

LNMS EVALUATION REPORT

M11 J4 Northbound Slip Road Merge



April 2006



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M11 J4 NORTHBOUND SLIPROAD MERGE

JOB NUMBER: 4416515			DOCUMENT REF: POPE of LNMS - M11 J4 NB Slip Road Merge_FINAL.doc			
Revision	Purpose / Description	Originated	Checked	Reviewed	Authorised	Date
-	FINAL	JS	HB	JS	PR	APR 2006
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1. INTRODUCTION

BACKGROUND

- 1.1 Beyond the merge between the A406 West, and A406 South, to the M11 north link roads, the carriageway was marked out as two lanes and a hard shoulder. Both the A406 West and A406 South, to M11 north link roads were reduced from two lanes to one lane on the approach to the existing merge of these two link roads. During evening peak hours, queues developed on the A406 west, to M11 north, link road, as traffic regularly exceeded the single lane capacity.
- 1.2 The improvement scheme was completed on the 1st December 2003, in conjunction with two other schemes in the vicinity of the Junction 4 Merge of slip roads scheme.

Original PAR Document

- 1.3 The PAR was produced by Mouchel Consulting and was last updated in June 2003.

The Scheme

- 1.4 The scheme involved widening the M11 northbound carriageway merge area from two to three lanes with an extra lane and hard shoulder constructed on the embankment, and reinstating the A406 west to M11 north slip road to 2 lanes. Figure 1.1 illustrates the reinstated two lane slip from the A406 slip north to the M11 north.



Figure 1-1 – Reinstated two lane slip from A406 north to M11 north

1.5 Figure 1.2 below shows the location of the scheme.

M11 J4 Northbound Slip Roads Merge

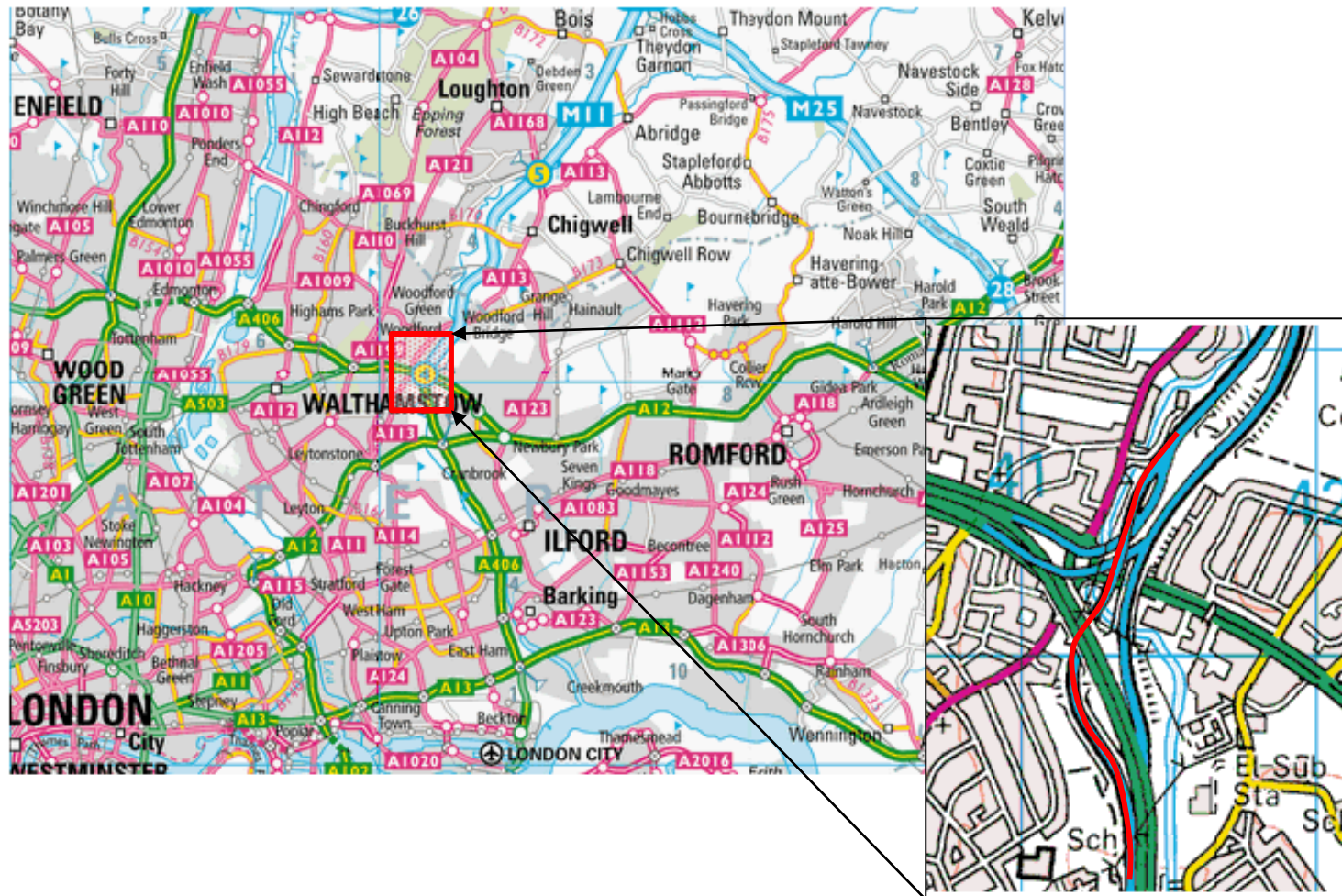


Figure 1-2 - M11 Junction 4 Slip Road Merge

- 1.6 The primary problem identified within the Project Appraisal Report (PAR) was the development of evening peak queuing and delays on the A406 west to M11 north link road caused by the capacity restraint prior to the merge with the link road from the A406 south.
- 1.7 Other options considered were:
- No other options were considered as a part of the PAR.

SCHEME OBJECTIVES

- 1.6 The scheme objective as detailed in the PAR is to increase the capacity of the carriageway to accommodate traffic growth, reduce congestion and improve safety.

