HITRANS and Highlands & Islands Enterprise (HIE)

A9 Upgrade Impacts Study

Modelling and Economic Appraisal Report

Final Report

May 2008

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EXECUTIVE SUMMARY

E.1 Background

E.1.1 This appraisal is an evaluation of the potential benefits from dualling the A9 from Perth to Inverness, for the whole route and targeted sections of the route. The evaluation, which is based on a TEE appraisal, is presented in this report as a high-level assessment using a CUBE Voyager/TRIPS traffic model and the Transport User Benefits Appraisal (TUBA) program. No cost estimates were prepared and included in the TEE appraisal, and only the Present Value of Benefits (PVBs) have been estimated.

E.2 Appraisal Assumptions

E2.1 The specific economic assumptions and cost adjustments are consistent with the Government's Scottish Transport Appraisal Guidance (STAG)/webTAG appraisal convention. All monetary values are in market prices, and values are discounted to the base year 2002, as adopted in TUBA. The test discount rate is 3.5% for project years 1 to 30, and 3% thereafter. An appraisal period of 60 years has been adopted, with a first year construction year (opening year) in 2010, and a horizon year (final appraisal year) in 2069. The modelled years are from 2010 and 2025.

E2.2 As this assessment is only a partial appraisal, with no account taken of the costs, the assumptions relating to costs such as risk and optimism bias do not apply. As pointed out above, only the benefits are presented here.

E.3 Appraisal Results: Full Dualling

E3.1 The results of the TUBA appraisal on monetised benefits are shown below.

- User benefits (Consumers): £582 million;
- User benefits (Businesses): £594.1 million;
- Carbon benefits: -£3.3 million; and
- Net Present Value (PVB) £1,173.3 million.

E3.2 It should be noted that TUBA does not take account of accident impacts. However these results show that the predominant benefits are travel-time savings. Savings on vehicle operating costs are also a feature of the benefits, although they are less significant.

E.4 Appraisal Results: Targeted Dualling

E4.1 The appraisal of targeted sections of the A9 was based on a pro-rata of time savings at key sections of the A9 against the total saving along the whole route, multiplied by the total PVB. The appraisal shows the PVBs for the three top individual sections of the A9 in terms of benefits:

- Between Kingussie junction and Aviemore North junction: a PVB of £17.4 million per km in 2002 prices;
- Between Aviemore North junction and Slochd: a PVB of £12.8 million per km in 2002 prices; and
- Drumochter to Dalwhinnie junction: a PVB of £12.1 million per km in 2002 prices.

E.5 Concluding remarks

E5.1 Although ideally full dualling of the entire A9 would be the preferred option with the investment returning benefits of over £1.1 billion (in 2002 prices), clearly there will be huge cost implications to this scale of investment. To cope with the cost profile, an alternative option is to dual sections staggered over a period of time. The appraisal above shows which sections could be prioritised in terms of upgrading, based on their relative contribution in benefits.

1. INTRODUCTION

1.1 Background

1.1.1 The A9 is the main trunk route from the central belt to the Highlands and Islands and as such has been assessed as having the highest level of functionality of any transport link in the region, accounting for almost all passenger journeys and freight movements between Inverness and the central belt along the corridor. It is a lifeline route for the island communities of Orkney, Lewis and Harris for supplies and business links and is an essential route for tourist trips visiting the north of Scotland.

1.1.2 Growth in the study area has been consistently better than that of Scotland as a whole, but remains substantially worse off in terms of Gross Value Added (GVA) per capita, with a value for Moray of only 89% of that of Scotland in 2005. Low GVA per capita and low earnings, despite some recent positive trends, is characteristic of the area compared to Scotland as a whole. The importance of the A9 has emerged in sharp relief as the economy and population of Inverness and the surrounding Moray and East Highland region has grown significantly in recent years. There is a growing perception that competitiveness and continuing economic success of the sub-region cannot be guaranteed without investment to upgrade the A9, in particular dualling of key sections of the route, or dualling the entire route between Inverness and Perth.

1.1.3 Evidence from various sources of data and consultations suggests that the A9 is substandard in terms of safety and the lack of overtaking opportunities, both of which cause considerable stress on drivers. This is deemed as a more serious issue than long or unreliable journey times.

1.2 About this Economic Appraisal

1.2.1 A recent strategic economic appraisal study looking at the potential wider economic impacts of improving the A9 undertaken for HITRANS/HIE in 2007 identified considerable potential GVA and Economic Activity and Locational Impacts (EALI) benefits than may result from upgrading of the A9[1]. Sensitivity tests carried out using local projections of employment changes supplied by HIE, which took into account proposals and policies set out in local economic and development strategies, suggested there could be further significant increases to these GVA benefit estimates.

1.2.2 Although the overall conclusion from this research is that there are likely to be significant economic benefits to upgrading the A9, the study also found that there would be significant Transport Economic Efficiency (TEE) benefits in terms of time savings and other highway benefits underpinning the wider economic appraisal. Consequently, HITRANS and HIE have asked Scott Wilson to carry out a high-level TEE appraisal of the potential benefits of upgrading the A9 from Perth to Inverness.

1.2.3 The TEE appraisal presented in this report is a high-level assessment, using the TUBA programme rather than the detailed more detailed NESA model. No cost estimates were prepared and included in the TEE appraisal. Hence, only Present Value of Benefits (PVBs) have been estimated.

1.2.4 For the purposes of the scheme evaluation, it is assumed full dualling can be accommodated on the line of the existing alignment of the A9. No engineering design works to DMRB standards were proposed in the high-level TEE appraisal.

[1] A9 Perth to Inverness Economic Appraisal Study, Strategic Impact Assessment and EALI Analysis, Scott Wilson, October 2007

1.2.4 The previous Strategic Impact Assessment (SIA) Study was commissioned to help inform decision-makers of the economic benefits of improvements to the A9. The purpose of this report is to further quantify the economic benefits of the full dualling option of the A9 trunk road between Perth and Inverness identified in the previous SIA Report.

1.3 Structure of this Report

1.3.1 The remainder of the report is organised as follows:

Chapter 2 - sets out the existing and new traffic data used in this appraisal.

Chapter 3 - describes the traffic model developed for analysing present and future traffic conditions.

Chapter 4 - outlines the TEE appraisal process and associated results.

Chapter 5 - sets out the overall conclusions.

2. NETWORK COVERAGE AND NEW TRAFFIC DATA

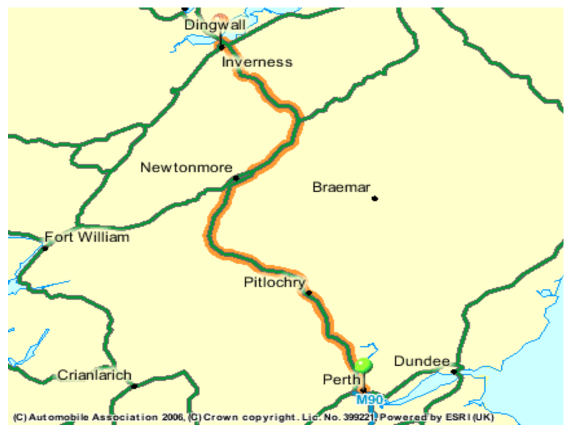
2.1 Introduction

2.1.1 This Chapter describes the network in broad terms and depicts the area covered by the appraisal. The study has set up a new zonal system that defines the study area immediately adjacent to the A9 required by the modelling procedure.

2.1.2 Data from both the previous SIA study and new data was used as the basis of the appraisal. Additional ATC data was used, and junction counts were carried out. An additional roadside interview (RSI) was undertaken to determine traffic origin and destination patterns which complemented other RSIs along the A9, which were also used.

2.2 Network and area covered

2.2.1 The A9 is the main trunk route from the central belt to the Highlands and Islands, linking Perth and Inverness via a number of towns including Dunkeld, Pitlochry, Blair Atholl, Dalwhinnie, Kingussie and Aviemore. The A9 has been assessed as having the highest functionality of any transport link in the region, accounting for 98% of all passenger journeys between Inverness and the central belt, and almost all freight movements along the corridor[2].



2.2.2 The A9 between Perth and Inverness is the main commercial corridor for goods and services to be transported into and out of the Inverness and the western Moray Firth areas. It also provides access to the northern and western Highlands, including Caithness, Sutherland, and Wester Ross for business and leisure purposes.

2.2.3 The A9 also provides access to the remoter Islands communities of Orkney, Lewis and Harris for supplies, business trips and for tourists; and also provides important ancillary access to parts of the western Highlands, including Skye, Lochaber and Lochalsh for both business and leisure trips.

2.2.4 The A9 trunk road between Perth and Inverness is approximately 182 km in length and analysis of journey times using the AA Milemaster system suggests it takes approximately 2 hours and 10 minutes to travel by road[3]. The road is predominantly single carriageway, with only around 42 km of it dualled. The Figure (above) shows the route of the A9 through the study area.

2.2.5 The route is of a generally good standard, comprising a mixture of rural single carriageway, dual carriageway and WS2+1 carriageway, with the carriageway width meeting the current minimum standard 7.3 metres over the entire length of the route.

2.2.6 For the purposes of this study the A9 has been divided up into 25 zones, of which 21 border the A9. The zones are numbered on a north to south axis. These zones are shown in Table 2.1

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[2] Complementarity of Proposals to Upgrade Road and Rail Links in the Inverness-Perth Corridor: Reference Economic Consultants, July 2006

[3] Milemaster Journey Time System, Automobile Association, 2006

Table 2.1: Description of the Zones of the Study Area

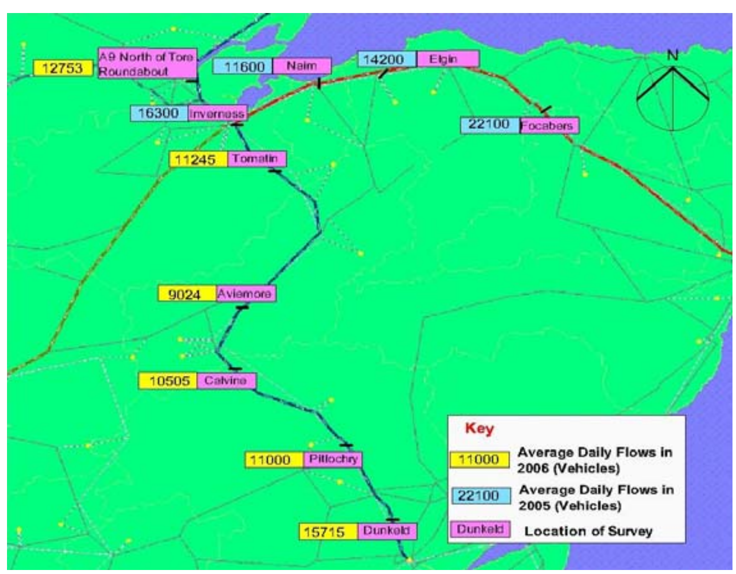
Zone	Zone Name	Zone	Zone Name	Zone	Zone Name
1	Inverness Central/North/North-West	**11**	Ballindalloch	**21**	Perth & Central Belt
2	Inverness East/Culloden	**12**	Nethy Bridge	**22**	NE Scotland
3	Inverness West/Central-West	**13**	Aviemore	**23**	NW Scotland
4	Inverness South/South-West	**14**	Pitlochry	**24**	SW Scotland & Ireland
5	Nairn	**15**	Blairgowrie North	**25**	SE Scotland & Rest of UK
6	Tomatin/Moy	**16**	Blairgowrie South		
7	Granton-on-Spey	**17**	Dunkeld		
8	Newtonmore	**18**	Luncarty		
9	Carrbridge	**19**	Perth North/North-West		
10	Boat of Garten	**20**	Perth East/North-East		

2.3 Traffic surveys

Previous Traffic Data

2.3.1 Traffic data was obtained from a number of automatic traffic count (ATC) sites along the A9, and travel information was also obtained from roadside interview (RSI) surveys. Because of the differing patterns of travel experienced along the route of the A9 from Perth to Inverness, the A9 was divided into 3 sections to capture the different characteristics of movements at each section. These sections were south of the study route (just north of Perth), the middle of the study route (at Aviemore) and north of the study route (at Inverness). Information from traffic surveys was obtained for each of these sections of the A9.

