

ONE YEAR AFTER STUDY

M4 Junction 18 Eastbound Diverge



Contents

<i>Section</i>	<i>Page</i>
1. Introduction	1
Background to Scheme	1
POPE One Year After Report	3
2. Traffic Analysis	5
Data Collection	5
Traffic Volume Analysis	5
Journey Time Analysis	12
3. Safety	17
Accidents	17
Security	21
4. Economy	22
Introduction	22
Economic Evaluation	22
Reliability	25
5. Environmental Impact	27
Introduction	27
Data Collection	27
Evaluation	28
Noise	28
Local Air Quality	29
Greenhouse Gases	30
Landscape	31
Biodiversity	34
Heritage	36
Water	37
Journey Ambience	38
Unevaluated Sub-objectives	39
6. Accessibility and Integration	41
Integration	41

Accessibility	41
7. Summary	42

List of Tables

Table 2.1 – Average Weekday Traffic (AWT)	7
Table 2.2 – Average Daily Traffic (ADT)	7
Table 2.3 – HGVs as a proportion of the AWT	8
Table 2.4 – Traffic Forecasts	11
Table 2.5 – Forecast vs. Outturn AADTs	12
Table 2.6 – Changes in Average speeds on Weekdays (Feb 2005 – Feb 2007)	13
Table 3.1 – Personal Injury Accidents by Severity	17
Table 3.2 – Number of Casualties by Severity	20
Table 3.3 – Forecast Safety benefits over 60 years	21
Table 4.1 – Forecast of 60 year Present Value Benefits (£million, 2002 prices)	23
Table 4.2 – Present Value Costs (£million, 2002 prices)	24
Table 4.3 – Forecast and Evaluated Benefit / Cost Ratios (BCR)	25
Table 5.1 – Summary of Environmental Consultation Responses	27
Table 5.2 – Evaluation of Opening Year Carbon Emissions	30
Table 7.1 – Achievement of Scheme Objectives	42
Table 7.2 – Appraisal Summary Table (December 2004)	43
Table 7.3 – Evaluation Summary Table (2002 prices and values)	44

List of Figures

Figure 1.1 – Scheme location	1
Figure 1.2 – View of the start of the Eastbound Diverge	2
Figure 2.1 – Average Weekday Traffic (AWT) – Before and After	6
Figure 2.2 – Daily Traffic Volume Trends on the M4 J19-18 Eastbound	9
Figure 2.3 – Monday - Friday Hourly flows on M4 J19-18 eastbound in 2004 and 2007	10
Figure 2.4 – Hourly flows on M4 J18 eastbound off slip in 2007	11
Figure 2.5 – Average Speeds on M4 eastbound carriageway within J18	14
Figure 2.6 – Average Speeds at foot of J18 Eastbound slip road	15
Figure 3.1 – Locations of Injury Accidents on M4 Eastbound carriageway and J18 off slip, Before and After	19
Figure 5.1 – New landscape planting with existing vegetation retained	32
Figure 5.2 – Reinforced earth slope at top of embankment slope	32
Figure 5.3 – Calcareous soil area above retaining wall allowed to re-colonise naturally	33
Figure 5.4 – Gantry 1 with open views to the local landscape	33
Figure 5.5 – Temporary reptile refugia as part of the ecological monitoring	35
Figure 5.6 – View from motorway verge to Grade II Listed Barley Close Farm	36

Figure 5.7 – Pond 2	37
Figure 5.8 – Pond 1	38
Figure 5.9 – Gantry 3 near the Junction 18 off slip	39
Figure 5.10 – View from the motorway verge to the existing footpath and underpass below the motorway	40

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Glossary

The following table details the acronyms and specialist terms used within the context of this report.

Term	Definition
ADT, AADT	Average Daily Traffic , Annual Average Daily Traffic. Average of 24 hour flows, seven days a week.
AWT, AAWT	Average Weekday Traffic, Annual Average Weekday Traffic. As ADT but for five days, (Monday to Friday) only.
AONB	Area of Outstanding Natural Beauty
AST	Appraisal Summary Table. This records the impacts of the scheme according to the Government’s five key objects for transport, as defined in DfT guidance contained on its Transport Analysis Guidance web pages, WebTAG
ASTIS	Avon & Somerset Tactical Information System A system for monitoring traffic conditions and providing driver information via electronic signs operated by the Regional traffic Control Centre in Avonmouth.
ATC	Automatic Traffic Count
BCR	Benefit Cost Ratio - this is the ratio of the PVB divided by the PVC.
Climbing lane	DMRB defines a climbing lane is defined as an additional lane added to a single or dual carriageway in order to improve capacity and/or safety because of the presence of the steep gradient. A steep gradient is the primary reason for adding a lane.
COBA	COst Benefit Analysis – a computer program which compares the costs of providing road schemes with the benefits derived by road users (in terms of time, vehicle operating costs and accidents), and expresses the results in terms of a monetary valuation. The COBA model uses the fixed trip matrix.
Discounting	Discounting is a technique used to compare costs and benefits that occur in different time periods and is the process of adjusting future cash flows to their present values to reflect the time value of money, e.g. £1 worth of benefits now is worth more than £1 in the future. A standard base year needs to be used which is 2002 for the appraisal used in this report.
DMRB	Design Manual for Roads and Bridges
ES	Environmental Statement
EST	Evaluation Summary Table. In POPE studies, this is a summary of the evaluations of the TAG objectives using a similar format to the forecasts in the AST.
HGV	Heavy Goods Vehicle. In the context of this report, the precise definition of the term is dependant on the way that traffic is being measured.

	Currently, traffic flow data as measured by ATCs uses a length based classification – the term HGV is used to refer to vehicles greater than 5.2m. Shorter vehicles are classified as ‘light’.
Highways Agency	An Executive Agency of the Department for Transport, responsible for operating, maintaining and improving the strategic road network in England.
LEAP	Landscape and Ecology Aftercare Plan
NATA	New Approach To Appraisal Used for transport scheme appraisal since 1998.
NRTF	National Road Traffic Forecast. This document defines the latest forecasts produced by the Department of the Environment, Transport and the Regions of the growth in the volume of motor traffic. The most recent one was issued in 2007 and the one previous was NRTF97.
PVB	Present Value of Benefits
PVC	Present Value of Costs
SWARMMS	South West ARea Multi-Modal Study or London to South West and South Wales Multi Modal Study This study was undertaken in 2002 with the aim of making recommendations for a long-term strategy to address passenger and freight transport needs within the key transport corridors between London and the South West of England and South Wales (M3, M4, M5, A303, A30, A38 and the parallel rail routes).
TEE	Transport Economic Efficiency
TEMPRO	Trip End Model Program This is a PC program which provides access to the Department for Transport’s national Trip End Model projections of growth in travel demand, and the underlying car ownership and planning data projections.
TPI	Targeted Programme of Improvements. This is the former name of the Highways Agency’s programme of investment in improvements to the trunk road and motorway network that is now know as Major Schemes. The programme is comprised of schemes costing over £5million.
vpd	vehicles per day
WebTAG	Department for Transport’s website for guidance on the conduct of transport studies.

Executive Summary

Scheme Title	M4 J18 Eastbound diverge
Opening Date	November 2005
POPE Stage	One Year After

Scheme Description

The scheme comprised the extension of the eastbound carriageway of the M4 over 1.8 miles in South Gloucestershire. Specific elements of the scheme included:

- A new 1.6 mile climbing lane on the incline
- An extended exit slip road with improved parallel-type diverge
- Three new gantries over the motorway to provide improved direction signs for drivers

Objectives	Objective Achieved?
• Relieve the congestion problems which were caused by the long uphill gradient on the eastbound approach to Junction 18	Yes
• Improve safety by reducing conflict problems between mainline and exiting traffic	Too early to conclude
• Construct the scheme within land owned by the Highways Agency	Yes
• Minimise the impact of the scheme on the Cotswold AONB and biodiversity	Too early to conclude

Key Findings

- The objective of the M4 Junction 18 Eastbound diverge scheme to relieve congestion due to the uphill gradient on the approach to the junction have been achieved.
- There has been a slight reduction in accident at the one year after stage in line with predictions, but it is too soon to be able to draw any firm conclusions based on such small numbers.
- It is also too early to assess the safety impacts of the scheme on the Cotswold AONB.
- Post opening traffic flows through the scheme are much lower than forecast, as a result of over-forecasting development and traffic growth in the area.
- Traffic flows on roads most likely to be impacted by the scheme show very low growth indicating that the scheme has not attracted new traffic to the area.
- Compared to before opening, traffic speeds and journey times are more consistent across the day. Speeds on the main carriageway have increased during the day and early evening.
- The re-forecast journey time benefits are half the forecast due to the traffic volumes on the M4 being lower than forecast. There is however some uncertainty over the value of the journey time benefits due to the uncertainty over the reliability of journey time data.
- The economic benefit from safety improvements has not been re-forecast as it is too soon to have adequate data;

- Outturn construction costs are lower than forecast but when an adjustment for the loss of taxation revenue is included, the cost of the scheme to public accounts is close to the forecast figure.
- The outturn BCR is lower than that forecast due to the much lower economic benefits.
- Environmental Impacts largely as predicted although it is not possible to fully evaluate biodiversity without further studies into the impacts on species and habitats.
- The scheme is entirely motorway-based and within the existing highway boundary, therefore has no impacts on accessibility.
- The scheme was recommended by the 2002 Multi-Modal Study for the area (SWARMMS) and is consistent with national and regional policy.

Summary of Scheme Impacts

Traffic

- On the section of the M4 which includes the scheme (eastbound J19-J18), there has been negligible change in the traffic volumes compared to before the scheme was implemented. This shows in absolute terms, that the scheme has not resulted in any new traffic being attracted to this part of the M4.
- The forecast for the opening year of was higher than the observed figure by 14%. SWARMMS overestimated traffic growth in the north Bristol area in the period assessed, as expected developments have not been completed.
- Speeds are consistent throughout the day on the main carriageway and off slip whereas previously there was congestion during the interpeak period on the M4 and in the PM peak on the off slip.
- Speeds on the main carriageway have increased by between 3 and 8 mph during the day and early evening.
- The combination of increased lanes and improved speeds indicates reduced congestion at the Junction 18 diverge as a result of the scheme.

Safety

- There has been a slight reduction in the number of accidents from almost 7 per year on average before opening down to just over 5. However, the reduction is not statistically significant.
- The slight reduction in accidents is in line with the predictions.
- After opening there have been fewer accidents at the eastbound carriageway with the uphill incline and around the diverge for the J18 off slip.
- The small numbers of accidents highlight the fact that the safety impact of this scheme cannot be measured such a short time after opening. It is recognised that accident trends decline over time and will be better evaluated in the Five Year After study.

Environment

- Based on the traffic forecast, which are lower than predicted, it is likely that the impacts on noise and air quality are better than expected.
- There has been a small impact on carbon emissions in the first year after opening. The 3% increase in emissions is exactly the same as the forecast.

- For biodiversity and landscape planting, it would appear that the environmental impacts for these sub-objectives are also likely to be as expected. To reach their full potential it will be essential for them to continue to establish satisfactorily and for the recommended work identified in the monitoring reports to be carried out.
- Other environmental matters were given due regard and mitigation measures fully implemented.
- The use of land within the highway boundary utilising the hard shoulder for the climbing lane, minimised land take. However, this meant less land was available for environmental mitigation measures.

Accessibility

- Being entirely motorway-based and within the existing highway boundary, the scheme has had no impacts on accessibility.
- The scheme has had no impact on non-motorised users or public transport. The only public right of way near the scheme is a pedestrian underpass near the western end of that is unchanged by the scheme. There are no scheduled bus services using the A46 junction although long distance coach services on the M4 main carriageway may potentially benefit from the climbing lane.

Integration

- This scheme was one of a number of measures recommended by the London to the South West and South Wales Multi-Modal Study (SWARMMS) in 2002 to relieve congestion on the M4/M5 around Bristol.

Summary of Economic Performance

	Costs in £m 2002 Prices discounted to 2002 at 3.5%	
	Pre-opening Forecast	Post-scheme re-forecast
Journey Time Benefit	£82.5m	£34.6m
Safety Benefits	-	-
Total 30 Year Benefits (PVB)	£82.5m	£34.6m
Costs (2002) prices	£11.0m	£8.2m
Indirect Tax and Operating Cost	£7.7m	£8.0m
Benefit Cost Ratio (BCR)	4.4	2.1

- Lower than expected traffic growth means that re-forecast journey time benefits at £34.6m are much lower than forecast. Safety benefits have not been calculated.
- The capital cost of the scheme was a quarter less than forecast prior to start of construction. This may be due to overestimating (in particular of the risk

allowance) as when the scheme entered the programme in 2002, the original estimate was much lower.

- The scheme may have large indirect tax disbenefits which can be responsible for nearly half of the cost of the scheme to central government.
- The estimated outturn BCR is lower than forecast, but still represents value for money.

1. Introduction

BACKGROUND TO SCHEME

Scheme Location

- 1.1 The M4 Junction 18 Eastbound Diverge scheme is located on the eastbound carriageway of M4 motorway approaching Junction 18 near Tormarton in South Gloucestershire, and partly within the Cotswolds Area of Outstanding Natural Beauty (AONB).
- 1.2 This scheme was one of a number of measures recommended by the ‘London to the South West and South Wales Multi-Modal Study’ (SWARMMS) in 2002 to relieve congestion on the M4/M5 around Bristol.