PURPOSE OF THE REPORT

- 1.7 The Highways Agency has a requirement to carry out re-evaluations of trunk road schemes recently implemented by the Department of Transport. The purpose of these re-evaluations is to provide a back check of the levels of benefit accruing from new schemes and to determine how far the department achieves the objectives and benefits it claims from its road programme.
- 1.8 This report will initially undertake an assessment of the 'physical' impact of the scheme, namely:
- A comparison of the 'Before' and 'After' journey times on the route to illustrate how traffic volumes have changed since the opening of the scheme; and
 - The report will also outline the changes in accidents on the route since the scheme has been implemented and establish whether they have changed as predicted since the opening of the scheme.
- 1.9 This is in turn, followed by the assessment of the scheme in accordance with the 'POPE methodology', which is being followed for the purpose of this study. This methodology aims to provide a method by which the forecast and outturn effects of a scheme can be evaluated on a common basis. This process ultimately presents two appraisals:
- Appraisal 1: The Original PAR assessment (including the original AST). This is a forecast of the cost/benefits of the scheme, calculated in accordance with PAR3 (1998 prices discounted at 6%).
 - Appraisal 2: An Evaluation Summary Table (EST) based on outturn effects, but evaluated on precisely the same terms (version of the
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PAR document, present value year and discount rate) of the original assessment. The calculation is usually a simple pro-rate of the original assessment based on the outturn impact with regard to user benefits and scheme costs. The advantage of this assessment is that it is an outturn assessment that is directly comparable with the original PAR AST.

1.10 Following this introduction, the 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 accident changes attributable to the A66;
- Section 4 presents an assessment of predicted and outturn economic benefits using the POPE methodology;
- Section 5 presents the original Appraisal Summary Table (AST) for the M11 Junction 4 Slip Roads Merge scheme, 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.

1.11 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

'BEFORE' SURVEYS

- 2.1 The PAR document submitted in support of the scheme was based upon the following data:
- Accident data for the years 1998 - 2002;
 - Traffic Count Information;
 - Journey Times; and,
 - Environmental Assessment

'AFTER' SURVEYS

- 2.2 In the course of undertaking the LNM evaluation of the scheme, the following data was utilised.

Automatic Traffic Counts (ATCs)

- 2.3 Traffic count data from the Highways Agency permanent count site 1435 at M11 Junction 4 Northbound On slip from A406 Westbound was obtained:

Accident Data

- 2.4 Accident data was obtained from the Highways Agency area team for 01/03/1999 to 28/02/2004.

Journey Times

- 2.5 Journey time surveys were undertaken by Count On Us and were based on the same methodology as that used in the before journey time surveys, so to allow for the two sets of date to be directly compared. The moving observer method was used to capture the journey times.

Environmental Data

- 2.6 Information obtained from the site visit, the Managing Agent and a desk-top study.

3. SCHEME IMPACT

OVERVIEW

- 3.1 This section provides details of the outturn safety, traffic and journey time impacts of the scheme. It should be noted that, in accordance with the original PAR, 0% traffic growth has been assumed throughout this evaluation.

SAFETY

- 3.2 The original PAR assessment of the scheme forecast an opening year accident reduction of 3.9 accidents which capitalised over the 30-year evaluation period would provide a saving of 119 accidents.
- 3.3 The outturn accident impact of the scheme was assessed and as part of this the pre-opening accidents were re-analysed using data for the period between April 1998 and April 2002. This provided a total of 49 months pre-opening accident data. The re-analysis resulted in a predicted accident saving of 0.3 accidents in the opening year. Differences between the original PAR prediction and the re-analysis carried out here are attributable to differences in the methodology used to select the accident data, further details of this can be found in Annex A.
- 3.4 The analysis in Table 3.1, which is based on the above mentioned pre-opening accident data and 13 months post-opening accident data, shows that there were 2.4 accidents per year pre-opening and no accidents per year post-opening, resulting in an outturn accident saving of 2.4 accidents per year. This capitalised over the 30 year evaluation period results in a saving of 73 accidents. These savings are lower than those predicted in the original PAR but significantly higher than the predictions based on the re-analysis of the pre-opening accident data.

Table 3.1 Accident Savings

Scenario	Number of Months	Observed Number of Accidents	
		Over observed period	Per Year
Pre-Opening (1998 to 2002)	49	10	2.4
Post Opening (Dec 2003 to Dec 2004)	13	0	0
Accident Savings in the opening year			2.4

- 3.5 In summary, the scheme has saved 2.4 accidents in the opening year. No conclusive comments can be made on the scheme's impact on accident severity and the location of accidents as no accidents have occurred post-opening. Therefore, as previously mentioned, further accident analysis should be carried out when more data is available.
- 3.6 Further detail of the analysis of accident data is presented in Annex A.

TRAFFIC FLOW

- 3.7 As a result of the scheme, it is considered that traffic flows on many parts of the surrounding network, as well as on the slip road in question, will experience changes. However, due to the complexity of evaluating the traffic flow changes on all of the network and to remain in line with the methodology used in the original PAR, only traffic travelling along the full length of the scheme will be used. Therefore flows from the Automatic Traffic Count (ATC) site 5/1435 which is located on the A406 westbound to M11 northbound slip road will be considered.
- 3.8 Data from this counter shows that prior to the opening of the scheme between the years of 1998 and 2003 the Annual Average Daily Traffic (AADT) has grown. However, traffic in the PM peak period (the period in which the problems of queuing and delays occur) remained at a constant of approximately 2000 vehicles per hour.
- 3.9 Following the opening of the scheme, traffic has increased significantly and data shows an annual average traffic growth in the peak hour of 26% between 2003 and 2005. Thus, suggesting that the scheme improvements have directly resulted in an increase in traffic on the slip road in question.
- 3.10 Further detail of the analysis of traffic data is presented in Annex B.

JOURNEY TIMES

- 3.11 One of original aims of this improvement scheme was focused on the reduction of delays in the PM peak period and thus, improving the economy. Therefore a key element of the original PAR assessment was the predicted journey time savings.
- 3.12 Based on before journey time surveys along the length of the road affected by the scheme, the original PAR predicted in the Appraisal Summary Table (AST) that there would be a slight benefit over cost in terms of journey times (See Appendix C for a discussion of the methodology used to calculate predicted journey time savings). However, within the PAR the units that apply to the predicted journey time savings were incorrectly entered. As a result the predicted journey time savings were in actuality 172 seconds (2.52
-

minutes) as against 2.52 seconds. In order to assess whether the scheme has actually achieved this predicted saving, post-opening journey time data was also collected. To ensure a comparison of likes, the post-opening journey time surveys were based on the same methodology as that used in the pre-opening journey time surveys. The moving observer method was used along the same section of highway during the same period and on the same day of the week.

- 3.13 Table 4.1 presents a summary of both the before and after journey times for the section covered by the surveys.

