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In Association with

MVA

Traffic and Economic Assessment Report

Dalkeith Northern Bypass

On behalf of

Scottish Executive Enterprise, Transport and Lifelong Learning Department

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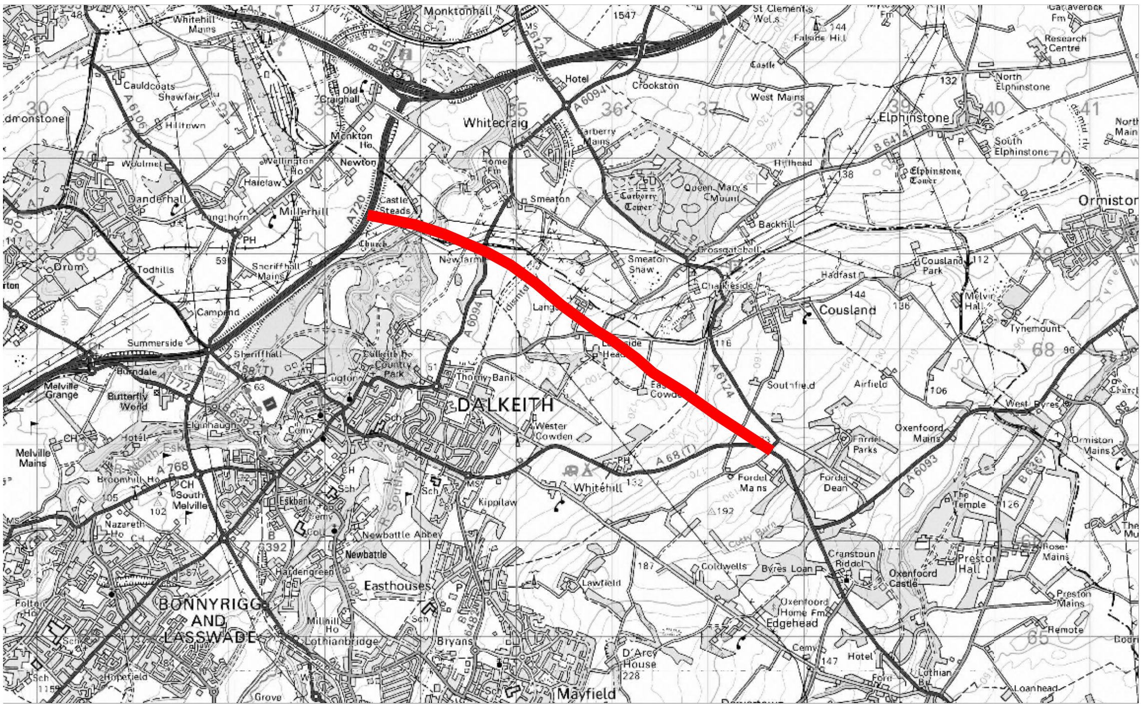
1 Introduction

1.1 Background

1.1.1 In 2005, a decision was taken by Scottish Ministers to construct a 5.3km Northern Bypass of Dalkeith between the A68 at Fordel Mains and the A720 City Bypass at Millerhill Interchange as shown in Figure 1.

Figure 1 General alignment of the Dalkeith Northern Bypass



1.1.2 The Dalkeith Northern Bypass is a proposed new road link to the north east of Dalkeith, which is intended to ease the congestion on the A68 Trunk Road as it passes through Dalkeith town centre. As such, it was viewed by Midlothian Council in its Local Plan as an integral part of a package to regenerate Dalkeith Town Centre by replacing high volumes of ‘through traffic’ with pedestrian friendly streets and other environmental enhancements.

1.1.3 Proposals for the bypass originate from the 1980s and had been developed by the (then) Scottish Office for implementation following public inquiries in the mid 1990s. Scheme development at the time included an economic appraisal undertaken by W.A. Fairhurst & Partners which found that the scheme would generate a positive Net Present Value (NPV) and Benefit: Cost Ratio >1.

1.1.4 The economic appraisal was based on a SATURN (Simulation and Assignment of Traffic to Urban Road Networks) model simulation of local traffic networks which was used to test the traffic effects of introducing the bypass. Key outputs from the model (e.g. journey times and vehicle speeds) were input to a NESA (Network

Evaluation from Surveys and Assignment) model to provide the economic appraisal.

1.1.5 As part of the programme to implement the scheme some 10 years on from the previous phase of development work, there was a clear realisation that, although through the public inquiry process the fundamental merits of the scheme had been established, many of the assumptions adopted in the previous economic assessment could no longer be supported, economic assessment methodologies had 'moved on' and the regional transport networks within which the scheme would now sit had changed markedly.

1.1.6 It was therefore decided to reappraise the economic performance of the scheme to ensure value for money criteria would still be met in investing public funds.

1.2 General Approach

1.2.1 A review of currently available economic assessment techniques was undertaken, following which it was decided that the TMfS (Transport Model for Scotland) should be used to identify the traffic effects of the bypass as it was the most up-to-date model available.

1.2.2 TMfS is multi-modal model of Scotland's strategic road and public transport networks. It incorporates the Trip End and Land Use Model of Scotland (TELMoS), which takes into consideration current and projected changes to population and use patterns, using local authority planning forecasts, 2001 census data and macroeconomic forecasts.

1.2.3 TMfS currently provides a base year simulation of road and public transport networks for 2002 and therefore includes a number of significant transport schemes implemented across the Lothian and Borders region since the previous SATURN/NESA appraisal of the Northern Bypass was undertaken. These include Edinburgh Greenways, dualling of the A1(T), Edinburgh Crossrail, 15-minute Edinburgh Glasgow rail service, the M8 Extension at Hermiston Gait, and Gogar Interchange.

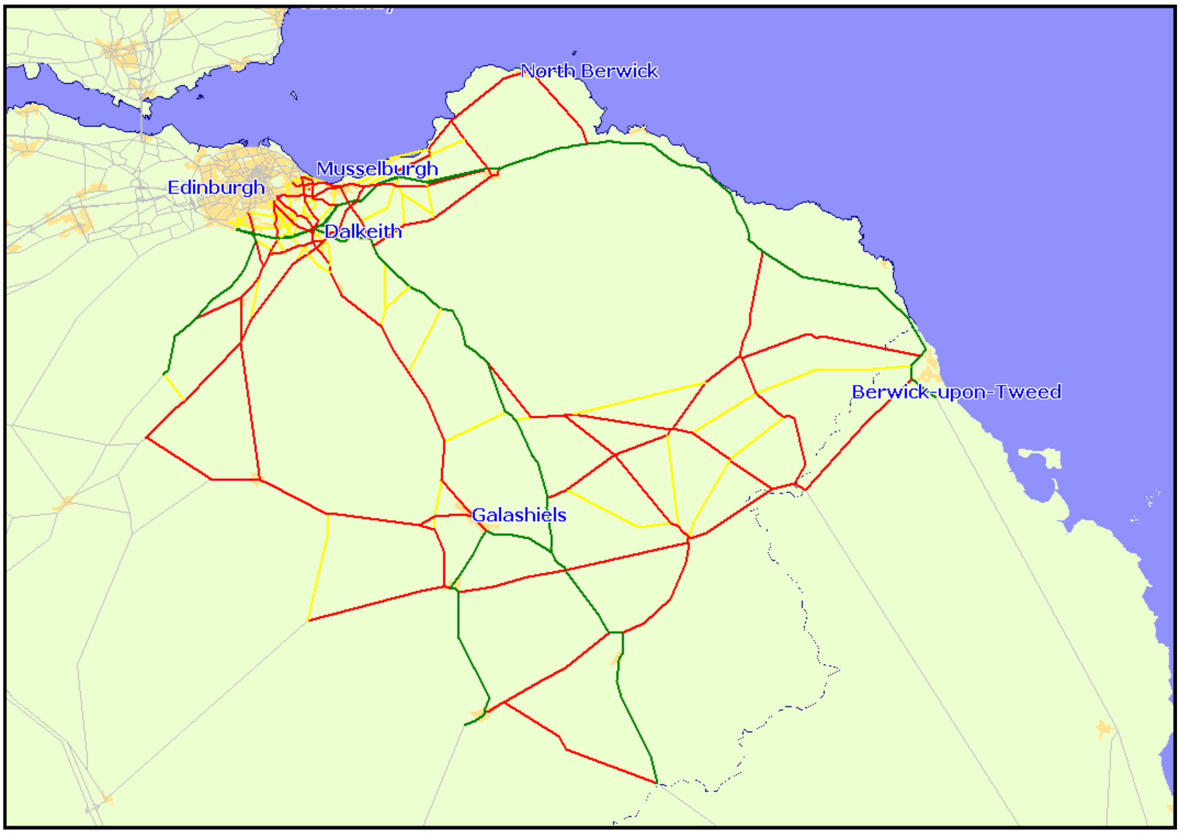
1.2.4 The spatial coverage of TMfS includes the Central Belt of Scotland between Glasgow and Edinburgh as well as the Scottish Borders, and north to Dundee and Aberdeen. It was recognised that any significant effects of the scheme would, by and large, be restricted to an area covering Edinburgh, East Lothian, Midlothian and the Scottish Borders.

