

LNMS EVALUATION REPORT

A47/A10 Hardwick Roundabout



October 2005



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1. Introduction

BACKGROUND

The Scheme

- 1.1 The A47/A10 Hardwick roundabout improvement scheme opened on 30th October 2003. The aim of the scheme was to reduce the problems caused by delays to traffic at Hardwick Roundabout, which is a key junction within the road hierarchy of west Norfolk where the A10(T), the A47(T), and the A149 all meet leading to delays to both trunk road and local traffic. The location of the scheme is illustrated in Figure 1.1.

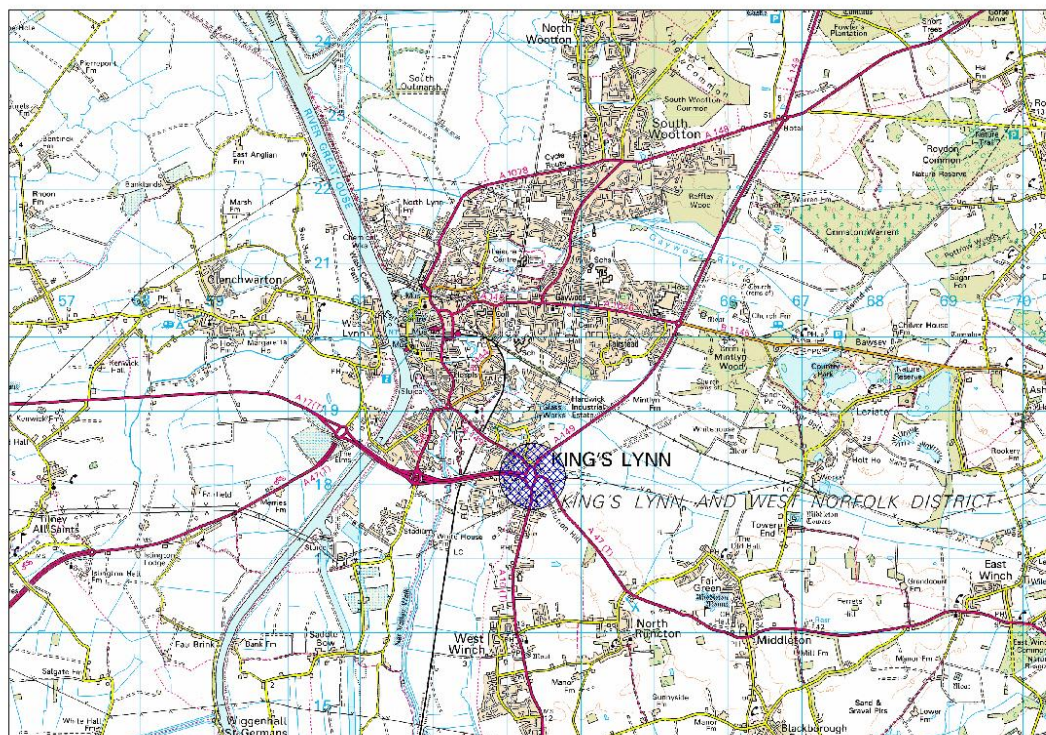


Figure 1.1 - Location of Hardwick Roundabout

- 1.2 The scheme provides a single carriageway flyover and terminal roundabout between the A47 west and the A47 East. It also included minor alignment improvements to the existing roundabout and part demolition and strengthening of an existing disused railway bridge. Figure 1.2 shows a photo of the new flyover and Figure 1.3 a schematic plan of the new junction arrangement.



Figure 1.2 – New Flyover over the Realigned Hardwick Roundabout



Figure 1.3 – Schematic Diagram of New Layout

- 1.3 The design was initially developed by consultant Owen Williams. In October 2001 consultant Halliburton KBR were commissioned to complete the detailed design and produce tender documents based on the geometry provided by Owen Williams. The design was revised to incorporate the existing roundabout in May/June 2002.

SCHEME OBJECTIVES

- 1.4 The schemes objectives were to develop an environmentally acceptable, well engineered, economical and safe scheme to accommodate trunk road and other traffic at A47 Hardwick Roundabout and to improve the operational characteristics of Hardwick roundabout, where possible within the existing highway boundary. This was undertaken while trying to achieve the following objectives:
- ◆ Economy – reducing delays for all traffic;
 - ◆ Environment – minimising any adverse impact on landscape and the community;
 - ◆ Integration – improving access to existing and future developments in line with local and regional plans;
 - ◆ Accessibility – improving journey reliability for current and potential public transport routes;
- 1.5 Local Network Management schemes are categorised in accordance with the principal aim that the scheme seeks to achieve. As the main aim of the scheme was the reduction of congestion and delay to traffic, the A47 Hardwick Roundabout Improvement of was categorised as an **Economy** scheme.
- 1.6 The Highways Agency (HA) webpage providing more information on the development of the scheme is:

http://www.highways.gov.uk/roads/projects/a_roads/a47/hardwick_flyover/index.htm

Original PAR Document

- 1.7 The PAR document that forms the basis of this post-opening evaluation was produced by Halliburton KBR Consultants with a last revision dated July 2002.

PURPOSE OF THE REPORT

- 1.8 The Highways Agency has commissioned a series of studies to re-evaluate recently implemented trunk road schemes. The aim of this process is to provide a check of the levels of benefit accruing from new schemes and to determine how far the department achieves the objectives and benefits claimed from its programme of schemes. In turn, this process seeks to identify measures which will in turn maximise the value for money from similar schemes in the future.
- 1.9 This report represents the evaluation report for the A47/A10 Hardwick roundabout at Kings Lynn, and has been prepared as part of the Post Opening Project Evaluation (POPE) Commission. It will initially review the 'physical' impact of the scheme, namely:
- ◆ A comparison of the 'Before' and 'After' traffic volumes on the A47/A10 Hardwick Roundabout to illustrate how traffic volumes have changed since the opening of the safety improvements;
 - ◆ A comparison of 'Before' and 'After' journey times to illustrate how journey times have changed since the opening of the safety improvements; and,

- ◆ The report will also outline the changes in accidents in the vicinity of the roundabout since the scheme has been implemented and establish whether they have changed as predicted since the opening of the scheme.
- 1.10 Following from the assessment of physical impact of the scheme the report considers the evaluation of the predicted benefits for the A47 Hardwick Roundabout as follows:
- ◆ Identification of the costs and benefits originally forecast for the scheme at Order Publication Report (OPR) stage;
 - ◆ Quantification of the outturn (actual) costs and the outturn level of benefits actually accruing, based on outturn traffic volume and journey time data for the scheme; and
 - ◆ Comparison of the results and quantify the difference in the Present Value of Benefits (PVB).
- 1.11 Overall, this report has been divided into five further sections as follows:
- ◆ Section 2 outlines existing data collation and new data collection;
 - ◆ Section 3 outlines the scheme's impact and reports on traffic volume and journey time changes attributable to the Hardwick Roundabout Improvements;
 - ◆ Section 4 presents an assessment of predicted and outturn economic benefits using the POPE journey time methodology;
 - ◆ Section 5 presents the original Appraisal Summary Table (AST) for the A47 Hardwick Roundabout Improvements, and then re-evaluates these predictions with an Evaluation Summary Table (EST); and
 - ◆ Section 6 summarises the main conclusions from the evaluations and the limitations to use.
- 1.12 It is intended that the findings of this report will feed into a wider summary of the outcomes of the POPE process.

2. Data Collection

DATA COLLECTION

- 2.1 The following data was available for the POPE re-evaluation of the A19 Hardwick Roundabout Junction Improvement:

'Before' Surveys

- 2.2 The PAR document submitted in support of the scheme was based upon the following data:

- ◆ Accident Data from the years 1997 – 2001;
- ◆ Journey Time Surveys;
- ◆ Environmental Assessment; and
- ◆ Traffic Count Data – MCC and ATC.

'After' Surveys

Automatic Traffic Counts

- 2.3 The following locations were subject to Automatic traffic counts for the period 26th September 2004 – 1st October 2004:

- ◆ Site 1 – A47 Flyover, Kings Lynn;
- ◆ Site 2 – A149 Hardwick Road, Kings Lynn;
- ◆ Site 22 – Slip Road to Retail Park;
- ◆ Site 3 – A47;
- ◆ Site 4 – A10 Kings Lynn; and
- ◆ Site 5 – Beveridge Way.

- 2.4 Additionally ATCS from the Traffic Monitoring Midlands commission were also obtained for the following two sites for

- ◆ A47 9533/4 west of Kings Lynn at Terrington St John; and
- ◆ A47 9531/2 East of Kings Lynn at East Winch.

- 2.5 An additional ATC site run by Norfolk County Council was utilised for the following dates as shown below:

- ◆ 04/08/04 for one week; and
- ◆ 02/11/04 for one week.

Manual Classified Counts

- 2.6 Manual Classified counts were undertaken at the Hardwick Roundabout and two adjacent junctions on Hardwick Road on Wednesday 29th September 2004.

Pedestrian and Cycle Counts

- 2.7 Pedestrians and Cyclists were counted on the foot/cycle path underneath the flyover on Wednesday 29th September 2004.

Journey Time Surveys

- 2.8 Journey time surveys were undertaken on Hardwick Roundabout on Wednesday 29th September 2004 for both the AM (07:30 – 09:30) and PM (16:30 – 18:30) peaks. Journey times were measured from 1km back, on each arm, from the junction until the survey vehicle entered the roundabout. Any delay experienced was noted and times recorded.

- 2.9 The journey time surveys were undertaken on the following arms:

- ◆ Arm A – A149 Queen Elizabeth Way;
- ◆ Arm B – Hardwick Road;
- ◆ Arm C – A47 West;
- ◆ Arm D – Beveridge Way;
- ◆ Arm E – West Winch Road;
- ◆ Arm F – A47 East;

Accident Data

- 2.10 Accident Data was provided by Norfolk County Council and the Managing Agent for Area 6. The data was provided for January 1998 to September 2004.