Table 3.2 - Before and After Journey Time Information

Journey Times over the surveyed length of road (in seconds)		
Pre-Opening (1999) (a)	Post – Opening (2006) (b)	Difference (a-b)
613	529	84

- 3.14 In comparison to the predicted journey time saving of 172 seconds, the actual saving of 84 seconds as stated above is less than expected. The higher observed journey time could be attributable to the increase in traffic flow along the section following the opening of the scheme.

SUMMARY

- The evaluation of safety impacts of the scheme show that for the first 13 months post opening of the scheme, there has been a reduction of around 2.4 accidents per annum. This is lower than the predicted 3.9 accident saving in the opening year. However, conclusive comments can not be made at this stage due to the limited amount of post-opening data.
- Prior to the opening of the scheme, traffic in the peak hour has remained at a constant of approximately 2000 vehicles per hour. Post scheme opening, PM peak hour traffic increased significantly at an average annual growth of 26%.
- The evaluation of journey time impacts of the scheme shows that although the journey time saving produced by the scheme is less than that predicted it has still provided a significant improvement.

4. ECONOMIC EVALUATION

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 re-evaluation, termed the Post Opening Project Evaluation (POPE) methodology, uses observed accident and link transit savings to provide an economic assessment of the performance of the scheme. This result is presented in the scheme Evaluation Summary Table (EST) and is expressed in same terms as the original evaluation (present value year of 1998, and discount rate of 6 per cent).

ACCIDENTS

- 4.2 The original Mouchel AST forecast a significant reduction in Personal Injury Accidents (PIAs) with a Present Value of Benefits (PVB) of £3.658m. The PAR actually states the predicted number of PIAs saved in the opening year to be 3.9. As discussed in Annex A, it was unclear upon which criteria the accidents included in the analysis had been selected; therefore the accident data for the period prior to scheme opening was re-analysed using the same methodology as that used for the post-opening accident analysis. As a result, the POPE evaluation results will be compared with the results of the re-analysis to ensure that a 'like' for 'like' assessment is being made. The PAR re-analysis forecast an accident saving of 0.3 accidents in the opening year. This equates to an accident saving over the 30 year assessment period in 1998 prices, and discounted to 1998 of 9 accidents. These accident benefits resulted in predicted monetary savings that equated to £16,551 in the opening year and when capitalised over the 30 year assessment period, this equates to £281,375. These are all in 1998 prices and discounted to 1998.
- 4.3 Section 3 presented Atkins analysis of the observed post-opening accident saving, which stands at 2.4 accidents per annum. These observed accident savings have in turn been used to forecast monetary accident benefits over the 30 year assessment period from the scheme, as detailed in Table 4.1. This table also presents the re-analysis of the PAR predicted scheme accident benefits.

Table 4.1 - POPE Comparison: Accident Benefits

Opening Year Accident Saving	30 Year Accident Saving	30 Year Accident Benefits
Original PAR Assessment		
3.9	119	£3,657,871
PAR Re-analysis		
0.3	9	£281,375
POPE: Post-Opening Assessment		
2.4	73	£2,250,997

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

- 4.4 The scheme has produced some OUTTURN accident benefits. The table shows that these benefits are lower than those predicted in the original PAR assessment but considerably higher than those calculated in the PAR re-analysis. This is due to the fact that the re-analysis produced a pre-opening accident rate that was already very low and the same methodology for predicting the accident savings as stated in the original PAR was used.

JOURNEY TIME BENEFITS

- 4.5 One of the main objectives of the scheme was to reduce delays on the slip road in question. The original PAR undertook pre-opening travel time surveys and upon the basis of which forecast a journey time benefit for the scheme. However, as discussed in section 3 above, during calculation the unit of seconds was applied to the journey time figure instead of the actual unit of minutes, resulting in an under-estimate of the journey time benefits. As a result the predictions were re-calculated resulting in a forecast monetised benefit of £867,859 in the opening year and £15,621,466 over the 30 year estimation period (both figures in 1998 prices and discounted to 1998).
- 4.6 In order to assess whether the scheme has achieved these forecast benefits the observed post-opening journey time benefits, as discussed in section 3, have been monetised. 61,734 vehicles hours have been saved in the opening year resulting in an opening year benefit of £536,623 and a benefit of £9,659,210 over the 30 year assessment period (both figures in 1998 prices and discounted to 1998). These results are summarised in Table 4.2 below.
- 4.7 As discussed in Appendix B, traffic flow data suggests that the peak hour traffic seems to have been constant (around 2000 vehicles per hour) over the pre-opening years of 1998 to 2003. However, post scheme opening, traffic growth stands at 26% indicating that the scheme has resulted in

additional traffic onto the improved slip road. This additional traffic flow therefore does not experience the total benefit of the scheme and for the present evaluation it has been assumed that this traffic would accrue only half the actual benefits.

Table 4.2 POPE Comparison: Journey Time Benefits

Opening Year Vehicle Hours Saved (hours/year)	Opening Year Monetary Benefits (£)	30 Year Monetary Benefits(£)
Original PAR Assessment		
1820m	0.016m	0.133m
PAR Re-calculation		
99,840	0.868m	15.621m
POPE: Post-Opening Assessment		
61,734	0.537m	9.659m

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

- 4.8 The scheme has produced some Outturn journey time benefits. These benefits are less than those forecast by the PAR re-calculation which is likely to be attributable to the substantial traffic growth following the opening of the improved slip road. However, these benefits are considerably higher than the original PAR assessment and the scheme has therefore far exceeded the benefits originally expected from it.

SCHEME COST

- 4.9 The original PAR predicted the total Present Value Cost (PVC) of the scheme, in 1998 market prices, discounted to 1998 at 6%, to be £1.206m with the estimate year as 1998 quarter 3.
- 4.10 On revisiting the cost worksheet it was noted that an error occurred in the construction year discount factor used to predict the PVC in the original PAR document. This was therefore modified and the PAR predicted PVC was corrected to be, £1.351m (in 1998 market prices, discounted to 1998), with the estimate year as 1998 quarter 3. This provided a difference of £0.144m (£1.351m-£1.206m) between the PAR predicted PVC and the PAR predicted corrected PVC.
- 4.11 The total OUTTURN current project cost provided by the project sponsor was £1.345m. This includes design and supervision costs as well as land costs. In the absence of more detailed information it is assumed that this figure excludes VAT.
- 4.12 Table 4.3 presents the conversion of the outturn cost to the present value year. It is noted that the present value base year is currently 2002 and the

recommended discount rate is 3.5%. However, in order to allow the comparison of like with like in terms of the predicted and outturn costs, the outturn costs will be converted to 1998 base year prices and a discount rate of 6% will be used as per the original PAR.

