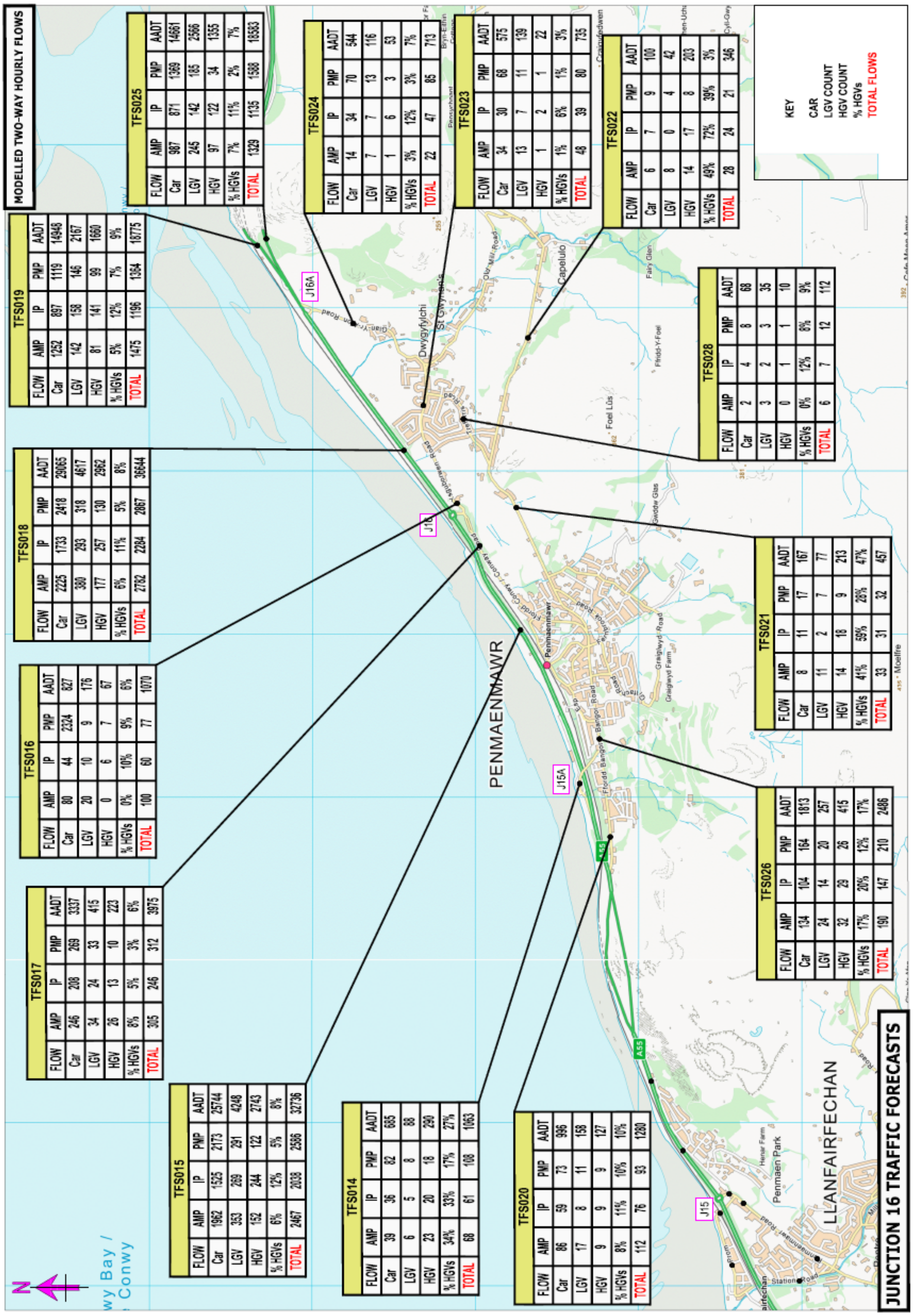

Figure 7.20: 2016 ‘Do Nothing’ Modelled Flows (Junction 16)

8. CONCLUSION

8.1.1 This Assignment Model Validation Report has outlined the development and validation of the A55TM. The results presented in this report are for the base year of 2016.

8.1.2 The results demonstrate that the model performs well against WelTAG and WebTAG criteria in terms of:

- Convergence
- Observed and modelled link lengths
- Journey times
- Calibration of flows
- Validation of flows

8.1.3 Based on the results detailed in this report it can be concluded that the A55TM is a sufficiently robust model that reflects the existing situation in terms of flows and journey times and is suitable for assessing the impact of the new scheme, environmental assessment and economic cost benefit analysis. It gives a good comparison between observed and modelled data and is fit for the purpose of appraising A55 J15&16 at WelTAG Stage 3.