HS2 Phase Two

Model Development Report
PLANET Framework Model version 6.1

November 2016

CS655A3

Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

High Speed Two (HS2) Limited,
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA

Telephone: 020 7944 4908

General email enquiries: HS2enquiries@hs2.org.uk

Website: www.gov.uk/hs2

High Speed Two (HS2) Limited has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the HS2 website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard please contact High Speed Two (HS2) Limited.

recycle

Printed in Great Britain on paper containing at least 75% recycled fibre.

Contents

Contents

1 Introduction

1.1 Background

1.1.1 The High Speed 2 (HS2) scheme comprises a network of new high speed rail lines to be built in the UK in three phases:

- Phase 1 is due for completion in the year 2026 and will see high speed train services linking London and Birmingham.
- Phase 2a is an extension of Phase 1 that aims to extend high speed services to Crewe to provide a fast link to the West Coast Mainline (WCML) in 2027.
- Phase 2b, which is forecast for completion in 2033, is a Y-shaped network that will further connect Manchester and Leeds to Birmingham and London.

1.1.2 HS2 Ltd will be preparing Business Cases for the various phases of the HS2 scheme over the course of 2016 to 2017.

1.1.3 The PLANET Framework Model (PFM) is the primary tool for forecasting rail demand for HS2 and calculating associated economic benefits and revenue to support the HS2 Business Case. PFM is a suite of models, comprising:

- PLANET Long Distance (PLD), a strategic model of all long-distance rail, car and air services and demand in England, Wales and Scotland; and
- PLANET South (PS), PLANET Midlands (PM) and PLANET North (PN) are more detailed, rail-only regional models that capture shorter-distance services and demand in the main urban areas served by HS2.

1.1.4 In each model, the area of coverage is divided into geographic zones, and observed base year demand is stored in a series of matrices expressing the number of trips between each pair of zones. These are assigned to the base year transport network (i.e. rail and air services and roads) to create a base year model. Future year models are created by applying growth factors to the base year matrices and assigning these to the network.

1.1.5 HS2 Ltd's most recent publication to use outputs from PFM was the *HS2 Phase 2a: Strategic Outline Business Case* (SOBC) in 2015, which used model version PFMv5.2b.

1.1.6 Since the release of PFMv5.2b, a programme of model development has been undertaken on the PFM in order to release PFMv6.1c for use in supporting future HS2 Business Cases. This work has focused on updating the base year model, updating the matrices from a 2010/11 to 2014/15 base year, and making the corresponding updates to the rail and highway networks to reflect changes that have occurred over this period.

1.1.7 This report provides an overview of the changes and updates incorporated into the base year model as part of the PFM development. This will also provide context for changes in PFMv6.1c model outputs for the SOBC findings in 2016.

1.1.8 This report only records the changes to the base year model. Analysis of the changes to forecast years and other wider changes in PFMv6.1c are provided in other associated documents:

- *PFMv6.1c Forecast Report*. This details the impacts of new growth forecasts for rail, highway and air demand.
- *PFMv6.1c Assumptions Report*. This details updates on:
    - forecasting assumptions;
    - economic appraisal methodology;
    - highway and air networks future year assumptions; and
    - future year 'do minimum' and 'do something' (with HS2) rail networks.
- *HS2 Phase Two: Summary of Key Changes to the Economic Case Since November 2015*. This documents the step-by-step changes in the model development for the incremental updates from PFMv5.2b to PFMv6.1c.

1.2 Document structure

1.2.1 This report describes the process by which each set of matrices and the rail and highway networks have been updated . The remainder of this report is structured as follows:

- Chapter 2 explains the methodology for development of the PLD base rail demand matrix.
- Chapter 3 explains the methodology used for updating the PM and PN base rail demand matrices.
- Chapter 4 explains the methodology used for updating the PS base rail demand matrices.
- Chapter 5 explains the methodology used for updating the base highway demand matrices.
- Chapter 6 explains the methodology used for updating the base air demand matrices.
- Chapter 7 explains the methodology used for updating the base rail and highway networks.

2 PLANET Long Distance rail matrix update

2.1 Introduction

2.1.1 This chapter describes the work undertaken to update the base rail matrices for the PLANET Long Distance (PLD) component of PFM as part of the development and update of the modelling suite from PFMv5.2b (the previous model release version) to PFMv6.1c. However, because this report is concerned with the update to the base year PLD matrices, the methodology is compared with that used for PFMv4.3, which was the last release version where the base model was updated.

2.1.2 The key element of the PLD base demand matrix update is to utilise up-to-date rail demand data to update the base year model from 2010/11 (undertaken for PFMv4.3) to 2014/15 (PFMv6.1c). This is so that the modelling suite is kept up to date and reflects recent trends in rail demand. To remain consistent with the previous matrix development methodology that was used for the 2010/11 base model, wherever appropriate the same methodology was applied to the 2014/15 rail demand data.

2.1.3 The remaining sections in this chapter detail the various steps of the methodology used to create the PLD base year demand matrix.

2.2 PLANET Long Distance demand matrix building process – Summary

2.2.1 The PLD demand matrix process applied to generate the matrices for PFMv6.1c has been designed to be as consistent as possible with previous methodologies while at the same time incorporating improvements to the overall methodology. A broad overview of the process is supplied below in Figure 1.

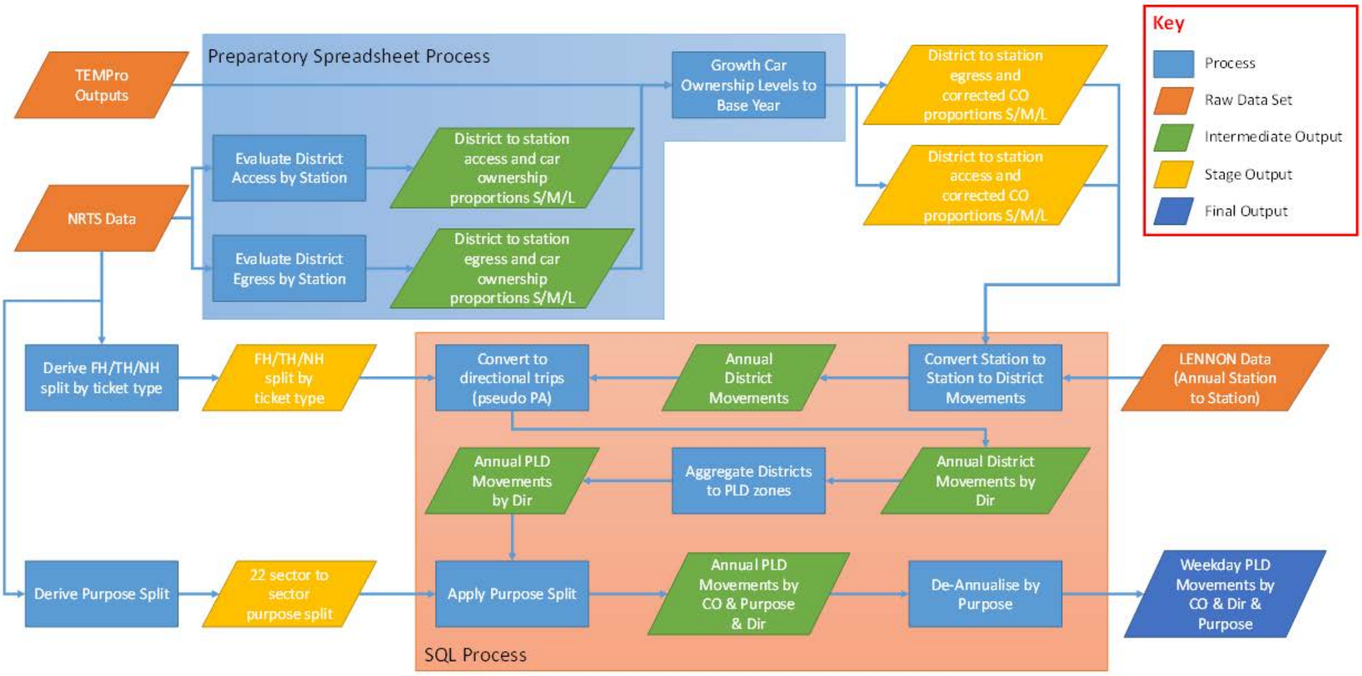


Figure 1: PLANET Long Distance demand matrix derivation process

2.2.2 The yellow boxes in Figure 1 review input parameters to the main calculation process that are developed using spreadsheet tools. The main calculation is undertaken in SQL. The preparation of each set of parameters is discussed individually in the following sections. The remainder of this section contains a high-level summary of the steps involved in PLD matrix development.

2.2.3 The process applied to produce PLD zonal rail travel demand matrices from LENNON is undertaken using SQL. Inputs consist of the LENNON data and several tables reflecting assumptions, mappings etc. The following is a description of the process.

2.2.4 The LENNON dataset mostly consists of station-to-station journey counts. However, a significant portion of entries are virtual journeys, reflecting accounting records, rather than 'real' journeys. The first step of the SQL process removes entries with a negative number of journeys, and organises each station-to-station movement into categories that reflect whether it can be considered a real movement. This is based on origin and destination stations; every unique LENNON station has been manually verified and classified as either a real station or an accounting placeholder. Ticket category is also recorded here.

2.2.5 The second step converts station-to-station movements to district-to-district movements and drops all non-real journeys. At this point these inter-district movements are also classified into three groups by rail travel distance with cut-off points at 20km and 40km. Based on distance class and on origin and destination districts each inter-district movement is split by car availability.

2.2.6 During the first two steps, movements that are assumed to be virtual (either due to having a non-'real' station at each end or due to having non-positive journeys or revenue) are excluded. These make up 18.7% of all records in the LENNON 2014/15 dataset.

2.2.7 Based on sector directionality proportions (from home/to home/non-home for single tickets; correct direction/transposed direction/non-home for return tickets), during the third step inter-zonal movements are split by direction.

2.2.8 The fourth step converts district-to-district movements to PLD zone-to-zone movements, and is entirely consistent with the previous approach based on original districts' distribution rather than PLD zones. Most districts fit entirely into a zone; where that is not the case a district's journeys are split between the zones the district covers in proportion to area. Based on origin and destination sectors, movements are hereby split by purpose.

2.2.9 Finally, based on ticket category each movement is deannualised producing the final matrices. They consist of inter-zonal movements split by purpose, direction (to home/from home/non-home) and car availability.

2.2.10 The sections that follow describe this process in a greater level of detail.

2.3 Key data sources

2.3.1 There are three key data sources used in the development of the base year rail matrices:

LENNON data

2.3.2 LENNON is the standard rail industry ticket database, which comprises details of all national rail tickets sold in Great Britain. This dataset provides the basis for development of zone-to-zone rail matrices and the data has been provided for the financial year 2014/15 (data has also been provided for 2010/11 for the purpose of verifying the methodology used against the previous methodology).

2.3.3 Entries in the LENNON data consist of an origin station, destination station, a product type and the total journeys, issues and net receipts associated with them. Products are mostly journey tickets, but they also include other transactions such as promotional items, refunds or various accounting entries and these are removed as part of the process.

National Rail Travel Survey

2.3.4 The National Rail Travel Survey (NRTS) is a dataset published by the Department for Transport (DfT) which gathered data using a self-completion questionnaire to collect passenger and trip information including stations used, origin and destination addresses, access and egress modes, trip purpose, ticketing information and demographic information, for trips made on an average weekday. The NRTS data was originally gathered in 2001 for London and the surrounding area but was subsequently expanded in 2004 to 2005 to cover the rest of the country.

2.3.5 NRTS data is used primarily to link information on station movements to person movements, particularly to disaggregate by car ownership, journey purpose, and link to an origin and destination.

Trip end data

2.3.6 The National Trip End Model (NTEM) forecasts and the TEMPro (Trip End Model Presentation Program) software are used to provide trip end information at a specified geographic level. For the PLD rail matrices, this focused on car ownership over time.

2.4 Station zonal distributions

2.4.1 The PLD matrices are expected to detail trips between ultimate origin and destination, for instance home to work or home to place of education, but LENNON only provides detail on station-to-station movements. It is first necessary to undertake some pre-processing of the LENNON dataset before it can be converted into a demand matrix. To distribute trips arriving or leaving a station, the NRTS data has been analysed to find patterns of distribution by district, which are then applied to the LENNON station movements.

Station naming correspondence

2.4.2 There are around 2,500 railway stations in the UK. LENNON data for 2014/15 contains approximately 7,000 unique values for station names. An alignment between LENNON stations and actual stations was created based on the steps in Table 1.

2.4.3 The main reason to create consistent names for each station is so that a distribution can be attached to the station to convert to district movements as discussed. In some cases, applying the NRTS data does not suffice, thus some special types of district distribution have been designed, which are discussed below.

Table 1: Authorised input locations

Step	Description
1	Map stations based on their initial names, searching out mismatches in naming conventions such as 'QUEEN'S PARK (STRATHCLYDE)' and 'Queens Park (Glasgow)'.
2	Check for LENNON station names that include ongoing travel, such as 'ABERDEEN-PETERHEAD BUS-K600' where the egress station will be Aberdeen.
3	Check for stations that aren't necessarily considered part of National Rail but which may appear in LENNON, in particular underground and metro stations.
4	Check the remaining records and categorise in some manner to allow for journey totals to be attributed to them.
5	Calculate the total issues, journeys and revenue by standard station name to ensure the majority of issues and journeys are accounted for and revise mapping accordingly.

Direct allocations

2.4.4 A large number of stations can be aligned directly with a clear station description (consistent with NRTS) through their description, with some interpretation for inconsistent spelling and additional offerings (such as ongoing bus travel). These stations account for approximately 54% of all LENNON movements in the dataset.

Stations not included in National Rail Travel Survey

2.4.5 NRTS only contains information about National Rail stations that existed when the survey was taken, and contains no information on new stations (less than 10 years old), underground stations or metro stations. Since the LENNON data contains journeys allocated to these non-specified stations there is a need to provide assumptions to account for them within the PLD matrices.

2.4.6 For the stations that fall into the categories above, a local distribution was assumed where all trips are associated with the district in which the station is physically located, and the car availability split is taken as the 2014/15 TEMPro car availability split for the region. This is based on the assumption that, if someone is using an underground or metro system, they are likely to be very close to their ultimate origin or destination, otherwise they would have chosen an alternative station. This does not necessarily apply to new stations but is arguably the most appropriate approach without undertaking a new origin destination survey.

2.4.7 There are approximately 7% of trips in the 2014/15 LENNON data that have at least one end associated with the stations that fall into the above categories.

Generic zone definitions

2.4.8 All metro and underground stations have been included as stations even though they are not included in NRTS, but in some cases passengers purchase an area-based ticket, for instance based on travel zones in London. These stations were aligned with a 'generic' location-specific station (London, Manchester and Liverpool), which in turn had a specific distribution generated for it to convert to districts.

2.4.9 Specifically, among these, journeys associated with London zone definitions accounted for approximately 31% of all journeys and, to ensure they were handled appropriately, a 'generic London' distribution was created based on all NRTS observations for stations within London to convert to districts. This is an improvement compared with the previous approach, which applied the distribution for London Euston to all London stations.

Unidentified zones

2.4.10 While an approach was identified and implemented for handling zonal-based tickets with some degree of locational reference e.g. a city, in some cases these station descriptions did not provide any description of location and merely indicated a zone with no further information. These account for a small minority of trips (less than 0.05%) and were excluded from further analysis.

Ticket types and shop names

2.4.11 Some LENNON descriptions have no clear reference to a station and instead have a description that details a ticket type product, shop name or travel agent. Together, these account for around 1% of journeys and there is no evidence base to identify the geographical location of these trips, so they are excluded from further analysis.

Authorised input locations

2.4.12 Six codes account for a large number of journeys, approximately 16% of the total for 2014/15 LENNON dataset. These could not be reliably assigned geographically so, consistent with the previous matrix development process, were excluded from the analysis.

Other

2.4.13 Even after classifying a large majority of station descriptions and identifying approaches to account for them, there are still some station descriptions within

LENNON that cannot be classified in a meaningful way or aggregated further, and these have been simply incorporated within the classification designated 'other'.

2.4.14 These trips account for approximately 3.1% of journeys in the annual LENNON data and, although it was discussed during development that it may be appropriate to assume these are similar to the identifiable trips from the matrix and therefore applying an overall uplift to the matrix could be considered justifiable, this has not been undertaken at this time and the trips are instead excluded completely from further analysis.

Summary of station allocation

2.4.15 The outcome of the station naming correspondence is that a high proportion of issues and journeys have been allocated to a standard station name, accounting for the proportion of total issues and journeys as shown in Table 2, noting that these classifications are not mutually exclusive (a trip could have an origin in one classification and destination in another) and so only direct allocations are completely accurate in terms of scale.

2.4.16 It is also highlighted that the stations not included in NRTS are included within direct allocation as they have been given a unique district distribution.

2.4.17 A key result of this alignment is that only direct allocations and stations classified as 'generic London' are converted to district movements, and 18.2% of annual LENNON journeys are excluded from the PLD travel demand matrices as they cannot be reasonably aligned with an origin or destination.

Table 2: Station naming alignment summary

Station category	Annual journeys (LENNON)	Proportion of annual journeys
Aligned	753,571,790	50.6%
Generic London	463,836,927	31.2%
Shop name	312,161	0.0%
Others	46,193,813	3.1%
Ticket type	11,917,082	0.8%
Authorised input location	212,186,641	14.3%
Total	1,488,018,414	100.0%

2.5 District distributions

2.5.1 To create district distributions, the NRTS survey data origin or destination postcode was spatially associated with local authority districts (LAD), which in turn can be related to the origin and destination station. For each station a list is generated which contains the access districts that make up the journey origins, which is used when the station appears as the origin station in a LENNON entry, and similarly a list of egress districts is generated for use when the station appears as a destination.

2.5.2 The complete set of trips for each station are then collected and the top 15 districts (ordered by number of trips) are considered to represent completely the total number of trips arriving at or leaving a station. This assumption is purely to limit processing to a reasonable level and in practice accounts for over 99% of trips in the NRTS database, and typically the only stations which are restricted in their distributions are the larger London stations.

2.5.3 In the rare cases where trips are associated with districts in addition to the designated top 15 districts, the trips are redistributed among the top 15 districts for each station. This process is entirely consistent with the previous methodology with the exception that both origins and destinations consider a maximum of 15 districts while previously only origin stations considered 15 districts, with destinations considering 10.

2.5.4 In practice, this means that every station-to-station set of trips in LENNON is converted into up to 225 district-to-district trips, where the sum of all 225 equals the original station-to-station number of journeys.

2.5.5 Distributions have been calculated individually for six classifications of trip, segmented by car availability (car available or no car available) and crow-fly trip distance defined as:

- short-distance trips, which are 20km or less;
- medium-distance trips, which are greater than 20km and less than 40km; and
- long-distance trips, which exceed 40km in length.

2.5.6 All trip distances are based on a crow-fly distance between stations. Car availability is obtained directly from the NRTS data and is self-reported.

2.6 Car availability

2.6.1 Due to the age of the NRTS data (2001 for London and the Southeast and 2004/05 for the rest of the UK), growth factors were applied to the car availability proportions based on TEMPro. These factors were based on comparing the number of households with car available or no car available in the financial years 2001/02 and 2014/15 for London and the Southeast, and 2004/05 and 2014/15 for the rest of the UK.

2.6.2 These factors were applied to the expansion factors (representative of total trips) from NRTS to produce a total number of trips. Although this is different from that reported in NRTS, given that everything in the associated analysis is based on proportions, it ultimately does not impact the results.

Table 3: Car availability growth factors

Sector	Name	NCA proportion	CAV proportion
1	East	87.75%	102.17%
2	East Midlands	89.35%	103.31%
3	London	86.75%	105.94%
4	North East	87.20%	106.86%

Sector	Name	NCA proportion	CAV proportion
5	North West	86.22%	105.92%
6	Scotland	90.08%	104.59%
7	South East	81.06%	103.88%
8	South West	87.90%	102.82%
9	Wales	90.63%	103.16%
10	West Midlands	89.22%	104.01%
11	Yorkshire and the Humber	88.64%	104.88%

2.6.3 The approach to scaling car availability has been revised from previous approaches, which simply scaled up the car availability (CAV) proportion of trips and then assumed the non-car-available (NCA) component was the remainder of the total. The car availability split is applied at the same time as district conversion, by defining two proportions (CAV and NCA) for both the access district and the egress district associated with a station. This approach was considered to better reflect the levels of both strata given that NRTS will not have the same initial car available split.

2.6.4 To obtain trip numbers for district-to-district journeys by car availability and to maintain the total number of trips, a station-to-station set of trips is multiplied with proportions associated with access districts and those associated with egress districts (broken down by car availability).

2.6.5 It should be noted that, for a small number of trips (of the order of 3%), the above process may be modified by other assumptions applied in the matrix development process (see below).

Additional considerations

2.6.6 District/car availability distributions are calculated from NRTS on the basis of the recorded ends of the journey. When processing the data, if a particular station and trip length combination had no records, the assumption for distribution was that all trips were local (the distribution is made up of the district in which the station is located) and the car availability split is based on the full set of records associated with a station (regardless of trip length).

2.6.7 In a small number of cases there were no records associated with a station (of any trip length), and in this case all trips are assumed to be local (completely allocated to the district in which the station is located) and the car availability split is based on the sector value. As these stations have a low number of trips associated with them, and this is expected to apply equally to the LENNON data as well, the impact of these simplifications is limited.

2.7 Conversion to production–attraction format

2.7.1 There are two matrix formats commonly used in transport modelling. The key difference between the two approaches is in how they treat return trips, such as trips from home to work (and back). Origin—destination (OD) matrices record the outward and return movements as two separate trips, one with the 'home' end as the origin and the destination as 'work', and the other with 'work' as the origin and 'home' as the destination. The same return trip will appear only once in a production–attraction (PA) matrix, with 'home' as the production and 'work' as the attraction. Modelling productions and attractions is generally advantageous in demand modelling as it ensures the outward and return legs are treated consistently and enables links to land use to be made more easily.

2.7.2 As the primary source for trip numbers in the PLD matrices is LENNON, which is origin–destination based, certain assumptions are applied to convert to an approximation of PA format.

Number of journeys per ticket

2.7.3 There are two basic types of trip considered here, single or return, where return trips include all tickets which have multiple journeys associated, notably season tickets. NRTS has been used to evaluate the relationship between each of these types of ticket and the type of trip (from home/to home/non-home).

2.7.4 Ticket types must be classified as either single or return in order to apply assumptions to convert from origin–destination data into production–attraction data. This also allows for ticket types that have no associated journeys (e.g. railcard sales, excess fares) to be deleted (note that under LENNON definitions there may still be issues and receipts associated with them).

2.7.5 Ticket types were designated primarily on the basis of the ratio of the number of issues/journeys associated with each ticket definition in LENNON.

2.7.6 The table below provides details on the proportion of national trips that are made under each type of journey.

Table 4: LENNON ticket type correspondence summary 2014/15

Classification	Total issues	Total journeys	Total receipts
Single	66%	25%	38%
Return	34%	75%	62%
Total	100.0%	100.0%	100.0%

2.7.7 Note that for the purpose of PLD matrices there is no significant requirement at this point to classify season tickets directly but, depending on future updates, it may be a requirement to separate them out. For the current PLD forecast update, all calculations treat season tickets as return tickets although they remain classified as season tickets.

Direction conversion

2.7.8 All analysis has been derived individually for the 11 sectors discussed above (based on NRTS sector location) to provide a more localised calibration.

2.7.9 NRTS has an ambiguous ticket type classification within its questionnaire where respondents can respond multiple times as to the class of their ticket. This can ultimately lead to contradictory answers for ticket classification purposes, and in those cases the following hierarchy was applied:

- If a season ticket type was selected, the ticket was assumed to be a return regardless of any other selection.
- If a Cheap Day Return, Open Return, or One Day Travelcard was selected, the ticket was assumed to be a return.
- All remaining options result in a single ticket, notably including the 'other' classification.

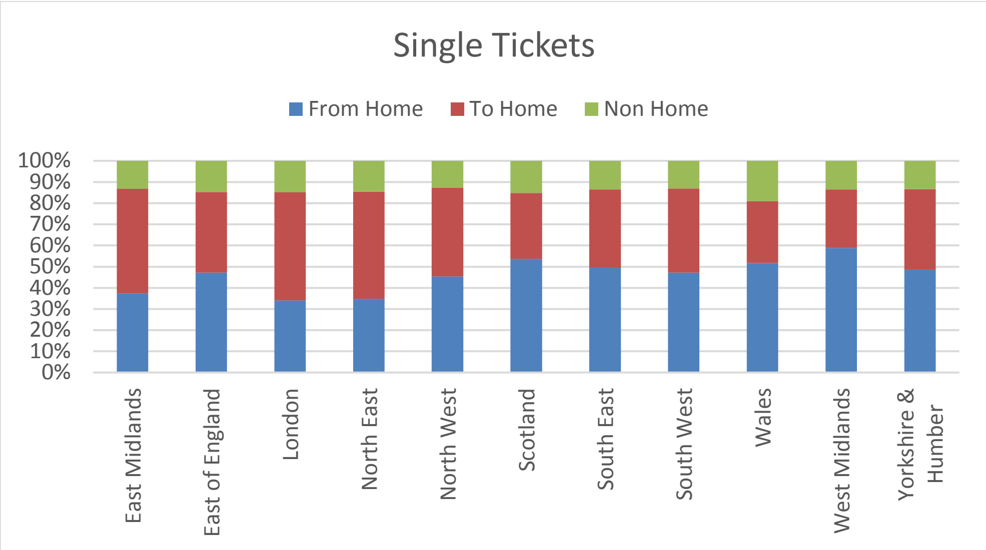
2.7.10 Previous versions of the PLD model have not modelled 'car availability' at the same time as 'directionality', as there was insufficient data available to allow such stratification to be applied reliably, and that assumption is still considered valid here, hence car availability is not considered.

Single tickets

2.7.11 Journeys have already been defined in the data as from home, to home, or non-home.

2.7.12 Figure 2 shows that typically around 15% of single tickets are non-home based and generally an approximately equal split of trips is observed across 'from home' and 'to home' (as would to some degree be expected). The most notable variation to this trend is London, which has a much larger proportion of to home trips in comparison with from home trips and enforces the decision that a geographically specific factor should be applied.

Figure 2: Allocation of single tickets to home-based and non-home-based trips



Return tickets

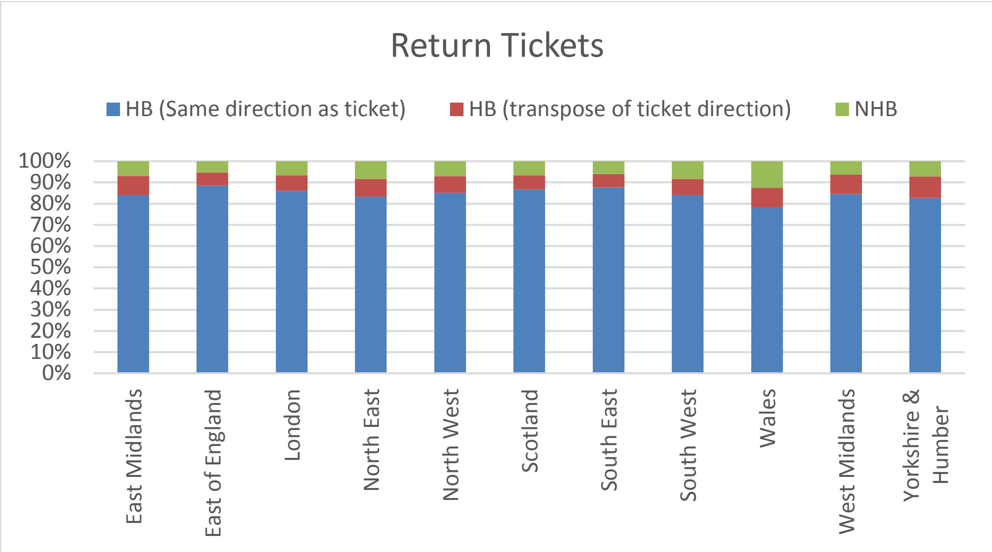
2.7.13 While it is acceptable simply to reverse the legs of a return journey in origin–destination-based matrices, to model the PA approach effectively the home end of the trip must be isolated (or approximated). Analysis of the NRTS data was again undertaken to establish firstly whether a trip was home based or not, but then also to generate appropriate assumptions to identify the home end of a journey based on the ticket data.

2.7.14 The NRTS questionnaire provides three questions that help to analyse this, specifically:

- Where have you come from (home or other)?
- Why are you travelling to your destination (home or other)?
- What type of journey were you undertaking (outward or return)?

2.7.15 Where records indicated an outbound trip going to home or a return trip leaving from home, this indicates that the from home trip is in the opposite direction to that indicated by the outbound direction of the ticketed stations, and therefore can be used to identify the proportion of trips which fall into this category. These proportions (typically less than 8%) are then assumed valid to apply to the station-to-station journeys to convert to PA trips during the later processing of LENNON data.

Figure 3: Allocation of return tickets to home-based and non-home-based trips



2.8 Conversion to journey purpose

2.8.1 LENNON data contains a summation of the number of trips between stations but no information on journey purpose, so the NRTS was again used to provide data to convert from ticket type to journey purpose.

2.8.2 It is highlighted that this does not follow the widely recognised approach adopted in the *Passenger Demand Forecasting Handbook* (PDFH), which has conversion factors to convert from ticket type to journey purpose that vary by distance and with some specific regional variations (i.e. London and South East). However, previous developments in PLD matrices have highlighted that this approach had the following issues:

- The education trip purpose is handled inconsistently in PDFH in comparison with assumptions within the PLD matrix development process.
- The mappings are typically based on general figures that include weekends rather than being weekday specific.
- Ticket type definitions are different from those currently available from LENNON.

Derivation

2.8.3 NRTS provides weekday information on both the origin and destination purpose, which in turn can then be used to define a trip as one of five classifications:

- Home-Based Commute (HBCOM);
- Home-Based Business (HBEB);
- Non-Home-Based Business (NHBEB);
- Home-Based Other (HBO); and
- Non-Home-Based Other (NHBO).

2.8.4 For journey purposes, 'Other' is also often interchangeable with 'Leisure'.

2.8.5 The conversion matrix for relating the expanded origin and destination purpose (from a set of 13 classifications) to the modelling purposes defined above is provided in Appendix A.

2.8.6 Having related every trip in NRTS to a trip type, the origin and destination are then related to sectors (22-sector system, which includes the original 11 sectors plus 11 additional sectors for major cities) to create a 22 x 22 sector total of trips by purpose, which are used to derive proportions to apply to LENNON data.

2.8.7 Where less than 200 records exist between two sectors within a car availability segment, the aggregated records based on former Government Office Regions (GORs) are used to provide a larger sample size, noting that these correspond to the first 11 sectors, and this effectively just overwrites intra-city movements.

Application

2.8.8 To apply these proportions, the Commute proportion of all home-based trips is applied to the home-based trips to identify Commute trips before then deriving the employer's business and other proportions of home-based and non-home-based independently. An example with some dummy numbers is provided below to aid understanding.

Table 5: Purpose proportion derivation example

Stage	Details	Home based			Non-home based		Sum
		Commute	Business	Leisure	Business	Leisure	
1	Trips	1,000					1,000
	Relevant proportion	50.0%					
2	Trips		300	700			1,000
	Relevant proportion		30.0%	70.0%			
3	Trips				100	200	300
	Relevant proportion				33.3%	66.7%	
	Sum	1,000	300	700	100	200	2,300

2.8.9 Where the sum of Business trips and Leisure is zero in the home-based or non-home-based category, it is assumed that trips will be evenly split between the two purposes (proportion of 50%), and it is noted that this will likely only happen where there are low observations and hence it would be expected low demand in the demand matrices so the impact will be minimal.

2.9 Rationalise annual data

2.9.1 The LENNON data analysed represents a one-year time period. This data therefore needs to be rationalised to provide the average weekday demand used in the PLANET models. PLD matrices are for a 16-hour period.

2.9.2 In order to maintain consistency with the previous PLD approach, ticket products have also been aggregated into categories.[1] This categorisation is used to assign a journey an appropriate de-annualisation factor. The factors have been derived based on assuming a constant number of working days (245) and making an assumption (predominantly retained from PFMv4.3) on how much travel there is at weekends. The factors, as well as the proportion of LENNON trips in each category are shown below in Table 6.

Table 6: De-annualisation factors

Category	Description	Proportion at weekend	Factor	Inverse factor	Demand	Proportion demand
1	Cheap Day Return	35%	0.00265	377	185,208,595	18%
2	Miscellaneous	32%	0.00278	360	1,240,398	0%
3	Season	6%	0.00384	261	371,237,552	37%
4	Reduced	32%	0.00278	360	95,060,413	9%
5	Standard Return	0%	0.00408	245	150,427,282	15%
6	Standard Single	32%	0.00278	360	208,764,540	21%
	Total				1,011,938,779	100%

2.9.3 There are two key changes to the factors applied to various trip length distances for particular ticket types that were not included in the previous approach. Firstly, there was a previous assumption that 33% of short-distance weekday single tickets were unaccounted for due to fare evasion and hence not in the LENNON data. This assumption has been removed from the PLD matrix build process because the information and the basis on which it was made was unclear. As a result, the number of single trips in the average weekday PLD matrices is reduced; however, this will not impact significantly on the PLD matrix.

[1] The SQL process uses an expanded set which considers independent factors for trips terminating in London, but in practice these factors are the same as their non-London counterparts.

2.9.4 Secondly, for tickets classified as standard returns, in PFMv4.3 long-distance trips were assumed to included 15% of tickets travelling in first class at the weekend. For the same reasons as set out above, the assumption has been removed and as a result the weekday proportion for these tickets increases and more of these trips are retained in the final matrices.

2.10 Long-distance mask

2.10.1 The PLD model applies a masking process through the use of a control matrix applied to the input demand matrices to exclude certain movements that are out of scope for the PLD model. For example, movements within London and the South East are handled by the PLANET South model and so are masked out of the PLD matrices.

2.10.2 The movements masked by the PLD are generally incorporated from the three regional models where they are represented to a higher level of detail. The masked PLD matrices exclude trips wholly within London, East and South East, around 90% of trips between South West and London/East/South East, and between 2% and 11% of trips between East Midlands and London/East/South East.

2.10.3 The PLD masking matrices were applied by station zone in the London and South East regions. Analysis shows that the masking process applied has removed all but long-distance trips in London, the South East and East, while retaining shorter-distance trips elsewhere, which complicates interpretation of the matrix analyses and prevents like-for-like comparisons with station usage data, National Travel Survey (NTS) trip rates and PDFH purpose splits. However, verification of the unmasked areas (Scotland, North East, North West, Yorkshire and the Humber, and Wales) confirmed that it is good.

2.10.4 The trip matrix mask was developed in an earlier phase of model development and not subsequently reviewed as part of this model update.

2.11 Verification of 2011 demand matrices

2.11.1 Although the current PLD development is focused on developing matrices representing 2014/15 demand, it is first necessary to compare the impact of the change in assumptions on consistent input data. Therefore, verification of these matrices used a two-stage approach, firstly comparing the matrices produced using 2010/11 LENNON data processed with the latest assumptions against the PFMv4.3 matrices, and then comparing the change in demand between 2010/11 and 2014/15 using the latest assumptions consistently across the 2010/11 and 2014/15 datasets.

2010/11 demand comparison

2.11.2 The main approach to the verification of the process and results have been a direct comparison based on LENNON database for total journeys and computing correlations between old and new results for 2010/11 sector-to-sector and zone-to-zone journeys. These have also been applied to subsets of journeys defined by purpose, car availability and directionality.

2.11.3 A close match has been obtained between the matrices developed using the methodology from PFMv6.1c and the matrices produced with the PFMv4.3 approach. Table 7 shows total trips across the dataset and the purpose/car availability/directionality split, for both masked and unmasked matrices. (NCA – No Car Available, CAV FH – Car Available From Home, CAV TH – Car Available To Home)

2.11.4 Up to the third step in the process (producing annual movements) more trips are retained compared with applying the process with the previous numerical assumptions. This is mainly due to a more complete mapping of access/egress districts to stations and a more complete classification of LENNON ticket products.

2.11.5 The de-annualisation factors applied to annual movements by ticket category have been recalculated. On average, they are slightly larger in the PFMv6.1c methodology than in PFMv4.3, thus producing weekday matrices that are slightly smaller (1% fewer journeys per weekday) than in PFMv4.3.

