MOTT MACDONALD

Solihull Local Plan Model Validation Report

November 2019

Solihull MBC

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Contents

Executive summary

This report covers the method used to update, calibrate and validate a base model of the Solihull area for the purposes of forecasting future year demand for the Solihull Local Plan, using PRISM 5.2. PRISM 5.2 is an average weekday model for a 2016 base year and models an average hour within the weekday peak periods. The peak periods are outlined below:

- AM period – 0700 to 0930;
- IP period – 0930 to 1530; and
- PM period – 1530 to 1900.

The PRISM highway assignment user classes are:

- Car Employers Business;
- Car Commute;
- Car Other;
- Light goods vehicle (LGV); and
- Heavy goods vehicle (HGV).

Local area highway networks have been produced for all three modelled time periods for a 2016 base year. As such, the observed traffic count data which was used in the development of PRISM 5.2 was used for this calibration process. Additional observed counts were obtained from TfWM Data Insight for the Solihull area and some counts from the Balsall Common Traffic Count study, undertaken by Mott MacDonald, were also used during calibration.

A process of network calibration and matrix estimation was carried out on the local networks. WebTAG unit M3.1 guidance was used to determine the level of model validation for all time periods.

The validation of the model is generally good with values above or suitably close to WebTAG criteria for screenlines, counts, and journey times in the Solihull local area. Overall, PRISM has remained close to the level of validation achieved in PRISM 5.0. This is in line with the objective which was to improve validation in Solihull without adversely impacting the overall PRISM highway network validation. The matrix changes due to matrix estimation are in line with WebTAG guidelines, and the assignment convergence meets the WebTAG guideline criteria. The model is therefore suitable as a basis for forecasting.

1 Introduction

1.1 Study Background

Mott MacDonald previously updated the 2016 base year highway models from PRISM 5.2 for the Solihull local area, with additional network coding. This study showed the level of validation on Solihull links was generally fine but fell short of the WebTAG criteria of 85%.

Consequently, an updated model of the Solihull area has been developed. This part of the study deals with the creation of a base year VISUM highway model, which will provide a basis for testing the three proposed forecast scenarios.

1.2 Modelling Background

The PRISM 5.2 highway model has been calibrated and validated to a 2016 base year.

Observed traffic counts and journey time data had already been collected and processed for 2016 base year in PRISM and this data was retained for use with the Solihull Local Plan model validation.

All PRISM modelling is undertaken in VISUM 16.01-14.

Generalised cost parameters were calculated based on the vehicle operating costs and values of time in the WebTAG data book (May 2019 v1.12).

1.3 Scope of Report

This report covers the Solihull Local Plan network and matrix building methodology, also summarising convergence and the calibration and validation results against WebTAG criteria.

2 Model Build Methodology

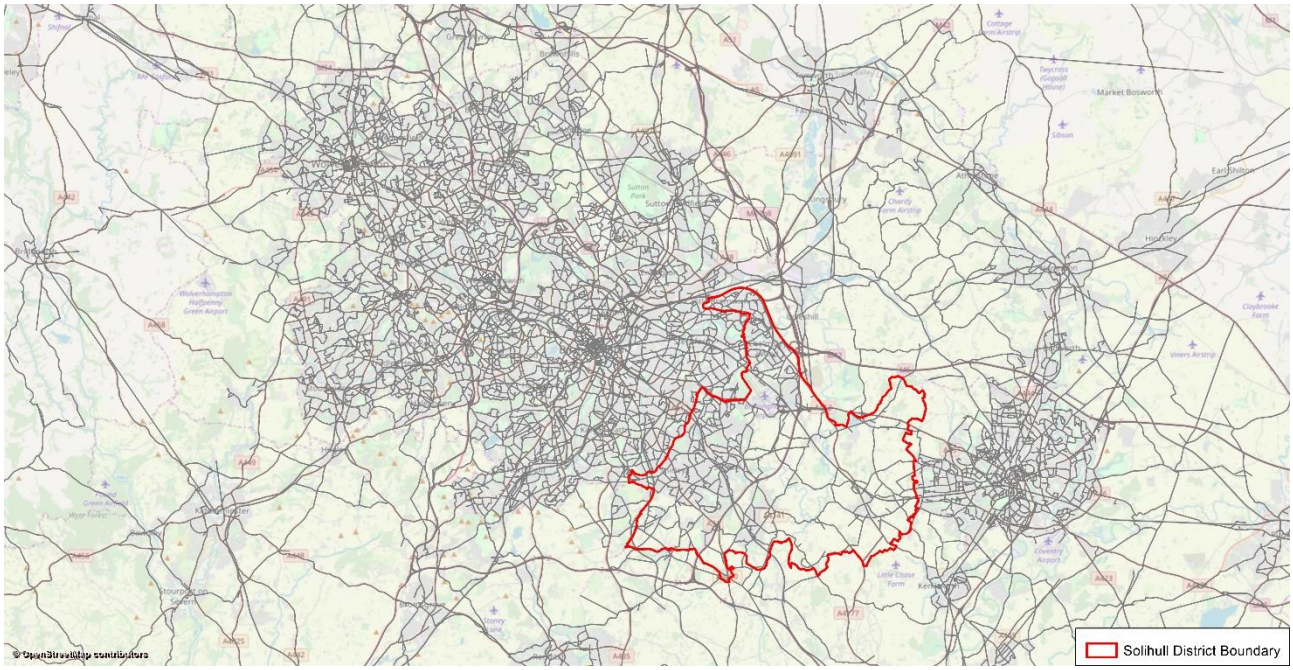
2.1 Highway network

The Solihull Local Plan highway network was created by updating the PRISM 5.2 2016 base year highway networks. The modelling has been focused within the Solihull District Boundary, shown in Figure 1.

Local network detail was added to the Solihull area in the previous update of the base year for the Solihull Local Plan. The additional local detail included:

- coding multiple local roads, in Balsall Common, including Holly Lane, Frog Lane, Meeting House Lane, Windmill Lane, Hob Lane, Gilson Way, Silver Birch Road, Lugtrout Lane and Wootton Green Lane; and
- coding access to the SLP and DLP development sites (>100 dwellings) within Solihull.

Figure 1: PRISM Area of Detailed Modelling and Solihull District boundary

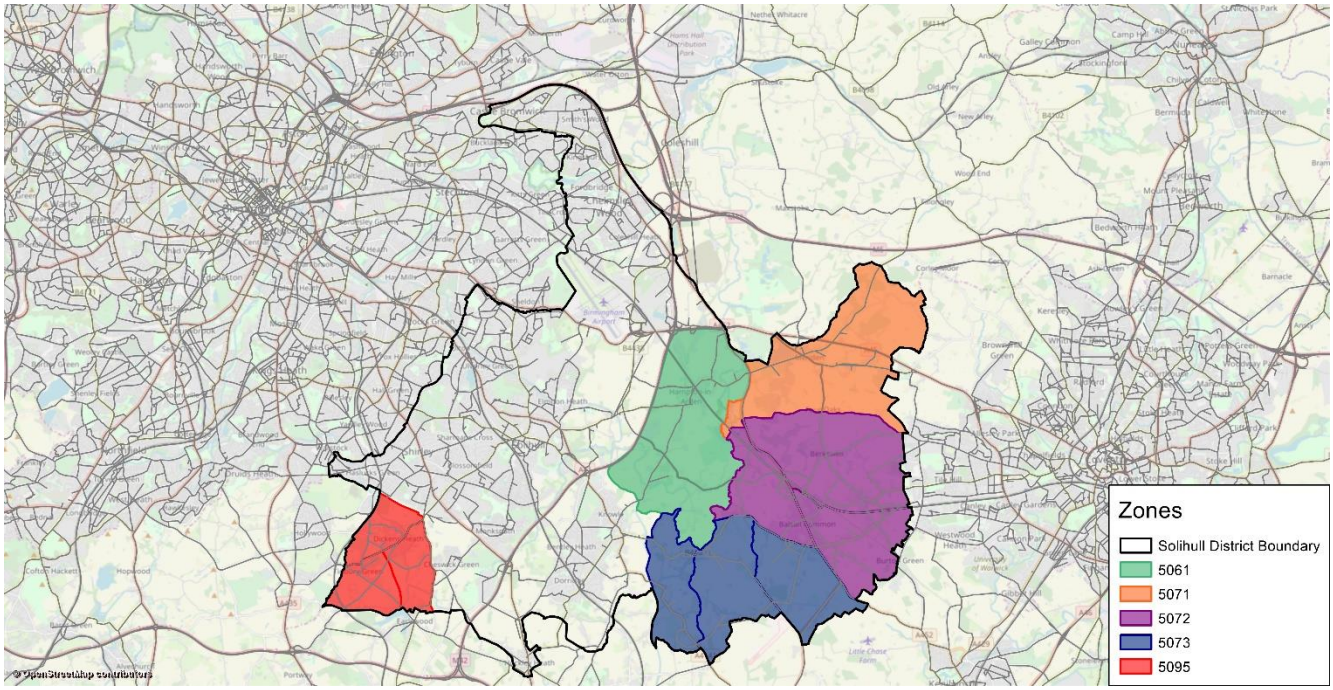


2.2 Matrix building

The PRISM zoning system was split for a handful of zones in the area around Solihull. A process using INRIX (GPS) OD data to calculate proportion splits was used to disaggregate the larger PRISM zones into smaller zones. INRIX OD trips were mapped to the Solihull Local Plan model zones. These values were then used to calculate proportion splits. The INRIX data used covers the period between 1st February 2016 and 31st July 2016.

Figure 2 shows the location of the split zones, with the colours representing the original parent zone. This increased the number of zones in the PRISM 5.2 highway network from 994, to 1004.

Figure 2: Zone splits



The starting point for the demand matrices was the PRISM 5.2 base year prior matrices. These are the prior trip matrices, before any matrix estimation was carried out in the full PRISM 5.2 highway model. These matrices were split into the more disaggregate zoning system as outlined above and then merged with a combination of both a synthetic and INRIX matrix.

The PRISM 5.2 prior and synthetic matrices trip ends within the Solihull District Boundary were investigated to see whether any zones, additional to the split zones, needed to be updated with a combination of INRIX and the new Synthetic data. In total 21 zones were updated. All Car matrices were produced using 70% new synthetic, and 30% INRIX matrices for the zones specified above. These splits were established through an assignment process, which produced a trip distribution broadly in line with travel patterns in DataShine. Both the HGV/LGV matrices were only updated to include the 15 split zones, no additional zones were updated. This was due to the trip ends in all other zones in the model being acceptable. The OD demand was calculated using the splits produced for HGV/LGV in the INRIX matrices and these were applied to the PRISM 5.2 prior matrices.

2.3 Highway assignment

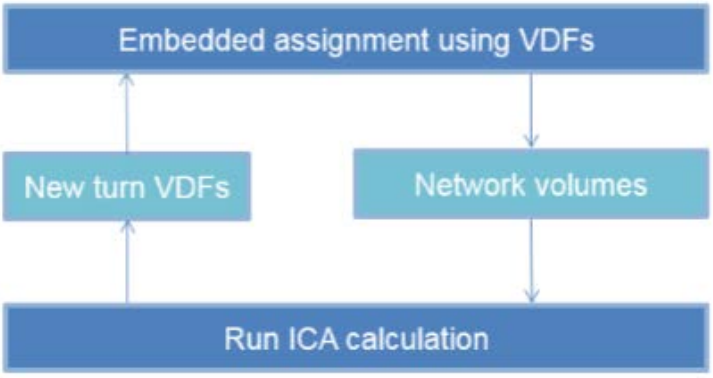
The assignment procedure used for the PRISM 5.2 highway model is an interaction between a subordinate/embedded assignment and a junction delay calculation, called Intersection Capacity Analysis (ICA).

Key to the assignment process is the concept of volume delay functions (VDFs). These are similar to traditional speed-flow curves, in that they can be used by a model to calculate the decrease in speed as flow increases. In Visum it is the delay (travel time) on link/turn that is estimated, and the VDF describes how this time increases as the traffic flow increases.

Overview of assignment with ICA

The process is illustrated in Figure 3. An embedded assignment is used to search for routes, this produces network flows that are passed to the ICA module, and then the ICA module estimates new VDFs taking into account conflicting flows at turns. This process iterates until the entire system has reached equilibrium.

Figure 3: Assignment with ICA



The ICA calculation requires that none of the flows are above capacity. The flows resulting from the equilibrium assignment (hereafter referred to as demand flows) can go above link/turn capacity due to the theoretical nature of assignment. To remedy this, a blocking back model is run within VISUM to create, what are called, actual flows – where no flow is greater than the capacity of turns.

This procedure reduces demand until no turns are above capacity and then feeds the excess demand back into the model forming queues. As well as providing queues upstream from overcapacity junctions this also produces an effect of reducing the flow after junctions as those vehicles are now represented in a queue, this effect is known as flow metering.

3 Observed Data

3.1 Journey Time Data

PRISM 5.2 used INRIX journey time data as the source of observed journey times. The data provided covers the period between 1st February 2016 and 31st July 2016. The files provided by INRIX contain many observed vehicle tracks with start, end, and way points and travel time information between each point.

Eleven one-directional routes for journey time validation have been used, these routes are either solely within Solihull boundary, or intersect. The observed data for these routes is made up of a combination of a large number of individual journeys recorded by INRIX. See Figure 4 below showing the location of the journey time routes and Table 1 showing a description of each route.

