Model Development and Baseline Report

HS2 London - West Midlands

Report for HS2 Ltd

MVA Consultancy, In Association With Mott MacDonald and Atkins

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Primary Author:	Julian Howes and others
Other Author(s):	Dan Fox, John Segal
Reviewer(s):	John Segal, Steve Lowe, Frank Shorter
Formatted by:	CM

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Appendices

1 Introduction

1.1 Background

1.1.1 In 2009, Atkins was appointed to develop a demand forecasting framework for High Speed Two Limited (HS2 Ltd.) to model and appraise options for a high speed rail link between London and the West Midlands. Outputs from that study were published in March 2010 along with a suite of technical documents describing the modelling approach[1]. During 2010 the modelling framework was updated and the outputs of this was used to deliver the analysis behind the February 2011 Consultation[2]. Documentation describing model development was published as the Model Development and Baseline Report in April 2011[3].

1.1.2 Since then, further analysis and model development work has been undertaken to help inform the Secretary of State's decision in January 2012 on whether to take HS2 forward. The main purpose of this report is to describe all of the changes to the demand modelling framework implemented since February 2011 and to present the validation of the new model. Forecasts and outputs from this updated model are provided in a separately published "Demand and Appraisal Report".

1.1.3 Atkins have also been assisting in updating the work alongside MVA and Mott MacDonald and this report jointly describes all of this work.

1.1.4 This programme of additional work has been undertaken to improve the robustness of the modelling and appraisal, and update assumptions underlying the forecasts to reflect political and economic changes. This additional work has focussed on improving and updating the modelling framework in a number of areas:

- Bringing the base demand and fares data up to date
- Changes to economic forecasts and their impact on the demand for travel
- Updating fares and transport cost assumptions
- Changes to transport supply assumptions
- Updating the representation of the HS2 scheme to reflect the latest design.

1.1.5 The overall demand modelling approach remains essentially the same throughout these updates, and is briefly summarised in Section 1.2 of this document. Section 1.3 summarises all of the updates to the modelling and appraisal approach that have been implemented since March 2010, and where these updates have been documented.

1 http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/hs2ltd/demandandappraisal/

2 http://webarchive.nationalarchives.gov.uk/20110720163056/http://highspeedrail.dft.gov.uk/library/documents/economic-case

3 http://www.hs2.org.uk/economicdocs

1.2 The HS2 Modelling Framework

1.2.1 HS2 proposals have been assessed using a modelling framework known as the PLANET Long Distance Framework. The PLANET Long Distance Framework was specifically developed to assess high speed rail options across the UK, including the location of stations. A brief overview of the model is presented below. Full details of the model are included in Atkins *Model Development Report: A Report for HS2*, published in February 2010.

1.2.2 The PLANET framework consists of three PLANET passenger demand models together with a Heathrow airport demand model integrated into a single framework. These models are:

- PLANET Long Distance (PLD)
- PLANET Midlands (PM)
- PLANET South (PS)
- Heathrow Airport Access Demand Model (ADM)

1.2.3 In the integrated framework the interaction between long distance and local demand is represented.

1.2.4 The framework takes into account a wide range of impacts on travel behaviour such as journey time, train service frequency, interchange (both between modes and within modes), crowding, and station access/egress times.

PLANET Long Distance (PLD)

1.2.5 PLANET Long Distance (PLD) is derived from the PLANET Strategic model. It is a multi-modal model with rail, highway and GB internal air[4] represented. It is an all day model.

1.2.6 A station choice model (SCM) has been incorporated into this model to assess how passengers access long distance rail services in Greater London and the West Midlands. Access/egress information for the SCM is taken from local transport models in London and Birmingham; Railplan (RP – developed and owned by Transport for London) and PRISM (owned by seven West Midlands Metropolitan Districts, Highways Agency and Mott MacDonald) respectively.

PLANET South (PS)

1.2.7 PLANET South (PS) is a tool for modelling local movements on the London and South East rail network.

1.2.8 It is a morning peak rail-only model, and includes all local services in the south of England, as well as the strategic services from other areas into London. Demand matrices for PS are adjusted to remove any demand from zones external to a cordon depicting travel within a South East, South Central and South Western cordon. To represent passengers on strategic services in PS model runs, demand is loaded onto the network at cordon points, to ensure that crowding levels are correctly represented.

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[4] GB Internal Air Demand refers to trips made by air where the ultimate starting and finishing location are both within Great Britain (i.e. not including Northern Ireland).

PLANET Midlands (PM)

1.2.9 PLANET Midlands (PM) is similar to PLANET South, but covers a much smaller area, as the cordon used for this exercise is much tighter, only covering services that are local to Birmingham and the West Midlands county (i.e. reaching out as far as Wolverhampton and Coventry). Again it is a morning peak rail-only model, with strategic demand passed from PLD in the form of link based pre-loads to ensure that crowding levels are correctly represented.

Heathrow Airport Access Demand Model (ADM)

1.2.10 The Heathrow Airport Access Demand Model (ADM) forecasts travel to/from Heathrow so as to catch flights to international destinations. It includes both air and surface access to Heathrow for this purpose.

1.3 Summary of Model Changes since March 2010

1.3.1 Table 1.1 summarises the changes that have been made to the model and appraisal framework and where they have been documented.

Table 1.1 HS2 Modelling and Appraisal Framework Documentation since March 2010

	Report Author and Title	Changes implemented and documented
Published March 2010	**WS Atkins** *Model Development Report- A Report for HS2 (March 2010)* *Baseline Forecasting Report - A Report for HS2 (March 2010)* *HS2 Model Framework Validation Report - A Report for HS2 (March 2010)*	Original Documentation to the PLANET Long Distance Framework published in March 2010
The following documents detail changes since March 2010		
Published April 2011	**WS Atkins** *Modelling and Appraisal Updates*	Inclusion of business non-car available rail benefits[5] Revision of weightings of generalised journey cost components

[5] Though discussed in the Atkins Report, these changes were implemented for the model runs to support the March 2010 Report.

Report Author and Title	Changes implemented and documented
and their impact on the HS2 Business Case - A Report for HS2 (March 2010) *PLANET Long Distance Framework Approach to Station Choice Modelling*	Revision of interaction between PLD and PS SCM changes: - address incomplete capture of local leg benefits - application of behavioural weighting to London local leg benefits - remove double weighting of local leg time transferred to PLD - apply local leg times and station shares on a production/attraction basis rather than OD - revised London local leg costs for London/W. Midlands movements - disaggregate London local leg benefits for economic appraisal - add W. Midland local leg costs to non-London movements Updates to ADM
MVA-Mott MacDonald *Model Development and Baseline Report (April 2011) –* includes some further work undertaken by Atkins not documented in above report)	Updates to future year demand matrices to take account of: - revised short-medium term economic growth forecasts (OBR Autumn 2010) - impact of Coalition government's policy on regulated rail fares (RPI+3% for three years) - the use of DfT's unconstrained air demand forecast rather than constrained for GB internal air demand - revised forecasts for Heathrow throughput for the ADM Further changes to the SCM: - calibration of the parameter controlling users' sensitivity to generalised cost - adjustments to access times to reflect the relative ease of interchange at Old Oak Common compared to Euston Changes to highway costs Changes to behavioural values of time Corrections to coding of certain rail services on the West Coast Main Line (WCML) Addressing convergence problems through changes to the Do Minimum scenario

	Report Author and Title	Changes implemented and documented
	HS2 Ltd *A summary of changes to the HS2 Economic Case (April 2011)*	Changes to capital costs Changes to operating costs Changes to treatment of indirect tax Impacts of connection to HS1 Corrections to discounting
Published April 2012	**MVA-Mott MacDonald-Atkins** *Model Development and Baseline Report (April 2012)* – This report describes changes made since April 2011	Updates to base demand matrices to most recent available year for each mode Update to rail fares matrices to most recent available year Updates to base year networks and train services Update to GDP forecasts Updated Do Minimum forecasts for each mode Updates to Do Minimum networks and train services Corrections to certain network coding, in particular connections to Birmingham HS2 stations Changes to appraisal methodology, including rebasing to 2011 and Wider Impacts

1.4 Structure of Report

1.4.1 The remainder of this report is structured as follows:

- Chapter 2 explains the update to the base rail matrices of demand and fares to bring them to the latest available year
- Chapter 3 explains the subsequent growth expected in rail demand and fares
- Chapter 4 describes the revised base year and forecast growth in highway demand
- Chapter 5 describes the revised base year and forecast growth in air demand
- Chapter 6 describes a number of model updates to reflect changes in assumption or corrections to transport supply and costs
- Chapter 7 describes changes to the appraisal process
- Chapter 8 provides an updated validation of the base year model and discusses model convergence.

1.4.2 The following appendices are provided:

- Appendix 1 – Details of rail growth from 2007 to 2010
- Appendix 2 – Airport Demand Model
- Appendix 3 – Future rail services
- Appendix 4 – Future air services

- Appendix 5 – Future highway schemes
- Appendix 6 – Model Validation.

2 Base Rail Demand and Fares

2.1 Background

2.1.1 This Chapter details the updating of the base year rail demand and fare (average yield) matrices from 2007/08 to 2010/11[6]. Firstly it provides some general background on how the PLANET Long Distance Framework uses base year data and why it is important to the accuracy of the forecast results. Sections then go on to explain the updates to rail base year demand matrices to a 2010 base year, as well as an associated update to the rail fares information in 2010 – which was developed consistently as part of this process. Other updates to the base year representation of travel costs are described in Chapter 6 of this report.

2.1.2 The PLANET Long Distance Framework uses an incremental modelling approach. Essentially, this involves developing a representation of current ("base year") patterns of passenger travel ("demand") and current costs[7] and journey times by different modes, then using a mixture of forecasting techniques to understand what demand and costs will be in future years on the basis of an agreed view of committed schemes ("future year Do Minimum"). This Do Minimum view of the demand and costs for travel then forms the basis from which forecasts of the demand impacts and time savings of high speed rail schemes are then estimated.

2.1.3 For all modes in the three constituent PLANET models, the future year Do Minimum demand forecasts are based on factoring the base year demand matrices. Hence, the accuracy of base year forecasts is an essential element in ensuring the forecasting robustness of the constituent models in future years.

2.1.4 Results presented in both HS2 Ltd's initial report to Government published in March 2010 and the Economic Case Consultation Document published in February 2011 were constructed using a 2007 base year. Although the same base year was used in both of these publications, future year Do Minimum forecasts changed as views on likely economic growth and other socio-demographic factors were updated to reflect the latest information, with a corresponding impact on associated travel demand forecasts.

2.1.5 The process of updating the model base year requires availability of data which can accurately reflect the demand and costs at a snapshot in time. For rail demand and costs, these data are relatively straightforward, as a large amount of data on travel movements are available from the LENNON ticket sales database. This database is maintained on behalf of the train operating companies and is commercially confidential. Combined with survey information on catchment areas for stations, this enables a semi-automated update of base year demand patterns of rail travel.

2.1.6 Updating the base year rail demand was particularly important due to the improvements to the WCML implemented in December 2008 which were not accurately captured in the demand forecasts made from the previous base year rail demand matrices. There have been other areas of strong rail growth as well.

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6 Throughout this document, model years are fiscal years and from this point on are referred to by the year in which they commence.

7 Costs consist of fares (which are based on average yield) for rail and air, and operating costs for car.

2.1.7 This section describes the development of new 2010 base year matrices for each of the rail elements in turn (PLD, PS and PM). The raw data sources used were consistent between the three models, although the different models required slightly different approaches to development of rail demand matrices for each of them.

2.1.8 More technical detail is given in Appendix 1 of this report; however an overview of the impact of the changes in base year for each of the models is given below.

Updating PLANET Long Distance (PLD)

2.1.9 The PLD model is the most important of any of the constituent models in terms of its impact on the HS2 business case, and requires the disaggregation of base year rail demand and average fare yield by journey purpose and car availability. The demand and fare matrices are developed using station-to-station volumes and revenues derived from a download of annual, operator-unallocated LENNON ticket sales journey information for the financial year 2010/11.

2.1.10 These data were then disaggregated by car availability and distributed from origin / destination station to origin / destination zone using the same process and National Rail Travel Survey (NRTS) data used to develop the 2007/08 matrices. Although the NRTS data was collected during 2004-06, no similar national data collection exercise has been undertaken since and it therefore remains the best source of evidence on the ultimate origin and destination of rail passengers.

2.1.11 However, there have been significant changes to the balance in journeys by ticket type, in particular a significant increase in the proportion of use of single advance purchase tickets through "single leg ticket pricing". Furthermore, all journey purposes, but particularly business travellers, have down-traded from First to Standard and from Anytime to Advance during the recession. It would therefore not be appropriate to use the same factors to convert ticket type to journey purpose in 2010 as were used in 2007. It was therefore decided to adjust the journey purpose splits to be identical (on a journey-pair basis) to those in the 2007 base year matrices: no empirical data were available to suggest that journey purpose had shifted significantly in either direction between 2007 and 2010.

Change between 2007 and 2010 PLD matrices

2.1.12 Overall the number of trips in the PLD matrices increased by 4% between 2007 and 2010. However, the PLD matrix includes all inter-zonal trips outside the South East and all intra-zonal trips (also outside the South East) that are greater than 50 miles. This means that it includes a large number of short distance trips that are not of interest to HS2. These short distance trips have grown at a much slower rate than the long distance trips. 60% of trips are less than 25 miles and these have not grown at all. Trips greater than 25 miles have grown by 11% over the three year period. This compares with the 13.5% growth in trips on long distance operators that is reported in National Rail Trends.

2.1.13 However, the growth rates between different parts of the country, and across different routes vary significantly. As would be expected, the largest growth rates are seen in regions benefiting from the improved December 2008 "Very High Frequency" (VHF) timetable for long-distance rail services on the WCML, where newly generated trips and abstraction from air have led to growth in rail demand of up to 50% on some flows between 2007 and 2010.

2.1.14 Figure 2.1 presents the PLD demand changes for rail travel between 2007 and 2010; these are shown between (and within) Government Office Regions and nations. Note that figures for travel between London, South East, South West and East of England zones[8] are generally represented in the PLANET South model, which is described later in this section.

Figure 2.1 Change in PLD rail trips between 2007/08 and 2010/11

	East Midlands	East of England	London	North East	North West	Scotland	South East	South West	Wales	West Midlands
East Midlands										
East of England	-11%									
London	3%									
North East	-10%	-1%	9%							
North West	11%	0%	45%	18%						
Scotland	20%	24%	48%	11%	47%					
South East	12%			1%	22%	30%				
South West	3%			-1%	10%	35%				
Wales	9%	11%	25%	-6%	-2%	22%	18%	26%		
West Midlands	18%	18%	37%	-9%	26%	59%	18%	7%	7%	
Yorks & Humber	18%	-8%	8%	4%	13%	-6%	-8%	1%	-2%	-7%

2.1.15 More detail of rail growth is provided in Appendix 1.

Updating PLANET South (PS)

2.1.16 The PS model covers most movements wholly within the London, South East, South West and East of England regions, where the majority of travel demand is for commuting trips. The model is within the framework model to understand the impacts of HS2 released capacity on the WCML, MML and ECML routes, with associated crowding benefits on both long-distance and improved shorter-distance commuter services.

2.1.17 Demand is only represented for the morning weekday peak period, defined by services arriving or leaving Central London between 07:00-09:59, and is dominated by combined rail and LUL journeys into Central London. As most ticket usage is on Travelcard tickets, ticket sales information alone does not give sufficient information on true journey origins and destinations.

2.1.18 The model also relies on the London Area Travel Survey (LATS), a comprehensive origin / destination and journey purpose survey of rail journeys in South East England undertaken between 2001 and 2003. This survey has not been subsequently repeated, and previous rebasing of the model in 2009 utilised other indirect information sources, including estimates of change in combined LUL / rail destination arrivals in Transport for London (TfL)'s RailPlan / LTS models.

8 Note that, although the majority of the East of England, South East and South West regions are in PLANET South, a limited number of areas from those regions are covered in PLD, to reflect current rail demand and service patterns more effectively.

2.1.19 Therefore, only limited information was available to update PS further to represent a 2010/11 base year. In particular, we were unable to obtain any robust information on changes in destination patterns for rail journeys terminating in Greater London. As a result, an aggregate approach to updating the base year model was used, to preserve consistency with previous modelling and maximise the confidence in new data provided:

- For flows entirely within Greater London, where neither patterns nor volume of demand can be reliably determined from ticket sales data, a uniform uplift of 11.5% was applied, on the advice of TfL's RailPlan team, based on the growth in London-wide rail travel. This means that origin and destination patterns within Greater London are assumed to have remained unchanged. Applying this uniform uplift is unlikely to have any significant impact on the HS2 business case.
- For flows entirely outside Greater London, and between areas outside Greater London and areas within Greater London, LENNON ticket sales data from 2007/08 and 2010/11 were compared to establish the level of change in origin station ticket sales, disaggregated by ticket type (season ticket, reduced ticket, Travelcard etc). These data were then used to estimate uplift factors for the existing 2007/08 demand data on a station-to-station basis, which were then applied to PS demand zones using a GIS correspondence.

Updating PLANET Midlands (PM)

2.1.20 The PLANET Midlands (PM) model is used to model the effect of HS2 on the morning weekday peak journeys on Birmingham's local rail network. Such travel is dominated by journeys on multimodal rail/bus season tickets, specifically the 'n-network' product range, administered by Centro, the West Midlands Integrated Transport Authority.

2.1.21 Initial analysis of ticket sales data captured in the (post-allocation) LENNON data base suggested that peak journeys originating at many stations in the Birmingham area had declined between 2007 and 2010. However this was contradicted by independent count data which showed peak demand had grown over the same period. The reduction suggested in the LENNON data is likely to be due to a rise in the share of n-network Travelcard sales occurring at non-station outlets, including newsagents and the 'Network West Midlands' website, and hence not included in the LENNON database. This emphasises the difficulty in developing demand matrices from incomplete data sources.

2.1.22 To avoid introducing inaccuracies to the PM matrices from this change in sales channels, it was decided to estimate 2007 to 2010 growth factors based on growth in all ticket sales at each station, after excluding Travelcards for reasons described above.

2.2 PLANET Long Distance Rail fares matrices

2.2.1 As described previously, updated fares matrices were also required for the rebasing of the PLD model part of the framework. PLD includes average rail fare paid as part of its calculation of the overall generalised cost of travel – to enable comparison with other modes. For the sake of clarity, the fares matrices represent the average yield per journey, reflected as zone-to-zone revenue totals divided by zone-to-zone journey totals, split by journey purpose. The multitude of fares available – including advance purchase, season and off-peak tickets – means that this is usually well below the notional "full fare" ticket price and above the lowest marketed advance fares.

2.2.2 The 2007 fares matrices were produced by an alternative technique, using data within the "EDGE[9]" forecasting tool, manually allocated to PLD zones. The opportunity was taken during the update to 2010 base year to improve the representation, by processing LENNON revenue data on a consistent basis to the journey data.

2.2.3 While this process works well for larger flows, there is a risk that flows with low demand in 2010/11 are assigned their fares based on an unrepresentatively small sample of journeys, skewing average figures. To avoid this, average fares per kilometre by journey purpose were calculated, measured on inter-regional flows only (as higher yields on shorter, mainly intra-regional flows, due to the 'taper' effect, and absence of advance purchase products would be expected). The median was used as the measure of the average to minimise the effect of extreme observations.