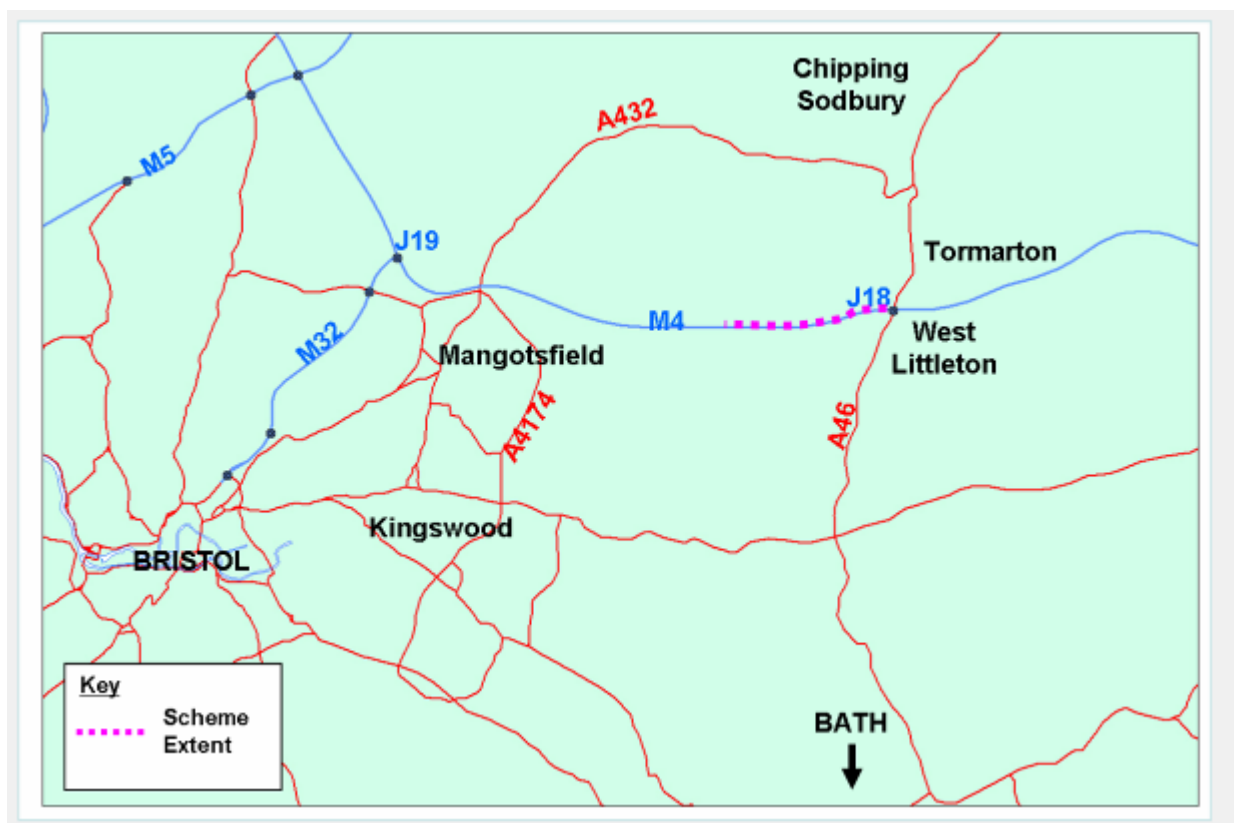


Figure 1.1 – Scheme location

Scheme description

- 1.3 The M4 eastbound approach to junction 18 is on a relatively steep uphill incline on the edge of the Cotswold escarpment. Before the improvement, this section of the M4 suffered from congestion due to the conflict between fast-moving vehicles exiting at Junction 18 and slow-moving vehicles, principally in the inside lane, wishing to continue along the motorway.
- 1.4 To tackle this congestion the scheme provides, within the highway boundary:
- A new 2.5km climbing lane on the incline;
 - An extended exit slip road with improved parallel type diverge at Tormarton; and
 - Three new gantries over the motorway to provide direction signs for drivers.
- 1.5 The total length of the scheme is approximately 3 km.

- 1.6 Figure 1.2 illustrates the view of the middle gantry and start of the eastbound diverge where it splits from the four lanes of the main carriageway which includes the additional climbing lane.



Figure 1.2 – View of the start of the Eastbound Diverge

History of the Scheme

- 1.7 The history of the M4 J18 scheme can be summarised as follows:
- *Construction of the M4 – mid 1960s;*
 - *SWARMMS final report made recommendations for improvements to M4 /M5 in Bristol area including this scheme – 2002;*
 - Scheme entered the TPI programme – December 2002;
 - Scheme awarded to Early Contractor Involvement (ECI) contractor – April 2004
 - Environmental Statement published – October 2004;
 - *Signalisation of J18/A46 roundabout, as recommend by SWARMMS (this was undertaken as part of the detrunking of the A46 and not part of this scheme) – May 2004;*
 - Start of work – 28th February 2005; and
 - Opened – 8th November 2005.

Objectives

- 1.8 The objectives of the scheme were to:
- Relieve the congestion problems caused by slow moving vehicles on the steep incline;
 - Relieve the congestion problems caused by conflicts between traffic leaving the motorway and slow-moving traffic on the inside lane remaining on the motorway through the junction; and

- Improve safety by lengthening the diverge, reducing the likelihood of last-minute manoeuvres ('swooping') onto the slip road.

1.9 The scheme's Environmental Statement stated that the scheme objectives were also to:

- Construct the scheme within land owned by the Highways Agency to avoid affecting adjacent land;
- Achieve no significant worsening of the Appraisal Summary Table criteria;
- Minimise impact on the Cotswolds Area of Outstanding Natural Beauty (AONB); and
- Minimise the scheme's impact on biodiversity.

1.10 The ES stated that:

- The proposal will meet Government objectives, and it is not anticipated that it will lead to the generation of additional traffic, as the scheme is providing only localised improvements to the benefit of M4 traffic and provides no improvement to the wider road network.

POPE ONE YEAR AFTER REPORT

1.11 No Traffic Impact Study was undertaken for this scheme. This is because following completion of this TPI scheme, works began on new gantries for the signing system ASTIS¹. The works finished on the section between J19 – J20 in May 2007.

Purpose

1.12 This one year after study will evaluate whether the original objectives of the scheme have been achieved and provide a comparison of the predicted scheme impacts against those emerging to date. The overall impacts of the scheme will also be assessed against the core NATA objectives of Economy, Safety, Environment, Integration and Accessibility in the form of an Evaluation Summary Table (EST), see Section 7.

1.13 More specifically, the report will set out the following:

- A comparison of the 'before' and 'after' traffic volumes on the M4 and 'A' roads in the vicinity of junction 18;
- A comparison of 'before' and 'after' journey times on the M4 and other routes;
- An outline of the changes in accident rates in the corridor following the opening of the scheme;
- Provide a comparison of the predicted and actual impacts of the Scheme (Evaluation Summary Table); and
- Evaluate the impact of the scheme upon the environment, more specifically its impact upon Noise, Air Quality, Landscape, Biodiversity, Heritage and Water.

Report Format

1.14 The structure of the remainder of this report is as follows:

¹ Avon Somerset Tactical Information System (ASTIS) This system involves the provision of gantry-mounted driver information systems and traffic monitoring on the motorway network around the Bristol area including this section of the M4.

- **Section 2 – Traffic Analysis.** This section is an analysis of the traffic impacts of the scheme and compares them with the forecast impacts;
- **Section 3 – Safety.** This section discusses whether at this stage, there are emerging changes in accident patterns as result of the scheme;
- **Section 4 – Economy.** This section examines what economic impacts of the scheme can be measured and compares these to the forecast benefits;
- **Section 5 – Environment.** A review of the environmental impacts of the scheme is given and supported by an evaluation of the mitigation measures described within the scheme's Environmental Statement;
- **Section 6 – Accessibility and Integration.** A review of how the scheme has affected accessibility for pedestrians, cyclists and public transport users is presented. Furthermore a review of how the scheme links with wider policy objectives; and
- **Section 7 – Appraisal and Evaluation Summary Tables.** This section contains an overview of the actual scheme impacts compared to those predicted in the original Appraisal Summary Table.

Sources

1.15 The sources upon which this evaluation is based include the following:

- Traffic counts and journey times from the Highways Agency's TRADS and HATRIS databases;
- Accident records obtained from Area team;
- A site visit made by a transport planner and a landscape architect;
- Reports appraising the scheme, prior to construction:
 - M4/M5 Improvement Studies Traffic Survey Report*, July 2003
 - M4 Junction 18 Climbing Lane Traffic and Economics Report*, September 2004
 - M4 Junction 18 Eastbound Diverge Environmental Statement*, October 2004
 - Appraisal Summary Tables from 2002 when the scheme entered the TPI programme and from 2004 when an updated version was produced to support the cost challenge workshop.
- Post construction reports;
 - M4 Junction 18 Eastbound Diverge Landscape and Ecology Aftercare Plan*, May 2006
 - M4 Junction 18 Eastbound Diverge Landscape and Ecology Aftercare Annual Monitoring Report*, July 2007

2. Traffic Analysis

2.1 In order to assess the traffic impacts of the scheme the following section reports on:

- 24-hour daily and weekday traffic volumes on the M4 and A46;
- Long term trends in daily traffic volumes;
- Impact on heavy goods vehicles;
- Observed traffic volumes compared against the traffic volumes forecast during the appraisal process; and
- Vehicle speeds on the M4 and off slip.

DATA COLLECTION

2.2 Traffic data was collected for this and adjacent sections of the M4 for the following time periods:

- November 2004 (before construction started);
- One Year After Opening (November 2006); and
- Two Years After opening (November 2007).

2.3 Following the completion of the scheme in November 2005, a programme of works started for the ASTIS signing system which clearly affected traffic flows within the study area considered for this report until May 2007. Hence, traffic data two years after opening has been collated in addition to one year after.

TRAFFIC VOLUME ANALYSIS

Average Weekday and Daily Traffic

2.4 Average 24-hour traffic flows for weekdays and all days of the week as observed for the month of November are shown in Table 2.1 and Table 2.2. The locations directly affected by the scheme are indicated in grey. Figure 2.1 illustrates the locations of changes in weekday traffic averages.

2.5 The data shown in these tables has not been adjusted for background traffic growth, therefore it would be expected that all roads would show a certain level of traffic growth. Based on the National Road Traffic Forecast (NRTF) of 1997, the traffic growth on rural motorways between 2004 and 2007 was forecast to be nearly 9%. The forecast for all road types in this area for the same time period as adjusted by Trip End Model Program (TEMPRO) is 5%. Thus, it can be seen that, in general, the traffic growth in the study area for this report has seen growth levels below the expected background traffic growth and therefore it can be concluded that there is no induced traffic as a result of this scheme.

2.6 The key points regarding the changes in traffic volumes in the area around the scheme are:

- On the section of the M4 which includes the scheme (eastbound J19-J18), there has been negligible change in the traffic volumes since before the construction. This shows in absolute terms, that the scheme has not resulted in any new traffic being attracted to this part of the M4;
- Conversely, the figures show that traffic on the westbound carriageway has a slightly larger increase, although there is no reason to link this with this scheme;
- Traffic flows on the A46 show small increases in line with background traffic growth in the region; and

- The importance of the scheme is indicated by the count data now available which shows that 12,000 vehicles per day (vpd) use the M4 J18 off slip two years after scheme completion. This represents 25% of the eastbound traffic on M4 from J19-J18.

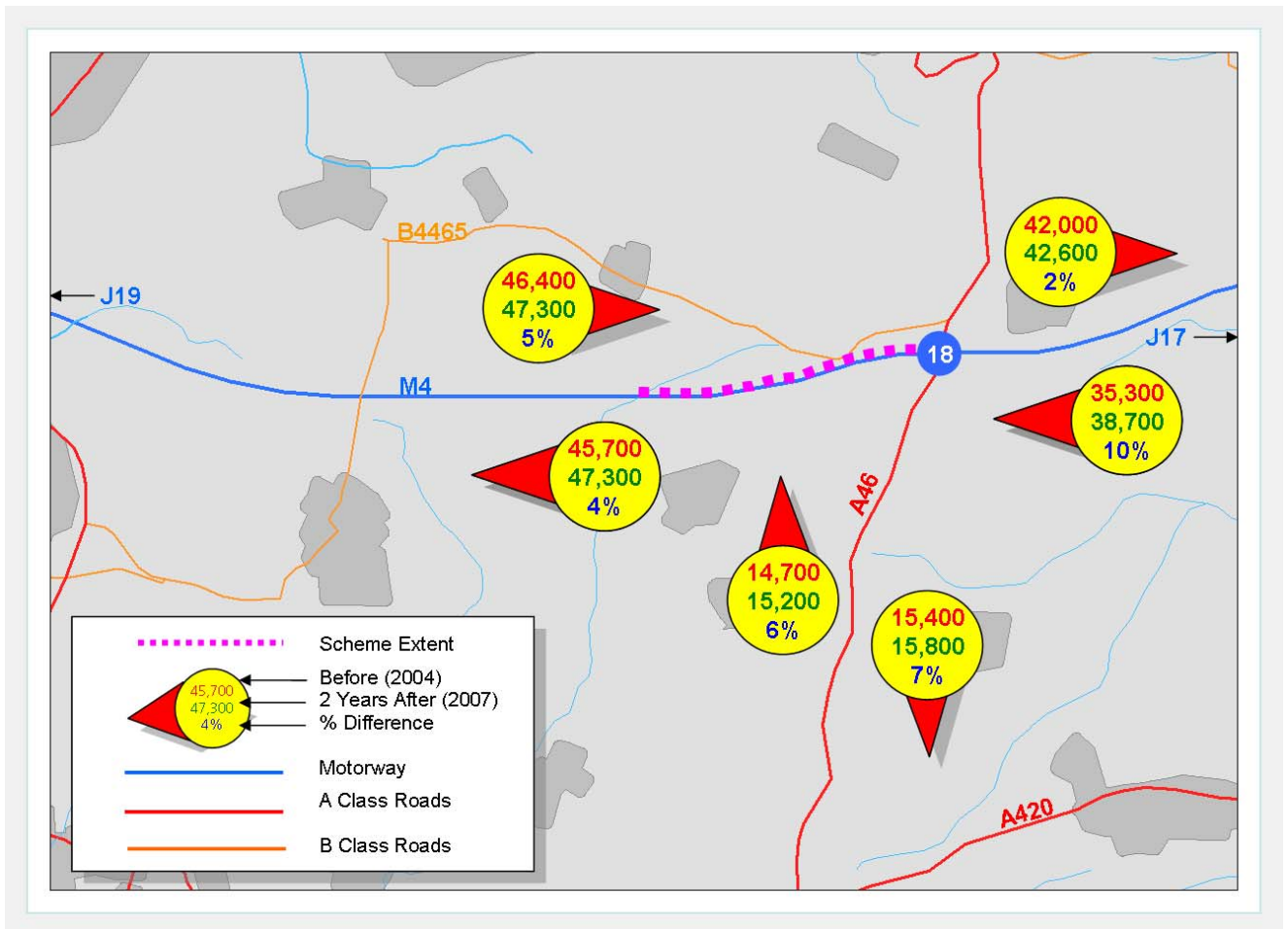


Figure 2.1 – Average Weekday Traffic (AWT) – Before and After

Table 2.1 – Average Weekday Traffic (AWT)

