PRISM 5.0
Data Summary Report
March 2018
PRISM Management Group

PRISM 5.0

Data Summary Report

March 2018
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# Contents

1 Introduction 1
   1.1 Overview 1
   1.2 Structure of this Report 1

2 Highway Assignment Model Data 2
   2.1 Traffic Count Locations 2
   2.2 Traffic Count Sources 2
   2.3 Traffic Count Factoring and Cleaning 8
   2.4 Journey Time Data 10
   2.5 Previous PRISM road network 15
   2.6 Google Maps/Earth 15
   2.7 Traffic Signal Specifications 15
   2.8 Observed Signal Timing 15
   2.9 M6 Toll Charges 17
   2.10 Trafficmaster GPS OD Matrices 17
   2.11 INRIX GPS OD Matrices 18
   2.12 PRISM Synthetic Car OD Matrices 18
   2.13 Census 2011 Journey to Work Matrices 19

3 Public Transport Assignment Model Data 20
   3.1 Public Transport Passenger Counts 20
   3.2 Public Transport OD Surveys 28
   3.3 PRISM Synthetic Public Transport OD Matrices 30
   3.4 Census 2011 Journey to Work Matrices 30
   3.5 PLANET Long Distance 30
   3.6 HS2 Data 30
   3.7 HS2 Time Period Factors 31
   3.8 Public Transport Timetable Service Data 31
   3.9 Public Transport Fares 32

4 Variable Demand Model Data 33
   4.1 Household Interview Surveys 33
   4.2 Socio-Demographics 34
   4.3 Parking Costs 36
   4.4 Park and Ride parking places 36
Tables
Table 1: Counts by source 4
Table 2: Annual Factors 8
Table 3: Monthly Factors 8
Table 4: Summary of changes made from cleaning inconsistent counts 10
Table 5: M6 Toll 2016 values in 2016 prices (actual cost of the toll in 2016) 17
Table 6: M6 Toll 2016 values in 2010 prices 17
Table 7: Ratios for deriving bus PM counts 21
Table 8: Annual factors 22
Table 9: ORR Train Annual Passenger by West Midlands Districts 24
Table 10: HS2 Time Period Factors – Phase 1 only 31
Table 11: HS2 Time Period Factors – Phase 1 and 2 31

Figures
Figure 1: All available traffic counts by source 5
Figure 2: Traffic counts used in PRISM 5.0 with screenines and Key Route Network 6
Figure 3: Traffic counts used in PRISM 5.0 by year 7
Figure 4: Tracsis counts used for vehicle type splits 9
Figure 5: AM INRIX observations 11
Figure 6: IP INRIX observations 12
Figure 7: PM INRIX observations 12
Figure 8: AM INRIX compared with Google range 13
Figure 9: IP INRIX compared with Google range 14
Figure 10: PM INRIX compared with Google range 14
Figure 11: Location and source of traffic signal data 16
Figure 12: Bus count locations 25
Figure 13: Metro count locations 26
Figure 14: Rail count locations 27
Figure 15: Location of OD surveys for bus, metro and rail 29
1 Introduction

1.1 Overview

The Policy Responsive Integrated Strategy Model (PRISM) is a multi-modal disaggregate demand model of the West Midlands Metropolitan Area. The model comprises separate highway and Public Transport (PT) assignment models linked together with a demand model. The clients are the seven Metropolitan districts of the West Midlands, Highways England and Transport for West Midlands.

PRISM was originally developed to represent a 2001 base year and was later rebased to 2006. A major update of the model was later undertaken to develop a 2011 base year model, known as PRISM 4.1. A series of PRISM versions all with a 2011 base year were subsequently produced to make incremental improvements to the model and to take account of changes to the Department for Transport’s (DfT’s) national assumptions; these versions of PRISM were known as PRISM 4.5 through to PRISM 4.8. A summary of the main differences between the previous versions of PRISM is presented in the PRISM 5.0 Model Validation Report (MVR).

In 2016 the PRISM Management Group (PMG) recognised that a 2011 base year would soon reach the end of its useful life according to the webTAG recommendation that model data should not be more than six years old. An extensive scoping exercise was undertaken to outline the methodology and identify the data required to update the model, which included discussions with the DfT to seek their advice and early engagement. Subsequently Mott MacDonald was commissioned to obtain new data and develop PRISM 5.0 with a 2016 base year. The main objective was to produce a version of PRISM based on more recent data, however through liaison with PMG we took the opportunity to introduce a number of other enhancements to the model. The differences between PRISM 5.0 and the previous version PRISM 4.8 are presented in the PRISM 5.0 MVR.

1.2 Structure of this Report

The purpose of this report is to summarise the data collected and used for the development of PRISM 5.0. The report is structured such that data for the highway assignment model, public transport assignment model and the variable demand model are presented in separate chapters.

For information on the technical aspects of the model development, please refer to the other PRISM 5.0 reports:

- PRISM 5.0 Model Validation Report
- PRISM 5.0 Future Year Report
2 Highway Assignment Model Data

2.1 Traffic Count Locations

To update the PRISM base year from 2011 to 2016, a large amount of traffic count data was required.

Screenlines and cordons were identified that were suitable for validating the trip matrices and that as far as possible made use of existing count data. Following this, a gap assessment was undertaken that identified the need for 176 additional traffic counts to be collected to complete the screenlines.

The number of existing counts not on screenlines exceeded practical limits of what should be included in strategic model. Therefore a process of identifying counts to keep and counts to ignore was undertaken, with a focus on the Key Route Network (KRN).

In total 2042 count locations (mostly 2-way) have been used in the development of PRISM 5.0.

Figure 1 shows the location of all available counts, colour coded by source. These may be useful for adding detail to local models derived from PRISM 5.0 if needed for specific applications.

Figure 2 shows the location of the counts used in PRISM 5.0, overlaid with the KRN and screenlines. This demonstrates where gaps in the screenlines were plugged with new counts, and how the selected counts provide suitable coverage of the KRN.

Figure 3 shows the location of the counts used in PRISM 5.0, by year.

2.2 Traffic Count Sources

Details of each count source are provided below.

Spectrum

Spectrum is a database of traffic count data collected within the West Midlands and maintained by Mott MacDonald. Traffic count data was extracted from Spectrum using the following conditions:

- Data is from an Automatic Traffic Count (ATC)
- The survey was undertaken between 2013 and 2017; and
- The survey lasted one week or more

Most of the count data extracted from Spectrum was for total vehicles and required splitting by vehicle type for use in PRISM 5.0. Details of this process is provided in section 2.3.

In addition some of the Spectrum counts required factoring to a neutral month in 2016. Details of this process is provided in section 2.3.

In total 832 counts, a mixture of one-way and two-way, were extracted from Spectrum for use in PRISM 5.0.
Coventry Area Strategic Model (CASM)

WSP Parsons Brinckerhoff provided the 2013 CASM (Coventry Area Strategic Model) base network which contained observed count data around Coventry. Many of the counts used in CASM were taken from Spectrum, however some additional counts undertaken specifically for CASM that were not available on Spectrum were extracted for use in PRISM 5.0.

The observed data in the CASM network represented a neutral month in 2013 and was split by the CASM time periods, therefore required factoring to 2016 and to the PRISM time periods. Details of this process are provided in section 2.3.