Figure 4: Journey time routes

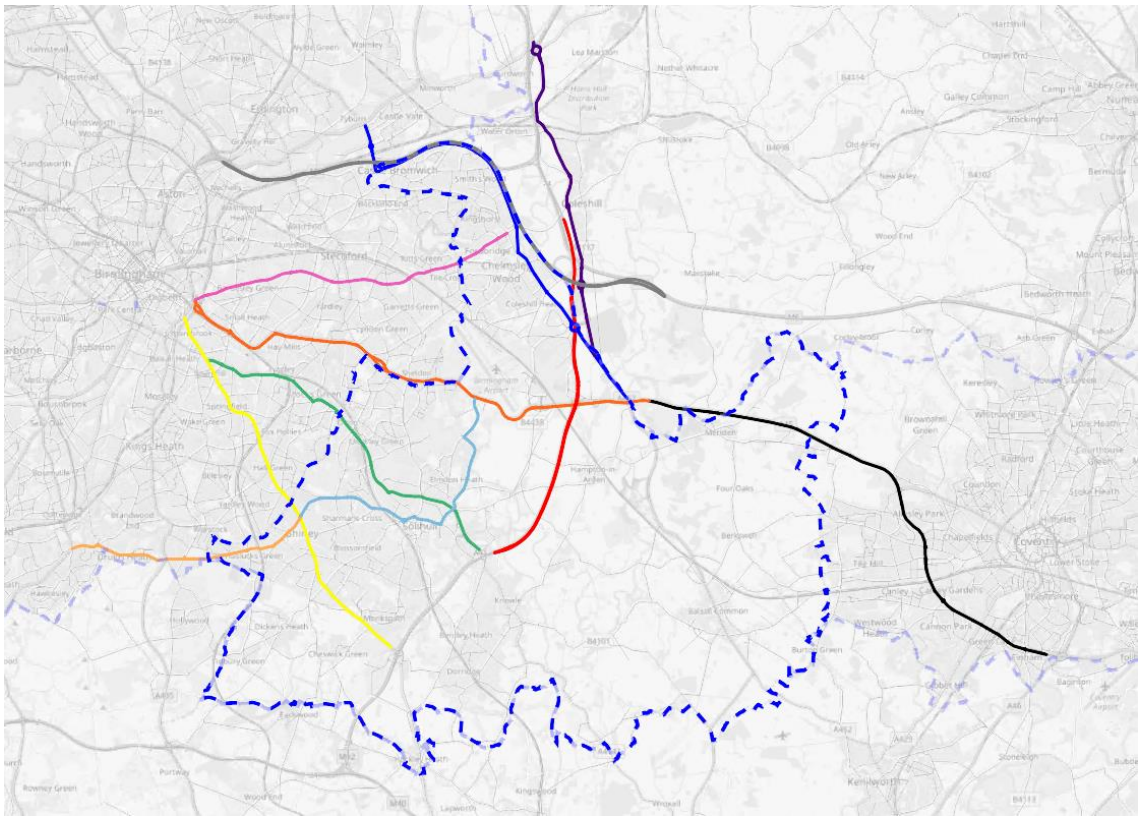


Table 1: Journey time route descriptions

ID	Route	From	To
1 – Black	A45 Stivichall Interchange - Stonebridge Island	A45/A452	A45/A46 Roundabout
2 – Orange	A45 Stonebridge Island - Bordesley Circus	A45/ Bordesley Middleway	Coventry Road / A45
3 – Green	A41 Warwick Road	A41 / A34	A41/M42
4 – Yellow	A34 Stratford Road	A34	A34 /M42
5 – Dark Blue	A452 Chester Road	Kingsbury Road / A452	A452/ A45
6 – Pink	B4128 Bordesley Green East	A4540/ B4128	B4128/B4114
7 – Light Blue	Damson Parkway/Streetsbrook Road	A34/ B4025	Damson Parkway / A45
8 – Light Orange	Kings Norton to Shirley	A441 / Wharf Road	Haslucks Green Road /A34
9 – Purple	A446 Lichfield Road/Stonebridge Road	A446/ A4097	A446/ A452
10 – Grey	M6 J6 - J3a	M6/ A38 (M)	M6 / M42
11 – Red	M6 - M42 J5	M42/Midlands Express Way	M42 /A4141

3.2 Traffic Count Data

Using the PRISM 5.2 base network as a starting point meant that there was already a good coverage of observed count data available in the Solihull Local Plan area. This data had already been processed and factored to be used for a 2016 base year in PRISM 5.2 so there was no extra work needed to factor these counts.

Observed data from PRISM comes from several sources and different years. All have been factored to a neutral month and to a 2016 base year. Full details of the PRISM observed traffic count data collection can be found in the PRISM 5 data collection report.

Additional observed traffic count data was obtained from TfWM Data Insight, providing multiple count sites for years 2015 and 2016. These counts have been processed into average hour counts for the PRISM peak periods and included in the local model calibration process. The 2015 counts were factored to be used consistently in the 2016 base network.

Further counts were available from a previous study Mott MacDonald undertook in Balsall Common, and these have been used as additional count sites, if they were absent from TfWM site locations. These counts were factored to a neutral month and to a 2016 base year.

The counts from both TfWM[1] and Balsall Common Traffic Study were then split into Car Business, Car Commute, Car Other, HGV and LGV using percentages applied to previous counts on comparable link types in the model.

[1] TfWM Data Insight Traffic Survey (2019): https://fme.tfwm.org.uk/count_self_serve/index.html

4 Calibration and Validation

4.1 Methodology

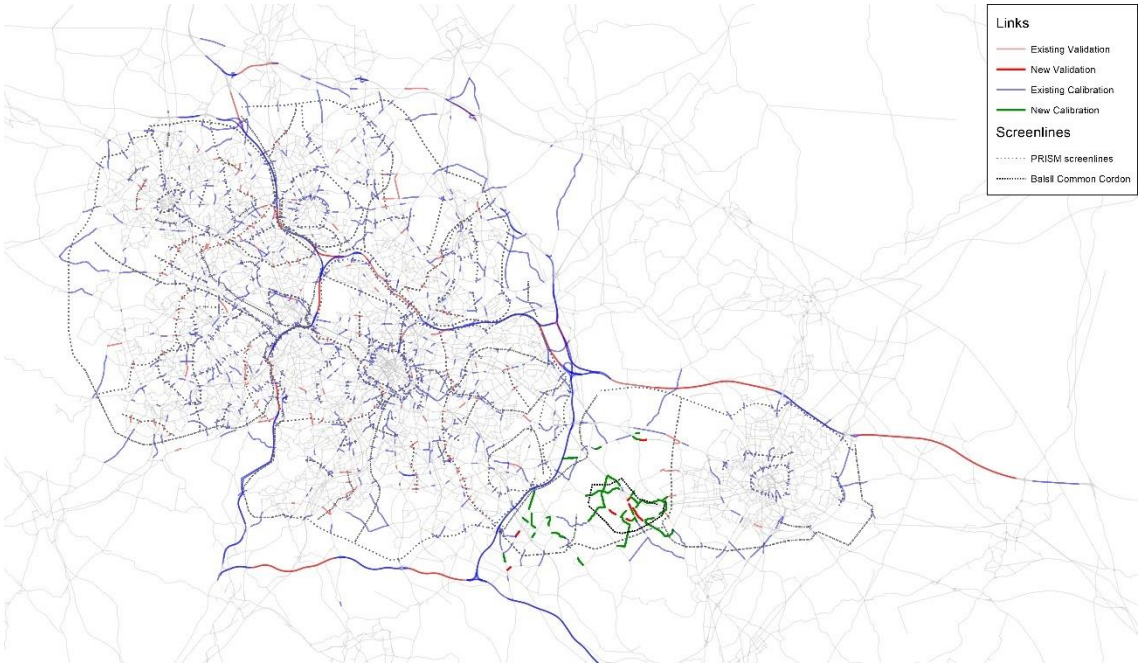
The PRISM 5.0 highway model was previously validated to a 2016 base year. For the purposes of the Solihull Local Plan, additional count data was obtained around Solihull and Balsall Common as outlined in Section 3. Additionally, a handful of PRISM zones in the Solihull area have been split into more disaggregate zones. A re-calibration and validation of the PRISM highway model is required to include these new counts and zones.

The methodology applied to re-calibrate the highway network was developed with a focus on making sure the level of validation in the area of interest, Solihull, was robust whilst attempting to limit the level of validation change elsewhere in the model between this version of the PRISM base and the PRISM 5.0 base.

All screenlines and link count data used previously in PRISM 5.0 base were retained. Screenlines and links were kept as either calibration or validation as per PRISM 5.0, apart from a few exceptions in the Solihull area which had a few designation alterations due to the addition of new count data. The new count data was split into calibration counts to be used in matrix estimation and validation counts to be retained for independent validation to be used alongside the existing PRISM counts.

Additional screenlines were produced to create a cordon around the centre of Balsall Common. Figure 5 below shows the location of the new count data and screenlines alongside the existing PRISM counts and screenlines.

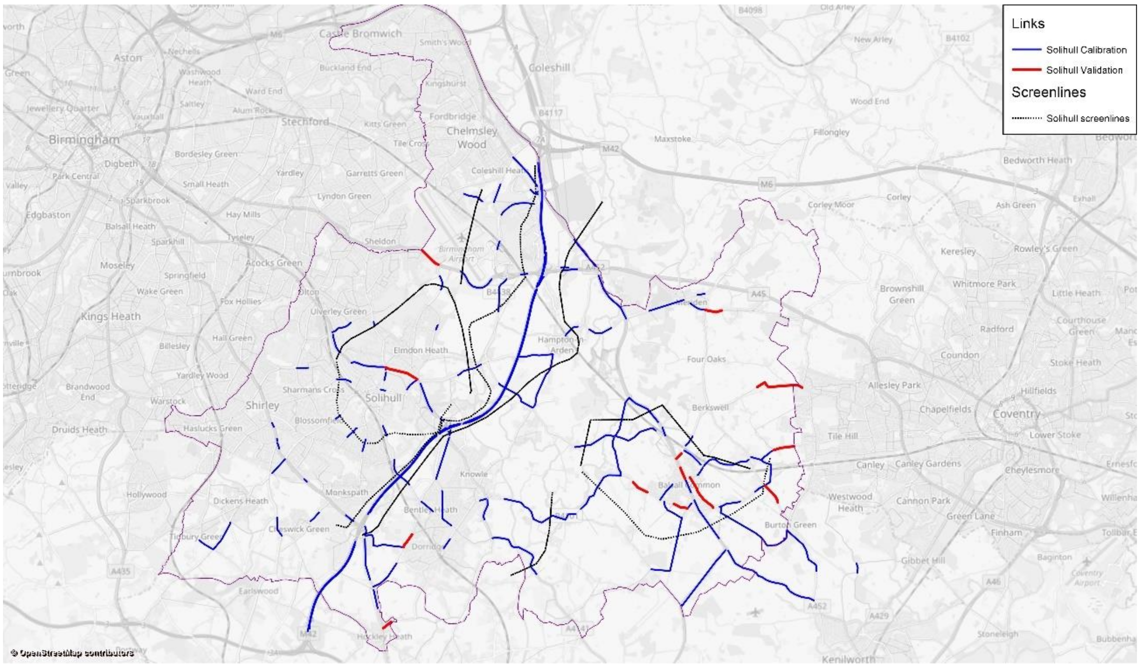
Figure 5: Count locations



As the focus was the level of validation in the Solihull area, only counts within this area were used in matrix estimation. After the completion of matrix estimation, a merging process of matrices was undertaken to produce the final base matrices to assign to the network. The matrix merging involved the matrices produced by this run of matrix estimation and the PRISM 5.0 validated base matrices. Values for all OD pairs that use the Solihull area count links were retained and all other OD pairs were set to the value of the PRISM 5.0 validated base matrices for all time-periods and user classes. This was to limit the level of validation change from PRISM 5.0 in the areas away from Solihull.

Figure 6 is zoomed into the count locations and screenlines in the Solihull area. These are the counts and screenlines included in the matrix estimation process and reported on for calibration and validation of the Solihull area.

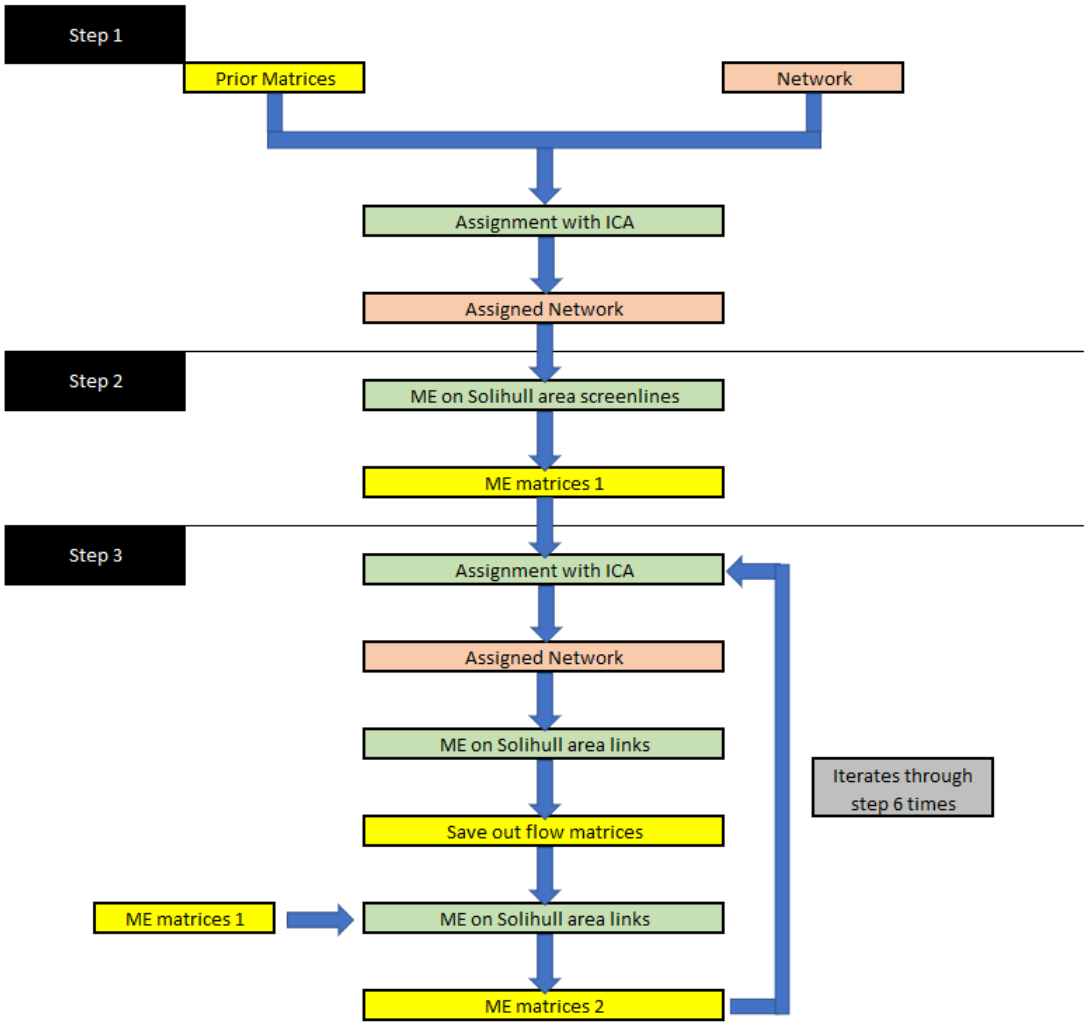
Figure 6: Count locations in Solihull area



Matrix estimation (ME) was undertaken using the TFlowFuzzy (TFF) tool within VISUM. As with most ME tools, TFF works by adjusting cells in the demand matrix so they better match the observed counts for a given set of paths. All count data in PRISM 5.0 was split by vehicle class (car, LGV and HGV) and the additional counts provided were processed to be split at the same level, so matrix calibration was undertaken at this vehicle class level.

The TFF process begins by running ME for the screenlines first, before focusing on all links included in the ME process. The function to use previously calculated flow matrices in the ME process is utilised to help refine the route choice within TFF as it iterates. The steps in the TFF process is summarised in the diagram in Figure 7.

Figure 7: Matrix Estimation Steps



Source: Mott MacDonald

Once completed, the 'ME Matrices 2' produced were merged with the PRISM 5.0 validated base matrices as described earlier in this section. These merged matrices are the final base year matrices for the SLP 2016 highway base year.

4.2 Validation results

4.2.1 Assignment validation criteria

Link performance against observed counts was measured using the below methods:

- The GEH statistic, which incorporates both relative and absolute errors; and
- The absolute percentage difference between modelled flows and observed counts

The WebTAG Unit M3.1 criteria and acceptability guidelines for link flows are defined in Table 2.

