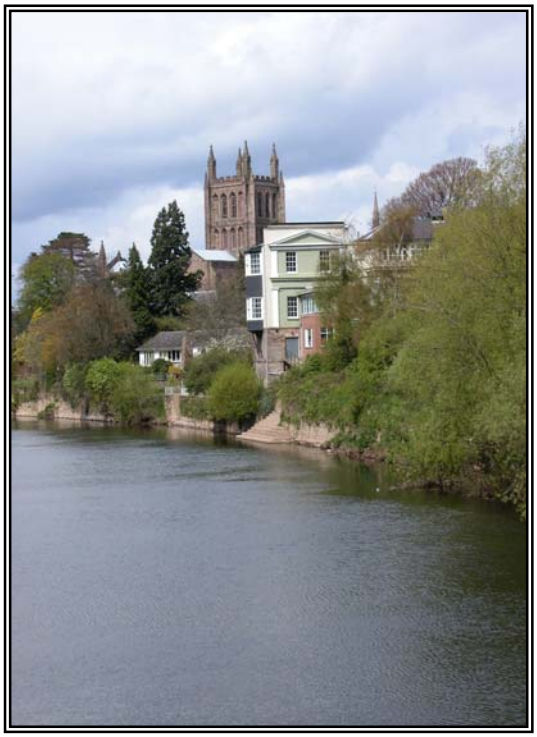
HEREFORDSHIRE COUNCIL

HEREFORD TRANSPORT REVIEW
LOCAL MULTI-MODAL STUDY



FINAL REPORT

February 2003

HEREFORDSHIRE COUNCIL

HEREFORD TRANSPORT REVIEW
LOCAL MULTI-MODAL STUDY

FINAL REPORT

FEBRUARY 2003

In association with:

Waterman Burrow Crocker
Stratford Court
Cranmore Boulevard
Shirley
Solihull
B90 4QT

Tel: 0121 733 7799
Fax: 0121 733 6620

PREPARED BY:

Transportation Planning (International) Ltd
Crystal Court
Aston Cross
Rocky Lane
Birmingham
B6 5RH

Tel No: 0121 333 3433
Fax No. 0121 359 3200
E-mail: info@tpi-bham.co.uk

TPi

Document Control

Project Title: Hereford Transport Review

Project No: 21344

Document Ref: 21344 13-02-03 Final Report

Document Status: Draft

Document Approval:

_____

Project Director

_____

Project Manager

_____

Issue Date and History:

18th January 2003 Draft Final Report

13th February 2003 Final Report

Distribution:

External:

Internal: File

HEREFORDSHIRE COUNCIL **FEBRUARY 2003**

HEREFORD TRANSPORT REVIEW
LOCAL MULTI-MODAL STUDY

FINAL REPORT

Contents

Figures

Appendices

EXECUTIVE SUMMARY

1 Introduction

At the end of January 2002 Transportation Planning (International) Ltd, (TPi), in association with Waterman Burrow Crocker were appointed to undertake a comprehensive transport review for the City of Hereford and its immediate environs. The review was to take the form of a local multi-modal study and, in particular, to utilise the findings and data that had resulted from a series of single mode studies that had been undertaken on behalf of Herefordshire Council since it was formed in 1998.

Hereford has been nominated as a sub-regional centre by the Regional Planning Body and the current transportation system is a significant constraint on the City fulfilling this role. A Public Inquiry into a proposed Trunk Road Eastern Bypass was held in 1991/92 followed by a Hereford Traffic Conference in 1993/94. However in 1998 the proposal was withdrawn from the National Roads Programme.

The study seeks to define a long term transport strategy beyond the current Local Transport Plan period to be incorporated into the second deposit draft Unitary Development Plan, Regional Planning Guidance and Regional Transport Strategy.

The study was required to follow the national transport objectives of integration, economy, safety, accessibility and care for the environment. In addition the Herefordshire Council has developed a vision and key priorities for transport, which have been incorporated into the Local Transport Plan. This led to an objective for the Study, which was -

"To develop a transport strategy which will contribute to the long term vitality, viability, safety and sustainability of the City and is capable of attracting the support of a wide range of stakeholders".

A radical departure from earlier land use / transportation studies is the development of a model to estimate total demand for travel which is forecast to occur in future years, rather than the anticipated growth in individual modes such as car travel. This allows the effects of introducing behavioural change in travel from new transport facilities and the effects of demand management to be incorporated into the future transport strategy.

The progress of the Study has been monitored and guided by a multi-agency Steering Group with representation from Herefordshire Council, Government Office West Midlands, Advantage West Midlands, Highways Agency, Chamber of Commerce and West Midlands Sustainability Forum.

The study considered the urban area of the City of Hereford, its approaches from the surrounding parishes and the transport links to the adjacent market towns and forecast travel demand for the years 2011 and 2031.

2 Surveys

Maximum use was made of travel data collected for previous studies, but some new data was collected to ensure the a comprehensive baseline was achieved. This new data collection included:

- pedestrian surveys at key junctions in the city centre
- roadside interviews and postcard surveys at key sites on the road network
- a survey of commercial vehicle journeys for vehicles crossing Greyfriars Bridge
- rail passenger counts at Hereford station
- an extensive programme of manual and automatic traffic counts were carried out at locations previously used to allow historical comparisons to be made.
- a series of journey time runs across the city along the main radial routes

3 Consultation

At the beginning of the study it was recognised that extensive consultation with members of the public and special interest groups had occurred during several of the studies and in the development of the LTP since 1998. However it was also felt that a multi-modal transport review was too important and far reaching in its possible effects not to involve more representatives than formed the Steering Group. Consequently a Wider Reference Group was created drawing together all key stakeholders including those who attended the two "Transport Summits" held in Hereford over recent years. It met at key stages in the study to consider: the development of initial options, appraisal of initial options and the development of a blended transport package. The overall purpose of the Wider Reference Group meetings were to:

- identify the problems and issues which the Study must address;
- identify local preferences which may influence the choice of solution;
- identify the acceptability of alternative solutions;
- assess whether the recommended solutions are locally acceptable; and
- ensure the involvement of a wide range of stakeholders in the development of the future transport strategy.
- contribute to building a consensus around the eventual outcome.

Briefing meetings were also held for representatives of Parish Councils and Members of Herefordshire Council. Additionally, a Herefordshire Council Member Board was kept informed of progress by Council Officers during the course of the study.

4 Constraints and Problems

The development of a future transport strategy starts from the existing transport situation, the commitment of the Local Transport Plan and the provisions of the deposit draft Unitary Development Plan. In the period from 1996 to 2011 approximately 11,700 new dwellings are proposed in Herefordshire together with significant industrial or commercial development at Rotherwas and adjacent to A4103 (Roman Road).

From previous consultation exercises carried out over recent years, five areas of concern were most frequently raised:

- need for improved bus services and facilities;
- need for Hereford By-pass;
- need for Park and Ride;
- opposition to any reduction in parking, especially for commuters; and
- need for integration of all transport modes.

These concerns have been reflected in the objectives of the study.

5 The Multi-Modal Model

A new multi modal computer model was developed to evaluate the effects of potential transport improvement scheme packages in Hereford. In order to undertake this, existing transport conditions at base year 2002 were replicated as accurately as possible for private vehicles (car and heavy goods vehicle), public transport (bus and train) and sustainable modes (pedestrian and cyclist). The time periods used were a weekday morning Peak Hour (0800 – 0900 hrs), inter-peak (1100-1200 hrs) and evening peak (1700 – 1800 hrs). The model was based on earlier work and updated by means of the 2002 surveys.

The computer model represented person travel demand at the Base Year (2002) and the two forecast years (2011 and 2031). In the case of the forecast years it incorporated the provisions of the Local Transport Plan, the deposit draft Unitary Development Plan and Government estimated socio-economic changes from 2016 to 2031. A detailed explanation of the development of the model and how it was used during the study is contained in the main study report.

6 Transport Objectives and Appraisal

As a local Multi-Modal Study, the recommendations of the Government publication 'Guidance on the Methodology for Multi-Modal Studies (GOMMMS) were followed as far as possible. This required a methodology which incorporates:

- the preparation of Appraisal Summary Tables (AST) showing performance against national transport objectives and sub-objectives;
- an assessment against local transport objectives and, inter-alia, an assessment of each strategy against its contribution to solving identified problems; and
- supporting analyses.

Government's five overarching objectives for future transport strategies consider accessibility, economy, care for the environment, integration of transport modes and the safety of travellers. These national objectives were augmented by the local objectives contained in the Local Transport Plan. Each strategy option to be tested was compared to a Reference Case which reflects the future situation when only the committed changes (generally from the LTP) are in place. As well as national and local objectives each strategy is also assessed for operational and economic performance and other criteria such as financial sustainability, practicability and public acceptability.

7 Development and Evaluation of Initial Option Packages

Following consultation with the Wider Reference Group, the Steering Group developed six initial strategy options ranging from ones with a strong emphasis on sustainable mode travel; (walk, cycle and public transport including a Metro from Belmont to Hereford station), to options which combine provision for sustainable modes with new road provision. Each option was compared against the Reference Case.

Appraisals and assessments were completed for the six initial Option Packages which indicated that none of the them totally satisfied the national or local objectives as defined. This was not unexpected since the initial packages were meant to represent a range of strategic approaches which could be combined in whole or part to produce the final strategy.

All the Option Packages tested achieve a reduction in traffic levels and congestion in the central area of the City, as compared to the Reference Case, but by different means. The public transport orientated Options achieved this through a significant shift from car to public transport principally as a result of demand restraint at junctions resulting from maximum bus priorities. Option Packages with some new road provision achieved similar reductions, through the provision of new highway facilities in the form of either inner or outer distributor roads, which removed certain road traffic movements from the central area. The latter packages do not achieve any significant modal shift to public transport and none of the six packages achieved any appreciable shift from car to the sustainable walk and cycle modes.

The transport efficiency of the option packages without new road provision produced a negative benefit cost ratio, which was well below the requirement for economic viability. The introduction of new road provision produces greater economic benefits so that the benefit cost ratio becomes strongly positive. However, all option packages which included new road schemes had serious environmental disadvantages.

Following the initial option appraisals a blended package was created for more refined testing and assessment. This incorporated extensive bus priorities, no metro , a significant behavioural shift from car driver to walk, cycle and public transport and also a single carriageway western distributor road from the A49 north to the A49 south to link with the Rotherwas Access Road. The package was tested both with and without the distributor road in order to evaluate the contribution of the road to the total package. The evaluation indicated that the amount of through traffic could not justify the provision of a by-pass. However, a new road which acted as a distributor for traffic wishing to enter and leave the city and catered for some of the by-passable traffic, would be economically and operationally viable.

8 Testing, Evaluation and Recommendations of a Blended Package

The measures incorporated into the Blended Package can be summarised as follows:

- all measures in the Reference Case, which include a bus based Park and Ride site on the A49 near the racecourse and the Rotherwas Access Road;
- maximum feasible bus priorities on all radial routes, Greyfriars Bridge and the Inner Relief Road;
- two additional bus based Park and Ride sites at A49 south and A465 south and new rail stations at Withington and Rotherwas;

- further pedestrianisation of the City Centre to include Widemarsh Street, High Street and Broad Street. Access for buses and cyclists would be permitted;
- improved facilities for cyclists and pedestrians throughout the City;
- 20mph zones in residential zones off main traffic routes;
- school transport package to reduce numbers of children being driven to school; and
- measures to produce a further modal shift from car journeys to sustainable modes to achieve a 6% change by 2011 and 12% by 2031.
- A western outer distributor road.

The evaluation indicated that in operational (traffic flow) and economic terms, the Blended Package with a western distributor performed significantly better than the same package without the new road by 2031. However, there are significant environmental disadvantages with the new road.

The Blended Package without the western distributor retains significant traffic overloading in the City Centre, specifically on Greyfriars Bridge and the Inner Relief Road. This overload would be particularly difficult to accommodate when associated with maximum bus priorities. The addition of the western distributor removes this overload and increases the travel time benefits to car traffic by over 70%, whilst at the same time nearly maintaining the level of public transport travel time benefits. The benefit cost ratio is strongly positive for both packages, but is slightly higher with the inclusion of the western distributor.

The consultants recommended to the Steering Group that the Blended Package with a western distributor should be adopted as the preferred strategy, at a 30 year investment cost of approximately £80million. The bus priority, cycle provision and most of the behavioural change should be implemented in the period 2006 - 2016 before the western distributor is constructed.

1.0 INTRODUCTION AND BACKGROUND

1.1 At the end of January 2002 Transportation Planning (International) Ltd, (TPi), in association with Waterman Burrow Crocker were appointed by Herefordshire Council to undertake a comprehensive transport review for the City of Hereford and its immediate environs. The review was to take the form of a local multi-modal study and, in particular, to utilise the findings and data that had resulted from a series of single mode studies that had been undertaken on behalf of Herefordshire Council since it was formed in 1998.

1.2 Following the Government publication of the Integrated Transport White Paper – A New Deal for Transport in July 1998 a number of multi-modal studies were announced. They were intended to look at the total demand for travel over a comparatively long time period and to establish a framework that would provide for an integrated transport system covering all modes including the more sustainable means of travel such as walking and cycling.

1.3 These multi-modal studies were regarded as important in the national strategic transport context, generally covered a wide geographic area and consequently were fully funded by Central Government. However, it was recognised that compatible local studies covering more discrete areas such as the larger free-standing towns and cities would be needed. These studies would perform a similar function to the national ones in that they would be for a long time scale, cover all modes and provide an integrated framework. They would also form the basis of policy documents and grant applications such as the Local Transport Plan, Unitary Development Plans, etc.

1.4 Hereford has been nominated as a sub-regional centre by the Regional Planning Body and with its current transportation system there is a strong feeling that the City will struggle to fulfil this role.

1.5 After many years of debate and consultation over the need for a bypass a proposal for an eastern route was the subject of a Public Inquiry in 1991/92. Following the Inquiry the initial proposal was put on hold and a Hereford Traffic Conference was held in December 1993 and January 1994 to consider the traffic problems in the City and to debate possible solutions. The Chairman's report was subsequently published in August 1994. This concluded that there was some disagreement over the need for a bypass but, if there was to be one, there was strong support for a route to the east of the city. There should however be changes in the line of the route in the areas of the River Lugg / Lugg Meadows and the Rotherwas Industrial Estate. In July 1998 the District Council learnt that the proposed bypass was to be withdrawn from the National Roads Programme.

1.6 There is a division of responsibility for highways in the City of Hereford because the Trunk Roads, A49 and A465 (South) are under the control of the Highways Agency. Various improvements to these routes have been implemented and are currently the subject of studies to effect further improvements. It is important that any changes to the transport system in the City are integrated with the Trunk Road proposals.

1.7 The development of the deposit draft Unitary Development Plan (UDP) required a corresponding integrated transport strategy whose time frame extended over a longer period than the current Local Transport Plan. The timing of the study was therefore set to ensure the outputs would be available for the deposit draft Unitary Development Plan. The findings

will also need to be incorporated into Regional Planning Guidance and the Regional Transport Strategy.

1.8 Extensive consultation with stakeholders, special interest groups and the general public has considered traffic and transport problems in the City; in particular a significant number of people at the Hereford Traffic Conference felt that an integrated transport strategy should be pursued, either separately or in conjunction with a bypass. This would include park and ride, bus and cycle priority, control of on-street and off-street parking provision and other traffic management measures.

1.9 Since Herefordshire District Council was created as a unitary authority in 1998 a number of modal and functional studies have been undertaken to consider specific issues and problems. One of the guiding principles in developing a multi-modal study was that it should utilise the data, analysis and findings from these previous studies wherever possible. This had the dual object of minimising any new data collection but also to ensure earlier recommendations were compatible and were capable of being integrated into an overall transport strategy.

1.10 The principal sources of data incorporated into the Transport Review from previous studies were:

- Herefordshire Local Transport Plan 2001/02 – 2005/06;
- Herefordshire Local Transport Plan Annual Progress Report (August 2001)
- Herefordshire Local Transport Plan Consultation Study;
- Herefordshire Rail Study;
- Rotherwas Industrial Estate Integrated Access Study;
- Herefordshire Park & Ride and Parking Study;
- Highways Agency Hereford Park & Ride Pilot Study;
- Hereford Bypass Business Case Study;
- Hereford Metro Study;
- Hereford Pedestrian Access Audit Study;
- Hereford Public Transport Interchange Study;
- Herefordshire Unitary Development Plan Development Options Transportation Study;
- Safer Routes to School Studies for Trinity Primary School, Whitecross High School, Haywood High School, St Thomas Cantilupe School and Broadlands Primary School;
- Herefordshire Safer Routes to School Strategic Assessment;
- Hereford and Worcester Cycling Strategy;
- Hereford City Centre Retail Site Assessment Study;
- Hereford City Centre Retail Floorspace Monitor;
- A49(T) Through Hereford Study 2001; and
- A49(T) Route Management Strategy Study (2002).

1.11 Summaries of these studies are included in an Appendix to the Data Review and Survey Report.

1.12 A number of these studies (and earlier ones) developed transport models, which were available to be incorporated into a base year multi-modal model. The vehicle road traffic movements were based on a SATURN model, which was developed for the Herefordshire UDP Development Options Transportation Study and partly updated in 2002 through

roadside interviews. Walk and Cycle movement is also modelled within SATURN with basic data obtained from the household survey undertaken in 2000 and classified counts in 1999 and 2002.

Study Aims and Objectives

1.13 Having determined that a local multi-modal study was the only practicable way to ensure that the development of the City's transport system fulfilled the identified needs the Council set out the aims and objectives it would need to follow. All multi-modal studies are expected to follow the national transport objectives spelt out in 1998 White Paper. They are summarised as:-

- **integration** – to ensure that all decisions are taken in the context of the Government's integrated transport policy,
- **economy** – to support sustainable economic activity and get good value for money,
- **safety** – to improve safety for all road users,
- **accessibility** – to improve access to everyday facilities for those without a car and to reduce community severance;
- **environment** – to protect the built and natural environment.

1.14 In the local context the Herefordshire Partnership has prepared a Plan, which seeks to establish key strategic priorities for the County. The guiding vision of the plan is to:

*"create **fair and thriving communities** which will be inclusive for all allowing equal and full access to opportunities and services; properly **protect the environment** and enhance it for all those who live and work in it and for those who visit it; and build a **strong, competitive and innovative economy** with a balanced mix of businesses, jobs and homes through which the local economy can flourish".*

This vision leads to the establishment of key priorities of which one is to:

"Develop an integrated transport system for Herefordshire".

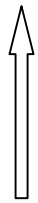
In turn, this key priority gives rise to a number of core objectives which have guided the formulation of the Local Transport Plan. They are:

- **CO1** – to support urban and rural communities to ensure full and equal access to services and opportunities whilst seeking to reduce car dependency;
- **CO2** – to promote sustainable economic growth, supporting a strong, competitive economy with a balanced mix of businesses;
- **CO3** – to protect and enhance the natural and built environment whilst accommodating planned development in sustainable and appropriate locations;
- **CO4** – to support the vitality and viability of urban and rural centres to ensure the provision of an appropriate range of services for local communities, resisting pressure which would lead to decentralised development; and
- **CO5** – to create a safe environment, which enables local residents to enjoy healthy lifestyles.

In implementing these objectives through plans, which directly affect the provision of transport services, the Council has adopted a hierarchy of travel modes:

Highest Priority

1. Pedestrians & people with mobility difficulties
2. Cyclists & public transport users
3. Commercial/business users & powered two wheelers
4. Car borne shoppers & coach borne visitors
5. Car borne commuters & visitors



Lowest Priority

Integrating these aims and objectives led to a final objective for a study which was

"To develop a transport strategy which will contribute to the long term vitality, viability, safety and sustainability of the City and that is capable of attracting the support of a wide range of stakeholders".

The Vision, Core Objectives and priority order of travel modes have generated a series of Detailed Transport Objectives which are shown at Table 1.1.

The Study Process

1.15 A radical departure from earlier land use / transportation studies is the development of the total demand for travel which is forecast to occur in future years, rather than the anticipated growth in individual modes such as car travel. This allows the effects of introducing behavioural change in travel from new transport facilities and the effects of demand management to be incorporated into the future transport strategy. The study process designed to achieve the development of an integrated transport strategy is shown at Figure 1.2. The two principal design years for the study were 2011 and 2031.

1.16 The progress of the Study has been monitored and guided by a Steering Group chaired by the Head of Engineering and Transportation for Herefordshire Council, with representatives from Government Office West Midlands, Regional Development Agency, Highways Agency, environmental and business groups. A full list of the members of the Steering Group and their affiliation is given at Appendix D.

1.17 The study area consisted of the urban area of the City of Hereford, its approaches from the surrounding parishes and the transport links to the adjacent market towns, and is shown in Figure 1.1.

The Report

1.18 The remaining sections of this report deal with the elements of the study. Chapter 2 covers new surveys and data extraction from previous studies. A large amount of the public and organisational consultation has been undertaken since 1998. A focused and targeted approach to incorporating the views of key stakeholder groups was adopted for this study which was designed to avoid 'consultation fatigue'. This is described in Chapter 3. The problems and constraints identified are discussed in Chapter 4 followed by the development, calibration and validation of the multi-modal model (Chapter 5). The individual aims and objectives set out above are discussed in more detail in Chapter 6. A range of initial

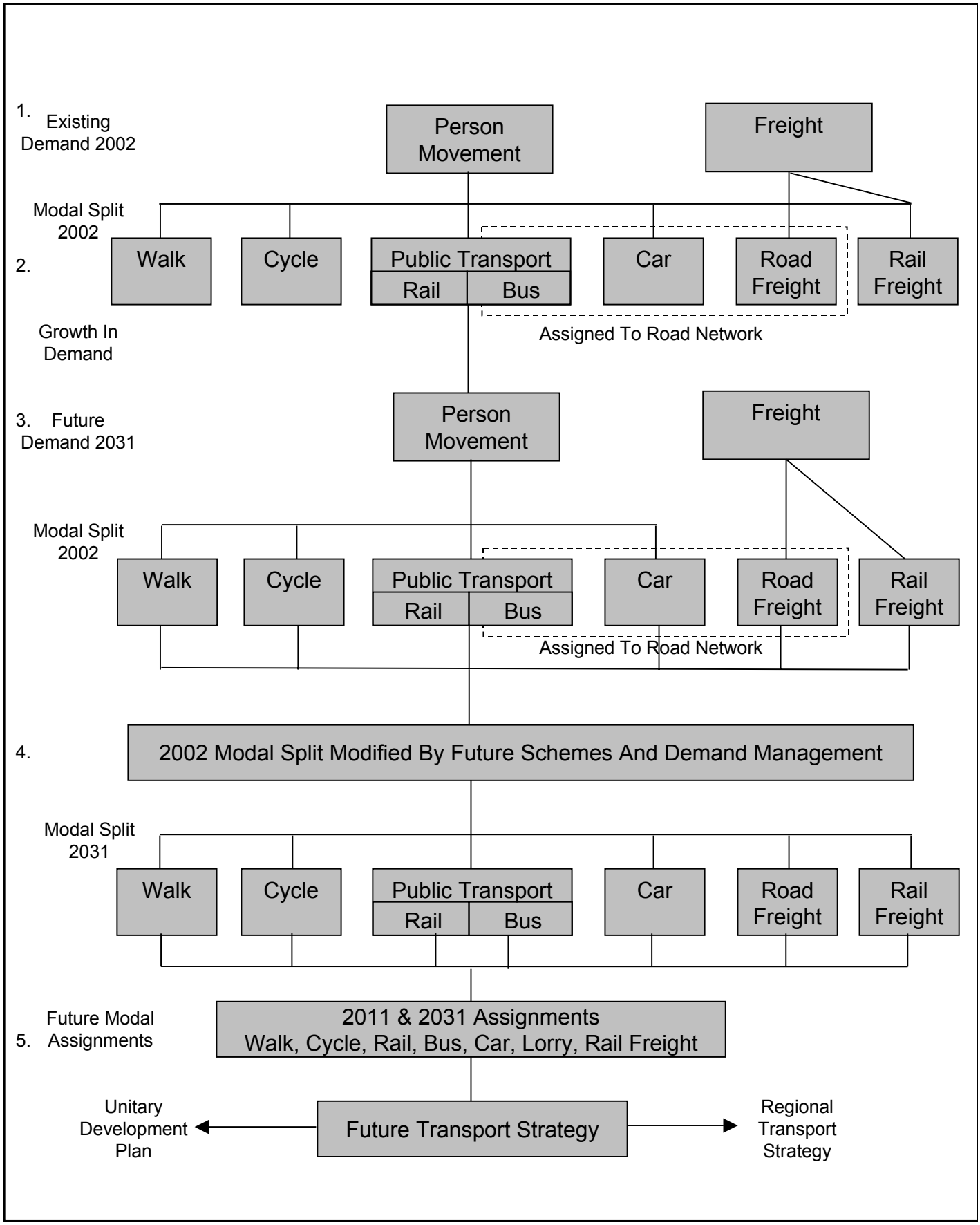
transport system options were developed and tested (Chapter 7) from which a blended package was created (Chapter 8). The recommendations are contained in Chapter 9.

1.19 Throughout this report, unless otherwise stated, AM Peak Hour refers to the time period 0800-0900 hrs and PM Peak refers to 1700-1800 hours. Where reference is made to the "City Centre" or Central Area in this report it covers the area generally bounded by the river and the Inner Ring Road.

Table 1.1: Detailed Transport Objectives

Hereford Integrated Transport Strategy	
HT1	To ensure that people can gain access to existing and future employment, education, leisure and shopping sites, particularly by public transport, cycling and walking.
HT2	To provide for the movement of freight into and out of the City whilst seeking to reduce the impact of road freight, and encourage greater use of rail.
HT3	To improve road safety and personal security, particularly for vulnerable road users, such as pedestrians and cyclists.
HT4	To make the transport system more accessible to people with mobility difficulties.
HT5	To increase the proportion of trips made by public transport, cycling and walking, particularly for journeys to the city centre and major work sites.
HT6	To improve the attractiveness and convenience of public transport so as to improve access to mobility for those without the use of a car and to reduce car dependence.
HT7	To reduce the impact of transport on the environment by encouraging the use of less polluting and more energy efficient modes, such as public transport, cycling and walking.
HT8	To conserve and enhance the environment of Hereford, particularly within the City Centre, and ensure that it remains an attractive place to visit and in which to live, work and invest.
HT9	To increase the proportion of short trips made by cycle or on foot.
HT10	To reduce the need to travel, in the longer term, by the co-ordination of land use planning with transport.
HT11	To ensure the City's transport system enables all the residents of Hereford
Rural Areas and Market Towns Integrated Transport Strategy	
RT1	To improve road safety and personal security, particularly for vulnerable road users, such as pedestrians and cyclists.
RT2	To make the transport system more accessible to people with mobility difficulties.
RT3	To improve access to employment areas for employees and freight, whilst seeking to reduce the impact of road freight and encourage the use of rail.
RT4	To improve the attractiveness and convenience of the rural public transport network, and to promote innovative community and voluntary transport initiatives, so as to improve access to mobility for those without the use of a car and to reduce car dependence.
RT5	To conserve and enhance the County's environment, particularly in remoter rural areas.
RT6	To increase the proportion of short trips made by cycle or on foot in Market Towns and larger villages.
RT7	To reduce the need to travel, in the longer term, by the co-ordination of land use planning with transport.
Local Road Safety Strategy	
S1	Promote an awareness of environmental and safety issues by education, training, enforcement and publicity.
S2	Carry out route improvements within the Strategic Highway and Main Distributor Network to enable selective safety and environmental improvements to be achieved.
S3	Introduce measures to reduce traffic speed to improve both safety and the quality of life on urban access roads.
S4	Introduce measures to reduce the impact of traffic on rural settlements.
S5	Promote the development of cycling and walking routes and facilities with particular emphasis being placed on increasing the safety and convenience of these modes.
Managing the Highways Network	
M1	To keep principal, distributor and access roads in an appropriately maintained condition, having regard to the character of the road and the traffic expected to use it.
M2	To ensure any major carriageway surface defects are repaired or made safe by warning signs within one working day of them being checked by the Council following notification from the public.
M3	To ensure that existing bridges are maintained at a load carrying capacity appropriate to the class and function of the road carried.
M4	To strengthen below strength bridges, other than those with permanent restrictions by 2004.
M5	To create a safe and more secure night-time environment, by providing a cost efficient and effective system of street lighting and illuminated signs.
M6	To reduce energy demand by improved lighting efficiency.


N
Kington
Leominster
Bromyard
Ledbury
Pontrilas
Hereford
A4110
A480
A49(T)
A465
A4103
A438
A465(T)
A49(T)
A438
Area of Influence
Core Area
Kinnerton
Nash
Shobdon
Kingsland
Stockton
Collington
Clifton upon Teme
Thornbury
Hatfield
Bridge
Monkland
Pembridge
Eywood
Old Radnor
Burlingjobb
Dolyhi
Gladestry
Lyonshall
Stretford
Wharton
Stoke Prior
Bredenbury
Broadwas
Alfrick
Glascwm
Kingswood Common
Holme Marsh
Dilwyn
Aulden
Knapton Green
Bowley
Pencombe
Upper Welson
Weobley
Birley
Westhope
Bodenham
Little Cowarne
Leigh
Newchurch
Upcott
Eardisley
Kinnersley
Canon-Pyon
Ullingswick
Longley Green
Brilley
Whitney
Willersley
Wormsley
Wellington
Burley Gate
Ridgeway Cross
Painscastle
Winforton
Norton Canon
Moreton on Lugg
Sutton St Nicholas
Castle Frome
Pen-y-parc
Letton
Portway
Burghill
Newtown
Clyro
Bredwardine
B4348
Byford
Credenhill
Bosbury
Llowes
The Bage
Ploughfield
Dorstone
Blakemere
Lulham
Sugwas
Ashperton
Wellington Heath
Llanigon
Madley
Tarrington
A449
Three Cocks
Shenmore
Clehonger
Aylton
Mordiford
Vowchurch
Woolhope
Putley
Preston
Michaelchurch Escley
Kingstone
Holme Lacy
Fownhope
B4216
Talgarth
B4347
St. Margarets
Much Marcle
Little Dewchurch
Much Dewchurch
B4224
Dymock
Abbey Dore
Much Birch
Kempley
Wormbridge
How Caple
Longtown
Bagwy Llydiart
A49
Crow Hill
Upleadon
A479
A466
Pengethley
M50
Linton
Newent
St. Weonards
Ross on Wye
Peterstow
A40
© 2000 Microsoft Corp. and/or its suppliers. All rights reserved.



TPi February 2003

Study Process and Strategy Development

Figure 1.2

I:\Projects\21344\Drawings\report Figures\Fig 1.2.ppt

2.0 SURVEYS

2.1 In order to re-calibrate and validate the computer model and turn it from a vehicle based model to a person movement model, data was extracted from other recent studies and some new data obtained. The former is described in Chapter 5 – The Multi-Modal Transport Model. The latter consisted of roadside interviews, journey time data and new counts for each mode; walk, cycle, bus and rail passengers, cars (and vehicle occupancy), and commercial vehicles. Each new survey element is briefly described below; with a fuller description contained in the Hereford Transport Review – Data Review and Survey Report.

2.2 Private car and Heavy Goods Vehicle (HGV) moments have been modelled and subject to updates since the original model was developed. The most recent study undertaken for the 2001/2011 Unitary Development Plan used the model updated in 1995. It was recalibrated against traffic counts in 2000 and 2001 but no interview surveys were undertaken at that time.

Pedestrian and Cycle Movement

2.3 Pedestrian surveys were undertaken at nine key junctions in 1999 and they were repeated at the same locations in April 2002. Not all pedestrians were counted for all time periods and the missing movements were synthesised. Maximum 2-way weekday pedestrian flow at all nine junctions occurred during the morning Off Peak 1000-1200 hrs. It is interesting to note that the total observed PM peak pedestrian movement is over twice the number of total observed pedestrian movements in the AM peak shown in Table 2.1.

2.4 The biggest weekday movement at individual crossings occurred during the AM off-peak at the junction of High Street/Widemarsh Street/High Town at just over 6000 pedestrians crossing the junction in a two hour period. The second biggest individual crossing movement occurred at the same time, at the junction of High Street/Broad Street/Eign Gate; with a total flow of over 5000. Both of these junctions provide links to the City Centre from the inner ring road.

2.5 Comparisons were made between these new 2002 counts with the 1999 counts. Results are shown in Figure 2.1 for the AM weekday peak (0800-0900), and Figure 2.2 for the PM weekday peak (1700-1800).

2.6 The AM weekday pedestrian flows have declined on almost all of the nine counted junctions between 1999 and 2002. On the major junctions of High Street/Broad Street/Eign Gate and High Street/Widemarsh Street/High Town flows have almost halved during the AM peak 0800-0900 between 1999 and 2002. During the PM peak this situation is reversed. Pedestrian flows on all junctions have increased between 1999 and 2002 and flows on the two major junctions have increased by some 4,500 pedestrians.

2.7 Inbound and outbound cycle movements for five major routes obtained from the 2002 manual classified counts are shown in Figures 2.3 and 2.4 for the AM and PM Peak Hours respectively. For both AM and PM, the major cycle route is the B4399 Holme Lacy Road with 37 inbound trips in the AM Peak and 62 outbound in the PM Peak. The next highest recorded flow is on the A438 Ledbury Road with 26 inbound trips in the AM peak and 30 outbound trips in the PM peak.