2.3.2 Traffic data was collected from the Scottish Roads Traffic Database (SRTDb) for various years, by different days and months. These are a suitable source of long-term traffic flow data and seasonal variations.

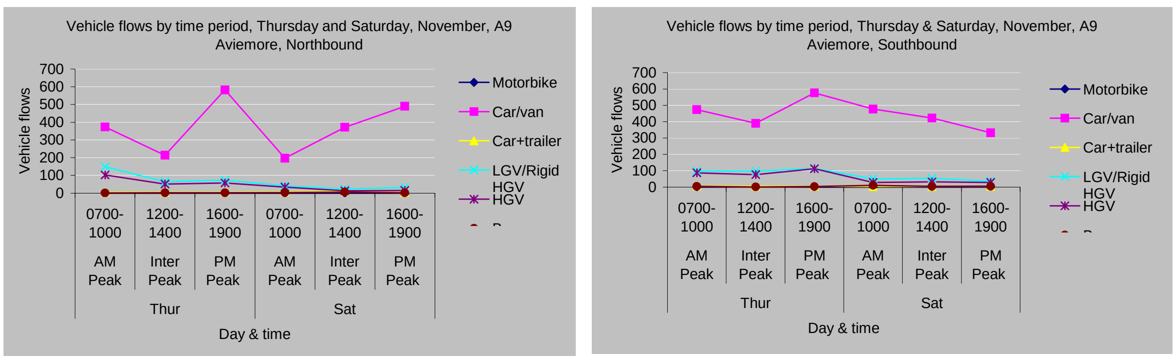


2.3.3 The analysis of this information has produced average daily traffic volumes on key roads in and around the study route, including on the A9 and some of its surrounding links. These flows were updated to 2007 as a base year, and are summarised in the Figure (right).

2.3.4 Focussing in on the A9, the data shows the busiest sections of the A9 are north of Perth followed by just south of Inverness. This is to be expected given the built-up nature of these important cities compared to the more rural sections of the route. However, the data also shows there are significant daily volumes along its entire route.

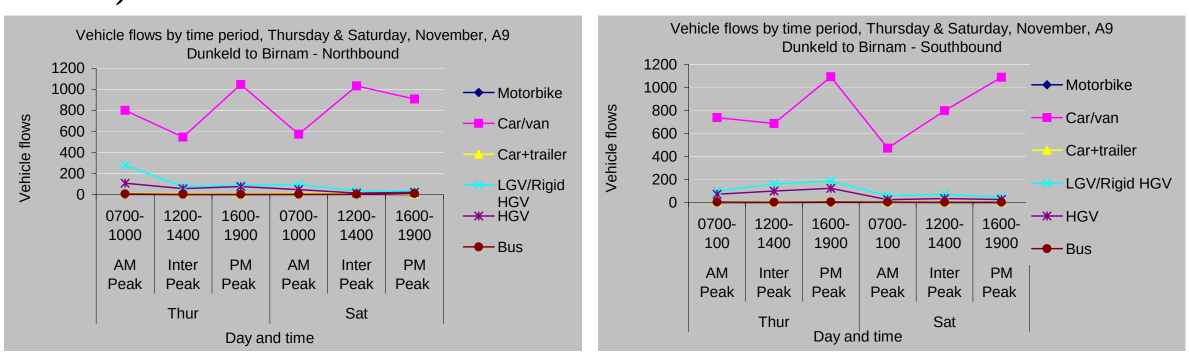
2.3.5 Figure 2.1 shows the hourly profile of traffic flows for a neutral day and a weekend day, for a neutral month (November) for Aviemore, derived from SRTDb data. The Figure clearly shows the PM peak in traffic flows, both northbound and southbound during the weekday. However weekend traffic data show opposing flows northbound and southbound, with flows rising through the day northbound, and falling through the day southbound at weekends.

Figure 2.1: Hourly Profile of Traffic Flows by Direction, Aviemore (SRTDb, 2007)



2.3.6 For comparison, Figure 2.2 shows the hourly profile of traffic flows for Dunkeld-Birnam, approximately 112 km south of Aviemore towards Perth. The major difference is the weekend traffic and in particular the rise in traffic volumes southbound between Dunkeld and Birnam, possible indicating the pull of Perth for shopping and other activities at the weekend for more southerly locations on the A9.

Figure 2.2: Hourly Profile of Traffic Flows by Direction, Dunkeld-Birnam, (SRTDb, 2007)



Previous Speed Surveys

2.3.7 A recent study by Reference Economic Consultants looked at journey times, vehicle speeds and platooning along the A9[4]. The section of the A9 which was analysed is approximately 173 km long and extends from the A912 Roundabout at Perth to Raigmore Interchange, Inverness.

2.3.8 A number of surveys were carried out at different times/months and the median observed journey times for the surveyed route ranged between:

- 1 hour and 59½ minutes (giving an average speed of 54 mph); and
- slightly under 1 hour & 54 minutes (representing an average speed of 57 mph).

[4] A9 Perth-Inverness & A96 Aberdeen-Inverness: Journey Times, Vehicle Speeds and Vehicle Platooning, Reference Economic Consultants, January 2007

2.3.9 This speed data was considered suitable for this assessment and hence was used in this appraisal. No new speed surveys were therefore carried out.

New surveys

2.3.10 A programme of new traffic counts were undertaken to supplement the data already collated from previous studies and to complement data from alternative sources. This includes a series of link and junction traffic counts at key locations along the A9, at the following locations:

- Dunkeld Rd Rndbt, Perth
- North of Luncarty, Perth
- Gauls Jnc, Bankfoot
- Birnam Jnc, South of Dunkeld
- Dunkeld/Inver Jnc
- Dalmarnock Link
- Logierait/Ballinluig Jnc
- Croltinload Jnc (incl On/Off Slips)
- Pitlochry Jnc
- Aldclune
- Pitagowan
- Calvine
- Dalnaspidal Lodge
- South of Dalwhinnie Jnc
- Etteridge
- South of Newtonmore
- Ruthven Jnc
- Kingussie Jnc
- Kincraig
- Polchar Jnc
- North of Grampian Rd
- Granish Jnc
- North of Kinveachy
- Jnc North of Bogroy
- South of Findhorn Bridge
- Jnc South of Moy
- Jnc with B851 South
- Daviot Jnc (B9154)
- House of Daviot Jnc (B851 North)
- Jnc with B9177
- Jnc with B8082
- Sir Walter Scott Drive
- North of Sir Walter Scott Drive
- Raigmore Interchange

2.3.11 The counts were carried out at the major three-arm and four arm junctions on the A9. They were undertaken over a total of eight road sections, 23 three-arm junctions, 3 four-arm junctions, on large four-arm junction just south of Inverness. One further count was carried out on the slip roads of the grade-separated junction on the Raigmore Junction in Inverness, using video surveys.

2.3.12 In addition to the vehicle counts, a 12-hour RSI was carried out, between 0700 and 1900 on the south side of Inverness. This was carried out on a Thursday at the end of November 2007 (neutral day and month). The new RSI gives valuable additional information on trip origins and destinations by vehicle type and by time period. This RSI is in addition to the three previous RSIs undertaken for the SIA study, and located at Aviemore, the junction of the A9 and B9177, and just outside Perth (Southbound). The RSI data is then used in order to build an origin-destination matrix of traffic movements for different vehicle types at different times of the day.

Annualisation Factors

2.3.13 Transport Scotland maintains a network of permanent Automatic Traffic Count (ATC) sites across the Scottish road network, several of which are located on the A9. The information collected from these ATC sites represent the most continuous data from which variations and trends in traffic flows on the A9 can be derived.

2.3.14 Information from this site was used to derive expansion factors to apply to the peak hour traffic assignments to estimate Annual Average Daily Traffic (AADT) flows and 18-hour traffic flows.

2.3.15 New ATC data used was for neutral days, Wednesdays or Thursdays, for the month of November, with two data sets for October. Both months are considered neutral months – that is where traffic flows are unlikely to be affected by seasonality factors.

3. MODEL DEVELOPMENT & CALIBRATION

3.1 Introduction

3.1.1 The traffic modelling for the A9 TEE Appraisal was carried out using the CUBE Voyager computer software. This is an industry-standard computer program used to examine proposed improvements in the road networks.

3.1.2 The CUBE Voyager model consists of the following key elements:

- a network representation of the road network;
- a trip matrix to define traffic movements within the modelled area;
- an assignment algorithm to allocate trips between each pair of zones to the network based on a defined generalised cost equation;
- a simulation of the network operational performance arising from the assigned traffic; and
- the production of road user benefits and other effects for use in the appraisal of new transport options.

3.1.3 There are two components to the CUBE Voyager model: a component representing the road network in the model area and a series of trip matrices representing origin-destination (OD) trips by different vehicle classes and time periods.

3.1.4 The CUBE Voyager model allows wider area routing so that the trips are correctly loaded at route zones around the boundary of the simulation area in the base and forecast year mode. The operation of the CUBE Voyager model allows forecasts based on growth factors derived from other programmes such as TEMPRO or NRTF[5].

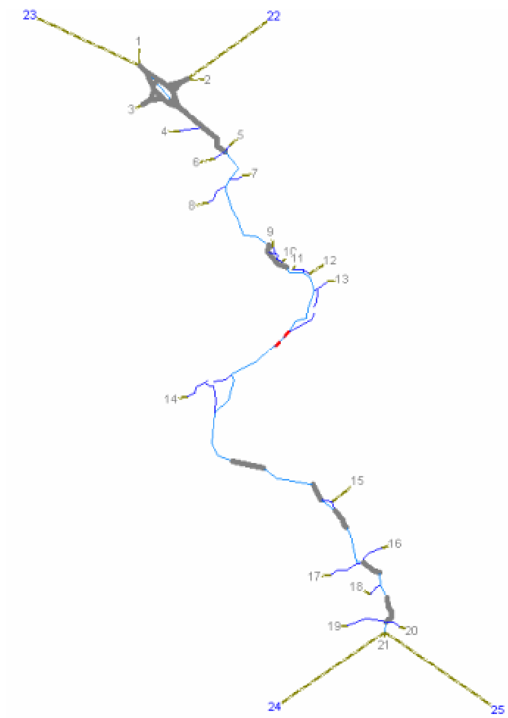
3.1.5 The CUBE Voyager model developed for this study is based on a Fixed Trip Matrix (FTM) assignment for the following reasons:

- FTM modelling is tried, tested and used extensively elsewhere;
- the FTM modelling process used in this study includes for the effects of road capacity influences on travel speeds and the resultant travel times;
- the network being modelled is a skeletal network with little route options for traffic to transfer to other areas if traffic flows exceed road capacity;
- other approaches require a whole rafter of additional assumptions which may not add to the accuracy of the model; and
- this appraisal is not modelling modal shift.

[5] National Road Traffic Forecasts, Department for Transport (DfT)

3.2 Base Model

3.2.1 The area modelled was divided into 25 zones. Of these 21 zones were decided upon by identifying the main junctions on the A9 and their hinterland into logical areas, which shared a common access point, or area of access onto the A9 road network to be modelled.



3.2.2 The 21 zones (Figure right) cover the entire route and adjacent areas between Inverness and Perth. The remaining zones (zones 22 to 25) cover the rest of the country.

3.2.3 The base model, which is essentially a representation of the existing conditions of the A9 trunk road and other major roads within the study area, was defined by a series of links and nodes. Each of the 25 zones feeds into the network at one of the nodes. Many of the nodes represent a single junction, however some are a simplified representation of more than one minor junction and/or accesses. All the major junctions within the modelled area are represented by at least one of the nodes.

3.2.4 The road categories used in the model are based on those given in the NESA Manual in DMRB Volume 13, Section 1, Part 5, Table 1/1. The link lengths and number of lanes are based on the existing physical conditions and the link capacities are based on DMRB Volume 5, Section 1, Part 3.

3.2.5 Every link was modelled in two directions. Speed limits are based on the actual speed limits on the existing road, i.e. 60mph on the A9. The A9 was modelled as a single carriageway, a wide single carriageway and as a dual carriageway, where appropriate.