Table 7: Total journeys comparison (PFMv6.1c vs PFMv4.3, LENNON 2011 data)

Masked matrices

	PFMv4.3 NCA	PFMv4.3 CAV FH	PFMv4.3 CAV TH	PFMv4.3 TOTAL	PFMv6.1c NCA	PFMv6.1c CAV FH	PFMv6.1c CAV TH	PFMv6.1c TOTAL
BUS	0	53,774	43,391	97,165	0	57,183	44,747	101,930
COM	12,145	38,941	38,941	90,027	10,607	37,155	36,994	84,756
LEI	36,072	73,568	56,595	166,235	34,502	73,301	55,097	162,900
All purposes	48,217	166,283	138,928	353,428	45,109	167,638	136,839	349,586

	PFMv4.3 NCA	PFMv4.3 CAV FH	PFMv4.3 CAV TH	PFMv4.3 TOTAL	PFMv6.1c NCA	PFMv6.1c CAV FH	PFMv6.1c CAV TH	PFMv6.1c TOTAL
BUS	*0%*	*15%*	*12%*	*27%*	*0%*	*16%*	*13%*	*29%*
COM	*3%*	*11%*	*11%*	*25%*	*3%*	*11%*	*11%*	*24%*
LEI	*10%*	*21%*	*16%*	*47%*	*10%*	*21%*	*16%*	*47%*
All purposes	*14%*	*47%*	*39%*	*100%*	*13%*	*48%*	*39%*	*100%*

Unmasked matrices

	PFMv4.3 NCA	PFMv4.3 CAV FH	PFMv4.3 CAV TH	PFMv4.3 TOTAL	PFMv6.1c NCA	PFMv6.1c CAV FH	PFMv6.1c CAV TH	PFMv6.1c TOTAL
BUS	0	273,448	174,350	447,797	0	256,523	171,342	427,866
COM	323,800	808,334	808,334	1,940,467	282,766	771,626	789,722	1,844,114
LEI	270,994	550,049	353,147	1,174,190	258,345	495,906	350,180	1,104,431
All purposes	594,794	1,631,831	1,335,830	3,562,454	541,111	1,524,055	1,311,245	3,376,411

	PFMv4.3 NCA	PFMv4.3 CAV FH	PFMv4.3 CAV TH	PFMv4.3 TOTAL	PFMv6.1c NCA	PFMv6.1c CAV FH	PFMv6.1c CAV TH	PFMv6.1c TOTAL
BUS	*0%*	*8%*	*5%*	*13%*	*0%*	*8%*	*5%*	*13%*
COM	*9%*	*23%*	*23%*	*54%*	*8%*	*23%*	*23%*	*55%*
LEI	*8%*	*15%*	*10%*	*33%*	*8%*	*15%*	*10%*	*33%*
All purposes	*17%*	*46%*	*37%*	*100%*	*16%*	*45%*	*39%*	*100%*

2.11.6 Sector-to-sector journeys (using the 22-sector system) see a very strong correlation between PFMv4.3 and PFMv6.1c results, with a coefficient of 0.9987 for unmasked matrices and 0.9954 for masked matrices.

2.11.7 Zone-to-zone journeys also show very strong correlations between old and new values. Table 8 shows regression results (R2 value, slope and intercept, where the Y variable are old values, and the X variable are new) for zone-to-zone journeys, first split by purpose, car availability and directionality, then by purpose alone, and finally aggregated. Regression results are slightly skewed by the general decrease in weekday journeys (due to revisions in de-annualisation factors), so a simple correlation coefficient is also presented in the table. This shows a close correlation between PFMv4.3 and PFMv6.1c matrices using 2010/11 demand.

Table 8: Interzonal unmasked journeys comparison: 2010/11 data, PFMv4.3 vs PFMv6.1c

	Journey purpose									Sub-total			Total
	Business			Commute			Leisure			BUS	COM	LEI	
	NCA	CAV FH	CAV TH	NCA	CAV FH	CAV TH	NCA	CAV FH	CAV TH				
R2	0	0.898	0.904	0.943	0.893	0.892	0.940	0.862	0.788	0.941	0.945	0.923	0.950
Slope	0	1.341	1.140	1.389	1.350	1.249	1.068	1.389	1.036	1.185	1.262	1.128	1.222
Intercept	0	-1.278	-0.381	-1.250	-4.226	-3.230	-0.088	-2.515	-0.177	-1.074	-6.993	-1.302	-10.185

2014/15 demand comparison

2.11.8 Once this task was completed and consistency was ensured, the same process was applied to 2014/15 data. The expectation was that results would be very similar to the results using 2010/11 LENNON data, with the only difference being a general growth in line with real growth in travel demand. Indeed, the results show a 4.6% annual increase over four years in total journeys, which matches the comparison between the LENNON dataset in 2010/11 and in 2014/15.

Table 9: Total journeys comparison (PFMv6.1c, 2014/15 LENNON vs 2010/11 LENNON)

Masked matrices

2010/11	NCA	CAV FH	CAV TH	TOTAL
BUS	0	57,183	44,747	101,930
COM	10,607	37,155	36,994	84,756
LEI	34,502	73,301	55,097	162,900
All purposes	45,109	167,638	136,839	349,586

2014/15	NCA	CAV FH	CAV TH	TOTAL
BUS	0	66,805	51,666	118,471
COM	11,988	42,438	42,183	96,609
LEI	39,229	84,282	62,432	185,944
All purposes	51,217	193,526	156,281	401,023

2010/11	NCA	CAV FH	CAV TH	TOTAL
BUS	*0%*	*16%*	*13%*	*29%*
COM	*3%*	*11%*	*11%*	*24%*
LEI	*10%*	*21%*	*16%*	*47%*
All purposes	*13%*	*48%*	*39%*	*100%*

2014/15	NCA	CAV FH	CAV TH	TOTAL
BUS	*0%*	*17%*	*13%*	*30%*
COM	*3%*	*11%*	*11%*	*24%*
LEI	*10%*	*21%*	*16%*	*46%*
All purposes	*13%*	*48%*	*39%*	*100%*

Unmasked matrices

2010/11	NCA	CAV FH	CAV TH	TOTAL
BUS	0	256,523	171,342	427,866
COM	282,766	771,626	789,722	1,844,114
LEI	258,345	495,906	350,180	1,104,431
All purposes	541,111	1,524,055	1,311,245	3,376,411

2014/15	NCA	CAV FH	CAV TH	TOTAL
BUS	0	305,185	200,336	505,521
COM	353,817	898,377	942,240	2,194,434
LEI	313,996	581,263	405,252	1,300,511
All purposes	667,813	1,784,826	1,547,828	4,000,467

2010/11	NCA	CAV FH	CAV TH	TOTAL
BUS	*0%*	*8%*	*5%*	*13%*
COM	*8%*	*23%*	*23%*	*55%*
LEI	*8%*	*15%*	*10%*	*33%*
All purposes	*16%*	*45%*	*39%*	*100%*

2014/15	NCA	CAV FH	CAV TH	TOTAL
BUS	*0%*	*8%*	*5%*	*13%*
COM	*9%*	*22%*	*24%*	*55%*
LEI	*8%*	*15%*	*10%*	*33%*
All purposes	*17%*	*45%*	*39%*	*100%*

2.11.9 A similar correlation analysis to the one in Table 8 can be undertaken for 2010/11 vs 2014/15 results, produced with the PFMv6.1c assumptions. This shows that, aside from the expected general increase in trips (slopes below 1), there is little change in the spatial distribution of trips as evidenced by the correlation coefficients being very close to 1.

Table 10: Interzonal unmasked journeys comparison: PFMv6.1c, 2010/11 data vs 2014/15 data

	Journey purpose									Sub-total			Total
	Business			Commute			Leisure			BUS	COM	LEI	
	NCA	CA FH	CA TH	NCA	CA FH	CA TH	NCA	CA FH	CA TH				
R^2	0	0.969	0.966	0.982	0.979	0.973	0.975	0.972	0.969	0.969	0.978	0.972	0.977
Slope	0	0.733	0.770	0.667	0.794	0.751	0.660	0.738	0.765	0.736	0.733	0.713	0.725
Intercept	0	0.595	0.309	0.848	1.062	1.491	0.923	1.209	0.725	1.009	4.249	3.211	8.592
Corr. Coeff.		0.984	0.983	0.991	0.989	0.986	0.987	0.986	0.984	0.984	0.989	0.986	0.988

2.12 Revisions to base rail fares matrices

2.12.1 Fares within the PLD process are based on the average yield per journey provided from LENNON and are provided on a zone-to-zone basis by purpose.

2.12.2 In order to create purpose-specific fares, assumptions from PDFH linking ticket types to purpose are used rather than the NRTS-derived geographical purpose conversion applied to the demand matrices. This separate process allows zonal demand and revenue to be adjusted independently by purpose and therefore generate fares that vary by purpose, which is not achievable using geographic splits.

Preparation

2.12.3 There is a large amount of consistency between the preparation of purpose-specific demand and the preparation of purpose-specific fares in converting from the initial annual LENNON data. A brief overview of the steps can be summarised as:

- align LENNON station codes with defined stations (primarily based on NRTS);
- link LENNON product descriptions with a defined PDFH-based fare category (Anytime, Reduced, or Season);
- aggregate demand and ticket sales (revenue) by station and various product classifications;
- distribute the associated demand and revenue by station access and egress to districts, ignoring disaggregation by car availability;
- convert demand and revenue district movements to zonal movements;
- de-annualise both demand and revenue data by factors based on LENNON product descriptions;

- summarise the zonal demand and revenue by fare category (Anytime, Reduced, and Season).

Conversion to purpose

2.12.4 The major variation from preparing demand matrices is classifying tickets by fare category, which allows the fare category to purpose conversion matrices from PDFH to be applied. These tables have been taken from PDFH v5.1 (April 2013) and are generally disaggregated by journey length (in minutes), and whether or not the journey originated or terminated in London.

2.12.5 The PDFH tables consider single and return tickets separately by purpose, but in order to reduce calculation steps an average single/return weighting is used to convert purpose, where the weightings of single and return proportions have been taken from total 2014/15 LENNON demand across all regions (no differentiation for London trips). It also assumes that advanced tickets are an element of reduced rather than an isolated ticket type.

2.12.6 The PDFH table used to convert ticket type to purpose is based on the skimmed journey time from the previous version of the PLD model, where journey time is assumed to include the in-vehicle time, interchange penalty, and initial wait time, but excludes walk times and crowding penalties (this is referred to as Generalised Journey Time in PDFH). This models the actual time spent on a train journey from arriving at the first station through to exiting the final station.

2.12.7 In some cases, where zone pairs do not have demand allocated between them, no journey time skim is available from the previous PLD model, and in these cases the median speed from all available zone pairs (52.9kph) is applied to the distance skim to yield a proxy.

2.12.8 Having identified the appropriate factors to apply from PDFH, they are applied to the demand and revenue by ticket type to produce demand and revenue by purpose.

Establishing the yield

2.12.9 Once the demand and revenue are available by purpose, the yield is easily calculated as:

$$Yield = \frac{Revenue}{Demand}$$

2.12.10 This yield is calculated for all zone pairs and purposes, then the median non-zero yield per km and the standard deviation of yields per km are taken by purpose for comparison. These are used to provide a set of bounds within which the yield must fall, which is defined as the median +/- one standard deviation for the yield per km. To ensure the chosen fares are reasonable, the following rules are applied to each zone pair:

- If there are more than 50 weekday trips in a zone pair or the trip is within a GORs region, Fare = MAX(Yield, £2.00).
- If there are less than 50 weekday trips in a zone pair or yield is outside the set bounds, Fare = MAX(distance * average yield / km, £2.00).
- Otherwise, Fare = MAX(Yield, £2.00).

Verification of fares

2.12.11 The fares verification was completed by following a similar process to that followed for the demand, by first comparing against the previous PLD matrices to ensure the variances to fares introduced by changes to methodology are reasonable and intuitive, before comparing the 2014/15 fares against the 2010/11 fares using a consistent approach.

2.12.12 It is difficult to evaluate the impact of a change in fare, as a large change in fare with no associated demand is largely irrelevant in the model while a relatively small change in fare with a large demand could have a significant impact, and so overall revenue is used to evaluate the changes, taken as the product of demand and fare by purpose and zonal pair and generally reported after summing across the entire modelled area.

2.12.13 Although the derivation of fare matrices includes an extraction of demand and conversion to purpose, this is inconsistent with the approach for demand matrices (which uses a geographical purpose conversion) and would in general simply come back to the LENNON data by purpose.

2.12.14 Instead, in order to evaluate the changes in a manner consistent with the model, the verification here will generally consider the overall changes in revenue by purpose which is calculated by multiplying the PLD demand matrices by the PLD fare matrices for 2011 and 2015.

Verification of 2010/11 fares

2.12.15 The overall change in revenue between the previous PLD matrices and the new approach is considered in Table 11 and shows very little variance overall (a 1% reduction overall), although it is noted that demand reduced by approximately 5% so ultimately there is an increase in the fares in the places where demand is located.

Table 11: PLANET Long Distance revenue comparison 2011 PFMv4.3 vs 2011 PFMv6.1c (total movements, 000s)

	Revenue				**Demand**			
	BUS	**COM**	**LEI**	**Total**	**BUS**	**COM**	**LEI**	**Total**
PFMv4.3	5,258	8,793	7,786	21,837	448	1,940	1,174	3,562
PFMv6.1c	4,775	9,595	7,160	21,531	428	1,844	1,104	3,376
Diff	-483	803	-627	-307	-20	-96	-70	-186
% Diff	-9%	9%	-8%	-1%	-4%	-5%	-6%	-5%

2.12.16 A similar comparison of the matrices after masking in Table 12 shows that the differences are slightly more marked, although, in large part, they are likely down to the changes in purpose. This is particularly notable as the latest approach moved from PDFH v5.0 to PDFH v5.1 and has a markedly different approach to applying purpose conversion based on journey length rather than regional movements, and predominately impacts on the business and leisure purposes.

Table 12: PLANET Long Distance revenue comparison 2010/11 data, PFMv4.3 vs PFMv6.1c (masked movements, 000s)

	Revenue				Demand			
	BUS	COM	LEI	Total	BUS	COM	LEI	Total
PFMv4.3	2,305	7,642	4,493	14,440	351	1,850	1,008	3,209
PFMv6.1c	1,876	8,406	3,944	14,226	326	1,759	942	3,027
Diff	-429	764	-550	-214	-25	-91	-66	-182
% Diff	-19%	10%	-12%	-1%	-7%	-5%	-7%	-6%

2.12.17 Although there are differences in the derivations of demand and fare matrices by purpose, it would be expected that a consistent comparison of revenue from the PLD process (demand * fare) and the LENNON data (processed to zonal pair and purpose) should have a level of correlation, and the overall figures for this are shown below in Table 13 and Table 14 for the total and masked cases respectively.

2.12.18 These both show a high level of correspondence in the overall level of revenue but highlight more variable values by purposes, which would be expected due to the varying approach to purpose conversion.

Table 13: Comparison of 2010/11 Planet Long Distance revenue vs LENNON weekday revenue (total trips, 000s)

	Business	Commute	Leisure	Total
Initial LENNON	5,612	8,397	6,597	20,606
Derived revenue	4,775	9,595	7,160	21,531
Diff	-836	1,198	563	925
% Diff	-15%	14%	9%	4%

Table 14: Comparison of 2010/11 Planet Long Distance revenue vs LENNON weekday revenue (masked trips 000s)

	Business	Commute	Leisure	Total
Initial LENNON	2,814	1,399	3,163	7,377
Derived revenue	2,899	1,189	3,216	7,305
Diff	85	-210	53	-72
% Diff	3%	-15%	2%	-1%

2.12.19 Overall, the levels of consistency with the previous PLD fare matrices are considered reasonable and reflective of improvements introduced to the approach for derivation which provides confidence in applying the process to 2014/15 data.

Verification of 2014/15 fares

2.12.20 Comparing the 2010/11 and 2014/15 revenues requires a more measured approach due to the large number of known changes inherent in the LENNON data, including:

- general background growth of rail demand;
- policy changes for regulated fares;
- changes in unregulated fares;
- changes in the Retail Prices Index (RPI) over time; and
- changes in ticket purchasing trends over time.

2.12.21 The table below shows that there is a general trend for rail demand to increase by 18%, which can be seen equally across all purposes as there are no deviations in the purpose conversion approach. The corresponding increase in revenue is approximately 30%, which suggests a general increase in fares of approximately 16%.

Table 15: PLD v6.1c revenue comparison 2010/11 vs 2014/15 (total movements, 000s)

	Revenue				Demand			
	BUS	COM	LEI	Total	BUS	COM	LEI	Total
2010/11	4,775	9,595	7,160	21,531	428	1,844	1,104	3,376
2014/15	6,145	12,587	9,353	28,085	506	2,194	1,301	4,000
Diff	1,369	2,992	2,193	6,554	78	350	196	624
% Diff	29%	31%	31%	30%	18%	19%	18%	18%

2.12.22 Over the time period 2011 to 2015, the increase in RPI for rail fares was 15.2%[2]. Regulated fares were controlled to RPI +1%, which would have led to an additional 4.1% increase. There is limited data on how unregulated fares have varied over time, although the LENNON data shows that there is an increased prevalence of advance tickets which would suggest that unregulated revenue would have decreased through increased uptake of these cheaper tickets. The combination of these impacts would provide confidence that the general level of growth in fares would be considered reasonable for the known conditions.

2.12.23 The comparison of the matrices after masking, which focuses on the areas where PLD modelling takes precedence over regional models, shows trends that are broadly comparable with the total case. Although the increase in revenue is slightly lower, the

[2] Office for National Statistics, *RPI: fares & other travel costs*. Retrieved 16 February 2016 from http://www.ons.gov.uk/ons/datasets-and-tables/data-selector.html?cdid=DOCW&dataset=mm23&table-id=2.1

demand also reduces by a similar amount, which would suggest that the level of increase on fares is largely steady throughout.

Table 16: PLD v6.1c revenue comparison 2010/11 vs 2014/15 (masked movements, 000s)

	Revenue				Demand			
	BUS	COM	LEI	Total	BUS	COM	LEI	Total
2011	2,899	1,189	3,216	7,305	102	85	163	350
2015	3,636	1,519	4,123	9,277	118	97	186	401
Diff	736	330	907	1,972	17	12	23	51
% Diff	25%	28%	28%	27%	16%	14%	14%	15%

2.12.24 As in the 2010/11 case, it would still be expected that the combination of PLD demand and fare would provide a close approximation of the initial LENNON revenue on which they were both based, and in considering Table 17 and Table 18 the general trends noticed in section 2.12 are still evident here, in particular:

- Overall levels of revenue are highly comparable, with a small 4% increase on the full matrix and a negligible impact on the matrix after masking.
- There are variances in the purpose-specific revenue approximations, primarily due to differing approaches to splitting trips into purposes.

Table 17: Comparison of 2014/15 Planet Long Distance revenue vs LENNON weekday revenue (total trips, 000s)

	BUS	COM	LEI	Total
Initial LENNON	7,229	11,108	8,790	27,126
Derived revenue	6,145	12,587	9,353	28,085
Diff	-1,084	1,479	563	958
% Diff	-15%	13%	6%	4%

Table 18: Comparison of 2014/15 Planet Long Distance revenue vs LENNON weekday revenue (masked movements, 000s)

	BUS	COM	LEI	Total
Initial LENNON	3,452	1,786	4,051	9,289
Derived revenue	3,636	1,519	4,123	9,277
Diff	183	-268	72	-12
% Diff	5%	-15%	2%	0%

Fare summary

2.12.25 Although there are some differences in fares at a zonal level due to changes in assumptions, the overall levels of revenue have been analysed for both the total modelled area and the areas that remain after masking where the PLD takes precedence, and the comparisons have shown improvements to the PLD fare derivation process as expected when considered against the previous approach.

2.12.26 Furthermore, applying these improvements on to 2015 LENNON data shows justifiable levels of growth from the consistent 2011 matrices.

2.13 Annualisation factors

2.13.1 The PLD model considers demand based on an average weekday, but in order to assess benefits in appraisal it is necessary to consider annual demand accounting for weekends and bank holidays. The approach documented here is largely consistent with the previous approach adopted in PFMv4.3 and makes use of the NTS dataset to create estimations of weekday travel to ultimately evaluate annual factors.

2.13.2 In order to avoid confusion it must be noted that annualisation and deannualisation are distinct processes and the annual demand derived using these factors is separate, distinct and different from the annual movements mentioned in paragraph 2.11.8.

- **Annual movements** are obtained as part of the PLD matrix production process.
- **De-annualisation factors** separate *by ticket category* are applied to the annual movements in order to get weekday matrices. This concludes the main process.
- The outputs from the main process, as well as the de-annualisation factors and extra survey data are all inputs to a separate process that produces **annualisation factors** *by purpose*.
- These annualisation factors are then applied to the PLD weekday matrices to obtain **annual journeys**.

National Travel Survey results

2.13.3 The NTS was interrogated to establish the proportion of demand available by purpose and weekday/weekend and therefore an implied annualisation figure by journey type, and this is shown below in Table 19 for the aggregated data from 2006 to 2010. This data only considers rail demand over 50 miles to provide a more valid comparison for the PLD matrices.

Table 19: Proportion of total weekly rail demand over 50 miles by journey purpose and weekday/weekend from National Travel Survey data

Trip purpose	Weekday	Weekend	Implied annualisation
Commute	21.9%	0.6%	251
Business	21.6%	0.9%	255
Leisure	35.5%	19.6%	381

Total	78.9%	21.1%	310

2.13.4 The implied annualisation here is based on an assumption of 245 working weekdays, calculated from 260 calendar weekdays, minus eight bank holidays, and a further reduction for atypical reduced demand in the Christmas period. This figure is consistent with the value used in the earlier de-annualisation process for deriving weekday matrices.

2.13.5 The implied annualisation is derived as:

$$Ann_P = 245 \times \frac{WD_P + WE_P}{WD_P}$$

Where:

Ann_P is the implied annualisation factor for purpose P;

WK_P is the proportion weekday travel by purpose P of a full week total; and

WE_P is the proportion weekend travel by purpose P of a full week total.

LENNON consistent annualisation factors

2.13.6 The NTS data listed in the previous analysis is clearly based on a small sample of data, and an improved approach to using these factors is to relate them to the subset of LENNON that is used in the PLD matrices. The annualisation factors are shown below in Table 20 along with the figures behind the numbers.

2.13.7 PLD matrices are based on an average weekday. Using these values to account for all weekdays, taking this from the annual figure (available from the initial LENNON data) and assuming the purpose split of weekends is consistent with NTS, allows an estimate on the weights of each purpose for both weekday and weekends, and hence an annualisation to be derived in the manner specified above. Laid out step by step, this is:

- The main process produces annual movement matrices, then, at its final step, de-annualises these movements by ticket category producing weekday matrices. Totals of these matrices, with 2014/15 data, appear in Table 20, labelled 'PLD annual demand' and 'PLD weekday demand' respectively.
- The weekday totals are all multiplied by 245 to get three inferred yearly-workdays totals, one for each purpose, which are then divided by the total of all annual movements, giving the percentages labelled 'PLD proportion of annual'. These sum up to 73.4% meaning that under PLD process assumptions (explained in section 2.9), 73.4% of all trips are weekday trips, and consequently 26.6% are weekend trips.
- The 26.6% figure is split between the three purposes using NTS 2014 weekend figures (shown in the row labelled 'NTS weekend demand') as weights. This produces the LENNON-consistent weekend split appearing under the label 'Assumed weekend proportion of PLD annual demand'.
- Finally, the formula in the previous section is applied by purpose, using the

derived weekday and weekend proportions and the final results are shown in the row '2015/15 annualisation factors' in Table 20.

- A similar process is applied to the 2010/11 data (using 2010 NTS data for the weekend purpose split) to obtain separate factors for 2010/11, presented in the row '2010/11 annualisation factors' in Table 20. There is an increase in annualisation factors between 2010/11 and 2014/15 reflecting a larger proportion of travel happening at weekends in 2014/15, which is confirmed by NTS figures.
- The factors used in PFMv4.3 are presented at the bottom of the table in the row '2010/11 annualisation factors' for comparison.

2.13.8 It is highlighted that these factors only consider long-distance trips (over 50 miles) from the PLD matrices with the masked areas removed, thus commuting which would be expected to be predominately short to medium distance in nature makes up a much smaller proportion of the annual figure than the full rail demand.

Table 20: 2014/15 PLANET Long Distance annualisation factors based on masked PLANET matrices annual demand over 50 miles

	Commute	**Business**	**Leisure**	**Total**
PLD weekday demand	40,400	97,415	112,021	249,836
PLD annual demand	13,136,203	32,654,305	37,571,653	83,362,161
PLD proportion of annual	11.9%	28.6%	32.9%	73.4%
NTS weekend demand	0.8%	1.0%	21.2%	23.0%
Assumed weekend proportion of PLD annual demand	0.9%	1.1%	24.5%	26.6%
2014/15 annualisation factors	264	255	428	
2010/11 annualisation factors	254	256	416	

3 PLANET Midlands and PLANET North rail matrices update

3.1 Introduction to regional matrices update process

3.1.1 This chapter describes a new matrix creation process that has been developed based on the review of documentation from previous model release versions and the availability of data. A new process was required because the PFMv4.3 matrices are themselves only an uplifted version of earlier demand matrices using factors based on component data that is no longer readily available. This means was not possible to replicate the existing matrices as a preliminary phase of the calculations.

3.1.2 The PLANET Midlands (PM) and PLANET North (PN) matrices are not provided in production–attraction (PA) and attraction–production (AP) segments, instead being defined for car-available and non-car-available segments within the three journey purposes (Business, Commute, and Leisure) and thus are defined in terms of six sub-matrices:

- Business – Car Available;
- Business – No Car Available;
- Leisure – Car Available;
- Leisure – No Car Available;
- Commute – Car Available; and
- Commute – No Car Available.

3.1.3 The principal data sources used are:

- a summary of the rail industry sales database for the 'rail year' 2014/15 (LENNON);
- 'infill' information,[3] which provides station-to-station flows of journeys made on zonal tickets within each passenger transport executive (PTE) area; and
- the National Rail Travel Survey (NRTS),[4] which provides evidence for the allocation of station demand to model zones taking into account car availability.

3.1.4 The PM and PN model values have been informed by recalculated Journey Purpose and de-annualisation factors, based on NRTS data focused on the more local movements for which regional matrix values are used by PFM. These journeys are masked out of the PLD matrices as discussed in the previous chapter. Matrices have been calculated using both the old and the new sets of journey purpose and de-annualisation factors, allowing the impact of the recalculation to be identified.

[3] 'Infill data' was commissioned by the Office of Rail Regulation (ORR) for the preparation of its Estimates of Station Usage dataset.
[4] The National Rail Travel Survey (NRTS) is a survey of passenger trips on the national rail system in Great Britain on weekdays outside school holidays, largely undertaken in 2004/05, for which responsibility is now held by DfT. It builds on the data collected in 2001 through the London Area Transport Survey (LATS).

3.1.5 For PLANET South (PS), a different method was followed which continued the approach of uplifting existing matrix values. This is set out in Chapter 4, where relevant supplementary data sources are also described. The process makes use of procedures for processing LENNON data outlined in the PM and PN update section.

3.2 Implications of the updated regional matrices

Implications for station choice model

3.2.1 Running the regional models involves modelling the origin and destination stations to be used by any particular zone-to-zone flow. The model is informed by a prior shortlist of candidate stations from which to select, which is defined appropriately for each origin and destination zone pair. For PM and PN this has been computed afresh (see Chapter 5), consistent with the sets of stations defined by the allocation of station demand to zones emerging from the matrix-building process described here.

Implications for preload factors

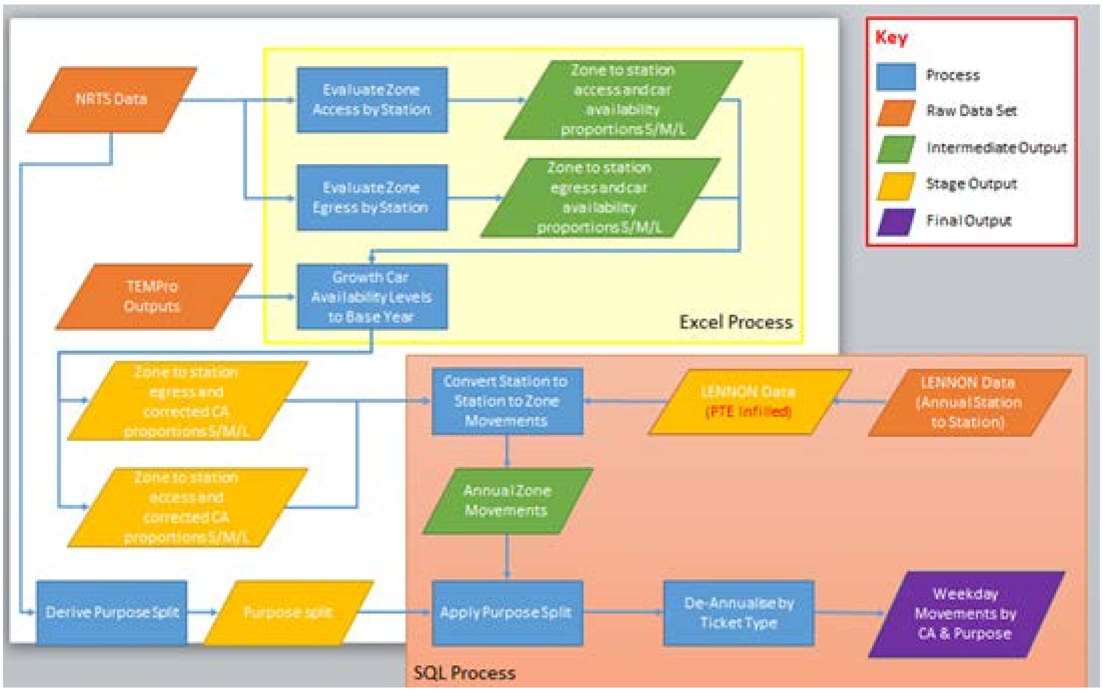
3.2.2 The modelling process requires the ability to feed estimates of station-to-station demand between regional and PLD models, both from PLD to regional models and vice versa. The preload factors include an element related to the three-hour span of the regional demand compared with the 16-hour span of PLD demand, and the recognition of tidal flow in relation to the directionality of the particular train services involved.

3.2.3 A review of preload factors has been undertaken separately to the matrix update described here. This has not been included in PFMv6.1c but may be reflected in future model updates.

3.3 PLANET North and PLANET Midlands matrices update process

3.3.1 The LENNON data records sales of station-to-station movements, by detailed ticket type. The principal steps in its conversion to PLANET matrices are its conversion to movements between model zones by car availability status, the ascription of journey purpose to the demand segments, and the scaling down of annual demand to a daily three-hour morning peak period. A flow-chart illustrating the process is given in Figure 4.

Figure 4: Process flow chart



3.3.2 Some of the required data has been sourced from the NRTS[5] which includes, for some flows in the portion of PM within the South East area, data from the London Area Travel Survey (LATS).[6] Key components include:

- The geographical spread of respondents is used to allocate demand at each station to appropriate model zones and to break down trips into car and non-car ownership categories.
- Journey purpose and time of day information, by ticket type, is used to inform journey purpose factors and 'within-day' components of the de-annualisation factor.

[5] The NRTS is a sample of journeys across the national rail network, controlled to counts at cordons primarily representing major conurbations, which was last undertaken in 2001/02 (South East area, known as LATS) and in 2004/05 for the remainder of the country. Although the surveys are recognised to be somewhat dated, there is no comprehensive better survey available. Exercises undertaken at the time of the 2010/11 update demonstrated that, despite significant change in the ticket types offered to customers largely for longer-distance movements, the broad composition of travel, at a national level, had not varied greatly.

[6] Dating from 2001.

3.3.3 The following sections set out, in detail, what has been done at each step, in line with the process flow chart shown in Figure 4. The description is set out in sections as follows:

- LENNON data conditioning (within the salmon-tinted part of the figure);
- allocation of demand to regional model zones (indicated in the yellow-tinted part of the figure);
- de-annualisation (indicated in the salmon-tinted part of the figure); and
- journey purpose allocation (included in the white-tinted part of the figure).

3.3.4 The recalculated journey purpose splits for morning peak demand based on the fresh analysis of the NRTS data are described in sections 3.6 and 3.7, followed by a review of updated model outputs.

3.4 LENNON data processing

3.4.1 The updated PM and PN matrices have been sourced from the same LENNON extract of all national rail sales data for 2014/15 as has been used for updating the PLD base demand matrices. The data is listed, in the extract, between all sales origins and destinations, recording for each ticket product sold the number of issues and the number of journeys associated with them. The number of journeys is identified in LENNON based on an assumed number of journeys actually undertaken, which varies between ticket product. Some of the journeys will have been made at weekends.

3.4.2 Application of the LENNON data has involved tasks which are described below, as follows:

- replacement of PTE product data by 'PTE infill' data;
- standardising the origin station name, destination station name and ticket types;
- expanding sales from or to 'station group' codes to individual stations; and
- applying procedures to deal with 'negative demand' records.

Replacement of PTE product data by PTE 'infill' data

3.4.3 PTE products typically allow travel within defined areas and thus are not represented in the LENNON dataset in terms of station-to-station flows and volumes. This step involved the replacement of PTE product data in LENNON by 'PTE infill' data for the same period, as provided to the Office of Rail and Road (ORR) for preparation of their Estimates of Station Usage dataset. The 'infill' data incorporates the outcomes from analysis to allocate the high-level demand on zonal ticket products to station-to-station flows, on the basis of survey and other information, recognising the directionality of journey-making within conurbations to preserve the 'quasi-PA' format of the sales data.

3.4.4 For PM and PN, infills were introduced to represent demand in the following seven areas: Merseyside, Greater Manchester, South Yorkshire, West Yorkshire, Tyne and Wear, West Midlands, and Strathclyde. The corresponding unallocated sales totals within LENNON for the relevant products were deleted to avoid double-counting. Table 21 presents how many journeys were taken out and how many were put back in as infills, while the ticket types corresponding to the infill are outlined in Table 22.

3.4.5 In Merseyside, South Yorkshire, West Yorkshire, and the West Midlands the infill process has brought in a considerable amount of additional volume (Strathclyde is similar but lies outside the area of interest of the regional models.) This is a plausible outcome as commentaries drafted for ORR as part of the infill production indicate that, in the year in which enhanced infills were first brought in, there were increases of 11 million journeys for Merseyside, 2 million journeys for Greater Manchester and 5 million journeys for the West Midlands regions.

Table 21: Number of journeys replaced by 'PTE infills'

PTE region	Journeys removed from LENNON	Journeys allocated in infill
Merseyside	8,955,665	20,590,275
Greater Manchester	5,874,008	5,874,798
South Yorkshire	467,112	1,213,801
West Yorkshire	3,854	8,569,585
Tyne and Wear	172,421	172,431
West Midlands	18,814,081	23,856,360
Strathclyde	229,339	6,256,036

Table 22: Ticket types replaced by 'PTE infills'

PTE region	Ticket types included in infill
Merseyside	Railpass, Trio, Saveaway, Day Saver Concessions Through tickets to Liverpool Airport
Greater Manchester	Traincard, Countycard, Daysaver, Rail Ranger, GM Wayfarer, GM Accompanied Child Through tickets to/from Metrolink
South Yorkshire	TravelMaster, TravelMaster Zonal, RailMaster, Day Tripper
West Yorkshire	MetroCard, Day Rover, Student Plus Through tickets to Leeds/Bradford Airport
Tyne and Wear	Through tickets to T&W Metro Through tickets to Newcastle Airport
West Midlands	n-Network, n-Train, Day Ranger Concessionary travel
Strathclyde	ZoneCard, Roundabout, Daytripper Through tickets to Subway Through tickets via ferry to Brodick, Dunoon and Rothesay Through tickets to Glasgow Airport Through tickets to Prestwick Airport

Standardising LENNON data

3.4.6 As well as standardising the origin and destination station names from LENNON, this task also involved aggregating detailed 'Class and Type of Ticket' (CTOT) records to higher-level ticket type groups.

3.4.7 The ticket type groups set up are as shown in Table 23, together with their categorisation in terms of Full, Reduced and Season for the subsequent allocation of zoning, journey purpose and annualisation factors. The details in the column 'Ticket type description' indicate the criteria used to allocate the individual sales records by CTOT to these groups.

Table 23: Ticket type to fare category correspondence

Ticket type code	Ticket type description	Category
SINGLE	Single journey ticket	Full
PK_TC	Day Travelcard valid in peak	Full
RETURN	Return ticket valid in peak, up to 80 miles approximately	Full
RETURN_LD	Return ticket valid in peak, beyond 80 miles approximately	Full
CDR	Cheap Day Return ticket	Reduced
OFF-PK_TC	Day Travelcard valid only in off-peak	Reduced
REDUCED	Return ticket valid only in off-peak but offering stayaway up to a month, offered typically over 80 miles	Reduced
PERIOD_PTE_LUL_TC[7]	Zonal season ticket sponsored by PTE	Season
PT-PT SEASON	Season ticket	Season

3.4.8 The data imported from the PTE/Transport for London infill sources are described only as Full, Reduced or Season; however, given that it represented zonal travel tickets for either day or period travel, the categories have been allocated wholly to Peak, Off-Peak and Period Travelcard ticket types respectively, following comparison of the products' validity details with those of the standard formulations.

Expanding sales from or to 'station group' codes to individual stations

3.4.9 Within the LENNON dataset, there are instances in which multiple stations within a localised area can be grouped. For example, Reading and Reading West stations might be grouped under 'Reading stations'. In this situation, it is necessary to undertake some processing of the data.