2.2.4 Where for any given inter-regional zone-zone flow, the actual yield per kilometre was significantly outside this range, the LENNON data were replaced by a "synthetic" fare which used a median per kilometre fare rate from all other movements. This approach was also applied for very small flows.

2.2.5 Although fares can differ somewhat depending on the direction of travel between two zones, reflecting the reality that TOCs are able to discount their advance purchase tickets more heavily in one direction, it is not possible in the LENNON data (that are used to calculate demand and fare) to be sure which direction is being travelled. Hence demand and revenue matrices were made symmetric and thus also the average yield.

2.2.6 Table 2.1 shows the impact of the update process on the largest revenue flows in PLD, reinforcing the conclusions from the region-to-region analysis. These fares were cross-validated against MOIRA data, which cannot be shown for reasons of commercial confidentiality.

Table 2.1 Top revenue flows between PLD zones: fares across all journey purposes

From Zone	To Zone	Yield 2007/08	Yield 2007 at average 2010/11 prices	Yield 2010/11	Change %
London Central	Manchester	£38.62	£42.40	£42.03	-0.9%
Manchester	London Central	£38.92	£42.73	£41.87	-2.0%
London Central	Leeds	£41.01	£45.03	£45.73	1.6%
London Central	Birmingham	£26.86	£29.49	£26.24	-11.0%
Birmingham	London Central	£23.42	£25.72	£26.46	2.9%
Leeds	London Central	£43.54	£47.81	£52.16	9.1%
Newcastle	London Central	£46.04	£50.55	£55.47	9.7%
City of Edinburgh	London Central	£39.21	£43.05	£49.26	14.4%
London Central	Newcastle	£41.42	£45.49	£51.43	13.1%
London Central	City of Edinburgh	£37.51	£41.19	£52.30	27.0%

9 Exogenous Demand Growth Estimation. 'Exogenous' is synonymous with 'beyond rail industry control'. However, fares' effects are also included.

2.2.7 It can be seen that there is no simple pattern of fares changes, in part because of the different process used to extract fares (with the current process being more appropriate). However, is does appear that fares in real terms on West Coast routes have typically become lower, whereas on East Cast routes they have generally increased.

3 Growth in Rail Demand and Fares

3.1 Introduction

3.1.1 This Chapter describes how the forecast growth in the demand for rail travel in the markets relevant to HS2 has changed since the February 2011 Consultation. It reflects both the change in the base year from 2007 to 2010 and revised exogenous inputs, notably GDP.

3.1.2 There have been a number of revisions to these demand forecasts over the course of HS2's work, primarily to account for changes in forecast economic growth as the long term effects of the recent downturn have become apparent, but also to take into account recent changes in government policy regarding regulated rail fares.

3.1.3 Each of the PLANET models forecasts future travel behaviour by assigning input matrices of trips between different places to the transport network. In PLD, separate 2010 input matrices are provided for each mode (rail, air, road - mainly car) and journey purpose. PM and PS each have a set of rail only matrices disaggregated by journey purpose.

3.1.4 Future year matrices are calculated by applying growth factors to the base year (2010) matrices – different factors can be applied to different cells to represent differences in growth between different geographical markets and journey purposes.

3.1.5 Growth factors are calculated independently for each mode, using standard DfT forecasting models, with the underlying assumptions for each mode being broadly consistent. However, because each mode is treated separately, the rail demand forecasts do not, for example, take account of changes in air or car demand, although they do take account (at least in a simple way) of trends in car costs. Similarly the air forecasts (Chapter 5) do not take account of any changes in rail or car costs or times, nor do the car forecasts (Chapter 4) take any explicit account of the effect of rail journey times, or highway congestion or fuel costs.

3.1.6 Furthermore, the growth factors do not take account of changes in the supply side. For example, growth in rail demand neither reflects improvements to services nor increased crowding.

3.1.7 The forecasts continue up to a 'cap year', after which there is no further growth in any mode, nor any assumed change to other factors such as rail fares; however, for appraisal purposes the value of time is assumed to increase in real terms over the 60 year appraisal period in line with forecast GDP per capita growth. Rather than assuming that demand grows indefinitely, applying the cap year is a proxy for the assumption that demand will eventually saturate. The derivation of the cap year is discussed further in Section 3.3.

3.1.8 However, while most commentators would accept that demand will eventually saturate, the precise level is inevitably uncertain. There is no evidence as yet for saturation of rail growth, and given both its market share compared to car, and the trip rates by different income groups, a case can be made for saturation occurring at much higher levels of demand.

3.1.9 Matrices are calculated for two future years (referred to as 'modelled years'), the first year being shortly before scheme opening, and the second being the cap year. Demand for the intervening years is calculated by interpolation.

3.1.10 The next section describes how the rail growth forecasts have been revised since the April 2011 report in response to updates to economic forecasts. This is followed by a discussion of the cap year (Section 3.3), then the resulting demand forecasts (section 3.4), and finally a section (3.5) on how future fares are expected to move.

3.2 Derivation of Rail Forecasts

3.2.1 All forecasts of exogenous rail demand growth used in the HS2 London - West Midlands business case are based on outputs from the DfT's EDGE model.

3.2.2 EDGE applies rail demand elasticities[10] from the Passenger Demand Forecasting Handbook (PDFH) to a range of different 'drivers' of demand, including:

- changes in income (measured through growth in GDP per capita)[11]
- population growth
- car ownership
- fares.

3.2.3 In keeping with WebTAG guidance (unit 3.15.4, April 2009), the exogenous (socio-economic and cross-modal) elasticities are drawn from PDFH v4.1, with fares elasticities from PDFH v4.0. The elasticity to GDP in PDFH v4.1 is a function of distance. For longer flows this can lead to implausibly high elasticities, for example 3.7 for London to Aberdeen. In line with DfT practice, the elasticity is capped at a value of 2.8, corresponding to 250 miles.

3.2.4 EDGE produces demand factors for (a) First plus Standard full-fares, (b) discounted (i.e. 'Reduced') products and (c) Season tickets that, after transformation to journey purpose (business, leisure, and commute), are applied as uplifts to the 2010/11 base matrices in PLANET Long Distance (PLD), PLANET South (PS) and PLANET Midlands (PM).

3.2.5 For the forecasts used in the February 2011 Economic Case, demand was assumed to grow up to a cap year of 2043. Since that report two key changes have been made to the modelling framework:

- revised forecasts of economic growth from the Office for Budget Responsibility (OBR) provided by the DfT
- updating of the model base from 2007/8 to 2010/11, thus, capturing actual growth in rail demand between those three years.

Demand Drivers

3.2.6 EDGE requires fourteen input demand drivers as part of the forecasting calculations. Table 3.1 below outlines the sources and methodology of each driver.

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10 Elasticities measure the sensitivity of rail demand to a one per cent change in a given demand driver. For example, a GDP per capita elasticity of 2.0 indicates that when per capita incomes increase by 1%, rail demand increases by 2%.

11 Note that for Commute trips, employment is used as the driver rather than GDP per capita.

Table 3.1 EDGE Demand Drivers and Origin

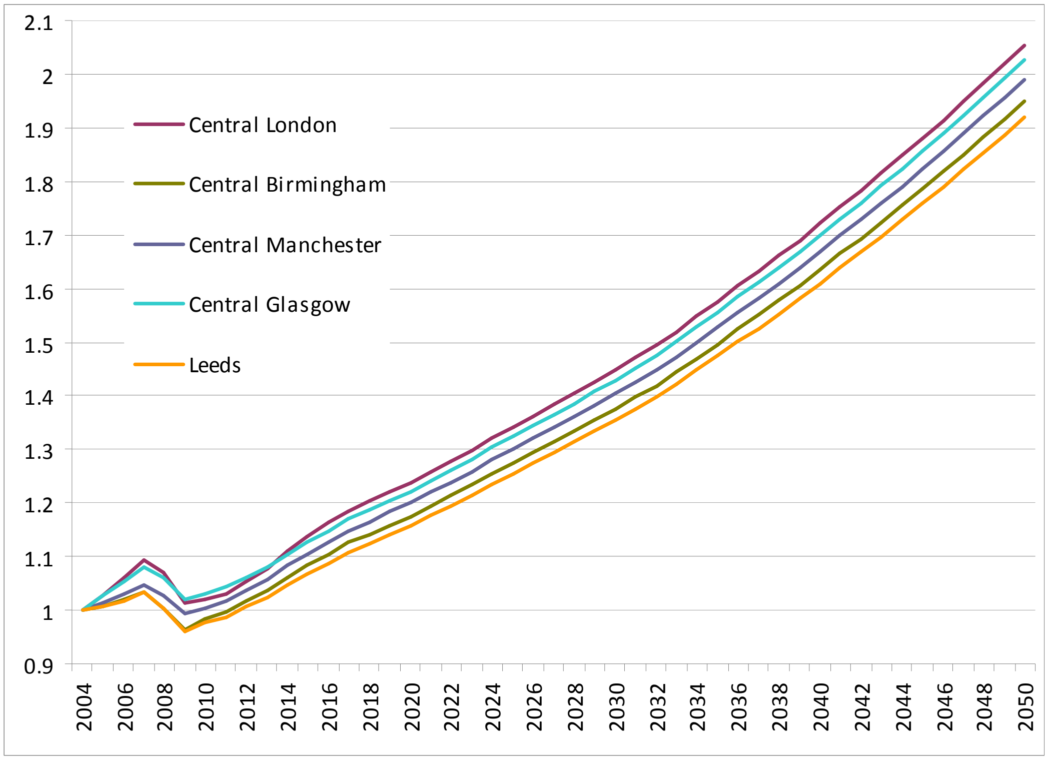
Demand Driver	Origin	Methodology / assumptions	Changes from HS2 consultation model
GDP per Capita	DfT Rail Analysis (RA) division	Based on Office for Budget Responsibility (OBR) forecasts of national GDP (July 2011), with medium term regional adjustments from Oxford Economics	Simplified approach to spatial disparities using regional rather than sub-regional spatial granularity
Population	DfT RA division	Oxford Economics (March 2011 forecast), with long term forecasts taken from ONS	
Employment	DfT RA division	Compatible with OBR forecasts July 2011	
Rail fares	DfT RA division	Fares rise in line with RPI plus a premium of 1% or 3% until the cap year	RPI+3 assumed in 2012-2014 inclusive. (Constant RPI+1% at consultation)
Car Availability	DfT RA division	NTEM v6.2	
Car Fuel Cost	DECC Oil Price Projections	DfT calculations	
Car Journey time	DfT Transport Appraisal and Strategic Modelling (TASM) division	National Transport Model (NTM)	
Air Passengers	Air Passenger Demand & CO2 forecasts report released by DfT in January 2009. The report provided growth values for UK airports up to 2030.	Air passenger growth rates for the specific airport flows were extracted from the data provided. The growth rates were smoothed by taking a three year average	

Demand Driver	Origin	Methodology / assumptions	Changes from HS2 consultation model
Air Headway		Air headway was updated using flight frequency between domestic airports. Rest of Country (ROC) to London Travelcard (LT) area, LT area to ROC and non-London inter-urban flows. Flights leaving an airport to a destination were assigned to a specific flow and summed and used to give airport frequency per flow. The frequencies for all airports are summed and divide the average operating time (16 hours) to give a headway value for domestic airports for a given flow. The data provided were in five year intervals up to 2030. The headway values were interpolated to give year on year values. Percentage change were calculated and applied to RIFF.	
Air Cost		Values for forecast domestic air fare was also provided. The year on year percentage was calculated and applied to the ROC to LT area, LT area to ROC and non-London inter-urban flows.	
Bus Time	DfT Local Economics		
Bus Headway	DfT Local Economics		
Bus Cost	DfT Local Economics		
London Underground Fares		At the advice of TfL London Underground fares are assumed to increase by 2% each year until 2017 and 0% thereafter.	

Demand Driver Trends

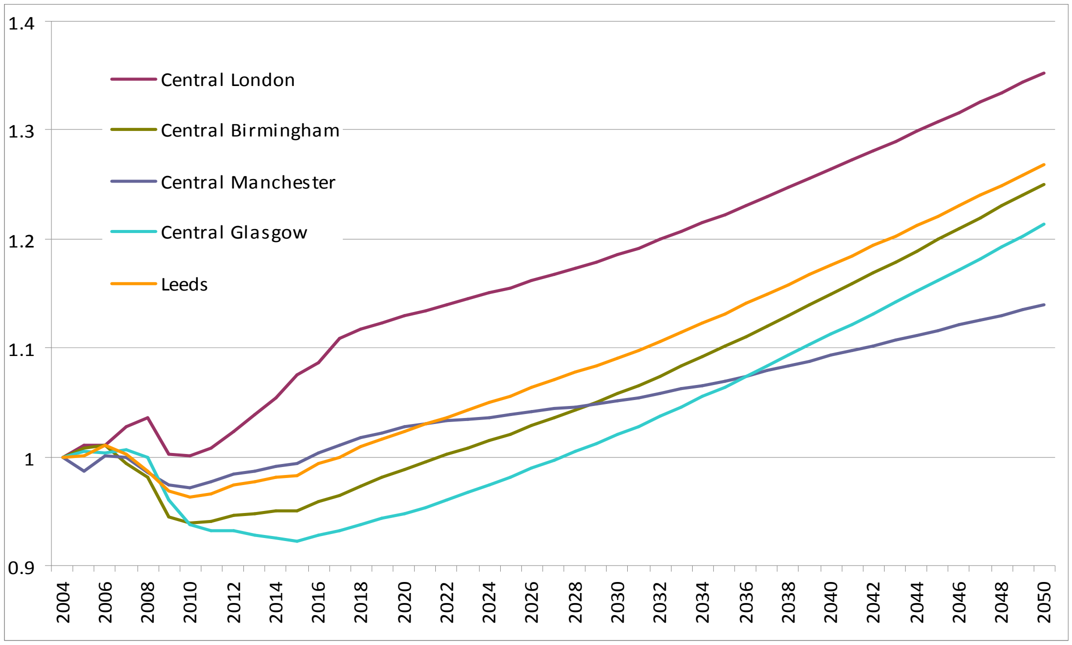
3.2.7 For long distance rail trips GDP per capita is the most influential driver of demand; the PDFH guidance attaches high elasticities of demand to GDP per capita and it also grows more rapidly than population. Figure 3.1 shows the growth in GVA per capita between 2004 and 2050 for some of the economic centres that might be served by a wider HS2 scheme. GDP per capita is forecast to grow at a similar rate nationally with the rate fastest in Central London.

Figure 3.1 GVA per Capita growth (DfT calculations, September 2011, based on OBR and ONS forecasts), index 2004 = 1.0



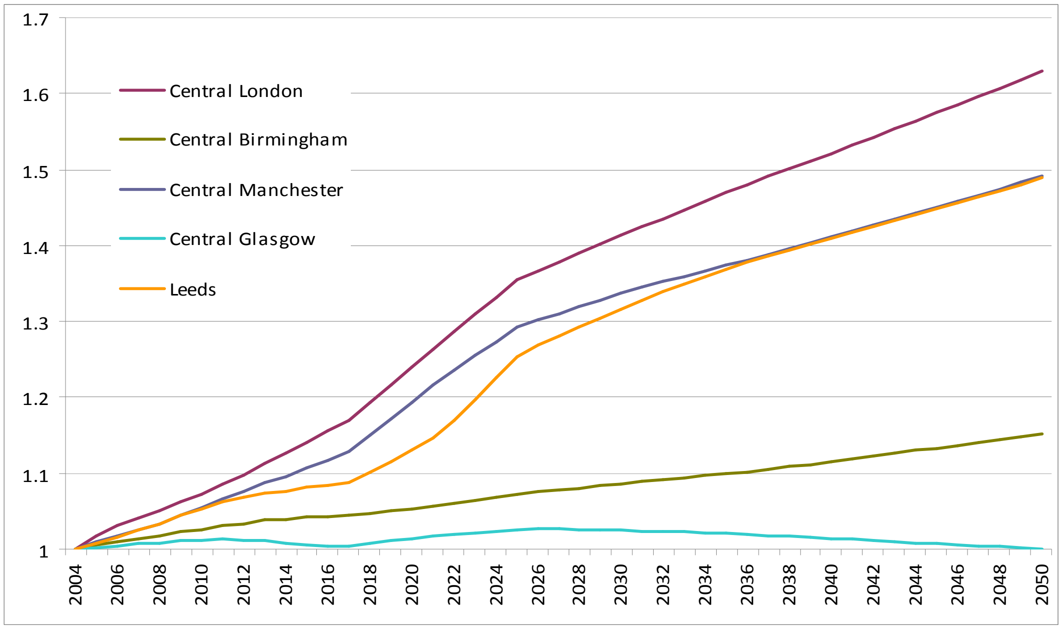
3.2.8 Employment growth is much more varied, with strong growth in London apparent from Figure 3.2 below. Employment rather than GDP per capita is the driver in PDFH that affects growth in commuting.

Figure 3.2 Employment growth (DfT forecasts based on OBR and TEMPRO forecasts September 2011), index 2004 = 1.0



3.2.9 Population growth also varies, with virtually static growth in Glasgow compared with exceptionally high growth in London, Manchester and Leeds between 2018 and 2026 and this can be seen in Figure 3.3 below. To avoid double counting with employment, population only affects business and leisure travel, not commuting. PDFH recommends that relative population growth (e.g. growth in the proportion of L&SE population in a particular area) should be taken into account, but this is not implemented in the DfT EDGE model, so was not addressed in the HS2 forecasts.

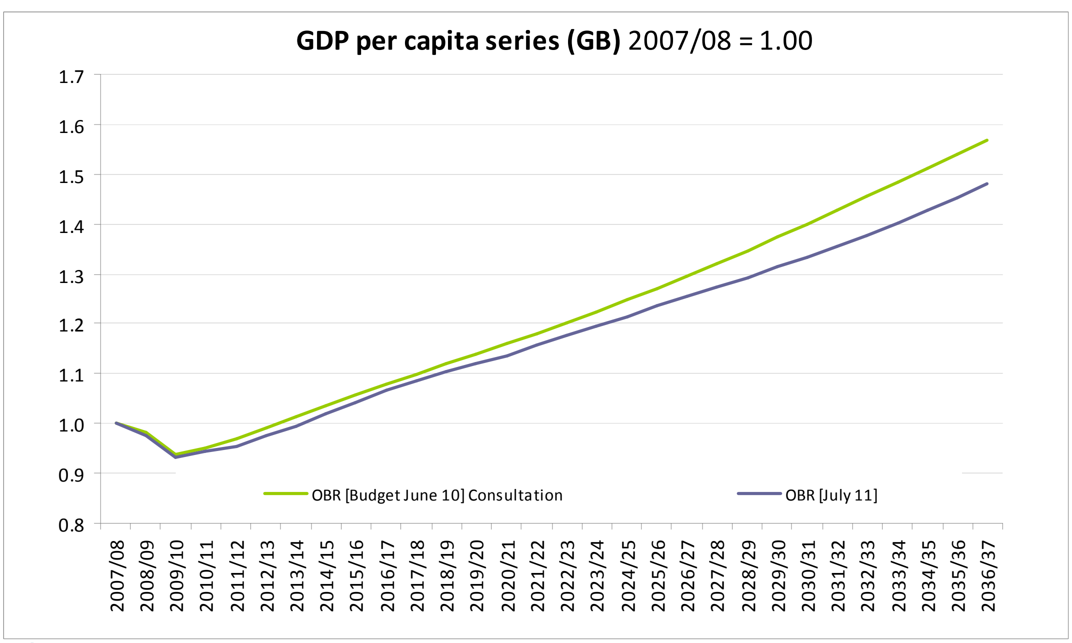
Figure 3.3 Population growth (DfT calculations based on ONS forecasts September 2011), index 2004 = 1.0



3.2.10 To understand the differences between the demand drivers in the consultation work with those being used in the update work the figures below compare the three sets of data after indexing to a 2007/08 base.