3.2.6 The CUBE Voyager model time periods are consistent with other upper level models such as Transport Model for Scotland (TMfS) for possible compatibility with national forecasts. The CUBE Voyager model therefore utilises the following time periods:

- AM Peak 1/3 average of 0700-1000hrs;
- Inter Peak 1/6 average of 1000-1600hrs; and
- PM Peak 1/3 average of 1600-1900hrs.

3.2.7 There is no suggestion that these hours represent the peak throughout the modelled area. However, for the purposes of the model, they represent a defined hour within the peak and interpeak periods.

3.2.8 A multi user-class assignment has been adopted for the CUBE Voyager model This assigns four vehicle classes to the network, defined as:

- Cars;
- Light Goods Vehicles (LGVs);
- Heavy Goods Vehicles (HGVs); and
- Buses.

3.3 Base Trip Matrix Preparation

3.3.1 In order to estimate observed traffic demand patterns a number of 25 by 25 origin/destination base trip matrices were prepared. The RSI data was used as the starting point for the development of the OD matrices. OD tables were produced from data from all the four RSI surveys for each vehicle class and time period. The data from the four separate RSI sites was then merged into one complete OD table for each vehicle class and time period.

3.3.2 The result was a series of demand matrices. However, as is normal with RSI survey information, there were some gaps in the observed movements which to be in-filled. For this purpose the standard Furness trip distribution model was used. The RSI OD 'seed' matrices were input into a series of Furness spreadsheet models ensuring that the seed matrices matched the target flows derived from observed traffic counts, providing a more reliable set of matrices on which the model was built.

3.3.3 Having developed and implemented the different parts of the base year model, they were integrated into a single framework and the relationships within and between the components calibrated.

3.4 Assignment Procedure & Generalised Costs

3.4.1 The assignment procedure in the CUBE Voyager model is an Equilibrium Assignment which, using a set of algorithms, optimally combines a series of assignments such that the ultimate flow pattern reflects the multi-routing evident on the network and satisfying the criterion known as 'Wardrop Equilibrium'.

3.4.2 The assignment process combines as assignment stage and a junction simulation stage. The delay information from the simulation is passed back to the assignment stage where a new trip pattern is derived. The process is iterated until convergence is reached.

3.4.3 The CUBE Voyager model has a number of parameters which can be set to determine when a suitable level of convergence has been reached. Convergence was deemed to be satisfactory at the point where 99% of link flows changed by less than 1% between two successive iterations. This resulted in a 'gap' statistic of less than 1%. This 'gap' statistic is equivalent to the 'delta' referred to in DMRB Volume 12 Section 2 Part 1 Appendix I, and the convergence criteria therefore meet the DMRB requirements for both proximity and stability.

3.4.4 Under this condition, traffic is arranged on the network such that the cost of travel on all routes used between an origin/destination pair is equal to the minimum cost of travel and all unused routes have an equal or greater cost. The calculation of generalised cost co-efficients has used the recommended approach in Volume 12 of the DMRB and the example in Volume 13.

3.4.5 There are no tolled roads within the modelled area, so a generalised cost equation based only on time and distance is required. As four vehicle type matrices (cars, LGVs, HGVs and buses) are assigned, it was considered appropriate to reflect the different characteristics of light and heavy vehicles through the use of separate generalised cost equations.

3.4.6 Following the example given in DMRB Volume 13 Section 2, the generalised cost equations can be summarised as follows:

- Cars 1.00 x time + 0.54 x distance;
- LGVs 1.00 x time + 0.54 x distance;
- HGVs 1.00 x time + 2.91 distance; and
- Buses 1.00 x time + 2.91 distance.

3.5 Traffic Growth Forecasts

3.5.1 Future traffic flows for the base network were estimated for 2010 and 2025 i.e. the expected opening year for the scheme and the design year. The estimated future flows were calculated using TEMPRO growth factors. The 2007 traffic flows were split into cars, Light Goods Vehicles (LGVs), Heavy Goods Vehicles (HGVs) and buses, and the appropriate growth factors applied to each vehicle category. The growth factors derived from TEMPRO and applied to the 2007 traffic matrices were 1.03 for 2010 and 1.11 for 2025.

3.5.2 At the time of the model build and calibration, there were no known committed developments or land use changes likely to have a significant effect on traffic flows within the study area. Therefore only flows from the TEMPRO growth factors were added to the 2005 flows to obtain predicted flows for 2010 and 2025.

3.5.3 It should be noted that the predicted future flows, especially those for 2025, are in reality unlikely to occur on the existing road network as in many locations they are above the capacity of the existing roads. However as the CUBE Voyager software uses demand modelling, the predicted future flows must be based on unrestrained growth.

3.6 Model Calibration Tests

Model Convergence

3.6.1 Within the assignment, a number of loadings are undertaken until such time as defined criteria are met. The resulting Equilibrium Assignment is designed to fulfil Wardrop's First Principle that for any origin/destination pair, all used routes have equal generalised costs while unused routes have equal or greater costs. The CUBE Voyager model produces a number of convergence statistics for the assignment. This includes the difference between costs on chosen routes and costs on minimum routes, summed across the whole network, and expressed as a unit of minimum costs (RAAD, delta Δ).

3.6.2 This tends to decrease towards a minimum value as the number of iterations increases. For the assignment loop, the main indicator of convergence is a total network wide value of RAAD, which does not change by less than as certain value (here 0.005) between successive iterations.

3.6.3 A high level of convergence was achieved in all time periods, with statistics as presented in Table 3.1.

Table 3.1: Convergence Statistics

Time Period	Assignment (Δ)
AM Peak	0.00193
Inter-Peak	0.00179
PM Peak	0.00175

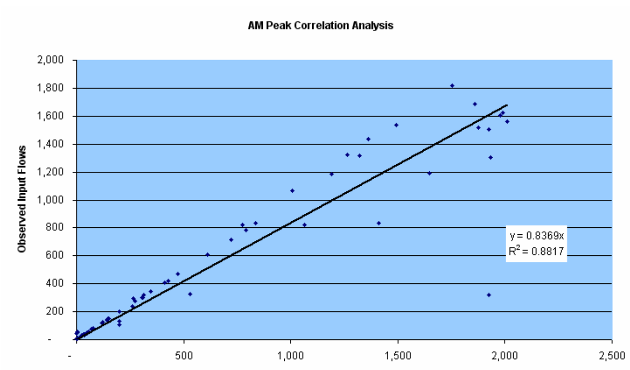
Regression Analysis Tests

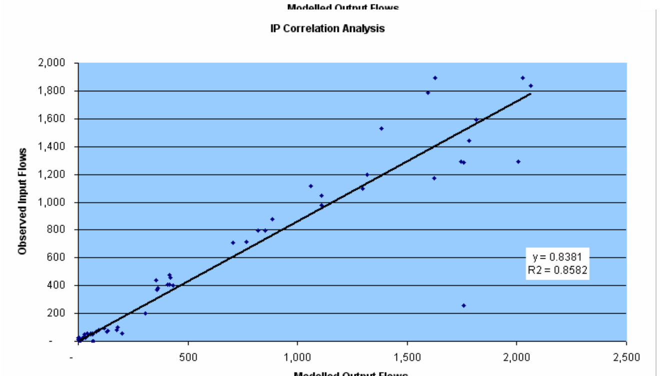
3.6.4 For each time period the model was calibrated to individual link flows, and all available count datasets were input to each run of the model. For a perfect fit, R^2 should tend to one in each case although anything greater than 0.75 was considered reasonable for the size of the model.

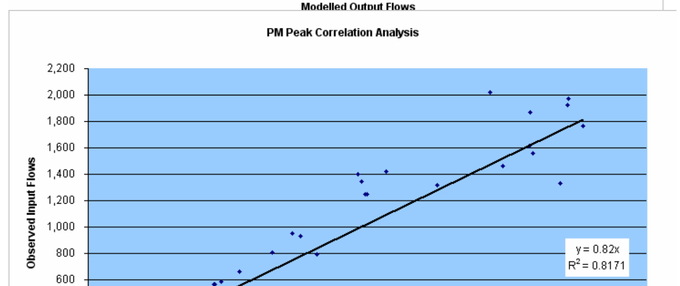
3.6.5 A comparison of modelled and observed flows using regression analysis produced satisfactory results as presented in Table 3.2.

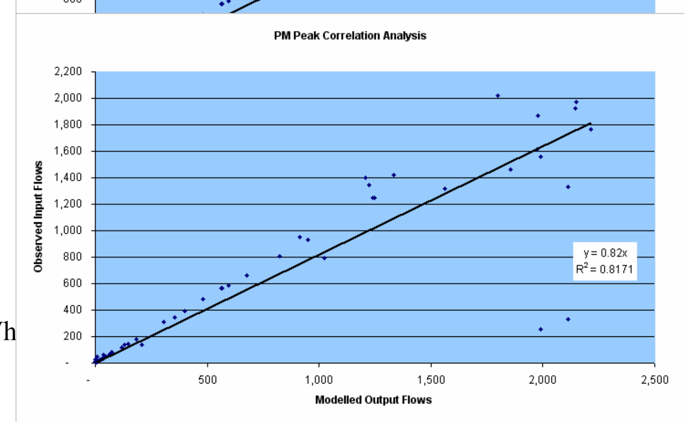
Table 3.2: Regression Analysis Results

Time Period	R^2
AM Peak	0.88
Inter-Peak	0.86
PM Peak	0.82









3.6.6 The Figures (right and below right) show the graphical plots of the regression analysis for the AM peak, Interpeak and PM peak with the best-fit straight line and R^2 value.

3.6.7 The plots clearly illustrate the close fit of the curve to the data points for each time periods, with values well over 0.75. This suggests that both observed and modelled outputs are closely correlated for all three time periods.

3.6.8 The best fit is for the AM peak hour, but the differences in R^2 values are so small between the time periods that for practical purposes they can be ignored.

Logic Checks

3.6.9 A series of range and logic checks were carried out including:

- movement logic checks;
- directions of trip flows;
- travel times, distances and speeds; and
- network connectivity.

Goodness-of-Fit Tests

3.6.10 In accordance with standard modelling practices and Government advice, a series of statistical goodness-of-fit tests was carried out comparing predicted against observed flows. Any discrepancies were investigated and remedial measures carried out. As recommended in Government Guidance, the GEH statistic was used:

Wh

$$GEH = \sqrt{\frac{(V_2 - V_1)^2}{(V_1 + V_2)/2}}$$

3.6.11 This statistical goodness-of-fit test was carried out for various sites in the model area, which capture observed movements in November 2007. Various iterations were undertaken, which involved carrying out statistical tests and making improvements to the highway assignment model, until a suitable level of fit was achieved.

3.6.12 Acceptability Guidelines for GEH values are usually 5.0 for much smaller (local) models. For a model area as large as this it would seem reasonable to aim for a value of 10.0. The reason for this is that the guidelines are for guidance purposes only, and are not rigid. There does not appear to be any indication in DMRB as to where these guidelines are derived from.

3.6.13 Furthermore the unit of flow in GEH statistics is vehicles per hour. Since the GEH statistic is not unit free, different guideline values will be relevant if units of flow are different from vehicles per hour. The units for GEH are the square root of flow, so that for example with a pcu/vehicle ratio of about 1.2 the GEH guideline value moves from 5.0 to 5.5. The scale of the study is also highly relevant.

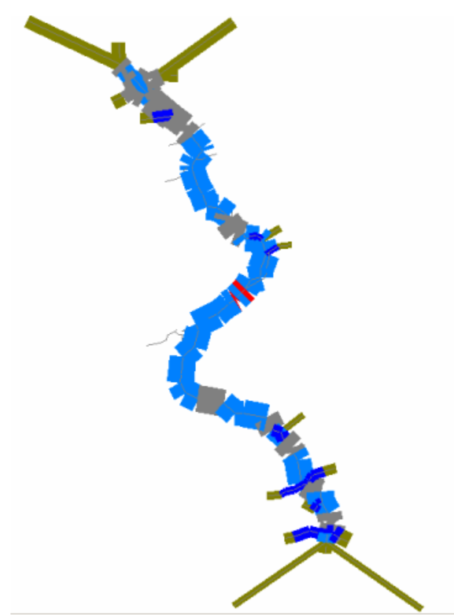
3.6.14 For each time period, 90 links in the model network were assessed using the standard GEH calculation. The analysis showed:

- in the AM peak, about 92% of the links met the GEH criteria with an average network-wide GEH value of 2.84%;
- in the Interpeak, 89% of the model links achieved the GEH criteria with a network-wide average of 4.12%; and
- in the PM peak, 94% of the links satisfied the GEH criteria with an average GEH result of 3.05% across the network.

