ATKINS

Greater Bristol Rapid Transit

G-BATS3 v2.3 Rapid Transit (Line 2: Ashton Vale to City Centre) - Forecast Report

March 2009

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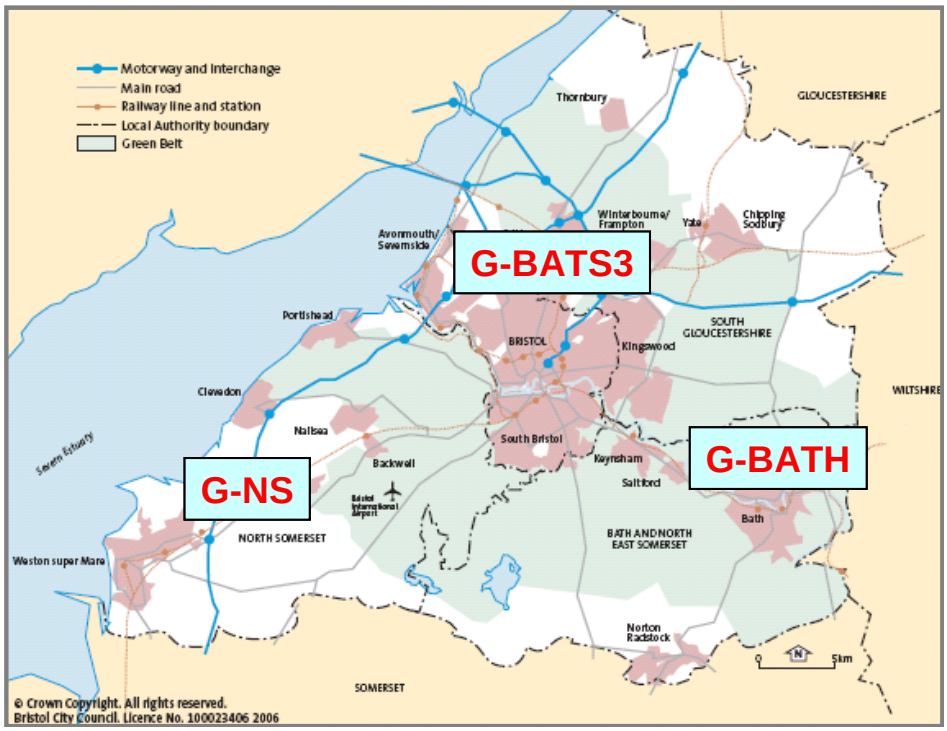
1. Introduction

Background

1.1 This Forecasting Report has been prepared by Atkins Limited under a commission to provide Consultancy Support for Transport Modelling to the West of England Partnership and its four constituent Unitary Authorities (UAs): North Somerset Council (NSC), Bristol City Council (BCC), Bath and North East Somerset Council (B&NES) and South Gloucestershire Council (SGC).

1.2 The commission included the development of a suite of models for the West of England sub-region's main urban areas: Greater Bristol, Greater Bath and North Somerset. The model development phase has produced a new modelling system referred to as the Greater Bristol Modelling Framework (GBMF), which follows Department for Transport (DfT) WebTAG guidance. This modelling system has been applied to each of the three models in the West of England sub-region. Each of the three models is free standing covering their respective areas of focus (Figure 1.1).

Figure 1.1 – GBMF Study Area



The G-BATS3 Model

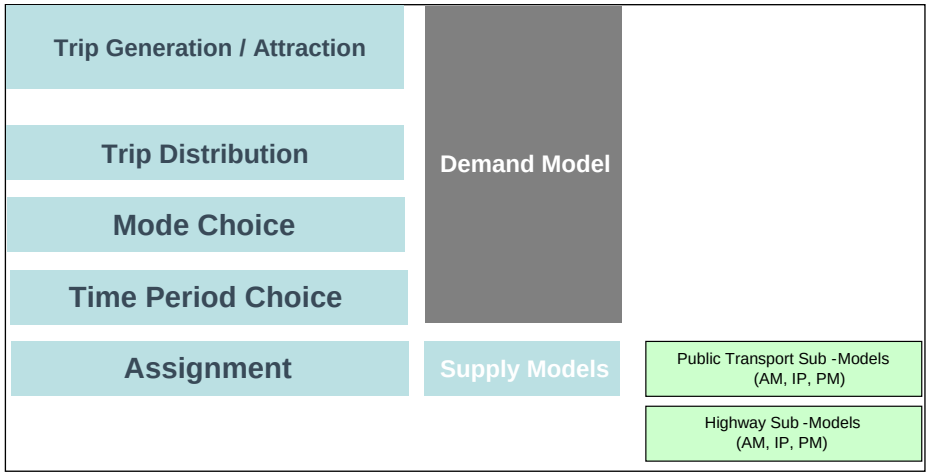
1.3 The Greater Bristol (G-BATS3) modelling system consists of three key elements:

- a highway model representing vehicle-based movements across the Greater Bristol area for a typical 2006 morning peak hour (08:00 – 09:00), an average inter-peak hour (10:00 – 12:00) and an evening peak hour (17:00 – 18:00);
- a public transport model representing bus and rail-based movements across the same area; and

- a five-stage multi-modal incremental demand model that considers the impact on frequency choice, main mode choice, time period choice, destination choice, and sub-mode choice in response to changes in generalised costs across the 24-hour period (07:00 – 07:00).

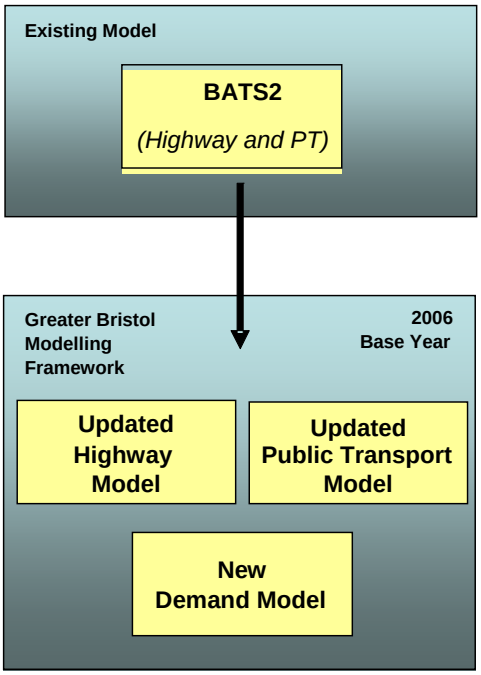
1.4 All three models have been developed to be compliant with the requirements for appropriate Variable Demand Modelling (TAG Unit 3.10), Modelling Public Transport Schemes (TAG Unit 3.11) and Modelling Road Pricing (TAG Unit 3.12). The overall structure of the G-BATS3 model is shown below (Figure 1.2).

Figure 1.2 – G-BATS3 Modelling Structure



1.5 The development of the 2006 G-BATS3 modelling system is summarised below in Figure 1.3, the system using the earlier Bristol Area Transport Study 2 model (BATS2) which included a Public Transport model as a starting point and the GBMF Demand module to create the local G-BATS3 v2.3 models.

Figure 1.3 – G-BATS3 Model Development



Model Development

1.6 The BATS2 model, with a base year of 2004, was previously developed by Atkins Planning Consultants for BCC. The development of the BATS2 model, undertaken by Atkins, was

described in the report *Bristol Area Traffic Studies 2 Model Development and Validation Report (Atkins, July 2005)*

1.7 As part of the development of the Greater Bristol Modelling Framework (GBMF), the BATS2 model was updated and re-based to 2006. These update tasks included:

- develop a demand model using the principles common to all GBMF models;
- update the public transport model, including;
  - revised service frequencies;
  - updates to the public transport network
  - conversion of the BATS2 trip matrices to the unified, ward-based zoning system used for G-BATS3 including revisions to centroid connectors where necessary;
  - calibration and validation of the G-BATS3 model using the latest 2006 survey data.
- update the highway model, including:
  - junction improvements and revisions to signal timings since 2004;
  - conversion of the BATS2 trip matrices to the unified, ward-based zoning system used for G-BATS3 including revisions to centroid connectors where necessary;
  - updates to bus routes and frequencies;
  - additional data collection surveys including link counts, turning counts and journey time surveys;
  - inclusion of newly collected data into the G-BATS3 highway matrices
  - calibration and validation of the G-BATS3 model using the latest 2006 survey data.

1.8 More detailed information can be found in the following reports, all of which are included in appendices:

- G-BATS3 v2.3 Highway Local Model Validation Report (*Atkins, March 2009*);
- G-BATS3 v2.3 Public Transport Local Model Validation Report (*Atkins, March 2009*); and
- G-BATS3 v2.3 Demand Model Validation Report (*Atkins, March 2009*).

Forecasting Approach

1.9 Transport forecasting is a three stage process. The first stage requires the generation of future year travel demand and is referred to as the 'reference case'. The second stage requires known changes in the supply of transport to be incorporated into the model, and is referred to as the 'without intervention case'. The final stage is to create the transport intervention and this is referred to as the 'with intervention case'.

1.10 The modelling framework has been developed to represent a 2006 Base Year to which the model has been calibrated and validated; and two forecast years: 2016 and 2031.

1.11 TEMPRO projections of population, employment and trip ends were used in the model to forecast travel growth across the whole of the sub-region for the G-BATS3 Model, however in order to more realistically reflect projected land use changes, travel demand growth has been distributed throughout the area using more detailed local planning data supplied by the West of England Partnership.

1.12 The following changes in transport supply were also made:

- Greater Bristol Bus Network - 10 Showcase Bus Corridors / new bus services in North Fringe;

- Bristol to Avonmouth Rail - Increased frequency from hourly to every 40 mins ;
- Cabot Circus – Completion of the new gyratory;
- Jacobswell Roundabout – signalisation;
- A38-Cribbs Causeway Distributor - New road as part of Filton Northfield development;
- Harry Stoke / A4174 - New junction and roads (including PT link) as part of Harry Stoke development;
- SBRR Phase 1 & 2 - A38-A370 link road & A38 to Hengrove; and
- Callington Road Link.

1.13 Additionally for 2031, the following schemes were included:

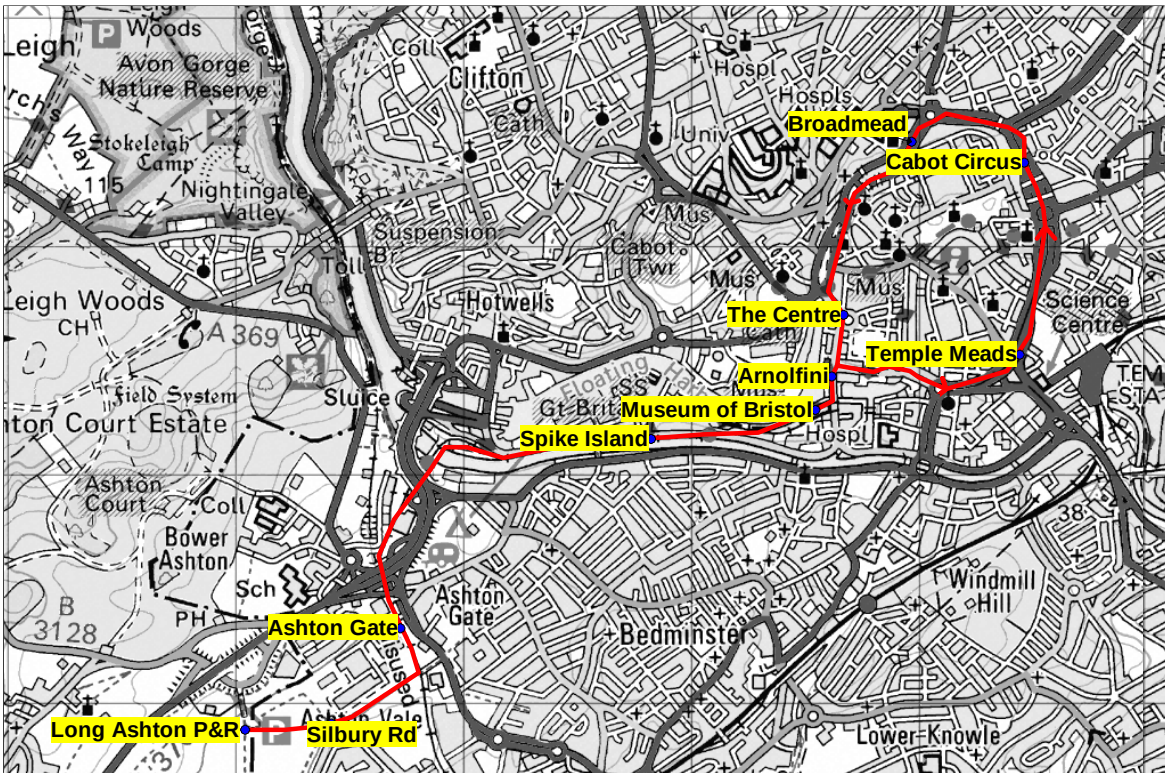
- Portishead to Bristol Rail Line;
- Ashton Vale Infrastructure - supporting infrastructure and bus services for the South West Area Development; and
- Barrow Gurney Bypass - Road linking A37 and A370.

The Scheme

1.14 This Forecasting Report accompanies the Bristol Rapid Transit Major Scheme Bid. The preferred option for this work includes:

- Ashton Vale to Temple Meads and Bristol City Centre Rapid Transit Scheme
  - consisting segregated corridors and an on-street section within the central area of Bristol with services extending out to the wider sub-region. The segregated corridor section consists of guided and non-guided sections ("the busway");
  - The alignment of the Rapid Transit line 2 is shown in Figure 1.4;
- Rerouting of the 354, X1 and X7 buses to use the new RT alignment.

Figure 1.4 – Rapid Transit Alignment



Structure of Report

1.15 This Forecasting Report accompanies the Major Scheme Bid submission for Bristol Rapid Transit Line 2 (RT2) and provides details on the outputs from the G-BATS3 model used to undertake the appropriate modelling and appraisal for RT2. This report contains the following sections:

- Chapter two describes the key land use assumptions that underpin the reference case travel demand;
- Chapter three sets out the future year travel supply assumptions detailing the schemes which have been included in Without-Intervention Case;
- Chapter four sets out the forecasting assumptions with regards to Vehicle Operating Costs, Values of Time, Bus fares, Rail fares and Parking charges;
- Chapter five sets out the forecast results for years 2016 and 2031 for the Without-Intervention Case; and
- Chapter six describes the forecast results for years 2016 and 2031 for the With-Intervention Case.

2. Future Year Demand Assumptions

Introduction

2.1 This chapter focuses on the development of future year trip matrices, describing the method used in calculating the trip ends. It also sets out how TEMPRO and local planning data have been utilised in the development of the future year 2016 and 2031 matrices.

Forecast Years

2.2 Centralised planning data forecasts are available for a range of forecast years through the DfT National Trip End Model (and hence TEMPRO) between 2001 and 2031. The LTP cycle is focussed on five-yearly intervals with LTP reflecting the period 2001-2006 whilst, more recently, LTP2 focussed on the period 2006-2011.

2.3 The recent submissions to the Regional Assembly have looked further ahead with assessments made for 2016, 2021, 2026 and 2031 reflecting both medium and/or longer term planning horizons. As such, the majority of the planning data currently available from the local authorities reflects 2011, 2016, 2021, 2026 and 2031 forecast years.

2.4 The modelling framework has been developed to represent a 2006 Base Year to which the model has been calibrated and validated; and two forecast years: 2016 and 2031.

Background Demand Growth

2.5 The need to forecast growth in car, public transport and heavy goods vehicles trip ends from 2006 to 2016 and 2031 is termed background growth. In order to calculate the vehicle and public transport forecast trip ends, TEMPRO (v5.4) was used to obtain growth forecasts supplemented by information relating to future land use provided by the West of England Partnership Office (WEPO).

2.6 DfT's TEMPRO data provides overall estimates for the growth of population, employment and trip ends for future years. The forecasts from TEMPRO are for each mode type (bus, car and rail for this model) and, in line with DfT forecasting requirements, are further split by trip purpose.

2.7 TEMPRO planning and trip end data by mode, trip purpose and car availability was utilised for the following areas:

- Bath & NE Somerset (Bath, Keynsham, Midsomer Norton / Radstock, Rural);
- City of Bristol;
- North Somerset (Clevedon / Backwell, Portishead, Rural, Weston-Super-Mare); and
- South Gloucestershire (Chipping Sodbury, Kingswood, Patchway, Rural, Thornbury, Winterbourne).

2.8 Table 2.1 summarises the overall population and employment figures for the West of England sub-region authorities.

2.9 Based on the TEMPRO trip ends, growth factors were calculated corresponding to each of the areas mentioned above by car availability and the five trip purposes considered within the GBMF:

- Home Based Work (HBW) – trips that have home at one end and work at the other end;
- Home Base Other (HBO) – trips that have home at the one end and do not have work at the other end. This would include trips relating to education, shopping, holidays, sport etc;
- Home Base Employers Business (HBEB) - trips from home to a place visited during the course of work;

- Non Home Based Employer's Business (NHBEB) – trips which do not begin or end at home but where one trip end is either the workplace or a place visited in the course of work; and
- Non Home Based Other (NHBO) – all remaining trips where one trip end is for education, shopping, personal business, sport, holidays etc.

