

LNMS Evaluation Report

A45/A46 Stivichall Junction Improvements



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1. Introduction

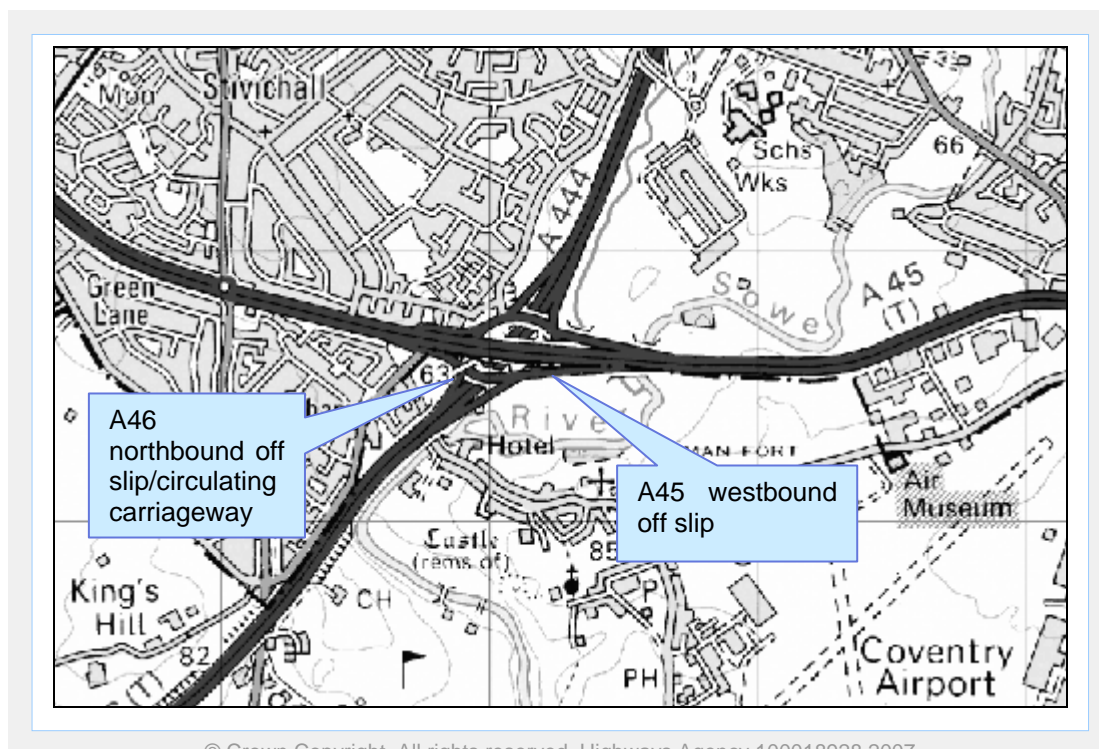
BACKGROUND

- 1.1 The junction of the A45 and A46 at Stivichall is a double grade separated junction located within Highways Agency (Area 11) to the south of Coventry and forms a key interchange between the A45 and A46. Key features of the junction include those described as follows:
- ◆ The A45 is a key corridor linking Birmingham with Coventry and the national motorway network;
 - ◆ The Stivichall junction is located on the outer Coventry Ring Road and therefore is heavily used by vehicles bypassing Coventry;
 - ◆ The junction is a key interchange that serves strategic traffic movements between M6 (Junction 2), East Birmingham, Warwick and the M40;
- 1.2 Prior to the scheme opening high traffic flows at the junction meant that that congestion was a regular occurrence. Specific traffic issues at the Stivichall Interchange as identified in the January 2004 Project Appraisal Report (Version 3.2) include:
- ◆ Significant queuing and delays on the A46 northbound off slip and A45 westbound off slip as result of limited road capacity; and
 - ◆ A high incidence of congestion related accidents (55% of Pre-Opening PIAs involved stationary vehicles/queuing traffic)
- 1.3 The location of the A45/A46 junction in relation to the wider geographical area and trunk road network is illustrated in **Figure 1.1** and **1.2**.

Figure 1.1 - Location of A45/A46 Scheme



Figure 1.2 - A45/A46 Stivichall Junction Detail



SCHEME DESCRIPTION

- 1.4 The A45/A46 junction improvements were completed on 20th May 2004. Key features of the scheme that are examined within this post opening report include:
- ◆ The construction of a third lane on the A45 westbound off slip approach to the roundabout to create a designated lane to the A46 southbound;
 - ◆ The installation of traffic signals at the A46 northbound off slip/circulating carriageway junction; and
 - ◆ New road signs, line markings and safety fencing.

SCHEME CATEGORISATION AND OBJECTIVES

- 1.5 Local Network Management Schemes are categorised according to which of the five assessment objectives of Safety, Economy, Environment, Accessibility and Integration is primarily addressed by the scheme. As detailed in the PAR document, the scheme was objectives were to:
- ◆ Increase the efficiency of this junction by reducing the existing capacity problems;
 - ◆ Facilitate a reduction in congestion and hence reduce the incidence of congestion related accidents; and
 - ◆ Improve the journey ambience for users of the junction.
- 1.6 The scheme has therefore been categorised as an **economy scheme**.

PURPOSE OF THIS REPORT

- 1.7 As part of an ongoing requirement of the Highways Agency to re-evaluate the impacts of new trunk road schemes, Atkins Consultants Ltd has been commissioned by the Highways Agency to undertake post-opening evaluations of large Local Network Management Schemes (LNMS) with an implementation cost of between £1m and £5m. The aim of this process is to assist the Highways Agency (HA) and their managing agents to:
- ◆ Quantify the outturn benefits and disbenefits accruing from new schemes and to ascertain which schemes offer the greatest value for money;
 - ◆ Develop the pre-scheme appraisal processes (PAR Guidance) and ensure that accurate predictions are made about the possible impacts of highway schemes on safety, congestion, environment, accessibility and integration in the future; and
 - ◆ Ensure that the HA continues to deliver schemes that offer the greatest value for money and that are most effective solutions to problems on the core network.
- 1.8 This document specifically sets out the results of the Post Opening Project Evaluation (POPE) of the A45/A46 Stivichall junction Improvements Scheme as implemented in May 2004. More specifically the report examines the economic, safety, environmental, accessibility, and integration impacts resulting from the installation of signals on the A46 Northbound off-slip, the installation of a free-flow lane on the A45 westbound off-slip and the accompanying signing and lining modifications.

POPE METHODOLOGY OVERVIEW

- 1.9 This report initially presents an assessment of the physical impacts of the scheme and more specifically:
- ◆ A comparison of the 'before' and 'after' traffic volumes at the junction to illustrate how overall traffic conditions have changed following scheme opening; and
 - ◆ An outline of changes in accident rates at the junction following scheme opening.
- 1.10 This is then followed by an assessment of the scheme in accordance with the POPE methodology. This methodology aims to provide a method by which forecast and out-turn effects of a scheme can be evaluated on a common basis. This process ultimately derives two assessments:
- ◆ **Assessment 1:** The original Project Appraisal Report (PAR) Assessment. This represents the forecast benefits of the scheme and includes an AST. Where necessary values are updated to 2002 discounting and price bases; and
 - ◆ **Assessment 2:** An Evaluation Summary Table based on the out-turn effects of the scheme using a methodology consistent with the original PAR assessment undertaken prior to scheme opening.
- 1.11 POPE is based on an evaluation of the schemes out-turn impacts against the five core NATA objectives as listed below:

- ◆ **Economy** - concerned with improving the economic efficiency of transport for example journey time savings and reliability;
- ◆ **Safety** - concerned with reducing the loss of life, injuries and damage to property resulting from transport incidents and crime;
- ◆ **Environment** - reducing the direct and indirect impacts of transport facilities on the physical and social environment of both users and non-users;
- ◆ **Accessibility** - concerned with the ability with which people can reach different locations and facilities by different modes; and
- ◆ **Integration** - aims to ensure that all decisions are taken in the context of the Government's integrated transport policy.

REPORT STRUCTURE

1.12 Following this introduction, the report has been structured as follows:

- ◆ **Section 2 – Scheme Detail and Stakeholder Feedback:** Provides details of the scheme including 'as built' plans and photos illustrating the schemes key features and summarises stakeholder feedback;
- ◆ **Section 3 – Economy Impacts:** Outlines the economic impact of the scheme;
- ◆ **Section 4 – Safety Impacts:** Analyses the safety impact of the scheme;
- ◆ **Section 5 – Environment, Accessibility and Integration;**
- ◆ **Section 6 - Summary of Findings and Recommendations:** This summarises the findings of the assessment.

2. Scheme Detail and Stakeholder Feedback

- 2.1 This section examines the details of the layout of the scheme. The specific aims of this section are to:
- ◆ Identify and provide details of the measures implemented;
 - ◆ Provide a summary of the feedback from the MAC and project sponsor regarding the overall effectiveness of the scheme in achieving the intended objectives.