3.2.11 Figure 3.4 compares the current GB wide GDP per capita growth assumptions, based on July 2011 Office for Budget Responsibility (OBR) forecasts, with those from the consultation work, based on June OBR 2010 forecasts. This indicates a lower level of GDP per capita growth to the 2037 cap year than previously forecast.

Figure 3.4 Comparison of GDP per capita growth (Consultation v January 2012 Economic Case)

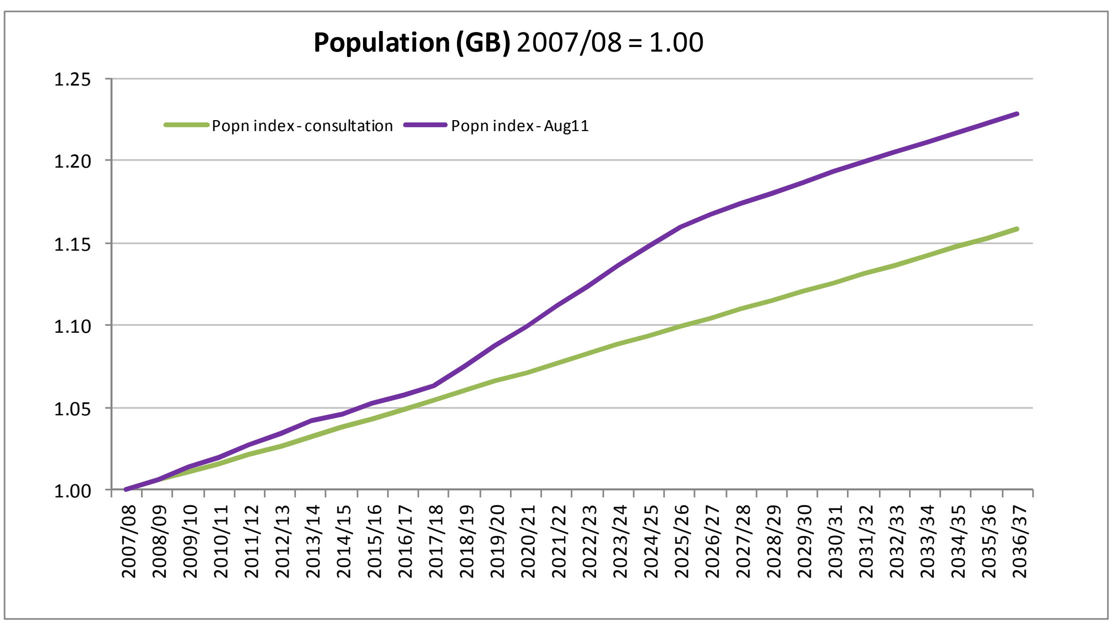


3.2.12 Figure 3.5 compares the current GB wide employment growth assumptions (based on figures from August 2011) with those from the consultation work. This shows a smaller reduction in employment through to 2014 and then larger growth through to the 2037 cap year used in the current forecasts.

Figure 3.5 Comparison of Employment Growth (Consultaton v January 2012 Economic Case)

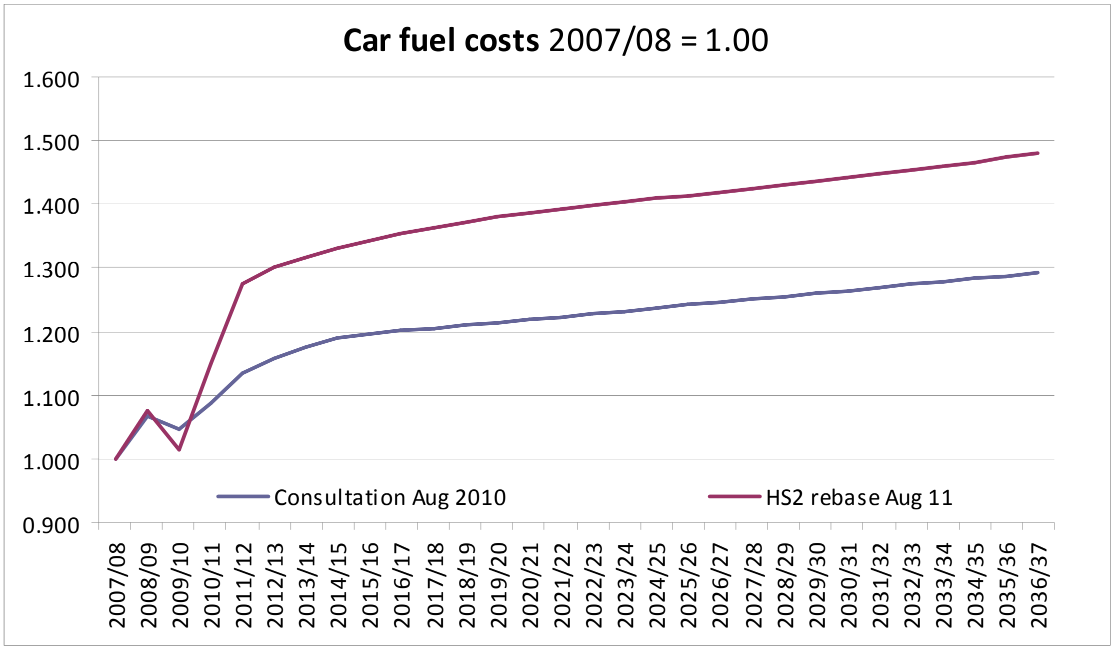
3.2.13 Figure 3.6 below compares the current GB wide population growth assumptions with those from the consultation indexed to a 2007 base. These show much a greater increase in population from 2017 onwards through to the 2037 cap year.

Figure 3.6 Comparison of Population Growth (Consultaton v January 2012 Economic Case)



3.2.14 Figure 3.7 below compares the fuel cost growth assumptions with those from the consultation indexed to a 2007 base. This reflects a much higher increase in fuel costs through to 2011 and then similar levels of growth onwards.

Figure 3.7 Comparison of Car Fuel Cost Growth (Consultaton v January 2012 Economic Case)



3.3 Derivation of Cap Year

3.3.1 It is unlikely that demand for travel will continue to grow forever. In the Consultation forecasts demand was capped in 2043 on the basis that demand in this year on the WCML between Rugby and Coventry was equal to the level forecast in March 2010 in 2036; this represented an approximate doubling of demand on this section of the line.

3.3.2 For the purposes of the current update, focusing on demand on the section between Rugby and Coventry did not seem appropriate, as substantial growth had already occurred on this section due to the WCML Upgrade. It was therefore decided to cap rail demand using all rail trips within the PLD model of greater than 100 miles, as this is the target market for HS2. The number of such trips was calculated for the cap year (2043), and the cap year for the current model was selected to broadly reflect that figure.

3.3.3 Because of the growth in long distance rail demand between 2007 and 2010 of about 11% (see para 2.1.12), which contrasts with the reduction of 9% due to the recession forecast in the Economic Case published in February 2011, the base level of demand is substantially higher than was expected. This means that, despite lower economic growth, the level of demand in any future year is higher than was being forecast in the Consultation work. Hence the cap year is brought earlier.

3.3.4 Using the 2010 base demand, a cap year of 2037 was identified, compared to 2043 used for the consultation forecasts.

3.3.5 While this cap year methodology produces broadly the same level of long distance rail demand in the cap year as in the Consultation model, there is a significantly different distribution of demand. The growth in base year demand has been fastest on the WCML which means that, in the cap year, demand on the WCML will generally be higher than in February 2011, with demand on many other flows being lower to compensate.

3.3.6 As the concept of cap year is essentially something to represent saturation of demand in the long term, there is no 'correct' way it should be calculated. There is currently no evidence that the growth in rail demand is slowing; indeed recent growth during the recession has been stronger than the standard forecasting methods in PDFH would have forecast. Hence, while some long term saturation must be expected, there is uncertainty about when it may happen.

3.3.7 As well as changing the cap year, the intermediate modelled year has been changed from 2021 to 2026. Having an intermediate modelled year representing the opening year of HS2 is analytically more useful than one chosen to be 5 years prior to opening as demand and benefits between 2026 and 2037 are derived by interpolation. By itself however, this change to the intermediate year should not have any significant impact on results.

3.4 Growth in Reference Case PLANET matrices (2010 to 2026 and 2037)

3.4.1 The tables below show the growth in total journeys from 2010 after assignment to the three PLANET models' networks. Table 3.2 summarises certain key rail zone to zone movements in the PLD matrices. Trips are both directions added together.

Table 3.2 PLANET Long Distance: Growth in Total Weekday Trips (without HS2)

Key HS2 zone to zone movements[12]	2010 demand	2026 demand	% Growth 2010 – 2026	2037 demand	% Growth 2010 - 2037
Birmingham - Central London	7,500	11,700	55%	16,000	113%
Manchester - Central London	7,000	12,100	74%	16,700	140%
Leeds - Central London	4,300	7,200	66%	10,300	136%
Glasgow - Central London	1,300	2,100	62%	2,900	125%
Liverpool - Central London	2,900	4,500	55%	6,100	107%
Newcastle - Central London	2,300	3,900	66%	5,500	138%
Edinburgh - Central London	2,200	3,800	68%	5,400	141%

12 These are based on flows between PLD zones which are not necessarily the same as Local Authorities.

3.4.2 Because we have chosen to apply the demand cap at a particular level of demand, the overall growth to 2037 is broadly similar to that seen up to 2033 in the March 2010 report. However, updates to the economic forecasts used since the Consultation report have not only affected the overall level of forecast growth, but also the forecast relative growth rates between different parts of the country.

Growth by TOC: PLANET Long Distance

3.4.3 Table 3.3 shows the growth in Do Minimum case long-distance demand as measured by the change in assigned passenger kilometres by long-distance TOC. These figures exclude local demand modelled in the regional sub-models. These results are consistent with the key flows in Table 3.2 above, noting that overall growth in passenger kilometres will be lower than the growth rates reported in Table 3.2 as the passenger kilometre figures are for all flows and not just those to/from Central London (where growth is highest).

Table 3.3 Weekday Passenger Kilometres by Long Distance Franchise (PLD) (without HS2) '000s

TOC	2010	2026	% growth	2037	% growth
Intercity East Coast, plus Open Access	14,300	22,500	57%	30,300	111%
Greater Western (South Wales and Cotswold Routes only)	4,200	5,600	32%	7,100	67%
East Midlands (Midland Main Line service)	4,500	6,500	43%	8,700	91%
Intercity West Coast	19,000	27,600	45%	36,200	91%
Cross Country	9,400	10,200	8%	12,000	27%
Trans Pennine	4,500	5,800	27%	6,600	45%

3.4.4 It should be noted that:

- East Coast figures include the open-access operators (Hull Trains and Grand Central) that currently operate on the East Coast Main Line, as well as the East Coast franchise
- Great Western figures only include flows modeled in PLD. The majority of flows on GW are modeled in PLANET South, with only flows to South Wales and the Cotswolds modeled in PLD.

3.4.5 CrossCountry and Transpennine growth rates are lower than other long-distance franchises as they do not serve London, where demand growth is forecast to be higher than the rest of the country.

3.5 Future rail fares

3.5.1 From 2010, rail fares (average yield) are assumed to increase up to the cap year.

3.5.2 Although only a minority of long distance fares are regulated, it was decided that the level of regulation was a reasonable proxy for the likely future change in rail fares. In part this was because some other fares are constrained by the level of the regulated fares (Advance fares cannot be higher than the (regulated) off-peak return fare at off-peak times or no-one will buy them); in part because they have broadly moved in a similar way historically, although not during the recent recession.

3.5.3 Accordingly, future rail fares were assumed to increase by RPI+1% in 2011, then three years of RPI+3%, followed by RPI+1% thereafter up to the cap year. After the cap year no change is assumed in rail fares. This is consistent with the assumption that after the cap year, no change is made to any element within the demand modelling. (The only change is the growth in value of time for appraisal purposes).

3.5.4 In making these assumptions, the relatively recent change to regulation to reduce the fares increase for January 2012 to RPI+1% was not taken into account, as this would have involved a late change in the modelling that was not warranted given that the link to regulation is only an indication of what might happen. Furthermore, the continuance of RPI+1% is an assumption, not an indication that it is government policy.

4 Growth in Highway Demand and Costs

4.1 Introduction

4.1.1 This chapter considers highway (car) demand. It covers both the update of the base demand to 2010 and also subsequent growth.

4.1.2 For highway (car), travel information is not collected on such a systematic basis which can enable updates of the base year matrix. Therefore only a partial update can be undertaken, where available data on observed changes in travel demand are used to factor historic data. This provides a more marginal improvement in accuracy where assumed growth can be replaced with observed growth, albeit at a relatively aggregate level depending on the extent of observed data available.

4.2 Base Year Highway Demand Matrices

4.2.1 The base year highway demand matrices for the 2010/11 model were developed from the original 2007/08 PLD model matrices. Some consideration was also given to using the matrices from the DfT's Long Distance Model (LDM) but this approach was discounted as there was no clear evidence that the LDM matrices were more robust than those already in the PLD model.

4.2.2 To rebase the PLD matrices a number of alternative data sources were considered to provide information on highway growth – TEMPRO 6.2's National Trip End Model (NTEM), Highways Agency TRADS (automatic traffic count database) data and traffic trend data from the DfT.

4.2.3 The use of NTEM data was discounted as it is an unconstrained modelled forecast that does not reflect observed data. Overall TEMPRO growth in England between 2007/08 and 2010/11 is 2% which does not reflect recent decreases in highway flows.

4.2.4 A comparison of TRADS datasets between 2007 and 2010 showed there had been a decline in traffic volumes of 3% for motorways and 9% across A roads, producing a 5% reduction in volumes overall. However, this rate is simply an accumulation of all the counts, which is liable to double counting and clearly covers only certain sections of the motorway and A road network and so was not felt to be an appropriate source for the growth factor.

4.2.5 Data from DfT statistics are shown in Table 4.1 below. These show the growth in traffic (billion vehicle miles) within the eleven TEMPRO regions, between 2007 and 2010 on 'all major roads ' which are the links long distance trips are likely to use.

4.2.6 The table shows a consistent reduction in traffic by about 2% which is relatively constant over all regions and sub regions. The growth in the areas more relevant to the HS2 corridor: London and the West Midlands have a reduction of 'traffic' of 3% and 2% respectively. This traffic within a region is estimated from the accumulation of highway links within that region. It would by definition include three elements:

- Within that region (internal-internal);
- With one end in that region (internal-external and external-internal); and
- No ends in the region (external-external) traffic.

4.2.7 To rebase the highway matrices only the first two elements should be included and not the external traffic though information on the proportion of each component is impossible to access. Due to this reason and the fact that the growth is so consistent across regions, a global factor of 0.98 was used to rebase the PLD long distance matrix from 2007/08 to a 2010/11 base.

4.2.8 Clearly this change in 'traffic' contains an element of change in distance travelled, which must be stripped out to arrive at change in 'trips', which should be used to adjust our matrices. However, the DfT state that "overall, the average length of all car trips has remained fairly constant over time." It can thus be inferred that figures in Table 4.1 generally represent the change in trip ends.

Table 4.1 Growth in road traffic 2007-2010 (National Statistics), index 2007 = 1.0

Area	All Major Roads, change compared to 2007
North East	0.98
Tyne and Wear FMC	*0.96*
Rest of North East	*0.97*
North West	0.99
Greater Manchester FMC	*0.98*
Merseyside FMC	*0.99*
Rest of North West	*0.99*
Yorkshire and the Humber	0.97
South Yorkshire FMC	*0.96*
West Yorkshire FMC	*0.96*
Rest of Yorkshire and the Humber	*0.95*
East Midlands	0.98
West Midlands	0.98
West Midlands FMC	*0.98*
Rest of West Midlands	*0.97*
East of England	0.98
London	0.97
South East	0.97
South West	0.99
England	0.98
Scotland	0.98
Great Britain	**0.98**

Source: http://www.dft.gov.uk/statistics/tables/tra0103 (Motor vehicle traffic (vehicle miles) by road class and region and country in Great Britain, annual 2010)

4.3 Future year highway matrices

4.3.1 Road demand is included in the Planet Long Distance (PLD) model in two ways:

- long distance (>30km) road passenger demand (predominantly car) is provided in matrix format in a similar manner to rail and air (note any demand within a single zone is excluded)
- in addition, a pre-load representing shorter distance traffic (<50miles) is added to the Highway network, to enable congestion on the road network to be modelled.

4.3.2 As for rail demand, the growth forecasts for highway do not take into account changes to the highway network, whether improvements as a result of road construction or (more likely in most cases) lengthened travel times due to congestion.

4.3.3 The earlier work carried out in 2010 (as reported in the "HS2 Model Development and Baseline Report", April 2011) forecast growth in the long distance road matrix using the growth in trip ends (where people start and finish journeys) from TEMPRO v5.4[13], and growth in the pre-load flows using the National Transport Model (NTM)[14] 2009 (May 2010 revision) National Road Traffic Forecasts (NRTF) for the years 2021, 2036 and a cap year of 2043. These were grown from a 2008 base year.

4.3.4 The current work carried out to January 2012 used a base year of 2010/11 for the long distance matrices and pre-load flows for 2010. The matrices were created for the years 2025/26 and 2035/36; the latter was used as an approximation for the 2037 cap year, being based on an earlier estimate of the cap year and not subsequently adjusted.

Long Distance Car Matrices

4.3.5 The long distance matrices were grown from the new base year 2011 (which represents 2% lower demand than previously) to forecast years 2026 and 2036 using the latest approved TEMPRO 6.2 dataset. Forecast numbers of highway person trips (car driver plus car passenger) to and from each TEMPRO zone in the base year and future years were extracted from the TEMPRO dataset by origin and destination. The pre-existing lookup table matching PLD zones to TEMPRO zones (developed using GIS by Atkins in the previous study) was used to transfer these to the required zoning system.

4.3.6 The growth in the number of trips by PLD zone was then calculated for the Business, Commuting and Other purposes using the same process as for the consultation, but based on the updated TEMPRO data. Note that this is an unconstrained forecast of growth which does not take into account road congestion; furthermore, it only takes account of GDP growth implicitly (through car ownership).

4.3.7 The output Origin and Destination (O&D) factors were used to grow the O&D trip ends of the base year matrices respectively; the base matrix was then successively adjusted by applying

[13] TEMPRO is DfT's forecasts of trip ends – i.e. where people start and finish trips; it is not constrained by congestion or cost; it is one of the principal drivers of road demand.

[14] NTM is DfT's model of growth in demand for travel; it is at an aggregate level, but when combined with TEMPRO can produce disaggregate forecasts.

factors first to origins and then to destinations to create a close match to the desired trip ends.