In total 8 counts were extracted from the CASM network for use in PRISM 5.0.

Walsall Council

Automatic number plate recognition (ANPR) counts for a number of roads in Walsall town centre were provided by Walsall Council. 10 of these were used in PRISM 5.0. These counts were collected in March 2016 meaning no factoring was required to bring them up to PRISM 5.0 base although they were total vehicle counts needed splitting by vehicle type.

Midlands Regional Transport Model (MRTM)

A large amount of observed traffic count data collected for and used in the calibration and validation of the Midland Regional Traffic Model was provided by Highways England. The count data contained a mix of both motorway and non-motorway counts, however only non-motorway counts were used for PRISM 5.0 as we extracted new motorway counts from WebTRIS (see below).

The observed data from MRTM represented a neutral month in 2015 and was split by the MRTM time periods, therefore required factoring to 2016 and to the PRISM time periods. Details of this process are provided in section 2.3.

In total 51 counts from MRTM were used in PRISM 5.0.

WebTRIS

Highways England’s repository of traffic counts WebTRIS was used to obtain count data on the strategic road network. WebTRIS data was downloaded for all days between 1st February 2016 and 31st July 2016 to be consistent with the INRIX data used for journey times. Bank holidays during this period were removed from the data. Data from WebTRIS records vehicle length which we used to split the count data into Lights and Heavies using a cut-off of 6.6m as advised in webTAG Unit M1 para 3.3.34.

In total 161 counts were extracted from WebTRIS for use in PRISM 5.0.

AECOM

Count data collected at four locations was shared by AECOM. Three of the counts were total vehicle counts conducted over two weeks in February 2016. These were located around the M6 J10 area on A454 Wolverhampton Road, A454 Black Country Route and Churchill Road. These three counts needed to be split into vehicle types for use in PRISM 5.0. The fourth count was a two week count collected in September/October 2016 just outside Birmingham on Spring Hill. This count was split by vehicle types so just needed factoring to a neutral month for use in PRISM 5.0.
Streetwise

Streetwise were commissioned to collect two week Automatic Traffic Counts (ATCs) at 96 sites to plug gaps in screenlines. These sites were a mix of one and two directional counts and were undertaken in March 2016, with a few sites needing to be re-installed during May 2016.

The Streetwise counts were provided by Lights and Heavies therefore we had to split Lights into cars and LGVs for use in PRISM 5.0. Details of this process are provided in section 2.3.

Tracsis

To spread the workload we also commissioned Tracsis to collect two week ATCs at 80 additional sites. All these were two directional counts and were undertaken in March 2016.

The Tracsis counts were provided by car, LGV and HGV and therefore no further factoring was required.

Summary

Table 1 provides a summary of the count data used in PRISM 5.0

Table 1: Counts by source

<table>
<thead>
<tr>
<th>Source</th>
<th>Year</th>
<th>Type</th>
<th>Vehicle splits</th>
<th>Number of counts used in PRISM 5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>AECOM</td>
<td>2016</td>
<td>ATC</td>
<td>Car, LGV, HGV</td>
<td>1</td>
</tr>
<tr>
<td>AECOM</td>
<td>2016</td>
<td>ATC</td>
<td>Total</td>
<td>3</td>
</tr>
<tr>
<td>CASM</td>
<td>2013</td>
<td>Turning count</td>
<td>Car, LGV, HGV</td>
<td>2</td>
</tr>
<tr>
<td>CASM</td>
<td>2013</td>
<td>ATC</td>
<td>Car, LGV, HGV</td>
<td>6</td>
</tr>
<tr>
<td>MRTM</td>
<td>2015</td>
<td>ATC</td>
<td>Car, LGV, HGV</td>
<td>51</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2011</td>
<td>ATC</td>
<td>Total</td>
<td>1</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2012</td>
<td>ATC</td>
<td>Total</td>
<td>1</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2013</td>
<td>ATC</td>
<td>Total</td>
<td>36</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2013</td>
<td>ATC</td>
<td>Lights &amp; Heavies</td>
<td>1</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2014</td>
<td>ATC</td>
<td>Total</td>
<td>182</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2014</td>
<td>ATC</td>
<td>Lights &amp; Heavies</td>
<td>1</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2015</td>
<td>ATC</td>
<td>Total</td>
<td>384</td>
</tr>
<tr>
<td>Spectrum</td>
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<td>ATC</td>
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<td>1</td>
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<tr>
<td>Spectrum</td>
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<td>ATC</td>
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<td>220</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2016</td>
<td>ATC</td>
<td>Lights &amp; Heavies</td>
<td>1</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2017</td>
<td>ATC</td>
<td>Total</td>
<td>3</td>
</tr>
<tr>
<td>Spectrum</td>
<td>2017</td>
<td>ATC</td>
<td>Lights &amp; Heavies</td>
<td>1</td>
</tr>
<tr>
<td>Streetwise</td>
<td>2017</td>
<td>ATC</td>
<td>Lights &amp; Heavies</td>
<td>96</td>
</tr>
<tr>
<td>Tracsis</td>
<td>2017</td>
<td>ATC</td>
<td>Car, LGV, HGV</td>
<td>80</td>
</tr>
<tr>
<td>Walsall Council</td>
<td>2016</td>
<td>ANPR</td>
<td>Total</td>
<td>10</td>
</tr>
<tr>
<td>WebTRIS</td>
<td>2016</td>
<td>MIDAS</td>
<td>Lights &amp; Heavies</td>
<td>161</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>1242</strong></td>
</tr>
</tbody>
</table>
Figure 1: All available traffic counts by source
Figure 2: Traffic counts used in PRISM 5.0 with screenlines and Key Route Network
Figure 3: Traffic counts used in PRISM 5.0 by year
2.3 Traffic Count Factoring and Cleaning

Factoring to a Neutral Month in 2016

Two factors were calculated to factor all count data to a neutral month in 2016. Firstly, annual factors for AM, IP and PM were calculated using WebTRIS data for 11 motorway sites around the West Midlands. Data was extracted for 2011 up to 2017 in order to calculate annual factors to convert counts from all years to 2016. WebTRIS data was used because it was the only source of permanent count site data in the West Midlands from which annual factors could be calculated.

Seasonal factors to convert to a neutral month were calculated using the only available permanent count on the A38(M), extracting the data from 2011 up to 2016. March has been used as the target neutral month.

Table 2 shows the annual factors applied to counts. The AM and PM annual factors are all close to one, however the IP shows clear growth in traffic, indicating a peak spreading effect.