Table 2.1 – TEMPRO Population and Employment Growth Data

Unitary Authority	Population			Employment		
	2006	2016	2031	2006	2016	2031
Bath & NE Somerset	155,940	170,207	191,264	96,013	107,252	123,452
Bristol City	388,275	423,001	470,212	231,926	260,395	309,987
North Somerset	182,850	206,666	243,872	85,171	95,358	109,810
South Gloucestershire	210,614	230,478	262,859	91,070	101,295	116,220
Sub-Region Total	*937,679*	*1,030,352*	*1,168,207*	*504,180*	*564,300*	*659,469*

2.10 These TEMPRO projections were used in the model to forecast growth across the whole of the West of England sub-region, however in order to more realistically match projected land use changes, travel demand growth has been distributed throughout the area using more detailed local planning data.

2.11 In the case of external (UK wide) zones, growth factors were taken from National Road Traffic Forecasts for all vehicle types combined.

Local Planning Data

2.12 Planning data (Table 2.2) provided by West of England Partnership gave a most likely scenario for the size and location of all planned new developments from the base year (2006) up to 2031, allowing estimates of 2016 and 2031 totals to be made to correspond to future forecast years.

Table 2.2 – WEPO Population and Employment Data

Unitary Authority	Total New Dwellings		Employment (jobs)	
	2016	2031	2016	2031
Bath & NE Somerset	8,700	23,542	11,300	17,972
Bristol City	19,539	34,753	25,039	48,722
North Somerset	10,865	31,879	12,356	23,310
South Gloucestershire	13,535	38,511	16,981	35,026
West of England sub-region	*52,640*	*128,685*	*65,676*	*125,695*

2.13 Each new development within the planning data was classified by land-use type as follows:

- Residential developments, specified in number of new houses.
- Employment developments , specified in GFA; further subcategorised into:
  - Retail
  - B1 (Office/Light Industrial sites)
  - B2 (General Industrial sites)
  - B8 (Storage and Distribution sites)

2.14 In addition to this data the site locations for these planned developments provided the basis for the spatial distribution of trips for the forecast model, by considering the locality of the developments in relation to the zones in the model. The total number of new houses and jobs were then allocated to the appropriate model zones.

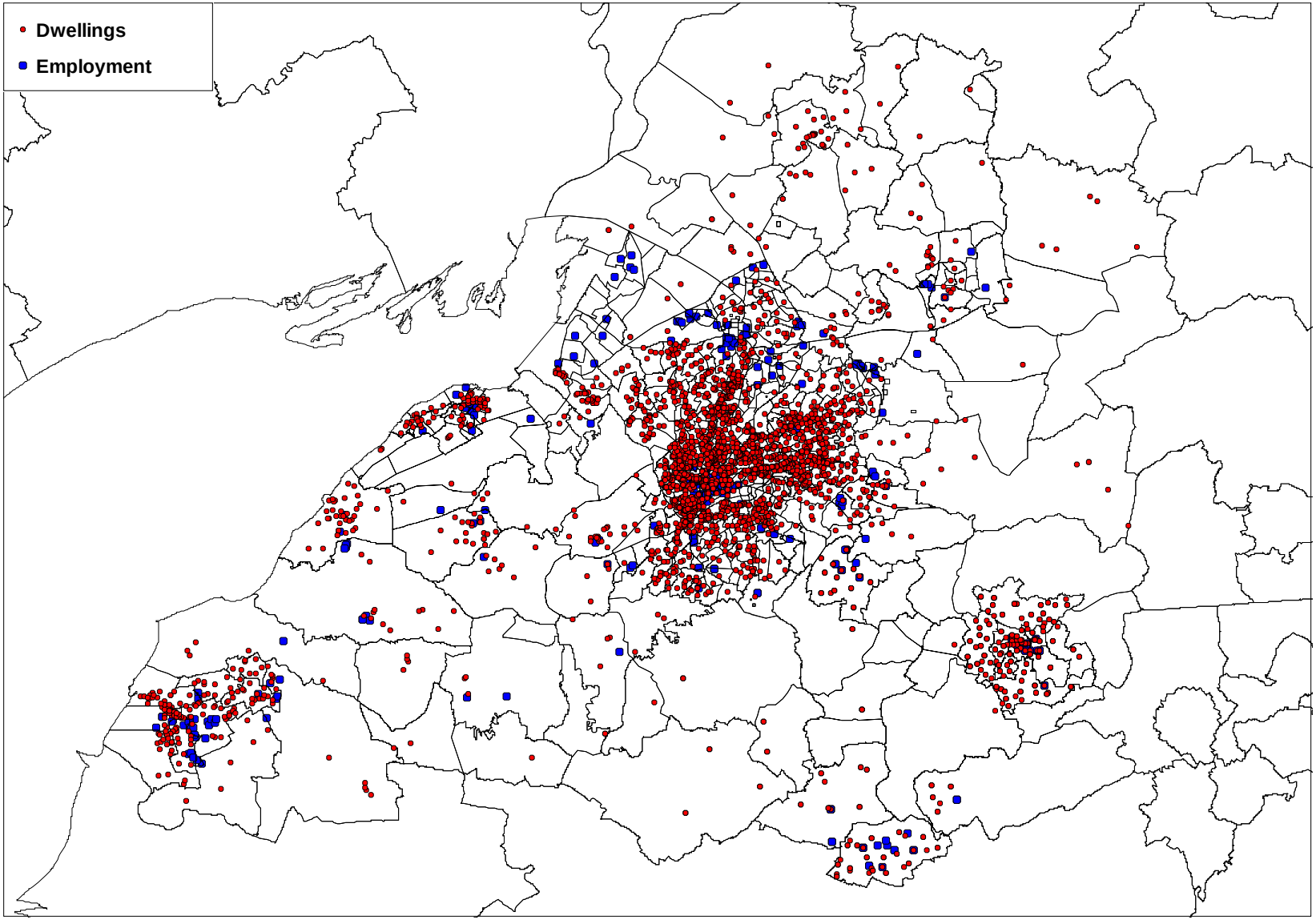
2.15 The location of development sites is shown in Figure 2.1. The level of household and employment growth is indicated in Figures 2.2 to 2.5.

Development Trip Rates

2.16 In order to work out trip end estimates (required for the allocation process) trip rates were calculated and applied to the planning data supplied by West of England Partnership.

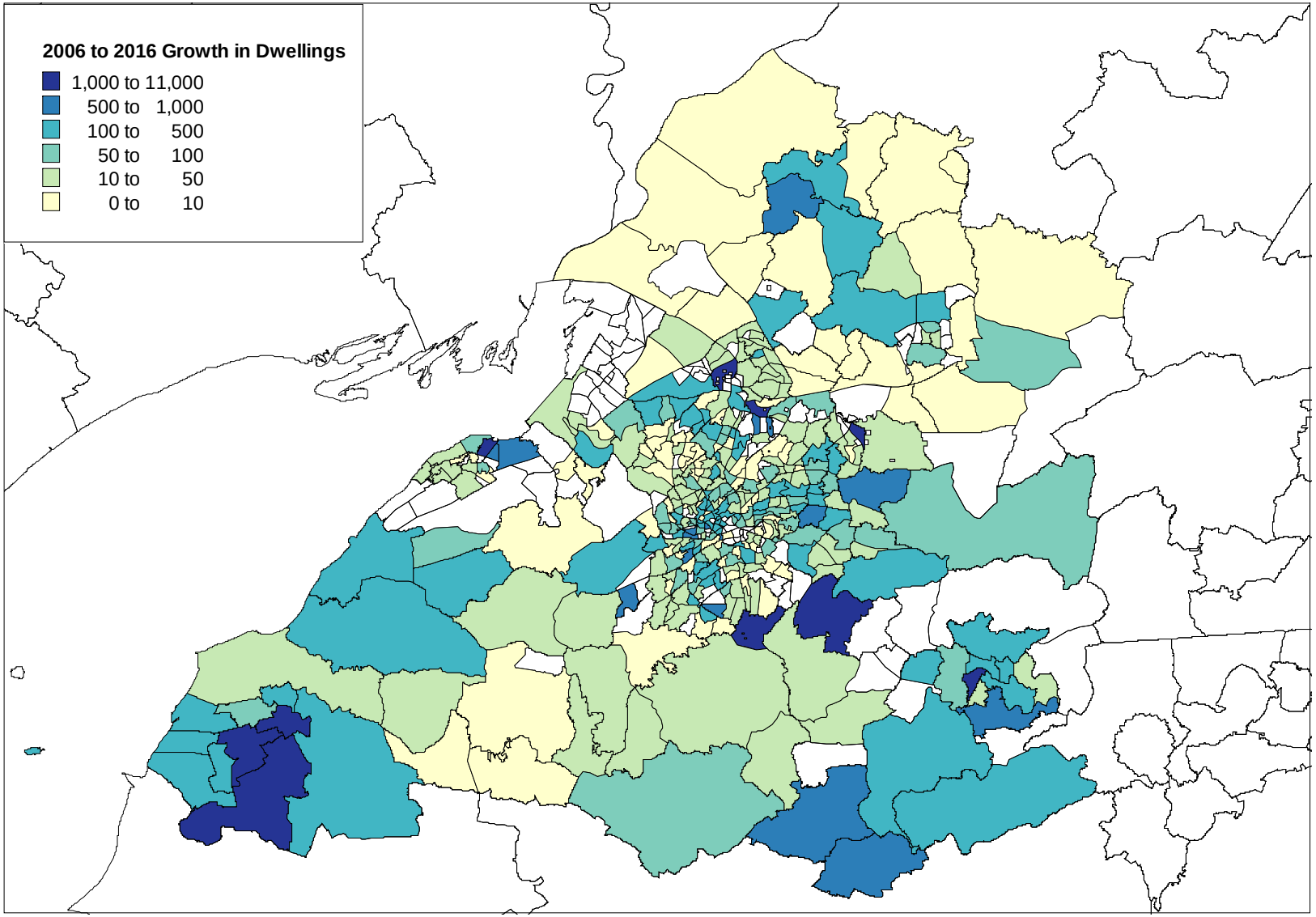
2.17 Source data for the trip rate calculations was the trip rate database package TRICS2008, which uses data collected from surveys throughout the UK to calculate average rates for both highway and public transport trip generation according to different types of land use.

Figure 2.1 – Location of Development Sites in West of England Sub-Region



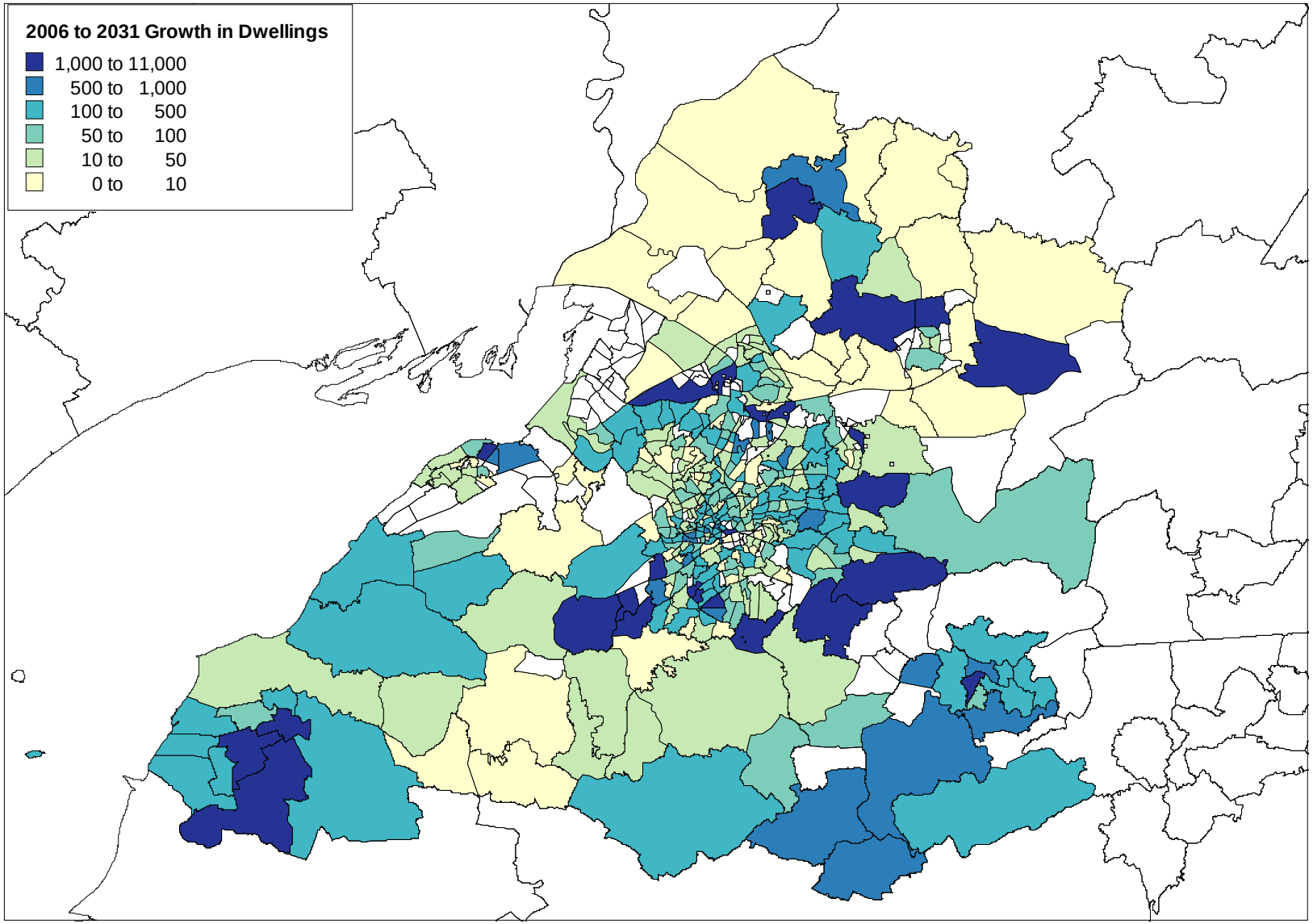
Source : West of England Partnership (2008)

Figure 2.2 – Household Growth 2006 to 2016



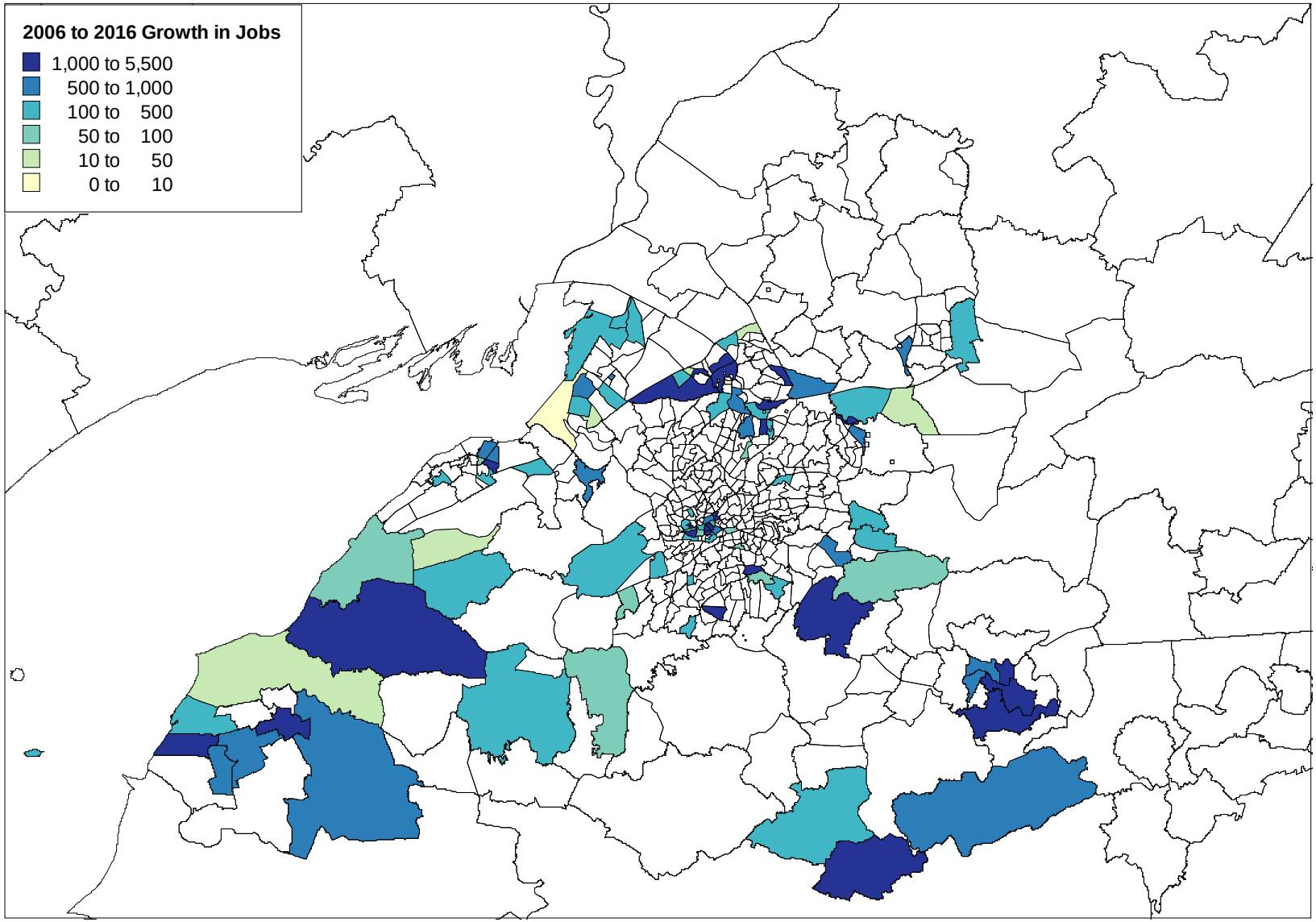
Source: West of England Partnership (2008)