3. Scheme Impact: Safety, Traffic Flows and Journey Times

3.1 This section examines the impact of the scheme in terms of safety, traffic flow, and vehicles journey times. The conclusions from this section feed directly into the economic re-evaluation presented in Section 4.

SAFETY

3.2 Accident data for the study area covering the period 1998 to September 2004 was obtained from both Norfolk County Council and the Managing Agents for Area 6. Data was obtained for a 'study area box' encompassing the roundabout and up to a one kilometre approach distance each arm in order to take account of accidents associated with possible queuing traffic at the junction. In addition the 'study area box' also included any accidents on the new flyover that may have occurred since the completion of the scheme.

3.3 Table 3.1 presents a summary of the accident data.

Table 3.1 – Accident Data

Year	Fatal	Serious	Slight	Total
1998	-	1	21	22
1999	-	5	20	25
2000	1	4	21	26
2001	-	1	21	22
2002	1	2	18	21
2003	-	-	18	18
2004 (9 months)	-	-	10	10
TOTAL	2	13	129	144
<i>Pre (70 months)</i>	2	13	116	<i>131 (1.87 Acc per month)</i>
<i>Post (11 months)</i>			13	<i>13 (1.18 Acc per month)</i>

3.4 **The table shows that pre opening there were on average 1.87 accidents per month (22.44 a year) whilst post opening there were 1.18 accidents per month (14.16 a year), indicating a lower level of accidents post-opening compared to pre-opening.**

3.5 Further analysis was also undertaken regarding the location of accidents in relation to the junction. Data from the pre-opening period showed that accidents tended to occur more on the approaches to the junctions. This was in accordance with the general perception that accidents previously occurred as vehicles approached queuing traffic at the junction. In contrast data for the post-opening period indicates a shift in the location of accidents towards the circulatory carriageway of the roundabout. It is not immediately apparent why this shift in location has occurred but it may be related to a lower level of queuing on the approaches to the junctions, coupled with higher speeds on the circulatory section of the roundabout. However, whatever the reason for the shift it does not alter the basic conclusion of the accident analysis in that fewer accidents have occurred after the scheme than before it.

TRAFFIC FLOW

3.6 As noted in Section 2, Atkins commissioned manual classified traffic counts at the junction undertaken both immediately prior to the completion of the scheme, and after the opening of the scheme. In addition further data was available from automatic traffic counters located on the approaches to the scheme, again for both the pre-opening and post-opening situations.

Automatic Traffic Count Data

3.7 Traffic count data was available for both the pre-opening and post-opening conditions on the approaches to the junction. This data is summarised in Figure 3.1 which provides a comparison between Pre and Post Opening ATC two way flows.

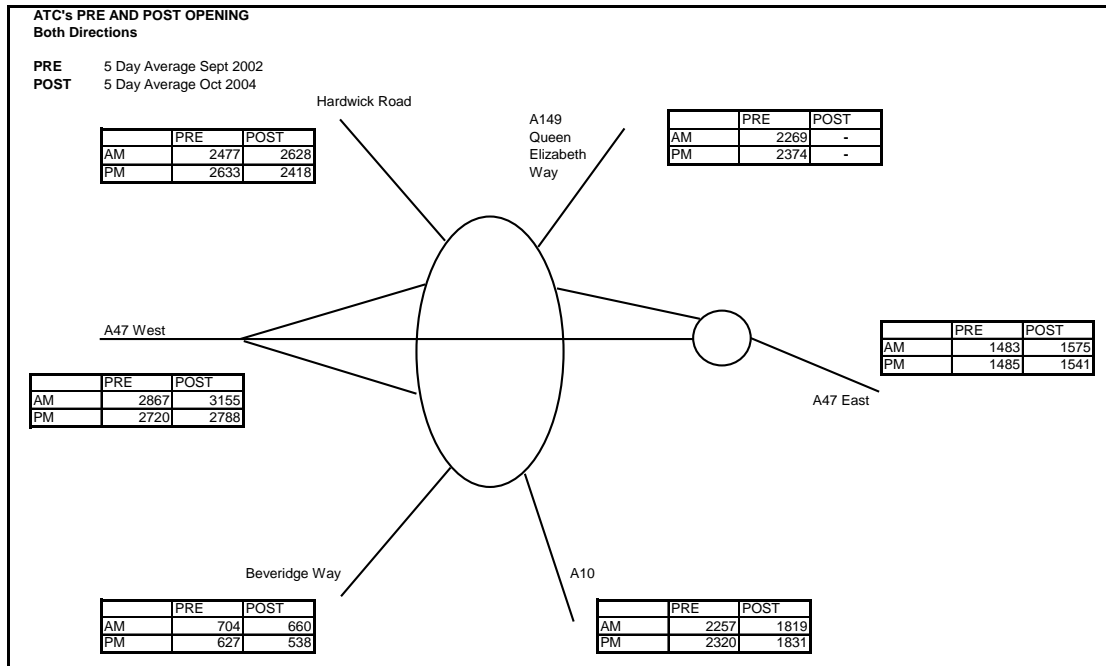


Figure 3.1 – ATCS Pre and Post Opening

3.8 Figure 3.1 illustrates:

- ◆ An slight increase in flow on both the east and west arms of the A47;
- ◆ A slight decrease in flow on Beveridge Way; and,
- ◆ A significant decrease in traffic flow to/from the A10. In the AM peak this is in the order of 438 vehicles (19.4% of total flow), and in the PM peak it is 489 vehicles (21.1% of total flow). It is not apparent why this reduction in flow has occurred as it appears to be counter-intuitive in that the improvements to the junction should have encouraged traffic from the A10 rather than discourage it. It is intended that further data from ATC counters on the A10 will be obtained to further substantiate this finding.

3.9 It should be noted that due to technical problems ATC data could not be obtained for A149 Queen Elizabeth Way and Hardwick Road.

Manual Classified Counts – Link Flows

3.10 Manual classified count (MCC) data was obtained from a number of sources, as detailed in Section 2, covering both the pre and post opening situation at the junction. Figures illustrating related traffic flows can be found in Annex A.

-
- 3.11 Figure A1 details an average pre opening flow (average of a MCC in April 1999, March 2000 and May 2000) into and out of each arm as well as a total junction throughput.
- 3.12 Figure A2 details a post opening flow (a MCC in October 2004) into and out of each arm as well as a total junction throughput.
- 3.13 Figure A3 shows the difference between the post opening counts and pre opening counts where a positive percentage represents an increase in traffic between pre and post opening and a negative percentage represents a decrease between pre and post opening.
- 3.14 The main points to note from Figures A1 to A3 are that:
- ◆ The slight reduction in traffic to/from the A10 that was apparent in the ATC data is reflected in the MCC data;
 - ◆ There has been a substantial increase in traffic to/from Beveridge Way and to/from Queen Elizabeth Way (A149). This is consistent with the pre-conception that scheme would make the roundabout more attractive to some local users and as such would result in additional traffic on these arms;
 - ◆ There has been a slight decrease in traffic from/to Hardwick Road. This is inconsistent with the pre-conception that scheme would make the roundabout more attractive to some local users and as such would result in additional traffic on these arms;
 - ◆ Total inflow to the main roundabout has remained approximately the same in the AM peak period between the post-opening and pre-opening cases; And
 - ◆ There has been a significant increase (36%) in the level of traffic travelling eastbound on the A47 West during the AM peak period.

A decrease in total inflow into the roundabout was expected, however this has only occurred in the PM peak period and the magnitude of that change is perhaps not as great as expected. This is a function of:

- The scheme has made the junction more attractive in terms of overall delay, which has encouraged traffic to use the junction (e.g. increase in flow on the A149, Beveridge Way and the A10);
 - Traffic using the link between the main roundabout and the terminal roundabout.
- 3.15 The absence of change in the total inflow into the roundabout during the AM peak period was not expected. There is concern regarding the post opening junction inflow from the A47 West in the AM peak period. The observed value for this movement was 1301 vehicles, however Figure A1 illustrates that only 1372 vehicles are joining the roundabout from the A47 West in the pre opening period. Therefore it could be concluded that there has been no significant change in the number of vehicles joining Hardwick roundabout from the A47 West in the AM peak.
- 3.16 However, Figure A2 identifies 568 vehicles travelling eastbound on the flyover from the A47 West. Therefore in total 1869 vehicles are travelling eastbound from the A47 West, a 36% increase in traffic travelling eastbound from the A47 West. There are a number of possible reasons for this increase in traffic, including:
- ◆ Errors in the collection of the Manual Classified Counts; and,
 - ◆ Traffic Re-assignment;

- 3.17 Table 3.2 illustrates the change in movements for vehicles travelling eastbound on the A47 West approaching Hardwick roundabout pre and post scheme opening in the AM peak period.
- 3.18 Table 3.2 highlights increases in traffic travelling eastbound on the A47 West to Hardwick Rd (56%), A149 Queen Elizabeth Way (47%) and A47 East (57%). This could be due to vehicles that previously travelled west on the A47 exiting onto the A148 to reach destinations either on the east side of Kings Lynn or Hardwick industrial estate, are now remaining on the A47 until Hardwick roundabout due to perceived quicker journey times.
- 3.19 Table 3.2 also highlights a decrease in vehicles travelling from the A47 West to A10 West Winch Road (48%) and Beveridge Way (41%). It is unclear why this decrease has occurred.