Location		Before (2004)	1 year After (2006)	2 years After (2007)	% Diff. ('04 – '07)
M4 EB	Junction 18 - 17	42,000	41,700	42,600	2%
	Junction 19 - 18	46,400	45,600	47,300	2%
	Junction 20 - 19	61,300	62,400	64,300	5%
	within junction 18	n/a	33,900	34,400	n/a
	J18 eastbound off slip	n/a	11,500	12,000	n/a
M4 WB	Junction 17 - 18	35,300	41,900	38,700	10%
	Junction 18 - 19	45,700	n/a	47,300	4%
	Junction 20 - 19	60,000	n/a	63,500	6%
A46	NB, A46, Between A420 - M4 Junction 18	14,700	14,800	15,200	6%
	SB, A46, Between A420 - M4 Junction 18	15,400	15,300	15,800	7%
	NB, A420 - A4	10,000	10,400	10,500	3%
	SB, A420 - A4	10,100	10,500	10,800	2%

Table 2.2 – Average Daily Traffic (ADT)

Location		Before (2004)	1 year After (2006)	2 years After (2007)	% Diff. ('04 – '07)
M4 EB	Junction 18 - 17	39,400	38,900	40,700	3%
	Junction 19 - 18	43,900	43,100	44,900	2%
	Junction 20 - 19	57,300	57,900	59,500	4%
	within junction 18	n/a	32,400	33,000	n/a
	J18 eastbound off slip	n/a	10,500	11,000	n/a
M4 WB	Junction 17 - 18	34,100	40,000	36,300	6%
	Junction 18 - 19	42,600	n/a	43,900	3%
	Junction 20 - 19	55,500	n/a	59,300	7%
A46	NB, A46, Between A420 - M4 Junction 18	9,400	9,800	10,000	5%
	SB, A46, Between A420 - M4 Junction 18	9,400	9,800	10,000	6%
	NB, A420 - A4	13,800	14,800	14,300	3%
	SB, A420 - A4	14,300	14,300	14,700	3%

Heavy Good Vehicles (HGV) usage

- 2.7 Data on HGV usage on this section of the M4 is shown in Table 2.3.
- 2.8 This data indicates that the proportion of HGVs using the section of M4 affected by the scheme (J18 – J19) has not significantly changed since the opening of the scheme.

Table 2.3 – HGVs as a proportion of the AWT

Location	Before (2004)	After (2005)	1yr After (2006)	2yr After (2007)
M4 J19 – 18 eastbound	20.6%	20.8%	20.6%	20.6%
within junction 18	n/a	20.7%	23.1%	23.4%
J18 eastbound off slip	n/a	13.1%	14.5%	14.2%

Trends in Daily Traffic flows

- 2.9 Figure 2.2 shows the average daily traffic flows trend on the eastbound section of the M4 between J19 and J18 since 2003, including the construction period for this scheme.
- 2.10 The key points regarding the trends in daily traffic flows as illustrated in Figure 2.2 are:
- In the 'before' situation, M4 flows varied over the year with seasonal variation on the road giving lower flows during the winter, with a minimum in January of below 40,000 vehicles per day, and higher flows in the summer, reaching a maximum in August approaching 50,000 vehicles per day;
 - During the construction period, data was limited but there is some evidence that flows were slightly lower during the summer months;
 - Following the completion of this scheme, the pattern of daily traffic flows through the year returned to that seen before the scheme was built; and
 - As already stated, there is no evidence that the scheme has attracted additional traffic to this part of the M4 over and above the expected change through national growth.

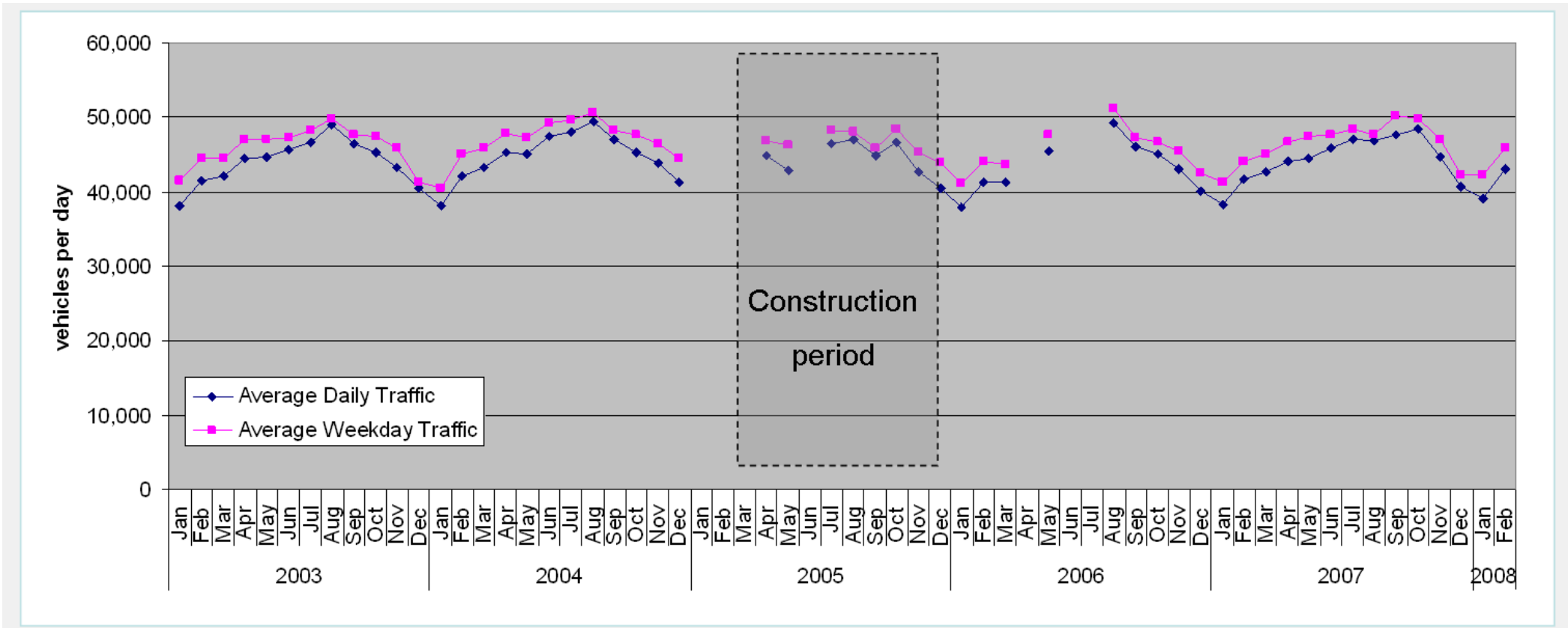


Figure 2.2 – Daily Traffic Volume Trends on the M4 J19-18 Eastbound

Hourly Traffic usage though the scheme

2.11 Table 2.1 showed that there was little overall change in the weekday daily traffic flows over 24 hours. To evaluate whether there has been any impact on the traffic patterns across the day, the average weekday hourly flows have been examined.

Hourly Flow on M4 J19 – J18 main carriageway approaching scheme

2.12 Figure 2.3 compares the hourly eastbound traffic flows on weekdays in November 2004, before construction started, with the same month in 2007, two years following scheme opening. The main points shown in Figure 2.3 are:

- There has been little change in the traffic profile across the day in the period before and after the scheme opened; and
- The peak periods show the same profile; there has been no change to the spread of the peak periods.

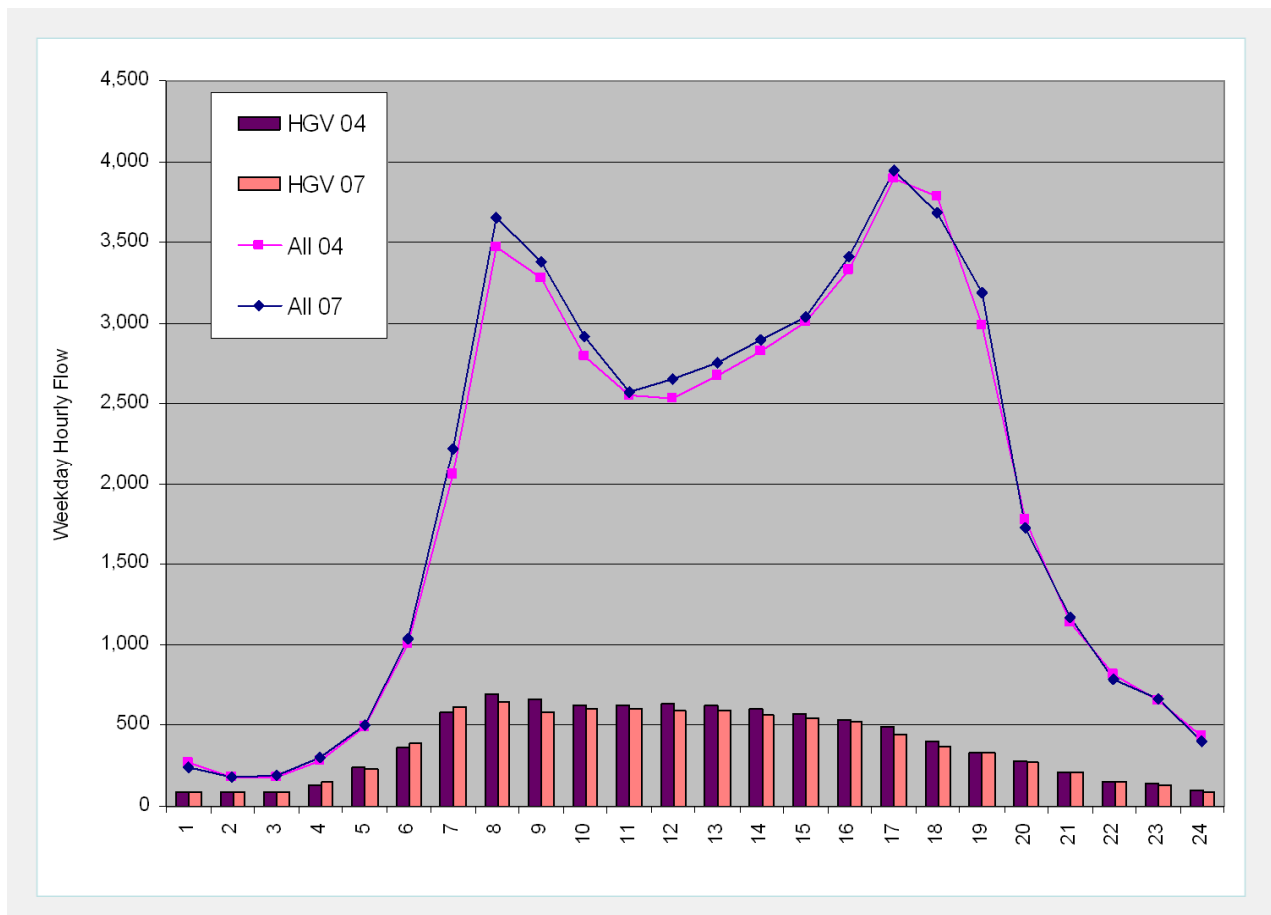


Figure 2.3 – Monday - Friday Hourly flows on M4 J19-18 eastbound in 2004 and 2007

Hourly Flow on eastbound off slip

2.13 The hourly flow profile for traffic on the eastbound off slip is shown in Figure 2.5 for November 2007, two years after the scheme was completed. No traffic data is available for the ‘before’ period.

2.14 Compared to the flow profile for the main eastbound carriageway, the slip road traffic shows a much greater peak-effect in the PM peak period; with flows double that in the inter-peak period. This suggests that the route is heavily used by homebound commuters in the PM peak.