Figure 2.3 – Household Growth 2006 to 2031



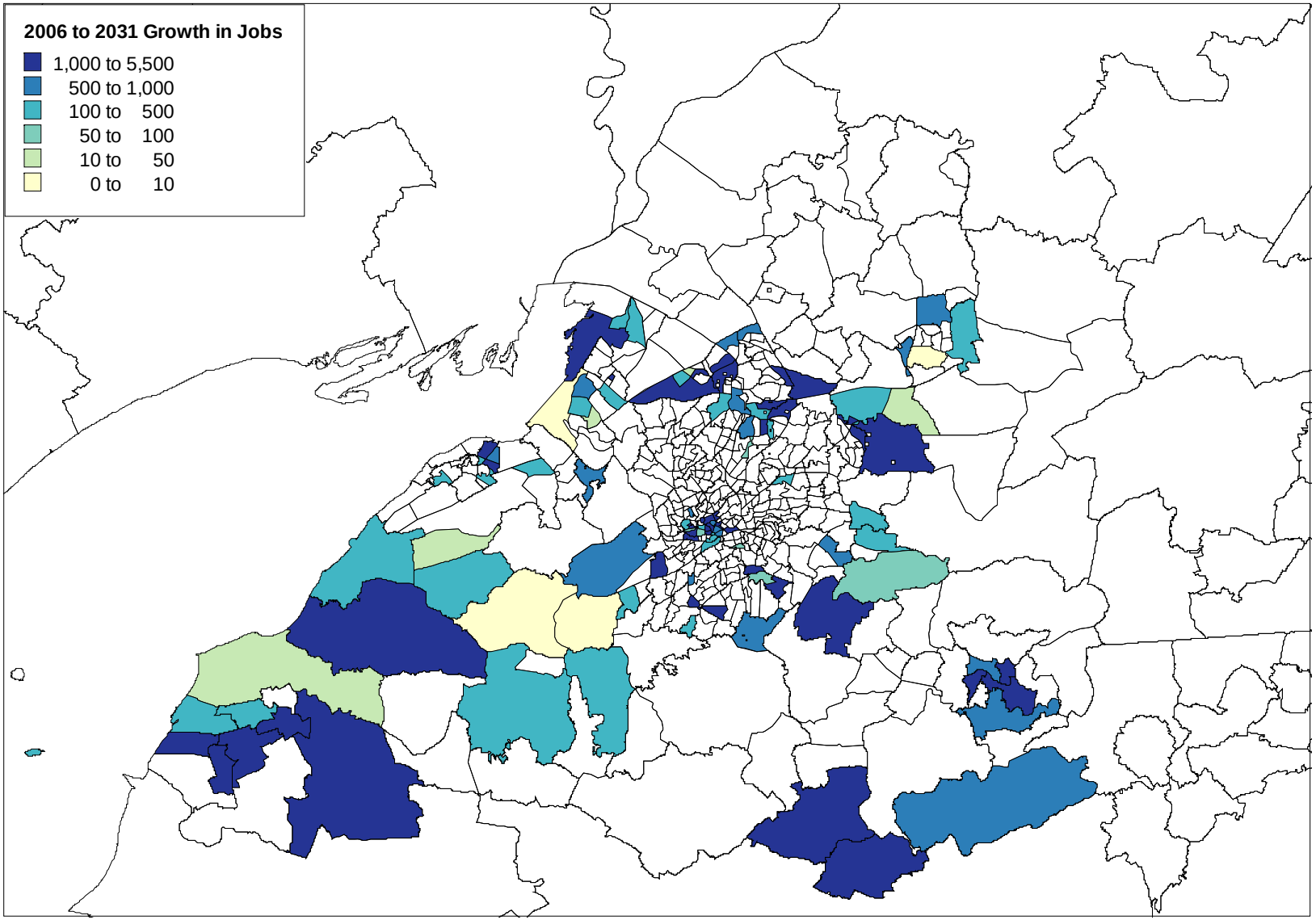
Source: West of England Partnership (2008)

Figure 2.4 – Employment Growth 2006 to 2016



Source: West of England Partnership (2008

Figure 2.5 – Employment Growth 2006 to 2031



Source: West of England Partnership (2008

Development Trip Distribution

2.18 For the majority of zones, trips were distributed based on the original distribution of trips in the base year model. The planning data however included a number of 'greenfield' sites where development is planned on currently unused sites. For these zones, the base year demand matrices did not provide a sound basis for the incremental choice modelling as there were either no trips at all or a distribution of trips that was not appropriate for the new development. Consequently the base year trip matrices were "seeded" with a trip distribution for the relevant 'greenfield' sites.

2.19 Greenfield sites were assigned to the zone which was geographically the nearest, with the trip distribution of the base zone being overwritten with the greenfield site characteristics using a synthetic trip distribution. It was decided not to use the spare development zones, as previously stated, as this would have entailed rebuilding the base databank. The synthetic distribution takes account of the generalised cost of travel between zones and the relative attractiveness of each destination zone as measured by the forecast attraction trip ends. A separate synthetic distribution was derived for each mode (car, bus and rail), trip purpose and time period, using a gravity model formulation.

2.20 The distribution process used the standard destination choice modelling techniques set out in TAG Unit 3.10.3 sections 1.7.13, 1.7.14, and 2.1.12 and followed a generalised form of "gravity" model using a negative exponential (or logit) deterrence function.

2.21 The forecast mode splits read into the demand model are based on the base zone mode split for non-greenfield zones and a 90% / 10% highway / public transport split for greenfield zones. The demand model then adjusts the mode split depending on the public transport accessibility for each respective zone.

2.22 It was assumed that the proportion of people in each income band in future years would remain the same as the base year.

LGV and HGV Growth

2.23 Table 2.3 below shows the growth rates used to forecast Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) from the Base Year to 2016 and 2031 respectively for all three models. Growth factors were derived from the Department for Transports 2007 Road Forecasts for England.

Table 2.3 – LGV/HGV Growth factors

Vehicle Type	2016	2031
LGV	1.32	2.02
HGV	1.05	1.15

Trip End Data Summary

2.24 Tables 2.4 below summarise the highway, bus and rail trip ends for years 2006, 2016 and 2031.

Table 2.4 – G-BATS3 v2.3 Trip End Data Summary

Productions	Total Trips Ends								
	Highway			Bus			Rail		
	2006	2016	2031	2006	2016	2031	2006	2016	2031
AM Peak Car Available	361,955	407,738	482,466	27,413	32,029	34,161	8,448	9,926	14,102
AM Peak Non Car Available	-	-	-	14,443	13,243	13,573	4,451	4,300	4,045
AM Total	**361,955**	**407,738**	**482,466**	**41,856**	**45,272**	**47,734**	**12,900**	**14,226**	**18,146**
IP Peak Car Available	450,632	507,730	581,492	17,146	20,125	22,631	6,659	8,336	10,873
IP Peak Non Car Available	-	-	-	13,344	12,478	12,094	5,182	5,005	4,794
IP Total	**450,632**	**507,730**	**581,492**	**30,490**	**32,603**	**34,726**	**11,841**	**13,341**	**15,667**
PM Peak Car Available	186,734	209,969	240,261	3,554	4,527	5,866	2,141	2,886	4,428
PM Peak Non Car Available	-	-	-	1,373	1,276	1,268	824	803	789
PM Total	**186,734**	**209,969**	**240,261**	**4,927**	**5,803**	**7,134**	**2,965**	**3,689**	**5,217**

Attractions	Total Trips Ends								
	Highway			Bus			Rail		
	2006	2016	2031	2006	2016	2031	2006	2016	2031
AM Peak Car Available	361,955	411,429	482,466	27,413	30,630	34,161	8,448	9,776	14,102
AM Peak Non Car Available	-	-	-	14,443	13,373	13,573	4,451	4,287	4,045
AM Total	**361,955**	**411,429**	**482,466**	**41,856**	**44,003**	**47,734**	**12,900**	**14,063**	**18,146**
IP Peak Car Available	450,632	515,416	586,952	17,146	20,081	22,671	6,659	8,768	11,670
IP Peak Non Car Available	-	-	-	13,344	12,639	12,356	5,182	5,003	4,754
IP Total	**450,632**	**515,416**	**586,952**	**30,490**	**32,720**	**35,027**	**11,841**	**13,771**	**16,425**
PM Peak Car Available	186,734	209,969	241,804	3,572	4,527	5,765	2,137	2,886	4,526
PM Peak Non Car Available	-	-	-	1,373	1,276	1,284	824	803	783
PM Total	**186,734**	**209,969**	**241,804**	**4,945**	**5,803**	**7,049**	**2,961**	**3,689**	**5,309**

Source: G-BATS3 v2.3 Trip End Model, numbers in PA format for peak periods

3. Future Year Supply Assumptions

Introduction

3.1 The following section summarises the schemes included in the Without-Intervention Case networks for each of the three models for 2016 and 2031. The inclusion of potential future year schemes was determined in accordance with WebTAG (Draft for Consultation) Guidance (TAG Unit 3.15.5).

3.2 The Without-Intervention Case represents those elements of the planned package that can reasonably be expected to be delivered by a specific forecast year. The Without-Intervention Case schemes have been determined based on an uncertainty log which allocates schemes to one of four categories as follows:

- *Near Certain* : The outcome will happen or there is a high probability that it will happen;
- *More than likely*: The outcome is likely to happen but there is some uncertainty;
- *Reasonably Foreseeable*: The outcome may happen but there is significant uncertainty; and
- *Hypothetical*: There is considerable uncertainty whether the outcome will ever happen.

3.3 Based on the uncertainty log, the Without-Intervention Case should include schemes that are considered 'near certain' or 'more than likely'. The Without-Intervention Case should represent a realistic view of what is likely to happen in the absence of any specific scheme proposals. It should focus on maintaining present transport facilities and implementing the more certain aspects of regional and local transport strategies.

Without-Intervention Case Networks

3.4 The Without-Intervention Case network includes modifications to the public transport and highways networks. These are described in more detail below and shown in Figure 3.1.

Public Transport Model

In addition to the base year public transport services, the following changes were made to the public transport network:

- Greater Bristol Bus Network - 10 Showcase Bus Corridors / new bus services in North Fringe
- Bristol to Avonmouth Rail - Increased frequency from hourly to every 40 mins.

3.5 Additionally for 2031, the following schemes were included:

- Portishead to Bristol Rail Line
- Ashton Vale Infrastructure – supporting bus services for the South West Urban Extension Development

Highway Model

3.6 Improvements were made to the highway network to include the following schemes:

- Cabot Circus – Completion of the new gyratory;
- Jacobswell Roundabout – signalisation;
- A38-Cribbs Causeway Distributor - New road as part of Filton Northfield development;
- Harry Stoke / A4174 - New junction and roads (including PT link) as part of Harry Stoke development;

- SBRR Phase 1 & 2 - A38-A370 link road & A38 to Hengrove; and
- Callington Road Link.

3.7 Additionally for 2031, the following schemes were included:

- Ashton Vale Infrastructure - supporting infrastructure for the South West Urban Extension Development
- Barrow Gurney Bypass - Road linking A37 and A370

4. Forecasting Assumptions

Introduction

4.1 There are a number of key forecasting assumptions, in addition to changes in supply and demand, that affect model forecasting. This section describes the assumptions with regarding to the following:

- Vehicle occupancy;
- Vehicle operating costs;
- Values of time;
- Bus fares;
- Rail fares; and
- Parking charges.

4.2 It is noted that the models are defined to work in real terms – i.e. excluding the effects of inflation. A constant inflation assumption of 2.5% per annum based on RPI has been used consistent with the advice given in WebTAG. This means that only changes in real costs and values need to be included in the forecasts.

Vehicle Occupancy

4.3 Vehicle occupancy is assumed to increase per annum by the factors shown in Table 4.1.

Table 4.1 – Annual Vehicle Occupancy Growth Factors

Time Period	Purpose	
	Work	Non-Work
AM	0.48%	0.67%
IP	0.40%	0.65%
PM	0.62%	0.43%

Vehicle Operating Costs and Values of Time

4.4 Vehicle operating costs are taken from WebTAG unit 3.5.6 and increased to 2006 prices. Non-fuel costs are assumed to remain constant in real terms over the forecast period. The cost parameters used are shown in Table 4.2 below. These parameters (non-fuel based vehicle operating costs) are used in calculating the PPK (pence per kilometre) values.

4.5 Fuel costs are assumed to increase in line with WebTAG recommendations.

4.6 Future year value of time is calculated from the 2006 figures in terms of pence per minute and pence per kilometre (based on fuel and speed) for vehicles, and only pence per minute for passengers within the demand model. These are increased by the percentage suggested in WebTAG unit 3.5.6 for the respective year and are shown in Table 4.3 for person pence per minute.

4.7 Calculated vehicle operating costs in pence per kilometre are shown, along with values of time in pence per minute in Table 4.4.

Table 4.2 – Non Fuel Based Vehicle Operating Costs

Vehicle Category	Perceived Cost Parameters	
	a1	b1
Work Car	4.575	125.236
Non-Work Car	4.284	0.00
Average Car	4.333	21.415
Work LGV	6.645	43.401
Non-Work LGV	8.034	0.00
Average LGV	6.812	38.192
OGV1	6.185	243.032
OGV2	12.032	468.460
PSV	28.061	639.827

Table 4.3 – Values of Time (Person Pence per Minute, 2006 prices)

Purpose	2016	2031
HBW IL	5.91	7.21
HBW IM	9.61	11.74
HBW IH	13.99	17.09
Other IL	7.44	9.09
Other IM	9.59	11.72
Other IH	11.53	14.09
Work	47.21	60.61

Table 4.4 – Vehicle Values of Time and Distance (Person Pence per Minute, 2006 prices)

	2006						2016						2031					
Purpose	AM		IP		PM		AM		IP		PM		AM		IP		PM	
	PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK
Work	53.10	13.48	51.25	12.33	54.73	14.25	64.84	10.16	62.74	8.97	66.60	6.21	76.27	13.18	74.05	11.55	77.94	9.42
Non-Work Low Income	8.49	6.48	10.30	5.84	10.25	5.88	9.85	1.82	11.90	1.59	11.94	1.93	11.04	5.36	13.26	4.67	13.45	5.70
Non-Work Med Income	11.60	6.48	13.67	5.84	13.47	5.88	13.51	1.82	15.81	1.59	15.68	1.93	15.22	5.36	17.62	4.67	17.66	5.70
Non-Work High Income	15.50	6.48	16.56	5.84	16.08	5.88	18.10	1.82	19.22	1.59	18.74	1.93	20.45	5.36	21.55	4.67	21.12	5.70
LGV	16.99	8.18	20.36	8.00	16.05	7.04	20.10	3.92	24.31	4.04	18.81	3.28	23.12	7.06	27.99	6.73	21.46	6.66
HGV	17.48	35.78	17.48	35.72	17.48	35.72	21.51	35.08	21.51	32.84	21.51	27.11	25.57	35.32	25.57	33.07	25.57	27.34

* Note: The PPK value decreases in future years since fuel efficiency is assumed to improve in future years.

PPK = Pence Per Kilometre
PPM = Pence Per minute

Bus Fares

4.8 Changes in bus fares were derived using historical fare data taken from the Bulletin of Public Transport Statistics[1]. Table 4.5 shows the changes in bus fare receipts since 1990/91. On this basis, a linear bus fare growth factor of 1.096% p.a. in real terms was calculated for the period 1990/91 – 2005/06, and this was assumed to apply from 2006 base year onwards.