Table 2: Acceptability guidelines for individual link flow and turning movement validation

Criteria	Description of criteria	Acceptability guideline
1	Individual flows within 100 vehicles/hour of counts for flows less than 700 vehicles/hour	>85% of cases
	Individual flows within 15% of counts for flows from 700 to 2700 vehicles/hour	>85% of cases
	Individual flows within 400 vehicles/hour of counts for flows more than 2,700 vehicles/hour	>85% of cases
2	GEH <5 for individual flows	>85% of cases

Source: WebTAG Unit M3.1 (3.2.8, Table 2)

As recommended in WebTAG Unit M3.1 (paras 4.3.4, 4.3.5 and 9.3.1), the flows on individual links are validated at the car and total vehicle flow level only.

The acceptability guidelines for screenline flows as stated in WebTAG Unit M3.1 are defined in Table 3.

Table 3: Acceptability guidelines for screenlines

Criteria	Acceptability guideline
Differences between modelled flows should be less than 5% of counts	All or nearly all screenlines

Source: WebTAG Unit M3.1 (3.2.5)

For some of the smaller screenlines with low flows, particularly LGV and HGV flows, measuring performance using percent difference is not appropriate as a small difference in trips can result in a large percentage difference. We have therefore also measured performance using older WebTAG guidelines that recommended the modelled flows should be less than 4 GEH of the counts across screenlines. The results presented below show the percentage of screenlines that pass either of these two criteria.

4.2.2 Link validation results

Table 4**Error! Reference source not found.** presents the assignment validation of the link counts retained for independent validation in the Solihull area. The validation levels across PRISM after this run of calibration and validation have been compared with the PRISM 5 validation results and are provided in Appendix B. Link validation plots for Solihull and PRISM can be found in Appendix A.

Table 4: Validation link results in the Solihull Area (WebTAG Criteria)

		Percentage of counts passing WebTAG criteria	
Time-period	Number of Counts	Car	Total
AM	26	85%	81%
IP	26	88%	88%
PM	26	85%	85%

The results above show that the level of validation within Solihull is strong, achieving or nearly achieving the WebTAG criteria for all time-periods. The overall validation results for PRISM show little to no change from PRISM 5.0 as expected.

4.2.3 Link calibration results

Error! Reference source not found. Table 5 presents the performance of link counts used in matrix estimation in the Solihull area. The modelled calibration results across PRISM have been

compared with the PRISM 5 calibration results and are provided in Appendix D. Link calibration plots for Solihull and PRISM can be found in Appendix C.

Table 5: Calibration link results in the Solihull Area (WebTAG Criteria)

		Percentage of counts passing WebTAG criteria	
Time-period	Number of Counts	Car	Total
AM	223	87%	85%
IP	223	93%	89%
PM	223	83%	81%

The results above show a good level of fit achieved by counts used in matrix estimation for the Solihull local area. As with the validation link results, there are only small changes to the overall PRISM calibration results when compared to PRISM 5.0.

4.2.4 Screenline validation

All screenlines in the Solihull area have been used in matrix estimation to aid the validation in the local area of interest. Overall screenline validation levels in PRISM have remained consistent across all time-periods. Screenline performance in the re-calibrated PRISM base are reported in Appendix F.

4.2.5 Screenline calibration

The performance of screenlines used in matrix estimation are summarised below in Table 6 for the Solihull area.

Table 6: Calibration screenline results in the Solihull Area

		Percentage of screenlines with relative difference less than 5% or 4 GEH	
Time-period	Count	Car	Total
AM	16	100%	100%
IP	16	100%	100%
PM	16	88%	88%

These results show a good fit between modelled and observed across the screenlines within the Solihull local area. The two urban centre cordons around Solihull town centre and Balsall Common town centre both pass WebTAG criteria for car and total vehicles in all time-periods. Screenline plots for Solihull can be found in Appendix E.

Calibration screenline results for PRISM can be found in Appendix G.

4.3 Journey time validation

PRISM 5.0 includes more journey time routes than previous versions and a tiered approach was adopted. The routes were classified as either Tier 1, Tier 2 or Tier 3, these are described below. The WebTAG validation targets are in line with guidelines for the important Tier 1 routes but are relaxed for the Tier 2 and Tier 3 routes. The criteria and acceptability guidelines for journey times are defined in Table 7. This means the model performance overall can be better monitored across the entire Key Route Network and performance on routes that otherwise may not have been included are within a reasonable (but slightly relaxed) range. This was considered a proportionate approach for a strategic model and should provide a better starting point for local models. All PRISM journey time routes are shown in Figure 8.

Figure 8: PRISM journey time routes

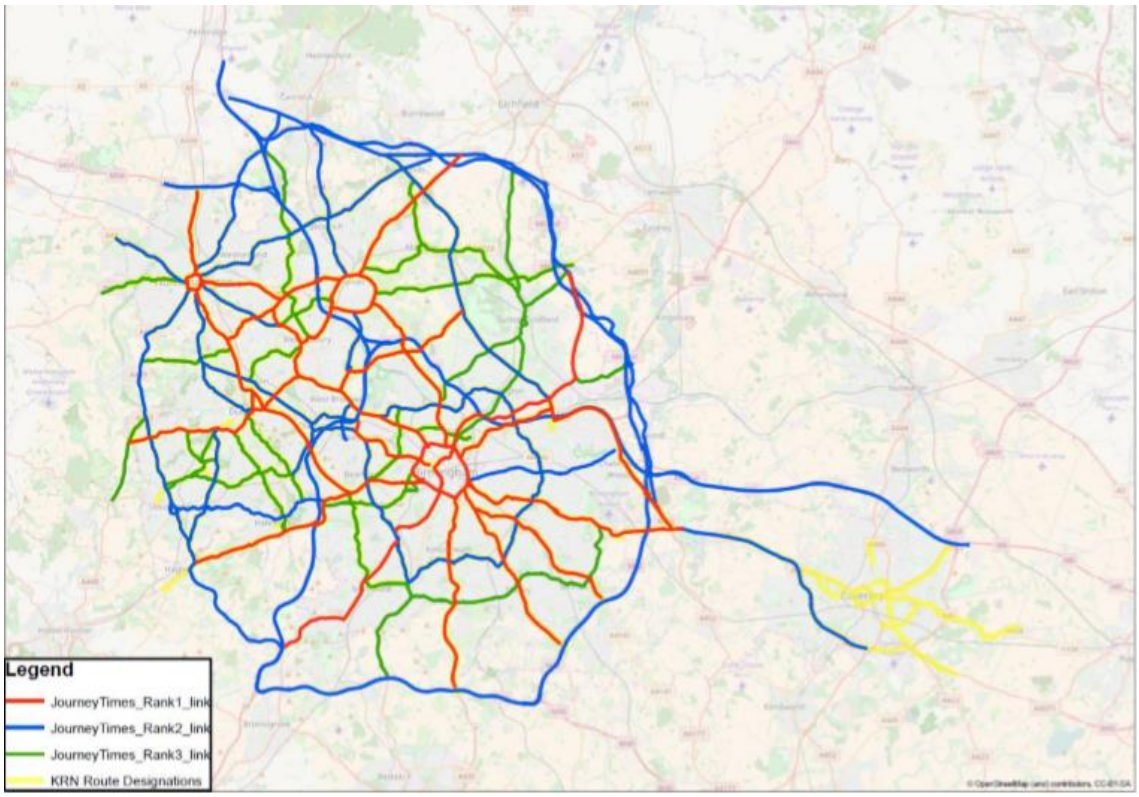


Table 7: Acceptability guidelines for journey time validation

Tier	Criteria	Acceptability guideline
Tier 1	Modelled times along routes should be within 15% of surveyed times (or 1 minute)	>85% of cases
Tier 2	Modelled times along routes should be within 25% of surveyed times	>85% of cases
Tier 3	Modelled times along routes should be within 35% of surveyed times (or 1 minute)	>85% of cases

Source: WebTAG Unit M3.1 (para 3.2.10, Table 3) – Tier 1 only

Table 8 shows the validation levels of the journey time routes in the Solihull area, as outlined in section 3, both against WebTAG and their hierarchy criteria. This shows a good level of validation in Solihull. Journey time validation for the eleven two-way routes are summarised in detail in Appendix H. Journey time validation results for PRISM after this validation run are presented in Appendix I.

Table 8: Journey time validation Solihull area

Time-period	Number of routes	% routes passing WebTAG	% routes passing All Tier Criteria
AM	22	91%	95%
IP	22	91%	100%
PM	22	77%	100%

4.4 Matrix impact of matrix estimation

WebTAG Unit M3.1 (para 8.3.13) advises that changes brought about by matrix estimation should not be significant and should be monitored carefully by the following means:

- Changes to matrix zonal cell values;
- Changes to matrix trip ends;
- Changes to trip length distributions;
- Changes to sector to sector level matrices; and

In addition to the above, we have also measured changes to the matrix totals.

4.4.1 Changes to matrix totals

Table 9 and Table 10 summarise the changes in overall matrix totals due to matrix estimation, by time-period and user class. The impact on the matrix totals is relatively small for all user classes and the pattern is reasonably consistent across time periods.

Table 9: Impact of matrix estimation on matrix totals (overall)

Time-period	Prior Total	Post Total	Percentage Change
AM	549,358	570,767	3.90%
IP	499,598	524,313	4.95%
PM	587,346	617,147	5.07%

Table 10: Impact of matrix estimation on matrix totals (individually)

Time-period	Car Business	Car Commute	Car Other	LGV	HGV	Overall Change
AM	3.23%	2.50%	6.55%	-1.83%	9.73%	3.90%
IP	5.39%	4.40%	5.52%	-0.07%	7.50%	4.95%
PM	4.71%	2.65%	7.93%	-1.57%	10.96%	5.07%

4.4.2 Changes to zonal cells

Table 11 shows the change brought about by matrix estimation for each time-period at the zonal cell level. WebTAG Unit M3.1 (Table 5) states the following criteria for zonal cell values:

- Gradient within 0.98 and 1.02;
- Intercept near 0; and
- R^2 in excess of 0.95.

Table 11: Impact of matrix estimation on zonal cell values

Time-period	User Class	Gradient	Intercept	R^2
AM	Car Business	1.01	0.00	0.96
	Car Commute	1.00	0.01	0.99
	Car Other	1.00	0.01	0.97
	LGV	1.00	0.00	1.00
	HGV	1.03	0.00	0.92
IP	Car Business	1.04	0.00	0.93

Time-period	User Class	Gradient	Intercept	R^2
	Car Commute	1.00	0.00	0.97
	Car Other	1.00	0.02	0.96
	LGV	1.00	0.00	0.99
	HGV	1.02	0.00	0.82
PM	Car Business	1.01	0.00	0.95
	Car Commute	1.00	0.01	0.98
	Car Other	1.01	0.02	0.96
	LGV	1.00	0.00	1.00
	HGV	1.03	0.00	0.90

The R^2 values in the tables above are close to or slightly above the WebTAG criteria. The gradient and intercept are also strong values, with the weakest results for goods vehicles, this is consistent with expectations, as the data sources for LGV and HGV are always more prone to fleet-bias and represent a small proportion of the LGV and HGV fleet.

4.4.3 Changes to trip ends

Table 12 and Table 13 show the change brought about by matrix estimation for each matrix for trip origins and destinations. WebTAG Unit M3.1 (Table 5) states the following criteria for matrix zonal trip ends:

- Gradient within 0.99 and 1.01;
- Intercept near 0; and
- R^2 in excess of 0.98.

Table 12: Impact of matrix estimation on zonal trip ends - origins

Time-period	User Class	Gradient	Intercept	R^2
AM	Car Business	1.03	-0.09	0.98
	Car Commute	1.00	7.19	0.98
	Car Other	1.01	9.91	0.95
	LGV	0.99	-0.51	0.99
	HGV	1.06	0.76	0.97
IP	Car Business	1.04	0.58	0.98
	Car Commute	1.00	3.39	0.96
	Car Other	1.00	17.11	0.96
	LGV	1.00	-0.16	0.99
	HGV	1.04	0.81	0.95
PM	Car Business	1.01	2.08	0.98
	Car Commute	0.98	9.78	0.97
	Car Other	1.01	17.83	0.95
	LGV	1.00	-0.51	0.99
	HGV	1.05	1.10	0.94

Table 13: Impact of matrix estimation on zonal trip ends - destinations

Time-period	User Class	Gradient	Intercept	R^2
AM	Car Business	1.01	1.03	0.98
	Car Commute	1.00	7.15	0.98
	Car Other	1.00	11.50	0.96
	LGV	1.00	-0.85	0.99
	HGV	1.07	0.63	0.97
IP	Car Business	1.02	1.14	0.97
	Car Commute	0.99	3.61	0.96
	Car Other	1.01	16.06	0.96
	LGV	1.01	-0.28	0.99
	HGV	1.04	0.84	0.96
PM	Car Business	1.03	1.08	0.97
	Car Commute	0.99	8.79	0.97
	Car Other	1.02	13.98	0.95
	LGV	1.00	-0.60	0.99
	HGV	1.08	0.50	0.97

The R^2 values in the tables above are close to or above the WebTAG criteria indicating that the change brought about by matrix estimation is small.

4.4.4 Changes to trip length distributions

Table 14 presents the mean trip length before and after matrix estimation, by user class and time-period. TAG Unit M3.1 (Table 5) states that the mean trip length should not change by more than 5%. This has been achieved for all user classes and time-periods.

Table 14: Impact of matrix estimation on mean trip length

		Mean trip length (km)		
Time-period	User Class	Prior	Post	Percentage Diff
AM	Car Business	53.1	52.7	-1%
	Car Commute	13.3	12.9	-2%
	Car Other	11.2	11.0	-2%
	LGV	29.2	29.3	1%
	HGV	68.1	70.9	4%
IP	Car Business	57.0	55.8	-2%
	Car Commute	15.2	14.8	-3%
	Car Other	10.5	10.3	-1%
	LGV	26.9	27.1	1%
	HGV	80.2	82.7	3%
PM	Car Business	50.8	49.4	-3%
	Car Commute	13.8	13.4	-3%
	Car Other	10.8	10.4	-3%
	LGV	25.2	25.6	2%
	HGV	72.6	77.2	6%

Graphs illustrating the change in trip length distribution between the prior and post matrices are illustrated in Appendix J. The values in Table 14 indicate that the change brought about by matrix estimation is small.

4.5 Assignment convergence

4.5.1 Convergence criteria

Table 15 describes the assignment convergence criteria in WebTAG and its applicability to the VISUM software.

Table 15: WebTAG highway assignment convergence criteria

Measure of Convergence	Description	Acceptability guideline	Use in VISUM
Delta	The difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as the percentage of the minimum costs	Less than 0.1% or at least stable with convergence fully documented and all other criteria met	A delta statistic is reported for the embedded assignment. Analogous to criteria 7 in the table below.
%GAP	Like Delta, however the costs are calculated directly from simulation[2] rather than delay curves.	Less than 0.1% or at least stable with convergence fully documented and all other criteria met	Visum 16 does not measure %GAP, however Mott MacDonald have developed a tool to measure it as described below Analogous to criteria 0 in the table below.
(P)<1%	The percentage of links with flow change less than 1%.	More than 98% for four consecutive iterations	Visum measures GEH of volume difference rather than percentage difference. Analogous to criteria 1 and 2 (for links and turns, respectively) in the table below.
(P2)<1%	The percentage of links with cost change less than 1%.	More than 98% for four consecutive iterations	Visum measures percentage difference in delay rather than total cost (combination of delay, distance and toll) and so potentially stricter. Analogous to criteria 3 and 4 (for links and turns, respectively) in the table below.