Table 4.3 - Conversion of Outturn Cost to Present Value Cost

Total Current Project Cost (a)	RPF of Estimate (b)	RPI of Estimate (c)	RPI (Base Yr: 1998) (d)	Discount Factor (2003) (e)	General Taxation (f)	Present Value Cost (a*b*d/c)*e*f
£1,345,471	1.00(P)	181.3	162.8	0.75	1.209	£1,095,515

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

- 4.13 Table 4.4 compares the predicted cost and the outturn costs for the scheme. It shows that the outturn scheme cost was 9% below the predicted value as given in the original PAR for the scheme and 19% below the PAR predicted corrected cost.

Table 4.4– Comparison of Predicted and Outturn Costs

Present Value Costs			Percentage Difference	
Original PAR Predicted (1)	PAR Predicted Corrected (2)	Outturn (3)	Outturn vs. Original PAR Predicted (3-1)/1	Outturn vs. PAR Predicted Corrected (3-2)/2
£1,206,624	£1,350,698	£1,095,515	9% lower	19% lower

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

SUMMARY

- 4.14 Table 4.5 presents a summary of the original PAR and POPE economic evaluation of the scheme. The assessment is expressed in terms of 1998 prices, discounted to 1998 at 6%, and the methodology used is in accordance with PAR 3.0.

Table 4.5 - POPE Comparison: Summary

	Original PAR Worksheets	Corrected PAR Worksheets	POPE Assessment
Accident Benefits			
Opening Year	£0.215m	£0.016m	£0.132m
30 Year Assessment period (PVB)	£3.658m	£0.281m	£2.251m
Journey Time Benefits			
Opening Year	£0.016m	£0.868m	£0.537m
30 Year Assessment period	£0.133	£15.621m	£9.659
Net Disbenefits (PVB)			
Opening Year	£0.231m	£0.884	£0.669m
30 Year Assessment period (PVB)	£3.791	£15.903m	£11.910m
Scheme Costs & Value			
PVC	£1.207m	£1.351	£1.096m
Net Present Value {NPV}=(PVB-PVC)	£2.585m	£14.552m	£10.815m
First Year Rate of Return (FYRR) and Cost Benefit Ratio			
First Year Rate of Return (FYRR)	19.1%	65.5%	61%
Benefit Cost Ratio (BCR)	3.14	11.77	10.87

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

4.15 The main points to note are:

- The scheme has resulted in accident benefits of approximately £132,411 in the opening year and when capitalised over a 30 year assessment period the benefits are expected to be approximately £1,491,262. These values are both approximately 38% lower than forecast by the original PAR.
- The scheme has resulted in journey time benefits of approximately £536,622 in the first year after opening and £9,659,210 over the 30 year assessment period. These benefits are considerably higher than those predicted by the original PAR. The Outturn benefits are however approximately 38% lower than the predicted corrected values.
- The Outturn scheme cost was approximately 9% lower than the original PAR prediction and 19% lower than the corrected prediction.
- The FYRR of the scheme is 61%, which is higher than the original PAR predicted FYRR of 19.1%; and
- The benefit cost ratio is 10.87, which is approximately 346% higher than original PAR predictions.

- 4.16 Overall the scheme continues to represent good value for money. The actual benefits of the scheme are far greater than the benefits predicted by the original PAR but lower than the predicted corrected values.**

5. SUMMARY OF APPRAISAL AND EVALUATION SUMMARY TABLES

INTRODUCTION

- 5.1 In order to fully evaluate the effects of the M11 J4 northbound slip road merge scheme, Atkins has undertaken a review of the original PAR document prepared by Mouchel Consulting Ltd. The Appraisal Summary Table (AST) from this document, which summarises the predicted impact of the scheme under the five objectives of environment, safety, economy, accessibility and integration, is presented as Annex C in 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 M11 J4 northbound slip road merge scheme are as follows.

Environment

- 5.5 A full environmental assessment was not deemed necessary for this scheme; however, the PAR did undertake a partial assessment of the predicted environmental impacts of the scheme.
- 5.6 The following points were noted:
- Local Air Quality - The PAR predicts that the concentration of Nitrogen Dioxide (NO₂) and PM10 at the roadside are calculated to be above the National Air Quality Strategy (NAQS) objectives both with and without the scheme. It was therefore concluded that the impact of the scheme on local air quality would be neutral.
 - Landscape - The PAR states that although the study area lies within an area of landscape and nature conservation value, the dominance of the motorway both visually and in terms of noise generation has a significant impact on the serenity of the river corridor within which the motorway lies. Therefore, a reduction of queuing at peak travel times should have a slight beneficial effect.
 - Heritage of Historical Resources - The PAR predicts that the scheme will have no impact on the existing historic cultural resources, however there

maybe a slight adverse impact on any undiscovered archaeological remains in the River Rodding Archaeological Priority Area.

- Biodiversity – The scheme is predicted to have a neutral impact on the biodiversity of the area.
- Water Environment – The PAR predicts that there maybe a slightly adverse to neutral impact on the water environment of the area but this only includes the River Rodding itself and its flood plain. Discharge will be increased by approximately 10% (in terms of volume). There are no impacts on the underground water. Overall the scheme will have a slightly adverse to neutral effect on the water environment.

Safety

- 5.7 The PAR identified that there were 24 accidents in the 4 years between 1998 and 2002. Of the 24 accidents 5 were of serious severity and 19 were slight, a severity index of 20.8%
- 5.8 The 24 accidents over the four year period equated to a personal injury accident rate of 6 PIAs a year. When compared to the national average accident rate of 2.1 PIAs a year, it is clear that the scheme location has an average accident rate of nearly four times that for comparable roads.
- 5.9 The PAR predicts that the scheme will save 3.9 accidents a year (bringing the accident rate in line with the national average).

Economy

- 5.10 The proposed improvements were forecast to cause a slight improvement in journey times over the route affected by the scheme. According to the PAR, using the route during the peak period prior to the opening of the scheme took an average of 10.13 seconds. Post scheme opening, the PAR predicts it to take 7.22 seconds and thus the scheme will create an average saving of 2.52 seconds in the peak period. However, it should be noted that following the examination of the PAR document it was found that the units were incorrectly entered and the journey times were actually 10 minutes 13 seconds and 7 minutes 22 seconds respectively and the predicted saving was 2 minutes and 52 seconds rather than 2.52 seconds.
- 5.11 The PAR predicts that 1820 vehicle hours per year will be saved in the opening year. This increases to 99,840 hours following the correction of the units. With a Value of Time of 1159p per hour per average vehicle, VOT savings in opening year were predicted to be £15,820 in the opening year but corrected to £867,859 in the opening year (both figures in 1998 prices and discounted to 1998).