Table 4.5 – Bus Fare Index (Constant Prices, Outside London)

Year	Fare Index, (constant prices)
1990/91	90.3
1991/92	93.7
1992/93	95.8
1993/94	97.8
1994/95	99.3
1995/96	100.5
1996/97	103.4
1997/98	105.9
1998/99	107.6
1999/00	110.6
2000/01	112.4
2001/02	116.0
2002/03	118.2
2003/04	119.5
2004/05	120.8
2005/06	125.4

Rail Fares

4.9 Similarly, fares indices were derived for non London and South East operators from data published in National Rail Trends[2]. It was considered that only data collected after rail privatisation in 1997 was representative. A linear rail fare growth of 1.05% p.a. in constant prices was calculated for the period January 1998 – January 2004. This was applied to factor up base year rail fares for each forecast year (Table 4.6).

[1] Bulletin of Public Transport Statistics, Great Britain, 2002 Edition, DfT, November 2002, Annex B Table 9.
[2] National Rail Trends 2003-2004, Q3, SRA, March 2004

Table 4.6 – Rail Fare Indices – Non London and South East Operators

Year	Fares Index (Constant Prices) 1995=100
1998	99.4
1999	100.8
2000	102.9
2001	103.4
2002	105.7
2003	106.0
2004	105.9

Parking Charges

4.10 It was assumed that there would be no increase of parking charges in real terms or changes in parking supply for the Without-Intervention Case.

5. Without-Intervention Case Headline Indicators

Introduction

5.1 This section presents a set of headline indicators for the Without-Intervention Case forecasts for 2016 and 2031. The key indicates include:

- model convergence;
- demand response;
- highway network performance; and
- public transport network performance.

Model Convergence

5.2 Model convergence is an indicator of the stability of the model. Convergence is measured by the % Gap between supply and demand curves with the demand model. Perfectly converged models would have a % Gap of zero and the guidance recommends values of less that 0.2%.

5.3 The demand model convergence is shown in Table 5.1 and it can be seen that suitable convergence is reached in 16 loops in 2016 and 12 loops in 2031. Highway model convergence is shown in Table 5.2. The nature of the public transport model assignment (ie without capacity restraint) means that very high levels of convergence are always reached.

Table 5.1 – G-BATS3 v2.3 Demand Model Convergence Results

Criteria	2016 (24 hr)	2031 (24 hr)
Convergence after Loop #	14	14
% Gap	0.146	0.166

Table 5.2 – G-BATS3 v2.3 Highway Model Convergence Results

Criteria	AM Peak			Inter Peak			PM Peak		
	2006	2016	2031	2006	2016	2031	2006	2016	2031
Convergence after loop #	11	75	80	9	27	80	16	80	80
% Link Flows differing by <5%	98.7	99.9	100	98.7	99	99.9	97.9	99.9	99.9
% Gap	0.09	0.05	0.13	0.02	0.05	0.06	0.05	0.07	0.23

Demand Response

Response by Purpose

5.4 The demand model forecasts demand by mode and purpose for the given forecast year. The forecast demand by car, bus and rail modes for home based work (HBW), other home based trips (HBO) and employer's business (EB) trips are shown in Table 5.3 below. These purposes are listed as they refer to the different purpose groupings in the highway model.

Table 5.3 – Person Trips by Mode and Purpose for Each Time Period

Mode	Purpose						Total	
	Other		EB		HBW			
	2016	2031	2016	2031	2016	2031	2016	2031
Morning Peak								
Car	53,770	57,046	18,264	20,152	93,587	103,417	165,621	180,615
Bus	5,377	5,475	1,942	1,942	11,991	12,329	19,309	19,746
Rail	2,286	4,303	923	1,545	4,140	6,718	7,349	12,565
Total	**61,434**	**66,824**	**21,128**	**23,639**	**109,717**	**122,463**	**192,279**	**212,926**
Inter-Peak								
Car	100,946	116,466	22,961	27,426	19,851	23,083	143,758	166,975
Bus	6,489	6,709	1,839	1,888	2,118	2,227	10,446	10,823
Rail	2,919	4,587	903	1,355	828	1,267	4,650	7,208
Total	**110,354**	**127,761**	**25,703**	**30,669**	**22,797**	**26,576**	**158,854**	**185,006**
Evening Peak								
Car	98,903	109,111	8,762	10,065	66,550	74,768	174,216	193,944
Bus	6,144	6,752	933	961	10,815	11,251	17,892	18,964
Rail	3,113	6,286	445	813	3,765	6,133	7,323	13,232
Total	**108,161**	**122,149**	**10,140**	**11,839**	**81,130**	**92,152**	**199,430**	**226,140**

5.5 Mode split for motorised travel modes (i.e. excluding walking and cycling) is summarised in Table 5.4 for 2006, 2016 and 2031.

Table 5.4 – G-BATS3 v2.3 Mode Split 2006, 2016, 2031

Mode	AM			IP			PM		
	2006	2016	2031	2006	2016	2031	2006	2016	2031
Car	88%	86%	85%	92%	90%	90%	90%	87%	86%
Bus	10%	10%	9%	7%	7%	6%	7%	9%	8%
Rail	3%	4%	6%	1%	3%	4%	3%	4%	6%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Response by Location

5.6 The demand by mode has been sectored using the sector system shown in Figure 5.1. This system splits the modelled area into the following five sectors:

- Within Bristol Central Cordon
- Within Bristol Inner Cordon
- Within Bristol Outer Cordon
- Rest of Greater Bristol sub-region; and
- Rest of UK

Figure 5.1 – G-BATS3 Sector System

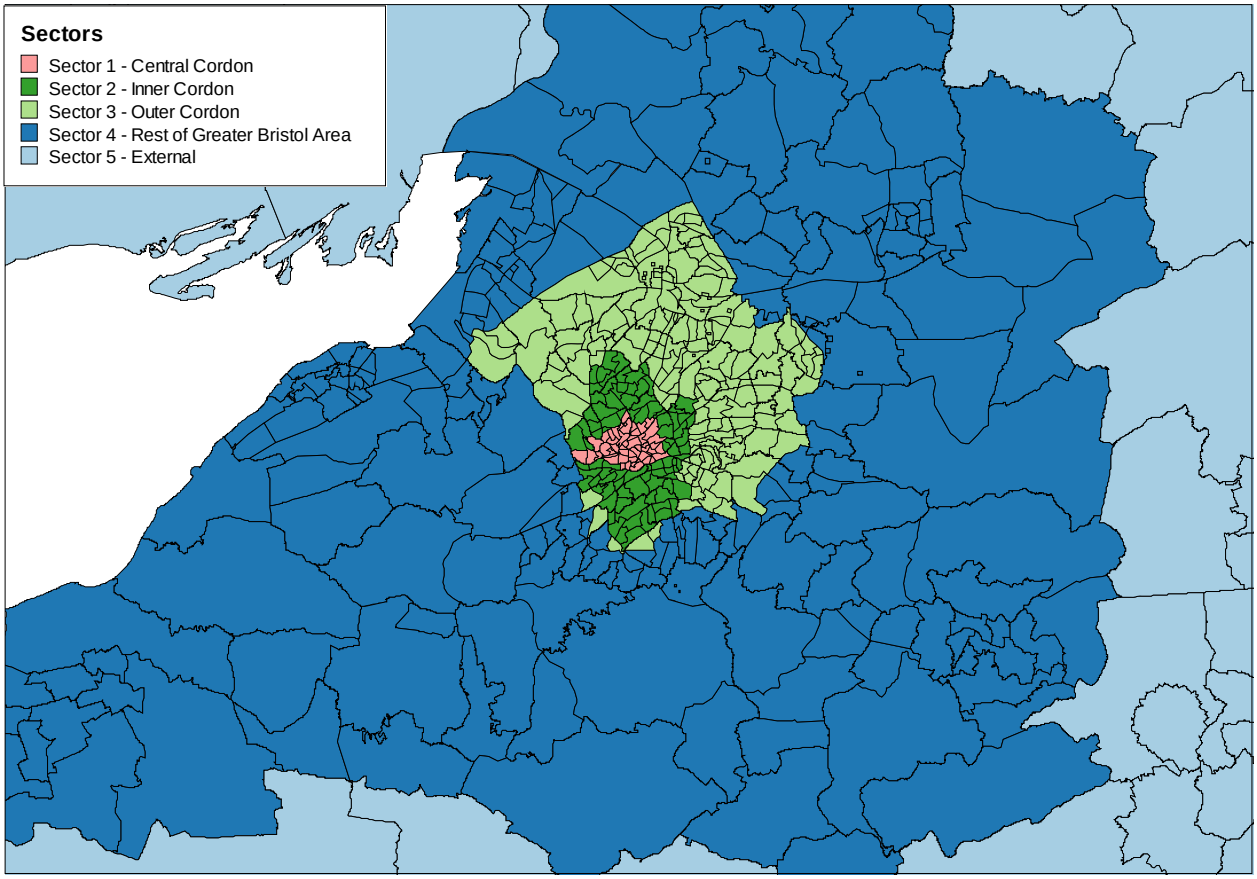


Table 5.5 – G-BATS3 v2.3 Sector Summary Morning Peak Hour – 2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,654	3,553	2,710	2,614	982	**14,513**
Sector 2	6,188	8,046	5,422	4,538	987	**25,181**
Sector 3	3,848	6,174	31,347	11,260	2,765	**55,394**
Sector 4	3,613	4,704	13,171	23,208	7,074	**51,771**
Sector 5	1,182	710	4,679	7,271	4,919	**18,761**
Total	**19,487**	**23,188**	**57,329**	**48,891**	**16,726**	**165,621**
Bus						
Sector 1	918	895	1,224	648	43	**3,728**
Sector 2	2,205	1,086	863	390	16	**4,560**
Sector 3	2,252	794	2,075	367	0	**5,488**
Sector 4	3,144	451	638	1,180	12	**5,424**
Sector 5	99	6	0	3	0	**108**
Total	**8,619**	**3,232**	**4,800**	**2,587**	**72**	**19,309**
Rail						
Sector 1	1	197	791	398	271	**1,658**
Sector 2	419	359	253	180	55	**1,265**
Sector 3	842	324	49	92	100	**1,407**
Sector 4	818	253	160	200	335	**1,766**
Sector 5	224	47	80	242	660	**1,252**
Total	**2,303**	**1,181**	**1,333**	**1,111**	**1,421**	**7,349**

Table 5.6 – G-BATS3 v2.3 Sector Summary Inter-Peak Hour -2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,665	4,218	3,180	3,109	891	**16,063**
Sector 2	3,899	6,649	5,557	4,156	751	**21,012**
Sector 3	2,960	5,404	27,381	10,754	2,425	**48,924**
Sector 4	2,834	4,267	10,336	20,534	5,511	**43,481**
Sector 5	845	848	2,221	5,246	5,118	**14,278**
Total	**15,202**	**21,386**	**48,675**	**43,800**	**14,695**	**143,758**
Bus						
Sector 1	630	895	905	989	129	**3,548**
Sector 2	736	704	448	292	22	**2,202**
Sector 3	770	428	1,185	256	4	**2,643**
Sector 4	775	281	230	642	15	**1,944**
Sector 5	77	13	3	12	4	**109**
Total	**2,989**	**2,321**	**2,771**	**2,191**	**174**	**10,446**
Rail						
Sector 1	1	190	361	372	227	**1,151**
Sector 2	187	361	157	117	50	**872**
Sector 3	351	170	22	108	83	**734**
Sector 4	410	125	119	165	221	**1,040**
Sector 5	204	46	82	224	297	**852**
Total	**1,152**	**892**	**741**	**986**	**878**	**4,650**

Table 5.7 – G-BATS3 v2.3 Sector Summary Evening Peak Hour -2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,948	5,897	4,511	3,917	1,302	**20,575**
Sector 2	4,028	7,780	6,927	5,183	1,000	**24,917**
Sector 3	3,659	6,476	32,782	13,332	4,146	**60,395**
Sector 4	3,153	5,072	12,584	22,633	6,882	**50,323**
Sector 5	1,010	1,006	2,866	6,721	6,402	**18,005**
Total	**16,798**	**26,231**	**59,669**	**51,785**	**19,732**	**174,215**
Bus						
Sector 1	1,061	1,937	2,118	2,445	147	**7,707**
Sector 2	906	952	682	416	5	**2,962**
Sector 3	1,210	783	1,914	538	3	**4,448**
Sector 4	625	388	367	1,258	6	**2,644**
Sector 5	98	17	2	14	1	**131**
Total	**3,899**	**4,076**	**5,084**	**4,670**	**162**	**17,891**
Rail						
Sector 1	2	436	714	783	278	**2,212**
Sector 2	199	435	282	235	69	**1,219**
Sector 3	580	211	42	192	165	**1,189**
Sector 4	469	188	153	318	336	**1,465**
Sector 5	301	73	162	355	345	**1,238**
Total	**1,551**	**1,343**	**1,353**	**1,883**	**1,193**	**7,323**

Table 5.8 – G-BATS3 v2.3 Sector Summary Morning Peak Hour - 2031

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	5,081	3,585	2,690	2,735	944	**15,035**
Sector 2	5,802	8,014	5,135	5,077	838	**24,867**
Sector 3	3,516	5,773	31,953	12,292	2,778	**56,314**
Sector 4	3,537	5,331	14,021	32,523	8,639	**64,051**
Sector 5	1,155	646	4,682	8,686	5,180	**20,348**
Total	**19,091**	**23,349**	**58,482**	**61,314**	**18,379**	**180,614**
Bus						
Sector 1	1,081	790	1,093	641	43	**3,648**
Sector 2	2,116	981	839	587	17	**4,541**
Sector 3	2,203	748	2,202	629	1	**5,782**
Sector 4	2,560	636	818	1,628	15	**5,657**
Sector 5	100	8	1	9	0	**118**
Total	**8,060**	**3,163**	**4,953**	**3,494**	**76**	**19,746**
Rail						
Sector 1	1	285	838	1,042	212	**2,378**
Sector 2	616	380	299	593	50	**1,939**
Sector 3	1,033	365	89	445	105	**2,037**
Sector 4	2,012	604	518	1,212	500	**4,846**
Sector 5	212	52	101	412	589	**1,366**
Total	**3,873**	**1,687**	**1,846**	**3,704**	**1,455**	**12,565**

Table 5.9 – G-BATS3 v2.3 Sector Summary Inter-Peak Hour -2031

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	5,026	4,259	3,353	3,412	986	**17,038**
Sector 2	4,012	6,789	5,523	5,046	761	**22,131**
Sector 3	3,184	5,392	28,539	12,767	2,747	**52,629**
Sector 4	3,443	5,456	13,045	29,635	6,976	**58,554**
Sector 5	930	840	2,517	6,621	5,715	**16,624**
Total	**16,595**	**22,736**	**52,977**	**57,481**	**17,186**	**166,974**
Bus						
Sector 1	723	844	832	904	138	**3,441**
Sector 2	699	652	425	401	28	**2,206**
Sector 3	703	411	1,212	335	4	**2,665**
Sector 4	770	386	327	883	22	**2,387**
Sector 5	83	16	3	17	5	**124**
Total	**2,977**	**2,310**	**2,799**	**2,540**	**197**	**10,823**
Rail						
Sector 1	1	333	406	939	250	**1,928**
Sector 2	316	385	168	262	55	**1,185**
Sector 3	385	186	28	213	77	**890**
Sector 4	927	308	228	493	311	**2,266**
Sector 5	226	52	75	310	275	**938**
Total	**1,854**	**1,265**	**905**	**2,217**	**968**	**7,208**

Table 5.10 – G-BATS3 v2.3 Sector Summary Evening Peak Hour -2031

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	5,513	5,755	4,398	3,851	1,348	**20,866**
Sector 2	4,130	7,898	6,592	5,844	964	**25,428**
Sector 3	3,874	6,358	33,952	14,542	4,404	**63,130**
Sector 4	3,476	5,858	14,383	31,754	8,620	**64,091**
Sector 5	1,099	926	3,135	8,388	6,880	**20,427**
Total	**18,093**	**26,796**	**62,459**	**64,379**	**22,217**	**193,944**
Bus						
Sector 1	1,241	1,858	2,061	2,167	153	**7,479**
Sector 2	816	874	653	568	7	**2,918**
Sector 3	1,129	775	2,072	787	4	**4,767**
Sector 4	667	547	602	1,830	13	**3,658**
Sector 5	101	19	3	18	1	**142**
Total	**3,954**	**4,072**	**5,391**	**5,369**	**178**	**18,964**
Rail						
Sector 1	2	727	982	2,263	292	**4,267**
Sector 2	387	464	327	533	74	**1,785**
Sector 3	724	256	87	501	185	**1,753**
Sector 4	1,381	528	474	1,208	503	**4,095**
Sector 5	278	73	171	493	317	**1,333**
Total	**2,772**	**2,049**	**2,041**	**4,999**	**1,372**	**13,232**