Source: WebTAG Unit M3-1 (Section 3.3.17, Table 4)

The convergence criteria measured by VISUM 16 are defined as criteria 1-7 in Table 16.

A more detailed description of these criteria can be found in the PRISM 5.0 Model Validation Report.

Table 16: PRISM 5.2 highway assignment convergence criteria

Description of test	Acceptability guidelines
Overall Assignment	

[2] For VISUM, the 'from simulation costs' are those calculated on turns directly from the ICA calculation, and on links from the volume delay function plus any queuing penalty. The costs used in the subordinate assignment (and for the delta statistic) are derived from modified delay curves on turns and links that were estimated based on the ICA results.

	Description of test	Acceptability guidelines
0	%GAP: Using costs calculated from ICA, the difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as the percentage of the minimum costs (referred to as '%GAP' in TAG unit M3-1 section C.2.7)	Less than 0.1%
1	The link volumes from the current embedded assignment and the previous embedded assignment are close	More than 95% of links have a difference in volume less than GEH 1
2	The turn volumes from the current embedded assignment and the previous embedded assignment are close	More than 95% of turns have a difference in volume less than GEH 1
3	The turn volumes from the current embedded assignment and the "smoothed" turn volumes used in ICA are close	More than 95% of turns have a difference in volume less than GEH 1
4	The final link delays from the embedded assignment and those obtained from running ICA/Blocking Back are close, i.e. testing if the link VDFs are a good estimate of delay	More than 98% of turns have a relative difference in delay less than 1%
5	The final turn delays on links from the embedded assignment and those obtained from running ICA/Blocking Back are close, i.e. testing if the turn VDFs are a good estimate of delay	More than 98% of turns have a relative difference in delay less than 1%
6	The mean deviation in queue lengths on links is sufficiently small i.e. the queues have stabilised.	Less than 1 vehicle
Embedded Assignment		
7	DELTA: The difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as the percentage of the minimum costs (referred to as 'delta' in TAG unit M3-1 section C.2.4)	Less than 0.05%

4.5.2 Assignment convergence

The highway assignment performance of the Solihull Local Plan highway model against the convergence criteria has been recorded for the final four consecutive iterations, as shown in Table 17. The convergence of the local base year highway assignment meets the WebTAG criteria.

Table 17: Highway Convergence

Time Period	Iteration	Criteria							
		0	1	2	3	4	5	6	7
AM	27		100%	100%	100%	100%	98%	0.0	0.01%
	28		100%	100%	100%	100%	98%	0.0	0.01%
	29		100%	100%	100%	100%	98%	0.0	0.01%
	30	0.03%	100%	100%	100%	100%	98%	0.0	0.00%
IP	22		100%	100%	100%	100%	98%	0.0	0.00%
	23		100%	100%	100%	100%	98%	0.0	0.00%
	24		100%	100%	100%	100%	98%	0.0	0.01%
	25	0.01%	100%	100%	100%	100%	98%	0.0	0.00%
PM	35		100%	100%	100%	100%	98%	0.0	0.00%
	36		100%	100%	100%	100%	98%	0.0	0.00%
	37		100%	100%	100%	100%	98%	0.0	0.00%
	38	0.08%	100%	100%	100%	100%	98%	0.0	0.00%
Target	-	0.1%	95%	95%	95%	98%	98%	1	0.01%

5 Summary

This report details the validation process and results for the Solihull Local Plan highway model. This model used PRISM 5.2 and is independently calibrated and validated in the modelled area with additional counts. The Solihull area has had additional network detail added to make the model more suitable for the highway assessment within Solihull.

The validation of the model is generally good with values above or suitably close to WebTAG criteria for screenlines, counts, and journey times in the Solihull local area. Overall, PRISM has remained close to the level of validation achieved in PRISM 5.0. This is in line with the objective which was to improve validation in Solihull without adversely impacting the overall PRISM highway network validation. The matrix changes due to matrix estimation are in line with WebTAG guidelines, and the assignment convergence meets the WebTAG guideline criteria. The model is therefore suitable as a basis for forecasting.

Appendices

A. Link Validation

Figure 9: AM validation Solihull

Figure 10: AM validation PRISM

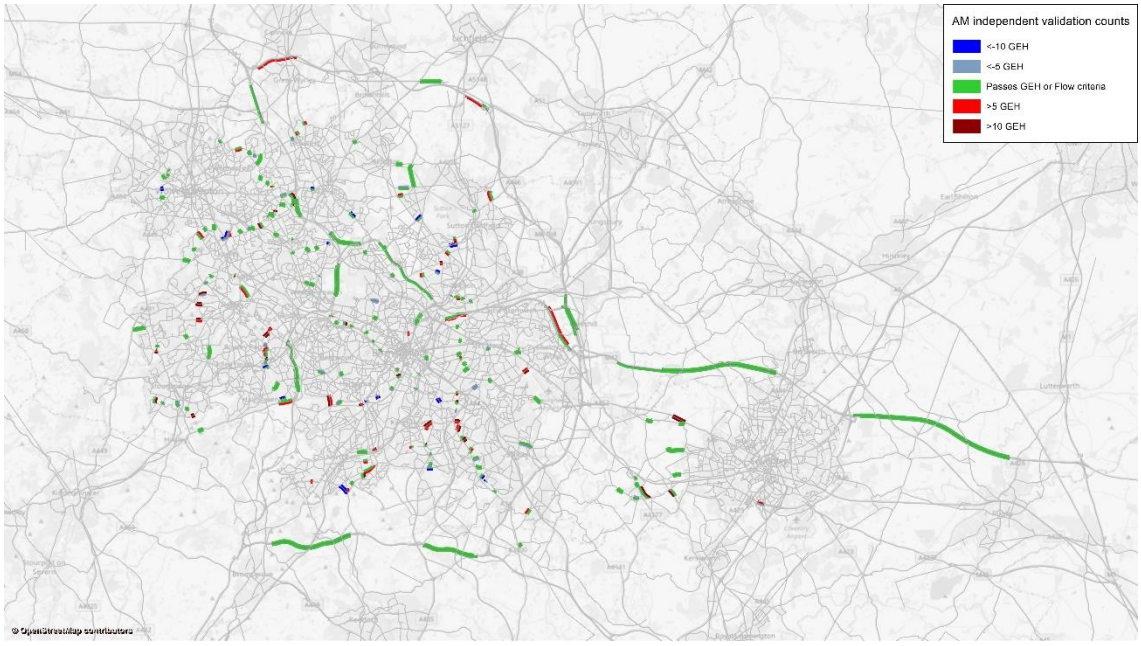


Figure 11: IP validation Solihull

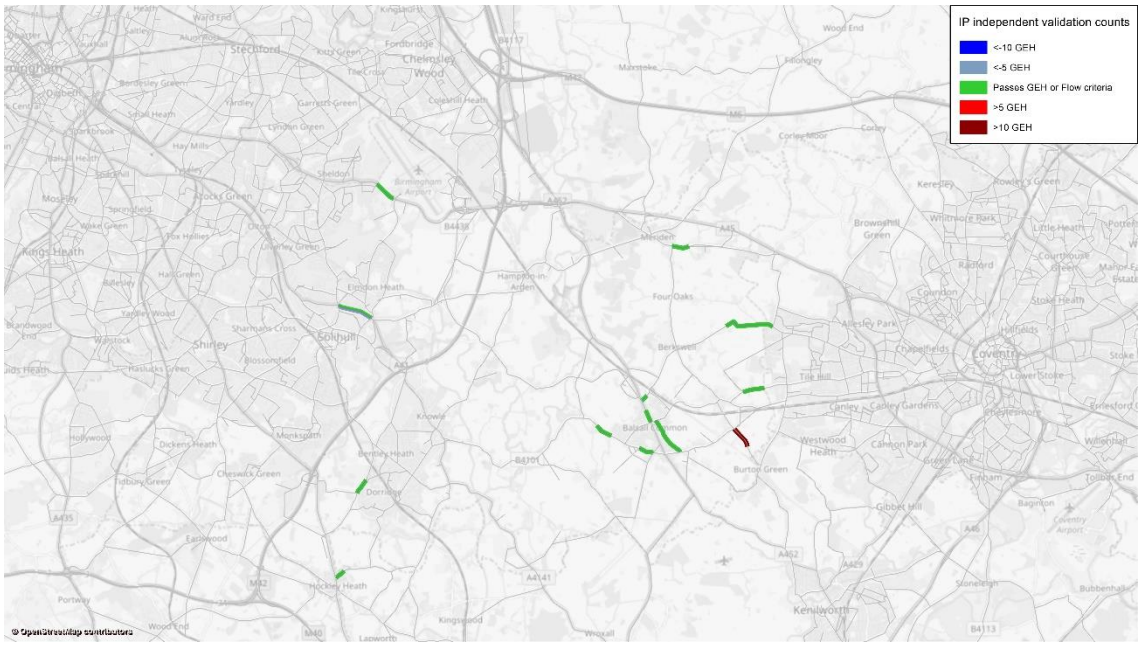


Figure 12: IP validation PRISM

Figure 13: PM validation Solihull

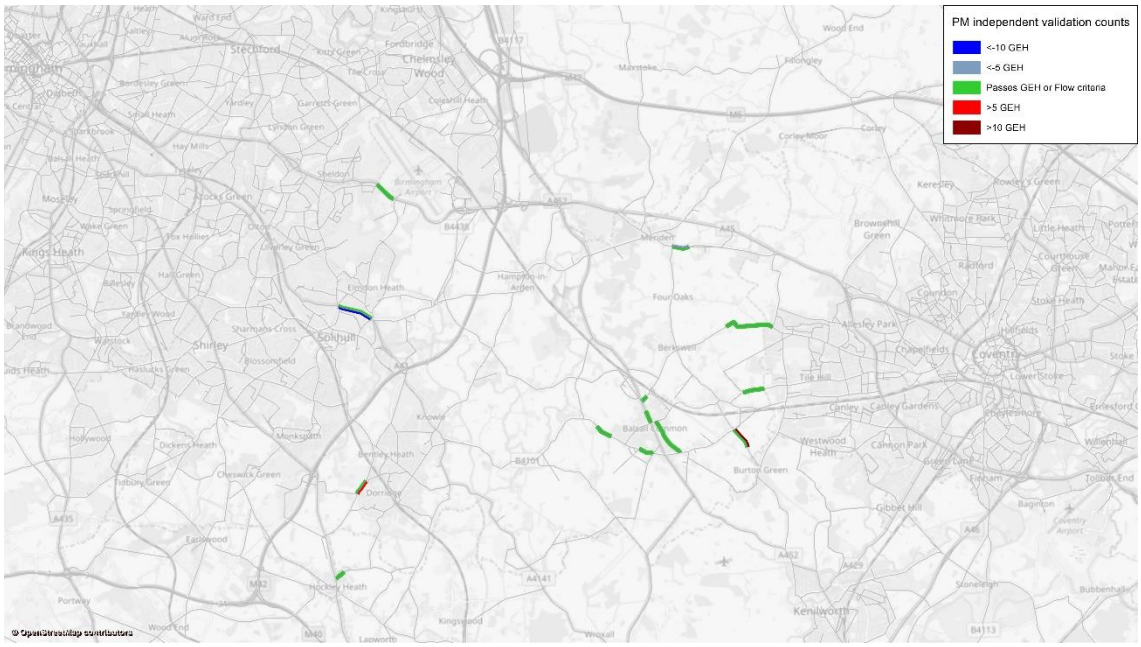
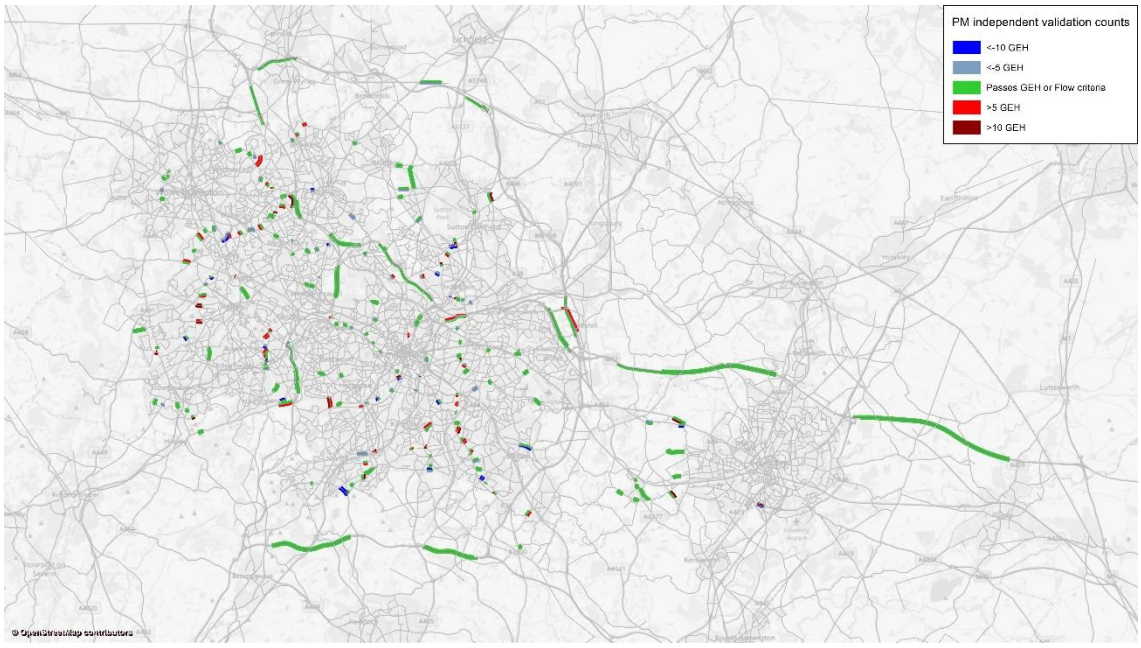


Figure 14: PM validation PRISM



B. PRISM link validation results

Table 18: Validation link results PRISM (WebTAG Criteria)

		Percentage of counts passing WebTAG criteria		Percentage of counts passing WebTAG criteria in PRISM 5	
Time-period	Number of Counts	Car	Total	Car	Total
AM	386	63%	62%	64%	63%
IP	386	67%	64%	67%	64%
PM	386	62%	61%	62%	61%

As with PRISM 5.0, extending the GEH range shows that the overall model fit to the counts is reasonable with over 85% within 10 GEH as shown in **Error! Reference source not found.**.