Accessibility

- ◆ The PAR predicted that there would be no impact on accessibility in the area due to the scheme and therefore an assessment was not applicable.

Integration

- As above, the PAR predicted that there would be no impact on integration in the area and therefore an assessment was not applicable.

Appraisal Summary Table (AST)

- 5.12 The main points to note from the AST of the M11 J4 northbound slip road merge improvement scheme are:

Environment

- Concentrations of nitrogen and PM10 at the roadside are calculated to be above the NAQS objectives both with and without the scheme.
- In terms of the landscape, the AST states that the scheme will have a slight beneficial effect. A section of the existing screen will be removed as part of the scheme. However, a large section of the carriageway is already visible and additional planting should off-set the effect in the long term.
- The AST predicts that the scheme may have a slight adverse effect on the heritage of the area. Although the scheme does not affect any existing known cultural heritage resources, it may have a slight impact on any undiscovered archaeological remains.
- The biodiversity of the area is predicted not to be greatly effected as the existing site is of limited value in biodiversity terms. Additional on-site planting should promote biodiversity by introducing a wider range of species on site.
- The water environment in the area will only be slightly adversely affected.

Safety

- The AST states that a significant reduction in Personal Injury Accidents is anticipated. This will accumulate in a PVB of £3.658m.

Economy

- The AST identifies that there would be a slight benefit over cost in terms of Transport Economy Efficiency. It states that there will be a Net Present Value (NPV) of £0.130 for Users and a NPV of £1.206 for Public Providers.

Accessibility

- Neutral

Integration

- Neutral

OUTTURN EFFECTS

5.13 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 format and appearance of the AST, and includes details of the actual sub-objectives that have been evaluated. The EST is presented in Annex D.

5.14 Section three has already discussed the economy and safety impacts of the scheme. No assessment has been made of the following impacts:

- ◆ **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.

5.15 This section therefore concentrates on the other impacts included in the AST, namely

- **Environmental Impacts** such as noise, local air quality, landscape, biodiversity, heritage and water;

5.16 The assessments that follow are all subjective assessments from members of the evaluation team.

5.17 The following reiterates the statements that accompanied these impacts before providing evidence that the mitigating measures have been implemented.

Environment

5.18 ***Local Air Quality – Concentration of nitrogen dioxide and PM10 at the roadside are calculated to be above the NAQS objectives both with and without the scheme. Therefore, there will be a neutral impact on local air quality.***

In the absence of a full assessment of the scheme impact on local air quality it is assumed that the predictions made in the PAR and AST hold true. Hence, there has been a neutral impact on local air quality.

- 5.19 Landscape – A selection of existing screen will be removed as part of the scheme. However, a large section of the carriageway is already visible and additional planting should off-set the effect in the long-term.**

From a visit to the site it was apparent that some of the existing screen had been removed. As stated in the PAR and AST a large section of the carriageway was already very visible and the scheme has not exaggerated this fact a great deal, as illustrated in figure 5.1.



Figure 5-1 – A406 Northbound to M11 Northbound Merge

- 5.20 Heritage of Historic Resources - The scheme will have no impact on the existing historic cultural resources. However, it may have a slight adverse impact on any undiscovered archaeological remains in the River Roding Archaeological Priority Area.**

In the absence of a full assessment of the schemes impact on the heritage of historic resources it is assumed that the predictions made in the PAR and AST hold true. Hence, there has been a slight adverse impact on the heritage of historic resources.

- 5.21 **Biodiversity - *The existing site is of limited value in biodiversity terms. Additional on-site planting should promote biodiversity by introducing a wider range of species on site, thus, resulting in a neutral impact.***

Considering that the existing site was of limited value in biodiversity terms and additional on-site planting has taken place it can be assumed that the predictions made in the PAR and AST hold true. Hence, there has been a neutral impact.

- 5.22 **Water Environment – *The river water quality is good and the impact of widening the scheme is low with regards to its impact on discharge, on the flood plain and on ground water. Overall, there will be a slight adverse impact on the water environment.***

In the absence of a full water assessment, it is assumed that the predictions made in the PAR and AST hold true. As a result there has been a slight adverse impact on the water environment.

6. CONCLUSIONS

- 6.1 The main points to note from this evaluation of the M11 Junction 4 northbound slip road merge improvement are:

Traffic Volumes

- 6.2 Annual average daily traffic travelling along the full length of the scheme on the A406 westbound to M11 northbound slip road has grown over the years 1998 to 2004. It was noted however that, prior to scheme opening, traffic using the A406 westbound to M11 northbound in the peak period remained constant at 2000 vph between 1998 and 2003. Post scheme opening, annual average peak period traffic growth between 2003 and 2005 stands at 26% at the same site, therefore suggesting that additional traffic is now using the slip road in question as a result of the scheme improvements.

Safety

- 6.3 The scheme has delivered an annual saving of 2.4 accidents which results in a 100% accident saving due to the fact that no accidents have occurred post-opening. However, further accident analysis should be carried out when further data is available. A more informed conclusion can then be made regarding the impact of the scheme on safety including accident severity, locations and the type of accidents that are occurring.

Journey Times

- 6.4 The evaluation of the journey time impacts of the scheme shows that the improvements have resulted in a decrease in journey time along the section in question of 84 seconds. Although this saving is less than that predicted it has still provided a significant improvement.

Scheme Costs

- 6.5 The scheme was built at a cost which is approximately 19% less than predicted.

Economic Evaluation – POPE Method

- 6.6 The scheme has provided some accident benefits and significantly greater journey time benefits than those predicted by the original PAR. These benefits are however, less than the predicted corrected benefits and despite the PVC of the scheme being 19% lower than predicted, the outturn FYRR (61%), NPV (£10.814m) and BCR (10.87) are 7%, 26% and 8% respectively lower than the predicted corrected values.

Overall

- 6.7 The scheme appears to have been a success and has delivered more benefit than predicted in the original PAR, partly as a result of lower than predicted cost and partly due to the significant under-estimation of the journey time benefits. However it should be noted that the original predictions have since been adjusted and the outturn benefits are less than the adjusted figures.
- 6.8 The scheme should be re-evaluated in future years when more post opening data is available. This will enable more robust conclusions to be drawn, particularly in terms of safety.