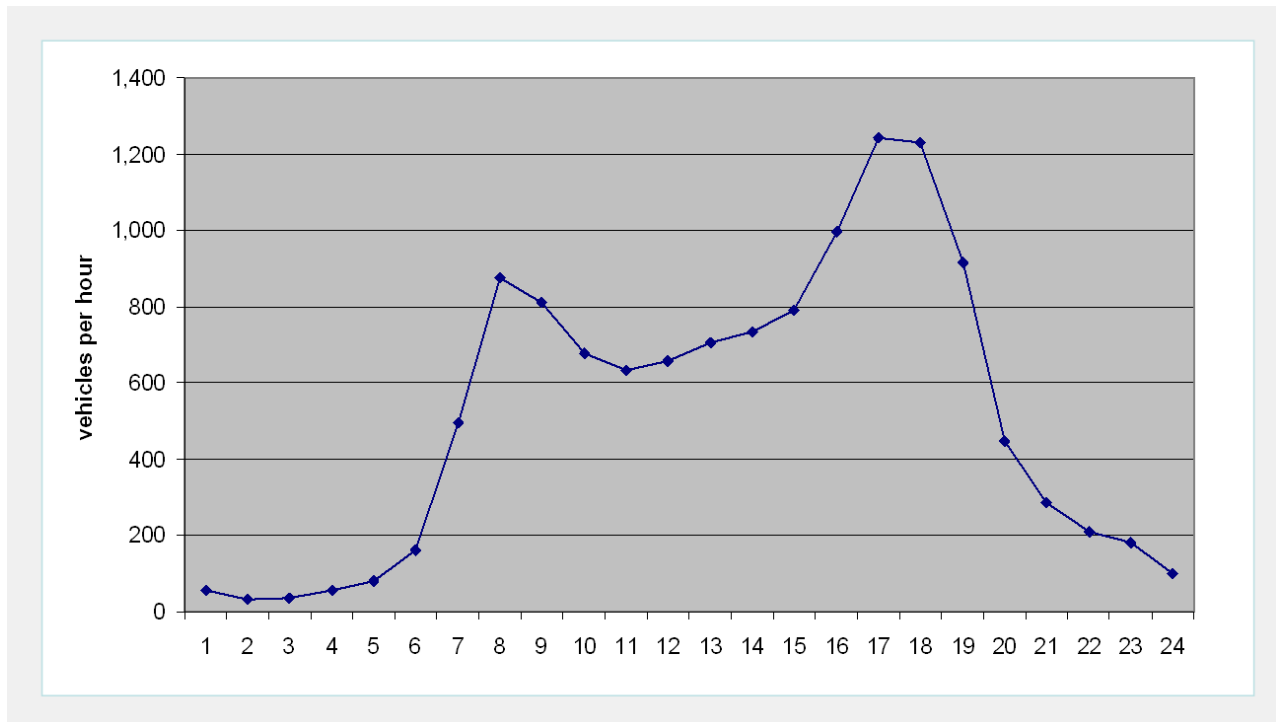


Figure 2.4 – Hourly flows on M4 J18 eastbound off slip in 2007

Analysis of Forecast vs. Outturn Traffic Volumes

2.15 The forecasting report² used observed traffic flows from 2000 and 2002. Then, using NRTF / TEMPRO growth factors, forecasts were produced for 2006. However, the forecasting report stated that:

Given that in 2000, roadworks on the M5 south of Almondsbury had severely disrupted traffic, it was considered that this may have had some knock-on effect on the M4. Taking this and the expected high level of development in and around Bristol’s Northern Fringe area into account, an additional 5% was added to the forecasts.

2.16 Table 2.4 shows how the opening year forecast of 50,600 was generated in the appraisal.

Table 2.4 – Traffic Forecasts³

Base Year	AADT	Growth Factor	2006 Forecast	2006 Forecast +5%
2000	43,495	1.126	48,975	51,424
2002	44,456	1.086	48,279	50,693
Figure used for forecasting purposes				50,600

2.17 Table 2.5 compares observed AADT figures in the first two years of the scheme, as stated in the TRADS yearly reports, with a variety of forecasts. This shows that the forecast for the opening year of 2006 was higher than the observed figure by 14%.

² M4 Climbing Lane Traffic and Economics Report, Section 4, September 2004

³ Ibid, Table 4.4

Table 2.5 – Forecast vs. Outturn AADTs

Source		Year	AADT
Observed	Outturn flows	2006	43,600
		2007	44,100
Forecast	M4 J18 Transport & Economics Report	2006	50,600
	SWARMMS	2010/11	55,600
		2021	62,900

2.18 The reasons for the opening year flows being below the forecast include:

- The AADT figures for 2000 and 2002 used as the baseline in the appraisal and shown in Table 2.4, are above the reposted figures currently given in TRADS for the same years⁴;
- While the additional 5% growth as detailed in paragraph 2.15 may have been a valid assumption at the planning stages, there is no information to justify this figure. The Bristol Northern fringe is about 10 miles west of this scheme, whilst there are few urban areas for some distance east of the scheme. The developments providing the basis for this growth may not have been completed when expected. It seems that the claim for 5% increase in M4 traffic as a result of development is overestimated; and
- During 2006, there was ongoing road works around this part of the M4 for the ASTIS system which seems to have depressed flows and the same effect may have continued after the completion of works.

JOURNEY TIME ANALYSIS

Journey Time Database

2.19 Journey times for the M4 J19 to J18 are available in the Highways Agency's HATRIS database for the period covered by this study. However, the journeys are based on ITIS data which tends to cover a relatively small number of vehicles and is skewed toward fleet vehicles and HGVs. The available data for the 'before' period is labelled as being of low quality. In addition, the journey times cover the whole link from J19 to J18, a distance of 12.3km (7.6miles), more than four times the length of the motorway directly affected by the scheme; therefore, it is difficult to identify the impact of the scheme from this data.

2.20 An analysis of the available data over the section suggests a slight improvement in journey times in the AM peak period but a worsening in the PM peak period. However, the limitations of the data mean that this is not considered to be adequate evidence of a change in journey times over the 12km never mind to be indicative of the impact of this scheme.

Speeds from NTCC data

2.21 Speed data is available at NTCC sites at the eastern end of the scheme both on the slip road and on the main carriageway within the junction. Unfortunately, these sites only supply data from January 2005 and scheme construction started on 28th February 2005, therefore February 2005 has been chosen as the 'before' month and has been compared with February 2007 to give a like-for-like

⁴ 42,183 in 2000 and 43,592 in 2002, i.e. 2-3% lower than the figures in the 2004 report.

seasonal comparison. It should be noted that February has below average traffic volumes and therefore there would have been less congestion in the before period. It seems probable that the summer months have experienced a greater increase in speeds due to there having been a greater congestion problem before construction.

Table 2.6 – Changes in Average speeds on Weekdays (Feb 2005 – Feb 2007)

Time period	J19 – J18 EB Main Carriageway		J18 EB Slip road	
	Change in mph	%	Change in mph	%
06:00 - 07:00	1.2	2%	-0.6	-1%
07:00 - 08:00	2.3	4%	2.3	4%
08:00 - 09:00	2.3	4%	2.6	5%
09:00 - 10:00	3.8	6%	0.7	1%
10:00 - 11:00	6.5	11%	1.4	2%
11:00 - 12:00	6.6	11%	1.2	2%
12:00 - 13:00	6.6	11%	2.2	4%
13:00 - 14:00	7.8	13%	2.1	4%
14:00 - 15:00	7.4	12%	1.9	3%
15:00 - 16:00	6.0	10%	1.3	2%
16:00 - 17:00	3.9	6%	1.8	3%
17:00 - 18:00	3.8	6%	3.7	7%
18:00 - 19:00	2.4	4%	4.2	8%
19:00 - 20:00	0.7	1%	-0.2	0%

2.22 Weekdays have higher traffic volumes and a greater proportion of HGVs than weekends, thus have a greater risk of congestion which the scheme was designed to reduce. For this reason, only weekday speeds are studied here. The changes in the average speeds by hour are shown in Table 2.6 and are shown graphically in Figure 2.5 and Figure 2.6.

2.23 These speed measurements are based on a single point only but the locations are directly affected by the scheme.

Speed changes on the J19 – J18

2.24 On the main carriageway, the addition of the climbing lane built for this scheme seems to have the following impacts:

- Speeds in the interpeak between 10:00 and 16:00 have improved significantly by more than 10%; and
- Speeds in February 2007 were fairly consistently free-flow of between 65 – 68 mph for the majority of the day indicating increased journey reliability when compared to the before situation when speeds used to drop during the interpeak, coinciding with the increased HGV numbers as shown in Figure 2.3.

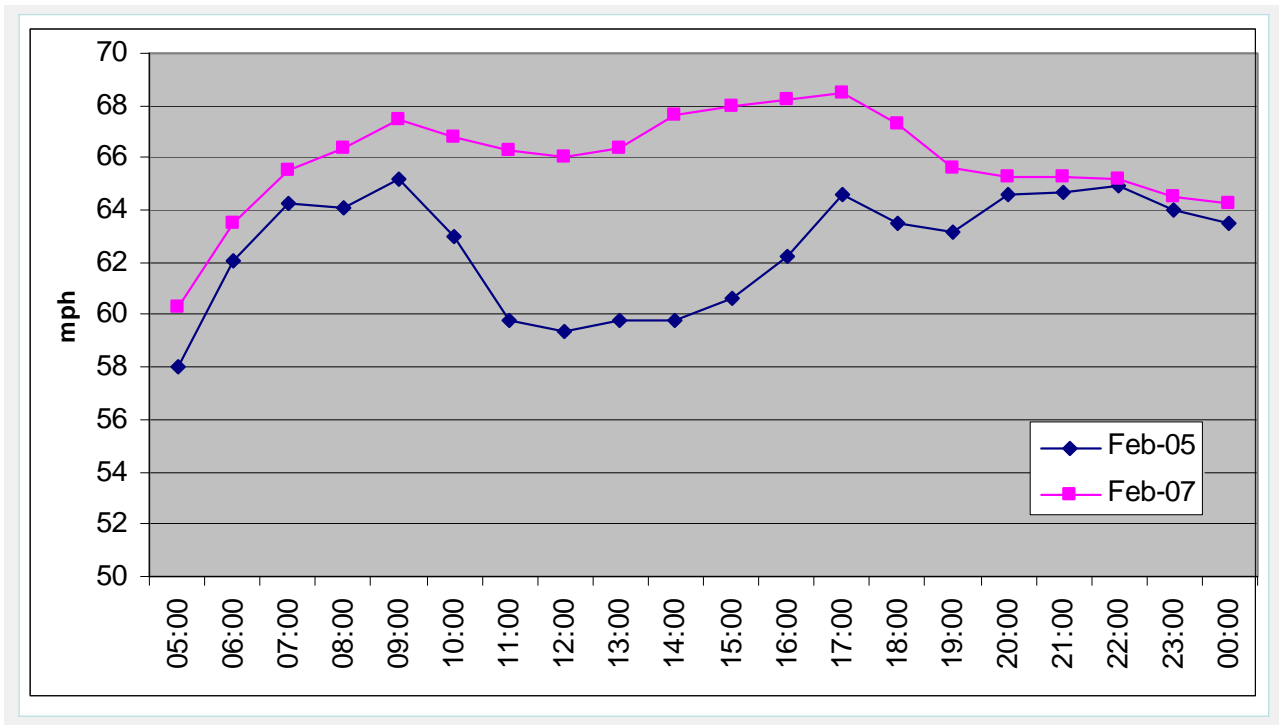


Figure 2.5 – Average Speeds on M4 eastbound carriageway within J18

Speed changes on J18 off slip

- 2.25 On the slip road, approaching the roundabout speeds are naturally slower. It should be noted that the roundabout was signalised in 2004, before any of the data shown here. Comparing the speeds before and after the scheme was constructed shows the main impacts are:
- From 08:00 to 19:00 there is a slight improvement of around 2mph;
 - The most significant change has been the smoothing out of the slump in speeds at the PM peak; and
 - The slight dip in the speed in the PM peak is consistent with the high traffic flows as shown in Figure 2.4.
- 2.26 For the main carriageway and the slip road, there is little change in the early morning and late evening speeds, reflecting the lower flows at these periods resulting in no apparent congestion, at least in February.

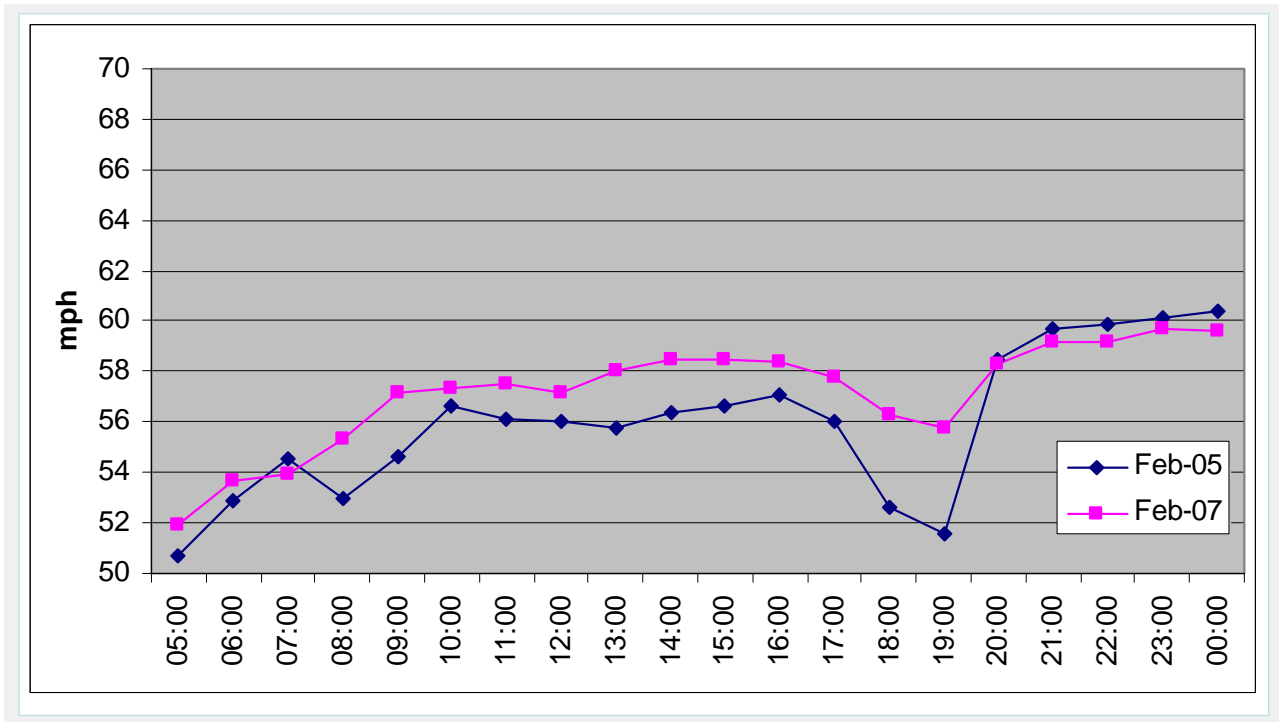


Figure 2.6 – Average Speeds at foot of J18 Eastbound slip road

KEY POINTS FROM SECTION 2 - MAIN TRAFFIC CONCLUSIONS

Traffic Volumes

- Traffic flows on roads most likely to be impacted by the scheme, the eastbound M4 and A46 south of the junction show very low growth of only 2-3%, indicating that the completion of the scheme has not attracted new traffic to the area.
- 12,000 vehicles use the off slip on weekdays, representing a quarter of eastbound traffic approaching J18.
- No impact on hourly flow profile.
- No impact on HGV usage.