Table 19: Link Validation results PRISM – wider ranges

		Percentage of counts passing WebTAG criteria			
Time-period	Number of Counts	Car <7.5 GEH	Total < 7.5 GEH	Car <10 GEH	Total <10 GEH
AM	386	74%	73%	86%	84%
IP	386	77%	78%	88%	88%
PM	386	76%	76%	87%	87%

C. Link Calibration

Figure 15: AM calibration Solihull

Figure 16: AM calibration PRISM

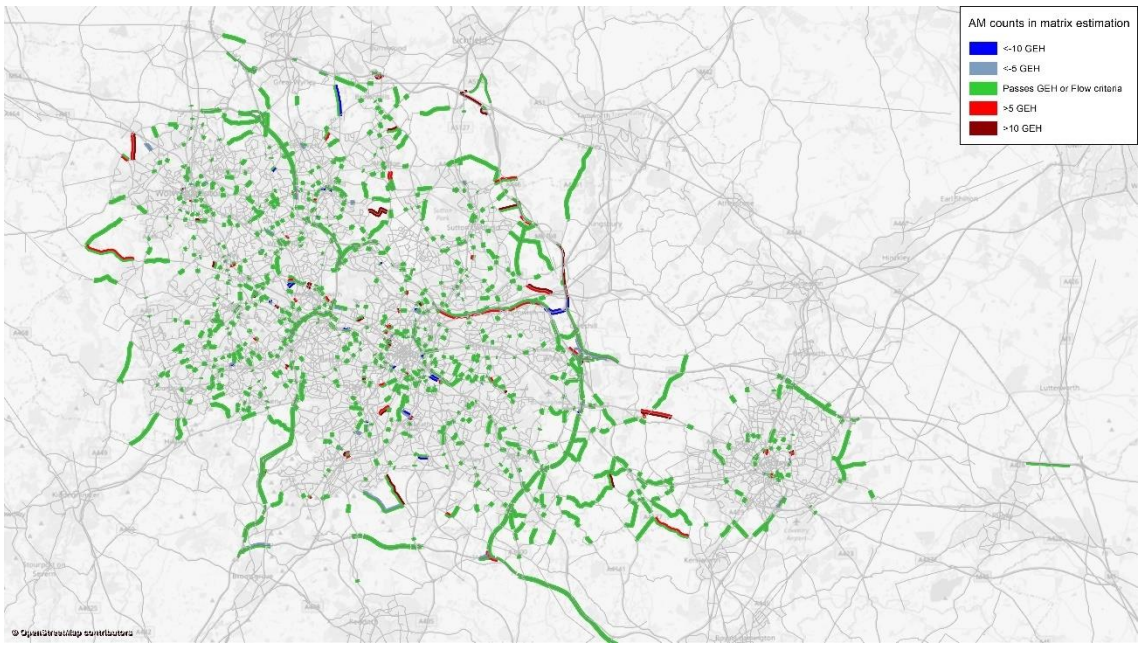


Figure 17: IP calibration Solihull

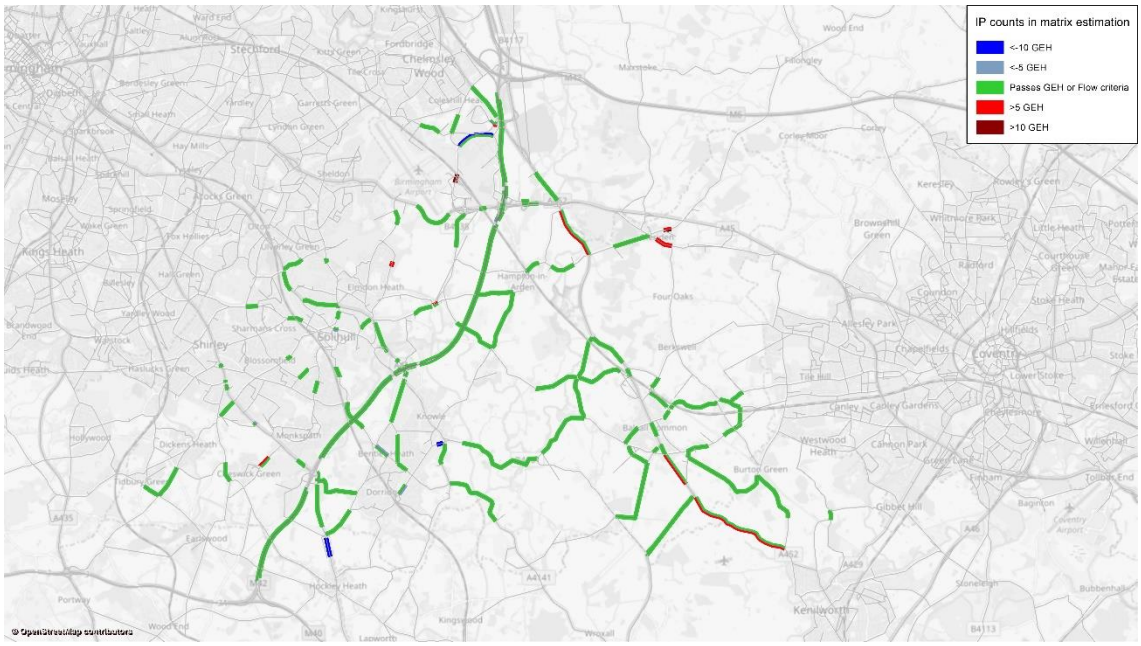


Figure 18: IP calibration PRISM

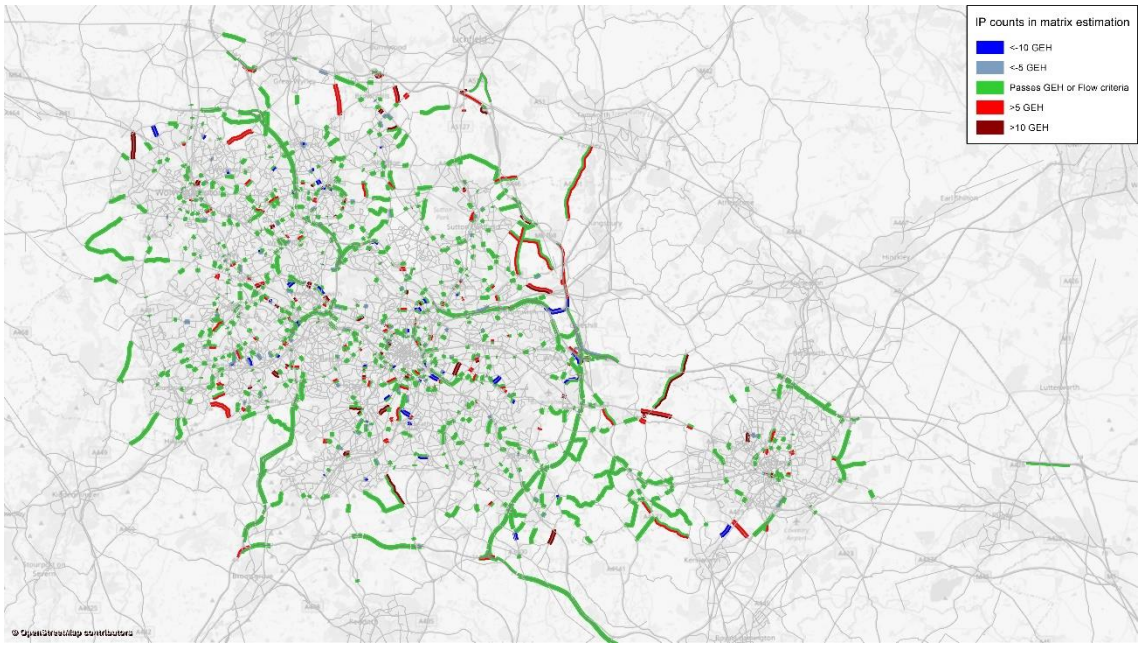
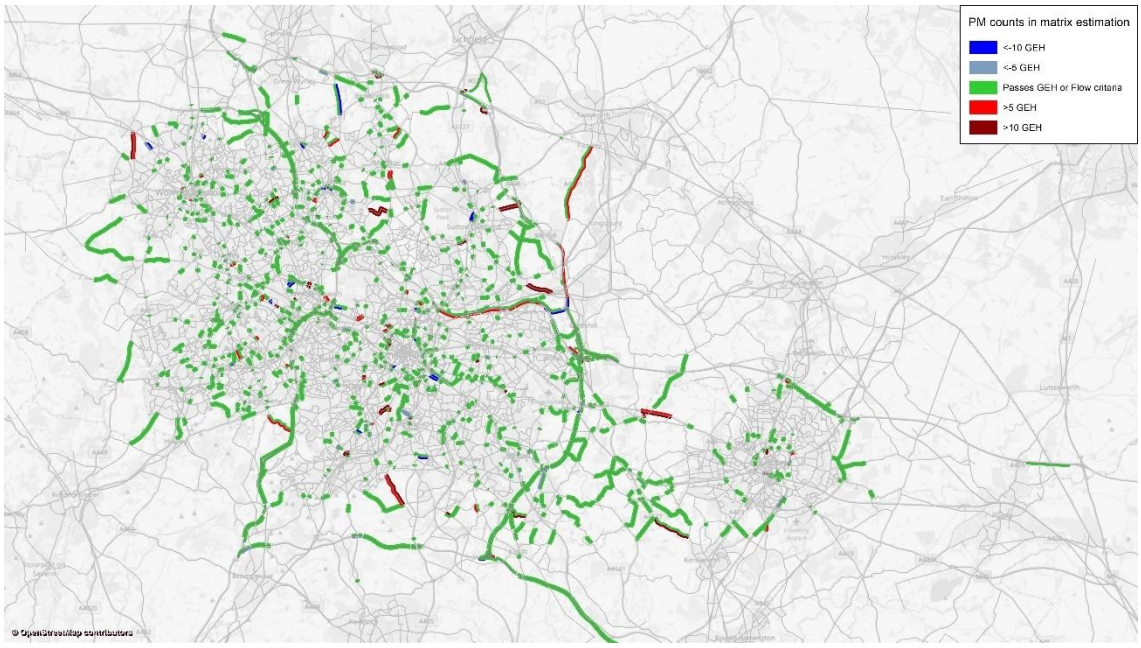


Figure 19: PM calibration Solihull

Figure 20: PM calibration PRISM



D. PRISM link calibration results

Table 20: Calibration link results PRISM (WebTAG Criteria)

		Percentage of counts passing WebTAG criteria		Percentage of counts passing WebTAG criteria in PRISM 5	
Time-period	Number of Counts	Car	Total	Car	Total
AM	2054	81%	76%	84%	79%
IP	2054	85%	79%	87%	81%
PM	2054	81%	78%	83%	80%

The PRISM calibration results with the same extended ranges as shown above for the validation links are presented below in **Error! Reference source not found.**, showing a very good fit to counts when the range is extended.

Table 21: Link Calibration results PRISM – wider ranges

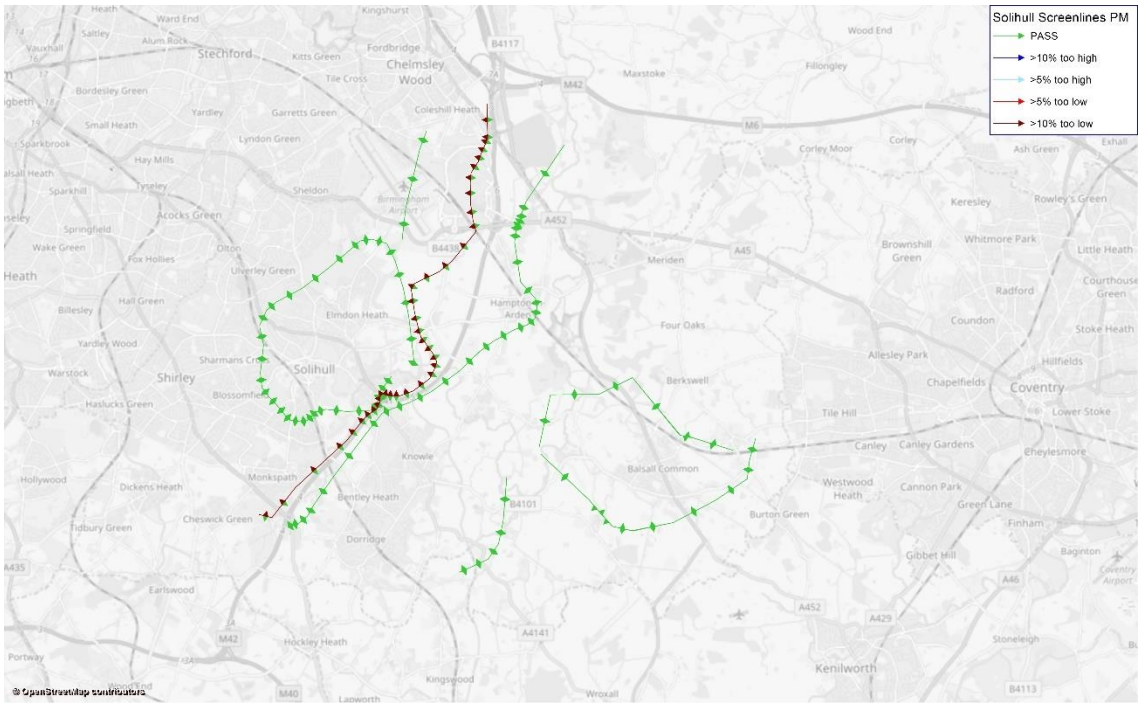
		Percentage of counts passing WebTAG criteria			
Time-period	Number of Counts	Car <7.5 GEH	Total < 7.5 GEH	Car <10 GEH	Total <10 GEH
AM	2054	87%	84%	93%	91%
IP	2054	89%	86%	94%	93%
PM	2054	86%	85%	93%	91%

E. Solihull Screenlines

Figure 21: AM screenlines in Solihull

Figure 22: IP screenlines in Solihull

Figure 23: PM screenlines in Solihull



F. PRISM validation screenlines

Table 22: Validation screenline results PRISM

		Percentage of screenlines with relative difference less than 5% or 4 GEH				Percentage of screenlines with relative difference less than 5% or 4 GEH in PRISM 5			
Time-period	Count	Car	LGV	HGV	Total	Car	LGV	HGV	Total
AM	44	50%	84%	75%	52%	59%	87%	67%	63%
IP	44	52%	98%	52%	57%	57%	98%	52%	54%
PM	44	48%	100%	75%	48%	54%	100%	72%	54%

Error! Reference source not found. shows total vehicle results with the WebTAG criteria ranges extended, showing that for those screenlines that don't pass WebTAG criteria, they aren't far from doing so. This is consistent with the PRISM 5.0 base network and reasonable for such a large strategic model.

Table 23: Validation screenline results PRISM – wider ranges

		Percentage of screenlines (total vehicles) with relative difference of either:		
Time-period	Count	<5% or <4 GEH	<7.5% or <6 GEH	<10% or <10 GEH
AM	44	52%	68%	93%
IP	44	57%	70%	98%
PM	44	48%	61%	93%

G. PRISM calibration screenlines

Table 24: Validation screenline results PRISM

		Percentage of screenlines with relative difference less than 5% or 4 GEH				Percentage of screenlines with relative difference less than 5% or 4 GEH in PRISM 5			
Time-period	Count	Car	LGV	HGV	Total	Car	LGV	HGV	Total
AM	154	80%	99%	84%	80%	85%	100%	92%	85%
IP	154	84%	100%	92%	84%	85%	99%	94%	85%
PM	154	84%	99%	90%	81%	86%	99%	95%	87%

The below table shows total vehicle results with the WebTAG criteria ranges extended, showing that for those screenlines that don't pass WebTAG criteria, they aren't far from doing so. The results show good performance for the calibration screenlines in PRISM.