Table 2: Annual Factors

<table>
<thead>
<tr>
<th>Year of count</th>
<th>AM Factor</th>
<th>IP Factor</th>
<th>PM Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>0.98</td>
<td>1.05</td>
<td>1.01</td>
</tr>
<tr>
<td>2012</td>
<td>1.00</td>
<td>1.07</td>
<td>1.02</td>
</tr>
<tr>
<td>2013</td>
<td>0.99</td>
<td>1.05</td>
<td>1.01</td>
</tr>
<tr>
<td>2014</td>
<td>0.99</td>
<td>1.04</td>
<td>1.00</td>
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<tr>
<td>2015</td>
<td>0.99</td>
<td>1.02</td>
<td>1.00</td>
</tr>
<tr>
<td>2016</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2017</td>
<td>1.00</td>
<td>0.99</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 3: Monthly Factors

<table>
<thead>
<tr>
<th>Month of count</th>
<th>Factor to get to neutral month</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1.09</td>
</tr>
<tr>
<td>February</td>
<td>1.01</td>
</tr>
<tr>
<td>March</td>
<td>1.00</td>
</tr>
<tr>
<td>April</td>
<td>1.04</td>
</tr>
<tr>
<td>May</td>
<td>1.04</td>
</tr>
<tr>
<td>June</td>
<td>0.99</td>
</tr>
<tr>
<td>July</td>
<td>1.08</td>
</tr>
<tr>
<td>August</td>
<td>1.09</td>
</tr>
<tr>
<td>September</td>
<td>1.00</td>
</tr>
<tr>
<td>October</td>
<td>0.99</td>
</tr>
<tr>
<td>November</td>
<td>0.99</td>
</tr>
<tr>
<td>December</td>
<td>1.06</td>
</tr>
</tbody>
</table>

Factoring to Vehicle Type

The majority of counts for use in PRISM 5.0 were either total vehicle counts or split between lights and heavies only. These counts needed to be split out into Car, LGV and HGV. All counts
received from Tracsis were recorded with these three vehicle splits and these counts were used as the basis to calculate factors for all counts that needed splitting.

A mapping process to match all Tracsis counts within a 12km radius and of the same link type of any count that needed to be split was undertaken. Three levels of link classifications were used: dual-carriageways, A-roads, and other. All Tracsis counts that were matched for an individual count site that needed splitting, were used to calculate a vehicle type factor for that individual count. The only area where this couldn’t be done was for Coventry, as all Tracsis counts were primarily conducted west of the M42. Therefore, counts in Coventry that needed splitting into vehicle types were done using the same method, but using all Tracsis counts on matching link types to calculate a vehicle type factor for each individual count.

Figure 4 illustrates the coverage of Tracsis counts used for vehicle type splits (with a 12km radius circle for illustration purposes).

Figure 4: Tracsis counts used for vehicle type splits

Motorway count data from WebTRIS comes split into lights and heavies, with no distinction for car and LGV. It was decided not to use the Tracsis counts to split the motorway data into car and LGV from lights as the split on motorway and non-motorway roads is unlikely to be similar. Therefore, motorway count data was retained at a lights and heavies level.

Cleaning to remove Inconsistent Counts

With so much data from various sources, it was important to clean the count data to remove any inconsistent counts. The TFlowFuzzy (TFF) tool used for matrix estimation in VISUM provides a diagnostic file which, among other information, provides information on pairs of links where the observed data conflicts making it hard for matrix estimation to work. For instance, if one link had a count that required a reduction in modelled trips along the link to closer match the count and another link, which many of the same OD pairs use, required an increase in modelled trips to closer match the count, the TFF diagnostic file might list these two count locations as being in conflict.
Using this diagnostic file we could identify counts that appeared to be in conflict and check the raw data to see if there was any issue that meant the count needed to be removed or replaced with a count from a different year at the same site. Table 4 below summarises the changes made to the count data following this investigation using the TFF diagnostic file.

Table 4: Summary of changes made from cleaning inconsistent counts

<table>
<thead>
<tr>
<th>Investigation into count findings</th>
<th>Number of sites replaced due to issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outliers in raw data, an alternative count sourced in the same location</td>
<td>6</td>
</tr>
<tr>
<td>Raw data mentions roadworks present impacting traffic, an alternative count sourced in the same location</td>
<td>1</td>
</tr>
<tr>
<td>Count was placed on incorrect link in the model, move to correct link</td>
<td>3</td>
</tr>
</tbody>
</table>

2.4 Journey Time Data

Observed data for PRISM 5.0 journey time validation was provided by INRIX. The data provided covers the period between 1st February 2016 to 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.

The INRIX files were converted to GPX file format which can be read into VISUM as paths and matched to links in the PRISM 5.0 network. This provides multiple observations along all journey time route links allowing for an average observed link time to be obtained for all PRISM 5.0 journey time route links.

A process to remove unwanted trip data from the INRIX files was undertaken before importing into the PRISM 5.0 network. This process removed trips that did not fit the below criteria:

- Car or LGV
- Occurs on a weekday and not a bank holiday
- Average time gap between gpx points is less than 5 seconds
- Minimum number of gpx points per track is 10

The frequency that devices ping their location can vary, from a few seconds to over a minute. The higher the frequency of the pings (or gpx points), the more accurate the trip record in terms of its route, location and time. In order to retain as much accuracy as possible within the observed data, we removed trip records with a low frequency between gpx points. From experimentation we found that removing trip records with more than 5 seconds between gpx points retained a sufficient number of observations.

INRIX data was purchased covering all the PRISM Area of Detailed Modelling. Only data required for the journey time routes was processed, however it would be possible to process the data for other routes in future if needed.

Cleaning of outliers

Once imported to VISUM, a process to clean the INRIX data for outliers was undertaken. Firstly, all observations with a speed less than 5kph or greater than 120kph (or 150kph for motorways) were filtered out from the data.
Secondly, a number of extreme outliers were still present and these were cleaned by removing records where the observed time was outside an 80% range of the average for each link. This final data set was then used to calculate an average observed time for each journey time link, making up the observed time for all routes.

The above process was fine for most links but there were a couple of additional steps to take for a small number of links along the journey time routes. Once the above cleaning was done, of the 7307 links along journey time routes, there were 24 links across the three time-periods that were left with no data due to the observed speed falling outside the filter criteria. These were all links of extremely small length, many 0.001km long, that exist due to the fact bus stops from the Public Transport network are positioned next to each other. For these few links, the average of the handful of observations were taken with no filtering. As they are such small links, many with observed times of 1 or 2 seconds, they will not have much impact on the overall journey time route times.

Additionally, when the INRIX data was imported into VISUM, there were a small number of links which ended up with no data. In this instance, 2016 TrafficMaster data was used to get observed times for these few additional links to ensure all journey time routes were complete.

Sample size

The graphs below illustrate the number of observations across all the journey time route links in the network per time-period after cleaning of the data.

**Figure 5: AM INRIX observations**

![AM INRIX observations after cleaning](image-url)
Verification against Google journey times

A further check on the INRIX data was carried out by comparing it with the expected minimum and maximum travel time from Google. This check was done for all tier 1 journey time routes, excluding the ring road routes around the urban centres. In all but 1 case in the AM and PM, the
INRIX data fell within the minimum and maximum range when compared to Google. The Google minimum and maximum travel time was taken from a weekday in March 2016 for 8AM, 12PM and 5PM for the AM, IP and PM time-periods. See graphs below comparing INRIX with minimum and maximum times from Google.

**Figure 8: AM INRIX compared with Google range**
Figure 9: IP INRIX compared with Google range

Figure 10: PM INRIX compared with Google range
2.5 Previous PRISM road network

Rather than building an entirely new network for PRISM 5.0 2016 base, the PRISM 4.8 2011 base year networks were used as a starting point and updated to 2016 road conditions based on scheme and roadwork information provided from the local authorities of the West Midlands. A list of the schemes and roadworks included in the 2016 base network are provided in the PRISM 5.0 MVR.