1.2.5 On that basis, MVA were commissioned by W.A. Fairhurst & Partners to extract a Dalkeith Sub-Area Model (DALSAM) from TMfS, the coverage of which is shown in Figure 2. The twin purpose of DALSAM was :

- to provide broad estimates of changes in traffic flow across the model area considered likely to arise from the scheme in the context of current and likely future regional road and public transport networks; and

- to provide inputs to a revised economic assessment, based on current economic appraisal guidance.

Figure 2 Network Coverage of the Dalkeith Sub Area Model



1.2.6 The first stage of constructing DALSAM was to extract a TMfS Base Year (2002) sub area model. This base model was enhanced to better represent sub-regional and local conditions, and then validated against observed data as detailed in Appendix A.

1.2.7 Model outputs from TMfS were used to produce forecast matrices for DALSAM, which was then used to test scenarios with and without the Dalkeith Northern Bypass for the modelled years 2011 and 2021. DALSAM predictions were then input into the Department for Transport's (DfT) Transport Users Benefit Appraisal (TUBA) software to produce the revised economic appraisal.

1.2.8 DALSAM is a capacity restrained highway assignment model which operates in the following time periods:

- AM Peak hour (08:00 – 09:00);
- Inter Peak Hour (average hour between 10:00 and 16:00); and
- PM Peak hour (17:00 – 18:00).

1.2.9 The following Chapters detail DALSAM results and the resulting economic appraisal of the Dalkeith Northern Bypass.

2 DALSAM Model Specifications

2.1 General Model Specifications

2.1.1 The zonal detail of DALSAM retains that of TMfS. As a result, flows in and around Dalkeith can be significantly distorted by the arrival of a zone centroid. A primary focus of the validation and calibration exercise reported in Appendix A was therefore the accuracy of model forecasts in and around Dalkeith Town Centre.

2.1.2 Reference Case (or 'Do Minimum') tests were undertaken for each of the TMfS forecast years; namely: 2006, 2011 and 2021. Sub area matrices were extracted from each of these TMfS model runs to feed into fixed matrix analysis using DALSAM.

2.1.3 The schemes included in the Reference Case runs are described in Table 2.1, only those schemes relevant to the East of Scotland are included in the table. The schemes noted are in addition to the 2002 Base Year TMfS networks.

2.1.4 The TMfS runs did not include the 2nd Forth Road Bridge or Edinburgh Tram Line 3 as these were deemed to be speculative schemes. The potential grade separation of Sheriffhall Roundabout was also not included in the absence of a committed design, although it was recognised that as the primary purpose of this potential scheme would be to relieve east-west congestion along the A720 Edinburgh City Bypass, it had the potential to generate further network benefits (in terms of journey times, for example) when combined with the proposed Dalkeith Northern Bypass.

2.1.5 TMfS runs included forecast planning data from the TELMoS model. These include the Local Plan commitment to South East Wedge development, which based on discussions with consultants to the Trunk Roads Network Management Division (TRNMD), was modelled with a primary access to the strategic road network on the A7, north of the Sheriffhall roundabout.

2.1.6 By using TELMoS, Any significant changes in demand in the Dalkeith area, due to new developments or car ownership growth, are passed down to the detailed sub area model.

Table 2.1 East of Scotland Reference Case schemes included in the TMfS

2006	2011	2021
Cameron Toll – New Layout	M8 Upgrades	Rosyth Bypass
Park and Ride Sites	M74 Completion Scheme	Borders Rail
£1 Tolls on Forth Road Bridge	2nd Kincardine Bridge	
WEBS	Stirling to Alloa Rail Line	
Edinburgh Bus Priority Lanes	A8000 Upgrade	
A1 Haddington to Dunbar Dualling	Airdrie to Bathgate Rail Line	
Edinburgh Park Rail Station	Edinburgh Airport Rail Link	
Central Edinburgh Traffic Management	Edinburgh Tram Lines 1 and 2	
Increased frequency Glasgow-Edinburgh Rail Services	A801 Upgrade	
	South East Wedge Development	

2.2 Dalkeith Northern Bypass

2.2.1 The Northern Bypass will run for 5.3km between the A68 near Fordel Mains services and the A720 (Edinburgh City Bypass) at Millerhill Junction, 1km west of Old Craighall Junction. The scheme will connect to the A6094 between Dalkeith and Whitecraig near Smeaton. It will also bridge the B6414 with no connection between the two.

2.2.2 Model coding for the bypass is based on the scheme design included in the Environmental Mitigation Report (drawing 21440/E/00/001). The Northern Bypass will be a single carriageway road with a southbound climbing lane between its junctions at the A6094 Salters Road and at Fordel Mains. The junction between the A68(T)/ A6214 junction at Fordel mains is also reconfigured to accommodate the Bypass and a 2-roundabout diamond connection will be made at the Millerhill junction of the Edinburgh City Bypass.

2.3 The Northern Bypass and Dalkeith Town Centre Regeneration

2.3.1 As well as the proposed Northern Bypass, pedestrianisation of Dalkeith Town Centre has also been included in the economic analysis. The Northern Bypass is supported within the current Midlothian Local Plan and its fundamental purpose of the Northern Bypass is to facilitate the regeneration of Dalkeith Town Centre through the removal of 'through' traffic from the Town Centre.

2.3.2 The pedestrianisation scheme currently envisaged by Midlothian Council provides access for loading, buses and taxis, but prevents general through traffic on the existing A68 at South Street and along High Street (between Buccleuch Street and South Street) as shown in Figure 3. An alternative routing of the A68 for 'through' traffic would be provided along Buccleuch Street and Old Edinburgh Road.

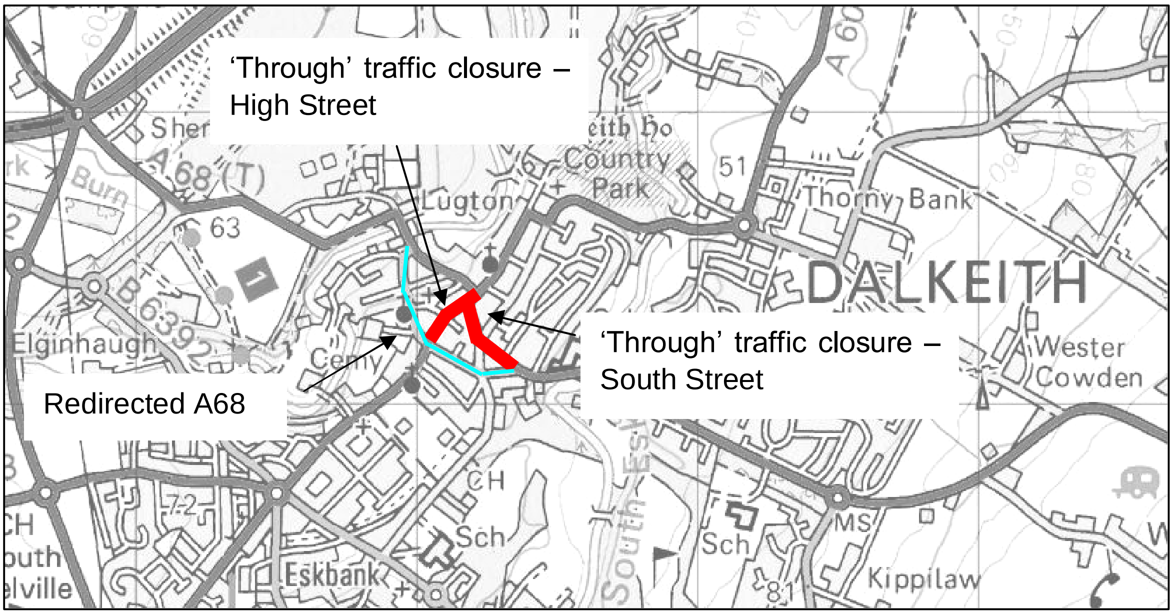
2.3.3 Although the current pedestrianisation scheme includes a proposal to redirect the A68 along Buccleuch Street and Old Edinburgh Road, this pre-dates the recent commitment to deliver the Dalkeith Northern Bypass. The scheme was developed to include this element in the absence (at the time of Town Centre proposal development) of the Northern Bypass at that time.

2.3.4 Discussions with officers of Midlothian Council indicated that at a recent public consultation exercise on the Town Centre proposals, there was a generally negative public reaction to this element of the proposal, with the result the closure and pedestrianisation of South Street along the A68 may have been removed from the scheme to retain through vehicle traffic.