Pre-loads

4.3.8 The pre-loaded short distance demand was grown from the revised base pre-loads using the same method as before. We used the same NTM traffic level forecast data as during the late 2010 work, i.e. NTM 2009 (revised May 2010) National Road Traffic Forecasts (NRTF)[15] from DfT:

- Average Annual Daily Flow (AADF) traffic levels for the 2003 base year and forecast years 2015, 2025, 2035
- derived from NTM model forecasts using TEMPRO v5.4 trip ends
- traffic levels by region and road type derived from the NTM Fitting On of Road Growth (FORGE) v2.0 constraint mechanism.

4.3.9 The flows for the years required for this study (2011 base, 2025 and 2035[16]) were derived using linear interpolation where necessary. While this will not represent the downturn in base demand (as the base year 2010 NRTF growth factors from 2003 were derived by linear interpolation assuming uniform growth over the years 2003-2015), we nevertheless used the growth rates from 2010-2025 and 2010-2035 directly as derived from these NTM figures. The 2025 and 2035 factors were drawn directly from the NTM data set and did not require interpolation.

4.3.10 As before, the link pre-loads were uplifted based on Regional Growth Factors from the National Transport Model (NTM) – which is constrained.

4.4 Future car costs

4.4.1 No change was made to future highway costs from those used in the Consultation model. These represent the perceived costs of motoring when people are making decisions on mode choice; in keeping with standard transport planning practice, they include only fuel costs and tolls (which are zero in most cases).

4.4.2 Fuel costs are the combination of petrol (diesel and other fuel) prices and fuel efficiency. Future year movements of these elements are forecast in WebTAG, with little net effect as increases in fuel costs are largely offset by improvements in fuel efficiency. As a simplification car costs do not change in this part of the model; due to the incremental nature of the model, they would have very little impact on the forecasts and economic appraisal.

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15 www.dft.gov.uk/publications/road-transport-forecast-dft-ntm-results-2009/

16 2035 was the first estimate of the cap year date; due to the expected small impact, it was not updated for the purpose of highway forecasts

5 Growth in Air Demand and Fares

5.1 Introduction

5.1.1 This chapter considers air demand. It covers both the update of the base demand to 2010 and also subsequent growth.

5.1.2 For air, travel information data are better than for car, but not all airports are surveyed annually. Rather than seek to create our own assessment of base and future air demand, it was decided to use the DfT's forecasting model called National Air Passenger Allocation Model (NAPALM) (previously the model with similar functionality was called SPASM).

5.2 Base Year Air Demand Matrices

5.2.1 New air demand matrices were developed for PLD based on the NAPALM aviation model. The NAPALM model has a base year of 2008 with the demand data derived from Civil Aviation Authority (CAA) surveys undertaken continuously at five airports and from a rolling programme of surveys at other airport. No air demand matrices exist for a later base year so the 2010 version of NAPALM would have been a forecast from 2008 and would not have reflected observed changes in air demand which since 2008 have been significantly impacted by the economic downturn.

5.2.2 Only purely domestic travel (i.e. end to end travel only) were extracted from NAPALM for this purpose, so domestic transfer flights or 'interlining passengers' are not included (such passengers are considered within the Heathrow Airport Demand Model (ADM), however). The demand data are broken down into two purposes, business and leisure, as commuting is unlikely to rely on air travel.

5.2.3 The demand data for each purpose type were aggregated to be consistent with the PLD zoning system and factored using Civil Aviation Authority (CAA) data to be representative of 2010. Since 2010 passenger end-to-end movements were not available, the growth factors to 2010 were developed by comparing all domestic (mainland only) air trips as recorded by CAA data for 2008 and 2010.

5.2.4 This was considered to be the most appropriate way of developing the 2010 demand, whilst being mindful of the recent changes to air services. Notably between 2008 and 2010 the following services ceased to operate:

- Edinburgh-Inverness
- Heathrow – Teesside & Leeds/ Bradford
- London City – Manchester
- Stansted – Manchester & Newquay.

5.2.5 However since 2008 a service between Gatwick and Leeds/ Bradford began operating, along with some services to Manston airport in Kent. Discussions with the Consultants who were responsible for developing the NAPALM model indicated that since the demand contained within the model is end to end demand, and not airport to airport demand, it is inappropriate to attempt to scale down the demand to reflect the modified route changes.

5.2.6 Therefore it was agreed that the most appropriate way of developing the 2010 demand was to scale down the demand nationally, based on the CAA data. Analysis was undertaken to compare how demand to/from Scotland may differ from that to English only demand and the difference was insignificant. As such this was not progressed.

5.2.7 As summarised by CAA in 'Recent trends in growth of UK air passenger demand, Jan 09', domestic air passenger numbers in the UK have declined in recent years. On average domestic (mainland only) passenger numbers in the UK fell by approximately 11.6% between 2008 and 2010. The 2008 NAPALM were factored to reflect these numbers, with the final daily matrices demand summarised in Table 5.1 below.

Table 5.1 Annual Domestic End-to-End Air Demand

	2008 NAPALM Data	Factored 2010	% Growth
Business	14,869	13,143	-11.6%
Leisure	11,979	10,589	-11.6%
Total	**26,848**	**23,732**	**-11.6%**

5.2.8 The 2007 PLD demand data were based on a forecast from the 2004 base year NAPALM model which assumed growth in air demand. However, a comparison of the two NAPALM base demand matrices showed that air demand had actually fallen by 26% between 2004 and 2008 and by 32% between the 2007 PLD matrix (based on a 2004 model base year) and the 2008 NAPALM matrix.

5.2.9 The latest forecast figures for 2010 show a reduction in demand of over 30% from the 2007 PLD figures. This is summarised in Table 5.2 below.

Table 5.2 PLD Comparison between 2007 & 2010 Daily Air Demand

	2007 PLD Matrix	2010 PLD Matrix	% Growth
Business	19,893	13,143	-34%
Leisure	15,657	10,589	-32%
Total	**35,551**	**23,732**	**-33%**

5.3 PLANET Air Fares Matrices

5.3.1 Air services are represented on a simple basis in PLD, with individual transit lines representing flights operating between different UK airports. This was updated to reflect 2010 fares, using average fares paid by leisure and business users.

5.3.2 Average fare data were developed based on CAA survey data, which was sourced from the DfT. The fare data were 'average fare paid' (including appropriate taxes, etc) and was available from 2004 – 2010. Fare data were not available for every year on every route, and so where appropriate values were interpolated using data from previous years. Single fares are estimated at half the recorded return fare, with some slight variation in price depending on the direction of the outbound flight.

5.3.3 This average fare data were ultimately factored by the 2010 average business and leisure fares as detailed in the DfT's Aviation Model fares profile, to derive typical fares for each route by journey purpose.

5.3.4 Base air fares are provided in Table 5.4.

5.4 Heathrow Airport Demand Model Update (ADM)

5.4.1 The ADM forecasts trips to/from Heathrow for the purpose of making onward international trips. These are included for all access modes, including rail, air and car.

5.4.2 The demand data in the previous model were for an average of 2007 and 2008 drawn from the CAA surveys for these years. This was updated to an average of 2009 and 2010, the latest years for which data are available. More detail on the ADM is provided in Appendix 2.

5.5 Future year air matrices

5.5.1 To be consistent with the rail and highway forecasts, the air forecasts were also unconstrained by limitations on capacity. They thus represent an inherent demand for air travel at the fare estimated. This is an appropriate approach when considering the potential market that long distance rail might abstract from air. The forecasts are not, however, consistent with published air forecasts which take into account expected constraints on growth.

5.5.2 Growth factors for domestic air demand were developed for the DfT's UK Aviation Forecast (August 2011) and supplied by URS Scott Wilson. Domestic growth factors were provided for each year between 2010 and 2045 and were stored in the NAPALM 455 zone system. Growth rates for 2018 and 2019 were interpolated using the values for 2017 and 2020 as the DfT factors for these years were not considered reliable.

5.5.3 The 2008 base year domestic air demand matrices previously used in constructing future year forecasts were replaced with updated base matrices for 2010. These matrices had been adjusted using CAA factors to reflect the recession occurring between these years. The 2010 matrices contained daily demand segregated by business and leisure travel. These demand matrices were consistent with the 235 zone PLD zoning system.

5.5.4 In order to uplift the demand matrices to reflect growth in air demand, the DfT growth factors were converted from NAPALM format to the 235 zone structure used in PLD. This was achieved by first creating a set of growth factors (weighted by the associated business and leisure demand of the corresponding NAPALM zones) for the 406 Long Distance Model (LDM) zones, and then using a further correspondence list provided by Atkins to convert these growth factors from LDM to PLD format.

5.5.5 The matrices were created for future years of 2026 and 2035, the latter, proxying the actual cap year of 2037, was based on an earlier estimate of the cap year and not subsequently adjusted. An average of the growth factors of the origin and destination PLD zones was used for each year, to ensure that the matrix remained symmetrical in demand between origins and destinations. Base demand was multiplied by the average growth factor of the two zones to provide domestic air demand for the future year matrices.

5.5.6 Future year matrices are summarised in the following table of aggregate growth in demand.

Table 5.3 Growth in air demand

	2010 Demand	2026 Demand	2035 Demand	2026 cf. 2010	2010 to 2026	2035 cf. 2010	2010 to 2035
	Adj 2008 w/ CAA Factors	Atkins 2010 w/ DfT Factors	Atkins 2010 w/ DfT Factors	% Change	CAGR	% Change	CAGR
Business	13,100	21,200	26,400	61%	3.02%	101%	2.84%
Leisure	10,600	17,000	21,300	61%	3.01%	101%	2.83%

5.6 Forecast Air Fares

5.6.1 In order to be consistent with the domestic fares model underlying the forecasts in the DfT's UK Aviation Forecast Report (August 2011)[17] the projected air fare changes were incorporated into PLD. As provided by DfT, the forecasts for single domestic air fares are in 2008 prices for the report's central demand scenario are summarised in Table 5.4 below.

5.6.2 These are based on expected movement in air operating costs and airport charges. As the latter are a fixed price per passenger, the net effect on business and leisure passengers is different in proportional terms.

5.6.3 The DfT forecasts indicate that business fares are forecast to decline in both future year scenarios, whereas leisure air fares are forecast to increase.

Table 5.4 Forecast Average Air Single Fare for UK Domestic End-to-End Passengers (2010/11 prices)

	Forecast Average Single Business Fare (2010/11 prices)	Forecast Average Single Leisure Fare (2010/11 prices)	% Change in Business	% Change in Leisure
2010	£91.62	£47.09	-	-
2026	£86.51	£48.25	-5.58%	+2.45%
2036	£86.07	£49.43	-6.06%	+4.99%

5.6.4 The existing base year fares were factored accordingly, based on the percentage changes in the table above.

17 http://www.dft.gov.uk/publications/uk-aviation-forecasts-2011

6 Transport Supply Assumptions

6.1 Introduction

6.1.1 This Chapter describes the updates made to the transport supply networks in the rail, air and highway elements of the model framework. These included the development of revised base year networks to reflect the move to a 2010 base year and revised forecast year Do Minimum networks for 2026 and the 2037 cap year.

6.1.2 In addition changes were made to the base year rail networks to improve the modelling of connectivity within Birmingham and Manchester.

6.2 Base Year Rail Networks 2010

6.2.1 Rail Service Transit Lines have been produced in an automated way for the PLANET Models used in modelling the High Speed 2 rail schemes. This was undertaken in this way for the following reasons:

- a national timetable data set was required to be converted in as efficient way as possible in the timescales – an automated method was essential for this
- five network models were required to be built in total from the national data set and so a consistent and repeatable method was required.

6.2.2 The Base Year is 2010. Timetables are extracted from the Summer 2010 timetable, valid from May to December 2010.

6.2.3 The timetable date used for the extraction of the transit lines was the 'ORCATS[18] day' of Wednesday, 16th June 2010. This date is generally accepted to be the most reliable day to use in the CIF file, as operators' allocation of revenue is based upon the timetable on that day.

6.2.4 The weekday timetable is constant across the entire timetabled period, with typically only summer Saturdays varying across the year.

6.2.5 The Base Year data were extracted from a CIF file and vehicle formation file provided by Delta Rail. The extraction process was undertaken by way of a Perl script.

6.2.6 The transit lines produced are based upon the following periods:

- 07:00 to 09:59 (AM); PLANET South, PLANET Midlands
- 07:00 to 22:59 (all day); PLANET Long Distance.

6.2.7 The time periods refer to a fixed 'window' of time, though a single train may exist in more than one time period. Potentially this could result in over-estimating the number of trains so to avoid this, a train is classified as belonging to a single time period only. This time period is taken from the highest 'hierarchy station' on the route.

18 ORCATS is a system designed to allocate revenue to operators of services.

6.2.8 The main changes to the base year assumptions were:

- Completion of the West Coast mainline upgrade and introduction of enhanced timetable
- Introduction of service between St Pancras and Corby
- Opening of East Midlands Parkway
- Extension of St Pancras – Derby services to Sheffield to provide 2tph between St Pancras and Sheffield

Table 6.1 Base Year Rail Services Trains per Day 2007/08 – 2010/11

From	To	2007/08	2010/11
West Coast Main Line			
Euston	Birmingham New Street	13	24
Birmingham New Street	Euston	13	26
Euston	Wolverhampton	19	19
Wolverhampton	Euston	18	19
Euston	Manchester Piccadilly	33	42
Manchester Piccadilly	Euston	33	46
Euston	Liverpool Lime Street	15	17
Liverpool Lime Street	Euston	14	16
Euston	Glasgow Central	8	12
Glasgow Central	Euston	8	12
East Coast Main Line			
King's Cross	Leeds	28	28
Leeds	King's Cross	28	28
King's Cross	Newcastle	12	12
Newcastle	King's Cross	13	13
King's Cross	Edinburgh	6	6
Edinburgh	King's Cross	7	7
King's Cross	Glasgow Central	5	6
Glasgow Central	King's Cross	6	6
King's Cross	Aberdeen	3	3
Aberdeen	King's Cross	3	3
Midland Main Line			
St Pancras	Derby	13	5
Derby	St Pancras	12	2
St Pancras	Leeds	4	3
Leeds	St Pancras	3	2
St Pancras	Nottingham	28	27
Nottingham	St Pancras	29	28
St Pancras	Sheffield	16	26
Sheffield	St Pancras	16	28
St Pancras	Corby	-	12
Corby	St Pancras	-	12
London Midland			
Euston	Birmingham New Street	4	17
Birmingham New Street	Euston	0	17

From	To	2007/08	2010/11
Euston	Crewe	1	11
Crewe	Euston	0	12
Euston	Milton Keynes Central	19	20
Milton Keynes Central	Euston	18	17
Euston	Northampton	40	19
Northampton	Euston	41	15
Euston	Tring	28	29
Tring	Euston	26	30
Chiltern			
Marylebone	Bicester North	15	16
Bicester North	Marylebone	13	14
Marylebone	Birmingham Snow Hill	25	25
Birmingham Snow Hill	Marylebone	23	23
Marylebone	Banbury	5	7
Banbury	Marylebone	6	6
Marylebone	High Wycombe	24	25
High Wycombe	Marylebone	30	31
Marylebone	Kidderminster	4	4
Kidderminster	Marylebone	5	5
Marylebone	Princes Risborough	8	9
Princes Risborough	Marylebone	4	8
Marylebone	Stratford-upon-Avon	7	5
Stratford-upon-Avon	Marylebone	8	6

London Underground/DLR/Buses

6.2.9 London Underground services are contained within PLANET South. These were carried forward from the previous validated base for 2009, and modified to include the following:

- changes to the Circle Line, now formed as a 'paper clip', running from Hammersmith, around the circle and terminating at Edgware Road (and return)
- frequencies of the underground lines were factored to be comparable with TfL's Railplan model.

6.2.10 The bus network was carried forward unchanged. This is a reasonable assumption, as the bus services do not have crowding applied to them, and are essentially a feeder mode.

6.3 Future Year Rail Networks

6.3.1 This section sets out how the future year transit lines (rail services) for the Do Minimum model networks were derived for the forecast year of 2026, and which were then carried forward for the 2037 cap year. It is this Do Minimum network that will be the base against which the options will be compared.

6.3.2 There is no single source of data for the future year rail networks, and hence this was assembled from:

- PDF timetables
- Spreadsheets of marked up service changes
- MOIRA .SPG files of timetables.

6.3.3 A summary of the changes to the services on key routes for HS2 are shown below. Further details are found in Appendix 3.

West Coast

6.3.4 The future year West Coast timetable is derived from the HLOS 2 document received from DfT. This states that all Euston – Lancaster services will be extended to Glasgow in 2014, to be operated by 9 car Pendolino stock.

6.3.5 Furthermore, following discussions with DfT, it was decided that any planned services between Euston and Blackpool/ Preston would be routed to Lancaster, operated by 5 car Voyager stock.

6.3.6 The following assumptions about vehicle types for West Coast services were agreed with the DfT.

- 11-car Class 390 Pendolinos for Birmingham / Wolverhampton and Manchester via Stoke
- 9-car Class 390 Pendolinos for the remaining Manchester, Liverpool, Glasgow services
- 9-car Class 390 Pendolinos for Birmingham-Scotland
- 5-car Class 220 Voyagers for Chester/Bangor and Lancaster
- 10-car Class 220 Voyagers for Holyhead.

Chiltern

6.3.7 The Evergreen 3 Project involved a significant re-write of the Chiltern main line timetable from September 2011 onwards, allowing higher speeds and thus shorter journey times. Additionally, Bicester North trains are diverted via a new curve to Bicester Town and on to Oxford from 2013/14.

6.3.8 The 2010 MOIRA2 coding was used as a template, with a mixture of 2 and 3 car Class 165s on the short distance trains and 3 car Class 168s on the longer distance services beyond Banbury.

Midland Mainline

6.3.9 For Midland Mainline services, no future detailed timetable was proposed, so the base year Summer 2010 was carried over. All services are formed of Class 222 stock except for Leeds and Lincoln services which are formed with HST stock.

6.3.10 There is an aspiration to create a 2 hour London to Sheffield journey time, though this is not yet in the form of a detailed timetable. As such the journey times are unchanged at this point.

East Coast Mainline

6.3.11 The East Cost Do Minimum timetable was developed from a MOIRA .SPG file was obtained from the DfT giving the East Coast, Hull Trains and Grand Central services plus vehicle types.

6.3.12 The East Coast assumptions are a partial implementation of the Intercity Express Programme (IEP). As such, there is a mixture of new IEP stock and carried over Mk 4 stock, with new unspecified electric locomotives.

Summary of future year train services

6.3.13 The detailed number of trains assumed in the future years is provided in Appendix 3.

Birmingham Connectivity

6.3.14 Modelling of the interconnectivity between Birmingham stations was not appropriate in the February 2011 model.

Table 6.2 Connections between stations in Birmingham – February 2011 model

	IVT[19] (mins)	Headway (mins)	Walk (km)	Effective GJT[20] (mins)
Moor Street to New Street	30	5	0	64.0
Snow Hill to New Street	30	5	0	64.0
New Street to Curzon Street	30	5	0	64.0
Moor Street to Curzon Street	0	0	0.2	9.6
PLUS				
Birmingham International to Birmingham Interchange				Not coded

Note: PLD applies a weighting of 4 when converting walk time to GJT.

6.3.15 As can be seen, there is no connection between Birmingham International and Birmingham Interchange (HS2), also very slow connections provided for cross-Birmingham interchange.