2.6 Google Maps/Earth

Ariel mapping with Google Maps was used to update road and junction layouts and as a method of checking for updates that needed to be made to bring PRISM 5.0 base network up to 2016.

2.7 Traffic Signal Specifications

The Intersection Capacity Analysis (ICA) module within VISUM has been used in conjunction with an equilibrium assignment to model junction delay within the Area of Detailed Modelling. In order to correctly model a junction using ICA, it is necessary to specify junction geometry, including the number of lanes per approach, the permissible turns per lane, and the number of flared lanes. Additionally information on the signal staging and timings are required.

Initial signal specifications have been retained from PRISM 4.8. These were provided by the seven metropolitan authorities for the majority of signalised junctions within the Area of Detailed Modelling during the development of PRISM 4.5 in 2015.

2.8 Observed Signal Timing

Initial signal timings have been retained from PRISM 4.8. These were collected for each signalised junction during the development of PRISM 4.5 in 2015 through liaison with the relevant local highway authorities. The councils at Birmingham, Coventry, Sandwell, Solihull and Wolverhampton each have dedicated Urban Traffic Control (UTC) centres. Traffic signals in Walsall and Dudley are operated through Wolverhampton’s control centre.

Wherever possible, the timings were based on recorded data. This was possible wherever the junction was connected to the local Urban Traffic Control (UTC) centre or where the junction operated on MOVA (Micro-processor Optimised Vehicle Actuation) control. The signal timings collected were stage based rather than phased based, giving stage and inter-stage times. The inter-stage times were calculated from the traffic signal controller specification for each junction.

For junctions that did not have recorded signal timings available, or where the recorded data was clearly incorrect, the stage times were calculated using the maximum green times in the controller specification. These green times are the maximum time that the controller will allow the signal to be on green when operating under VA (Vehicle Actuation) control. Whilst these are unlikely to be the actual signal times, they are likely to give reasonably realistic green splits between stages. In other words, the green time is divided proportionally between stages based on the amount of traffic demand for each stage.

For some junctions where no data was available (or the data seemed implausible and caused calibration issues), the signal timings were estimated using VISUM inbuilt tools and local knowledge. Figure 11 shows the location of traffic signals in the model and their data sources.
Figure 11: Location and source of traffic signal data
2.9 M6 Toll Charges

Within the route-choice element of the VISUM highway assignment, a toll cost is modelled on the M6 Toll road.

The tolls have been coded into PRISM following guidance provided in WebTAG. Toll charges have been extracted from the internet with 2016 values and subsequently factored to 2010 prices (as per the price base for generalised costs in the model) using the GDP deflator in the July 2017 WebTAG Data Book.

Finally, the tolls were amended for reductions in Value Added Tax (VAT) for the Car Business, LGV and HGV user classes whereby the majority of drivers and businesses would be eligible to claim back the VAT portion of the toll costs.

Table 5: M6 Toll 2016 values in 2016 prices (actual cost of the toll in 2016)

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>LGV</th>
<th>HGV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Plaza</td>
<td>£5.50</td>
<td>£11.00</td>
<td>£11.00</td>
</tr>
<tr>
<td>Local Plaza</td>
<td>£4.00</td>
<td>£10.00</td>
<td>£10.00</td>
</tr>
</tbody>
</table>

Source: https://web.archive.org/web/20160116084051/http://www.m6toll.co.uk:80/pricing/pricing-guide

Table 6: M6 Toll 2016 values in 2010 prices

<table>
<thead>
<tr>
<th></th>
<th>Car Commute/Other</th>
<th>Car Business</th>
<th>LGV</th>
<th>HGV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Plaza</td>
<td>£5.01</td>
<td>£4.18</td>
<td>£8.35</td>
<td>£8.35</td>
</tr>
<tr>
<td>Local Plaza</td>
<td>£3.64</td>
<td>£3.04</td>
<td>£7.59</td>
<td>£7.59</td>
</tr>
</tbody>
</table>

It should be noted that in order to calibrate the route choice in the PRISM highway assignment, a weighting of 0.25 is applied to the toll value in the Impedance function for generalised journey time. This is discussed in more detail in the PRISM 5.0 MVR.

2.10 Trafficmaster GPS OD Matrices

New base year highway matrices were created from a combination of four data sources, noting the year of the data in brackets:

- Trafficmaster GPS matrices (2014/15)
- INRIX GPS route information (2016)
- PRISM Synthetic matrices (2016)
- Census journey to work data (2011)
- MRTM Prior matrices (using the mobile phone data derived long-distance trips) (2015)

Details of the highway matrix build are provided in the PRISM 5.0 MVR.

Data from Trafficmaster GPS (Global Positioning System) trackers was made available by the DfT. The DfT were able to provide trip records for the academic year 2014/15 where the origin or destination was within the PRISM fully modelled area but not through trips.

The DfT was able to provide data in matrix format – showing:

- Origin and destination zone (Trafficmaster zones not PRISM zones);
- Time of travel (trip start); and
- Vehicle type (Car, LGV, HGV).
The dataset provided contains 45,000 vehicles, 10,046,564 trips and 160,140,189 vehicle kilometres.

A number of cleaning processes were introduced;

1. to remove trips that were considered unrealistically long (> 3hrs with no break),
2. to remove the trips on bank holidays or similar non-neutral days,
3. to merge trip records where the gap between journeys was considered too short (this is likely to be caused by a vehicle stalling, or engine auto-stop/start).

In the first two steps the number of trips removed and remaining was tracked to ensure we kept the correct data. For step 3 the number of vehicle kilometres was tracked to ensure whilst we reduced the number of trips, we were successfully stitching them together into longer trips.

The final data set had 9,336,063 trips, and 150,127,459 vehicle kilometres. This included weekday AM, IP, PM, OP and weekend trips. For the PRISM 5 base matrices only the AM, IP and PM trips were retained.

A GIS process of area overlap was used to convert the data from Trafficmaster zones to PRISM zones – this was done at the final stage of processing and trip-km were checked before and after to ensure no loss of data.

2.11 INRIX GPS OD Matrices

Data from INRIX GPS trackers was procured by TfWM. Data was provided for 6 months in 2016 – February to July inclusive.

The dataset provided contains 17,232,607 trips from 5,421,663 devices (covering a number of vehicle types including car, LGV, HGV). Unlike Trafficmaster data, trip km are not provided with the record however start and end GPS points are included instead. This allows for more accurate mapping into PRISM zones.

Due to the way INRIX devices work, there is sometimes a delay before the first GPS point is recorded in a trip – this means the start point recorded may not be the true start point. To correct for this the previous end point (for a specific device) was used as the new start point, provided they were within a short distance of each other (<2km).

Other cleaning processes were also introduced;

1. to remove trips that were considered unrealistically long (> 3hrs with no break),
2. to remove the trips on bank holidays or similar non-neutral days,
3. to merge trip records where the gap between journeys was considered too short (this is likely to be caused by a vehicle stalling, or engine auto-stop/start).