Table 3.2 – Changes in traffic patterns and volumes for movements from the A47 West resulting from the re-opening of Hardwick roundabout (AM Peak)

From A47 West to:	Pre - Opening (Average) (A)	Post Opening RBT Inflow (B)	Post Opening Flyover (C)	Post Opening Combined (D) = (B) + (C)	Actual Change (E) = (D) – (A)	Percentage Change (D)/(A)*100-100
A47 West	0	0	23	23	23	n/a
Hardwick Rd	474	724	15	739	265	56%
A149 Queen Elizabeth Way	391	565	10	575	184	47%
A47 East	249	0	392	392	143	57%
A10 West Winch Road	180	7	87	94	-86	-48%
Beveridge Way	78	5	41	46	-32	-41%
Total	1372	1301	568	1869	497	36%

Manual Classified Counts – Routing of Traffic

- 3.20 A further key element of the scheme was the assignment of traffic with regard to the alternative routes available for traffic at the new junction. For example, under the scheme it is possible for traffic from the A149 Queen Elizabeth Way to access the A47 eastbound either by using the flyover, or alternatively by using the existing roundabout.
- 3.21 Detailed analysis of each movement at the junction is contained in Annex B, however a summary of the key movements that potentially could use either the existing junction or the flyover are as follows:

Table 3.3 – Routing of Traffic: AM Peak

Approach Arm	Total Traffic on Approach	Traffic to A47 (west)				
		Total	Traffic Using Roundabout		Traffic Using Flyover	
			Vehicles	%	Vehicles	%
Hardwick Road	2158	496	43	8.7%	453	91.3%
A149	1035	238	21	8.7%	217	91.3%
A47 east	1363	545	0	0.0%	545	100.0%
A10	634	108	108	100.0%	0	0.0%
Beveridge Way	398	96	96	100.0%	0	0.0%

Table 3.4 – Routing of Traffic: PM Peak

Approach Arm	Total Traffic on Approach	Traffic to A47 (west)				
		Total	Traffic Using Roundabout		Traffic Using Flyover	
			Vehicles	%	Vehicles	%
Hardwick Road	799	368	208	56.5%	160	43.5%
A149	1185	332	36	10.7%	296	89.3%
A47 east	1847	1053	0	0.0%	1053	100.0%
A10	965	376	376	100.0%	0	0.0%
Beveridge Way	217	61	59	96.4%	2	3.6%

3.22 Tables 3.3 and 3.4 illustrate that:

- ◆ All traffic from the A47 east uses the flyover to access the A47 west (as would be expected);
- ◆ Traffic from the A10 and Beveridge Way do not use the new Flyover but instead use the existing roundabout to access the A47 west;
- ◆ In the AM peak traffic very few vehicles from Hardwick Road and Queen Elizabeth Way use the roundabout, with almost all traffic using the flyover. However in the PM peak this changes with more traffic from Hardwick Road using the roundabout in preference to the flyover. In contrast, traffic from Queen Elizabeth Way does not have an increased tendency to use the flyover in the PM peak. This finding is surprising and somewhat difficult to explain, but perhaps is

a function of local highway congestion on Hardwick Road in the PM peak that is absent in the AM peak.

3.23 Further detail on the routes chosen by traffic is presented in Annex B.

JOURNEY TIMES

Journey Time Surveys

3.24 Pre opening journey time surveys were obtained for 05/09/2002 and post opening surveys were undertaken on 29/09/2004. The surveys were undertaken using identical methodology and timing points. The journey time surveys were in vehicle with timing started at 1km points away from the junction. Any delay experienced was timed and timing finished when the survey vehicle successfully merged onto the Hardwick Roundabout.

3.25 Table 3.4 presents the summary data from both surveys.

Table 3.5 – Pre and Post Opening Journey Times

Approach Arm	AM Peak			PM Peak		
	Pre	Post	Difference	Pre	Post	Difference
A149 Queen Elizabeth Way	2:53	1:51	-1:02 (-36%)	3:15	1:51	-1:24 (-44%)
Hardwick Road	2:31	2:21	-0:10 (-7%)	3:28	2:48	-0:40 (-19%)
A47 West	1:30	1:41	+0:11 (+12%)	1:25	1:27	+0:02 (+2%)
Beveridge Way	0:50	0:41	-0:09 (-18%)	0:50	0:49	-0:09 (-2%)
A10	4:45	2:27	-2:18 (-48%)	2:43	1:20	-1:23 (-52%)
A47 East	2:02	1:11	-0:51 (-42%)	2:22	1:05	-1:17 (-54%)

Note: All times expressed as minutes and then seconds. Negative differences equates to a quicker journey time post opening

3.26 From Table 3.4 it is apparent that in the AM Peak all post opening journey were quicker than pre opening apart from A47 West. The following percentage reductions in journey times were observed (Post scheme as compared to Pre opening)

- ◆ A149 Queen Elizabeth Way journey times reduced by 36%;
- ◆ Hardwick Road journey times reduced by 7%;
- ◆ A47 West journey times increased by 12%;
- ◆ Beveridge Way journey times reduced by 18%;
- ◆ A10 journey times reduced by 48%;
- ◆ A47 East journey times reduced by 42%;

3.27 All PM peak journey times were quicker post opening than pre opening apart from A47 west. The following percentage reductions in journey times were observed in the PM peak.

- ◆ A149 Queen Elizabeth Way journey times reduced by 44%;
- ◆ Hardwick Road journey times reduced by 19%;
- ◆ A47 West journey times increased by 2%;
- ◆ Beveridge Way journey times reduced by 2%;

- ◆ A10 journey times reduced by 52%;
- ◆ A47 East journey times reduced by 54%;

3.28 In summary, the reconfigured roundabout with flyover reduced journey times on all arms apart from the A47 West.

4. POPE Methodology

INTRODUCTION

- 4.1 This section assesses the level of economic benefits predicted for the scheme and compares these predictions with actual benefits accrued when considering actual traffic volume changes and actual journey time benefits. The approach that we have taken is termed the Post Opening Project Evaluation (POPE) methodology. This approach focuses on relating actual changes in flows and journey times against those forecast. In addition a similar approach is undertaken in using
- 4.2 A consequence of the POPE methodology is that all costs and benefits are expressed in terms of the present value year and the discount rate prevalent at the time that the original PAR was submitted. For this scheme the present value year is 1998, and the discount rate was 6 per cent. In addition all costs and benefits are expressed in terms of market prices rather than factor cost reflecting the original PAR evaluation which was done in accordance with PAR3 guidance. This is an important change from the PAR2 assessments which were undertaken in terms of factor cost. This is an important consideration, especially when the majority of the assessments undertaken elsewhere in this study were in accordance with PAR2.

SPECIFIC ISSUES WITH THE HARDWICK ASSESSMENT

- 4.3 There are a number of approaches that could be adopted in assessing the post-opening economic performance of the scheme. In this case we have adopted two separate approaches in order to provide a 'sense-check' of the evaluation outcome:
- ◆ A practical approach based on observed traffic flow and journey time changes at the junction; and,
 - ◆ A second more technical approach using the original JUICE assessments re-worked using TRANSYT model output based on outturn flows.
- 4.4 In addition, while the original PAR evaluation did not claim safety benefits, it is clear from the examination of post-opening data that a reduction in accident numbers has occurred and that the inclusion of accidents benefits would be correct.

PRACTICAL APPROACH

- 4.5 The 'practical approach' towards the POPE assessment of the Hardwick Roundabout utilises the journey time and traffic flow data collected by Atkins before and after the scheme was implemented. At its simplest level this approach calculates the overall travel time saving by taking the changes in flow and travel time in each of the AM and PM peak periods. These are then turned into monetised benefits, capitalised over a thirty year period, and expressed in terms of a 1998 present value year.
- 4.6 Particular issues regarding the practical assessment were:
- ◆ The treatment of journey time changes were easy to evaluate (in most cases the delay at the junction decreased), however there were also significant flow changes at the junction with (a) A47 traffic using the flyover, but (b) some more local traffic re-assigning towards the junction. These changes in flow were dealt with by, first, calculating the benefit of the journey time reduction for the baseload

traffic (usually existing users) then, secondly, treating new users to the junction in accordance with the 'rule of a half'; and,

- ◆ Separate assessment was required of the delay to traffic at the terminal roundabout. The journey time data collection exercise had not included delay at the junction, and therefore an assessment based on site observation was made to the effect that all vehicles using the terminal roundabout would be delayed by 10 seconds.
- 4.7 On each approach arm delay to traffic was lower after the scheme was opened than before (Table 3.4), resulting in a benefit for 'baseload' traffic which amounted to 95% of the time benefits from the scheme. The remaining 5% of time benefit was derived from the 'new users' that were attracted to the roundabout. These were attributed a time benefit in accordance with the 'rule-of-half'. Finally an assessment was made of the delay attributable to the flyover traffic that whilst not using the at-grade element of the junction was in turn delayed by the small terminal roundabout. This amounted to a reduction in the overall time benefit from the scheme of about 7%.
- 4.8 **The assessment of time benefits undertaken using this approach provided a 30-year PVB (1998 prices discounted to 1998) of £16.0m at low growth and £19.2m at high growth.** Further detail regarding this calculation is presented in Annex C.

TRANSYT/JUICE ASSESSMENT

Original PAR Assessment

- 4.9 Within the PAR document forecast scheme benefits were assessed using a TRANSYT junction model of the proposed scheme, the output from which was then used to derive an overall economic benefit from the scheme using the evaluation spreadsheet JUICE7.
- 4.10 The PAR document presents user benefits for the low and high growth scenarios of £66,256,000 and £61,240,000 respectively (note: the low growth value is greater than the high growth value).
- 4.11 The original Do Something (termed 'Do Minimum' within the PAR) and Do Minimum (termed 'Do Nothing' within the PAR) TRANSYT and JUICE files were provided by the consultant for the scheme, however when examined there were some discrepancies, as detailed in Table 4.1.

Table 4.1 – Travel Time Benefits

Model	Growth	Travel Time Benefits
JUICE	High Growth	£63,485,890
	Low Growth	£52,585,090
PAR	High Growth	£61,240,000
	Low Growth	£66,256,000
% Difference JUICE – PAR	High Growth	+4%
	Low Growth	-21%

- 4.12 This discrepancy was carried over into the following POPE evaluation which, by necessity, had to be based on the available TRANSYT/JUICE model information.