Table 25: Validation screenline results PRISM – wider ranges

		Percentage of screenlines (total vehicles) with relative difference of either:		
Time-period	Count	<5% or <4 GEH	<7.5% or <6 GEH	<10% or <10 GEH
AM	154	80%	92%	99%
IP	154	84%	95%	98%
PM	154	81%	95%	99%

H. Journey time Validation

Table 26: AM Solihull journey time validation

ID	Route	Dir	Observed time (s)	Modelled time (s)	Time diff (s)	Time diff (%)	Pass Tier X Criteria?	Pass WebTAG Criteria?
1 – Black	A45 Stivichall Interchange - Stonebridge Island	EB	1040	1043	-2	0.2%	✓	✓
1 – Black	A45 Stivichall Interchange - Stonebridge Island	WB	1058	1008	50	4.8%	✓	✓
2 – Orange	A45 Stonebridge Island - Bordesley Circus	EB	1283	1208	75	5.9%	✓	✓
2 – Orange	A45 Stonebridge Island - Bordesley Circus	WB	1395	1262	133	9.5%	✓	✓
3 – Green	A41 Warwick Road	NB	1335	1430	-95	7.1%	✓	✓
3 – Green	A41 Warwick Road	SB	1411	1321	91	6.4%	✓	✓
4 – Yellow	A34 Stratford Road	NB	1666	1576	90	5.4%	✓	✓
4 – Yellow	A34 Stratford Road	SB	1597	1507	90	5.6%	✓	✓
5 – Dark Blue	A452 Chester Road	NB	869	988	-119	13.7%	✓	✓
5 – Dark Blue	A452 Chester Road	SB	935	994	-59	6.3%	✓	✓
6 – Pink	B4128 Bordesley Green East	EB	1237	1300	-63	5.1%	✓	✓
6 – Pink	B4128 Bordesley Green East	WB	1398	1431	-34	2.4%	✓	✓
7 – Light Blue	Damson Parkway/Streetsbrook Road	NB	1111	1081	30	2.7%	✓	✓
7 – Light Blue	Damson Parkway/Streetsbrook Road	SB	1058	1106	-48	4.5%	✓	✓
8 – Light Orange	Kings Norton to Shirley	EB	890	832	58	6.5%	✓	✓
8 – Light Orange	Kings Norton to Shirley	WB	886	858	27	3.1%	✓	✓
9 – Purple	A446 Lichfield Road/Stonebridge Road	NB	665	888	-223	33.5%	×	×
9 – Purple	A446 Lichfield Road/Stonebridge Road	SB	778	775	3	0.4%	✓	✓
10 – Grey	M6 J6 - J3a	NB	802	619	183	22.8%	✓	×
10 – Grey	M6 J6 - J3a	SB	659	592	67	10.1%	✓	✓
11 – Red	M6 - M42 J5	NB	359	324	35	9.8%	✓	✓
11 – Red	M6 - M42 J5	SB	491	522	-32	6.4%	✓	✓

Table 27: IP Solihull journey time validation

ID	Route	Dir	Observed time (s)	Modelled time (s)	Time diff (s)	Time diff (%)	Pass Tier X Criteria?	Pass WebTAG Criteria?
1 – Black	A45 Stivichall Interchange - Stonebridge Island	EB	879	952	-73	8.3%	✓	✓
1 – Black	A45 Stivichall Interchange - Stonebridge Island	WB	900	933	-33	3.6%	✓	✓
2 – Orange	A45 Stonebridge Island - Bordesley Circus	EB	1172	1269	-98	8.3%	✓	✓
2 – Orange	A45 Stonebridge Island - Bordesley Circus	WB	1274	1200	73	5.8%	✓	✓
3 – Green	A41 Warwick Road	NB	1267	1333	-67	5.3%	✓	✓
3 – Green	A41 Warwick Road	SB	1238	1303	-66	5.3%	✓	✓
4 – Yellow	A34 Stratford Road	NB	1678	1522	155	9.2%	✓	✓
4 – Yellow	A34 Stratford Road	SB	1688	1532	156	9.2%	✓	✓
5 – Dark Blue	A452 Chester Road	NB	890	933	-43	4.8%	✓	✓
5 – Dark Blue	A452 Chester Road	SB	851	880	-30	3.5%	✓	✓
6 – Pink	B4128 Bordesley Green East	EB	1336	1380	-44	3.3%	✓	✓
6 – Pink	B4128 Bordesley Green East	WB	1354	1338	16	1.2%	✓	✓
7 – Light Blue	Damson Parkway/Streetsbrook Road	NB	899	1043	-144	16.1%	✓	×
7 – Light Blue	Damson Parkway/Streetsbrook Road	SB	982	1125	-144	14.6%	✓	✓
8 – Light Orange	Kings Norton to Shirley	EB	850	828	22	2.6%	✓	✓
8 – Light Orange	Kings Norton to Shirley	WB	845	831	14	1.7%	✓	✓
9 – Purple	A446 Lichfield Road/Stonebridge Road	NB	645	670	-25	3.8%	✓	✓
9 – Purple	A446 Lichfield Road/Stonebridge Road	SB	620	567	53	8.5%	✓	✓

ID	Route	Dir	Observed time (s)	Modelled time (s)	Time diff (s)	Time diff (%)	Pass Tier X Criteria?	Pass WebTAG Criteria?
10 – Grey	M6 J6 - J3a	NB	621	669	-48	7.8%	✓	✓
10 – Grey	M6 J6 - J3a	SB	585	609	-24	4.1%	✓	✓
11 – Red	M6 - M42 J5	NB	351	433	-82	23.4%	✓	×
11 – Red	M6 - M42 J5	SB	428	466	-38	8.9%	✓	✓

Table 28: PM journey time validation

ID	Route	Dir	Observed time (s)	Modelled time (s)	Time diff (s)	Time diff (%)	Pass Tier X Criteria?	Pass WebTAG Criteria?
1 – Black	A45 Stivichall Interchange - Stonebridge Island	EB	896	992	-96	10.7%	✓	✓
1 – Black	A45 Stivichall Interchange - Stonebridge Island	WB	1101	1001	100	9.1%	✓	✓
2 – Orange	A45 Stonebridge Island - Bordesley Circus	EB	1415	1243	172	12.2%	✓	✓
2 – Orange	A45 Stonebridge Island - Bordesley Circus	WB	1382	1254	128	9.3%	✓	✓
3 – Green	A41 Warwick Road	NB	1501	1471	29	2.0%	✓	✓
3 – Green	A41 Warwick Road	SB	1368	1398	-30	2.2%	✓	✓
4 – Yellow	A34 Stratford Road	NB	1810	1611	199	11.0%	✓	✓
4 – Yellow	A34 Stratford Road	SB	1860	1736	123	6.6%	✓	✓
5 – Dark Blue	A452 Chester Road	NB	1077	1047	30	2.8%	✓	✓
5 – Dark Blue	A452 Chester Road	SB	992	923	68	6.9%	✓	✓
6 – Pink	B4128 Bordesley Green East	EB	1438	1477	-39	2.7%	✓	✓
6 – Pink	B4128 Bordesley Green East	WB	1362	1416	-54	4.0%	✓	✓
7 – Light Blue	Damson Parkway/Streetsbrook Road	NB	932	1164	-232	24.9%	✓	×
7 – Light Blue	Damson Parkway/Streetsbrook Road	SB	1161	1403	-242	20.9%	✓	×
8 – Light Orange	Kings Norton to Shirley	EB	930	885	45	4.8%	✓	✓
8 – Light Orange	Kings Norton to Shirley	WB	912	930	-18	2.0%	✓	✓
9 – Purple	A446 Lichfield Road/Stonebridge Road	NB	795	820	-25	3.2%	✓	✓
9 – Purple	A446 Lichfield Road/Stonebridge Road	SB	655	589	67	10.2%	✓	✓
10 – Grey	M6 J6 - J3a	NB	731	606	125	17.0%	✓	×
10 – Grey	M6 J6 - J3a	SB	625	591	34	5.4%	✓	✓
11 – Red	M6 - M42 J5	NB	433	358	75	17.3%	✓	×
11 – Red	M6 - M42 J5	SB	559	425	135	24.1%	✓	×

I. PRISM journey time validation

Table 29: Journey time validation PRISM

Time-period	Percentage of routes passing				
	All	Tier 1	Tier 2 non-motorway	Tier 2 motorway	Tier 3
	-	< 15%	< 25%	< 25%	< 35%
Count	204	58	56	34	56
AM		84%	93%	91%	93%
IP		78%	96%	100%	93%
PM		81%	95%	88%	93%

The journey time validation has remained very similar to that of PRISM 5.0, and most routes that do not meet their criteria are only just outside. For instance, the tier 1 routes, 95% are within 20% in the AM, 91% in the IP and 93% in the PM.