6.3.16 We reviewed the published proposals for these connections. For the Birmingham Interchange/ International connection it is clear that this should be a transit connection. Published documentation states that a transit connection would be between 5 and 7 minutes long. A transit connection will incur board and wait penalties in the model. A reasonable assumption would therefore be that a service will operate every 10 minutes with a journey

19 IVT stands for in vehicle time. That is the time spent actually in a vehicle rather than accessing it or waiting for it.

20 GJT stands for Generalised Journey Time. It consists of time in the vehicle plus time spent waiting for it and time walking; factors are applied to all elements, with IVT having a factor of 1.

time of 6 minutes (which operationally would allow a 4 minute turnaround at each end, and a service to be operated by two units).

6.3.17 For the cross Birmingham link reference has been made to published transfer time assumptions. However, it is evident that the relatively short distances involved in Birmingham make a walk connection a shorter (and more sensible) modelled time than a transit connection. The revised coding is therefore shown in Table 6.3 below, with the modelled time also shown.

Table 6.3 Birmingham connectivity assumptions used in updated base model

	IVT (mins)	Headway (mins)	Walk (km)	Effective GJT (mins)
Moor Street to New Street	0	0	0.5*	24.0
Snow Hill to New Street	0	0	0.9*	43.2
New Street to Curzon Street	0	0	0.6*	28.8
Moor Street to Curzon Street	0	0	0.2*	9.6
PLUS				
Birmingham International to Birmingham Interchange	6	10	0	44.0

* The walk links recommended here have been assumed to include an additional 0.1km of distance to reflect the multi level access/egress involved.

Manchester Connectivity

6.3.18 Modelling of the interconnectivity between the Manchester stations represented in PLD has also been changed since the consultation model and is summarised below. Note that Oxford Road to Piccadilly is a direct rail link and is unchanged.

Table 6.4 Connections between stations in Manchester – February 2011 model

	IVT (mins)	Headway (mins)	Walk (km)	Effective GJT (mins)
Piccadilly to Victoria	30	5	0	64
Oxford Road to Victoria	30	5	0	64

6.3.19 The following table summarises revised coding for Manchester.

Table 6.5 Manchester connectivity assumptions used in updated base model

	IVT (mins)	Headway (mins)	Walk (km)	Effective GJT (mins)
Piccadilly to Victoria	8	12	0	47.6
Oxford Road to Victoria	32	6	0	66.8

6.4 Base Year Air Networks 2010

6.4.1 Air services are represented on a simple basis in PLD, with individual transit lines representing flights operating between different UK airports and this was updated to reflect 2010 networks. Journey times and distances were taken from the 2008 dataset where available, and filled in using manual lookups where services have changed.

6.4.2 CAA air punctuality statistics were used to update the air services. The punctuality statistics are published for all flights between key airports in the UK. Data were used for October 2010 – on the basis that this is generally regarded as a neutral month. The punctuality statistics data summarises the frequency of flights operating to and from the top ten airports in the UK, and the flight operator. The monthly flights were converted to typical daily flights and used as the basis of the air services coding, with weekday / weekend frequencies calculated using the current timetable as a proxy.

6.4.3 As the CAA punctuality data only list services operating to and from the top ten 10 UK airports, some regional services were missing from the list. Details of these additional services were obtained from a review of airline and airport websites.

6.5 Future Year Air Networks

6.5.1 Planet Long Distance (PLD) deals with air transport in a slightly different way to the other modes, in that there is no fixed infrastructure on the air routes and no crowding effects are assumed on the air services. Therefore terminal and runway capacities are not coded into PLD. Furthermore, crowding effects are not incorporated into the air model within PLD.

6.5.2 To provide the greatest level of consistency with development of the air demand matrices, the future year air networks were taken from the DfT's NAPALM Aviation model. They were derived from the NAPALM central demand case which has airport capacity constrained to the maximum use of existing runway capacity (the Core s02 scenario). These forecasts were detailed in the DfT's UK Aviation Forecasts (August 2011).

6.5.3 It is noted that the air service provision within the Aviation model changes based on the following key variants:

- the model makes route viability tests for each route at the start of each forecast year and where there are shadow costs caused by airport constraint routes may close or transfer to neighbouring airports
- the model also takes account of changes in aircraft size and average load on a route by route basis when calculating the frequencies

- the route viability and aircraft size/load calculations will also use demand from domestic-international transfer traffic, demand which is outside the input internal domestic matrices
- the model includes HS2 from 2026 onwards, although its effect on frequencies is likely to be modest compared to the shadow costs which can be seen to displace routes from Heathrow well before 2026.

6.5.4 The following assumptions were made in developing the PLD future year air services:

- The future year demand matrices were developed using the Aviation model, using growth factors which provided an unconstrained forecast demand which did not include HS2. This was not possible for the supply side, which is taken from the constrained case which includes HS2, so the two sources of data do differ. However given the way air services are modelled within PLD, the adopted approach is considered sufficiently robust and represents the likely future year air service provision to the best of our knowledge
- Since the PLD 2010 base air networks were developed based on observed (CAA) data, these were considered more 'accurate' than the Aviation models forecast 2010 level of service provision. Although a comparison indicated that the two sources were very similar, there were some discrepancies
- The PLD 2010 base air services were factored based on the relative change between the Aviation model services during the relevant years (e.g. 2010 to 2026). This ensured that where the service provision between the modelled years remained constant, this was reflected in the PLD future year scenario – particularly relevant where the PLD 2010 base and the Aviation models 2010 forecast service provision differed slightly – and ensured that artificial reductions in future year service provision were avoided
- The data were also checked for both new services and for the possibility of some services ceasing to operate and amended accordingly
- The data were provided in five year intervals, starting at 2010. For modelling purposes the Aviation models 2025 service provision was assumed to be reflective of the PLD 2026 service provision – likewise 2035 and 2045 services were taken to represent the 2037 and 2046 future years
- It was noted that the Aviation model did not include services to Dundee or Manston (Kent). For the purposes of the PLD model, these were assumed to be the same as the 2010 service provision.

6.5.5 Tables A4.1 and A4.2 in Appendix 4 show the services that have ceased operating between 2010 and each of the future years, and the additional services that have begun operating between 2010 and each of the future years, respectively.

6.5.6 In addition air services were identified in the DfT's 2010 forecast year model which could not be identified as operating in 2010. These services were still operating in the DfT model's 2025 forecast year and so for consistency were included in the PLD forecast networks. These services can be seen in Table A4.3 of Appendix 4.

6.6 Base Year Highway Networks 2010

6.6.1 The highway networks were updated to include any highway schemes that opened between October 2007 and October 2010 and that could be represented in the PLD network.

6.6.2 The primary data sources were the list of major projects completed in the 2008/2009 and 2009/2010 financial years under the Highways Agency's Motorways and Major Trunk Roads Programme which highlighted eighteen major schemes that are included within the PLD highway model coverage. In addition the DfT identified a further seven schemes which could also be considered for coding into the model.

6.6.3 Due to the strategic nature of the PLD highway network a number of the schemes were identified as being too small to be reflected in highway network coding. In all five schemes were identified as suitable to be incorporated into the model and these schemes are shown below.

Table 6.6 Base Year Highway Network Changes 2007-2010

Scheme Title	Highways Agency Area	Opening Data
A1(M) Bramham to Wetherby	Area 12	July 2009
A595 Parton to Lillyhall Improvement	Area 13	December 2008
M27 Junctions 3 - 4 Widening	Area 3	January 2009
Birmingham Box Phase 1	Area 9	November 2009
M1 Junction 25 to Junction 28 Widening	Area 7	May 2010

6.7 Future Year Highway Networks

6.7.1 Since the development of the previous 2007 model planned improvements to the highway network have been impacted by the move away from traditional motorway widening and towards managed motorway schemes (hard shoulder running), and the impact of the 2010 Spending Review which led to a number of schemes being cancelled or deferred.

6.7.2 The previous list of schemes that had been provided by the DfT was reviewed against the Highways Agency's current programme with the revised list of schemes being developed following the approach detailed below:

- schemes identified as 'withdrawn' were not included in the networks
- schemes opened since October 2010 (base year network) were included in the networks
- all other schemes identified as in some stage of the planning process – from 'under construction' to 'on hold' were included in the networks.

6.7.3 The rationale behind the third point was that by the time of the first modelled year (2026) it was reasonable to expect that the majority of these schemes will have been constructed even if there is no firm programme to take them forward at present. This assumption was discussed with the DfT and it was agreed that it was reasonable to follow this approach.

6.7.4 Appendix 5 gives details of the highway schemes included in the 2026 and 2037 networks.

7 Appraisal Process

7.1 WebTAG Appraisal

7.1.1 In February 2011 the appraisal had been given in 2009 price levels discounted to 2009. The main change made to the appraisal was to update it to 2011 values, discounted to 2011.

7.1.2 This clearly has no effect on any demand figures. Revenue and economic benefits and many costs are simply adjusted by a factor that represents inflation. Construction costs are changed to the best estimates made at 2011 price levels. In addition there are slight changes to discounting affecting all costs, benefits and revenues, with two less years of discounting at 3.5%, with the year at which the discount rate reduces from 3.5% to 3% changed from 2040 to 2042.

7.1.3 The changes to the appraisal process had only small impacts on the BCR, although the NPVs of all elements change as a result of the changes in price level and discount year by a factor of 13.6%.

7.2 Other changes to the Appraisal

7.2.1 Further changes were made to the appraisal to ensure consistency with the scheme definition and the demand and revenue forecasts:

- cap year is 2037 – no further growth in demand, fares, costs
- second forecast year is 2037
- value of time growth adjusted to reflect the GDP forecasts used for the rail demand forecasts; this continues to grow beyond the cap year.

7.3 Value of Time

7.3.1 Growth in the value of time is linked to changes in income (measured through per capita GDP growth). As GDP forecasts have been revised values of time have been recalculated. Forecast Values of Time (VOTs) annual percentage growth rates for working and non-working time originated from WebTAG 3.5.6 Table 3b and Office for Budgetary Responsibility GDP growth rate forecasts (July 2011).

7.3.2 Table 7.1 gives details of the growth rate indices that have been used in the appraisal. Also provided in this table are the equivalent Consultation values used, which are slightly higher than those used for the January 2012 Economic Case.

Table 7.1 Growth in Values of Time Index for Business and Leisure PLD (2002=100)

Year	Segment	January 2012 Economic Case Value of Time Growth (real)	Consultation Value of Time Growth (real)
2026	Business	1.39	1.41
	Other	1.30	1.32
2037	Business	1.66	1.73
	Other	1.50	1.55

7.4 Wider Economic Impacts Assessment

7.4.1 The principles behind the calculation of Wider Economic Impacts (WEIs) remains unchanged. The only difference being the use of revised input data on cost and time of travel. The WEIs are also updated to 2011 prices and discounted to 2011.

7.5 Appraisal Impacts

7.5.1 The effects of these changes to the appraisal methodology are summarised in the Economic Case Document (January 2012), and described in more detail in the Demand and Appraisal Report (April 2012).

8 Base Year Validation

8.1 Background

8.1.1 Previously, the HS2 model framework base year validation was presented in the HS2 London – West Midlands Consultation, Model Development and Baseline Report, April 2011.

8.1.2 Subsequently, a number of changes have been made to the modelling framework, as described in this report. They include:

- update to rail networks in order to replicate 2010/11 service patterns
- update to rail demand to replicate 2010/11 levels of demand.

8.1.3 All relevant changes have been applied to the base year model so that their impact on base year rail passenger flow validation can be assessed. This Chapter presents a summary of this assessment. More detail is provided in Appendix 6.

8.2 Model Stability

8.2.1 As with all assignment based models, there is a risk that the model might not converge or be stable. This typically occurs when load factors are very high and there are large crowding penalties. Hence before considering the validation of the model, we have checked that the model is stable.

8.2.2 Model stability needs to be considered in terms of the overall demand modelling framework and the individual sub model assignment procedures.

8.2.3 During runs of the base year model and future year runs of the Do Minimum model there are no demand responses in the overall modelling framework (mode choice or elasticity functions are not invoked), therefore the only considerations are assignment convergence within the sub models. During forecasting, runs of the PLD model within the framework are separated by a mode choice model, and elasticity functions are also included in the rail sub models, these all impact on rail demand, model stability within the overall modelling framework becomes an issue.

8.2.4 WebTAG 3.10.4 sets out key recommendations for convergence of demand-supply models which apply equally to highway models, rail models and multi-modal models. The integration between the PLD sub-models is complex. Convergence or stability of demand and supply are not automatically monitored as part of a model run, as the model architecture as presently implemented does not report this.

8.2.5 The overall PLD model is iterated to a high number of loops during assignment to ensure stability of results between runs. Within the PLD Framework there are a number of rail, highway and air assignments. For each of the sub-models individual assignment convergence statistics are produced and these statistics are also reproduced for the final PLD model scenario rail assignment.

8.2.6 A number of measures have been implemented to monitor stability and convergence of the model. These are calculated at the end of a model run:

- The overall change in total rail passenger kilometres across the whole network (% and/or absolute) between the last two (or more) scenarios is calculated.
- Modelled flows along key routes in successive model (not assignment) iterations are monitored to ensure there are no significant differences. Changes in 2-way demand at important locations on the West Coast, East Coast, Midland Main Line and High Speed Line between the last two scenarios (model, not assignment iterations) are calculated and network wide plots are also produced to illustrate the stability of the rail assignment. WebTAG 3.10.4 (para 1.5.3) recognises that some models use stability statistics such as maximum % changes in flows between iterations.
- To demonstrate that network costs do converge, the change in overall generalised journey time by demand segment across the whole network (% and/ or absolute) between the last two (or more) scenarios has been calculated.

8.2.7 Assignment convergence outputs from the last 10 iterations of transit assignment of the final network scenario of PLANET Long Distance for the base year PLD model are shown in Table 8.1. (Note that, as this is a base year model run, other stability analysis is not presented).

Table 8.1 PLD Rail Assignment Summary Statistics

Last 10 Iterations	Total Passenger km ('000)	Change in Total Passenger km	
		Absolute ('000)	Percentage (%)
0	71,360		
1	71,317	7,219	10.12%
2	71,263	2,283	3.20%
3	71,239	584	0.82%
4	71,218	341	0.48%
5	71,213	288	0.40%
6	71,210	183	0.26%
7	71,199	136	0.19%
8	71,198	100	0.14%
9	71,198	91	0.13%
10	71,197	80	0.11%

8.2.8 This demonstrates a good level of model stability.

8.3 PLD Rail Assignment Validation

8.3.1 It is normal practice to validate transport models by checking whether they accurately represent the current situation – for PLD this would be to check that the assignment gives the current demand by train service. Where possible this should be done using independent data. However to ensure the PLD model is as robust as possible, the model update process has already used the majority of the available data, and certainly the most reliable. As a result, undertaking a detailed validation of PLD is challenging, as alternative sources of data are likely to be less robust.

8.3.2 Of the data sources available, MOIRA[21] represents one of the best, although it is not strictly independent as both PLD and MOIRA draw their data from LENNON, the rail industry ticket sales data. It does, however represent a valuable model validation check.

8.3.3 Guards' counts data represents a further data source, and unlike MOIRA, it is an independent data source; however, these data are likely to be less accurate than the LENNON data used to create PLD. As with MOIRA, these data provide a useful validation check of PLD.

8.3.4 The Emme/2 modules within PLD have been used to output assigned transit segment volumes for the updated Base Year Validation model. Results of the validation across screenlines are presented in Appendix 6, along with a comparison of the results of the previous February 2011 validated base year model. It should be noted the different base years of the models means they cannot be compared directly. Instead comparisons with relevant base year data are used to compare the validation performance of the models.

8.3.5 In most cases the model accurately assigns demand to the appropriate train services. However, in some cases there are differences from the estimates in MOIRA and/or the Guards' counts data. This is to be expected, as models will always be better at modelling some areas than others. In general, where the PLD model differs to other data sources, these are:

- outside of the core areas of interest, i.e. the proposed HS2 scheme alignment
- where significant amounts of local demand are modelled outside PLD (by PLANET South/ Midlands). In these locations, an improved level of validation is observed when the models (PLD and the relevant regional model) are considered together
- where fare differential may be affecting choice of route – though the total level of demand across these routes is more robust
- where MOIRA predicts flow patterns that are unlikely to be observed in reality (e.g. where flows differ substantially by direction).

8.3.6 Overall, the updated model appears to perform at least as well, and in some cases significantly better than, the previous Consultation model.

8.4 Conclusions

8.4.1 The major changes made to the base year model have had a significant impact on modelled passenger volumes. New passenger services and new demand have produced a different

[21] MOIRA is the rail industry's standard model for forecasting the effect of small changes to train timetables.

base year of 2010/11. Nevertheless, the model is stable and the overall rail passenger flow validation either remains consistent or improves upon the February 2011 model validation. The differences are as expected given the scale of modifications to the model – i.e. they are in the geographical areas where most changes were made.

8.4.2 No model of the size and complexity of the PLD model is going to produce a perfect validation. On the WebTAG criteria being examined, the validation is good; in some areas it is better than, and in other areas very similar to, that of the February 2011 Consultation Model.

8.4.3 In conclusion, we believe that the model is fit for purpose.

Appendix 1 Rail growth from 2007 to 2010

PLANET Long Distance (PLD)

Table A1.1 below shows the ten largest increases and decreases in PLD rail demand, by origin between 2007/08 and 2010/11. The figures include trips to all destinations from each origin zone, which are often dominated by shorter distance commuter journeys made between adjacent zones.

Some of the associated changes in short distance demand are associated with improved representation of PTE ticket sales for those shorter journeys, which particularly affect travel estimates in the West Yorkshire and Strathclyde areas. The highest growing PLD zones in terms of originating trips include Central London, and areas served by the West Coast Main Line (WCML).