Table 2.1 Observed and Synthesised Pedestrian Movements at Junctions – April 2002

Location	*Weekday*					*Saturday*			*Weekday Total All Periods*	*Saturday Total All Periods*	*Weekday and Saturday Total All Periods*
	AM Peak 0800-0900 (1 Hour)	*AM Off Peak 1000-1200 (2 Hour)*	*Lunch Peak 1230-1330 (1 Hour)*	*PM Off Peak 1400-1600 (2 Hour)*	*PM Peak 1700-1800 (1 Hour)*	*AM Off Peak 1000-1200 (2 Hour)*	*Lunch Peak 1230-1330 (1 Hour)*	*PM Off Peak 1400-1600 (2 Hour)*			
Widemarsh St/IRR	402	1121	810	480	1306	3392	899	3309	4119	7600	11719
Commercial Rd/IRR	456	2799	2022	1746	3261	2321	615	2264	10283	5200	15484
St Owens St/IRR	57	201	115	68	143	312	83	304	584	698	1282
Eign St/Eign Gate/IRR	340	850	633	375	1020	1559	413	1521	3218	3493	6712
Wye Bridge on Bridge St	302	687	496	370	724	1201	318	1172	2579	2691	5270
Victoria Footbridge	84	191	138	103	201	-	-	-	717	0	717
Barton Rd/IRR Junction	179	567	422	250	680	494	131	482	2098	1107	3205
High St/Broad St/Eign Gate	613	5063	2332	1008	4999	7584	1981	6801	14015	16366	30381
High St/Widemarsh St/High Town	559	6025	2775	4078	4559	7852	2040	8284	39113	18176	57289
TOTAL OBSERVED + SYNTHESISED	2992	17503	9743	8478	16893	24715	6480	24137	76727	55332	132059
PROPORTION OBSERVED	2935	7235	3142	7932	7172	22350	5051	20219	28416	47620	76036
PROPORTION SYNTHESISED	57	10268	6601	546	9721	2365	1429	3918	48311	7712	56023

(surveys undertaken by Count-on-Us)

Bus and Rail Passenger Flows

2.8 Bus data from previous studies were limited and new information was obtained from the 2002 manual classified counts. The largest inbound flow of buses to the city in the AM peak of 25 vehicles/hr occurs on the A438 Ledbury Road. The major inbound flow in the PM peak of 11 inbound vehicles is again on the A438 White Cross Road. Of the outbound movements the largest flow occurs on the A465 Commercial Road with 20 outbound vehicles in the AM peak and 13 outbound vehicles in the PM peak. Bus counts undertaken at Greyfriars Bridge during the Roadside Interview Surveys, showed that during the AM Peak 34 buses travelled southbound and 33 northbound along Greyfriars Bridge. During the PM Peak there were 57 buses southbound and 27 buses northbound. Figures 2.5 and 2.6 show AM and PM Peak bus flows on the principal radial routes.

2.9 Peak and inter peak rail movements were derived from boarding and alighting counts undertaken in September 2002. The largest destination route for rail passengers is the Ledbury direction in both the AM and PM peak. During the inter peak however the largest destination route is Leominster. The largest origin route in the AM peak is from Leominster with 151 passenger arrivals at Hereford rail station. During the PM peak the majority of passengers arrive from the Ledbury direction. Of particular interest is the fact that 274 passengers arrive at Hereford Station during the AM peak but only 109 passengers were recorded as departing in the PM peak. This suggests that passengers who arrive in the morning peak hour depart Hereford at various times during the day other than the PM peak. The summary data obtained from the boarding and alighting surveys are shown in Table 2.2.

Table 2.2 Peak and Inter Peak Hourly Movements Derived From Boarding and Alighting Surveys At Hereford Rail Station September 2002

Direction of Trips at Hereford Station				
Time Periods	***Railway Line at Hereford***	***Departures***	***Arrivals***	***Two-Way Trips***
AM Peak Hour	Leominster	20	151	171
	Ledbury	49	87	136
	Abergavenny	18	36	54
	All Lines	87	274	361
PM Peak Hour	Leominster	42	23	65
	Ledbury	46	45	91
	Abergavenny	21	16	37
	All Lines	109	84	193
Inter Peak Hour	Leominster	54	22	76
	Ledbury	16	17	33
	Abergavenny	17	15	32
	All Lines	87	54	141

Source: TPi

Roadside Interview Surveys

2.10 Roadside Interview (RSI) Surveys were undertaken in 2002 by TPi on a sample of roads to establish the trip origins and destinations (O/D) of vehicles travelling into and through the core study area, on a typical weekday. The surveys were undertaken in order to update previous surveys and to enhance the SATURN highway trip matrices developed from the 2000 household survey and the 2001 UDP model.

2.11 Details of the survey sites are shown in Table 2.3.

Table 2.3 Roadside Interview Survey Site Details

Site No	Survey Location	Interview Direction	Date	Time Periods	Survey Type	Surveyor
1	A49 North (OS Grid Ref: 3502 2450	(S/B)	24th April 2002	0730-0930 1000-1200 1630-1830	Interview	TPi
2	A49 South (OS Grid Ref: 3500 2358)	(N/B)	23rd April 2002	0730-0930 1000-1200 1630-1830	Interview	TPi
3	A465 West (OS Grid Ref: 3482 2378)	(E/B)	25th April 2002	0730-0930 1000-1200 1630-1830	Interview	TPi
4	A465 Commercial Road (OS Grid Ref: 3520 2406)	(W/B)	1st May 2002	0730-0930 1000-1200 1630-1830	Postcard	TPi
5	A49 Greyfriars Bridge (OS Grid Ref: 3507 2397)	(S/B)	30th April 2002	0730-0930 1000-1200 1630-1830	Postcard	TPi
6	A49 Greyfriars Bridge (OS Grid Ref: 3507 2397)	(N/B)	1st May 2002	0730-0930 1000-1200 1630-1830	Postcard	TPi

Source: TPi

2.12 A 12-hour classified count was undertaken, for each direction of traffic flow, at all of the RSI sites (7am-7pm). The traffic count records are referred to in Chapter 5 and were used as follows:

- to measure the total flow volume to which the RSI sample of trip O/D data should be 'expanded' in the direction of survey;
- to measure the flow, in the opposite direction to the survey, to which reverse O/D data should be transposed and expanded; and
- to check the normality of traffic conditions on the day of RSI survey by comparing manual counts with other data obtained from the same location.

2.13 Surveys were carried out during the morning peak period (0730-0930 hrs), interpeak (1000-1200 hrs) and the evening peak (1630-1830 hrs). The dates during which the RSI's were carried out did not coincide with public and school holidays. The surveys were undertaken without any major problems, and no serious accidents or major incidents occurred which disrupted traffic. Interviews were carried out in compliance with DfT guidelines to define the site layout, signing, coning and lighting required for different road conditions. Two police officers were present on site to direct traffic during all periods of interviewing.

2.14 Satisfactory sample rates were achieved at all the RSI sites, the lowest sample rate was 8% or greater (on Greyfriars Bridge), whilst at best, the sample rates ranged between 25% and 100%. The rates achieved are acceptable within the guidelines of the DMRB Traffic Appraisal Manual. Taking each survey day as a whole, the minimum sample rate amounted to 9%.

2.15 Sample rates achieved during the critical peak periods at the RSI sites are shown in Table 2.4. The lower sample rate achieved on the A49 (T) at Greyfriars Bridge was partly a consequence of the use of postcards and partly a reflection of the high traffic flows through the site, however the achieved rate was sufficient to provide a statistically reliable sample to expand to the full traffic count.

Table 2.4 Peak Period Interview Sample Rates at RSI Sites

Site No	Location	Sample Rate (%)	
		AM Peak 8am-9am	PM Peak 5pm-6pm
1	A49 North (S/B)	35%	32%
2	A49 South (N/B)	26%	34%
3	A465 West (E/B)	47%	51%
4	A465 Commercial Road (W/B)	21%	16%
5	A49 Greyfriars Bridge (S/B)	11%	13%
6	A49 Greyfriars Bridge (N/B)	8%	9%

Source: TPi

2.16 A limited analysis was made of the principal trip patterns which emerged from the RSI origin/destination surveys. The principal aims were to identify the relative proportion of trips that had origins or destinations within Hereford, the proportion that passed through the city, the proportion that accessed the central area within the inner ring road and the largest zone to zone movements that passed through each RSI site.

2.17 Table 2.5 shows trip movements for private and heavy vehicles recorded at the Roadside Interview sites. The largest through movements occur at site 1 the A49 (T) north, accounting to 32% of private vehicles and 62% of HGV's. For all sites the proportion of through movements is greater for HGV's than private vehicles.

2.18 Table 2.6 shows the proportion of trips with city centre origin or destination. Site 4 at the A465 (east), westbound, had the highest proportion of city centre trips in both the AM and PM peak at 31% and 17% respectively. The highest proportion of city centre trips at off peak times occurred at site 6 the A49 (T) Greyfriars Bridge northbound at just over 25% of total trips.

2.19 Table 2.7 shows trip destination journey purpose at all six sites. The largest trip destination journey purpose during the AM peak was work with site 5 A49 (T) Greyfriars Bridge southbound having the highest proportion at just over 60%. The largest trip destination journey purpose in the PM peak was people travelling to go home with again site 5 having

the highest proportion of trips to home at just over 65%. In the off peak period people mainly travelled for "other", employers business or personal business purposes. The A465 (east) westbound had the highest proportion of other trips at 73%. Key findings are summarised for all six sites in Table 2.7.

Table 2.5 Proportions of Private and Heavy Vehicle movements recorded at the Roadside Interview Sites.

Site Location	Vehicle Type	Percentage of Recorded Trips				
		Through	from External	from Hereford	Within	Largest Zone to
		Hereford	to Hereford	to External	Hereford	Zone Movement
1. A49N – S/B	Private	32%	68%	0%	0%	23% A49N-A49S
	Heavy	62%	38%	0%	0%	47% A49N-A49S
1. A49N – N/B	Private	32%	0%	68%	0%	23% A49S-A49N
	Heavy	62%	0%	38%	0%	45% A49S-A49N
2. A49S – N/B	Private	24%	76%	0%	0%	16% A49S-A49N
	Heavy	37%	63%	0%	0%	23% A49S-A49N
2. A49S – S/B	Private	24%	0%	76%	0%	16% A49N-A49S
	Heavy	37%	0%	63%	0%	24% A49N-A49S
3. A465W – E/B	Private	28%	72%	0%	0%	17% A465W – A49N
	Heavy	56%	44%	0%	0%	42% A465W – A49N
3. A465W – W/B	Private	28%	0%	72%	0%	15% A49N – A465W
	Heavy	56%	0%	44%	0%	47% A49N – A465W
4. A465E – 2-way	Private	8%	22%	25%	45%	2% A465E – A49N
	Heavy	14%	35%	31%	20%	5% A465E – A49N
5. A49 Greyfriars Br. - S/B	Private	12%	22%	22%	44%	3% A49N-A49S
	Heavy	35%	22%	22%	21%	8% Holmer-A49S
6. A49 Greyfriars Br. - N/B	Private	11%	30%	13%	46%	4% A49S-A49N
	Heavy	31%	30%	22%	17%	10% A49S-A49N

Table 2.6 Proportion of Trips with City Centre Origin or Destination

Site No.	O/D Survey Location	O/D Survey Direction	AM Peak (07.30-09.30)			Inter Peak (10.00-12.00)			PM Peak (16.30-18.30)			6-Hour Total Trips
			Central Area Trips	Non Central Area Trips	Total Trips	Central Area Trips	Non Central Area Trips	Total Trips	Central Area Trips	Non Central Area Trips	Total Trips	
1	A49 North	Southbound	189	905	1094	169	642	811	72	785	857	2762
		%	17.3	82.7	100.0	20.8	79.2	100.0	8.4	91.6	100.0	
2	A49 South	Northbound	229	681	910	101	543	644	51	672	723	2277
		%	25.2	74.8	100.0	15.7	84.3	100.0	7.1	92.9	100.0	
3	A465 West	Eastbound	105	455	560	78	385	463	53	646	699	1722
		%	18.8	81.3	100.0	16.8	83.2	100.0	7.6	92.4	100.0	
4	A465 East	Westbound	394	884	1278	233	1062	1295	180	873	1053	3626
		%	30.8	69.2	100.0	18.0	82.0	100.0	17.1	82.9	100.0	
5	A49 Greyfriars Bridge	Southbound	169	1863	2032	325	1671	1996	375	2645	3020	7048
		%	8.3	91.7	100.0	16.3	83.7	100.0	12.4	87.6	100.0	
6	A49 Greyfriars Bridge	Northbound	928	2891	3819	696	1966	2662	214	2721	2935	9416
		%	24.3	75.7	100.0	26.1	73.9	100.0	7.3	92.7	100.0	

Source: TPi

Table 2.7 Trip Destination Journey Purpose

Site No.	O/D Survey Location	O/D Survey Direction	AM Peak (07.30-09.30) Journey Purpose					Inter Peak (10.00-12.00) Journey Purpose					PM Peak (16.30-18.30) Journey Purpose					6-Hour Total Trips
			Home	Work	Employer's Business	Other	Total Trips	Home	Work	Employer's Business	Other	Total Trips	Home	Work	Employer's Business	Other	Total Trips	
1	A49 North	Southbound	5	547	310	231	1093	66	102	307	334	809	474	49	139	195	857	2759
		%	0.5	50.0	28.4	21.1	100.0	8.2	12.6	37.9	41.3	100.0	55.3	5.7	16.2	22.8	100.0	
2	A49 South	Northbound	30	396	245	238	909	36	55	316	239	646	386	71	105	160	722	2277
		%	3.3	43.6	27.0	26.2	100.0	5.6	8.5	48.9	37.0	100.0	53.5	9.8	14.5	22.2	100.0	
3	A465 West	Eastbound	14	230	139	178	561	14	48	130	271	463	352	48	76	224	700	1724
		%	2.5	41.0	24.8	31.7	100.0	3.0	10.4	28.1	58.5	100.0	50.3	6.9	10.9	32.0	100.0	
4	A465 East	Westbound	18	752	93	414	1277	56	228	67	943	1294	303	149	28	572	1052	3623
		%	1.4	58.9	7.3	32.4	100.0	4.3	17.6	5.2	72.9	100.0	28.8	14.2	2.7	54.4	100.0	
5	A49 Greyfriars Bridge	Southbound	152	1258	200	420	2030	512	222	412	849	1995	2013	335	119	553	3020	7045
		%	7.5	62.0	9.9	20.7	100.0	25.7	11.1	20.7	42.6	100.0	66.7	11.1	3.9	18.3	100.0	
6	A49 Greyfriars Bridge	Northbound	219	2291	314	994	3818	221	447	407	1584	2659	1309	421	254	952	2936	9413
		%	5.7	60.0	8.2	26.0	100.0	8.3	16.8	15.3	59.6	100.0	44.6	14.3	8.7	32.4	100.0	

Source:TPi

Traffic Counts

2.20 Short period automatic traffic counts (ATC's) were undertaken to update existing counts used in the 2001 SATURN model for the Hereford UDP Study. The locations of the ATC's can be found in Figures 2.7 and 2.8. The ATC's were undertaken during a 3 week period in April 2002.

2.21 The first week in which the ATC's were undertaken was a school holiday. Traffic flows during the three weeks have been compared to find the percentage range of differences in traffic flows between normal conditions and school holidays. Ignoring the A465 Abergavenny Road which experienced technical faults during the ATC's, the broadest range of differences in traffic flows within the three weeks occurred on the A438 Lugwardine Bridge and the A438 Ledbury Road. Table 2.8 shows comparisons of the AM Peak and a 12 hour average weekday between the three weeks. It can be seen that the range of a 12 hour average weekday traffic flow between normal conditions and school holidays is between -5% to 15%, but with many roads showing very small differences. On the other hand the morning peak hour flows tend to show a much larger variation. This is expected since school holidays have fewer school and work journeys, but other compensating trips are made during the day for leisure and personal business purposes.

2.22 Manual classified counts (MCC's) were undertaken at all ATC sites and at sixteen sites at key locations around the case study area.

Table 2.9 shows traffic flows on the main radial routes within the study area together with percentage of HGVs on the route. The heaviest two way radial 12 hour flow occurs on A465(T) Belmont Road, although A49 (T) Edgar Street has the highest one way flow northbound and consequently would be expected to have the highest two-way flow of some 19000 vehicles of over a twelve hour day. As expected the A49 (T) Greyfriars Bridge and its approaches carries the heaviest traffic flows in Hereford as shown in Table 2.8, but the A49 (T) at Edgar Street has the highest proportion of HGVs with 18% during the AM peak and 29% off peak.

Table 2.8 Comparisons of AM Peak and 12 Hour Average Weekday Two Way Traffic Flows: Percentage Variation between School Term Flows and Holiday Flows

Location	*Week Beginning*					
	School Holiday		*School Term Time*		*School Term Time*	
	8th April		*15th April*		*22nd April*	
	12 hour AWT	*AM Peak hour AWT*	*% Difference 12 hour*	*% Difference AM Peak hour*	*% Difference 12 hour*	*% Difference AM Peak hour*
A438 Lugwardine Bridge	7306	765	10	44	15	51
B4399 Holme Lacy Road	10072	1023	1	0	1	0
A465 Abergavenny Road	13749	1145	33	2	29	32
A438 Kings Acre Road	12354	1123	1	8	0	0
A4110 Three Elms Road	8215	723	8	27	-	-
A49 Holmer Road	17460	1555	0	3	-1	2
A4103 Lugg Bridge	12576	1287	3	9	4	11
A438 Whitecross Road	15494	1316	8	28	4	1
A49 Edgar Street (northbound Only)	18916	1561	0	3	-1	2
A465 Commercial Road	12455	1098	3	15	4	13
A438 Ledbury Road	10101	955	9	35	14	41
A49 Ross Road North of Holme Lacy Road	20012	1800	2	8	-3	4
A465 Belmont Road	22549	1789	-5	13	-4	-3
C1095 Grandstand Road	4547	462	6	33	6	43
B4224 Hampton Park Road Eastern Position	5091	490	3	17	10	36
B4224 Hampton Park Road Western Position	4265	424	5	16	13	36
A49 Ross Road	13634	991	13	34	10	24
C1261 Hoarwithy Road	2465	219	2	29	15	47
A465 Aylestone Hill	8859	827	5	21	7	26

Source: TPi

AWT – Average weekday traffic – axles/2

Table 2.9 Typical Traffic Flows

Location	Total Vehicles – Two Way			
	12 Hour	Am Peak (% HGV)	Inter Peak (% HGV)	Pm Peak (% HGV)
B4224 Hampton Park Rd	5531	664 (5%)	365 (4%)	692 (1%)
A49 Ross Rd	9582	1128 (13%)	716 (19%)	802 (11%)
Holme Lacy Rd (Rotherwas Access)	9827	963 (11%)	749 (15%)	950 (5%)
A4103 Lugg Bridge	12,902	1359 (6%)	1037 (18%)	1238 (3%)
A438 Whitecross Rd	14,682	1250 (6%)	1206 (15%)	1390 (3%)
A49 Edgar St (Northbound)	9519	733 (18%)	796 (29%)	843 (12%)
A465 Belmont Rd	18,185	920 (7%)	1501 (7%)	1976 (3%)
A465 Aylestone Hill	13,524	1301 (5%)	1155 (7%)	1176 (3%)
A438 Ledbury Rd	11,863	1418 (5%)	871 (13%)	1359 (3%)

Source: TPi

HGV – Vehicles over 7.5 tonnes gross vehicle weight

2.23 Heavy lorries are frequently cited as a major contributor to traffic problems in Hereford. However, only a limited amount of origin/destination data could be collected from goods vehicles entering the city. Therefore, additional surveys were undertaken on the A49(T) Greyfriars Bridge, in the northbound and southbound directions and on the A465 Commercial Road both directions, to collect O/D information on goods vehicle movement.

2.24 To obtain the information, the registration number of each vehicle was recorded together with vehicle type and any contact details for the freight operator/haulier. Then, data regarding trip origin/destination and type of freight consignment were collected by telephone call-back to the operator.

2.25 Table 2.10 shows total traffic within and through the city and Table 2.11 shows total traffic entering the city (across the outer cordon) at AM peak, PM peak and Inter peak calculated from the car and HGV trip matrices. It should also be noted that HGV external to external movements, as a proportion of the total HGV movements entering the city, lies between 19% and 28% over all time periods.

Table 2.10 Total Traffic Within and Through the City

	Cars & Light Goods	Heavy Goods	Through Cars %	Through HGVs %
AM Peak	23,069	1,207	4	5
Inter Peak	16,284	1,255	4	5
PM Peak	21,481	769	3	6

Source: TPi (flow in vehicles per hour)

Table 2.11 Total Traffic Entering the City (Across Outer Cordon)

	Cars & Light Goods	Heavy Goods	Through Cars %	Through HGVs %
AM Peak	5,514	286	15	22
Inter Peak	3,056	329	22	19
PM Peak	3,888	173	17	28

Source: TPi (flow in vehicles per hour)

2.26 From Tables 2.10 and 2.11 it can be seen that the absolute numbers of Heavy Goods Vehicles which do not have an origin or destination in Hereford (through movements) are small, varying between just over 60 vehicles and hour in the morning to less than 50 an hour in the evening. The overwhelming majority of vehicular traffic in the city is generated by the area and the amount of purely bypassable traffic is small.

Results of Freight Surveys

2.27 During the A49(T) Southbound survey a total of nearly 700 goods vehicles were counted in the 6 hour survey period. Of these, vehicle details were recorded for a 35% sample. Final call-back responses were obtained for 9% of the counted vehicles. In the A49 (T) northbound survey vehicle details were recorded for a 46% sample, whilst final call-back responses were obtained for 14% of the flow. In the A465 survey a total of 325 goods vehicle were counted in the 6 hour period. Vehicle details were recorded for a 35% sample, whilst final-call back responses were obtained for an 8% sample of the counted traffic.

2.28 In both directions on the A49 (T) Greyfriars Bridge, the largest group of freight movements were through trips with an origin and destination external to the study area. These external/external movements represented 34% of Southbound trips and 41% of northbound HGV trips. In contrast, on the A465 Commercial Road external/external freight movements only accounted for 12% of total movements.

2.29 At the survey sites only a relatively small proportion of trips on the A49 (T) in both directions and on the A465, were wholly internal to the urban area. These internal/internal movements equated to 16% of A49 (T) northbound, 24% of A49 (T) southbound and 15% of A465 freight movements.

Journey Times

2.30 A representative picture was needed of the time taken to travel on different highway links within the study area, during morning, evening and off-peak periods, in order to provide input data for the various transport models. To obtain this information, journey time surveys were undertaken in both directions along five separate routes in both directions, measuring the following elements of a typical journey:

- free-flow link travel time (when moving at average vehicle speed);
- time spent queuing on approaches to junctions (travelling at less than walking speed);
- time taken to negotiate each junction; and
- overall route journey time.

2.31 Once the reliability of the timed runs had been checked, (and abnormal timings removed) the average journey times were calculated for each route direction and time period. The

average times were used to validate the traffic model and to assess the relative attractiveness of different journey routes either passing through or avoiding the main routes in Hereford. They were also to be used to assess the impact of any future schemes that might change the relative travel times on the available routes.

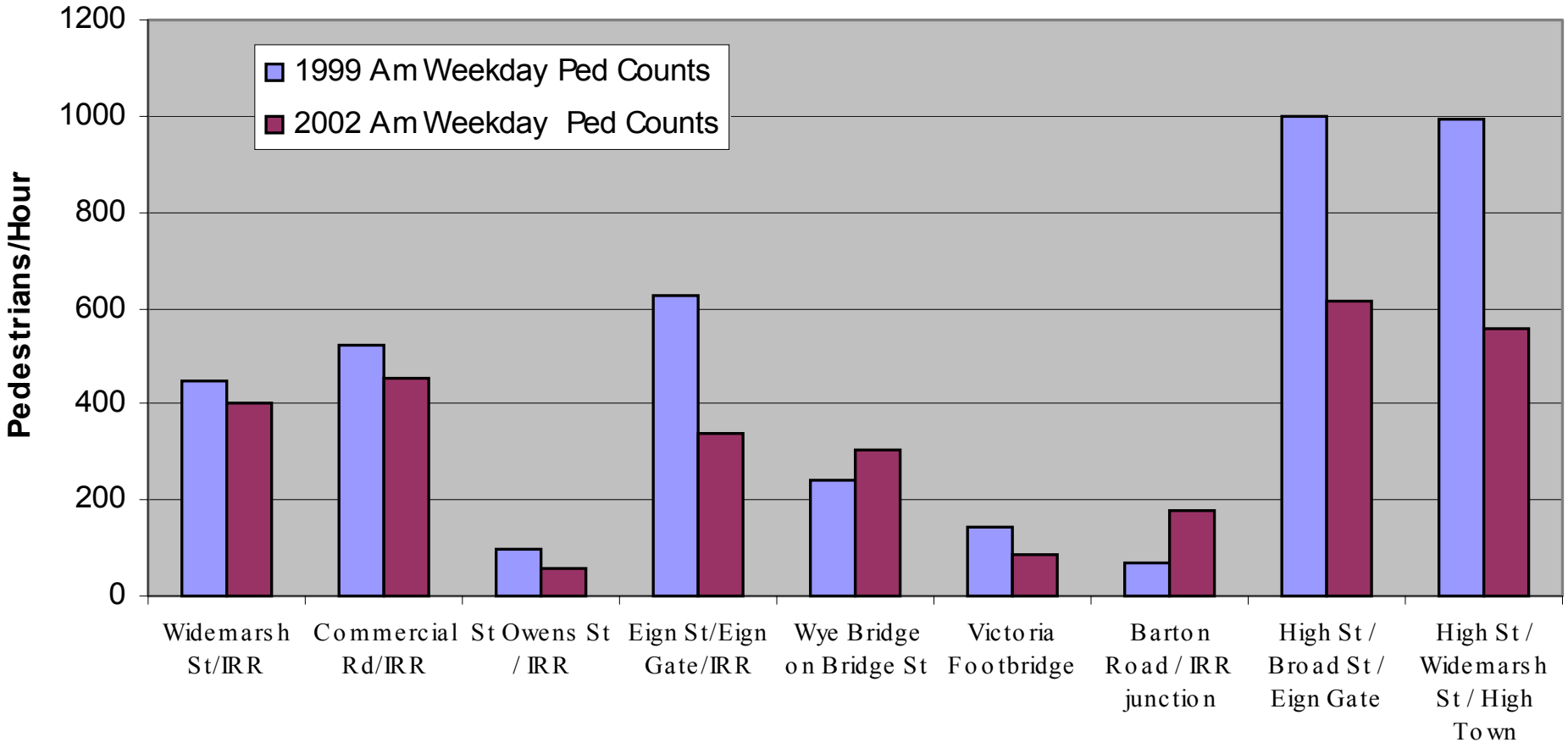
2.32 The configuration of the journey time routes is shown in Figure 2.9. In total there were five routes undertaken in both directions.

2.33 Journey time surveys were undertaken over a 4-week period in April/May 2002 using the floating car method where the survey vehicle maintains its position relative to other vehicles in the traffic stream. The routes were timed at least 6 times in each direction in accordance with the advice of the Traffic Appraisal Manual (TAM), on at least two different days of each of two different weeks, covering the AM, PM and interpeak time periods.

2.34 Junction delays were notably worse on some routes than others. For example route 5 (A438 Kings Acre Rd to A438 Ledbury Rd via Victoria St/Newmarket St) experienced a total average junction delay of nearly 12 minutes in the AM peak, or 54% of the total travel time. Route 6 (A438 Ledbury Rd to A438 Kings Acre Rd via Victoria St/Newmarket St) where junction delay accounted for 44% (nearly 10 mins) of the total journey time in the PM peak. The worst individual junctions for delay are on Eign Street at Sainsbury's signals and Victoria Street and on the Bath Street (East) approach to the Bath Street/Commercial Road junction, where a 10 minute average delay was recorded. During the evening peak other significant junction delays occurred on the southbound approach to the Barton Road junction, near Greyfriars Bridge (average 9 mins) and over 17 minutes on the A49(T) approach to Holme Lacy Road in the evening.

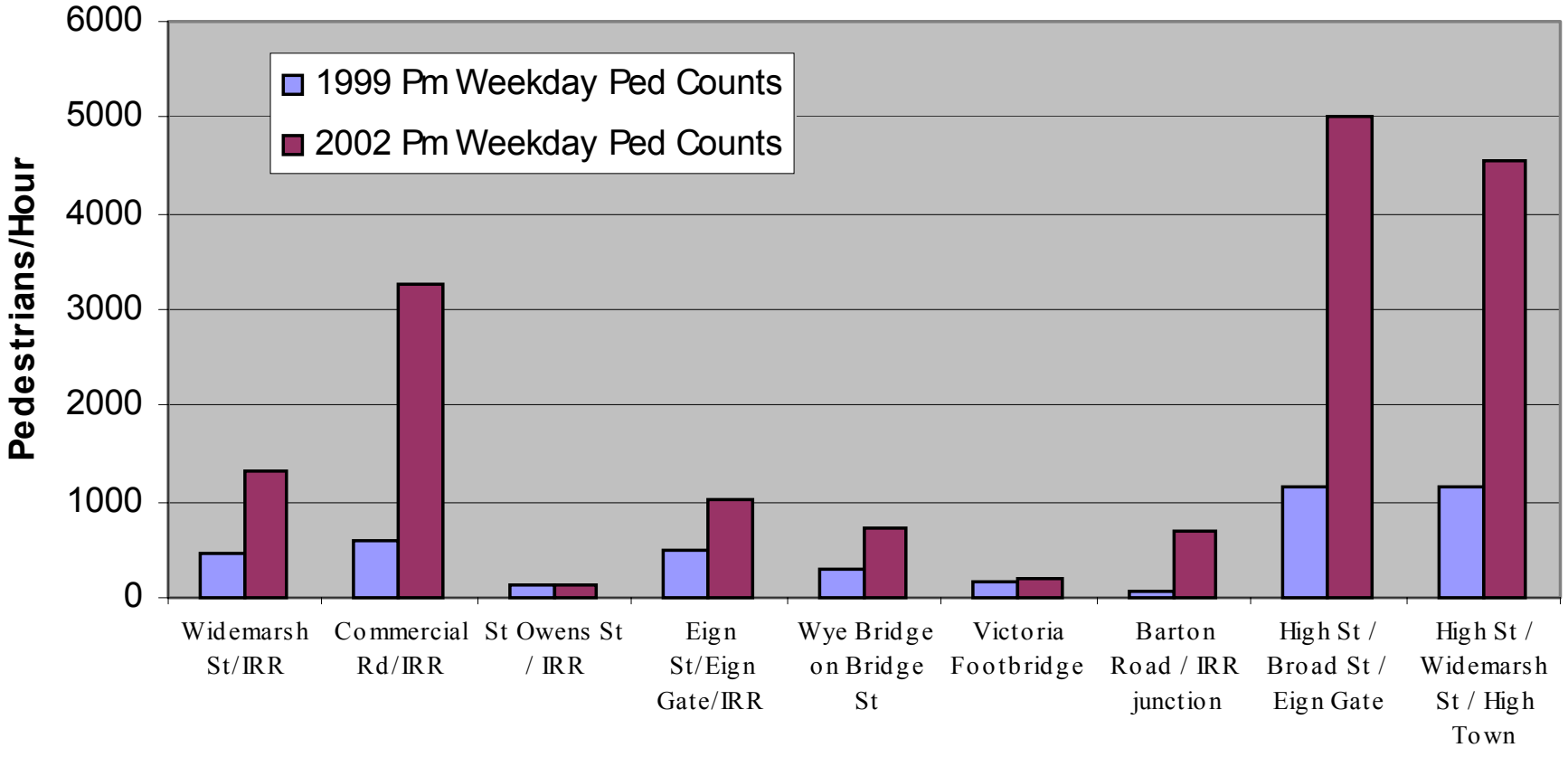
2.35 Figures 2.10 and 2.11 show the proportion of total queuing time against total travel time in the AM and PM peaks respectively, for all 5 routes in both directions. Also shown is the average speed in miles per hour. This shows again that the slowest routes were routes 5 and 6 with route 5 having the lowest average speed of just 14mph in the PM peak and route 6 in the AM peak also having the same lowest average speed of 14mph. Also notable were routes 9 and 10 which also experienced low speeds in both peaks, with route 10 having the lowest average speed of just 15mph in the PM peak. All surveyed routes crossed the whole of the city between opposite edges of the built up area and it was found that, whilst speeds on the outer links were relatively high, the central area speeds were much lower in all time periods, owing to network congestion.