3.4.10 Expanding sales from or to 'station group' codes to individual stations was done by using total demand between constituent stations from groupings and individual stations. The proportion of the group ticket allocation was assigned according to the respective proportion that each constituent station held, of the in-scope journeys having station defined. This exercise was done in ticket type groups so that demand

[7] LUL relates to validity on London Underground, and applies only to PLANET South (PS) described in Chapter 4. The relevant tickets are sponsored by Transport for London (TfL).

from ticket types with a different associated journey purpose would not pollute the overall demand.

3.4.11 Where there is demand between a station within a station group, and a station group, the demand is calculated in the same way as above for each station group. This gives two figures of demand for each movement, depending on the station-to-station demand and the respective station-to-group demand. The multiplication of these figures provides a matrix for the total distribution of journeys between each station to station. The proportion of the group ticket allocation was assigned according to the distribution matrix. This again was done individually for each ticket type group.

3.4.12 Where there is joint station demand but no individual station to station demand to inform the distributional split between stations, the proportional split is taken from an appropriate other ticket grouping.

3.4.13 Once the group stations had been re-distributed all journeys were aggregated by standard origin name, standard destination name and ticket type, giving a point to point matrix with unique values.

3.5 Allocation of demand to regional model zones

Introduction

3.5.1 Factors were developed to map demand at origin and destination stations to model zones for car available (CA) and non-car available (NCA) segments, by rail journey distance. The mapping was based on evidence from the NRTS survey, and is similar to that used for the PLD demand matrix update.

3.5.2 For each station the zonal pattern of ultimate origin has been determined, within a six-way segmentation of car availability (CA/NCA) against length of the station-to-station rail journey (less than 20km, between 20km and 40km, and over 40km), identifying the top 15 regional model zones within each segment. Because of the number of years that have elapsed since the NRTS surveys, the demand from/to each model zone has been uplifted by the change in car availability during the intervening years up to 2014/15 using TEMPro data at a planning region level.

3.5.3 The same exercise has been undertaken for stations at the destination end of journeys, although in this case the output has been calculated as the zonal spread within car available/not available segments, as (in the overall computation for matrix production) these segments are set in the mapping at the origin end of processing for each LENNON flow leaving a simpler task for the destination mapping.

3.5.4 Two specific issues have been recognised in informing the regional models by NRTS data, which are described in sections further below:

- coverage of respondent origins and destinations by our allocation to 15 zones; and
- allocations for stations new since the date of NRTS.

Coverage of range of National Rail Travel Survey respondent origins and destinations

3.5.5 In PM and PN, the zones are built up from Middle Layer Super Output Areas[8] (MSOAs) allowing the use of smaller zones in areas of focus (e.g. in metropolitan areas of Manchester and Birmingham). This could have resulted in NRTS origins/destinations being extended over a greater number of zones than our analysis could handle. Findings for the proportion of demand that was able to be recognised specifically by our allocation process are given in Table 24 and Table 25, which show both the aggregate position and the picture for the stations and journey types having the lowest noted coverage by our 15-zone analysis (i.e. those journeys having the most diffuse range of origins, interacting with the small size of zones in main conurbation centres). The surplus demand is split proportionally across the top 15 zones within each market segment at each station.

Table 24: Percentage of NRTS demand, in CA/NCA segment, covered by '15 top zone' analysis, PLANET North origins

	Total journeys in NRTS sample (000s)	**Car availability / length of rail journey segment versus 20km and 40km boundaries**					
		NCA Short	**NCA Medium**	**NCA Long**	**CA Short**	**CA Medium**	**CA Long**
Whole NRTS sample	2,495	99.8	99.7	98.9	99.8	99.8	98.6
Stations displaying lowest coverage in most sensitive journey type:							
Manchester Piccadilly	15.7	91	93	73	95	98	71
Liverpool Lime Street	9.1	97	100	82	98	100	74
Doncaster	3.8	100	100	87	100	96	67
Stockport	2.8	98	100	94	92	99	57

[8] Middle Layer Super Output Areas are a geographic hierarchy designed to improve the reporting of small area statistics in England and Wales, defined by the Office for National Statistics, with mean population 7,200 and minimum 5,000.

Table 25: Percentage of NRTS demand, in CA/NCA segment, covered by '15 top zone' analysis, PLANET Midlands origins

	Total journeys in NRTS sample (000s)	**Car availability / length of rail journey segment versus 20km and 40km boundaries**					
		NCA Short	**NCA Medium**	**NCA Long**	**CA Short**	**CA Medium**	**CA Long**
Whole NRTS sample	2,495	99.8	99.7	98.9	99.8	99.8	98.6
Stations displaying lowest coverage in most sensitive journey type:							
Birmingham New Street	28.1	90	88	60	96	94	77
Nottingham	8.5	98	92	79	98	86	72
Leicester	7.3	100	96	80	99	92	69
Derby	5.5	100	100	85	100	85	71

3.5.7 The station-to-station distance bands used for the mapping of catchment areas at each station are the same as those used in the equivalent exercise in the PLD model. Although not optimum for the length of journeys in the masked regional model, they have been retained for consistency with PLD. While, for example, only 57% of long-distance originating demand has been covered by the identified zones at Stockport in the PN model (the lowest coverage found), the proportion of journeys within this longer-distance band, within the masked portion of the regional models, is relatively low.

3.5.8 The previous 2007/08 PM and PN matrix development approach (which informed the PLDv4.3 updating), where there was any NRTS record for a given station-to-station flow (separately within the CA and NCA segments), used those NRTS records to define the pattern of origin and destination zones for that flow. These flow-specific patterns overwrote the zonal distributions derived from the analysis on a station basis described above. We have not applied this overwriting in this update, primarily as we do not believe that the method consistently adjusted the default station-based allocations in recognition that many flows were thus taken out of its scope, and also to maintain consistency with the PLD updating where such a component was not applied.

Stations new since National Rail Travel Survey

3.5.9 Stations which have opened since the date of the NRTS have been considered individually and the majority have had all their demand allocated to the zone in which the station lies. This is appropriate as in most cases the new stations are stations created to serve local markets outside the 'masked' regional matrix area or have low demand.

3.5.10 Four new stations do, however, have more significance in the PM and PN models. Origin and destination spreads of demand were created for Buckshaw Parkway and Liverpool South Parkway (for PN) and Coleshill Parkway and East Midlands Parkway (for PM), in terms of catchment characteristics, based on local geography and observations of, and in relation to, nearby existing stations.

For these stations NCA/CA splits have been informed by data for adjacent stations represented in NRTS. For journeys originating at the station, demand has been allocated according to population of the zones within catchment areas defined by 800m and 2,000m radii of the station; while distribution for journeys terminating at the stations has been estimated according to the employment within these areas. The approach was modified for East Midlands Parkway station to reflect its characteristics as both an airport-access and a 'parkway' station with good trunk road accessibility.

3.6 De-annualisation

3.6.1 The LENNON data incorporates standard values representing the number of journeys made per ticket issue, by ticket type. For the annual dataset, the de-annualisation task is required to first break the total down to a standard weekday, and then within that to determine the portion expected to travel in the PLANET morning peak.

3.6.2 The calculations include a consolidation of the 'year to weekday' components as well as a calculation of the 'morning peak' proportions from the NRTS weekday survey (which was also used for the determination of journey purpose as outlined in section 3.7). Significant components include:

- identifying that a significant proportion of purchased season ticket / season Travelcard journeys (15%) are not made in the morning peak and so fall outside the models; and
- following Atkins' precedent in including an allowance for ticketless travel, by uplifting the volume of travellers emerging from de-annualisation nominally on 'single' tickets; however, recognising overall proportions of ticketless travel of 6% (PM) and 9% (PN), as informed by an examination of publicly available regional survey evidence. These components do lead to a significant uplift of the modelled 'single' ticket type.

3.6.3 The output of the computations gives the de-annualisation factors shown in Table 26, for use in the relevant models. The figures shown represent the value by which the annual demand needs to be divided to give the weekday morning peak (0700–0959 arrival) demand. Ticket products having only minimal volume in the masked LENNON extract have not been shown. Values for PM and PN have also been equalised except in the cases of seasons and single tickets (both having high materiality and good sample sizes in NRTS).

Table 26: Recalculated (i.e. 'Option 2') de-annualisation factors by ticket type for both PLANET Midlands and PLANET North

Ticket type	PM	PN
CDR	2,558	2,558
RETURN	558	558
PERIOD_PTE_LUL_TC	595	613
PT-PT SEASON	595	613
SINGLE	473	473

3.6.4 The factors previously used by Atkins in PFMv4.3, and retained for the intermediate set of matrices, are shown in Table 27.

Table 27: PFMv4.3 de-annualisation factors by ticket type for both PLANET Midlands and PLANET North (intermediate matrices)

Ticket type	PM	PN
CDR	3,692	3,120
RETURN	490	480
PERIOD_PTE_LUL_TC	521	494
PT-PT SEASON	521	494
SINGLE	1,714	1,733
Based on information provided by Atkins, and believed to have been used in 2007/8 and 2010/11		

3.6.5 The application of the recalculated factors to the underlying dataset suggested that there could be reductions in the previously estimated volumes of passengers in the morning peak period of around 8% overall, driven to a significant extent by the reduction in regularity of season-ticket use in the peak, noted above.

3.6.6 There is a significant increase in the number of morning peak journeys (modelled as if using single tickets) associated with the increase in allowance for ticketless travel noted in paragraph 3.6.2, demonstrated by the change in de-annualisation factor shown in Table 28. The proportion of morning peak travellers modelled as single tickets (whether ticketed or not) is now between 5% and 6%, as shown in Table 28.

3.6.7 The emerging profile of morning peak travellers by ticket type, following recalculation, is as shown in Table 28. This suggests a higher proportion of users on ordinary tickets, and fewer on season tickets (whether point-to-point or PTE zonal), in PN than in PM. This may reflect a wider opportunity to make use of day or reduced tickets, and a greater prevalence of open stations and pay train operations in the PN area than in the PM area.

Table 28: Ticket-type profile of morning peak travellers, for both PLANET Midlands and PLANET North

Ticket type	PM	PN
CDR	12%	17%
RETURN	14%	22%
PERIOD_PTE_LUL_TC	19%	16%
PT-PT SEASON	44%	35%
SINGLE (or unticketed)	5%	6%
Others e.g. free concessions / staff	4%	3%
Total	100%	100%

3.7 Journey purpose allocation

3.7.1 Reviews of the PLD matrix had suggested both that ticket usage by type had varied significantly since the inception of the model, and that there would be value (for PLD) in disaggregating the journey purposes by corridor.

3.7.2 An overview of in-scope regional flows (insofar as they are identifiable within the National Rail Passenger Survey (NRPS)[9]) has suggested that, for PM and PN, the proportions of tickets purchased at the 'broad ticket type group' level have remained more stable than in the case of PLD. This largely reflects the prevalence of commuting and use of season tickets, as well as the greater propensity on these generally shorter-distance trips not to take advantage of any advance-purchase deals available. Therefore, in updating the PM and PN models, no need was seen to move from the 'by ticket type' approach as initially used in 2007/08. However, the journey purpose split by ticket type was re-estimated as part of this updating, informed by the flows within the masked area of the regional matrices.

3.7.3 Our approach consisted of analysing appropriate extracts of the NRTS dataset, filtered on journeys within the relevant masked areas for PM or PN as appropriate. There had been proposals to re-classify educational trips as Leisure trips (as has been done for long-distance movements in PLD) but on inspection of the associated NRTS it was clear that such trips at short distances dominating in the regional matrices remain day trips to and from schools or colleges and as such they were retained within the Commute category.

3.7.4 The data was also filtered to include only records completing their station-to-station journey between 0700 and 0959, and is thus better aligned towards the weekday morning peak period forming the scope of the models, delivered by the de-annualisation process described in section 3.6.

3.7.5 The resulting recalculated journey purpose splits applied in this update, by ticket type, are as shown in Table 29 and Table 30, for PM and PN respectively. The analysis was informed by samples of 24,102 and 42,773 NRTS records for PM and PN respectively for morning peak hours within the masked model areas.

Table 29: PFMv6.1c Recalculated journey purpose splits by ticket type: PLANET Midlands in morning peak

Ticket type	Commute	Business	Leisure	Overall
CDR	62.11%	17.74%	20.16%	100%
OFF-PK_TC	27.83%	0.00%	72.17%	100%
PK_TC *	69.36%	15.21%	15.43%	100%
RETURN	73.59%	15.50%	10.91%	100%
RETURN_LD	0.00%	49.84%	50.16%	100%
REDUCED	76.72%	11.44%	11.84%	100%
PERIOD_PTE_LUL_TC	94.85%	3.08%	2.07%	100%

[9] The National Rail Passenger Survey (NRPS), published by Transport Focus, provides a twice-yearly network-wide picture of customers' satisfaction with rail travel and, to some degree, a profile of passenger characteristics. See: http://www.transportfocus.org.uk/research-publications/publications/national-rail-passenger-survey.

Ticket type	Commute	Business	Leisure	Overall
PT-PT SEASON	94.72%	2.53%	2.75%	100%
SINGLE	71.87%	10.64%	17.49%	100%
* Peak Travelcard included here, but minimal volume exists in dataset.				

Table 30: PFMv6.1c Recalculated journey purpose splits by ticket type: PLANET North in morning peak

Ticket type	Commute	Business	Leisure	Overall
CDR	71.66%	13.09%	15.25%	100%
OFF-PK_TC	27.83%	0.00%	72.17%	100%
PK_TC *	69.36%	15.21%	15.43%	100%
RETURN	82.87%	9.21%	7.92%	100%
RETURN_LD	0.00%	49.84%	50.16%	100%
REDUCED	76.72%	11.44%	11.84%	100%
PERIOD_PTE_LUL_TC	94.43%	2.44%	3.13%	100%
PT-PT SEASON	95.01%	2.49%	2.51%	100%
SINGLE	78.56%	6.98%	14.47%	100%
* Peak Travelcard included here, but minimal volume exists in dataset.				

3.8 Masking of PLANET Midlands and PLANET North matrices

3.8.1 Due to the focus on core masked areas that has been used in the derivation of the matrices, it is not appropriate or helpful to make comparisons with the total matrices, which include significant volumes of demand that is considerably remote from the areas of interest to HS2. Detailed comparison between matrices has therefore been undertaken after applying masking for each model to both old and new matrices. As outlined previously, what is left in the regional matrices after masking consists of journeys:

- within the main conurbation travel to work areas; or
- between adjacent PLD zones on core trunk routes WCML, MML or ECML.

3.8.2 The figures which follow show, for PM and PN, the zones for which movements between regional matrix ODs remain after masking was applied.

Figure 5: PLANET Midlands zones retained after masking

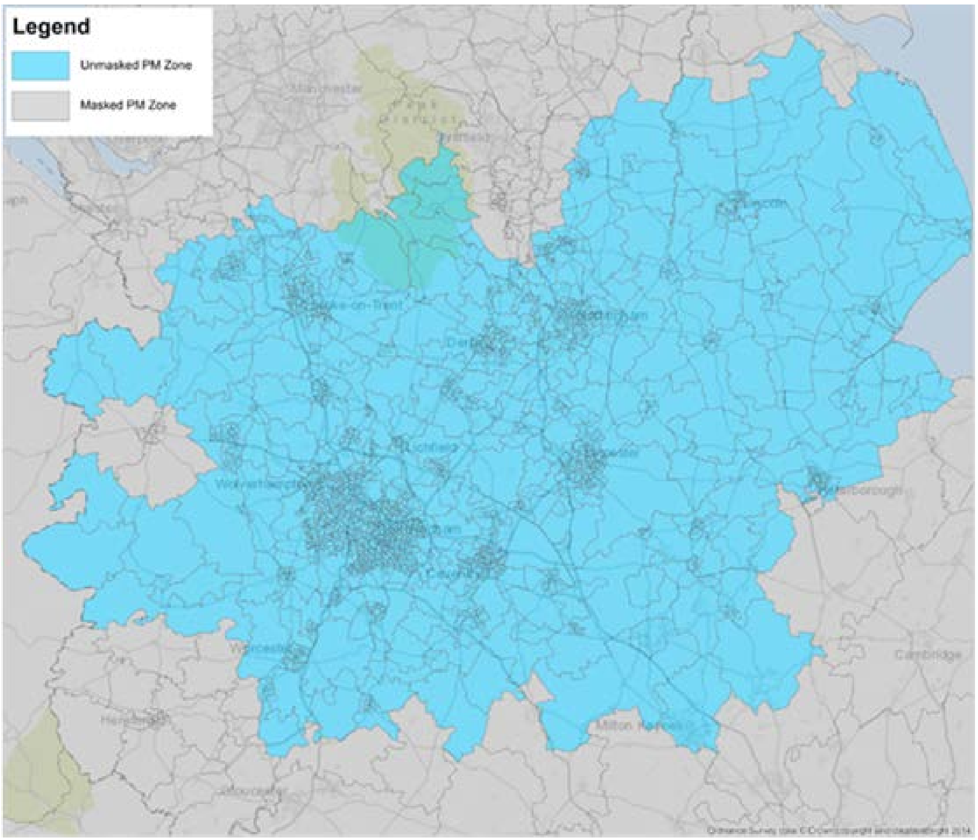
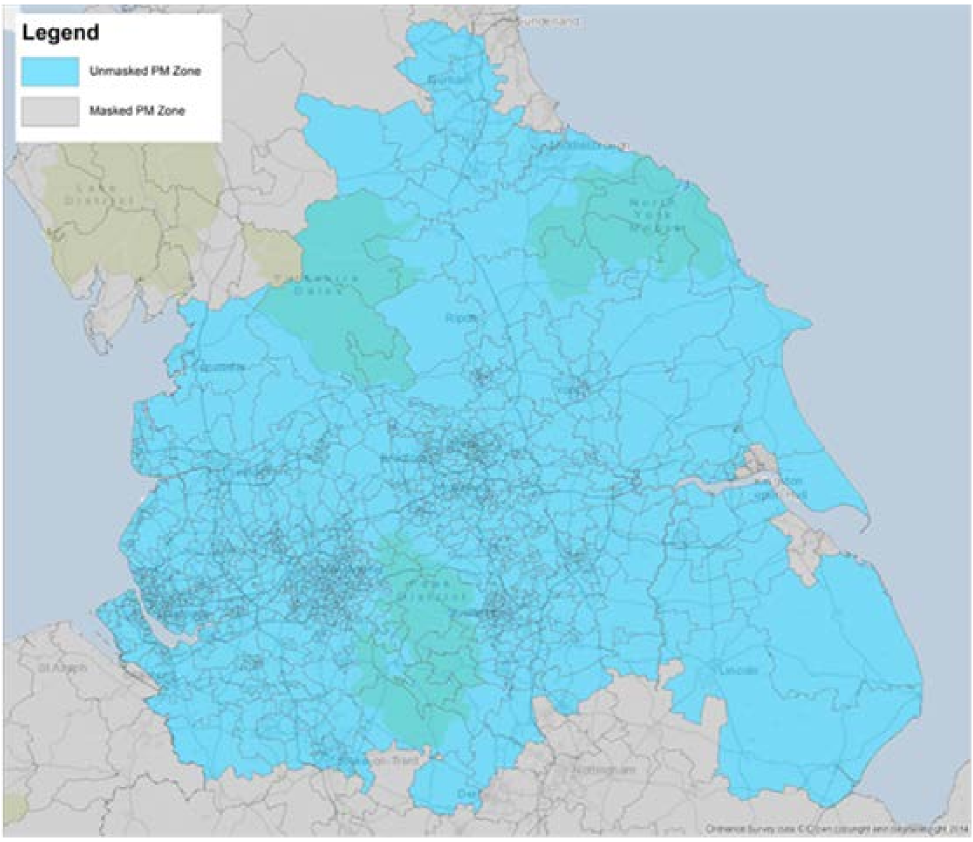


Figure 6: PLANET North zones retained after masking



3.9 Updated PLANET Midlands matrix

2014/15 masked matrix totals

3.9.1 Matrix totals, for the six matrices by journey purpose / car availability segment, are shown in Table 31. It can be seen that the effects of the recalculated de-annualisation and journey purpose factors, although only minor at an aggregate level, are to increase Commute trips in this morning peak matrix by around 10%, and to reduce other journey purposes by around a quarter.

3.9.2 The overall growth in the matrices between 2010/11 and 2014/15 is 21%, which may be compared with growth in rail journeys, for the period quoted, by 'CENTRO' (the West Midlands PTE) of 22% and by ORR for all rail journeys wholly within the West Midlands Region of 29%.

Table 31: PLANET Midlands: matrix totals compared with PFMv4.3 matrices: Journeys

Matrix component	Matrix journeys		Percentage change on PFMv4.3 matrices	Impact of recalculated de-annualisation and journey purpose – % change
	PFMv4.3	PFMv6.1c	PFMv6.1c	
CAV_Commute	42,184	52,308	24%	9%
NCA_Commute	6,589	9,900	50%	10%
CAV_Business	4,669	4,305	-8%	-27%
NCA_Business	690	740	7%	-28%
CAV_Leisure	5,198	4,762	-8%	-24%
NCA_Leisure	802	835	4%	-24%
Total matrix	60,131	72,851	21%	2%

3.9.3 It can also be seen that the impact of the matrix updating indicates, compared with the PFMv4.3 matrix at a 'total matrix' level, an increase of around 27% in Commute trips and a reduction of around 7% in Business and Leisure journey purposes.

Commentary on matrix, by planning regions

3.9.4 Table 32 shows the PN masked matrix between in-scope government planning regions, while Table 33 shows the equivalent for the PFMv4.3 matrix. Note that the masking process is geared around PLD zones, which in turn are informed by planning regions, such that movements between the East Midlands and the West Midlands are largely masked out of the regional matrices. Flows to and from other planning regions are similarly reduced by the masking to only those portions of the regions extended into by the defined 'Travel to Work' areas of the key cities, so that there is only marginal involvement of the North West, Eastern and South East regions in the matrix flows.

Table 32: PLANET Midlands masked matrix journeys, 2014/15

Region	East Midlands	Eastern	North West	South East	West Midlands	Total
East Midlands	8,176	283	0	11	232	8,702
Eastern	144	0	0	0	0	144
North West	0	0	0	0	145	145
South East	5	0	0	0	0	5
West Midlands	408	0	142	0	63,306	63,856
Total matrix	8,732	283	142	11	63,683	72,851

Table 33: PLANET Midlands masked matrix journeys, 2010/11

Region	East Midlands	Eastern	North West	South East	West Midlands	Total
East Midlands	8,584	347	0	0	166	9,096
Eastern	374	0	0	0	0	374
North West	0	0	0	0	957	957
South East	1	0	0	0	0	1
West Midlands	669	0	142	0	48,892	49,703
Total matrix	9,628	347	142	0	50,014	60,131

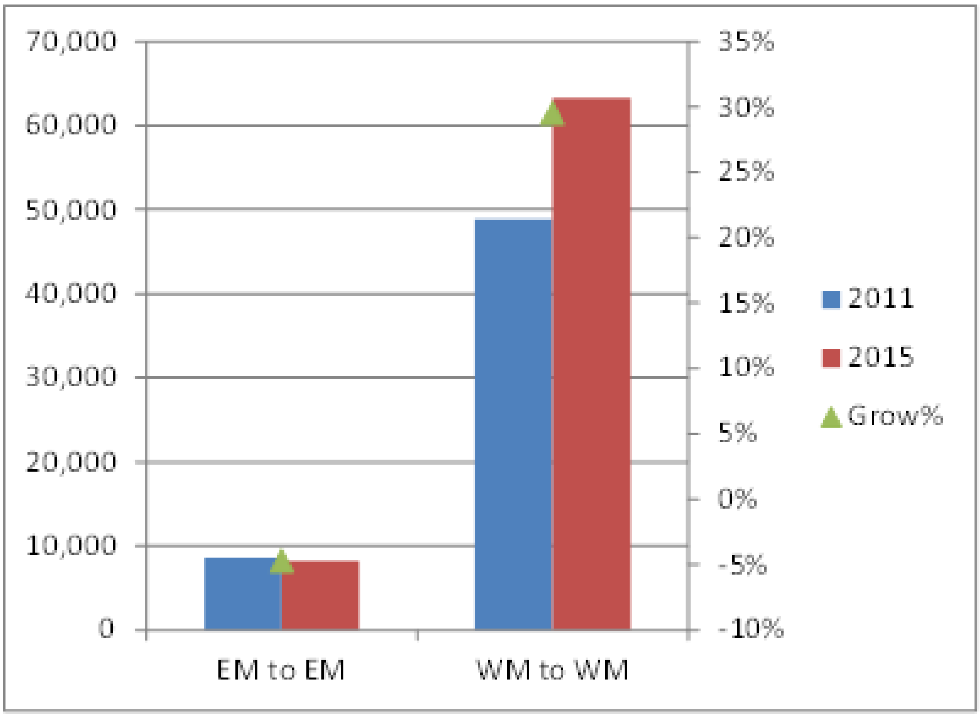
Table 34: PLANET Midlands masked matrix journeys: Differences 2014/15– 010/11

Region	East Midlands	Eastern	North West	South East	West Midlands	Total
East Midlands	-408	-63	0	10	67	-394
Eastern	-231	0	0	0	0	-231
North West	0	0	0	0	-813	-813
South East	4	0	0	0	0	4
West Midlands	-261	0	0	0	14,414	14,153
Total matrix	-896	-63	0	10	13,668	12,713

3.9.5 The principal flows within the matrix can be seen to be within the East Midlands (EM) and the West Midlands (WM) regions, completely dwarfing the flows between planning regions. Figure 10 shows the growth in these two internal sector flows, having reported growth in the EM region of -5% and of 29% within the WM region.

3.9.6 The negative growth on some inter-regional flows in the masked matrix (shown in Table 34) (albeit of much reduced materiality compared with the within-planning region flows), is in the context of strong growth in Commute journeys, offset by minor reductions in Business and Leisure journeys (associated with the recalculation of the journey purpose factors for morning peak travel). However, the reductions in journeys far outweigh even the partial reductions in minority purposes, and are likely therefore to be associated with differences between the models in the allocation of flows to zones, potentially impacting more heavily on minority inter-regional flows heavily dependent on zone and region boundaries, and the marginal changes to the allocation of demand to zones.

Figure 7: PLANET Midlands masked matrix journeys, 2014/15 compared with 2010/11 matrix, by region: EM to EM and WM to WM, 000s



Commentary on matrix by trip end locations

Journey origins and destinations

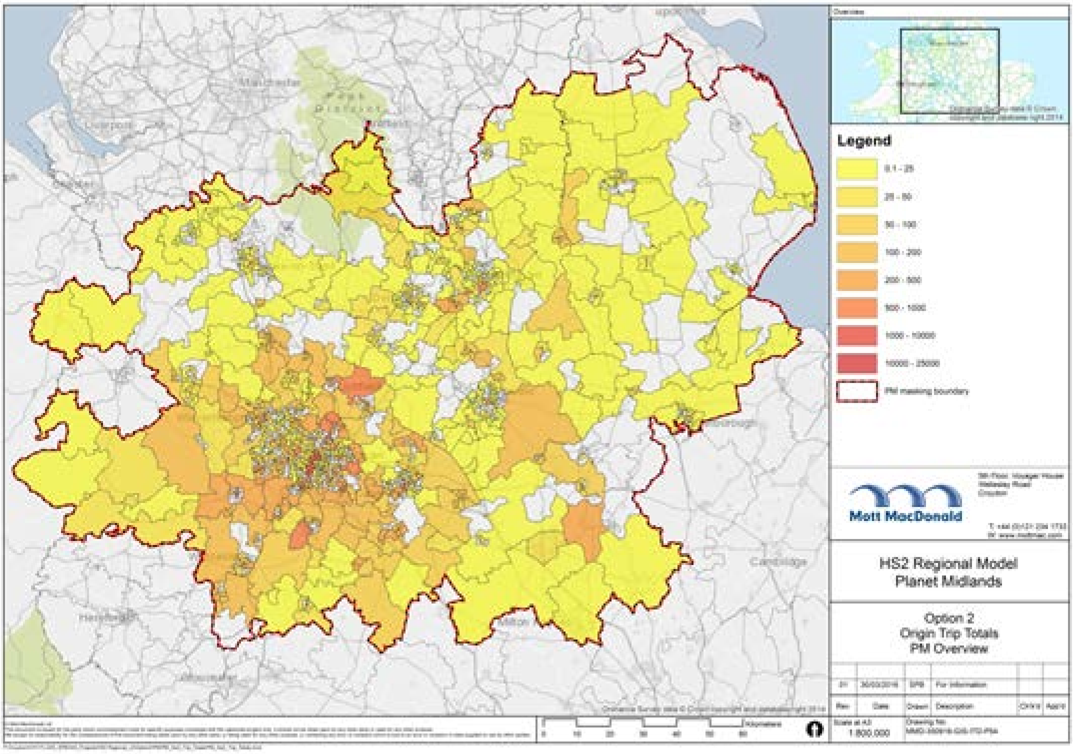
3.9.7 The following charts describe the PLDv6.1c outputs, having a total of 21% growth over the PFMv4.3 matrices. The charts and text are concerned with the aggregated demand across all six sub-matrices which, as can be seen from Table 31, are heavily dominated by the 'commuting car available' segment.

3.9.8 In the figures that follow it should be noted that moderation of the observed number of trips per zone is provided by the reduced size of the zones in the conurbation centres.

3.9.9 There are a number of zones shown as having no demand in both 2010/11 and 2014/15. Where this is not due to masking, it can also reflect that the NRTS survey, from 2004, used to allocate station demand in both years, may not have identified any local rail usage from/to these zones. Very often such zones do not have railway stations within them.

3.9.10 Figure 8 shows the origins of local rail demand, all sub-matrices by journey purpose / car availability combined. The journeys illustrated here only relate to travel within the masked combined 'travel to work area' shown in Figure 5.

Figure 8: PFMv6.1c Journeys: By origin zone



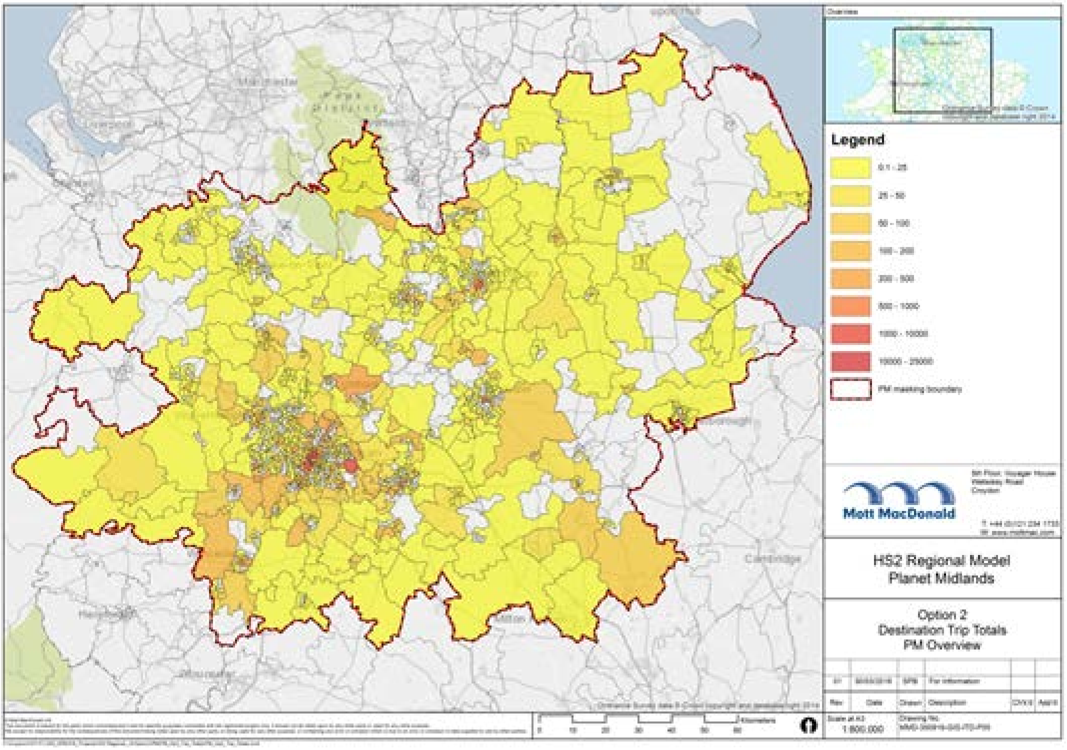
3.9.11 The map shows mid-tones of demand spread along rail corridors, such as those from Worcester/Kidderminster and Telford/Wolverhampton, Bromsgrove, the cross-City line from north and south, Coventry and Leamington Spa, Wellingborough and East Midlands Parkway.

3.9.12 There is also demand from areas surrounding these nodes, which can indicate hinterlands accessed by car or bus as well as more local demand using any station lying in the zone.

3.9.13 Despite the diffused spread of origins there are some zones of significant size generating no commuting demand within the area. At a fine scale, there are some smaller zones within the conurbation for which no demand has been recorded due to none of the relevant NRTS postcodes having centroids within that zone. In these cases, the demand will have been mapped to the adjacent zone in which the postcode centroid lies.

3.9.14 Figure 9 similarly shows the destinations of local rail demand, all sub-matrices by journey purpose / car availability segment combined.

Figure 9: PFMv6.1c journeys: By destination zone

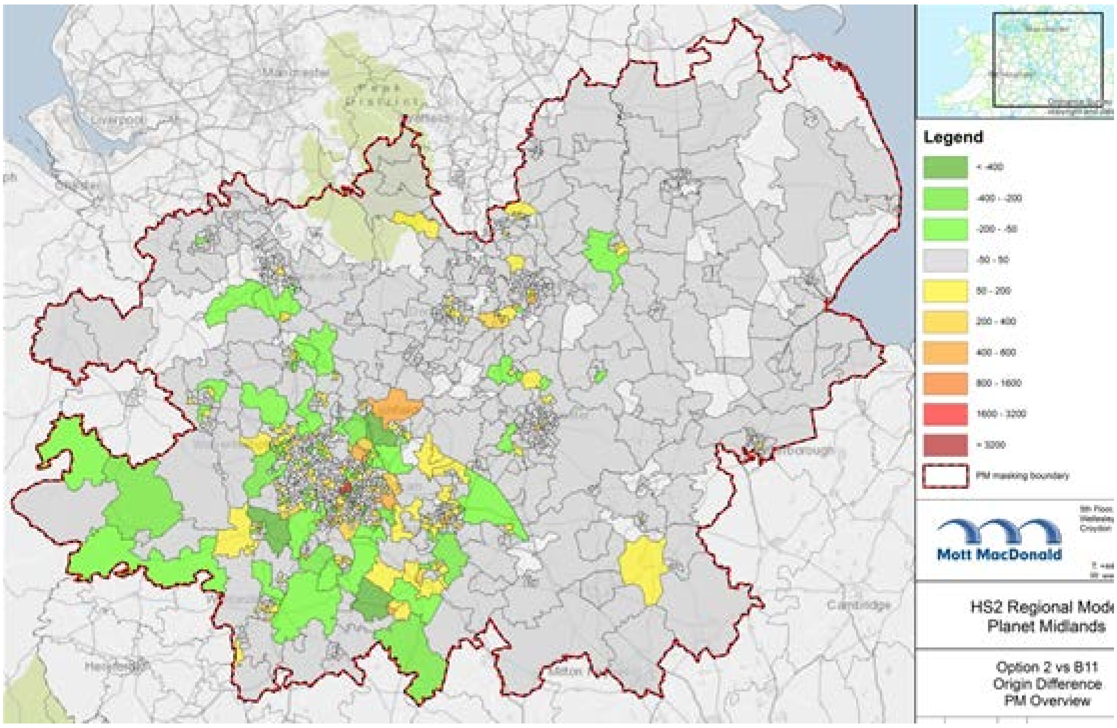


3.9.15 While there is a patchwork of zones having less than 100 journeys as destinations, major destinations such as Birmingham, Birmingham (University), Coventry and Nottingham are evident, each having over 1,000 journeys, and Leicester having over 500. All of these are locations with finely-divided zones, so the darker tints are focused in only the small central areas. Where inward travel occurs to freestanding stations outside the main urban areas, such as Lichfield and Chesterfield, the appropriate tint extends into the surrounding countryside due to the larger zone sizes in these locations.

Demand changes from 2010/11

3.9.16 Figure 10 shows the locations of increasing or decreasing originating demand, compared with the 2010/11 demand in the previous PLANET matrices, all sub-matrices combined, in terms of origins.