Table A1.0.1Largest increase and decreases in PLD rail demand by origin PLD zone between 2007/08 and 2010/11

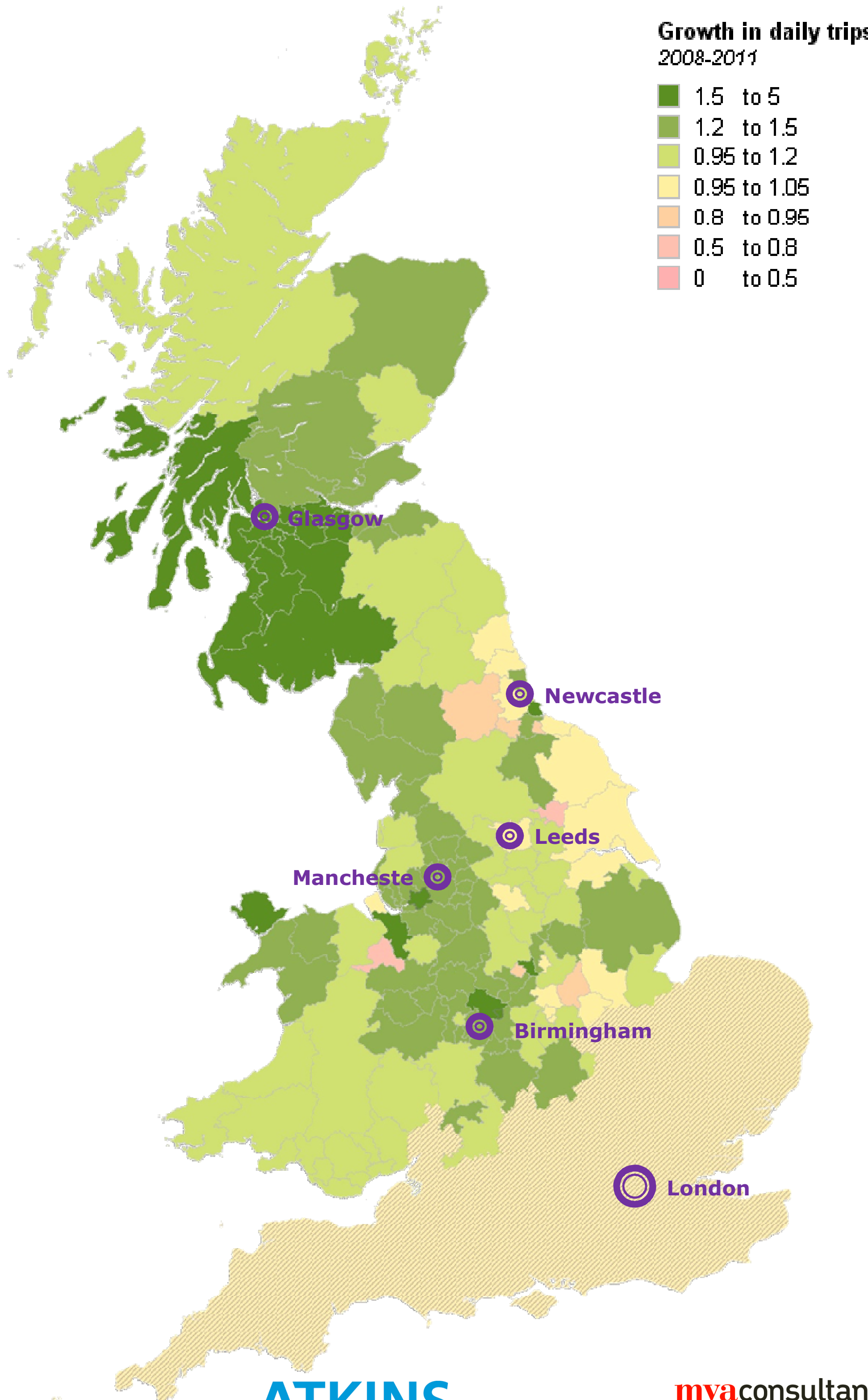
Rank	Origin Zone (Largest Increases)	Change in origin demand (day)	(%)	Origin Zone (Largest Decreases)	Change in origin demand (day)	(%)
1	London Central	8,500	19%	Leeds	-4,400	-8%
2	Manchester incl Metrolink area	6,800	11%	York*	-3,200	-34%
3	City of Edinburgh	3,800	11%	West of Glasgow	-2,000	-13%
4	Cardiff	3,400	13%	Renfrewshire	-1,400	-11%
5	Liverpool	2,600	6%	W Dumbartonshire	-1,100	-16%
6	Sheffield	2,300	18%	Fife	-1,000	-10%
7	Birmingham	1,600	6%	Oldham	-900	-28%
8	Chester & Ellesmere Port	1,400	23%	Bradford	-800	-4%
9	Vale of Glamorgan	1,300	26%	North Lanarkshire	-800	-6%
10	Northamptonshire WCML	1,100	20%	City of Glasgow	-700	-1%

* The largest percentage demand change between 2007/ 08 and 2010/ 11 relates to the York zone. This can be attributed in part to a coding issue in the LENNON data, which has led to an under-estimate of demand from this area in the 2010/ 11 model. Tests which focus on providing HS2 services to the York area will therefore underestimate the demand impacts and associated benefits. This issue will be resolved in the next update of the PLD model framework.

Figure A1.1 shows the growth in PLD trips from 2007/08 to 2010/11 to London, the main driver of forecasts of demand and time savings for HS2 testing. It can be seen that the highest growth involves journeys from WCML origins. The area blanked out in Figure A1.1

relates to journeys wholly within the PS area, and therefore containing no travel demand to London in either the 2007/08 or 2010/11 PLD matrices.

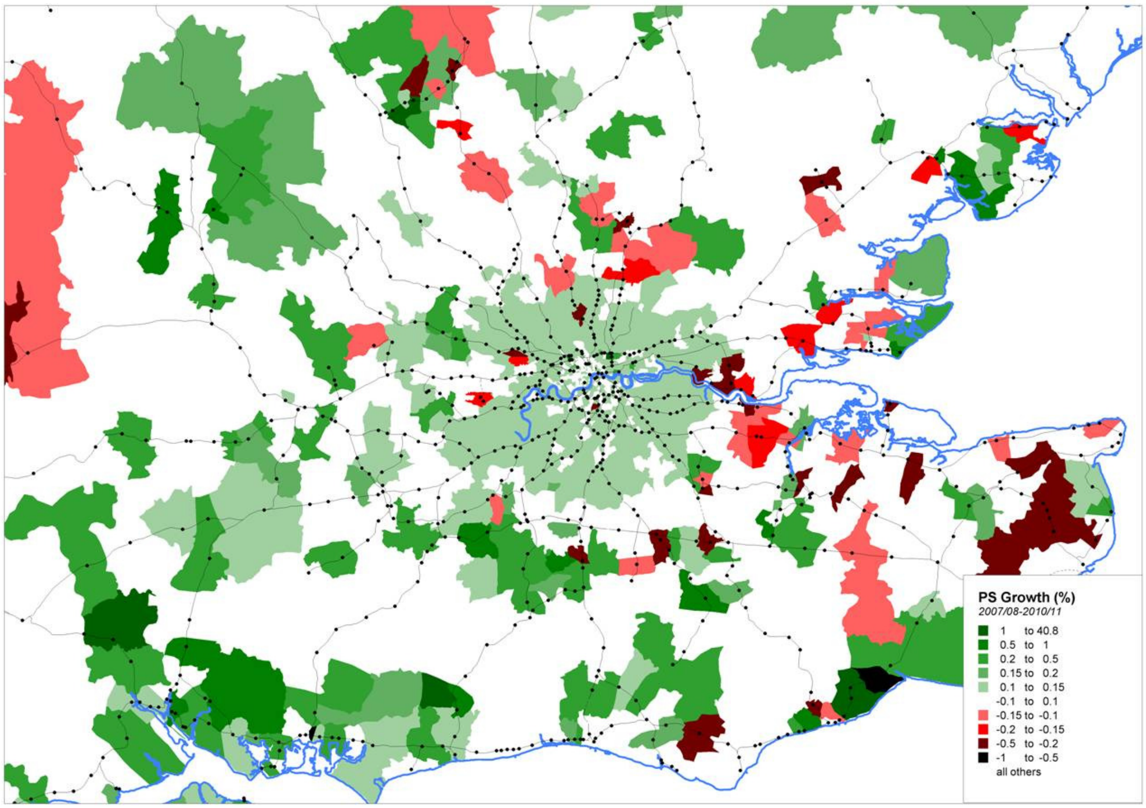
Figure A1.1 Relative change in trips from each PLD origin zone to Central London between 2007/08 and 2010/11



PLANET South (PS)

Figure A1.2 shows the resulting assumed change in originating demand for PS zones, between 2007/08 and 2010/11. The graphs show a general increase in rail demand from outside Greater London apart from on key commuting routes into the City of London from the east (from North Kent and Essex) which have seen a drop in demand due to the recent recession, and on some areas served by Thameslink services which have been heavily affected by weekend and evening route closures since 2007/08.

Figure A1.2 Change in originating demand from PS zones between 2007 and 2010



PLANET Midlands (PM)

PLANET Midlands has a much smaller effect on the HS2 benefits than the other components of the modelling framework. The changes in demand are as expected.

Appendix 2 Airport Demand Model

Two separate air passenger markets are represented within the PLANET framework.

GB Internal Air Demand refers to trips made by air where the ultimate starting and finishing location are both within Great Britain (i.e. not including Northern Ireland). These are trips that could be potentially attracted to rail, and as mentioned above, are therefore included in the PLD strategic model. They are not included in the ADM.

Transfer Air Demand refers specifically to passengers travelling to or from London Heathrow to catch flights to international destinations. These are represented in the Heathrow Airport Demand Model (ADM), along with 'non-transfer' passengers who are making international journeys starting at Heathrow. This is a spreadsheet model which predicts mode of access to Heathrow, and incorporates forecasts of future passenger throughput at Heathrow.

The three following examples help illustrate the distinction:

- a passenger who uses a Manchester – Heathrow flight in the course of travelling from their home in Manchester to go to a business meeting in London counts as GB Internal Air Demand; whereas
- a passenger who travels from their home in Manchester and uses the same flight, but instead transfers to an international flight at Heathrow counts as Transfer Air Demand;
- a passenger who travels from their home in Manchester and uses rail or car to access an international flight at Heathrow also counts as Transfer Demand.

The original version of the Spreadsheet Heathrow Airport Demand Model (ADM) developed by SKM had a model base Year of 2008 and was developed for the London to Birmingham study in 2009. To reflect the most up to date data and economic climate, a variety of technical modifications were required to the model to reflect a new model years and changes to the key assumptions.

Change of Model Forecast Years

The original version of the model only accepted 2008, 2021 and 2031 as input model years. For the model update, the required model years have been changed to 2010, 2026 and 2037. This required modification to the formulae within the spreadsheet to ensure that they worked using the different year inputs. In particular, "IF" statements that switched between the model years, cells with data validation, and the VBA automation were updated to make the ADM function properly in the new PLD model.

Model Parameter Updates

The following growth parameters required updating to reflect the modelling changes. The source of the updated growth used is indicated:

- Value of Time Business - WebTAG
- Value of Time Leisure - WebTAG
- Car Fuel Cost – WebTAG
- Rail and Coach Fare – Interpolation/Extrapolation of existing data
- Airport Parking Charges – GDP Growth provided by Motts/MVA
- Taxi/Minicab fares – GDP Growth provided by Motts/MVA.

The key parameters were modified to reflect changes to the input assumptions, guidance documents and economic forecasts. Where no appropriate guidance was available, geometric interpolation/extrapolation was used to infill the required parameters; this method was undertaken for rail and coach fares, where coach fare growth was assumed to be the same as rail. The growth factors were converted into the appropriate format for input into the spreadsheet with a 2003 base year for parameters (normalised to 100).

Review of Base Mode Shares, implementation of Revised CAA data and forecasts.

The original model used a 50:50 split of 2007 and 2008 CAA access mode survey data to produce the 2008 base year mode shares. To update this for the new 2010 model base year, the corresponding CAA data were obtained for all years from 2007-2010. The approach undertaken was to use the 2007 and 2008 to check the data processing produced mode shares consistent with the original model. When this was verified with the help of DfT, the same process was applied to produce a 50:50 split of 2009 and 2010 CAA data for the 2010 mode shares. All data provided were converted from 406 zone district/TEMPRO zones to PLD zones using a correspondence list.

The processing of the CAA Heathrow access survey data required the choice of main mode from (up to) three different access modes used in the course of the entire journey. The simplified approach used was to use the final mode as the main mode, with the exception that rail would be chosen as main mode if any part of the journey was made using rail. Although there were differences between the approaches to processing the data, in aggregate the total differences were small.

The CAA data do not include Air as a mode used to access the airport. In the original version of the air demand model, there is a significant proportion that uses air as the main access mode. As the source of this approximation is not known, there is uncertainty as to what approximation should be used, and how the demand in the ADM should interact with the Domestic and International Air demand within PLD. As the CAA data are sparse, gaps on the base mode shares were infilled using the original model shares.

The final stage of the model update was to update the Heathrow surface access trip forecasts that represent the total forecast year demand. The output model was run by DfT for 2010, 2026 and 2036. These were converted to PLD zoning and inserted into the spreadsheet over the previous model years from the original version.

Appendix 3 Future rail services

Table A3.1 below shows the number of weekday trains originating or terminating at West Coast stations on services to or from Euston.

Table A3.1 Number of Weekday Trains To/From Euston Originating/ Terminating at West Coast Stations

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
Up to Euston		
Bangor	1	1
Birmingham International	1	1
Birmingham New Street	26	26
Chester	7	7
Glasgow Central	12	14
Holyhead	5	5
Lancaster	3	9
Liverpool Lime Street	16	16
Manchester Piccadilly	46	46
Preston	2	
Rugby	1	
Wolverhampton	19	19
Down from Euston		
Bangor	2	2
Birmingham New Street	24	24
Chester	8	8
Crewe	1	0
Glasgow Central	12	15
Holyhead	4	4

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
Lancaster	3	9
Liverpool Lime Street	17	17
Manchester Piccadilly	43	43
Preston	3	0
Wolverhampton	19	20

Table A3.2 below shows the number of weekday trains originating or terminating at West Coast stations on services to or from Euston.

Table A3.2 Number of Weekday Trains To/From Marylebone Originating/ Terminating at Chiltern Line Stations

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
Up to Marylebone		
Aylesbury	6	10
Bicester North	14	
Birmingham Moor Street		12
Birmingham Snow Hill	23	15
Banbury	6	11
Gerrards Cross	1	8
High Wycombe	31	29
Kidderminster	5	4
Leamington Spa	1	-
Oxford		19
Princes Risborough	8	8
Stratford upon Avon	6	5
Warwick Parkway	1	1
West Ruislip	1	4
Down from Marylebone		
Aylesbury	8	17
Bicester North	16	
Birmingham Moor Street		13
Birmingham Snow Hill	25	15
Banbury	7	15
Gerrards Cross	2	4

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
High Wycombe	25	28
Kidderminster	4	4
Leamington Spa		1
Oxford		15
Princes Risborough	9	7
Stratford upon Avon	5	6
South Ruislip		2
Stourbridge Junction	1	2
Warwick Parkway	1	
West Ruislip		4

Table A3.3 below shows the number of weekday trains originating or terminating at Midland Mainline stations on services to or from St Pancras.

Table A3.3 Number of Weekday Trains To/From St Pancras Originating/ Terminating at Midland Mainline Stations

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
Up to St Pancras		
Corby	12	12
Derby	2	2
Leeds	2	2
Lincoln Central	1	1
Nottingham	28	28
Sheffield	28	28
Down from St Pancras		
Corby	12	12
Derby	5	5
Leeds	3	3
Lincoln Central	1	1
Melton Mowbray	1	1
Nottingham	27	27
Sheffield	26	26

Table A3.4 below shows the number of weekday trains originating or terminating at East Coast Mainline stations on services to or from Kings Cross. These include services by both franchise and Open Access operators.

Table A3.4 Number of Weekday Trains To/From King's Cross Originating/ Terminating at East Coast Mainline Stations

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
Up to King's Cross		
Aberdeen	3	3
Bradford Forster Square	1	1
Bradford Interchange	2	3
Berwick upon Tweed		1
Dundee		1
Edinburgh	7	20
Glasgow Central	6	1
Harrogate	1	2
Hull	8	7
Inverness	1	1
Leeds	28	41
Lincoln Central		1
Newcastle	13	17
Peterborough		1
Skipton	1	1
Sunderland	4	3
Down from King's Cross		
Aberdeen	3	3
Bradford Forster Square	1	1
Bradford Interchange	3	3
Edinburgh	6	21

	2010 (trains per 16-hour day)	2026/2037 (trains per 16-hour day)
Glasgow Central	6	1
Hull	7	7
Inverness	1	1
Leeds	28	43
Lincoln Central		1
Newcastle	12	16
Sunderland	4	4
York	1	1

Appendix 4 Future air services

Table A4.1 shows base year air services additional to those found in CAA data that were identified using data from airline and airport websites. These services are coded into the PLD model to operate in both directions.

Table A4.1 Additional Base Year Air Services

From	To
Aberdeen	Bristol
Aberdeen	Cardiff
Aberdeen	Durham Tees Valley
Aberdeen	East Midlands
Aberdeen	Exeter
Aberdeen	Humberside
Aberdeen	Leeds
Aberdeen	Newquay
Aberdeen	Norwich
Aberdeen	Southampton
Bristol	Inverness
Bristol	Leeds
Bristol	Newquay
Bristol	Manchester
East Midlands	Newquay
Exeter	Leeds
Inverness	Southampton
Leeds	Newquay
Leeds	Southampton
Liverpool	Southampton
Manchester	Stansted

Table A4.2 shows 2010 air services that do not operate in future year scenarios. Where a service is shown as blank it operates in the year concerned; for example, Aberdeen to Gatwick does not operate in 2026, but does in 2036 and 2046.

Table A4.2 2010 Air Services which no Longer Operate in Future Year Scenarios

2026	2036	2046
		Aberdeen to East Midlands
Aberdeen to Gatwick		
	Aberdeen to Heathrow	Aberdeen to Heathrow
Aberdeen to Luton		
		East Midlands to Aberdeen
		East Midlands to Edinburgh
		Edinburgh to East Midlands
		Edinburgh to Heathrow
Edinburgh to Luton	Edinburgh to Luton	
Edinburgh to Stansted	Edinburgh to Stansted	Edinburgh to Stansted
Gatwick to Aberdeen		
Gatwick to Manchester	Gatwick to Manchester	Gatwick to Manchester
Glasgow to Heathrow	Glasgow to Heathrow	Glasgow to Heathrow
	Glasgow to Leeds Bradford	
Glasgow to London City	Glasgow to London City	Glasgow to London City
Glasgow to Manchester	Glasgow to Manchester	Glasgow to Manchester
	Heathrow to Aberdeen	Heathrow to Aberdeen
		Heathrow to Edinburgh
Heathrow to Glasgow	Heathrow to Glasgow	Heathrow to Glasgow
Heathrow to Manchester	Heathrow to Manchester	Heathrow to Manchester
Inverness to Luton		
	Leeds Bradford to Glasgow	

2026	2036	2046
London City to Glasgow	London City to Glasgow	London City to Glasgow
	London City to Inverness	London City to Inverness
Luton to Aberdeen		
Luton to Edinburgh		
Luton to Inverness		
	Luton to Edinburgh	
Manchester to Gatwick	Manchester to Gatwick	Manchester to Gatwick
Manchester to Glasgow	Manchester to Glasgow	Manchester to Glasgow
Manchester to Heathrow	Manchester to Heathrow	Manchester to Heathrow
		Manchester to Plymouth
		Plymouth to Manchester
Prestwick to Stansted	Prestwick to Stansted	Prestwick to Stansted
		Stansted to Aberdeen
Stansted to Edinburgh	Stansted to Edinburgh	Stansted to Edinburgh
	Stansted to Inverness	Stansted to Inverness
Stansted to Prestwick	Stansted to Prestwick	Stansted to Prestwick

Table A4.3 shows additional air services that operate in future year scenarios but do not operate in 2010. In this case, a blank entry shows that the service does not operate.