Comparison of AM Weekday Pedestrian Flows November 1999/2002



AM Peak 0800-0900

Comparison of PM Weekday Pedestrian Flows November 1999/2002



PM Peak 1700-1800

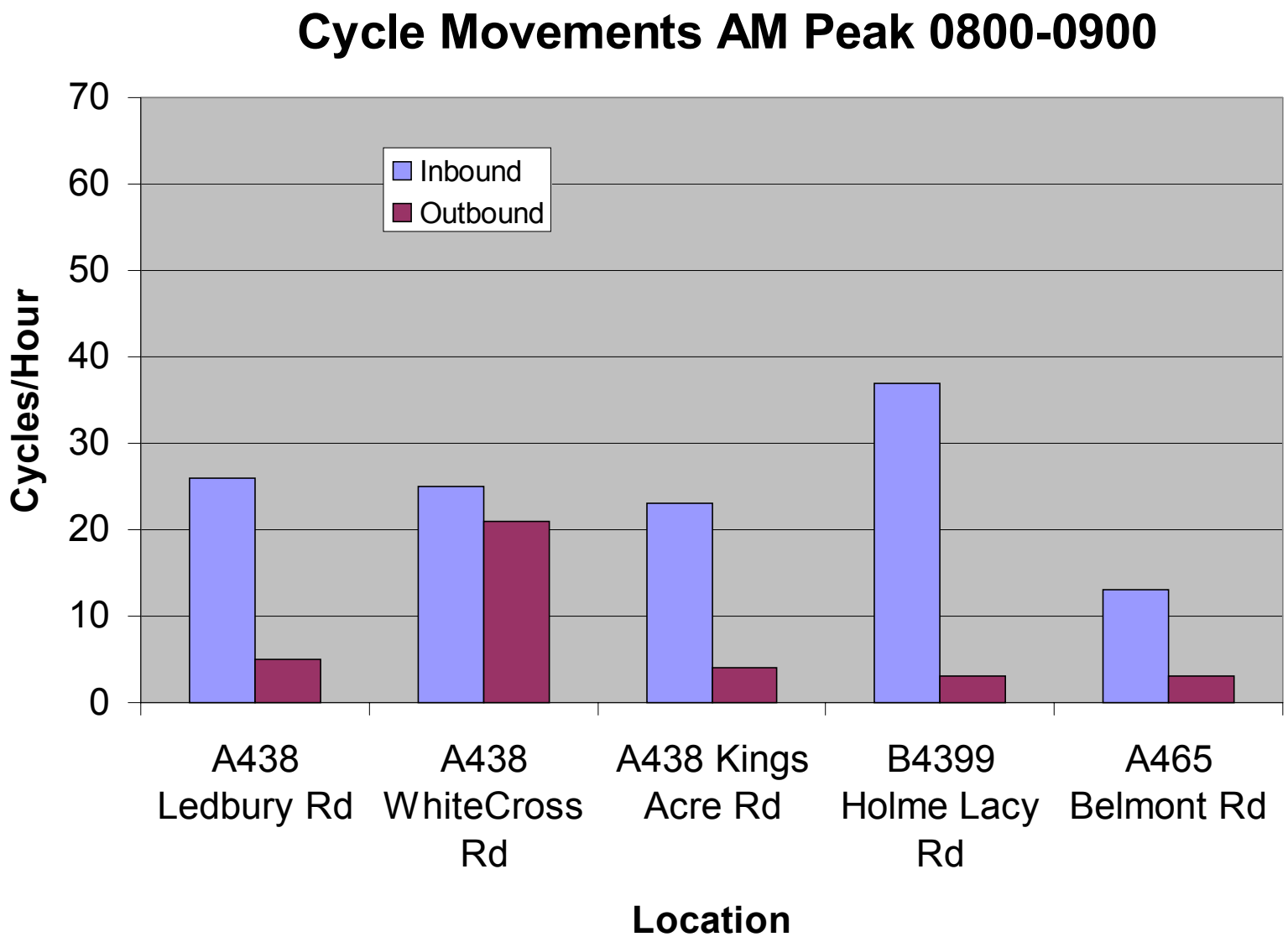
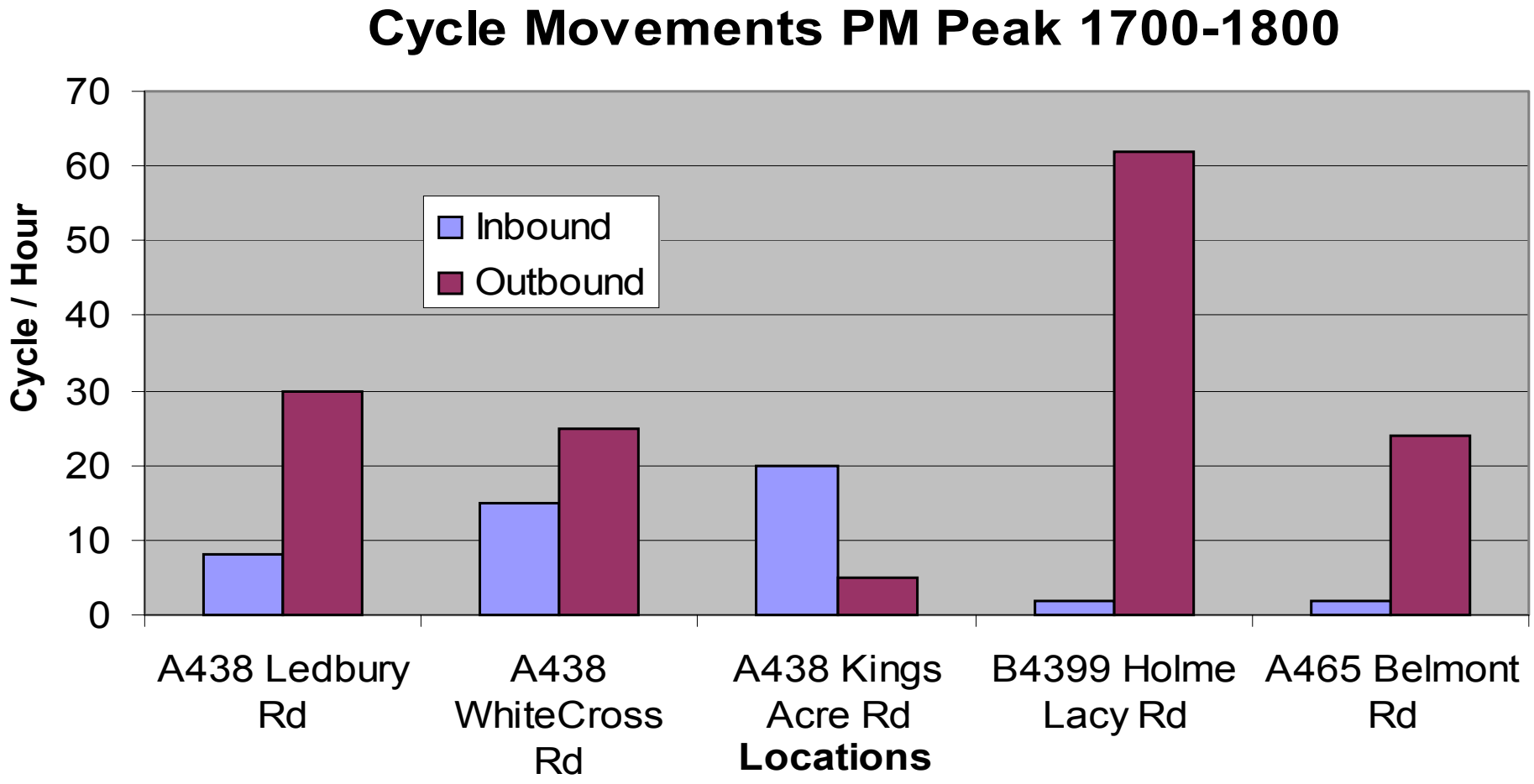
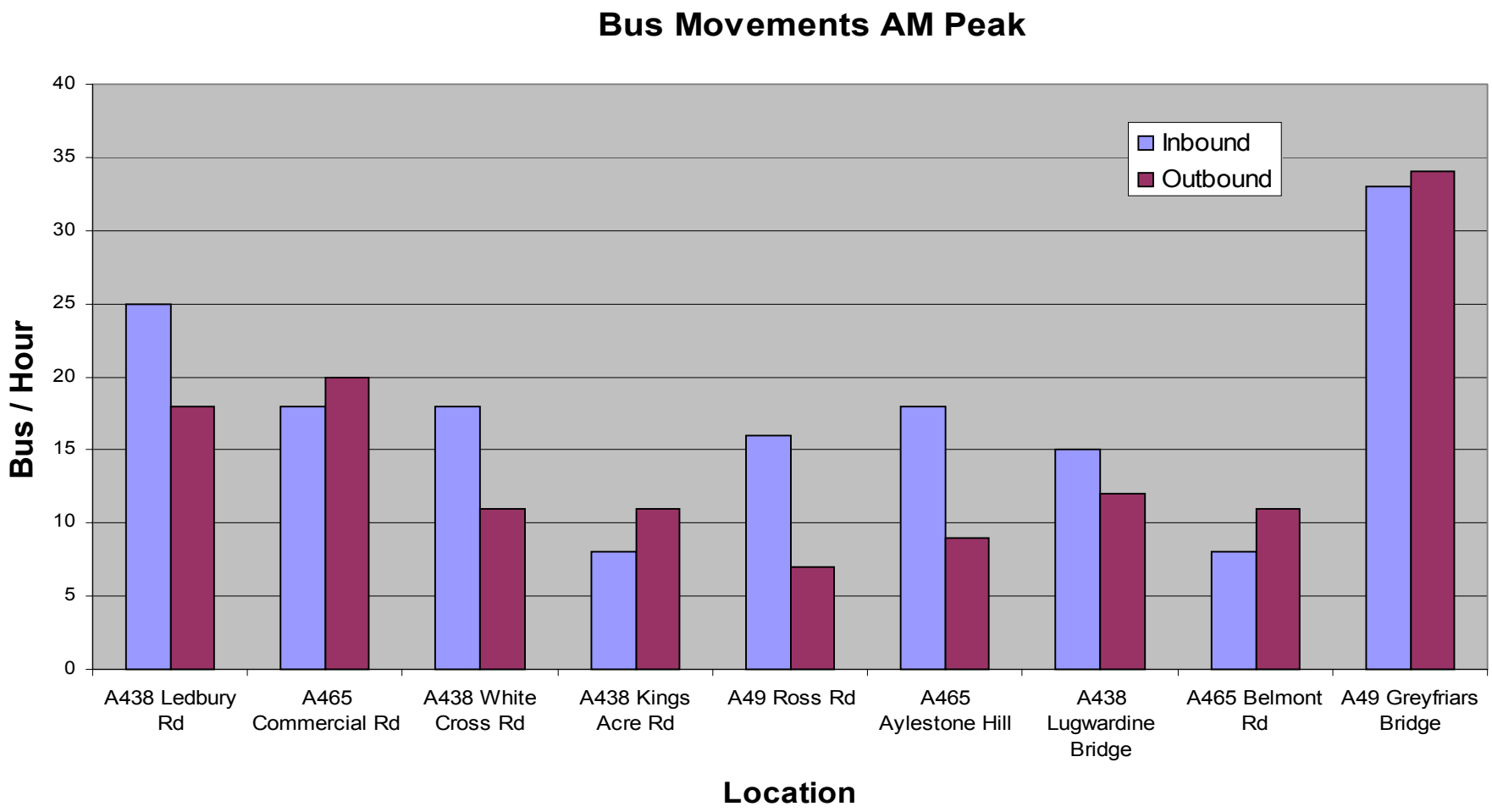
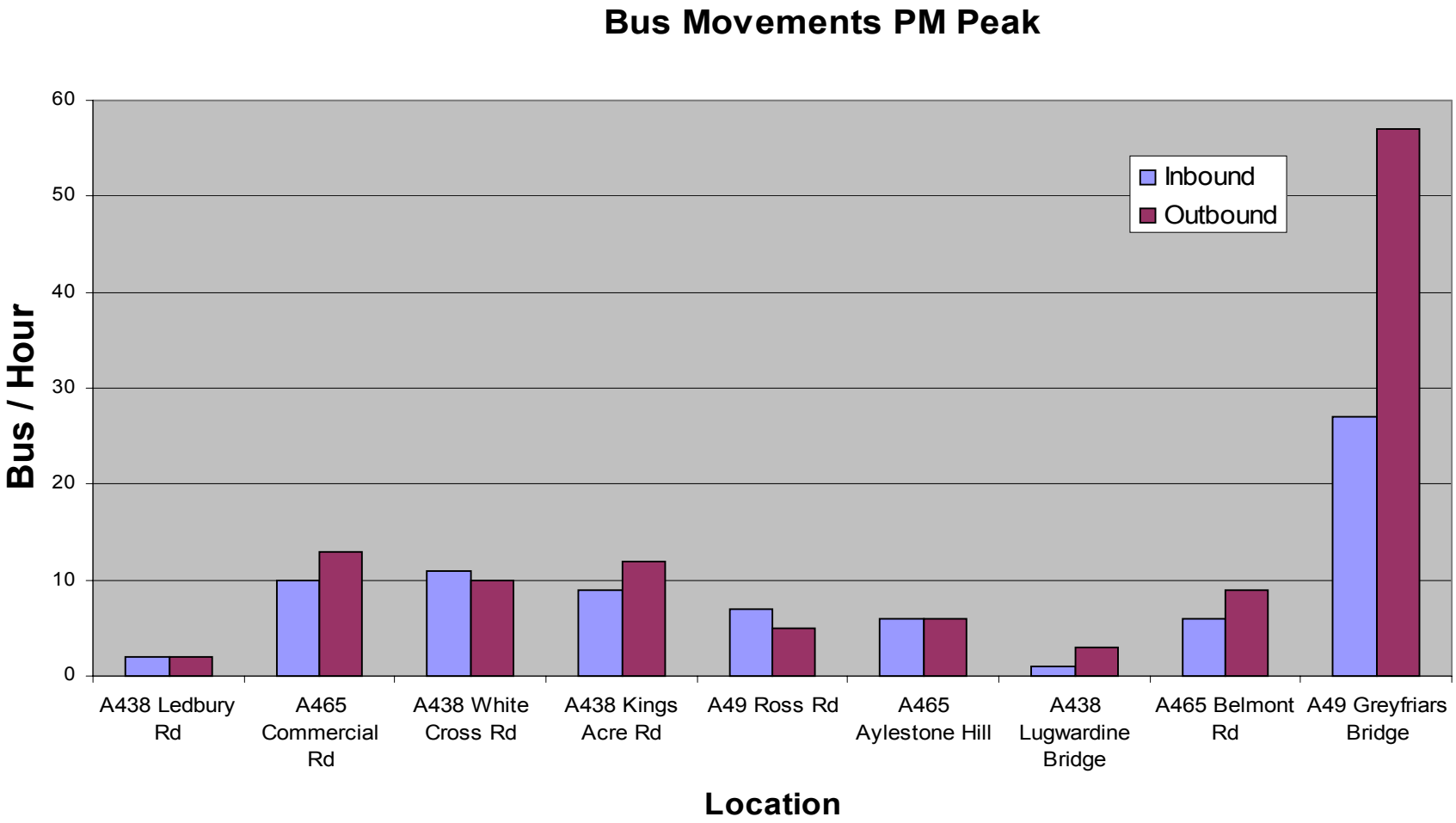
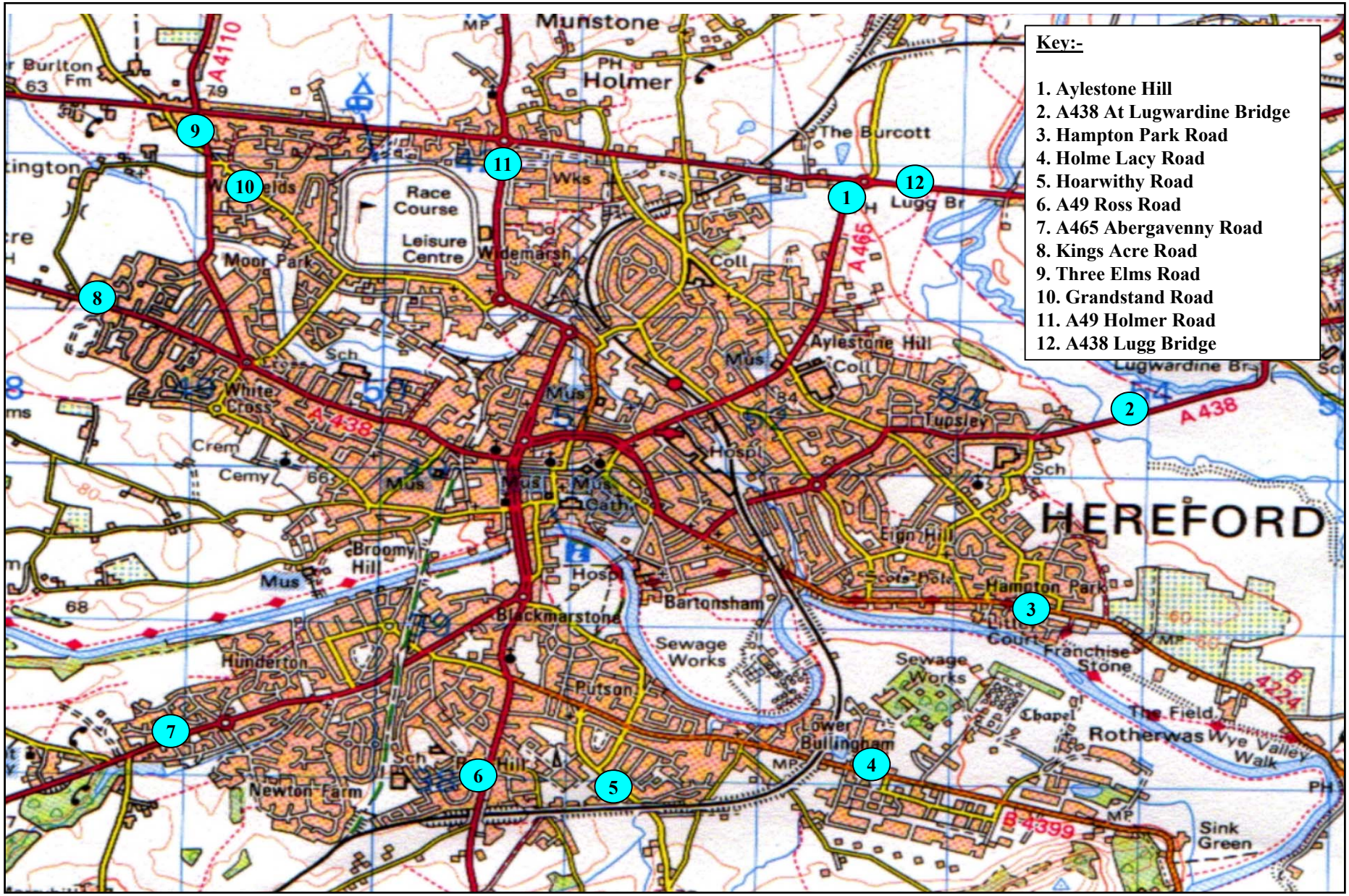

Cycle Movements AM Peak 0800-0900
70
60
50
40
30
20
10
0
Cycles/Hour
Inbound
Outbound
A438 Ledbury Rd
A438 WhiteCross Rd
A438 Kings Acre Rd
B4399 Holme Lacy Rd
A465 Belmont Rd
Location

Figure 2.3


Cycle Movements PM Peak 1700-1800
Cycle / Hour
70
60
50
40
30
20
10
0
Inbound
Outbound
A438 Ledbury Rd
A438 WhiteCross Rd
A438 Kings Acre Rd
B4399 Holme Lacy Rd
A465 Belmont Rd
Locations


Bus Movements AM Peak
Bus / Hour
40
35
30
25
20
15
10
5
0
Inbound
Outbound
A438 Ledbury Rd
A465 Commercial Rd
A438 White Cross Rd
A438 Kings Acre Rd
A49 Ross Rd
A465 Aylestone Hill
A438 Lugwardine Bridge
A465 Belmont Rd
A49 Greyfriars Bridge
Location

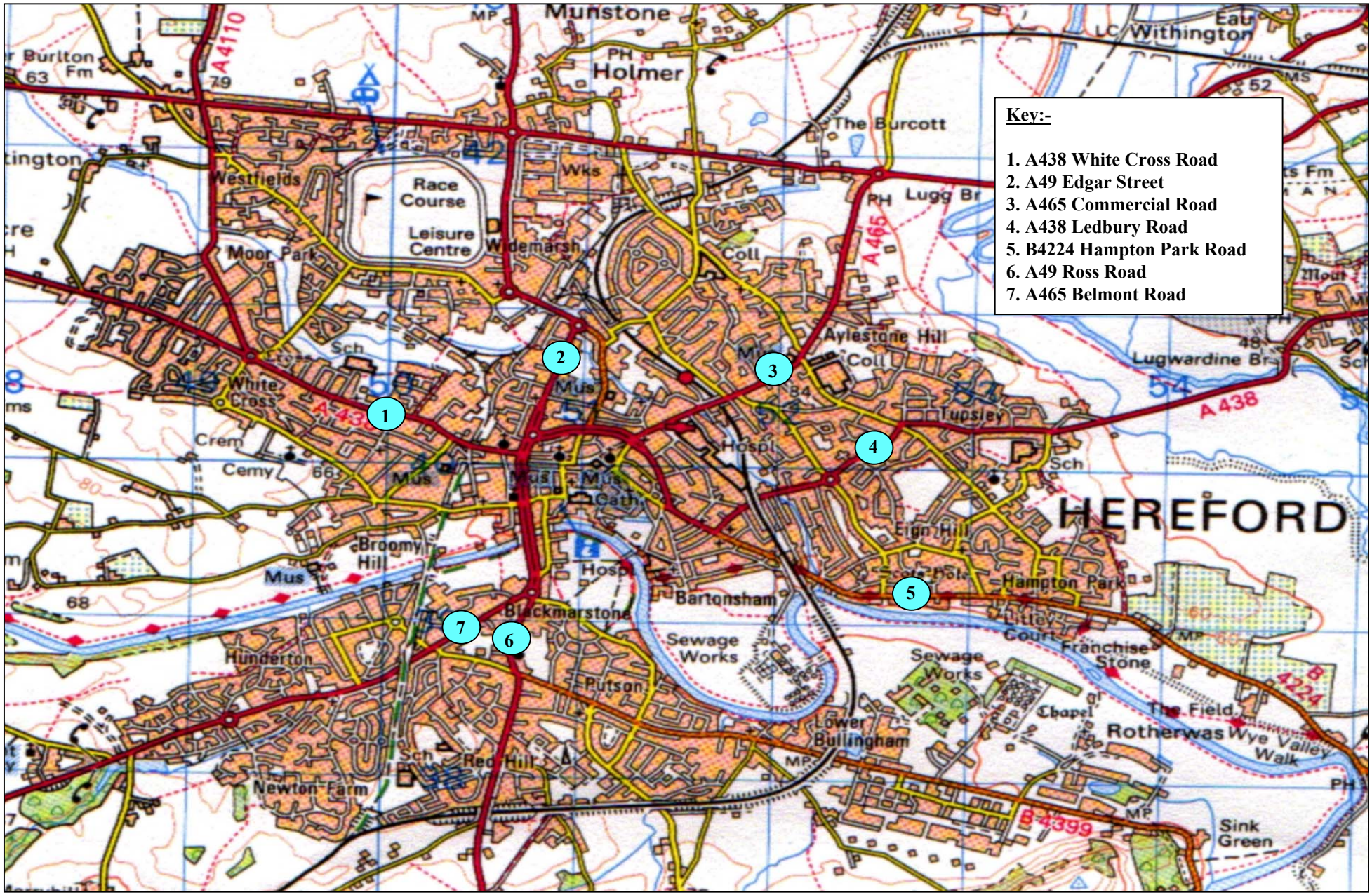

Bus Movements PM Peak
Bus / Hour
60
50
40
30
20
10
0
Inbound
Outbound
A438 Ledbury Rd
A465 Commercial Rd
A438 White Cross Rd
A438 Kings Acre Rd
A49 Ross Rd
A465 Aylestone Hill
A438 Lugwardine Bridge
A465 Belmont Rd
A49 Greyfriars Bridge
Location



Outer Cordon ATC and MCC Count Location Plan

Figure 2.7

I:\Projects\21344 - Hereford MMS\Drawings\Report Figures\Report Figures.ppt

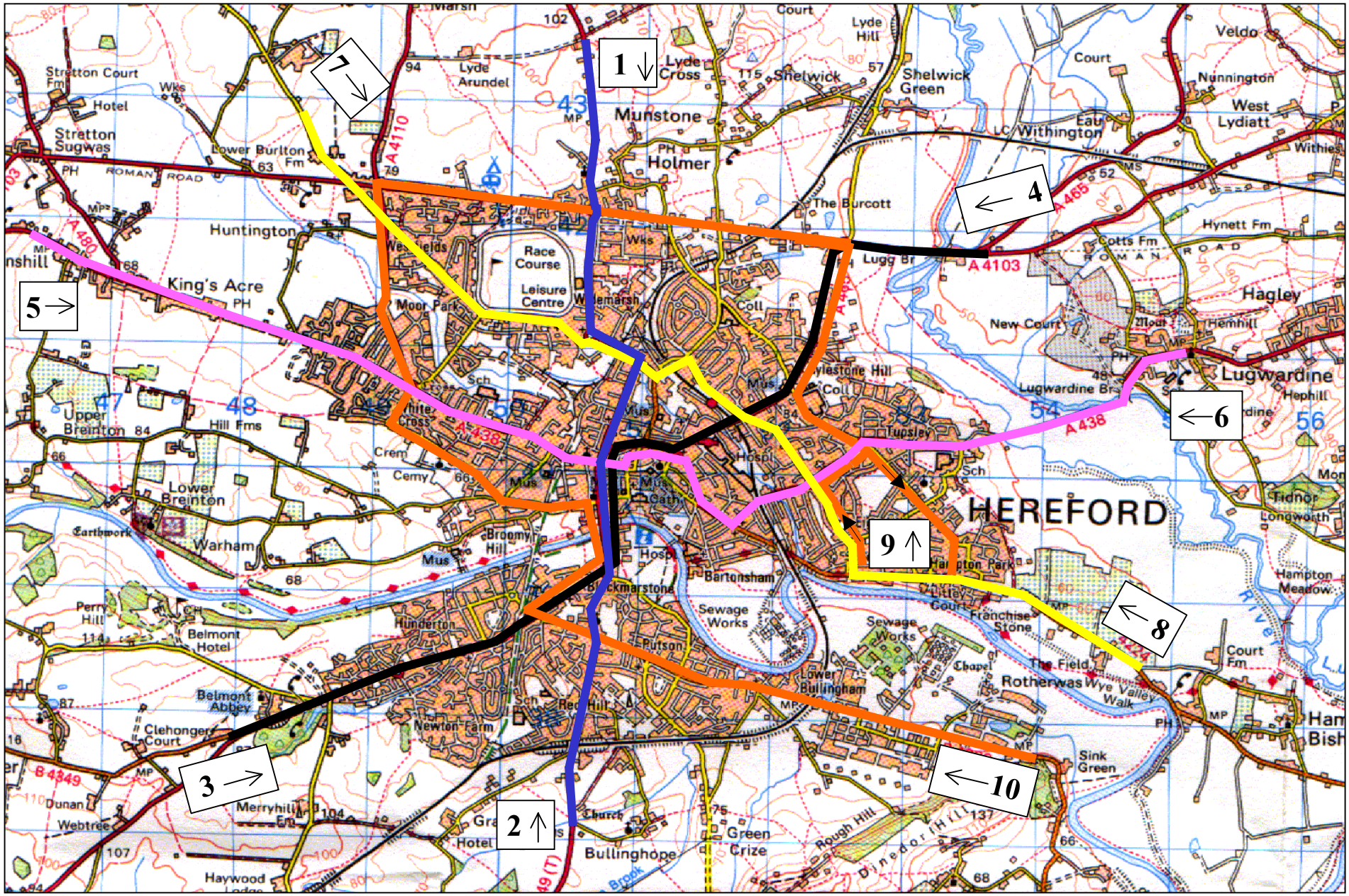


February 2003

Inner Cordon ATC and MCC Count Location Plan

Figure 2.8

I:\Projects\21344 - Hereford MMS\Drawings\Report Figures\Report Figures.ppt

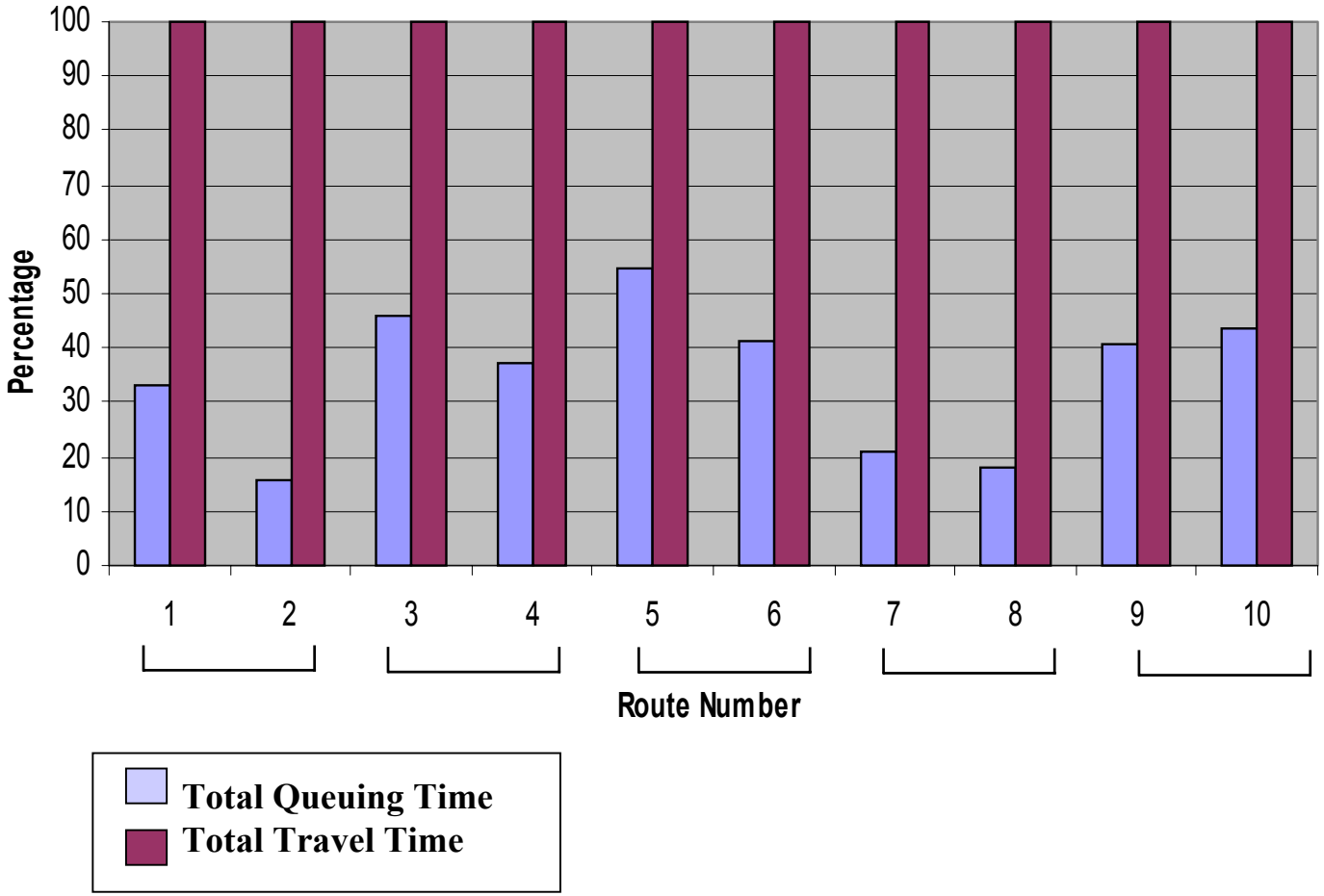


TPi Journey Time Routes

Figure 2.9

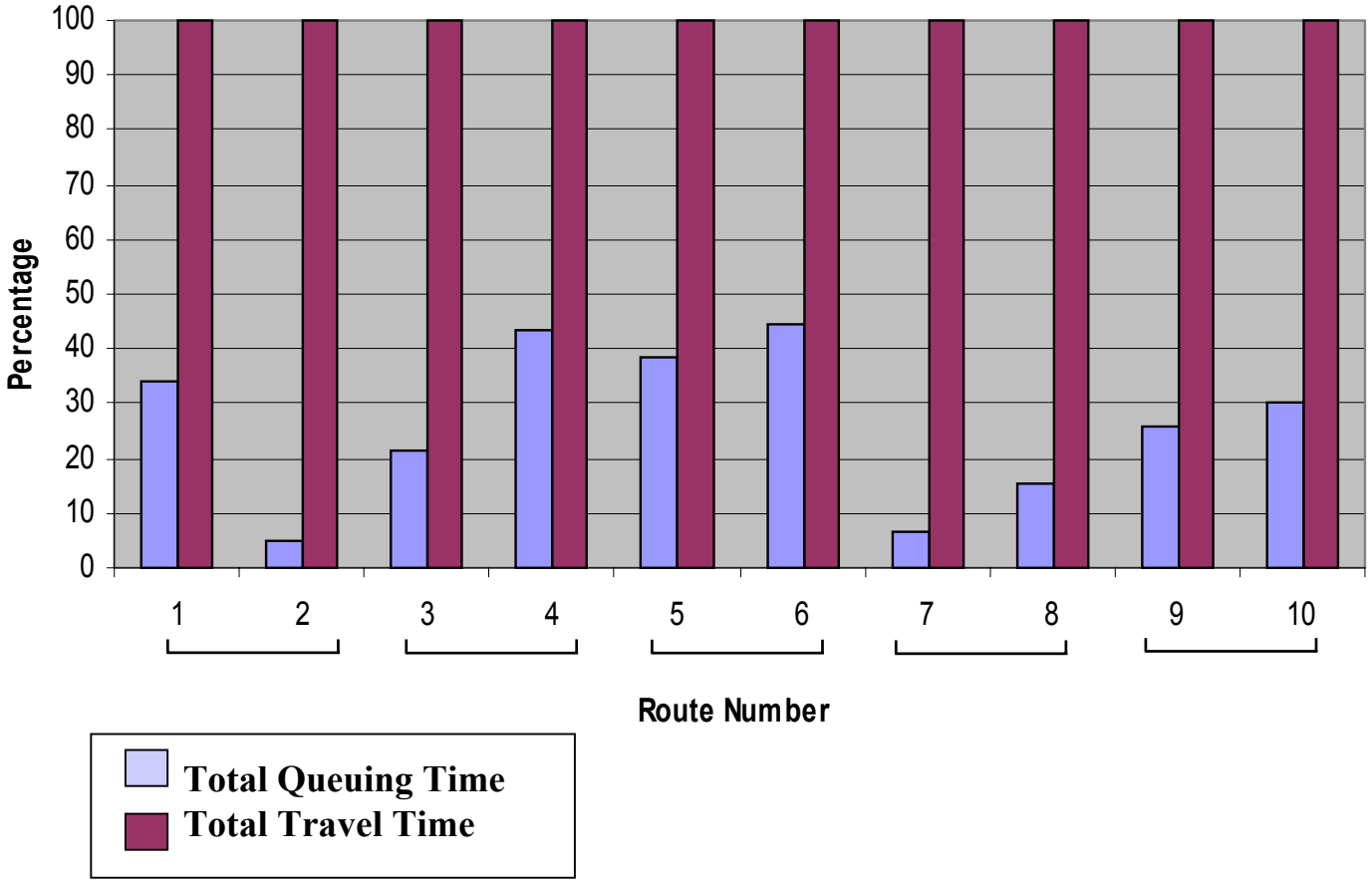
I:\Projects\21344 - Hereford MMS\Drawings\Report Figures\Report Figures.ppt

Proportion of Queuing Time Against Total Journey Time in the AM Peak



	Average Speed – mph	Average Journey Time – Mins:Secs
Route 1	22 mph	13:40
Route 2	25 mph	11:52
Route 3	20 mph	16:06
Route 4	19 mph	15:50
Route 5	14 mph	22:35
Route 6	15 mph	20:30
Route 7	22 mph	16:05
Route 8	22 mph	16:08
Route 9	16 mph	37:04
Route 10	15 mph	39:09

Proportion of Total Queuing Time Against Total Travel Time in the PM Peak



	Average Speed – mph	Average Journey Time – Mins:Secs
Route 1 = 20 mph		14:49
Route 2 = 21 mph		13:51
Route 3 = 27 mph		11:21
Route 4 = 17 mph		18:01
Route 5 = 16 mph		18:49
Route 6 = 14 mph		21:21
Route 7 = 27 mph		12:59
Route 8 = 23 mph		14:59
Route 9 = 19 mph		30:03
Route 10 = 18 mph		31:21

3.0 CONSULTATION

3.1 At the beginning of the study it was recognised that extensive consultation with members of the public and special interest groups had occurred during several of the studies which have been undertaken since 1998. However it was also felt that a multi-modal transport review was too important and far-reaching in its possible effects not to involve more representatives than formed the Steering Group. Consequently a Wider Reference Group was created based on representation at recent 'Transport Summits' in Hereford. In turn it was intended that the Wider Reference Group would form the basis for the future composition of the Herefordshire Partnership Transport Ambition Group. This body would comprise representatives of the Statutory Agencies, Police, Government Agencies, environmental and special interest groups and the wider business community. It would meet at key stages in the study; the development of initial options, appraisal of initial options and the development of a blended transport package. By adopting this approach the Steering Group hoped to achieve a targeted and focused consideration of each main stage of the Study, whilst avoiding 'consultation fatigue' which might occur with extensive involvement of the general public. The membership of the Wider Reference Group and the agenda for each meeting are shown in Appendix E.