J. Trip Length Distributions

Figure 24: AM Car Business

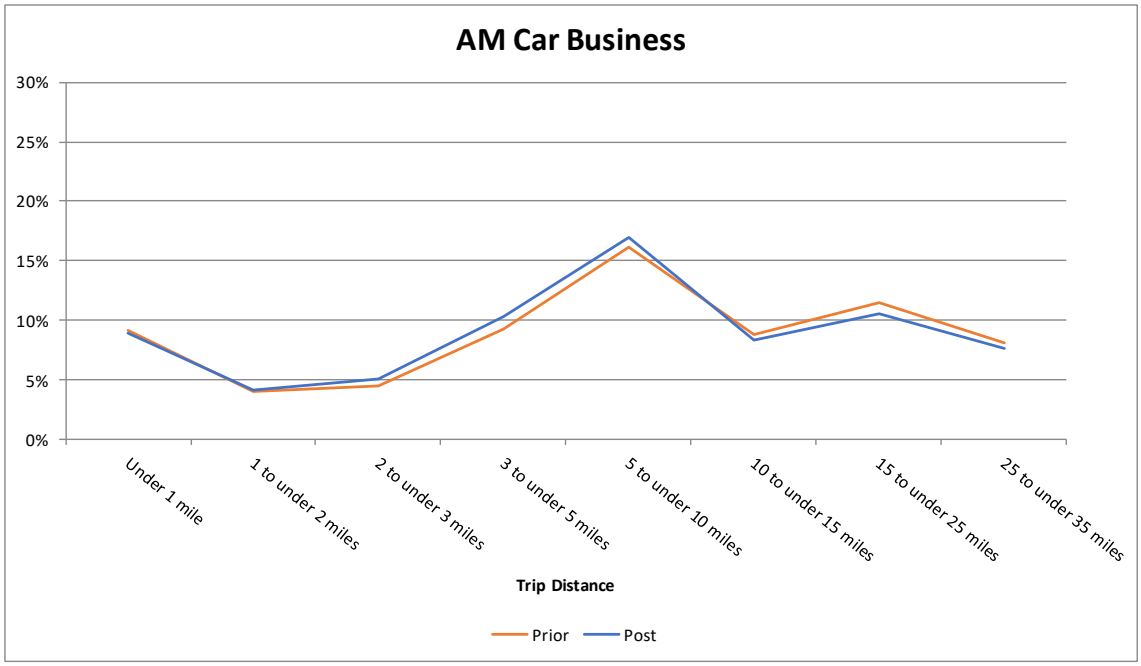


Figure 25: AM Car Commute

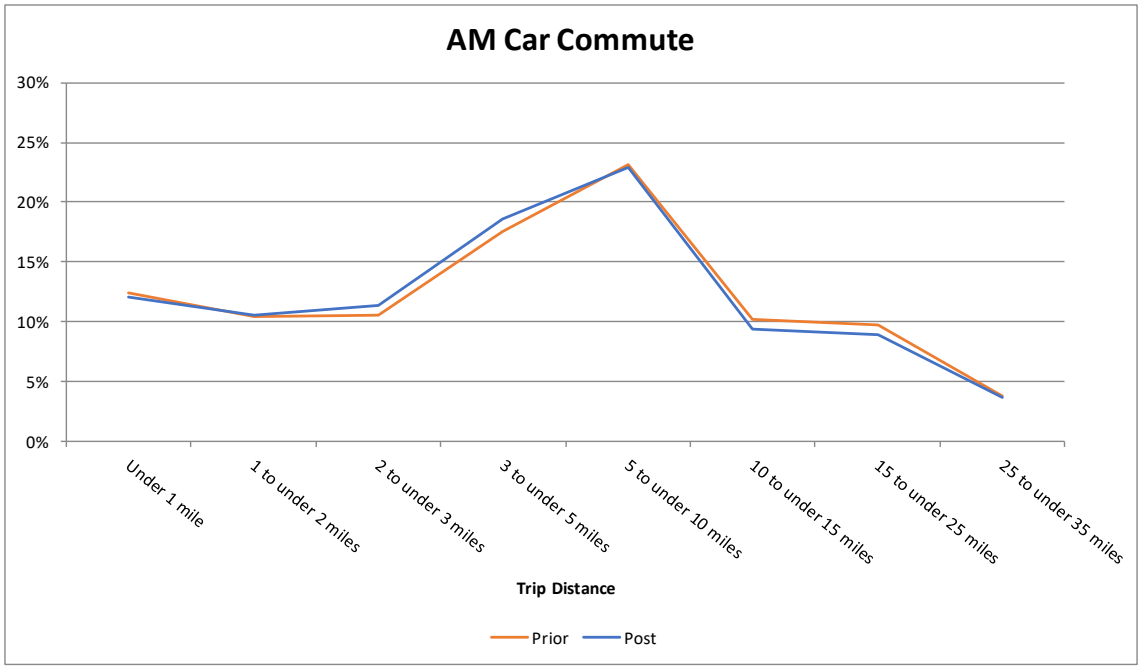


Figure 26: AM Car Other

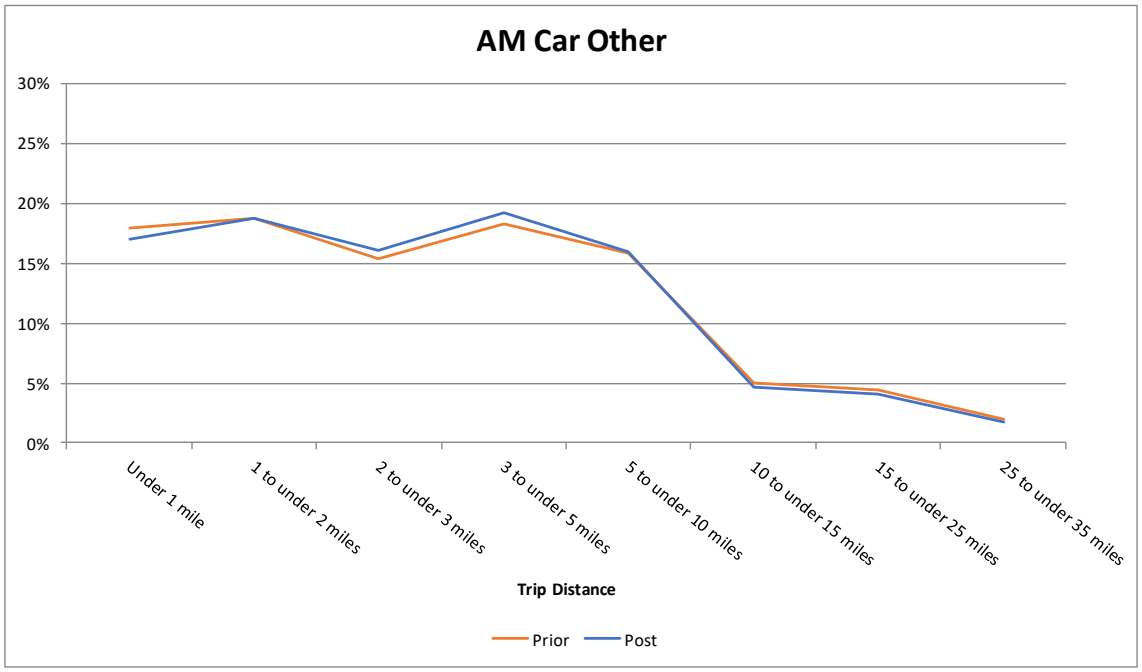


Figure 27: AM LGV

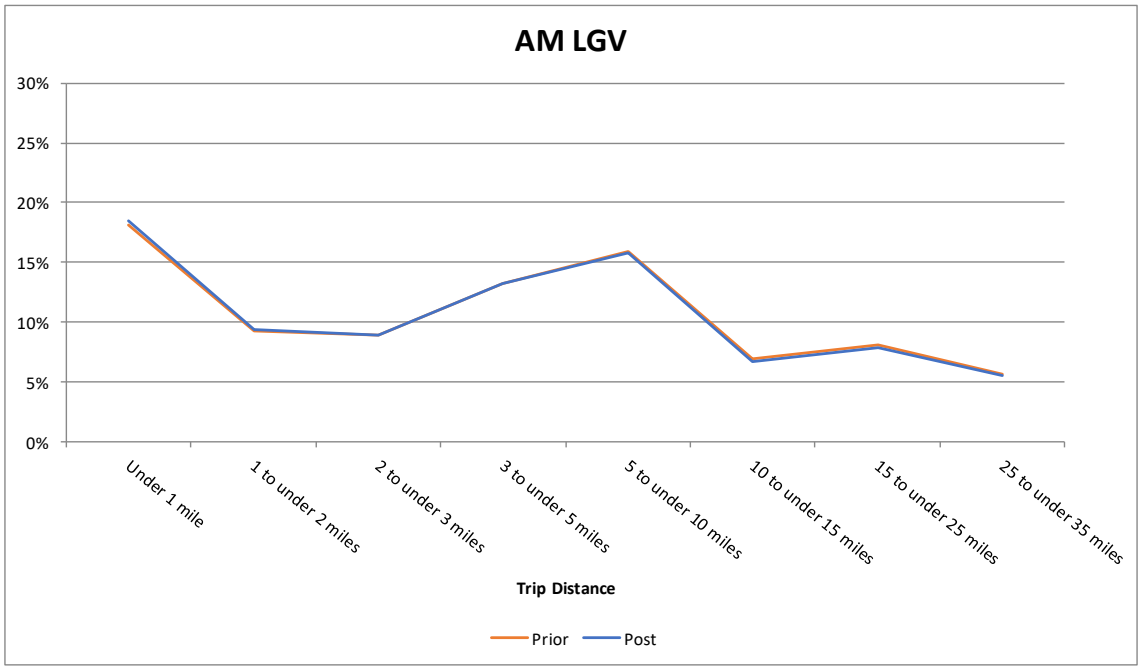


Figure 28: AM HGV

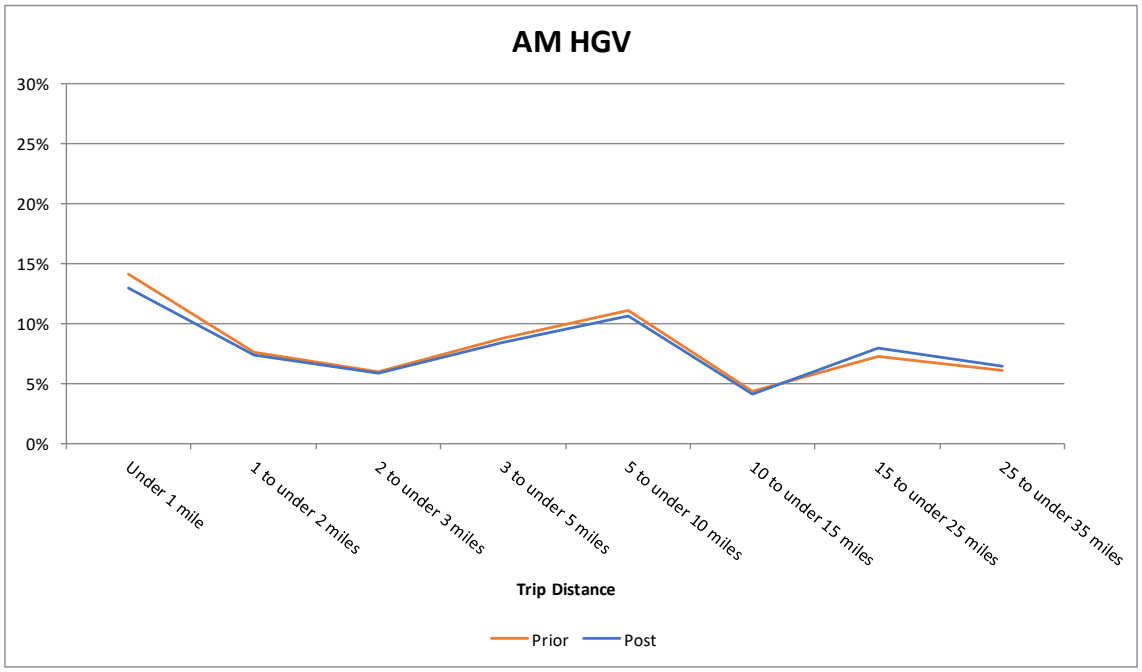


Figure 29: IP Car Business

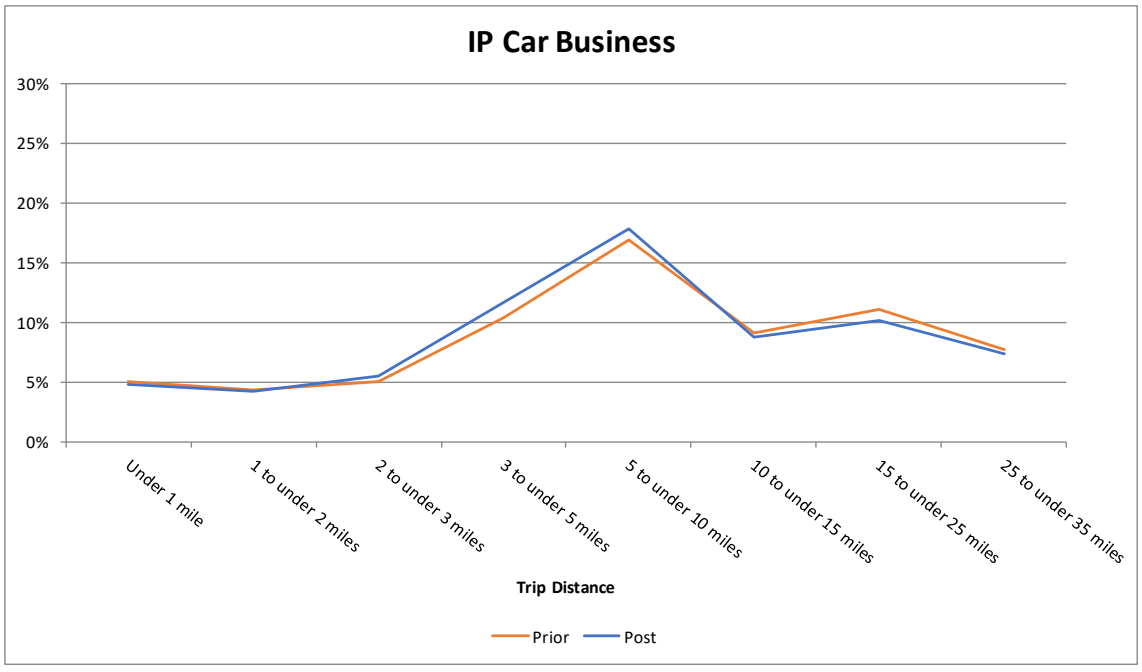


Figure 30: IP Car Commute

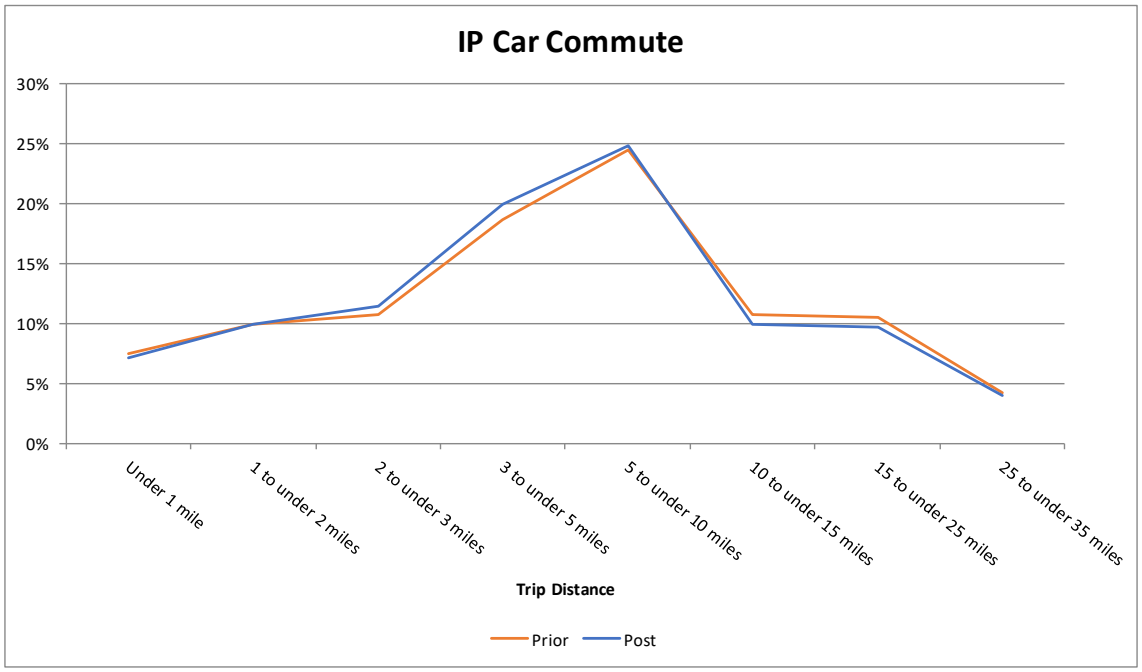


Figure 31: IP Car Other