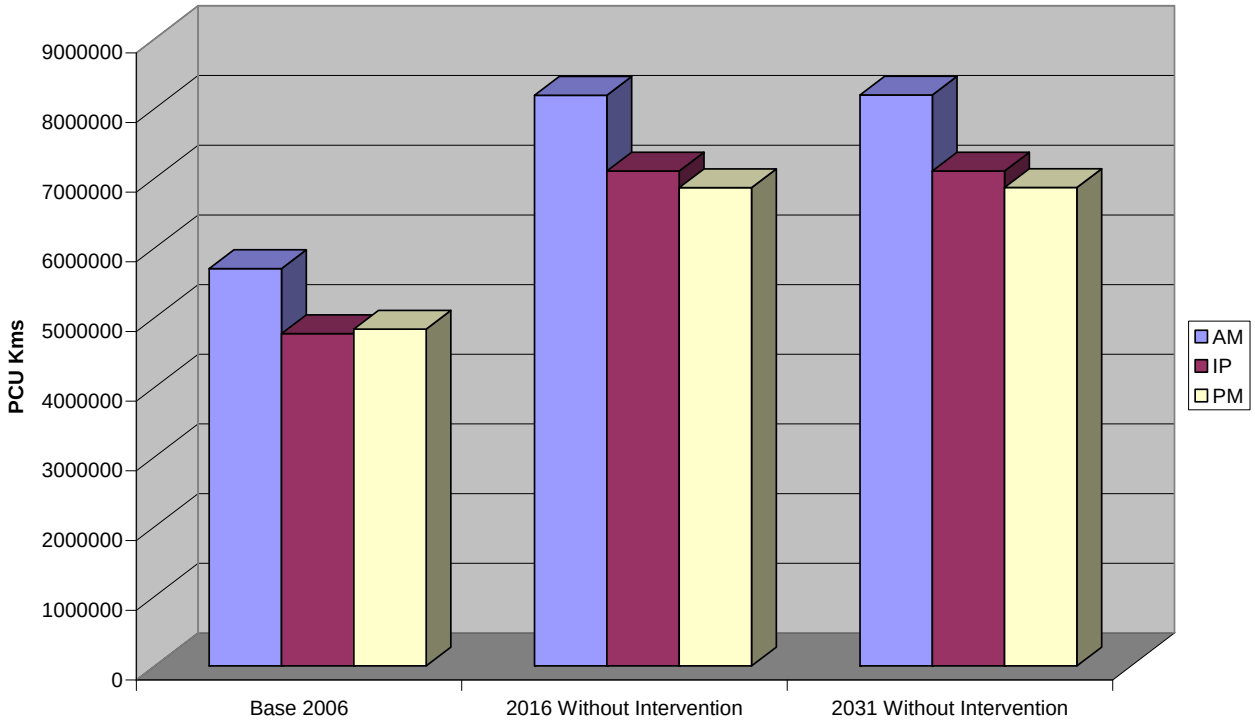
Highway Network Performance

5.7 The overall network performance for the whole of the G-BATS3 modelled area is summarised in terms of the following:

- Total Distance Travelled (pcu kilometres) - the total distance travelled on the modelled highway network multiplied by the number of passenger car units (pcu's);
- Total Travel Time (pcu hours) - the total time travelled on the modelled highway network including delays multiplied by the number of passenger car units (pcu's);
- Average Network Speed (km/hr) - the average speed is the total distance travelled divided by the total travel time; and
- Total Delay (pcu hours) - total delay is taken as the difference between congested and free flow travel time on the modelled highway network in hours multiplied by the number of passenger car units (pcu's).

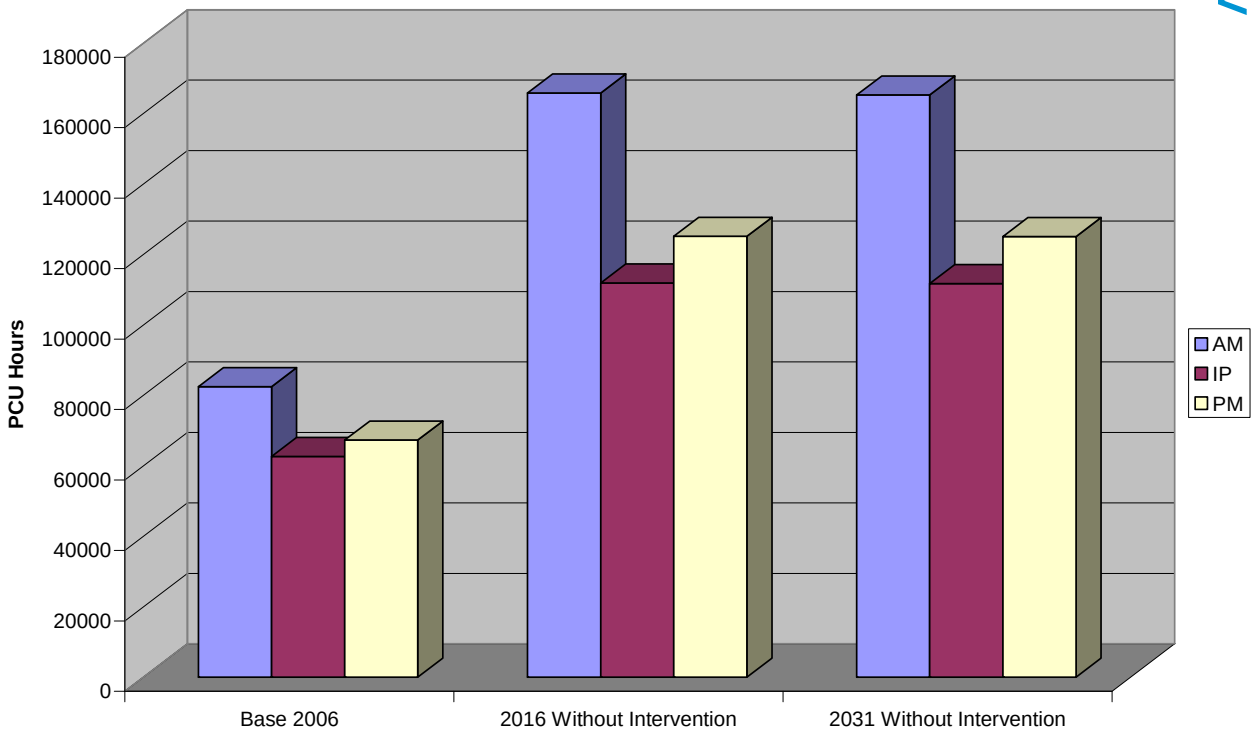
5.8 These are shown in Figures 5.2 to 5.5 respectively.

Figure 5.2 – G-BATS3 v2.3 Total Distance Travelled - Highway



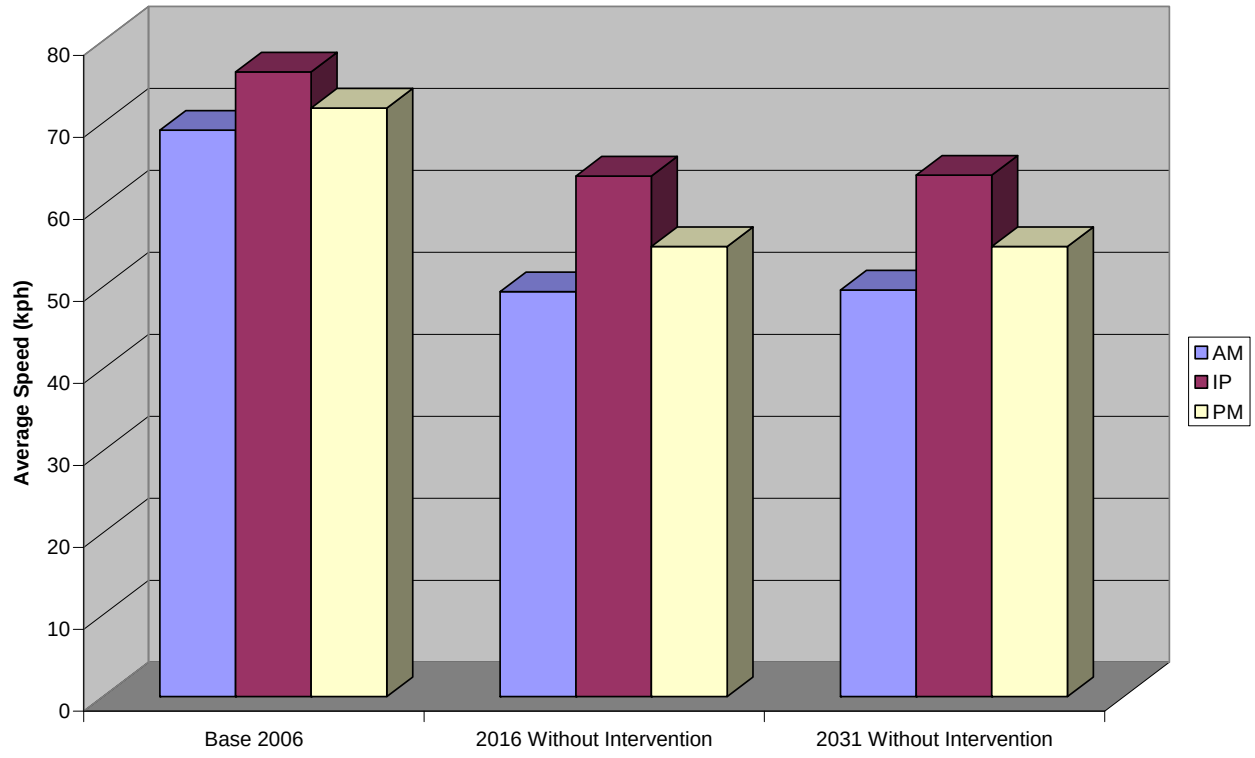
Source: G-BATS3 v2.3 Modelling System (2009)

Figure 5.3 – G-BATS3 v2.3 Total Travel Time - Highway



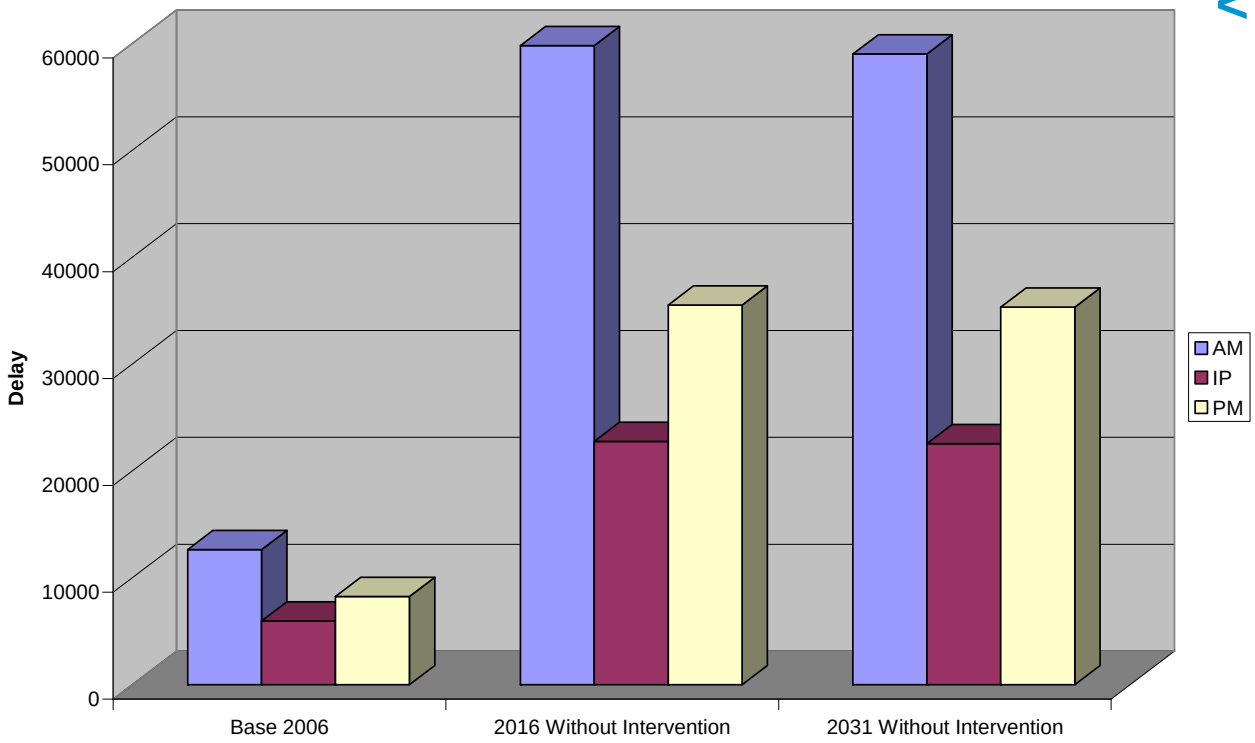
Source: G-BATS3 v2.3 Modelling System (2009)

Figure 5.4 – G-BATS3 v2.3 Average Network Speed - Highway



Source: G-BATS3 v2.3 Modelling System (2009)

Figure 5.5 – G-BATS3 v2.3 Total Delay - Highway



Source: G-BATS3 v2.3 Modelling System (2009)

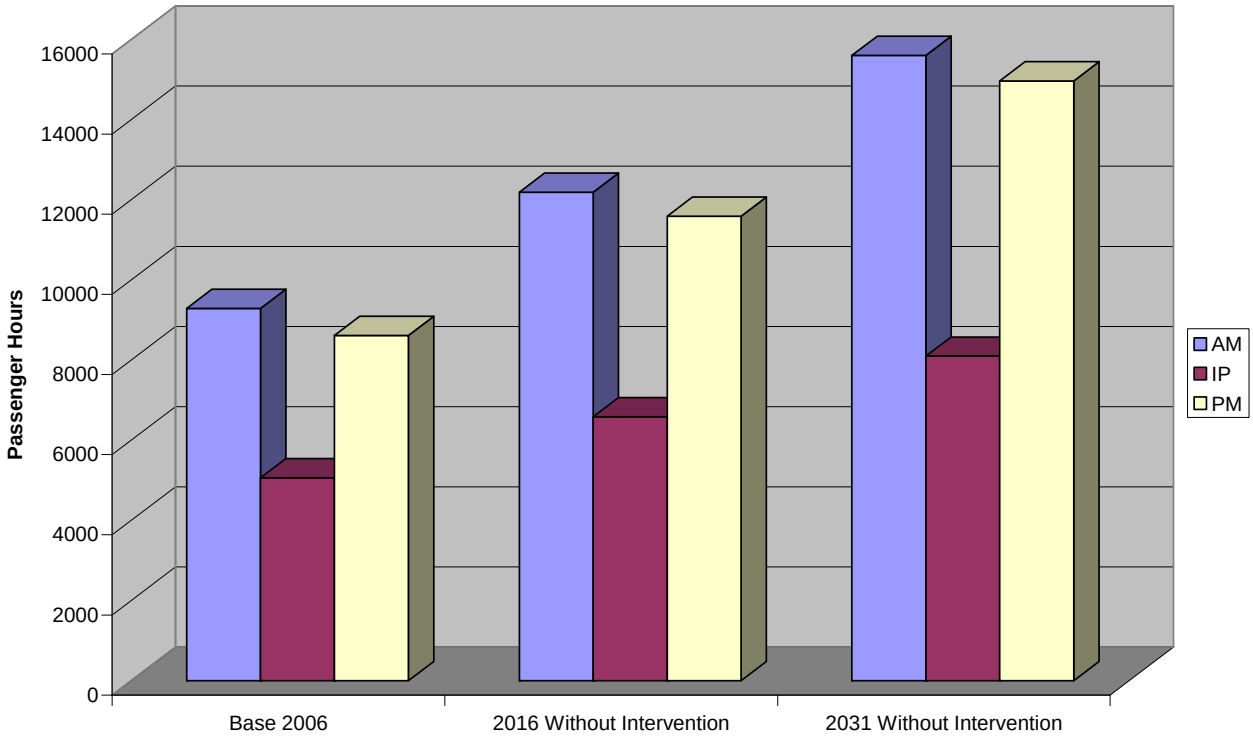
Public Transport Model Performance

5.9 The overall public transport network performance for the whole of the G-BATS3 modelled area is summarised in terms of the following:

- Total Travel Time (passenger hours) - the total time travelled on the modelled public transport network time;
- Total Distance Travelled (passenger kilometres) - the total distance travelled on the modelled public transport network multiplied by the number of passengers;
- Passenger boarding's – the number of public transport boarding's.