Table A4.3 Additional Air Services That Begin Operating in Future Year Scenarios

2026	2036	2046
Aberdeen to Stansted	Aberdeen to Stansted	
Stansted to Aberdeen	Stansted to Aberdeen	
Bournemouth to Inverness	Bournemouth to Inverness	Bournemouth to Inverness
Inverness to Bournemouth	Inverness to Bournemouth	Inverness to Bournemouth
Cardiff to Inverness		
Inverness to Cardiff		
Exeter to Inverness	Exeter to Inverness	Exeter to Inverness
Inverness to Exeter	Inverness to Exeter	Inverness to Exeter
London City to Inverness		
Inverness to London City		
Stansted to Inverness		
Inverness to Stansted		
Doncaster to Luton	Doncaster to Luton	Doncaster to Luton
Luton to Doncaster	Luton to Doncaster	Luton to Doncaster
Prestwick to Leeds	Prestwick to Leeds	Prestwick to Leeds
Leeds to Prestwick	Leeds to Prestwick	Leeds to Prestwick
Prestwick to Liverpool	Prestwick to Liverpool	Prestwick to Liverpool
Liverpool to Prestwick	Liverpool to Prestwick	Liverpool to Prestwick
Prestwick to Manchester	Prestwick to Manchester	Prestwick to Manchester
Manchester to Prestwick	Manchester to Prestwick	Manchester to Prestwick
Manchester to Luton	Manchester to Luton	Manchester to Luton
Luton to Manchester	Luton to Manchester	Luton to Manchester
Norwich to Newquay	Norwich to Newquay	Norwich to Newquay
Newquay to Norwich	Newquay to Norwich	Newquay to Norwich

2026	2036	2046
	Glasgow to Norwich	Glasgow to Norwich
	Norwich to Glasgow	Norwich to Glasgow
	Leeds Bradford to Plymouth	
	Plymouth to Leeds Bradford	
	East Midlands to Humberside	
	Humberside to East Midlands	
	Luton to Norwich	Luton to Norwich
	Norwich to Luton	Norwich to Luton
	Liverpool to Newquay	Liverpool to Newquay
	Newquay to Liverpool	Newquay to Liverpool
	Doncaster to Norwich	Doncaster to Norwich
	Norwich to Doncaster	Norwich to Doncaster
		Blackpool to Glasgow
		Glasgow to Blackpool
		Bournemouth to Aberdeen
		Aberdeen to Bournemouth
		Humberside to Birmingham
		Birmingham to Humberside

Table A4.4 shows services operating in the 2010 forecasts, and for subsequent forecast years, from the DfT's aviation model but could not be identified as operating in 2010. These services were added to the future year networks.

Table A4.4 Additional Future Year Air Services

From	To
Bristol	Manchester
Bristol	Newquay
Bristol	Plymouth
Edinburgh	Doncaster
Edinburgh	Inverness
Newquay	Leeds Bradford
Newquay	Stansted
Norwich	Exeter
Bristol	Leeds Bradford
Newquay	Newcastle
Newquay	London City
Inverness	East Midlands
Birmingham	Newquay

Appendix 5 Future highway schemes

Table A5.1 below shows the highway schemes included in the 2026 networks along with the status of each scheme, likely start date and the uncertainty classification (in line with WebTAG guidance).

Table A5.1 Highway Schemes Included in 2026 Networks

Scheme	Status	Work To Start-	Uncertainty Classification
A1 Bramham - Wetherby	Open	-	Open
A1 Dishforth – Barton- Leeming	Construction	2009	On Site
A1 Gateshead/ Newcastle Bypass	On Hold	2021+	Reasonably Foreseeable
A11 Fiveways to Thetford	Planned	2012	Near Certain
A14 Kettering J7 - J9	Planned	2016+	More Than Likely
A160/A180 Improvements Immingham	Planned	2013	Near Certain
A23 Handcross to Warninglid	Planned	2011	Near Certain
A3 Hindhead Improvement	Open	-	Open
A421 Bedford to M1 Junction 13	Open	-	Open
A45/A46 Tollbar End Improvement;	Planned	2016+	More Than Likely
A453 Widening (M1 J24 to A52 Nottingham)	Planned	2016+	More Than Likely
A46 Newark Widmerpool	Construction	2009	On Site
A465 upgrade between Abergavenny to Hirwaun	Planned/ Construction	Complete by 2020	Near Certain/ On site
A505 Dunstable Northern Bypass (A5-M1 Link)	Planned	2016+	More Than Likely
A556 Knutsford to Bowdon Improvement	Planned	2014	Near Certain
A90 Aberdeen Western Peripheral Road	Planned	?	More Than Likely
M1 J10-13 HSR	Construction	2011	Near Certain
M1 J19 to M6	Planned	2016+	More Than Likely
M1 J21a to J25 HSR	On Hold	2021+	Reasonably Foreseeable
M1 J25 to J28 widening	Open	-	Open
M1 J28-31 HSR	Planned	2014	Near Certain
M1 J32-35a HSR	Planned	2012	Near Certain

Scheme	Status	Work To Start-	Uncertainty Classification
M1 J35a-37 HSR	On Hold	2021+	Reasonably Foreseeable
M1 J37–39 HSR	On Hold	2021+	Reasonably Foreseeable
M1 J39-42 HSR	Planned	2014	Near Certain
M25 J16-23 widening	Construction	2009	On Site
M25 J23-27 HSR	Planned	2014	Near Certain
M25 J27-30 widening	Construction	2009	On Site
M25 J30 widening	Planned	2016+	More Than Likely
M25 J5 to J6/7 HSR	Planned	2014	Near Certain
M27 J3-4 widening	Open	-	Open
M3 J2-4a HSR	Planned	2016+	More Than Likely
M4 J19-20 HSR	Planned	2012	Near Certain
M4 J3-12 HSR	Planned	2016+	More Than Likely
M4 J3-2 Bus Lane Suspension	Open	-	Open
M4 upgrades between J23A–J29	Programme Entry	?	More Than Likely
M40 J16 to M42 J3A HSR	Open	-	Open
M42 J7-J9 HSR	Open	-	Open
M5 J15-17 HSR	Planned	2012	Near Certain
M54 to M6 (Toll) link along A460	Planned	2016+	More Than Likely
M6 J10a-13 HSR	Planned	2016+	More Than Likely
M6 J13-19 HSR	On Hold	2021+	Reasonably Foreseeable
M6 J4-5 HSR	Open	-	Open
M6 J5-8 HSR	Planned	2012	Near Certain
M6 J8-10a HSR	Open	-	Open
M60 J12-15 widening (lane gain)	Planned	2014	Near Certain
M60 J8-12 HSR	Planned	2014	Near Certain
M62 J18-20 HSR	Planned	2014	Near Certain
M62 J25-30 HSR	Planned	2011	Near Certain
M74 completion between Fullarton Road roundabout & J20 M8	Open	-	Open
M8 Baillieston to Newhouse Improvements	Planned	?	Near Certain
M80 Upgrade between Stepps & Mollinsburn	Open	-	Open

For the 2037 cap year, additional schemes were included to reflect likely increases in capacity on the motorway network. Whilst these schemes are not currently in any programmes these schemes were taken from earlier National Transport Model (NTM) assumptions about likely capacity increases. These schemes are all hard shoulder running schemes and do not include permanent carriageway widening.

This assumption was discussed with the DfT and their view was that it was reasonable to assume that additional capacity will be added to the motorway network over the period beyond 2026 and that the NTM list of schemes should be used as a guide. These schemes are shown in Table A5.2 below.

Table A5.2 Additional Highway Schemes Included in 2037 Networks

Scheme	Status	Work To Start-	Uncertainty Classification
M1 J13 to J19 HSR	N/A	-	Hypothetical
M20 J3 – J5 HSR	N/A	-	Hypothetical
M23 J8 – J10 HSR	N/A	-	Hypothetical
M27 J4 – J11 HSR	N/A	-	Hypothetical
M3 J9 to J14 HSR	N/A	-	Hypothetical
M5 J4a – J6 HSR	N/A	-	Hypothetical
M6 J2 – J4 HSR	N/A	-	Hypothetical
M6 J21A – J26 HSR	N/A	-	Hypothetical
M60 J12 – J18 HSR	N/A	-	Hypothetical
M60 J24 – J27 HSR	N/A	-	Hypothetical
M62 J10 – J12 HSR	N/A	-	Hypothetical
M62 J26 – M606 Link HSR	N/A	-	Hypothetical

PLD Rail Assignment Validation

Emme/2 has been used to output assigned transit segment volumes for the updated Base Year Validation model. Results of the validation across screenlines are presented in Tables A6.1 to A6.16 below, along with a comparison of the results of the previous February 2011 validated base year model. It should be noted that direct comparisons cannot be made between the current model and the previous Consultation model, as they each represent different base years – the February 2011 model was a 2007/8 base year, the present model has a base year of 2010/11.

Each link on a screenline has been designated as a 'Pass' or 'Fail' to indicate whether it meets the WebTAG validation guidance[22] of being within 25% of observed on each modelled link flow. Screenlines are also labelled as a 'Pass' or 'Fail' to show if they meet WebTAG validation guidance of being within 15% of the screenline observations as a whole.

London Termini Validation

Figure A6.1 London Termini Screenlines

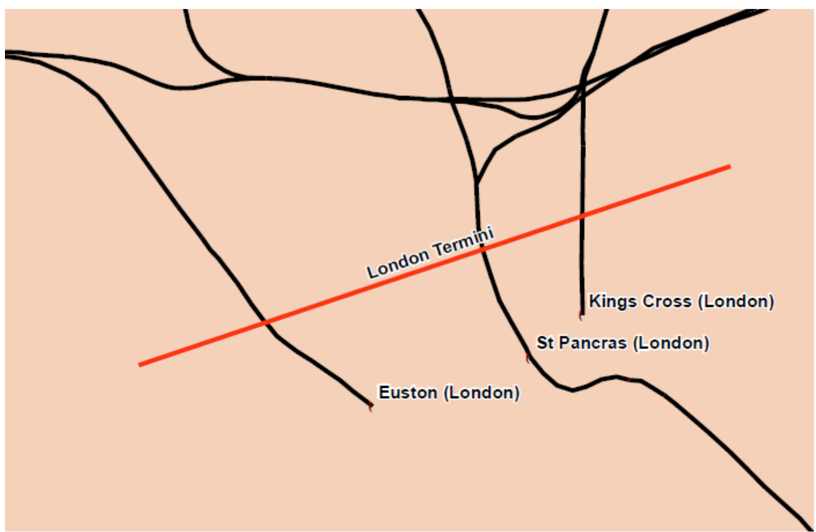


Figure A6.1 above shows the screenline for three London termini – Euston, St. Pancras and Kings Cross. The validation data are calculated for long-distance TOCs only. There are two sources of observed data at these locations – MOIRA and Guards' counts. The available data are a useful check against the assigned flows on each TOC, but are incomplete in terms of other TOCs operating from the same stations. This potentially implies that if data for a particular TOC do not match, it will not be clear whether the overall loading on the link is incorrect, or whether the balance between TOCs in that corridor is incorrect.

22 TAG Unit 3.11.2 para 10.1.6

Table A6.1 shows the validation of the modelled flows using the Guards' counts. As can be seen, the modelled flows on long distance WCML services at Euston are higher than observed Guards' counts, whilst flows into St. Pancras are lower. It should be noted that the absolute differences between modelled flows and counts at Euston are slightly less than the February 2011 base model, and higher demand levels in 2010/11 means validation improves slightly.

There is a noticeable under-prediction on both the ECML and MML, however this does not appear to be due to long-distance demand. Modelled flows are closer to MOIRA flows on the ECML north and south of Peterborough (Tables A6.3 and A6.4) and on MML north and south of Bedford (Tables A6.5 and A6.6). This suggests that it is the PLANET South flows that are affecting the validation at King's Cross and St Pancras. The same is not the case on the WCML, where validation at Milton Keynes (Tables A6.7 and A6.8) and Euston (Tables A6.1, A6.2) both show an over-estimation of modelled flows.

Table A6.2 shows London termini screenline validation using MOIRA data. The Guards' counts show an all-day balanced flow, whilst MOIRA suggests directionally imbalanced demand allocations to MML and ECML. Additionally, MOIRA 'counts' do not take account of crowding - important for Central London trains. The trends observable from the Guards' counts, with under allocation at St. Pancras and Kings Cross are exaggerated using MOIRA data.

Overall, the model appears to validate well for long distance trains, just outside the Planet South boundary (Tables A6.3 - A6.6). Within this boundary there are problems of allocations to the right TOC – the tables only consider flows, and counts, from strategic TOCs, and not local ones (London Midland at Euston, Thameslink/FCC at St. Pancras, First Capital Connect at Kings Cross). Most models will tend to produce passenger interchanges to save small journey times, and the model may be predicting more changes between TOCs than actually occur. The PS validation (shown later) is more relevant when considering the calibration at London terminals.

Table A6.1 London Termini Screenline - Counts

			February 2011 Base Model					November 2011 Base Model				
Route / Strategic TOC	Station	Direction	Guard Count (2007)	PLD Model (Modelled)	Difference	% Difference	Pass / Fail	Guard Count (2010)	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
West Coast Main Line	Euston	N-bound	19,124	24,805	5,681	30%	Fail	27,097	30,624	3,526	13%	Pass
		S-bound	18,717	24,752	6,035	32%	Fail	27,123	31,191	4,068	15%	Pass
Midland Main Line	St Pancras	N-bound	12,975	12,181	-794	-6%	Pass	14,558	10,767	-3,791	-26%	Fail
		S-bound	12,307	11,872	-435	-4%	Pass	13,896	10,639	-3,257	-23%	Pass
East Coast Main Line	King's Cross	N-bound	15,106	16,984	1,878	12%	Pass	17,129	14,326	-2,803	-16%	Pass
		S-bound	14,025	18,174	4,149	30%	Fail	16,882	14,953	-1,929	-11%	Pass
Total		**N-bound**	**47,205**	**53,970**	**6,765**	**14%**	**Pass**	**58,784**	**55,717**	**-3,067**	**-5%**	**Pass**
		S-bound	**45,049**	**54,798**	**9,749**	**22%**	**Fail**	**57,900**	**56,783**	**-1,117**	**-2%**	**Pass**

Table A6.2 London Termini Screenline - MOIRA Flows

Route / Strategic TOC	Station	Direction	February 2011 Base Model: MOIRA 2007/08	February 2011 Base Model: PLD Model (Modelled)	February 2011 Base Model: Difference	February 2011 Base Model: % Difference	February 2011 Base Model: Pass / Fail	November 2011 Base Model: MOIRA 2010/11	November 2011 Base Model: PLD Model (Modelled)	November 2011 Base Model: Difference	November 2011 Base Model: % Difference	November 2011 Base Model: Pass / Fail
West Coast Main Line	Euston	N-bound	22,281	24,805	2,524	11%	Pass	28,739	30,624	1,885	7%	Pass
		S-bound	23,079	24,752	1,673	7%	Pass	28,537	31,191	2,654	9%	Pass
Midland Main Line	St Pancras	N-bound	12,993	12,181	-812	-6%	Pass	17,542	10,767	-6,775	-39%	Fail
		S-bound	14,321	11,872	- 2,449	- 17%	Pass	15,344	10,639	-4,705	-31%	Fail
East Coast Main Line	King's Cross	N-bound	19,775	16,984	- 2,791	- 14%	Pass	21,180	14,326	-6,854	-32%	Fail
		S-bound	17,829	18,174	345	2%	Pass	17,654	14,953	-2,701	-15%	Pass
Total		**N-bound**	**55,049**	**53,970**	**- 1,079**	**-2%**	**Pass**	**67,461**	**55,717**	**- 11,744**	**-17%**	**Fail**
		S-bound	**55,229**	**54,798**	**-431**	**-1%**	**Pass**	**61,535**	**56,783**	**-4,752**	**-8%**	**Pass**

Table A6.3 Peterborough North Screenline *

Route / Strategic TOC	Station	Direction	November 2011 Base Model: MOIRA 2010/11	November 2011 Base Model: PLD Model (Modelled)	November 2011 Base Model: Difference	November 2011 Base Model: % Difference	November 2011 Base Model: Pass / Fail
East Coast and Open Access	Peterborough	Northbound	16,820	16,533	-287	-2%	Pass
		Southbound	16,637	16,381	-256	-2%	Pass
Total		**Northbound**	**16,820**	**16,533**	**-287**	**-2%**	**Pass**
		Southbound	**16,637**	**16,381**	**-256**	**-2%**	**Pass**

* For this, and other tables, where the November 2011 base model figures only are shown, the equivalent comparisons for February 2011 were not undertaken at the time.

Table A6.4 Peterborough South Screenline

Route / Strategic TOC	Station	Direction	November 2011 Base Model: MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
East Coast and Open Access	Peterborough	Northbound	19,052	17,288	-1,764	-9%	Pass
		Southbound	19,040	16,826	-2,214	-12%	Pass
Total		**Northbound**	**19,052**	**17,288**	**-1,764**	**-9%**	**Pass**
		Southbound	**19,040**	**16,826**	**-2,214**	**-12%**	**Pass**

Table A6.5 Bedford North Screenline

Route / Strategic TOC	Station	Direction	November 2011 Base Model: MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
Midland Main Line	Bedford	Northbound	10,244	9,868	-376	-4%	Pass
		Southbound	10,301	9,891	-410	-4%	Pass
Total		**Northbound**	**10,244**	**9,868**	**-376**	**-4%**	**Pass**
		Southbound	**10,301**	**9,891**	**-410**	**-4%**	**Pass**

Table A6.6 Bedford South Screenline

Route / Strategic TOC	Station	Direction	November 2011 Base Model: MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
Midland Main Line	Bedford	Northbound	12,732	10,812	-1,920	-15%	Pass
		Southbound	11,991	10,783	-1,208	-10%	Pass
Total		**Northbound**	**12,732**	**10,812**	**-1,920**	**-15%**	**Pass**
		Southbound	**11,991**	**10,783**	**-1,208**	**-10%**	**Pass**

Validation for Midlands Screenlines

Figure A6.2 shows the location of the South of Midlands screenlines, and Figure A6.3 the location of the North of Midlands screenlines. Tables A6.7 and A6.8 show the validation for the South of Midlands screenlines, and Tables A6.9 and A6.10 the validation for the North of Midlands screenlines.