3.6.15 As can be seen from the above, the average GEH value for each time period was below 10.0 which was considered acceptable given the points identified in Paragraphs 3.6.7 and 3.6.8 above. Appendix A contains the calculations for each link over each time period.

Modelled Flows

3.6.16 The modelled flows are shown in the Figure (right). This Figure clearly indicates the flows on the single carriageway alignments (blue) with those on the dual carriageway alignments (grey) and the short WS+1 alignments (red). The green flows are those connecting the end of the A9 to the regions outside the immediate A9 zones (i.e. with the rest of the country).



4. ECONOMIC APPRAISAL RESULTS

4.1 Application of the Traffic Model

4.1.1 The CUBE Voyager model estimates the reductions in journey times across the various roads in the modelled network. These are simulated for the AM, inter-peak and PM peak periods to reflect different travel patterns of the day. Similarly, the model also estimates the journey distances travelled across the network. These estimates of time and distance are annualised using expansion factors to give the annual equivalents.

4.1.2 The CUBE Voyager model is not re-assigning flows because this is a linear scheme, nor is it capping flows to road capacity levels. The CUBE Voyager model is therefore showing the unrestrained demand that would occur if the road was assumed to be able to absorb the increase in traffic flows. Both the base and the test flows are demand flows, that is, they represent the traffic that would like to be using the road in the assignment hours. The Cube Voyager model calculates the impacts of the forecast traffic flows in the network, the results of which are fed into the economic appraisal which is discussed below.

4.2 Appraisal Assumptions

4.2.1 The Department for Transport's Transport User Benefits Appraisal (TUBA) program was used to undertake the Transport Economic Efficiency (TEE) appraisal of the Full Dualling Option. The specific economic assumptions and cost adjustments are consistent with the Government's Scottish Transport Appraisal Guidance (STAG)/webTAG appraisal convention.

4.2.2 All monetary values are in market prices, and values are discounted to the base year 2002, as adopted in TUBA. The test discount rate is 3.5% for project years 1 to 30, and 3% thereafter. An appraisal period of 60 years (as per webTAG procedures) has been adopted, with a first year construction year (opening year) in 2010, and a horizon year (final appraisal year) in 2069. The modelled years are from 2010 and 2025.

4.2.3 This assessment is only a partial appraisal, with only the benefits of the Full Dualling option taken account of, and not the costs. Therefore the assumptions relating to costs such as risk and optimism bias do not apply. Only the benefits are presented here.

4.3 Appraisal Results

4.3.1 The results of the TUBA appraisal on monetised benefits are shown in Table 4.1. From these, it will be possible to gain an insight into the economic efficiency of the scheme.

4.3.2 Table 4.1 demonstrates that the predominant benefits are those associated with travel-time savings. Savings on vehicle operating costs are also a feature of the benefits, although they are less prominent than travel time benefits.

Table 4.1: Summary of Present Value of Benefits

Benefits	Value (£000)
User Benefits (Consumers)	£582,512
User Benefits (Businesses)	£594,083
Accident Benefits	Not assessed by TUBA
Carbon Benefits	-£3,285
Net Present Value of Benefits (PVB)	£1,173,310

Note: all figures are at 2002 prices, as per TUBA

4.3.3 The PVBs for the Full Dualling Option are therefore £1,173 million in 2002 prices It should however be observed that the TUBA estimates PVBs in 2002 prices while the original SIA Study had a price base of 2005. Therefore this is not an exact like-for-like comparison. However, applying a growth rate of 3.5% per annum to 2005 would increase the above PVB to approximately £1,301 million at 2005 levels. This equates reasonably closely to the GVA estimates over 60 years as estimated in the previous studies' High-Level Estimates Technical Note[6]. A printout of the TUBA model is shown in Appendix B.

Targeted Dualling of Sections of the A9

4.3.4 The above results relate to the Full Dualling Option, however the original SIA Study also examined a Partial (Strategic) Dualling Option. In the original GVA calculations it was assumed that the Partial (Strategic) Dualling Option would provide approximately two-thirds of the time benefits as the Full Dualling Option.

4.3.5 However, it is possible to carry out a high-level appraisal of the potential benefits which could be gained by dualling a targeted number of sections of the A9 as identified in Table 4.2 below. This was based on a pro rata of time savings at each section of the A9 against the total saving along the whole route, multiplied by the total PVB. The Table clearly shows that the greatest benefits could be gained by dualling the section between Kingussie junction and the Aviemore North junction indicating a PVB of £17.4 million per kilometre in 2002 prices, followed by the section between Aviemore North junction and Slochd which returns a PVB per kilometre of £12.8 million per kilometre in 2002 prices. The section with the least benefits per kilometre is between Slochd/Tomatin and Inverness (a PVB of £3.6 million/km). The section from Perth to Drumochter is outside the HITRANS area and also is being developed as part of the Perth to Blair Atholl proposals, hence we have not included an analysis along this section of the A9.

Table 4.2: Analysis of PVBs at Targeted Sections

Link	PVB (£000)	PVB (£000) Per km	Ranking
Perth to Drumochter d/c (Dalnacardoch lodge)	£318,610	Outwith HITRANS area	
Drumochter d/c (Dalnaspidal lodge) to Dalwhinnie junction (A889)	£124,300	£12,070	3
Dalwhinnie junction to Kingussie junction (A86)	£124,300	£5,470	4
Kingussie junction to Aviemore north junction (A95)	£373,000	£17,430	1
Aviemore north to Slochd d/c	£202,000	£12,790	2
Slochd d/c (Tomatin) to Inverness	£31,100	£3,570	5

Note: all figures are at 2002 prices, as per TUBA

4.3.6 The ranking column in the above table suggests the potential order of implementing any strategic dualling along the A9.

[6] High-Level Estimates of GVA Benefits over 60 Years – Technical Note, Scott Wilson, November 2007

5 CONCLUSIONS

5.1 Introduction

5.1.1 The A9 is the main trunk route from the central belt to the Highlands and Islands and as such has been assessed as having the highest level of functionality of any transport link in the region. It is also a lifeline route to the north of Scotland and the peripheral islands. Growth in the study area has been consistently better than that of Scotland as a whole, but remains substantially worse off in terms of GVA per capita.

5.1.2 Upgrading the A9 is seen as an opportunity to close this 'wealth gap', particularly given the increasing importance of the route linking communities on the route and connecting to the wider economy. There is a growing perception that competitiveness and continuing economic success of the sub-region cannot be guaranteed without this investment in the A9, in particular either in dualling key sections of the route, or dualling the entire route between Inverness and Perth.

5.1.3 The purpose of this report is to further quantify the economic benefits of the Full Dualling Option of the A9 trunk road between Perth and Inverness identified in the earlier SIA/EALI report. In this way this study complements the earlier study by serving to buttress the wider benefits discussed in the earlier study. However, this is only a partial appraisal, as no cost estimates have been prepared and included in the assessment. Only the present values of benefits (PVBs) have been estimated.

5.2 Model Development

5.2.1 The traffic modelling for the A9 TEE Appraisal was carried out using the CUBE Voyager computer software. This is an industry-standard computer program used to examine proposed improvements in the road networks. The operation of the CUBE Voyager model, based on a Fixed Matrix assignment, allows forecasts based on growth factors derived from other programmes such as TEMPRO, which was used in this assessment for traffic growth forecasts for 2010 and 2025.

5.2.2 The area modelled was divided into 25 zones. 21 of the zones covered the entire route and adjacent areas between Inverness and Perth. The remaining zones (zones 22 to 25) linked to the rest of the country. The A9 was modelled as a single carriageway, a wide single carriageway and as a dual carriageway, where appropriate. Every link was modelled in two directions, and speed limits were based on the actual speed limits on the existing road, 60mph on the A9. The AM peak, Interpeak and PM peak periods were modelled, and four vehicle classes were assigned to the network: cars, LGVs, HGVs and buses.

5.2.3 The RSI data was used for the development of the 25 by 25 origin/destination 2007 base trip matrices. These were further refined to ensure a more reliable set of matrices on which to build the model. The model was subjected to a number of calibration tests, including model convergence, regression analysis and statistical goodness-of-fit tests, and was assessed as being suitable for the modelling requirements.

5.3 TEE Results

5.3.1 The Department for Transport's Transport User Benefits Appraisal (TUBA) program was used to undertake the appraisal of the Full Dualling Option for the modelled years, 2010 and 2025. This adopted the standard appraisal parameters in line with the Government's appraisal convention. However, this assessment is only a partial appraisal, and does not take into account the costs of the investment. The PVBs for the Full Dualling Option are calculated as £1,173 million in 2002 prices and £1,301 million in 2005 prices.

Appendix A

GEH Model Calibration Tests Results

Ref	Location	A-Node	B-Node		Flow (vehs)		Obs - Mod	Percent	GEH Stat.	Criteria Tests	
					Observed	Modelled		Diff.		GEH	Flow
Calibration Links - AM Peak Hour											
1	A9 Inverness	1000	1010	10001010	1,433	1,361	-72	-5.00	1.9	✓	✓
2	A9 Inverness	1010	1000	10101000	1,818	1,754	-64	-3.53	1.5	✓	✓
3	A9	1010	1020	10101020	819	1,065	246	30.06	8.0	✓	✗
4	A9	1040	1010	10401010	834	1,412	578	69.26	17.2	✗	✗
5	A96	1050	1060	10501060	1,534	1,492	-42	-2.72	1.1	✓	✓
6	A96	1060	1070	10601070	1,534	1,492	-42	-2.72	1.1	✓	✓
7	A96	1060	1050	10601050	823	776	-47	-5.71	1.7	✓	✓
8	A96	1090	1060	10901060	823	776	-47	-5.71	1.7	✓	✓
9	A82	1100	1110	11001110	274	275	1	0.40	0.1	✓	✓
10	A82	1110	1100	11101100	1,186	1,190	4	0.35	0.1	✓	✓
11	A82	1110	1130	11101130	274	275	1	0.40	0.1	✓	✓
12	A82	1140	1110	11401110	1,186	1,190	4	0.35	0.1	✓	✓
13	B8082	1220	1240	12201240	317	315	-2	-0.50	0.1	✓	✓
14	B8082	1240	1220	12401220	786	790	4	0.47	0.1	✓	✓
15	A9 South of Inverness	1260	1290	12601290	1,689	1,861	172	10.18	4.1	✓	✓
16	A9 South of Inverness	1280	1290	12801290	1,625	1,988	363	22.36	8.5	✓	✗
17	A9 South of Inverness	1290	1260	12901260	1,606	1,978	372	23.17	8.8	✓	✗
18	A9 South of Inverness	1290	1280	12901280	1,519	1,874	355	23.40	8.6	✓	✗
19	B9177	1290	1320	12901320	57	56	-1	-2.28	0.2	✓	✓
20	B9177	1290	1310	12901310	49	51	2	3.06	0.2	✓	✓
21	B9177	1310	1290	13101290	82	77	-5	-6.59	0.6	✓	✓
22	B9177	1320	1290	13201290	37	33	-4	-11.62	0.7	✓	✓
23	B9154	1370	1460	13701460	40	37	-3	-7.75	0.5	✓	✓
24	B9154	1410	1460	14101460	41	50	9	21.46	1.3	✓	✓
25	A9 Craggie	1430	1480	14301480	30	26	-4	-12.00	0.7	✓	✓
26	B9154	1460	1370	14601370	53	50	-3	-6.04	0.4	✓	✓
27	B9154	1460	1410	14601410	33	37	4	11.82	0.7	✓	✓
28	B851	1480	1430	14801430	74	71	-4	-4.73	0.4	✓	✓
29	B851	1480	1490	14801490	30	26	-4	-12.00	0.7	✓	✓
30	B851	1490	1480	14901480	74	71	-4	-4.73	0.4	✓	✓
31	B851	1490	1500	14901500	30	26	-4	-12.00	0.7	✓	✓
32	B851	1500	1490	15001490	74	71	-4	-4.73	0.4	✓	✓
33	B851	1500	1510	15001510	30	26	-4	-12.00	0.7	✓	✓
34	B851	1510	1500	15101500	74	71	-4	-4.73	0.4	✓	✓
35	A938	1640	1780	16401780	10	4	-6	-61.00	2.3	✓	✓
36	A9	1700	1710	17001710	241	262	21	8.59	1.3	✓	✓
37	-	1710	1700	17101700	297	264	-34	-11.28	2.0	✓	✓
38	-	1710	1720	17101720	148	150	2	1.49	0.2	✓	✓
39	-	1710	1740	17101740	116	117	1	0.69	0.1	✓	✓
40	-	1720	1710	17201710	124	123	-1	-0.73	0.1	✓	✓
41	-	1740	1710	17401710	149	146	-3	-2.21	0.3	✓	✓
42	-	1780	1640	17801640	9	5	-4	-46.67	1.6	✓	✓
43	A938	1780	1790	17801790	6	3	-3	-50.00	1.4	✓	✓
44	A938	1780	1800	17801800	4	1	-3	-77.50	2.0	✓	✓
45	A938	1790	1780	17901780	5	2	-3	-60.00	1.6	✓	✓
46	A938	1800	1780	18001780	5	3	-2	-44.00	1.1	✓	✓
47	A9 Aviemore	1840	1870	18401870	1,306	1,932	626	47.94	15.6	✗	✗
48	A95	1840	1910	18401910	145	141	-4	-2.76	0.3	✓	✓
49	A95	1850	1910	18501910	201	201	0	0.10	0.0	✓	✓
50	A9 Aviemore	1870	1840	18701840	1,507	1,926	419	27.82	10.1	✗	✗