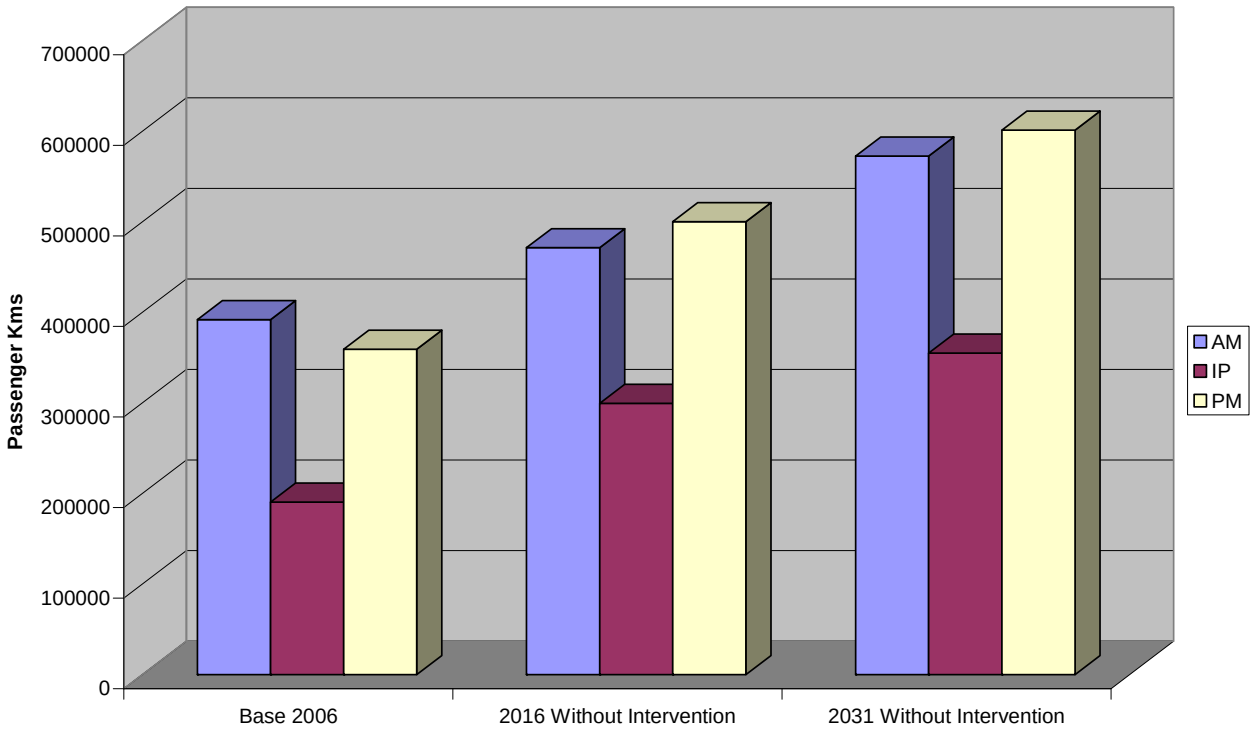
5.10 These are shown in Figures 5.6 to 5.8 respectively.

Figure 5.6 – G-BATS3 v2.3 Passenger Hours - All Public Transport modes)



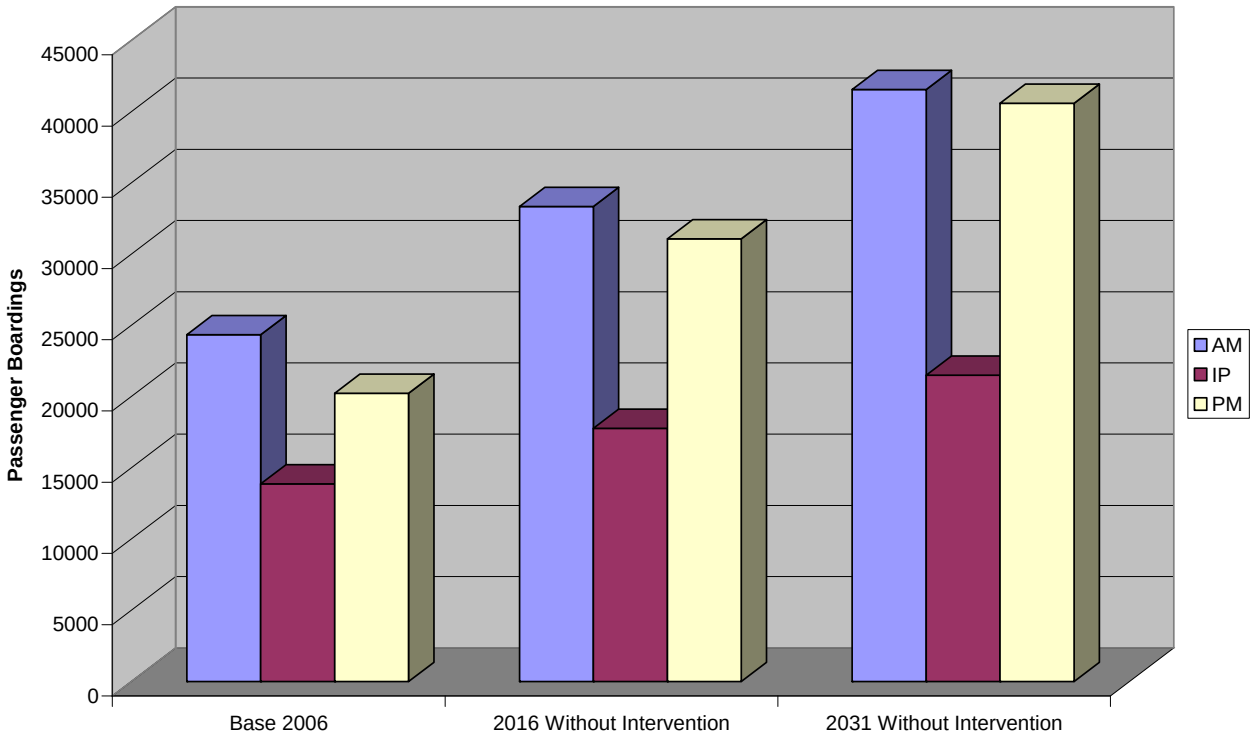
Source: G-BATS3 v2.3 Modelling System (2009)

Figure 5.7 – G-BATS3 v2.3 Passenger Distance - All Public Transport modes)



Source: G-BATS3 v2.3 Modelling System (2009)

Figure 5.8 – G-BATS3 v2.3 Passenger Boardings - All Public Transport modes



Source: G-BATS3 v2.3 Modelling System (2009)

6. Scheme Options Results

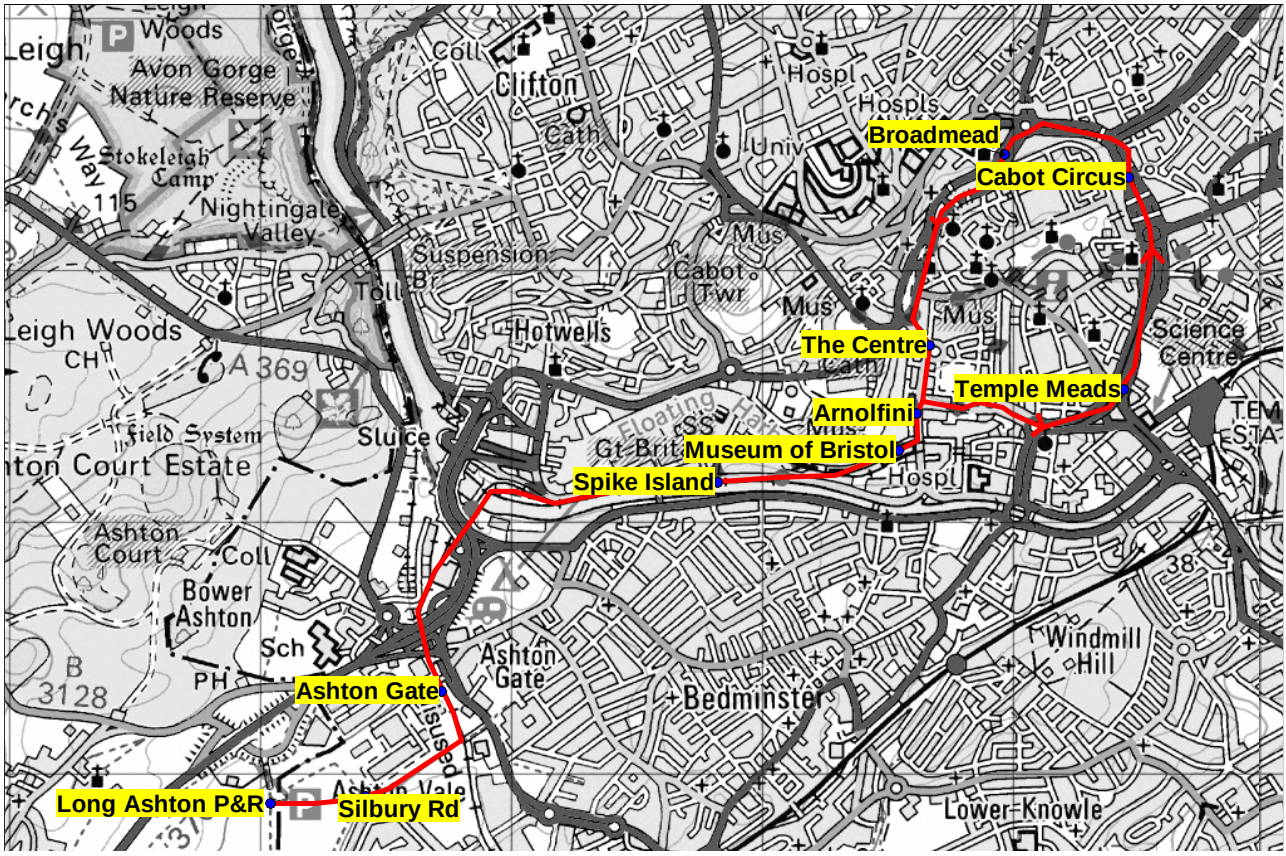
Introduction

6.1 In this chapter, the headline indicators for the With-Intervention Case forecasts for 2016 and 2031 are presented. The scheme contains the following elements, as shown in Table 6.1 and Figure 6.1 below.

Table 6.1 – With-Intervention Case Scheme Components

Component	With Intervention
1. Ashton Vale to Bristol Temple Meads Rapid Transit Line	✓
2. Bus service 354 – Nalisea to Bristol rerouted to RT alignment	✓
3. Bus service X1 – Weston-super-Mare to Bristol rerouted to RT alignment	✓
4. Bus service X7 – Clevedon to Bristol rerouted to RT alignment	✓

Figure 6.1 – Rapid Transit Alignment



6.2 The key indicators for both options include:

- model convergence;
- demand response;
- highway network performance; and
- public transport network performance.

Model Convergence

6.3 Model convergence is an indicator of the stability of the model and the robustness of the results. Convergence is measured by the % Gap between supply and demand curves. Perfectly converged models would have a % Gap of zero and the guidance recommends values of less that 0.2%. Tables 6.2 and 6.3 show demand model and highway model convergence statistics.

Table 6.2 – G-BATS3 v2.3 Demand Model Convergence Results

Criteria	2016 (24 hr)	2031 (24 hr)
Convergence after loop #	14	15
% Gap	0.175	0.135

Table 6.3 – G-BATS3 v2.3 Highway Model Convergence Results

Criteria	AM Peak			Inter Peak			PM Peak		
	2006	2016	2031	2006	2016	2031	2006	2016	2031
Convergence after loop #	11	80	80	9	26	80	16	80	80
% Link Flows differing by <5%	98.7	99.9	100	98.7	99.5	99.9	97.9	99.9	99.9
% Gap	0.087	0.038	0.15	0.021	0.039	0.116	0.052	0.07	0.301

Demand Response

Response by Purpose

6.4 The demand model forecasts demand by mode and purpose for the given forecast year. The forecast demand by car, bus and rail modes for home based work (HBW), other home based trips (HBO) and employer's business (EB) trips are shown in Table 6.4 to 6.5 below. These purposes are listed as they refer to the different purpose groupings in the highway model.

Table 6.4 – Person Trips by Mode and Purpose for Each Time Period for the Preferred Option

Mode	Purpose						Total	
	HBO		EB		HBW			
	2016	2031	2016	2031	2016	2031	2016	2031
Morning Peak								
Car	53,777	56,985	18,253	20,112	93,181	102,816	**165,212**	**179,913**
Bus	5,209	5,389	1,858	1,859	11,443	12,009	**18,510**	**19,257**
Rail	2,237	4,145	889	1,454	4,064	6,469	**7,190**	**12,068**
Total	**61,224**	**66,518**	**21,000**	**23,425**	**108,688**	**121,294**	**190,912**	**211,237**
Inter Peak								
Car	100,876	116,319	22,936	27,379	19,782	22,980	**143,594**	**166,679**
Bus	6,192	6,472	1,765	1,811	2,047	2,178	**10,003**	**10,460**
Rail	2,849	4,390	871	1,274	814	1,220	**4,534**	**6,883**
Total	**109,917**	**127,181**	**25,571**	**30,463**	**22,643**	**26,378**	**158,131**	**184,022**
Evening Peak								
Car	98,494	108,551	8,732	10,021	66,271	74,356	**173,497**	**192,929**
Bus	5,934	6,613	884	917	10,383	10,955	**17,201**	**18,485**
Rail	3,024	5,980	428	761	3,694	5,900	**7,147**	**12,641**
Total	**107,452**	**121,144**	**10,045**	**11,699**	**80,348**	**91,211**	**197,845**	**224,054**

Source: G-BATS3 v2.3 Modelling System (2009)

6.5 Mode split for motorised travel modes (i.e. excluding walking and cycling) is summarised in Table 6.5 for 2006, 2016 and 2031.

Table 6.5 – G-BATS3 v2.3 Mode Split 2006, 2016, 2031

Mode	AM			IP			PM		
	2006	2016	2031	2006	2016	2031	2006	2016	2031
Car	87.5%	85.8%	84.4%	92.1%	90.4%	90.0%	89.5%	87.1%	85.4%
Bus	9.5%	9.6%	9.0%	7.0%	6.3%	5.7%	7.4%	8.6%	8.2%
Rail	3.0%	3.7%	5.7%	0.8%	2.9%	3.7%	3.1%	3.6%	5.6%
BRT	0.0%	0.8%	0.9%	0.0%	0.5%	0.6%	0.0%	0.7%	0.8%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

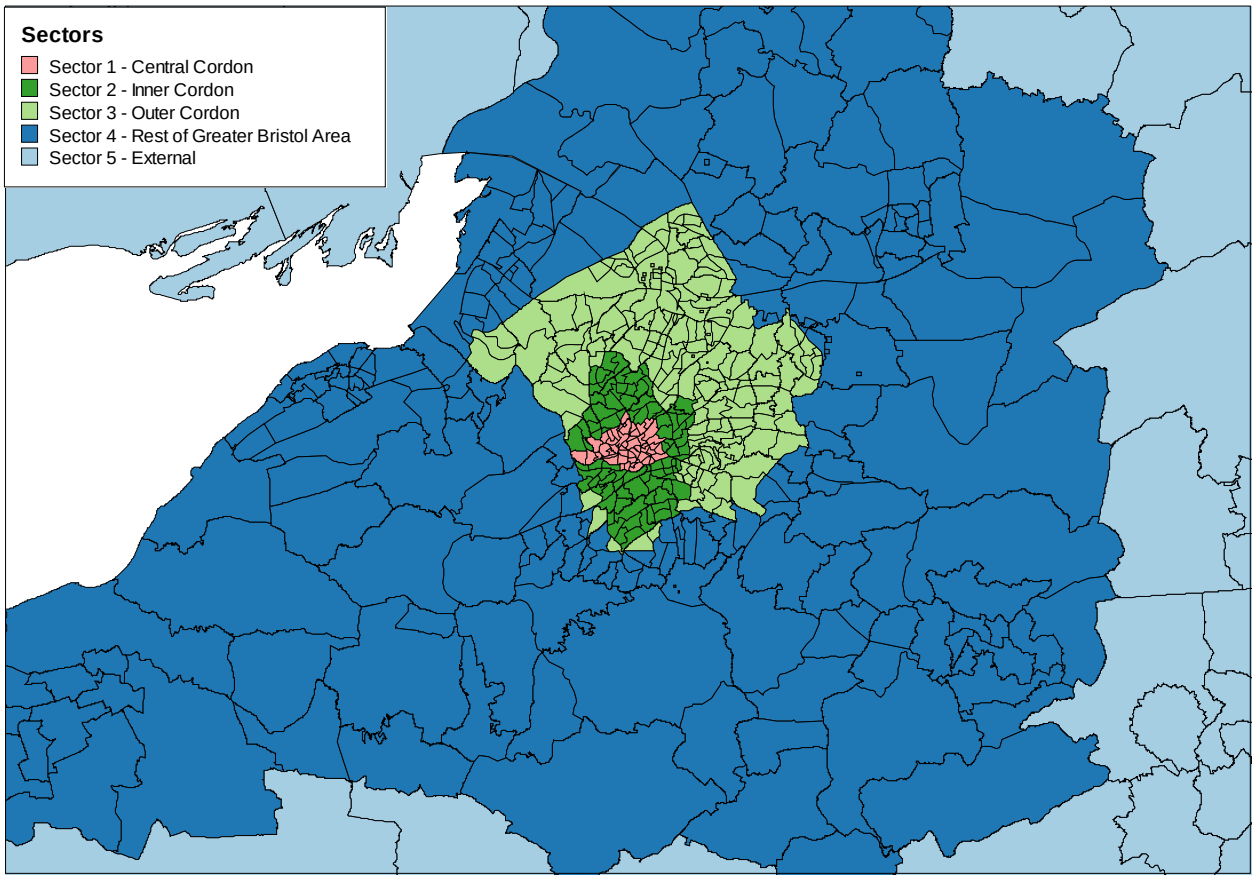
Source: G-BATS3 v2.3 Modelling System (2009)