Figure A6.2 South of Midlands Screenlines

Figure A6.3 North of Midlands Screenlines

Table A6.7 South of Midlands Upper Screenline Results

			February 2011 Base Model					November 2011 Base Model				
Route	Station	Direction	MOIRA 2007/08	PLD Model (Modelled)	Difference	% Difference	Pass / Fail	MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
West Coast	Milton Keynes	N-bound	24,445	23,227	-1,218	-5%	Pass	27,067	29,601	2,534	9%	Pass
		S-bound	24,397	22,991	-1,406	-6%	Pass	27,462	30,189	2,727	10%	Pass
Chiltern	Bicester North	N-bound	2,730	3,245	515	19%	Pass	4,020	2,981	-1,039	-26%	Fail
		S-bound	2,651	3,166	515	19%	Pass	4,095	3,032	-1,063	-26%	Fail
Cross Country	Oxford	N-bound	3,882	2,967	-915	-24%	Pass	4,343	4,506	163	4%	Pass
		S-bound	3,957	3,129	-828	-21%	Pass	4,265	4,077	-188	-4%	Pass
Total		**N-bound**	**31,057**	**29,439**	**-1,618**	**-5%**	**Pass**	**35,430**	**37,088**	**1,658**	**5%**	**Pass**
		S-bound	**31,005**	**29,286**	**-1,719**	**-6%**	**Pass**	**35,822**	**37,298**	**1,476**	**4%**	**Pass**

Table A6.8 South of Midlands Lower Screenline Results

			February 2011 Base Model					November 2011 Base Model				
Route	Station	Direction	MOIRA 2007/08	PLD Model (Modelled)	Difference	% Difference	Pass / Fail	MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
West Coast	Milton Keynes	N-bound	29,483	24,888	-4,595	-16%	Pass	28,397	30,124	1,727	6%	Pass
		S-bound	29,433	24,598	-4,835	-16%	Pass	28,537	30,677	2,140	7%	Pass
Chiltern	Bicester North	N-bound	3,647	3,769	122	3%	Pass	5,209	3,152	-2,057	-39%	Fail
		S-bound	3,668	3,621	-47	-1%	Pass	5,275	3,178	-2,097	-40%	Fail
Cross Country	Oxford	N-bound	3,535	3,320	-215	-6%	Pass	4,165	4,611	446	11%	Pass
		S-bound	3,328	3,464	136	4%	Pass	3,538	4,213	675	19%	Pass
Total		**N-bound**	**36,665**	**31,977**	**-4,688**	**-13%**	**Pass**	**37,771**	**37,888**	**117**	**0%**	**Pass**
		S-bound	**36,429**	**31,683**	**-4,746**	**-13%**	**Pass**	**37,350**	**38,067**	**717**	**2%**	**Pass**

Table A6.9 North of Midlands Upper Screenline

Station	Direction	February 2011 Base Model: MOIRA 2007/08	February 2011 Base Model: PLD Model (Modelled)	February 2011 Base Model: Difference	February 2011 Base Model: % Difference	February 2011 Base Model: Pass / Fail	November 2011 Base Model: MOIRA 2010/11	November 2011 Base Model: PLD Model (Modelled)	November 2011 Base Model: Difference	November 2011 Base Model: % Difference	November 2011 Base Model: Pass / Fail
Crewe	N-bound	8,270	9,894	1,624	20%	Pass	13,402	15,599	2,197	16%	Pass
	S-bound	8,103	9,524	1,421	18%	Pass	13,835	16,256	2,421	18%	Pass
Stoke	N-bound	7,229	7,701	472	7%	Pass	8,292	8,843	551	7%	Pass
	S-bound	7,466	8,431	965	13%	Pass	8,003	8,139	136	2%	Pass
Total	**N-bound**	**15,499**	**17,595**	**2,096**	**14%**	**Pass**	**21,694**	**24,441**	**2,747**	**13%**	**Pass**
	S-bound	**15,569**	**17,955**	**2,386**	**15%**	**Fail**	**21,838**	**24,395**	**2,557**	**12%**	**Pass**

Table A6.10 North of Midlands Lower Screenline Results

Station	Direction	February 2011 Base Model: MOIRA 2007/08	February 2011 Base Model: PLD Model (Modelled)	February 2011 Base Model: Difference	February 2011 Base Model: % Difference	February 2011 Base Model: Pass / Fail	November 2011 Base Model: MOIRA 2010/11	November 2011 Base Model: PLD Model (Modelled)	November 2011 Base Model: Difference	November 2011 Base Model: % Difference	November 2011 Base Model: Pass / Fail
Crewe	N-bound	8,727	10,360	1,633	19%	Pass	13,156	13,635	479	4%	Pass
	S-bound	8,554	9,627	1,083	13%	Pass	13,455	14,310	855	6%	Pass
Stoke	N-bound	7,772	8,378	606	8%	Pass	8,825	9,427	602	7%	Pass
	S-bound	7,953	8,906	953	12%	Pass	8,564	8,751	187	2%	Pass
Total	**N-bound**	**16,499**	**18,738**	**2,239**	**14%**	**Pass**	**21,981**	**23,062**	**1,081**	**5%**	**Pass**
	S-bound	**16,497**	**18,533**	**2,036**	**12%**	**Pass**	**22,019**	**23,061**	**1,042**	**5%**	**Pass**

The updated 2010/11 base model modelled total rail passenger volumes validate as well as, or better, than the February 2011 model on the rail network south of Midlands. The differences between observed and modelled rail passenger volumes pass the WebTAG validation criteria for both South of Midlands screenlines as a whole (modelled flows being within 15% of observed flows).

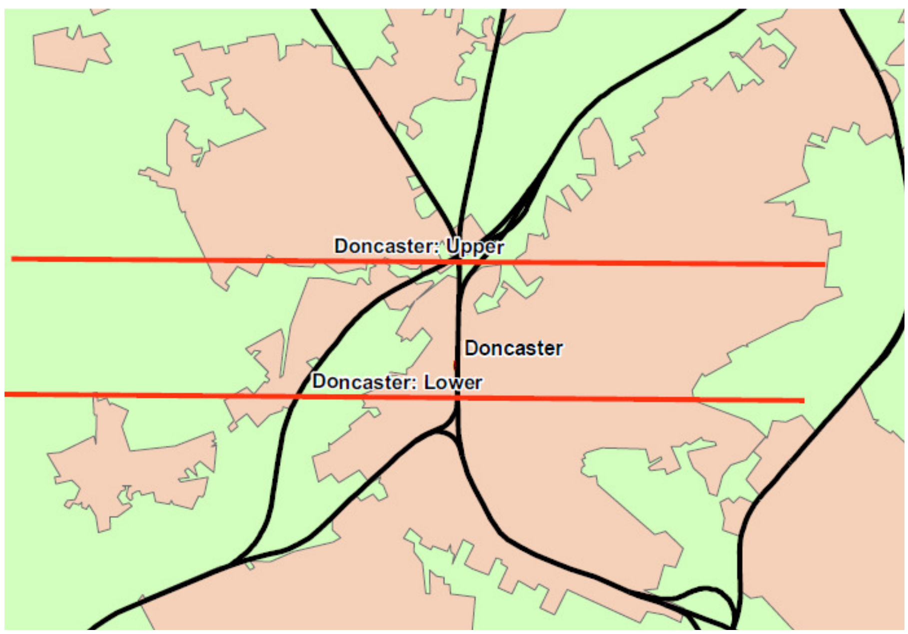
By individual TOC, there is an imbalance between the West Coast Mainline (which is over-assigned) and Chiltern, resulting in a failure to meet WebTAG validation criteria at Bicester North on both screenlines. This imbalance can be seen on both directions of flow. As at Euston, this suggests the model over-allocates passengers to WCML instead of Chiltern for long distance trips. As previously commented, we believe this is because PLD does not take account of fares when assigning routes (Chiltern fares are generally slightly lower than WCML).

For the north of Midlands screenlines all movements meet the WebTAG validation guidance of being within 25% of observed on the modelled link flows, and within 15% of the screenline as a whole. Validation in this model shows an improvement to that of the February 2011 model.

North of England Screenlines

The North of Midlands screenlines (shown previously) give an indication of the quality of the validation at various points between London/Birmingham and Manchester/Liverpool/Glasgow – i.e. the West Coast route. To show validation for routes to Leeds/York/Newcastle/Edinburgh, screenlines were also examined for the North of England on the East Coast route.

Figure A6.4 Doncaster Screenlines



There are two screenlines in the Doncaster area, lower and upper, as shown in Figure A6.4 above. Results are presented in Tables A6.11 and A6.12 below.

Table A6.11 Doncaster Upper Screenline Results

Route	Station	Direction	February 2011 Base Model: MOIRA 2007/08	February 2011 Base Model: PLD Model (Modelled)	February 2011 Base Model: Difference	February 2011 Base Model: % Difference	February 2011 Base Model: Pass / Fail	November 2011 Base Model: MOIRA 2010/11	November 2011 Base Model: PLD Model (Modelled)	November 2011 Base Model: Difference	November 2011 Base Model: % Difference	November 2011 Base Model: Pass / Fail
Cross Country	Doncaster	N-bound	-	-	-	-	-	1,534	1,945	411	27%	Fail
		S-bound	-	-	-	-	-	1,769	2,037	268	15%	Pass
East Coast and Open Access	Doncaster	N-bound	13,364	14,967	1,603	12%	Pass	15,101	14,551	-550	-4%	Pass
		S-bound	13,318	15,527	2,209	17%	Pass	15,418	14,781	-637	-4%	Pass
Total		**N-bound**	**13,364**	**14,967**	**1,603**	**12%**	**Pass**	**16,635**	**16,497**	**-138**	**-1%**	**Pass**
		S-bound	**13,318**	**15,527**	**2,209**	**17%**	**Fail**	**17,187**	**16,818**	**-369**	**-2%**	**Pass**

Table A6.12 Doncaster Lower Screenline Results

Route	Station	Direction	February 2011 Base Model: MOIRA 2007/08	February 2011 Base Model: PLD Model (Modelled)	February 2011 Base Model: Difference	February 2011 Base Model: % Difference	February 2011 Base Model: Pass / Fail	November 2011 Base Model: MOIRA 2010/11	November 2011 Base Model: PLD Model (Modelled)	November 2011 Base Model: Difference	November 2011 Base Model: % Difference	November 2011 Base Model: Pass / Fail
Cross Country	Doncaster	N-bound	-	-	-	-	-	1,731	2,064	333	19%	Pass
		S-bound	-	-	-	-	-	2,393	2,315	-78	-3%	Pass
East Coast and Open Access	Doncaster	N-bound	13,442	16,036	2,594	19%	Pass	15,611	15,469	-142	-1%	Pass
		S-bound	13,151	15,811	2,660	20%	Pass	15,526	15,476	-50	0%	Pass
Total		**N-bound**	**13,442**	**16,036**	**2,594**	**19%**	**Fail**	**17,342**	**17,533**	**191**	**1%**	**Pass**
		S-bound	**13,151**	**15,811**	**2,660**	**20%**	**Fail**	**17,919**	**17,791**	**-128**	**-1%**	**Pass**

At both these screenlines we show a substantial improvement in validation from the previous version of the model. The Doncaster Upper screenline, whilst struggling to differentiate between TOCs at this location, nevertheless meets WebTAG criteria for the screenline. Whilst we have shown the Cross Country match here as a fail, both Cross Country and East Coast services cross the screenline at the same point.

The Doncaster Lower screenline meet the WebTAG validation guidance for each link, and for the screenline as a whole, a considerable improvement from the February 2011 model.

Newcastle screenlines are shown in Figure A6.5 below, with results in Tables A6.13 and A6.14.

Figure A6.5 Newcastle Screenlines

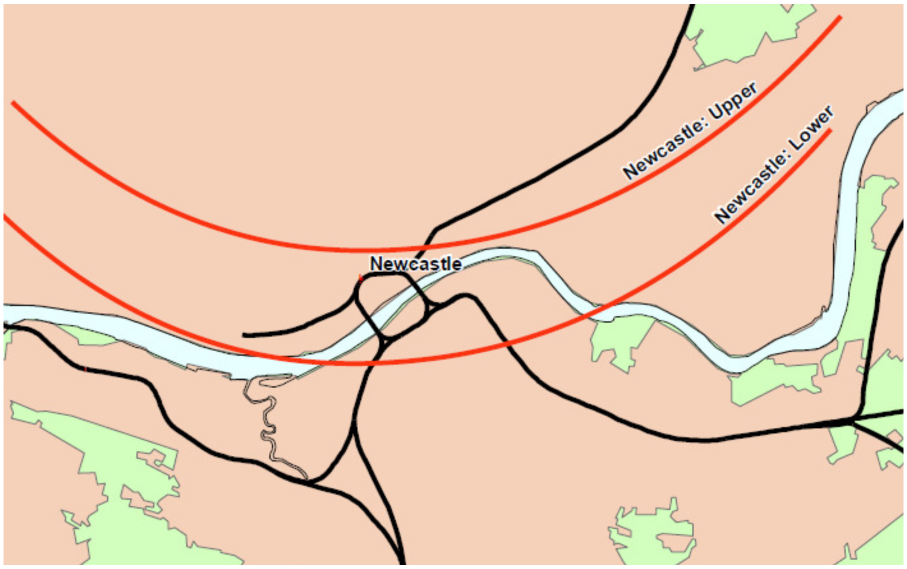


Table A6.13 Newcastle Upper Screenline Results

Route	Station	Direction	February 2011 Base Model: MOIRA 2007/08	PLD Model (Modelled)	Difference	% Difference	Pass / Fail	November 2011 Base Model: MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
Cross Country	Newcastle	N-bound	-	-	-	-	-	1,685	1,873	188	11%	Pass
		S-bound	-	-	-	-	-	1,593	1,781	188	12%	Pass
East Coast	Newcastle	N-bound	3,978	4,535	557	14%	Pass	4,611	4,558	-53	-1%	Pass
		S-bound	3,845	4,781	936	24%	Pass	4,726	4,671	-55	-1%	Pass
Total		**N-bound**	**3,978**	**4,535**	**557**	**14%**	**Pass**	**6,296**	**6,431**	**135**	**2%**	**Pass**
		S-bound	**3,845**	**4,781**	**936**	**24%**	**Fail**	**6,319**	**6,451**	**132**	**2%**	**Pass**

Table A6.14 Newcastle Lower Screenline

Route	Station	Direction	February 2011 Base Model: MOIRA 2007/08	PLD Model (Modelled)	Difference	% Difference	Pass / Fail	November 2011 Base Model: MOIRA 2010/11	PLD Model (Modelled)	Difference	% Difference	Pass / Fail
Cross Country	Newcastle	N-bound		-	-	-	-	3,645	3,671	26	1%	Pass
		S-bound		-	-	-	-	3,619	3,477	-142	-4%	Pass
East Coast	Newcastle	N-bound	6,177	7,245	1,068	17%	Pass	6,505	7,159	654	10%	Pass
		S-bound	5,900	7,603	1,703	29%	Fail	6,818	7,321	503	7%	Pass
Total		**N-bound**	**6,177**	**7,245**	**1,068**	**17%**	**Fail**	**10,150**	**10,830**	**680**	**7%**	**Pass**
		S-bound	**5,900**	**7,603**	**1,703**	**29%**	**Fail**	**10,437**	**10,798**	**361**	**3%**	**Pass**

The screenlines at Newcastle also show an improvement in validation, compared to the February 2011 model. As can be seen, all TOC flows meet the WebTAG validation guidance of being within 25% of observed on the modelled link flows, and within 15% of the screenline as a whole.

PLANET South and PLANET Midland Assignment Validation

For Planet South, results of validation at Central London stations are presented in Table A6.15. Overall levels of validation for the screenline remain within WebTAG criteria, but flows at individual links, while generally within WebTAG criteria, do not validate as well as with the previous model. We believe this reflects the difficulty of modelling the interaction between the peak period Planet South model of predominantly commuter flows, with the all day, long distance only PLD model. Nevertheless, flows show an acceptable level of validation, given this area is not the focus of interest.

Table A6.15 PLANET South Validation Flows (07:00 - 09:59 arrivals in Central London)

	February 2011 Base Model					November 2011 Base Model				
Route Station Direction	**Green Book (PIXC) Counts 2007**	**PS Framework**	**Difference**	**% Difference**	**Pass / Fail**	**Green Book (PIXC) Counts 2010**	**PS Framework**	**Difference**	**% Difference**	**Pass / Fail**
Great Western Main Line (Paddington)	22,973	21,486	-1,487	-6%	Pass	28,275	22,508	-5,767	-20%	Pass
Chiltern Main Line (Marylebone)	10,222	7,763	-2,459	-24%	Pass	11,546	7,311	-4,235	-37%	Fail
West Coast Main Line (Euston)	17,256	18,737	1,481	9%	Pass	22,603	19,751	-2,853	-13%	Pass
Midland Main Line (St Pancras)	23,543	23,828	285	1%	Pass	23,144	27,388	4,244	18%	Pass
East Coast Main Line (Finsbury Pk)	32,752	32,238	-514	-2%	Pass	35,939	32,800	-3,140	-9%	Pass
Total	**106,746**	**104,052**	**-2,694**	**-3%**	**Pass**	**121,508**	**109,757**	**-11,751**	**-10%**	**Pass**

Planet Midland validation results are shown in Table A6.16 below. Validation remains at about the same level as the previous base year model. The Solihull Corridor flow remains significantly different from the observed data in percentage terms, but the flow is extremely small and in absolute terms the impact is small.

Table A6.16 Planet Midland Validation Results (To Birmingham New Street)

	February 2011 Base Model					November 2011 Base Model				
Corridor From Direction	Observed Counts 2007/08	PM Framework	Difference	% Difference	Pass / Fail	Observed Counts 2010/11	PM Framework	Difference	% Difference	Pass / Fail
West Coast Main Line (Coventry Corridor)	4,228	3,738	-490	-12%	Pass	4,851	4,985	135	3%	Pass
Solihull Corridor to New St (Long-distance TOCs)	311	109	-202	-65%	Fail	421	134	-287	-68%	Fail
West Coast Main Line (Wolverhampton Corridor)	4,647	4,765	118	3%	Pass	5,959	6,868	909	15%	Pass
All Corridors	**9,186**	**8,612**	**-574**	**-6%**	**Pass**	**11,230**	**11,987**	**757**	**7%**	**Pass**

Validation Conclusion

There has been a significant change to the base rail data in the model and hence to the validation. The overall rail passenger flow validation either remains consistent or improves upon the February 2011 model validation, with the differences being as expected given the scale of modifications to the model.

On the WebTAG criteria being examined, the validation is good. Where individual flows fail the validation tests there is an explanation, either due to model functionality (lack of fares modelling), geographical coverage, or to questions regarding the validation data.

In conclusion, we believe that the model is fit for purpose.

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For more information visit www.mvaconsultancy.com

Abu Dhabi
AS Business Centre, Suite 201, Al Ain Road, Umm al Nar, P.O. Box 129865, Abu Dhabi, UAE
T: +971 2 510 2402 F: +971 2 510 2403

Birmingham
Second Floor, 37a Waterloo Street
Birmingham B2 5TJ United Kingdom
T: +44 (0)121 233 7680 F: +44 (0)121 233 7681

Dublin
First Floor, 12/13 Exchange Place
Custom House Docks, IFSC, Dublin 1, Ireland
T: +353 (0)1 542 6000 F: +353 (0)1 542 6001

Edinburgh
Second Floor, Prospect House, 5 Thistle Street,
Edinburgh EH2 1DF United Kingdom
T: +44 (0)131 220 6966 F: +44 (0)131 220 6087

Glasgow
Seventh Floor, 78 St Vincent Street
Glasgow G2 5UB United Kingdom
T: +44 (0)141 225 4400 F: +44 (0)141 225 4401

London
Seventh Floor, 15 Old Bailey
London EC4M 7EF United Kingdom
T: +44 (0)20 3427 6273 F: +44 (0)20 3427 6274

Lyon
11, rue de la République, 69001 Lyon, France
T: +33 (0)4 72 10 29 29 F: +33 (0)4 72 10 29 28

Manchester
25th Floor, City Tower, Piccadilly Plaza
Manchester M1 4BT United Kingdom
T: +44 (0)161 236 0282 F: +44 (0)161 236 0095

Marseille
76, rue de la République, 13002 Marseille, France
T: +33 (0)4 91 37 35 15 F: +33 (0)4 91 91 90 14

Paris
12-14, rue Jules César, 75012 Paris, France
T: +33 (0)1 53 17 36 00 F: +33 (0)1 53 17 36 01

Woking
Dukes Court, Duke Street, Woking
Surrey GU21 5BH United Kingdom
T: +44 (0)1483 728051 F: +44 (0)1483 755207

Email: info@mvaconsultancy.com

Offices also in
Bangkok, Beijing, Hong Kong, Shenzhen and Singapore

mvaconsultancy