Ref	Location	A-Node	B-Node		Flow (vehs)		Obs - Mod	Percent	GEH Stat.	Criteria Tests	
					Observed	Modelled		Diff.		GEH	Flow
51	B9152	1900	3182	19003182	326	532	206	63.19	9.9	✓	✗
52	B9152	1900	2080	19002080	52	5	-47	-90.38	8.8	✓	✓
53	A95	1910	1850	19101850	141	141	0	0.00	-	✓	✓
54	A95	1910	1840	19101840	129	201	72	55.97	5.6	✓	✓
55	B9152	1910	1920	19101920	59	3	-56	-94.92	10.1	✗	✓
56	B9152	1920	1910	19201910	47	1	-46	-97.87	9.4	✓	✓
57	B9152	2080	1900	20801900	59	4	-55	-93.22	9.8	✓	✓
58	A889	2270	2280	22702280	19	15	-4	-21.05	1.0	✓	✓
59	A889	2280	2270	22802270	31	27	-4	-14.19	0.8	✓	✓
60	A923	2810	2860	28102860	423	430	7	1.58	0.3	✓	✓
61	Dunkeld	2810	2820	28102820	304	308	4	1.28	0.2	✓	✓
62	Dunkeld	2810	2800	28102800	109	201	92	84.40	7.4	✓	✓
63	A822	2820	2810	28202810	344	347	3	0.76	0.1	✓	✓
64	A822	2820	2830	28202830	304	308	4	1.28	0.2	✓	✓
65	A822	2830	2820	28302820	344	347	3	0.76	0.1	✓	✓
66	A822	2830	2840	28302840	304	308	4	1.28	0.2	✓	✓
67	A822	2840	2830	28402830	344	347	3	0.76	0.1	✓	✓
68	A822	2840	2850	28402850	304	308	4	1.28	0.2	✓	✓
69	A822	2850	2840	28502840	344	347	3	0.76	0.1	✓	✓
70	A923	2860	2870	28602870	423	430	7	1.58	0.3	✓	✓
71	A822	2860	2810	28602810	405	411	6	1.51	0.3	✓	✓
72	A923	2870	2880	28702880	423	430	7	1.58	0.3	✓	✓
73	A923	2870	2860	28702860	407	411	4	1.01	0.2	✓	✓
74	A923	2880	2870	28802870	407	411	4	1.01	0.2	✓	✓
75	B867	2940	2970	29402970	304	310	6	1.97	0.3	✓	✓
76	B867	2970	2940	29702940	716	720	4	0.54	0.1	✓	✓
77	A9 Bankfoot	3020	2940	30202940	1,191	1,646	455	38.17	12.1	✗	✗
78	A9	3090	3100	30903100	1,559	2,011	452	28.97	10.7	✗	✗
79	A85	3100	3160	31003160	1,068	1,007	-61	-5.70	1.9	✓	✓
80	-	3100	3110	31003110	610	613	3	0.51	0.1	✓	✓
81	A85	3110	3120	31103120	610	613	3	0.51	0.1	✓	✓
82	A85	3110	3100	31103100	472	475	3	0.61	0.1	✓	✓
83	A85	3120	3130	31203130	610	613	3	0.51	0.1	✓	✓
84	A85	3120	3110	31203110	472	475	3	0.61	0.1	✓	✓
85	A85	3130	3120	31303120	472	475	3	0.61	0.1	✓	✓
86	-	3140	3150	31403150	1,319	1,321	2	0.14	0.1	✓	✓
87	A85	3140	3100	31403100	831	835	4	0.52	0.1	✓	✓
88	-	3150	3140	31503140	831	835	4	0.52	0.1	✓	✓
89	Perth	3160	3100	31603100	1,326	1,266	-60	-4.53	1.7	✓	✓
90	A9 North of Kingussie	3182	1900	31821900	319	1,926	1607	503.82	48.0	✗	✗
			Totals		**43,923**	**49,332**	**5409.25**	**2.18**	**2.84**	**92%**	**88%**

Ref	Location	A-Node	B-Node		Flow (vehs)		Obs - Mod	Percent	GEH Stat.	Criteria Tests	
					Observed	Modelled		Diff.		GEH	Flow
Calibration Links - Inter Peak Hour											
1	A9 Inverness	1000	1010	10001010	1,895	1,629	-266	-14.05	6.3	✓	✓
2	A9 Inverness	1010	1000	10101000	1,789	1,595	-194	-10.85	4.7	✓	✓
3	A9	1010	1020	10101020	1,195	1,319	124	10.33	3.5	✓	✓
4	A9	1040	1010	10401010	1,099	1,295	196	17.86	5.7	✓	✗
5	A96	1050	1060	10501060	1,528	1,382	-146	-9.53	3.8	✓	✓
6	A96	1060	1070	10601070	1,528	1,382	-146	-9.53	3.8	✓	✓
7	A96	1060	1050	10601050	1,115	1,059	-56	-5.02	1.7	✓	✓
8	A96	1090	1060	10901060	1,115	1,059	-56	-5.02	1.7	✓	✓
9	A82	1100	1110	11001110	477	415	-62	-13.08	3.0	✓	✓
10	A82	1110	1100	11101100	980	1,110	130	13.23	4.0	✓	✓
11	A82	1110	1130	11101130	408	415	7	1.62	0.3	✓	✓
12	A82	1140	1110	11401110	1,049	1,110	61	5.79	1.8	✓	✓
13	B8082	1220	1240	12201240	96	118	22	23.13	2.1	✓	✓
14	B8082	1240	1220	12401220	706	706	-0	-0.04	0.0	✓	✓
15	A9 South of Inverness	1260	1290	12601290	1,837	2,064	227	12.33	5.1	✓	✓
16	A9 South of Inverness	1280	1290	12801290	1,439	1,782	343	23.84	8.5	✓	✗
17	A9 South of Inverness	1290	1260	12901260	1,591	1,814	223	14.01	5.4	✓	✓
18	A9 South of Inverness	1290	1280	12901280	1,894	2,028	134	7.07	3.0	✓	✓
19	B9177	1290	1320	12901320	69	80	11	16.38	1.3	✓	✓
20	B9177	1290	1310	12901310	57	40	-17	-29.12	2.4	✓	✓
21	B9177	1310	1290	13101290	81	95	14	16.91	1.5	✓	✓
22	B9177	1320	1290	13201290	26	22	-4	-13.85	0.7	✓	✓
23	B9154	1370	1460	13701460	16	19	3	20.63	0.8	✓	✓
24	B9154	1410	1460	14101460	10	18	8	79.00	2.1	✓	✓
25	A9 Craggie	1430	1480	14301480	38	27	-11	-28.16	1.9	✓	✓
26	B9154	1460	1370	14601370	10	18	8	79.00	2.1	✓	✓
27	B9154	1460	1410	14601410	16	19	3	20.63	0.8	✓	✓
28	B851	1480	1430	14801430	49	30	-19	-38.57	3.0	✓	✓
29	B851	1480	1490	14801490	38	27	-11	-28.16	1.9	✓	✓
30	B851	1490	1480	14901480	49	30	-19	-38.57	3.0	✓	✓
31	B851	1490	1500	14901500	38	27	-11	-28.16	1.9	✓	✓
32	B851	1500	1490	15001490	49	30	-19	-38.57	3.0	✓	✓
33	B851	1500	1510	15001510	38	27	-11	-28.16	1.9	✓	✓
34	B851	1510	1500	15101500	49	30	-19	-38.57	3.0	✓	✓
35	A938	1640	1780	16401780	17	15	-2	-9.41	0.4	✓	✓
36	A9	1700	1710	17001710	75	133	58	77.07	5.7	✓	✓
37	-	1710	1700	17101700	68	131	63	92.35	6.3	✓	✓
38	-	1710	1720	17101720	-	67	67	0.00	11.6	✗	✓
39	-	1710	1740	17101740	-	68	68	0.00	11.7	✗	✓
40	-	1720	1710	17201710	-	69	69	0.00	11.8	✗	✓
41	-	1740	1710	17401710	-	64	64	0.00	11.3	✗	✓
42	-	1780	1640	17801640	14	10	-4	-28.57	1.2	✓	✓
43	A938	1780	1790	17801790	-	6	6	0.00	3.5	✓	✓
44	A938	1780	1800	17801800	-	9	9	0.00	4.3	✓	✓
45	A938	1790	1780	17901780	-	5	5	0.00	3.1	✓	✓
46	A938	1800	1780	18001780	-	5	5	0.00	3.3	✓	✓
47	A9 Aviemore	1840	1870	18401870	1,293	2,006	713	55.14	17.6	✗	✗
48	A95	1840	1910	18401910	58	58	0	0.17	0.0	✓	✓
49	A95	1850	1910	18501910	58	67	9	14.66	1.1	✓	✓
50	A9 Aviemore	1870	1840	18701840	1,285	1,758	473	36.78	12.1	✗	✗