In each step, the number of trips was tracked to reduce the risk of erroneously removing good data. The final data set had 13,635,604 trips, including weekends and OP. Only the weekday AM, IP and PM trips were retained for the final matrix merge.

2.12 PRISM Synthetic Car OD Matrices

To further supplement the matrix build, data from synthetic matrices were used. The synthetic matrix was created using the PRISM 4.8 demand model with PRISM 5.0 2016 inputs of highway and PT cost skims and planning data.
2.13 Census 2011 Journey to Work Matrices

To further supplement the matrix build, the 2011 national Census was used as an additional data source for commute trips.

The Census data provides records aggregated to MSOA zones, these records contain home address and usual place of work. Using trip rate information derived from the West Midlands Household Interviews this information was converted into an all-day tour matrix. This was further disaggregated into PRISM zones and into time periods using local data.
3 Public Transport Assignment Model Data

3.1 Public Transport Passenger Counts

In order to help build the Public Transport prior matrices and calibrate the PT Assignment Model (PTAM), passenger count data for the base year was required. The data used in PRISM 5.0 had already been collected by Mott MacDonald and TfWM during Autumn 2016.

There are nine urban centres defined within the West Midlands Strategic Transport Plan, “Movement for Growth”. Every two years, each centre has a cordon survey conducted where every motorised person movement is captured as it crosses the defined cordon for the centre to establish a mode split for each centre.

Each set of count data is discussed in turn below for bus, metro and rail.

Bus cordon counts for urban centres

For bus passengers, the bus stops located immediately outside of the cordon are counted, capturing alighting passengers, boarding passengers and passengers on board the vehicle. This data can then provide the number of passengers entering the cordon (on-board passenger count) and the volume of passengers approaching the cordon (passengers on board minus boarding, plus alighting).

Details are below:
- **Locations:** as shown in Figure 12
- **Date:** Birmingham – November 2015
  - Brierley Hill – April 2015
  - Coventry – October 2015
  - Dudley – November 2016
  - Solihull – September 2015
  - Sutton Coldfield – September 2016
  - Walsall - March 2015
  - West Bromwich - March 2016
- **Wolverhampton – October 2016**

  **Time periods:**
  - AM: 0700-0900
  - IP: 1000-1200
  - PM: no data collected (PM derived as explained below).

- **Direction:** inbound and selected outbound (outbound derived as explained below)

**Derivation of PM counts**

The PM data was derived by applying ratios by time period and direction to the AM counts. The ratios were calculated from the 2011 bus count data by urban cordon, and are shown in Table 7.

For example, to calculate the PM inbound count, we applied the ratio of PMinbound:AMoutbound derived from the 2011 data. PM bus count data is therefore less robust than the AM and IP data.
Table 7: Ratios for deriving bus PM counts

<table>
<thead>
<tr>
<th>Location</th>
<th>PM in : AM out</th>
<th>PM out : AM in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birmingham</td>
<td>1.80</td>
<td>1.21</td>
</tr>
<tr>
<td>Coventry</td>
<td>1.40</td>
<td>1.36</td>
</tr>
<tr>
<td>Sutton</td>
<td>1.39</td>
<td>1.18</td>
</tr>
<tr>
<td>Solihull</td>
<td>0.91</td>
<td>1.39</td>
</tr>
<tr>
<td>West Bromwich</td>
<td>1.38</td>
<td>1.58</td>
</tr>
<tr>
<td>Walsall</td>
<td>0.95</td>
<td>1.19</td>
</tr>
<tr>
<td>Wolverhampton</td>
<td>1.47</td>
<td>1.15</td>
</tr>
<tr>
<td>Dudley</td>
<td>0.77</td>
<td>1.06</td>
</tr>
<tr>
<td>Brierley Hill</td>
<td>1.35</td>
<td>1.42</td>
</tr>
</tbody>
</table>

Source: 2011 bus count data on urban cordons

Derivation of outbound counts

In order to keep the data collection exercise manageable, not all cordon points are surveyed every day or in both directions. Instead, some cordon points are surveyed inbound every day (about 30%, acting as control locations) and others are surveyed on single days inbound. To calculate the outbound flows, each control location is counted outbound on a single day.

Using the data from the control locations, it is possible to calculate day-of-week factors which can then be used to expand the non-control cordon points from single day values to values for the remainder of the week.

Once inbound values are known for each cordon point, the outbound values captured at the control locations can be used to generate inbound/outbound factors. These factors can then be applied to the previously calculated day of week values for each cordon point.

The outbound bus count data is therefore less robust than the inbound data.

This work was undertaken by TfWM, who provided the inbound/outbound factors.

Bus boarding/alighting counts at origin-destination survey locations

Manual boarding/alighting counts were undertaken at 182 bus stops in Birmingham City Centre in 2016. Details are provided below:

- Locations: as shown in Figure 12
- Date: September to November 2016, February 2017
- Time periods:
  - AM: 0700-0900
  - IP: 1000-1500
  - PM: 1600-1800
- Direction: not calculated, see below

TfWM commissioned counts and surveys of most bus stops within Birmingham City Centre and supplied the list of stops providing NaPTAN, OSGR, service list and service frequency. This exercise counted all boarding and alighting passengers. Adjacent bus stops along with those on the opposite side of the road were ‘clustered’ together into a single stop point within the network – an exercise undertaken by TfWM and reflected in the NaPTAN assigned to a stop.

It is technically possible to derive the direction of these counts using the stop pole information, to which the count data is initially allocated. However, because stop poles are subsequently
clustered to a stop point, and the intention was to validate bus counts at groups of stop points (called stop areas within the model) it was not necessary to calculate these bus counts by direction.

In addition to the Birmingham city centre counts, various sources of bus boarding/alighting counts were available in other locations collected between 2012 and 2016. The location of these counts are shown in Figure 12. Counts from earlier years were factored to 2016 for use in PRISM 5.0 using annual factors derived travel trends published on TfWM’s website, as shown in Table 8.

Table 8: Annual factors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>West Midlands Bus Passenger Journeys (millions)</td>
<td>276.3</td>
<td>278.8</td>
<td>275.1</td>
<td>267.0</td>
<td>261.0</td>
</tr>
<tr>
<td>Factor to 2016/17</td>
<td>0.94</td>
<td>0.94</td>
<td>0.95</td>
<td>0.98</td>
<td>1.00</td>
</tr>
</tbody>
</table>


**Metro Automatic Passenger Counts**

Automatic Passenger Counts (APC) from the tram doors were provided by TfWM. Details are provided below:

- Locations: all Metro stops (see Figure 13)
- Date: October 2016 (full month)
- Time periods: 24hr counts recorded each time the tram doors open
- Direction: not calculated, see below

It is technically possible to derive the direction of these counts using the vehicle ID, time/date stamps and stop name, however the additional data needed for this was not initially made available. Metro APC counts were therefore processed with both directions combined into a total boarding and total alighting per stop.

**Metro boarding/alighting counts**

Manual boarding/alighting counts were available at six Metro stations, namely: Grand Central, Corporation Street, Bull Street, St Chads, St Pauls and Jewellery Quarter by direction

At these stations, the average of the manual boarding/alighting count and APC have been calculated.