POPE: JUICE/TRANSYT Technical Re-evaluation

- 4.13 As detailed above, a second POPE evaluation of the benefit from the scheme was undertaken using the original TRANSYT models, but based on observed traffic flow changes. The outputs from these models were then fed into the JUICE assessment of the scheme.
- 4.14 Table 4.2 presents the opening year assessment of total vehicle hours from the TRANSYT models of the scheme. First the PAR Do Minimum and PAR Do Something assessments are presented, and the difference between these calculated. Then the POPE Do Something total vehicle hours, based on the re-run DS TRANSYT model but with observed flows, is presented and the difference between this and the original DM calculated.

Table 4.2 – TRANSYT Models: Vehicle Hours in First Year on Roundabout

Total Vehicle Hours per Year			
		Low Growth	High Growth
PAR Assessment	Do Minimum	382,299 hrs	448,976 hrs
	'PAR' Do Something	166,010 hrs	
	Difference (DS– Do Min)	216,289 hrs	282,966 hrs
POPE Re-evaluation	'POPE' Do Something	189,121 hrs	
	Difference (DS– Do Min)	193,179 hrs	259,855 hrs
	Benefits Difference Post/Predicted	-11%	-8%

- 4.15 Table 4.4 demonstrates that the scheme delivers a 193,179 vehicle hour saving in the opening year low growth and a 259,855 vehicle hour saving in the opening year high growth. This was approximately 10% less vehicle hour benefit than what was forecast by the original PAR assessment. This reflects the greater delay to each vehicle from the additional non-A47 traffic using the junction.
- 4.16 **The output from the POPE TRANSYT models was then used as input into the JUICE economic assessment of the scheme providing time benefits of £41.474m and £52.375m at low and high growth respectively.**

COMPARISON OF 'PRACTICAL' AND TRANSYT/JUICE POPE ASSESSMENTS

- 4.17 The POPE 'Practical' and more technical TRANSYT/JUICE economic re-evaluations provide differing levels of scheme forecast time benefits with £16.011m and £19.213m (low and high growth respectively) for the 'Practical' assessment, but much higher values of £41.474m and £52.375m for the TRANSYT/JUICE assessment. While it is re-assuring that both assessments provide a generally good level of scheme benefits, there is a need to understand why the different approaches have provided apparently different assessments.
- 4.18 With regard to the 'Practical' assessment, it is accepted that the evaluation may represent an underestimate of overall benefit for the following reasons:
- ◆ This approach is based on opening year values and does not account for increasing delay as traffic grows over time; and,

- ◆ The assessment is based on delay to the approach arm only and does not include for changes in delay on the circulatory carriageway.
- 4.19 However, the 'Practical' approach has the distinct advantage in that it is based totally on observed data.
- 4.20 With regard to the JUICE/TRANSYT assessment, this has the advantage in that it is based on a more comprehensive assessments, taking account for changes over time, and of changes on the circulatory carriageway

SAFETY

- 4.21 The PAR assessment submitted in support of the scheme did not forecast any accident savings as a result of the scheme, and as such there is no safety benefit attributable to the scheme included in the economic evaluation. However, the assessment of the accident record at the Hardwick roundabout both before and after the implementation of the scheme indicates that the scheme has actually resulted in a reduction in accident numbers of 8.25 accidents in the opening year (Section 3). Consequently it is prudent to include an assessment of the forecast level of accident savings with the post-opening re-evaluation.
- 4.22 Table 4.3 presents the evaluation of accident benefits from the scheme. **This illustrates that over the 30-year evaluation period the scheme is forecast to save between 231 and 281 accidents (low and high growth respectively), and to provide an accident benefits of between £7.3m and £8.6m (again, low and high growth respectively).**

Table 4.3 – Accident Evaluation

Item	Low Growth	High Growth
A. Opening Year Accident Saving	8.25	
B. Cost per 2003 PIA	£76,558	
C. Discount Factor to 1998	0.75	
E. Capitalisation Factor: Accident Benefits	15.5	18.25
Economic Benefit (A*B*C*D)	£7,342,391	£8,645,073
F. Capitalisation Factor: Accident Numbers	28	34
Accidents Saved (A*F)	231	281

SCHEME COST

- 4.23 Figures for the outturn scheme cost were £2.5m in 2002, £6.5m in 2003, and £0.157m in 2004. These values included all preparation and supervision, but excluded VAT. Table 4.4 converts the outturn scheme cost into a Present Value of Cost (PVC) expressed in 1998 prices discounted to 1998 at 6%

Table 4.4 – POPE Comparison: Conversion of Outturn Cost to Present Value Cost

Original PAR	Outturn 2002	Outturn 2003	Outturn 2004	Total Outturn

Cost (1)	£3,756,635	£2,449,920	£6,461,503	£156,772	-
RPI (2)	-	176	181.3	186.7	-
RPF (3)	-	0.98	1	1	-
RPI (1998) (4)	-	162.8	162.8	162.8	-
Discount Factor (2003) (5)	-	0.79	0.75	0.70	-
Taxation adjustment	-	1.209	1.209	1.209	-
PVC	£3,590,859	£2,121,158	£5,155,892	£115,692	£7,392,742

All Costs are in 1998 prices discounted to 1998 at 6%.

4.24 The outturn PVC of £7.393m is over twice that forecast in the PAR assessment of £3.590m.

SUMMARY

4.25 Table 4.5 presents a summary of the economic evaluation of the scheme, containing:

- ◆ Original PAR evaluation;
- ◆ POPE re-evaluation based on the 'Practical' approach; and,
- ◆ POPE re-evaluation based on the TRANSYT/JUICE approach.

Table 4.5 – POPE Comparison: Summary

	PAR		POPE JUICE/TRANSYT		POPE 'Practical'	
	Low	High	Low	High	Low	High
Time Benefit	£66.256m	£61.240m	£41.474m	£52.375m	£16.011m	£19.213m
Accident Benefit	-	-	£7.342m	£8.645m	£7.342m	£8.645m
PVB	£66.256m	£61.240m	£48.816m	£61.020m	£23.353m	£27.858m
PVC	£3.590m	£3.590m	£7.392m	£7.392m	£7.392m	£7.392m
NPV	£62.746m	£57.649m	£41.424m	£53.628m	£15.961m	£20.466m
BCR	18	17	6.60	8.26	3.16	3.77

All costs and benefits are 1998 prices discounted to 1998 at 6%.

4.26 Table 4.5 compares the PAR evaluation against both the 'Practical' and JUICE/TRANSYT POPE re-evaluations. In each case the POPE evaluation produces a lower level of journey time benefits, however, the POPE re-evaluation includes accident benefits which were not recognised by the PAR evaluation. Despite this the POPE present value of benefits (PVB) are lower than the original PAR values. With regard to scheme cost, the outturn cost is over double that of the original PAR assessment, although in each the level of benefit is sufficiently high to ensure that the scheme has both a positive net present value (NPV) and robust benefit cost ratios (BCR), with BCR values in the range 6.60 to 8.26 for the POPE JUICE/TRANSYT re-evaluation, and 3.16 to 3.77 for the 'Practical' re-evaluation.

5. Summary of Appraisal and Evaluation Summary Tables

INTRODUCTION

5.1 In order to fully evaluate the effects of the bridge, Atkins has undertaken a review of the original PAR document prepared by Halliburton KBR. The Appraisal Summary Table (AST) from this document, which summarise the predicted impact of the scheme under the five objectives of environment, safety, economy, accessibility and integration, is presented as Annex D of this report.

5.2 The Atkins review focused on:

- ◆ The main body of the PAR document itself; and,
- ◆ The Appraisal Summary Table (AST) from the PAR.

5.3 Each of these is dealt with in turn below.

PAR DOCUMENT

5.4 The main points to note from the PAR document of the A47 Hardwick Roundabout improvements are as follows.

Environment

5.5 An environmental assessment was carried out prior to publication of draft orders. This was followed by a stage 2 Environmental Assessment, draft Stage 3 Environmental Assessment. Authority to proceed with the scheme was given in the GOER letter of 22nd July 1994. There was no Notice of Determination.

Environment – Greenhouse Gases

5.6 Greenhouse gases were assessed with do something levels being 103% of present do minimum and 100% of future do minimum, hence assessed as neutral.

Environment – Landscape

5.7 Increased visual impact in an area of important landscape quality resulting from elevated traffic on embankments/structure.

5.8 Pattern – slight adverse. New flyover would be visible from the east, but against a backdrop of existing industry. Offsite planting by agreement.

5.9 Land cover – slight adverse – increased visibility of junction.

5.10 Summary of Character – pleasant open landscape with some attractive elements, degraded by existing traffic and industrial urban edge. Slight adverse, declining over time as mitigation measures establish.

Environment: Biodiversity – Plan Level

- 5.11 Direct loss and severance of remaining species rich wet and dry grassland, mitigated in part by translocation. Minor adverse based on stage 2 environmental assessment report, plus on-site observation.

Safety

- 5.12 Accident data was provided between 1997 and 2001, which identified that there were 56 accidents in total, with 51 slight accidents and 5 serious accidents which equated to a severity index of 9%.

Economy

- 5.13 AADT values were provided with 24300 vehicles westbound and 14900 vehicles eastbound on the A47. The percentage HGV's were 18% HGVs westbound and 13% eastbound with percentage PSV's of 0.5% westbound and 1.1% eastbound.
- 5.14 It stated that the maximum degree of saturation was 186% with the time period of maximum degree of saturation being AM peak.

Transport Economic Efficiency (TEE)

- 5.15 JUICE 7 used for economic assessment.
- 5.16 Low growth - £66,256,000
- 5.17 High growth - £61,240,000

Appraisal Summary Table (AST)

- 5.18 The main points to note from the AST A47 Hardwick Roundabout Improvements PAR are:

Environment - Noise

- ◆ No significant effects – properties are too far away to be affected; *Neutral*.