ANNEX A – ANALYSIS OF ACCIDENT DATA

The original Mouchel PAR and AST forecast that the scheme would provide significant accident savings. In order to evaluate whether these forecast savings have occurred or will occur, Atkins has undertaken an initial evaluation of accident savings accrued post opening.

It is usual for accident savings to be evaluated at least three years after opening in order to get a fair reflection of the changes in accidents in the vicinity of the scheme. Therefore this evaluation should be considered to be an initial view based upon only 13 months of available data.

Accident Prediction & Evaluation

The PAR examined accidents between 1998 and April 2002. During this period, the PAR identified the occurrence of 24 PIA's, of which 5 were serious and 19 were slight. This resulted in an accident rate of 6 PIA's a year. Based on the assumption that the scheme would reduce accidents to the same rate as the national accident average (2.1) the predicted PIA saving in the opening year was 3.9.

For the purpose of this evaluation, accident data was revisited to assess the pre and post opening accident record for 7 years from 01/04/1998 to 31/12/2004. STATS 19 observed accident data for these 7 years for the two slips in question was acquired. Generally, accidents which are beyond the scheme and not directly related to the scheme are excluded from the analysis. However, it was unclear if these criteria had been used to select the accidents stated in the PAR. Therefore, the pre-opening accidents were re-analysed on the same basis as that used for the post-opening accident data so that a 'like' for 'like' assessment of the 'before' and 'after' accident data could be undertaken. In the re-analysis accidents due to reasons such as debris on the carriageway and slippery surface were excluded.

Due to its unavailability at the time of writing the PAR assessment, data for the months May 2002 to November 2003 has not been included in the PAR prediction of the accident benefits. Therefore, to ensure a true comparison can be made between the predicted and outturn accident benefits this data will also be omitted in the re-analysis of the pre-opening accident data.

As a result of the re-analysis, accident data showed that prior to the opening of the scheme, between April 1998 and April 2002 there were 10 scheme related PIAs, of which 8 were slight and 2 were serious. This resulted in an accident rate of 2.4 accidents per

year which, when using the same methodology as the PAR to predict accident savings (accident rate reduced to the national accident average of 2.1), results in a predicted accident saving of 0.3.

Figure A1 provides an indicative plan of the location of accidents on the A406 westbound and southbound to M11 northbound slip roads for the period 1st April 1998 to 31st December 2004 (excluding the accidents that occurred during the period between the writing of the PAR and the opening of the scheme), while Table A1 summarises this data.

Table A1 – Selected Accidents on A406 Southbound and Westbound to M11 Northbound slip roads

Year	Slight	Serious	Fatal	Total
1998 (April – Dec)	1	-	-	1
1999	1	-	-	1
2000	2	-	-	2
2001	4	2	-	6
2002 (Jan – April)	0	-	-	0
Pre-opening (49 Months)	8	2	0	10
Pre-opening accidents per year				2.4
Dec 2003 – Dec 2004	-	-	-	0
Post Opening (13 months)	0	0	0	0
Post-Opening accidents per year				0

From Table A1 it can be seen that the number of accidents varied between years. The scheme opening date was 1st December 2003, therefore there are only 13 months of post-opening data in which no accidents occurred. When examining the number of accidents per year, there were on average, 2.4 accidents per year pre opening and 0 accidents per year post opening. Therefore, it may be concluded that the scheme has provided an accident saving of 2.4 PIA's in the opening year. However, the small volume of data for the post-opening scenario means that this figure should be treated with caution.

The Outturn opening year accident saving is lower than that predicted by the original PAR (3.9 accidents per year). However, it is higher than the opening year accident saving predicted by the re-analysis (0.3 accidents per year). This is due to the fact that the re-analysis showed that accidents were already low pre-opening. Therefore it can be

concluded that the scheme has improved safety more than expected. However, again, it should be remembered that this is based on only a small amount of post-opening data.

Figure A1 shows that pre opening the accidents on the slip roads and in the vicinity of the merge were generally concentrated around the A406 westbound off-slip with a few on the bends of the slip roads. No accidents have occurred post-opening of the scheme, therefore no conclusive comments can be made with regard to the scheme's impact on the location of accidents.

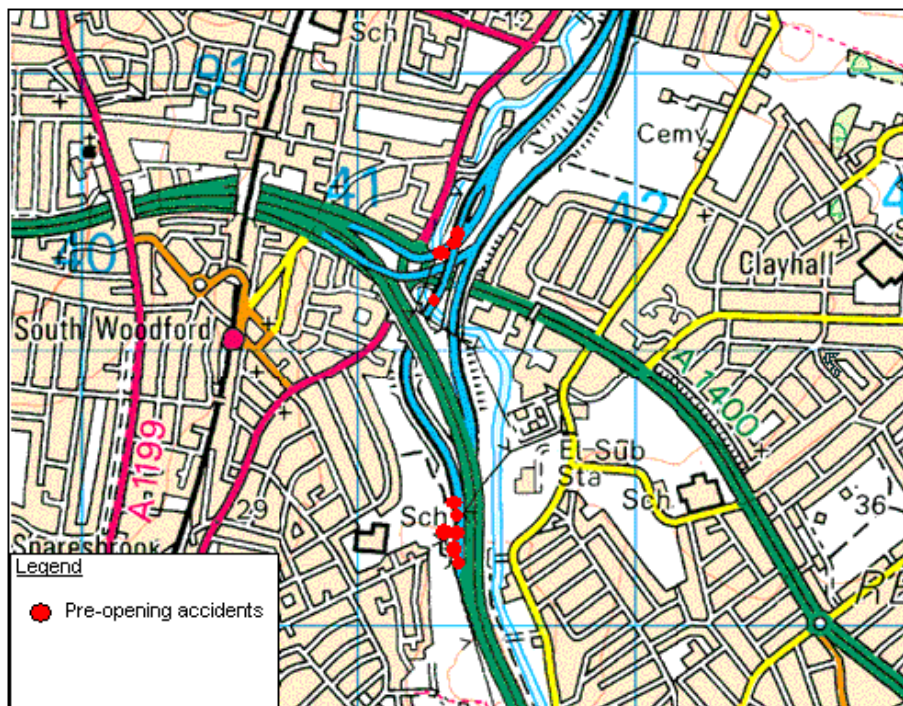


Figure A-1 – Accidents within the Vicinity of the slip roads and merge

Of the 10 accidents that occurred in the 49 months pre-opening 5 were attributable to vehicles changing lanes and 5 were attributable to queuing traffic. Those attributable to changing lanes are mainly concentrated around the slip diverge from the A406 WB to M11 NB and were likely to have occurred either prior to the slip being reduced to one lane or directly at the point of the slip diverge as vehicles change lanes to access the slip road.