3.2 The overall purpose of the Wider Reference Group meetings were to:

- identify the problems and issues which the Study must address;
- identify local preferences which may influence the choice of solution;
- identify the acceptability of alternative solutions;
- assess whether the recommended solutions are locally acceptable;
- ensure the involvement of a wide range of stakeholders in the development of the future transport strategy; and
- contribution to building a consensus around the eventual outcome.

3.3 Similar meetings were held, with a smaller number of participants, for representatives of Parish Councils, and Members of Herefordshire District Council. Additional briefings have been given to a Member Board by Council Officers during the course of the study.

3.4 It was always accepted that with the diverse range of interests represented on the Wider Reference Group it would never be easy to achieve a consensus on all issues, particularly as the study progressed towards a recommended strategy. It was however felt important that the full range of views should be accommodated into the study process, particularly the development and appraisal of option packages (see Chapter 7).

First Wider Group Reference Meeting

3.5 The initial meeting held in April 2002 considered the Study Objectives and the technical process that would be followed. The participants were then advised of their role and what would be expected of them. The Steering Group had initiated a series of six option packages ranging from options with a strong emphasis on providing for sustainable modes without new road provision to options which combine provision for sustainable modes with new

road provision. Feedback indicated that although there were significant preferences for one package or another, the range of options covered the limit of solutions that were likely to be practicable, and the process was endorsed.

Second Wider Group Reference Meeting

3.6 The second meeting was primarily to report on study progress and in particular the results of the new surveys. Of particular interest were the amount of through traffic, i.e. that which is genuinely by-passable and has no business in the city and the relative importance of different roads and the results of the journey time surveys.

3.7 At this meeting the opportunity was also taken to explain the transport modelling process in non-technical terms. This was done by a lay (non-transport specialist) member of the Steering Group giving a presentation in his own terms. The approach was regarded as being successful, but inevitably many of the questions and discussion required technical answers which had to be provided by the Consultants.

Third Wider Group Reference Meeting

3.8 This meeting held in October 2002 was primarily to consider the results of the initial option package testing. The Consultants presented the key features of each package in terms of operations (modal split, public transport and highway flows), appraisal summaries and economic performance comparisons. It was determined that on the basis of these initial results no one package as tested would deliver a transport strategy that would meet the study objectives.

3.9 Participants were invited to indicate whether they believed that any of the initial packages could be modified to meet the objectives, or whether two or more packages could be combined to give a composite package, possibly with additional demand management or behavioural change measures incorporated in the final recommended strategy.

3.10 A range of views were expressed but the majority of participants felt that a combination of extensive public transport measures, better facilities for walking and cycling and an outer distributor road should form the basis for the final stage of strategy testing.

4.0 CONSTRAINTS AND PROBLEMS

4.1 No future transport strategy, apart from the development of a 'new town', can start with a clean sheet. The existing urban form, transport networks, heritage sites and buildings and environmental considerations all dictate how the future transport strategy will be based. Hereford is a historic city with a wealth of listed buildings, a cathedral and many narrow streets carrying too much traffic for the environment. It is also surrounded by areas of high ecological and landscape value.

4.2 The starting points for the development of a transport strategy are therefore the existing situation, the provisions of the Local Transport Plan and the distribution of population and jobs as adopted by Herefordshire Council for the deposit draft Unitary Development Plan for 2011. These assumptions are summarised below.

Residential Development

4.3 The deposit draft UDP makes provision for approximately 11,700 new dwellings in the period 1996-2011. Of these 4993 were completed in the period 1996-2001. The phasing of dwelling completions is as follows:

1996-2001	4993 dwellings
2001-2005	3560 dwellings
2006-2011	3153 dwellings

4.4 Most housing provision will be concentrated in Hereford and the market towns, with a second tier of provision being located in the main villages and outside these settlements, a third tier to meet local housing needs in the rural areas.

4.5 The deposit draft UDP gives detailed dwelling proposals and completions from 1996-2011 by phase, in Hereford and the market towns and main villages as summarised in Table 4.1.

Table 4.1 Herefordshire Housing Allocation

1996-2001 Dwellings Completions	2001-2011 Anticipated dwellings from:	2001-2006	2006-2011	Total 1996-2011
Hereford				
	2001 commitments	187	60	
	Windfalls	343	420	
	UDP allocation	642	605	
938	Hereford Total	1172	1085	3195
Market Towns				
278	Leominster	436	279	1002
252	Ross-on-Wye	246	176	674
806	Ledbury	81	51	938
237	Bromyard	108	120	465
73	Kington	102	100	275
1655	Market Towns Total	973	726	3354
1560	Main villages total	727	718	3005
840	Rural Areas	688	624	2152
4993	Total	3560	3153	11706

4.6 The deposit draft UDP identifies specific sites for development for housing in Hereford and the market towns. For Hereford, these allocations are similar to the base forecast assumptions used in the Hereford UDP Study. The largest designations within the City for the period 2001-2011 are the Bradbury Estate (former Stirling Lines), 300 dwellings, Putson (400 dwellings) and Land at Holmer (300 dwellings). These detailed figures were correlated to zones in the SATURN transport model and used as a basis for estimating increases in zonal trip generation/attraction to 2011.

Employment Land Development

4.7 Again the draft UDP identifies employment land development sites in the City for commercial and business and industrial uses which are similar to the assumptions made in the Hereford UDP study. The main allocations indicated are at Rotherwas (15ha) and north of the A4103 Roman Road (13ha), which were again used to estimate increases in trip generation/attraction for the relevant SATURN zones.

Perceived Problems

4.8 Extensive consultation on the perceived transport problems and priorities of people living in the city and surrounding areas has been undertaken as part of the studies carried out by Herefordshire Council since 1998. The key outputs were the Local Transport Plan, the deposit draft Unitary Development Plan and the Hereford Audit Access Study report. Generally the consultation for each produced similar concerns, but showed a diverse range of views as to whether pedestrians should be given the highest priority or drivers, or whether a by-pass was needed or not.

4.9 The most comprehensive all-embracing consultation (as opposed to single mode issues) were provided by the Local Transport Plan exercise. This covered the following groups:

- Parish Councils, organisations and special interest groups (approximately 50 groups);
- Independent Focus Groups;

- Local Area Forum; and
- a Leaflet to Households.

4.10 Other studies covered:

- Youth Groups;
- Community Access Points;
- Special exhibitions; and
- Employers and business interests.

4.11 The issues raised were subsequently addressed as far as possible in the Local Transport Plan.

4.12 The following extracts from the Local Transport Plan consultation effectively summarise the problems and concerns of these respondents:

Transport Priorities

4.13 The Local Transport Plan included a transport priority list, which placed pedestrians at the top and car commuters at the bottom, however, a number of concerns were expressed about this hierarchy. It was felt by some that the car should be given priority and car parking should be maintained at least to its current standard. However, general support was received for the Plan's priorities, as well as for improved pedestrianisation, cycling and disabled facilities. Some respondents suggested that two sets of transport priorities should be devised to reflect the different transport issues for rural and urban areas. This was to reflect the fact that in rural areas there are very limited alternatives to the private car.

4.14 Many respondents felt that the Provisional Plan was biased in favour of urban issues at the expense of provision for the rural areas. This was reflected both in direct comments and also, as stated above, in relation to comments on the transport priorities, which some felt, should be separated into urban and rural priorities.

Public Transport

4.15 Over the range of consultation exercises, one of the most significant findings was the comprehensive support for increased investment in public transport. This was an issue which received support from both rural and urban residents, with specific support for the following:

- increased frequency of services and extended services;
- better quality buses with improved access;
- better integration of bus termini and rail facilities;
- coordination of community transport with scheduled bus services for the more isolated rural areas.

4.16 Several consultees expressed concern that rail issues were not covered adequately in the Provisional LTP, consequently suggestions were made that the Plan should seek to encourage improved rail services, support the opening of new stations and even to re-open disused rail lines. Additionally a number of respondents felt that the Plan needed to include more evidence of integration between modes, in particular bus, rail, cycling and walking.

Traffic Congestion

4.17 Traffic congestion is regarded as being unacceptable on the A49 (T) particularly in the vicinity of Greyfriars Bridge and on the Inner Relief Road during the morning and evening peak periods. However only minimal support was received for traffic reduction measures which would penalise car users. A number of respondents were strongly opposed to reduction in parking spaces and a similar number stated that the Plan should actively support the use of the car. However, there was support for the introduction of park and ride measures particularly in respect of those residents who need to access Hereford from the outlying rural areas.

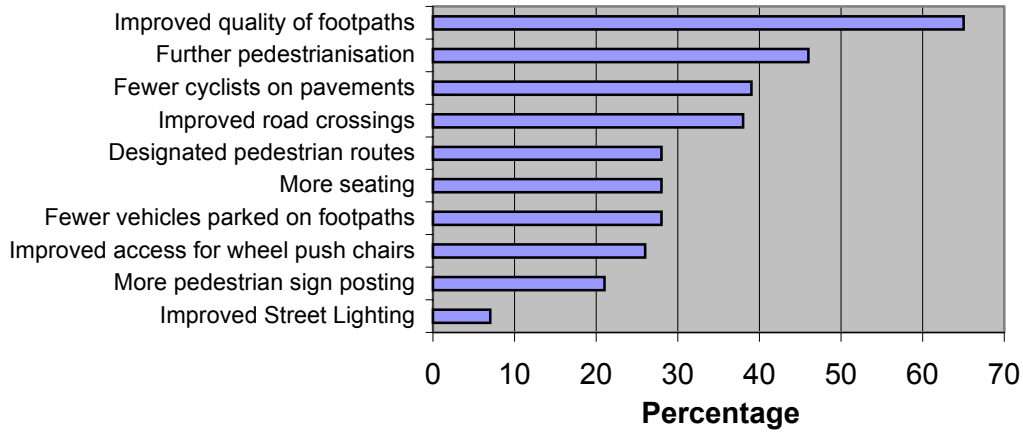
Hereford Bypass

4.18 Different reactions were evident concerning a bypass for Hereford, but in general it received a significant level of support. Reasons given in support of a bypass included, reducing congestion, supporting the economy and improving movement for residents in the rural areas. However, a minority of consultees expressed opposition to a bypass and concern at comments included in the Plan.

Walking and Cycling

4.19 Detailed comments on the problems experienced by pedestrians and cyclists were covered in the Hereford Access Audit Study undertaken in 2000. Cyclists were generally deterred by the lack of an integrated network of dedicated cycle routes, pedestrians were more satisfied with current conditions and generally felt that pedestrian facilities were adequate but there was considerable room for improvement. Figure 4.1 shows how respondents ranked possible improvements in the City to make walking more pleasant and by inference to encourage greater use of that mode.

Figure 4.1 Ranked improvements to making walking in Hereford more pleasant



Source: Ove, Arup and Partners

Summary

4.20 The most frequent issues raised during consultation both during earlier studies and the Multi-Modal Study can be summarised as follows:

- concern at congestion, particularly on roads around the city centre;
- poor access to industrial areas which will affect the commercial and industrial economy;
- intrusion of traffic into residential areas;
- lack of integration of passenger interchange facilities;
- poor reliability of bus and rail services;
- poor quality of the bus fleet;
- the need for improvised road safety;
- better pedestrian facilities;
- lack of facilities for cyclists;
- too many journeys to school by car; and
- environmental damage that would be caused by any new road.

5.0 THE MULTI-MODAL TRANSPORT MODEL

Introduction

5.1 In overview, a new multi modal model was developed to evaluate the effects of potential transport improvement scheme packages in Hereford. In order to undertake this evaluation, a preliminary modelling stage was completed, whereby existing transport conditions at base year 2002 were represented as accurately as possible for private vehicles (car and heavy goods vehicle), public transport (bus and train) and sustainable modes (pedestrian and cyclist).

5.2 Essentially, the model consisted of two main components, namely:

- a SATURN model for representing car, HGV, pedestrian and cycle; movements; and
- a PTTRIPS model for representing bus and train passengers and for predicting travel mode choice.

5.3 Time periods for which modelling was undertaken comprise a weekday AM peak hour (8am-9am), PM peak hour (5pm-6pm) and typical inter peak hour (11am-12midday).

Purpose of Transport Modelling

5.4 The functions of the Hereford model were, first, to produce a base that replicates the current 2002 level of total person trips in the City, the proportionate split of trips between available travel modes and people's route choice between origin/destination (O/D) zones. Its second purpose was to forecast the likely future level of person trips, taking account of expected changes in land use and zone O/D trip movements.

5.5 The third purpose of the model was to predict the manner in which the forecast future person trips would split between travel modes. This future mode split varies under a range of package options that involve different degrees of improvement to the available travel networks. A fourth purpose of the model was to evaluate the impact of the predicted trips upon each mode scheme network, in terms of travel patterns and journey costs.

Unconstrained Person Trip Movement

5.6 Travel demand in Hereford has been determined in terms of total person trips. However, trips that are allocated to car and HGV modes have been factored for vehicle occupancy and for vehicle/passenger car unit (pcu) equivalence, before assignment in SATURN.

5.7 Future year growth in person trips, which will arise through economic and land use change, has not been constrained to any limits of transport network capacity. This unconstrained approach has been adopted, because of the need to assess what enhancements to network capacity and what behavioural changes would be required, in order to accommodate the level of travel demand in Hereford in future years.

Scope of the Transport Modelling

5.8 In the remainder of this Chapter, six aspects of the transport modelling are discussed in turn. These are as follows:

- format of the base year 2002 models by travel mode;
- mode choice model;
- base year 2002 model outputs and calibration of modelled and observed network characteristics;
- forecast future year person trip demand at 2011 and 2031;
- future year travel mode split at 2011 and 2031; and
- future year 2011 and 2031 model outputs for combined scheme option packages.

Format of Base Year 2002 Models

5.9 Five separate travel modes have been modelled in the following manner:

- highway model for car and LGV combined, using SATURN;
- highway model for HGV, using SATURN;
- public transport model for bus and rail passengers combined, using PTTRIPS;
- sustainable mode model for pedestrians, using SATURN; and
- sustainable mode model for cycles, using SATURN.

5.10 Only limited data sources were available for constructing the five modal models, owing to the budget constraints on the project. Some new information was collected in 2002, regarding highway trip O/D patterns, journey times and flow volumes of cars, HGV's, pedestrians and cycles, but maximum use was made of existing data for all of the modal models.

5.11 It was inherent in the study approach that the validation of the base year 2002 models would be limited, because of the shortage of new information on trip O/D movements for all modes and the shortage of passenger flow data for public transport. All new data would be used for calibration

5.12 It was necessary to synthesise a significant proportion of zone-to-zone O/D movements within the trip matrices for each travel mode, using 'matrix estimation'. This synthesis was required to fill in O/D movements where data was missing. Matrix estimation predicts missing trips on the basis of most-likely trip routeings and observed flows of trips at certain points in the network.

Highway Car and HGV Model

5.13 A single highway SATURN simulation network was constructed for modelling car and HGV movements together as two 'user classes' (1 and 2, respectively). The division of user classes was made so as to allow input of different route choice criteria for cars and HGV's (in terms of time/distance unit costs, permissible roads, etc.). The simulation format used in SATURN required that all road junctions were modelled in detail, with regard to layout and capacity. The model highway network included all main radial routes, the Inner Relief Road and key local distributor roads that connect the main radial routes together.

5.14 A 'stacked' O/D trip matrix for cars and HGV's was used, comprising 66 zones, of which, 54 zones were internal to the City and 12 zones were external access points on the edge of the core study area. Base year 2002 AM, PM and Inter Peak hour trip matrices were derived from the following sources, with adjustments to remove duplicate O/D movements:

- Hereford AM 2000 household trip survey, with the car/LGV sample expanded, transposed and factored to the level of the urban population and to a 1-hour time period;
- Spring 2002 roadside interview O/D records at 6 sites, expanded and transposed;
- 1995 Hereford model HGV matrix;
- Spring 2002 HGV freight trip surveys on A49 and A465; and
- SATME2 matrix estimation, to infill missing O/D movements, using observed count volumes.

5.15 Highway model assignments were completed using a Wardrop, least-cost user-equilibrium technique. Full convergence and stability of each model run were monitored, so as to ensure that the modelled trip routeings were sensible. In all base models the 'P' value of flow convergence was 95% or higher, whilst the 'Delta' value of cost convergence was less than 1%. No 'elastic' assignment was undertaken, because it was important to assess the total demand without trip suppression or re-timing of journeys in the future.

Public Transport Bus and Rail Model

5.16 A base year public transport network was modelled using PTTRIPS, with bus and rail treated as one combined travel mode. The aggregation of bus and rail into one mode was done on the basis that public transport travellers are not captive to one mode, but may switch between bus and train/metro.

5.17 Rail journeys were not modelled explicitly in the base year, because there was insufficient rail trip data available from the 2000 household survey. Furthermore, all existing Hereford train users have a trip origin or destination outside the study area and would be unlikely to switch mode in any of the future scheme scenarios.

5.18 The reason for including rail in the public transport model was to assess any potential switch on to train in future, from other modes, if new stations are provided within the study area.

5.19 Network links were included corresponding to all the existing regular bus service routes in Hereford. Network nodes were specified at major staging points and at key access points for land use zones, because it was impractical to include all bus stops as nodes. For convenience the public transport nodes generally coincide with road junctions, most of which are also in the SATURN highway network.

5.20 A public transport zoning system was used that replicated the 66-zone SATURN system. Each zone was connected to several stops (nodes) and some stops were connected to more than one zone.

5.21 Representation of each public transport service was made by specifying the following:

- node-to-node route description;
- frequency per hour as contained in current timetables; and
- route speed, determined from link distance and timetabled time between major stops.

5.22 Travel cost penalties were applied to all public transport modes, to reflect the deterrence factors experienced by passengers. These penalties comprised the following:

- in-vehicle time - no weighting was applied to the true in-vehicle travel time;
- wait time – weighting factor of x2.0 was applied to the true wait time;

- walk time – weighting factor of x2.0 was applied to the true walk time; and
- vehicle boarding – no penalty was applied.

5.23 Base year 2002 public transport AM/PM/IP trip matrices were derived from the Hereford AM 2000 household trip survey. The bus/train sample was expanded, transposed and factored to the level of the core study area population and to a 1-hour time period. Matrix estimation was then applied to the public transport matrix in PTTRIPS, using a very limited amount of bus part-trip O/D data.

Sustainable Travel Mode Pedestrian and Cycle Models

5.24 Pedestrian and cycle movements were modelled on separate networks in SATURN. In both cases, the network configuration largely corresponds to the links and junction nodes in the highway network. However, additional connections have been included in the pedestrian and cycle networks to represent 'back streets' and non-highway accesses through local communities.

5.25 The SATURN networks for pedestrians and cyclists were developed in 'simulation' format. However, no junction capacities or delays were included, because walkers and cyclists, as they are not generally mixed with other road traffic, do not experience the same level of queuing or delay.

5.26 Instead, a constant link travel speed was input throughout each of the pedestrian and cycle networks. This speed was adjusted to reflect delays from road-crossing and negotiating intersections. The input speeds were as follows:

- walk link speed – 4kph; and
- cycle link speed – 15kph.

5.27 Link speed/flow/capacity functions were also attached to all links in the pedestrian and cycle networks, to compensate for the lack of junction constraints.

5.28 The zoning system for the pedestrian and cycle models was identical to the 66-zone system in the highway model, with slight adjustments to zone connection points. SATME2 matrix estimation was applied to infill missing O/D movements, using observed count volumes.

Mode Choice Model

5.29 The mode choice model is essentially a mathematical function for determining the proportion of total travel demand that will use a particular travel mode, based upon the relative costs of different modes, between specific O/D zones. The Hereford mode choice model was implemented using PTTRIPS, in the form of an 'absolute hierarchical logit' function. This function involves trip demand being split in three successive stages according to the value of a 'scaling parameter' applied at each stage. The three stages in the mode choice model are as follows:

- split total trips into walk and non-walk trips;
- split non-walk trips into cycle and non-cycle trips; and
- split non-cycle trips into car and bus trips.

5.30 Mode split was performed on the total person trip matrix at base year 2002 for each time period, in order to calibrate the mode choice model. However, this total matrix excluded HGV trips, because HGV's were considered to be a fixed freight mode, largely unaffected by mode choice criteria. The total person trip matrix was produced by aggregating together each of the calibrated highway, public transport, walk and cycle trip matrices, taking account of vehicle occupancy.

5.31 Calibration of the mode choice model comprised making adjustment to the scaling parameters, such that when split, the total base 2002 person trip matrix reproduced the same highway, public transport, walk and cycle matrices as in the calibrated base models.

5.32 Inputs to the mode choice calibration for each of the AM/PM/IP time periods were as follows:

- total person trip demand 2002;
- skimmed generalised travel cost matrix (combined time and distance), for 4 modes; and
- scaling parameters.

5.33 In order to calibrate the mode split, it was necessary to apply weighting factors to the travel cost matrices for walk and cycle. These weightings reflected the deterrence factors associated with using these travel modes. The calibrated mode choice for each base year time period is shown at Figures 5.1, 5.2 and 5.3.

5.34 Once the mode choice model had been calibrated, the same scaling parameters were input to the future year scheme mode choice models. This reflects the view that travellers will react to available mode choice in the future as they do now, without induced behavioural change which can be applied at a later stage in the modelling process.

Base Year 2002 Model Outputs and Calibration

5.35 Key outputs from the base year 2002 AM, PM and Inter peak models consisted of the number of O/D movements in the calibrated trip matrices, for each travel mode and the degree of similarity between modelled and observed network flows achieved in the calibrated models.

Base Year 2002 Matrix Trip Totals and Mode Choice Model Calibration

5.36 Table 5.1 shows the total number of person trips in each of the calibrated base matrices by travel mode. It also shows the proportionate split of total person trips between modes.

Table 5.1 Base Year 2002 Trip Matrix Totals and % Split by Travel Mode

	AM Peak		PM Peak		Inter Peak	
Travel Mode	**No. Person Trips**	**% Total Trips**	**No. Person Trips**	**% Total Trips**	**No. Person Trips**	**% Total Trips**
Car & LGV	25,111	65.7	26,402	62.5	21,251	61.2
Public Transport	4,301	11.3	4,301	10.2	3,742	10.8
Pedestrian	5,743	15.0	9,192	21.8	6,738	19.4
Cycle	956	2.5	977	2.3	740	2.1
HGV	2,114	5.5	1,341	3.2	2,263	6.5
Total	38,225	100.0	42,213	100.0	34,734	100.0

5.37 Calibration of the base year 2002 mode choice model and its scaling parameters was very accurate. Almost all of the trip totals, by mode, output from the mode choice model were within 0.5% difference from the observed base matrices. The one mode split matrix outside this range was that for Inter peak pedal cycles, which was only 1.2% different from observed. These results suggested that the parameters in the mode choice model were suitable for use in testing the future year Hereford scheme options.

Base Network Flows and Matrix Calibration – Highway Model

5.38 Total modelled car flows on major highway links within Hereford, at base year 2002, are shown in the Appendix Figures A10, A11 and A12, for the AM peak, PM peak and Inter Peak (IP) periods, respectively. Similarly, total modelled HGV (pcu) flows are shown in Figures A13, A14 and A15, for the AM, PM and IP periods.

5.39 With the amount of observed roadside data input to the Hereford base trip matrices, it was not possible to undertake extensive matrix calibration. However, comparison has been made between the matrix movements crossing the River Wye and observed traffic volumes counted on Greyfriars Bridge. The results are displayed in Table 5.2.

Table 5.2 Comparison of Base Matrix Movements and Observed Flows on Greyfriars Bridge

	AM			PM			IP		
	Obs. (pcu/hr)	Mod. (pcu/hr)	% Dif.	Obs. (pcu/hr)	Mod. (pcu/hr)	% Dif.	Obs. (pcu/hr)	Mod. (pcu/hr)	% Dif.
South-bound	1788	2093	+17%	2109	2259	+7%	1753	1767	+1%
North-bound	2360	2699	+14%	1774	1872	+6%	1744	1907	+9%

5.40 The modelled flows will be higher than the observed because it includes the shuttle working flow across the old Wye Bridge.

5.41 Existing highway link flow volumes have been recorded at a number of locations across the City. These count locations give a reasonable coverage of most inbound/outbound, north/south and east/west directional trip movements. A comparison has been made between the modelled and observed flows at the counted link locations, for each of the AM, PM and IP model periods and for the two modelled user classes: car and HGV.

5.42 A useful and accepted measure of correspondence between observed and modelled data is the 'GEH' error statistic. A GEH value of 5 or less indicates that a modelled value has highly satisfactory degree of accuracy compared to an observed value. The GEH statistic is calculated according to the following formula, where 'obs.' is the observed flow and 'mod.' is the modelled flow:

GEH = square root [(obs.- mod.)squared / (obs.+ mod.)x 0.5]

5.43 The calibration has been assessed in accordance with the DfT's procedures, as set out in DMRB (volume 12, section 2, part 1, Chapter 4, Table 4.2), 'Traffic Appraisal in Urban Areas'. Table 5.3 gives a summary of the calibration of modelled car and LGV flows against DfT criteria, for each of the AM, PM and IP periods.

Table 5.3 Accuracy of SATURN Base Year 2002 Modelled Car & LGV Flow Calibration

Calibration Criterion	Min. % of Mod. Flows required to meet criterion	% of Mod. Flows achieving criterion		
		AM Peak	PM Peak	Inter Peak
% flows(700-2700vph) mod. within 15% of obs.	85%	69%	80%	100%
% flows(>2700vph) mod. within 400vph of obs.	85%	N/A	N/A	N/A
% flows(<700vph) mod. within 100vph of obs.	85%	82%	97%	92%
% of all flows with GEH<5.0	85%	83%	96%	88%

5.44 It can be seen from Table 5.3 that against most of the calibration criteria, for which data is available, the model accuracy for car movements is good, particularly in the PM and IP periods. The only significant shortfall in the calibration is in the AM model for higher-volume car flows (700-2700vph), where only 69% of flows are within 15% of observed. However, this figure is distorted by there being only 13 links with flows of this magnitude. The overall GEH value for car flows on all links combined amounts to 2 in the AM, 3 in the PM and 1 in the IP. These GEH values are significantly below 5 and indicate that modelled car flows can be regarded as reliable.

5.45 Table 5.4 gives a summary of the calibration of modelled HGV flows against DfT criteria, for each of the AM, PM and IP periods.

Table 5.4 Accuracy of SATURN Base Year 2002 Modelled HGV Flow Calibration

Calibration Criterion	Min. % of Mod. Flows required to meet criterion	% of Mod. Flows achieving criterion		
		AM Peak	PM Peak	Inter Peak
% flows(700-2700vph) mod. within 15% of obs.	85%	N/A	N/A	N/A
% flows(>2700vph) mod. within 400vph of obs.	85%	N/A	N/A	N/A
% flows(<700vph) mod. within 100vph of obs.	85%	98%	100%	100%
% of all flows with GEH<5.0	85%	95%	94%	98%

5.46 It is clear from Table 5.4 that the model calibration in terms of HGV flows is very good for all time periods. All HGV link flows are less than 700 vehicles per hour. Substantially more than the required 85% of modelled HGV flows are within 100vph of observed. The overall GEH value for HGV flows on all links combined amounts to 4 in the AM, 5 in the PM and 2 in the IP. Since all GEH values are less than or equal to 5, this shows that the HGV flow calibration is reliable.

5.47 Typical current travel times were recorded along 10 directional routes within the City, for comparison against journey times predicted in the highway base model. The journey time routes were as follows:

- route 1 – A49 through Hereford northwards (Ross Road to Holmer Road);
- route 2 – A49 through Hereford southwards (Holmer Road to Ross Road);
- route 3 – A465 through Hereford north-eastwards (Belmont Road to Aylestone Hill);
- route 4 – A465 through Hereford south-westwards (Aylestone Hill to Belmont Road);
- route 5 – A438 through Hereford eastwards (Kings Acre Road to Ledbury Road);
- route 6 – A438 through Hereford westwards (Ledbury Road to Kings Acre Road);
- route 7 – A4110 northwest to B4224 southeast (Canon Pyon Road to Grandstand Road to Barr's Court Road to Bodenham Road to Hampton Park Road);
- route 8 – B4224 southeast to A4110 northwest (Hampton Park Road to Bodenham Road to Barr's Court Road to Grandstand Road to Canon Pyon Road);
- route 9 – B4224 southeast to B4399 southeast (Hampton Park Road to Folly Lane to Aylestone Hill to Roman Road to Three Elms Road to White Cross Road to Belmont Road to Holme Lacy Road); and
- route 10 – B4399 southeast to B4224 southeast (Holme Lacy Road to Belmont Road to White Cross Road to Three Elms Road to Roman Road to Aylestone Hill to Folly Lane to Hampton Park Road).

5.48 Modelled journey times have been assessed in line with DMRB (volume 12) 'Traffic Appraisal in Urban Areas'. Results from the journey time calibration have been summarised in Table 5.5. The proportion of modelled times that meet the calibration criteria is more than satisfactory for the PM and IP models (at 90% in each case), but falls slightly short in the AM (at 80%).

Table 5.5 Comparison of Modelled Highway Journey Times against Calibration Criteria

Calibration Criterion	Min. % of journey times required to meet criterion	% of journey times achieving criterion		
		AM Peak	PM Peak	Inter Peak
Mod. times within 15% of obs.	85%	80%	90%	90%
Mod. times within 1 min. of obs. (if mod.>obs.)	85%	50%	80%	50%

5.49 On routes where the modelled time is greater than observed there is a shortfall in the number of runs that have a time difference of one minute or less. The proportion of runs fulfilling the one-minute criteria amounts to 50% in the AM, 80% in the PM and 50% in the IP. However, in no instance does a modelled journey time exceed an observed time by more than 2 minutes. This level of calibration is considered to be acceptable.

5.50 The overall GEH values associated with each model period, for all routes combined, are good, amounting to 3 in the AM, 2 in the PM and 5 in the IP. Since none of these GEH values exceeds 5, the accuracy of the journey time calibration is considered sufficient for the Hereford base model to be reliable.

Base Network Flows and Matrix Calibration – Public Transport Model

5.51 Total modelled bus passenger flows on major highway links within Hereford, at base year 2002, are shown in Appendix Figures A7, A8 and A9, for the AM peak, PM peak and Inter peak periods. No base year rail passenger flows were modelled, for the reasons explained in section 5.16.

5.52 Since there was not much newly observed public transport passenger trip data input to the base model, it was not possible to carry out a detailed matrix calibration, however, a combined passenger matrix/assigned flow calibration has been undertaken for two link sections of the A49 adjacent to Greyfriars Bridge. This comparison of modelled and observed movements has been made on the basis of recorded bus flows and a typical observed bus capacity and average bus occupancy during the AM, PM and Inter peaks. Table 5.6 shows the results of the public transport calibration. Total passengers were modelled across the river but only counted on Greyfriars Bridge, thus modelled flows would not correspond exactly to the observed because some passengers cross on buses using the old bridge.

Table 5.6 Public Transport Trip Matrix and Model Flow Calibration on A49

	AM Peak					PM Peak					Inter Peak				
Link Section	Obs. No. buses	% occu-pancy	Obs. bus pass.	Mod. bus pass.	% diff.	Obs. No. buses	% occu-pancy	Obs. bus pass.	Mod. bus pass.	% diff.	Obs. No. buses	% occu-pancy	Obs. bus pass.	Mod. bus pass.	% diff.
A49 Greyfriars Br (northbound)	33	60%	990	942	-5%	23	15%	173	197	+14%	37	35%	666	682	+2%
A49 Greyfriars Br (southbound)	31	15%	233	245	+5%	23	60%	690	818	+19%	33	45%	759	783	+3%
A49 Barton Rd-Eign St (northbound)	43	60%	1290	1453	+13%	25	15%	188	332	+77%	41	35%	738	764	+4%
A49 Barton Rd-Eign St (southbound)	32	15%	240	285	+19%	31	60%	930	678	-27%	39	45%	897	724	-19%

5.53 Given the shortage of bus passenger data for building the public transport base matrices, it is considered that a percentage difference between modelled and observed flows of 25% or less, on the A49, shows good model accuracy. On this basis, Table 5.6 indicates that the base AM, PM and IP models were reliable for all monitored movements on the A49, except for the northbound PM flow between Barton Road and Eign Street. This movement was overestimated by some 77% in the model, but this probably reflects an underestimation of bus occupancy in the observed data.

5.54 Total modelled pedestrian flows alongside major highway links within Hereford, at base year 2002, are shown in Appendix Figures A1, A2 and A3, for the AM peak, PM peak and Inter peak periods. Similarly, total modelled cyclist flows on main routes are shown in Figures A4, A5 and A6, for the AM, PM and IP periods.

5.55 As was the case in the public transport model, there was a shortage of newly collected pedestrian and cyclist count data within Hereford. Consequently, very detailed calibration of the walk and cycle models was not possible. Nevertheless, a summary of the pedestrian model calibration, using available data, is provided in Table 5.7.

Table 5.7 Accuracy of SATURN Base Year 2002 Modelled Pedestrian Flow Calibration

Calibration Criterion	Min. % of Mod. Flows required to meet criterion	% of Mod. Flows achieving criterion		
		AM Peak	PM Peak	Inter Peak
% flows(700-2700pph) mod. within 15% of obs.	85%	N/A	33%	N/A
% flows(>2700pph) mod. within 400pph of obs.	85%	N/A	N/A	N/A
% flows(<700pph) mod. within 100pph of obs.	85%	97%	85%	95%
% of all flows with GEH<5.0	85%	97%	70%	90%

5.56 Results in Table 5.7 show that the pedestrian model calibration was generally accurate for those links that were available to be included. There was, however, some shortfall in the number of links in the PM model that had GEH values less than 5. There were also only 3 links in the PM model with observed flows greater than 700pph, so the calibration for these links was distorted.