Environment – Local Air Quality

- ◆ No significant effects – properties are too far away to be affected. Possible local benefit due to reduced congestion; *Neutral*

Environment – Greenhouse Gases

- ◆ No significant effects; *Neutral*

Environment – Landscape

- ◆ Slight adverse in early years. On and off site planting should assist in softening the urban edge. Scheme is adjacent to Area of Important Landscape Quality, but existing urban edge is locally intrusive. Scheme will remove some existing vegetation and elevate traffic/lighting etc in local views. *Slight Adverse*

Environment – Townscape

- ◆ Urban edge dominated by large scale retail/warehouse structures. Some residential/commercial property nearby. Existing roads/junction dominate character. *Neutral*

Environment – Heritage of Historic Resources

- ◆ Archaeological interest in vicinity of junction. Underlying archaeology likely to have been disturbed by existing road/junction. *Neutral*

Environment – Biodiversity

- ◆ Loss of established vegetation, including species rich grassland. *Slight Adverse.*

Environment - Water Environment

- ◆ Small increase in hard surfaced area. *Neutral*

Environment – Physical Fitness

- ◆ Provision of public footpath/cycle facilities around junction. *Neutral*

Environment – Journey Ambience

- ◆ Reduced congestion, attractive ‘gateway’ entrance to Kings Lynn, balanced against increased earthworks, structures. *Neutral*

Safety – Accidents

- ◆ There are no predicted accident savings with the proposed scheme. Safety is not a principal problem at the junction. *Neutral*

Safety – Security

- ◆ There is no change to the likely incidence of crime or fear of crime related to road users. *Neutral*

Economy – Transport Economic Efficiency

- ◆ Substantial economic benefits due to reduced delays. *Beneficial.*

Economy – Reliability

- ◆ Substantial but not quantified. *Not Assessed.*

Economy – Wider Economic Impacts

- ◆ Reduction in traffic delays will assist regeneration in surrounding area. *Slight Beneficial*

Accessibility – Option Values

- ◆ No new public transport services. *Neutral*

Accessibility – Severance

- ◆ Beneficial impact for pedestrians and cyclists with additional facilities. *Slightly Beneficial*

Accessibility – Access to the transport system

- ◆ Journey times will improve which will encourage bus patronage. *Slight Beneficial.*

Integration – Transport Interchange

- ◆ No change to interchange facilities. *Neutral.*

Integration – Land Use Policy

- ◆ Will assist local policies with respect to encouraging increased bus patronage and cycle/pedestrian facilities. *Slight Beneficial.*

Integration – Other Government Policies

- ◆ No recognisable effect on other government policies. *Neutral.*

OUTTURN EFFECTS

- 5.19 In order to assess the actual or outturn effects of the opening of the scheme, we have produced an Evaluation Summary table (EST), which mirrors the appearance of the AST, and includes details of the actual sub objectives that have been evaluated. The EST is presented in Annex E.
- 5.20 Section three discussed the economy and safety impacts of the scheme. This section concentrates on the other three impacts included in the AST, namely
- ◆ **Environmental Impacts** such as noise, local air quality, landscape, biodiversity, heritage and water;
 - ◆ **Accessibility Impacts** such as change in access to public transport, severance within communities and impact on pedestrian and other modes; and
 - ◆ **Integration** measured by how the scheme accords with policy.
- 5.21 The assessments that follow are all subjective assessments from members of the evaluation team.

Environment

Landscape – Increased visual impact in an area of Important Landscape Quality resulting from elevated traffic on embankments/structures. Slight adverse in early years. On and off site planting should assist in softening the urban edge.

- 5.22 During our visit to the site nothing had been planted on or off the site. Figure 5.1 shows a picture of the un-landscaped roundabout. Hence it is too early to say whether planting would have the affect of reducing a slight adverse to neutral. The flyover does raise traffic to a level where it is far more visible and includes raised lighting. This would categorise the scheme as slight adverse.



Figure 5.1 – Unlandscaped Roundabout

Biodiversity – Loss of established vegetation, including species rich grassland. Slight Adverse.

- 5.23 For the purposes of this evaluation it is assumed that as the roundabout has been enlarged then there has been the loss of established vegetation including species rich grassland hence the slight adverse rating.

Accessibility

Accessibility Severance – Beneficial impact for pedestrians and cyclists with additional facilities. Slight Beneficial

- 5.24 On a visit to the site it was established that a new footpath/cycle path had been provided as well as two pedestrian crossings (incorporated into the signals).
- 5.25 Figure 5.2, 5.3 and 5.4 show examples of different facilities.



Figure 5.2 – Cyclist Using New Cycle path



Figure 5.3 – New Cycle Signage



Figure 5.4 – New Cycle/Footpath + Sign

5.26 Table 5.1 shows pre and post opening pedestrian and cycle counts at Hardwick Roundabout. All Counts are 12 hour counts from 7:00AM to 7:00PM.

Table 5.1 - Pedestrian and Cycle 12 hour Counts at Hardwick Roundabout

	27/04/1999	28/03/2000	12/05/2000	29/09/2004
A47 West	40	30	41	70
Hardwick Road	6	4	3	-
A149 Queen Elizabeth Way	3	6	10	-
A47 East	2	0	6	-
A10 West Winch Road	4	5	6	-
Beveridge Way	20	11	27	-

5.27 Values taken from Table 5.1 establish that pre opening there were on average 37 pedestrians/cyclists crossing the A47 west arm of the roundabout whilst post opening this had increased to 70 pedestrians/cyclists. This is approximately a 90% increase in the number of pedestrians/cyclists post opening compared to pre opening. (Note pre opening there were three counts and post opening one count, counts were also undertaken at different times of the year and most likely in different weather conditions).

5.28 The post opening pedestrian and cycle count undertaken on 29th September 2004 is displayed on an hour by hour basis by direction in Figure 5.5.

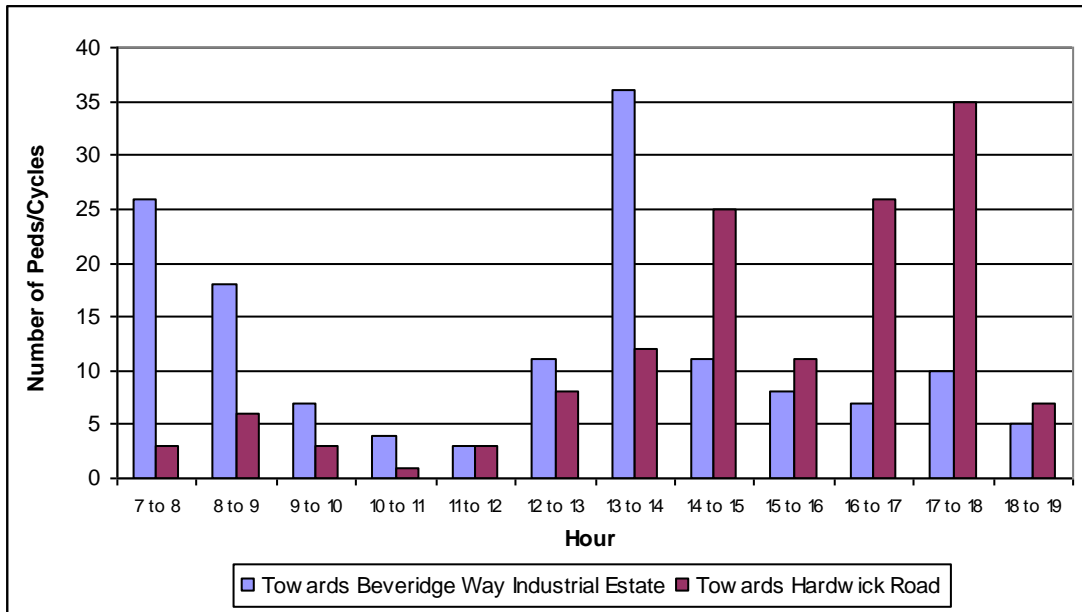


Figure 5.5 – Pedestrian/Cycle Flows underneath A47 Flyover.

5.29 Due to this increased patronage by pedestrians and cycles we agree with Halliburton’s prediction of a slight beneficial impact.

Accessibility – Access to the Transport System – Journey times will improve which will encourage bus patronage - Slightly Beneficial

5.30 Section three demonstrated that journey times have improved on all arms apart from A47 West. If there is a correlation between quicker journey times and increased bus patronage then the slight beneficial assessment undertaken by KBR can be agreed with (this is in the absence of pre and post opening bus patronage figures). It can be argued that quicker journey times are experienced by all vehicles hence bus will be no better off than any other vehicles hence there will be no mode switch due to a reduction in journey times.

5.31 We have therefore assessed this as neutral/slight beneficial.

Integration

Integration – Land-Use Policy – will assist local policies with respect to encouraging increased bus patronage and cycle/pedestrian facilities.

5.32 We have assessed this as neutral with regard to bus patronage and slight beneficial with regard to cycle/pedestrian facilities for the reasons given above.

6. Conclusions

Safety

- 6.1 Early indication is that the scheme has reduced accidents on approaches but has increased accidents on the circulatory carriageway. But this is based on only 11 months of post opening data. **However there has been an annual decrease in 8.25 accidents in the opening year of the scheme.**

Traffic Flows

- 6.2 A comparison between pre and post opening flows identified that there was an increase in traffic entering the roundabout on most arms especially Beveridge Way. An increase in traffic was identified travelling eastbound on A47 West during the AM peak period.

Traffic Routing

- 6.3 Traffic from Hardwick Road to A47 West, approximately 90% use the flyover and 10% the roundabout in the AM peak and 55% use the flyover and 45% the roundabout in the PM peak.
- 6.4 Traffic from Queen Elizabeth Way to A47 West, approximately 90% use the flyover and 10% the roundabout in both peak periods.
- 6.5 A47 West to A10 and Beveridge Way where approximately 90% travel by the flyover and 10% the roundabout apart from the PM peak to Beveridge Way where 80% use the flyover and 20% the roundabout.