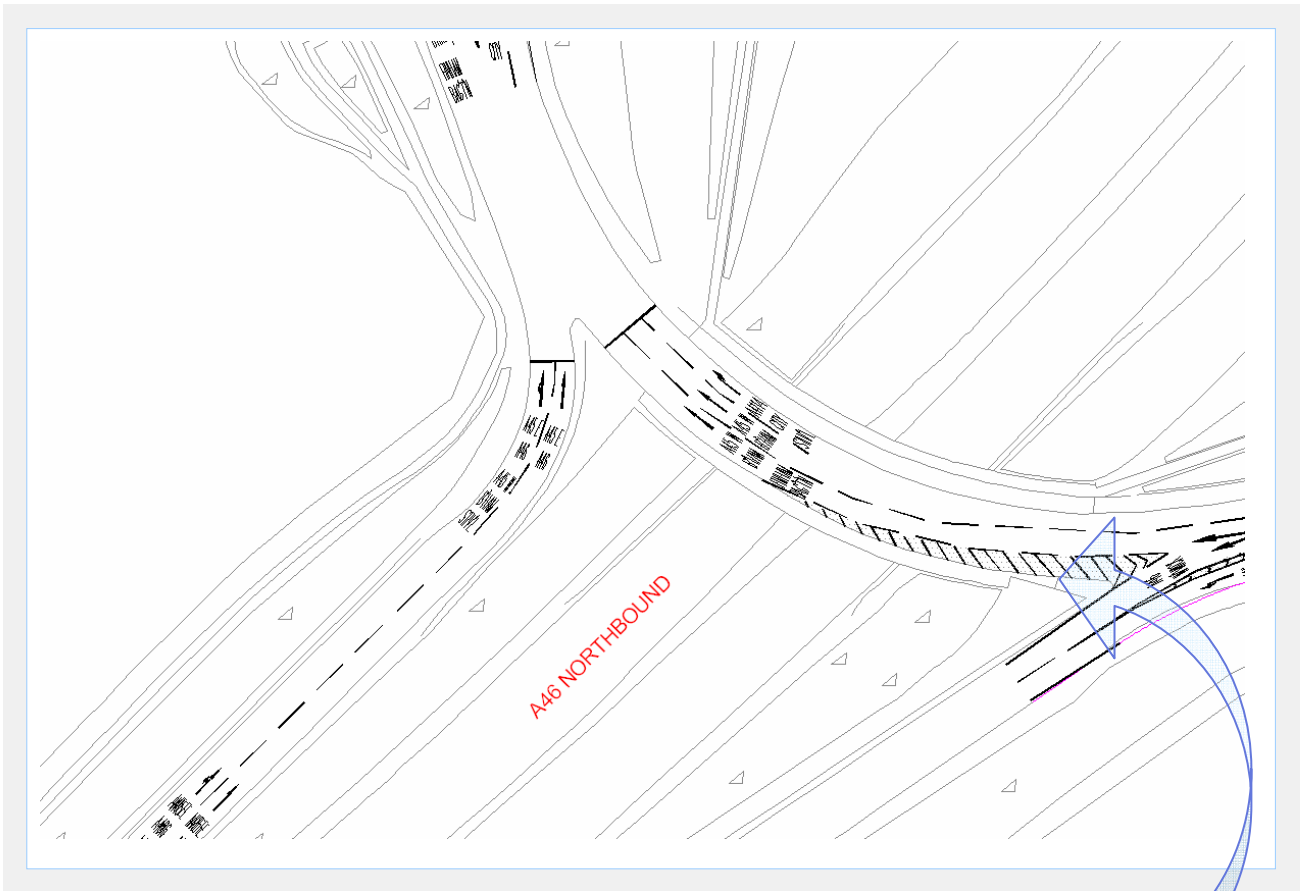
MEASURES IMPLEMENTED

- 2.2 **Figure 2.1** presents the 'As built' layout. The main elements of the scheme include:
- ◆ Signalisation of the A46 northbound off-slip;
 - ◆ Installation of a free flow left turn lane from the A45 westbound off slip to the A46 southbound on-slip;
 - ◆ Improved road markings and signage showing destinations designed to reduce route uncertainty;
 - ◆ Pavement resurfacing at the A45 westbound off-slip, A46 northbound off-slip and two other locations on the circulatory carriageway; and
 - ◆ Installation of a maintenance lay-by between the A45 westbound off slip and A46 northbound on-slip.

Signalisation

- 2.3 The signals are operated by a Microprocessor Optimised Vehicle Actuation (MOVA) control which changes signals times in response to changing traffic flows. The duration of the green phase changes according to the volume of traffic entering the roundabout from the A46 northbound arm and on the circulating carriageway. By increasing the length of green time given to vehicles on the A46 N/B off slip the potential for queuing back on to the main carriageway is reduced.
- 2.4 Details of the traffic signal layout are illustrated in **Figure 2.1** overleaf:

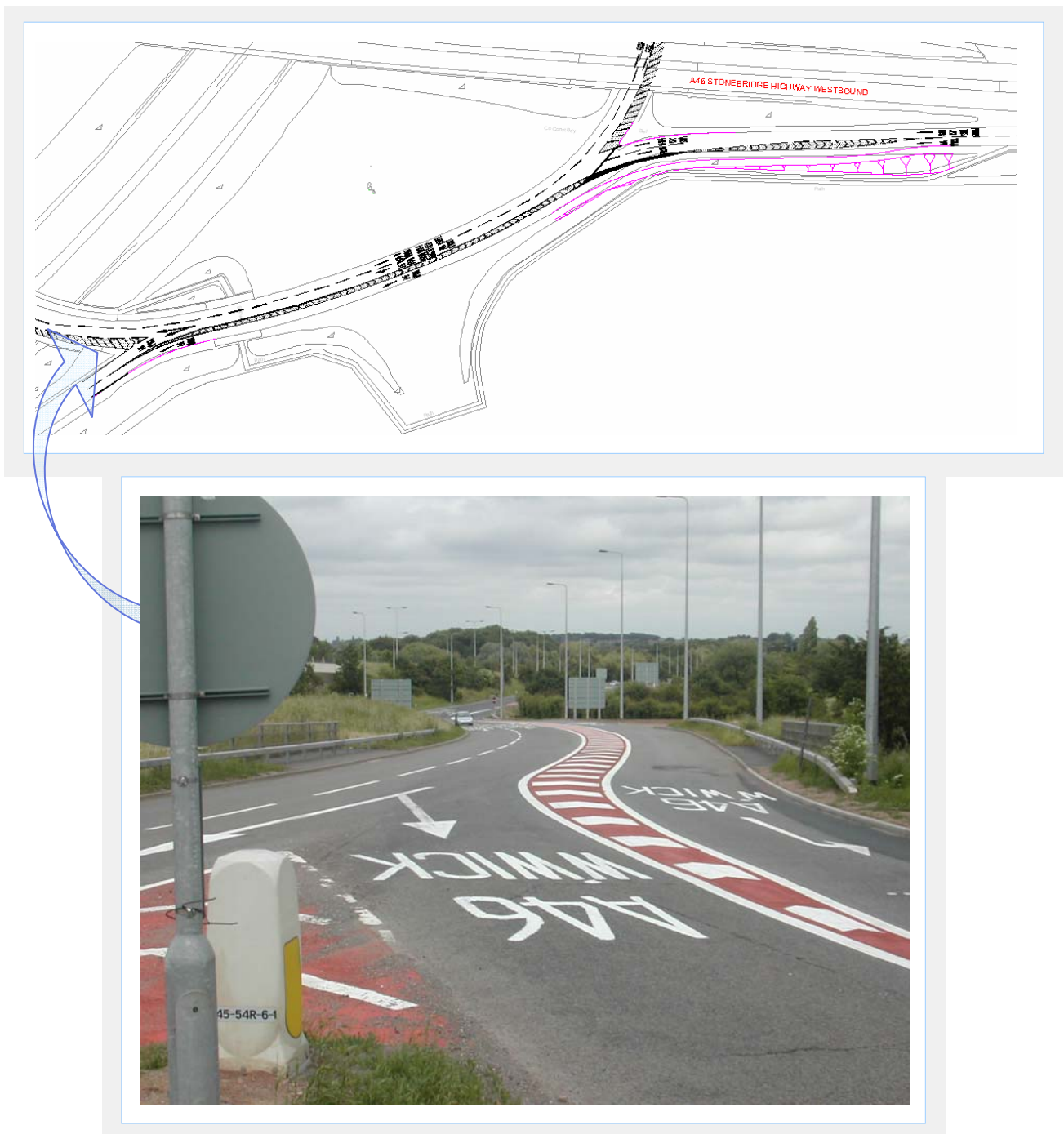
Figure 2.1 - As built signal arrangement on A46 northbound off slip/circulating carriageway