Traffic Forecasts

- Traffic flows through the scheme are much lower than was forecast.
- Inaccuracy of the forecast seems to be as a result of over-forecasting development and traffic growth over the wider M4/M5 and Bristol area rather than related to issues with the diverge scheme in particular.

Journey Times and Speeds

- Speeds measured at the start of the off slip and on the main carriageway through the junction, both show improvements in vehicle speeds.
- On the main carriageway, the inter-peak speeds have increased by up to 7mph, representing improvements of 10-12% between 10am and 4pm giving a reliable speed throughout the day suggesting a reduction in congestion and more freely flowing traffic.
- On the slip road, the impact of the scheme seems to be that the drop in speed previously experienced at the peak flows during the PM peak has been largely removed.
- Data for speed improvements is based on February – it is likely that speed improvements in the summer months are greater.

3. Safety

ACCIDENTS

Introduction

- 3.1 This section looks at the changes in personal injury accidents occurring in the three years before scheme construction and in the period since opening.
- 3.2 Note that this analysis does not include damage-only accidents, as data is not comprehensively reported for those accidents. DfT guidance is that there is an average of 7.6 damage-only accidents for every personal injury accident recorded on motorways⁵.

Data Source

- 3.3 For the purposes of this study, accident data was obtained for the part of the M4 directly affected by this scheme from Interroute, the Highways Agency's managing agent for the area. The accident data is based on the records of personal injury accidents recorded in the STATS19 data collected by the local police when attending accidents.

Signalisation of roundabout

- 3.4 The roundabout at the M4 J18 / A46 junction was previously recognised as a site with a history as an injury accident concentration⁶. During 2004, prior to the construction of the Diverge scheme evaluated in this report, the Highways Agency installed signal control on the roundabout to address this problem. This measure is not part of the scheme evaluated in this report.

Evaluation of Accident Numbers

Number of Personal Injury Accidents

- 3.5 Table 3.1 below shows the total number of accidents on the eastbound carriageway in the area immediately impacted by the scheme before the start of construction and in the early period after opening.
- 3.6 The figures shown in Table 3.1 suggest that there has been a slight reduction in the annual accident rate and the severity of accidents. However, a statistical test⁷ on these numbers, taking into account the change in the traffic volume, shows that this change in the accident rate is not statistically significant i.e. it could easily have occurred by chance.

Table 3.1 – Personal Injury Accidents by Severity

Time Period	Number of Accidents by Severity			Total	Average Annual Total
	Fatal	Serious	Slight		
3 years before construction (Mar '03 – Feb '05)	0	2	18	20	6.7
19 months after opening (Nov '05)	0	0	8	8	5.1

⁵ Highways Economic Note No. 1: 2004

⁶ Road Casualty Review for South Gloucestershire: Accident and Casualty Statistics in 2005

⁷ Chi-square test with 5% level of significance

– May '07)					
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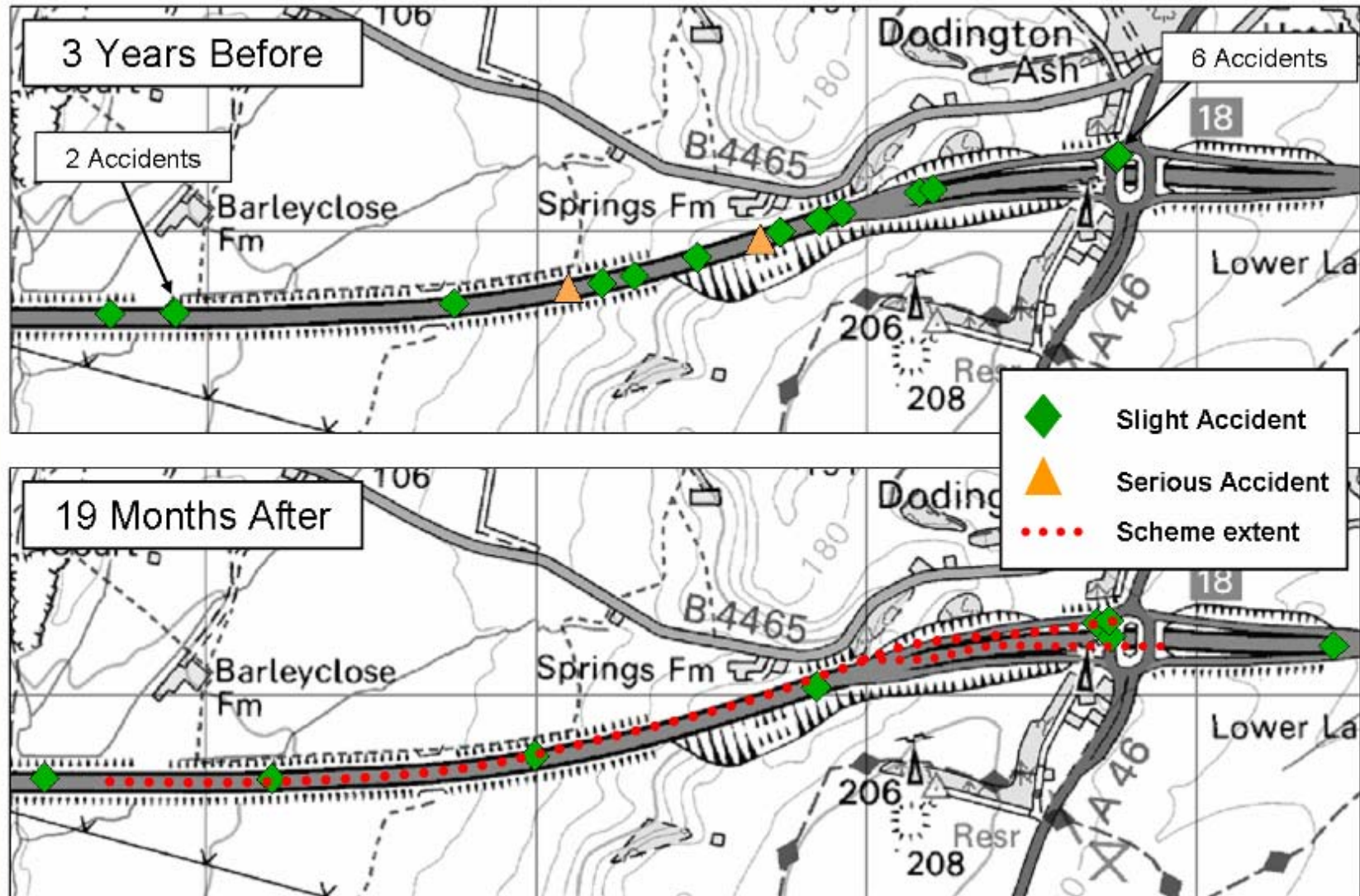


Figure 3.1 – Locations of Injury Accidents on M4 Eastbound carriageway and J18 off slip, Before and After

Number of Casualties

- 3.7 The numbers of casualties injured in the accidents given in Table 3.1 are detailed in Table 3.2.
- 3.8 The figures in Table 3.2 suggest a slight reduction in the annual number of casualties.
- 3.9 All the accidents in the post opening period involved only a single person injured in each accident, whereas in the three years before there was an average of 1.35 casualties per accident. Thus, there has been a greater fall in the annual casualty rate than in the accident rate. However, this reduction is not statistically significant.

Table 3.2 – Number of Casualties by Severity

Time Period	Number of Casualties by Severity			Total	Average Annual Total
	Fatal	Serious	Slight		
3 years before construction (Mar '03 – Feb '05)	0	2	25	27	9.0
19 months after opening (Nov '05 – May '07)	0	0	8	8	5.1

Locations of Accidents

- 3.10 The locations of the accidents in the eastbound carriageway of the M4 before and after scheme construction are shown in Figure 3.1. The key points shown in these maps are:
- The Before map clearly shows that the accidents are clustered around the section of the eastbound carriageway with the uphill incline, around the diverge for the J18 off slip and at the roundabout stop line; and
 - The After map although clearly covering a shorter period, does indicate much fewer accidents on the incline and at the diverge.
- 3.11 Thus at this early stage the accident maps show that there are indications of a safety improvement at the part of the eastbound carriageway most directly affected by this scheme. Accidents on the off slip at the roundabout stop line, which was not targeted by this scheme, show no improvement. Arguably, these accidents could be removed from the figures in the tables, but, even omitting these from the totals, the overall conclusion is still that it is too soon to be able to conclude whether there is a real change still holds.

Analysis of Forecast vs. Outturn Accident numbers

- 3.12 DMRB guidance (Volume 13 Section 1) gives the same accident rate for three- and four-lane motorways, therefore accident savings were not included in the original economic forecasts, or in the 2004 COBA model (see section 4).
- 3.13 Forecast savings of casualties and accidents are however specified in the 2004 AST and the ES (Table 15-2 in the ES which details travellers' safety impacts). These are summarised in Table 3.3 below. The relatively small number of casualties and accidents forecast to be saved can be considered to be loosely in accord with the small observed saving.
- 3.14 The small numbers in this table highlight the fact that the safety impact of this scheme cannot be measured such a short time after opening. It is recognised that accident trends decline over time and this issue will be better evaluated in the Five Year After study.

Table 3.3 – Forecast Safety benefits over 60 years

Forecast	Casualties Saved	Accidents Saved
AST 60 year forecast (November 2004)	63	-
ES 60 year forecast (October 2004, central growth)	28	17
Observed		
Observed annual saving based on first 19 months	3.9	1.6

SECURITY

- 3.15 The Appraisal Summary Table forecast that for the Security sub-objective, the scheme would include maintaining present level of emergency phones, lighting and signing.
- 3.16 The level of provision of emergency phones and lighting has not been assessed in this study but it is assumed that the level was maintained.

KEY POINTS FROM SECTION 3 - MAIN SAFETY CONCLUSIONS

- There has been a slight reduction in accident and casualty numbers particularly on the steepest part of the incline, but at this stage, it is too soon to be able to draw any firm conclusions based on such small numbers.
- No change to driver security.

4. Economy

INTRODUCTION

Forecasting the 60 years Benefit Stream

- 4.1 The economic impacts of the scheme were assessed for a 60-year period following the opening of the scheme. For the M4 J18 Eastbound Diverge, the economic assessment was undertaken using the COBA (Cost Benefit Analysis) program.
- 4.2 With regard to the economic appraisal of climbing lanes schemes, DMRB Volume 6 Section 1 Part 1 TD9/93 Amendment No 1 Chapter 5 states:

Economy: The procedure for economic appraisal shall be based upon the guidance provided in DMRB Volume 13 (Economic Assessment of Road Schemes, Part 5, Paragraph 2.15 for single carriageways and Paragraph 3.13 for dual carriageways). This provides a means within COBA of modelling the economic benefits accruing through the introduction of a section of climbing lane. The Do Something (climbing lane) can be measured against the Do Nothing (no climbing lane) as well as an assessment of alternative climbing lane length and slope configurations.

It is also worth noting that in economic terms, HGVs do not benefit much from the provision of a climbing lane on a single carriageway road. It is the light vehicles that benefit most from the increased overtaking opportunities provided and increased speed.

- 4.3 Usually, the economic benefits for a major scheme will include accident benefits derived from accidents saved over the evaluation period. This is not the case for this scheme because current guidance⁸ is that default accident rates on motorways are the same irrespective of the number of lanes. Hence, adding an additional lane whether as part of a climbing lane scheme or a larger widening scheme has no impacts on the forecast accident benefits.
- 4.4 For this scheme, the majority of the benefits were forecast to be derived from the value of time for the journey time savings.

ECONOMIC EVALUATION

Forecast

- 4.5 Together with the M5 climbing lanes schemes, the economics of this scheme were re-assessed in November 2004 just prior to start of construction using COBA11 release 6 for a 60-year evaluation period. This was to ensure that the scheme was still forecast to be value for money in economic terms in line with the latest appraisal guidance.
- 4.6 The COBA manual states⁹:

Unfortunately, the COBA default speed/flow relationships are not appropriate for the assessment of adding a climbing lane to an existing road because the speed/flow research was not developed for short lengths of uphill gradient.

⁸ DMRB volume 13, part 2, chapter 4, Table 4/1

⁹ DMRB volume 13, part 5 chapter 3, paragraph 3.13

- 4.7 On this basis, it was considered appropriate at the early stages of development of this scheme, in 2002, to create a COBA model with a custom speed flow profile. The custom speed flow curve was based on surveys undertaken on the incline to represent more accurately the Do Minimum situation on the links to be improved.
- 4.8 When the scheme economics were re-assessed in November 2004 just prior to start of construction, the appraisal period was updated to 60 years; the custom speed-flow model was re-run and compared to the situation with the default speed-flow profile. Compared to the evaluation based on the default speed-flow model, the custom speed-flow profile results in significantly higher benefits. The models based on the default and custom speed flow were considered to represent the optimistic and pessimistic bounds of the economic appraisal.

Re-evaluation of Economic benefits using COBA model

- 4.9 The post opening economic evaluation of this scheme is based upon re-running the 2004 pre-construction COBA models with the default and custom speed flow curves as described above, but with the models adjusted to reflect:
- Observed flows; and
 - Opening year was 2005 not 2006 as forecast.
- 4.10 Observed data for the ADT in November 2007 has been used in order to avoid the impact of the ASTIS roadworks. As in the 2004 pre-construction model, no additional flows in the corridor due to the scheme traffic are modelled. Hence, the total flows for this part of the M4 would have been identical with or without the scheme.
- 4.11 Forecasts of the future rates of traffic and economic growth are the same as those used in the modelling for the appraisal before construction.
- 4.12 The comparison of the 60-year benefits as forecast before construction and as re-forecast based on observed data two years post opening are shown in Table 4.1. The re-forecast benefits are based on the use of observed outturn traffic flows.
- 4.13 Note all values are given in 2002 prices discounted to 2002 at a rate of 3.5% for the first 30 years then 3% thereafter.