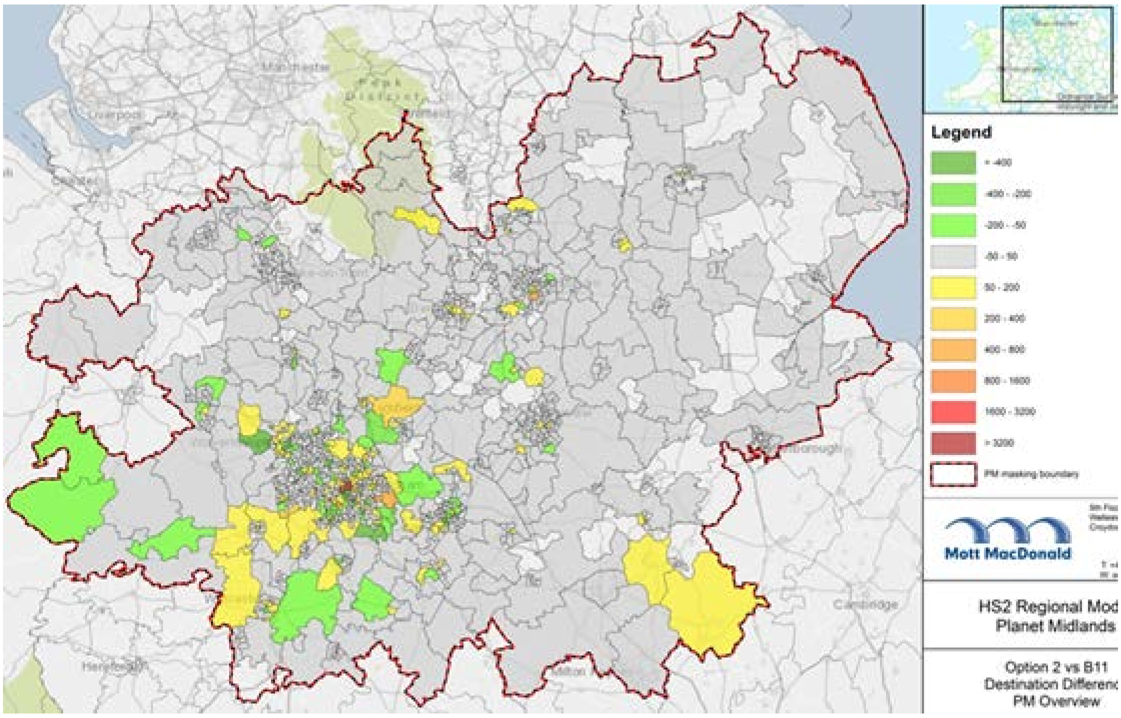
Figure 10: PFMv6.1c journeys aggregate differences over 2010/11 by zone: Origins



3.9.17 While the more rural areas are broadly neutral in terms of trip origins (with a number of large zones showing small gains or losses), there is a more consistent pattern of growth in centres of settlements such as Worcester, Kidderminster, Wolverhampton, Lichfield, Coventry, Leamington Spa, Wellingborough, Leicester, Derby, Mansfield and Nottingham, together with the East Midlands Airport area. There is very strong growth in the centre of Birmingham.

3.9.18 Figure 11 shows the locations of increasing or decreasing demand, all sub-matrices combined, in terms of destinations.

Figure 11: PFMv6.1c journeys aggregate differences over 2010/11 by zone: Destinations



3.9.19 While the picture for destinations is similar to that for origins, significant change is noticeably more focused on commuting centres, although rural zones with a low level of increase are observable to the south-west of Birmingham and south of Wellingborough. There is growth at Birmingham University and (at the highest level, of over 3,200 journeys per zone) in the two Birmingham city-centre zones.

Conurbation analysis

3.9.20 In order to understand the content of the matrices in relation to the main flows into the key centres, independently of the fine detail of the zone structure, flows to the principal city centres were aggregated into 'bullseye' geographic ensembles including demand originating within a defined radius of each city centre, all journey-purpose sub-matrices combined. Table 35 is filtered on journeys from zones having centroids within this radius that have destinations in zones in the central area of the three main cities in the PM model, and demonstrates the high coverage by this analysis of demand within the travel to work masking area.

Table 35: PFMv6.1c Masked matrix demand to city centre, all journey purposes combined

City	City centre circle radius (km)	Demand to city centre circle			
		Total from within masked matrix	Demand from 40km annulus (from outside city centre circle)	% of demand covered by 40km annulus	City centre origins as portion of total
Birmingham	1.5	41,198	36,760	89%	6%
Leicester	1.5	1,354	1,227	91%	3%
Nottingham	1.5	2,068	1,997	97%	0%

3.9.21 Nottingham and Leicester have very much lower levels of rail peak journeys than Birmingham (or any of the PN cities). The growth, from the PFMv4.3 matrices, in these ensemble demand totals is shown in Table 36; and the composition of this change is described by sector in city-specific sections below.

Table 36: PLANET Midlands: Growth in masked matrix demand to city centre circle, 2010/11 to 2014/15

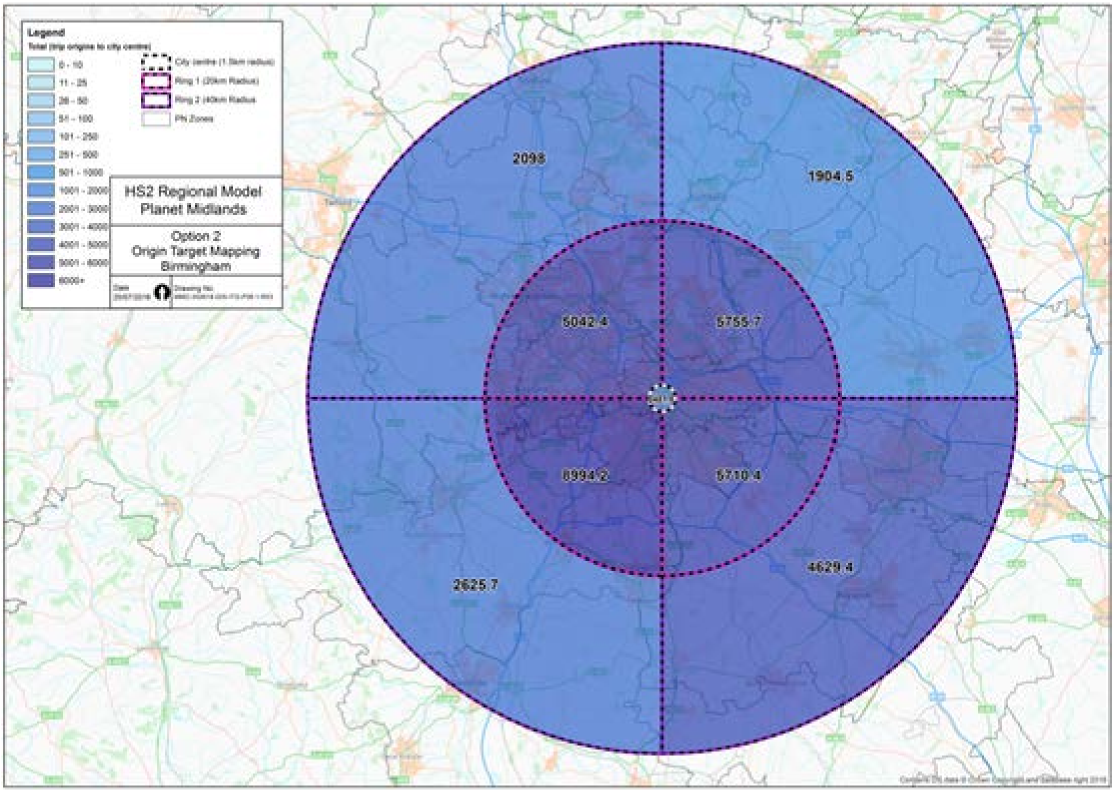
City	Total within masking	Total within 40km
Birmingham	37%	34%
Leicester	12%	15%
Nottingham	36%	39%

Birmingham peak period arrivals

3.9.22 Figure 12 shows the volume of demand, having destination within Birmingham's inner area, that originates from inner and outer rings to radii of 20km and 40km respectively, as well as internal demand within the central area 1.5km in radius. The origin rings are divided into the four quadrants superimposed on the map[10] and are annotated with the number of originating journeys in the matrix to the relevant city centre. The radius defining Birmingham's 'central area' takes in centroids of the zones surrounding and extending from the three central stations of New Street, Snow Hill and Moor Street, but does not include zones around the Jewellery Quarter and Five Ways 'close to centre' stations. This has allowed the capture of almost all demand having destination in the city centre without invoking internal demand between these stations, although internal demand does amount to 6% of destination demand).

[10] The density of shading indicates the volume originating in the sectors.

Figure 12: PFMv6.1c journeys to Birmingham central area: Origins by geographic segment



3.9.23 The picture for Birmingham has a high demand coming from each of the identified quadrants, with a much greater density of demand in the inner annulus compared with the outer one. Among the inner quadrants, it is the south-west one, including Bromsgrove and Kidderminster, that is the strongest; while the south-east is much the strongest of the outer quadrants, including Coventry and Leamington Spa.

3.9.24 Figure 13 shows changes in these sector demands[11] over the four-year period since 2010/11. The comparisons rely on the accuracy of the values in the PFMv4.3 matrices for the equivalent zone-to-zone movements, and correspond to overall increases in demand within the 40km radius. The growth, from the previous matrices, in these ensemble demand totals is shown in Table 37; and the composition of this change is described by sector in city-specific sections below.

Table 37: Birmingham: Growth in masked matrix demand to city centre circle, 2010/11 to 2014/15

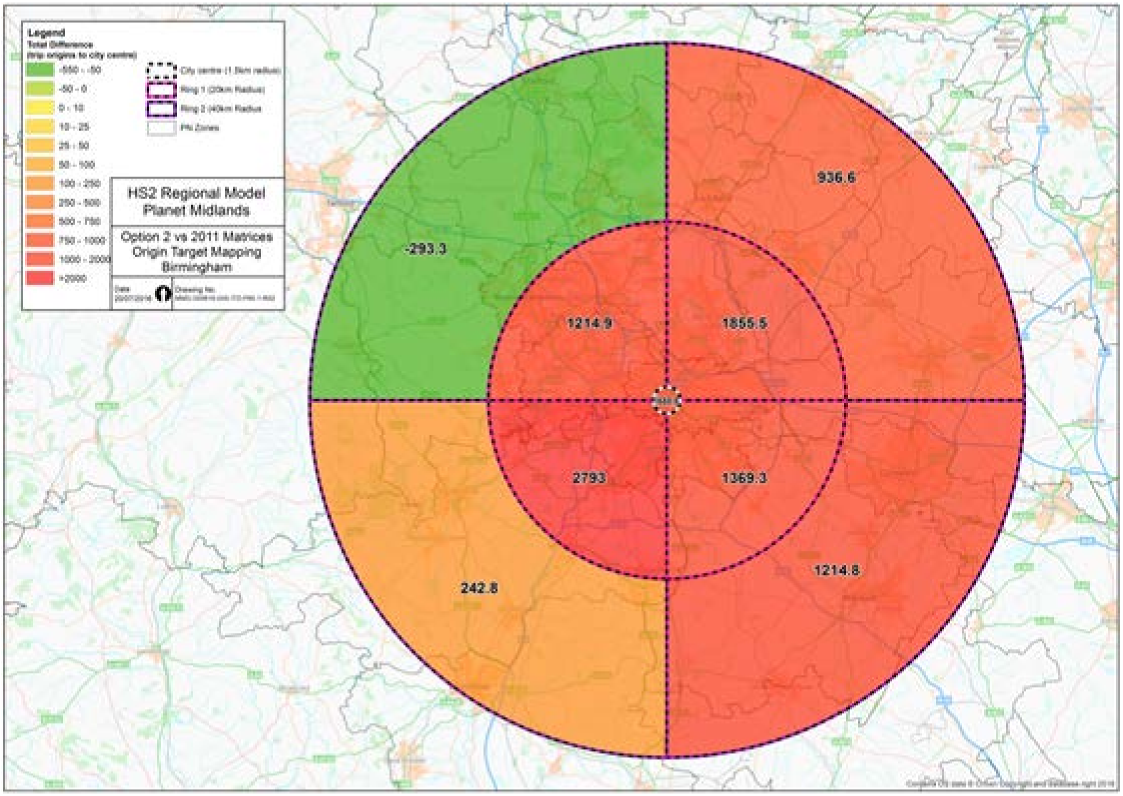
City sector	Demand 2014/15	Growth on 2010/11
City centre circle	2,482	213%
Birmingham ring 1	25,503	40%
Birmingham ring 2	11,258	23%
Total within masking	41,198	37%

3.9.25 Overall, while there has been an increase of journeys recorded as internal central area movements (of magnitude 4% of masked matrix movements to the central area), the

[11] In this chart the changes are shown using a scale from reduction (green) via yellow to largest growth (red).

principal changes are of growth of 40% from origins in the inner ring, and of 23% from origins in the outer ring. The highest recorded growth is on the inner south-west sector, while the outer north-west sector records a reduction amounting to 12% of its 2010/11 model matrix value. These changes are potentially consistent with the change in flow mapping associated with the new demand infills for PTE zonal products.

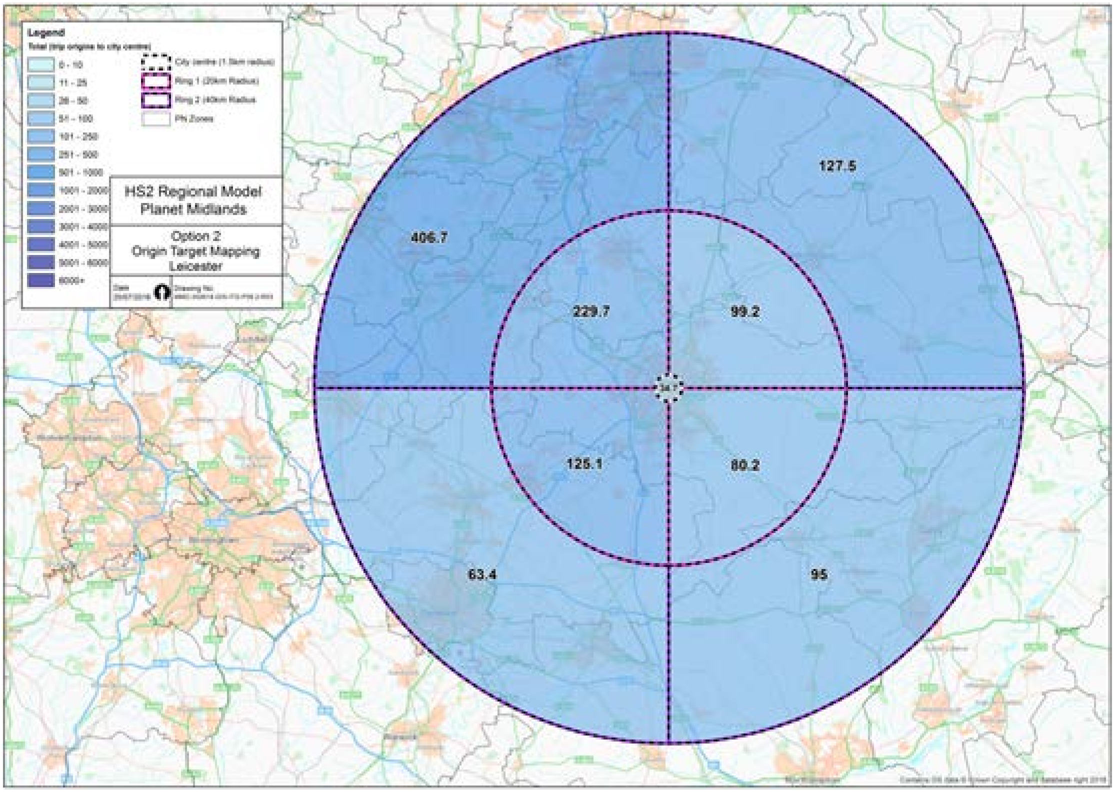
Figure 13: PFMv6.1c journeys to Birmingham city centre by origin segment: Differences from 2010/11



Leicester peak period arrivals

3.9.26 Figure 14 shows the volume of demand, having destination within Leicester's central area, that originates from central, inner and outer rings respectively, using the same ring radii as used for Birmingham. While the volumes are very small in comparison with Birmingham, the figure shows that the regional morning peak demand into Leicester largely originates from the outer north-west quadrant including Long Eaton and substantial parts of Derby and Nottingham, with much smaller volumes coming from the south-west and south-east. Similarly, the inner north-west sector is the next strongest, including Loughborough and local stations on the main line north of Leicester.

Figure 14: PFMv6.1c journeys to Leicester central area: Origins by geographic segment



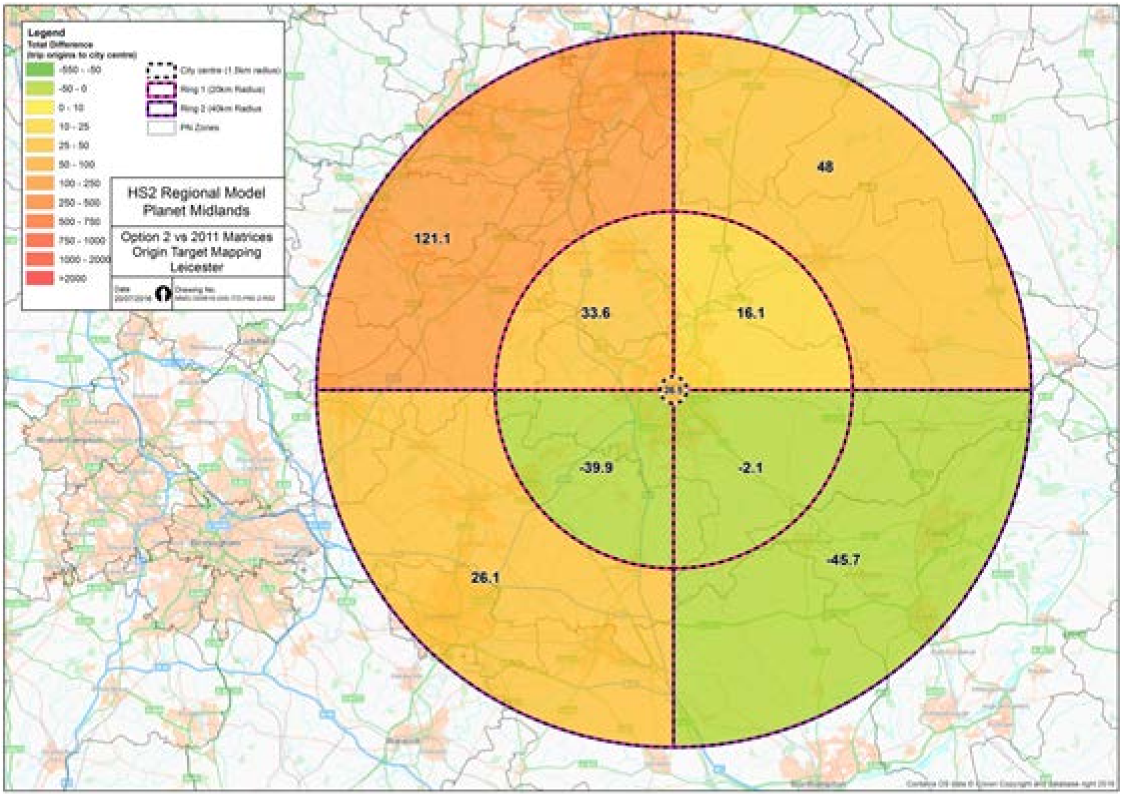
3.9.27 Figure 15 shows changes in these sector demands over the four-year period since 2010/11, aggregating to growth in the specific Leicester 40km radius demand as shown in Table 38. The comparisons clearly rely on the accuracy of the values in the PFMv4.3 matrices for the equivalent zone-to-zone movements.

Table 38: Leicester: growth in masked matrix demand to city centre circle, 2010/11 to 2014/15

City sector	Demand 2014/15	Growth on 2010/11
Leicester centre	35	323%
Leicester ring 1	534	1%
Leicester ring 2	693	27.5%
Total within masking	1,354	12%

3.9.28 While there has been an increase of journeys recorded as internal central area movements, the volume concerned is very small. The principal changes are of overall stagnation in origins in the inner ring; and of 27% growth from origins in the outer ring, with 42% growth in the principal (outer north-west) sector being the main driver. The reduction in the outer south-east sector is of 32%, representing 46 passengers per weekday.

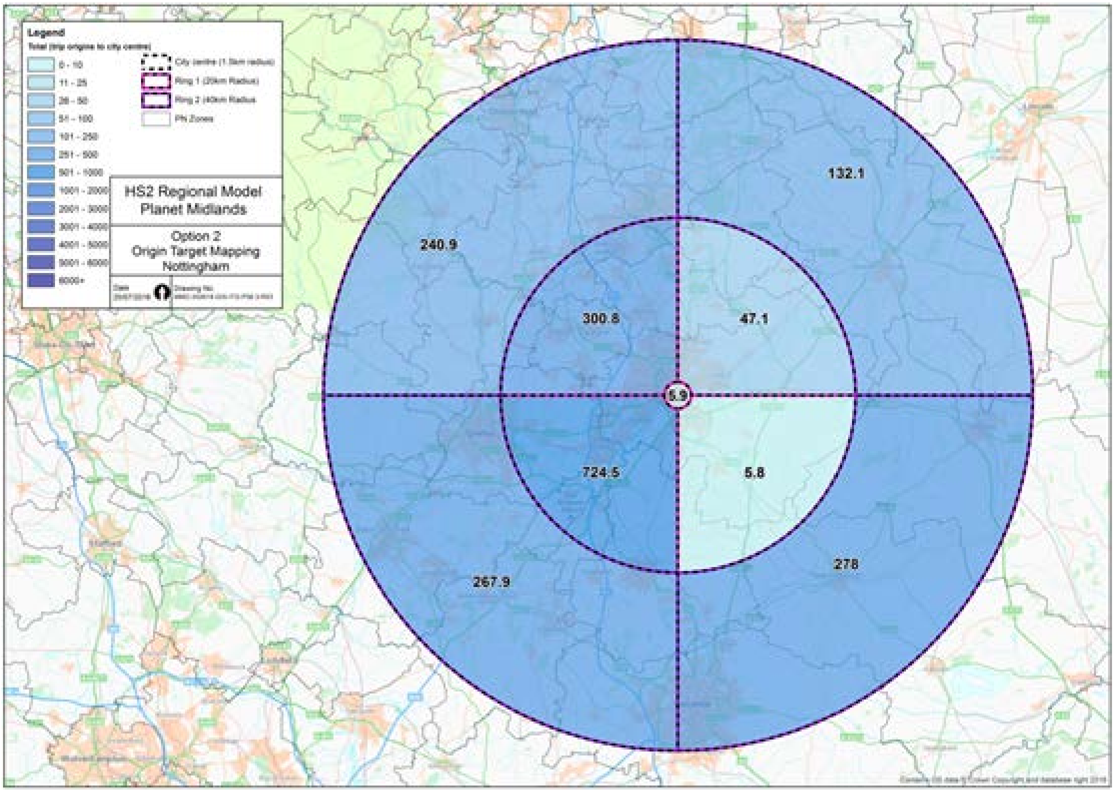
Figure 15: PFMv6.1c journeys to Leicester city centre circle by origin segment: Differences from 2010/11



Nottingham peak period arrivals

3.9.29 Figure 16 shows the volume of demand, having its destination within Nottingham's central area, that originates from central, inner and outer rings respectively, using the same ring radii as used for Birmingham. While (as previously noted) the volumes are very small in comparison with Birmingham, the figure shows that the vast majority of local rail demand into Nottingham originates from the north-west and south-west, with the latter being dominant, including the local stations towards Long Eaton, Loughborough and Leicester.

Figure 16: PFMv6.1c journeys to Nottingham city centre circle: Origins by geographic segment



3.9.30 Figure 17 shows changes in these sector demands[12] over the four-year period since 2010/11, corresponding to overall increases in demand within the 40km radius into Nottingham as shown in Table 39. The comparisons clearly rely on the accuracy of the values in the PFMv4.3 matrices for the equivalent zone-to-zone movements.

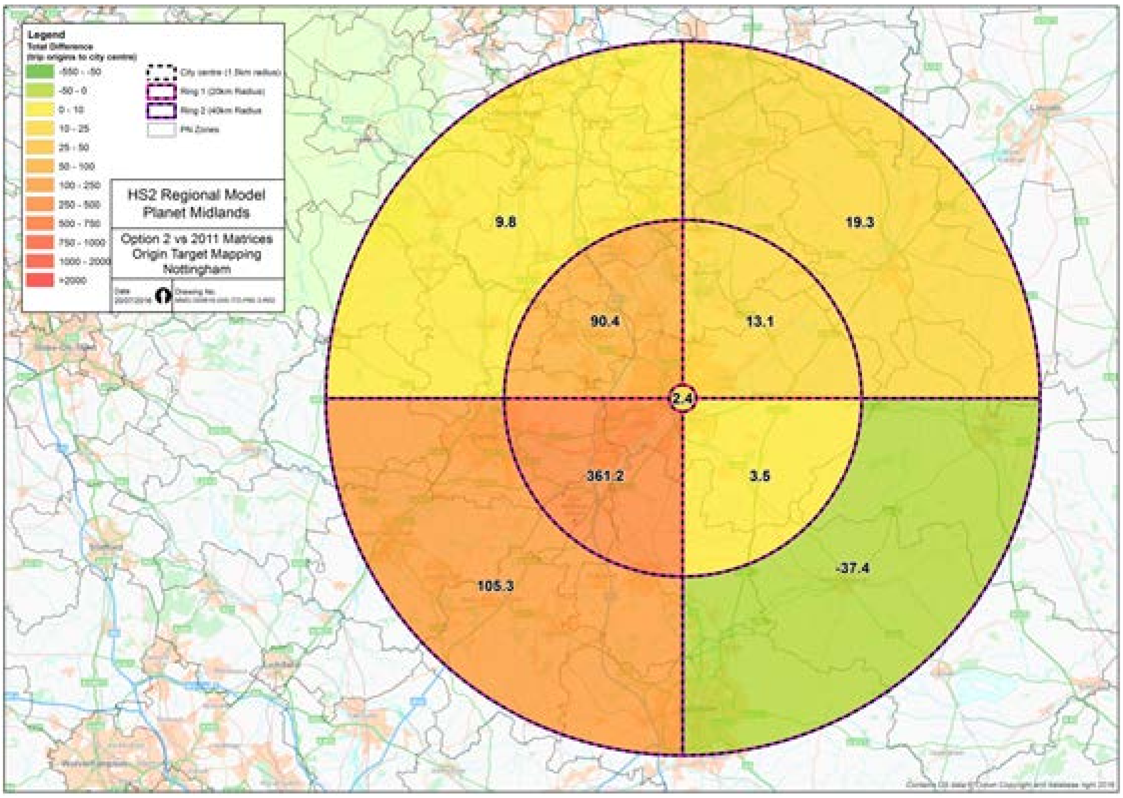
Table 39: Nottingham: Growth in masked matrix demand to city centre circle, 2010/11 to 2014/15

City sector	Demand 2014/15	Growth on 2010/11
Nottingham city centre circle	6	69%
Nottingham ring 1	1078	77%
Nottingham ring 2	919	12%
Total within the masking	2,068	36%

3.9.31 The principal changes are of growth of 77% from origins in the inner ring; and of 12% from origins in the outer ring. The highest recorded growth (65%) is on the outer south-west sector, while the outer south-east sector records a reduction amounting to 12% of its 2010/11 model matrix value. The main difference in terms of numbers of journeys consists of the total of 466 extra journeys from the south-western sector, which has stabilised with a frequent service pattern following the completion of re-signalling and refurbishment at Nottingham station. This corridor also includes East Midlands Parkway station offering commuting opportunities into Nottingham.

[12] In this chart the changes are shown using a scale from reduction (green) via yellow to largest growth (red).

Figure 17: PFMv6.1c journeys to Nottingham city centre circle by origin segment: Differences from 2010/11



3.10 Updated PLANET North Matrix

3.10.1 Matrix totals, for the six matrices by journey purpose / car availability segment, are shown in Table 40. It can be seen that the effect of the recalculated de-annualisation and journey purpose factors, although only minor at an aggregate level, are to increase Commute trips in this morning peak matrix by around 10%, and to reduce other journey purposes by 50% (Business) and a quarter (Leisure).

3.10.2 The overall growth in the matrices between 2010/11 and 2014/15 is 47%, which may be compared with growth in rail journeys, for the period quoted, by ORR for all rail journeys wholly within the North West Planning Region of 9% and within the Yorkshire and the Humber region of 12%. While this is a major difference, it may be noted that it is not certain that the 2010/11 matrices were wholly correct.[13]

3.10.3 The PFMv6.1c masked matrix total of almost 130,000 journeys appears realistic in the light of estimates of morning peak volumes derived from ORR's published tabulation of regional journeys. Assuming a morning peak portion of 29% and plausible weekdays/year conversions would suggest that 130,000 journeys should be found, which stands favourable comparison with the total in Table 40.

[13] One possibility is that the 'infill' of PTE products has been more comprehensively undertaken in this update, with the possibility of having brought in significant volume not previously recognised, particularly in the Merseyside region. It will be noted from Table 21 that a very large number of PTE-ticketed journeys were brought in in this update, which had not been previously known to LENNON, in the South and West Yorkshire areas and, especially, in the Merseyside area. The Merseyside additional volume alone would account for 13% growth in the total matrix volume.

Table 40: PLANET North matrix totals compared with PFMv4.3 matrices: Journeys

Matrix component	Matrix journeys		Percentage change on original 2010/11 matrices	Impact of recalculated de-annualisation and journey purpose factors – % change
	PFMv4.3	PFMv6.1c	PFMv6.1c	
CAV_Commute	47,374	89,252	88%	10%
NCA_Commute	12,378	20,530	66%	11%
CAV_Business	13,087	5,843	-55%	-54%
NCA_Business	2,888	1,217	-58%	-56%
CAV_Leisure	9,999	10,152	2%	-25%
NCA_Leisure	2,309	2,261	-2%	-24%
Total matrix	88,034	129,255	47%	-2%

3.10.4 It can also be seen that the impact of the matrix updating, compared with the PFMv4.3 matrix at a 'total matrix' level, indicates an increase of around 85% in Commute trips and a reduction of around 56% in Business journeys, with a marginal increase in Leisure journey purposes.

Commentary on matrix, by planning regions

3.10.5 Table 41 shows the PN masked matrix between in-scope government planning regions, while Table 42 shows the equivalent for the PFMv4.3 matrix. Note that the masking process is geared around PLD zones, which in turn are informed by planning regions, such that movements between the North West, and Yorkshire and the Humber, are entirely masked out of the regional matrices, entering the PFM only through PLD. Flows to and from other planning regions are similarly cut back by the masking to only those portions of the regions extended into by the defined 'Travel to Work' areas of the key cities.

Table 41: PLANET North masked matrix journeys, 2014/15

Region	North West	North East	Yorkshire and the Humber	East Midland s	West Midlands	Total
North West	77,083	0	0	294	47	77,424
North East	0	222	88	0	0	309
Yorkshire and the Humber	0	95	47,274	434	0	47,803
East Midlands	1,901	0	1,061	711	2	3,675
West Midlands	42	0	0	1	0	43
Total matrix	79,026	317	48,423	1,440	49	129,255

Table 42: PLANET North masked matrix journeys, 2010/11

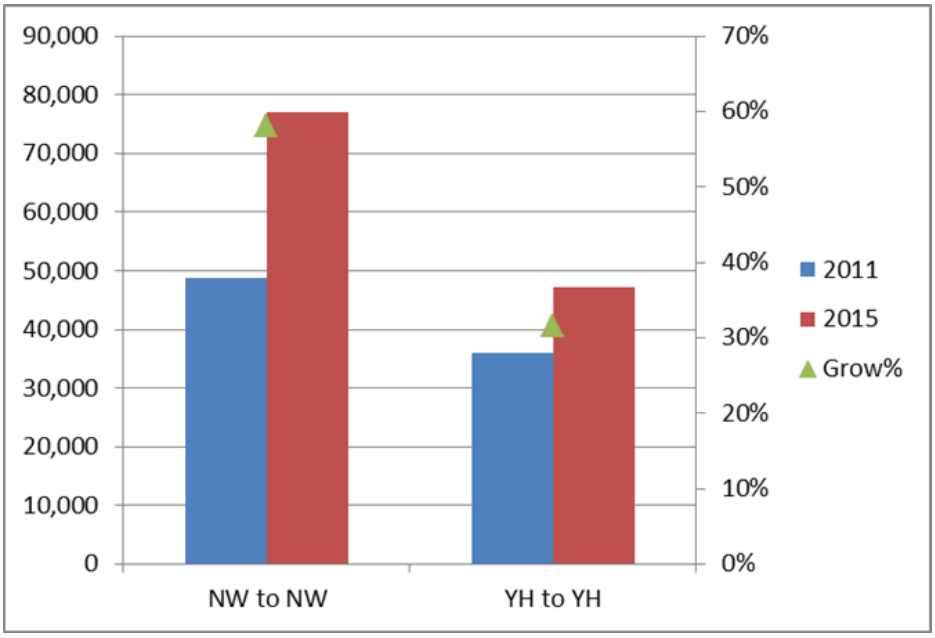
Region	North West	North East	Yorkshire and the Humber	East Midlands	West Midlands	Total
North West	48,770	0	0	101	30	48,901
North East	0	70	99	0	0	169
Yorkshire and the Humber	0	110	35,958	223	0	36,291
East Midlands	1,580	0	659	427	0	2,666
West Midlands	7	0	0	0	0	7
Total matrix	50,356	181	36,716	751	30	88,034

Table 43: PLANET North masked matrix journeys: Differences 2014/15–2010/11

Region	North West	North East	Yorkshire and the Humber	East Midlands	West Midlands	Total
North West	28,313	0	0	193	17	28,523
North East	0	151	-11	0	0	140
Yorkshire and the Humber	0	-15	11,316	211	0	11,513
East Midlands	322	0	402	284	2	1,009
West Midlands	35	0	0	1	0	37
Total	28,670	136	11,707	689	18	41,221

3.10.6 The principal regional flows can be seen to be within the North West (NW) and the Yorkshire and the Humber (Y&H) regions, completely dwarfing the flows between planning regions. Figure 18 therefore shows the growth in these two internal flows, having growth in internal flows in the NW of 58% and growth in internal flows in Y&H of 31%. This is likely to have been significantly impacted by the better infill of PTE products in 2014/15, especially for the Merseyside region where significant volumes of ticket sales have been brought in which were previously omitted.

Figure 18: PLANET North masked matrix journeys, 2014/15 compared with 2010/11 matrix, by region: NW to NW and Y&H to Y&H, 000s



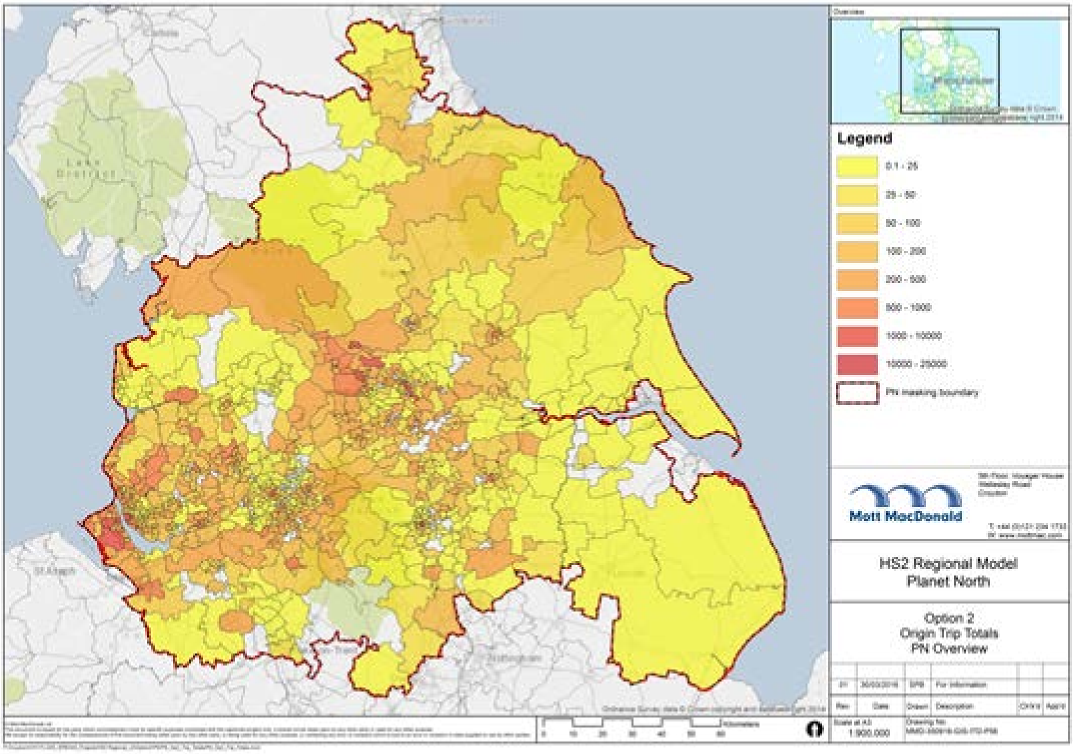
Commentary on matrix by trip end locations

Journey origins and destinations

3.10.7 The following charts describe the PFMv6.1c outputs, having a total of 47% growth over the PFMv4.3 matrices. The charts and text are concerned with the aggregated demand across all six sub-matrices which, as can be seen from Table 39, is heavily dominated by the 'commuting car available' segment.