Free Flow Lane

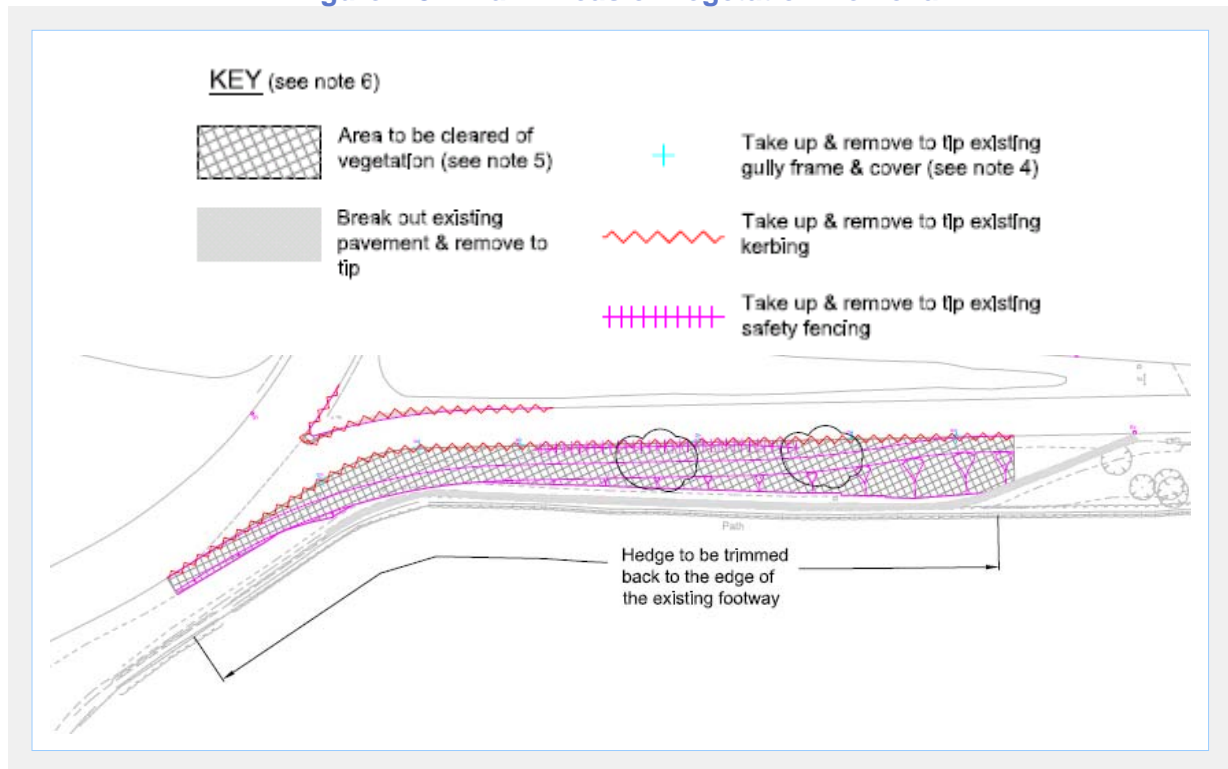
2.5 A free flow lane represents a link within the interchange where traffic using it is separated from the circulating lanes of traffic and hence removes the need for traffic on the approach to give way to other junction users. A free flow left turn lane was constructed to alleviate congestion on the A45 westbound off-slip and is segregated by road surface hatching. Details of this free flow link are illustrated in **Figure 2.2**.

Figure 2.2 - As built free flow lane on the A45 Westbound off slip to A46 Southbound
(Source: Optima Infrastructure Management)



2.6 The main area of site clearance required to make way for the free flow link is illustrated in **Figure 2.3**. All other roadside features including trees were retained and protected from the works.

Figure 2.3 – Main Areas of Vegetation Removal



Source: Optima Infrastructure Management

Road Markings and Signage

- 2.7 One of the scheme objectives was to reduce driver route uncertainty by introducing new road signing and markings. Prior to the scheme opening there were minimal road markings on the circulatory carriageway, whilst road markings that were in place were poorly maintained. As part of the improvements, road markings and signing were introduced (see **Figures 2.4** and **2.5**)

Figure 2.4 - Lane Markings 'before' (Right) and 'After' (Left) Opening



- 2.8 A total of 20 signs were removed as part of the scheme and replaced by 41 new signs. These new signs are intended to reduce driver route uncertainty on the circulatory carriageway as illustrated in **Figure 2.5** below.

Figure 2.5 - New signage associated with the scheme



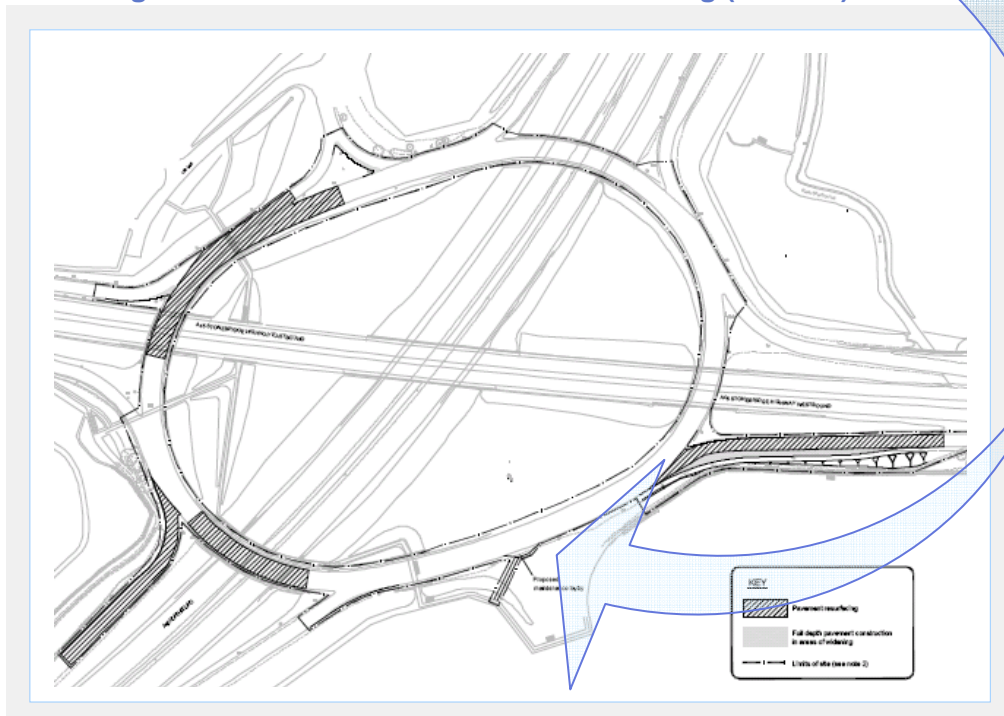
Maintenance Lay-by and Pavement Resurfacing

2.9 A maintenance lay-by has been constructed off the A45 (westbound) arm to allow maintenance vehicle to stop safely to carry out their work (Figure 2.6). Pavement resurfacing has also been undertaken on the A45 (westbound) arm, A46 (northbound) arm and on the circulatory carriageway before the A46 (northbound) off slip and prior to Leaf Lane.

Figure 2.6 – Maintenance Lay-by



Figure 2.7 – Areas of Pavement Resurfacing (Shaded)



Source: Optima Infrastructure Management

STAKEHOLDER FEEDBACK

2.10 Consultation with the Project Sponsor was undertaken on 13th February 2007. Overall the scheme was regarded as a success in terms of reducing queuing and delay, although residents of Leaf Lane had voiced a number of concerns to the HA including:

- ◆ Requests to alter the lining to reduce confusion on the southern side of the island with traffic making late lane change manoeuvres at the A45 EB exit from the island. These alterations have since been carried out and the island now seems to be operating more efficiently.
- ◆ Residents of Leaf Lane, and also a local councillor, have also raised concerns over the number of HGVs that are mistakenly taking the Leaf Lane turn and then turning around to head back onto the island. This issue has been investigated and alterations to the signing were planned to be undertaken as part of the RSA3 works that were programmed to commence on the 5th March 2007.

2.11 Consultation with Optima (the Managing Agent) was undertaken on 16th April 2007. Key points of interest include:

- ◆ The improvements appeared to have made a significant visual improvement to queue lengths at the junction;
- ◆ There is too much white lining destinations and drivers are bombarded with too much information to the extent that they start to ignore it;
- ◆ The MAC was in general agreement with issues regarding Leaf Lane as identified by the Project Sponsor.

Key Points to note from Section 2 include:

- ◆ Main elements of the scheme include:
 - Signalisation of the A46 northbound off-slip;
 - Installation of a free flow left turn lane from the A45 westbound off slip to the A46 southbound on-slip;
 - Improved road markings and signage showing destinations designed to reduce route uncertainty;
- ◆ Stakeholder feedback suggests the improved road markings and signing have not reduced route uncertainty at some locations on the junction but appear to have helped alleviate queues on the approaches to the junction.

3. Scheme Impact – Economy

INTRODUCTION

3.1 This section summarises the transport economic efficiency impacts of the scheme and includes:

- ◆ A review of the changes in traffic volumes over the period January 2002 to May 2007;
- ◆ An examination of the analysis used in the PAR to predict the post opening journey time savings;
- ◆ Details of the post opening evaluation methodology used to evaluate the schemes impacts; and
- ◆ An assessment of the level of economic benefits predicted for the scheme and a comparison of these predictions with actual benefits accrued when considering out-turn traffic volume changes and journey time benefits.

TRAFFIC VOLUME CHANGES

3.2 Traffic volume changes are examined in order to ensure that benefits/disbenefits of the scheme are attributed solely to the improvements made at the junction and not a result of background changes in traffic volumes during the assessment period.

3.3 **Table 3.1** shows the variations in traffic flows at the ATC count location extracted from the annual reports on the TRADS2 database for a six year period between 2002 and 2007 on the A46. Average Daily Traffic (ADT) data for the period January to May has been extracted for each year to enable 'before' and 'after' scheme opening trends to be compared on a like for like basis.