Ref	Location	A-Node	B-Node		Flow (vehs)		Obs - Mod	Percent Diff.	GEH Stat.	Criteria Tests	
					Observed	Modelled				GEH	Flow
51	B9152	1900	3182	19003182	199	306	107	53.77	6.7	✓	✗
52	B9152	1900	2080	19002080	13	2	-11	-84.62	4.0	✓	✓
53	A95	1910	1850	19101850	51	58	7	13.92	1.0	✓	✓
54	A95	1910	1840	19101840	51	67	16	30.39	2.0	✓	✓
55	B9152	1910	1920	19101920	26	2	-24	-92.31	6.4	✓	✓
56	B9152	1920	1910	19201910	13	1	-12	-92.31	4.5	✓	✓
57	B9152	2080	1900	20801900	26	3	-23	-88.46	6.0	✓	✓
58	A889	2270	2280	22702280	27	34	7	24.07	1.2	✓	✓
59	A889	2280	2270	22802270	19	20	1	2.63	0.1	✓	✓
60	A923	2810	2860	28102860	457	419	-38	-8.29	1.8	✓	✓
61	Dunkeld	2810	2820	28102820	385	363	-22	-5.77	1.1	✓	✓
62	Dunkeld	2810	2800	28102800	80	177	97	121.25	8.6	✓	✓
63	A822	2820	2810	28202810	440	356	-85	-19.20	4.2	✓	✓
64	A822	2820	2830	28202830	385	363	-22	-5.77	1.1	✓	✓
65	A822	2830	2820	28302820	440	356	-85	-19.20	4.2	✓	✓
66	A822	2830	2840	28302840	385	363	-22	-5.77	1.1	✓	✓
67	A822	2840	2830	28402830	440	356	-85	-19.20	4.2	✓	✓
68	A822	2840	2850	28402850	385	363	-22	-5.77	1.1	✓	✓
69	A822	2850	2840	28502840	440	356	-85	-19.20	4.2	✓	✓
70	A923	2860	2870	28602870	457	419	-38	-8.29	1.8	✓	✓
71	A822	2860	2810	28602810	368	357	-11	-2.91	0.6	✓	✓
72	A923	2870	2880	28702880	457	419	-38	-8.29	1.8	✓	✓
73	A923	2870	2860	28702860	368	357	-11	-2.91	0.6	✓	✓
74	A923	2880	2870	28802870	368	357	-11	-2.91	0.6	✓	✓
75	B867	2940	2970	29402970	57	198	141	247.89	12.5	✗	✗
76	B867	2970	2940	29702940	103	180	77	74.66	6.5	✓	✓
77	A9 Bankfoot	3020	2940	30202940	1,173	1,623	450	38.35	12.0	✗	✗
78	A9	3090	3100	30903100	1,293	1,746	453	35.03	11.6	✗	✗
79	A85	3100	3160	31003160	878	884	6	0.69	0.2	✓	✓
80	-	3100	3110	31003110	410	408	-2	-0.44	0.1	✓	✓
81	A85	3110	3120	31103120	410	408	-2	-0.44	0.1	✓	✓
82	A85	3110	3100	31103100	399	434	35	8.75	1.7	✓	✓
83	A85	3120	3130	31203130	410	408	-2	-0.44	0.1	✓	✓
84	A85	3120	3110	31203110	399	434	35	8.75	1.7	✓	✓
85	A85	3130	3120	31303120	399	434	35	8.75	1.7	✓	✓
86	-	3140	3150	31403150	798	851	53	6.63	1.8	✓	✓
87	A85	3140	3100	31403100	794	818	24	2.98	0.8	✓	✓
88	-	3150	3140	31503140	794	818	24	2.98	0.8	✓	✓
89	Perth	3160	3100	31603100	717	769	52	7.18	1.9	✓	✓
90	A9 North of Kingussie	3182	1900	31821900	258	1,758	1500	581.24	47.2	✗	✗
			Totals		**40,814**	**45,334**	**4520.15**	**11.11**	**4.12**	**89%**	**90%**

Ref	Location	A-Node	B-Node		Flow (vehs) Observed	Flow (vehs) Modelled	Obs - Mod	Percent Diff.	GEH Stat.	Criteria Tests GEH	Criteria Tests Flow
Calibration Links - PM Peak Hour											
1	A9 Inverness	1000	1010	10001010	2,018	1,798	-220	-10.89	5.0	✓	✓
2	A9 Inverness	1010	1000	10101000	1,402	1,209	-193	-13.77	5.3	✓	✓
3	A9	1010	1020	10101020	1,314	1,563	249	18.97	6.6	✓	✗
4	A9	1040	1010	10401010	793	1,026	233	29.34	7.7	✓	✗
5	A96	1050	1060	10501060	1,346	1,225	-121	-9.00	3.4	✓	✓
6	A96	1060	1070	10601070	1,346	1,225	-121	-9.00	3.4	✓	✓
7	A96	1060	1050	10601050	1,423	1,335	-88	-6.20	2.4	✓	✓
8	A96	1090	1060	10901060	1,423	1,335	-88	-6.20	2.4	✓	✓
9	A82	1100	1110	11001110	563	565	2	0.27	0.1	✓	✓
10	A82	1110	1100	11101100	804	823	19	2.40	0.7	✓	✓
11	A82	1110	1130	11101130	563	565	2	0.27	0.1	✓	✓
12	A82	1140	1110	11401110	804	823	19	2.40	0.7	✓	✓
13	B8082	1220	1240	12201240	348	355	7	1.90	0.4	✓	✓
14	B8082	1240	1220	12401220	307	307	-0	-0.10	0.0	✓	✓
15	A9 South of Inverness	1260	1290	12601290	1,974	2,149	175	8.88	3.9	✓	✓
16	A9 South of Inverness	1280	1290	12801290	1,614	1,974	360	22.32	8.5	✓	✗
17	A9 South of Inverness	1290	1260	12901260	1,869	1,977	108	5.75	2.5	✓	✓
18	A9 South of Inverness	1290	1280	12901280	1,921	2,146	225	11.70	5.0	✓	✓
19	B9177	1290	1320	12901320	66	64	-2	-3.48	0.3	✓	✓
20	B9177	1290	1310	12901310	50	48	-2	-4.60	0.3	✓	✓
21	B9177	1310	1290	13101290	77	75	-2	-2.99	0.3	✓	✓
22	B9177	1320	1290	13201290	41	35	-6	-13.66	0.9	✓	✓
23	B9154	1370	1460	13701460	31	28	-4	-11.29	0.6	✓	✓
24	B9154	1410	1460	14101460	21	19	-2	-9.05	0.4	✓	✓
25	A9 Craggie	1430	1480	14301480	34	32	-2	-6.76	0.4	✓	✓
26	B9154	1460	1370	14601370	21	19	-2	-9.05	0.4	✓	✓
27	B9154	1460	1410	14601410	31	28	-4	-11.29	0.6	✓	✓
28	B851	1480	1430	14801430	36	32	-4	-10.00	0.6	✓	✓
29	B851	1480	1490	14801490	34	32	-2	-6.76	0.4	✓	✓
30	B851	1490	1480	14901480	36	32	-4	-10.00	0.6	✓	✓
31	B851	1490	1500	14901500	34	32	-2	-6.76	0.4	✓	✓
32	B851	1500	1490	15001490	36	32	-4	-10.00	0.6	✓	✓
33	B851	1500	1510	15001510	34	32	-2	-6.76	0.4	✓	✓
34	B851	1510	1500	15101500	36	32	-4	-10.00	0.6	✓	✓
35	A938	1640	1780	16401780	18	14	-4	-20.00	0.9	✓	✓
36	A9	1700	1710	17001710	135	132	-3	-2.00	0.2	✓	✓
37	-	1710	1700	17101700	83	75	-8	-9.40	0.9	✓	✓
38	-	1710	1720	17101720	69	69	-0	-0.29	0.0	✓	✓
39	-	1710	1740	17101740	65	64	-1	-2.00	0.2	✓	✓
40	-	1720	1710	17201710	40	36	-4	-11.00	0.7	✓	✓
41	-	1740	1710	17401710	41	40	-1	-2.93	0.2	✓	✓
42	-	1780	1640	17801640	10	4	-6	-56.00	2.1	✓	✓
43	A938	1780	1790	17801790	9	7	-2	-26.67	0.9	✓	✓
44	A938	1780	1800	17801800	9	8	-1	-13.33	0.4	✓	✓
45	A938	1790	1780	17901780	4	2	-2	-60.00	1.4	✓	✓
46	A938	1800	1780	18001780	5	3	-2	-44.00	1.1	✓	✓
47	A9 Aviemore	1840	1870	18401870	1,332	2,111	779	58.51	18.8	✗	✗
48	A95	1840	1910	18401910	51	9	-42	-83.14	7.8	✓	✓
49	A95	1850	1910	18501910	37	35	-2	-6.22	0.4	✓	✓
50	A9 Aviemore	1870	1840	18701840	1,561	1,989	428	27.40	10.2	✗	✗

Ref	Location	A-Node	B-Node		Flow (vehs)		Obs - Mod	Percent	GEH Stat.	Criteria Tests	
					Observed	Modelled		Diff.		GEH	Flow
51	B9152	1900	3182	19003182	333	2,111	1778	534.05	50.9	✗	✗
52	B9152	1900	2080	19002080	12	-	-12	-100.00	4.9	✓	✓
53	A95	1910	1850	19101850	11	9	-2	-21.82	0.8	✓	✓
54	A95	1910	1840	19101840	64	35	-29	-45.78	4.2	✓	✓
55	B9152	1910	1920	19101920	25	3	-22	-88.00	5.9	✓	✓
56	B9152	1920	1910	19201910	8	1	-7	-87.50	3.3	✓	✓
57	B9152	2080	1900	20801900	25	2	-23	-92.00	6.3	✓	✓
58	A889	2270	2280	22702280	41	37	-5	-10.98	0.7	✓	✓
59	A889	2280	2270	22802270	27	23	-4	-16.30	0.9	✓	✓
60	A923	2810	2860	28102860	661	678	17	2.56	0.7	✓	✓
61	Dunkeld	2810	2820	28102820	585	595	10	1.68	0.4	✓	✓
62	Dunkeld	2810	2800	28102800	136	209	73	53.68	5.6	✓	✓
63	A822	2820	2810	28202810	481	482	1	0.19	0.0	✓	✓
64	A822	2820	2830	28202830	585	595	10	1.68	0.4	✓	✓
65	A822	2830	2820	28302820	481	482	1	0.19	0.0	✓	✓
66	A822	2830	2840	28302840	585	595	10	1.68	0.4	✓	✓
67	A822	2840	2830	28402830	481	482	1	0.19	0.0	✓	✓
68	A822	2840	2850	28402850	585	595	10	1.68	0.4	✓	✓
69	A822	2850	2840	28502840	481	482	1	0.19	0.0	✓	✓
70	A923	2860	2870	28602870	661	678	17	2.56	0.7	✓	✓
71	A822	2860	2810	28602810	396	399	3	0.73	0.1	✓	✓
72	A923	2870	2880	28702880	661	678	17	2.56	0.7	✓	✓
73	A923	2870	2860	28702860	396	399	3	0.73	0.1	✓	✓
74	A923	2880	2870	28802870	396	399	3	0.73	0.1	✓	✓
75	B867	2940	2970	29402970	147	148	1	0.82	0.1	✓	✓
76	B867	2970	2940	29702940	116	120	4	3.53	0.4	✓	✓
77	A9 Bankfoot	3020	2940	30202940	1,763	2,214	451	25.60	10.1	✗	✗
78	A9	3090	3100	30903100	1,460	1,857	397	27.22	9.8	✓	✗
79	A85	3100	3160	31003160	1,250	1,239	-11	-0.90	0.3	✓	✓
80	-	3100	3110	31003110	180	183	3	1.89	0.3	✓	✓
81	A85	3110	3120	31103120	180	183	3	1.89	0.3	✓	✓
82	A85	3110	3100	31103100	564	567	3	0.59	0.1	✓	✓
83	A85	3120	3130	31203130	180	183	3	1.89	0.3	✓	✓
84	A85	3120	3110	31203110	564	567	3	0.59	0.1	✓	✓
85	A85	3130	3120	31303120	564	567	3	0.59	0.1	✓	✓
86	-	3140	3150	31403150	929	950	21	2.25	0.7	✓	✓
87	A85	3140	3100	31403100	1,246	1,247	1	0.06	0.0	✓	✓
88	-	3150	3140	31503140	1,246	1,247	1	0.06	0.0	✓	✓
89	Perth	3160	3100	31603100	953	915	-38	-4.00	1.2	✓	✓
90	A9 North of Kingussie	3182	1900	31821900	256	1,989	1733	676.84	51.7	✗	✗
			Totals		**45,634**	**51,709**	**6075.45**	**6.08**	**3.05**	**94%**	**90%**

Appendix B

TUBA Printout for Full Dualling Option

Transport User Benefit Appraisal TUBA v1.7a
Program run on Thursday, 27 March 2008 at 18:05:29

INPUT_SUMMARY

Run name	A9 Full Dualling
DM scheme	Do Minimum
DS scheme	Full Dualling

Economic parameter file C:\Program Files\TUBA 1.7\economics\std_economics_1.7.txt
Scheme parameter file T:\MOU10 RJB\TrP\000 - Projects\A9 HITRANS (S100867)\TEE\TUBA\A9 Full Dualling.txt

First year of scheme costs	2007
First Appraisal Year	2010
Last Appraisal Year	2069
Modelled years	2010 2025

Time period	Total hours
AM peak	759
PM peak	1518
Inter-peak	759
Total	3036

Note: All monetary values are in 2002 market prices. All monetary values discounted to 2002 unless otherwise stated.