5.57 A comparison of observed and modelled cyclist flows in the base year 2002 model is contained in Table 5.8.

Table 5.8 Accuracy of SATURN Base Year 2002 Modelled Cyclist Flow Calibration

Calibration Criterion	Min. % of Mod. Flows required to meet criterion	% of Mod. Flows achieving criterion		
		AM Peak	PM Peak	Inter Peak
% flows(700-2700cph) mod. within 15% of obs.	85%	N/A	N/A	N/A
% flows(>2700cph) mod. within 400pph of obs.	85%	N/A	N/A	N/A
% flows(<700cph) mod. within 100cph of obs.	85%	100%	100%	100%
% of all flows with GEH<5.0	85%	100%	100%	100%

5.58 Table 5.8 indicates that the cycle base model calibration was very accurate for the limited number of links where observed data was available. One hundred percent of all monitored link flows satisfied the calibration criteria. The accuracy reflects the amount of cycle data available and should not be taken to indicate the relative accuracy of the cycle model against the pedestrian model.

Forecast Future Year Trip Demand at 2011 and 2031

5.59 It was recognised that the total demand for making trip O/D movements in Hereford would increase in future years as a consequence of economic development, household increase, greater wealth and technological advances. Any transport strategy would have to accommodate these increased trips, so it was important to make reliable forecasts of how trip O/D movements will change.

5.60 Future year trip demand has been forecast as person trips at an aggregate level, starting from the 2002 base, for all travel modes combined. The resulting forecast trips, for years 2011 and 2031, were split between available travel modes in each of the proposed option packages. This mode split was calculated using the calibrated mode choice model, taking account of the differences between schemes in the relative costs and attractiveness of the various modes.

5.61 Forecast trip demand has been derived from several components added together, as follows:

- new non-HGV trip arrivals and departures, at specific model zones, associated with planned changes in scale and type of land use;
- residual growth in existing, non-HGV trip O/D movements, in line with published TEMPRO data for local growth in Hereford;
- growth in existing non-HGV external-to-external 'through' trips, in line with National Road Traffic Forecast (NRTF) for 'all vehicles'; and
- growth in all existing HGV trip movements, in line with NRTF for HGV's.

5.62 New car O/D trips, associated with planned land use changes, were predicted for the AM and PM peaks on the basis of the proposed UDP allocations. In the UDP there are particular sizes and types of development allocated to specific model zones. Car trip rates associated with each size and type of land use were derived from the TRICS database. The new AM and PM development car trips were increased to take account of trips on other modes, using a weekday mode split factor of 1.681 which was extracted from the TEMPRO 2002 database. The average AM/PM trip ends were also factored to an Inter Peak level, using an inter peak/peak flow factor of 0.87 derived from observed highway flows at the base year.

5.63 The new development non-HGV trip O/D totals were added to the base 2002 AM/PM/IP person trip matrices, using the 'Furness' technique to balance the overall origin and destination totals. No new development trips were added to external-to-external movements in the matrix.

5.64 Any residual trip growth was calculated as necessary to make up the difference between planned development trips and overall TEMPRO 'central case' local growth (2002-2011 and 2011-2031). There was expected to be no residual growth at 2011 (since new development would constitute the whole of TEMPRO growth), but additional growth was expected by 2031.

5.65 External-to-external person trips (excluding HGV's) were factored from the 2002 base to 2011 and 2031, in line with NRTF 'all vehicle' central case growth of 15.4% (2002-2011) and 24.9% (2011-2031).

5.66 Growth in HGV movements throughout the base 2002 matrices was calculated and applied in line with NRTF HGV central case growth of 14.1% (2002-2011) and 35.1% (2011-2031).

5.67 Components of the non-HGV person trip forecasts were added together for 2011 and 2031 for input to the mode choice model. A breakdown of the various components of the aggregate forecast person trip matrices, at 2011 and 2031 is provided in Table 5.9.

Table 5.9 Components of Forecast Trip Matrices

	2002			2011				2031			
Time period	Non-HGV person trips	HGV person trips	Total person trips	Non-HGV person trips	HGV person trips	Total person trips	% total growth from 2002	Non-HGV person trips	HGV person trips	Total person trips	% total growth from 2002
AM Peak	36111	2114	38225	41458	2412	43870	14.8	44524	3259	47783	25.0
PM Peak	40872	1341	42213	45617	1530	47147	11.7	50536	2067	52603	24.6
Inter Peak	32471	2263	34734	36784	2582	39366	13.3	40226	3488	43714	25.9

Future Year Travel Mode Split

Mode Choice Model

5.68 Aggregate forecast travel demand for 2011 and 2031 (in person trips, by time period), was proportioned between available travel modes. This proportioning was carried out using the PTTRIPS mode choice model and the calibrated scaling parameters from the base year 2002 model. The proportionate split of demand between modes was controlled by the particular characteristics of each scheme option package, in terms of the relative travel costs and attractiveness of each mode.

5.69 HGV trips were to be excluded from the mode choice model, because HGV's were considered to be a fixed freight mode, unaffected by mode choice criteria. Therefore, the aggregate demand matrices input to the model were as defined by 'non-HGV person trips' in Table 5.9, above. The HGV trip matrices were assigned separately to the highway model and the HGV trip totals were constant across all scheme options for a given year and time period.

5.70 Inputs to the mode choice model for each time period, forecast year and scheme option package were of the same format as in the base model, namely:

- total person trip demand AM/PM/IP, 2011/2031;
- skimmed generalised travel cost matrix (combined time and distance), for 4 modes, by scheme option; and
- scaling parameters.

However, a separate model was required for every option package to take account of the different pattern of relative travel costs amongst the available modes in each one.

5.70 Generalised costs associated with each mode in a particular option were 'skimmed' for base year 2002 flows only and then applied to both future years 2011 and 2031. This was necessary, because no breakdown of trip matrices by mode was yet available at 2011 or 2031 for carrying out cost skims (total trip matrices, only, had been created, as in Table 5.9). Although it could be argued that future cost skims might change from the base year, thus altering modal split, a basic premise of the study was that mode choice in future years would be determined on the same basis as it is currently made until a final behavioural change effect was imposed.

Package Testing

Initial Testing

5.71 Following initial development of the forecast model it was used to assess the extent to which the six option packages covering the range of transport solutions, satisfied the study objectives. These packages were developed from concepts considered by the Steering Group and discussed in some detail by the Wider Reference Group. They are detailed in Chapter 7 of this report.

5.72 Significant refinement of the models was undertaken following initial testing so it is not possible to directly compare the initial six options with the combined packages. However, comparison is valid across the initial options which was used to assess whether any of them would meet the study objectives by themselves or if some combination would be required.

Blended Package Testing

5.73 Three final option configurations were assessed using the refined forecast transport model. These were as follows:

- Reference Case – comprising:
  - Rotherwas access road;
  - 2-way bus and HGV priority lanes on A49 Edgar Street;
  - inbound bus lanes on A438 Eign Street and A465 Commercial Road; and
  - bus-based park and ride service on A49(N) between Racecourse (at A4103 Roman Road) and City Centre;

- Blended Package with Western Distributor – comprising:
  - all Reference Case schemes;
  - Western outer distributor road, between A49(N) and A49(S);
  - moderate bus priority lanes, 2-way, on all main radial routes, ie. A49(N&S), A465(NE&SW), A438(E&W), Inner Ring Road;
  - bus-based park and ride service on A49(S) and A465(SW);
  - rail services at new stations at Withington and Rotherwas;
  - City Centre full pedestrianisation;
  - maximum cycle and pedestrian priority;

- Blended Package without Western Distributor – comprising:
  as above, but no Western Distributor Road.

Behavioural Change in Use of Travel Modes

5.74 It was recognised from the preliminary scheme option testing that none of the options tested would be likely to encourage sufficient transfer of trips away from 'car' travel to avoid serious highway congestion and associated environmental/safety problems in future. Therefore, the Steering Group determined a 'behavioural shift' in people's travel patterns and choice of mode would be needed, as part of any scheme option, over and above a simple reaction to relative travel costs on different modes. This shift would consist of a transfer away from car to public transport, walk and cycle modes. The behavioural shift would be achieved through education and persuasion rather than simply perceived journey cost considerations.

5.75 The Steering Group considered the report Making Travel Plans Work published by the Department for Transport in July 2002. This report gave examples of the achievement of behavioural change for car journeys to more sustainable modes through such measures as Green Travel Plans for employment sites and School Travel Plans. The reduction in car journeys to work regarded as successful and appropriate to the Hereford situation achieved an average percentage of 11.2%.

5.76 In the future year mode choice model it was therefore assumed that an additional mode shift, over and above the reaction to relative travel costs, could be implemented. The shift was only applied to the blended scheme option packages and not to the reference case. This additional shift was specified as follows:

- at 2011:
  - 6% reduction in car person trips;
  - with residual trips transferred and split evenly between public transport, walk -and cycle modes; and

- at 2031:
  - 12% reduction in car person trips;
  - with residual trips transferred and split evenly between public transport, walk and cycle modes.

Forecast Travel Mode Split

5.77 The future year mode choice model was run and the behavioural mode shift added in order to produce the predicted mode split proportions shown in Table 5.10, for 2011 and in Table 5.11 for 2031.

Table 5.10 Future Year 2011 Trip Matrix Totals and % Split by Travel Mode, for Scheme Options

	AM Peak		PM Peak		Inter Peak	
Travel Mode	**No. Person Trips**	**% Total Trips**	**No. Person Trips**	**% Total Trips**	**No. Person Trips**	**% Total Trips**
Reference Case						
Car & LGV	27352	62.3	28191	59.8	23396	59.4
Public Transport	5473	12.5	5225	11.1	4506	11.4
Pedestrian	6630	15.1	10326	21.9	7557	19.2
Cycle	2003	4.6	1875	4.0	1325	3.4
HGV	2412	5.5	1530	3.2	2582	6.6
Total	43870	100.0	47148	100.0	39366	100.0
Blended Package – with W. Distributor						
Car & LGV	26042	59.4	25107	53.3	20567	52.2
Public Transport	6060	13.8	7419	15.7	6580	16.7
Pedestrian	7057	16.1	10771	22.8	7923	20.1
Cycle	2298	5.2	2320	4.9	1715	4.4
HGV	2412	5.5	1530	3.2	2582	6.6
Total	43869	100.0	47147	100.0	39367	100.0
Blended Package – with no W. Distributor						
Car & LGV	24156	55.1	24127	51.2	20144	51.2
Public Transport	7839	17.9	8293	17.6	6940	17.6
Pedestrian	7074	16.1	10821	23.0	7960	20.2
Cycle	2389	5.4	2375	5.0	1741	4.4
HGV	2412	5.5	1530	3.2	2582	6.6
Total	43870	100.0	47146	100.0	39367	100.0

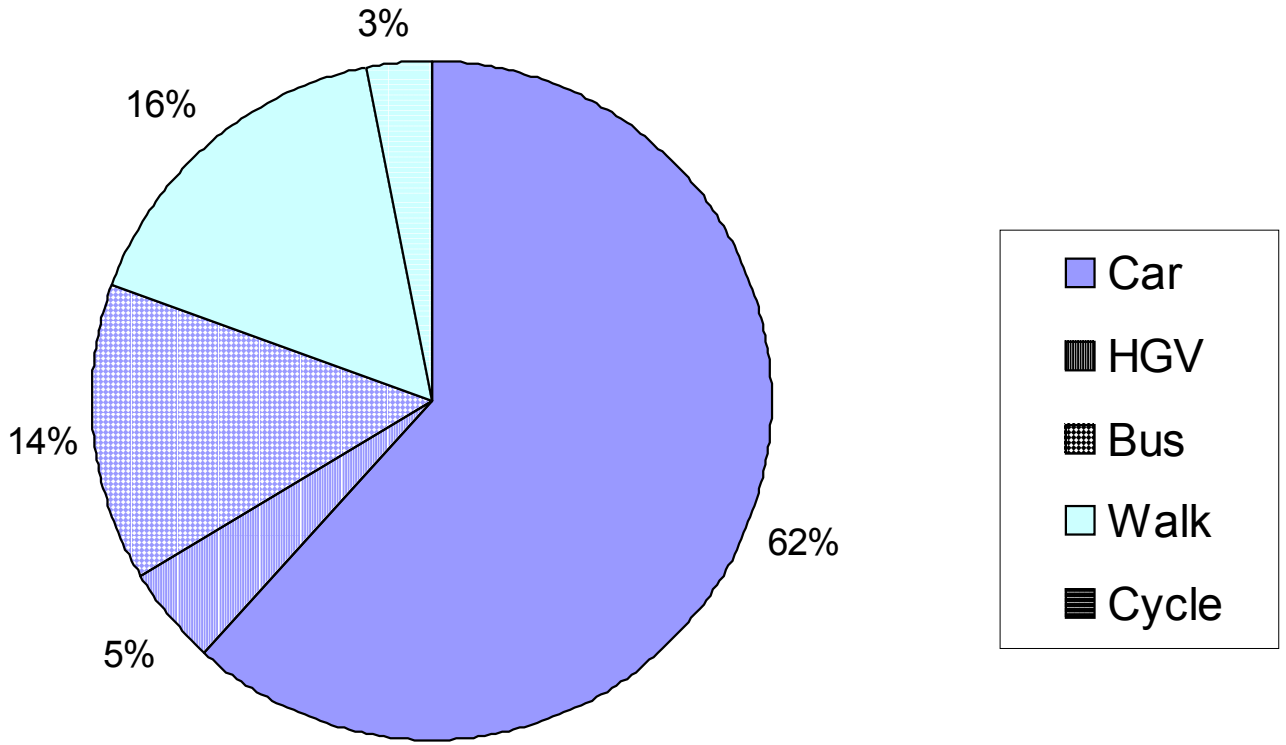
Table 5.11 Future Year 2031 Trip Matrix Totals and % Split by Travel Mode, for Scheme Options

	AM Peak		PM Peak		Inter Peak	
Travel Mode	**No. Person Trips**	**% Total Trips**	**No. Person Trips**	**% Total Trips**	**No. Person Trips**	**% Total Trips**
Reference Case						
Car & LGV	29847	62.5	31459	59.8	25822	59.1
Public Transport	5647	11.8	5613	10.7	4802	11.0
Pedestrian	6945	14.5	11406	21.7	8163	18.7
Cycle	2085	4.4	2059	3.9	1439	3.3
HGV	3259	6.8	2067	3.9	3488	8.0
Total	47783	100.0	52603	100.0	43714	100.0
Blended Package – with W. Distributor						
Car & LGV	26572	55.6	26343	50.1	21284	48.7
Public Transport	6927	14.5	8537	16.2	7530	17.2
Pedestrian	8017	16.8	12494	23.8	9053	20.7
Cycle	3008	6.3	3161	6.0	2358	5.4
HGV	3259	6.8	2067	3.9	3488	8.0
Total	47783	100.0	52602	100.0	43713	100.0
Blended Package – with no W. Distributor						
Car & LGV	24679	51.6	25287	48.1	20860	47.7
Public Transport	8778	18.4	9508	18.1	7907	18.1
Pedestrian	7995	16.7	12543	23.8	9084	20.8
Cycle	3073	6.4	3197	6.1	2374	5.4
HGV	3259	6.8	2067	3.9	3488	8.0
Total	47784	100.0	52602	100.0	43713	100.0

Future Year Model Outputs at 2011 and 2031

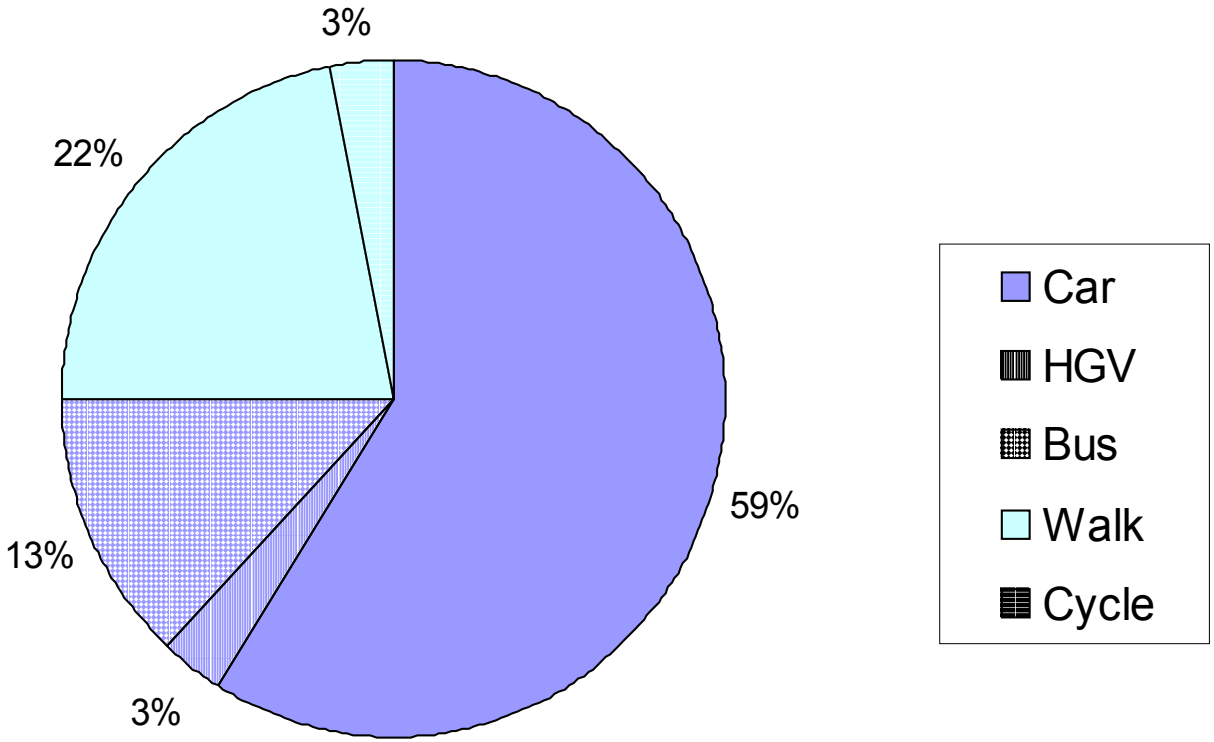
5.78 Future year trip matrices for each travel mode (car, HGV, public transport, walk and cycle), as output from the mode choice model, were assigned to the reference case and blended package networks in the respective SATURN and PTTRIPS models.

5.79 Assigned network flows have been summarised in diagrammatic form, for highway, public transport, walk and cycle modes, for each future year, scheme option and time period, and are shown in Appendix B for Initial Options and Appendix C for the Blended Package with and without a western distributor road.



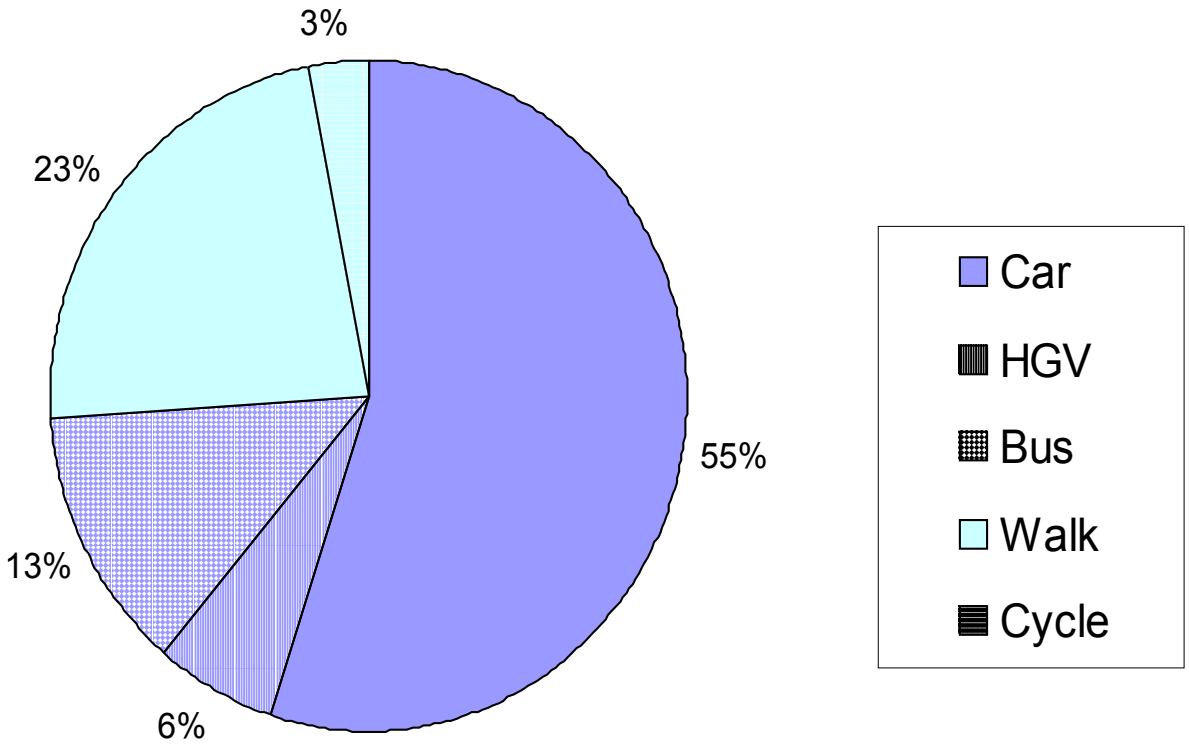
Percentage Base Year Mode Split at AM Peak

Figure 5.1



Percentage Base Year Mode Split at Inter Peak

Figure 5.2



Percentage Base Year Mode Split at PM Peak

Figure 5.3

Appraisal Methodology

6.1 This section of the report outlines the appraisal process used for the Hereford Transport Review. Although the Review is not a formal Multi-Modal Study the appraisals of options as far as possible follows the Government publication 'Guidance on the Methodology for Multi-Modal Studies' (GOMMS).

6.2 The appraisal methodology adopted for each strategy option included the following main strands:

- the preparation of Appraisal Summary Tables (AST) showing performance against national transport objectives and sub-objectives;
- an assessment against local transport objectives and, inter-alia, an assessment of each strategy against its contribution to solving identified problems; and
- supporting analyses.

These strands of the appraisal are described in detail below.

The Appraisal Summary Table (AST)

6.3 GOMMMS recommends that Appraisal Summary Tables (ASTs), which record and make an assessment of impacts, should be completed for each strategy option being considered in a Study.

6.4 The recommended methodology is more easily applied to corridor studies and specific plan options rather than local area strategies. The approach therefore used the inputs and indicators that most logically apply to a local area study and which were available as part of the Study process. The approach is particularly appropriate for the initial set of strategy options where the level of detail will be less than for the appraisal of a fully developed strategy. The Study timescale and budget available limited the depth of appraisal to the strategic level.

6.5 It is important to bear in mind that in interpreting performance of the options, the various objectives will be given different priorities by each stakeholder. However, the AST's are normally presented in a factual manner without any attempt at determining relative weightings. There are also potential overlaps, for example, between economy and accessibility. It is also clear that whilst economy, environment and safety are final objectives, integration is an intermediate objective through which other objectives may be achieved.

National Objectives

6.6 The AST process is intended to appraise the impact of each option under the five Government-set National Objectives of Accessibility, Economy, Environment, Integration and Safety. The initial scenarios appraised were combinations of the Reference Case plus different types and levels of intervention in transport policy, initiatives, services and infrastructure provision.

6.7 The process involved appraisals against the base-line Reference Case for the agreed strategic scenarios. GOMMMS suggests that the appraisals process can either be objective-led approach or problem-orientated. It was agreed that the Hereford Transport Review would

adopt the former approach, each strategy being assessed according to the extent to which it satisfied the objectives relative to the Reference Case.

6.8 GOMMMS sets out a series of sub-objectives 'nested' within the five overarching Government objectives, as listed below, and the Study has sought to identify the area-wide impacts of each strategy under these objectives and sub-objectives:

Objective	*Sub-objectives:*
Accessibility	**- to improve access to facilities for those without a car and to reduce severance**
	to increase ***travel options***
	to reduce ***severance***
	to improve ***access to the transport system***
Economy	**- to support sustainable economic activity and get good value for money**
	to improve ***transport economic efficiency***
	to improve ***reliability***
	to provide beneficial ***wider economic impacts***
Environment	**- to protect the built and natural environment**
	to reduce ***noise***
	to improve ***local air quality***
	to reduce ***greenhouse gases***
	to protect and enhance the ***Landscape***
	to protect and enhance the ***townscape***
	to protect the ***heritage of historic resources***
	to support ***biodiversity***
	to protect the ***water environment***
	to encourage ***physical fitness***
	to improve ***journey ambience***
Integration	**- to ensure that all decisions are taken in the context of the Government's integrated transport policy**
	to improve ***transport interchange***
	to integrate transport policy with ***land use policy***
	to integrate transport policy with ***other government policies***
Safety	**- to improve safety**
	to reduce ***accidents***
	to improve ***security***

6.9 The AST's produced display the degree to which the five Government objectives and related sub-objectives are achieved. The indicators and values used for assessing each of the sub-objectives within the five main objectives are discussed below.

Local Transport Objectives

6.10 The second strand of the appraisal deals with the assessment of the degree to which local transport objectives of the study are achieved in comparison to the Reference Case. It was recommended that the Core Objectives and the main Transport Objectives (for the Hereford Package Strategy) as included in the Local Transport Plan should be adopted for this purpose within the Study. These objectives are based on the vision and key strategic priorities for the County developed by the Herefordshire Partnership. These specific Study objectives are 'nested' within the five overarching National objectives as shown in Tables 6.1 and 6.2.

6.11 For the purpose of the Study the Transport Problems described in Part 1.3 of the Herefordshire LTP have been assumed to be covered by the Transport Objectives set out in the LTP. These problems have been identified as part of the LTP consultation process and as a result of various technical studies and reports and, as such, are considered to be the best available distillation of the traffic and transport problems faced by the City. The identified transport problems relating to the City are set out in the LTP under the following headings:

- congestion;
- poor access to industrial areas
- intrusion of traffic in urban areas;
- lack of integration at passenger interchanges;
- poor reliability of bus services;
- poor quality of bus fleet;
- lack of quality passenger waiting facilities;
- road Safety;
- poor pedestrian links
- lack of facilities for cyclists;
- journeys to school by car;
- social exclusion;
- (Limited awareness of travel choices).

6.12 This assessment will consist of a written summary of the performance of each strategy option in respect of each identified objective and associated problem with reference to the performance indicators listed in Table 6.3 and other model outputs as appropriate.

Performance Indicators

6.13 GOMMMS identifies two overall approaches that could be adopted for the appraisal process. The first of these is an objectives-led approach in which objectives are first specified and then used to identify problems by assessing the extent to which current or predicted future conditions, in the absence of new measures, fail to meet the identified objectives.

6.14 The second approach, a problem-orientated approach, is based on the definition of a full list of current and potential problems and the use of data on current or future conditions to identify where and when these problems occur.

6.15 Early in the Study process it was agreed with the Steering Group that the objectives-led approach would be used and local objectives have been extracted from the Herefordshire LTP for this purpose and 'nested' within the Governments' five over-arching objectives.

6.16 GOMMMS recognises that it is impractical to set a single set of targets or thresholds to which there would be general agreement nationally and that Steering Groups (and Wider Reference Groups) for different studies will have different ideas as to the relative importance and seriousness of different types of problems.

6.17 The only national targets available are those set out in Annex 2 of the Governments' 10-year Plan for Transport but local transport-related targets are also set out the Herefordshire LTP. These targets are listed in Table 6.3 and cross-referenced to the relevant performance indicators.

6.18 For consistency the same indicators, as detailed in Table 6.3, were used to determine how well a particular strategy performed against both National and Local Transport Objectives.

Table 6.3 cross-references the local objectives with the national sub-objectives and the associated indicators.

Economic Analysis

6.19 The model outputs from the package tests have been input into the standard Government multi-modal economic analysis programme TUBA (Transport User Benefits Assessment) to determine user benefits compared with the Reference Case and a comparison of discounted benefits with costs. The transport economic efficiency of each option package is based on the use of the TUBA software over the period 2001 to 2041 using two modelled years, 2011 and 2031. For the purpose of comparison the 2011 scenario assumes that all option package schemes are in place by that date. This was done to assess the date at which the various initiatives might be required.

6.20 The benefits and costs indicated are at year 2002 prices discounted to 2000 at a social discount rate of 6%. Discounting is the procedure used to convert future costs and benefits of public spending into present day values. Government has very recently reduced the discount rate for project appraisal from 6% to 3.5%. Although the TUBA analyses have not been re-run on this basis, it is considered unlikely that the economic ranking of the option packages would change if this were done.

6.21 Cost Estimates for all measures tested in the option packages have been undertaken using the best available data as summarised in Appendix F. We believe that the accuracy of package costs is to within +/-10%, although this level of accuracy should not be ascribed to individual schemes within packages.

Supporting Analyses

6.22 GOMMMS lists three additional groups of issues, which are relevant to the choice of a multi-modal strategy or plan but do not fit within easily within the AST. This is because the AST always takes the perspective of the overall public interest at Study Area or even national level. The issues listed below relate to the implications of the proposed strategy or plan for particular groups of users, non-users, operators and public sector authorities and have been considered as part of the supporting analysis:-

Distribution and equity - e.g. transport economic efficiency table providing a breakdown of NPV

Affordability and financial sustainability - e.g. the financial impact on the public and private sector of carrying out the strategy; and

Practicability and public acceptability - e.g. consideration of the overall practicability of each strategy or plan covering likely technical and legal feasibility, implementing bodies, complexity and time-scale and phasing and likely public acceptability.

Table 6.1 Study Objectives

STUDY AIMS:	To develop a transport strategy which will contribute to the long term vitality, viability, safety and sustainability of the City and that is capable of attracting the support of a wide range of stake-holders.				
Government's five National Objectives for transport	**NO1-ACCESSIBILITY**	**NO2-ECONOMY**	**NO3-ENVIRONMENT**	**NO4 -INTEGRATION**	**NO5-SAFETY**
	To improve access to everyday facilities for those without a car and to reduce community severance.	To support sustainable economic activity and get good value for money.	To protect the built and natural environment.	To ensure that all decisions are taken in the context of the Government's integrated transport policy.	To improve safety for all road users.
Issues identified in the Study Terms of Reference	The Study is to: • Consolidate and integrate transport studies undertaken since 1998 to ensure compatibility; • Provide input to Local Transport Plan updates, Urban Development Plan and development control policy; • Determine transport options to accommodate future travel demand in the City; • Develop policies to support sustainable growth; and • Promote safe travel.				
PRIMARY TRANSPORT OBJECTIVE	To create a safe, modern, efficient and cohesive network of integrated transport facilities and services for the Study Area which serves the accessibility and mobility needs of both individuals and the business community in an environmentally friendly manner				
CORE OBJECTIVES (LTP)	CO1 - To support urban and rural communities to ensure full and equal access to services and opportunities whilst seeking to reduce car dependency	CO2 - To promote sustainable economic growth, supporting a strong, competitive economy with a balanced mix of businesses	CO3 – To protect and enhance the natural and built environment whilst accommodating planned development in sustainable and appropriate locations	CO4 – To support the vitality and viability of urban and rural centres to ensure the provision of an appropriate range of services for local communities, resisting pressures which would lead to decentralised development	CO5 – To create a safe environment which enables local residents to enjoy healthy lifestyles.
DETAILED TRANSPORT OBJECTIVES			SEE TABLE 6.2		

Table 6.2 Cross Reference of National Transport Objectives and the LTP Detailed Transport Objectives

National Objectives	Local Transport Plan Objectives	
NO1, NO3	HT1	To ensure that people can gain access to existing and future employment, education, leisure and shopping sites, particularly by public transport, cycling and walking.
NO2, NO3	HT2	To provide for the movement of freight into and out of the City whilst seeking to reduce the impact of road freight, and encourage greater use of rail.
NO5	HT3	To improve road safety and personal security, particularly for vulnerable road users, such as pedestrians and cyclists.
NO1	HT4	To make the transport system more accessible to people with mobility difficulties.
NO1, NO3	HT5	To increase the proportion of trips made by public transport, cycling and walking, particularly for journeys to the city centre and major work sites.
NO1, NO4	HT6	To improve the attractiveness and convenience of public transport so as to improve access to mobility for those without the use of a car and to reduce car dependence.
NO3	HT7	To reduce the impact of transport on the environment by encouraging the use of less polluting and more energy efficient modes, such as public transport, cycling and walking.
NO2, NO3	HT8	To conserve and enhance the environment of Hereford, particularly within the City Centre, and ensure that it remains an attractive place to visit and in which to live, work and invest.
NO3	HT9	To increase the proportion of short trips made by cycle or on foot.
NO4	HT10	To reduce the need to travel, in the longer term, by the co-ordination of land use planning with transport.
NO3, NO5	HT11	To ensure the City's transport system enables all the residents of Hereford to lead a healthy lifestyle.

Table 6.3 Key Performance Indicators

PERFORMANCE INDICATORS	OBJECTIVES		TARGETS		STUDY APPRAISAL VALUES (For each strategic option c.f. Reference Case)
	National Sub-objectives	LTP Transport Objectives	Government 10-Year Plan	Herefordshire LTP	
ACCESSIBILITY OBJECTIVE					
Change in Public Service Vehicle kms.	To increase travel options.	HT1 HT4 HT6			Change in bus and rail passenger service vehicle kilometres from transport model
% Mode shift from car to bus/rail		HT1 HT5	Increase bus use by 10% and rail use by 50% over current levels by 2010.	To increase the number of bus and rail users by 2% per annum	%age shift from car to public transport from model.
Change in pedestrian severance	To reduce severance	HT1			Length of highway/rail routes with increased or decreased severance.
Change in access to public transport	To improve access to the transport system	HT1 HT4 HT6			Change in bus and rail passenger service vehicle kilometres from transport model.
ECONOMY OBJECTIVE					
Transport User Benefit/Cost ratio and economic analyses (TUBA)	To improve transport economic efficiency				Overall TUBA benefit/cost ratio, net present value etc.
Change in road vehicle journey time reliability and congestion	To improve reliability	HT8	Reduction of congestion on the inter-urban area and in large urban areas to current levels by 2010.	To restrict traffic growth in Hereford to 1% pa during the period 2001 to 2010	Road traffic growth and congestion measurements.
Improved access to regeneration areas, industrial and commercial zones.	To provide wider economic impacts	HT2			Number of regeneration areas, industrial and commercial zones with improved transport access.