Table 3.1 - Variations in Traffic Flows at ATC Count Locations

A46 (Sites 554 & 555)							
Period	Year	Northbound			Southbound		
		ADT	%	Cumulative % Increase	ADT	%	Cumulative % Increase
Before Opening	2002	27514	-	-	26531	-	-
	2003	28203	3%	3%	27577	4%	4%
	2004	27609	-2%	0%	26330	-5%	-1%
After Opening	2004	28797	4%	5%	27761	5%	5%
	2005	28932	0%	5%	27835	0%	5%
	2006	30294	5%	10%	29372	6%	11%

3.4 Averaging the 29 months of 'before' (January 2002 – May 2004) and 36 months of 'after' data (June 2004 – May 2007) shows an overall 7% increase in traffic in a northbound direction and 7% in a southbound direction since the scheme opened. NRTF central growth factors indicate that, based on national growth estimates, background traffic is likely to have increased by 8.6% in the period 2002 to 2007. In the absence of post opening traffic count data at the junction it has been assumed that changes in traffic on the main routes are indicative of what is

happening at the junction hence traffic is likely to have increased at a rate comparable to NRTF estimates.

PREDICTED JOURNEY TIME BENEFITS - PAR ASSESSMENT

- 3.5 A key element of the original PAR assessment of the scheme was the predicted vehicle hours saving in the opening year of **308,799 hours**.
- 3.6 This was calculated using a comparison of Do Minimum (DM) and Do Something (DS) delay estimates as forecast using ARCADY and LINSIG modelling software. LINSIG was used to predict the impacts of the signals installed on the A46 northbound offslip and circulatory carriageway, whilst ARCADY was used to model the remainder of the junction. The PAR assessment of journey time impacts was based on the following assumptions:
- ◆ The dis-benefits of the signals installed on the A46 off slip during the inter-peak on the circulatory carriageway were not included in the analysis;
 - ◆ The pre-scheme appraisal only considered AM traffic flows as a proxy to junction conditions in the peak period;
 - ◆ Impacts were accrued over 250 days per year at 4 peak hours per day in which the savings occurred;
 - ◆ An average 3.74 minute saving per vehicle was assumed irrespective of the arm from which it was approaching (In reality this is not the case as the benefits on some arms are far greater than those on others);
 - ◆ The DS model that all traffic from the A46 (northbound) off slip uses just the off side lane to access the A45 (eastbound). In the as built layout drivers are entitled to use both the nearside and offside lanes to gain access to the A45. This assumption considerably reduces the capacity of the arm.
- 3.7 Furthermore it is important to note that there is no evidence in the PAR that the base model was calibrated against observed delays or journey times through the junction. **Table 3.2** provides a summary of the PAR predicted delay benefits and dis-benefits for the AM peak period. The average saving was 3.74 minutes per vehicle.

Table 3.2 - Summary of Modelled PAR Predicted Journey Time Benefits/Disbenefits (per vehicle)

Arm	Pre-scheme Layout (ARCADY) Delay (Mins/Veh)	Proposed Layout (ARCADY + LINSIG) Delay (Mins/Veh)	Predicted Time Savings (Mins/Veh)
A46 (northbound)	8.97	4.3	4.67
A45 (Eastbound)	0.12	0.74	-0.62
Leaf Lane	0.14	0.18	-0.04
A444 (Southbound)	0.13	0.59	-0.46
A45 (Westbound)	0.23	0.04	0.19
TOTAL	9.59	5.85	3.74

- 3.8 Based purely on modelling outputs, the PAR predicted:
- ◆ A reduction in delays on the northbound off-slip of 4.3 minutes per vehicle as a result of signal installation;
 - ◆ A saving of 12 seconds for vehicles approaching the junction from the westbound A45; and
 - ◆ Marginal dis-benefits across the remainder of the junction.
- 3.9 The PAR stated a total number of vehicle hours saved in the opening year of 308,799 amounting to a value of time saved in the opening year of £4.1m (2002 prices). This translates to a scheme life saving (30 years) of £110.1m (2002 prices, discounted to 2002).

PREDICTED CORRECTED JOURNEY TIME BENEFITS

- 3.10 In order to ensure that a like for like comparison of the predicted and out-turn economic impact can be made a PAR 'predicted corrected' appraisal of the scheme economic benefits has been undertaken. The purpose of the PAR predicted corrected appraisal is to:
- ◆ Ensure that the predicted and out-turn scheme impacts are considered using a like for like approach;
 - ◆ Account for differences in the scheme appraised in the PAR and the scheme implemented;
 - ◆ Ensure that all appropriate benefits are considered as part of the predicted scenario; and
 - ◆ Account for any obvious errors in the original PAR calculations;
- 3.11 More specifically a predicted corrected assessment of the journey time benefits has been undertaken to:
- ◆ Distribute impacts such that each vehicle entering the junction at a particular arm will accrue a share of the benefits and disbenefits incurred on the arm from which it approaches;
 - ◆ To re-run the DS LINSIG model to allow traffic from the A46 northbound to turn right using both the near and offside lane markings (as per the as built design); and
 - ◆ To ensure the correct value of time (appropriate to the actual year of opening) is used in benefit calculations.
- 3.12 The PAR predicted corrected journey time saving equates to a total vehicle hour saving in the opening year of **296,160 hours**. This is equivalent to £106.1m over 30 years and £3.7m in the opening year alone. A breakdown of how these benefits are distributed across the junction is shown in **Table 3.3**.

Table 3.3 – Summary of PAR Predicted Corrected Journey Time Savings (AM Peak)

Arm	DM Delay	DS Delay	JT Savings (mins)	Flow (veh)	JT Saving (mins)
A46 South	8.97	0.3	8.64	2090	18049
A45 West	0.12	0.74	-0.62	620	-384
Leaf Lane	0.14	0.18	-0.04	250	-10
A444 North	0.13	0.59	-0.46	406	-186
A45 East	0.23	0.04	0.19	1586	301
TOTAL	9.59	1.9	7.7	4952	17769

OUTTURN JOURNEY TIME SAVINGS – POPE EVALUATION

- 3.13 Where possible the re-evaluation of scheme benefits uses observed outturn journey timesavings. In order to ascertain the outturn total number of vehicle hours saved in the opening year, analysis has been undertaken using a combination of observed traffic conditions and ARCADY modelled data. The methodology through which the outturn economic benefits have been derived has a number of distinct advantages over the PAR predicted methodology. These advantages include:
- ◆ The PAR Prediction excludes circulatory delay impacts;
 - ◆ Our assessment uses observed data where possible to replace modelled outputs; and
 - ◆ Our assessment does not average out benefits across all vehicles
- 3.14 Observed data provides a much more accurate representation of actual traffic conditions compared to modelled outputs. To minimise survey costs, observed data was collected to coincide with where the greatest benefits were likely to be derived as described below:
- ◆ Queuing delay and passing count surveys for the A46 N/B offslip (AM and PM peak periods);
 - ◆ Queuing delay and passing count surveys for the circulatory A46 N/B traffic signals (AM and PM peak periods); and
 - ◆ A46 w/b offslip journey time survey (AM peak only) and passing count (AM peak and PM peak).
- 3.15 The observed delay surveys were undertaken by a method replicating the technique that LINSIG uses for calculating queuing delay. This methodology adopted is described in **Appendix A** of this report. The outturn delay for the remaining arms/ turning movements was calculated using ARCADY modelled predictions only.
- 3.16 A summary of the out-turn AM peak hour journey timesavings is given in **Table 3.4**. Furthermore, **Table 3.5** below provides a summary of the predicted, predicted corrected and out-turn monetised economic benefits of the scheme.

Table 3.4 – Summary of Outturn Delay Savings (AM Peak)

Arm	DM Delay (mins/veh)	DS Delay (mins/veh)	Delay Savings (mins/veh)	Flow (veh)	Delay Saving (mins)
A46 N/B	8.97	0.16*	8.81	2090	18412.9
A45 E/B	0.12	0.74	-0.62	620	-384.4
Leaf Lane	0.14	0.18	-0.04	250	-10
A444 North	0.13	0.59	-0.46	406	-186.76
A45 W/B	0.23	0.04*	0.19	1586	301.34
Circulatory	n/a	0.18	-0.18	650	-117
TOTAL	9.59	1.89	7.70	5602	18016

* The out-turn DS delay is that calculated using observed traffic delay and journey time survey data collected on 21 March 2007.