DM_SCHEME_COSTS
Do minimum scheme costs. Undiscounted £000s

Mode	Year	Prep.	Superv.	Constr.	Land	Maint.	Oper.	Grant/Sub.	Dev._Cont
Road	2007	0	0	0	0	0	0	0	0
Road	2008	0	0	0	0	0	0	0	0
Road	2009	0	0	0	0	0	0	0	0
Road	2010	0	0	0	0	0	0	0	0
Road	2011	0	0	0	0	0	0	0	0
Road	2012	0	0	0	0	0	0	0	0
Road	2013	0	0	0	0	0	0	0	0
Road	2014	0	0	0	0	0	0	0	0
Road	2015	0	0	0	0	0	0	0	0
Road	2016	0	0	0	0	0	0	0	0
Road	2017	0	0	0	0	0	0	0	0
Road	2018	0	0	0	0	0	0	0	0
Road	2019	0	0	0	0	0	0	0	0
Road	2020	0	0	0	0	0	0	0	0
Road	2021	0	0	0	0	0	0	0	0
Road	2022	0	0	0	0	0	0	0	0
Road	2023	0	0	0	0	0	0	0	0
Road	2024	0	0	0	0				

	0		0		0		0		
Road		2025		0		0		0	0
	0		0		0		0		
Road		2026		0		0		0	0
	0		0		0		0		
Road		2027		0		0		0	0
	0		0		0		0		
Road		2028		0		0		0	0
	0		0		0		0		
Road		2029		0		0		0	0
	0		0		0		0		
Road		2030		0		0		0	0
	0		0		0		0		
Road		2031		0		0		0	0
	0		0		0		0		
Road		2032		0		0		0	0
	0		0		0		0		
Road		2033		0		0		0	0
	0		0		0		0		
Road		2034		0		0		0	0
	0		0		0		0		
Road		2035		0		0		0	0
	0		0		0		0		
Road		2036		0		0		0	0
	0		0		0		0		
Road		2037		0		0		0	0
	0		0		0		0		
Road		2038		0		0		0	0
	0		0		0		0		
Road		2039		0		0		0	0
	0		0		0		0		
Road		2040		0		0		0	0
	0		0		0		0		
Road		2041		0		0		0	0
	0		0		0		0		
Road		2042		0		0		0	0
	0		0		0		0		
Road		2043		0		0		0	0
	0		0		0		0		
Road		2044		0		0		0	0
	0		0		0		0		
Road		2045		0		0		0	0
	0		0		0		0		
Road		2046		0		0		0	0
	0		0		0		0		
Road		2047		0		0		0	0
	0		0		0		0		
Road		2048		0		0		0	0
	0		0		0		0		
Road		2049		0		0		0	0
	0		0		0		0		
Road		2050		0		0		0	0
	0		0		0		0		
Road		2051		0		0		0	0
	0		0		0		0		
Road		2052		0		0		0	0
	0		0		0		0		
Road		2053		0		0		0	0
	0		0		0		0		
Road		2054		0		0		0	0
	0		0		0		0		
Road		2055		0		0		0	0
	0		0		0		0		
Road		2056		0		0		0	0
	0		0		0		0		
Road		2057		0		0		0	0
	0		0		0		0		
Road		2058		0		0		0	0

						0	0	0	0
Road	2059	0	0	0	0	0	0	0	0
Road	2060	0	0	0	0	0	0	0	0
Road	2061	0	0	0	0	0	0	0	0
Road	2062	0	0	0	0	0	0	0	0
Road	2063	0	0	0	0	0	0	0	0
Road	2064	0	0	0	0	0	0	0	0
Road	2065	0	0	0	0	0	0	0	0
Road	2066	0	0	0	0	0	0	0	0
Road	2067	0	0	0	0	0	0	0	0
Road	2068	0	0	0	0	0	0	0	0
Road	2069	0	0	0	0	0	0	0	0

DS_SCHEME_COSTS
Do something scheme costs. Undiscounted £000s

Mode	Year	Prep.	Superv.	Constr.	Land	Maint.	Oper.	Grant/Sub.	Dev._Cont
Road	2007	0	0	0	0	0	0	0	0
Road	2008	0	0	0	0	0	0	0	0
Road	2009	0	0	0	0	0	0	0	0
Road	2010	0	0	0	0	0	0	0	0
Road	2011	0	0	0	0	0	0	0	0
Road	2012	0	0	0	0	0	0	0	0
Road	2013	0	0	0	0	0	0	0	0
Road	2014	0	0	0	0	0	0	0	0
Road	2015	0	0	0	0	0	0	0	0
Road	2016	0	0	0	0	0	0	0	0
Road	2017	0	0	0	0	0	0	0	0
Road	2018	0	0	0	0	0	0	0	0
Road	2019	0	0	0	0	0	0	0	0
Road	2020	0	0	0	0	0	0	0	0
Road	2021	0	0	0	0	0	0	0	0
Road	2022	0	0	0	0	0	0	0	0
Road	2023	0	0	0	0	0	0	0	0
Road	2024	0	0	0	0	0	0	0	0
Road	2025	0	0	0	0	0	0	0	0
Road	2026	0	0	0	0	0	0	0	0

Road	2027	0	0	0	0	0	0	0	0
Road	2028	0	0	0	0	0	0	0	0
Road	2029	0	0	0	0	0	0	0	0
Road	2030	0	0	0	0	0	0	0	0
Road	2031	0	0	0	0	0	0	0	0
Road	2032	0	0	0	0	0	0	0	0
Road	2033	0	0	0	0	0	0	0	0
Road	2034	0	0	0	0	0	0	0	0
Road	2035	0	0	0	0	0	0	0	0
Road	2036	0	0	0	0	0	0	0	0
Road	2037	0	0	0	0	0	0	0	0
Road	2038	0	0	0	0	0	0	0	0
Road	2039	0	0	0	0	0	0	0	0
Road	2040	0	0	0	0	0	0	0	0
Road	2041	0	0	0	0	0	0	0	0
Road	2042	0	0	0	0	0	0	0	0
Road	2043	0	0	0	0	0	0	0	0
Road	2044	0	0	0	0	0	0	0	0
Road	2045	0	0	0	0	0	0	0	0
Road	2046	0	0	0	0	0	0	0	0
Road	2047	0	0	0	0	0	0	0	0
Road	2048	0	0	0	0	0	0	0	0
Road	2049	0	0	0	0	0	0	0	0
Road	2050	0	0	0	0	0	0	0	0
Road	2051	0	0	0	0	0	0	0	0
Road	2052	0	0	0	0	0	0	0	0
Road	2053	0	0	0	0	0	0	0	0
Road	2054	0	0	0	0	0	0	0	0
Road	2055	0	0	0	0	0	0	0	0
Road	2056	0	0	0	0	0	0	0	0
Road	2057	0	0	0	0	0	0	0	0
Road	2058	0	0	0	0	0	0	0	0
Road	2059	0	0	0	0	0	0	0	0
Road	2060	0	0	0	0	0	0	0	0

Road	2061	0	0	0	0	0	0	0	0	0
Road	2062	0	0	0	0	0	0	0	0	0
Road	2063	0	0	0	0	0	0	0	0	0
Road	2064	0	0	0	0	0	0	0	0	0
Road	2065	0	0	0	0	0	0	0	0	0
Road	2066	0	0	0	0	0	0	0	0	0
Road	2067	0	0	0	0	0	0	0	0	0
Road	2068	0	0	0	0	0	0	0	0	0
Road	2069	0	0	0	0	0	0	0	0	0

PRESENT_VALUE_COSTS
Scheme investment and operating costs (i.e. excluding grant/subsidy, developer contributions and delays) and differences. £000s.

Mode	Year	DM_scheme_costs	DS_scheme_costs	Difference
Road	2007	0	0	0
Road	2008	0	0	0
Road	2009	0	0	0
Road	2010	0	0	0
Road	2011	0	0	0
Road	2012	0	0	0
Road	2013	0	0	0
Road	2014	0	0	0
Road	2015	0	0	0
Road	2016	0	0	0
Road	2017	0	0	0
Road	2018	0	0	0
Road	2019	0	0	0
Road	2020	0	0	0
Road	2021	0	0	0
Road	2022	0	0	0
Road	2023	0	0	0
Road	2024	0	0	0
Road	2025	0	0	0
Road	2026	0	0	0
Road	2027	0	0	0
Road	2028	0	0	0
Road	2029	0	0	0
Road	2030	0	0	0
Road	2031	0	0	0
Road	2032	0	0	0
Road	2033	0	0	0
Road	2034	0	0	0
Road	2035	0	0	0
Road	2036	0	0	0
Road	2037	0	0	0
Road	2038	0	0	0
Road	2039	0	0	0
Road	2040	0	0	0
Road	2041	0	0	0
Road	2042	0	0	0
Road	2043	0	0	0
Road	2044	0	0	0
Road	2045	0	0	0
Road	2046	0	0	0
Road	2047	0	0	0
Road	2048	0	0	0
Road	2049	0	0	0
Road	2050	0	0	0
Road	2051	0	0	0

Road	2052	0	0	0
Road	2053	0	0	0
Road	2054	0	0	0
Road	2055	0	0	0
Road	2056	0	0	0
Road	2057	0	0	0
Road	2058	0	0	0
Road	2059	0	0	0
Road	2060	0	0	0
Road	2061	0	0	0
Road	2062	0	0	0
Road	2063	0	0	0
Road	2064	0	0	0
Road	2065	0	0	0
Road	2066	0	0	0
Road	2067	0	0	0
Road	2068	0	0	0
Road	2069	0	0	0
Road	Total	0	0	0

TRIP_MATRIX_TOTALS
Annualised total trip numbers(thousands)

Submode	Year	Time period	DO MIN	DO SOM
Car	2010	AM peak	5261	5261
Car	2010	PM peak	9441	9441
Car	2010	Inter-peak	5574	5574
Car	2010	All	20275	20275
Car	2025	AM peak	5669	5669
Car	2025	PM peak	10174	10174
Car	2025	Inter-peak	6007	6007
Car	2025	All	21850	21850
LGV Personal	2010	AM peak	1170	1170
LGV Personal	2010	PM peak	1893	1893
LGV Personal	2010	Inter-peak	704	704
LGV Personal	2010	All	3768	3768
LGV Personal	2025	AM peak	1261	1261
LGV Personal	2025	PM peak	2041	2041
LGV Personal	2025	Inter-peak	759	759
LGV Personal	2025	All	4061	4061
LGV Freight	2010	AM peak	648	648
LGV Freight	2010	PM peak	995	995
LGV Freight	2010	Inter-peak	376	376
LGV Freight	2010	All	2018	2018
LGV Freight	2025	AM peak	698	698
LGV Freight	2025	PM peak	1072	1072
LGV Freight	2025	Inter-peak	405	405
LGV Freight	2025	All	2174	2174
OGV1	2010	AM peak	54	54
OGV1	2010	PM peak	965	965
OGV1	2010	Inter-peak	376	376
OGV1	2010	All	1395	1395
OGV1	2025	AM peak	54	54
OGV1	2025	PM peak	965	965
OGV1	2025	Inter-peak	376	376
OGV1	2025	All	1395	1395
All	2010	AM peak	7133	7133
All	2010	PM peak	13294	13294
All	2010	Inter-peak	7030	7030
All	2010	All	27456	27456
All	2025	AM peak	7682	7682
All	2025	PM peak	14251	14251
All	2025	Inter-peak	7546	7546
All	2025	All	29480	29480

DM&DS_USER_COSTS
Total value of user costs, DM and DS. £000s.
Mode Year DMtot_time DMtot_charge DMtot_fuel DMtot_nonfuel
DStot_time DStot_charge DStot_fuel DStot_nonfuel

Road	2010	422252	0	122390	114510	368781	0	124421	113017
Road	2025	318677	0	73598	72613	298597	0	74322	72128

FUEL_CONSUMPTION

Total fuel consumption, DM and DS. kilolitres.