**Rail boarding/alighting counts**

Manual boarding/alighting counts undertaken during 2016 for almost all the rail stations within the West Midlands conurbation were provided by TfWM. An extensive data collection exercise was undertaken at New Street station providing data for PRISM 5.0 that was not available for previous versions of PRISM.

Details are below:

- **New Street station**
  - Manual counts on each platform over 3 days
    - Day 1 (Tuesday 01/11/2016) Platforms A-B
    - Day 2 (Wednesday 02/11/2016) Platforms C-D
    - Day 3 (Thursday 03/11/2016) Platforms E-F
– Time periods:
  ○ AM: 0700-0900
  ○ IP: 1000-1500
  ○ PM: 1600-1800
– By service and direction:
  ○ Directionality was retained, however the data was summed over all services for use in PRISM 5.0
  ○ Origin and destination station recorded for through trips that change service at New Street
  ○ Through trips without an interchange are not captured in the count data (e.g. Cardiff – Nottingham).
  ○ Inbound alighters and outbound boarders recorded separately for services terminating at New Street
– Adults and children (younger than 15 based on surveyors’ judgement) recorded separately

● Jewellery Quarter, Five Ways, Snow Hill and Moor Street stations
  – Manual counts at each station
    ○ Jewellery Quarter: 07/11/2016
    ○ Five Ways: 07/11/2016
    ○ Snow Hill: 08/11/2016
    ○ Moor Street: 12/10/2016
  – Time periods for Jewellery Quarter, Five Ways and Snow Hill
    ○ AM: 0700-0900
    ○ IP: 1000-1500
    ○ PM: 1600-1800
  – Time periods for Moor Street
    ○ First service to last service
  – By service and direction
    ○ Directionality was retained, however the data was summed over all services for use in PRISM 5.0
  – Adults and children (younger than 15 based on surveyors’ judgement) recorded separately

● All other rail stations in West Midlands conurbation
  – One day manual counts in June - July 2016
  – Time periods:
    ○ AM: 0700-0900
    ○ IP: 1000-1500
    ○ PM: 1600-1800
  – By service and direction:
    ○ Directionality was retained, however the data was summed over all services for use in PRISM 5.0
- Adults and children (younger than 15 based on surveyors’ judgement) recorded separately

Figure 14 shows the location of rail counts used for PRISM 5.0.

**Office for Road and Rail (ORR) Statistics**

The Office for Road and Rail publish annual passengers by sub-mode and area, which we have used to validate the overall number of trips by sub-mode within the base year matrices. It is important to note that the ORR uses data from LENNON supplemented by TfWM’s own count data (based on 7 control stations which are counted on a single day every month).

Table 9 shows the annual passengers by sub-mode in the West Midlands conurbation for 2016.

**Table 9: ORR Train Annual Passenger by West Midlands Districts**

<table>
<thead>
<tr>
<th>WM District</th>
<th>Annual Passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birmingham</td>
<td>36,716,455</td>
</tr>
<tr>
<td>Coventry</td>
<td>3,945,097</td>
</tr>
<tr>
<td>City of Wolverhampton</td>
<td>2,373,169</td>
</tr>
<tr>
<td>Dudley</td>
<td>1,262,255</td>
</tr>
<tr>
<td>Sandwell</td>
<td>3,056,858</td>
</tr>
<tr>
<td>Solihull</td>
<td>5,407,549</td>
</tr>
<tr>
<td>Walsall</td>
<td>747,467</td>
</tr>
<tr>
<td>Rest of WM</td>
<td>18,070,549</td>
</tr>
</tbody>
</table>

Figure 12: Bus count locations

Source: <Insert Notes or Source>
Figure 13: Metro count locations
Figure 14: Rail count locations
3.2 Public Transport OD Surveys

In order to create base year demand matrices for the Public Transport assignment model, observed data from traditional origin-destination surveys was provided by TfWM.

TfWM and Mott MacDonald developed a programme of passenger origin-destination surveys for bus, metro and rail undertaken during September, October and November 2016 and February 2017 in Birmingham City Centre.

Figure 15 shows the locations of the OD surveys.

Bus

Bus surveys were undertaken face-to-face with passengers waiting to board the buses. In total 8,724 interviews were carried out at 182 bus stops in Birmingham city centre, with 8,558 records taken forward as clean. A sample rate of 17.3% was achieved for the AM, with sample rates of 12.7% and 10.0% for the IP and PM.

Metro

Metro surveys were undertaken face-to-face with passengers waiting to board the Metro. In total 714 interviews were carried out at 12 Metro stops in Birmingham City Centre, with 684 records taken forward as clean. A sample rate of 22.0% was achieved for the AM, with sample rates of 14.2% and 11.7% for the IP and PM.

Rail

Rail surveys were undertaken by handing out survey forms to passengers waiting at the station who self-completed and returned via post or the internet. In total 15,000 forms were handed out across five rail stations in Birmingham city centre. From these approximately 2,500 responses were received giving a sample rate of 4.3% based on a count of around 59,000 boarding passengers.
Figure 15: Location of OD surveys for bus, metro and rail
3.3 **PRISM Synthetic Public Transport OD Matrices**

In order to help infill OD movements that are not observed in traditional surveys, the synthetic matrices were used as an additional component in the matrix merge. The synthetic matrices were generated by the PRISM 4.8 demand model using 2016 planning data and cost inputs.

Details of the prior matrix build are provided in the PRISM 5.0 MVR.

3.4 **Census 2011 Journey to Work Matrices**

To further supplement the matrix build, the 2011 national Census was used as an additional data source for commute trips.

Details of how the commute matrices were derived from Census are provided in section 2.13

3.5 **PLANET Long Distance**

The PRISM synthetic matrices do not represent tours by public transport where the production end is outside the core model area, so an alternative source is required to represent trips to the core area (i.e. Manchester to Birmingham) or passing through the core area (i.e. Manchester to London). The source of these long distance rail trips was matrices from the PLANET Long Distance (PLD) model (PFMv6_Base14_v17f – Base year 2014), provided by HS2 Ltd for use in PRISM only.

The data was provided as zonal matrices using the PLD zone system for a 16hr average weekday in 2014. A number of adjustments were made in order to derive time periods and to convert the demand to the PRISM zoning system. A mask was also applied to filter-out trips that would not travel through the modelled area, or trips that are captured by the PRISM synthetic matrices.

Time period factors were derived from MOIRA2 data to split the PLD 16-hour matrices into PRISM time periods. Time period factors were derived by purpose, direction and trip distance.

The PLD zones were first mapped to a group of PRISM PT zones contained within each PLD zone. The PLD matrices were then apportioned to each PRISM PT zone system based on the number of rail trips in the existing PRISM matrices.

In addition, passenger flows were provided for a cordon around the PRISM FMA, for calibrating the long-distance rail matrices.

3.6 **HS2 Data**

Various data was provided by HS2 Ltd from the following PLANET Framework Models:

- PFMv6_Base14_v17f – Base year 2014
- PFMv71_D26 – Phase 1 2026
- PFMv71_Y26 – Phase 2 2026 + Do Minimum
- PFMv71_D37 – Phase 1 2037
- PFMv71_Y37 – Phase 2 2037 + Do Minimum

The data included:

- HS2 Passengers by Mode
Boarding and alighting HS2 passenger flows at Curzon Street and Interchange are provided by access/egress mode from the Station Choice Model, for use in the PRISM-LENS module for representing local impacts of HS2 passengers.