3.10.8 Figure 19 shows the origins of local rail demand, all sub-matrices combined. The journeys illustrated here only relate to travel within the masked combined 'travel to work area' shown in Figure 6.

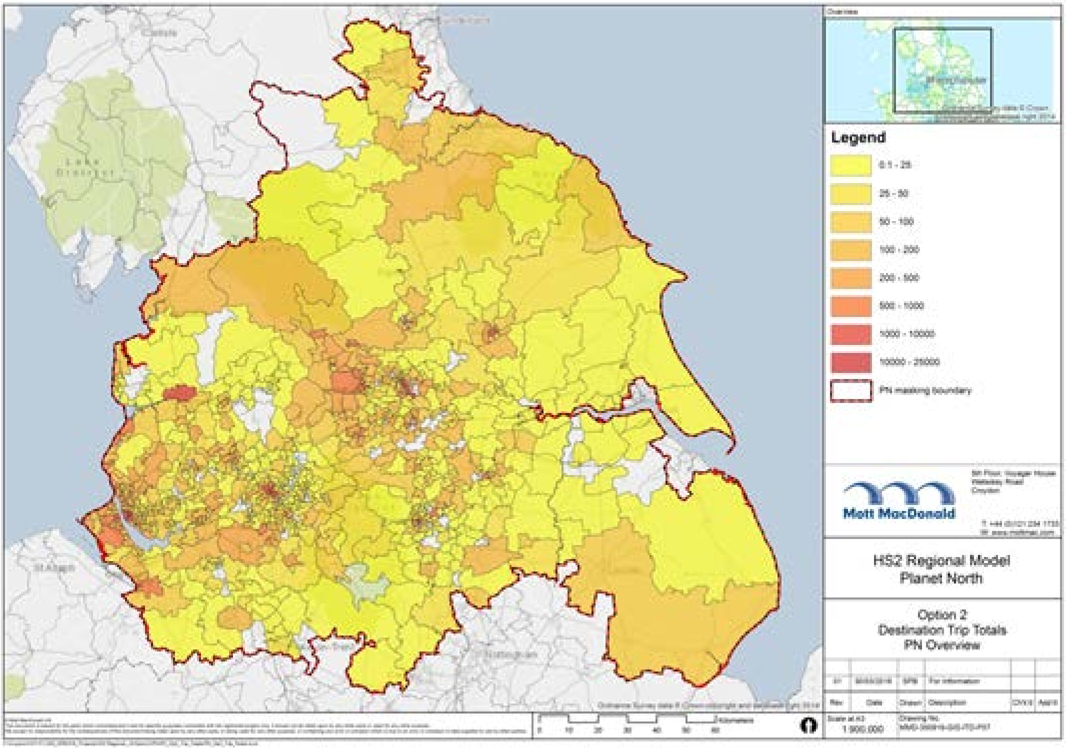
Figure 19: PFMv6.1c journeys: By origin zone



3.10.9 The map shows mid-tones spread along rail corridors around the main conurbations, notably along the established Merseyrail Electrics routes. Demand sources can also be seen across Cheshire and Lancashire, at Warrington, Rochdale, Huddersfield, the Aire Valley, the Wakefield area, between Sheffield, Doncaster and Thorne, and between Leeds and York/Selby. There is also demand from areas surrounding these nodes, which can indicate hinterlands accessed by car or bus as well as more local demand to any station lying in the zone.

3.10.10 Figure 20 shows the destinations of local rail demand, all sub-matrices combined.

Figure 20: PFMv6.1c journeys: By destination zone



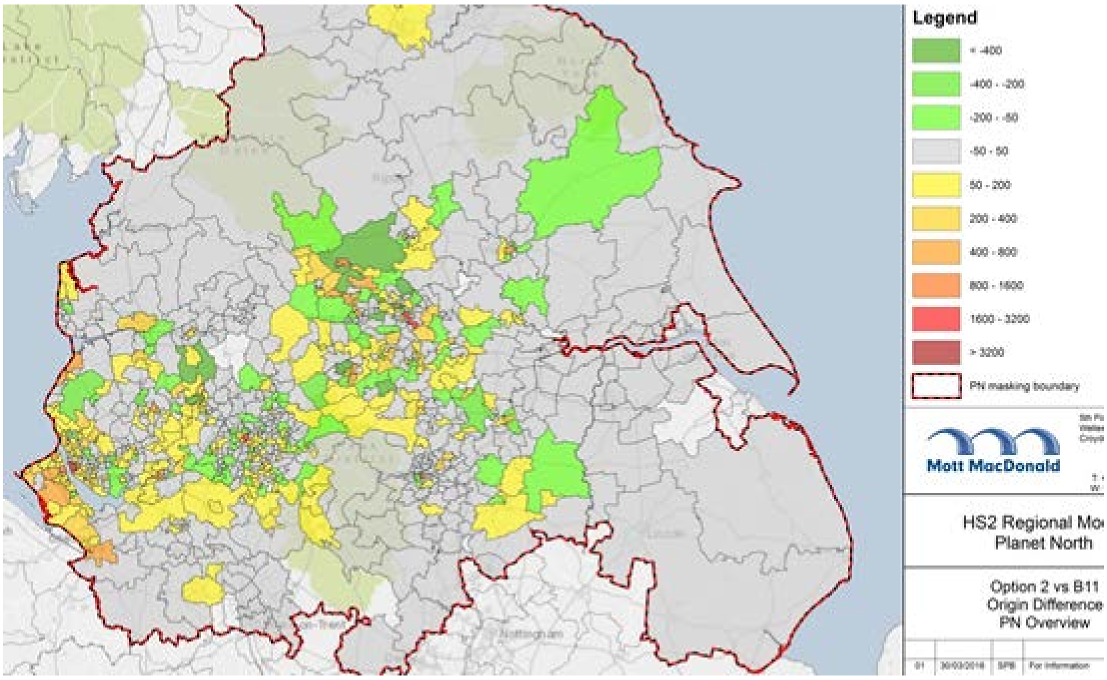
3.10.11 While there is a patchwork of zones having less than 100 journeys as destinations, major destinations such as Chester, Liverpool, Preston, Manchester, Leeds, Sheffield and York are evident, each having over 1,000 journeys, with other locations such as Wilmslow, Bradford, Meadowhall and Doncaster having over 500 journeys in the central zone. Other locations having established rail commuting services such as Birkenhead and Southport may also be evident. All of these are locations with finely divided zones, so the darker tints are focused in only the small central areas. Where inward travel occurs to freestanding stations outside the main urban areas, such as Lancaster, Lincoln or Skipton, the appropriate tint extends into the surrounding countryside due to the larger zone sizes in these locations.

Demand changes from 2010/11

3.10.12 Figure 21 shows the locations of increasing or decreasing originating demand, compared with the 2010/11 demand in the PFMv4.3 matrices, all sub-matrices combined, in terms of origins.

3.10.13 The figures that follow are presented in terms of aggregate gain or loss of journeys, rather than as percentage changes, as the latter can vary considerably in response to quite minor inputs whereas actuals provide a more understandable picture. It should be noted, however, that moderation of the observed number of trips per zone is provided by the reduced size of the zones in the conurbation centres.

Figure 21: PFMv6.1c journeys aggregate differences over 2010/11 by zone: Origins

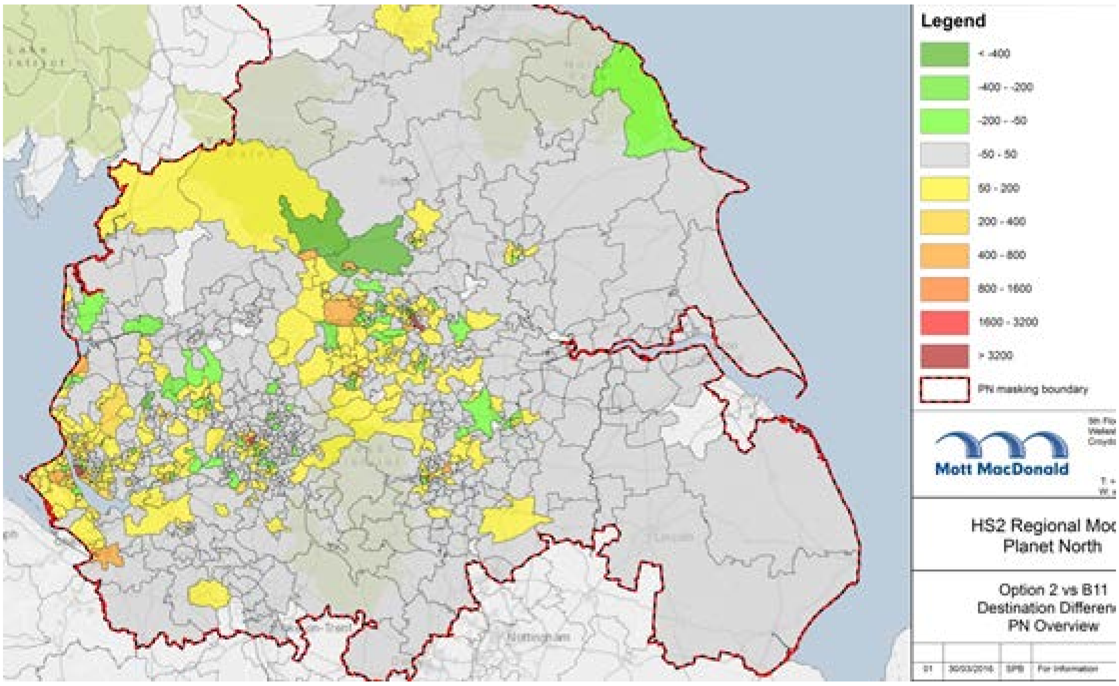


3.10.14 While the more rural areas are broadly neutral in terms of trip origins (with a number of large zones showing small gains or losses), the most coherent area of strong growth is in the Wirrall and Merseyrail waterfront routes, suggesting that the import of PTE tickets in this area has been more thorough in 2014/15 than in 2010/11. There is strong, focused growth in the city centres of Manchester and Leeds, and extended growth in the commuter lands of Cheshire and Lancashire, Huddersfield, Barnsley, the Aire Valley and south/east of Leeds. It appears that zoning issues have shifted some demand between the Harrogate, Ilkley and Aire Valley zones resulting in compensating indications of increase and decrease across these zones, with similar issues likely to have occurred in central Lancashire and between parts of Huddersfield.

3.10.15 The overall picture indicates broad stability overlaid by significant growth in the Merseyside area, with concentrations of growth as origins in the central Manchester and Leeds areas.

3.10.16 Figure 22 shows the locations of increasing or decreasing demand, all sub-matrices combined, in terms of destinations.

Figure 22: PFMv6.1c journeys aggregate differences over 2010/11 by zone: Destinations



3.10.17 Growth in destinations is more focused than that for origins, with strong growth concentrated in the centres of Liverpool, Manchester, Leeds and Sheffield, although there is also noticeable growth shown for Meadowhall and Lancaster.

Conurbation analysis

3.10.18 In order to understand the content of the matrices in relation to the main flows into the key centres, independent of the fine detail of the zone structure, flows to the principal city centres were aggregated into ensembles including demand originating within a defined radius of each city centre, all journey-purpose sub-matrices combined. Table 44 is filtered on journeys from zones having centroids within this radius that have destinations in zones in the central area of the four main cities in the PN model.

Table 44: PFMv6.1c masked matrix demand to city centre, all journey purposes combined

City	City centre circle radius (km)	Demand to city centre circle			
		Total from within masked matrix	Demand from 24km annulus (from outside city centre circle)	% of demand covered by 24km annulus	City centre origins as portion of total
Liverpool	3	20,289	17,258	85%	7%
Manchester	3	20,172	15,642	78%	2%
Leeds	3	17,449	13,207	76%	3%
Sheffield	3	2,520	1,798	71%	3%

3.10.19 Table 44 demonstrates the high coverage by this analysis of demand within the TTW masking area. Liverpool has the highest proportion of arrivals coming from within the 24km radius selected, accounting for 85% of model arrivals in the city centre. This feature may be accentuated by the throttle on road competition provided by the need to make use of the tolled Mersey tunnels.

3.10.20 There is also a higher percentage of internal central area movements than is the case with the other stations (7%), which may be associated with the significant number of central-area stations in Merseyside and the likelihood of intra-central-area rail movements, notably across the Mersey from Birkenhead.

3.10.21 For Manchester and Leeds, the 24km radius accounts for 78% and 76% of journeys respectively, while it may be noted that Sheffield has a significantly lower level of morning peak arrivals than the other cities, of which 29% comes from outside the 24km radius including flows from other main centres such as Manchester, Wakefield and Doncaster.

3.10.22 The growth, from the PFMv4.3 matrices, in these ensemble demand totals is shown in Table 45; and the composition of this change is described, by sector, in city-specific sections below. In the cases of Merseyside, West Yorkshire and South Yorkshire, a large portion of the noted growth is associated with the increase in recognised demand arising from completion of incorporation of demand associated with PTE zonal tickets, as a result of the 'PTE infill' process adopted in this matrix update.

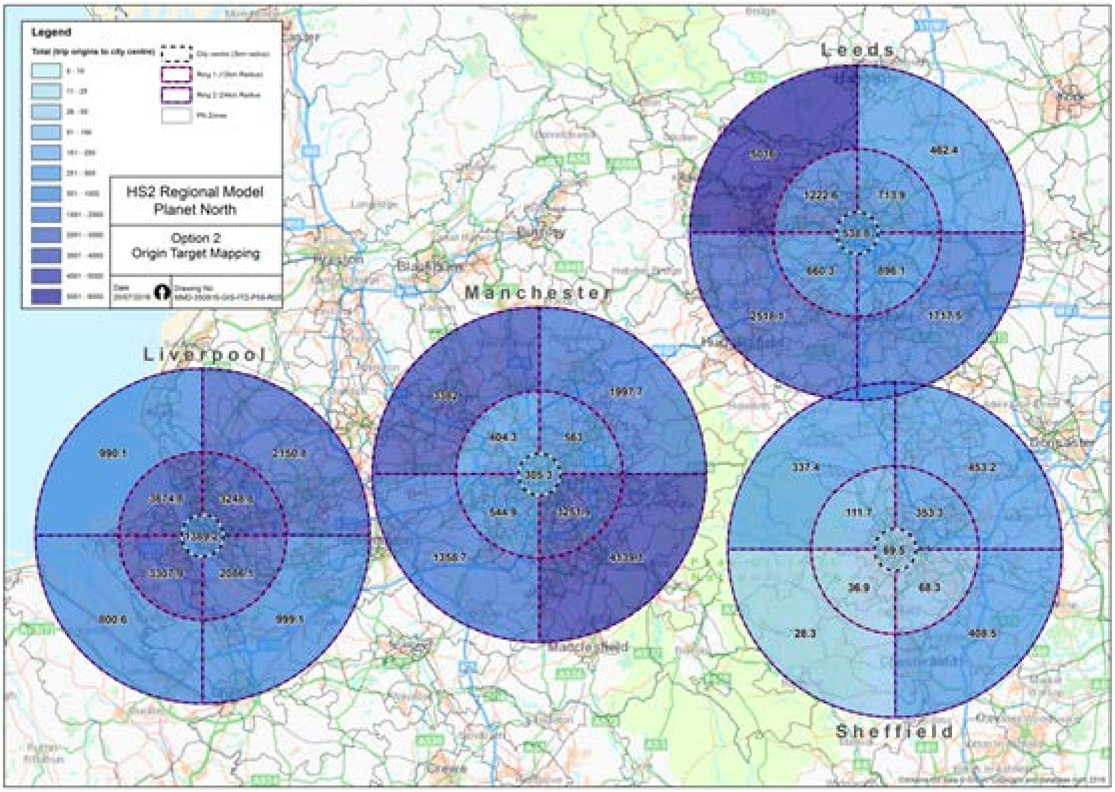
Table 45: PLANET North: Growth in masked matrix demand to city central zone, 2010/11 to 2014/15

City	Total within masking	Total within 40km
Liverpool	54%	49%
Manchester	52%	52%
Leeds	32%	39%
Sheffield	59%	62%

3.10.23 Figure 23 shows the volume of demand, having destination within the cities' inner areas, that originates from inner and outer rings to radii of 12km and 24km respectively, as well as internal demand within the central areas 3km in radius. The outer radii are chosen to represent the large majority of demand to the conurbation centres, while avoiding complication of overlap. The origin rings are divided into four quadrants, and are annotated with the number of originating journeys in the matrix to the relevant city centre.[14]

[14] The density of shading indicates the volume originating in the sectors.

Figure 23: PFMv6.1c journeys to PLANET North city centres: Origins by geographic segment



3.10.24 For Liverpool, the figure shows that, while for the inner annulus the western side – including the Mersey tunnel to Birkenhead – is marginally the stronger, for the outer annulus it is the north-east quadrant towards Lancashire and Manchester that is strongest.

3.10.25 For Manchester, the paucity of stations in the inner quadrant in all but the south-east is reflected by demand volumes, a pattern replicated to some degree in the outer ring, although here there are important commuting stations towards Lancashire and at and beyond Wigan, so that this quadrant comes second to the south-west quadrant, which includes Hazel Grove and New Mills.

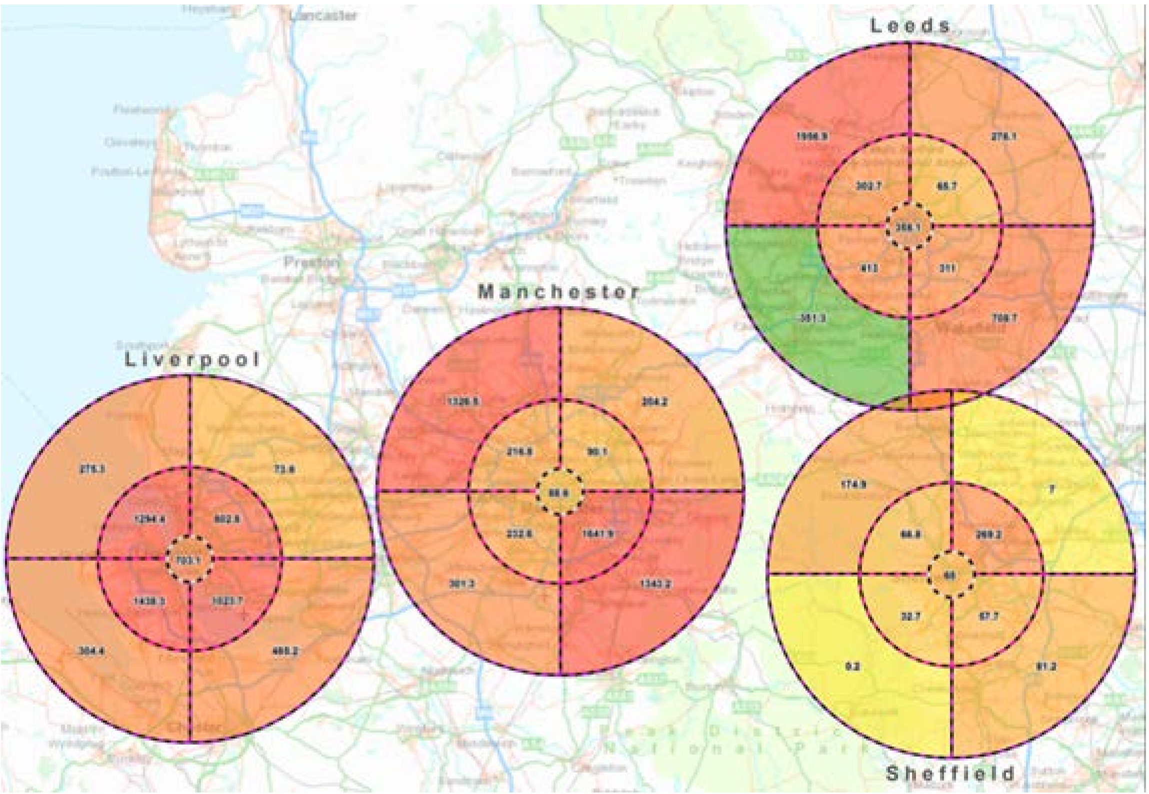
3.10.26 For Leeds, the dominance of Aire Valley commuting (with both Harrogate and Bradford in the same north-west quadrant) is shown, followed by the south-west quadrant towards Huddersfield. There are few substantial rail-served settlements in the outer north-east quadrant, while the south-east quadrant includes both the Wakefield/Castlefield routes and Garforth on the Selby route.

3.10.27 The volume of commuting into Sheffield is very much lower than into the other main cities, with the south-west quadrant being almost devoid of major habitations, Dore being the largest. Volumes from sectors in the remainder of the outer annulus are broadly similar, including Barnsley in the north-west, Mexborough in the north-east, and Chesterfield and Worksop in the south-east quadrants. In the inner annulus, the dominant north-east quadrant includes Meadowhall and Rotherham.

Peak arrivals by city

3.10.28 Figure 24 shows changes in the city arrivals matrix demand values[15] over the four-year period since 2010/11. The comparisons clearly rely on the accuracy of the values in the PFMv4.3 matrices for the equivalent zone-to-zone movements, and are heavily influenced by the more complete infill of PTE products (and directionality) in the current update.

Figure 24: Journeys to PLANET North city centres by origin segment: Differences from 2010/11



3.10.29 For Liverpool, the figure shows that while growth has been strong throughout the inner annulus, as shown in Table 46, it is the high-volume outer north-eastern quadrant that has had by comparison minimal growth (only 4%, compared with an average within the masking of 54%).

Table 46: Liverpool: Growth in masked matrix demand to central zone, 2010/11 to 2014/15

City sector	Demand 2014/15	Growth on 2010/11
Liverpool city centre	1,389	102%
Liverpool ring 1	12,318	59%
Liverpool ring 2	4,941	30%
Total within masking	20,289	54%

[15] In this chart the changes are shown using a scale from reduction (green) via yellow to largest growth (red).

3.10.30 For Manchester, growth has been strongest throughout the inner annulus, as shown in Table 47, while the outer north-west and south-east strongest quadrants also demonstrated the largest growth, amounting to approximately a doubling of recorded volume. These findings are consistent with a renewed emphasis on revenue protection activity during the 2014/15 period. The north-east quadrant has had the weakest growth, most likely because demand will have been abstracted by the opening of the competing Metrolink route to Oldham and on to Rochdale, and reconstruction works at Manchester Victoria station.

Table 47: Manchester: Growth in masked matrix demand to central zone, 2010/11 to 2014/15

City sector	Demand 2014/15	Growth on 2010/11
Manchester city centre	305	41%
Manchester ring 1	4,764	84%
Manchester ring 2	10,878	41%
Total within masking	20,172	52%

3.10.31 For Leeds, growth has applied broadly evenly to the inner and outer rings, as shown in Table 48, although there has also been a significant increase in internal movements within the central zone.[16] Growth has been strongest on the north-west quadrant, amounting to around 40% of current volume. However, the much smaller growth in the north-east quadrant nevertheless amounts to around 60% of current volume. An apparent reduction in the south-west quadrant, equivalent to around 15% of current volume, is most likely to reflect a significant change in allocation of PTE ticket infill in the new methodology as commissioned by ORR, which may also explain some of the growth in the north-west quadrant.

Table 48: Leeds: Growth in masked matrix demand to central zone, 2010/11 to 2014/15

City sector	Demand 2014/15	Growth on 2010/11
Leeds city centre	539	198%
Leeds city ring 1	3,493	46%
Leeds city ring 2	9,714	36%
Total within masking	**17,449**	**32%**

3.10.32 The most significant change in the Sheffield catchment is a quadrupling of demand from the dominant inner north-east quadrant, mirrored by growth in the inner ring as a whole, as shown in Table 49. There has also been a more than doubling of previous volume in the outer north-west quadrant. These changes are consistent with the application of the new 'infill' data for PTE tickets reflecting main areas of use from Barnsley, Mexborough and Meadowhall, so result from the improved methodology rather than reflecting what has happened in reality.

[16] The only other station within the 3km 'central area' radius is Burley Park. Granted the emphasis on revenue protection with the introduction of ticket barriers at Leeds station, it may be that Burley Park provides a default origin for passengers arriving at the barrier without tickets to claim that they have originated from, inflating origins from this station.

Table 49: Sheffield: Growth in masked matrix demand to central zone, 2010/11 to 2014/15

City sector	Demand 2014/15	Growth on 2010/11
Sheffield city centre	69	1444%
Sheffield ring 1	570	297%
Sheffield ring 2	1,227	27%
Total within masking	**2,520**	**59%**

3.11 Regional Station Choice Model (Transfer.exe) updates

3.11.1 This section provides an overview of changes made to the PM and PN Transfer.exe input files. The Transfer.exe is referred to in this document as the Station Choice Model (SCM). The changes to the SCM input files were required as a consequence of changes made to the base demand matrices in the regional models allowing for a wider geographical catchment of demand for each model.

3.11.2 This section provides an overview of changes made to the base year model SCM (Transfer.exe) files for the 2014/15 base year update. The SCM changes made are the result of the changes in regional matrices and stations within geographical scope of each zone.

New percentage split files

3.11.3 The SCM uses choice information, contained in percentage split files, to allocate zonal demand to station demand. The previous percentage splits contained information for all origin and destination zonal pairs present in the previous base year demand matrices. However, with updated demand matrices came new OD pairs that had not been present previously. For these new zonal ODs, new percentage splits were required. In order to properly reflect the loadings of the base year model, new percentage split files were developed for all OD pairs in the new base year matrices, superseding the previous files.

3.11.4 The process of creating these files was similar to that of the process of creating the regional matrices. The LENNON data (station to station) was allocated to zones using the NRTS for the matrices and then the individual stations were aggregated by zone to create a zone-to-zone matrix (Figure 25). By skipping this step, a station-to-zone relationship was used to inform the station OD of each zone OD. This was used to create new split files for PN and PM (Figure 26).

Figure 25: Regional matrix: Station-to-zone allocation

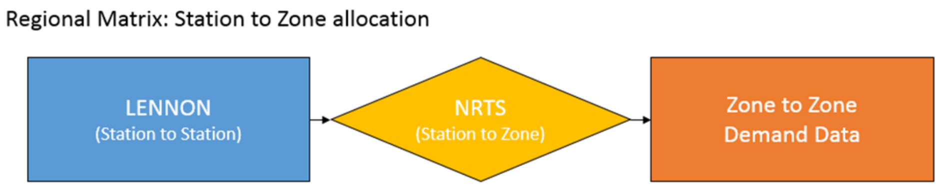
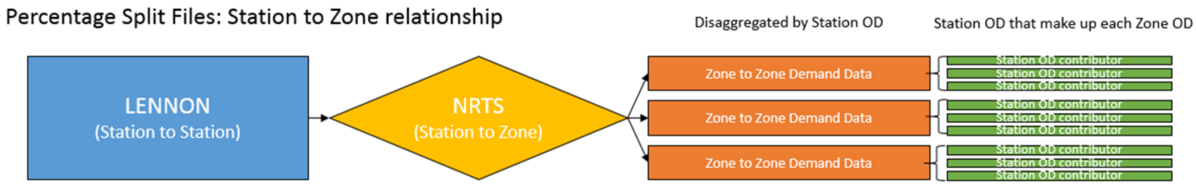


Figure 26: Station Choice Model split file percentages: Station-to-zone relationship



3.11.5 Where applicable, the station choices for any particular zone were limited to the stations that had access/egress costs for that particular zone as per the fixed variable files in the Transfer program. In some cases, none of the associated demand came from the stations with access/egress costs and so all contributing ODs were used to determine the split.

3.12 Validation of PLANET Midlands and PLANET North matrices

PLANET Midlands

3.12.1 The Planet Midland validation was undertaken on screenlines around Birmingham, Leicester and Nottingham in the morning peak. The Birmingham cordon does not meet the validation criteria; however, the key corridors of Coventry and Wolverhampton do validate. Both Leicester and Nottingham screenlines met the Web Based Transport Analysis Guidance criteria (WebTAG Unit M3.2 Section 7) of achieving modelled flows within 15% of observed flows.

PLANET North

3.12.2 The Planet North validation has been undertaken for cordons around the key centres of Manchester, Leeds and Sheffield for flows inbound to these centres in the morning peak period, reflecting the peak flow direction. The validation at all three stations is to a high level and the results meet the validation criteria set out by WebTAG Unit M3.2 Section 7.

4 PLANET South rail matrices update

4.1 Overview

4.1.1 In PFMv4.3 the PLANET South (PS) matrices were initially informed by analysis of LATS in construction of PFMv3.4 (SDG 2004/05), with subsequent updates created by uplift processes both for PFMv4 (2007/08) and for PFMv4.3 (2010/11). The PS matrices are composed of six components consisting of the production–attraction (PA) and attraction–production (AP) segments for each of the three journey purposes:

- Business PA;
- Business AP;
- Leisure PA;
- Leisure AP;
- Commute PA; and
- Commute AP.

4.1.2 The current update to PS matrices is primarily driven by the same LENNON data that informed the updating of the PM and PN matrices. Travelcard-layer data from MOIRA2 was added to the dataset and equivalent LENNON records removed. 'Freedom Pass' (a free facility for pensioners and others in the London area) data was not imported as it would only dilute the estimates of growth of paid-for tickets that is required for PLANET South.

4.1.3 The PS base year rail matrices are expressed in PA format, segmented by journey purpose but not by car availability. Their coverage includes the London Travelcard area, within which (in a similar way to the PTE areas for PN and PM) large volumes of travel are undertaken on zonal tickets (Travelcards), and there are also increasing volumes of travel for which ticketing is undertaken via Oyster and a variety of smart card mechanisms. There are also major ticketed flows transferring between National Rail and London Underground or Docklands Light Railway (DLR).

4.1.4 However, details were not available of the mechanism by which the existing matrices were originally derived from sales data, with the following essential components being notably unavailable:

- details of the PA conversion;
- bespoke data on the appropriate 'time of day' factor, consistent with the PA formulation.

4.1.5 Since equivalent current information did not exist to replace these absent components, by which a rebuild of the matrices could be undertaken, the current update therefore consisted of a further 'uplifting of the existing 2010/11 matrices' (as had also been done in previous sets of updates).

4.1.6 The approach taken involved computation of discrete growth uplift factors to apply to geographical elements within the existing PA and AP matrices. The process was undertaken separately for flows wholly within the Travelcard area and for other flows (consisting of flows having both origins and destinations outside the Travelcard area, as well as flows having either origin or destination within the Travelcard area):

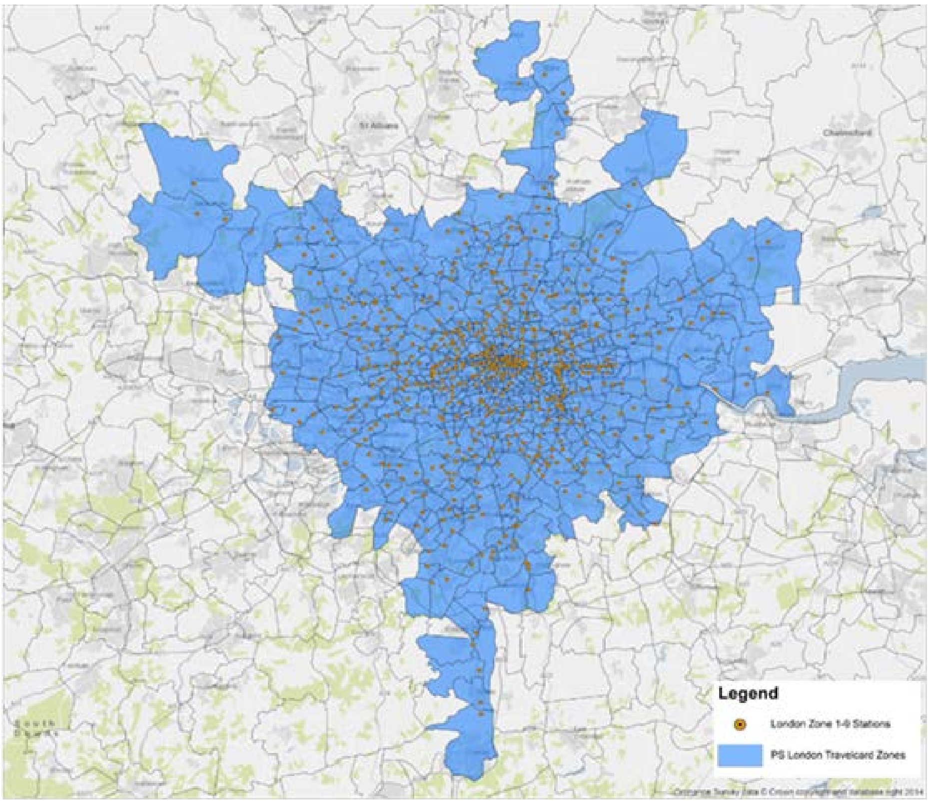
- Flows wholly within the Travelcard area were uplifted by the London borough-to- London borough flow uplift factor computed.
- Other flows were uplifted by the growth factor computed for the origin station only.
- For journeys between the London area and outside the Travelcard area, the growth factor for the station outside the Travelcard area was used irrespective of whether the flow was an inward one towards London or an outward one.

4.1.7 Once growth factors were produced for zones within and outside the London Travelcard (TC) area, the six matrices for particular segments were partitioned to represent: TC area, non-TC area or TC–non-TC movements. Particular matrices were grouped by trip ends, and uplifting using the Furness method was applied.

Determination of the Travelcard area

4.1.8 It was ruled that a particular zone would lie within the TC area if it had at least one Travelcard station within it. Subsequently, zones with no heavy rail station but clearly within the catchment area of the London Travelcard were manually added into the 'TC area' group of zones. All zones that were not included in the 'TC area' were classified as 'non-TC'. The outcome of this classification can be seen in Figure 27, on which in-boundary National Rail stations are also marked.

Figure 27: Zones classified as within the London Travelcard area



4.2 Procedure: outside-Travelcard area

4.2.1 While LENNON data formed the primary source of volume data for stations outside the London Travelcard area, Travelcard-layer data from MOIRA2 was added to the dataset and equivalent LENNON records removed. This therefore provided more complete allocation to stations of travel, on these multimodal tickets, than would have been obtained from National Rail sales alone.

4.2.2 In order to associate LENNON data with PLANET South demand zones, an extract of the existing PFMv4.3 model's file containing volumes on the existing station-to-zone connectors was obtained. The proportion of origin station demand from each zone was used to apportion the LENNON sales data for the comparison years 2010/11 and 2014/15 to PLANET zones.

4.2.3 The growth of the originating sales journeys for each PLANET zone was computed and used to calculate demand growth in each of the PLANET matrix cells from this zone and also (for flows from the London Travelcard area only) to calculate demand growth in each of the PLANET matrix cells to this zone.

4.2.4 The growth factor approach did have limitations, over and above its strong dependence on previous data – in particular:

- Uplifting only existing movements is possible: therefore in this case zones with no existing demand in the 2010/11 matrices are not addressed.
- It did not permit all the identified demand to be wholly allocated to model zones where there were new stations not featuring in the existing 'link flow' file, such as Aylesbury Vale Parkway and Corby. Inability to recognise actual demand at these stations may have led, therefore, to understatement in zones that could have been impacted by them.

4.3 Procedure: within-Travelcard area

4.3.1 For stations within the Travelcard area, daily throughput by station was obtained (for National Rail, from ORR's Estimates of Station Usage datasets; and for London Underground stations from Transport for London's Rolling Origin and Destination Survey (RODS) datasets for appropriate years) and aggregated by London borough. The uplifts between 2010/11 and 2014/15, by borough, were combined (by 'furnessing') to derive an output uplift matrix between London boroughs.

4.3.2 The uplift data incorporates the following key features:

- Leaving the DLR and Croydon Tramlink out of the in-scope demand (as well as other public transport demand such as buses and taxis) focused the calculation on longer-distance movements relevant to the National Rail services which are the target for PS modelling.
- Station ridership was obtained for National Rail using the annual total entrances and exits published by ORR for the year, and for London Underground using the RODS 'All day' weekday access and egress figures.

- Interchange stations between National Rail and London Underground could potentially have received increased weighting due to making use of throughputs for both modes. To avoid this, an adjustment was made by subtracting the component of the Underground demand identified in the RODS dataset as having accessed the Underground station by 'National Rail/DLR/Tram' (with further allowance made for the likely DLR or tram components at the few stations where this was also relevant).

4.3.3 The overall average growth in weekday demand between 2010/11 and 2014/15 was 20% (which may be compared with 22% published for all rail and Underground volume within London over the period). The average includes a number of boroughs having increases of over 30%, including Broxbourne, Haringey, Hertsmere, Islington and Watford, as well as Crawley Borough which will have been disproportionately impacted by throughput increases at Gatwick Airport station. The highest increases were noted for Hackney (87%) and Newham (56%), the former strongly influenced by the re-opening of the East London Line, and the latter comprising largely of strong growth at Stratford.