		Do minimum		Do something	
Submode	Year	petrol	diesel	petrol	diesel
Car	2010	93907	33347	95205	33548
Car	2025	73455	44266	73935	44392
LGV Personal	2010	5658	27140	5662	27040
LGV Personal	2025	6100	29197	6102	29140
LGV Freight	2010	3106	14898	3108	14843
LGV Freight	2025	3347	16020	3348	15991
OGV1	2010	0	39378	0	41589
OGV1	2025	0	40057	0	41589
All	2010	102671	114762	103975	117019
All	2025	82903	129541	83385	131111
Car	Total	4540706	2561409	4575263	2569559
LGV Personal	Total	362456	1735356	362572	1731586
LGV Freight	Total	198908	952232	198971	950254
OGV1	Total	0	2397990	0	2495329
All	Total	5102071	7646987	5136807	7746729

CARBON_EMISSION

		Emissions (tonnes)			cost (£000s, low)			cost (£000s, central)			cost (£000s, high)		
Submode	Year	DM	DS	Increase	DM	DS	Increase	DM	DS	Increase	DM	DS	Increase
Car	2010	80427	81358	930	2845	2878	33	5057	5116	59	9482	9592	110
Car	2025	74892	75268	376	2108	2119	11	3338	3355	17	5797	5827	29
LGV Personal	2010	22342	22274	-67	790	788	-2	1405	1401	-4	2634	2626	-8
LGV Personal	2025	23827	23789	-38	671	670	-1	1062	1060	-2	1844	1842	-3
LGV Freight	2010	12264	12227	-37	434	433	-1	771	769	-2	1446	1442	-4
LGV Freight	2025	13074	13054	-20	368	367	-1	583	582	-1	1012	1011	-2
OGV1	2010	27414	28954	1540	970	1024	54	1724	1821	97	3232	3414	182
OGV1	2025	27638	28694	1057	778	808	30	1232	1279	47	2139	2221	82
All	2010	142447	144813	2365	5039	5123	84	8957	9106	149	16794	17073	279
All	2025	139431	140806	1375	3925	3964	39	6214	6276	61	10793	10900	106
Car	Total	4512662	4539189	26527	102262	102905	642	157131	158141	1010	266884	268629	1745
LGV Personal	Total	1417270	1414736	-2534	31908	31849	-60	48907	48814	-93	82909	82750	-160

LGV Freight	Total	777703	776375	-1328	17510	17478	-31	26838	26789	-49	45497	45413	-84
OGV1	Total	1655854	1723084	67230	37408	38968	1560	57407	59825	2418	97411	101543	4132
All	Total	8363488	8453384	89896	189088	191200	2111	290283	293569	3285	492702	498334	5633

MODE
User benefits and changes in revenues by mode, all years. £000s.

Mode	Year	User Time	User_Charges PT_fares_(pri	Vehicle_Operating_Cost Fuel	Non_fuel	Operator_Rev PT_fares_(pri	Indirect Taxes
Road	2010	53471	0	-2031	1493	0	1365
Road	2011	50873	0	-1903	1399	0	1275
Road	2012	48231	0	-1783	1309	0	1191
Road	2013	45669	0	-1669	1224	0	1112
Road	2014	43183	0	-1562	1143	0	1038
Road	2015	40771	0	-1461	1066	0	968
Road	2016	38433	0	-1366	993	0	902
Road	2017	36165	0	-1275	924	0	839
Road	2018	33966	0	-1190	859	0	781
Road	2019	31834	0	-1110	796	0	726
Road	2020	29767	0	-1035	737	0	675
Road	2021	27765	0	-966	681	0	629
Road	2022	25735	0	-900	628	0	586
Road	2023	23779	0	-838	578	0	546
Road	2024	21895	0	-779	531	0	508
Road	2025	20080	0	-724	486	0	471
Road	2026	19654	0	-699	469	0	455
Road	2027	19238	0	-676	453	0	440
Road	2028	18831	0	-653	438	0	425
Road	2029	18432	0	-631	423	0	411
Road	2030	18042	0	-610	409	0	397
Road	2031	17660	0	-589	395	0	383
Road	2032	17354	0	-569	382	0	370
Road	2033	17053	0	-550	369	0	358
Road	2034	16758	0	-531	356	0	346
Road	2035	16468	0	-513	344	0	334

Road	2036	16183	0	-496	333	0	323
Road	2037	15952	0	-481	323	0	313
Road	2038	15725	0	-467	314	0	304
Road	2039	15501	0	-454	304	0	295
Road	2040	15281	0	-441	296	0	287
Road	2041	15063	0	-428	287	0	278
Road	2042	14849	0	-415	279	0	270
Road	2043	14638	0	-403	271	0	262
Road	2044	14429	0	-391	263	0	255
Road	2045	14224	0	-380	255	0	247
Road	2046	14022	0	-369	248	0	240
Road	2047	13823	0	-358	240	0	233
Road	2048	13626	0	-348	233	0	226
Road	2049	13433	0	-338	227	0	220
Road	2050	13242	0	-328	220	0	213
Road	2051	13054	0	-318	214	0	207
Road	2052	12851	0	-309	207	0	201
Road	2053	12652	0	-300	201	0	195
Road	2054	12455	0	-291	195	0	190
Road	2055	12262	0	-283	190	0	184
Road	2056	12071	0	-275	184	0	179
Road	2057	11884	0	-267	179	0	174
Road	2058	11699	0	-259	174	0	168
Road	2059	11518	0	-251	169	0	164
Road	2060	11339	0	-244	164	0	159
Road	2061	11163	0	-237	159	0	154
Road	2062	11006	0	-230	154	0	150
Road	2063	10851	0	-223	150	0	145
Road	2064	10698	0	-217	145	0	141
Road	2065	10547	0	-210	141	0	137
Road	2066	10399	0	-204	137	0	133
Road	2067	10253	0	-198	133	0	129
Road	2068	10108	0	-193	129	0	125
Road	2069	9966	0	-187	125	0	122

Road	Total	1187873	0	-37407	26129	0	24557

SUBMODE

User benefits and changes in revenues by submode/vehicle type, modelled years and total. £000s.

Submode	Year	User Time	User_Charges PT_fares_(pri	Vehicle_Operating_Cost Fuel	Vehicle_Operating_Cost Non_fuel	Operator_Rev PT_fares_(pri	Indirect Taxes
Car	2010	40354	0	-826	694	0	562
Car	2025	14252	0	-205	171	0	135
LGV Personal	2010	4892	0	55	0	0	-36
LGV Personal	2025	2025	0	19	0	0	-12
LGV Freight	2010	5233	0	31	165	0	-20
LGV Freight	2025	2173	0	10	52	0	-7
OGV1	2010	2992	0	-1291	634	0	859
OGV1	2025	1631	0	-549	262	0	355
All	2010	53471	0	-2031	1493	0	1365
All	2025	20080	0	-724	486	0	471
Car	Total	857196	0	-12093	10363	0	8058
LGV Personal	Total	114403	0	1011	0	0	-648
LGV Freight	Total	127532	0	550	2834	0	-358
OGV1	Total	88742	0	-26876	12932	0	17505
All	Total	1187873	0	-37407	26129	0	24557

PERSON_TYPES

User benefits and changes in revenues by person type, modelled years and total. £000s.

Person_type	Year	User Time	User_Charges PT_fares_(pri	Vehicle_Operating_Cost Fuel	Vehicle_Operating_Cost Non_fuel	Operator_Rev PT_fares_(pri	Indirect Taxes
All	2010	53471	0	-2031	1493	0	1365
All	2025	20080	0	-724	486	0	471
All	Total	1187873	0	-37407	26129	0	24557

PURPOSE

User benefits and changes in revenues by trip purpose, modelled years and total. £000s.

Purpose	Year	User Time	User_Charges PT_fares_(pri	Vehicle_Operating_Cost Fuel	Vehicle_Operating_Cost Non_fuel	Operator_Rev PT_fares_(pri	Indirect Taxes
Business	2010	26911	0	-1397	1493	0	932
Business	2025	9734	0	-566	486	0	367
Commuting	2010	7128	0	-277	0	0	188

Commuting	2025	3262	0	-83	0	0	55
Other	2010	19432	0	-357	0	0	244
Other	2025	7084	0	-75	0	0	50
Business	Total	596062	0	-28109	26129	0	18351
Commuting	Total	178239	0	-4542	0	0	3018
Other	Total	413572	0	-4757	0	0	3189

PERIOD
User benefits and changes in revenues by time period, modelled years and total. £000s.

Period	Year	User Time	User_Charges PT_fares_(pri	Vehicle_Operating_Cost Fuel	Non_fuel	Operator_Rev PT_fares_(pri	Indirect Taxes
AM peak	2010	12968	0	-227	263	0	154
AM peak	2025	0	0	0	0	0	0
PM peak	2010	24730	0	-1242	783	0	833
PM peak	2025	20080	0	-724	486	0	471
Inter-peak	2010	15772	0	-562	447	0	378
Inter-peak	2025	0	0	0	0	0	0
AM peak	Total	95821	0	-1467	1808	0	986
PM peak	Total	975675	0	-32163	21253	0	21062
Inter-peak	Total	116377	0	-3777	3068	0	2510

SENSITIVITY
Total user benefits as a percentage of total DM user costs

	Modelled Years	
Mode	2010	2025
Road	8.03%	4.27%

Economy:Economic Efficiency of the Transport System(TEE)

Consumers	ALL MODES	Road
User benefits	TOTAL	
Travel Time	591810	591810
Vehicle operating costs	-9299	-9299
User charges	0	0
During Construction & Maintenance	0	0
NET CONSUMER BENEFITS	582512	582512

Business			
User benefits		Personal	Freight
Travel Time	596062	379789	216274
Vehicle operating costs	-1979	8580	-10560
User charges	0	0	0
During Construction & Maintenance	0	0	0
Subtotal	594083	388369	205714

Private Sector Provider Impacts		
Revenue	0	0
Operating costs	0	0
Investment costs	0	0
Grant/subsidy	0	0

Subtotal	0	0
Other business Impacts		
Developer contributions	0	0
NET BUSINESS IMPACT	594083	

TOTAL

Present Value of Transport Economic Efficiency Benefits (PVB)	1176595

Note: Benefits appear as positive numbers, while costs appear as negative numbers.
Note: All entries are present values discounted to 2002, in 2002 prices

Public Accounts

	ALL MODES TOTAL	Road
Local Government Funding		
Revenue	0	0
Operating costs	0	0
Investment costs	0	0
Developer Contributions	0	0
Grant/Subsidy Payments	0	0
NET IMPACT	0	0
Central Government Funding		
Revenue	0	0
Operating costs	0	0
Investment costs	0	0
Developer Contributions	0	0
Grant/Subsidy Payments	0	0
Indirect Tax Revenues	-24557	-24557
NET IMPACT	-24557	-24557

TOTAL

TOTAL Present Value of Costs (PVC)	-24557

Note: Costs appear as positive numbers, while revenues and developer contributions appear as negative numbers.
Note: All entries are present values discounted to 2002, in 2002 prices

Analysis of Monetised Costs and Benefits

Non-Exchequer Impacts	
Consumer User Benefits	582512
Business User Benefits	594083
Private Sector Provider Impacts	0
Other Business Impacts	0
Accident Benefits	Not assessed by TUBA
Carbon Benefits	-3285
Net present Value of Benefits (PVB)	1173310
Local Government Funding	0
Central Government Funding	-24557
Net present Value Costs (PVC)	-24557
Overall Impact	
Net present Value (NPV)	1197867
Benefit to Cost Ratio (BCR)	-47.779
Appraisal Period	2010 to 2069

Note: There may also be other significant costs and benefits, some of which cannot be presented in monetised
form. Where this is the case, the analysis presented above does NOT provide a

good measure of value for money
and should not be used as the sole basis for decisions.

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