3.17 The results from this analysis show a total number of vehicle hours saved in the opening year of **300,268** hours.

Table 3.5 – Comparison of Predicted and Outturn Economic Benefits

Scenario	Total Vehicle Hours Saved in Opening Year	VOT per average vehicle in Opening Year (pence)	VOT Saving in Opening Year	30 year VOT Benefits	
				Low Growth	High Growth
PAR Predicted	308,799	1,301	£3.751m	£103.991m	£116.109m
PAR Predicted Corrected	296,160	1,327	£3.669m	£100.547m	£111.556m
Outturn	300,268	1,327	£3.720m	£101.928m	£113.094m

Note: All values are in 2002 prices discounted to 2002 at 3.5%

3.18 Key findings from the post opening evaluation of journey time benefits include the following:

- ◆ The out-turn monetised economic benefits are slightly less than those originally expected, although more than those predicted in the PAR predicted corrected calculations;
- ◆ In economic terms the scheme has offered excellent value for money with a first year rate of return of 400% based on economic benefits only;
- ◆ The scheme has offered a 30 year benefit cost ratio (BCR) of 116 compared to an original estimate of 79 further illustrating the schemes excellent value for money;

- ◆ A majority of the net economic benefit has emerged from installation of the MOVA signals on the A46 N/B offslip and has saved 8 minutes per vehicle alone in the peak hour.
- 3.19 The above conclusions should be treated with some caution as they rely on the following major assumptions:
- ◆ That the DM model has been appropriately calibrated to adequately reflect pre-opening traffic conditions;
 - ◆ That the out-turn DM scenario as modelled using ARCADY and LINSIG is indicative of conditions that may have emerged in the schemes opening year if it had not have been built;
 - ◆ That the eight minute before delay recorded in the PAR for the before scenario on the A46 northbound of slip is accurate.

SCHEME COSTS

PAR Predicted

- 3.20 The scheme had a predicted cost of **£1.356m** (2002 prices, discounted to 2002 at 3.5%). This includes site preparation costs of £20,659 (2002 prices), site supervision costs of £51,648 (2002 prices) and an optimism bias adjustment of 10% (£0.109m).

Outturn

- 3.21 The outturn cost of the scheme was **£0.930m** (2002 prices, discounted to 2002 at 3.5%). This includes site preparation costs but does not include supervision costs as it was procured under the Derived Price agreement as such costs are not specifically attributed to individual schemes. In addition cyclical maintenance costs were not considered and there were no costs for third party land take.
- 3.22 It should be noted that the complete estimate as quoted in the PAR included a lane gain arrangement on the A45. This lane gain element was not provided (partly because of the impending TPI scheme at the junction), and therefore partially explains the reduced outturn costs as compared with the original prediction. Furthermore during design, the new interim standards for safety fence became live and this substantially increased the signing costs. This signing cost was subsequently funded from a separate signing budget and therefore a large proportion of the costs were removed from the project cost.
- 3.23 However as the outturn costs are considered to be those costs that result from the construction of all the 'as built' elements of the scheme regardless of where those scheme costs were incurred the actual out-turn cost of the scheme was adjusted to **£0.930m** (2002 prices, discounted to 2002 at 3.5%).

Table 3.3 - Comparison of Original PAR Costs and Actual Outturn Costs

Scenario	Preparation and Supervision	Optimism Bias (%)	Total Present Value Cost (2002 prices discounted)
PAR (predicted)	£0.714m	10%	£1.356m
Outturn (excluding signing)	£0	0%	£0.465m
Outturn (including signing)	£0	0%	£0.930m

Note: 2002 Prices discounted to 2002 at 3.5%

3.24 In summary the PAR predicted cost of the scheme (£1.356m) was £0.426m higher than the outturn cost (£0.930m) partially due to:

- ◆ the withdrawal of the lane gain element of the scheme;
- ◆ the inclusion of 10% optimism bias in the PAR prediction;
- ◆ No preparation or supervision costs were included in the outturn scenario whereas 2% and 5% respectively were assumed in the PAR and PAR predicted corrected;
- ◆ Non inclusion of tax in the outturn scenario.

Key Points to note from Section 3 include:

- ◆ The PAR document predicted a total vehicle hours saved in the opening year of 308,799 hours
- ◆ A PAR Predicted Corrected total vehicle hours saved in the opening year of 296,160 hours has been estimated.
- ◆ Outturn total number of vehicle hours saved in the opening year of 300,268 hrs has been calculated from a combination of delay observations and delay derived from ARCADY modelled data.
- ◆ There has been a reduction in journey time of 101.6s/PCU on the A45 free flow off slip which amounts to no congestion induced delay observed for vehicles utilising the left turn free flow lane.
- ◆ Delay on the A45 westbound off slip has reduced by 0.19 mins/veh whilst delay on the A46 northbound off slip has reduced by 8.81 mins/veh.
- ◆ The scheme has resulted in value of time benefits of £3.720m in the opening year and £107.511m (Average of High and low growth) in the 30 year assessment horizon. These benefits are higher than those predicted (predicted corrected) by a marginal 1.4%;
- ◆ Overall the scheme appears to work well and has resulted in a large monetised benefit when considering the number of vehicle hours saved. Whilst there is no doubt that the scheme has had a large benefit the exact monetised value of journey time savings should be regarded as an over estimate given the inaccuracies of the DM model in predicting delays at RFC value over 1.0.
- ◆ The predicted cost of the scheme (£1.356m) was £0.426m higher than the outturn.

4. Scheme Impact - Safety

INTRODUCTION

- 4.1 This section examines accident data at the junction both 'before' and 'after' scheme and compares this to the forecast impact of the scheme.

ORIGINAL PAR PREDICTED SAFETY IMPACTS

- 4.2 In the original PAR assessment personal injury accident (PIA) data was collated between 1999 and 2001 for all arms of the junction within approximately 600m of the centre of the junction. No other information on the criteria used to select accidents for the PAR was available.
- 4.3 The PAR demonstrated an observed accident rate of 8.3 PIA/yr. The AST predicted an accident saving of 3.9 in the opening year and an accident saving of 103.97 (low growth) and 116.38 (high growth) over the 30 year design period. The predicted accident saving of 3.9 accidents in the opening year was derived from an assumption that the observed accident rate would be reduced to 4.4, a level that reflects the comparable national average accident rate as detailed in the COBA manual, DMRB 13.1.2.

PAR PREDICTED CORRECTED SAFETY IMPACTS

- 4.4 A PAR 'predicted corrected' analysis has been undertaken in order to replicate the accident statistics as set out in the PAR and to reflect the most recent three years of 'before' opening accident data (January 2001 to the 19th February 2004). This ensures that a like for like comparison of predicted and outturn analysis can be made. Accidents occurring during the construction period have been excluded from the before data.
- 4.5 Between January 2001 and 19th February 2004, 21 accidents were recorded that occurred within 600m of the junction, 19 slight and 2 serious. Of these 16 were considered to be a direct result of the junction and have therefore been selected for further analysis.
- 4.6 Based on these 16 selected accidents at the junction a PAR predicted corrected total PIA rate of 5.1 PIA/year and a severity index of 6% has been calculated. The PAR predicted corrected saving has been estimated as 0.7 PIA/year assuming, as per the PAR, that the observed accident rate would be reduced to 4.4, a level that reflects the comparable national average accident rate as detailed in the COBA manual, DMRB 13.1.2 (5.1 PIA/yr - 4.4 PIA/yr = **0.7 PIA/yr**)
- 4.7 Accident causation was extracted from the accident report files. These show that of the 16 selected PIA accidents, 13 (81%) involved stationary/slow moving vehicles whilst 13% involved vehicles changing lanes.

OUTTURN SAFETY IMPACTS

- 4.8 The post opening analysis of accidents has been undertaken using 19 months of post opening data from 20th May 2004 (opening day) to December 2005 within 600m of the junction. Ideally accident savings should be evaluated for at least

three years after opening in order to gain a fair reflection of the post accident number and severity. Consequently the results presented in this report should be regarded as an initial assessment.

- 4.9 Of the 14 accidents that have occurred between 20th May 2004 and December 2005 just 7 are considered to be a direct result of the junction and as such have been selected for further analysis. When only the selected accidents at the junction are considered the results show a total average PIA rate of 4.4 PIA/year.
- 4.10 The outturn severity index was 14% compared to 6% pre-opening. Accident causation data was extracted from the accident report files. These show that of the 5 accidents (*with causation data available*) in the period, 4 (60%) involved stationary/slow moving vehicles waiting to make their desired manoeuvres whilst 1 (20%) involved vehicles changing lanes and a further 1 (20%) had an accident whilst making a left turn. Given the limited availability of post opening PIA data, no robust conclusions on post opening causation should be drawn.

ACCIDENT ANALYSIS SUMMARY AND CONCLUSIONS

- 4.11 **Table 4.1** shows a summary of the findings of the accident analysis:

Table 4.1 – Summary of Accident Analysis

Ref	First Year Accident Saving	Scenario	Severity Index
PAR	+3.9	All Accidents	24%
PAR Predicted Corrected	+0.7	Selected Accidents	6%
Outturn	+0.7	Selected Accidents	14%

Note: PAR and PAR Predicted Corrected used COBA rates for predicted after saving

- 4.12 We can be 95% confident that the overall change in accident rate could have occurred by chance alone and therefore the change in accident rate is not necessarily a direct impact of the scheme.