2.3.5 Not being able to close and pedestrianise South Street would have removed one of the fundamental elements of the Dalkeith Regeneration Scheme. The Northern Bypass therefore presents an opportunity to ensure that Town Centre pedestrianisation is implemented to meet its intended objectives.

2.3.6 Dalkeith Town Centre pedestrianisation is not included within the 2002 TMfS Reference Case network but has been included in the 2006, 2011 and 2021 forecast years. This was done as presented in Figure 3.

Figure 3 Current Dalkeith Town Centre Pedestrianisation Proposals



3 DALSAM Results

3.1 Test Scenarios

3.1.1 Based on the base DALSAM specifications described in Chapter 2, the following DALSAM test runs are reported here in terms of its likely effects on the strategic road network:

- Reference Case with modelled years of 2011 and 2021.
- Northern Bypass Test Case with modelled years of 2011 and 2021.

3.2 Flow Analysis

3.2.1 At the northern end of the Northern Bypass, near its connection with the A720(T), AADT flows will be approximately 5,100 northbound, and 6,700 southbound in 2011, and 4,800 northbound and 6,400 southbound in 2021.

3.2.2 Figures 4 and 5 (inclusive) highlight changes in predicted traffic flow (Annual Average Daily Traffic, AADT) between the test scenarios for 2011 and 2021 respectively. Red bands indicate increased traffic flow and blue bands represent a decrease, the thickness of the line indicating the size of this change. No changes are shown for new links (i.e. those associated with the proposed bypass).

Figure 4 2011 Network Difference Plot (AADT) – Reference vs. Test Case

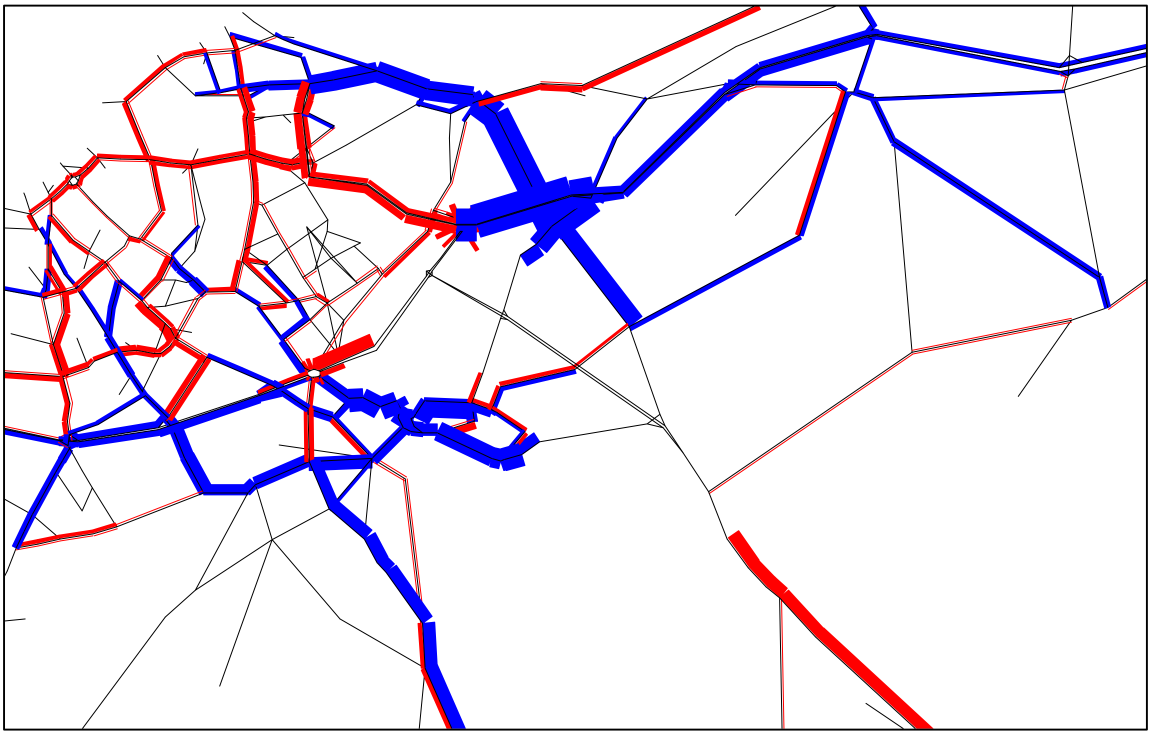
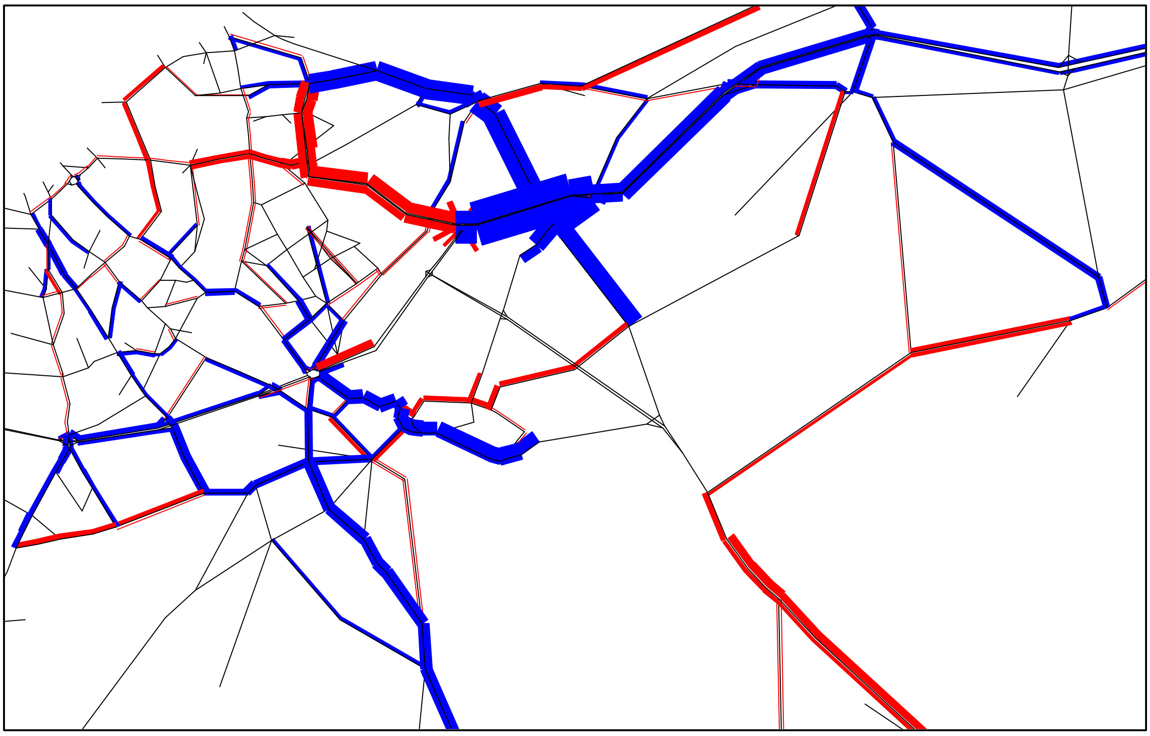


Figure 5 2021 AADT TP5 - RP5 Network Difference Plot



3.2.3 Figures 4 and 5 identify several general effects of the Northern Bypass, which may be summarised as follows:

- Large decrease in flow along the current A68(T) through Dalkeith between Wester Cowden and Sheriffhall Roundabout.
- Large decrease in flow along the A7 between the Scottish Borders and the A720 City Bypass at Sheriffhall.
- Large decrease in flow along the A6214 between Cousland and Musselburgh
- Large decrease in flow along the A199 between Musselburgh and Edinburgh
- Large decrease in flow along the A1(T) to the east of Old Craighall.
- Large increase in flow along the A68(T) south of Fordel Mains.
- Large increase in flow along the A1(T) between Old Craighall and Duddingston

3.2.4 Many of these effects may be explained by the transfer of traffic with origins/destinations in the City of Edinburgh (North east of the City in particular) away from the 'Scottish Border routes' along the A7 and A1 (and the A68 through Dalkeith) to use instead the Northern Bypass in combination with the A1(T) between Old Craighall and Duddingston and A720(T) City Bypass through Sheriffhall.

3.2.5 At the Sheriffhall Roundabout, consistent with the generally evident pattern, the minor north-south arms (current A68 and A7) all show a decrease in flow entering the junction, resulting in a slight reduction in the delay on these arms.

3.2.6 The major east-west **exit** links from Sheriffhall along the A720(T) City Bypass both show increased flow, consistent with the generally evident pattern. However, high levels of base delay on both the east and westbound **approaches** to the Sheriffhall roundabout result is a significant constraint on the transfer of traffic away from the current A68 and A7 to travel, via the Northern Bypass, east-west along the Edinburgh City Bypass.