- HS2 future year timetables

### 3.7 HS2 Time Period Factors

The HS2 passengers are provided for a 16 hour period and therefore require factoring to time period. Factors were derived from the calibrated demand profiles from Moira 2.

Because Moira provides proportion of demand rather than actual demand, the resulting time of day profiles were identical for outbound and return, which implies that London attracts exactly the same number of people from the West Midlands as the West Midlands attracts from London, which does not seem logical.

We therefore supplemented the Moira data with the daily Production-Attraction totals derived from the Midlands Regional Traffic Model (MRTM) mobile phone matrices. This showed that London attracts more people from the West Midlands than vice-versa, and so we were able to derive adjusted outbound and return time period factors.

The MRTM matrices also showed that the West Midlands attracts more people from Manchester/Leeds than vice-versa, and therefore we adjusted the outbound and return time period factors to represent when HS2 Phase 2 extends to Manchester and Leeds.

The HS2 time period factors for Phase 1 (only) and for Phase 1 and 2 (combined) are presented in Table 10 and Table 11.

#### Table 10: HS2 Time Period Factors – Phase 1 only

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Direction</th>
<th>B/A</th>
<th>AM</th>
<th>IP</th>
<th>PM</th>
<th>OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>From WM</td>
<td>Board</td>
<td>26.1%</td>
<td>28.8%</td>
<td>32.4%</td>
<td>12.6%</td>
</tr>
<tr>
<td></td>
<td>To WM</td>
<td>Alight</td>
<td>28.2%</td>
<td>28.3%</td>
<td>30.4%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Commute</td>
<td>From WM</td>
<td>Board</td>
<td>28.3%</td>
<td>15.7%</td>
<td>36.4%</td>
<td>19.5%</td>
</tr>
<tr>
<td></td>
<td>To WM</td>
<td>Alight</td>
<td>23.3%</td>
<td>15.2%</td>
<td>43.7%</td>
<td>17.7%</td>
</tr>
<tr>
<td>Other</td>
<td>From WM</td>
<td>Board</td>
<td>16.1%</td>
<td>40.4%</td>
<td>30.5%</td>
<td>13.1%</td>
</tr>
<tr>
<td></td>
<td>To WM</td>
<td>Alight</td>
<td>17.7%</td>
<td>41.3%</td>
<td>28.6%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

#### Table 11: HS2 Time Period Factors – Phase 1 and 2

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Direction</th>
<th>B/A</th>
<th>AM</th>
<th>IP</th>
<th>PM</th>
<th>OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>From WM</td>
<td>Board</td>
<td>26.6%</td>
<td>28.7%</td>
<td>32.0%</td>
<td>12.7%</td>
</tr>
<tr>
<td></td>
<td>To WM</td>
<td>Alight</td>
<td>27.7%</td>
<td>28.4%</td>
<td>30.9%</td>
<td>12.9%</td>
</tr>
<tr>
<td>Commute</td>
<td>From WM</td>
<td>Board</td>
<td>26.5%</td>
<td>15.5%</td>
<td>39.1%</td>
<td>18.9%</td>
</tr>
<tr>
<td></td>
<td>To WM</td>
<td>Alight</td>
<td>25.2%</td>
<td>15.4%</td>
<td>41.0%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Other</td>
<td>From WM</td>
<td>Board</td>
<td>16.4%</td>
<td>40.6%</td>
<td>30.1%</td>
<td>13.0%</td>
</tr>
<tr>
<td></td>
<td>To WM</td>
<td>Alight</td>
<td>17.4%</td>
<td>41.1%</td>
<td>29.0%</td>
<td>12.6%</td>
</tr>
</tbody>
</table>

### 3.8 Public Transport Timetable Service Data

Google Transit Feed Specification (GTFS) data was downloaded from TfWM databases to represent the bus network for the week commencing 10th October 2016. GTFS data can be
imported directly into VISUM, where a number of initial checks and changes were undertaken by TfWM. This included:

- Re-naming of services from the “dummy” generated numbers to the actual service numbers (and operator). Where there were duplicate services, such as a number of National Express No. 1 services, the re-naming included the area of operation, e.g. “WOL” for Wolverhampton.
- Checks that all expected services and/or timetables were included. Any missing services were noted and included at the next stage of the import to VISUM; and
- Removal of timetable data for very early mornings, weekends and bank holidays.

3.9 Public Transport Fares

Public transport fares are an input to the public transport assignment models so that fares can be included in the Impedance function for generalised journey time for the ‘Fare’ demand segments. Matrices of fare are then skimmed from the assignment models and fed to the demand model to be combined in to the utility functions for the calculation of demand.

The ‘fare’ demand segment represents trips made with cash purchased tickets on the day of travel, therefore concessionary travel and season tickets such as all-day fares or return fares are not taken into account for this demand segment, and are included in the no fare’ segment instead.

Passengers boarding a bus service pay a maximum single fare of £2.40 in 2016 (http://nxbus.co.uk/singles/). A short hop fare of £1.50 is also available for travel within the seven District urban centres, however this ticket type is not represented in PRISM 5.0.

For Metro a complete fare matrix was provided by TfWM which gives the single adult cash fare between all stops on the line, ranging from £1 to £4 in 2016. It is not feasible to include a fare matrix in the PTAM1 so we approximated it using a function of boarding fare and stop-to-stop fare. The approximation is a good fit to the actual fare matrix with a \([\sqrt{\text{sum}(\text{error}^2)}]\) less than 10 pence across all station to station fares. The fare matrix and the approximated fares for Metro are presented in the PRISM 5.0 MVR.

For rail, station to station standard single fares in 2016 were obtained from national rail (http://ojp.nationalrail.co.uk/service/timesandfares/) for all stations in the West Midlands, and a linear distance-based regression with a fixed boarding fare was fit to the data. The fit was better when the distance component was estimated separately for stations within the core area from those outside the core area. The fit to data was not particularly strong with \(R^2\) values of 0.33 and 0.59. The distance-based fare system for rail is presented in the PRISM 5.0 MVR.

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1 PTV review of Centro model
4 Variable Demand Model Data

4.1 Household Interview Surveys

Household interview survey (HIS) data was used for the estimation of the PRISM tour-based disaggregate demand model by RAND Europe.

The existing HIS data was collected between 2009 and 2012 and consideration was given to updating the survey data for PRISM 5.0. Since there has not been a large change in population in the West Midlands since 2012 it is likely that parameters derived from any new HIS data would not change significantly from those derived from the existing survey data. Given the prohibitively large costs and time required to undertake a programme of new HIS, it was decided not to update the data for PRISM 5.0. This decision is in line with historical updates of PRISM, whereby the original 2001 HIS was not re-surveyed for the 2006 re-base of the model.

Between 2009 and 2012 data was collected from 5,030 households with the sample made up of:

- 4,712 households sampled using a random walk method with a restriction on the number of households interviewed per street, stratified by ward within each metropolitan district;
- 150 households who also took part in the GPS-aided study, which was used to research the propensity to under report trips; and
- 168 households randomly selected from the Post Office Address File, in order to compare the average trip rate between this and the random walk sampling methodology.