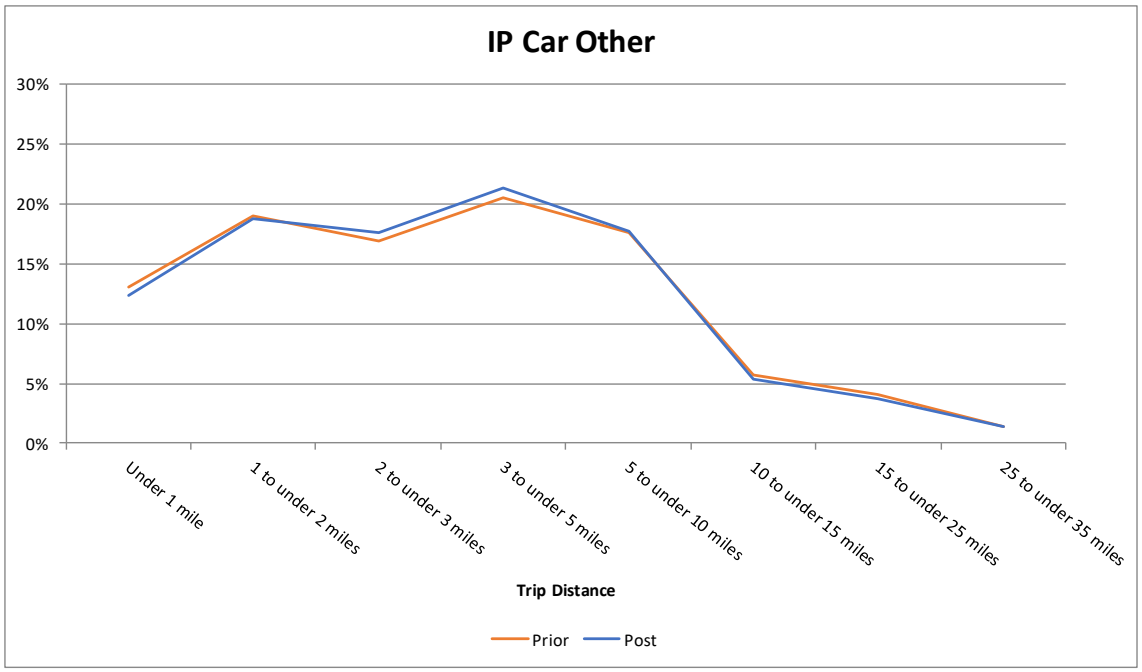


Figure 32: IP LGV

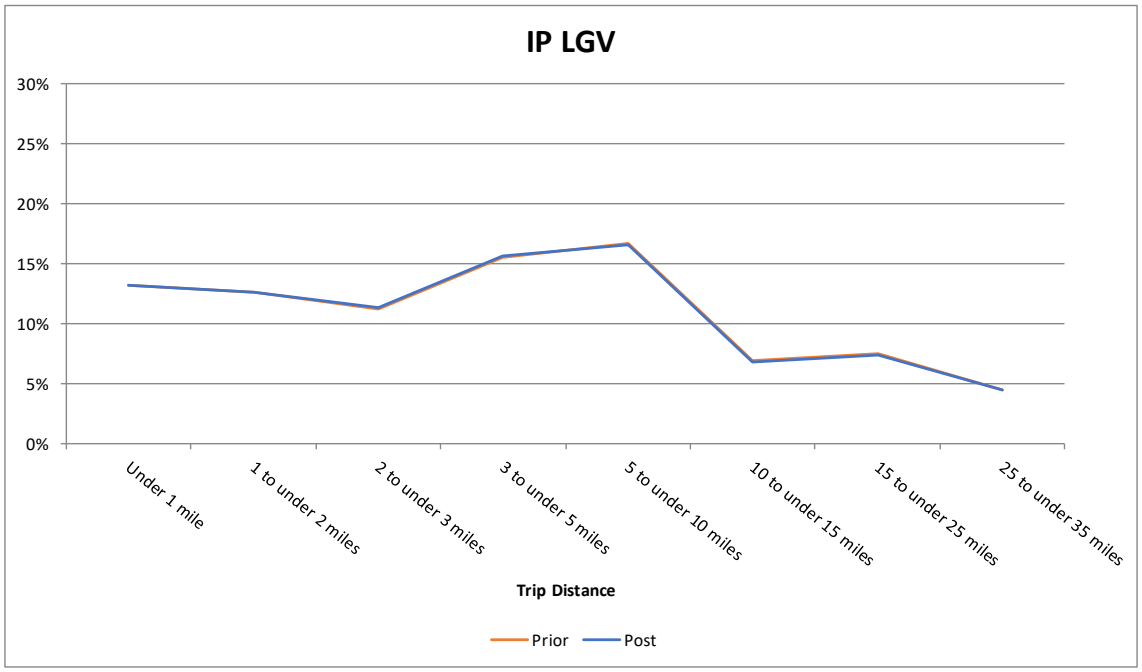


Figure 33: IP HGV

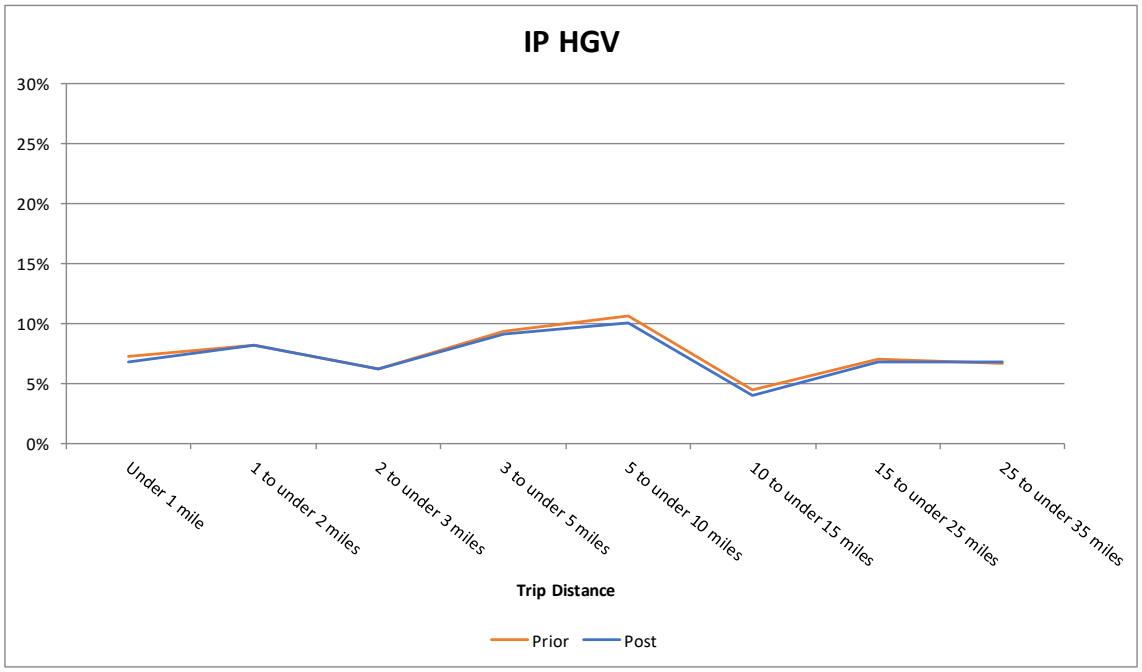


Figure 34: PM Car Business

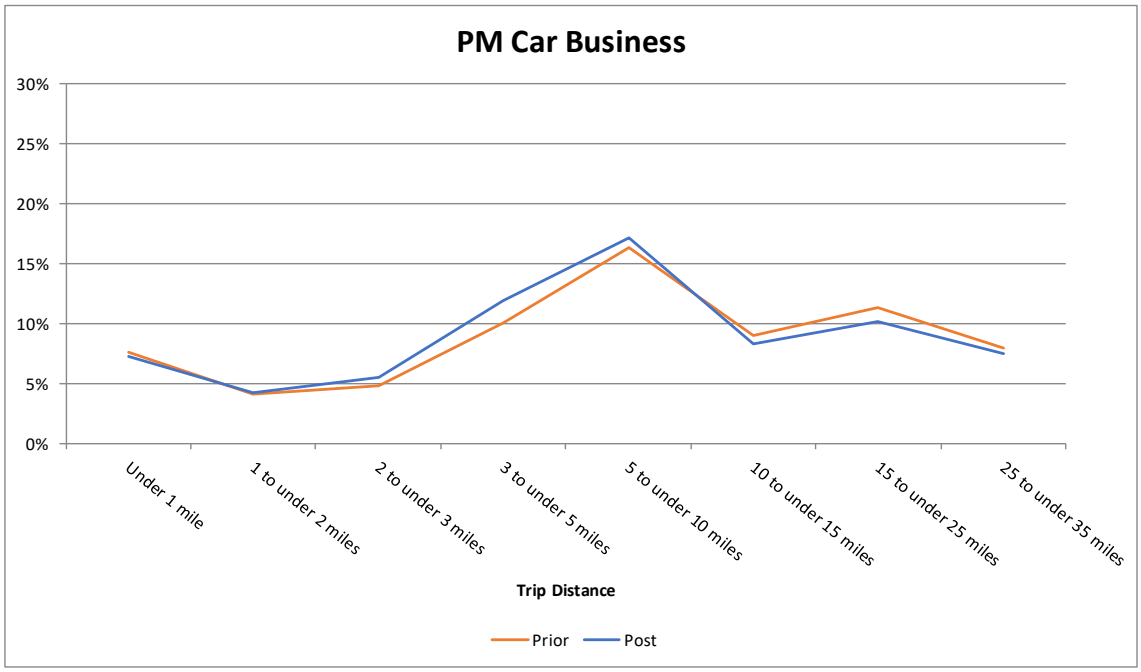


Figure 35: PM Car Commute

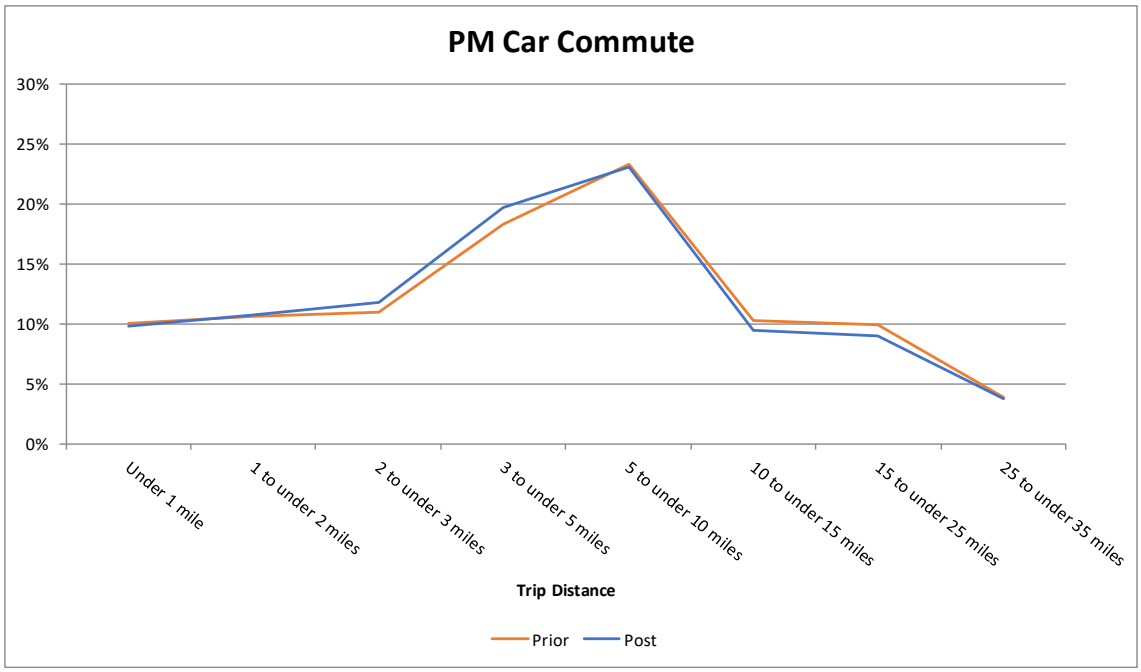


Figure 36: PM Car Other

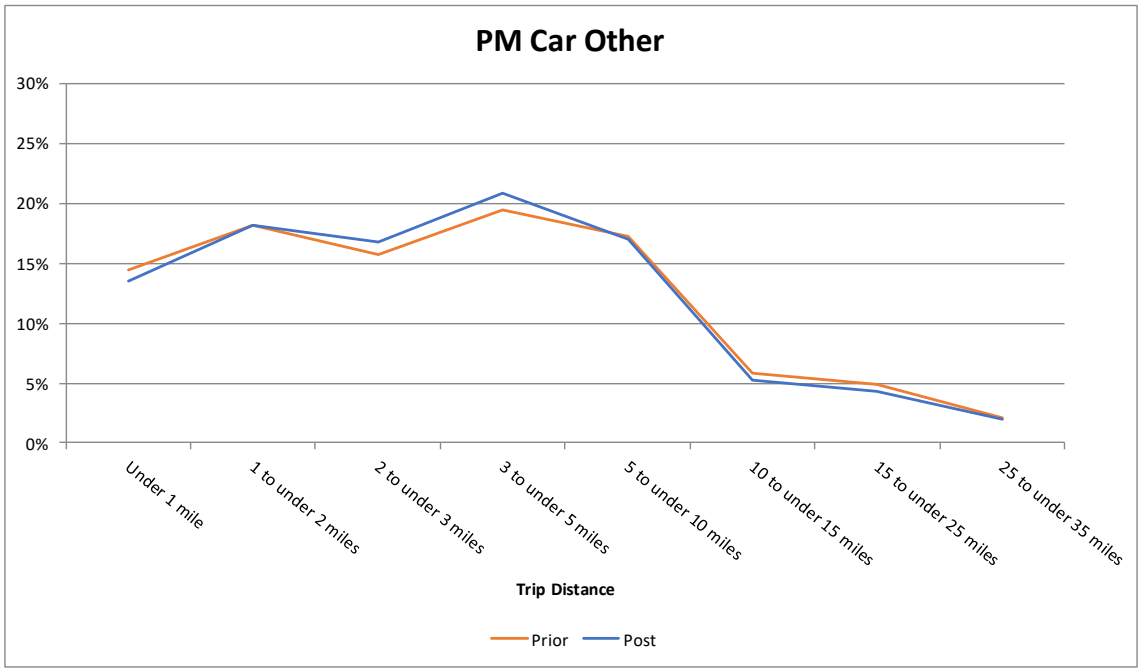


Figure 37: PM LGV

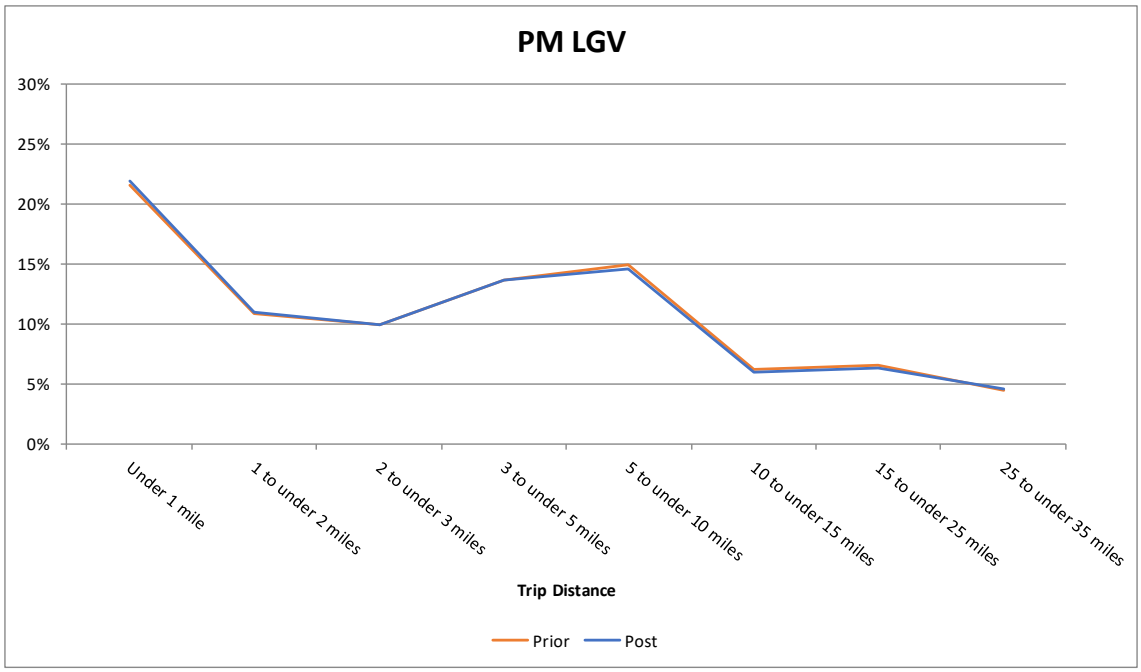
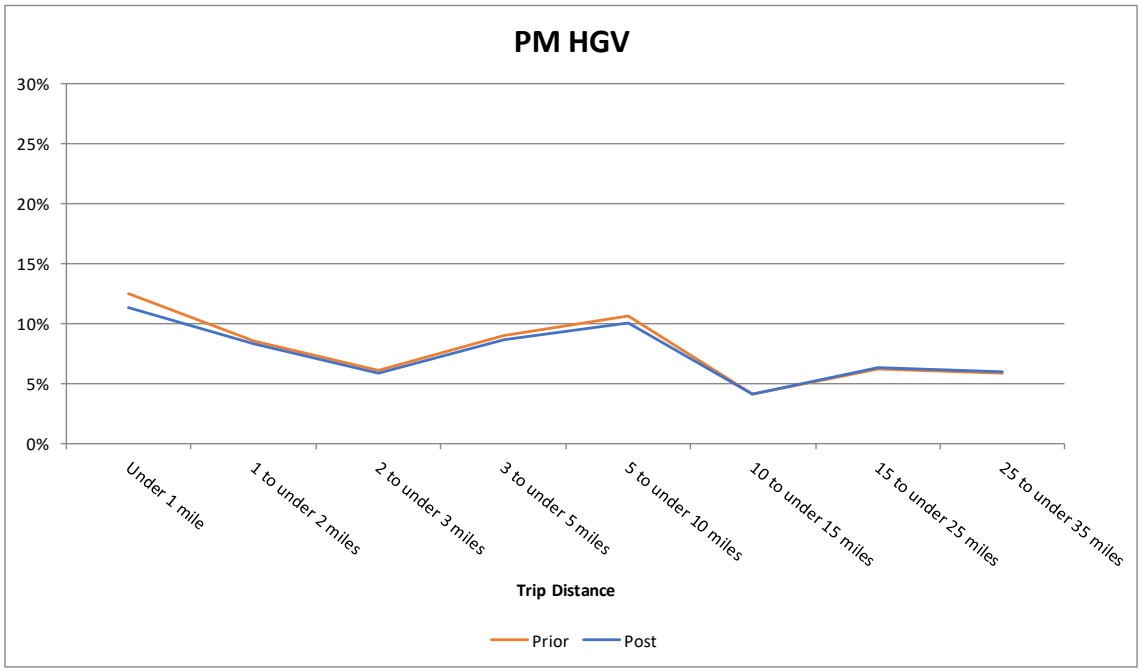


Figure 38: PM HGV



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