As a result of no accidents occurring in the period post-opening, it seems that the scheme has alleviated all accidents in the vicinity of the slip road and the merge. It would seem that reinstating the A406 WB to M11 NB slip road to 2 lanes has relieved the problem of queuing traffic and thus reduced the number of accidents attributable to this. However, as previously mentioned, these results should be considered with caution due to the small amount of post-opening data currently available. As a result no conclusive comments can be made on the schemes impact on the causation of accidents in the area.

Accident Severity

Pre opening there were only two accidents of a severity greater than slight in the vicinity of the scheme. However, no accidents have occurred post-opening to date, therefore the schemes impact on accident severity can not be commented upon until more data is available.

The main points to note from the safety section are:

- Average number of accidents per year pre-opening was 2.4
- Accident saving in the opening year is 2.4
- As a result of only a short period of post-opening accident data being available no conclusive comments can be made on the scheme's impact on safety. Further accident analysis should be carried out when more data is available.

ANNEX B – ANALYSIS OF TRAFFIC FLOW DATA

Traffic Volume Changes

Figure B1 shows the changes in annual average daily volumes of traffic travelling from the A406 westbound to the M11 northbound (site 5/1435). It is apparent that traffic flow at site 5/1435 has grown between 1998 and 2004. This location is a Highways Agency permanent monitoring site on the respective slip road. Although it is expected that the scheme has an effect on traffic flows on other parts of the network, including the surrounding slip roads, it was decided that due to the complexity of calculating such an effect and in light of the methodology used in the original PAR, this site alone will be considered. Thus, traffic travelling over the full length of the scheme (A406 westbound to M11 northbound slip road) will only be considered.

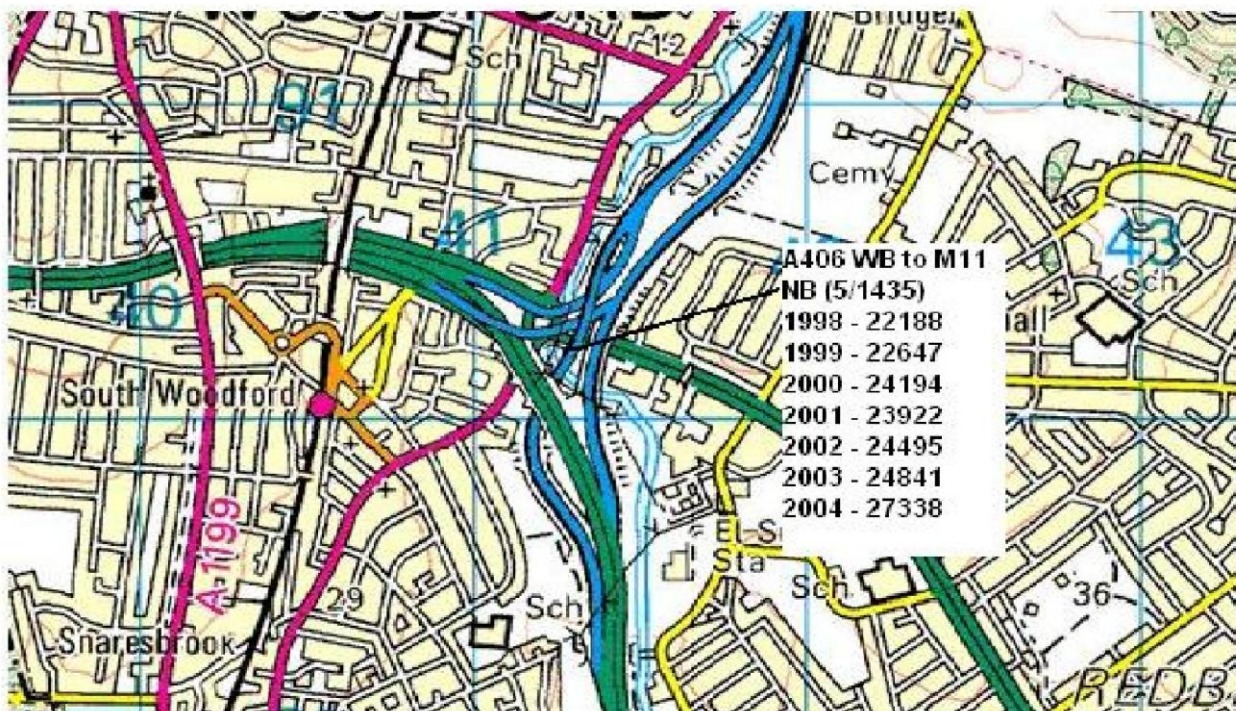


Figure B1- Traffic Volume Changes on the A406 WB to M11 NB slip road

The original PAR document considered only the 4 hour peak period traffic between 1500 and 1900 when assessing pre-opening journey times and estimating post-opening journey time savings produced by the scheme. Therefore in this evaluation, traffic in this period will also only be considered.

Traffic Growth

Table B1 shows the average Monday to Friday peak hour traffic flow over the years 1998 to 2005 collected by TRADS.

Table B1 –Average Monday to Friday Peak Hour Traffic

Year	Average Peak Hour Traffic Flow
1998	1989
1999	2022
2000	2011
2001	1892
2002	1980
2003	2013
2004	2724
2005	3213

It can be seen from the above table that prior to the opening of the scheme in December 2003, traffic flow in the peak hour remained constant at approximately 2000 vehicles per hour with little or no growth between the years of 1998 and 2003. This links in with the original PAR document which estimated 2000 vehicles per peak hour to calculate the predicted journey time savings produced by the scheme. Following the opening of the scheme, it can also be seen that traffic flow in the peak hour has significantly increased in the years 2004 and 2005. Annual average traffic growth between 2003 and 2005 stands at 26% and therefore reflects the significant increase in traffic following the opening of the scheme. It is assumed that this increase in traffic is a result of additional traffic using the slip road as a result of the improvements put in place by the scheme.

In summary the main points to note from the traffic flow section are:

- Only traffic travelling along the full length of the scheme is considered.
- Pre-opening peak hour traffic flow remained constant at approximately 2000 vehicles per hour each year.

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- Annual average peak period traffic growth between 2003 and 2005 following the opening of the scheme stands at 26%.