3.2.7 The Northern Bypass also appears to marginally increase the attractiveness of the east-west A6094 route through Dalkeith by 2021, an effect considered likely to be attributable to east-west delays at Sheriffhall roundabout in the absence of any committed proposals to increase east-west traffic capacity along the City Bypass.

3.3 Network Statistics Analysis

3.3.1 Table 3.1 presents the vehicle kilometre and time statistics for the 2021 DALSAM assignments. These show that the Northern Bypass slightly reduces the distance and time travelled over the entire DALSAM network.

Table 3.1 2021 Network Travel Statistics

Period	Vehicle Kilometres				Vehicle Hours			
	Reference	Test	Difference	% diff.	Reference	Test	Difference	% diff.
AM	719329	717427	-1902	-0.3%	12889	12827	-62	-0.5%
IP	691077	690013	-1065	-0.2%	11719	11707	-12	-0.1%
PM	899851	896993	-2859	-0.3%	17319	17206	-113	-0.7%

3.3.2 Whilst providing a shorter route for some trips, for most trips the Dalkeith Northern Bypass generally provides a faster if slightly longer distance route. The overall time in the network reduces as a result of this. The vehicle distance in the network reduces overall as the number of trips with a shorter distance outweighs the number who use a longer distance route.

3.4 Conclusions and Recommendations

3.4.1 DALSAM results indicate that the introduction of the Dalkeith Northern Bypass would serve to reduce traffic on existing north-south routes in the Dalkeith area, in particular, the existing A68(T) through Dalkeith, the A6124 and the A7.

3.4.2 There is a predicted general pattern of strategic re-routeing, where trips from the Scottish Borders and East Lothian (particularly from south of the A1) via the A1 and A7 change route to make use of the bypass in combination with the Edinburgh City Bypass and the A1(T) west of Old Craighall.

3.4.3 Junction turning delays at Sheriffhall Roundabout experience a small reduction with the introduction of the proposed bypass, due to the reduction in traffic on the minor arms into the south of the junction. Large base delays on the Edinburgh City Bypass approaches to Sheriffhall tend to hinder the transfer of this minor road traffic away from the A7 and current A68 approaches.

3.4.4 Based on these results, it is recommended that further DALSAM tests are run to include grade separation of the Sheriffhall Roundabout to remove all junction delay current incurred by east-west traffic flow along the Edinburgh City Bypass. Based on the results presented above this scheme is expected to complement the Bypass by offering further journey time improvements through use of the Northern Bypass to access destinations across Edinburgh and therefore further the attractiveness of the current A68(T) through Dalkeith.

3.4.5 Improvements at Sheriffhall of this nature are known to be under consideration by the Scottish Executive as a means of improving existing operational conditions and accommodating Local Plan commitments for future development (e.g. South-East Wedge). However, there is no policy commitment at this stage to a Sheriffhall grade-separation scheme.

3.4.6 Therefore, the economic appraisal reported in the following Chapters does not take account of this possibility. As a result, appraisal results are considered likely to underestimate the network benefits of the Northern Bypass should, as is expected, grade separation at Sheriffhall proceed.

4 Economic Appraisal

4.1 Introduction

4.1.1 As outlined in Chapter 1, previous historic economic appraisals of the proposed Northern Bypass in the 1990's indicated that the scheme represented value for money in terms of public sector investment. However, as many fundamental changes to the regional transport network have occurred since then as well as methods of economic appraisal, there is a need to update the appraisal to ensure value for money in public investment.

4.1.2 Revised modelling of the Northern Bypass to take account of the current and future planned regional transport networks across Edinburgh, the Lothians and Scottish Borders was undertaken using the DALSAM model, extracted from TMfS, as reported in Chapter 3.

4.1.3 This Chapter summarises the revised economic appraisal of the Northern Bypass using output from DALSAM. The economic analysis has been undertaken using TUBA, combined with ACCDNT (ACCiDeNT) for the evaluation of road safety benefits. This is in accordance with current WebTAG guidance and parameters for economic appraisal.

4.2 Accident Analysis

4.2.1 ACCDNT calculates absolute numbers of casualties and the costs associated with them by link type and link speed, based on traffic model outputs. The software also differentiates between different severities of accident and attributes a monetary cost to each accident.

4.2.2 The casualties and costs for the model tests are shown in Table 4.1. A casualty is assumed to be a person suffering a slight, serious or fatal injury as a result of an accident. Tables with the casualties split by level of severity and by local authority area are presented in Appendix B.

Table 4.1 Accident Analysis (costs are in £000's)

Year	Annual Casualties - Reference	Annual Casualties – Test	Annual Casualties Saved	Annual Costs - Reference	Annual Costs – Test	Annual Cost Saving
2011	364.8	363.4	1.4	46,281	46,028	253
2021	371.2	369.6	1.6	56,663	56,405	258

4.2.3 Table 4.1 shows that the introduction of the bypass will result in a net saving of 1.4 casualties per year in 2011 and 1.6 casualties in 2021. Whilst there is a net saving in accidents, there are some increases in accidents in Edinburgh and the Borders, the savings are all made in Midlothian and East Lothian, as shown in Appendix B.

4.2.4 The cost saving associated with these accident reductions is over £250,000 in all cases and the absolute value of cost savings is lower when pedestrianisation is in place.

4.2.5 The costs associated with these accidents have been used to obtain sixty year cost benefits for use in the economic analysis. The sixty year cost saving is £6.075 million (discounted to 2002 prices).

4.3 Revised Economic Analysis

4.3.1 Economic analysis undertaken by TUBA has been combined with outputs from the accident analysis to generate the following outputs:

- Transport Economic Efficiency (TEE) tables (reported in full in Appendix C).
- Net Present Value (NPV)
- Benefit: Cost Ratio (BCR)

4.3.2 The economic analysis has been performed over a sixty year appraisal period with a scheme opening year of 2007. It should be noted that TUBA discounts all costs to 2002 levels. The cost of the Northern Bypass has been estimated at £26.716 million.

4.3.3 Maintenance costs for the Bypass scheme have also been included within the economic appraisal. Department for Transport (DfT) guidance states that single-carriageway road schemes have a maintenance cost of £7,400 per kilometre per year. This implies a maintenance cost for the Northern Bypass of £1.2215 million over the sixty years for which the scheme is appraised. For the purposes of this economic appraisal this cost has been spread evenly over the sixty year period.

4.3.4 Optimism bias is also included within the costs of the scheme; this cost represents the risk of overruns which are inherent in transport schemes. Optimism Bias has been applied at the standard Scottish Executive uplift rate of 25%. When this uplift is applied the cost of the scheme becomes £33.394 million. A Net Present Value (NPV) of £12,921,000 and Benefit Cost Ratio (BCR) of 1.349 are estimated from this analysis.

4.3.5 TEE results in Appendix C indicate that the scheme generates high vehicle operating cost benefits. There are two reasons for this as follows:

- Travel times in the network are reduced with the introduction of the Bypass, thereby reducing the fuel costs (see Table 3.1); and,

- the Bypass provides a shorter distance route between North Edinburgh and Midlothian than existing routes, resulting in reduced non-fuel vehicle operating costs (e.g. wear and tear, oil consumption, and depreciation).

4.4 Summary

4.4.1 The revised economic appraisal shows that the Dalkeith Northern Bypass will provide value for money in terms of public expenditure. These benefits include accident saving of 1.5 average casualties per annum as well as vehicle travel time and operating cost benefits.

5 Summary and Recommendations

5.1 Summary

5.1.1 In 2005, a decision was taken by Scottish Ministers to construct a 4.6km Northern Bypass of Dalkeith between the A68 at Fordel Mains and the A720 City Bypass at Millerhill Junction as shown in Figure 1.

5.1.2 Although the fundamental merits of the scheme had been established in the 1990's, it was considered that many of the assumptions adopted in the previous economic assessment could no longer be supported, economic assessment methodologies had 'moved on' and the regional transport networks within which the scheme would now sit had changed markedly.

5.1.3 It was therefore decided to reappraise the economic performance of the scheme to ensure value for money criteria would still be met in investing public funds.

5.1.4 This was done by constructing a sub-area model of the Edinburgh, Midlothian, East Lothian and Scottish Borders areas most likely to be affected by scheme from the 2002 base Transport Model for Scotland (TMfS). As such, it includes the effects of a number of current and future committed transport schemes in the area (e.g. dualling of the A1(T), Edinburgh Greenways and the Waverley Line Railway)

5.1.5 The Dalkeith Sub-Area Model (DALSAM) was thus constructed and validated against a selection of journey time surveys and traffic counts to ensure it presented a reasonably accurate representation of base regional traffic conditions upon which the traffic effects of the scheme could be identified.

5.1.6 The fundamental objective of the Northern Bypass is to reduce traffic along the current A68(T) through Dalkeith Town Centre and facilitate the Midlothian Council Local Plan commitment to pedestrianise the Town Centre. Although this scheme is not included in the source 2002 TMfS model, it was included in the sub-regional DALSAM model to ensure the model represented current and significant future planned changes to local transport networks.