Journey Time Surveys

- 6.6 Journey times on the approaches to the roundabout reduced on all arms apart from the A47 West.

Economic Evaluation – Post Opening Project Evaluation (POPE) Method

- 6.7 The POPE evaluation has been undertaken using two approaches; the first based on observed changes in flow and delay at the junction ('Practical' approach), with the second based on a revised TRANSYT and JUICE assessment (junction modelling programs) using observed flows (JUICE/TRANSYT approach). The benefits from these were as follows:
- ◆ Practical Approach – Time Benefit of £16.011m at low growth, £19.213m at high growth.
 - ◆ JUICE TRANSYT Approach – Time Benefit of £41.474m at low growth, £52.375m at high growth.
- 6.8 The observed accident saving is forecast to provide an accident benefit of £7.342m at low growth and £8.645m at high growth.
- 6.9 The overall scheme Present Value of Benefits (PVB) is as follows:

-
- ◆ Practical Approach – PVB of £23.353m at low growth, £27.858m at high growth.
 - ◆ JUICE TRANSYT Approach – PVB of £48.816m at low growth, £61.020mm at high growth.
- 6.10 It is recognised that the ‘Practical Approach’ may provide an underestimate of the benefit from the scheme, but that it possesses an advantage in that at least the first year benefits are based on observed values.
- 6.11 The outturn Present Value of Costs (PVC) of £7.393m is over twice that forecast in the PAR assessment of £3.590m.**
- 6.12 Under the POPE assessment the overall scheme Benefit Cost Ratio (BCR) values are robust irrespective of which approach to the evaluation is adopted. For the ‘Practical Approach’ the BCR values are in the range 3.16 to 3.77, while in the JUICE/TRANSYT approach the BCR ratios are in the range 6.60 to 8.26.**

Evaluation – Atkins Evaluation Summary Table (EST)

- 6.13 The scheme provides additional facilities for pedestrians/cyclists and has resulted in an 80% rise in numbers travelling between Hardwick Road and Beveridge Way since scheme implementation.
- 6.14 It is argued that the scheme does not encourage an increase in bus patronage as was predicted pre opening.

Overall

- 6.15 The POPE evaluation of the scheme indicates that the scheme is forecast to deliver less benefit than originally predicted. In addition the scheme PVC is greater than forecast. However, the scheme has resulted in a substantial reduction in accidents over its opening year, which was not foreseen by the original evaluation, thus providing an additional source of benefit above that predicted by the original evaluation. Additionally the POPE evaluation of the scheme shows that the forecast BCR values are robust being between 3.16 and 3.77 in a ‘pessimistic’ evaluation or between 6.60 to 8.26 in a more optimistic assessment. However these are less than the original BCR values of 18.0 and 17.0.

Annex A – Traffic Flow Diagrams for Hardwick Roundabout

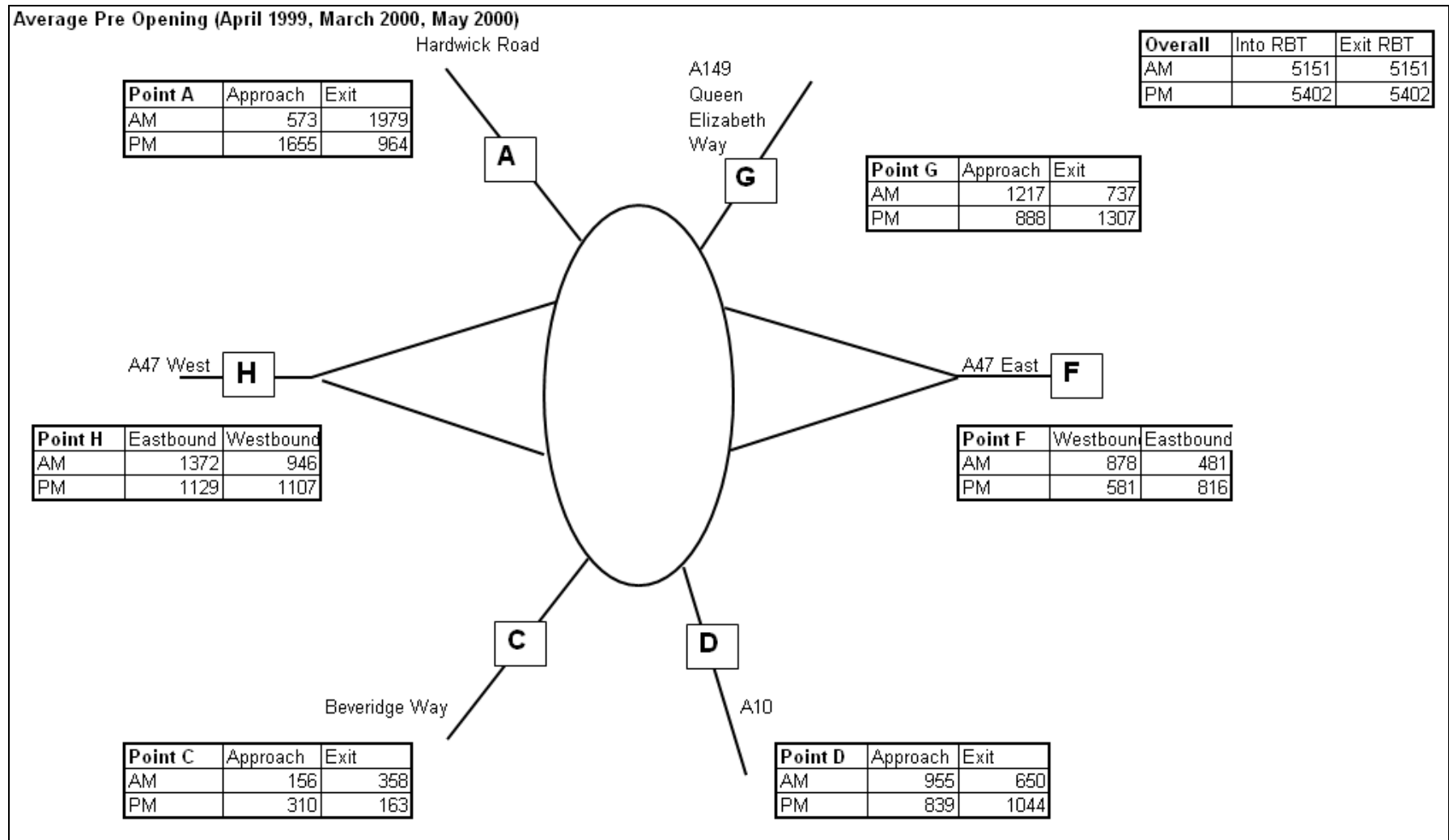


Figure A1 - Average Pre Opening MCC (Various Sources)

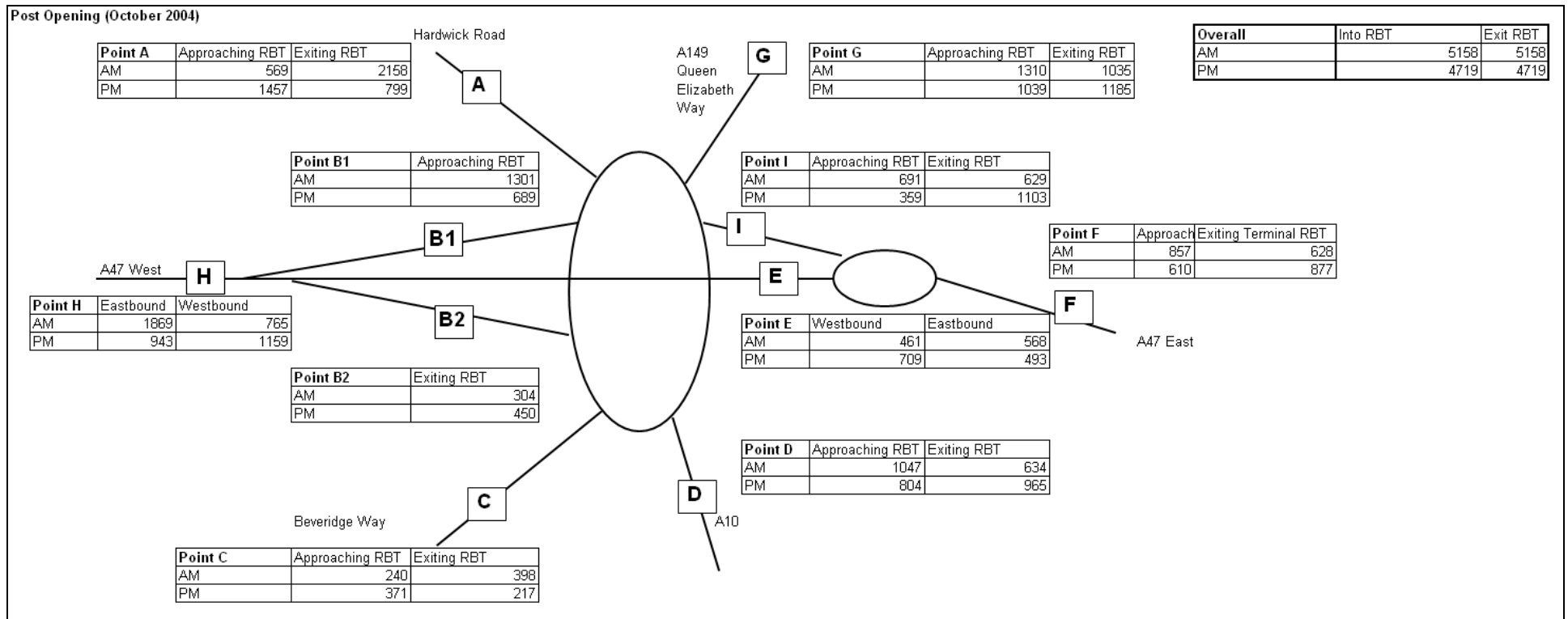


Figure A2 - Post Opening MCC (Atkins)