Table 4.1 – Forecast of 60 year Present Value Benefits (£million, 2002 prices)

Present Value Benefit (PVB)	AST	2004 Pre-construction COBA Forecast		Outturn	
		Default speed flow	Custom speed flow	Default speed flow	Custom speed flow
Customer Users	£22.09m	£7.3m	£34.5m	£3.5m	£12.9m
Business Users	£31.74m	£8.3m	£47.5m	£3.9m	£21.3m
Private Sector providers	-	£0m	£0.5m	£0m	£0.4m
Safety	£1.6m	-	-	-	-
Total PVB	£53.83m	£15.6m	£82.5m	£7.4m	£34.6m

- 4.14 As stated earlier, there was no forecast financial benefit from accident savings. The short period of accident records evaluated in this report as shown in section 3, show no clear statistical evidence of savings therefore this study does not attempt to forecast a 60-year financial benefit of the accident

saving. This will be re-examined in the five years after study when it may be possible to identify a clear trend and thus forecast a robust economic return.

4.15 Delays during the construction period are also not included in this evaluation.

4.16 The key points regarding the forecast economic benefits of the scheme are:

- The use of default and custom speed flow profiles in the model has a huge impact on the benefits, with the pre-construction forecasts differing by a factor of five. This was described in the economic appraisal as representing the optimistic and pessimistic bounds;
- For all models, the benefits are comprised of a roughly even split between TEE (Transport Economy Efficiency) benefits for business and customer users; and
- Based on the observed flows in 2007, after scheme opening, the 60-year re-forecast benefits are estimated to be in a range between £7million – £35 million, about a half of that pre-construction forecast. The reason for the reduction in the forecast relates to the observed outturn flows being lower than forecast, as detailed in the traffic analysis shown in Table 2.4.

Scheme Cost

4.17 In addition to re-assessing the level of benefits accrued by the scheme, a review of predicted and actual present value costs has been undertaken as shown in Table 4.2. The overall cost of the scheme is termed the Present Value Cost (PVC) and is related to the cost to public accounts in the wider sense, not simply the cost to the Highways Agency. Changes in fuel consumption will change the indirect tax generated from users of the road.

4.18 Table 4.2 presents the predicted costs calculated before opening, as part of the justification of the scheme, as well as the actual costs converted to the same price base, 2002, so that direct comparisons can be made between them¹⁰.

Table 4.2 – Present Value Costs (£million, 2002 prices)

Present Value Costs (PVC)	Traffic & Economics Report and AST	2004 Pre-construction Forecast		Outturn	
		Default speed flow	Custom speed flow	Default speed flow	Custom speed flow
Capital Cost ¹¹		£11.0m		£8.2m	
Indirect Tax ¹²		£-2.2m	£7.1m	£-1.6m	£7.4m
Operating costs		£0m	£0.6m	£0m	£0.6m

¹⁰ Outturn costs as spent during the preparation and construction of the scheme were converted between different price bases by using the RPI. Prices were then discounted at a rate of 3.5%.

¹¹ Capital cost (also referred to as investment costs) is the Highways Agency's spend on the scheme, as obtained from the scheme Project Sponsor.

¹² Indirect Tax is the change in revenue to the government as a result of the scheme. In this case, it is largely due to changes in fuel consumption affecting the amount of VAT and fuel duty paid by consumers. The outturn figures for indirect tax are given as two predicted values from the COBA model re-forecast.

Total PVC to public accounts	£16.3m	£8.7m	£18.6m	£6.6m	£16.2m
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4.19 Table 4.2 shows that:

- The actual capital cost of the scheme was a quarter less than predicted;
- The overall present value costs of the scheme is highly dependent on the impact of indirect tax; and
- Evaluation of the outturn present value is dependent of the unknown level of indirect tax, but based on the COBA modelling of this tax, the PVC is below that forecast.

4.20 It is not clear why the capital cost was nearly a quarter below forecast. At the time the scheme entered the TPI programme in 2002, the AST prepared at that time quoted a present value cost of £5.3m. Since that time, part 1 claims, optimism bias and risk assessment are routinely added to cost forecasts. It can be speculated that this scheme was relatively straightforward and that the risk allowance was too large.

Benefit Cost Ratio

4.21 The partial Benefit Cost Ratio (BCR) for the scheme is the ratio between the benefits and costs and is used as a measure of value for money in economy terms. This is not the same as the full benefit assessment shown in the AST.

4.22 Using the forecast and outturn PVB and PVCs shown in the previous tables, the BCRs are as shown in Table 4.3.

Table 4.3 – Forecast and Evaluated Benefit / Cost Ratios (BCR)

	Traffic & Economics Report and ES AST	2004 Pre-construction Forecast		Outturn	
		Default speed flow	Custom speed flow	Default speed flow	Custom speed flow
PVB	£55.5m	£15.6m	£82.5m	£7.4m	£34.6m
PVC	£16.3m	£8.7m	£18.6m	£6.6m	£16.2m
BCR	3.4	1.8	4.4	1.1	2.1

4.23 Table 4.3 shows that despite the costs being slightly below forecast, the outturn BCR is lower than that forecast due to the much lower economic benefits.

4.24 Overall, the scheme economics show a positive BCR that confirms the scheme as beneficial in economy terms.

RELIABILITY

4.25 Reliability of Journey times is an important economic factor for travellers but is not simple to measure. WebTAG guidance uses the measurement of the route stress as a reasonable proxy for measuring the reliability sub-objective; the concept of 'stress' has been developed to provide a broad indication of the relationship between volumes and capacity on a road.

4.26 The calculation of stress is calculated to be the ratio of the AADT volume to the Congestion Reference Flow (CRF) expressed as a percentage. The lower the percentage, the higher the

likelihood that journey time reliability is better. The CRF is defined in the DMRB Volume 5 section 1 Part 3 as:

$$\text{CRF} = \text{CAPACITY} * \text{No of Lanes} * \text{WidthFactor} * 100/\text{PeakFlow} * 100/\text{PeakDirectionSplit} * \text{AADT}/\text{AAWT}$$

The capacity of a road is based on the number of lanes and the proportion of HGVs in the peak period. Note that this does not take into account the impact of the incline.

- 4.27 The results of the route stress calculations for the M4 J18-19 show that the addition of the extra lane has reduced the stress from 56% to 42%.
- 4.28 The AST forecast that the scheme would be moderately beneficial for the reliability sub-objective. Given the reduction in route stress, it is concluded that this has been achieved.

KEY POINTS FROM SECTION 4 – ECONOMY

- The re-forecast of the 60-year benefit stream indicate that benefits will be in region of £35 million. There is some uncertainty over value of the benefits is due to the uncertainty over exact level of impact of the scheme on journey times.
- The re-forecast benefits are only half the pre-construction forecasts because the traffic volumes on the M4 are lower than forecast.
- It is not possible to re-forecast an economic benefit from safety improvements at this stage because it is too soon to have adequate data.
- The capital cost of the scheme was £8.2million in 2002 prices which was one third less than forecast in 2004 just prior to construction but higher than had been initially forecast when the scheme was first approved in 2002.
- Due to the impact of the loss of revenue from indirect taxation, the overall cost of the scheme to public accounts was above the capital cost at £16m which is close to the forecast figure.
- The overall benefit cost ratio was 2.1, indicating that the scheme is value for money.
- Reliability has improved.

5. Environmental Impact

INTRODUCTION

- 5.1 This section documents the findings of the One Year After evaluation for the Environmental sub-objectives for the M4 Junction 18 Eastbound Diverge scheme.

DATA COLLECTION

- 5.2 The Data Collection process consisted of four main stages:

- Data collection and analysis;
- Site Inspection;
- Undertaking Consultations with statutory environmental bodies; and
- Consultation with the local authority, South Gloucestershire Council.

Obtaining and Analysing Data

- 5.3 Copies of the following documents have been used in the compilation of this report:

- Appraisal Summary Table (December 2004);
- M4 Junction 18 Eastbound Diverge Environmental Statement (October 2004);
- M4 Junction 18 Eastbound Diverge Landscape and Ecology Aftercare Plan, May 2006; and
- M4 Junction 18 Eastbound Diverge Landscape and Ecology Aftercare Annual Monitoring Report, July 2007.

Site Inspection

- 5.4 A site inspection was undertaken in November 2007.

Consultations

- 5.5 Three statutory environmental organisations (Natural England, English Heritage and the Environment Agency) and the local authority have been contacted regarding their views on the impacts they perceive the road scheme has had on the environment, and whether they feel that the mitigation measures implemented have been effective. Table 5.1 lists the organisations contacted, their area of interest, and the responses received.

Table 5.1 – Summary of Environmental Consultation Responses

Organisation	Field of Interest	Comments
Natural England	Biodiversity, Landscape	No response
English Heritage	Heritage	By telephone – no nationally designated archaeology. No comments received for built heritage
Environment Agency	Water	No response
South Gloucestershire	General	Commented on landscape, noise and local air quality

Council		
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EVALUATION

5.6 The following environmental sub-objectives have been evaluated in this report:

- Noise,
- Local Air Quality,
- Greenhouse Gases,
- Landscape,
- Biodiversity,
- Heritage,
- Water Environment, and
- Journey Ambience.

5.7 Three of the environmental sub-objectives (noise, local air quality and greenhouse gases) are directly related to traffic flows. The ES noted that the M4 between Junctions 18 and 19 carried approximately 44,400 vehicles (base year 2002 flows) eastbound on an average day. Of these approximately 7,500 (17%) were HGV's. This compared to an average motorway figure for HGV's of 12.7%. Traffic within this corridor was expected to grow along the national growth trends (approximately 2% per annum).

5.8 The scheme itself was not expected to lead to the generation of additional traffic using the motorway. Traffic counts two years after the scheme opened as detailed in the Traffic Analysis in Section 2 show that the observed traffic flow was close to the forecast used in the ES as the basis for evaluation¹³.

NOISE

5.9 The AST predicted that 11 residential properties would be affected by the scheme proposals with changes of approximately 1dB. The quantitative assessment indicated that 2 people would be less affected in the 65-69 dB band, with 3 people more affected in the 70-74 dB band. Overall the estimated population annoyed (EPA) was predicted to be +1.

5.10 The ES stated the following:

- Existing noise levels for residential receptors at Springs Farm and Watts Barn Cottages were considered to be relatively high and dominated by traffic noise from the motorway;
- Noise levels on the Cotswold Way National Trail were high close to the motorway and relatively quiet distant from the motorway;
- A low noise surface would be used on the climbing lane and new hard shoulder;
- Noise levels at all receptors would increase by less than 1 dB(A) when the scheme opened to traffic which was considered to be insignificant in terms of environmental impact. However, there were likely to be ten properties eligible for insulation under the Noise Regulations 1975; and
- Changes in noise as a result of the scheme were likely to be insignificant because the effect of the quieter surface will offset the effect of traffic being closer to receptors.

¹³ Note the traffic forecast in the ES was close to observed after data which is unlike the later traffic forecasts for the economic evaluation of the scheme.

Consultation

- 5.11 South Gloucestershire Council responded to the consultation stating that it had not received any information indicating that noise levels had changed as a result of the scheme, it had not carried out, nor was in possession of, any pre or post monitoring and was unable to advise as to the effectiveness of the low noise surfacing. It was not aware of any complaints relating to the road improvements.

Evaluation

- 5.12 No new noise modelling or survey work has been undertaken for this report.
- 5.13 The noise modelling undertaken for the ES, used forecast traffic flows which overestimated traffic growth in the area (as detail in the traffic analysis section). Based on this and the fact that traffic analysis indicates that no new traffic has been generated as a result of the scheme it is likely that any changes in the local noise climate are as expected or better.

LOCAL AIR QUALITY

- 5.14 The AST stated that there were no air quality management areas (AQMA) along the scheme, and the operation of the scheme would not result in the declaration of an AQMA. There would be a negligible decrease in PM10 and no change in NO2 concentrations with the operation of the scheme (PM10 was expected to decrease by -0.3 at three properties).
- 5.15 The ES stated the following:
- South Gloucestershire Council had revoked their AQMA for annual average NO₂ along the length of the M4;
 - Springs Farm was the only sensitive receptor within 200m of the scheme and this was the only NO₂ monitoring site close to the scheme;
 - The DMRB and advance air quality dispersion modelling indicated that there would be no exceedences of any of the AQS objectives in the opening year with the operation of the scheme. Compared with the 'do-minimum', there would be no change in pollutant concentrations with the operation of the scheme;
 - There would be an increase in emissions of carbon monoxide (CO) and particulate (PM₁₀) with the operation of the scheme compared with the 'do minimum' in the opening year 2006; and
 - There would be no significant effects of the scheme compared with a future scenario if the scheme was not built.

Consultation

- 5.16 South Gloucestershire Council responded to the consultation stating that it had not received any information indicating that air quality had changed as a result of the scheme, it had not carried out, nor was in possession of, any pre or post monitoring. It was not aware of any complaints relating to the road improvements.

Evaluation

- 5.17 No new modelling or survey work has been undertaken for this report.
- 5.18 The scheme has not resulted in the generation of additional traffic flows, vehicle speeds have increased slightly and based on below-forecast traffic flows it is likely that the scheme will have had no significant effects on the local air quality environment.

GREENHOUSE GASES

Background

- 5.19 The assessment of the impacts of transport schemes on emissions of greenhouse gases is now one of the environment sub-objectives. WebTAG notes that Carbon Dioxide (CO₂) is considered the most important greenhouse gas therefore, has been used as the key indicator for the purposes of assessing the impacts of transport options on climate change. Changes in CO₂ levels are considered in terms of equivalent tonnes of Carbon released as a result of the scheme under evaluation. Carbon emissions should be estimated for the 'with scheme' and 'without scheme' options for each year of the appraisal period.

Forecast

- 5.20 The AST predicted an increase in annual CO₂ emissions in the opening year of 2005, with the scheme, of 625 tonnes representing 3.6% of total emissions over the study area. This forecast was calculated using the DMRB screening methodology¹⁴ and was based on the assumptions that the scheme would result in no change in traffic volumes and that speeds would increase by 5kph.