5.1.7 DALSAM results predict a general transfer of traffic with origins/destinations in the City of Edinburgh (North east of the City in particular) away from the 'Scottish Border routes' along the A7 and A1 (and the A68 through Dalkeith) to use instead the Northern Bypass in combination with the A1(T) between Old Craighall and Duddingston and A720(T) City Bypass through Sheriffhall.

5.1.8 Related to this is a significant predicted shift in traffic flows at the Sheriffhall Roundabout away from the A68 and A7 approaches to utilise the A720 Edinburgh City Bypass approaches instead, although the operational (and therefore economic) benefits of this transfer (in particular improved vehicle journey times) are significantly constrained by base delays at this junctions.

5.1.9 Using DALSAM output, a revised economic appraisal was undertaken using TUBA and ACCDNT. This indicates that the Northern Bypass represents value for money in terms of the investment of public funds.

5.2 Recommendations

5.2.1 Although the economic appraisal reported here indicates that the Dalkeith Northern Bypass is a sound economic investment, its economic efficiency is likely to be underestimated by current operational constraints at the Sheriffhall roundabout, in particular east-west delays along the A720(T) Edinburgh City Bypass.

5.2.2 Proposals to introduce a grade-separated junction at this location are known to be under consideration at this location to remove existing east-west City Bypass delays. However, there is currently no policy commitment to do so, and so any such scheme has not been included in this assessment.

5.2.3 Given the network benefits considered likely to arise from such a scheme, it is therefore recommended that further DALSAM and TUBA tests be undertaken to identify the potential further network gains that might arise from improvements at Sheriffhall.

Appendix A DALSAM Validation

1 DALSAM Enhancement

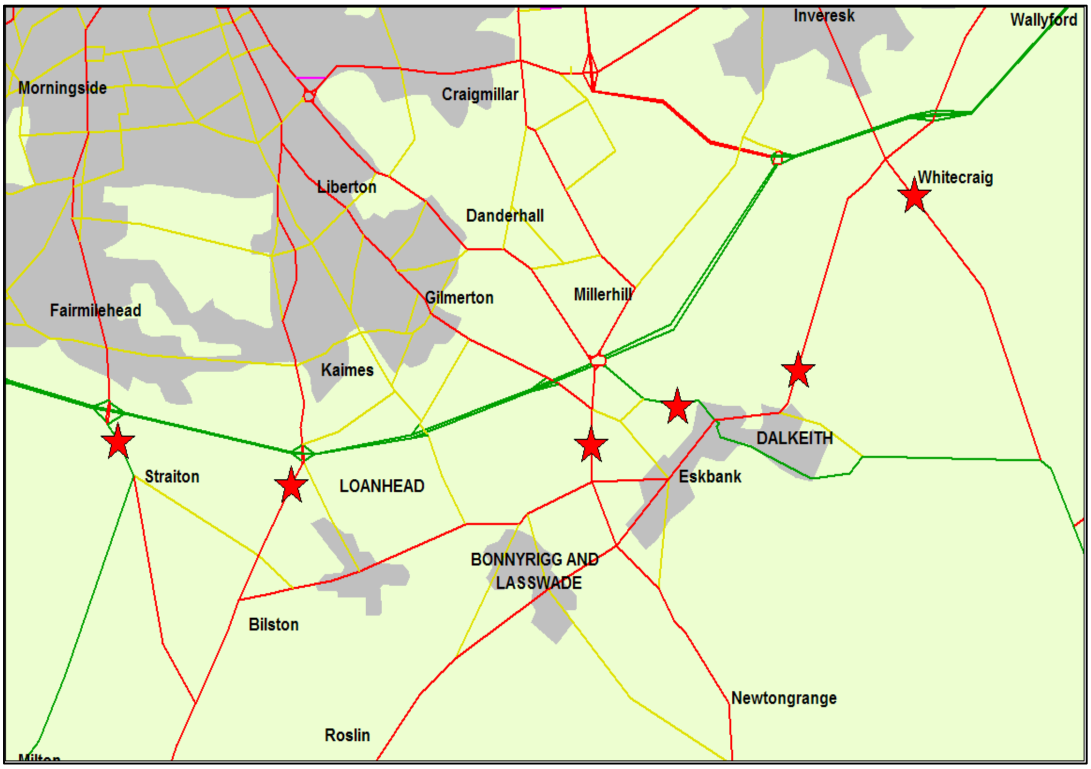
1.1 TMfS is a strategic model covering of the majority of Scotland's road and rail based transport system. In extracting a sub area model of a local area, it is necessary to undertake a review of the network and zonal definition and to consider the quality of travel pattern and count data used to calibrate and validate the main model in this area. This review was undertaken and discussed with W.A. Fairhurst and Partners.

1.2 The network definition contains all Trunk and Non Trunk A Class roads, the majority of B Class Roads and a minority of unclassified roads. The network definition in and around Dalkeith itself is low, containing no local unclassified roads. Although the B703 to Tranent and the B6392 between Dalkeith and Newtongrange are not included within TMfS they have been included within the DALSAM network. The remainder of the network definition is commensurate with the requirements of TMfS and the available survey data.

1.3 The zonal definition is also commensurate with the requirements of TMfS and the available survey data. It should be noted that TMfS does not contain intra-zonal trips and therefore such movements as 'intra-Dalkeith' are not included. This, coupled with the orientation of the observed travel patterns that are included in the matrix development process, will result in a lower level of anticipated delay in and around Dalkeith.

1.4 Figure A1 illustrates the location of relevant Road Side Interview (RSI) Sites used in the development of the TMfS in the Dalkeith Area.

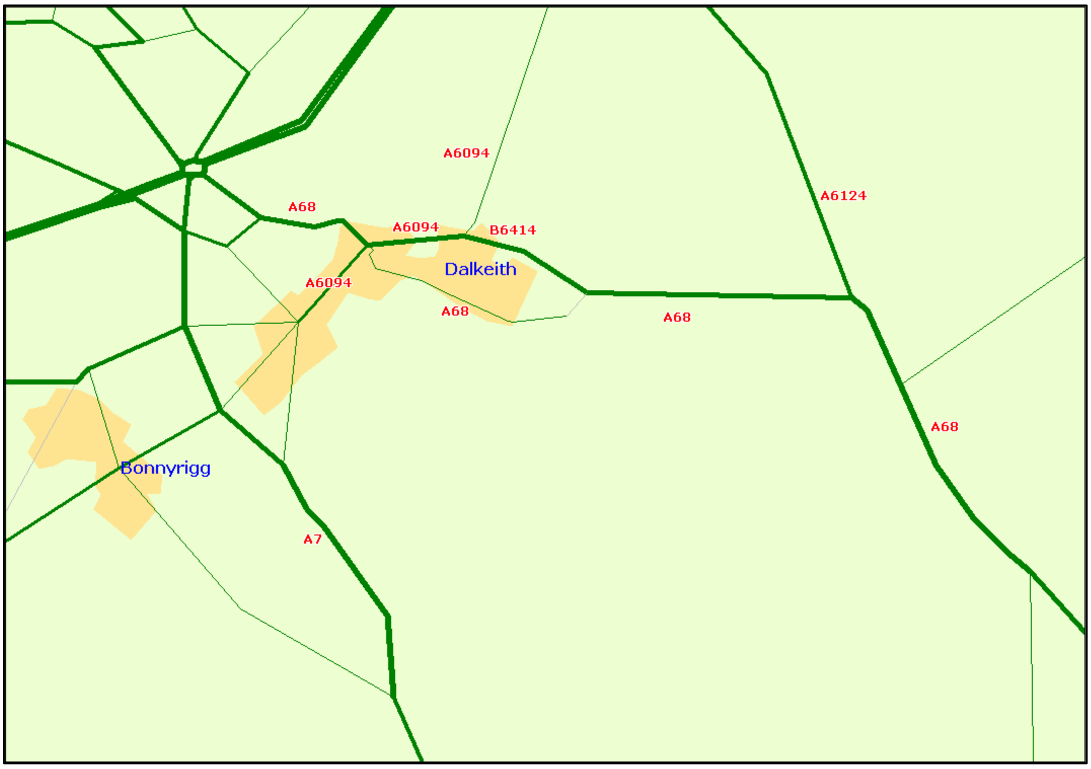
Figure A1 TMfS Dalkeith and Surrounding Area RSI Locations



1.5 Figure A1 illustrates a strategic cordon of North\South RSIs along the main radial routes into (and out of) South East Edinburgh. This cordon represents a good degree of coverage of observed traffic movements that would use a proposed Dalkeith Northern Bypass (i.e. a North\South movement). The East\West local movement through Dalkeith is not covered by the RSI data and therefore some benefits that may accrue from the introduction of the Dalkeith Northern Bypass as a local distributor may be under-estimated.