ANNEX C- ANALYSIS OF JOURNEY TIMES

Journey Times

Within the AST a slight benefit over cost was predicted in terms of journey times. This prediction was based on pre-opening journey time surveys which were undertaken over the scheme length on Thursday 26th March 1999 using the moving observer method. The original PAR assumed that the post-opening peak period journey times would be equal to the pre-opening off-peak journey times. As can be seen in Table C1, in order to predict the journey time savings produced by the scheme the PAR took the difference between the pre-opening off-peak journey times and the pre-opening peak journey times. This resulted in a predicted journey time saving of 2 minutes and 52 seconds.

Table C1 – Predicted Journey Time Savings

Pre-Opening Off-Peak Journey Time (a)	Pre-Opening Peak Journey Times (b)	Predicted Post-Opening Journey Time Saving (a-b)
10 mins 13 secs	7 mins 22 secs	2 mins 52 secs

In order to determine the actual impact of the scheme on journey times which can be compared with the above prediction, journey time surveys have been undertaken by Atkins as part of this post opening evaluation. This will enable a direct comparison between pre- and post-opening journey times

Methodology

These surveys were based on the same methodology as that used for the pre-opening surveys to ensure a reliable comparison can be made between the two sets of data. As in the before scenario the after surveys were undertaken on a Thursday, on 12th January 2006 over the same stretch of road that is affected by the scheme. The moving observer method was used wherein the vehicle is driven along the survey route maintaining the speed of other vehicles and without exceeding the speed limit. The journey start and end times are recorded to estimate the journey times. An effort was made to ensure that the after surveys were as comparable to the before journey time survey results as possible by starting and ending at the same points. The start point for each run was located at the point where the A406 crosses the railway line just north of the A406/A118 junction near Ilford (OS GR: 543100, 186300) and ended at Luxborough Bridge as it crosses the M11 northbound (OS GR: 542800, 192900), thus encompassing the improved A406 northbound to M11 northbound slip road and the preceding and proceeding affected links.

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As per the before surveys, 15 runs were undertaken during the 4 hour PM peak period between 1500 and 1900.

Table C1 below presents the average journey times (seconds) before and after the opening of the scheme for the peak period as stated above:

Table C2– Pre- and Post-Opening Journey Times

Description	Average time taken to travel affected length (seconds)
(1) Pre-opening	613
(2) Post-opening	529
(1) – (2)	84

In comparing the before and after journey times, Table C1 shows that the scheme, post-opening, has provided a positive impact in the peak period with a decrease in journey time of 84 seconds over the entire surveyed length. Although the actual journey time saving is less than the predicted journey time saving (172 seconds) which is likely to be a result of the increase in traffic flow as discussed in Annex B of this report, the scheme does appear to have had the desired impact upon journey times and thus, reduced delays along the slip road in the peak period.

▪ **ANNEX D - ORIGINAL SCHEME AST**

Original AST

Proposal name		M11 J4 Northbound Slip Road Merge	Present Value of Cost £1.206m
OBJECTIVES		QUALITATIVE IMPACTS	QUANTITATIVE MEASURE
ENVIRONMENT	Noise		Estimated Population Annoyed by Noise
	Local air quality	Concentration of nitrogen dioxide and PM10 at the roadside are calculated to be above the NAQS objectives both with and without the scheme.	Concentration weighted for exposure
	Greenhouse Gases		Tonnes of CO ₂
	Landscape	A section of existing screen will be removed as part of the scheme. However, a large section of the carriageway is already visible, additional planting should off-set the effect in the long-term.	Slight Beneficial
	Townscape`	N/A	Neutral
	Heritage of Historic Resources	The scheme does not affect any existing known cultural heritage resources. However, it may have a slight impact on any undiscovered archaeological remains.	Slight Adverse
	Biodiversity	The existing site is of limited value in biodiversity terms. Additional on-site planting should promote biodiversity by introducing a wider range of species on site.	Neutral
	Water Environment	The river water quality is good and the impact of widening the scheme is low with regards to its impact on discharge, on the flood plain and ground water.	Slight Adverse
	Physical Fitness	N/A	Neutral
	Journey Ambience	N/A	Neutral
SAFETY	Accidents	A significant reduction in Personal Injury Accidents is anticipated.	PVB £3.658m
	Security	N/A	Neutral
ECONOMY	Transport Economic Efficiency	Slight Benefit over Cost	Users: NPV £0.130m Private providers: NPV £m Public providers: NPV £1.206m Other Government: NPV £m
	Reliability	N/A	Neutral
	Wider Economic Impacts	N/A	Neutral
ACCESSIBILITY	Option Values	N/A	PVB £m
	Severance	N/A	Neutral
	Access to the transport System	N/A	Neutral
INTEGRATION	Transport Interchange	N/A	Neutral
	Land-Use Policy	N/A	Neutral
	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 E - ATKINS EST

Atkins EST

Proposal name		M11 J4 Northbound Slip Road Merge	Present Value of Cost £1.096m	
OBJECTIVES		QUALITATIVE IMPACTS	QUANTITATIVE MEASURE	ASSESSMENT
ENVIRONMENT	Noise	N/A	N/A	N/A
	Local air quality			Neutral
	Greenhouse Gases	N/A	N/A	N/A
	Landscape	The carriageway was already very visible and extra planting has occurred.		Slight Beneficial
	Townscape`	N/A	N/A	N/A
	Heritage of Historic Resources			Slight Adverse
	Biodiversity	Some additional planting in the area of the scheme has occurred		Neutral
	Water Environment			Slight Adverse
	Physical Fitness	N/A	N/A	N/A
	Journey Ambience	N/A	N/A	N/A
SAFETY	Accidents	No conclusive comments can be made on the schemes impact on safety as only 13 months of post-opening accident data was available.	2.4 accidents saved in the opening year and 73 accidents saved over the 30 year assessment period.	PVB £2.251m
	Security	N/A	N/A	N/A
ECONOMY	Transport Economic Efficiency	Delays along the A406 WB to M11 NB have reduced as a result of the scheme	61,734 vehicle hours saved in the opening year	Users: NPV £9.659m Private providers: N/A Public providers: N/A Other Government: N/A
	Reliability	N/A	N/A	N/A
	Wider Economic Impacts	N/A	N/A	N/A
ACCESSIBILITY	Option Values	N/A	N/A	N/A
	Severance	N/A	N/A	N/A
	Access to the transport System	N/A	N/A	N/A
INTEGRATION	Transport Interchange	N/A	N/A	N/A
	Land-Use Policy	N/A	N/A	N/A
	Other Government Policies	N/A	N/A	N/A

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