Evaluation of Carbon Emissions

- 5.21 Since this scheme was evaluated, greenhouse gas emissions are now measured in terms of tonnes of Carbon rather than CO₂. Also, the COBA modelling software has been enhanced and now provides estimates of the carbon impact of the modelled scheme.
- 5.22 The impact of the scheme on carbon emissions has been evaluated both using the latest DMRB screening methodology and using the latest COBA software.
- 5.23 The latest version of COBA¹⁵ was used to re-calculate a carbon forecast using the pre-construction scheme model and to calculate an estimate of the outturn emissions in the opening year based on the observed traffic volumes. The customised speed flow curve (as described in paragraph 4.7) is used for both models. Note that the COBA model covers the entire length of the eastbound carriageway between J19 and J18 which is why the total emissions for the two scenarios are much larger for COBA.
- 5.24 The DMRB method was used to recalculate a forecast and an outturn impacts based on the length of the scheme only. Table 5.2 summarises the results.

Table 5.2 – Evaluation of Opening Year Carbon Emissions

Scenario	Carbon (tonnes/year)			
	DMRB (scheme length only)		COBA (entire 12km J19 – 18)	
	Forecast	Outturn	Forecast	Outturn
Do Minimum – No scheme	4,708	4,218	19,388	17,099
Do Something – with scheme	4,834	4,350	19,428	17,085
Difference	127	132	40	-14
% Difference	3%	3%	0.21%	-0.08%

¹⁴ DMRB Air Quality Spreadsheet

¹⁵ COBA11R7

- 5.25 The carbon evaluation in the above table shows that, although the DMRB method and COBA method produce differing results, the overall conclusion is the same: the scheme has negligible impact in carbon emissions in the opening year.

LANDSCAPE

- 5.26 The AST predicted that new sign gantries would introduce permanent urban features into an otherwise rural landscape setting. Loss of vegetation from within the highway estate would result in further direct impacts within and adjoining the Cotswolds AONB (Area of Outstanding Natural Beauty). This was described as a landscape of both national and international importance for its landscape quality. New plantings implemented as part of the scheme would provide some landscape enhancement. A moderate adverse impact was predicted overall.
- 5.27 The ES assessed the effects of the scheme on landscape as follows:
- Moderate adverse effect upon the local landscape character of this part of the Cotswolds AONB, primarily due to the impacts of the gantries;
 - Main visual impact for residential properties, public rights of way and local roads would result from the gantries – approximately 10.8m (top height) above the level of the carriageway;
 - Some night-time visual impact from limited directional lighting associated with the gantries;
 - Slight adverse impacts on views from the Players Golf Course adjoining the B4465;
 - Visual impacts of vegetation removal adjacent to the hardshoulder considered to be relatively slight; and
 - Very localised moderate adverse impact upon the visual amenity of the Bristol and Bath Green Belt, although with no direct effects.
- 5.28 Mitigation measures would include:
- Extent of vegetation clearance only sufficient to facilitate construction with existing vegetation beyond this area retained;
 - Reinforced earth slopes would be seeded with an appropriate grass seed mix in order to assimilate the steepened motorway embankments into the surrounding landscape;
 - Short length of vertical retaining wall 1m high close to Springs Farm and where cutting steepened at toe by soil nailing, would be faced with Cotswold stone or similar;
 - Seeding with an appropriate grassland mix;
 - New tree and shrub planting and reinstatement of some existing vegetation would take place within the highway boundary, where space allowed, using native species to achieve integration into the landscape; and
 - Planting would be carefully managed to aid establishment.
- 5.29 Overall the impact of the scheme was considered to be moderate adverse due to the introduction of the gantries which would comprise a prominent feature of the motorway within a landscape setting of outstanding scenic quality. The gantries would also introduce an urban landscape component within an otherwise rural landscape setting.

Consultation

- 5.30 South Gloucestershire Council commented as follows:

- The visual impacts with regard to landscape have been much as expected both from within the motorway corridor and from without, although the gantry sign nearest Junction 18 probably has had a greater visual impact than anticipated;
- The new planting is as anticipated and appears to be establishing; and
- The small plant building alongside the roundabout at Junction 18 is not detailed in the manner we would have expected for a new building in the AONB.

Evaluation

5.31 With regard to the consultation comment about the small plant building, it should be noted that this did not form part of this scheme design and was constructed as part of a communications infrastructure upgrade.



Figure 5.1 – New landscape planting with existing vegetation retained

5.32 It would appear that the landscape planting and seeding have been implemented in line with the mitigation proposals, an example of new planting integrating with existing vegetation can be seen in Figure 5.1 above. Establishment of vegetation on the soil nailed slopes at the retention ponds was variable see Figure 5.8 in Water section. Other reinforced earth slopes have also been seeded and at the time of the site visit, weed growth was evident at some locations see Figure 5.2 below.



Figure 5.2 – Reinforced earth slope at top of embankment slope

5.33 The Landscape and Ecology Aftercare Plan (LEAP) May 2006 states that new planting took place in December 2005/ January 2006 and the maintenance period will run for five years following the issue

of the Taking Over Certificate. Monitoring and review procedures are outlined in the LEAP and include the requirement for an annual review – the first of these Annual Monitoring Reports was produced in July 2007.

- 5.34 This Annual Monitoring Report concluded that ‘the findings of the landscape monitoring to date confirm that establishment of landscape areas is generally satisfactory’. The report noted that regeneration of calcareous grass areas has been slow, but this was to be expected given the nature of the reused existing calcareous soil. Exposed rock cut areas above the ‘Cotswold stone’ wall were also noted as slow to re-colonise and would continue to be monitored see Figure 5.3 below. There had also been some damage to landscape post scheme completion and reinstatement by others was required.



Figure 5.3 – Calcareous soil area above retaining wall allowed to re-colonise naturally



Figure 5.4 – Gantry 1 with open views to the local landscape

- 5.35 As expected the sign gantries are visually prominent within the local landscape, Figure 5.4 above illustrates gantry 1 against a background of the edge of the Cotswold escarpment.
- 5.36 No evaluation of the effects of lighting has been undertaken for this report. The ES states that it was considered that the gantries would introduce relatively little additional luminance in to the landscape when compared to the visible existing glare from car headlights on the westbound carriageway. It is reasonable to assume that this has been as expected. This will be considered in the Five Year After study.

BIODIVERSITY

- 5.37 The AST predicted that there would be a significant impact to broadleaf plantation woodland, scrub or other species-poor semi-improved grassland supporting reptiles but also including a limited impact to orchid-rich secondary calcareous grassland. The overall impact was assessed as moderate adverse.
- 5.38 Biodiversity interests noted in the ES were:
- Several Sites of Nature Conservation Interest (SNCI) designated by South Gloucestershire Council occur close to or within the scheme – particularly a site supporting calcareous grassland adjacent to Springs Farm;
 - Species of relevance identified by surveys included reptiles (slow worms and grass snakes), bats and badgers;
 - Several notable plants were recorded including Adder’s-tongue fern and habitat near Junction 18 was known for its orchid populations, including common spotted orchid, pyramidal orchid and occasionally bee orchid;
 - Several uncommon terrestrial invertebrates were found, the most notable being the glow worm which occurred within the highway estate near Hawkes Tynning Clump – this species was of particular concern (to the then English Nature) as being indicative of valuable grassland invertebrate faunas; and
 - Checks for presence of Dormice within the highway estate failed to identify any evidence of them within habitat associated with the scheme. It is thus it was concluded that the scheme was unlikely to have had any impact on dormice.
- 5.39 Mitigation measures were to be included as follows:
- Relocation or translocation of slow worms and grass snakes as part of the advanced works programme. Provision of hibernacula and egg-laying sites. General enhancement of vegetation structure to improve basking opportunities and foraging potential;
 - Minimum use of lighting to avoid adverse effects of light pollution on Glow Worms, focus illumination at signage;
 - Protected species fencing at specific locations, particularly in the vicinity of the River Boyd and at the wetland treatment attenuation ponds;
 - Minimising the loss of existing habitat particularly the SNCI and habitats that constituted a Biodiversity Action Plan (BAP) resource;
 - Translocation of adder’s-tongue fern and Bee orchids;
 - Some calcareous grassland disturbed in order to facilitate construction of the scheme would be replaced in appropriate locations. Soils containing seed bank and root material would be conserved and reused;
 - Planting would be carefully managed to increase its value for nature conservation; and
 - The creation of two treatment and attenuation ponds would provide new wetland habitat, with potential benefits in terms of biodiversity. The ES noted that the primary function of the wetland areas would be that of water quality management.
- 5.40 In the longer term (10-15 years), the ES predicted that there would be no significant adverse effects or benefits. The most notable effects would be the net loss of habitat, particularly valuable calcareous grass and habitat and the impact on reptile populations within the highway estate.

Consultation

- 5.41 No consultation responses have been received.

Evaluation

- 5.42 No survey work has been undertaken specifically for this report.
- 5.43 Monitoring requirements for ecological constraints were included in the LEAP and the Annual Monitoring reported stated that the aims of the monitoring surveys were to:
- Establish whether the calcareous grassland soils had been successfully translocated;
 - Establish whether the reptile translocation operation had been successful; and
 - Determine whether there had been any post-construction changes in the water quality of watercourses adjacent to the scheme.
- 5.44 Monitoring in 2007 resulted in the following findings included in the 2007 Annual Report:

Botanical Monitoring

- Translocated grassland on the soil-nailed slopes beginning to establish in adjacent areas but herbicide spray drifted onto translocated soil area see figure in Water section;
- Translocated orchid turves heavily grazed by rabbits – temporary rabbit fencing suggested;
- Translocated Adder’s-tongue fern - protective/maintenance work was noted to be required as soon as possible to prevent any further reduction in the quality of the requisite habitat (included fencing, notices, tree work and bramble removal).

Reptiles

- Monitoring after translocation confirmed that slow worms were present and breeding at all receptor sites although in smaller numbers than were translocated. The report stated that further surveys would be carried out in 2007 and beyond.



Figure 5.5 – Temporary reptile refugia as part of the ecological monitoring

Aquatic Invertebrate Monitoring

- Findings of the surveys to 2007 indicated that the construction works had not had any effect, detrimental or otherwise on the aquatic invertebrate communities within watercourses suggesting that water quality at these sites remained unaffected by the construction works.
- 5.45 The monitoring report concludes that the ‘findings of the ecological monitoring to date confirms that establishment of ecological mitigation is generally satisfactory’.

- 5.46 No information relating to Glow Worms post construction has been available to include within this report.

HERITAGE

- 5.47 The AST predicted that there would be a possible impact on the visual setting of Grade II Listed Barley Close Farmhouse due to the loss of embankment screening and uncertain direct / indirect effects on unknown archaeology. The overall impact was assessed as slight adverse.
- 5.48 The ES stated that there would be no significant effects, all of the work would take place within Highways Agency land and most of the improvements would occur within land already disturbed by the original construction of the motorway.
- 5.49 Three areas of undisturbed land would be potentially affected by the scheme and the ES stated that within those areas, the proposals would have a direct impact upon a number of likely post-medieval historic landscape features and palaeo-channel of low significance. There was potential for waterlogged archaeological deposits within an area of alluvium associated with the River Boyd. Also, the line of the scheme had the potential to contain archaeology dating to all periods including a Roman crossing point of the River Boyd.
- 5.50 No designated sites would be directly affected, only the setting of Barley Close Farm would be subject to slight adverse effect.

Consultation

- 5.51 English Heritage stated that there was no nationally designated archaeology impacted on by the scheme. No comments were received regarding built heritage.

Evaluation

- 5.52 Barley Close Farm is clearly visible from the motorway see Figure 5.6 and it is likely that the impacts are as expected.



Figure 5.6 – View from motorway verge to Grade II Listed Barley Close Farm

- 5.53 No information relating to archaeology has been available for this report.

WATER

- 5.54 The AST stated that the existing drainage system would be improved and the creation of two separate treatment and attenuation ponds would have a slight beneficial effect on water quality of the River Boyd.
- 5.55 The ES stated that the proposals would improve the existing drainage system, including replacement of filter drains with sealed carrier drains and provision of treatment and attenuation ponds. No adverse effects were predicted and it was considered that the creation of two separate wetland treatment and attenuation ponds should have a slight beneficial effect on water quality in the River Boyd.
- 5.56 Limited clearing of highway ditches would be undertaken.
- 5.57 No works to the drainage system serving the eastbound off slip were proposed and highway run-off would continue to be collected by the existing drain. It was expected that the existing westbound carriageway drainage would be separated from the proposed new drainage for the eastbound carriageway.

Consultation

- 5.58 No consultation responses have been received.

Evaluation

- 5.59 The treatment and attenuation ponds have been constructed on site see figures 5.8 and 5.9 below. The 2007 Annual Monitoring report noted that reed growth had been slower to establish in Pond 2 largely due, it was thought, to the drier conditions and establishment would continue to be monitored.



Figure 5.7 – Pond 2



Figure 5.8 – Pond 1

- 5.60 The finding of the monitoring of aquatic invertebrates as part of the ongoing biodiversity monitoring is included in the Biodiversity section above, and indicates no change.
- 5.61 No other information has been available as part of this study.

JOURNEY AMBIENCE

- 5.62 The AST predicted that the proposed scheme would assist flows and relieve congestion and thus reduce travel time. Travellers' stress would be reduced due to a reduction in driver frustration and the fear of potential accidents. The overall impact was assessed as slight beneficial.
- 5.63 The ES considered that there would be no significant change to the extent of travellers' views from the motorway and the impact of the proposals was considered to be neutral. However, the proposed gantries would form noticeable components within these views.
- 5.64 The ES stated that the greatest benefit to vehicle travellers would be the positive effects on driver stress gained by;
- The use of an additional climbing lane to assist flows and relieve congestion, which was presently at a high level;
 - Improved and quieter road surfacing used in construction of the climbing lane and modified diverge layout; and
 - The use of clear signage and the proposed use of gantries.

Travellers' Views Evaluation

- 5.65 New planting has been included to replace existing vegetation lost to the scheme and provide some visual screening and integration near the sign gantries. The changes to travellers' views are likely to be neutral, as expected.