VALUATION OF SAVINGS

- 4.13 When selected accidents at the junction are considered (based on accident location and causation) there is an outturn accident **benefit** of 0.7 PIA/yr which amounts to a benefit of £57,245 (2002 prices discounted to 2002 at 3.5%) in the opening year. **Table 4.2** below presents the 30 year accident cost benefits attributed to the scheme:

Table 4.2 – Comparison of Pre (PPC) and Post (Outturn) Opening Accidents

Growth Rate	PAR Predicted Corrected			Outturn		
	First Year Accident Saving	30 Year Accident Saving	30 Year Accident Benefits	First Year Accident Saving	30 Year Accident Saving	30 Year Accident Benefits
Low	0.7	19	£1.171m	0.7	19	£1.171m
High	0.7	22	£1.312m	0.7	22	£1.312m

Note: all costs are in 2002 prices discounted to 2002 at 3.5%

Capitalisation factor assumptions: Accident Benefits – 20.55 (LG), 23.03 (HG); and

Accident Numbers – 27.8 (LG), 31.47 (HG)

Key Points to note from Section 4 include:

- ◆ Since the scheme opened there has been a reduction in accidents of **0.7 accidents per year** amounting to a saving of **£1.242m** over the 30 year scheme life (average of low and high growth).
- ◆ This is less than the PAR predicted saving of 3.9 accidents per year but the same as the PAR predicted corrected saving.
- ◆ The severity index has increased from 6% to 14% suggesting an increase in serious accidents at the junction in the post opening scenario;
- ◆ A Chi squared test has revealed that we can be 95% confident that the change in accident rate and severity could have occurred by chance alone and therefore the change in accident rate is not necessarily a direct impact of the scheme.
- ◆ In the PAR Predicted Corrected analysis, 81% of accidents (with causation available) involved stationary or slow moving vehicles. In the outturn scenario this had reduced to 60%.

5. Environment, Accessibility and Integration

INTRODUCTION

- 5.1 The PAR stated that with the exception of a beneficial impact on journey ambience all other impacts on the accessibility, integration and environment criteria would be neutral.
- 5.2 This chapter aims to assess the outturn impacts of the scheme on the built and natural environment. This includes the direct and indirect environmental effects of the transport improvements. The environment impacts of concern include noise, atmospheric pollution of differing kinds, and impacts on the countryside and wildlife, ancient monuments and historic buildings, physical fitness and journey ambience.

ENVIRONMENT

Noise

- 5.3 Noise annoyance is defined by the World Health Organisation (WHO) as 'a feeling of displeasure evoked by noise'. It should be recognised that, relatively large changes in traffic flows and speeds are required to bring about significant changes to noise levels in the longer term.
- 5.4 The PAR predicted that impacts of noise resulting from the scheme would be neutral. PAR guidance states that the impacts of noise can be considered neutral if the project does not provide noise mitigation and there are no properties within 300m of the road centre line. If these criteria are not met then the impact can still be regarded as neutral if change in traffic flow is less than 25%; and change in percentage of HGVs is less than 20%; and change in speed is less than 5kph.
- 5.5 There are several properties within 300m of the new traffic signals on the A46 (northbound) off-slip at Milgrove, Roman Way and Vardon Drive however the impact can still be regarded as neutral as traffic flow change is less than 25%, change in HGVs is less than 20% and change in speed is less than 5kph.

Local Air Quality

- 5.6 The PAR predicted that impacts of the scheme on local air quality would be neutral.
- 5.7 Emission rates under stop start driving conditions are much higher than those when vehicles are driven more smoothly. The free flow left turn lane from the A45 should therefore improve the local air quality by reducing this stop start movement. Whilst there has been a reduced journey time and congestion with the addition of signals on the A46 off-slip the stop start traffic flow is likely to have been maintained with the new signal arrangement.
- 5.8 There is a diminishing contribution that vehicle emissions make to local air quality over distance. Beyond 200m, the contribution of vehicle emissions from the road

centre to local pollution levels is not significant. PAR guidance states that the impacts on local air quality would be neutral if there are no properties within 50m of the edge of the carriageway. As this is the case the outturn impacts of the scheme can be deemed **neutral**.

Greenhouse gases

- 5.9 The PAR predicted that impacts of the scheme on greenhouse gases would be neutral. PAR guidance states that the impacts can be considered neutral if the change in the total distance travelled on roads affected by the scheme is less than 10%. There is no evidence from this study to suggest that travel distance has increased by 10% and therefore the impact has been assessed as **neutral**.

Landscape

- 5.10 The PAR predicted that impacts of the scheme on landscape would be neutral.
- 5.11 PAR guidance states that the impacts can be considered neutral if the project is wholly within the carriageway or verge, is not adjacent to sensitive sites and does not involve the installation of lighting, signals, large signs, gantries, masts or traffic calming measures.
- 5.12 As the scheme has involved the installation of additional signals and large signs, the impacts of this scheme on landscape cannot be considered neutral. The visual impact created by the proliferation of signs and signals in this scheme would suggest an **adverse** impact on landscape.

Townscape

- 5.13 The PAR predicted that impacts of the scheme on townscape would be neutral. PAR guidance states that Townscape impacts will apply only to projects located in built up areas (cities, towns and villages), or where a project will serve to reduce traffic flows in a built up area and, in doing so, will facilitate improvements to the townscape. As neither of the above are applicable to this scheme the impacts on townscape can be considered **neutral**.

Heritage

- 5.14 The PAR predicted that impacts of the scheme on heritage would be neutral. PAR guidance states that the impact on Heritage of Historic Resources can be considered neutral if the project is wholly within the highway boundary and there is no impact on archaeological or noteworthy built heritage sites. Based on the above criteria it can be said that the scheme has had no impact on Heritage and therefore the outturn impacts can be considered **neutral**.

Biodiversity

- 5.15 The PAR predicted that impacts of the scheme on biodiversity would be neutral. PAR guidance states that the impact on biodiversity can be considered neutral if the project is wholly within the highway verge and not adjacent to a sensitive site. There are no protected species or breeding birds or any habitat of value existing prior to implementation that could be affected by the project.

- 5.16 Based on the above criteria it can be said that, as in the PAR prediction, the scheme has had no impact on biodiversity and therefore the outturn impacts can be considered **neutral**.

Water Environment

- 5.17 The PAR predicted that impacts of the scheme on the water environment would be neutral. PAR guidance states that the impact on the water environment can be considered neutral if there is no change to the highway drainage or to the means of discharge, and there is negligible change to the volume and quality discharged.
- 5.18 Based on the above criteria it can be said that the scheme has had no impact on the water environment and therefore the outturn impacts can be considered **neutral**.

Physical Fitness

- 5.19 The PAR predicted that impacts of the scheme on physical fitness would be neutral. PAR guidance states that the impact on physical fitness can be considered neutral if there is no change to the length and number of walking and cycling trips made as a result of the scheme.
- 5.20 As no elements of the scheme involved changes to the walking or cycling environment it can be said that the outturn impacts on physical fitness can be considered to be **neutral**.

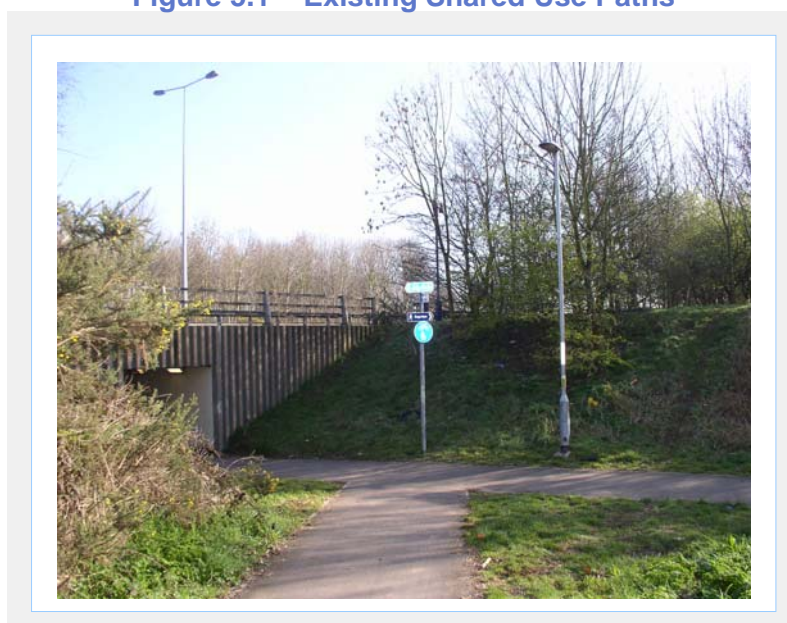
Journey Ambience

- 5.21 The PAR predicted that impacts of the scheme on journey ambience would be slightly beneficial. It was anticipated that the scheme would help reduce traveller stress due to the predicted reduction in excessive queuing and congestion and the route uncertainty will decrease as a result of the new road signing and road markings. PAR guidance states that the impact on journey ambience can be considered neutral if there is no change in the roadside facilities provided for road users, to the views from the road, or to the accident rate or to journey times.
- 5.22 The slight benefit to journey ambience predicted in the PAR was based on the assumption that traveller stress will be reduced as congestion and queuing is minimised and the new road markings and signage will result in less route uncertainty for travellers.
- 5.23 The results of the journey time surveys shows that queuing and congestion has been reduced as a result of the scheme however consultation with the project sponsor has revealed that there have been issues with vehicles incorrectly making the turn into Leaf Lane. It can be said that journey ambience has improved due to the reduced queuing and delay however route uncertainty still appears to be an issue. Based on PAR guidance the outturn impacts on Journey Ambience can be considered to be **slightly beneficial**.

ACCESSIBILITY

- 5.24 Accessibility can be defined as improving access to facilities for those without a car and to reduce severance. The PAR predicted that there would be no impact on accessibility as a result of the scheme.
- 5.25 PAR guidance states that the impact on community severance can be considered neutral if there is no change to the routes used by pedestrians, equestrians or cyclists; or to the standard and quality of the routes which may result in a change of patronage.
- 5.26 The junction is a large grade separated interchange with few key trip attractors in the immediate vicinity of the junction. Few cyclists or pedestrians would use the circulatory carriageway particularly given the existing high quality off carriageway routes linked by subways beneath the roundabout (**Figure 5.1**).