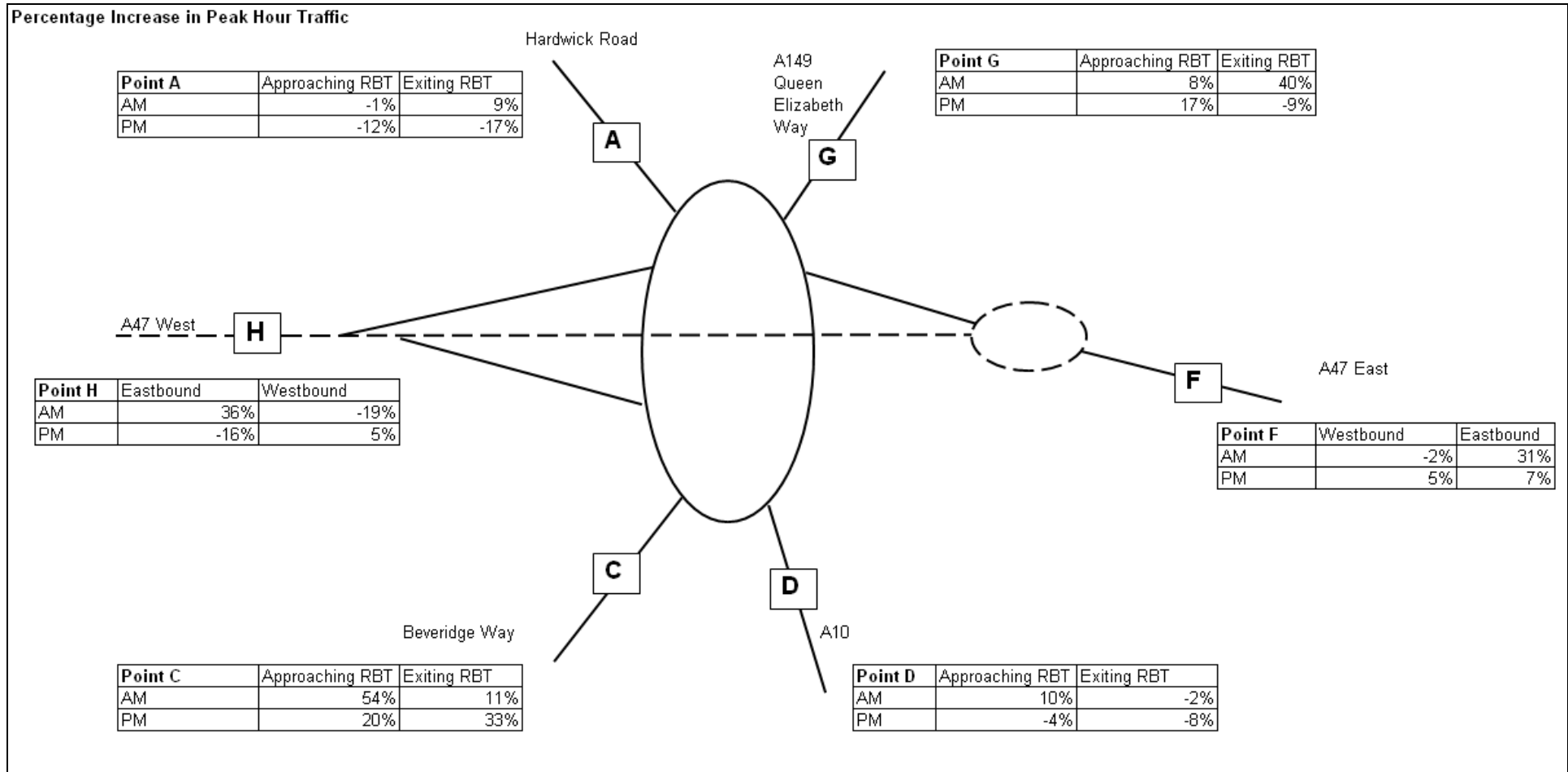


Figure A3 - Percentage Increase in Peak Hour Traffic: Pre and Post Opening

Annex B – Analysis of Routes Used by Traffic at the Hardwick Roundabout

Traffic Routing

The post opening manual classified count was used to establish the destination of traffic entering at each arm to see what effect the flyover has. The following sections examine each arm in turn.

Hardwick Road

Table B1 shows the routings from Hardwick Road in the peak periods.

Table B1 – Routing of Traffic From Hardwick Road in the AM and PM peaks

From Hardwick Road to:	AM	PM
A149	20%	0%
A47 East	20%	25%
A10	26%	4%
Beveridge Way	11%	26%
A47 West (via roundabout)	2%	26%
A47 West (via flyover)	21%	20%
TOTAL %(N=)	100% (N=568)	100% (N=1457)

From Table B1 it is apparent that:

- ◆ The destination of traffic entering the roundabout from Hardwick Road is relatively evenly distributed by arm.
- ◆ 9 out of 10 vehicles travelling from Hardwick Road to A47 West in the AM peak uses the flyover whilst in the PM peak 5.5 out of the 10 use the flyover.
- ◆ Twice the amount of traffic enters the roundabout from Hardwick Road in the PM peak compared to the AM peak.

A149 Queen Elizabeth Way

Table B2 shows the routings used by traffic entering the roundabout in the AM and PM peaks from the A149 Queen Elizabeth Way.

Table B2 – Routing of Traffic From A149 in the AM and PM peaks

From A149 to:	AM	PM
A47 East	8%	7%
A10	20%	41%
Beveridge Way	10%	6%
A47 West (via roundabout)	2%	3%
A47 West (via flyover)	21%	25%

A47/A10 Hardwick Roundabout

Hardwick Road	38%	18%
TOTAL %(N=)	100% (N=1310)	100% (N=1039)

Table B2 shows that

- ◆ In both the AM and PM peaks 9 out of 10 vehicles use the flyover to get to the A47 West.
- ◆ Traffic levels are similar in both the AM and PM peaks but routings differ with the majority of traffic having a Hardwick Road destination in the AM peak and A10 in the PM peak.

A47 East

Table B3 shows the routings used by traffic entering the roundabout in the AM and PM peaks from the A47 East.

Table B3 – Routing of Traffic From A47 East in the AM and PM peaks

From A47 East to:	AM	PM
A10	13%	11%
Beveridge Way	9%	7%
A47 West (via roundabout)	0%	0%
A47 West (via flyover)	40%	57%
Hardwick Road	29%	14%
A149	9%	10%
TOTAL %(N=)	100% (N=857)	100% (N=610)

Table B3 shows that

- ◆ In both peak periods all traffic uses the flyover to access the A47 West;
- ◆ In the AM peak the majority of traffic accesses the A47 West and Hardwick Road; and
- ◆ In the PM peak the majority of traffic accesses the A47 West.

A10

Table B4 shows the routings used by traffic entering the roundabout in the AM and PM peaks from the A10.

Table B4 – Routing of Traffic From A10 in the AM and PM peaks

From A10 to:	AM	PM
Beveridge Way	8%	6%
A47 West (via roundabout)	17%	39%
A47 West (via flyover)	0%	0%

A47/A10 Hardwick Roundabout

Hardwick Road	51%	24%
A149	23%	31%
A47 East	0%	0%
TOTAL %(N=)	100% (N=857)	100% (N=610)

Table B6 shows that:

- ◆ In the AM peak over half the traffic that entered at A10 has a destination of Hardwick Road.
- ◆ In the PM peak traffic was relatively evenly distributed between A47 West, Hardwick Road and A149.

Beveridge Way

Table B5 shows the routings used by traffic entering the roundabout in the AM and PM peaks from Beveridge Way.

Table B5 – Routing of Traffic From Beveridge Way in the AM and PM peaks

From Beveridge Way to:	AM	PM
A47 West (via roundabout)	24%	27%
A47 West (via flyover)	0%	1%
Hardwick Road	55%	38%
A149	12%	22%
A47 East	4%	6%
A10	6%	6%
TOTAL %(N=)	100% (N=240)	100% (N=371)

Table B5 shows that:

- ◆ Over half the traffic exiting Beveridge Way in the AM peak was accessing Hardwick Road.
- ◆ 50% more traffic exits Beveridge Way in the PM peak than the AM peak period.

A47 West

Table B6 shows the routings of traffic entering the survey site at the A47 West.

Table B6 – Routings from A47 West in the AM and PM peaks

From A47 West to:	AM	PM
Hardwick Road via roundabout	724	188
Hardwick Road via flyover	15	2
A149 via roundabout	565	495

A47/A10 Hardwick Roundabout

A149 via flyover	10	6
A47 East via roundabout	0	1
A47 East via flyover	392	397
A10 via roundabout	7	2
A10 via flyover	87	73
Beveridge Way via roundabout	5	3
Beveridge Way via flyover	41	11

A47 West to Hardwick Road

- ◆ In AM peak A47 West to Hardwick Road 98% via roundabout and 2% via flyover (N = 739)
- ◆ In PM peak A47 West to Hardwick Road 99% via roundabout and 1% via flyover (N = 190)

A47 West to A149

- ◆ In AM peak A47 West to A149 98% via roundabout and 2% via flyover (N = 575)
- ◆ In PM peak A47 West to A149 99% via roundabout and 1% via flyover (N = 501)

A47 West to A47 East

- ◆ In AM peak A47 West to A47 East 0% via roundabout and 100% via flyover (N = 392)
- ◆ In PM peak A47 West to A47 East 0% via roundabout and 100% via flyover (N = 398)

A47 West to A10

- ◆ In AM peak A47 West to A10 7% via roundabout and 93% via flyover (N = 94)
- ◆ In PM peak A47 West to A10 3% via roundabout and 97% via flyover (N = 75)

A47 West to Beveridge Way

- ◆ In AM peak A47 West to Beveridge Way 11% via roundabout and 89% via flyover (N = 46)
- ◆ In PM peak A47 West to Beveridge Way 21% via roundabout and 79% via flyover (N = 14)

The Main points to note from the traffic routing section is that:

- ◆ Traffic from Hardwick Road to A47 West, approximately 90% use the flyover and 10% the roundabout in the AM peak and 55% use the flyover and 45% the roundabout in the PM peak.
- ◆ Traffic from Queen Elizabeth Way to A47 West, approximately 90% use the flyover and 10% the roundabout in both peak periods.