1.6 It was agreed that the zonal definition of the sub area model would not be enhanced. At this stage, the principal focus is on strategic traffic flows and initial estimates of anticipated traffic flows on the Dalkeith Northern Bypass. However, analysis of the TMfS assignment process highlighted a routeing issue within Dalkeith that should be addressed within DALSAM. Although the total amount of traffic on the A68 South and North of Dalkeith compared well with observed traffic count data, the majority of traffic routed via the B6414 and A6094 as opposed to the A68. Figure A2 contains a flow bandwidth diagram where thicker green lines denote higher flow levels; this illustrates the routeing issue where more traffic travels via the North of Dalkeith as opposed to the South.

Figure A2 TMfS AM Peak, Base Routeing



1.7 The principal reason for this was, lack of junction definition (and consequently delay) within Dalkeith and comparable speed flow curves for both alternative routes. From further work undertaken by MVA in 2004 to prepare a Dalkeith Centre VISSIM model, information could be extracted relating to junction specification and estimated delays to better represent the network conditions and therefore routeing within DALSAM. Journey time and queue wait time surveys were conducted in September 2005 and as a result further network alterations were made. These were the inclusion of the town centre competing route of Buccleuch St/Old Edinburgh Road plus an additional zone centroid for the Dalkeith zone loading onto the A68.

2 Journey Time Surveys

2.1 Journey time surveys conducted were along the A68 from the current A68 junction with the A6124 to Sheriffhall Roundabout plus queue wait time surveys at the signalised junction between the A68 and the A6094 as shown in blue on Figure A3. The surveys were conducted during the AM (8:00am to 9:00am) and PM (5:00pm to 6:00pm) peaks hours on Thursday 15th September. The route was travelled three times in each direction for both of the peak hours surveyed. Table A1 presents the journey times recorded for each route.

Figure A3 A68 Dalkeith Journey Time Survey Route

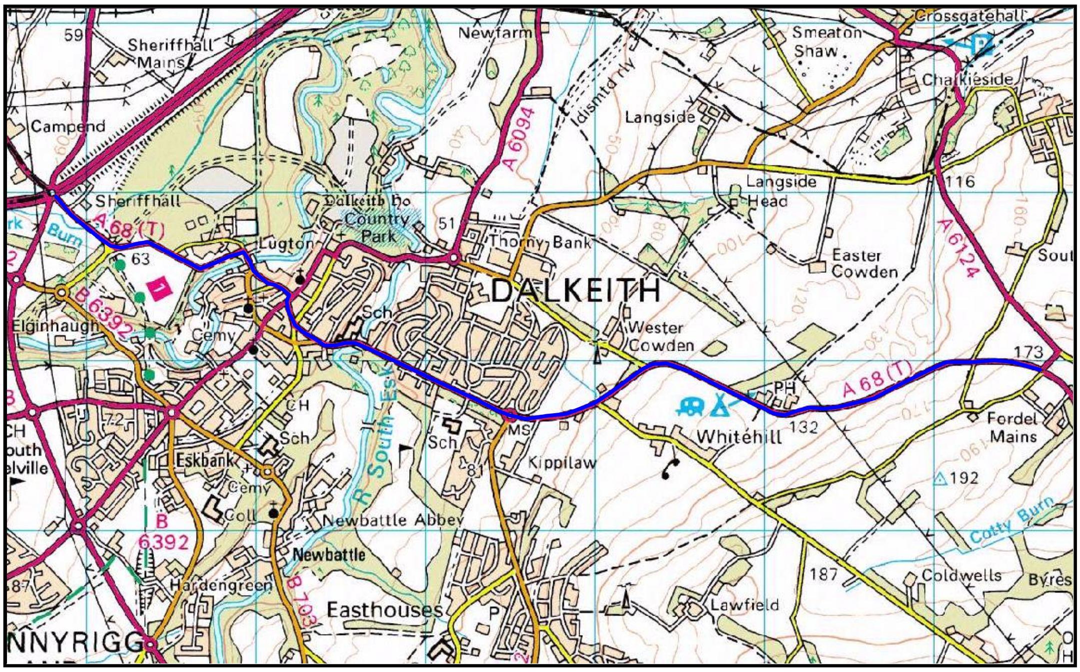


Table A1 Journey Time Route Surveys

	Westbound		Eastbound	
Survey	**AM Peak**	**PM Peak**	**AM Peak**	**PM Peak**
1	8.77	8.38	8.95	8.42
2	8.48	8.52	9.18	7.52
3	10.90	8.72	9.75	8.53
Average	**9.38**	**8.54**	**9.29**	**8.16**

2.2 Table A1 illustrates that the journey times surveyed were quite consistent with the range of results being within 3.38 minutes, with the fastest time being 7.52 minutes (PM Peak Eastbound i.e. away from Edinburgh) and the slowest 10.90 (AM Peak Westbound i.e. towards Edinburgh).

2.3 Table A2 shows how the modelled times compare against the average journey time by peak hour. The existing 2006 reference case was used for this comparison as this is closer to the survey year than the base (2002) assignment.

Table A2 Comparison of modelled and observed journey times (minutes)

Peak	Direction	Modelled	Observed	Difference
AM Peak	Westbound	7.75	9.38	-1.63
	Eastbound	7.61	9.29	-1.68
PM Peak	Westbound	7.63	8.54	-0.91
	Eastbound	7.79	8.16	-0.37

2.4 Table A2 shows the model to be underestimating the time taken to travel this route. This is not unexpected as the network does not contain a high level of detail within Dalkeith Town Centre. Also, the zone centroid that represents Dalkeith does not load onto the A68 but on the A6094 to the

North of Dalkeith. Due to the size of the zone representing Dalkeith there are also no intra-Dalkeith movements modelled.

3 Queue Wait Time Survey

3.1 The signalised junction at the centre of Dalkeith between the A68 and the A6094 is the main junction within Dalkeith and as a result the time taken to proceed through this junction was surveyed.

3.2 Each of the four main arms of this junction were surveyed (during the same periods on the same day as the journey time surveys) over a period of 15 minutes with random cars being chosen as they joined the queue and timed until they left the junction. Figure A4 shows the orientation of the arms used and Table A3 details the observed wait times (in seconds) and averages.

Figure A4 Orientation of junction used in queue wait time survey

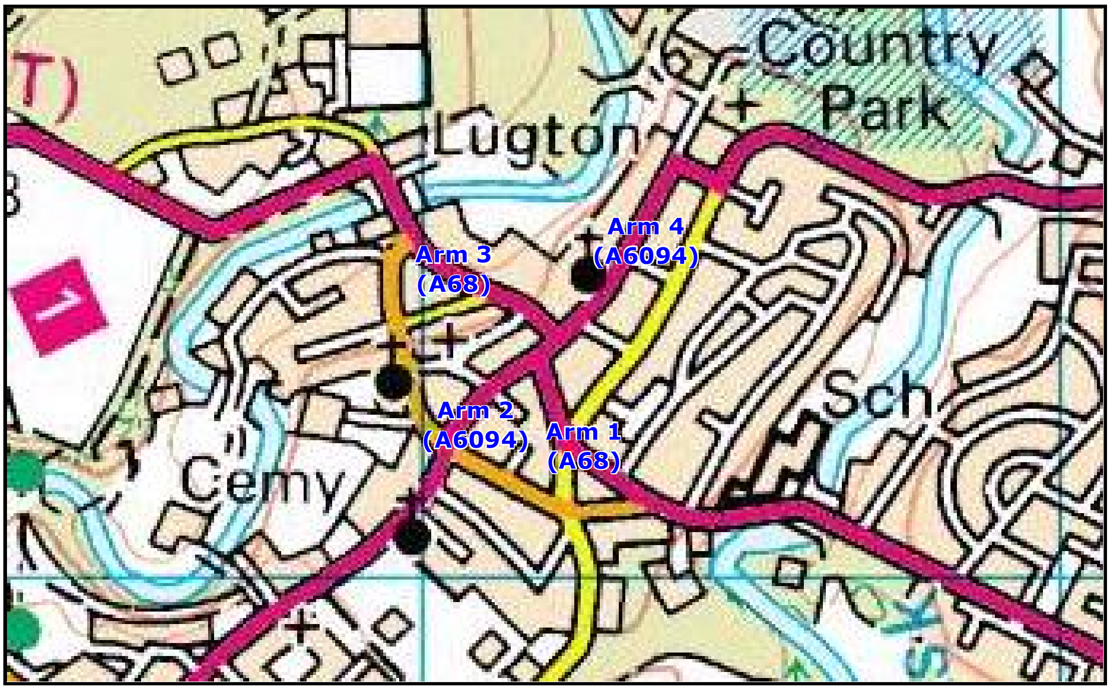


Table A3 Observed queue wait times (seconds)

	Arm 1 (A68)		Arm 2 (A6094)		Arm 3 (A68)		Arm 4 (A6094)	
Vehicle	**AM Peak**	**PM Peak**	**AM Peak**	**PM Peak**	**AM Peak**	**PM Peak**	**AM Peak**	**PM Peak**
1	39	72	32	71	82	47	30	20
2	81	83	42	75	60	82	38	70
3	71	45	60	53	34	75	45	52
4	55	46	27	41	52	108	50	17
5	88	48	55	66	56	38	22	25
6	65	10	44	24	75	48	40	53
7	24	49		30	71	42	39	7
8	61	75		65	70	63		60
9		89			70	50		45
Average	61	57	43	53	63	61	38	39

3.3 Table A4 shows how the modelled times compare against the average queue wait time by peak hour. The existing 2006 reference case run was used for this comparison as this is closer to the survey year rather than the base (2002) assignment.