Figure 5.1 – Existing Shared Use Paths



- 5.27 The improvements at the junction have not resulted in any changes to these existing routes used by pedestrians or cyclists and no pedestrian phase has been included in the new signals on the A46 northbound off-slip. The outturn impacts of the scheme on accessibility can therefore be considered to be **neutral**, where no impacts, positive or negative have occurred.

INTEGRATION

- 5.28 Integration can be characterised as ensuring that all decisions are taken in the context of local, regional and national transport policies. A review of this transport policy is provided below.

2006 – 2011 West Midlands LTP

- 5.29 The Warwickshire North/South corridor is both densely populated and highly developed, and includes a number of key travel destinations including Coventry city centre, Warwick University and Coventry Airport. The corridor also includes the Coventry to Nuneaton Regeneration Zone, the Coventry/Solihull/Warwick High Technology triangle, and a number of significant proposed or potential development/regeneration sites.
- 5.30 It is predicted that travel patterns and demands in the corridor will continue to increase, particularly with the pressures from further development within both Warwickshire and Coventry. There are also strong links between the corridor and other towns and cities in the West Midlands including Birmingham and Solihull, and from the northern part of the corridor towards Hinckley and Leicester.

M1 to Birmingham Route Management Strategy

- 5.31 The M1 to Birmingham Route Management Strategy (RMS) covered five key routes, including the A45 between the M45 and the A46 at Stivichall, and the A46 Coventry Eastern Bypass between the A45/A46 at Tollbar End and the M6 at Junction 2.
- 5.32 The RMS proposed a significant improvement to the junction at Tollbar End, which is now being pursued by the Highways Agency with a view to implementation by 2010/11 (see below). Completion of these works along with the improvement at M40 Junction 15 (Longbridge) is predicted to leave most of the junctions on the A46 between the M69 and Stratford-upon-Avon free flowing. The exceptions to this are the two junctions on the A46 Coventry Eastern Bypass (the A46/A428 TGI Friday junction near Binley Woods, and the A45/A46 interchange at Stivichall).
- 5.33 The Highways Agency has responsibility for the Tollbar End junction, and is currently in the process of preparing a major improvement scheme for the roundabout. This is likely to include a grade separation of the A45/A46, which will significantly relieve congestion at the junction. Also included in the scheme package are proposals to improve the A46/A45 Stivichall interchange, located approximately 2km to the west of Tollbar End. The scheme is due to be delivered by the Highways Agency towards the end of the LTP period (2011).
- 5.34 This scheme appears to compliment other schemes in the area and integrates well with current policy in the area.

6. Summary of Findings and Recommendations

INTRODUCTION

- 6.1 The POPE assessment of the A45/A46 Stivichall junction improvements has utilised the data available to examine the out-turn impacts of the scheme compared to those forecast in the original PAR. The purpose of this section is to:
- ◆ Draw together the key impacts emerging from the POPE evaluation;
 - ◆ Summarise the key lessons emerging from this evaluation; and
 - ◆ Suggest recommendations that will facilitate and increase the accuracy of future PAR appraisals for schemes similar to that implemented at the A45/A46 Stivichall junction.

SUMMARY OF KEY IMPACTS

- 6.2 **Table 6.1** provides a summary of the monetised benefits of the enhancements at M40 J15. The Appraisal Summary Table (AST) and Evaluation Summary Table (EST) are also included at the end of this chapter.

Table 6.1 – Summary of Scheme benefits (Predicted, Predicted Corrected and Outturn)

	Predicted	Predicted Corrected	Actual
First Year Benefits (2002 prices)*	£4.1m	£3.7m	£3.8m
30 Year Benefits (2002)*	£110.1m	£106.1m	£108.8m
Costs (2002 Prices)*	£1.4m	£1.4m	£0.931m
Benefit Cost Ratio (BCR)	78.6	75.7	116
%FYRR	300%	275%	406%

All costs are in 2002 prices and discounted to 2002

- 6.3 Key points to note from the above include:
- ◆ The total first year benefits of the scheme were broadly comparable to those predicted. Safety benefits were significantly overestimated whilst economy benefits were broadly comparable;
 - ◆ The scheme was delivered £0.469m below the predicted corrected cost estimate (£1.4m);
 - ◆ The out-turn BCR was greater than one and the out-turn FYRR of 406% suggests that the scheme would pay for itself within the first year.
- 6.4 The main economy, safety, environment, accessibility and integration impacts of the scheme are listed below.

Economy

- ◆ The outturn first year economic benefits of the scheme were broadly as expected (£3.8m);
- ◆ The out-turn FYRR and BCR was 406% and 116 respectively demonstrating excellent value for money;

- ◆ Daily traffic on the A46 (south of the junction) is around 7% higher for the period June '04 to May '07 when compared with January 2002 – May 2004 average. This compares with an NRTF growth rate of 8% over the same time period;
- ◆ There has been an observed reduction in journey time on the A45 westbound to A46 southbound movement;
- ◆ Total vehicle hour savings at the junction were 300,268 vehicle hours compared to a predicted saving of 308,799;
- ◆ Disbenefits caused by the installation of signals on the circulatory carriageway have been substantially offset by journey time benefits materialising from signal installation on the A46 off-slip; and
- ◆ The reliability of the POPE assessment is subject to the accuracy of the 'before' delays stated in the PAR.

Safety

- ◆ The scheme saved 0.7 accidents per year this is less than original predicted saving of 3.9 accidents per year;
- ◆ The severity index has increased from 6% to 14%;
- ◆ The proportion of accidents involving stationary or slow moving traffic has fallen from 81% to 60%; and
- ◆ A Chi squared test has revealed that the change in accident rate and severity could have occurred by chance alone and therefore the observed accident saving is not necessarily attributable to the scheme

Environment

- ◆ The visual impact created by the proliferation of signs and signals in this scheme would suggest an adverse impact on landscape;
- ◆ The scheme delivered some slight journey ambiance benefits through small improvements to journey times and enhanced signing and lining.

Accessibility

- ◆ The scheme had no measurable impacts on public transport interchange or cycling/walking accessibility

Integration

- ◆ The objectives of the scheme were in alignment with policy priorities identified in the M1 to Birmingham Route Management Strategy and West Midlands LTP.

KEY LESSONS LEARNT

- ◆ MOVA signals implemented at the junction have offered significant journey time savings and have resulted in a observed improvement to junction efficiency;
- ◆ The PAR methodology provided a slight overestimate of economic benefits but did not consider the effects of the following:
 - Delays to circulating traffic caused by the installation of traffic signals;

- Modelling of two right turn lanes for traffic approaching the signals from the A46 off slip (the PAR assessment assumed just one right-turn lane; and
- Variations in journey time savings by arm.
- ◆ The economic calculations included in PAR were based on a junction layout design different to that built on the ground;
- ◆ There was no observed before data (delays or journey time information) available to verify the accuracy of LINSIG or ARCADY outputs stated in the PAR and hence the POPE assessment assumes that before delays quoted in the PAR are correct;
- ◆ The PAR considered all accidents within 600m of the junction irrespective of accident causation or location at the junction. This resulted in a large overestimate of accident savings;
- ◆ There is currently insufficient post opening data to verify whether accident savings are a direct result of the junction improvements; and
- ◆ Costs were lower than expected due to the withdrawal of the lane gain element of the scheme and the inclusion of 10% optimism bias in the PAR prediction.

SUMMARY OF RECOMMENDATIONS

- ◆ Where feasible the PAR should include some observed journey time/delay data to verify outputs from ARCADY/LINSIG and pre-opening journey times (pre and post opening);
- ◆ For schemes involving the introduction of signals on roundabouts the PAR should take into account introduced delay on the circulatory carriageways and the delay impact of signals in the inter-peak periods;
- ◆ PAR predicted savings should take account of the fact that the benefits for some users are greater than those for others and not assume that all users receive an equal share of the benefits of the scheme;
- ◆ Implementation PAR's and economic calculations should be updated to included final changes in out-turn scheme design;
- ◆ Only accidents of relevance to the scheme should be included in PAR appraisals to avoid an overestimate of savings that can be attributed to a scheme; and
- ◆ Further empirical data is required to predict the likely effectiveness of MOVA in reducing delays at isolated junctions;
- ◆ PAR should include some element of policy research to illustrate how schemes of national relevance fit with the local agenda.

CONCLUDING REMARKS

- 6.5 In summary this POPE evaluation has demonstrated that the scheme has delivered considerable journey time benefits particularly on the A45 (westbound) and A46 (northbound) whilst safety benefits were smaller than forecasted in the PAR assessment. Whilst modelling can provide an appreciation of likely delays or journey times occurring at a junction it does not offer a substitute for observed

data. Consequently as is the case for many Large LNMS schemes there was a distinct lack of observed data to support the pre-scheme economic appraisal calculations in the before scenario and hence a major assumption in this report has been that the DM model was appropriately calibrated. The journey time benefits calculated in this report should therefore only be used to provide the HA and other readers with an indication of the overall scheme benefits.