A47/A10 Hardwick Roundabout

- ◆ A47 West to A10 and Beveridge Way where approximately 90% travel by the flyover and 10% the roundabout apart from the PM peak to Beveridge Way where 80% use the flyover and 20% the roundabout.

Annex C –Economic Evaluation: Practical Approach

A47/A10 Hardwick Roundabout

A47 Hardwick Roundabout: 'Practical Assessment' of User Time Benefits

AM Peak

Arm	Time (secs) AM Pre	AM Post	AM Time (Post-Pre)	Inflow AM Pre	AM Post	AM Change (Post-Pre)	Baseload Users Opening Year Time Hours 760	Secs New Users (ROH)	Opening Year Time Hours (ROH) 760
A149	173	111	-62	733	1035	302	-9594	-9362	-1976
Hardwick Road	151	141	-10	1703	2158	455	-3595	-2275	-480
A47 W	90	101	11	850	304	-546	706	0	0
Beveridge Way	50	41	-9	301	398	97	-572	-436.5	-92
A10	285	147	-138	592	634	42	-17247	-2898	-612
A47E	122	71	-51	503	628	125	-5416	-3187.5	-673
							-34958		-3074

Note: A negative Time is a Benefit

Terminal Roundabout Adjustment: AM			Opening Year Additional Time 760
	Flow	Assumed Delay (secs)	
RB Approach	500	10	1056
A47 E	735	10	1552
A47 W	546	10	1153
Total			3760

PM Peak

Arm	Time (secs) PM Pre	PM Post	PM Diff	Inflow PM Pre	PM Post	PM Diff	Baseload Users Opening Year Time Hours 500	Secs New Users (ROH)	Opening Year Time Hours (ROH) 500
A149	195	111	-84	1210	1185	-25	-21014	0	0
Hardwick Road	208	168	-40	902	799	-103	-7617	2060	0
A47 W	85	87	2	1146	450	-696	190	0	0
Beveridge Way	50	49	-1	139	217	78	-29	-39	-8
A10	163	80	-83	987	965	-22	-16909	0	0
A47E	142	65	-77	776	877	101	-12614	-3888.5	-821
							-57493		-329

Note: A negative Time is a Benefit

Terminal Roundabout Adjustment: PM			Opening Year Additional Time 500
	Flow Reduction	Assumed Delay (secs)	
RB Approach	500	10	694
A47 E	970	10	1347
A47 W	696	10	967
Total			3008

Monetisation and Capitalisation

	No ROH	ROH
Total Hours Saved in Opening Yea	88691	92094
Opening Year (First Full)	2003	2003
Discount Factor (1998 PV at 6%)	0.75	0.75
VOT 2004 Low £	£11,590	£11,590
Capitalisation Factor Low	20	20
Low VOT Benefit	£15,419,015	£16,010,576
VOT 2004 High £	£11,590	£11,590
Capitalisation Factor High	24	24
High VOT Benefit	£18,502,818	£19,212,691

Notes

1. It is assumed that the Terminal Roundabout Delay is included for A57 E traffic (i.e. it is included in the 1km journey time approach)
2. It is assumed that the missing traffic from the A47 W approach does not include any delay at the terminal roundabout, and as such a separate adjustment is made
3. ROH is 'Rule of a Half'

Annex D - Original Scheme AST

Original Scheme AST

Proposal Name		Option description		
OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE MEASURE	ASSESSMENT
ENVIRONMENT	Noise	No significant effects – properties are too far away to be affected	Number of properties experiencing: - increase in noise = 0 - decrease in noise = 0	No properties win or lose significantly with the scheme. Assessment – Neutral
	Local Air Quality	No significant effects – properties are too far away to be affected. Possible local benefit due to reduced congestion.	Number of properties experiencing - better quality = 0 - worse quality = 0	No significant change to properties. Assessment – Neutral
	Greenhouse Gases	No significant effects	No net increase in Co2 emissions	Neutral
	Landscape	Scheme is adjacent to 'Area of Important Landscape Quality', but existing urban edge is locally intrusive. Scheme will remove some existing vegetation and elevate traffic/lighting etc in local views	N/A	Slight Adverse in early years. On and off site planting should assist in softening urban edge.
	Townscape	Urban edge dominated by large-scale retail/warehouse structures. Some residential/commercial property nearby. Existing roads/junction dominate character	N/A	Neutral
	Heritage of Historic Resources	Archaeological interest in vicinity of junction. Underlying Archaeology likely to have been disturbed by existing road/junction	N/A	Neutral
	Biodiversity	Loss of established vegetation, including species rich grassland	N/A	Slight Adverse
	Water Environment	Small increase in hard surfaced area		Neutral
SAFETY	Physical Fitness	Provision of public footpath/cycle facilities around junction	N/A	Neutral
	Journey Ambience	Reduced congestion, attractive gateway entrance to Kings Lynn, balanced against increased earthworks, structures etc.	N/A	Neutral
	Accidents	There are no predicted accident savings with the proposed scheme. Safety is not the principal problem at the junction.	N/A	Neutral
	Security	There is no change to the likely incidence of crime or fear of crime related to road users	N/A	Neutral

ECONOMY	Transport Economic Efficiency	Substantial economic benefits due to reduced delays	Journey Time Savings	Avg. NPV £60.157m
	Reliability	Substantial but not quantified	Not Undertaken	Not Assessed
	Wider Economic Impacts	Reduction in traffic delays will assist regeneration in surrounding area	Not Undertaken	Slight Beneficial
ACCESSIBILITY	Option values	No new public transport services	N/A	Neutral
	Severance	Beneficial impact for pedestrians and cyclists with additional facilities	Not Undertaken	Slightly Beneficial
	Access to the Transport System	Journey times will improve which will encourage bus patronage	Not Undertaken	Slightly Beneficial
INTEGRATION	Transport Interchange	No change to interchange facilities	N/A	Neutral
	Land Use Policy	Will assist local policies with respect to encouraging increased bus patronage and cycle/pedestrian facilities	Not Undertaken	Slightly Beneficial
	Other Government Policies	No recognisable effect on other government policies	N/A	Neutral

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

Annex D - Atkins EST

Atkins EST

Proposal Name		Option description		Current Cost £9.069m Date: Outturn 2002 to 2004
OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE MEASURE	ASSESSMENT
ENVIRONMENT	Noise	No significant effects – properties are too far away to be affected	Number of properties experiencing: - increase in noise = 0 - decrease in noise = 0	Neutral
	Local Air Quality	No significant effects – properties are too far away to be affected. Possible local benefit due to reduced congestion.	Number of properties experiencing - better quality = 0 - worse quality = 0	Neutral
	Greenhouse Gases	No significant effects	No net increase in Co2 emissions	Neutral
	Landscape	Scheme is adjacent to 'Area of Important Landscape Quality', but existing urban edge is locally intrusive. Scheme will remove some existing vegetation and elevate traffic/lighting etc in local views	N/A	Slight Adverse
	Townscape	Urban edge dominated by large-scale retail/warehouse structures. Some residential/commercial property nearby. Existing roads/junction dominate character	N/A	Neutral
	Heritage of Historic Resources	Archaeological interest in vicinity of junction. Underlying Archaeology likely to have been disturbed by existing road/junction	N/A	Neutral
	Biodiversity	Loss of established vegetation, including species rich grassland	N/A	Slight Adverse
	Water Environment	Small increase in hard surfaced area		Neutral
	Physical Fitness	Provision of public footpath/cycle facilities around junction	N/A	Neutral
SAFETY	Journey Ambience	Reduced congestion, attractive gateway entrance to Kings Lynn, balanced against increased earthworks, structures etc.	N/A	Neutral
	Accidents	The scheme has provided an opening year accident saving of 8.25 accidents.	231 to 281 accidents over evaluation period	£7.3m to £8.6m
ECONOMY	Security	There is no change to the likely incidence of crime or fear of crime related to road users	N/A	Neutral
	Transport Economic Efficiency	Substantial economic benefits due to reduced delays at existing at-grade roundabout	Journey Time Savings	Substantial Benefit NPV £41.424m to £53.628m
	Reliability	Substantial but not quantified	Not Undertaken	Neutral

	Wider Economic Impacts	Reduction in traffic delays will assist regeneration in surrounding area	Not Undertaken	<i>Neutral</i>
ACCESSIBILITY	Option values	No new public transport services	N/A	<i>Neutral</i>
	Severance	Beneficial impact for pedestrians and cyclists with additional facilities	Not Undertaken	<i>Slight Beneficial</i>
	Access to the Transport System	Journey times will improve which will encourage bus patronage	Not Undertaken	<i>Neutral/Slight Beneficial</i>
INTEGRATION	Transport Interchange	No change to interchange facilities	N/A	<i>Neutral</i>
	Land Use Policy	Will assist local policies with respect to encouraging increased bus patronage and cycle/pedestrian facilities	Not Undertaken	<i>Neutral/Slight Beneficial</i>
	Other Government Policies	No recognisable effect on other government policies	N/A	<i>Neutral</i>
Version of 11 December 2000		Cost benefit analysis (low / high)	PVB £48.8m to £61.0m, PVC £7.4m NPV £41.4m to £53.6m BCR 6.6 to 8.3	

All costs and benefits are in 1998 prices discounted to 1998 at 6%