Travellers' Stress Evaluation

- 5.66 According to WEBTAG guidance, travellers' stress is the adverse mental and physiological effects experienced by travellers. Route uncertainty is one of the main factors influencing travellers' stress.

- 5.67 A part of the improvements to the eastbound diverge, three new signed gantries were installed which should help drivers choose the correct lane in the approach to the diverge at Junction 18 and thus reduce route uncertainty see Figure 5.9.



Figure 5.9 – Gantry 3 near the Junction 18 off slip

- 5.68 The provision of the climbing lane was expected to reduce driver stress by reducing congestion and assisting traffic flows and average speeds. Driver stress in lane 1 would reduce from High to Moderate and in lane 2 from Moderate to Low. Lane 3 would remain at Low. For the new climbing lane driver stress levels would be High due to high traffic flows, low average speeds and a high proportion of HGV's as expected for a climbing lane.
- 5.69 The AST worksheet assessment forecast that travellers' stress would be reduced.
- 5.70 Based on traffic flows being lower than forecast but little changed since the scheme was built, it is likely that the impact on drivers' stress is as forecast.
- 5.71 The improved signage provided by the new gantries installed as part of this scheme is intended to reduce route uncertainty for drivers approaching the junction and thus reduce likelihood of last-minute manoeuvres (swooping), reducing travellers' stress.

UNEVALUATED SUB-OBJECTIVES

Townscape

- 5.72 The townscape sub-objective is not applicable to this scheme as it is located entirely in a rural area and is not expected to have any wider impacts on settlements in the area.

Physical Fitness

- 5.73 The AST worksheet for the physical fitness sub-objective forecast that the scheme would have no impact on walking and cycling.
- 5.74 This sub-objective also has not been evaluated because it considered that as the scheme is located entirely within the existing highway boundary, it seems to be entirely reasonable to presume that the forecast of no impact for non-motorised users is correct.
- 5.75 A single right of way passes under the M4 near the western end of the scheme but this has been unchanged by the scheme and at the time of the site visit appeared to be little-used by pedestrians see Figure 5.10 below.

5.76 The visual impact of the sign gantries on public rights of way is included in the Landscape section above.



Figure 5.10 – View from the motorway verge to the existing footpath and underpass below the motorway

KEY POINTS FROM SECTION 5 - MAIN ENVIRONMENT CONCLUSIONS

- Very few consultation responses have been received.
- Based on traffic flows it is likely that the impacts for noise and air quality are as expected.
- Negligible impact on carbon emissions in the opening year.
- Based on the information available, including the ongoing monitoring that is being undertaken as part of the scheme for biodiversity and landscape planting, it would appear that the environmental impacts for these sub-objectives are also likely to be as expected.
- For the landscape and biodiversity mitigation measures to reach their full potential it will be essential for them to continue to establish satisfactorily and for the recommended work identified in the monitoring reports to be carried out. It would be appropriate to evaluate these aspects as part of the five year after report and it would be hoped that the Annual Monitoring Reports, together with any other survey/monitoring information would be made available at that time.
- The Consultation identified that the local authority considered that a small plant building constructed at the roundabout had not been built in a style suitable for the Cotswolds AONB, however this building did not form part of this scheme and was constructed as part of a communications infrastructure upgrade.
- Further study would be required to evaluate the other sub-objectives fully.

6. Accessibility and Integration

INTEGRATION

Land Use and Policy Integration

- 6.1 This scheme was one of a number of measures recommended by the London to the South West and South Wales Multi-Modal Study (SWARMMS) in 2002 to relieve congestion on the M4/M5 around Bristol.

ACCESSIBILITY

- 6.2 The AST forecast that being entirely motorway-based and within the existing highway boundary, the scheme would have no impacts on accessibility.

Non-Motorised Users

- 6.3 The scheme has had no impact on non-motorised users. It is entirely based on the motorway. The only public right of way near the scheme is a pedestrian underpass near the western end of the scheme that is unchanged by the scheme.

Public Transport

- 6.4 There are no scheduled bus services using the A46 junction. Long distance coach services on the M4 main carriageway may potentially benefit from the climbing lane, but it is normally considered that it is primarily light vehicles that gain from the reduced congestion and increased speeds from climbing lane schemes. The economic evaluation provided by the COBA model as detailed in section 4 gives a negligible impact for buses and coaches.

KEY POINTS FROM SECTION 6- ACCESSIBILITY AND INTEGRATION

- The scheme was recommended by the 2002 Multi-Modal Study for the area and is therefore considered to be consistent with national and regional policy.
- No impact on the Accessibility sub-objectives.

7. Summary

Appraisal Summary Table

- 7.1 The Appraisal Summary Table (AST) is a one page summary of the main economic, environmental and social impacts of a trunk road scheme.
- 7.2 An AST was prepared for this scheme when it first entered the TPI programme in 2002 and an updated one was subsequently produced in 2004 for a cost challenge workshop.
- 7.3 The most recent AST for this scheme is shown in Table 7.2.
- 7.4 The AST summarises the predicted impacts of the scheme upon the five core government objectives for transport. The AST summarises the following:
- **Safety** – measured reduction in accidents;
 - **Economy** – estimated impact of the scheme upon Journey Times, Vehicle Operating Costs, Scheme cost and Journey reliability;
 - **Environment** – an estimate of scheme impact upon factors such as noise, local air quality, landscape, biodiversity, heritage and water;
 - **Accessibility** – a review of scheme impact upon access to the public transport network, community severance and non-motorised user impact; and
 - **Integration** – a description of how a scheme is integrated with wider local planning policy objectives.

Evaluation Summary Table

- 7.5 In order to ascertain the accuracy of predictions made prior to the scheme construction, a review of the AST has been undertaken. Whilst the AST format is a standard from the NATA process, the Evaluation Summary Table (EST) has been devised for the POPE process to record a summary of the outturn impacts for the NATA objectives, compared to the predictions in the AST.
- 7.6 Where possible, the format of the EST mirrors the appearance and process of the AST to enable comparison between the two.

Achievement of Objectives

- 7.7 The POPE assessment of the achievement of the scheme's objectives in the first two years is summarised in below.

Table 7.1 – Achievement of Scheme Objectives

Objective	Achieved?
Reduce traffic congestion caused by slower-moving traffic on main carriageway	Yes
Improve safety by allowing traffic to leave the motorway earlier and reducing the number of last-minute manoeuvres	Too soon to judge
Minimise the environmental impact of the scheme on the Cotswold AONB and biodiversity	Too soon to judge
Construct the scheme within land owned by the Highways Agency	Yes

Table 7.2 – Appraisal Summary Table (December 2004)

Option		Description: M4 Junction 18 Eastbound Diverge	Problems: Steep incline to junction, safety problems due to weaving	Present Value of Costs to Public Accounts: £16.30m
OBJECTIVE	SUB- OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE ASSESSMENT	ASSESSMENT
ENVIRONMENT	Noise	There are 11 residential properties affected by the scheme proposals though the changes are approximately 1dB.	2 people are less affected in the 65-69 dB with 3 more people affected in the 70-74dB band.	EPA +1
	Local Air Quality	There are no air quality management areas (AQMA) along the scheme, and the operation of the scheme will not result in the declaration of an AQMA. There is a negligible decrease in PM10 and no change in No2 concentrations with the operation of the scheme.	Properties where PM ₁₀ levels improve=3, same=0; deteriorate=0 Properties where NO ₂ levels improve=0, same=3; deteriorate=0	NO ₂ : 0.00 PM ₁₀ : -0.3
	Greenhouse Gases	An increase in annual CO ₂ emissions is predicted in the opening year of 2005 with the scheme.	Present Do-Minimum: 119% Future Do-Minimum: 104%	+625 tonnes of CO ₂
	Landscape	New sign gantries would introduce permanent urban features into an otherwise rural landscape setting. Loss of vegetation from within the highways estate would result in further direct impacts within and adjoining the Cotswolds AONB. This is a landscape of both national and international importance for its landscape quality. New plantings implemented as part of the scheme would provide some landscape enhancement.	Not applicable	Moderate Adverse
	Townscape	Not applicable	Not applicable	Not applicable
	Heritage of Historic Resources	Possible visual setting impact due to loss of embankment screening for Barleyclose Farmhouse. Uncertain direct / indirect effects on unknown archaeology.	1 Grade II listed building – Barleyclose farmhouse	Slight adverse
	Biodiversity	Significant impact to broadleaf plantation woodland, scrub and other species-poor semi-improved grassland supporting reptiles but also including a limited impact to orchid-rich secondary calcareous grassland.	Not applicable	Moderate Adverse
	Water Environment	The existing drainage system would be improved and the creation of two separate treatment and attenuation ponds would have a slight beneficial effect on the water quality of the River Boyd	Not applicable	Slight Beneficial
	Physical Fitness	Due to motorway improvement, the number of people walking or cycling will still be zero.	Not applicable	Neutral
	Journey Ambience	The proposed scheme would assist flows and relieve congestion thus reduce travel time. Travellers' stress would be reduced due to a reduction in driver frustration and the fear of potential accidents.	Not applicable	Slight beneficial
SAFETY	Accidents	Small savings associated with highway improvement	Savings: Fatal: 1.0 Serious: 3.0 Slight: 59	PVB £1.6m
	Security	Motorway improvement which will include maintaining present level of emergency phones, lighting and signing.	Not applicable	Neutral
ECONOMY	Public Accounts	Positive return on investment	Central Govt PVC, Local Govt PVC	PVC £16.3m
	Transport Economic Efficiency: Business Users & Transport Providers	Business Users will experience reduce congestion and improved reliability	Users PVB, Providers PVB, Other PVB	PVB £31.74m
	Transport Economic Efficiency: Consumers	Consumer users will experience reduced congestion and improved reliability	Users PVB, Providers PVB, Other PVB	PVB £22.09m Overall BCR = 3.4
	Reliability	Motorway improvements should improve reliability.	Not applicable	Moderate beneficial
	Wider Economic Impacts	Reductions in congestion should assist in the inward investment into the study area. As no regeneration area – no EIR was carried out.	Not applicable	Moderate beneficial
ACCESSIBILITY	Option Values	None – not a passenger transport improvement	Not applicable	Neutral
	Severance	No change to existing severance due to Motorway improvement	Not applicable	Neutral
	Access to the Transport System	No change to access	Not applicable	Neutral
INTEGRATION	Transport Interchange	No provision for interchange included in this motorway improvement.	Not applicable	Neutral
	Land-use Policy	The addition of a single climbing lane will meet both operational and strategic objectives for the motorway. The strategic importance of the motorway is supported by the majority of the local regional and national policies. The scheme would however be in conflict with policies related to designated landscapes, heritage and nature conservation areas. These designations range from local to national designations. That national policy on sustainable transport is also not fully supported by the scheme. The potential planning conflicts would not however detract from the overall strategic and operational highway benefits accruing from the provision of a climbing lane.	Not applicable	Neutral
	Other Government Policies	The scheme is assessed as being complimentary to other government policy. In terms of both the number of policies and degree of impact, the scheme adheres to a greater proportion of policies than it conflicts with. The overall assessment of the scheme in relation to Other Government Policy is therefore beneficial as it performs extremely well against national, regional and local policies. Implementation of the scheme is in accordance with the recommendations of SWARMMS and the announcement by the secretary of State on 10 December 2002.	Not applicable	Neutral

Table 7.3 – Evaluation Summary Table (2002 prices and values)

Option		Description: M4 Junction 18 Eastbound Diverge		Present Value of Costs to Public Accounts: £6.6m – £16.2m
OBJECTIVE	SUB- OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE ASSESSMENT	POPE ASSESSMENT
ENVIRONMENT	Noise	Based on traffic flows which have shown less growth than forecast should be better than forecast but no new modelling or survey carried out		Potentially better than forecast
	Local Air Quality	Based on traffic flows which have shown less growth than forecast should be better than forecast but no new modelling or survey carried out		Potentially better than forecast
	Greenhouse Gases	Better than forecast		-14 tonnes Carbon in opening year
	Landscape	As expected the sign gantries are prominent within the local landscape. New planting and seeding has been implemented and this should establish satisfactorily in due course to integrate the scheme into the local landscape and reinstate the visual screening of traffic provided by the original planting.		As forecast
	Townscape	N/A		-
	Heritage of Historic Resources	No information has been available regarding any impacts on buried archaeology a result of the scheme. The visual impacts of the sign gantries on Grade II Listed Barley Close Farm are as expected		As forecast
	Biodiversity	Ongoing ecological monitoring will inform on the success of the biodiversity measures with regard to translocation of species and habitats. Findings from the Annual Monitoring Report to date suggest that establishment is satisfactory.		As forecast
	Water Environment	Attenuation and Treatment ponds incorporated into the scheme. No consultation responses received. No information to suggest that the scheme is operating other than as intended		As forecast
	Physical Fitness	N/A		-
	Journey Ambience	Likely that impact on travellers' views is as expected. It is also likely that driver stress is reduced due to improved signage on gantries and observed improvements in the traffic flow.		As forecast
SAFETY	Accidents	Too soon to identify benefits from potential small savings.		-
	Security	No change to provision of emergency phones and lighting.		As forecast
ECONOMY	Public Accounts	Government investment=£8.2m but large indirect tax impacts raises PVC to £6.6m – £16.2m		£6.6m – 16.2m
	Transport Economic Efficiency: Business Users & Transport Providers	Assessed by COBA modelling which gives a range of values		£3.9m - £21.3m
	Transport Economic Efficiency: Consumers	Assessed by COBA modelling which gives a range of values		£3.5m - £12.9m
	Reliability	Route stress reduced from 56% to 42%		As forecast
	Wider Economic Impacts	Too soon to evaluate		-
ACCESSIBILITY	Option Values	No impact		As forecast
	Severance	No impact		As forecast
	Access to the Transport System	No Impact		As forecast
INTEGRATION	Transport Interchange	No Impact		As forecast
	Land-use Policy	Not evaluated		-
	Other Government Policies	Not evaluated		-