Table A4 Comparison of modelled and observed journey times (minutes)

Peak	Arm	Modelled	Observed	Difference
AM Peak	Arm 1	28	61	-32
	Arm 2	46	43	3
	Arm 3	28	63	-35
	Arm 4	49	38	11
PM Peak	Arm 1	28	57	-30
	Arm 2	47	53	-6
	Arm 3	32	61	-30
	Arm 4	68	39	29

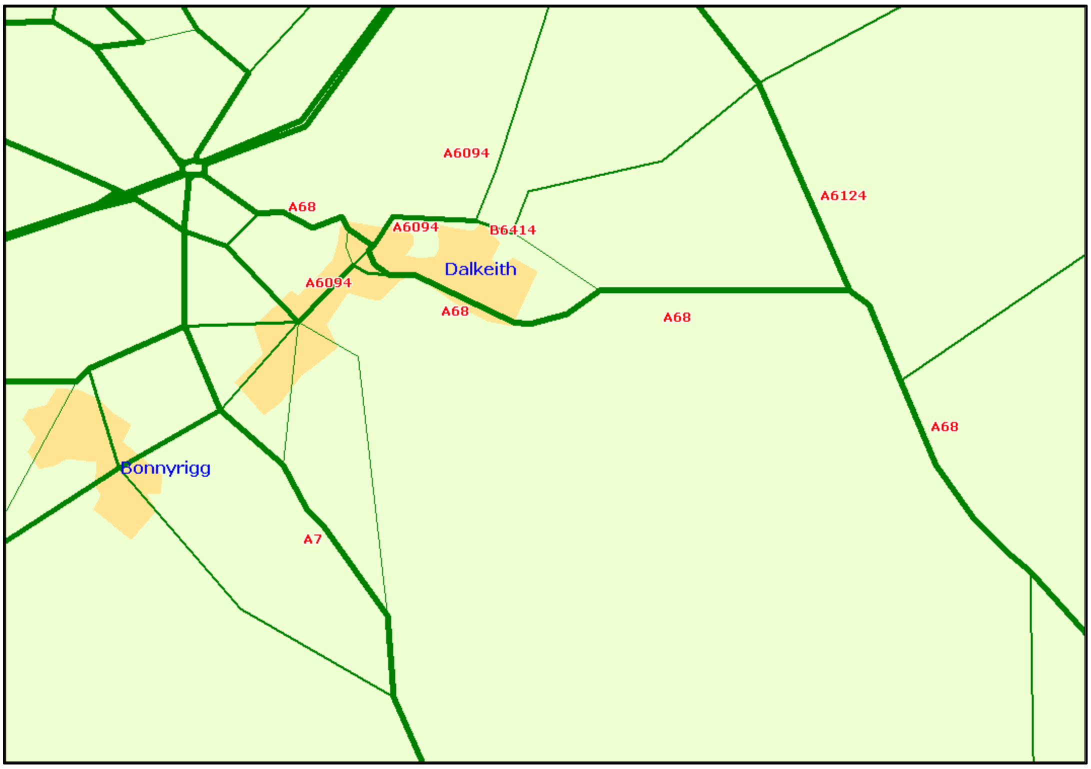
3.4 Table A4 shows the model to be underestimating the time taken to travel through the junction from the A68 but is more representative for the traffic from the A6094 in comparison to the average. However, for all arms except arm 3 the modelled times fall within the range of observed times. This is not unexpected as the zone centroid that represents Dalkeith loads onto the A6094 North of observed junction, increasing modelled flow to/from that arm and reducing it to/from the A68 arms. Also, due to the size of the Dalkeith zone, no intra-Dalkeith trips are modelled.

4 DALSAM Validation

4.1 Once the DALSAM network was extracted from the TMfS 2002 Base Highway Network and the enhancements were made to Dalkeith Centre as discussed above, the 2002 demand matrices were then extracted from TMfS and assigned to the sub area model to check the general validation of the Base Model at key links in the network.

4.2 As a result of the network and junction enhancements within Dalkeith, Figure A5 illustrates the revised routeing through Dalkeith.

Figure A5 DALSAM AM Peak, Updated Base Routeing

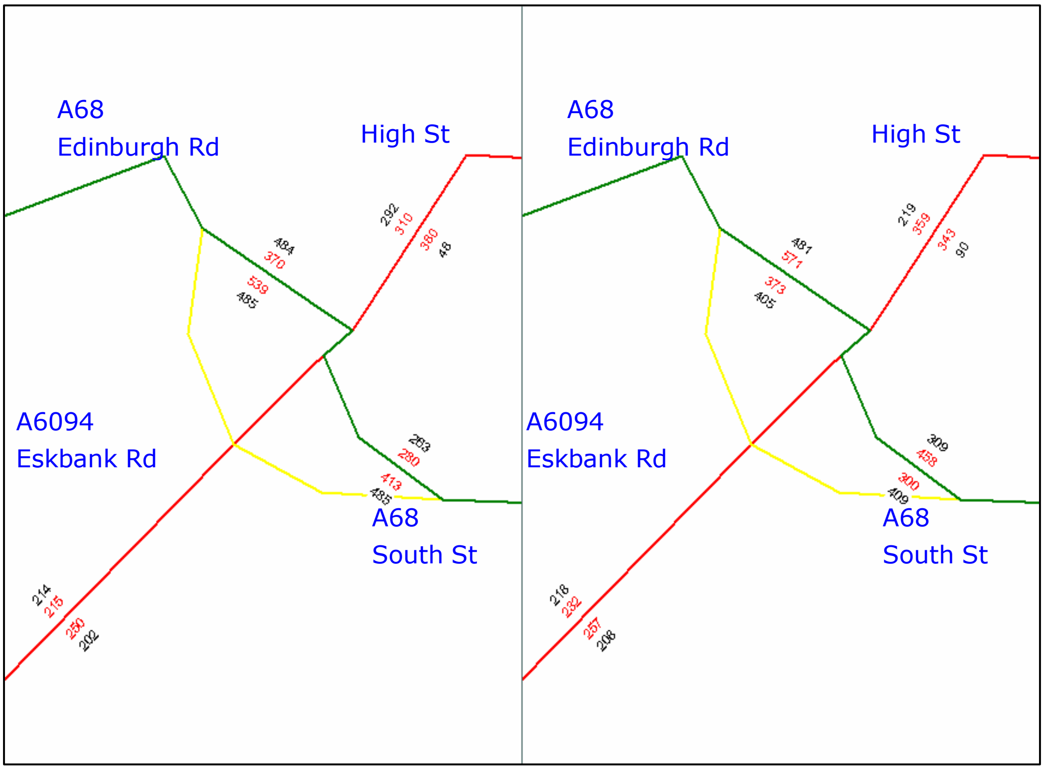


4.3 Figure A5 shows that the revised routeing through Dalkeith travels through the South of the town as opposed to the North. This revised travel pattern within Dalkeith is supported by the count data used to validate the model.

4.4 Example journey times within the DALSAM area were not available for the base year (2002) and therefore the validation of the model was undertaken using count data only. Count data was available for sites previously used in the development of both TMfS and the Dalkeith Centre VISSIM model.

4.5 The validation of the area local to the DALSAM enhancements is illustrated in Figure A6 and tabulated in Table A5. The validation of the area outwith that local to the DALSAM enhancements is illustrated in Figure A7 and tabulated in Table A6.