PERFORMANCE INDICATORS	OBJECTIVES		TARGETS		STUDY APPRAISAL VALUES (For each strategic option c.f. Reference Case)
	National Sub-objectives	LTP Transport Objectives	Government 10-Year Plan	Herefordshire LTP	
ENVIRONMENT OBJECTIVE					
Change in area-wide vehicle-kms. in Study Area	To reduce noise	HT8			%age change in vehicle kms. over Study Area.
Change in total transport emissions of NO_2 and PM_{10} in Study Area	To improve local air quality	HT8	To improve air quality by meeting the National Air Quality Strategy Targets.		%age change in vehicle kms. to calculate change in emission tonnage in Area.
Change in total transport emissions of CO_2 in Study Area	To reduce greenhouse gases	HT8	To reduce greenhouse gases emissions by 12.5% from 1990 levels and a 20% reduction in Carbon dioxide by 2010.		%age change in vehicle kms. to calculate change in emission tonnage in Study Area.
Impact of infrastructure and traffic on Landscape (qualitative)	To protect and enhance the Landscape				Score on a GOMMMS 8 point scale
Impact of infrastructure and traffic on townscape (qualitative)	To protect and enhance the townscape				Score on a GOMMMS 8 point scale
Impact of infrastructure and traffic on Heritage (qualitative)	To protect the heritage of historic resources	HT2 HT8	Increase rail freight's share of the freight market by 80% by 2010.		Score on a GOMMMS 4 point scale
Impact of infrastructure and traffic on biodiversity(qualitative)	To support biodiversity				Score on a GOMMMS 6 point scale
Impact of infrastructure and traffic on water quality (qualitative)	To protect the water environment				Score on a GOMMMS 4 point scale
% Mode shift from car to walk/cycle	To encourage physical fitness	HT1 HT5 HT7 HT9 HT11	Triple the number of cycling trips by 2010 compared with a 2000 base.	Increase number of walk trips in Central Area by 5% by 2006 and to double cycle usage in Hereford on 1991 figures by 2012.	%age shift from car to soft modes.
Changes in traveller care, views and stress on a corridor basis (qualitative)	To improve journey ambiance	HT11			Score on a GOMMMS 4 point scale

PERFORMANCE INDICATORS	OBJECTIVES		TARGETS		STUDY APPRAISAL VALUES (For each strategic option c.f. Reference Case)
	National Sub-objectives	**LTP Transport Objectives**	**Government 10-Year Plan**	**Herefordshire LTP**	
INTEGRATION OBJECTIVE					
New or improved transport and freight interchanges	To improve transport interchange	HT6			Number of new or improved transport and freight interchanges
Identify whether option is integrated with other land use policy and proposals (qualitative)	To integrate transport policy with land use policy	HT10			GOMMMS three point scale – neutral, beneficial or adverse.
SAFETY OBJECTIVE					
Forecast accident totals by severity and road type.	To reduce accidents	HT3	Reduction of all serious injury and fatal road accidents by 40% by 2010 and those involving children by 50% by 2010.	To achieve, by 2010 a 43% reduction in the number of people killed or seriously injured and a 50% reduction in the number of children killed or seriously injured. To achieve a 10% reduction in slight casualty rate by 2010	Predicted accident totals by route type and severity from transport model. Consideration of vulnerable road users.
Change in security for road users, public transport passengers and freight (qualitative)	To improve security	HT3 HT11			GOMMMS three point scale – consistent, no contribution or inconsistent.

7.0 DEVELOPMENT AND EVALUATION OF INITIAL OPTION PACKAGES

Option Development and Operational Performance

7.1 The approach adopted for examining the possible range of strategic transport options for Hereford over the next thirty years was based on identifying a range of transport schemes, initiatives and measures that could be grouped into a series of packages representing alternative strategies. An initial set of Package Options was developed, in consultation with the Steering Group, representing a range of strategic approaches putting varying emphasis on either the public transport or highway component of the strategy. Any new road scheme was assumed to be a single carriageway two lane standard.

7.2 The following sections of the report outline the schemes, measures and initiatives included in each of the initial Option Packages and describe the main operational characteristics of various scheme elements within each of the six option packages for the Hereford Transport Review. Impacts are quantified in terms of changes to travel mode split and vehicle and passenger flow volumes on the network. Network diagrams for each option package showing forecast modelled flow volumes and modal share can be found in Appendix B.

7.3 In some circumstances it is very difficult to identify individual scheme impacts where, for instance, two scheme measures reinforce or counterbalance one another. For example, the introduction of bus/freight lanes on A49 and also an outer distributor road will both tend to reduce vehicle flows on the A49. By contrast, widening of the A49 to dual 2-lane carriageway will tend to suppress the reduction in vehicle flow on the A49 that results from the bus/freight lanes.

7.4 For brevity and clarity, the scheme operational impact assessments described below concentrate on the AM peak model period, at forecast year 2031. All operational impact comparisons have been made relative to the 2031 AM peak Do-Nothing situation which, as implied, represents no change to the existing transport system in Hereford. It should be noted that the simulation technique adopted for the Study required that all highway junctions were modelled in detail with regard to layout and capacity because, in a congested urban environment, junction rather than link capacity is normally the limiting factor. It is accepted that this form of capacity restraint could in a few isolated cases give flows on a link between junctions in excess of the theoretical maximum capacity of that link.

Reference Case

7.5 All the options examined were deemed to include a **Reference Case** scenario. This option package represents currently envisaged changes to Hereford's transport infrastructure and covers committed schemes only, including the Rotherwas Access Road and the continuation of current trends in travel behaviour. The schemes and measures included in the Reference Case are identified below:

- Local Transport Plan Schemes;
- UDP Committed Land Use;
- the Rotherwas Access Road;
- the Highways Agency A49 Bus and Freight Lane on Edgar Street;
- inbound Bus and Freight Lanes on Eign Street and Commercial Road;
- one Bus-Based Park and Ride Site (A49 north); and

- Roman Road on-line improvement.

7.6 Compared with the **2031 Do-Nothing** scenario the significant operational impacts of the **2031 Reference Case** can be briefly described as follows:

- *A49 north: Edgar Street 2-way bus/freight lanes*
  There will be a 10% decrease in vehicle flow on A49(N) (i.e. -269 vehicles).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 109% in bus trips on A49(N) (i.e. +263 trips).

- *A438 Eign Street inbound bus lane*
  This will cause a 13% decrease in vehicle flow inbound on Eign Street (i.e. –355 vehicles).

- *A465 Commercial Road inbound bus lane*
  This will, likewise, result in a 13% reduction in vehicle flow on Commercial Road (i.e. –201 vehicles).

- *Rotherwas Access Road*
  This link road will remove 19% of vehicles from Holme Lacy Road (i.e. –639 vehicles).

- *A49 Greyfriars Bridge*
  There will be no change to vehicle or public transport passenger flows on Greyfriars Bridge in the Reference Case.

- *Overall Network*
  Across the whole network there will be a 2% decrease in the proportion of car trips (i.e. –1385 trips) and a 2% increase in the proportion of cycle movements (i.e. +1339 trips). Other modes will remain virtually unchanged from the do-nothing.

Option Package 1

7.7 The package comprises public transport and pedestrianisation improvements together with new park and ride provisions. The main public transport improvements include the implementation of maximum bus priorities in the City by means of bus-only lanes and appropriate bus priorities at junctions. These would be supplemented by a light rail 'Metro' route, running south-west/north-east through the City Centre, between Belmont and Aylestone Hill with a spur connection to the railway station.

7.8 The individual schemes and measure included within the package are as follows:

- the Reference Case;
- one bus based park and ride site (A49 south);
- Metro linked to park and ride sites A465 north and south;
- maximum bus priorities;
- city centre full pedestrianisation (Widemarsh St, High St, Broad St – access for bus, cyclists and pedestrians only);
- new rail station at Rotherwas;
- improved cycle and pedestrian facilities;

- 20mph zones in residential areas;
- one rail-based park and ride site at Withington;
- dedicated school bus provision; and
- no new road schemes.

7.9 The principal forecast operational effects of Option Package 1, including the Reference Case, when compared to the Do-Nothing scenario are summarised below:

- *A49 north: Edgar Street 2-way bus/freight lanes*
  There will be a 78% decrease in vehicle flow on A49(N) (i.e. –2031 vehicles).

- *Maximum bus priority on 'A' road radials*
  For the main radials taken together, there will be a 39% fall in vehicle flows (i.e. –6948 vehicles) and a 143% rise in bus passenger flows (i.e. +4167 trips).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 269% on A49(N) (i.e. +649 trips).

- *A49 south: bus park and ride and 2-way bus lane*
  Park and ride trips will constitute 19% of bus trips on A49(S) (i.e. 355 trips), whilst there will be an overall increase of 104% in bus trips on A49(S) (i.e. +977 trips).

- *A465 north and south: LRT park and ride*
  The Metro will account for 26% of public transport trips in the corridor (i.e. 1184 trips) and will result in a 68% rise in public transport use on the A465 north and south (i.e. +1879 trips).

- *Withington Rail Station*
  This will have negligible impact, with new trips that use this rail facility constituting only a very small proportion (< 0.1%) of total public transport trips (i.e. 7 trips).

- *Rotherwas Rail Station*
  This station will have significantly more impact than Withington, with new rail trips accounting for 5% of total public transport trips on the network (i.e. 519 trips).

- *A49 Greyfriars Bridge*
  There will be a 23% fall in vehicle flow (i.e. –2002 vehicles) and a 68% rise in public transport passenger flow (i.e. +1879 trips) on Greyfriars Bridge in Package 1.

- *Overall Network*
  Across the whole network there will be an 8% decrease in the proportion of car trips (i.e. 4234 trips), a 6% increase in the proportion of public transport trips (i.e. +3262 trips) and a 2% increase in the proportion of cycle movements (i.e. +1175 trips). Other modes will remain unchanged from the do-nothing.

Option Package 2

7.10 The second package of measures is similar to the first but includes an additional two bus-based park and ride sites and omits the 'Metro' scheme and its associated park and ride sites.

7.11 The individual schemes and measure included within the package are as follows:

- the Reference Case;
- three Bus-Based Park and Ride Site (A49 south and A465 north and south);
- maximum bus priorities;
- city centre full pedestrianisation (Widemarsh St, High St, Broad St – access for bus, cyclists and pedestrians only);
- new rail station at Rotherwas;
- improved cycle and pedestrian facilities;
- 20mph zones in residential areas;
- one rail-based park and ride site at Withington;
- dedicated school bus provision; and
- no new road schemes.

7.12 The forecast operational impact of Package 2, which again includes the Reference Case schemes, is very similar to Package 1 as summarised below:

- *A49 north: Edgar Street 2-way bus/freight lanes*
  There will be a 78% decrease in vehicle flow on A49(N) (i.e. –2020 vehicles).

- *Maximum bus priority on 'A' road radials*
  For the main radials taken together, there will be a 37% fall in vehicle flows (i.e. –6278 vehicles) and a 131% rise in passenger flows (i.e. +3822 trips).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 266% in bus trips on A49(N) (i.e. +642 trips).

- *A49 south: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 107% in bus trips on A49(S) (i.e. +1003 trips).

- *A465 north and south: bus park and ride*
  The bus park and ride will increase public transport trips in the corridor and a 65% rise in bus use on the A465 north and south (i.e. +1776 trips) will occur.

- *Withington Rail Station*
  In competition with the A465 north bus-based P&R, Withington Rail Station will have negligible impact, with new trips that use this rail facility constituting a small proportion (0.3%) of total public transport trips (i.e. 40 trips).

- *Rotherwas Rail Station*
  This station will have significantly more impact than Withington, with new rail trips accounting for 4% of total public transport trips on the network (i.e. 475 trips).

- *A49 Greyfriars Bridge*
  There will be a 22% fall in vehicle flow (i.e. –1961 vehicles) and a 65% rise in public transport passenger flow (i.e. +1776 trips) on Greyfriars Bridge in scheme 2.

- *Overall Network*
  Across the whole network there will be a 7% decrease in the proportion of car trips (i.e. –4338 trips), a 5% increase in the proportion of public transport trips (i.e. +3183

trips) and a 2% increase in the proportion of cycle movements (i.e. +1177 trips). Other modes will remain unchanged from the do-nothing.

Option Package 3

7.13 The third package represents a lower level of bus priorities together with a significant highway element. The latter takes the form of an eastern distributor road between the A49(T) North to the Rotherwas Access Road which is included in the Reference Case. Together with a link between the A49 and A465 south-west of the city this provides an eastern outer two lane distributor road between A49(N) and A465(S). Option Package 3 also includes a single bus-based park and ride site, city-centre pedestrianisation, improved cycle and pedestrian facilities and a rail-based park and ride at Withington scheme, all in addition to the Reference Case.

7.14 The individual schemes and measure included within the package are as follows:

- the Reference Case;
- one Bus-Based Park and Ride Site (A49 South);
- limited Bus Priorities;
- city Centre Pedestrianisation (Widemarsh St and High St);
- rail-Based Park and Ride at Withington;
- improved Cycle and Pedestrian Facilities; and
- outer Eastern Distributor road (including A49 south to A465 south link).

7.15 The forecast operational impact of Package 3 is summarised below:

- *A49 north: Edgar Street 2-way bus/freight lanes*
  There will be a 53% decrease in vehicle flow on A49(N) (i.e. –1383 vehicles).

- *Eastern Outer Distributor and minimum bus priority on 'A' road radials*
  For the main radials taken together, there will be a 36% fall in vehicle flows (i.e. –6444 vehicles) and only a 1% rise in passenger flows (i.e. +19 trips).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 77% on A49(N) (i.e. +186 trips).

- *A49 south: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will decrease by 1% in bus trips on A49(S) (i.e. –9 trips).

- *Withington Rail Station*
  This will have a slight impact, with new rail trips that use this station making up 2% of total public transport trips on the network (i.e. 124 trips).

- *A49 Greyfriars Bridge*
  There will be a 46% fall in vehicle flow (i.e. –4049 vehicles) and a 49% fall in public transport passenger flow (i.e. –1336 trips) on Greyfriars Bridge in scheme 3.

- *Overall Network*
  Across the whole network there will be a 1% increase in the proportion of car trips (i.e. +568 trips), a 2% decrease in the proportion of public transport trips (i.e. –1234

trips) and a 1% increase in the proportion of cycle movements (i.e. +861 trips). Other modes will remain unchanged from the do-nothing.

Option Package 4

7.16 Package 4 is very similar to Package 3. It again comprises the Reference Case plus some bus priority on all main radial routes and new facilities for pedestrians and cyclists. It includes significant highway construction, this time in the form of a western outer distributor road between A49(N) and A49(S), to link with the Rotherwas Access Road. It has no park and ride on A465 north or south and it incorporates a new rail station at Withington but not at Rotherwas.

7.17 The individual schemes and measure included within the package are as follows:

- the Reference Case;
- one Bus-Based Park and Ride Site (A49 South);
- Limited Bus Priorities;
- city Centre Pedestrianisation (Widemarsh St, High St);
- rail-Based Park and Ride at Withington;
- improved Cycle and Pedestrian Facilities; and
- western Distributor (A49 south to A49 north).

7.18 Option Package 4 has the following operational impact on the transport network:

- *A49 north: Edgar Street 2-way bus/freight lanes*
  There will be a 66% decrease in vehicle flow on A49(N) (i.e. –1736 vehicles).

- *Western Outer Distributor and minimum bus priority on 'A' road radials*
  For the main radials taken together, there will be a 39% fall in vehicle flows (i.e. –7066 vehicles) and only a 14% rise in passenger flows (i.e. +403 trips).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 120% in bus trips on A49(N) (i.e. +288 trips).

- *A49 south: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 11% on A49(S) (i.e. +105 trips).

- *Withington Rail Station*
  This will have a slight impact, with new rail trips that use this station making up 2% of total public transport trips on the network (i.e. 154 trips).

- *A49 Greyfriars Bridge*
  There will be a 45% fall in vehicle flow (i.e. –3967 vehicles) and a 43% fall in public transport passenger flow (i.e. –1195 trips) on Greyfriars Bridge in scheme 4.

- *Overall Network*
  Across the whole network there will be a 1% decrease in the proportion of car trips (i.e. –517 trips) and a 1% decrease in the proportion of public transport trips (i.e. –395 trips). There will also be a 2% increase in the proportion of cycle movements (i.e. +1020 trips). Other modes will remain unchanged from the do-nothing

Option Package 5

7.19 Overall Package 5 is also similar to Option Package 3 and 4 in terms of the combination of public transport and highway schemes. The package comprises the Reference Case plus some bus priority on all main radial routes and new facilities for pedestrians and cyclists. It includes highway construction, in the form of an eastern inner distributor road and new bridge crossing, between A49(N) and A49(S) Instead of an outer eastern or western distributor road it includes an inner eastern distributor route passing through the urban fabric, closer to the City Centre, between the A49 north and Rotherwas. However, there is improved capacity on the existing A49, by means of introducing dual 2-lane carriageway along the entire length of the A49 within the urban area. The scheme has no park and ride on A465 north or south and it incorporates a new rail station at Withington but not at Rotherwas.

7.20 The individual schemes and measure included within the package are as follows:

- the Reference Case;
- one Bus-Based Park and Ride Site (A49 South);
- limited Bus Priorities;
- city Centre Pedestrianisation (Widemarsh St, High St);
- rail-Based Park and Ride at Withington;
- improved Cycle and Pedestrian Facilities;
- new link and river bridge within the City – East – from A49 Newtown;
- roundabout to B4399 Rotherwas; and
- dualling A49 completed within urban area.

7.21 The principal operational effects of Option Package 5 when compared to the Do-Nothing scenario are summarised below:

- *A49 north: Edgar Street 2-way bus/freight lanes and dualling*
  There will be a 30% decrease in vehicle flow on A49(N) (i.e. –785 vehicles).

- *A49 south: Ross Road 2-way dualling*
  There will be a 61% decrease in vehicle flow on A49(S) (i.e. –3279 vehicles).

- *Eastern Inner Distributor and minimum bus priority on 'A' road radials*
  For the main radials taken together, there will be a 29% fall in vehicle flows (i.e. –5259 vehicles) and a 21% rise in passenger flows (i.e. +610 trips).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 140% on A49(N) (i.e. +337 trips).

- *A49 south: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 33% on A49(S) (i.e. +312 trips).

- *Withington Rail Station*
  This will have a slight impact, with new rail trips that use this station making up 2% of total public transport trips on the network (i.e. 154 trips).

- *A49 Greyfriars Bridge*
  There will be a 53% fall in vehicle flow (i.e. –4666 vehicles) and a 10% rise in public transport passenger flow (i.e. +270 trips) on Greyfriars Bridge in scheme 5.

- *Overall Network*
  Across the whole network there will be a 3% decrease in the proportion of car trips (i.e. –1323 trips), a 1% increase in the proportion of public transport trips (i.e. +259 trips) and a 2% increase in the proportion of cycle movements (i.e. +1159 trips). Other modes will remain unchanged from the do-nothing.

Option Package 6

7.22 Package 6 comprises the Reference Case plus some bus priority on all main radial routes and new facilities for pedestrians and cyclists. It includes highway construction in the form of a western inner distributor road and new bridge crossing, between A49(N) and A465(S). However, there is improved capacity on the existing A49, by means of introducing dual 2-lane carriageway along the entire length of the A49 within the urban area. The scheme has no park and ride on A465 north or south and it incorporates a new rail station at Withington but not at Rotherwas.

7.23 The individual schemes and measure included within the package are as follows:

- the Reference Case;
- one Bus-Based Park and Ride Site (A49 South);
- limited Bus Priorities;
- city Centre Pedestrianisation (Widemarsh St, High St);
- rail-Based Park and Ride at Withington;
- improved Cycle and Pedestrian Facilities;
- new link and river bridge within the City – West from A438 Kings Acre Road to A465 Belmont Road, and road improvements to connect to A49 (north); and
- dualling A49 completed within urban area.

7.24 Option Package 6 has the following operational impact on the transport network:

- *A49 north: Edgar Street 2-way bus/freight lanes and dualling*
  There will be a 7% decrease in vehicle flow on A49(N) (i.e. –185 vehicles).

- *A49 south: Ross Road 2-way dualling*
  There will be a 27% decrease in vehicle flow on A49(S) (i.e. –1481 vehicles).

- *Western Inner Distributor and minimum bus priority on 'A' road radials*
  For the main radials taken together, there will be a 14% fall in vehicle flows (i.e. –2565 vehicles) and a 16% rise in passenger flows (i.e. +465 trips).

- *A49 north: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 106% on A49(N) (i.e. +255 trips).

- *A49 south: bus park and ride and 2-way bus lane*
  Park and ride and bus passenger trips will increase by 22% on A49(S) (i.e. +211 trips).

- *Withington Rail Station*
  This will have a slight impact, with new rail trips that use this station making up 2% of total public transport trips on the network (i.e. 144 trips).

- *A49 Greyfriars Bridge*
  There will be a 48% fall in vehicle flow (i.e. –4247 vehicles) and a 34% fall in public transport passenger flow (i.e. –937 trips) on Greyfriars Bridge in Option Package 6.

- *Overall Network*
  Across the whole network there will be a 2% decrease in the proportion of car trips (i.e. –791 trips), no change in the proportion of public transport trips and a 2% increase in the proportion of cycle movements (i.e. +1104 trips). Other modes will remain unchanged from the do-nothing.

Table 7.1 Initial Option Packages: Summary of Principal AST Outcomes

OBJECTIVE	SUB-OBJECTIVE	VALUE	OPTION PACKAGE 1	OPTION PACKAGE 2	OPTION PACKAGE 3	OPTION PACKAGE 4	OPTION PACKAGE 5	OPTION PACKAGE 6
ENVIRONMENT	**Noise**	Change in area wide vehicle-kms in Study Area	-10.10%	-9.90%	+15%	+13.4%	-1.20%	+2.7%
	Local Air Quality	Change in area wide vehicle-kms in Study Area	-10.10%	-9.90%	+15%	+13.4%	-1.20%	+2.7%
		Change in emissions of NO_2 (and PM_{10}) in Study Area	-6.5tpa (-0.5tpa)	-6.4tpa (-0.5tpa)	+14.6tpa (+0.5tpa)	+13.0tpa (+0.4tpa)	+3.6tpa (-0.2tpa)	+5.9tpa (-0.1tpa)
	Greenhouse Gases	Change in area wide vehicle-kms in Study Area	10.10%	-9.90%	+15%	+13.4%	-1.20%	+2.7%
		Change in emissions of CO_2 in Study Area	-12,485tpa	-12,311tpa	+3,247tpa	+2,195tpa	-11,291tpa	-11,240tpa
	Landscape	8 Point Scale	Moderate Adverse	Moderate Adverse	Large Adverse	Large Adverse	Moderate Adverse	Large Adverse
	Townscape	8 Point Scale	Moderate Adverse	Moderate Adverse	Slight Adverse	Slight Adverse	Moderate Adverse	Moderate Adverse
	Heritage of Historic Resources	4 Point Scale	Negative	Negative	Mixed	Mixed	Negative	Negative
	Biodiversity	6 Point Scale	Intermediate Negative	Minor Negative	Major Negative	Intermediate Negative	Intermediate Negative	Intermediate Negative
	Water Environment	4 Point Scale	Mixed	Mixed	Significant Negative	Significant Negative	Significant Negative	Significant Negative
	Physical Fitness	% mode shift from car to walk/cycle	0.2%	0.2%	-1.1%	-0.90%	-0.45%	-0.80%
	Journey Ambience	4 Point Scale	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial
SAFETY	**Accidents**	Change in PI accident nos.(%)	-40 no. (-9.4%)	-40 no. (-9.4%)	-20 no. (-4.7%)	-18 no. (-4.2%)	-71 no. (-16.6%)	-64 no. (-14.9%)
	Security	8 Point Scale	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial
ECONOMY	**Transport Economic Efficiency**	Net Present Value Present Value Costs Benefit Cost Ratio	-£227m -£59m -2.8	-£233m -£31m -6.5	+£913m -£32m 29.7	+£499m -£27m 19.1	+£840m -£30m 29.4	+£436m -£28m 16.3
	Reliability	Change in road vehicle journey time & congestion	-29%	-29%	-43%	-29%	-40%	-21%
	Wider Economic Impacts	Improved access to regeneration areas, industrial and commercial zones	2	2	3	3	2	1
ACCESSIBILITY	**Option Values**	% mode shift from car to bus/rail (% change in psv kms)	+10.3% (+30%)	+10.0% (+27%)	-0.4% (-5%)	+0.17% (+0%)	+1.5% (+12%)	+0.3% (+0%)
	Severance	Change in pedestrian severance	Large Benefit	Large Benefit	Large Benefit	Large Benefit	Large Benefit	Large Benefit
	Access to the Transport System	Change in access to PT by population without access to car	Strong Beneficial	Strong Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial	Moderate Beneficial
INTEGRATION	**Transport Interchange**	New or improved transport and freight interchanges	6	5	2	2	2	2
	Land-Use Policy	3 Point Scale	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial

Option Appraisal

7.25 An Appraisal Summary Table (AST) has been produced for each Option Package as set out in Appendix F and, as advised by GOMMMS, all the AST sub-objectives are measured relative to the Reference Case. A further summary of the AST information is set out in Table 7.1 showing the overall comparison of the six packages against the Reference Case and the sub-objectives. Where numerical values are given in the AST these represent the comparison between the 2031 Option Package and Reference Case scenarios except for the Transport Economic Efficiency sub-objective, which summarises the TUBA analyses over the period 2001 to 2041 against the Reference Case. The TUBA results are also summarised in Table 7.3. A description of the principal AST outcomes for each initial option package follows.

Option Package 1

Environment

7.26 This package would lead to a mode shift from car to public transport of approximately 10% and a similar percentage reduction in road vehicle kilometres. On an area-wide basis the latter reduction would give rise to proportionate reductions in noise and emissions of oxides of nitrogen, particulates and carbon dioxide emissions, qualitatively assessed as beneficial. Detailed scheme-specific noise and air quality assessments have not been carried out for this or any other option.

7.27 The Metro would give rise to moderately adverse impacts on Landscape and Townscape while the bus and Metro park and ride sites would have a negative impact on Biodiversity and would have a mixed impact on the Water Environment sub-objective

7.28 Potentially the removal of traffic from parts of the central area would have a positive impact on Heritage but the new rail station at Rotherwas and its potential impact on Rotherwas Chapel would have a negative impact.

7.29 Other Environment sub-objectives for Option Package 1 are similar for other packages with a small shift (0.2%) to walk and cycle giving slight benefits for physical fitness and a slight beneficial impact on journey ambience.

Safety

7.30 Road accident calculations have been based on statistical accident rates related to vehicle-kilometres. Option Package 1 gives an overall reduction in personal injury road traffic accidents, relative to the Reference Case, of 40 accidents per annum, a 9.4% decrease. Security for travellers, as with all packages, shows a slight beneficial impact due to improvements for cyclists and pedestrians and new transport interchange facilities.

Economy

7.31 The TUBA analysis for Option Package 1 indicates a negative Benefit Cost Ratio (BCR). The heavily negative Net Present Value for this package of -£227m (at current prices discounted at 6% pa to 2000) is primarily due to the delay imposed on private vehicles at key junctions in order to deliver maximum bus priorities. The Present Value of Costs (PVC) for the package is £59m (discounted).

7.32 Although this strategy delivers a 10.3% shift of trips from car to public transport it would require very significant grants or subsidies totalling £55m (discounted) to fund initial investment costs of £43.6m and fare revenue support of £11.4m over the evaluation period.

7.33 Journey time reliability would improve dramatically compared with the Reference Case with a 29% reduction in time lost due to road congestion at key junctions. In terms of wider economic effects this package would improve access to Rotherwas industrial estate by rail and to the City Centre via bus and Metro and associated park and ride.

Accessibility

7.33 Increased bus service frequencies, with a 30% increase in public service vehicle (psv) kilometres, together with park and ride facilities would improve travel options. Improved bus services and the Metro would give much better access to the transport system for those without cars. Due to the reduction in road traffic through the central area and on the main radial routes there would be large beneficial effect on severance for pedestrians and cyclists.

Integration

7.34 In total Option Package 1 provides 6 new or improved transport interchanges and it supports the deposit draft Herefordshire UDP Town Centre and Retail policies and the Rotherwas Employment area policy.

Option Package 2

Environment

7.35 Option Package 2 is similar to the first but includes an additional two bus-based park and ride sites and omits the 'Metro' scheme and its associated park and ride sites. The package would lead to a similar mode shift from car to public transport of approximately 10% and a similar percentage reduction in road vehicle kilometres. Accordingly the benefits for noise, local air quality and green house gas are very similar.

7.36 Moderately adverse impacts on Landscape and Townscape would arise from Package 2 from the three bus-based park and ride sites (the same impacts arose from the Metro option in Package 1). Impacts on Biodiversity reduce to minor negative with the omission of the Metro P&R sites but other Environment sub-objectives are similar to Option Package 1.

Safety

7.37 Impacts on Safety sub-objectives for Option Package 2 are also similar to option Package 1 with an overall reduction in personal injury road traffic accidents of 40 accidents per annum, a 9.4% decrease relative to the Reference Case.

Economy

7.38 The TUBA analysis for Option Package 2 again indicates a negative Benefit Cost Ratio (BCR). The PVC for this package is £31m with a heavily negative NPV of -£233m again mainly due to the delays to private vehicles as a result of the maximum bus priorities. It should be noted that the incremental benefits of Package 1 over Package 2 are only £22m relative to an increase in PVC of £28m giving an incremental BCR of less than unity, which

indicates that the Metro scheme would not represent value for money when competing for passengers against significantly improved bus services and Park and Ride.

7.39 Option Package 2 delivers a 10% shift of trips from car to public transport but it would require significant grants or subsidies, equivalent to £26.8m (discounted), rather than the £55m required for Option Package 1, broken down into £21.2m investment costs and £5.6m fare revenue support.

7.40 Other economic sub-objectives would be similar to Option Package 1.

Accessibility

7.41 Increased bus services frequencies, with a 27% increase in public service vehicle (psv) kilometres, together with bus park and ride facilities would improve travel options. Improved bus services would give better access to the public transport system for those without cars. As for Option Package 1 the reduction in road traffic through the central area and on the main radial routes would give a large beneficial effect on the Severance sub-objective for pedestrians and cyclists.

Integration

7.42 In total Option Package 2 provides 5 new or improved transport interchanges and the draft Herefordshire UDP Town-Centre and Retail policies and the Rotherwas Employment area policy are supported.

Option Package 3

7.43 The third package represents a lower level of bus priorities together with a significant highway element in the form of an outer eastern distributor road linking the A49 North to the Rotherwas Access Road, the A49 South and A465 South.

Environment

7.44 Option Package 3 gives an increase of 15% in annual road vehicle kilometres within the Study Area compared with the Reference case with a small mode shift of 0.4% away from public transport to car. The increase in vehicle kilometres would give rise to increases in noise and other vehicle emissions such as oxides of nitrogen, particulates and carbon dioxide emissions but higher vehicle speeds and operating efficiencies on new highway facilities would give lower proportionate increase in emissions.

7.45 The most serious impacts on Environmental sub-objectives relate to the eastern distributor road and its effect on the River Lugg flood meadows and the River Wye crossing which would have a probable major negative impact on Biodiversity, a large adverse impact on Landscape and a significant negative impact on Water Environment.

7.46 Potentially the removal of traffic from parts of the central area would have a positive impact on Heritage but other schemes in this package would have a mixed impact on this sub-objective.

7.47 Other Environment sub-objectives indicate a shift of 1.1% away from sustainable modes to car compared with the Reference Case giving an adverse impact on the Physical Fitness sub-objective.

Safety

7.48 Option Package 3 gives an overall reduction of 20 personal injury road traffic accidents per annum, a 4.7% decrease. Security for travellers, as with all packages, shows a slight beneficial impact due to improvements for cyclists and pedestrians and new transport interchange facilities.

Economy

7.49 The TUBA analysis for Option Package 3 indicates a Benefit Cost Ratio (BCR) of 29.7. The heavily positive NPV for this package of £913m (at current prices discounted at 6% pa to 2000) is mainly due to private and goods vehicle user benefits (£842m and £116m respectively). The PVC for the package is £32m (discounted) with a relatively small requirement for investment and fare revenue support, through grants or subsidies, equivalent to £3.5m (discounted). The percentage of bus trips decrease slightly compared with the Reference Case.

7.50 Journey time reliability would improve dramatically compared with the Reference Case with a 43% reduction in time lost due to road congestion. In terms of wider economic effects this package would improve access to the Rotherwas and Holmer Road industrial estates by road and to the City Centre via bus and associated park and ride.

Accessibility

7.51 Limited bus priorities together with park and ride facilities will improve travel options and these improved bus services, together with improvements to pedestrian and cycle facilities, will improve travel options and conditions for those without access to a car. Due to the reduction in road traffic through the central area and on the main radial routes there would be large beneficial effect on the Severance sub-objective for pedestrians and cyclists.

Integration

7.52 Option Package 3 provides 2 new interchanges in the form of one bus-based and one rail-based P&R site. It supports the deposit draft Herefordshire UDP Transport, Town-Centre and Retail and Employment policies.

Option Package 4

7.53 This package has a similar combination of public transport and highway elements as Option Package 3 but includes a western distributor road, between the A49 north and south of the City, in lieu of the eastern distributor between Rotherwas and the A49 north.

Environment

7.54 Option Package 4 gives an increase of 13.4% in annual road vehicle kilometres within the Study Area compared with the Reference Case, with a small mode shift of 0.2% away from car to public transport. The increase in vehicle kilometres gives rise to increased noise and other vehicle emissions such as oxides of nitrogen, particulates and carbon dioxide emissions. The effect of higher vehicle speeds and operating efficiencies on new highway facilities give lower proportionate increase in emissions compared with Options 1 and 2.

7.55 The outer western distributor in the Belmont, River Wye crossing and Breinton areas has a large adverse effect on the Landscape sub-objective with a probable intermediate negative impact on Biodiversity and a significant negative impact on Water Environment.

7.56 The impacts of Option Package 4 in relation to other Environment sub-objectives are similar to Package 3.

Safety

7.57 The Safety sub-objectives for Option Package 4 are almost identical to Package 3 with an overall reduction of 18 personal injury road traffic accidents per annum, a 4.2% decrease compared with the Reference Case. Security for travellers shows a slight beneficial impact.

Economy

7.58 The TUBA analysis for Option Package 4 indicates a Benefit Cost Ratio (BCR) of 19.14. The positive NPV for this package of £499m is mainly due to private and goods vehicle user benefits of £452m and £78m respectively. The PVC for the package is £27m with a relatively small requirement for investment and fare revenue support, through grants or subsidies, equivalent to £5m (discounted) with a small, 0.2% shift from car to bus compared with the Reference Case.

7.59 Again journey time reliability would improve dramatically compared with the Reference Case with a 29% reduction in time lost due to road congestion. In terms of wider economic effects this package would improve access to the Rotherwas and Holmer Road industrial estate by road and to the City Centre via bus and associated park and ride.