Response by Location

6.6 The demand by mode has been sectored using the sector system shown in Figure 6.2. This system splits the modelled area into the following five sectors:

- Within Bristol Central Cordon
- Within Bristol Inner Cordon
- Within Bristol Outer Cordon
- Rest of Greater Bristol sub-region; and
- Rest of UK

Figure 6.2 – G-BATS3 Sector System



6.7 The sectored demand for the With Intervention case by mode, time period and year are shown in Tables 6.6 to 6.11.

Table 6.6 – G-BATS3 v2.3 Demand Sector Summary Morning Peak – 2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,606	3,550	2,738	2,584	987	**14,466**
Sector 2	6,121	7,965	5,453	4,561	998	**25,097**
Sector 3	3,788	6,173	31,355	11,264	2,768	**55,347**
Sector 4	3,490	4,682	13,169	23,135	7,054	**51,530**
Sector 5	1,184	711	4,684	7,272	4,919	**18,771**
Total	**19,189**	**23,082**	**57,398**	**48,816**	**16,726**	**165,211**
Bus						
Sector 1	847	795	1,184	630	41	**3,497**
Sector 2	2,117	1,014	836	382	14	**4,363**
Sector 3	2,252	787	2,073	369	0	**5,482**
Sector 4	2,824	445	627	1,154	12	**5,061**
Sector 5	99	6	0	3	0	**108**
Total	**8,139**	**3,046**	**4,720**	**2,538**	**67**	**18,510**
Rail						
Sector 1	1	185	776	385	265	**1,612**
Sector 2	416	342	250	173	54	**1,234**
Sector 3	843	324	49	91	100	**1,407**
Sector 4	781	240	153	186	325	**1,685**
Sector 5	225	47	79	240	660	**1,252**
Total	**2,266**	**1,137**	**1,308**	**1,074**	**1,405**	**7,190**
BRT						
Sector 1	70	261	7	76	0	**414**
Sector 2	159	155	5	13	0	**332**
Sector 3	3	12	4	3	0	**22**
Sector 4	750	43	11	63	0	**867**
Sector 5	0	0	0	0	0	**0**
Total	**981**	**470**	**27**	**155**	**0**	**1,634**

Table 6.7 – G-BATS3 v2.3 Demand Sector Summary Inter-Peak – 2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,668	4,205	3,179	3,057	889	**15,999**
Sector 2	3,882	6,638	5,570	4,151	751	**20,991**
Sector 3	2,956	5,411	27,386	10,754	2,427	**48,934**
Sector 4	2,789	4,259	10,337	20,501	5,509	**43,395**
Sector 5	841	850	2,222	5,243	5,118	**14,274**
Total	**15,136**	**21,362**	**48,694**	**43,707**	**14,694**	**143,593**
Bus						
Sector 1	610	832	879	916	123	**3,359**
Sector 2	690	662	433	298	18	**2,100**
Sector 3	750	415	1,182	257	4	**2,608**
Sector 4	676	279	229	634	15	**1,833**
Sector 5	74	11	3	12	4	**104**
Total	**2,800**	**2,197**	**2,726**	**2,116**	**164**	**10,003**
Rail						
Sector 1	1	187	357	359	224	**1,127**
Sector 2	175	344	157	111	49	**836**
Sector 3	345	169	22	105	83	**724**
Sector 4	397	117	116	155	217	**1,002**
Sector 5	201	45	82	220	297	**845**
Total	**1,119**	**863**	**733**	**950**	**870**	**4,534**
BRT						
Sector 1	3	144	4	170	0	**320**
Sector 2	123	108	6	12	0	**249**
Sector 3	3	7	0	2	0	**11**
Sector 4	163	12	2	16	0	**193**
Sector 5	0	0	0	0	0	**0**
Total	**292**	**271**	**12**	**199**	**0**	**774**

Table 6.8 – G-BATS3 v2.3 Demand Sector Summary Evening Peak –2016

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,854	5,751	4,422	3,713	1,285	**20,025**
Sector 2	3,988	7,711	6,928	5,157	997	**24,782**
Sector 3	3,661	6,501	32,795	13,315	4,149	**60,421**
Sector 4	3,114	5,087	12,598	22,577	6,885	**50,261**
Sector 5	1,011	1,011	2,868	6,714	6,402	**18,007**
Total	**16,628**	**26,060**	**59,612**	**51,477**	**19,718**	**173,497**
Bus						
Sector 1	1,017	1,827	2,082	2,235	143	**7,305**
Sector 2	808	887	671	419	4	**2,790**
Sector 3	1,167	763	1,917	534	3	**4,384**
Sector 4	616	379	369	1,229	6	**2,599**
Sector 5	93	14	2	13	1	**123**
Total	**3,702**	**3,869**	**5,042**	**4,430**	**157**	**17,201**
Rail						
Sector 1	1	433	713	755	280	**2,182**
Sector 2	184	417	282	224	69	**1,176**
Sector 3	562	208	42	186	164	**1,162**
Sector 4	447	177	150	301	331	**1,405**
Sector 5	295	72	162	347	345	**1,221**
Total	**1,489**	**1,307**	**1,348**	**1,813**	**1,189**	**7,147**
BRT						
Sector 1	26	178	11	541	0	**757**
Sector 2	227	128	14	17	0	**385**
Sector 3	2	3	0	4	0	**9**
Sector 4	89	18	4	74	0	**184**
Sector 5	0	0	0	0	0	**0**
Total	**343**	**328**	**29**	**635**	**0**	**1,335**

Table 6.9 – G-BATS3 v2.3 Demand Sector Summary Morning Peak – 2031

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	4,978	3,531	2,699	2,657	958	**14,823**
Sector 2	5,650	7,965	5,158	5,101	844	**24,718**
Sector 3	3,451	5,798	31,963	12,282	2,774	**56,269**
Sector 4	3,397	5,336	14,041	32,349	8,619	**63,742**
Sector 5	1,158	651	4,685	8,686	5,180	**20,360**
Total	**18,634**	**23,281**	**58,545**	**61,075**	**18,376**	**179,912**
Bus						
Sector 1	1,013	695	1,057	628	41	**3,435**
Sector 2	2,013	901	803	567	14	**4,297**
Sector 3	2,202	733	2,187	644	1	**5,767**
Sector 4	2,490	635	824	1,676	15	**5,640**
Sector 5	100	7	1	9	0	**117**
Total	**7,819**	**2,972**	**4,872**	**3,524**	**71**	**19,257**
Rail						
Sector 1	1	262	829	1,002	210	**2,302**
Sector 2	593	361	294	548	49	**1,845**
Sector 3	1,021	362	88	434	104	**2,009**
Sector 4	1,861	556	494	1,149	486	**4,547**
Sector 5	214	51	101	409	589	**1,364**
Total	**3,690**	**1,592**	**1,806**	**3,542**	**1,438**	**12,068**
BRT						
Sector 1	66	243	30	133	0	**472**
Sector 2	186	159	10	131	0	**486**
Sector 3	27	18	8	34	0	**87**
Sector 4	629	95	15	92	0	**831**
Sector 5	0	0	0	0	0	**0**
Total	**908**	**516**	**63**	**391**	**0**	**1,877**

Table 6.10 – G-BATS3 v2.3 Demand Sector Summary Inter-Peak – 2031

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	5,029	4,208	3,336	3,326	984	**16,883**
Sector 2	3,941	6,791	5,549	5,064	766	**22,112**
Sector 3	3,151	5,414	28,555	12,768	2,750	**52,638**
Sector 4	3,366	5,472	13,053	29,559	6,971	**58,422**
Sector 5	927	846	2,519	6,617	5,715	**16,624**
Total	**16,414**	**22,731**	**53,012**	**57,335**	**17,186**	**166,679**
Bus						
Sector 1	698	776	806	873	132	**3,286**
Sector 2	641	600	404	414	22	**2,082**
Sector 3	687	393	1,200	346	4	**2,630**
Sector 4	699	380	329	916	21	**2,345**
Sector 5	80	13	3	17	5	**117**
Total	**2,805**	**2,162**	**2,743**	**2,565**	**185**	**10,460**
Rail						
Sector 1	1	318	396	889	248	**1,852**
Sector 2	293	366	166	234	53	**1,113**
Sector 3	374	184	28	203	77	**866**
Sector 4	873	268	217	461	304	**2,123**
Sector 5	223	51	74	305	275	**929**
Total	**1,765**	**1,187**	**881**	**2,093**	**957**	**6,883**
BRT						
Sector 1	2	152	19	202	0	**375**
Sector 2	129	115	9	71	0	**324**
Sector 3	15	11	0	14	0	**40**
Sector 4	191	81	21	46	0	**339**
Sector 5	0	0	0	0	0	**0**
Total	**337**	**358**	**50**	**334**	**0**	**1,078**

Table 6.11 – G-BATS3 v2.3 Demand Sector Summary Evening Peak –2031

	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Total
Car						
Sector 1	5,325	5,476	4,237	3,621	1,334	**19,991**
Sector 2	4,056	7,846	6,624	5,872	968	**25,367**
Sector 3	3,857	6,378	33,975	14,566	4,408	**63,185**
Sector 4	3,435	5,881	14,396	31,620	8,621	**63,953**
Sector 5	1,107	931	3,134	8,379	6,880	**20,432**
Total	**17,779**	**26,512**	**62,366**	**64,059**	**22,212**	**192,928**
Bus						
Sector 1	1,187	1,739	2,037	2,122	151	**7,235**
Sector 2	720	797	638	568	6	**2,730**
Sector 3	1,089	744	2,063	807	4	**4,707**
Sector 4	659	525	613	1,872	13	**3,682**
Sector 5	95	15	3	17	1	**131**
Total	**3,751**	**3,820**	**5,353**	**5,386**	**174**	**18,485**
Rail						
Sector 1	2	705	981	2,118	295	**4,100**
Sector 2	354	443	325	485	74	**1,680**
Sector 3	704	252	86	477	185	**1,704**
Sector 4	1,295	476	453	1,126	493	**3,842**
Sector 5	274	71	171	482	316	**1,315**
Total	**2,629**	**1,947**	**2,015**	**4,687**	**1,363**	**12,641**
BRT						
Sector 1	39	199	42	559	0	**838**
Sector 2	217	134	13	86	0	**450**
Sector 3	24	9	3	9	0	**44**
Sector 4	182	146	33	171	0	**532**
Sector 5	0	0	0	0	0	**0**
Total	**462**	**488**	**91**	**824**	**0**	**1,865**

Highway Network Performance

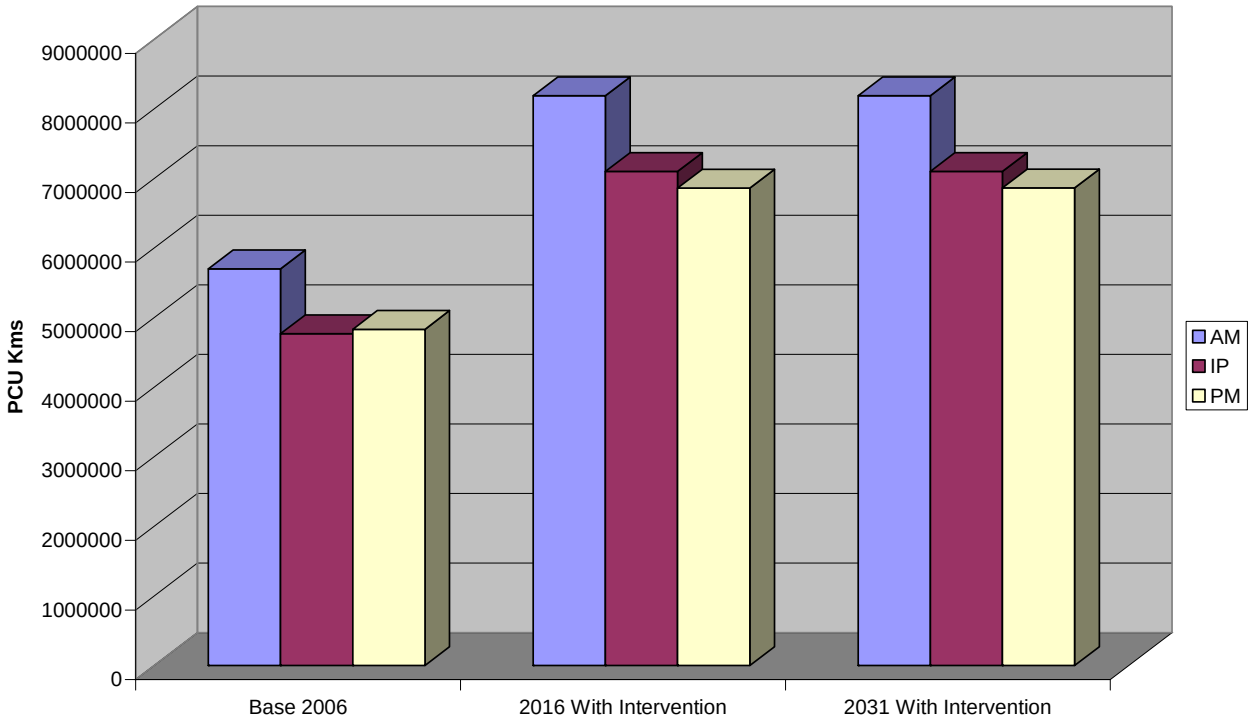
Network Wide Performance

6.8 The overall network performance for the whole of the G-BATS3 modelled area is summarised in terms of the following:

- Total Distance Travelled (pcu kilometres) - The total distance travelled on the modelled highway network multiplied by the number of passenger car units (pcu's);
- Total Travel Time (pcu hours) - The total time travelled on the modelled highway network including delays multiplied by the number of passenger car units (pcu's);
- Average Network Speed (km/hr) - The average speed is the total distance travelled divided by the total travel time; and
- Total Delay (pcu hours) - Total delay is taken as the difference between congested and free flow travel time on the modelled highway network in hours multiplied by the number of passenger car units (pcu's).

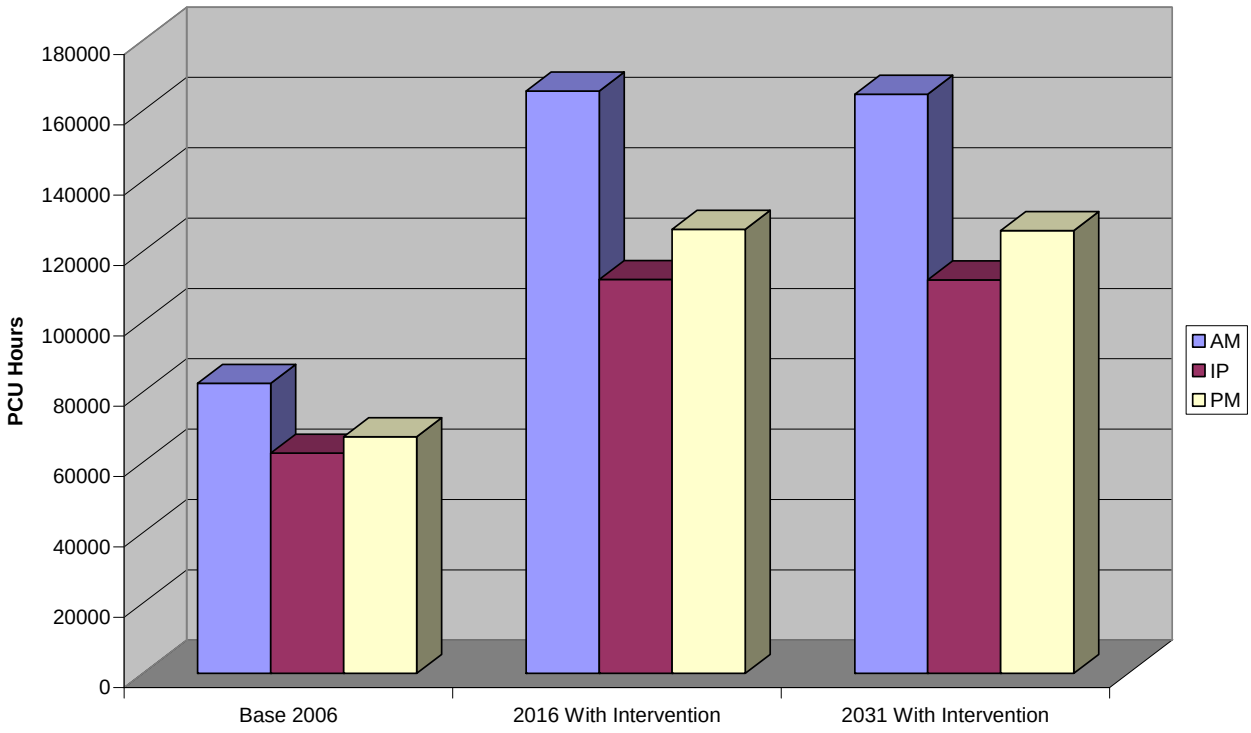
6.9 These are shown in Figures 6.3 to 6.6.