4.4 Updated PLANET South matrix

Matrix comparisons by regional ensembles

4.4.1 The ensembles used in reporting the impacts of PS updating included the following geographic areas: the North, the West Midlands, Wales, Central, East Anglia, the South West, the South and London.

4.4.2 Table 50 shows the matrices in terms of these ensembles, with Table 51 showing the growth from the 2010/11 matrices and Table 52 showing this in percentage terms. No journeys are recorded to or from the West Midlands, Wales or the North ensembles.

Table 50: PLANET South journeys: PFMv6.1c totals by regional ensembles, 000s

	London	South	South West	Central	East Anglia	Airport zones
London	1,353	24	2	13	6	9
South	150	84	1	3	0	0
South West	2	2	5	1	0	0
Central	71	3	1	13	1	0
East Anglia	72	0	0	1	17	0
Airport zones	7	0	0	0	0	0

Table 51: PLANET South journeys: Totals by regional ensembles – difference between 2014/15 and 2010/11 matrix, 000s

	London	South	South West	Central	East Anglia	Airport zones
London	237	2	0	2	1	1
South	14	6	0	0	0	0
South West	0	0	0	0	0	0
Central	9	0	0	2	0	0
East Anglia	7	0	0	0	2	0
Airport zones	0	0	0	0	0	0

Table 52: PLANET South journeys: Totals by regional ensembles – difference between 2014/15 and 2010/11 matrix, percentage of 2010/11 values

	London	South	South West	Central	East Anglia	Airport zones
London	21%	10%	6%	18%	10%	8%
South	10%	8%	7%	17%	11%	27%
South West	-1%	-12%	6%	13%	-1%	33%
Central	15%	14%	-7%	18%	30%	19%
East Anglia	10%	19%	-7%	9%	10%	-19%
Airport zones	5%	42%	-	21%	-15%	6%

4.4.3 The matrix changes are dominated by growth within the London ensemble, followed by movements to/from and between the Central and East Anglia ensembles. In percentage terms, growth is typically in a range of 10% to 20%, with the London internal growth being 21% and flows between the South and South West and the 'airport zones' also showing strong growth.

Matrix comparisons by PLANET South zones

4.4.4 Figure 28 and Figure 29 show the changes in origin and destination journeys between the PFMv4.3 matrix and the current PS update, by model zone, while Figure 30 and Figure 31 provide the same information although focused on the London area. The presentation, based on change in absolute numbers in each zone, is intended to demonstrate the areas of change in an informative way without being liable to be obscured by anomalous figures (as can easily occur when illustrating on the basis of percentage changes). Nevertheless, it should be recognised that some zones (particularly destination zones such as in the City of London) have high base demand values, and thus so far as their demand change is concerned will enjoy an exceptionally high 'magnifier' of their percentage growth (or decline).

Figure 28: Total PLANET South originating journeys: Difference from 2010/11 matrix, daily journeys

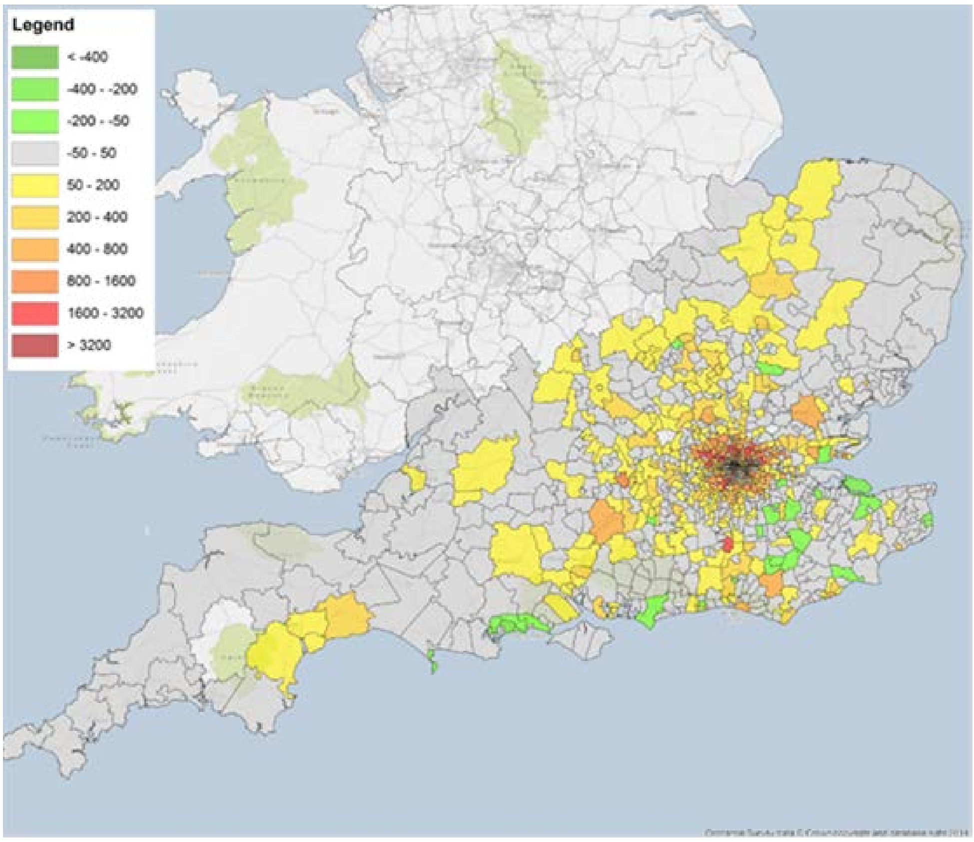


Figure 29: Total PLANET South journey destinations: Difference from 2010/11 matrix, daily journeys

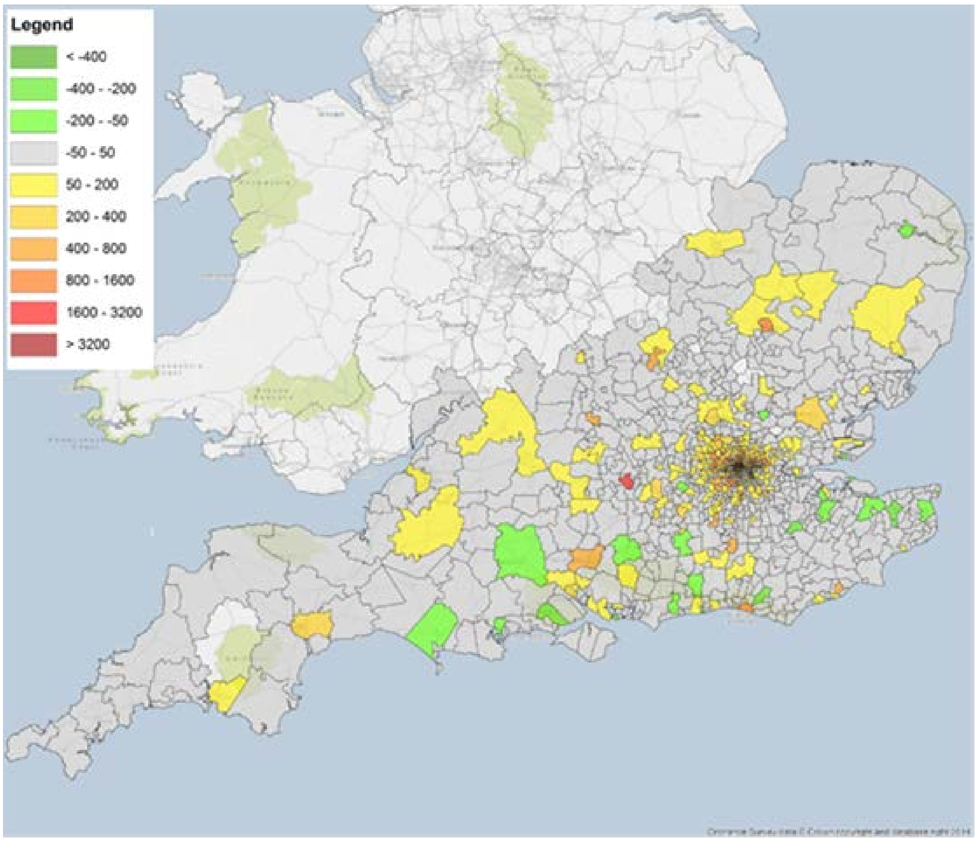


Figure 30: Total PLANET South matrix: origins difference vs PFMv4.3 matrix – London Area

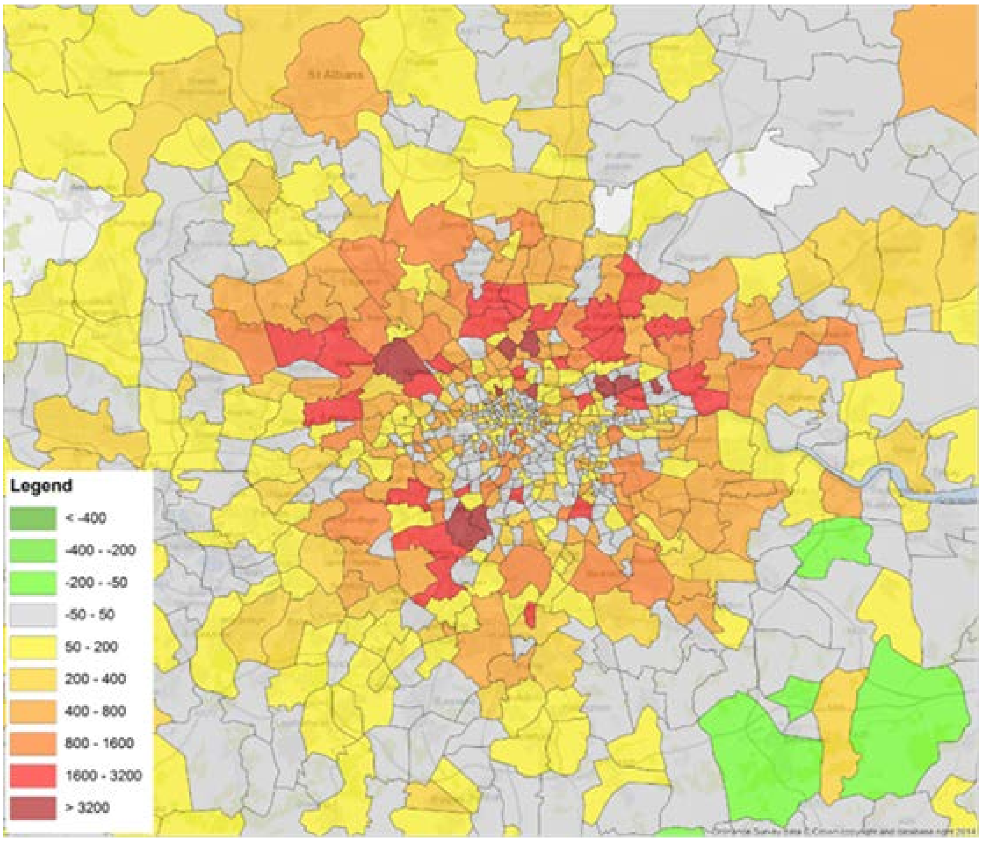
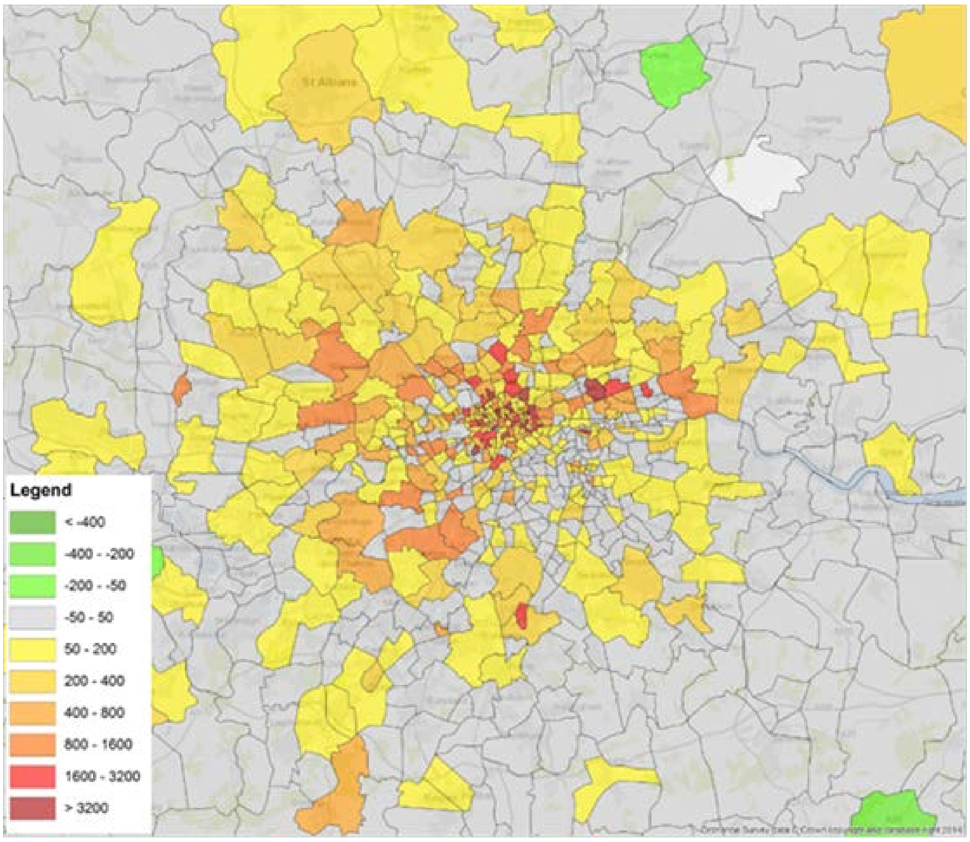


Figure 31: Total PLANET South matrix: Destinations difference vs PFMv4.3 matrix –London Area



4.4.5 Typically, the picture is one of growth, with locations for the highest growths tending to be focused on London and particularly the City and east London, which has benefited from growth in the Docklands, development for the Olympic Games and related areas (east London and Tottenham), and the re-opening of the East London Line (2011–2012).

4.4.6 The growth factor for Hackney borough (which has had major investment in East London Line services) has increased due to the re-classification of Old Street station as part of the adjoining Islington borough. This station had a lower (i.e. closer to the average) level of growth, thus its removal resulted in Hackney's uplift rising towards the level associated with the growth at the borough's small number of East London Line stations.

4.4.7 Outside London, there is significant growth for the majority of zones in the London 'commuter belt', with particular growth in some further areas with significant local commuter markets, such as Reading/Basingstoke, South Hampshire and the Sussex coastal belt. There is a bias towards continuing strong growth in eastern Essex and along the Cambridge corridor to King's Lynn. Growth in origins is also evident in south Devon particularly along the Torbay coast where it is served by National Rail.

4.4.8 Zones with negative growth may be seen at two nodes in south-east London and, in the wider region, to be scattered among Dorset, the Kent 'Weald' areas and the Isle of Sheppey. Possible reasons for these reductions have been sought among new smartcard ticketing, ticketing by Megabus (potentially outside LENNON) or other factors. The reduction in the Dorset area, both in origins and destinations, is in contrast to the increases in the similar coastal dormitory regions noted above.

Zones with no demand

4.4.9 In the PFMv4.3 base year matrices there were zones with no demand. The method of using growth factors does not eliminate this problem, and the problem is carried through to the current update. These zones can be seen in the origins maps as light grey areas with no data associated with them. Examination of all zones with no demand reveals only the outcome for Amersham (zone 132402) as inappropriate. The cause is believed to lie within the town's status as a joint London Underground/National Rail station remote from London in the PFMv4.3 modelling. The other zones do not have modelled stations within them, and the majority of them simply reflect sparse patterns of settlement generating no demand in the PFMv4.3 model.

PLANET South validation – London screenlines

4.4.10 In PLANET South, validation has been undertaken across a screenline into London, representing the peak flow direction in the morning peak, and covering all of the north-facing stations that it is appropriate to understand would be relevant for HS2. Both the overall screenline and each individual train operating company (TOC) meet the WebTAG validation criteria, indicating a good level of validation. The findings indicate an improved level of validation compared with PFMv4.3, with all corridors passing the criteria.

5 Highway base year matrices update

5.1 Introduction

5.1.1 As part of the update of the PFM base year highway matrices were also developed for the new 2014/15 base year. This chapter describes the work undertaken to enhance the base highway matrices for the PLD model.

5.1.2 The PLD highway model covers the whole of Great Britain, and previously had a base year of 2010/11. The highway person demand represents an average 24-hour weekday (Monday to Friday), for three trip purposes: Business, Commute and Leisure.

5.1.3 The demand is built in PA format and used in the PLD demand model and highway assignment, after converting into hourly demand and adjusting by car occupancy to convert persons into vehicle trips.

5.1.4 The previous 2010/11 matrices comprised long-distance trips derived from the Long Distance Model (LDM) and infilled with some short-distance trips from regional models around the UK, but this process was only applied in specific geographical regions.

5.1.5 The objective of the update to the PLD highway matrices was to:

- update the existing long-distance car passenger matrices with the best and most reliable information available; and
- rebase the matrices to a base year of 2014/15.

5.1.6 The updates to the highway matrices focused on refreshing the existing trips in the matrix to 2014/15 without the infill process.

5.1.7 The overarching methodology to create the new 2014/15 base year matrices was to show growth, based on the Furness model, in the existing trips in the highway matrices using growth factors obtained from TEMPro v6.2.

5.1.8 The following sections now detail the individual steps required to get from the starting matrices and data to the revised 2014/15 base year matrices.

5.2 Updating the highway matrices

Demand growth factors

5.2.1 Data was extracted from TEMPro version 6 with dataset version 6.2; trip ends were obtained by time period for car driver and car passenger combined and were obtained for weekday AM Peak, Inter Peak, PM Peak and Off Peak time periods.

5.2.2 The trip purposes within TEMPro were combined in the following way with the TEMPro purpose first followed by the PLD purposes, divided by home-based (HB) and non-home-based (NHB) categories:

- HB Work – Commute;
- HB Employer Business – Business;
- HB Education – Education;
- HB Shopping – Leisure;
- HB Personal Business – Leisure;
- HB Recreation/Social – Leisure;

- HB Visiting friends and relatives – Leisure;
- HB Holiday/Day trip – Leisure;
- NHB Work – Commute;
- NHB Employers Business – Business;
- NHB Education – Education;
- NHB Shopping – Leisure;
- NHB Personal Business – Leisure;
- NHB Recreation/Social – Leisure; and
- NHB Holiday/Day trip – Leisure.

5.2.3 It should be noted that Education is not a PLD trip purpose and was not included in the process.

5.2.4 Trip ends were downloaded in this format for all combinations of the above purposes, time periods and car availability for 2010, 2011, 2014 and 2015. These trip ends were then combined into 24-hour financial year trip ends (by PLD purpose) using the following formulation:

$$(AM + IP + PM + OP)^{YEAR1} * 275/365 + (AM + IP + PM + OP)^{YEAR2} * 90/365$$

5.2.5 These trip ends were then converted from TEMPro zones to PLD zones using the EDGE process.

5.2.6 The output of this process is a set of 2010/11 and 2014/15 TEMPro trip ends at PLD zone level by purpose, with an associated set of growth factors by PLD zone and purpose between 2010/11 and 2014/15.

5.2.7 The following sections describe the processes applied to the long-distance and short-distance demand matrices.

Long-distance matrices

5.2.8 Long-distance highway trips in the PLD model are identified by the following process:

- First, highway distance skims from the model are interrogated and used to split up the demand matrix by distance group. This identifies the trips relevant for both the long-distance (trips of 50 miles and over) and short-distance (trips under 50 miles) matrices.
- Second, the existing non-zero trips are identified using a database process.
- Finally, for existing trips over 50 miles, the 2010/11 trip ends are multiplied by the growth factors calculated in the previous sub-section to give the 2014/15 long-distance trips.

5.2.9 Once the 2014/15 trip ends for each purpose have been developed they are passed change to 'through a process based on the Furness model' with the following steps:

- First, a single step is undertaken where the derived pattern is multiplied by both the production and attraction trip ends to get the 0^{th} iteration matrix. Each zone is then scaled to get the correct production trip end.

- Second, attraction trip end ratios are then produced and applied to the matrix. This is then averaged with the matrix produced in the step above.
- Third, production trip end ratios are then produced and applied to the matrix. This is then averaged with the matrix produced in the step above.
- The second and third steps are then repeated until the 100th iteration is reached. For each purpose, this provides a high level of convergence.

5.2.10 This gives the 2014/15 long-distance highway matrix for each modelled purpose within PLD.

Short-distance matrices

5.2.11 A very similar process exists for the existing short-distance matrices (i.e. the limited number of cells in the PLD matrices that are under 50 miles) as has been outlined above for the long-distance matrices. The short-distance trip ends are calculated in a spreadsheet using the same methodology but looking at journeys below 50 miles.

5.2.12 Then a similarprocess based on the Furness model was undertaken, with the output being the updated 2014/15 demand matrices by PLD purpose, and, as with the long-distance trips, a high level of convergence was reached.

Finalised combined matrices

5.2.13 The long- and short-distance matrices are then combined into a final set of matrices.

5.2.14 As part of this combination process an adjustment factor is applied due to the GDP growth assumptions in TEMPro being different from those used in the EDGE process for rail. This difference in the two GDP growth assumptions is because one is based on the Retail Prices Index (RPI) measure and the other based on the Consumer Price Index (CPI) measure and, to ensure consistency with the rail matrices, this factoring is applied. The GDP growth factors in TEMPro are also not updated as regularly as the inputs to the EDGE process. The factors are:

- Commute – 99.63%;
- Work – 99.36%; and
- Other – 99.37%.

5.3 Comparison of PFMv4.3 and PFMv6.1c PLANET Long Distance highway matrices

5.3.1 This section provides an overview of the outputs, presented separately by purpose and for each of the three sections compared with the matrices from PFMv4.3. The comparisons are provided in Table 53 for long-distance trips, Table 54 for short-distance trips and Table 55 for total trips.

5.3.2 As Table 53 shows, there are only minor increases in the trips for each category, with a slightly higher increase for long-distance Leisure trips of 3.4% but with the increase in the totals of long-distance trips between PFMv4.3 and PFMv6.1c being 3.0%.

Table 53: Long-distance highway trip totals

	PFMv4.3	PFMv6.1c	Difference (Number and %)
Commute trips	153,955	157,278	3,323 (2.2%)
Business trips	312,263	318,963	6,700 (2.1%)
Leisure trips	868,816	898,313	29,497 (3.4%)
Total	**1,335,034**	**1,374,553**	**39,519 (3.0%)**

5.3.3 Table 54 shows that there are only minor increases in the trips for each category of short-distance trips and, as with long-distance trips, with a slightly higher increase for short-distance Leisure trips of 3.6% when compared against the other categories. However, the overall increase in the totals of short-distance trips between PFMv4.3 and PFMv6.1c is 3.2%.

Table 54: Short-distance highway trip totals

	PFMv4.3	PFMv6.1c	Difference (number and %)
Commute trips	19,448	19,984	536 (2.8%)
Business trips	16,700	17,133	433 (2.6%)
Leisure trips	54,560	56,513	1,953 (3.6%)
Total	**90,708**	**93,630**	**2,922 (3.2%)**

5.3.4 When considering all trips, Table 55 shows that both Commute and Business trips increased by 2.2% between PFMv4.3 and PFMv6.1c. Leisure trips in both the long- and short-distance categories increased by 3.4%.

Table 55: Total PLANET Long Distance highway trips

	PFMv4.3	PFMv6.1c	Difference (number and %)
Commute trips	173,403	177,262	3,859 (2.2%)
Business trips	328,964	336,095	7,131 (2.2%)
Leisure trips	923,376	954,826	31,450 (3.4%)
Total	1,425,742	1,468,183	42,441 (3.0%)

5.3.5 Overall, the increases in highway trips between PFMv4.3 and PFMv6.1c are very low at only 3.0%.

5.3.6 The full matrices comparing the PFMv4.3 and PFMv6.1c PLD highway matrices are presented in Appendix B, presented by sector in order to show the impact of the growth calculation process on different geographical areas.

Masking addendum

5.3.7 The 2010/11 original base year matrix as referenced in this note was built for the PFMv4.3 version of the model and the figures quoted in this report include the matrix masking that was applied at that time. For comparison purposes, the updated values have been compared with the old ones using this same mask.

5.3.8 However, during the creation of the business case model PFMv5.2b, released in 2015, the mask was revised with some slight changes to the boundaries between PLD and the regional models. The matrix totals for the matrices described in this report using that mask are shown in Table 56.

Table 56: Highway base year matrices totals

	Business	Commute	Leisure
2010/11 old mask	328,964	173,403	923,376
2014/15 old mask	336,095	177,262	954,826
2010/11 new mask	293,519	144,878	786,467
2014/15 new mask	300,091	148,215	813,608

5.3.9 In the forecasting work undertaken, which was developed from these new base year matrices, it is this new mask that was used and hence in the forecasting report it is these matrices that will be used for comparison purposes.

5.4 Preloads

Overview

5.4.1 Following the development of new base year assignment matrices, the highway preloads also required updating to reflect the changes in the highway matrices.

5.4.2 Previously the highway preloads were derived from the Highways England (HE) database Traffic Flow Data System (TRADS), but as that dataset was no longer maintained an alternative source for the data was required. The dataset chosen was the DfT's traffic counts, rather than the direct TRADS replacement.

5.4.3 The DfT traffic counts have the benefit of being split by vehicle type, requiring no further processing and full road coverage for the UK. The drawback is that they are undertaken using manual counts once every five years and are therefore less accurate, but for the purpose of the highway model in PLANET Long Distance this was deemed to be satisfactory.

Process

5.4.4 Highway traffic count data was obtained from the DfT's major round two-way flow count set.[17] The full dataset was downloaded and the 2014 values used for the comparison with the modelled flows (the latest year available at the time of the exercise).

5.4.5 In addition, an initial base year model run was undertaken using the new matrices with the highway preloads set to zero. This provided flows from a pure un-congested assignment to be compared against the DfT counts.

5.4.6 The counts and the flows were matched with the PLD links through use of geographic information systems (GIS) software. All the counts and the base year PLD highway

[17] See: https://data.gov.uk/dataset/gb-road-traffic-counts.

network were plotted in ArcGIS and each count was then assigned to any link within 300m.

5.4.7 This meant that some links were connected to multiple counts and, on rare occasions, counts were connected to multiple links. However, when rationalised, this resulted in a correspondence list between PFM links and DfT count site IDs.

5.4.8 This correspondence list was used to connect the count data, GIS data and the flow data from the assignment and calculate the preloads. The steps below provide an overview of the process adopted:

- For each link in the model the road name(s) and two-way count data are collated.
- The average flow by vehicle type is then calculated, and combined with GIS outputs to bring together the link flow from the base year assignment and the count data.
- The differences are then calculated as the preload value.
- Finally, these are used as the new 2014 preload values to be applied in PFM and growth calculated to 2026 and 2036 values for the forecast years.

6 Air base year matrices

6.1 Introduction

6.1.1 This chapter describes the methodology for developing the domestic air passenger demand matrices (i.e. excluding interlining trips that are the first leg of an international journey). The air demand matrices for the PFMv4.3 2010/11 model base year have been updated for the 2014/15 base year. The approach for developing the PFMv4.3 air demand matrices was to adopt the DfT Aviation Model forecasts of supply and demand.

6.1.2 Within PFM, air is only represented in the PLD model and only includes those trips made exclusively within Great Britain and therefore excludes movements to/from Northern Ireland, Isle of Man etc. It also excludes interlining trips as described above.

6.2 DfT Aviation Model

6.2.1 The DfT Aviation Model forecasts the number of passengers passing through UK airports each year and includes trip matrices for UK and foreign residents travelling to, from or within the UK. The internal domestic market sector (excluding interlining trips as described above) required for PLD accounts for approximately 15% of the passengers in the DfT Aviation Model matrices.

6.2.2 The model has a base year of 2008 with forecasts being developed at yearly intervals. To ensure that the model is accurately replicating observed aviation activity in those years where data is now available, a model validation was undertaken for 2011. Detail on the results of the validation and the wider DfT Aviation Model Framework can be found in *UK Aviation Forecasts* published by DfT in January 2013.

6.3 Changes in air demand between PFMv4.3 and PFMv6.1c

6.3.1 The DfT Aviation Model was previously used to forecast air demand in the PFM for the 2010/11 and 2026/27 modelled years. In order to derive 2014/15 base year air demand matrices, the new matrices were interpolated between 2010/11 and 2026/27.

6.3.2 While this method does not use the DfT Aviation Model to model the 2014/15 year specifically, it utilises two modelled years to interpolate the 2014/15 level of air demand. This was deemed an appropriate methodology given that the air matrices are not then taken forward for forecasting directly from the base year. Instead, demand matrices for forecast years are taken directly from the DfT's National Air Passenger Allocation Model (NAPALM).

6.4 Air fares

6.4.1 The base year domestic air fare matrix, from the DfT Aviation Model, provides the air fares between all modelled airports in 2008 prices and values. These are adjusted to the 2014/15 base year using the index of changes in real domestic business and leisure fares supplied by the DfT. The fare matrix is based on a distance function that has been developed for each individual airport with domestic flights.

7 Highway and rail network updates

7.1 Introduction

7.1.1 This chapter details the updates that were incorporated into the 2014/15 base highway and rail networks. Between the previous 2010/11 base and the new 2014/15 base years, several changes occurred to the base networks and so it was necessary to represent these in the modelling. These changes include updates to rail service patterns, as well as rail and highway infrastructure upgrades.

7.2 Rail network update

7.2.1 The updating of the base year railway network for PFMv6.1c was undertaken in a phased manner to allow partial updates by TOCs to be applied during the development of PFMv6.1c and to ensure that a base year model would be available to meet the Strategic Outline Business Case (SOBC) timescales.

7.2.2 The original 2010/11 base year is based on a CIF file (a standard industry format for coding timetables) extracted from the timetable as per 'ORCATS18 day' of Wednesday, 16 June 2010. For the new base year, the process makes selective use of the 2010/11 base year coding, the PFMv5.2b 2026/27 'do minimum' coding and specific new coding in order to reflect the new 2014/15 base year.

Train operating company updates categorisation

7.2.3 For the process of updating the base year model, a review of service patterns for each modelled TOC was undertaken. The TOCs were separated into three categories based on whether the PFMv4.3 base or PFMv5.2b 'do minimum' (DM) timetable was the most suitable source for the 2014/15 update. The following categories were defined:

- Category 1: the PFMv4.3 2010/2011 base year coding sufficiently reflects the requirements of the 2014/15 updated base year and no change is required.
- Category 2: the PFMv5.2b 2026/27 DM coding sufficiently reflects the requirements of the 2014/15 updated base year.
- Category 3: neither the PFMv4.3 base year nor the PFMv5.2b 2026/27 'do minimum' coding sufficiently reflects the requirements of the 2014/2015 updated base year.

7.2.4 The second category utilised the DM files from PFMv5.2b and updated the vehicle types, network files, transit lines and associated preload files, as well as some SCM settings and amended them to reflect a 2014/15 base year.

7.2.5 The third category of changes required wholly new coding to be developed.

Category 1: Train operating company updates categorisation (Source: PFMv4.3 base year)

7.2.6 The TOCs in Table 57 have been identified to have minimal changes between 2010/11 and 2014/15 and therefore the existing base year coding from PFMv4.3 was retained.

7.2.7 The table also identifies the key timetable changes that have occurred between 2010/11 and 2014/15. Although it was acknowledged that some TOCs will be inaccurately represented in the revised base model coding, unless further specific changes are made (which is not currently proposed), the differences were relatively minor or peripheral to the Hs2 scheme.

Table 57: Category 1 train operating company updates

TOC	Changes
c2c, CrossCountry, Hull Trains and Merseyrail	No significant changes
Great Western Railway	Capacity improvements 2 trains per hour (2tph) Reading to Gatwick
ScotRail	Airdrie to Bathgate re-opening 4tph Shotts Line additional frequency Carstairs frequency changes Stock changes
South West Trains	Exeter route changes
Thameslink	London Bridge rebuild impacts Sevenoaks/Orpington services Capacity changes

Category 2: Train operating company updates categorisation (Source: PFMv5.2b 'do minimum')

7.2.8 The TOCs in Table 58 have been identified to have significant changes between 2010/11 and 2014/15, the majority of which are captured in the previous DM coding.

7.2.9 It is recognised that there may be additional future year changes in the DM coding that are not in place in 2014/15; however, this timetable is still considered the most representative of 2014/15.

Table 58: Category 2 train operating company updates

TOC	Changes
Arriva Trains Wales	Holyhead to Cardiff and vice versa loco-hauled service Extension of Cambrian Coast/Holyhead to Birmingham service onwards to Birmingham International Minor extensions to Manchester Piccadilly
Grand Central	Additional Sunderland and Bradford services
Greater Anglia	Removal of through workings New 1tph off-peak electric multiple unit Cambridge to Stansted Airport

TOC	Changes
London Midland	Class 350 at 110mph: faster running Euston to Crewe Rugeley Line changes Capacity enhancements Crewe extensions / Stopping pattern changes
London Overground	Dalston Junction to Clapham Junction opens (4tph) New units
Southeastern	Thameslink remapping impacts London Bridge
Virgin Trains West Coast	Euston to Scotland via Birmingham Shrewsbury and Blackpool services introduction Pendolino changes

7.2.10 The following TOCs were updated with relevant DM coding to represent services in 2014/15:

- Arrive Trains Wales
- Southeastern
- Abellio Greater Anglia
- Virgin West Coast
- Grand Central
- London Overground

7.2.11 Upon further consideration of the impacts, London Midland services were moved to Category 3 for complete new coding; and Heathrow Express services were added to Category 2.

Category 3: train operating company updates categorisation (new coding)

7.2.12 There were several TOCs where neither the 2010/11 base year nor the current DM coding sufficiently matches the 2014/15 timetable.

7.2.13 A summary of the key timetable changes that were addressed by re-coding these TOCs are summarised in Table 59.

Table 59: Category 3 train operating company updates

TOC	Changes
Chiltern Railways	Evergreen timetable
Virgin Trains East Coast	Eureka timetable Full 2tph service King's Cross to Leeds 1 train per day (1tpd) each way King's Cross to Lincoln
East Midlands Trains	MML acceleration: reducing journey times between Nottingham/Sheffield/Derby and London Matlock to Derby improved to 1tph and extended to Nottingham. Crewe to Nottingham cut back to Derby only Most trains lengthened to 4-car class 158 between Liverpool and Nottingham
TransPennine Express	Manchester Airport to Scotland services diverted via Wigan using the Chat Moss route

TOC	Changes
	5tph Leeds to Manchester with new Liverpool to Manchester to Newcastle service and changes to remaining cross-Pennine services Rolling stock changes
Northern	Stock changes Cumbrian coast enhanced service NT retiming due to TPE 5tph

7.2.14 The following TOCs were updated with wholly new coding to reflect the December 2014 timetable:

- Chiltern Railways
- East Coast
- East Midlands Trains
- London Midland
- Northern
- TransPennine Express

7.2.15 The new transit line coding for each TOC was based on a range of sources to provide a sufficiently detailed level of information to code the services. The sources included:

- MOIRA text output files (.spg) containing information for services specific to the TOC in December 2014;
- MOIRA Basic by Stop (BBS) output files containing a more detailed view of the stopping patterns, but with limited detail with regards to stock type;
- December 2014 Train Plans with a list of service IDs and stock formations, used previously for the DM update. In general, Train Plans were found to have more accurate stock allocations and were used in preference to the BBS data.

Rail network updates

7.2.16 The changes required to update the rail network infrastructure (as opposed to TOC service patterns) from 2010/11 to 2014/15 were identified during a scoping process, based on a comparison between the previous 2010/11 base year and DM files, along with an understanding of known significant timetable changes between 2010/11 and 2014/15 that would require incorporation into a new base year model.

7.2.17 The comparisons were based on the following baseline information:

- 2010/11 base model: PFMv4.2_Base10_v2l
- DM files: PFMv5.2b Reference Case Model

7.2.18 The process identified that the following structural changes would be required to amend the DM network to represent the 2014/15 base year situation:

- The existing 'HS Old Oak Common–London Paddington Link' in the model was changed from an underground link in the DM forecast back to a walking link for the base network to reflect the existing base year connectivity in 2014/15.
- The original base year model included a link for the 'West Drayton (HRPK)' HS2 Heathrow connection, which is no longer required.

7.2.19 The decision to adopt the 'do minimum' network as the basis for the new 2014/15 base network required changes to the SCM input files to be made. The station zone used for Meadowhall in the 'do minimum' differs from that in the original base model.

7.2.20 The PFMv5.2b PLD and PN 'do minimum' networks include additional nodes to represent the separate routes and platforms at Meadowhall. The extra detail provided by the two nodes was adopted in the 2014/15 base year.

7.2.21 The travel time between the original node and the two platform nodes is zero, so no additional journey times or penalties are incurred through this operation. However, this did require that the previous 2010/11 base year transit lines that passed through the single Meadowhall node had to be identified and recoded so that they called at the appropriate platform nodes in the revised 2014/15 network.