Accessibility

7.60 Impacts under the Accessibility sub-objectives are the same as for Option Package 3. Limited bus priorities together with park and ride facilities will improve travel options and these schemes, together with improvements to pedestrian and cycle facilities, will also improve travel options and conditions for those without access to a car. Due to the reduction in road traffic through the central area and on the main radial routes there would be large beneficial effect on the Severance sub-objective for pedestrians and cyclists.

Integration

7.61 Option Package 4 provides two new interchanges in the form of one bus-based and one rail-based P&R site. It supports the deposit draft Herefordshire UDP Transport, Town-Centre and Retail and Employment policies.

Option Package 5

7.62 This package is also similar to Option Package 3 in terms of the combination of public transport and highway schemes. However instead of an outer eastern distributor road Option Package 5 includes an inner eastern distributor route passing through the urban fabric, closer to the City Centre, between the A49 north and Rotherwas.

Environment

7.63 Option Package 5 gives a small decrease of 1.2% in annual road vehicle kilometres compared with the Reference Case, with a small mode shift of 1.5% from car to public transport. The increase in vehicle kilometres gives rise to small increases noise and other vehicle emissions such as oxides of nitrogen, particulates and carbon dioxide emissions.

7.64 The inner eastern distributor, particularly its new bridge over the Wye, though having a lesser impact the outer eastern distributor in Package 3, will have a moderate adverse impact (rather than large adverse) on the Landscape sub-objective and a probable intermediate negative (rather than probable major negative) on the Biodiversity sub-objective. However, the inner distributor road would have a significant negative impact on Water Environment and adverse impacts on the Townscape (moderate adverse) and Heritage (negative impact) sub-objectives. The latter effects are principally due to the dualling of parts of the existing A49 and the new River Wye bridge.

7.65 The impacts of Option Package 5 in relation to other Environment sub-objectives are similar to Package 3.

Safety

7.66 The Safety sub-objectives for Option Package 5 are more beneficial than Package 3 with an overall reduction of 71 personal injury road traffic accidents per annum, a 16.6% decrease compared with the Reference Case.

Economy

7.67 The TUBA analysis for Option Package 5 indicates a Benefit Cost Ratio (BCR) of 29.4. The positive NPV for this package of £840m is mainly due to private and goods vehicle user benefits of £755m and £134m respectively. The PVC for the package is £30m with a relatively small requirement for investment costs and fare revenue support, through grants or subsidies, equivalent to £3.4m with a 1.5% shift from car to bus compared with the Reference Case.

7.68 Again journey time reliability would improve dramatically compared with the Reference Case with a 39.6% reduction in time lost due to road congestion. In terms of wider economic effects this package would improve access to the Rotherwas industrial estate by road and to the City Centre via bus and associated park and ride.

Accessibility

7.69 Limited bus priorities together with park and ride facilities will improve travel options and these schemes, together with improvements to pedestrian and cycle facilities, will also improve travel options and conditions for those without access to a car. Due to the reduction in road traffic through the central area and on the main radial routes there would be large beneficial effect on the Severance sub-objective for pedestrians and cyclists.

Integration

7.70 Option Package 5 provides two new interchanges in the form of one bus-based and one rail-based P&R site in addition to the Reference Case. The Package supports the draft Herefordshire UDP Transport, Town-Centre and Retail and Employment policies.

Option Package 6

7.71 This option is similar to Option Package 5 but substitutes an inner distributor road west of the city centre, between the A438 and A465, for the inner eastern distributor in Package 5.

Environment

7.72 Option Package 6 gives a decrease of 2.7% in annual road vehicle kilometres compared with the Reference Case, with a small mode shift of 0.3% from car to public transport. The increase in vehicle kilometres gives rise to small increases in noise and other vehicle emissions such as oxides of nitrogen, particulates and carbon dioxide emissions.

7.73 The adverse impacts on Landscape and Biodiversity associated with the outer western distributor are not significantly reduced compared with the inner western distributor included in Package 6, with large adverse and probably intermediate impacts still arising at the River Wye crossing. The impact on Townscape would be moderately adverse in consequence of the dualling of parts of the A49.

7.74 The impacts of Option Package 6 in relation to other Environment sub-objectives are similar to Package 4.

Safety

7.75 The Safety sub-objectives for Option Package 5 are more beneficial than Package 4 with an overall reduction of 64 personal injury road traffic accidents per annum, a 16.6% decrease compared with the Reference Case. This is principally due to the transfer of traffic to new and safer roads.

Economy

7.76 The TUBA analysis for Option Package 6 indicates a Benefit Cost Ratio (BCR) of 16.3. Again the positive NPV for this package of £436m is mainly due to private and goods vehicle user benefits of £399m and £69m respectively. The PVC for the package is £28m with a relatively small requirement for investment and fare revenue support, through grants or subsidies, equivalent to £4.9m discounted. The Package shows a small shift of 0.3% from car to bus compared with the Reference Case.

7.77 Journey time reliability would improve significantly compared with the Reference Case with a 21.1% reduction in time lost due to road congestion. In terms of wider economic effects this package would improve access to the City Centre, via bus and associated park and ride, but not to any other commercial or industrial areas.

Accessibility

7.78 Limited bus priorities together with park and ride facilities will improve travel options and these schemes, together with improvements to pedestrian and cycle facilities, will also improve travel options and conditions for those without access to a car. Due to the reduction in road traffic through the central area and on the main radial routes there would be large beneficial effect on the Severance sub-objective for pedestrians and cyclists.

Integration

7.79 Option Package 6 provides two new interchanges in the form of one bus-based and one rail-based P&R site in addition to the Reference Case. The Package supports the deposit draft Herefordshire UDP Transport, Town-Centre and Retail and Employment policies.

Assessment Against Local Transport Objectives

7.80 In addition to the AST appraisal against National Objectives this section details the assessment of the initial option packages against local transport objectives. The Herefordshire Local Transport Plan (LTP) sets out perceived problems and objectives and these have been identified and discussed in Section 6 of this Report. In Table 7.2 a distillation of this assessment of the six Option Packages against the LTP objectives for Hereford is presented.

Table 7.2 Initial Option Packages: Distillation Against Local Transport Objectives

LOCAL TRANSPORT OBJECTIVE	REF.	SUMMARY OF IMPACTS
To ensure that people can gain access to existing and future employment, education, leisure and shopping sites, particularly by public transport, cycling and walking.	HT1	Options 1 and 2 increase public transport options significantly with an increase of around 30% in psv kms and a mode switch of 10% from car to public transport compared with the Reference Case. Option Packages 3 to 6 incorporate less public transport options and produce little change in public transport share. All Option packages include improvements to walk and cycle facilities but indicate only small increases or decreases in 'soft' mode share. Options 1 and 2 are slightly beneficial in this respect whilst other options are slightly adverse. Reduced traffic flows in the Central Area in all Options would give large beneficial effects in reducing severance for pedestrians and cyclists.
To provide for the movement of freight into and out of the City whilst seeking to reduce the impact of road freight, and encourage greater use of rail.	HT2	All Option Packages will improve road conditions relative to the Reference Case by reducing congestion and thereby reduce delays to freight movements in and out of the City. Option Packages 3 and 5, which incorporate outer and inner eastern distributor roads, reduce congestion delay by 40%, Options 1, 2 and 4 by around 30% and Option 6 by 20%. Options 3, 4 and 5 would also improve road access for freight to the Rotherwas industrial estates. Rail freight facilities could potentially be improved by the new rail station at Rotherwas as included in Options 1 and 2. Options 3 and 4 which incorporate outer distributor roads help to remove HGV traffic from the central area with positive benefits for Heritage of Historic Resources**.**
To improve road safety and personal security, particularly for vulnerable road users, such as pedestrians and cyclists.	HT3	Forecast annual accident reductions compared with the Reference Case vary from 18 to 20 PIA's for Option Packages 3 and 4, 40 PIA's for Packages 1 and 2 and 64 to 71 PIA's for Option Package 5 and 6. Security for travellers shows a slight beneficial improvement for all Options due to pedestrianisation in the City Centre, new or improved passenger interchanges and improved provisions for pedestrians and cyclists.
To make the transport system more accessible to people with mobility difficulties.	HT4	Public transport improvements incorporated within all options would need to pay due attention to improving access for people with mobility difficulties but the increase in Public Transport provision in Options 1 and 2 will also be beneficial to this group.
To increase the proportion of trips made by public transport, cycling and walking, particularly for journeys to the city centre and major work sites.	HT5	The proportion of trips made by public transport compared with the Reference Case is significantly increased, by a 10% shift from car to public transport, only for Option Packages 1 and 2. There is a small mode shift from car to walk and cycle of 0.2% for Option Packages 1 and 2 but 'soft' mode share reduces slightly for other Options.
To improve the attractiveness and convenience of public transport so as to improve access to mobility for those without the use of a car and to reduce car dependence.	HT6	Option Packages 1 and 2 significantly increase the availability and convenience of public transport with increased frequencies and the Metro scheme in Package 1. These options also include 5 or 6 new or improved passenger interchanges including P&R sites, new rail stations which will improve access to public transport. Public transport provision in other Option packages is significantly less.
To reduce the impact of transport on the environment by encouraging the use of less polluting and more energy efficient modes, such as public transport, cycling and walking.	HT7	Option Packages 1 and 2 are the only packages that significantly contribute to this objective.
To conserve and enhance the environment of Hereford, particularly within the City Centre, and ensure that it remains an attractive place to visit and in which to live, work and invest.	HT8	All packages would contribute to this objective by the reduction of traffic and congestion in the central area compared with the Reference Case. This would also positive benefits in relation to Heritage in the City Centre. Although all Options would give a reduction in noise and other vehicle emissions in the central area, Option Packages 3 and 4 would significantly increase vehicle emissions over the whole Study Area.
To increase the proportion of short trips made by cycle or on foot.	HT9	None of the initial options indicate a significant increase in walk or cycle trips compared with the Reference case.
To reduce the need to travel, in the longer term, by the co-ordination of land use planning with transport.	HT10	All Options have been tested using development assumptions consistent with the draft Unitary Development Plan for Herefordshire.
To ensure the City's transport system enables all the residents of Hereford to lead a healthy lifestyle.	HT11	All options show slight beneficial impacts on Security and Journey ambiance. Only Options 1 and 2 show significant benefits in reducing noise and improving air quality compared with the Reference Case whilst Options 3 and 4 show significant adverse impacts in this respect due to the increase in vehicle kilometres.

Evaluation

7.81 The appraisals and assessments completed for the six initial Options Packages indicate that none of the packages totally satisfy the national or local objectives as defined. This is not unexpected since the initial packages were meant to represent a range of strategic approaches which could be combined in whole or part to produce the final strategy.

Operational

7.82 All the Option Packages tested achieve a reduction in traffic levels and congestion in the central area of the City, as compared to the Reference Case, but by different means. The public transport orientated Options 1 and 2 achieve this through a significant shift from car to public transport principally as a result of maximum bus priorities and associated demand restraint on other road vehicles. Option Packages 3,4,5 and 6 achieve similar reductions, through the provision of new highway facilities in the form of either inner or outer distributor roads, which remove certain road traffic movements from the central area. The latter packages do not achieve any significant modal shift to public transport and none of the six packages achieves any appreciable shift from car to the sustainable walk and cycle modes. All packages retain more two-way traffic on the main city centre roads in 2031 than are currently using these roads.

Distribution and Equity

7.83 The transport economic efficiency of each package has been assessed using the Government's standard Transport User Benefits Analysis (TUBA) software. This enables an assessment of the NPV for each option to broken down as shown in Table 7.3. It can be seen that Options 1 and 2 produce a negative Benefit Cost Ratio and are far below economic viability. The principal reason is the very large disbenefits to private travellers as a result of the maximum bus priorities and the delays to private vehicles at principal junctions in the central area and on radial routes. These were deliberately set to a high level in the initial option testing to examine the maximum potential for modal shift to public transport.

Affordability and Financial Sustainability

7.84 Option Packages 3,4,5 and 6, which include major highway components in the form of inner or outer distributor roads, are shown to be strongly viable from an economic viewpoint.

7.85 The economic and financial viability of the public transport schemes is flagged as an issue by the initial package tests with both Options 1 and 2 requiring very large investment and fare revenue support, through grants or subsidies, equivalent to £55m and £27m respectively. In particular the analysis of the incremental BCR between Package 2 and Package 1 illustrates that the Metro scheme included in Option Package 1 would only produce an extra £22m in discounted benefits for an additional investment of £28m i.e. a BCR of less than 1. It would therefore not be financially or economically viable if competing against the level of bus improvements included in Option 1.

Practicability and Public Acceptability

7.86 The eastern outer distributor road included in Option Package 3 has a large adverse impact environmentally, particularly on Biodiversity, Landscape and Water Environment sub-objectives. The route would be similar over much of its length to the former A49 Trunk Road Bypass which was rejected at Public Inquiry (at dual carriageway standard). Given the

environmental impact of this scheme its deliverability and public acceptability must be questionable. Similar concerns are attached to the inner eastern and western distributors and A49 dualling included in Packages 5 and 6. Although the environmental impact is not as severe as the outer eastern distributor these schemes also have an adverse impact on Heritage.

Table 7.3 Detailed Transport Economic Efficiency Indicators (TUBA)
(costs & benefits in £'000's at current prices discounted to year 2000 at 6% pa)

	Option Package 1	Option Package 2	Option Package 3	Option Package 4	Option Package 5	Option Package 6
User Benefits:						
Private Travel Time	-256666	-292785	840002	462828	737705	400899
Goods Travel Time	76350	78878	83288	56972	97994	51392
Public Transport Travel Time	9013	8520	-300	-317	-365	-300
Vehicle Operating Costs	13991	13205	35310	9920	53390	16199
User Charges	404	413	-47	-46	-57	-47
Net User Benefits	-156908	-191769	958253	529357	888667	468143
Private Sector Provider Impacts						
Revenue	2934	2770	-2912	-2767	-1199	-2727
Operating Costs	-14324	-8400	-221	-1787	-1787	-1787
Investment Costs	-43562	-21181	-400	-400	-400	-400
Grant/Subsidy Payments	54952	26811	3533	4954	3386	4914
Net Impact	0	0	0	0	0	0
Public Sector Provider Impacts						
Revenue	0	0	0	0	0	0
Operating Costs	-138	-138	-3285	-2664	-2890	-2764
Investment Costs	-1172	-1172	-27922	-22647	-24565	-23499
Net Impact	-1310	-1310	-31207	-25311	-27455	-26263
Other Government Impacts						
Grant/Subsidy Payments	-54952	-26811	-3533	-4954	-3386	-4914
Indirect Tax Revenue	-13617	-12814	-10080	-252	-17559	-1350
Net Impact	-68569	-39625	-13613	-5206	-20945	-6264
Net Present Value NPV	-226787	-232704	913433	498840	840267	435616
Present Value of Costs, PVC	-59196	-30891	-31828	-27498	-29642	-28450
Present Value to Government	-56262	-28121	-34740	-30265	-30841	-31177
Benefit/Cost Ratio, BCR	-2.83	-6.53	29.70	19.14	29.35	16.31
Value/Cost to Government Ratio, VCGR	-4.03	-8.28	26.29	16.48	27.25	13.97

8.0 DEVELOPMENT AND EVALUATION OF COMBINED PACKAGES

Development of Blended Package Options

8.1 The overall evaluation of the initial packages was based on the key issues highlighted in the Appraisal Summary Tables and the comparison of Option Package performance with the Local Transport Objectives. Based on this evaluation, the consultants worked with the Steering Group and the Wider Reference Group to identify a combined or blended package of schemes and measures for further testing.

8.2 The principal decisions reached in formulating the Blended Package options can be briefly summarised as follows:

- The Metro and linked P&R sites, as included in Option Package 1, was omitted from further consideration on the grounds that it did not represent value for money;

- The junction delays modelled in the initial options to represent the implementation of bus priority measures were set at a high level to assess the maximum mode shift that might result from such measures. Bus priorities were taken forward but the associated junction delays to other traffic used in the modelling of Options 1 and 2 were scaled back to a more realistic level to reduce the time disbenefits imposed. This was judged to represent the maximum deliverable level of bus priority measures;

- Two bus-based P&R sites (A49 south and A465 south), a rail-based P&R site at Withington and a new rail station at Rotherwas were included in the blended packages. The remainder of the public transport, cycle and pedestrian schemes in the initial packages were also carried forward to the Blended Package for further consideration;

- The road-building elements of Option Packages 5 and 6 i.e. the internal eastern and western distributor roads respectively together with the completion of dualling of the A49 within the urban area , were also omitted from further consideration. The deliverability of these schemes is questionable and strong concern was expressed during the consultation that these schemes would have an unacceptable impact on the environment and heritage of the City. Both schemes were therefore omitted from further consideration;

- Although the business community appeared to favour an eastern outer distributor road, as tested in Option Package 3, the major adverse environmental implications of such a route had raised significant opposition during consultation. Comparisons had been drawn between this route and the formerly proposed A49 trunk road bypass, which raised questions over its deliverability. This scheme was also omitted from further consideration;

- The majority of respondents in the consultation supported some degree of new road-building. It was therefore decided to include the remaining highway scheme, the western outer distributor road, in the Blended Package. However the Steering Group also requested that the Blended Package should be tested with and without the

western distributor to identify whether the Study objectives could be adequately achieved without the western outer distributor; and

- All the initial option packages were tested on the assumption that current attitudes and behavioural responses to alternative transport choices would remain the same. It was recognised from the initial option testing that no transport improvements in Hereford would be likely to encourage sufficient transfer of trips away from 'car' travel to avoid serious highway congestion and associated environmental/safety problems in future. Only initial Options 1 and 2 showed a significant shift to public transport and none of the six options showed any significant shift to walk and cycle modes as compared with the Reference Case. The Steering Group were of the opinion that behavioural change could be encouraged through a wide range of 'soft' initiatives including Employee Travel Plans, School Travel Plans, improved travel information, improved standards of public transport, cycling and pedestrian facilities etc. Based on currently available data on the success elsewhere of these measures it was considered that a 'Behavioural Change Campaign', through education and persuasion rather than simply perceived journey cost considerations, could conceivably achieve an additional shift from car to more sustainable public transport, walk and cycle modes of 6% by 2011 and 12% by 2031. This 'behavioural shift' in people's travel patterns and choice of mode would be needed, as part of any strategy option, over and above a simple reaction to relative travel costs on different modes.

8.3 The individual schemes and measures included within the Blended Package, as agreed by the Steering Group, are therefore:

- city centre full pedestrianisation (Widemarsh St, High St, Broad St – access for bus, cyclists and pedestrians);
- improved cycle and pedestrian facilities;
- two bus-based park and ride sites (A49 south and A465 south);
- maximum feasible bus priorities;
- new rail station at Rotherwas;
- rail-based park and ride site at Withington;
- 20mph zones in residential areas off main routes;
- school transport package;
- behavioural Change Campaign (additional shift from car of 6% by 2011 and 12% by 2031); and
- the 'Blended Package with the Western Distributor' includes the western outer distributor road. The 'Blended Package without the Western Distributor' omits this scheme.

8.4 As with the initial option packages, the Blended Package options also include the Reference Case schemes listed below:

- Rotherwas Access Road;
- 2-way bus and HGV priority lanes on A49 Edgar Street;
- inbound bus lanes on A438 Eign Street and A465 Commercial Road; and
- bus-based park and ride service on A49(N) between Racecourse (at A4103 Roman Road) and City Centre.

Transport Forecasts and Operational Assessment

Mode Share

8.5 The overall modal share for the Blended Package options for the 2011 and 2031 peak hours are shown in Table 8.1 below. It should be noted that the additional behavioural change of 6% mode shift from car to other modes in 2011 and 12% in 2031 is included in the figures below both for the two Blended Packages.

Table 8.1 Forecast Mode Share 2011 and 2031

	Reference Case		Blended Package with Western Distributor		Blended Package without the Western Distributor	
Mode	**AM Peak**	**PM Peak**	**AM Peak**	**PM Peak**	**AM Peak**	**PM Peak**
Year 2011						
Car	62%	60%	59%	53%	55%	51%
Public transport	12%	11%	14%	16%	18%	18%
Walk	15%	22%	16%	23%	16%	23%
Cycle	5%	4%	5%	5%	5%	5%
HGV	5%	3%	5%	3%	5%	3%
Year 2031						
Car	62%	60%	56%	50%	52%	48%
Public transport	12%	11%	14%	16%	18%	18%
Walk	15%	22%	17%	24%	17%	24%
Cycle	4%	4%	6%	6%	6%	6%
HGV	7%	4%	7%	4%	7%	4%

Comparison of 2031 AM Peak Hour Flows with Current 2002 Flows

8.6 The operational impacts of the Blended Package, with and without the outer Western Distributor, are considered below for key links in the Hereford network. In order to give a benchmark for comparison which is readily understandable, forecast AM Peak Hour flows for 2031 are compared with current (Year 2002) flows.

- *A49 north: Edgar Street*

  Blended Package with the Western Distributor:

  Forecast reduction in 2-way vehicle flows is -19% (i.e. –1243 vehs.) to 5199 vehs/hr with an increase in bus passengers of 22% (i.e. 414 pass.)

  without the Western Distributor:

  Forecast reduction in 2-way vehicle flows is -9% (i.e. –598 vehicles) to 5900 vehs/hr with an increase in passenger flows of 94% (i.e. 1791 pass.)

- *A49 Greyfriars Bridge*

  Blended Package with the Western Distributor:

  Forecast reduction in 2-way vehicle flows is –13% (i.e. –576 vehs.) to 4038 vehs/hr with an increase in passengers of 24% (i.e. 496 pass.)

  without the Western Distributor:

  Forecast increase in 2-way vehicle flows is 10% (i.e. 486 vehs) to 5100 vehs/hr with an increase in passenger flows of 115% (i.e. 2348 pass.)

- *A49 north: near race-course*

  Blended Package with the Western Distributor:

  Forecast reduction in 2-way vehicle flows is –41% (i.e. –880 vehs.) to 1288 vehs/hr with an increase in public transport flows of 1042 passengers.

  without the Western Distributor:

  Forecast reduction in 2-way vehicle flows is –41% (i.e. –878 vehs.) to 1290 vehs/hr with an increase in public transport flows of 522 passengers.

- *A49 south: south of Holmer Road*

  Blended Package with the Western Distributor:

  Forecast reduction in 2-way vehicle flows is –42% (i.e. –542 vehs.) to 748 vehs/hr with an increase in public transport flows of 523 passengers.

  without the Western Distributor:

  Forecast reduction in 2-way vehicle flows is –9% (i.e. –113 vehs.) to 1176 vehs/hr with an increase in public transport flows of 613 passengers.

- *Main 'A' road radials*

  Blended Package with the Western Distributor:

  Forecast reduction in 2-way vehicle flows on all main radials is –11% (i.e. –1194 vehs.) to 9765 vehs/hr with an increase in public transport flows of 2360 passengers.

  without the Western Distributor:

  Forecast reduction in 2-way vehicle flows is –3% (i.e. –280 vehs.) to 10379 vehs/hr with an increase in public transport flows of 3453 passengers.

- *Western Outer Distributor*

  The Blended Package with the Western Distributor:

  Forecast flows on the western distributor in the 2031 AM Peak Hour vary from a two-way flow of 890 vehs/hr on the northern section, 2260 vehs/hr on the central section and 1027 vehs/hr on the southern section.

- *Public Transport*

  The Blended Package with the Western Distributor:

  The introduction of a western distributor road reduces the number of bus passengers when compared with the Blended Package without a new road. In the latter situation, total bus passengers increase significantly over the Reference Case. Once a new road is built, bus passenger loadings on each link tend to revert to numbers which are closer to those found in the Reference Case.

TABLE 8.2 Blended Package with the Western Distributor: Appraisal Summary Table

Blended Package with Western Distributor	**Package Description:** **Two bus based park and ride site (A49 south and A465 south)** **Maximum feasible bus priorities** **City centre full pedestrianisation (Widemarsh St, High St, Broad St – access for bus, cyclists and pedestrians)** **New rail station at Rotherwas** **Improved cycle and pedestrian facilities** **20mph zones in residential areas** **One rail based park and ride site at Withington** **School transport package** **Behavioural Change Campaign to achieve shift from car to more sustainable modes of 6% by 2011 and 12% by 2031** **Western Distributor Road**	**Implementation Cost at Current (2002) Prices = £ 83.6M** (plus Behavioural Change @ £300,000 pa and Dedicated School Bus provision @ £500,000 pa)

OBJECTIVE	*SUB- OBJECTIVE*	*QUALITATIVE IMPACTS*	*QUANTITATIVE MEASURE*	*ASSESSMENT*
ENVIRONMENT	*Noise*	Reduction in Study Area road traffic produces a slight benefit in respect of noise.	%age change in annual vehicle kms.	-13.4%
	Local Air Quality	Reduction in road vehicle traffic in Study Area has a slight benefit on the local air quality.	%age change in annual vehicle kms. Approx change in NOx emissions (tonnes/year) Approx. change in PM emissions (tonnes/year)	-13.4% -4.3 tonnes/year -0.5 tonnes/year
	Greenhouse Gases	Reduction in road vehicle traffic in the Study Area reduces green house gas emissions.	%age change in annual vehicle kms. Approx. change in CO_2 emissions (tonnes/year)	-13.4% -10,644 tonnes/year
	Landscape	Western Outer Distributor gives a large adverse impact on landscape. Two bus park and ride moderate adverse. Rail park and ride slight adverse. Remainder neutral.	1 Scheme large adverse. 1 Scheme moderate adverse. 1 Scheme slight adverse. 7 Schemes neutral.	Large Adverse.
	Townscape	Moderate adverse impact on townscape from two bus-based park and ride. Slight adverse impact from rail-based park and ride. Moderate beneficial effect from pedestrianisation.	1 Scheme moderate beneficial. 1 Scheme moderate adverse. 1 Scheme slight adverse. 7 Schemes neutral	Moderate Adverse.
	Heritage of Historic Resources	Potential positive effects from removal of traffic from historic area. Negative effects from the new rail station at Rotherwas.	8 Schemes Mixed. 1 Schemes Potential Positive. 1 Scheme Negative	Negative Impact
	Biodiversity	Slight negative impact on biodiversity from bus/rail park & ride sites and rail station. Moderate negative impact from Western Outer Distributor.	3 Schemes slight negative impact. 1 Scheme moderate negative impact. 6 Schemes insignificant impact.	Moderate Negative Impact.
	Water Environment	Mixed impacts from rail park & ride and rail station. Western Outer Distributor significant negative impact. Other impacts insignificant.	1 Scheme significant negative 2 Schemes mixed impact. 7 Schemes insignificant impact.	Significant Negative Impact.
	Physical Fitness	The overall effect of the package of measures is a shift from car to soft modes (walk and cycle) giving physical fitness benefits.	%age Mode shift from car to soft modes.	6.9%
	Journey Ambience	Western Distributor, two-bus and one rail park and ride provide moderate beneficial impacts. Maximum bus priorities, new rail station at Rotherwas, and improved cycle and pedestrian facilities provide slight beneficial impact.	3 schemes moderate beneficial impact 3 schemes slight beneficial impact 4 schemes neutral impact	Moderate beneficial impact
SAFETY	*Accidents*	A reduction in road vehicle traffic will lead to a reduction in accidents.	Reduction in all personal injury accidents	76no. (-22.3%)
	Security	Pedestrianisation, a new rail station at Rotherwas and improved cycle/pedestrian facilities provide a slight beneficial impact.	3 Schemes slight beneficial impact 7 Schemes neutral impact	Slight beneficial impact.
ECONOMY	*Transport Economic Efficiency*	Current analysis is evaluating Transport Economic Efficiency over the period 2001 to 2041 using two modelled years 2011 and 2031	Forecast Users Benefits by mode – Private: £866.4m Goods: £118.5m Public Transport: £6.7m	Overall NPV £891.1m Overall PVC -£69.3m PVC to Gov. -£64.0m (Grant/Subsidy -£38m) Overall BCR 13.9
	Reliability	Less congestion due to traffic moving from the centre and using the new western distributor road.	% Change in congestion delay.	-64%
	Wider Economic Impacts	Improved access to Rotherwas industrial area by train. Improved access to City commercial centre via bus and park & ride. Western Distributor improves access to both Rotherwas and Holmer.	No. of regeneration, commercial and industrial areas with improved transport access.	3 areas
ACCESSIBILITY	*Option Values*	Increased bus service frequencies, park and ride and new rail station will increase travel options.	Change in public service vehicle-kms. % Mode shift from car to public transport.	+23.7% increase in psv-kms +8.0% shift to public transport
	Severance	The central area has a very large benefit with an average 38% reduction in traffic flow, whilst the A49 also has a large benefit with an average 39% reduction. Similarly the A465 benefits with an average 27% reduction in flow.	Assessment from the change in am peak hour 2 way road vehicle flows	Large benefit due to the significant reduction in traffic within the central area.
	Access to the Transport System	The improved bus priorities and frequencies, rail station, improved cycle and pedestrian facilities will all benefit those who do not have access to a car.		Strong Beneficial
INTEGRATION	*Transport Interchange*	New interchanges as a result of two bus based park and ride, one rail based park and ride and a new rail station at Rotherwas.	No. of new or improved transport and freight interchanges.	4 new interchanges
	Land-Use Policy	The Blended Package plan options will support the draft UDP policies S4 Employment, S5 Town centres and retail and S6 Transport.	Three point GOMMMS scale	Beneficial

TABLE 8.3 Blended Package without the Western Distributor Appraisal Summary Table

Blended Package Without Western Distributor	**Package Description:** **Two bus based park and ride site (A49 south and A465 south)** **Maximum feasible bus priorities** **City centre full pedestrianisation (Widemarsh St, High St, Broad St – access for bus, cyclists and pedestrians)** **New rail station at Rotherwas** **Improved cycle and pedestrian facilities** **20mph zones in residential areas** **One rail based park and ride site at Withington** **School transport package** **Behavioural Change Campaign to achieve shift from car to more sustainable modes of 6% by 2011 and 12% by 2031**	**Implementation Cost at Current (2002) Prices = £ 43.2M** (plus Behavioural Change @ £300,000 pa and Dedicated School Bus provision @ £500,000 pa)

OBJECTIVE	*SUB- OBJECTIVE*	*QUALITATIVE IMPACTS*	*QUANTITATIVE MEASURE*	*ASSESSMENT*
ENVIRONMENT	*Noise*	Reduction in Study Area road traffic produces a slight benefit in respect of noise.	%age change in annual vehicle kms.	-21.8%
	Local Air Quality	Reduction in road vehicle traffic in Study Area has a slight benefit on the local air quality.	%age change in annual vehicle kms. Approx.change in NOx emissions (tonnes/year) Approx. change in PM emissions (tonnes/year)	-21.8% -10.4 tonnes/year -0.7 tonnes/year
	Greenhouse Gases	Reduction in road vehicle traffic in the Study Area reduces green house gas emissions	%age change in annual vehicle kms. Approx. change in CO_2 emissions (tonnes/year)	-21.8% -16,482 tonnes/year
	Landscape	Two bus park and ride moderate adverse. Rail park and ride slight adverse. Remainder neutral.	1 Scheme moderate adverse. 1 Scheme slight adverse. 7 Schemes neutral.	Moderate Adverse.
	Townscape	Moderate adverse impact on townscape from two bus-based park and ride. Slight adverse impact from rail-based park and ride. Moderate beneficial effect from pedestrianisation.	1 Scheme moderate beneficial. 1 Scheme moderate adverse. 1 Scheme slight adverse. 6 Schemes neutral	Moderate Adverse.
	Heritage of Historic Resources	Potential positive effects from removal of traffic from historic area. Negative effects from the new rail station at Rotherwas.	7 Schemes Mixed. 1 Schemes Potential Positive. 1 Scheme Negative	Negative Impact
	Biodiversity	Slight negative impact on biodiversity from bus/rail park & ride sites and rail station.	3 Schemes slight negative impact. 6 Schemes insignificant impact.	Slight Negative Impact.
	Water Environment	Mixed impacts from rail park & ride and rail station. Other impacts insignificant.	2 Schemes mixed impact. 7 Schemes insignificant impact.	Mixed Impact.
	Physical Fitness	The overall effect of the package of measures is a shift from car to soft modes (walk and cycle) giving physical fitness benefits.	%age Mode shift from car to soft modes.	7.1%
	Journey Ambience	Two-bus and one rail park and ride provide moderate beneficial impacts. Maximum bus priorities, new rail station at Rotherwas, and improved cycle and pedestrian facilities provide slight beneficial impact.	2 schemes moderate beneficial impact 3 schemes slight beneficial impact 4 schemes neutral impact	Moderate beneficial impact
SAFETY	*Accidents*	Reduction in road vehicle traffic will lead to a proportionate reduction in accidents.	Reduction in all personal injury accidents	75no. (-22.0%)
	Security	Pedestrianisation, a new rail station at Rotherwas and improved cycle/pedestrian facilities provide a slight beneficial impact.	3 Schemes slight beneficial impact 6 Schemes neutral impact	Slight beneficial impact.
ECONOMY	*Transport Economic Efficiency*	Current analysis is evaluating Transport Economic Efficiency over the period 2001 to 2041 using two modelled years 2011 and 2031	Forecast Users Benefits by mode – Private: £513.7m Goods: £85.8m Public Transport: £7.3m	Overall NPV £535.6m Overall PVC -£45.9m PVC to Gov. -£38.6m (Grant/Subsidy -£36.7m) Overall BCR 12.7
	Reliability	The reduction in vehicle-kilometres due mainly to fewer car trips results in less traffic delay due to congestion on the network.	% Change in congestion delay.	-47%
	Wider Economic Impacts	Improved access to Rotherwas industrial area by train. Improved access to City commercial centre via bus and park & ride.	No. of regeneration, commercial and industrial areas with improved transport access.	2 areas
ACCESSIBILITY	*Option Values*	Increased bus service frequencies, park and ride and new rail station will increase travel options.	Change in public service vehicle-kms. % Mode shift from car to public transport.	+52.6% increase in psv kms +11.6% shift to public transport
	Severance	The central area has a very large benefit with an average 35% reduction in traffic flow, whilst the A49 also has a large benefit with an average 41% reduction. Similarly, the A465 benefits with an average 35% reduction in traffic flow.	Assessment from the change in am peak hour 2 way road vehicle flows	Large benefit due to the significant reduction in traffic within the central area.
	Access to the Transport System	The improved bus priorities and frequencies, rail station, improved cycle and pedestrian facilities will all benefit those who do not have access to a car.		Strong Beneficial
INTEGRATION	*Transport Interchange*	New interchanges as a result of two bus based park and ride, one rail based park and ride and a new rail station at Rotherwas.	No. of new or improved transport and freight interchanges.	4 new interchanges
	Land-Use Policy	The Blended Package plan options will support the draft UDP policies S4 Employment, S5 Town centres and retail and S6 Transport.	Three point GOMMMS scale	Beneficial

Option Appraisal

8.7 An Appraisal Summary Table (AST) for the Blended Package with and without the Western Distributor are shown in Tables 8.2 and 8.3. As with the initial options the AST compares the performance of the Blended Package with the Reference Case in 2031. The following sections of the report compare the performance of the two Blended Package options against the Study objectives relative to the Reference Case.