Figure 6.3 – G-BATS3 v2.3 Total Distance Travelled – Highway



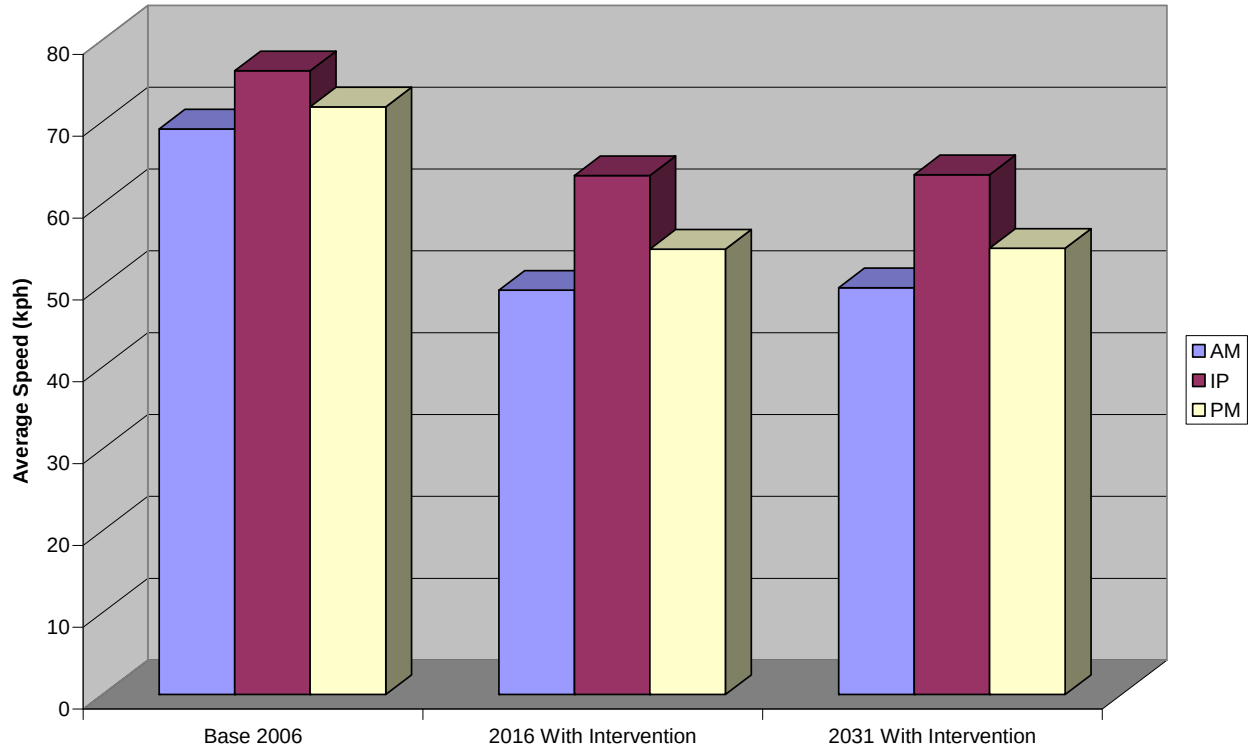
Source: G-BATS3 v2.3 Modelling System (2009)

Figure 6.4 – G-BATS3 v2.3 Total Travel Time - Highway



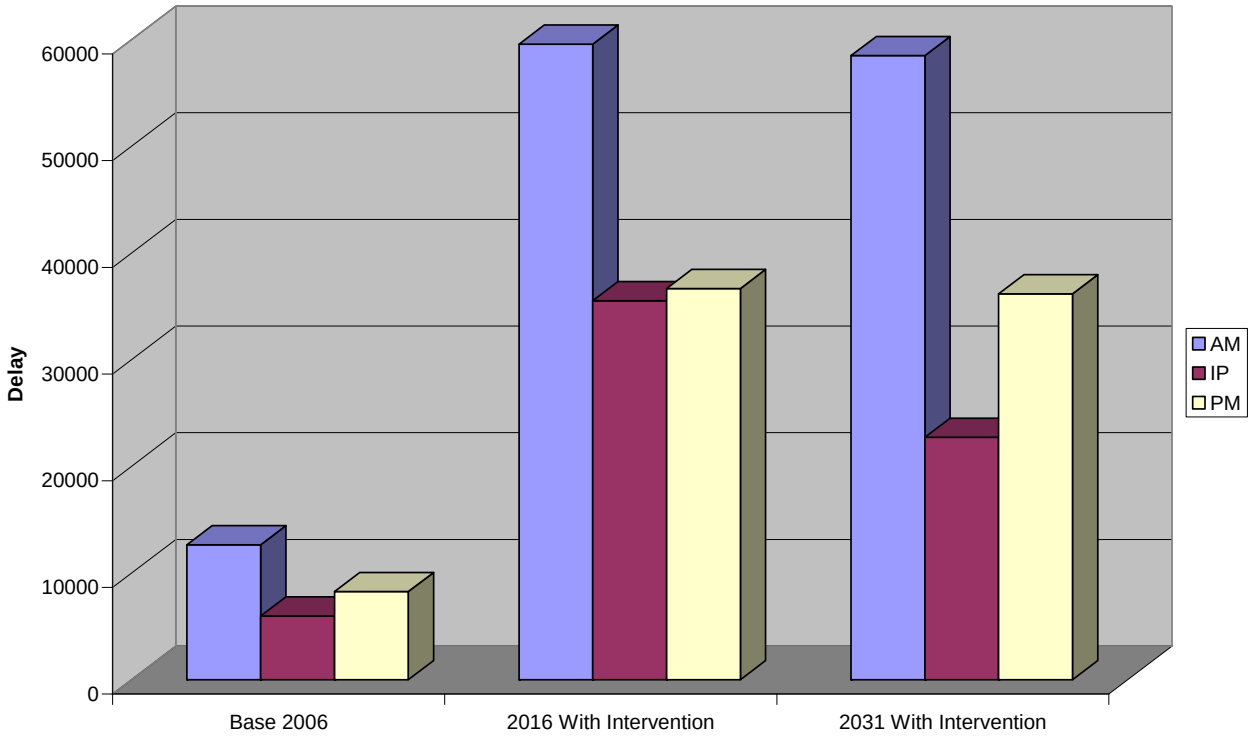
Source: G-BATS3 v2.3 Modelling System (2009)

Figure 6.5 – G-BATS3 v2.3 Average Network Speed - Highway



Source: G-BATS3 v2.3 Modelling System (2009)

Figure 6.6 – G-BATS3 v2.3 Total Delay – Highway



Source: G-BATS3 v2.3 Modelling System (2009)

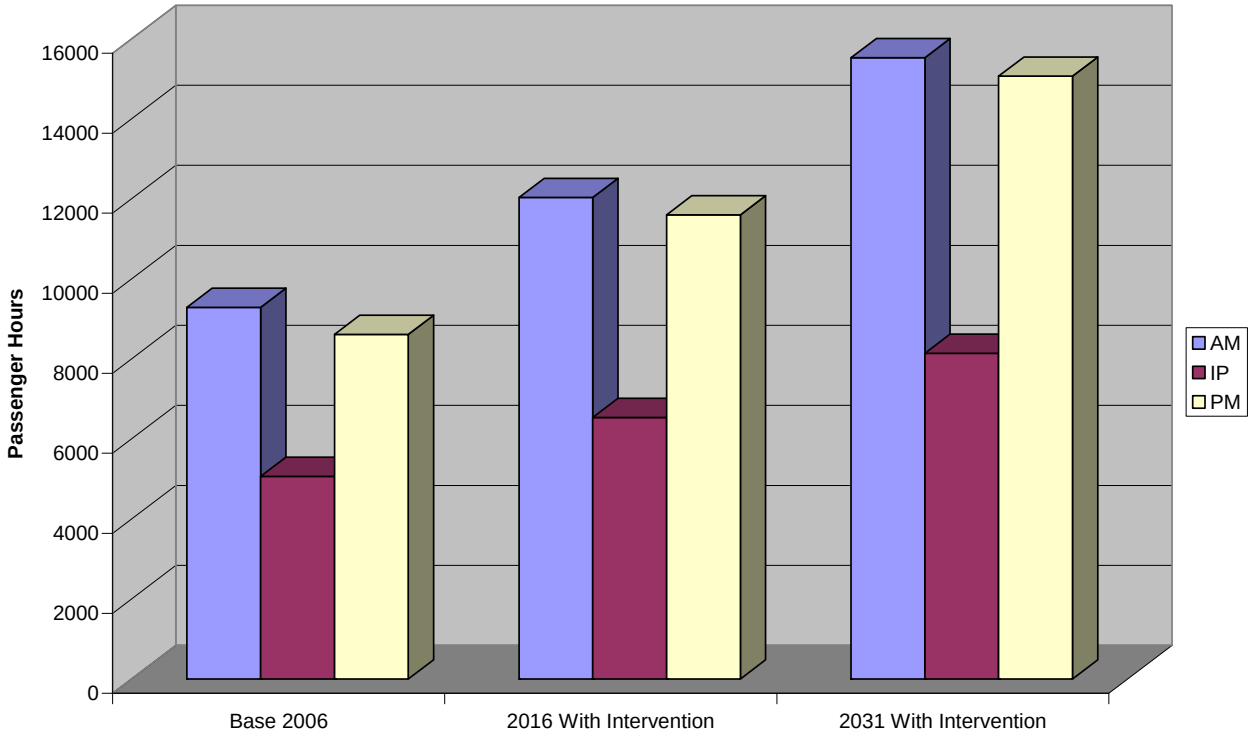
Public Transport Model Performance

6.10 The overall public transport network performance for the whole of the G-BATS3 modelled area is summarised in terms of the following:

- Total Travel Time (passenger hours) - the total time travelled on the modelled public transport network time;
- Total Distance Travelled (passenger kilometres) - the total distance travelled on the modelled public transport network multiplied by the number of passengers;
- Passenger boarding's – the number of public transport boarding's.

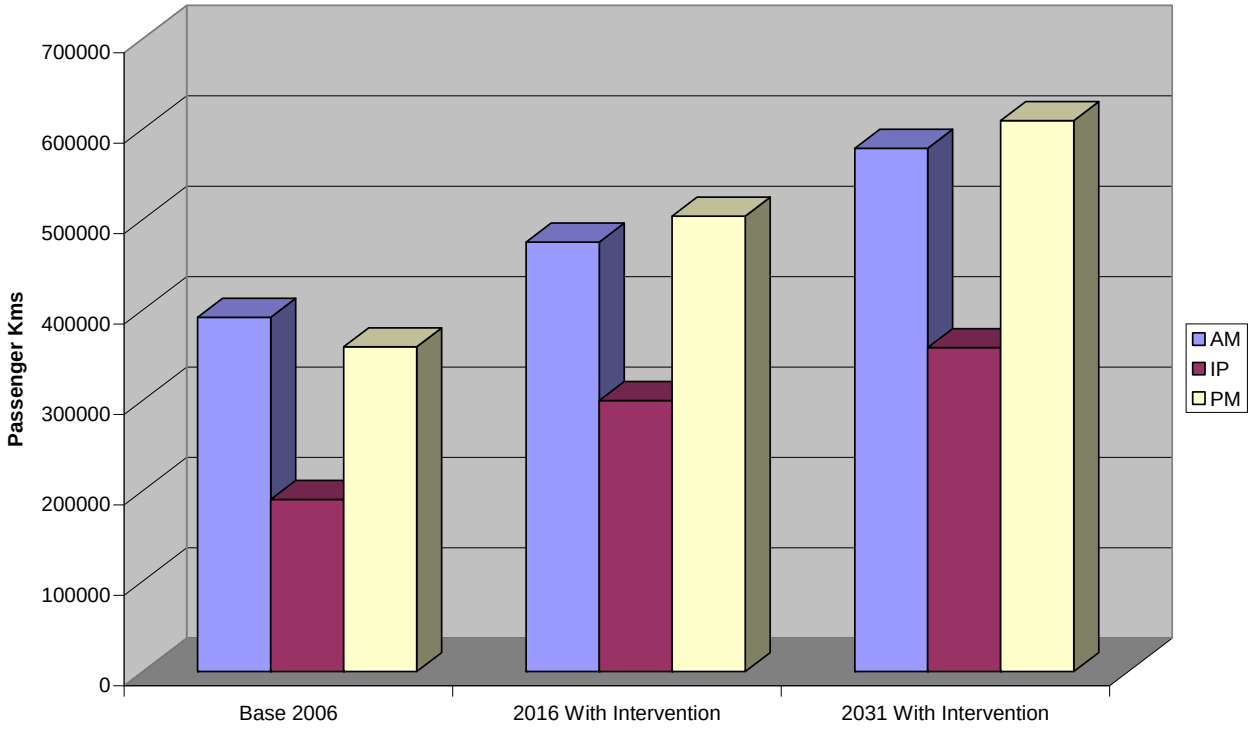
6.11 These are shown in Figures 6.7 to 6.9.

Figure 6.7 – G-BATS3 v2.3 Passenger Hours – All Public Transport Modes



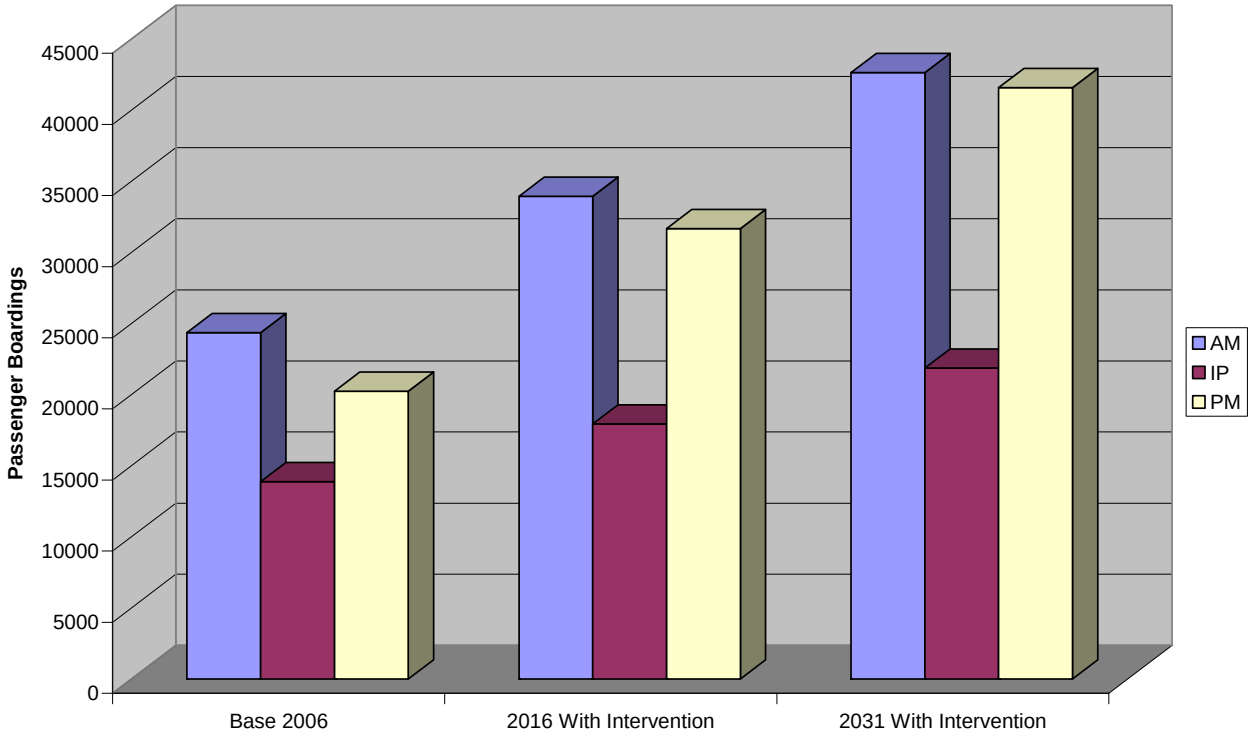
Source: G-BATS3 v2.3 Modelling System (2009)

Figure 6.8 – G-BATS3 v2.3 Passenger Distance – All Public Transport Modes



Source: G-BATS3 v2.3 Modelling System (2009)

Figure 6.9 – G-BATS3 v2.3 Passenger Boardings – All Public Transport Modes



Source: G-BATS3 v2.3 Modelling System (2009)

Scheme Specific Performance

6.12 Further results regarding the operation of the Rapid Transit Scheme are available in the *RT Demand Forecasting* modelling note of March 2009 reported in a separate Appendix.