Table 6.2 – Appraisal Summary Table (AST)

Appraisal Summary Table		A45/A46 Stivichall Junction		
Objective	Sub-Objective	Qualitative Impacts	Quantitative Measures	Assessment
ENVIRONMENT	Noise	No Impact		Neutral
	Local Air Quality	No Impact		Neutral
	Greenhouse Gases	No Impact		Neutral
	Landscape	No Impact		Neutral
	Townscape	No Impact		Neutral
	Heritage of Historic Resources	No Impact		Neutral
	Biodiversity	No Impact		Neutral
	Water Environment	No Impact		Neutral
	Physical Fitness	No Impact		Neutral
	Journey Ambience	Traveller stress will be reduced as congestion and queueing is minimised. This will have a positive effect on journey ambience for users		N/A
SAFETY	Accidents	Reduced accident rate due to a decrease in congestion related accidents (55% occurred in stationary traffic)	103.97 accidents Low Growth	PVB £4.86m LG
			116.38 accidents High Growth	PVB £5.38m HG
ECONOMY	Cost of Scheme			£1,356,774.42
	Consumer Users	User benefits result from reduced congestion and faster journey times. User benefits are the only benefits	Users PVB £83.55m LG Users PVB £93.28m HG	PVB £83.55m LG PVB £93.28m HG
	Reliability	The revised layout combined with new signing and lining will reduce congestion and thus delays improving journey time reliability		Neutral
	Wider Economic Impacts	No Impact		Neutral
ACCESSIBILITY	Option Values	No Impact		Neutral
	Severance	No Impact		Neutral
	Access to Trans System	No Impact		Neutral
INTEGRATION	Transport Interchange	No Impact		Neutral
	Land Use Policy	No Impact		Neutral
	Other Government Policies	No Impact		Neutral

Note: This table reproduces the AST of the PAR document. All costs and benefits are in 1998 prices, discounted to 1998 at 6%

Table 6.3 – Evaluation Summary Table (EST)

Evaluation Summary Table		A45/A46 Stivichall Junction		
Objective	Sub-Objective	Qualitative Impacts	Quantitative Measures	Assessment
ENVIRONMENT	Noise	No Impact		Neutral
	Local Air Quality	No Impact		Neutral
	Greenhouse Gases	No Impact		Neutral
	Landscape	The visual impact created by the proliferation of signs and signals in this scheme would suggest an adverse impact on landscape.		Slight Negative
	Townscape	No Impact		Neutral
	Heritage of Historic Resources	No Impact		Neutral
	Biodiversity	No Impact		Neutral
	Water Environment	No Impact		Neutral
	Physical Fitness	No Impact		Neutral
	Journey Ambience	Traveller stress has been reduced as congestion and queueing is minimised. This will have a positive effect on journey ambience for users.		Slight Beneficial
SAFETY	Accidents	Reduced accident rate however we can be 95% confident that the change in accident rate could have occurred by chance alone and therefore the change in accident rate is not necessarily a direct impact of the scheme.	0.8 accidents saved in the opening year	PVB £1.36m LG
				PVB £1.52m HG
ECONOMY	Cost of Scheme	There were no supervision costs for this scheme because it was procured under the Derived Price agreement. Cyclic Maintenance costs were not considered and there were no costs for third party land take.		£930,623
	Consumer Users	User benefits result from reduced congestion and faster journey times. User benefits are the only benefits	300,268 total vehicle hours saved in opening year. Opening year benefits £3.7m.	30 yr PVB £101,928,935 (low growth) 30 yr PVB £113,094,969 (high growth)
	Reliability	The revised layout combined with new signing and lining has reduced congestion and thus delays improving journey time reliability		Benefit
	Wider Economic Impacts	No Impact		Neutral
ACCESSIBILITY	Option Values	No Impact		Neutral
	Severance	No Impact		Neutral
	Access to Trans System	No Impact		Neutral
INTEGRATION	Transport Interchange	No Impact		Neutral
	Land Use Policy	No Impact		Neutral
	Other Government Policies	No Impact		Neutral

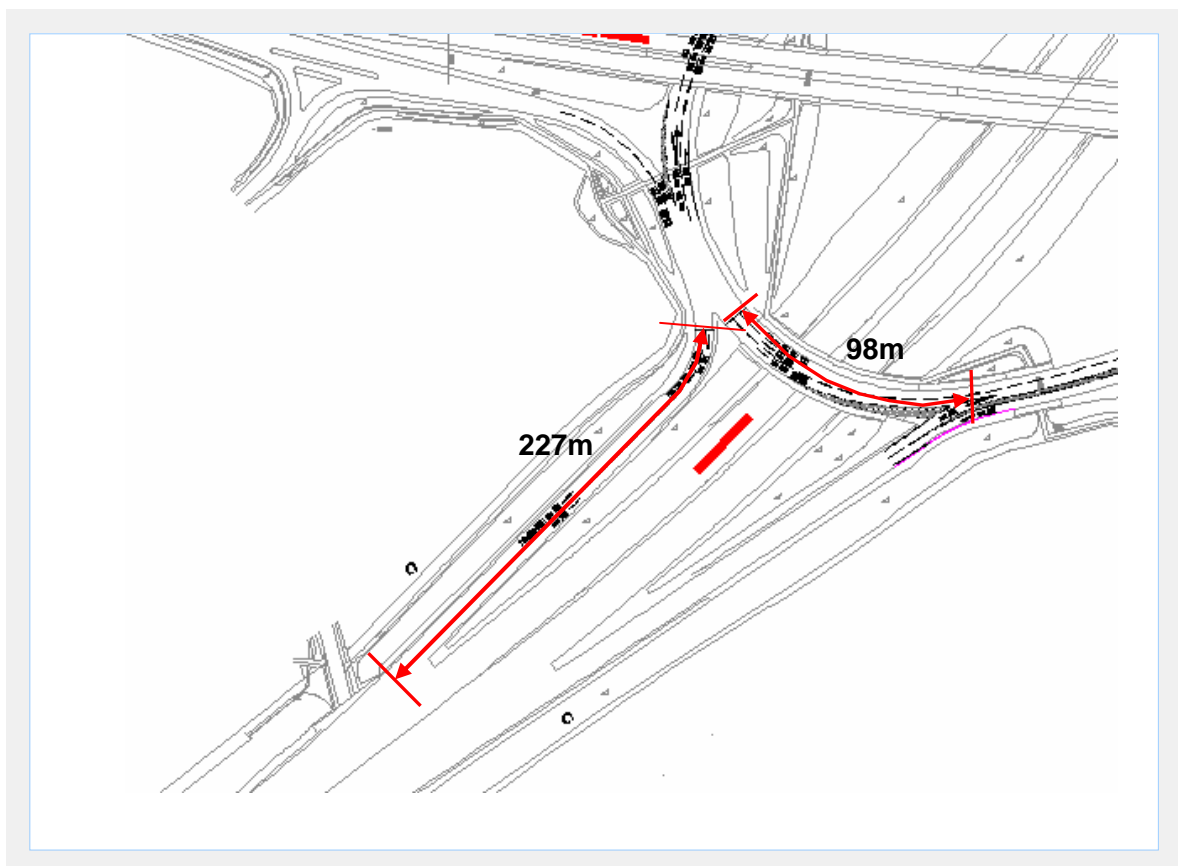
Note: All costs are in 2002 prices and Discounted to 2002

APPENDIX A - DELAY SURVEY METHODOLOGY

Delay Survey Methodology

- B.1 The following methodology was used for both the A46 (northbound) off slip and the circulatory carriageway prior to the new signals.
- ◆ Vehicles were observed on each approach for approximately 10 minutes prior to the survey start time to determine the point at which vehicles start to noticeably slow down approaching the junction.
 - ◆ A start point, upstream from the junction was established that was far enough back from the stop line to exclude queuing vehicles. Once this point was established it was kept constant for the duration of the survey i.e. the start point did not change as queues began to dissipate, for example, in the off-peak. The start points for each approach are illustrated below.
 - ◆ The time taken for a vehicle to travel from the upstream start point to the point at which the vehicle cleared the stop/give way line was then noted. A note was also made of the time of day and if any of the cars observed did not slow down at all in the observation area or join a queue. This was noted as 'free flow' conditions i.e. no queuing or stopping.
 - ◆ This technique was repeated with the next available car to cross the upstream point after the journey time and time of day were recorded. The sample was random and reflected the fact that some vehicles stopped at the stop line and some did not.

Survey Start Points



APPENDIX B – GLOSSARY

ADT – Average Daily Traffic

AST – Appraisal Summary Table

BCR – Benefit Cost Ratio

COBA – Cost Benefit Analysis

DM – ‘Do Minimum’

DMRB – Design Manual for Roads and Bridges

DS – ‘Do Something’

EST – Evaluation Summary Table

FYRR – First Year Rate of Return

HA – Highways Agency

HGV – Heavy Goods Vehicle

LNMS - Local Network Management Schemes

LTP – Local Transport Plan

MAC - Managing Agent Contractor

MOVA - Microprocessor Optimised Vehicle Actuation

NRTF – National Road Traffic Forecast

PAR – Project Appraisal Report

POPE - Post Opening Project Evaluation

RMS – Route Management Strategy

VOT – Value of Time