A total of 13,647 individuals were observed making 31,582 trips and for each survey, information was gathered regarding the household, vehicle, person and travel diaries.

The following household information was gathered:

- Address;
- Household type (e.g. detached, bungalow etc.);
- Ownership type (e.g. owner occupied, rented from council etc.);
- Working status of the head of the household;
- Main income earner’s socio-economic group;
- Number of bicycles in the household;
- Number of motorised vehicles in the household; and
- Household gross annual income.

The following vehicle information was gathered:

- Fuel type;
- Date of vehicle registration (pre- or post-2001);
- Vehicle engine capacity and tax code;
- Annual mileage; and
- Vehicle ownership (e.g. owner, employer etc.).

The following person information was gathered:

- Relationship with head of household;
- Age group;
- Ethnic group;
- Working status;
- Education level;
- Type of driving licence;
- Mobility problems; and
- Type of public transport pass held.

The following information was gathered for each trip given in the travel diary:

- Origin location and purpose;
- Destination location and purpose;
- Mode;
- Type of car parking; and
- Parking charge.

Further information can be found in the following reports which can be downloaded from the PRISM website, www.prism-wm.com:

- HIS data collection: PRISM Surveys 2011: Household Travel Survey

### 4.2 Socio-Demographics

Planning data is a key input to the Population Model and a key driver to the travel patterns forecast by the Travel Demand Models. The following data is supplied to the models:

- Population: Some of the Travel Demand Models also use total population as an attraction variable;
- Employment: Some of the Travel Demand Models use total employment, retail employment and service employment as attraction variables; and
- Enrolments: The education-purpose Travel Demand Models use primary, secondary or tertiary enrolments as attraction variables.
- Zonal Targets: The Population Model requires targets for each zone in the FMA, broken down into various population strata for use in the calculation of the future West Midlands population:
  - Gender; age group; worker status; students; household type; and total income.

#### Population

Population figures were obtained from the Office for National Statistics (ONS) mid-year estimates for 2015 (2016 data was not available in time). These were available for Lower Super Output Areas (LSOAs) that we split to Output Areas (OAs) using the 2011 census data. A final set of growth factors were applied at the Middle Super Output Area (MSOA) level using NTEM 7.2 population growth factors, to produce estimates of 2016 population in OAs.

This data was apportioned to PRISM model zones using residential Address Points (APs) within the West Midlands Region. Outside of this area, the OA populations were attributed using postcode points.

#### Employment

Data from the Business Register and Employment Survey (BRES) 2015 were obtained at the Lower Super Output Area (LSOA). These were attributed to the PRISM zone using the same
method as describe above for population, using commercial Address Points rather than residential within the West Midlands Region.

Enrolments

The PRISM model requires enrolment information for the 3 education models (primary secondary and tertiary) and also for home-escort which includes a representation of taking people to school. This is achieved by tabulating enrolments for primary, secondary, further and tertiary places (in terms of student ages, the breakdown is roughly 5-12, 13-16, 16-18, and 18+)

2016 enrolment figures for PRISM 5.0 were obtained from a variety of sources for each of primary, secondary, further and tertiary. It was assumed that data from the academic year 2015-16 would be most representative of 2016 conditions.

Primary and secondary education was sourced from the Department for Education published statistics on school and pupil numbers2. This provided the number of pupils by age and postcode. Age was used to split pupils into primary and secondary, and postcode was used to map to PRISM zones.

Unfortunately, this source only included colleges or sixth-forms attached to a school, so for further education we downloaded performance tables published by the Government3. This provided the number of KS5 pupils by postcode, which were mapped to PRISM zones.

For Tertiary (university) enrolment, ‘Table 1 - HE students by HE provider, level of study, mode of study and domicile 2015/16’ was downloaded as a starting point from the Higher Education Statistics Agency (HESA) website4. This contained the number of part-time and full-time undergraduate and postgraduate students for each University.

For universities within the West Midlands, the Universities were e-mailed separately to confirm student numbers and (importantly) splits between campuses. Mixed responses were received, and so in some cases the split assumed (or obtained from the University) from the PRISM 4.1 2011 data was retained. In this context – campus relates to the location a student most usually goes for study. Campus splits were sense checked using geographic size and 2011 data as a benchmark.

Zonal Targets

The Population Model requires population targets for each zone in the AoDM. These targets are broken down in to various population strata for use in the calculation of the future West Midlands population.

The 2011 Census was the starting point for developing the 2016 zonal targets. The following information was extracted from the 2011 Census at the OA level, and was apportioned to PRISM model zones using the same process as described above for population:

- Gender proportions;
- Age group proportions;
- Household-type proportions;
- Worker status proportions;
- Worker-to-population ratio;

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3 https://www.compare-school-performance.service.gov.uk
4 https://www.hesa.ac.uk/files/student_1516_table_1.xlsx
● Student-to-population ratio; and
● Household-to-population ratio.

Household Income

An important zonal target not available from ONS is total household income per zone. This was purchased from CACI, who provided average household income in 2016 per PRISM model zone.

The data was provided with 2016 values in 2016 prices, that we converted to 2010 prices using the GDP deflator from the WebTAG DataBook (July 2017).

CACI License restrictions

Due to the way CACI licenses data the ownership is with WMCA with Mott MacDonald listed as a named user, also the licence lasts for one year (expiring in March 2018). An important restriction is that Mott MacDonald cannot publish data directly derived from the CACI data set (i.e. we cannot confirm average income per zone), only WMCA are able to publish directly derived data – but not the raw data. Also, while the data may sit in the PRISM model perpetually, the licence restrictions mean than MM must delete the raw data after the 12 month anniversary of data delivery (March 2018). Hence no new analysis on the raw data can be conducted after that point.

4.3 Parking Costs

Car park costs are used in the demand model as part of the generalised cost, representing a (dis)utility of travelling to a particular location.

The location of car parks and the parking cost data for 2016 were assembled from the online Parkopedia\(^5\) database. Parking cost data was collected for the urban centres of each of the seven districts in the AoDM. For all other locations it is assumed that parking is free.

Some model zones contain more than one car park, and so to allow representative parking costs to be calculated, information on the total number of spaces in each car park was also obtained from Parkopedia. Average costs for each zone were then calculated as a weighted average over the car parking spaces in that zone.

Information on Private Non-Residential parking (i.e. workplace parking) was not obtained and is not represented in PRISM.

4.4 Park and Ride parking places

The park and ride models in the demand model need to know which model zones contain metro or rail park and ride stops, and how many spaces are available. Without this information demand to/from these stations will be artificially suppressed.

An extensive exercise between Mott MacDonald and TfWM in 2015 compared various statistics on the number of park and ride parking places. From this an agreed list of rail and metro zones/spaces was agreed. For PRISM 5.0 this list was reviewed by TfWM and changes to the number of spaces made to reflect conditions in 2016. In addition, unofficial nearby spaces were also added to the list.

\(^{5}\) https://en.parkopedia.co.uk/
Zones containing a station but with no dedicated spaces are marked as containing zero spaces, rather than being omitted from the list. This is because it is plausible someone could be dropped off (so called ‘kiss and ride’), which is also predicted by the demand model.