7.2.22 The PFMv5.2b PS 'do minimum' network included an additional node between Oxford and Islip, which was not reflected in the base year transit line files. This affected transit line files for three services in the Oxford area, which were updated to match the logic of the 'd minimum' network.

7.2.23 In addition to network changes, TOC-specific updates for new dummy nodes were also required to accommodate the transit line updates (described above).

Vehicle file updates

7.2.24 Several vehicle types were not present in DM vehicle files but were referenced in files originating from the base year model. These were reflected in the new base year coding:

- 2 sets of 5-car class 222 (Voyager) trains;
- 9-car class 43 (HST) trains;
- 4-car/8-car class 321 trains;
- 6-car class 323 trains;
- 4-car class 333 trains;
- a range of 1-car to 6-car diesel unit combinations, particularly on London Midland;
- proxy vehicle class for bus service connections between Oxford and Bicester.

7.2.25 The proxy vehicle class for the bus service was required in order to reflect a bus replacement service that ran during 2014 and 2015 while ongoing construction took place. This bus service was included in the National Rail Timetable (NRT), the SPG and the BBS timetable.

7.2.26 Where vehicle types were already present in the DM vehicle files, capacities were updated as appropriate where new capacity assumptions were available.

Preloads file updates

7.2.27 The preload files identify 'packets' of transit lines to exchange demand between the PLD and regional models. There are preload files between each of the regional models and PLD; however, for PS, there is no PLD-PS Preload because wormholes handle this demand transfer.

7.2.28 The preload files are independent of the network files, but reflect the transit lines in each model. The original base year preload sheets were used as a starting point and were updated to reflect the coding changes for the TOCs taken from the 'do minimum', as listed above.

7.2.29 Any preload packets in the new base year model relating to the TOCs where lines were sourced from the 'do minimum' were removed from the line matching in the base year preloads, and replaced by the packages used in the 'do minimum' preload spreadsheets.

Other changes

7.2.30 Settings in the EMME software were also changed to permit the increased number of transit line segments in the new base year coding in the PM databank to run.

7.3 Highway network update

7.3.1 The base year highway network was last updated with the release of PFMv4.3 (2013) and the current review of the highway networks as part of the base year update is based upon a list of schemes provided by the DfT, based on built, under-construction and committed Road Investment Scheme Period 1 (RIS1) infrastructure programmes included in the National Transport Model (NTM). This was provided initially in December 2014, with an updated version following in December 2015.

The PFM highway network

7.3.2 The highway network component of PFM is part of a strategic-level assignment model with a simple link and node structure. As such, it is not possible to include detailed junction improvements and minor roads.

7.3.3 Each link has the following attributes:

- Volume-delay function (vdf) category – this assigns a speed-flow curve to each link based on DfT cost benefits analysis (COBA) specifications,[18], allowing supply-based (congestion) impacts to journey times to be taken into account. These are restricted to single carriageway, dual carriageway and motorway speed-flow types.
- Number of lanes – this is the unidirectional number of road lanes.
- Local traffic preloads – this is a base level of short-distance highway trips (under 50 miles), which are not included in the assignment model but are included in highway network attributes for the purposes of calculating congestion-based journey time penalties.

Base year highway network review

7.3.4 The last update of the PFM highway network was carried out during the production of PFMv4.3. The PFMv3.0 highway network was updated as part of the work to rebase from 2007/08 to 2010/11. This included incorporating into the model networks highway schemes that had been opened between 2007 and 2010.

[18] See: https://www.gov.uk/government/publications/coba-11-user-manual.

7.3.5 Information relating to the proposed enhancements to the highway network between 2010/11 and 2026/27 was provided by the DfT and was based on schemes included in the DfT's NTM. This was reviewed against lists on the Highways Agency's Road Projects website, together with the Welsh and Scottish equivalents, the National Infrastructure Plan 2011 and subsequent DfT announcements.

7.3.6 The RIS1 schemes detailed in the DfT's NTM lists have been compared against the existing highway network coding where a new vdf, number of lanes and/or new link has been proposed. The proposed updates were submitted to DfT, and the returned final list of approved schemes was coded into a model run.

7.3.7 The extent of the highway network updates – covering predominantly the upgrade of major motorways to the 'smart' motorway network – would be expected *a priori* to have a minimal impact on the highway and rail assignments and hence the business case for HS2.

7.3.8 The RIS1 network updates are summarised as follows by category:

Smart motorway schemes

- A1(M) J5–9 Welwyn–Baldock
- M5 J4a–6 south of Birmingham
- A1(M) J6–8 Stevenage
- M53 J11–5 capacity improvements
- M1 J23a–J24 smart motorways
- M56 J6–8
- M1 J13–19 south of Rugby
- M6 J10a–13 widening
- M1 J24–25 (Long Eaton)
- M6 J5–8 widening (Birmingham Box Phase 3)
- M20 J3–5 (Maidstone)
- M6 J16–19 Birmingham to Manchester
- M23 J8–10 (Gatwick)
- M6 J13–15 between Birmingham and Manchester
- M25 J10–12 SM widening
- M6 J2–4 between Coventry and Birmingham
- M25 J14–16 SM widening (a)
- M6 J21a–26 west of Manchester
- M25 J14–16 SM widening (b)
- M60 J1–4 widening (link to M56 J3 not coded)
- M27 J4–11 (Southampton)
- M60 J24–27 widening
- M3 J9–14 (Southampton)
- M60 J8–12 widening
- M4 J3 (Uxbridge) to J12 (Reading West) upgrading to smart motorway, linking Reading to Heathrow
- M62 J25–30 widening
- M40/M42 interchange: upgrading to smart motorway from M40 J16 to M42 J3–3a
- M62 J10–12 (Manchester)

Other schemes

- A1 Leeming to Barton upgrade to motorway standard
- A5036 access to Port of Liverpool
- A1 Lobley Hill
- M4 J3–12 widening
- A14 Cambridge to Huntingdon
- M42 J10 to M69 J1 –(A5 Hinckley)
- A19 Norton to Wynyard
- M54 to M6 (Toll) link (New Road but upgrade A460)

- A21 Tonbridge to Pembury
- M60 J8–12 widening
- A5 Hinckley widening to dual carriageway where it carries traffic for both the A5 and A47
- A500 Etruria Valley widening
- M1 new junction 11A near Luton/Dunstable, plus a new road to link to the nearby A5

7.3.9 38 RIS1 schemes were not included in the updates because the PFM highway network structure did not require any action to be taken. These included detailed junction upgrades and areas that are not modelled in detail in PFM.

7.3.10 The following list includes those road schemes identified as 'open' by the DfT:

Scheme open

- A1 Bramham to Wetherby
- A3 Hindhead improvement
- A421 Bedford to M1 J13
- M1 J25–28 widening
- M25 J16–23 widening
- M25 J27–30 widening
- M27 J3–4 widening
- M42 J7–9 HSR
- M6 J4–5 HSR
- M6 J8–10A managed motorways (Birmingham Box Phase 2)
- M74 completion
- M80 Stepps to Haggs

Updated highway network comparison vs existing rad network

7.3.11 After the new coding file of the proposed highway network was generated, a high-level comparison was conducted against the DfT's 2015 major roads GIS file. This was to check that the future year highway network did not have any major omissions in its strategic representation of the trunk road network.

7.3.12 While the PFM highway network is clearly strategic in nature and sparsely modelled in areas away from the UK rail network, the representation of road infrastructure in areas affected by HS2 is suitably detailed.

7.3.13 However, three additional network changes have been incorporated into the highway network update. These include new link additions on the A1 (Morpeth) and M62 (Liverpool), together with minor centroid connector road type changes.

Highway network update conclusions

7.3.14 NTM RIS1 scheme lists were provided by DfT to HS2 in December 2014 and December 2015. These schemes were compared against existing PFM highway network coding. Proposed updates were then submitted to DfT, and a list of approved 'open' schemes coded into the base year network where appropriate.

7.3.15 The extent of the highway network updates – covering predominantly the upgrade of major motorways to the smart motorway network – has a negligible overall impact on the HS2 business case in terms of transport user benefits.

8 Summary

8.1.1 Since the release of PFMv5.2b, there have been a series of model development tasks undertaken on the PLANET Framework Model (PFM) modelling suite to update the inputs and model base year to take advantage of more recent information.

8.1.2 This note has described the following principal updates to the PFM base year model:

- The base demand matrices for the PLANET Long Distance (PLD), PLANET Midlands (PM) and PLANET North (PN) models have been updated with recent LENNON data in order to update the model base year from 2010/11 to 2014/15.
- The base demand matrices for the PLANET South (PS) model have also been updated to reflect a base year of 2014/15 from 2010/11.
- The highway demand matrices included in the PLD model have been grown from 2010/11 to 2014/15 using data extracted from the DfT's TEMPro software.
- The air demand matrices used by the model have been rebased to 2014/15.
- The highway and rail networks in the base model have been updated accordingly to reflect the infrastructure conditions in 2014/15.

8.1.3 The updates to the model are intended to provide a more robust and up-to-date base model from which to forecast the future years contributing to the development of the business case for the HS2 scheme. The data and processes used to update the base model are consistent with previous methodologies utilised in model development of the PFM.

Appendix A Purpose matrix

Descriptions	Home	Shopping	Normal workplace	Other workplace/ meeting	Personal business (e.g. doctor, hospital, bank)	Visiting friends or relatives	Sport or entertainment (e.g. concert, theatre)	Other leisure activity	School/ college/ university (as student)	School/ college (accompanying pupil)	Taking someone to the airport, station, hotel	Meeting someone at the station, airport, hotel	Other
Home	HBO	HBO	HBCOM	HBEB	HBO	HBO	HBO	HBO	HBO	HBO	HBO	HBO	HBO
Shopping	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Normal workplace	HBCOM	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Other workplace/meeting	HBEB	NHBO	NHBEB	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Personal business (e.g. doctor, hospital, bank)	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Visiting friends or relatives	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Sport or entertainment (e.g. concert, theatre)	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Other leisure activity	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
School/college/university (as student)	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
School/college (accompanying pupil)	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Taking someone to the airport, station, hotel	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Meeting someone at the station, airport, hotel	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Other	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO

Trip purpose definitions:

HBCOM	Home-Based Commuter
HBO	Home-Based Other
HBEB	Home-Based Employer's Business
NHBO	Non-Home-Based Other
NHBEB	Non-Home-Based Employer's Business

Appendix B Comparison of PLANET Long Distance highway matrices

Appendix B.1 Long-distance matrices

Table B.1 to Table B.4 show the impact of the growthing process on the long-distance Commute matrices. Table B.1 shows the 2010/11 matrix, Table B.2 the 2014/15, Table B.3 the percentage change and Table B.4 the absolute difference.

Table B.1: 2010/11 Commute long-distance trips by sector

Base

Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	5,787	5,174	831	127	2,698	85	1,590	233	326	8,374	3,779	29,005
East of England	4,931	-	-	18	130	1	-	127	191	2,423	284	8,105
London	722	-	-	16	50	-	-	358	211	702	116	2,176
North East	125	25	21	252	482	467	30	10	8	32	1,902	3,355
North West	2,594	150	58	485	8,932	263	115	89	587	3,159	5,129	21,562
Scotland	97	1	-	418	237	17,708	4	2	16	153	166	18,803
South East	1,561	-	-	24	123	2	-	649	164	2,734	245	5,502
South West	262	156	397	6	118	2	622	1,261	1,962	1,994	50	6,829
Wales	315	188	263	9	664	23	176	2,129	1,175	2,184	97	7,223
West Midlands	7,532	2,282	766	36	3,335	156	2,707	1,858	1,985	4,103	887	25,646
Yorkshire and The Humber	3,876	334	123	2,040	5,366	193	227	54	86	895	12,556	25,749
Total	27,800	8,310	2,460	3,431	22,135	18,900	5,471	6,770	6,712	26,753	25,211	153,955

Table B.2: 2014/15 Commute long-distance trips by sector

Rebase

Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	5,934	5,370	881	128	2,769	86	1,677	241	330	8,455	3,887	29,759
East of England	5,118	-	-	19	136	1	-	128	197	2,486	296	8,382
London	764	-	-	17	53	-	-	368	221	728	123	2,275
North East	126	26	22	249	488	472	31	10	8	32	1,939	3,404
North West	2,661	157	62	492	9,075	270	121	92	596	3,193	5,297	22,015
Scotland	98	1	-	422	242	17,992	4	2	16	154	170	19,102
South East	1,646	-	-	25	129	3	-	659	171	2,822	259	5,713
South West	271	157	408	6	123	2	632	1,277	2,011	2,040	52	6,978
Wales	319	194	275	9	673	23	182	2,182	1,178	2,173	98	7,307
West Midlands	7,604	2,339	794	36	3,372	156	2,792	1,900	1,975	4,096	896	25,959
Yorkshire and The Humber	3,984	348	131	2,080	5,540	198	239	56	87	903	12,816	26,384
Total	28,525	8,592	2,573	3,482	22,601	19,203	5,679	6,916	6,790	27,082	25,835	157,278

Table B.3: Percentage difference: Commute long-distance trips by sector

% Change												
Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	2.5%	3.8%	6.0%	0.9%	2.6%	1.5%	5.5%	3.4%	1.3%	1.0%	2.9%	2.6%
East of England	3.8%	0.0%	0.0%	2.9%	4.3%	4.9%	0.0%	0.9%	3.1%	2.6%	4.4%	3.4%
London	5.9%	0.0%	0.0%	4.5%	5.7%	0.0%	0.0%	2.7%	4.7%	3.7%	6.1%	4.5%
North East	0.9%	2.7%	4.5%	-1.3%	1.4%	1.1%	3.6%	2.8%	0.1%	-0.5%	1.9%	1.5%
North West	2.6%	4.2%	5.6%	1.4%	1.6%	2.3%	5.0%	4.1%	1.5%	1.1%	3.3%	2.1%
Scotland	1.2%	3.8%	0.0%	0.9%	2.0%	1.6%	5.3%	1.4%	-0.3%	0.2%	2.4%	1.6%
South East	5.4%	0.0%	0.0%	3.7%	5.1%	5.7%	0.0%	1.5%	3.9%	3.2%	5.7%	3.8%
South West	3.4%	0.7%	2.7%	2.8%	4.2%	2.0%	1.5%	1.3%	2.5%	2.3%	3.8%	2.2%
Wales	1.3%	3.1%	4.7%	0.1%	1.4%	0.1%	3.9%	2.5%	0.3%	-0.5%	1.1%	1.2%
West Midlands	1.0%	2.5%	3.7%	-0.4%	1.1%	0.5%	3.1%	2.2%	-0.5%	-0.2%	1.0%	1.2%
Yorkshire and The Humber	2.8%	4.3%	6.1%	2.0%	3.2%	2.7%	5.6%	3.9%	1.1%	1.0%	2.1%	2.5%
Total	2.6%	3.4%	4.6%	1.5%	2.1%	1.6%	3.8%	2.1%	1.2%	1.2%	2.5%	2.2%

Table B.4: Absolute difference: Commute long-distance trips by sector

Absolute Change												
Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	147	196	49	1	71	1	87	8	4	81	109	754
East of England	188	-	-	1	6	0	-	1	6	63	13	277
London	42	-	-	1	3	-	-	10	10	26	7	98
North East	1	1	1	-3	7	5	1	0	0	-0	37	50
North West	67	6	3	7	143	6	6	4	9	34	169	453
Scotland	1	0	-	4	5	284	0	0	-0	0	4	299
South East	85	-	-	1	6	0	-	10	6	88	14	211
South West	9	1	11	0	5	0	9	16	49	46	2	149
Wales	4	6	12	0	10	0	7	52	3	-11	1	85
West Midlands	72	57	28	-0	37	1	85	42	-10	-8	9	313
Yorkshire and The Humber	109	14	8	40	174	5	13	2	1	9	260	635
Total	725	282	112	51	466	303	208	145	78	329	624	3,323

Table B.5 to Table B.8 show the impact of the growthing process on the long-distance Business matrices. Table B.5 shows the 2010/11 matrix, Table B.6 the 2014/15, Table B.7 the percentage change and Table B.8 the absolute difference. A significant number of Business trips are generated in the North West and West Midlands in the new base year.

Table B.5: 2010/11 Business long-distance trips by sector

Base												
Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	8,516	5,415	2,114	1,085	6,237	618	3,376	1,071	1,998	8,342	5,896	44,667
East of England	5,089	-	-	194	1,149	101	-	264	1,403	5,188	1,828	15,216
London	2,234	-	-	175	567	89	-	513	1,972	3,506	950	10,006
North East	992	222	214	415	2,453	2,330	315	127	239	559	5,016	12,883
North West	5,770	1,423	688	2,835	16,342	2,038	1,147	803	2,661	8,373	8,267	50,346
Scotland	432	97	84	1,662	1,397	25,237	140	89	204	783	783	30,909
South East	3,172	-	-	266	1,016	165	-	1,359	1,121	7,410	1,442	15,951
South West	925	280	575	90	992	160	1,234	2,958	4,524	5,053	431	17,222
Wales	1,970	1,299	2,062	220	2,276	318	1,188	4,155	2,152	5,834	1,016	22,489
West Midlands	8,319	5,121	3,588	597	8,134	997	6,954	4,627	5,881	3,987	3,490	51,696
Yorkshire and The Humber	5,812	1,990	988	5,648	8,358	1,213	1,507	516	1,067	3,674	10,106	40,878
Total	43,231	15,846	10,313	13,187	48,921	33,266	15,861	16,483	23,221	52,709	39,224	312,263

Table B.6: 2014/15 Business long-distance trips by sector

Rebase												
Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	8,742	5,616	2,221	1,098	6,405	629	3,548	1,110	2,018	8,389	6,041	45,815
East of England	5,281	-	-	200	1,203	105	-	267	1,443	5,299	1,906	15,704
London	2,350	-	-	183	600	94	-	527	2,054	3,616	1,004	10,429
North East	1,005	229	224	415	2,498	2,367	329	131	239	557	5,107	13,102
North West	5,924	1,488	727	2,887	16,699	2,100	1,212	839	2,688	8,448	8,513	51,524
Scotland	440	101	89	1,691	1,439	25,589	147	93	204	788	806	31,386
South East	3,334	-	-	277	1,074	173	-	1,380	1,159	7,619	1,521	16,536
South West	960	283	589	93	1,039	167	1,255	2,993	4,633	5,162	447	17,621
Wales	1,994	1,337	2,147	220	2,299	320	1,230	4,249	2,134	5,773	1,025	22,727
West Midlands	8,368	5,229	3,695	595	8,215	1,002	7,147	4,725	5,815	3,946	3,505	52,241
Yorkshire and The Humber	5,961	2,074	1,044	5,754	8,610	1,247	1,591	536	1,075	3,693	10,291	41,878
Total	44,358	16,358	10,736	13,414	50,080	33,792	16,458	16,849	23,463	53,288	40,165	318,963

Table B.7: Percentage difference: Business long-distance trips by sector

% Change												
Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	2.6%	3.7%	5.1%	1.2%	2.7%	1.7%	5.1%	3.6%	1.0%	0.6%	2.5%	2.6%
East of England	3.8%	0.0%	0.0%	3.3%	4.7%	4.0%	0.0%	1.2%	2.9%	2.1%	4.3%	3.2%
London	5.2%	0.0%	0.0%	4.7%	5.9%	5.4%	0.0%	2.6%	4.2%	3.1%	5.7%	4.2%
North East	1.3%	3.3%	4.6%	0.0%	1.8%	1.6%	4.4%	3.3%	0.2%	-0.3%	1.8%	1.7%
North West	2.7%	4.6%	5.7%	1.8%	2.2%	3.0%	5.6%	4.5%	1.0%	0.9%	3.0%	2.3%
Scotland	1.9%	4.1%	5.4%	1.7%	3.0%	1.4%	5.3%	4.3%	0.3%	0.6%	2.8%	1.5%
South East	5.1%	0.0%	0.0%	4.3%	5.7%	5.1%	0.0%	1.5%	3.4%	2.8%	5.5%	3.7%
South West	3.7%	1.3%	2.5%	3.2%	4.7%	4.4%	1.6%	1.2%	2.4%	2.2%	3.9%	2.3%
Wales	1.2%	2.9%	4.1%	0.2%	1.0%	0.4%	3.5%	2.3%	-0.9%	-1.0%	0.8%	1.1%
West Midlands	0.6%	2.1%	3.0%	-0.4%	1.0%	0.5%	2.8%	2.1%	-1.1%	-1.0%	0.4%	1.1%
Yorkshire and The Humber	2.6%	4.3%	5.7%	1.9%	3.0%	2.8%	5.6%	3.9%	0.8%	0.5%	1.8%	2.4%
Total	2.6%	3.2%	4.1%	1.7%	2.4%	1.6%	3.8%	2.2%	1.0%	1.1%	2.4%	2.1%

Table B.8: Absolute difference: Business long-distance trips by sector

Absolute Change												
Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	226	201	107	13	168	11	172	38	20	47	145	1,148
East of England	192	-	-	6	54	4	-	3	41	111	78	488
London	116	-	-	8	34	5	-	13	82	110	54	423
North East	13	7	10	0	45	37	14	4	1	- 2	90	218
North West	155	65	39	51	357	62	64	36	27	74	246	1,178
Scotland	8	4	5	29	42	352	7	4	1	5	22	477
South East	162	-	-	12	57	8	-	20	38	208	79	585
South West	35	4	15	3	47	7	20	35	108	109	17	399
Wales	24	38	85	0	23	1	42	94	- 18	- 61	9	238
West Midlands	49	108	107	- 2	81	5	193	98	- 66	- 41	15	545
Yorkshire and The Humber	149	85	56	107	252	34	85	20	8	19	185	999
Total	1,127	512	423	227	1,159	526	597	366	242	579	941	6,700

Table B.9 to Table B.12 show the impact of the growthing process on the long-distance Leisure matrices. Table B.9 shows the 2010/11 matrix, Table B.10 the 2014/15, Table B.11 the percentage change and Table B.12 the absolute difference.

Table B.9: 2010/11 Leisure long-distance trips by sector

Base

Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	23,579	16,827	3,001	2,258	10,121	2,145	10,888	1,843	2,625	11,809	15,361	100,456
East of England	16,141	-	-	1,179	3,419	910	-	922	3,745	4,377	3,597	34,290
London	3,551	-	-	1,241	1,962	654	-	1,038	4,381	7,416	2,286	22,529
North East	2,015	952	1,031	2,210	8,515	8,696	1,505	621	696	707	10,107	37,056
North West	10,810	3,302	2,072	9,328	53,384	7,051	4,271	2,968	16,925	17,476	24,498	152,085
Scotland	1,901	763	692	8,191	6,493	91,217	1,026	753	1,080	1,473	3,422	117,010
South East	12,340	-	-	1,405	4,521	1,060	-	3,552	2,948	13,651	4,931	44,407
South West	1,620	958	994	373	3,802	817	3,015	7,239	14,219	17,380	1,165	51,583
Wales	2,584	2,759	4,160	911	14,728	1,200	2,625	14,858	30,442	14,267	2,354	90,889
West Midlands	12,189	4,172	7,583	948	14,980	2,176	13,586	14,981	14,791	13,663	3,878	102,948
Yorkshire and The Humber	15,536	3,398	2,174	10,677	22,817	4,438	5,181	1,801	2,452	3,893	43,196	115,563
Total	102,267	33,131	21,707	38,722	144,742	120,363	42,097	50,575	94,304	106,113	114,796	868,816

Table B.10: 2014/15 Leisure long-distance trips by sector

Rebase

Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	24,509	17,581	3,135	2,324	10,384	2,214	11,318	1,925	2,720	12,160	16,086	104,358
East of England	16,866	-	-	1,225	3,552	950	-	960	3,917	4,560	3,808	35,838
London	3,710	-	-	1,289	2,035	682	-	1,086	4,576	7,686	2,419	23,483
North East	2,076	990	1,072	2,252	8,729	8,941	1,554	646	716	724	10,523	38,224
North West	11,097	3,431	2,149	9,557	54,243	7,246	4,400	3,064	17,312	17,829	25,385	155,714
Scotland	1,964	797	723	8,426	6,674	93,869	1,065	785	1,112	1,517	3,580	120,510
South East	12,830	-	-	1,449	4,657	1,099	-	3,659	3,052	14,085	5,200	46,030
South West	1,696	996	1,038	388	3,929	853	3,105	7,532	14,803	18,019	1,230	53,589
Wales	2,679	2,886	4,350	937	15,062	1,235	2,721	15,455	31,384	14,647	2,456	93,813
West Midlands	12,559	4,347	7,863	971	15,294	2,240	14,024	15,545	15,170	13,998	4,037	106,049
Yorkshire and The Humber	16,284	3,599	2,302	11,118	23,646	4,639	5,468	1,901	2,558	4,058	45,129	120,704
Total	106,271	34,628	22,633	39,937	148,205	123,967	43,656	52,557	97,322	109,283	119,855	898,313

Table B.11: Percentage difference: Leisure long-distance trips by sector

% Change												
Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3.9%	4.5%	4.5%	2.9%	2.6%	3.2%	4.0%	4.5%	3.6%	3.0%	4.7%	3.9%
East of England	4.5%	0.0%	0.0%	3.9%	3.9%	4.4%	0.0%	4.2%	4.6%	4.2%	5.9%	4.5%
London	4.5%	0.0%	0.0%	3.9%	3.7%	4.4%	0.0%	4.6%	4.5%	3.6%	5.8%	4.2%
North East	3.0%	4.0%	3.9%	1.9%	2.5%	2.8%	3.2%	4.1%	2.9%	2.5%	4.1%	3.2%
North West	2.7%	3.9%	3.7%	2.5%	1.6%	2.8%	3.0%	3.3%	2.3%	2.0%	3.6%	2.4%
Scotland	3.3%	4.4%	4.4%	2.9%	2.8%	2.9%	3.8%	4.3%	3.0%	3.0%	4.6%	3.0%
South East	4.0%	0.0%	0.0%	3.2%	3.0%	3.7%	0.0%	3.0%	3.5%	3.2%	5.5%	3.7%
South West	4.7%	4.0%	4.4%	3.9%	3.3%	4.4%	3.0%	4.0%	4.1%	3.7%	5.6%	3.9%
Wales	3.7%	4.6%	4.6%	2.8%	2.3%	2.9%	3.7%	4.0%	3.1%	2.7%	4.3%	3.2%
West Midlands	3.0%	4.2%	3.7%	2.4%	2.1%	2.9%	3.2%	3.8%	2.6%	2.5%	4.1%	3.0%
Yorkshire and The Humber	4.8%	5.9%	5.9%	4.1%	3.6%	4.5%	5.5%	5.6%	4.3%	4.2%	4.5%	4.4%
Total	3.9%	4.5%	4.3%	3.1%	2.4%	3.0%	3.7%	3.9%	3.2%	3.0%	4.4%	3.4%

Table B.12: Absolute difference: Leisure long-distance trips by sector

Absolute Change												
Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	930	755	134	66	263	69	430	82	95	351	725	3,902
East of England	725	-	-	46	133	40	-	39	172	183	212	1,548
London	159	-	-	48	73	29	-	48	195	270	133	955
North East	61	38	41	43	213	245	49	25	20	17	416	1,168
North West	287	128	77	229	860	195	130	97	387	353	887	3,629
Scotland	62	34	31	235	181	2,652	39	32	32	44	158	3,500
South East	489	-	-	44	136	39	-	106	105	434	269	1,623
South West	76	38	44	15	127	36	90	293	584	639	65	2,006
Wales	95	128	190	26	334	35	96	597	942	380	102	2,924
West Midlands	371	175	280	22	314	64	439	564	379	335	159	3,101
Yorkshire and The Humber	748	202	128	441	829	202	287	100	106	165	1,933	5,141
Total	4,004	1,498	925	1,214	3,463	3,604	1,559	1,983	3,017	3,171	5,059	29,497

Table B.13 to Table B.16 show the impact of the growthing process on the long-distance total matrices. Table B.13 shows the 2010/11 matrix, Table B.14 the 2014/15, Table B.15 the percentage change and Table B.16 the absolute difference. The top three places with the biggest changes are Yorkshire and the Humber, East Midlands and the North West.

Table B.13: 2010/11 total long-distance trips by sector

Base												
All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	37,882	27,416	5,946	3,471	19,056	2,848	15,854	3,147	4,949	28,524	25,035	174,128
East of England	26,161	-	-	1,391	4,697	1,012	-	1,313	5,340	11,988	5,709	57,610
London	6,507	-	-	1,432	2,579	743	-	1,910	6,564	11,624	3,352	34,711
North East	3,132	1,199	1,267	2,877	11,450	11,493	1,850	758	943	1,298	17,026	53,294
North West	19,174	4,875	2,818	12,649	78,658	9,353	5,533	3,859	20,173	29,008	37,893	223,993
Scotland	2,430	861	776	10,271	8,127	134,163	1,170	843	1,299	2,410	4,372	166,722
South East	17,073	-	-	1,694	5,660	1,227	-	5,560	4,233	23,795	6,618	65,861
South West	2,807	1,393	1,966	469	4,912	979	4,872	11,458	20,705	24,427	1,646	75,634
Wales	4,869	4,245	6,484	1,140	17,668	1,541	3,989	21,142	33,770	22,285	3,468	120,601
West Midlands	28,040	11,575	11,937	1,581	26,450	3,328	23,246	21,467	22,657	21,754	8,255	180,290
Yorkshire and The Humber	25,224	5,721	3,285	18,365	36,541	5,844	6,914	2,371	3,606	8,462	65,858	182,190
Total	173,298	57,287	34,481	55,341	215,798	172,529	63,428	73,829	124,237	185,575	179,231	1,335,034

Table B.14: 2014/15 total long-distance trips by sector

Rebase												
All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	39,185	28,568	6,237	3,550	19,558	2,929	16,543	3,276	5,068	29,003	26,015	179,932
East of England	27,265	-	-	1,444	4,890	1,056	-	1,356	5,558	12,344	6,011	59,924
London	6,824	-	-	1,489	2,689	776	-	1,981	6,851	12,030	3,546	36,187
North East	3,207	1,245	1,318	2,917	11,715	11,780	1,913	788	964	1,314	17,569	54,730
North West	19,683	5,075	2,938	12,936	80,017	9,615	5,733	3,996	20,596	29,470	39,195	229,254
Scotland	2,501	899	812	10,539	8,355	137,450	1,217	880	1,332	2,458	4,555	170,998
South East	17,809	-	-	1,751	5,860	1,274	-	5,697	4,382	24,526	6,980	68,279
South West	2,926	1,437	2,036	487	5,091	1,022	4,991	11,802	21,447	25,221	1,730	78,188
Wales	4,992	4,417	6,772	1,166	18,034	1,577	4,133	21,886	34,696	22,593	3,580	123,847
West Midlands	28,531	11,916	12,352	1,601	26,881	3,398	23,963	22,170	22,960	22,040	8,439	184,249
Yorkshire and The Humber	26,230	6,022	3,477	18,953	37,796	6,085	7,298	2,493	3,721	8,654	68,236	188,965
Total	179,154	59,579	35,942	56,833	220,886	176,962	65,792	76,322	127,575	189,654	185,855	1,374,553

Table B.15: Percentage difference: Total long-distance trips by sector

% Change												
All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3.4%	4.2%	4.9%	2.3%	2.6%	2.9%	4.3%	4.1%	2.4%	1.7%	3.9%	3.3%
East of England	4.2%	0.0%	0.0%	3.8%	4.1%	4.3%	0.0%	3.3%	4.1%	3.0%	5.3%	4.0%
London	4.9%	0.0%	0.0%	4.0%	4.2%	4.5%	0.0%	3.7%	4.4%	3.5%	5.8%	4.3%
North East	2.4%	3.8%	4.1%	1.4%	2.3%	2.5%	3.4%	3.9%	2.2%	1.2%	3.2%	2.7%
North West	2.7%	4.1%	4.2%	2.3%	1.7%	2.8%	3.6%	3.5%	2.1%	1.6%	3.4%	2.3%
Scotland	2.9%	4.4%	4.5%	2.6%	2.8%	2.5%	3.9%	4.3%	2.5%	2.0%	4.2%	2.6%
South East	4.3%	0.0%	0.0%	3.3%	3.5%	3.9%	0.0%	2.5%	3.5%	3.1%	5.5%	3.7%
South West	4.3%	3.1%	3.5%	3.8%	3.6%	4.4%	2.4%	3.0%	3.6%	3.2%	5.1%	3.4%
Wales	2.5%	4.0%	4.4%	2.3%	2.1%	2.3%	3.6%	3.5%	2.7%	1.4%	3.2%	2.7%
West Midlands	1.8%	2.9%	3.5%	1.3%	1.6%	2.1%	3.1%	3.3%	1.3%	1.3%	2.2%	2.2%
Yorkshire and The Humber	4.0%	5.3%	5.8%	3.2%	3.4%	4.1%	5.6%	5.2%	3.2%	2.3%	3.6%	3.7%
Total	3.4%	4.0%	4.2%	2.7%	2.4%	2.6%	3.7%	3.4%	2.7%	2.2%	3.7%	3.0%

Table B.16: Absolute difference: Total long-distance trips by sector

Absolute Change												
All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	1,303	1,152	291	80	502	81	689	128	119	479	979	5,804
East of England	1,105	-	-	53	192	44	-	43	219	357	302	2,314
London	317	-	-	57	110	33	-	71	287	406	194	1,476
North East	75	46	51	39	265	287	63	30	21	15	544	1,436
North West	509	200	119	287	1,360	263	200	137	423	461	1,302	5,261
Scotland	72	38	35	268	228	3,287	46	36	33	49	184	4,275
South East	736	-	-	57	200	48	-	136	149	731	363	2,419
South West	119	43	69	18	179	43	119	344	742	793	84	2,554
Wales	123	171	288	26	367	36	145	743	927	308	112	3,247
West Midlands	491	340	415	20	431	69	718	703	303	286	183	3,960
Yorkshire and The Humber	1,006	301	192	588	1,255	241	384	122	115	192	2,378	6,775
Total	5,856	2,292	1,461	1,492	5,088	4,433	2,364	2,494	3,338	4,078	6,624	39,519

Appendix B.2 Short-distance matrices

Table B.17 to Table B.20 show the impact of the growthing process on the existing short-distance Commute matrices. Table B.17 shows the 2010/11 matrix, Table B.18 the 2014/15, Table B.19 the percentage change and Table B.20 the absolute difference.

Table B.17: 2010/11 Commute short-distance trips by sector

Base												
Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	585	61	-	-	13	-	-	-	-	181	1,048	1,888
East of England	44	-	-	-	-	-	-	-	-	-	-	44
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	43	-	-	-	-	-	-	-	43
North West	12	-	-	-	4,247	2	-	-	18	178	308	4,766
Scotland	-	-	-	-	1	1,885	-	-	-	-	-	1,886
South East	-	-	-	-	-	-	-	-	-	12	-	12
South West	-	-	-	-	-	-	-	218	31	31	-	280
Wales	-	-	-	-	21	-	-	34	13	39	-	106
West Midlands	157	-	-	-	257	-	13	29	33	596	-	1,084
Yorkshire and The Humber	1,326	-	-	-	290	-	-	-	-	-	7,723	9,339
Total	2,125	61	-	43	4,830	1,886	13	281	95	1,036	9,079	19,448

Table B.18: 2014/15 Commute short-distance trips by sector

Rebase												
Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	604	63	-	-	13	-	-	-	-	184	1,072	1,937
East of England	46	-	-	-	-	-	-	-	-	-	-	46
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	44	-	-	-	-	-	-	-	44
North West	12	-	-	-	4,357	2	-	-	18	180	345	4,913
Scotland	-	-	-	-	1	1,922	-	-	-	-	-	1,924
South East	-	-	-	-	-	-	-	-	-	13	-	13
South West	-	-	-	-	-	-	-	228	31	29	-	288
Wales	-	-	-	-	21	-	-	33	13	40	-	107
West Midlands	160	-	-	-	258	-	13	27	34	602	-	1,094
Yorkshire and The Humber	1,356	-	-	-	318	-	-	-	-	-	7,944	9,619
Total	2,178	63	-	44	4,968	1,924	13	288	96	1,048	9,361	19,984

Table B.19: Percentage difference: Commute short-distance trips by sector

% Change												
Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3.2%	3.9%	0.0%	0.0%	-4.4%	0.0%	0.0%	0.0%	0.0%	2.1%	2.4%	2.6%
East of England	4.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.1%
London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North East	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%
North West	-3.9%	0.0%	0.0%	0.0%	2.6%	1.3%	0.0%	0.0%	0.3%	0.8%	11.9%	3.1%
Scotland	0.0%	0.0%	0.0%	0.0%	0.2%	2.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.0%
South East	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	3.5%
South West	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.6%	-0.9%	-7.3%	0.0%	2.7%
Wales	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	-0.6%	0.0%	3.7%	0.0%	1.2%
West Midlands	2.3%	0.0%	0.0%	0.0%	0.3%	0.0%	3.5%	-7.9%	4.4%	1.1%	0.0%	1.0%
Yorkshire and The Humber	2.2%	0.0%	0.0%	0.0%	9.8%	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%	3.0%
Total	2.5%	3.9%	0.0%	1.4%	2.9%	2.0%	3.5%	2.7%	1.3%	1.1%	3.1%	2.8%

Table B.20: Absolute difference: Commute short-distance trips by sector

Absolute Change												
Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	19	2	0	0	-1	0	0	0	0	4	25	49
East of England	2	0	0	0	0	0	0	0	0	0	0	2
London	0	0	0	0	0	0	0	0	0	0	0	0
North East	0	0	0	1	0	0	0	0	0	0	0	1
North West	-0	0	0	0	109	0	0	0	0	2	37	147
Scotland	0	0	0	0	0	38	0	0	0	0	0	38
South East	0	0	0	0	0	0	0	0	0	0	0	0
South West	0	0	0	0	0	0	0	10	-0	-2	0	8
Wales	0	0	0	0	0	0	0	-0	-0	1	0	1
West Midlands	4	0	0	0	1	0	0	-2	1	6	0	10
Yorkshire and The Humber	30	0	0	0	28	0	0	0	0	0	221	280
Total	53	2	0	1	138	38	0	8	1	11	283	536

Table B.21 to Table B.24 show the impact of the growthing process on the existing short-distance Business matrices. Table B.21 shows the 2010/11 matrix, Table B.22 the 2014/15, Table B.23 the percentage change and Table B.24 the absolute difference.