Figure A6 AM and PM Peak Flows (Dalkeith Town Centre: Junction of A68 and A6094)



Key:

The image on the left denotes AM Peak Flows, on the right PM Peak flows

Red (nearest to the link) = Count (Total PCUs)

Black (furthest from the link) = Modelled Flow (Total PCUs)

Figure A7 Location of validation sites outwith local DALSAM area

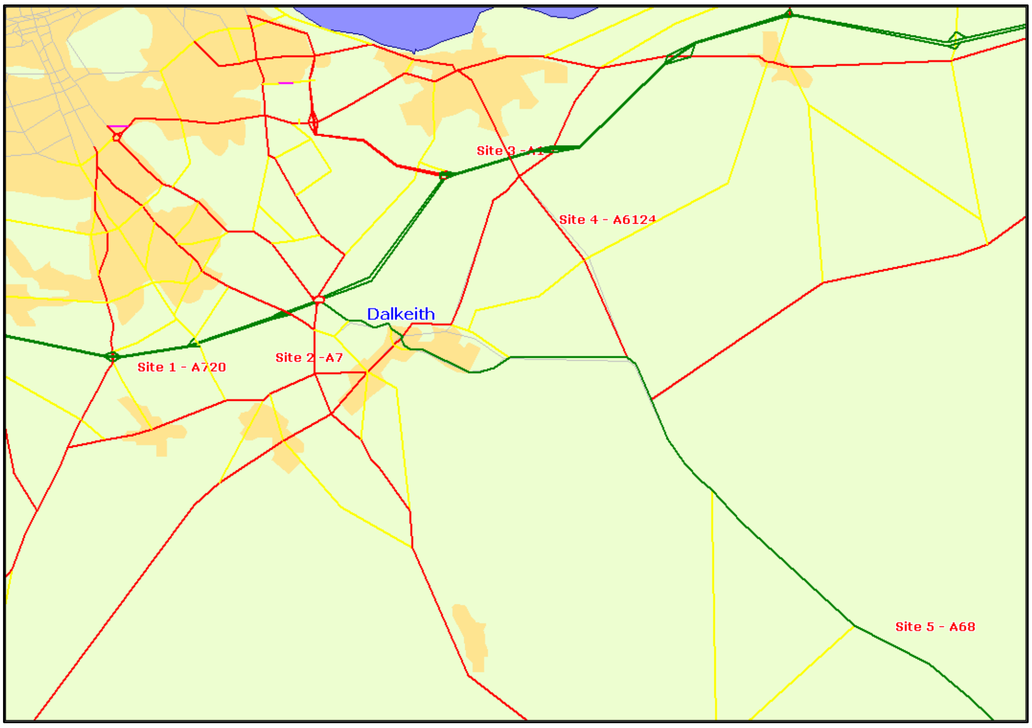


Table A5 Link Count Analysis for Central Dalkeith

Location	Direction	A-node	B-node	Count (PCUs)	Flow (PCUs)	% Diff	GEH
			AM Peak Hour				
A6094 Eskbank Road	To Junction	1449	1479	215	214	-1%	0.10
A6094 Eskbank Road	From Junction	1479	1449	250	202	-19%	3.20
A68 Edinburgh Road	To Junction	1434	1459	370	484	31%	5.53
A68 Edinburgh Road	From Junction	1459	1434	539	485	-10%	2.40
High Street	To Junction	1431	1475	380	48	-87%	22.70
High Street	From Junction	1475	1431	310	292	-6%	1.02
A68 South Street	To Junction	22763	22765	413	485	17%	3.38
A68 South Street	From Junction	22765	22763	280	263	-6%	1.02
			PM Peak Hour				
A6094 Eskbank Road	To Junction	1449	1479	232	218	-6%	0.95
A6094 Eskbank Road	From Junction	1479	1449	257	208	-19%	3.18
A68 Edinburgh Road	To Junction	1434	1459	571	481	-16%	3.94
A68 Edinburgh Road	From Junction	1459	1434	373	405	9%	1.62
High Street	To Junction	1431	1475	343	90	-74%	17.19
High Street	From Junction	1475	1431	359	219	-39%	8.25
A68 South Street	To Junction	22763	22765	300	409	36%	5.78
A68 South Street	From Junction	22765	22763	458	309	-33%	7.61

Table A6 Link Count Analysis for area outwith local DALSAM area

Location	Direction	A-node	B-node	Count (PCUs)	Flow (PCUs)	% Diff	GEH
			AM Peak Hour				
Site 1 – A720	Eastbound	1759	1760	2313	2111	-9%	4.29
Site 1 – A720	WestBound	2120	2121	2310	2584	12%	5.54
Site 2 – A7	Northbound	1768	1767	884	911	3%	0.90
Site 2 – A7	Southbound	1767	1768	697	499	-28%	8.10
Site 3 – A1	Eastbound	1889	1888	1439	1003	-30%	12.48
Site 3 – A1	WestBound	1788	1789	2586	2837	10%	4.82
Site 4 – A6124	Northbound	1438	1419	264	360	36%	5.43
Site 4 – A6124	Southbound	1419	1438	102	103	1%	0.10
Site 5 – A68	Northbound	22734	22735	436	522	20%	3.93
Site 5 – A68	Southbound	22735	22734	247	235	-5%	0.77
			PM Peak Hour				
Site 1 – A720	Eastbound	1759	1760	2763	2566	-7%	3.82
Site 1 – A720	WestBound	2120	2121	2178	1906	-12%	6.02
Site 2 – A7	Northbound	1768	1767	563	835	48%	10.29
Site 2 – A7	Southbound	1767	1768	941	944	0%	0.10
Site 3 – A1	Eastbound	1889	1888	2836	2645	-7%	3.65
Site 3 – A1	WestBound	1788	1789	1476	1437	-3%	1.02
Site 4 – A6124	Northbound	1438	1419	105	158	50%	4.62
Site 4 – A6124	Southbound	1419	1438	200	332	66%	8.09
Site 5 – A68	Northbound	22734	22735	327	298	-9%	1.64
Site 5 – A68	Southbound	22735	22734	480	504	5%	1.08

4.6 In general, the majority of counts vs modelled flows are comparable both in the AM and PM Peaks, particularly on the A68 which would be anticipated to receive the majority of relief from the inclusion of the Dalkeith Northern Bypass for more strategic traffic. The generally good comparison of these links is attributed to the observed movements from the RSI cordon and good calibration from TMfS.

4.7 The East\West local movement is not fully observed from RSI data (as discussed earlier) and therefore is less well validated. Given no further alterations (for example matrix estimation and new counts) were to be undertaken to the DALSAM model, the model does demonstrate a reasonable level of validation to count information.

5 Conclusions

5.1 DALSAM is able to provide an indication of strategic flow information for the proposed Dalkeith Northern Bypass and the anticipated effects on the principle road network. It is also able to provide an indication of expected economic performance, although it should be borne in mind that lack of junction definition and local movements (both intra-zonal traffic and East\West travel patterns from Dalkeith) throughout the model may underestimate delays and consequently economic performance.

Appendix B Detailed Accident Analysis

Table B1 Accidents by accident severity

Year	Scenario	Fatal Casualties	Serious Casualty	Slight Casualty	Total Casualties
2011	Reference	3.4	32.7	328.8	364.8
	Test	3.4	32.2	327.8	363.4
2021	Reference	3.4	33.3	334.5	371.2
	Test	3.4	33.3	332.9	369.6

Table B2 Accidents by Local Authority area

Year	Local Authority	Annual Casualties - Reference	Annual Casualties - Test	Annual Casualties - Saved
2011	East Lothian	36.6	35.5	1.1
	Midlothian	40.4	39.1	1.3
	Edinburgh	117.8	118.3	-0.5
	England and The Borders	170.0	170.5	-0.5
	Total	**364.8**	**363.4**	**1.4**
2021	East Lothian	36.1	35.1	1.0
	Midlothian	40.1	39.2	0.9
	Edinburgh	126.9	127.2	-0.3
	England and The Borders	168.1	168.1	0.1
	Total	**371.2**	**369.6**	**1.6**

Appendix C TEE Table

Reference vs. Test – 25% Optimism Bias Uplift

Economy: Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	Road	
User benefits	TOTAL		
Travel Time	9246	9246	
Vehicle operating costs	6631	6631	
User charges	0	0	
During Construction & Maintenance	0	0	
NET CONSUMER BENEFITS	15877	15877	
Business			
User benefits		Personal	Freight
Travel Time	20586	12434	8152
Vehicle operating costs	7369	2860	4509
User charges	0	0	0
During Construction & Maintenance	0	0	0
Subtotal	27955	15294	12661
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	27955		
TOTAL			
Present Value of Transport Economic Efficiency Benefits (PVB)	43832		

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	Road
Local Government Funding	TOTAL	
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	507	507
Investment costs	31815	31815
Developer Contributions	0	0
Grant/Subsidy Payments	0	0
Indirect Tax Revenues	4665	4665
NET IMPACT	36986	36986
TOTAL		
TOTAL Present Value of Costs (PVC)	36986	

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	15877
Business User Benefits	27955
Private Sector Provider Impacts	0
Other Business Impacts	0
Accident Benefits	6075
Net present Value of Benefits (PVB)	49907
Local Government Funding	0
Central Government Funding	36986
Net present Value Costs (PVC)	36986
Overall Impact	
Net present Value (NPV)	12921
Benefit to Cost Ratio (BCR)	1.349

Appraisal Period 2007 to 2066

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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