Environmental Objectives

8.8 The overall environmental impact of the two Blended Package options is differentiated principally by the inclusion or exclusion of the Western Distributor as discussed below:

Emissions (Noise, Local Air Quality, Greenhouse Gases)

8.9 Forecast annual total vehicle-kms in the Study Area for the Blended Package with Western Distributor are reduced by 13.4%, from the Reference Case levels. The main effect of the inclusion of the western distributor is an increase in road vehicle journey lengths compared to Blended Package without the Western Distributor.

8.10 The reduction of 13.4% in annual vehicle kilometres which results from the Blended Package with Western Distributor gives rise to a reduction in oxides of nitrogen (4.3 tonnes/year), and a decrease in particulates (0.5 tonnes/year) and carbon dioxide (10,644tonnes/year) as well as a proportionate reduction in noise.

8.11 In contrast, Blended Package without the Western Distributor gives a 21.8% reduction in total annual vehicles-kms as a result of the public transport and behavioural change measures, together with the provision of park and ride. This gives rise to proportionate reductions in oxides of nitrogen (10.4tonnes/year), particulates (0.7 tonnes/year) and carbon dioxide (16,482 tonnes/year) and a proportionate reduction in noise.

Landscape

8.12 Significant Landscape impacts, other than those due to the Western Distributor, are limited except for the potential moderate adverse impact of a bus-based P&R sited on the edge of the urban area at Belmont on the A465 south of the River Wye.

8.13 The Landscape to the west of Hereford contains many areas and features of recognised Landscape Value. These include the River Wye, Belmont Parkland and the area around Breinton. A western distributor would inevitably adversely affect one or more of these areas and the impact would be large adverse and, in the case of the Wye Valley, Landscape impact would be difficult to mitigate.

8.14 Overall the Blended Package with the Western Distributor has a large adverse Landscape impact and but without the Western Distributor this is reduced to a moderate adverse impact.

Townscape

8.15 Both Blended packages have similar impacts on Townscape since any outer western distributor would not affect the urban fabric of the City. Townscape impacts for both packages include full city centre pedestrianisation - moderate beneficial, two bus-based park and ride sites - moderate adverse, rail-based park and ride - slight adverse and all other

schemes are neutral. Overall, both Blended packages are assessed as moderate adverse Townscape impact.

Heritage of Historic Resources Impacts

8.16 A new rail station at Rotherwas could have a negative impact on Heritage due to its potential effect on a Scheduled Ancient Monument (The Chapel), but full pedestrianisation of city centre has a positive impact. A western distributor would have potential benefits arising from the removal of traffic from areas of historic value within the city but also potential for adverse effects on sites or areas of interest along the route. All other schemes would have a mixed impact. Overall, both Blended Packages are assessed as having a negative impact on Heritage of Historic Resources.

Biodiversity Impacts

8.17 The bus-based and rail-based park and ride sites together with the new Rotherwas rail station would have a probable slight negative impact on Biodiversity. All other schemes in Blended Package without the Western Distributor have an insignificant impact on Biodiversity.

8.18 The landscape to the west of Hereford contains a number of sites and areas of recognised biodiversity value. Protected fauna is also known to use the area. The River Wye is a site of particular importance and it is likely that a Western Distributor, if included in the Blended Package, would affect sites or species of value and impact is assessed as having a probable moderate negative impact.

8.19 Overall the Blended Package with the Western Distributor has a probable moderate negative impact on Biodiversity and without it a probable slight negative impact.

Water Environment

8.20 In relation to the schemes included in Blended Package without the Western Distributor, the rail-based park and ride and Rotherwas rail station have mixed impacts on the Water Environment sub-objective. All other schemes have an insignificant contribution.

8.21 Any western distributor would need to cross the River Wye and whilst a crossing is likely to be at high level and have little effect on the flood plain, potential impacts on water quality exist. Probably significant negative impacts could result.

8.22 Overall therefore with the Western Distributor the Blended Package has a significant negative impact and without this scheme, a mixed impact on the Water Environment sub-objective.

Physical Fitness

8.23 The effect of both packages is to increase walk and cycle trips with a modal shift from car to the sustainable modes of around 7%. This shift is due mainly to the additional behavioural change modelled in the Blended Packages.

Journey Ambiance

8.24 The Blended Packages give a moderate beneficial impact on Journey Ambiance due to the introduction of park and ride facilities and the Western Distributor, if included. Other schemes give a slight or neutral impact on this sub-objective.

Safety Objectives

8.25 The performance of Blended Package with and without the Western Distributor against the safety sub-objectives are compared as follows:

Accidents

8.26 In both cases the Blended Package delivers a potential 22% decrease in personal injury accidents per annum, equivalent to a reduction of 75 accidents per annum compared to the Reference Case.

Security

8.27 Both cases show a slight beneficial impact on the Security sub-objectives due to the pedestrianisation in the City centre and the improvements to walk and cycle facilities. The new rail station at Rotherwas also has a slight beneficial impact.

Economy Objectives

Transport Economic Efficiency

8.28 The TUBA analysis has been completed for each of the Blended Package based on two modelled years, 2011 and 2031, covering the period 2001 to 2041. The total estimated investment cost at current prices for the Blended Package with the Western Distributor is £83.6m and, without the Western Distributor, £43.2m. In addition an annual expenditure of £300,000 has been included in each option for behavioural change initiatives.

8.29 The Blended Package with and without the Western Distributor give positive BCRs of 13.9 and 12.7 respectively. Net Present Values (NPV) of £891m and £536m respectively also indicate strong economic viability. However the public transport elements of the packages would require significant support. At this stage the investment cost for bus priority schemes have been included as private sector provider costs. On this basis the overall discounted investment and operating costs for the public transport schemes in both options would require fare revenue support through grants or subsidies of around £37m (discounted).

Reliability

8.30 The Reliability sub-objective has been assessed by reference to the reduction in congestion afforded by each option. The Blended Package with the Western Distributor gives a reduction of 64% in time lost to congestion on the road network compared to the Reference Case. Although not as effective in this respect, the Blended Package without the Western Distributor also produces a significant decrease in congestion of 47%.

Wider Economic Effects

8.31 The Blended Package with the Western Distributor produces wider economic benefits by improving road access via the western distributor to Rotherwas and Holmer industrial estates. Public transport access to the City centre commercial area and Rotherwas are also improved. Without the Western Distributor the Blended Package is less beneficial in relation to Wider Economic Effects.

Accessibility Objectives

Option Values

8.32 The aim of this sub-objective is to provide additional travel options. With increased bus frequencies, park and ride and the new station at Rotherwas both Blended Packages options are beneficial in this regard. As a result The Blended Package without the Western Distributor produces a 12% mode shift from car to public transport compared to the Reference Case. The effect of the inclusion of the Western Distributor in Blended Package is to reduce this mode shift to 8%.

Severance

8.33 Both blended options result in large reductions in traffic flow in the central area of up to 40% compared with the Reference Case. Consequentially, perceived severance for pedestrians and cyclists will be substantially reduced producing a large benefit.

Access to the Transport System

8.34 This sub-objective is strongly beneficial for both blended options. Improved, high frequency bus services, improved cycle and pedestrian facilities and the new Rotherwas rail station will all benefit people who do not have access to a car.

Integration Objectives

Transport Interchange

8.35 Both blended packages each provide a total of four new transport interchanges in the form of two bus-based park and ride sites (A49 south and A465 south), one rail-based site (at Withington) and a rail station at Rotherwas.

Land-Use Policy

8.36 Again both Blended Options are beneficial in terms of this sub-objective, supporting the deposit draft UDP policies, S4 Employment, S5 Town Centres and S6 Transport.

Assessment Against Local Transport Objectives

8.37 In addition to the AST appraisal against National Objectives this section sets our assessment of the blended packages against local transport objectives. The Herefordshire Local Transport Plan (LTP) sets out perceived problems and objectives and these have been identified and discussed in Section 6 of this Report. In Table 8.4 we present a distillation of this assessment of the two Blended Option Packages against the LTP objectives for Hereford.

Table 8.4 Blended Packages Options: Distillation Against Local Transport Objectives

LOCAL TRANSPORT OBJECTIVE	REF.	SUMMARY OF IMPACTS
To ensure that people can gain access to existing and future employment, education, leisure and shopping sites, particularly by public transport, cycling and walking.	HT1	Both Blended Package options increase public transport options significantly with respective increases of 24% and 56% in psv kms and a mode switch of 8% (with the western distributor) and 12% (without the western distributor) from car to public transport compared with the Reference Case. Both packages include improvements to walk and cycle facilities and indicate a 7% increase shift from car to 'soft' modes. Substantially reduced traffic flows in the Central Area of up to 40% compared with the Reference Case for both Blended options would give large beneficial effects in reducing severance for pedestrians and cyclists.
To provide for the movement of freight into and out of the City whilst seeking to reduce the impact of road freight, and encourage greater use of rail.	HT2	Both Blended Package options will significantly improve road conditions relative to the Reference Case by reducing congestion and thereby reduce delays to freight movements in and out of the City. The Blended Package with an outer Western Distributor road reduces congestion delay by 62%, and without this scheme by around 47%. The Blended Package with the Western Distributor would also improve road access for freight to the Rotherwas industrial estates and rail freight facilities could potentially be improved by a new rail station at Rotherwas. The Blended Package with the Western Distributor would help to remove HGV traffic from the central area with positive benefits for Heritage of Historic Resources.
To improve road safety and personal security, particularly for vulnerable road users, such as pedestrians and cyclists.	HT3	Forecast annual accident reductions compared with the Reference Case are 75 PIA's for both Blended Option Packages. Security for travellers shows a slight beneficial improvement for both Options due to pedestrianisation in the City Centre, new or improved passenger interchanges and improved provisions for pedestrians and cyclists.
To make the transport system more accessible to people with mobility difficulties.	HT4	Public transport improvements incorporated within both Blended Options would need to pay due attention to improving access for people with mobility difficulties but the increase in Public Transport provision will also be beneficial to this group.
To increase the proportion of trips made by public transport, cycling and walking, particularly for journeys to the city centre and major work sites.	HT5	The proportion of trips made by public transport compared with the Reference Case is significantly increased by a 12% shift from car to public transport for the Blended Package without the Western Distributor and lesser 8% for the Blended Package with Western Distributor. There is a significant mode shift from car to walk and cycle of 7% for both Blended Package options due to Behavioural Change initiatives.
To improve the attractiveness and convenience of public transport so as to improve access to mobility for those without the use of a car and to reduce car dependence.	HT6	Both Blended Package options significantly increase the availability and convenience of public transport with increased frequencies. These options also include 4 new passenger interchanges including P&R sites, new rail stations which will improve access to public transport.
To reduce the impact of transport on the environment by encouraging the use of less polluting and more energy efficient modes, such as public transport, cycling and walking.	HT7	Both Blended Package option contribute significantly to this objective.
To conserve and enhance the environment of Hereford, particularly within the City Centre, and ensure that it remains an attractive place to visit and in which to live, work and invest.	HT8	Both Blended packages would contribute to this objective by the reduction of traffic and congestion in the central area compared with the Reference Case. This would also positive benefits in relation to Heritage in the City Centre. Both Options would give a reduction in noise and other vehicle emissions in the central area and would significantly reduce vehicle emissions over the whole Study Area.
To increase the proportion of short trips made by cycle or on foot.	HT9	Both Blended options result in a significant increase in walk or cycle trips compared with the Reference Case due to Behavioural Change.
To reduce the need to travel, in the longer term, by the co-ordination of land use planning with transport.	HT10	Options have been tested using development assumptions consistent with the draft Unitary Development Plan for Herefordshire.
To ensure the City's transport system enables all the residents of Hereford to lead a healthy lifestyle.	HT11	Both options show slight beneficial impacts on Security and Journey ambiance and also significant benefits in reducing noise and improving air quality compared with the Reference Case.

Evaluation and Selection of Preferred Option

8.38 For the final stages of selection of the preferred Blended Package a distillation of the performance of the two options, essentially with and without the Western Distributor, against the full range of criteria and objectives has been assembled under the following sub-headings:

- Transport forecasts and operational assessment;
- GOMMMS Sub-objectives and Appraisal Summary Tables;
- Local Transport Objectives;
- Supporting Analyses; and
- Conclusion.

Transport Forecasts and Operational Assessment

8.39 The appraisals and assessments completed for the Blended Package Options indicate that both packages satisfy the national and local transport objectives to a significantly higher level than the initial options tested. Both Blended Packages achieve a significant reduction in traffic levels and congestion in the central area of the City, as compared to the Reference Case. Table 8 below indicates the total vehicle-hours lost to congestion in the Base Year 2002 and in the future modelled years 2011 and 2031. Average journey time indices (taking the Base Year value as 100) are also indicated for future year forecasts.

8.40 In the 2011 Reference Case journey times per vehicle-km would be similar to existing 2002 but overall vehicle hours lost to congestion would increase from 28400 hrs to 32200 hrs on a typical weekday due to traffic growth. By 2031 the transport model indicates that total weekday delays would almost double to 51400hrs with average journey times per vehicle-km increasing by around 21% over existing levels.

8.41 The Blended Package without the Western Distributor reduces existing levels of congestion by around 50% by 2011 but by 2031 vehicle-hours lost due to congestion increase to approximately 70% to 75% of current levels. The Blended Package with the Western Distributor produces further significant reductions in time lost to congestion in both 2011 and 2031. This is particularly so in 2031 by which year the introduction of the Western Distributor reduces total time lost to congestion to 12187 vehicle-hours as compared with the levels achieved by the 'without Western Distributor' option of 14123 vehicle-hours in 2011 and 20437 vehicle–hours in 2031.

Table 8.5 Forecast Congestion Delays compared with Base Year 2002

Year	2002	2011			2031		
Scenario	Existing	Reference Case	Blended Package		Reference Case	Blended Package	
			With Western Distributor	Without Western Distributor		With Western Distributor	Without Western Distributor
Average weekday (0700hrs to 1900hrs)							
Total congestion delay (veh-hrs)	28383	32241	10619	14123	51442	12187	20437
Index of average journey time per vehicle-km	100	99	57	70	121	57	79
Average AM peak hour							
Total congestion delay (veh-hrs)	3549	3641	1713	1867	5977	1976	2651
Index of average journey time per vehicle-km	100	93	58	69	118	60	80

8.42 In total, the Blended Package with Western Distributor reduces total annual private vehicle trips by 15% of which 8% transfer to public transport and 7% to walk and cycle. The Blended Package without the Western Distributor gives a 19% decrease in private vehicle trips, split 12% to public transport and 7% to walk and cycle. The shift to more sustainable modes in each case is essentially due to the inclusion of additional behavioural change in the blended packages.

8.43 To relate future forecast conditions with the current situation it is useful to compare 2031 traffic flows for the Blended Package with Base Year 2002 flows. Overall the Blended Package (with and without the Western Distributor) potentially reduces 2031 peak hour flows to below existing traffic levels. As discussed above, the effect of this reduction in general traffic levels means that forecast levels of congestion in 2031 compared with the 2031 Reference Case are substantially reduced i.e. by 64% with the Western Distributor and by 47% without the Western Distributor.

8.44 The transport model indicates an average 11% reduction in current AM peak flows on all main radial routes with the Western Distributor and a 3% reduction without this scheme compared with current 2002 traffic flows. An important exception to this is the Greyfriars Bridge where only the Blended Package with the Western Distributor achieves a reduction (13%) of existing 2002 AM Peak Hour traffic flows in 2031. Without the Western Distributor a 10% increase is indicated at this location over and above 2002 traffic levels.

8.45 By 2031 traffic movements across the River Wye will be 10% higher than current AM peak hour levels if the Western Distributor is not included in the Blended Package.

GOMMMS Sub-objectives and Appraisal Summary Tables

8.46 The AST's for the Blended Package shown in Table 8.2 and 8.3 illustrate the additional environmental impact associated with the inclusion of the Western Distributor. In relation to the Environmental sub-objectives, on an area-wide basis in 2031, additional noise and emissions result from:

- a smaller reduction in overall vehicle-kms of -13.8% with the Western Distributor and -21.8% without and,

- a reduced mode shift from car to other modes of 14.9% with and 18.9% without the Western Distributor.

8.47 Conversely, with its higher levels of congestion, the Blended Package without the Western Distributor is likely to result in worse localised air quality particularly in the central area.

8.48 The largest environmental impacts of a Western Distributor are in the Belmont, River Wye crossing and Breinton areas and the scheme would have a large adverse effect on the Landscape sub-objective with a probable intermediate negative impact on Biodiversity and a significant negative impact on Water Environment. The Blended Package without this highway scheme has a lesser impact on these sub-objectives. Impact on other Environmental sub-objectives including Townscape, heritage, Physical Fitness and Journey Ambiance are similar with or without the Western Distributor.

8.49 Safety sub-objectives i.e. Accidents and Security are also similar. The former despite the increase in vehicle-kms for with the Western Distributor because accident rates for newly engineered highways are statistically lower.

8.50 The Economy sub-objectives the Blended Package with the Western Distributor is superior in terms of Transport Economic Efficiency with discounted Net Present Value (£891m cf £536m) and Benefit Cost Ratio (13.9 cf 12.7). It is also significantly better in terms of the Reliability sub-objective with reduction in congestion of 64% compared to the Reference Case as against a 47% reduction without the Western Distributor. In relation to Wider Economic Impacts the Western Distributor improves access for cross-river road traffic to and from the industrial areas north and south of the River Wye.

8.51 The Accessibility sub-objectives are similar for the Blended Packages except that without the Western Distributor, compared to the Reference case, there is a 52.6% increase in public transport vehicle-kms required to carry the 11.6% mode shift from car to public transport. With this highway scheme mode shift falls to 8.1%.

8.52 Both Blended Packages, with and without the Western Distributor support the AST Integration sub-objectives by the provision of four new transport interchanges and both are consistent with deposit draft UDP policies on Employment, Town centres and retail and Transport.

Local Transport Objectives

8.53 Table 8.4 sets out a distillation of the performance of the Blended Package against Local Transport Objectives and both Blended Packages, with and without the Western Distributor, generally satisfy all these Objectives to some degree. Differences in performance relate to the principally to Objective HT2 '*to provide for the movement of freight into and out of the City whilst seeking to reduce the impact of road freight , and to encourage greater use of rail'* for which the 'with Western Distributor option is superior.

Distribution and Equity

8.54 The transport economic efficiency of each package has been assessed using the Government's standard Transport User Benefits Analysis (TUBA) software. This enables the NPV for each option to broken down as shown in Table 8.6. The Table indicates that The Blended Package with the Western Distributor provides much higher private user benefits of

and savings in vehicle operating costs and higher goods vehicle benefits. The Blended Package without the Western Distributor gives higher public transport user benefits.

Affordability and Financial Sustainability

8.55 The total investment cost for the Blended Package with Western Distributor at £83.6m, excluding investment in Behavioural Change, reflects the inclusion of the western distributor in this package. This package has a slightly higher BCR of 13.9 than the Blended Package without the Western Distributor value of 12.7 despite its lower investment cost of £43.2m.

8.56 Both the Blended Package options require grant/subsidy funding of around £37m to £38m discounted for the public transport measures including £23m to £24m investment costs and fare revenue support of £13m to £15m. The bulk of the investment costs would be for the implementation and maintenance of the bus priority measures.

8.57 The incremental costs and benefits of the Western Distributor are as set out Table 8.6. As a stand alone scheme added to the Blended Package it is economically robust, producing an additional Net Present Value of £354m and a Benefit Cost Ratio of 15.5.

Practicability and Public Acceptability

8.58 Despite being an economically beneficial scheme with significant advantages in terms of reducing traffic flows and congestion within the City, the western outer distributor included in the Blended Package with Western Distributor would have adverse environmental impacts, particularly in terms of landscape, water environment and biodiversity as discussed in 8.2 above. The inclusion of this road scheme in gives an additional investment requirement of £40m. The public acceptability of this major road scheme is obviously a factor to be considered.

8.59 The Blended Package without the Western Distributor is however more dependant on the success of the proposed behavioural change initiatives and this constitutes a major risk in terms of its economic viability.

Cost of Implementation

8.60 The estimated (undiscounted) cost of implementation of each element of the Blended Packages is shown at Appendix F, Table F7. Total cost of the Blended Package with a western distributor road is estimated to be £83.6m at current prices. Without a western distributor, the cost is £43.2m. In addition, a sum of £300,000 per annum should be earmarked for implementing behavioural change. This sum was estimated by considering the current spend of £50,000 per annum which allows for one Council Officer to be wholly dedicated to the programme. The increase allows for 3 staff to cover the whole county and a sum to repeat the Home Interview Travel Survey at 5 yearly intervals.

8.61 The estimated cost of each scheme in Table F7 was derived from various sources. Where previous studies had provided cost estimates, these were used, updated if necessary to 2002 prices. The western distributor road used indicative cost per kilometre, prepared for the earlier by-pass studies, again updated to current prices. Bus priority, pedestrian and cycle facilities were derived by considering each key junction and estimating the cost of improvement to provide the necessary right of way for each mode on the basis of an average cost per junction or link.

Conclusion

8.62 The evaluation and comparison of the Blended Packages as set out above essentially revolves around the environmental disbenefits, principally the impacts on landscape, biodiversity and water environment, of including the Western Distributor weighed against the loss of congestion relief and economic benefits if this scheme is excluded. In the medium to long term, i.e. beyond the 2011, if the Western Distributor is excluded from the Blended Package, delays, congestion and unreliable journey times for cross-river road traffic, whether through-traffic or traffic wishing to access the commercial and industrial areas of the City north and south of the River Wye, will revert to those experienced today.

8.63 The introduction of the major public transport improvements, together with cycle and pedestrian improvements together with the promotion in travel change behaviour as included in the Blended Package is designed to produce a mode shift from car to the more sustainable modes. The inclusion of additional highway capacity in the network can work against this goal particularly if this occurs before new travel patterns and behaviour are established.

8.64 It is therefore concluded that the advantages of including the Western Distributor in the Blended Package could outweigh the environmental disadvantages but only if the scheme is built in the medium to long term after the bulk of the other schemes and measures are delivered. The timescale for delivery of similar schemes is currently 12 to 15 years although in relation to Trunk Road schemes, the Highways Agency is examining ways of speeding up the delivery and reducing this time to eight years after entry to the Governments Targeted Programme of Improvements.

8.65 The Blended Package as identified by this Study as far as practicable should be programmed for implementation over the next 15 years with a target date for the completion of the western distributor after 2016, subject to the prior achievement of the objectives of the more sustainable elements of the Package. A suggested implementation programme is shown at Figure 9.1.

8.66 This indicative timing would fit in with the current timetable for major road schemes to be implemented. Although it can only be regarded as indicative, the Highways Agency allocate the following average time for the delivery of a Trunk Road scheme under the traditional procurement route:

• Investigate alternatives and prepare for consultation	143 weeks;
• Public consultation and selection of Preferred Route	45 weeks;
• Preferred Route announcement and preparation for order publication	152 weeks;
• Draft Orders published and preparation for PI	40 weeks;
• Public Inquiry and Secretary of State decision announced, orders made	45 weeks;
• Contract Documents prepared, contract awarded	118 weeks;
Sub-Total	10.5 years
• Start of consultation to road open	2 years
Total Project Duration	***12.5 years***

8.67 These times are based on historic projects. With innovative procurement, it is hoped to reduce this time but the consultants feel that for the purpose of timetabling delivery of any strategy which included a western distributor the current delivery period should be used.

Table 8.6 Detailed Transport Economic Efficiency Indicators (TUBA) (Costs and benefits in £'000's at current prices discounted to 2000 at 6% pa)

	Blended Package with Western Distributor	Blended Package without the Western Distributor	Incremental Costs and Benefits for Western Distributor
User Benefits:			
Private Travel Time	830696	484548	346148
Goods Travel Time	83857	60875	22982
Public Transport Travel Time	6694	7313	-619
Vehicle Operating Costs	70263	54105	16158
User Charges	24	31	-7
Net User Benefits	**991534**	**606872**	**384662**
Private Sector Provider Impacts			
Revenue	5340	7271	-1931
Operating Costs	-20060	-20060	0
Investment Costs	-23264	-23947	0
Grant/Subsidy Payments	37984	36736	1931
Net Impact	**0**	**0**	**0**
Public Sector Provider Impacts			
Revenue	0	0	0
Operating Costs	-2733	-196	-2878
Investment Costs	-23233	-1705	-21528
Net Impact	**-25966**	**-1901**	**-24406**
Other Government Impacts			
Grant/Subsidy Payments	-37984	-36736	-1931
Indirect Tax Revenue	-36497	-32683	-3814
Net Impact	**-74481**	**-69419**	**-5745**
Net Present Value NPV	**891087**	**535552**	**354511**
Present Value of Costs, PVC	**-69290**	**-45908**	**-24406**
Present Value to Government	-63950	-38637	-26337
Benefit/Cost Ratio, BCR	**13.86**	**12.67**	**15.53**
Value/Cost to Government Ratio, VCGR	13.93	13.86	13.46

9.0 RECOMMENDATIONS

Introduction

9.1 Based on the evaluation of the initial option packages, the Steering Group, a majority of the Wider Reference Group and the Consultants concluded that as tested none of these option packages would satisfy the objectives set for the study. Recent announcements by Government indicated that it would not be formally targeting a specific reduction figure for congestion within the ten-year plan. However it was accepted by all three groups that some reduction in congestion in Hereford was still a worthwhile objective and the selected strategy should reflect this.

9.2 The evaluation of the Combined Package (with a Western Distributor) produced the desired reduction in traffic growth, modal shift and a satisfactory economic benefit for the investment. It was acknowledged that the Western Distributor would have adverse environmental effects together with function improvements required to deliver the level of bus priority regarded as necessary.

9.3 Although both Blended Packages produce significant benefits, the Package with a western distributor meets the national and local objectives better in operational and economic terms, than if the western distributor is omitted. The Blended Package without the western distributor relies very significantly on achieving the additional behavioural change of 12% of car drivers to more sustainable modes, to meet the study objectives. Thus, the Blended Package with a western distributor has much greater flexibility and can accommodate variations in the level of achievement of each measure and timetable.

9.4 A further benefit of a western distributor which is more difficult to quantify is the effect of the current absence of an alternative crossing of the River Wye to the existing Greyfriars Bridge. Commercial interests and residents may accept the current situation but the absence of an alternative has been put forward as inhibiting inward investment by industrial and commercial enterprises looking to expand or relocate in Hereford or even to retaining existing enterprises.

9.5 This degree of flexibility in the transport system will become increasingly important as pressure on the system increases through complexity of utilities and greater intensity of transport use. This means that disruption due to roadworks and streetworks will increase, making alternative routes and modes a very important element of the overall transport strategy.

The Strategy Summarised

9.6 The elements of the recommended strategy are as follows:

Walking: Review of footway provision and pedestrian crossing facilities, dropped kerbs, pedestrianise city centre.

Cycling: Completed network of cycle routes covering all main radial directions.

Public Transport: Four Park and Ride Schemes implemented. Monday-Saturday each week.

	Major Bus Priorities on all radials and Inner Relief Road. Signal priority at junctions for buses. New rail stations at Rotherwas and Withington.
Highways:	20mph zones in residential areas. Junction improvements to accommodate bus priorities. Western distributor road.
Parking:	In accordance with Herefordshire Council Parking Strategy, ensure PNR/Publicly available balance is biased in favour of publicly available through development control. Increase existing provision to 2800 off-sheet spaces and 800 Park and Ride spaces. (Approximately 200 additional off-street spaces will be required mostly to be on the south side of city. Introduce on-street charging related to Park and Ride provision.
Behavioural Change:	Persuade 6% of car drivers by 2011 and 12% by 2031 to change mode over and above scheme generated modal shift.

9.7 The advantages and disadvantages of a rail based Park and Ride site at Withington compared with a bus based one at the northern edge of the City will require more detailed assessment than is possible in a strategic study. It is unlikely that both would be justified and a bus based Park and Ride could be implemented initially, making use of the bus priorities which will be required on the A465 north, from the city centre to the edge of the urban area, replaced at a later date with the rail based Park and Ride at Withington.

9.8 The additional behavioural change to achieve a modal shift of car drivers to more sustainable modes (6% by 2011 and 12% by 2031) was recognised as being difficult, but not impossible, to achieve. However the transport modelling indicates that this is unlikely to occur without significantly higher investment in persuading drivers to change their current behaviour. Thus this aspect of behavioural change should be regarded as an investment requiring funding just as much as more physical measures such as bus priorities.

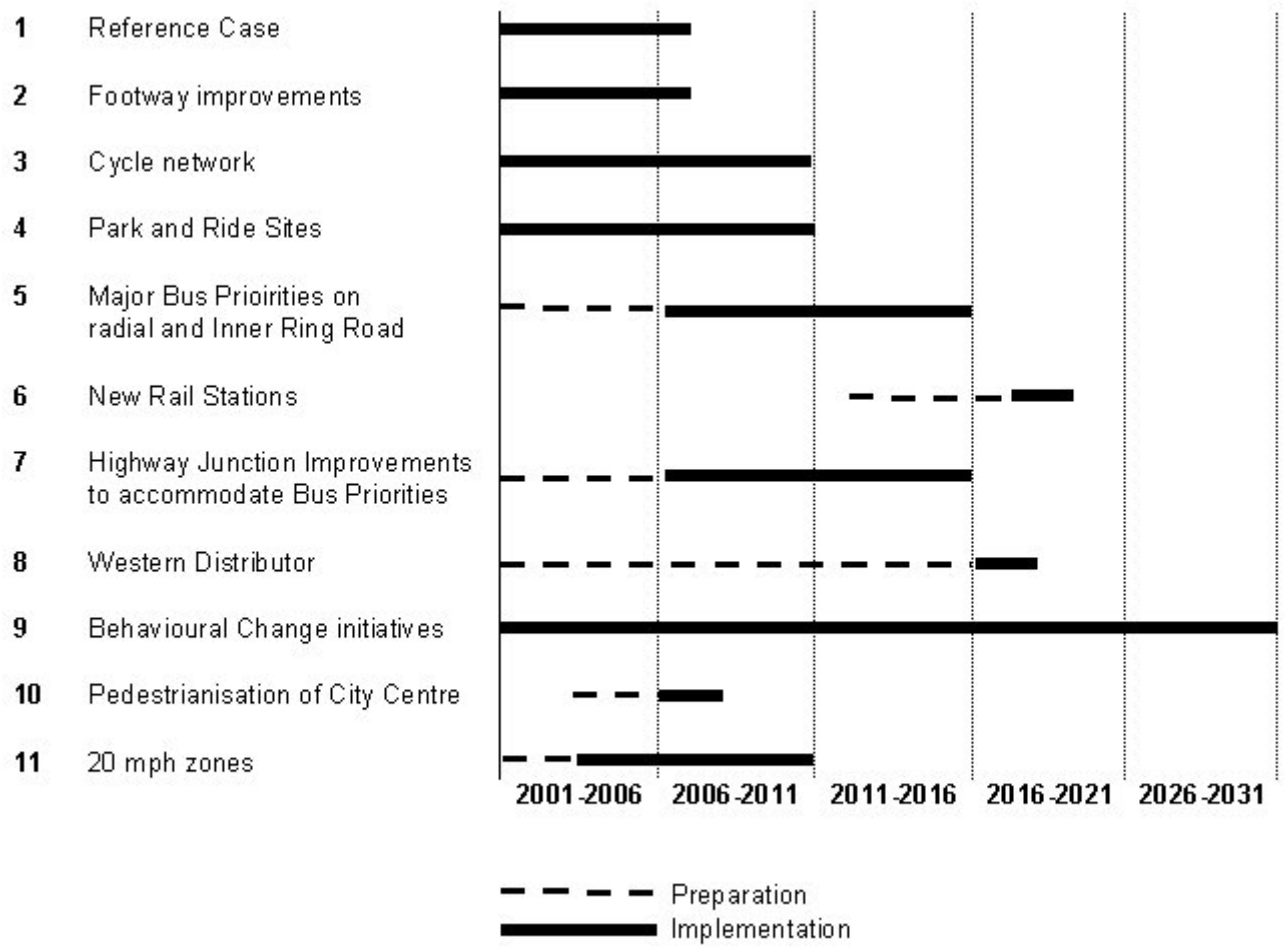
9.9 Suggested target dates for implementation of the various elements of a recommended strategy are shown at Figure 9.1. Dates have taken account as far as possible what the consultants believe are practicable and realistic periods that will be required for preparation and construction.

Potential Funding Sources

9.10 There are several potential sources of funding for the various schemes and initiatives which could be available to implement the preferred strategy when it is finally approved. Currently these might include European Union (Objective 2 status), Central Government, Highways Agency, Regional Development Agency (Advantage West Midlands), Herefordshire Council and private organisations. These latter could be involved through Private Finance Initiatives (PFI) or developer contributions through Section 106 or 278 Agreements.

9.11 The total capital investment cost of the recommended strategy would be just over £80m over the 30 year period. In addition, annual costs of £0.5m and £0.3m would be required for maintaining the dedicated school bus provision and behavioural changes respectively. Approximately £0.9m will be required annually to operate the bus based Park and Ride sites and the rail stations and associated infrastructure at Rotherwas and Withington. An additional maintenance cost would be required for enhanced bus priority signalling. This

would be small compared with the overall system maintenance cost and can only be determined following scheme feasibility design but could be of the order of £300,000 per year.


1 Reference Case
2 Footway improvements
3 Cycle network
4 Park and Ride Sites
5 Major Bus Prioirities on radial and Inner Ring Road
6 New Rail Stations
7 Highway Junction Improvements to accommodate Bus Priorities
8 Western Distributor
9 Behavioural Change initiatives
10 Pedestrianisation of City Centre
11 20 mph zones
2001-2006
2006-2011
2011-2016
2016-2021
2026-2031
Preparation
Implementation