Table B.21: 2010/11 Business short-distance trips by sector

Base

Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	790	29	-	-	20	-	-	-	-	147	699	1,684
East of England	27	-	-	-	-	-	-	-	-	-	-	27
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	80	-	-	-	-	-	-	-	80
North West	16	-	-	-	4,545	2	-	-	42	200	338	5,144
Scotland	-	-	-	-	1	2,354	-	-	-	-	-	2,355
South East	-	-	-	-	-	-	-	-	-	13	-	13
South West	-	-	-	-	-	-	-	360	51	37	-	447
Wales	-	-	-	-	40	-	-	44	13	30	-	127
West Midlands	144	-	-	-	327	-	13	35	34	502	-	1,055
Yorkshire and The Humber	700	-	-	-	364	-	-	-	-	-	4,703	5,766
Total	1,677	29	-	80	5,297	2,356	13	439	140	928	5,739	16,700

Table B.22: 2014/15 Business short-distance trips by sector

Rebase

Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	815	31	-	-	19	-	-	-	-	150	713	1,727
East of England	28	-	-	-	-	-	-	-	-	-	-	28
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	82	-	-	-	-	-	-	-	82
North West	16	-	-	-	4,663	2	-	-	43	201	369	5,292
Scotland	-	-	-	-	1	2,407	-	-	-	-	-	2,408
South East	-	-	-	-	-	-	-	-	-	14	-	14
South West	-	-	-	-	-	-	-	374	51	33	-	458
Wales	-	-	-	-	40	-	-	44	13	31	-	128
West Midlands	146	-	-	-	328	-	14	32	36	508	-	1,063
Yorkshire and The Humber	714	-	-	-	393	-	-	-	-	-	4,824	5,932
Total	1,720	31	-	82	5,444	2,409	14	449	142	937	5,906	17,133

Table B.23: Percentage difference: Business short-distance trips by sector

% Change												
Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3.2%	4.0%	0.0%	0.0%	-3.5%	0.0%	0.0%	0.0%	0.0%	2.0%	2.0%	2.5%
East of England	3.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%
London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North East	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%
North West	-4.9%	0.0%	0.0%	0.0%	2.6%	1.2%	0.0%	0.0%	0.2%	0.5%	9.0%	2.9%
Scotland	0.0%	0.0%	0.0%	0.0%	0.2%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
South East	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	3.5%
South West	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%	-1.0%	-8.3%	0.0%	2.4%
Wales	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	-0.8%	-0.3%	5.1%	0.0%	0.9%
West Midlands	2.0%	0.0%	0.0%	0.0%	0.1%	0.0%	3.7%	-10.1%	6.2%	1.2%	0.0%	0.8%
Yorkshire and The Humber	2.1%	0.0%	0.0%	0.0%	8.1%	0.0%	0.0%	0.0%	0.0%	0.0%	2.6%	2.9%
Total	2.5%	4.0%	0.0%	1.6%	2.8%	2.2%	3.7%	2.3%	1.1%	0.9%	2.9%	2.6%

Table B.24: Absolute difference: Business short-distance trips by sector

Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	25	1	0	0	-1	0	0	0	0	3	14	42
East of England	1	0	0	0	0	0	0	0	0	0	0	1
London	0	0	0	0	0	0	0	0	0	0	0	0
North East	0	0	0	1	0	0	0	0	0	0	0	1
North West	-1	0	0	0	118	0	0	0	0	1	31	149
Scotland	0	0	0	0	0	53	0	0	0	0	0	53
South East	0	0	0	0	0	0	0	0	0	0	0	0
South West	0	0	0	0	0	0	0	14	-1	-3	0	11
Wales	0	0	0	0	0	0	0	-0	-0	2	0	1
West Midlands	3	0	0	0	0	0	0	-4	2	6	0	8
Yorkshire and The Humber	14	0	0	0	30	0	0	0	0	0	122	166
Total	43	1	0	1	147	53	0	10	2	9	166	432

Table B.25 to Table B.28 show the impact of the growthing process on the existing short-distance Leisure matrices. Table B.25 shows the 2010/11 matrix, Table B.26 the 2014/15, Table B.27 the percentage change and Table B.28 the absolute difference.

Table B.25: 2010/11 Leisure short-distance trips by sector

Base

Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	2,338	89	-	-	30	-	-	-	-	201	1,924	4,582
East of England	98	-	-	-	-	-	-	-	-	-	-	98
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	429	-	-	-	-	-	-	-	429
North West	29	-	-	-	10,671	6	-	-	200	492	913	12,311
Scotland	-	-	-	-	5	7,226	-	-	-	-	-	7,232
South East	-	-	-	-	-	-	-	-	-	26	-	26
South West	-	-	-	-	-	-	-	719	113	147	-	979
Wales	-	-	-	-	199	-	-	121	120	80	-	519
West Midlands	208	-	-	-	842	-	30	129	83	1,669	-	2,961
Yorkshire and The Humber	1,751	-	-	-	1,090	-	-	-	-	-	22,583	25,424
Total	4,424	89	-	429	12,837	7,232	30	969	515	2,615	25,420	54,560

Table B.26: 2014/15 Leisure short-distance trips by sector

Rebase

Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	2,441	94	-	-	29	-	-	-	-	209	1,984	4,757
East of England	103	-	-	-	-	-	-	-	-	-	-	103
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	443	-	-	-	-	-	-	-	443
North West	28	-	-	-	10,920	6	-	-	206	505	970	12,633
Scotland	-	-	-	-	5	7,456	-	-	-	-	-	7,461
South East	-	-	-	-	-	-	-	-	-	27	-	27
South West	-	-	-	-	-	-	-	745	118	152	-	1,015
Wales	-	-	-	-	204	-	-	126	122	82	-	534
West Midlands	218	-	-	-	864	-	31	134	85	1,716	-	3,048
Yorkshire and The Humber	1,803	-	-	-	1,149	-	-	-	-	-	23,539	26,492
Total	4,593	94	-	443	13,171	7,462	31	1,006	530	2,691	26,493	56,513

Table B.27: Percentage difference: Leisure short-distance trips by sector

% Change												
Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	4.4%	5.4%	0.0%	0.0%	-3.8%	0.0%	0.0%	0.0%	0.0%	4.4%	3.1%	3.8%
East of England	5.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.2%
London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North East	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.3%
North West	-4.1%	0.0%	0.0%	0.0%	2.3%	2.0%	0.0%	0.0%	2.8%	2.5%	6.3%	2.6%
Scotland	0.0%	0.0%	0.0%	0.0%	1.5%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%
South East	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.8%	0.0%	3.8%
South West	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	4.3%	3.5%	0.0%	3.7%
Wales	0.0%	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%	4.3%	1.9%	2.8%	0.0%	2.9%
West Midlands	4.7%	0.0%	0.0%	0.0%	2.6%	0.0%	3.9%	3.9%	2.8%	2.8%	0.0%	2.9%
Yorkshire and The Humber	3.0%	0.0%	0.0%	0.0%	5.4%	0.0%	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
Total	3.8%	5.4%	0.0%	3.3%	2.6%	3.2%	3.9%	3.7%	2.9%	2.9%	4.2%	3.6%

Table B.28: Absolute difference: Leisure short-distance trips by sector

Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	103	5	0	0	-1	0	0	0	0	9	59	175
East of England	5	0	0	0	0	0	0	0	0	0	0	5
London	0	0	0	0	0	0	0	0	0	0	0	0
North East	0	0	0	14	0	0	0	0	0	0	0	14
North West	-1	0	0	0	248	0	0	0	6	13	57	323
Scotland	0	0	0	0	0	229	0	0	0	0	0	229
South East	0	0	0	0	0	0	0	0	0	1	0	1
South West	0	0	0	0	0	0	0	26	5	5	0	36
Wales	0	0	0	0	5	0	0	5	2	2	0	15
West Midlands	10	0	0	0	22	0	1	5	2	47	0	87
Yorkshire and The Humber	53	0	0	0	59	0	0	0	0	0	956	1,068
Total	169	5	0	14	334	229	1	36	15	77	1,073	1,954

Table B.29 to Table B.32 show the impact of the growthing process on the existing short-distance total matrices. Table B.29 shows the 2010/11 matrix, Table B.30 the 2014/15, Table B.31 the percentage change and Table B.32 the absolute difference.

Table B.29: 2010/11 total short-distance trips by sector

Base

All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3,713	179	-	-	63	-	-	-	-	528	3,670	8,154
East of England	169	-	-	-	-	-	-	-	-	-	-	169
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	552	-	-	-	-	-	-	-	552
North West	58	-	-	-	19,464	10	-	-	261	870	1,559	22,220
Scotland	-	-	-	-	8	11,465	-	-	-	-	-	11,473
South East	-	-	-	-	-	-	-	-	-	52	-	52
South West	-	-	-	-	-	-	-	1,297	195	214	-	1,706
Wales	-	-	-	-	260	-	-	198	145	148	-	751
West Midlands	508	-	-	-	1,426	-	56	194	149	2,767	-	5,100
Yorkshire and The Humber	3,777	-	-	-	1,744	-	-	-	-	-	35,009	40,530
Total	8,225	179	-	552	22,964	11,474	56	1,689	751	4,579	40,238	90,708

Table B.30: 2014/15 total short-distance trips by sector

Rebase

All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3,860	188	-	-	61	-	-	-	-	543	3,769	8,421
East of England	177	-	-	-	-	-	-	-	-	-	-	177
London	-	-	-	-	-	-	-	-	-	-	-	-
North East	-	-	-	568	-	-	-	-	-	-	-	568
North West	55	-	-	-	19,939	10	-	-	266	885	1,683	22,839
Scotland	-	-	-	-	8	11,785	-	-	-	-	-	11,793
South East	-	-	-	-	-	-	-	-	-	54	-	54
South West	-	-	-	-	-	-	-	1,347	199	214	-	1,761
Wales	-	-	-	-	265	-	-	203	148	153	-	769
West Midlands	524	-	-	-	1,449	-	58	193	155	2,827	-	5,206
Yorkshire and The Humber	3,874	-	-	-	1,861	-	-	-	-	-	36,308	42,043
Total	8,490	188	-	568	23,583	11,794	58	1,743	769	4,676	41,760	93,630

Table B.31: Percentage difference: Total short-distance trips by sector

% Change												
All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3.9%	4.7%	0.0%	0.0%	-3.8%	0.0%	0.0%	0.0%	0.0%	2.9%	2.7%	3.3%
East of England	4.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.7%
London	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North East	0.0%	0.0%	0.0%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%
North West	-4.3%	0.0%	0.0%	0.0%	2.4%	1.7%	0.0%	0.0%	2.2%	1.7%	8.0%	2.8%
Scotland	0.0%	0.0%	0.0%	0.0%	1.1%	2.8%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%
South East	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%	3.7%
South West	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%	2.1%	-0.1%	0.0%	3.2%
Wales	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	2.3%	1.6%	3.5%	0.0%	2.3%
West Midlands	3.2%	0.0%	0.0%	0.0%	1.6%	0.0%	3.8%	-0.4%	3.9%	2.2%	0.0%	2.1%
Yorkshire and The Humber	2.6%	0.0%	0.0%	0.0%	6.7%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	3.7%
Total	3.2%	4.7%	0.0%	2.9%	2.7%	2.8%	3.8%	3.2%	2.4%	2.1%	3.8%	3.2%

Table B.32: Absolute difference: Total short-distance trips by sector

All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	147	8	0	0	-2	0	0	0	0	15	98	266
East of England	8	0	0	0	0	0	0	0	0	0	0	8
London	0	0	0	0	0	0	0	0	0	0	0	0
North East	0	0	0	16	0	0	0	0	0	0	0	16
North West	-2	0	0	0	476	0	0	0	6	15	124	618
Scotland	0	0	0	0	0	320	0	0	0	0	0	320
South East	0	0	0	0	0	0	0	0	0	2	0	2
South West	0	0	0	0	0	0	0	50	4	-0	0	54
Wales	0	0	0	0	6	0	0	5	2	5	0	18
West Midlands	16	0	0	0	23	0	2	-1	6	60	0	106
Yorkshire and The Humber	97	0	0	0	117	0	0	0	0	0	1,299	1,513
Total	265	8	0	16	619	320	2	54	18	97	1,522	2,921

Appendix B.3 Total matrices

Table B.33 to Table B.36 show the impact of the growthing process on the total (combined long and short distance) demand matrices for Commute. Table B.33 shows the 2010/11 matrix, Table B.34 the 2014/15, Table B.35 the percentage change and Table B.36 the absolute difference.

Table B.33: 2010/11 total Commute trips by sector

Base

Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	6,372	5,235	831	127	2,711	85	1,590	233	326	8,554	4,826	30,892
East of England	4,975	-	-	18	130	1	-	127	191	2,423	284	8,149
London	722	-	-	16	50	-	-	358	211	702	116	2,176
North East	125	25	21	295	482	467	30	10	8	32	1,902	3,398
North West	2,606	150	58	485	13,179	265	115	89	605	3,338	5,437	26,328
Scotland	97	1	-	418	239	19,593	4	2	16	153	166	20,689
South East	1,561	-	-	24	123	2	-	649	164	2,746	245	5,514
South West	262	156	397	6	118	2	622	1,479	1,993	2,025	50	7,110
Wales	315	188	263	9	685	23	176	2,163	1,188	2,223	97	7,329
West Midlands	7,689	2,282	766	36	3,592	156	2,720	1,887	2,018	4,699	887	26,730
Yorkshire and The Humber	5,202	334	123	2,040	5,656	193	227	54	86	895	20,279	35,088
Total	29,925	8,371	2,460	3,474	26,965	20,786	5,483	7,051	6,807	27,790	34,290	173,403

Table B.34: 2014/15 total Commute trips by sector

Rebase

Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	6,538	5,434	881	128	2,781	86	1,677	241	330	8,639	4,959	31,696
East of England	5,164	-	-	19	136	1	-	128	197	2,486	296	8,428
London	764	-	-	17	53	-	-	368	221	728	123	2,275
North East	126	26	22	292	488	472	31	10	8	32	1,939	3,448
North West	2,673	157	62	492	13,432	271	121	92	614	3,373	5,642	26,928
Scotland	98	1	-	422	244	19,915	4	2	16	154	170	21,025
South East	1,646	-	-	25	129	3	-	659	171	2,835	259	5,726
South West	271	157	408	6	123	2	632	1,505	2,042	2,069	52	7,266
Wales	319	194	275	9	695	23	182	2,215	1,191	2,213	98	7,415
West Midlands	7,764	2,339	794	36	3,629	156	2,805	1,927	2,009	4,698	896	27,053
Yorkshire and The Humber	5,340	348	131	2,080	5,859	198	239	56	87	903	20,761	36,002
Total	30,703	8,655	2,573	3,526	27,569	21,127	5,692	7,204	6,887	28,130	35,196	177,262

Table B.35: Percentage difference: Total Commute trips by sector

% Change

Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	2.6%	3.8%	6.0%	0.9%	2.6%	1.5%	5.5%	3.4%	1.3%	1.0%	2.8%	2.6%
East of England	3.8%	0.0%	0.0%	2.9%	4.3%	4.9%	0.0%	0.9%	3.1%	2.6%	4.4%	3.4%
London	5.9%	0.0%	0.0%	4.5%	5.7%	0.0%	0.0%	2.7%	4.7%	3.7%	6.1%	4.5%
North East	0.9%	2.7%	4.5%	-0.9%	1.4%	1.1%	3.6%	2.8%	0.1%	-0.5%	1.9%	1.5%
North West	2.6%	4.2%	5.6%	1.4%	1.9%	2.3%	5.0%	4.1%	1.4%	1.1%	3.8%	2.3%
Scotland	1.2%	3.8%	0.0%	0.9%	2.0%	1.6%	5.3%	1.4%	-0.3%	0.2%	2.4%	1.6%
South East	5.4%	0.0%	0.0%	3.7%	5.1%	5.7%	0.0%	1.5%	3.9%	3.2%	5.7%	3.8%
South West	3.4%	0.7%	2.7%	2.8%	4.2%	2.0%	1.5%	1.8%	2.5%	2.2%	3.8%	2.2%
Wales	1.3%	3.1%	4.7%	0.1%	1.4%	0.1%	3.9%	2.4%	0.3%	-0.4%	1.1%	1.2%
West Midlands	1.0%	2.5%	3.7%	-0.4%	1.0%	0.5%	3.1%	2.1%	-0.4%	0.0%	1.0%	1.2%
Yorkshire and The Humber	2.7%	4.3%	6.1%	2.0%	3.6%	2.7%	5.6%	3.9%	1.1%	1.0%	2.4%	2.6%
Total	2.6%	3.4%	4.6%	1.5%	2.2%	1.6%	3.8%	2.2%	1.2%	1.2%	2.6%	2.2%

Table B.36: Absolute difference: Total Commute trips by sector

Commute	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	166	198	49	1	70	1	87	8	4	85	133	804
East of England	190	0	0	1	6	0	0	1	6	63	13	279
London	42	0	0	1	3	0	0	10	10	26	7	98
North East	1	1	1	-3	7	5	1	0	0	-0	37	50
North West	67	6	3	7	253	6	6	4	9	35	206	601
Scotland	1	0	0	4	5	322	0	0	-0	0	4	336
South East	85	0	0	1	6	0	0	10	6	89	14	211
South West	9	1	11	0	5	0	9	26	49	44	2	156
Wales	4	6	12	0	10	0	7	52	3	-9	1	86
West Midlands	75	57	28	-0	38	1	86	40	-8	-1	9	323
Yorkshire and The Humber	138	14	8	40	203	5	13	2	1	9	481	914
Total	778	284	112	52	604	341	209	153	80	340	907	3,859

Table B.37 to Table B.40 show the impact of the growthing process on the total (long and short distance) demand matrices for Business. Table B.37 shows the 2010/11 matrix, Table B.38 the 2014/15, Table B.39 the percentage change and Table B.40 the absolute difference.

Table B.37: 2010/11 total Business trips by sector

Base Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	9,306	5,444	2,114	1,085	6,257	618	3,376	1,071	1,998	8,489	6,594	46,352
East of England	5,116	-	-	194	1,149	101	-	264	1,403	5,188	1,828	15,243
London	2,234	-	-	175	567	89	-	513	1,972	3,506	950	10,006
North East	992	222	214	496	2,453	2,330	315	127	239	559	5,016	12,964
North West	5,786	1,423	688	2,835	20,887	2,040	1,147	803	2,703	8,573	8,605	55,490
Scotland	432	97	84	1,662	1,399	27,591	140	89	204	783	783	33,264
South East	3,172	-	-	266	1,016	165	-	1,359	1,121	7,423	1,442	15,964
South West	925	280	575	90	992	160	1,234	3,317	4,576	5,089	431	17,669
Wales	1,970	1,299	2,062	220	2,315	318	1,188	4,199	2,165	5,864	1,016	22,616
West Midlands	8,462	5,121	3,588	597	8,462	997	6,967	4,663	5,915	4,489	3,490	52,751
Yorkshire and The Humber	6,512	1,990	988	5,648	8,722	1,213	1,507	516	1,067	3,674	14,808	46,645
Total	44,908	15,876	10,313	13,267	54,218	35,622	15,874	16,923	23,361	53,638	44,964	328,964

Table B.38: 2014/15 total Business trips by sector

Rebase Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	9,557	5,647	2,221	1,098	6,424	629	3,548	1,110	2,018	8,538	6,754	47,542
East of England	5,309	-	-	200	1,203	105	-	267	1,443	5,299	1,906	15,733
London	2,350	-	-	183	600	94	-	527	2,054	3,616	1,004	10,429
North East	1,005	229	224	497	2,498	2,367	329	131	239	557	5,107	13,183
North West	5,940	1,488	727	2,887	21,362	2,102	1,212	839	2,731	8,648	8,881	56,817
Scotland	440	101	89	1,691	1,440	27,996	147	93	204	788	806	33,794
South East	3,334	-	-	277	1,074	173	-	1,380	1,159	7,632	1,521	16,550
South West	960	283	589	93	1,039	167	1,255	3,366	4,684	5,195	447	18,079
Wales	1,994	1,337	2,147	220	2,339	320	1,230	4,293	2,147	5,804	1,025	22,855
West Midlands	8,514	5,229	3,695	595	8,543	1,002	7,161	4,757	5,851	4,454	3,505	53,304
Yorkshire and The Humber	6,675	2,074	1,044	5,754	9,003	1,247	1,591	536	1,075	3,693	15,115	47,810
Total	46,078	16,389	10,736	13,496	55,524	36,201	16,472	17,298	23,605	54,225	46,071	336,095

Table B.39: Percentage difference: Total Business trips by sector

% Change

Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	2.7%	3.7%	5.1%	1.2%	2.7%	1.7%	5.1%	3.6%	1.0%	0.6%	2.4%	2.6%
East of England	3.8%	0.0%	0.0%	3.3%	4.7%	4.0%	0.0%	1.2%	2.9%	2.1%	4.3%	3.2%
London	5.2%	0.0%	0.0%	4.7%	5.9%	5.4%	0.0%	2.6%	4.2%	3.1%	5.7%	4.2%
North East	1.3%	3.3%	4.6%	0.3%	1.8%	1.6%	4.4%	3.3%	0.2%	-0.3%	1.8%	1.7%
North West	2.7%	4.6%	5.7%	1.8%	2.3%	3.0%	5.6%	4.5%	1.0%	0.9%	3.2%	2.4%
Scotland	1.9%	4.1%	5.4%	1.7%	3.0%	1.5%	5.3%	4.3%	0.3%	0.6%	2.8%	1.6%
South East	5.1%	0.0%	0.0%	4.3%	5.7%	5.1%	0.0%	1.5%	3.4%	2.8%	5.5%	3.7%
South West	3.7%	1.3%	2.5%	3.2%	4.7%	4.4%	1.6%	1.5%	2.4%	2.1%	3.9%	2.3%
Wales	1.2%	2.9%	4.1%	0.2%	1.0%	0.4%	3.5%	2.2%	-0.9%	-1.0%	0.8%	1.1%
West Midlands	0.6%	2.1%	3.0%	-0.4%	1.0%	0.5%	2.8%	2.0%	-1.1%	-0.8%	0.4%	1.0%
Yorkshire and The Humber	2.5%	4.3%	5.7%	1.9%	3.2%	2.8%	5.6%	3.9%	0.8%	0.5%	2.1%	2.5%
Total	2.6%	3.2%	4.1%	1.7%	2.4%	1.6%	3.8%	2.2%	1.0%	1.1%	2.5%	2.2%

Table B.40: Absolute difference: Total Business trips by sector

Business	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	251	203	107	13	167	11	172	38	20	50	159	1,190
East of England	193	0	0	6	54	4	0	3	41	111	78	489
London	116	0	0	8	34	5	0	13	82	110	54	423
North East	13	7	10	1	45	37	14	4	1	-2	90	220
North West	154	65	39	51	475	62	64	36	28	75	277	1,327
Scotland	8	4	5	29	42	405	7	4	1	5	22	530
South East	162	0	0	12	57	8	0	20	38	209	79	586
South West	35	4	15	3	47	7	20	49	108	106	17	410
Wales	24	38	85	0	23	1	42	94	-19	-59	9	239
West Midlands	52	108	107	-2	81	5	194	94	-64	-35	15	553
Yorkshire and The Humber	164	85	56	107	281	34	85	20	8	19	307	1,165
Total	1,170	513	423	228	1,306	579	598	376	244	588	1,107	7,132

Table B.41 to Table B.44 show the impact of the growthing process on the total (long and short distance) demand matrices for Leisure. Table B.41 shows the 2010/11 matrix, Table B.42 the 2014/15, Table B.43 the percentage change and Table B.44 the absolute difference.

Table B.41: 2010/11 total Leisure trips by sector

Base												
Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	25,917	16,915	3,001	2,258	10,151	2,145	10,888	1,843	2,625	12,009	17,285	105,039
East of England	16,239	-	-	1,179	3,419	910	-	922	3,745	4,377	3,597	34,387
London	3,551	-	-	1,241	1,962	654	-	1,038	4,381	7,416	2,286	22,529
North East	2,015	952	1,031	2,638	8,515	8,696	1,505	621	696	707	10,107	37,484
North West	10,839	3,302	2,072	9,328	64,055	7,058	4,271	2,968	17,125	17,968	25,410	164,396
Scotland	1,901	763	692	8,191	6,498	98,443	1,026	753	1,080	1,473	3,422	124,242
South East	12,340	-	-	1,405	4,521	1,060	-	3,552	2,948	13,677	4,931	44,434
South West	1,620	958	994	373	3,802	817	3,015	7,958	14,332	17,527	1,165	52,562
Wales	2,584	2,759	4,160	911	14,927	1,200	2,625	14,979	30,562	14,347	2,354	91,408
West Midlands	12,397	4,172	7,583	948	15,822	2,176	13,615	15,111	14,874	15,333	3,878	105,909
Yorkshire and The Humber	17,287	3,398	2,174	10,677	23,907	4,438	5,181	1,801	2,452	3,893	65,779	140,987
Total	106,690	33,219	21,707	39,151	157,580	127,595	42,127	51,544	94,820	108,727	140,215	923,376

Table B.42: 2014/15 total Leisure trips by sector

Rebase												
Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	26,950	17,675	3,135	2,324	10,413	2,214	11,318	1,925	2,720	12,370	18,070	109,115
East of England	16,969	-	-	1,225	3,552	950	-	960	3,917	4,560	3,808	35,941
London	3,710	-	-	1,289	2,035	682	-	1,086	4,576	7,686	2,419	23,483
North East	2,076	990	1,072	2,695	8,729	8,941	1,554	646	716	724	10,523	38,667
North West	11,125	3,431	2,149	9,557	65,163	7,252	4,400	3,064	17,518	18,334	26,354	168,347
Scotland	1,964	797	723	8,426	6,679	101,324	1,065	785	1,112	1,517	3,580	127,971
South East	12,830	-	-	1,449	4,657	1,099	-	3,659	3,052	14,112	5,200	46,057
South West	1,696	996	1,038	388	3,929	853	3,105	8,277	14,921	18,171	1,230	54,604
Wales	2,679	2,886	4,350	937	15,266	1,235	2,721	15,581	31,506	14,729	2,456	94,347
West Midlands	12,777	4,347	7,863	971	16,158	2,240	14,055	15,679	15,255	15,715	4,037	109,097
Yorkshire and The Humber	18,088	3,599	2,302	11,118	24,795	4,639	5,468	1,901	2,558	4,058	68,668	147,196
Total	110,864	34,722	22,633	40,379	161,376	131,428	43,686	53,563	97,852	111,975	146,347	954,826

Table B.43: Percentage difference: Total Leisure trips by sector

% Change												
Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	4.0%	4.5%	4.5%	2.9%	2.6%	3.2%	4.0%	4.5%	3.6%	3.0%	4.5%	3.9%
East of England	4.5%	0.0%	0.0%	3.9%	3.9%	4.4%	0.0%	4.2%	4.6%	4.2%	5.9%	4.5%
London	4.5%	0.0%	0.0%	3.9%	3.7%	4.4%	0.0%	4.6%	4.5%	3.6%	5.8%	4.2%
North East	3.0%	4.0%	3.9%	2.1%	2.5%	2.8%	3.2%	4.1%	2.9%	2.5%	4.1%	3.2%
North West	2.6%	3.9%	3.7%	2.5%	1.7%	2.8%	3.0%	3.3%	2.3%	2.0%	3.7%	2.4%
Scotland	3.3%	4.4%	4.4%	2.9%	2.8%	2.9%	3.8%	4.3%	3.0%	3.0%	4.6%	3.0%
South East	4.0%	0.0%	0.0%	3.2%	3.0%	3.7%	0.0%	3.0%	3.5%	3.2%	5.5%	3.7%
South West	4.7%	4.0%	4.4%	3.9%	3.3%	4.4%	3.0%	4.0%	4.1%	3.7%	5.6%	3.9%
Wales	3.7%	4.6%	4.6%	2.8%	2.3%	2.9%	3.7%	4.0%	3.1%	2.7%	4.3%	3.2%
West Midlands	3.1%	4.2%	3.7%	2.4%	2.1%	2.9%	3.2%	3.8%	2.6%	2.5%	4.1%	3.0%
Yorkshire and The Humber	4.6%	5.9%	5.9%	4.1%	3.7%	4.5%	5.5%	5.6%	4.3%	4.2%	4.4%	4.4%
Total	3.9%	4.5%	4.3%	3.1%	2.4%	3.0%	3.7%	3.9%	3.2%	3.0%	4.4%	3.4%

Table B.44: Absolute difference: Total Leisure trips by sector

Leisure	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	1,033	760	134	66	262	69	430	82	95	360	785	4,076
East of England	730	0	0	46	133	40	0	39	172	183	212	1,553
London	159	0	0	48	73	29	0	48	195	270	133	955
North East	61	38	41	57	213	245	49	25	20	17	416	1,182
North West	286	128	77	229	1,108	195	130	97	393	366	944	3,952
Scotland	62	34	31	235	181	2,881	39	32	32	44	158	3,729
South East	489	0	0	44	136	39	0	106	105	435	269	1,624
South West	76	38	44	15	127	36	90	319	589	644	65	2,042
Wales	95	128	190	26	339	35	96	602	945	382	102	2,940
West Midlands	381	175	280	22	335	64	440	569	381	382	159	3,189
Yorkshire and The Humber	801	202	128	441	888	202	287	100	106	165	2,889	6,209
Total	4,173	1,503	925	1,228	3,797	3,833	1,560	2,019	3,032	3,248	6,132	31,450

Table B.45 to Table B.48 show the impact of the growthing process on the total matrices. Table B.45 shows the 2010/11 matrix, Table B.46 the 2014/15, Table B.47 the percentage change and Table B.48 the absolute difference.

Table B.45: 2010/11 total trips by sector

Base

All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	41,595	27,595	5,946	3,471	19,119	2,848	15,854	3,147	4,949	29,052	28,706	182,283
East of England	26,330	-	-	1,391	4,697	1,012	-	1,313	5,340	11,988	5,709	57,780
London	6,507	-	-	1,432	2,579	743	-	1,910	6,564	11,624	3,352	34,711
North East	3,132	1,199	1,267	3,429	11,450	11,493	1,850	758	943	1,298	17,026	53,845
North West	19,231	4,875	2,818	12,649	98,121	9,362	5,533	3,859	20,433	29,878	39,452	246,214
Scotland	2,430	861	776	10,271	8,135	145,627	1,170	843	1,299	2,410	4,372	178,195
South East	17,073	-	-	1,694	5,660	1,227	-	5,560	4,233	23,847	6,618	65,913
South West	2,807	1,393	1,966	469	4,912	979	4,872	12,755	20,900	24,641	1,646	77,341
Wales	4,869	4,245	6,484	1,140	17,927	1,541	3,989	21,340	33,915	22,433	3,468	121,352
West Midlands	28,548	11,575	11,937	1,581	27,876	3,328	23,302	21,660	22,806	24,521	8,255	185,390
Yorkshire and The Humber	29,001	5,721	3,285	18,365	38,285	5,844	6,914	2,371	3,606	8,462	100,867	222,720
Total	181,523	57,466	34,481	55,892	238,762	184,004	63,484	75,517	124,988	190,155	219,469	1,425,742

Table B.46: 2014/15 total trips by sector

Rebase

All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	43,045	28,755	6,237	3,550	19,619	2,929	16,543	3,276	5,068	29,547	29,783	188,353
East of England	27,442	-	-	1,444	4,890	1,056	-	1,356	5,558	12,344	6,011	60,101
London	6,824	-	-	1,489	2,689	776	-	1,981	6,851	12,030	3,546	36,187
North East	3,207	1,245	1,318	3,484	11,715	11,780	1,913	788	964	1,314	17,569	55,298
North West	19,738	5,075	2,938	12,936	99,956	9,625	5,733	3,996	20,862	30,355	40,878	252,093
Scotland	2,501	899	812	10,539	8,363	149,235	1,217	880	1,332	2,458	4,555	182,790
South East	17,809	-	-	1,751	5,860	1,274	-	5,697	4,382	24,579	6,980	68,333
South West	2,926	1,437	2,036	487	5,091	1,022	4,991	13,149	21,646	25,435	1,730	79,949
Wales	4,992	4,417	6,772	1,166	18,300	1,577	4,133	22,088	34,844	22,747	3,580	124,616
West Midlands	29,055	11,916	12,352	1,601	28,330	3,398	24,022	22,363	23,115	24,867	8,439	189,455
Yorkshire and The Humber	30,103	6,022	3,477	18,953	39,657	6,085	7,298	2,493	3,721	8,654	104,544	231,008
Total	187,645	59,766	35,942	57,401	244,469	188,756	65,851	78,065	128,343	194,330	227,615	1,468,183

Table B.47: Percentage difference: Total trips by sector

% Change All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	3.5%	4.2%	4.9%	2.3%	2.6%	2.9%	4.3%	4.1%	2.4%	1.7%	3.8%	3.3%
East of England	4.2%	0.0%	0.0%	3.8%	4.1%	4.3%	0.0%	3.3%	4.1%	3.0%	5.3%	4.0%
London	4.9%	0.0%	0.0%	4.0%	4.2%	4.5%	0.0%	3.7%	4.4%	3.5%	5.8%	4.3%
North East	2.4%	3.8%	4.1%	1.6%	2.3%	2.5%	3.4%	3.9%	2.2%	1.2%	3.2%	2.7%
North West	2.6%	4.1%	4.2%	2.3%	1.9%	2.8%	3.6%	3.5%	2.1%	1.6%	3.6%	2.4%
Scotland	2.9%	4.4%	4.5%	2.6%	2.8%	2.5%	3.9%	4.3%	2.5%	2.0%	4.2%	2.6%
South East	4.3%	0.0%	0.0%	3.3%	3.5%	3.9%	0.0%	2.5%	3.5%	3.1%	5.5%	3.7%
South West	4.3%	3.1%	3.5%	3.8%	3.6%	4.4%	2.4%	3.1%	3.6%	3.2%	5.1%	3.4%
Wales	2.5%	4.0%	4.4%	2.3%	2.1%	2.3%	3.6%	3.5%	2.7%	1.4%	3.2%	2.7%
West Midlands	1.8%	2.9%	3.5%	1.3%	1.6%	2.1%	3.1%	3.2%	1.4%	1.4%	2.2%	2.2%
Yorkshire and The Humber	3.8%	5.3%	5.8%	3.2%	3.6%	4.1%	5.6%	5.2%	3.2%	2.3%	3.6%	3.7%
Total	3.4%	4.0%	4.2%	2.7%	2.4%	2.6%	3.7%	3.4%	2.7%	2.2%	3.7%	3.0%

Table B.48: Absolute difference: Total trips by sector

Absolute Change All	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands	Yorkshire and The Humber	Total
East Midlands	1,450	1,160	291	80	499	81	689	128	119	495	1,077	6,070
East of England	1,113	-	-	53	192	44	-	43	219	357	302	2,322
London	317	-	-	57	110	33	-	71	287	406	194	1,476
North East	75	46	51	55	265	287	63	30	21	15	544	1,452
North West	507	200	119	287	1,835	263	200	137	429	476	1,426	5,879
Scotland	72	38	35	268	228	3,607	46	36	33	49	184	4,595
South East	736	-	-	57	200	48	-	136	149	732	363	2,421
South West	119	43	69	18	179	43	119	394	746	793	84	2,608
Wales	123	171	288	26	372	36	145	748	929	313	112	3,264
West Midlands	507	340	415	20	454	69	720	702	309	346	183	4,065
Yorkshire and The Humber	1,103	301	192	588	1,372	241	384	122	115	192	3,677	8,288
Total	6,121	2,300	1,461	1,508	5,707	4,752	2,366	2,548	3,355	4,175	8,146	42,441

High Speed Two (HS2) Limited,
Two Snowhill
Snow Hill Queensway
Birmingham B4 6GA

www.gov.uk/hs2